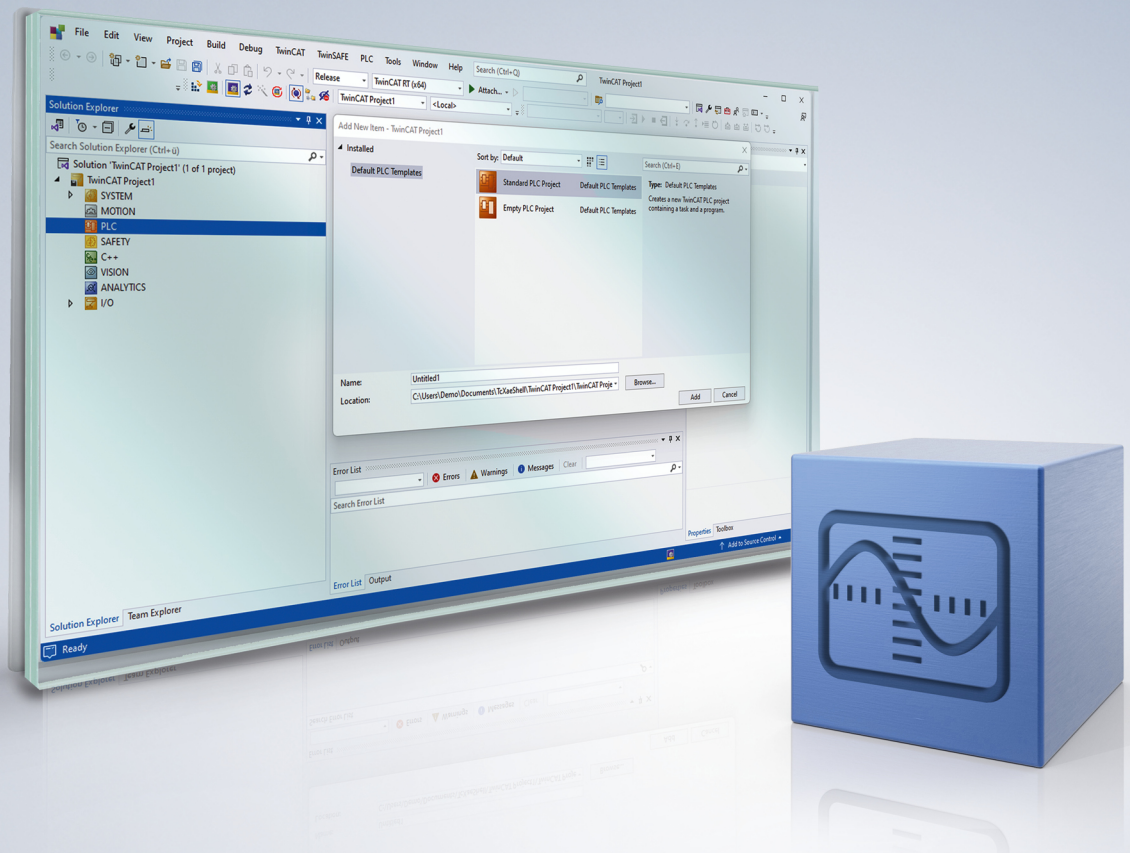
BECKHOFF New Automation Technology

Manual | EN

TE13xx

TwinCAT 3 | Scope View



2025-10-22 | Version: 1.20.2

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1 Foreword

1.1 Notes on the documentation

This description is intended exclusively for trained specialists in control and automation technology who are familiar with the applicable national standards.
The documentation and the following notes and explanations must be complied with when installing and commissioning the components.
The trained specialists must always use the current valid documentation.

The trained specialists must ensure that the application and use of the products described is in line with all safety requirements, including all relevant laws, regulations, guidelines, and standards.

Disclaimer

The documentation has been compiled 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 notice.
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1.2 For your safety

Safety regulations

Read the following explanations for your safety.
Always observe and follow product-specific safety instructions, which you may find at the appropriate places in this document.

Exclusion of liability

All the components are supplied in particular hardware and software configurations which are 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 technology who are familiar with the applicable national standards.

Signal words

The signal words used in the documentation are classified below. In order to prevent injury and damage to persons and property, read and follow the safety and warning notices.

Personal injury warnings

⚠ DANGER

Hazard with high risk of death or serious injury.

⚠ WARNING

Hazard with medium risk of death or serious injury.

⚠ CAUTION

There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE

The environment, equipment, or data may be damaged.

Information on handling the product



This information includes, for example:
recommendations for action, assistance or further information on the product.

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.

In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our https://www.beckhoff.com/secguide.

Beckhoff products and solutions undergo continuous further development. This also applies to security functions. In light of this continuous further development, Beckhoff expressly recommends that the products are kept up to date at all times and that updates are installed for the products once they have been made available. Using outdated or unsupported product versions can increase the risk of cyber threats.

To stay informed about information security for Beckhoff products, subscribe to the RSS feed at https://www.beckhoff.com/secinfo.

2 Overview

TwinCAT 3 Scope is the charting and analysis tool for TwinCAT. Variables in TwinCAT can be recorded and displayed graphically. Sampling rates can be adjusted individually for each channel. Recordings in the µs range and long-term recordings over several days are equally possible. Due to division into a Scope View with multi-core support for the display of the signals and a Scope Server for the recording of the values, it is possible it to connect to servers distributed in the field from a central View. A tool is thus available not only for machine commissioning, but also for process monitoring. The TwinCAT 3 Scope functionality includes cursor tools and trigger functions.

TwinCAT 3 Scope also sets new standards for Engineering. Like TwinCAT 3 itself, it is integrated in Microsoft Visual Studio. It is thus possible to use TwinCAT 3 projects and Scope projects in parallel in a single solution. Variables can be shifted very simply from the TwinCAT 3 project to a Scope configuration. Of course the Scope can also still be used as a standalone tool in the framework of the TwinCAT XAE Shell.

Due to the constantly increasing range of functions required of data analysis tools, the TwinCAT 3 Scope is subdivided into product levels with different ranges of features. The TwinCAT 3 Scope Base contains a license-free View and a license-free Server. Both are installed together with TwinCAT 3 XAE.

Product note

The TwinCAT 3 Scope software consists of two products:

- TwinCAT 3 Scope View is a TwinCAT 3 engineering product and supplies the graphic interface for the configuration of recordings and the display of signal curves. The View is available in different product levels and is licensed for the device on which it is displayed. This document contains the technical product description.
- TwinCAT 3 Scope Server is a TwinCAT 3 function and provides the software for data logging. The server sends the recorded data to the View. The software is installed on distributed devices or on the local target device. The server license is issued for the device on which the server runs. In most cases the Base version, which is installed together with TwinCAT XAE or the Scope View, is sufficient. The server license is only required if it is used independently, i.e. without View, e.g. for control via a PLC function block. The TwinCAT 3 Scope server is documented separately as part of the TwinCAT 3 functions.

Both components must be available in the system in order to be able to use the Scope.

Principle of operation

The principle of operation of the two main components View and Server is explained in detail in the Basic Concept [▶ 19] in the Technical Introduction.

Product level / feature list

The following table shows which functionalities are available with which TwinCAT Scope level and the corresponding licensing arrangement.

Features	Scope Base		Scope Server Full Licence		Scope View Professional	
	Server	View	Server		View	
			Full	7 days trial version	Full	7 days trial version
General:						
Free of charge	✓	✓	✗	✓	✗	✓
Local record	✓	✓	✓	✓	✓	✓
Remote Record using Target Server	✗	✓	✓	✓	✓	✓
Remote Record using Local Server	✓	✓	✓	✓	✓	✓
Scope Control Integration	-	✗	-	-	✓	✓
Long Time Records > 1h	-	✗	-	-	✓	✗
Ring Buffer	✓	✓	✓	✓	✓	✓
Auto Save	-	✗	-	-	✓	✓
Auto Export	-	✗	-	-	✓	✗
Restart Record	-	✗	-	-	✓	✓
View Multicore Support	-	✓	-	-	✓	✓
Communication:						
ADS	✓	✓	✓	✓	✓	✓
OPC UA	✗	✗	✓	✓ (3 Nodes)	✓	✓ (3 Nodes)
Base:						
Configuration Wizard	-	✓	-	-	✓	✓
Target Browser Filter	-	✓	-	-	✓	✓
Individual Sample Rate	-	✓	-	-	✓	✓
Drag and Drop for Configuration	-	✓	-	-	✓	✓
Docking Windows	-	✓	-	-	✓	✓
YT Time based Charts	-	✓	-	-	✓	✓
XY Charts	-	✓	-	-	✓	✓
Array Bar Charts	-	✓	-	-	✓	✓

Features	Scope Base		Scope Server Full Licence		Scope View Professional	
Overview Chart	-	✓	-	-	✓	✓
Stacked Y-Axes	-	✓	-	-	✓	✓
Logarithmic Y-Axes	-	✓	-	-	✓	✓
Chart synchronisation	-	✓	-	-	✓	✓
Master Chart synchronisation	-	✓	-	-	✓	✓
Channel Marks	-	✓	-	-	✓	✓
Channel Offset	-	✓	-	-	✓	✓
Channel Scaling	-	✓	-	-	✓	✓
Panning	-	✓	-	-	✓	✓
Zoom	-	✓	-	-	✓	✓
Cursor	-	✓	-	-	✓	✓
Fillmode	-	✓	-	-	✓	✓
Print Report	-	✗	-	-	✓	✓
Data export wizard	-	✓	-	-	✓	✓
Export tool	✓	✓	✓	✓	✓	✓
Extended data export formats	-	✗	-	-	✓	✗
Attach/Detach Client to/from recording server	✗	✗	✓	✗	✓	✓
Autostart Record after Serverstart	✗	-	✓	✗	-	-
Curve Creator		✓			✓	✓
Curve Creator Transformationen	-	✗	-	-	✓	✗
Layer	-	✗	-	-	✓	✓ (max 1)
Data Scout	-	✓	-	-	✓	✓
Data Scout Toolbar snipping buttons		✗			✓	✗
Trigger:						
Event Marker	-	✓	-	-	✓	✓

Features	Scope Base		Scope Server Full Licence		Scope View Professional	
Start Record	-	✓	-	-	✓	✓
Stop Record	-	✓	-	-	✓	✓
Stop Display	-	✓	-	-	✓	✓
Restart Display	-	✓	-	-	✓	✓
Start Subsave	-	✗	-	-	✓	✓
Stop Subsave	-	✗	-	-	✓	✓
Reporting Trigger	-	✗	-	-	✓	✗
Reporting Collector	-	✗	-	-	✓	✗
Reporting Collector + Trigger	-	✗	-	-	✓	✗
Units:						
Unit Property	-	✓	-	-	✓	✓
Unit Wizard	-	✓	-	-	✓	✓
Unit Dictionary Editor	-	✗	-	-	✓	✗
Unit generation by Terminal selection	-	✗	-	-	✓	✗
Parse Units from PLC Code	-	✓	-	-	✓	✓
Units in Target Browser	-	✓	-	-	✓	✓
Units in Tooltips	-	✓	-	-	✓	✓
Units in Cursor Window	-	✓	-	-	✓	✓
Vision Integration:						
Vision Acquisitions	-	✗			✓	✓ (max 1)
Vision picture export	✗	✗			✓	✗
Reporting Integration:						
24/7-Reporting with Trigger Groups	-	✗	-	-	✓	✗
Include comments		✓ (max 1)	-	-	✓	✓ (max 1)

Features	Scope Base		Scope Server Full Licence		Scope View Professional	
On-Demand-Reporting						
Adding Additional Information	-	✔ (max 1)	-	-	✔	✔ (max 1)
Select specific Scope Information	-	✘	-	-	✔	✘
Select specific charts	-	✘	-	-	✔	✘
Comments:						
Create coments for elements	-	✔	-	-	✔	✔
Create comments for data points	-	✔	-	-	✔	✔
Edit comments in comment window	-	✔	-	-	✔	✔
Templates for comments	-	✘	-	-	✔	✘
Auto generated comments for trigger	-	✘	-	-	✔	✘

3 Installation

3.1 System requirements

The following system requirements must be fulfilled for proper functioning of the TwinCAT 3 Scope View.

Supported operating systems

Windows 10

TwinCAT

Minimum is TwinCAT 3 ADS.

.NET Framework

.NET Framework 4.7.2 is required.

The TwinCAT 3 Scope Base is installed together with TwinCAT 3 XAE. The further product levels and features are enabled by licensing. If you use a newer Scope version outside a TwinCAT 3 XAE update, or if you want to install the Scope in stand-alone mode on a PC without TwinCAT 3 Engineering, you can download the corresponding setup file from the internet.

Scope View can be licensed as a full version or as a 7-day test version. For limitations of the test version, please refer to the product overview page.

3.2 Downloading the setup file

The TwinCAT Measurement Setup is available as a download from the Beckhoff website. This is the latest version of various measurement products such as Scope View, Scope Server, Bode Plot, Filter Designer etc.. The range of functions, which is sometimes very varied, can only be activated via the licenses. Follow these steps to download the setup file:

1. Open the web browser of your choice and go to the Beckhoff website: www.beckhoff.com.
2. In the structure tree of the web page, go to the Automation node and select the relevant product. For example: > TwinCAT 3 > TE1xxx | TC3 Engineering > TE13xx | TC3 Scope View Professional.
3. Click on the download link to place the software in the shopping cart. Then click on **Start download**.
4. (Optional) Transfer the downloaded file to the TwinCAT runtime system you want to install the product on.

3.3 Installation

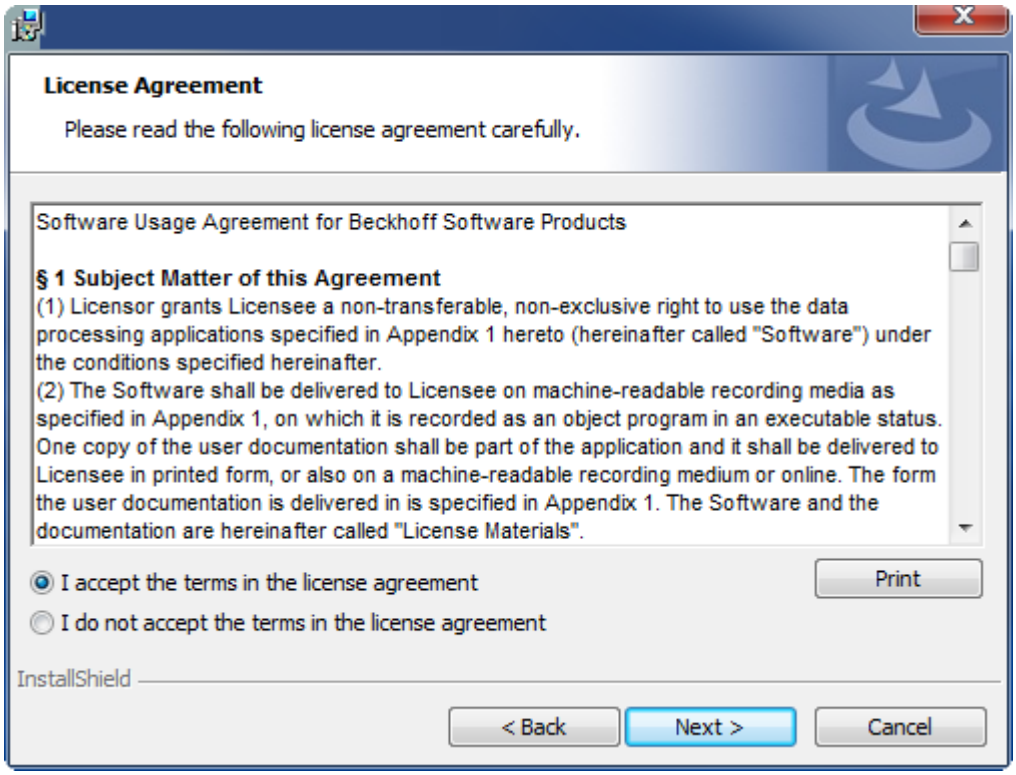
Setup installation (TwinCAT 3.1 Build 4024)

The following section describes how to install the TwinCAT 3 function for Windows-based operating systems.

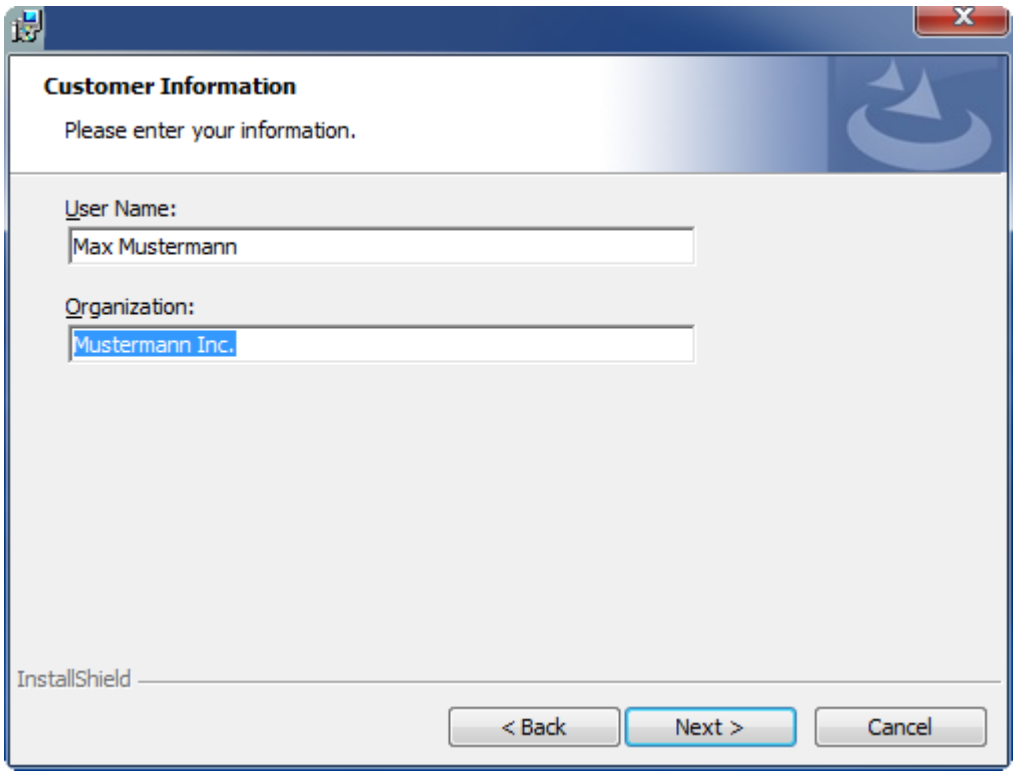
✓ The TwinCAT 3 function setup file was downloaded from the Beckhoff website.

1. Run the setup file as administrator. To do this, select the **Run As Admin** command in the context menu of the file.
   ⇨ The installation dialog opens.

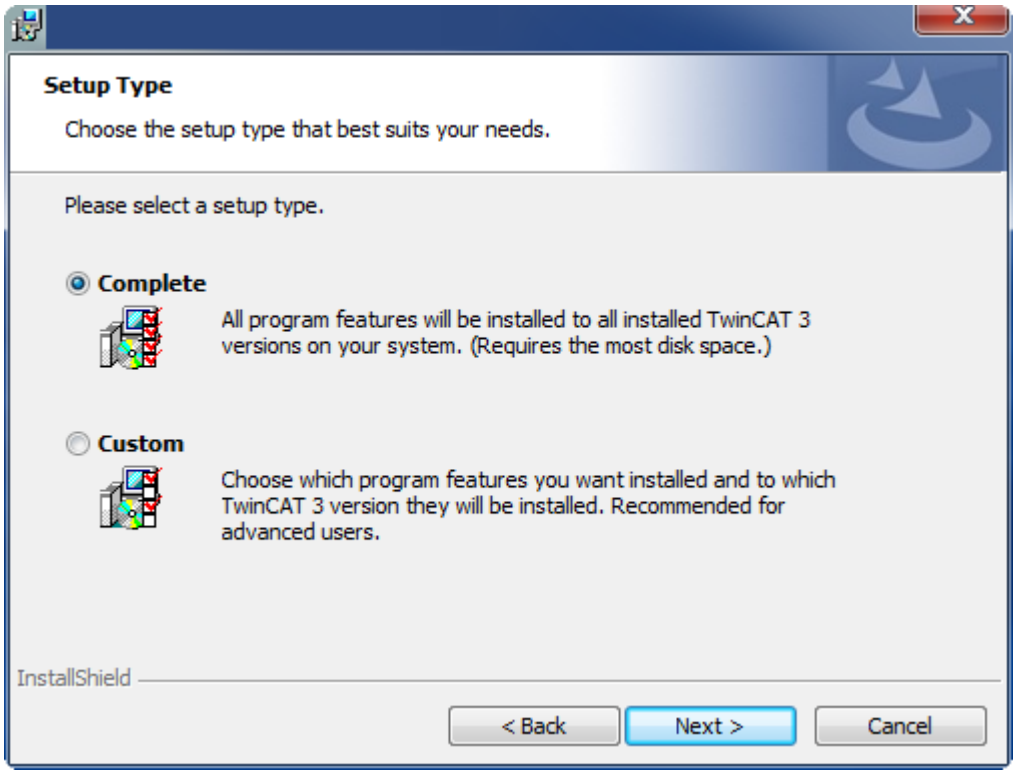
2. Accept the end user licensing agreement and click **Next**.



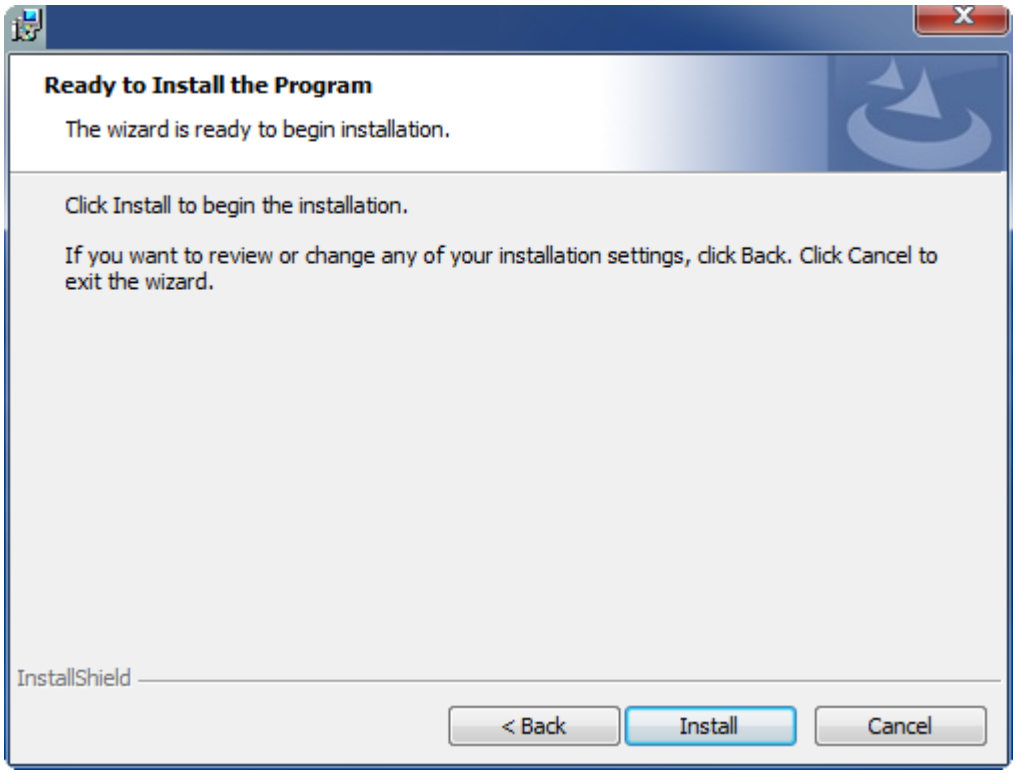
3. Enter your user data.



4. If you want to install the full version of the TwinCAT 3 function, select **Complete** as the installation type. If you want to install the TwinCAT 3 function components separately, select **Custom**.

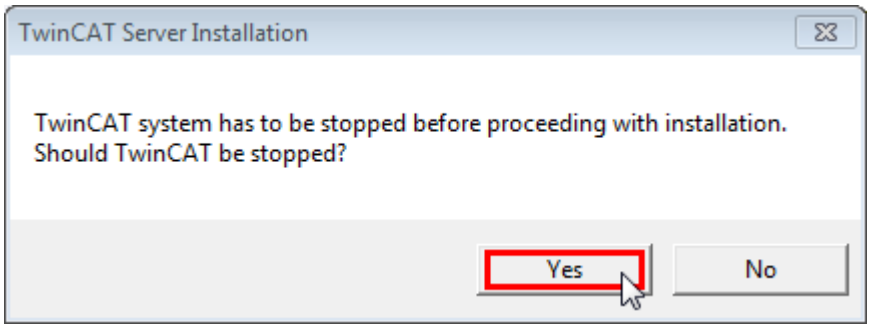


5. Click **Next**, then **Install** to start the installation.

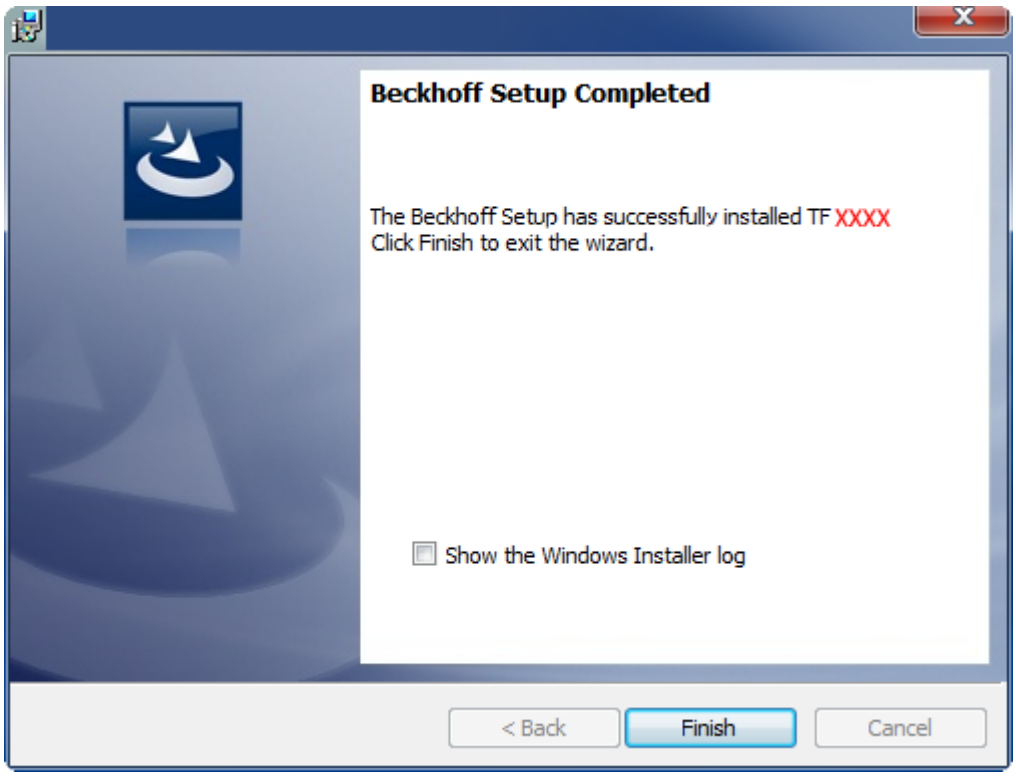


⇨ A dialog box informs you that the TwinCAT system must be stopped to proceed with the installation.

6. Confirm the dialog with **Yes.**



7. Click **Finish** to exit the setup.



⇨ The TwinCAT 3 function has been installed successfully.

3.4 After the Installation

The next step after successful installation is licensing of the products “TE130x Scope View” and/or “TF3300 Scope Server”. By default the product level “Base” is active, which is available without a license. The advanced functionality can be enabled through corresponding licensing, e.g. for the product level “Professional”. Further steps then are:

- First steps with TwinCAT 3 Scope [▶ 372]
- Detailed documentation of the individual functions [▶ 20]
- The integration of TwinCAT 3 Scope View Control into your own .NET-based visualization

3.5 Licensing

The TwinCAT 3 function can be activated as a full version or as a 7-day test version. Both license types can be activated via the TwinCAT 3 development environment (XAE).

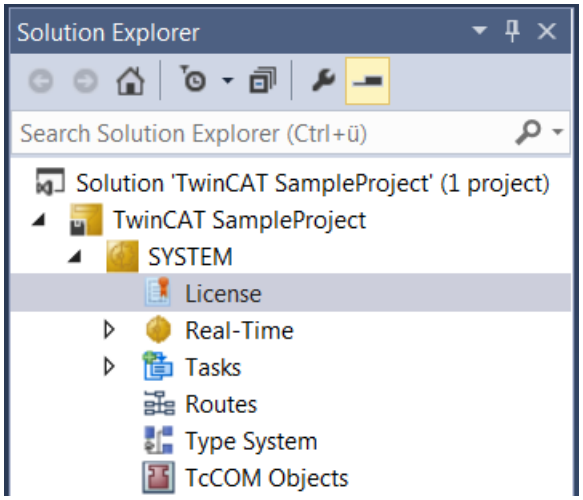
Licensing the full version of a TwinCAT 3 Function

A description of the procedure to license a full version can be found in the Beckhoff Information System in the documentation "TwinCAT 3 Licensing".

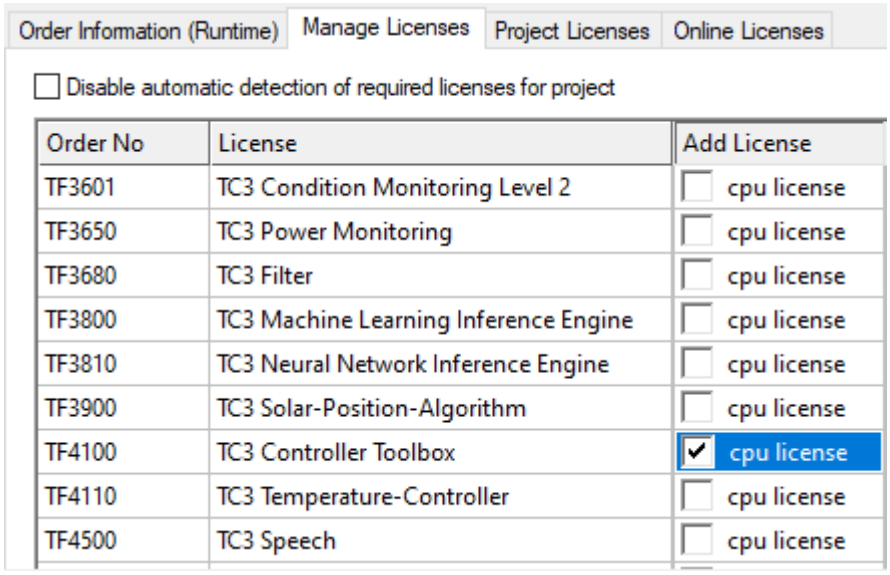
Licensing the 7-day test version of a TwinCAT 3 Function

A 7-day test version cannot be enabled for a TwinCAT 3 license dongle.

1. Start the TwinCAT 3 development environment (XAE).
2. Open an existing TwinCAT 3 project or create a new project.
3. If you want to activate the license for a remote device, set the desired target system. To do this, select the target system from the **Choose Target System** drop-down list in the toolbar.
   ⇨ The licensing settings always refer to the selected target system. When the project is activated on the target system, the corresponding TwinCAT 3 licenses are automatically copied to this system.
4. In the **Solution Explorer**, double-click **License** in the **SYSTEM** subtree.



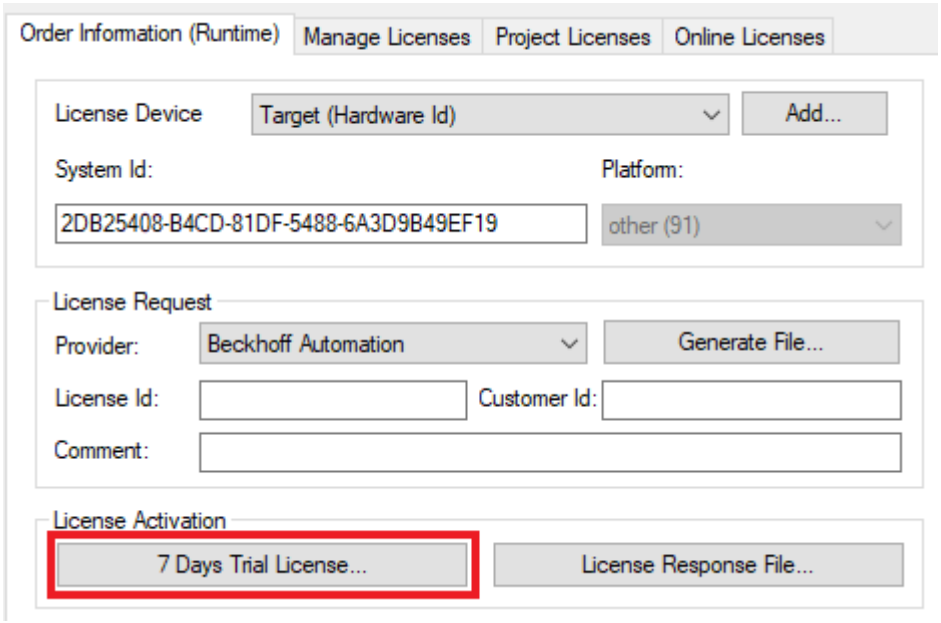
   ⇨ The TwinCAT 3 license manager opens.
5. Open the **Manage Licenses** tab. In the **Add License** column, check the check box for the license you want to add to your project (e.g. "TF4100 TC3 Controller Toolbox").



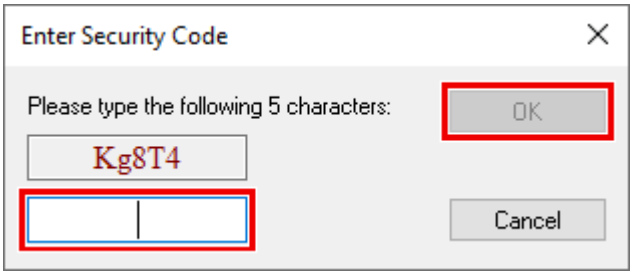
Order No	License	Add License
TF3601	TC3 Condition Monitoring Level 2	cpu license
TF3650	TC3 Power Monitoring	cpu license
TF3680	TC3 Filter	cpu license
TF3800	TC3 Machine Learning Inference Engine	cpu license
TF3810	TC3 Neural Network Inference Engine	cpu license
TF3900	TC3 Solar-Position-Algorithm	cpu license
TF4100	TC3 Controller Toolbox	cpu license
TF4110	TC3 Temperature-Controller	cpu license
TF4500	TC3 Speech	cpu license

6. Open the **Order Information (Runtime)** tab.
   ⇨ In the tabular overview of licenses, the previously selected license is displayed with the status “missing”.

7. Click **7-Day Trial License...** to activate the 7-day trial license.



⇨ A dialog box opens, prompting you to enter the security code displayed in the dialog.



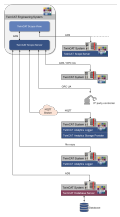
8. Enter the code exactly as it is displayed and confirm the entry.
9. Confirm the subsequent dialog, which indicates the successful activation.
   ⇨ In the tabular overview of licenses, the license status now indicates the expiry date of the license.
10. Restart the TwinCAT system.

⇨ The 7-day trial version is enabled.

4 Technical introduction

4.1 Basic concept

TwinCAT Scope is divided into two main components: Scope View and Scope Server. The Scope Server handles the actual data collection. It can connect to control systems via ADS, OPC UA or MQTT live and record data. In addition, historized data from your own svdx files, from binary files of the Analytics Logger, as well as from the Analytics Storage Provider via MQTT can be read via the server. The configuration necessary for this is done in the Scope View. Apart from the configuration, the recorded data are also graphically displayed there in various types of chart.



The Scope View normally runs on the engineering systems of the service or commissioning engineers or on machine computers intended to prepare recorded data graphically for the machine personnel. It is therefore intended for commissioning and also for the continuous monitoring of machines and systems.

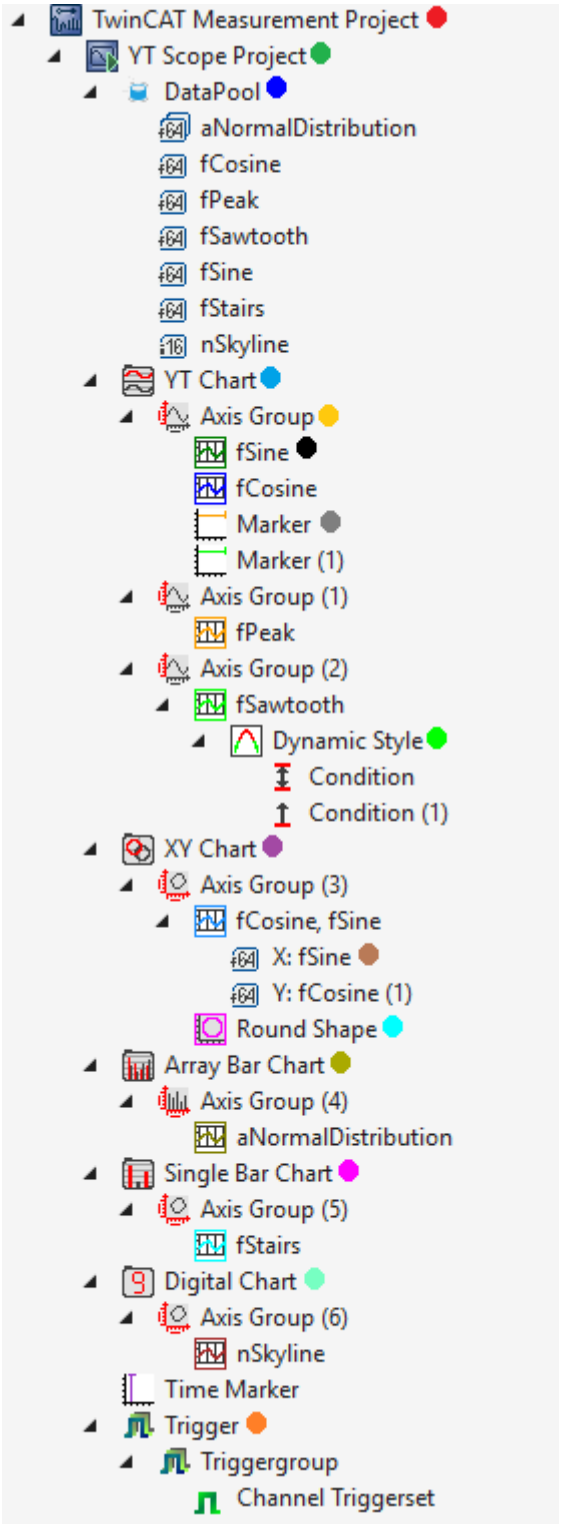
An ADS connection is necessary in order to be able to start a recording with a Scope View on a Remote Scope Server. A disconnection is also possible from version 3.3.3140.0. This means that the configuration is downloaded to the server and continues to run autonomously there. Alternatively the remote server can be controlled by a PLC function block. If no Scope Server is installed on the control system, the Scope Server on the device with the Scope View –the so-called local server –can also be used. For this there must be a constant connection to the remote device during the recording.

Apart from many properties in the Scope View for the graphic display and analysis of the data streams, the Scope also offers the option of triggered, i.e. event-based operation. Furthermore it is possible to export the recorded data in various file formats to external tools for further processing.

5 Configuration

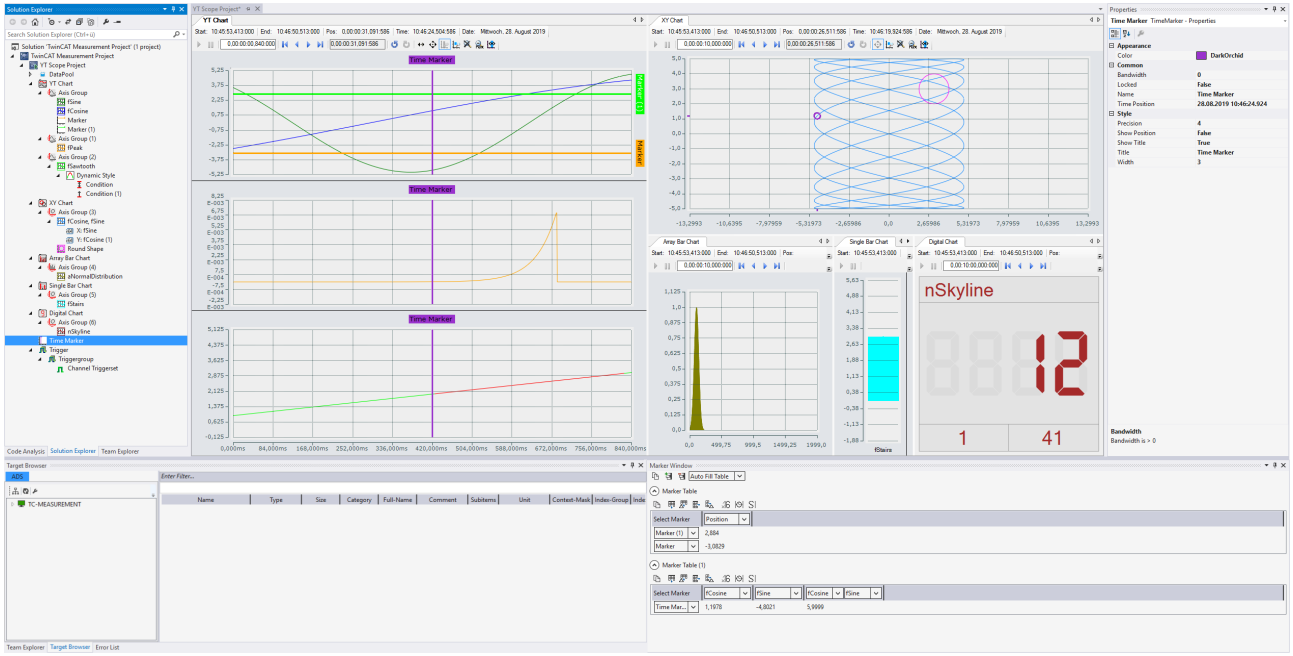
5.1 Architecture

Not only are signal curves represented in the TwinCAT 3 Scope View; recording configurations are also created. For the creation of these configurations it is important to be familiar with the architecture of the TwinCAT 3 Scope View. This is reflected in the tree structure of the measurement project in the **Solution Explorer**. By right-clicking on the tree node, context menus can be opened with which various Scope functions can be called up, such as opening a window or adding elements below the selected node.



Measurement Scope Project	Main level, at which several Scopes can be added. The Scopes within a project can be controlled independently of one another.	
Standard Scope Project	A Scope always stands for a recording configuration. This means that all elements inserted below it are subject to the same recording settings. If a Scope is selected, the setting options such as recording time and ring buffer are displayed in the Visual Studio **Properties** window. See also: Scope node [▶ 22]	
DataPool	All raw acquisitions whose data are to be recorded are located in the DataPool. Whether they are displayed in the View as graphs depends on the configuration of the charts. A distinction is made between raw acquisitions and interpreted acquisitions	
YT Chart	Several YT charts can exist in parallel in a Scope. They are the actual display area in the view and provide the time base. Each chart has its own toolbar for changing the display. The color and axis settings can be made in the **Properties** window. Clicking on the signal curve in the chart highlights the respective channel in the **Solution Explorer**. See also: YT chart properties [▶ 47]	
	Axis	A chart (YT, XY, array or single bar) can have several axes. An axis provides the value range for the connected channels. Amongst others, the automatic or free scaling can be set in the **Properties** window. See also: YT axis properties [▶ 51]
	Channel	A channel represents the style characteristics of a selected variable. In the **Properties** window the color, marks and other parameters can be set. Double-clicking on the channel highlights the respective signal in the chart.
	Acquisition	The acquisition contains information on the actually selected variables.
	Marker	Markers are hierarchically assigned to the charts. X and Y markers can be added within a chart. Amongst other things, the current values of the signal/ marker intersection and differences to the other markers are displayed in the Marker Tool window. Any desired number of X and Y markers can be set. See also: Marker [▶ 147]
	Dynamic Style	With the help of Dynamic Styles [▶ 157], the style properties such as graph thickness or graph color can be changed at runtime based on the states of the same or other acquisitions.
XY Chart	Several XY charts can exist in parallel in a Scope. They represent the actual display area in the view. Each chart has its own toolbar for changing the display. The color and scaling settings can be made in the Properties window. Clicking on the signal curve in the chart highlights the respective channel in the **Solution Explorer**. See also: XY chart properties [▶ 59]	
	Shapes	Shapes [▶ 161] are geometric figures that can be placed in the charts. The figures can be individualized accordingly through the specification of coordinates.
Array Bar Chart	An array bar chart can connect to an array in the controller and display each array element as a bar. Several array bar charts can exist in parallel in a Scope. The settings for the chart can be made in the **Properties** window.	
Single Bar Chart	The bar chart displays a single variable as a bar diagram. The settings [▶ 79] for this chart type can be made in the Property window.	
Digital Chart	The Digital Chart displays one value per channel. In the Digital Chart the values are shown in a numerical display and axis groups can be used to group the channels. See also: Digital Chart properties [▶ 88]	
Trigger	Triggers are assigned to the Scopes in the tree structure of the Scope View. The trigger action, e.g. a Stop Record, can be set in the Properties window of the Trigger Group. The lower-level triggers can be logically linked to form a trigger condition. The variable selection also takes place here in the **Properties** window. See also: Trigger properties [▶ 107]	

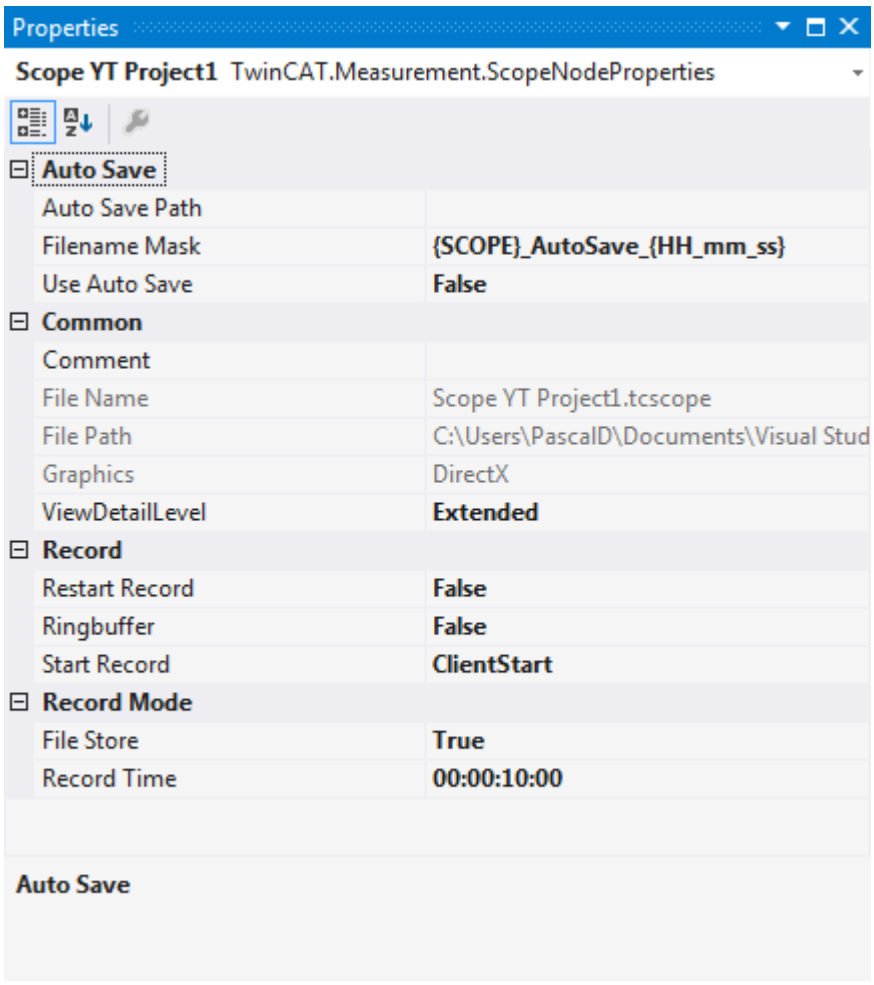
The interfaces for the control of the Scope View are divided into several individual windows (Tool windows) and their position and size are freely configurable.



Solution Explorer	Display of the project structure within a solution. See also: Architecture [▶ 20]
Markers	Display of the values present at the X/Y-marker. See also: Markers [▶ 147]
Target Browser	Channels can be added to a Scope configuration via their symbol names using the Target Browser. See also: Target Browser [▶ 166]
Properties	The settings of the element marked in the Solution Explorer are displayed in the Properties and can be edited. See also: Scope nodes [▶ 22]
Error list	List of errors, warnings and messages. Each scope project lists the generated messages independently here. The messages for the respectively selected Scope can be deleted via the context menu command **Clear Error List**.
ScopeViewControl	Display of the individual charts. The charts can be displayed next to each other or in overlapping tabs within the control, exactly like all other windows.

5.1.1 Scope nodes

The Scope node in the Solution Explorer is a type of administration shell for the Scope configuration. Several Scope nodes can be created in a measurement project. A Scope contains the charts, axes and channels of a configuration. With selected Scope nodes the higher-level properties are displayed in the Property window. These fulfill the following functions.


Properties
Scope YT Project1 TwinCAT.Measurement.ScopeNodeProperties
Auto Save
Auto Save Path
Filename Mask
{SCOPE}_AutoSave_{HH_mm_ss}
Use Auto Save
False
Common
Comment
File Name
Scope YT Project1.tcscope
File Path
C:\Users\PascalD\Documents\Visual Stud
Graphics
DirectX
ViewDetailLevel
Extended
Record
Restart Record
False
Ringbuffer
False
Start Record
ClientStart
Record Mode
File Store
True
Record Time
00:00:10:00
Auto Save

Auto Save

Auto Save Path	Here you can select the path for saving the recording via the file browser.
Filename Mask	Affects the filename of the recording to be saved. In this way it is possible to realize continuous timestamps, for example.
Use Auto Save	Turns on automatic saving for a stopped recording.
Auto delete mode	Here you can set the mode in which the Auto Delete function should run. If set to "Disabled", no files will be deleted. "Capacity“ deletes the oldest file in the folder if more than the number of files specified in "Delete more than" has been saved. If set to "OlderThan", all files older than the time specified in "Delete older than" will be deleted. The option "CapacityOrOlderThan" is a combination of "Capacity" and "OlderThan". That is, files are deleted when the conditions for either option are met.
Auto Save Mode	After a recording is stopped: None – no data is stored automatically. SVDX – the data is automatically stored in a *.svdx* file. Export – the data is exported. The export configuration can be customized.
Configuration	With this option, the configuration of the export can be set via the wizard [▶ 290].
Delete more than	This option defines when and with how many created files the oldest is to be deleted. The option is only active as long as "Capacity" or "CapacityOrOlderThan" is selected in "Auto Delete".
Delete older than	This option defines the number of seconds after which a file is to be deleted with Auto Delete. This option is only active as long as "OlderThan" or "CapacityOrOlderThan" is selected in "Auto Delete".
Image Delete Mode	Here you can set in which mode the Auto Delete function for the image data should run. If set to "Disabled", no files will be deleted. "Capacity“ deletes the oldest file in the folder if more than the number of files specified in "Delete more than" has been saved. If set to "OlderThan", all files older than the time specified in "Delete older than" will be deleted. The option "CapacityOrOlderThan" is a combination of "Capacity" and "OlderThan". That is, files are deleted when the conditions for either option are met. With the "Like Data" setting, the settings are taken from the data.
Delete Images older than	This option defines the number of seconds after which a file is to be deleted with Auto Delete. This option is only active as long as "OlderThan" or "CapacityOrOlderThan" is selected in "Auto Delete".
Delete Images more than	This option defines when and with how many created files the oldest is to be deleted. The option is only active as long as "Capacity" or "CapacityOrOlderThan" is selected in "Auto Delete".

Common

Comment	A free comment can be stored here.
File Name	Filename of the current Scope instance.
File Path	Directory in which the Scope instance was saved.
Graphics	Shows the currently used graphic. A distinction is made between GDI+ and DirectX.
ViewDetailLevel	Here you can set the level of detail for showing or hiding various options. For a better overview, the Extended level is particularly recommended for XY plots. The option is therefore only available for XY plots at present. The options “Default” and “Extended” are available for all chart types.

Record

Restart Record	Here you can restart a stopped recording.
Ring buffer	Here you can specify how the server should respond, once the recording time has been reached. • If the option is disabled, the recording is stopped when the recording time is reached. The recording can be terminated prematurely via the stop button. • If the option is enabled the recording is not stopped, but the oldest data in the memory is overwritten. This increases the start time of the recording. The recording can be stopped by pressing the stop button.
Start Record	Here you can set whether the recording should be started via the recording button (UserStart) or when a trigger event occurs (TriggerStart).

Record Mode

File Store	Here you can specify whether the server should buffer the data in a local file (True) or only in the RAM (False). The choice depends on the quantity of data to be recorded and the recording equipment. The access time is faster, if only the RAM is used. For larger data quantities it is usually necessary to activate the “File Store” option.
Record Time	Here you can specify the total recording time. It is entered in the format Days:Hours:Minutes:Seconds.
Synchronization mode	This option sends a command to the selected TwinCAT controllers to activate timestamp correction. This can be done in the familiar Soft, Medium and Hard levels from the TwinCAT configuration. This option only takes effect if the TwinCAT configuration of the selected controllers has also configured the respective mode. Subsequent configuration from the scope is not possible.

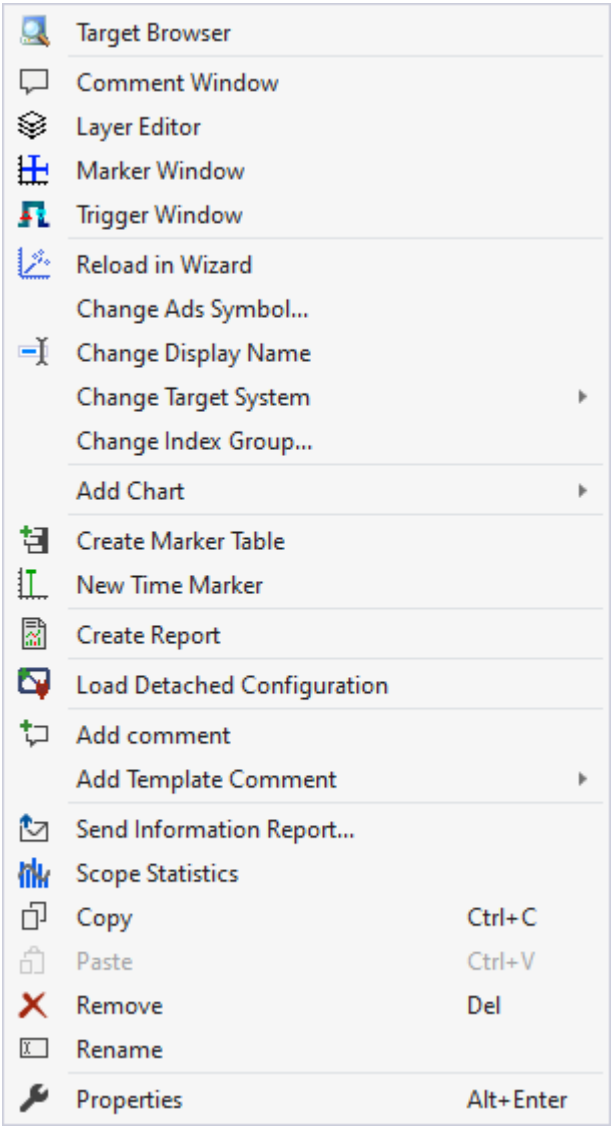
Changing the settings of several Scopes at the same time

To change the settings for several Scopes at the same time, please refer to the chapter Multiple selection [▶ 389].

Context menu

The context menu entries for a Scope project differ depending on whether the project is a pure Scope configuration or whether it is a loaded SVDX.

Context menu of a pure Scope configuration



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

In the following group, the existing configuration can be reconfigured with just a few clicks.

"Reload in Wizard"
This function can be used to open the Scope project in the Project Wizard [▶ 281] in order to reconfigure it there. However, this function is only available if only ADS acquisitions are available.

"Change Ads Symbol..."
If the symbol names have changed in several ADS acquisitions, parts of the name can be exchanged using this function.

"Change Display Name"
The "Change Display Name" function can be used to set the level of detail to be displayed for the names of the channels and acquisitions.

"Change Target System"
If the target system of all ADS acquisitions is to be changed, this can be done with this function by selecting the new target system in the submenu.

"Change Index Group..."
This function can be used to change the Index Group of all ADS variables. Either an offset can be calculated or a new value can be entered.

"Add Chart"
The various chart types or images can be added to the project using the submenu.

The following group offers various functions for interacting with the markers.

"Create Marker Table"
This function is used to create tables for all charts in the Marker window that are linked to the charts to display all chart information.

"New Time Marker"
Creates a new Time Marker and adds it to the selected element.

"Create Report"
Creates a report based on the project. [▶ 259]

"Load Detached Configuration"
This function can be used to load a detached project from a connected server [▶ 183].

"Add comment"
To write additional information to the selected node, this function can be used to add a new comment, which is displayed in the comment window.

"Add Template Comment"
In this submenu, new templates can be created or selected in order to add them.

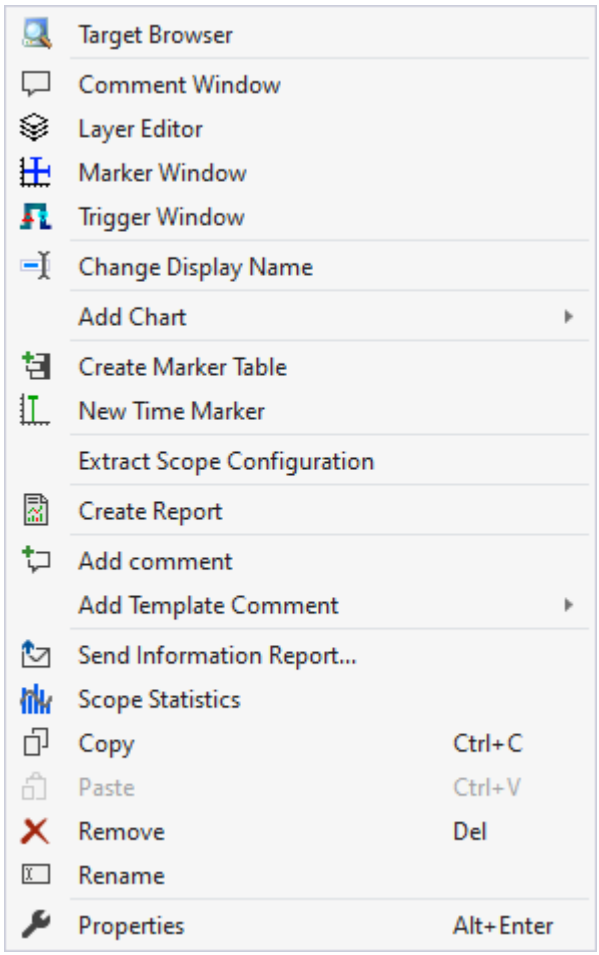
Various standard functionalities can be found in the last two groups.

"Send Information Report..."
Open the Support Information Report [▶ 319] to send a message to the support team.

"Scope Statistics"
Open the Scope statistics [▶ 314].

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

Context menu of an SVDX file



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

In the following group, the existing configuration can be reconfigured with just a few clicks.

"Change Display Name"
The "Change Display Name" function can be used to set the level of detail to be displayed for the names of the channels and acquisitions.

"Add Chart"
The various chart types or images can be added to the project using the submenu.

The following group offers various functions for interacting with the markers.

"Create Marker Table"
This function is used to create tables for all charts in the Marker window that are linked to the charts to display all chart information.

"New Time Marker"
Creates a new Time Marker and adds it to the selected element.

"Extract Scope Configuration"
Extracts the Scope configuration from the selected .svdx.

"Create Report"
Creates a report based on the project. [▶ 259]

"Add comment"
To write additional information to the selected node, this function can be used to add a new comment, which is displayed in the comment window.

"Add Template Comment"
In this submenu, new templates can be created or selected in order to add them.

Various standard functionalities can be found in the last two groups.

"Send Information Report..."
Open the Support Information Report [▶ 319] to send a message to the support team.

"Scope Statistics"
Open the Scope statistics [▶ 314].

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

5.1.2 Data pool

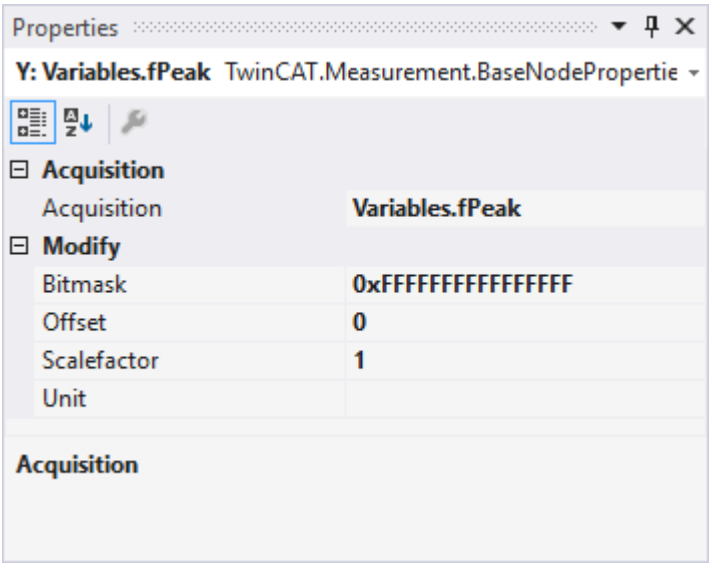
The data pool is a container for project acquisitions. All acquisitions created for the project are placed in the data pool. Acquisitions that are enabled at the start of a recording are recorded and can be referenced in the interpreter of a channel during both the configuration and the recording in order to display the data of the acquisition.

There are two types of acquisition, the array bar acquisition, which is displayed with a green accent, and other acquisitions, which are displayed with a red accent. The array bar acquisitions can only be referenced in array bar channel interpreters and not in other channel interpreters or trigger set interpreters.

Each project has a data pool that is automatically added during creation.

In order to start a recording there may not be any acquisitions with the same configuration in the data pool. Since several interpreters may point to an acquisition, acquisitions with the same configuration are not necessary.

Acquisition interpreters



Acquisition interpreters can reference an acquisition of the data pool and forward the data after manipulation.

The following settings can be made:

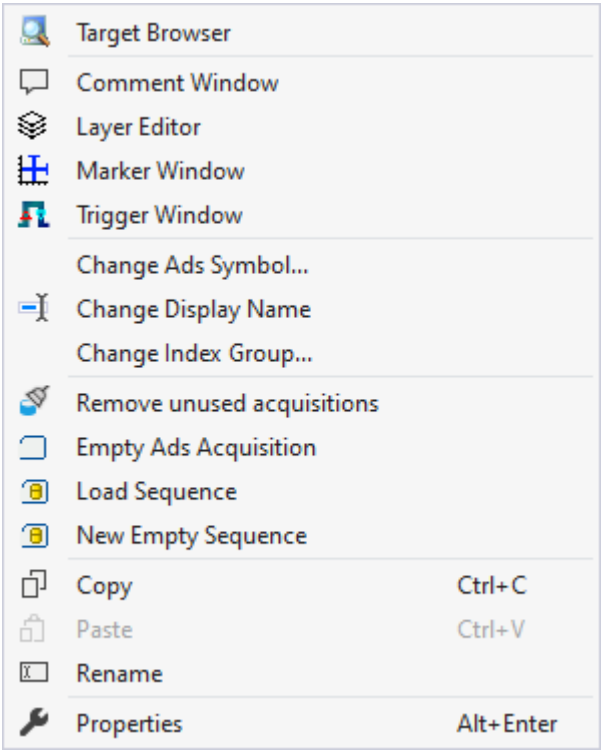
Acquisition

Acquisition	Selection of the acquisition used from the data pool.

Modify

Bitmask	In this field a value can be entered with which the display value is masked, provided it is not of the type floating point. This means that the value of the channel is ANDed with the binary value of the mask. This helps you, for example, to observe individual bits of a status byte.
Offset	A free offset can be added to the function value of the channel in the offset field.
Scalefactor	The display value of a channel can be changed with the scale factor.
Unit	This property enables the physical unit to be configured individually for the X-acquisition and the Y-acquisition of the channel. This can be done with the aid of the "Unit Wizard", which can be opened using the button on the right in the field. A further option is to define the units beforehand as attributes in the PLC code. These are then read out directly and entered in the Unit field. Detailed information on the units and their configuration options can be taken from the chapter [▶ 191].

Context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

In the following group, the existing configuration can be reconfigured with just a few clicks.

"Change Ads Symbol..."
If the symbol names have changed in several ADS acquisitions, parts of the name can be exchanged using this function.

"Change Display Name"
The "Change Display Name" function can be used to set the level of detail to be displayed for the names of the channels and acquisitions.

"Change Index Group..."
This function can be used to change the Index Group of all ADS variables. Either an offset can be calculated or a new value can be entered.

In the fourth group, further acquisitions can be added or deleted.

"Remove unused acquisitions"
If acquisitions are not used in the remaining Scope configuration, they can be deleted from the data pool.

"Empty Ads Acquisition"
Add a new and unconfigured Ads Acquisition.

"Load Sequence"
If data for a sequence is already available in a file [▶ 219], this data can be loaded into a sequence using this function.

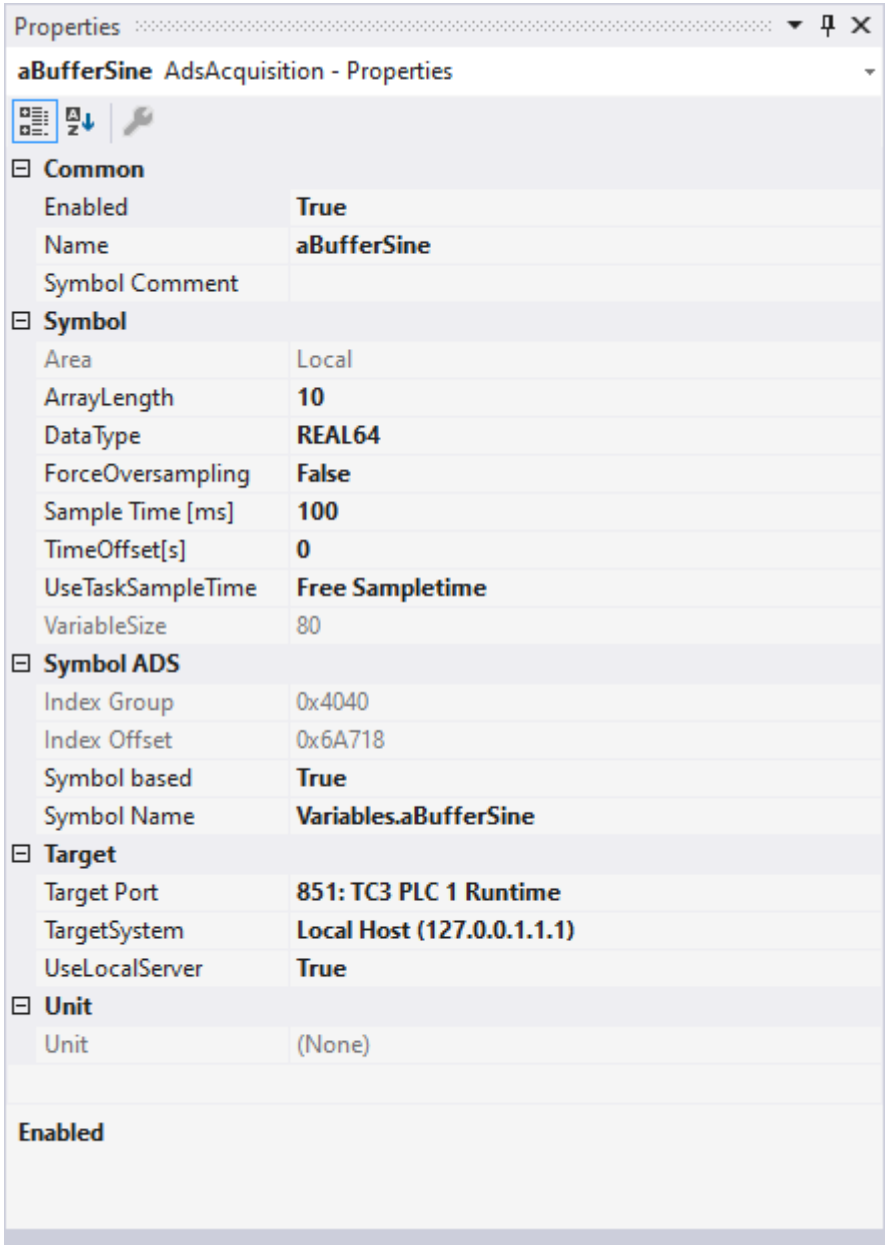
"New Empty Sequence"
A new sequence can be created using the Curve Creator [▶ 219].

Various standard functionalities can be found in the last two groups.

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

5.1.2.1 ADS Acquisition

Ads Acquisition describes a variable for which the values are communicated via Ads.



Common

Enabled	Here you can decide whether the configured channel should be recorded or not.
Name	Here you can edit the name of the acquisition.
Symbol Comment	Here the actual symbol comment is displayed, if such a comment exists.

Symbol

Area	Indicates the variable range.
ArrayLength	Indicates the length of the selected array.
DataType	Indicates the data type of the selected variable.
ForceOversampling	Indicates whether the specified variable is an oversampling variable.
SampleTime [ms]	Specifies the sampling interval for the variable.
TimeOffset[s]	This can be used for one-time manipulation of the original time stamp during recording of the data point. e.g. to compensate path differences of different target systems. The phase differences have to be determined manually by the user.
UseTaskSampleTime	Here you can specify whether the data for the selected variables are to be sampled with the TaskSampleTime or the FreeSampleTime. FreeSampleTime can be used to set the Sample Time.
VariableSize	Shows the size of the variables in bytes

Symbol ADS

Index group	Group index of the variable.
Index offset	Offset index of the variable.
Symbol based	If this option is set, the variables are communicated via the symbol name. If this option is not set, the variables are communicated via the Group and Offset indices, and the input fields for Group and Offset are enabled.
Symbol Name	Symbol name of the selected variable.

Target

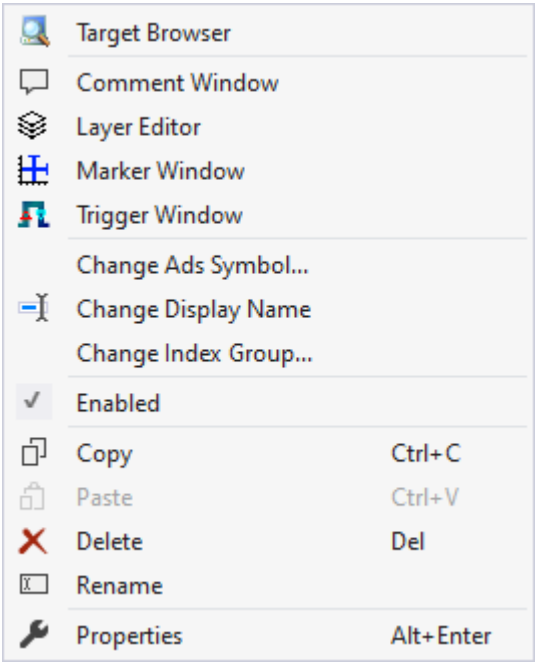
TargetSystem	Indicates the target system selected for a recording. By default this is the target system for the selected variable.
UseLocalServer	If this option is set, the Scope Server installed on the Scope View system is used for the recording. If the option is not set, the system tries to connect to the remote server of the target system.

TargetPort	Shows the variable port on the respective TwinCAT system. A drop-down box can be used to select the available ports for the selected target system.

Unit

If a unit is defined for the variable, it is displayed here. However, it cannot be edited. If a unit is to be added to the display, it must be specified with the channel.

Context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

In the following group, the existing configuration can be reconfigured with just a few clicks.

"Change Ads Symbol..."
If the symbol names have changed in several ADS acquisitions, parts of the name can be exchanged using this function.

"Change Display Name"
The "Change Display Name" function can be used to set the level of detail to be displayed for the names of the channels and acquisitions.

"Change Index Group..."
This function can be used to change the Index Group of all ADS variables. Either an offset can be calculated or a new value can be entered.

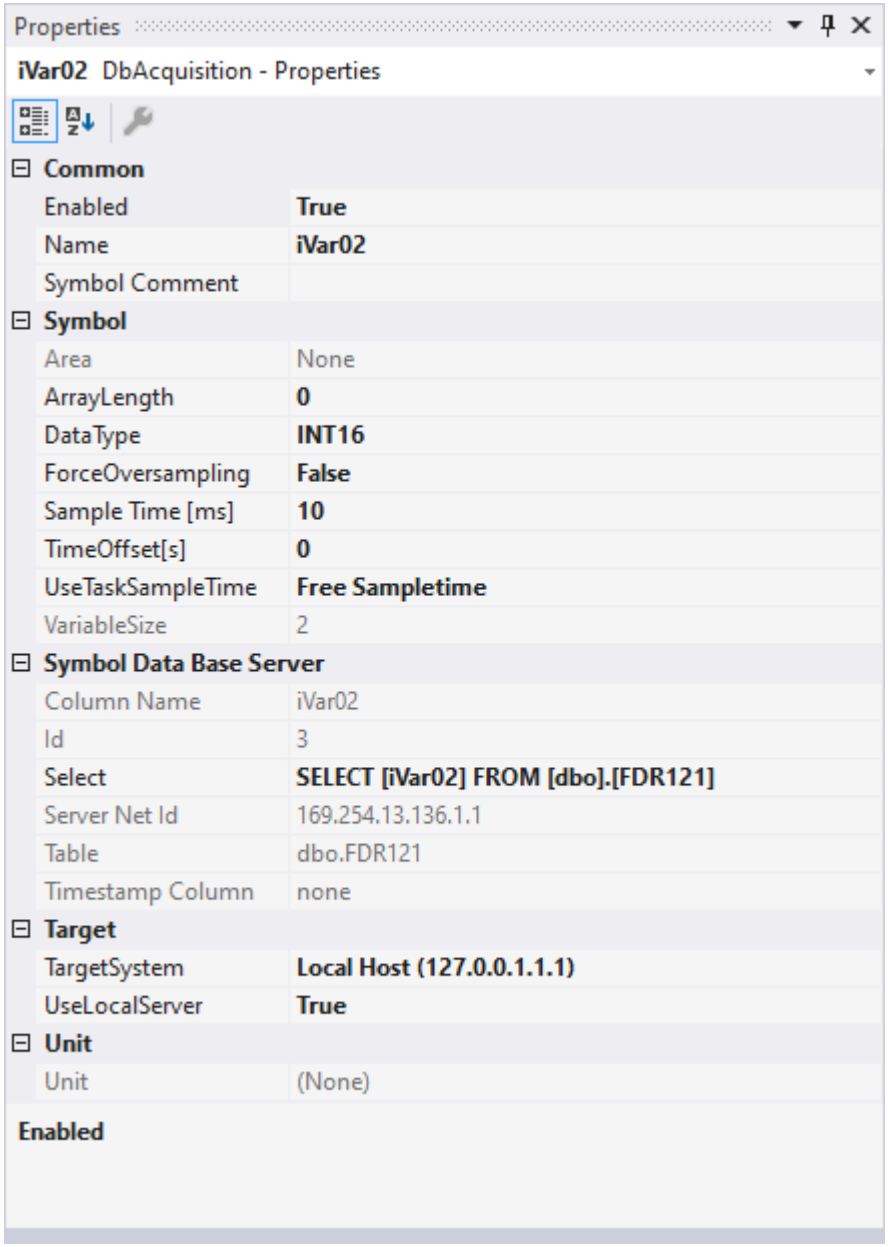
"Enabled"
This setting can be used to set whether or not data should be recorded for the acquisition. If the setting is active (tick is visible on the left), data is collected and the acquisition can also be used in the rest of the configuration.

Various standard functionalities can be found in the last two groups.

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

5.1.2.2 Database Acquisition

DataBase Acquisition describes a variable to which the values are loaded from a database server.



Common

Enabled	Here you can decide whether the configured channel should be recorded or not.
Name	Here you can edit the name of the acquisition.
Symbol Comment	Here the actual symbol comment is displayed, if such a comment exists.

Symbol

Area	Indicates the variable range.
ArrayLength	Indicates the length of the selected array.
DataType	Indicates the data type of the selected variable.
ForceOversampling	Indicates whether the specified variable is an oversampling variable.
SampleTime [ms]	Specifies the sampling interval for the variable.
TimeOffset[s]	This can be used for one-time manipulation of the original time stamp during recording of the data point. e.g. to compensate path differences of different target systems. The phase differences have to be determined manually by the user.
UseTaskSampleTime	Here you can specify whether the data for the selected variables are to be sampled with the TaskSampleTime or the FreeSampleTime. FreeSampleTime can be used to set the Sample Time.
VariableSize	Shows the size of the variables in bytes

Symbol Data Base Server

Column Name	Indicates the column name of the database.
Id	Indicates the ID of the database server.
Select	Indicates the Select command used to access the database.
Server Net Id	Specifies the NetID of the system on which the Data Base Server is running.
Table	Provides the name of the table.
Timestamp Column	Indicates the name of the column in which the timestamp is stored.

Target

TargetSystem	Indicates the target system selected for a recording. By default this is the target system for the selected variable.
UseLocalServer	If this option is set, the Scope Server installed on the Scope View system is used for the recording. If the option is not set, the system tries to connect to the remote server of the target system.

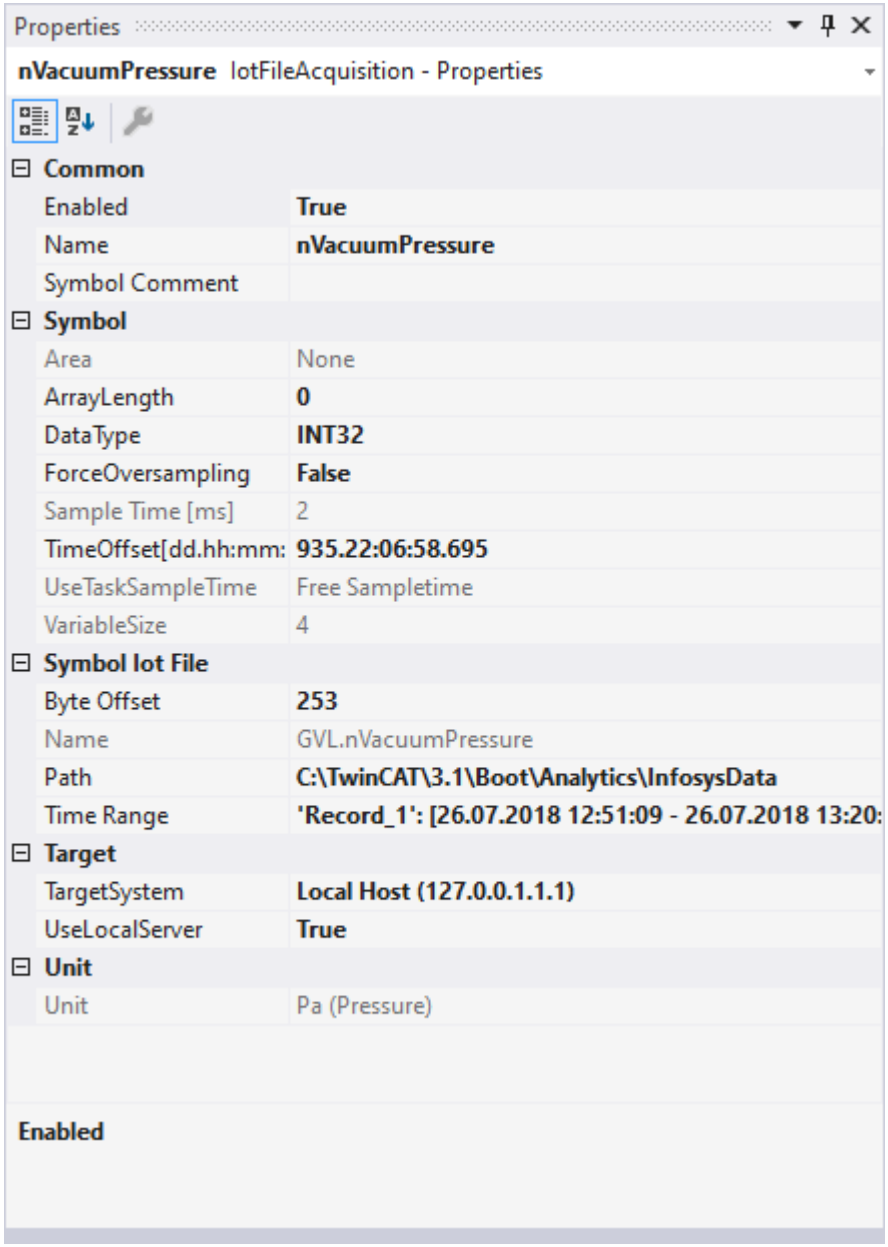
Unit

If a unit is defined for the variable, it is displayed here. However, it cannot be edited. If a unit is to be added to the display, it must be specified with the channel.

Context menu
Further information can be found in the Acquisition context menu. [▶ 46]

5.1.2.3 Analytics File Acquisition

Analytics File Acquisition describes a variable for which the values are read from an Analytics File.



Common

Enabled	Here you can decide whether the configured channel should be recorded or not.
Name	Here you can edit the name of the acquisition.
Symbol Comment	Here the actual symbol comment is displayed, if such a comment exists.

Symbol

Area	Indicates the variable range.
ArrayLength	Indicates the length of the selected array.
DataType	Indicates the data type of the selected variable.
ForceOversampling	Indicates whether the specified variable is an oversampling variable.
SampleTime [ms]	Specifies the sampling interval for the variable.
TimeOffset[s]	This can be used for one-time manipulation of the original time stamp during recording of the data point. e.g. to compensate path differences of different target systems. The phase differences have to be determined manually by the user.
UseTaskSampleTime	Here you can specify whether the data for the selected variables are to be sampled with the TaskSampleTime or the FreeSampleTime. FreeSampleTime can be used to set the Sample Time.
VariableSize	Shows the size of the variables in bytes

Symbol IotFile

Byte Offset	Indicates the byte offset of the variable in the IoT File.
Name	Symbol name of the selected variable.
Path	Selection of the path for the IotFiles.
Time Range	Select which time range of the historical recording will be used in the new recording.

Target

TargetSystem	Indicates the target system selected for a recording. By default this is the target system for the selected variable.
UseLocalServer	If this option is set, the Scope Server installed on the Scope View system is used for the recording. If the option is not set, the system tries to connect to the remote server of the target system.

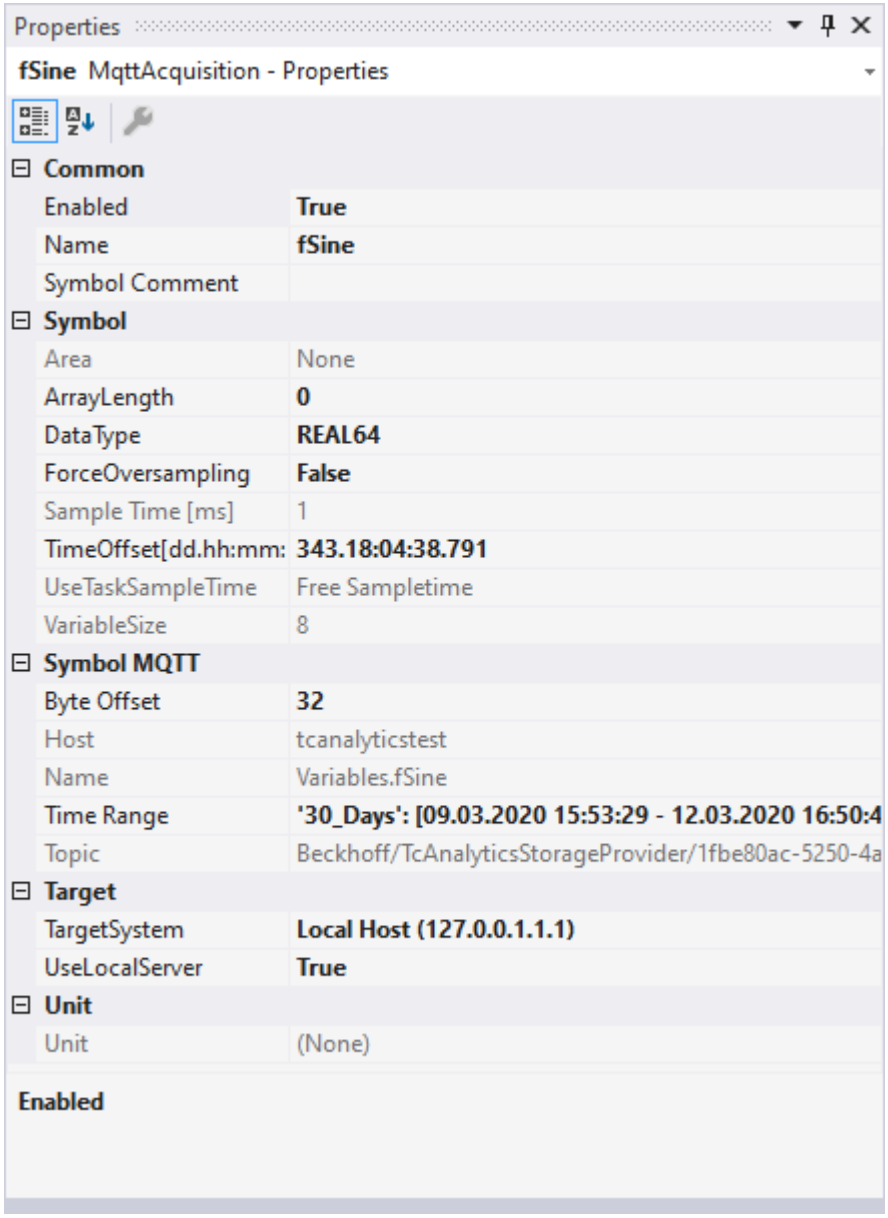
Unit

If a unit is defined for the variable, it is displayed here. However, it cannot be edited. If a unit is to be added to the display, it must be specified with the channel.

Context menu
Further information can be found in the Acquisition context menu. [▶ 46]

5.1.2.4 Analytics MQTT Acquisition

Mqtt Acquisition describes a variable for which the values are communicated via Mqtt.



Common

Enabled	Here you can decide whether the configured channel should be recorded or not.
Name	Here you can edit the name of the acquisition.
Symbol Comment	Here the actual symbol comment is displayed, if such a comment exists.

Symbol

Area	Indicates the variable range.
ArrayLength	Indicates the length of the selected array.
DataType	Indicates the data type of the selected variable.
ForceOversampling	Indicates whether the specified variable is an oversampling variable.
SampleTime [ms]	Specifies the sampling interval for the variable.
TimeOffset[s]	This can be used for one-time manipulation of the original time stamp during recording of the data point. e.g. to compensate path differences of different target systems. The phase differences have to be determined manually by the user.
UseTaskSampleTime	Here you can specify whether the data for the selected variables are to be sampled with the TaskSampleTime or the FreeSampleTime. FreeSampleTime can be used to set the Sample Time.
VariableSize	Shows the size of the variables in bytes

Symbol MQTT

Byte Offset	Specifies the offset of a symbol.
Host	Specifies the host name of the Mqtt broker.
Name	Symbol name of the selected variable.
Time Range	Select which time range of the historical recording will be used in the new recording.
Topic	Specifies the topic under which the symbol is located.

Target

TargetSystem	Indicates the target system selected for a recording. By default this is the target system for the selected variable.
UseLocalServer	If this option is set, the Scope Server installed on the Scope View system is used for the recording. If the option is not set, the system tries to connect to the remote server of the target system.

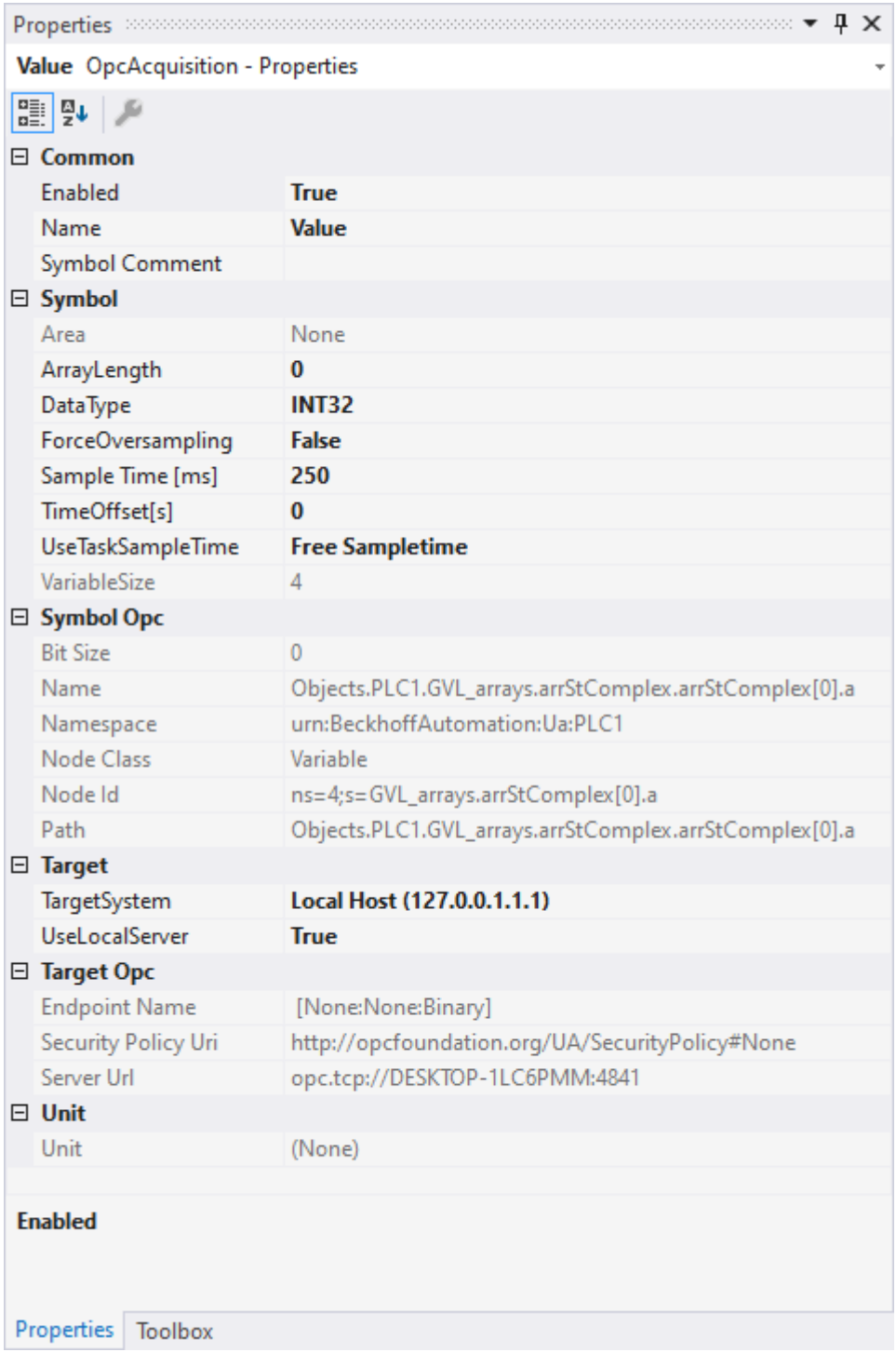
Unit

If a unit is defined for the variable, it is displayed here. However, it cannot be edited. If a unit is to be added to the display, it must be specified with the channel.

Context menu
Further information can be found in the Acquisition context menu. [▶ 46]

5.1.2.5 OPC Acquisition

Opc Acquisition describes a variable for which the values are communicated via Opc.



Common

Enabled	Here you can decide whether the configured channel should be recorded or not.
Name	Here you can edit the name of the acquisition.
Symbol Comment	Here the actual symbol comment is displayed, if such a comment exists.

Symbol

Area	Indicates the variable range.
ArrayLength	Indicates the length of the selected array.
DataType	Indicates the data type of the selected variable.
ForceOversampling	Indicates whether the specified variable is an oversampling variable.
SampleTime [ms]	Specifies the sampling interval for the variable.
TimeOffset[s]	This can be used for one-time manipulation of the original time stamp during recording of the data point. e.g. to compensate path differences of different target systems. The phase differences have to be determined manually by the user.
UseTaskSampleTime	Here you can specify whether the data for the selected variables are to be sampled with the TaskSampleTime or the FreeSampleTime. FreeSampleTime can be used to set the Sample Time.
VariableSize	Shows the size of the variables in bytes

Symbol Opc

Bit Size	Size of the symbol in bits.
Name	Name of the symbol.
Namespace	Namespace of the symbol.
Node Class	Name of the node to which the symbol is assigned in the hierarchy.
Node Id	Id of the system node.
Path	Path to the symbol.

Target

TargetSystem	Indicates the target system selected for a recording. By default this is the target system for the selected variable.
UseLocalServer	If this option is set, the Scope Server installed on the Scope View system is used for the recording. If the option is not set, the system tries to connect to the remote server of the target system.

Target Opc

Endpoint Name	Name of the selected OPC UA end point. Contains information about the encryption method and signing.
Security Policy Uri	URI of the selected encryption method.
Server URL	URL of the OPC UA Server from which the symbol is to be recorded.

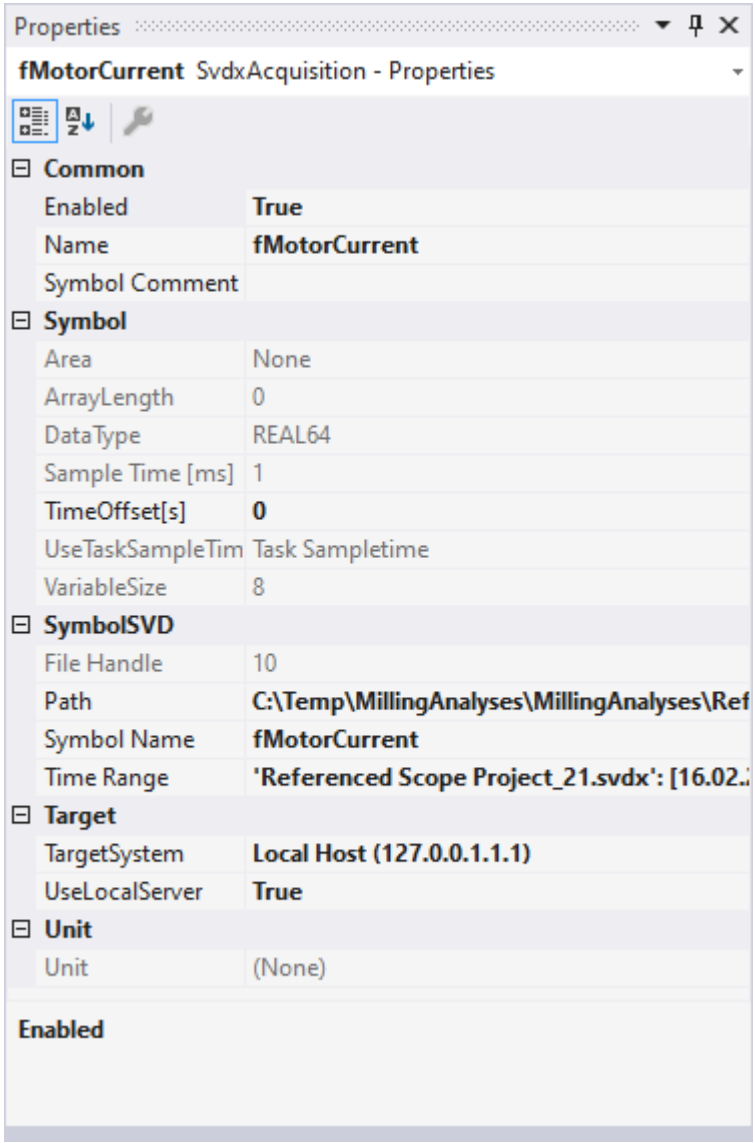
Unit

If a unit is defined for the variable, it is displayed here. However, it cannot be edited. If a unit is to be added to the display, it must be specified with the channel.

Context menu
Further information can be found in the Acquisition context menu. [▶ 46]

5.1.2.6 svdx Acquisition

Svdx Acquisition describes a variable to which the values from a Svdx file are read.



Common

Enabled	Here you can decide whether the configured channel should be recorded or not.
Name	Here you can edit the name of the acquisition.
Symbol Comment	Here the actual symbol comment is displayed, if such a comment exists.

Symbol

Area	Indicates the variable range.
ArrayLength	Indicates the length of the selected array.
DataType	Indicates the data type of the selected variable.
ForceOversampling	Indicates whether the specified variable is an oversampling variable.
SampleTime [ms]	Specifies the sampling interval for the variable.
TimeOffset[s]	This can be used for one-time manipulation of the original time stamp during recording of the data point. e.g. to compensate path differences of different target systems. The phase differences have to be determined manually by the user.
UseTaskSampleTime	Here you can specify whether the data for the selected variables are to be sampled with the TaskSampleTime or the FreeSampleTime. FreeSampleTime can be used to set the Sample Time.
VariableSize	Shows the size of the variables in bytes

Symbol SVDX

File Handle	Specifies the handle to the variable in the SVDX file.
Path	Select the path of the SVDX file.
Symbol Name	Symbol name of the selected variable.
Time Range	Select which time range of the historical recording will be used in the new recording.

Target

TargetSystem	Indicates the target system selected for a recording. By default this is the target system for the selected variable.
UseLocalServer	If this option is set, the Scope Server installed on the Scope View system is used for the recording. If the option is not set, the system tries to connect to the remote server of the target system.

Unit

If a unit is defined for the variable, it is displayed here. However, it cannot be edited. If a unit is to be added to the display, it must be specified with the channel.

Context menu
Further information can be found in the Acquisition context menu. [▶ 46]

5.1.2.7 Sequences

A sequence is an acquisition that contains its own data and does not use data recorded by the Scope Server. Therefore it is also possible to display sequences before the recording has been started.

Only the values but no times are stored in sequences. In the Curve Creator, the values are displayed on an index-based axis. As a reference curve in layers, the sample time of the sequence and the start time in the layer are used to create time values.

The sequences of a Scope project are displayed in the Solution Explorer in the data pool in a separate folder.

Saving

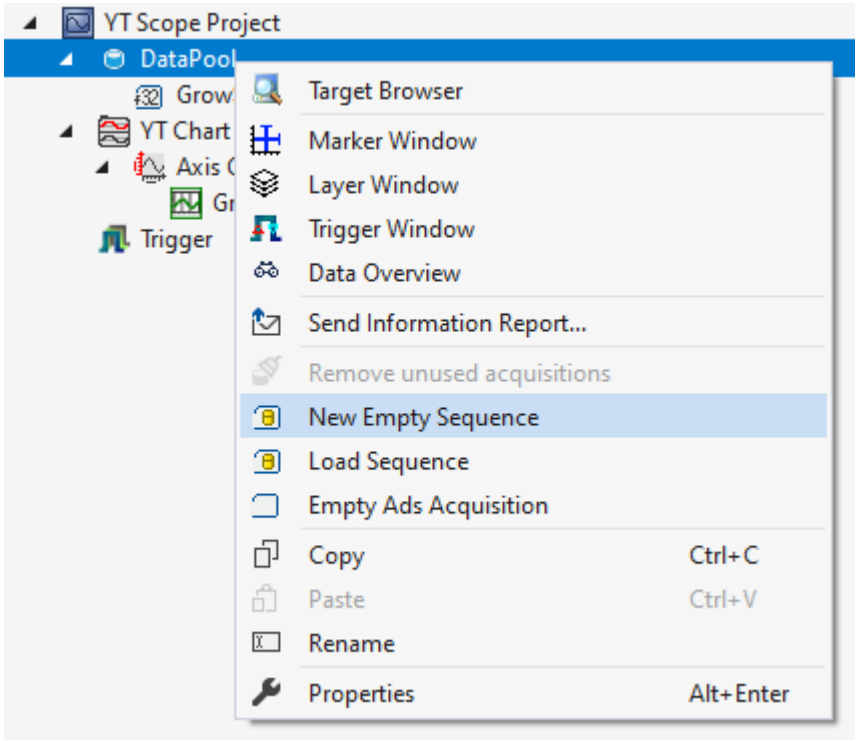
The data of a sequence is saved in a file when the Scope project is saved. The files are available in Analytics File Format. They are placed in a folder named after the sequence.

Add sequences

There are three ways to add new sequences to a Scope project.

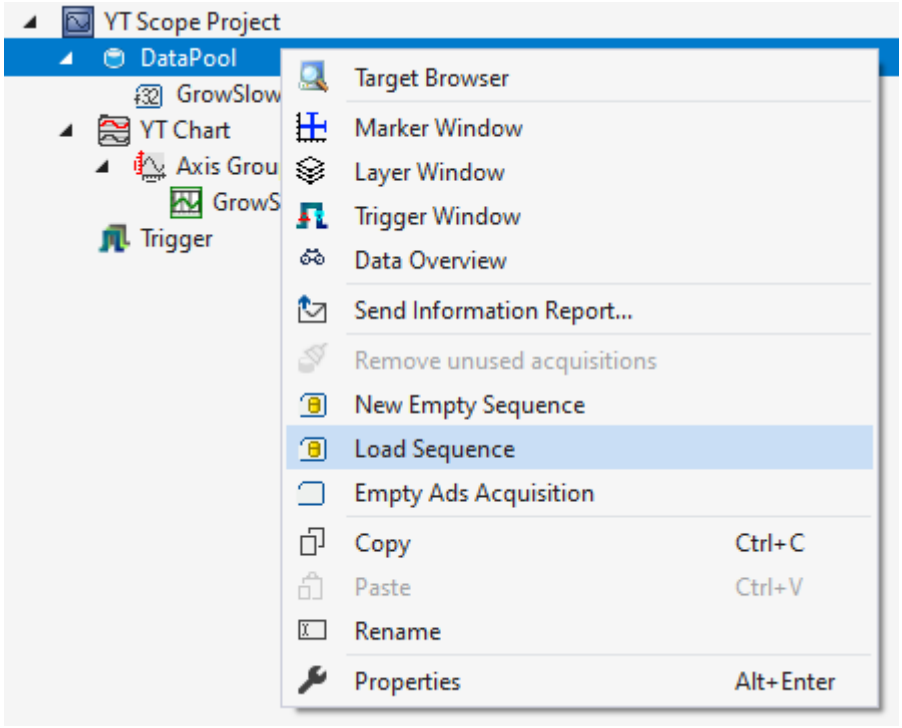
Create new sequence

In the context menu of the data pool a new sequence can be created with **New Empty Sequence**, which consists at the beginning only of zeros. In Curve Creator [▶ 224] this sequence can be edited as desired and finally added as a new sequence in the data pool.

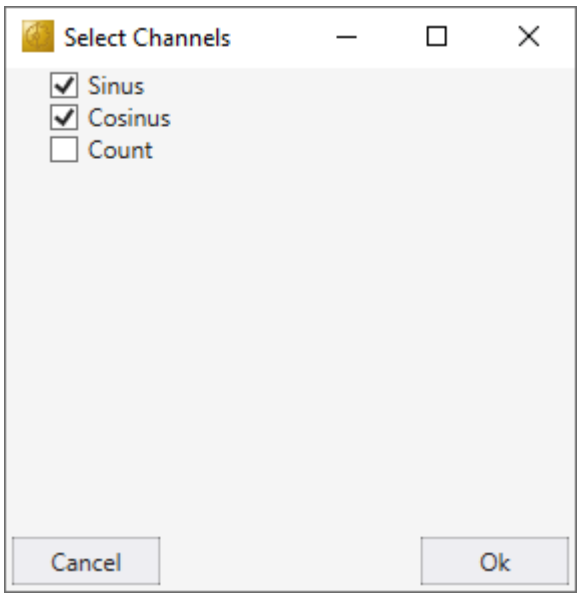


Load from file

If reference data already exists as an Analytics file or in a CSV, these files can also be opened to add the data as a sequence.
To add a sequence via this way, one or more new sequences can be inserted via the context menu from the data pool with **Load Sequence**.



If there are several data series in the Analytics File or CSV file, a window for selecting the appropriate data series will open.



When the selection is confirmed with **Ok**, the window closes and the sequences are added to the data pool. If there is only one data series in the selected file, this window is skipped and the sequence is added automatically.

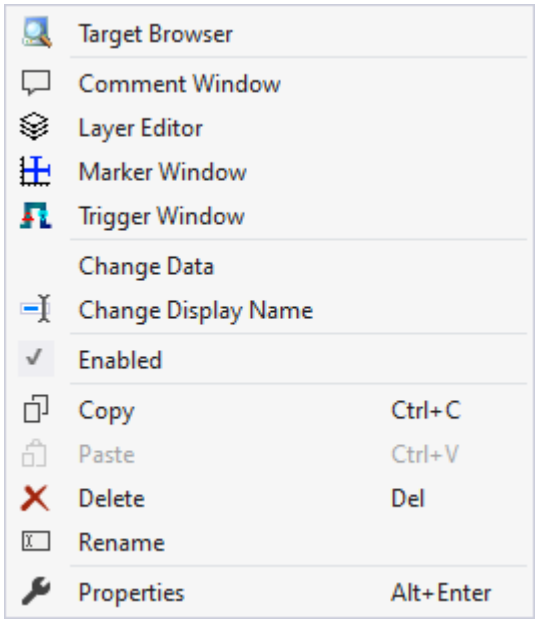
The data structure in the CSV file consists of a first row containing the names of the data series. The following rows contain the data of the data series.

```
Value1,Value2
1,5
2,4
3,3
4,2
5,1
```

Convert data from a current recording into a sequence

If a recording is already available, sequences can be generated directly from the recorded data and added to the data pool. This can be done with the Curve Creator.

Context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

"Change Data"
With the help of the Curve Creator [▶ 224] the data of a sequence can be viewed or manipulated. It is also possible to select multiple sequences in the Solution Explorer and edit them all simultaneously.

It is also possible to view the values in the Property window.

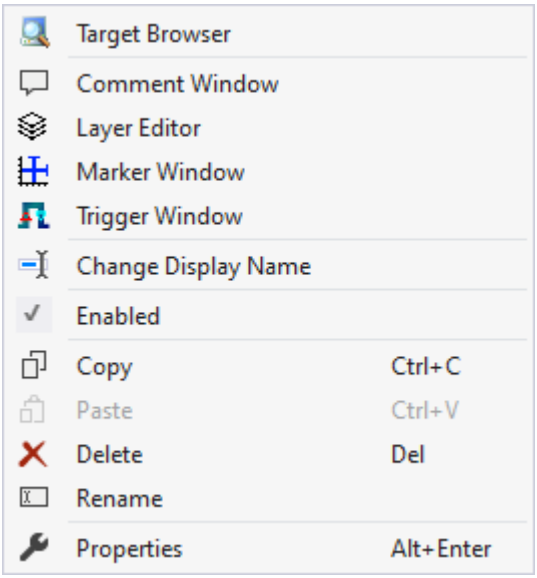
"Change Display Name"
The "Change Display Name" function can be used to set the level of detail to be displayed for the names of the channels and acquisitions.

"Enabled"
This setting can be used to set whether or not data should be recorded for the acquisition. If the setting is active (tick is visible on the left), data is collected and the acquisition can also be used in the rest of the configuration.

Various standard functionalities can be found in the last two groups.

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

5.1.2.8 Acquisition context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

In the following group, the existing configuration can be reconfigured with just a few clicks.

"Change Display Name"
The "Change Display Name" function can be used to set the level of detail to be displayed for the names of the channels and acquisitions.

"Enabled"
This setting can be used to set whether or not data should be recorded for the acquisition. If the setting is active (tick is visible on the left), data is collected and the acquisition can also be used in the rest of the configuration.

Various standard functionalities can be found in the last two groups.

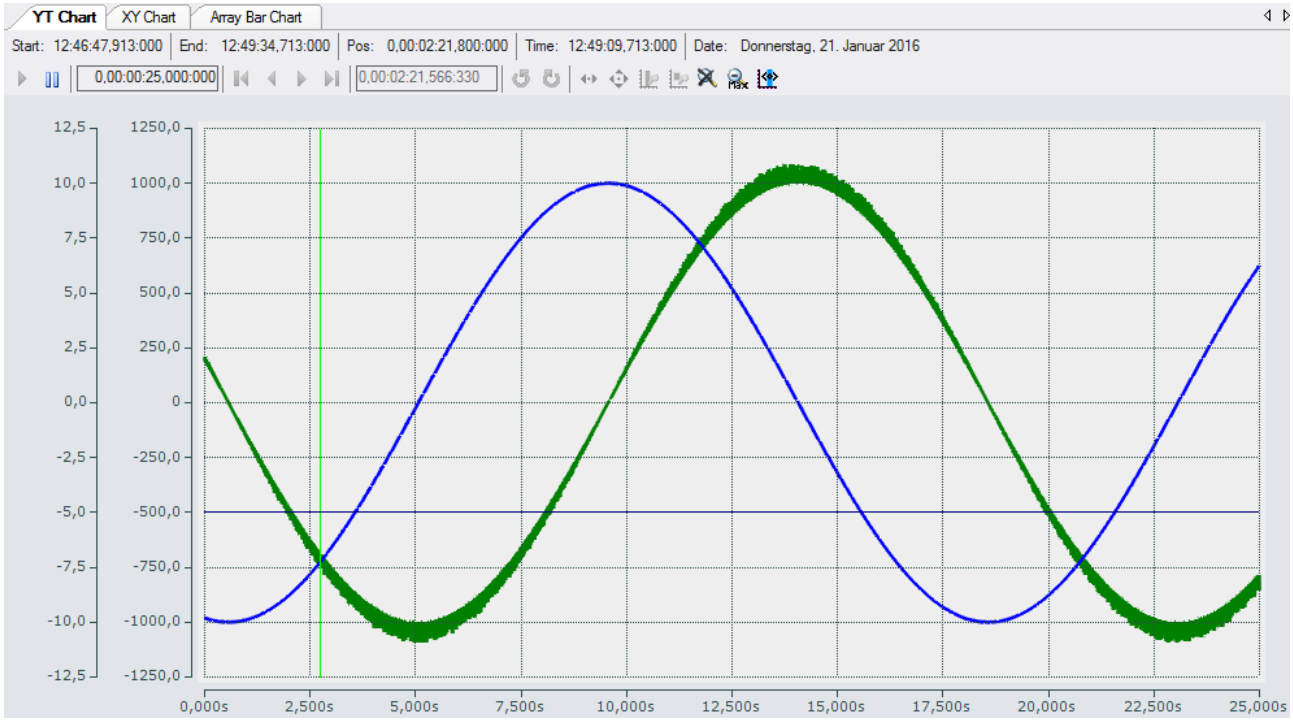
The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

5.1.3 Charts and channels

5.1.3.1 YT Chart

All the properties of the individual hierarchy levels of YT Charts are explained below.

The View Detail level, which can be set in the Scope settings, can be used to separate Channel Style and Channel Acquisition at channel level through an additional hierarchy level. Channel Style and Channel Acquisition are described separately below.



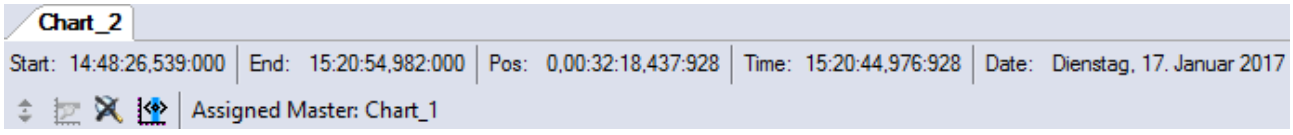
5.1.3.1.1 YT chart properties

Here you can enter all the settings relating to a YT chart.



Behaviour

Auto Start	If this option is enabled, the chart starts the live display when a new recording is started.
Data Tool Tip	If this option is enabled, a click on a data point results in display of a tool tip with the exact values of the data point on the X- and Y-axis, plus the timestamp and name of the corresponding channel.
Default Display Width	This time specifies the standard width of the associated chart. This value is set, for example, when the rescale button is selected in the chart toolbar.
Invert X-Axis	Switches the signal sequence from the default (left to right) to right to left
Master Chart	In the drop-down list that is available here, a chart that is part of the current configuration can be selected and designated as master chart. All actions that are executed in the master chart are also automatically executed in this chart. A separate stop display option is provided, through which Y-zoom and Y-panning modes are available. An overview chart can also be displayed.



Time Bar	Specifies whether the time bar is displayed in the chart.
Tool Bar	Specifies whether the toolbar is displayed in the chart.

Color

The background and frame color can be set by means of color dialogs.

Common

Comment	A free comment can be saved here.
CPU Core	Here you can set (for each chart individually) which CPU core should be used for the current chart display. If required, multiple CPU cores can be specified for a chart. This may improve the performance.
Show Name	Specifies whether the name of the chart is shown in the graph.

X-Axis Grid

Use X-Axis Grid	The X-subdivisions in the chart can be switched on or off here.
Use X-Axis SubGrid	Auxiliary lines for the finer X-subdivision of the main grid can be shown or hidden here.
X-Grid Color	Color of the grid
X-Grid Line Width	Line width of the grid in pixels
X-SubGrid Divisions	Number of areas into which the main grid is subdivided by auxiliary lines.

X-Axis Style

Since the X-axis is permanently assigned to a chart, all associated settings can be made here.

Ticks	Number of subdivisions
X-Axis Color	Color of the X axis
X-Axis LineWidth	Line width of the axis in pixels

Y-Settings

Scale on Zoom	If this option is selected, the chart instructs all axes (X and Y) to perform an auto-scaling after a zoom or panning action. This can be used to expand the selected area.
Stacked Y-axes	This setting can be used to specify whether the axes of a chart should be displayed side by side, so that the values of the attached channels are shown within the same area, or whether the axes should be above each other, each with its own representation range.
Y-Zoom	Here you can set the chart behavior during zooming. If the option is set, you can navigate in the data of a chart in the Y-direction as well. This includes both zooming and panning (shifting the display with the mouse).

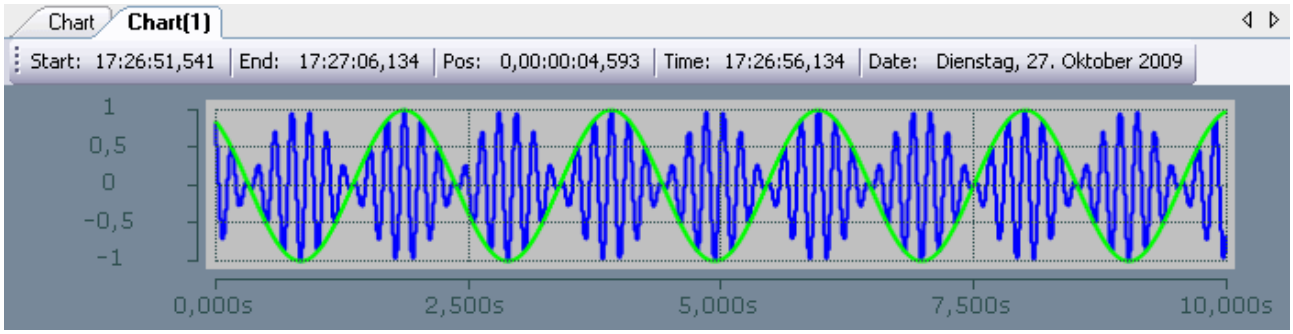
To change the settings for several charts at the same time, please refer to the chapter Multiple selection [▶ 389].

The chart display is operated with the toolbar. The overview shows all buttons and their explanation (from left):

Play	Starts the live display mode. The data currently being accumulated are displayed.
Break	The display switches to the pause mode. You can now navigate in the data already recorded without stopping the recording.
Display-Width	The current display width is displayed here. It can be edited in the format hh:mm:ss,fff. The zoom function works down to the µs range. Alternatively, the display width can be changed by turning the mouse wheel in the selected chart window. The changed value is adopted automatically.
Scroll buttons	The outer scroll buttons move the current display in steps that correspond to the display width. The inner scroll keys move the display only by a tenth of the display width and can be kept pressed to view the data set.
Position	Shows the position. It can be edited in the format hh:mm:ss,fff. The colons are used as separators. If not all units are edited the format is sorted in ascending order, starting with seconds.
Undo/Redo Time/ Position	This option can be used to undo step changes in the display width or the current position, irrespective of how they were made (e.g. zoom, scroll, etc.). The right mouse button is likewise assigned this function. Once undone, values can be repeated with redo.
Panning Horizontal	In the horizontal panning mode the current display can be shifted along the X-axis by clicking and dragging with the mouse.
Panning Free	In the free panning mode the current display can be shifted along the X- and Y-axes by clicking and dragging with the mouse.
Zoom Horizontal	A new time range for the display can be selected by stretching a rectangle over the X-axis.
Zoom Free	You can zoom into the current display by stretching a rectangle over the graphic area.
Zoom to Default	Carries out an autoscale on all axes. The X-axis is/axes are set to the default display time.
Zoom Out Max	Scales the X-axis in such a way that all current values in the recording appear in the display.
Overview	Use the Overview option to display a chart within the chart. The signal range currently shown in the main chart is highlighted in the Overview Chart. The Overview Chart also offers an absolute time axis for the whole recording time.
Chart Snipping Tool	Screenshots of a chart can be edited and sent using the tool, see Chart Snipping Tool [▶ 274].

By turning the mouse wheel you can also zoom in or out on the current display. The cursor position of the mouse determines the center.

The current recording times are displayed in the chart toolbar:



Start-Time	The common starting point of the recordings of all connected channels. The start time defines the zero point of the recording.
End-Time	Maximum common time of all connected channels. The end time thus marks the final value of the recording. The difference between the end time and start time is maximally as large as the record time set (see Scope nodes [▶ 22]).
Position	The position time represents the zero point of the current chart, i.e. the time from the start time to the beginning of the display.
Time	Absolute time at the chart origin
Date	Absolute date at the chart origin

Context menu

You can find more information on this at Chart context menu. [▶ 103]

5.1.3.1.2 YT axis properties

Here you can implement separate settings for each available YT axis.


Properties
Axis Group AxisGroup - Properties
Common
Canvas Color 245, 245, 245
Comment
Enabled True
Name Axis Group
Show Title Hide
Time-Axis
Color (t) 30, 30, 30
Color Mode (t) Custom
Inverted (t) False
Linewidth (t) 1
Precision (t) 6
Show absolute times (t) None
Show Title (t) Hide
Title (t) Time Axis
Visible (t) True
Time-Grid
Grid Color (t) 30, 30, 30
Grid Divisions (t) 10
Grid Linewidth (t) 1
Subgrid Divisions (t) 5
Use Grid (t) True
Use Subgrid (t) False
Y-Axis
Color (Y) 30, 30, 30
Color Mode (Y) Custom
Inverted (Y) False
Linewidth (Y) 1
Logarithmic (Y) False
Manual Max (Y) 0,5
Manual Min (Y) -0,5
Precision (Y) 6
Scale Mode (Y) auto grow only
Scientific Notation (Y) True
Show Title (Y) Hide
Show Unit AllChannels
Title (Y) Value Axis
Visible (Y) True
Y-Grid
Grid Color (Y) 30, 30, 30
Grid Divisions (Y) 10
Grid Linewidth (Y) 1
Subgrid Divisions (Y) 5
Use Grid (Y) True
Use Subgrid (Y) False
Color (Y)
Properties
Toolbox

Common

Canvas Color	Defines the color of the chart.
Comment	A free comment can be saved here.
Enabled	Here you can switch the axis on or off completely. This functionality is also available via the context menu.
Name	Specifies whether the name of the X-axis is shown in the chart.
Show Title	Determines which title is displayed above the chart. This function is only displayed if there is only one axis group, or if the axis groups are not stacked. **Hide:** no title is displayed **Custom:** the value from the 'Title' setting is displayed **Name:** the name of the axis group is selected **X-Axis Title:** the title of the X-axis is reused **Y-Axis Title:** the title of the Y-axis is reused **First Channel:** the name of the first channel is reused All channels are listed below and a channel can be explicitly selected.
Title	If Show Title is set to 'Custom', this title will be displayed above the chart.

(Time/Y)-Axis

Color (Time/Y)	Color of the axis.
Color Mode (Time /Y)	Defines which color is displayed at the axis. **Custom:** the value from the 'Color Mode' setting is displayed **First Channel:** the name of the first channel is reused Below that, all channels are listed in order to select them explicitly.
Inverted (Time /Y)	Inverts the direction of the axis.
Linewidth (Time /Y)	Line width in pixels.
Logarithmic (Y)	Switches between logarithmic and linear scaling of the axes.
Manual Max (Y)	Maximum value for manual scaling.
Manual Min (Y)	Minimum value for manual scaling.
Precision (Time /Y)	Here you can specify the number of significant digits for the axis labeling. Corresponds to the number of digits on the axis.
Show absolute times (t)	After recording, the times on the time axis can also be indicated by absolute times. None: The relative times are also displayed after recording. Default: The times are displayed in absolute time on the time axis. Depending on how far you have zoomed in, the times are displayed with or without milliseconds. Custom: With this setting, a manual time format can be set using the "Times format" setting.
Scale Mode (Y)	Specifies the Scale Mode for the axis. There are three modes to choose from. In case of **Manual**, the range of the axis can be fixed. **AutoGrowOnly** automatically increases the area of the axis, if data points are outside the specified range. **AutoGrowNShrink** further shrinks the range if extreme values in the data are no longer in the displayed time range.
Scientific Notation (Y)	Specifies whether the scientific notation should be used.
Show Title (t/Y)	Determines which title is displayed on the axis **Hide:** no title is displayed **Custom:** the value from the 'Title (t/Y)' setting is displayed **Name of axisgroup:** the name of the axis group is selected **First Channel:** the name of the first channel is reused All channels are listed below and a channel can be explicitly selected.
Show Unit (Y)	Determines whether the unit should also be displayed as an axis label. **Hide:** No unit is displayed. **AllChannels:** All units configured channels are displayed. If different units are used, the units are separated by a comma.
Times format (t)	If the "Show absolute times" setting is set to "Custom", this setting is visible in order to be able to specify the time format of the axis. Possible placeholders for the timestamps are as follows: dd - day MM - month yyyy - year HH - hours in 24-hour format hh - hours in 12-hour format mm - minutes ss - seconds fff - milliseconds
Title (X/Y)	Axis title.
Visible (X/Y)	Specifies whether the axis is shown or hidden in the chart.

(Time/Y)-Grid

Grid Color (Time/Y)	Color of the grid.
Grid Divisions (Time /Y)	Number of subdivisions.
Grid Linewidth (Time /Y)	Line width of the grid in pixels.
Subgrid Divisions (Time / Y)	Number of areas into which the main grid is subdivided by auxiliary lines. In the case of logarithmic scaling the auxiliary lines for subdivision are shown only in the set number if the range of values per tick is precisely one decade. Otherwise the displayed auxiliary line shows the decades not displayed in the main grid.
Use Grid (Time /Y)	The X-subdivisions of the axis can be shown or hidden here.
Use SubGrid (Time /Y)	Auxiliary lines for the finer X-subdivision of the main grid can be shown or hidden here. Auxiliary lines have no axis labeling.

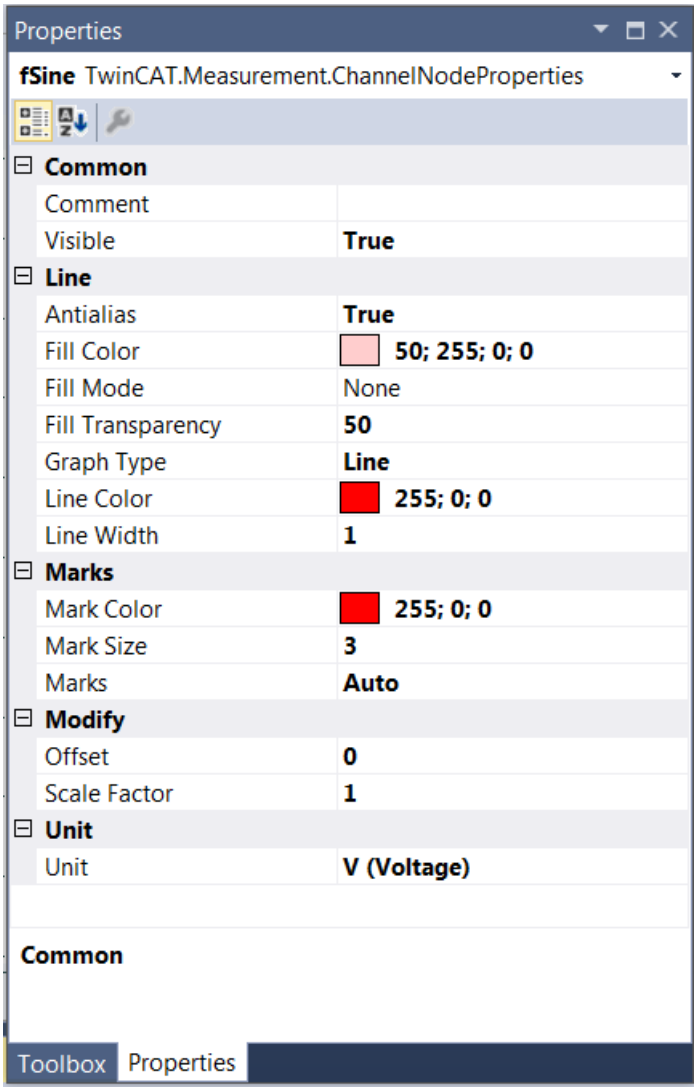
To change the settings for several axes at the same time, please refer to the chapter Multiple selection [▶ 389].

Context menu

You can find more information on this at Axes context menu. [▶ 105]

5.1.3.1.3 YT channel style

All style settings belonging to a YT channel can be made here.



Common

Comment	A free comment can be saved here. If applicable the comment will be adopted from the connected ADS symbol.
Visible	Here you can set whether the channel should be displayed in the chart.

Line

Antialias	This option decides how the lines will be drawn. Antialias is "nicer" but requires considerably more computing. This has an effect in particular if there are many channels with large movements.
Fill Color	Fill mode can be used to color an area, e.g. above or below a curve. Here you can select the fill color.
Fill Mode	Fill mode can be used to color an area, e.g. above or below a curve. The default setting is “None”. Variables with the data type BOOL are an exception. For BOOL variables the default value is “Horizontal Zero”. Further alternatives: Bottom, Top, Center and Source.
Fill Transparency	Here you can set the transparency value of the fill color. The default value is 50.
Line Color	Graph color
Line Width	Line width of the chart. The line width 1 requires least computing.
Type	Changes the value display between line, steps and bars. The default value is line.

Marks

Mark Color	Color of the interpolation point markers
Marks	Selection of the visibility of markings: On (permanently visible) | Auto (dependent on the zoom level) | Off (markings switched off).
Mark Size	Size of the interpolation point markers

Modify

Bit Mask	In this field a value can be entered with which the display value is masked, provided it is not of the type floating point. This means that the value of the channel is ANDed with the binary value of the mask. This helps you, for example, to observe individual bits of a status byte.
Offset	A free offset can be added to the function value of the channel in the offset field.
Scale Factor	The display value of a channel can be changed with the scale factor. This makes sense if angle signals are to be displayed in degrees, rather than radians, for example. With a scaling factor of k = 360 / (2*Pi) = 57.296, therefore, degrees would be displayed instead of radians.
Time Shift	This option enables the graph to be moved along the time axis. This can be useful to compensate a known bus runtime, for example.

Unit

Unit	This property allows the physical unit of the respective channel to be configured. This can be done with the aid of the "Unit Wizard", which can be opened using the button on the right in the field. A further option is to define the units beforehand as attributes in the PLC code. These are then read out directly and entered in the Unit field. Detailed information on the units and their configuration options can be taken from the section Physical units [▶ 191].

To change the settings for several channels at the same time, please refer to the chapter Multiple selection [▶ 389].

Configuration of channel style properties with the aid of PLC attributes

All style properties of a channel can be set directly on a variable or a data type in the PLC with the aid of attributes. This makes it possible to always display a certain symbol with the same style properties without having to reconfigure it every time.

A PLC attribute is specified directly via the declaration of a variable or a data type in curly brackets.

```
28      {attribute 'TcScope' := '<LineWidth:3, LineColor:red>'}
29      fTriangular             : LREAL;
```

The following syntax applies to the assignment of the channel style properties:

{attribute 'TcScope' := '<Property1:value, Property2:value,…>'}

Example:
{attribute 'TcScope' := '<LineWidth:3, LineColor:red>'}

Any number of channel style properties can be specified in an attribute.

A separate syntax applies to the specification of the unit (Unit property; see: Configuration of units with the aid of PLC attributes [▶ 207]).

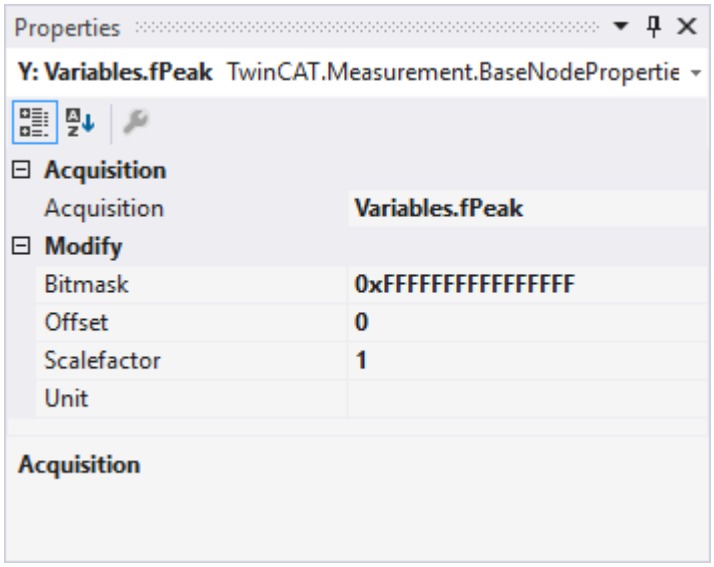
Context menu

You can find more information on this at Channel context menu. [▶ 106]

5.1.3.1.4 YT channel acquisition interpreter

All acquisition settings belonging to a YT channel can be made here.

Acquisition interpreters



Acquisition interpreters can reference an acquisition of the data pool and forward the data after manipulation.

The following settings can be made:

Acquisition

Acquisition	Selection of the acquisition used from the data pool.

Modify

Bitmask	In this field a value can be entered with which the display value is masked, provided it is not of the type floating point. This means that the value of the channel is ANDed with the binary value of the mask. This helps you, for example, to observe individual bits of a status byte.
Offset	A free offset can be added to the function value of the channel in the offset field.
Scalefactor	The display value of a channel can be changed with the scale factor.
Unit	This property enables the physical unit to be configured individually for the X-acquisition and the Y-acquisition of the channel. This can be done with the aid of the "Unit Wizard", which can be opened using the button on the right in the field. A further option is to define the units beforehand as attributes in the PLC code. These are then read out directly and entered in the Unit field. Detailed information on the units and their configuration options can be taken from the chapter [▶ 191].

Different properties

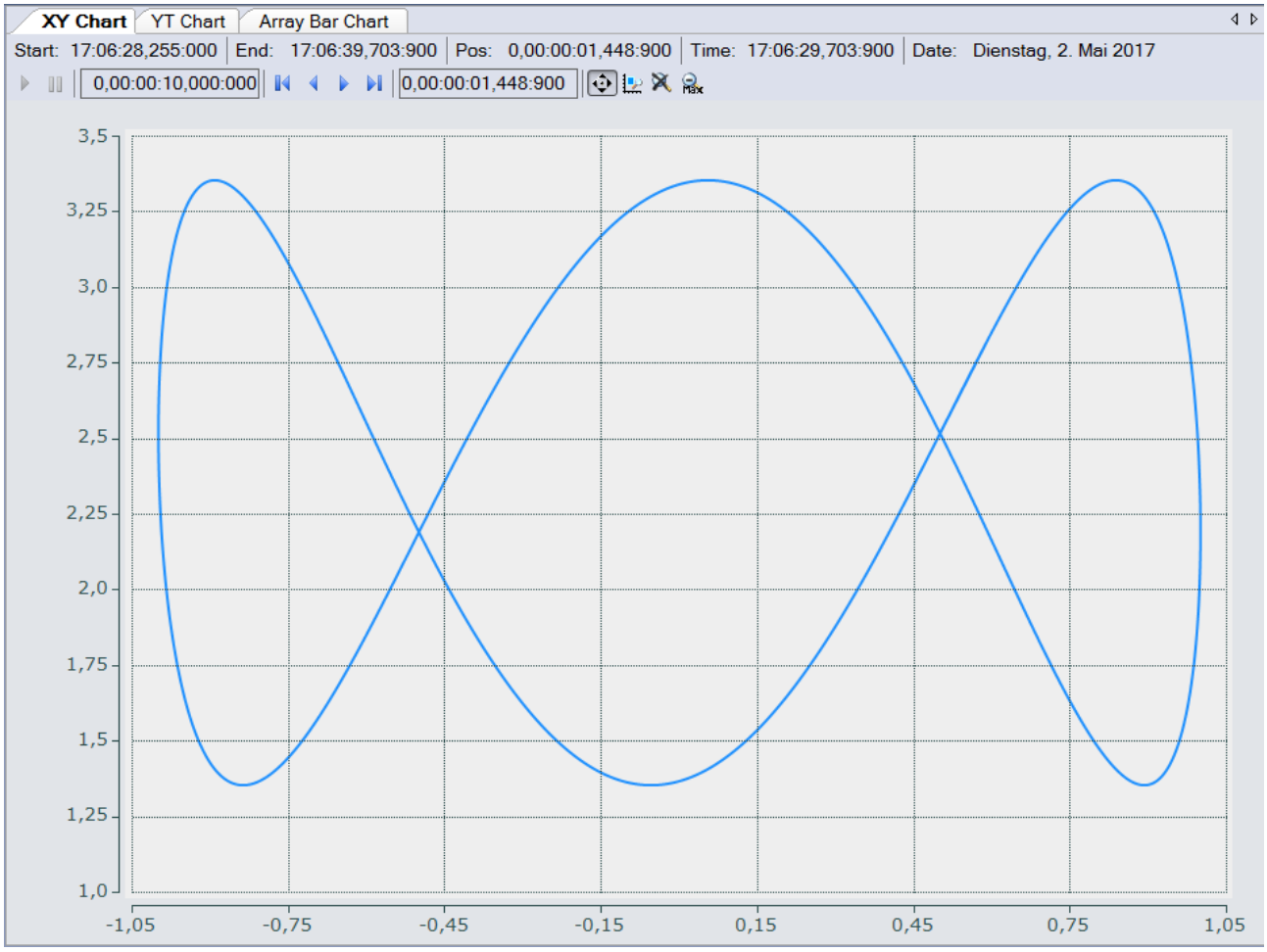
The properties of the channels can deviate from the illustration shown here.
Some setting possibilities are visible / editable only for special channels.
Example: The **Array Length** setting is only visible in the case of array symbols.

To change the settings for several channels at the same time, please refer to the chapter Multiple selection [▶ 389].

5.1.3.2 XY Chart

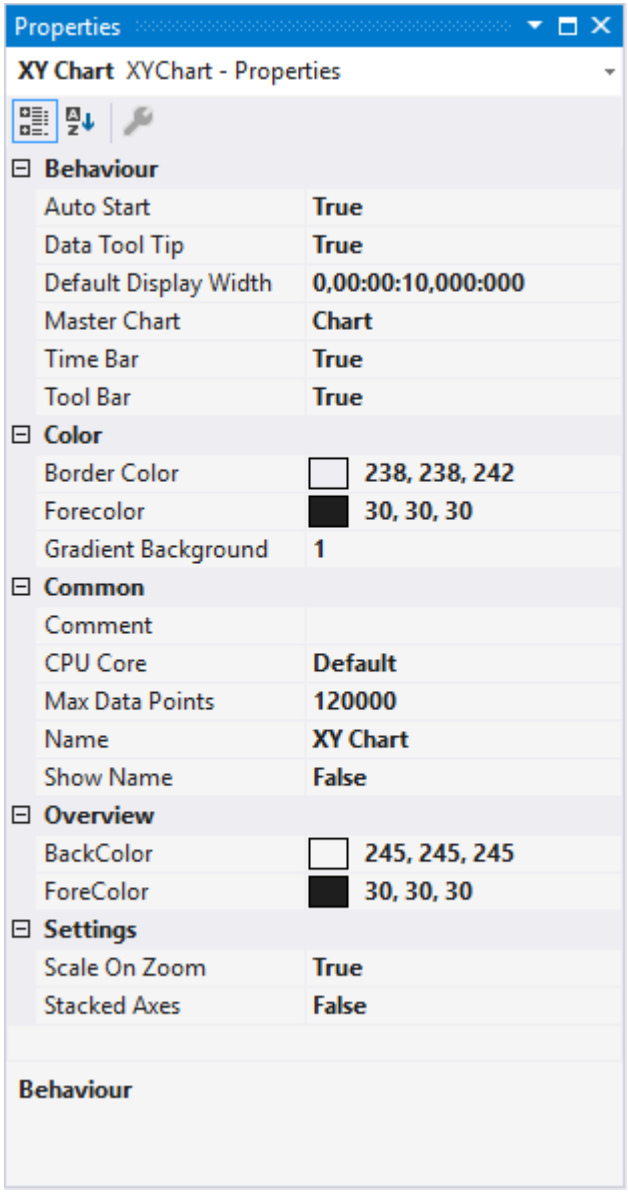
All the properties of the individual hierarchy levels of XY Charts are explained below.

The View Detail level, which can be set in the Scope settings, can be used to separate Channel Style and Channel Acquisition at channel level through an additional hierarchy level. Channel Style and Channel Acquisition are described separately below.



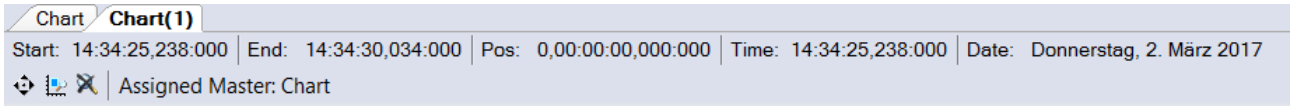
5.1.3.2.1 XY chart properties

All settings assigned to the XY chart can be made here.



Behaviour

Auto Start	If this option is enabled, the chart starts the live display when a new recording is started.
Data Tool Tip	If this option is enabled, a click on a data point results in display of a tool tip with the exact values of the data point on the X- and Y-axis, plus the timestamp and name of the corresponding channel.
Default Display Width	This time indicates the display time for the signal or the signal length in the XY chart. This value is set, for example, when the rescale button is selected in the chart toolbar.
Master Chart	In the drop-down list that is available here, a chart that is part of the current configuration can be selected and designated as master chart. All actions that are executed in the master chart are also automatically executed in this chart. A separate pause option is provided, through which XY-zoom and XY-panning modes are available.



Time Bar	Specifies whether the time bar is displayed in the chart.
Tool Bar	Specifies whether the toolbar is displayed in the chart.

Color

The background and frame color can be set by means of color dialogs.

Common

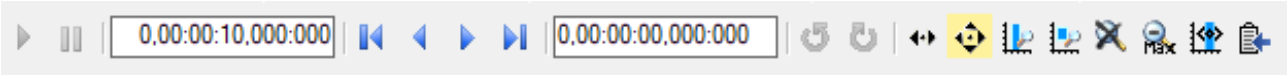
Comment	A free comment can be saved here.
CPU Core	Here you can set (for each chart individually) which CPU core should be used for the current chart display. If required, multiple CPU cores can be specified for a chart. This may improve the performance.
Max Data Points	Determines the maximum number of data points that can be displayed at the same time. The default value is 120,000. This means that, at a sampling rate of 1 ms (TaskSampleTime), the maximum recording time for which values can be displayed simultaneously is 2 minutes.
Show Name	Specifies whether the name of the chart is shown in the graph.

Settings

Scale on Zoom	If this option is selected, the chart instructs all axes (X and Y) to perform autoscaling after a zoom or panning action. This can be used to expand the selected area.
Stacked Axes	This setting can be used to specify whether the axes of a chart are shown side by side or above each other. In the side by side display, the values of the appended channels are shown within the same area. If they are shown above each other, the channels are displayed in their own areas.

To change the settings for several charts at the same time, please refer to the chapter Multiple selection [▶ 389].

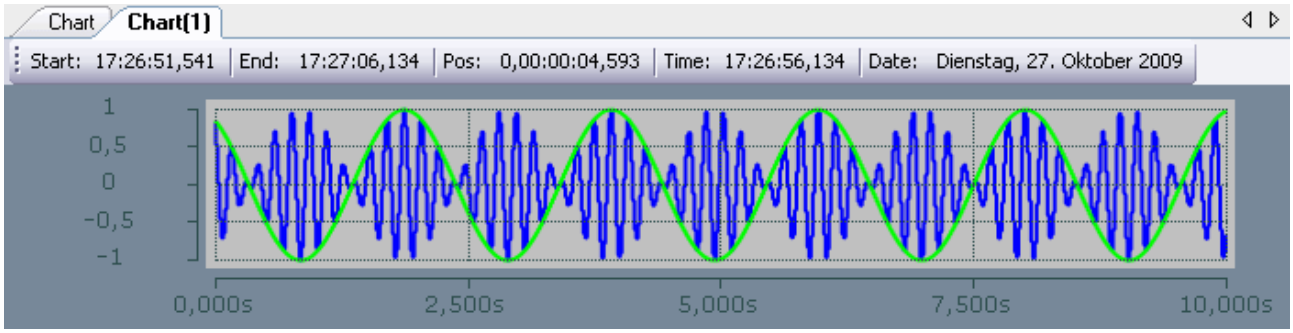
The chart display is operated with the toolbar. The overview shows all buttons and their explanation (from left):



Play	Starts the live display mode. The data currently being accumulated are displayed.
Break	The display switches to the pause mode. You can now navigate in the data already recorded without stopping the recording.
Display-Width	The current display width is displayed here. It can be edited in the format hh:mm:ss,fff. Alternatively, the display width can be changed by turning the mouse wheel in the selected chart window. The changed value is adopted automatically.
Scroll buttons	The outer scroll buttons move the current display in steps that correspond to the display width. The inner scroll keys move the display only by a tenth of the display width and can be kept pressed to view the data set.
Position	Shows the position. It can be edited in the format hh:mm:ss,fff. The colons are used as separators. If not all units are edited the format is sorted in ascending order, starting with seconds.
Panning Free	In the free panning mode the current display can be shifted along the X- and Y-axes by clicking and dragging with the mouse.
Zoom Free	You can zoom into the current display by stretching a rectangle over the graphic area.
Zoom to Default	Carries out an autoscale on all axes. The X-axis is/axes are set to the default display time.
Zoom Out Max	Scales the X and Y-axis in such a way that all current values in the recording appear in the display. Up to the maximum number of data points that can be shown. The maximum number is 60,000 data points.
Chart Snipping Tool	Screenshots of a chart can be edited and sent using the tool, see Chart Snipping Tool [▶ 274].

By turning the mouse wheel you can also zoom in or out on the current display. The cursor position defines the center.

The current recording times are displayed in the chart toolbar:



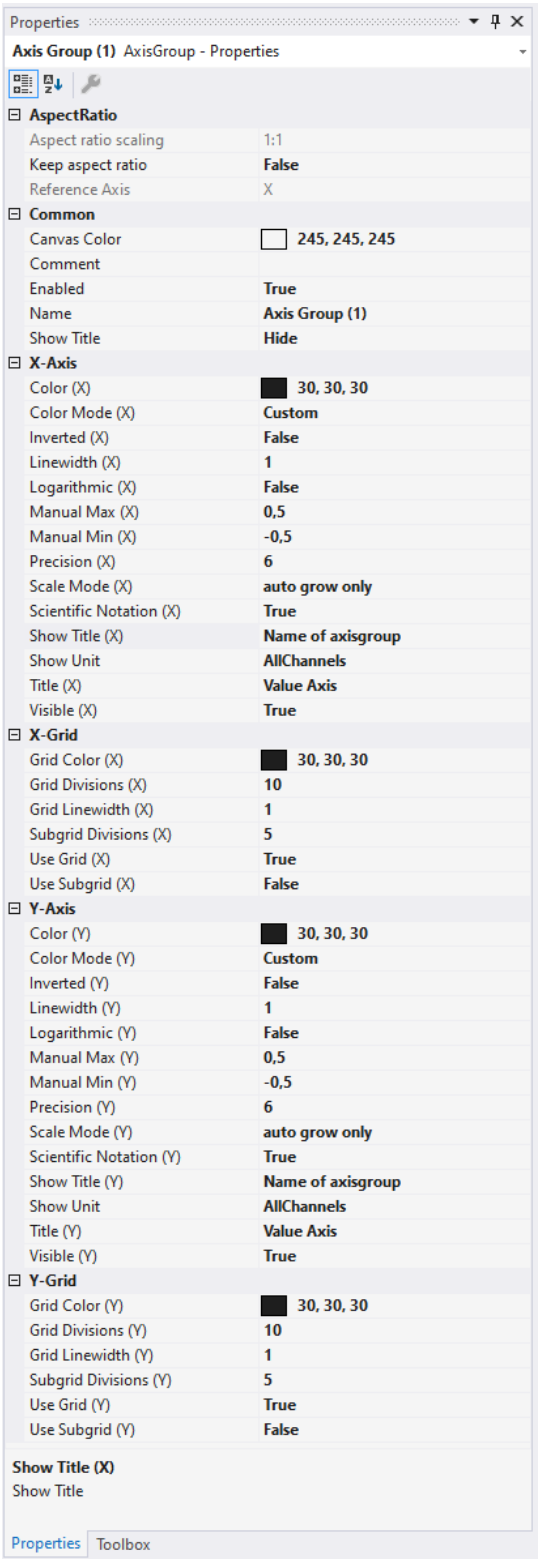
Start-Time	The common starting point of the recordings of all connected channels. The start time defines thus the zero point of the recording.
End-Time	Maximum common time of all connected channels. The end time marks the end value of the recording. The difference between the end time and start time is maximally as large as the record time set (see also: Scope nodes [▶ 22]).
Position	The position time represents the zero point of the current chart, i.e. the time from the start time to the beginning of the display.
Time	Absolute time at the chart origin.
Date	Absolute date at the chart origin.

Context menu

You can find more information on this at Chart context menu. [▶ 103]

5.1.3.2.2 XY axis properties

Here you can implement separate settings for each available XY-axis.



AspectRatio

Aspect ratio scaling	Aspect ratio between the axes.
Keep aspect ratio	Enables the function to maintain the aspect ratio between the axes.
Reference Axis	Specifies the axis that defines the scaling.

Common

Canvas Color	Defines the color of the chart.
Comment	A free comment can be saved here.
Enabled	Here you can switch the axis on or off completely. This functionality is also available via the context menu.
Name	Specifies whether the name of the X-axis is shown in the chart.
Show Title	Determines which title is displayed above the chart. This function is only displayed if there is only one axis group, or if the axis groups are not stacked. **Hide:** no title is displayed **Custom:** the value from the 'Title' setting is displayed **Name:** the name of the axis group is selected **X-Axis Title:** the title of the X-axis is reused **Y-Axis Title:** the title of the Y-axis is reused **First Channel:** the name of the first channel is reused Below that, all channels are listed in order to select them explicitly.
Title	If Shot Title is set to 'Custom', this title will be displayed above the chart.

(X/Y) Grid

Grid Color (X/Y)	Color of the grid.
Grid Divisions (X/Y)	Number of subdivisions.
Grid Linewidth (X/Y)	Line width of the grid in pixels.
Subgrid Divisions (X/Y)	Number of areas into which the main grid is subdivided by auxiliary lines. In the case of logarithmic scaling the auxiliary lines for subdivision are shown only in the set number if the range of values per tick is precisely one decade. Otherwise the displayed auxiliary line shows the decades not displayed in the main grid.
Use Grid (X/Y)	The X-subdivisions of the axis can be shown or hidden here.
Use SubGrid (X/Y)	Auxiliary lines for the finer X-subdivision of the main grid can be shown or hidden here. Auxiliary lines have no axis labeling.

(X/Y)-Axis

Color (X/Y)	Color of the axis.
Color Mode (X/Y)	Defines which color is displayed at the axis. **Custom:** the value from the 'Color Mode' setting is displayed **First Channel:** the name of the first channel is reused Below that, all channels are listed in order to select them explicitly.
Inverted (X/Y)	Inverts the direction of the axis.
Linewidth (X/Y)	Line width in pixels.
Logarithmic (X/Y)	Switches between logarithmic and linear scaling of the axes.
Manual Max (X/Y)	Maximum value for manual scaling.
Manual Min (X/Y)	Minimum value for manual scaling.
Precision (X/Y)	Here you can specify the number of significant digits for the axis labeling. Corresponds to the number of digits on the axis.
Scale Mode (X/Y)	Specifies the Scale Mode for the axis. There are three modes to choose from. In case of **Manual**, the range of the axis can be fixed. **AutoGrowOnly** automatically increases the area of the axis, if data points are out of range. **AutoGrowNShrink** further shrinks the range if extreme values in the data are no longer in the displayed time range.
Show Title (X/Y)	Determines which title is displayed on the axis **Hide:** no title is displayed **Custom:** the value from the 'Title (t/Y)' setting is displayed **Name of axisgroup:** the name of the axis group is selected **First Channel:** the name of the first channel is reused All channels are listed below and a channel can be explicitly selected.
Show Unit (X/Y)	Determines whether the unit should also be displayed as an axis label. **Hide:** No unit is displayed. **AllChannels:** All units configured channels are displayed. If different units are used, the units are separated by a comma.
Title (X/Y)	Axis title.
Visible (X/Y)	Specifies whether the axis is shown or hidden in the chart.

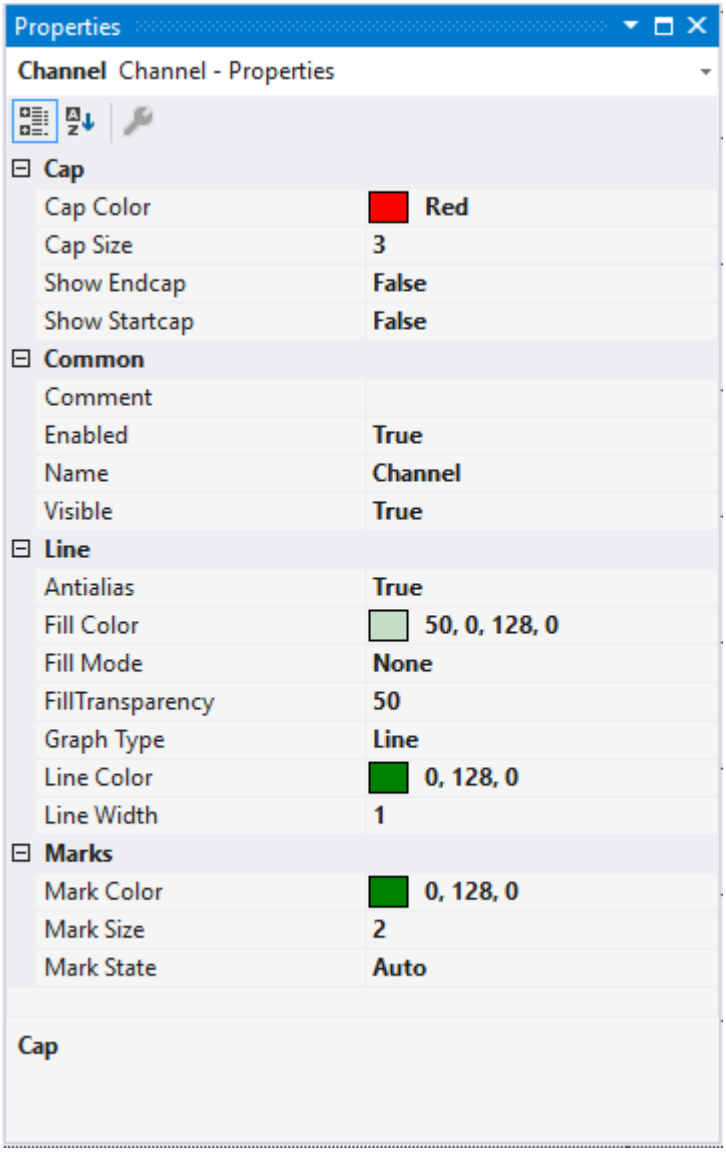
To change the settings for several axes at the same time, please refer to the chapter Multiple selection [▶ 389].

Context menu

You can find more information on this at Axes context menu. [▶ 105]

5.1.3.2.3 XT channel style

All style settings belonging to a XY channel can be made here.



Cap

Cap Color	Specifies the colour of the active cap.
Cap Size	Specifies the size of the cap.
End Cap	Activates the end cap for the channel.
Start Cap	Activates the start cap for the channel.

Common

Comment	A free comment can be saved here. If applicable the comment will be adopted from the connected ADS symbol.
Enabled	Enables the channel.
Name	channel name.
Visible	Here you can set whether the channel should be displayed in the chart.

