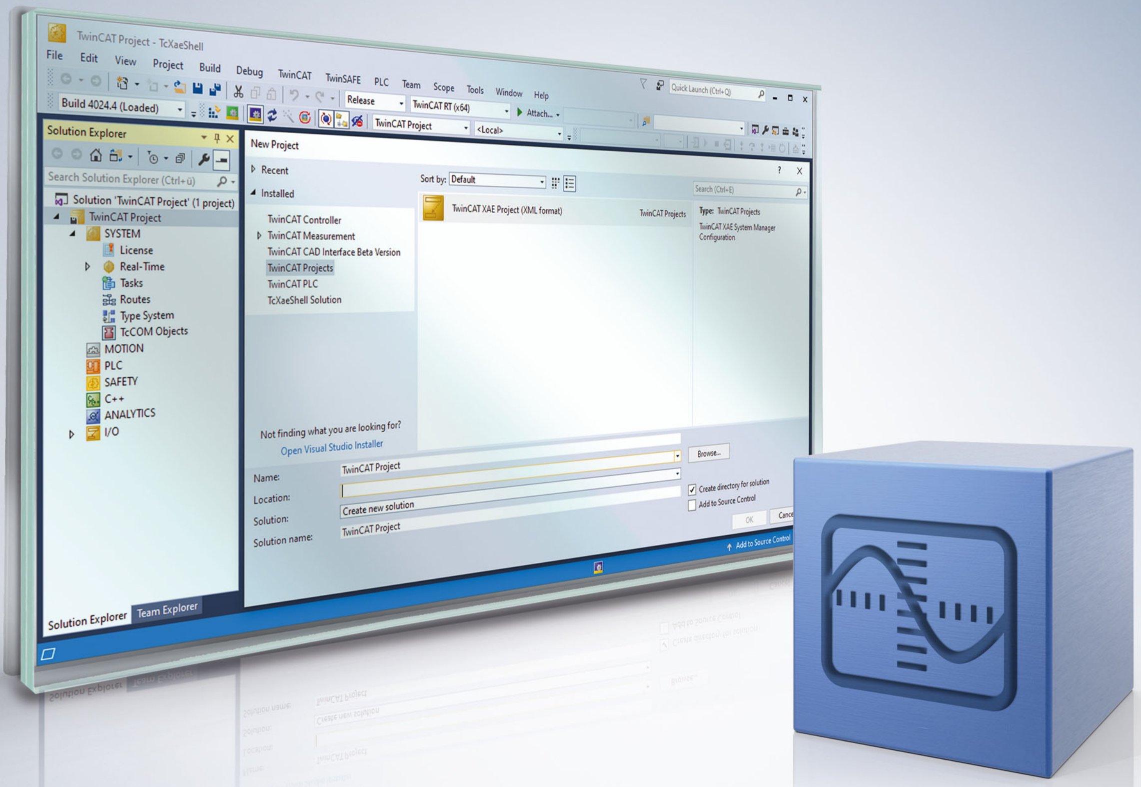
BECKHOFF New Automation Technology

Manual | EN

TF3710

TwinCAT 3 | Interface for LabVIEW™



2024-04-15 | Version: 1.5.2

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.
For installation and commissioning of the components, it is absolutely necessary to observe the documentation and the following notes and explanations.
The qualified personnel is obliged to always use the currently valid documentation.

The responsible staff must ensure that the application or use of the products described satisfies all requirements for safety, including all the relevant laws, regulations, guidelines, and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.
We reserve the right to revise and change the documentation at any time and without notice.
No claims to modify products that have already been supplied may be made on the basis of the data, diagrams, and descriptions in this documentation.

Trademarks

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Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents:
EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702
with corresponding applications or registrations in various other countries.

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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

ℹ 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.

1.4 Documentation issue status

Version	Changes
1.5.x	TwinCAT 3.1 Build 4026 • Brief information on installation [▸ 11]
	New: • CoE Read and CoE Write [▸ 81] ◦ VIs for reading and writing CoE objects from LabVIEW™ • Example CoE Read or Write [▸ 109]

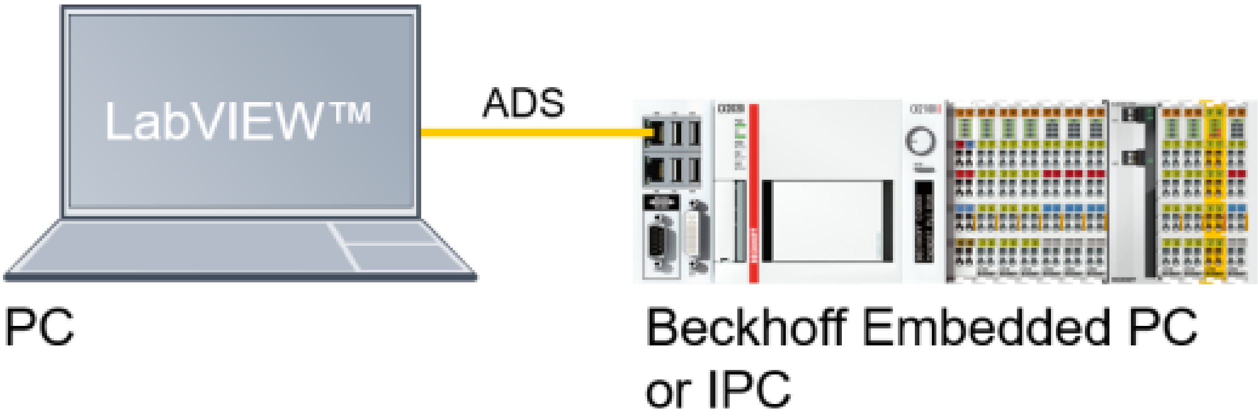
Table of contents

2 Overview

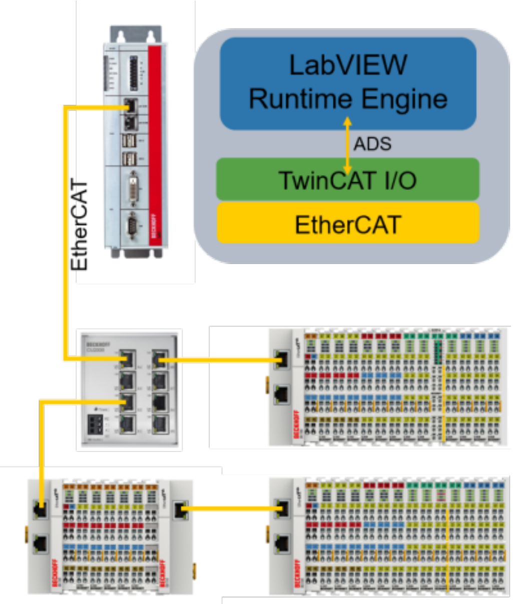
The TwinCAT 3 interface for LabVIEW™ enables data exchange between LabVIEW™ and one or more TwinCAT runtime environments. The data exchange takes place via the *TwinCAT ADS* protocol.

Product information

TF3710 TwinCAT 3 interface for LabVIEW™ combines the worlds of NI™ and Beckhoff. High-performance data exchange between a TwinCAT runtime environment and your LabVIEW™ application gives you the option to implement part of your application in TwinCAT and another part in LabVIEW™. The apportionment is up to the user. In a minimal configuration, you can use TwinCAT solely as a driver for your fieldbus devices and implement your application entirely in LabVIEW™. Similarly, you can implement your application mainly in TwinCAT and use LabVIEW™ only as an HMI.



The TwinCAT 3 interface for LabVIEW™ supports all LabVIEW™ editions including *Base*, *Full*, *Professional* and also the *Runtime Engine*, so that you can optionally deliver your LabVIEW™ application as a stand-alone application with the LabVIEW™ application builder. The Windows operating systems on Beckhoff IPCs and Embedded PCs are ideally suited as a platform directly on the machine controller.



Product components

The TF3710 TwinCAT 3 interface for LabVIEW™ product consists of the following components:

- LabVIEW™ Virtual Instruments (VIs) for your function palette
- Product-specific dynamic-link libraries (DLLs)
- Example VIs.

When installing on a system with LabVIEW™ runtime, only the DLLs are installed; otherwise, all components are installed.

3 Installation

System requirements

The minimum requirements for using the TF3710 TwinCAT 3 Interface for LabVIEW™ product are described below.

Please observe the following distinction: the TF3710 license is required on the TwinCAT runtime environment. The components of the TF3710 TwinCAT 3 Interface for LabVIEW™, on the other hand, are required on the system with the LabVIEW™ installation.

Engineering

In your engineering environment you need a TwinCAT 3.1 ADS installation, in addition to LabVIEW™. There is no need to install TwinCAT 3.1 ADS if you have a TwinCAT 3 Engineering environment or a TwinCAT Runtime installed on your engineering system.

- TwinCAT 3.1 ADS
- LabVIEW™ 2017, 2018, 2019, 2020, 2021, 2022, 2023
  - Runtime, Base, Full, Community, Professional Edition
  - 32-bit, 64-bit

Runtime

For the TwinCAT runtime you need the following components:

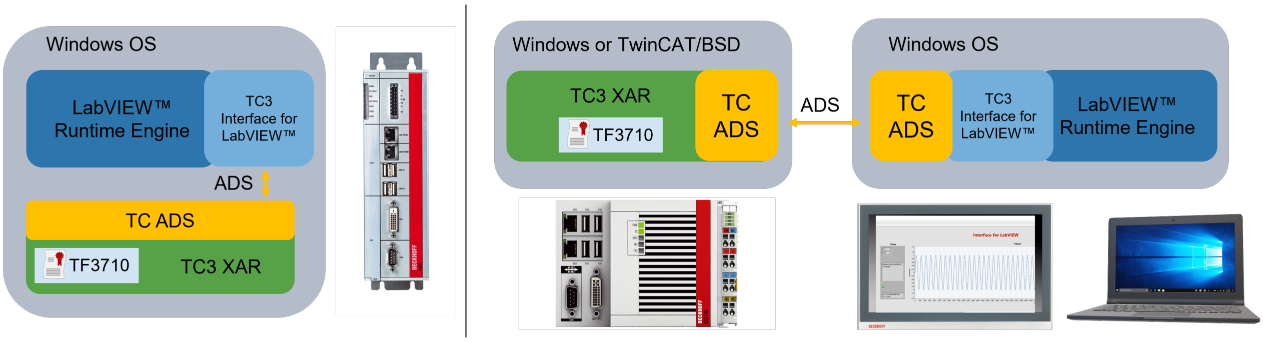
- TwinCAT 3.1 XAR build 3.1.4024.12 or higher
  If a lower version is required, please contact Beckhoff Support.
- Operating systems: Windows operating system, TwinCAT/BSD
- One license for TF3710 TwinCAT 3 Interface for LabVIEW™

For testing purposes, a 7-day trial version can be activated repeatedly.

For the LabVIEW™ runtime the following components are required:

- LabVIEW™ Runtime Engine 2017, 2018, 2019, 2020, 2021, 2022, 2023
- Windows NT-based operating system

It should be noted that the TwinCAT and LabVIEW™ runtimes can be installed on the same system or on separate systems connected via a network.



TwinCAT Package Manager: Installation (TwinCAT 3.1 Build 4026)

Detailed instructions on installing products can be found in the chapter Installing workloads in the TwinCAT 3.1 Build 4026 installation instructions.

Install the following workload to be able to use the product:

TF3710 | TwinCAT 3 Interface for LabVIEW™

TwinCAT setup: Installation (TwinCAT 3.1 build 4024 and earlier)

The following section describes the installation of the TwinCAT 3 Function TwinCAT 3 Interface for LabVIEW™ for Windows-based operating systems.

NOTICE

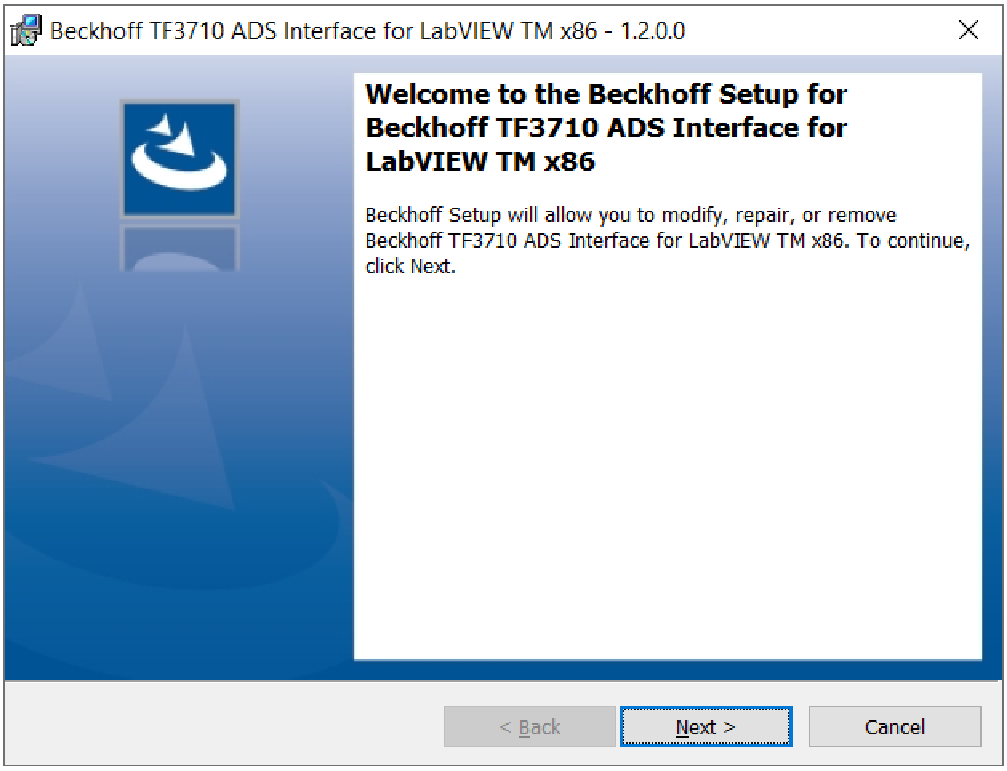
Different setups for 32bit and 64bit LabVIEW™

Two setups can be found on the download page of the Beckhoff website. The setup labeled "x86" integrates the interface for LabVIEW™ into installed 32bit LabVIEW™ environments. The setup labeled "x64" is suitable for 64bit LabVIEW™ environments.

✓ 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.



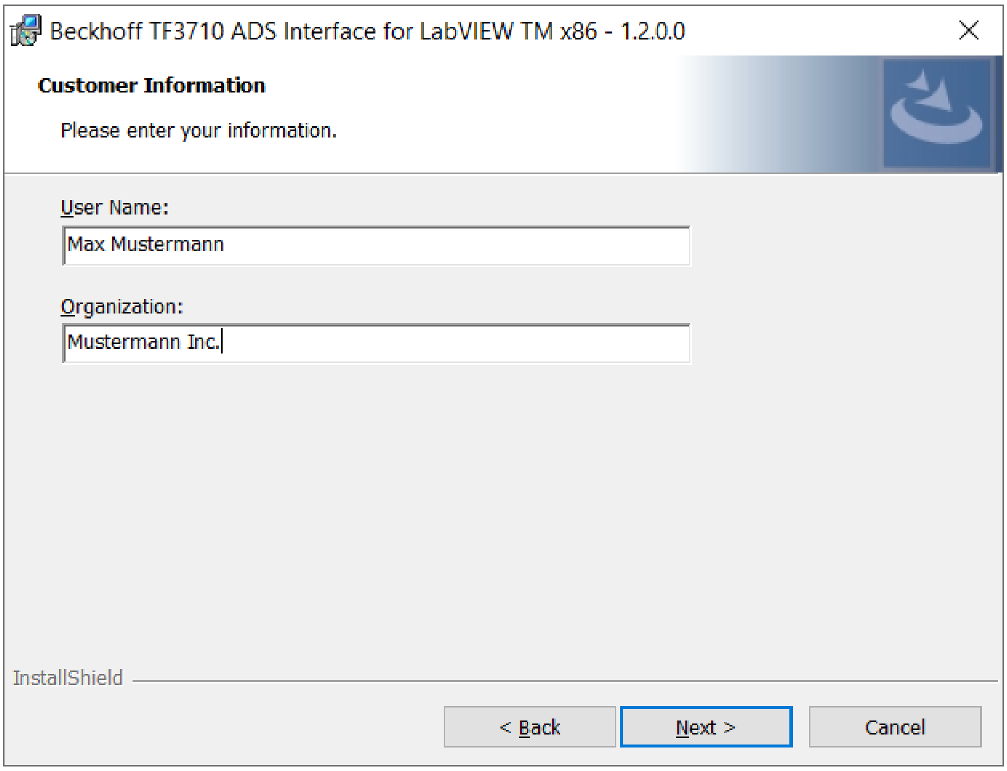
Beckhoff TF3710 ADS Interface for LabVIEW TM x86 - 1.2.0.0

Welcome to the Beckhoff Setup for Beckhoff TF3710 ADS Interface for LabVIEW TM x86

Beckhoff Setup will allow you to modify, repair, or remove Beckhoff TF3710 ADS Interface for LabVIEW TM x86. To continue, click Next.

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

3. Enter your user data.



Beckhoff TF3710 ADS Interface for LabVIEW TM x86 - 1.2.0.0

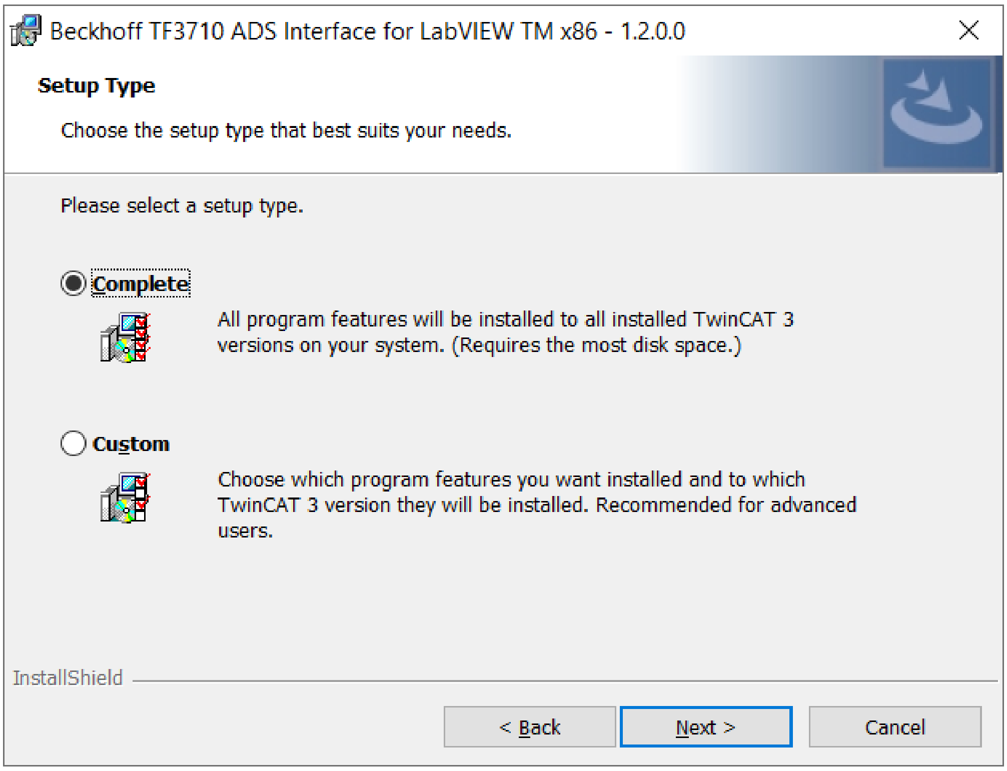
Customer Information

Please enter your information.

User Name:
Max Mustermann

Organization:
Mustermann Inc.

4. If you want to install the full version of the TwinCAT 3 function, select **Complete** as installation type. This installs the product for each LabVIEW™ found on the system. Select **Custom** if you only want to install the product for individual LabVIEW™ environments.



Beckhoff TF3710 ADS Interface for LabVIEW TM x86 - 1.2.0.0

Setup Type

Choose the setup type that best suits your needs.

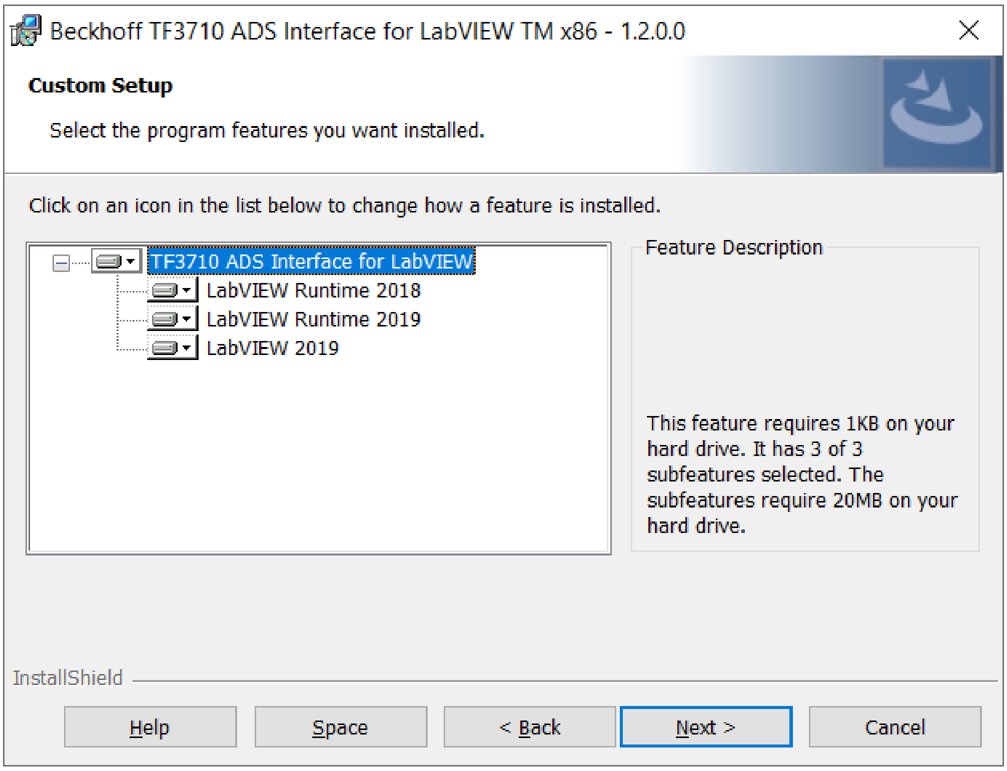
Please select a setup type.

● **Complete**

All program features will be installed to all installed TwinCAT 3 versions on your system. (Requires the most disk space.)

○ **Custom**

Choose which program features you want installed and to which TwinCAT 3 version they will be installed. Recommended for advanced users.



Beckhoff TF3710 ADS Interface for LabVIEW TM x86 - 1.2.0.0

Custom Setup

Select the program features you want installed.

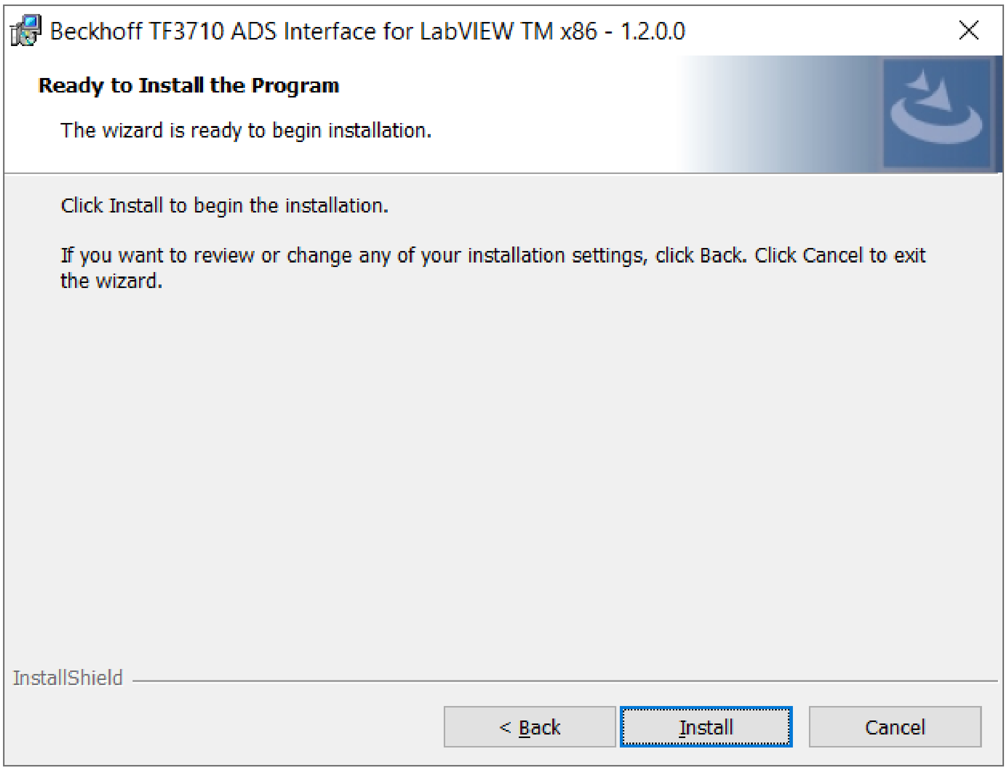
Click on an icon in the list below to change how a feature is installed.

- TF3710 ADS Interface for LabVIEW
  - LabVIEW Runtime 2018
  - LabVIEW Runtime 2019
  - LabVIEW 2019

Feature Description

This feature requires 1KB on your hard drive. It has 3 of 3 subfeatures selected. The subfeatures require 20MB on your hard drive.

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



Beckhoff TF3710 ADS Interface for LabVIEW TM x86 - 1.2.0.0

Ready to Install the Program

The wizard is ready to begin installation.

Click Install to begin the installation.

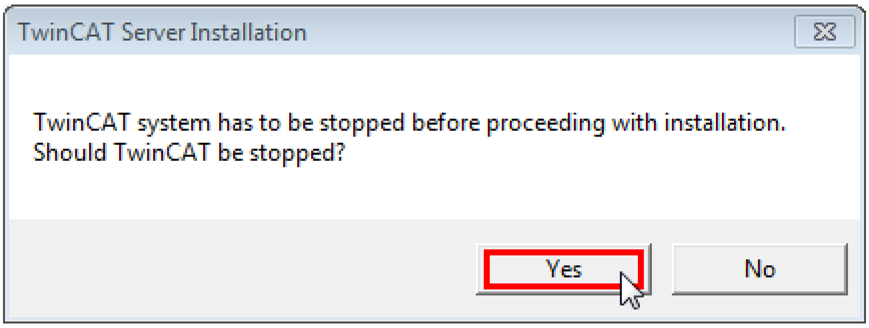
If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.

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

Mass compile

During installation, the TwinCAT 3 Interfaces for LabVIEW™ library is added for the mass compilation of VIs. A LabVIEW™ VI is started for this purpose.

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



TwinCAT Server Installation

TwinCAT system has to be stopped before proceeding with installation. Should TwinCAT be stopped?

Fig. 1:

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

⇨ The TwinCAT 3 function has been successfully installed and can be licensed (see Licensing).

4 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).

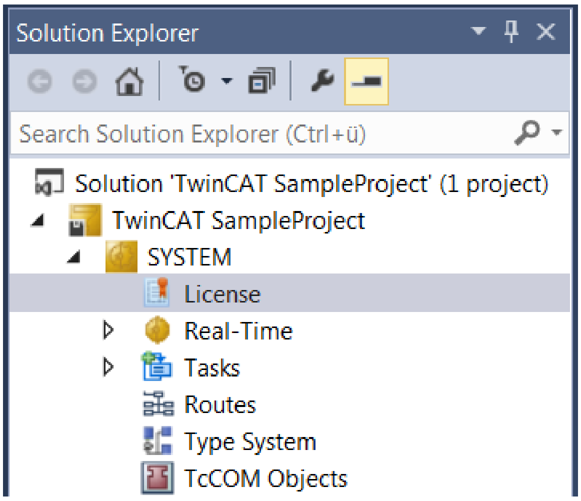
Licensing the full version of a TwinCAT 3 Function

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

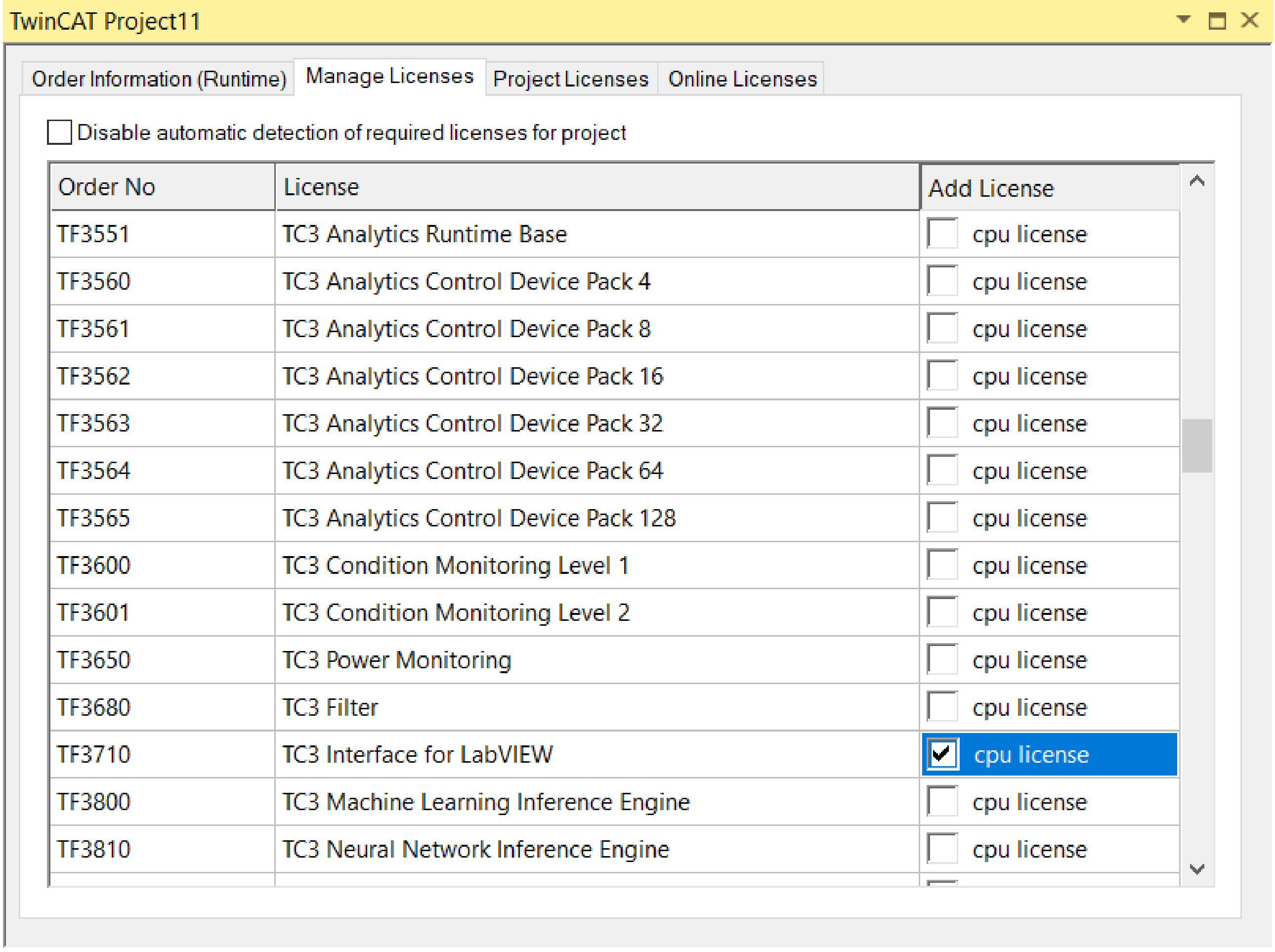
Licensing the 7-day test version of a TwinCAT 3 Function

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. "TF3710 TwinCAT 3 Interface for LabVIEW").

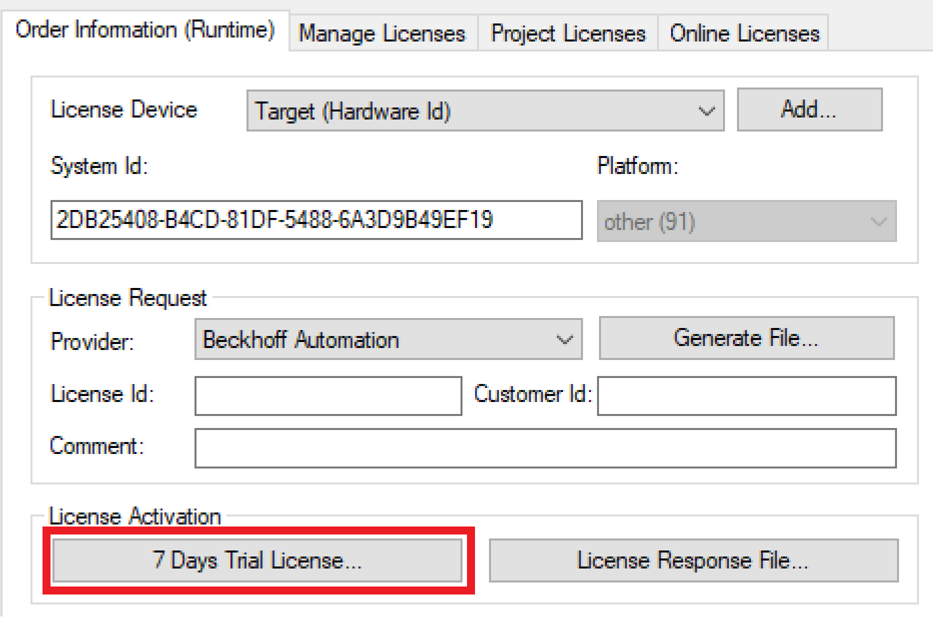


TwinCAT Project11

□ Disable automatic detection of required licenses for project

Order No	License	Add License
TF3551	TC3 Analytics Runtime Base	□ cpu license
TF3560	TC3 Analytics Control Device Pack 4	□ cpu license
TF3561	TC3 Analytics Control Device Pack 8	□ cpu license
TF3562	TC3 Analytics Control Device Pack 16	□ cpu license
TF3563	TC3 Analytics Control Device Pack 32	□ cpu license
TF3564	TC3 Analytics Control Device Pack 64	□ cpu license
TF3565	TC3 Analytics Control Device Pack 128	□ cpu license
TF3600	TC3 Condition Monitoring Level 1	□ cpu license
TF3601	TC3 Condition Monitoring Level 2	□ cpu license
TF3650	TC3 Power Monitoring	□ cpu license
TF3680	TC3 Filter	□ cpu license
TF3710	TC3 Interface for LabVIEW	☑ cpu license
TF3800	TC3 Machine Learning Inference Engine	□ cpu license
TF3810	TC3 Neural Network Inference Engine	□ 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.



License Device: Target (Hardware Id)

System Id: 2DB25408-B4CD-81DF-5488-6A3D9B49EF19

Platform: other (91)

License Request

Provider: Beckhoff Automation

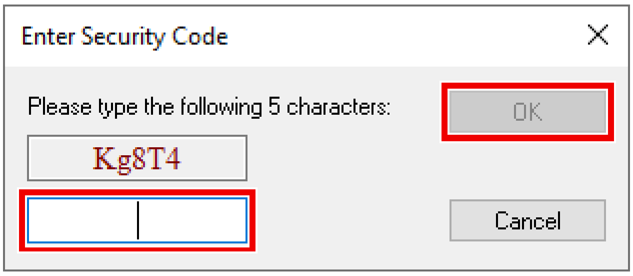
License Id:

Customer Id:

Comment:

License Activation

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



Enter Security Code

Please type the following 5 characters:

Kg8T4

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.

Quick-Guide: license query fails

Different error messages may occur during the license query in LabVIEW™, e.g.: *License state issue*, *No License found, License expired, License invalid, License invalid System id*.

Check the following:

- If a license query failed previously, restart LabVIEW™ so that the ADS client in Interface for LabVIEW™ is completely unloaded.
- Use the TwinCAT XAE to check the license status on the target system and adjust it if necessary.

5 Quick start

The following describes how to set up the connection between LabVIEW™ and TwinCAT using an exemplary measuring task. Thereby data is generated in TwinCAT, which is read by LabVIEW™.

Activating a TwinCAT project

✓ Download this https://infosys.beckhoff.com/content/1033/TF3710_TC3_Interface_for_LabVIEW/Resources/10083995531/.zip. There is a tnzip file in the ZIP archive.

1. Open TwinCAT XAE and select **File > Open > Open Solution From Archive...** to load the tnzip.
2. If you do not already have a valid TF3710 license on the target system, go to **System > License > Manage Licenses** and select the checkbox for the TF3710 license.
3. Activate the project, e.g. on your local PC or on a remote target system and start the PLC.

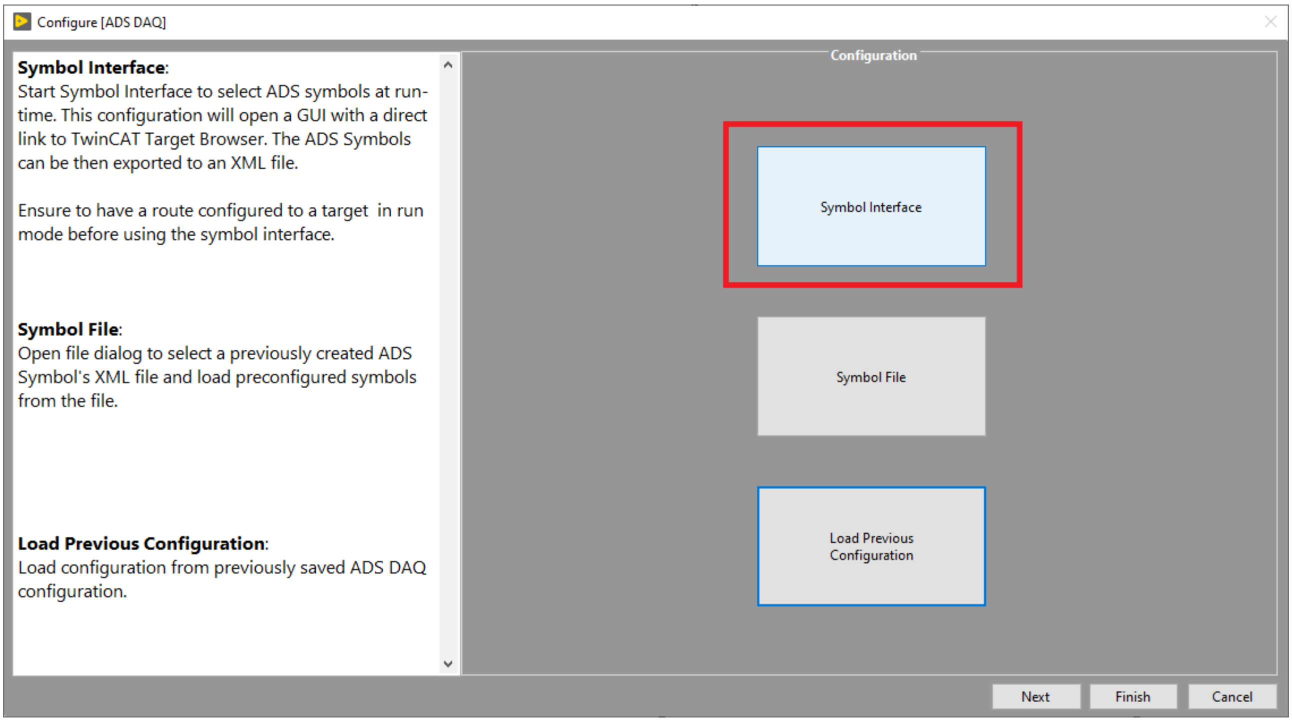
⇨ The TwinCAT project is now running on your target system.

Creating LabVIEW™ project

✓ LabVIEW™ is open.

1. Create a new project and open an empty VI.
2. Save the VI.
3. Place an instance of the ADS DAQ VI on the block diagram. To do this, navigate in the **Functions palette** to **User Libraries > Beckhoff LabVIEW Interface > ADS DAQ**.

   ⇨ A user interface for configuring the connection to TwinCAT opens automatically.
4. Select **Symbol Interface** to create a new configuration.



Configure [ADS DAQ]

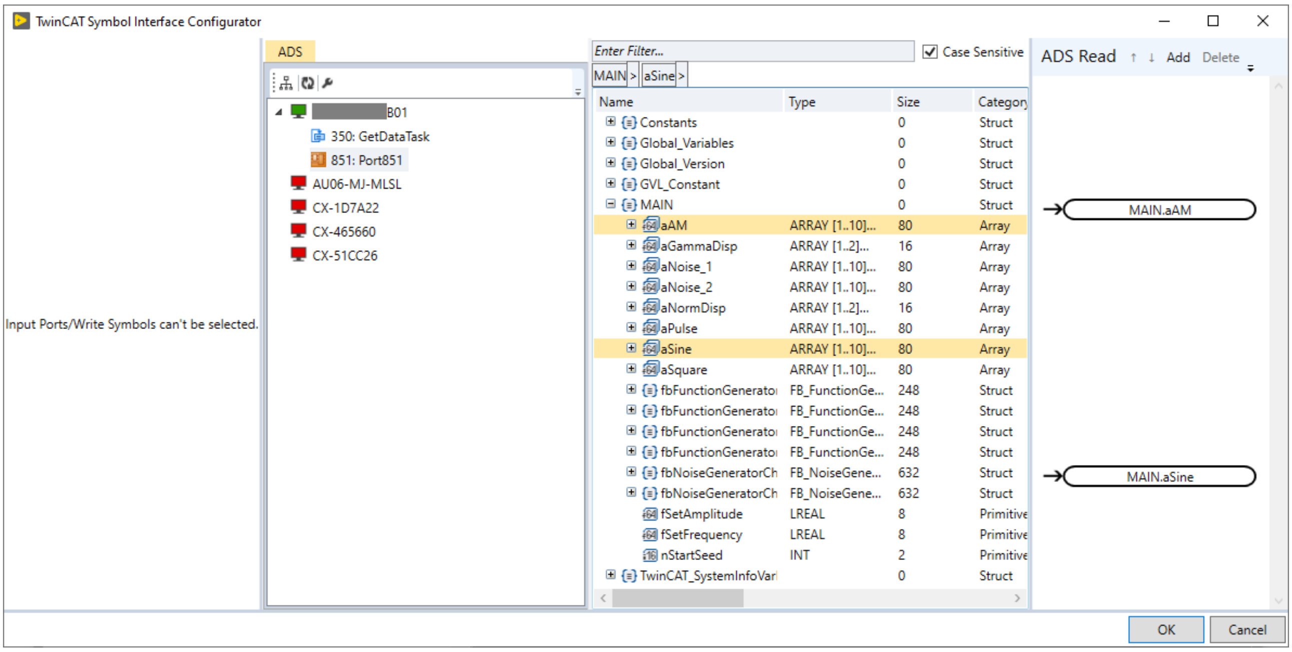
Symbol Interface:
Start Symbol Interface to select ADS symbols at run-time. This configuration will open a GUI with a direct link to TwinCAT Target Browser. The ADS Symbols can be then exported to an XML file.

Ensure to have a route configured to a target in run mode before using the symbol interface.

Symbol File:
Open file dialog to select a previously created ADS Symbol's XML file and load preconfigured symbols from the file.

Load Previous Configuration:
Load configuration from previously saved ADS DAQ configuration.

5. Browse with the Target Browser in the middle field into your target on which you have activated the TwinCAT project.
6. Then select the ADS symbols to be read. Navigate to **851: Port851 > MAIN** and select the ADS symbols aAM and aSine. Drag and drop both icons to the right area (**ADS Read** area).



TwinCAT Symbol Interface Configurator

ADS

- [redacted]B01
  - 350: GetDataTask
  - 851: Port851
- AU06-MJ-MLSL
- CX-1D7A22
- CX-465660
- CX-51CC26

Input Ports/Write Symbols can't be selected.

Enter Filter... ☑ Case Sensitive

MAIN > aSine >

Name	Type	Size	Category
Constants		0	Struct
Global_Variables		0	Struct
Global_Version		0	Struct
GVL_Constant		0	Struct
MAIN		0	Struct
aAM	ARRAY [1..10]...	80	Array
aGammaDisp	ARRAY [1..2]...	16	Array
aNoise_1	ARRAY [1..10]...	80	Array
aNoise_2	ARRAY [1..10]...	80	Array
aNormDisp	ARRAY [1..2]...	16	Array
aPulse	ARRAY [1..10]...	80	Array
aSine	ARRAY [1..10]...	80	Array
aSquare	ARRAY [1..10]...	80	Array
fbFunctionGenerato	FB_FunctionGe...	248	Struct
fbFunctionGenerato	FB_FunctionGe...	248	Struct
fbFunctionGenerato	FB_FunctionGe...	248	Struct
fbFunctionGenerato	FB_FunctionGe...	248	Struct
fbNoiseGeneratorCh	FB_NoiseGene...	632	Struct
fbNoiseGeneratorCh	FB_NoiseGene...	632	Struct
fSetAmplitude	LREAL	8	Primitive
fSetFrequency	LREAL	8	Primitive
nStartSeed	INT	2	Primitive
TwinCAT_SystemInfoVar		0	Struct

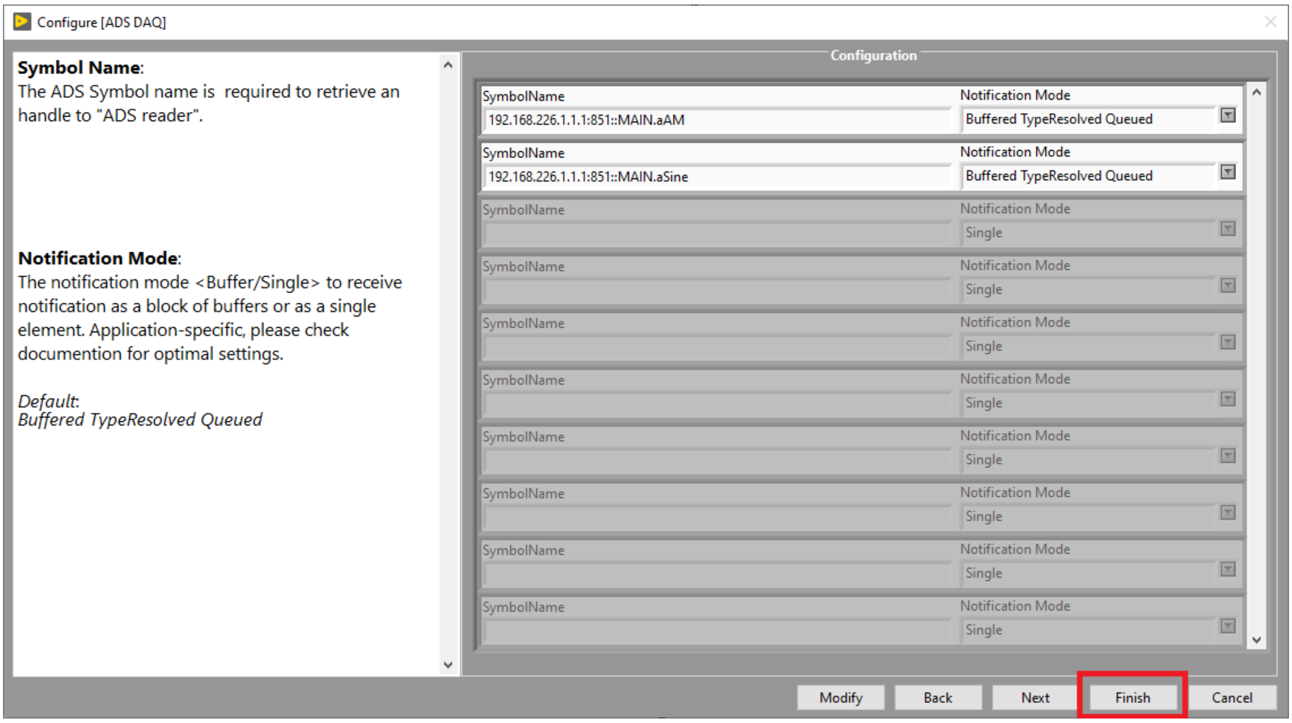
ADS Read ↑ ↓ Add Delete

MAIN.aAM

MAIN.aSine

7. Click **OK**.

   ⇨ The Symbol Interface Configurator closes and you are shown further setting options. Don't change the default settings and select **Finish**.



Configure [ADS DAQ]

Symbol Name:
The ADS Symbol name is required to retrieve an handle to "ADS reader".

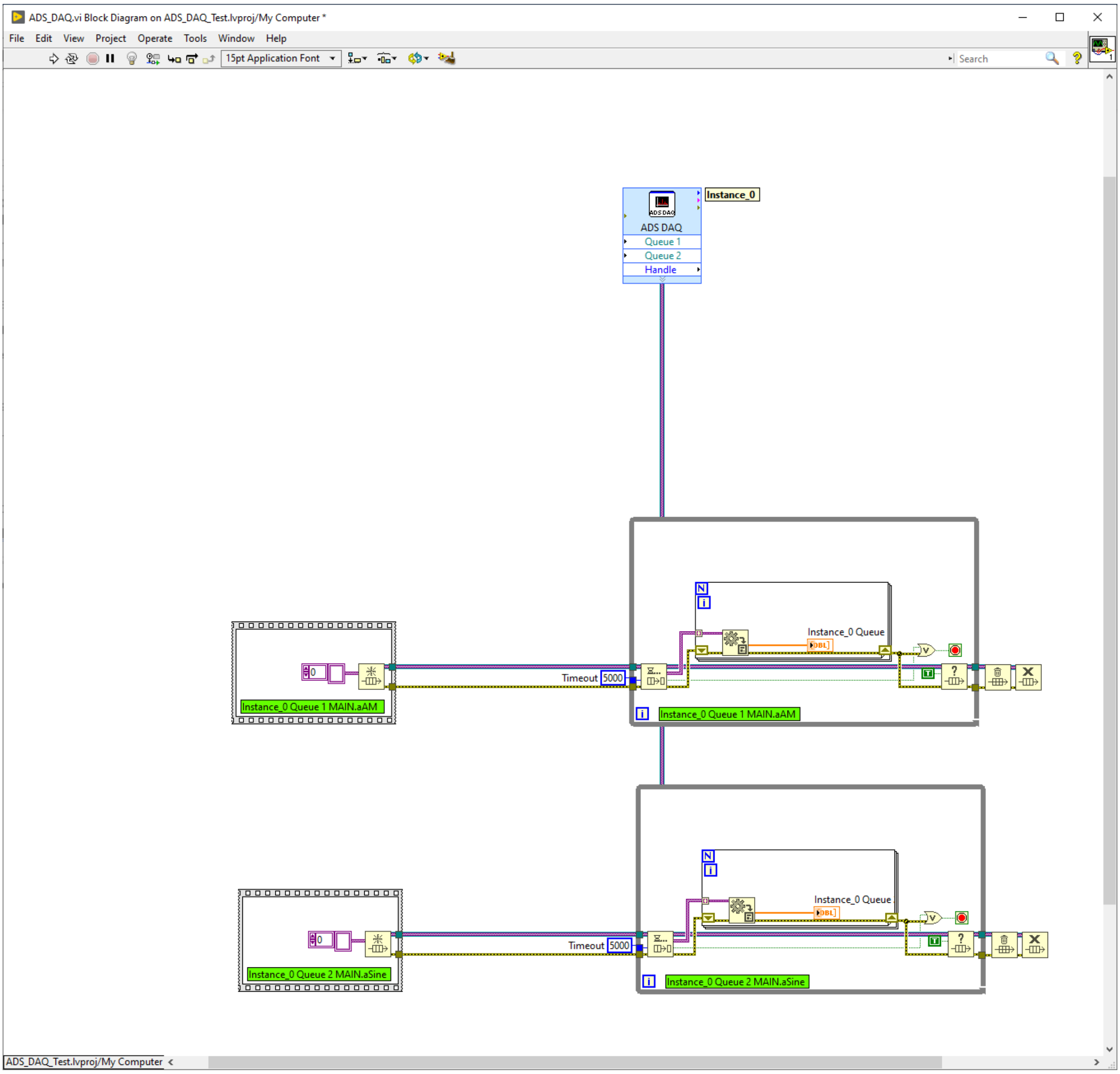
Notification Mode:
The notification mode <Buffer/Single> to receive notification as a block of buffers or as a single element. Application-specific, please check documention for optimal settings.

Default:
Buffered TypeResolved Queued

Configuration

SymbolName	Notification Mode
192.168.226.1.1.1:851::MAIN.aAM	Buffered TypeResolved Queued
192.168.226.1.1.1:851::MAIN.aSine	Buffered TypeResolved Queued
	Single
	Single
	Single
	Single
	Single
	Single
	Single
	Single

⇨ The user interface is closed and code is automatically generated on the block diagram according to the configuration. You can change and extend this individually.

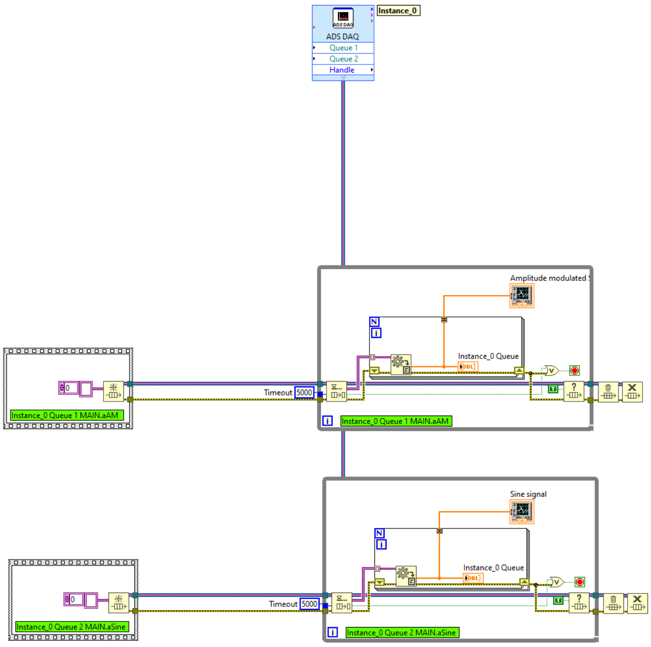

ADS_DAQ.vi Block Diagram on ADS_DAQ_Test.lvproj/My Computer *
File Edit View Project Operate Tools Window Help
15pt Application Font
Search
Instance_0
ADS DAQ
ADS DAQ
Queue 1
Queue 2
Handle
Instance_0 Queue
DBL
Timeout 5000
Instance_0 Queue 1 MAIN.aAM
Instance_0 Queue 1 MAIN.aAM
Instance_0 Queue
DBL
Timeout 5000
Instance_0 Queue 2 MAIN.aSine
Instance_0 Queue 2 MAIN.aSine
ADS_DAQ_Test.lvproj/My Computer

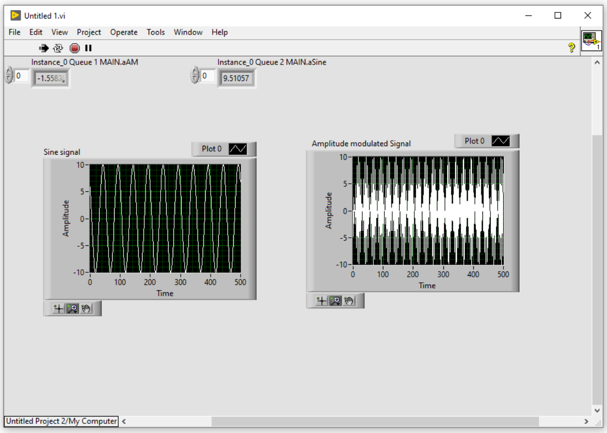
Extending block diagram

✓ Code was generated on the block diagram (see above).

8. Extend the block diagram, e.g. with a waveform graph.
9. Set your VI to Run mode.

⇨ In this case, look at the two time signals on the front panel.


Instance_0
ADS DAQ
Queue 1
Queue 2
Handle
Amplitude modulated
Instance_0 Queue
Timeout 5000
Instance_0 Queue 1 MAIN.aAM
Sine signal
Instance_0 Queue
Timeout 5000
Instance_0 Queue 2 MAIN.aSine


Untitled 1.vi
File Edit View Project Operate Tools Window Help
Instance_0 Queue 1 MAIN.aAM
-1.5583
Instance_0 Queue 2 MAIN.aSine
9.51057
Sine signal
Plot 0
Amplitude
Time
Amplitude modulated Signal
Plot 0
Untitled Project 2/My Computer

6 Technical introduction

Data exchange between LabVIEW™ and TwinCAT 3 takes place using the Automation Device Specification (ADS) server-client protocol. With the Interface for LabVIEW™ an ADS client is realized in LabVIEW™, which enables a performant data exchange with TwinCAT runtimes. The TwinCAT runtimes implement the ADS server accordingly.

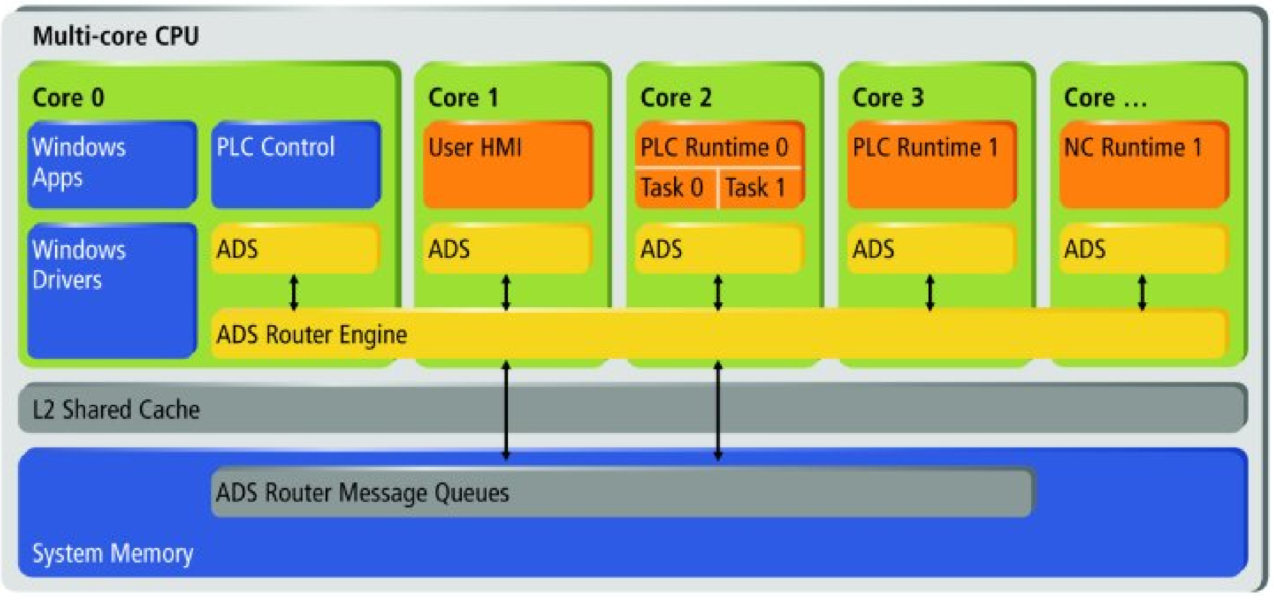
6.1 TwinCAT ADS

Basic structure of ADS devices and ADS symbols

Automation Device Specification (ADS) forms the basis for the LabVIEW™ interface. ADS describes a device- and fieldbus-independent interface and enables communication between ADS devices.

The ADS device concept and the identification of an ADS device are explained below.

The modular system architecture of TwinCAT allows the individual parts of the software (e.g. TwinCAT PLC, TwinCAT NC ...) to be regarded as independent devices: there is a software module for each individual task. The servers in the system are the executing devices that provide certain services. The clients are programs that request the services of the servers. A client initially establishes a connection to the server and requests a service: for example, it requests reading the value of a variable or it requests writing a variable.



The interface for LabVIEW™ provides an ADS client interface, which enables data exchange (read and write) with TwinCAT runtimes. The TwinCAT runtime, or its ADS devices, thus provide their services as ADS servers and can be used from LabVIEW™.

ADS data exchange between ADS devices takes place via the ADS router. As shown in the diagram above, data exchange between ADS devices implemented on the same system takes place via the system memory. If two ADS devices, e.g. LabVIEW™ and the TwinCAT runtime, are on different systems, a route can be created between two ADS routers. When creating the ADS route, the transport type (usually TCP/IP) for communication between the two ADS routers can be defined. Accordingly, an ADS device identifies itself via the AMS NetId of the ADS router and a port number, which then specifies the ADS device on the system. For example, port 851 is the default port for the first PLC instance in the TwinCAT runtime. ADS services of an ADS device are then specified by two parameters, the Index Group and the Index Offset. For example, a PLC variable is accessible for reading or writing under a specific Index Group and Index Offset.

If an application is to be created that is to be used on several target systems and in which LabVIEW^{TM} and TwinCAT run on the same system, the relative AMS NetId can be used. The relative AMS NetId always points to the local system. For this purpose, 0.0.0.0.0.0 is used for the address.

Summary

- AMS NetId: Identifies the ADS router, i.e. the system.
- ADS Routes
- Port: Identifies an ADS device.
- Index Group/Offset: Specifies the ADS system service, e.g. a variable for reading and writing.

In order to make the addressing of variables in a TwinCAT runtime more convenient for the user, TwinCAT creates ADS symbols, which can be searched with the Target Browser, for example. The Target Browser is also integrated into the interface for LabVIEW™ in the VI Symbol Interface [▶ 64] so that ADS symbols can be selected easily and quickly. An ADS symbol for a variable in TwinCAT then contains the information mentioned above: AMS NetId, Port, Index Group and Index Offset and furthermore the Bit Size as well as a symbol name and the data type of the variable.

For more information on ADS, please see the following links:

- AMS NetId and Port: ADS device identification
- Index Group and Index Offset: Specification for ADS devices
- ADS Routes: System Node "Routes" and Add Route
- Connecting Devices with same AMS NetId: AmsNAT
- Using MQTT and Message Broker with ADS: ADS-over-MQTT
- TLS encrypted ADS: Secure ADS
- Target Browser
- Record ADS communication: ADS Monitor

Basic ADS data communication

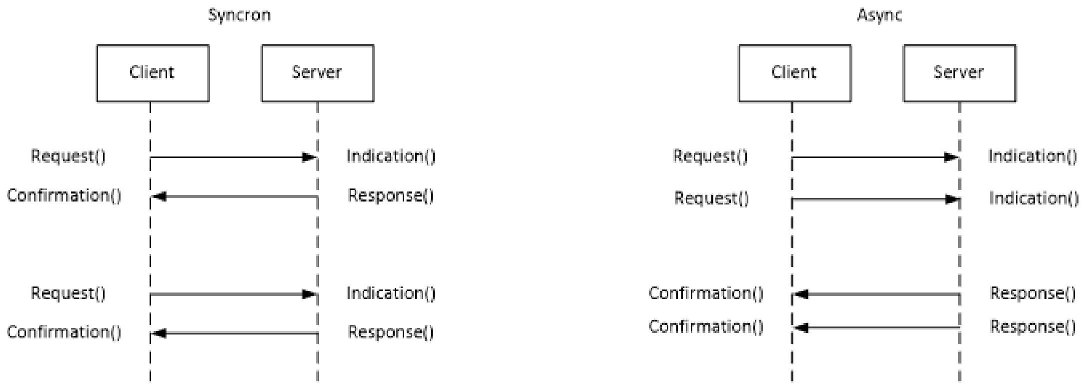
Basically, there are three different possibilities/modes for data communication in ADS.

Synchronous reading or writing

- The ADS client in LabVIEW™ waits for a response from the ADS server before proceeding with code execution.

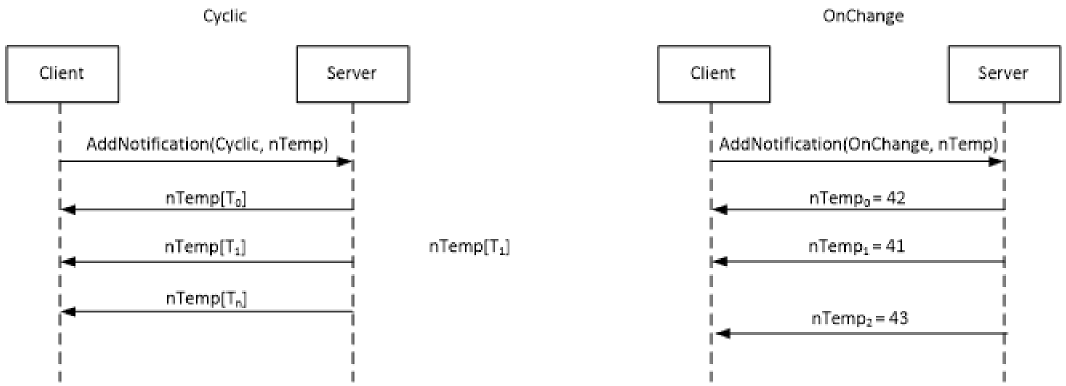
Asynchronous reading or writing

- The ADS client in LabVIEW™ sends a read or write request to the ADS server but does not wait for a response; instead, it continues to execute other parts of the program (for example, requests to other variables).



Event-based communication (read only)

- An ADS notification is only registered once on the server. The notification can be registered "on change" or "cyclic". After a notification has been registered at the server, it sends requested data to the server without any further requests from the client.



The VIs ADS Read [▶ 66] and ADS Write [▶ 71] are polymorphic. The desired communication mode (sync, async or notification) can be selected there. The VIs also provide extensions to these basic modes that involve LabVIEW™-side buffering of data and passing it to the LabVIEW™ process.

6.2 Communication modes

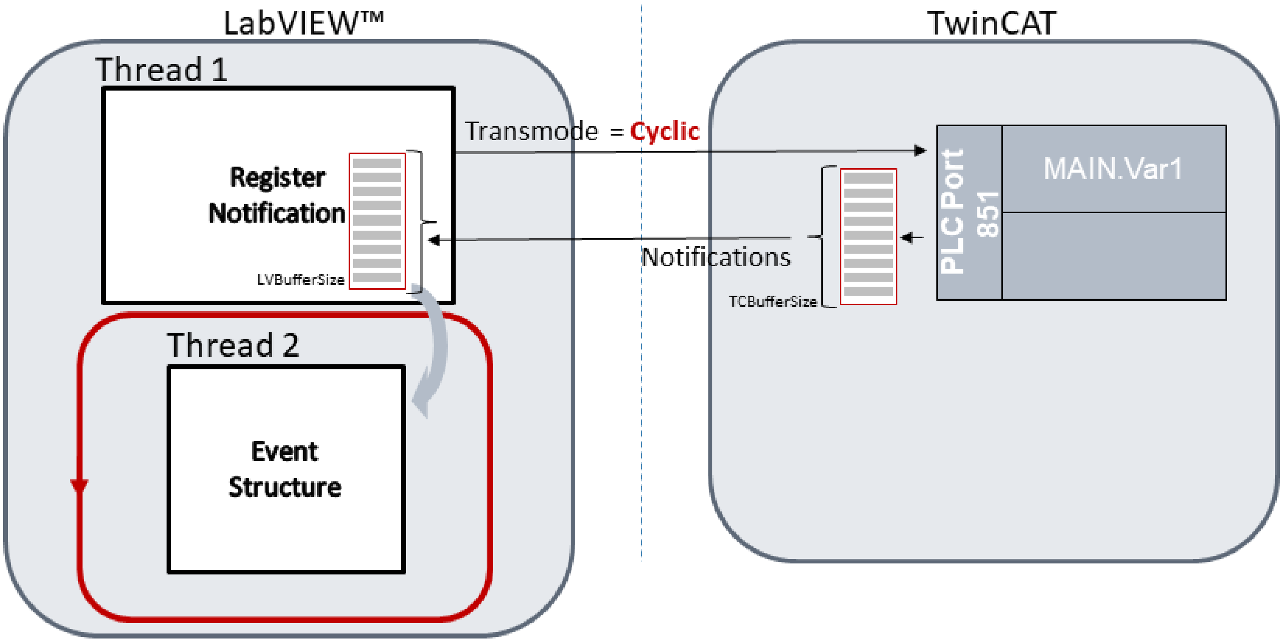
Initial classification

The extensions to the basic functionalities (sync, async and notification) are explained below. Practical recommendations are also given as to which mode is a preferred choice for exemplary applications.

The following table shows all provided modes with an initial classification.

Mode	Read	Write	Short description
Sync Single [▶ 28]	X	X	Read/write a variable in a self-contained one-time action. The client waits during the request to the server.
Async Single [▶ 29]	X	X	Read/write a variable in a self-contained one-time action. The client does not wait during the request to the server.
Noti. Single [▶ 29]	X		Waiting for an "On Change" event in TwinCAT as a one-time action. The notification is unregistered after the event.
Noti. Buffered [▶ 30]	X		One-time reading of a time series with a defined length. The notification is unregistered after receiving the time series.
E-Noti. Single [▶ 33]	X		Continuous reading (cyclic or "on change"). The notification is not automatically unregistered; it runs until it is explicitly unregistered. The notifications received are forwarded to an event structure in LabVIEW™.
E-Noti. Buffered [▶ 35]	X		Buffered continuous reading (cyclic or "on change“). The notification is not automatically unregistered; it runs until it is explicitly unregistered. The notifications received are forwarded to an event structure in LabVIEW™. The buffer enables higher data throughput, but causes latency.
LVB-Noti. Single [▶ 31]	X		Continuous reading (cyclic or "on change"). The notification is not automatically unregistered; it runs until it is explicitly unregistered. On the LabVIEW side, the data is written to a buffer to which the user has direct access.

In the table above some modes are assigned the property "Buffered". The diagram below illustrates the system structure. For "Noti. Buffered" and "E-Noti. Buffered", the addressed buffer refers to a LabVIEW™-side buffer of size `LVBufferSize`. The buffer is filled with data read from TwinCAT and transferred to LabVIEW™ when the buffer size is reached. In addition, there is a TwinCAT-side buffer from the standard ADS interface, which, however, can only be used with ADS notifications of the type *Cyclic*. By default the size of this buffer is `TcBufferSize` = 10 samples, although it can be adjusted.



In the following section, the above example is considered with the following parameters:

TcBufferSize = 10

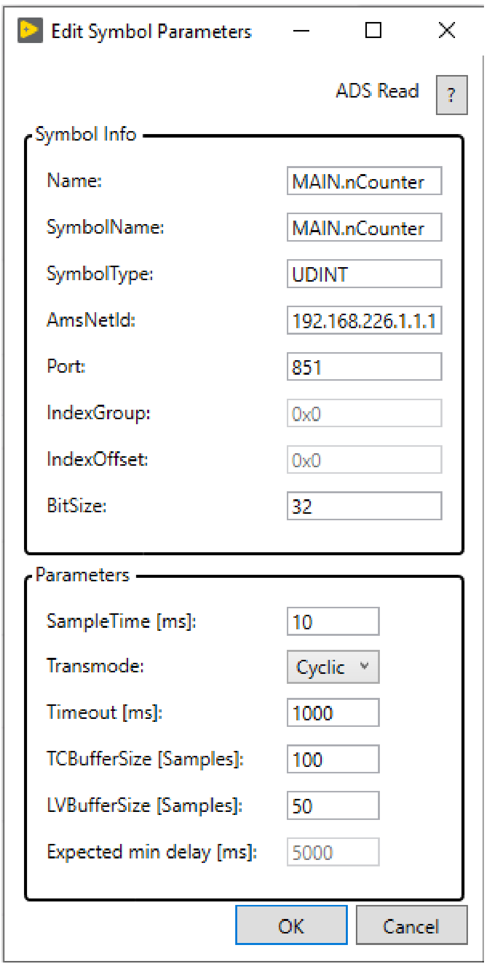
LVBufferSize = 500

ADS notification of the Cyclic type with 1 ms sample time (corresponds here to the cycle time of the PLC).

Every 1 ms a sample is now written into the TwinCAT-side buffer. After 10 ms the buffer is full and is transferred to the LabVIEW™-side buffer. After receiving 50 messages with 10 samples each, i.e. after 500 ms (plus communication time), the LabVIEW™-side buffer is full and then transfers the entire data packet of 500 samples to LabVIEW™. Accordingly, there is a *delay time* of at least 500 ms until the data packet is received in LabVIEW™. The minimum expected delay time is also displayed in the configuration dialog (Edit Symbol Parameters) in the lower part as "Expected min delay".

Parameterizing and realizing the communication modes

The parameters mentioned in the above section can be set in the User Interface (UI) of the Symbol Interface [▸ 64].



Edit Symbol Parameters

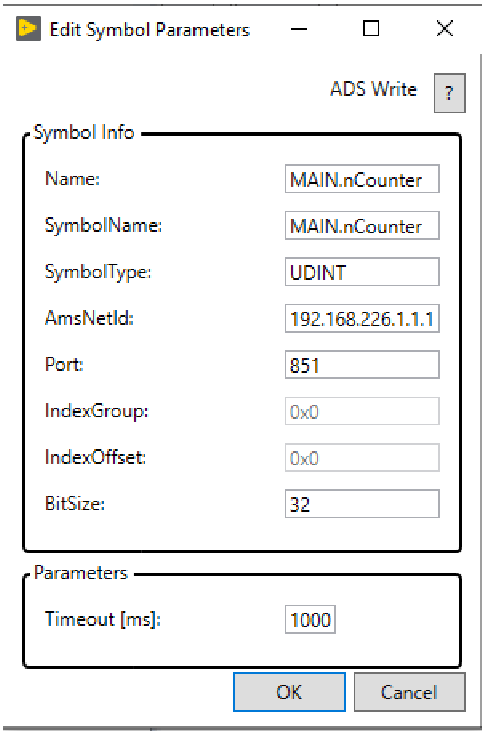
ADS Read

Symbol Info

Name:	MAIN.nCounter
SymbolName:	MAIN.nCounter
SymbolType:	UDINT
AmsNetId:	192.168.226.1.1.1
Port:	851
IndexGroup:	0x0
IndexOffset:	0x0
BitSize:	32

Parameters

SampleTime [ms]:	10
Transmode:	Cyclic
Timeout [ms]:	1000
TCBufferSize [Samples]:	100
LVBufferSize [Samples]:	50
Expected min delay [ms]:	5000



Edit Symbol Parameters

ADS Write

Symbol Info

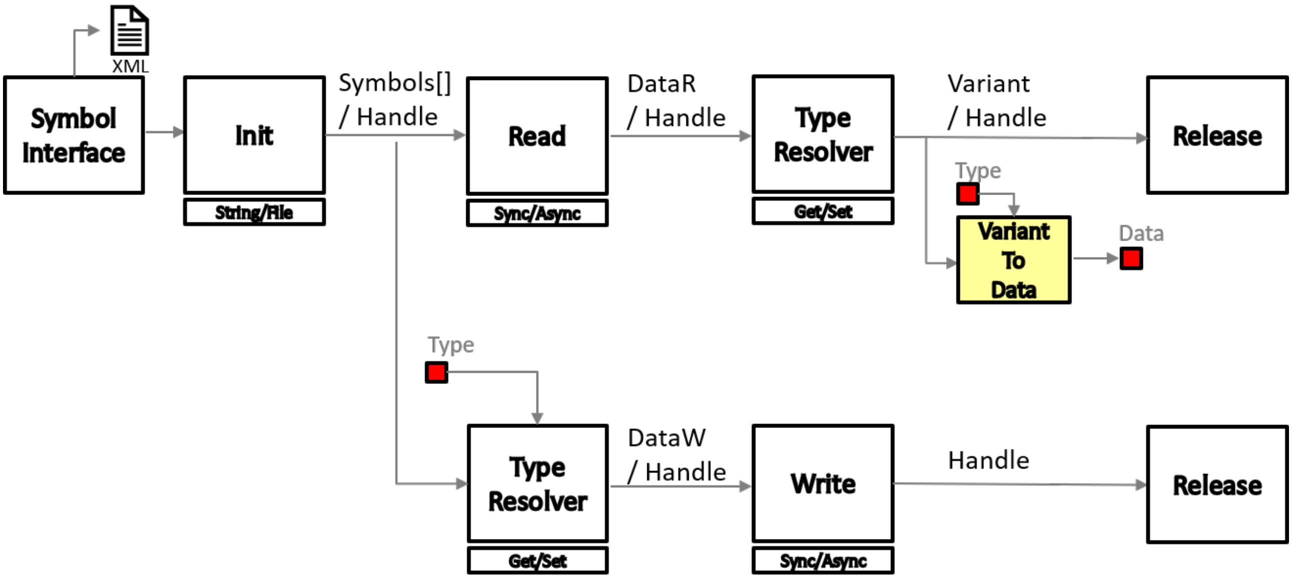
Name:	MAIN.nCounter
SymbolName:	MAIN.nCounter
SymbolType:	UDINT
AmsNetId:	192.168.226.1.1.1
Port:	851
IndexGroup:	0x0
IndexOffset:	0x0
BitSize:	32

Parameters

Timeout [ms]:	1000

In addition to the parameterization of the ADS symbols, the basic structure of the LabVIEW™ program must be observed, which is outlined below.

The Symbol Interface [▶ 64] opens a dialog with the Target Browser and the possibility to parameterize each ADS symbol according to the above figure. The output of the Symbol Interface is a string in XML format describing all selected ADS symbols and their parameterization. This string is linked to the Init VI [▶ 65]. Alternatively, the Symbol Interface can export the XML. This XML file can then be passed directly to the Init VI. The Init VI then passes handles of the ADS symbols to a Read VI [▶ 66], which can be set as a polymorphic VI to the options described above. At the output there are data handles, which are linked with a Type Resolver VI [▶ 72]. The output of the Type Resolver VI is a Variant Type, which can be cast to the correct format. When writing, the order of Type Resolver and Write VI [▶ 71] is reversed accordingly.



The above diagram illustrates the structure with Low Level VIs. To simplify programming, several Low Level VIs are combined, depending on the communication mode. See Sync Read [▸ 28] or Async Read [▸ 29], for example.

Practical considerations

There are various options for reading data. In order to simplify the selection in practice, a table is provided below which describes exemplary application scenarios and suggests a communication mode.

Signal type in TwinCAT	Example	Communication mode
Quasi-static parameters	Read the current parameter set of a PID controller or the ID of the current product in the machine. Reading machine settings.	Sync Read [▸ 28], Async Read [▸ 29]
Continuous signal	Stream of one or more sensor signals (temperature, strain, force, …). There is no defined end of the data stream.	Fast response required: E-Noti. Single [▸ 33] (Transmode "cyclic")
	General DAQ application	High data throughput: E-Noti. Buffered [▸ 30] or LVB-Noti. Single [▸ 31]
Event	Waiting for TwinCAT event, e.g. start of a process: bStart changes from FALSE to TRUE. The event appears once. It is then no longer required and can be unregistered.	Noti. Single [▸ 29] (Transmode "on change")
Event	Responding to changes in states, e.g. changing the signals to be read depending on the state of the machine: Viewing the nState variables. The event occurs frequently and this event should be observed throughout.	E-Noti. Single [▸ 33] (Transmode "on change")
Signal of defined length	Reading of exactly 1000 samples of a specific sensor signal.	Noti. Buffered [▸ 30]

6.2.1 One-time reading

This communication mode is ideal, for reading a TwinCAT configuration or a completely filled data buffer in the PLC once, for example. In contrast to continuous reading [▸ 31], one-time reading requires no additional programming in LabVIEW™.

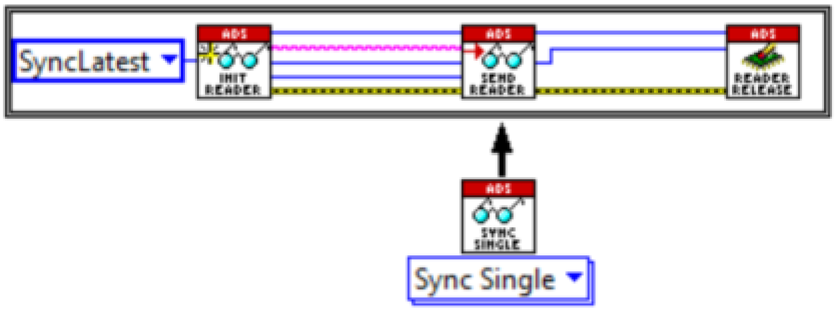
The TF3710 TwinCAT 3 Interface for LabVIEW™ product categorizes one-time reading into four cases:

1. Synchronous reading
2. Asynchronous reading
3. Notification Single
4. Notification Buffered

Synchronous reading

With synchronous reading, after a request has been sent by the client, a response from the ADS server is awaited before the program code is executed further. The reader is released immediately after successful confirmation from the server. This type of reading is therefore suitable for calculating or displaying the data directly after it has been received from TwinCAT.

The polymorphic "**Sync Single**" block is composed of several low-level VIs [▸ 84] and thus combines the creation of a handle, reading and releasing.

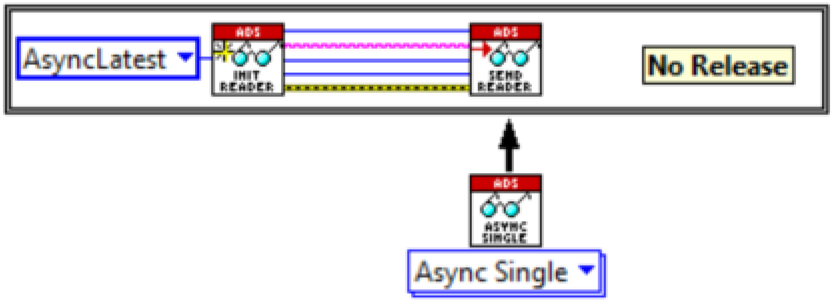


Examples in LabVIEW™: Basic examples [▶ 102]

Asynchronous reading

With asynchronous reading, the client does not wait for a response from the ADS server. In this mode, there is no guarantee that the reader has already received the data packet or not. As a result, the reader cannot be released.

The polymorphic VI "**Async Single**" therefore initializes the reader and sends the request to TwinCAT. The release is not part of the VI.



Examples in LabVIEW™: Basic examples [▶ 103]

Notification Single

Notification Single is only supported for *Transmode* **"on change"**.

The block **"Noti. Single"** , in contrast to Notification E-Single [▶ 33], does not require a user-programmed event structure. The notification is only intended for one-time use, i.e. to catch a one-time event. The notification is registered in the background, received and then removed.

This block returns an array of two values, the last state before the value change and the new state after the value change, e.g. [FALSE, TRUE], if a variable has changed its value from FALSE to TRUE.

ADS
SINGLE
Noti. Single

Examples in LabVIEW™: Basic examples [▶ 102]

Notification Buffered

The block **"Noti. Buffered"**, in contrast to Event driven reading [▶ 35], does not require a user-programmed event structure. The block uses a buffer of size `LVBufferSize` to save the data received from TwinCAT in an intermediate layer. The notification is not removed until the buffer is full. The saved data are then passed to LabVIEW™.

Accordingly, reception of a time series with predefined length (LVBufferSize samples) can easily be realized with this communication mode.

NOTICE

LVBufferSize

The buffer size is determined by the parameter `LVBufferSize` when creating the ADS symbol, see Symbol Interface [▶ 64] VI.

ADS
BUFF.
Noti. Buffered

Examples in LabVIEW™: Basic examples [▶ 102]

6.2.2 One-time writing

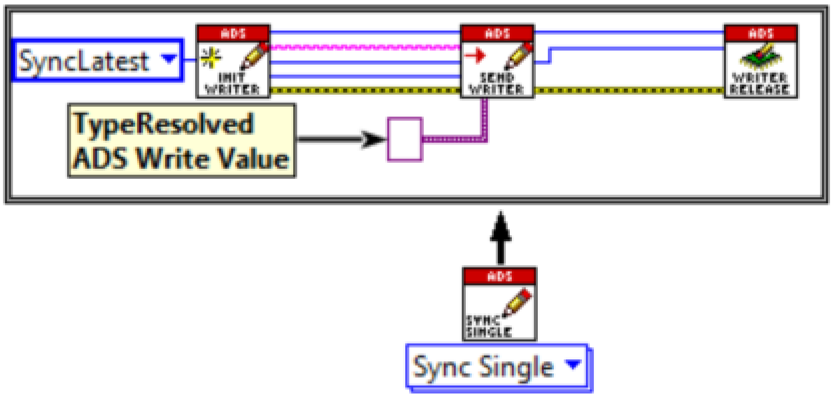
The TwinCAT 3 Interface for LabVIEW™ categorizes one-time writing as follows:

1. Synchronous writing
2. Asynchronous writing

Synchronous writing

During synchronous writing, the system waits for a response from the server (TwinCAT). The writer is released after the data packet has successfully been sent to TwinCAT.

This process is performed in the background by the polymorphic VI "**Sync Single**".

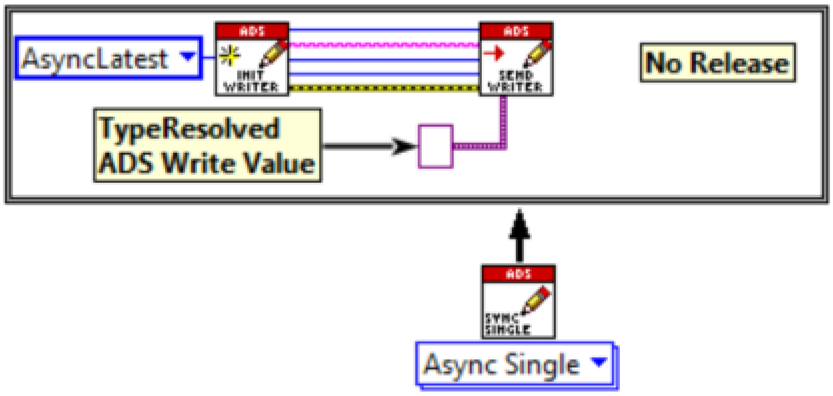


Examples in LabVIEW™: Basic examples [▶ 104]

Asynchronous writing

When writing asynchronously, the system does not wait for a positive acknowledgement from the server. In this mode, there is no guarantee that the Writer has already sent the data packet or not. As a result, the writer cannot be released.

The polymorphic VI "**Async Single**" therefore initializes the writer and sends only the request to the server. A release is not executed in the VI.



Examples in LabVIEW™: Basic examples [▶ 104]

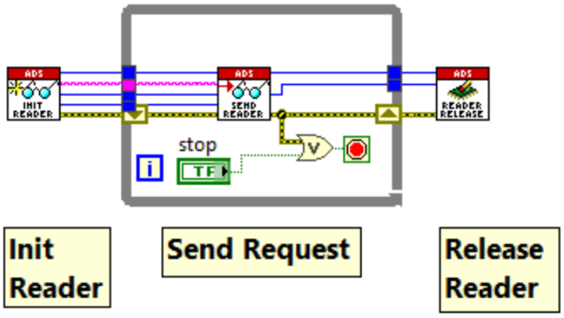
6.2.3 Reading data continuously

When continuously reading a time series from TwinCAT, the client in LabVIEW™ continuously receives data packets from the ADS server. The data packets can be requested cyclically through a polling procedure or event-based as ADS notification. Both options are explained below.

Reading with polling cycle

Simple reading

With polling, the client sends requests to the server at a defined time interval. This can be easily built using the Low-Level [▶ 84] VIs, for example. The ADS reader is initialized only once and requests a new data packet from TwinCAT with each cycle of the loop. With each cycle a new request is sent to the server and a corresponding response is awaited. The ADS reader is released once the termination condition of the loop has been reached. The image below shows the complete procedure in LabVIEW™.

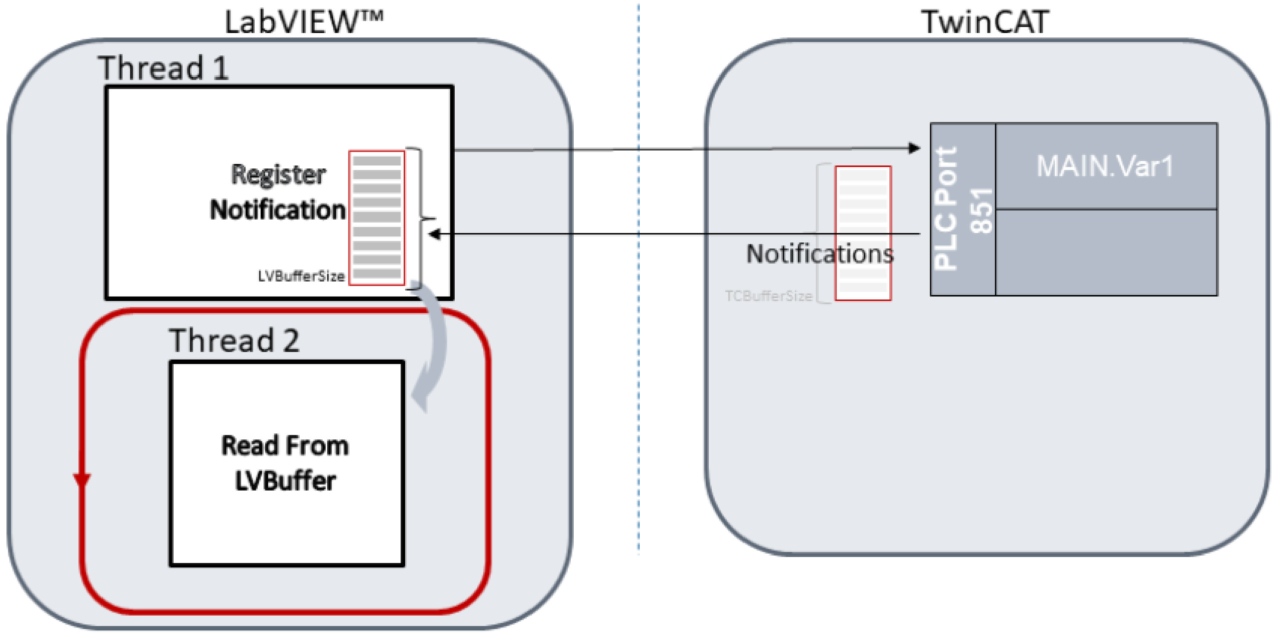


Example in LabVIEW™: Basic examples [▶ 104]

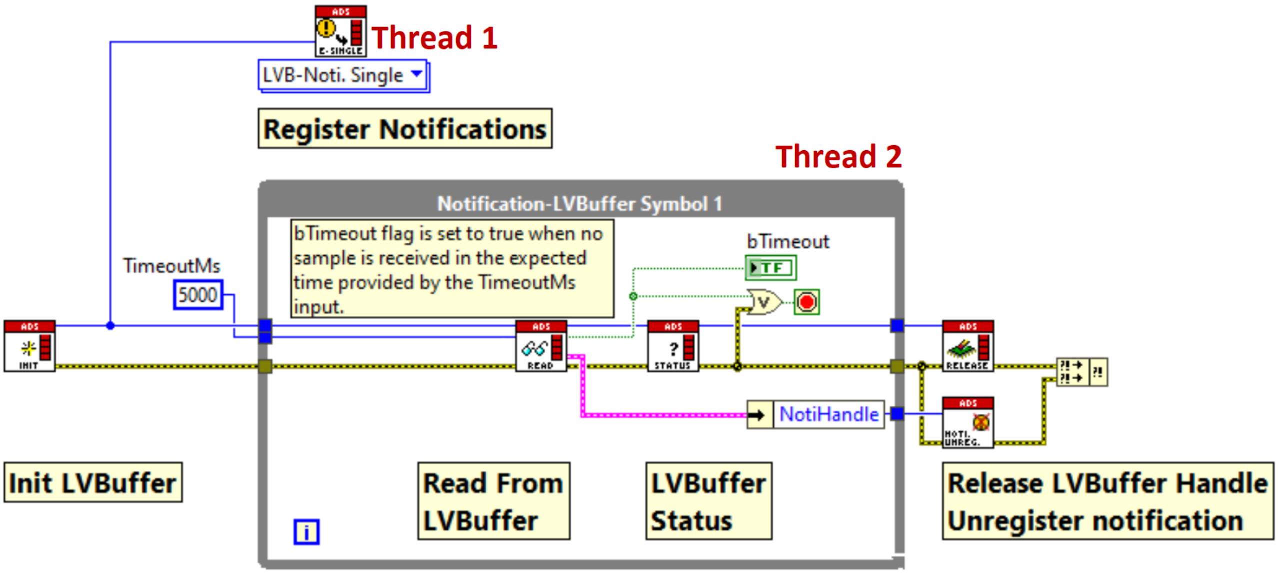
The procedure is error-prone in the sense that it cannot be guaranteed that a cyclically changing value in the PLC is sampled without gaps. For this use case, it is recommended to work with e-notifications, which are described below.

Reading with LVB notification

Compared to Event-driven reading [▶ 33], the ADS notifications can also be read continuously with a specific polling cycle. Reading in this case happens asynchronously, as described in the graphic below. Here the ADS notifications are registered by the Thread1 and written into the LVBuffer. Later the LVBuffer is read with the Thread2.



In contrast to Notification E-Buffered [▶ 35], no LabVIEW™ events are used in this case. Accordingly, the LabVIEW™ user has direct access to the **LVBuffer**. In LabVIEW™ the block diagram looks like this:


Thread 1
E-SINGLE
LVB-Noti. Single
Register Notifications
Thread 2
Notification-LVBuffer Symbol 1
bTimeout flag is set to true when no sample is received in the expected time provided by the TimeoutMs input.
bTimeout
TF
TimeoutMs
5000
INIT
READ
STATUS
RELEASE
NOTI. UNREG.
NotiHandle
Init LVBuffer
Read From LVBuffer
LVBuffer Status
Release LVBuffer Handle Unregister notification

Examples in LabVIEW™: Read Notification-LVBuffer Multiple [▶ 106]

The block diagram uses the LVBuffer blocks (see LVBuffer [▶ 79]):

- Init LVBuffer Handle
- Read From LVBuffer
- LVBuffer status
- Release LVBuffer Handle

The block diagram uses the ADS notification blocks:

- ADS-Read [▶ 70]
- Notification [▶ 79]

NOTICE

Polling cycle

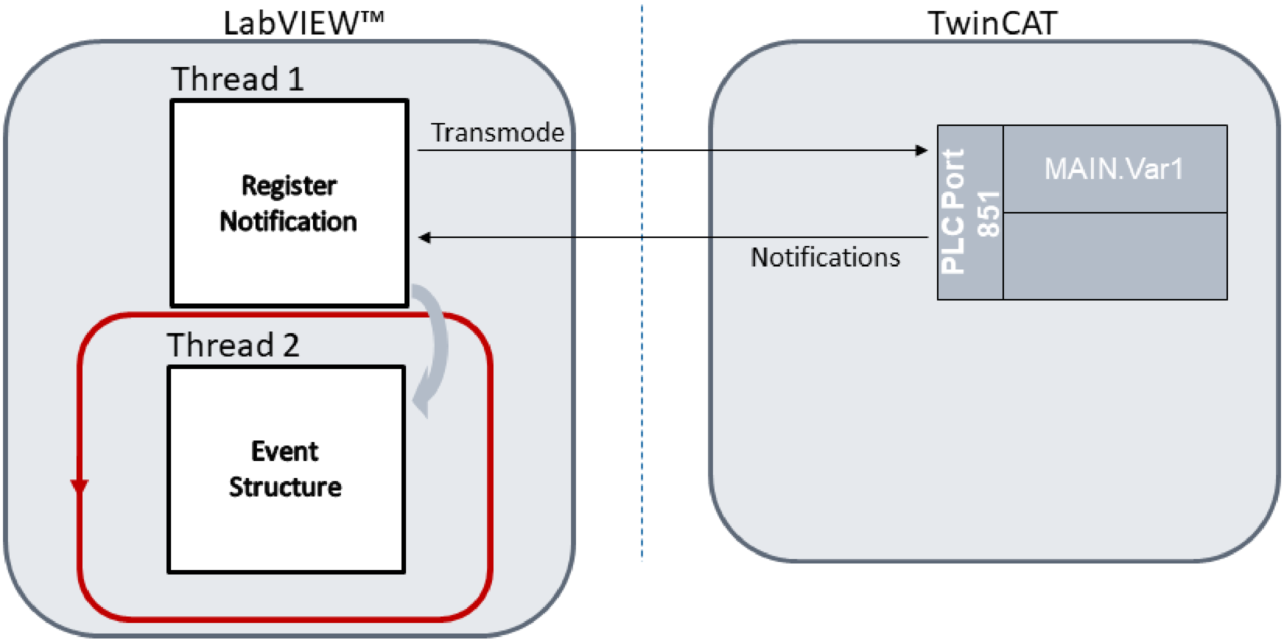
If the polling cycle is slower than the notification cycle time, the LVBuffer may overflow and samples may be lost.

6.2.3.1 Event driven reading

With event-driven reading, LabVIEW™ events and ADS notifications are used together. An ADS notification only has to be registered once on the server. The server data are then received cyclically or on change (see "Transmode" in chapter Communication modes [▸ 25]) from the client. Accordingly, the client only needs to issue one request, and the server then controls whether a new message needs to be sent to the client.

The ADS client in LabVIEW™ forwards the received notifications (data packets) as LabVIEW™ event to an *event structure*. See also the LabVIEW™ documentation on User events. The event structure inserts the received LabVIEW™ event into an internal queue. The events in the queue are processed by LabVIEW™ using the FIFO principle. If the notifications are received faster than it is possible to process the event structure in LabVIEW™, the queue becomes larger. This ensures that no notification is lost. It must be noted that this increases the amount of memory used. Accordingly, it must be taken into account that a point in time must be reached at which the memory requirement (the pending events) can be processed.

We recommend using the LabVIEW™ *Event Inspector Window* (View > Event Inspector Window) to observe the processing of LabVIEW™ events.



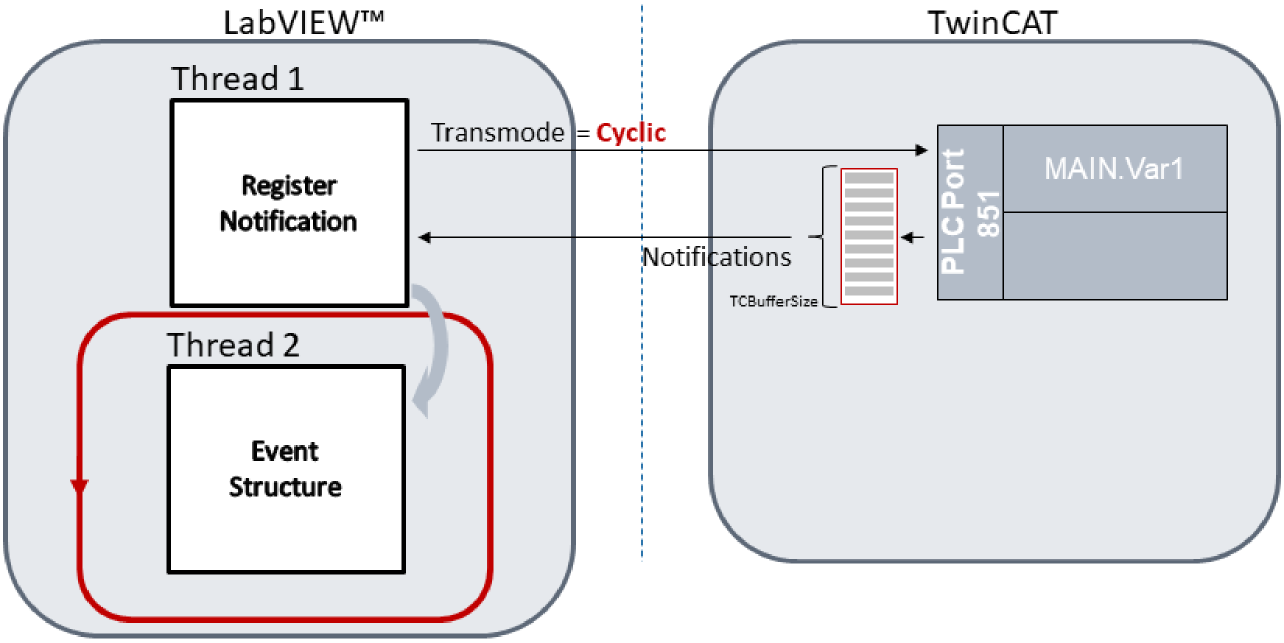
The interface for LabVIEW™ offers two different modes of operation for continuously registering ADS notifications as LabVIEW™ events:

1. E-Notification Single
2. E-Notification Buffered

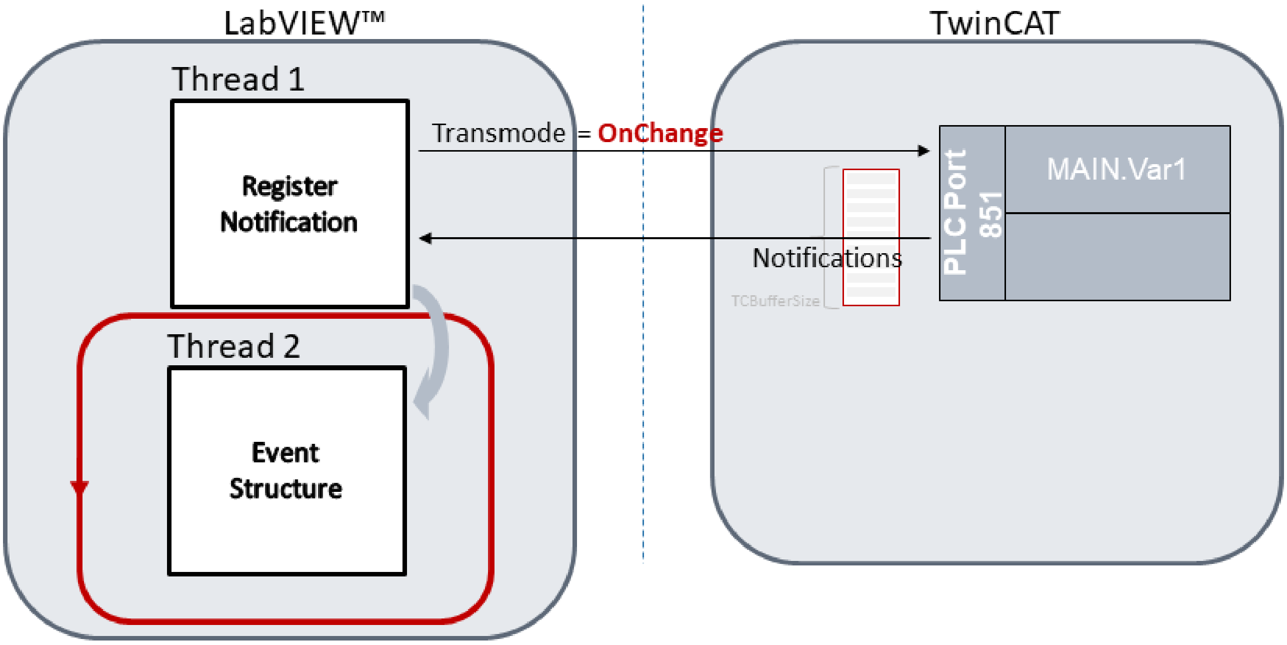
E-Notification Single

The operation mode *E-Notification Single* immediately forwards the received ADS data packet to the LabVIEW™ event structure, i.e. it directly generates a LabVIEW™ event. A data packet can contain several samples. *Transmode* and *TCBufferSize* are key parameters for this:

Transmode "**Cyclic**" uses the TwinCAT-side buffer (of size TCBufferSize). In this case notifications are first written to the TCBuffer and then bundled and sent to the LabVIEW™ client when the buffer is full. This achieves higher data throughput, and there is less load on network thanks to fewer messages with low user data volume.