Line

Antialias	This option decides how the lines will be drawn. Antialias is "nicer" but requires considerably more computing. This has an effect in particular if there are many channels with large movements.
Fill Color	Fill mode can be used to color an area, e.g. above or below a curve. Here you can select the fill color.
Fill Mode	Fill mode can be used to color an area, e.g. above or below a curve. The default setting is “None”. Alternatives are: Horizontal Zero, Bottom, Top, Center and Source.
Fill Transparency	Here you can set the transparency value of the fill color. The default value is 50.
Graph Type	Specifies the graph type. You can choose between Line and Stair.
Line Color	Graph Colour.
Line Width	Line width of the chart. The line width 1 requires least computing.

Marks

Mark Color	Color of the interpolation point markers.
Mark State	Specifies the visibility of markers: On (permanently visible) | Auto (depending on the zoom level) | Off (markers disabled).
Mark Size	Size of the interpolation point markers.

To change the settings for several channels at the same time, please refer to the chapter Multiple selection [▶ 389].

Configuration of channel style properties with the aid of PLC attributes

All style properties of a channel can be set directly on a variable or a data type in the PLC with the aid of attributes. This makes it possible to always display a certain symbol with the same style properties without having to reconfigure it every time.

A PLC attribute is specified directly via the declaration of a variable or a data type in curly brackets.

```
28      {attribute 'TcScope' := '<LineWidth:3, LineColor:red>'}
29      fTriangular             : LREAL;
```

The following syntax applies to the assignment of the channel style properties:

{attribute 'TcScope' := '<Property1:value, Property2:value,…>'}

Example:
{attribute 'TcScope' := '<LineWidth:3, LineColor:red>'}

Any number of channel style properties can be specified in an attribute.

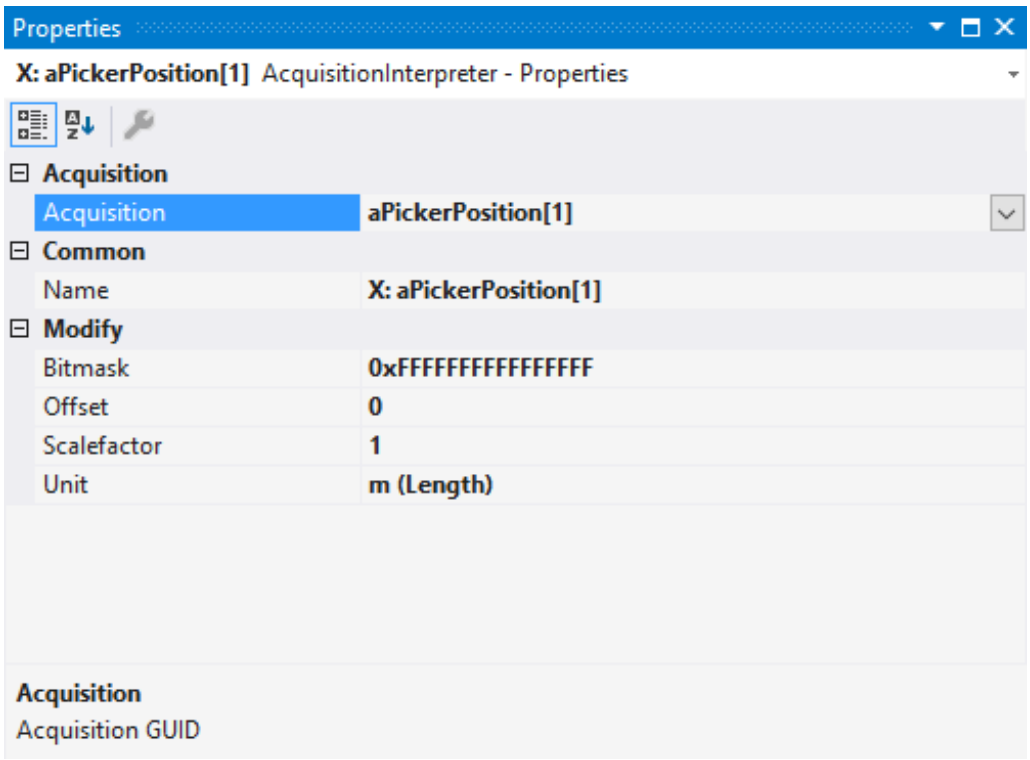
Note here that the X-acquisition and Y-acquisition sometimes have common channel style properties. For example, the properties that concern the line or the marks. If two symbols are added to an XY channel in which such properties are stored as PLC attributes, the properties of the symbol added last are always set. A separate syntax applies to the specification of the unit (Unit property; see: Configuration of units with the aid of PLC attributes [▶ 207]).

Context menu

You can find more information on this at Channel context menu. [▶ 106]

5.1.3.2.4 XY channel acquisition

This chapter explains all the acquisitions settings for XY charts.



Acquisition

Acquisition	Selection of the acquisition used from the data pool.

Common

Name	The name of the interpreter.

Modify

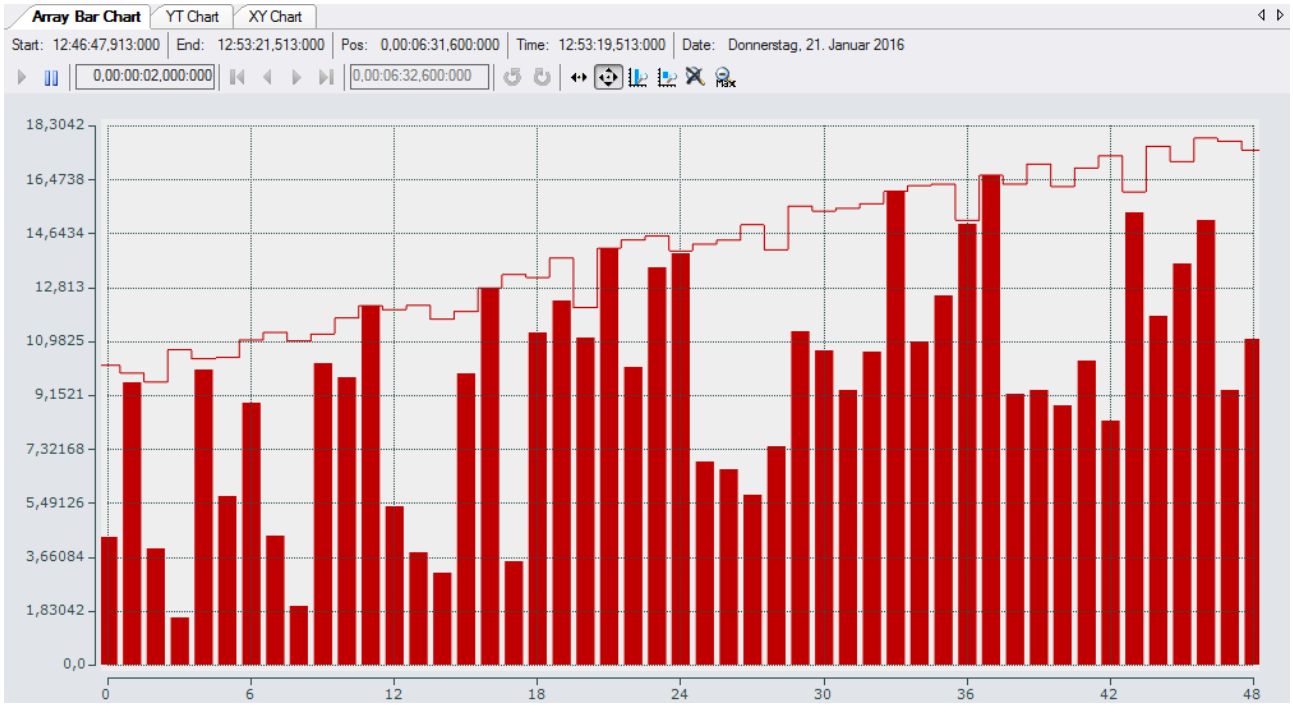
Bitmask	In this field a value can be entered with which the display value is masked, provided it is not of the type floating point. This means that the value of the channel is ANDed with the binary value of the mask. This helps you, for example, to observe individual bits of a status byte.
Offset	Here a free offset can be added to the function value of the channel.
Scalefactor	The display value of a channel can be changed with the scale factor.
Unit	This property allows the physical unit to be configured for the respective acquisition. This can be done with the aid of the "Unit Wizard", which can be opened using the button on the right in the field. A further option is to define the units beforehand as attributes in the PLC code. These are then read out directly and entered in the Unit field. Detailed information on the units and their configuration options can be found in the chapter on Physical units [▶ 191].

To change the settings for several channels at the same time, please refer to the chapter Multiple selection [▶ 389].

5.1.3.3 Array Bar Chart

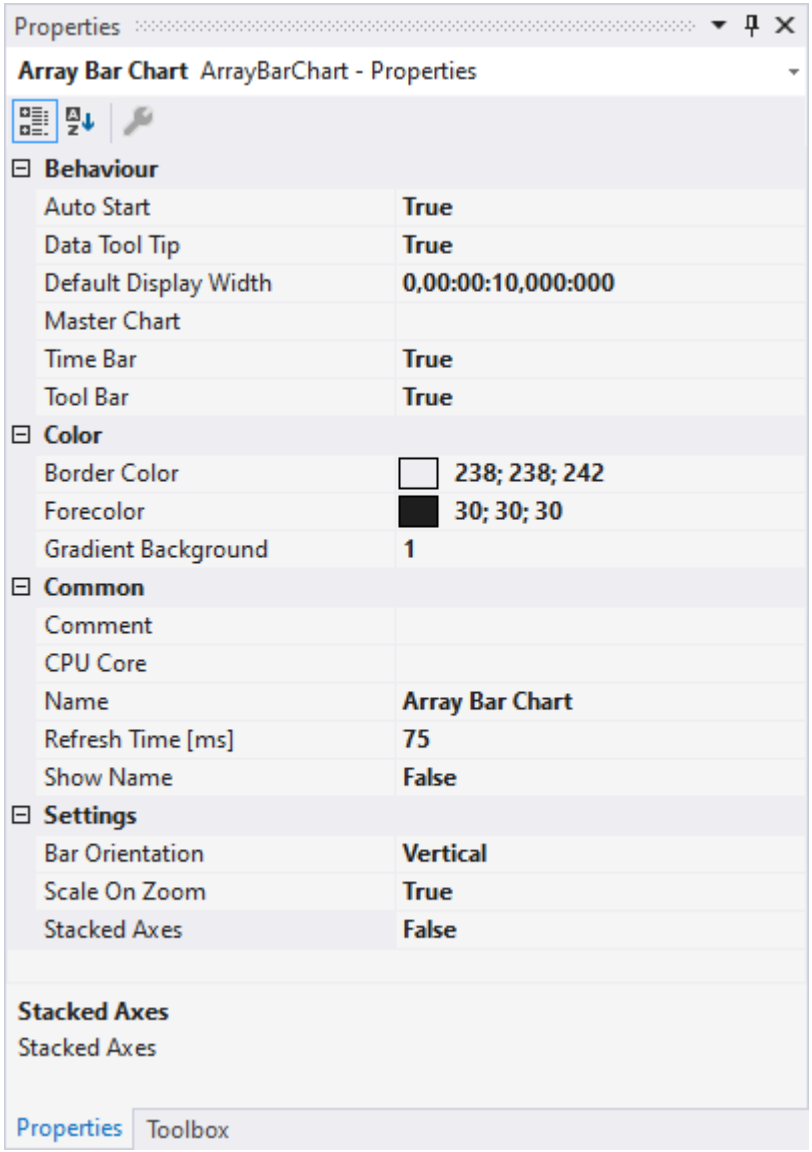
The properties of the individual hierarchy levels of array bar charts are explained below.

The View Detail level, which can be set in the Scope settings, can be used to separate Channel Style and Channel Acquisition at channel level through an additional hierarchy level. Channel Style and Channel Acquisition are described separately below.



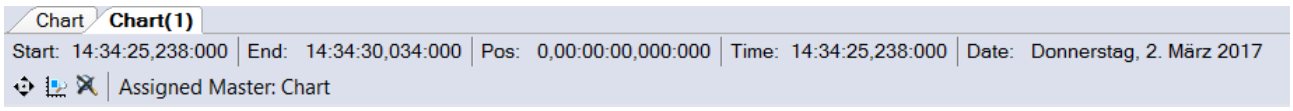
5.1.3.3.1 Bar chart properties

Here you can enter all the settings relating to an array bar chart.



Behaviour

Auto Start	. If this option is enabled, the chart starts the live display when a new recording is started.
Data Tool Tip	If this option is enabled, a click on a data point results in display of a tool tip with the exact values of the data point on the X- and Y-axis, plus the timestamp and name of the corresponding channel.
Default Display Width	This time refers to the display times of the minimum and maximum values in the array bar chart. The extreme values are always recorded. The freely adjustable display time makes it possible to display an extended history of the extreme values.
Master Chart	In the drop-down list that is available here, a chart that is part of the current configuration can be selected and designated as master chart. All actions that are executed in the master chart are also automatically executed in this chart. A separate pause option is provided, through which XY-zoom and XY-panning modes are available.



Time Bar	Specifies whether the time bar is displayed in the chart.
Tool Bar	Specifies whether the toolbar is displayed in the chart.

Color

Border Color	The color of the chart border.
Forecolor	The color of the chart name.
Gradient Background	A value between 0 and 1 can be used to display a color gradient in the background of the chart.

Common

Comment	A free comment can be saved here.
CPU Core	Here you can set (for each chart individually) which CPU core should be used for the current chart display. If required, multiple CPU cores can be specified for a chart. This may improve the performance.
Name	Here you can set the name of the chart.
Refresh Time [ms]	Defines the interval in which new values are to be displayed.
Show Name	Specifies whether the name of the chart is shown in the graph.

Settings

Bar Orientation	The bar orientation parameter can be used to set the orientation of the bars. Vertical: the bars are displayed vertically Horizontal: the bars are displayed horizontally
Scale on Zoom	After zooming, the axes are rescaled to make it easier to read the values.
Stacked Axes	This setting can be used to specify whether the axes of a chart are shown side by side or above each other. In the side by side display, the values of the appended channels are shown within the same area. If they are shown above each other, the channels are displayed in their own areas.

To change the settings for several charts at the same time, please refer to the chapter Multiple selection [▶ 389].

The chart display is operated with the toolbar. The overview shows all buttons and their explanation (from left):



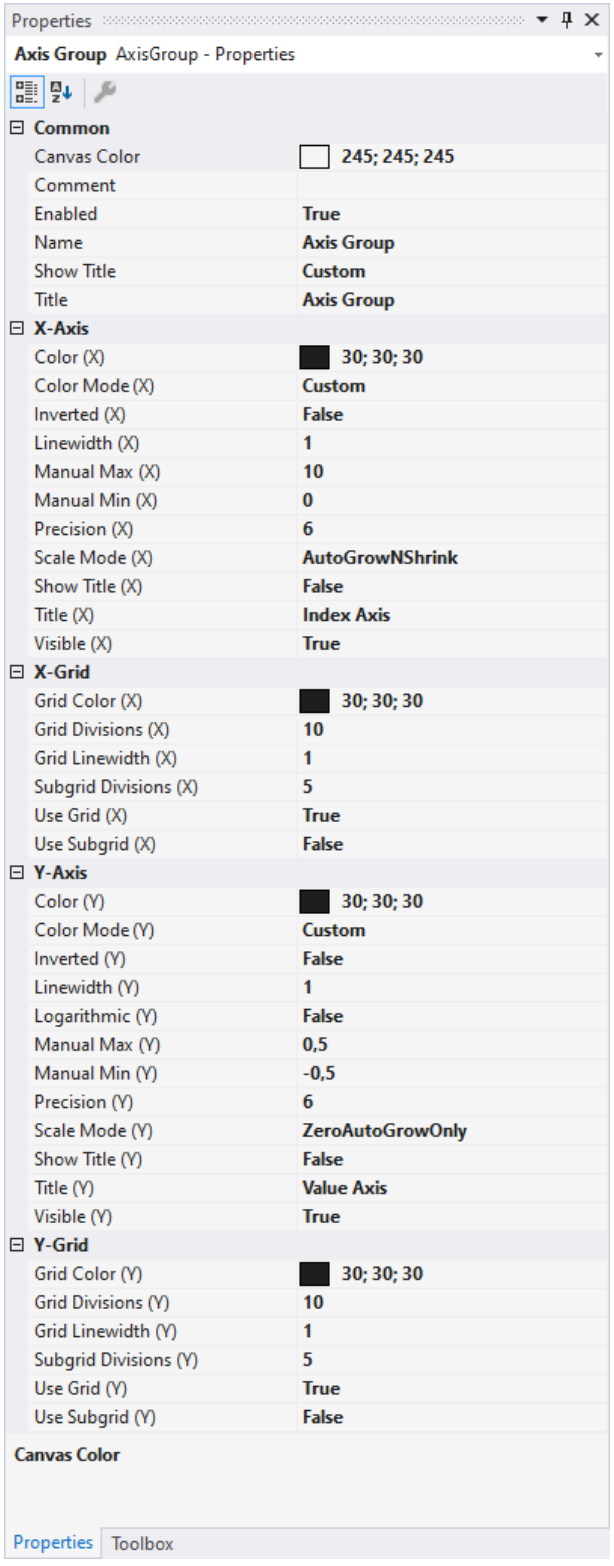
Play	Starts the live display mode. The data currently being accumulated are displayed.
Break	The display switches to the pause mode. You can now navigate in the data already recorded without stopping the recording.
Display-Width	This time refers to the display times of the minimum and maximum values in the array bar chart. The extreme values are always recorded. The freely adjustable display time makes it possible to display an extended history of the extreme values.
Scroll buttons	The outer scroll buttons move the current display in steps that correspond to the display width. The inner scroll keys move the display only by a tenth of the display width and can be kept pressed to view the data set.
Position	The displayed position can be edited in the Position field in the format hh:mm:ss,fff. The colons serve here as separators. If not all units are edited the format is sorted in ascending order, starting with seconds.
Undo/Redo Time/ Position	This option can be used to undo step changes in the display width or the current position, irrespective of how they were made (e.g. zoom, scroll, etc.). The right mouse button is likewise assigned this function. Once undone, values can be repeated with redo.
Panning Horizontal	In the horizontal panning mode the current display can be shifted along the X-axis by clicking and dragging with the mouse.
Panning Free	In the free panning mode the current display can be shifted along the X- and Y-axes by clicking and dragging with the mouse.
Zoom Horizontal	A new time range for the display can be selected by stretching a rectangle over the X-axis.
Zoom Free	You can zoom into the current display by stretching a rectangle over the graphic area.
Zoom to Default	If autoscale is set, this option triggers a zoom to the maximum number of array elements. If autoscale is disabled, the zoom automatically focuses on the defined limits.
Zoom Out Max	Scales the X-axis such that all array elements are displayed.
Chart Snipping Tool	Screenshots of a chart can be edited and sent using the tool, see Chart Snipping Tool [▶ 274].

Context menu

You can find more information on this at Chart context menu. [▶ 103]

5.1.3.3.2 Bar axis properties

All the settings for the axes of array bar charts are described here.


Properties
Axis Group AxisGroup - Properties
Common
Canvas Color 245; 245; 245
Comment
Enabled True
Name Axis Group
Show Title Custom
Title Axis Group
X-Axis
Color (X) 30; 30; 30
Color Mode (X) Custom
Inverted (X) False
Linewidth (X) 1
Manual Max (X) 10
Manual Min (X) 0
Precision (X) 6
Scale Mode (X) AutoGrowNShrink
Show Title (X) False
Title (X) Index Axis
Visible (X) True
X-Grid
Grid Color (X) 30; 30; 30
Grid Divisions (X) 10
Grid Linewidth (X) 1
Subgrid Divisions (X) 5
Use Grid (X) True
Use Subgrid (X) False
Y-Axis
Color (Y) 30; 30; 30
Color Mode (Y) Custom
Inverted (Y) False
Linewidth (Y) 1
Logarithmic (Y) False
Manual Max (Y) 0,5
Manual Min (Y) -0,5
Precision (Y) 6
Scale Mode (Y) ZeroAutoGrowOnly
Show Title (Y) False
Title (Y) Value Axis
Visible (Y) True
Y-Grid
Grid Color (Y) 30; 30; 30
Grid Divisions (Y) 10
Grid Linewidth (Y) 1
Subgrid Divisions (Y) 5
Use Grid (Y) True
Use Subgrid (Y) False
Canvas Color
Properties
Toolbox

Common

Canvas Color	Defines the color of the chart.
Comment	A free comment can be saved here.
Enabled	Here you can switch the axis on or off completely. This functionality is also available via the context menu.
Name	Defines the name of the axes.
Show Title	Determines which title is displayed above the chart. This function is only displayed if there is only one axis group, or if the axis groups are not stacked. **Hide:** no title is displayed **Custom:** the value from the 'Title' setting is displayed **Name:** the name of the axis group is selected **X-Axis Title:** the title of the X-axis is reused **Y-Axis Title:** the title of the Y-axis is reused **First Channel:** the name of the first channel is reused Below that, all channels are listed in order to select them explicitly.
Title	If Shot Title is set to 'Custom', this title will be displayed above the chart.

X-axis

Color (X)	Color of the axis.
Color Mode (X/Y)	Defines which color is displayed at the axis. **Custom:** the value from the 'Color Mode' setting is displayed **First Channel:** the name of the first channel is reused Below that, all channels are listed in order to select them explicitly.
Inverted (X)	Axis inversion.
Linewidth (X)	Line width in pixels
Manual Max (X)	If Auto Scale is inactive, the maximum value can be edited directly.
Manual Min (X)	If Auto Scale is inactive, the minimum value can be edited directly.
Precision (X)	Here you can specify the number of significant digits for the axis labeling. It corresponds to the number of visible digits on the axis.
Scale Mode (X)	Two Auto Scale modes are available for selection. The default mode is **AutoGrowOnly**. This means the X-axis always scales to the historic maximum, until a rescale is carried out for the current view. Alternatively, select **AutoGrowNShrin**k. This mode always automatically adjusts the maximum of the X-axis to the maximum in the current view (display width).
Show Title (X)	Specifies whether the name of the X-axis is shown in the chart.
Title (X)	Here you can enter an X-axis label.
Visible (X)	Specifies whether the axis is shown or hidden in the chart.

X-Grid

Grid Color (X)	Color of the grid.
Grid Divisions (X)	Maximum number of subdivisions. If there is not enough space for the selected number of ticks, these are automatically reduced in the chart. In the case of logarithmic scaling the number of ticks depends on the displayed range of values and can thus deviate from the settings.
Grid Linewidth (X)	Line width of the grid in pixels.
Subgrid Divisions (X)	Number of areas into which the main grid is subdivided by auxiliary lines. In the case of logarithmic scaling the auxiliary lines for subdivision are shown only in the set number if the range of values per tick is precisely one decade. Otherwise the displayed auxiliary line shows the decades not displayed in the main grid.
Use Grid (X)	The X-subdivisions of the axis can be shown or hidden here.
Use Subgrid (X)	Auxiliary lines for the finer X-subdivision of the main grid can be shown or hidden here. Auxiliary lines have no axis labeling.

Y-axis

Color (Y)	Color of the axis.
Inverted (Y)	Axis inversion.
Linewidth (Y)	Line width in pixels.
Logarithmic (Y)	Switches between logarithmic and linear scaling of the axes.
Manual Max (Y)	If Auto Scale is inactive, the maximum value can be edited directly.
Manual Min (Y)	If Auto Scale is inactive, the minimum value can be edited directly.
Precision (Y)	Here you can specify the number of significant digits for the axis labeling. It corresponds to the number of visible digits on the axis.
Scale Mode (Y)	Two Auto Scale Modes are available for selection. The default mode is AutoGrowOnly. This means the y-axis always scales to the historic maximum, until a rescale is carried out for the current view. Alternatively, AutoGrowNShrink can be selected. This mode always automatically adjusts the maximum of the y-axis to the maximum in the current view (display width).
Show Title (Y)	Specifies whether the name of the y-axis is shown in the chart.
Title (Y)	Here you can enter an y-axis label.
Visible (Y)	Specifies whether the axis is shown or hidden in the chart.

Y-Grid

Grid Color (Y)	Color of the grid.
Grid Divisions (Y)	Maximum number of subdivisions. If there is not enough space for the selected number of ticks, these are automatically reduced in the chart. In the case of logarithmic scaling the number of ticks depends on the displayed range of values and can thus deviate from the settings.
Grid Linewidth (Y)	Line width of the grid in pixels.
Subgrid Divisions (Y)	Number of areas into which the main grid is subdivided by auxiliary lines. In the case of logarithmic scaling the auxiliary lines for subdivision are shown only in the set number if the range of values per tick is precisely one decade. Otherwise the displayed auxiliary line shows the decades not displayed in the main grid.
Use Grid (Y)	The Y-subdivisions of the axis can be shown or hidden here.
Use Subgrid (Y)	Auxiliary lines for the finer Y-subdivision of the main grid can be shown or hidden here. Auxiliary lines have no axis labeling.

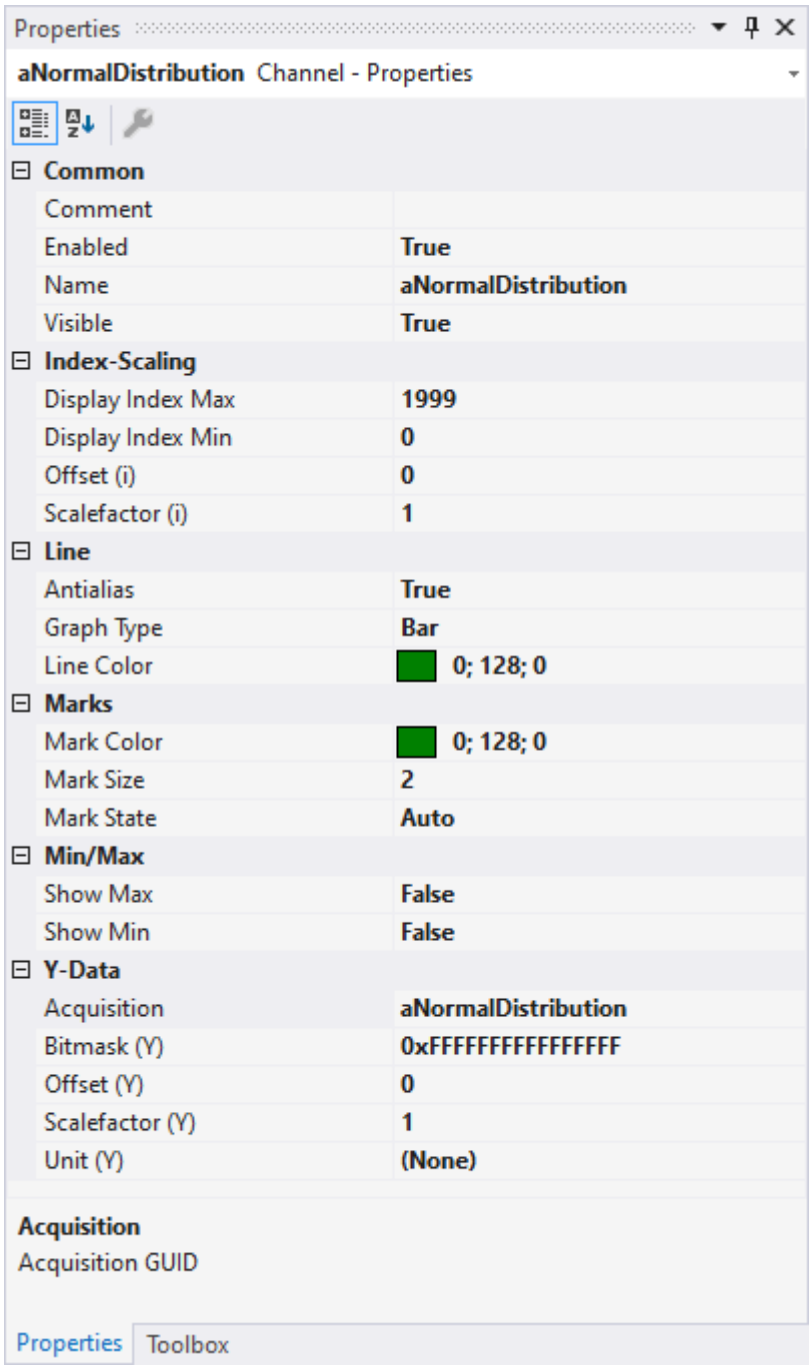
To change the settings for several axes at the same time, please refer to the chapter Multiple selection [▶ 389].

Context menu

You can find more information on this at Axes context menu. [▶ 105]

5.1.3.3.3 Bar channel properties

All Style properties of array bar chart channels are explained here.



Common

Comment	A free comment can be saved here. If applicable the comment will be adopted from the connected ADS symbol.
Enabled	Specifies whether values are loaded into the Scope View for the channel. The performance can be optimized, compared to the "Visible" setting.
Name	channel name.
Visible	Here you can set whether the channel should be displayed in the chart.

Index Scaling

Display Index Max	The maximum index of the linked array is set to the value entered for the display.
Display Index Min	The minimum index of the linked array is set to the value entered for the display.
Offset (i)	A free offset can be added to the function value of the channel in the offset field.
Scalefactor (i)	The display value of a channel can be changed with the scale factor.

Line

Antialias	This option decides how the lines will be drawn. Antialias is "nicer" but requires considerably more computing. This has an effect in particular if there are many channels with large movements.
Graph Type	Here you can switch between different display types. The default value for an array bar chart is Bar. Other options are: Line and Stair.
Line Color	Graph Colour.
Line Width	Line width of the chart. The line width 1 requires least computing.
Show Max	If the option is set to TRUE, the maximum values for the set display width are shown.
Show Min	If the option is set to TRUE, the minimum values for the set display width are shown.

Marks

Mark Color	Color of the interpolation point markers.
Marks	Selecting the visibility of markings → On (permanently visible) | Off (markings switched off).
Mark Size	Size of the interpolation point markers.

Min/Max

Show Max	If the option is set to TRUE, the maximum values for the set display width are shown.
Show Min	If the option is set to TRUE, the minimum values for the set display width are shown.

Y-Data

Acquisition	Here you can select the acquisition that will be displayed in the channel.
Bismask (Y)	In this field a value can be entered with which the display value is masked, provided it is not of the type floating point. This means that the value of the channel is ANDed with the binary value of the mask. This helps you, for example, to observe individual bits of a status byte.
Offset (Y)	A free offset can be added to the function value of the channel in the offset field.
Scalefactor (Y)	The display value of a channel can be changed with the scale factor.
Unit (Y)	This property enables the physical unit to be configured individually for the X-acquisition and the Y-acquisition of the channel. This can be done with the aid of the "Unit Wizard", which can be opened using the button on the right in the field. A further option is to define the units beforehand as attributes in the PLC code. These are then read out directly and entered in the Unit field. Detailed information on the units and their configuration options can be found in the chapter on Physical units [▶ 191].

To change the settings for several channels at the same time, please refer to the chapter Multiple selection [▶ 389].

Configuration of channel style properties with the aid of PLC attributes

All style properties of a channel can be set directly on a variable or a data type in the PLC with the aid of attributes. This makes it possible to always display a certain symbol with the same style properties without having to reconfigure it every time.

A PLC attribute is specified directly via the declaration of a variable or a data type in curly brackets.

```
28      {attribute 'TcScope' := '<LineWidth:3, LineColor:red>'}
29      fTriangular             : LREAL;
```

The following syntax applies to the assignment of the channel style properties:

{attribute 'TcScope' := '<Property1:value, Property2:value,…>'}

Example:
{attribute 'TcScope' := '<LineWidth:3, LineColor:red>'}

Any number of channel style properties can be specified in an attribute.

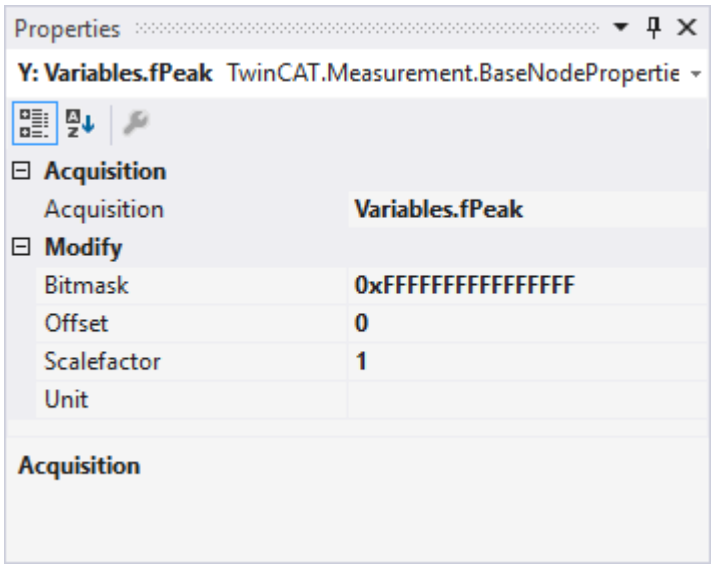
A separate syntax applies to the specification of the unit (Unit property; see: Configuration of units with the aid of PLC attributes [▶ 207]).

Context menu

You can find more information on this at Channel context menu. [▶ 106]

5.1.3.3.4 Bar channel acquisition interpreter

Acquisition interpreters



Acquisition interpreters can reference an acquisition of the data pool and forward the data after manipulation.

The following settings can be made:

Acquisition

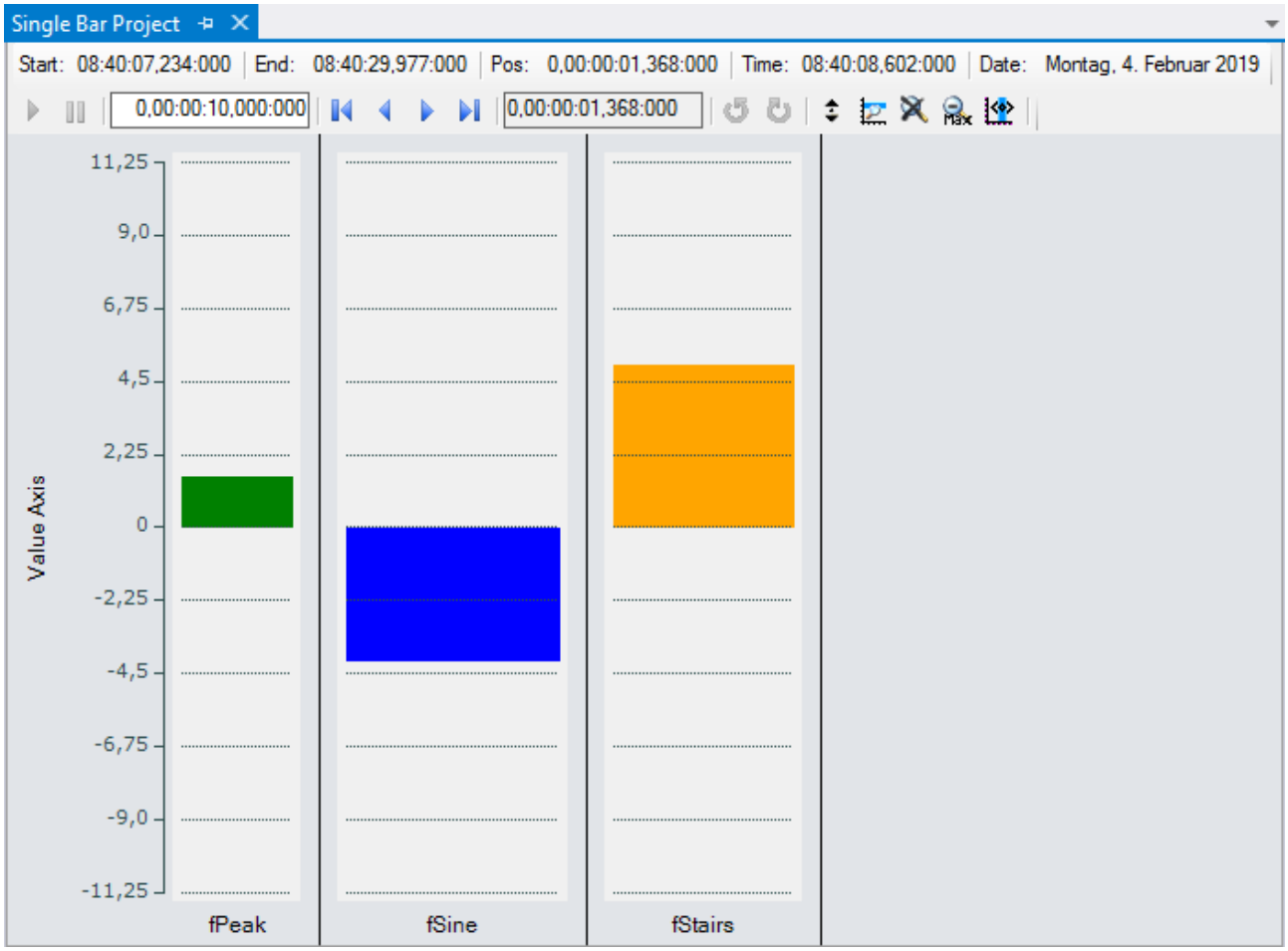
Acquisition	Selection of the acquisition used from the data pool.

Modify

Bitmask	In this field a value can be entered with which the display value is masked, provided it is not of the type floating point. This means that the value of the channel is ANDed with the binary value of the mask. This helps you, for example, to observe individual bits of a status byte.
Offset	A free offset can be added to the function value of the channel in the offset field.
Scalefactor	The display value of a channel can be changed with the scale factor.
Unit	This property enables the physical unit to be configured individually for the X-acquisition and the Y-acquisition of the channel. This can be done with the aid of the "Unit Wizard", which can be opened using the button on the right in the field. A further option is to define the units beforehand as attributes in the PLC code. These are then read out directly and entered in the Unit field. Detailed information on the units and their configuration options can be taken from the chapter [▶ 191].

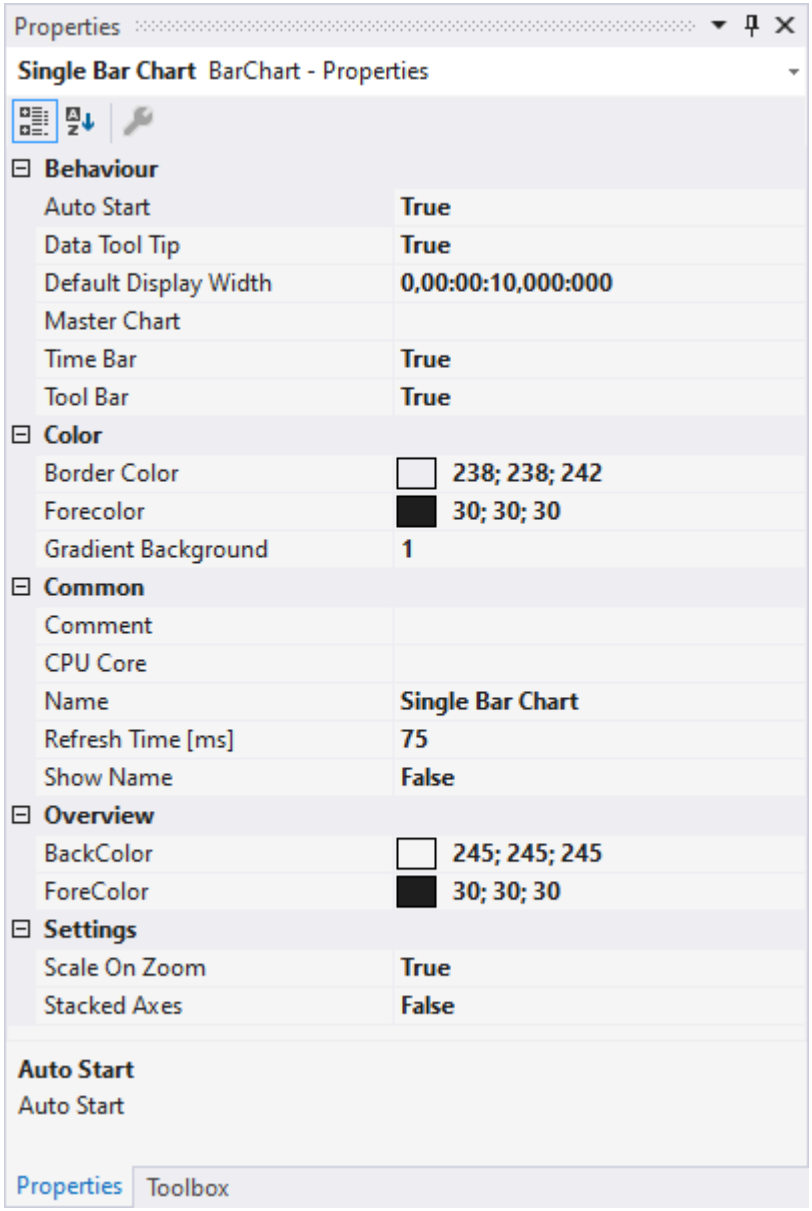
5.1.3.4 Single bar chart

All the properties of the individual hierarchy levels of single bar charts are explained below.



5.1.3.4.1 Single bar chart properties

All settings assigned to the single bar chart can be made here.



Behaviour

AutoStart	If this option is enabled, the chart starts the live display when a new recording is started.
Data Tool Tip	If this option is activated, a tool tip showing the exact values of a data point is displayed when clicking on the data point. The time stamp and the name of corresponding channel are also shown.
Default Display Width	This time specifies the standard width of the associated chart. This value determines the period between the displayed minimum and maximum values.
Master Chart	In the drop-down list that is available here, a chart that is part of the current configuration can be selected and designated as master chart. All actions that are executed in the master chart are also automatically executed in this chart. A separate pause option is provided, through which Y-zoom and Y-panning modes are available. An overview chart can also be displayed.
Time Bar	Specifies whether the time bar (information bar with time values) is displayed in the chart.
Tool Bar	Specifies whether the toolbar is displayed in the chart.

Color

Border Color	Defines the background color of the chart.
Forecolor	Specifies the color of the chart name.
Gradient Background	Provides for a color gradient in the background color.

Common

Comment	A free comment can be saved here.
CPU Core	Here you can set (for each chart individually) which CPU core should be used for the current chart display. If required, multiple CPU cores can be specified for a chart. This may improve the performance.
Name	Name of the chart.
Refresh Time [ms]	Defines a rate at which the chart in the user interface is refreshed.
Show Name	Specifies whether the name of the chart is shown in the graph.

Overview

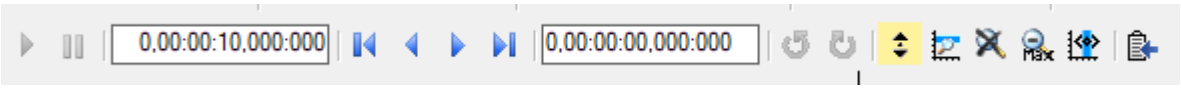
BackColor	Specifies the background color of the overview chart.
ForeColor	Specifies the text and grid colors of the overview chart.

Settings

Scale on Zoom	If this option is selected, the chart instructs the Y-axes to perform autoscaling after a zoom or panning action. The selected area can thus be widened.
Stacked Axes	With this setting you can select whether the various axis groups are arranged on a horizontal line or underneath one another.

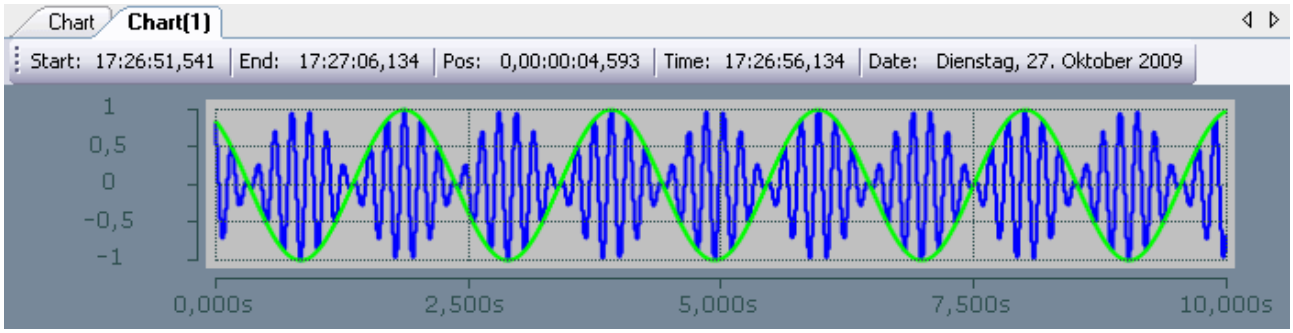
To change the settings for several charts at the same time, please refer to the chapter Multiple selection [▶ 389].

The chart display is operated with the toolbar. The overview shows all buttons and their explanation (from left):



Play	Starts the live display mode. The data currently being accumulated are displayed.
Break	The display switches to the pause mode. You can now navigate in the data already recorded without stopping the recording.
Display-Width	The current display width is displayed here. It can be edited in the format hh:mm:ss,fff. The zoom function works down to the µs range.
Scroll buttons	The outer scroll buttons move the current display in steps that correspond to the display width. The inner scroll keys move the display only by a tenth of the display width and can be kept pressed to view the data set.
Position	Shows the position. It can be edited in the format hh:mm:ss,fff. The colons are used as separators. If not all units are edited the format is sorted in ascending order, starting with seconds.
Undo/Redo Time/ Position	This option can be used to undo step changes in the display width or the current position, irrespective of how they were made (e.g. zoom, scroll, etc.). The right mouse button is likewise assigned this function. Once undone, values can be repeated with redo.
Panning Vertical	In the vertical panning mode the current display can be shifted along the Y-axis by clicking and dragging.
Zoom Vertical	A new value range for the Y-axis can be selected by stretching a rectangle over the axis.
Zoom to Default	Carries out an autoscale on all axes. The display range is reset to the default display time.
Zoom Out Max	Sets the display range to the maximum recording length.
Overview	Use the Overview option to display a chart within the chart. The signal range currently shown in the main chart is highlighted in the Overview Chart. In addition the overview chart offers an absolute time axis for the entire recording duration.
Chart Snipping Tool	Screenshots of a chart can be edited and sent using the tool, see Chart Snipping Tool [▶ 274].

The current recording times are displayed in the chart toolbar:



Start-Time	The common starting point of the recordings of all connected channels. The start time defines the zero point of the recording.
End-Time	Maximum common time of all connected channels. The end time thus marks the final value of the recording. The difference between the end time and start time is maximally as large as the record time set (see Scope nodes [▶ 22]).
Position	The position time represents the zero point of the current chart, i.e. the time from the start time to the beginning of the display.
Time	Absolute time at the chart origin
Date	Absolute date at the chart origin

Context menu

You can find more information on this at Chart context menu. [▶ 103]

5.1.3.4.2 Single bar axis properties

Settings can be made separately for each available single bar axis here.


Properties
Axis Group (1) AxisGroup - Properties
Common
Canvas Color 245; 245; 245
Comment
Enabled True
Name Axis Group (1)
Show Title Custom
Title Axis Group
Y-Axis
Color (Y) 30; 30; 30
Color Mode (Y) Custom
Inverted (Y) False
Linewidth (Y) 1
Logarithmic (Y) False
Manual Max (Y) 0,5
Manual Min (Y) -0,5
Precision (Y) 3
Scale Mode (Y) AutoGrowOnly
Show Title (Y) False
Title (Y) Value Axis
Visible (Y) True
Y-Grid
Grid Color (Y) 30; 30; 30
Grid Divisions (Y) 10
Grid Linewidth (Y) 1
Subgrid Divisions (Y) 5
Use Grid (Y) True
Use Subgrid (Y) False
Canvas Color
Properties
Toolbox

Common

Canvas Color	Defines the color of the chart.
Comment	A free comment can be saved here.
Enabled	Here you can switch the axis on or off completely. This functionality is also available via the context menu.
Name	Here the name of the axis can be edited.
Show Title	Determines which title is displayed above the chart. This function is only displayed if there is only one axis group, or if the axis groups are not stacked. **Hide:** no title is displayed **Custom:** the value from the 'Title' setting is displayed **Name:** the name of the axis group is selected **X-Axis Title:** the title of the X-axis is reused **Y-Axis Title:** the title of the Y-axis is reused **First Channel:** the name of the first channel is reused Below that, all channels are listed in order to select them explicitly.
Title	If Shot Title is set to 'Custom', this title will be displayed above the chart.

Y-axis

Color (Y)	Color of the axis
Color Mode (X/Y)	Defines which color is displayed at the axis. **Custom:** the value from the 'Color Mode' setting is displayed **First Channel:** the name of the first channel is reused Below that, all channels are listed in order to select them explicitly.
Inverted (Y)	Invert axis value.
Linewidth (Y)	Line width in pixels
Logarithmic (Y)	Switches between logarithmic and linear scaling of the axes.
Manual Max (Y)	If the Scale Mode is set to MinMax, the maximum value can be edited directly.
Manual Min (Y)	If the Scale Mode is set to MinMax, the minimum value can be edited directly.
Precision (Y)	Here you can specify the number of significant digits for the axis labeling. It corresponds to the number of visible digits on the axis.
Scale Mode (Y)	Two Auto Scale modes are available for selection. The default mode is **AutoGrowOnly**. This means the Y-axis always scales to the historic maximum, until a rescale is carried out for the current view. Alternatively, select **AutoGrowNShrink**. This mode always automatically adjusts the maximum of the Y-axis to the maximum in the current view (display width).
Show Title (Y)	Specifies whether the name of the axis is shown in the chart.
Title (Y)	Defines the name of the axis.
Visible (Y)	Specifies whether the axis is shown or hidden in the chart.

Y-Grid

Grid Color (Y)	Color of the grid.
Grid Divisions (Y)	Maximum number of subdivisions. If there is not enough space for the selected number of ticks, these are automatically reduced in the chart. In the case of logarithmic scaling the number of ticks depends on the displayed range of values and can thus deviate from the settings.
Grid Linewidth (Y)	Line width of the grid in pixels
Subgrid Divisions (Y)	Number of areas into which the main grid is subdivided by auxiliary lines. In the case of logarithmic scaling the auxiliary lines for subdivision are shown only in the set number if the range of values per tick is precisely one decade. Otherwise the displayed auxiliary line shows the decades not displayed in the main grid.
Use Grid (Y)	The subdivision of the axis can be shown or hidden here.
Use Subgrid (Y)	Auxiliary lines for the finer Y-subdivision of the main grid can be shown or hidden here. These auxiliary lines have no axis labeling.

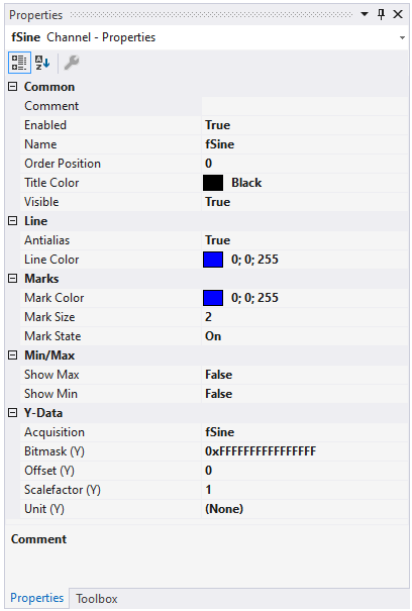
To change the settings for several axes at the same time, please refer to the chapter Multiple selection [▶ 389].

Context menu

You can find more information on this at Axes context menu. [▶ 105]

5.1.3.4.3 Single bar channel properties

All settings belonging to a single bar channel can be made here.



Common

Comment	Comment on the channel.
Enabled	No data are acquired for the channel if Enabled is set to false.
Name	Specifies the name of the channel.
Order Position	Position of the channel in the chart.
Title Color	Specifies the title color for the channel.
Visible	Here you can set whether the channel should be displayed in the chart.

Line

Antialias	This option decides how the lines will be drawn. The computing time is longer with antialias. This has an effect in particular if there are many channels with large movements.
Line Color	Graph Colour.

Marks

Mark Color	Color of the interpolation point marking.
Mark Size	Size of the interpolation point marking.
Mark State	Selecting the visibility of markings → On (permanently visible) | Off (markings switched off).

Min/Max

Show Max	If the option is set to TRUE, the maximum values for the set display width are shown.
Show Min	If the option is set to TRUE, the minimum value for the set display width is shown.

Y-Data

Acquisition	Here you can select the acquisition that will be displayed in the channel.
Bismask (Y)	In this field a value can be entered with which the display value is masked, provided it is not of the type floating point. This means that the value of the channel is ANDed with the binary value of the mask. This helps you, for example, to observe individual bits of a status byte.
Offset (Y)	A free offset can be added to the function value of the channel in the offset field.
Scalefactor (Y)	The display value of a channel can be changed with the scale factor.
Unit (Y)	This property enables the physical unit to be configured individually for the X-acquisition and the Y-acquisition of the channel. This can be done with the aid of the "Unit Wizard", which can be opened using the button on the right in the field. A further option is to define the units beforehand as attributes in the PLC code. These are then read out directly and entered in the Unit field. Detailed information on the units and their configuration options can be found in the chapter on Physical units [▶ 191].

To change the settings for several channels at the same time, please refer to the chapter Multiple selection [▶ 389].

Configuration of channel style properties with the aid of PLC attributes

All style properties of a channel can be set directly on a variable or a data type in the PLC with the aid of attributes. This makes it possible to always display a certain symbol with the same style properties without having to reconfigure it every time.

A PLC attribute is specified directly via the declaration of a variable or a data type in curly brackets.

```
28      {attribute 'TcScope' := '<LineWidth:3, LineColor:red>'}
29      fTriangular             : LREAL;
```

The following syntax applies to the assignment of the channel style properties:

{attribute 'TcScope' := '<Property1:value, Property2:value,…>'}

Example:
{attribute 'TcScope' := '<LineWidth:3, LineColor:red>'}

Any number of channel style properties can be specified in an attribute.

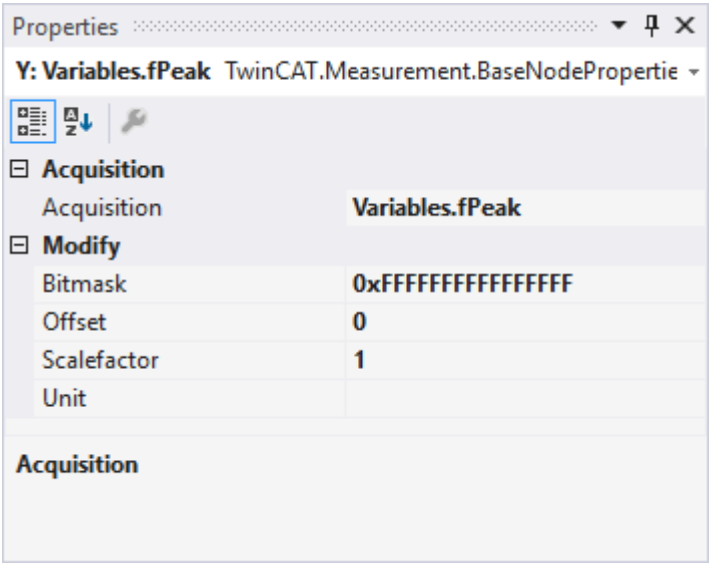
A separate syntax applies to the specification of the unit (Unit property; see: Configuration of units with the aid of PLC attributes [▶ 207]).

Context menu

You can find more information on this at Channel context menu. [▶ 106]

5.1.3.4.4 Single bar acquisition interpreter

Acquisition interpreters



Acquisition interpreters can reference an acquisition of the data pool and forward the data after manipulation.

The following settings can be made:

Acquisition

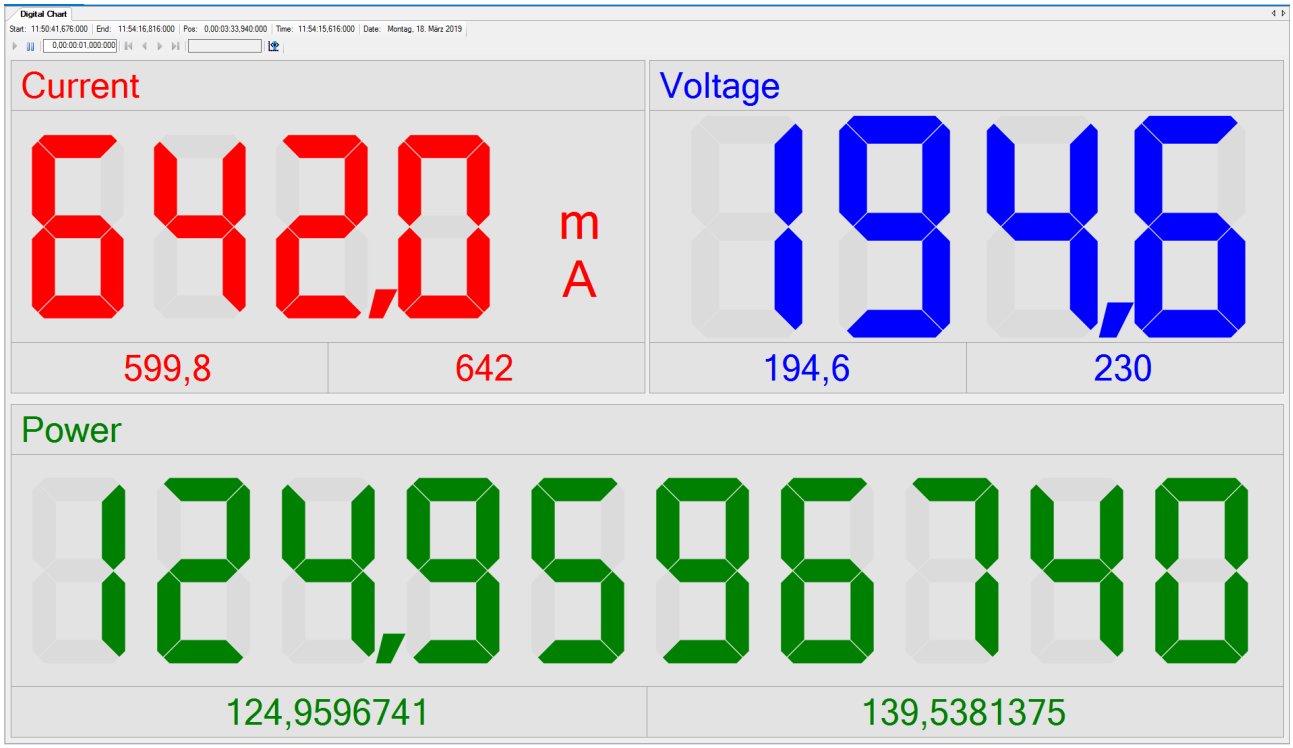
Acquisition	Selection of the acquisition used from the data pool.

Modify

Bitmask	In this field a value can be entered with which the display value is masked, provided it is not of the type floating point. This means that the value of the channel is ANDed with the binary value of the mask. This helps you, for example, to observe individual bits of a status byte.
Offset	A free offset can be added to the function value of the channel in the offset field.
Scalefactor	The display value of a channel can be changed with the scale factor.
Unit	This property enables the physical unit to be configured individually for the X-acquisition and the Y-acquisition of the channel. This can be done with the aid of the "Unit Wizard", which can be opened using the button on the right in the field. A further option is to define the units beforehand as attributes in the PLC code. These are then read out directly and entered in the Unit field. Detailed information on the units and their configuration options can be taken from the chapter [▶ 191].

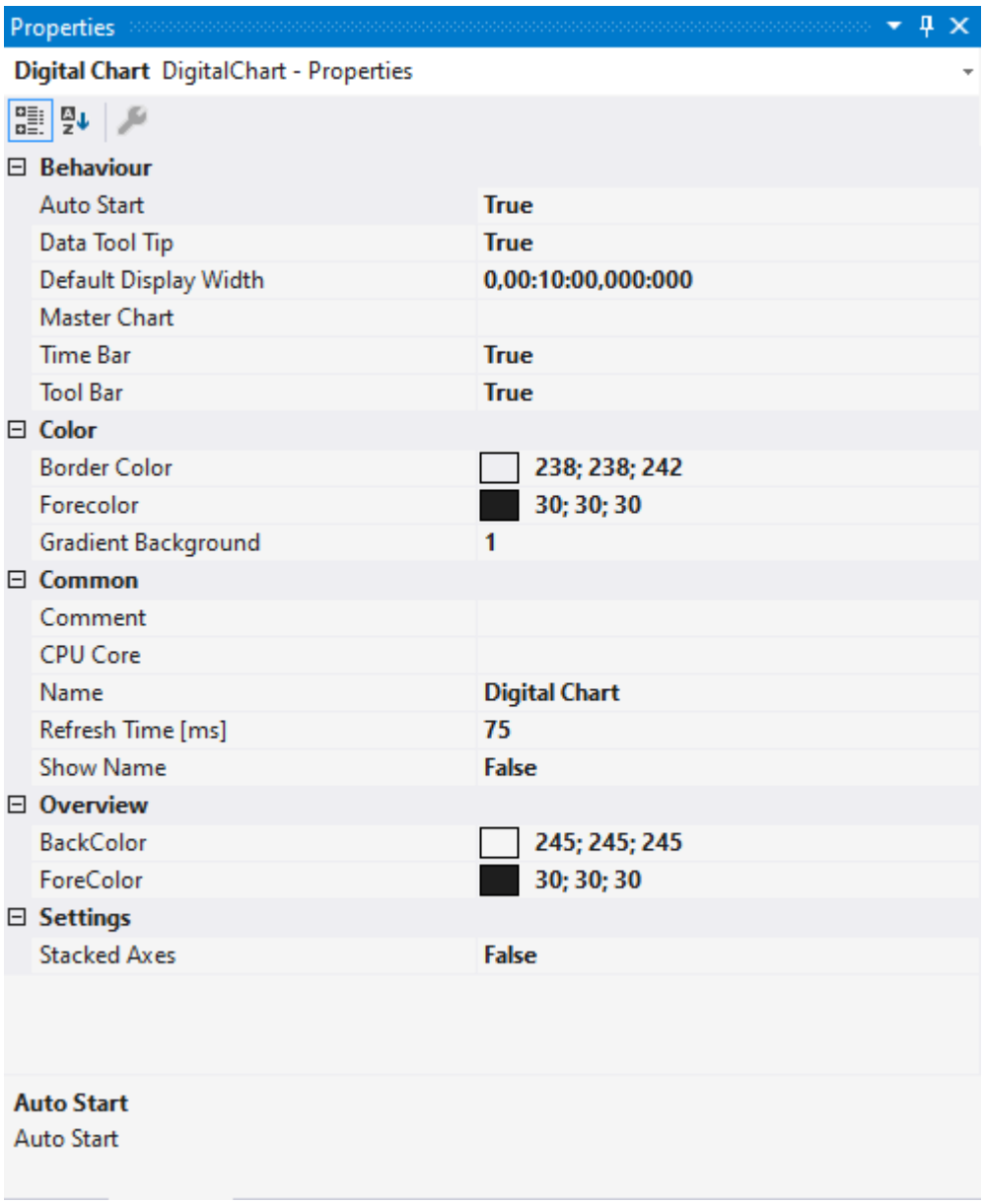
5.1.3.5 Digital Chart

All the properties of the individual hierarchy levels of the Digital Chart are explained below.



5.1.3.5.1 Digital Chart properties

All settings assigned to the Digital Chart can be made here.



Behaviour

AutoStart	If this option is enabled, the chart starts the live display when a new recording is started.
Data Tool Tip	If this option is activated, a tool tip showing the exact values of a data point is displayed when clicking on the data point. The time stamp and the name of corresponding channel are also shown.
Default Display Width	This time specifies the standard width of the associated chart. This value determines the period between the displayed minimum and maximum values.
Master Chart	In the drop-down list that is available here, a chart that is part of the current configuration can be selected and designated as master chart. All actions that are executed in the master chart are also automatically executed in this chart. Only the Overview Chart can be shown in the toolbar.
Time Bar	Specifies whether the time bar (information bar with time values) is displayed in the chart.
Tool Bar	Specifies whether the toolbar is displayed in the chart.

Color

Border Color	Defines the background color of the chart.
Forecolor	Specifies the color of the chart name.
Gradient Background	Provides for a color gradient in the background color.

Common

Comment	A free comment can be saved here.
CPU Core	Here you can set (for each chart individually) which CPU core should be used for the current chart display. If required, multiple CPU cores can be specified for a chart. This may improve the performance.
Name	The name of the chart.
Refresh Time [ms]	Defines the interval in which new values are to be displayed.
Show Name	Specifies whether the name of the chart is shown in the graph.

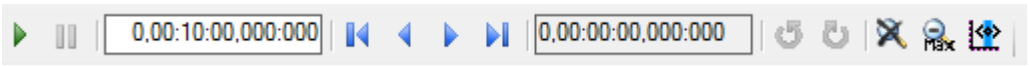
Overview

BackColor	Sets the background color of the overview.
ForeColor	Sets the color of the axis labels and grids of the overview.

Settings

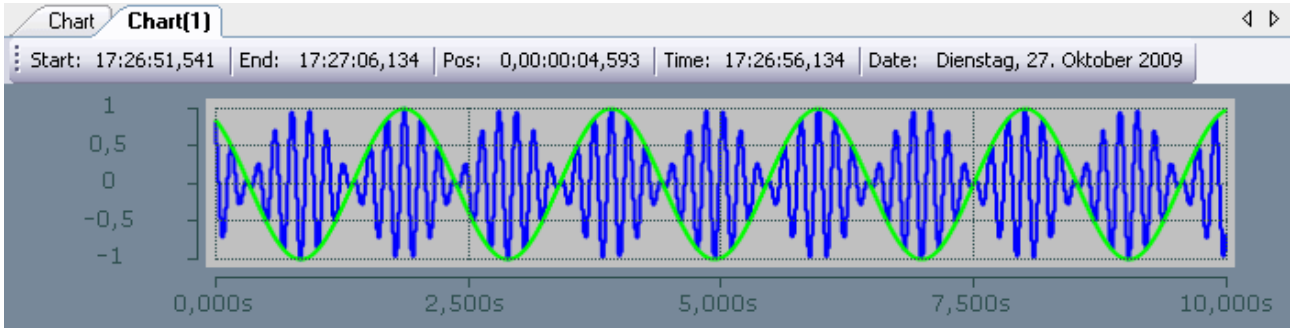
Stacked Axes	Defines the stacking direction for axes. False for horizontal stacking of the axes and true for vertical stacking.

The chart display is operated with the toolbar. The overview shows all buttons and their explanation (from left):



Play	Starts the live display mode. The currently pending data are displayed.
Break	Stops the live display mode and changes to the break mode. Here you can navigate in the data already recorded without stopping the recording.
Display width	The current display width is displayed here. It can be edited in the format hh:mm:ss,fff. The zoom function works down to the µs range.
Scroll buttons	The outer scroll buttons move the current display in steps that correspond to the display width. The inner scroll buttons move the display only by a tenth of the display width and can be kept pressed to view the data set.
Position	Shows the position. It can be edited in the format hh:mm:ss,fff. The colons are used as separators. If not all units are edited the format is sorted in ascending order, starting with seconds.
Undo/Redo Time/ Position	This option can be used to undo step changes in the display width or the current position, irrespective of how they were made (e.g. zoom, scroll, etc.). Once undone, values can be repeated with redo.
Zoom to Default	Resets the display width to the Default Display Width.
Zoom Out Max	Sets the display range to the maximum recording length.
Overview	Use the Overview option to display a chart within the chart. The signal range currently shown in the main chart is highlighted in the Overview Chart. In addition the overview chart offers an absolute time axis for the entire recording duration.

The current recording times are displayed in the chart toolbar:



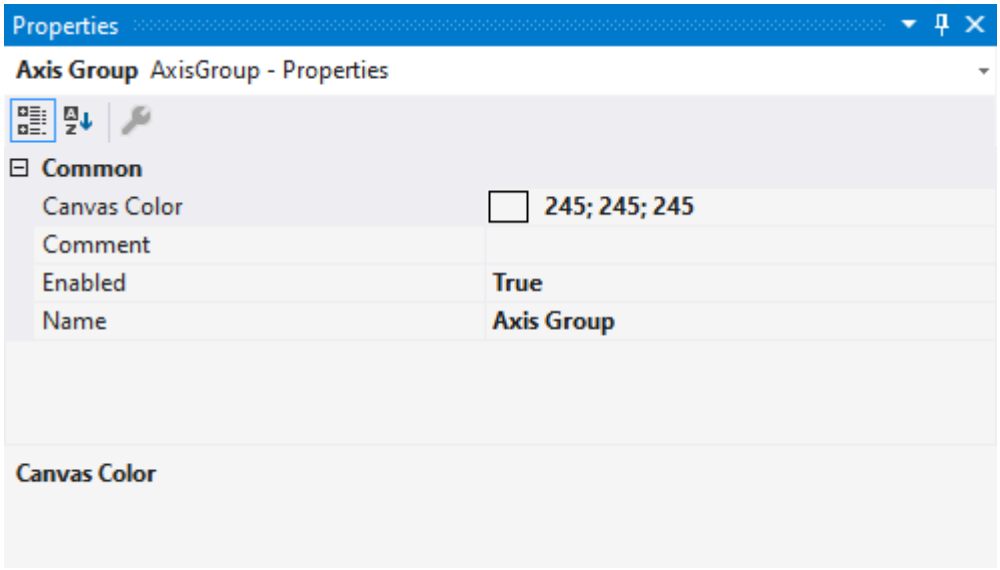
Start-Time	The common starting point of the recordings of all connected channels. The start time defines the zero point of the recording.
End-Time	Maximum common time of all connected channels. The end time thus marks the final value of the recording. The difference between the end time and start time is maximally as large as the record time set (see Scope nodes [▶ 22]).
Position	The position time represents the zero point of the current chart, i.e. the time from the start time to the beginning of the display.
Time	Absolute time at the chart origin
Date	Absolute date at the chart origin

Context menu

You can find more information on this at Chart context menu. [▶ 103]

5.1.3.5.2 Digital axis properties

Settings for digital chart axis groups can be made here.



Common

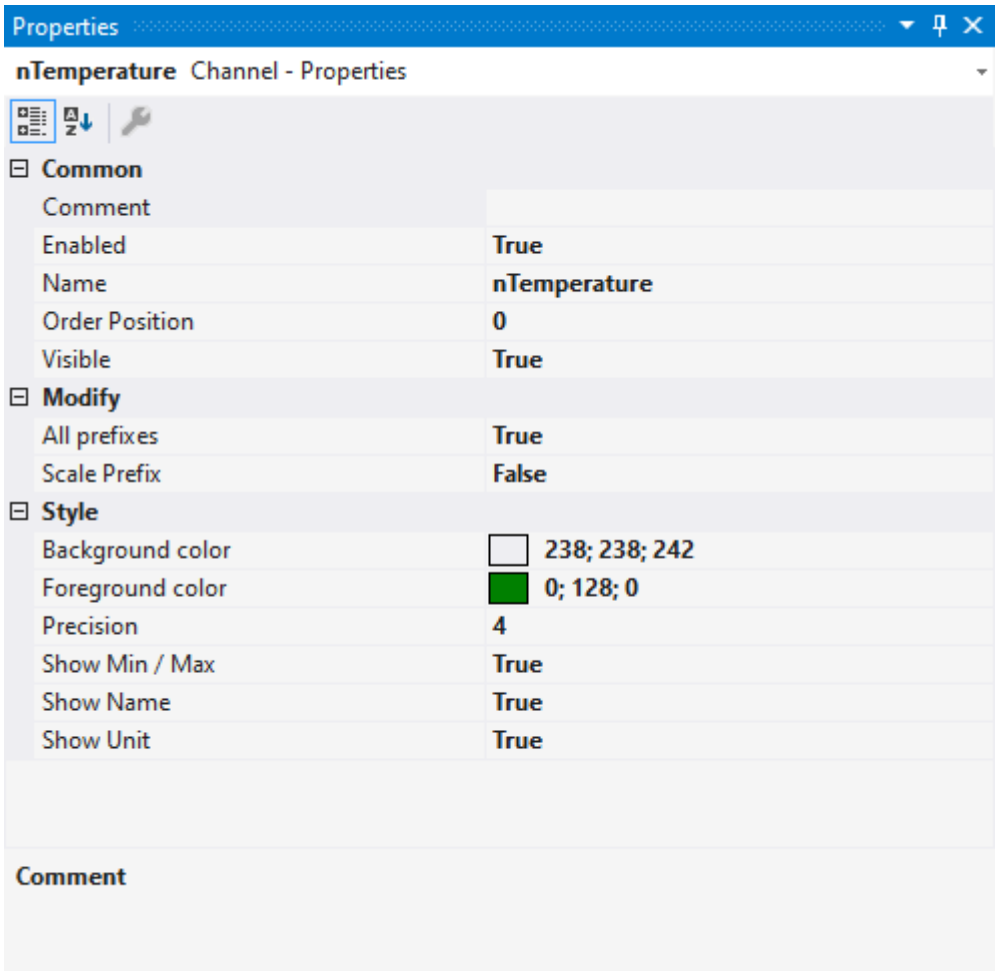
Canvas Color	Defines the color for the axis group.
Comment	A free comment can be saved here.
Enabled	The axis group can be completely disabled here. This functionality is also available via the context menu.
Name	The name of the axis group.

Context menu

You can find more information on this at Axes context menu. [▶ 105]

5.1.3.5.3 Digital channel properties

All settings assigned to the Digital Chart can be made here.



Common

Comment	A free comment can be saved here. If applicable the comment will be adopted from the connected ADS symbol.
Enabled	Defines whether data should be recorded for the channel.
Name	The name of the channel.
Order Position	Defines the order in which the channels are arranged within an axis group.
Visible	Here you can set whether the channel is to be displayed in the axis group.

Modify

All prefixes	If this option is set to true, all available prefixes are used for the prefix scaling; otherwise deca, hecto, deci and centi are not considered.
Scale Prefix	The prefix scaling can be switched on or off here. With the prefix scaling, the displayed value is scaled with the aid of prefixes in such a way that it can be displayed with the lowest possible number of digits.

Style

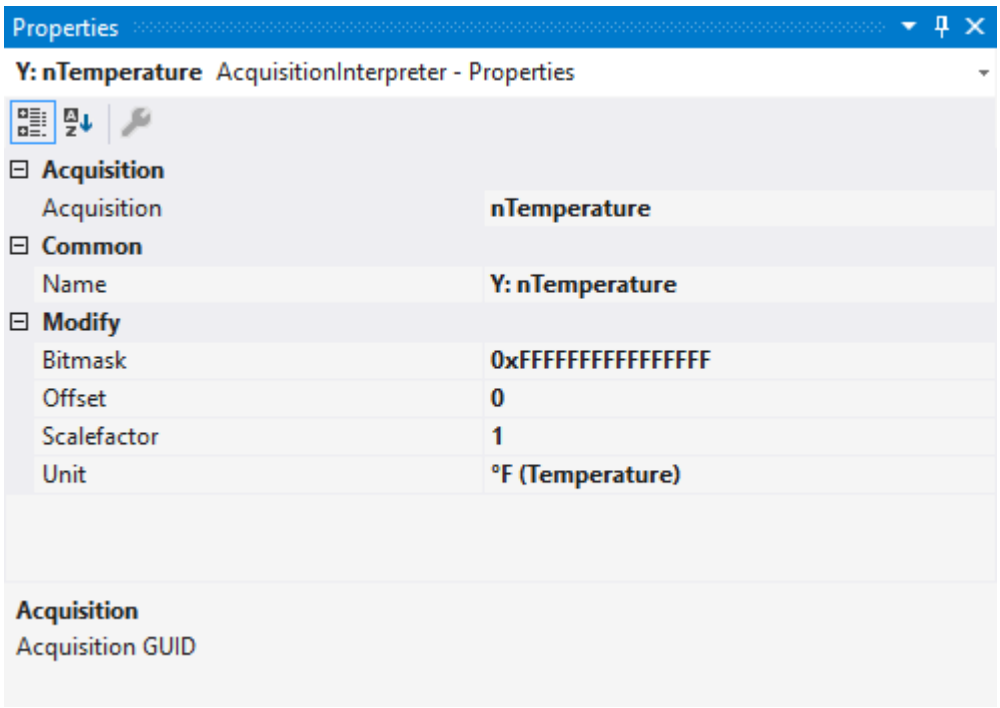
Background color	Defines the color of the background of a channel.
Foreground color	Defines the color of the text and the digital digits.
Precision	The number of digits to be displayed can be set here.
Show Min / Max	This option determines whether the minimum and maximum values of the channel should be displayed below the digital digits.
Show Name	This option defines whether or not the name of the channel is to be displayed by the digital digits.
Show Unit	This option defines whether unit or prefix is to be displayed if it is present.

Context menu

You can find more information on this at Channel context menu. [▶ 106]

5.1.3.5.4 Digital channel acquisition

All the settings for digital channel acquisition are explained here.



Acquisition

Acquisition	Selection of the acquisition used from the data pool.

Common

Name	The name of the interpreter.

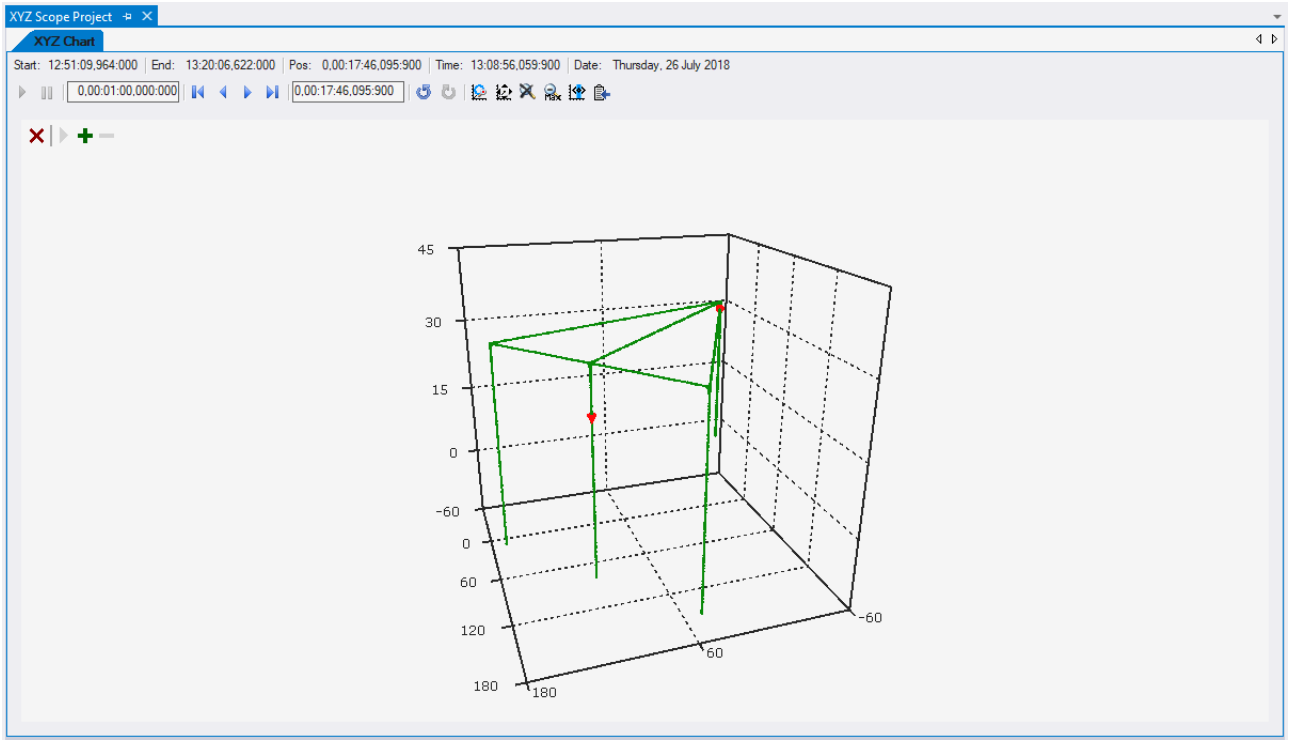
Modify

Bitmask	In this field a value can be entered with which the display value is masked, provided it is not of the type floating point. This means that the value of the channel is ANDed with the binary value of the mask. This helps you, for example, to observe individual bits of a status byte.
Offset	A free offset can be added to the function value of the channel in the offset field.
Scalefactor	The display value of a channel can be changed with the scale factor.
Unit	This property enables the physical unit to be configured individually for the X-acquisition and the Y-acquisition of the channel. This can be done with the aid of the "Unit Wizard", which can be opened using the button on the right in the field. A further option is to define the units beforehand as attributes in the PLC code. These are then read out directly and entered in the Unit field. Detailed information on the units and their configuration options can be taken from the chapter [▶ 191].

5.1.3.6 XYZ Chart

XYZ Chart enables 3-dimensional representation of signals in TwinCAT 3 Scope. Three data series are combined to one channel.

XYZ Chart is available from version 3.4.3145.0.



Requirements:

To use 3D charts in TwinCAT 3 Scope, OpenGL must be installed on the system. To use all features and performance improvements OpenGL version 2.1 or higher is required.

5.1.3.6.1 XYZ Chart movement

XYZ Chart can be moved while holding down the left mouse button.

A distinction is made between two different movement types:

Orbital movement:

In case of orbital movement, the direction of view rotates around the marked central point when the mouse is moved. The distance to the central point can be changed via the mouse wheel.

Shift:

The chart can be moved at the screen level by moving the mouse. The mouse wheel moves the chart depth.

Unlike orbital movement, displacement changes the relative position of the central point to the chart.

Commutation:

The ALT key is used to switch between the movement modes. When the ALT key is held down, "Shift" mode is active by default.



The button marked in red can be used to invert the effect of the ALT key. In this way, movements are possible without a keyboard (e.g. on a touch screen).

Jump to a data point:



The button marked in red activates the "Zoom to selected point" function. If a data point is clicked with the function active, the camera jumps to the selected data point and sets it as the central point. This makes it possible to look closely at the surroundings of a data point.

Reset:

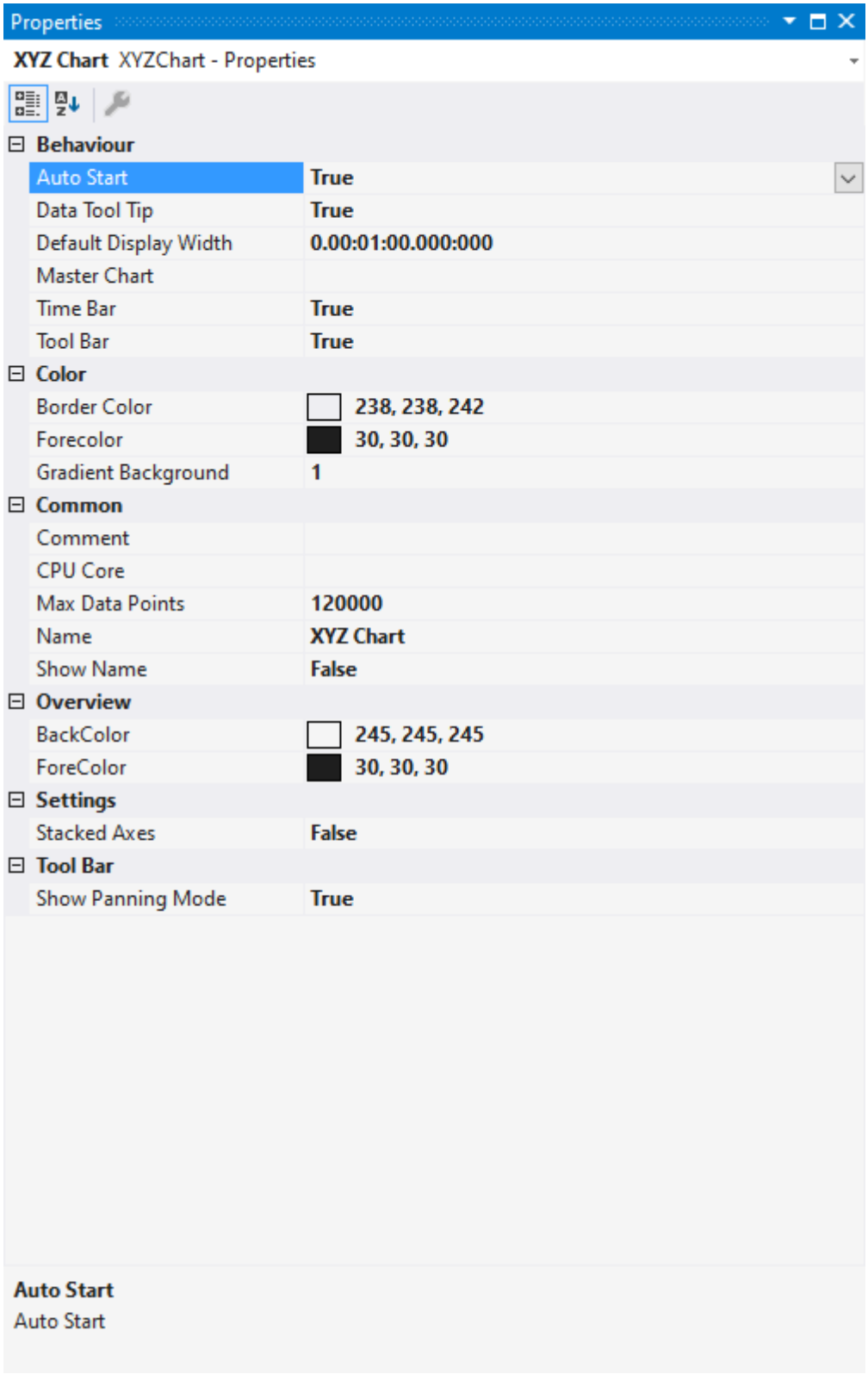
The current view can be reset to the default view by pressing the ESC key or by pressing the red "X" in the upper left corner.

Animation:

With XYZ Chart it is possible to add several views to an animation and to run them automatically one after the other. The chart can be controlled using the buttons in the top left corner of the chart.

	Starts the animation
	Pauses the animation
	Adds the current view to the animation
	Deletes all views from the animation

5.1.3.6.2 XYZ chart properties



Behaviour

Auto Start	If this option is enabled, the chart starts the live display when a new recording is started.
Data Tool Tip	If this option is enabled, clicking on a data point displays the exact value, the timestamp and the name of the corresponding channel in the upper left corner.
Default Display Width	This time specifies the standard width of the associated chart. This value is set, for example, when the rescale button is selected in the chart toolbar.
Master Chart	In the drop-down list that is available here, a chart that is part of the current configuration can be selected and designated as master chart. All actions that are executed in the master chart are also automatically executed in this chart. A separate pause option is provided, through which Y-zoom and Y-panning modes are available. An overview chart can also be displayed.
Time Bar	Specifies whether the time bar is displayed in the chart.
Tool Bar	Specifies whether the toolbar is displayed in the chart.

Color

The background and frame color can be set by means of color dialogs.

Common

Comment	A free comment can be saved here.
CPU Core	Here you can set (for each chart individually) which CPU core should be used for the current chart display. If required, multiple CPU cores can be specified for a chart. This may improve the performance.
Max Data Points	Determines the maximum number of data points that can be displayed at the same time. The default value is 120,000. This means that, at a sampling rate of 1 ms (TaskSampleTime), the maximum recording time for which values can be displayed simultaneously is 2 minutes.
Show Name	Specifies whether the name of the chart is shown in the graph.

Settings

Stacked Axes	Defines the stacking direction for axes. False for horizontal stacking of the axes and true for vertical stacking.

Tool Bar

Show Panning Mode	Specifies whether the button for toggling the ALT functionality is displayed in the toolbar. XYZ Chart movement [▶ 94]

Context menu

You can find more information on this at Chart context menu. [▶ 103]

5.1.3.6.3 XYZ-axis properties

Here you can find all settings for the axes in an XYZ chart.


Properties
Axis Group AxisGroup - Properties
Common
Canvas Color 245, 245, 245
Comment
Enabled True
Name Axis Group
Show Title Custom
Title Axis Group
X-Axis
Color (X) 30, 30, 30
Color Mode (X) Custom
Inverted (X) False
Linewidth (X) 1
Logarithmic (X) False
Manual Max (X) 0.5
Manual Min (X) -0.5
Precision (X) 6
Scale Mode (X) AutoGrowOnly
Show Title (X) False
Title (X) Value Axis
Visible (X) True
X-Grid
Grid Color (X) 30, 30, 30
Grid Divisions (X) 4
Use Grid (X) True
Y-Axis
Color (Y) 30, 30, 30
Color Mode (Y) Custom
Inverted (Y) False
Linewidth (Y) 1
Logarithmic (Y) False
Manual Max (Y) 0.5
Manual Min (Y) -0.5
Precision (Y) 6
Scale Mode (Y) AutoGrowOnly
Show Title (Y) False
Title (Y) Value Axis
Visible (Y) True
Y-Grid
Grid Color (Y) 30, 30, 30
Grid Divisions (Y) 4
Use Grid (Y) True
Z-Axis
Color (Z) 30, 30, 30
Color Mode (Z) Custom
Inverted (Z) False
Linewidth (Z) 1
Logarithmic (Z) False
Manual Max (Z) 0.5
Manual Min (Z) -0.5
Precision (Z) 6
Scale Mode (Z) AutoGrowOnly
Show Title (Z) False
Title (Z) Value Axis
Visible (Z) True
Z-Grid
Grid Color (Z) 30, 30, 30
Grid Divisions (Z) 4
Use Grid (Z) True
Canvas Color

Common

Canvas Color	Here you can set the background color of the drawing area.
Comment	Here you can add a free comment.
Enabled	Shows/hides the entire axis.
Name	Indicates the name of the axis group. This is used in the Solution Editor.
Show Title	Determines which title is displayed above the chart. This function is only displayed if there is only one axis group, or if the axis groups are not stacked. **Hide:** no title is displayed **Custom:** the value from the 'Title' setting is displayed **Name:** the name of the axis group is selected **X-Axis Title:** the title of the X-axis is reused **Y-Axis Title:** the title of the Y-axis is reused **First Channel:** the name of the first channel is reused Below that, all channels are listed in order to select them explicitly.
Title	If Shot Title is set to 'Custom', this title will be displayed above the chart.

(X/Y/Z) axis

Color (X/Y/Z)	Color of the axis.
Color Mode (X/Y/Z)	Defines which color is displayed at the axis. **Custom:** the value from the 'Color Mode' setting is displayed **First Channel:** the name of the first channel is reused Below that, all channels are listed in order to select them explicitly.
Inverted (X/Y/Z)	Inverts the scaling of the axis
Line Width (X/Y/Z)	Specifies the line width of the axis
Logarithmic (X/Y/Z)	Specifies whether the axis is scaled logarithmically.
Manual Max (X/Y/Z)	Specifies the maximum value for manual scaling.
Manual Min (X/Y/Z)	Specifies the minimum value for manual scaling.
Precision (X/Y/Z)	Specifies the number of significant digits for the axis label.
Scale Mode (X/Y/Z)	Specifies the Scale Mode for the axis. There are three modes to choose from. In case of **Manual**, the range of the axis can be fixed. **AutoGrowOnly** automatically increases the area of the axis, if data points are outside the specified range. **AutoGrowNShrink** further shrinks the range if extreme values in the data are no longer in the displayed time range.
Show Title (X/Y/Z)	Specifies whether to display the title of the axis.
Title (X/Y/Z)	Axis title
Visible (X/Y/Z)	Toggles the visibility of the axis label.

(X/Y/Z) Grid

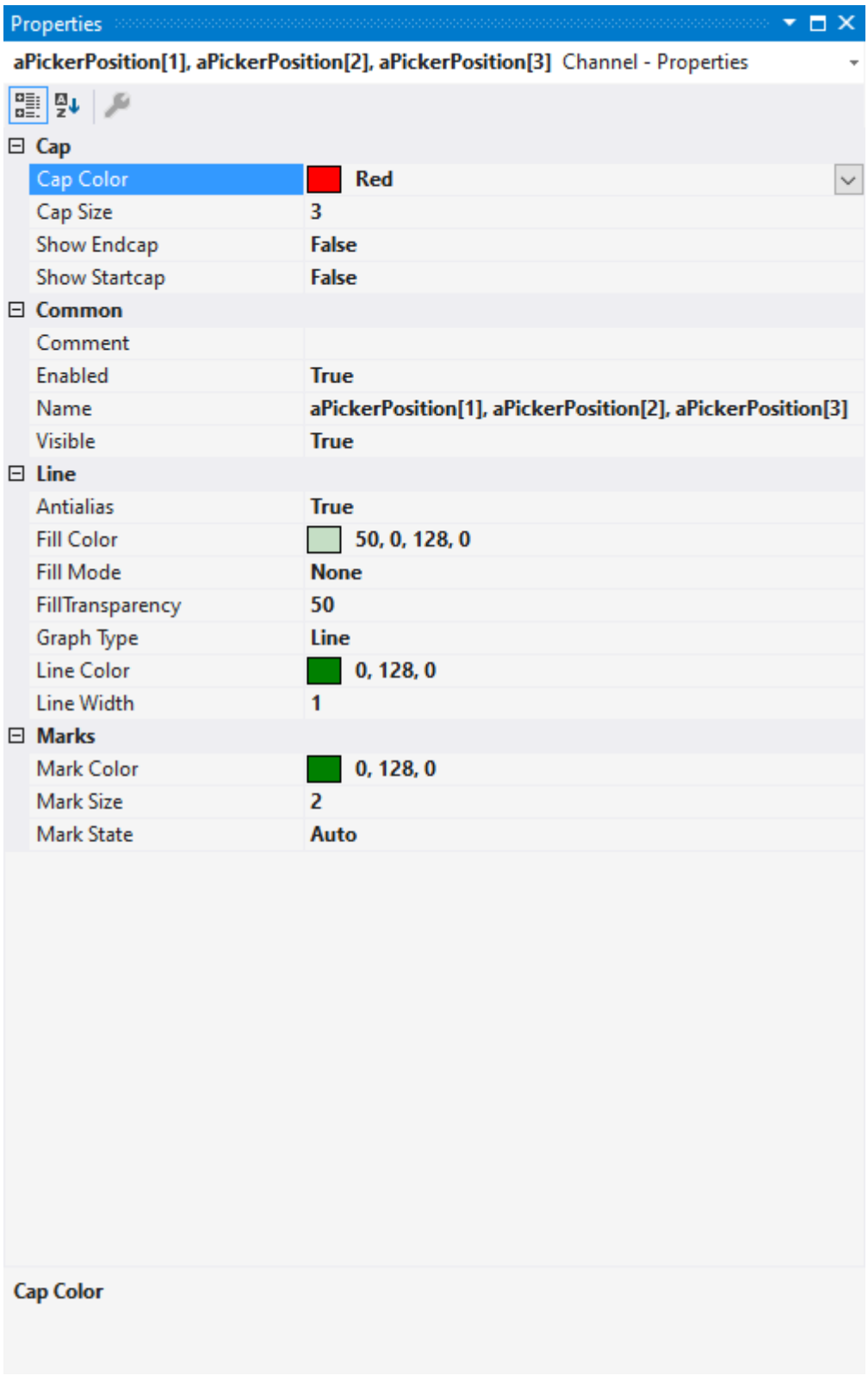
Grid Color (X/Y/Z)	Color of the grid.
Grid Divisions (X/Y/Z)	Maximum number of grid subdivisions. If the drawing space is insufficient for the number of divisions, the system automatically switches to fewer divisions.
Use Grid (X/Y/Z)	The X-divisions can be switched on and off here.

Context menu

You can find more information on this at Axes context menu. [▶ 105]

5.1.3.6.4 XYZ channel properties

Here you will find all settings for the channel properties.



Cap

Cap Color	Specifies the color of the active cap.
Cap Size	Specifies the size of the caps.
Show Endcap	Activates the end cap for the channel.
Show Startcap	Activates the start cap for the channel.

Common

Comment	A free comment can be saved here. If applicable the comment will be adopted from the connected ADS symbol.
Enabled	General switching on and off of the channel.
Name	channel name. This is initially put together automatically from the individual acquisitions and can then be changed.
Visible	Drawing of the channel in the graph can be enabled or disabled here. Even if drawing is disabled, the data is recorded.

Line

Antialias	This option decides how the lines will be drawn. Antialias is "nicer" but requires considerably more computing. This has an effect in particular if there are many channels with large movements.
Fill Color	Fill mode can be used to color an area, e.g. above or below a curve. Here you can select the fill color.
Fill Mode	Fill mode can be used to color an area, e.g. above or below a curve. The default setting is “None”. Alternatives are: Horizontal Zero, Bottom, Top, Center and Source.
Fill Transparency	Here you can set the transparency value of the fill color. The default value is 50.
Graph Type	Here you can select different presentation types for the graph.
Line Color	Graph Colour.
Line Width	Line width of the chart. The line width 1 requires least computing.

Marks

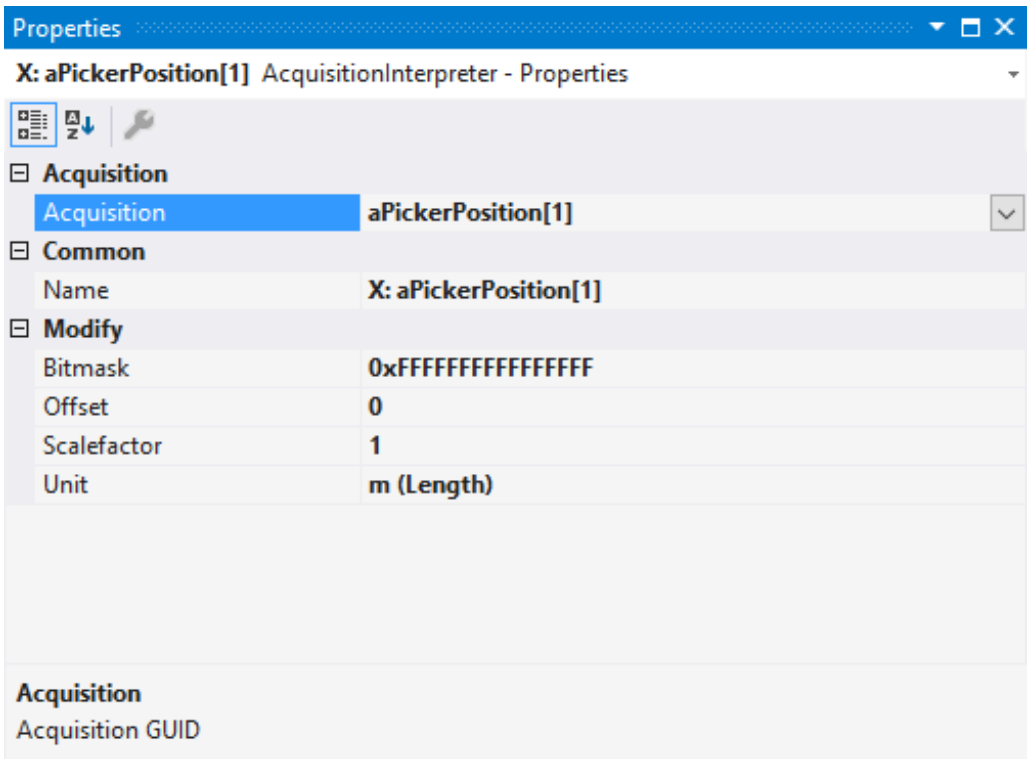
Mark Color	Color of the interpolation point markers.
Mark Size	Size of the interpolation point markers.
Mark State	Specifies the visibility of markers: On (permanently visible) | Auto (depending on the zoom level) | Off (markers disabled).

Context menu

You can find more information on this at Channel context menu. [▶ 106]

5.1.3.6.5 XYZ Channel Acquisition

This chapter explains all the acquisitions settings for XYZ charts.



Acquisition

Acquisition	Selection of the acquisition used from the data pool.

Common

Name	The name of the interpreter.

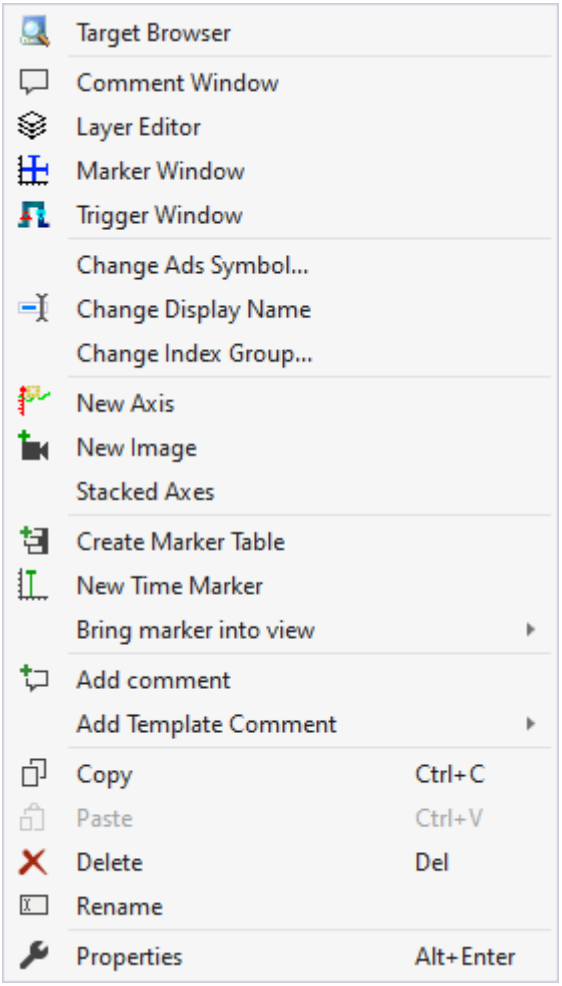
Modify

Bitmask	In this field a value can be entered with which the display value is masked, provided it is not of the type floating point. This means that the value of the channel is ANDed with the binary value of the mask. This helps you, for example, to observe individual bits of a status byte.
Offset	Here a free offset can be added to the function value of the channel.
Scalefactor	The display value of a channel can be changed with the scale factor.
Unit	This property allows the physical unit to be configured for the respective acquisition. This can be done with the aid of the "Unit Wizard", which can be opened using the button on the right in the field. A further option is to define the units beforehand as attributes in the PLC code. These are then read out directly and entered in the Unit field. Detailed information on the units and their configuration options can be found in the chapter on Physical units [▶ 191].

5.1.3.7 Context menu

5.1.3.7.1 Chart context menu

Context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

In the following group, the existing configuration can be reconfigured with just a few clicks.

"Change Ads Symbol..."
If the symbol names have changed in several ADS acquisitions, parts of the name can be exchanged using this function.

"Change Display Name"
The "Change Display Name" function can be used to set the level of detail to be displayed for the names of the channels and acquisitions.

"Change Index Group..."
This function can be used to change the Index Group of all ADS variables. Either an offset can be calculated or a new value can be entered.

Elements below the chart can be added in the fourth group.

"New Axis"
A new axis group is added below the chart with this function.

"New Image"
If no image has yet been created below the chart, a new image can be created here.

"Stacked Axes"
Here you can change the setting that allows you to select whether the axes of a chart should be next to each other. If no tick is visible on the left, the axes are next to each other and the values of the added channels are displayed within the same area. If the tick is visible, the axes are displayed one above the other and each axis has its own presentation range.

The following group offers various functions for interacting with the markers.

"Create Marker Table"
This menu entry can be used to add a table in the Maker Window [▶ 108], which is automatically filled in with all the information from the chart.

"New Time Marker"
Creates a new Time Marker and adds it to the selected element.

"Bring marker into view"
This function can be used to move a time marker that is fixed to an axis to the center of the currently visible area of the chart.

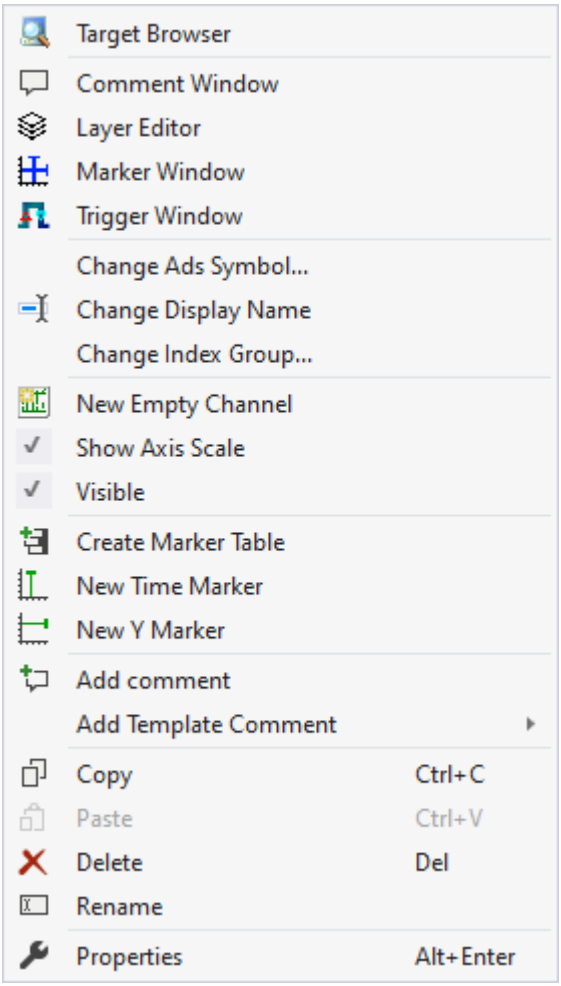
"Add comment"
To write additional information to the selected node, this function can be used to add a new comment, which is displayed in the comment window.

"Add Template Comment"
In this submenu, new templates can be created or selected in order to add them.

Various standard functionalities can be found in the last two groups.

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

5.1.3.7.2 Axis context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

In the following group, the existing configuration can be reconfigured with just a few clicks.

"Change Ads Symbol..."
If the symbol names have changed in several ADS acquisitions, parts of the name can be exchanged using this function.

"Change Display Name"
The "Change Display Name" function can be used to set the level of detail to be displayed for the names of the channels and acquisitions.

"Change Index Group..."
This function can be used to change the Index Group of all ADS variables. Either an offset can be calculated or a new value can be entered.

"New Empty Channel"
A new channel can be added below the axis group with this entry.

"Show Axis Scale"
Setting whether the axes should be displayed or not. If the tick is visible on the left, the axes are drawn, otherwise they are not. This does not change the visibility of the channels or the chart.

"Visible"
Setting whether the entire axis group should be displayed. If the tick is present, the visible channels and the corresponding chart are displayed. If the tick is not visible, nothing more of the axis group is displayed.

The following group offers various functions for interacting with the markers.

"Create Marker Table"
This function can be used to add an automatically generated table in the Marker Window, which displays all information on the selected axis group.

Depending on the chart type, different types of markers can be inserted using the menu entries below.

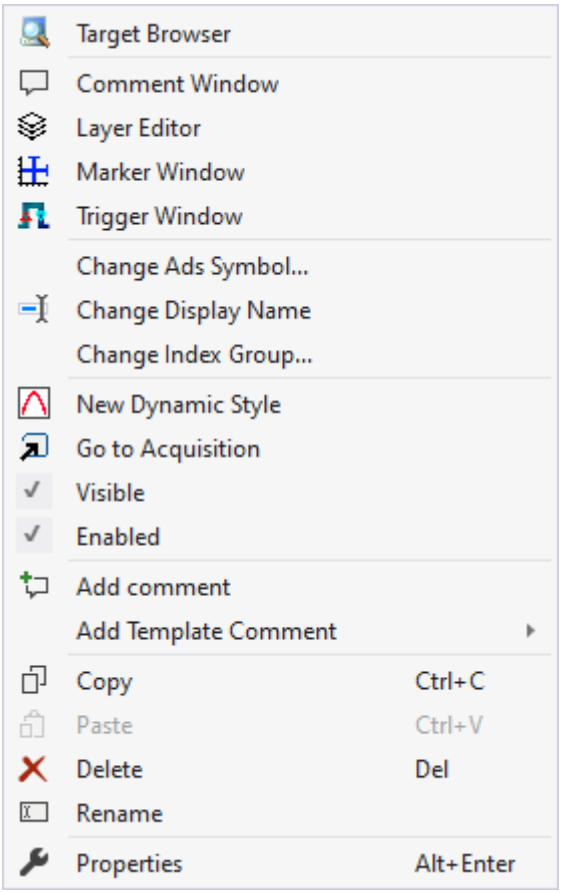
"Add comment"
To write additional information to the selected node, this function can be used to add a new comment, which is displayed in the comment window.

"Add Template Comment"
In this submenu, new templates can be created or selected in order to add them.

Various standard functionalities can be found in the last two groups.

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

5.1.3.7.3 Channel context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

In the following group, the existing configuration can be reconfigured with just a few clicks.

"Change Ads Symbol..."
If the symbol names have changed in several ADS acquisitions, parts of the name can be exchanged using this function.

"Change Display Name"
The "Change Display Name" function can be used to set the level of detail to be displayed for the names of the channels and acquisitions.

"Change Index Group..."
This function can be used to change the Index Group of all ADS variables. Either an offset can be calculated or a new value can be entered.

"New Dynamic Style"
This context menu entry can be used to create a new Dynamic Style and add it to the channel.

"Go to Acquisition"
With this function, all acquisitions of the channel are marked in the Solution Explorer.

"Visible"
A channel can be made invisible and visible again with this setting. If the entry is active (tick is visible on the left), the channel is displayed in the chart.

"Enabled"
If this menu entry is active, data is prepared for the channel in order to be displayed.

"Add comment"
To write additional information to the selected node, this function can be used to add a new comment, which is displayed in the comment window.

"Add Template Comment"
In this submenu, new templates can be created or selected in order to add them.

Various standard functionalities can be found in the last two groups.

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

5.1.4 Trigger

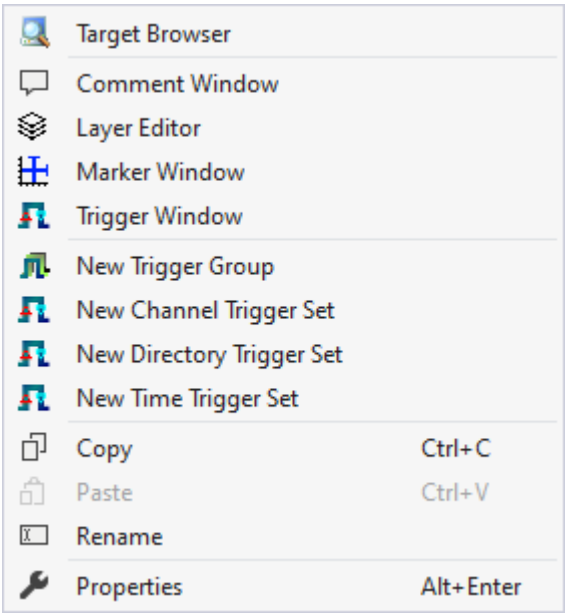
Triggers can be a useful addition to the scope configuration for controlling a scope recording or for marking significant events in the data stream.

The triggers in the scope are organized in groups [▶ 110] and sets [▶ 143]. In a group the trigger action such as Start Record or Set Mark can be selected. The set defines the actual trigger condition, e.g. exceeding of a limit value of a particular variable. The sets can be linked using logical operators.

A basic distinction is made between two types of sets, a channel and a menu directory type.

Trigger groups and trigger sets can be added via the trigger context menu.

Context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

The entries in the third group can be used to create new trigger groups.

"New Trigger Group"
Creates an empty Trigger Group [▶ 110].

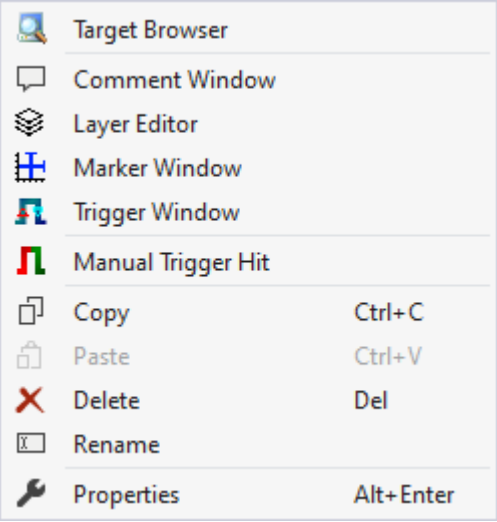
New Channel/Directory/Time Trigger Set
Creates a new Trigger Group [▶ 110] with a new Trigger Set of the type Channel [▶ 144], Directory [▶ 145] or Time [▶ 146].

Various standard functionalities can be found in the last two groups.

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

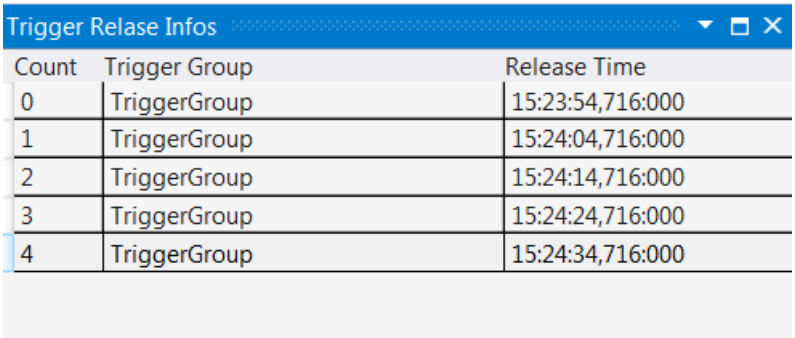
Manual triggering of trigger set

Triggers can be manually triggered for test purposes via the Trigger Set context menu command **Manual Trigger Hit**.



Trigger Window

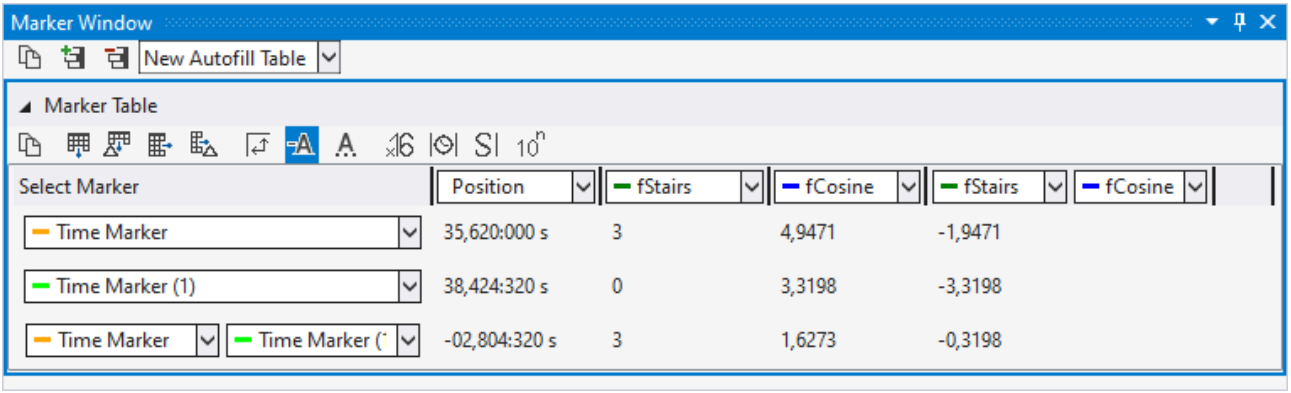
The Trigger window can be opened via the Trigger context menu. It displays the triggers with the times at which they were triggered. If you pause the chart displays and select the corresponding events in the trigger window, the display in the chart jumps to the corresponding position.



Count	Trigger Group	Release Time
0	TriggerGroup	15:23:54,716:000
1	TriggerGroup	15:24:04,716:000
2	TriggerGroup	15:24:14,716:000
3	TriggerGroup	15:24:24,716:000
4	TriggerGroup	15:24:34,716:000

Marker Window

In the Marker Window, channel values from the times of markers or trigger events (timers) can be output and compared with other timer values. A Marker Window always refers to the project selected in the Solution Explorer.



The Marker Window consists of a menu bar and an arbitrary number of tables. The tables can be freely created and also deleted again.

The menu bar at the top edge of the Marker Window contains the following buttons:

- Copy: Copies all values from the Marker Window to the clipboard so that they can be pasted into another program.
- Add table: Adds a new table.
- Delete table: Deletes the selected table.
- At the side of the buttons there is also a selection box in which all charts existing in the configuration are listed. If a chart is selected there, an automatic table is created containing all markers and channels that refer to the chart.

All tables are pictured below one another under the menu bar. The values of the various channels at the different times of the timers are displayed in a table.

There are two different options for the rows and columns.

- Option 1: Select one timer / channel; in this case only the value of one time/one channel is output.
- Option 2: Select two timers/channels; in this case the difference between the values is calculated.
  If two timers and two channels are selected, the difference is calculated between the 1st channel and the 1st time (position) and between the 2nd channel and the 2nd time (position).

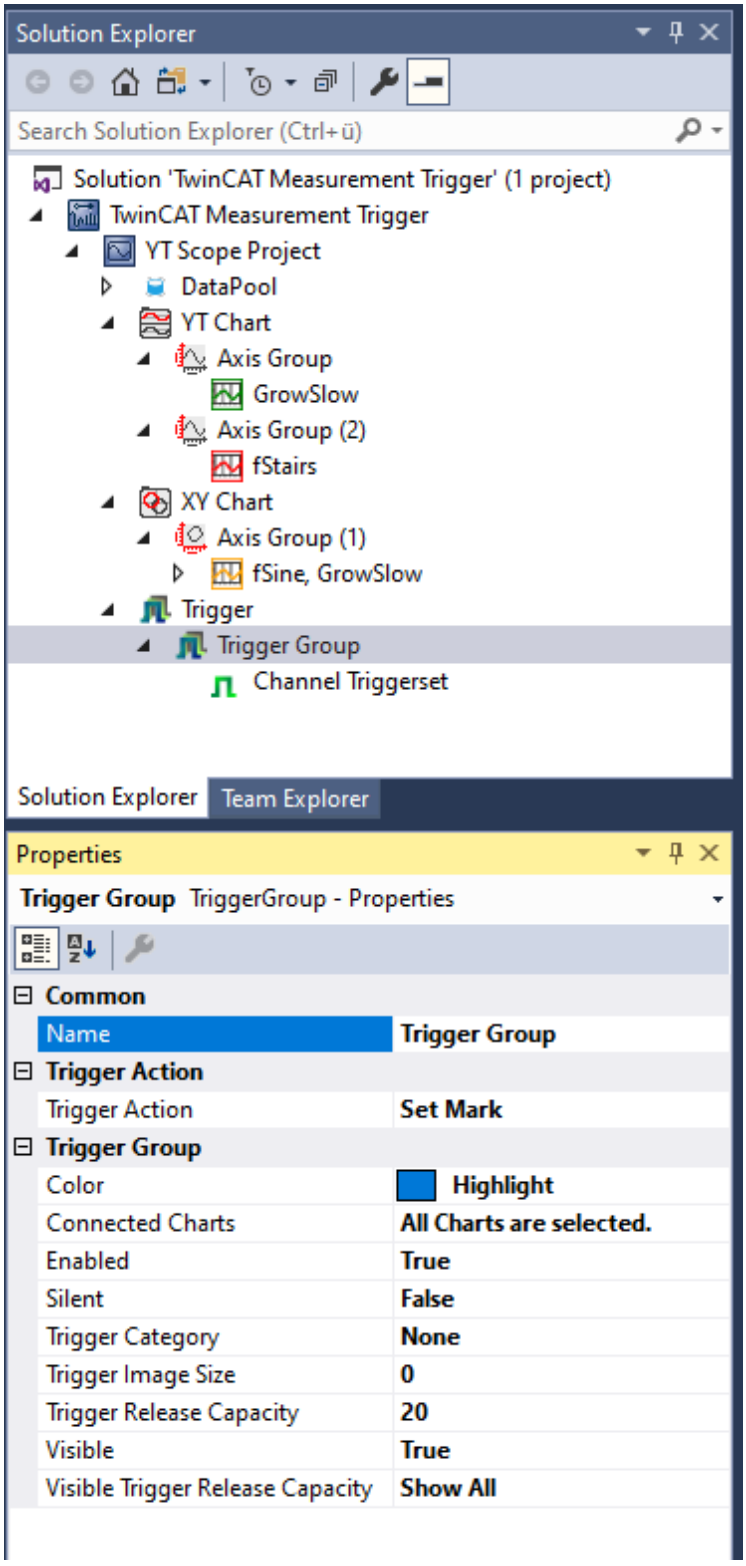
The following buttons are available for the configuration of the table:

- Copy: Copies the values from the table.
- Add row: Adds a row with a single selection option.
- Add difference row: Adds a row with a double selection option for a difference.
- Add column: Adds a column with a single selection option.
- Add difference column: Adds a column with a double selection option for a difference.
- Rotate orientation: The orientation setting button lets you define whether the timers or channels are in columns or in rows.
- Colored marking: In order to be able to assign markers and channels not only on the basis of the names, small lines can be displayed in front of the name, which have the same color as the associated elements.
- Colored numbers: The data can be drawn in the table in the same colors as the color of the associated timer.
- Hex notation: The values are displayed using hexadecimal notation.
- Absolute time: The time is displayed as an absolute time.
- Unit: The units of the channels are also displayed in the table.
- Scientific Notation: If the Scientific Notation is set to 'default' for the markers, this setting can be used to overwrite the value for the display in the Marker window.

If the 'Components Highlight' setting is active in the options [▶ 311], the associated channels and markers can be highlighted in the diagram by clicking on a cell. If the value is set to 'Enabled', simply selecting the cell is sufficient. If the option is set to 'DoubleClick', a cell must be selected by double-clicking on it.

5.1.4.1 Trigger Group

Trigger Groups can contain several Trigger Sets. They offer setting options regarding Trigger Actions and general properties depending on the selected action. For an overview of the available actions, see Trigger Action [▶ 112].



Properties of the trigger group

The properties of the trigger group can deviate from the illustration shown here, because some setting options are visible and editable only with special trigger actions. For example, the **Trigger Position** setting is visible only with the trigger actions "Stop Display" and "Restart Display".

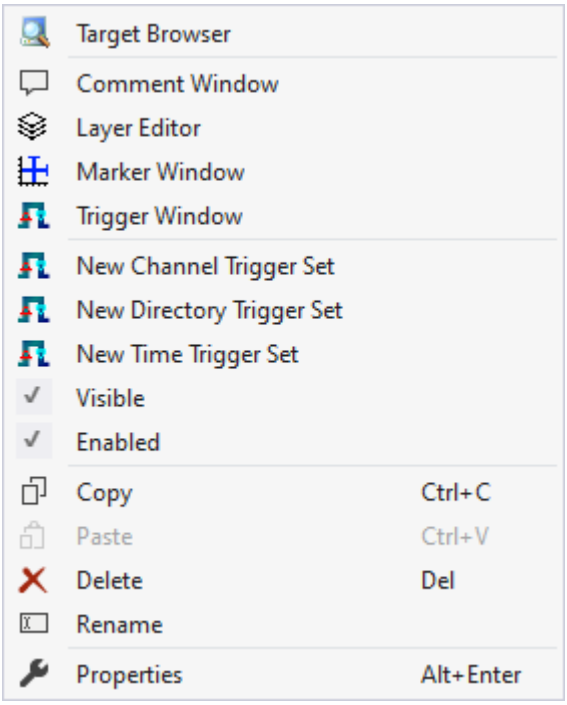
Common

Name	Name of the trigger group

Trigger Action

Trigger Action	Displays the selected trigger action for the corresponding trigger group

Context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

"New Channel Trigger Set"
This entry can be used to add a new Channel Trigger Set [▶ 144]. However, this entry is only displayed if no Directory Trigger Set exists in the Trigger Group.

"New Directory Trigger Set"
This entry can be used to add a new Directory Trigger Set [▶ 145]. However, this entry is only displayed if no Trigger Set has yet been added to the Trigger Group.

"New Time Trigger Set"
This entry can be used to add a new Time Trigger Set [▶ 146]. However, this entry is only displayed if no Directory Trigger Set exists in the Trigger Group.

"Visible"
If this entry has a tick on the left, this means that the Trigger Group is visible. This means that the Trigger Release information is displayed in the charts and also in the Trigger window.

"Enabled"
Trigger events are searched for in the data during recording only if this setting is active (tick on the left).

Various standard functionalities can be found in the last two groups.

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

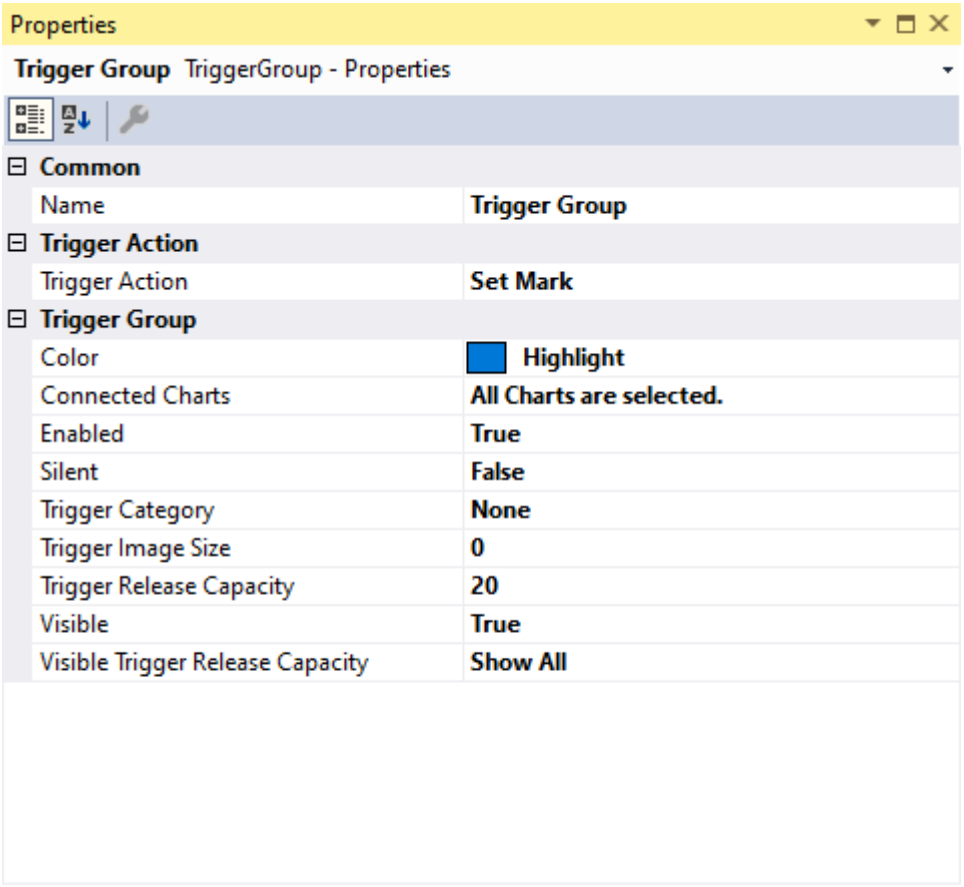
5.1.4.1.1 Trigger Action

The following trigger actions are available for selection.

Trigger Action	Short description
Set Mark [▶ 112]	Sets markers at significant locations in the data stream
Start Record [▶ 115]	Starts a recording based on an event
Stop Record [▶ 117]	Stops a recording based on an event
Start Subsave [▶ 119]	Starts one of up to five additional background recordings based on an event
Stop Subsave [▶ 122]	Stops the background recording that was started first based on an event
Stop Display [▶ 124]	Pauses the display based on an event; recording continues
Restart Display [▶ 127]	Starts the display based on an event
Export [▶ 129]	Exports the current data due to an event.
Reporting Trigger [▶ 133]	Triggers the generation of the report in the Reporting Server.
Reporting Collector [▶ 136]	Sends the data to the Reporting Server.
Reporting Collector + Trigger [▶ 140]	Sends the data to the Reporting Server and triggers the generation of the report.

5.1.4.1.1.1 Set Mark

The Set Mark Trigger action marks significant locations in the data stream. These can be circles in the XY chart or vertical lines in the YT chart. In the latter, additional small images can optionally highlight the event. You can use your own images or those that the scope itself provides for certain event categories.


Properties
Trigger Group TriggerGroup - Properties
Common
Name
Trigger Group
Trigger Action
Trigger Action
Set Mark
Trigger Group
Color
Highlight
Connected Charts
All Charts are selected.
Enabled
True
Silent
False
Trigger Category
None
Trigger Image Size
0
Trigger Release Capacity
20
Visible
True
Visible Trigger Release Capacity
Show All
Misc

Trigger Group

Color	Here you can specify the color for marking the event in the chart
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created.
Enabled	The selected trigger group can be switched on and off here
Silent	If you set Silent to TRUE, no more trigger messages are displayed in the engineering message window
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously
Visible	Here you can set whether the event should also be visibly marked in the data stream
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity"

Trigger Category

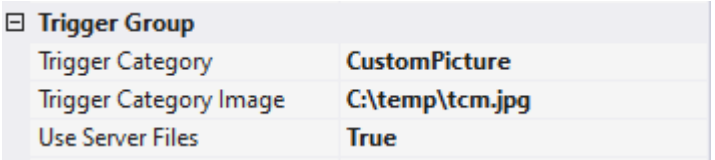
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



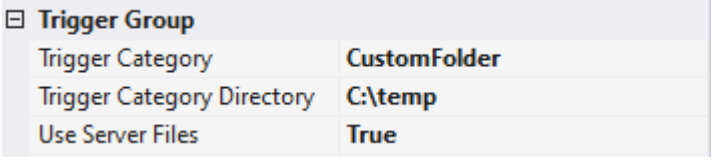
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder

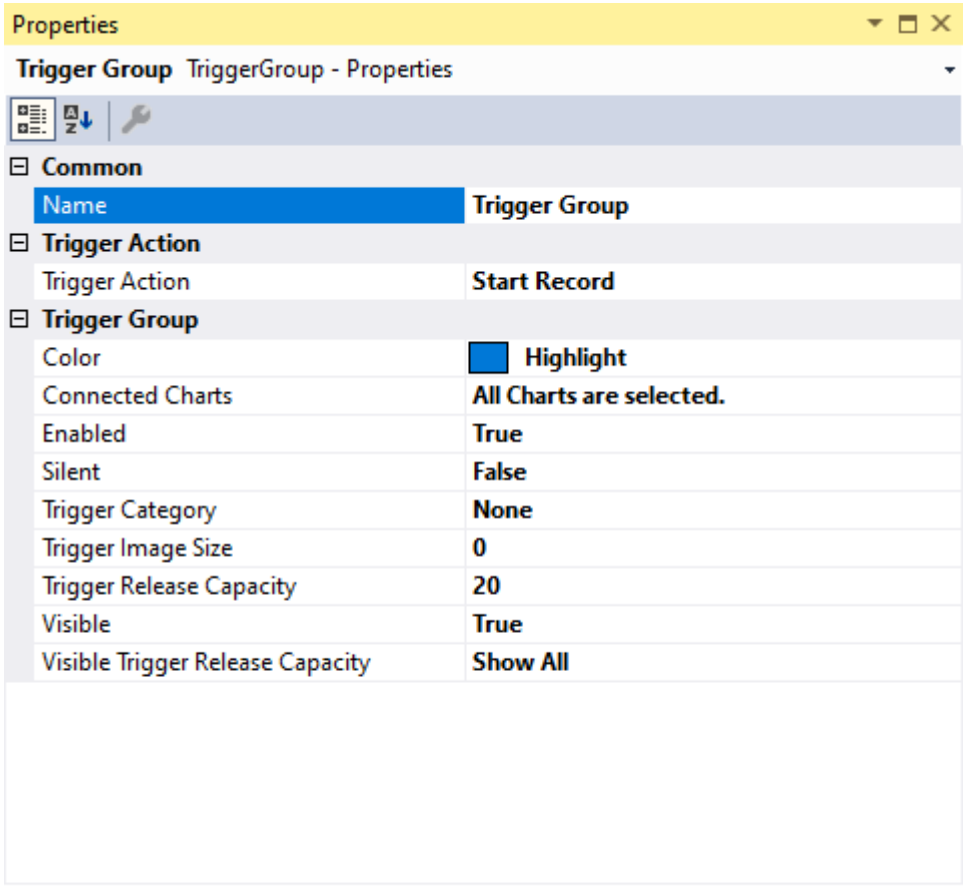


Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.1.1.2 Start Record

If this option is selected, the start mode in the scope settings is automatically set to "TriggerStart". The Scope View connects to the selected Scope Server as usual after you have clicked Start Record in the toolbar. The connected channels will now be screened, but without starting the actual recording. Recording starts automatically at the trigger time of the last trigger set condition.

This trigger action also works well in combination with the Restart Record function in the scope settings. The click on the record button is automated for further recordings after it has been pressed once.



Name

Trigger Group

Color	Here you can specify the color for marking the event in the chart
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created.
Enabled	The selected trigger group can be switched on and off here
Silent	If you set Silent to TRUE, no more trigger messages are displayed in the engineering message window
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously
Visible	Here you can set whether the event should also be visibly marked in the data stream
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity"

Trigger Category

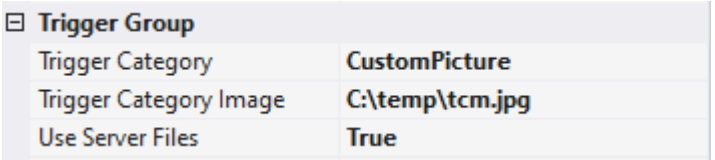
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



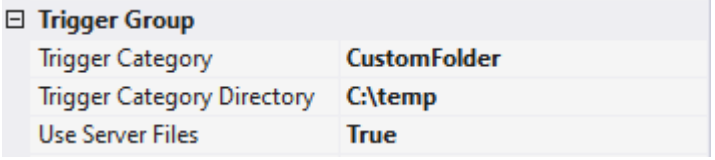
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder

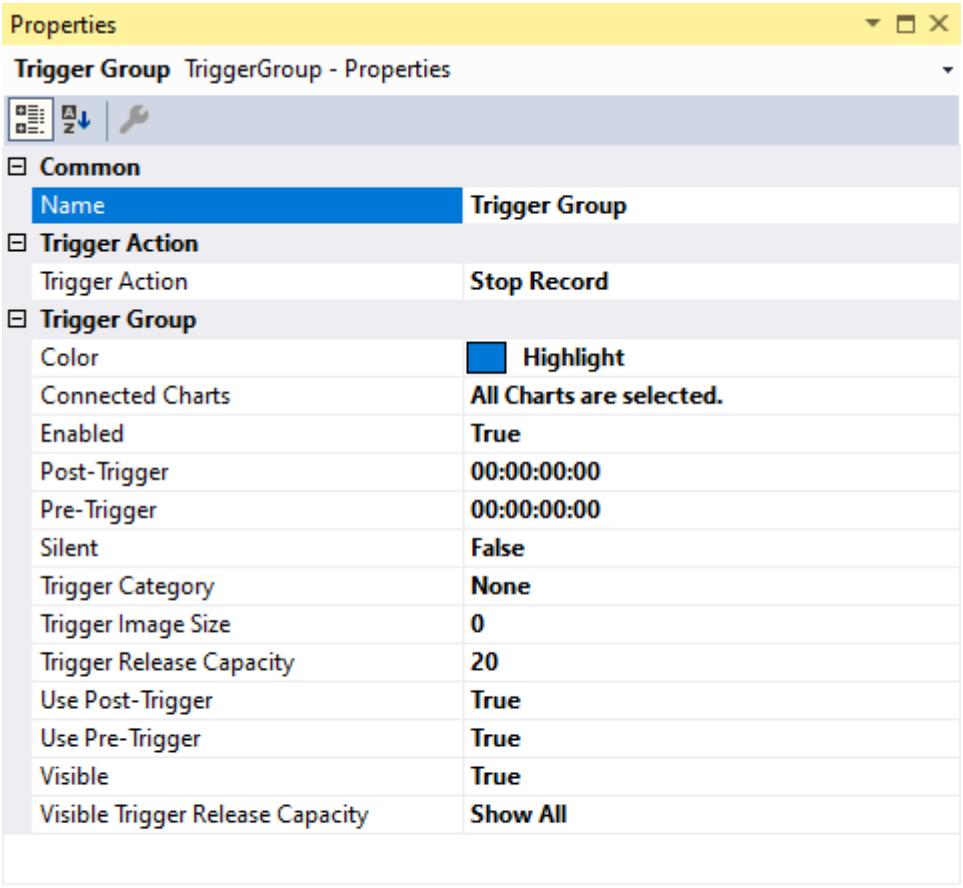


Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.1.1.3 Stop Record

This trigger action is ideal for monitoring malfunctions in applications that occur after an unspecified time. For this application we recommend operating the scope in ring buffer mode with the Stop Record Trigger Action selected. This is the best way to use the options for pre- and post-trigger time. because with these options you can decide whether you want to see a time range before and after the trigger event in the recording. It is also possible to use only one of the two options. If you use the pre-trigger time, all valid trigger events before this time expires will be ignored.

This function works best with the scope options Auto Save and Restart Record [▶ 22].



Name

Trigger Group

Color	Here you can specify the color for marking the event in the chart
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created.
Enabled	The selected trigger group can be switched on and off here
Post-Trigger	Here you can set a time in the format dd:HH:mm:ss for the recording to continue after the trigger event has occurred
Pre-Trigger	In the format dd:HH:mm:ss the minimum time that must elapse before the trigger event can be set
Silent	If you set Silent to TRUE, no more trigger messages are displayed in the engineering message window
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously
Use Post-Trigger	If TRUE, the time set under post-trigger is taken into account
Use Pre-Trigger	If TRUE, the time set under pre-trigger is taken into account
Visible	Here you can set whether the event should also be visibly marked in the data stream
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity"

Trigger Category

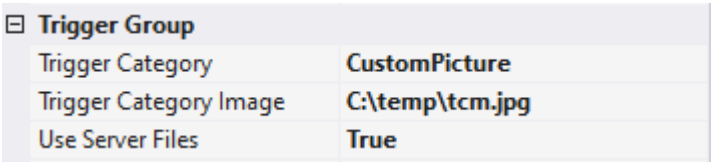
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



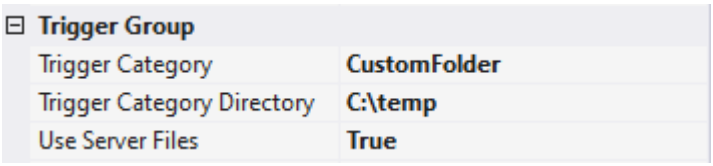
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder



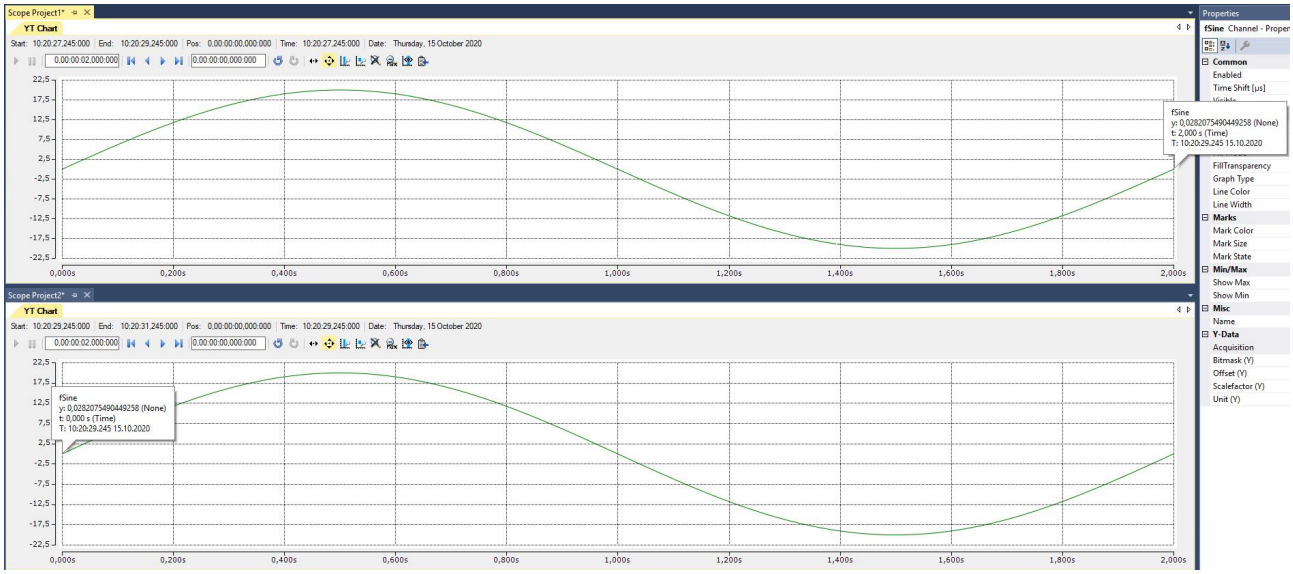
Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.1.1.4 Start Subsave

The main use case for this trigger action is to store data packets during a long recording in order to make important data persistent. If you select this trigger action, another recording of the current configuration is started invisibly in the background when the trigger event occurs. This background recording always runs in the ring buffer, regardless of the scope settings.

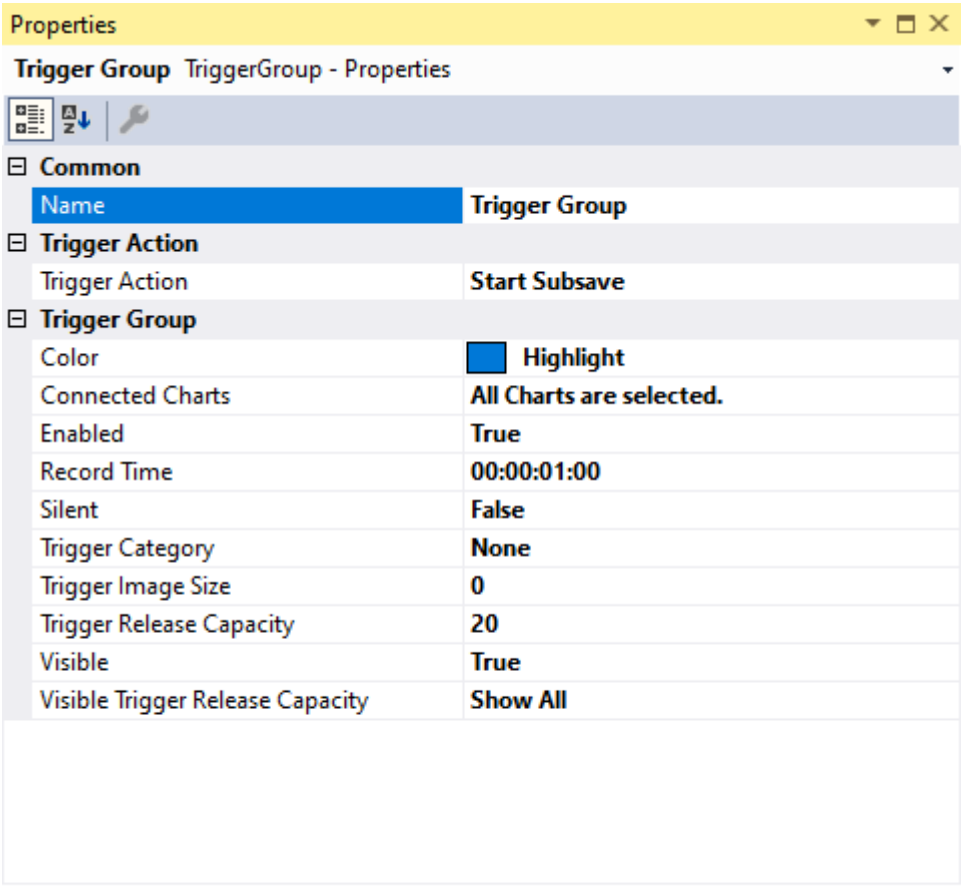
Please note that the maximum number of background recordings that can be started in parallel is five. A record time can also be specified here, irrespective of the actual scope settings. This also determines the required memory, which should be taken into account. The system must be designed for basic configuration and a maximum of five background recordings in RAM and hard disk.

With subsave recordings it is possible to store overlapping and also gapless recordings. Please note that the same trigger condition must be used for the gapless recordings, e.g. "rising edge by 5". Which then duplicates this sample, with the result that is in the saved recording and in the restarted recording.



Note on Subsave Trigger

Start and Stop Subsave Triggers can only be used together. A configuration that only contains a Start Subsave trigger group does not make sense, because background recordings that have been started must be terminated with Stop Subsave. Only a manual stop of the basic recording also leads to the saving of the background recordings.


Properties
Trigger Group TriggerGroup - Properties
Common
Name
Trigger Group
Trigger Action
Trigger Action
Start Subsave
Trigger Group
Color
Highlight
Connected Charts
All Charts are selected.
Enabled
True
Record Time
00:00:01:00
Silent
False
Trigger Category
None
Trigger Image Size
0
Trigger Release Capacity
20
Visible
True
Visible Trigger Release Capacity
Show All

Name

Trigger Group

Color	Here you can specify the color for marking the event in the chart
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created.
Enabled	The selected trigger group can be switched on and off here
Record Time	Here you can set the ring buffer recording time for the background recordings in the format dd:HH:mm:ss
Silent	If you set Silent to TRUE, no more trigger messages are displayed in the engineering message window
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously
Visible	Here you can set whether the event should also be visibly marked in the data stream
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity"

Trigger Category

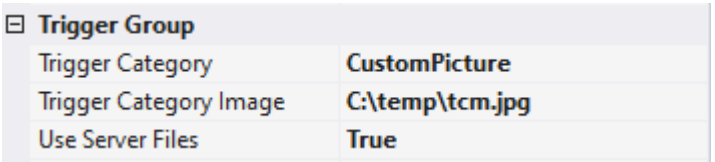
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



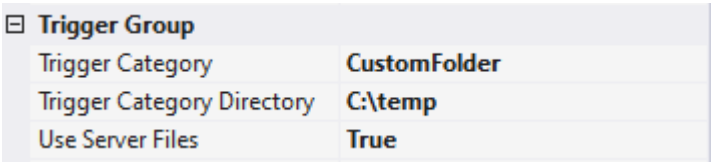
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder

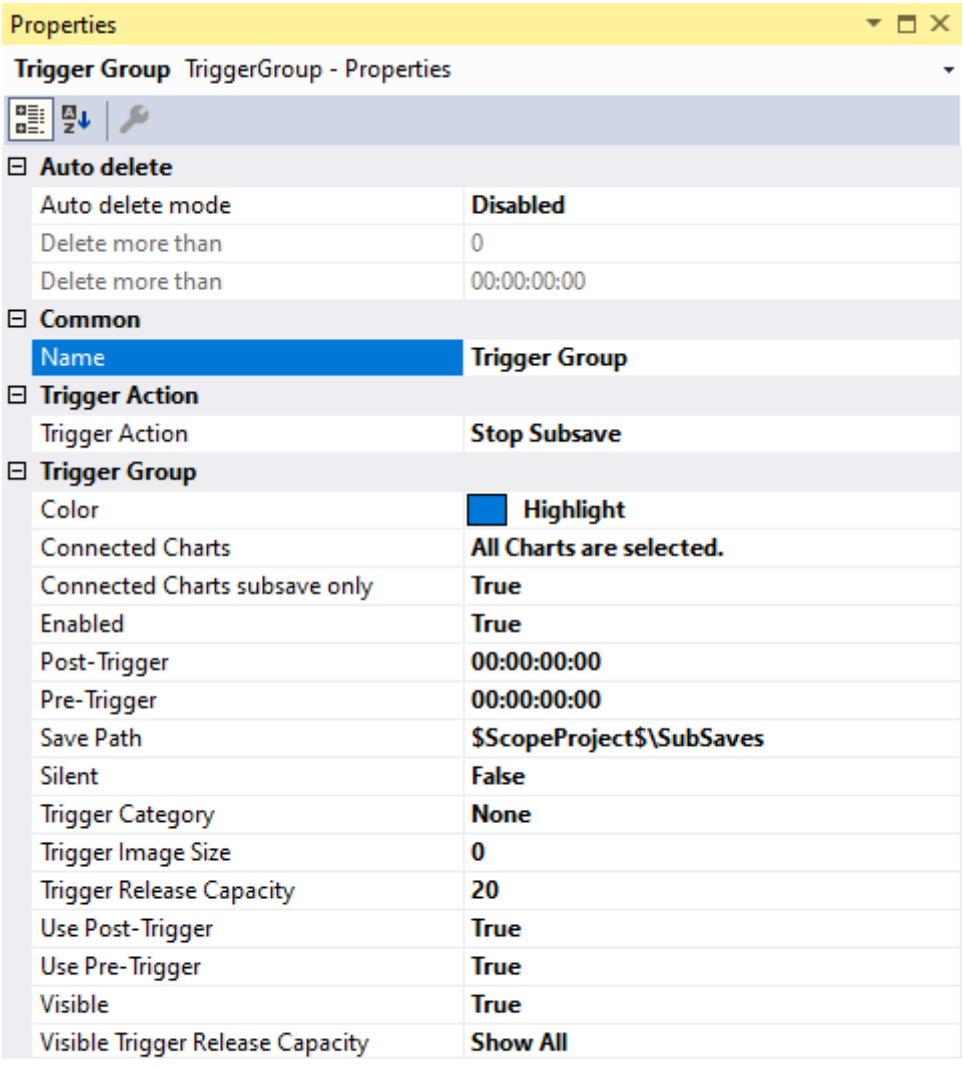


Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.1.1.5 Stop Subsave

This trigger action stops background recordings already started by the Start Subsave trigger. If several background recordings (maximum 5) are already running, the oldest background recording is stopped first by a corresponding event and automatically saved in the specified path as an *.svdx* file. The generated file name consists of the name of the Scope in the basic configuration and an ID composed of the date and time, in alphanumeric order.

The Auto Delete functions are a special feature. This enhances storage space management on the target system. Automatically saved *.svdx* files can be deleted from the folder after a certain number of *.svdx* files has been reached, or the oldest files can be deleted after a specified time.



Name

Trigger Group

Color	Here you can specify the color for marking the event in the chart.
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created.
Connected Charts subsave only	In the subsave, only the charts that are connected in this trigger group are added. The acquisitions that are not used in the selected charts are also not saved.
Enabled	The selected trigger group can be switched on and off here.
Post-Trigger	Here you can set a time in the format dd:HH:mm:ss for the recording to continue after the trigger event has occurred.
Pre-Trigger	In the format dd:HH:mm:ss the minimum time that must elapse before the trigger event can be set.
Save Path	Here you can specify the path for the svdx files to be saved.
Silent	If you set Silent to TRUE, no more trigger messages are displayed in the engineering message window.
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area.
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously.
Use Post-Trigger	If TRUE, the time set under post-trigger is taken into account.
Use Pre-Trigger	If TRUE, the time set under pre-trigger is taken into account.
Visible	Here you can set whether the event should also be visibly marked in the data stream.
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity".

Auto Delete

Auto Delete mode	Here you can set the mode in which the Auto Delete function should run. If set to "Disabled", no files will be deleted. "Capacity“ deletes the oldest file in the folder if more than the number of files specified in "Delete more than" has been saved. If set to "OlderThan", all files older than the time specified in "Delete older than" will be deleted. The option "CapacityOrOlderThan" is a combination of "Capacity" and "OlderThan". That is, files are deleted when the conditions for either option are met.
Delete more than	This option defines when and with how many created files the oldest is to be deleted. The option is only active as long as "Capacity" or "CapacityOrOlderThan" is selected in "Auto Delete".
Delete older than	This option defines the number of seconds after which a file is to be deleted with Auto Delete. The option is only active as long as "OlderThan" or "CapacityOrOlderThan" is selected in "Auto Delete".

Trigger Category

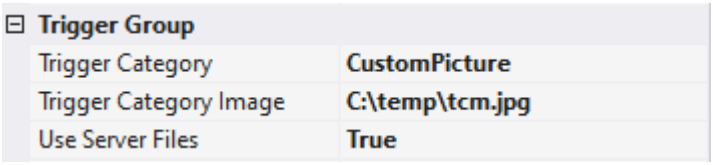
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



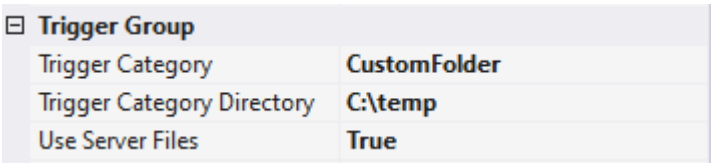
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder

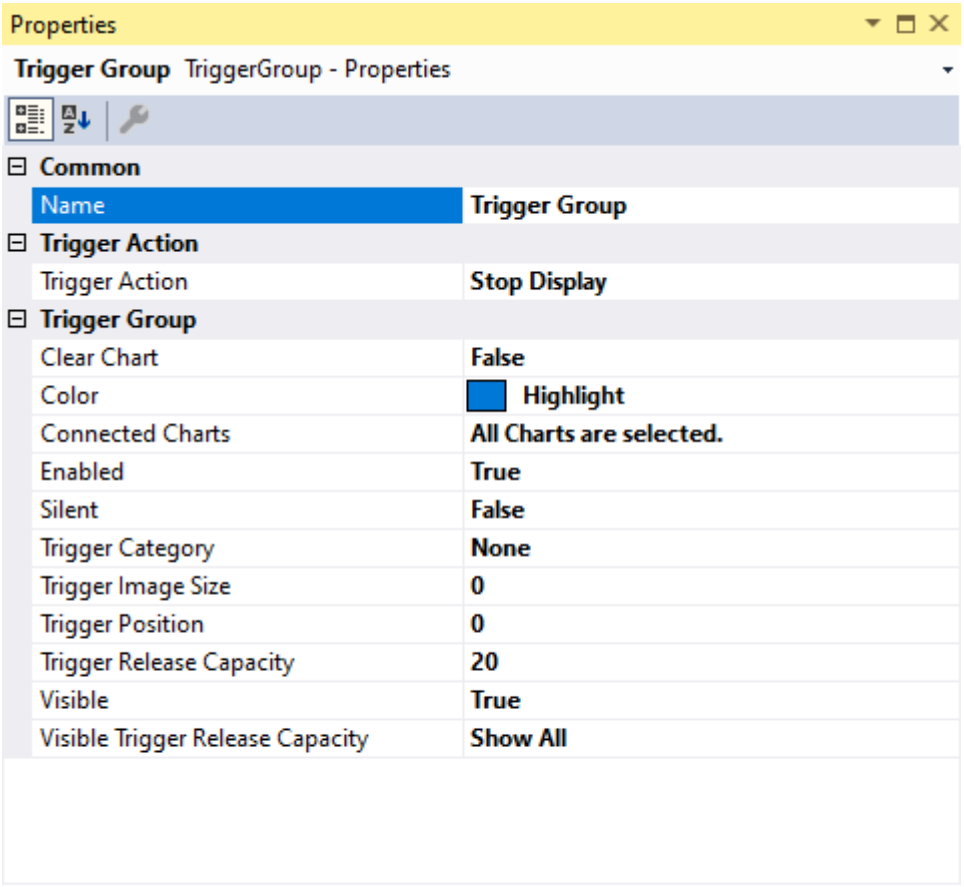


Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.1.1.6 Stop Display

With this trigger action you can pause the display of a chart. If the trigger condition occurs, all charts that are in live mode at that time are automatically stopped. If the trigger condition is met again, the display jumps to this new event. In order to prevent this retriggering, the Pause button can be pressed in the corresponding chart.