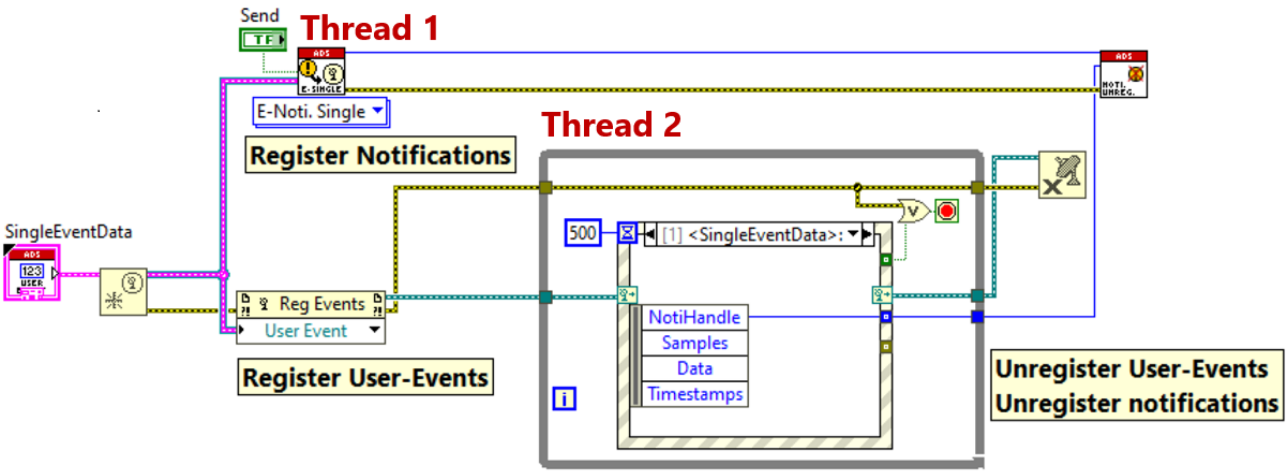
With *Transmode* "**OnChange**" the TCBuffer is **not** used. Here, the individual notifications **are forwarded directly to the client without** buffering. The client receives any change of state with minimal latency and can respond directly.



In LabVIEW™ the block diagram corresponds in principle to the above picture. Here the *Register Notification Block* and the *Event Structure* run in two different threads. The event is registered only once. The system then waits for the notifications in the event structure. Each received notification contains:

- Notification Handle
- Number of samples
- Array of notification data
- Array of ADS timestamps

If no notification is received, the event structure times out.



Examples in LabVIEW™: Read Notification-Event Single [▶ 105], Read Notification-Event Multiple [▶ 106]

E-Notification Buffered

The operation mode *E-Notification Buffered* uses a data buffer on LabVIEW™ side in addition to the above structure. The buffer size is set by the parameter `LVBufferSize` when the ADS symbol is created. The received ADS data packets are first written to the LabVIEW™-side buffer in an intermediate layer and only forwarded to the event structure as a LabVIEW™ event when the buffer has been filled.

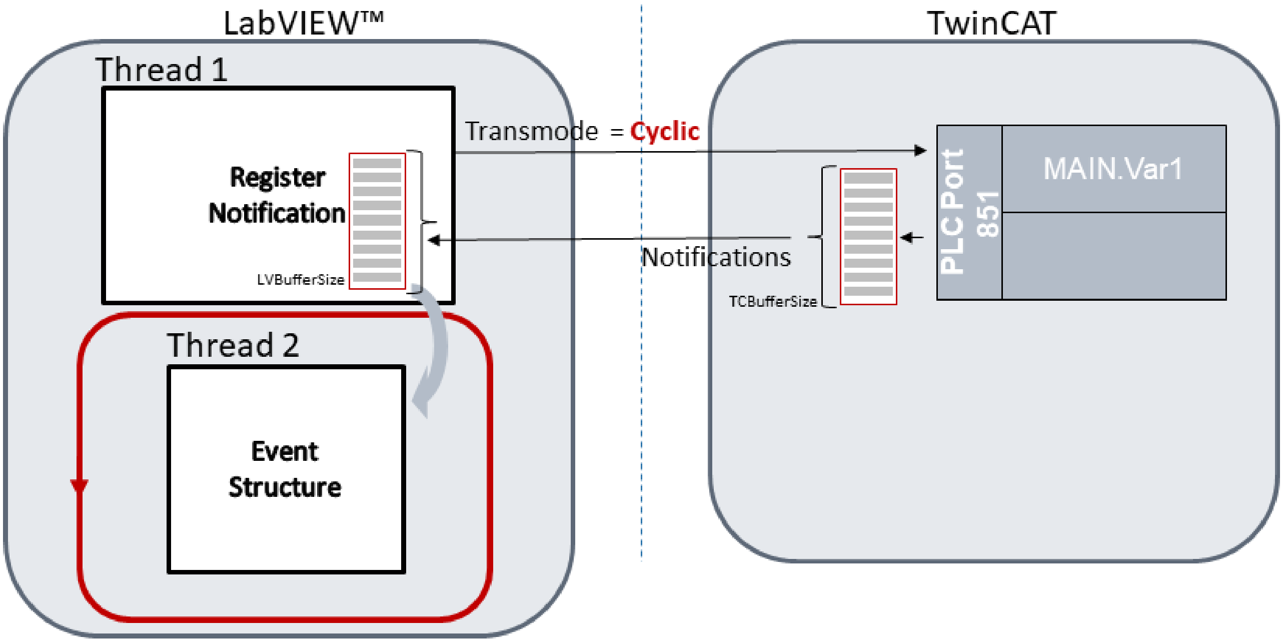
This approach generates LabVIEW™ events less frequently than in the E-Notification Single variant. By submitting larger data packets to LabVIEW™, processing can be made more efficient, resulting in higher overall data throughput.

Buffer size

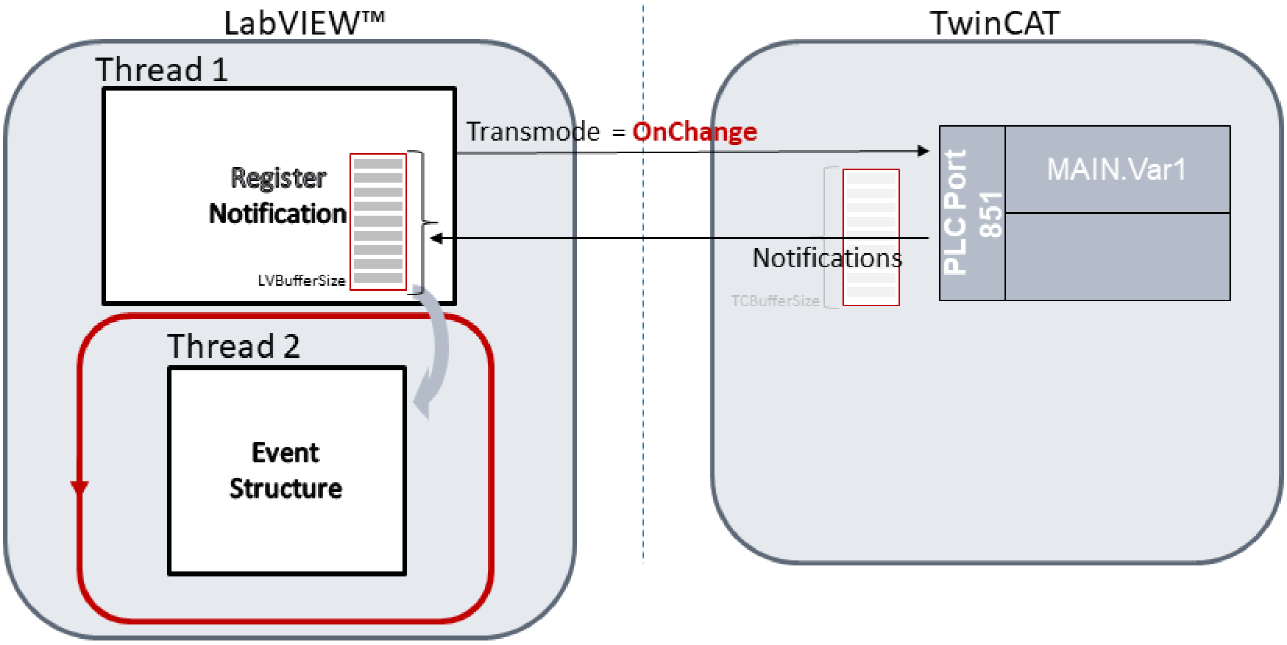
The TwinCAT 3 interface for LabVIEW™ reserves an additional 10% buffer memory when generating LVBuffer.

Transmode and *TCBufferSize* are also the key parameters for this operation mode:

With *Transmode* "**Cyclic**" the TCBuffer and the LVBuffer are used.

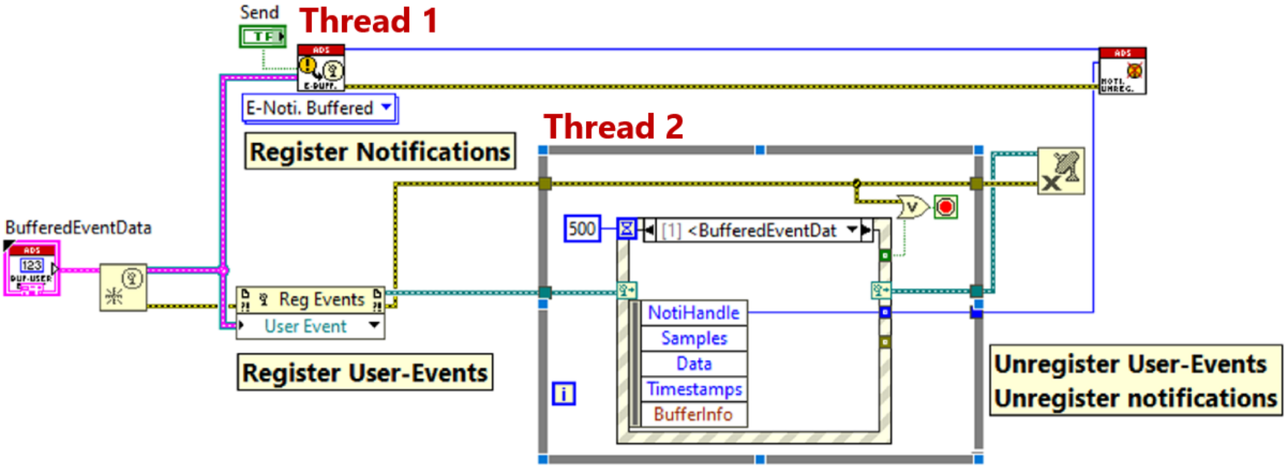


With *Transmode* "**OnChange**" the TCBuffer is **not** used. The individual notifications are transferred directly to LVBuffer without buffering.



In LabVIEW™ the block diagram is similar to the E-Notification Single mode. Each received notification has an additional field called *BufferInfo*. BufferInfo provides additional information about the LVBuffer:

- Previous Overflow Samples: Describes a counter that indicates how often the created buffer was not sufficient. Example: The buffer has been created by the user with 50 samples. As described above, 10% more storage space is created internally, i.e. 55 samples. Several samples can be transferred for each notification thanks to TwinCAT-side buffering. If the buffer in LabVIEW™ is already occupied with 45 samples and another packet with 10 samples arrives, the maximum buffer is not exceeded and the counter does not increment. If, on the other hand, the ADS packet was to contain more than 10 samples, data would be lost because the buffer would not be sufficient. Accordingly, the counter would increment by one.
- Missing Samples: Describes the difference between received and expected samples. Example: The LabVIEW™-side buffer has 50 samples, so 50 samples are expected. However, if only 48 samples are received, the value of Missing Samples is two.
- Buffer Usage: in percent %



Example in LabVIEW™: Read Notification-Event Buffered [▶ 105], Read Notification-Event Multiple [▶ 106]

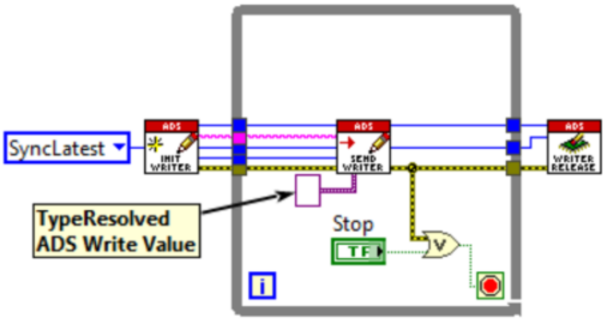
6.2.4 Writing data continuously

During continuous writing LabVIEW™ sends write requests to TwinCAT. Sending of requests is based on a polling cycle.

Writing with polling cycle

Writing with the ADS synchronous block uses so-called continuous polling. Here the low-level [▶ 84] writer blocks are used. The ADS writer is initialized only once. It sends a new *TypeResolved* data packet to the ADS server with each cycle (iteration). With each cycle a new request is sent to the server and an acknowledgement is awaited. The ADS writer is released once the condition for exiting the loop had been reached. The image below shows the complete procedure in LabVIEW™.

This type of writing from LabVIEW™ to TwinCAT can be used to write values directly to an output terminal with short cycle times, for example.



Example in LabVIEW™: Basic examples [▶ 107]

6.3 Type Resolving

The TwinCAT 3 Interface for LabVIEW™ provides **TypeResolver,** to parse the ADS data stream from LabVIEW™ data type to TC3 data type or vice versa. A comparison is first made between the LabVIEW™ data type and the TC3 data type. If the data types are the same, the ADS data stream is parsed and copied appropriately. The TypeResolver supports the following operation modes:

1. Resolve ADS data stream from TC3.
2. Resolve ADS data stream for TC3.

Resolve ADS data stream from TC3

The **From TC** block initializes the TypeResolver, parses and converts the ADS data read from TwinCAT with ADS Read into the LabVIEW™ data type *Variant*. The block Type Release releases the TypeResolver from memory. *Variant* is converted to the appropriate LabVIEW™ data type via Variant-to-Data VI.

The following graphic shows how the composition of TypeResolver from the Low Level VIs [▶ 89]. In this example we assume a structure in TwinCAT that consists of three elements.

Definition of the structure:

```
TYPE ST_toLabVIEW :
STRUCT
    TCSignedWord  : INT;
    TCUnsignedInt : UINT;
    TCStringArray : ARRAY [1..5] OF STRING;
END_STRUCT
END_TYPE
```

The TC3 data type and the LabVIEW™ data type must match for the conversion process. In the appendix you will find a translation table [▶ 115] as an overview. On the right side of the block diagram is a LabVIEW™ container that mirrors the above structure.

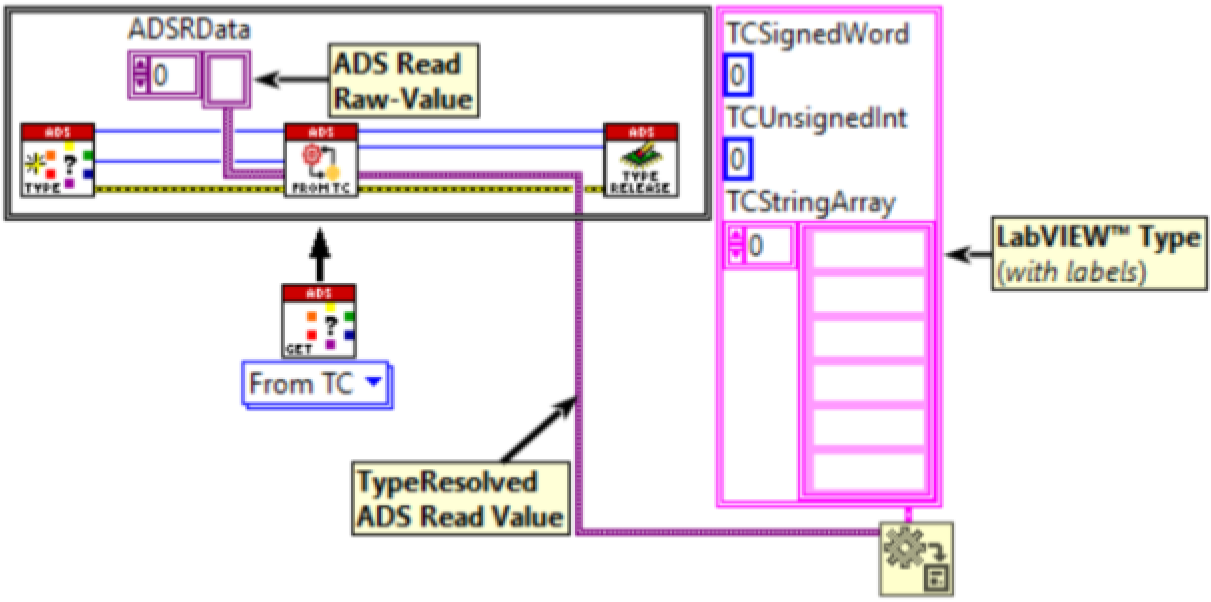
Structure of the LabVIEW™ container (not initialized, merely defined):

- I16
- U16
- TCStringArray is 1..n Elements and of type string (not further specified in LabVIEW™)

Copying data may fail for the following reasons:

- The elements of the LabVIEW™ container are not configured in the correct order.

- The entries of the structure and the container do not have the same data type.



Resolve ADS data stream for TC3

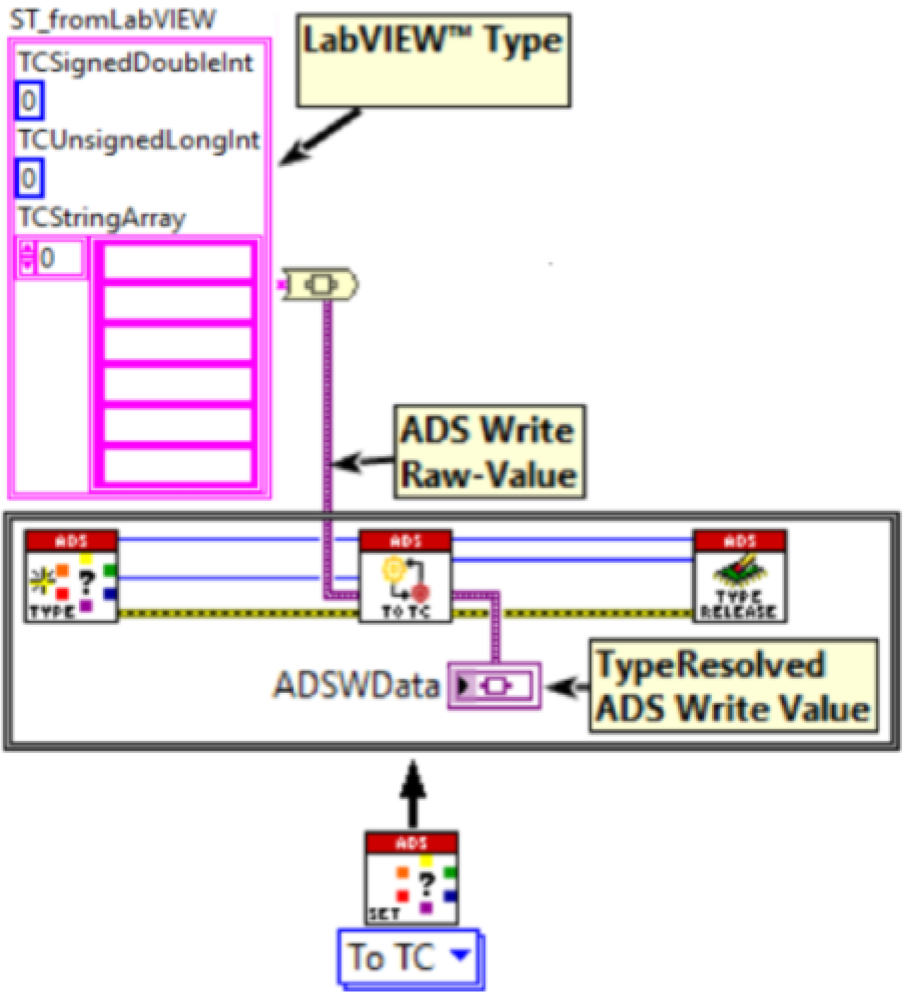
The *To TC* block initializes the TypeResolver, compares the LabVIEW™ data type with the TC3 data type and converts the LabVIEW™ data into ADS raw data. The block then releases the TypeResolver from the memory. The converted ADS data can then be passed directly to an ADS Write [▶ 71] block.

The diagram below shows a similar scenario as described earlier for *From TC*. In this case the data are converted from a LabVIEW™ data type to a TC3 data type. The conversion may fail for the following reasons:

- The elements of the LabVIEW™ container are not configured in the correct order.
- The entries of the structure and the container do not have the same data type.
- The elements in the structure are not initialized.

Initialization of the LabVIEW™ data type

When converting from LabVIEW™ to TC3 data type, the LabVIEW™ data type must be pre-initialized. For a complex data type, such as a structure, the complete data type must be initialized. For an array the individual elements must be initialized.



For the diagram above, for example, the following TwinCAT structure is conceivable in the PLC as a target for writing:

```
TYPE ST_fromLabVIEW :
STRUCT
    TCSignedDoubleInt  : DINT;
    TCUnsignedLongInt : ULINT;
    TCStringArray : ARRAY [1..6] OF STRING(80);
END_STRUCT
END_TYPE
```

The matching initialized LabVIEW™ container is then structured as follows:

- I32
- U64
- String array with 6 elements (80 characters per array element may be used here)

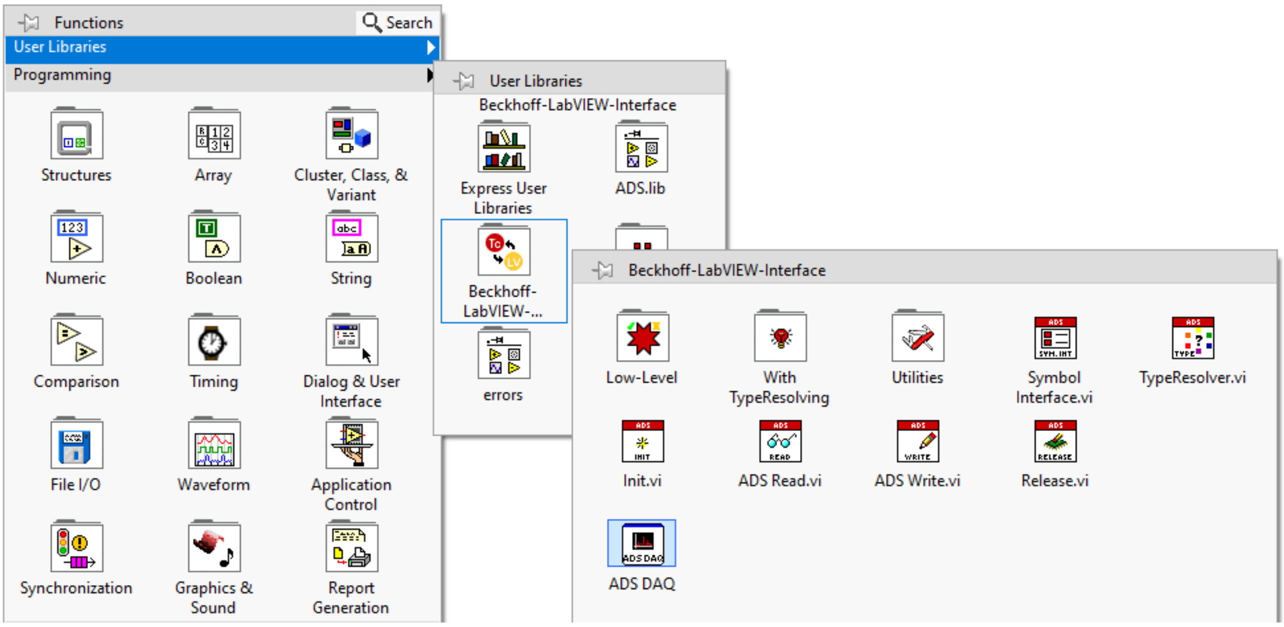
Automatic type generation

Manual creation of matching data types in LabVIEW™ can be time consuming and error-prone. The TwinCAT Interface for LabVIEW™ offers the possibility of automatic type generation. Use the TypeResolver [▶ 89] and the Utilities [▶ 76] wrapper block for this purpose. See the chapter Examples [▶ 102] for several variations on how to use these VIs effectively: Example Type Resolver [▶ 76].

7 LabVIEW™ VIs

The TwinCAT 3 Interface for LabVIEW™ provides controls and VIs for use in LabVIEW™.

The VIs are located in the block diagram in the *functions palette*: **Functions > User Libraries > Beckhoff-LabVIEW-Interface**.



The main folder contains the basic VIs that can be used to build a program for reading via ADS, writing via ADS, TypeResolving and releasing the ADS client. In addition, the main folder contains the subfolders: Low-Level, With TypeResolving and Utilities.

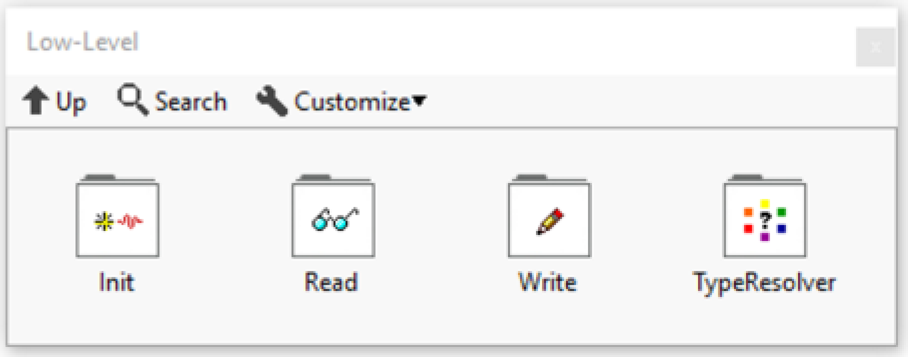
Low-Level

The *Low-Level* subfolder contains Low-Level-VIs. The low-level VIs operate based the same principle as the basic VIs. The low-level VIs involve a little more programming effort but offer higher performance (in terms of data throughput) than the basic VIs and more flexibility for realizing complex programs. Reading data continuously [▶ 31] is an example that uses the Low-Level-VIs for fast reading via ADS. Writing data continuously [▶ 37] is a similar example. Not only reading and writing can be accelerated in this way, but also TypeResolving, see Continous Read [▶ 104], for example.

The table describes the subfolders and their contents and function:

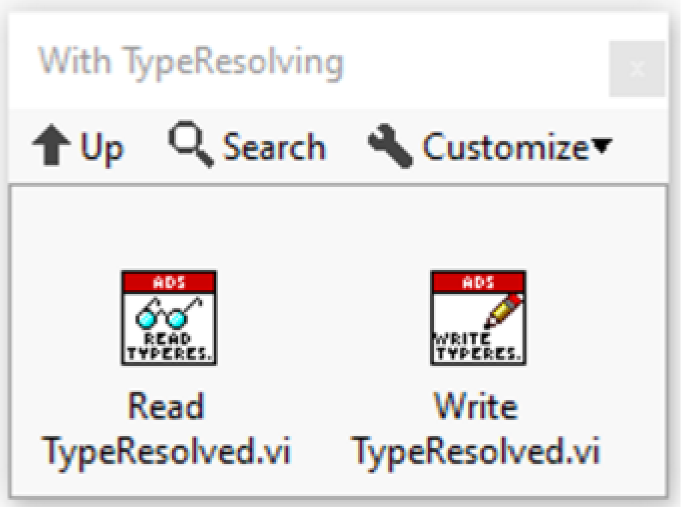
Subfolder	VIs	Function
Init [▶ 84]	Base Init	Initializes the ADS client.
	Get List of ReadWrite Symbols	Creates a list of ADS read and write symbols.
	Get List of Registered Targets	Creates a list of registered ADS target systems.
Read [▶ 85]	Init Reader	Initializes the ADS Reader.
	Send Reader-Request	Sends a request to the ADS server.
	Register Notification	Registers the notification on the ADS server.
	TryReadData	Checks the response from the server and reads the data stream.
	Release Reader	Releases the reader from memory.
Write [▶ 87]	Init Writer	Initializes the ADS Writer.
	Send Writer Request	Sends a request to the ADS server.
	CheckWriteStatus	Checks for the response from the ADS server to ascertain whether the data packet was received.
	Release Writer	Releases the writer from memory.

Subfolder	VIs	Function
TypeResolver [▶ 89]	Init Type	Initializes the TypeResolver.
	Resolve From TC Type	Converts the TC3 data type to a LabVIEW™ data type variant.
	Resolve To TC Type	Converts the LabVIEW™ data type variant to TC3 data type.
	Release Type	Releases the TypeResolver from memory.



With TypeResolving

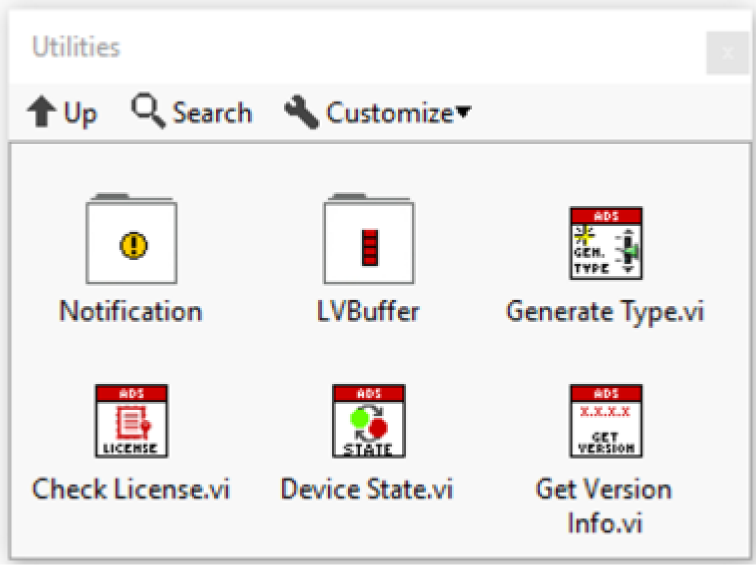
The *With TypeResolving* subfolder contains two VIs for reading and writing via ADS with integrated TypeResolver block.



Utilities

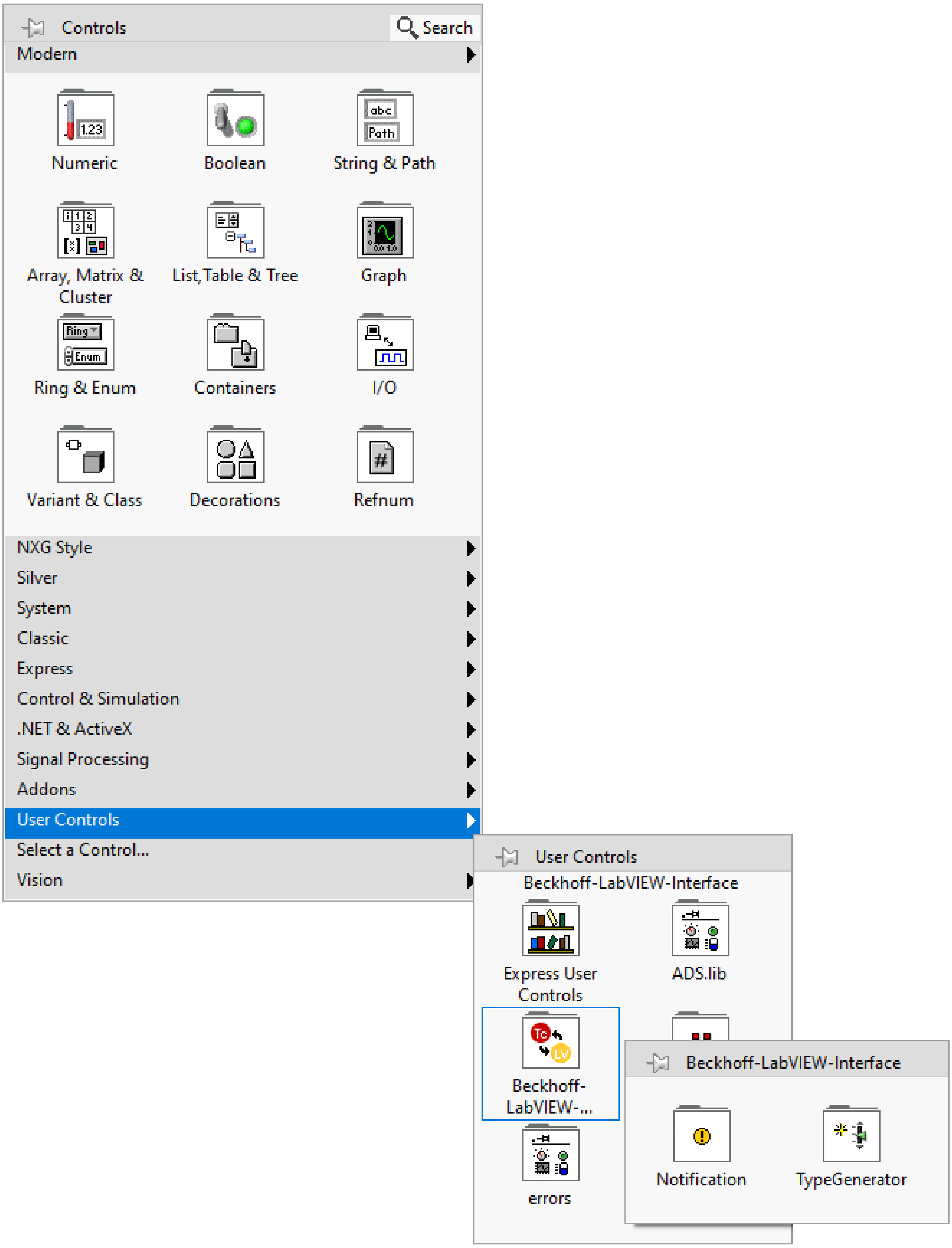
The *Utilities* subfolder contains additional VIs for the following purposes:

Subfolder	VIs	Function
Notification [▶ 77]	ADS To LabVIEW Timestamp	Converts ADS timestamps to LabVIEW™ timestamps.
	Notification Data To Variant Array	Builds an array of LabVIEW™ *Variant* from the notification data stream.
	Stop Notification	Stops the ADS notifications.
	Start Notification	Starts the ADS notifications.
	Unregister Notification	Unregisters the notification on the server.
	Check License	Checks the license state on a given target system.
	Set Device State, Get Device State	Reads or changes the state of an ADS device.
	Get Version Info	Provides information regarding the product version.



Operating elements

The controls are located in the front panel in the *controls palette* under: **User Controls > Beckhoff-LabVIEW-Interface**.



The Notification subfolder contains controls that are required when initializing the LabVIEW™ event for ADS notifications.

Furthermore, the subfolder "TypeGenerator" contains TypeGenerator [▶ 91] class objects to convert TwinCAT types into LabVIEW™ types (see Basic examples [▶ 107]).

The following table describes the function of the controls:

Subfolder	Controls	Function
Notification	Single User-Event Data	Control for initializing a LabVIEW™ event for **Single** ADS notifications.

Subfolder	Controls	Function
	Buffered User-Event Data	Control for initializing a LabVIEW™ event for **Buffered** ADS notifications.
TypeGenerator	CBase	Class object; base class of the TypeGenerator
	CBool	Class object; Boolean class of the TypeGenerator.
	CNumeric	Class object; numeric class of the TypeGenerator.
	CString	Class object; LabVIEW™ string class of the TypeGenerator.
	CArray	Class object; array class of the TypeGenerator.
	CTimestamp	Class object; LabVIEW™ timestamp class of the TypeGenerator.
	CCluster	Class object; LabVIEW™ cluster class of the TypeGenerator.

7.1 ADS DAQ

The ADS DAQ (**Da**ta **Acq**uisition) VI is a LabVIEW™ Express VI for easy configuration of measuring tasks with TwinCAT 3, i.e. you can use this VI for read access to TwinCAT runtimes.

The user interface of the ADS DAQ VI guides you step by step through the configuration of your measuring task:

- Selection of the data points to be read (ADS symbols)
- Configuration of the read mode (ADS notification)
- Type generator configuration
- Configuration of start and end condition of the measuring task

The configuration window opens after placing the ADS DAQ instance in the LabVIEW™ block diagram or by double-clicking. The configurations can be made with the help of the selection windows described below. After the configuration is complete, the instance creates all the necessary resources for reading the data.

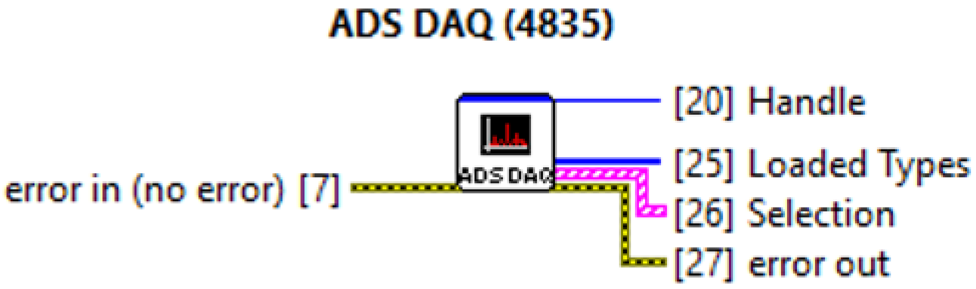
Save VI before using the ADS DAQ VI

The ADS DAQ VI stores the configuration of an instance in the path of the current project/VI. Therefore, it is necessary to save the project/VI beforehand.

Open ADS DAQ VI in an accelerated way

✓ The library must be precompiled.

1. Open the settings for "Mass Compile" in the LabVIEW™ settings at **Tools > Advanced**.
2. Select the folder of the TwinCAT 3 Interfaces for LabVIEW™ library, e.g. *C:\Program Files\ National Instruments\LabVIEW 2023\user.lib\Beckhoff-LabVIEW-Interface*.
3. Start "Mass Compile".



Output	Meaning
[20] Handle	Handle to the ADS client
[25] Loaded Types	An array of LabVIEW™ Enums: • Describes which data types have been generated.
[26] Selection	LabVIEW™ cluster consisting of two elements: • SymbolName: The name of the ADS symbol

Output	Meaning
	• Notification Mode: LabVIEW™ Enum ◦ Single TypeResolved Queue: Reads only one sample as notification and adds the sample to the LabVIEW™ queue (only in LabVIEW™ 32-bit). ◦ Single TypeResolved Control: Reads only one sample as notification and writes the sample to the LabVIEW™ display element (only in LabVIEW™ 32-bit). ◦ Buffered TypeResolved Queue: Reads a number of samples as described by **LVBufferSize**, and adds the samples to the LabVIEW™ queue. ◦ Buffered TypeResolved Control: Reads a number of samples as described by **LVBufferSize**, and writes the samples to the LabVIEW™ display element.

Number of symbols

Currently, the ADS DAQ block supports reading a maximum of 10 ADS symbols per instance. Use multiple instances or the upgrade ADS FlexDAQ [▶ 53] if you want to read more than 10 ADS symbols.

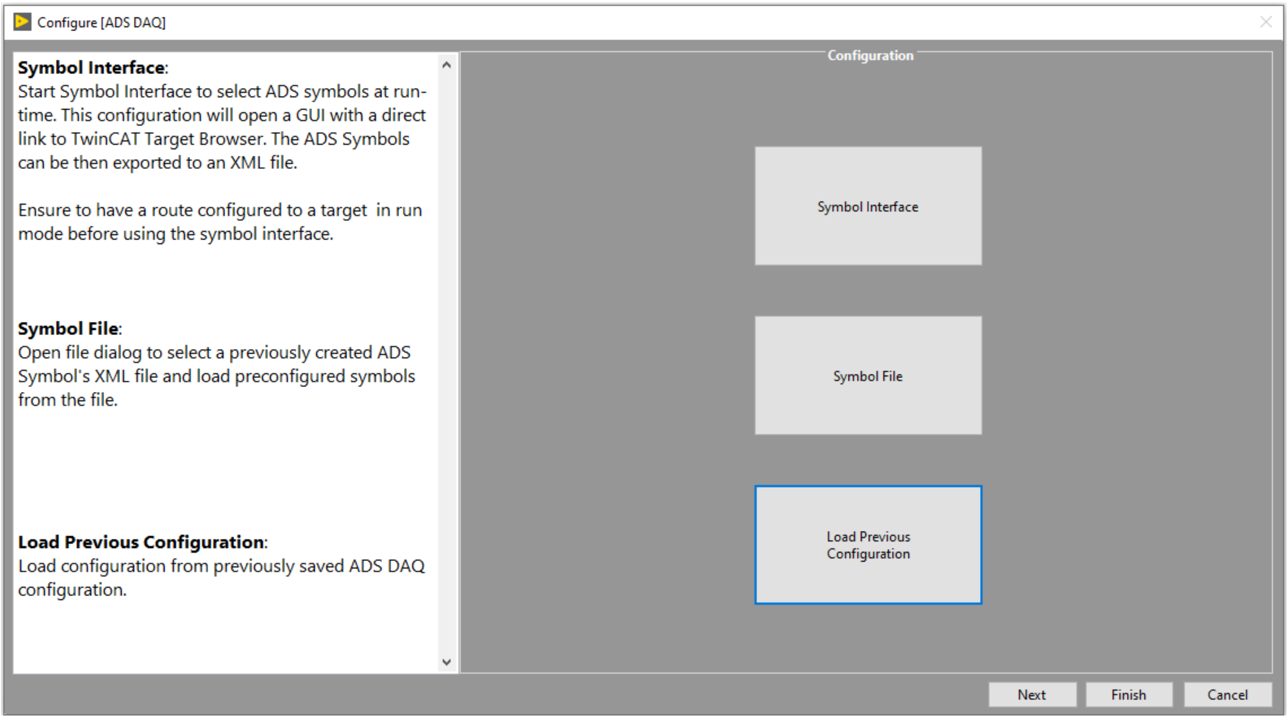
Generation of TwinCAT 3 data types

To support all notification modes, all generated types are converted to arrays. Notifications Buffered as well as Notifications Single are supported in the same way.

Symbol selection window

This window is used to select the ADS symbols to be read with the ADS DAQ instance. The window offers three different ways to select the ADS symbols:

1. Symbol Interface [▶ 64]**:** Opens an additional graphical user interface for browsing ADS symbols.
    - Browse into the connected targets.
    - Select the desired ADS symbols and drag and drop them into the right field.
    - Optionally, in the right field you can export the selected ADS symbols as a list and save them as an XML file.
2. **Symbol File:** Opens a LabVIEW™ file dialog box to read in the ADS symbols using an XML file exported from the Symbol Interface.
    - Reads only the symbols, but does not include all other settings of the ADS DAQ VI from the other configuration views.
3. **Load Previous Configuration:** Loads the last configuration (if existing) with which the ADS DAQ instance has already been configured.
    - The configuration always opens as an empty configuration. If you want to adjust the existing configuration, select **Load Previous Configuration**.



Symbol Interface:
Start Symbol Interface to select ADS symbols at run-time. This configuration will open a GUI with a direct link to TwinCAT Target Browser. The ADS Symbols can be then exported to an XML file.

Ensure to have a route configured to a target in run mode before using the symbol interface.

Symbol File:
Open file dialog to select a previously created ADS Symbol's XML file and load preconfigured symbols from the file.

Load Previous Configuration:
Load configuration from previously saved ADS DAQ configuration.

After selecting the ADS symbols, select **Next**.

Click **Finish** in the dialog at any time to save and close the configuration.

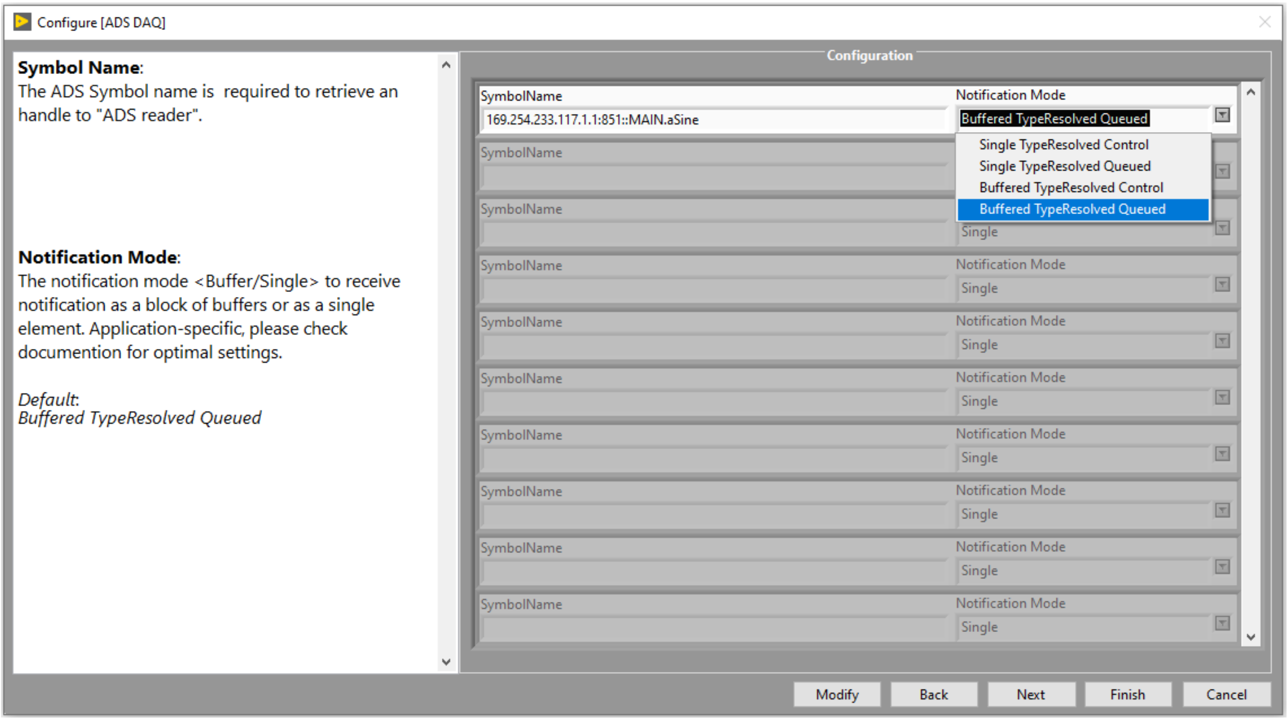
Notification selection window

In this window the notification mode is specified for individual selected ADS symbols. The Notification Mode describes on one side the way of reading (*single/buffered*) and on the other side the display of the read data in LabVIEW™ (*control/queue*). Default setting is *Buffered TypeResolved Queued*.

The following table describes the different properties:

	Single TypeResolved	**Buffered TypeResolved**
Control (Only recommended if the data do not need to be processed or saved)	The individual notifications are displayed directly in a LabVIEW™ control.	Notifications are first written to an intermediate buffer layer and passed into the LabVIEW™ process when the buffer is filled. The data are displayed in a LabVIEW™ control.
Queued (Recommended if data are to be processed, saved, ...)	The individual notifications are inserted directly into a LabVIEW™ queue.	Notifications are first written to an intermediate buffer layer and passed into the LabVIEW™ process when the buffer is filled. The data are inserted into a LabVIEW™ queue.

For more information on single and buffered mode, see Communication modes [▶ 25] and Event driven reading [▶ 33].



Configure [ADS DAQ]

Symbol Name:
The ADS Symbol name is required to retrieve an handle to "ADS reader".

Notification Mode:
The notification mode <Buffer/Single> to receive notification as a block of buffers or as a single element. Application-specific, please check documention for optimal settings.

Default:
Buffered TypeResolved Queued

Configuration

SymbolName: 169.254.233.117.1.1:851::MAIN.aSine

Notification Mode: Buffered TypeResolved Queued

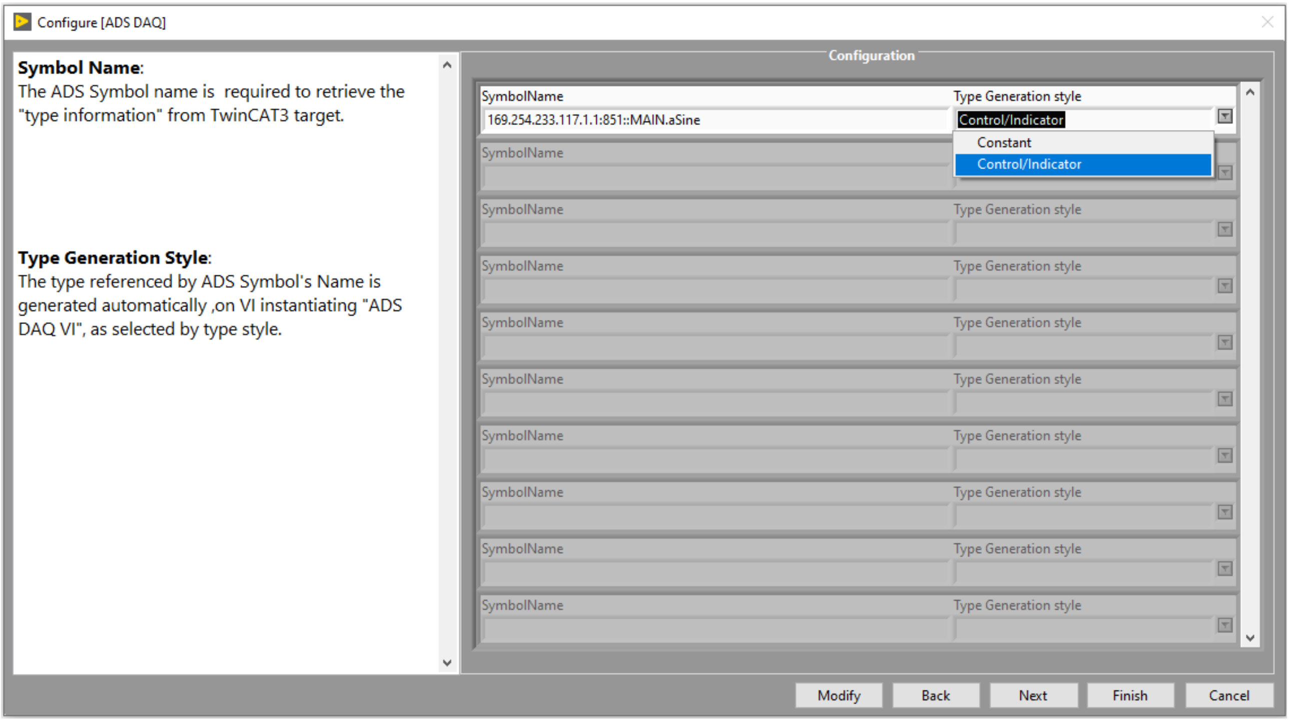
Single TypeResolved Control
Single TypeResolved Queued
Buffered TypeResolved Control
Buffered TypeResolved Queued
SymbolName
Notification Mode
Single
Modify
Back
Next
Finish
Cancel

Click **Modify** to open the Symbol Interface and make changes to the ADS symbols to be read.

Click **Next** to go to the next configuration page.

Type generation selection window

In this window you can select whether the respective data type of the ADS symbol to be read is to be generated as a LabVIEW™ constant or as a control/display element. Both constants and control/display elements are automatically generated in the block diagram of the VI, where the ADS DAQ instance is also located. Default setting is *Control/Indicator*.



Configure [ADS DAQ]

Symbol Name:
The ADS Symbol name is required to retrieve the "type information" from TwinCAT3 target.

Type Generation Style:
The type referenced by ADS Symbol's Name is generated automatically ,on VI instantiating "ADS DAQ VI", as selected by type style.

Configuration

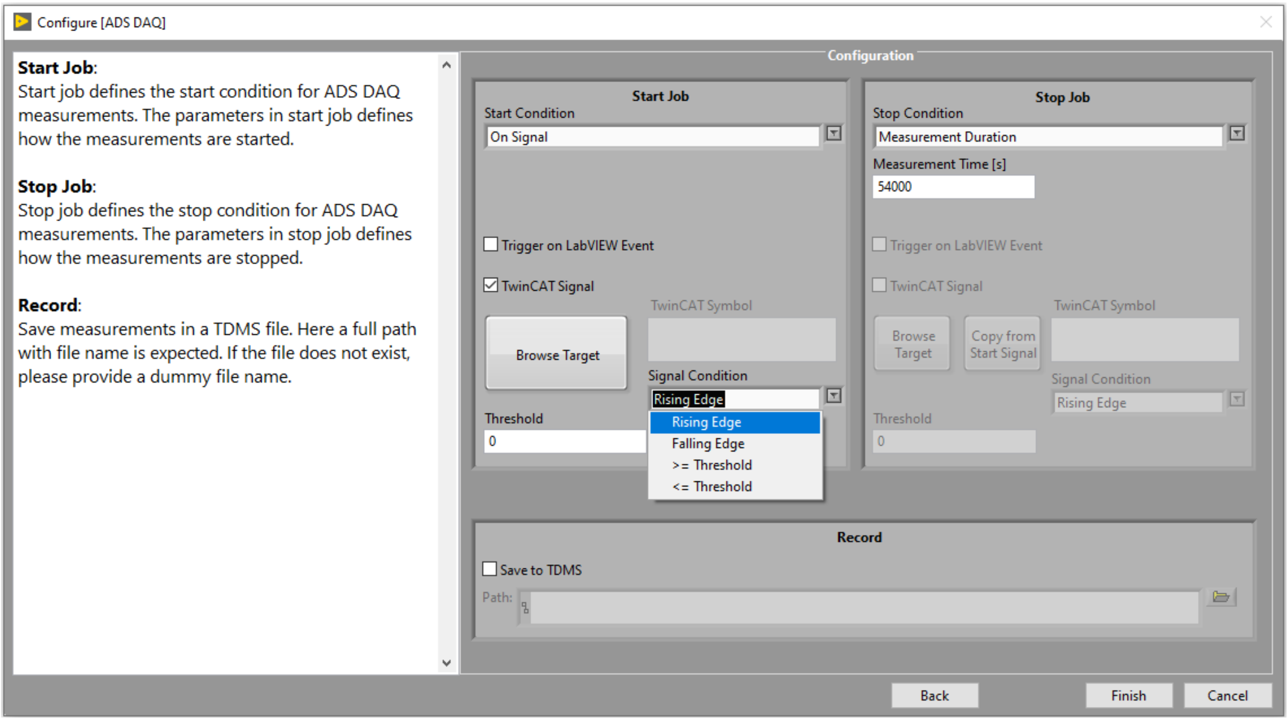
SymbolName: 169.254.233.117.1.1:851::MAIN.aSine

Type Generation style: Control/Indicator

Measurement Job configurator

In this window the ADS DAQ instance can be configured with additional start/stop/record conditions.

Default setting is at *Start: LabVIEW run* and at *Stop: LabVIEW Abort, no Record*.



Configure [ADS DAQ]

Start Job:
Start job defines the start condition for ADS DAQ measurements. The parameters in start job defines how the measurements are started.

Stop Job:
Stop job defines the stop condition for ADS DAQ measurements. The parameters in stop job defines how the measurements are stopped.

Record:
Save measurements in a TDMS file. Here a full path with file name is expected. If the file does not exist, please provide a dummy file name.

Configuration

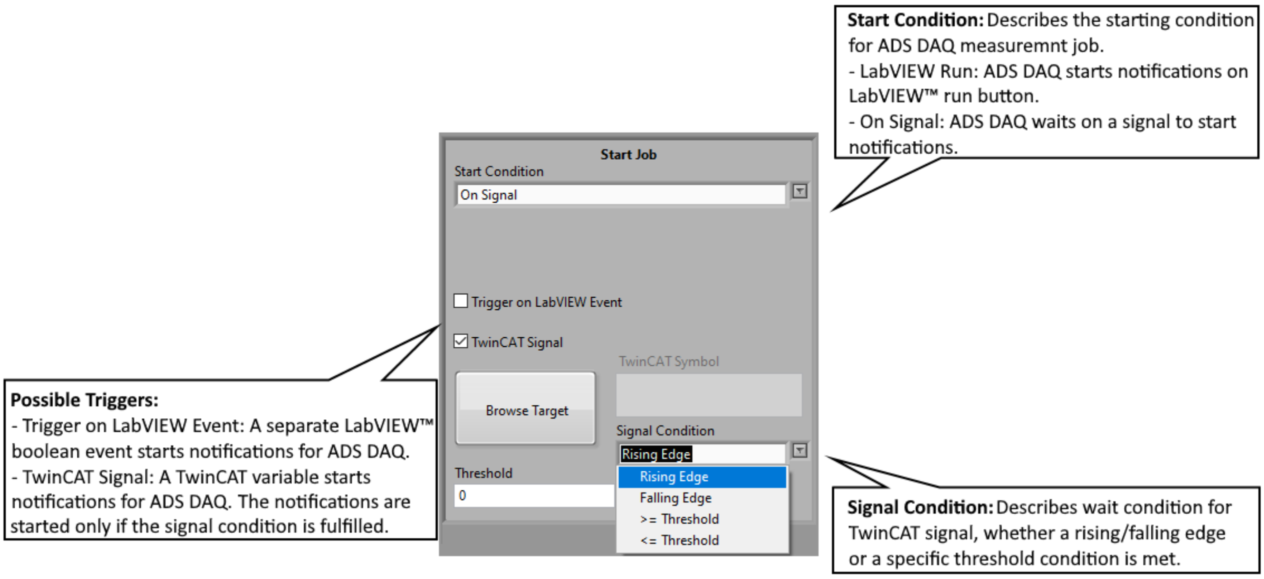
Start Job
Start Condition: On Signal
□ Trigger on LabVIEW Event
☑ TwinCAT Signal
TwinCAT Symbol:
Signal Condition: Rising Edge
Threshold: 0

Stop Job
Stop Condition: Measurement Duration
Measurement Time [s]: 54000
□ Trigger on LabVIEW Event
□ TwinCAT Signal
TwinCAT Symbol:
Signal Condition: Rising Edge
Threshold: 0

Record
□ Save to TDMS
Path:

Start Job

The control *Start Job* configures the start of the reading process. The parameter *Start Condition* describes the way of starting.



Start Condition: Describes the starting condition for ADS DAQ measuremnt job.
- LabVIEW Run: ADS DAQ starts notifications on LabVIEW™ run button.
- On Signal: ADS DAQ waits on a signal to start notifications.

Possible Triggers:
- Trigger on LabVIEW Event: A separate LabVIEW™ boolean event starts notifications for ADS DAQ.
- TwinCAT Signal: A TwinCAT variable starts notifications for ADS DAQ. The notifications are started only if the signal condition is fulfilled.

Signal Condition: Describes wait condition for TwinCAT signal, whether a rising/falling edge or a specific threshold condition is met.

Start Job
Start Condition: On Signal
□ Trigger on LabVIEW Event
☑ TwinCAT Signal
TwinCAT Symbol:
Signal Condition: Rising Edge
Threshold: 0

- **LabVIEW™ Run:** The ADS notifications are both automatically registered and started after starting the VI.
- **On Signal:** The ADS notifications are not started automatically in this case. The ADS DAQ instance waits for a specific trigger from LabVIEW™ or TwinCAT.
  - **Trigger on LabVIEW™ Event:** With this selection the ADS DAQ instance generates a separate event logic to start the ADS notifications from LabVIEW™.

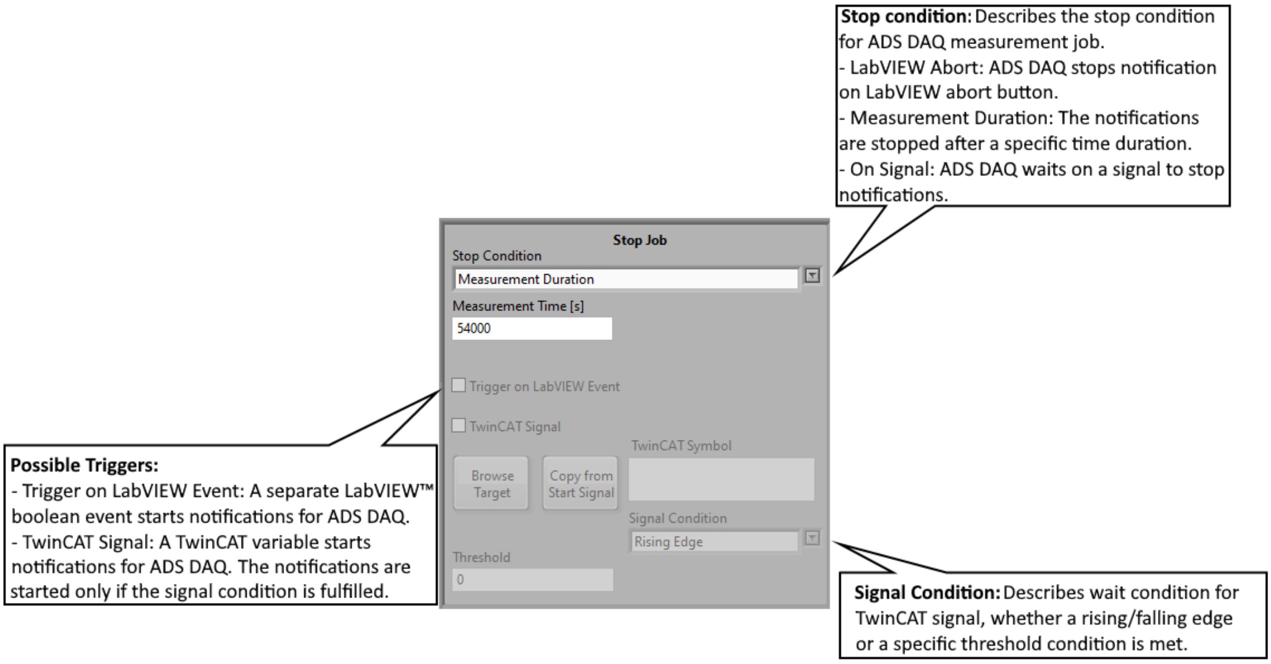
  - **TwinCAT Signal:** The DAQ instance is triggered by an (additional) TwinCAT signal and therefore does not start the ADS notifications automatically. The button *Browse Target* opens the Symbol Interface. Drag an ADS symbol to the right onto the "Read" area. All primary data types are allowed. Furthermore, a signal condition has to be defined on which the ADS DAQ VI is to be triggered.

The table below describes the transition (*Last value* ➔ *New value*) of different TwinCAT types with the definition of Rising and Falling Edge used here.

TwinCAT type	Rising Edge		Falling Edge	
	Last value	New value	Last value	New value
Boolean type	0	1	1	0
Numeric integer type (i8, i16, i32, i64, u8, u16, u32, u64)	< Threshold	= Threshold	> Threshold	= Threshold
Numeric rational type (float32, float64) Epsilon: $1.0\ e^{-7}$	< Threshold	= Threshold	> Threshold	= Threshold

Stop Job

The control *Stop Job* configures the stopping of ADS notifications, i.e. the stopping of the reading process. The parameter *Stop Condition* describes the way of stopping.



Stop condition: Describes the stop condition for ADS DAQ measurement job.
- LabVIEW Abort: ADS DAQ stops notification on LabVIEW abort button.
- Measurement Duration: The notifications are stopped after a specific time duration.
- On Signal: ADS DAQ waits on a signal to stop notifications.

Stop Job

Stop Condition: Measurement Duration

Measurement Time [s]: 54000

□ Trigger on LabVIEW Event

□ TwinCAT Signal

TwinCAT Symbol

Signal Condition: Rising Edge

Threshold: 0

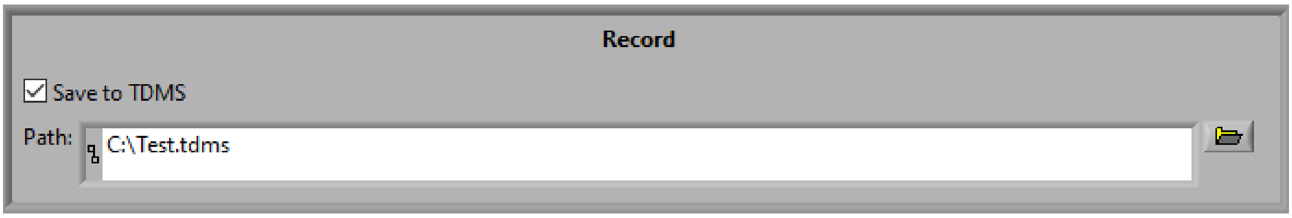
Possible Triggers:
- Trigger on LabVIEW Event: A separate LabVIEW™ boolean event starts notifications for ADS DAQ.
- TwinCAT Signal: A TwinCAT variable starts notifications for ADS DAQ. The notifications are started only if the signal condition is fulfilled.

Signal Condition: Describes wait condition for TwinCAT signal, whether a rising/falling edge or a specific threshold condition is met.

- **LabVIEW™ Abort:** The ADS notifications are automatically unregistered as well as stopped after stopping the VI.
- **Measurement Duration:** The ADS notifications stop automatically after the measurement time has elapsed.
- **On Signal:** This option behaves identically to the selection *On Signal* in **Start Job** (see above).
  - Click **Copy from Start Signal** to copy the start condition from Start to Stop Job (applies only to the TwinCAT signal).

Record Job

The recording of ADS DAQ measured data can be configured with the control *Record Job*. After configuration and clicking **Finish**, the ADS DAQ instance generates an additional Block To TDMS to save the received data as a LabVIEW™ TDMS file under the specified file name and path.



Record

☑ Save to TDMS

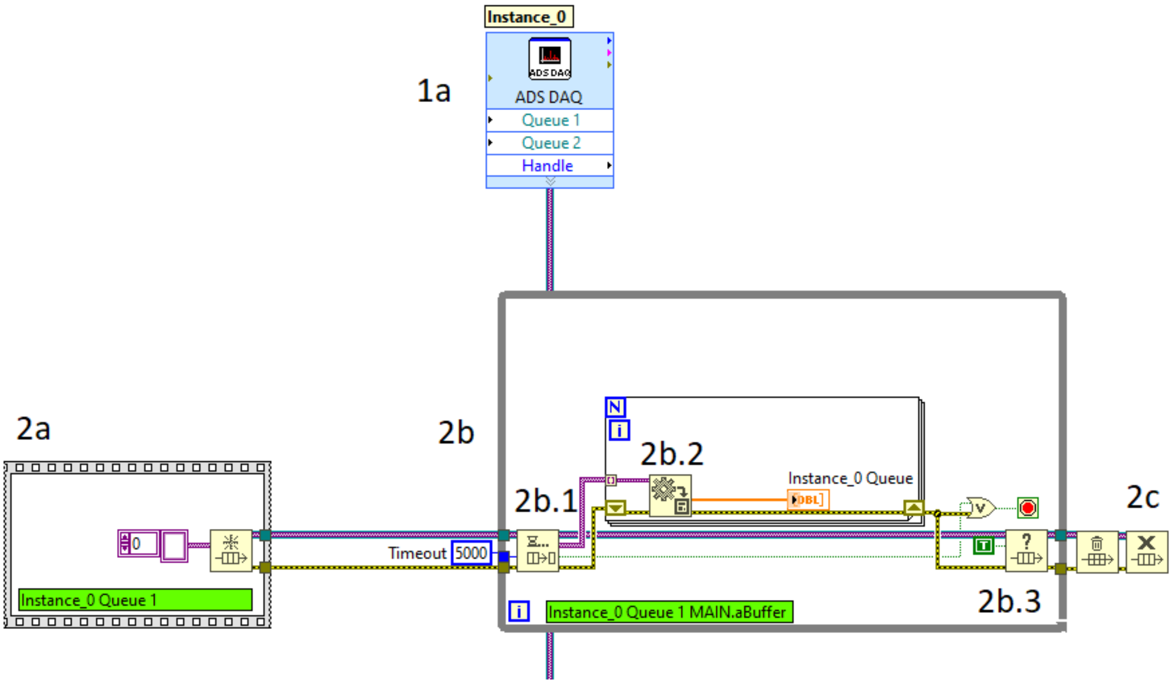
Path: C:\Test.tdms

Click **Finish** to save the settings. The automatic code generation for your configuration starts.

Automatically generated code in the block diagram

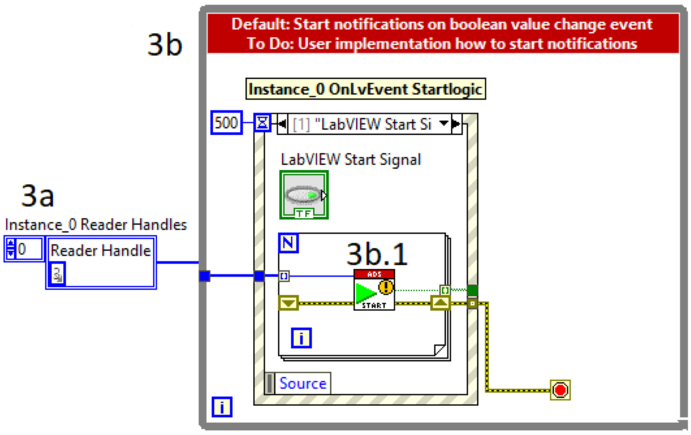
In the following, two variants of the automatically generated code are explained as examples.

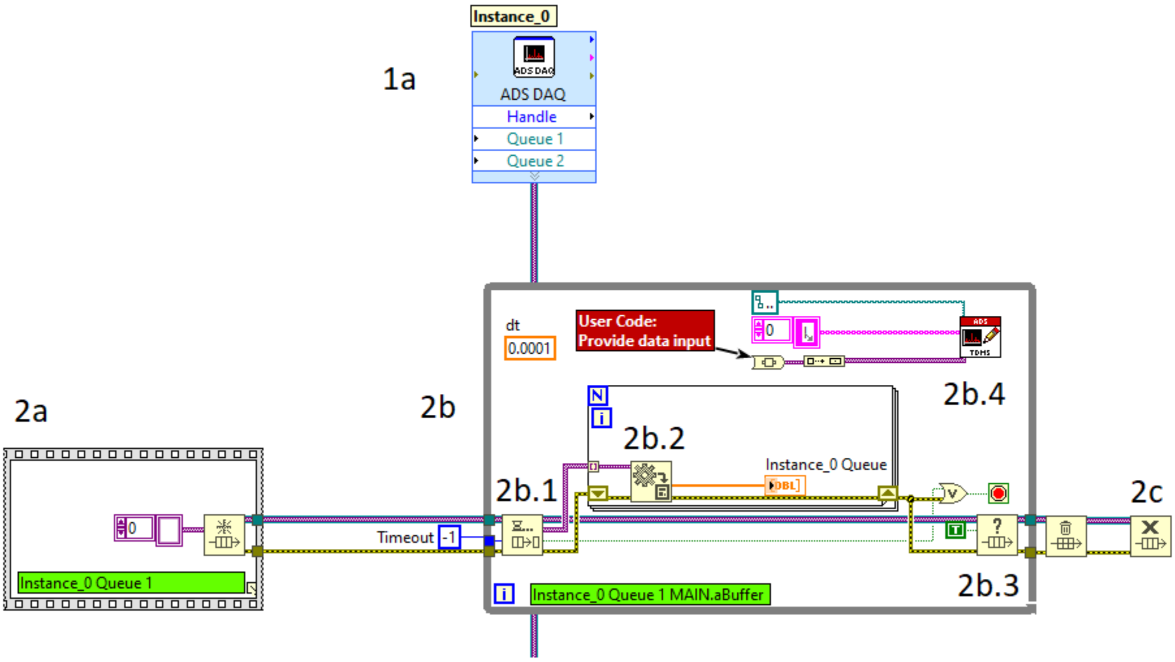
In the first example, the ADS DAQ VI is generated with **default settings**, i.e. Buffered Type Resolved Queue, Control/Indicator, Start with LabVIEW™ Run, Stop with LabVIEW™ Stop. An ADS symbol MAIN.aBuffer is read.



- **1a:** A handle from Queue 1 goes from the instance of ADS DAQ VI to the underlying queue blocks. The queue of the ADS DAQ VI already contains Type-Resolved data packets. Each data packet is of size *LvBufferSize* (cf. settings in the Symbol Properties [▸ 25]), as **Buffered Type Resolved Queue** has been configured.
- **2a:** Initialization of the queue with a LabVIEW™ Variant Array as data type.
- **2b:** While loop with start condition "LabVIEW™ Run" and end condition "Timeout or error occurred".
- **2b.1:** Dequeue element: Waits for received data packets with specified timeout of 5 seconds (customizable).
- **2b.2:** For loop: Takes the individual elements of the Variant array and converts the data type to the corresponding LabVIEW™ data type. Here, for example, the user can directly access the converted type and continue working with it.
- **2b.3:** Checks the current state of the queue, e.g. whether the queue is growing steadily. If this is the case, the data will arrive from ADS DAQ VI faster than it can be converted to the LabVIEW™ data type. Optionally, the user can insert a display element or similar here to monitor the queue.
- **2c:** Releases the queue memory. After that the queue is released from the LV memory. Optionally, after these steps, the user can release the ADS client handle from memory.

In the second example, the start condition is changed from LabVIEW™-Run to Trigger on LabVIEW™-Event and the *recording* to a TDMS file is enabled.


3b
Default: Start notifications on boolean value change event
To Do: User implementation how to start notifications
Instance_0 OnLvEvent Startlogic
500
[1] "LabVIEW Start Si
LabVIEW Start Signal
3a
Instance_0 Reader Handles
0
Reader Handle
3b.1
ADS
START
Source

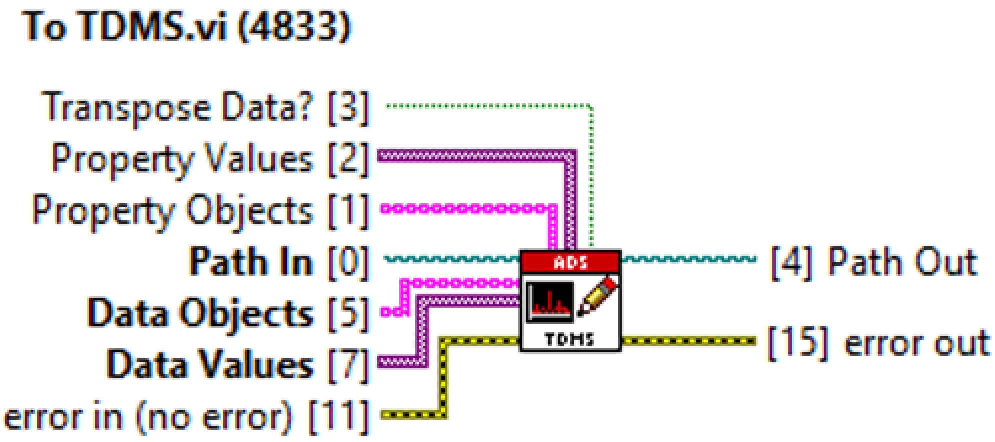


- The blocks already described in the first example remain identical in their function. Only the timeout was set to -1 in this case (wait infinitely), because the start of the measurement is triggered by LabVIEW™.
- **2b.4:** The TDMS block is automatically generated based on the setting that a *recording* should take place. The user must manually link the data to be saved to the To Variant block. If the received data correspond to a LabVIEW™ signal, they can be converted to a LabVIEW™ waveform before the To Variant. The user can use the automatically generated constant *dt* which corresponds to the time distance between two data points (sampling period duration).
- **3a:** The ADS reader handles are regenerated with each new configuration of the ADS DAQ VI. The obsolete reader handles are automatically released from memory.
- **3b:** Logic is created that generates a trigger-event when a Boolean value change occurs. This is used to start the ADS notifications.
- **3b.1:** Starts the ADS Notification for the registered ADS symbols.

Notes on the "To TDMS" in the block diagram

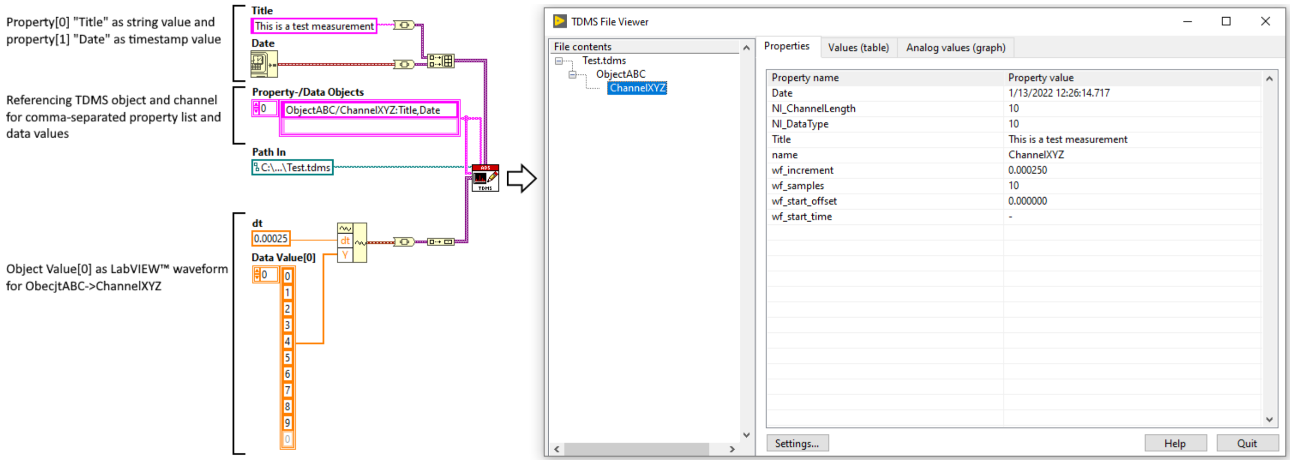
The *To TDMS* block allows you to save ADS DAQ instance data to a LabVIEW™ TDMS file (the NI TDMS file format). This block is automatically generated by the ADS DAQ instance, but only if *Queued* has been selected as the notification mode, cf. ADS DAQ [▶ 46].

The TDMS file format provides TDMS objects and TDMS channels to hierarchically arrange data or properties (name, date, ...) among TDMS objects. The inputs **Property-/Data Objects** can be used to reference or classify both properties and data. The inputs **Property-/Data Values** help to enter measured values under TDMS objects and channels.



Input/output	Meaning
[0] Path In	The path to the TDMS file
[1] Property Objects	An array of a LabVIEW™ string: • References a specific object (channel) for properties with the format described below: 1. Object and channels are separated with slash "/". 2. The list of properties is entered by a comma-separated string (","). 3. Items 1 and 2 are separated by a colon (":"). **Sample:** Property Object[0]=ObjectABC/ChannelXYZ:Name,Author,Date TDMS Object=ObjectABC TDMS Channel=ChannelXYZ Property[0]=name (string) Property[1]=author (string) Property[2]=date (timestamp)
[2] Property Values	An array of LabVIEW™ variants: • Describes the values of properties.
[3] Transpose Data?	*Flag* to transpose the entered 2D of 3D arrays.
[5] Data Objects	An array of a LabVIEW™ string: • References a specific object (channel) for data. The following format is used for referencing: 1. Object and channels are separated with slash ("/"). **Sample:** Data Object[0]=ObjectABC/ChannelXYZ
[7] Data Values	An array of LabVIEW™ variants with the following supported LabVIEW™ types: • LabVIEW™ waveform • 1D, 2D, 3D array (2D, 3D array are internally converted to 1D): ◦ Boolean type ◦ Integer numeric types (i8 ... i64,u8 ... u64) ◦ Non-integer numeric types (float32, float64) ◦ LabVIEW™ string
[4] Path Out	The path of the TDMS file

The following graphic shows an example of the *To TDMS* block in use.


Property[0] "Title" as string value and property[1] "Date" as timestamp value
Referencing TDMS object and channel for comma-separated property list and data values
Object Value[0] as LabVIEW™ waveform for ObecjtABC->ChannelXYZ
Title
This is a test measurement
Date
Property-/Data Objects
0
ObjectABC/ChannelXYZ:Title,Date
Path In
C:\...\Test.tdms
ADS
TDMS
dt
0.00025
Data Value[0]
0
0
1
2
3
4
5
6
7
8
9
0
dt
Y
TDMS File Viewer
File contents
Test.tdms
ObjectABC
ChannelXYZ
Properties
Values (table)
Analog values (graph)
Settings...
Help
Quit

Property name	Property value
Date	1/13/2022 12:26:14.717
NI_ChannelLength	10
NI_DataType	10
Title	This is a test measurement
name	ChannelXYZ
wf_increment	0.000250
wf_samples	10
wf_start_offset	0.000000
wf_start_time	-

7.2 ADS FlexDAQ

The ADS FlexDAQ (**Flex**ible **D**ata **Acq**uisition) VI is a further development of the ADS DAQ [▶ 44] VI. As with the ADS DAQ, this is a LabVIEW™ Express VI that simplifies the configuration of measuring tasks with TwinCAT 3 and provides read access to the TwinCAT runtime.

The ADS FlexDAQ VI also offers the following additional options:

- Any number of ADS symbols can be read per instance.
- A unique Loop-ID can be assigned to the symbols. Symbols with the same Loop-ID are read in the same while loop.
- Each symbol can be assigned a corresponding TDMS flag to store the data to be read in a TDMS file.

The user interface guides you step by step through the configuration of your measuring task:

- Selection of the data points to be read (ADS symbols)
- Configuration of the read mode (ADS notification)
- Configuration of the Loop-IDs
- Configuring the storage of measured data in a TDMS file
- Configuration of start and end condition of the measuring task

The configuration window opens after placing the ADS FlexDAQ instance in the LabVIEW™ block diagram or by double-clicking. The configurations can be made with the help of the selection windows described below. After the configuration is complete, the instance creates all the necessary resources for reading the data.

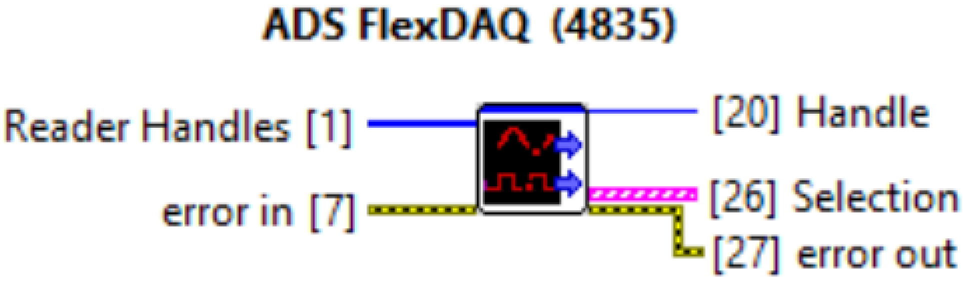
Save VI before using the ADS FlexDAQ VI

The ADS FlexDAQ VI stores the configuration of an instance in the path of the current project. Therefore, it is necessary to save the project beforehand.

Open ADS FlexDAQ VI in an accelerated way

✓ The library must be precompiled.

1. Open the settings for "Mass Compile" in the LabVIEW™ settings at **Tools > Advanced**.
2. Select the folder of the TwinCAT 3 Interfaces for LabVIEW™ library, e.g. *C:\Program Files\ National Instruments\LabVIEW 2023\user.lib\Beckhoff-LabVIEW-Interface* .
3. Start "Mass Compile".



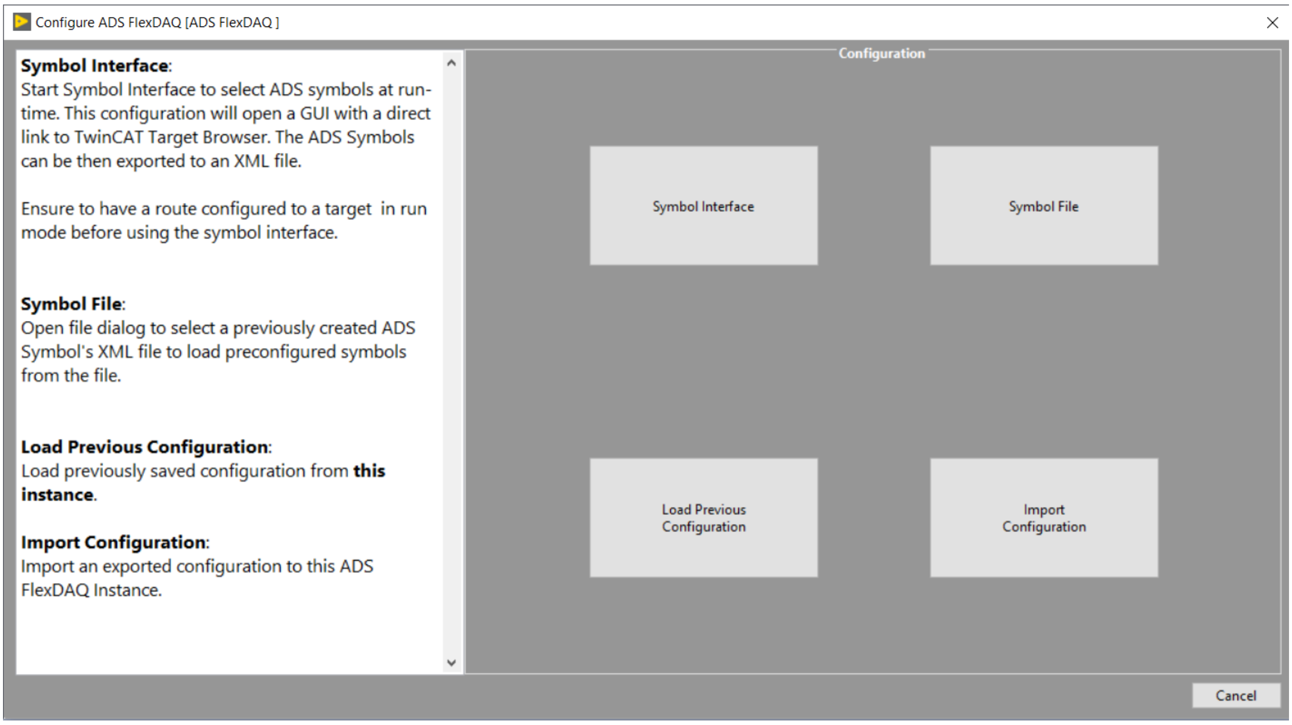
Input/output	Meaning
[1] Reader handles	Handles on the reading symbols
[20] Handle	Handle to the ADS client
[26] Selection	LabVIEW™ cluster consisting of two elements: • SymbolName: The name of the ADS symbol • Notification Mode: LabVIEW™ Enum ◦ Single TypeResolved Queue: Reads only one sample as notification and adds the sample to the LabVIEW™ queue (only in LabVIEW™ 32-bit). ◦ Single TypeResolved Control: Reads only one sample as notification and writes the sample to the LabVIEW™ display element (only in LabVIEW™ 32-bit). ◦ Buffered TypeResolved Queue: Reads a number of samples as described by **LVBufferSize**, and adds the samples to the LabVIEW™ queue. ◦ Buffered TypeResolved Control: Reads a number of samples as described by **LVBufferSize**, and writes the samples to the LabVIEW™ display element.

TwinCAT 3 data type generation

To support all notification modes, all generated types are converted to arrays. Notifications Buffered as well as Notifications Single are supported in the same way.

Symbol selection window

Just as with ADS DAQ [▶ 44], the Symbol selection window is used to select the ADS symbols to be read with the ADS Flex DAQ instance. In addition, there is an option **Import Configuration,** which can be used to import a saved configuration**.** For this purpose, a LabVIEW™ file dialog box opens, in which a path to an exported configuration can be selected.



Configure ADS FlexDAQ [ADS FlexDAQ]

Symbol Interface:
Start Symbol Interface to select ADS symbols at run-time. This configuration will open a GUI with a direct link to TwinCAT Target Browser. The ADS Symbols can be then exported to an XML file.

Ensure to have a route configured to a target in run mode before using the symbol interface.

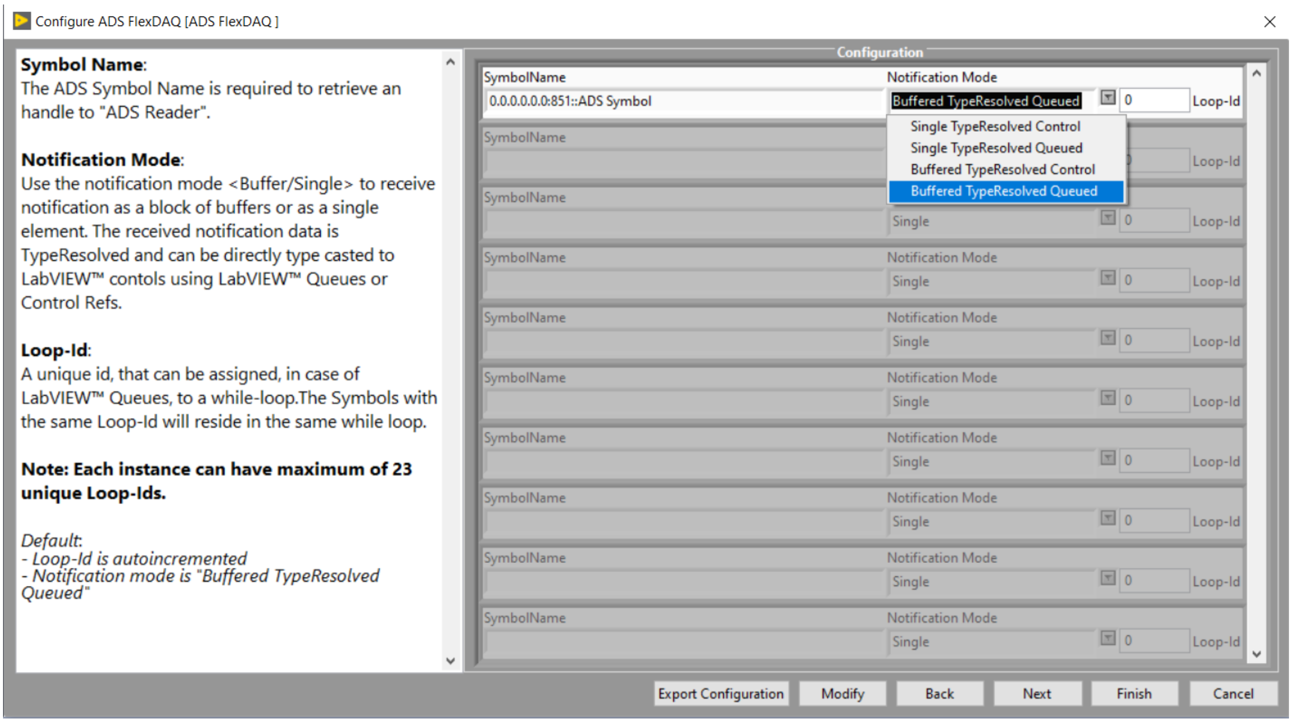
Symbol File:
Open file dialog to select a previously created ADS Symbol's XML file to load preconfigured symbols from the file.

Load Previous Configuration:
Load previously saved configuration from **this instance**.

Import Configuration:
Import an exported configuration to this ADS FlexDAQ Instance.

Notification and Loop-ID selection window

In this window the Notification Mode and the Loop-ID are selected. The possible notification modes can be found in the section ADS DAQ [▶ 46]. The Loop-ID is used to distribute the reading of the symbols to while loops. With the ADS Flex DAQ it is possible to assign the same Loop-ID to several symbols. These are then processed in the same while loop. This reduces the number of loops.



Configure ADS FlexDAQ [ADS FlexDAQ]

Symbol Name:
The ADS Symbol Name is required to retrieve an handle to "ADS Reader".

Notification Mode:
Use the notification mode <Buffer/Single> to receive notification as a block of buffers or as a single element. The received notification data is TypeResolved and can be directly type casted to LabVIEW™ contols using LabVIEW™ Queues or Control Refs.

Loop-Id:
A unique id, that can be assigned, in case of LabVIEW™ Queues, to a while-loop.The Symbols with the same Loop-Id will reside in the same while loop.

Note: Each instance can have maximum of 23 unique Loop-Ids.

Default:
- Loop-Id is autoincremented
- Notification mode is "Buffered TypeResolved Queued"

SymbolName: 0.0.0.0.0.0:851::ADS Symbol
Notification Mode: Buffered TypeResolved Queued
Loop-Id: 0

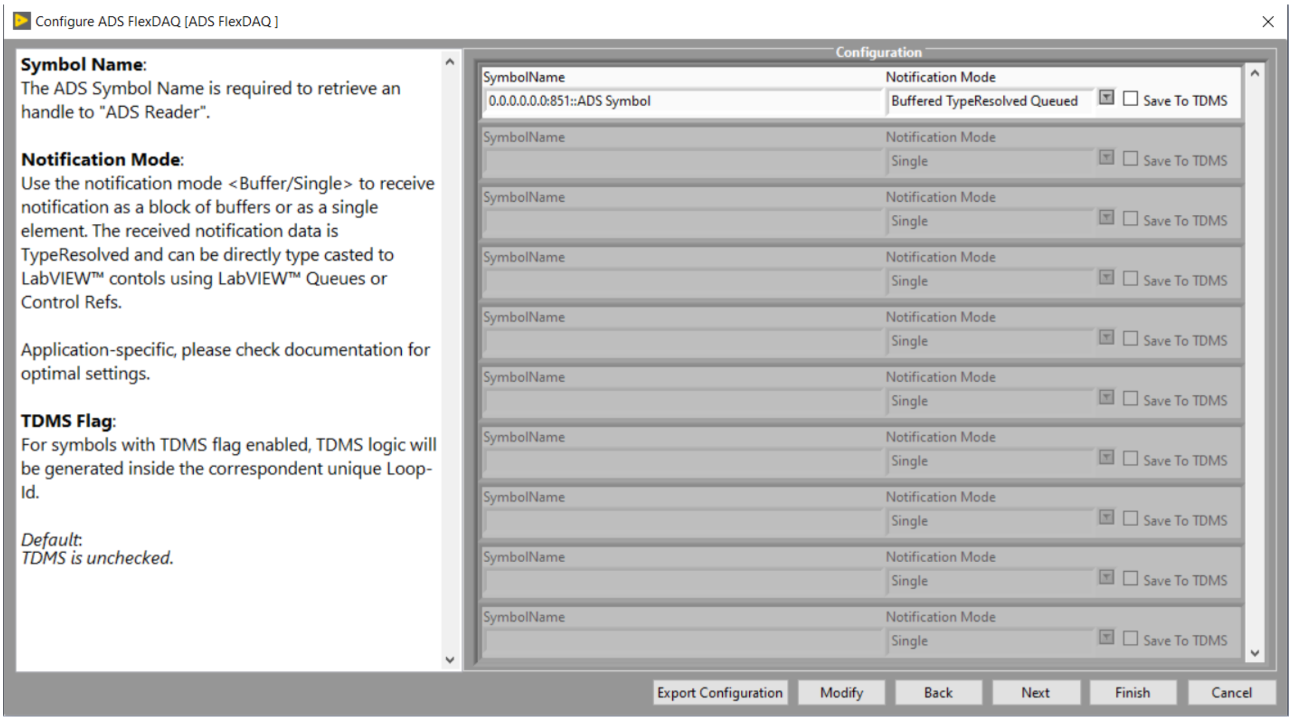
Configuration
SymbolName
Notification Mode
Loop-Id
Single TypeResolved Control
Single TypeResolved Queued
Buffered TypeResolved Control
Buffered TypeResolved Queued
Single
0
Export Configuration
Modify
Back
Next
Finish
Cancel

Maximum Loop-IDs

The number of inputs is limited to 23 for the ADS Flex DAQ instance. Consequently, a maximum of 23 different Loop-IDs can also be assigned.

Save measured data

For each symbol there is the option "Save To TDMS", which saves the respective symbol in a TDMS file when reading from TwinCAT. The block "To TDMS [▸ 51]" like in the ADS DAQ is used for this purpose.



Configure ADS FlexDAQ [ADS FlexDAQ]

Symbol Name:
The ADS Symbol Name is required to retrieve an handle to "ADS Reader".

Notification Mode:
Use the notification mode <Buffer/Single> to receive notification as a block of buffers or as a single element. The received notification data is TypeResolved and can be directly type casted to LabVIEW™ contols using LabVIEW™ Queues or Control Refs.

Application-specific, please check documentation for optimal settings.

TDMS Flag:
For symbols with TDMS flag enabled, TDMS logic will be generated inside the correspondent unique Loop-Id.

Default:
TDMS is unchecked.

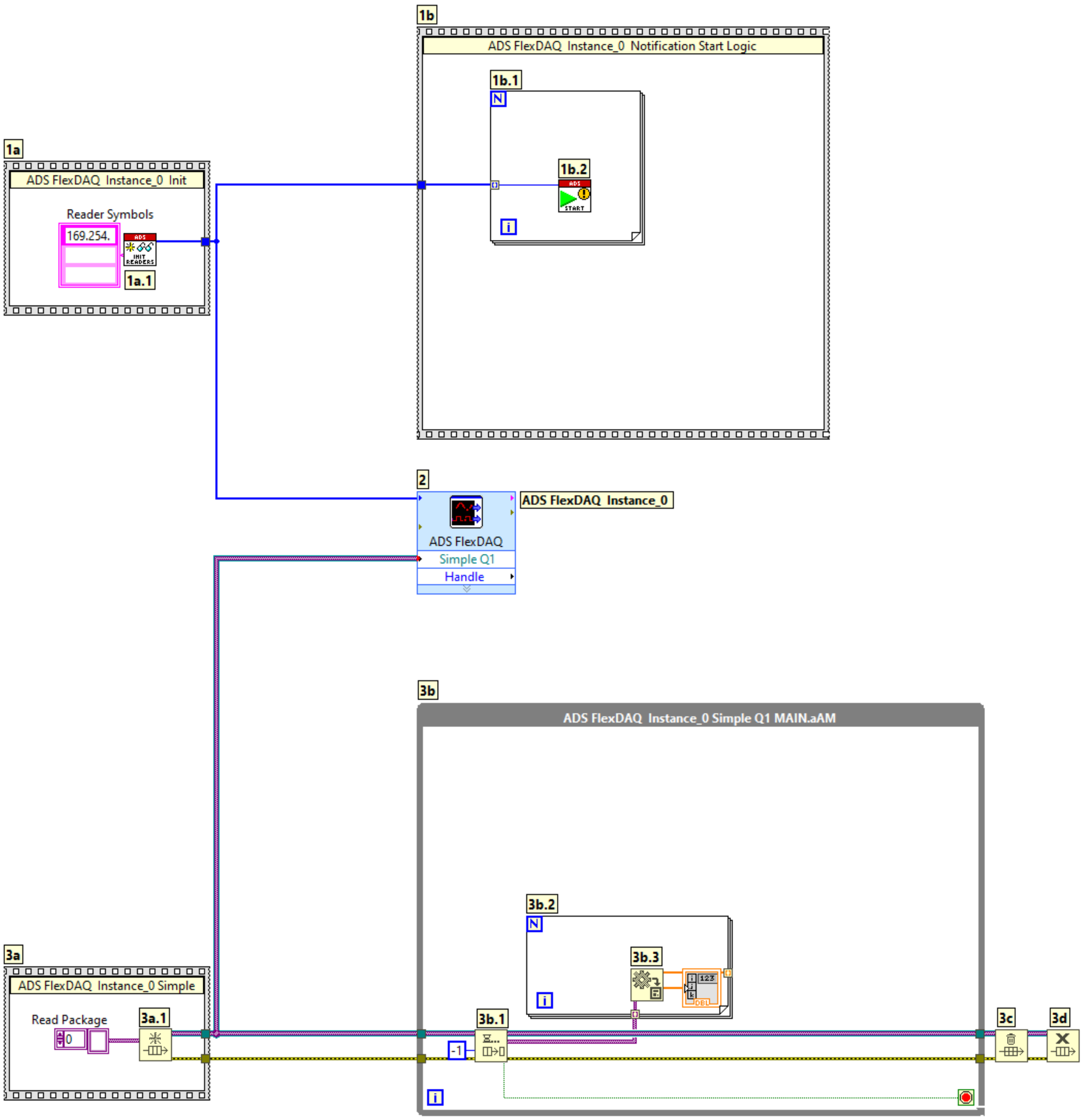
Configuration

SymbolName	Notification Mode	
0.0.0.0.0.0:851::ADS Symbol	Buffered TypeResolved Queued	□ Save To TDMS
	Single	□ Save To TDMS
	Single	□ Save To TDMS
	Single	□ Save To TDMS
	Single	□ Save To TDMS
	Single	□ Save To TDMS
	Single	□ Save To TDMS
	Single	□ Save To TDMS
	Single	□ Save To TDMS
	Single	□ Save To TDMS

Automatically generated code in the block diagram

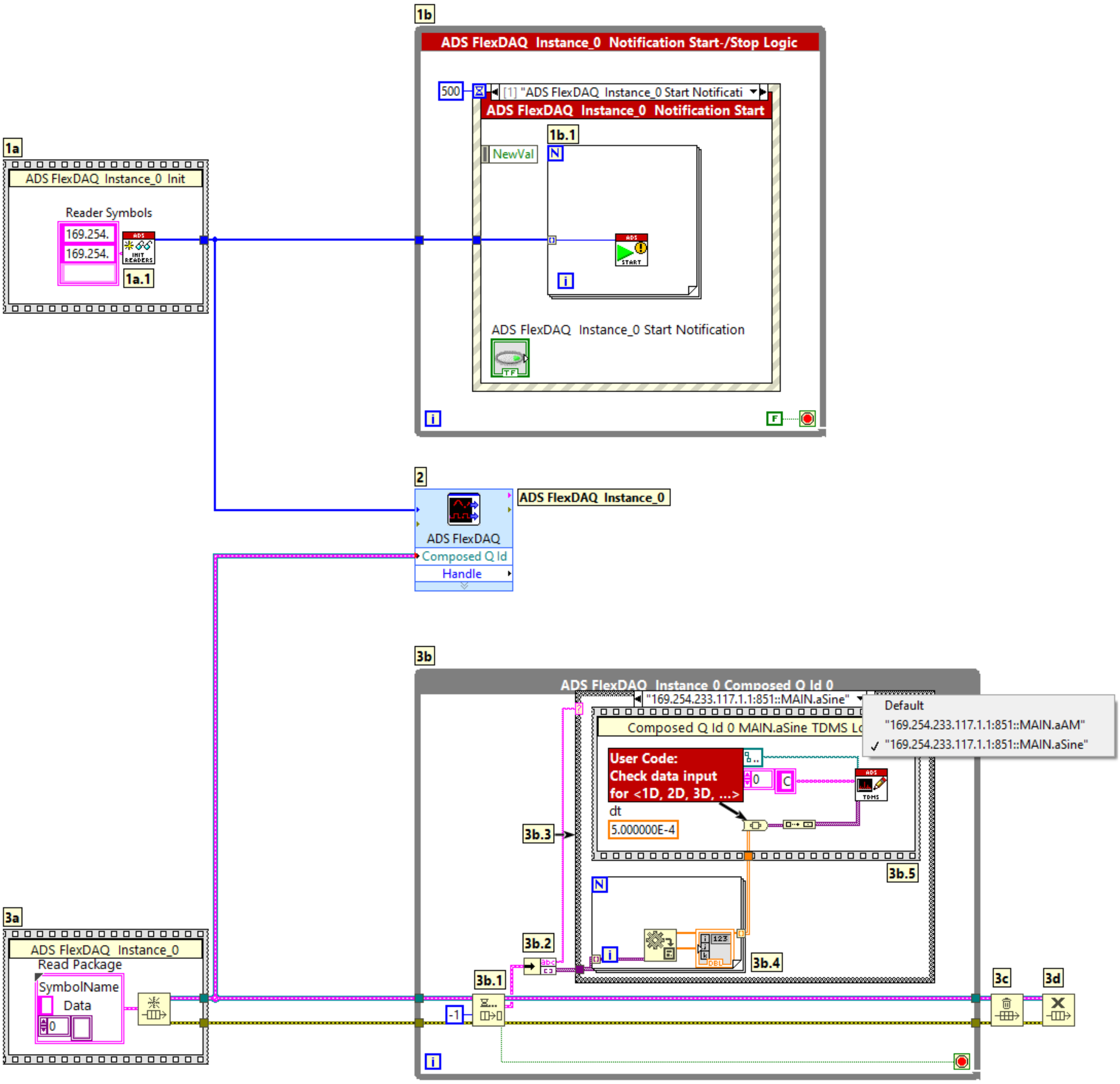
In the following, two variants of the automatically generated code are explained as examples.