Clear Chart is a special option. This option allows you to remove the previously drawn graphs from the display. Drawing continues from the event onwards.


Properties
Trigger Group TriggerGroup - Properties
Common
Name
Trigger Group
Trigger Action
Trigger Action
Stop Display
Trigger Group
Clear Chart
False
Color
Highlight
Connected Charts
All Charts are selected.
Enabled
True
Silent
False
Trigger Category
None
Trigger Image Size
0
Trigger Position
0
Trigger Release Capacity
20
Visible
True
Visible Trigger Release Capacity
Show All

Name

Trigger Group

Clear Chart	If this option is activated, all graphs in the displays with the event are deleted and redrawn starting from the display position of the event
Color	Here you can specify the color for marking the event in the chart
Connected Charts	If not every chart of the configuration is to be stopped, charts can be selected here, which are stopped by the trigger. Each chart is automatically added when it is created.
Enabled	The selected trigger group can be switched on and off here
Silent	If you set Silent to TRUE, no more trigger messages will be displayed in the engineering message window
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area.
Trigger Position	Here you can specify (in percent) at which position in the display the trigger event should appear when the display is stopped.
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously.
Visible	Here you can set whether the event should also be visibly marked in the data stream.
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity"

Trigger Category

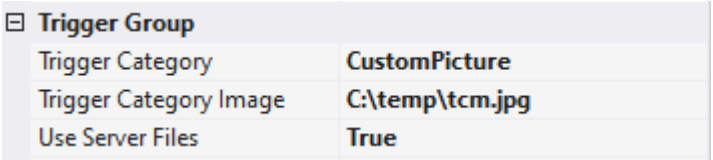
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



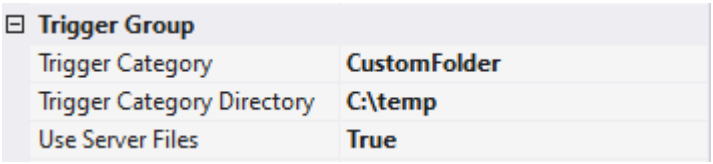
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

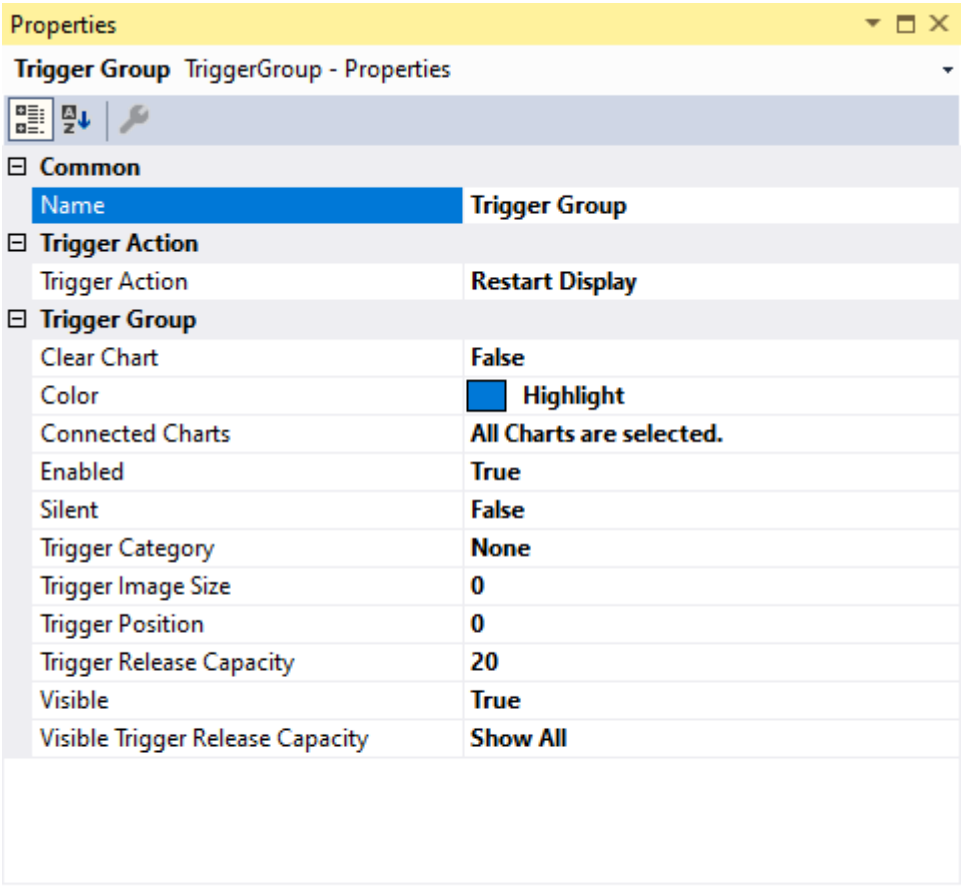
Custom Folder



Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.1.1.7 Restart Display

This trigger action restarts all displays paused by a Stop Display trigger when the trigger condition is met.



Name

Trigger Group

Clear Chart	Deletes the previously drawn graphs in a display when the event occurs
Color	Here you can specify the color for marking the event in the chart
Connected Charts	If not every chart of the configuration should be restarted, charts can be selected here, which will be restarted by the trigger. Each chart is automatically added when it is created.
Enabled	The selected trigger group can be switched on and off here
Silent	If you set Silent to TRUE, no more trigger messages are displayed in the engineering message window
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area
Trigger Position	Here you can specify (in percent) at which position in the display the trigger event should be when the display is restarted
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously
Visible	Here you can set whether the event should also be visibly marked in the data stream
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity"

Trigger Category

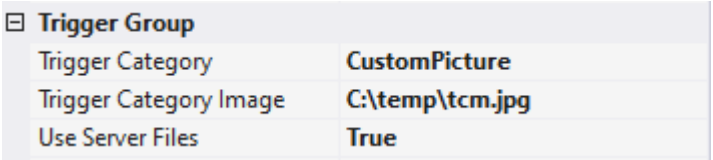
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



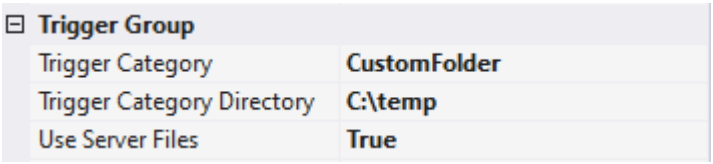
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



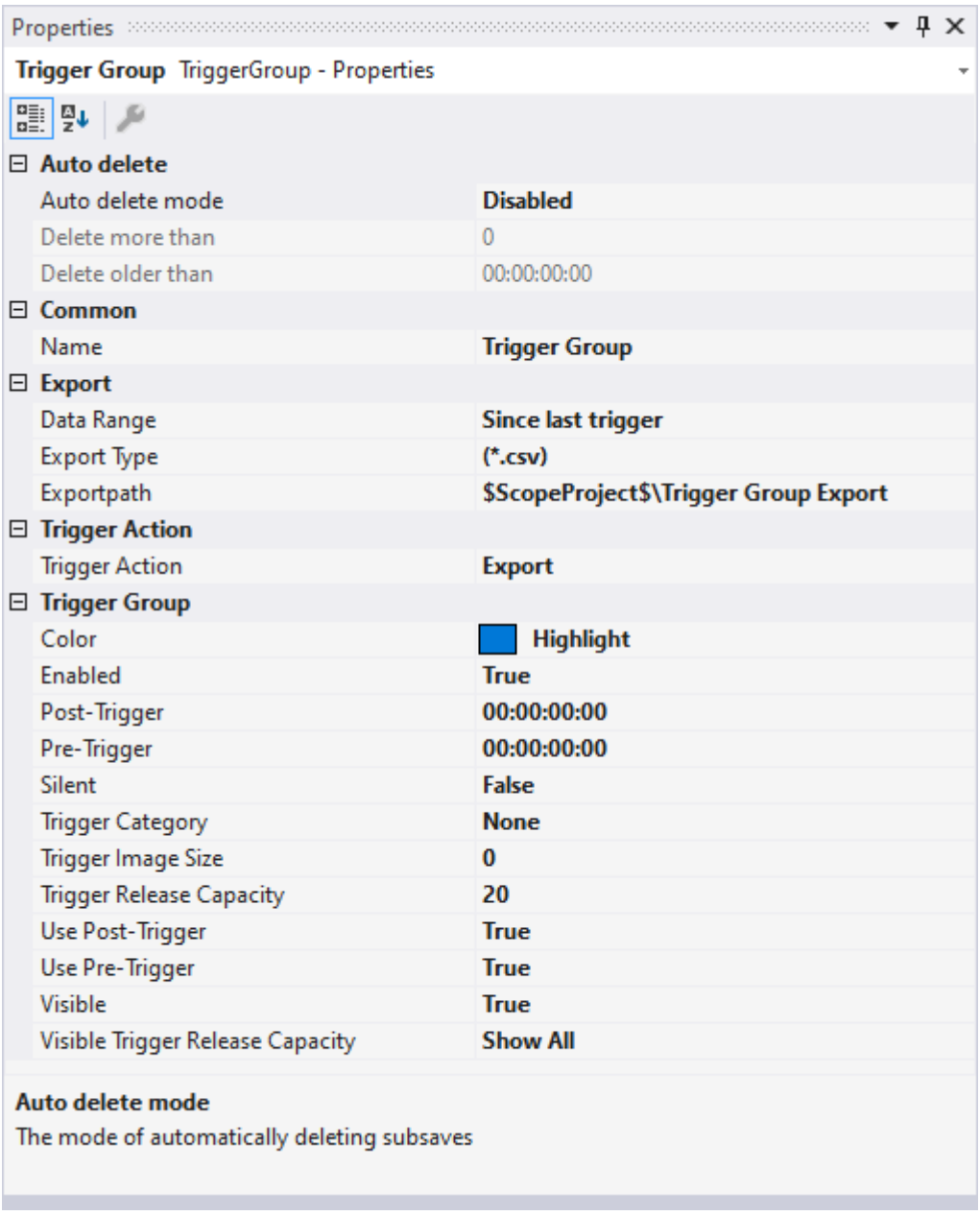
Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder



Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.1.1.8 Export



Auto Delete

Auto Delete mode	Here you can set the mode in which the Auto Delete function should run. If set to "Disabled", no files will be deleted. "Capacity“ deletes the oldest file in the folder if more than the number of files specified in "Delete more than" has been saved. If set to "OlderThan", all files older than the time specified in "Delete older than" will be deleted. The option "CapacityOrOlderThan" is a combination of "Capacity" and "OlderThan". That is, files are deleted when the conditions for either option are met.
Delete more than	This option defines when and with how many created files the oldest is to be deleted. The option is only active as long as "Capacity" or "CapacityOrOlderThan" is selected in "Auto Delete".
Delete older than	This option defines the number of seconds after which a file is to be deleted with Auto Delete. The option is only active as long as "OlderThan" or "CapacityOrOlderThan" is selected in "Auto Delete".

Export

Data Range	This option determines which time period is to be exported. "Last Data" stands for the last value that is valid at the time of the trigger. The time period between the last two trigger events can be selected with the option "Since last trigger". "Time Range" can be used to define a free time range.
Export Type	With this option, the configuration of the export can be set via the wizard.
Exportpath	Specify the path where the exported data is to be saved. With the placeholder "$ScopeProject" the path of the current project is automatically inserted.

Trigger Group

Color	Here you can specify the color for marking the event in the chart.
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created. The charts selected here are automatically selected in the Export Window in the "Export Type" property. If all channels or images are added in the export, only those from the selected charts will be added.
Enabled	The selected trigger group can be switched on and off here.
Post-Trigger	Here you can set a time in the format dd:HH:mm:ss for the recording to continue after the trigger event has occurred.
Pre-Trigger	In the format dd:HH:mm:ss the minimum time that must elapse before the trigger event can be set.
Silent	If you set Silent to TRUE, no more trigger messages will be displayed in the engineering message window.
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area.
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously.
Use Post-Trigger	If TRUE, the time set under post-trigger is taken into account.
Use Pre-Trigger	If TRUE, the time set under pre-trigger is taken into account.
Visible	Here you can set whether the event should also be visibly marked in the data stream.
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity".

Trigger Category

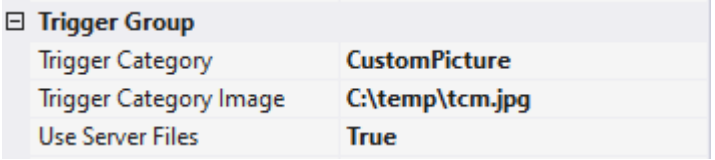
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



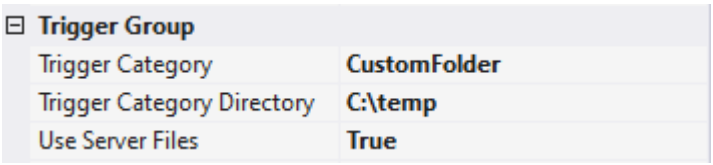
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



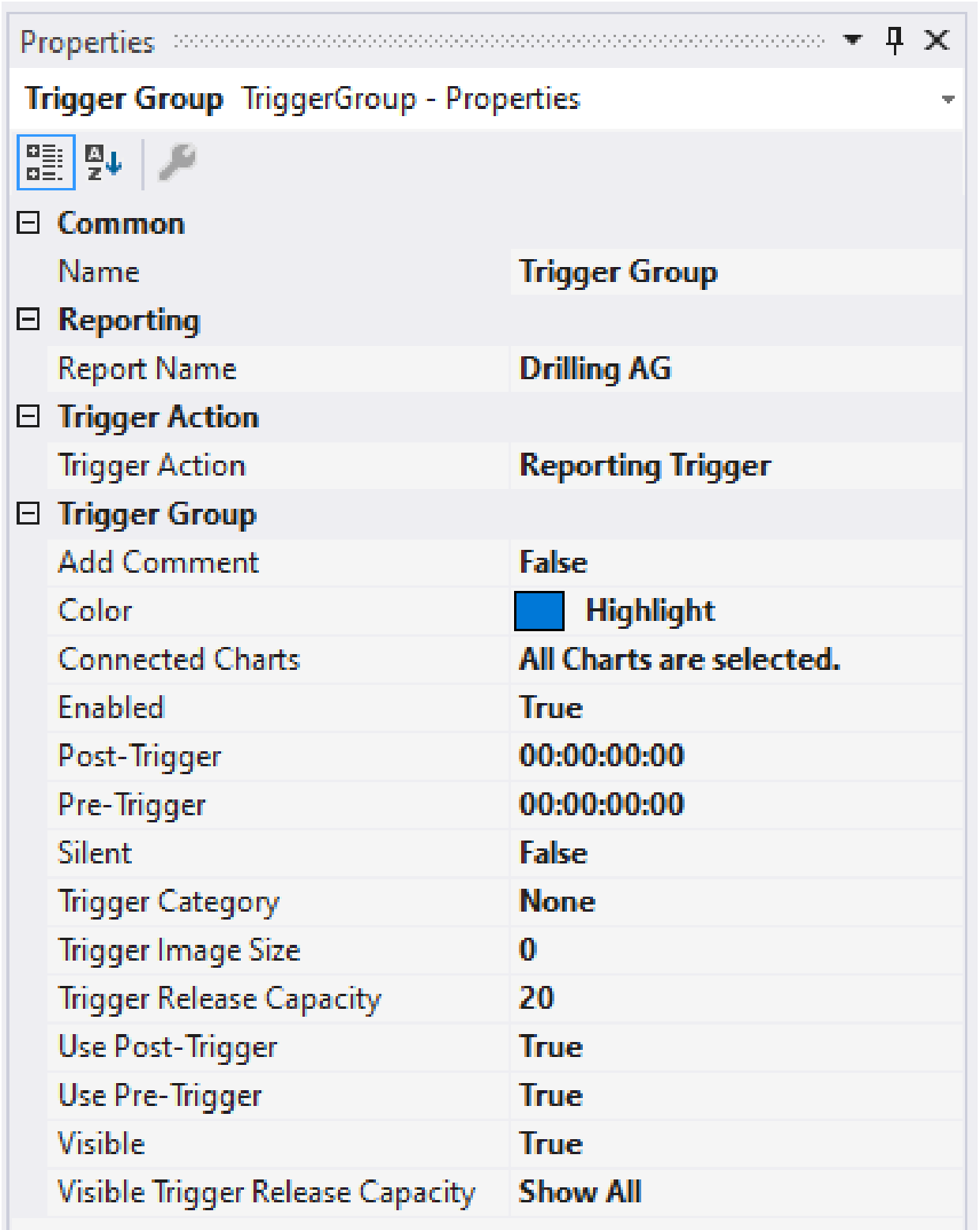
Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder



Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.1.1.9 Reporting Trigger



Auto Delete

Auto Delete mode	Here you can set the mode in which the Auto Delete function should run. If set to "Disabled", no files will be deleted. "Capacity“ deletes the oldest file in the folder if more than the number of files specified in "Delete more than" has been saved. If set to "OlderThan", all files older than the time specified in "Delete older than" will be deleted. The option "CapacityOrOlderThan" is a combination of "Capacity" and "OlderThan". That is, files are deleted when the conditions for either option are met.
Delete more than	This option defines when and with how many created files the oldest is to be deleted. The option is only active as long as "Capacity" or "CapacityOrOlderThan" is selected in "Auto Delete".
Delete older than	This option defines the number of seconds after which a file is to be deleted with Auto Delete. The option is only active as long as "OlderThan" or "CapacityOrOlderThan" is selected in "Auto Delete".

Reporting

Report Name	Here you can select the report name. The drop-down menu lists the available reports from the reporting server. Alternatively, a free text can be entered.

Trigger Group

Color	Here you can specify the color for marking the event in the chart.
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created. The charts selected here are automatically selected in the Export Window in the "Export Type" property. If all channels or images are added in the export, only those from the selected charts will be added.
Enabled	The selected trigger group can be switched on and off here.
Post-Trigger	Here you can set a time in the format dd:HH:mm:ss for the recording to continue after the trigger event has occurred.
Pre-Trigger	In the format dd:HH:mm:ss the minimum time that must elapse before the trigger event can be set.
Silent	If you set Silent to TRUE, no more trigger messages will be displayed in the engineering message window.
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area.
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously.
Use Post-Trigger	If TRUE, the time set under post-trigger is taken into account.
Use Pre-Trigger	If TRUE, the time set under pre-trigger is taken into account.
Visible	Here you can set whether the event should also be visibly marked in the data stream.
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity".

Trigger Category

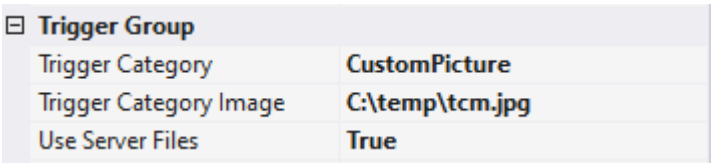
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



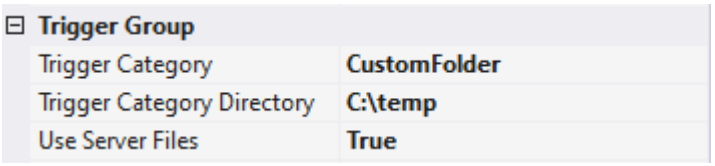
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



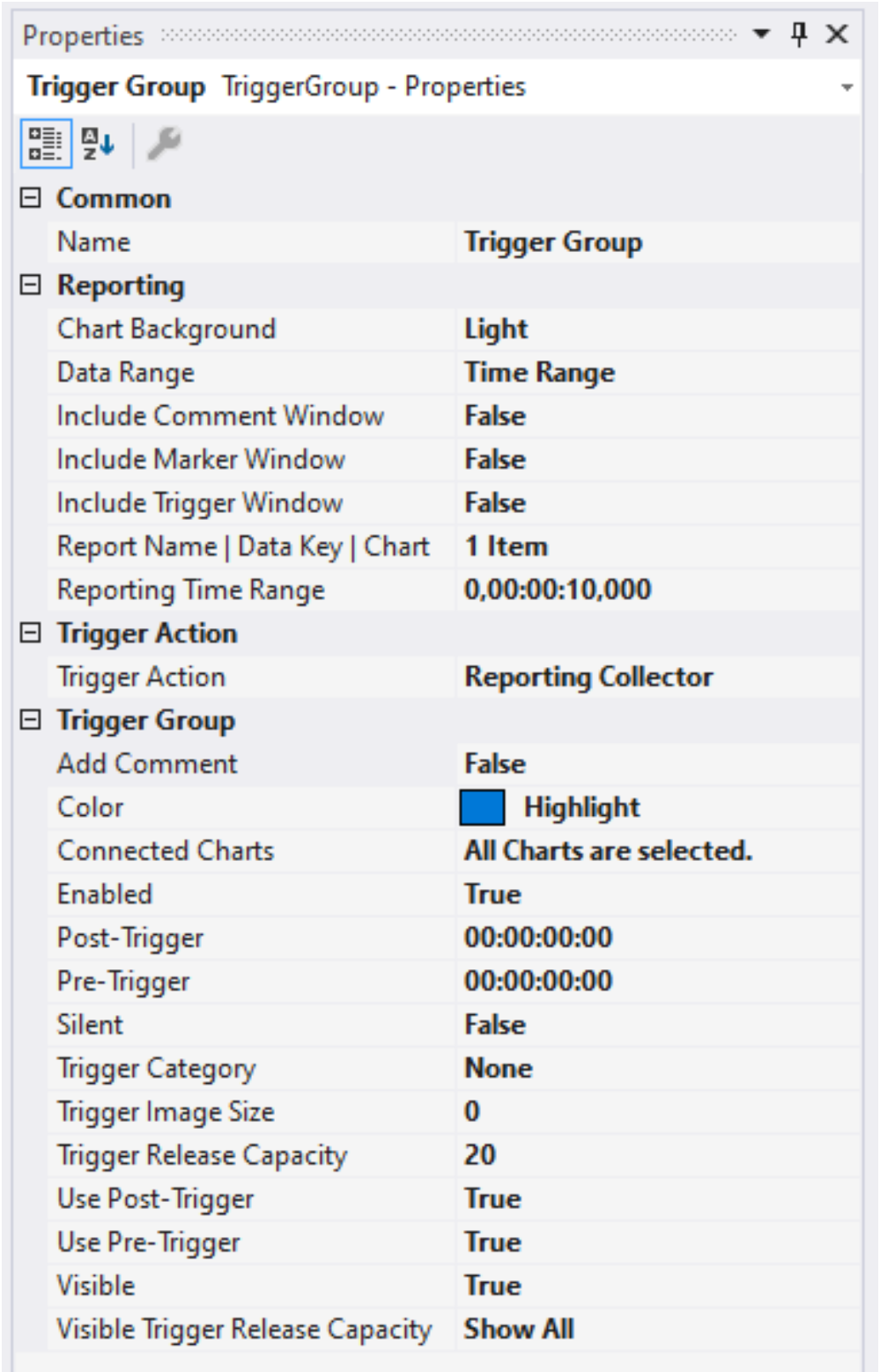
Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder



Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.1.1.10 Reporting Collector

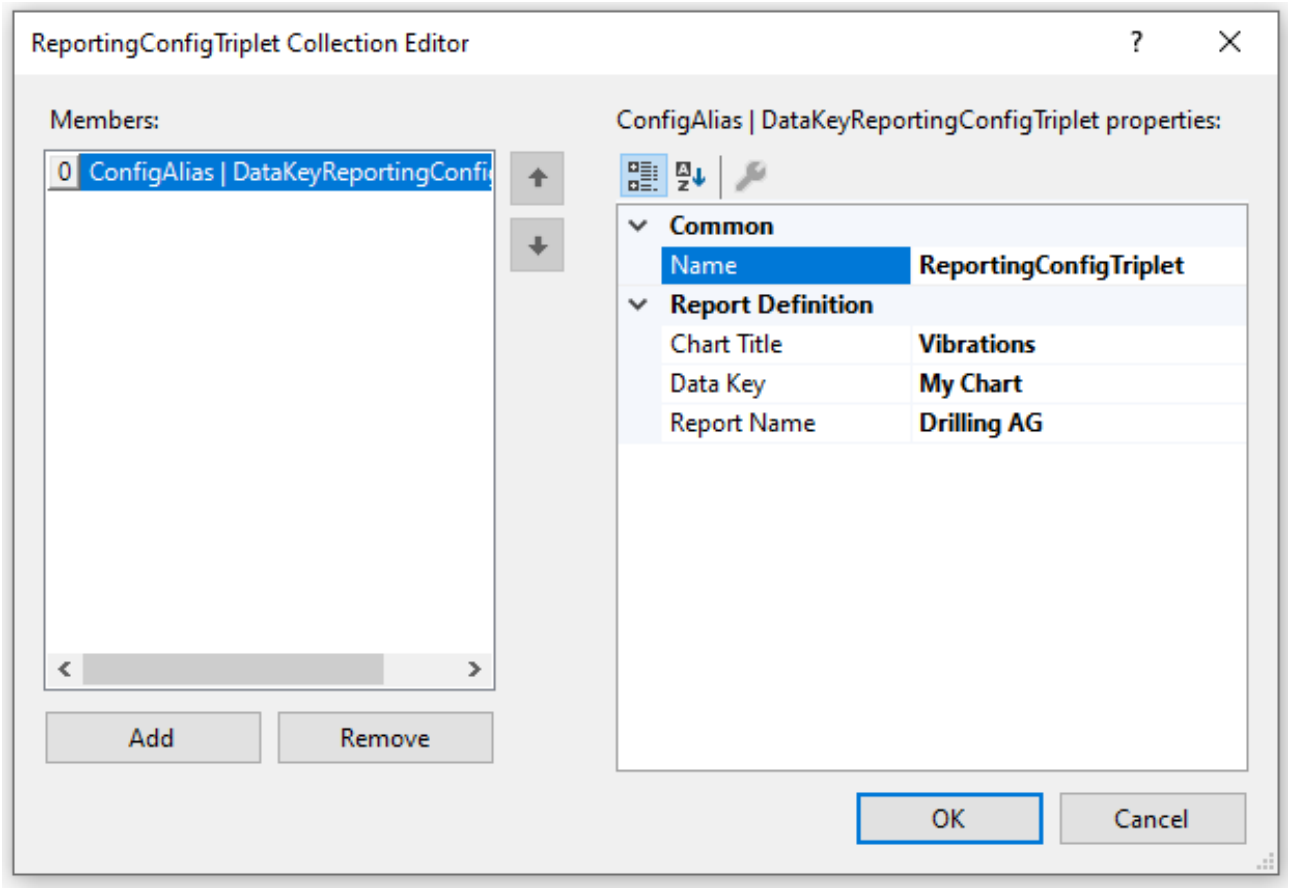


Auto Delete

Auto Delete mode	Here you can set the mode in which the Auto Delete function should run. If set to "Disabled", no files will be deleted. "Capacity“ deletes the oldest file in the folder if more than the number of files specified in "Delete more than" has been saved. If set to "OlderThan", all files older than the time specified in "Delete older than" will be deleted. The option "CapacityOrOlderThan" is a combination of "Capacity" and "OlderThan". That is, files are deleted when the conditions for either option are met.
Delete more than	This option defines when and with how many created files the oldest is to be deleted. The option is only active as long as "Capacity" or "CapacityOrOlderThan" is selected in "Auto Delete".
Delete older than	This option defines the number of seconds after which a file is to be deleted with Auto Delete. The option is only active as long as "OlderThan" or "CapacityOrOlderThan" is selected in "Auto Delete".

Reporting

Chart Background	This option determines which background design is used for the charts in the report.
Data Range	This option defines which period should be displayed in the chart and included in the report. The time period between the last two trigger events can be selected with the option "Since last trigger". "Time Range" can be used to define a free time range.
Include Marker Window	This option determines whether the Marker Window for the corresponding chart should be integrated into the report (Markers [▶ 147]).
Include Trigger Window	This option determines whether the Trigger Window should be integrated into the report (Trigger [▶ 107]).
Include Comment Window	This option determines whether the Comment Window should be integrated into the report.
Report Name | Data Key	This option allows linking a chart to a report. A Reporting Triplet consists of a chart, the unique Data Key and the corresponding Report Name. A lot of Reporting Triplets can be created in the triplet editor (see figure below this table).
Reporting Time Range	This option is only available if Time Range is selected in the Data Range option. This option allows to set a free time range.



Trigger Group

Color	Here you can specify the color for marking the event in the chart.
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created. The charts selected here are automatically selected in the Export Window in the "Export Type" property. If all channels or images are added in the export, only those from the selected charts will be added.
Enabled	The selected trigger group can be switched on and off here.
Post-Trigger	Here you can set a time in the format dd:HH:mm:ss for the recording to continue after the trigger event has occurred.
Pre-Trigger	In the format dd:HH:mm:ss the minimum time that must elapse before the trigger event can be set.
Silent	If you set Silent to TRUE, no more trigger messages will be displayed in the engineering message window.
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area.
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously.
Use Post-Trigger	If TRUE, the time set under post-trigger is taken into account.
Use Pre-Trigger	If TRUE, the time set under pre-trigger is taken into account.
Visible	Here you can set whether the event should also be visibly marked in the data stream.
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity".

Trigger Category

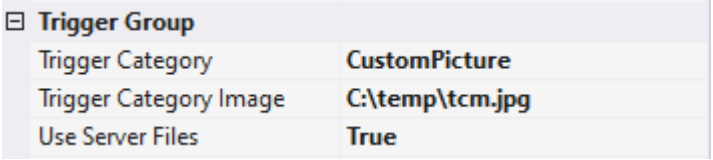
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



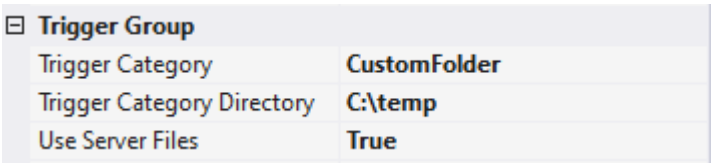
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



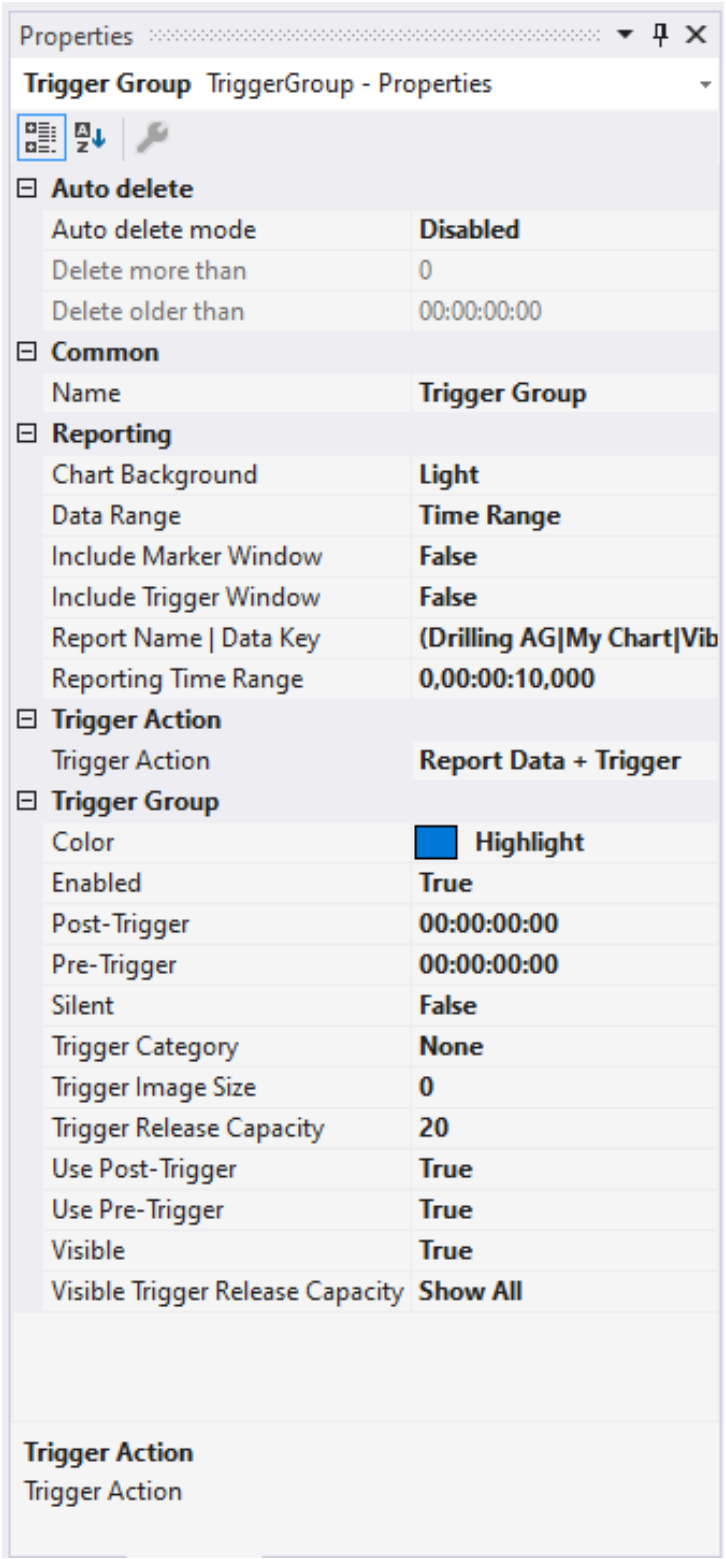
Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder



Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.1.1.11 Reporting Collector + Trigger

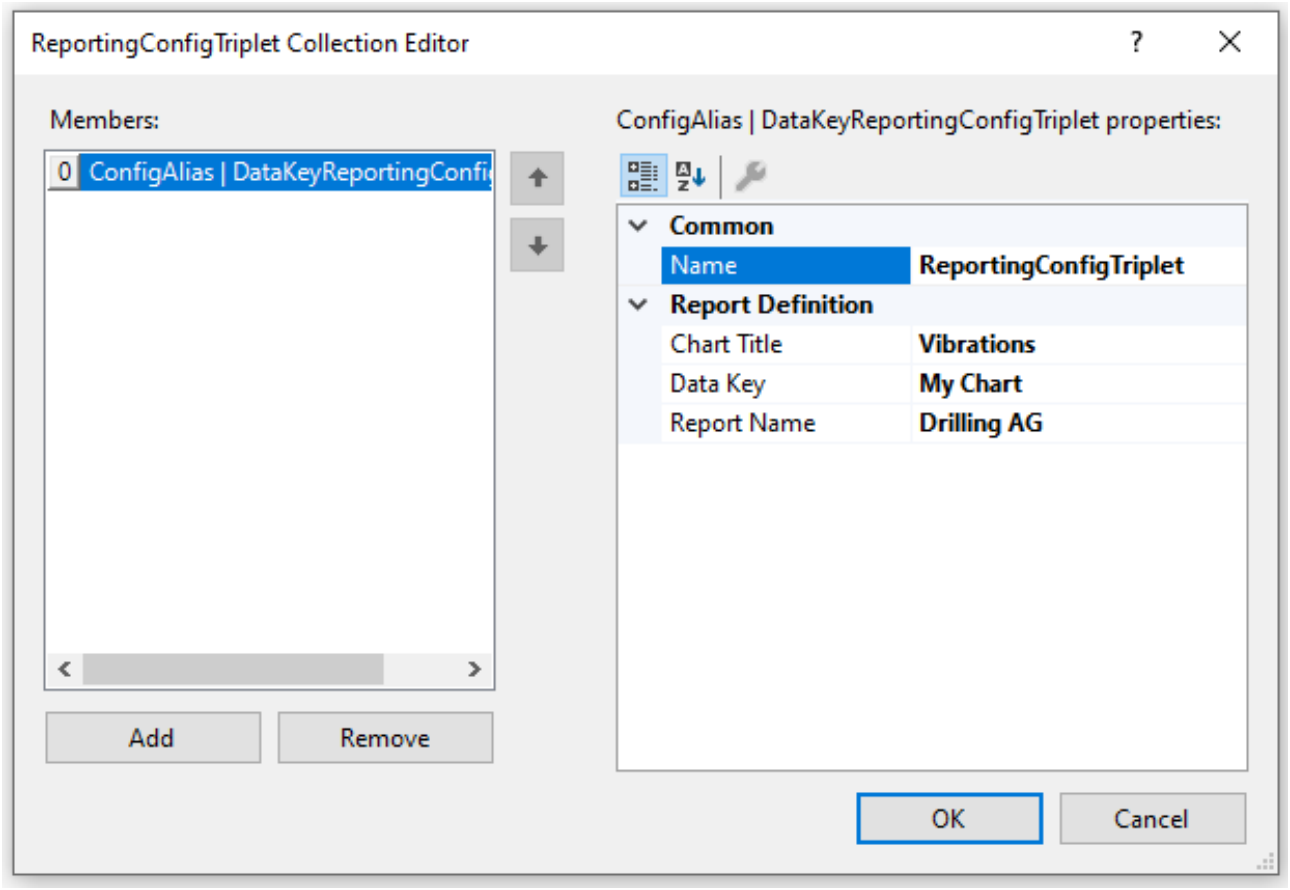


Auto Delete

Auto Delete mode	Here you can set the mode in which the Auto Delete function should run. If set to "Disabled", no files will be deleted. "Capacity“ deletes the oldest file in the folder if more than the number of files specified in "Delete more than" has been saved. If set to "OlderThan", all files older than the time specified in "Delete older than" will be deleted. The option "CapacityOrOlderThan" is a combination of "Capacity" and "OlderThan". That is, files are deleted when the conditions for either option are met.
Delete more than	This option defines when and with how many created files the oldest is to be deleted. The option is only active as long as "Capacity" or "CapacityOrOlderThan" is selected in "Auto Delete".
Delete older than	This option defines the number of seconds after which a file is to be deleted with Auto Delete. The option is only active as long as "OlderThan" or "CapacityOrOlderThan" is selected in "Auto Delete".

Reporting

Chart Background	This option determines which background design is used for the charts in the report.
Data Range	This option defines which period should be displayed in the chart and included in the report. The time period between the last two trigger events can be selected with the option "Since last trigger". "Time Range" can be used to define a free time range.
Include Marker Window	This option determines whether the Marker Window for the corresponding chart should be integrated into the report (Markers [▶ 147]).
Include Trigger Window	This option determines whether the Trigger Window should be integrated into the report (Trigger [▶ 107]).
Include Comment Window	This option determines whether the Comment Window should be integrated into the report.
Report Name | Data Key	This option allows linking a chart to a report. A Reporting Triplet consists of a chart, the unique Data Key and the corresponding Report Name. A lot of Reporting Triplets can be created in the triplet editor (see figure below this table).
Reporting Time Range	This option is only available if Time Range is selected in the Data Range option. This option allows to set a free time range.



Trigger Group

Color	Here you can specify the color for marking the event in the chart.
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created. The charts selected here are automatically selected in the Export Window in the "Export Type" property. If all channels or images are added in the export, only those from the selected charts will be added.
Enabled	The selected trigger group can be switched on and off here.
Post-Trigger	Here you can set a time in the format dd:HH:mm:ss for the recording to continue after the trigger event has occurred.
Pre-Trigger	In the format dd:HH:mm:ss the minimum time that must elapse before the trigger event can be set.
Silent	If you set Silent to TRUE, no more trigger messages will be displayed in the engineering message window.
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area.
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously.
Use Post-Trigger	If TRUE, the time set under post-trigger is taken into account.
Use Pre-Trigger	If TRUE, the time set under pre-trigger is taken into account.
Visible	Here you can set whether the event should also be visibly marked in the data stream.
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity".

Trigger Category

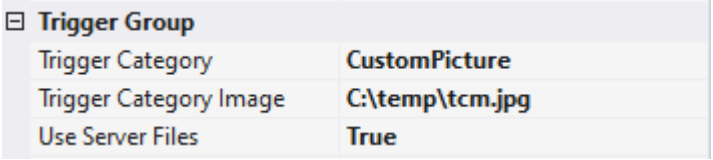
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



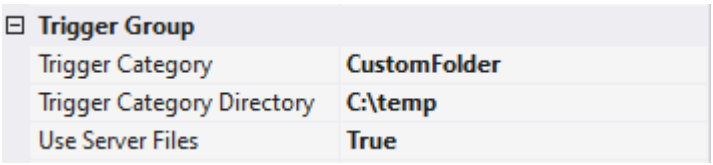
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder



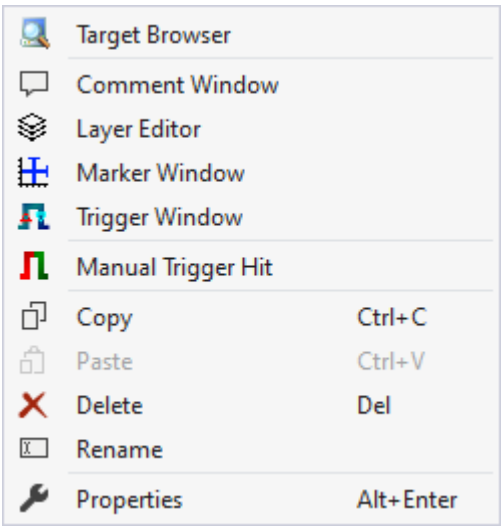
Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.1.4.2 Trigger Set

Trigger sets can start the trigger actions selected in the trigger groups. A basic distinction is made between two types of trigger sets.

Channel Trigger Sets [▶ 144] for variables from the scope configuration and Directory Trigger Sets [▶ 145] for file operations in file folders on the hard disk.

Context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 108] and finally the Trigger Window [▶ 108].

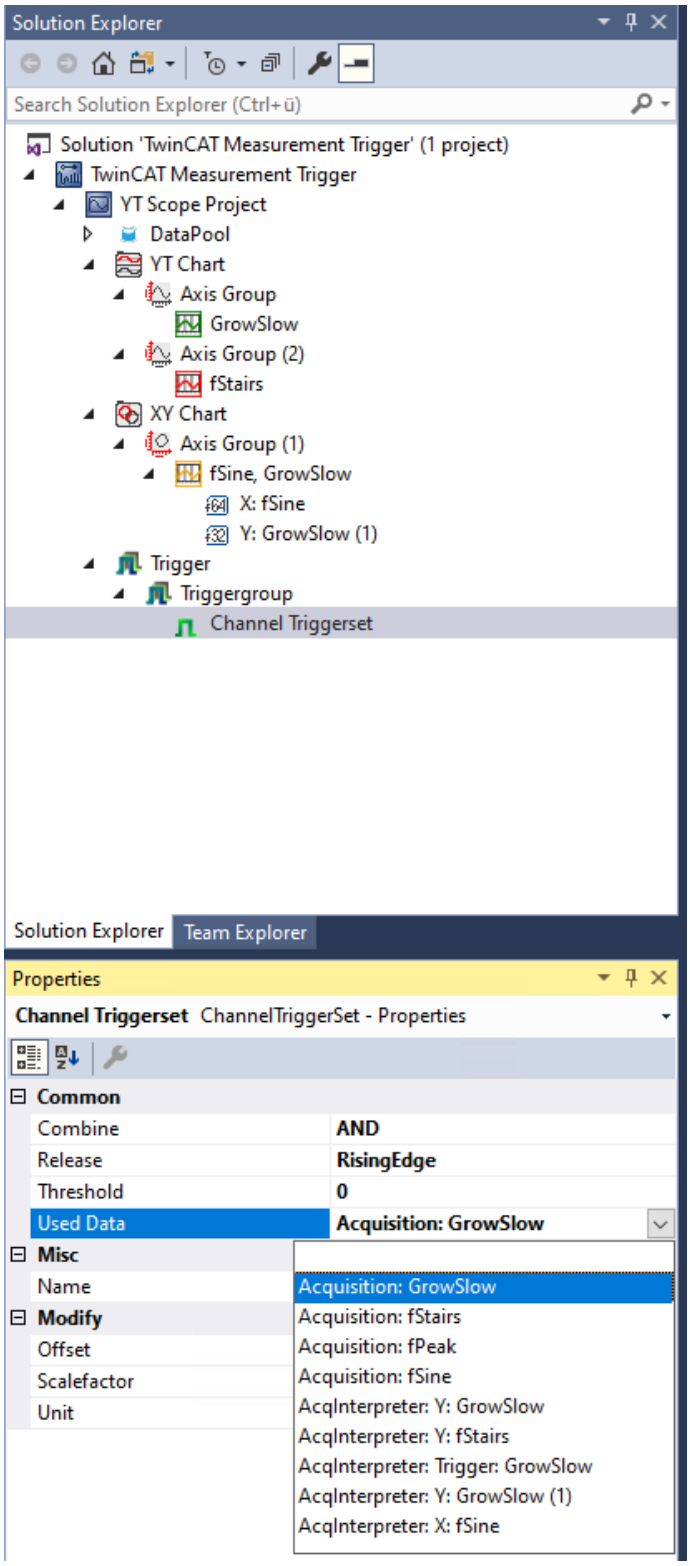
"Manual Trigger Hit"
This function can be used to test a trigger.

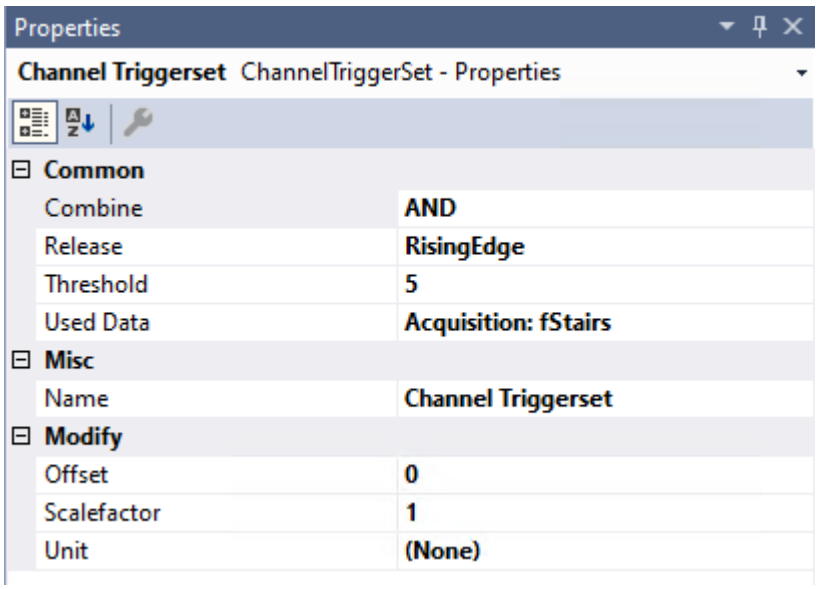
Various standard functionalities can be found in the last two groups.

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

5.1.4.2.1 Channel Trigger Set

Channel trigger sets refer to the actual variable from the scope configuration that can lead to the start of the trigger group based on a condition occurring. A trigger set can be regarded as a stand-alone trigger condition. Within a trigger group, trigger sets can also be linked to each other via logical operators. For variable selection, raw acquisitions from the data pool and interpreted variables from the channels are available. If raw acquisition is selected, it is possible to specify offset, scale factor and physical unit in the trigger set. For an interpreted acquisition, the data is taken from the selected channel.





Common

Combine	By selecting a logic operation these individual conditions can be placed in relation to one another. Note here that AND operations are handled before OR operations.
Release	The release condition can be defined as follows: Rising Edge: Rising edge through x Falling Edge: Falling edge through x OnChangeEnds: End of a change
Threshold	The numerical limit value that must be crossed
Used Data	The interpreted acquisition or raw acquisition from the data pool (when an acquisition is selected, a new interpreter is created under the channel trigger set)

Misc

Name	Each trigger set can have its own name

Modify

Offset	Offset for a raw acquisition
ScaleFactor	Scale factor for a raw acquisition
Unit	Physical unit for a raw acquisition

When a Trigger Set is triggered, the icon in the Solution Explorer changes from to . All trigger sets remain set until the entire trigger group has been triggered.

5.1.4.2.2 Directory Trigger Set

Directory Trigger Set

A directory trigger set monitors a directory. If an image is added to this folder or optionally also to the subfolders, this image is displayed above a trigger marking. The image is displayed in a kind of preview directly above the marker. Clicking on this preview displays a larger version of the image. The position of the trigger info is based on the name of the file. The name must be formatted in TwinCAT in order to be displayed correctly.

There are three possibilities to format file names:

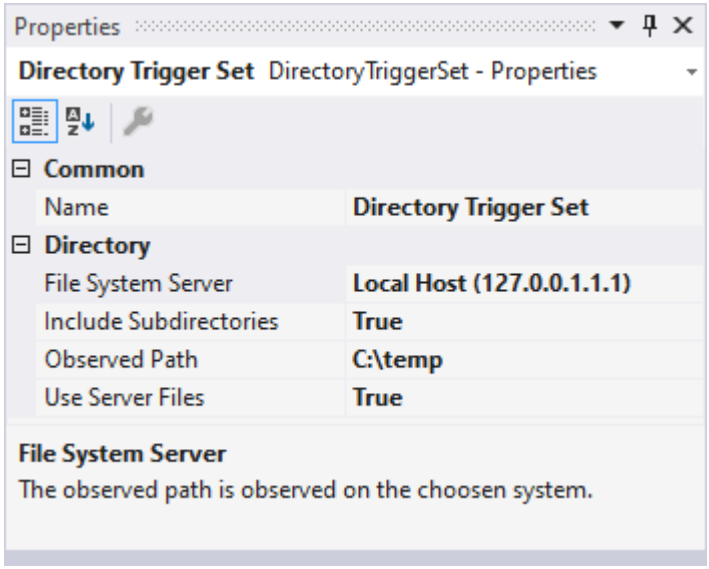
"TC_" plus a timestamp in Windows file time format (example: TC_131835504293051402)

"PLC_" plus a timestamp in PLC format (example: PLC_1539076850)

"DC_" plus a timestamp in DC format (example: DC_592392059744685800)

It is also possible to drag images with a suitably formatted name onto a chart and to display them as triggers. This is possible during recording, after a recording has been stopped (data in RAM) and with a recording loaded as .svdx.

Supported file formats include: png, bmp, jpg, jpeg, tif, tiff and gif.



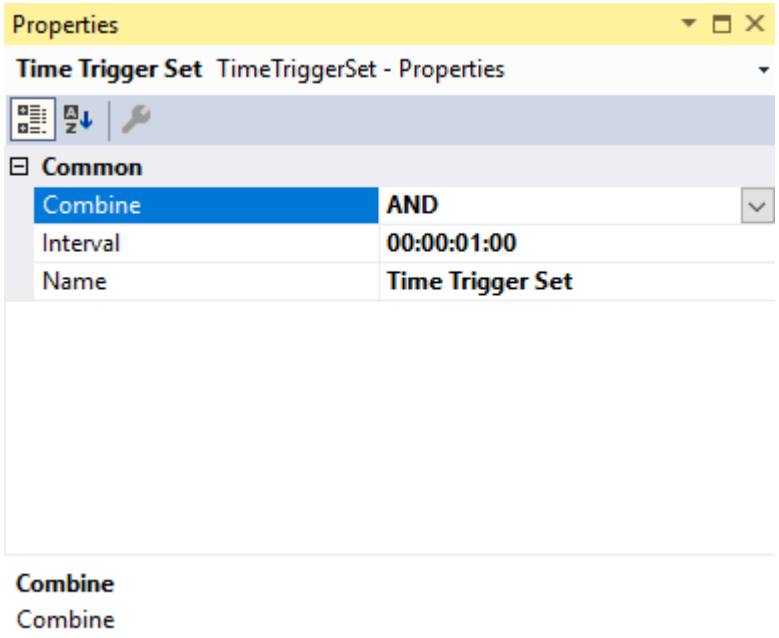
The directory trigger set offers the following setting options:

Directory

File System Server	Server system on which the specified folder is located. All systems can be selected on which the server is also used.
Include Subdirectories	If this option is enabled, subfolders of the "Observed Path" are also monitored for new images.
Observed Path	Path to a folder that should be monitored.
Use Server Files	Activate the function to search for images not only on the local system but also on the connected Scope Server systems.

5.1.4.2.3 Time Trigger Set

Time Trigger Sets refer to the time axis of the recording. Time Trigger Sets trigger automatically after the preset interval has elapsed and can thus be used for automatic Export [▶ 129] or Subsave [▶ 119]. The trigger action "Start Record [▶ 115]" cannot be combined with a Time Trigger Set.



Combine	By selecting a logic operation these individual conditions can be placed in relation to one another. Note here that AND operations are handled before OR operations.
Interval	Time interval after which the Trigger Set is triggered.
Name	Each Trigger Set can have its own name.

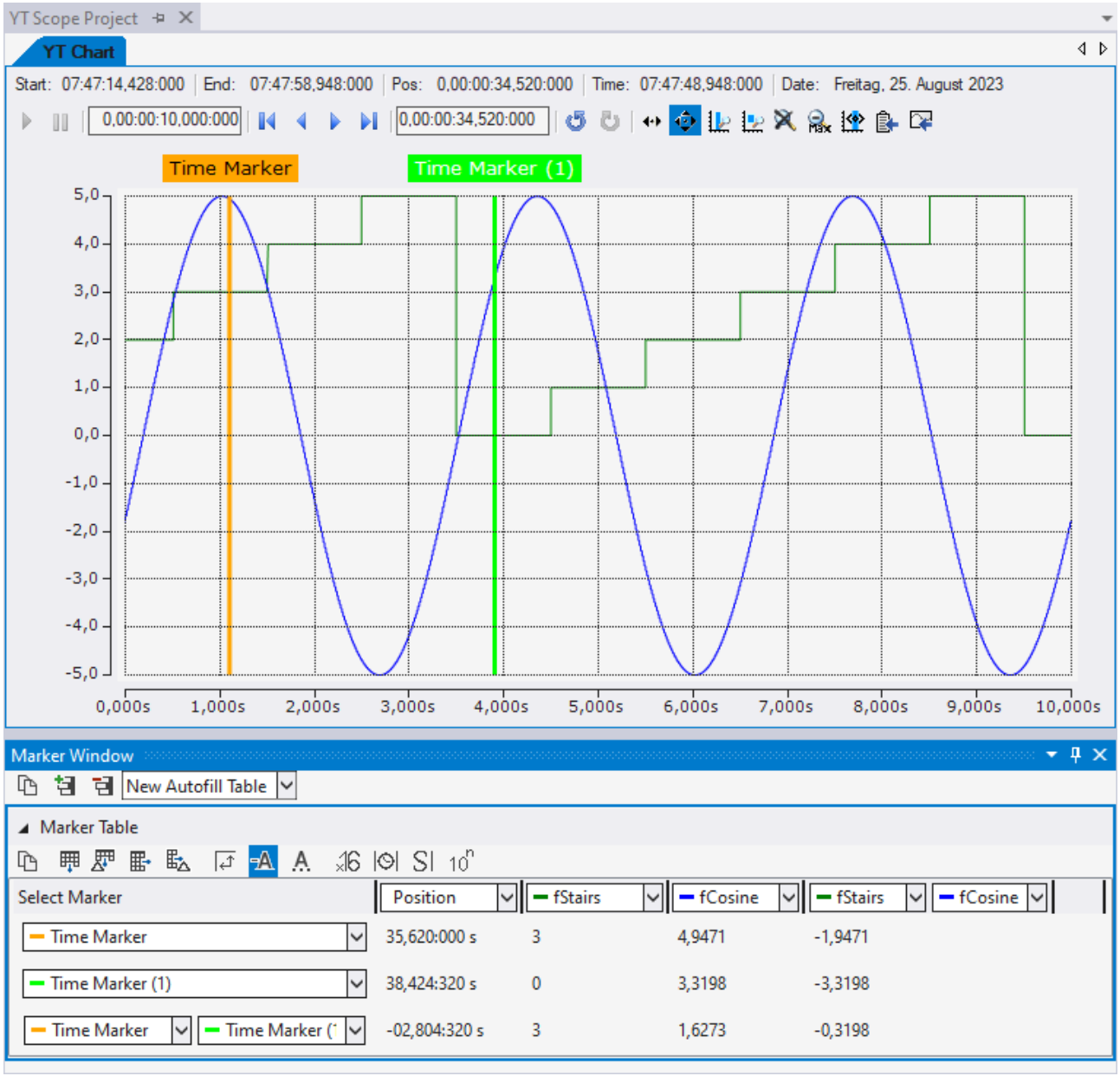
5.1.5 Markers

A marker is a chart element that can be docked to an axis. The marker consists of a line that can be found in the chart and a text field that appears alongside the chart and displays the name of the marker.

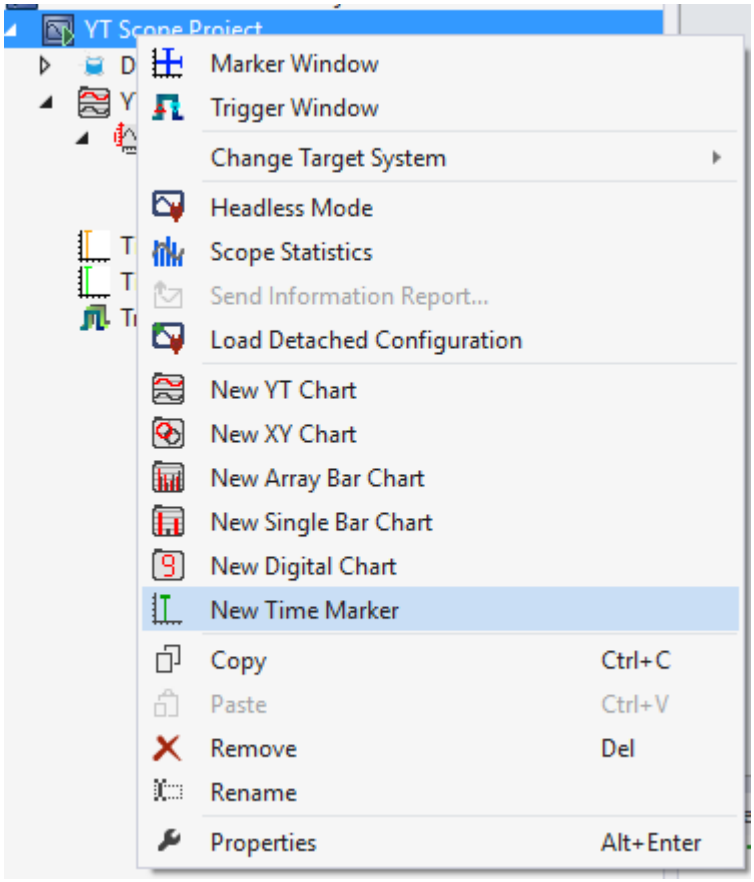
On clicking on the marker, a tooltip appears that displays the position next to the name.

If the marker was added to a time axis (YT chart) or an index axis (array bar chart and single bar chart), the values of the channel appear in the tooltip.

The values of the different markers can be viewed in the marker window and compared with other markers.

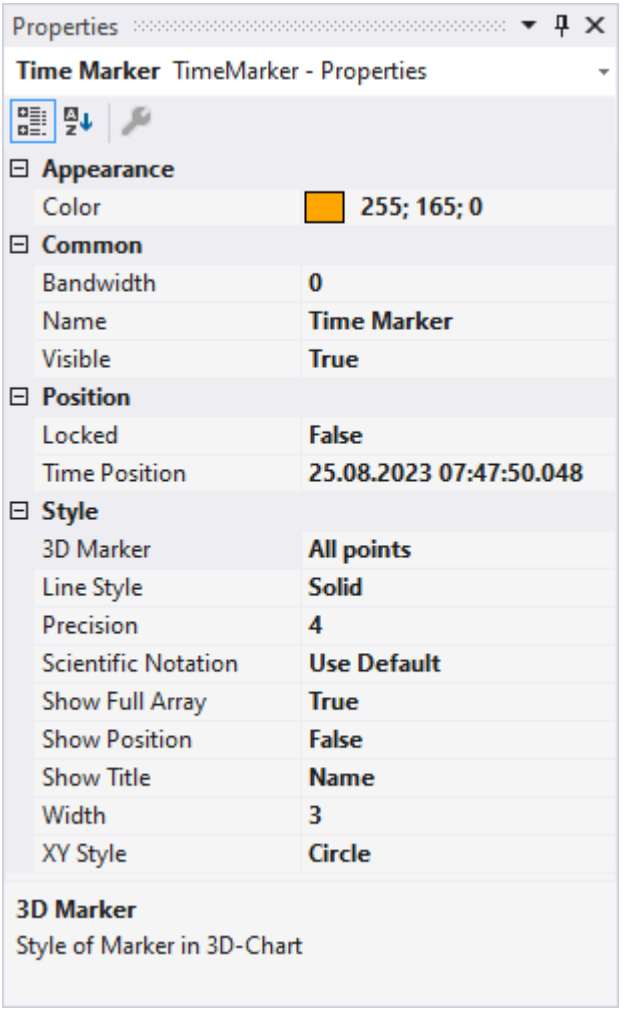


A marker is added via the context menu of a project, a chart or an axis group.



Furthermore, a marker can also be created on a data point via the context menu in the chart.

All the properties of a marker are explained here.



Appearance

Color	Color of a marker.

Common

Bandwidth	Width of the rectangle behind a marker. Specification indicates the width from the marker to the edge of the rectangle. The value of the specification is identical to the input of the position.
Name	The name of the marker is the same as that displayed in the project tree and, depending on the "Show Title" setting, this value can also be displayed in the text field above the chart.
Visible	Setting whether the marker should currently be visible or invisible.

Position

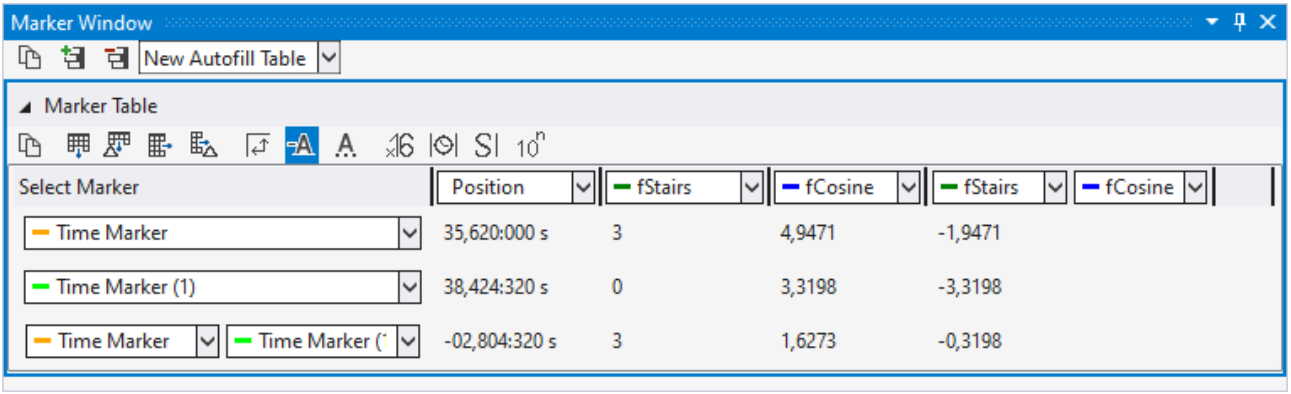
Bind Axisvalue (only for time markers under a chart or axis group)	If this value is set to 'false', a percentage value can be entered in the "Position" setting. This means that the marker is always displayed in the current chart and the time can be calculated as follows: chart position + display width * marker position If the marker is to have a fixed time, this value must be set to 'true'. An absolute timestamp can then be set for the position.
Locked	If Locked is set to false the marker can be moved freely within the chart with the mouse.
Position	Position of a cursor. The absolute value of the axis is entered here for value and index axes and the percentage value or absolute timestamp for time axes.

Style

3D Marker (only for markers below the project or a 3D chart)	The display of a marker within a 3D chart is made up of 5 components, which can be freely combined with each other: • Highlight data point - the marker draws a dot around the data points that belong to the current point in time • Show grid point - points are drawn on the axis surfaces • Show axis point - a marker is added to the value axes • Show line on grid - a line is drawn between the points on the axis and on the axis surface • Show line to grid - a line is drawn between the points in the channel and on the axis surface
Line Style	This setting can be used to set the line type of the marker.
Precision	Precision of the display values.
Scientific Notation	Specifies whether the value is displayed in scientific notation in the tooltip and Marker window. • True - the scientific notation is used • False - the scientific notation is not used • Use Default - the current setting of the default settings is applied
Show Full Array (only for time markers)	Specifies whether all values of an array or only a specific value is displayed in the tooltip and Marker window. If only a specific value is to be specified, a position can be specified in addition to the time position.
Show Position	If this is selected, the position is also displayed in the marker label.
Show Title	This setting can be used to configure which text is displayed above the chart in the marker. • Hide – no text is displayed • Name – the name of the marker is displayed (the same as in the project tree) • Custom – the text from the 'Title' setting is displayed
Title	Specifies the text that can be displayed in the marker.
Width	Specifies the width of the marker line in pixels.
XY Style (only for markers below the project or an XY chart)	The display of a marker within an XY chart can be configured in different ways: • Circle - the data points that belong to the selected point in time are outlined • Cross - the data points that belong to the selected point in time are marked with a cross • Marker - a line is drawn between the axis and the data point • Fill - the circle or cross can be filled and/or left blank in the center to avoid overdrawing the data point

Marker Window

In the Marker Window, channel values from the times of markers or trigger events (timers) can be output and compared with other timer values. A Marker Window always refers to the project selected in the Solution Explorer.



The Marker Window consists of a menu bar and an arbitrary number of tables. The tables can be freely created and also deleted again.

The menu bar at the top edge of the Marker Window contains the following buttons:

- Copy: Copies all values from the Marker Window to the clipboard so that they can be pasted into another program.
- Add table: Adds a new table.
- Delete table: Deletes the selected table.
- At the side of the buttons there is also a selection box in which all charts existing in the configuration are listed. If a chart is selected there, an automatic table is created containing all markers and channels that refer to the chart.

All tables are pictured below one another under the menu bar. The values of the various channels at the different times of the timers are displayed in a table.

There are two different options for the rows and columns.

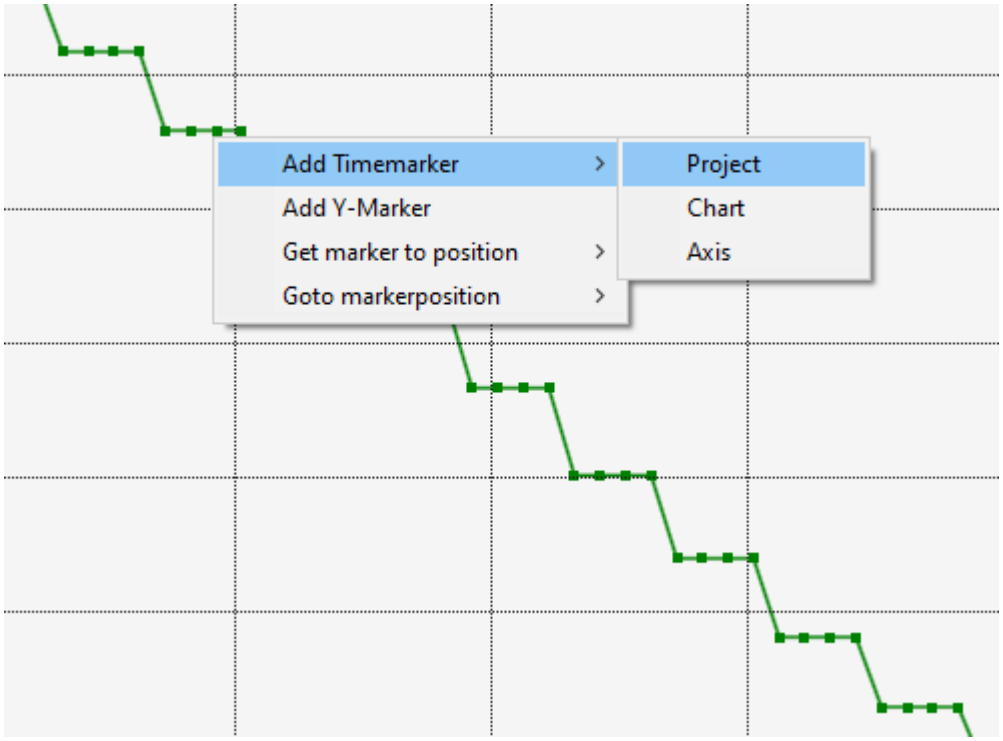
- Option 1: Select one timer / channel; in this case only the value of one time/one channel is output.
- Option 2: Select two timers/channels; in this case the difference between the values is calculated.
  If two timers and two channels are selected, the difference is calculated between the 1st channel and the 1st time (position) and between the 2nd channel and the 2nd time (position).

The following buttons are available for the configuration of the table:

- Copy: Copies the values from the table.
- Add row: Adds a row with a single selection option.
- Add difference row: Adds a row with a double selection option for a difference.
- Add column: Adds a column with a single selection option.
- Add difference column: Adds a column with a double selection option for a difference.
- Rotate orientation: The orientation setting button lets you define whether the timers or channels are in columns or in rows.
- Colored marking: In order to be able to assign markers and channels not only on the basis of the names, small lines can be displayed in front of the name, which have the same color as the associated elements.
- Colored numbers: The data can be drawn in the table in the same colors as the color of the associated timer.
- Hex notation: The values are displayed using hexadecimal notation.
- Absolute time: The time is displayed as an absolute time.
- Unit: The units of the channels are also displayed in the table.
- Scientific Notation: If the Scientific Notation is set to 'default' for the markers, this setting can be used to overwrite the value for the display in the Marker window.

If the 'Components Highlight' setting is active in the options [▶ 311], the associated channels and markers can be highlighted in the diagram by clicking on a cell. If the value is set to 'Enabled', simply selecting the cell is sufficient. If the option is set to 'DoubleClick', a cell must be selected by double-clicking on it.

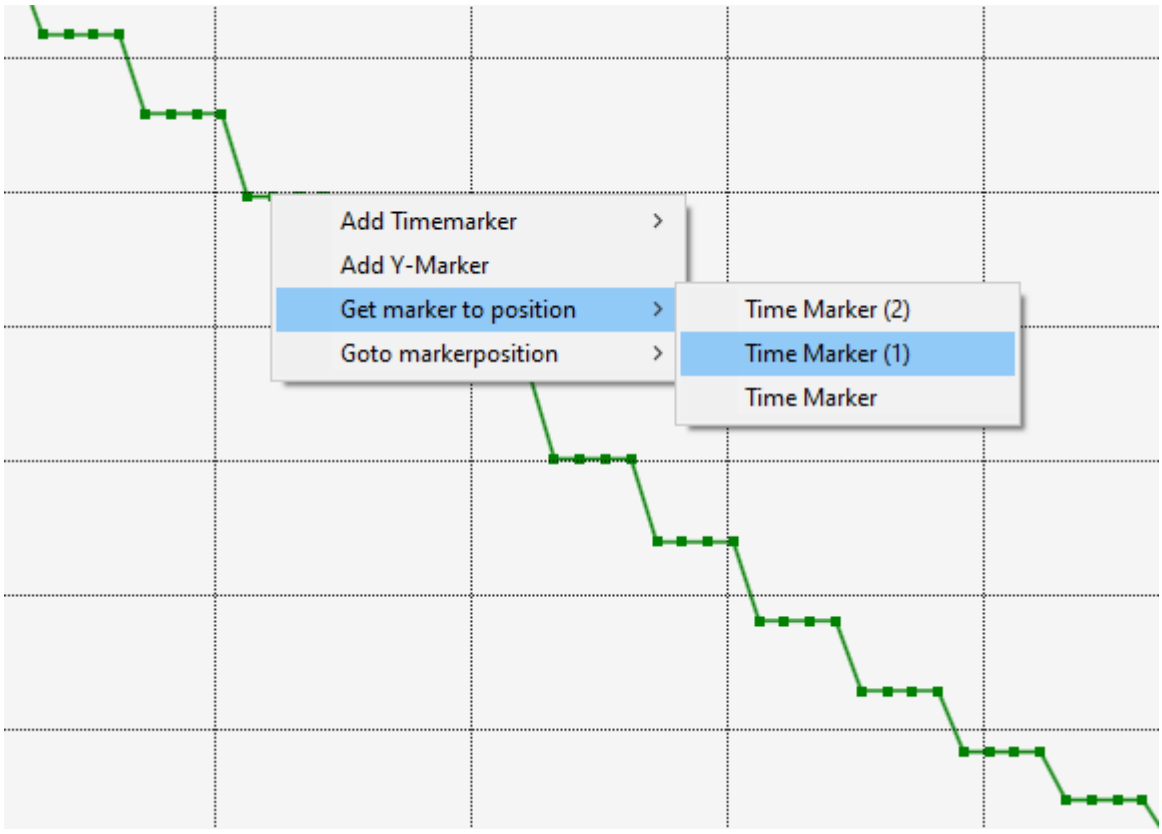
The context menu of a data point in the chart can be used to create new markers, move markers or jump to the marker with the chart.



For the different markers there are different entries in the context menu for adding the markers.

First, a time marker can be added at the location of the clicked data point using **Add Timemarker**. Since time markers can be added under the project, chart and axis, this can also be selected at this point in the submenu.

The screenshot shows a YT chart. Therefore, time markers and Y-markers can be added there. The Y marker is added in the axis group where the channel is. This is comparable for charts that offer an X marker. Index markers can also be created and added.

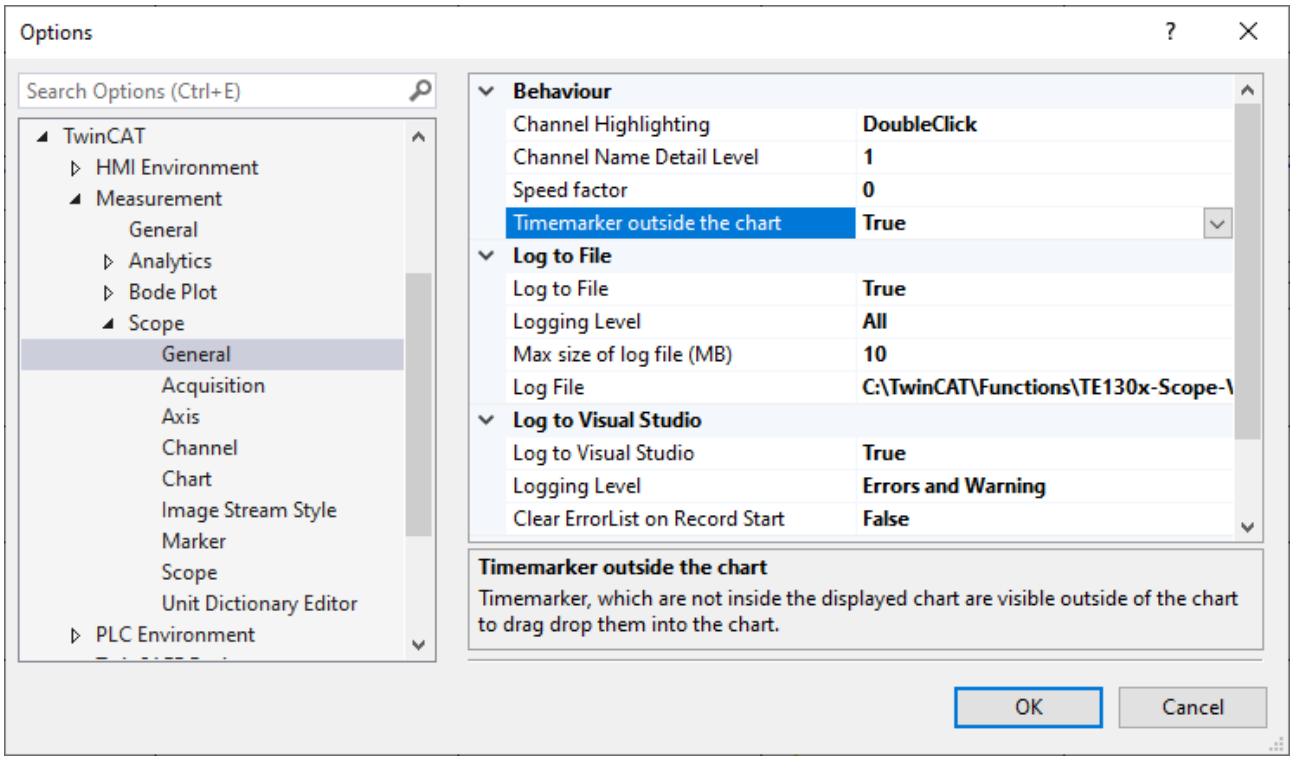


The menu entry **Get marker to position** can be used to move a marker that already exists in the project to the position of the data point. Here you can select all markers that are related to the selected channel. Thus, for example, markers from other charts fall out. The selectable markers must not be curly.

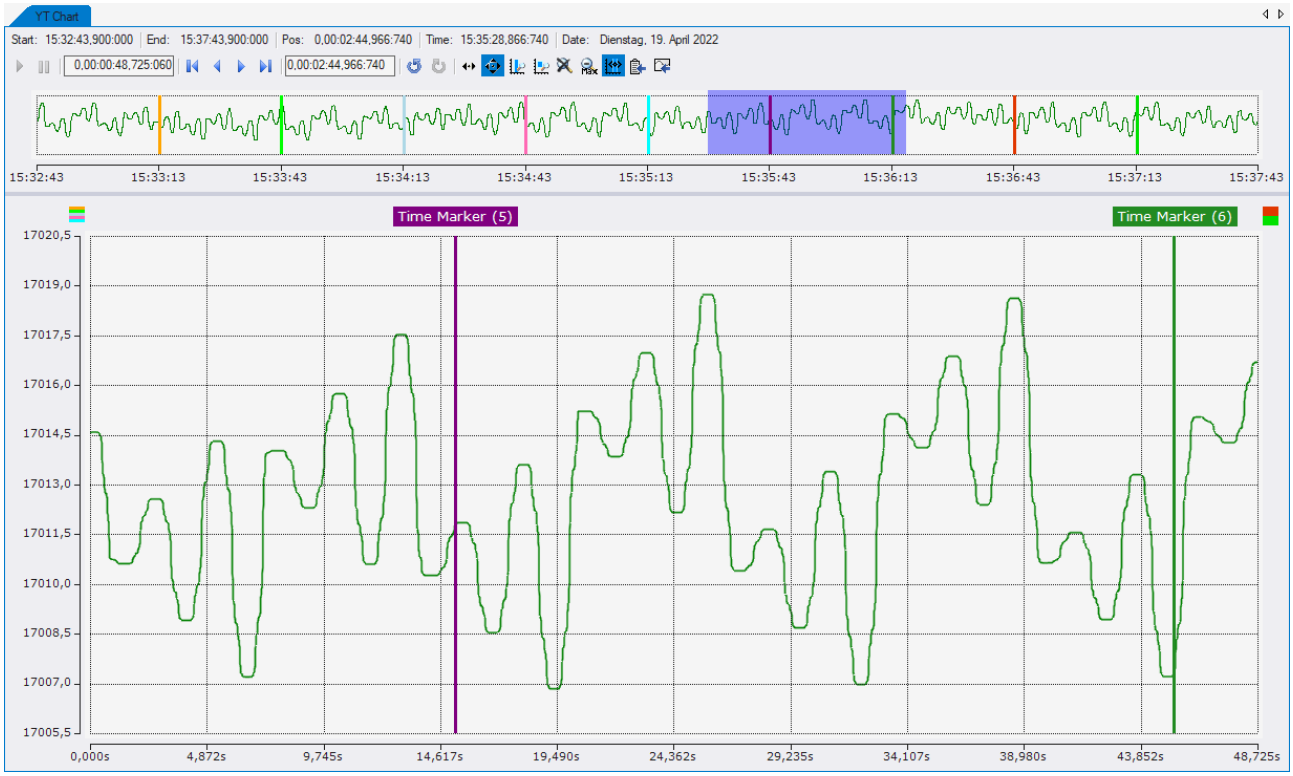


By selecting a marker in the submenu of the entry **Goto markerposition** the chart can be moved to the selected marker. Again, only the markers that are related to the selected channel are displayed.

If time markers are outside the currently visible time range, they are not visible. With the setting **Timemarker outside the chart** the markers can still be displayed.



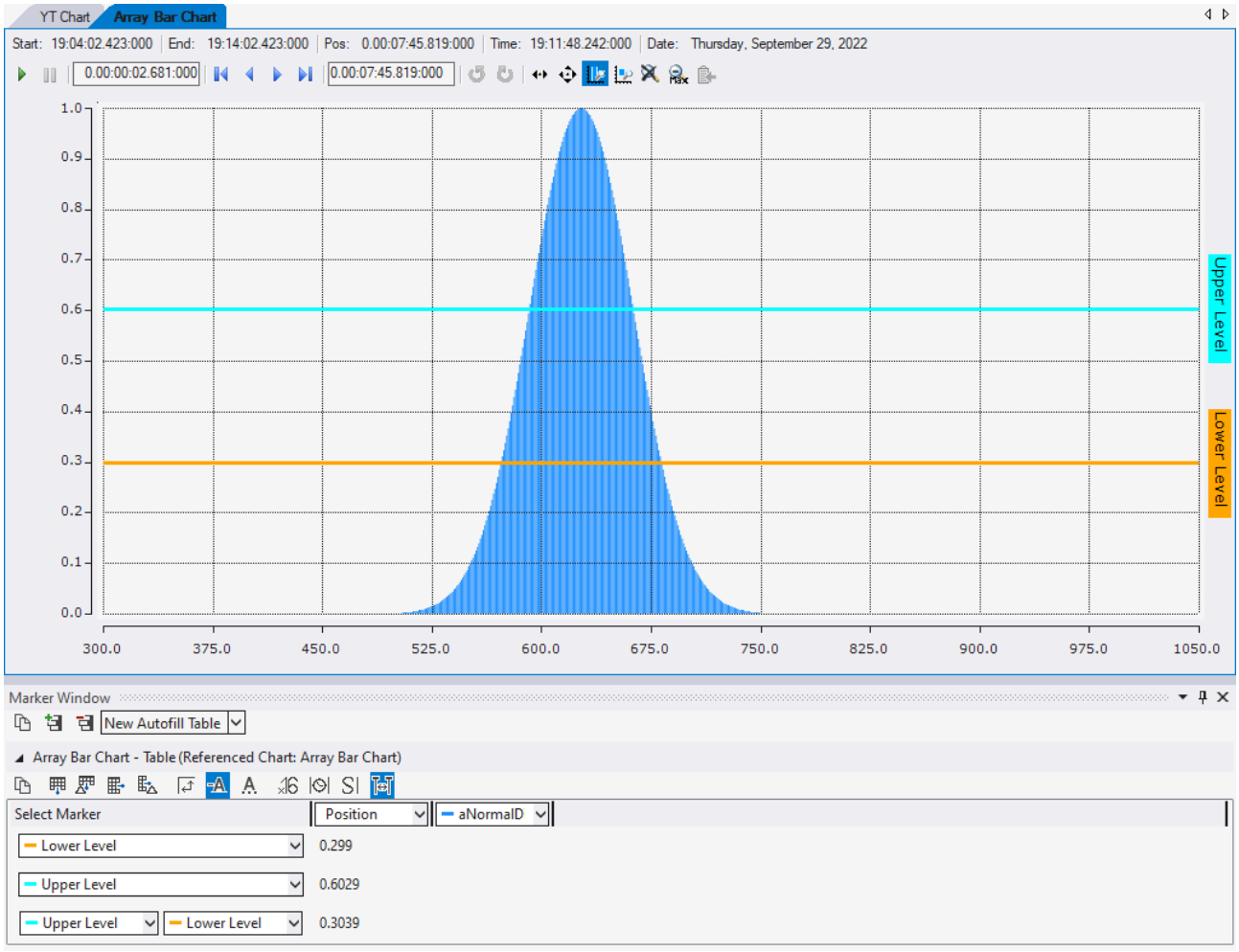
If the setting is set to **True**, the markers that lie outside the time range are displayed to the right and left of the data.



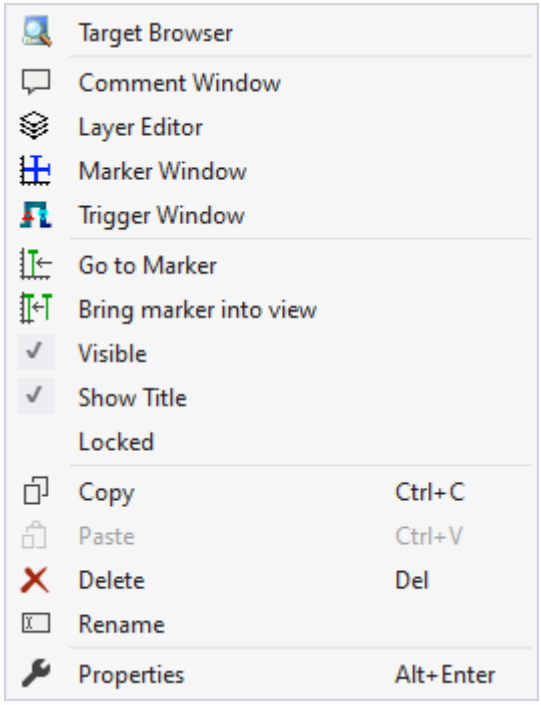
In the screenshot you can see the case where five markers are in front of the current chart position and two markers are behind the visible area. The five earlier markers are now displayed at the top left, above the Y-axis, and the two later markers are displayed at the top right. If the markers are not locked, the marker can be dragged and dropped from there to the current time range.
With a click on the markers, which are outside of the chart, you can jump to the current marker position.

Special marker functions for Array Bar Charts

In Array Bar Charts, Y-axis markers can be created in addition to X-axis markers. These can be added via the axis node in the Array Bar Chart through the context menu in the Solution Explorer. Most of the same functions and features are available as for the other markers. Clicking on the Y marker in the chart or in the Solution Explorer shows the corresponding properties in the Properties window.



Context menu



The first two groups contain the functionalities for opening various Windows tools. These include firstly the Target Browser [▶ 166], the Comment Window, the Layer Editor [▶ 211], the Marker Window [▶ 151] and finally the Trigger Window [▶ 108].

Properties of the marker can be edited in the third group.

"Go to Marker"
If the marker is a time marker, the time position of a chart can be moved to the marker using this menu entry. If this function is applied to a project marker, all charts at that point in time are moved.

"Bring marker into view"
This function can be used to move markers into the visible area of a chart by resetting the time position. The marker is positioned in the center of the currently visible area. This only works with time markers that are connected to an axis. Depending on their position in the project hierarchy, there is a case distinction in the menu entries:

- The marker is below a chart or below an axis:
  This function gives the marker a new position based on the position of the chart above it.
- The marker is below the project:
  If the marker is below the project, a chart in which the marker is to be positioned must be selected in a submenu for this function.

"Visible"
If this entry is active, the tick is visible on the left and the marker is displayed in the chart. If the entry is deactivated, the marker is not displayed in the chart.

"Show Title"
If the entry is active, a text field is displayed outside the chart in which the name of the marker is displayed.

"Locked"
This entry can be activated so that the marker cannot be moved freely with the mouse in the chart. The marker is then still displayed in the chart, but cannot be moved with the mouse.

Various standard functionalities can be found in the last two groups.

The selected node can be copied ("Copy"), removed ("Remove"), renamed ("Rename") or inserted below it ("Paste"). The Visual Studio properties window can also be opened for further parameterization ("Properties").

5.1.6 Dynamic Style

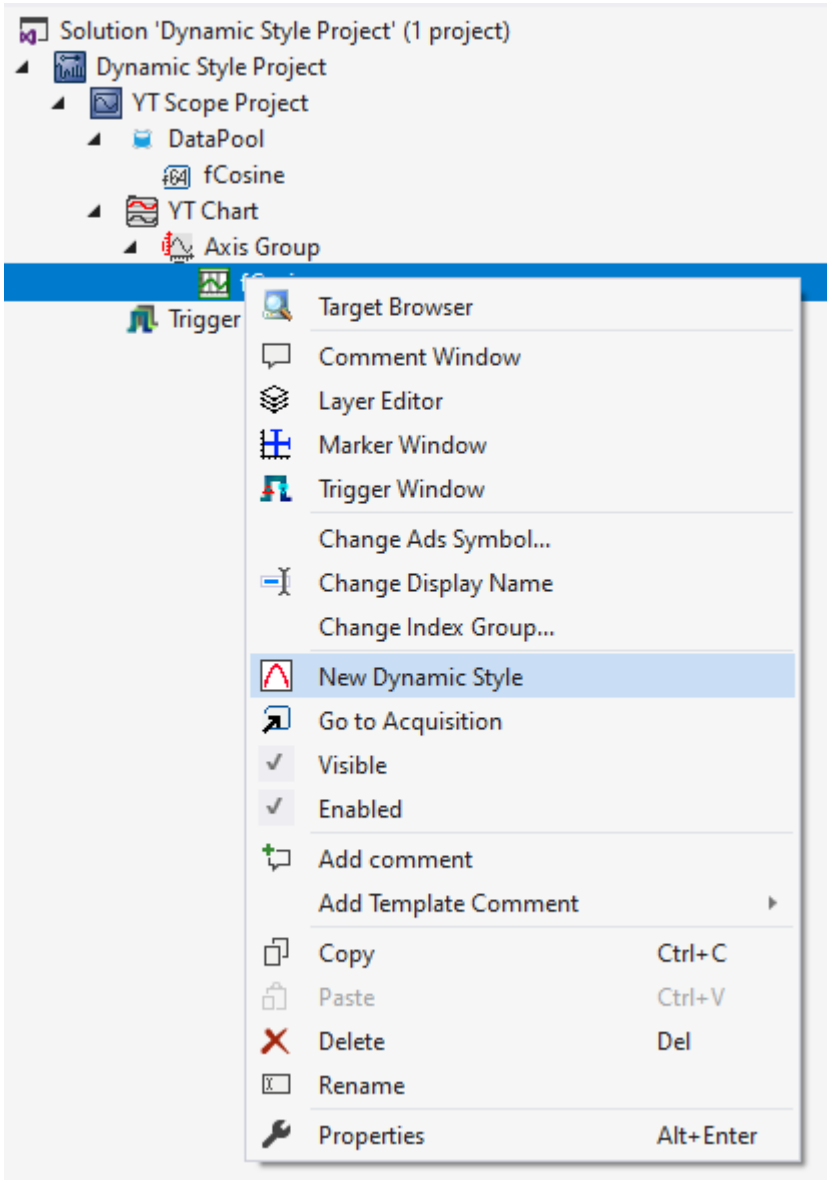
With the aid of Dynamic Styles the appearance of a channel can be adapted section-wise using an additional data series. Hence sections of the graph can be displayed in a different color, dashed, invisible or thicker.

Restrictions with GDI+

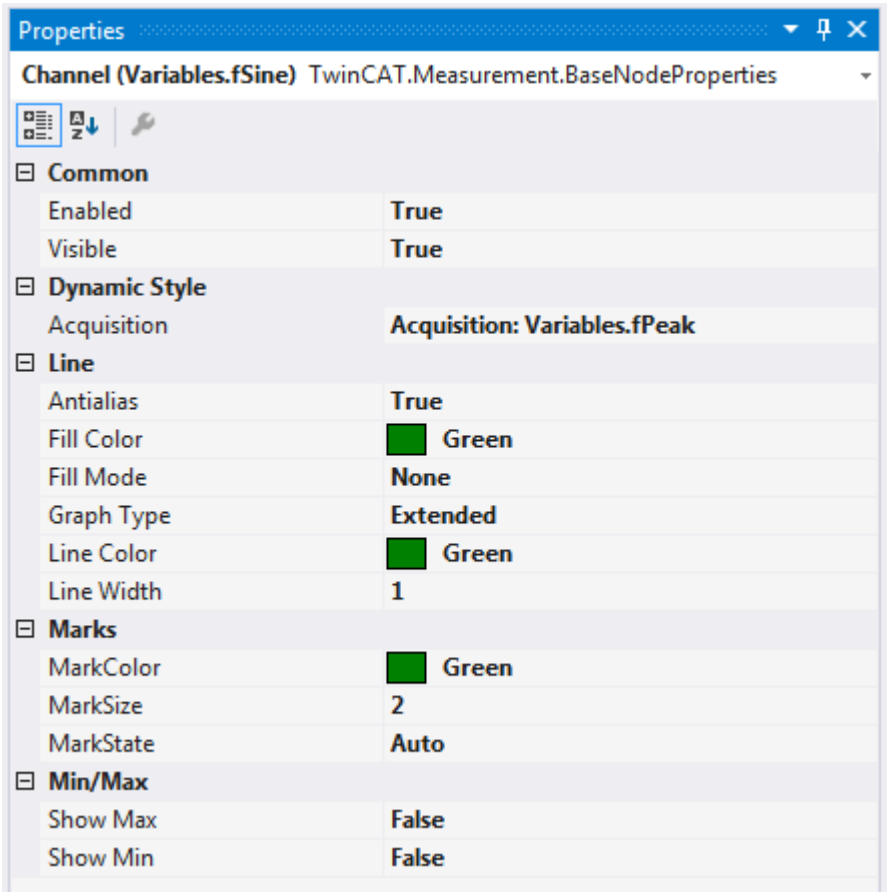
There is a restriction that no color change and no dashed lines can be implemented as a Dynamic Style with the GDI+ graphics library. If these two style switches do not work for you, please check the graphic settings in the Scope > Graphic Library menu

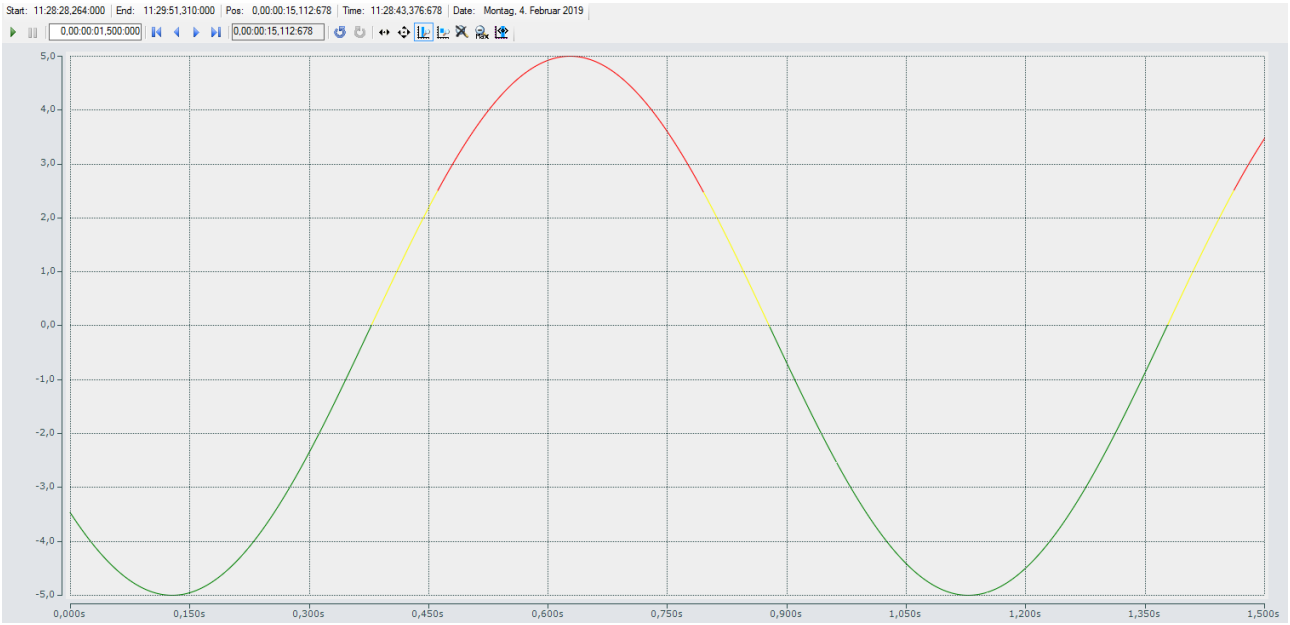
Any number of Dynamic Styles can be appended to a graph. Each Dynamic Style makes a change to a property of the graph (e.g. changing the color to red). Under each Dynamic Style there must be at least one condition that defines whether this action is to be executed with the current data value. Several conditions are also possible, which are then "ANDed" or "ORed".

A Dynamic Style is added via the context menu of the channel.



If a channel contains at least one Dynamic Style, then a new entry "Acquisition" is displayed in the "Dynamic Style" group in the properties window of the channel. The data series for all dynamic styles can be defined here. This must be recorded by the same target system and sampled with the same sampling rate as the other data series of the channel.

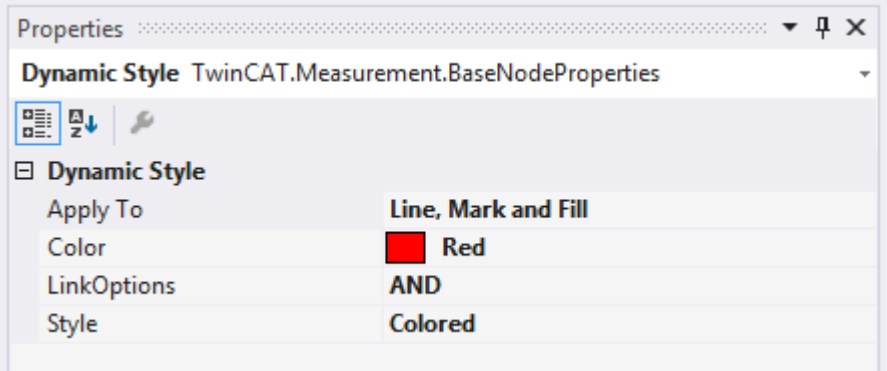




Dynamic Styles can be used on channels in XY charts as well as on channels in YT charts. This opens up a wide range of possible applications. Also in the Motion area for the illustration of contours or simple alarm states.

5.1.6.1 Dynamic style properties

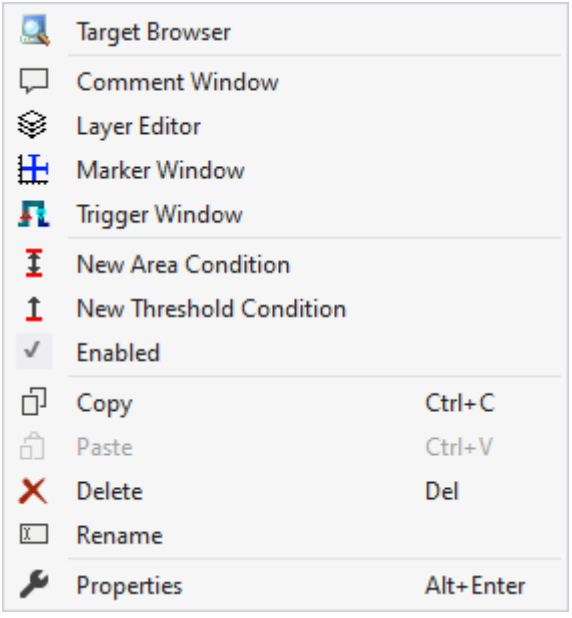
All settings assigned to the dynamic style can be made here.



Apply To	Defines which part(s) of the graph will be changed by the dynamic style. (Line, marker and/or fill area)
Color	Defines the color that will be used when changing color. (Visible only if Style is set to "Colored").
LinkOption	Specifies how the different conditions underneath the dynamic style are to be linked ("and" or "or")
Style	Specifies how the dynamic style should influence the graphs: • Normal → no change • Bold → bold • Dashed → dashed • Colored → other color • Invisible → invisible

5.1.6.2 Dynamic Style Condition

There are two different conditions in TwinCAT 3 Scope. One is the Threshold condition, which checks whether a value lies above or below a limit. The other is the Area condition, which checks whether a value lies within a range. The conditions can be added via the context menu of the dynamic styles:



Threshold condition

A Threshold condition has the following properties:

Enabled	Activates this condition
Threshold	Sets the limit value for switchover
Operator	Specifies the comparison operator between limit value and comparison value (smaller than, smaller than/equal to, greater than/equal to, or greater than)

Area condition

An Area condition has the following properties:

Enabled	Activates this condition
Lower Limit	The lower limit of the area to be checked
Lower Operator	Comparison operator for the lower limit (greater than or greater than/equal to)
Upper Limit	The upper limit of the area to be checked
Upper Operator	Comparison operator for the upper limit (smaller or smaller than/equal to)

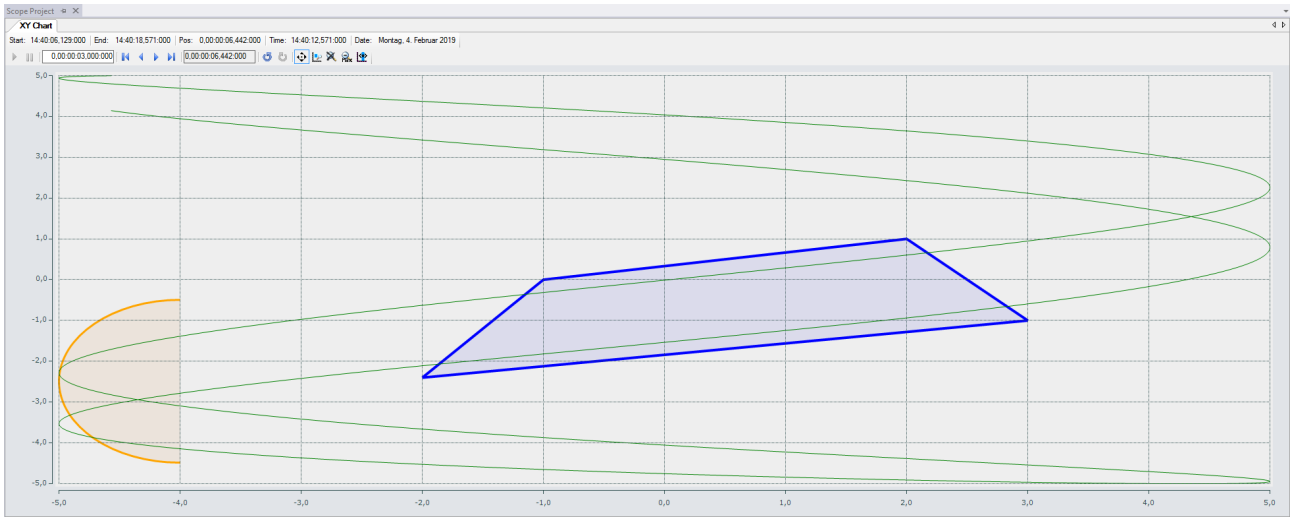
5.1.7 Shapes

The shapes form a new subgroup of the graph elements. They are created under the axis group in an XY chart.

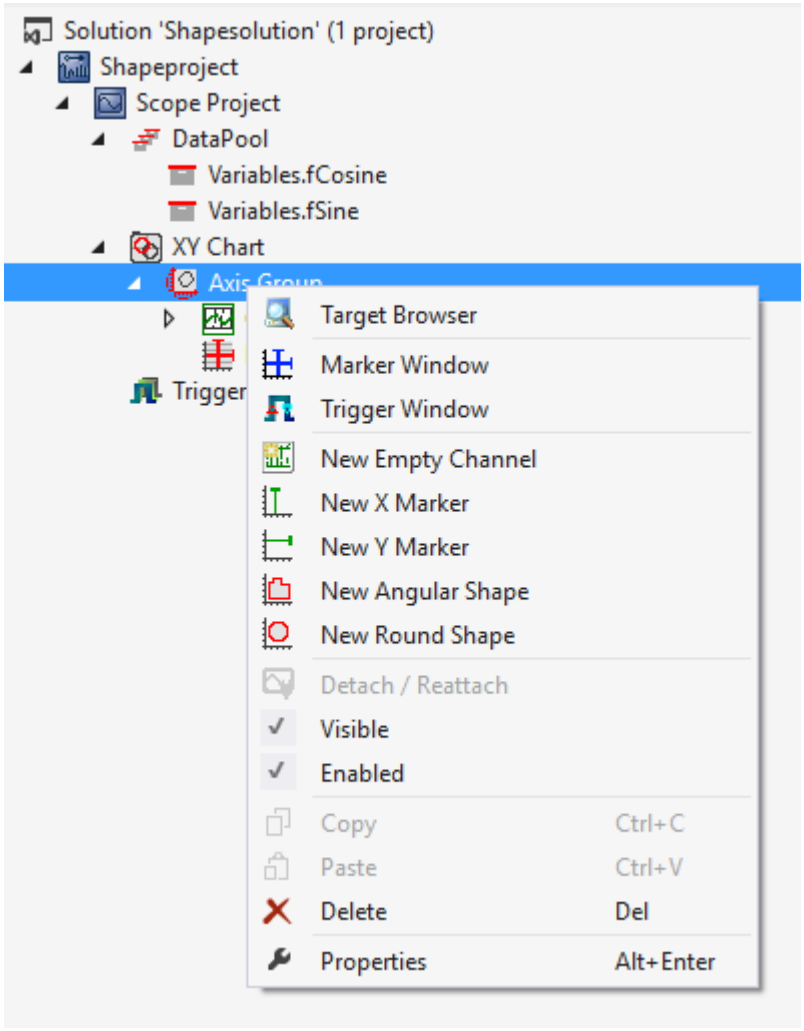
There are two types of shape:

- Angular shapes (defined by coordinates)
- Round shapes (defined by a center point and two radii)

From version 3.4.3146.0 it is even possible that the shapes move within the XY plot. For this purpose, offset and scaling factor or alternatively the individual significant points of the shapes can be linked to variables from the data pool.

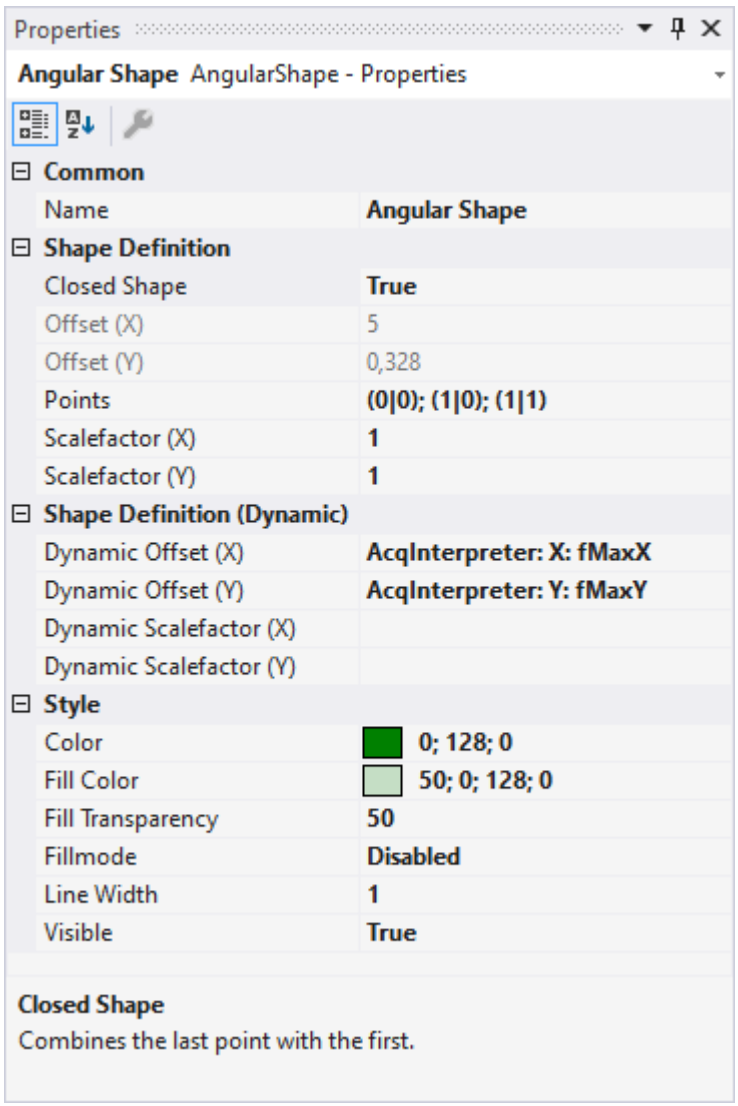


A shape is added via the context menu of an axis group:

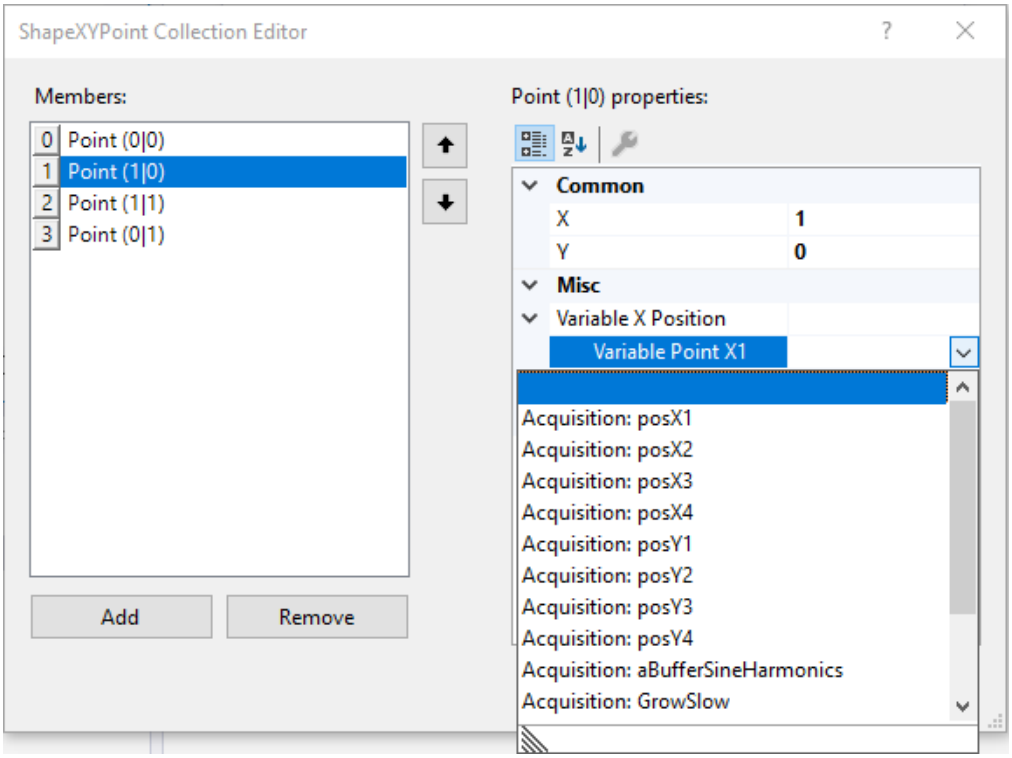


5.1.7.1 Angular shape properties

All the properties of an angular shape are explained here.


Properties
Angular Shape AngularShape - Properties
Common
Name
Angular Shape
Shape Definition
Closed Shape
True
Offset (X)
5
Offset (Y)
0,328
Points
(0|0); (1|0); (1|1)
Scalefactor (X)
1
Scalefactor (Y)
1
Shape Definition (Dynamic)
Dynamic Offset (X)
AcqInterpreter: X: fMaxX
Dynamic Offset (Y)
AcqInterpreter: Y: fMaxY
Dynamic Scalefactor (X)
Dynamic Scalefactor (Y)
Style
Color
0; 128; 0
Fill Color
50; 0; 128; 0
Fill Transparency
50
Fillmode
Disabled
Line Width
1
Visible
True
Closed Shape
Combines the last point with the first.

Shape definition

Closed Shape	If Closed Shape is selected, the last point is connected to the first point again.
Points	List of all points. (Notation: (x|y);(x|y)) For a better input of the points a Shape Point Editor can be opened:  In the Dynamic area, variables can be defined for the individual points instead of fixed coordinates. Mixed operation is also possible.
Offset (X)	In the offset field a free offset can be added to the coordinates of the shape in the X-direction.
Scalefactor (X)	The points of the shape can be changed in the X-direction with the scale factor.
Offset (Y)	In the offset field a free offset can be added to the coordinates of the shape in the Y-direction.
Scalefactor (Y)	The points of the shape can be changed in the Y-direction with the scale factor.

Shape definition (dynamic)

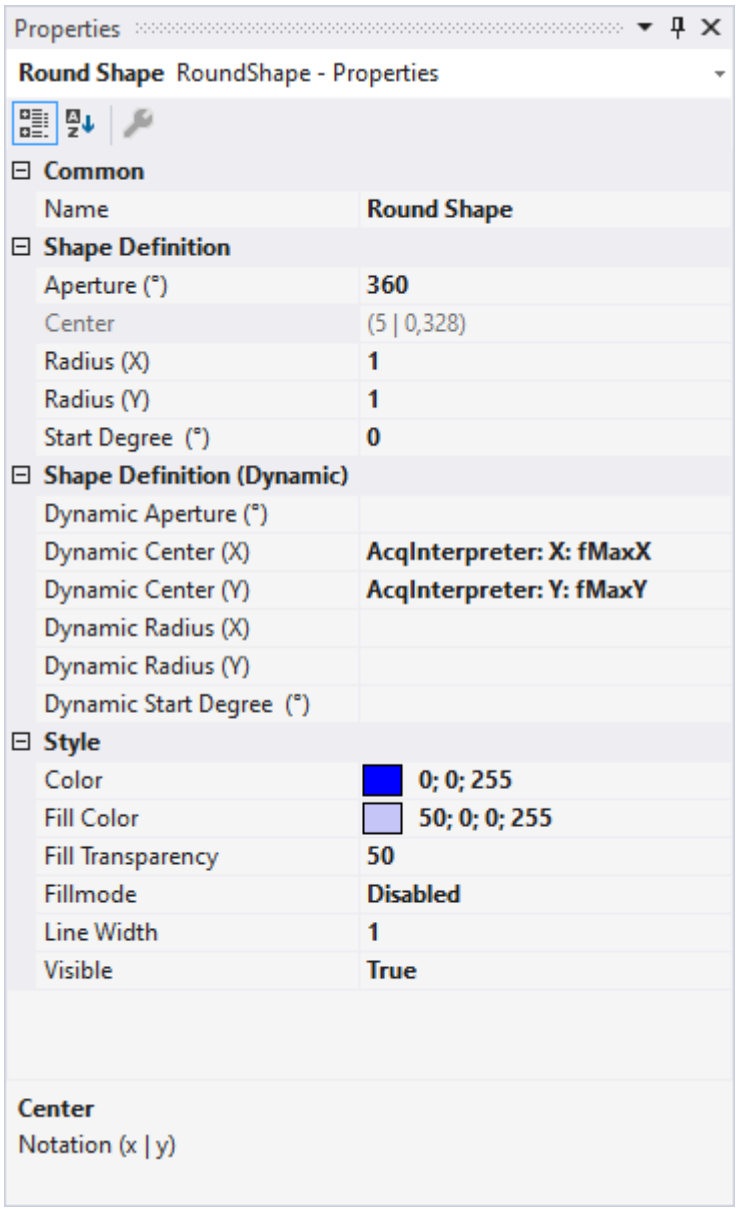
Dynamic Offset (X)	Select a variable from the data pool or an interpreted channel for a dynamic change of the offset.
Dynamic Scalefactor (X)	Select a variable from the data pool or an interpreted channel for a dynamic change of the scaling factor.
Dynamic Offset (Y)	Select a variable from the data pool or an interpreted channel for a dynamic change of the offset.
Dynamic Scalefactor (Y)	Select a variable from the data pool or an interpreted channel for a dynamic change of the scaling factor.

Style

Fill Color	Color of the area content.
Line Width	Width of the edges in pixels.
Color	Color of the edge.
Fillmode	The fill area of the shape always starts at the first point. To obtain a correct fill area, the shape must be convex with respect to the starting point. This means that all other points of the shape are reached with a straight line without leaving the shape.

5.1.7.2 Round shape properties

All the properties of a round shape are explained here.



Shape definition

Aperture	The aperture specifies how wide the circle will be drawn.
Center	Center point of the circle.
Radius (X)	Radius of the circle in the X-direction.
Radius (Y)	Radius of the circle in the Y-direction.
Start Degree (°)	Starting angle from which the circle will be drawn.

Shape Definition (dynamic)

Dynamic Aperture (°)	Here you can link a variable that specifies how far the object is drawn.
Dynamic Center (X)	A variable can be linked here, which can be used to specify the center point of the object in the X direction.
Dynamic Center (Y)	A variable can be linked here, which can be used to specify the center point of the object in the Y direction.
Dynamic Radius (X)	Here a variable can be linked, with which the radius of the object can be changed in X direction.
Dynamic Radius (Y)	Here a variable can be linked, with which the radius of the object can be changed in Y direction.
Dynamic Start Degree (°)	Here you can link a variable that specifies the start angle of the object.

Style

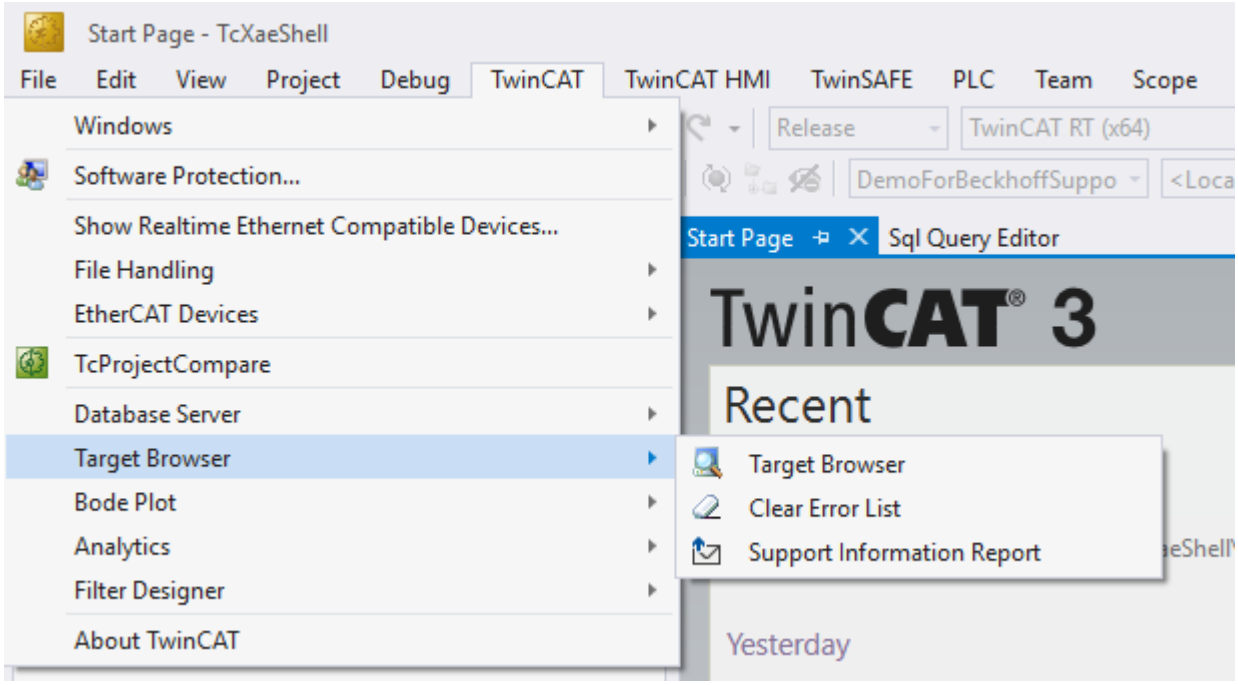
Fill Color	Color of the area content.
Line Width	Width of the edges in pixels.
Color	Color of the edge.
Fillmode	The fill area of the shape always starts at the first point. To obtain a correct fill area, the shape must be convex with respect to the starting point. This means that all other points of the shape are reached with a straight line without leaving the shape.

5.1.8 TwinCAT Target Browser

The TwinCAT Target Browser is the central data management interface in the TwinCAT 3 Engineering. It can provide data from various TwinCAT target systems live via ADS or access historic data in databases. Depending on what TwinCAT 3 functions are installed on an engineering system, the ADS standard extension of the TwinCAT Target Browser is extended by further extensions (see Extensions [▶ 167]).

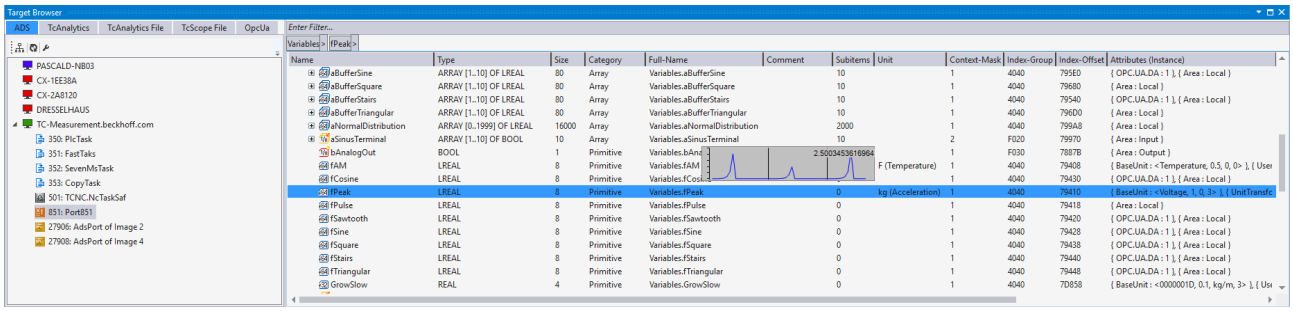
Call options

The Target Browser can be called via the Scope menu in Visual Studio®. Due to its ever increasing use in the TwinCAT system, it can also be opened via the TwinCAT menu under the item **Target Browser**.



In addition, it is possible that the various tools that use the Target Browser will provide additional calls. For example, some products do this via the context menu on their respective project nodes.

Architecture



Within Microsoft Visual Studio® the TwinCAT Target Browser is a tool window that is subdivided into two sections. Target systems are displayed on the left-hand side ("Specific Target Area"). You can switch between the various extensions via the tabs. The details of the respective target system or the selected object respectively are displayed on the right-hand side ("Common Symbol Area").

Many extensions support a "Value Preview" for variables. This means that if you select a variable and press and hold the space bar, a small chart appears. In this way you can determine whether data have arrived or exist in a database. A search bar above the right-hand section enables the filtering/reduction of the visible symbols. The entry must be confirmed with the [Enter] key.

A breadcrumb navigation bar shows the current location.

Extensions

The following table shows an overview of the current extensions and the product from which they were installed. Further information on the extensions can be found in the associated document sections.

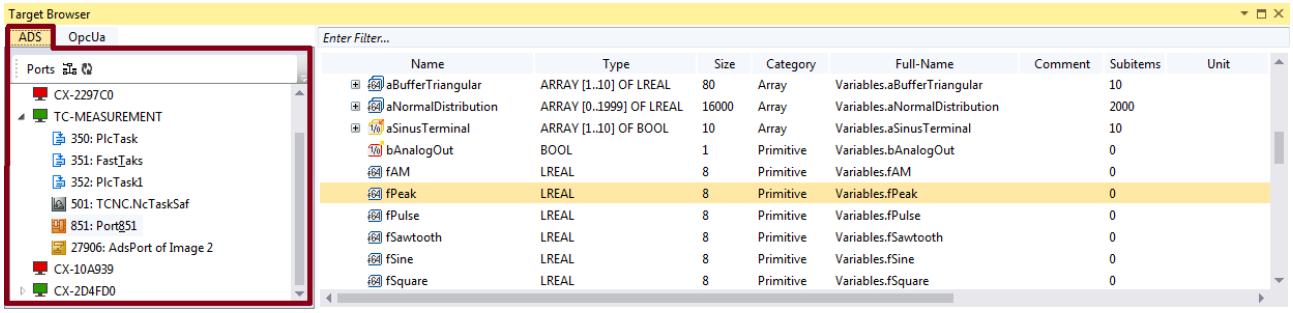
Extension name	Products
ADS [▶ 167]	TwinCAT XAE, TwinCAT Scope, TwinCAT IoT Data Agent, TwinCAT Data base Server, TwinCAT Analytics Service Tool
OPC UA [▶ 170]	TwinCAT Scope, TwinCAT IoT Data Agent
TcAnalytics [▶ 172]	TwinCAT Analytics Workbench and Service Tool, TwinCAT Scope
TcAnalytics File [▶ 174]	TwinCAT Analytics Workbench and Service Tool, TwinCAT Scope
TcDBSrv [▶ 175]	TwinCAT Scope

5.1.8.1 Extension – ADS

The TwinCAT Target Browser ADS extension is used most frequently within the TwinCAT system.

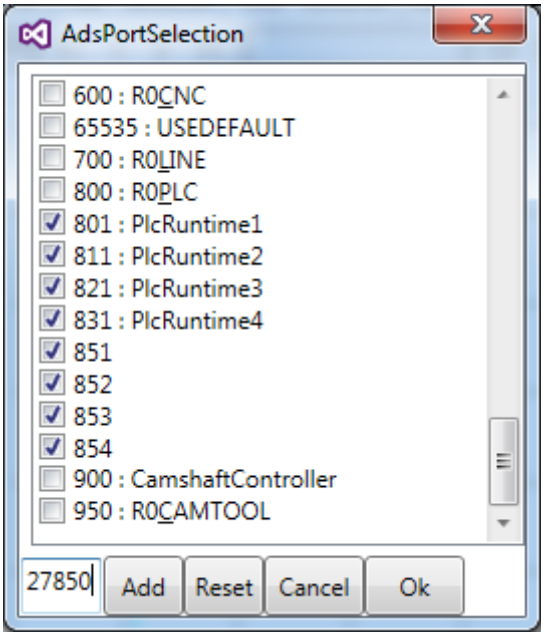
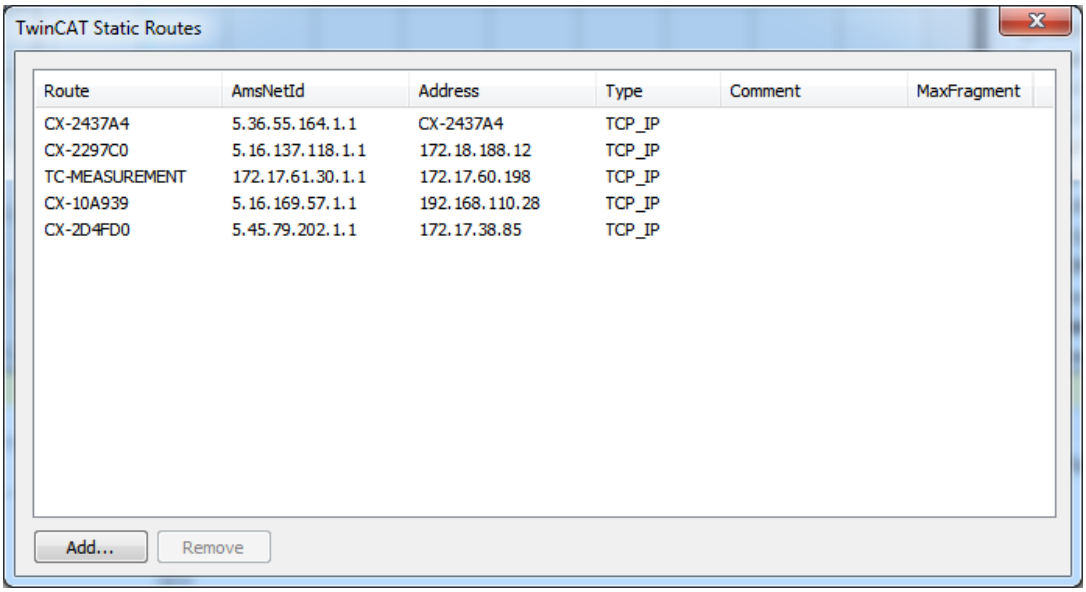
Specific Target Area

All target systems registered to the local TwinCAT 3 Engineering are displayed in a tree structure in the left-hand area of the TwinCAT Target Browser (ADS). In first place is the local system, followed by the target systems such as Industrial PCs or Embedded PCs in the order of registration. The prefixed screen symbol indicates the state of the system (green: run mode, blue: config mode, red: stop mode or unreachable). The available default ADS ports are listed below a target system. If you select a port, the available symbols/ variables are displayed in the Common Symbol Area on the right-hand side of the TwinCAT Target Browser.



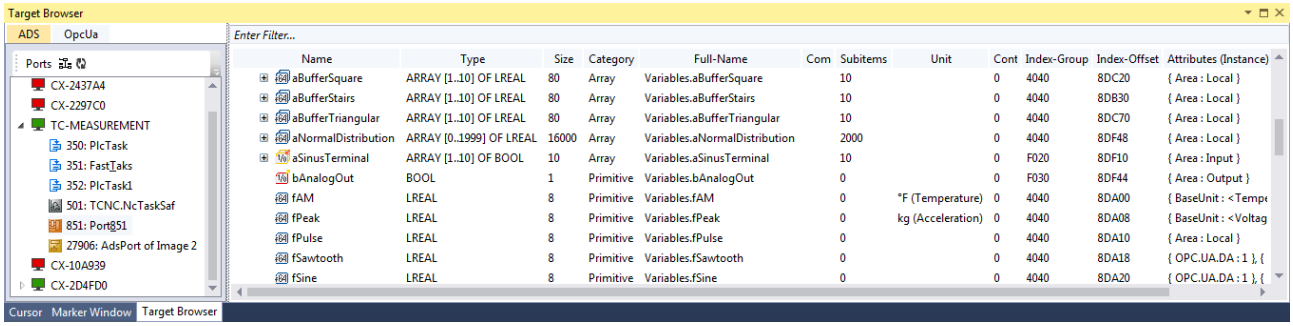
Toolbar

The toolbar of the ADS extension makes the following functions available:

Ports 	If an ADS port is not displayed by default, further ports can be added to a selection via this command. 
Edit Routes 	If an ADS route to a target system is missing, further target systems can be added via this button. 
Refresh 	The display of the target system states can be manually updated with this button.

Common Symbol Area

The ADS symbols available at the selected port are displayed in the right-hand area of the TwinCAT Target Browser. The addresses and the attributes, for example, are also displayed in addition to the name, the data type, the size and the symbol name. Special attributes, such as those of the units, are interpreted and output in their own columns.

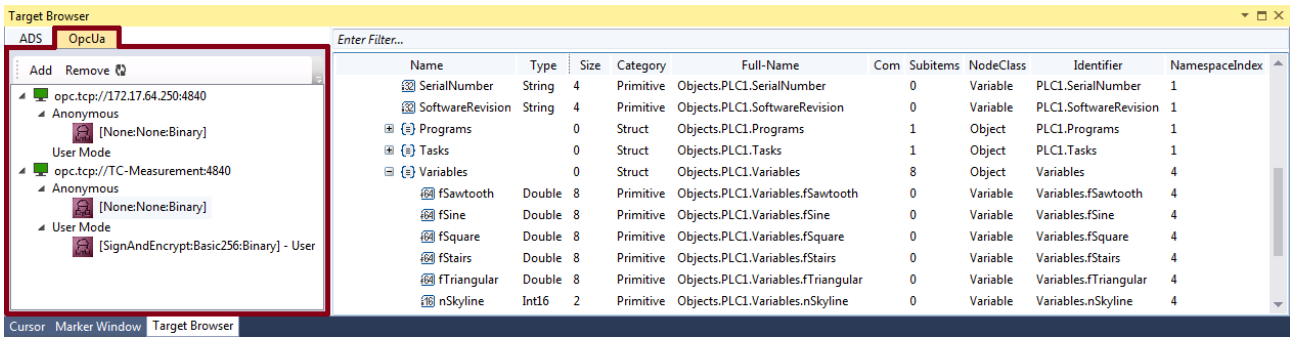


5.1.8.2 Extension - OPC UA

The TwinCAT Target Browser OPC UA extension offers a standardized way into the TwinCAT 3 Engineering.

Specific Target Area

All OPC UA Servers that have been added using the **Add** command in the toolbar are displayed in a tree structure in the left-hand area of the TwinCAT Target Browser (OpcUa). The screen symbol in front of the server designation at the first level of the tree structure indicates the connection status. Below the server the created end points are subdivided into "Anonym" (anonymous) and "Authenticated" (user mode). The encryption method is displayed in brackets for each end point. If you select an end point, the available OPC UA Nodes are displayed on the right-hand side of the TwinCAT Target Browser (see also: Displaying OPC UA Nodes [▶ 171])



Toolbar

The toolbar of the OPC UA extension makes the following functions available:

Add 	New connections to existing OPC UA Servers can be established with this command (see also: Adding OPC UA Servers [▶ 170])
Remove 	A registered server can be removed with this command.
Refresh 	The display in the Target Browser tree can be manually updated with this button.

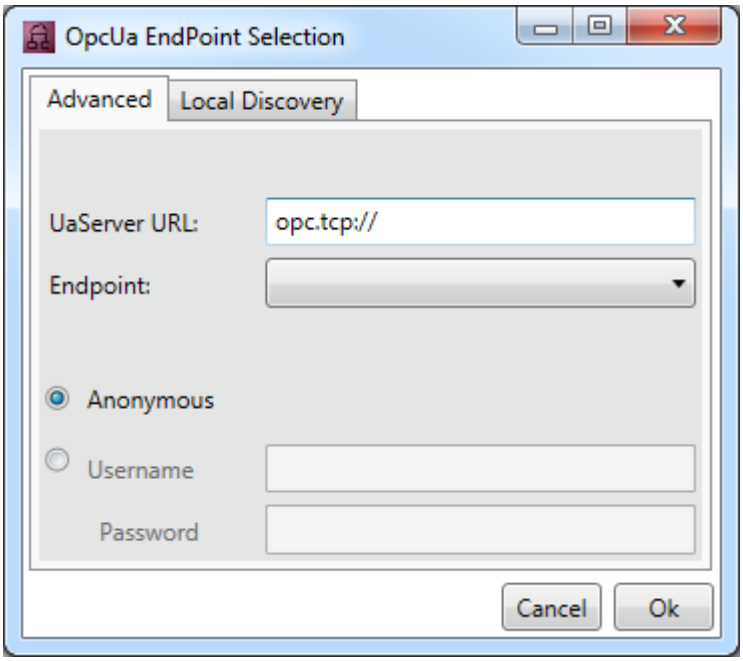
Common Symbol Area

The available OPC UA Nodes are displayed on the right-hand side of the TwinCAT Target Browser. These reflect the hierarchical structure of the PLC project. The node class and the identifier, for example, are also displayed in addition to the name, the data type, the size and the full object name.

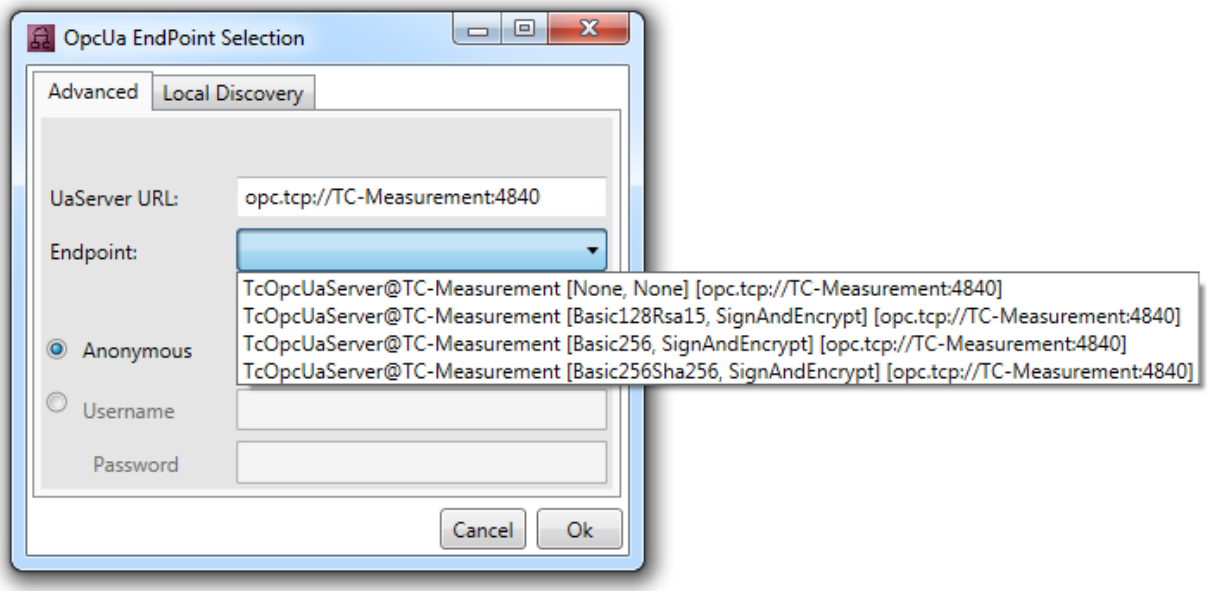
Adding OPC UA Servers

1. Click on **Add** in the OPC UA toolbar.

⇨ The dialog **OpcUa EndPoint Selection** opens.



2. Enter the URL of the server.
3. Select the end point from the drop-down list. With OPC UA you can determine via the corresponding end points whether and which method of encryption is used. It is also possible to add several end points to a server. To do this, execute the **Add** command again.

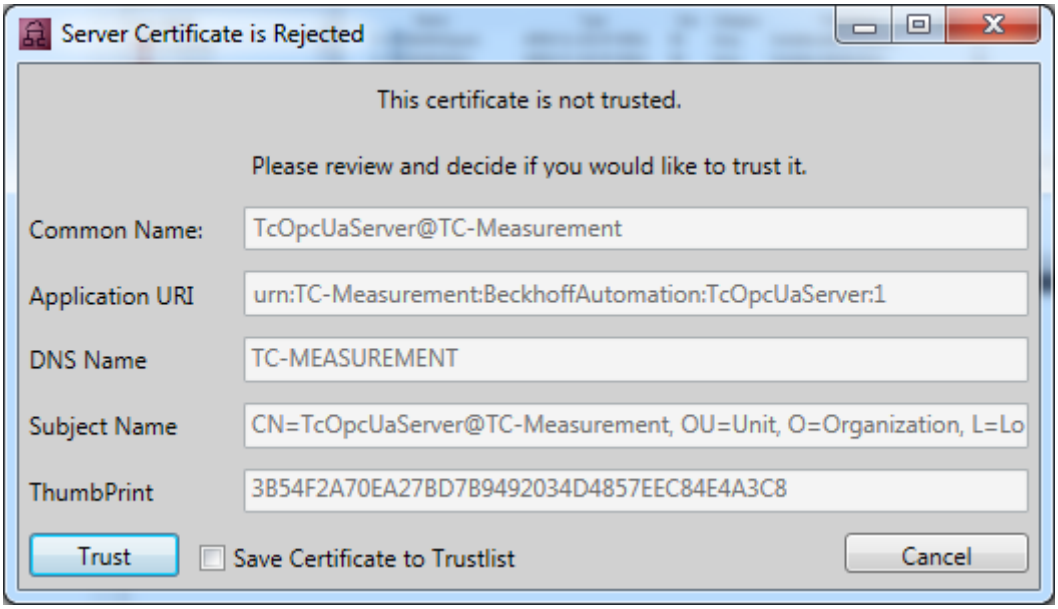


4. Select whether the access is anonymous or authenticated. If the access is authenticated, enter a user name and password. Authenticated access may be required if a password-protected user management has been set up for the OPC UA server (e.g. different user accounts with different rights).
5. Confirm the dialog.

⇨ The OPC UA Server is added to the tree structure in the Target Browser with the selected end points.

Displaying OPC UA Nodes

In order to display the available OPC UA Nodes, select the respective end point in the tree structure on the left-hand side. If you select an end point without certified access, the nodes will be displayed directly. If the selected end point is certified, you must first trust the server certificate in a corresponding dialog.



You can trust the certificate in a single case (until the Visual Studio instance is closed) or add it to the list of trusted certificates via the check box **Save Certificate to Trustlist**.

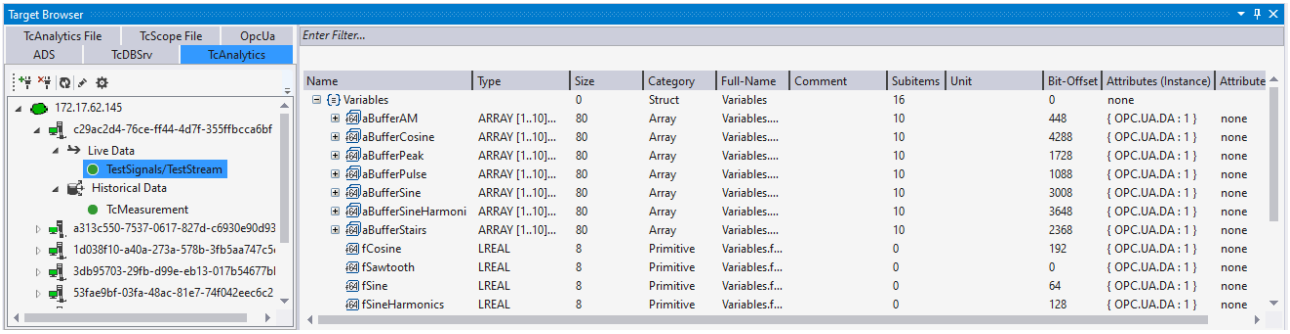
During the first attempt to connect to an OPC UA Server it is additionally necessary to trust the certificate of the client (Target Browser) on the server side. To do this, copy the respective certificate in the certificate directory of the OPC UA Server from the "rejected" folder to the "trusted" folder.

5.1.8.3 Extension – TcAnalytics

With the help of the TcAnalytics Extension of the TwinCAT Target Browser, MQTT data streams from different brokers and topics can be displayed and made available for different measurement products. All you have to do is drag and drop the desired stream symbols into the corresponding engineering tools.

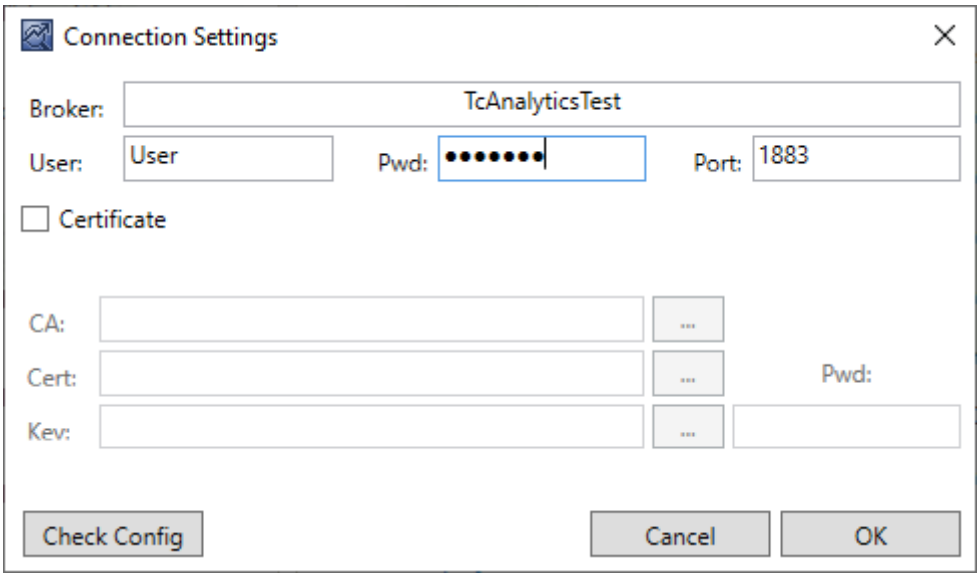
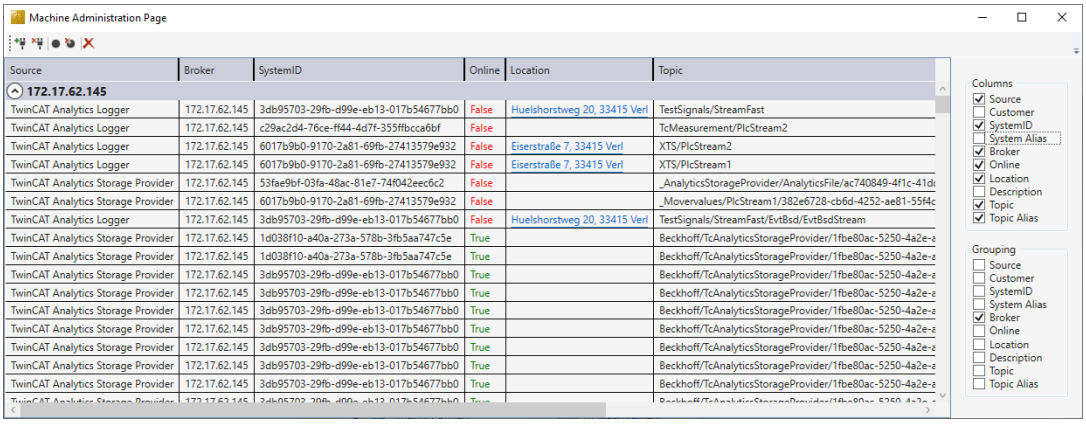
Specific Target Area

In the left area of the TwinCAT Target Browser (TcAnalytics) all brokers and their data streams are displayed in a tree structure. In addition, historical data streams are also displayed. The current status of the system or the data stream is indicated by the preceding symbols (green: available, red: unreachable, gray: unknown status).



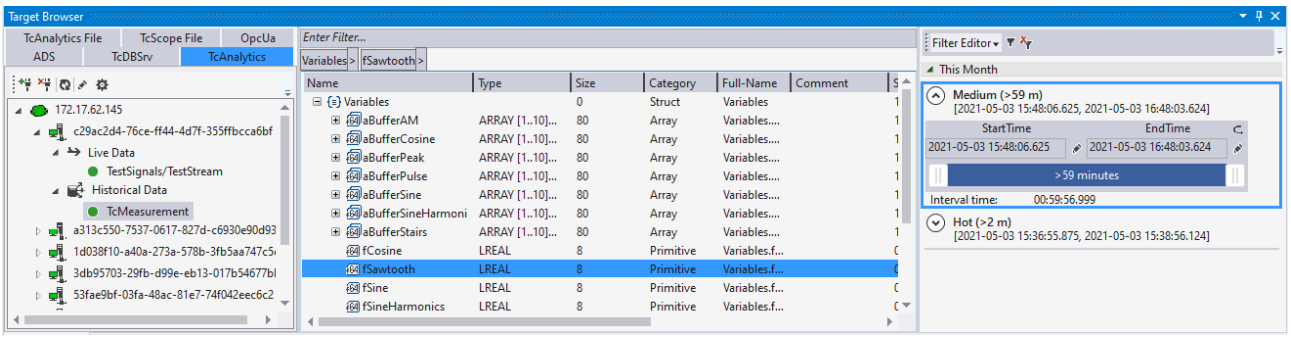
Toolbar

The toolbar of the TcAnalytics extension provides the following functions:

Add broker connection 	This button can be used to add broker connections. 
Delete broker connection 	This button can be used to delete existing connections to a broker from the tree.
Refresh 	The display of the target system states can be manually updated with this button.
Edit connection 	This button can be used to subsequently change the connection parameters.
Machine Administration Page 	This button opens the machine administration page. The incoming data streams of the various "machines" can be managed via this page. 

Common Symbol Area

The symbols of the different data streams are displayed in the right-hand area of the TwinCAT Target Browser (TcAnalytics). In addition to the name, data type, size and symbol name, attributes are also displayed, for example. Special attributes, such as those of the units, are interpreted and output in their own columns. If a historized data stream is selected, the individual recordings and their time ranges are also displayed.

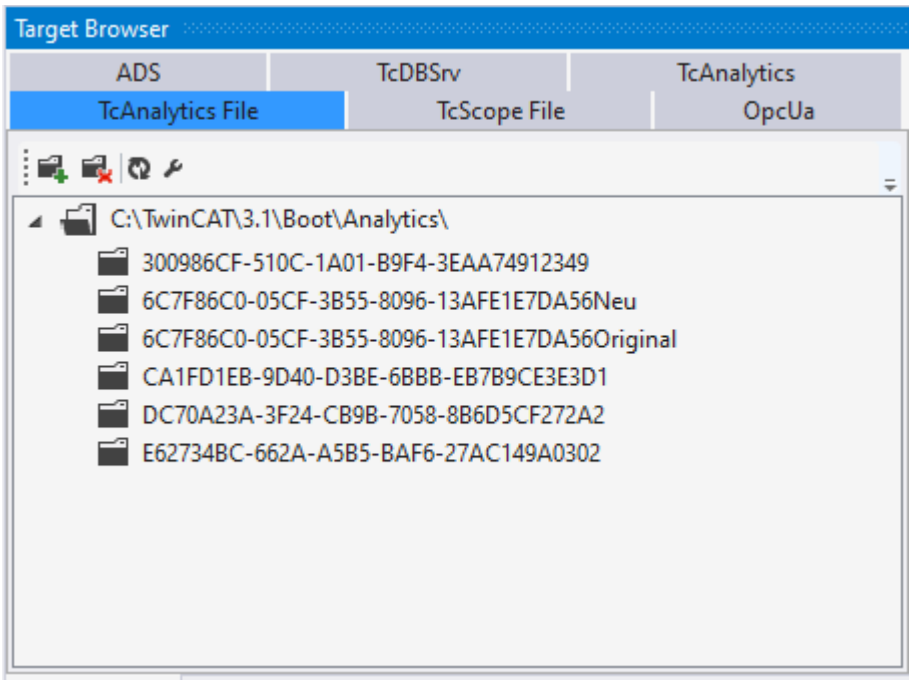


5.1.8.4 Extension – TcAnalytics File

With the help of the TcAnalytics Extension of the TwinCAT Target Browser, MQTT data streams from different brokers and topics can be displayed and made available for different measurement products. All you have to do is drag and drop the desired stream symbols into the corresponding engineering tools.

Specific Target Area

In the left area of the TwinCAT Target Browser (TcAnalyticsFile) all folders are displayed in which a search for AnalyticsFile folders is to take place. Any AnalyticsFile folders that are found are then displayed in a tree structure.



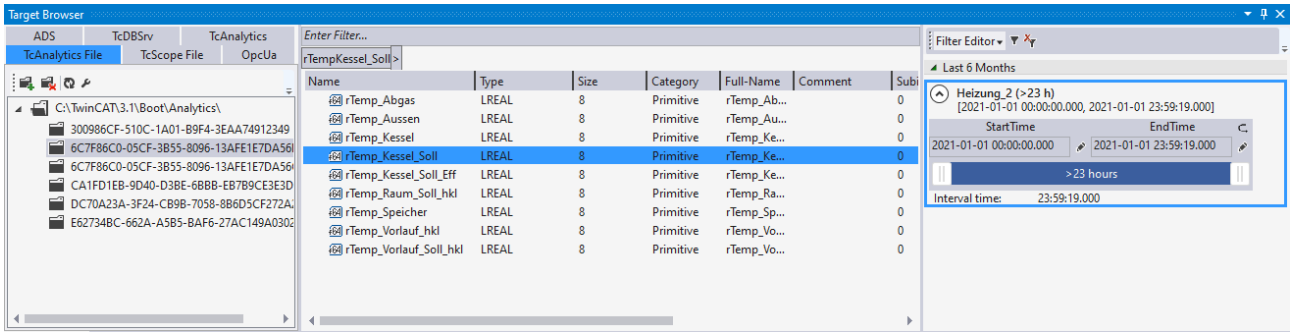
Toolbar

The toolbar of the TcAnalyticsFile extension provides the following functions:

New folder	This button can be used to add folder paths in which a search for AnalyticsFile folders is to take place.
Delete folder	This button can be used to delete the selected folder from the tree.
Refresh	This button can be used to manually update the displays.
Properties	This button can be used to customize various properties of the TcAnalyticsFile extension.

Common Symbol Area

The symbols of the different AnalyticsFiles are displayed on the right in the TwinCAT Target Browser (TcAnalyticsFile). In addition to the name, data type, size and symbol name, attributes are also displayed, for example. Special attributes, such as those of the units, are interpreted and output in their own columns. In addition, the individual recordings and their time ranges are displayed.