In the first example, the ADS FlexDAQ VI is generated with **default settings**, i.e. Buffered Type Resolved Queue, no storage of measured data, Start with LabVIEW™ Run, Stop with LabVIEW™ Stop. An ADS symbol MAIN.aAM is read.


1b
ADS FlexDAQ_Instance_0 Notification Start Logic
1b.1
N
1b.2
i
1a
ADS FlexDAQ_Instance_0 Init
Reader Symbols
169.254.
1a.1
2
ADS FlexDAQ
Simple Q1
Handle
ADS FlexDAQ_Instance_0
3b
ADS FlexDAQ_Instance_0 Simple Q1 MAIN.aAM
3b.2
N
3b.3
i
3a
ADS FlexDAQ_Instance_0 Simple
Read Package
3a.1
3b.1
-1
3c
3d
i

- **1a:** ADS Reader handles are initialized for the selected ADS symbols. The ADS reader handles are regenerated with each new configuration of the ADS FlexDAQ VI. The obsolete reader handles are automatically released from memory.
- **1b:** The ADS notification is started with the help of the handle. For this purpose, iteration is performed on each individual handle and the ADS notification is started.
- **2:** A handle from Simpe Queue1 goes from the instance of ADS FlexDAQ to the underlying queue blocks. The queue of the ADS FlexDAQ VI already contains Type-Resolved data packets. Each data packet is of size *LvBufferSize* (cf. settings in the Communication modes [▶ 25]), as **Buffered Type Resolved Queue** has been configured.
- **3a:** The queue is initialized with a LabVIEW™ Variant Array as data type.
- **3b:** While loop with start condition "LabVIEW™ Run" and without end condition.
- **3b.1:** Dequeue element: Waits for received data packets for an infinite time (customizable).
- **3b.2:** For loop: Takes the individual elements of the Variant array and converts the data type to the corresponding LabVIEW™ data type. Here, for example, the user can directly access the converted type and continue working with it.
- **3c and 3d:** The queue memory is released. After that the queue is released from the LabVIEW™ memory. Optionally, after these steps, the user can release the ADS client handle from memory.

In the second example, the start condition is changed from LabVIEW™-Run to "Trigger on LabVIEW™ Event" and the data storage to a TDMS file is enabled. Two symbols are read: MAIN.aAM and MAIN.aSine. These are assigned the same Loop-ID. Thus, both symbols are read in the same while loop.


1b
ADS FlexDAQ Instance_0 Notification Start-/Stop Logic
500
[1] "ADS FlexDAQ Instance_0 Start Notificati
ADS FlexDAQ Instance_0 Notification Start
1b.1
NewVal
N
i
ADS FlexDAQ Instance_0 Start Notification
F
1a
ADS FlexDAQ Instance_0 Init
Reader Symbols
169.254.
169.254.
1a.1
2
ADS FlexDAQ
Composed Q Id
Handle
ADS FlexDAQ Instance_0
3b
ADS FlexDAQ Instance 0 Composed Q Id 0
"169.254.233.117.1.1:851::MAIN.aSine"
Default
"169.254.233.117.1.1:851::MAIN.aAM"
"169.254.233.117.1.1:851::MAIN.aSine"
Composed Q Id 0 MAIN.aSine TDMS Lo
User Code:
Check data input
for <1D, 2D, 3D, ...>
dt
5.000000E-4
3b.3
3b.5
3b.2
3b.4
3b.1
-1
3c
3d
3a
ADS FlexDAQ Instance_0
Read Package
SymbolName
Data
0

- The blocks **1a, 2, 3b, 3b.2, 3b.4, 3c** and **3d** already described in the first example remain identical in their function.
- **1b:** Logic is created that generates a trigger-event when a Boolean value change occurs. This is used to start the ADS notifications.
- **3a:** The queue is initialized with a LabVIEW™ cluster as data type with the member variables:
  - SymbolName: Identifies the read data packet
  - Data: TypeResolved ADS notification data packet
- **3b.2:** The read data packet is unpacked and distributed to the corresponding case structure.
- **3b.3:** Case structure that passes the ADS data for the unpacked symbol data to LabVIEW™. In the example, the case structure manages two ADS symbols MAIN.aAM and MAIN.aSine.
- **3b.5:** The TDMS block is generated automatically based on the setting that the data should be saved. The data to be saved is automatically linked to the To Variant block. If the received data correspond to a LabVIEW™ signal, they can be converted to a LabVIEW™ waveform before the To Variant. The user can use the automatically generated constant *dt* which corresponds to the time distance between two data points (sampling period duration).

7.3 ADS Write Assistant

Like the ADS FlexDAQ [▸ 53], the ADS Write Assistant VI is a LabVIEW™ Express VI that simplifies the configuration of transfer tasks. The ADS Write Assistant VI can be used to write data from LabVIEW™ to TwinCAT 3.

The user interface of the ADS Write Assistant VI guides you step by step through the configuration of your transfer task:

- Selection of the data points to be written (ADS symbols)
- Configuration of the Loop-IDs
- Configuration of start and end condition of the write operation using the transfer job selection window

The configuration window opens after placing the ADS Write Assistant instance in the LabVIEW™ block diagram or by double-clicking. The configurations can be made with the help of the selection windows described below. After the configuration is complete, the instance creates all the necessary resources for writing the data.

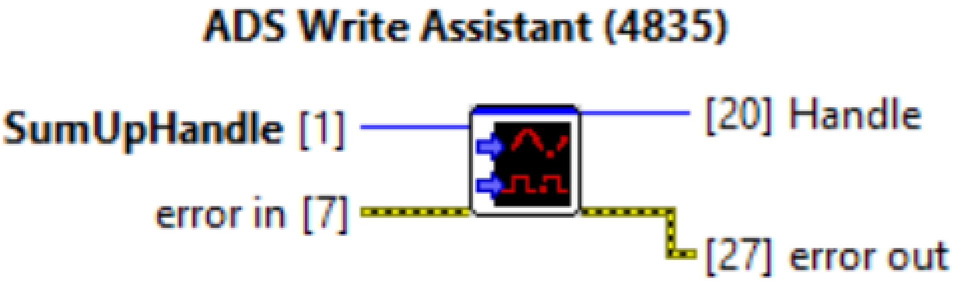
Save VI before using the ADS Write Assistant VI

The ADS Write Assistant VI saves the instance configuration in the path of the current project. Therefore it is necessary that the project has been saved before.

Open ADS Write Assistant VI in an accelerated way

✓ The library must be precompiled.

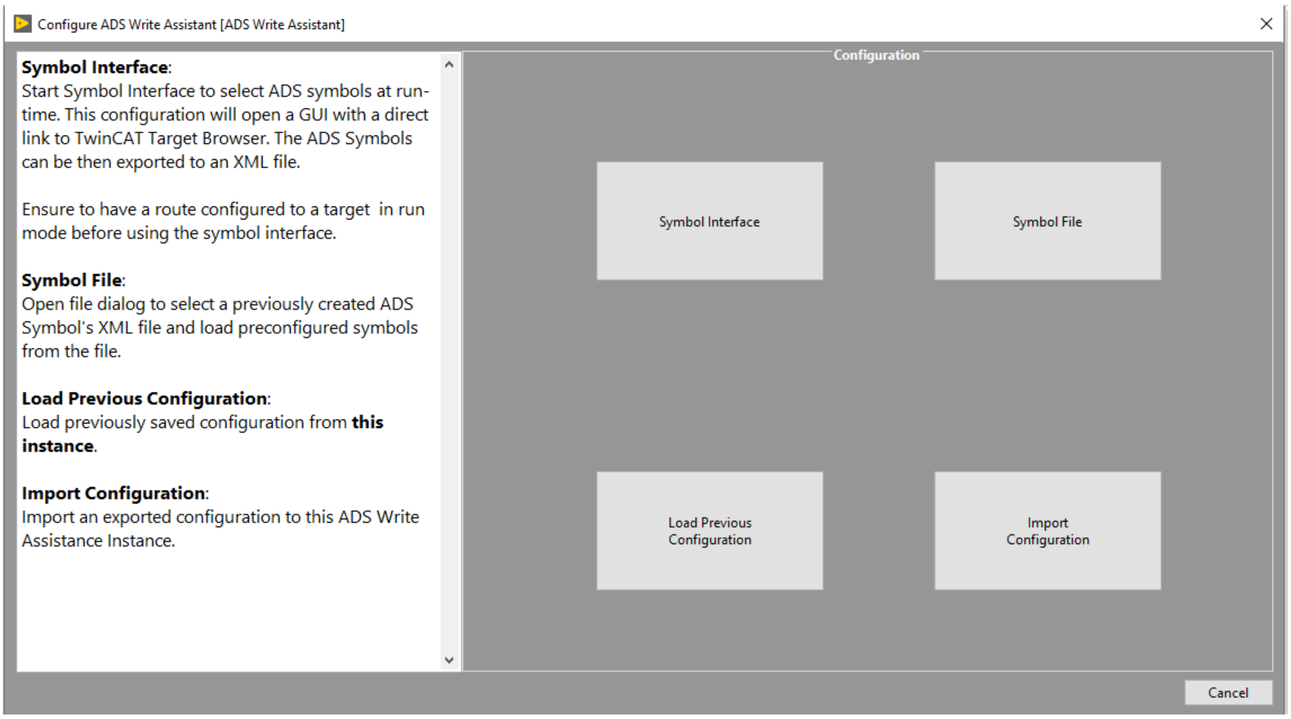
1. Open the settings for "Mass Compile" in the LabVIEW™ settings at **Tools > Advanced**.
2. Select the folder of the TwinCAT 3 Interfaces for LabVIEW™ library, e.g. *C:\Program Files\ National Instruments\LabVIEW 2023\user.lib\Beckhoff-LabVIEW-Interface*.
3. Start "Mass Compile".



Input/output	Meaning
[1] SumUp handle	Handle to the SumUp Writer
[20] Handle	Handle to the ADS client

Symbol selection window

The symbol selection window at the ADS Write Assistant offers the same functionality as at ADS FlexDAQ [▸ 54]. Here one of the options can be selected to start a new configuration or to apply the settings of an existing configuration. If you start a new configuration via Symbol Interface, you will automatically move on to the next window.



Configure ADS Write Assistant [ADS Write Assistant]

Symbol Interface:
Start Symbol Interface to select ADS symbols at run-time. This configuration will open a GUI with a direct link to TwinCAT Target Browser. The ADS Symbols can be then exported to an XML file.

Ensure to have a route configured to a target in run mode before using the symbol interface.

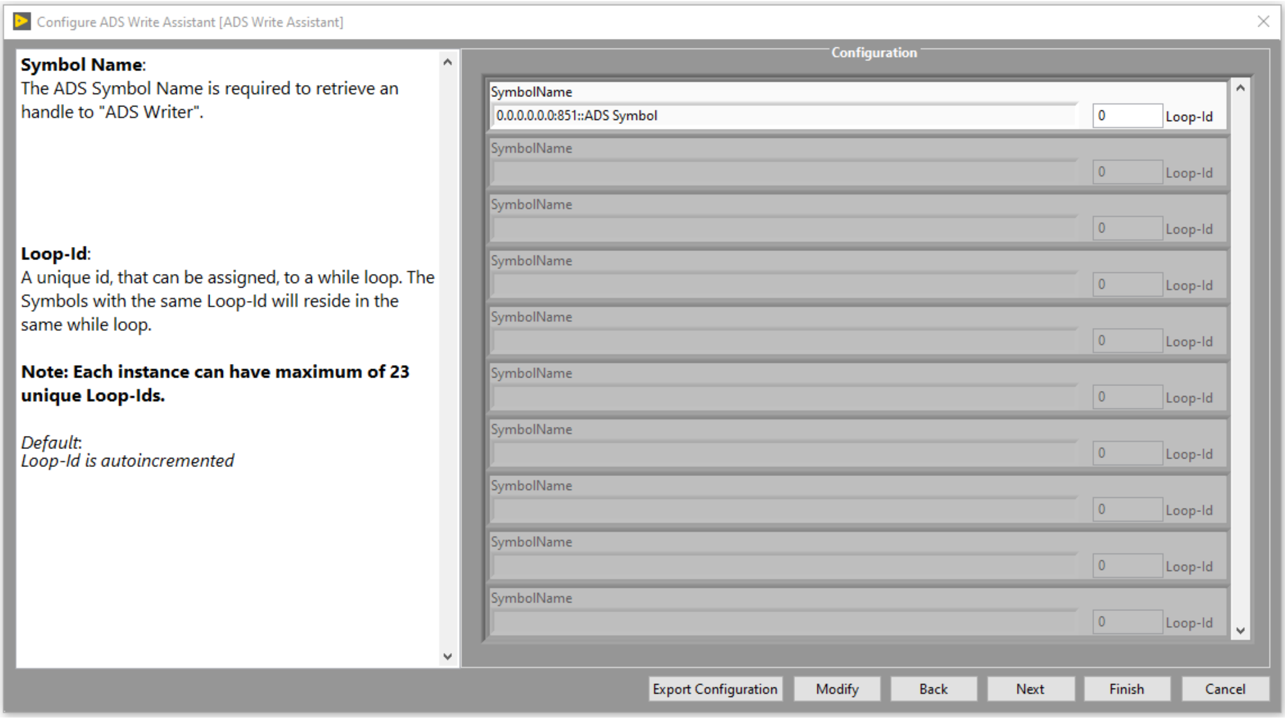
Symbol File:
Open file dialog to select a previously created ADS Symbol's XML file and load preconfigured symbols from the file.

Load Previous Configuration:
Load previously saved configuration from **this instance**.

Import Configuration:
Import an exported configuration to this ADS Write Assistance Instance.

Loop-ID window

In this window, the symbols are assigned a unique Loop-ID. This distributes the writing of the symbols to different while loops. If two symbols have the same Loop-ID, both symbols have used the same loop. The number of Loop-IDs determines the number of generated while loops in the LabVIEW™ block diagram.



Configure ADS Write Assistant [ADS Write Assistant]

Symbol Name:
The ADS Symbol Name is required to retrieve an handle to "ADS Writer".

Loop-Id:
A unique id, that can be assigned, to a while loop. The Symbols with the same Loop-Id will reside in the same while loop.

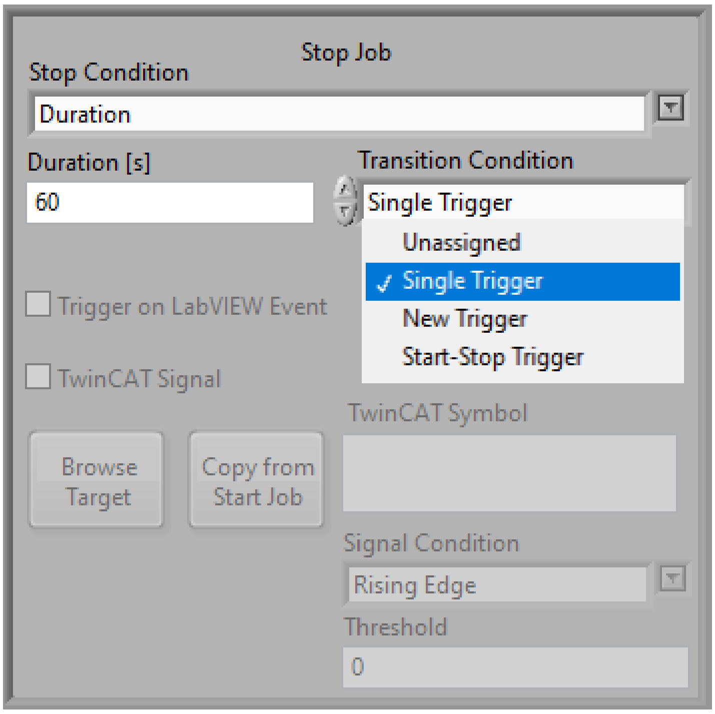
Note: Each instance can have maximum of 23 unique Loop-Ids.

Default:
Loop-Id is autoincremented

SymbolName: 0.0.0.0.0.0:851::ADS Symbol
Loop-Id: 0

Write operation configurator (selection window)

In this window the start/stop condition for the data transport from LabVIEW™ to TwinCAT 3 can be configured. The configurator behaves identically to ADS DAQ [▶ 47] except for the stop condition.



Stop Job

Stop Condition: Duration

Duration [s]: 60

Transition Condition: Single Trigger

□ Trigger on LabVIEW Event

□ TwinCAT Signal

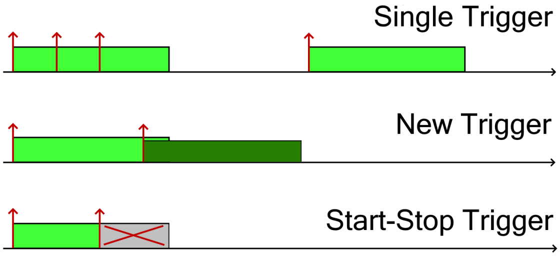
TwinCAT Symbol:

Signal Condition: Rising Edge

Threshold: 0

With the control **Stop Job** you configure the stopping of the writing process. The parameter **Stop Condition** describes the stop condition.

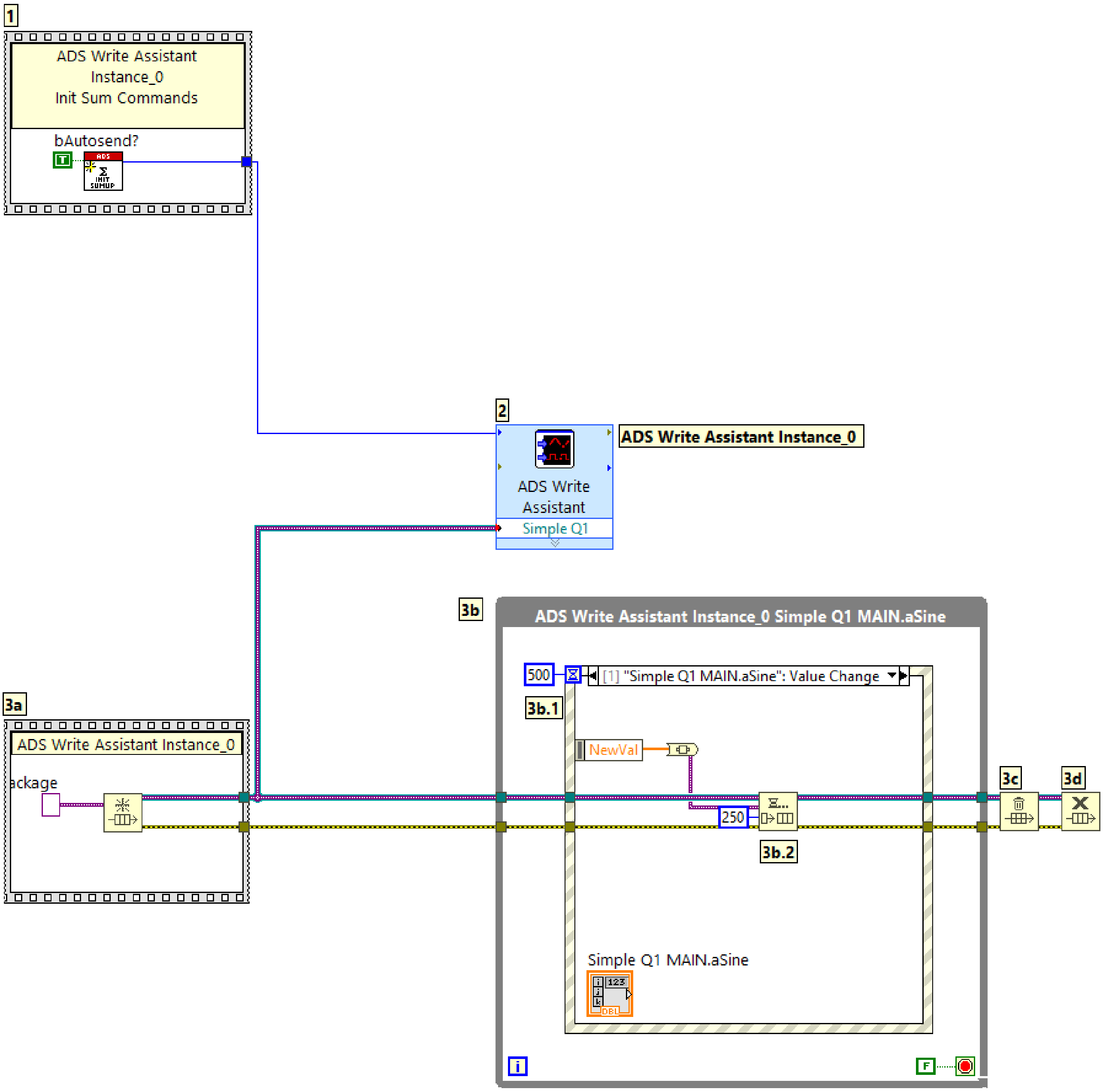
- The options **LabVIEW™ Abort** and **On Signal** are described in ADS DAQ [▶ 47].
- **Duration**: If Duration is selected as a stop condition, then the write operation is determined after a time. With this condition, the "Transition Condition" option is also available. This allows the write duration to be influenced by a trigger. The image below shows the different "Transition Condition" triggers.
  - Single Trigger: Starts a new write duration only if no other write operation is present.
  - New Trigger: Always starts a new write operation.
  - Start-Stop Trigger: Starts a write operation if no other is present or, on the contrary, stops an existing write operation.



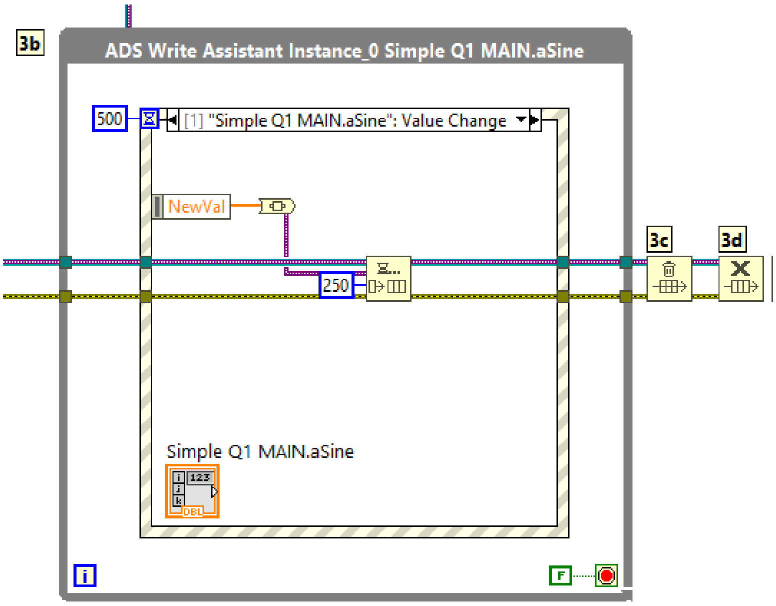
Automatically generated code in the block diagram

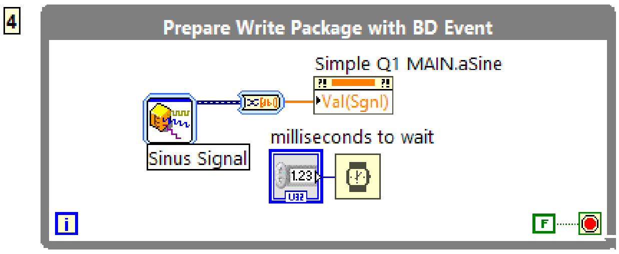
In the following, two variants of the automatically generated code are explained as examples.

In the first example, the ADS Write Assistant VI is generated with **default settings**, i.e. Start with LabVIEW™ Run, Stop with LabVIEW™ Stop. An ADS symbol MAIN.aSine is written. A sine signal generated by LabVIEW™ and transferred to the TwinCAT 3 Runtime.

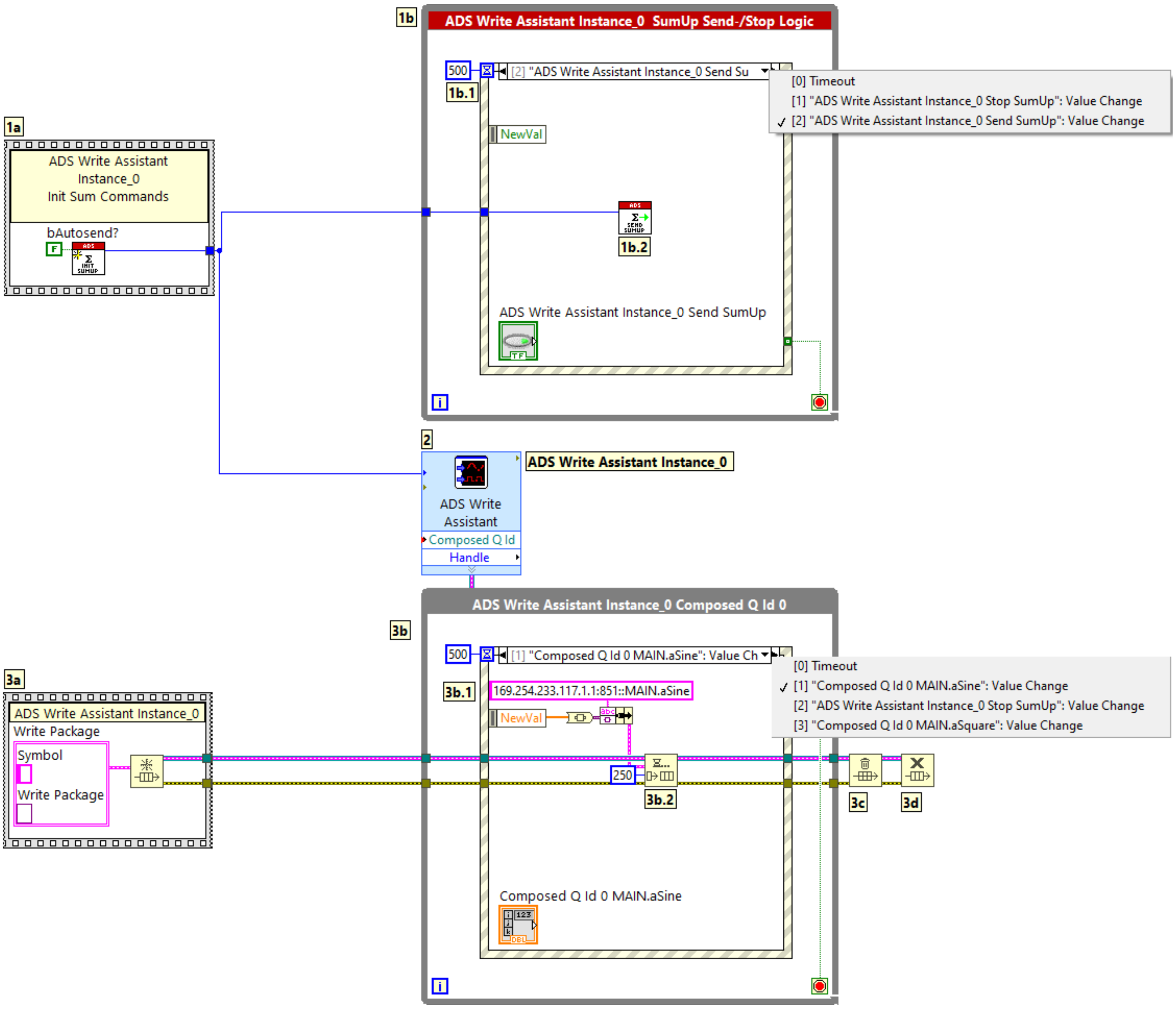

1
ADS Write Assistant Instance_0 Init Sum Commands
bAutosend?
T
2
ADS Write Assistant
Simple Q1
ADS Write Assistant Instance_0
3b
ADS Write Assistant Instance_0 Simple Q1 MAIN.aSine
500
[1] "Simple Q1 MAIN.aSine": Value Change
3b.1
NewVal
250
3b.2
3a
ADS Write Assistant Instance_0
ackage
3c
3d
Simple Q1 MAIN.aSine
i
F

- **1:** The ADS Writer SumUp handle is initialized and the flag *bAutosend?* is set to **True**. Thus, each new packet is automatically transported from LabVIEW™ to the TwinCAT 3 Runtime.
- **2:** A handle goes from the ADS Write Assistant to the underlying queue blocks. The queue forwards each new data packet to the ADS Write Assistant. Until then, the data packet only contains raw data, which is then automatically converted into a TwinCAT 3 data type by the ADS Write Assistant using the TypeResolver and then transferred to TwinCAT using the ADS SumUp.
- **3a:** The queue is initialized with a LabVIEW™ variant as data type.
- **3b:** While loop with start condition "LabVIEW™ Run" without end condition.
- **3b.1**: The ADS Write Assistant generates an event case with the property "value change" for each selected symbol. Only value changes are made available to the SumUp handle. The image below shows an example of how the new data can be generated. This is about the so-called LabVIEW™ block diagram events.
- **4**: The ADS symbol MAIN.aSine is in this case a LREAL array of 20 elements. The generated sine signal therefore also contains only 20 data points.
- **3b.2**: Enqueue element: Waits for new data packets and inserts each new data packet into the queue.
- **3c and 3d**: Releases the queue memory. After that the queue is released from the LabVIEW™ memory. Optionally, after these steps, the user can release the ADS client handle from memory.


3b
ADS Write Assistant Instance_0 Simple Q1 MAIN.aSine
500
[1] "Simple Q1 MAIN.aSine": Value Change
NewVal
250
Simple Q1 MAIN.aSine
3c
3d



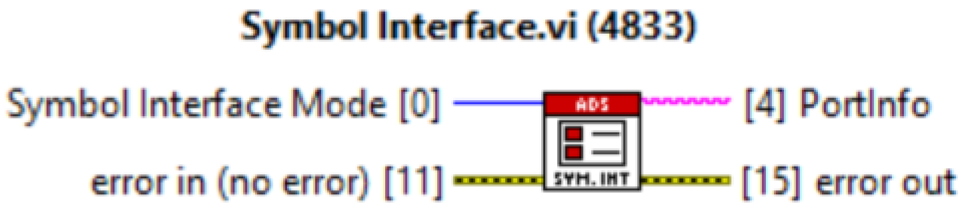
In the second example, the start/stop conditions are set to Trigger on LabVIEW™ Event. In addition, two symbols are written here with the SumUp handle: MAIN.aSquare and MAIN.aSine. The two symbols are assigned the same Loop-ID. Thus, both symbols use a while loop and the same event structure.


1b
ADS Write Assistant Instance_0 SumUp Send-/Stop Logic
500
1b.1
[2] "ADS Write Assistant Instance_0 Send Su
[0] Timeout
[1] "ADS Write Assistant Instance_0 Stop SumUp": Value Change
✓ [2] "ADS Write Assistant Instance_0 Send SumUp": Value Change
NewVal
1b.2
ADS Write Assistant Instance_0 Send SumUp
1a
ADS Write Assistant Instance_0 Init Sum Commands
bAutosend?
F
2
ADS Write Assistant
ADS Write Assistant Instance_0
Composed Q Id
Handle
ADS Write Assistant Instance_0 Composed Q Id 0
3b
500
[1] "Composed Q Id 0 MAIN.aSine": Value Ch
[0] Timeout
✓ [1] "Composed Q Id 0 MAIN.aSine": Value Change
[2] "ADS Write Assistant Instance_0 Stop SumUp": Value Change
[3] "Composed Q Id 0 MAIN.aSquare": Value Change
3b.1
169.254.233.117.1.1:851::MAIN.aSine
NewVal
250
3b.2
3c
3d
3a
ADS Write Assistant Instance_0 Write Package
Symbol
Write Package
Composed Q Id 0 MAIN.aSine

- The blocks **2**, **3b**, **3b.1**, **3b.2**, **3c** and **3d** already described in the first example remain identical in their function.
- **1a:** The ADS Writer SumUp handle is initialized and the flag *bAutosend?* is set to **False** . The new packet must be sent explicitly to TwinCAT 3. In the example this is done by the separate event "Send SumUp".
- **1b:** Logic is created that generates a trigger-event when a Boolean value change occurs. The value change starts the write process.
- **1b.2:** A write operation is started using a SumUp handle.
- **3a:** The queue is initialized with a LabVIEW™ cluster as data type with the following member variables:
  - SymbolName: Identifies the data packet to be written.
  - Write Package: Contains the data packet to be transferred.

7.4 Symbol Interface

The *Symbol Interface* block provides a graphical user interface (UI) for browsing ADS symbols. It simplifies the selection of different ADS symbols as read or write symbols and the parameterization of the symbols. The block creates, based on the configuration created by the user, a LabVIEW™ string which can be passed to the Init VI. Likewise, an XML file of the created configuration can be saved from the UI so that the configuration can be loaded and passed to the Init VI without repeated manual configuration.

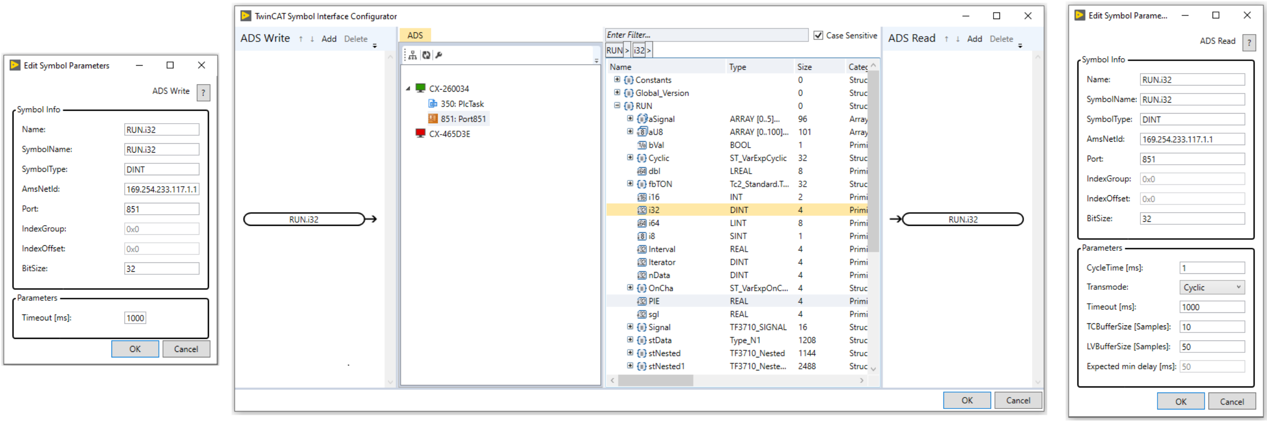


Input/output	Meaning
[0] Symbol Interface Mode	LabVIEW™ Enum consisting of three modes: • ADS symbols for read access only • ADS symbols for write access only • Read & Write: Reading and writing are allowed.
[4] PortInfo	LabVIEW™ string in XML with ADS read and/or write symbols.

Microsoft Windows only

The *Symbol Interface* block can be accessed only with a Windows operating system.

Running the *Symbol Interface* will open the graphical user interface shown below. The TwinCAT Target Browser is integrated in the middle part. This is used to browse target systems or their ADS symbols. By drag and drop an ADS symbol (or by multi-select several ADS symbols at the same time) can be dragged to the right area for read accesses or to the left area for write accesses. For each selected ADS symbol a graphic element appears in the Write or Read area. By double-clicking on these graphical elements (multi-select is also possible here) another window appears. The window describes the information of the ADS symbol and offers the option to attach parameters to the ADS symbol, which are used for certain read or write commands.



Symbol Info

Name: RUN.i32

SymbolName: RUN.i32

SymbolType: DINT

AmsNetId: 169.254.233.117.1.1

Port: 851

IndexGroup: 0x0

IndexOffset: 0x0

BitSize: 32

Parameters

Timeout [ms]: 1000

Enter Filter... ☑ Case Sensitive

RUN > i32 >

Name	Type	Size	Categ
⊞ Constants		0	Struc
⊞ Global_Version		0	Struc
⊟ RUN		0	Struc
⊞ aSignal	ARRAY [0..5]...	96	Array
⊞ aU8	ARRAY [0..100]...	101	Array
bVal	BOOL	1	Primi
⊞ Cyclic	ST_VarExpCyclic	32	Struc
dbl	LREAL	8	Primi
⊞ fbTON	Tc2_Standard.T...	32	Struc
i16	INT	2	Primi
i32	DINT	4	Primi
i64	LINT	8	Primi
i8	SINT	1	Primi
Interval	REAL	4	Primi
Iterator	DINT	4	Primi
nData	DINT	4	Primi
⊞ OnCha	ST_VarExpOnC...	4	Struc
PIE	REAL	4	Primi
sgl	REAL	4	Primi
⊞ Signal	TF3710_SIGNAL	16	Struc
⊞ stData	Type_N1	1208	Struc
⊞ stNested	TF3710_Nested	1144	Struc
⊞ stNested1	TF3710_Neste...	2488	Struc

Symbol Info

Name: RUN.i32

SymbolName: RUN.i32

SymbolType: DINT

AmsNetId: 169.254.233.117.1.1

Port: 851

IndexGroup: 0x0

IndexOffset: 0x0

BitSize: 32

Parameters

CycleTime [ms]: 1

Transmode: Cyclic

Timeout [ms]: 1000

TCBufferSize [Samples]: 10

LVBufferSize [Samples]: 50

Expected min delay [ms]: 50

Manual addressing via AmsNetId, Port, Index Group and Index Offset is also possible. To do this, create a new element under ADS-Read or ADS-Write with **New** and you can fill in the "Symbol Info" area manually.

Paramater CycleTime

The cycle time in which the selected ADS symbol is executed in the TwinCAT runtime is always offered as the default value for the CycleTime. Only multiples of this cycle time are allowed, since an ADS notification with the new value is sent after each completed cycle. If a value other than CycleTime is entered, it is always rounded up to the next permissible value.

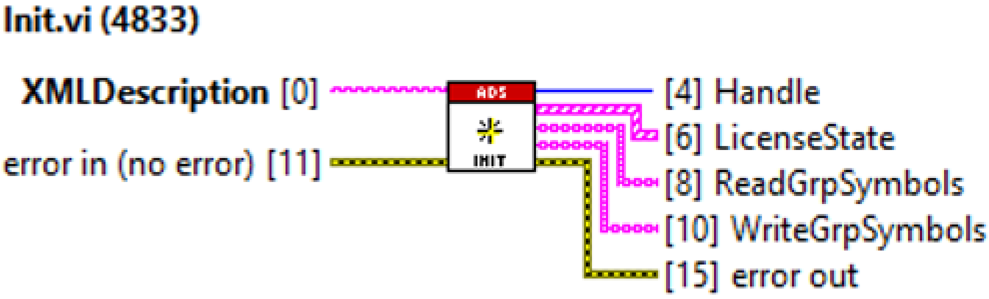
7.5 Init

The main task of the *Init* block is to initialize and connect the ADS client to the ADS router. After successful initialization, LabVIEW™ receives a handle back to the ADS client. For this purpose the *Init* block uses the low-level Init [▸ 84] blocks in the background.

In addition to its main task, the *Init* block performs the following other tasks:

- Creates a list of ADS target systems based on the input XMLDescription.

- Checks each individual target system for a valid TF3710 TwinCAT 3 Interface for LabVIEW™ license.
- Creates a list of target systems on which a valid TF3710 TwinCAT 3 Interface for LabVIEW™ could be retrieved. Reading and writing is only possible on target systems with a valid license.
- Creates a sorted list of ADS read symbols based on the input *XMLDescription*.
- Creates a sorted list of ADS write symbols based on the input *XMLDescription*.



Input/output	Meaning
[0] XMLDescription	LabVIEW™ XML string with ADS read and write symbols **or** the path as a string to an existing, already created (exported) XML file.
[4] Handle	Handle to the ADS client
[6] LicenseState	List of license states of the TwinCAT target systems
[8] ReadGrpSymbols	List of ADS reading symbols
[10] WriteGrpSymbols	List of ADS writing symbols

NOTICE

Client Handle

The handle to the ADS client in LabVIEW™ is only released if a valid TF3710 TwinCAT 3 Interface for LabVIEW™ license is found on at least one of the selected target systems. If no license could be found, the Init block returns an error via error out [15].

7.6 ADS-Read

The *ADS-Read*- block is a polymorphic VI and supports the following ADS communication modes [▸ 25] to read data from TwinCAT:

- Sync Single [▸ 28]
- Async Single [▸ 29]
- Noti. Single [▸ 29]
- Noti. Buffered [▸ 30]
- E-Noti. Sinlge [▸ 33]
- E-Noti Buffered [▸ 35]
- E-Noti. Multiple Symbols [▸ 70]
- LVB-Noti. Single Symbol [▸ 70]
- LVB-Noti. Multiple Symbols [▸ 71]

All modes use the low-level Read [▸ 85] blocks in the background to:

1. Initialize the ADS Reader.
2. To send the ADS request.
3. To wait for answer and
4. finally release the reader from the memory.

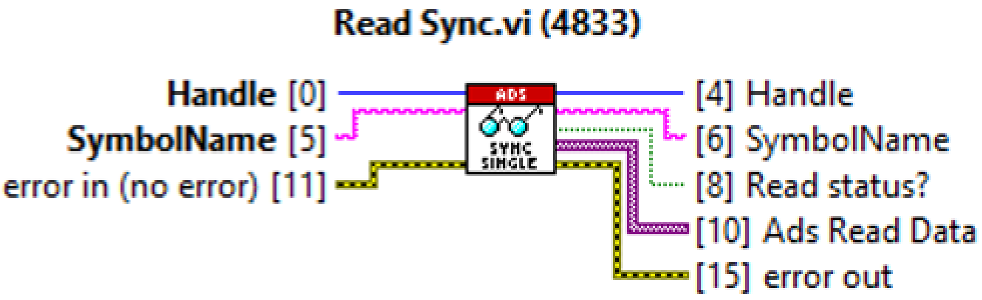
The section Communication modes [▸ 25] provides further information as well as practical application recommendations. In the chapter Examples [▸ 102] you will find exemplary implementations in LabVIEW™.

Depending on the selected communication mode, the parameters configured in Symbol Interface [▶ 64] are used or remain unused. The relevant parameters are named below.

Sync Single [▶ 28]

In this operation mode, the ADS client (LabVIEW™) sends a request to the ADS server (TwinCAT) and waits for a response from the server in the program sequence.

Relevant parameter: Timeout

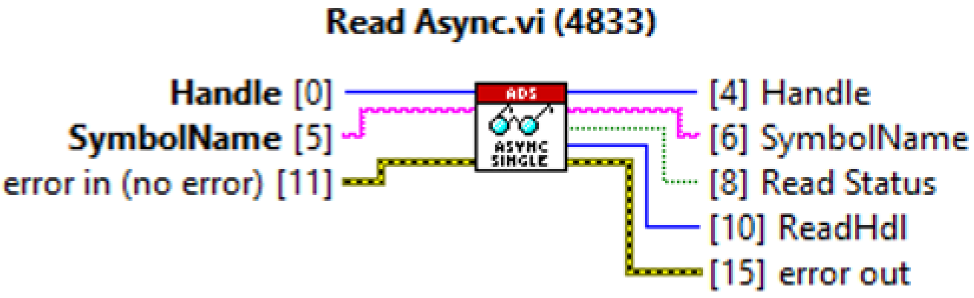


Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] Read status?	Read status
[10] Ads Read Data	ADS raw data

Async Single [▶ 29]

In this operation mode, the ADS client (LabVIEW™) sends a request to the ADS server (TwinCAT) and does not wait for a response from the server in the program sequence.

Relevant parameter: Timeout

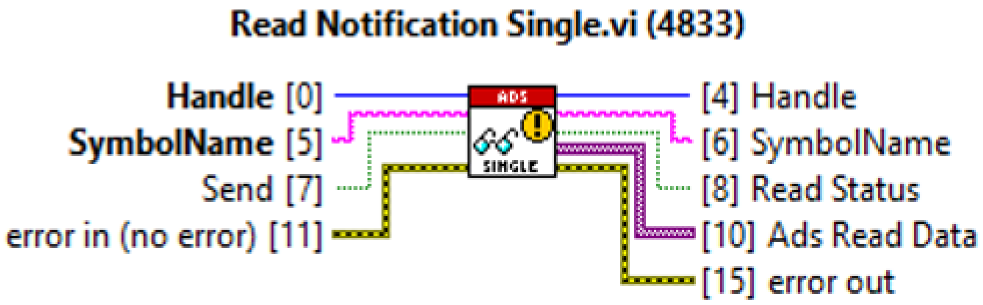


Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] Read Status	Read status
[10] ReadHdl	Handle to the ADS reader

Noti. Single [▶ 29]

In this operation mode ADS notifications are registered to the relevant ADS symbols in TwinCAT. Only "on change" registration is possible. The ADS notification is unregistered again from the ADS server when the first "on change" notification is received in LabVIEW™.

Relevant parameters: Timeout, Transmode (= on change)



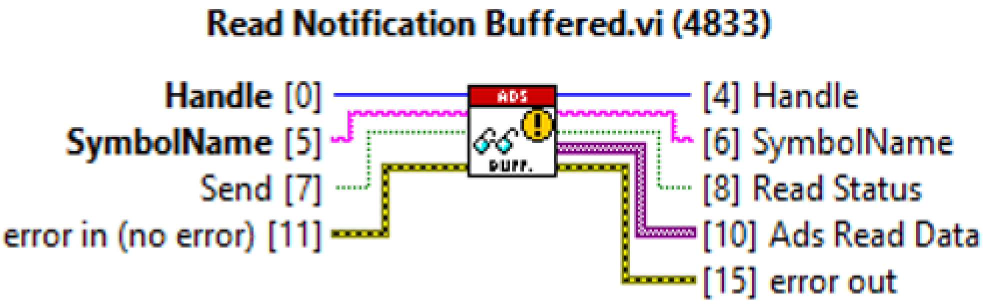
Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[7] Send	Send flag, TRUE registers the ADS notification
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] Read Status	Read status
[10] Ads Read Data	ADS raw data (array of two entries, previous value and current value)

Noti. Buffered [▸ 30]

In this communication mode ADS notifications are registered on the respective ADS symbols in TwinCAT. The ADS client in LabVIEW™ also uses a buffer memory, which is first filled with feedback messages from TwinCAT before the entire buffer memory is transferred to LabVIEW™. After passing the buffered data to LabVIEW™, the ADS notification is unregistered from the server. Both ADS notification types, "on change" and "cyclic", are supported.

Relevant parameters: Timeout, Transmode, SampleTime, LVBufferSize, TCBufferSize

With Transmode = "on change" the SampleTime and the TCBufferSize are not relevant.



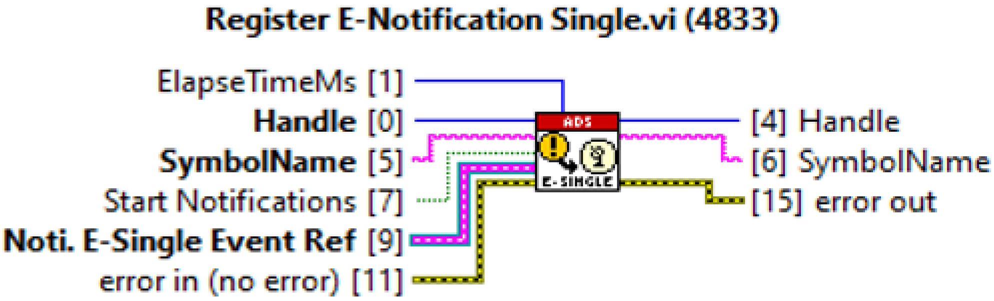
Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[7] Send	Send flag, TRUE registers the ADS notification
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] Read Status	Read status
[10] Ads Read Data	Buffered ADS raw data

E-Noti. Single [▸ 33]

In this operating mode, ADS notifications are registered on the relevant ADS symbols in TwinCAT and then continuously transmitted to LabVIEW™ as a LabVIEW™ event. The ADS notification reports after a defined time if ElapseTimeMs is greater than zero, or remains until it is actively unregistered. For the use of user events in LabVIEW™, see LabVIEW™ documentation. In contrast to E-Noti. Buffered (see below), no LabVIEW™-side buffer memory is used in this case.

Relevant parameters: Timeout, Transmode, SampleTime, TCBufferSize

With Transmode = "on change" the SampleTime and the TCBufferSize are not relevant.



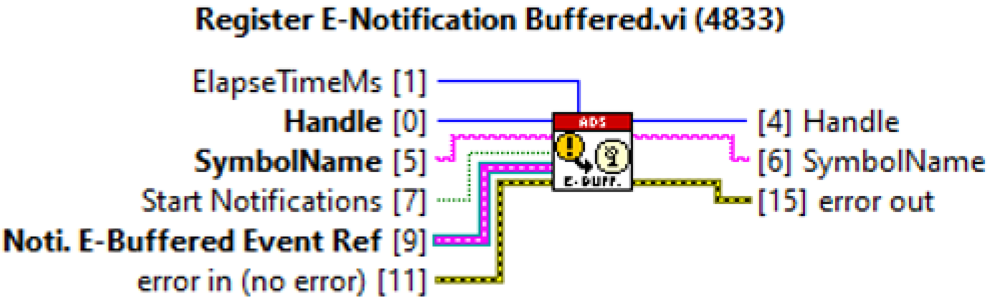
Input/output	Meaning
[0] Handle	Handle to the ADS client
[1] ElapseTimeMs	Measurement duration in milliseconds: • ElapseTimeMs > 0: the notifications stop after the time has elapsed. • ElapseTimeMs = 0: the notifications must be stopped from outside.
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[7] Send	Send Flag, TRUE starts the ADS notification
[9] user event	Reference to user event
[4] Handle	Handle to the ADS client
[6] SymbolName	The ADS symbol consisting of AMSNetId and symbol name

E-Noti Buffered [▶ 35]

In this operating mode, ADS notifications are registered on the relevant ADS symbols in TwinCAT and then continuously transmitted to LabVIEW™ as a LabVIEW™ event. The ADS notification reports after a defined time if ElapseTimeMs is greater than zero, or remains until it is actively unregistered. For the use of user events in LabVIEW™, see LabVIEW™ documentation. In contrast to E-Noti. Single (see above), a LabVIEW™-side buffer memory of size LVBufferSize is used in this case. When the buffer is filled the collected data are passed to LabVIEW™ via an event.

Relevant parameters: Timeout, Transmode, SampleTime, TCBufferSize, LVBufferSize

With Transmode = "on change" the SampleTime and the TCBufferSize are not relevant.



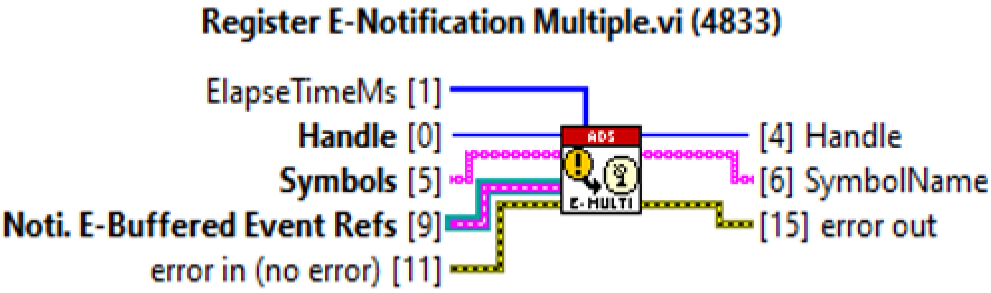
Input/output	Meaning
[0] Handle	Handle to the ADS client
[1] ElapseTimeMs	Measurement duration in milliseconds: • ElapseTimeMs > 0: the notifications stop after the time has elapsed. • ElapseTimeMs = 0: the notifications must be stopped from outside.
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[7] Send	Send Flag, TRUE starts the ADS notification
[9] user event	Reference to user event
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name

E-Noti. Multiple Symbols

This operation mode works like E-Noti. Buffered [▸ 69], except that this VI can be used for several ADS symbols at the same time.

Relevant parameters: Timeout, Transmode, SampleTime, TCBufferSize, LVBufferSize

With Transmode = "on change" the SampleTime and the TCBufferSize are not relevant.



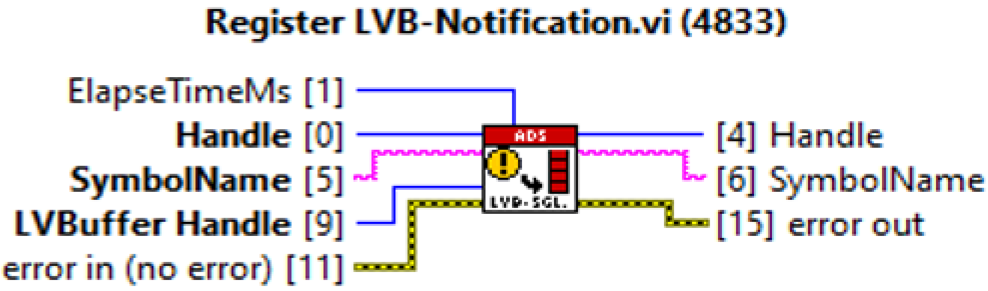
Input/output	Meaning
[0] Handle	Handle to the ADS client
[1] ElapseTimeMs	An array of U32 consisting of measurement duration in milliseconds: • Element of ElapseTimeMs > 0: the notifications stop after the time expires. • Element of ElapseTimeMs = 0: the notifications must be stopped externally.
[5] Symbols	An array of LabVIEW™ strings: • The ADS symbol consisting of AMS address and symbol name
[9] Noti. E-Buffered Event Refs	An array of references to user event
[4] Handle	Handle to the ADS client
[6] SymbolName	The ADS symbol consisting of AMS address and symbol name

LVB-Noti. Single Symbol

This operation mode works like E-Noti. Buffered [▸ 69], except that this VI provides direct access to LVBuffer [▸ 79] instead of using LabVIEW™ events. As a result, no LabVIEW™ events are required to read the notifications.

Relevant parameters: Timeout, Transmode, SampleTime, LVBufferSize, TCBufferSize

With Transmode = "on change" the SampleTime and the TCBufferSize are not relevant.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[1] ElapseTimeMs	Measurement duration in milliseconds: • ElapseTimeMs > 0: the notifications stop after the time has elapsed. • ElapseTimeMs = 0: the notifications must be stopped from outside.
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[9] LVBuffer Handle	Handle to the LVBuffer

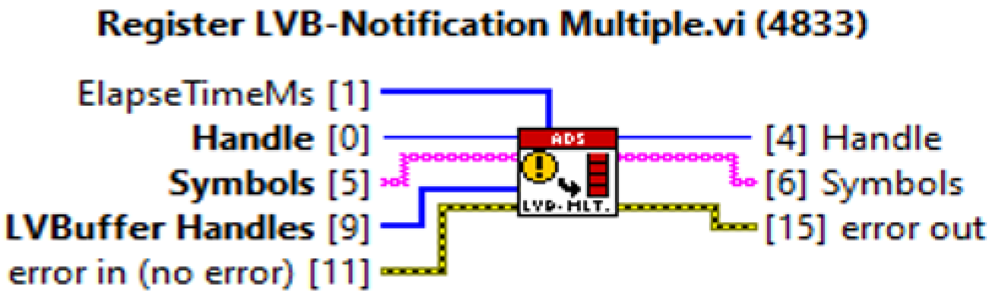
Input/output	Meaning
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name

LVB-Noti. Multiple Symbols

This operation mode works exactly like LVB-Noti. Single Symbol [▸ 70], with the difference that this VI can be used for several ADS symbols at the same time.

Relevant parameters: Timeout, Transmode, SampleTime, LVBufferSize, TCBufferSize

With Transmode = "on change" the SampleTime and the TCBufferSize are not relevant.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[1] ElapseTimeMs	An array of U32 consisting of measurement duration in milliseconds: • Element of ElapseTimeMs > 0: the notifications stop after the time expires. • Element of ElapseTimeMs = 0: the notifications must be stopped externally.
[5] Symbols	An array of LabVIEW™ strings: • The ADS symbol consisting of AMS address and symbol name
[9] LVBuffer Handle	An array of U32 consisting of handle on LVBuffer
[4] Handle	Handle to the ADS client
[6] Symbols	An array of LabVIEW™ strings: • The ADS symbol consisting of AMS address and symbol name

7.7 ADS-Write

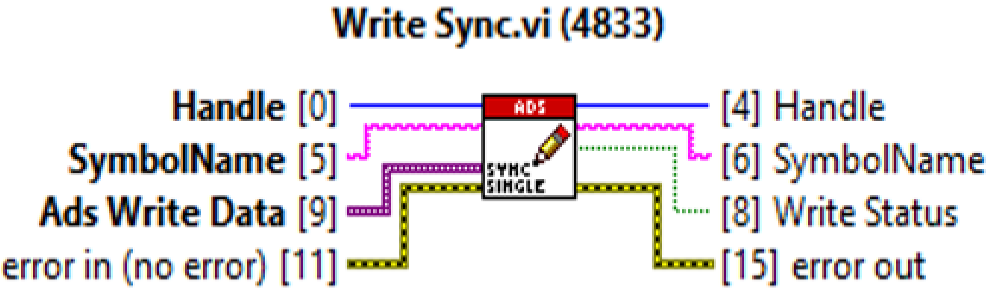
The *ADS-Write* block is a polymorphic VI and supports the following ADS communication modes [▸ 25] to write data to TwinCAT:

- Sync Single [▸ 30]
- Async Single [▸ 30]

For ADS-Write only one parameter is relevant, which can be set in the Symbol Interface [▸ 64] and that is the parameter *Timeout*.

Sync Single [▸ 30]

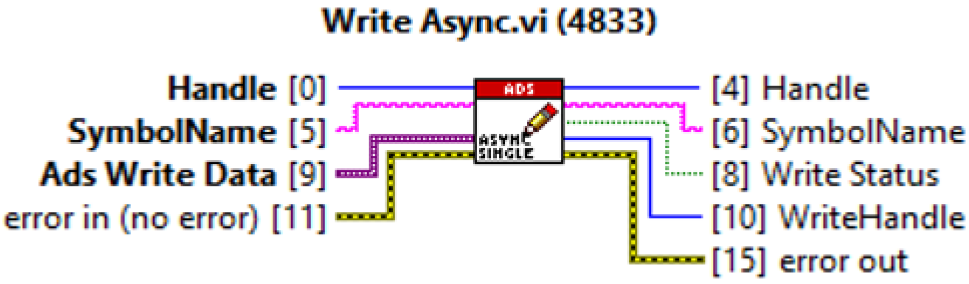
In this operation mode, the ADS client in LabVIEW™ sends a write request with the type-resolved ADS value to the ADS server in TwinCAT and waits for a response as to whether the value has been written.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[9] Ads Write Data	Type-resolved ADS value
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] Write Status	Write status

Async Single [▶ 30]

In this operation mode the ADS client in LabVIEW™ sends a write request with the type-resolved ADS value to the ADS server in TwinCAT and does **not** wait for a response whether the value has been written.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[9] Ads Write Data	Type-resolved ADS value
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] Write Status	Write status
[10] WriteHandle	Handle to the ADS Writer

7.8 TypeResolver

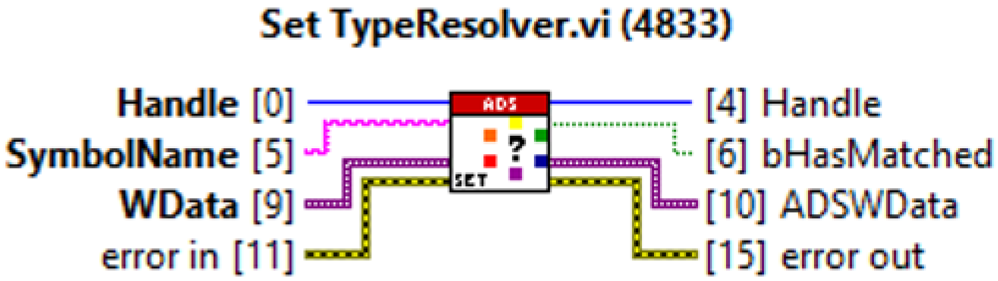
The *TypeResolver* block is a polymorphic VI and supports the following operation modes to convert data types:

- To TC (for writing from LabVIEW™ to TwinCAT)
- From TC (for reading from TwinCAT to LabVIEW™)

To TC

The *To TC* block initializes the TypeResolver, compares the LabVIEW™ data type with the TC3 data type and converts the LabVIEW™ data into ADS raw data. The block then releases the TypeResolver from the memory.

For more information see: Type Resolving [▶ 38].

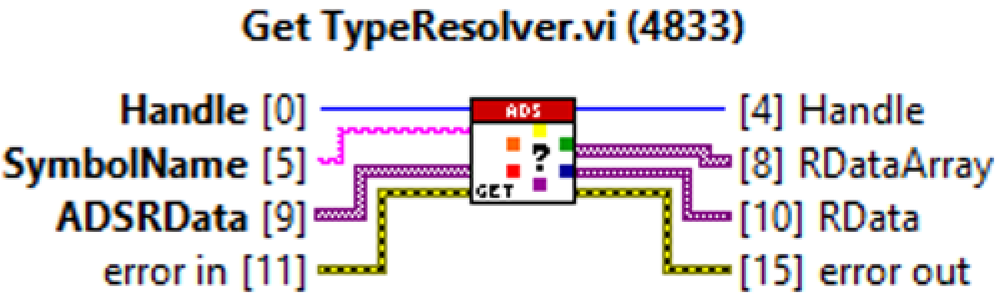


Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[9] WData	Raw data for ADS-Write
[4] Handle	Handle to the ADS client
[6] bHasMatched	Flag (TRUE if TC3 and LabVIEW™ data type are identical, otherwise FALSE)
[10] ADSWData	Type-resolved ADS write value

From TC

The *From TC* block initializes the TypeResolver, parses and converts the ADS data read from TwinCAT with ADS Read into the LabVIEW™ data type *Variant*. The block Type Release releases the TypeResolver from memory.

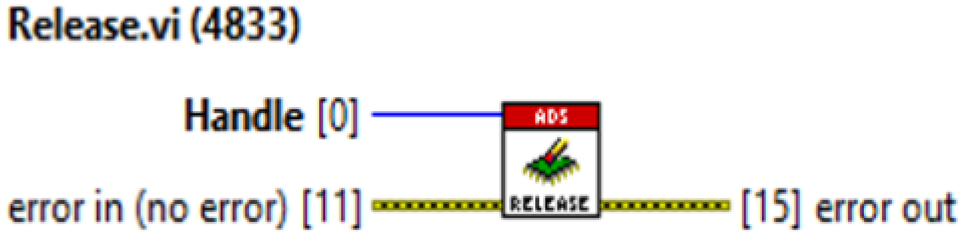
For more information see: Type Resolving [▶ 37].



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[9] ADSRData	Raw data from ADS-Read
[4] Handle	Handle to the ADS client
[8] RDataArray	Type-resolved ADS read array for the LabVIEW™ data type
[10] RData	Type-resolved ADS read value for the LabVIEW™ data type

7.9 Release

The *Release* block releases the handle to the ADS client from memory.



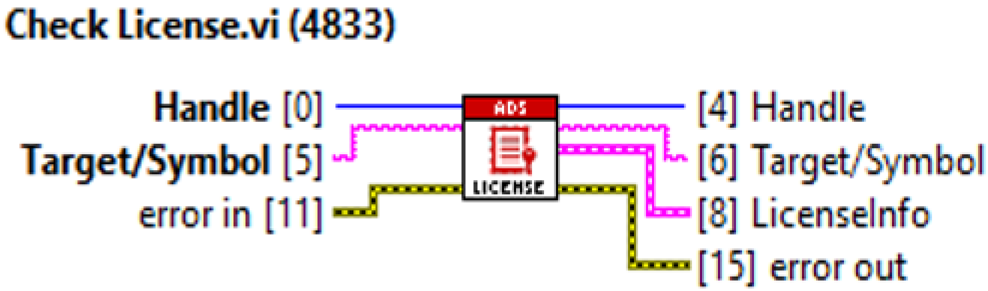
Input	Meaning
[0] Handle	Handle to the ADS client

7.10 Utilities

Additional VIs can be found under Utilities.

Check License

The *Check License* block checks the target system for a valid TF3710 TwinCAT 3 Interface for LabVIEW™ license.



Input/output	Meaning
[0] Handle	The handle to the client
[5] Target/Symbol	ADS target as string consisting of AMSNetId or ADS symbol as string consisting of AMSNetId and symbol name
[4] Handle	The handle to the client
[6] Target/Symbol	ADS target as string consisting of AMSNetId or ADS symbol as string consisting of AMSNetId and symbol name
[8] LicenseInfo	LabVIEW™ cluster consisting of three elements: • Boolean flag (TRUE if license is valid, FALSE otherwise) • AMSNetId of the target system • String with message about the license state, e.g. "license is valid" or "trial license denied“

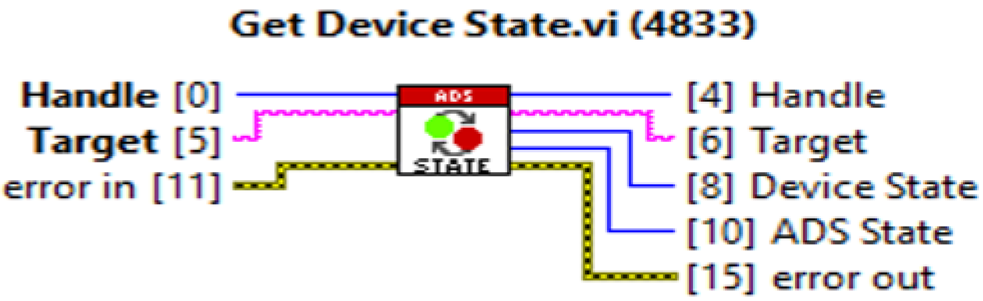
Get Device State

The *Device State* block is a polymorphic VI and can be operated as *Get Device State* and *Set Device State*.

The operation mode *Get Device State* reads the current state of the target system and the PLC.

The following table describes the ADS port and its meaning:

ADS Port	ADS State	State
TC3 PLC Port > 851	ADS_STATE_RUN	PLC is running.
	ADS_STATE_STOP	PLC is stopped.
	ADS_STATE_RESET	PLC is reset.
System Port = 10000	ADS_STATE_RECONFIG	TwinCAT is in Config mode.
	ADS_STATE_RESET	TwinCAT is in Run mode.



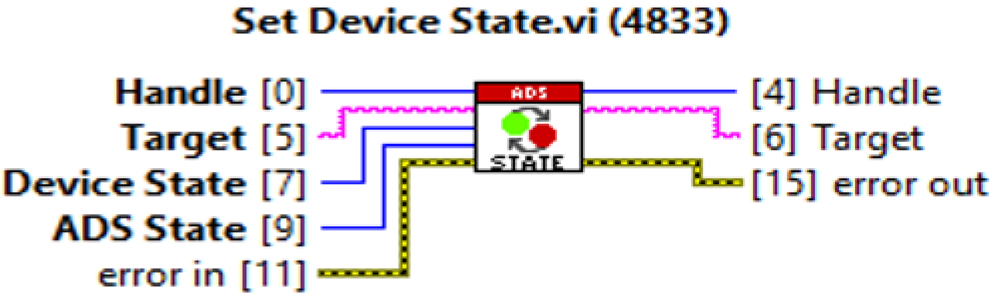
Input/output	Meaning
[0] Handle	The handle to the client
[5] Target	ADS target as string consisting of AMSNetId
[4] Handle	The handle to the client
[6] Target	ADS target as string consisting of AMSNetId
[8] Device State	State of the target system (ENUM)
[10] ADS State	State of the PLC (ENUM)

Set Device State

The *Set Device State* block changes the current state of the target system and the PLC.

With a specific ADS Port and ADS State the PLC or TwinCAT can be set to a corresponding state. The following table describes the ADS port and its usage:

ADS Port	ADS State	State
TC3 PLC Port > 851	ADS_STATE_RUN	Starts the PLC.
	ADS_STATE_STOP	Stops the PLC.
	ADS_STATE_RESET	Resets the PLC.
System Port = 10000	ADS_STATE_RECONFIG	Puts TwinCAT in Config mode.
	ADS_STATE_RESET	Puts TwinCAT in Run mode.

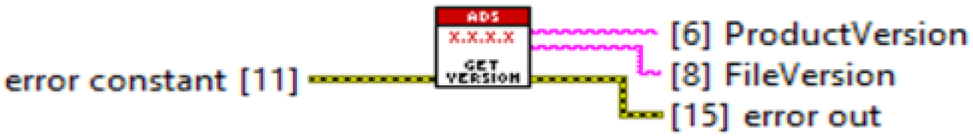


Input/output	Meaning
[0] Handle	The handle to the client
[5] Target	ADS target as string consisting of AMSNetId
[7] Device State	New state of the target system (numeric)
[9] ADS State	New state of the PLC (ENUM)
[4] Handle	The handle to the client
[6] Target	ADS target as string consisting of AMSNetId

Get Version Info

The *Get Version Info* block returns the current version of the TF3710 setup and the installed TF3710 library as a LabVIEW™ string.

Get Version Info.vi (4833)



Output	Meaning
[6] ProductVersion	Setup version as string
[8] FileVersion	Version of the installed TF3710 library as string

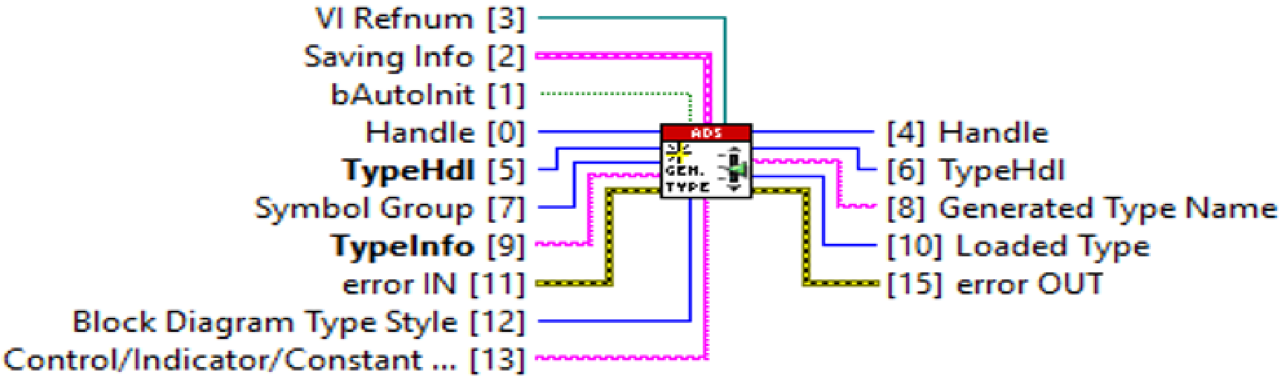
Generate Type

The *Generate Type* block automatically generates the LabVIEW™ data type based on a TypeInfo description from a TwinCAT 3 data type.

The LabVIEW™ type can be inserted as a constant or control on a block diagram or saved as a LabVIEW™ ctl file. The *Generate Type* block is a wrapper VI and uses low-level class objects from TypeGenerator [▸ 91] together with the TypeResolver [▸ 89]. There are several ways in which the wrapper block can be parameterized.

1. **The TypeResolver is already initialized externally and LabVIEW™ already has a TypeHandle. The bAutoInit flag has the value "False"**:
   - The TypeResolver already has information regarding the TwinCAT 3 data type.
   - The wrapper block can generate the new type.
   - The example Generate Type using Symbol Interface or Symbol's file [▸ 107] uses this method.
2. **The TypeResolver is not initialized externally and LabVIEW™ does not have a TypeHandle. The bAutoInit flag has the value "True"**:
   - The TypeResolver has no information regarding the TwinCAT 3 data type.
   - The wrapper block needs the TypeInfo to generate the type.
   - The example Generate Type using TypeInfo file [▸ 108] uses this method.

Generate Type.vi (4833)



Input/output	Meaning
[0] Handle	The handle to the client
[1] bAutoInit	Boolean flag (True = TypeResolver is initialized internally, otherwise False)
[2] Saving Info	LabVIEW™ cluster consisting of three elements: • CustomDir: Boolean flag TRUE = LabVIEW™ type is saved in a specific folder (Dir Name). If this folder does not exist, the block creates the folder. FALSE = LabVIEW™ type is saved in the project folder, subfolder Ctl. • Dir Name: LabVIEW™ string (name of the folder) • Control FileName: LabVIEW™ string (name of the new Ctl. If empty, the block uses the name from the TypeInfo)

Input/output	Meaning
[3] VI Refnum	A static VI Refnum The block uses the VI Refnum to insert the LabVIEW™ type as a Constant/Control/Indicator on the block diagram.
[5] TypeHdl	The handle to the TypeResolver
[7] Symbol Group	LabVIEW™ Enum: • Read symbol: The block generates a control. • Write symbol: The block generates a control.
[9] TypeInfo	LabVIEW™ string as XML description of TwinCAT 3 data type
[12] Block Diagram Type Stype	LabVIEW™ Enum: • Constant • Control/Indicator
[13] Control/Indicator/ Constant Name	LabVIEW™ string. Empty string: Default name of the TypeInfo. Otherwise: Name of the Control/Indicator/Constant.
[8] Generated Type Name	LabVIEW™ string as the name of the generated type
[10] Loaded Type	LabVIEW™ Enum Describes which data type was generated.

"Symbol Group" parameter

The Symbol Group parameter can be used to select whether a control/display element must be generated. For the control, the TypeGenerator generates the type without name, because the TypeResolver supports the control without name. If the control is a LabVIEW™ cluster, then the cluster members are also generated without names.

7.10.1 Notification

The *Notification* folder contains additional blocks that can be used with ADS notifications when reading. The folder contains the following VIs:

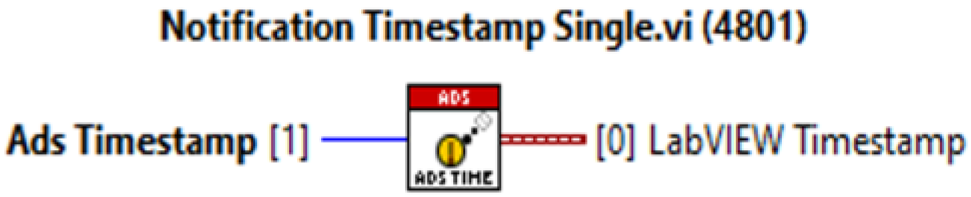
- ADS To LabVIEW Timestamp
- Notification Data To Variant Array
- Stop Notification
- Unregister Notification

ADS To LabVIEW Timestamp

The *ADS To LabVIEW Timestamp* block is a polymorpohic VI and supports single and multiple ADS timestamps (as array). The block converts ADS timestamps, as transmitted by an ADS notification from TwinCAT, into LabVIEW™ timestamps.

Notification Timestamp Single

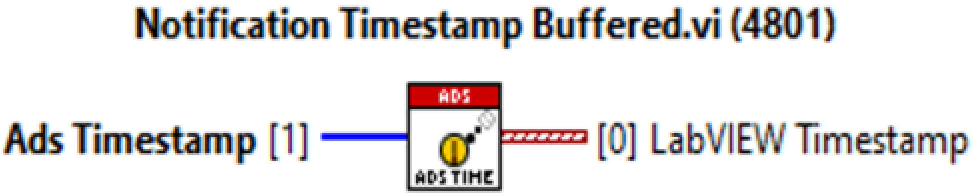
The *Notification Timestamp Single* block converts single ADS timestamps to LabVIEW™ timestamps.



Input/output	Meaning
[1] ADS Timestamp	Single ADS timestamp
[0] LabVIEW Timestamp	Single converted LabVIEW™ timestamp

Notification Timestamp Buffered

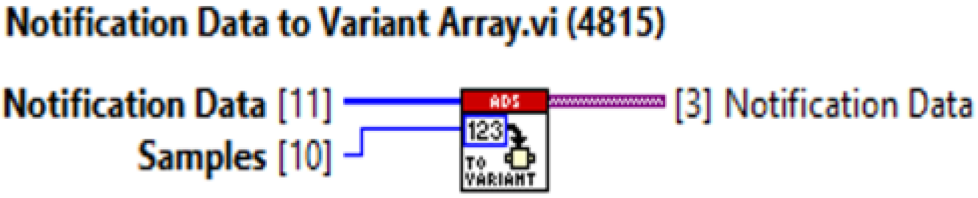
The *Notification Timestamp Buffered* block converts multiple ADS timestamps to LabVIEW™ timestamps.



Input/output	Meaning
[1] ADS Timestamp	Array of ADS timestamps
[0] LabVIEW Timestamp	Array of converted LabVIEW™ timestamps

Notification Data To Variant Array

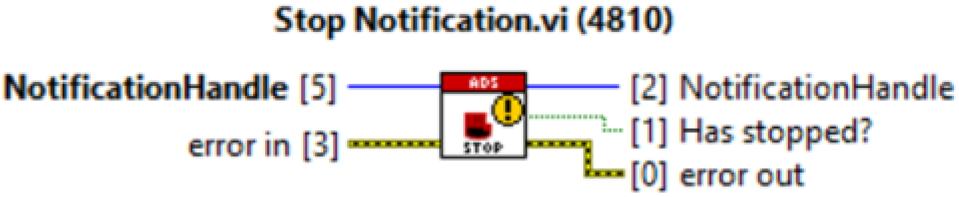
The *Notification Data To Variant Array* block converts ADS raw data that has been read with ADS notification into a suitable LabVIEW™ Variant.



Input/output	Meaning
[11] Notification Data	ADS raw data
[10] Samples	Number of samples
[3] Notification Data	Converted raw data in LabVIEW™ variant

Stop Notification

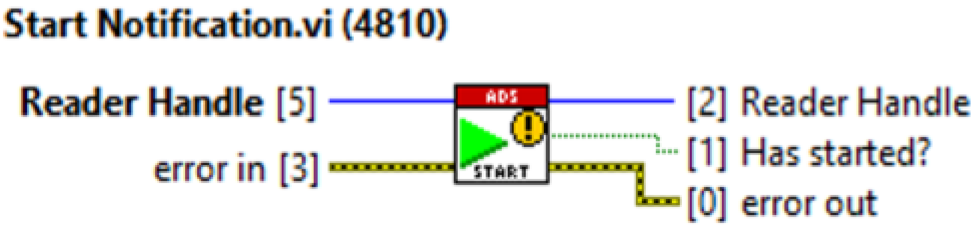
The *Stop Notification* block stops receiving ADS notifications.



Input/output	Meaning
[5] Notification/Reader handle	Handle to the ADS Notification/Reader
[2] Notification/Reader handle	Handle to the ADS notification/ADS reader
[1] Has stopped?	Boolean flag (TRUE if notification is stopped, FALSE otherwise)

Start Notification

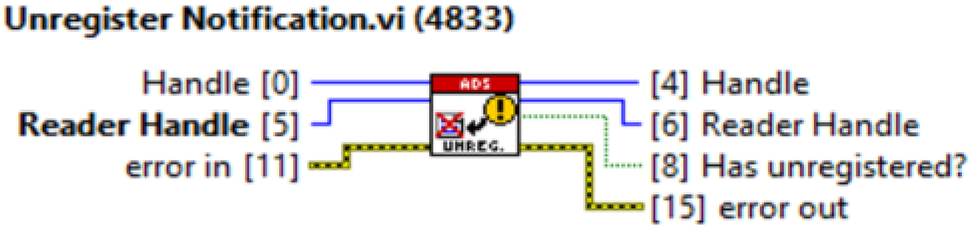
The *Start Notification* block starts the registered notification.



Input/output	Meaning
[5] Reader Handle	Handle to the ADS reader
[2] Reader Handle	Handle to the ADS reader
[1] Has started?	Boolean flag (TRUE if notification is started, FALSE otherwise)

Unregister Notification

The *Unregister Notification* block unregisters the notification on the ADS server.



Input/output	Meaning
[0] Handle	The handle to the client (can also be left blank)
[5] Reader Handle	The handle to the ADS reader
[4] Handle	The handle to the client
[6] Reader Handle	The handle to the ADS reader
[8] Has unregistered?	Boolean flag (TRUE if notification is registered, FALSE otherwise)

7.10.1.1 Notification controls

These controls can be found at:
Front Panel Palette > User Controls > Beckhoff LabVIEW Interface > Notification.

Single Buffer Info

The *Single Buffer Info* control describes/defines the information needed for reading the Noti. Buffered [▸ 68].

Single User-Event Data

The *Single User-Event Data* control describes/defines information needed for continuous reading of the E-Noti. Single [▸ 68] with LabVIEW™ events.

Buffered User-Event Data

The *Buffered User-Event Data* control describes/defines information needed for continuous reading of the E-Noti. Buffered [▸ 69] with LabVIEW™ events.

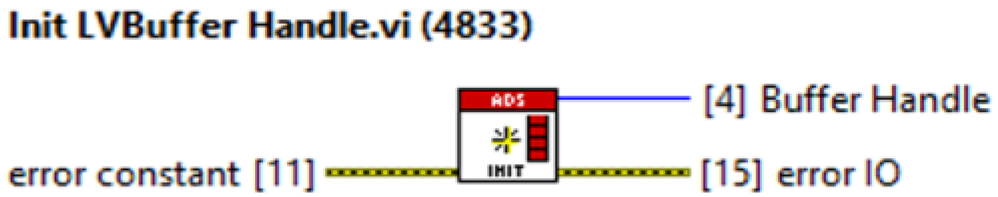
7.10.2 LVBuffer

The LVBuffer folder contains blocks that can be used when reading an ADS notification. The folder contains the following VIs:

- Init LVBuffer Handle
- Read From LVBuffer
- LVBuffer status
- Release LVBuffer Handle

Init LVBuffer Handle

The *Init LVBuffer Handle* block initializes a handle on the LVBuffer.

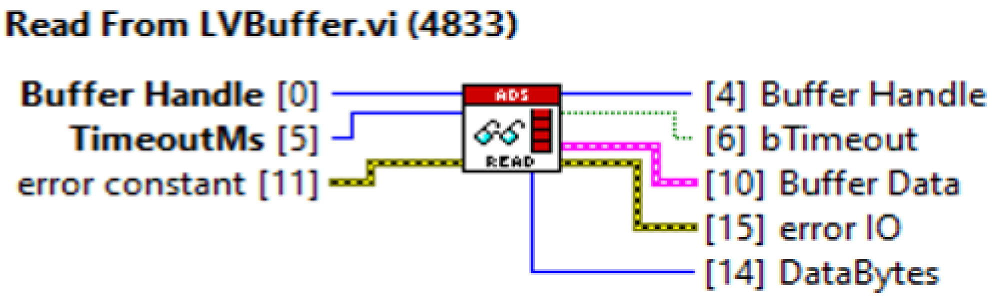


Output	Meaning
[4] Buffer handle	The handle to the LVBuffer

Read From LVBuffer

The *Read from LVBuffer* block waits for samples in the LVBuffer (LabVIEW™-side data buffer, cf. Communication modes [▶ 25]). The TimeoutMs influences the waiting. The block waits for a defined time if TimeoutMs > 0, otherwise the block waits forever. If the LVBuffer receives a sample while waiting, the block reads the sample and passes it to LabVIEW™.

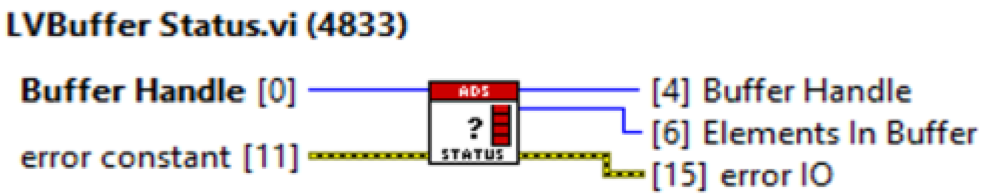
Relevant parameters: LVBufferSize



Input/output	Meaning
[0] Buffer handle	The handle to the LVBuffer
[5] TimeoutMs	The waiting time in milliseconds: • TimeoutMs>0: *Read From Buffer* block waits for the defined time. • TimeoutMs<0: *Read From Buffer* block waits forever.
[4] Buffer handle	The handle to the LVBuffer
[6] bTimeout	Boolean flag: • True: if there is no sample in the LVBuffer in the defined time. • False: LVBuffer continuously gets new samples and the *Read From Buffer* block can read them.
[10] Buffer Data	Samples from the LVBuffer
[14] DataBytes	Number of bytes in LVBuffer

LVBuffer status

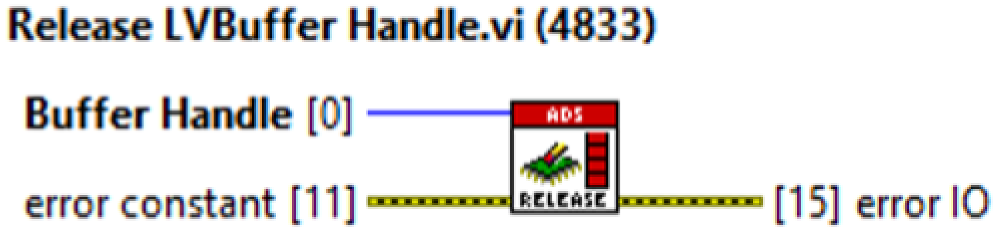
The *LVBuffer Status* block returns the current state of the LVBuffer regarding samples in the LVBuffer.



Input/Output	Meaning
[0] Buffer handle	The handle to the LVBuffer
[4] Buffer handle	The handle to the LVBuffer
[6] Elements In Buffer	Number of samples in LVBuffer that are still to be read.

Release LVBuffer Handle

The release LVBuffer Handle block releases the handle to the LVBuffer from memory.



Input	Meaning
[0] Buffer handle	The handle to the LVBuffer

7.10.3 CoE

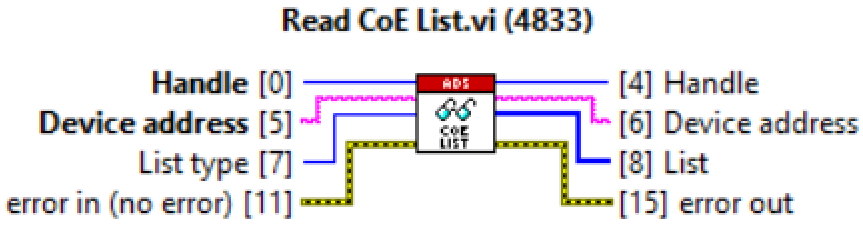
The CoE (**C**ANopen **o**ver **E**therCAT) section contains blocks that enable the reading and writing of CoE objects. The AMS address of the EtherCAT device is used here. The address is made up of the master AMS NetId and the AMS port of the client. The folder contains the following VIs:

- Read CoE List
- Read CoE Description
- Read CoE Entry
- Read CoE Value
- Write CoE Value

The example CoE Read or Write [▸ 109] describes the use of CoE blocks.

Read CoE List

The VI *Read CoE List* reads a CoE directory of a subscriber and lists all objects in an array that are available for the selected device. The objects are identified via indices that are used by subsequent CoE VIs for access.

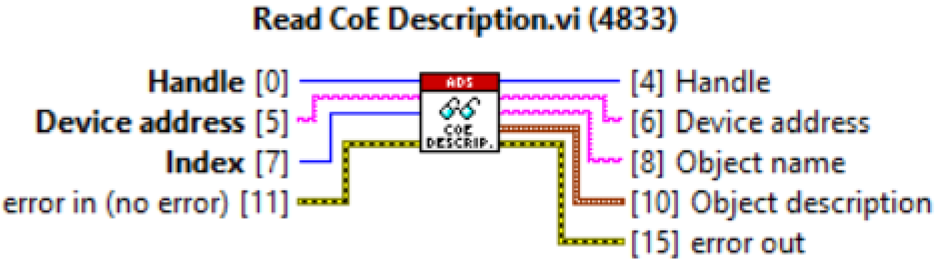


Input/output	Meaning
[0][4] Handle	Handle to the ADS client
[5][6] DeviceAddress	AMS address of the device consisting of: • AMS NetId of the master • AMS port of the client
[7] ListType	LabVIEW™ Enum Describes which indices from the directory are to be listed: • TotalNumberOfLists: Lists the number of elements in the AllCoEObjects, RxPDOs, TxPDOs, StoredForDevice and StartUp directories. • AllCoEObjects: List of all CoE objects • RxPDOs: List of all RxPDO objects • TxPDOs: List of all TxPDO objects • SettingObjects: List of all objects that are relevant when the device is replaced.

Input/output	Meaning
	• StartUp: List of objects that can be used as StartUp parameters.
[8] List	1D array of the indices of the objects

Read CoE Description

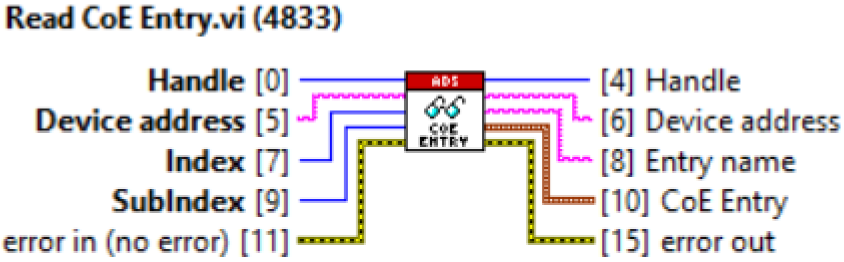
The VI *Read CoE Description* calls up the CoE object description of the device and sends it to LabVIEW™. The description includes the object name and the number of entries or subindices of the object.



Input/output	Meaning
[0][4] Handle	Handle to the ADS client
[5][6] DeviceAddress	AMS address of the device consisting of: • AMS NetId of the master • AMS port of the client
[7] Index	Index of the object
[8] ObjectName	Name of the object
[10] ObjectDescription	LabVIEW™ cluster consisting of the following elements: • Index: Index of the object • DataType: Data type of the object • MaxSubIndex: Number of subindices of the object

Read CoE Entry

The VI *Read CoE Entry* reads a CoE entry of an object. The object is referenced via the index and subindex. Information is returned, such as the name of the entry and the access.

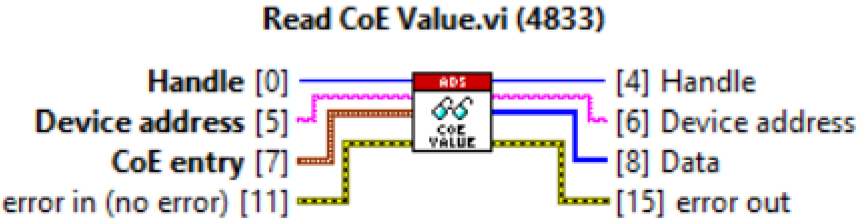


Input/output	Meaning
[0][4] Handle	Handle to the ADS client
[5][6] DeviceAddress	AMS address of the device consisting of: • AMS NetId of the master • AMS port of the slave
[7] Index	Index of the object
[8] Entry Name	Type of entry
[9] SubIndex	Subindex of the entry
[10] CoE Entry	LabVIEW™ cluster consisting of the following elements: • Index: Index of the object • SubIndex: Subindex of the entry

Input/output	Meaning
	• BitLength: The length of the entry in bits • ObjectAccess: Information on changeability, e.g. whether it can only be read or also written.

Read CoE Value

The VI *Read CoE Value* reads the value of a CoE entry. An array of the length BitLength in bytes is returned. The array specifies the value in hexadecimal numbers in little-endian format.

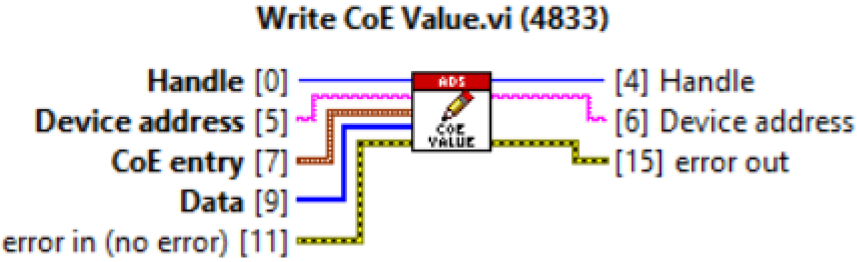


Input/output	Meaning
[0][4] Handle	Handle to the ADS client
[5][6] DeviceAddress	AMS address of the device consisting of: • AMS NetId of the master • AMS port of the slave
[7] CoE Entry	LabVIEW™ cluster consisting of the following elements: • Index: Index of the object • SubIndex: Subindex of the entry • DataType: Data type of the entry • BitLength: The length of the value of the entry in bits • ObjectAccess: Describes the EtherCAT state in which the object can be accessed.
[8] Data	1D byte array with the value of the CoE entry

The value of the CoE entry is displayed in hexadecimal and the bytes are transferred in little-endian order. Character strings and arrays are transferred from left to right, whereby the elements of the array are stored in little-endian.

Write CoE Value

The *Write CoE Value* block writes the value of the CoE entry. The value to be written is an array of bytes of the size BitLength. The values must be specified in hexadecimal numbers in little-endian format.



[0][4] Handle	Handle to the ADS client
[5][6] DeviceAddress	AMS address of the device consisting of: • AMS NetId of the master • AMS port of the slave
[7] Object Entry	LabVIEW™ cluster consisting of the following elements: • Index: Index of the object

[0][4] Handle	Handle to the ADS client
	• SubIndex: SubIndex of the entry • DataType: Data type of the entry • BitLength: The length of the value of the entry in bits • ObjectAccess: Describes the EtherCAT state in which the object can be accessed.
[9] Data	1D byte array with the value of the CoE entry

7.11 Low-Level

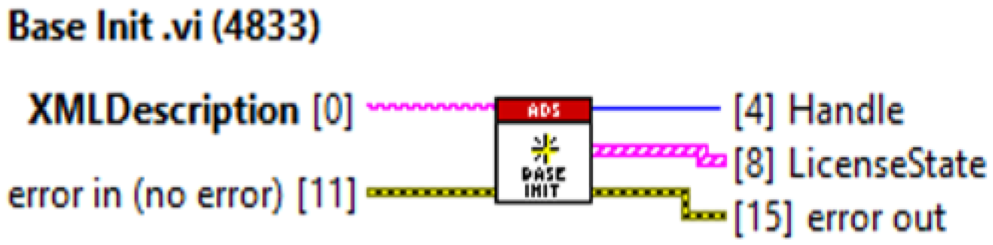
Low-Level VIs [▶ 40] can be used to provide more programming flexibility in certain situations, or to increase read or write speed.

7.11.1 Init

The subfolder *Init* contains low-level blocks that are necessary for initializing and connecting the ADS client.

Base Init

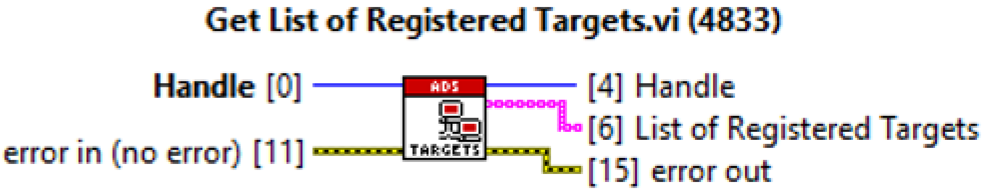
The *Base Init* block initializes and establishes a connection between ADS client and ADS router. The block checks the licenses on the target systems after a successful connection. After successful verification the block returns a valid handle to the ADS client.



Input/output	Meaning
[0] XML Description	LabVIEW™ XML string with ADS read and write symbols **or** the path as a string to an existing, already created (exported) XML file.
[4] Handle	Handle to the ADS client
[8] LicenseState	List of license states of the TwinCAT target systems

Get List of Registered Targets

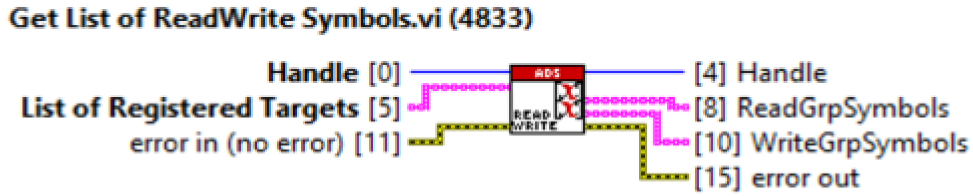
The *Get List of Registered Targets* block creates a list of ADS target systems which have been selected by the user in Symbol Interface [▶ 64] or entered in the directly loaded XML file.


Get List of Registered Targets.vi (4833)
Handle [0]
error in (no error) [11]
ADS
TARGETS
[4] Handle
[6] List of Registered Targets
[15] error out

Input/output	Meaning
[0] Handle	Handle to the ADS client
[4] Handle	Handle to the ADS client
[6] List of Registered Targets	List of registered target systems

Get List of ReadWrite Symbols

The *Get List of ReadWrite Symbols* block creates a list of registered ADS read and write symbols, which have been selected by the user in Symbol Interface [▶ 64] or entered in the directly loaded XML file.



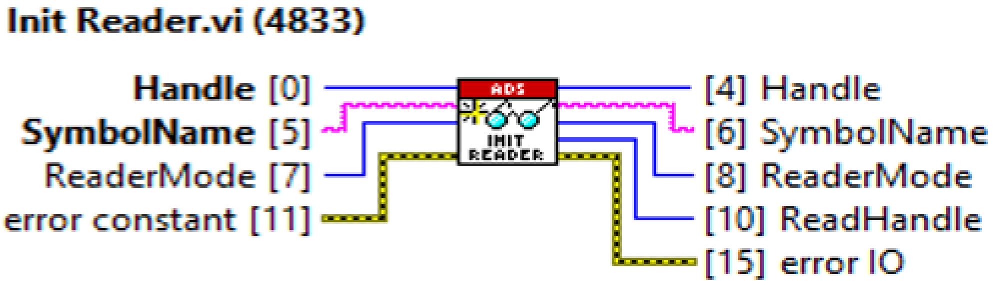
Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] List of Registered Targets	List of registered target systems
[4] Handle	Handle to the ADS client
[8] ReadGrpSymbols	List of ADS reading symbols
[10] WriteGrpSymbols	List of ADS writing symbols

7.11.2 Read

The subfolder *Read* contains low-level blocks which are necessary for reading via ADS.