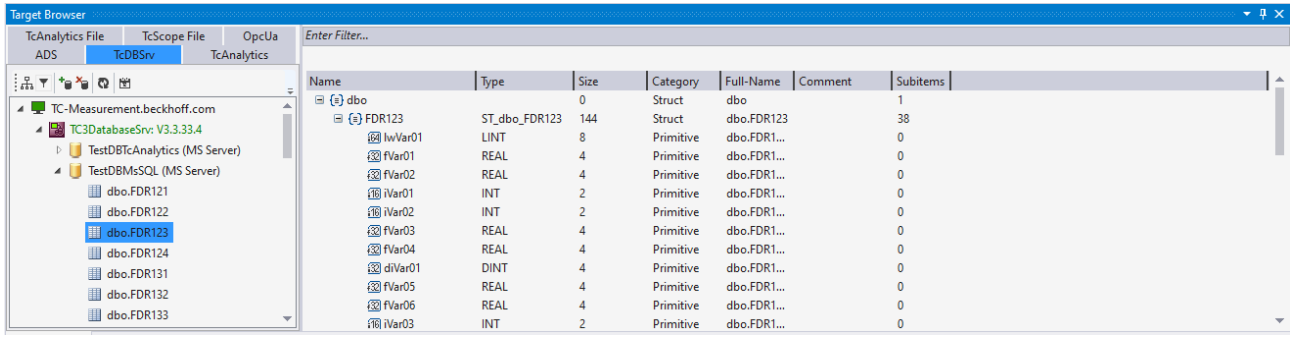


5.1.8.5 Extension – TcDBSrv

The TcDBSrv extension of the TwinCAT Target Browser can be used to display data sets from databases in TwinCAT Scope via the TwinCAT Database Server. Only the desired columns of the tables have to be dragged into TwinCAT Scope. A corresponding SQL command is generated automatically, which can of course still be customized manually.

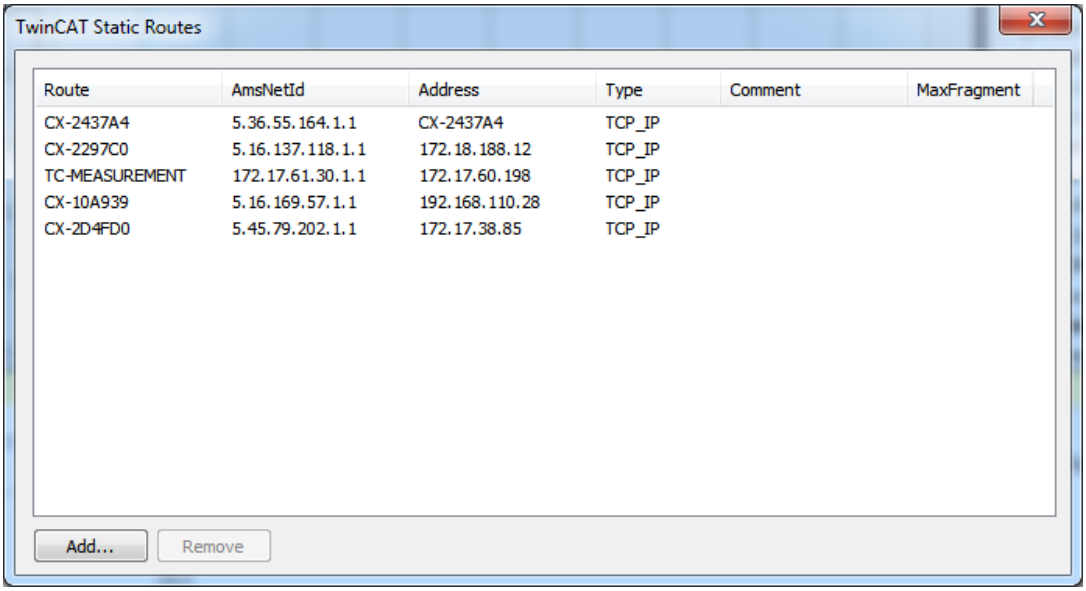
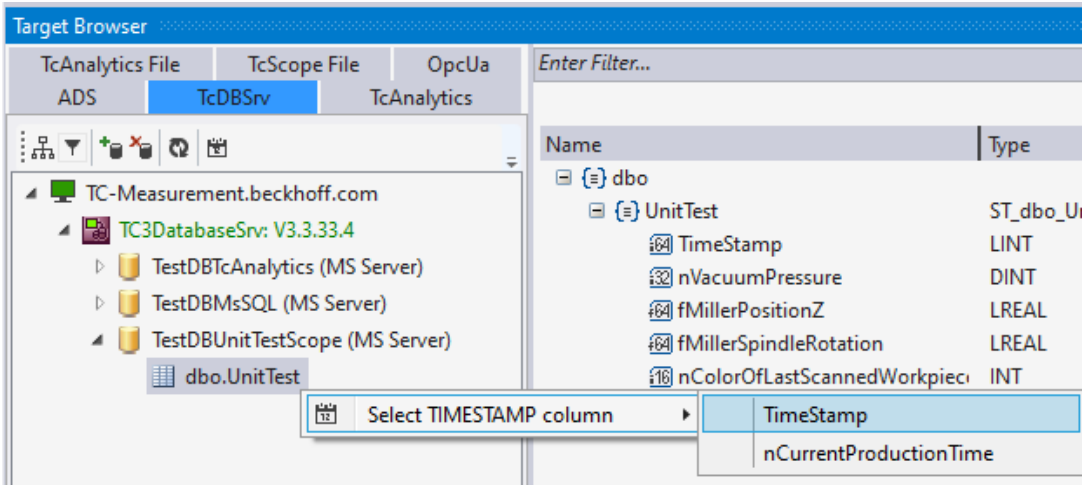
Specific Target Area

All target systems registered to the local TwinCAT 3 Engineering are displayed in a tree structure in the left-hand area of the TwinCAT Target Browser (TcDBSrv). In first place is the local system, followed by the target systems such as Industrial PCs or Embedded PCs in the order of registration. The prefixed screen symbol indicates the state of the system (green: run mode, blue: config mode, red: stop mode or unreachable). The available TwinCAT Database Server instances are listed below a target system. Below you will find all configured databases with their accessible tables. If a table node is selected, the individual table columns are displayed in the "Common Symbol Area".



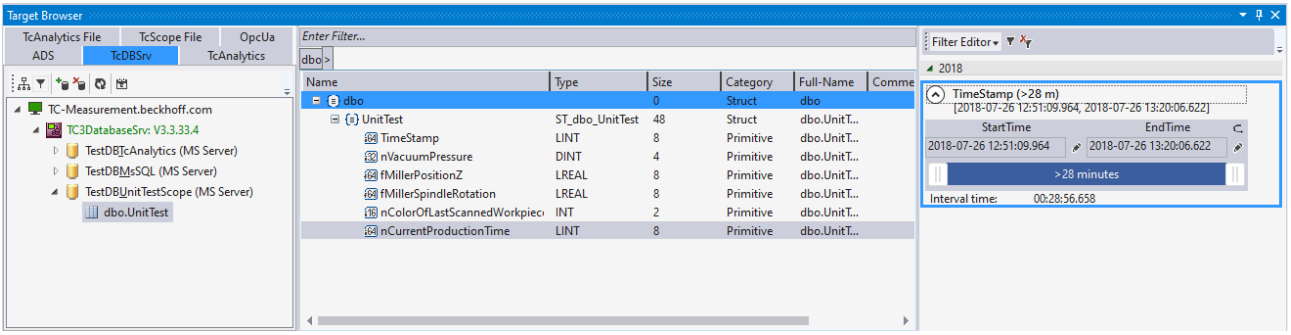
Toolbar

The toolbar of the TcDBSrv extension provides the following functions:

Edit Routes 	If an ADS route to a target system is missing, further target systems can be added via this button. 
Filter 	If the filter is active, only those routes are displayed where a TwinCAT Database Server is installed and accessible.
Add database 	This button can be used to create database configurations. Databases from the database pool or new configurations can be created on the TwinCAT Database Server. The familiar configuration editors open.
Delete database 	This button can be used to delete the selected database configuration from the TwinCAT Database Server.
Refresh 	The display of the target system states can be manually updated with this button.
Set timestamp column 	This button or the corresponding context menu item in the table node can be used to specify a column as timestamp; the time range of the table is read out based on this column. 

Common Symbol Area

The tables are displayed with their columns in the right-hand area of the TwinCAT Target Browser (TcDBSrv). In addition to the name and the data type, the size of the columns is also displayed. If a column is defined as a timestamp column, the time range of the data is displayed



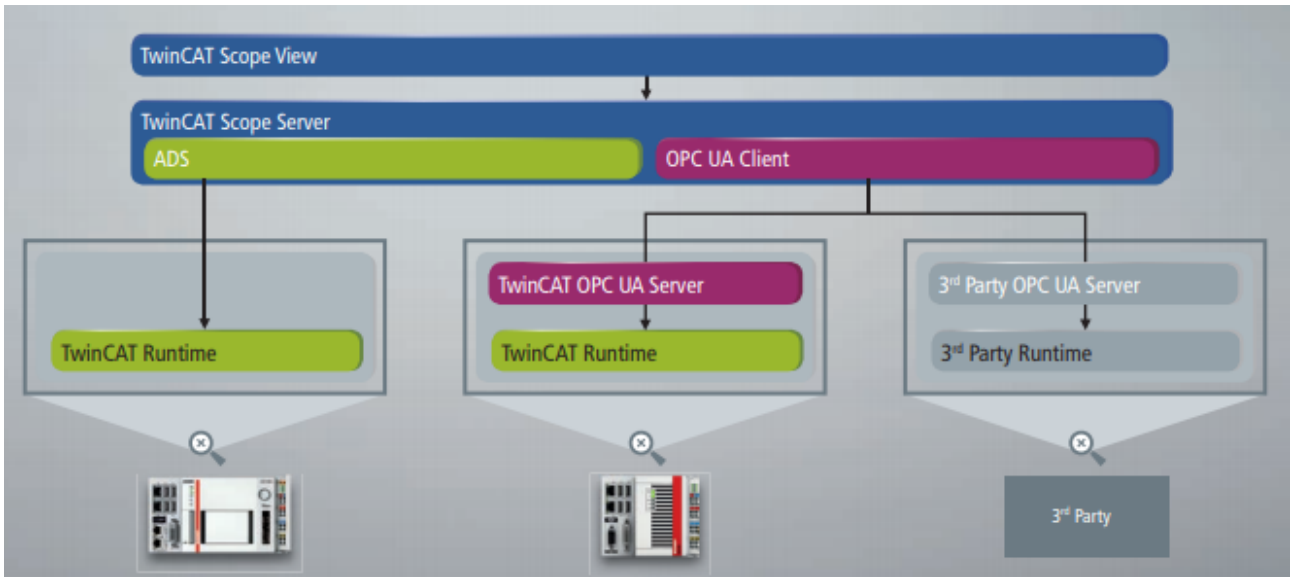
5.2 Special features

5.2.1 Communication

In principle the TE1300 and TF3300 documentation refers to the TwinCAT-specific communication via ADS. The TwinCAT 3 Scope itself is also capable of receiving data via other communication channels and displaying them. For example via OPC UA. In this section the differences relating to the communication channels are illustrated and explained.

5.2.1.1 OPC UA

In addition to the standard communication protocol ADS, the TwinCAT 3 Scope View offers the option of transmitting measured data via the standardized communication channel OPC UA. This is made possible by an OPC UA Client implemented in the TwinCAT 3 Scope Server and has the advantage that data can also be recorded from third-party suppliers' systems and analyzed (see illustration).



In the following, the special features of communication via OPC UA are explained in comparison with ADS communication.

5.2.1.1.1 Addition of OPC UA symbols

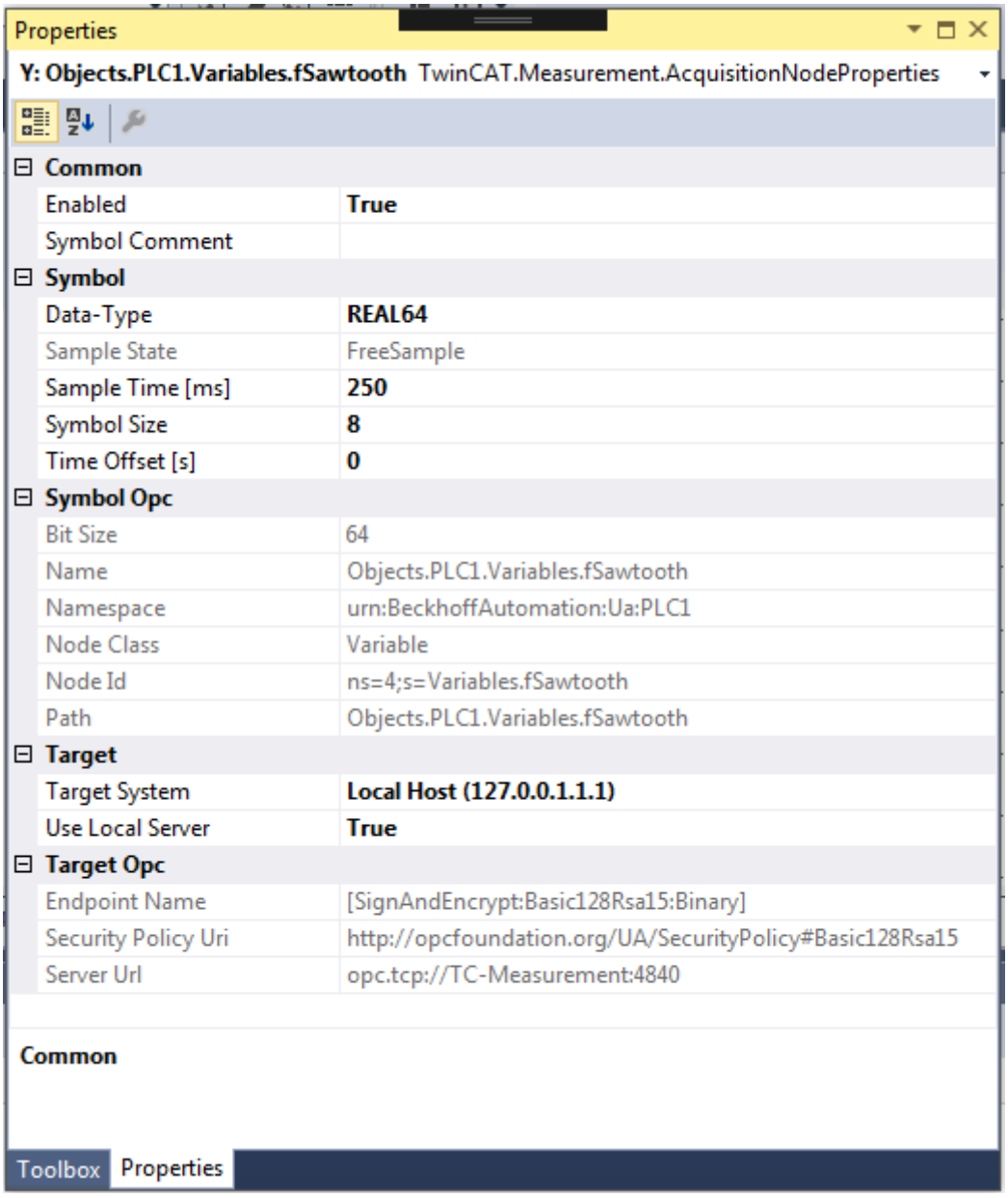
In order to record symbols via OPC UA with the TwinCAT 3 Scope View, they must first be added to the Scope project with the aid of the Target Browser, as is also the case with ADS.

In the **Target Browser** on the **OPC UA** tab you can add any number of target systems on which an OPC UA Server runs. The associated symbols are then listed in a hierarchical tree structure in the right-hand area of the Target Browser and can be added to the Scope project by drag-and-drop. (See also Extension - OPC UA [▶ 170])

5.2.1.1.2 Acquisition of OPC UA symbols

The acquisition of OPC UA symbols differs in part from the ADS acquisition. Since the properties of the groups "Common", "Symbol" and "Target" are identical to the ADS acquisition, only the specific OPC UA properties are explained in the following.

Properties



Symbol Opc

Bit Size	Size of the symbol in bits.
Name	Name of the symbol.
Namespace	Namespace of the symbol.
Node Class	Name of the node to which the symbol is assigned in the hierarchy.
Node Id	Id of the system node.
Path	Path to the symbol.

Target Opc

Endpoint Name	Name of the selected OPC UA end point. Contains information about the encryption method and signing.
Security Policy Uri	URI of the selected encryption method.
Server URL	URL of the OPC UA Server from which the symbol is to be recorded.

See also: Properties

5.2.1.1.3 Recording of OPC UA symbols

The function of recording symbols via OPC UA is available only with a Scope View Professional license.

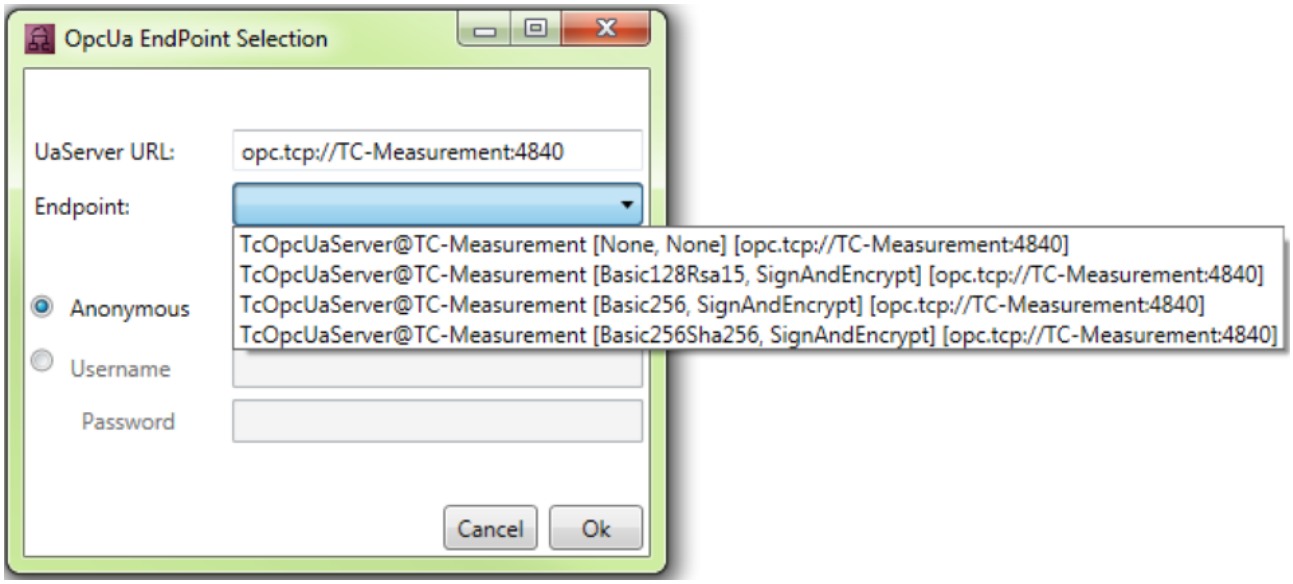
In principle the recording of signals via OPC UA can be started as usual via the **Start Record** button.

However, you should note the following special features:

- **Sample Time:** When recording OPC UA symbols there is no task sample time as with ADS symbols. The sample state is thus always set to "Free Sample". Therefore, set the desired sample time before starting the recording. Select only sampling rates that are also supported by the respective OPC UA Server. Otherwise an error message will appear when starting the recording and the sample time will be changed automatically to the sample time returned by the OPC UA Server.
- **Oversampling:** For arrays it is also possible to use the oversampling function with OPC UA. However, since there is no task sample time and the oversampling actually refers to the task sample time, the interpretation does not correspond to the conventional oversampling with ADS. In the interpretation of the measured data this must be taken into account in particular with free sample times, which deviate widely from the actual task sample time.
- **Encrypted and/or authenticated connections:** If the measured data are recorded by means of an encrypted and/or authenticated OPC UA connection, some further steps have to be performed following the first actuation of the **Start Record** button. More precise information on this can be found in the sections Encrypted connections [▶ 179] and Authenticated access [▶ 181].
- **Determinism:** The intervals between the data points that are transmitted via OPC UA correspond approximately to the set sampling rate. However, it is not necessarily to be expected that all data points are really equidistant as in the case of ADS. There may very well be deviations of 1-2 ms.
- **Missing data:** If "gaps" should occur in the data when recording data via OPC UA (the interval between the data points is not equal to the set sample time), this may be due to the respective OPC UA Server and/or the quality of the connection. In this case, check the Scope Server log if necessary.

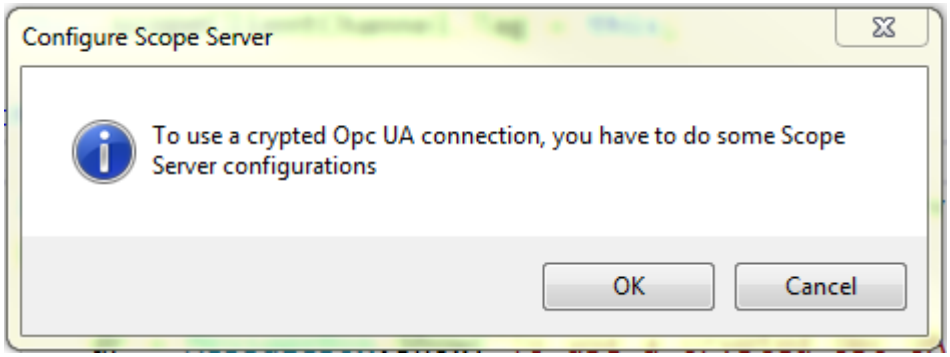
5.2.1.1.4 Encrypted connections

OPC UA offers the possibility to implement a secure communication channel via encrypted connections. Even before adding the symbol you can select the encryption method via the respective end point during the creation of the OPC UA Server in the **Target Browser** (see also: Adding an OPC UA Server [▶ 170]).

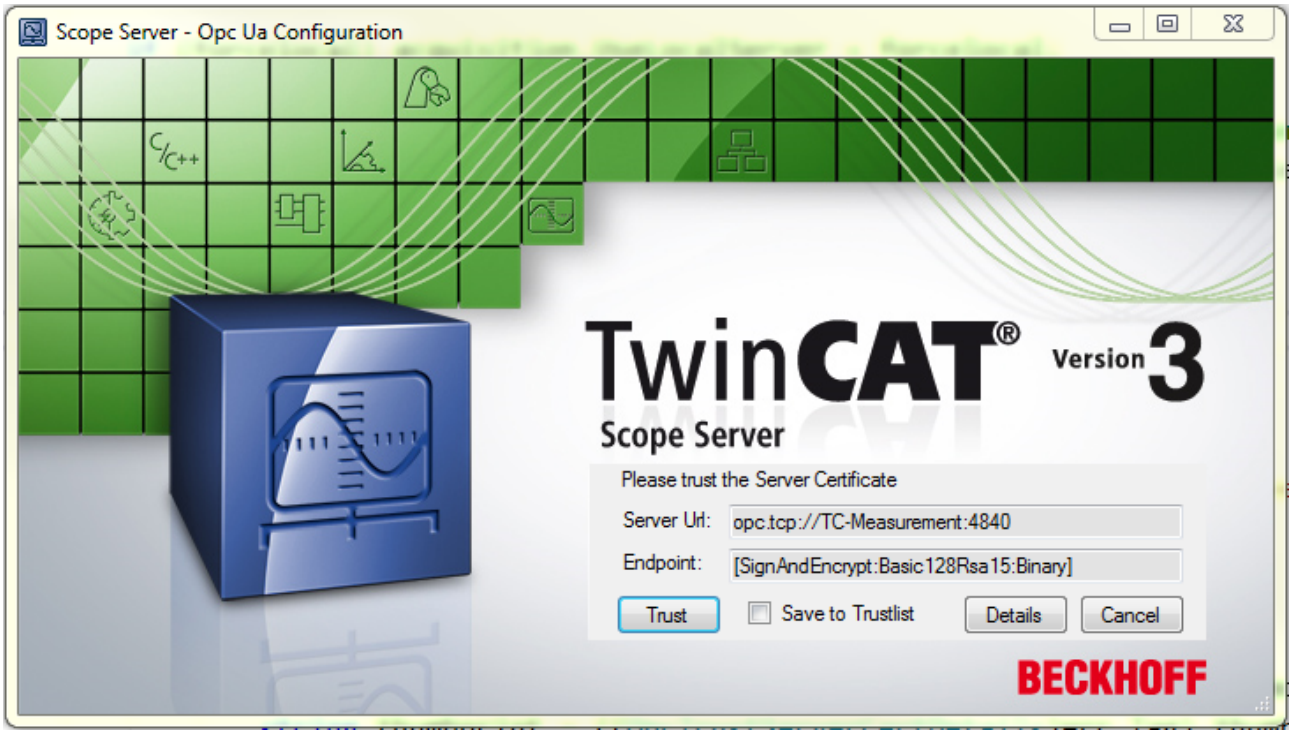


If you add the symbol to the Scope project, the selected encryption method is automatically adopted (see also: Addition of OPC UA symbols [▶ 177]).

As soon as you click on **Start Record** to start the recording, a dialog appears requesting you to adjust the Scope Server configuration.

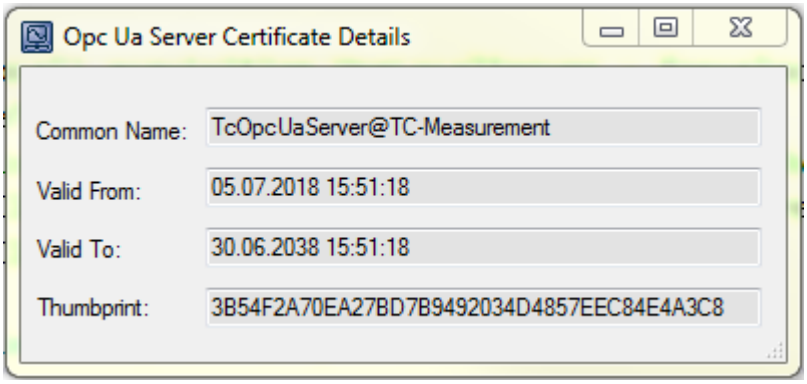


In order to make the necessary configurations on the Scope Server so that the recording can be started, confirm the dialog. The **Scope Server – Opc Ua Configuration** window opens in which you are requested to trust the certificate of the OPC UA Server, with which the communication is to take place, on the client side (Scope Server) (**Trust** button).



You can trust the certificate in a single case or add it to the list of trusted certificates via the check box **Save to Trustlist**.

In order to check the server certificate, the server URL of the OPC UA Server and the selected end point have to be entered in the window. You can open the detailed information about the certificate via the **Details** button.



In addition to the "Common name" and the period of validity of the certificate ("Valid from/to"), the "Thumbprint" is of particular relevance. On the basis of the thumbprint you can determine whether the certificate is really that of the OPC UA Server to which you wish to connect.

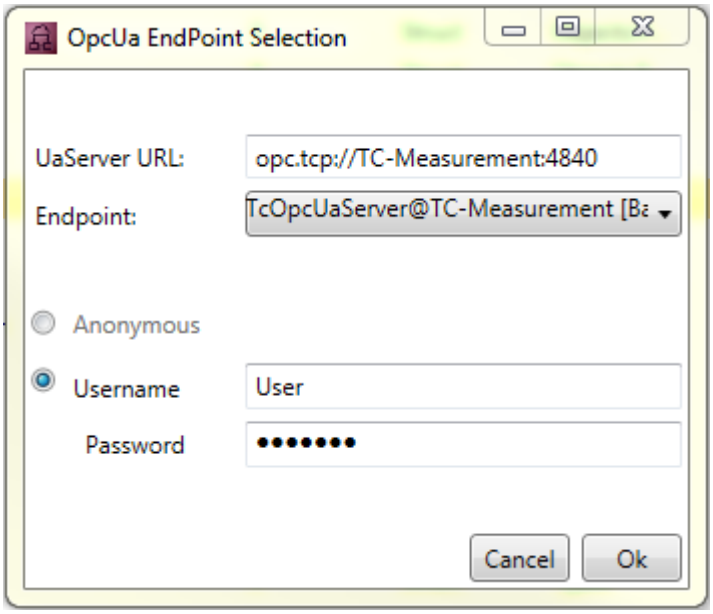
During the first attempt to connect to an OPC UA Server it is additionally necessary to trust the certificate of the client (Scope Server) on the server side. The following error message informs you: „Connection to OPC UA Server failed. Please trust the client certificate at OPC UA Server.” In order to trust the certificate of the client on the server, copy the respective certificate in the certificate directory of the OPC UA Server from the "rejected" folder to the "trusted" folder.

If the certificates have been exchanged on both sides and you have trusted both, you can start the recording.

5.2.1.1.5 Authenticated access

OPC UA offers the option of an authenticated access. To do this the user must log in with his user data (user name and password) in order to be able to communicate data via OPC UA. This is necessary, for example, if various user accounts have been set up on the target device on which the OPC UA Server is running and these accounts are locked via an authentication, or if various authorizations are to be implemented for different data.

In a similar way to the encrypted connections, you define the identity type (anonymous/authenticated) before adding the symbol when creating the OPC UA Server in the **Target Browser**. For an authenticated access, activate the "Username" option instead of the "Anonymous" option and enter a user name and a password (see also: Adding an OPC UA Server [▶ 170]).



When you add the symbol to the Scope project, the identity type and the user name are transferred with it (see also: Addition of OPC UA symbols [▶ 177]). Before starting the recording the password is requested again for security reasons.

As soon as you click on **Start Record** to start the recording, the window **Scope Server – Opc Ua Configuration** opens, in which you are requested to enter the password. The user name that was entered in the **Target Browser** appears automatically.



The recording is started after confirming the entry via **OK** and correct authentication.

If an incorrect password is entered, the connection attempt is regarded as having failed ("Wrong credentials. Start Record not possible") and you are given the option to enter the password again.

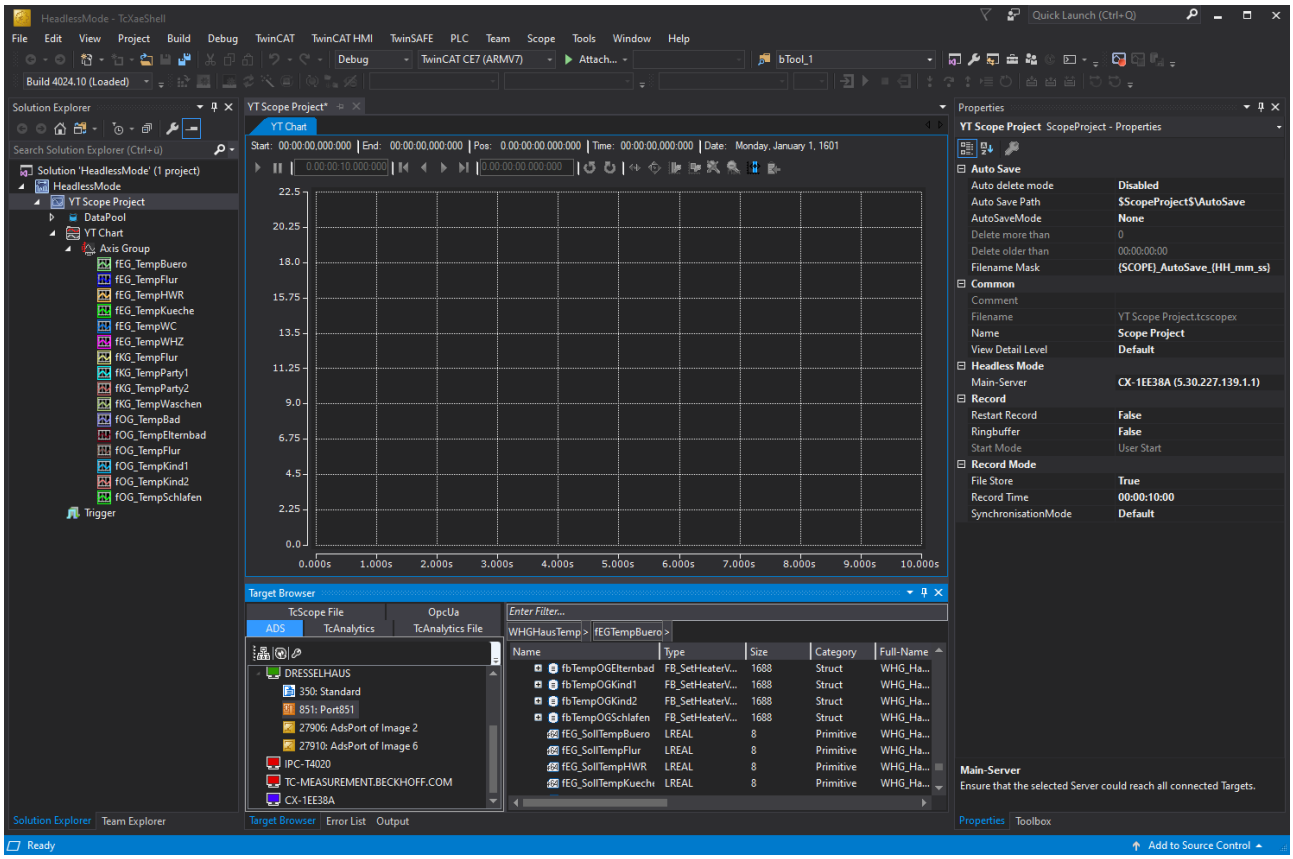
5.2.2 Headless mode

Headless mode allows you to download a configuration to a local server or remote scope server (TF3300), start it and then disconnect the ADS connection that is established at that time. The recording continues to run autonomously in the server with the current settings. A connection to the active recording can subsequently be re-established with the View. If you do not have the current configuration, it can be loaded from the server to the View.

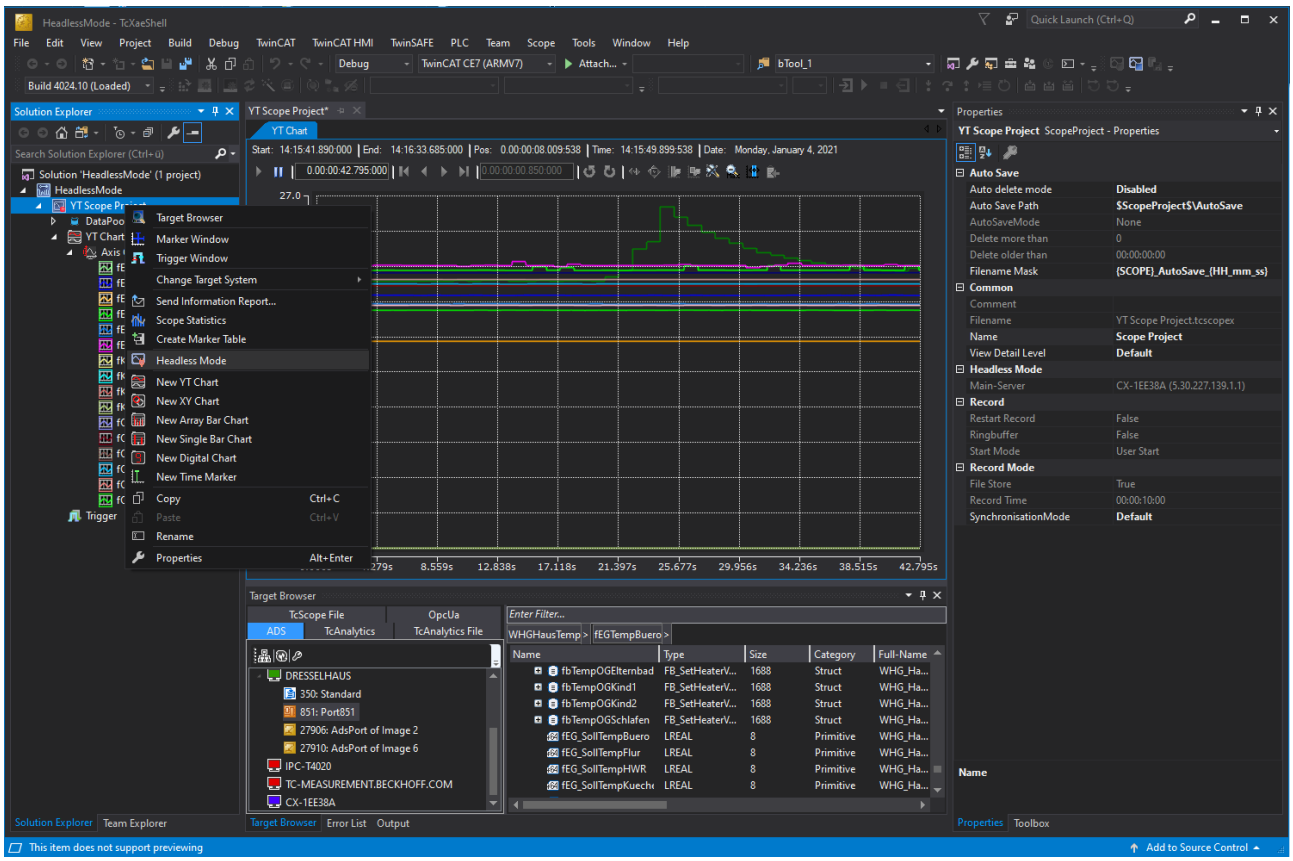
The prerequisite for this is a scope server previously installed via the measurement setup on the device where the recording is to run.

Procedure

Configure your scope as usual. For each acquisition, the data pool contains the target system on which the actual process runs. The scope node properties in the Solution Explorer contain a **Headless Mode** category, where you can define the main server, i.e. the scope server that is responsible for the recording. This may be the scope server of the target system (see data pool) or a server on a completely different system.

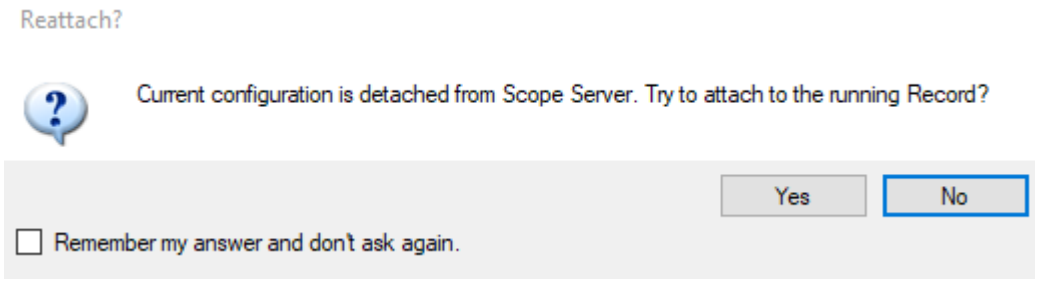


Once these settings have been implemented, start recording as usual using the Record button. You can now see how the data in the chart is updated cyclically. To switch to Headless mode, right-click the **Scope node** in the Solution Explorer. The context menu opens and the command for the Headless mode can be selected.



Once the command has been executed, the display in the chart ceases and the recording continues on the selected scope server. If you now select the Headless command again via the context menu, you will reconnect to the active recording. The data is displayed again immediately, and all the usual functions are available.

As an alternative to the context menu entry, the Start Record button can be pressed again. The scope detects that an identically configured recording is already running. You will be asked whether a new recording should indeed be started or whether the connection to the existing recording should be restored:

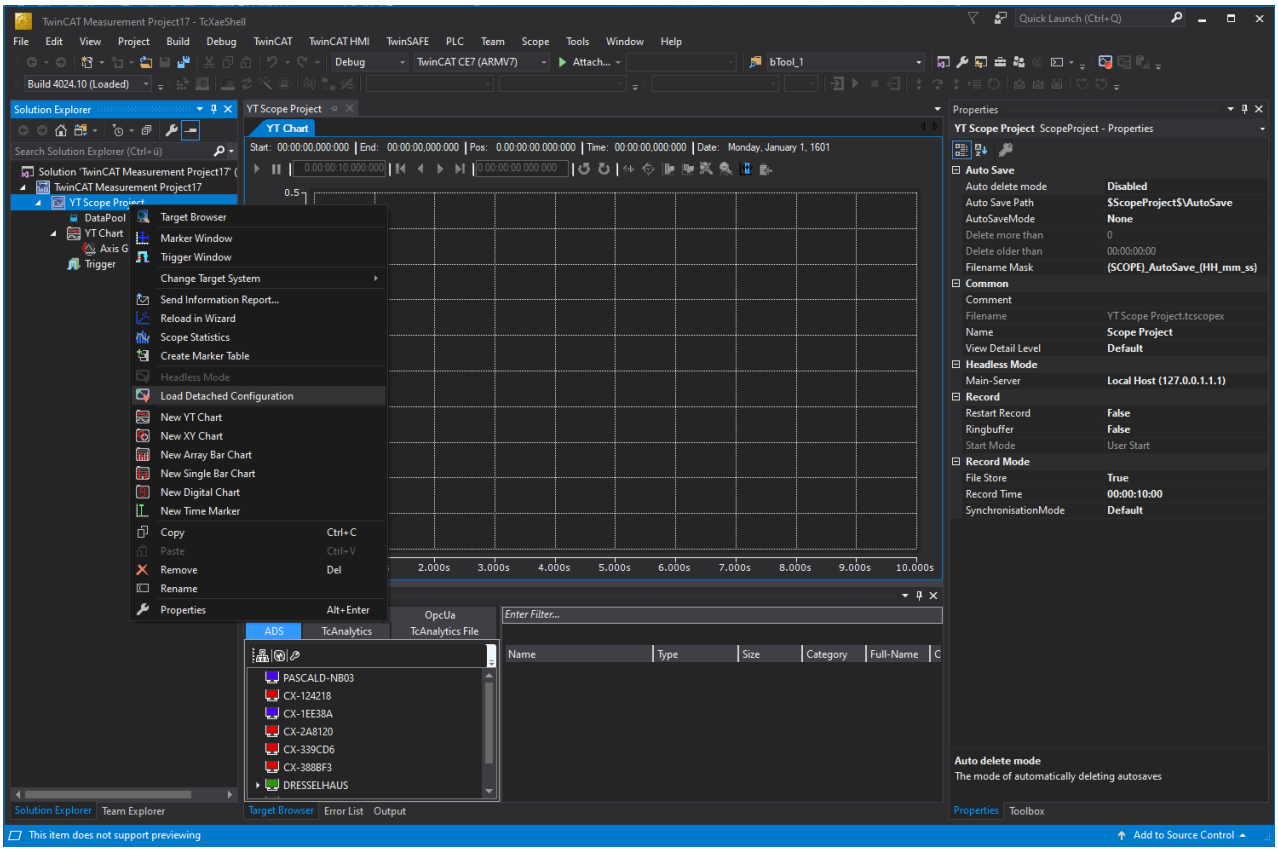


Loss of data

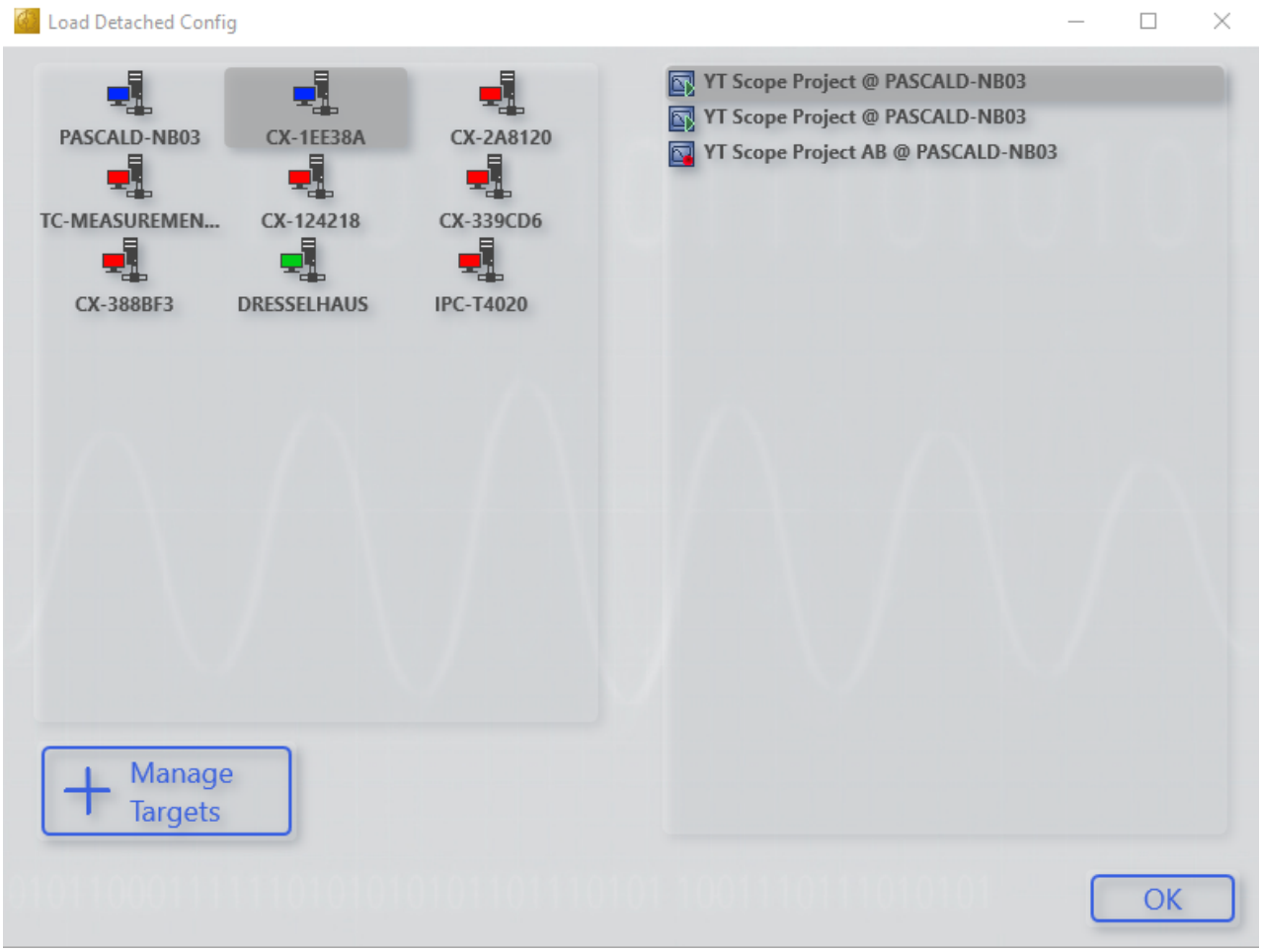
If a recording was terminated regularly during the headless phase, it can only be loaded once by a client afterwards. The data must then be saved consistently as svdx or exported to other formats. Otherwise the data is discarded.

If you do not have the configuration that is currently running on a scope server but would like to view it, you have two options.

In your view you can select the command **Load Detached Configuration** from the context menu of the scope node in the Solution Explorer.



A wizard opens in which you can select the target system (Config or Run mode). If recordings are available, they can be selected and loaded accordingly. If a recording is active, you can connect to it accordingly and see the current values.

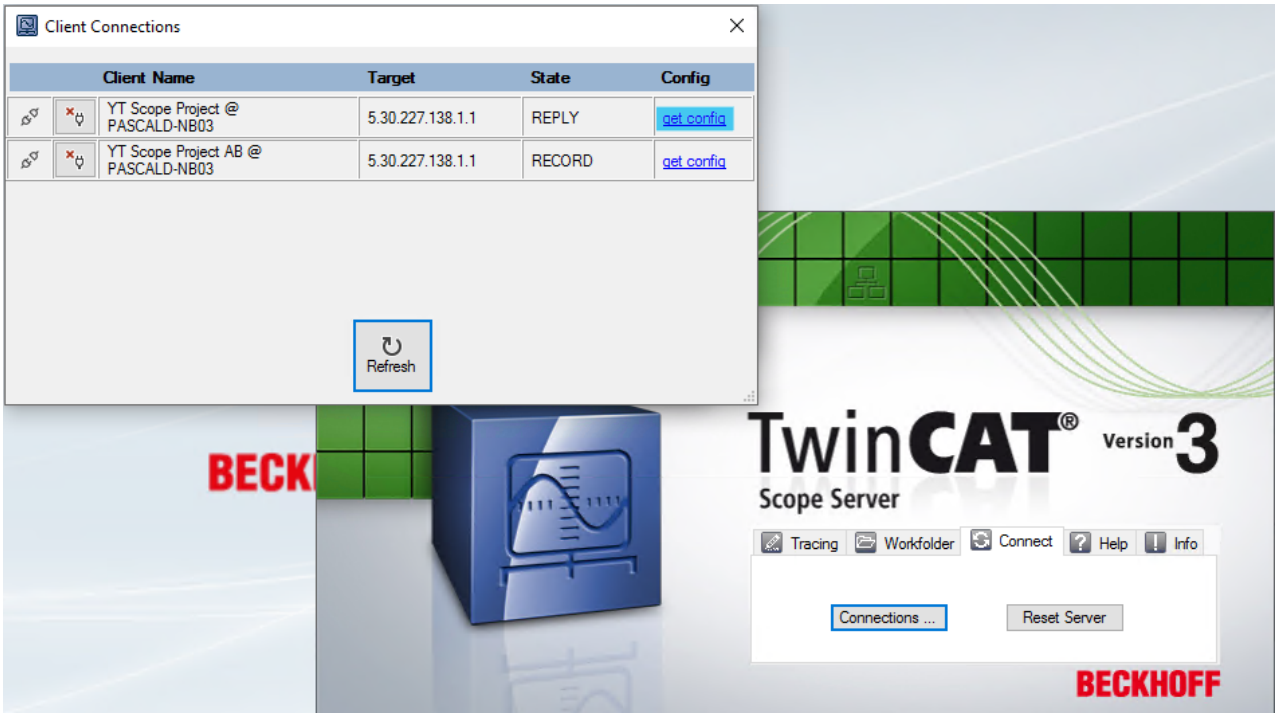


The green Play icon indicates that the recording is complete. The red icon indicates that the recording is still in progress. In both cases, you can load the configuration and connect accordingly.

Alternatively, you can save the configuration locally as a *.tcscopex* file via the Scope Server UI. You can then pass this configuration on to an engineering system with Scope View.



In the Scope Server UI, switch to the **Connect** tab and click the **Connections** button. You will then see an overview of the available configurations and their status.

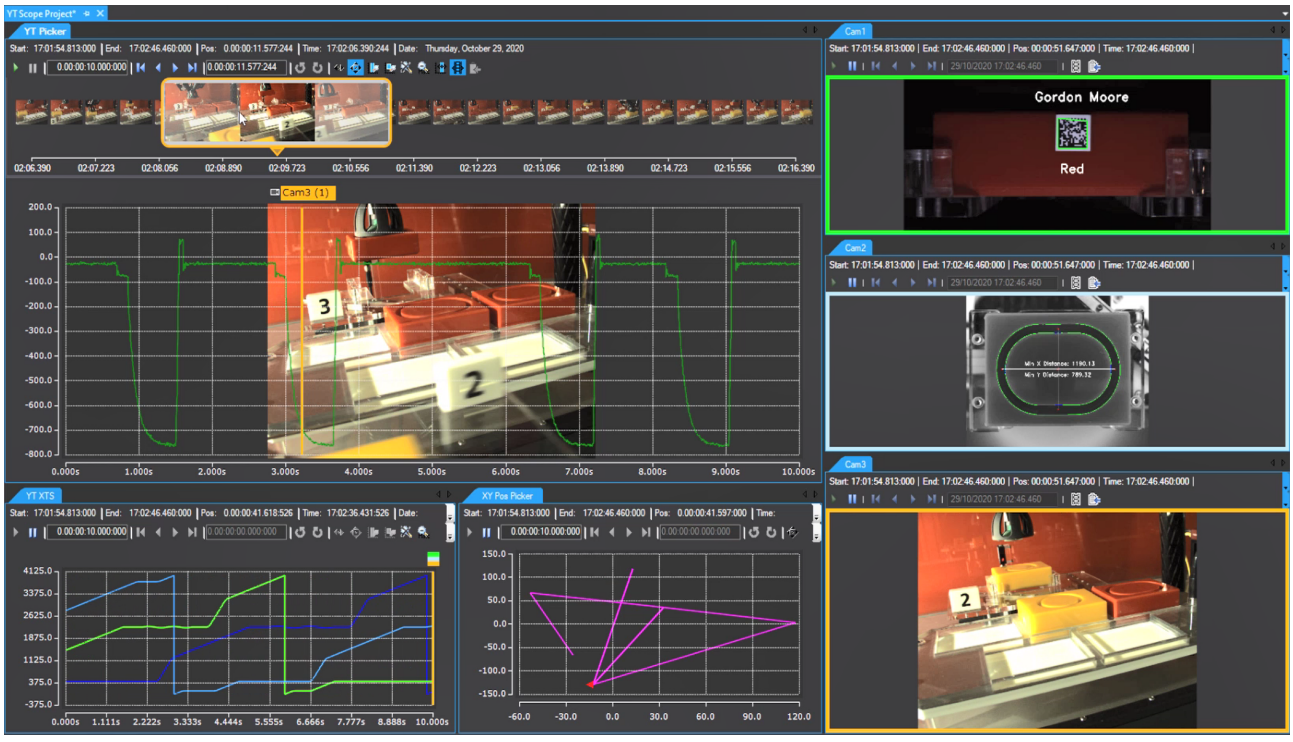


Use the "get config" link to obtain the corresponding configuration as a *.tcscopex* file.

5.2.3 Vision integration

In addition to the process data, Scope View can also display the images that are generated and analyzed with TwinCAT Vision. Thanks to the synchronization between the images and the process data, more than just the measurable values can be controlled via the images.

In addition to the simple display functionality, the images can also be exported [▶ 307] as single images or as video.



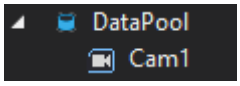
5.2.3.1 TwinCAT settings

Some settings are required in TwinCAT and in the PLC for the Vision images to be recorded and displayed in Scope.

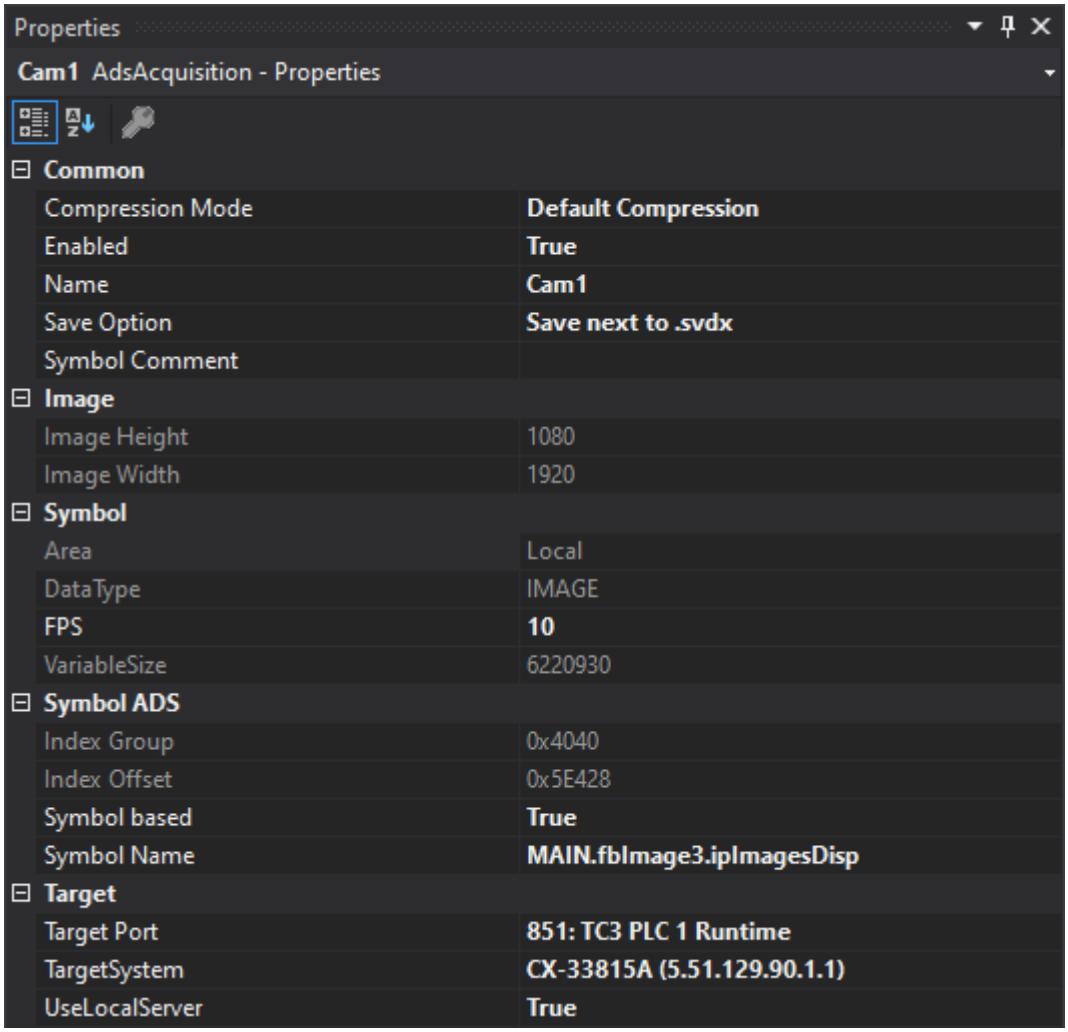
- TwinCAT Version: >= 4024.13
- Data type of the image that should appear in Scope: ITcVnDisplayableImage

5.2.3.2 Image acquisition

After adding an image variable from the Target Browser to the Scope project, an image acquisition is added to the data pool.



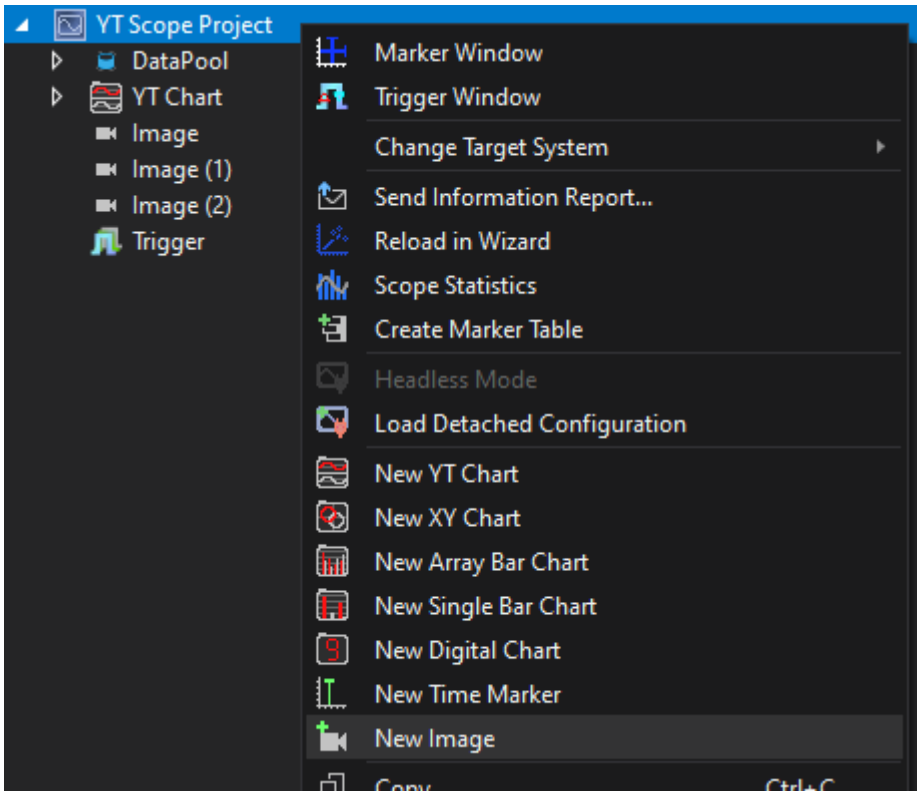
In addition to the typical settings, there are other image-specific settings.



Compression mode	"Default Compression" is set as standard. The incoming images are stored in the server after a jpg compression to keep the file size low. The "Uncompressed" option can be used to save the incoming images in their original size.
Save option	Specify where the images should be saved [▶ 288].
Image Height / Image Width	Information about the dimension of the selected image.
FPS	Number of images to be captured in one second.

5.2.3.3 Image display

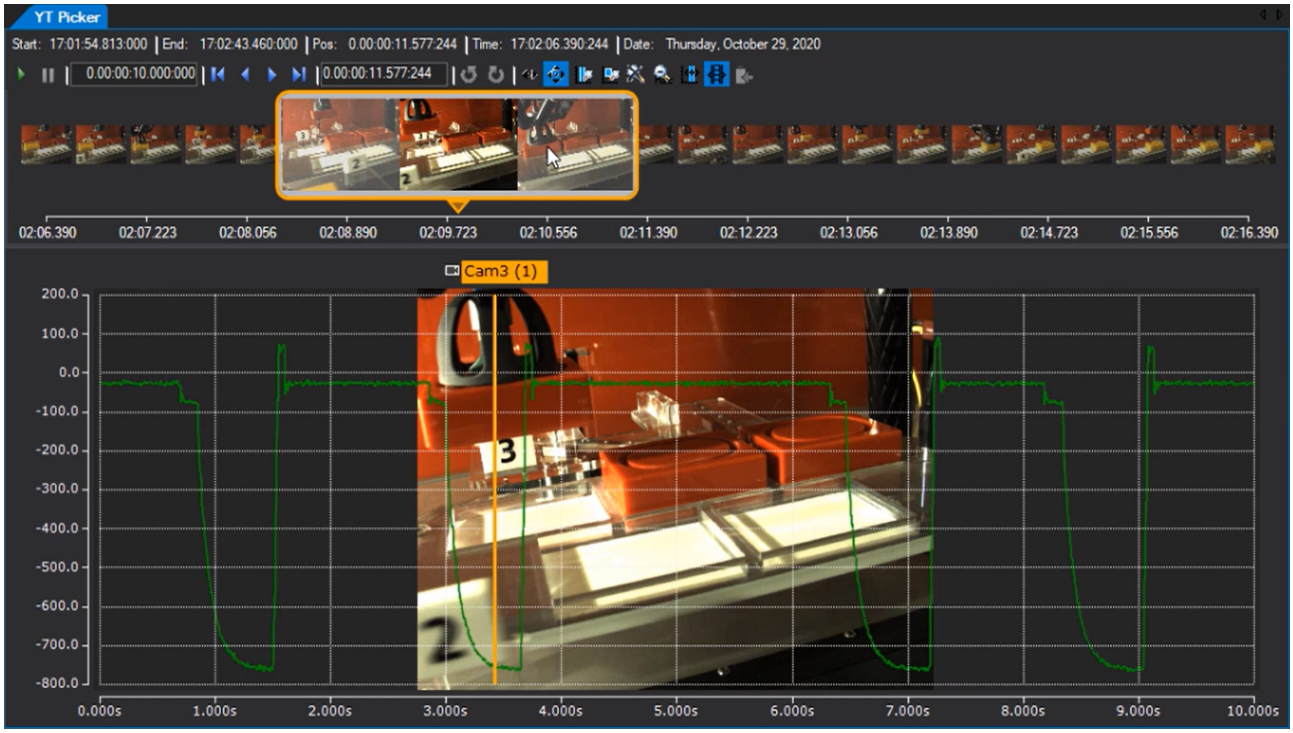
In order to be able to display the images from the image acquisition, a new "Image" can be added via the context menu in the Scope Project or in any chart. You can also drag and drop an image acquisition from the data pool into a chart or the project.



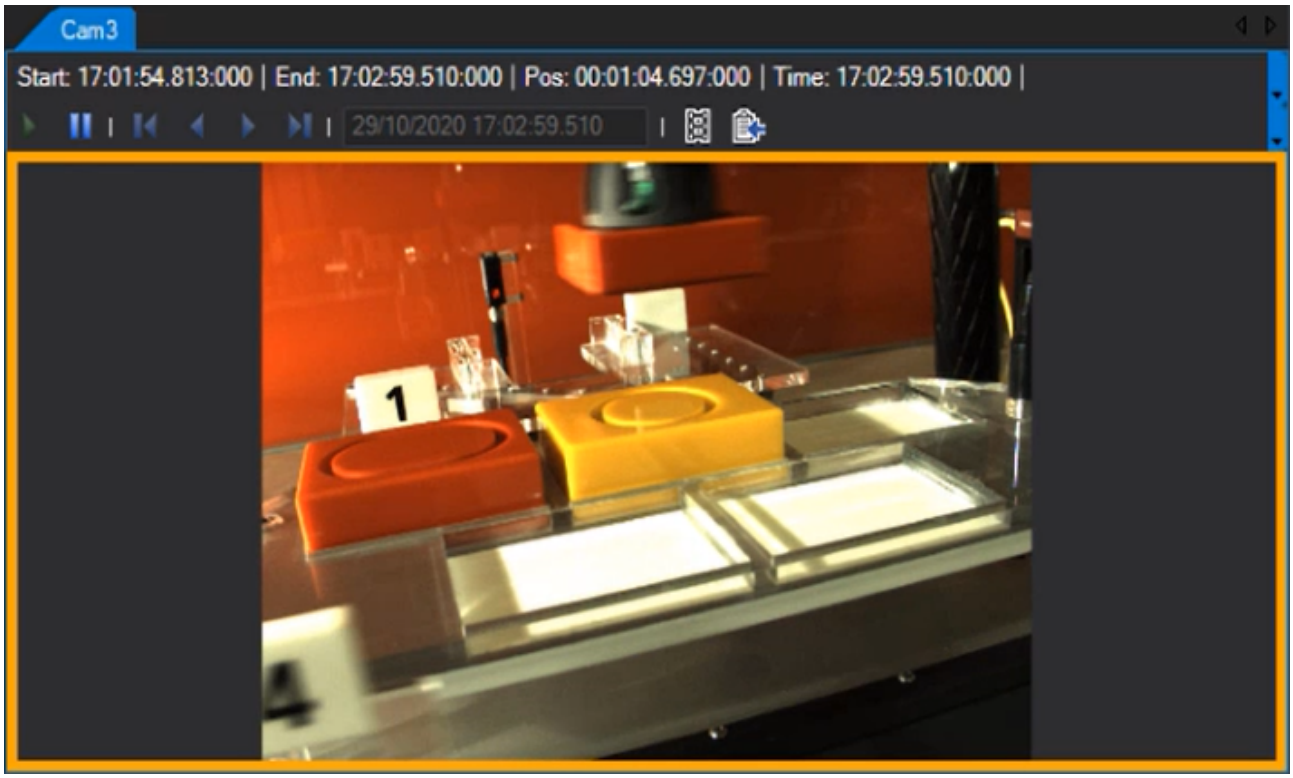
A project can contain any number of images; a chart can contain only one image.

Depending on the position of the image, the element consists of several displayed objects.

If the image is inserted under a chart, another time marker is displayed in the chart, which always shows the position of the current image. By moving the time marker, the currently displayed image can be changed. The current image is displayed behind the chart.



If the image is under a Scope project, the displayed objects can be found in several places. Each chart contains a time marker, which marks the current time of the image. There is also another image view that can be docked next to the charts. The view only shows the data and information of the one image. For better recognition between the time markers in the charts and the image view, the image is outlined in the marker color.



An overview of the entire record is also displayed above the current image in the film track control.

The control can be shown or hidden using the



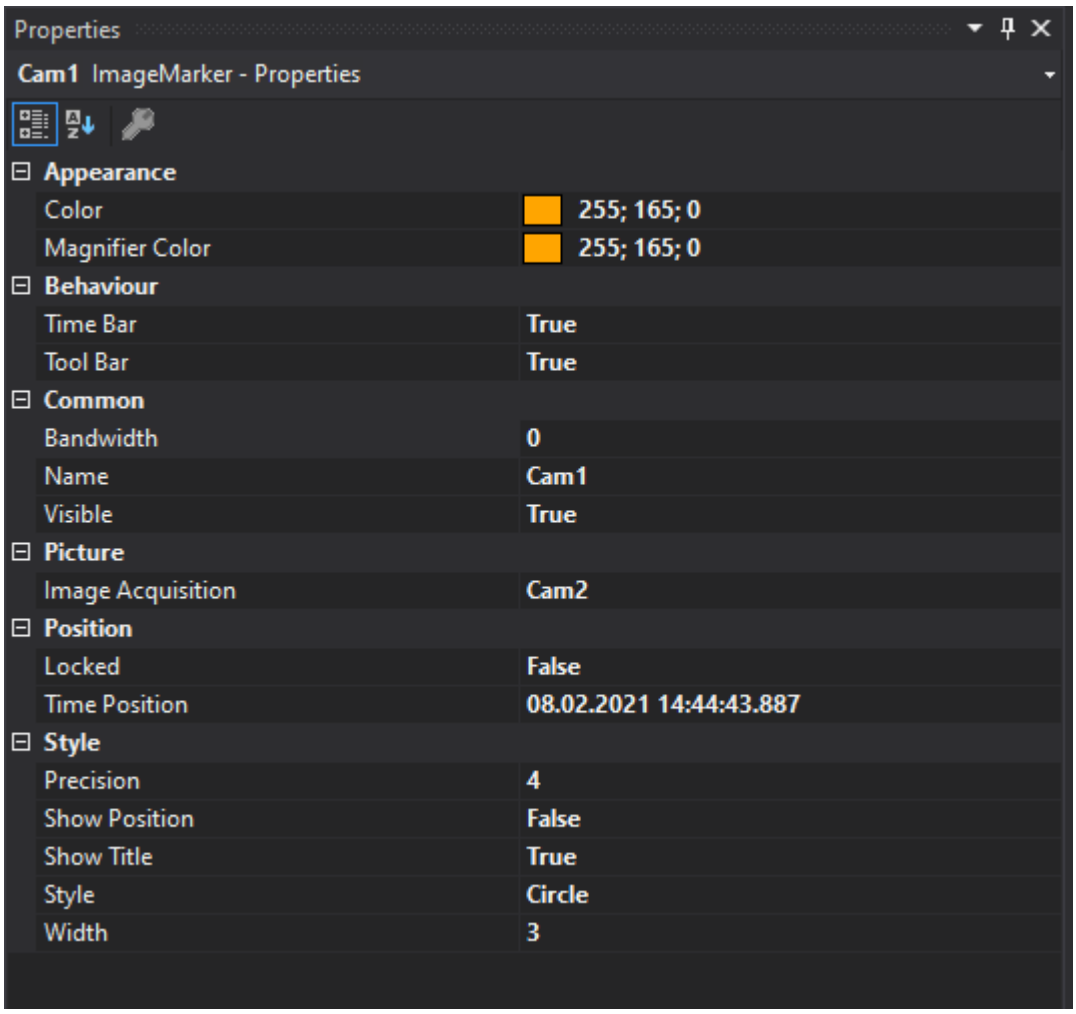
Film Track icon.

Within the film track, images of the recording are displayed above the time axis in two layers.

Images of the entire recording time are displayed in the layer at the back. Clicking on an image also makes the enlarged image move to the respective time, and the enlarged version of the clicked image is displayed.

The magnifier is displayed in the layer at the front. This is used for better and more accurate scrolling through the images. Use the mouse to drag the magnifier across the time bar to change the position of the current image. Additional images are displayed within the magnifier. The current image is displayed in the center, and the immediately preceding or following images are displayed to the right and left. By clicking on the images, the current image position moves to the next image. This allows you to scroll through the recording image by image. In addition to the images, the magnifier also shows the current position on the time bar.

In addition to the default marker settings, there are a several other settings:



Color	Adjust the color of the marker and the image control border.
Magnifier Color	Adjust the color of the magnifier in the image control.
Time Bar	Show or hide time information in the image control.
Tool Bar	Show or hide controls in the image control.
Image acquisition	Selection of the current image acquisition.

5.2.3.4 Performance optimization

- In order to optimize communication with larger images, the router memory should be increased on the TwinCAT system.
- To reduce the network load, the size of the images sent to the Scope server can be reduced.
- Since the raw images are communicated between the TwinCAT system and the Scope server, it makes sense to run the Scope server locally on the control system. The communication between the Scope components can be optimized by image compression for display.
  "UseLocalServer [▶ 188]" must be set to False for this purpose.
- If you have a very high network load and many large images, it is advisable to lower the FPS [▶ 188].

5.2.4 Physical units

Measured values can be recorded and displayed as a graph with the aid of the TwinCAT 3 Scope. To make interpretation of the recorded data easier, the TwinCAT 3 Scope offers the option of setting a physical unit for each individual channel. Firstly, this enables the unit in which the measured values were recorded to be made known. Secondly, the data can be converted into other units so that the user has the option to view the data, meaningfully scaled, in a unit that he selects.

5.2.4.1 Introduction

Base units

The units in TC3 Scope are based on the SI system of units. Both the seven standard SI units and all units that can be derived from the product of any powers of these seven standard SI units are designated base units. These base units are coded in TC3 Scope via unique Enum values. To do this, four bits are interpreted as a signed value for each power value of the base units and combined to form a 32-bit integer (Int32), so that any derived units (limited only by the size of the data type) can be formed. Each digit of the Enum value represents one of the base units so that a unit is formed from the following equation in the case of an Enum value of "0xabcdefgh":

E = Angle^{a} * Luminous Intesity^{b} * Amount of Substance^{c} * Temperature^{d} * Current^{e} * Time^{f} * Mass^{g} * Length ^{h}

The following table shows the basic values for the calculation of the derived units.

Measured variable	Name of the unit	Symbol of the unit	Enum value
Dimensionless values	Unit of One	1	0x00000000
Length	Meter	m	0x00000001
Mass	Kilogram	kg	0x00000010
Time	Second	s	0x00000100
Current	Ampere	A	0x00001000
Temperature	Degree Celsius	°C	0x00010000
Amount of Substance	Mole	mol	0x00100000
Luminous Intensity	Candela	cd	0x01000000
Angle	Radian	rad	0x10000000

In addition to the seven standard SI units, two further units are listed here that are relevant for practical use. One of them is the "Unit of One" for dimensionless variables, which also serves as the default value if no other unit has been set. On the other hand, the angle is also considered, since there are several units such as the angular velocity or the solid angle that are composed of the powers of the angle, even though the angle is actually dimensionless. A further peculiarity is mass with its SI unit of kilogram, because unlike the other SI units it already contains a prefix in its basic form. Therefore, in order to be able to carry out scaling with the aid of prefixes, gram is assumed as the unit of mass in TC3 Scope View instead of kilogram. For the derived units, however, the mass percentage is nevertheless represented as kilograms, as the definition would otherwise no longer fit.

In order to form units derived from these basic values, the powers of the standard SI units must be multiplied accordingly. For example, if a force is to be illustrated in Newton, the rule is: N = m^{1} * kg^{1} * s^{-2}, resulting in an Enum value of 0x00000E11. E represents the power of "-2" here, which results from the display as two's complement in the hexadecimal system. All the derived base units already predefined in TC3 Scope are listed below.

Measured variable	Name of the unit	Symbol of the unit	Enum value
Absorbed Dose	Gray	Gy	0x00000E02
Acceleration	Meter per square second	$m * s^{-2}$	0x00000E01
Angular Acceleration	Radian per square second	$rad * s^{-2}$	0x10000E00
Angular Velocity	Radian per second	$rad * s^{-1}$	0x10000F00
Area	Square meter	m^2	0x00000002
Capacity	Farad	F	0x000024FE,
Catalytic Activity	Katal	kat	0x00100F000
Charge	Coulomb	C	0x00001100
Conductance	Siemens	S	0x000023FE
Energy	Joule	J	0x00000E12
Force	Newton	N	0x00000E11
Frequency	Hertz	Hz	0x00000F00
Illuminance	Lux	lx	0x0100000E
Inductance	Henry	H	0x0000EE12
Luminous Flux	Lumen	lm	0x21000000
Magnetic Flux	Weber	Wb	0x0000FE12
Magnetic Flux Density	Tesla	T	0x0000FE10
Power	Watt	W	0x00000D12
Pressure	Pascal	Pa	0x00000E1F
Resistance	Ohm	Ω	0x0000ED12
Solid Angle	Steradian	sr	0x20000000
Velocity	Meter per second	$m * s^{-1}$	0x00000F01
Voltage	Volt	V	0x0000FD12
Volume	Cubic meter	m^3	0x00000003

Any other base units can be formed by means of the Enum values (see also Configuration of units with the aid of PLC attributes [▶ 207]).

However, the specification of the base unit is insufficient in order to represent a unit completely and to scale the measured values in a suitable manner afterwards. Therefore, further parameters need to be specified: a scaling factor, an offset and a prefix. The scaling factor and the offset are used to convert the raw values into the appropriate unit. The prefix offers the option to scale a unit by the power of ten. The following prefixes are available. For example, if "milli" is selected as the prefix, the respective unit is divided by 10^{-3} so that automatic adjustment of the scaling takes place.

Name of the prefix	Symbol of the prefix	Multiplication factor	Enum value
Yocto	y	10^{-24}	-24
Zepto	z	10^{-21}	-21
Atto	a	10^{-18}	-18
Femto	f	10^{-15}	-15
Pico	p	10^{-12}	-12
Nano	n	10^{-9}	-9
Micro	µ	10^{-6}	-6
Milli	m	10^{-3}	-3
Centi	c	10^{-2}	-2
Deci	d	10^{-1}	-1
None	-	10^{0}	0
Deca	da	10^{1}	1
Hecto	h	10^{2}	2
Kilo	k	10^{3}	3
Mega	M	10^{6}	6
Giga	G	10^{9}	9
Tera	T	10^{12}	12
Peta	P	10^{15}	15
Exa	E	10^{18}	18
Zetta	Z	10^{21}	21
Yotta	Y	10^{24}	24

Transformations

In the measurement technology application area, it is frequently the case that an SI unit has to be converted into another SI unit. This is the case, for example, when an acceleration is measured with the aid of a sensor and a fieldbus terminal. Voltages or currents are initially measured, which should give an indication of the acceleration. For this reason, the TC3 Scope also provides for the transformation from one SI unit into another SI unit. Such a transformation is defined by a source variable (source unit), a target variable (target unit), a scaling factor for the conversion and a name.

Example:

- Source variable: Voltage
- Target variable: Acceleration
- Scaling factor: 0.101937
- Name: Accelerometer

User units

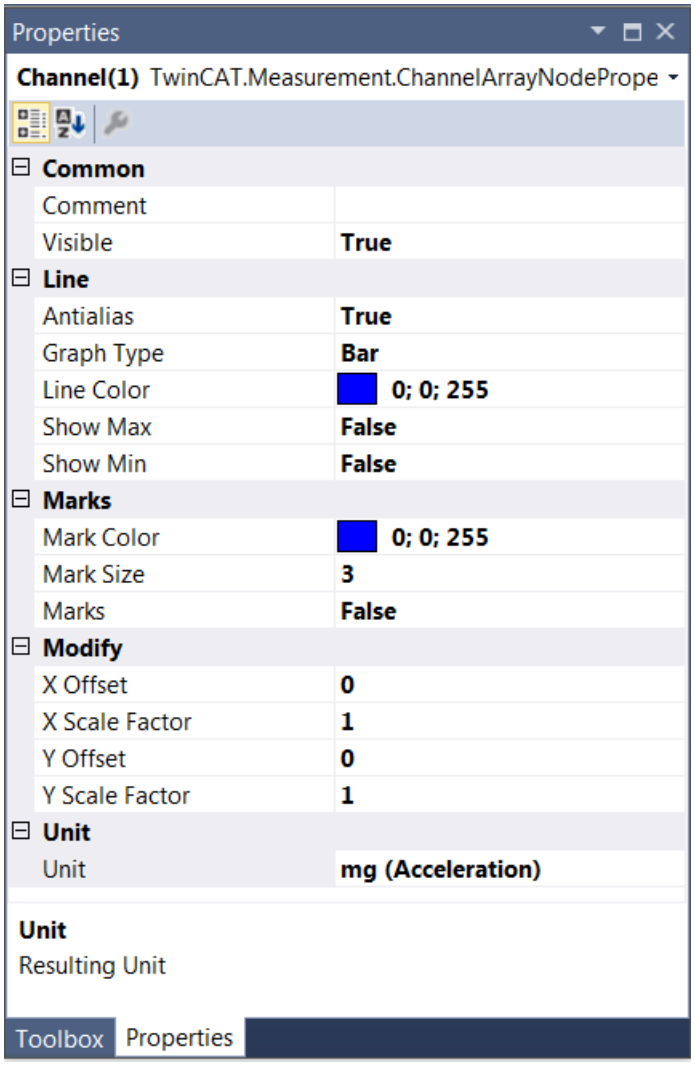
In addition to the SI system of units there are further systems of units that are also used in practice (CGS system of units, Anglo-American system of measurement, etc.). In order to be able to represent such units too, the TC3 Scope provides for so-called user units into which the base units can be converted. A user unit is defined through its associated basic variable, the name and the symbol of the user unit, a scaling factor and an offset for conversion as well as a prefix. For the user unit gravitation (g), for example, this results in the following values:

- Basic variable: Acceleration
- Name: Gravity
- Symbol: g
- Scaling factor: 1 / 9.81
- Offset: 0
- Prefix: none

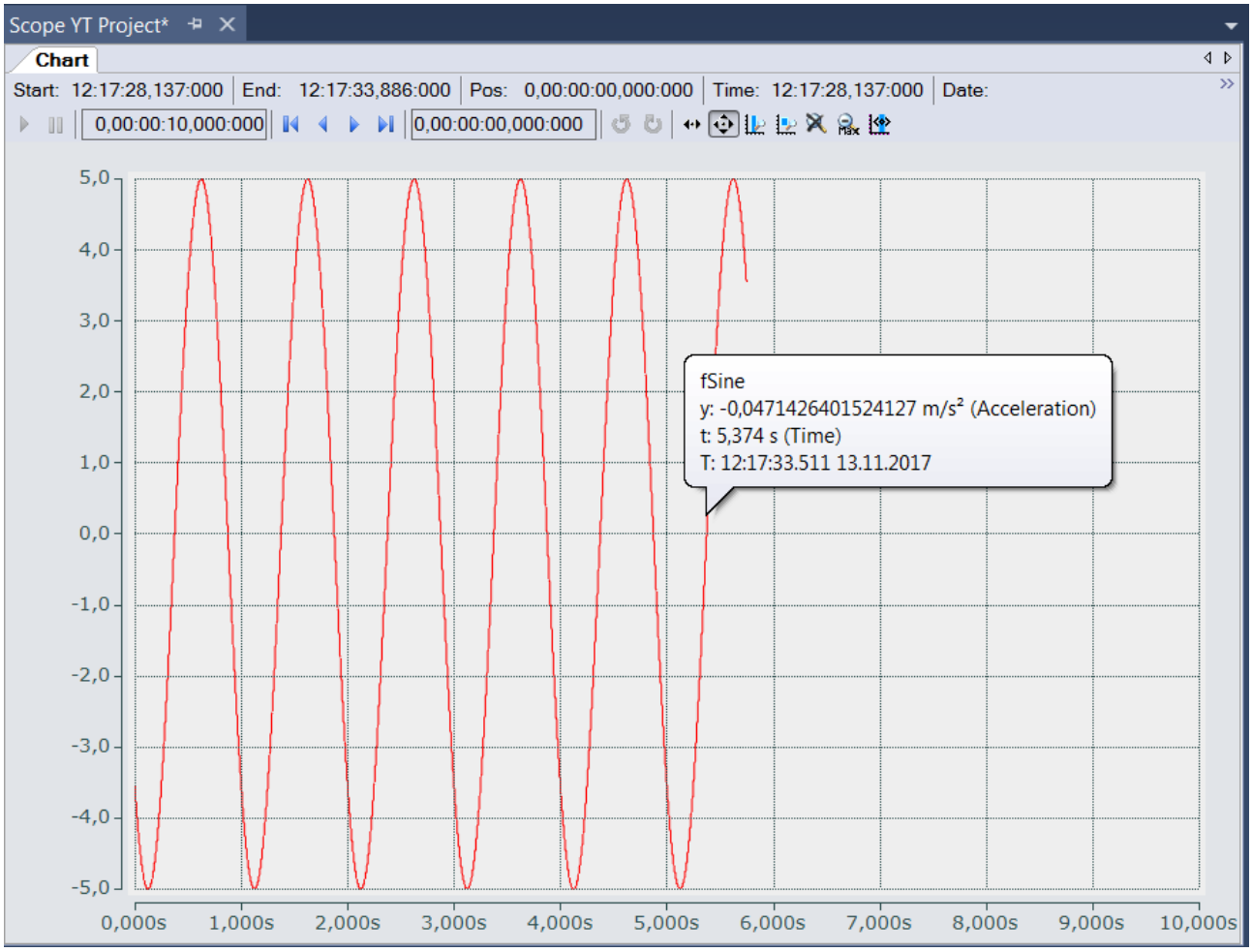
Resulting unit

A unit in the TC3 Scope can thus be composed of the three elements base unit, transformation and user unit, depending on what is required in the specific application case. However, it is always the resulting unit that is displayed. If a voltage is the basic variable, which is then converted via a transformation into an acceleration in m/s^2 and from there into g with the aid of a user unit, the measured data and offset with the scaling factors and offsets and the result is the acceleration in g.

The following illustration shows how the resulting unit is displayed in the Properties window:



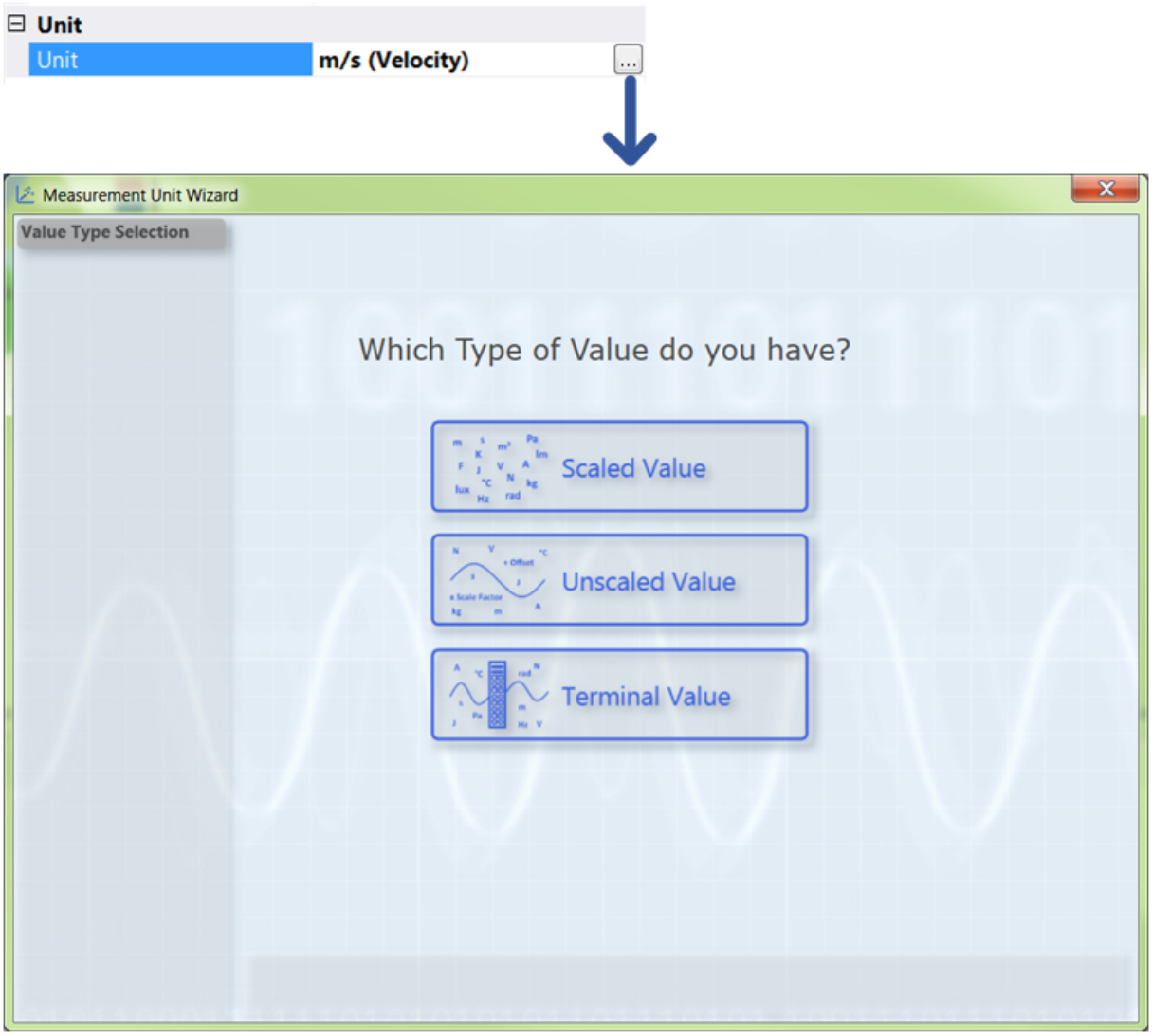
If existent, the symbol for the prefix will be displayed first. After that comes the symbol for the unit and subsequently the measured variable in brackets. Apart from the display in the **Properties** window, the units also appear in the tooltips that appear when clicking on a data point (see illustration) and are displayed in the marker window.



5.2.4.2 Configuring units with the aid of the Unit Wizard

The units can be set for each individual channel in the TC3 Scope. They are displayed in the **Properties** window for the channel style and can also be configured there with the aid of the Unit Wizard.

To open the Unit Wizard, click on the button with the three points on the right of the field.

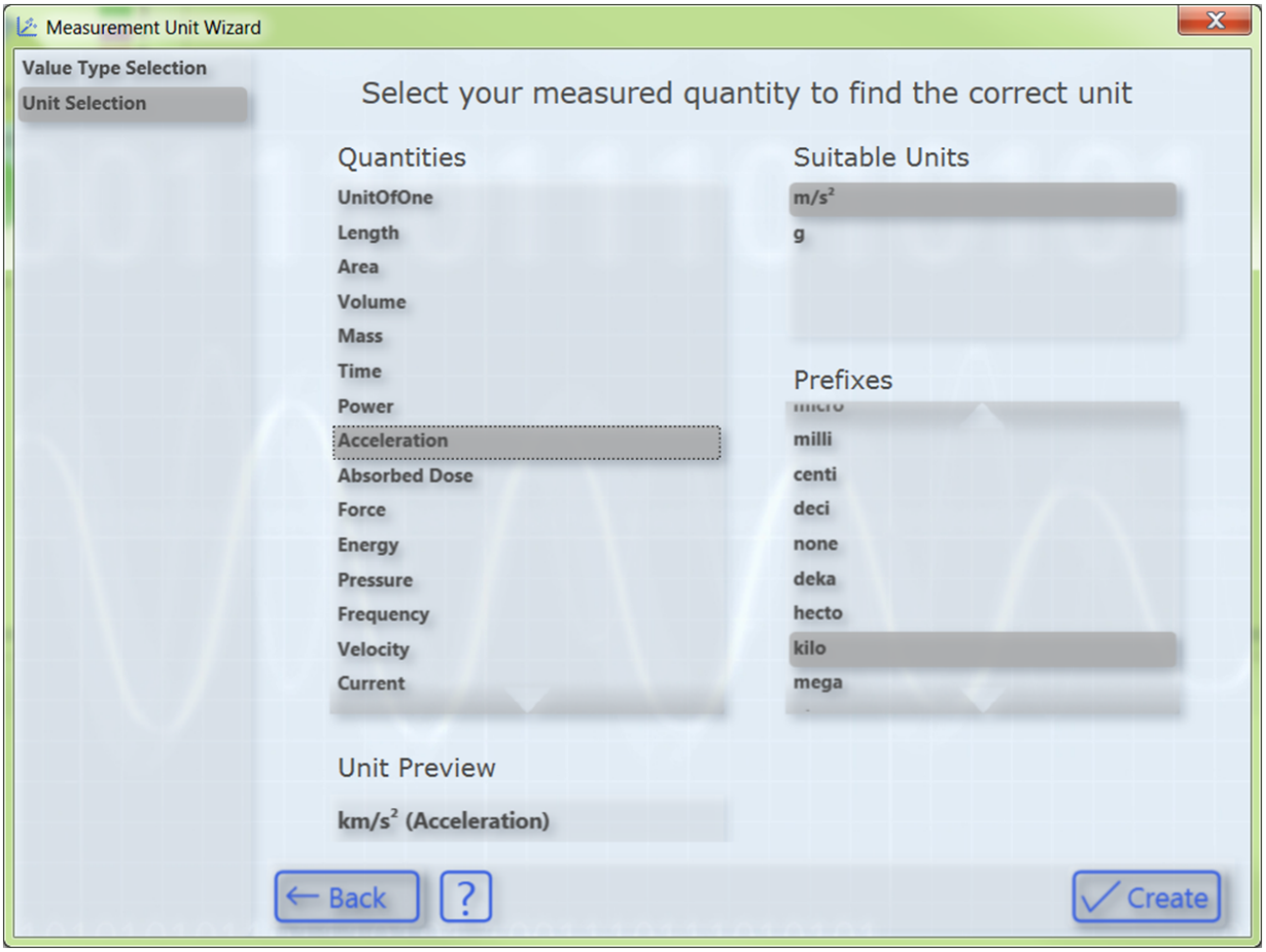


On the first page of the wizard there are three selection options between which you can choose, depending on the type of values you have measured and recorded with the TC3 Scope.

- Scaled Value**:** If you have already scaled your values as desired and only wish to enter the appropriate unit, select the option "Scaled Value" [▶ 197].
- Unscaled Value**:** If you have not yet scaled your values and wish to scale them yourself with the aid of a scaling factor and an offset in addition to selecting the unit, select the option "Unscaled Value" [▶ 198].
- Terminal Value**:** If you have measured your values using a Beckhoff fieldbus terminal and now wish to scale the values automatically through the setting of the hardware employed and to generate a unit, select the option "Terminal Value" [▶ 202]. (However, this option is available only with the Scope View Professional License).

Scaled Value

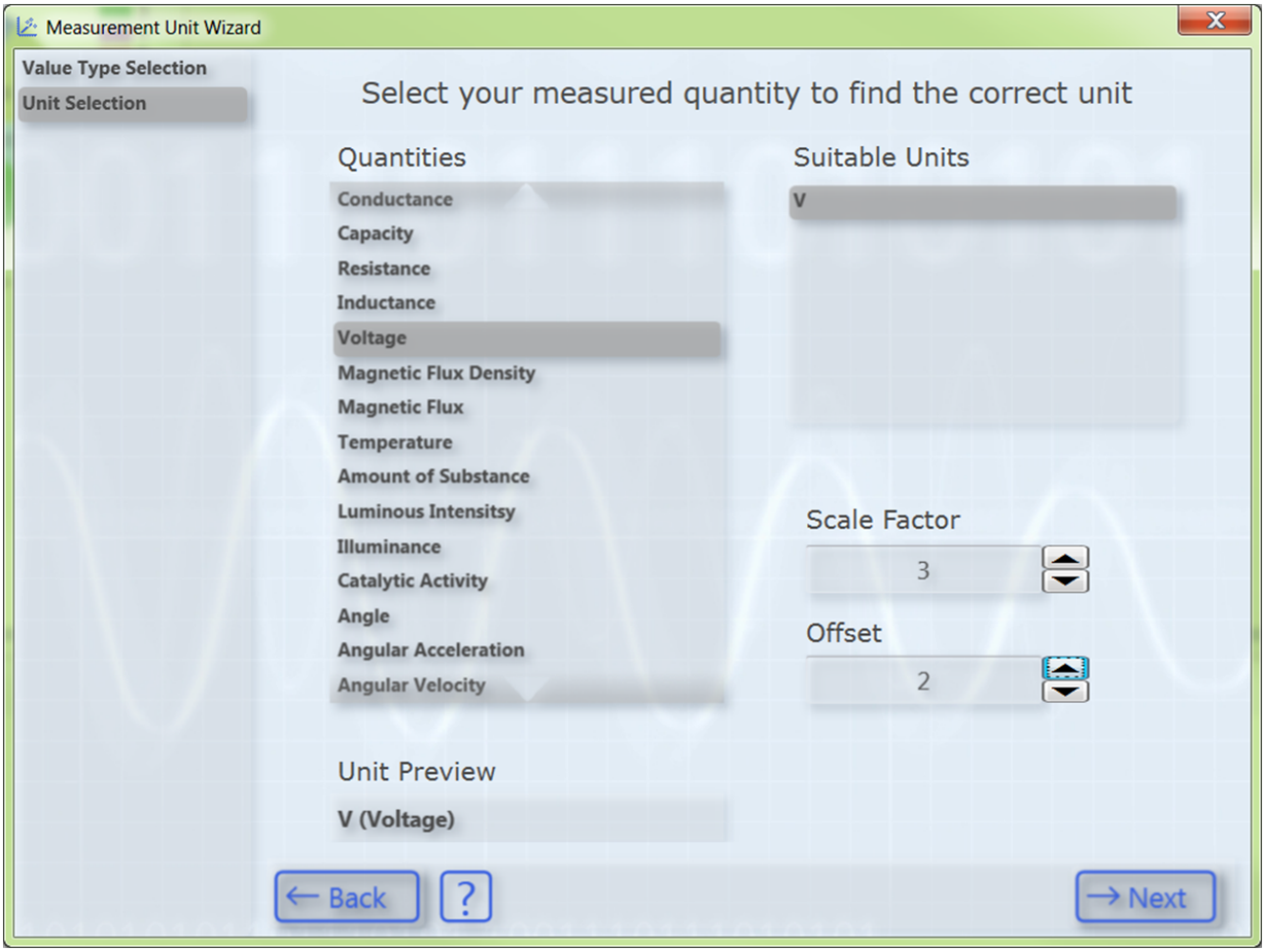
If you have selected the option "Scaled Value", the following page opens:



In order to select a unit, first select your measured variable. Subsequently, all units that come into question for the selected measured variable are displayed on the right-hand side. After you have selected the desired unit you can optionally select a prefix. In the "Unit Preview" field at the bottom left you can see how the currently selected unit will be displayed later in the **Properties** window. Finally, you can set the unit with the **Create** button. Since the values have already been scaled appropriately, no conversion of the values takes place in this case. The selected unit is merely entered and displayed.

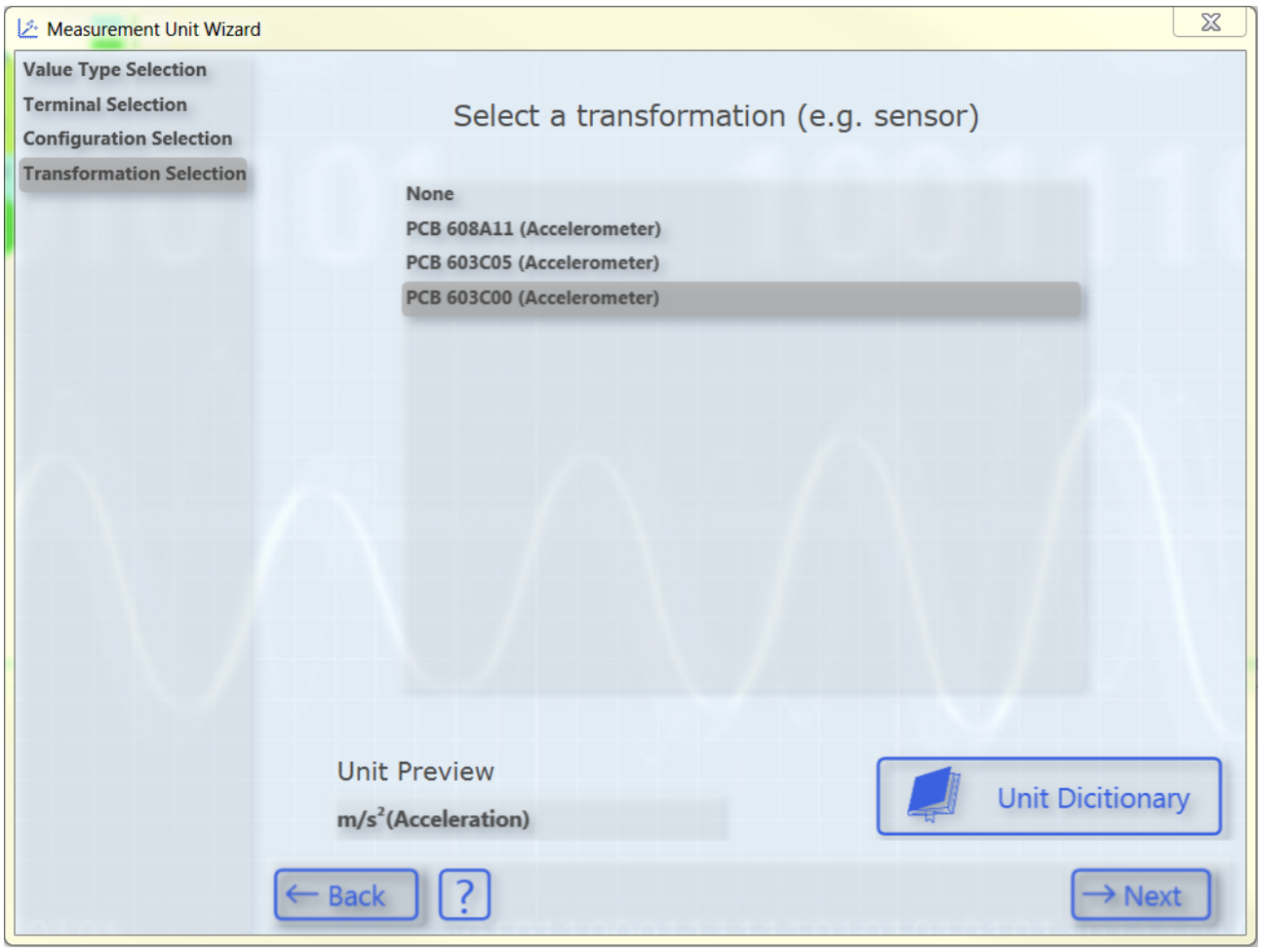
Unscaled Value

If you have selected the option "Unscaled Value", the following page opens:



In order to select a unit, first select your measured variable. Subsequently, all units that come into question for the selected measured variable are displayed on the right-hand side. After having selected the desired unit you can specify a scaling factor and an offset with which the measured values are to be converted into the appropriate unit.

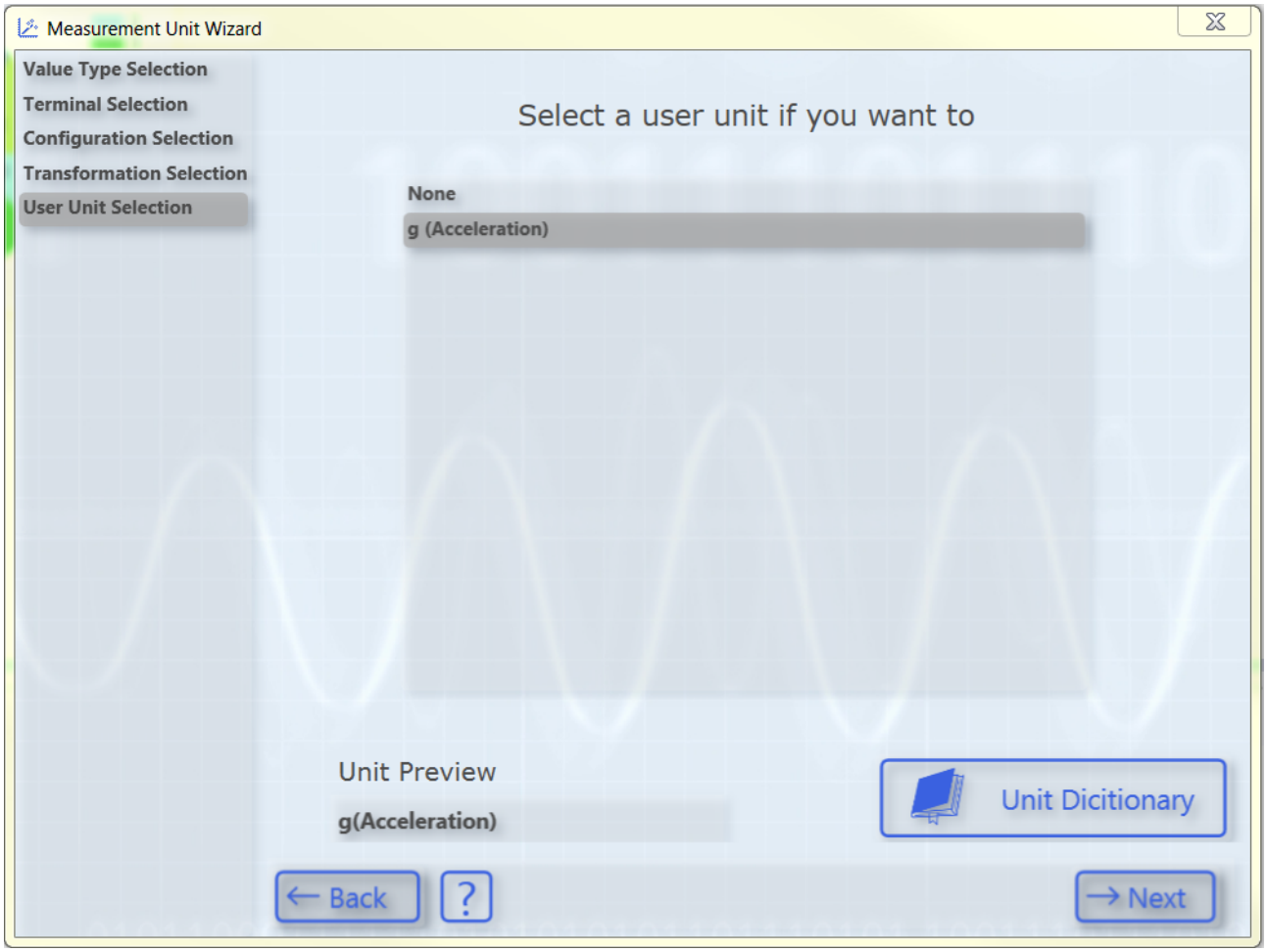
Subsequently, the **Next** button takes you to the next page, on which you can optionally select a transformation (e.g. a sensor). However, this page only appears if the previously selected unit is a base unit and not a user unit. Otherwise you will be taken directly to the last page of the dialog (Prefix Selection).



The list shows transformations from one SI unit to another SI unit. The list contains only transformations whose source unit corresponds to the previously selected base unit. The associated target unit is displayed in the "Unit Preview" field at the bottom left if a transformation is selected. If no transformation is required, simply select **None**.

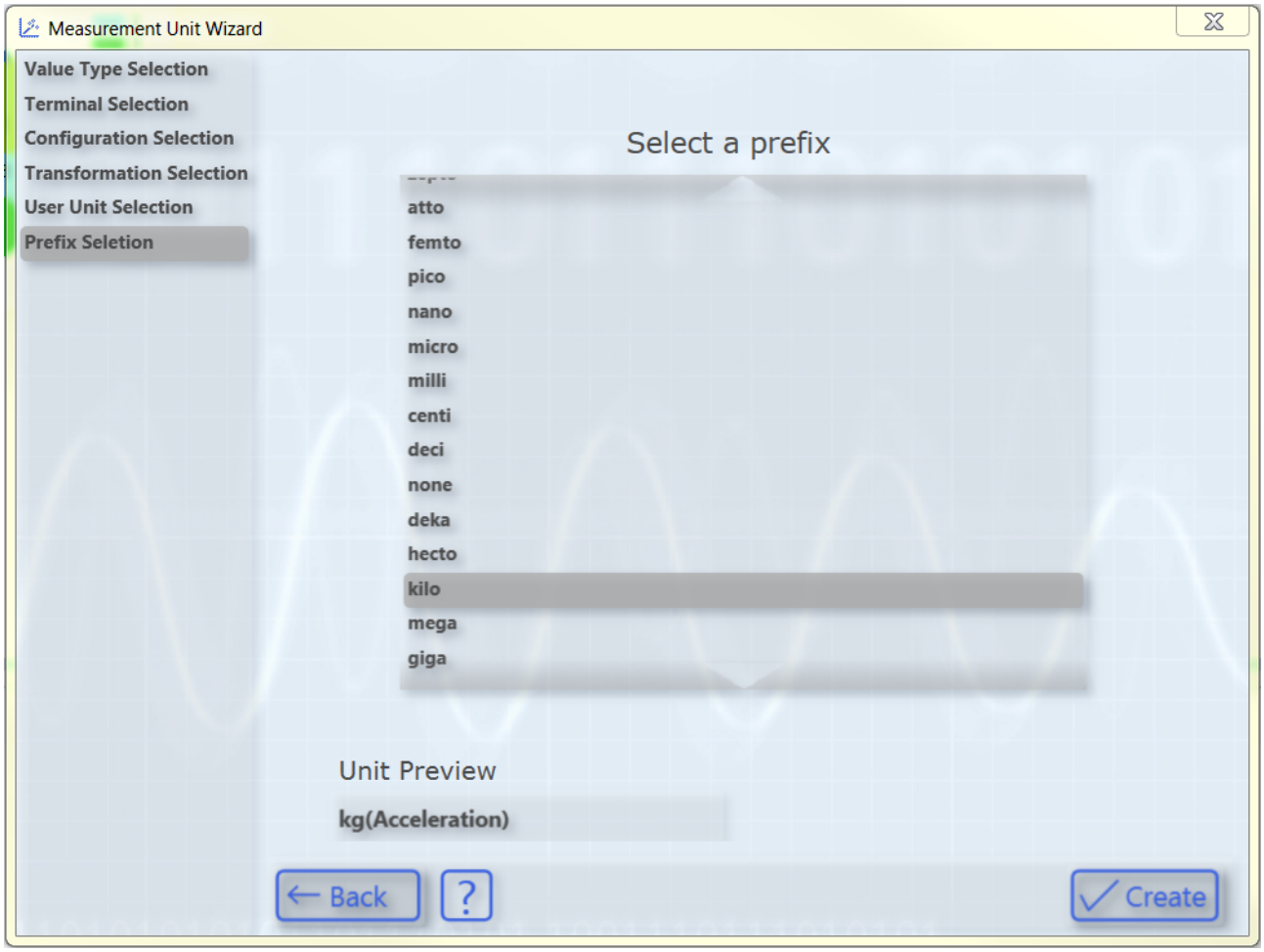
Some transformations are predefined as examples in the TC3 Scope. However, these frequently depend on the specific application case (sensor, measuring setup, etc.), therefore it is not particularly useful to define a large number of generally valid transformations. You can therefore create your own transformations with the aid of the Unit Dictionary, which you can access via the button at the bottom right or via the Scope options [▶ 311]. Detailed information about the Unit Dictionary can be found in the section Unit Dictionary Editor [▶ 208]. Furthermore, there is an option to enter transformations via the PLC attributes (see Configuration of units with the aid of PLC attributes [▶ 207]).

After having selected the desired transformation, the **Next** button opens the next page, on which you can optionally select a user unit.



Once again, only user units that match the previously selected base unit appear. Some frequently used user units are predefined. As with the transformations, further user units can be added via the Unit Dictionary or the PLC attributes.

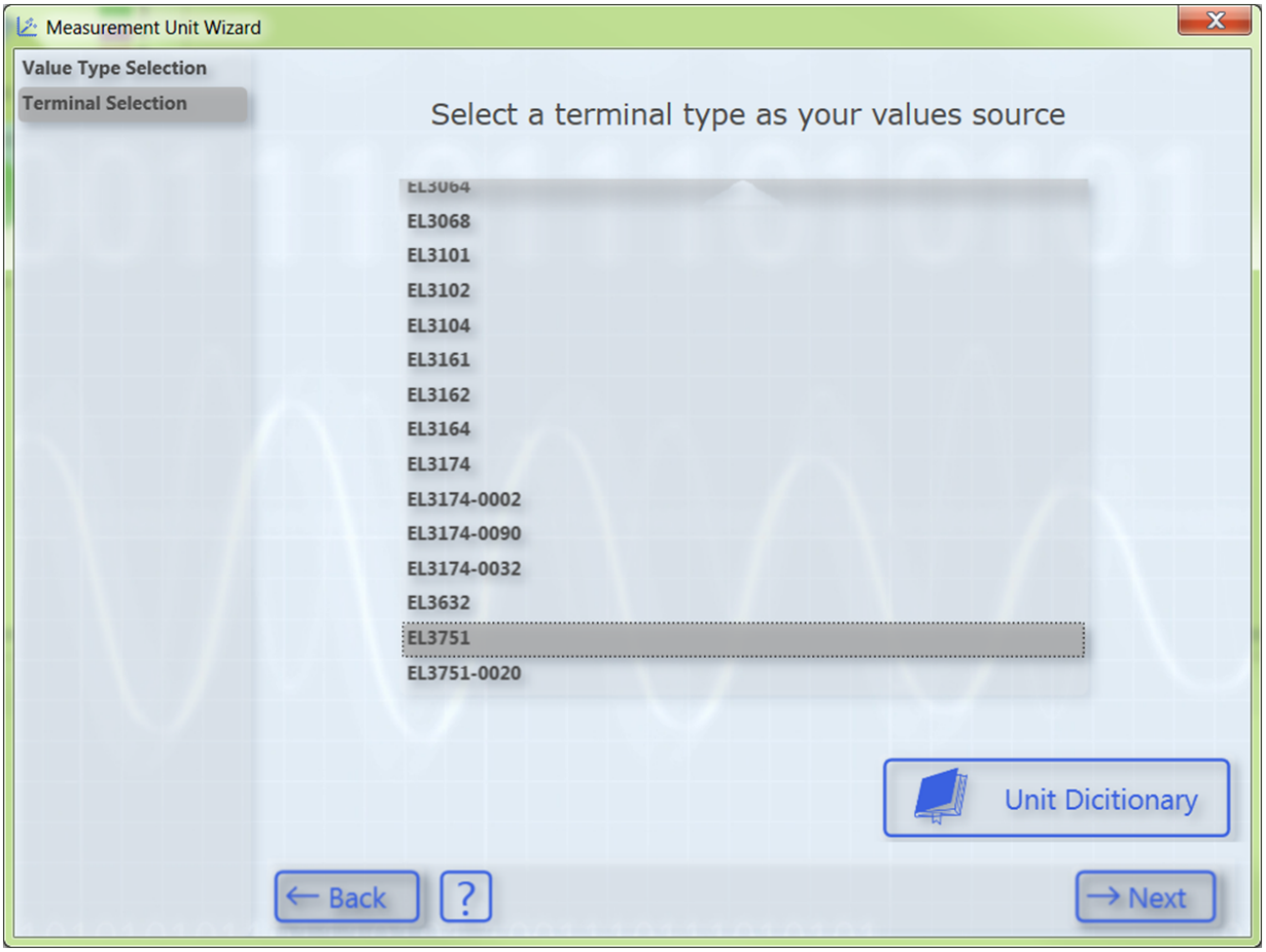
After selecting the user unit, you will be taken to the last page of this dialog:



Here you can optionally select a prefix for your unit. This is then also displayed in the "Unit Preview". Finally, you can create the configured unit with the aid of the **Create** button.

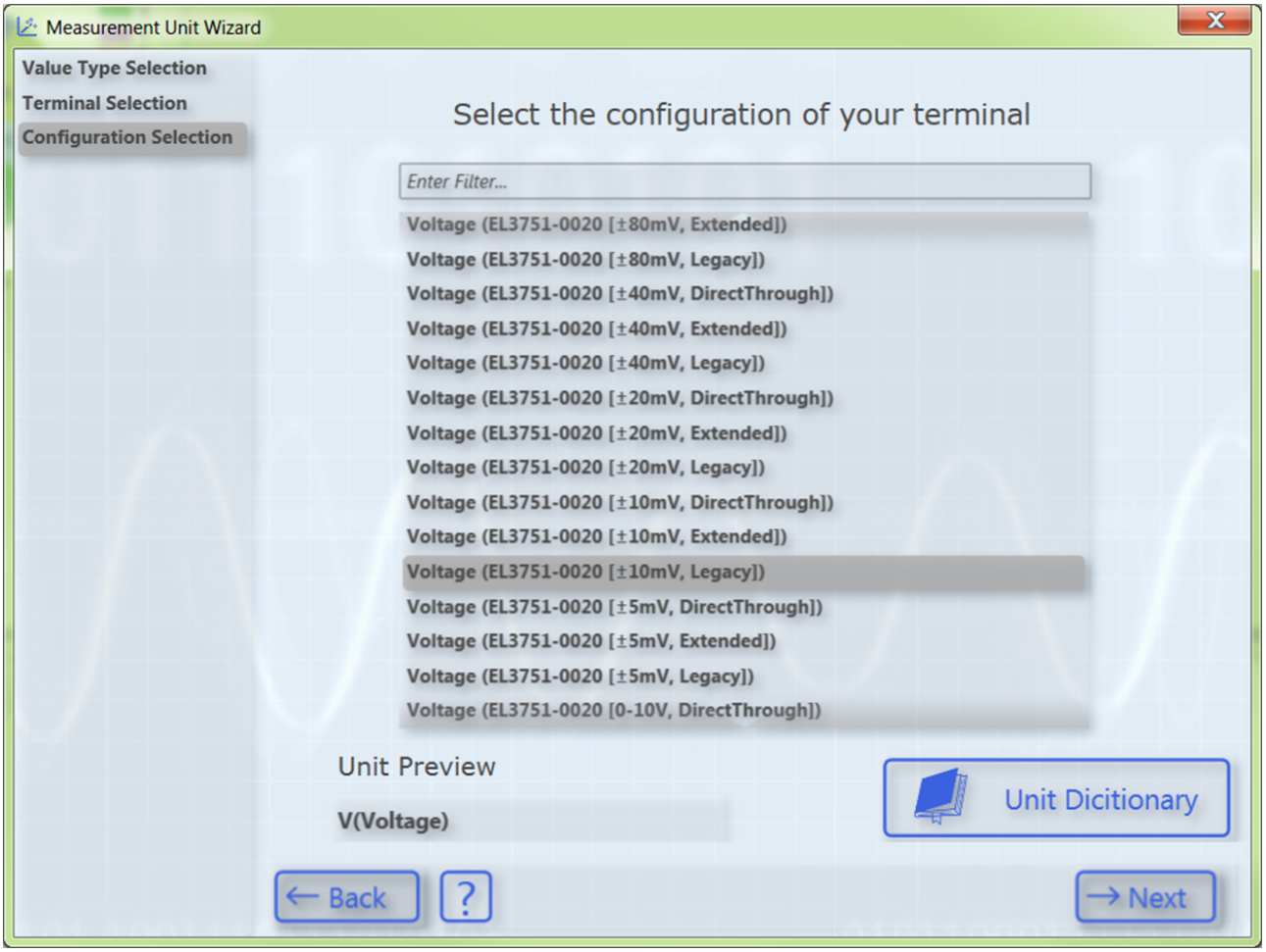
Terminal Value

If you have selected the option "Terminal Value", the following page opens:



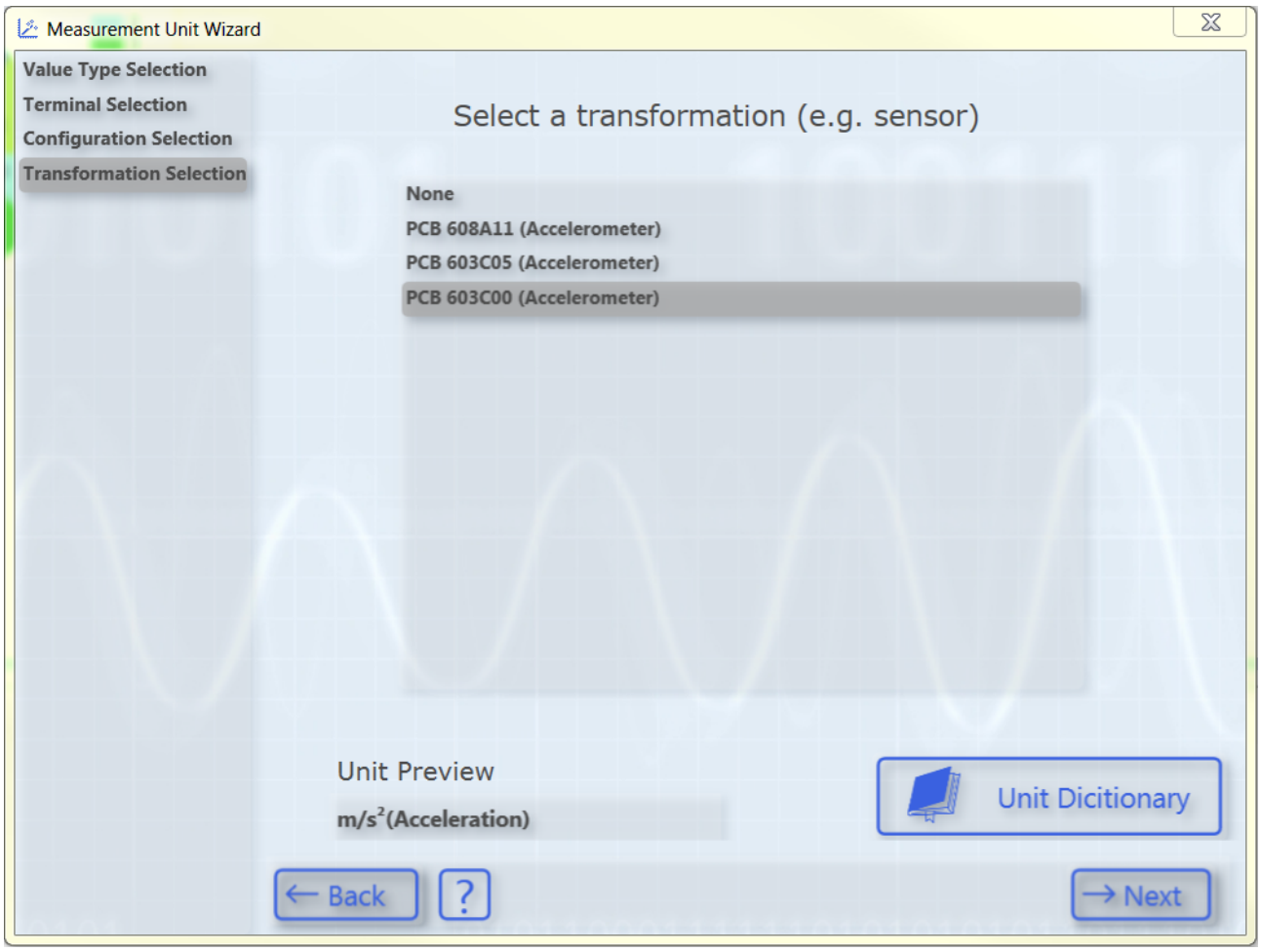
On this page you can select the type of terminal with which you recorded your measured values. Several Beckhoff EtherCAT terminals are already predefined. You can use the Unit Dictionary to view them or to add further terminals (see also Unit Dictionary Editor [▶ 208]).

Since a Beckhoff EtherCAT terminal can be configured in different ways, you must select the set configuration of your terminal on the next page.



All configuration options of the previously selected terminal type appear in the list. You can filter the configuration options via the text search in order to quickly find the appropriate configuration. The various configuration options are also stored in the Unit Dictionary.

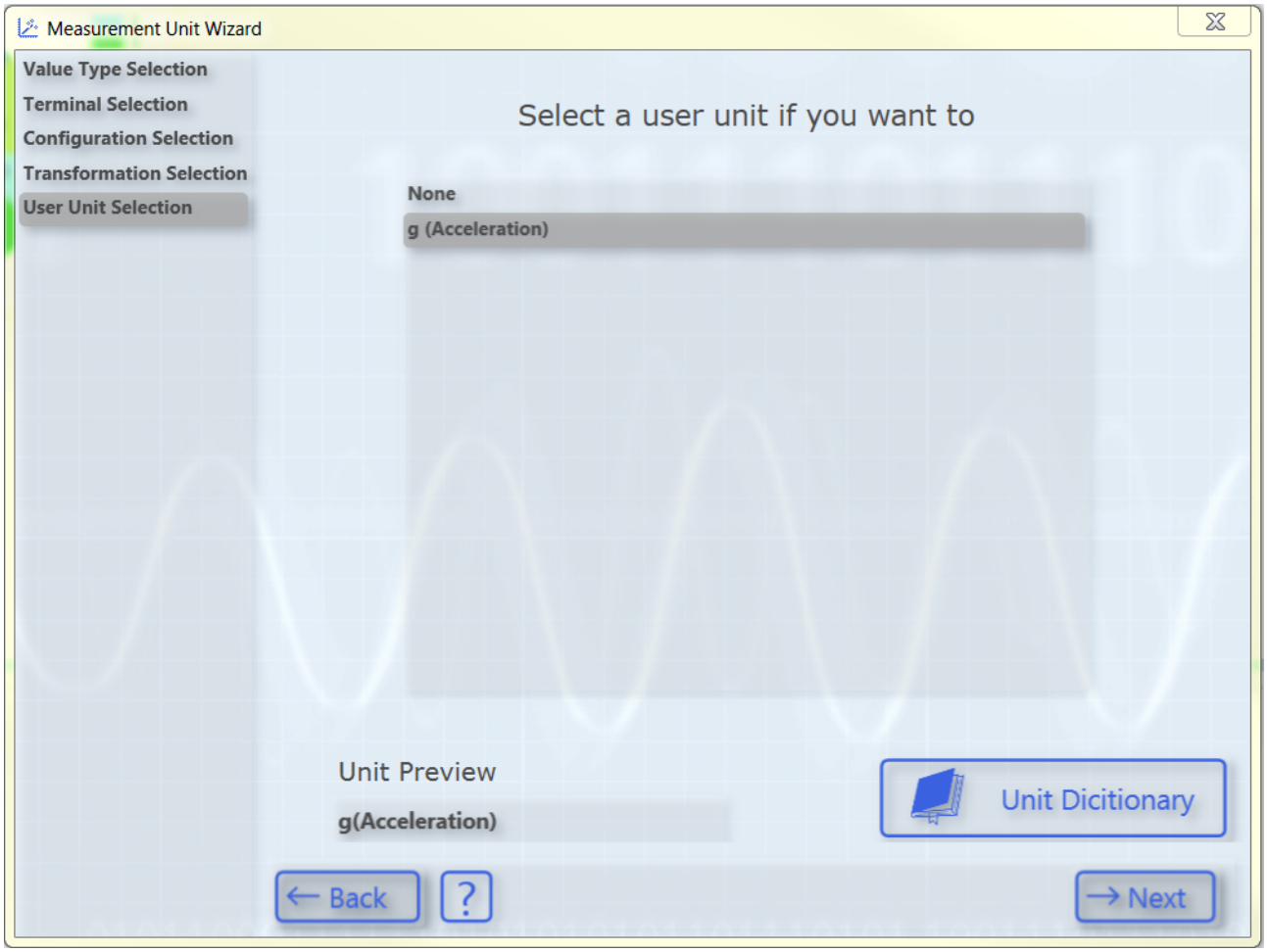
Subsequently, the **Next** button takes you to the next page, on which you can optionally select a transformation (e.g. a sensor).



The list shows transformations from one SI unit to another SI unit. The list contains only transformations whose source unit corresponds to the previously selected base unit. You can see the associated target unit in the "Unit Preview" field at the bottom left when a transformation is selected. If no transformation is required, simply select **None**.

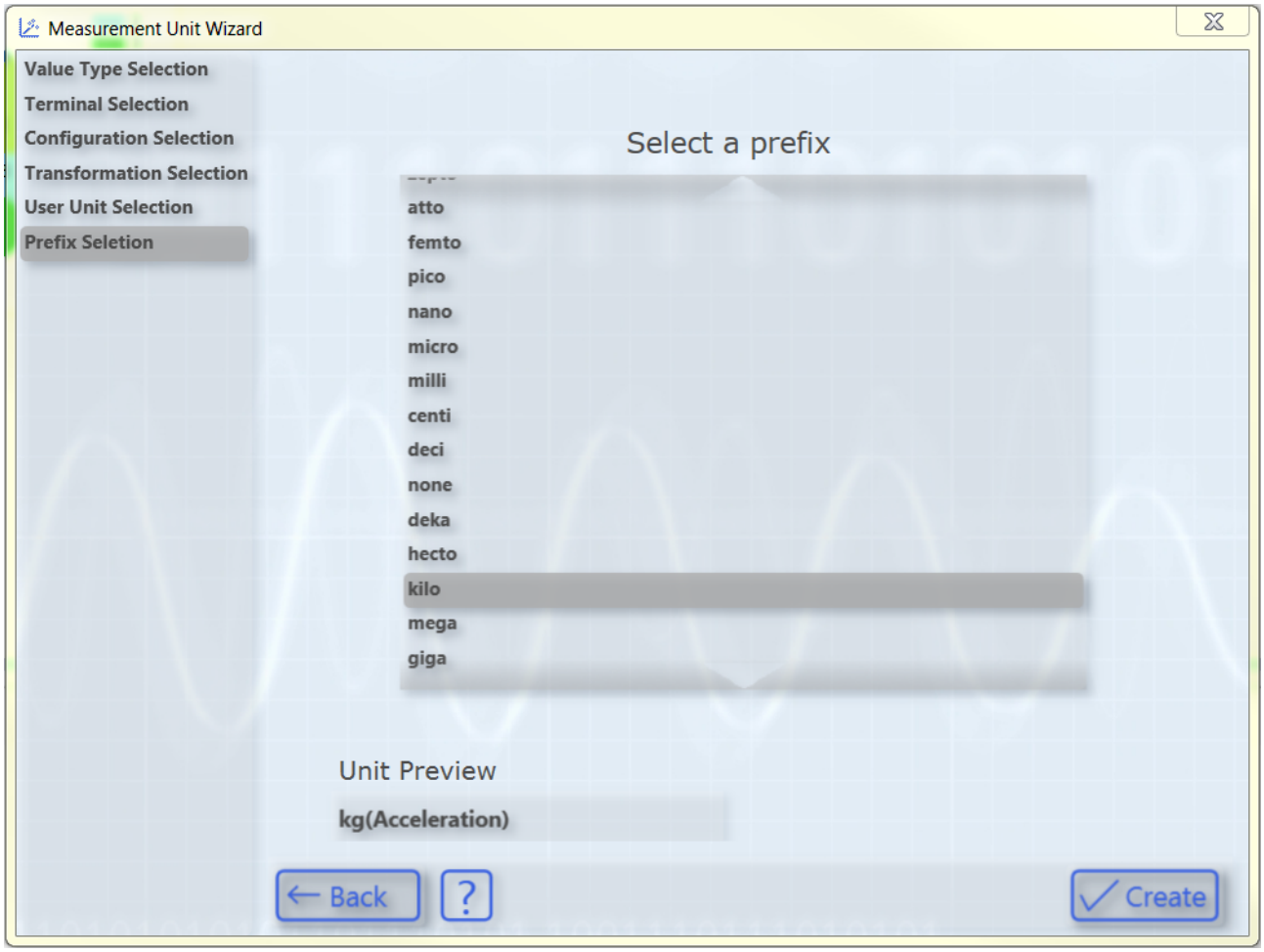
Some transformations are predefined as examples in the TC3 Scope. However, these frequently depend on the specific application case (sensor, measuring setup, etc.), therefore it is not useful to define a large number of generally valid transformations. You can therefore create your own transformations with the aid of the Unit Dictionary, which you can access via the button at the bottom right or via the Scope options [▶ 311]. Detailed information about the Unit Dictionary can be found in the section Unit Dictionary Editor [▶ 208]. Furthermore, there is an option to enter transformations via the PLC attributes (see Configuration of units with the aid of PLC attributes [▶ 207]).

After having selected the desired transformation, the **Next** button opens the next page, on which you can optionally select a user unit.



Once again, only user units that match the previously selected base unit appear. Some frequently used user units are predefined. As with the transformations, further user units can be added via the Unit Dictionary or the PLC attributes.

After selecting the user unit, you will be taken to the last page of this dialog:



Here you can optionally select a prefix for your unit. This is then also displayed in the "Unit Preview". Finally, you can create the configured unit with the aid of the **Create** button.

5.2.4.3 Configuration of units with the aid of PLC attributes

In addition to the input option via the Unit Wizard, units can also be configured with the aid of the attributes of a symbol or a data type in the PLC code. This is useful, for example, if a certain variable is recorded more frequently using the TC3 Scope. The unit then only needs to be provided once as an attribute and not reconfigured every time.

PLC attributes are specified directly via the declaration of a variable or the data type in curly brackets, as can be seen in the illustration below.

```
17      {attribute 'BaseUnit' := '<AngularVelocitiy, 0.5, 0, 3>'}
18      fSine                   : LREAL;
```

Three different unit elements can be specified with the aid of the PLC attributes: Base units (BaseUnit), transformations (UnitTransformation) and user units (UserUnit).

The syntax for their input is as follows:

Base units

{attribute 'BaseUnit' := '< BaseUnit, ScaleFactor, Offset, Prefix >'}

e.g.: {attribute 'BaseUnit' := '< AngularVelocity, 0.5, 0, kilo>'}

→ The unit is then krad/s (AngularVelocity) with a ScaleFactor of 0.5.

Transformations

{attribute 'UnitTransformation' := '<SourceUnit, TargetUnit, ScaleFactor, Name>'}

e.g.: {attribute 'UnitTransformation' := '<Current, Temperature, 10, Current-Temperature Converter>'}

→ The resulting unit is the temperature in °C.

User units

{attribute 'UserUnit' := '<BaseUnit, UserUnit, Symbol, ScaleFactor, Offset, Prefix >'}

e.g.: {attribute 'UserUnit' := '<Temperature, Fahrenheit, °F, 1.8, 32, 0>'}

→ The resulting unit is the temperature in °F.

For the base units and prefixes the Enum values can be entered as numbers in addition to the names. This enables any base units and prefixes to be selected even if they are not predefined.

The three different elements can be specified individually or in combination. Note, however, that not all combinations make sense. A transformation and a user unit, for example, should be specified with an appropriate base unit. If no appropriate base unit is specified it will automatically be set to the base unit of the transformation or user unit.

In the case of input errors in the attribute syntax, the default value, i.e. a "Unit of One" is set automatically with a scale factor of "1", an offset of "0" and the prefix "none".

5.2.4.4 Unit Dictionary Editor

For the user the Unit Dictionary Editor represents the interface to the Unit Dictionary, in which all available unit elements are stored. The predefined elements can be viewed and new values added via the Unit Dictionary Editor.

The Unit Dictionary Editor is available only with a Scope View Professional License.

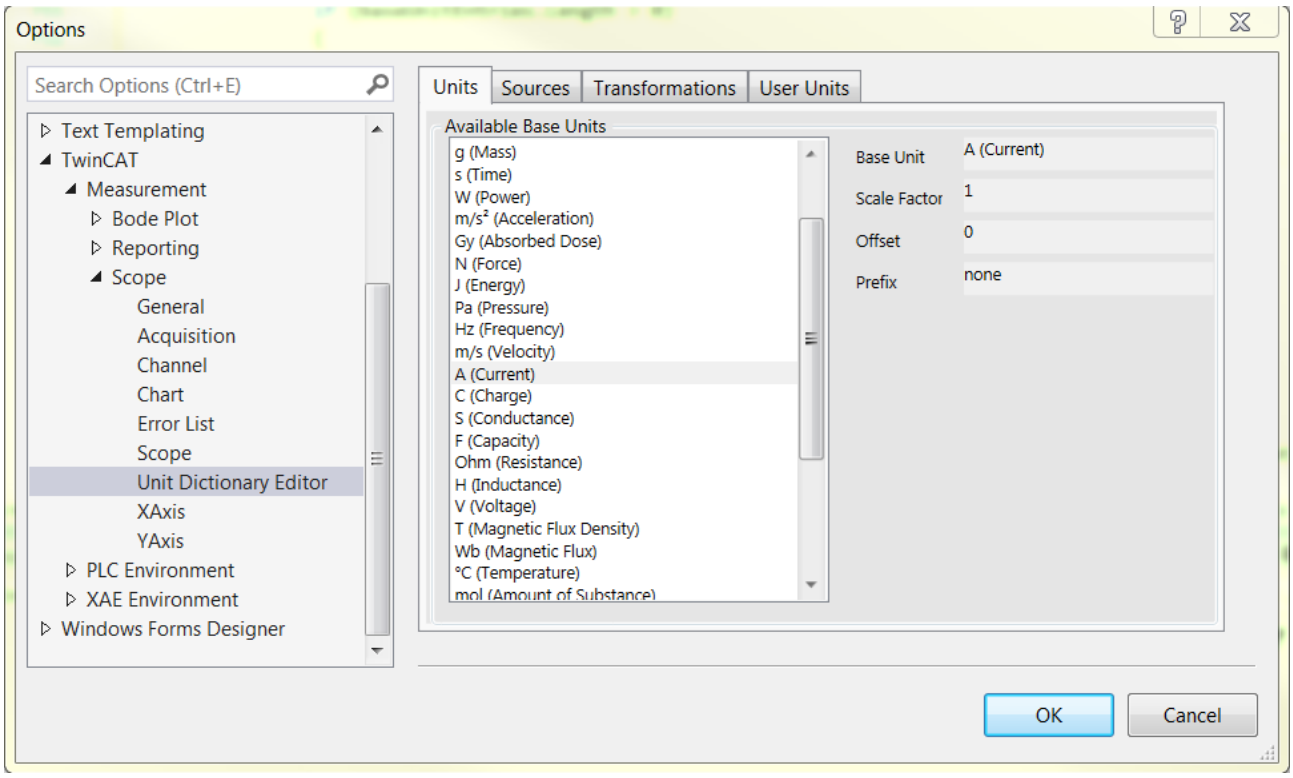
On the one hand the editor can be called from the Unit Wizard via the **Unit Dictionary** button, which always appears when terminals, transformations or user units can be selected. On the other hand, the editor can be called via the Scope Options [▶ 311].

The Unit Dictionary Editor contains four different tabs containing the various elements:

- Units [▶ 208]
- Sources [▶ 209]
- Transformations [▶ 210]
- User Units [▶ 210]

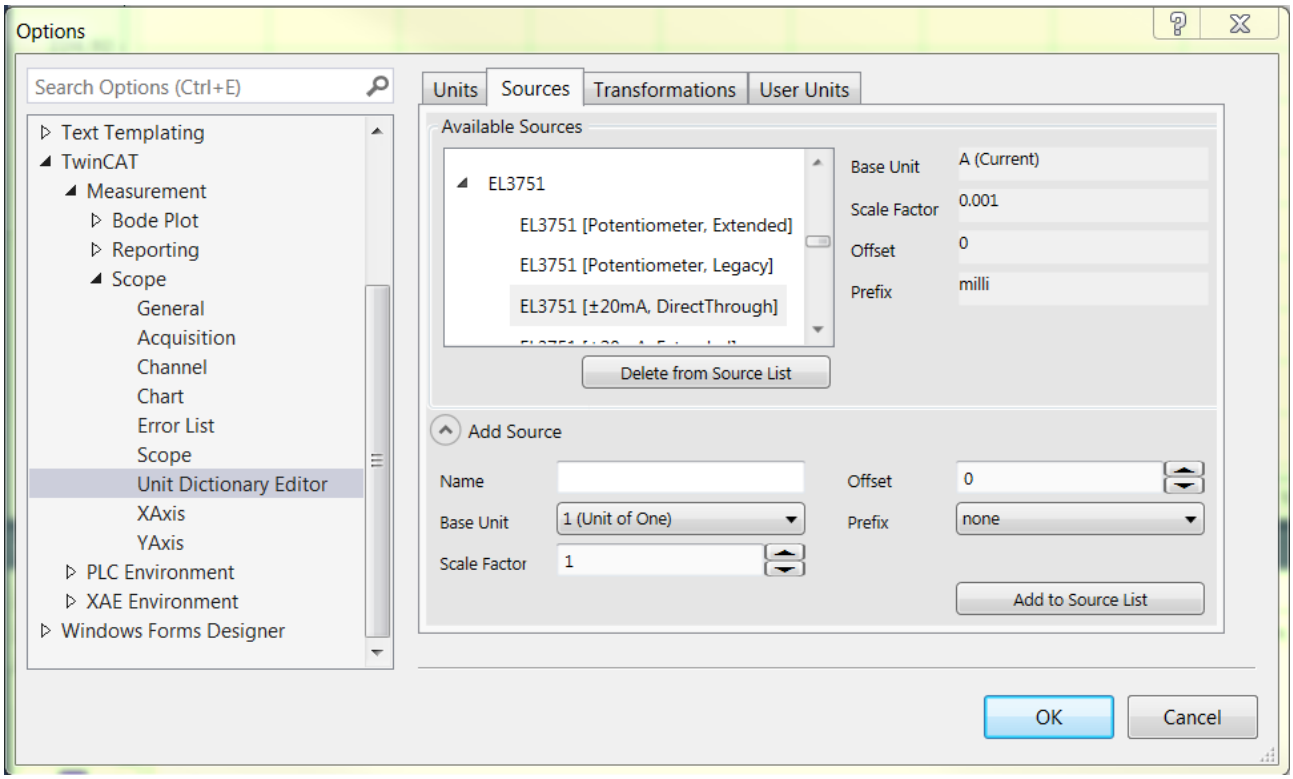
Units

The **Units** tab contains a list of all base units. These are predefined and cannot be changed using the Unit Dictionary Editor. If additional base units are required, they must be entered by means of the Enum values as PLC attributes (see also Configuration of units with the aid of PLC attributes [▶ 207]).



Sources

The **Sources** tab contains the Beckhoff EtherCAT terminals. However, as other sources are also conceivable for the measured values depending on the application case, the tab is generally called "Sources".



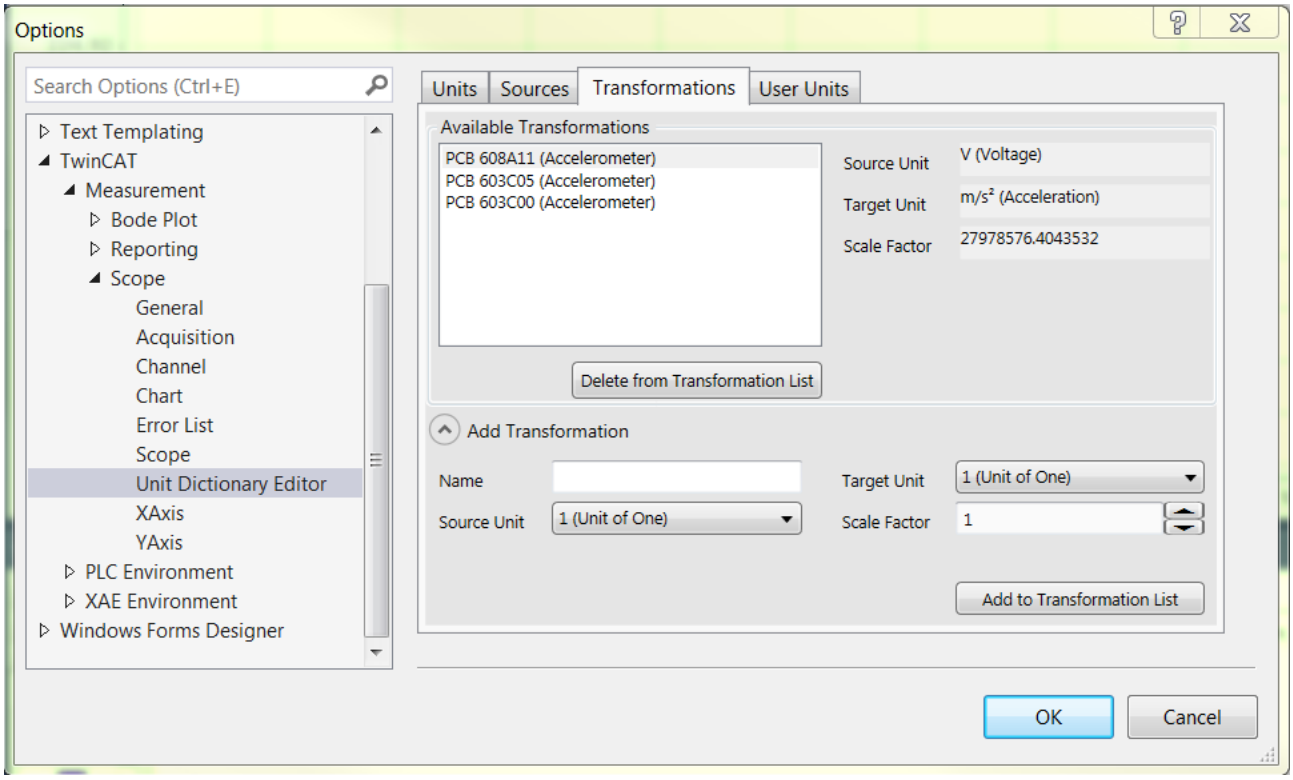
The terminal types with their configuration options are displayed in the list at the top left. To the right of that the properties of the respectively selected terminal can be viewed.

An input field can be opened in the lower area with the **Add Source** button. Further terminals or other user-specific sources can be added there. To do this it is merely necessary to fill out the fields. The element created can then be added using the **Add to Source List** button. A selected element can be deleted again with the **Delete from Source List** button. However, predefined values cannot be deleted from the list.

Note that when entering new "Source" elements, a terminal type and the associated configuration options should be entered so that they can be sorted in the Unit Dictionary Editor and in the Unit Wizard analogous to the existing elements. For example, the terminal type in the above screenshot is "EL3751". Its associated configuration options are added as individual elements. The name of the configuration begins with the designation of the terminal type and contains the respective configuration option behind that in square brackets.

Transformations

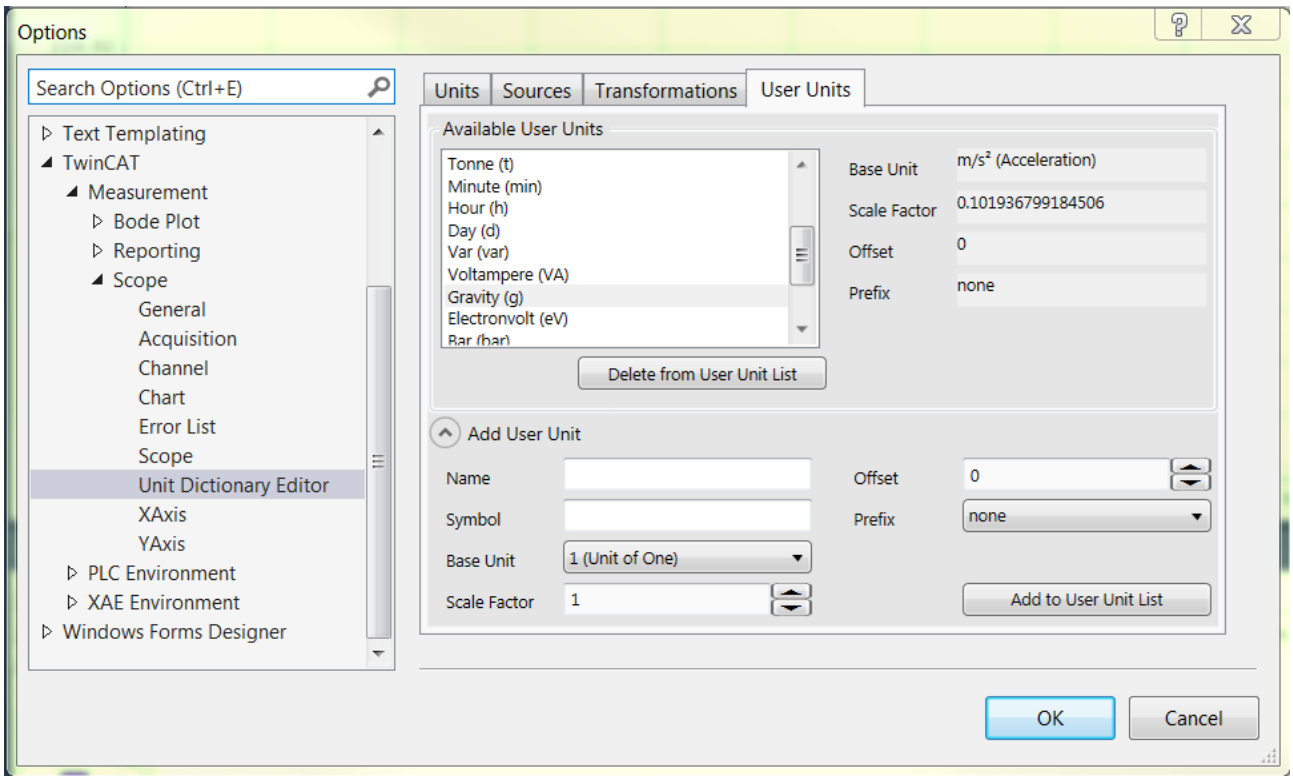
The **Transformations** tab contains all predefined transformations.



The properties of a selected transformation can be seen on the right. In order to define a new transformation, the input field must be opened via the **Add Transformations** button and the corresponding data entered. The transformation can then be added using the **Add to Transformation List** button. A selected transformation can be deleted again with the aid of the **Delete from Transformation List** button. Note that predefined transformations cannot be deleted.

User Units

The **User Units** tab contains all predefined user units.

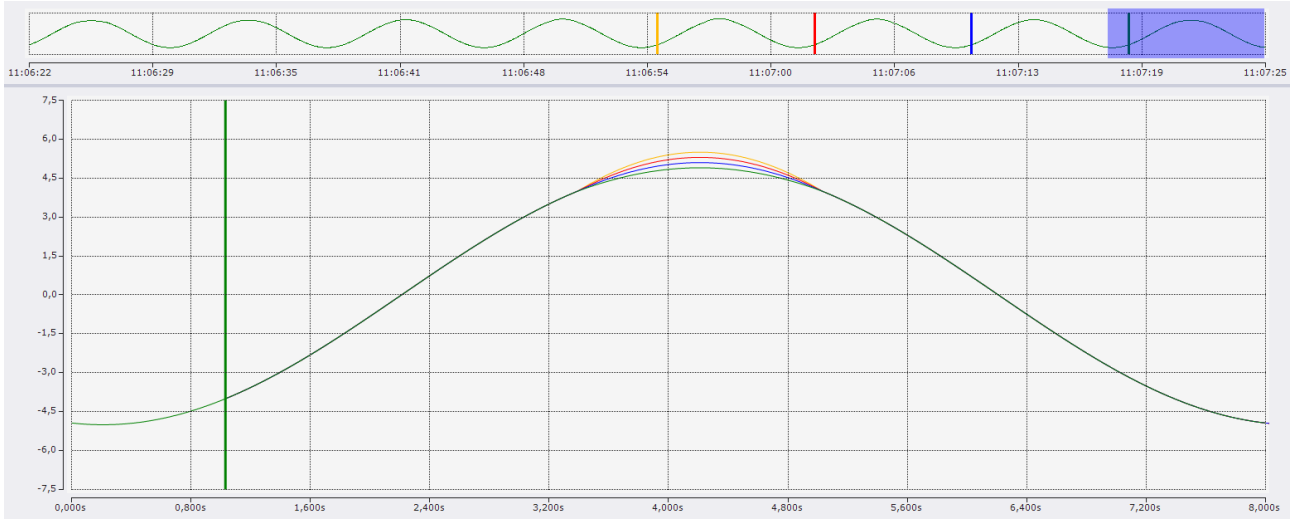


The properties of a selected user unit can be seen on the right-hand side. In order to define a new user unit, the input field must be opened via the **Add User Unit** button and the corresponding data entered. The user unit can then be added using the **Add to User Unit List** button. A selected user unit can be deleted again with the aid of the **Delete from User Unit List** button. Note that predefined user units cannot be deleted.

5.2.5 Layer Charts

The layer function is used to compare signal curves with each other. Here it is possible to load reference curves so that they are visually displayed next to the data that is currently being recorded or was last recorded. In addition, data from the current recording at different times can also be compared.

Currently, these functions are implemented for YT and XY charts.



5.2.5.1 Basic functionality

To compare data with each other, various layers can be added under YT and XY charts. Here, a layer represents a collection of graphs that are displayed in the current chart. The data displayed in this layer are freely configurable.

The configurations for the Layer Chart are made exclusively in the Layer Editor.

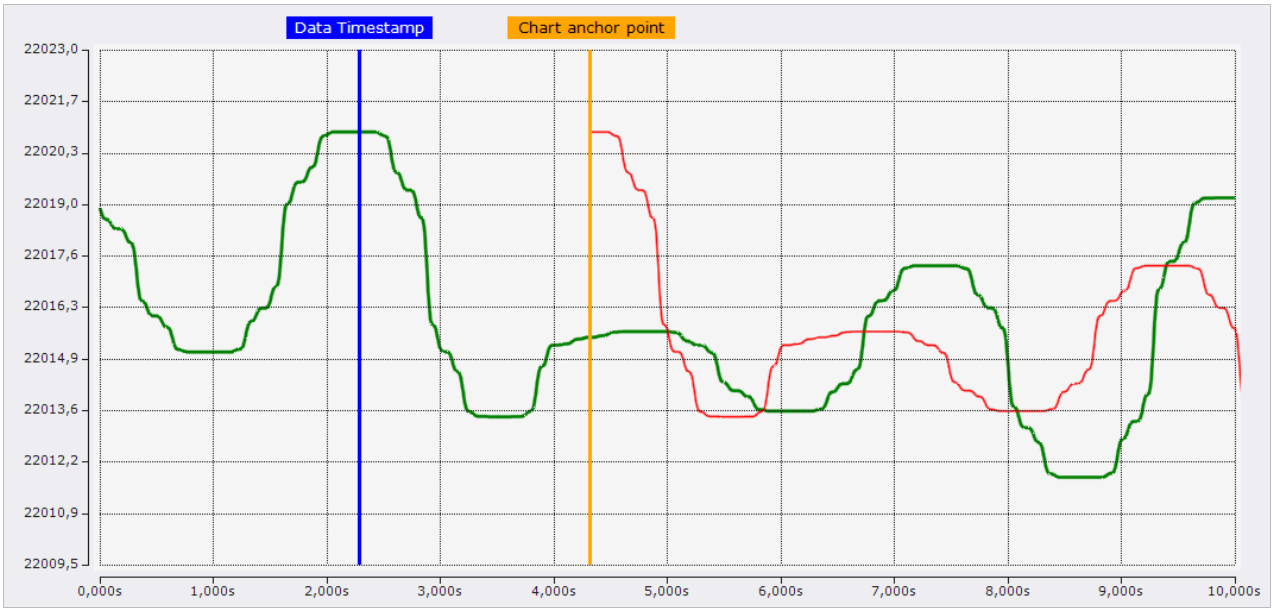
Basic settings in the chart

First, a point in time (anchor point) must be selected in the chart. This anchor point serves as a starting point for all layers defined in this chart. For example, if reference curves are added, the anchor point is the point in the chart where the recording of the curve begins.