Init Reader

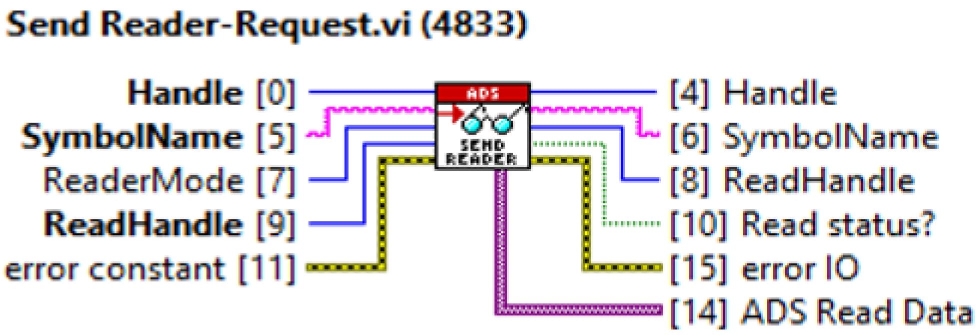
The *Init Reader* block initializes the ADS reader. When a call is successful the block returns a handle to the ADS reader.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[7] ReaderMode	The reading mode (ENUM: Sync/Async)
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] ReaderMode	The reading mode (Sync/Async)
[10] ReadHandle	Handle to the ADS reader

Send Reader-Request

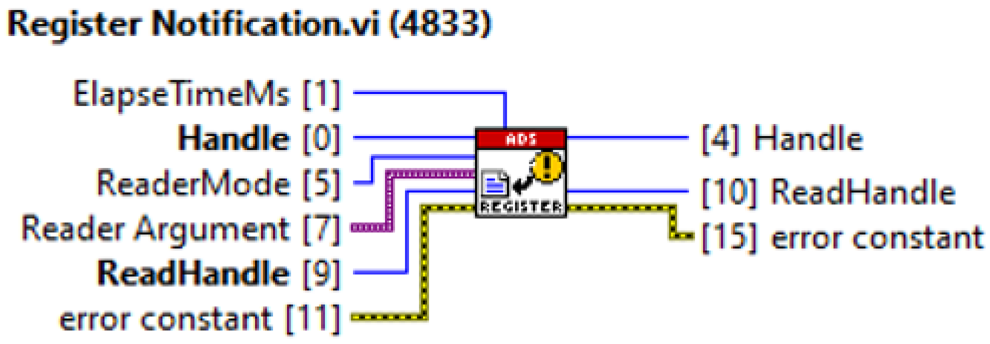
The *Send Reader-Request* block sends a read request to the ADS server. The block waits for a response from the server if the reader has been initialized with the "Synchronous" operation mode. Otherwise the block does not wait for the response and passes the ReadHandle.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[7] ReaderMode	The reading mode (ENUM: Sync/Async)
[9] ReadHandle	Handle to the ADS reader
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] ReadHandle	Handle to the ADS reader
[10] Read status?	Read status
[14] ADS-Read Data	ADS raw data

Register Notification

The *Register Notification* block registers the ADS notification with the ADS server and waits until the notification is explicitly unregistered from the outside. The registration does not start the notifications automatically. They have to be started explicitly.

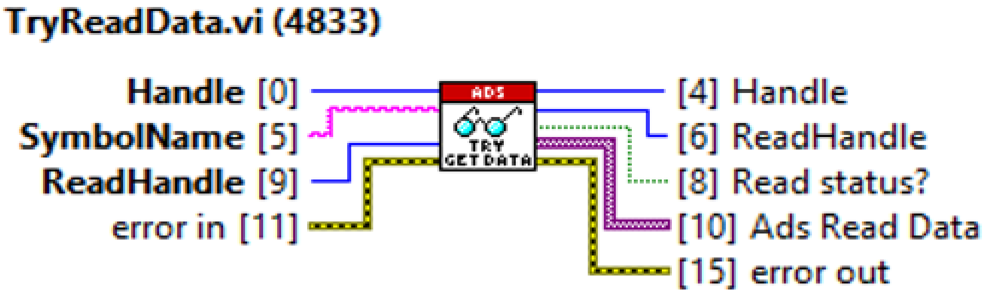


Input/output	Meaning
[0] Handle	Handle to the ADS client
[1] ElapseTimeMs	ADS symbol consisting of AMSNetId and symbol name
[5] ReaderMode	The type of reading: LabVIEW™-ENUM: • Noti. Single [▶ 67] • Noti. Buffered [▶ 68] • E-Noti. Single [▶ 68] • E-Noti. Buffered [▶ 69] • LVB-Noti. Single Symbol [▶ 70]
[7] Reader Argument	Reader arguments vary with the ReaderMode: • Noti. Single: no argument • Noti. Buffered: Single Buffer Info [▶ 79] • E-Noti. Single: LabVIEW™ Event Ref to Single User-Event Data [▶ 79]

Input/output	Meaning
	• E-Noti.Buffered: LabVIEW™ Event Ref to Buffered User-Event Data [▶ 79] • LVB-Noti.Single Symbol: Handle to LVBuffer to type (UINT32)
[9] ReadHandle	Handle to the ADS reader
[4] Handle	Handle to the ADS client
[10] ReadHandle	Handle to the ADS reader

TryReadData

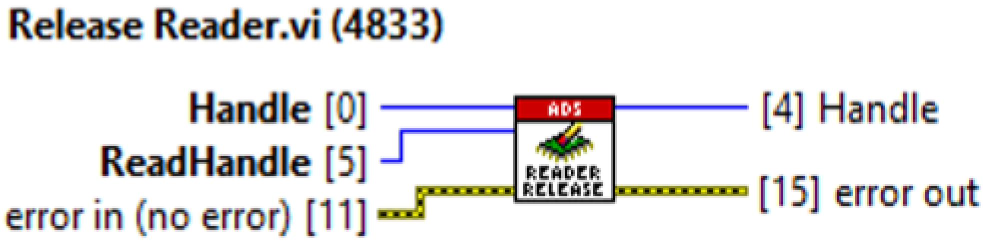
In connection with the "Asynchronous" operation mode the *TryReadData* block checks for successful receipt of a response (ADS data packet) from the ADS server.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[9] ReadHandle	Handle to the ADS reader
[4] Handle	Handle to the ADS client
[6] ReadHandle	Handle to the ADS reader
[8] Read status?	Read status
[10] ADS-Read Data	ADS raw data

Release Reader

The *Release Reader* releases the handle to the reader from memory.



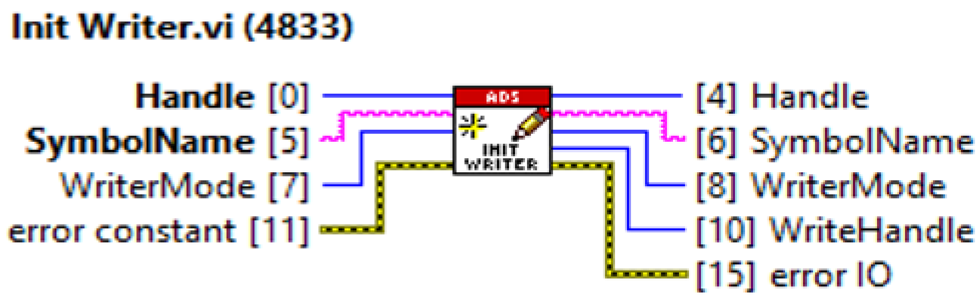
Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] ReadHandle	Handle to the ADS reader
[4] Handle	Handle to the ADS client

7.11.3 Write

The subfolder *Write* contains low-level blocks that are necessary for writing via ADS.

Init Writer

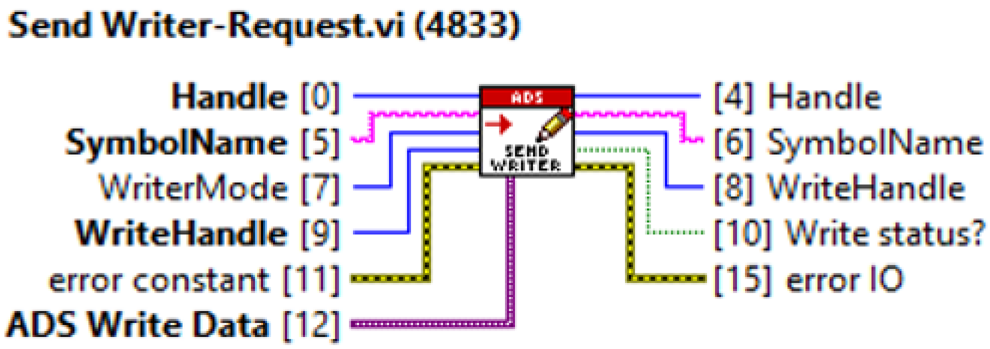
The *Init Writer* block initializes the ADS writer. When a call is successful the block returns a handle to the ADS writer.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[7] WriterMode	Writing mode (Sync/Async)
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] WriterMode	Writing mode (Sync/Async)
[10] WriteHandle	Handle to the ADS Writer

Send Writer Request

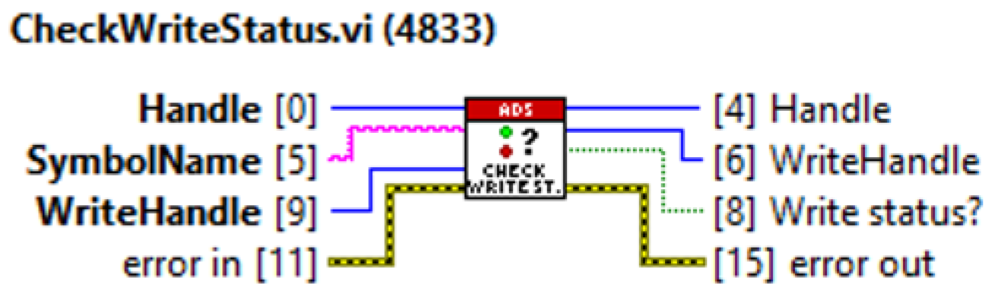
The *Send Writer-Request* block sends a write request to the ADS server. The block waits for a response from the server if the writer has been initialized with the "Synchronous" operation mode. Otherwise the block does not wait for the response and passes the WriteHandle.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[7] WriterMode	Writing mode (Sync/Async)
[9] WriteHandle	Handle to the ADS Writer
[12] ADS-Write Data	TypeResolved ADS data package
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] WriteHandle	Handle to the ADS Writer
[10] Write status?	Write status

CheckWriteStatus

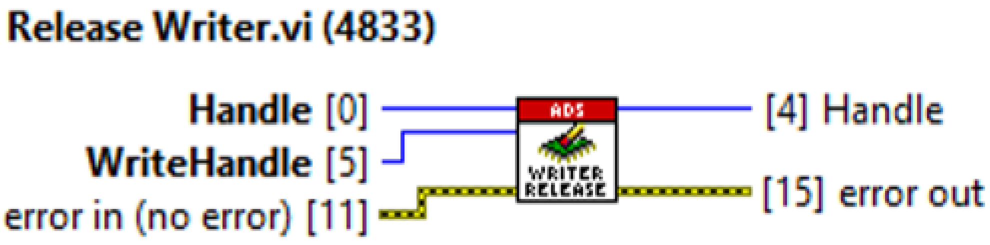
The *CheckWriteStatus* block checks for successful write access to the ADS server in connection with the "Asynchronous" operation mode.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[9] WriteHandle	Handle to the ADS Writer
[4] Handle	Handle to the ADS client
[6] WriteHandle	Handle to the ADS Writer
[8] Write status?	Write status

Release Writer

The *Release Writer* releases the handle to the writer from memory.



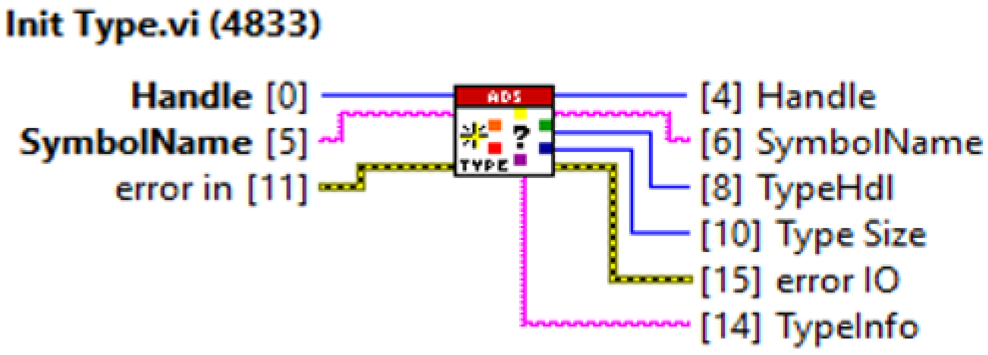
Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] WriteHandle	Handle to the ADS Writer
[4] Handle	Handle to the ADS client

7.11.4 TypeResolver

The subfolder *TypeResolver* contains low-level blocks necessary for converting and comparing between the LabVIEW™ data type and the TC3 data type.

Init Type

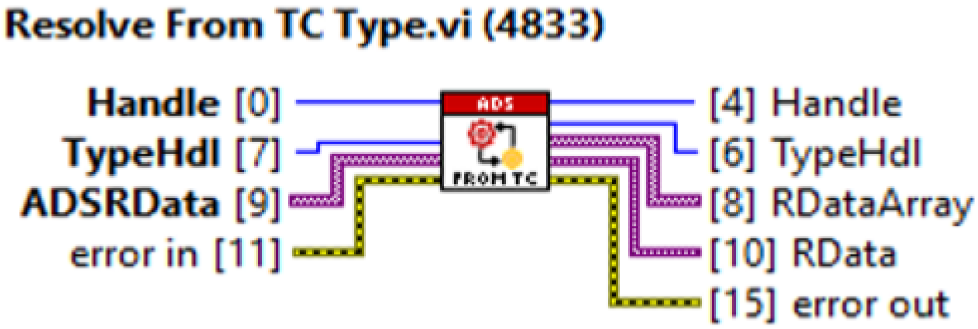
The *Init Type* block initializes the TypeResolver based on SymbolName and Handle. Upon successful initialization, the block passes the handle to the TypeResolver and the TC3 data type of the ADS symbol as a LabVIEW™ string in XML description to the LabVIEW™ process.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] TypeHdl	Handle to the TypeResolver
[10] Type Size	Data type size in bytes
[14] TypeInfo	Type Description in XML as LabVIEW™ string

Resolve From TC Type

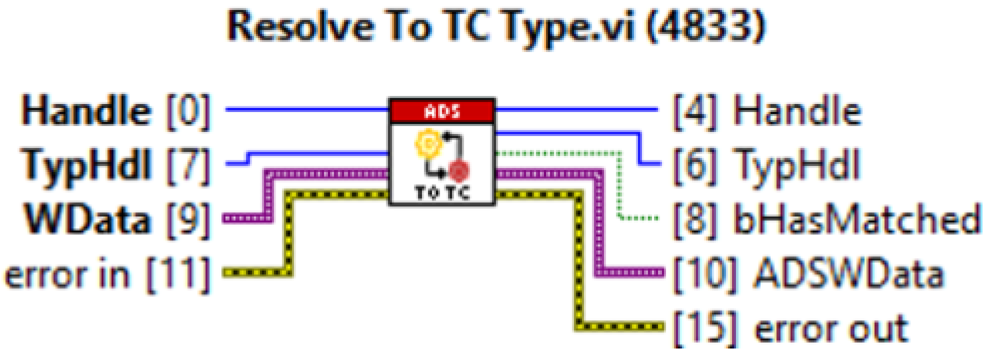
The *Resolve From TC Type* block compares and converts the raw data from the ADS read to the corresponding LabVIEW™ data type "Variant". The conversion only takes place if the comparison between the two data types was successful.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[7] TypeHdl	Handle to the TypeResolver
[9] ADSRData	ADS data package as raw data
[4] Handle	Handle to the ADS client
[6] TypeHdl	Handle to the TypeResolver
[8] RDataArray	TypeResolved ADS raw data as Variant array
[10] RData	TypeResolved ADS raw data as Variant

Resolve To TC Type

The *Resolve To TC Type* block converts the raw data for ADS-Read from a LabVIEW™ data type "Variant" to the appropriate TC3 data type. The conversion only takes place if the comparison between the two data types was successful.

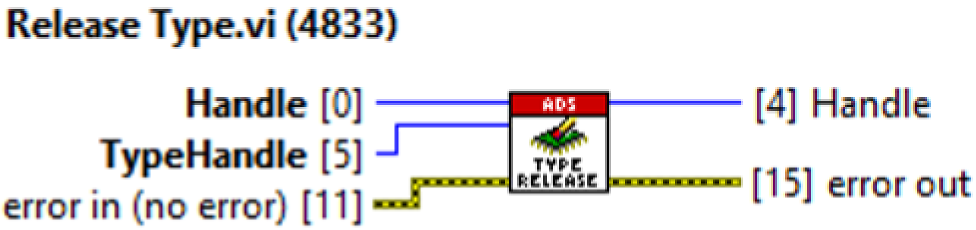


Input/output	Meaning
[0] Handle	Handle to the ADS client
[7] TypeHdl	Handle to the TypeResolver
[9] WData	ADS data package as raw data

Input/output	Meaning
[4] Handle	Handle to the ADS client
[6] TypeHdl	Handle to the TypeResolver
[8] bHasMatched	Flag (TRUE if TC3 and LabVIEW™ data type are identical, otherwise FALSE)
[10] ADSWData	TypeResolved ADS raw data as Variant

Release Type

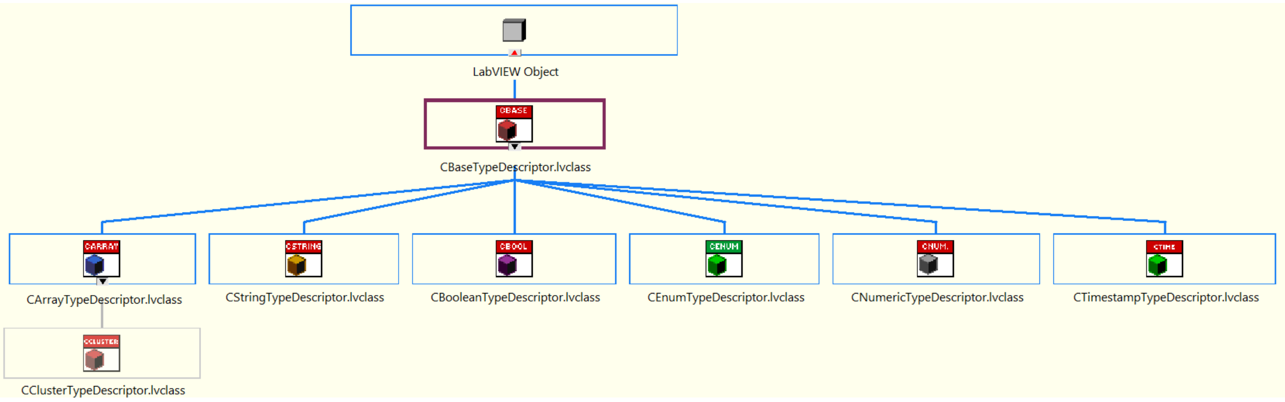
The *Release Type* releases the handle to the TypeResolver from memory.



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] TypeHandle	Handle to the TypeResolver
[4] Handle	Handle to the client

7.11.4.1 TypeGenerator

The subfolder *TypeGenerator* contains LabVIEW™ classes that are responsible for generating a supported LabVIEW™-Data types [▶ 115]. The following graphic shows the relationship or inheritance between the *TypeGenerator* classes.

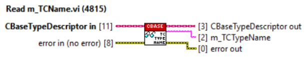

LabVIEW Object
CBASE
CBaseTypeDescriptor.lvclass
CARRAY
CArrayTypeDescriptor.lvclass
CSTRING
CStringTypeDescriptor.lvclass
CBOOL
CBooleanTypeDescriptor.lvclass
CENUM
CEnumTypeDescriptor.lvclass
CNUM.
CNumericTypeDescriptor.lvclass
CTIME
CTimestampTypeDescriptor.lvclass
CCLUSTER
CClusterTypeDescriptor.lvclass

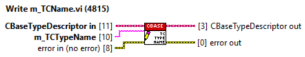
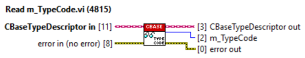
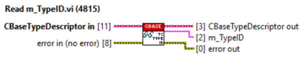
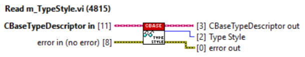
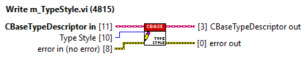
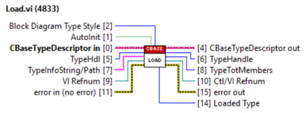
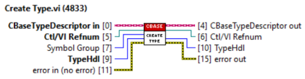
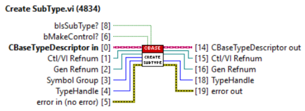
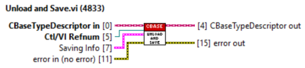
Use of the classes

The TypeGnerator classes of the respective data types were derived from the Base class and have inherited the functions. See also the information about the wrapper block Utilities [▶ 76].

CBaseTypeDescriptor class

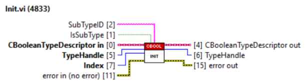
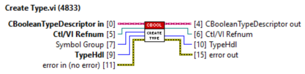
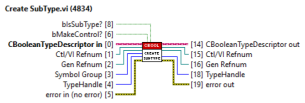
The CBaseTypeDescriptor class is the top class in the hierarchy. This class provides general methods and properties for the other classes that inherit from it. The table presents general information about the public properties and methods. The LabVIEW™ blocks provide further detailed information.

VI	Property/method	Access (Scope)	Meaning
 Read m_TCName.vi (4815) CBaseTypeDescriptor in [11] error in (no error) [8] CBASE TC TYPE NAME [3] CBaseTypeDescriptor out [2] m_TCTypeName [0] error out	Read m_TCName	Public	Reads the property m_TCName (name of the loaded type)

VI	Property/method	Access (Scope)	Meaning
 Write m_TCName.vi (4815) CBaseTypeDescriptor in [11] m_TCTypeName [10] error in (no error) [8] CBASE TC TYPE NAME [3] CBaseTypeDescriptor out [0] error out	Write m_TCName	Public	Writes the property m_TCName (name of the loaded type)
 Read m_TypeCode.vi (4815) CBaseTypeDescriptor in [11] error in (no error) [8] CBASE TYPE CODE [3] CBaseTypeDescriptor out [2] m_TypeCode [0] error out	Read m_TypeCode	Public	Reads the property m_TypeCode (defines a numeric value for the loaded type)
 Read m_TypeID.vi (4815) CBaseTypeDescriptor in [11] error in (no error) [8] CBASE TC TYPE ID [3] CBaseTypeDescriptor out [2] m_TypeID [0] error out	Read m_TypeID	Public	Reads the property m_TypeID (ID as GUID of the loaded type)
 Read m_TypeStyle.vi (4815) CBaseTypeDescriptor in [11] error in (no error) [8] CBASE TYPE STYLE [3] CBaseTypeDescriptor out [2] Type Style [0] error out	Read m_TypeStyle	Public	Reads the property m_TypeStyle (LabVIEW™ Enum: Describes how the loaded type should be generated)
 Write m_TypeStyle.vi (4815) CBaseTypeDescriptor in [11] Type Style [10] error in (no error) [8] CBASE TYPE STYLE [3] CBaseTypeDescriptor out [0] error out	Write m_TypeStyle	Public	Writes the property m_TypeStyle (LabVIEW™ Enum: Describes how the loaded type should be generated).
 Load.vi (4833) Block Diagram Type Style [2] AutoInit [1] CBaseTypeDescriptor in [0] TypeHdl [5] TypeInfoString/Path [7] VI Refnum [9] error in (no error) [11] CBASE LOAD [4] CBaseTypeDescriptor out [6] TypeHandle [8] TypeTotMembers [10] Ctl/VI Refnum [15] error out [14] Loaded Type	Load	Public, Static Dispatch	Loads TwinCAT3 type information into memory based on TypeResolver or **TypeInfo.**
 Create Type.vi (4833) CBaseTypeDescriptor in [0] Ctl/VI Refnum [5] Symbol Group [7] TypeHdl [9] error in (no error) [11] CBASE CREATE TYPE [4] CBaseTypeDescriptor out [6] Ctl/VI Refnum [10] TypeHdl [15] error out	Create Type	Public, Dynamic Dispatch	The method is empty. The classes that inherit from this class implement this method.
 Create SubType.vi (4834) bIsSubType? [8] bMakeControl? [6] CBaseTypeDescriptor in [0] Ctl/VI Refnum [1] Gen Refnum [2] Symbol Group [3] TypeHandle [4] error in (no error) [5] CBASE CREATE SUBTYPE [14] CBaseTypeDescriptor out [15] Ctl/VI Refnum [16] Gen Refnum [18] TypeHandle [19] error out	Create SubType	Public, Dynamic Dispatch	The method is empty. The classes that inherit from this class implement this method.
 Unload and Save.vi (4833) CBaseTypeDescriptor in [0] Ctl/VI Refnum [5] Saving Info [7] error in (no error) [11] CBASE UNLOAD AND SAVE [4] CBaseTypeDescriptor out [15] error out	Unload and Save	Public, Static Dispatch	Unloads the loaded type from memory and saves the new type (if Ctl).

CBooleanTypeDescriptor class

The CBooleanTypeDescriptor class generates a Boolean type as a constant or control (in a block diagram) or as a ctl on the hard disk. The table presents general information about public methods. The LabVIEW™ blocks provide further detailed information.

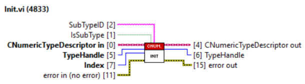
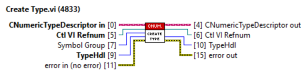
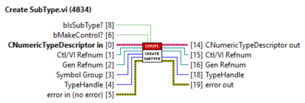
	Method	Access (Scope)	Meaning
 Init.vi (4833) SubTypeID [2] IsSubType [1] CBooleanTypeDescriptor in [0] TypeHandle [5] Index [7] error in (no error) [11] CBOOL INIT [4] CBooleanTypeDescriptor out [6] TypeHandle [15] error out	Init	Public, Static Dispatch	Initializes a Boolean type based on the loaded TypeInfo.
 Create Type.vi (4833) CBooleanTypeDescriptor in [0] Ctl/VI Refnum [5] Symbol Group [7] TypeHdl [9] error in (no error) [11] CBOOL CREATE TYPE [4] CBooleanTypeDescriptor out [6] Ctl/VI Refnum [10] TypeHdl [15] error out	Create Type	Public, Static Dispatch	Generates a Boolean type based on the loaded TwinCAT 3 type information.
 Create SubType.vi (4834) bIsSubType? [8] bMakeControl? [6] CBooleanTypeDescriptor in [0] Ctl/VI Refnum [1] Gen Refnum [2] Symbol Group [3] TypeHandle [4] error in (no error) [5] CBOOL CREATE SUBTYPE [14] CBooleanTypeDescriptor out [15] Ctl/VI Refnum [16] Gen Refnum [18] TypeHandle [19] error out	Create SubType	Public, Static Dispatch	Generates a Boolean type as a sub-type, e.g. the element of a cluster.

IEC 61131-3 BIT data type

The CBooleanTypeDescriptor class supports BOOL and BIT data types and can therefore be used to generate both.

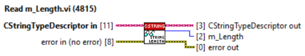
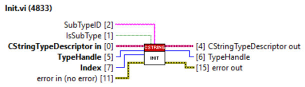
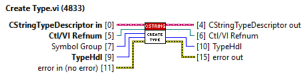
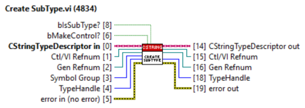
CNumericTypeDescriptor class

The CNumericTypeDescriptor class generates a numeric type with proper representation (I8, I16, I32, Single, ...) as constant or controls (in a block diagram) or as ctl on the hard disk. The table presents general information about public methods. The LabVIEW™ blocks provide further detailed information.

	Method	Access (Scope)	Meaning
	Init	Public, Static Dispatch	Initializes the numeric type, based on the loaded TypeInfo.
	Create Type	Public, Static Dispatch	Generates a numeric type based on the loaded TypeInfo.
	Create SubType	Public, Static Dispatch	Generates a numeric type as a sub-type, e.g. the element of a cluster.

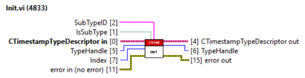
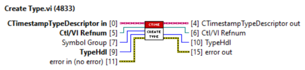
CStringTypeDescriptor class

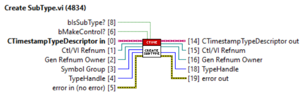
The CStringTypeDescriptor class generates a LabVIEW™ string as a constant or control (in a block diagram) or as a ctl on the hard disk. The table presents general information about public methods. The LabVIEW™ blocks provide further detailed information.

	Property/method	Access (Scope)	Meaning
	Read m_Length	Public	Reads the property m_Length (length of the TwinCAT 3 string of the loaded TypeInfo).
	Init	Public, Static Dispatch	Initializes a LabVIEW™ string based on the loaded TypeInfo.
	Create Type	Public, Static Dispatch	Generates a LabVIEW™ string based on loaded TypeInfo.
	Create SubType	Public, Static Dispatch	Generates a LabVIEW™ string as a sub-type, e.g. an element of a LabVIEW™ cluster.

CTimestampTypeDescriptor class

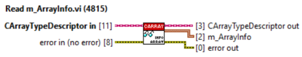
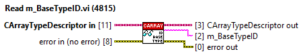
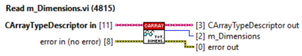
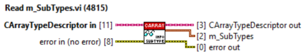
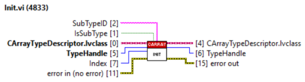
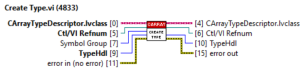
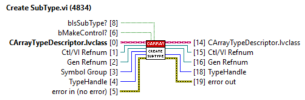
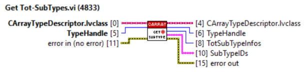
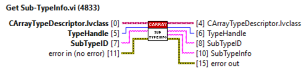
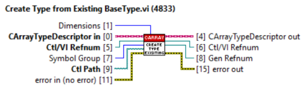
The CTimestampTypeDescriptor class generates a timestamp LabVIEW™ type as a constant or control (in a block diagram) or as a ctl on the hard disk. The table presents general information about public methods. The LabVIEW™ blocks provide further detailed information.

	Method	Access (Scope)	Meaning
	Init	Public, Static Dispatch	Initializes the timestamp based on the loaded TypeInfo.
	Create Type	Public, Static Dispatch	Generates a timestamp based on the loaded TypeInfo.

	Method	Access (Scope)	Meaning
 Create SubType.vi (4834) bIsSubType? [8] bMakeControl? [6] CTimestampTypeDescriptor in [0] Ctl/VI Refnum [1] Gen Refnum Owner [2] Symbol Group [3] TypeHandle [4] error in (no error) [5] CTIME CREATE SUBTYPE [14] CTimestampTypeDescriptor out [15] Ctl/VI Refnum [16] Gen Refnum Owner [18] TypeHandle [19] error out	Create SubType	Public, Static Dispatch	Generates a timestamp as a sub-type, e.g. an element of a LabVIEW™ cluster.

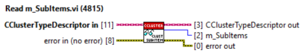
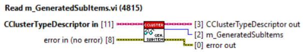
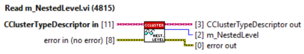
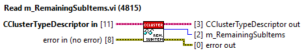
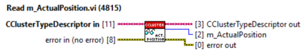
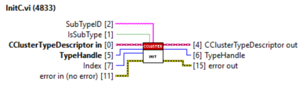
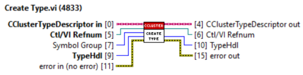
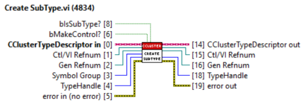
CArrayTypeDescriptor class

The CArrayTypeDescriptor class generates an array LabVIEW™ type as a constant or control (in a block diagram) or as a ctl on the hard disk. The table presents general information about public methods. The LabVIEW™ blocks provide further detailed information.

	Property/method	Access (Scope)	Meaning
 Read m_ArrayInfo.vi (4815) CArrayTypeDescriptor in [11] error in (no error) [8] CARRAY INFO ARRAY [3] CArrayTypeDescriptor out [2] m_ArrayInfo [0] error out	Read m_ArrayInfo	Public	Reads the property m_ArrayInfo (information regarding TwinCAT 3 Array Dimension elements)
 Read m_BaseTypeID.vi (4815) CArrayTypeDescriptor in [11] error in (no error) [8] CARRAY ID BASE TYPE [3] CArrayTypeDescriptor out [2] m_BaseTypeID [0] error out	Read m_BaseTypeID	Public	Reads the property m_BaseTypeID (ID as GUID of the loaded base type)
 Read m_Dimensions.vi (4815) CArrayTypeDescriptor in [11] error in (no error) [8] CARRAY TOT. DIMENS. [3] CArrayTypeDescriptor out [2] m_Dimensions [0] error out	Read m_Dimensions	Public	Reads the property m_Dimensions (number of TwinCAT 3 Array Dimensions)
 Read m_SubTypes.vi (4815) CArrayTypeDescriptor in [11] error in (no error) [8] CARRAY INFO SUBTYPE [3] CArrayTypeDescriptor out [2] m_SubTypes [0] error out	Read m_SubTypes	Public	Reads the property m_SubTypes (for arrays of LabVIEW™ clusters, this property specifies the number of cluster elements generated)
 Init.vi (4833) SubTypeID [2] IsSubType [1] CArrayTypeDescriptor.lvclass [0] TypeHandle [5] Index [7] error in (no error) [11] CARRAY INIT [4] CArrayTypeDescriptor.lvclass [6] TypeHandle [15] error out	Init	Public, Static Dispatch	Initializes the array based on the loaded TypeInfo.
 Create Type.vi (4833) CArrayTypeDescriptor.lvclass [0] Ctl/VI Refnum [5] Symbol Group [7] TypeHdl [9] error in (no error) [11] CARRAY CREATE TYPE [4] CArrayTypeDescriptor.lvclass [6] Ctl/VI Refnum [10] TypeHdl [15] error out	Create Type	Public, Static Dispatch	Generates an array based on the loaded TypeInfo.
 Create SubType.vi (4834) bIsSubType? [8] bMakeControl? [6] CArrayTypeDescriptor.lvclass [0] Ctl/VI Refnum [1] Gen Refnum [2] Symbol Group [3] TypeHandle [4] error in (no error) [5] CARRAY CREATE SUBTYPE [14] CArrayTypeDescriptor.lvclass [15] Ctl/VI Refnum [16] Gen Refnum [18] TypeHandle [19] error out	Create SubType	Public, Static Dispatch	Generates an array as a sub-type, e.g. an element of a LabVIEW™ cluster.
 Get Tot-SubTypes.vi (4833) CArrayTypeDescriptor.lvclass [0] TypeHandle [5] error in (no error) [11] CARRAY GET# SUBTYPE [4] CArrayTypeDescriptor.lvclass [6] TypeHandle [8] TotSubTypeInfos [10] SubTypeIDs [15] error out	Get Tot SubTypes	Public, Static Dispatch	Returns information about the number of complex sub-types of the array and their IDs as GUID (e.g.: array with complex BaseType, where the BaseType contains further arrays with complex BaseTypes).
 Get Sub-TypeInfo.vi (4833) CArrayTypeDescriptor.lvclass [0] TypeHandle [5] SubTypeID [7] error in (no error) [11] CARRAY SUB TYPEINFO [4] CArrayTypeDescriptor.lvclass [6] TypeHandle [8] SubTypeID [10] SubTypeInfo [15] error out	Get Sub-TypeInfo	Public, Static Dispatch	Reads TypeInfo of the complex BaseType or SubType with entered ID as GUID.
 Create Type from Existing BaseType.vi (4833) Dimensions [1] CArrayTypeDescriptor in [0] Ctl/VI Refnum [5] Symbol Group [7] Ctl Path [9] error in (no error) [11] CARRAY CREATE TYPE EXISITING [4] CArrayTypeDescriptor out [6] Ctl/VI Refnum [8] Gen Refnum [15] error out	Create Type From Existing BaseType	Public, Static Dispatch	Generates an array of a ctl from a path.

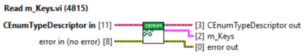
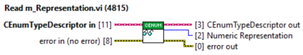
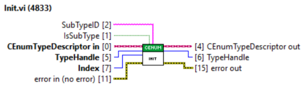
CClusterTypeDescriptor class

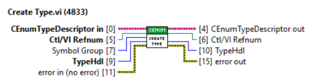
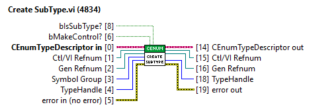
The CClusterTypeDescriptor class generates a cluster LabVIEW™ type as a constant or control (in a block diagram) or as a ctl on the hard disk. The table presents general information about public methods. The LabVIEW™ blocks provide further detailed information.

	Property/method	Access (Scope)	Meaning
 Read m_SubItems.vi (4815) CClusterTypeDescriptor in [11] error in (no error) [8] CCLUSTER CLUST SUBITEM [3] CClusterTypeDescriptor out [2] m_SubItems [0] error out	Read m_SubItems	Public	Reads the property m_SubItems (the number of elements in the current cluster).
 Read m_GeneratedSubItems.vi (4815) CClusterTypeDescriptor in [11] error in (no error) [8] CCLUSTER GEN. SUBITEM [3] CClusterTypeDescriptor out [2] m_GeneratedSubItems [0] error out	Read m_GeneratedSubItems	Public	Reads the property m_GeneratedSubItems (the number of generated elements in the current cluster).
 Read m_NestedLevel.vi (4815) CClusterTypeDescriptor in [11] error in (no error) [8] CCLUSTER NEST. LEVEL [3] CClusterTypeDescriptor out [2] m_NestedLevel [0] error out	Read m_NestedLevel	Public	Reads the property m_NestedLevel (the nested level of the current cluster).
 Read m_RemainingSubItems.vi (4815) CClusterTypeDescriptor in [11] error in (no error) [8] CCLUSTER REM. SUBITEM [3] CClusterTypeDescriptor out [2] m_RemainingSubItems [0] error out	Read m_RemainingSubItems	Public	Reads the property m_RemainingSubItems (the number of elements of the current cluster that are yet to be generated).
 Read m_ActualPosition.vi (4815) CClusterTypeDescriptor in [11] error in (no error) [8] CCLUSTER ACT. POSITION [3] CClusterTypeDescriptor out [2] m_ActualPosition [0] error out	Read m_ActualPosition	Public	Reads the property m_ActualPosition (iterator of the SubTypes in the cluster).
 InitC.vi (4833) SubTypeID [2] IsSubType [1] CClusterTypeDescriptor in [0] TypeHandle [5] Index [7] error in (no error) [11] CCLUSTER INIT [4] CClusterTypeDescriptor out [6] TypeHandle [15] error out	InitC	Public, Static Dispatch	Initializes the clusters, based on the loaded TypeInfo.
 Create Type.vi (4833) CClusterTypeDescriptor in [0] Ctl/VI Refnum [5] Symbol Group [7] TypeHdl [9] error in (no error) [11] CCLUSTER CREATE TYPE [4] CClusterTypeDescriptor out [6] Ctl/VI Refnum [10] TypeHdl [15] error out	Create Type	Public, Static Dispatch	Generates a cluster based on the loaded TypeInfo.
 Create SubType.vi (4834) bIsSubType? [8] bMakeControl? [6] CClusterTypeDescriptor in [0] Ctl/VI Refnum [1] Gen Refnum [2] Symbol Group [3] TypeHandle [4] error in (no error) [5] CCLUSTER CREATE SUBTYPE [14] CClusterTypeDescriptor out [15] Ctl/VI Refnum [16] Gen Refnum [18] TypeHandle [19] error out	Create SubType	Public, Static Dispatch	Generates a cluster as a sub-type, e.g. an element of a LabVIEW™ cluster.

CEnumTypeDescriptor class

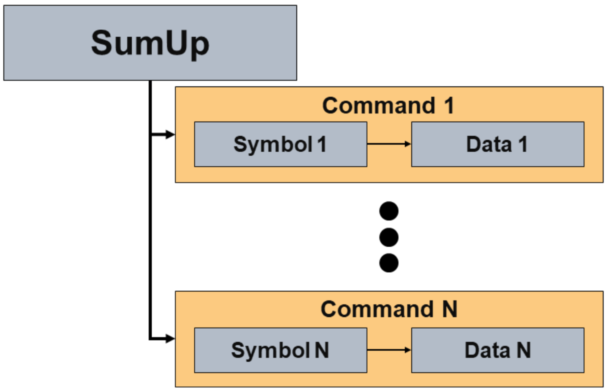
The CEnumTypeDescriptor class generates an Enum LabVIEW™ type as a constant or control (in a block diagram) or as a ctl on the hard disk. The table presents general information about public methods. The LabVIEW™ blocks provide further detailed information.

	Property/method	Access (Scope)	Meaning
 Read m_Keys.vi (4815) CEnumTypeDescriptor in [11] error in (no error) [8] CENUM [3] CEnumTypeDescriptor out [2] m_Keys [0] error out	Read m_Keys	Public	Reads the property m_Keys (All text elements of the Enum).
 Read m_Representation.vi (4815) CEnumTypeDescriptor in [11] error in (no error) [8] CENUM [3] CEnumTypeDescriptor out [2] Numeric Representation [0] error out	Read m_Representation	Public	Reads the property m_Representation (The underlying memory of the Enum).
 Init.vi (4833) SubTypeID [2] IsSubType [1] CEnumTypeDescriptor in [0] TypeHandle [5] Index [7] error in (no error) [11] CENUM INIT [4] CEnumTypeDescriptor out [6] TypeHandle [15] error out	Init	Public, Static Dispatch	Initializes the Enum, based on the loaded TypeInfo.

	Property/method	Access (Scope)	Meaning
 Create Type.vi (4833) CEnumTypeDescriptor in [0] Ctl/VI Refnum [5] Symbol Group [7] TypeHdl [9] error in (no error) [11] CENUM CREATE TYPE [4] CEnumTypeDescriptor out [6] Ctl/VI Refnum [10] TypeHdl [15] error out	Create Type	Public, Static Dispatch	Generates an Enum based on the loaded TypeInfo.
 Create SubType.vi (4834) bIsSubType? [8] bMakeControl? [6] CEnumTypeDescriptor in [0] Ctl/VI Refnum [1] Gen Refnum [2] Symbol Group [3] TypeHandle [4] error in (no error) [5] CENUM CREATE SUBTYPE [14] CEnumTypeDescriptor out [15] Ctl/VI Refnum [16] Gen Refnum [18] TypeHandle [19] error out	Create SubType	Public, Static Dispatch	Generates an Enum as a sub-type, e.g. an element of a LabVIEW™ cluster.

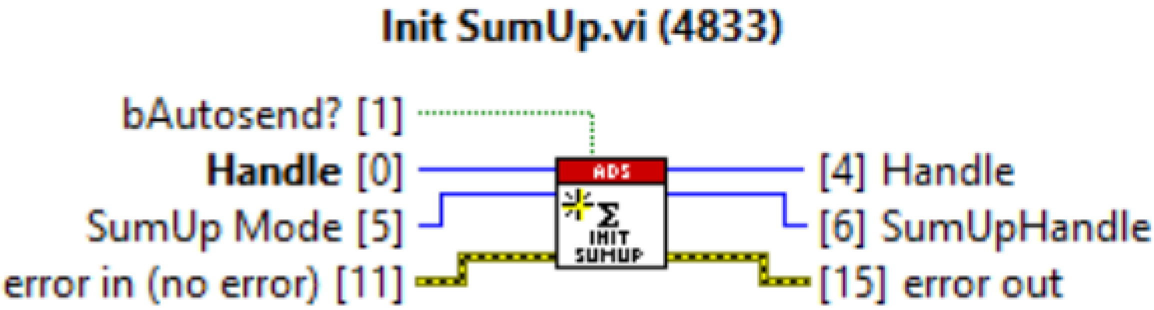
7.11.5 SumUp

The subfolder *SumUp* contains low-level blocks that allow writing or reading multiple ADS symbols with one API call. Compared to simple ADS Read or Write statements, only one handle is needed for writing or reading multiple symbols with the SumUp. The handle can in turn contain several subcommands that are sent simultaneously to the TwinCAT 3 Runtime.



Init SumUp

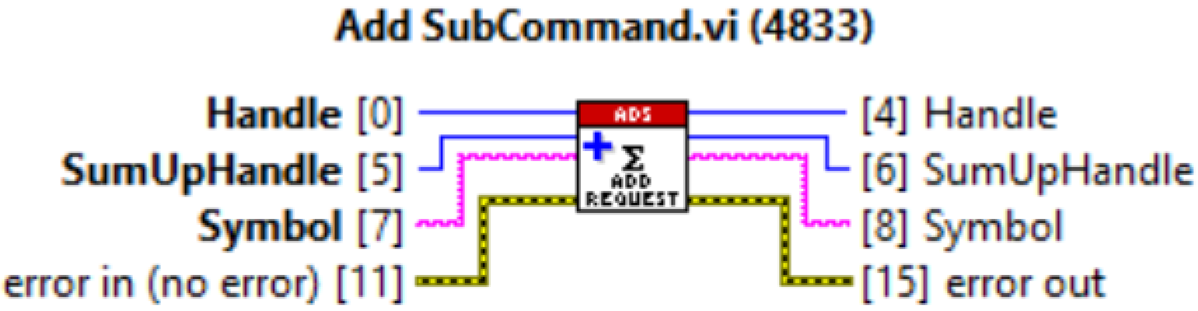
The block *Init SumUp* initializes the ADS SumUp. If the call is successful, the block returns a handle to the ADS SumUp.



Input/output	Meaning
[0] [4] Handle	Handle to the client
[1] bAutosend	Autosend flag enables automatic sending of the SubCommand
[5] SumUp mode	SumUp modes: • Write • Read
[6] SumUp handle	Handle on the SumUp

Add SubCommand

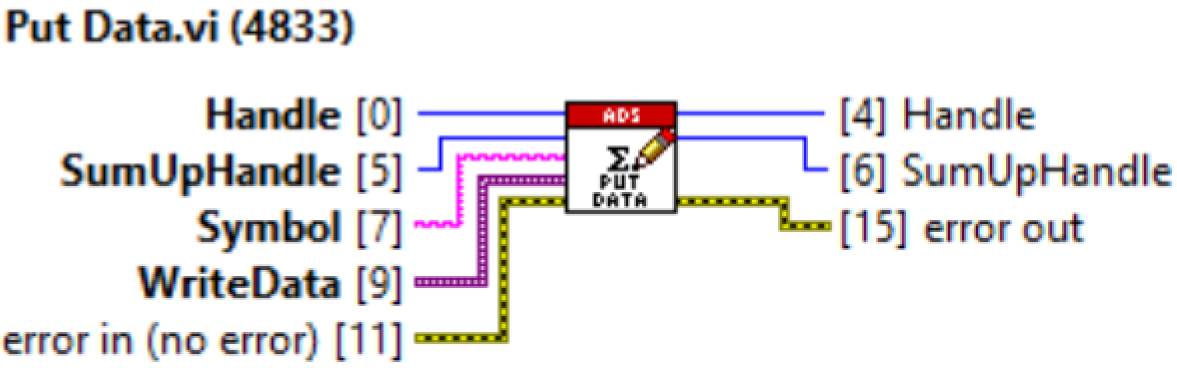
The block *Add SubCommand* initializes a new subcommand and adds it to the SumUp handle.



Input/output	Meaning
[0] [4] Handle	Handle to the client
[5] [6] SumUpHandle	Handle on the SumUp
[7] [8] Symbol	Sub-command symbol

Put Data

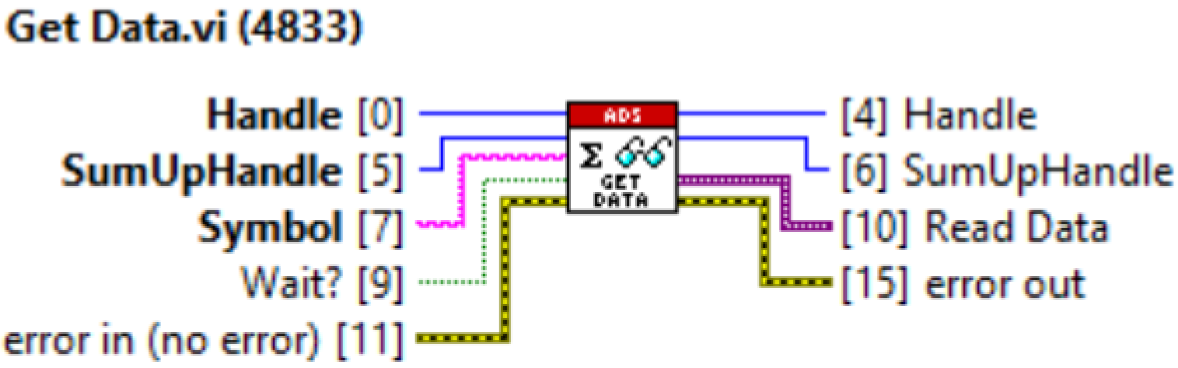
The block *Put Data* adds new data to the initialized sub-command. For this the block needs the symbol name to identify the sub-command. The block can only be used for writing SumUp commands.



Input/output	Meaning
[0] [4] Handle	Handle to the client.
[5] [6] SumUpHandle	Handle on the SumUp
[7] Symbol	Sub-command symbol
[9] WriteData	Data that is to be written

Get Data

The block *Get Data* retrieves new data from the initialized sub-command. For this the block needs the symbol name to identify the sub-command. The block can only be used for reading SumUp commands.

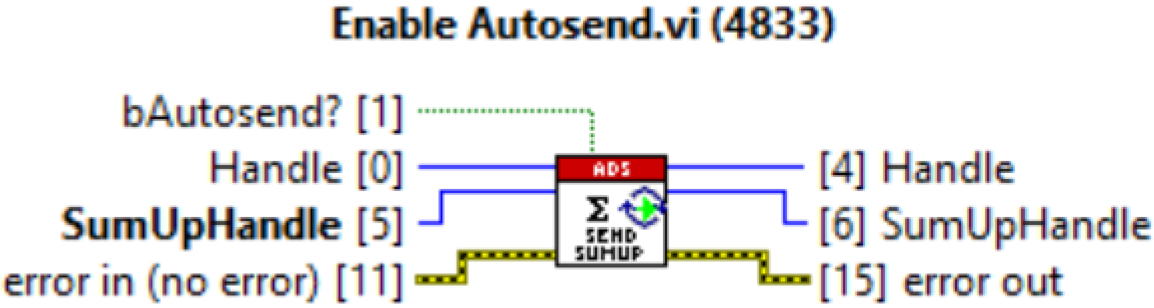


Input/output	Meaning
[0] [4] Handle	Handle to the client
[5] [6] SumUpHandle	Handle on the SumUp

Input/output	Meaning
[7] Symbol	Sub-command symbol
[9] Wait?	Wait flag that defines whether to wait for the data to be read. • True: The block waits until the timeout to see if the new data has come in. • False: The block does not wait for the new data.
[15] Read Data	The data to be read

Enable Autosend

The block *Enable Autosend* enables the automatic sending of the SumUp command.