See the Layer Editor [▶ 213] for more information on the various configuration options for this time point.

Basic settings in Ghosting mode

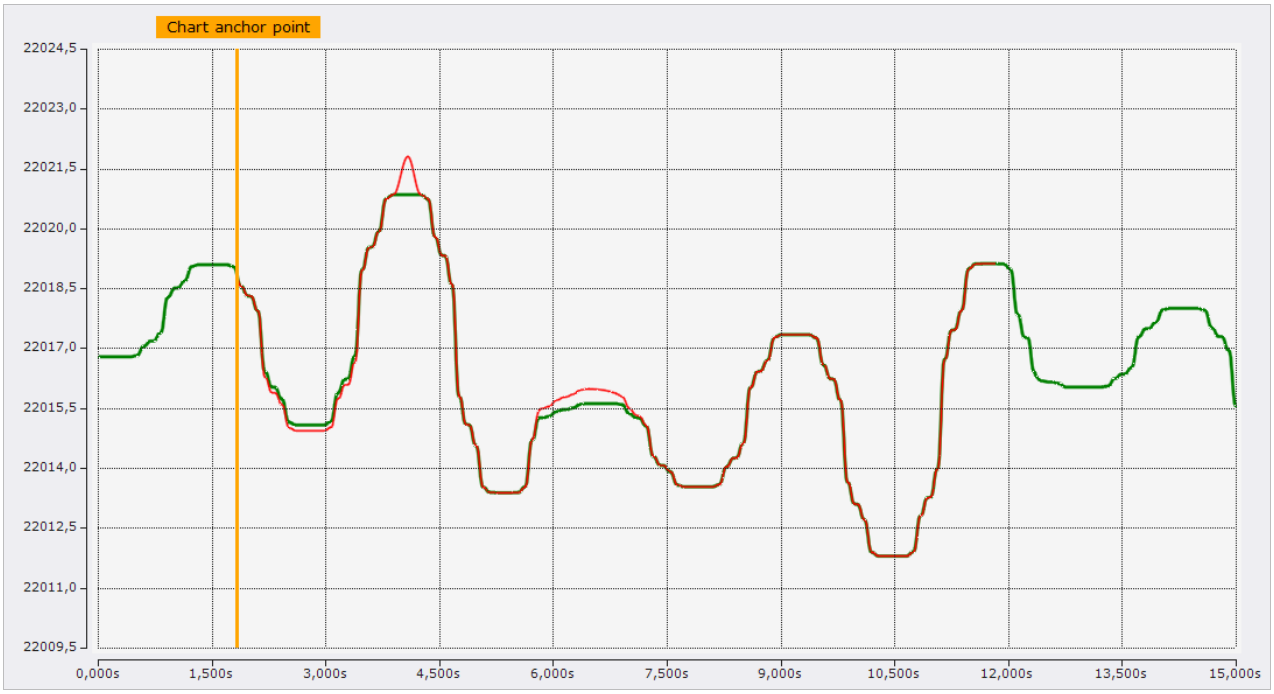
In Ghosting mode, data from different points in time can be superimposed from a current recording. In this mode, a point in time (data starting point) is first selected from the current recording. Now the graphs belonging to the layer show the data from the data starting point, only that the starting point in the display is no longer the recording time, but that of the anchor point of the chart.



In the screenshot, the green graph shows the channel, which is known to be below the chart, and the red graph is the representation of a layer. The orange marker shows the anchor point of the chart and the blue marker shows the point in time, which is selected in the layer as the data starting point. Since the data in the layer is now drawn from the anchor point, the green graph is now slightly shifted in red.

Basic settings for reference curves

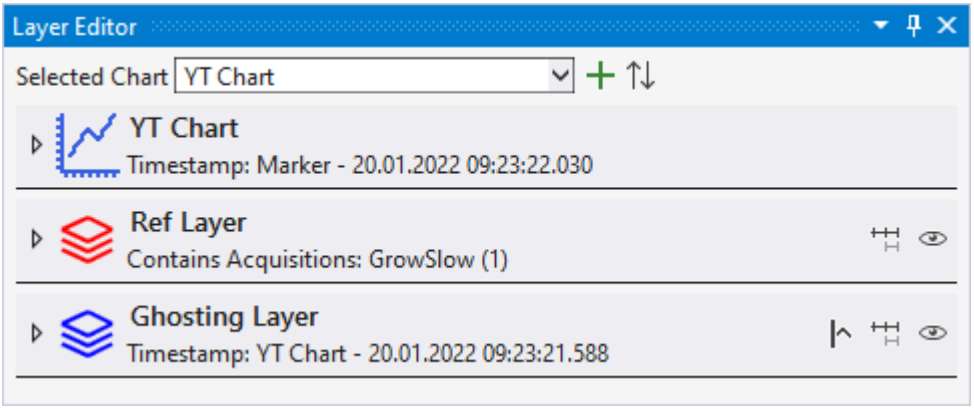
To compare the data of the current recording with reference curves, this reference data from the data pool must be connected to the layer. See the chapter Reference Data Mode [▶ 219] for more information on reference curves.



The screenshot shows the channel in green, which is below the chart as usual. The red curve shows a layer containing a reference curve. This reference curve starts at the anchor point of the chart, which is indicated by the marker, and is then drawn over a length of 10 seconds, since the reference curve contains 1000 data points and these data points are interpreted with a sampling rate of 10 ms.

5.2.5.2 Layer Editor

In the Layer Editor, which is integrated as a tool window in Visual Studio®, all settings for the layers are made. The editor is divided into three areas.



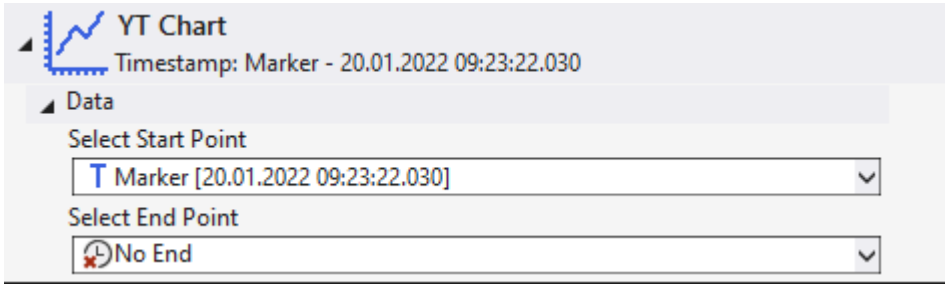
General settings



The upper area contains general settings. On the one hand, the chart to be edited can be selected there.

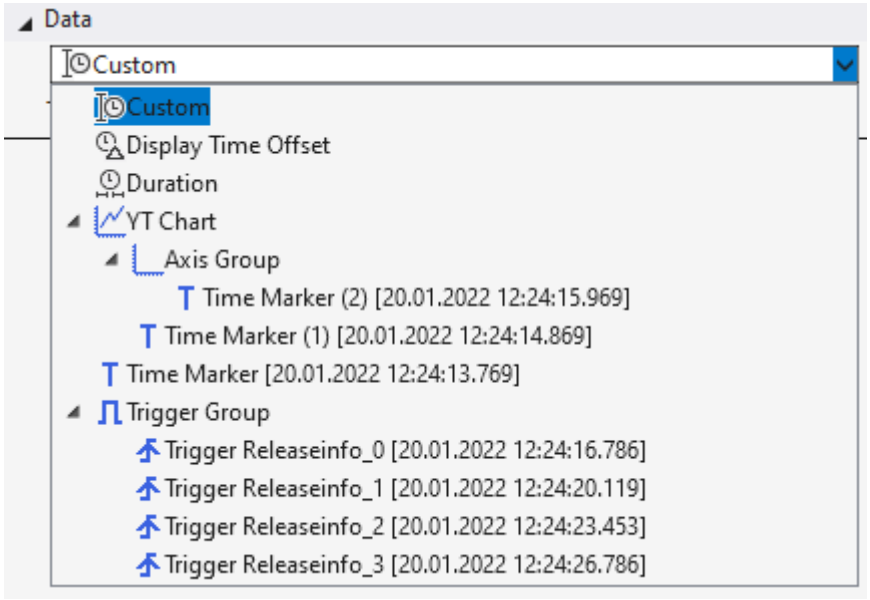
Use the plus + to add new layers and the arrows ↑↓ to sort the existing layers. Here, the layers are sorted in ascending order according to their data starting point.

Chart settings

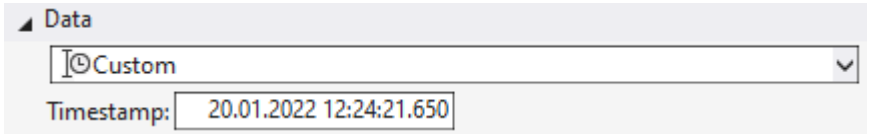


The middle area includes all settings related to the selected chart. These are the settings of the anchor point. In addition to the anchor point at which the drawing of the graphs begins, an end point can also be defined. The end point specifies the time up to which the graphs are to be drawn.

The following options can be selected to set the point in time.

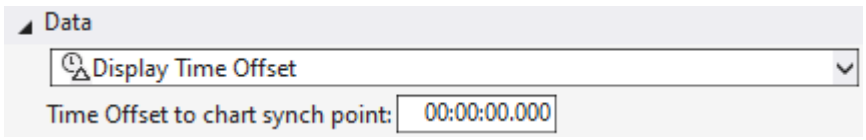


Custom

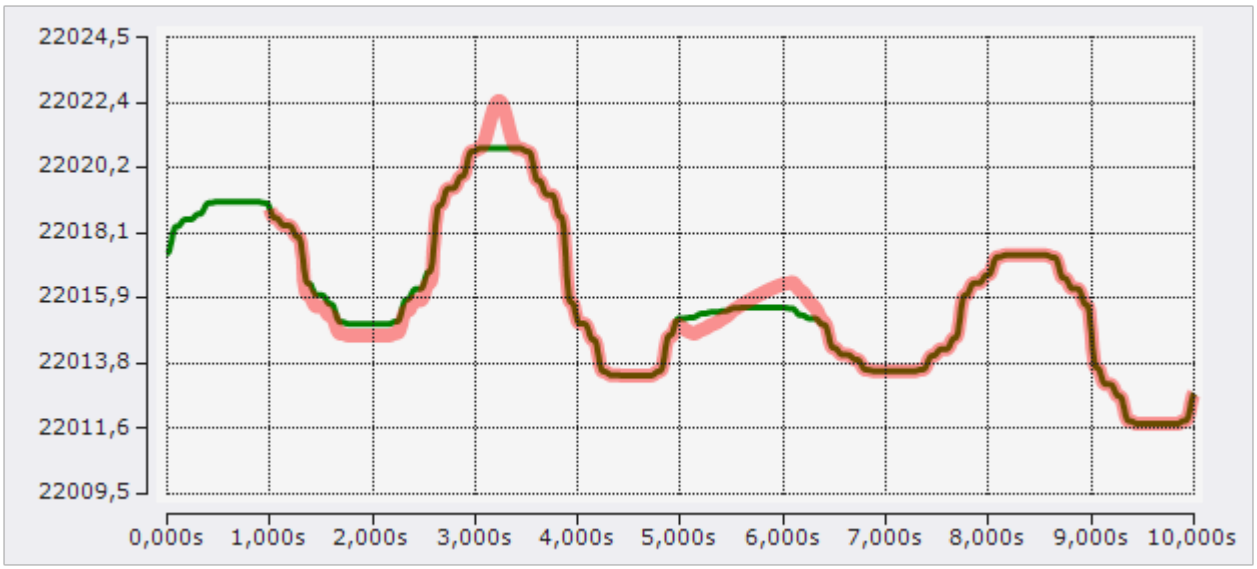


If Custom is selected, a fixed timestamp can be entered for Timestamp.

Display Time Offset

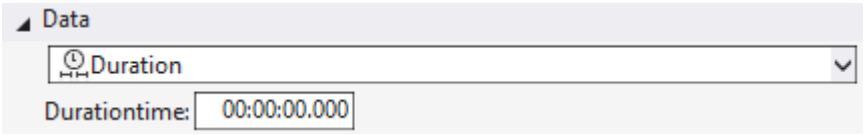


This setting can be used to configure a dynamic time. The adjustable time is an offset which is added to the current position on the chart to calculate the time of the anchor point.



The screenshot shows a configuration where a Display Time Offset of +1 s has been set in the chart, resulting in the reference curve starting at one second.

Duration



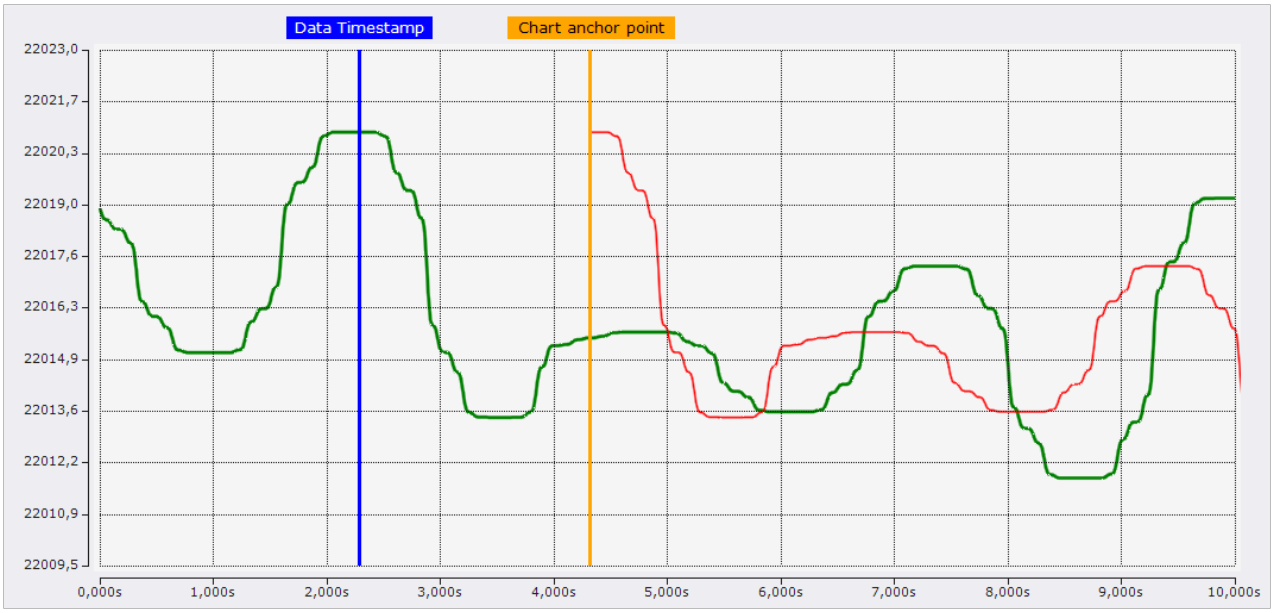
The Duration setting is another dynamic time configuration. With this configuration, the point in time is determined anew every x time units. X is the time that can be configured in the window. The recording start time forms the first point in time. From then on, the associated timestamp is always the recording start time plus a multiple of the Duration setting. During recording, the timestamp jumps by one duration every x time units and after recording, the timestamp is at the last possible time.

Charts

When linking to a chart, the linked timestamp is always linked to the current position of the selected chart.

Time marker

If a timestamp is linked to a time marker, the timestamp is always set to the time of the marker.

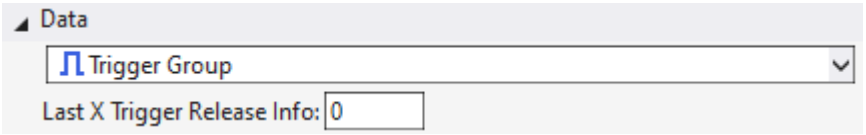


In the configuration shown in the screenshot, the anchor point is connected to the orange marker and the layer is connected to the blue marker. With this configuration option, the connected timestamps can be easily and accurately set to the appropriate time.



If a marker is set to the correct position, it is recommended to lock the marker (set the marker's lock property to true) so that it is not accidentally moved on the chart.

Trigger Group



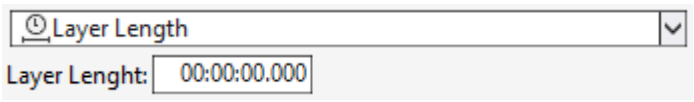
With the selection of a trigger group, the timestamp is also updated dynamically again. With this configuration, the associated timestamp is always set by the trigger events that occurred in this trigger group. With the adjustable number you can still set which trigger event should be used. Here, the count is always from new to old. If the counter is set to 0, the timestamp always represents the time of the latest trigger event. If the trigger is set to 1, always the penultimate, etc.

Trigger Release Info

For Trigger Release Info, a trigger event can be explicitly selected to set the associated timestamp to the time of the event.

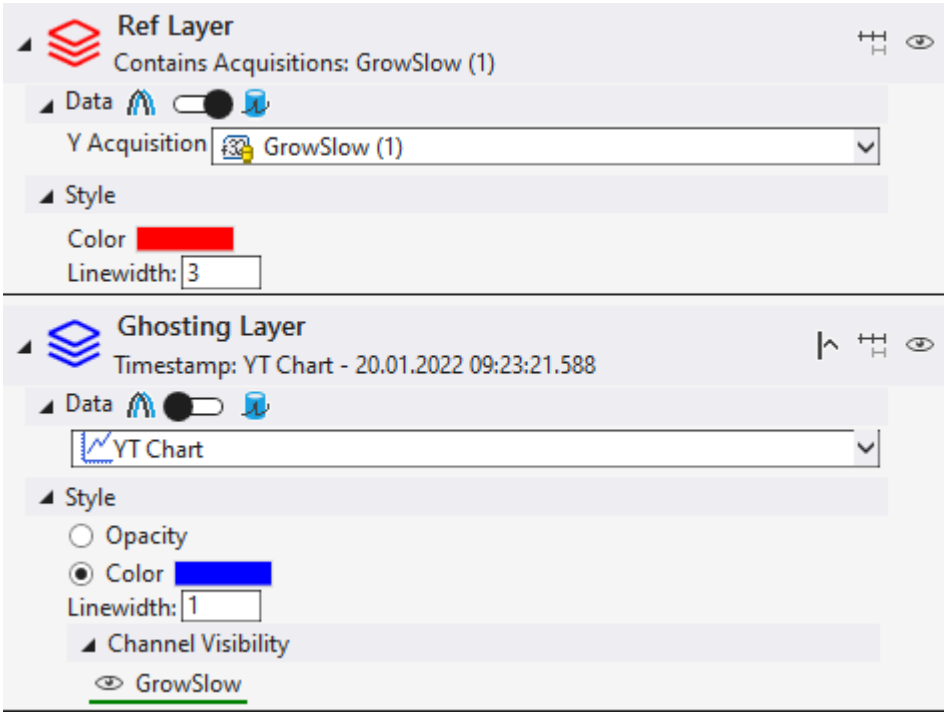
Set end point

The end point of a chart can be set using the same functions as the anchor point. Only the Duration function at the end is replaced by the Layer Length setting.



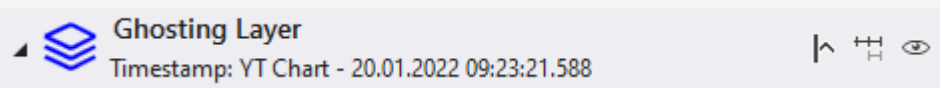
A fixed Layer Length can be set here.

Layer settings



The third and lower area of the editor contains the settings of the layers. Each layer gets its own area so that all settings can be made there.

The settings are again divided into different areas.
First there is the layer header:



In the layer header the most important information is shown on the left and on the right there are buttons for configuring the layer.

- Setting the visibility of a graph before the anchor point. If this setting is activated, data of a ghost graph will be drawn even before the anchor point, if data are already available for the time range. If the setting is deactivated, the layers only start at the anchor point.
- This toggle button is used to enable/disable the Echo mode.
- Turn visibility of the layer on and off.

The Data setting area is a dynamic area, which is structured differently in the various modes and is therefore explained further there.

The third area is for configuring the style of the graphs that are displayed in the layer.

- Opacity - With this setting the colors of the original channels are adopted for the ghost graphs and adjusted in opacity. Thus, the different graphs can be easily assigned to each other and still be distinguished. Since there are no associated channels for reference curves, this setting is only available for ghost layers.
- Color - The color selected here will be set for all graphs of the layer.
- Linewidth - The graphs of this layer will be drawn in the specified line width.
- Channel Visibility - If not all channels are to be displayed for ghost layers, the individual ghosts of the channels can be hidden.

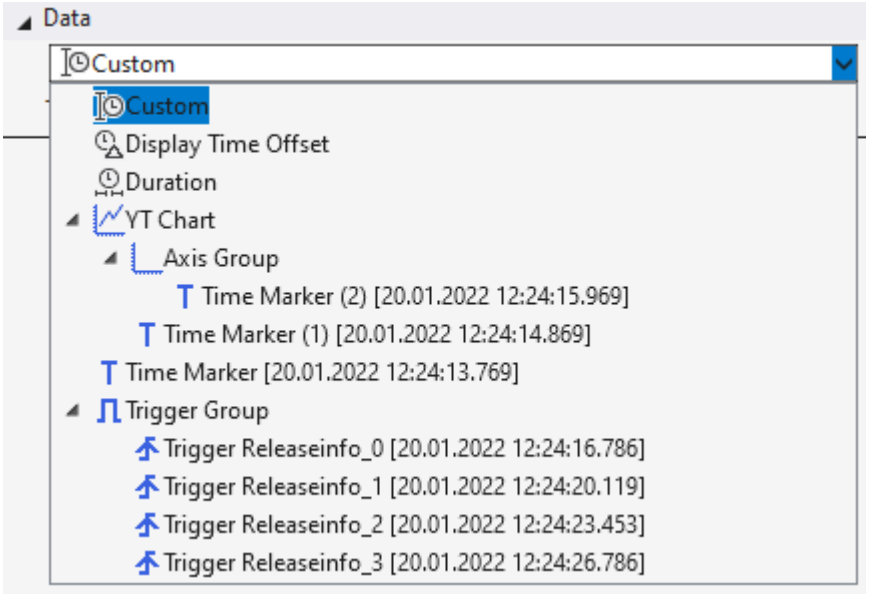
5.2.5.3 Ghost mode

To use the Ghost mode, in the data area of a layer the switch must select the left Ghost mode.

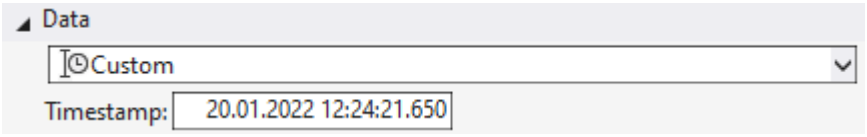


The data output point can be set in the data area.

The following options can be selected to set the point in time.

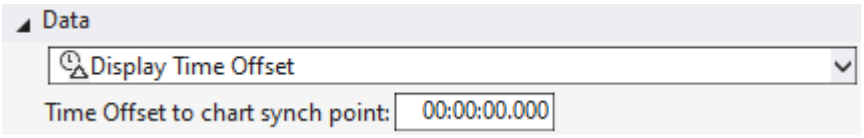


Custom

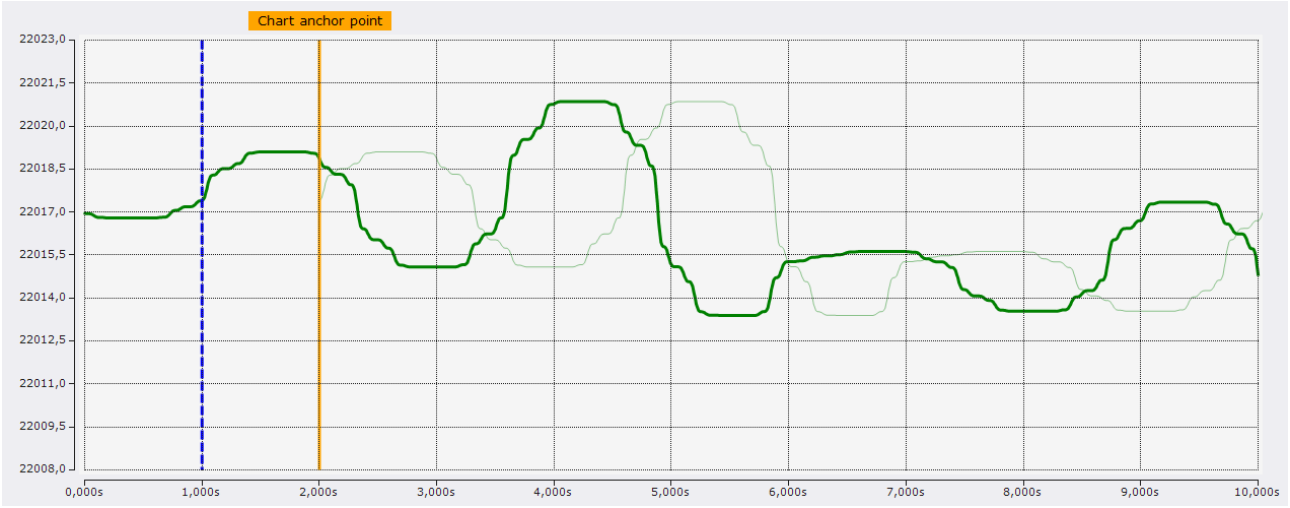


If Custom is selected, a fixed timestamp can be entered for Timestamp.

Display Time Offset



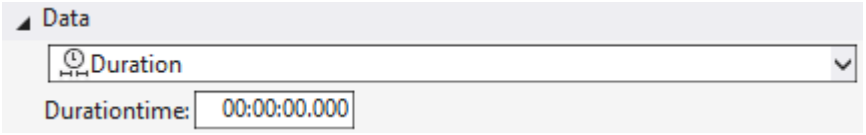
This setting can be used to configure a dynamic time. The adjustable time is an offset which is added to the anchor position of the chart to calculate the time of the data to be repeated.



The screenshot shows a configuration where in the chart the orange marker was selected as anchor point and in the layer the Display Time Offset was set to -1 s. Thus, the data output point of the layer is one second before the anchor point. This location is indicated by the blue marker.

With a negative offset, data from the past can thus be displayed in the display of more recent data. The opposite can be achieved with a positive offset.

Duration



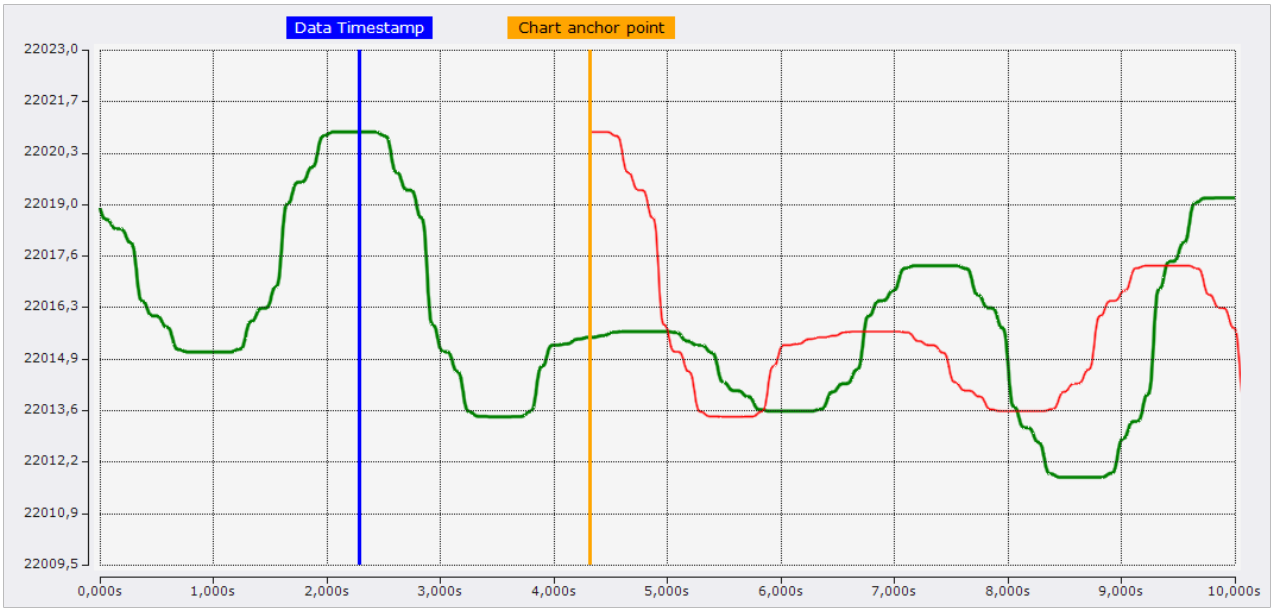
The Duration setting is another dynamic time configuration. With this configuration, the point in time is determined anew every x time units. X is the time that can be configured in the window. The recording start time forms the first point in time. From then on, the associated timestamp is always the recording start time plus a multiple of the Duration setting. During recording, the timestamp jumps by one duration every x time units and after recording, the timestamp is at the last possible time.

Charts

When linking to a chart, the linked timestamp is always linked to the current position of the selected chart.

Time marker

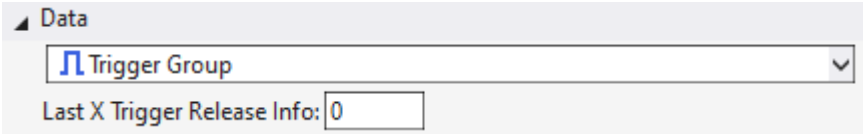
If a timestamp is linked to a time marker, the timestamp is always set to the time of the marker.



In the configuration shown in the screenshot, the anchor point is connected to the orange marker and the layer is connected to the blue marker. With this configuration option, the connected timestamps can be easily and accurately set to the appropriate time.

If a marker is set to the correct position, it is recommended to lock the marker (set the marker's lock property to true) so that it is not accidentally moved on the chart.

Trigger Group



With the selection of a trigger group, the timestamp is also updated dynamically again. With this configuration, the associated timestamp is always set by the trigger events that occurred in this trigger group. With the adjustable number you can still set which trigger event should be used. Here, the count is always from new to old. If the counter is set to 0, the timestamp always represents the time of the latest trigger event. If the trigger is set to 1, always the penultimate, etc.

Trigger Release Info

For Trigger Release Info, a trigger event can be explicitly selected to set the associated timestamp to the time of the event.

5.2.5.4 Reference Data Mode

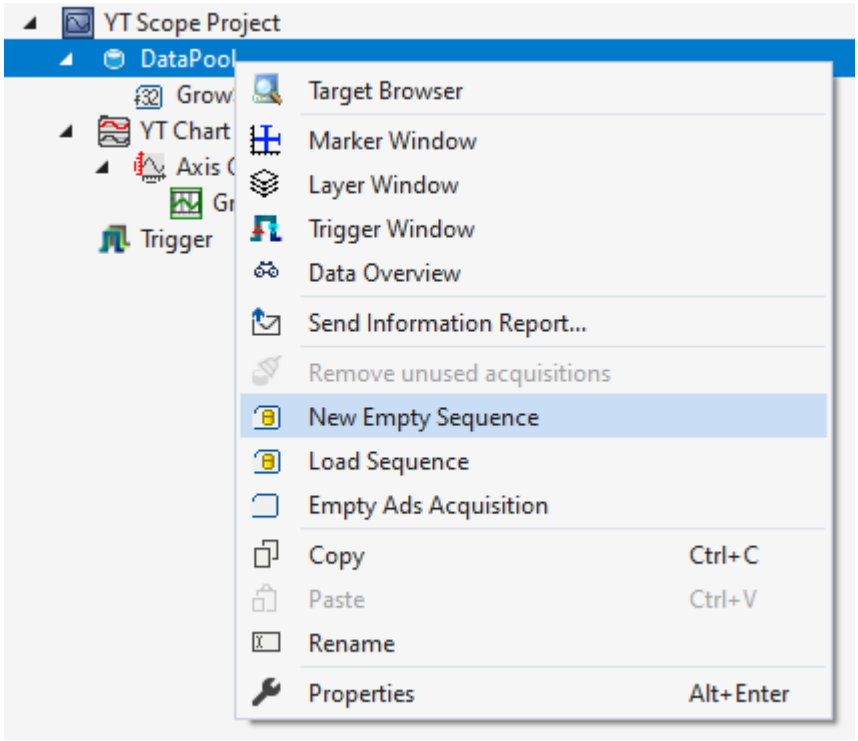
To compare the data of the current recording with reference curves, the data of the reference curve must first be added to the data pool as sequences. Sequences are collected in the data pool in a Sequences folder.

Add sequences

There are three ways to add new sequences to a Scope project.

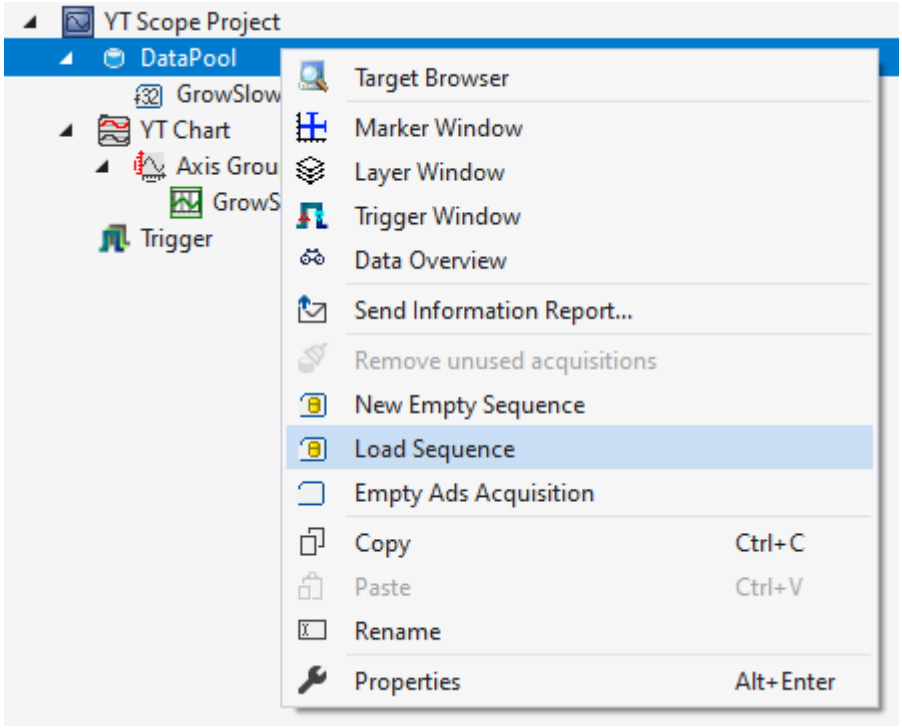
Create new sequence

In the context menu of the data pool a new sequence can be created with **New Empty Sequence**, which consists at the beginning only of zeros. In Curve Creator [▶ 224] this sequence can be edited as desired and finally added as a new sequence in the data pool.

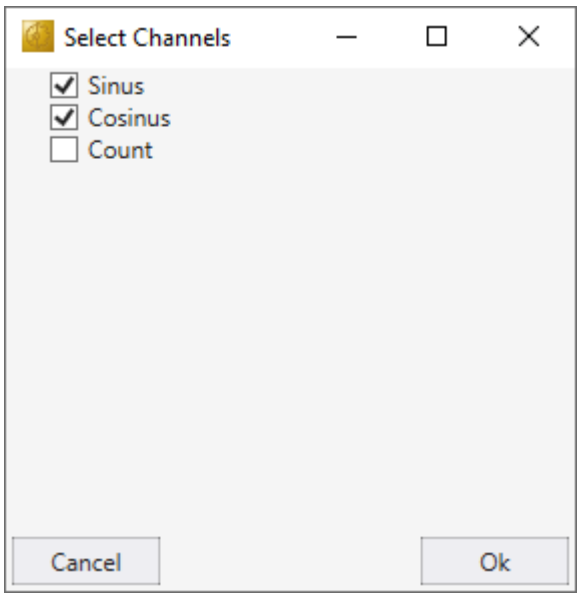


Load from file

If reference data already exists as an Analytics file or in a CSV, these files can also be opened to add the data as a sequence.
To add a sequence via this way, one or more new sequences can be inserted via the context menu from the data pool with **Load Sequence**.



If there are several data series in the Analytics File or CSV file, a window for selecting the appropriate data series will open.



When the selection is confirmed with **Ok**, the window closes and the sequences are added to the data pool. If there is only one data series in the selected file, this window is skipped and the sequence is added automatically.

The data structure in the CSV file consists of a first row containing the names of the data series. The following rows contain the data of the data series.

```
Value1,Value2
1,5
2,4
3,3
4,2
5,1
```

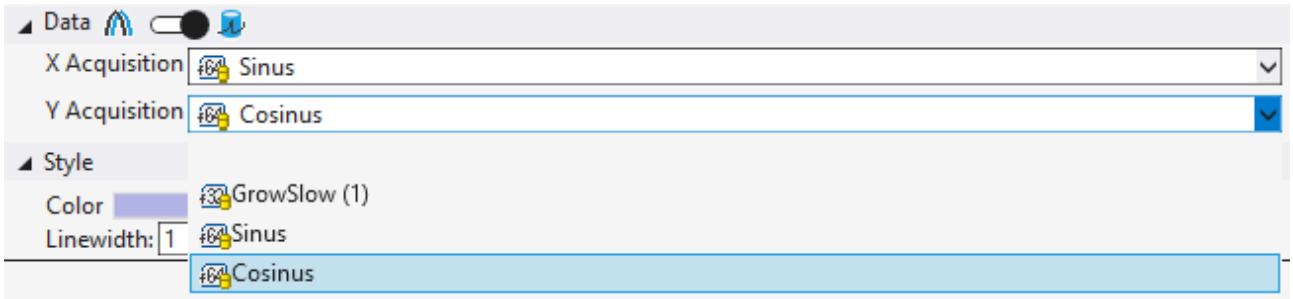
Convert data from a current recording into a sequence

If a recording is already available, sequences can be generated directly from the recorded data and added to the data pool. This can be done with the Curve Creator.

If sequences are added to the data pool, the layer can be configured with reference data.

First the switch must be set to the right reference data mode.

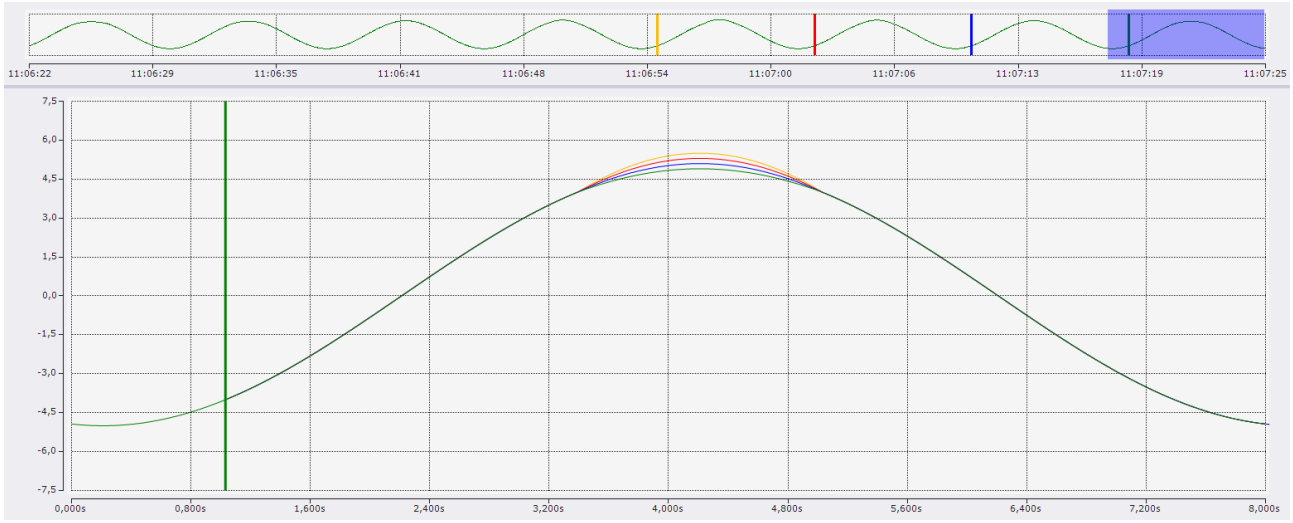
Then, for XY charts, the X and Y Acquisition (for YT charts, only the Y Acquisition) can be filled with sequences. For this purpose, the sequence can either be selected in the dropdown box or dragged and dropped from the Solution Explorer onto the dropdown box.



5.2.5.5 Echo mode

If data is to be compared which recurs in a fixed cycle, the use of an echo layer is recommended. This layer consists internally of x further layers, where the data output point is always shifted to each other by a definable length. If the defined length is configured to the cycle length, the data output points of the layers in the echo layer always have a distance of one cycle length. Thus, the past cycles can be easily superimposed.

From the mode of operation, the echoes build on the use of the Duration setting of the data settings. The first layer always has the current data starting point. However, it always has only the second newest possible value for the duration calculation, so that a full frequency of data is always available for the echoes.

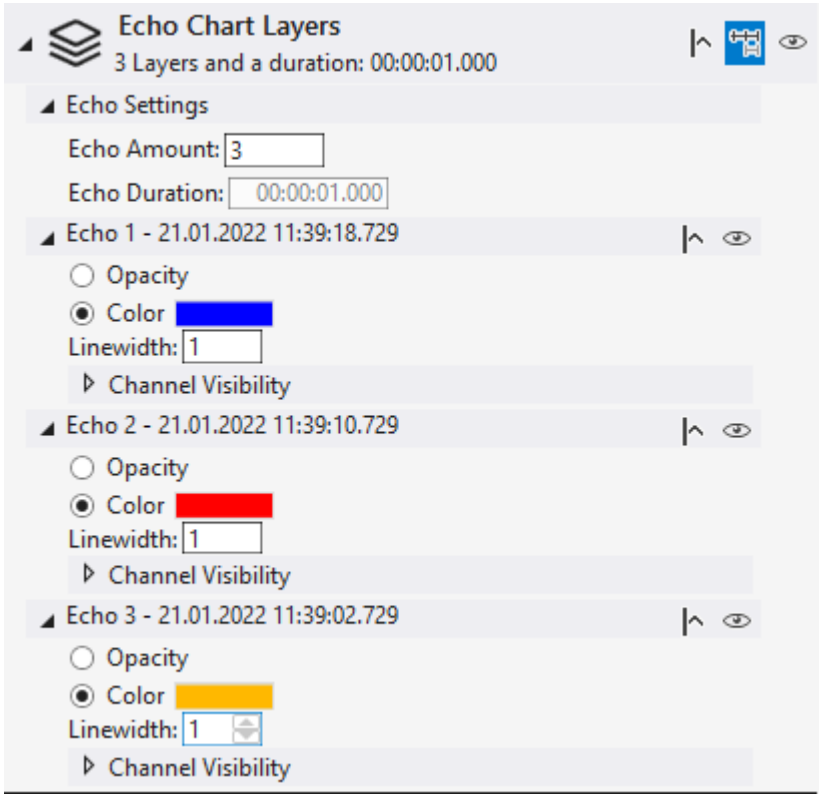


The screenshot of the scope shows the echo mode using the example of a curve with a frequency of eight seconds. These eight seconds are also displayed as Duration length in the chart with this configuration. The current anchor position of the chart is marked with the green marker in the screenshot. From there, all three echoes are drawn in the echo layer. The data output points of the echoes are represented by markers in the same color in the overview chart. The blue marker belongs to the first echo layer, which can be seen as a blue graph in the chart. This time is eight seconds before the anchor point of the chart. Another eight seconds before that is the red marker representing the data output point of the second echo, which is represented in the chart by the red graph. The orange graph belongs to the third echo, which is represented by the orange marker in the overview chart and is also eight seconds before the red marker (2nd echo).

The display with the echo mode can be optimized during recording by using the Restart Display Trigger in conjunction with the Time Trigger [▶ 146].

For configuration, the Clear Display function should be activated for the Restart Display Trigger and the Time Trigger Set should be set to the duration length. With this configuration, each time a new duration is started, the chart is cleaned up and the echoes load the data from the past durations. Then the charts are filled with new data, so that the new data gradually overlays the echoes.

Settings



To activate the echo mode, it must be activated in the header.

Echo Settings:

- Echo Amount - number of echoes in this layer
- Echo Duration - length of the frequency. If Duration mode is selected for the anchor point at the chart layer, the frequency cannot be set in this layer because the length is taken from the chart.

The appearance of the echoes can be configured in the same way as the other layers.

- Setting the visibility of a graph before the anchor point. If this setting is activated, data of a ghost graph will be drawn even before the anchor point, if data are already available for the time range. If the setting is deactivated, the layers only start at the anchor point.
- Turn visibility of the layer on and off.
- Opacity - With this setting the colors of the original channels are adopted for the ghost graphs and adjusted in opacity. Thus, the different graphs can be easily assigned to each other and still be distinguished. Since there are no associated channels for reference curves, this setting is only available for ghost layers.
- Color - The color selected here will be set for all graphs of the layer.
- Linewidth - The graphs of this layer will be drawn in the specified line width.
- Channel Visibility - If not all channels are to be displayed for ghost layers, the individual ghosts of the channels can be hidden.

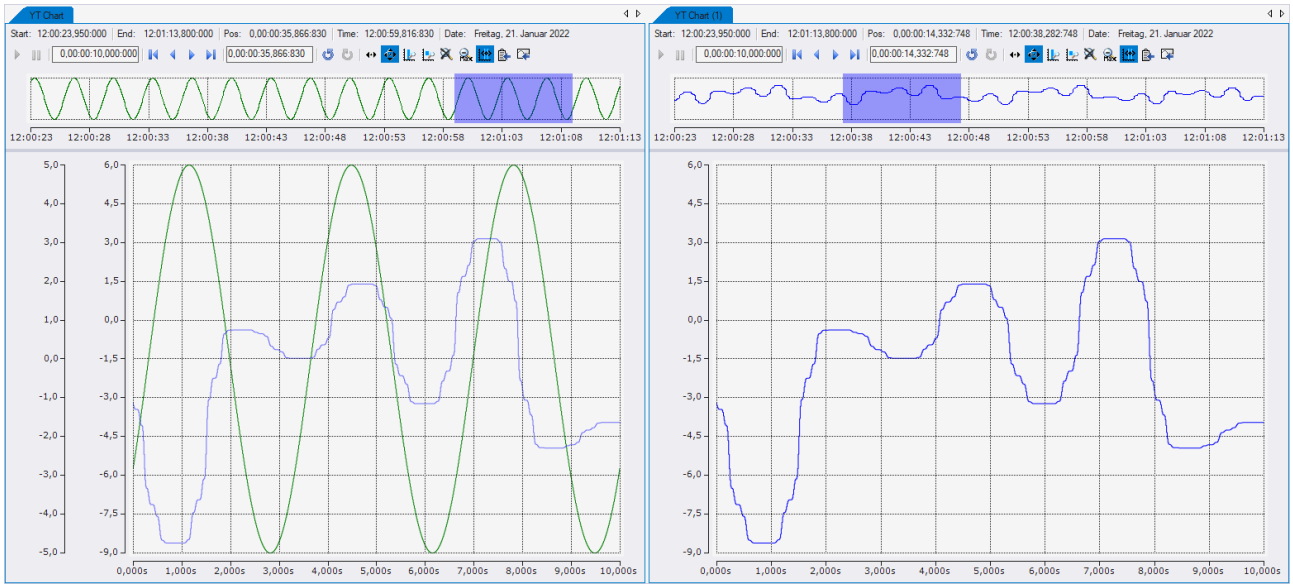
5.2.5.6 Compare channels from different charts

If two channels in different charts are to be compared at different times, this can also be done through the layers.

To do this, simply drop a channel that is to be displayed as a layer in the other chart from the Solution Explorer into the empty area of the Layer Editor of the target chart.

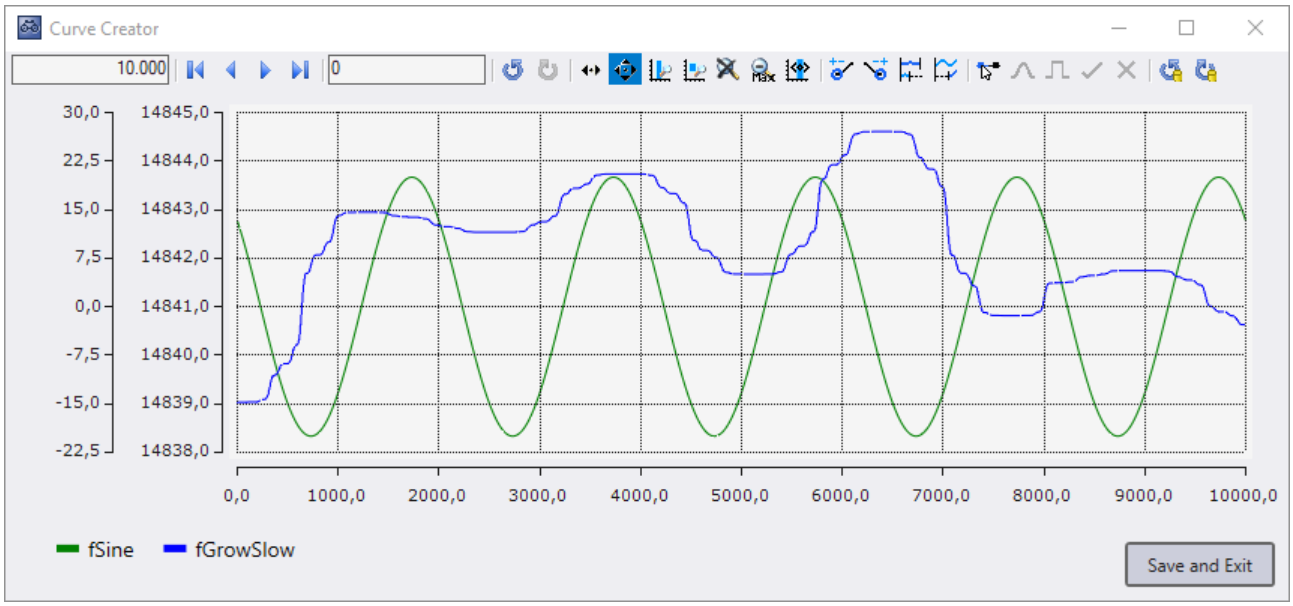
In the target chart, this channel is now automatically added invisible and only displayed visible in a new layer. The data starting point of the new layer is referenced to the old chart. In this way, you can select the position in the old chart that you want to compare in the new chart.

The result of such an operation may look like this:



In this example, the blue channel from the right chart was dropped into the Layer Editor of the left chart. The anchor point of the left chart is set to Display Time Offset with an offset of 0. Thus, the anchor point is the current chart position. By this configuration, what is shown in the right chart is also in the display in the left chart.

5.2.6 Curve Creator



The Curve Creator can be used to display and manipulate data, from different sources, in one chart, on a common index axis. In addition to the chart, the Curve Creator also provides a legend that displays the names and colors of the graphs, as well as buttons that are used to save the graphs as an Analytics file.

Open tool from a YT chart

It is possible to load the currently displayed graphs of a YT Chart into the Curve Creator. For this, the recording of the scope view must be stopped.

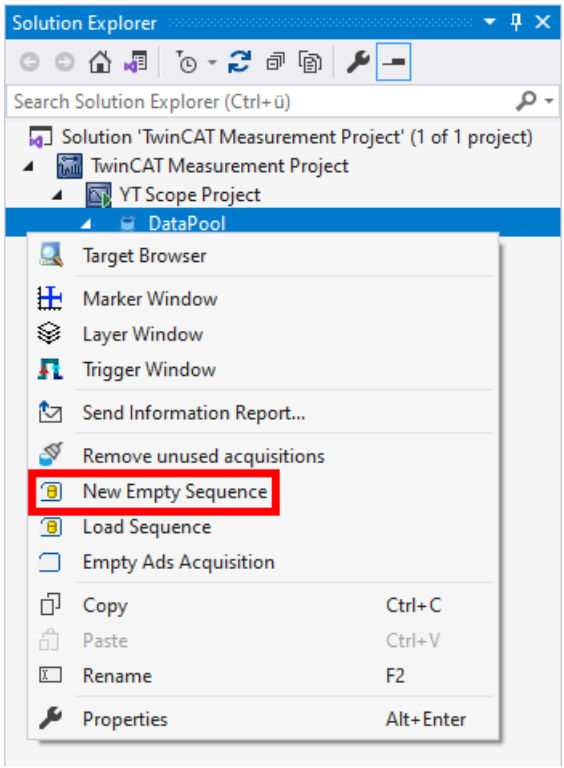


When you click on the highlighted icon of the toolbar in the YT Chart, a new Curve Creator window will open. In the Curve Creator, the displayed data of the channels of the YT chart are then displayed.

The values of the graphs can then be saved using the **Save and Exit** button. When saving, you can specify whether only the visible or also the invisible graphs are to be saved. You can also specify whether the data should be saved in the same folder as the Scope project or in a freely selectable folder. After closing the window, the graphs are stored as a sequence in the data pool.

Create new sequences

There is a possibility to create new sequences with freely adjustable data. For this purpose, **New Empty Sequence** must be selected in the context menu of the data pool.

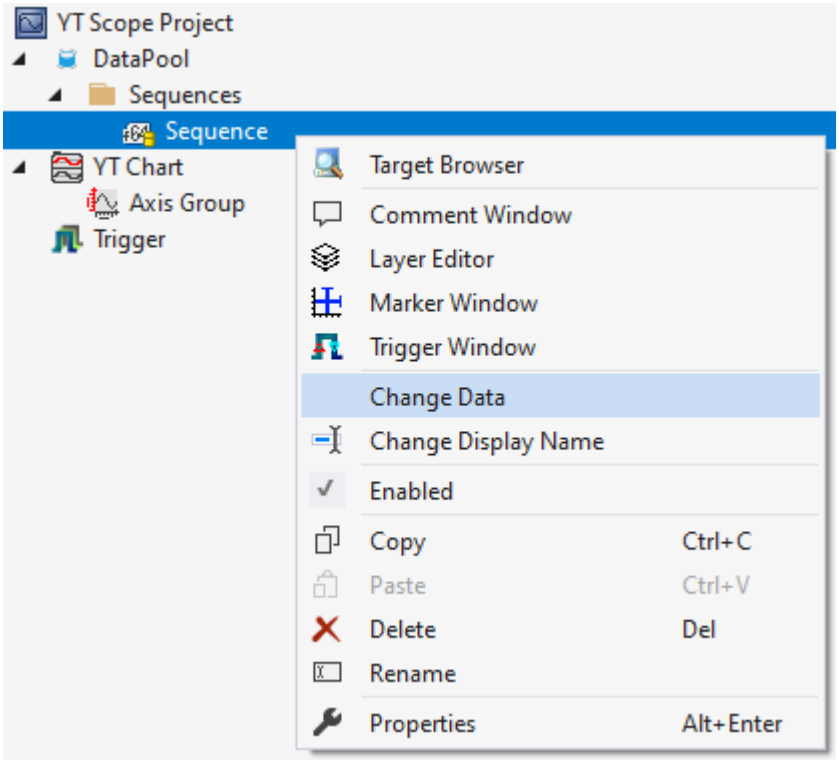


Then a new Curve Creator window will open. In the window there is a graph containing 1000 zero values. These can then be extended, shortened and edited.

When closing via the button **Save and Exit**, you are first asked whether only the visible or also the invisible graphs should be saved. You are then asked whether the data should be saved as an Analytics File, next to the project or in a folder of your choice. After saving, a new sequence with the saved data is added to the data pool

Editing in the data pool

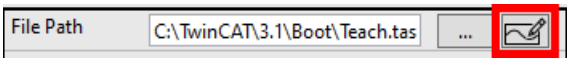
Sequences can be viewed and edited using the Curve Creator. To do this, one or more sequences must be selected in Solution Explorer. Then the context menu can be opened and with **Edit** a Curve Creator window can be opened.



When you click the **Save and Exit** button, the data is written to its original sequence.

Analytics Workbench file path parameters

In Analytics Workbench there are several functions with file path parameters. Here the Curve Creator can be used to create or view Analytics files.



When the button in the File Path parameter is clicked for editing, a Curve Creator window opens. If the specified file does not exist, then a new graph is created, otherwise the first symbol of the Analytics file is displayed.

When saving, either a new folder where the data will be saved can be selected or if the file already existed, then the **Override and Exit** button can be used to replace the opened file. When a new file has been saved, the file path in the parameter is updated.

Track Editor

In Analytics Data Scout, the Curve Creator can be used in the Track Editor to modify track data. When opened, the range that is also displayed in the chart is loaded from the track data and displayed in the Curve Creator.

When closing via the button **Save and Exit**, you are first asked whether only the visible or also the invisible graphs should be saved. The graphs are then saved in an Analytics File and the changed area in the tracks is replaced with the new Analytics File. If the functions have been used to change the start or end point of graphs, it is not the selected range that is replaced, but the range from which the data originate. After closing the Curve Creator, the number of samples remains the same.

Operation

In Curve Creator, there are several functions in the toolbar for editing and displaying graphs.

Navigation



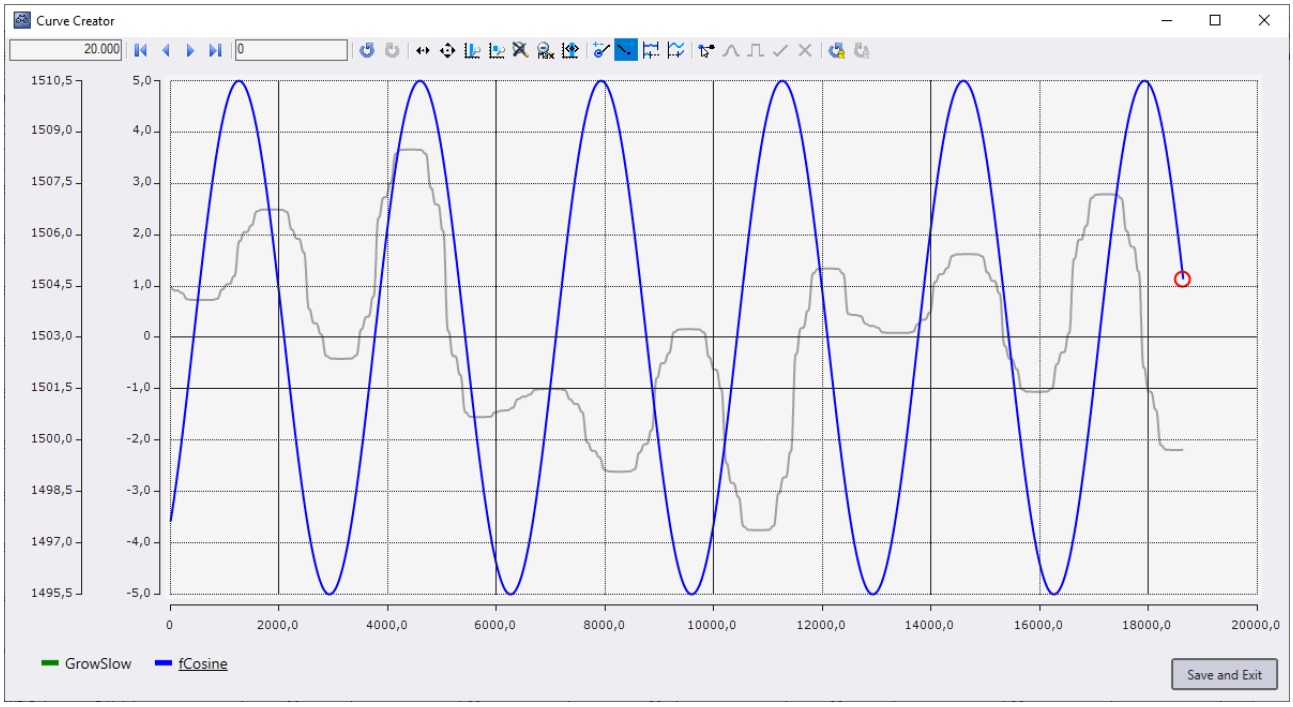
Similar to a YT chart, the displayed area can be changed in the Curve Creator. However, no time is displayed on the X-axis, but indices. Therefore, the display width text field and the position text field contain index values and no times.

Since there is no adjustable default display width, Zoom to default only returns the Y-axis and not the X-axis to the default value.

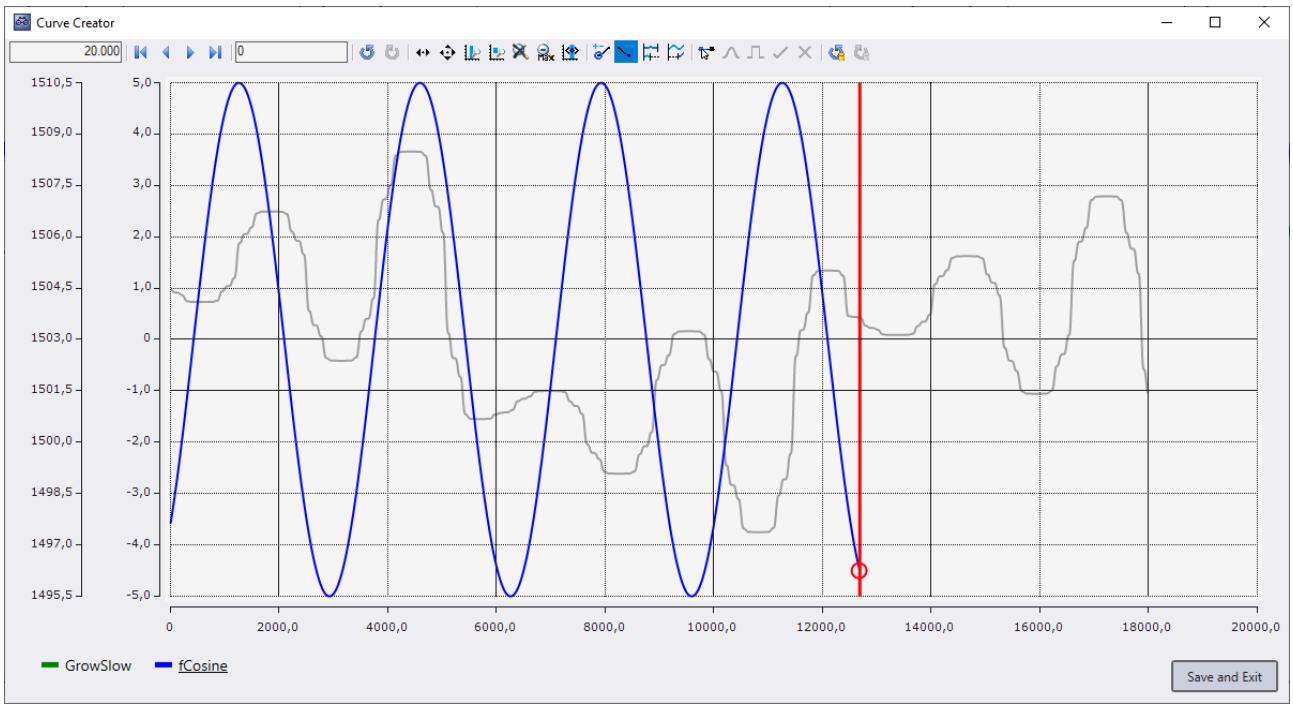
Change start and end point



It is possible to lengthen or shorten the graphs using these mouse modes, at the start or at the end. If one of the modes is selected, all graphs are selected. This can be recognized by the fact that all graph names are underlined in the legend. The graph can be selected or deselected by clicking on a graph name. If a graph is no longer selected, it is displayed in a slightly grayish color and is no longer underlined in the legend. You can also click on a graph in the chart to select it. After clicking on the graph, only this graph is selected. If the [Ctrl] key is pressed during the click, a multiple selection of the graphs can be edited. In addition, you can press a free area of the chart and draw a rectangle by holding down the left mouse button. When you release the mouse button, all the graphs that were inside the rectangle at the time of your release will be selected.
All selected graphs have a round shape at the start or end; the unselected graphs are grayed out.



The round red shape that now appears can be clicked. When clicked, a marker is displayed. This can be moved by moving the mouse.



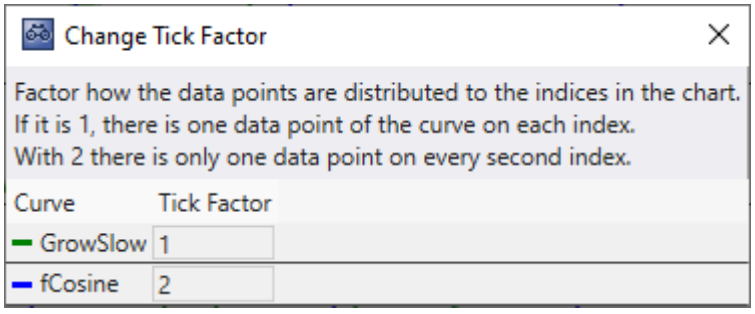
When the left mouse button is released, the selected graphs are lengthened or shortened to the position of the marker. This happens even if the marker has not been moved for some time, but the action is not completed until the mouse button is released.

If several graphs are selected and do not start or end at the same point, the distance between the graphs is maintained when they are lengthened or shortened.

Compress and stretch



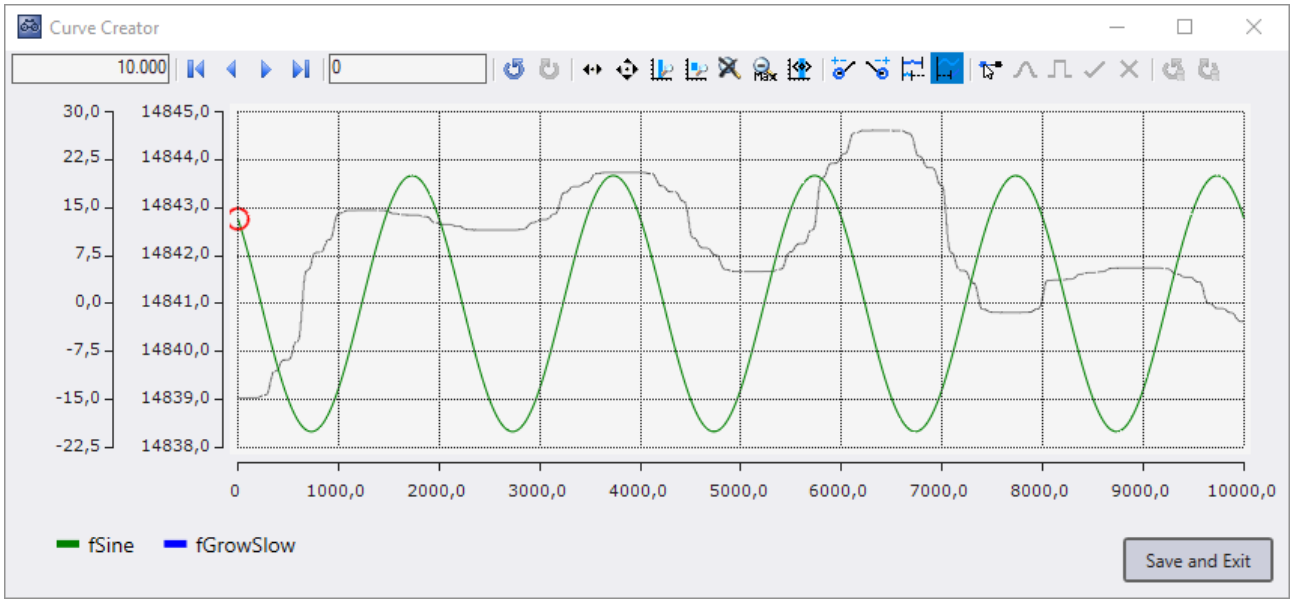
This functionality allows you to change the distances between the values of a graph on the X-axis. The values of the graphs are not changed, only the index distance between the values. To use this function, the window shown below is opened, in which the factor of the distance between the values on the X-axis can be set. If one data point is to be displayed on each index of the X-axis, the factor must be set to '1'. If only one data point is to be on every second index, select the factor '2'.



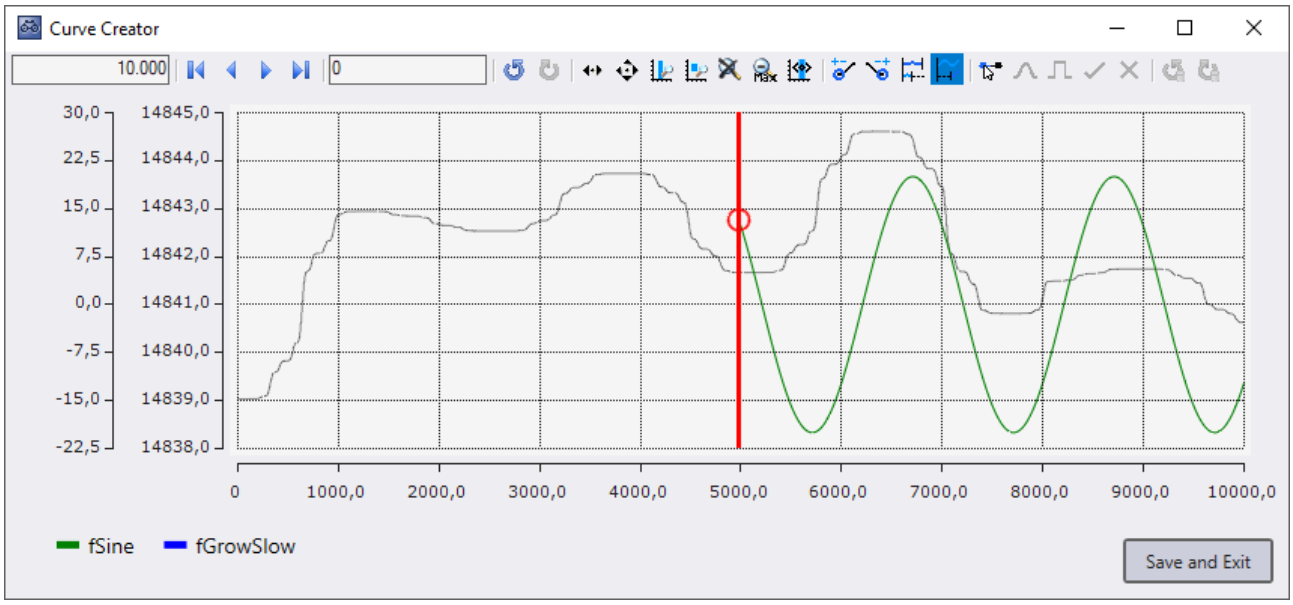
Set start offset



This mouse mode can be used to set the start position of graphs on the X-axis. To set the start offset, graphs must be selected by clicking on them. Selected graphs get a red round shape at the start, unselected graphs are grayed out.



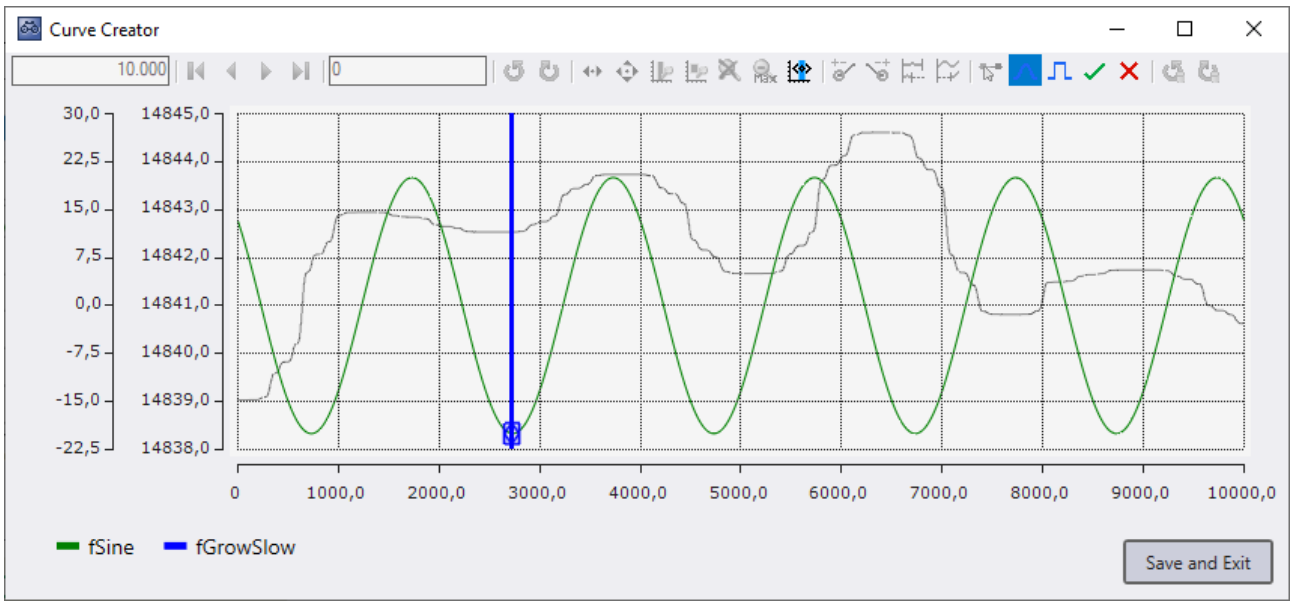
When a shape is clicked with the left mouse button, a marker appears. This marker indicates where the start position of the graphs should be. As long as the mouse button is pressed, the marker can be moved by moving the mouse. When you release the mouse button, the marker disappears and the start offset of the graphs is adjusted.



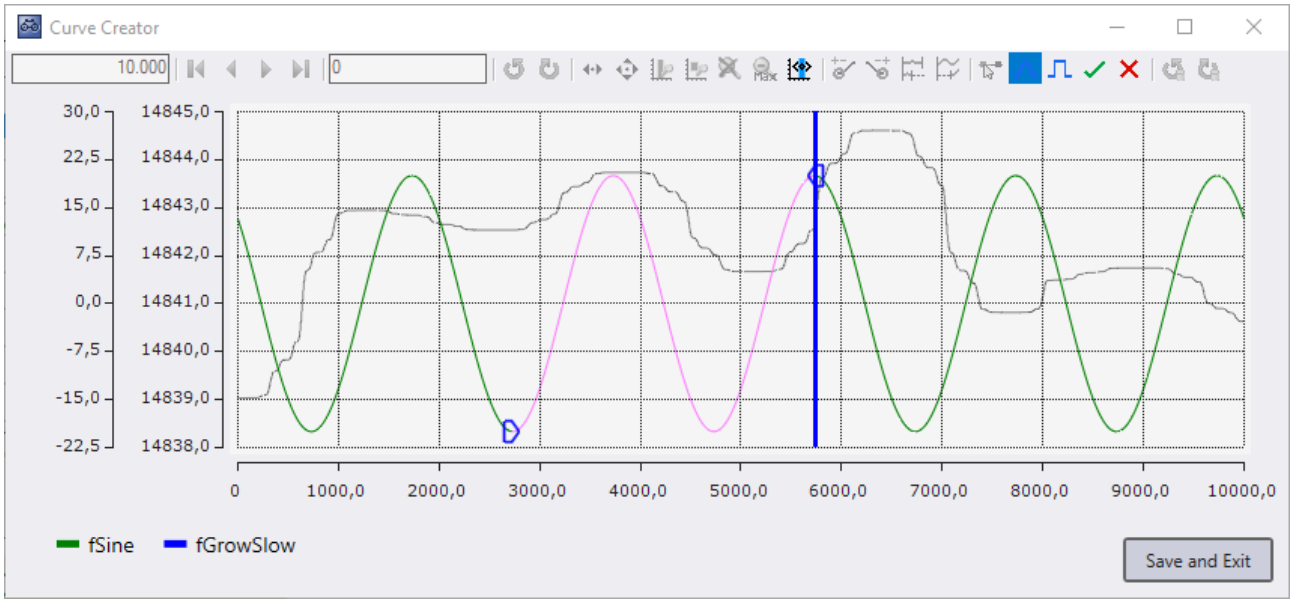
Selection mode



The Curve Creator can be used to manipulate the values of graphs. To manipulate values, an area in a graph must first be selected. The selection mode can be activated for this purpose. Then a graph can be clicked to start a selection.

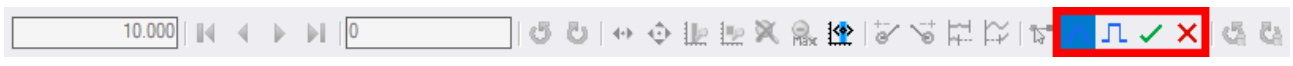


A marker and two blue shapes are displayed at the value clicked on in the graph. As long as the mouse button remains pressed, the marker can be moved by moving the mouse. When moving the marker, an area between the start point and the marker is selected. The selected area has a different color than the unselected area and has a blue shape at the start and at the end. When the mouse button is released, the marker disappears.



With the help of the blue shapes the selected area can be changed afterwards. To do this, just click on one of the shapes and a marker will appear that can be moved as in the initial selection.

There can be only one selected area in the Curve Creator. Once an area has been selected, only the buttons for editing the selected area are operable.

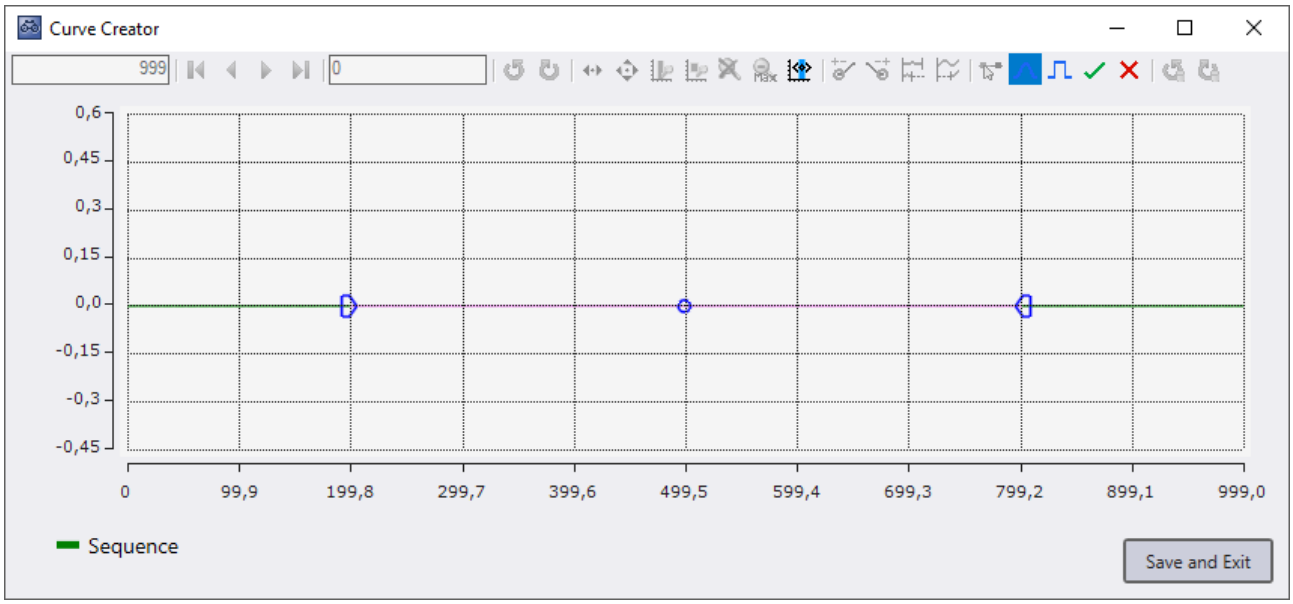


To cancel the selection, the editing can be ended by clicking on the checkmark in the toolbar or canceled by clicking on the X in the toolbar. When canceling, the graph is reset to the state before the selection. When clicking in the empty area in the chart, the selection, as when clicking on the checkmark, is canceled and the changes to the graph are applied.

Transformations

The transformation mouse modes are only available if an area has been selected with the selection mode. The transformations can be used to edit a selected area. To do this, click with the left mouse button on the selected graph, then a round blue shape will appear at the place where the center of the transformation is.

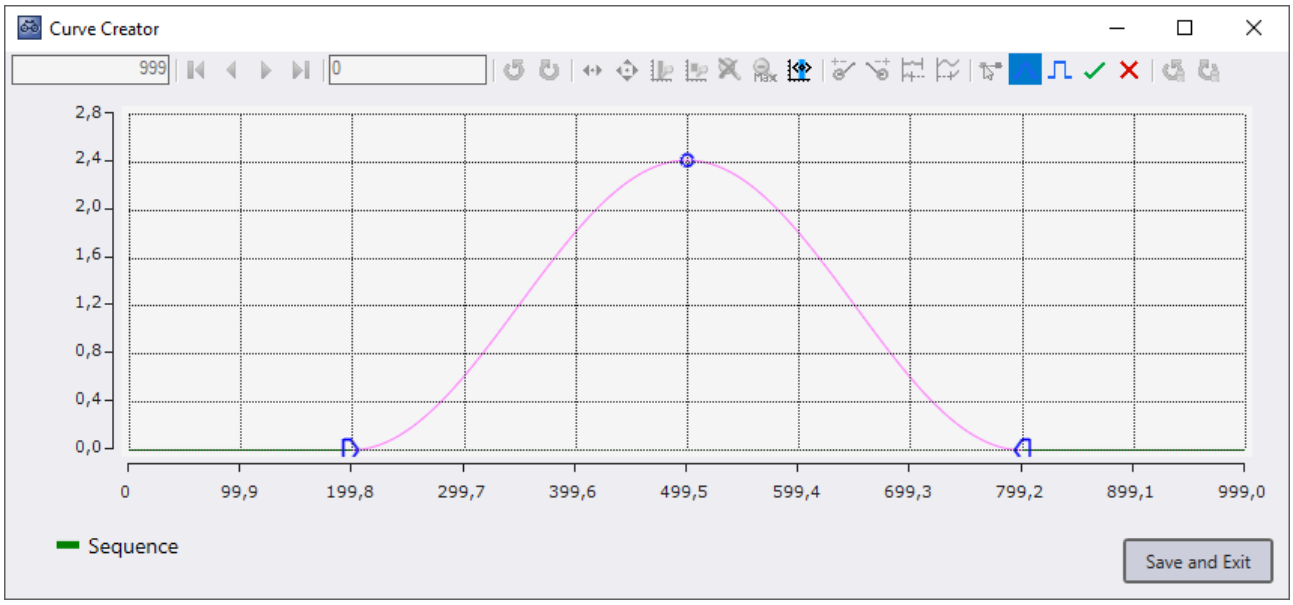
By moving the mouse while the mouse button is pressed, the center of the transformation can be moved up or down. When the mouse button is released, the round blue shape disappears and the transformation is complete. Several transformations can be applied before the selection mode is terminated.



Curves transformation



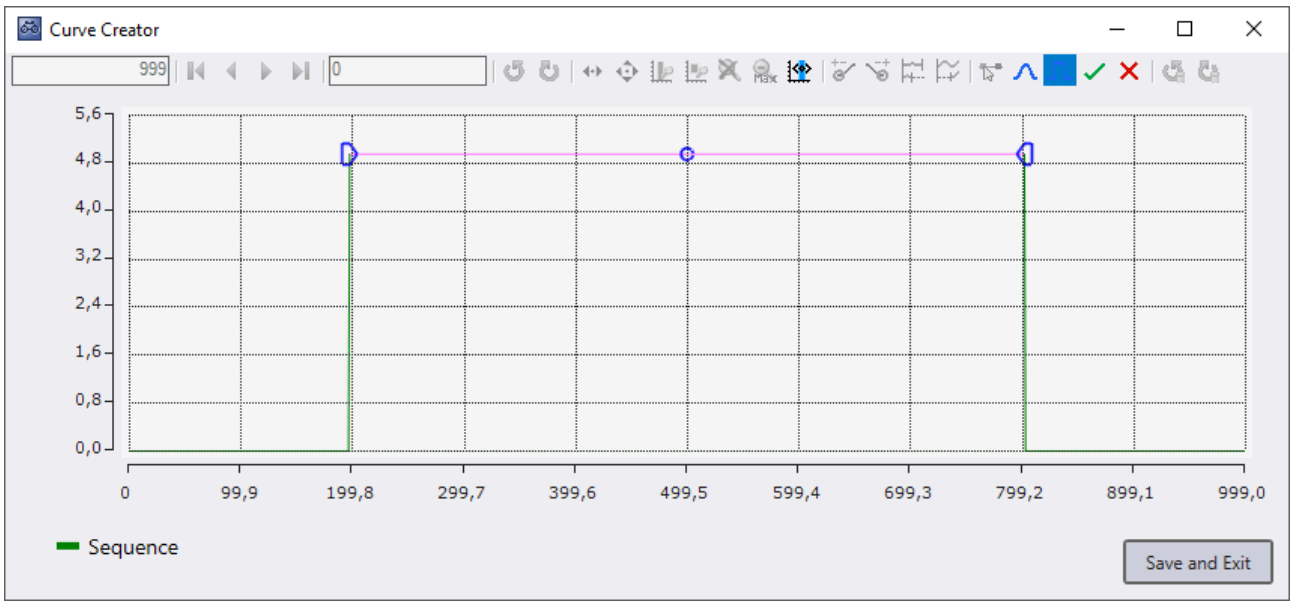
The Curves transformation puts a curved offset on the graph. The change is greatest at the center and becomes smaller the closer the value is to the start or end of the selection.



Y offset transformation



The offset transformation gives each value in the selected range the same offset based on how far the mouse has moved up or down from the start of the transformation.



Undoing actions

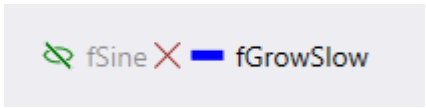


In the Curve Creator it is possible to undo certain actions. This includes lengthening, shortening, compressing, stretching, setting start offset and transforming graphs. To undo these actions you can use the Undo Redo buttons on the right side. The Undo Redo buttons in the navigation area only undo the change of the displayed area.

Legend

A legend is displayed below the chart, listing all Curve Creator graphs by name and color.

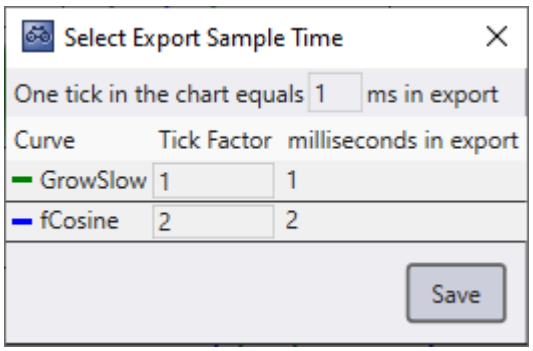
Hide graphs



It is possible to hide the graphs in the Curve Creator. Hidden graphs will be grayed out in the legend. To hide a graph, either click on the colored rectangle in the legend or right-click on a graph in the context menu. Hidden graphs are saved as well. You can click again on the colored area in the legend to unhide. If the Curve Creator has been opened from a YT chart, graphs can be deleted via the legend or the context menu. Deleted graphs are not saved.

Export with Sample Time setting

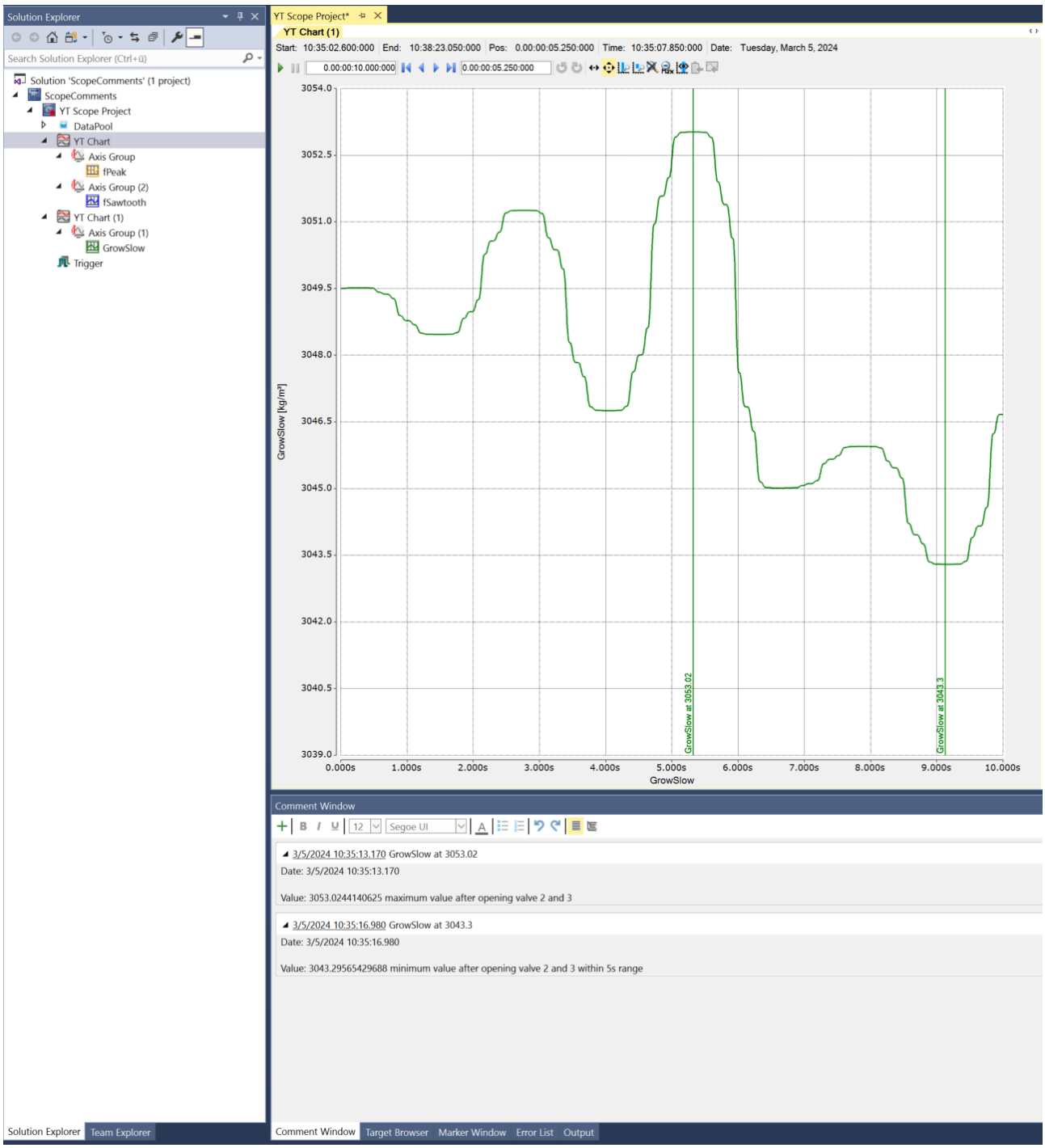
If the Sample Time can be set for the exported data, the window shown below will open before the export. The Base Sample Time with which the graphs are to be exported can be defined in the upper area of the window.
The table lists the various graphs with their factor ("compression and stretching") and their associated Sample Time. The Sample Time is calculated by multiplying the Base Sample Time by the factor, as the Base Sample Time indicates the duration of an index on the X-axis.



5.2.7 Comment function

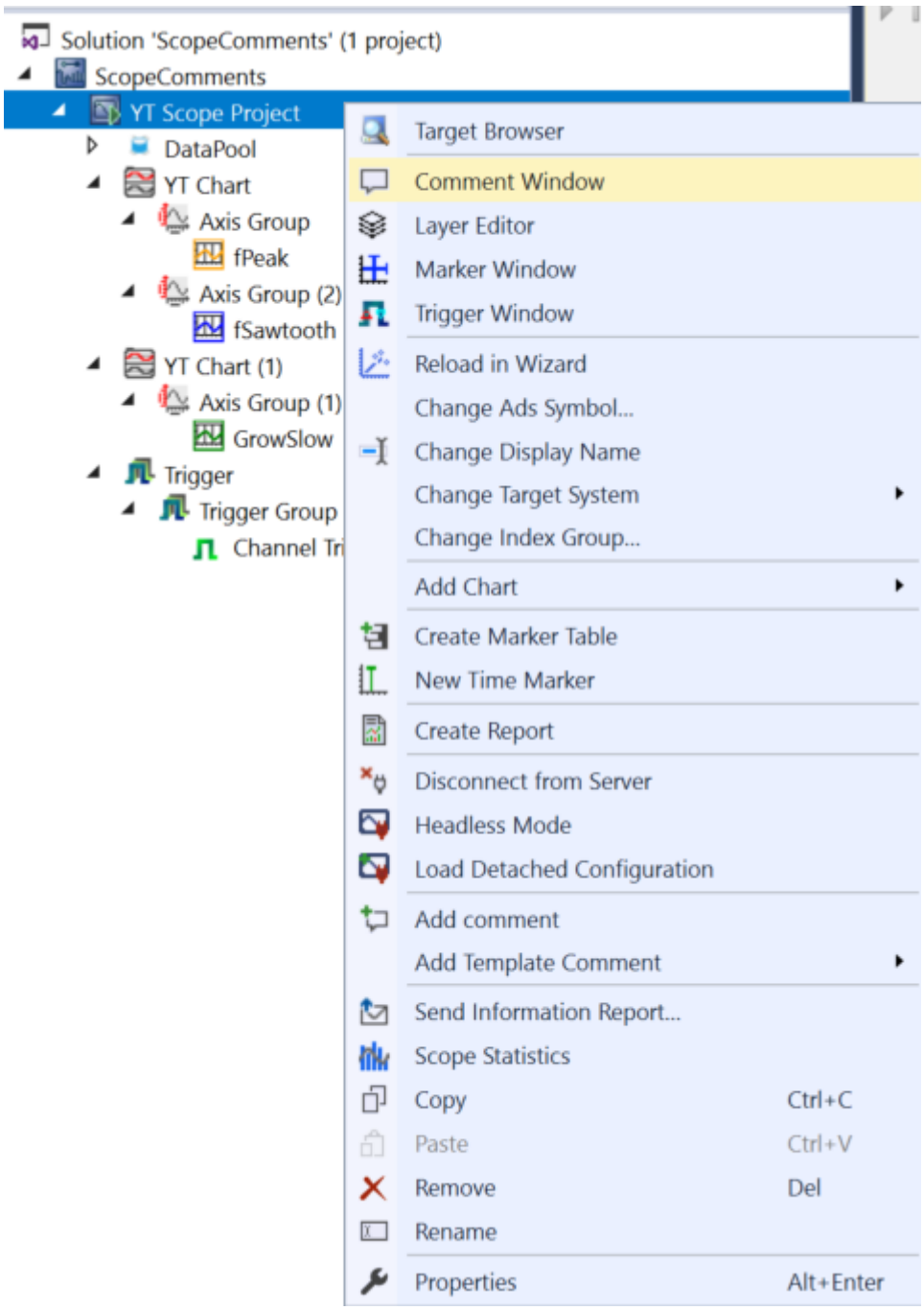
In the TwinCAT Scope View it is possible to enter comments in many places, especially at the hierarchical levels of charts, axes and channels. The comments can be displayed summarized as a flat list or as a hierarchical tree in the comments window. It is also possible to automatically write comments in the comment window by using triggers.

The individual comment functions are explained in more detail in the following sub-chapters.

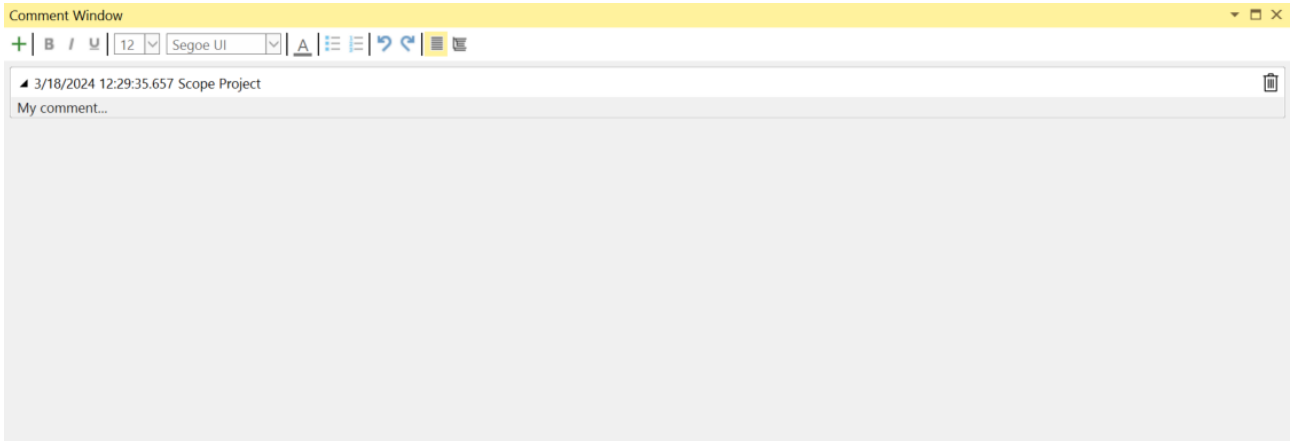


5.2.7.1 Comment window

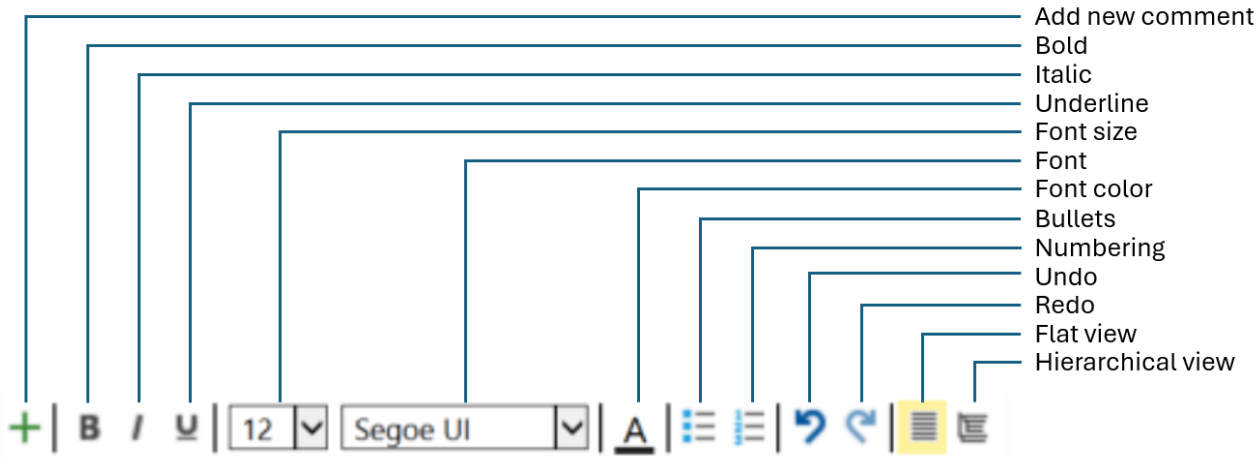
You can open the comment window in different ways. Manually via the Scope menu in the menu bar of the engineering software or via the context menu of the various Scope nodes in the Solution Explorer. The comment window opens automatically after setting a comment marker at a data point in the chart.



When the window is open, comments can be added to the window manually via the context menus in Scope or automatically via a trigger. The figure below shows the window with a manually created comment on the Scope node in the Measurement project.

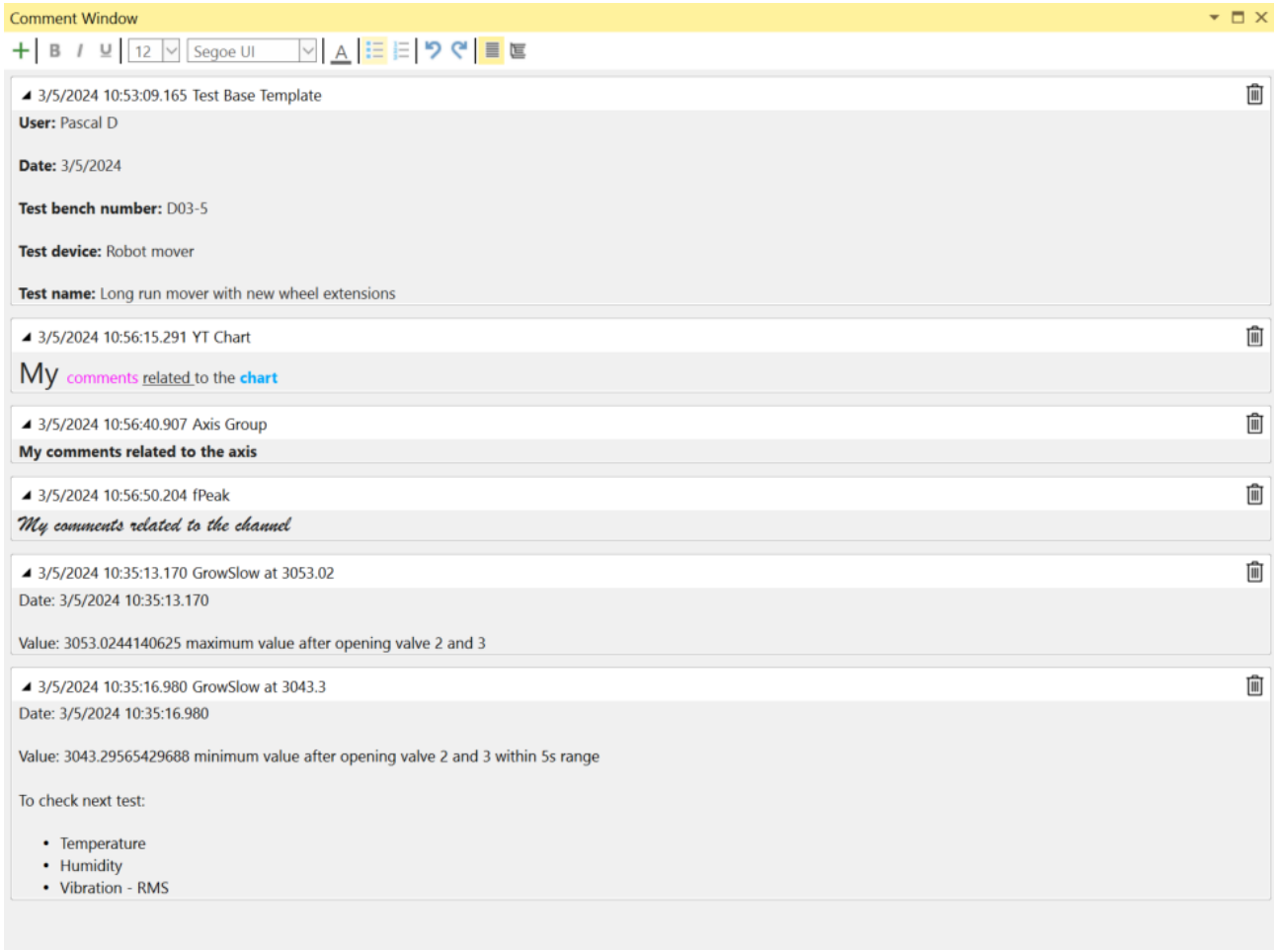


To create the comment itself, please click under the heading and start typing. The following functions are available in the toolbar, which also directly influence the appearance of the text.



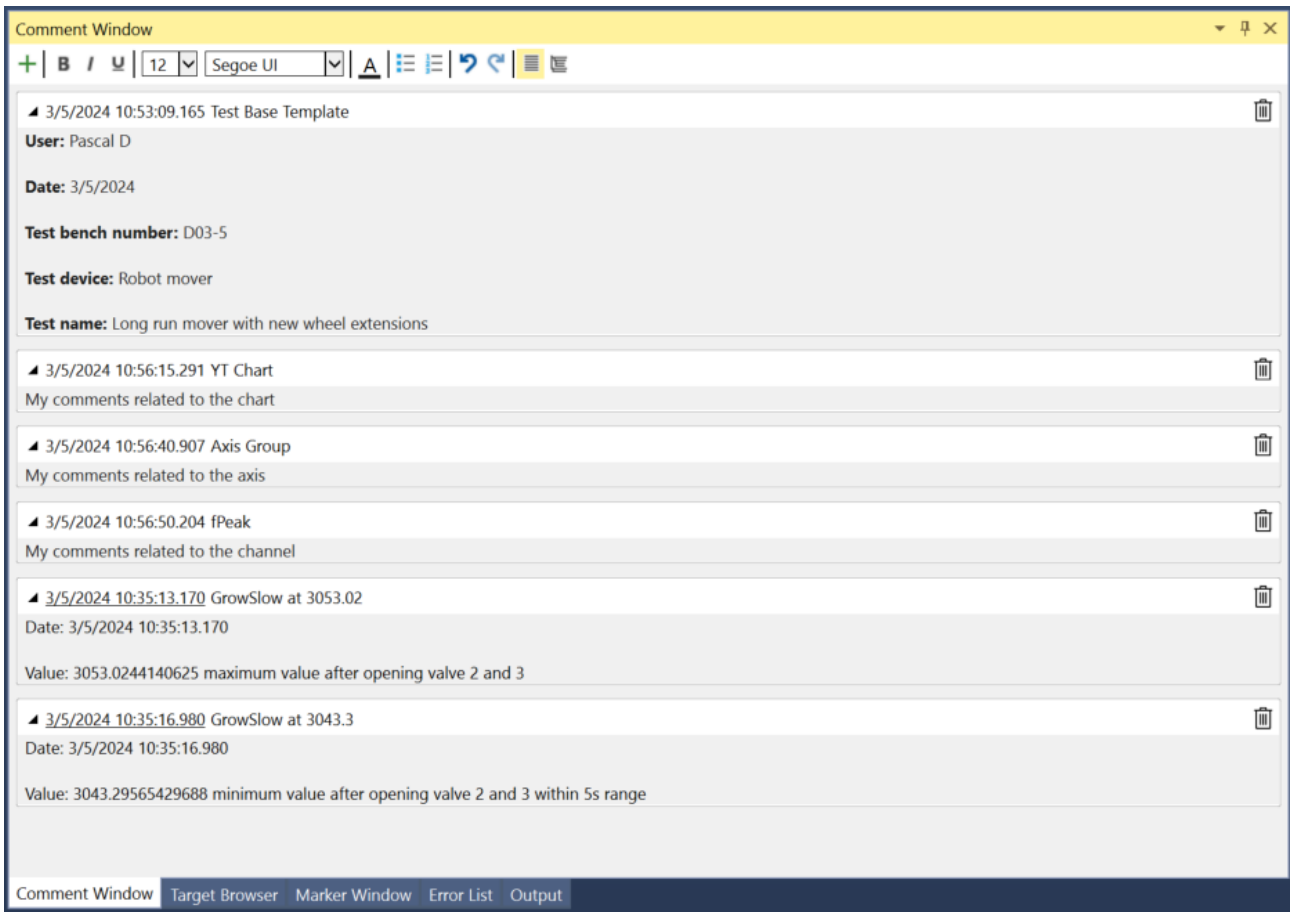
- Add new comment: Always adds a new comment at the highest project level
- Bold: The selected character string is displayed in bold
- Italic: The selected character string is displayed in italics
- Underline: The selected character string is underlined
- Font size: Font size
- Font: Font
- Font color: Font color
- Bullets: Bullets
- Numbering: Numbered enumeration
- Undo: Undo
- Redo: Redo
- Flat view: Represents a flat list of comments
- Hierarchical view: Provides a nested display of the comments corresponding to the tree in the Solution Explorer

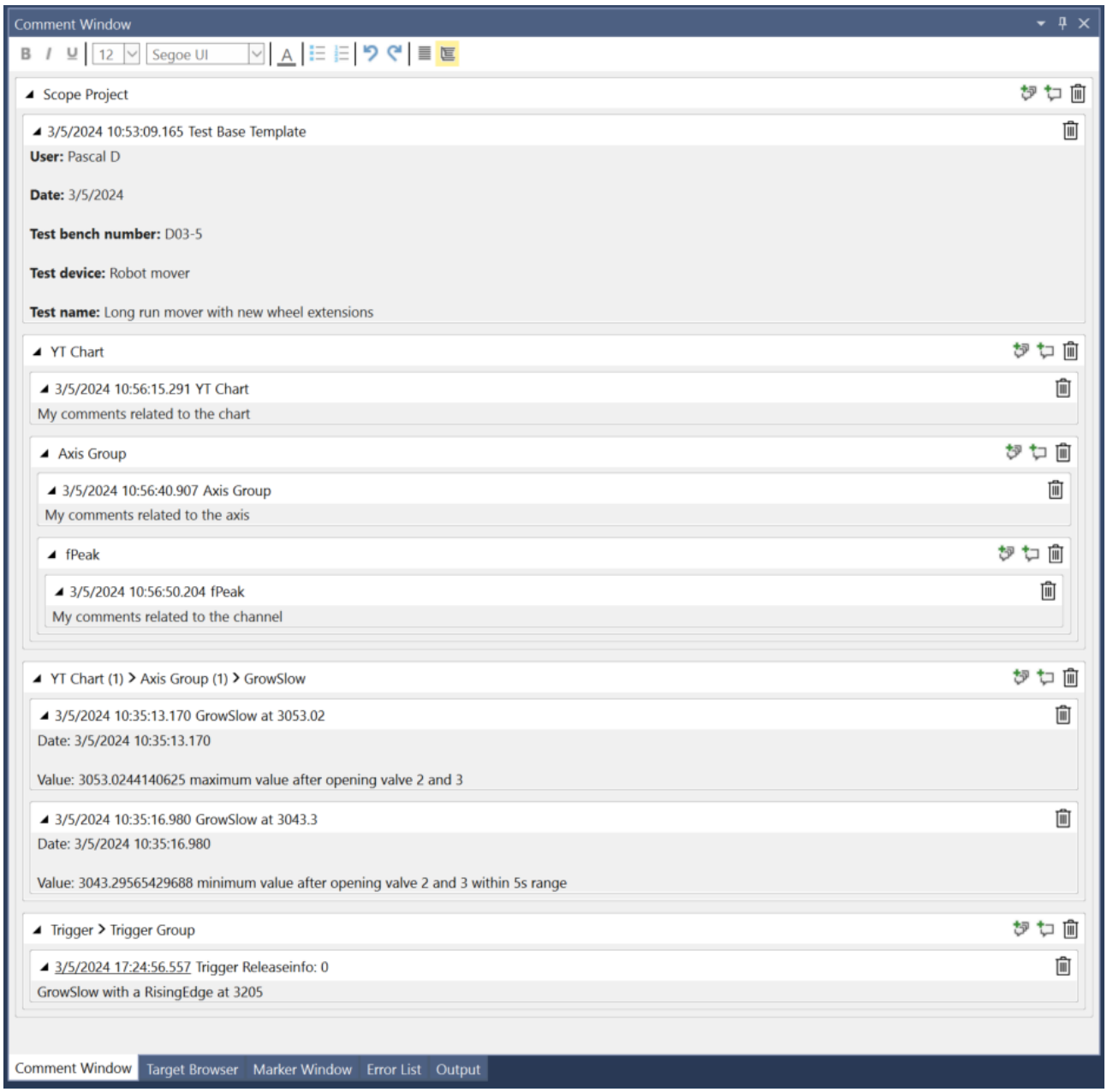
In the following illustration, you can see the potential options you have in the area of formatting with the comment window.



As can be seen in the image, comments can always be removed at the end of a line by clicking on the dustbin symbol.

You can switch between a flat list of comments and a hierarchically structured variant as required. The comments can be displayed in different ways. You can see the differences in the following two screenshots.


Comment Window
12
Segoe UI
3/5/2024 10:53:09.165 Test Base Template
User: Pascal D
Date: 3/5/2024
Test bench number: D03-5
Test device: Robot mover
Test name: Long run mover with new wheel extensions
3/5/2024 10:56:15.291 YT Chart
My comments related to the chart
3/5/2024 10:56:40.907 Axis Group
My comments related to the axis
3/5/2024 10:56:50.204 fPeak
My comments related to the channel
3/5/2024 10:35:13.170 GrowSlow at 3053.02
Date: 3/5/2024 10:35:13.170
Value: 3053.0244140625 maximum value after opening valve 2 and 3
3/5/2024 10:35:16.980 GrowSlow at 3043.3
Date: 3/5/2024 10:35:16.980
Value: 3043.29565429688 minimum value after opening valve 2 and 3 within 5s range
Comment Window
Target Browser
Marker Window
Error List
Output

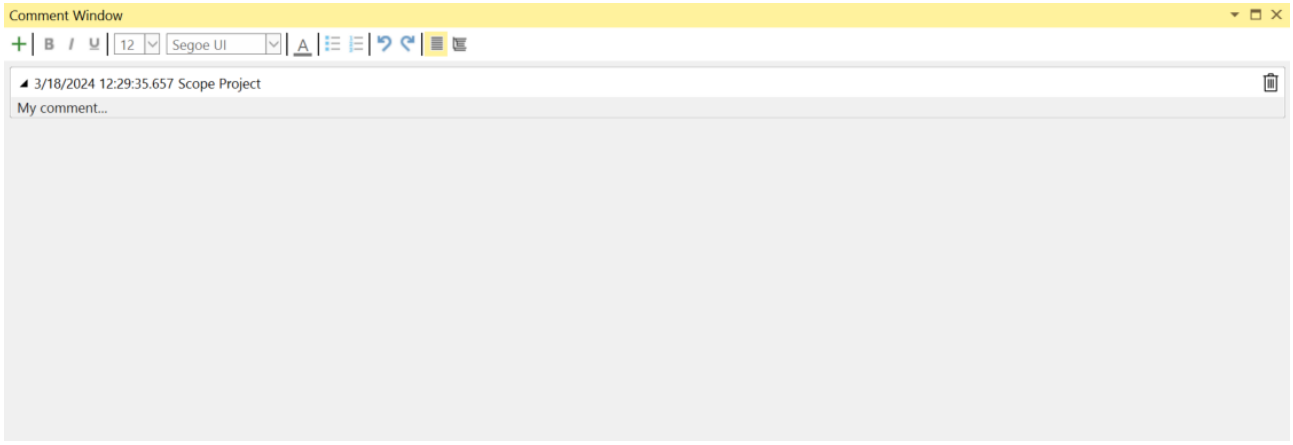


5.2.7.2 Manual comments

There are three ways to manually insert comments into the comment window.

1. In the comment window

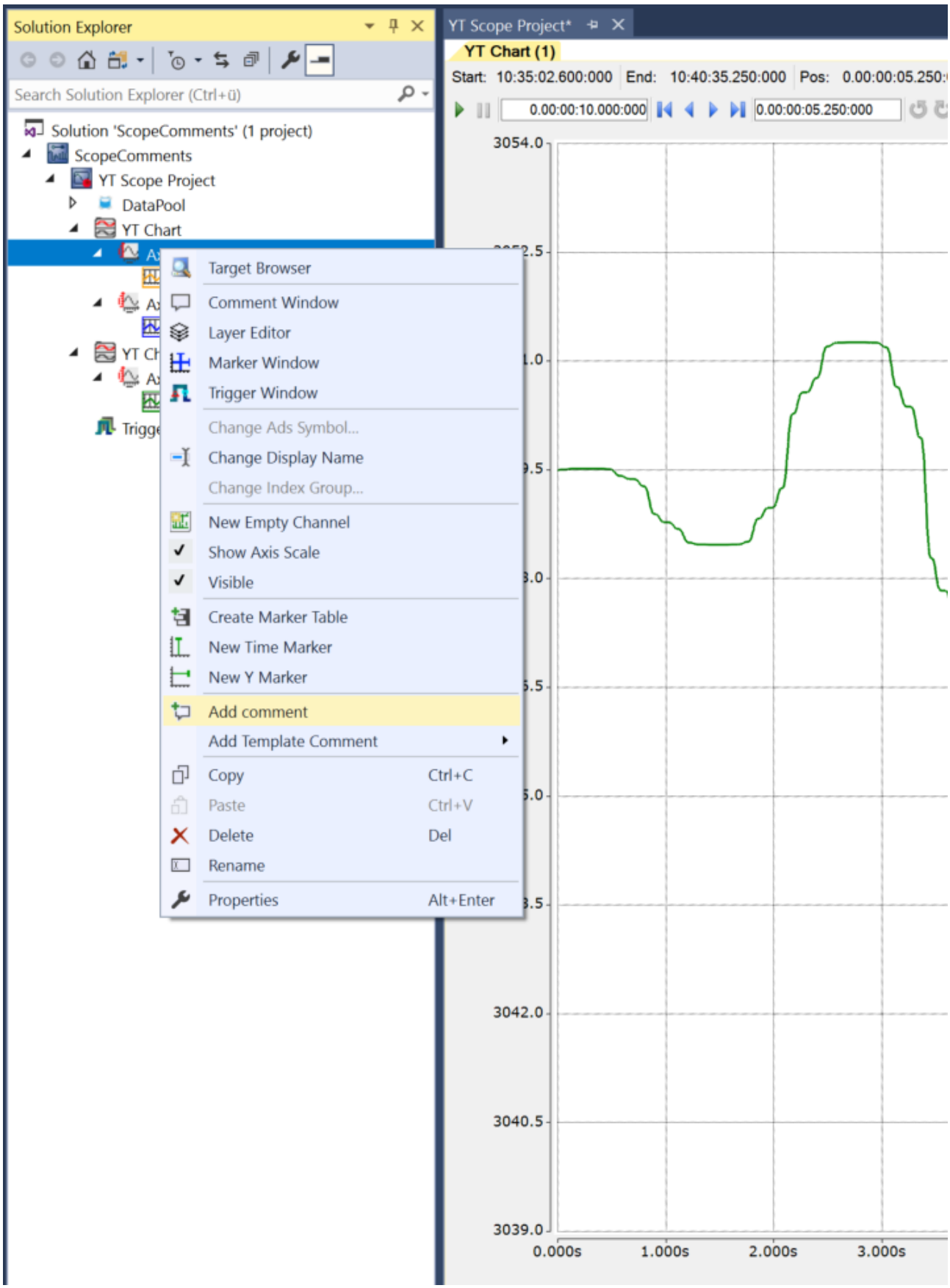
Within the comment window, you can add a new comment at the highest project level using the plus symbol in the toolbar. Particularly suitable for making a quick note for a Scope recording, for example.



For the TwinCAT Scope, the highest project level is the Scope node. The comments inserted in this way have no direct relationship to a data point in the recording.

2. Via the context menu in the Solution Explorer

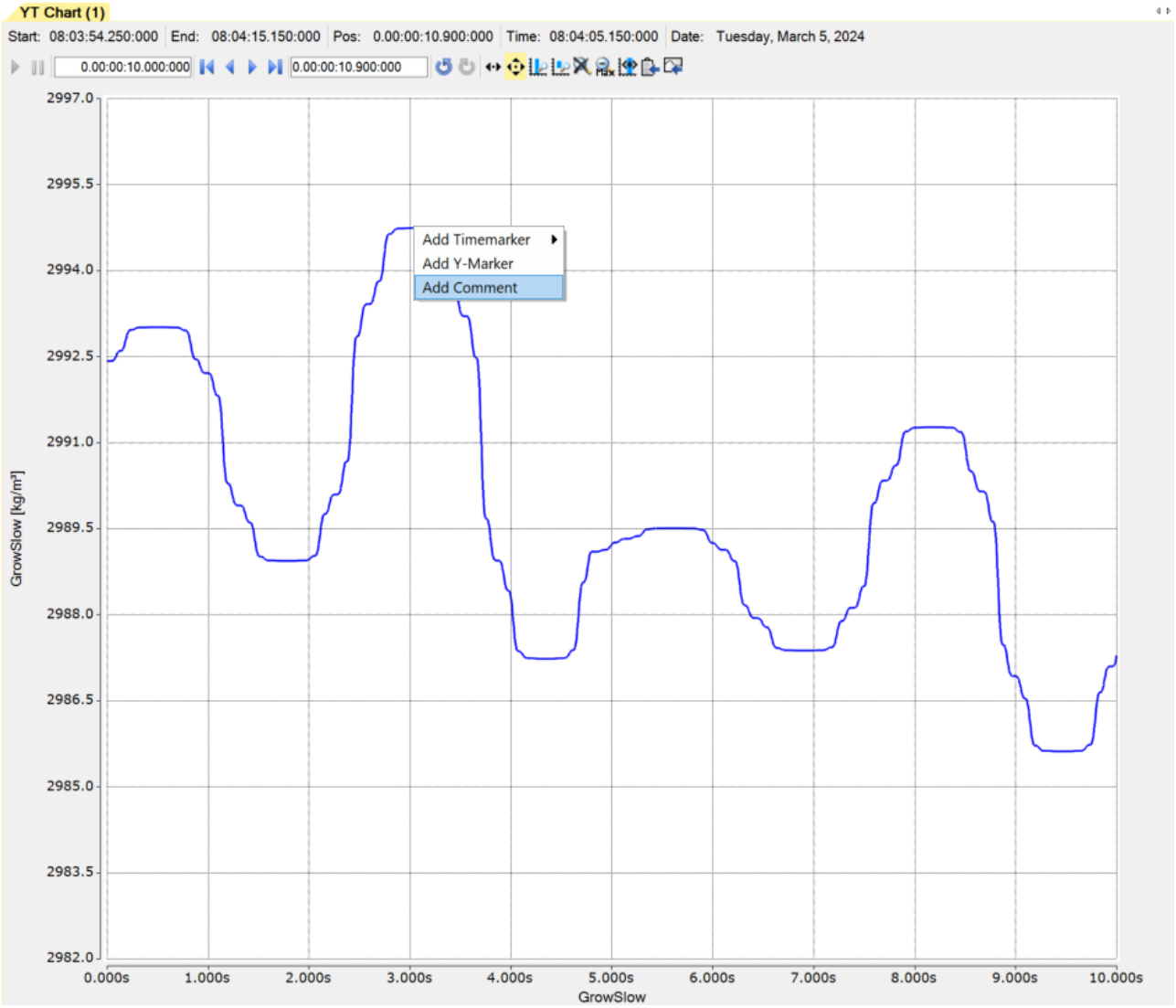
For the TwinCAT Scope, comments can be inserted at almost all hierarchical levels in the Solution Explorer. Examples are the Scope node, the charts, the axes, the channels or the acquisitions. To do this, go to the desired level in the project tree and right-click to open the context menu. There you can select the **Add comment** command.



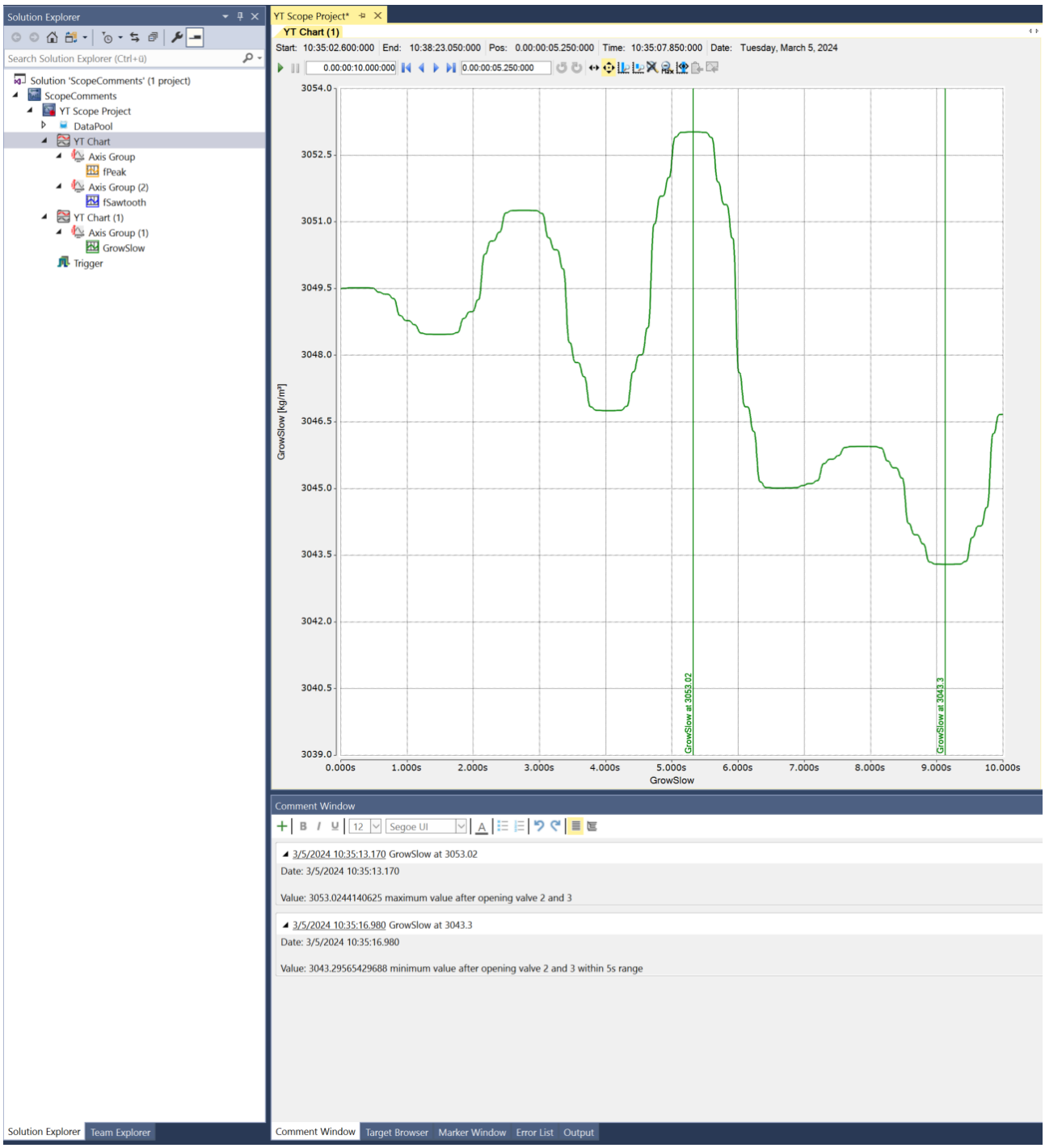
A new comment is then displayed in the comment window for the corresponding level, which you can fill in. This type of comment bears no relation to the actual signal curve in the chart.

3. Via the chart at the individual data points of the graphs

You can anchor comments directly to data points in the YT charts. Simply select the data point and right-click to open the context menu. Then select the Add Comment command. A corresponding comment is inserted in the comment window together with a timestamp.

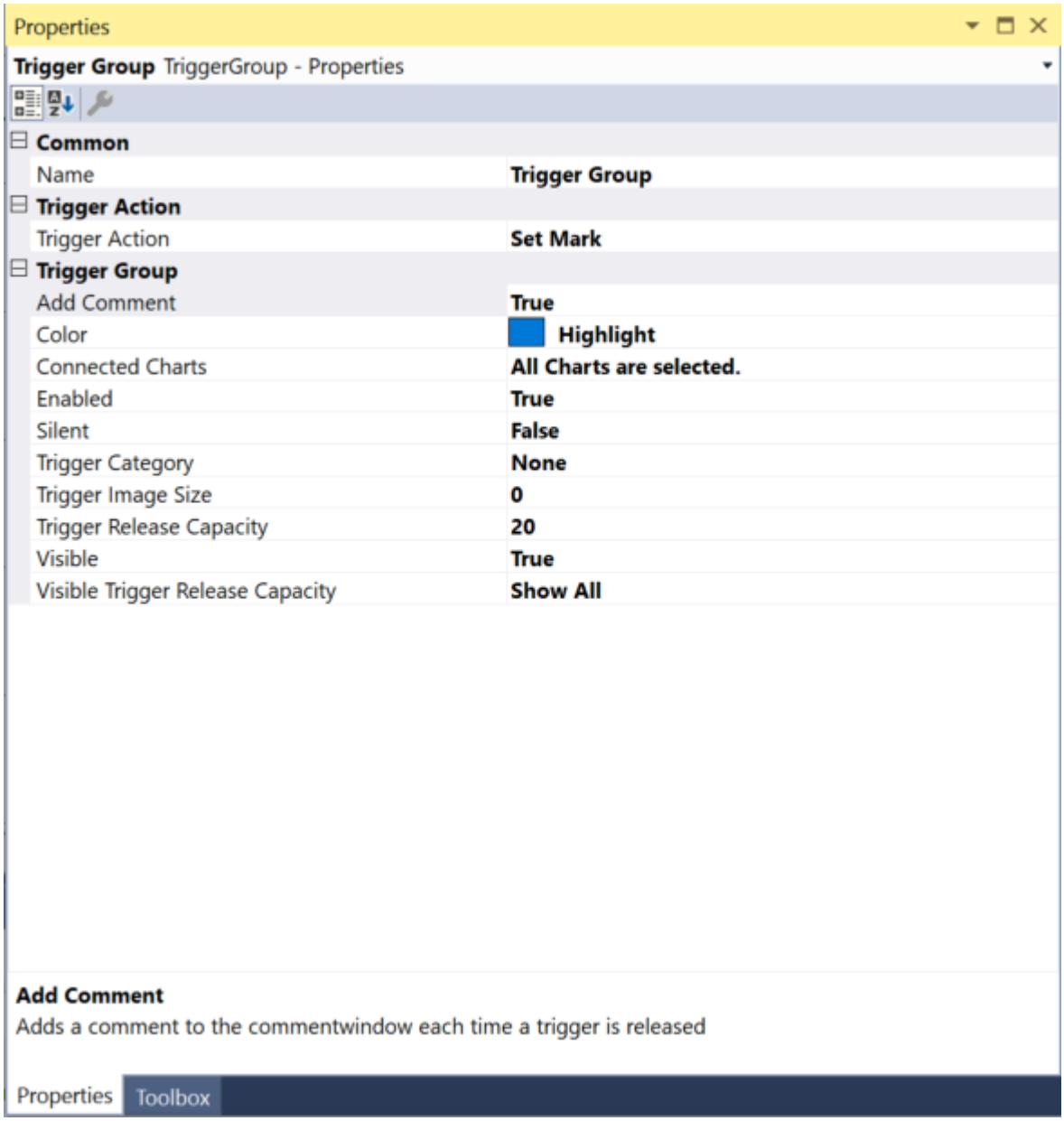


This means that there is a direct relationship between the data point and a comment you have formulated at the corresponding point. The timestamp becomes a link that can be clicked to jump directly back to the position of the comment in the chart. The link is underlined, as shown in the following illustration.

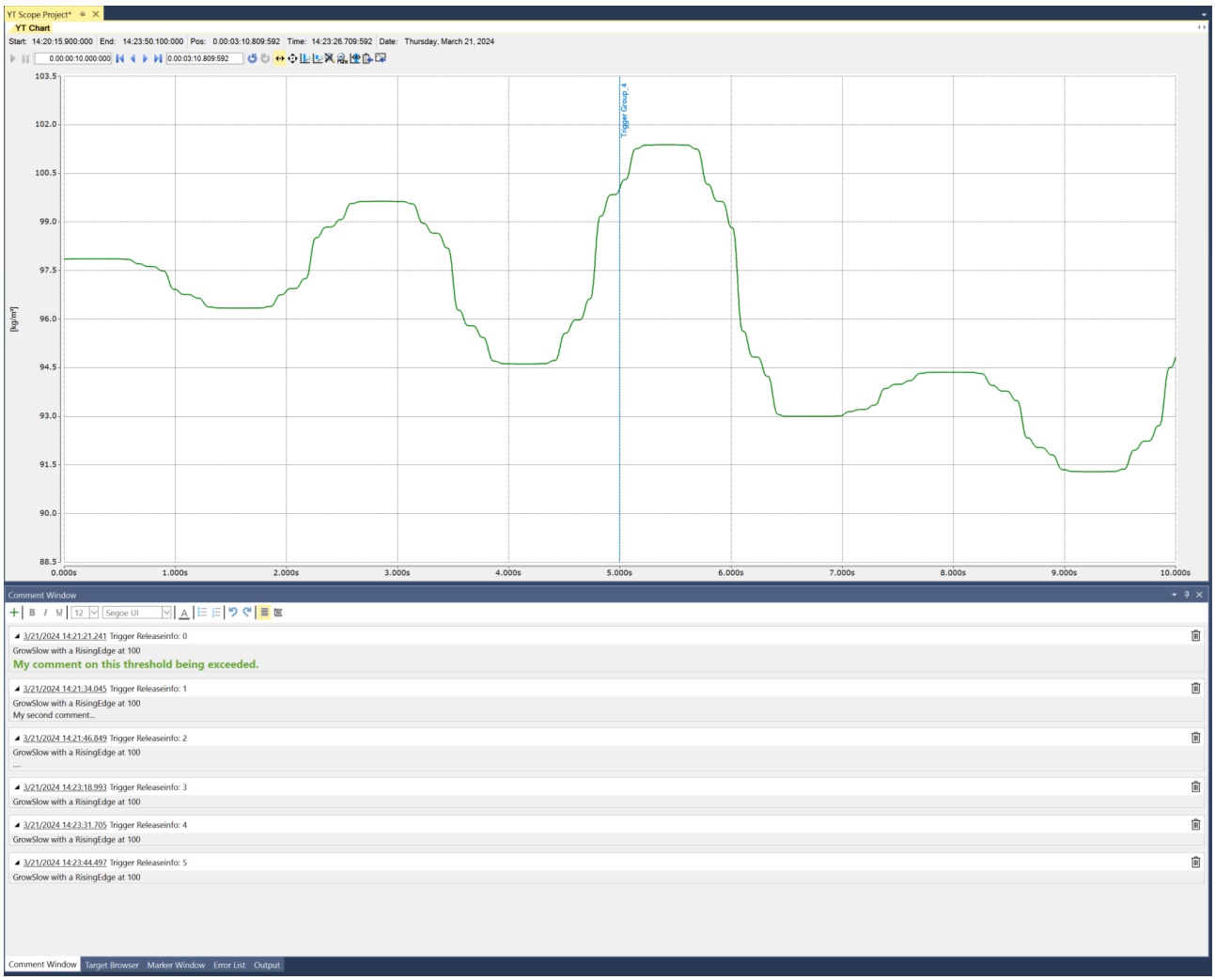


5.2.7.3 Automatic comments

Trigger functions can be used to automatically insert comments into the comment window. To do this, you can set the **Add Comment** setting to True in the settings for the various trigger groups.

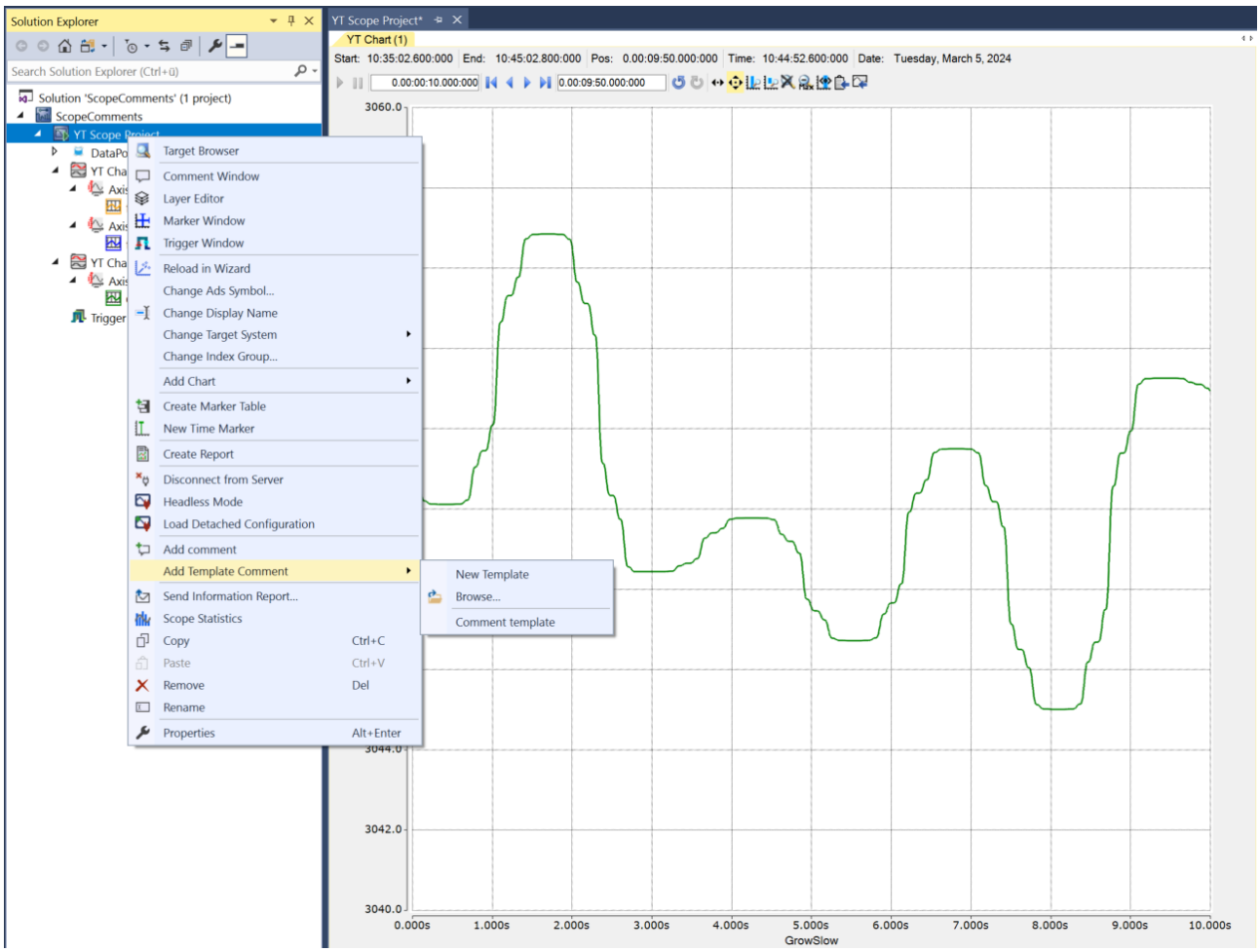


Depending on the limit value defined in the trigger sets, a comment is automatically inserted in the comment window when the value is exceeded or not reached. The comment receives a timestamp as a link, a consecutive number for the number of triggers and a standard text. The standard text displays the variable name and indicates whether the corresponding limit value has been reached. The link helps with navigation in the chart. This makes it very easy to jump from event to event for which a comment has been created. The comment itself essentially marks the position in the data stream and therefore has a direct link to the data. You can manually add further specific information about the event to the comments afterwards or during the recording.

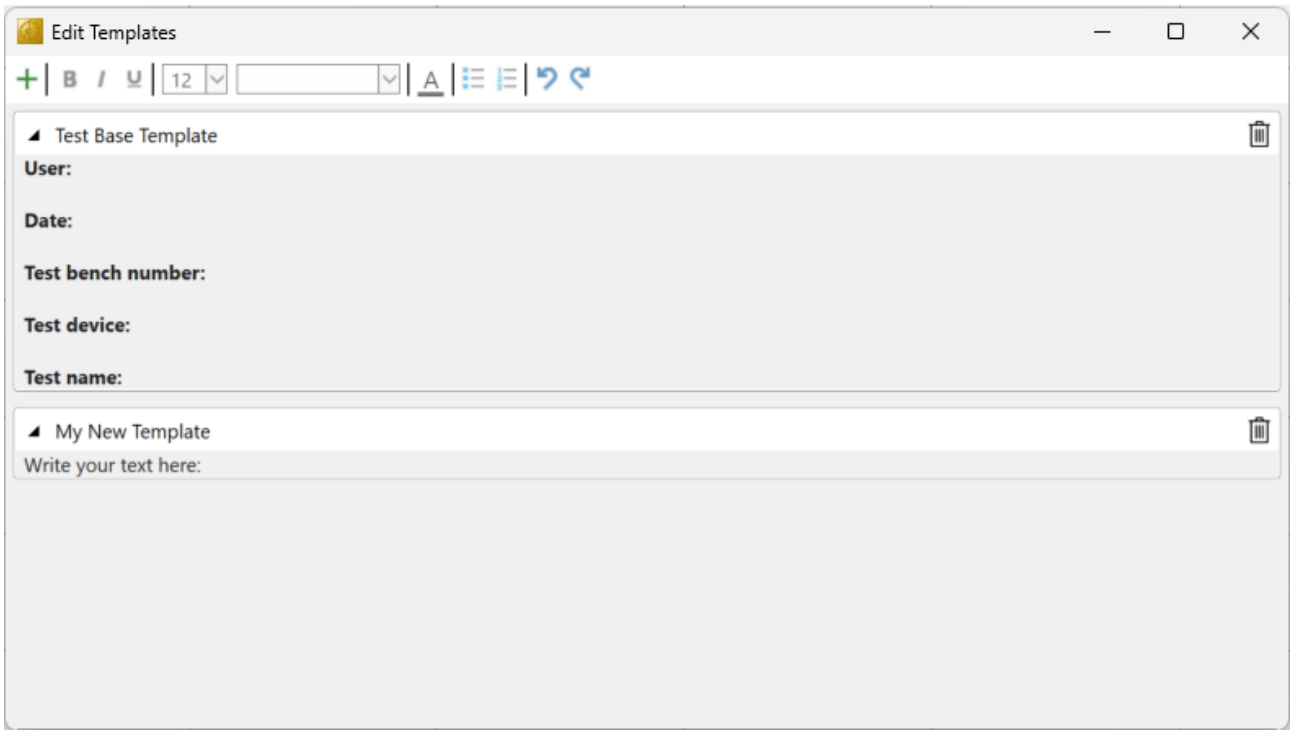


5.2.7.4 Comment templates

If you want your comments to be structured in a certain way and they are frequently repeated in your measurements, you can create a corresponding template. This function is ideal if, for example, you want to standardize test bench documentation or service assignments for end customers. Right-click on the Scope project node to open the context menu. Select the **Add Template Comment** entry. In the submenu, you can create new templates, search for existing templates on the hard disk or select already known templates directly. It is then transferred directly to the comment window.



If you want to create a new template, select the **New Template** command. A new window opens. The plus symbol in the toolbar can be used to create new/additional templates. The name of the template can be found in the top line and can be changed there accordingly. This name is then displayed later in the quick selection in the context menu. This allows a template to be integrated very quickly as a template in the comment window.



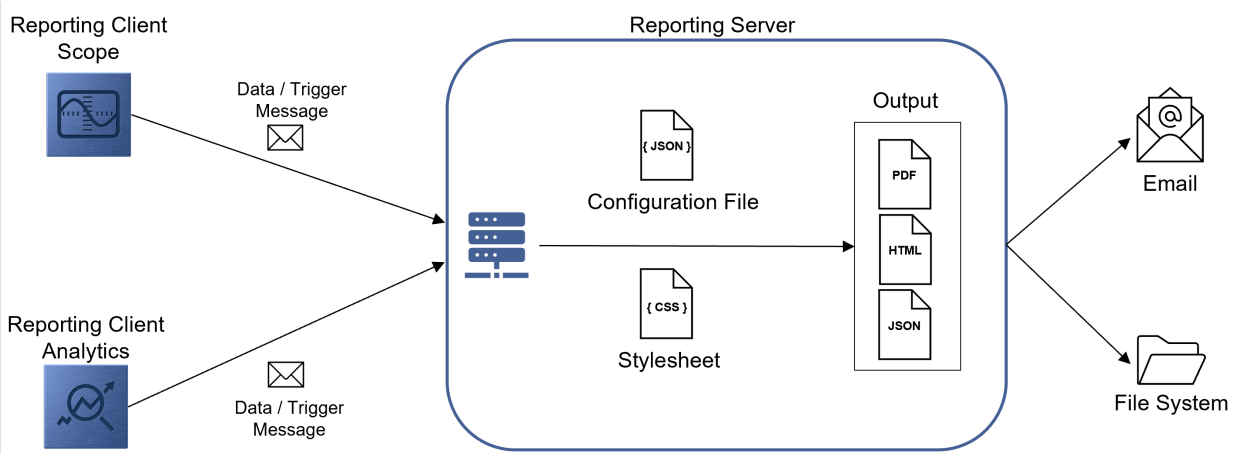
The templates can be formatted as required. The corresponding toolboxes are available in the toolbar. The templates are stored in the *\TwinCAT\Functions\TE130x-Scope-View\Comments* directory as *tcmctmpl* files.

These can be searched for in other directories using the browse function from the context submenu.

5.2.8 Reporting

5.2.8.1 Basic concept

The following figure shows the basic concept of TwinCAT Reporting from the Reporting Clients to the distribution of the generated Reports.



Reporting Clients

Currently, a Reporting Client is integrated in the TwinCAT Scope View as well as in the TwinCAT Analytics Workbench or in the TwinCAT Analytics Service Tool. These tools provide the ability to implement 24/7 reporting and on-demand reporting.

- Scope Reporting [▶ 248]
- Analytics Reporting

24/7 reporting is also possible via the PLC. The function blocks have the same functionality as the algorithms from TwinCAT Analytics.

- PLC Reporting

The Reporting Clients communicate with the TwinCAT Reporting Server. The Reporting Clients can send two types of messages. On the one hand, data messages can be sent with the associated data. On the other hand, so-called trigger messages can be communicated. This type of message triggers the generation of a report.

TwinCAT Reporting Server

The TwinCAT Reporting Server [▶ 263] has a variety of tasks. The server receives the messages from the Reporting Clients and stores the data in a DataStore. A report can be defined in an associated configuration file. The assignment of a data object to a report is established via a Report Name and a Data Key. The design of the report in can be customized in a stylesheet. As soon as a trigger message is received, a report with the associated data is generated in the configured formats and distributed accordingly.

Glossary

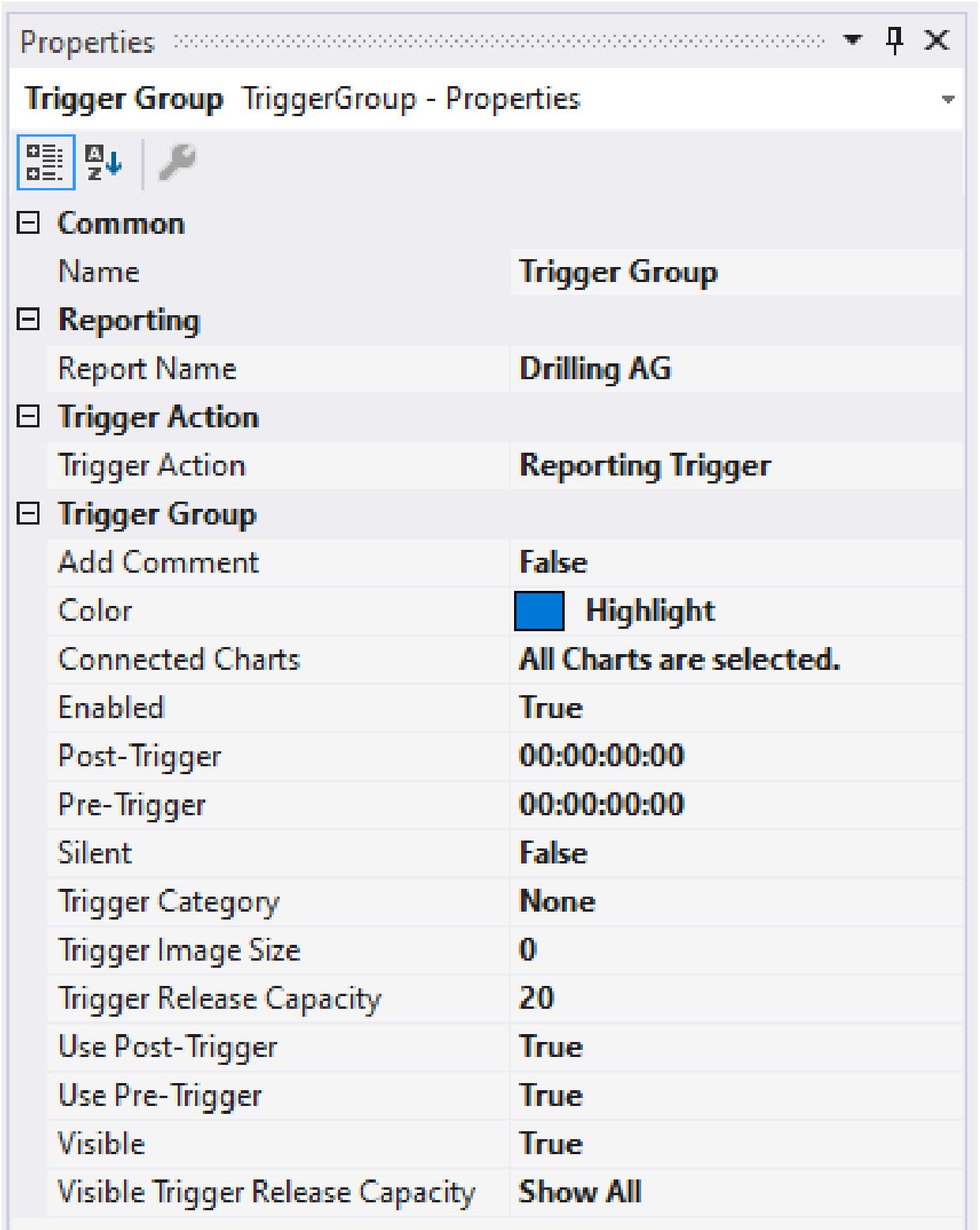
Term	Explanation
Report	A report is a document available in PDF, HTML and JSON formats. It contains the information and images.
Configuration file	The configuration file describes the structure of a report. It also offers the possibility to integrate static information into a report by default. Furthermore, settings can be made in the Reporting Server for the corresponding report.
Reporting Server	The Reporting Server manages the configuration files, receives information and creates individual reports from this information.
Reporting Client	A Reporting Client can be used to send data to the Reporting Server or to trigger the creation of a report.
Data message	A Reporting Client can send information to the Reporting Server via a data message. The contained data is cached in the Reporting Server.
Trigger message	A Reporting Client can send a trigger message to the Reporting Server, triggering the generation of a report. For this purpose, the Reporting Server uses all data received up to this point and belonging to the corresponding report. After generation, the data is deleted.
Report Name	The Report Name is used to identify a report. The Report Name is derived from the name of the configuration file without the extension (e.g.: configuration file: Beckhoff Report Template.json; Report Name: Beckhoff Report Template)
Data Key	A Data Key identifies a data object of a report. It must be unique within a report and its configuration file. This can ensure the assignment and sorting of data objects in the report.
24/7 Reporting	24/7 Reporting provides the ability to collect data and automatically generate reports.
On-demand reporting	On-demand reporting provides the ability to generate custom reports on demand.

5.2.8.2 Scope Reporting

5.2.8.2.1 24/7 Reporting

The 24/7 reporting can be configured using the following Trigger Action in a Trigger Group.

5.2.8.2.1.1 Reporting Trigger



Auto Delete

Auto Delete mode	Here you can set the mode in which the Auto Delete function should run. If set to "Disabled", no files will be deleted. "Capacity“ deletes the oldest file in the folder if more than the number of files specified in "Delete more than" has been saved. If set to "OlderThan", all files older than the time specified in "Delete older than" will be deleted. The option "CapacityOrOlderThan" is a combination of "Capacity" and "OlderThan". That is, files are deleted when the conditions for either option are met.
Delete more than	This option defines when and with how many created files the oldest is to be deleted. The option is only active as long as "Capacity" or "CapacityOrOlderThan" is selected in "Auto Delete".
Delete older than	This option defines the number of seconds after which a file is to be deleted with Auto Delete. The option is only active as long as "OlderThan" or "CapacityOrOlderThan" is selected in "Auto Delete".

Reporting

Report Name	Here you can select the report name. The drop-down menu lists the available reports from the reporting server. Alternatively, a free text can be entered.

Trigger Group

Color	Here you can specify the color for marking the event in the chart.
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created. The charts selected here are automatically selected in the Export Window in the "Export Type" property. If all channels or images are added in the export, only those from the selected charts will be added.
Enabled	The selected trigger group can be switched on and off here.
Post-Trigger	Here you can set a time in the format dd:HH:mm:ss for the recording to continue after the trigger event has occurred.
Pre-Trigger	In the format dd:HH:mm:ss the minimum time that must elapse before the trigger event can be set.
Silent	If you set Silent to TRUE, no more trigger messages will be displayed in the engineering message window.
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area.
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously.
Use Post-Trigger	If TRUE, the time set under post-trigger is taken into account.
Use Pre-Trigger	If TRUE, the time set under pre-trigger is taken into account.
Visible	Here you can set whether the event should also be visibly marked in the data stream.
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity".

Trigger Category

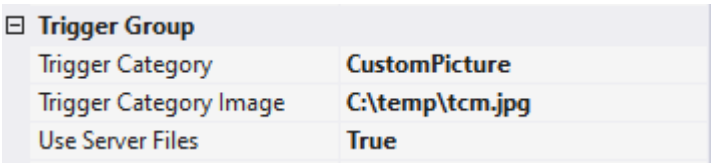
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



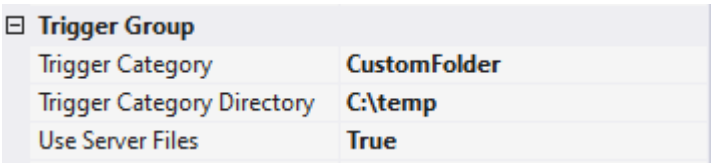
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



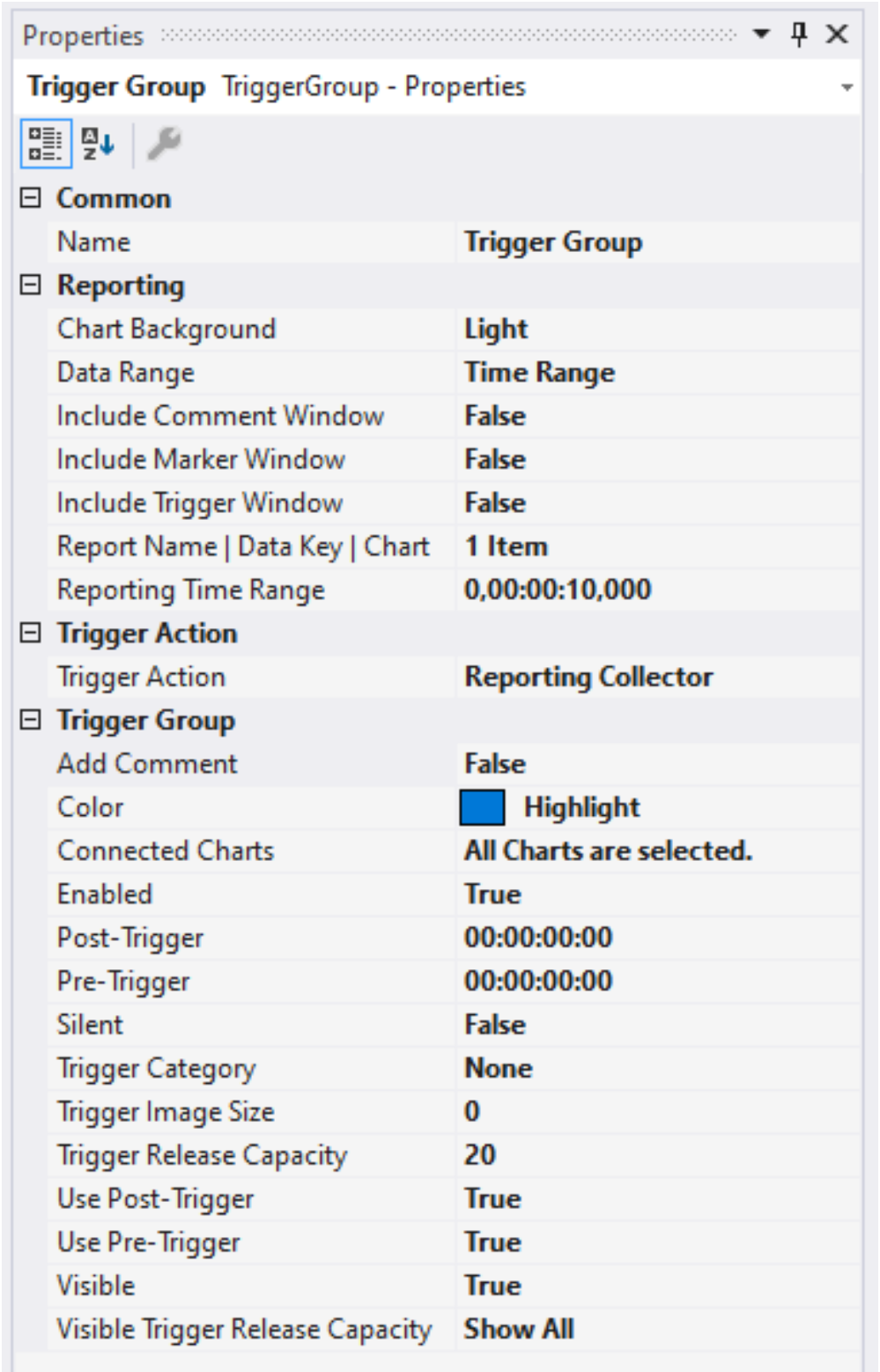
Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder



Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.2.8.2.1.2 Reporting Collector

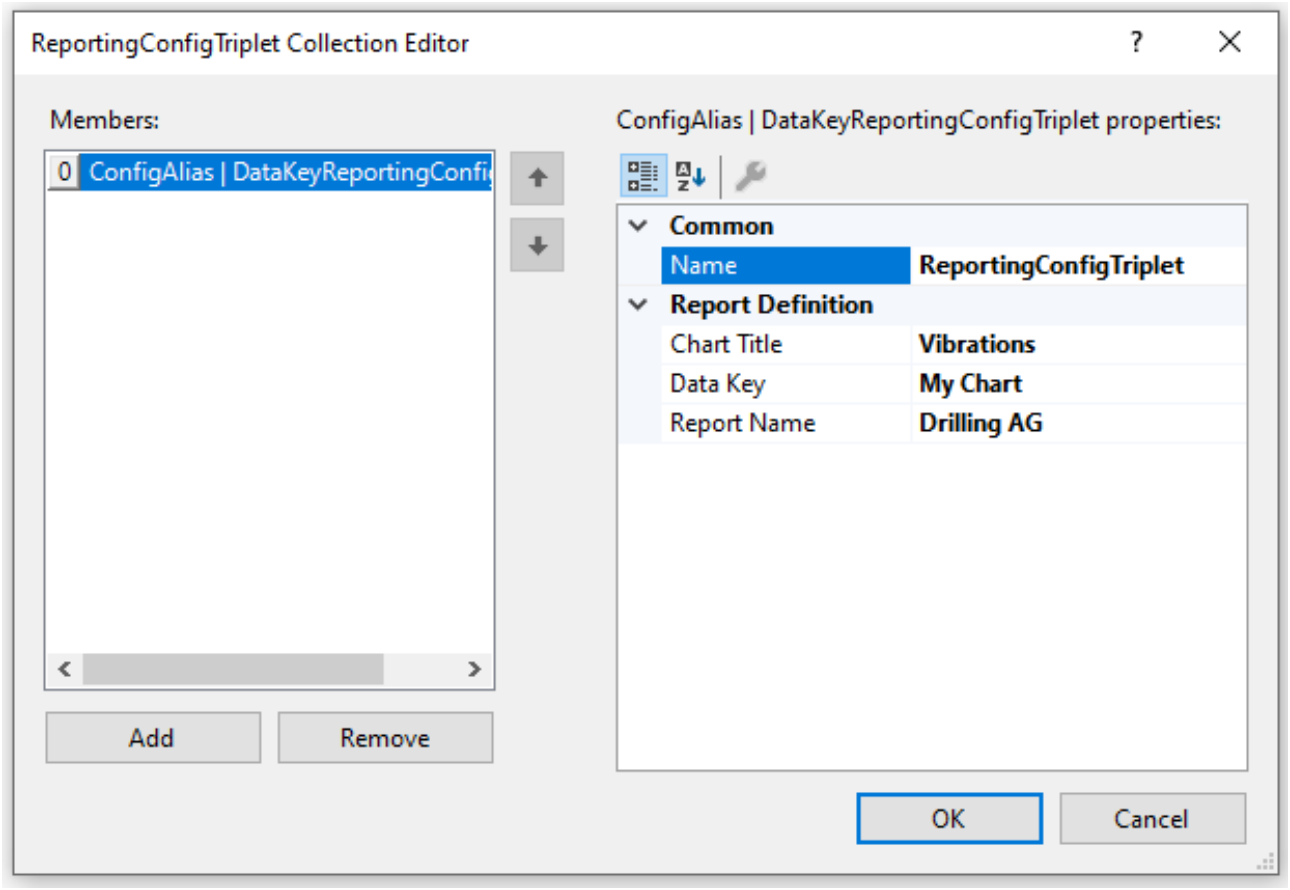


Auto Delete

Auto Delete mode	Here you can set the mode in which the Auto Delete function should run. If set to "Disabled", no files will be deleted. "Capacity“ deletes the oldest file in the folder if more than the number of files specified in "Delete more than" has been saved. If set to "OlderThan", all files older than the time specified in "Delete older than" will be deleted. The option "CapacityOrOlderThan" is a combination of "Capacity" and "OlderThan". That is, files are deleted when the conditions for either option are met.
Delete more than	This option defines when and with how many created files the oldest is to be deleted. The option is only active as long as "Capacity" or "CapacityOrOlderThan" is selected in "Auto Delete".
Delete older than	This option defines the number of seconds after which a file is to be deleted with Auto Delete. The option is only active as long as "OlderThan" or "CapacityOrOlderThan" is selected in "Auto Delete".

Reporting

Chart Background	This option determines which background design is used for the charts in the report.
Data Range	This option defines which period should be displayed in the chart and included in the report. The time period between the last two trigger events can be selected with the option "Since last trigger". "Time Range" can be used to define a free time range.
Include Marker Window	This option determines whether the Marker Window for the corresponding chart should be integrated into the report (Markers [▶ 147]).
Include Trigger Window	This option determines whether the Trigger Window should be integrated into the report (Trigger [▶ 107]).
Include Comment Window	This option determines whether the Comment Window should be integrated into the report.
Report Name | Data Key	This option allows linking a chart to a report. A Reporting Triplet consists of a chart, the unique Data Key and the corresponding Report Name. A lot of Reporting Triplets can be created in the triplet editor (see figure below this table).
Reporting Time Range	This option is only available if Time Range is selected in the Data Range option. This option allows to set a free time range.



Trigger Group

Color	Here you can specify the color for marking the event in the chart.
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created. The charts selected here are automatically selected in the Export Window in the "Export Type" property. If all channels or images are added in the export, only those from the selected charts will be added.
Enabled	The selected trigger group can be switched on and off here.
Post-Trigger	Here you can set a time in the format dd:HH:mm:ss for the recording to continue after the trigger event has occurred.
Pre-Trigger	In the format dd:HH:mm:ss the minimum time that must elapse before the trigger event can be set.
Silent	If you set Silent to TRUE, no more trigger messages will be displayed in the engineering message window.
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area.
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously.
Use Post-Trigger	If TRUE, the time set under post-trigger is taken into account.
Use Pre-Trigger	If TRUE, the time set under pre-trigger is taken into account.
Visible	Here you can set whether the event should also be visibly marked in the data stream.
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity".

Trigger Category

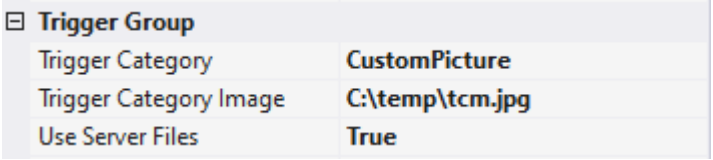
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



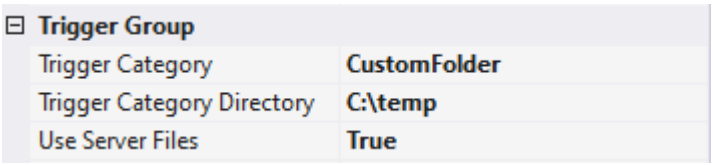
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



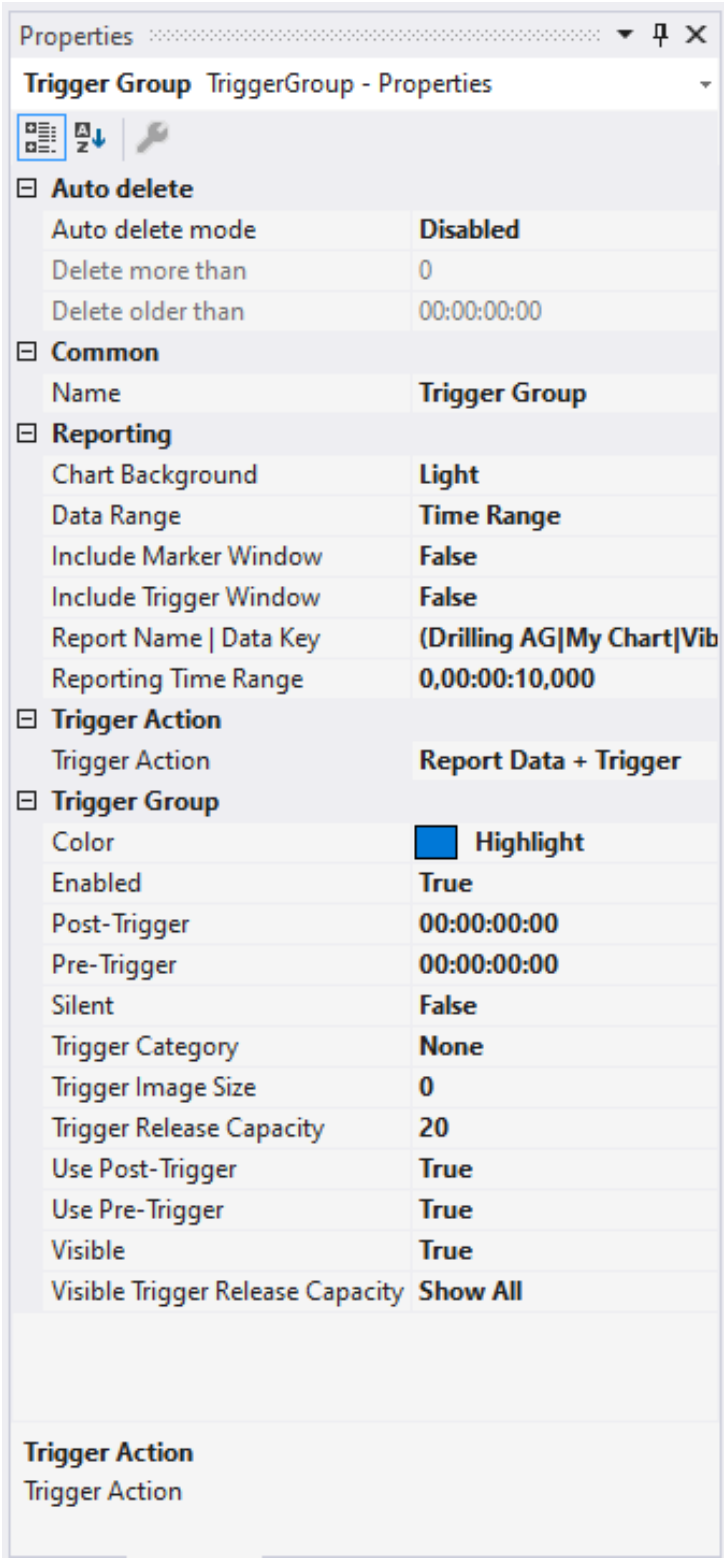
Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder



Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.2.8.2.1.3 Reporting Collector + Trigger

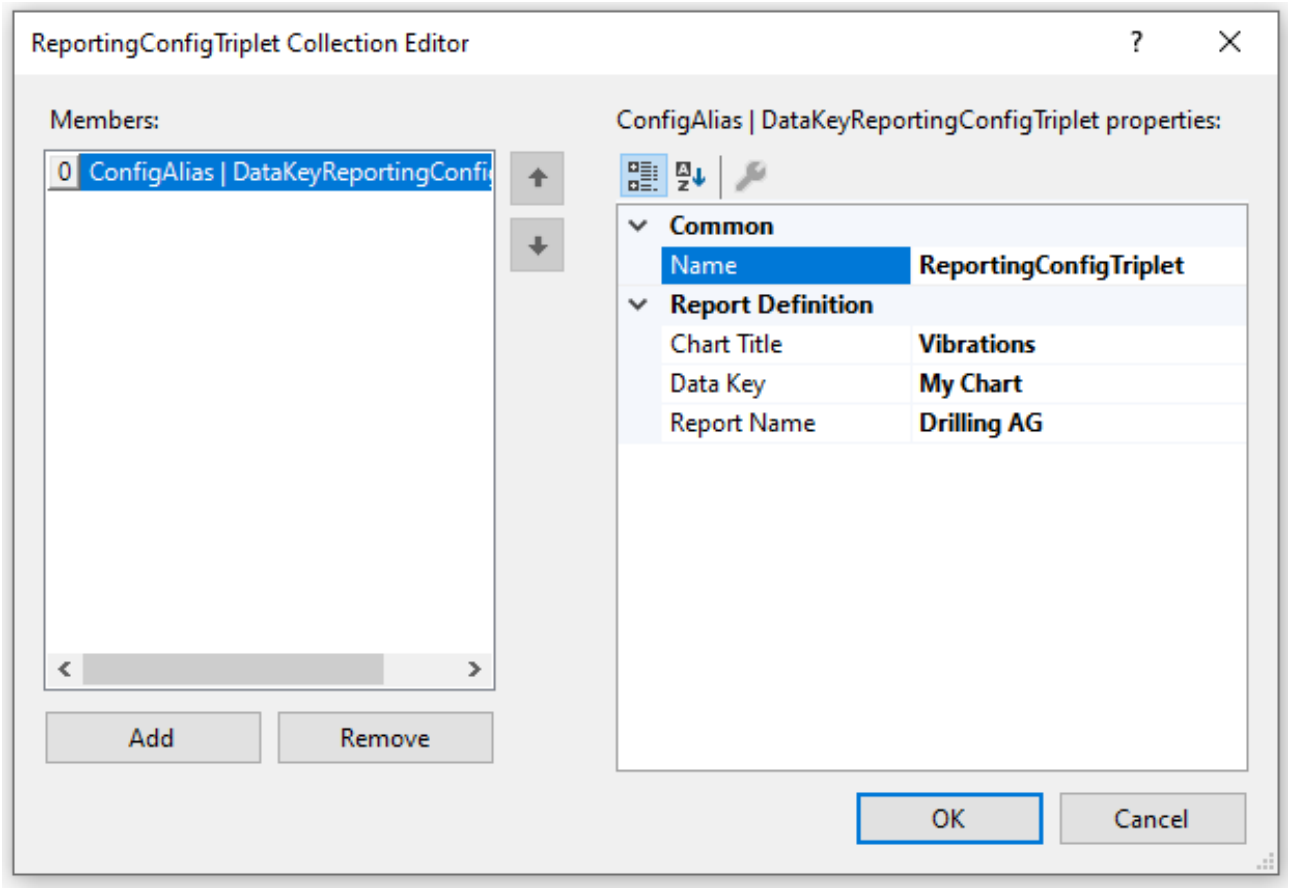


Auto Delete

Auto Delete mode	Here you can set the mode in which the Auto Delete function should run. If set to "Disabled", no files will be deleted. "Capacity“ deletes the oldest file in the folder if more than the number of files specified in "Delete more than" has been saved. If set to "OlderThan", all files older than the time specified in "Delete older than" will be deleted. The option "CapacityOrOlderThan" is a combination of "Capacity" and "OlderThan". That is, files are deleted when the conditions for either option are met.
Delete more than	This option defines when and with how many created files the oldest is to be deleted. The option is only active as long as "Capacity" or "CapacityOrOlderThan" is selected in "Auto Delete".
Delete older than	This option defines the number of seconds after which a file is to be deleted with Auto Delete. The option is only active as long as "OlderThan" or "CapacityOrOlderThan" is selected in "Auto Delete".

Reporting

Chart Background	This option determines which background design is used for the charts in the report.
Data Range	This option defines which period should be displayed in the chart and included in the report. The time period between the last two trigger events can be selected with the option "Since last trigger". "Time Range" can be used to define a free time range.
Include Marker Window	This option determines whether the Marker Window for the corresponding chart should be integrated into the report (Markers [▶ 147]).
Include Trigger Window	This option determines whether the Trigger Window should be integrated into the report (Trigger [▶ 107]).
Include Comment Window	This option determines whether the Comment Window should be integrated into the report.
Report Name | Data Key	This option allows linking a chart to a report. A Reporting Triplet consists of a chart, the unique Data Key and the corresponding Report Name. A lot of Reporting Triplets can be created in the triplet editor (see figure below this table).
Reporting Time Range	This option is only available if Time Range is selected in the Data Range option. This option allows to set a free time range.



Trigger Group

Color	Here you can specify the color for marking the event in the chart.
Connected Charts	If the markings are not to be displayed in every chart of the configuration, charts for which the markings are displayed can be selected here. Each chart is automatically added when it is created. The charts selected here are automatically selected in the Export Window in the "Export Type" property. If all channels or images are added in the export, only those from the selected charts will be added.
Enabled	The selected trigger group can be switched on and off here.
Post-Trigger	Here you can set a time in the format dd:HH:mm:ss for the recording to continue after the trigger event has occurred.
Pre-Trigger	In the format dd:HH:mm:ss the minimum time that must elapse before the trigger event can be set.
Silent	If you set Silent to TRUE, no more trigger messages will be displayed in the engineering message window.
Trigger Category	Predefined categories are available for the trigger markers. These are inserted with a symbol and a default color. The following categories are available: Alert Error Warning Info The "Text" option can be used to enter free text. This text is then displayed instead of a symbol. The "Custom Picture" or "CustomFolder" option can be used to select custom symbols or small images.
Trigger Image Size	Here you can enter the image size. The larger the value, the smaller the chart area.
Trigger Release Capacity	This property specifies the maximum number of trigger events that can be stored and displayed simultaneously.
Use Post-Trigger	If TRUE, the time set under post-trigger is taken into account.
Use Pre-Trigger	If TRUE, the time set under pre-trigger is taken into account.
Visible	Here you can set whether the event should also be visibly marked in the data stream.
Visible Trigger Release Capacity	This setting allows predefined values for simultaneous display of events during recording, up to the value set in "Trigger Release Capacity".

Trigger Category

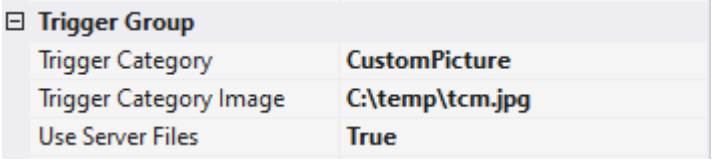
In addition to the four predefined categories, the markers can be further configured. Here you can choose between a text display and an image display.

Text



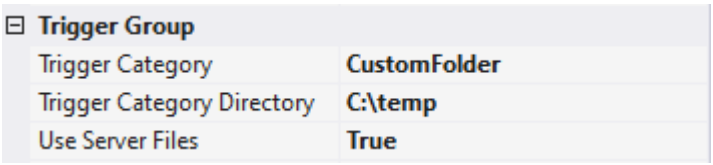
Trigger text	The setting can be used to specify the text to be displayed in the chart at the trigger.

Custom Picture



Trigger Category Image	A path to an image file can be specified. This image is displayed above the trigger in the chart.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

Custom Folder



Trigger Category Directory	A path to an image folder can be specified. With each new trigger event, the current image is read out in this trigger and added to the trigger.
Use Server Files	If this function is set, the specified path is not searched for on the local system, but on all server systems that are used in this trigger group.

5.2.8.2.2 On-Demand-Reporting

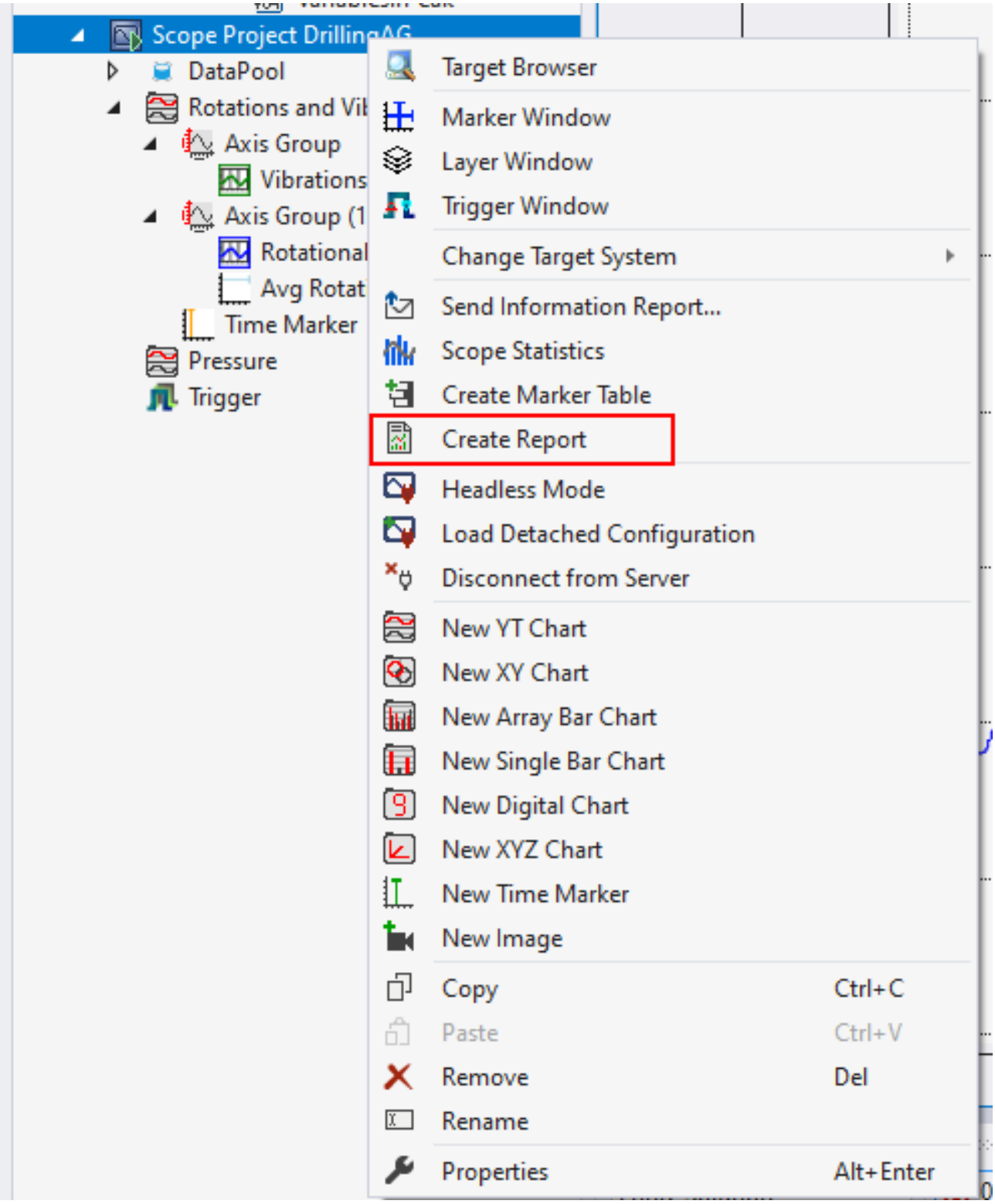
On-Demand-Reporting provides the ability to manually integrate charts and additional data into a report. The Scope Manual Report Wizard can be used on the one hand. The Chart Snipping Tool offers the option to export individual chart screenshots in a report on the other hand.

5.2.8.2.2.1 Scope Manual Report Wizard

On-demand reporting can be started in two ways. The reporting can be opened via the Reporting button in the toolbar on the one hand:

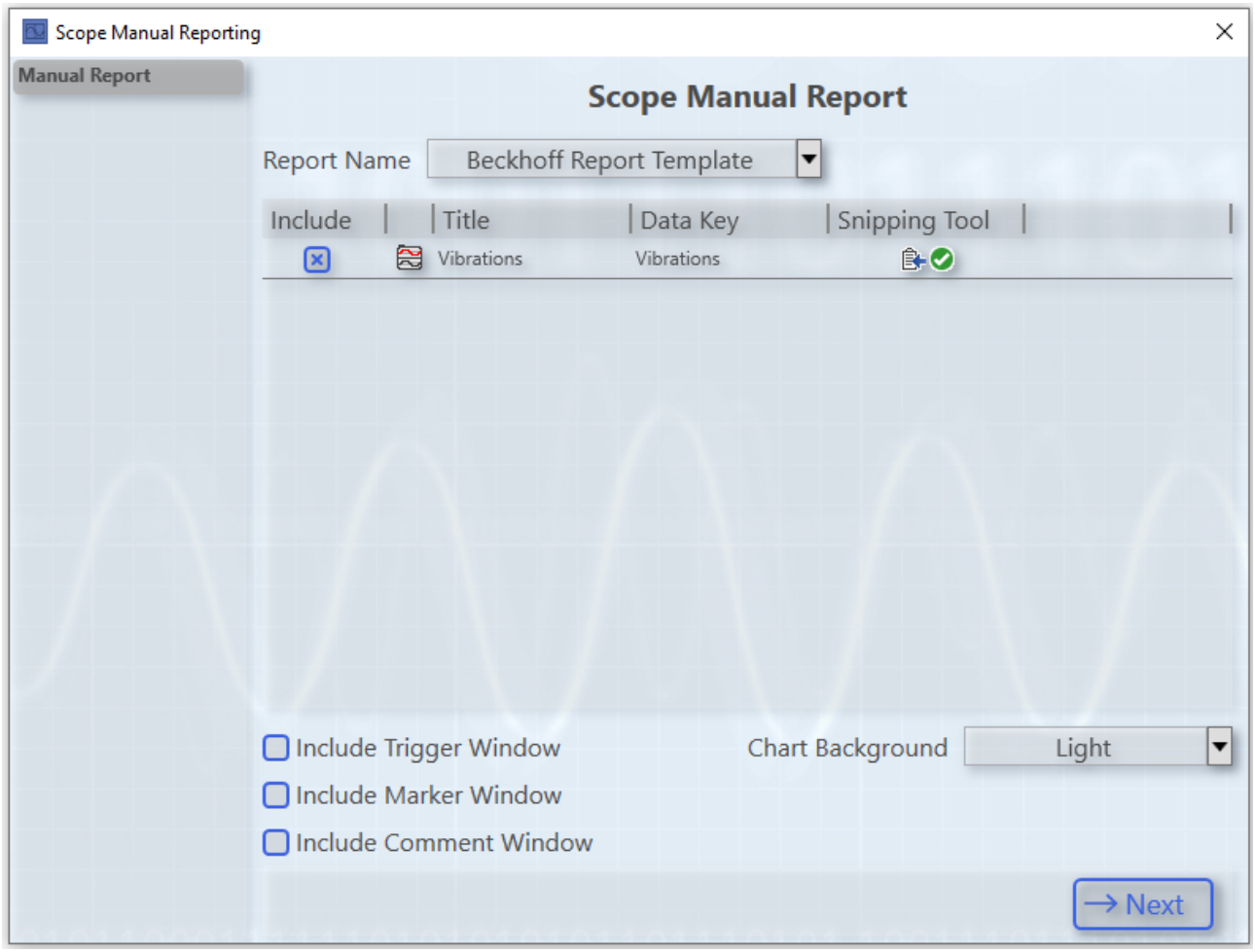


It can be started via the context menu on the Scope project on the other hand:



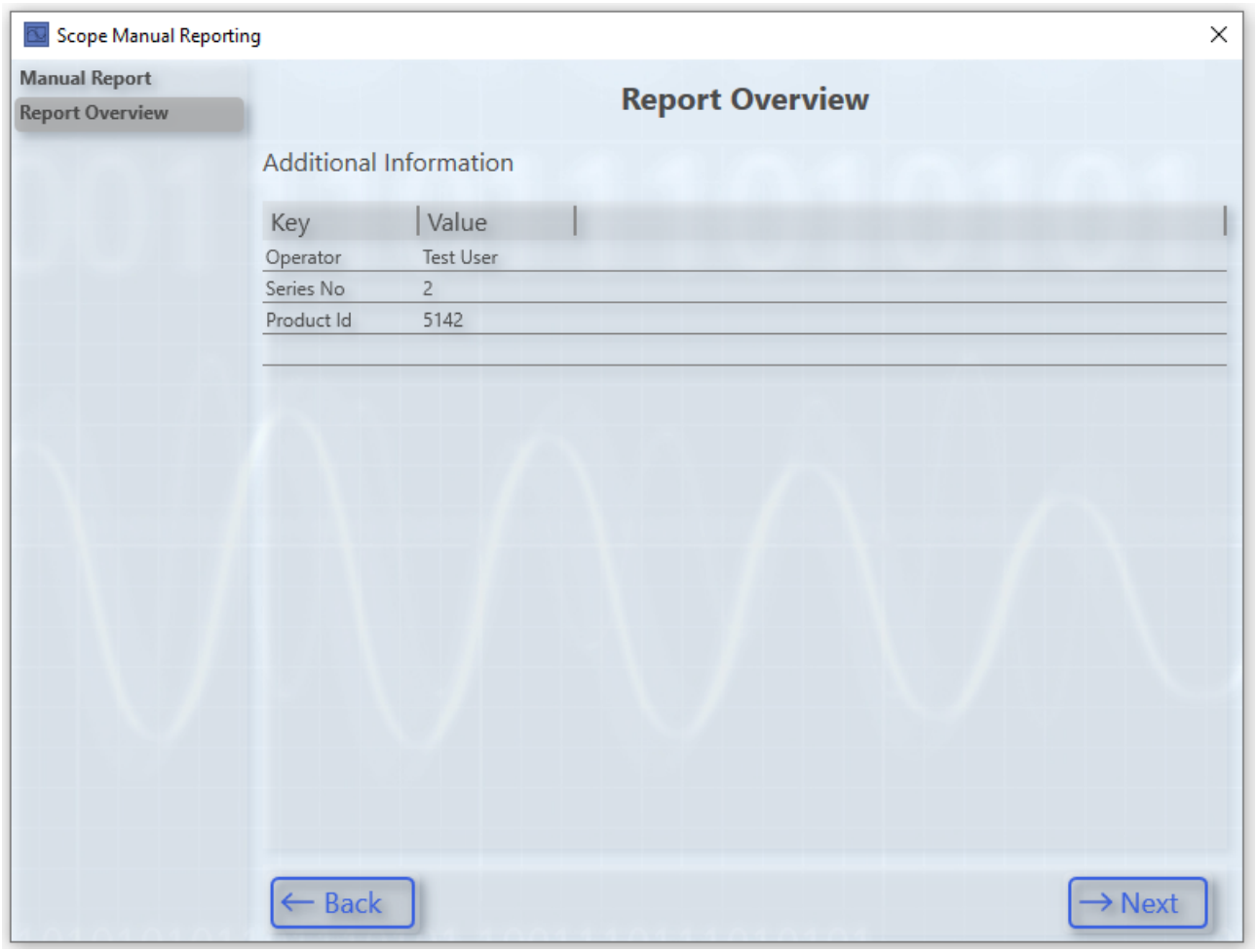
The wizard for on-demand reporting then opens.

The charts and the corresponding data can be selected on the first page. The chart can be edited using the Chart Snipping Tool button in the Snipping Tool column. After closing the Chart Snipping Tool, a green tick appears next to the Chart Snipping Tool button. The changes can be discarded by clicking on the green tick.



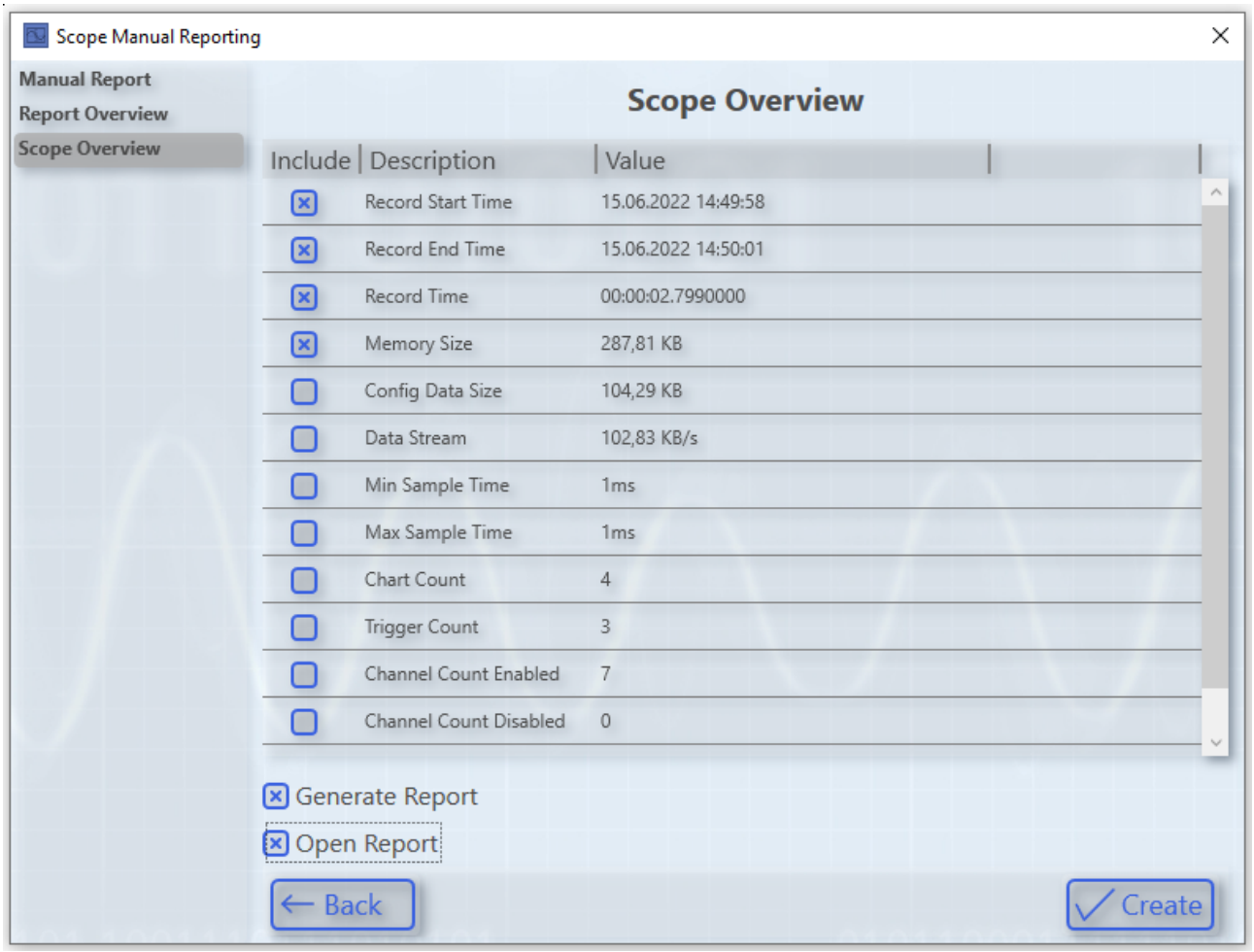
Report Name	Here you can select the report name. The drop-down menu lists the available reports from the reporting server. Alternatively, a free text can be entered.
Chart Background	This option defines which background design should be used for the charts in the report.
Include Marker Window	This option determines whether the Marker Window for the corresponding chart should be integrated into the report (Markers [▶ 147]).
Include Trigger Window	This option determines whether the Trigger Window should be integrated into the report (Trigger [▶ 107]).
Include Comment Window	This option determines whether the Comment Window should be integrated into the report.

You can add additional information to the report on the second page.



The additional information is built in a key-value structure. Another line can be added by clicking on the empty line. A selected line can be deleted by pressing the Delete key.

Information about the recording can be added to the report on the third page.



In the table, a lot of information is available for integration in a report. The checkbox in the Include column can be used to select or deselect individual pieces of information.

The Generate Report option defines whether the report should be generated with the configured data. If this option is not selected, only the data will be sent to the Reporting Server, but the report will not be generated yet. This option is useful when manually adding data from multiple products to a single report.

The Open Report option defines whether the report should be opened after generation. To use this option, a FilePublishLocation with PDF or HTML formats must be defined in the configuration file. If the report is generated in PDF and HTML format, the PDF report will be opened by default.

5.2.8.3 TwinCAT Reporting Server

5.2.8.3.1 Design

5.2.8.3.1.1 Configuration file

The configuration file offers the possibility to organize, sort and customize the report. The configuration files must be stored in the folder *.\TwinCAT\Functions\Reporting-Server\Configuration\ConfigFiles*.

The following options are supported in the Reporting Server.

Key	Description	Sample	Level
General			
Store Type	Specifies which store mode to use. Currently only "Ram" is supported.	`"StoreType": "Ram"`	1
Header	Provides the possibility to display three headers arranged one below the other. If the second and / or third header is not to be used, an empty string can be specified.	`"Header": [ "Header 1", "Header 2", "Header 3", ]`	1
Footer	The footer of a PDF page is divided into three areas. All three areas can be individualized with a free text. To display the date and time of creation, the placeholder "{date} {time}" must be specified. To display the page number, the placeholder "{page} of {total-pages}" must be specified. If a range is to be left blank, an empty string can be specified.	`"Footer": [ "Footer Left", "Footer Center", "Footer Right", ]`	1
Logo	The logo is displayed on the top right of the first page. The logo can be specified as a relative path to the folder *Reporting-Server\Configuration\ConfigFiles*. Alternatively, the logo can be specified as a Base64String with the preceding encoding.	`"Logo": ".//<Bildname.png>"` oder `"Logo": "data:image/ <Encoding>base64, <Base64String>"`	1
StyleSheet	Offers the possibility to customize the design of a report. To use a user-specific style sheet, its name must be specified (see Style Sheet [▶ 267]).	`"StyleSheet": "StyleBeckhoff.css"`	1
SignatureSettingsFile	Provides the possibility to sign a report (see Signing [▶ 270]).	`"SignatureSettingsFile": "BeckhoffSignatures.json",`	
Email text	This text will be included in every email unless a specific text is specified.	`"EmailText": "Custom of E-Mails send to all recipients with no or empty E-Mail-Text. Special. Ones"`	1
Required Keys	Is a collection from Data Key. If the data objects of these data keys are not available in the Reporting Server, the report will not be generated.	`"RequiredKeys": ["Data101"]`	1
Trigger On Required Key Received	Is another way to trigger the generation of a report. If true is selected for the option and all data objects with the required Data Keys are present, the report will be generated. This eliminates the need for a trigger message from a Reporting Client.	`"TriggerOnRequiredKeyReceived" : false`	1
Static Default Data			
Default Data	This object can be used to define data objects to be presented in each report.	`"DefaultData": {}`	1
Text Fields	This element is an array and can have multiple text field objects with the following elements.	`"TextFields": []`	2
Key	Used as a heading for the text field.	`"Key": "My Text Field"`	3
Comment	Serves as a comment for the data object. The comment is not displayed in the report.	`"Comment": "My Comment"`	3
Sort Priority	Specifies the position of the data object in the report.	`"SortPriority": 42`	3
Value	Contains an individual value and must be specified as STRING.	`"Value": "253-5553-9421"`	3
Tables	This element is an array and can have multiple table objects with the following elements.	`"Tables": []`	2

Key	Description	Sample	Level
Key	Used as a heading for the table.	`"Key": "My Table"`	3
Comment	Serves as a comment for the data object. The comment is not displayed in the report.	`"Comment": "My Comment"`	3
Sort Priority	Specifies the position of the data object in the report.	`"SortPriority": 42`	3
Value	This element is an object and contains the following elements.	`"Value": {}`	3
Header	This element is an array and receives the column titles of the table. The number of column titles must be equal to the columns of the table.	`"Header": ["Table Header 1", "Table Header 2"]`	4
DataTypes	This element is an array and receives the data types of the table column. The following data types are possible: BOOL, BYTE, SBYTE, CHAR, DECIMAL, DOUBLE, FLOAT, INT, UINT, LONG, ULONG, SHORT, USHORT, STRING. The number of data types must be equal to the columns of the table.	`"DataTypes": ["string", "double"]`	4
Values	This element is a 2D array and receives the value of the table. An array in the array represents a table column. The table column must match the specified data type. The number of arrays must be equal to the columns of the table. The arrays should be the same size.	`"Values": [[],[]]`	4
Images	This element is an array and can have multiple image objects with the following elements.	`"Images": []`	2
Key	Used as a caption for the image.	`"Key": "My Image"`	3
Comment	Serves as a comment for the data object. The comment is not displayed in the report.	`"Comment": "My Comment"`	3
Sort Priority	Specifies the position of the data object in the report.	`"SortPriority": 42`	3
Value	Contains the Base64String with PNG encoding.	`"Value": "<Base64String PNG-Encoding>"`	3
Value Pairs	This element is an array and can have multiple key-value pair objects with the following elements.	`"ValuePairs": []`	2
Key	Used as a heading for the collection from key-value pairs.	`"Key": "My Value Pair"`	3
Comment	Serves as a comment for the data object. The comment is not displayed in the report.	`"Comment": "My Comment"`	3
Sort Priority	Specifies the position of the data object in the report.	`"SortPriority": 42`	3
Value Pair Collection	Serves as a collection of key-value pairs. This element is an array and can have multiple objects with the following elements.	`"ValuePair_Collection": []`	3
Key	Contains an individual value and is displayed presented on the left side.	`"Key": "Serial number"`	4
Data Type	Describes the data type of the "Value" element.	`"DataType": "string"`	4
Value	Contains an individual value and is presented on the right side. The value must be specified as STRING.	`"Value": "253-5553-9421"`	4
Data Configurations			
Data Configurations	Data Configurations can be used to sort and individualize the data that is sent dynamically from the Reporting Clients. This element is an array and can have multiple objects with the following elements.	`"DataConfigurations": []`	1

Key	Description	Sample	Level
Key	Corresponds to the Data Key of the data object. This ensures that this data configuration is applied to a unique data object. (Required)	`"Key": "DataTable101"`	2
Title	Provides the option of a better name as a heading. (optional)	`"Title": "Rotations and vibrations"`	2
SortPriority	Specifies the position of the data object in the report. (Required)	`"SortPriority": 42`	2
IsRequired	Indicates whether this data object is required for generating the report. (see: TriggerOnRequiredKey)	`"IsRequired": false`	2
StoreMode	Provides the option to store individual data objects in a specific way and display them accordingly. Currently, four different store modes are supported: • **Blocking**: The first data object is saved and all subsequent data objects with the same data key are discarded. • **Overwriting**: The newly received data object replaces the last data object with the same data key. • **Appending**: The newly received data object is saved. The previously received data objects are also held and presented in the report. In the case of a table, the data is merged. • **Appending_Series**: This store mode corresponds to the store mode "Appending". However, the data objects are numbered and presented in individual tables.	`"StoreMode": "Overwriting"`	2
RoundTo	Provides the option to round floating-point numbers to a specified decimal place.	`"SortPriority": 4`	2
TimestampFormat	Provides the option to convert Timestamp to a specified format. By default, the following formatting is selected: "yyyy-MM-dd HH:mm:ss.ffff" (See also: Custom date and time format strings)	`"TimestampFormat": "HH:mm:ss.ffff"`	2
IsAsc	Provides the option to specify the sort order of a data table. If the value is true, the first data set is presented in the first line.	`"IsAsc": true`	2
StyleClass	Provides the option to use a custom CSS style class. The CSS style class must be defined in the CSS file and the CSS file must be referenced under the StyleSheet option.	`"StyleClass": "CustomClass"`	2
Publish Locations			
Publish Locations		`"PublishLocations": []`	1
Email Publish Location	Used to forward the report as an e-mail. This element is an array and can have multiple objects with the following elements.	`"EmailPublishLocations": []`	2
Type	Specifies the type of distribution.	`"Type": "File"`	3
Format	Offers the option to send only a selection of formats by email.	`"Format": ["PDF", "HTML", "JSON"]`	3
Address	Provides the ability to send the report to multiple email addresses.	`"Address": [ "m.mustermann@tester.com "]`	3
Use Bcc	Provides the option to set the email addresses in BCC.	`"UseBcc": false`	3

Key	Description	Sample	Level
Text	Provides the option to specify a specific email text. This text replaces the default email text.	`"Text": "Hello, \n insert email text here.\n Your Reporting Service.`	3
File Publish Location	Used to copy the report to a specified location. This element is an array and can have multiple objects with the following elements.	`"FilePublishLocations": []`	2
Type	Specifies the type of distribution.	`"Type": "File"`	3
Format	Offers the option, to send only a selection of formats by email.	`"Format": ["PDF", "HTML", "JSON"]`	3
Path	Provides the possibility to specify a destination path for the report. The destination path must not require administrator rights.	`"Path": "C:\\tmp\\CpyFolder"`	3

5.2.8.3.1.2 StyleSheet

The style sheets offer the possibility to customize the design of the report. The *StyleBeckhoff.css* style sheet serves as a template.This can be copied, renamed and customized. The name of the style sheet must then be specified in the corresponding configuration file. The style sheets must be stored in the folder *.\TwinCAT\Functions\Reporting-Server\Configuration\ReportStyleSheets*.
Basically, all HTML objects contained in an HTML report can be individualized in the custom style sheet. The following CSS objects are frequently used and are ideal for customization:

CSS element	Description
html	The HTML element refers to the entire report.
h1	Main heading of the header in the report
h3	Subheading of the header in the report; heading of a data object

The following CSS classes are used to design data objects:

CSS class	Description
reporting-header	Class for the header of the report.
reaporting-header img	Class for the icon on the top right of the header.
reporting-header table	The header is tabular and can be customized via this class.
reporting-body	Class for the content of the report.
reporting-body caption	The headings of the data objects are located in a Caption element.
reporting-body valuetable	Class for a data table in the report.
reporting-body valuepair	Class for a collection from key-value pairs in the report.
reporting-body infotable	Class for the additional information and analysis or recording information from the manual report.
reporting-body figure	Class for images, such as charts from the scope in the report.
reporting-body img	This class contains the actual image. It is located in the figure element.

5.2.8.3.2 Report format

The reports are generated in the following formats.

1. PDF

2. HTML
3. JSON

5.2.8.3.3 Network Configuration

A possible use case could be that the Reporting Server and the Reporting Client are running on different systems. The Reporting Server and the Reporting Client must be on the same network. To be able to map this use case, a JSON file must be extended. The file should be located under the following path and have the appropriate name: *.\TwinCAT\Functions\Reporting-Server\Configuration\Network\ReportingNetworkConfiguration.json*
A network configuration looks like this:

Name	Description	Data type
ConfigIds	Report names of the corresponding reports	List<string>
AmsNetId	AmsNetId of the target system. The Reporting Server is executed on the target system.	string

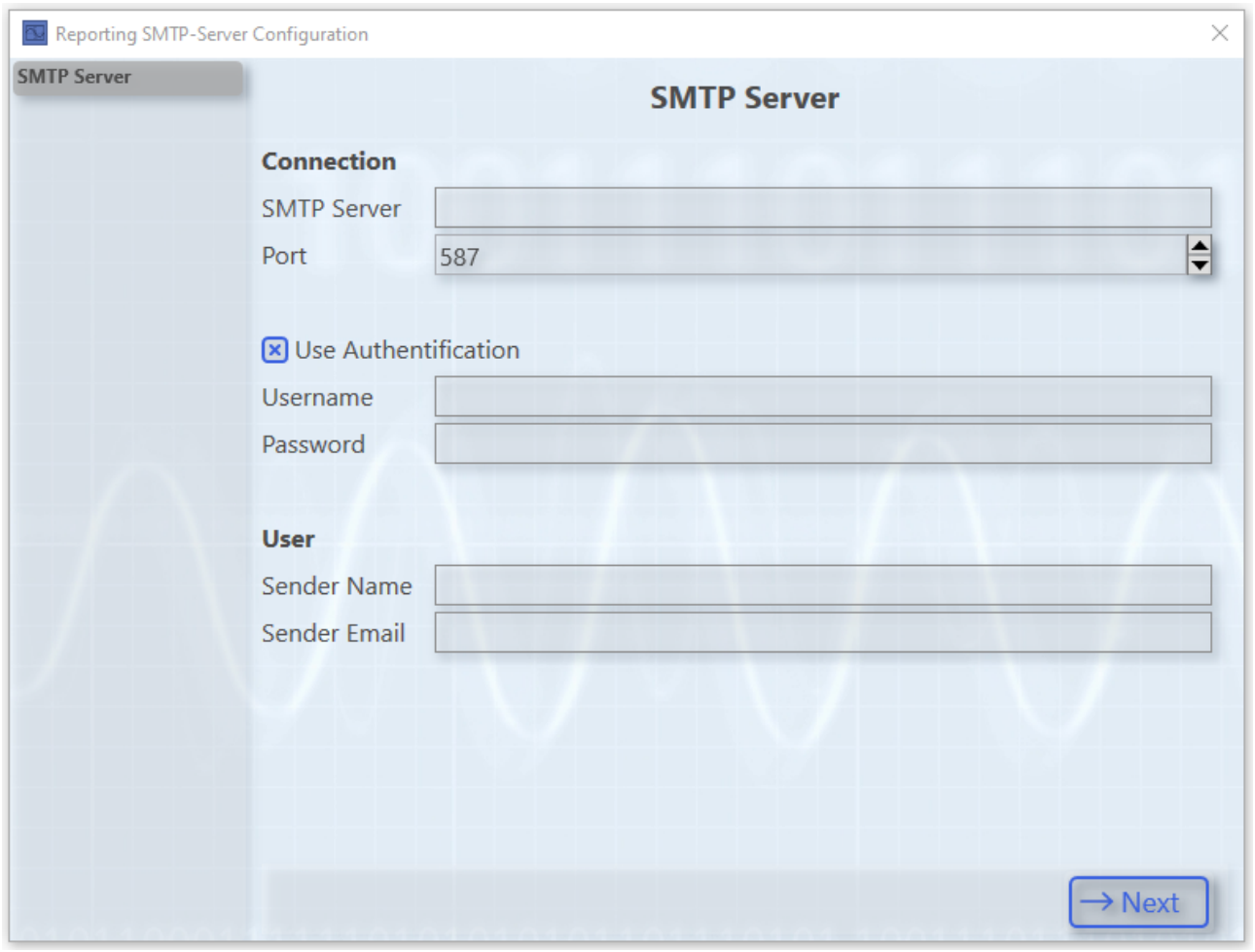
5.2.8.3.4 Email-Client configuration

A TwinCAT Reporting Server can be connected to an SMTP server. The SMTP server must be set up by the user and is not part of TwinCAT Reporting. The TwinCAT Reporting Server sends the configured email with the report to the SMTP server. This forwards the email to the recipient.

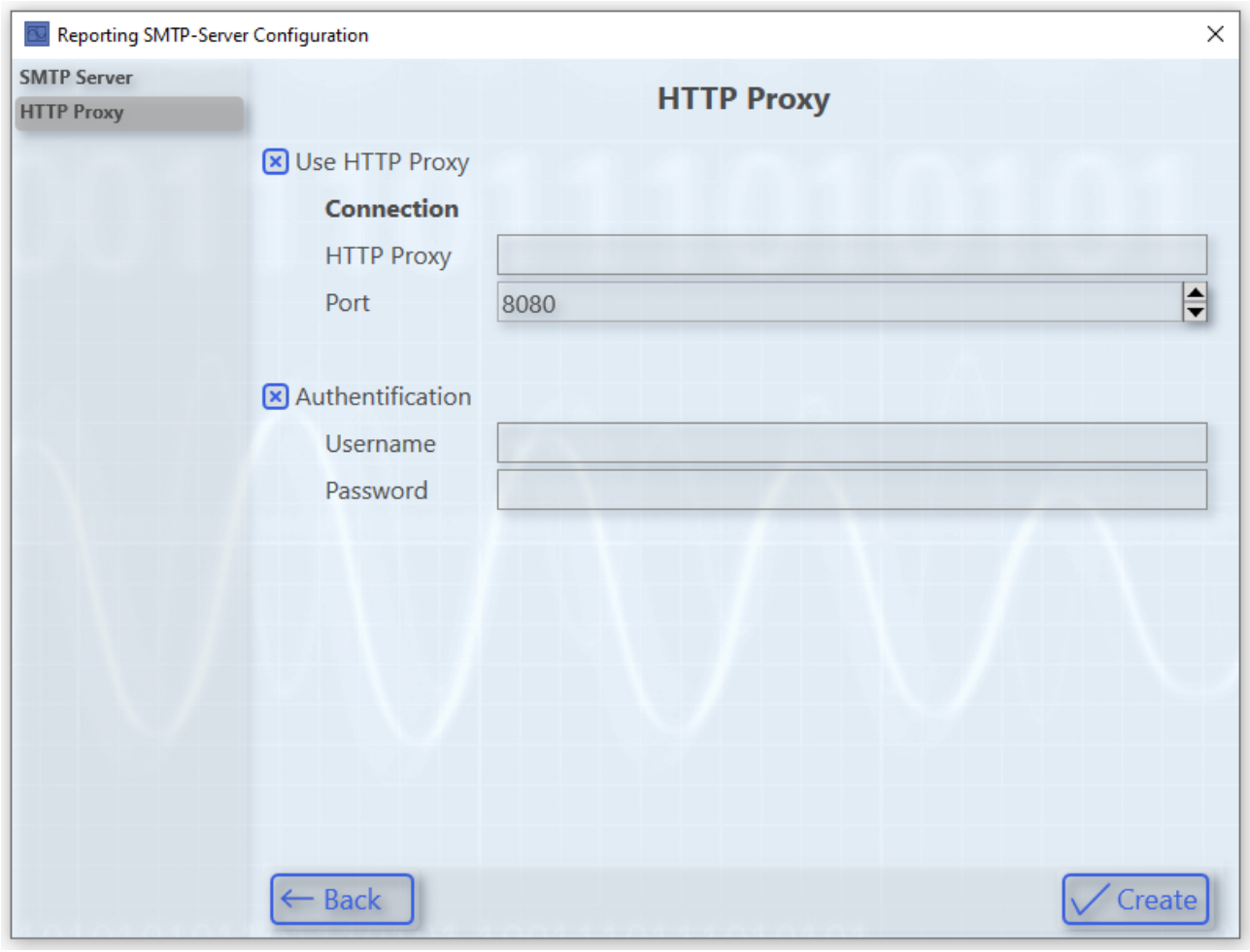
A wizard is available for configuring the connection to an SMTP server. The wizard can be opened in two ways.

1. **TwinCAT > Analytics > Reporting Email**
2. **Scope > Reporting Email**

In the first dialog you can configure a connection to the SMPT server.



The second dialog offers the possibility to configure a connection to an HTTP proxy. This option can be enabled if the user's architecture requires it.



After clicking the **Create** button, the configuration will be saved in a corresponding file.

5.2.8.3.5 Signing

In order to verify reports, PDF reports can be signed in TwinCAT Reporting. Digital and handwritten signatures are supported. The wizard for configuring signatures can be opened in the following ways.

- **TwinCAT > Analytics > Reporting > Reporting Signatures**
- **Scope > Reporting > Reporting Signatures**

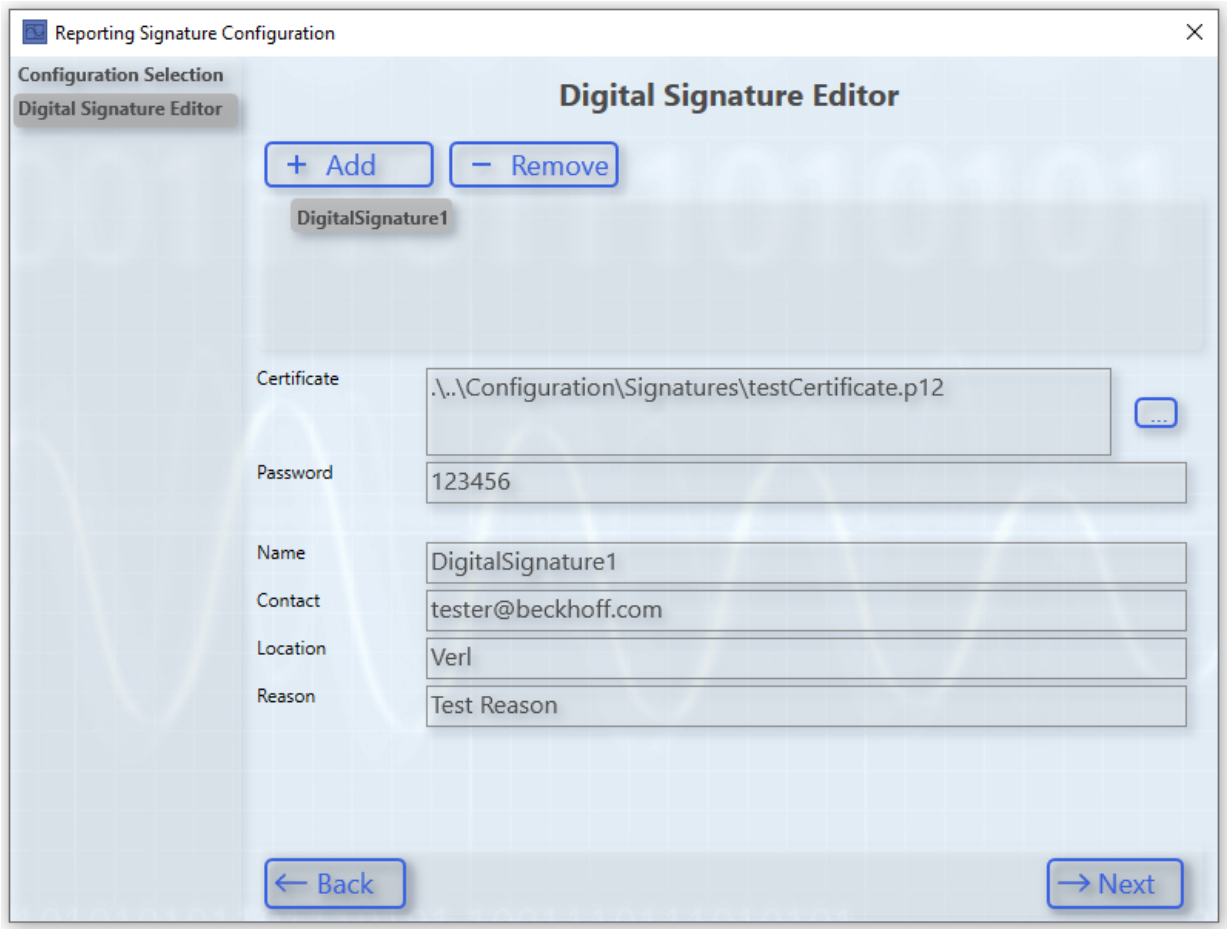
✓ The wizard offers the possibility to create multiple signature configurations, which can then be reused in multiple report configurations.

1. The name of this configuration must be referenced in the configuration file via the key "SignatureSettingsFile" (see Configuration file [▶ 263]).
   You can use the two checkboxes to select whether the configured signatures displayed on the next

pages should be used.
By clicking the button **Next** you can edit the selected configuration.

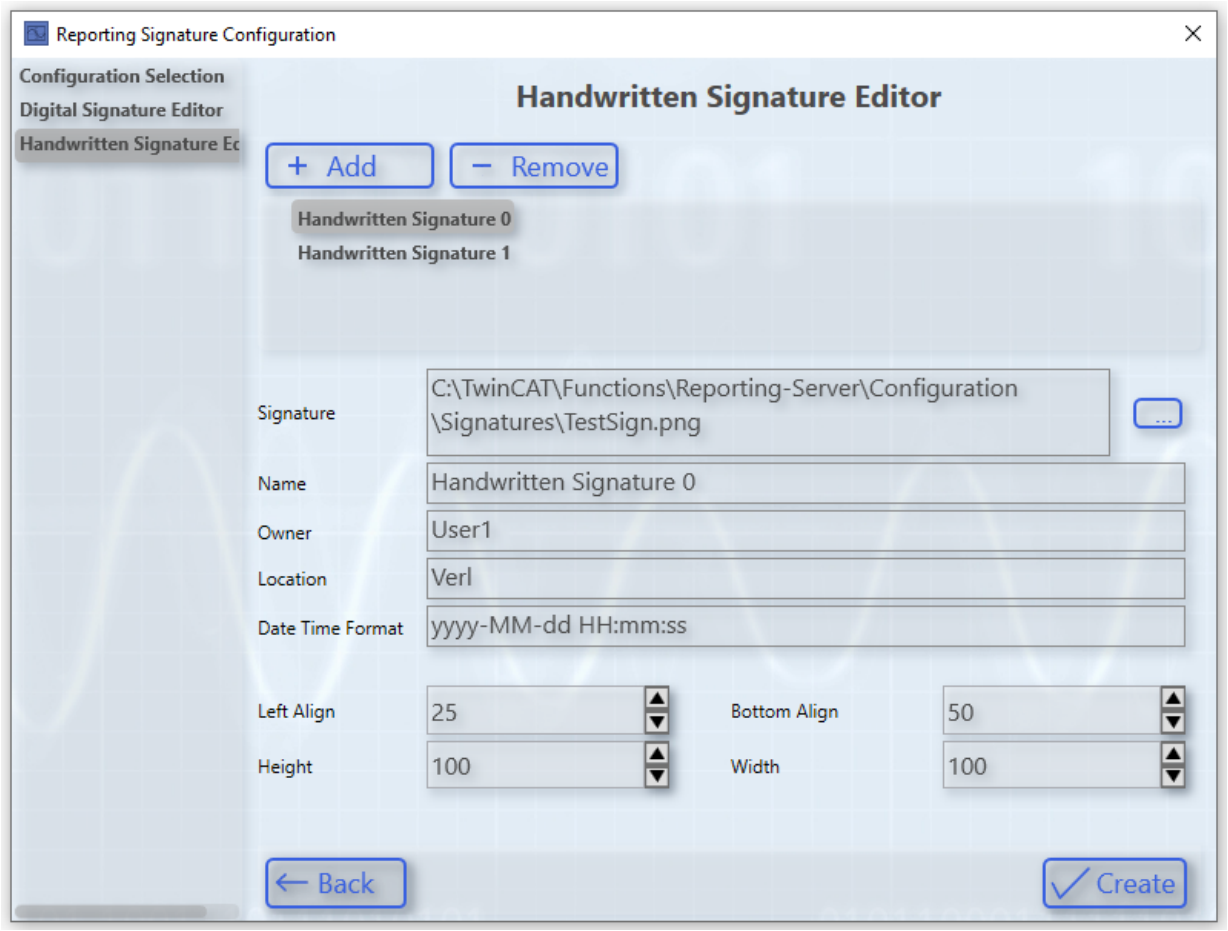


2. Here you can define a digital signature.



⇨ Pfx and p12 certificates are supported by TwinCAT Reporting.

3. Here you can define a handwritten signature.



⇨ If you use handwritten signatures, an additional signature page is inserted into the report.

4. The signatures can be positioned via the left and bottom alignment. The origin is at the bottom left of the signature page.
The following image shows an exemplary handwritten signature:



⇨ The signature configuration information is stored in the Reporting Server folder in plain text in a file.

5.2.8.3.6 Licensing

TwinCAT Reporting can be licensed as a full version and as a 7-day trial version.
The following products include the TwinCAT Reporting license.

Product number	Product name
TE1300	TwinCAT 3 Scope View Professional
TF3300	TwinCAT 3 Scope Server
TE3500	TwinCAT 3 Analytics Workbench
TE3520	TwinCAT 3 Analytics Service Tool

The following features are available with the full version or with the 7-day trial version in TwinCAT Reporting Server.

Features	TwinCAT Reporting Server	
	7-day trial	Full license
General:		
Reports	✓ (Max. 1)	✓ (unlimited)
Digital signatures	✗	✓
Handwritten signatures	✗	✓

Please refer to the product overview page for Reporting Client trial limitations.

5.2.8.4 Chart Snipping Tool

The Chart Snipping Tool contains various tools for marking a chart screenshot. The edited screenshot can be exported in various formats. Subsequently, it can be saved or sent directly via the tool by email.



You must make the settings for your chart such as zooming or panning before clicking the tool for copying to the clipboard for editing a screenshot. You cannot zoom with the tool.

Opening the tool

✓ The recording of the scope view must be ended via the Stop Record button  in the menu bar.



1. Click the icon at the end of the toolbar in the chart.

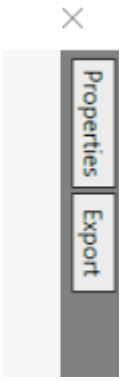
⇨ The tool opens in a new window with the screenshot of the frozen view.

Application areas in the overview



The Chart Snipping Tool consists of four areas

The Properties and Export columns must be opened by clicking the tabs at the top right edge of the screen.



1. Tool selection
2. Screenshot/editing area
3. Properties: options for the presentation type
4. Export: saving or sending the edited screenshot

⇨ The size, shape, color, text, etc. of the selected tool are individually set with the Properties.

You can delete every inserted shape afterwards if necessary. To do this, first click the Shape menu to activate the shape and then delete it via the Delete key.

Tool

The following overviews explain the selection options and buttons and, if applicable, the procedure to use and design the tool.

In all input boxes in the Properties there is an up or down arrow at the end of the input line. If you click an arrow and hold the mouse button down, the value is continuously increased or decreased.

Selection -1-	Properties -3-	Description
Shape		Double-click **Shape**. A circle is inserted in the editing area. The shape is subsequently designed in the Properties.
	Shape type	Via the drop-down menu you have various selection options for shapes that you can assign to the selection, such as rectangles and arrows.
	Fill Color	If you activate the checkbox, the area is activated for coloring and you can define the fill color of the shape.
	Border Color	If you activate the checkbox, the area is activated for coloring and you can define the border color of the shape.
	Border Width	If you click the up or down arrow at the end of the input line, the width of the border changes. Alternatively, you can enter a value and press the Enter key.
	Alignment	You can define the alignment and position of the shape via the input boxes in this area. Alternatively, you can change or move the active/ marked shape directly via the crosshair or the boundary points.
	Height/Width	You can define the alignment and position of the shape via the input boxes in this area.
Chart Control		Double-click **Chart Control**. A square new view is inserted in the editing area. This other screenshot is subsequently designed in the Properties. You can also apply all tools to the newly created window.  Legend: you can insert a legend via the icon in the top right screen of the window.
	Graphic Library	You can assign a graphic library, GDI_Plus or DirectX, via the drop-down menu.
	Scope View Data	Via the drop-down menu, select a chart that you wish to highlight/ edit via the new cut-out.
	Alignment, Height, Width	Settings for the alignment, height and width.
Image		Double-click **Image**. A square new view is inserted in the editing area. The view is subsequently designed in the Properties.
	Image	Via the drop-down menu, select an image with a timestamp that you wish to insert in the new cut-out. Via the file symbol you can select and insert any image you like.
	Alignment, Height, Width	Settings for the alignment, height and width.
Text		Double-click **Text**. A text box is inserted in the editing area. You can enter the text directly in the text box or in the text box in the Properties. Both input options are identical.
	Use Text Wrapping	If you activate the checkbox, the text in the text box is automatically wrapped according to the specified shape.
	Font Size, Color and Style	Settings for the font size, color and style.
	Alignment, Height, Width,	Settings for the alignment, height and width.
Eraser		With the eraser tool you can remove previously added drawing lines again.
	Width, Height, Shape	Settings for the height, width and shape of the eraser tool.
Marker		With the marker you can apply highlights freehand.

	Width, Height, Color, Shape	Settings for the height, width, color and shape of the marker.
Pencil		With the pencil you can do freehand drawings.
	Width, Height, Color, Shape	Settings for the height, width, color and shape of the pencil.

Export -4-

Selection		**Description**
Encoding		Via the tiles in the **Encoding** area you can select a file format for the screenshot you have made, such as PNG, TIFF, JPEG, BMP or WMP. The selected tile is given a purple background.
Options		
	DPI	In this area you can specify the resolution for the X and Y-axes.
	Transparent background	If you activate the checkbox, the chart background is removed and you can insert it without a background into another file or graphic.
Destination		
		**Save file as**: The "Save as" dialog is opened by clicking the icon.
		**Copy**: The edited screenshot is placed on the clipboard by clicking the icon. You can insert it directly in any position you like with the shortcut Ctrl + V.
		**Mail**: The edited screenshot is automatically attached to a new email by clicking the icon.
		**Reporting:** Clicking on the icon opens the Scope Manual Reporting Wizard. The edited screenshot is added to a Data Message sent to the Reporting Server.
Messages		Messages or error messages for saving/sending are shown in the lower area.

5.3 Loading, saving and exporting

5.3.1 Configurations

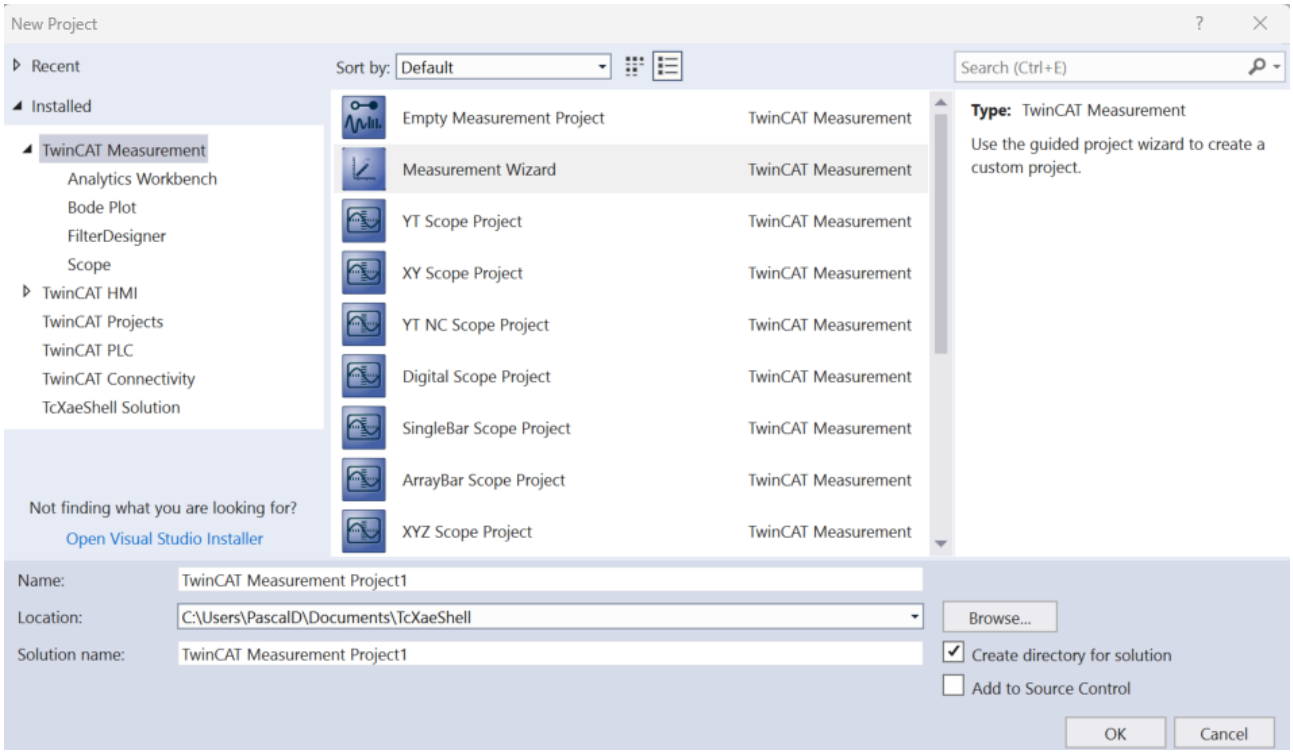
5.3.1.1 Creating and editing configurations

The following section describes how you can create and edit a Scope configuration.

5.3.1.1.1 Creating and editing a Scope project

5.3.1.1.1.1 Creating a measurement project

In the menu **File > New** select the command **Project**. In the dialog that opens select the category **TwinCAT Measurement** and the required template.

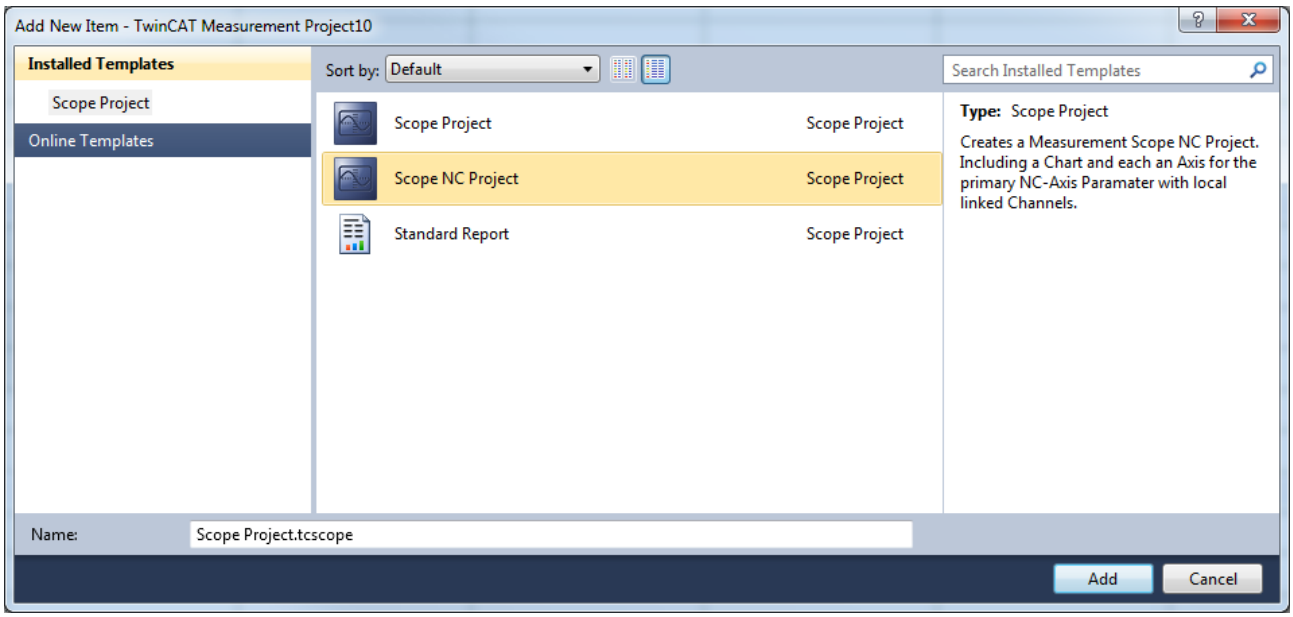


Available templates:

Empty Measurement project	Empty Measurement Project. Scope configurations (.sv2 | .tcscope | .tcscopex) or scope data (.svd | .svdx) can subsequently be inserted here.
Scope YT Project	Contains a Scope instance and a preconfigured YT chart with a corresponding axis.
Scope YT NC Project	Contains a Scope instance, which was specially preconfigured for working with drive axes. The template can easily be extended to the number of actually configured drive axes.
Scope XY Project	Contains a Scope instance and a preconfigured XY chart with a corresponding axis.
Scope Array Bar Project	Contains a Scope instance and a preconfigured array bar chart with a corresponding axis.

5.3.1.1.1.2 Add Scope report/project

In the context menu of the Measurement project select the command **Add > New Item...**, then select the required template in the dialog that opens.



Available templates:

Scope Project	Scope instance with a pre-configured chart and an axis.
Scope NC Project	Scope instance that has been specially pre-configured for working with axes.
Standard Report	Printing template for printing charts.

Adding an existing Scope project to a measurement project

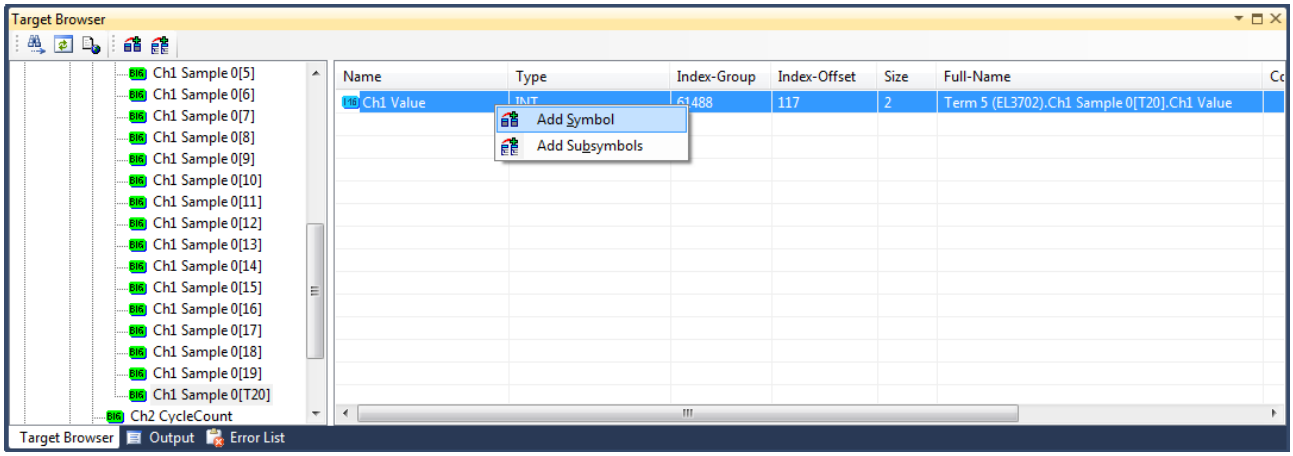
In the context menu of the measurement project, select the command **Add > Existing Item** and, in the dialog which then opens, select the desired file (.tcscopex | .tcscope | .sv2 | .svdx | .svd) or drag the desired file by drag & drop onto the project in the **Solution Explorer**.

5.3.1.1.1.3 Adding variables

Adding variable or channels

The prerequisite is a TwinCAT Measurement project with a Scope View. To add channels to the configuration, double-click in the **Target Browser** on the corresponding channels in the tree structure or mark channels and select the command **Add Symbols** (**Add Subsymbols**) in the context menu or the toolbar. The symbols are now inserted at the last-selected place in the Scope configuration. Alternatively, you can add selected elements anywhere in the configuration via drag & drop.

If you select a folder, an Ads Big type or an array containing subsymbols, the command **Add Subsymbols** adds a channel for each subsymbol. The command **Add Symbol** only adds one channel with the information for the selected symbol.



Disabling and enabling a channel

A channel can be disabled in the configuration in order to prevent it being recorded. However, it is retained when saving the configuration.

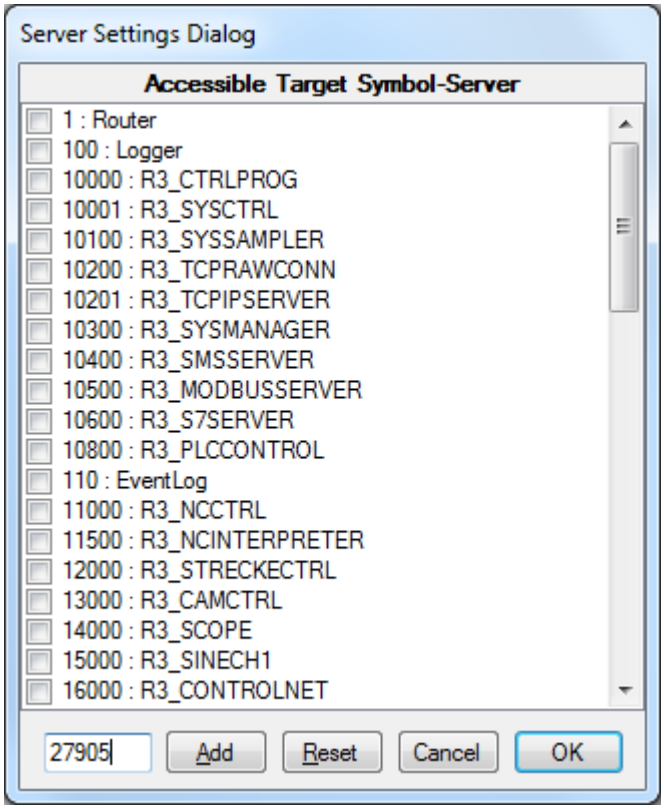
In the **Solution Explorer**, mark the channel to be deactivated and set the **Disabled** property in the **Properties** window to TRUE.

Task selection

If you select a target computer in the tree structure, the connected tasks become visible. These are marked in color:

- Green = PLC task
- Blue = NC task
- Red = other

If a task is not displayed, you can use **Enable Server Ports** to call up a selection menu that displays the restriction to particular tasks.



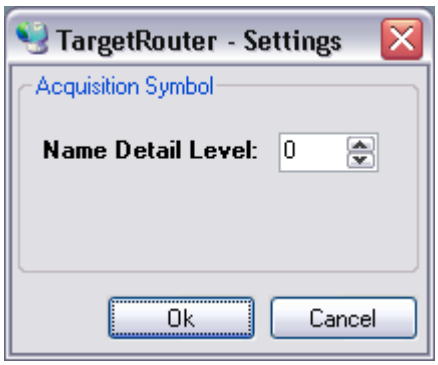
All popular Ads ports are displayed in the dialog, regardless of whether server tasks are concerned. If a port is not listed here it can be entered in the text field at the bottom left. All selected ports that are servers are adopted after confirming with **OK**. Subsequently a check is made as to which of the ports exist, in order to update the display.

Viewing the symbol list

If a symbol list is available for the selected task, you can call it by selecting. All symbols of a task are transferred into a hierarchical view according to separators (e.g. '.'), allowing simple browsing.

Settings

The option **Name Detail Level** in the settings can be used to set the detail level of the channel name formed from the symbol name. If the detail level is zero, only the part of the symbol name after the last dot is transferred. Each further level then adds the term before the respective next full stop. For example, with a detail level of “0” the symbol “Main.Signals.Sine” becomes “Sine”, with a detail level of “1” it becomes “Signals.Sine”, with a detail level of “2” or higher “Main.Signals.Sine”.



Starting and stopping a recording

Once you have selected all channels for the recording you can start the recording with the **Record** command in the TwinCAT Measurement toolbar ( ) and stop it again with the **Stop Record** command ( )

5.3.1.1.1.4 Adding and deleting elements

Adding a new chart

Select the **New YT Chart** or **New XY Chart** command in the context menu of the Scope instance.

Adding a new axis

Select the **New Axis** command in the context menu of the Scope / Chart instance.

Adding a new channel

- Select the **New Empty Channel** command in the context menu of the Scope / Chart / Axis instance.
- Drag & drop the symbol data from the **Target Browser** to an existing Scope / Chart / Axis instance.
- Select the **Add to Scope** command in the context menu of the variable in the PLC editor.

Deletion of elements

- In the **Solution Explorer**, mark the element to be deleted and press the **[Del]** button.
- Select the **Delete** command in the context menu of the element.

5.3.1.1.1.5 Shifting and copying elements

Moving and copying individual elements

Each element can be moved with drag & drop in the **Solution Explorer**. To copy an element, press the [Ctrl] button and shift the element by drag & drop.

Notes:

- If you move an element to another Scope, it is copied. Thus, it is still available in the original Scope.
- When moving an element, it must always be placed on an element of a higher hierarchical level.
- The described shift operations are available within a Scope even after the start of recording.

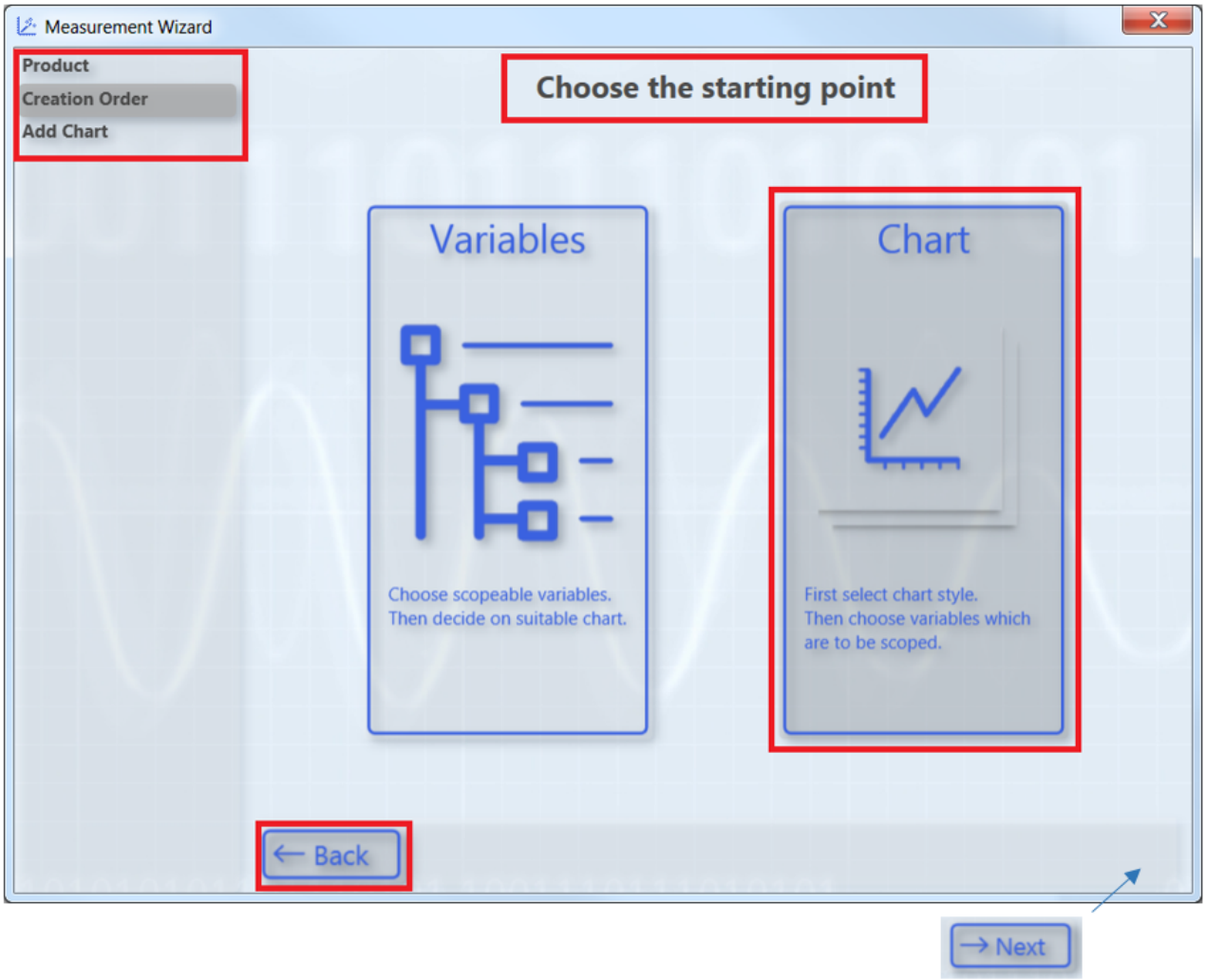
5.3.1.1.2 Creating and editing a Wizard project

The Measurement Wizard assists you in creating and configuring a user-defined Measurement Scope project by guiding you through the necessary steps with several successive dialogs.

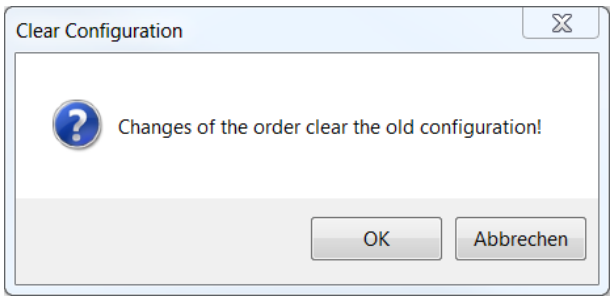
5.3.1.1.2.1 Structure and mode of operation of the Measurement Wizard

In the main area of the wizard you will be instructed with the help of various design elements to select the settings necessary for the Measurement Scope project. An option or setting is highlighted in gray after selection. The wizard usually moves automatically to the next configuration step. Otherwise a button labeled **Next** appears at the bottom of the screen via which you can proceed to the next configuration step.

The steps that have already been completed are displayed in the left-hand area of the Wizard. The current configuration step is highlighted in gray. You can return to an already completed configuration step via the progress indicator or the **Back** button at the bottom edge of the wizard and edit the setting again.



If you change a setting that had already been made, a dialog will inform you that you have changed the old configuration.

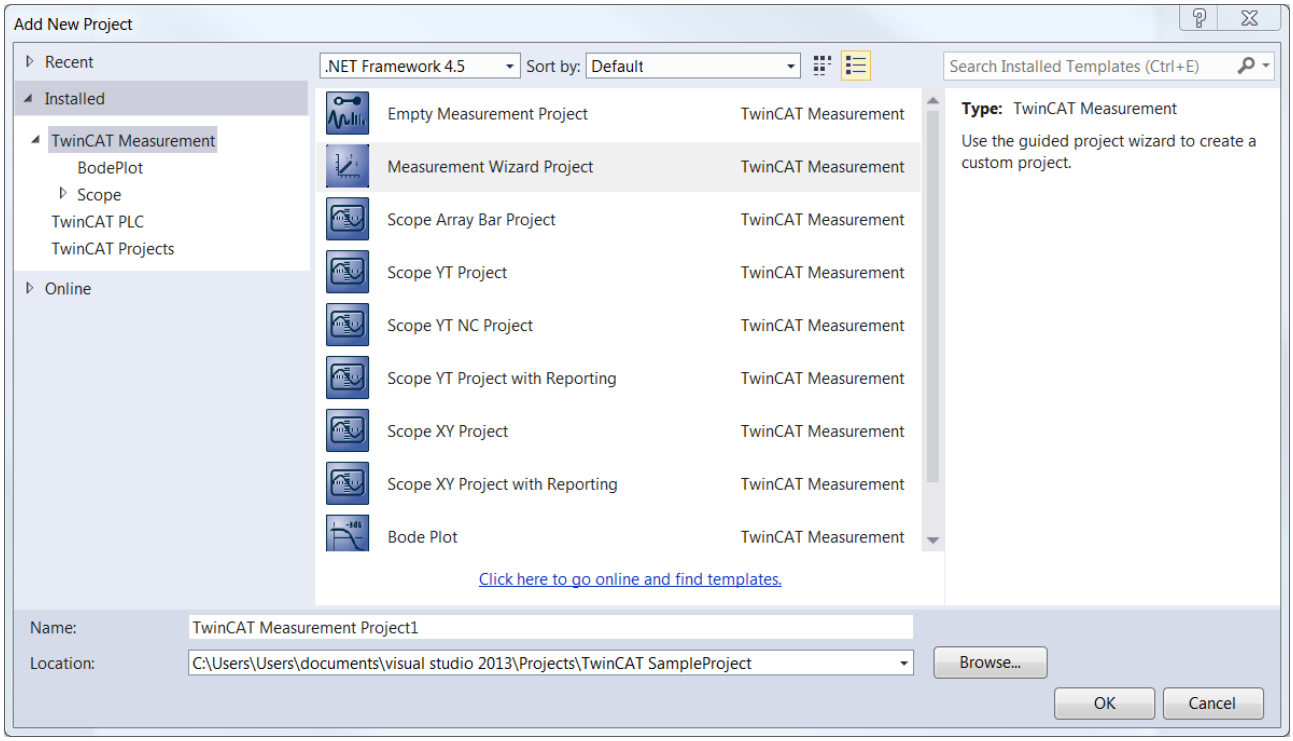


5.3.1.1.2.2 Creating and configuring a Measurement Wizard project

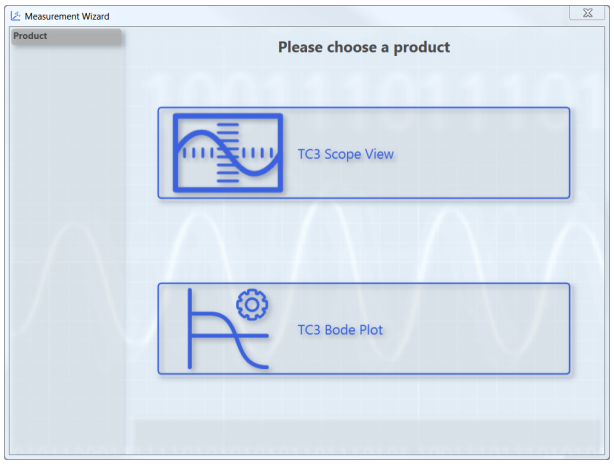
✓ TwinCAT is in RUN mode and the PLC project in online mode.

1. In the menu **File > New** select the command **Project**.

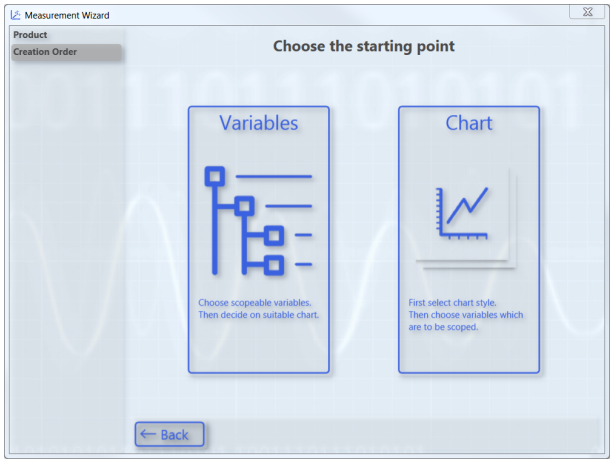
2. In the dialog that opens, select the TwinCAT Measurement category and the **Measurement Wizard Project** template.



⇨ The Measurement Wizard for TC3 Scope View, TC3 Bode Plot and TC3 Filter Designer opens.



3. Select **TC3 Scope View**.

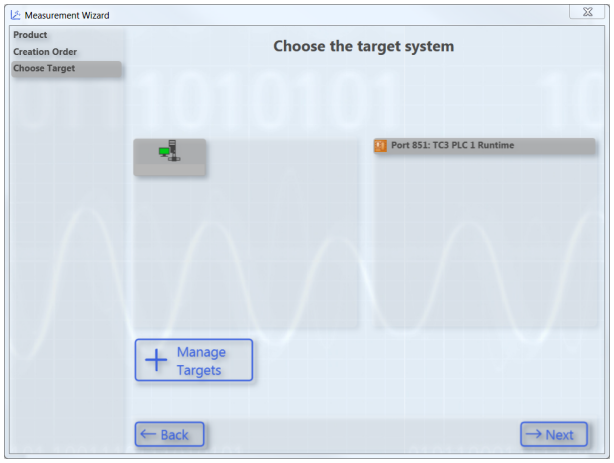


⇨ If you wish to select the variables to be recorded and displayed as a graph first and then the appropriate chart, select the "Variables" option [▶ 284]. If you wish to select the chart first and then the variables, select the "Chart" option [▶ 285].

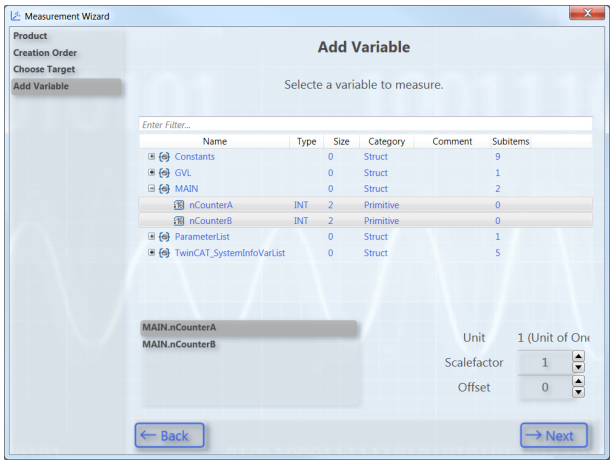
Selecting variables and then chart (Variables option)

✓ In the Measurement Wizard you selected the **Variables** option as the starting point.

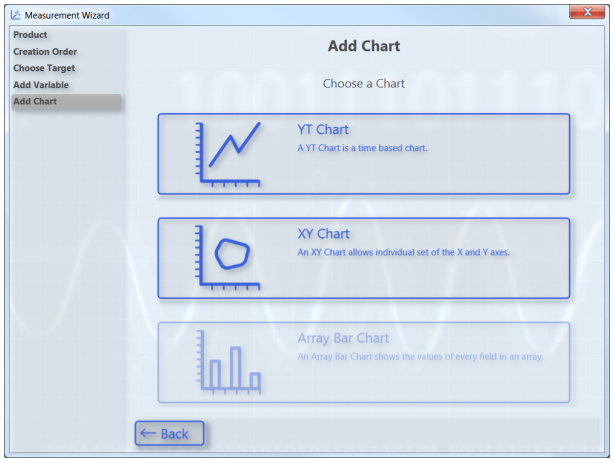
1. Select the target system and the corresponding ADS port. Optionally you can open the **TwinCAT Static Routes** dialog via the **Manage Targets** button in order to obtain information about the routes of the local TwinCAT system and to add new routes. Click on **Next.**



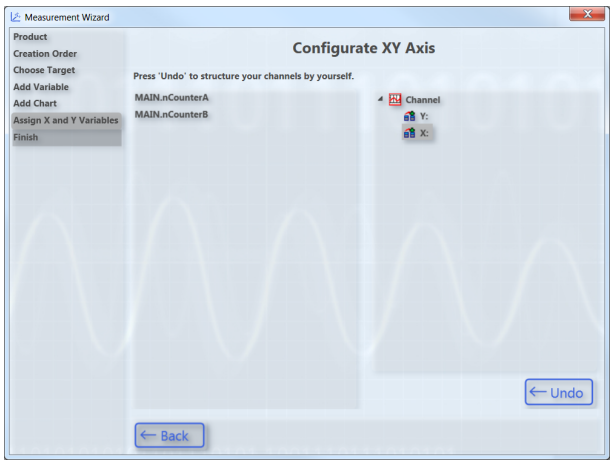
2. Select the variables that are to be recorded and displayed as a graph. To do this, navigate through the menu or enter a variable name in the filter text field. Optionally you can select a different scaling factor and an offset. Furthermore, you have the option to specify a warning level and an alert level. With these values you configure the dynamic style function for these variables. From the warning value the graph is drawn in yellow and from the alert in red. Click on **Next**.



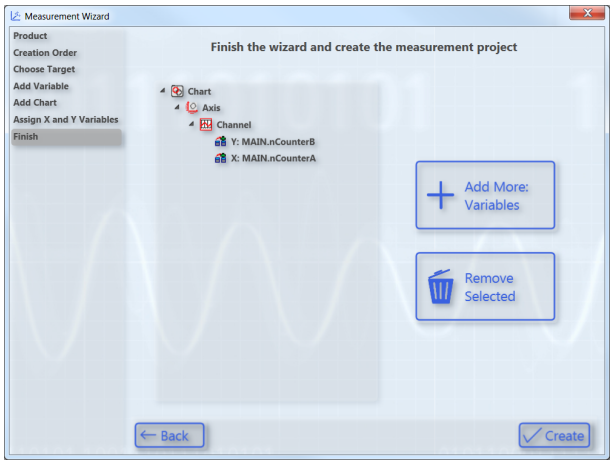
3. Select the chart type. You can only select chart types that match your variable selection. Here is an example of an XY chart.



4. Configure the axes. To do this, assign variables to the axes by marking the respective pairs. You can reset the selection with **Undo**. Click on **Next**.



⇨ The subsequent configuration step **Finish** shows an overview of the settings.



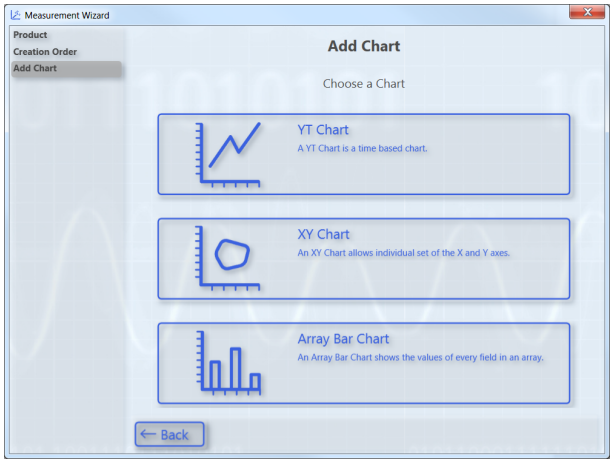
5. To delete a configured element again, mark it and click on **Remove Selected**. To add further variables to the configuration, click on **Add More: Variables.** Click on **Create** to end the configuration and create the project.

⇨ A TwinCAT Measurement Project with a ScopeWizard project is added to the Solution.

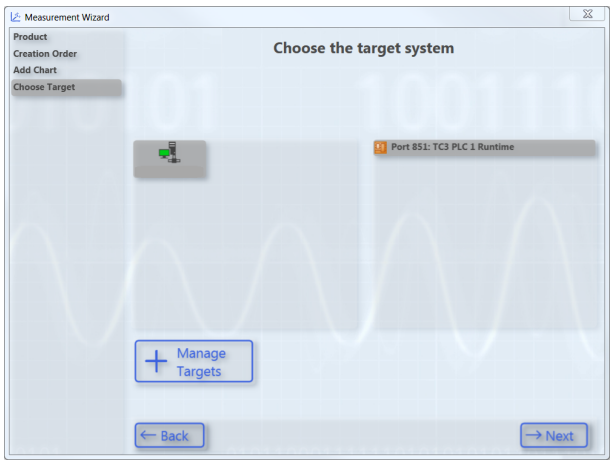
Selecting chart and then variables (Chart option)

✓ In the Measurement Wizard you selected the **Chart** option as the starting point.

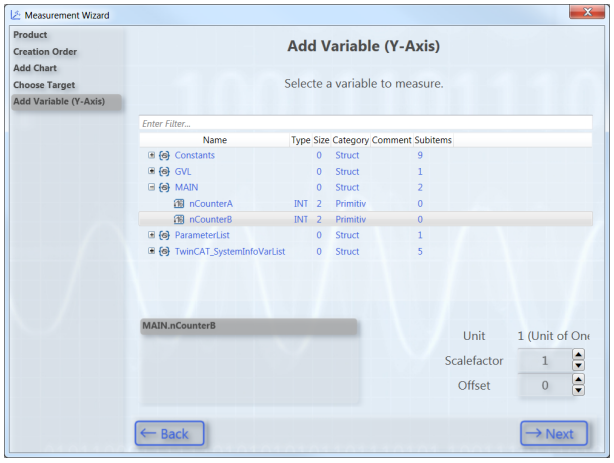
1. Select the chart type.



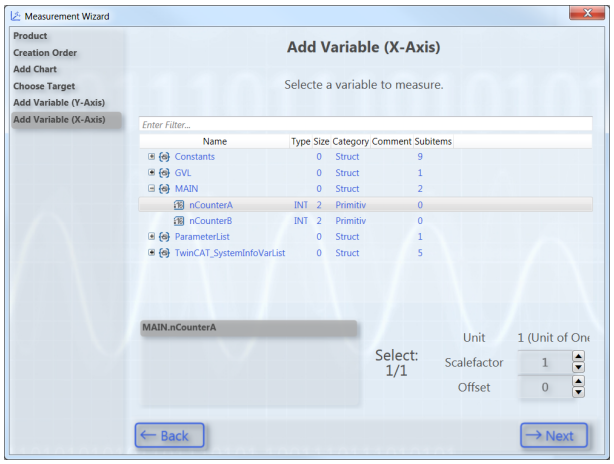
2. Select the target system. Optionally you can open the **TwinCAT Static Routes** dialog via the **Manage Targets** button in order to obtain information about the routes of the local TwinCAT system and to add new routes. Click on **Next.**



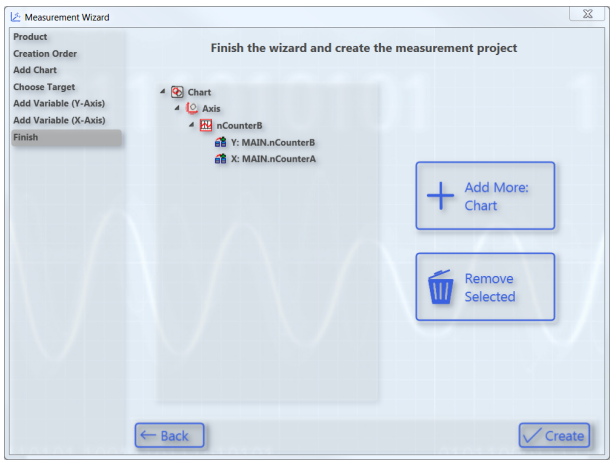
3. Assign a variable to the Y-axis. To do this, navigate through the menu or enter a variable name in the filter text field. Optionally you can select a different scaling factor and an offset. Furthermore, you have the option to specify a warning level and an alert level. With these values you configure the dynamic style function for these variables. From the warning value the graph is drawn in yellow and from the alert in red. Click on **Next**.



4. Assign a variable to the X-axis. To do this, navigate through the menu or enter a variable name in the filter text field. Optionally you can select a different scaling factor and an offset. Click on **Next**.



⇨ The subsequent configuration step **Finish** shows an overview of the settings.



5. To delete a configured element again, mark it and click on **Remove Selected**. To add a further chart to the configuration, click on **Add More: Chart.** Click on **Create** to end the configuration and create the project.

⇨ A TwinCAT Measurement Project with a ScopeWizard project is added to the Solution.

5.3.1.1.2.3 Editing Scope projects with the Scope Wizard

To edit a Measurement Wizard project or a Measurement Scope project with the aid of the Measurement Wizard, select **Update Project in Scope Wizard** in the context menu of the scope project in the **Solution Explorer**. The Measurement Wizard opens in which you can modify the configuration of the project.

Project update with Scope Wizard

The prerequisite for this function is that the original target system of the configuration is available on the engineering system.

5.3.1.2 Saving and loading a configuration

Saving a Scope configuration:

In the **File** menu select the command **Save**. (default keyboard shortcut: **[Ctrl] + [S]**)

Loading a Scope configuration

- In the **File > Open** menu, select the **Project/Solution** command and, in the dialog which then opens, select the project folder or the Measurement Project.
- Scope files (.tcscope | .sv2 | .svd) can be opened directly by double-clicking. Since a Measurement Project as the basis is missing, a selection dialog appears in which you can create a new project (Empty Measurement Project). The Scope called by a double-click is added to the newly created project. At the same time a copy of the file is placed in the new project directory.
- Measurement project files (.tcmproj) and solutions (.sln) can be opened directly by double-clicking.

5.3.1.3 Sending a configuration by e-mail

In the context menu of the Scope instance to be sent, select the command **Send Project By Email**.

If the Scope contains data (Scope state: replay), you can select whether the data should also be sent.

5.3.2 Data

5.3.2.1 Formats

The TwinCAT Scope has been on the market since 2008 and now supports a series of its **own** file formats due to new developments. This page provides an overview of them. All formats can always be used with the latest Scope version.

Configuration:

Scope version	File format
All in TwinCAT Scope2 (TwinCAT 2)	.sv2
From TwinCAT 3 Scope	.tcscope
Since TwinCAT 3 Scope version 3.3.3140.0	.tcscopex

The configuration files can always be converted into the more up-to-date formats. i.e. .sv2 >> .tcscope, .tcscope >> .tcscopex and also .sv2 >> .tcscopex.

Data:

The data are saved in .svd files in TwinCAT Scope 2 and also in TwinCAT 3 Scope up to version 3.3.3140.0. From version 3.3.3140.0 the files are saved in the new .svdx format. Old .svd files can also be converted into .svdx again.

From version 3.3.3140.0 a .tcscopex file is saved for the configuration. The data are written to a .svdx file.

5.3.2.2 Saving and loading data

Data that have been recorded with the TC3 Scope View can be saved as a .svdx file. A .svdx file is a specific, non-disclosed data format of the TwinCAT 3 Scope View.

Saving data

- Select the **Save Data** command in the **Scope** menu or in the toolbar. This creates a Scope data file (svdx) that can be added directly to the measurement project or saved in a directory via the directory selection dialog.
- If you add multiple files to a measurement project, the name of the svdx file is automatically incremented with a digit.

Saving with image data

When saving images in a Scope data file, please note that for each image acquisition a decision can be made whether the data should be saved within the Scope data file or next to it. If the images are saved next to the Scope data file, folders are created next to the file in which the image data is saved. When the Scope data file is reopened, the image data must still be right next to the file for the images to reopen. If this is not the case, the process data can still be opened, but the images can then no longer be displayed.
The advantage of saving the images next to the Scope data file is that the Scope data file remains smaller and thus more flexible, making it easier to share or send, for example.
If all data are always to be viewed together, it is more practical to store the image data within the *.svdx* file, so that all the information is bundled in one file.

Loading data

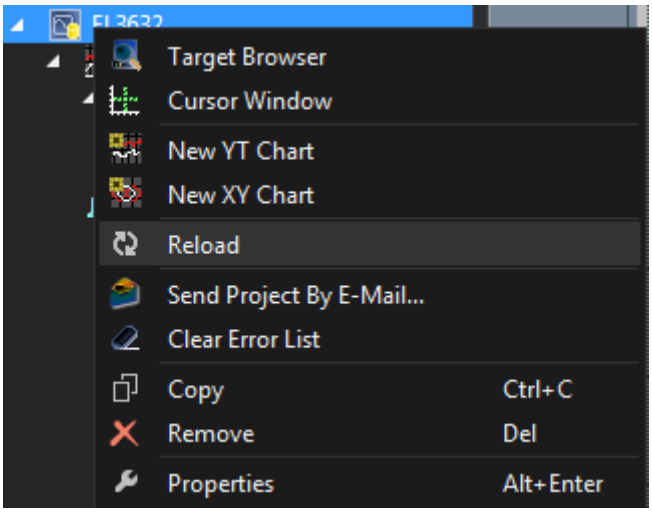
The following options are available for loading data:

- Double-click the desired .svdx file in the file system. Visual Studio opens and the dialog **New Project** appears. Select the **Empty Measurement Project**. The .svdx file is added to the new measurement project.
- If a measurement project already exists, the .svdx file can be selected and opened via the command **Add Existing Item**.

- Open the measurement project, to which the .svdx file that was created has been added. In menu **File > Open** select the command **Project/Solution**; in the dialog that opens open the corresponding project.

Reloading of svdx files

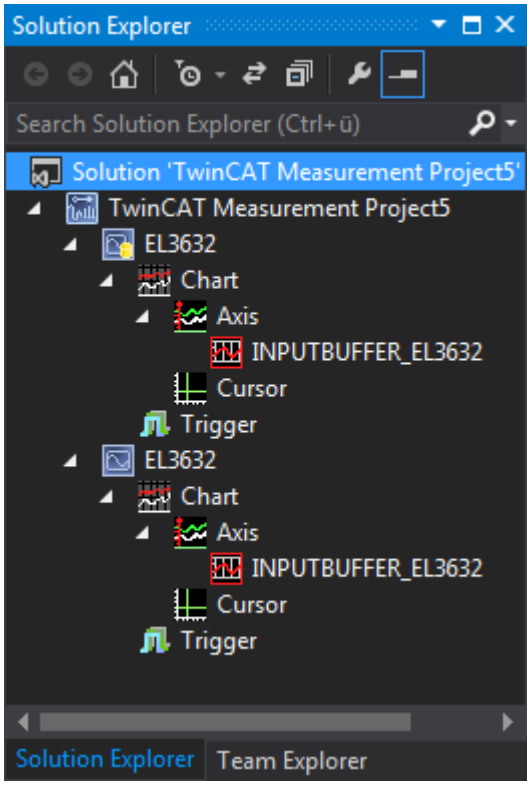
If already save data are no longer displayed due to a disconnection of the Scope's internal communication to the Scope Server, the **Reload** command is automatically available in the context menu for the .svdx file. You can reload the data with this command.



Extracting Scope configurations from an svdx file

A .svdx file is visually identified as such. A yellow data symbol is displayed in the **Solution Explorer**. This enables exclusively data analysis within the file.

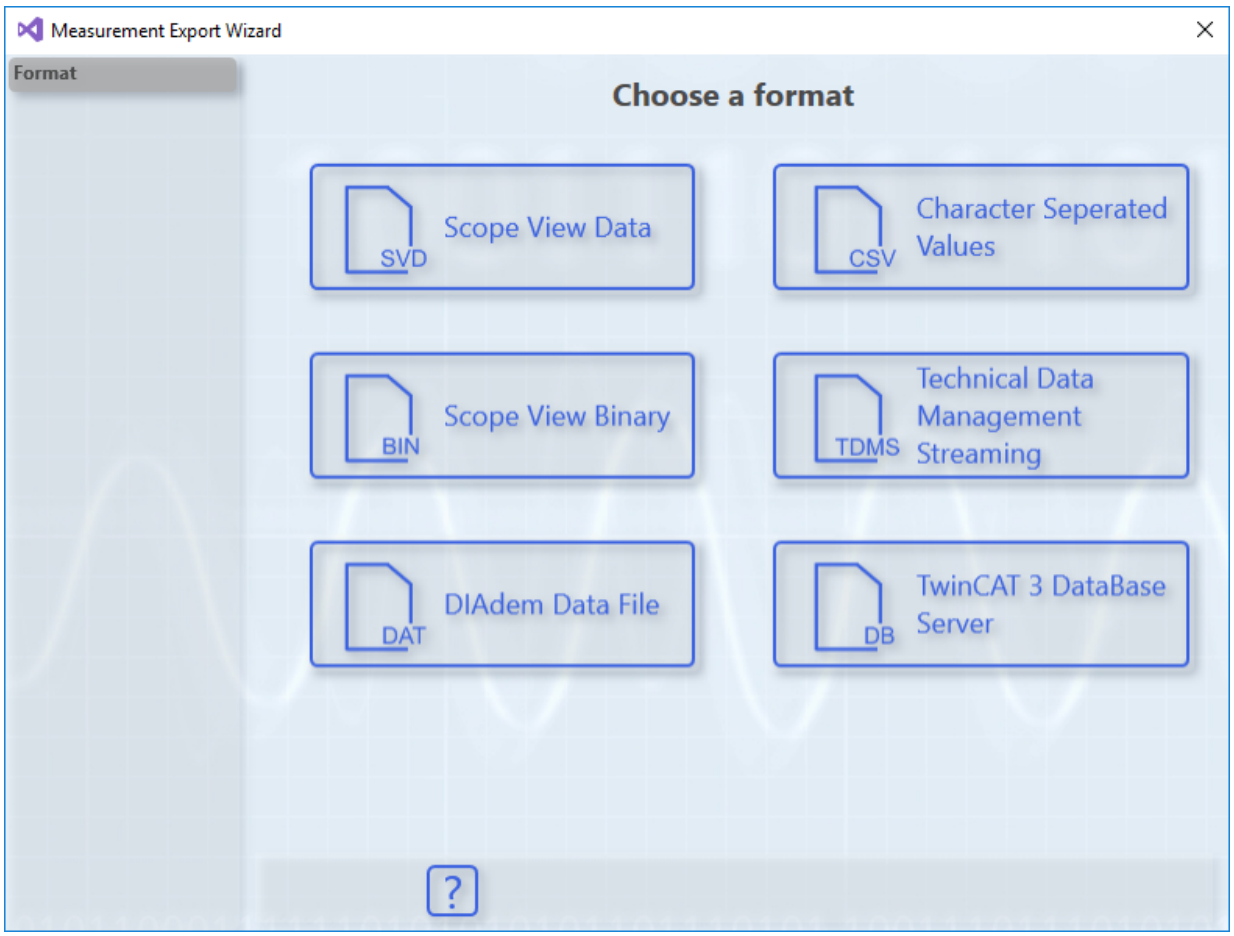
If you want to reuse the configuration, for example to make a new recording with the same configuration, select the command **Extract Scope Configuration** in the **Scope** menu.



5.3.2.3 Exporting data

In order to enable the further processing of the data recorded with the TwinCAT Scope, the data can be exported in various other data formats. The TwinCAT Measurement Export Wizard is provided in order to make this as simple and as individual as possible.

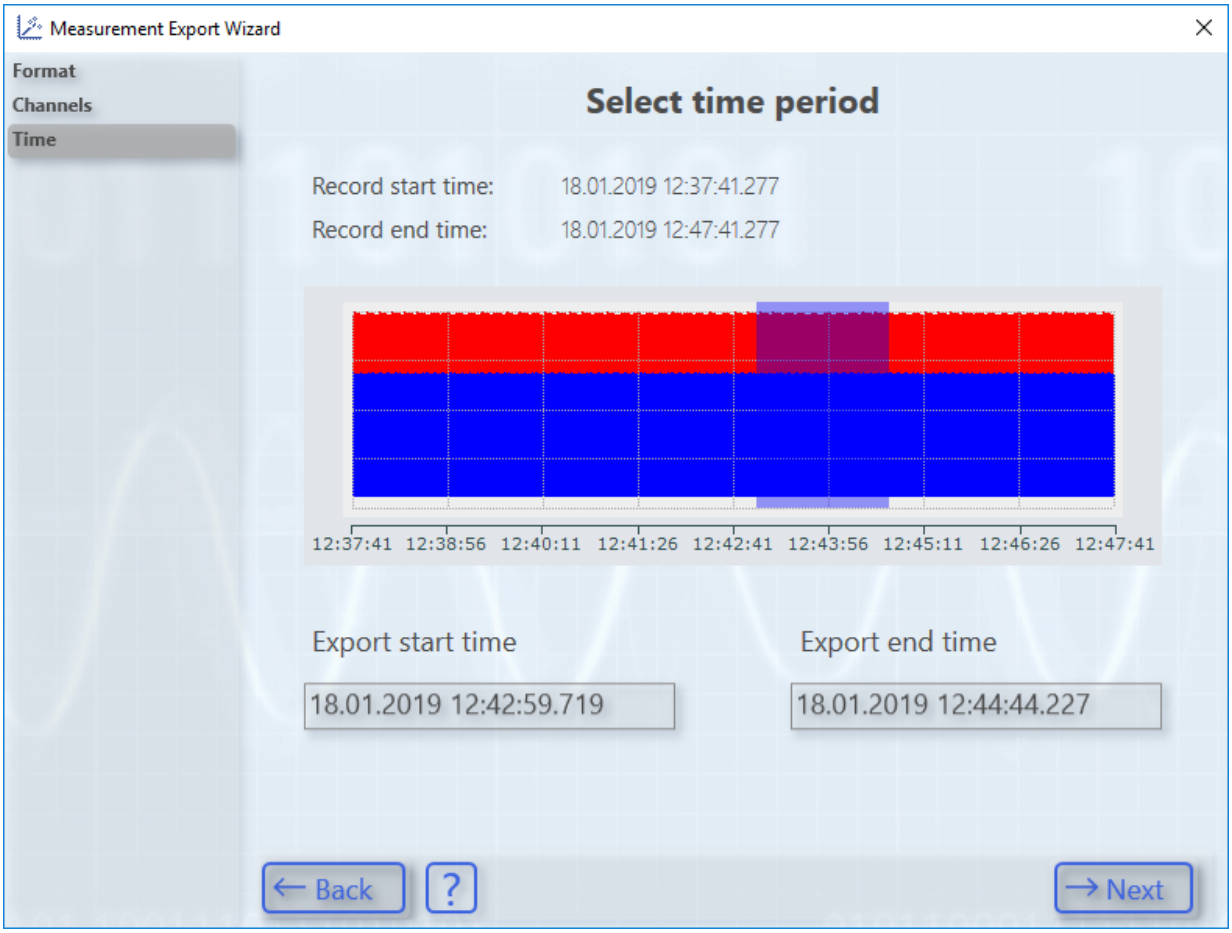
1. Open the Export Wizard via the **Scope** Menu **> Export…**
2. On the first page you can select the desired target format. The original svd format is thereby selectable again as the target simply in order to reduce existing scope recordings with regard to the number of channels or their duration. Further formats are csv, svb, tdms and dat.



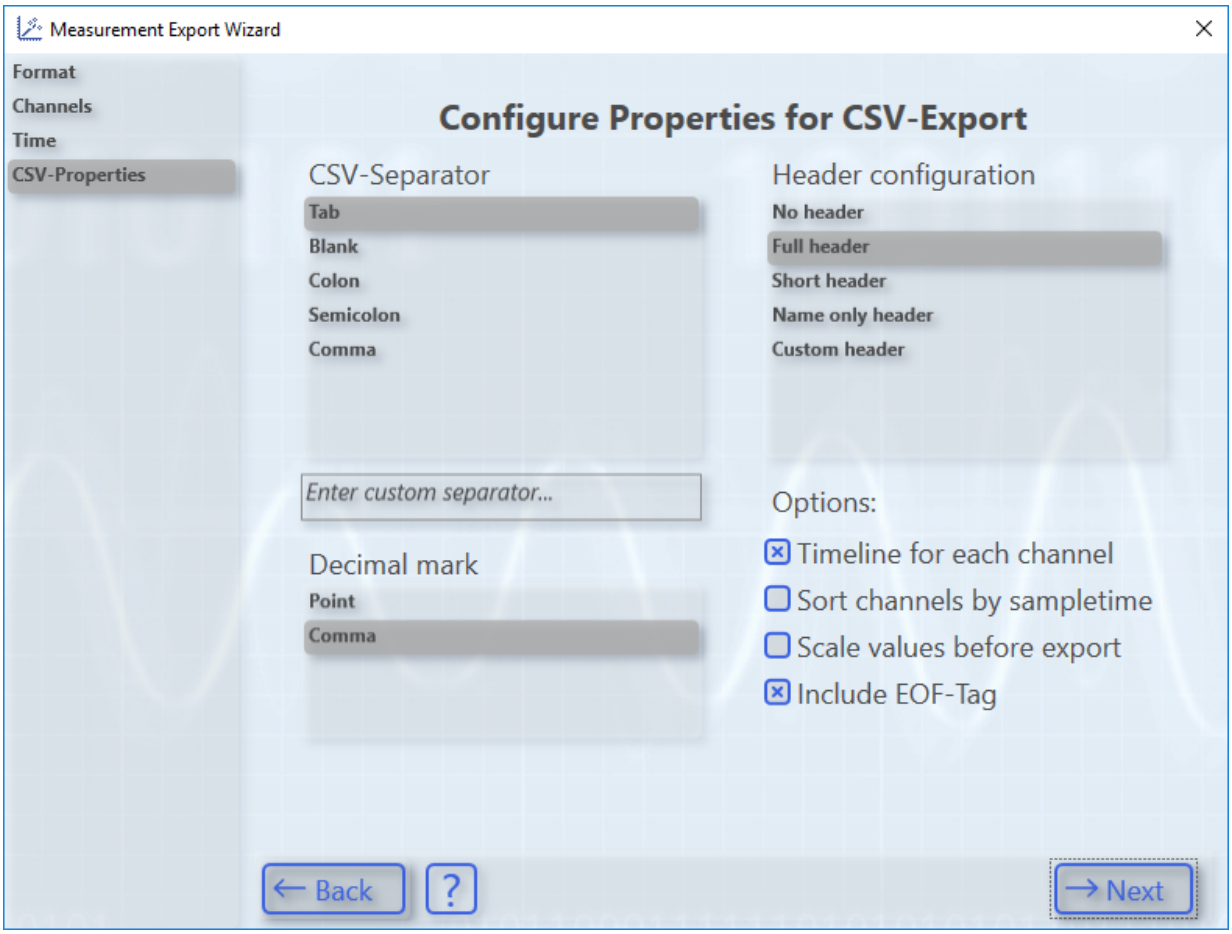
3. Subsequently, the channels to be exported in the new format can be selected via **Select channels**. Confirm with **Next.**



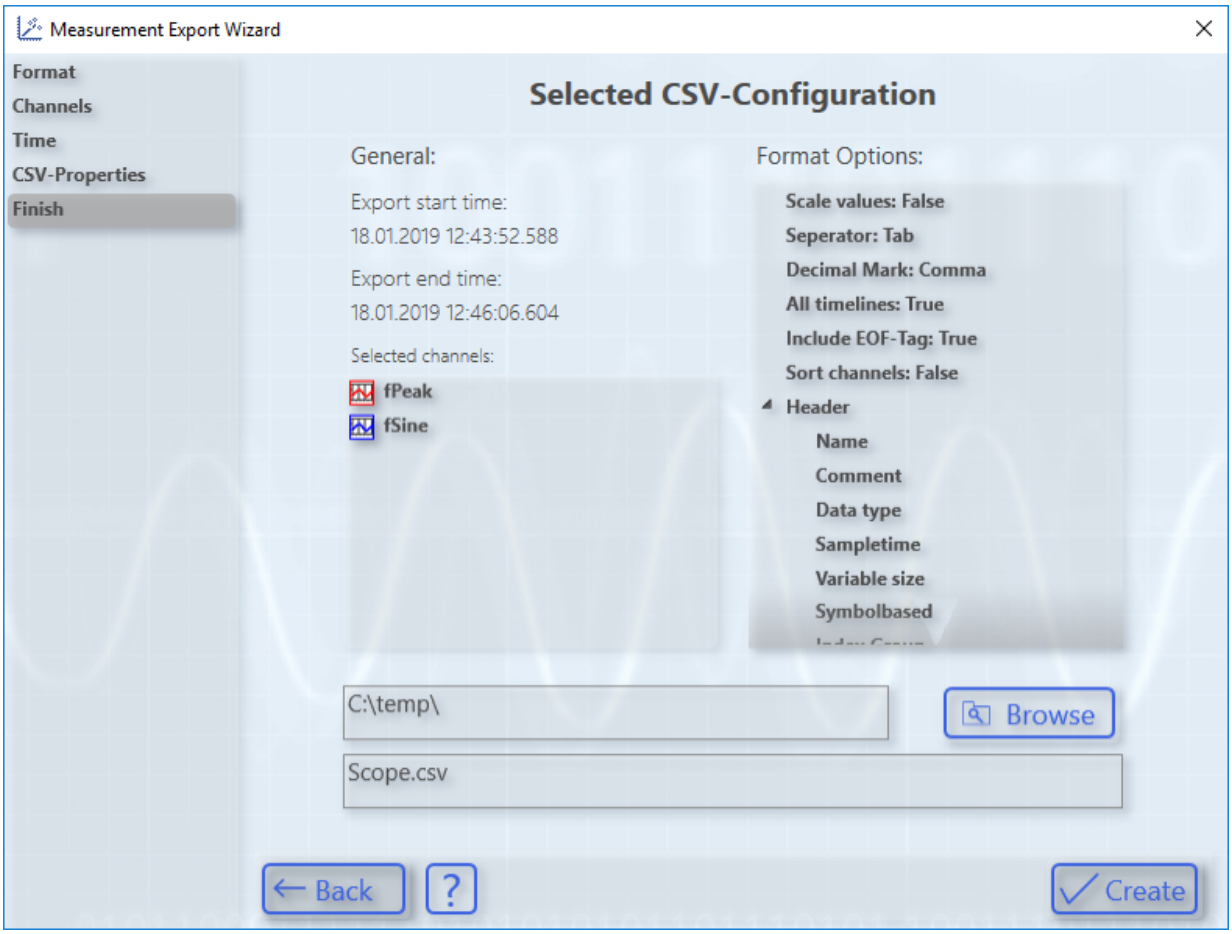
4. The timeframe that was defined by the recording is selected in the **Select time period** dialog. Select this timeframe graphically with the mouse or textually with **Export start time** and **Export end time**. Confirm with **Next**.



5. **Configure Properties for CSV-Export** enables individual settings to be made for each data format. Confirm your settings with **Next.**



6. **Selected CSV-Configuration provides a summary. The generation of the new file/files is started with Create.**



5.3.2.3.1 Export to csv

The export of data to a csv file enables the following individual settings to be made.

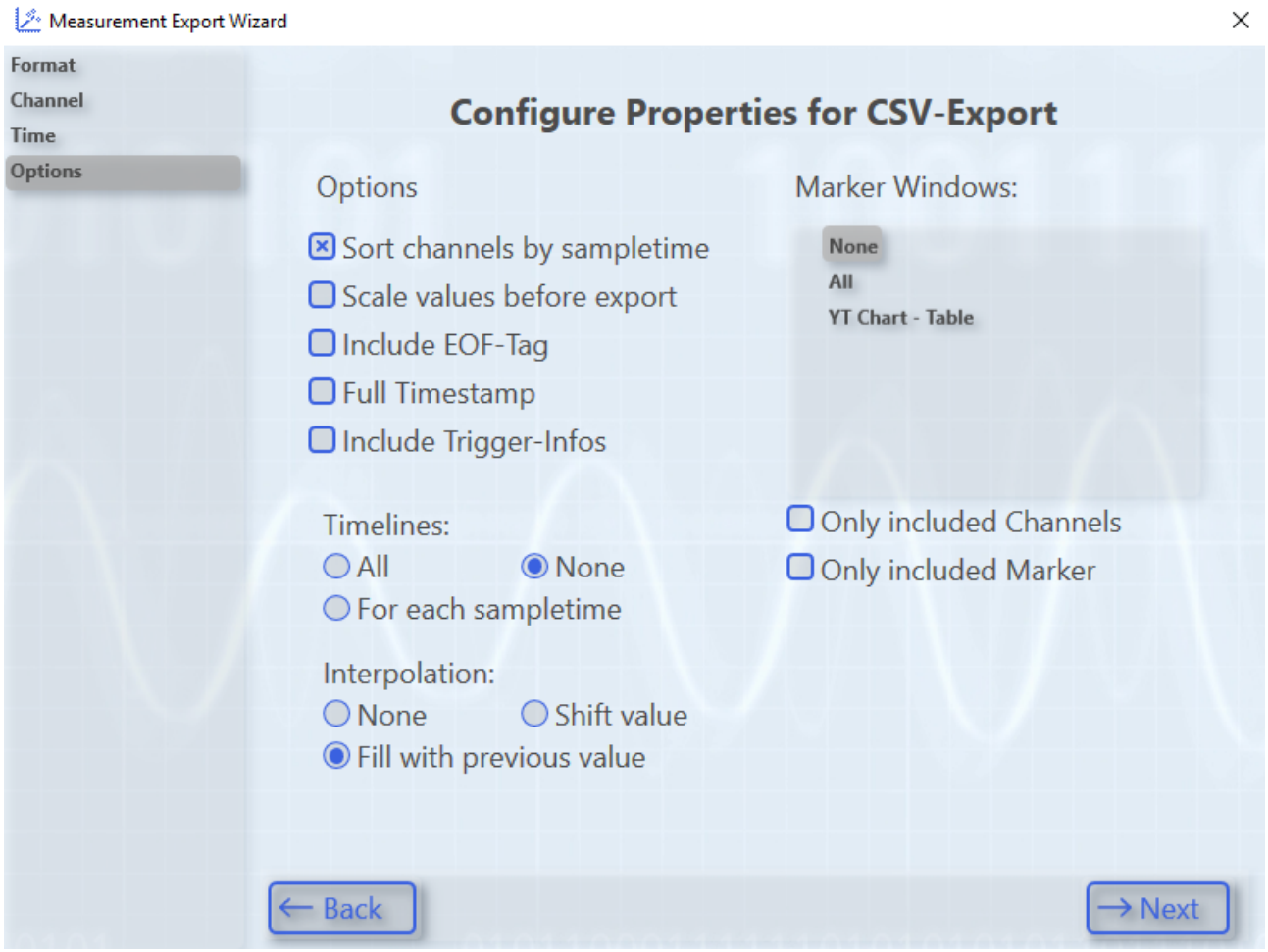


Fig. 1:

Sort channels by sampletime:

Sort the exported channels in ascending order according to the sampling time. This reduces the file size as less placeholders for missing values have to be stored.

Scale values before export:

Convert the values with the scaling factor and offset configured on the channel.

Include EOF tag:

At the end of the file a row with the letters EOF is inserted to mark the end of the file.

Full Timestamp:

Saving the timestamps in filetime format. Otherwise, the timestamps are stored as millisecond intervals from the first data point of the export.

Include trigger info:

Saving the triggered trigger events.

Timelines:

All	A separate time column for each channel
None	No time columns
For each sampletime	Successive channels with the same sampling time share the time column

Interpolation:

None	No interpolation of channels with lower sampling time
Shift value	Shifting values in channels with higher sampling time, so that values from the same timestamp are in one row.
Fill with previous value	Additional filling of the gaps with the previous value.

Marker Windows:

Either all, none, or only the selected marker tables can be included in the CSV.

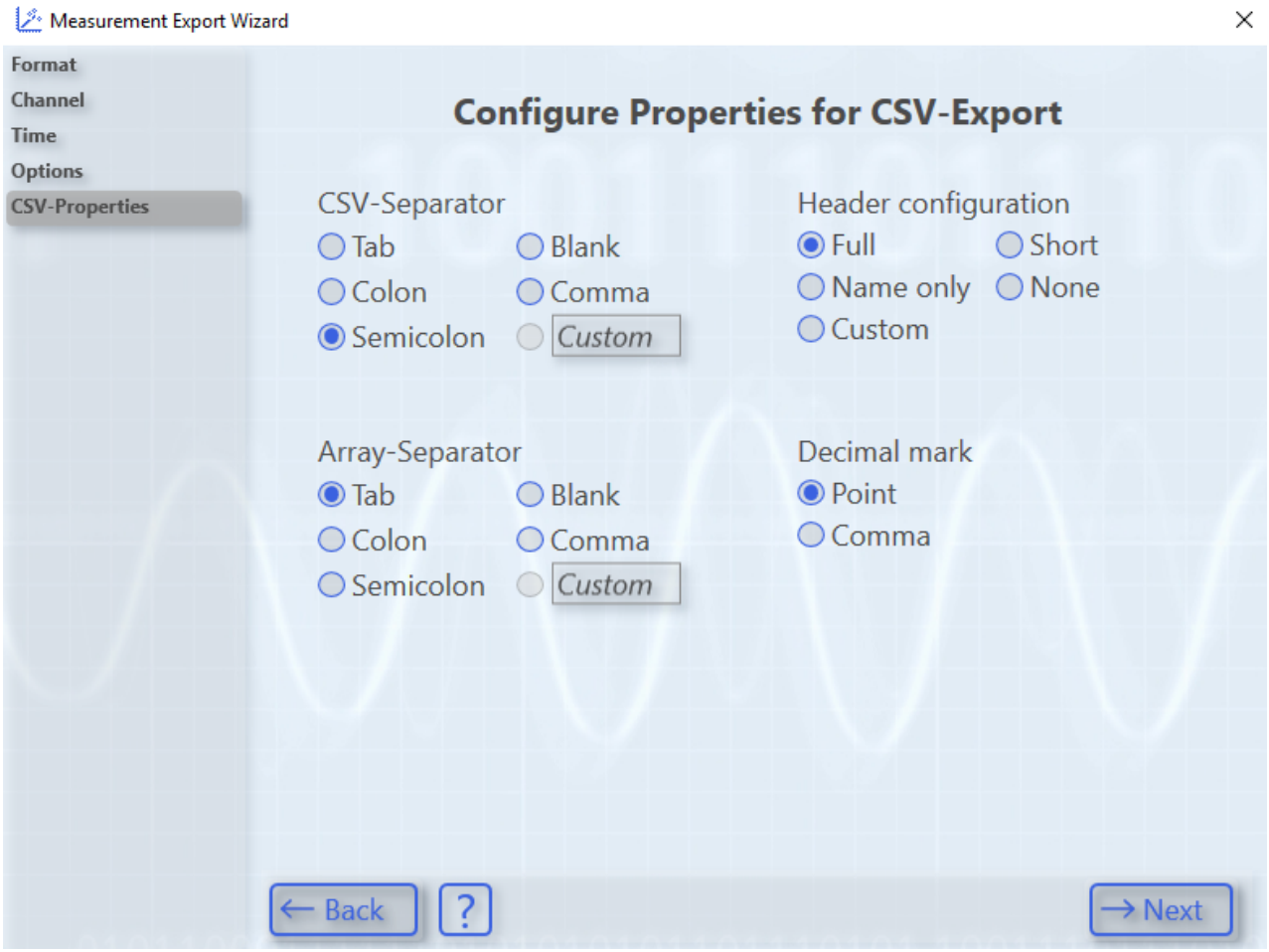
Only included Channels:

Rows or columns of channels that are not included in the export are not exported with the marker tables.

Only included marker:

Rows or columns of markers whose timestamps are outside the exported range will not be exported with the marker tables.

On the second page, further settings can be made.



CSV separator:

Selection of the separator between two columns. A custom character can be specified in the Custom field.

Array separator:

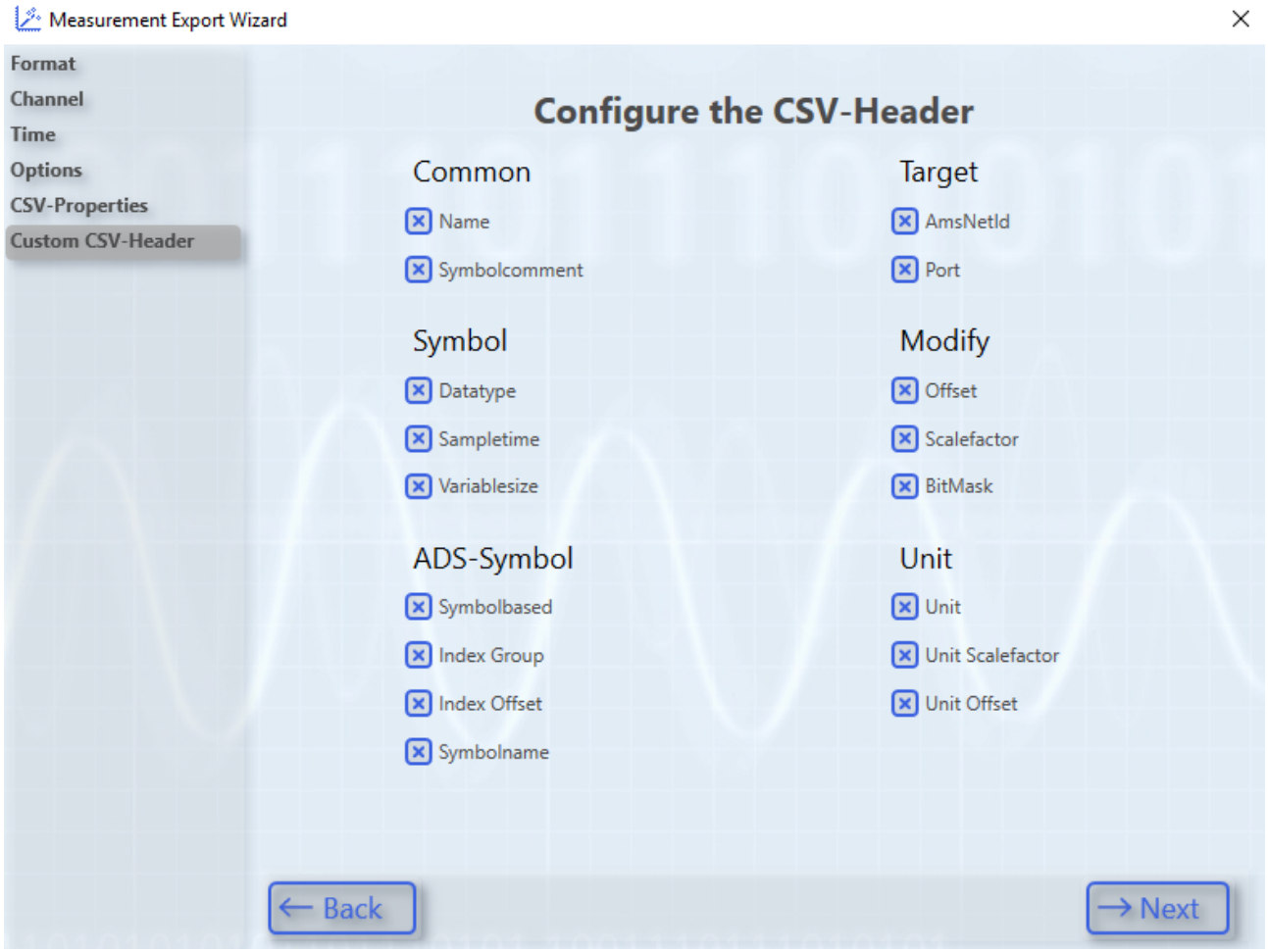
A different separator can be defined for channels with array values.

Decimal mark:

Selection of the decimal separator.

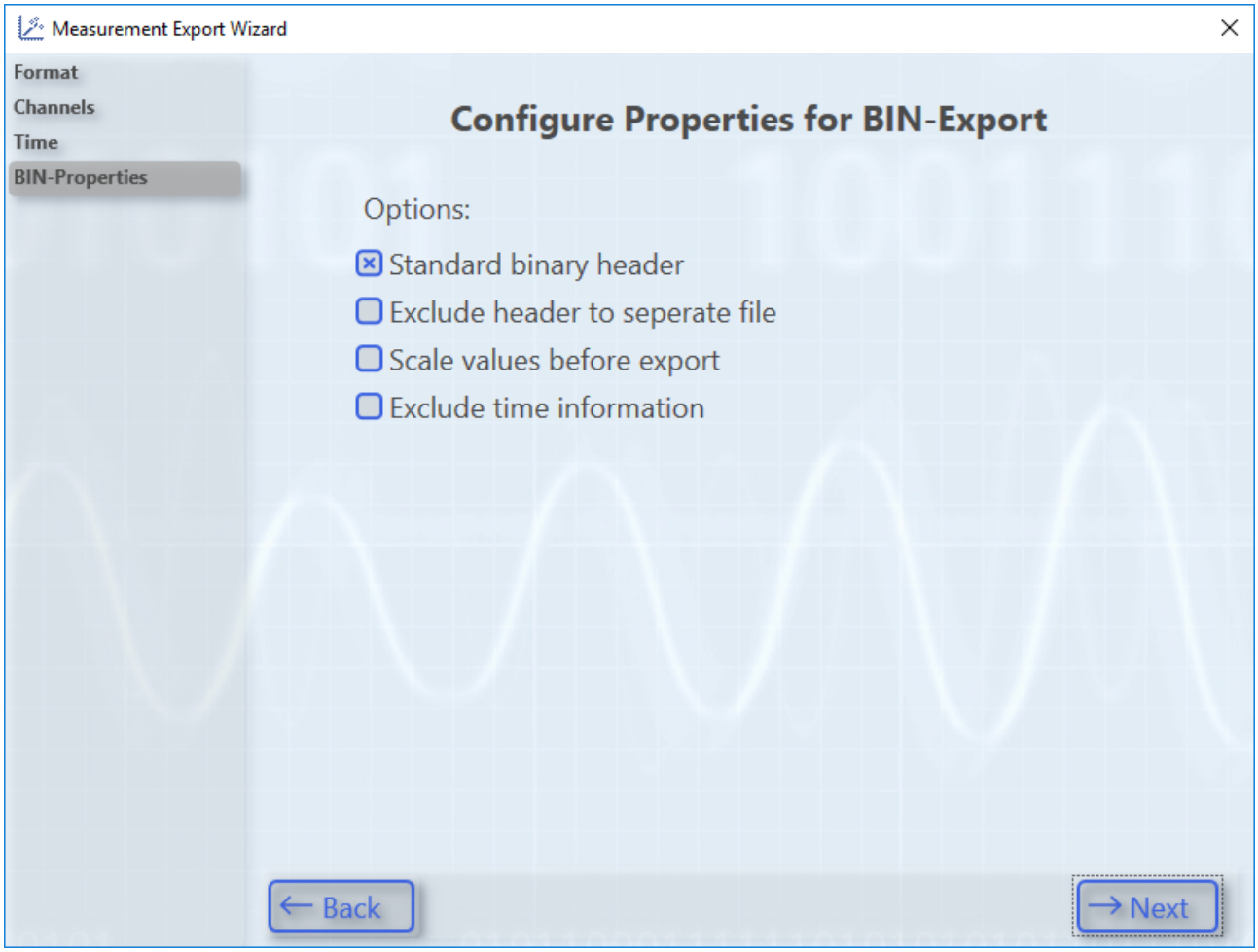
Header configuration:

There are several suggested configurations available for the header of the export. The Custom selection allows individual configuration of the head on the next page.



5.3.2.3.2 Export to svb

The TwinCAT Scope also supports the export of data to a binary format specified by Beckhoff. The file extension of the created file is svb. The following parameters can be set:



The header can be shown and hidden and also moved to its own file. You can choose whether to export the values in scaled or unscaled form, with and without sampling rate/time information.

Format description for developers

The binary data format is based on the text format but contains no separators. Instead the byte lengths of all variable data types (such as character strings) are contained in the corresponding headers. All times are specified in the file time format: 1 tick = 100 ns; origin is 1.1.1601 0h. All characters are stored in UTF8.

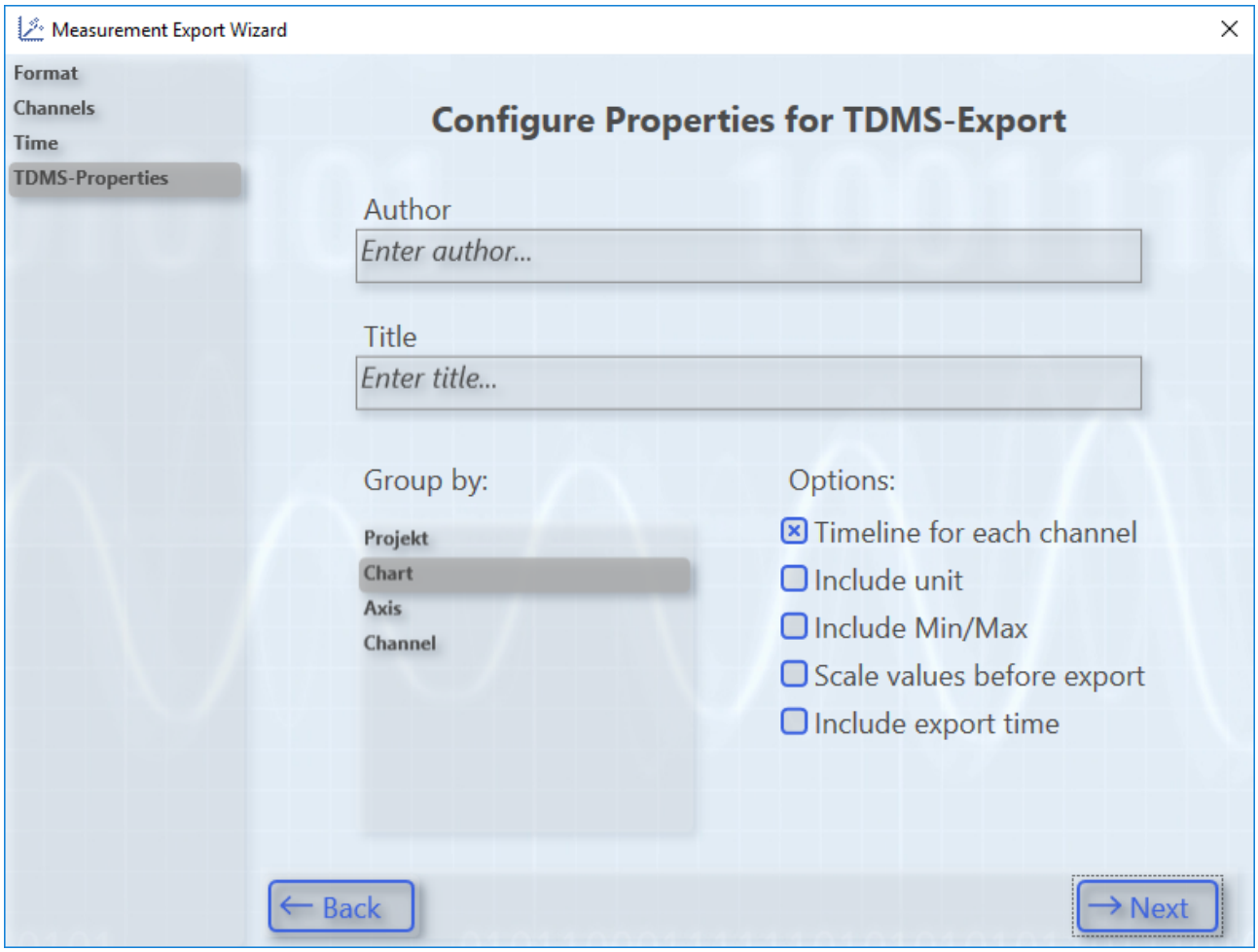
Variable	*Size (Bytes) or Number of character*	*DataType*
MAIN-HEADER		
HeaderSize	8	Int64
NameSize	4	Int32
Name	NameSize	Array of Char
StartTime	8	Int64
EndTime	8	Int64
ChannelCount	4	Int32
Variable	*Size (Bytes)*	*DataType*
Channel - Header #1		
ChannelHeaderSize	8	Int64
NameSize	4	Int32
Name	NameSize	Array of Char
NetIdSize	4	Int32
NetId	NetIdSize	Array of Char
Port	4	Int32
Sample Time	8	Int64
SymbolBased	1	bool (as byte)
SymoblNameSize	4	Int32
Symbol name:	SymbolNameSize	Array of Char
CommentSize	4	Int32
Comment	CommentSize	Array of Char
IndexGroup	8	Int64
IndexOffset	8	Int64
DataTypeSize	4	Int32
DataType	DataTypeSize	Array of Char
DataTypeId	4	Int32
VariableSize	4	Int32
Samples in File	8	Int64
Data in File	8	Int64
File-StartPosition	8	Int64
Offset	8	Real64
Scalefactor	8	Real64
Bitmask	8	Int64
Channel-Header #2		
...		
Channel-Header #MainHeader.ChannelCount		
Variable	*Size (Bytes)*	*DataType*
Data Channel #1		
DataPoint #1		
Timestamp	4	UInt32
Value	ChannelHeader1.VariableSize	ChannelHeader.DataType
DataPoint #2		
...		
DataPoint ChannelHeader #1.Samples In File		
Data Channel #2		
...		

Data Channel #MainHeader.ChannelCount

5.3.2.3.3 Export to tdms

The tdms format is a commonly used format in measurement technology and can be used with the aid of the TwinCAT 3 Scope View Professional License (TE1300).

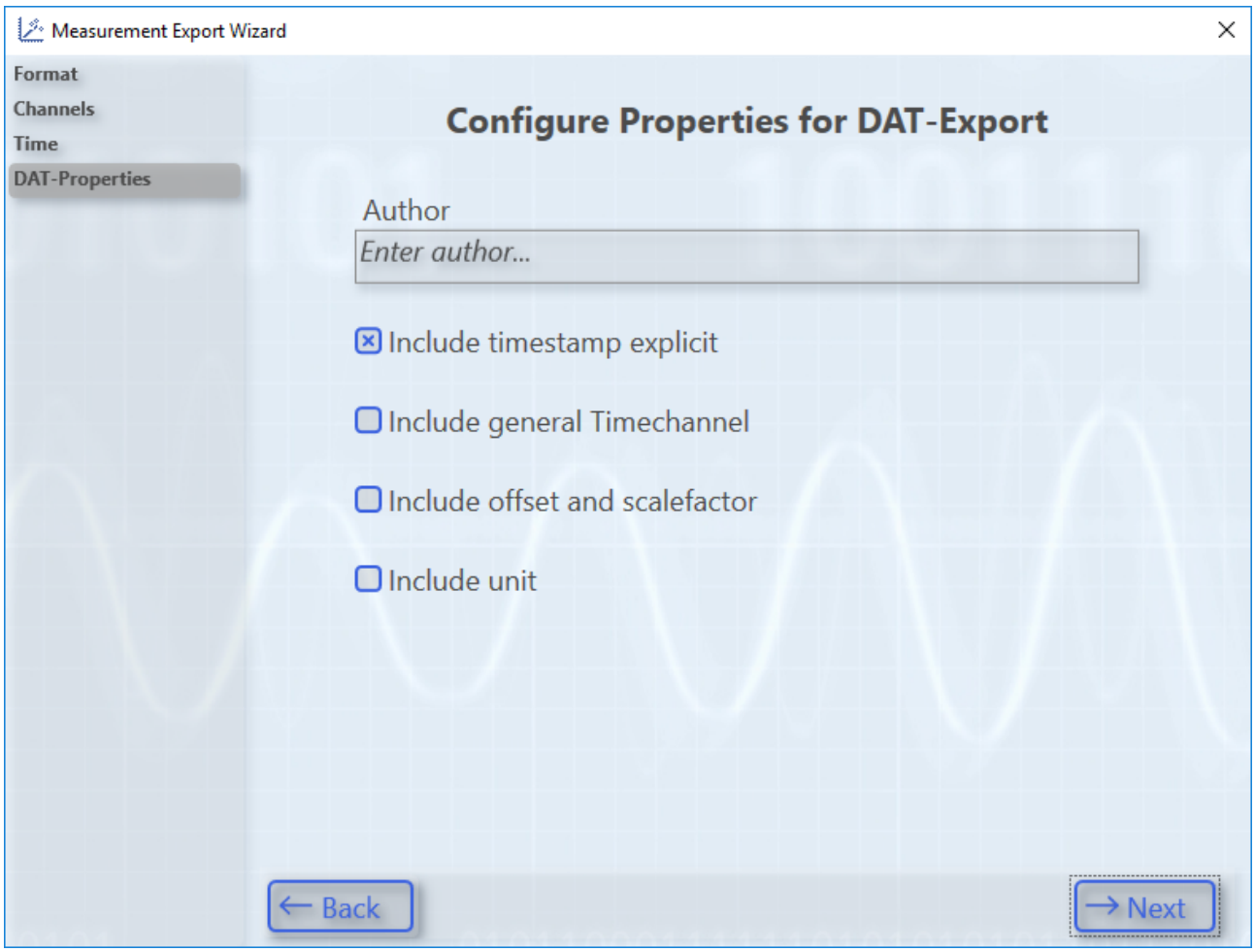
Apart from an author and a title for the measurement project conducted, you can also make settings with regard to the sampling rate or time axis. Furthermore, you can adopt physical units from the Scope and decide whether or not the values will be scaled. A grouping can also be specified for the tdms file.



5.3.2.3.4 Export to dat

The dat format is a commonly used format in measurement technology and can be used with the aid of the TwinCAT 3 Scope View Professional License (TE1300). The implementation of dat is not standardized, for which reason minor deviations can occur in the implementation.

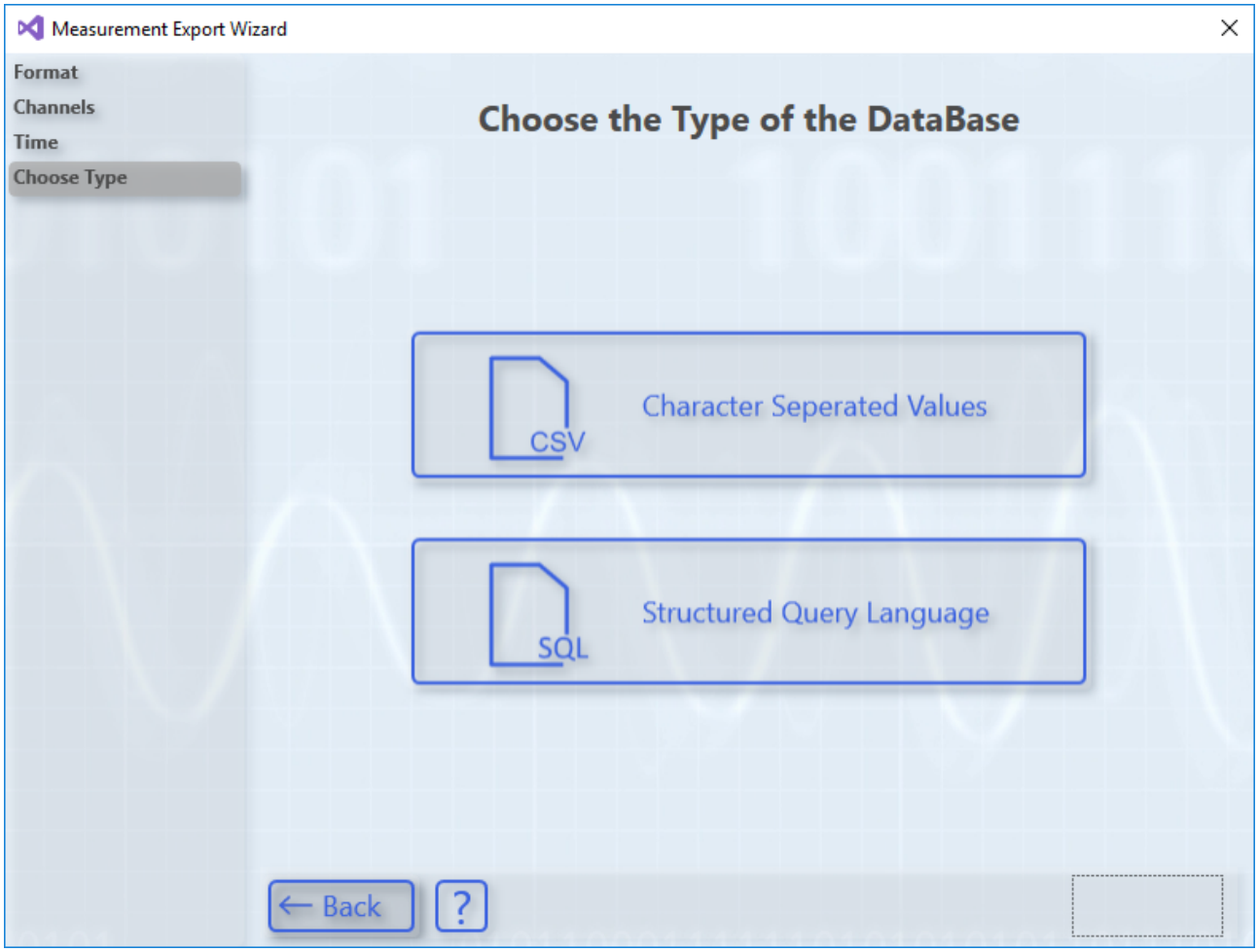
The following settings can be made:



5.3.2.3.5 Export to databases

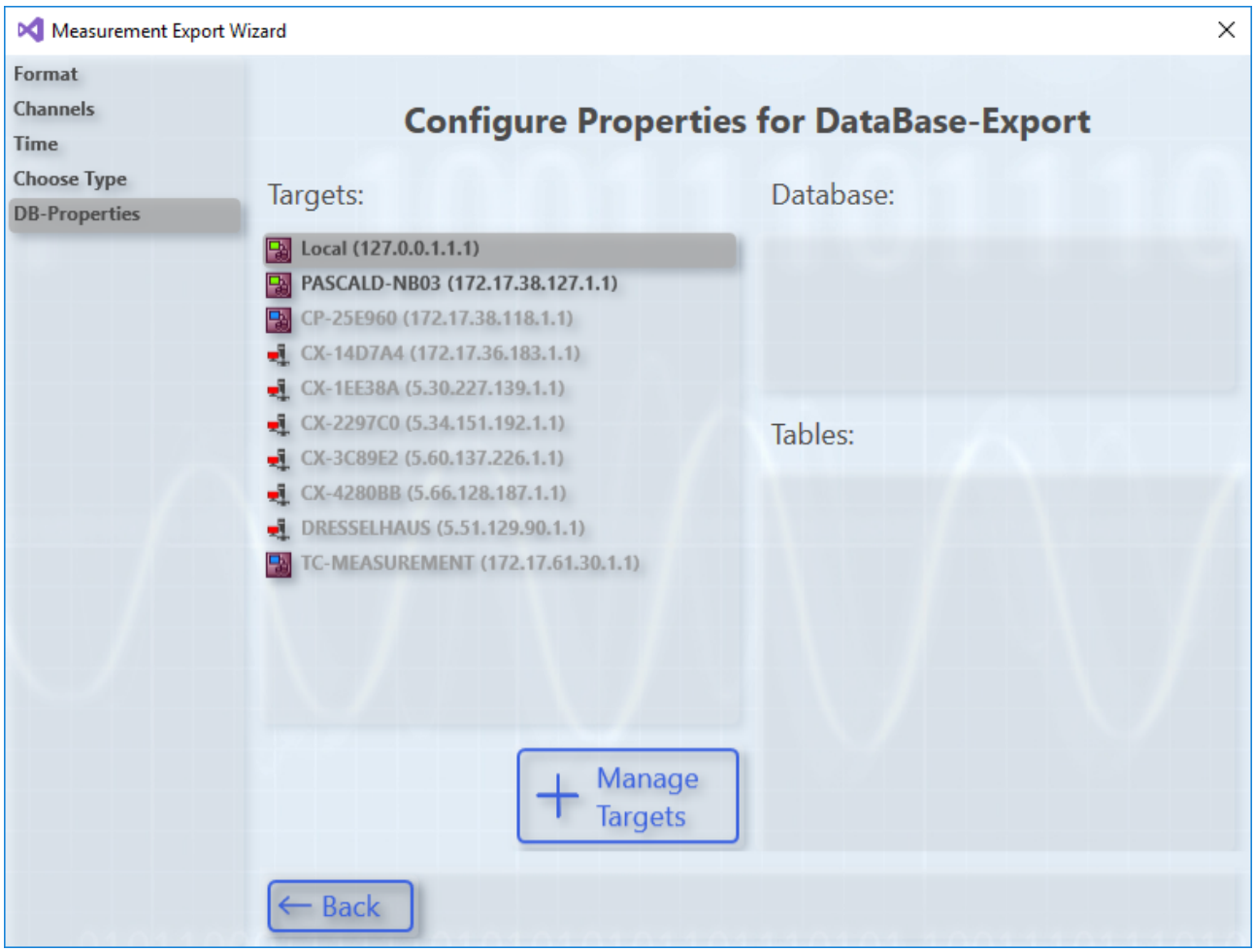
Data recorded with the TwinCAT Scope can be exported to a database with the help of the TwinCAT Database Server. There are two options.

1. In the base version it is possible to export data to a csv in such a way that this csv can be reused as a database with the Database Server.
2. The export of the data to SQL databases is possible with the Scope View Professional Version and a licensed TwinCAT Database Server.

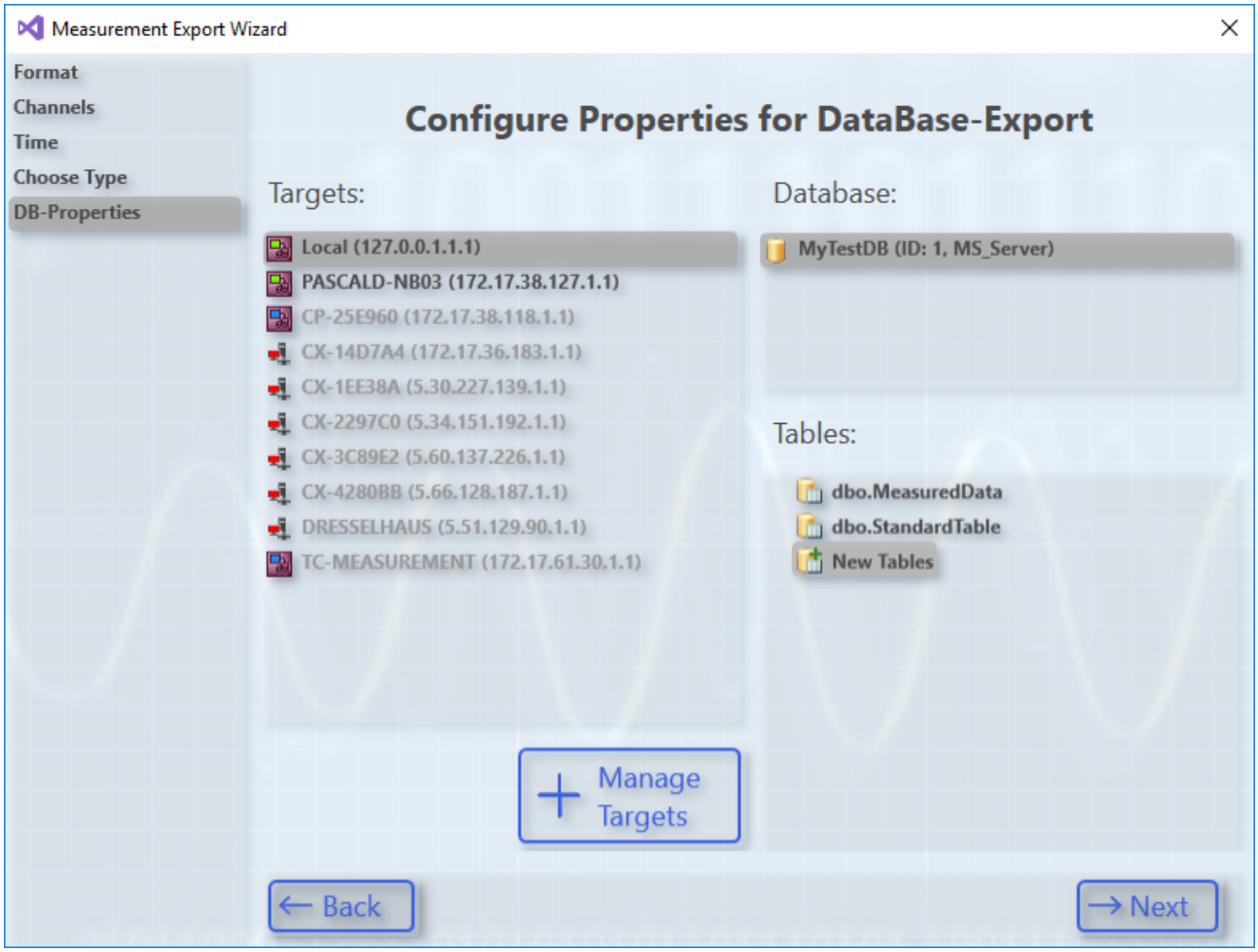


Supported SQL databases

In principle, only databases that can execute a bulk command are supported for the export. Up to now, only a Microsoft SQL connection has been implemented with version 3.4.3142.0. Regarding support of other databases via a bulk command please contact Support.

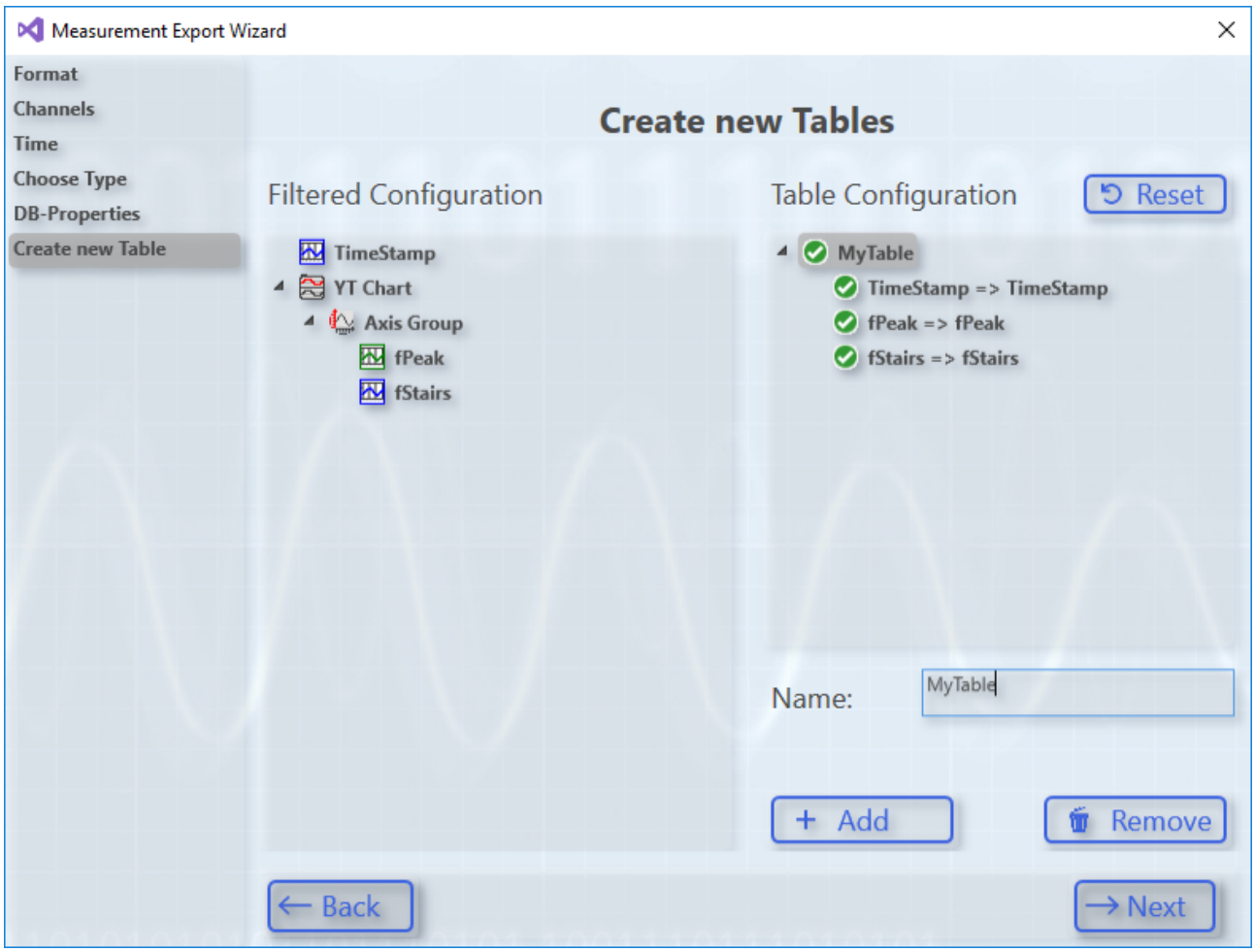


If you have chosen the second option, the TwinCAT Database Server must first be selected. This can also be located on a remote system. Subsequently, under the Database entry, select the database configured on the Database Server.



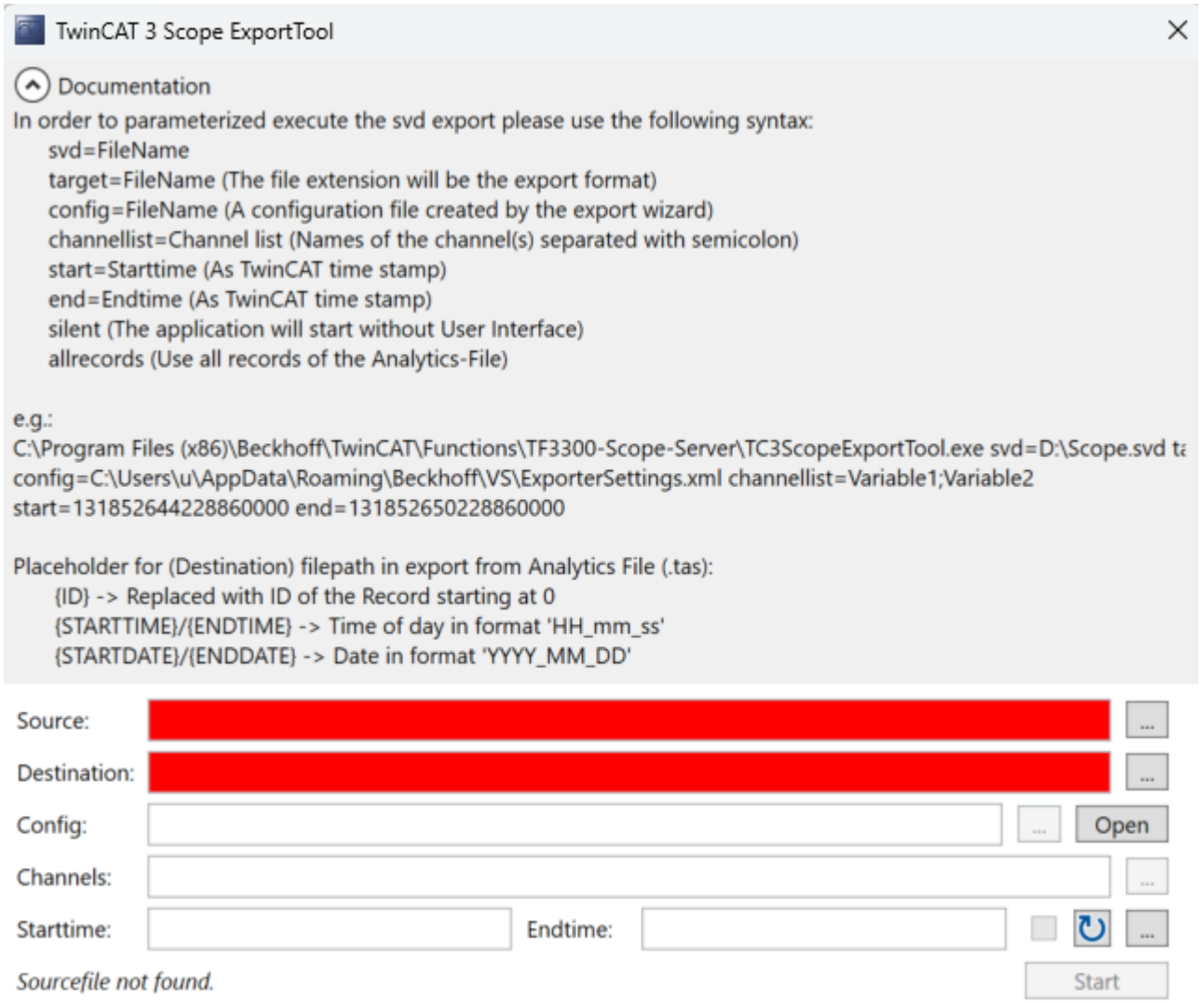
As soon as you have selected a database, the tables existing there are also displayed under Tables. You can select an existing table and map variables specifically to the existing structure or define a completely new table for this export.

The assignment takes place on the next page, to which you will also gain access if you had selected Option 1, the DB csv Export. The table names and column names can also be edited on this page. This assignment can also be reset. The timestamp is explicitly listed as a dedicated channel in the scope configuration for this type of export.



5.3.2.3.6 Automated export

Along with the Scope, the **TwinCAT 3 Scope Export Tool** is additionally installed in the TE130X Scope View and in the TF3300 Scope Server directory. This can be used to subsequently convert contents of svdx files into the supported export formats – without Visual Studio. The tool comes complete with its documentation. For the tdms and dat formats, a full View or server license is required.



The TwinCAT 3 Scope ExportTool can also be used for export via a command line call, based on specified parameters. The interface shown here can be suppressed by entering the keyword "silent" in the command line. In this case the export is executed in the background.

To automate the export, the tool can be called from the PLC via NT_StartProcess.
Code sample with fixed strings and fbStartExport as an instance of NT_StartProcess:

```
fbStartExport(
    NETID:= '',
    PATHSTR:= 'C:\Program Files (x86)\Beckhoff\TwinCAT\Functions\TF3300-Scope-
Server\TC3ScopeExportTool.exe',
    DIRNAME:= 'C:\Program Files (x86)\Beckhoff\TwinCAT\Functions\TE130x-Scope-View',
    COMNDLINE:= '"svd=c:\Scope Project.svd" target=c:\TestExport.csv silent',
    START:= bStart,
    TMOUT:= T#20S,
    BUSY=> ,
    ERR=> ,
    ERRID=> );
```

Export IoT File Arrays as Oversampling Symbols to CSV

To export an array symbol from an IoT file as an oversampling signal to a CSV file, only the array signal is selected in the signal selection.

When exporting, the oversampling signals are now saved in addition to the other signals and time stamps. Here, all signals which have the same oversampling rate and thus a new identical sampling rate are grouped and stored with the same time series.

Export IoT File Arrays as Oversampling Symbols to CSV

To export an array symbol from an IoT file as an oversampling signal to a CSV file, only the array signal is selected in the signal selection.

Separate tables are created for the different sampling rates of the selected signals. All signals with the same array length are thus grouped in a table. This means that all signals in a table have a value at any time.

If several signals with different sampling rates are selected during the export, the table name, which can be set in the configuration ("Config"), serves as the base name for the new tables. The sampling rate is appended after the base name (e.g. ExportTable_200_ms).

5.3.2.3.7 Export with images

Image data is exported using the Export Wizard.

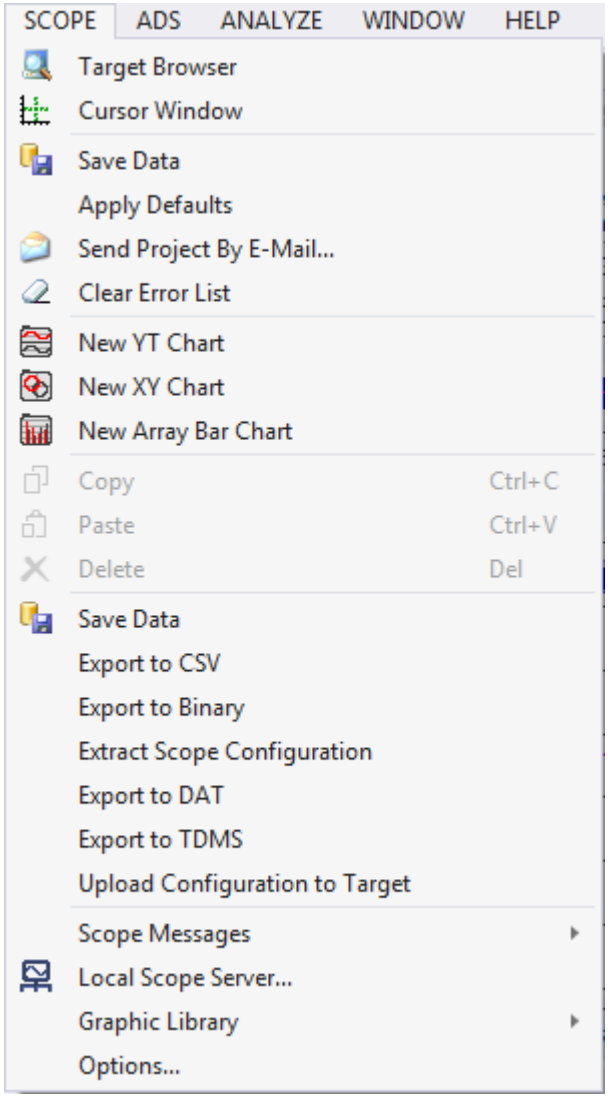
The following image export formats are available:

- SVDX
  For more information on the format see the previous section.
- JPG
  When exporting to jpg, all images in a selected period can be exported as individual images. The images of the different image members in the Scope are exported to separate folders.

5.4 Menus and options

5.4.1 Menu commands

You can select various Scope functions in the **Scope** menu. The menu will have different contents depending on the object selected in the **Solution Explorer**. (For this reason, the screenshot shown below differs from the description). You can also take the corresponding key assignments from the **Scope** menu.

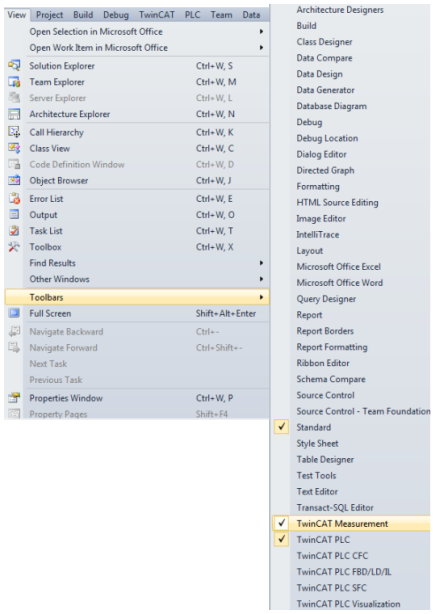

SCOPE
ADS
ANALYZE
WINDOW
HELP
Target Browser
Cursor Window
Save Data
Apply Defaults
Send Project By E-Mail...
Clear Error List
New YT Chart
New XY Chart
New Array Bar Chart
Copy Ctrl+C
Paste Ctrl+V
Delete Del
Save Data
Export to CSV
Export to Binary
Extract Scope Configuration
Export to DAT
Export to TDMS
Upload Configuration to Target
Scope Messages
Local Scope Server...
Graphic Library
Options...

Target Browser	Opens the **Target Browser**.
Cursor Window	Opens the cursor window.
Send Project By E-Mail...	Corresponds to the command **Send Project By E-Mail...** in the context menu of the Scope instance to be sent. If the Scope contains data (Scope state: replay), you can select whether the data should also be sent.
Clear error list	Deletes all entries (Error | Warning | Message) of the currently active Scope from the error list.
Change Ads Symbol...	Dialog for the replacement of character strings. The symbol names of all channels located below the selected element are edited.
Change Index Group...	Dialog for incrementing / decrementing the Index Group / Index Offset. The acquisitions of all channels located below the selected element are edited.
New YT Chart	Creates a new YT chart within the Scope.
New XY Chart	Creates a new XY chart within the Scope.
New Array Bar Chart	Creates a new array bar chart within the Scope.
New Axis	Creates a new axis within the chart. If the selected element is not a chart, then a new chart is additionally created.
New Empty Channel	Creates a new channel within the axis. If no axis is selected, then a new axis is additionally created.
Delete	Deletes the element currently selected in the Solution Explorer.
Export to CSV	Exports the data to a CSV or TXT file.
Export to Binary	Exports the data to a binary file.
Export to DAT	Exports the data to a DAT file.
Export to TDMS	Exports the data to a TDMS file.
Extract Scope Configuration	Extracts the Scope Configuration from the selected .svd file.
Upload Configuration To Target	Downloads the current configuration as a .tcscope file to a user-selected target system.
Save Data	After stopping the recording, the current data including the configuration can be saved in an .svd file. The generated Scope data file (.svd) can be added directly to the Measurement Project or saved in a directory of your choice via the directory selection dialog.
Scope Messages	Some frequently occurring message boxes in the scope are equipped with a checkbox – **Remember my answer and don't ask again!** – so that the question is not repeated the next time. This makes the handling of the program individually adjustable for each user. If a message box has been deactivated, it can be activated again here.
Local Scope Server...	Opens the configuration interface of the Scope Server.
Options...	Opens the Visual Studio Options window and selects the Scope entry.

5.4.2 Toolbar commands

The Scope recording can be started and stopped and the recorded data saved with the commands from the TwinCAT Measurement toolbar.

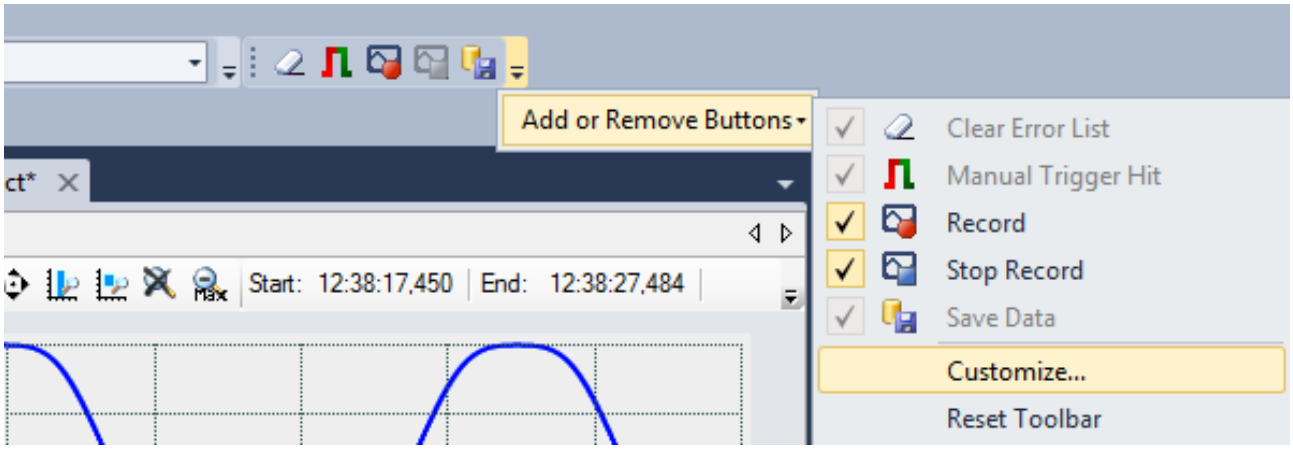
If the toolbar is not visible by default or was closed, you can call it up again via **View > Toolbars**.



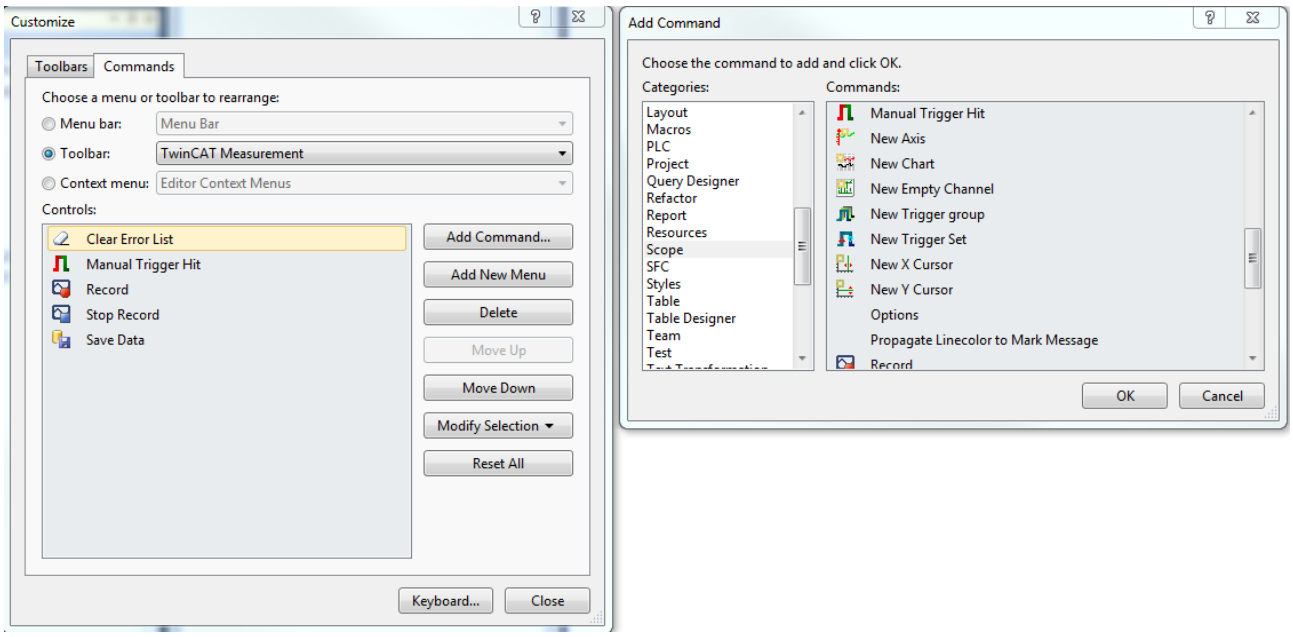
The following elements are available by default in the toolbar:

	Start Record	All required servers are called and the recording settings and connected channels are entered. If data are already present from a preceding session, then a query appears asking whether the current data should be saved. Afterwards the recording is started in accordance with the above settings. After the start it is no longer possible to change the Scope settings or acquisition or to add or remove channels.
	Stop Record	The recording is stopped. However, the recorded data remain on the connected servers and can be viewed. After stopping the recording, it is possible to change the Scope configuration. The current data will then be lost, however, if they are not saved.

You can expand the toolbar and adapt it individually as you wish. To do this, select the **Add or Remove Buttons** command in the toolbar context menu (can be displayed on the right-hand side of the toolbar) and, in the menu which then opens, select the **Customize** command. The **Customize** dialog opens.



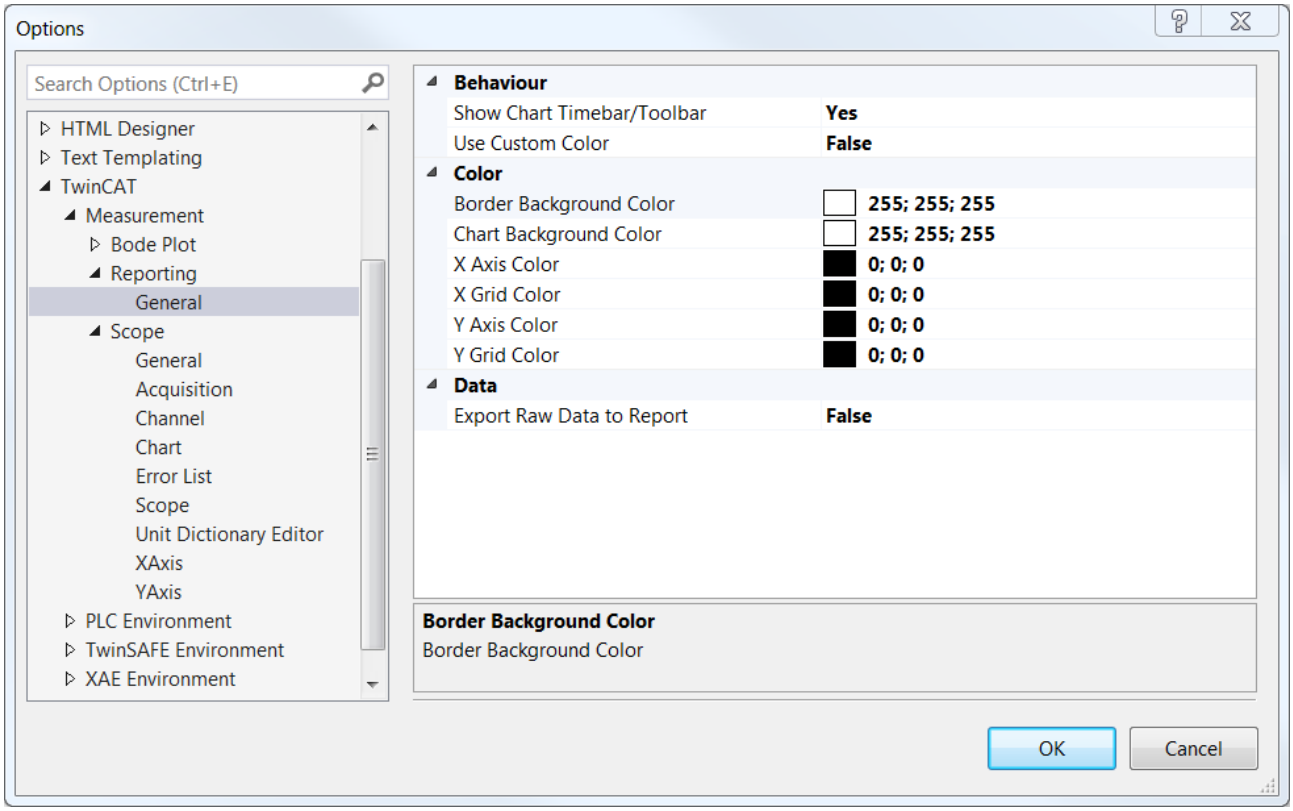
The commands belonging to the Scope can be found under **Add Command** in the **Scope** category.



5.4.3 Options

You can define the standard settings in the TwinCAT Measurement options. Open the options in Visual Studio via the **Options**… command in the **Scope** menu.

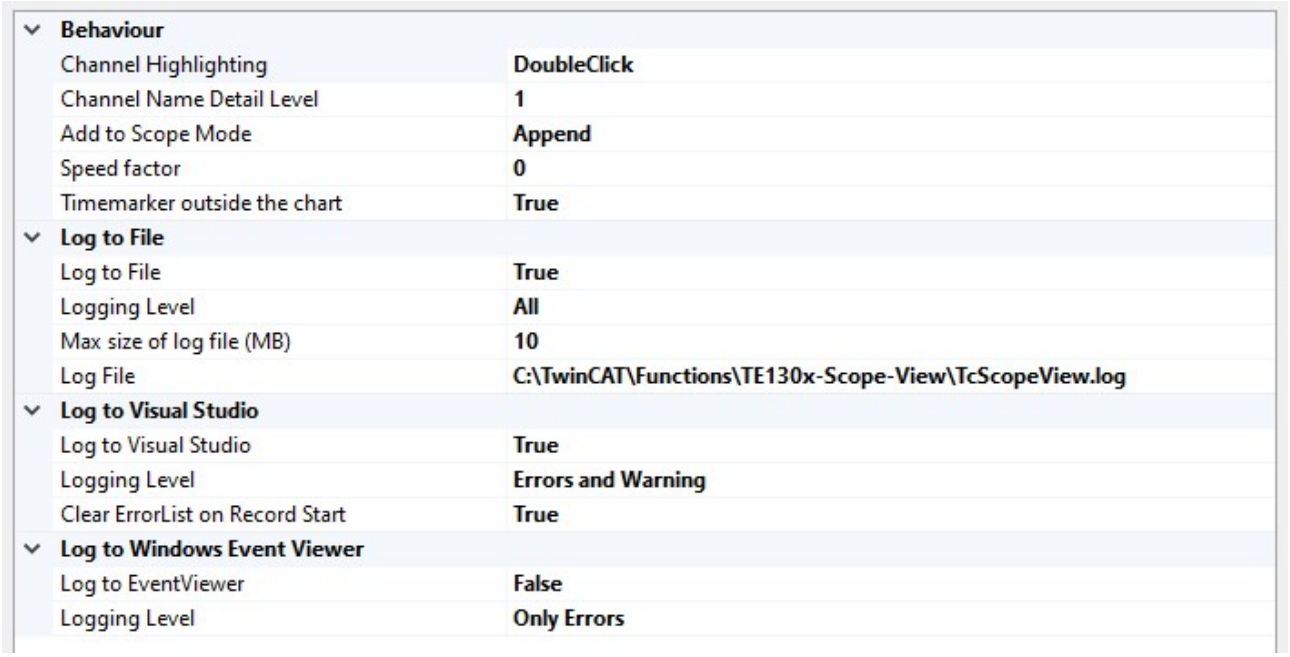
Options dialog



Reporting

General category

Show Chart Timebar/Toolbar	Specifies whether the time bar and toolbar of the Scope chart should be visible in the printing template.
Use Custom Color	TRUE: The following color settings will be applied before the chart is exported for the report. (You can select color combinations that reduce the ink consumption for printing).
Border Background Color	Color for the border of the chart
Chart Background Color	Color for the background of the chart
X-Axis Color	Color for the labeling of the X-axis
X-Axis Color	Color for the grid of the X-axis
Y-Axis Color	Color for the labeling of the Y-axis
Y-Axis Color	Color for the grid of the Y-axis
Export Raw Data to Report	Provides the raw chart data for the report. (Significantly extends the time it takes to generate a report | Only required for creating custom charts).



Scope

General	• Behaviour: general settings for the behavior of the scope • Log to File: settings for saving the events in the file format • Log to Visual Studio: settings for displaying events in the Visual Studio Error List • Log to Windows Event Viewer: settings for forwarding the events to the Windows Event Viewer • The logging level specifies the events to be processed in each case
Acquisition	Standard acquisition data (will be used if empty channels are inserted) See: Acquisition [▶ 57]
Channel	Standard channel settings (will be used if empty channels are inserted) See: YT channel style [▶ 55]
Chart	Standard chart settings (will be used if new charts are inserted) See: YT chart properties [▶ 47]
Scope	Standard Scope settings (will be used if new Scope instances are inserted) See also: Scope node [▶ 22]
Unit Dictionary Editor	The Unit Dictionary is a sort of dictionary for all unit elements. These include base units, transformations and user units. All available unit elements stored in the dictionary can be viewed with the aid of the Unit Dictionary Editor. In addition, there is an option to add new values via the editor. See: Physical units [▶ 191] and Unit Dictionary Editor [▶ 208]
X-axis	Standard axis settings for the X-axis (will be used if new axes are inserted) See: YT axis properties [▶ 51]
Y-axis	Standard axis settings for the Y-axis (will be used if new axes are inserted) See: YT axis properties [▶ 51]

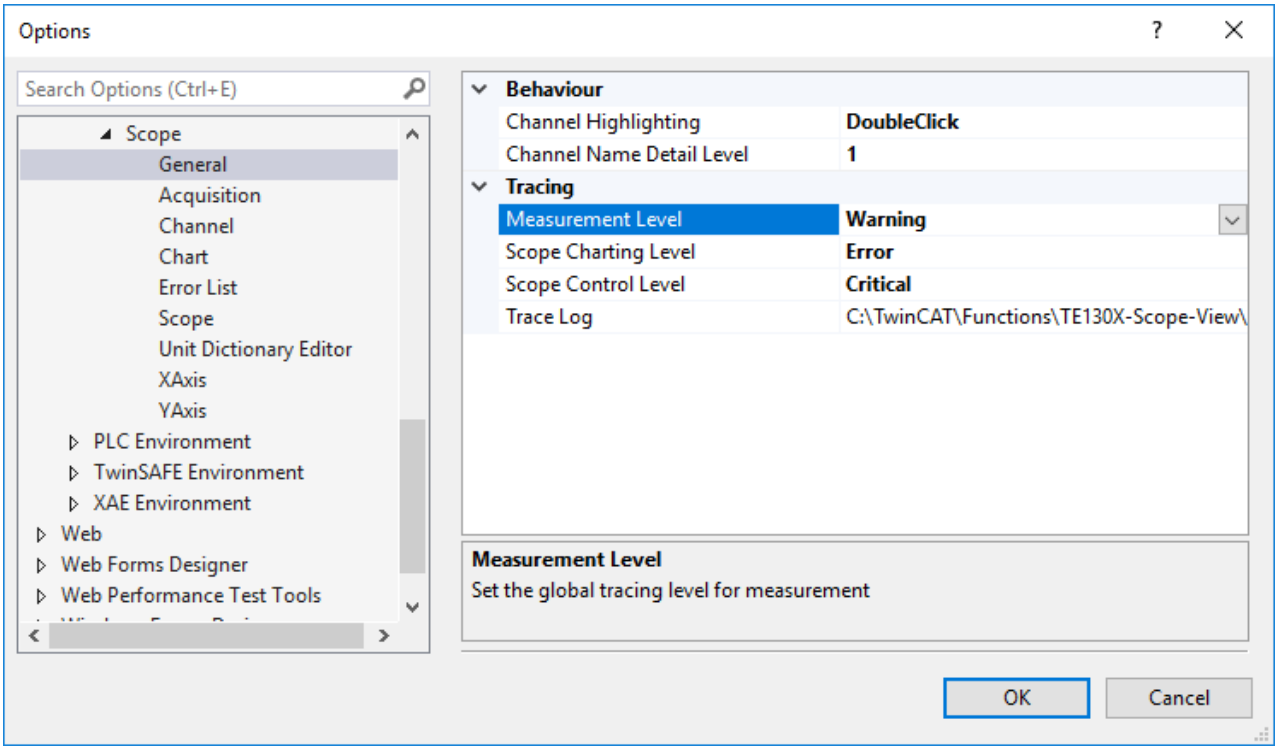
5.5 Scope Diagnostics

5.5.1 Debug messages

For a very deep diagnosis of the behavior of the TwinCAT Scope itself, debug messages can be activated in both main components, View and Server. This can take place at various levels. The messages are described in corresponding trace log files in the TwinCAT Functions directory, in each case under View and Server.

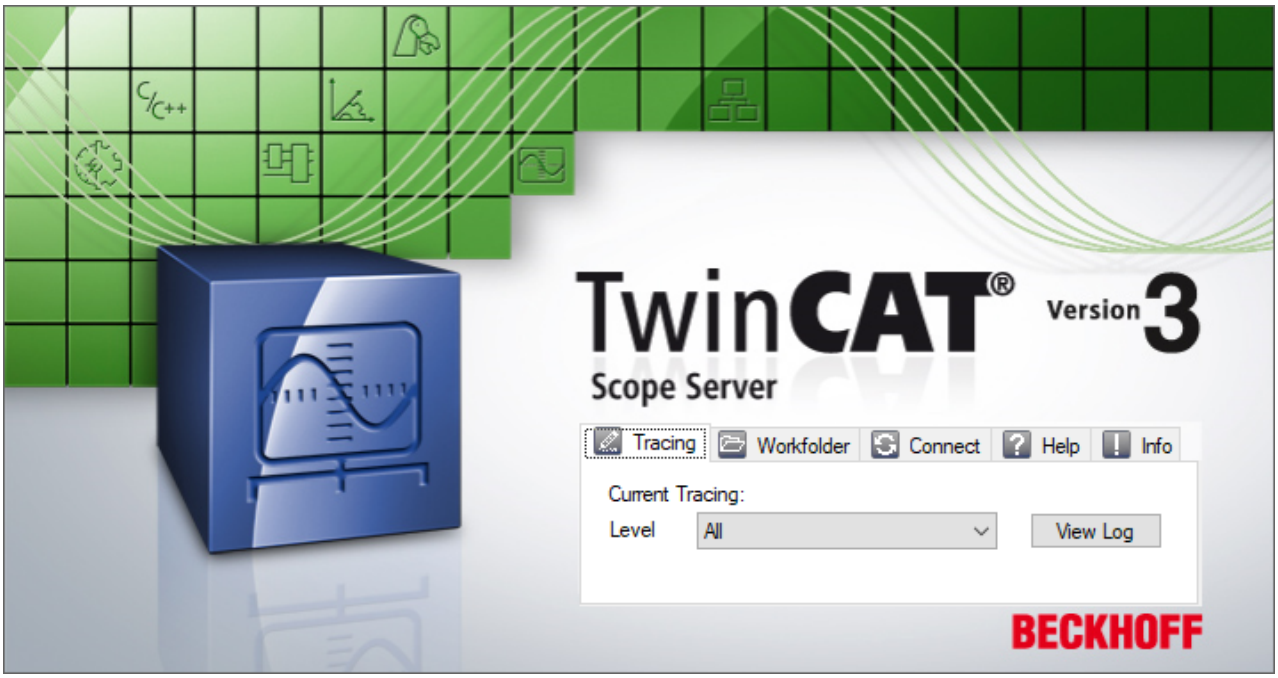
View:

In the Options [▶ 311] under General there is an option to activate a trace log for the control, the charting and the measurement. The target path is also specified and adjustable.



Server:

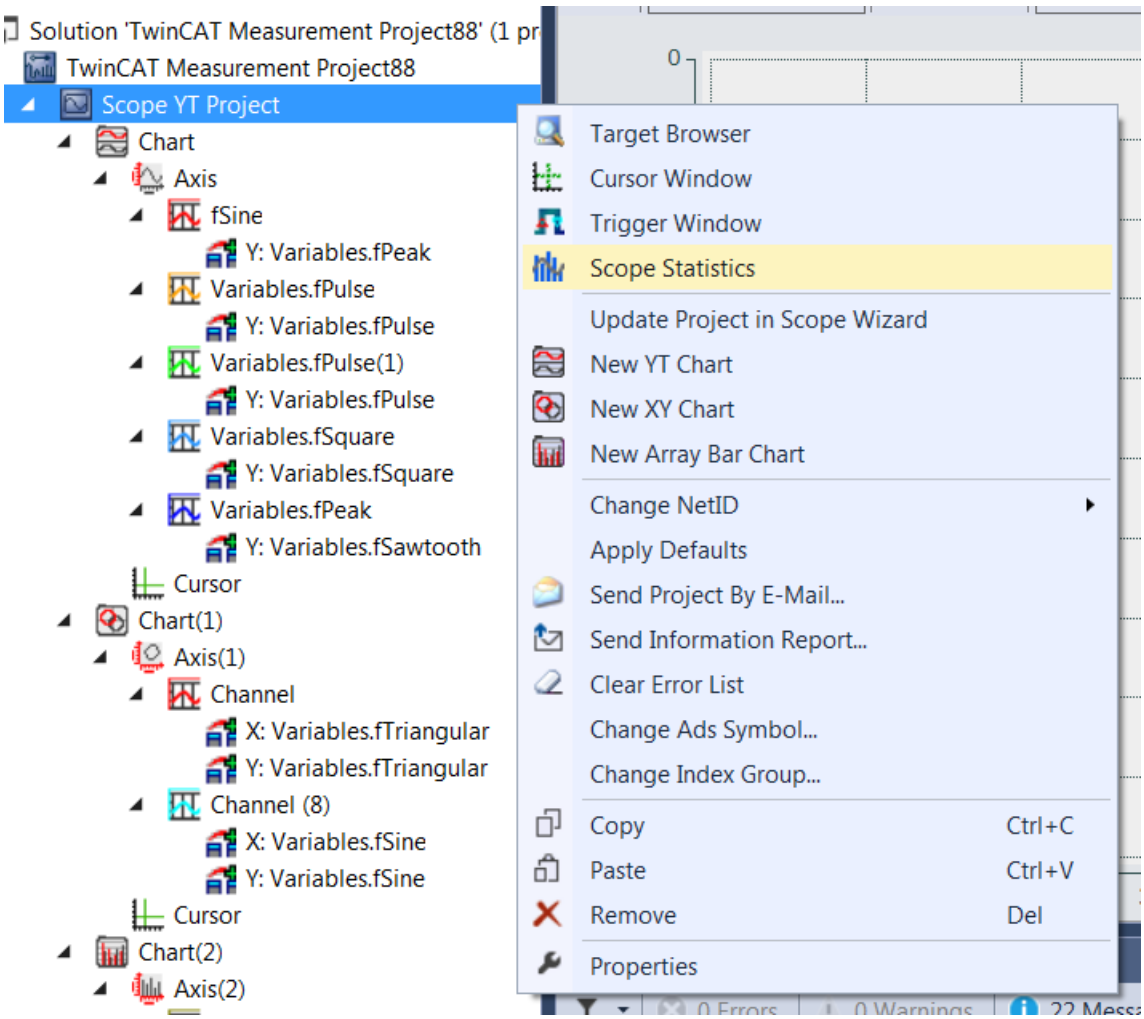
The settings for the server are to be made in the corresponding server interface. This is also described accordingly in the TF3300 documentation.



All trace logs can be sent with the Support Information Report [▶ 319].

5.5.2 Scope Statistics tool

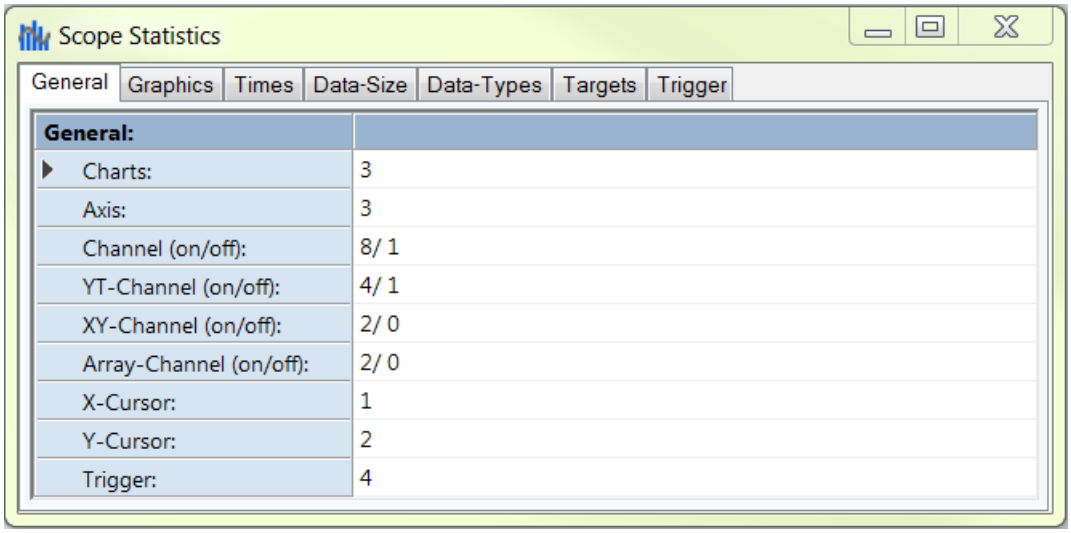
The Scope Statistics tool is used for the statistical evaluation of Scope projects. The tool is called with the **Scope Statistics** command in the context menu of the respective Scope project.



The statistics tool has seven different tabs for different topical areas.

General

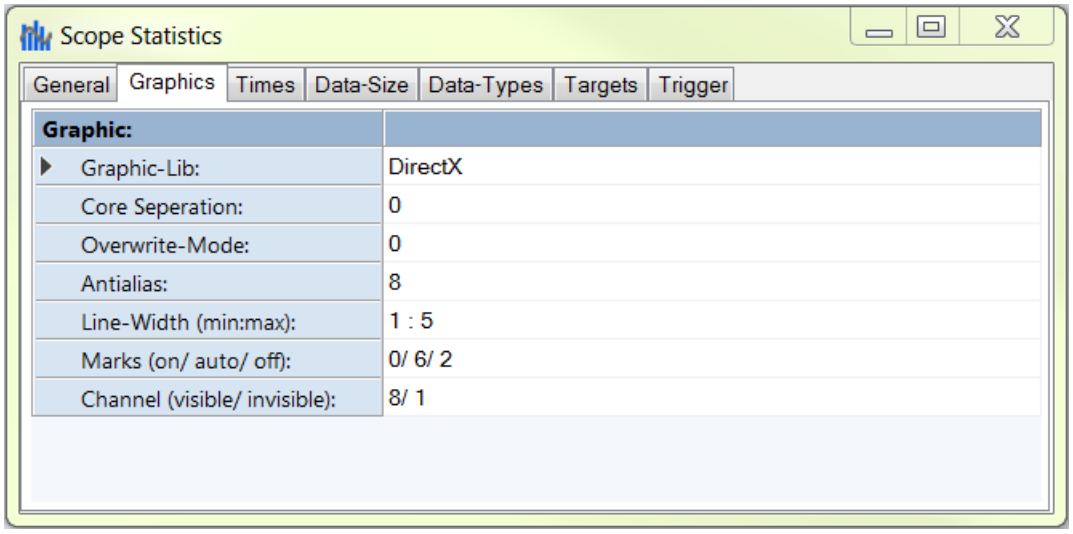
The **General** tab contains general information regarding the Scope project and provides an overview of the elements contained therein.



Charts	Number of charts in the project.
Axis	Number of axes in the project.
Channel (on/off)	Number of channels in the project that are enabled (on) or disabled (off) respectively.
YT-Channel (on/off)	Number of YT channels in the project that are enabled (on) or disabled (off) respectively.
XY-Channel (on/off)	Number of XY channels in the project that are enabled (on) or disabled (off) respectively.
Array-Channel (on/off)	Number of array channels in the project that are enabled (on) or disabled (off) respectively.
X-Cursor	Number of X cursors in the project.
Y-Cursor	Number of Y cursors in the project.
Trigger	Number of triggers in the project.

Graphics

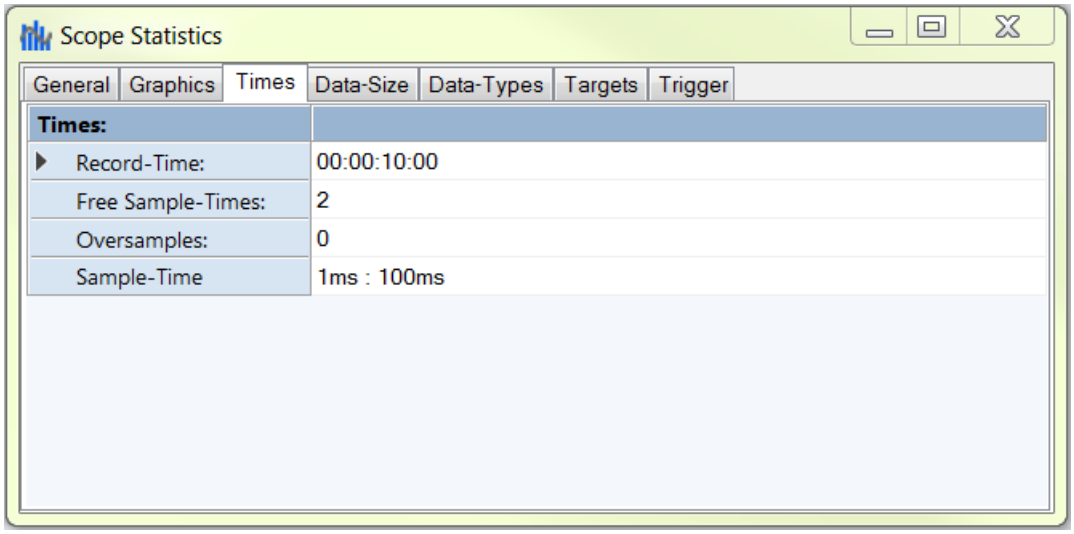
The **Graphics** tab contains information on the graphic properties of the respective project, as these affect the drawing performance.



Graphic-Lib	Graphic library currently in use.
Core Separation	Number of charts that use core separation.
Overwrite-Mode	Number of charts for which the overwrite mode is activated.
Antialias	Number of charts for which the "antialiasing" function is activated.
Line-Width (min:max)	Minimum and maximum set line width of the channels.
Marks (on/ auto/ off)	Number of channels for which the marks are activated (on), set to automatic (auto) or deactivated (off) respectively.
Channel (visible/ invisible)	Number of visible or invisible channels respectively.

Times

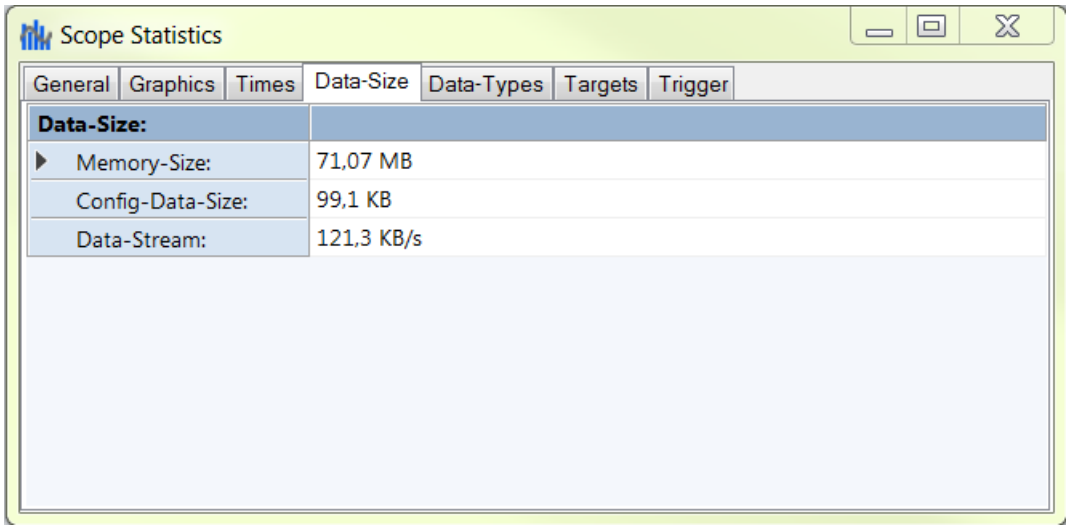
The **Times** tab provides information on the time settings of the project.



Record-Time	Set recording time of the project.
Free Sample-Times	Number of channels for which the sample state "FreeSampleTime" is set. This means that for these channels a free sampling rate has been set that is longer than the TaskSampleTime.
Oversamples	Number of channels for which oversampling is activated.
Sample-Time (min:max)	Minimum and maximum set sampling rate within the project.

Data-Size

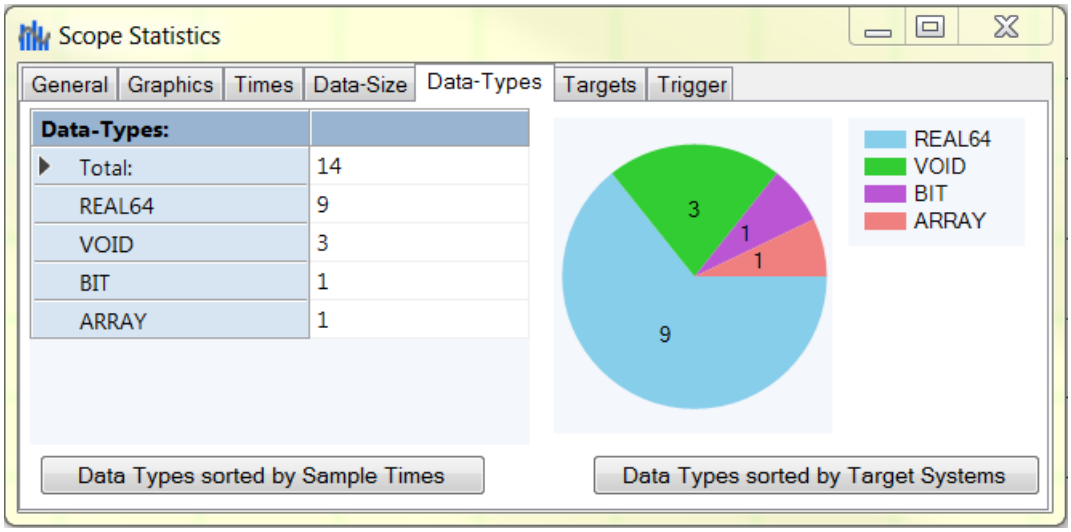
The **Data-Size** tab contains information about the memory sizes.



Memory-Size	File size of the complete recording.
Config-Data-Size	File size of the configuration file.
Data-Stream	Data stream during the recording.

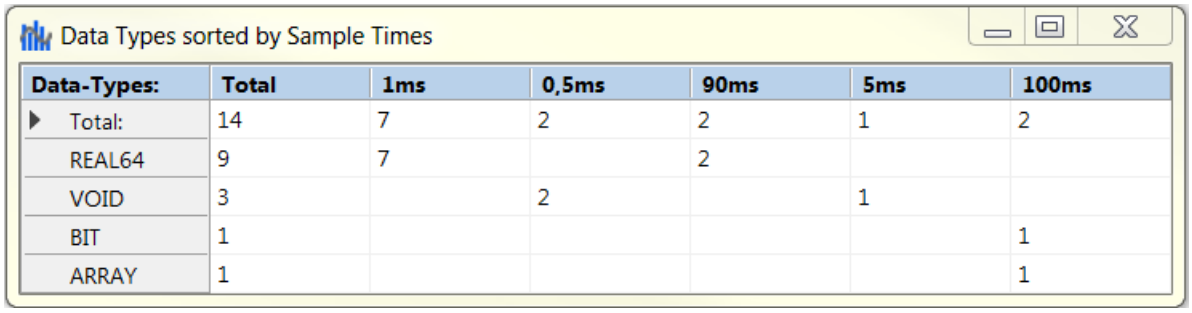
Data-Types

The **Data-Types** tab contains information about the data types within the Scope project.



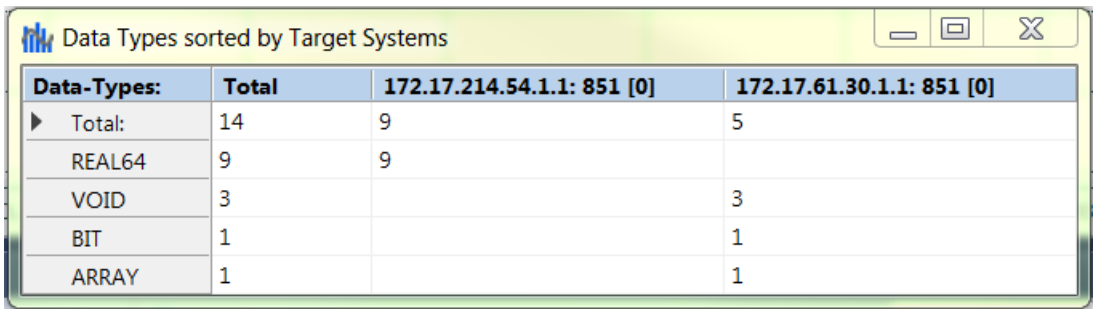
The various data types of the channel acquisition are illustrated in a table and as a pie chart. Note here that in the "ARRAY" line only the arrays of the array bar chart are listed. Other arrays, for example those used for oversampling purposes, are listed under the data types of their element.

To obtain a detailed overview, a table can be called via the **Data-Types sorted by Sample-Times** button in which the data types are listed in order of sampling rate.



Data-Types:	Total	1ms	0,5ms	90ms	5ms	100ms
Total:	14	7	2	2	1	2
REAL64	9	7		2		
VOID	3		2		1	
BIT	1					1
ARRAY	1					1

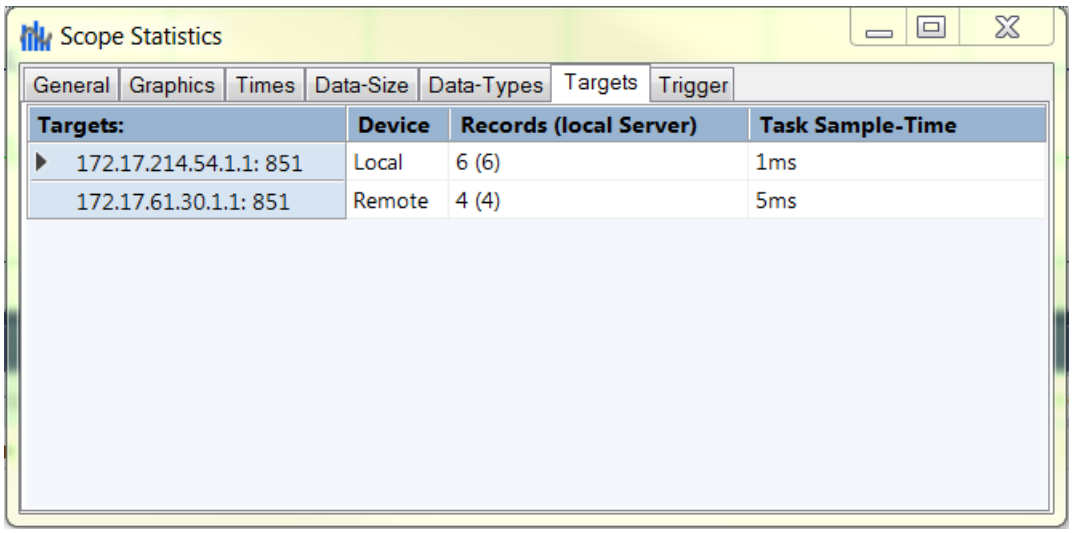
The data types sorted according to target system are illustrated in a table via the **Data-Types sorted by Target-System** button.



Data-Types:	Total	172.17.214.54.1.1: 851 [0]	172.17.61.30.1.1: 851 [0]
Total:	14	9	5
REAL64	9	9	
VOID	3		3
BIT	1		1
ARRAY	1		1

Targets

The **Targets** tab contains information on the target systems contained in the project.

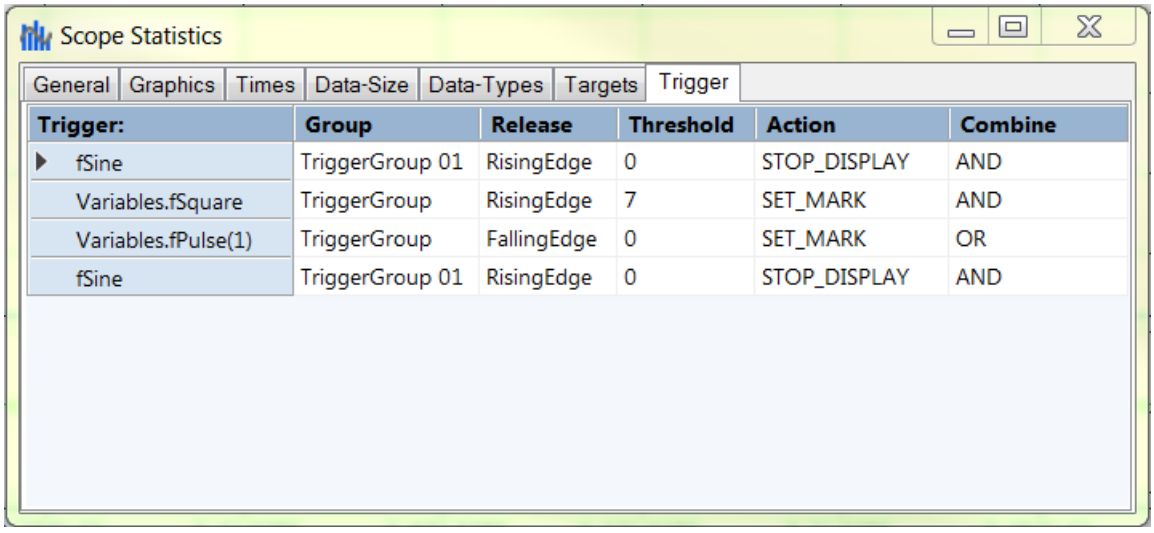


The following data are provided for each target system:

Targets	AMS-NetId and target port of the target system.
Device	Information about whether the system is a local or a remote access system.
Records (local Server)	Total number of records and the number of records on the local Scope Server.
Task Sample-Time	Task sample time for the respective target system.

Trigger

The **Trigger** tab contains information on all triggers that exist in the project.



The following data are displayed for each trigger:

Trigger	Associated channel whose state is to be tested for the selected trigger conditions.
Group	Trigger group to which the respective trigger belongs.
Release	Indicates whether the trigger condition is a rising or falling edge.
Threshold	Limit value of the trigger condition.
Action	Trigger action that is executed when it is triggered.
Combine	Selected linking options to the other trigger conditions.

5.5.3 Support Information Report

The Support Information Report is a tool for collecting product information for submission to Beckhoff technical support. Collecting product-related data such as TwinCAT version/build, product version, image version and device type reduces email traffic significantly and enables more efficient advice.

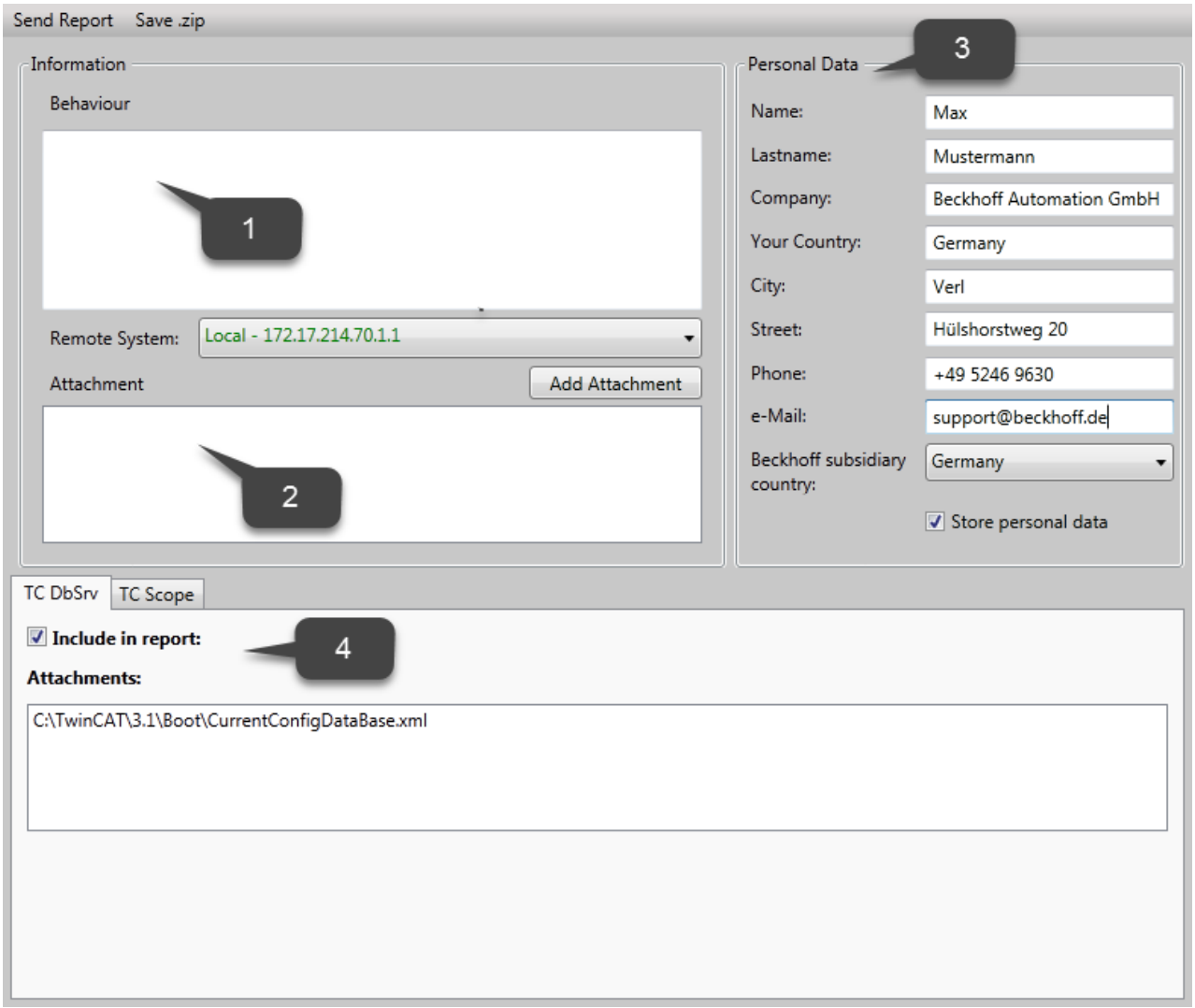
Plug-in mechanism

Various Beckhoff products interface with the Support Information Report via a plug-in mechanism. These products, such as the TwinCAT Database Server, have a Support Information Report entry in the corresponding product menu.

Creating and submitting a Support Information Report

✓ A Support Information Report is open.

1. Use the **Behaviour** text field to describe the behavior that occurred in as much detail as possible.
2. In the **Attachment** area, you can add files (screenshots etc.) to the report via the **Add Attachment** button, if required. Files can optionally be selected via remote access. To do this, select a target from the **Remote System** dropdown list. Depending on the selected target, it may be possible to browse Windows CE devices.
3. Enter your contact details and select a Beckhoff subsidiary for your country.
   This information is obligatory for submitting the Support Information Report.
4. You will be offered the option to store your contact details for future Support Information Reports. To do this, tick the **Store personal data** check box.
5. The product-specific plug-ins can be found in the lower section of the Support Information Report. Tick the **Include in report** check box. The information required for the product is added automatically, if it is available. The screenshot shows the current configuration of a TwinCAT Database Server in the form of an XML file as an example.
6. Submitting the Support Information Report:
   - If the device has an email connection, you can submit the Support Information Report directly to the Beckhoff subsidiary for your country via the **Send Report** button.
   - If the device does not have an email connection, you can save the Support Information Report locally as a .zip file via the **Save .zip** button and then make it available via FTP, USB etc.


Send Report
Save .zip
Information
Behaviour
1
Remote System:
Local - 172.17.214.70.1.1
Attachment
Add Attachment
2
Personal Data
3
Name:
Max
Lastname:
Mustermann
Company:
Beckhoff Automation GmbH
Your Country:
Germany
City:
Verl
Street:
Hülshorstweg 20
Phone:
+49 5246 9630
e-Mail:
support@beckhoff.de
Beckhoff subsidiary country:
Germany
Store personal data
TC DbSrv
TC Scope
Include in report:
4
Attachments:
C:\TwinCAT\3.1\Boot\CurrentConfigDataBase.xml

6 .NET API

If you wish use the Scope View Control in your own .NET-based HMI, the TE1300 setup must be carried out on the target system. Via the component installation you can select whether the View or even just the binaries are to be installed. Moreover, in this case the Engineering license for TE1300 has to be activated on the target system.

6.1 Comparison of integration in the two Scope versions

The differences between the old and new Scope View Control API are compared in the following comparison.

The basic methods of creating a YT chart are compared.

Loading a configuration

scopeViewControl.LoadScopeConfig(@"C:\temp\Scope YT Project.tcscope");
scopeViewControl.Operating.StartRecord();

```
//Project Panel
scopeProjectPanel.ScopeProject = ScopeProject.LoadScopeProject(@"C:\temp\YT Scope Project.svproj");
scopeProjectPanel.ScopeProject.StartRecord();
```

```
//Chart Panel
ScopeProject scopeProject = ScopeProject.LoadScopeProject(@"C:\temp\YT Scope Project.svproj");
chartPanel.ModelChart = scopeProject.SubMember.OfType<Chart>().First();
scopeProject.StartRecord();
```

The method of loading a configuration has been pulled out of the control in the new version and can be found in the ScopeProject, which can now be reached via a property in the control.

Apart from the control, which can display an entire project and displays the charts in a sanddock, there is now also an option to use a control for a single chart. This is displayed, for example, in the code under the comment "Chart Panel".

Creating a configuration in the code

```
ScopeViewControlChart chart_old       = scopeViewControl.NewChart(scopeDisplayModes.XT);
ScopeViewControlYAxis axis_old        = chart_old.NewAxis();
ScopeViewControlChannel channel_old   = axis_old.NewChannel();
```

```
ScopeProject scopeProject_new = new ScopeProject();
Chart chart_new               = new YTChart();
AxisGroup axisGroup_new       = new AxisGroup();
Channel channel_new = new Channel();
AcquisitionInterpreter acquisitionInterpreter_new = new AcquisitionInterpreter();
AdsAcquisition adsAcquisition_new = new AdsAcquisition();

scopeProject_new.AddMember(chart_new);
chart_new.AddMember(axisGroup_new);
axisGroup_new.AddMember(channel_new);
channel_new.AddMember(acquisitionInterpreter_new);
acquisitionInterpreter_new.AddMember(adsAcquisition_new);
```

The creation of a configuration in the C# code has passed from the static framework into a dynamic sequence. The methods to create a further object on the hierarchically higher object and to add it no longer exist. Now all objects can be created separately and added using the "AddMember" method.

Care should be taken here that the hierarchy is maintained as in the sample. It is possible not to create individual hierarchy steps. This will then be done automatically. (Example: adding an acquisition to an AxisGroup causes a channel and an AcquisitionInterpreter object to be created).

The objects are always added in the "SubMember" list of the superordinate object. If a search is carried out for an object later on, one can simply run recursively through the lists in order to get from the project object to the acquisition.

Adapting the style

```
channel_old.Style.ScaleFactor = 2;
channel_old.Style.Offset      = 2;
channel_old.Style.LineColor   = Color.Red;
channel_old.Style.MarkColor   = Color.DarkRed;
channel_old.Style.LineWidth   = 2;
```

```
acquisitionInterpreter_new.ScaleFactor = 2;
acquisitionInterpreter_new.Offset      = 2;
SeriesStyle seriesStyle                = channel_new.Style.SubMember.OfType<SeriesStyle>().First();
seriesStyle.DisplayColor               = Color.Green;
seriesStyle.MarkColor                  = Color.DarkRed;
seriesStyle.LineWidth                  = 2;
```

Properties that influence the values of a channel have been moved from the Channel.Style into the AcquisitionInterpreter.

Other style properties that define the style of a graph can be found in the SeriesStyle class. This class is a SubMember of the ChannelStyle class, which can in turn be found in the SubMembers of a channel.

The style classes have the following structure:

Overview of the various style hierarchies. The subordinate classes are always located in the SubMember lists of the superordinate class.

Chart

- ChartStyle (general style properties for a chart)
  - ChartZoomStyle (configuration option specifying how a chart should react to zoom functions).

AxisGroup

- AspectRatioScalingStyle (configuration option for uniform scaling between the axes)

Axis

- AxisStyle (general style properties for the axis)

Channel

- ChannelStyle (general style properties of a channel)
  - CapStyle (style properties of the Graphcaps)
  - MinMaxStyle (visibility properties of the minimum and maximum values)
  - SeriesStyle (style properties of a graph)

Adapting the acquisition

```
channel_old.Acquisition.AmsNetId      = new AmsNetId("172.17.61.30.1.1");
channel_old.Acquisition.TargetPort    = 851;
channel_old.Acquisition.IsSymbolBased = true;
channel_old.Acquisition.SymbolName    = "Variables.fSine";
channel_old.Acquisition.DataType      = Scope2DataType.REAL64;
channel_old.Acquisition.SampleTime    = (uint)TimeSpan.TicksPerMillisecond;
```

```
adsAcquisition_new.AmsNetIdString    = "172.17.61.30.1.1";
adsAcquisition_new.TargetPort        = 851;
adsAcquisition_new.IsSymbolBased     = true;
adsAcquisition_new.SymbolName        = "Variables.fSine";
adsAcquisition_new.DataType          = Scope2DataType.REAL64;
adsAcquisition_new.SampleTime        = (uint)TimeSpan.TicksPerMillisecond;
```

Nothing has changed in the configuration of the acquisition.

Controlling the recording

```
//Start Record
scopeViewControl.Operating.StartRecord();
scopeViewControl.Operating.StartAllDisplays();
//Stop Record
scopeViewControl.Operating.StopRecord();

//Save SVD
scopeViewControl.Operating.SaveData("ExportData.svd");
```

```
//Start Record
scopeProject.StartRecord();
foreach(Chart chart in scopeProject.SubMember.OfType<Chart>())
{
    chart.StartDisplay();
}

//Stop Record
scopeProject.StopRecord();

//Save SVD
scopeProject.SaveData("ExportData.svdx");
```

The functions for handling an exception have been moved from the Operating object directly into the ScopeProject class.

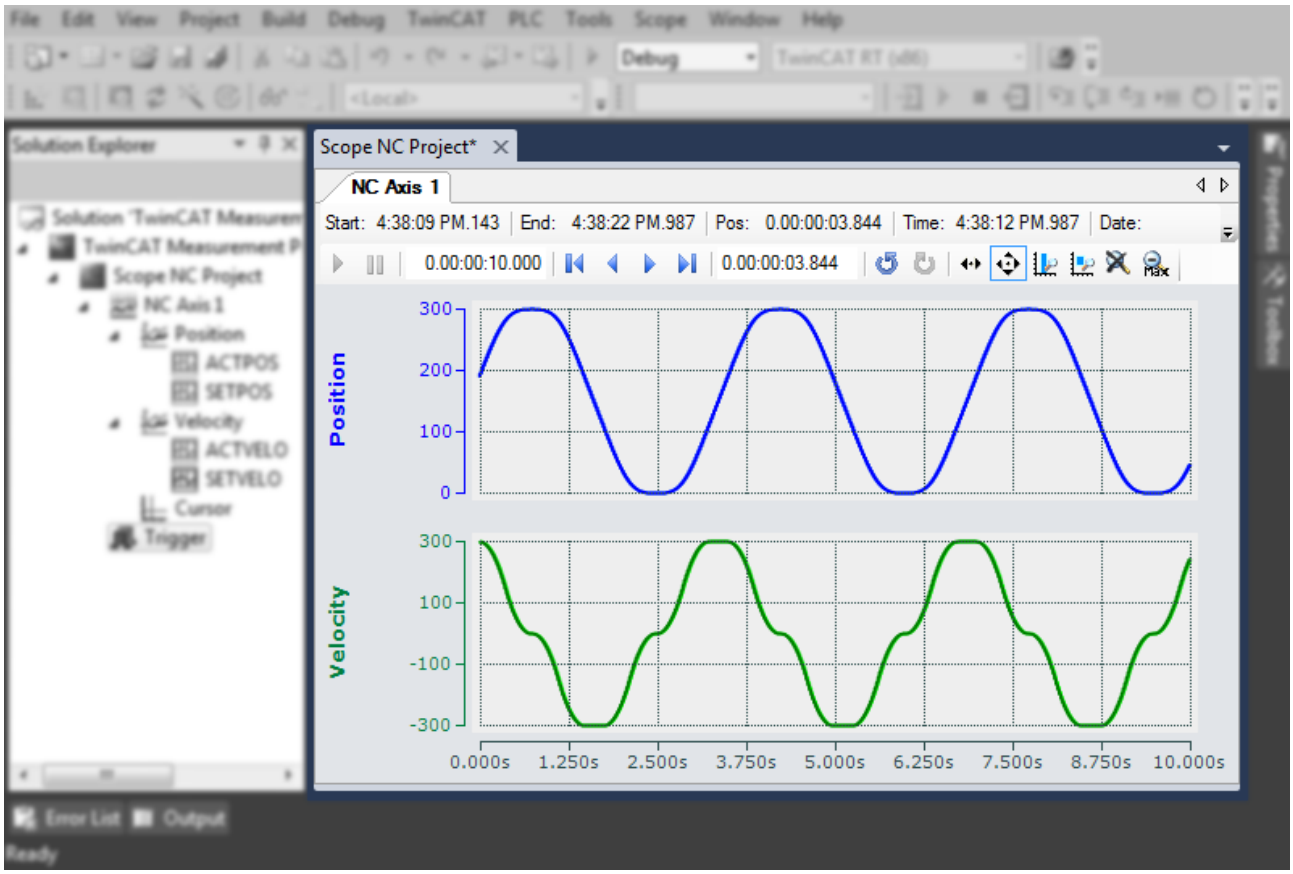
A chart is started directly via the StartDisplay method and no longer via the Operating class.

When saving, note that the extension of the new data format is "svdx" and no longer "svd".

6.2 Scope Control Integration

Integration of the ScopeViewControl in your own applications

The TwinCAT Scope consists of different components. The main components are Scope View and Scope Server. The Scope View in turn contains the ScopeProjectPanel and ChartPanel, which are usable as self-contained components for customer-specific visualizations. The ScopeViewControlXLib developed in .NET is available with the installation of TwinCAT 3.1 from version 3.3.3140. In this way simple integration is possible in C#, VB.Net or WPF applications.



Required software

The ScopeViewControl requires .NET Framework 4.5.1.

Installation of the .NET Framework 4.5.1

1. Right-click on the project and select **Properties**.
2. Under **Application**, select ".NET Framework 4.5.1" as the target framework.

⇨ The .NET Framework 4.5.1 is installed.

MS Visual Studio

In order to be able to add the panels to an existing or newly created project, use the Visual Studio Designer.

1. Open the form or the control to which a panel is to be added.
2. Right-click on a blank area in the toolbox and select **Choose Items...**.
   ⇨ A dialog opens
3. Select **Browse**.
4. Search for TwinCAT.Measurement.Scope.Control.dll in the Redist folder [▶ 325].
   (*Computer > Local Disk (C:) > TwinCAT > Functions > TE130X-Scope-View > Redist > TwinCAT.Measurement.Scope.Control*).
5. Select *TwinCAT.Measurement.Scope.Control.dll* and confirm.
   ⇨ The two controls now appear in the toolbox

ScopeProjectPanel
Provides a control that can display an entire Scope Project configuration. The charts are divided into different SandDoc pages.

ChartPanel
Provides a control that displays a chart.

6. Drag one or more panels into the designer with the mouse and position them.
   ⇨ You have added the ScopeViewControlX to a project.

If the project is now compiled, Visual Studio may report missing references to the TcAdsScope2Communications and TwinCAT.Scope2.Tools libraries. Execute the following steps:

7. Right-click on the current project in the **Solution Explorer** and select **Add Reference**.
   ⇨ A dialog opens.
8. In the **Browse** tab, select the installation path of the .NET-GAC (Global Assembly Cache).
9. Add the following libraries to the project:
   - TwinCAT.Ads.dll
   - TwinCAT.Scope2.Communications.dll
   - TwinCAT.Measurement.ProjectBase
   - TwinCAT.Measurement.Scope.API

6.2.1 Redist folder

The Redistributable folder in the Scope View folder (TwinCAT.Functions.TE130X-Scope-View) contains all libraries for the implementation of a ScopeView control in your own .NET application. All components contained here are installed by the Setup in the Global Assembly Cache (GAC) and also loaded from there when executing.

The Redist folder has the advantage that, when developing one's own applications, the referenced components and their dependents do not have to be laboriously sought in the GAC. All the files are located in this central folder so that development time is saved and unexpected version conflicts are avoided.

There are two possible scenarios for the installation of an application with Scope Control integration on another device.

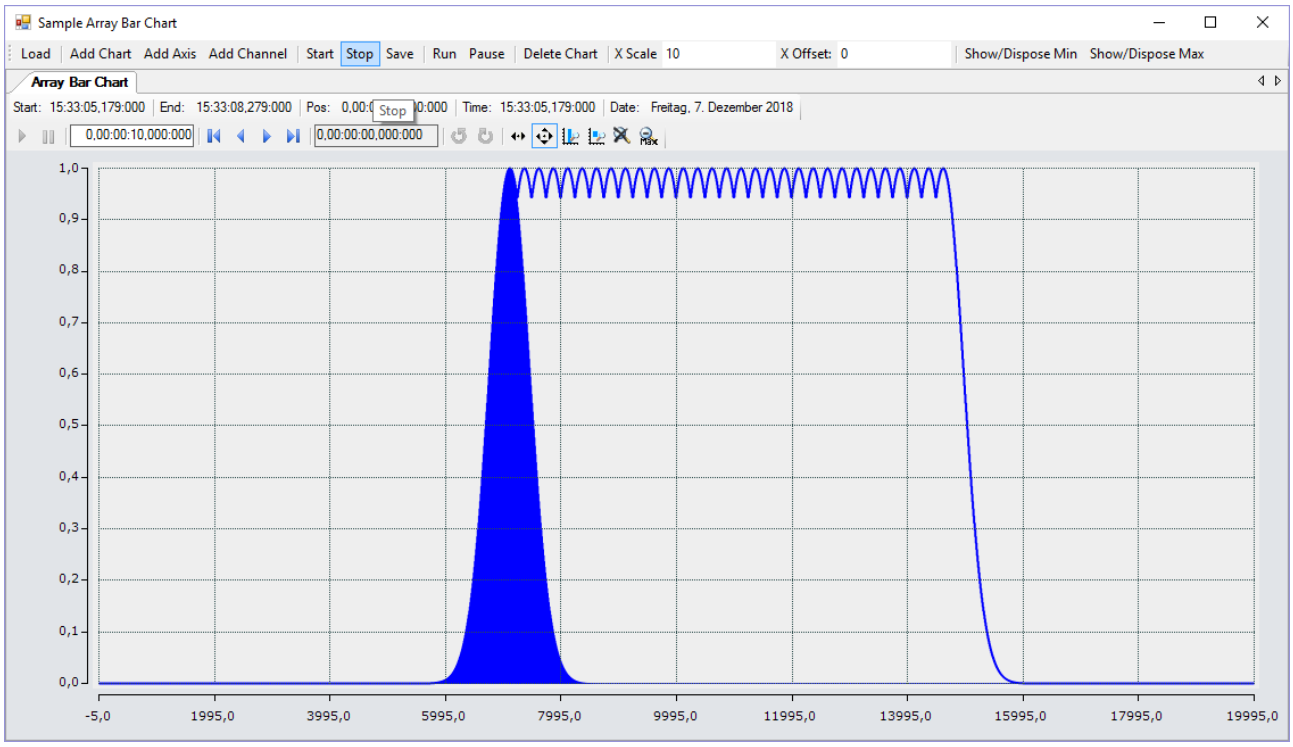
- In the ideal case the same scope version is installed on the target system as on the development system (build system). The libraries are then automatically loaded from the GAC in the correct version. Additional copying of the Redist folder is unnecessary (but is recommended, as only in this case the Scope Server is always available in the correct version).

- Only a Scope Server in the version corresponding to the Scope Control is installed on the target system.
  - Registration of the sources used on the development system in the GAC. All components in the Redist folder should be registered on the target system, irrespective of whether they are directly referenced in one's own application.
  - The libraries of the Redist folder must be placed on the executive system next to the .exe. All components in the Redist folder should be provided on the target system, irrespective of whether they are directly referenced in one's own application.

6.2.2 Sample YT chart

The application shown in the sample below serves to illustrate the main aspects of ScopeViewControl.

First, a new Windows Forms application is created. Use the toolbox to add a toolbar and the buttons shown above to the form. By double clicking, a click event handler can be created for each button, which is filled with the sample code below. Subsequently, a ScopeProjectPanel (as in this sample) or a ChartPanel is added to the form and the "Dock" property" is set to "Fill".



The sample developed here is available as a VS project: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/6515674123.zip

The sample accesses variables of the sample PLC program: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/2282225419.zip

6.2.2.1 Loading the configuration

The project, which is now executable, shows a gray surface at the start, since no configuration has been loaded or created. A configuration can either be created programmatically, or a file created with the TwinCAT Scope can be loaded. In this case, clicking on the **Load** button loads an existing configuration from a file.

The C# code sample shows the call from a "ButtonClick EventHandler":

```
private string filename = @"ScopeTestChart.tcscopex";
private void btnLoad_Click(object sender, EventArgs e)
{
  FileInfo fInfo = new FileInfo(filename);
  if (!fInfo.Exists)
  {
    MessageBox.Show("File not found! Please use the Add Chart button to create a config! Once a
```

```
config is created and saved it can be load using the Load button!", "File not found",
MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    //delete old configuration
    scopeProjectPanel.ScopeProject.Dispose();

    //load configuration
    ScopeProject Project = ScopeProject.LoadScopeProject(filename);
    scopeProjectPanel.ScopeProject = Project;
  }
}
```

The use of a ScopeProjectPanel is shown in this sample. If only a chart is to be displayed, however, then the functionality is the same, the difference being that a ChartPanel has to be created on the interface instead of the ScopeProjectPanel. Apart from that the ChartPanel class possesses no ScopeProject object, only a Chart object. Therefore, instead of this line:

```
scopeProjectPanel.ScopeProject = Project;
```

the following code must be created:

```
chartPanel.ModelChart = Project.SubMember.OfType<Chart>().First();
```

6.2.2.2 Adding elements

All hierarchical elements that can be found in the TwinCAT Scope in the Solution Explorer can also be added in the code during the integration. A hierarchical element is structured in such a way that it possesses a "SubMember" list, through which it is possible to iterate. Further objects can be added with "AddMember".

If the new object is not added to an object located directly above it, then everything is re-created by the adding object until the object to be added can be integrated into the hierarchy. However, care must be taken that a YT chart is always created as the standard chart type.

The fundamental hierarchy in the scope looks like this:

ScopeProject

┗┓ DataPool

┃ ┗ Acquisition

┣┓ Chart

┃ ┗┓ AxisGroup

┃ ┣┓ MarkerContainer

┃ ┃ ┗ Marker

┃ ┣┓ Axes

┃ ┗┓ Channels

┃ ┗ AcquisitionInterpreter

… further charts

Charts:

The chart is the environment, in which the graph with the coordinate system appears. The chart thus represents the base frame and must be created first.

```
private void btnAddChart_Click(object sender, EventArgs e)
{
  YTChart chart = new YTChart();
  scopeProjectPanel.ScopeProject.AddMember(chart);
  chart.SubMember.OfType<ChartStyle>().First().ToolTipEnabled = true;
}
```

Axes:

The AxisGroup contains firstly the axes, which ensure the correct scaling of the values, and secondly the channels that are displayed in the chart.

If the AxisGroup is now added to the chart, the axis objects are created automatically.

```
private void btnAddAxis_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().AddMember(new AxisGroup());
  }
}
```

Channels:

The channel contains all the information on the data that are recorded in the Scope and is attached under the axis group in which these values are to be shown.

```
private void btnAddChannel_Click(object sender, EventArgs e)
{
  Channel channel = new Channel();
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else if
(scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGroup>().Coun
t() == 0)
  {
    MessageBox.Show(this, "Please create a axis first!", "No axis connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGroup>().F
irst().AddMember(channel);
    ChangeChannelSettings(channel);
    SetAcquisitions(channel);
  }
}
```

6.2.2.3 Adapting the styles

Each of the elements created has "Style" properties as a sub-member, containing all the properties that can also be seen in the corresponding properties window in Visual Studio. For example, color and line width can be assigned in the style classes of a channel.

```
private void ChangeChannelSettings(Channel channel)
{
  SeriesStyle style =
channel.SubMember.OfType<ChannelStyle>().First().SubMember.OfType<SeriesStyle>().First();
  style.DisplayColor = Color.Red;
  style.MarkColor = Color.DarkRed;
  style.LineWidth = 2;
}
```

Overview of the various style hierarchies. The subordinate classes are always located in the SubMember lists of the superordinate class.

Chart

- ChartStyle (general style properties for a chart)
  - ChartZoomStyle (configuration option specifying how a chart should react to zoom functions).

AxisGroup

- AspectRatioScalingStyle (configuration option for uniform scaling between the axes)

Axis

- AxisStyle (general style properties for the axis)

Channel

- ChannelStyle (general style properties of a channel)
  - CapStyle (style properties of the Graphcaps)
  - MinMaxStyle (visibility properties of the minimum and maximum values)
  - SeriesStyle (style properties of a graph)

6.2.2.4 Adaptation of the acquisition data

The acquisition class of a channel describes the connection between the scope and the respective value of the machine controller. Therefore, for example, the name and size of a variable are expected at this point.

The acquisition object is hierarchically positioned below an AcquisitionInterpreter, which possesses further variable-independent information. Furthermore, the AcquisitionInterpreter is a member of a channel and, depending on the chart type, a channel may contain several AcquisitionInterpreters for the various axes. An acquisition can be appended directly to a channel as in the sample and the interpreter is automatically generated.

```
private void SetAcquisitions(Channel channel)
{
  AdsAcquisition acq = new AdsAcquisition();
  acq.AmsNetIdExchange = "localhost";
  acq.TargetPort = 851;
  acq.IsSymbolBased = true;
  acq.SymbolName = "Variables.fSine";
  acq.DataType = Scope2DataType.REAL64;
  acq.SampleTime = (uint)(10 * TimeSpan.TicksPerMillisecond);
  AcquisitionInterpreter acquisitionInterpreter = new AcquisitionInterpreter();
  acquisitionInterpreter.Acquisition = acq;
  channel.AddMember(acquisitionInterpreter);
}
```

6.2.2.5 Controlling the recording

Recording settings or methods of starting and stopping the recording and also saving the values are contained in the ScopeProject class, which was already created in the first step.

In order to start a recording you should first check whether data still exist. If so they can be deleted with Disconnect. After that the recording can be started in the ScopeProject with the "StartRecord" method.

```
private void btnStart_Click(object sender, EventArgs e)
{
  try
  {
    //discard old data
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
      scopeProjectPanel.ScopeProject.Disconnect(false);

    //start record
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Config)
      scopeProjectPanel.ScopeProject.StartRecord();
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on start record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

To stop a recording the "StopRecord" method is called on the ScopeProject. Before executing this method it is also possible to check whether a recording is running. If this is the case the ScopeState in the ScopeProject will indicate Record.

```
private void btnStop_Click(object sender, EventArgs e)
{
  try
  {
```

```
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on stop record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

Before closing the application, a running recording should be stopped first and the application should be cleanly disconnected from the Scope server.

```
private void Form1_FormClosing(object sender, FormClosingEventArgs e)
{
  if (scopeProjectPanel != null && scopeProjectPanel.ScopeProject != null)
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      scopeProjectPanel.ScopeProject.Disconnect();
    }
  }
}
```

6.2.2.6 Save configuration / recording

There are two possibilities to save:

- Saving the recorded data in a .svdx file
- Creating a configuration file (.tcscopex)

The difference is that the .svdx file can be opened in any TwinCAT 3 Scope View, in order to display the measured data. The .tcscopex file, on the other hand, only contains the configuration, without measured data. It can be used to start new recordings, as required.

```
private void btnSave_Click(object sender, EventArgs e)
{
  try
  {
    //save data and configuration
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      File.Create("ExportData.svdx").Close();
      scopeProjectPanel.ScopeProject.SaveData("ExportData.svdx");
    }
    //just save the configuration
    else
    {
      File.Create(filename).Close();
      scopeProjectPanel.ScopeProject.SaveToFile(filename);
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on save!",MessageBoxButtons.OK, MessageBoxIcon.Error);
  }
}
```

6.2.2.7 Controlling a chart

So that the toolbar and the time bar do not have to be shown permanently in the integration, it is possible to control the functions directly via the chart objects.

Since these functions can only be used in recording mode, the system checks whether signals are currently being recorded.
This can be started with the StartDisplay method of the chart. The display can be paused with the StopDisplay method. The recording continues in the background. This is apparent if the Overview chart is active, for example.

Before the chart is deleted, the system checks whether a chart is open in the display. It then checks whether recording is active. If this is the case, the current recording is stopped. Using the Disconnect method the graph can be deleted from the chart and the chart can then be deleted from the project using the RemoveMember method.

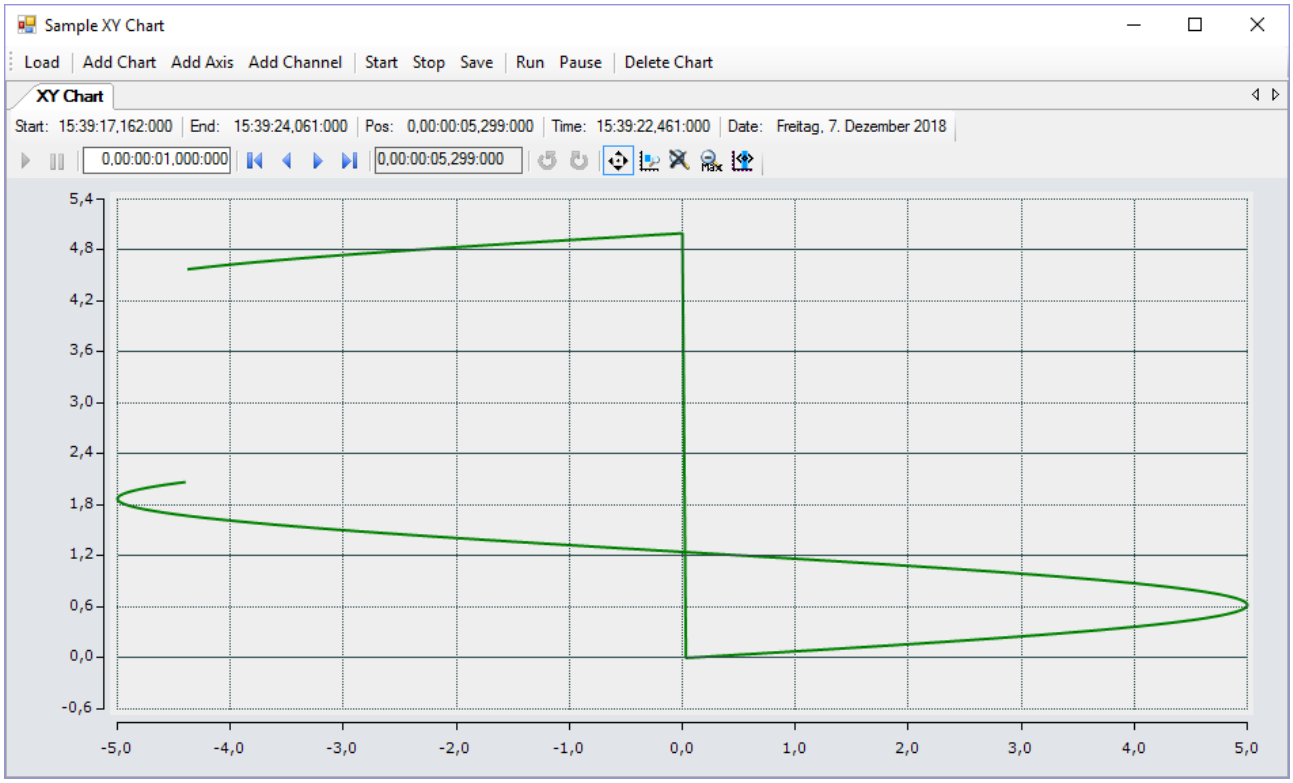
```
private void btnRun_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Run not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StartDisplay();
}
private void btnPause_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Pause not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StopDisplay();
}

private void btnDelChart_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "No chart is connected!", "Nothing to delete!",MessageBoxButtons.OK,
MessageBoxIcon.Exclamation);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    scopeProjectPanel.ScopeProject.StopRecord();
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
  {
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else
  {
    scopeProjectPanel.ScopeProject.RemoveMember(scopeProjectPanel.ScopeProject.SubMember.OfType<Char
t>().First());
  }
}
```

6.2.3 Sample XY chart

The application shown in the sample below serves to illustrate the main aspects of ScopeViewControl.

First, a new Windows Forms application is created. Use the toolbox to add a toolbar and the buttons shown above to the form. By double clicking, a click event handler can be created for each button, which is filled with the sample code below. Subsequently, a ScopeProjectPanel (as in this sample) or a ChartPanel is added to the form and the "Dock" property" is set to "Fill".



The sample developed here is available as a VS project: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/6515672459.zip

The sample accesses variables of the sample PLC program: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/2282225419.zip

6.2.3.1 Loading the configuration

The project, which is now executable, shows a gray surface at the start, since no configuration has been loaded or created. A configuration can either be created programmatically, or a file created with the TwinCAT Scope can be loaded. In this case, clicking on the **Load** button loads an existing configuration from a file.

The C# code sample shows the call from a "ButtonClick EventHandler":

```
private string filename = @"ScopeTestChart.tcscopex";
private void btnLoad_Click(object sender, EventArgs e)
{
  FileInfo fInfo = new FileInfo(filename);
  if (!fInfo.Exists)
  {
    MessageBox.Show("File not found! Please use the Add Chart button to create a config! Once a
config is created and saved it can be load using the Load button!", "File not found",
MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    //delete old configuration
    scopeProjectPanel.ScopeProject.Dispose();

    //load configuration
    ScopeProject Project = ScopeProject.LoadScopeProject(filename);
    scopeProjectPanel.ScopeProject = Project;
  }
}
```

The use of a ScopeProjectPanel is shown in this sample. If only a chart is to be displayed, however, then the functionality is the same, the difference being that a ChartPanel has to be created on the interface instead of the ScopeProjectPanel. Apart from that the ChartPanel class possesses no ScopeProject object, only a Chart object. Therefore, instead of this line:

```
scopeProjectPanel.ScopeProject = Project;
```

the following code must be created:

```
chartPanel.ModelChart = Project.SubMember.OfType<Chart>().First();
```

6.2.3.2 Adding elements

```
private void btnAddChart_Click(object sender, EventArgs e)
{
  XYChart chart = new XYChart();
  ChartStyle chartStyle = new ChartStyle();
  chartStyle.ToolTipEnabled = true;
  chart.AddMember(chartStyle);
  scopeProjectPanel.ScopeProject.AddMember(chart);
}
```

```
private void btnAddAxis_Click(object sender, EventArgs e)
{
  AxisGroup axisGroup = new AxisGroup();
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().AddMember(axisGroup);
  }
}
```

```
private void btnAddChannel_Click(object sender, EventArgs e)
{
  Channel channel = new Channel();
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else if
(scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGroup>().Coun
t() == 0)
  {
    MessageBox.Show(this, "Please create a axis first!", "No axis connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGroup>().F
irst().AddMember(channel);
    ChangeChannelSettings(channel);
    SetAcquisitions(channel);
  }

}
```

All hierarchical elements that can be found in the TwinCAT Scope in the Solution Explorer can also be added in the code during the integration. A hierarchical element is structured in such a way that it possesses a "SubMember" list, through which it is possible to iterate. Further objects can be added with "AddMember".

If the new object is not added to an object located directly above it, then everything is re-created by the adding object until the object to be added can be integrated into the hierarchy. However, care must be taken that a YT chart is always created as the standard chart type.

The fundamental hierarchy in the scope looks like this:

ScopeProject

└┬ DataPool

│└ Acquisition

└┬ Chart

│└┬ AxisGroup

│ └┬ MarkerContainer

Marker

Axes

Channels

AcquisitionInterpreter

… further charts

Charts:

The chart is the environment, in which the graph with the coordinate system appears. The chart thus represents the base frame and must be created first.

Axes:

The AxisGroup contains firstly the axes, which ensure the correct scaling of the values, and secondly the channels that are displayed in the chart.

If the AxisGroup is now added to the chart, the axis objects are created automatically.

Channels:

The channel contains all the information on the data that are recorded in the Scope and is attached under the axis group in which these values are to be shown.

6.2.3.3 Adapting the styles

```
private void ChangeChannelSettings(Channel channel)
{
  SeriesStyle seriesStyle =
  channel.SubMember.OfType<ChannelStyle>().First().SubMember.OfType<SeriesStyle>().First();
  seriesStyle.DisplayColor = Color.Green;
  seriesStyle.MarkColor = Color.DarkGreen;
  seriesStyle.LineWidth = 2;
}
```

Each of the elements created has "Style" properties as a sub-member, containing all the properties that can also be seen in the corresponding properties window in Visual Studio. For example, color and line width can be assigned in the style classes of a channel.

Overview of the various style hierarchies. The subordinate classes are always located in the SubMember lists of the superordinate class.

Chart

- ChartStyle (general style properties for a chart)
  - ChartZoomStyle (configuration option specifying how a chart should react to zoom functions).

AxisGroup

- AspectRatioScalingStyle (configuration option for uniform scaling between the axes)

Axis

- AxisStyle (general style properties for the axis)

Channel

- ChannelStyle (general style properties of a channel)
  - CapStyle (style properties of the Graphcaps)
  - MinMaxStyle (visibility properties of the minimum and maximum values)
  - SeriesStyle (style properties of a graph)

6.2.3.4 Adaptation of the acquisition data

```
private void SetAcquisitions(Channel channel)
{
  AdsAcquisition xAcquisition = new AdsAcquisition();
```

```
  xAcquisition.AmsNetIdExchange = "localhost";
  xAcquisition.TargetPort = 851;
  xAcquisition.IsSymbolBased = true;
  xAcquisition.SymbolName = "Variables.aBufferSine[1]";
  xAcquisition.DataType = Scope2DataType.REAL64;
  xAcquisition.SampleTime = (uint)(1 *   TimeSpan.TicksPerMillisecond);
  channel.AddMember(xAcquisition);

  AdsAcquisition yAcquisition = new AdsAcquisition();
  yAcquisition.AmsNetIdExchange = "localhost";
  yAcquisition.TargetPort = 851;
  yAcquisition.IsSymbolBased = true;
  yAcquisition.SymbolName = "Variables.aBufferSawtooth[1]";
  yAcquisition.DataType = Scope2DataType.REAL64;
  yAcquisition.SampleTime = (uint)(1 *   TimeSpan.TicksPerMillisecond);
  channel.AddMember(yAcquisition);
}
```

The acquisition class of a channel describes the connection between the scope and the respective value of the machine controller. Therefore, for example, the name and size of a variable are expected at this point.

The acquisition object is hierarchically positioned below an AcquisitionInterpreter, which possesses further variable-independent information. Furthermore, the AcquisitionInterpreter is a member of a channel and, depending on the chart type, a channel may contain several AcquisitionInterpreters for the various axes. An acquisition can be appended directly to a channel as in the sample and the interpreter is automatically generated.

6.2.3.5 Adapting the recording

Recording settings or methods of starting and stopping the recording and also saving the values are contained in the ScopeProject class, which was already created in the first step.

In order to start a recording you should first check whether data still exist. If so they can be deleted with Disconnect. After that the recording can be started in the ScopeProject with the "StartRecord" method.

```
private void btnStart_Click(object sender, EventArgs e)
{
  try
  {
    //discard old data
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
      scopeProjectPanel.ScopeProject.Disconnect(false);

    //start record
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Config)
      scopeProjectPanel.ScopeProject.StartRecord();
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on start record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

To stop a recording the "StopRecord" method is called on the ScopeProject. Before executing this method it is also possible to check whether a recording is running. If this is the case the ScopeState in the ScopeProject will indicate Record.

```
private void btnStop_Click(object sender, EventArgs e)
{
  try
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on stop record!",MessageBoxButtons.OK,
```

```
MessageBoxIcon.Error);
  }
}
```

Before closing the application, a running recording should be stopped first and the application should be cleanly disconnected from the Scope server.

```
private void Form1_FormClosing(object sender, FormClosingEventArgs e)
{
  if (scopeProjectPanel != null && scopeProjectPanel.ScopeProject != null)
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      scopeProjectPanel.ScopeProject.Disconnect();
    }
  }
}
```

6.2.3.6 Save configuration / recording

There are two possibilities to save:

- Saving the recorded data in a .svdx file
- Creating a configuration file (.tcscopex)

The difference is that the .svdx file can be opened in any TwinCAT 3 Scope View, in order to display the measured data. The .tcscopex file, on the other hand, only contains the configuration, without measured data. It can be used to start new recordings, as required.

```
private void btnSave_Click(object sender, EventArgs e)
{
  try
  {
    //save data and configuration
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      File.Create("ExportData.svdx").Close();
      scopeProjectPanel.ScopeProject.SaveData("ExportData.svdx");
    }
    //just save the configuration
    else
    {
      File.Create(filename).Close();
      scopeProjectPanel.ScopeProject.SaveToFile(filename);
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on save!",MessageBoxButtons.OK, MessageBoxIcon.Error);
  }
}
```

6.2.3.7 Controlling a chart

So that the toolbar and the time bar do not have to be shown permanently in the integration, it is possible to control the functions directly via the chart objects.

Since these functions can only be used in recording mode, the system checks whether signals are currently being recorded.
This can be started with the StartDisplay method of the chart. The display can be paused with the StopDisplay method. The recording continues in the background. This is apparent if the Overview chart is active, for example.

Before the chart is deleted, the system checks whether a chart is open in the display. It then checks whether recording is active. If this is the case, the current recording is stopped. Using the Disconnect method the graph can be deleted from the chart and the chart can then be deleted from the project using the RemoveMember method.

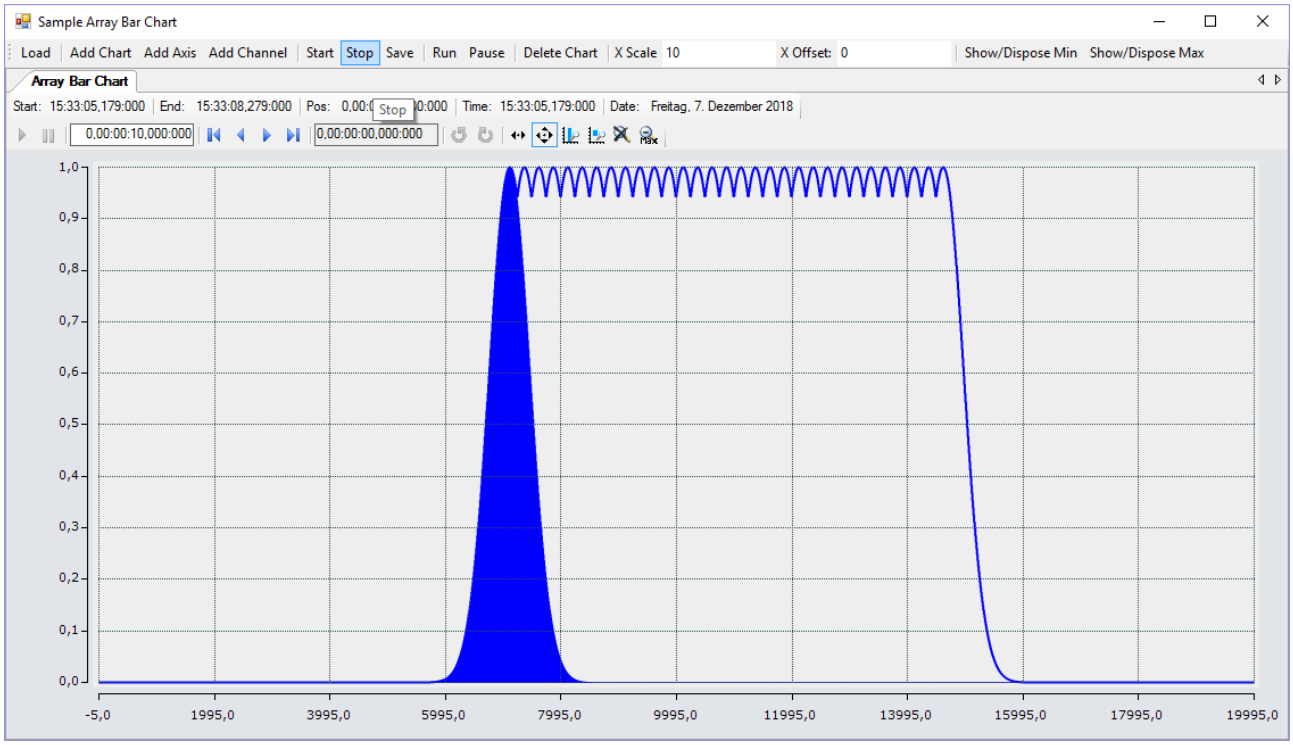
```
private void btnRun_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Run not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StartDisplay();
}
private void btnPause_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Pause not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StopDisplay();
}

private void btnDelChart_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "No chart is connected!", "Nothing to delete!",MessageBoxButtons.OK,
MessageBoxIcon.Exclamation);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    scopeProjectPanel.ScopeProject.StopRecord();
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
  {
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else
  {
    scopeProjectPanel.ScopeProject.RemoveMember(scopeProjectPanel.ScopeProject.SubMember.OfType<Char
t>().First());
  }
}
```

6.2.4 Sample Array Bar Chart

The application shown in the sample below serves to illustrate the main aspects of ScopeViewControl.

First, a new Windows Forms application is created. Use the toolbox to add a toolbar and the buttons shown above to the form. By double clicking, a click event handler can be created for each button, which is filled with the sample code below. Subsequently, a ScopeProjectPanel (as in this sample) or a ChartPanel is added to the form and the "Dock" property" is set to "Fill".



The sample developed here is available as a VS project: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/6515665803.zip

The sample accesses variables of the sample PLC program: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/2282225419.zip

6.2.4.1 Loading the configuration

The project, which is now executable, shows a gray surface at the start, since no configuration has been loaded or created. A configuration can either be created programmatically, or a file created with the TwinCAT Scope can be loaded. In this case, clicking on the **Load** button loads an existing configuration from a file.

The C# code sample shows the call from a "ButtonClick EventHandler":

```
private string filename = @"ScopeTestChart.tcscopex";
private void btnLoad_Click(object sender, EventArgs e)
{
  FileInfo fInfo = new FileInfo(filename);
  if (!fInfo.Exists)
  {
    MessageBox.Show("File not found! Please use the Add Chart button to create a config! Once a
config is created and saved it can be load using the Load button!", "File not found",
MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    //delete old configuration
    scopeProjectPanel.ScopeProject.Dispose();

    //load configuration
    ScopeProject Project = ScopeProject.LoadScopeProject(filename);
    scopeProjectPanel.ScopeProject = Project;
  }
}
```

The use of a ScopeProjectPanel is shown in this sample. If only a chart is to be displayed, however, then the functionality is the same, the difference being that a ChartPanel has to be created on the interface instead of the ScopeProjectPanel. Apart from that the ChartPanel class possesses no ScopeProject object, only a Chart object. Therefore, instead of this line:

```
scopeProjectPanel.ScopeProject = Project;
```

the following code must be created:

```
chartPanel.ModelChart = Project.SubMember.OfType<Chart>().First();
```

6.2.4.2 Adding elements

```
private void btnAddChart_Click(object sender, EventArgs e)
{
    ArrayBarChart chart = new ArrayBarChart();
    scopeProjectPanel.ScopeProject.AddMember(chart);
    chart.SubMember.OfType<ChartStyle>().First().ToolTipEnabled = true;
}
```

```
private void btnAddAxis_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().AddMember(new AxisGroup());
  }
}
```

```
private void btnAddChannel_Click(object sender, EventArgs e)
{
  Channel channel = new Channel();
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGro
up>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a axis first!", "No axis connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGroup>().F
irst().AddMember(channel);
    ChangeChannelSettings(channel);
    SetAcquisitions(channel);
  }
}
```

All hierarchical elements that can be found in the TwinCAT Scope in the Solution Explorer can also be added in the code during the integration. A hierarchical element is structured in such a way that it possesses a "SubMember" list, through which it is possible to iterate. Further objects can be added with "AddMember".

If the new object is not added to an object located directly above it, then everything is re-created by the adding object until the object to be added can be integrated into the hierarchy. However, care must be taken that a YT chart is always created as the standard chart type.

The fundamental hierarchy in the scope looks like this:

ScopeProject

- DataPool
  - Acquisition
- Chart
  - AxisGroup
    - MarkerContainer
      - Marker
    - Axes
    - Channels
      - AcquisitionInterpreter

… further charts

Charts:

The chart is the environment, in which the graph with the coordinate system appears. The chart thus represents the base frame and must be created first.

Axes:

The AxisGroup contains firstly the axes, which ensure the correct scaling of the values, and secondly the channels that are displayed in the chart.

If the AxisGroup is now added to the chart, the axis objects are created automatically.

Channels:

The channel contains all the information on the data that are recorded in the Scope and is attached under the axis group in which these values are to be shown.

6.2.4.3 Adapting the styles

```
private void ChangeChannelSettings(Channel channel)
{
    SeriesStyle style = channel.SubMember.OfType<ChannelStyle>().First().SubMember.OfType<SeriesStyl
e>().First();
    style.DisplayColor = Color.Blue;
    style.MarkColor = Color.DarkBlue;
    style.LineWidth = 2;
}
```

Each of the elements created has "Style" properties as a sub-member, containing all the properties that can also be seen in the corresponding properties window in Visual Studio. For example, color and line width can be assigned in the style classes of a channel.

Overview of the various style hierarchies. The subordinate classes are always located in the SubMember lists of the superordinate class.

Chart

- ChartStyle (general style properties for a chart)
  - ChartZoomStyle (configuration option specifying how a chart should react to zoom functions).

AxisGroup

- AspectRatioScalingStyle (configuration option for uniform scaling between the axes)

Axis

- AxisStyle (general style properties for the axis)

Channel

- ChannelStyle (general style properties of a channel)
  - CapStyle (style properties of the Graphcaps)
  - MinMaxStyle (visibility properties of the minimum and maximum values)
  - SeriesStyle (style properties of a graph)

6.2.4.4 Adaptation of the acquisition data

```
private void SetAcquisitions(Channel channel)
{
    //AmsNetId and AmsPort need the TwinCAT.Ads.dll
    AdsAcquisition acq = new AdsAcquisition();
    acq.AmsNetIdExchange = "localhost";
    acq.TargetPort     = 851;
    acq.IsSymbolBased  = true;
    acq.SymbolName     = "Variables.aNormalDistribution";
    acq.DataType       = Scope2DataType.REAL64;
    acq.SampleTime     = (uint)(100 * TimeSpan.TicksPerMillisecond);
    acq.ArrayLength    = 2000;
```

```
    acq.Oversample     = 2000;
    channel.AddMember(acq);
}
```

The acquisition class of a channel describes the connection between the scope and the respective value of the machine controller. Therefore, for example, the name and size of a variable are expected at this point.

The acquisition object is hierarchically positioned below an AcquisitionInterpreter, which possesses further variable-independent information. Furthermore, the AcquisitionInterpreter is a member of a channel and, depending on the chart type, a channel may contain several AcquisitionInterpreters for the various axes. An acquisition can be appended directly to a channel as in the sample and the interpreter is automatically generated.

6.2.4.5 Adapting the recording

Recording settings or methods of starting and stopping the recording and also saving the values are contained in the ScopeProject class, which was already created in the first step.

In order to start a recording you should first check whether data still exist. If so they can be deleted with Disconnect. After that the recording can be started in the ScopeProject with the "StartRecord" method.

```
private void btnStart_Click(object sender, EventArgs e)
{
  try
  {
    //discard old data
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
      scopeProjectPanel.ScopeProject.Disconnect(false);

    //start record
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Config)
      scopeProjectPanel.ScopeProject.StartRecord();
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on start record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

To stop a recording the "StopRecord" method is called on the ScopeProject. Before executing this method it is also possible to check whether a recording is running. If this is the case the ScopeState in the ScopeProject will indicate Record.

```
private void btnStop_Click(object sender, EventArgs e)
{
  try
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on stop record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

Before closing the application, a running recording should be stopped first and the application should be cleanly disconnected from the Scope server.

```
private void Form1_FormClosing(object sender, FormClosingEventArgs e)
{
  if (scopeProjectPanel != null && scopeProjectPanel.ScopeProject != null)
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
```

```
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      scopeProjectPanel.ScopeProject.Disconnect();
    }
  }
}
```

6.2.4.6 Save configuration / recording

There are two possibilities to save:

- Saving the recorded data in a .svdx file
- Creating a configuration file (.tcscopex)

The difference is that the .svdx file can be opened in any TwinCAT 3 Scope View, in order to display the measured data. The .tcscopex file, on the other hand, only contains the configuration, without measured data. It can be used to start new recordings, as required.

```
private void btnSave_Click(object sender, EventArgs e)
{
  try
  {
    //save data and configuration
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      File.Create("ExportData.svdx").Close();
      scopeProjectPanel.ScopeProject.SaveData("ExportData.svdx");
    }
    //just save the configuration
    else
    {
      File.Create(filename).Close();
      scopeProjectPanel.ScopeProject.SaveToFile(filename);
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on save!",MessageBoxButtons.OK, MessageBoxIcon.Error);
  }
}
```

6.2.4.7 Controlling a chart

So that the toolbar and the time bar do not have to be shown permanently in the integration, it is possible to control the functions directly via the chart objects.

Since these functions can only be used in recording mode, the system checks whether signals are currently being recorded.
This can be started with the StartDisplay method of the chart. The display can be paused with the StopDisplay method. The recording continues in the background. This is apparent if the Overview chart is active, for example.

Before the chart is deleted, the system checks whether a chart is open in the display. It then checks whether recording is active. If this is the case, the current recording is stopped. Using the Disconnect method the graph can be deleted from the chart and the chart can then be deleted from the project using the RemoveMember method.

```
private void btnRun_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Run not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StartDisplay();
}
private void btnPause_Click(object sender, EventArgs e)
{
```

```
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Pause not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StopDisplay();
}

private void btnDelChart_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "No chart is connected!", "Nothing to delete!",MessageBoxButtons.OK,
MessageBoxIcon.Exclamation);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    scopeProjectPanel.ScopeProject.StopRecord();
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
  {
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else
  {
    scopeProjectPanel.ScopeProject.RemoveMember(scopeProjectPanel.ScopeProject.SubMember.OfType<Char
t>().First());
  }
}
```

6.2.4.8 Displaying minimum and maximum

In the Array bar chart example shown above, lines for minimum and maximum can be seen. These can also be set via the style classes on a channel.

```
private void btnMin_Click(object sender, EventArgs e)
{
    foreach(Chart chart in scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>())
    {
        foreach(AxisGroup ag in chart.SubMember.OfType<AxisGroup>())
        {
            foreach(Channel channel in ag.SubMember.OfType<Channel>())
            {
                MinMaxStyle minMaxStyle = channel.SubMember.OfType<ChannelStyle>().First().SubMember
.OfType<MinMaxStyle>().First();
                minMaxStyle.ShowMin = !minMaxStyle.ShowMin;
            }
        }
    }
}

private void btnShowMax_Click(object sender, EventArgs e)
{
    foreach (Chart chart in scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>())
    {
        foreach (AxisGroup ag in chart.SubMember.OfType<AxisGroup>())
        {
            foreach (Channel channel in ag.SubMember.OfType<Channel>())
            {
                MinMaxStyle minMaxStyle = channel.SubMember.OfType<ChannelStyle>().First().SubMember
.OfType<MinMaxStyle>().First();
                minMaxStyle.ShowMax = !minMaxStyle.ShowMax;
            }
        }
    }
}
```

6.2.4.9 Scaling the X-axis

In this sample the X-axis can be scaled by entries so that a different value range is used. The values of the IndexScaling class, which is located in the AcquisitionInterpreter as a SubMember, are thereby edited. The value range can be shifted with the offset. The offset represents the starting value of the value range. The value range can be scaled differently with the scale factor. The value is multiplied by the value range.

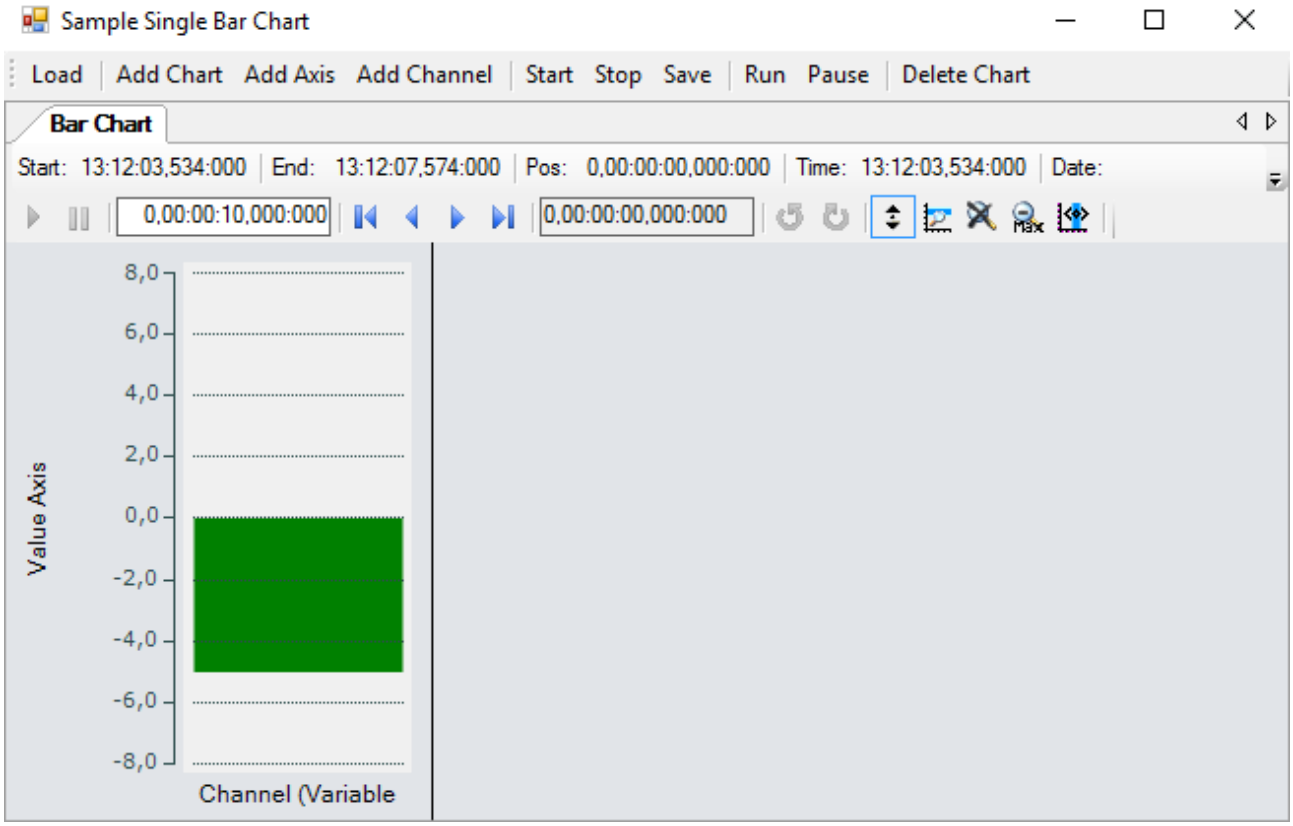
```
private void tbXScale_TextChanged(object sender, EventArgs e)
{
    foreach(Chart chart in scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>())
    {
        foreach(AxisGroup ag in chart.SubMember.OfType<AxisGroup>())
        {
            foreach(Channel channel in ag.SubMember.OfType<Channel>())
            {
                foreach(AcquisitionInterpreter ai in channel.SubMember.OfType<AcquisitionInterpreter
>().Where(x => x.Orientation == TwinCAT.Measurement.Scope.API.AxisOrientation.Y))
                {
                    IndexScaling indexScaling = ai.SubMember.OfType<IndexScaling>().First();
                    double factor = 0;
                    double.TryParse(tbXScale.Text, out factor);
                    indexScaling.ScaleFactor = factor;
                }
            }
        }
    }
}

private void tbXOffset_TextChanged(object sender, EventArgs e)
{
    foreach (Chart chart in scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>())
    {
        foreach (AxisGroup ag in chart.SubMember.OfType<AxisGroup>())
        {
            foreach (Channel channel in ag.SubMember.OfType<Channel>())
            {
                foreach (AcquisitionInterpreter ai in channel.SubMember.OfType<AcquisitionInterprete
r>().Where(x => x.Orientation == TwinCAT.Measurement.Scope.API.AxisOrientation.Y))
                {
                    IndexScaling indexScaling = ai.SubMember.OfType<IndexScaling>().First();
                    double offset = 0;
                    double.TryParse(tbXOffset.Text, out offset);
                    indexScaling.Offset = offset;
                }
            }
        }
    }
}
```

6.2.5 Sample Single Bar Chart

The application shown in the sample below serves to illustrate the main aspects of ScopeViewControl.

First, a new Windows Forms application is created. Use the toolbox to add a toolbar and the buttons shown above to the form. By double clicking, a click event handler can be created for each button, which is filled with the sample code below. Subsequently, a ScopeProjectPanel (as in this sample) or a ChartPanel is added to the form and the "Dock" property" is set to "Fill".



The sample developed here is available as a VS project: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/6515670795.zip

The sample accesses variables of the sample PLC program: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/2282225419.zip

6.2.5.1 Loading the configuration

The project, which is now executable, shows a gray surface at the start, since no configuration has been loaded or created. A configuration can either be created programmatically, or a file created with the TwinCAT Scope can be loaded. In this case, clicking on the **Load** button loads an existing configuration from a file.

The C# code sample shows the call from a "ButtonClick EventHandler":

```
private string filename = @"ScopeTestChart.tcscopex";
private void btnLoad_Click(object sender, EventArgs e)
{
  FileInfo fInfo = new FileInfo(filename);
  if (!fInfo.Exists)
  {
    MessageBox.Show("File not found! Please use the Add Chart button to create a config! Once a
config is created and saved it can be load using the Load button!", "File not found",
MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    //delete old configuration
    scopeProjectPanel.ScopeProject.Dispose();

    //load configuration
    ScopeProject Project = ScopeProject.LoadScopeProject(filename);
    scopeProjectPanel.ScopeProject = Project;
  }
}
```

The use of a ScopeProjectPanel is shown in this sample. If only a chart is to be displayed, however, then the functionality is the same, the difference being that a ChartPanel has to be created on the interface instead of the ScopeProjectPanel. Apart from that the ChartPanel class possesses no ScopeProject object, only a Chart object. Therefore, instead of this line:

```
scopeProjectPanel.ScopeProject = Project;
```

the following code must be created:

```
chartPanel.ModelChart = Project.SubMember.OfType<Chart>().First();
```

6.2.5.2 Adding elements

```
private void btnAddChart_Click(object sender, EventArgs e)
{
    BarChart chart = new BarChart();
    scopeProjectPanel.ScopeProject.AddMember(chart);
    chart.SubMember.OfType<ChartStyle>().First().ToolTipEnabled = true;
}
```

```
private void btnAddAxis_Click(object sender, EventArgs e)
{
  if(scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().AddMember(new AxisGroup());
  }
}
```

```
private void btnAddChannel_Click(object sender, EventArgs e)
{
  Channel channel = new Channel();
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGro
up>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a axis first!", "No axis connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGroup>().F
irst().AddMember(channel);
    ChangeChannelSettings(channel);
    SetAcquisitions(channel);
  }
}
```

All hierarchical elements that can be found in the TwinCAT Scope in the Solution Explorer can also be added in the code during the integration. A hierarchical element is structured in such a way that it possesses a "SubMember" list, through which it is possible to iterate. Further objects can be added with "AddMember".

If the new object is not added to an object located directly above it, then everything is re-created by the adding object until the object to be added can be integrated into the hierarchy. However, care must be taken that a YT chart is always created as the standard chart type.

The fundamental hierarchy in the scope looks like this:

ScopeProject

┗┳ DataPool

┃ ┗ Acquisition

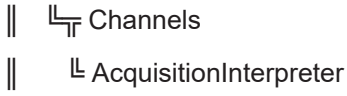
┣┳ Chart

┃ ┗┳ AxisGroup

┃ ┣┳ MarkerContainer

┃ ┃ ┗ Marker

┃ ┣┳ Axes



… further charts

Charts:

The chart is the environment, in which the graph with the coordinate system appears. The chart thus represents the base frame and must be created first.

Axes:

The AxisGroup contains firstly the axes, which ensure the correct scaling of the values, and secondly the channels that are displayed in the chart.

If the AxisGroup is now added to the chart, the axis objects are created automatically.

Channels:

The channel contains all the information on the data that are recorded in the Scope and is attached under the axis group in which these values are to be shown.

6.2.5.3 Adapting the styles

```
private void ChangeChannelSettings(Channel channel)
{
    SeriesStyle style = channel.SubMember.OfType<ChannelStyle>().First().SubMember.OfType<SeriesStyl
e>().First();
    style.DisplayColor = Color.Green;
    style.MarkColor = Color.DarkRed;
}
```

Each of the elements created has "Style" properties as a sub-member, containing all the properties that can also be seen in the corresponding properties window in Visual Studio. For example, color and line width can be assigned in the style classes of a channel.

Overview of the various style hierarchies. The subordinate classes are always located in the SubMember lists of the superordinate class.

Chart

- ChartStyle (general style properties for a chart)
  - ChartZoomStyle (configuration option specifying how a chart should react to zoom functions).

AxisGroup

- AspectRatioScalingStyle (configuration option for uniform scaling between the axes)

Axis

- AxisStyle (general style properties for the axis)

Channel

- ChannelStyle (general style properties of a channel)
  - CapStyle (style properties of the Graphcaps)
  - MinMaxStyle (visibility properties of the minimum and maximum values)
  - SeriesStyle (style properties of a graph)

6.2.5.4 Adaptation of the acquisition data

```
private void SetAcquisitions(Channel channel)
{
    //AmsNetId and AmsPort need the TwinCAT.Ads.dll
    AdsAcquisition acq = new AdsAcquisition();
    acq.AmsNetIdExchange = "localhost";
    acq.TargetPort = 851;
    acq.IsSymbolBased = true;
    acq.SymbolName = "Variables.fSine";
```

```
    acq.DataType = Scope2DataType.REAL64;
    acq.SampleTime = (uint)(10 * TimeSpan.TicksPerMillisecond);
    AcquisitionInterpreter acquisitionInterpreter = new AcquisitionInterpreter();
    acquisitionInterpreter.Acquisition = acq;
    channel.AddMember(acquisitionInterpreter);
}
```

The acquisition class of a channel describes the connection between the scope and the respective value of the machine controller. Therefore, for example, the name and size of a variable are expected at this point.

The acquisition object is hierarchically positioned below an AcquisitionInterpreter, which possesses further variable-independent information. Furthermore, the AcquisitionInterpreter is a member of a channel and, depending on the chart type, a channel may contain several AcquisitionInterpreters for the various axes. An acquisition can be appended directly to a channel as in the sample and the interpreter is automatically generated.

6.2.5.5 Controlling the recording

Recording settings or methods of starting and stopping the recording and also saving the values are contained in the ScopeProject class, which was already created in the first step.

In order to start a recording you should first check whether data still exist. If so they can be deleted with Disconnect. After that the recording can be started in the ScopeProject with the "StartRecord" method.

```
private void btnStart_Click(object sender, EventArgs e)
{
  try
  {
    //discard old data
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
      scopeProjectPanel.ScopeProject.Disconnect(false);

    //start record
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Config)
      scopeProjectPanel.ScopeProject.StartRecord();
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on start record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

To stop a recording the "StopRecord" method is called on the ScopeProject. Before executing this method it is also possible to check whether a recording is running. If this is the case the ScopeState in the ScopeProject will indicate Record.

```
private void btnStop_Click(object sender, EventArgs e)
{
  try
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on stop record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

Before closing the application, a running recording should be stopped first and the application should be cleanly disconnected from the Scope server.

```
private void Form1_FormClosing(object sender, FormClosingEventArgs e)
{
  if (scopeProjectPanel != null && scopeProjectPanel.ScopeProject != null)
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
```

```
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      scopeProjectPanel.ScopeProject.Disconnect();
    }
  }
}
```

6.2.5.6 Save configuration / recording

There are two possibilities to save:

- Saving the recorded data in a .svdx file
- Creating a configuration file (.tcscopex)

The difference is that the .svdx file can be opened in any TwinCAT 3 Scope View, in order to display the measured data. The .tcscopex file, on the other hand, only contains the configuration, without measured data. It can be used to start new recordings, as required.

```
private void btnSave_Click(object sender, EventArgs e)
{
  try
  {
    //save data and configuration
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      File.Create("ExportData.svdx").Close();
      scopeProjectPanel.ScopeProject.SaveData("ExportData.svdx");
    }
    //just save the configuration
    else
    {
      File.Create(filename).Close();
      scopeProjectPanel.ScopeProject.SaveToFile(filename);
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on save!",MessageBoxButtons.OK, MessageBoxIcon.Error);
  }
}
```

6.2.5.7 Controlling a chart

So that the toolbar and the time bar do not have to be shown permanently in the integration, it is possible to control the functions directly via the chart objects.

Since these functions can only be used in recording mode, the system checks whether signals are currently being recorded.
This can be started with the StartDisplay method of the chart. The display can be paused with the StopDisplay method. The recording continues in the background. This is apparent if the Overview chart is active, for example.

Before the chart is deleted, the system checks whether a chart is open in the display. It then checks whether recording is active. If this is the case, the current recording is stopped. Using the Disconnect method the graph can be deleted from the chart and the chart can then be deleted from the project using the RemoveMember method.

```
private void btnRun_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Run not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StartDisplay();
```

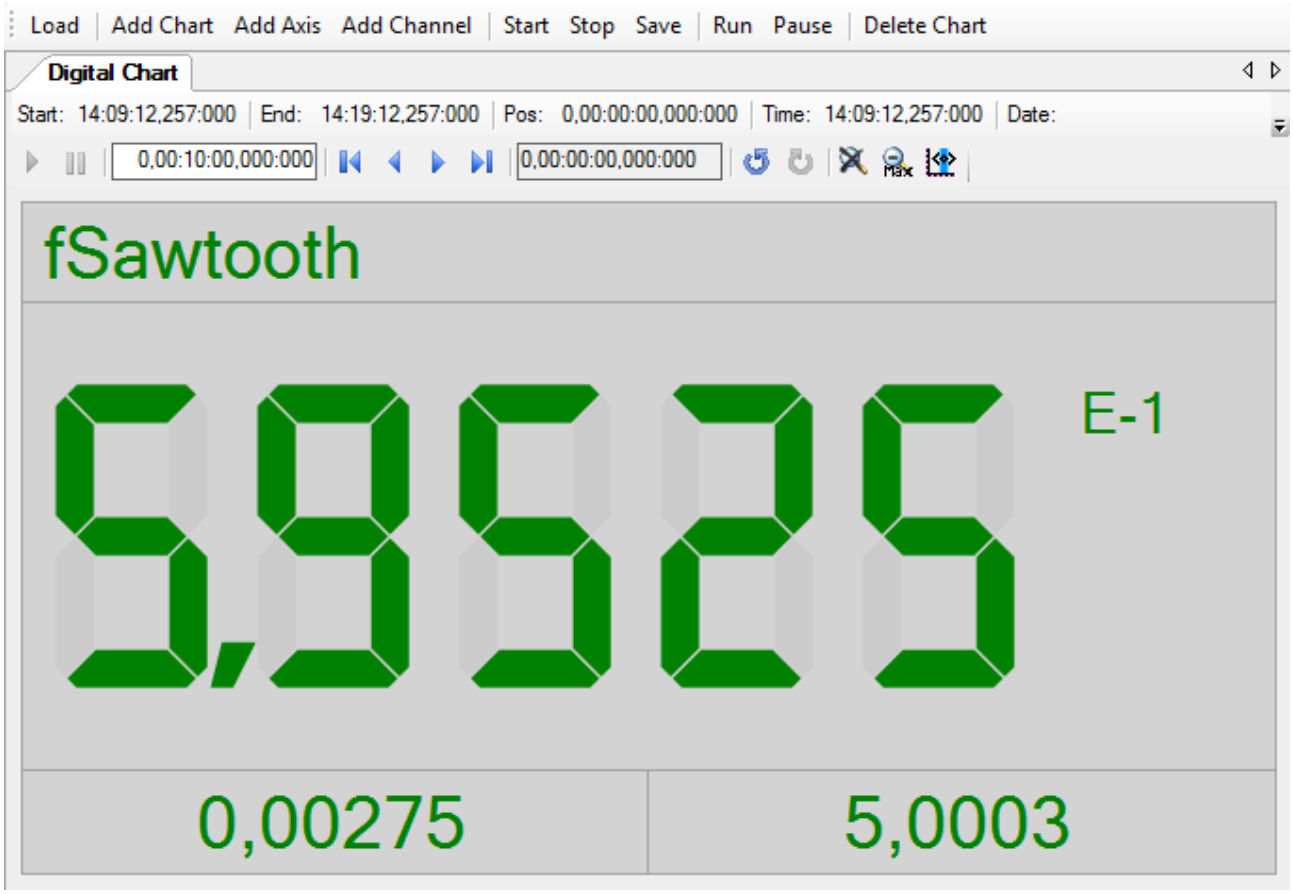
```
}
private void btnPause_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Pause not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StopDisplay();
}

private void btnDelChart_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "No chart is connected!", "Nothing to delete!",MessageBoxButtons.OK,
MessageBoxIcon.Exclamation);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    scopeProjectPanel.ScopeProject.StopRecord();
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
  {
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else
  {
    scopeProjectPanel.ScopeProject.RemoveMember(scopeProjectPanel.ScopeProject.SubMember.OfType<Char
t>().First());
  }
}
```

6.2.6 Sample Digital Chart

The application shown in the sample below serves to illustrate the main aspects of ScopeViewControl.

First, a new Windows Forms application is created. Use the toolbox to add a toolbar and the buttons shown above to the form. By double clicking, a click event handler can be created for each button, which is filled with the sample code below. Subsequently, a ScopeProjectPanel (as in this sample) or a ChartPanel is added to the form and the "Dock" property" is set to "Fill".



The sample developed here is available as a VS project: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/7138570379.zip

The sample accesses variables of the sample PLC program: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/2282225419.zip

6.2.6.1 Loading the configuration

The project, which is now executable, shows a gray surface at the start, since no configuration has been loaded or created. A configuration can either be created programmatically, or a file created with the TwinCAT Scope can be loaded. In this case, clicking on the **Load** button loads an existing configuration from a file.

The C# code sample shows the call from a "ButtonClick EventHandler":

```
private string filename = @"ScopeTestChart.tcscopex";
private void btnLoad_Click(object sender, EventArgs e)
{
  FileInfo fInfo = new FileInfo(filename);
  if (!fInfo.Exists)
  {
    MessageBox.Show("File not found! Please use the Add Chart button to create a config! Once a
config is created and saved it can be load using the Load button!", "File not found",
MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    //delete old configuration
    scopeProjectPanel.ScopeProject.Dispose();

    //load configuration
    ScopeProject Project = ScopeProject.LoadScopeProject(filename);
    scopeProjectPanel.ScopeProject = Project;
  }
}
```

The use of a ScopeProjectPanel is shown in this sample. If only a chart is to be displayed, however, then the functionality is the same, the difference being that a ChartPanel has to be created on the interface instead of the ScopeProjectPanel. Apart from that the ChartPanel class possesses no ScopeProject object, only a Chart object. Therefore, instead of this line:

```
scopeProjectPanel.ScopeProject = Project;
```

the following code must be created:

```
chartPanel.ModelChart = Project.SubMember.OfType<Chart>().First();
```

6.2.6.2 Adding elements

All hierarchical elements that can be found in the TwinCAT Scope in the Solution Explorer can also be added in the code during the integration. A hierarchical element is structured in such a way that it possesses a "SubMember" list, through which it is possible to iterate. Further objects can be added with "AddMember".

If the new object is not added to an object located directly above it, then everything is re-created by the adding object until the object to be added can be integrated into the hierarchy. However, care must be taken that a YT chart is always created as the standard chart type.

The fundamental hierarchy in the scope looks like this:

ScopeProject

╚═ DataPool

‖ ╚ Acquisition

╠═ Chart

‖ ╚═ AxisGroup

‖ ╠═ MarkerContainer

‖ ‖ ╚ Marker

‖ ╚═ Channels

‖ ╚ AcquisitionInterpreter

… further charts

Charts:

The chart is the environment in which the channel appears. The chart thus represents the base frame and must be created first.

```
private void btnAddChart_Click(object sender, EventArgs e)
{
  DigitalChart chart = new DigitalChart();
  ChartStyle chartStyle = new ChartStyle();
  chart.AddMember(chartStyle);
  scopeProjectPanel.ScopeProject.AddMember(chart);
}
```

Axis groups:

The AxisGroup is responsible for the scaling of the subordinate channel.

```
private void btnAddAxis_Click(object sender, EventArgs e)
{
  AxisGroup axisGroup = new AxisGroup();
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Last().AddMember(axisGroup);
  }
}
```

```
private void btnAddChannel_Click(object sender, EventArgs e)
{
  Channel channel = new Channel();
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else if
(scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Last().SubMember.OfType<AxisGroup>().Count
() == 0)
  {
    MessageBox.Show(this, "Please create a axis first!", "No axis connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Last().SubMember.OfType<AxisGroup>().La
st().AddMember(channel);
    ChangeChannelSettings(channel);
    SetAcquisitions(channel);
  }
}
```

Channels:

The channel contains all the information on the data that are recorded in the Scope and is attached under the axis group in which these values are to be shown.

6.2.6.3 Adapting the styles

Each of the elements created has "Style" objects as a sub-member, containing all the properties that can also be seen in the corresponding properties window in Visual Studio. The color and the number of digits, for example, can be set in the style classes of a channel.

```
private void ChangeChannelSettings(Channel channel)
{
    DigitalStyle digitalStyle =
channel.SubMember.OfType<ChannelStyle>().Last().SubMember.OfType<DigitalStyle>().Last();
    digitalStyle.BackgroundColor = Color.LightGray;
    digitalStyle.Precision = 5;
}
```

Overview of the various style hierarchies. The subordinate classes are always located in the SubMember lists of the superordinate class.

Chart

- ChartStyle (general style properties for a chart)

Channel

- ChannelStyle (general style properties of a channel)
  - DigitalStyle (contains special settings for the digital chart)

6.2.6.4 Adaptation of the acquisition data

The acquisition class of a channel describes the connection between the scope and the respective value of the machine controller. Therefore, for example, the name and size of a variable are expected at this point.

The acquisition object is hierarchically positioned below an AcquisitionInterpreter, which possesses further variable-independent information. Furthermore, the AcquisitionInterpreter is a member of a channel and, depending on the chart type, a channel may contain several AcquisitionInterpreters for the various axes. An acquisition can be appended directly to a channel as in the sample and the interpreter is automatically generated.

```
private void SetAcquisitions(Channel channel)
{
    AdsAcquisition acquisition = new AdsAcquisition();
    acquisition.AmsNetIdExchange = "localhost";
    acquisition.TargetPort = 851;
    acquisition.SymbolBased = true;
    acquisition.SymbolName = "Variables.fSawtooth";
```

```
    acquisition.DataType = Scope2DataType.REAL64;
    acquisition.SampleTime = (uint)(1 * TimeSpan.TicksPerMillisecond);
    AcquisitionInterpreter AcquisitionInterpreter = new AcquisitionInterpreter();
    AcquisitionInterpreter.Acquisition = acquisition;
    channel.AddMember(AcquisitionInterpreter);
}
```

6.2.6.5 Controlling the recording

Recording settings or methods of starting and stopping the recording and also saving the values are contained in the ScopeProject class, which was already created in the first step.

In order to start a recording you should first check whether data still exist. If so they can be deleted with Disconnect. After that the recording can be started in the ScopeProject with the "StartRecord" method.

```
private void btnStart_Click(object sender, EventArgs e)
{
  try
  {
    //discard old data
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
      scopeProjectPanel.ScopeProject.Disconnect(false);

    //start record
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Config)
      scopeProjectPanel.ScopeProject.StartRecord();
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on start record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

To stop a recording the "StopRecord" method is called on the ScopeProject. Before executing this method it is also possible to check whether a recording is running. If this is the case the ScopeState in the ScopeProject will indicate Record.

```
private void btnStop_Click(object sender, EventArgs e)
{
  try
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on stop record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

Before closing the application, a running recording should be stopped first and the application should be cleanly disconnected from the Scope server.

```
private void Form1_FormClosing(object sender, FormClosingEventArgs e)
{
  if (scopeProjectPanel != null && scopeProjectPanel.ScopeProject != null)
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      scopeProjectPanel.ScopeProject.Disconnect();
    }
  }
}
```

6.2.6.6 Save configuration / recording

There are two possibilities to save:

- Saving the recorded data in a .svdx file
- Creating a configuration file (.tcscopex)

The difference is that the .svdx file can be opened in any TwinCAT 3 Scope View, in order to display the measured data. The .tcscopex file, on the other hand, only contains the configuration, without measured data. It can be used to start new recordings, as required.

```
private void btnSave_Click(object sender, EventArgs e)
{
  try
  {
    //save data and configuration
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      File.Create("ExportData.svdx").Close();
      scopeProjectPanel.ScopeProject.SaveData("ExportData.svdx");
    }
    //just save the configuration
    else
    {
      File.Create(filename).Close();
      scopeProjectPanel.ScopeProject.SaveToFile(filename);
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on save!",MessageBoxButtons.OK, MessageBoxIcon.Error);
  }
}
```

6.2.6.7 Controlling a chart

So that the toolbar and the time bar do not have to be shown permanently in the integration, it is possible to control the functions directly via the chart objects.

Since these functions can only be used in recording mode, the system checks whether signals are currently being recorded.
This can be started with the StartDisplay method of the chart. The display can be paused with the StopDisplay method. The recording continues in the background. This is apparent if the Overview chart is active, for example.

Before the chart is deleted, the system checks whether a chart is open in the display. It then checks whether recording is active. If this is the case, the current recording is stopped. Using the Disconnect method the graph can be deleted from the chart and the chart can then be deleted from the project using the RemoveMember method.

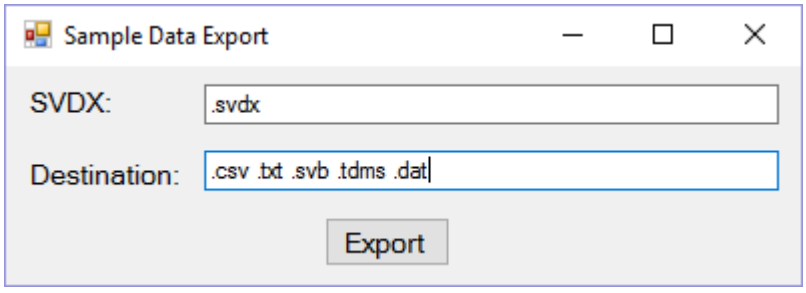
```
private void btnRun_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Run not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StartDisplay();
}
private void btnPause_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Pause not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StopDisplay();
```

```
}

private void btnDelChart_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "No chart is connected!", "Nothing to delete!",MessageBoxButtons.OK,
MessageBoxIcon.Exclamation);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    scopeProjectPanel.ScopeProject.StopRecord();
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
  {
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else
  {
    scopeProjectPanel.ScopeProject.RemoveMember(scopeProjectPanel.ScopeProject.SubMember.OfType<Char
t>().First());
  }
}
```

6.2.7 Sample Scope Export

The following sample shows how a Scope file is exported in a different data type.



This sample is based on the programming language C# in a Windows Forms project.
The interface for this sample consists of two text boxes for entering the paths and a button for starting the export.

The sample developed here is available as a VS project: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/6515669131.zip

The variables refer to the TwinCAT program behind the following file: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/2282225419.zip

6.2.7.1 Export

First, the content of the respective text box is assigned to the variables svdFile and destination. The system then checks whether the user has entered both paths correctly.

After that the configuration file (.svdx file) is loaded into a ScopeProject.

Once the configuration has been loaded, the path via which the new file is to be saved is checked. If the path is reachable, a window is transferred to the ShowProgress property that displays the status of the export and the export can then be started with the Export method.

```
private void btnExport_Click(object sender, EventArgs e)
{
    ScopeProject scopeProject = new ScopeProject();

    string svdxFile = textBox_SVDX.Text;
    string destination = @textBox_Export.Text;

    try
```

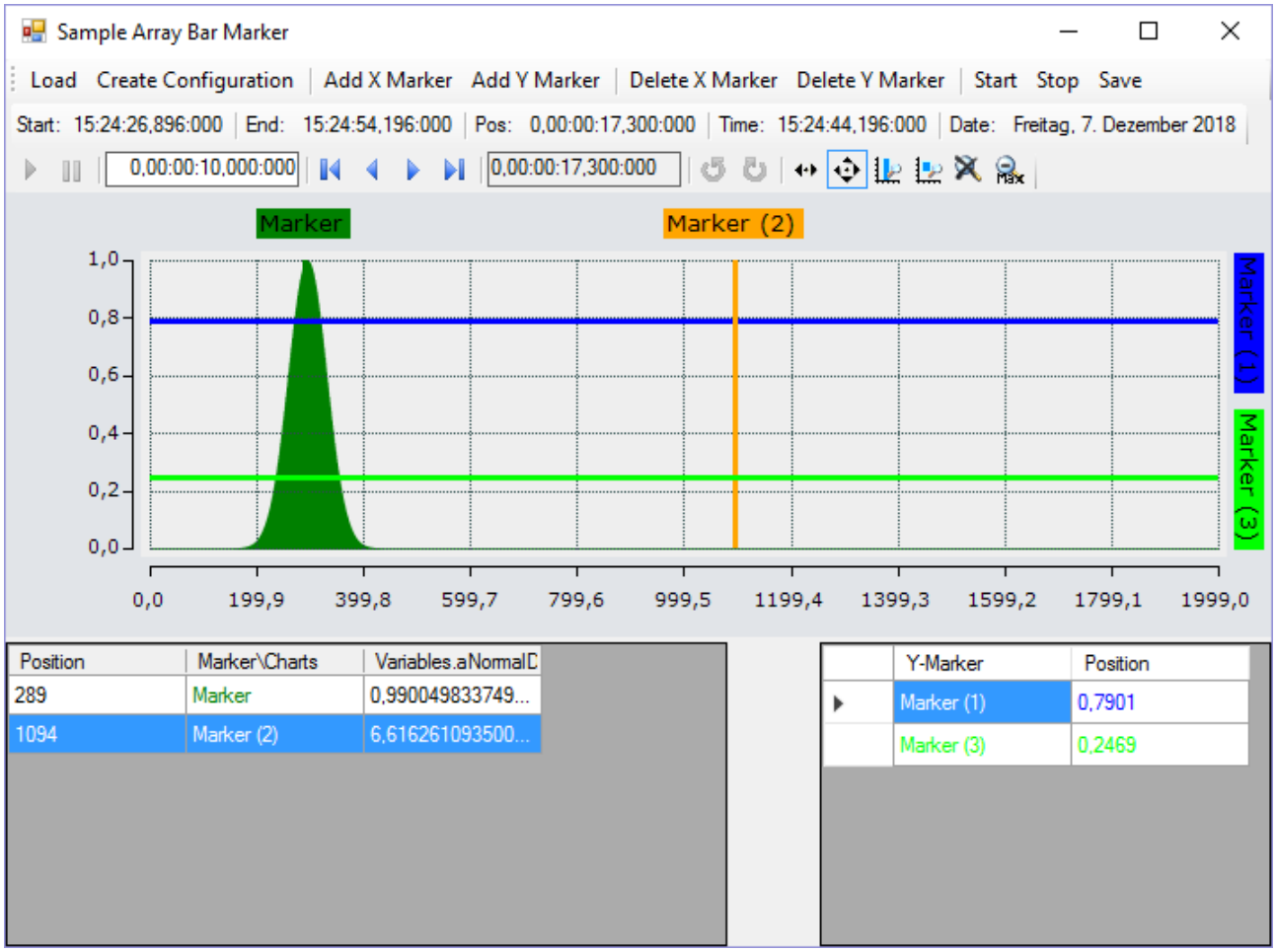
```
    {
        //Checking the existence of the path
        if (destination == null)
        {
            destination = Environment.CurrentDirectory;
        }
        else if (string.IsNullOrEmpty(svdxFile) || !File.Exists(svdxFile))
        {
            MessageBox.Show("SVDX File could not be found!", "SVDX Error", MessageBoxButtons.OK, Mes
sageBoxIcon.Exclamation);
        }
        else
        {
            scopeProject.SetFromFile(svdxFile);
        }

        if (string.IsNullOrEmpty(destination))
        {
            MessageBox.Show("No destination file defined!", "Destination Error", MessageBoxButtons.O
K, MessageBoxIcon.Exclamation);
        }
        else
        {
            try
            {
                //search the method with the right export
                scopeProject.ShowProgress = (string header, TwinCAT.Scope2.Tools.ProgressBox.WorkDel
egate work) => { return TwinCAT.Scope2.Tools.ProgressBox.Show(this, header, 100, work) == DialogResu
lt.OK; };
                scopeProject.Export(destination);
            }
            catch (Exception)
            {
                System.Diagnostics.Debug.Write("Could not save file");
            }
        }
        //Disconnect the .svdx File
        scopeProject.Disconnect(true);
        scopeProject.Dispose();
    }
    catch (Exception ex)
     {
        Console.Write(ex.ToString());
        Console.ReadLine();
        scopeProject.Disconnect(true);
    }
}
```

6.2.8 Sample Array Marker

The use of markers in a ScopeProject using an array bar chart is explained below.

In this sample the programming language C# is used.



First, a Windows Forms application is created. Use the toolbox to add a toolbar and the buttons shown above to the form. A ChartPanel is subsequently inserted and the "Dock" property is set to "Fill" so that the graph completely fills the window. Apart from that the marker values are to be illustrated in tables. To do this, two DataGridView elements must be added to the form. The two columns "Y-marker" and "Position" have to be added to the DataGridView on the right. To do this, click on **Browse** in the "Columns" row in the Properties window to open the dialog **Edit Columns**. You can then use **Add** to create new columns. The header text corresponds to the displayed column header.

The code behind the **Load** and **Create Configuration** buttons largely corresponds to the code from the sample of the array bar chart. All you have to do is create an additional column for the channel in DataGridView.

```
private string filename = @"..\..\ScopeTestYTMarker.tcscopex";
ScopeProject scopeProject = new ScopeProject();
AxisGroup axisGroup
{
    get
    {
        if (scopeProject.SubMember.OfType<Chart>().Count() == 0) return null;
        return scopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGroup>().First();
    }
}
private void btnLoad_Click(object sender, EventArgs e)
{
    FileInfo fInfo = new FileInfo(filename);
    if (!fInfo.Exists)
    {
        MessageBox.Show("File not found! Please use the Add Chart button to create a config! Once a
config is created and saved it can be load using the Load button!", "File not found",
        MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
    }
    else
    {
        //delete old configuration
        scopeProject.Dispose();

        //load new configuration
```

```
        scopeProject = ScopeProject.LoadScopeProject(filename);
    }
    chartPanel.ModelChart = scopeProject.SubMember.OfType<Chart>().First();
}
```

Create Configuration is a combination of the familiar buttons **Add Chart**, **Add Axis** and **Add Channel**.

```
private void btnCreateConfiguration_Click(object sender, EventArgs e)
{
    //Add Chart
    ArrayBarChart chart = new ArrayBarChart();
    scopeProject.AddMember(chart);

    //Add Axis
    AxisGroup axisGroup = new AxisGroup();
    chart.AddMember(axisGroup);

    //Add Channel
    Channel channel = new Channel();
    axisGroup.AddMember(channel);
    SetAcquisitions(channel);
    AdsAcquisition acquisition = (AdsAcquisition)channel.SubMember.OfType<AcquisitionInterpreter>().
First().Acquisition;
    dataGridView1.Columns.Add(acquisition.SymbolName, acquisition.SymbolName);

    chartPanel.ModelChart = chart;
}

private void SetAcquisitions(Channel channel)
{
    AdsAcquisition acq = new AdsAcquisition();
    acq.AmsNetId = AmsNetId.Local;
    acq.TargetPort = 851;
    acq.IsSymbolBased = true;
    acq.SymbolName = "Variables.aNormalDistribution";
    acq.DataType = DataTypeConverter.AdsToScope2Datatype(AdsDatatypeId.ADST_INT16);
    acq.SampleTime = (uint)(100 * TimeSpan.TicksPerMillisecond);
    acq.ArrayLength = 2000;
    acq.Oversample = 2000;
    AcquisitionInterpreter acquisitionInterpreter = new AcquisitionInterpreter();
    acquisitionInterpreter.Acquisition = acq;
    channel.AddMember(acquisitionInterpreter);
}
```

The sample developed here is available as a VS project: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/6515667467.zip

The variables refer to the TwinCAT program behind the following file: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/2282225419.zip

6.2.8.1 Adding markers

The markers of a chart are located as SubMembers under the respective axes.
In order to add a marker, an object of the Marker class is instanced and the axis is added using the "AddMember" method.
After creating the marker, method events are added in order to update the tables on the interface.
The new cursor, including its color, is then added in the table. Furthermore, the Marker_NewMarkerValues method is called in order to update the values in the table.

The created marker is always inserted at position '0' by default. In order for the marker to appear in the visible axis area, the currently visible area can be queried at the associated axis in order to be able to calculate the position of the marker. The currently visible range can be queried with the delegate "GetDisplayRange". The two transferred parameters return the minimum and maximum value of the visible axis after the call.

```
private void btnAddXMarker_Click(object sender, EventArgs e)
{
    try
    {
        Marker marker = new Marker();
        marker.Position = 0;
        marker.Orientation = TwinCAT.Measurement.Scope.API.CursorAlignment.Vertical;
        marker.Locked = false;
```

```
        axisGroup.SubMember.OfType<MarkerContainer>().First().AddMember(marker);

        marker.NewMarkerValues += Marker_NewMarkerValues;
        marker.PositionChanged += XMarker_PositionChanged;
        dataGridView1.Rows.Insert(axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.Of
Type<Marker>().Where(x => x.Orientation == TwinCAT.Measurement.Scope.API.CursorAlignment.Vertical).C
ount() - 1, marker.Position, marker.Title);
        dataGridView1.Rows[axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Ma
rker>().Where(x => x.Orientation == TwinCAT.Measurement.Scope.API.CursorAlignment.Vertical).Count()
- 1].Cells[1].Style.ForeColor = marker.DisplayColor;

        IndexAxis indexAxis = axisGroup.FirstOrDefault<IndexAxis>();
        if(indexAxis != null && indexAxis.GetDisplayRange != null)
        {
            indexAxis.GetDisplayRange.Invoke(out double min, out double max);
            marker.Position = min + ((max - min) / 2);
        }

        Marker_NewMarkerValues(marker, null);
    }
    catch (Exception) { }
}

private void btnAddYMarker_Click(object sender, EventArgs e)
{
    try
    {
        Marker marker = new Marker();
        marker.Orientation = TwinCAT.Measurement.Scope.API.CursorAlignment.Horizontal;
        marker.Locked = false;
        axisGroup.SubMember.OfType<MarkerContainer>().First().AddMember(marker);
        marker.PositionChanged += YMarker_PositionChanged;
        dataGridView2.Rows.Insert(axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.Of
Type<Marker>().Where(x => x.Orientation == TwinCAT.Measurement.Scope.API.CursorAlignment.Horizontal)
.Count() - 1, marker.Title, marker.Position);
        dataGridView2.Rows[axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Ma
rker>().Where(x => x.Orientation == TwinCAT.Measurement.Scope.API.CursorAlignment.Horizontal).Count(
) - 1].DefaultCellStyle.ForeColor = marker.DisplayColor;

        ValueAxis valueAxis = axisGroup.FirstOrDefault<ValueAxis>();
        if(valueAxis != null && valueAxis.GetDisplayRange != null)
        {
            valueAxis.GetDisplayRange.Invoke(out double min, out double max);
            marker.Position = min + ((max - min) / 2);
        }
    }
    catch (Exception) { }
}
```

6.2.8.2 Deleting markers

The markers located in the axis can be removed again using the RemoveMember method. In this sample the marker currently selected in the DataGrid is deleted. To do this the marker is first deleted from the axis, after which the row is deleted from the table.

```
private void btnDeleteXMarker_Click(object sender, EventArgs e)
{
    try
    {
        MarkerContainer ia = axisGroup.SubMember.OfType<MarkerContainer>().First();
        ia.RemoveMember(ia.SubMember.OfType<Marker>().Where(x => x.Orientation == TwinCAT.Measuremen
t.Scope.API.CursorAlignment.Vertical).ToArray()[dataGridView1.SelectedCells[0].RowIndex]);
        dataGridView1.Rows.RemoveAt(dataGridView1.SelectedCells[0].RowIndex);
    }
    catch (Exception) { }
}

private void btnDeleteYMarker_Click(object sender, EventArgs e)
{
    try
    {
        MarkerContainer va = axisGroup.SubMember.OfType<MarkerContainer>().First();
        va.RemoveMember(va.SubMember.OfType<Marker>().Where(x => x.Orientation == TwinCAT.Measuremen
t.Scope.API.CursorAlignment.Horizontal).ToArray()[dataGridView2.SelectedCells[0].RowIndex]);
        dataGridView2.Rows.RemoveAt(dataGridView2.SelectedCells[0].RowIndex);
    }
    catch (Exception) { }
}
```

The selection in the DataGridView can also be controlled by clicking on the marker in the chart.

To this end an EventHandler is registered to the member_Clicked event of the ChartPanel or ScopeProjectPanel. The selected model is handed over there so that it can continue to be used.

In the sample the matching index is sought in order to select the rows in the grid.

```
private void ChartPanel_Member_Clicked(object sender, TwinCAT.Measurement.ProjectBase.MeasurementMem
berBase e)
{
    foreach(AxisGroup ag in chartPanel.ModelChart.SubMember.OfType<AxisGroup>())
    {
        foreach(MarkerContainer mc in ag.SubMember.OfType<MarkerContainer>())
        {
            if (mc.SubMember.Contains(e))
            {
                switch (((Marker)e).Orientation)
                {
                    case TwinCAT.Measurement.Scope.API.CursorAlignment.Vertical:
                        dataGridView1.ClearSelection();
                        dataGridView1[1, mc.SubMember.OfType<Marker>().Where(x => x.Orientation == T
winCAT.Measurement.Scope.API.CursorAlignment.Vertical).ToList().IndexOf(e as Marker)].Selected = tru
e;
                        break;
                    case TwinCAT.Measurement.Scope.API.CursorAlignment.Horizontal:
                        dataGridView2.ClearSelection();
                        dataGridView2[0, mc.SubMember.OfType<Marker>().Where(x => x.Orientation == T
winCAT.Measurement.Scope.API.CursorAlignment.Horizontal).ToList().IndexOf(e as Marker)].Selected = t
rue;
                        break;
                    default:
                        break;
                }
            }
        }
    }
}
```

6.2.8.3 Update values

The following methods are available for updating the values in the tables: Marker_NewMarkerValues (updates the new channel values of the XMarker), XMarker_PositionChanges (updates the position value of the Marker) and YMarker_PositionChanged (updates the position value of the Marker). Since these methods are called through events, the respective marker is sent as a parameter.

This allows this marker to be found in the table first, so that the values can then be modified.

```
private void XMarker_PositionChanged(object sender, EventArgs e)
{
    Marker tmpMarker = (Marker)sender;
    //set new channel value
    for (int k = 0; k < axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Marke
r>().Count(); k++)
    {
        if (axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Marker>().Where(x
 => x.Orientation == TwinCAT.Measurement.Scope.API.CursorAlignment.Vertical).ToArray()
[k] == tmpMarker)
        {
            dataGridView1[0, k].Value = tmpMarker.Position;
            break;
        }
    }
}

private void YMarker_PositionChanged(object sender, EventArgs e)
{
    Marker tmpMarker = (Marker)sender;
    for(int k = 0; k< axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Marker>
().Count(); k++)
    {
        if(axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Marker>().Where(x
=> x.Orientation == TwinCAT.Measurement.Scope.API.CursorAlignment.Horizontal).ToArray()
[k] == tmpMarker)
        {
            dataGridView2[1, k].Value = tmpMarker.Position;
            break;
        }
```

```
    }
}

private void Marker_NewMarkerValues(object sender, EventArgs e)
{
    try
    {
        Marker tmpMarker = (Marker)sender;
        //set new channel value
        for (int k = 0; k <
axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Marker>().Count(); k++)
        {
            if
(axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Marker>().ToArray()[k] ==
tmpMarker)
            {
                var dict = tmpMarker.GetAllValues();
                for (int j = 0; j < dict.Count; j++)
                {
                    dataGridView1[j + 2, k].Value = dict.ElementAt(j).Value;
                }
                break;
            }
        }
    }
    catch (Exception) { }
}
```

6.2.8.4 Controlling markers by keyboard

When moving the markers by means of keyboard input, the marked marker is always moved. This is also selected on the interface.

The KeyDown event of the form is used to move the marker. This event is always triggered when a key is pressed. The value of the pressed key is located under the "KeyCode" parameter under the parameters of the type "KeyEventArgs". This value can be compared with the expected values. In this case the marker should be moved using the [D], [A], [W] and [S] keys.

The "Position" property is changed in order to shift the marker.

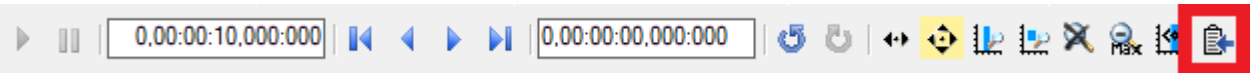
```
private void Form1_KeyDown(object sender, KeyEventArgs e)
{
    if (e.KeyCode == Keys.D)
    {
        try
        {
            axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Marker>().ToArray
()[dataGridView1.SelectedCells[0].RowIndex].Position += 1;
        }
        catch (Exception)
        {
            MessageBox.Show("There is no X-Axis to move!");
        }
    }
    else if (e.KeyCode == Keys.A)
    {
        try
        {
            axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Marker>().ToArray
()[dataGridView1.SelectedCells[0].RowIndex].Position -= 1;
        }
        catch (Exception)
        {
            MessageBox.Show("There is no X-Axis to move!");
        }
    }
    else if (e.KeyCode == Keys.W)
    {
        try
        {
            axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Marker>().ToArray
()[dataGridView1.SelectedCells[0].RowIndex].Position += 0.1;
        }
        catch (Exception)
        {
            MessageBox.Show("There is no Y-Axis to move!");
        }
```

```
    }
    else if (e.KeyCode == Keys.S)
    {
        try
        {
            axisGroup.SubMember.OfType<MarkerContainer>().First().SubMember.OfType<Marker>().ToArray
()[dataGridView1.SelectedCells[0].RowIndex].Position -= 0.1;
        }
        catch (Exception)
        {
            MessageBox.Show("There is no Y-Axis to move!");
        }
    }
}
```

6.2.9 Sample Chart Snipping Tool

The following explains how to use the Chart Snipping Tool within the Scope Control Integration.

In this sample the programming language C# is used.



The button for the snipping tool triggers the event

```
CopyToClipboard
```

of the class

```
TwinCAT.Measurement.Scope.API.Model.Chart
```

and provides the required parameters for further processing.

Subsequently, the static method

```
TwinCAT.Measurement.Reporting.Model.ReportingProject.ShowReportingProject(EVENT_PARAMATER,
BACKGROUND_COLOR, SCOPE_PROJECT);
```

can be called with the corresponding parameters.

The snipping tool is then called and displays the chart that triggered the event in the configuration interface.

For more information on using the snipping tool, see the article Chart Snipping Tool [▶ 274].

For use without the toolbar button, you can configure the necessary parameters yourself.

This requires the creation of instances of the class

```
TwinCAT.Measurement.Scope.API.CopyClipboardStartupArgs
```

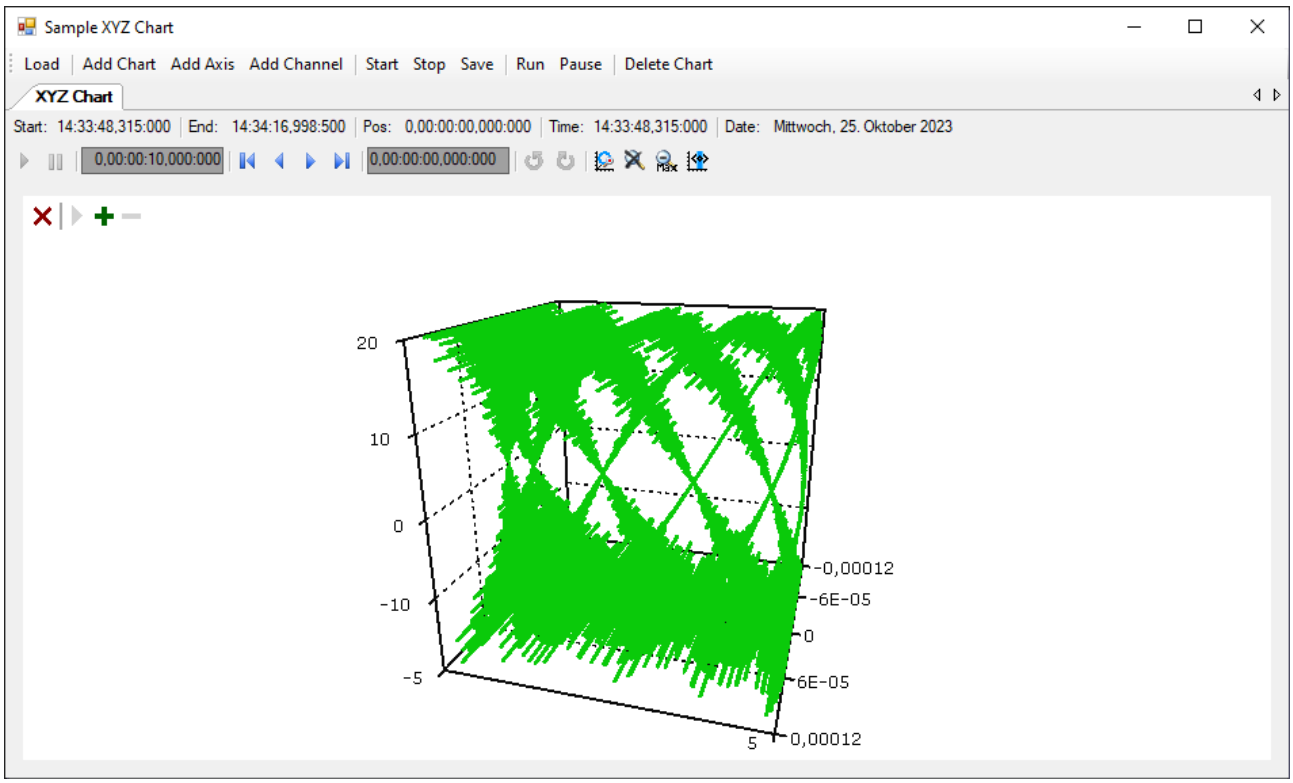
which must provide the respective chart, the size as rectangle, and the axis scaling as parameters.

The call is then made via the same static method as the call via the click event.

6.2.10 Sample XYZ-Chart

The application shown in the sample below serves to illustrate the main aspects of ScopeViewControl.

First, a new Windows Forms application is created. Use the toolbox to add a toolbar and the buttons shown above to the form. By double clicking, a click event handler can be created for each button, which is filled with the sample code below. Subsequently, a ScopeProjectPanel (as in this sample) or a ChartPanel is added to the form and the "Dock" property" is set to "Fill".



The sample developed here is available as a VS project: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/15286702603.zip

The sample accesses variables of the sample PLC program: https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/2282225419.zip

6.2.10.1 Loading the configuration

The project, which is now executable, shows a gray surface at the start, since no configuration has been loaded or created. A configuration can either be created programmatically, or a file created with the TwinCAT Scope can be loaded. In this case, clicking on the **Load** button loads an existing configuration from a file.

The C# code sample shows the call from a "ButtonClick EventHandler":

```
private string filename = @"ScopeTestChart.tcscopex";
private void btnLoad_Click(object sender, EventArgs e)
{
  FileInfo fInfo = new FileInfo(filename);
  if (!fInfo.Exists)
  {
    MessageBox.Show("File not found! Please use the Add Chart button to create a config! Once a
config is created and saved it can be load using the Load button!", "File not found",
MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    //delete old configuration
    scopeProjectPanel.ScopeProject.Dispose();

    //load configuration
    ScopeProject Project = ScopeProject.LoadScopeProject(filename);
    scopeProjectPanel.ScopeProject = Project;
  }
}
```

The use of a ScopeProjectPanel is shown in this sample. If only a chart is to be displayed, however, then the functionality is the same, the difference being that a ChartPanel has to be created on the interface instead of the ScopeProjectPanel. Apart from that the ChartPanel class possesses no ScopeProject object, only a Chart object. Therefore, instead of this line:

```
scopeProjectPanel.ScopeProject = Project;
```

the following code must be created:

```
chartPanel.ModelChart = Project.SubMember.OfType<Chart>().First();
```

6.2.10.2 Adding elements

All hierarchical elements that can be found in the TwinCAT Scope in the Solution Explorer can also be added in the code during the integration. A hierarchical element is structured in such a way that it possesses a "SubMember" list, through which it is possible to iterate. Further objects can be added with "AddMember".

If the new object is not added to an object located directly above it, then everything is re-created by the adding object until the object to be added can be integrated into the hierarchy. However, care must be taken that a YT chart is always created as the standard chart type.

The fundamental hierarchy in the scope looks like this:

ScopeProject

┗┳ DataPool

┃ ┗ Acquisition

┣┳ Chart

┃ ┗┳ AxisGroup

┃ ┣┳ MarkerContainer

┃ ┃ ┗ Marker

┃ ┣┳ Axes

┃ ┗┳ Channels

┃ ┗ AcquisitionInterpreter

… further charts

Charts:

The chart is the environment, in which the graph with the coordinate system appears. The chart thus represents the base frame and must be created first.

```
private void btnAddChart_Click(object sender, EventArgs e)
{
  XYZChart chart = new XYZChart();
  ChartStyle chartStyle = new ChartStyle();
  chartStyle.ToolTipEnabled = true;
  chart.AddMember(chartStyle);
  scopeProjectPanel.ScopeProject.AddMember(chart);
}
```

Axes:

The AxisGroup contains firstly the axes, which ensure the correct scaling of the values, and secondly the channels that are displayed in the chart.

If the AxisGroup is now added to the chart, the axis objects are created automatically.

```
private void btnAddAxis_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().AddMember(new AxisGroup());
  }
}
```

Channels:

The channel contains all the information on the data that are recorded in the Scope and is attached under the axis group in which these values are to be shown.

```
private void btnAddChannel_Click(object sender, EventArgs e)
{
  Channel channel = new Channel();
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "Please create a chart first!", "No chart connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else if
(scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGroup>().Coun
t() == 0)
  {
    MessageBox.Show(this, "Please create a axis first!", "No axis connected!",
      MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  else
  {
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().SubMember.OfType<AxisGroup>().F
irst().AddMember(channel);
    ChangeChannelSettings(channel);
    SetAcquisitions(channel);
  }
}
```

6.2.10.3 Adapting the styles

Each of the elements created has "Style" properties as a sub-member, containing all the properties that can also be seen in the corresponding properties window in Visual Studio. For example, color and line width can be assigned in the style classes of a channel.

```
private void ChangeChannelSettings(Channel channel)
{
  SeriesStyle style =
channel.SubMember.OfType<ChannelStyle>().First().SubMember.OfType<SeriesStyle>().First();
  style.DisplayColor = Color.Green;
  style.MarkColor = Color.DarkGreen;
  style.LineWidth = 2;
}
```

Overview of the various style hierarchies. The subordinate classes are always located in the SubMember lists of the superordinate class.

Chart

- ChartStyle (general style properties for a chart)
  - ChartZoomStyle (configuration option specifying how a chart should react to zoom functions).

AxisGroup

- AspectRatioScalingStyle (configuration option for uniform scaling between the axes)

Axis

- AxisStyle (general style properties for the axis)

Channel

- ChannelStyle (general style properties of a channel)
  - CapStyle (style properties of the Graphcaps)
  - MinMaxStyle (visibility properties of the minimum and maximum values)
  - SeriesStyle (style properties of a graph)

6.2.10.4 Adaptation of the acquisition data

The acquisition class of a channel describes the connection between the scope and the respective value of the machine controller. Therefore, for example, the name and size of a variable are expected at this point.

The acquisition object is hierarchically positioned below an AcquisitionInterpreter, which possesses further variable-independent information. Furthermore, the AcquisitionInterpreter is a member of a channel and, depending on the chart type, a channel may contain several AcquisitionInterpreters for the various axes. An acquisition can be appended directly to a channel as in the sample and the interpreter is automatically generated.

```
private void SetAcquisitions(Channel channel)
private void SetAcquisitions(Channel channel)
{
  AdsAcquisition xAcquisition = new AdsAcquisition();
  xAcquisition.AmsNetIdExchange =PLCNetID;
  xAcquisition.TargetPort = 851;
  xAcquisition.SymbolBased = true;
  xAcquisition.SymbolName = "Variables.aBufferSine[1]";
  xAcquisition.DataType = Scope2DataType.REAL64;
  xAcquisition.SampleTime = (uint)(1 *   TimeSpan.TicksPerMillisecond);
  AcquisitionInterpreter xAcquisitionInterpreter = new AcquisitionInterpreter();
  xAcquisitionInterpreter.Acquisition = xAcquisition;
  channel.AddMember(xAcquisition);

  AdsAcquisition yAcquisition = new AdsAcquisition();
  yAcquisition.AmsNetIdExchange =PLCNetID;
  yAcquisition.TargetPort = 851;
  yAcquisition.SymbolBased = true;
  yAcquisition.SymbolName = "Variables.aBufferSine[1]";
  yAcquisition.DataType = Scope2DataType.REAL64;
  yAcquisition.SampleTime = (uint)(1 *   TimeSpan.TicksPerMillisecond);
  AcquisitionInterpreter yAcquisitionInterpreter = new AcquisitionInterpreter();
  yAcquisitionInterpreter.Acquisition = yAcquisition;
  channel.AddMember(yAcquisition);

  AdsAcquisition zAcquisition = new AdsAcquisition();
  zAcquisition.AmsNetIdExchange =PLCNetID;
  zAcquisition.TargetPort = 851;
  zAcquisition.SymbolBased = true;
  zAcquisition.SymbolName = "Variables.aBufferSine[1]";
  zAcquisition.DataType = Scope2DataType.REAL64;
  zAcquisition.SampleTime = (uint)(1 *   TimeSpan.TicksPerMillisecond);
  AcquisitionInterpreter zAcquisitionInterpreter = new AcquisitionInterpreter();
  zAcquisitionInterpreter.Acquisition = zAcquisition;
  channel.AddMember(zAcquisition);
}
```

6.2.10.5 Adapting the recording

Recording settings or methods of starting and stopping the recording and also saving the values are contained in the ScopeProject class, which was already created in the first step.

In order to start a recording you should first check whether data still exist. If so they can be deleted with Disconnect. After that the recording can be started in the ScopeProject with the "StartRecord" method.

```
private void btnStart_Click(object sender, EventArgs e)
{
  try
  {
    //discard old data
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
      scopeProjectPanel.ScopeProject.Disconnect(false);

    //start record
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Config)
      scopeProjectPanel.ScopeProject.StartRecord();
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on start record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

To stop a recording the "StopRecord" method is called on the ScopeProject. Before executing this method it is also possible to check whether a recording is running. If this is the case the ScopeState in the ScopeProject will indicate Record.

```
private void btnStop_Click(object sender, EventArgs e)
{
  try
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on stop record!",MessageBoxButtons.OK,
MessageBoxIcon.Error);
  }
}
```

Before closing the application, a running recording should be stopped first and the application should be cleanly disconnected from the Scope server.

```
private void Form1_FormClosing(object sender, FormClosingEventArgs e)
{
  if (scopeProjectPanel != null && scopeProjectPanel.ScopeProject != null)
  {
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    {
      scopeProjectPanel.ScopeProject.StopRecord();
    }
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      scopeProjectPanel.ScopeProject.Disconnect();
    }
  }
}
```

6.2.10.6 Save configuration / recording

There are two possibilities to save:

- Saving the recorded data in a .svdx file
- Creating a configuration file (.tcscopex)

The difference is that the .svdx file can be opened in any TwinCAT 3 Scope View, in order to display the measured data. The .tcscopex file, on the other hand, only contains the configuration, without measured data. It can be used to start new recordings, as required.

```
private void btnSave_Click(object sender, EventArgs e)
{
  try
  {
    //save data and configuration
    if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
    {
      File.Create("ExportData.svdx").Close();
      scopeProjectPanel.ScopeProject.SaveData("ExportData.svdx");
    }
    //just save the configuration
    else
    {
      File.Create(filename).Close();
      scopeProjectPanel.ScopeProject.SaveToFile(filename);
    }
  }
  catch (Exception err)
  {
    MessageBox.Show(this, err.Message, "Error on save!",MessageBoxButtons.OK, MessageBoxIcon.Error);
  }
}
```

6.2.10.7 Controlling a chart

So that the toolbar and the time bar do not have to be shown permanently in the integration, it is possible to control the functions directly via the chart objects.

Since these functions can only be used in recording mode, the system checks whether signals are currently being recorded.
This can be started with the StartDisplay method of the chart. The display can be paused with the StopDisplay method. The recording continues in the background. This is apparent if the Overview chart is active, for example.

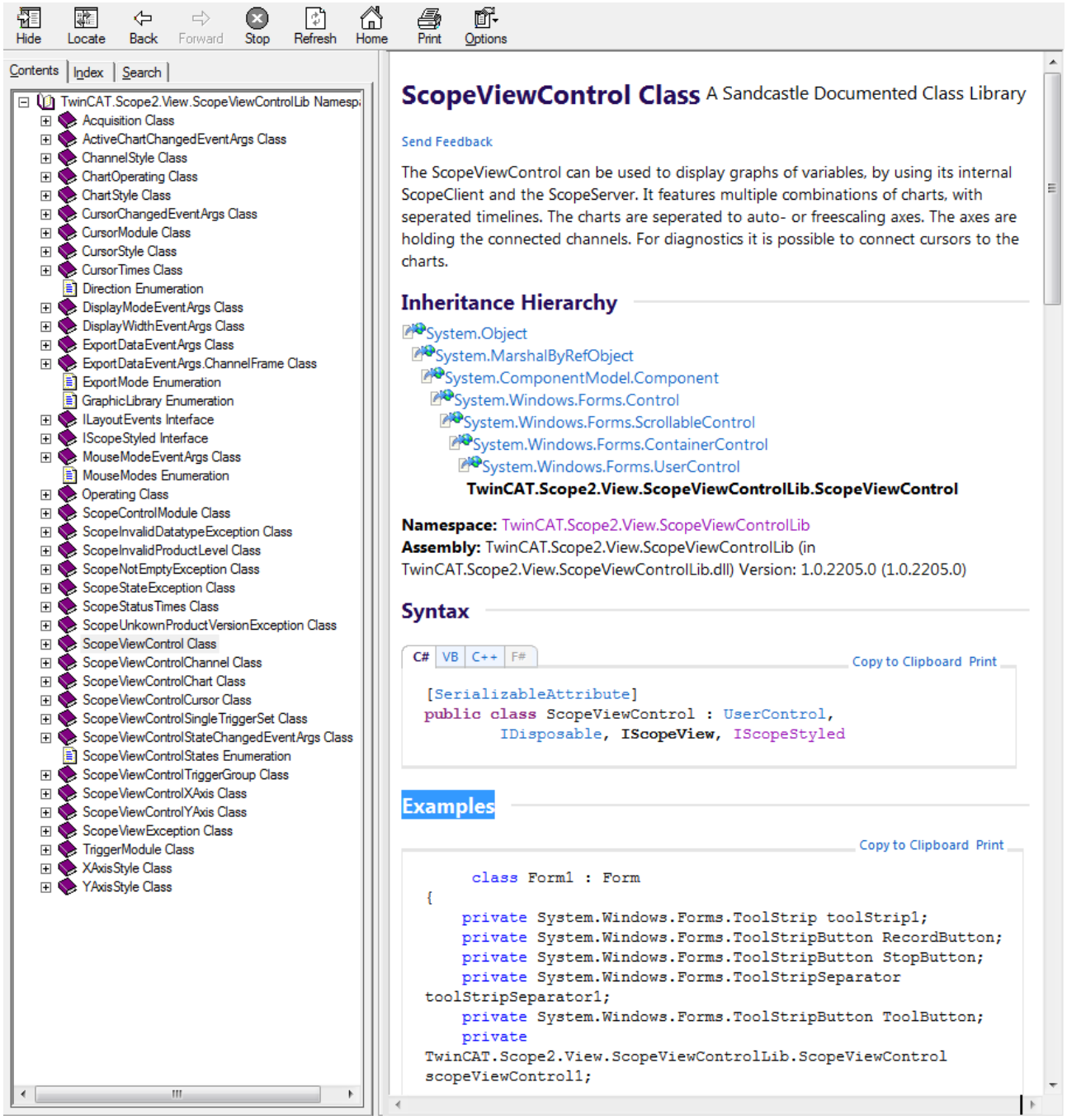
Before the chart is deleted, the system checks whether a chart is open in the display. It then checks whether recording is active. If this is the case, the current recording is stopped. Using the Disconnect method the graph can be deleted from the chart and the chart can then be deleted from the project using the RemoveMember method.

```
private void btnRun_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Run not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StartDisplay();
}
private void btnPause_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.ScopeState !=
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    MessageBox.Show(this, "Only possible if a record is running!", "Pause not
possible!",MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
  }
  if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
    scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().First().StopDisplay();
}

private void btnDelChart_Click(object sender, EventArgs e)
{
  if (scopeProjectPanel.ScopeProject.SubMember.OfType<Chart>().Count() == 0)
  {
    MessageBox.Show(this, "No chart is connected!", "Nothing to delete!",MessageBoxButtons.OK,
MessageBoxIcon.Exclamation);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Record)
  {
    scopeProjectPanel.ScopeProject.StopRecord();
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else if (scopeProjectPanel.ScopeProject.ScopeState ==
TwinCAT.Measurement.Scope.API.ScopeViewState.Reply)
  {
    scopeProjectPanel.ScopeProject.Disconnect(false);
  }
  else
  {
    scopeProjectPanel.ScopeProject.RemoveMember(scopeProjectPanel.ScopeProject.SubMember.OfType<Char
t>().First());
  }
}
```

6.3 API Documentation

The attached class library offers an extensive source of information for developers who work with the technologies and services of TwinCAT Scope. Amongst other things, the library contains instructions and reference documents as well as sample codes.



In order to find the desired contents, navigate through the table of contents, use the search function or switch to one of the sections of the library with the aid of a quick link.

For sample codes, switch in the left-hand area of the user interface to the **Search** tab and search for the keyword “examples”.

In the search results you will find sample codes for the trigger modules, cursor and many more.

See also:

https://infosys.beckhoff.com/content/1033/TE13xx_TC3_ScopeView/Resources/6519205387.zip

6.4 Integration in a WPF (Windows Presentation Foundation) project

To use the ScopeProjectPanel within WPF applications, you need a WindowsFormsHost as a basis, because the ScopeProjectPanel is a Windows Forms UserControl element.

1. Position a WindowsFormsHost control from the toolbar in the user interface of the WPF application you created.
2. Initialize the ScopeProjectPanel as described in the Windows Forms examples and add the created ScopeViewControl to the WindowsFormsHost. When using the ScopeProjectPanel within the WPF application, only the property “ScopeProjectPanel.SupportWPFRefresh” has to be set.

A sample implementation is shown below:

```
namespace WpfApplication
{
 ///
 /// Interaction logic for MainWindow.xaml
 ///
 public partial class MainWindow : Window
 {
    public MainWindow()
    {
     InitializeComponent();
     ScopeProjectPanel scopeProjectPanel = new ScopeProjectPanel();
     scopeProjectPanel.ScopeProject = new ScopeProject();
     scopeProjectPanel.SupportWPFRefresh = true;
     // Initialisierung des ScopeViewControl
     windowsFormsHost1.Child = scopeProjectPanel;
    }
 }
}
```

7 Samples

7.1 Creating and editing a Scope project

To enable fast familiarization and to simplify working with the TwinCAT 3 Scope software oscilloscope, important information is summarized and the first steps briefly described on the following pages.

1. Installation

A Scope Server is always installed with a Scope View, since otherwise no saved data can be displayed locally in the View. In contrast, the Scope component installation can install the Scope Server without Scope View on a target device.

2. Licensing

Regardless of whether you have installed the Scope View via its own setup or via the TwinCAT 3 XAE setup, the "base" licenses are initially activated for Scope View and Server. Please refer to the Overview [▶ 8] to see which functions can be enabled with which license key.

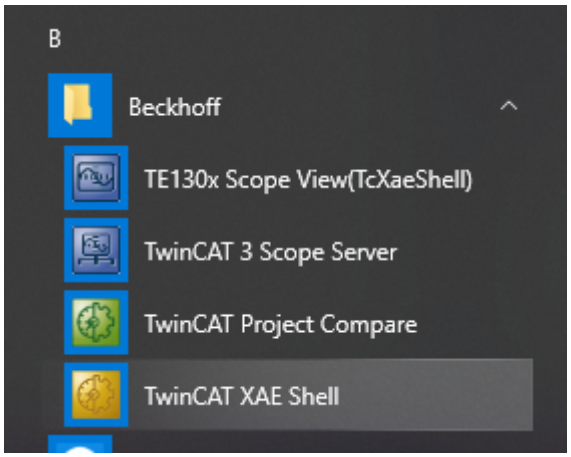
3. Creating a new project

The Measurement Wizard supports you in the creation and configuration of a user-defined Measurement Scope project by guiding you automatically through the necessary steps on the basis of successive dialogs.



You can also create your scope project in the conventional way without the Measurement Wizard, see TwinCAT Target Browser [▶ 166].

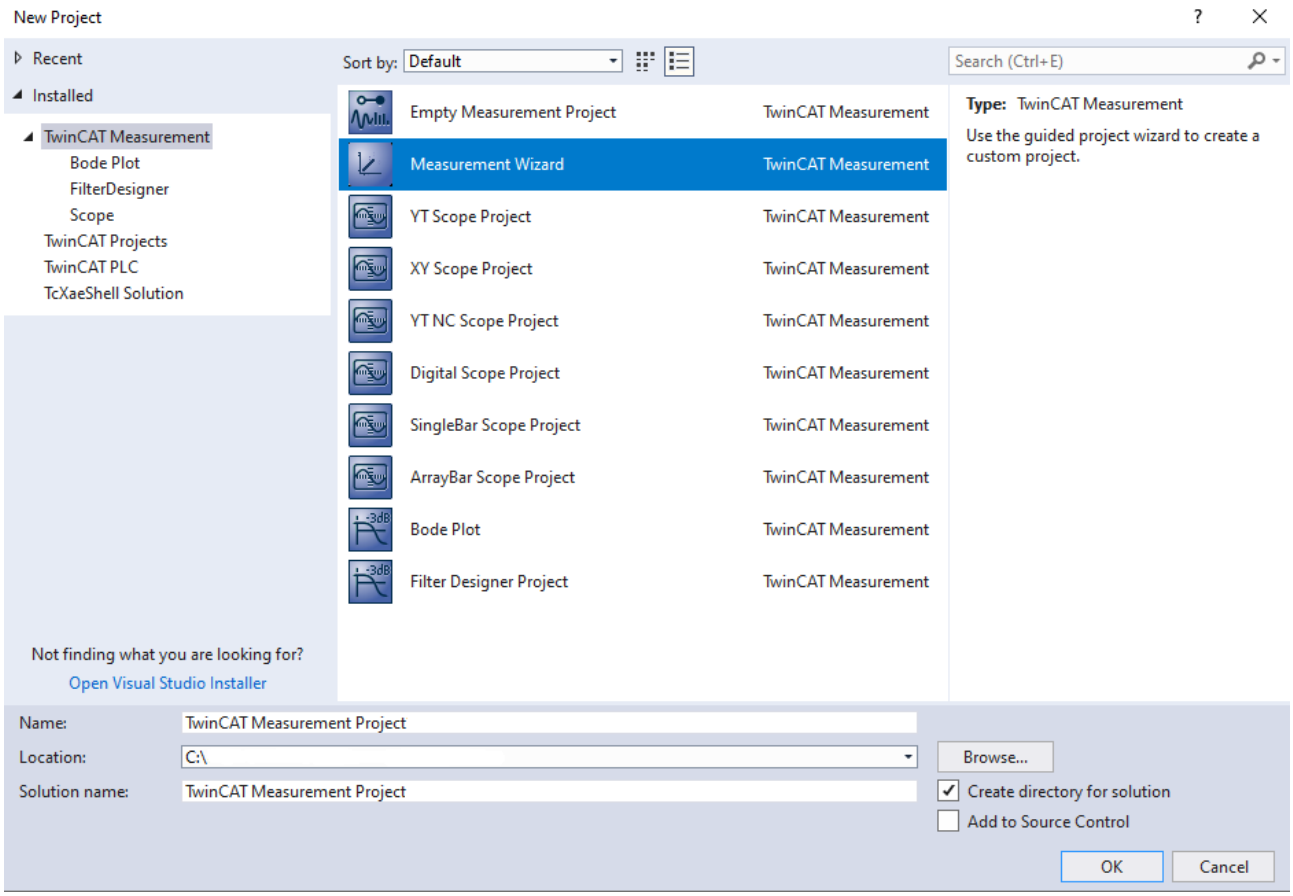
1. Open **Beckhoff > TwinCAT XAEShell** in the Windows Start menu.



⇨ The Visual Studio opens in its shell or in a full version if installed.

Start the Measurement Wizard

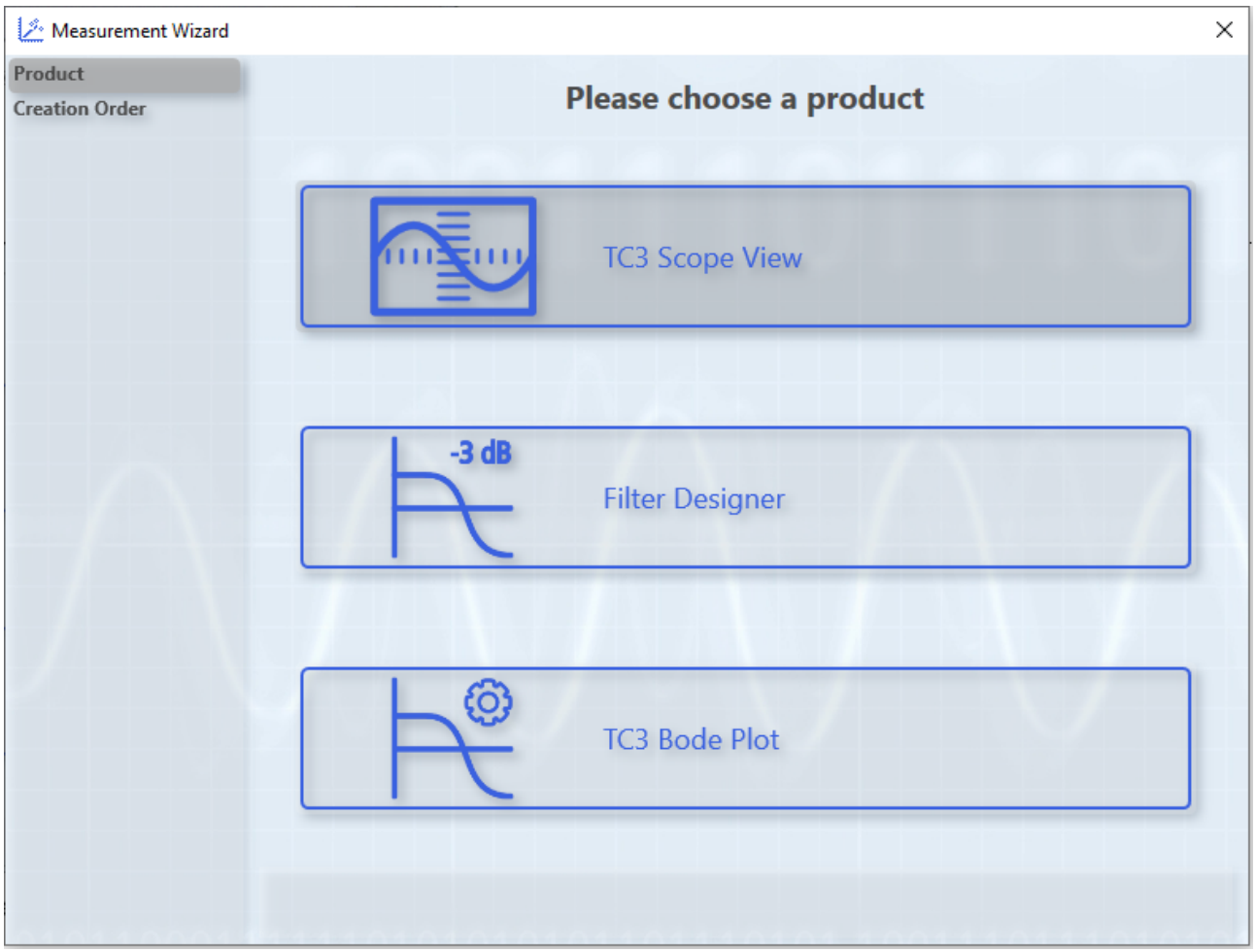
1. On the Start page, select a TwinCAT measurement project (for example **YT Scope Project**).
2. Select the **Measurement Wizard** in the following dialog box.
3. Enter the name and memory location of your project and confirm your entries with **OK**.



⇨ The Measurement Wizard for TC3 Scope View, Filter Designer and TC3 Bode Plot opens.

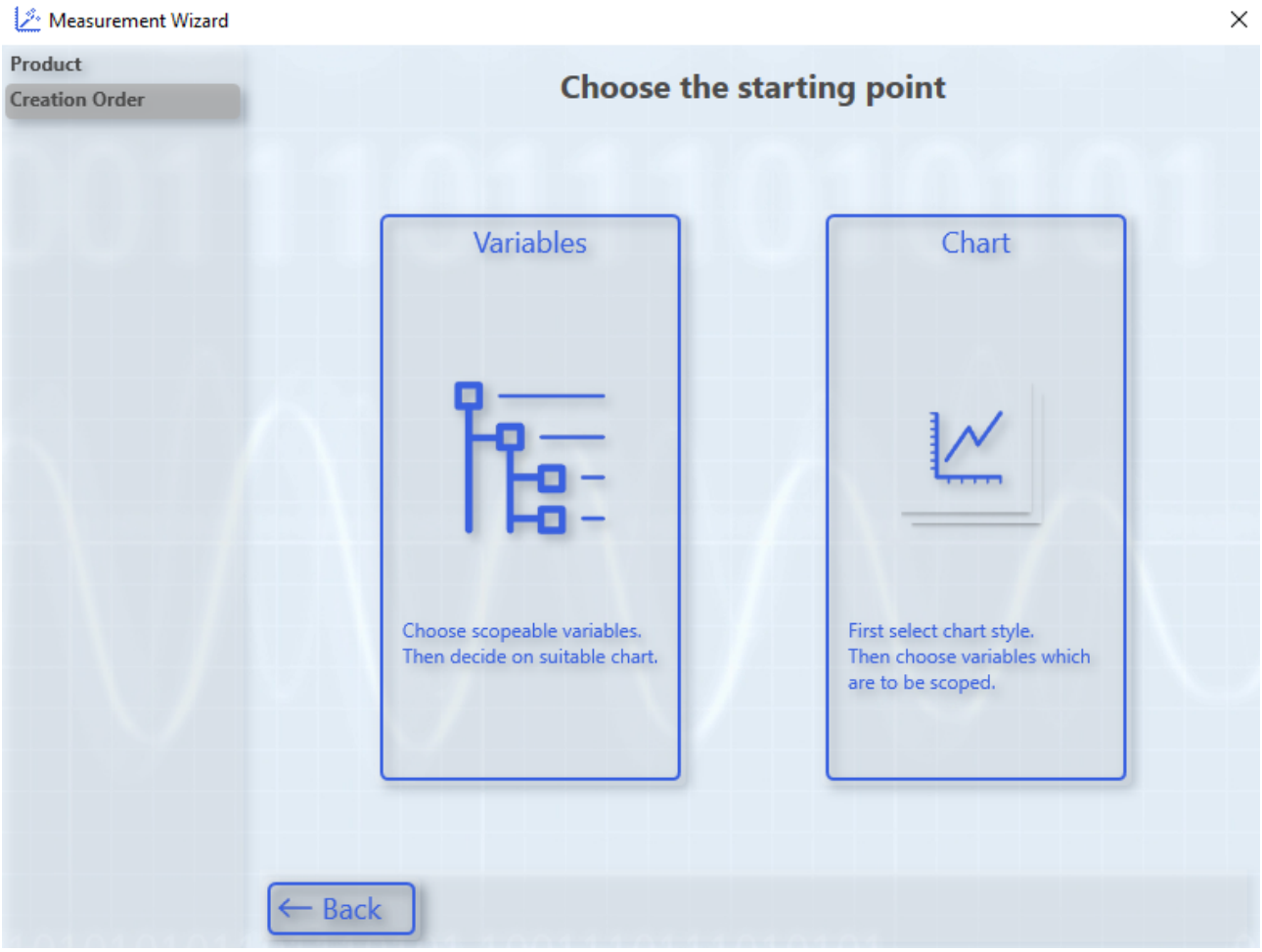
Select program variant

1. Select a **TC3 Scope View**.

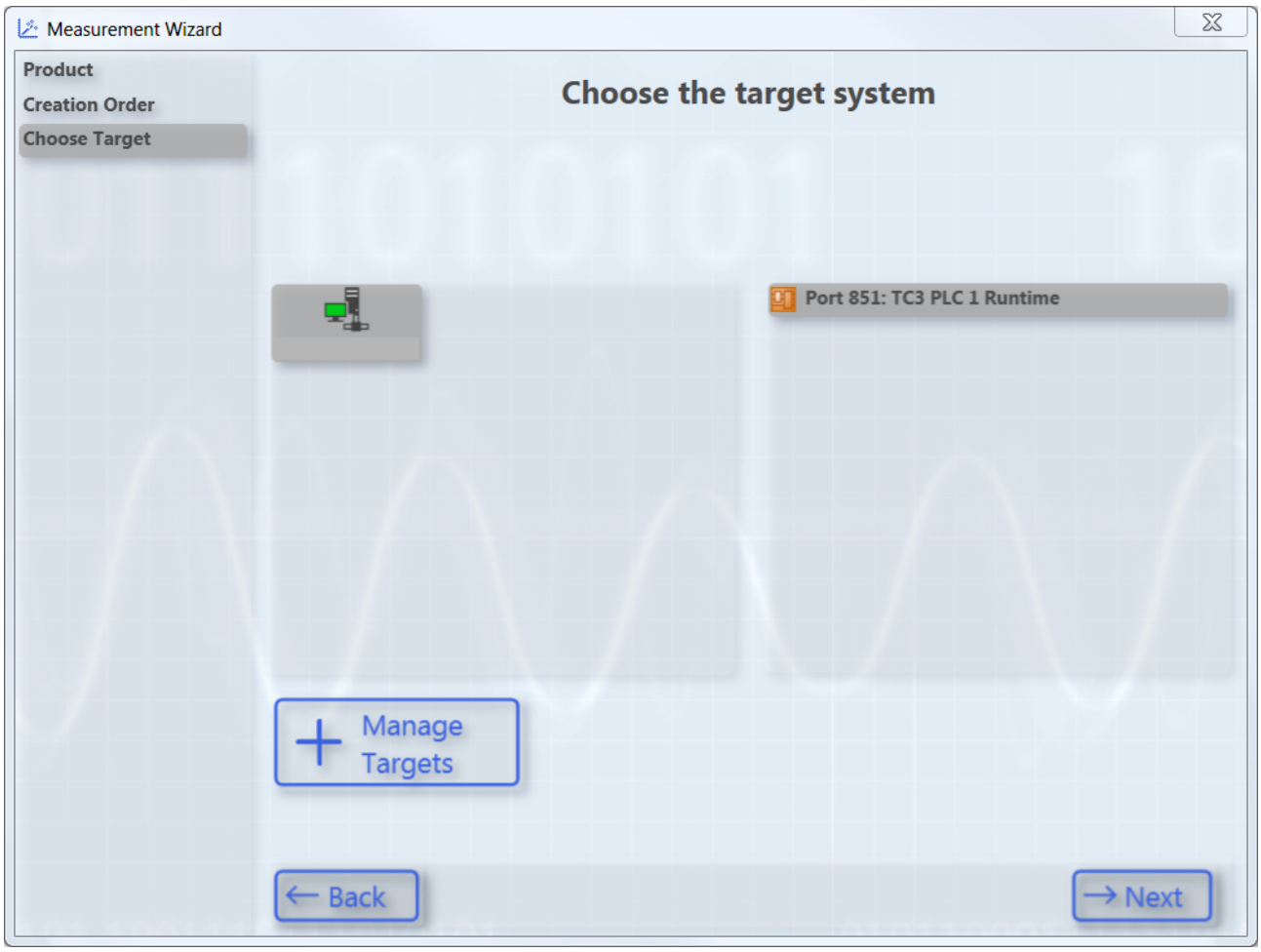


⇨ You can make coordinated settings in the following dialog box.

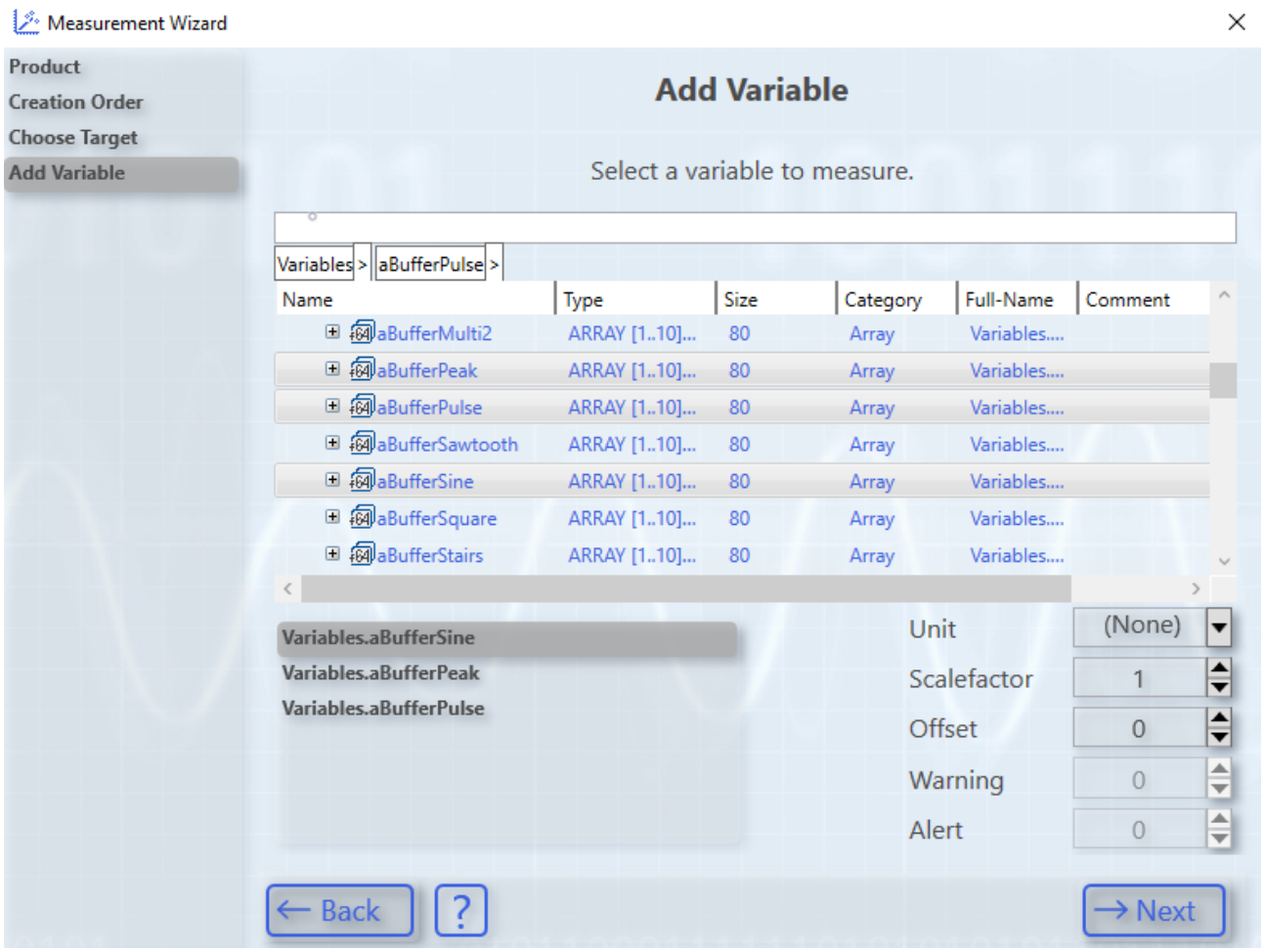
Define the starting point and select the target system



1. Click the **Variables** button.
   ⇨ With this option you initially select the variables that are to be recorded and graphically displayed.
2. Select the target system and the corresponding ADS port.
3. Click the **Next** button.



4. In the following dialog box, select the variables that are to be recorded and graphically displayed.



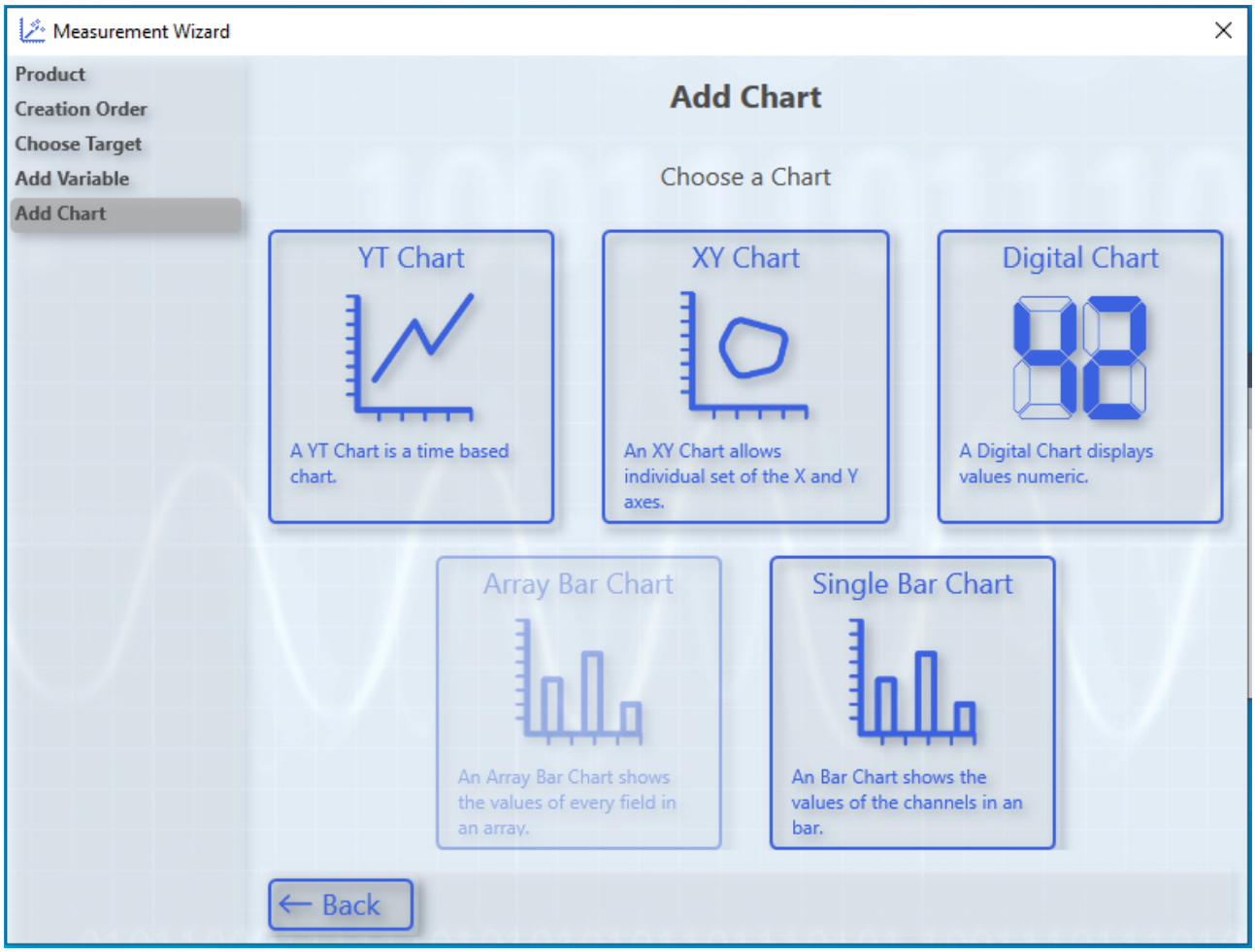
⇨ You have various options in this area:

- Navigate through the menu.
- Enter a variable name in the text box for filtering.
- Enter a different scaling factor and an offset.
- Enter a warning level and an alert level.

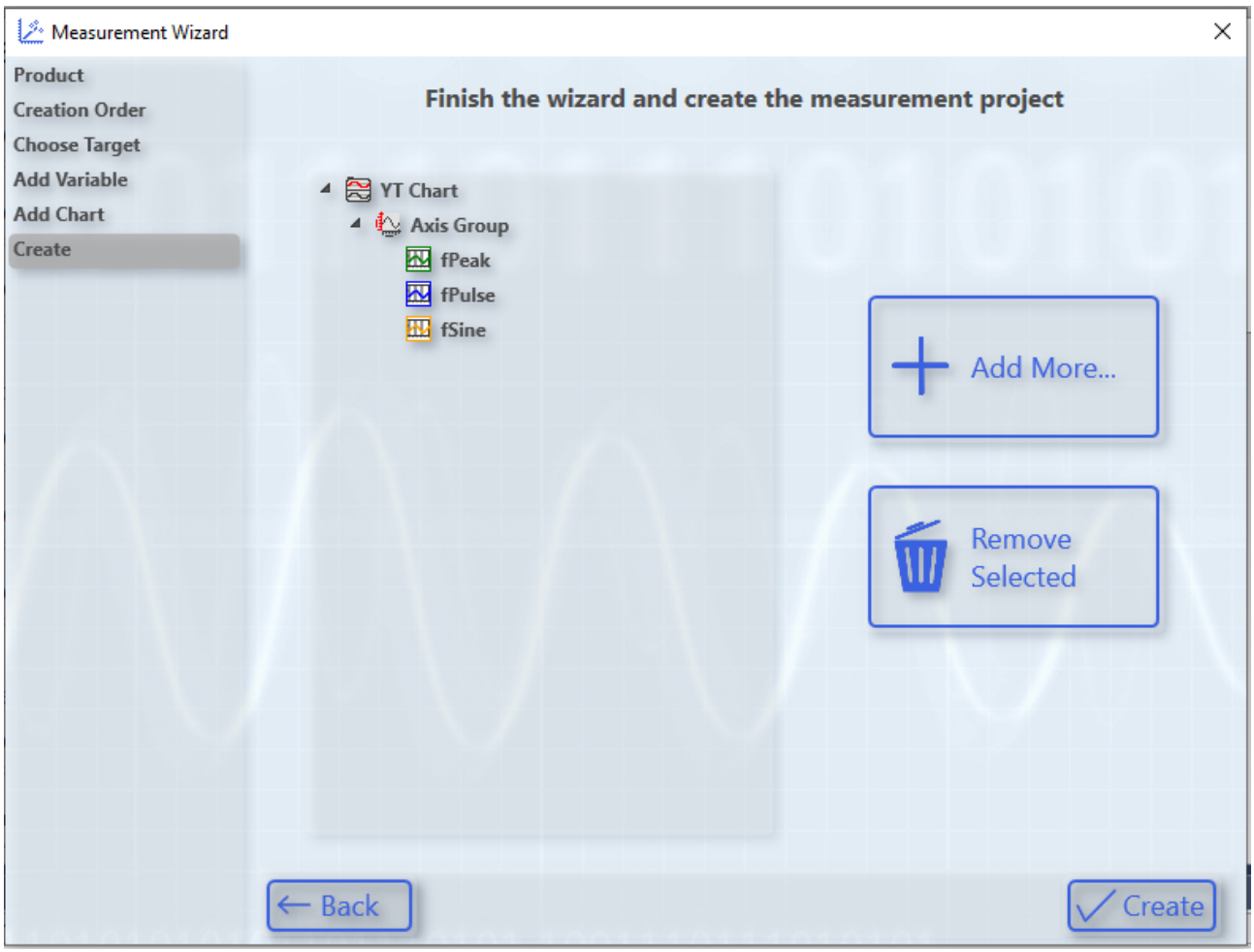
With these values you configure the dynamic style function for these variables. From the warning value the graph is drawn in yellow and from the alert in red.

- Click on **Next**.

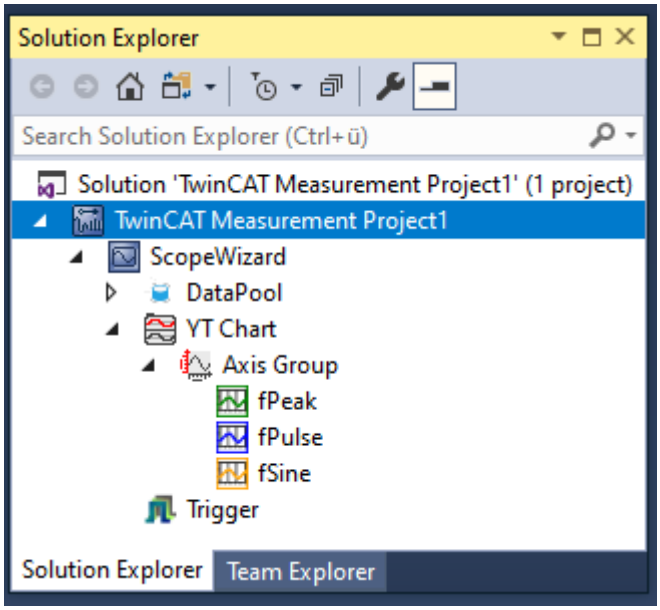
Adding a chart and configuring axes



1. Select the chart type.
   ⇨ You can only select chart types that match your variable selection. By way of example, here is a YT chart.
2. Add further axes if necessary.
   ⇨ Configure further axes in accordance with the menu navigation and assign variables to them. You can go back and undo/change the selection via **Back**.



3. Finally, click the **Create** button.



⇨ In the **Solution Explorer** the starting point for the new Scope configuration assembles itself automatically.

Defining the settings

Prior to a recording, the basic settings for the recording must be defined in the scope properties.

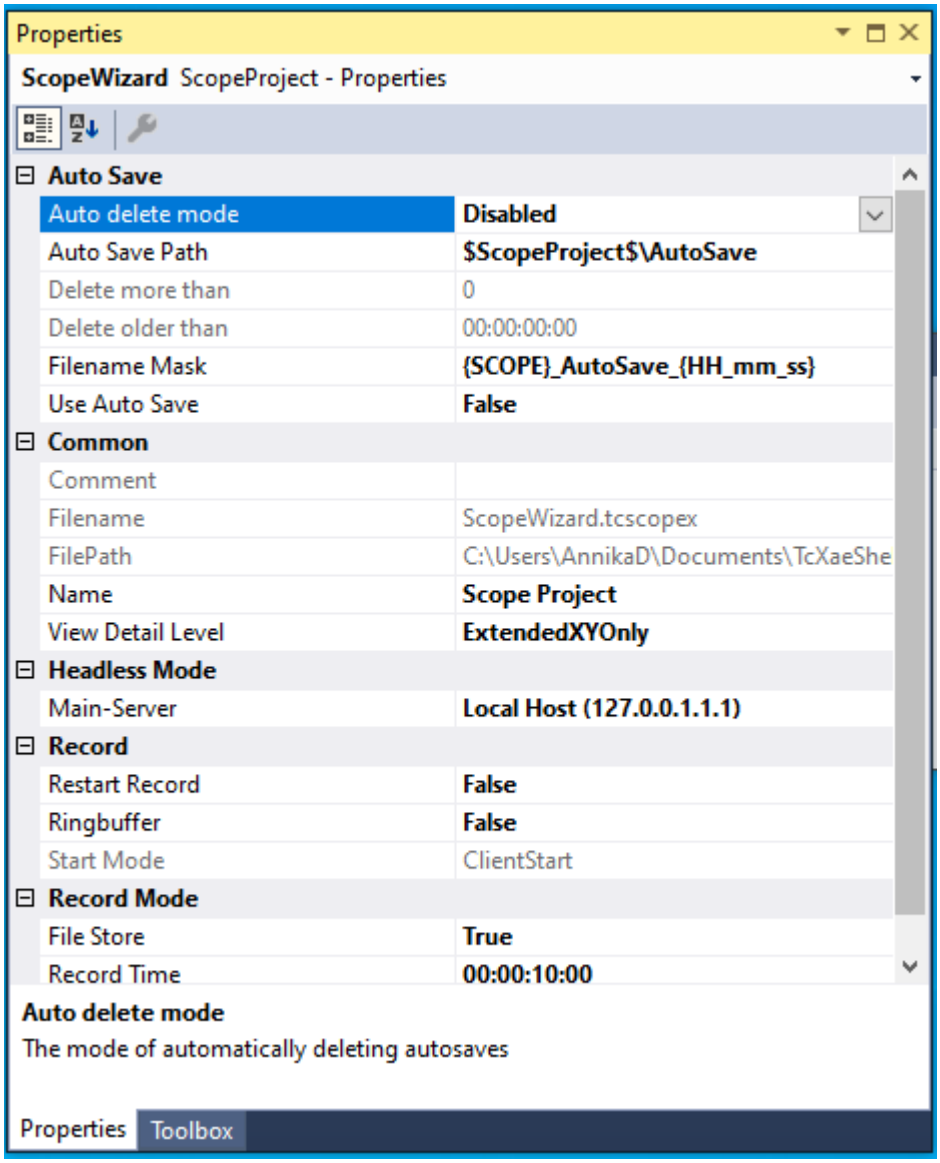
1. Select the respective element in the **Solution Explorer**.

⇨ If the **Properties** window has not yet opened automatically:
open it using the **Properties** command in the **View** menu.

Standard is a ten-minute recording which is started manually and automatically stopped after the respective time.

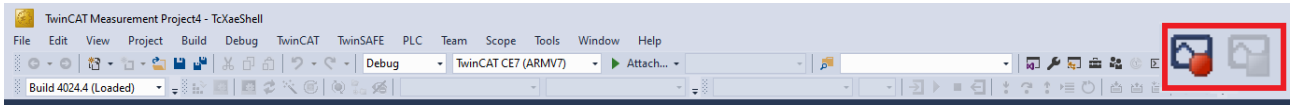
In the standard **Properties** window you can make settings for:

- All hierarchical levels of the scope,
- chart,
- axis,
- channel,
- trigger and
- marker.



Starting and ending the recording

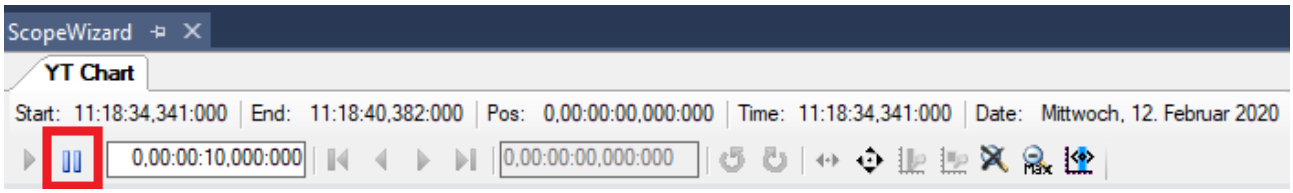
✓ When using for the first time, the TwinCAT Measurement toolbar must be activated in the menu **View > Toolbars**.



1. Click the icon with the red record symbol to start the recording.
2. Click the icon with the blue symbol to end the recording.

⇨ The standard recording time is 10 minutes.

Pausing the recording in the view



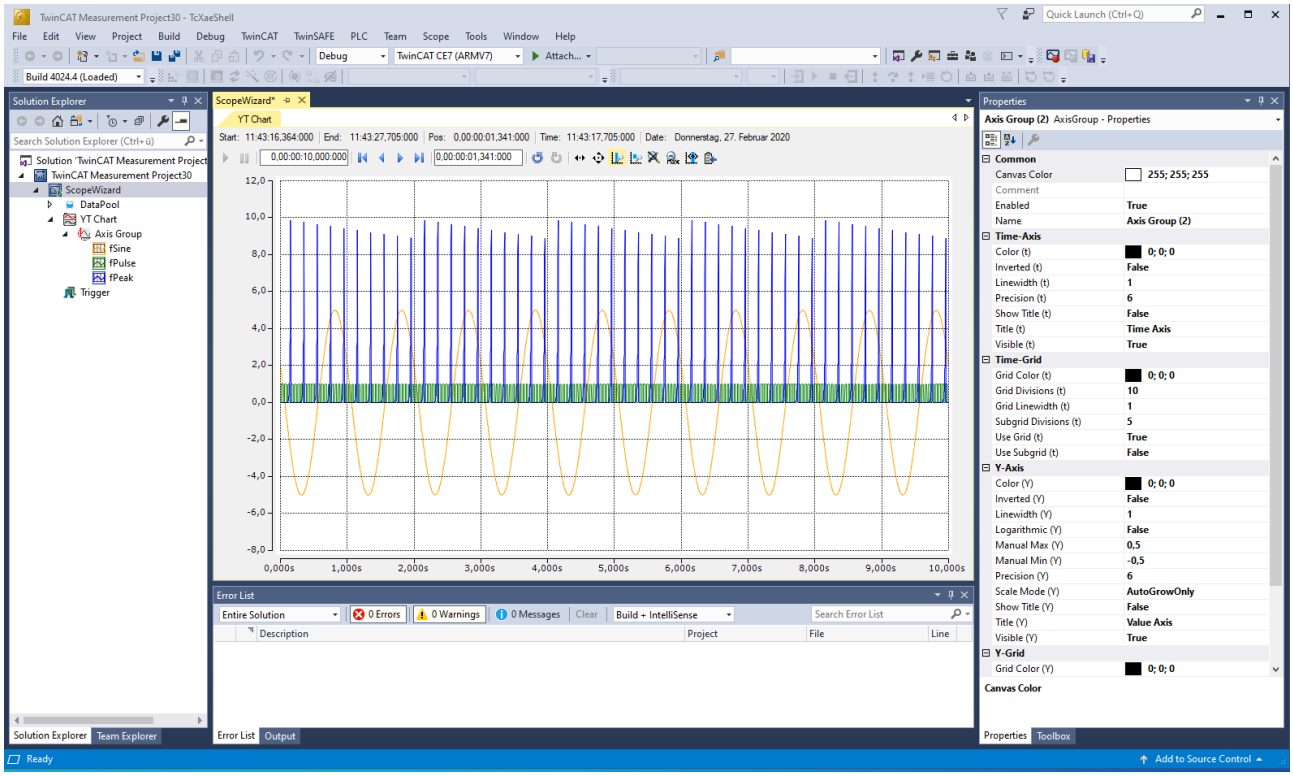
1. Click the pause icon in the chart.

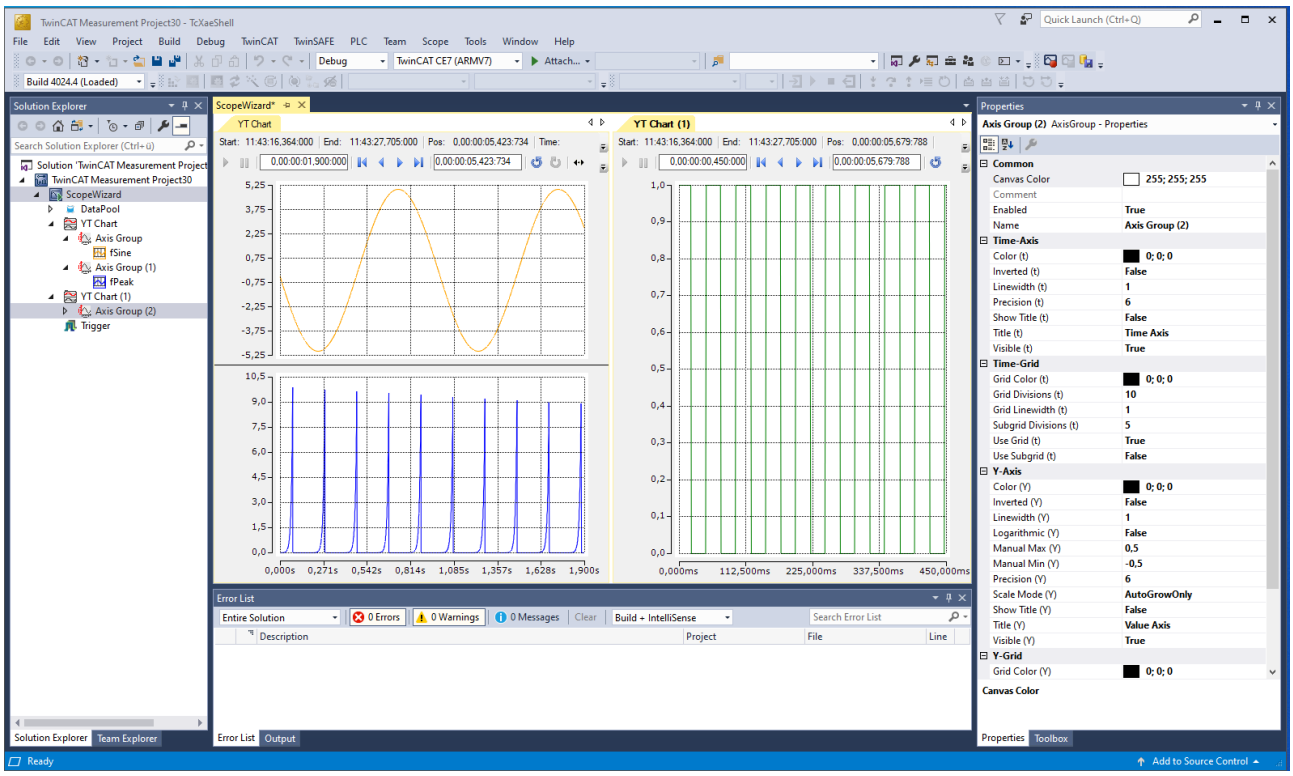
⇨ The graph is paused – only for viewing – in the display.

> While you pause the view in the chart using the pause icon, the recording continues to run in the background. You can pause the display in this way in order to zoom into the data or to analyze the signal curve.

Changing the display

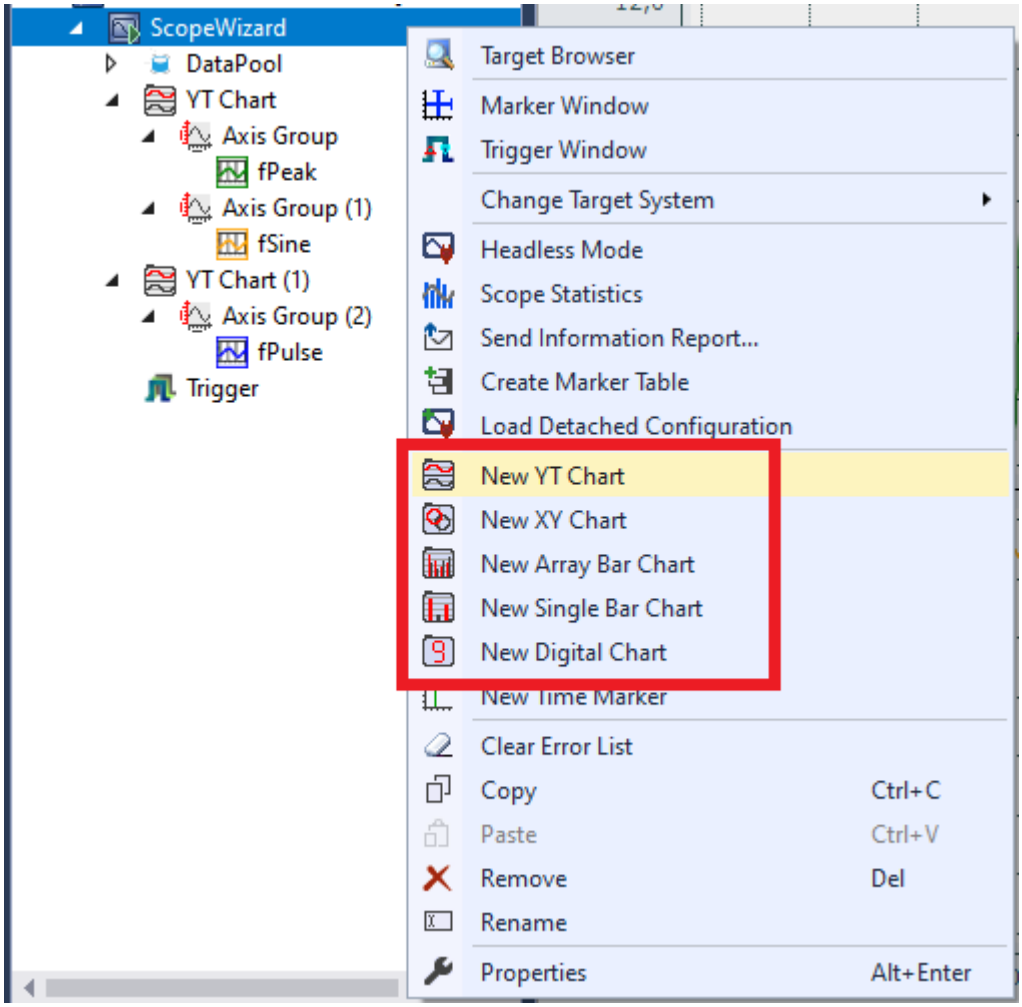
In order to improve the display of the channels in the View, charts and axes can be added even during the recording in TwinCAT 3 Scope View and channels can be shifted within the Scope.





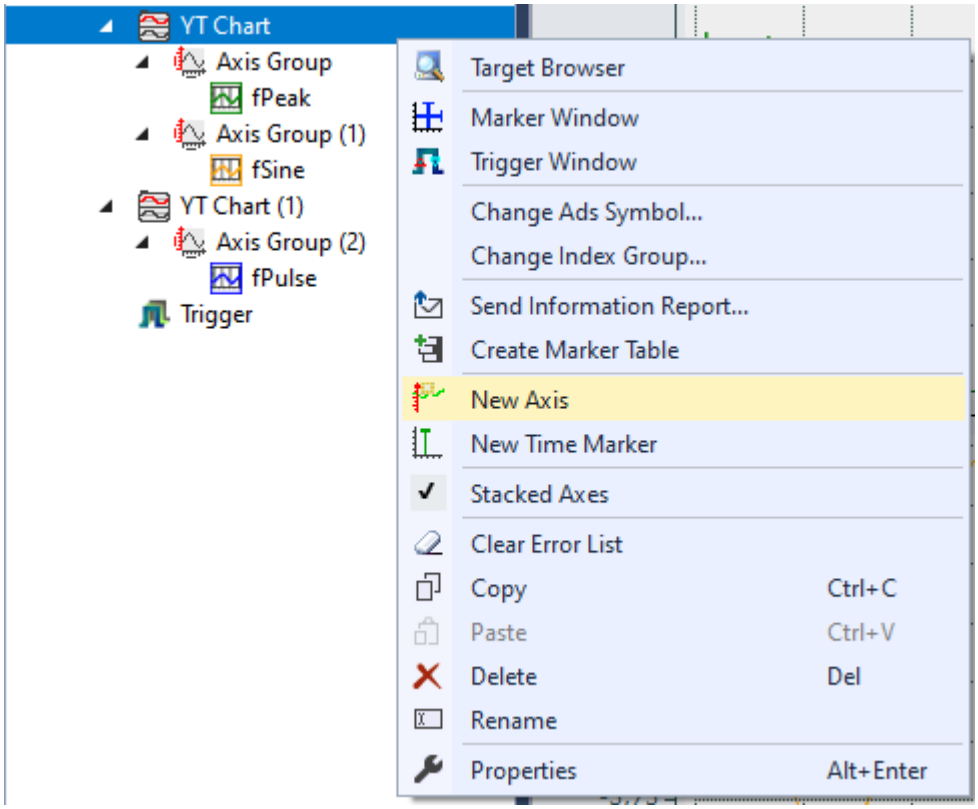
✓ Adding charts or axes and shifting channels

1. In order to generate a new chart, right-click **ScopeWizard** and select the desired chart.



2. In the tree structure of the Solution Explorer, move the desired channel by drag & drop to the newly created chart.

3. To create a new axis, right-click the respective chart and select **New Axis**.



4. In the tree structure of the Solution Explorer, move the desired channel by drag & drop to the newly created axis.

⇨ If necessary, use the icons in the respective chart for zooming and shifting in order to observe the signal curve more precisely.

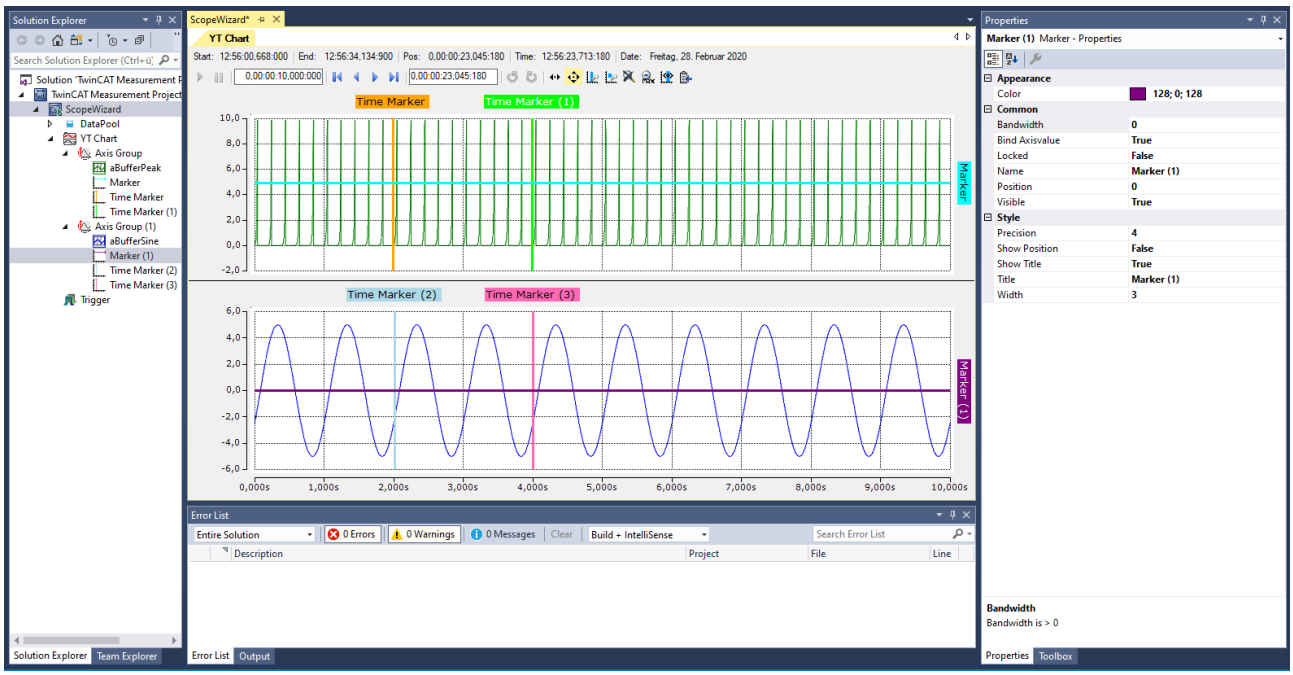


Adding markers to the axes

A marker is a chart element that can be docked to an axis. It is displayed as a line in the View and can be evaluated and compared with other markers in the Marker window.

1. Right-click the respective chart and select the desired markers for the X and Y axes.
2. If you wish to analyze the signal curve more precisely, click the pause icon in the respective chart and zoom into the data.

⇨ You can edit the markers in the properties window in the display and evaluate them in the Marker window.

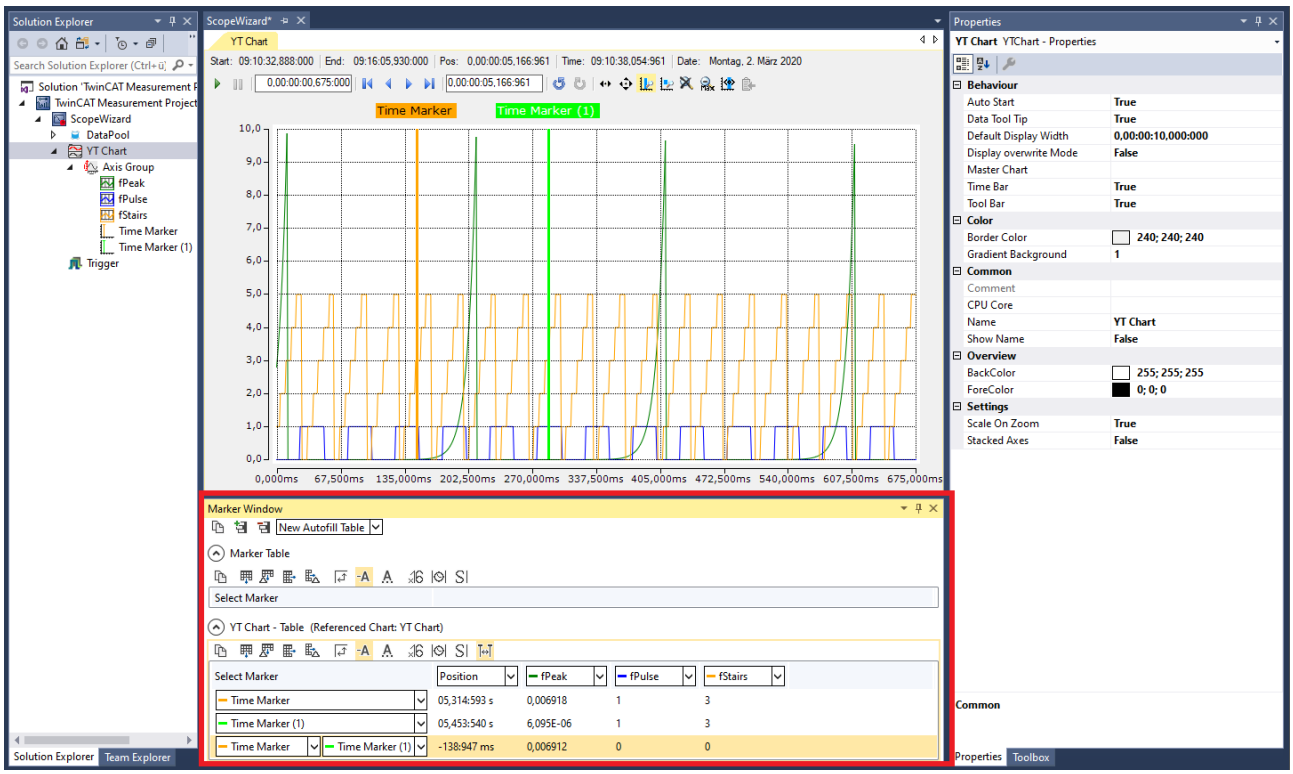


Marker window

Showing and hiding

1. Right-click the respective chart and select **Marker Window**.
   ⇨ The Marker window is displayed and can be shown clearly under the view for the analysis of the set markers.
2. In the drop-down menu at the top in the Marker window, select the option **New Autofill Table** and the corresponding chart.
   ⇨ Important parameters will be displayed automatically.
3. As an alternative to the auto-fill option, you can combine everything individually using the **Add…** command in the toolbar.
4. Click the comparison tool in the toolbar of the Marker window to display the differences between the set markers and the corresponding signal curves.

⇨ The position is constantly displayed. It mirrors the X axis.

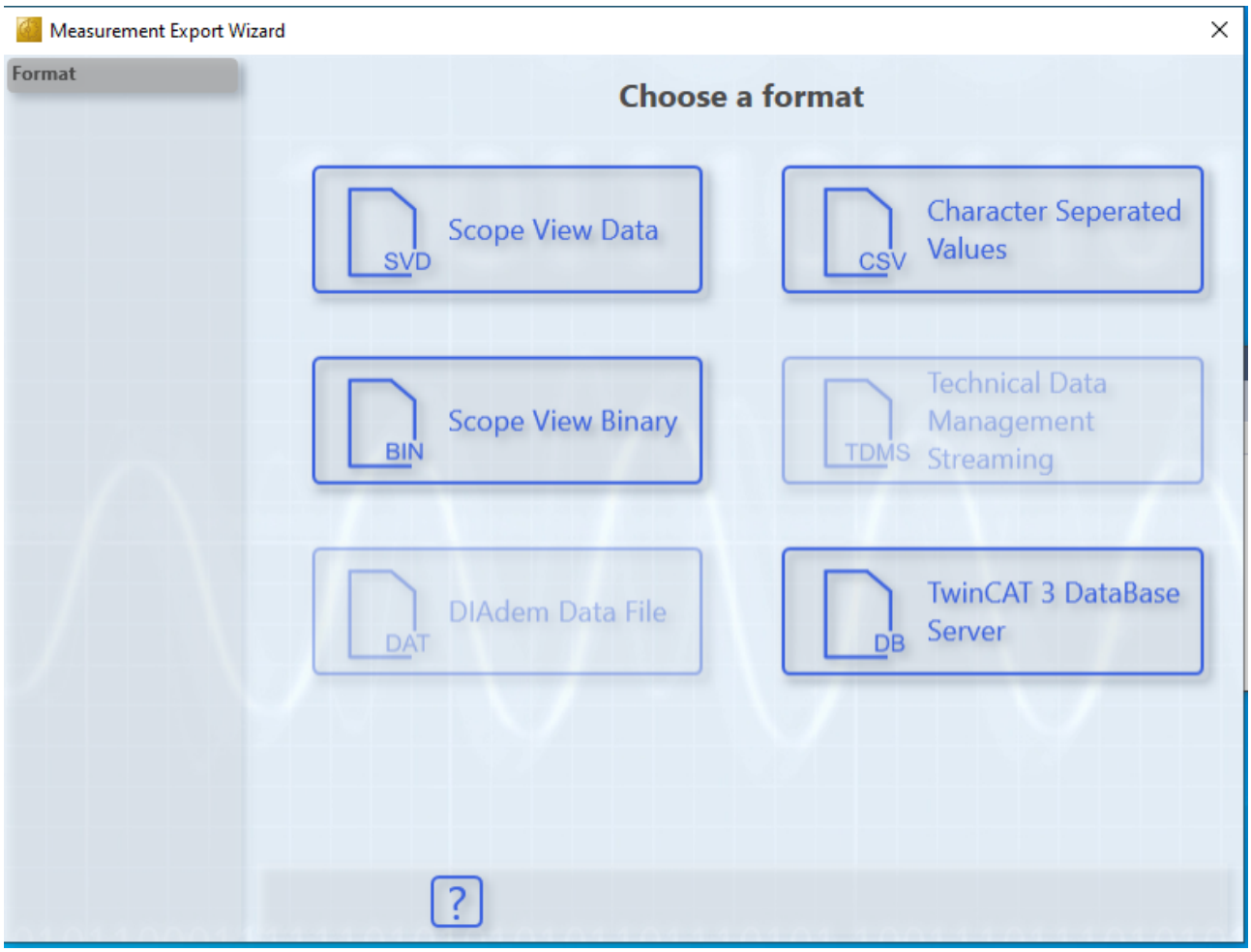


Save data

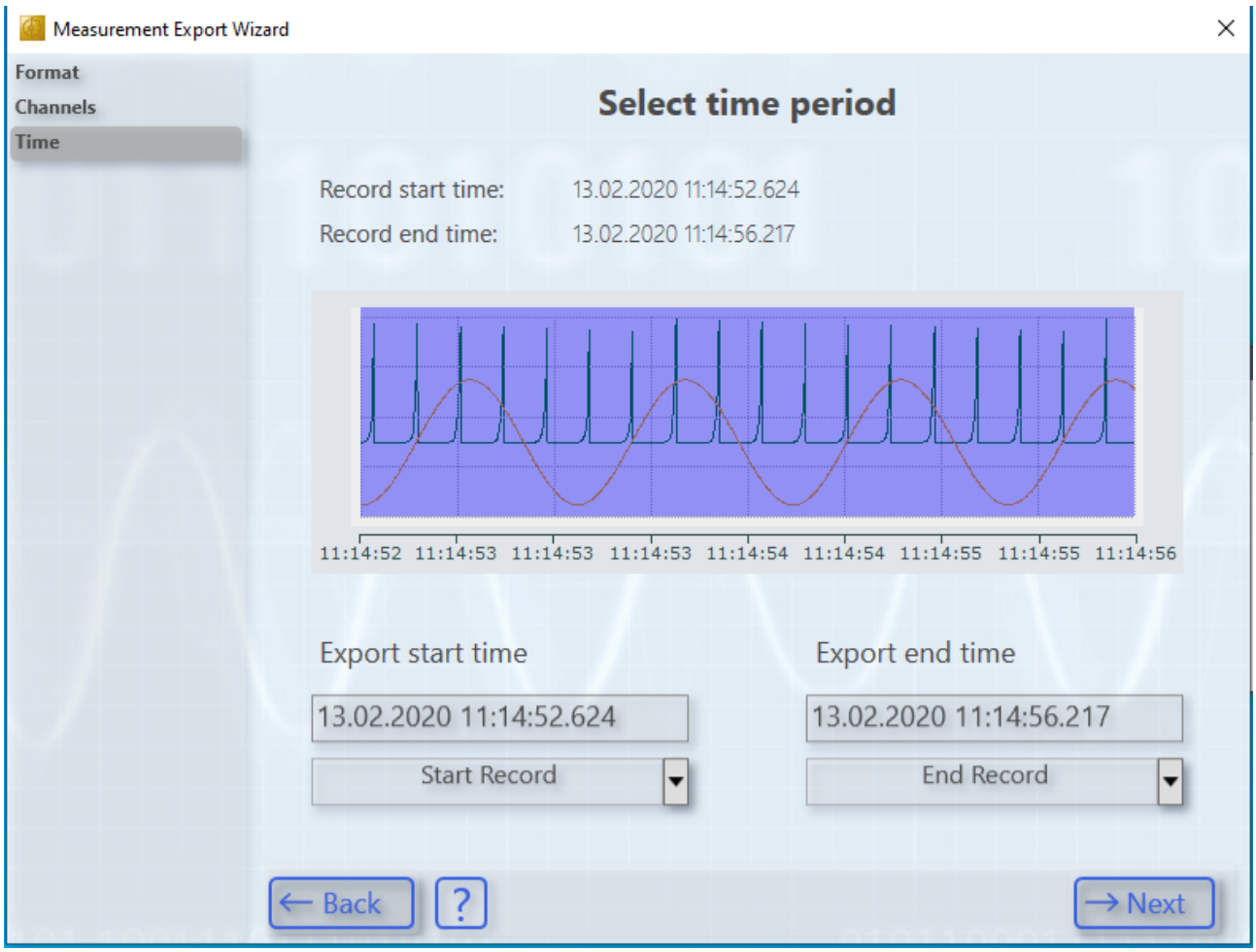
The data can be exported in various data formats for further processing.

✓ The recording must be ended via the TwinCAT Measurement toolbar, or must have been ended automatically after the preset expiry time.

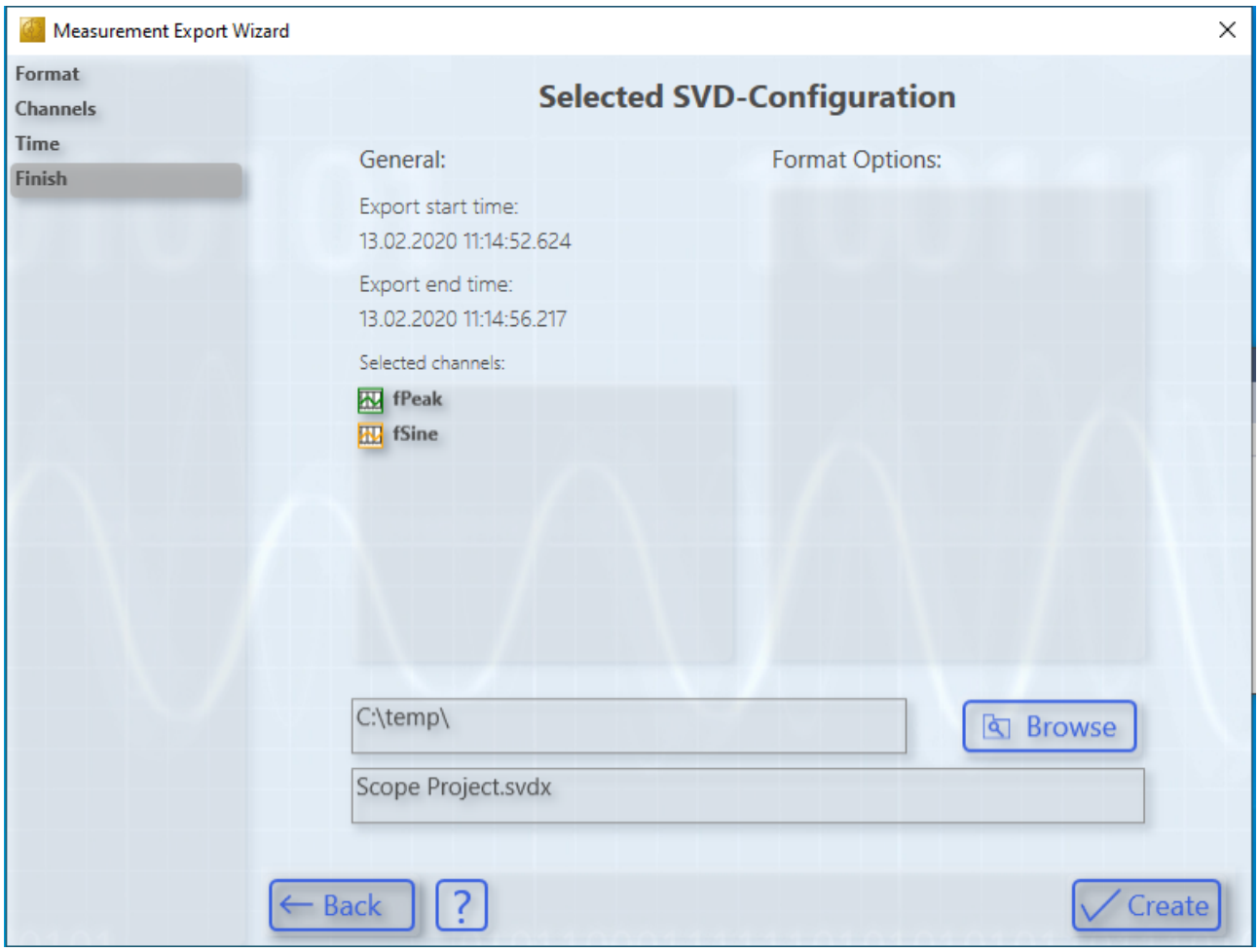
1. In the program, go to **Scope > Export...**.



2. For this sample, select the file type Scope View Data (SVD).
3. Select the time period to be saved and click **Next**.



4. Define the memory location and click **Create.**


Measurement Export Wizard
Format
Channels
Time
Finish
Selected SVD-Configuration
General:
Format Options:
Export start time:
13.02.2020 11:14:52.624
Export end time:
13.02.2020 11:14:56.217
Selected channels:
fPeak
fSine
C:\temp\
Browse
Scope Project.svdx
Back
?
Create

8 Appendix

8.1 How To

8.1.1 Changing common settings at the same time

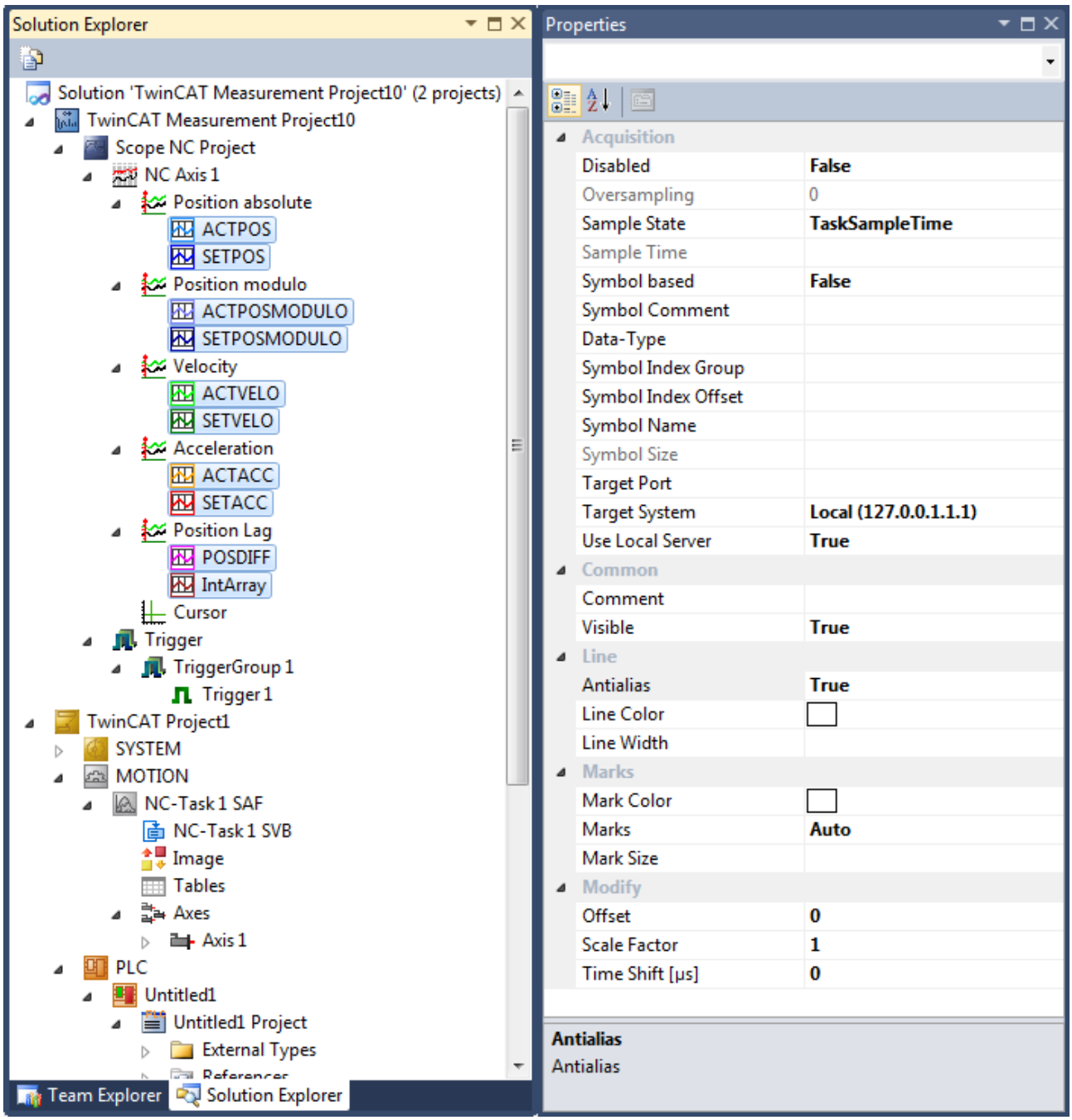
Multiple selection – changing group-wise

To change the settings of several elements at the same time, mark the elements in the **Solution Explorer** and edit the settings of all the marked elements in the **Properties** window. Data that differ between the selected elements are represented as empty fields.

To make multiple selections, keep the [Ctrl] key pressed while selecting the channels. In the case of successive elements, you can select the first element, keep the [Shift] key pressed and then select the last element in order to mark all elements in between.

To select all channels of a scope irrespective of the configuration structure, keep the [Alt] key pressed and double-click on the first channel in the Scope configuration.

All elements of the same type can be selected.



Multiple selection is implemented for:

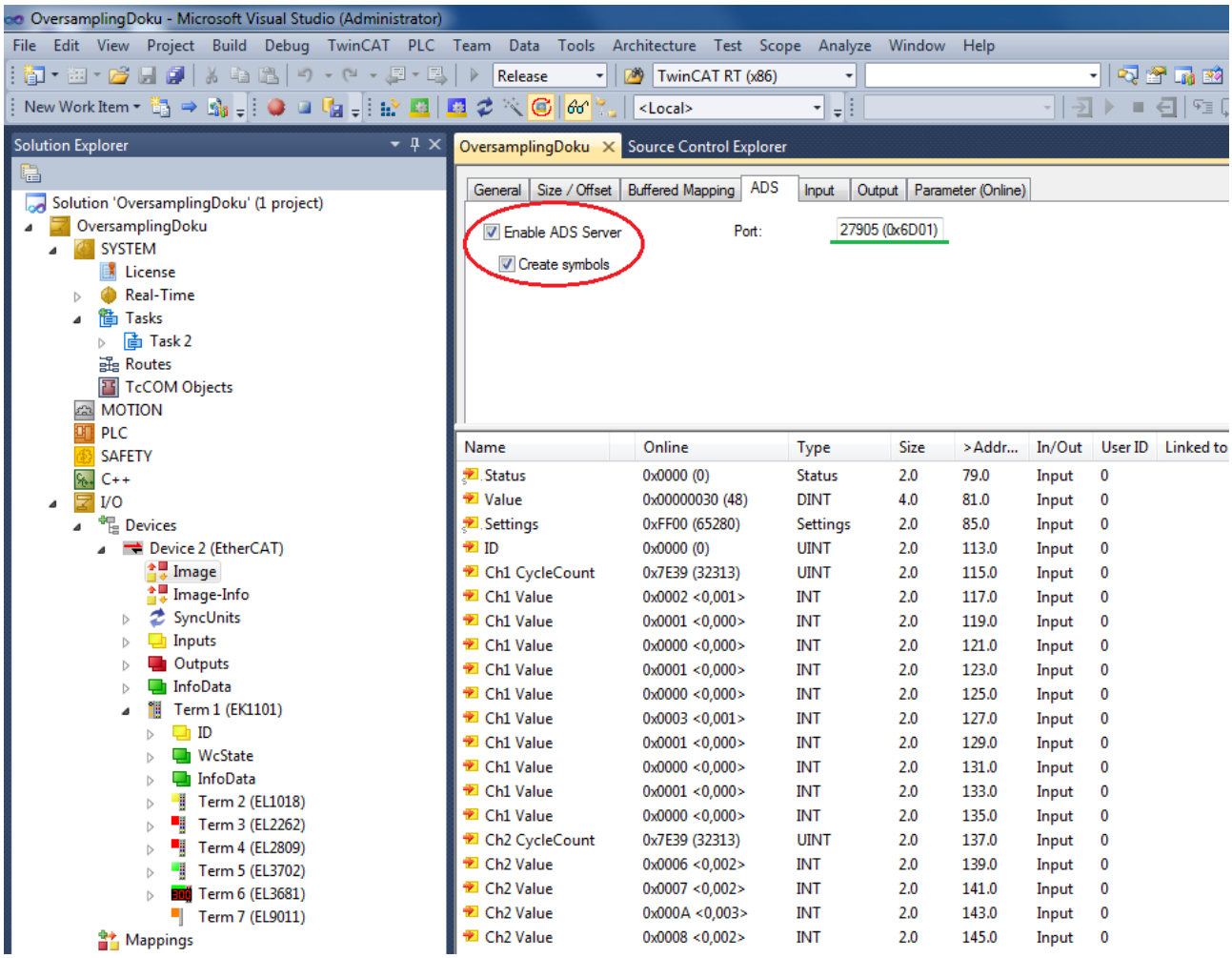
- Scopes
- Charts
- Axes
- Channels
- Cursor
- Trigger Groups
- Trigger Sets

8.1.2 Oversampling recordings with the TwinCAT 3 Scope

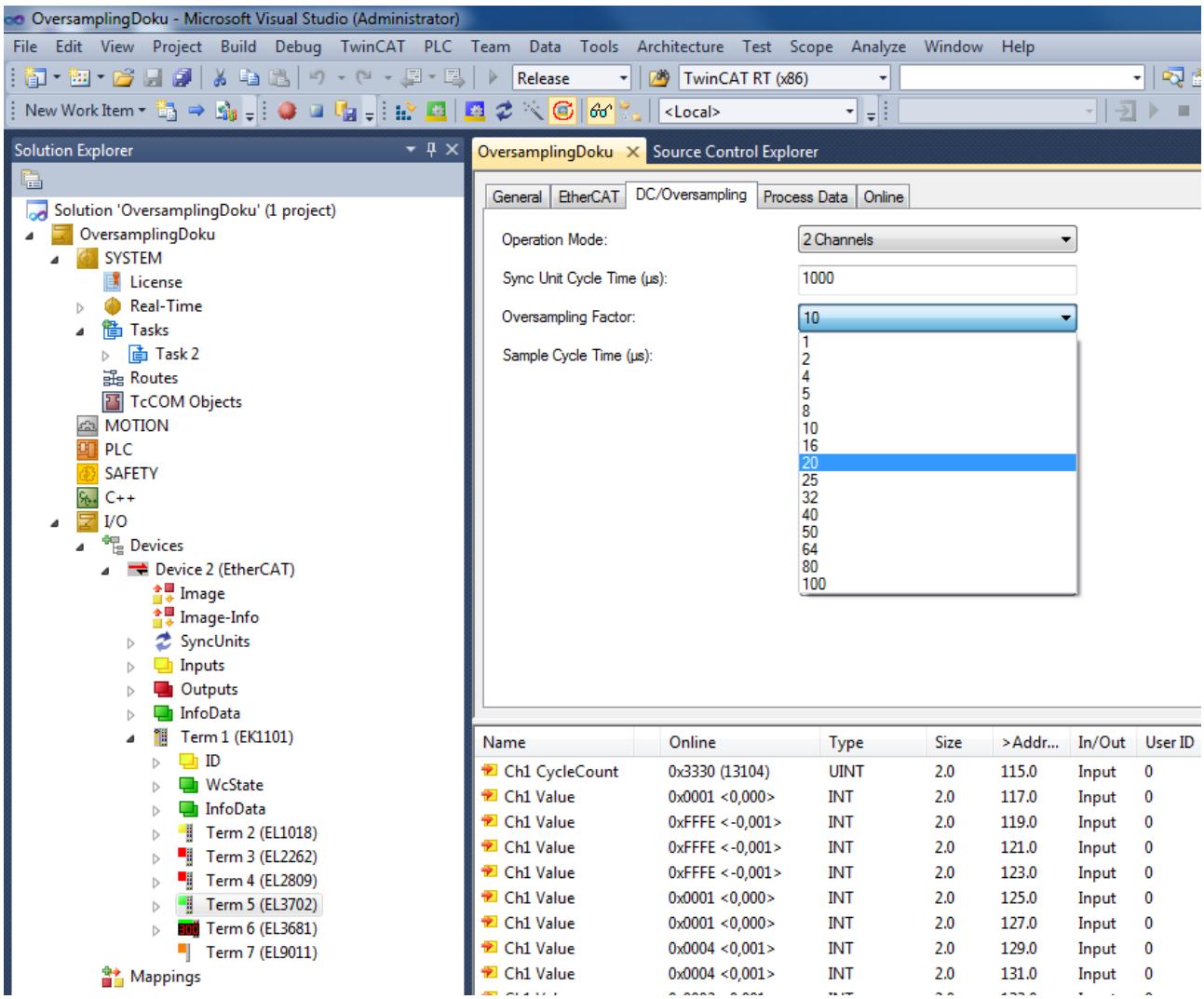
With the TwinCAT 3 Scope it is possible to represent oversampling values in a single variable. Since n values (n = oversampling factor) are recorded for each cycle when oversampling, the TwinCAT System Manager generates an ADS symbol containing a time stamp for each individual value. If a connection is made between the ADS symbol and the Scope, the Scope will accept all other settings to display the n values in the correct sequence.

So that the ADS symbol is created and can be directly scoped by an EtherCAT terminal (e.g. EL3702 or EL3632), some settings need to be made in the TwinCAT System Manager configuration:

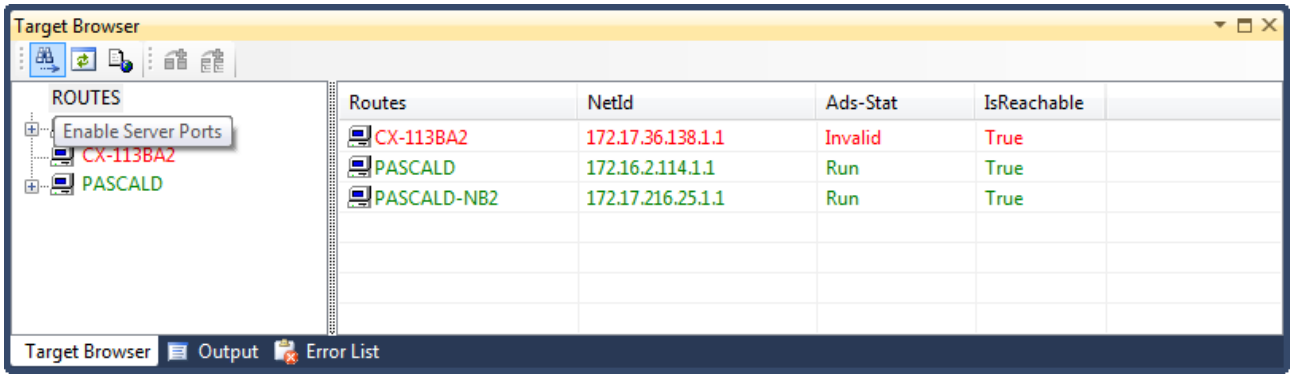
In the EtherCAT process image the **ADS** tab of the ADS servers must be enabled, and the option **Create symbols** must be switched on. The assigned ADS port has to be specified later in the Scope in order to find the ADS symbols.

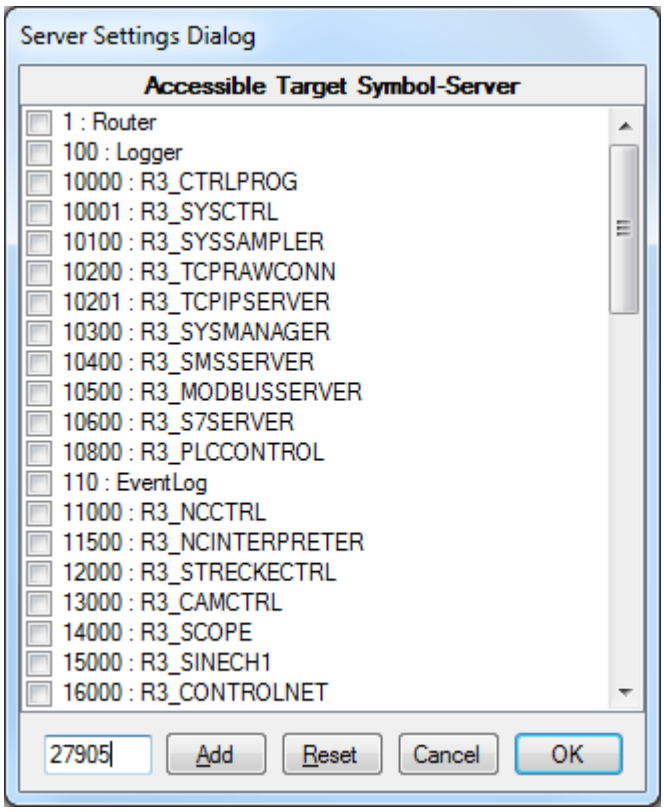


The desired oversampling factor should be set in the TwinCAT System Manager for the respective oversampling terminal before the configuration is activated.

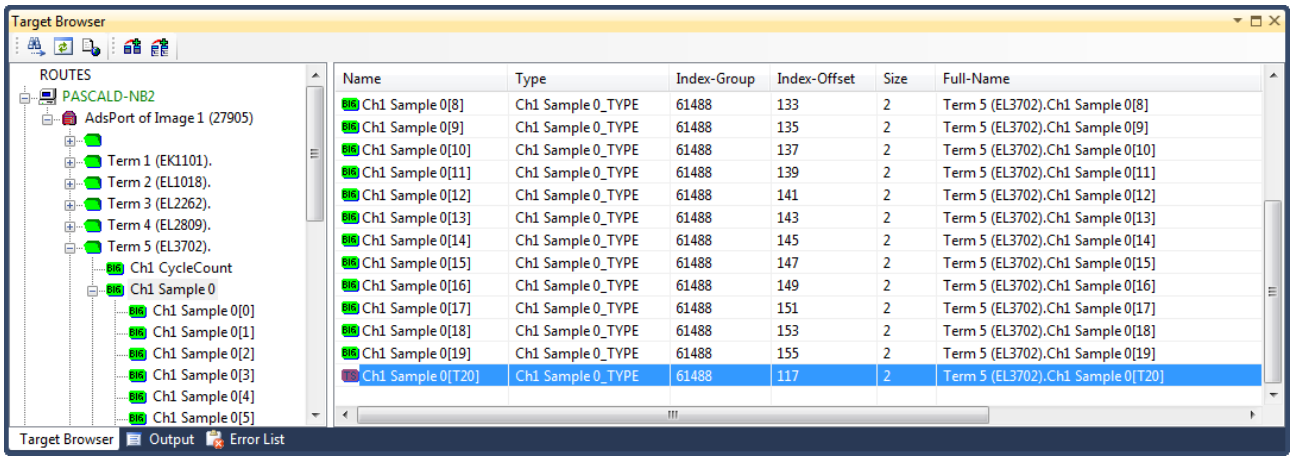


If the configuration was loaded successfully and TwinCAT is in Run mode, the TwinCAT 3 Scope can be called. The server settings must be defined in the Target Browser of the Scope. The ADS port number assigned by the TwinCAT System Manager must be entered in the corresponding dialog and added with the Add, provided the port has not already been entered.

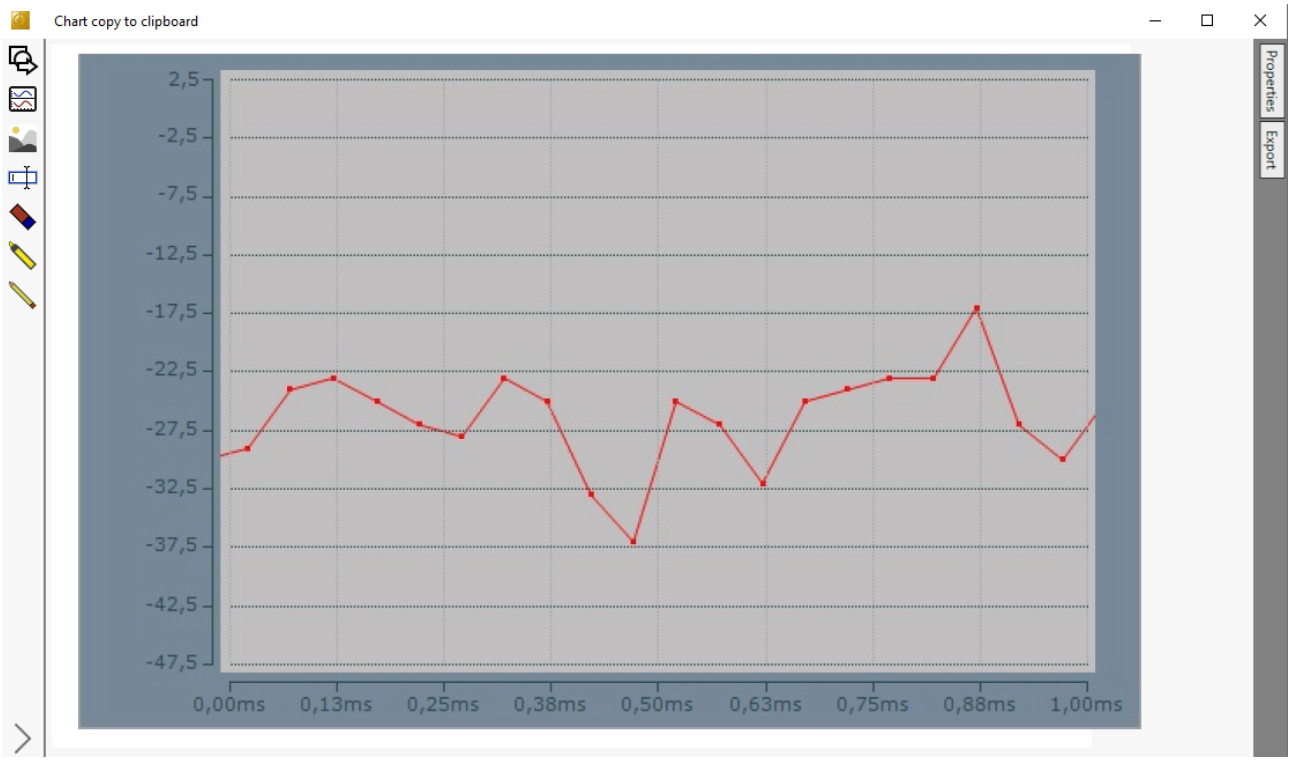




AdsPort of Image X (27905) appears in the Scope Target Browser. With this new entry, it is possible to browse the EtherCAT Terminals including the desired oversampling terminal. In the oversampling terminal, the variable shown in red with the supplement [T20] should be selected for the Scope recording. In this case 20 stands for 20 times oversampling. This number may vary according to the oversampling factor.



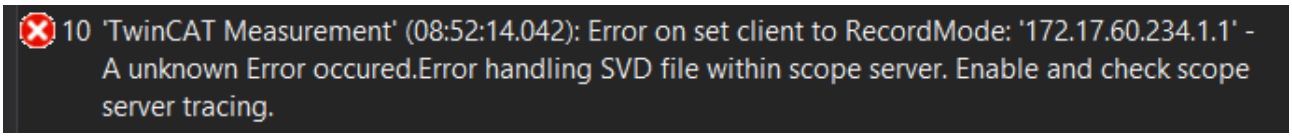
The INT16 variable can be recorded directly in TwinCAT Scope. In the following screenshot 20-fold oversampling with a cycle time of 1 ms.



8.1.3 Opening .svd files from a network directory

If a .svd file from the network is to be merged into the solution, the following error message will probably appear if appropriate preparations are not made.

An unknown Error occured. Error handling .svd file within scope server. Enable and check scope server tracing.



One of the following entries usually appears in the Server Tracing log:

- "ScopeServerTraceSource",Error,8442,"Access to the path '\\remote-PC\SVDs\test.svd' is denied.",,368,,"16","2014-04-28T07:26:59.9720667Z",,

or

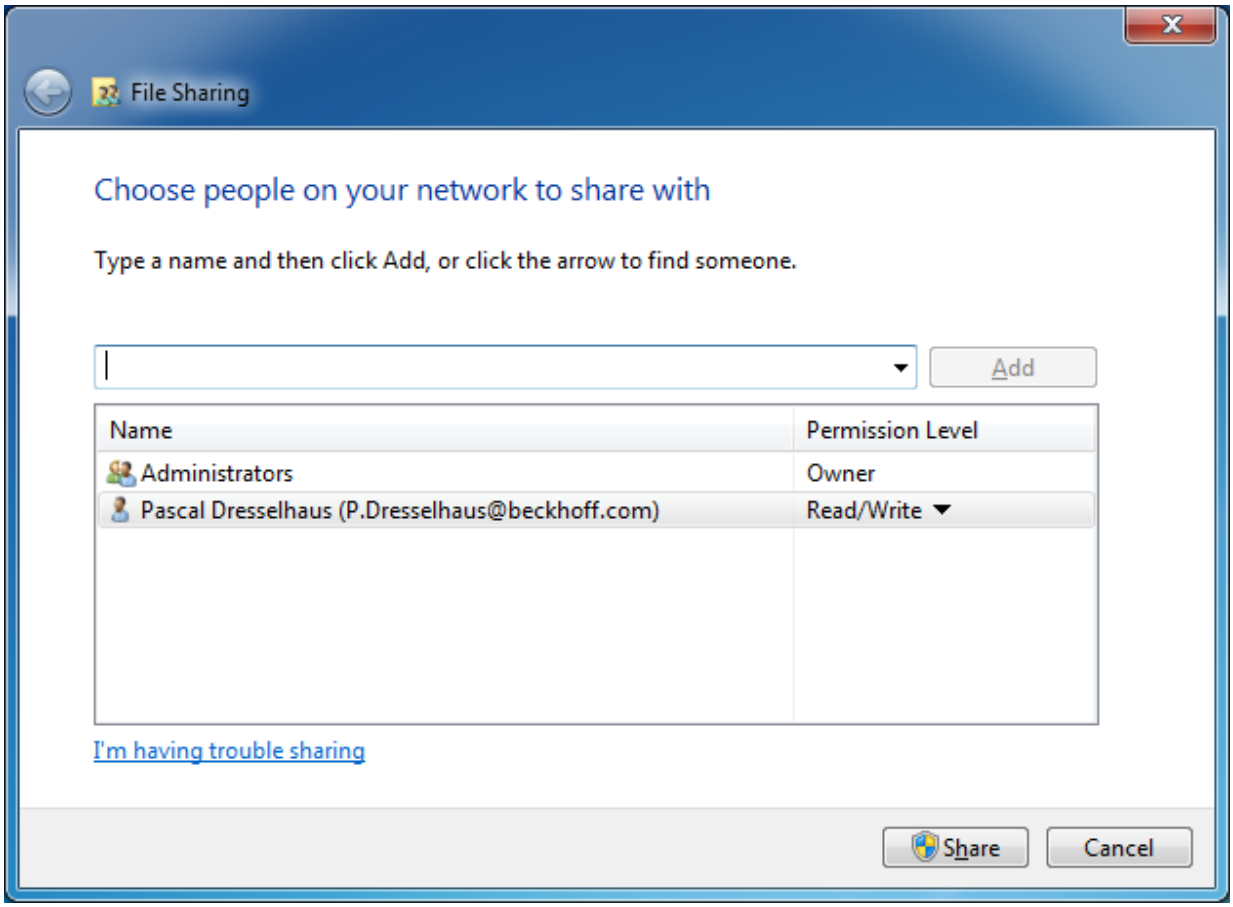
- "ScopeServerTraceSource",Error,8442," Could not find file '\\remote-PC\SVDs\test.svd '.",,3376,,"16","2014-04-28T07:26:59.9720667Z",,

Both errors indicate that the TwinCAT Scope server service has no rights of access to the network directory.

Proceed as follows to assign the required rights to the TwinCAT Scope server (example for Windows 7)**:**

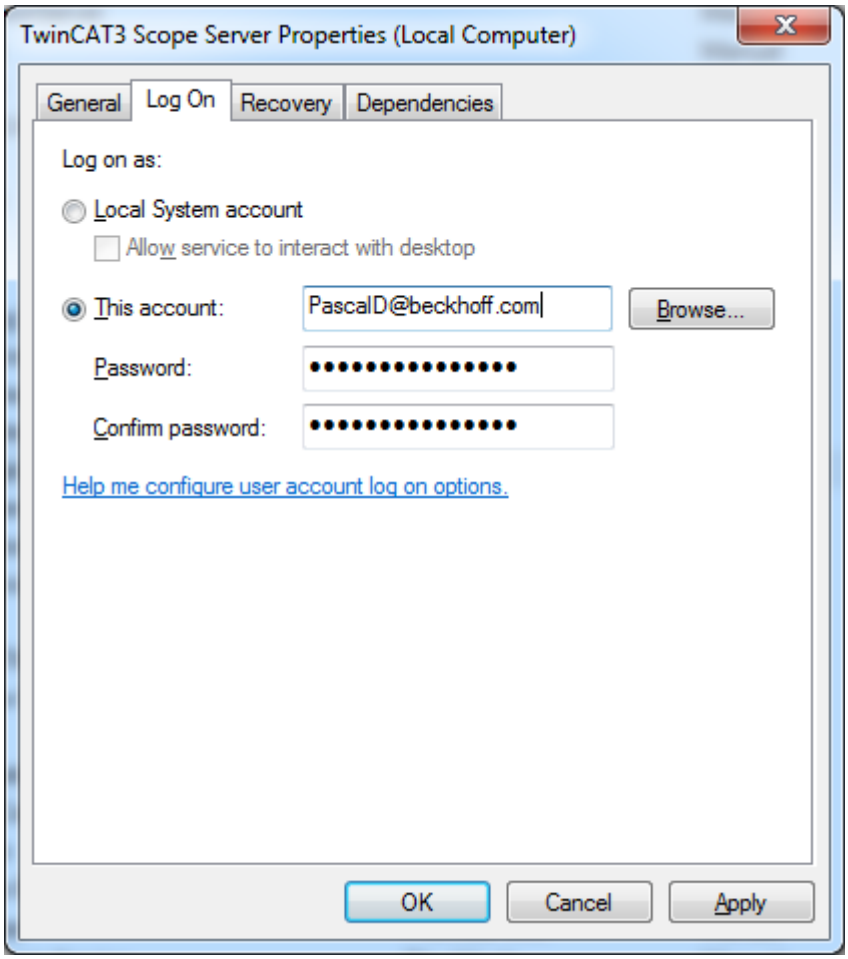
1. Right-click on the directory to be enabled, in order to open the context menu. Select the command **Properties**, and in the dialog that opens select the command **Share** in the **Sharing** tab.
   ⇨ The dialog **File Sharing** opens**,**

2. Enter the users who are to gain access to the directory. Permission level “Read” is sufficient for Scope server access and for displaying the .svd file.



3. Press **[Windows] + [R]** and enter “services.msc”. In the **TwinCAT3 Scope Server Properties** dialog select the **Log On** tab.

4. Enter the account with which you have rights of access to the network directory.



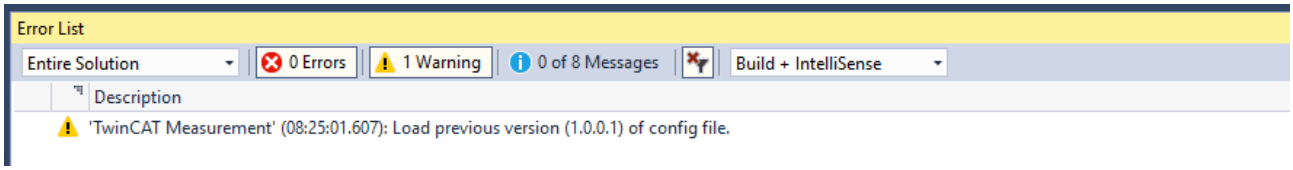
Pay attention to the correct use of your server domain.

5. After confirming, restart the service in order to accept the new user data.

⇨ Subsequently, .svd files from the configured network directory can be opened in the measurement project on this system.

8.1.4 Using old configuration files

The TwinCAT Scope is a very dynamic product. Nevertheless, old configuration files and data files can still be opened in the latest version. If an old configuration file (.sv2 from TwinCAT 2 Scope 2, .tcscope and .tcscopex from TwinCAT 3) opens with a brand new version in which there have been internal changes due to new functions, the Error List in Visual Studio displays the following message:



On saving the opened configuration, an updated configuration file will be saved in the project folder. Furthermore, the user will be asked whether he wishes to update the original file. If the new configuration file from the project folder or the updated original file is opened again, the warning does not appear in the Error List. If the original file is not to be updated and the warning no longer displayed, the warning for the Scope can be completely deactivated in the Options [▶ 311] (not recommended!).

8.2 FAQ

In this section frequently asked questions are answered in order to make your work with TwinCAT 3 Scope easier. If you have further questions, please contact our support (-157)

1. Is it true that "TwinCAT 3 Scope" in the TwinCAT 3 world is not a product, but a generic term for various products? [▶ 397]
2. Why are there different product levels for the TwinCAT 3 Scope? [▶ 397]
3. Can the Scope View Professional be operated with the Scope Server Base? What are the restrictions? [▶ 397]
4. Why do I need the TF3300 Scope Server when I can also enable the "Use local Server" option? [▶ 397]
5. Can I integrate the TwinCAT Scope View into my own visualization? [▶ 397]
6. Can I integrate the TwinCAT Scope View into a TwinCAT HMI web visualization? [▶ 397]
7. Is it possible to print out recorded Scope Charts? [▶ 397]
8. Is multimedia documentation available for TwinCAT 3 Scope? [▶ 398]
9. My Scope .svd files are on a network drive. Why can't I open them? [▶ 398]
10. Are open source software components used in TwinCAT Measurement products?

Is it true that "TwinCAT 3 Scope" in the TwinCAT 3 world is not a product, but a generic term for various products?

The TwinCAT 3 Scope is the most important product in the TwinCAT Measurement product family. TwinCAT 3 Scope is a generic term. The TwinCAT 3 Scope is subdivided into the Scope View and Scope Server products. This means that a TwinCAT 3 Scope always consists of the View and Server products. Beyond that there are also different product levels.

Why are there different product levels for the TwinCAT 3 Scope?

The Scope is a constantly growing tool for data logging and analysis; however, not every Scope user requires the full range of functions for his purposes. Therefore, we offer product levels tailored as far as possible to the application. The currently available product levels are Base and Professional. Base is free of license costs and is an outstanding tool for machine commissioning. Professional is very well suited for process monitoring in addition to machine commissioning.

Can the Scope View Professional be operated with the Scope Server Base? What are the restrictions?

Yes, you can also operate Professional View with the Base server. Only the limitations of the Base Server version need to be observed. It is also possible, for example, to scope a remote device with the local Base Server. To do this the **Use local Server** option must be set in the channel settings. Control via PLC function block or operation in headless mode is not possible.

Why do I need the TF3300 Scope Server when I can also enable the "Use local Server" option?

The TwinCAT TF3300 Scope Server function is required as soon as a Scope Server has to run autonomously on a remote device. The server can thus be controlled, for example from the PLC, without a View being connected.

Can I integrate the TwinCAT Scope View into my own visualization?

Yes, you can integrate Scope Control into your own .NET-based visualization application. This means that your application automatically receives all the data handling between the Control and the Scope Server, as well as all the functions available in the Control. This ranges from zooming and panning to the overview chart, tooltips for the data points and much more. For details, please read the following pages [▶ 324].



Scope View is an engineering product (TE1300). As the View/Control is integrated into a visualization in this use case, which may be running on a runtime device, it must be ensured that the TE1300 license is available on the runtime device.

Can I integrate the TwinCAT Scope View into a TwinCAT HMI web visualization?

Yes, this is also possible. The TF2300 product from the TwinCAT HMI range must be used for this. Although the front end is of course web-based in terms of technology, the data management via the Scope Server is absolutely identical to that of the Scope View in TwinCAT Engineering.

Is it possible to print out recorded Scope Charts?

Yes, with the Scope Snipping Tool [▶ 274] functionality it is possible to print, copy and share charts.

Is multimedia documentation available for TwinCAT 3 Scope?

Yes, there is a recording of a TwinCAT 3 Scope Webinar on the Beckhoff-Homepage. There are many small technical tutorials on this page.

My Scope .svd files are on a network drive. Why can't I open them?

That is probably because the TwinCAT 3 Scope server service has no rights of access to the network directory. In order to be able to open .svd files, you either need to copy them to the local system or grant the Scope server service the appropriate rights. (See section Opening .svd files from a network directory [▶ 394])

Are open source software components used in TwinCAT Measurement products?

Yes, various open source components are used.
Please see the information on the page Third-party components [▶ 398].

8.3 Third-party components

This software contains third-party components.
Please refer to the license file provided in the following folder for further information:
C:\Program Files(x86)\Beckhoff\Legal\TwinCAT-XAE-ScopeView

Glossary

Array Bar Chart

The chart provides the drawing interface for an array data type, the elements of which are assigned to a bar line or a bar.

Axis

A (Y-) axis represents the value scaling for connected channels.

Channel

The channel forms the connection of system variable and graph. Therefore, there is one setting window for the acquisition and another one for the general settings (colors, marks etc.).

Cursor

The cursor module serves to display graph and axis values and their differences.

Data Picker

Mouse pointer tool that is automatically activated in the chart when the cursor moves over a data point. Clicking brings up a tool tip showing the values of the X- and Y-axes, the channel name and the absolute time for the selected data point.

Marks

Marks are the actual data points of recorded variables. They can be adjusted via the channel properties.

Measurement project

The Measurement project may contain several Scope projects, in which the actual recording configurations are created.

Overview Chart

An Overview chart can be displayed within a YT chart. It provides an overview of the whole recording period with absolute times.

Quick View Chart

The Quick View chart is available in the Target Browser. It quickly and clearly indicates whether values are currently supplied.

Scope

The Scope forms the highest hierarchical element in a Scope configuration and manages all recording settings.

Scope Server

The Scope Server is the logger program of the TwinCAT Scope. A Scope connects itself to a server in order to record new data or to read an existing file (.svd).

Scope View

The Scope View is the front end of the TwinCAT Scope. From here configurations are created or loaded, the display adjusted and recordings controlled.

Solution Explorer

The Solution Explorer is a kind of project manager, which can also be used for the measurement projects that are required for a Scope recording.

Target Browser

All connected systems and their devices can be simply scanned for system variables with the target browser.

Trigger

Various actions can be triggered with freely configurable trigger groups.

XY Chart

The chart provides a drawing area for a channel that is calculated from two variables. One variable is shown on the X-axis, the other one on the Y-axis.

YT Chart

The chart provides a graphic area with time axis. All connected channels are scaled to the same time segment.

9 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.

Download finder

Our download finder contains all the files that we offer you for downloading. You will find application reports, technical documentation, technical drawings, configuration files and much more.

The downloads are available in various formats.

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You will also find further documentation for Beckhoff components there.

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- and extensive training program for Beckhoff system components

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