Input/output	Meaning
[0] [4] Handle	Handle to the client
[1] bAutosend	The Autosend flag enables automatic sending of the SubCommand
[5] [6] SumUpHandle	Handle on the SumUp

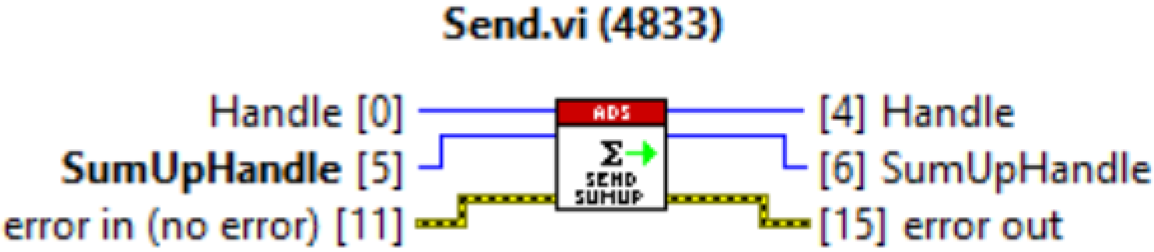
NOTICE

Sub-commands without data

Automatic sending fails for initialized sub-commands that do not contain any data.

Send SumUp

The block *Send SumUp* sends the sub-commands added to the SumUp handle to the TwinCAT 3 Runtime. In contrast to SumUp [▶ 98], the Send SumUp must be explicitly called cyclically to send the data to TwinCAT.



Input/output	Meaning
[0] [4] Handle	Handle to the client
[5] [6] SumUpHandle	Handle on the SumUp

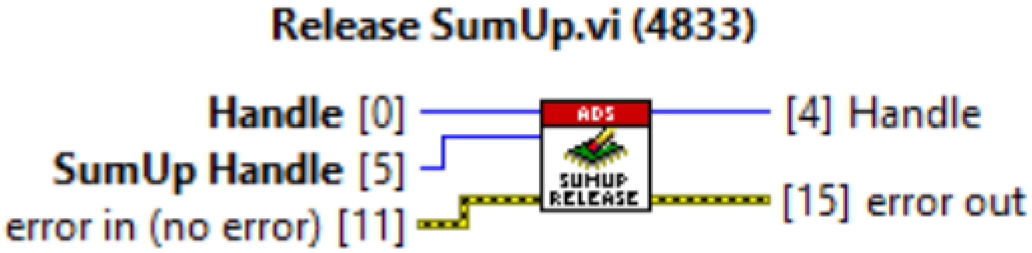
NOTICE

Sub-commands without data

Sending fails for initialized sub-commands that do not contain any data.

Release SumUp

The block *Release SumUp* releases the SumUp handle from memory.



Input/output	Meaning
[0] [4] Handle	Handle to the client
[5] SumUpHandle	Handle on the SumUp

7.12 With TypeResolving

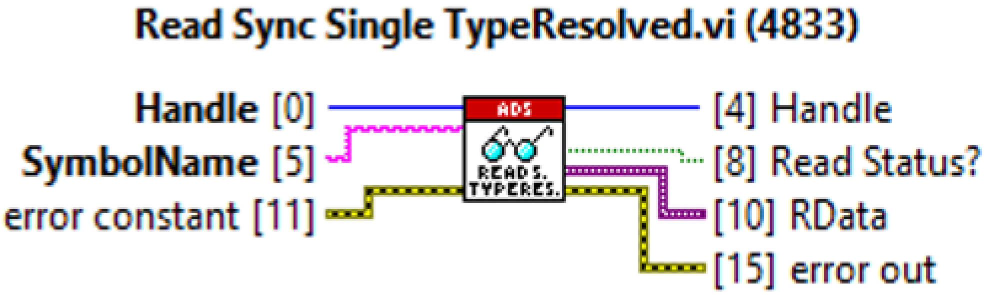
The folder *With TypeResolving* contains blocks that integrate reading and writing via ADS with TypeResolver and, accordingly, further simplify programming in LabVIEW™.

Read TypeResolved

The *Read TypeResolved* block is a polymorphic block that integrates reading via ADS with TypeResolver. The block offers synchronous and asynchronous reading via ADS.

Read Sync Single TypeResolved

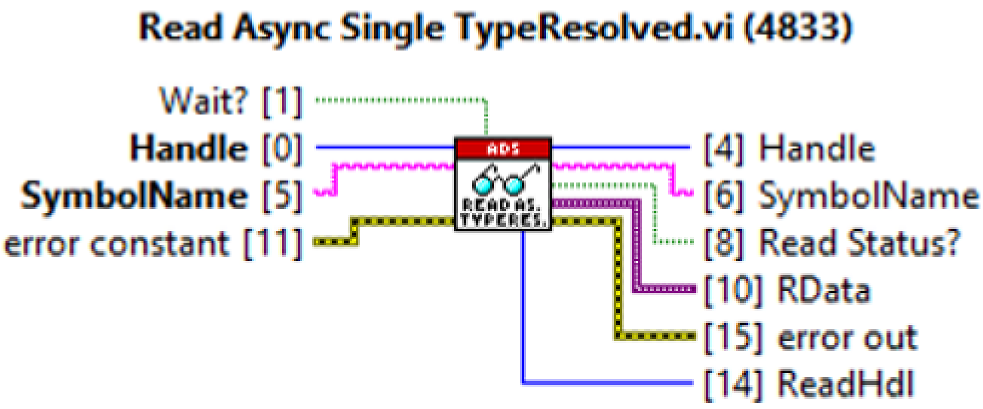
The *Read Sync Single TypeResolved* block calls the block ADS-Read [▸ 66] to receive the ADS data packet (as raw ADS data), **synchronously** from the ADS server, and then convert it to a LabVIEW™ data type using the block TypeResolver [▸ 73].



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[4] Handle	Handle to the ADS client
[8] Read Status?	Read status
[10] RData	TypeResolved ADS raw data as Variant

Read Async Single TypeResolved

The *Read Async Single TypeResolved* block calls the block ADS-Read [▸ 67] to receive the ADS data packet (as raw ADS data) **asynchronously** from the ADS server and then convert it to a LabVIEW™ data type using the block TypeResolver [▸ 73].



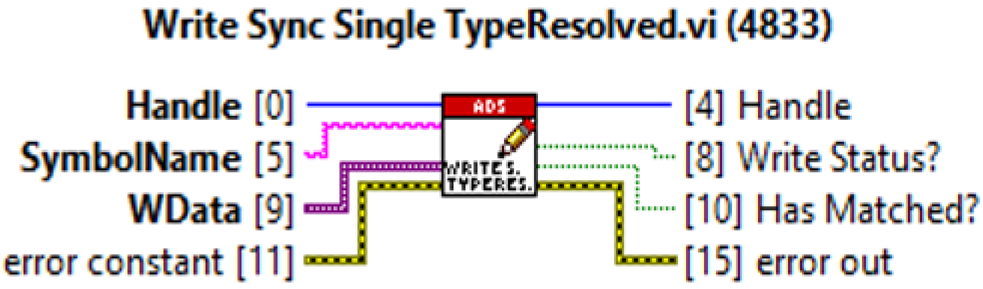
Input/output	Meaning
[0] Handle	Handle to the ADS client
[1] Wait?	TRUE = wait for server response (sync) FALSE (default) = do not wait for server response (async)
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] Read Status?	Read status
[10] RData	TypeResolved ADS raw data as Variant
[14] ReadHdl	Handle to the ADS reader

Write TypeResolved

The *Write TypeResolved* block is a polymorphic block that integrates writing via ADS with TypeResolver. The block offers synchronous and asynchronous writing via ADS.

Write Sync Single TypeResolved

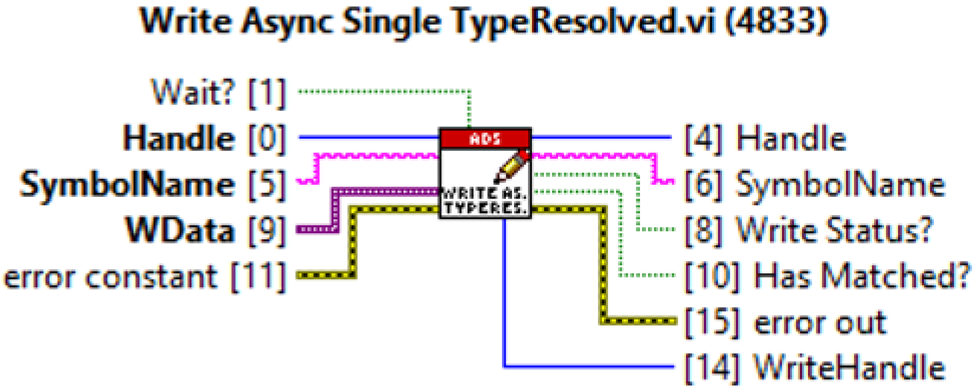
The *Write Sync Single TypeResolved* block calls the block TypeResolver [▶ 72] to convert the LabVIEW™ data type to a TC3 data type and then **synchronously** send the converted data packet to the ADS server with the call of block ADS-Write [▶ 71].



Input/output	Meaning
[0] Handle	Handle to the ADS client
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[9] WData	ADS data package as raw data
[4] Handle	Handle to the ADS client
[8] Write Status?	Write status
[10] Has Matched?	Flag indicating whether conversion and comparison between LabVIEW™ and TC3 data type was successful

Write Async Single TypeResolved

The *Write Async Single TypeResolved* block calls the block TypeResolver [▶ 72] to convert the LabVIEW™ data type to a TC3 data type and then send the converted data packet to the ADS server **asynchronously** with the call of block ADS-Write [▶ 71].



Input/output	Meaning
[0] Handle	Handle to the ADS client
[1] Wait?	TRUE = wait for server response (sync) FALSE (default) = do not wait for server response (async)
[5] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[9] WData	ADS data package as raw data
[4] Handle	Handle to the ADS client
[6] SymbolName	ADS symbol consisting of AMSNetId and symbol name
[8] Write Status?	Write status
[10] Has Matched?	Flag indicating whether conversion and comparison between LabVIEW™ and TC3 data type was successful
[14] WriteHandle	Handle to the ADS Writer

8 Samples

The TF3710 TwinCAT 3 Interface for LabVIEW™ product categorizes the examples into two different groups, which are described as follows:

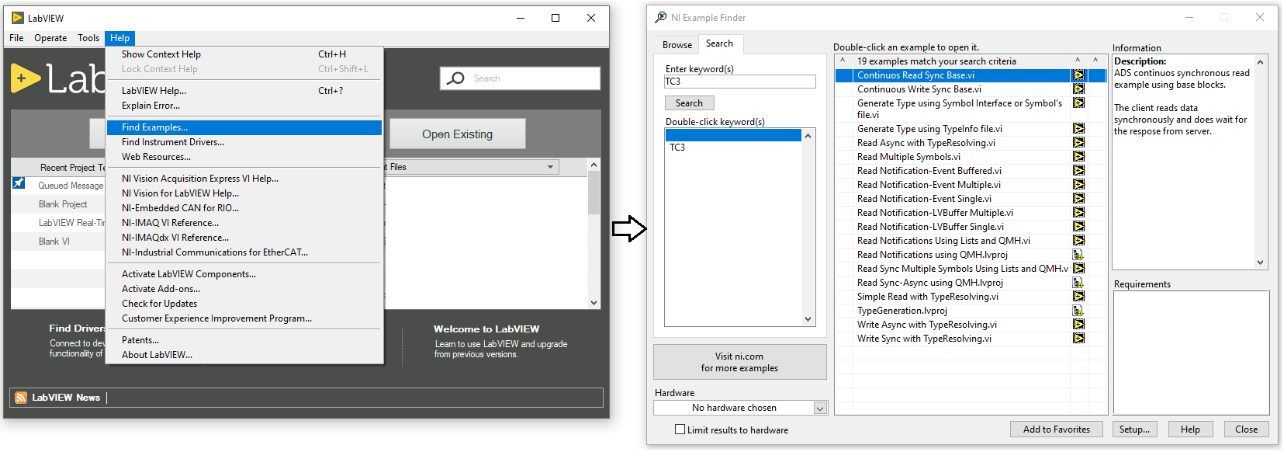
8.1 Basic examples

A large number of basic examples are included in the LabVIEW™ environment during the installation of the Interface for LabVIEW™. These can be found with the help of the **NI Example Finder**.

The following keywords facilitate the search for the examples:

- TC3
- Beckhoff
- Beckhoff-LabVIEW-Interface
- ADS
- TwinCAT
- TF3710

The NI Example Finder can be started in LabVIEW™ under **Menu > Help > Find Examples**.



Enter keyword(s): TC3

TC3

19 examples match your search criteria

- Continuos Read Sync Base.vi
- Continuous Write Sync Base.vi
- Generate Type using Symbol Interface or Symbol's file.vi
- Generate Type using TypeInfo file.vi
- Read Async with TypeResolving.vi
- Read Multiple Symbols.vi
- Read Notification-Event Buffered.vi
- Read Notification-Event Multiple.vi
- Read Notification-Event Single.vi
- Read Notification-LVBuffer Multiple.vi
- Read Notification-LVBuffer Single.vi
- Read Notifications Using Lists and QMH.vi
- Read Notifications using QMH.lvproj
- Read Sync Multiple Symbols Using Lists and QMH.v
- Read Sync-Async using QMH.lvproj
- Simple Read with TypeResolving.vi
- TypeGeneration.lvproj
- Write Async with TypeResolving.vi
- Write Sync with TypeResolving.vi

Description:
ADS continuos synchronous read example using base blocks.

The client reads data synchronously and does wait for the respose from server.

No hardware chosen

□ Limit results to hardware

Likewise, you can find all examples via the *Directory Structure* at
Beckhoff Automation > Beckhoff-LabVIEW-Interface.

The examples are categorized into the communication modes [▶ 25] described at the beginning of the documentation:

- One-time reading
- One-time writing
- Reading data continuously
- Writing data continuously
- Generate LabVIEW™ type
- SumUp Read or Write
- CoE Read or Write

One-time reading

Simple Read with TypeResolving.vi

The example, like the other examples in Basic examples [▶ 102], uses the basic VIs from the LabVIEW™ VIs [▶ 40] in the following steps:

1. In the first step, the Symbol Interface [▶ 64] basic block is called. When the example is executed, the user interface opens and the user can select an ADS symbol in the TwinCAT runtime.

   - If you have already exported an XML description of your ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the Init [▶ 65] basic block is called and the ADS client is initialized.
3. The ReadGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1). In the example, *Index Array* selects the first ADS symbol in the list.
4. After initialization the polymorphic ADS-Read [▶ 66] block is called. The **Read Choice** input can be used to select which read mode is to be used. The Read Choice input is a LabVIEW™ Enum and provides the following options:
   - **Read Sync**: For this, a synchronous read request is first sent to the TwinCAT runtime and a response is waited for. The received ADS data packet is then converted from raw data to the LabVIEW™ data type "Variant" using the TypeResolver.
   - **Noti. Single**: For this, an ADS notification is registered and individual received notifications are passed on to LabVIEW™. After reading the notification, the notifications are unregistered again. The received ADS data is then converted from raw data to the LabVIEW™ data type "Variant" with the help of the TypeResolver.
   - **Noti. Buffered**: For this, an ADS notification is registered and a block of received notifications is passed on to LabVIEW™. The number of notifications buffered in the block is determined by the `LVBufferSize` symbol parameter. After reading the notifications, they are unregistered. The received ADS data is then converted from raw data to the LabVIEW™ data type "Variant" with the help of the TypeResolver.
5. **Interaction**: Variant-to-Data can be used to customize the example to translate the Variant to an appropriate data type. The data type depends on the ADS symbol selected in the Symbol Interface. See Type Resolving [▶ 37].
6. In the last step, the Release [▶ 73] basic block is called and the ADS client is released from memory.

NOTICE

Noti. Single

Noti. Single supports only the `Transmode`=OnChange

Read Async with TypeResolving.vi

The example, like the other examples in Basic examples [▶ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▶ 40] in the following steps:

1. In the first step, the Symbol Interface [▶ 64] basic block is called. When the example is executed, the user interface opens and the user can select an ADS symbol in the TwinCAT runtime.
   - If you have already exported an XML description of the ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the Init [▶ 65] basic block is called and the ADS client is initialized.
3. The ReadGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1). In the example, *Index Array* selects the first ADS symbol in the list.
4. After initialization the With TypeResolving [▶ 99] block is called. An asynchronous read request is sent to the TwinCAT runtime for this purpose. The program code continues running without waiting for feedback.
5. In this example, the Read [▶ 87] low-level block is called in a while loop, waiting for a response from the addressed ADS server. Please note that this is an illustrative example. The implementation in actual applications may differ considerably. Once feedback has been received, the received data packet is converted to the appropriate LabVIEW™ data type "Variant".
6. **Interaction**: Variant-to-Data can be used to customize the example to translate the Variant to an appropriate data type. The data type depends on the ADS symbol selected in the Symbol Interface. See Type Resolving [▶ 37].
7. The next step is to call a Read [▶ 87] low-level block and thus release the Reader from memory.
8. In the last step the Release [▶ 73] basic block is called and thus the ADS client is released from memory.

One-time writing

Write Sync with TypeResolving.vi

The example, like the other examples in Basic examples [▸ 102], uses the basic VIs from LabVIEW™ VIs [▸ 40] in the following steps:

1. In the first step, the basic Symbol Interface [▸ 64] block is called. When the example is executed, the user interface opens and the user can select an ADS symbol in the TwinCAT runtime.
   - If you have already exported an XML description of your ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the Init [▸ 65] basic block is called and the ADS client is initialized.
3. The WriteGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1). In the example, *Index Array* selects the first ADS symbol in the list.
4. **Interaction**: Insert the appropriate data type in the place marked in red. The data type depends on the ADS symbol selected in the Symbol Interface. See Data types [▸ 115].
5. After initialization, the block Write Sync Single TypeResolved [▸ 100] is called. For this purpose, the raw data is first converted from the LabVIEW™ data type to a suitable TwinCAT 3 data type and then a synchronous write request is sent to TwinCAT. The block waits for a response from the server to ensure that the data was sent successfully.
6. In the last step the Release [▸ 73] basic block is called and thus the ADS client is released from memory.

Write Async with TypeResolving.vi

The example, like the other examples in Basic examples [▸ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▸ 40] in the following steps:

1. In the first step, the basic Symbol Interface [▸ 64] block is called. When the example is executed, the user interface opens and the user can select an ADS symbol in the TwinCAT runtime.
   - If you have already exported an XML description of your ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the Init [▸ 65] basic block is called and the ADS client is initialized.
3. The WriteGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1). In the example, *Index Array* selects the first ADS symbol in the list.
4. **Interaction**: Insert the appropriate data type in the place marked in red. The data type depends on the ADS symbol selected in the Symbol Interface. See Data types [▸ 115].
5. After initialization, the block Write Async Single TypeResolved [▸ 101] is called. For this purpose, first the raw data is converted from the LabVIEW™ data type to a suitable TwinCAT 3 data type and then an asynchronous write request is sent to TwinCAT. The block does not wait for a response from the ADS server.
6. In this example the low-level block CheckWriteStatus [▸ 88] is called in a While loop and waits for a response from the requested ADS server. Please note that this is an illustrative example. The implementation in actual applications may differ considerably.
7. The next step is to call the low-level block Release Writer [▸ 89] to release the writer from memory.
8. In the last step the Release [▸ 73] basic block is called and thus the ADS client is released from memory.

Reading data continuously

The examples in this group use the polling procedure or LabVIEW™ event-based procedures to request the data packets cyclically.

Continuos Read Sync Base.vi

The example, like the other examples in Basic examples [▸ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▸ 40] in the following steps:

1. In the first step, the basic Symbol Interface [▸ 64] block is called. When the example is executed, the user interface opens and the user can select an ADS symbol in the TwinCAT runtime.
    - If you have already exported an XML description of your ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the low-level blocks Base Init [▸ 84], Get List of ReadWrite Symbols [▸ 85] and Get List of Registered Targets [▸ 84] are called to initialize the ADS client.
3. **To speed up reading and type resolving**, the ADS Reader, with the call of Init Reader [▸ 85], and the TypeResolver, with the call of Init Type [▸ 89], are initialized in advance and only once in the next step.
4. In the next step the Send Reader-Request [▸ 85] block requests a new data packet from TwinCAT with each cycle of the loop. The received data packet is converted to a suitable LabVIEW™ data type "Variant" using the call Resolve From TC Type [▸ 90].
5. **Interaction**: Variant-to-Data can be used to customize the example to translate the Variant to an appropriate data type. The data type depends on the ADS symbol selected in the Symbol Interface. See Type Resolving [▸ 37].
6. When the termination condition for the loop is reached, the ADS reader is released from memory with the call Release Reader [▸ 87] and the TypeResolver with the call Release Type [▸ 91].
7. In the last step the Release [▸ 73] basic block is called and thus the ADS client is released from memory.

Read Notification-Event Single

The example, like the other examples in Basic examples [▸ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▸ 40] in the following steps:

1. In the first step, the basic Symbol Interface [▸ 64] block is called. When the example is executed, the user interface opens and the user can select an ADS symbol in the TwinCAT runtime. When selecting, note the parameter settings of the symbols for this operation mode: E-Noti. Single.
    - If you have already exported an XML description of your ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the Init [▸ 65] basic block is called and the ADS client is initialized.
3. The ReadGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1). In the example, *Index Array* selects the first ADS symbol in the list.
4. A User Event is created and registered. See also the LabVIEW™ documentation on user events.
5. When E-Noti. Single [▸ 68] is called, an ADS notification is registered on the ADS server for the selected ADS symbol.
6. The next step is to wait for the ADS notifications in the event structure. If no notification is received, the event structure times out. Calling the block Stop Notification [▸ 78] stops the ADS notification. The stop occurs at the ADS server so that no more messages are sent.
7. **Interaction**: Type Resolving [▸ 37] is not implemented in the example. Two options are available. The Resolving type is either realized within the event loop or after the ADS notification has been completed/unregistered. The following items in the event structure are relevant: Data and TimeStamps. The latter are the ADS timestamps.
8. When the block Unregister Notification [▸ 79] is called, the ADS notification of the symbol is unregistered at the ADS server and the handle to the ADS notification is released from memory.
9. In the last step the Release [▸ 73] basic block is called and thus the ADS client is released from memory.

Read Notification-Event Buffered.vi

The example, like the other examples in Basic examples [▸ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▸ 40]. The example is identical in structure to Read Notification-Event Single [▸ 105]. The only differences are:

- The polymorphic VI is set to E-Noti. Buffered [▸ 69].
- At the Data point in the event loop an array of size `LVBufferSize` is always passed.

Read Notification-Event Multiple

The example, like the other examples in Basic examples [▶ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▶ 40]. The example is identical in structure to Read Notification-Event Buffered [▶ 105]. The only differences are:

- The polymorphic VI is set to E-Noti. Multiple Symbols [▶ 70].
- For each ADS symbol a corresponding measurement duration *ElapseTimeMs* (in milliseconds) can be selected.
- Reading from each ADS symbol requires corresponding LabVIEW™ event case.

Read Notification-LVBuffer Multiple

The example, like the other examples in Basic examples [▶ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▶ 40] in the following steps:

1. In the first step, the basic Symbol Interface [▶ 64] block is called. When the example is executed, the user interface opens and the user can select an ADS symbol in the TwinCAT runtime. When selecting, observe the parameter settings of the symbols for the operation mode LVB-Noti. Multiple Symbols.
   - If you have already exported an XML description of your ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the Init [▶ 65] basic block is called and the ADS client is initialized.
3. The ReadGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1). In the example, *Array Subset* selects the first 3 ADS symbols in the list.
4. For each selected ADS symbol, a handle to the LVBuffer is initialized with the call to Init LVBuffer Handle [▶ 79].
5. When LVB-Noti. Multiple Symbols [▶ 71] is called, ADS notifications are registered on the ADS server for the selected ADS symbols. For this purpose the block takes an array of ADS symbols as input. In addition, the duration of the individual notification can be entered in milliseconds. Thus, the notifications are automatically stopped after the time expires.
6. In the next step, the individual symbols are read in a while loop. Reading can be waited for a defined time (timeout) or infinitely long.
7. When the block Unregister Notification [▶ 79] is called, the ADS notification of the symbol is unregistered at the ADS server and the handle to the ADS notification is released from memory.
8. When the block Release LVBuffer Handle [▶ 81] is called, the handle to the LVBuffer is released from memory.
9. In the last step the Release [▶ 73] basic block is called and thus the ADS client is released from memory.

Read Notification-LVBuffer Single

The example, like the other examples in Basic examples [▶ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▶ 40] in the following steps:

1. In the first step, the basic Symbol Interface [▶ 64] block is called. When the example is executed, the user interface opens and the user can select an ADS symbol in the TwinCAT runtime. When selecting, observe the parameter settings of the symbols for the operation mode LVB-Noti. Single Symbol.
   - If you have already exported an XML description of your ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the Init [▶ 65] basic block is called and the ADS client is initialized.
3. The ReadGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1). In the example, *Index Array* selects the first ADS symbol in the list.
4. A handle to the LVBuffer is initialized for the selected ADS symbol, with the call of Init LVBuffer Handle [▶ 79].
5. When LVB-Noti. Single Symbol [▶ 70] is called, ADS notifications are registered on the ADS server for the selected ADS symbol. In addition, the block allows to enter a measurement duration in milliseconds. Thus, the notifications are automatically stopped after the time expires.

6. In the next step, the selected symbol can be read in a while loop. Reading can be waited for a defined time (timeout) or infinitely long. It is important to consider whether the ADS notifications are sent Cyclic or OnChange from the server.
7. When the block Unregister Notification [▸ 79] is called, the ADS notification of the symbol is unregistered at the ADS server and the handle to the ADS notification is released from memory.
8. When the block Release LVBuffer Handle [▸ 81] is called, the handle to the LVBuffer is released from memory.
9. In the last step the Release [▸ 73] basic block is called and thus the ADS client is released from memory.

Writing data continuously

Continuos Write Sync Base.vi

The example, like the other examples in Basic examples [▸ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▸ 40] in the following steps:

1. In the first step, the basic Symbol Interface [▸ 64] block is called. When the example is executed, the user interface opens and the user can select an ADS symbol in the TwinCAT runtime.
    - If you have already exported an XML description of your ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the Init [▸ 65] basic block is called and the ADS client is initialized.
3. The WriteGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1). In the example, *Index Array* selects the first ADS symbol in the list.
4. To speed up writing and type resolving, the ADS Writer, with the call of Init Writer [▸ 87], and the TypeResolver, with the call of Init Type [▸ 89], are initialized in advance and only once in the next step.
5. In the next step the Send Writer-Request [▸ 88] block sends a new data packet to TwinCAT with each cycle of the loop. Before writing, the LabVIEW™ data type Variant is converted to a suitable TwinCAT 3 data type by calling Resolve To TC Type [▸ 90] block.
6. After reaching the termination condition of the loop, the ADS reader is released from memory by calling Release Writer [▸ 89] and the TypeResolver by calling Release Type [▸ 91].
7. In the last step, the Release [▸ 73] basic block is called and the ADS client is released from memory.

Generate LabVIEW™ type

To automatically generate a LabVIEW™ data type to an ADS symbol, the TypeResolver [▸ 89] and the Generate Type [▸ 76] wrapper block are used. The following examples describe two different ways to implement this:

- Generate Type using Symbol Interface or Symbol's file
- Generate Type using TypeInfo file

Generate Type using Symbol Interface or Symbol's file

The example, like the other examples in Basic examples [▸ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▸ 40] in the following steps:

1. In the first step, the basic Symbol Interface [▸ 64] block is called. When the example is executed, the user interface opens and the user can select an ADS symbol in the TwinCAT runtime.
    - If you have already exported an XML description of your ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the Init [▸ 65] basic block is called and the ADS client is initialized.
3. The ReadGrpSymbols and WriteGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1).
4. In a For loop is executed:

  - TypeResolver: With Init Type [▶ 89] the type description is loaded in the TypeResolver and passed to the LabVIEW™ process as XML string (**TypeInfo**).
  - TypeGenerator: Calling the Generate Type [▶ 76] Wrapper VI generates a LabVIEW™ type.
  - Release-Type: Releases the handle to the TypeResolver from memory.

5. Releases the handle to the client.

Generate Type using TypeInfo file

In contrast to Generate Type using Symbol Interface or Symbol's file [▶ 107], the example uses a pre-generated **TypeInfo** file to generate a LabVIEW™ type.

SumUp Read or Write

Read SumUp with TypeResolving.vi

The example, like the other examples in Basic examples [▶ 102], uses the basic VIs from the LabVIEW™ VIs [▶ 40] in the following steps:

1. In the first step, the Symbol Interface [▶ 64] basic block is called. When the example is executed, the user interface opens and the user can select an ADS symbol from his TwinCAT runtime.
   - If you have already exported an XML description of your ADS symbols from the Symbol Interface, you can also select the exported file in the Front Panel before starting the VI, so that the XML is loaded rather than calling the UI.
2. In the second step, the Init [▶ 65] basic block is called and the ADS client is initialized.
3. The ReadGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1). In the example, *Index Array* selects the first and second ADS symbols of the list.
4. After initialization of the ADS client, the TypeResolvers [▶ 37] are initialized with the selected symbols.
5. After that the SumUp handle is initialized for reading with the help of Init SumUp [▶ 96]. Here the flag *bAutosend* is set to true so that new data is read automatically.
6. The Add Request block assembles the SumUp sub-commands.
7. After that, the example splits into two different threads:
   - **Loop 1**: Reads cyclically the new data one after the other from the sub-commands. The read data is converted to corresponding LabVIEW™ data types using the initialized TypeResolver.
   - **Loop 2:** Enables or disables the automatic sending of ADS requests.
8. In the last step, all initialized handles are released from memory.

NOTICE

ADS error message when reading symbols with bAutosend set to false

ADS error messages may occur in Loop 1 if the flag *bAutosend* is set to false when initializing the SumUp handle. In this case, the block **Get Data** starts reading the data from the sub-commands even though they have not yet been sent to the ADS server and therefore do not contain any data.

Write SumUp with TypeResolving.vi

The example, like the other examples in Basic examples [▶ 102], uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▶ 40] in the following steps:

1. In the first step, the basic Symbol Interface [▶ 64] block is called. When the example is executed, the user interface opens and the user can select an ADS symbol from his TwinCAT runtime.
   - If you have already exported an XML description of the ADS symbols from the Symbol Interface, you can select it as a path so that the XML is loaded rather than calling the UI.
2. In the second step, the basic Init [▶ 65] block is called and the ADS client is initialized.
3. The WriteGrpSymbols output may contain more than one ADS symbol (if you selected more than one symbol in step 1). In the example two ADS symbols of the types timestamp and string are expected. With *Index Array* the first and the second ADS symbol of the list are selected.

4. After initialization, the TypeResolvers [▸ 37] are initialized to the selected symbols. Then it is checked whether the first symbol has the timestamp data type and the second has the string data type.
5. After that the SumUp handle is initialized for writing with the help of Init SumUp [▸ 96]. Here the flag *bAutosend* is set to false so that the new data is not written automatically.
6. After that, the example splits into two different threads:
    - **Loop 1**: Waits in an event structure for new data generated by Loop 2. The new data is distributed to the appropriate sub-commands and waited to be sent. Before that the raw data is transformed into a TwinCAT 3 data type. If the sub-command already contains data, these are replaced by the new data. In the event structure, automatic sending can be enabled or disabled.
    - **Loop 2:** Generates the block diagram events in a cycle of 250 ms.
7. In the last step, all initialized handles are released from memory.

CoE Read or Write

The example, like the other examples in this chapter, uses the basic VIs and the low-level VIs from LabVIEW™ VIs [▸ 40] in the following steps:

1. In the first step, the basic Init [▸ 65] block is called up with an empty character string and the ADS client is initialized.
2. The CoE blocks [▸ 81] expect the AMS address as a string of the EtherCAT device from which the CoE configuration is to be read. The Device Address control element expects a character string with the following format: AMS Net-Id of the master and AMS Port of the device (AMS NetId:Port).

If the control element is left empty, the example opens a dialog box for selecting an EtherCAT device.

1. The example reads the CoE list from the EtherCAT device.
2. **Interaction**:
    - Double-click on an object in the CoE list to select it and read the object description. This calls up the low-level VI.
    - An entry with a subindex can be read using the **Check Entry** button.
    - In the next step, various CoE entries can be read or written.
3. In the last step, the client handle is released from the memory.

8.2 Application example

The TwinCAT Solution and the corresponding VI (for x86 and x64 LabVIEW™ bit version) can be downloaded here: https://infosys.beckhoff.com/content/1033/TF3710_TC3_Interface_for_LabVIEW/Resources/10083995531/.zip.

The VIs are currently compiled with LabVIEW™ 2017 and can be used for subsequent LabVIEW™ versions (2018, 2019, 2020, 2021, 2022) as well.

Description of the example

TwinCAT: The TwinCAT project generates signals in the PLC via signal generator function blocks (sine, amplitude modulated signal, triangle signal, ...). The PLC runs with a cycle time of 5 ms. The signal generator generates 10 values per cycle for the generated signals. Accordingly, an oversampling of 10 is simulated here with the Beckhoff measurement terminals.

LabVIEW™: The LabVIEW™ project uses the Basic examples [▸ 105] example to read the ADS notifications as LabVIEW™ events. Two while loops are used in parallel.

1. The first while loop receives the ADS notifications and converts the raw ADS data to an appropriate LabVIEW™ data type "Variant" using the TypeResolver. The converted raw data is then inserted into a queue.
2. The second while loop reads the elements from the queue and uses the "Variant to Data" block to finally display the data in a graph. The received data and the ADS timestamps are displayed in two different graphs.

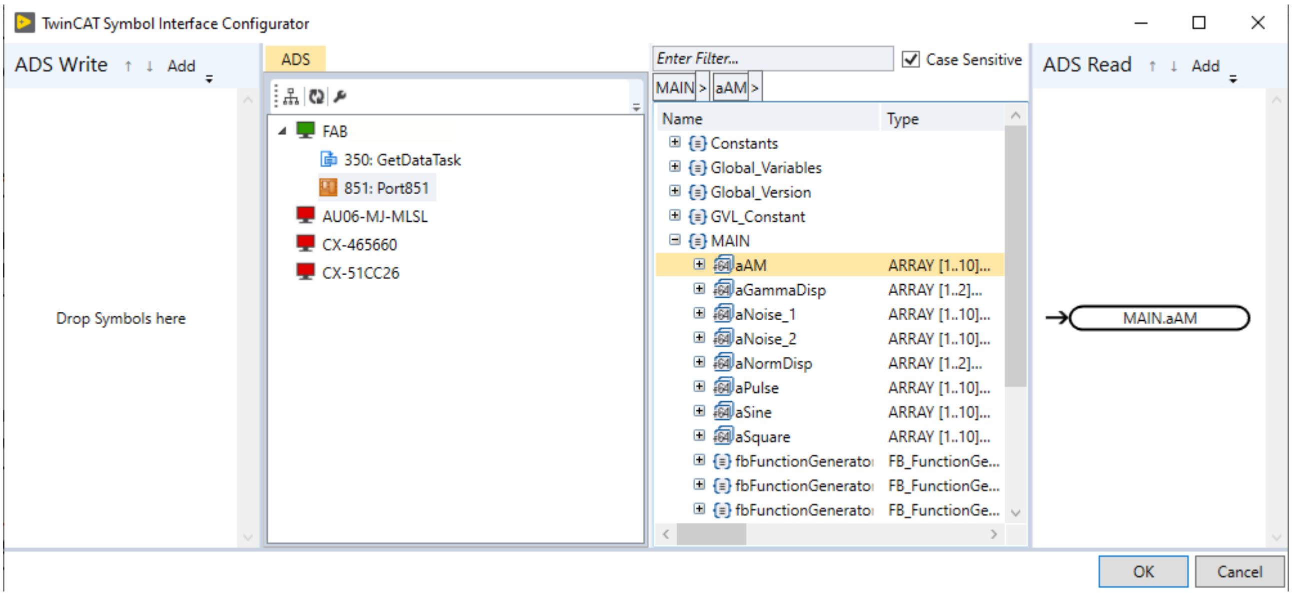
Opening and starting the example

The example contains a TC3 folder and a LabVIEW folder. In the TC3 folder there is a tnzip, which you can open with TwinCAT 3 via **File > Open > Open Solution From Archive** and then save as TwinCAT Solution on your PC.

You can start the TwinCAT Solution with *activate configuration* on the target system of your choice. Make sure that a TF3710 license is available on your target system. If you do not have a valid license, you can create a 7-day trial license.

If your TwinCAT runtime is active, you can display the generated signals in TwinCAT with the TC3 Scope. Depending on the selected target system, you only have to select your target system in the properties under **TC Signals > DataPool > aAM** (aNoise_1, aNoise_2, aSine).

In the LabVIEW folder select either 32bit (x86) or 64bit (x64) and open the VI contained in it. When you start the program the interface icon opens. Navigate to your target system and select one of the signals.



Name	Type
Constants	
Global_Variables	
Global_Version	
GVL_Constant	
MAIN	
aAM	ARRAY [1..10]...
aGammaDisp	ARRAY [1..2]...
aNoise_1	ARRAY [1..10]...
aNoise_2	ARRAY [1..10]...
aNormDisp	ARRAY [1..2]...
aPulse	ARRAY [1..10]...
aSine	ARRAY [1..10]...
aSquare	ARRAY [1..10]...
fbFunctionGenerato	FB_FunctionGe...
fbFunctionGenerato	FB_FunctionGe...
fbFunctionGenerato	FB_FunctionGe...

9 Appendix

9.1 Overview of error codes

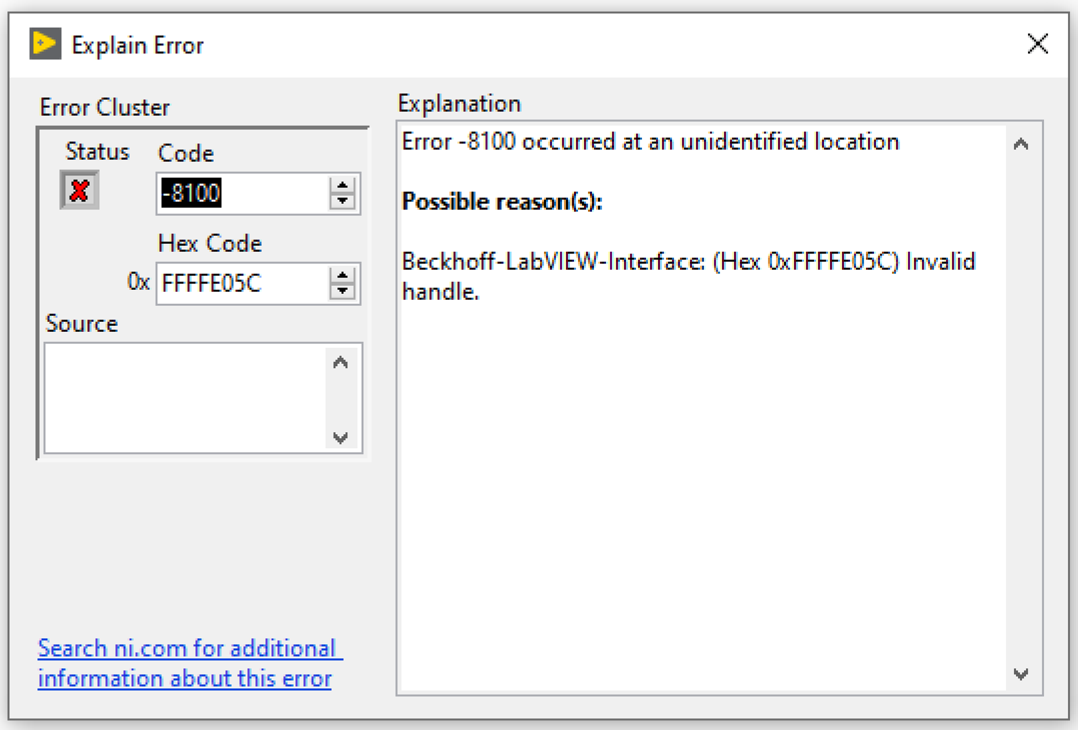
Error checking in the TF3710 TwinCAT 3 interface for LabVIEW™ product follows the standard LabVIEW™ data flow model. During the execution of LabVIEW™ VIs [▶ 40], error checking takes place at each executed node. The blocks only continue if no errors occur. If an error occurs in a block, it is passed to the next block and the affected part of the function or the block is no longer executed accordingly.

The LabVIEW™ error clusters are used for error checking, which then forwards the following information accordingly:

- Status: a Boolean value that returns TRUE if an error occurred.
- Error code: an error identifier in the form of a signed 32-bit integer. If the error code is not 0 and the status output is FALSE, it is a warning rather than an error.
- Source: specifies the source of the error in the form of a LabVIEW™ string.

The description of the error code can be found in LabVIEW™

Menu > Help > Describe Error.



Code: -8100

Hex Code: 0x FFFFE05C

Error -8100 occurred at an unidentified location

Possible reason(s):

Beckhoff-LabVIEW-Interface: (Hex 0xFFFFE05C) Invalid handle.

To avoid collision with existing LabVIEW™ errors, all error codes are described in user-defined error codes. The following error codes may occur when running LabVIEW™ VIs [▶ 40].

error value	See…
16#FFFF_DE04 - 16#FFFF_DCD9	Listed in ADS Return Codes (there without high-order WORD). Further information below on this page.
16#0000_1414 - 16#0000_1432	Listed in Support Return Codes [▶ 119].
16#0000_1464 - 16#0000_157C 16#FFFF_E05C – 16xFFFF_DFF9	Listed in Runtime Return Codes [▶ 116].

If an error occurs during initialization, the function block cannot be used.

Further information on standard TwinCAT Error Codes:

error value	symbol	Error description	Remedy option
16#FFFF_DDFA	NOMEMORY	No memory	Incorrect memory settings => Increase router memory.
16#FFFF_DDEB	TIMEOUT	Device has a timeout	A timeout can occur while waiting for feedback or sending a request. This can often be the case if the network is overloaded. With One-time reading [▸ 28] or One-time writing [▸ 30] the timeout is not so critical, because here the data packet is read or written in one pass.

9.2 ADS Return Codes

Grouping of error codes: ADS Return Codes [▸ 113], ADS Return Codes [▸ 112], ADS Return Codes [▸ 112], ADS Return Codes [▸ 115], ADS Return Codes [▸ 115]...

Global error codes

Hex	Dec	Name	Description
0xFFFFE504	-6908	ERR_NOERROR	No error.
0xFFFFE503	-6909	ERR_INTERNAL	Internal error.
0xFFFFE502	-6910	ERR_NORTIME	No real-time.
0xFFFFE501	-6911	ERR_ALLOCLOCKEDMEM	Allocation locked – memory error.
0xFFFFE500	-6912	ERR_INSERTMAILBOX	Mailbox full – the ADS message could not be sent. Reducing the number of ADS messages per cycle will help.
0xFFFFE4FF	-6913	ERR_WRONGRECEIVEHMSG	Wrong HMSG.
0xFFFFE4FE	-6914	ERR_TARGETPORTNOTFOUND	Target port not found – ADS server is not started or is not reachable.
0xFFFFE4FD	-6915	ERR_TARGETMACHINENOTFOUND	Target computer not found – AMS route was not found.
0xFFFFE4FC	-6916	ERR_UNKNOWNCMDID	Unknown command ID.
0xFFFFE4FB	-6917	ERR_BADTASKID	Invalid task ID.
0xFFFFE4FA	-6918	ERR_NOIO	No IO.
0xFFFFE4F9	-6919	ERR_UNKNOWNAMSCMD	Unknown AMS command.
0xFFFFE4F8	-6920	ERR_WIN32ERROR	Win32 error.
0xFFFFE4F7	-6921	ERR_PORTNOTCONNECTED	Port not connected.
0xFFFFE4F6	-6922	ERR_INVALIDAMSLENGTH	Invalid AMS length.
0xFFFFE4F5	-6923	ERR_INVALIDAMSNETID	Invalid AMS Net ID.
0xFFFFE4F4	-6924	ERR_LOWINSTLEVEL	Installation level is too low –TwinCAT 2 license error.
0xFFFFE4F3	-6925	ERR_NODEBUGINTAVAILABLE	No debugging available.
0xFFFFE4F2	-6926	ERR_PORTDISABLED	Port disabled – TwinCAT system service not started.
0xFFFFE4F1	-6927	ERR_PORTALREADYCONNECTED	Port already connected.
0xFFFFE4F0	-6928	ERR_AMSSYNC_W32ERROR	AMS Sync Win32 error.
0xFFFFE4EF	-6929	ERR_AMSSYNC_TIMEOUT	AMS Sync Timeout.
0xFFFFE4EE	-6930	ERR_AMSSYNC_AMSERROR	AMS Sync error.
0xFFFFE4ED	-6931	ERR_AMSSYNC_NOINDEXINMAP	No index map for AMS Sync available.
0xFFFFE4EC	-6932	ERR_INVALIDAMSPORT	Invalid AMS port.
0xFFFFE4EB	-6933	ERR_NOMEMORY	No memory.
0xFFFFE4EA	-6934	ERR_TCPSEND	TCP send error.
0xFFFFE4E9	-6935	ERR_HOSTUNREACHABLE	Host unreachable.
0xFFFFE4E8	-6936	ERR_INVALIDAMSFRAGMENT	Invalid AMS fragment.
0xFFFFE4E7	-6937	ERR_TLSSEND	TLS send error – secure ADS connection failed.
0xFFFFE4E6	-6938	ERR_ACCESSDENIED	Access denied – secure ADS access denied.

Router error codes

Hex	Dec	Name	Description
0xFFFFE004	-8188	ROUTERERR_NOLOCKEDMEMORY	Locked memory cannot be allocated.
0xFFFFE003	-8189	ROUTERERR_RESIZEMEMORY	The router memory size could not be changed.
0xFFFFE002	-8190	ROUTERERR_MAILBOXFULL	The mailbox has reached the maximum number of possible messages.
0xFFFFE001	-8191	ROUTERERR_DEBUGBOXFULL	The Debug mailbox has reached the maximum number of possible messages.
0xFFFFE000	-8192	ROUTERERR_UNKNOWNPORTTYPE	The port type is unknown.
0xFFFFDEEF	-8193	ROUTERERR_NOTINITIALIZED	The router is not initialized.
0xFFFFDFFE	-8194	ROUTERERR_PORTALREADYINUSE	The port number is already assigned.
0xFFFFDFFD	-8195	ROUTERERR_NOTREGISTERED	The port is not registered.
0xFFFFDFFC	-8196	ROUTERERR_NOMOREQUEUES	The maximum number of ports has been reached.
0xFFFFDFFB	-8197	ROUTERERR_INVALIDPORT	The port is invalid.
0xFFFFDFFA	-8198	ROUTERERR_NOTACTIVATED	The router is not active.
0xFFFFDFF9	-8199	ROUTERERR_FRAGMENTBOXFULL	The mailbox has reached the maximum number for fragmented messages.
0xFFFFDFF8	-8200	ROUTERERR_FRAGMENTTIMEOUT	A fragment timeout has occurred.
0xFFFFDFF7	-8201	ROUTERERR_TOBEREMOVED	The port is removed.

General ADS error codes

Hex	Dec	Name	Description
0xFFFFDE04	-8700	ADSERR_DEVICE_ERROR	General device error.
0xFFFFDE03	-8701	ADSERR_DEVICE_SRVNOTSUPP	Service is not supported by the server.
0xFFFFDE02	-8702	ADSERR_DEVICE_INVALIDGRP	Invalid index group.
0xFFFFDE01	-8703	ADSERR_DEVICE_INVALIDOFFSET	Invalid index offset.
0xFFFFDE00	-8704	ADSERR_DEVICE_INVALIDACCESS	Reading or writing not permitted.
0xFFFFDDFF	-8705	ADSERR_DEVICE_INVALIDSIZE	Parameter size not correct.
0xFFFFDDFE	-8706	ADSERR_DEVICE_INVALIDDATA	Invalid data values.
0xFFFFDDFD	-8707	ADSERR_DEVICE_NOTREADY	Device is not ready to operate.
0xFFFFDDFC	-8708	ADSERR_DEVICE_BUSY	Device is busy.
0xFFFFDDFB	-8709	ADSERR_DEVICE_INVALIDCONTEXT	Invalid operating system context. This can result from use of ADS function blocks in different tasks. It may be possible to resolve this through multitasking synchronization in the PLC.
0xFFFFDDFA	-8710	ADSERR_DEVICE_NOMEMORY	Insufficient memory.
0xFFFFDDF9	-8711	ADSERR_DEVICE_INVALIDPARM	Invalid parameter values.
0xFFFFDDF8	-8712	ADSERR_DEVICE_NOTFOUND	Not found (files, ...).
0xFFFFDDF7	-8713	ADSERR_DEVICE_SYNTAX	Syntax error in file or command.
0xFFFFDDF6	-8714	ADSERR_DEVICE_INCOMPATIBLE	Objects do not match.
0xFFFFDDF5	-8715	ADSERR_DEVICE_EXISTS	Object already exists.
0xFFFFDDF4	-8716	ADSERR_DEVICE_SYMBOLNOTFOUND	Symbol not found.
0xFFFFDDF3	-8717	ADSERR_DEVICE_SYMBOLVERSIONINVALID	Invalid symbol version. This can occur due to an online change. Create a new handle.
0xFFFFDDF2	-8718	ADSERR_DEVICE_INVALIDSTATE	Device (server) is in invalid state.
0xFFFFDDF1	-8719	ADSERR_DEVICE_TRANSMODENOTSUPP	AdsTransMode not supported.
0xFFFFDDF0	-8720	ADSERR_DEVICE_NOTIFYHNDINVALID	Notification handle is invalid.
0xFFFFDDEF	-8721	ADSERR_DEVICE_CLIENTUNKNOWN	Notification client not registered.
0xFFFFDDEE	-8722	ADSERR_DEVICE_NOMOREHDLS	No further notification handle available.
0xFFFFDDED	-8723	ADSERR_DEVICE_INVALIDWATCHSIZE	Notification size too large.
0xFFFFDDEC	-8724	ADSERR_DEVICE_NOTINIT	Device not initialized.
0xFFFFDDEB	-8725	ADSERR_DEVICE_TIMEOUT	Device has a timeout.
0xFFFFDDEA	-8726	ADSERR_DEVICE_NOINTERFACE	Interface query failed.
0xFFFFDDE9	-8727	ADSERR_DEVICE_INVALIDINTERFACE	Wrong interface requested.
0xFFFFDDE8	-8728	ADSERR_DEVICE_INVALIDCLSID	Class ID is invalid.

Hex	Dec	Name	Description
0xFFFFDDE7	-8729	ADSERR_DEVICE_INVALIDOBJID	Object ID is invalid.
0xFFFFDDE6	-8730	ADSERR_DEVICE_PENDING	Request pending.
0xFFFFDDE5	-8731	ADSERR_DEVICE_ABORTED	Request is aborted.
0xFFFFDDE4	-8732	ADSERR_DEVICE_WARNING	Signal warning.
0xFFFFDDE3	-8733	ADSERR_DEVICE_INVALIDARRAYIDX	Invalid array index.
0xFFFFDDE2	-8734	ADSERR_DEVICE_SYMBOLNOTACTIVE	Symbol not active.
0xFFFFDDE1	-8735	ADSERR_DEVICE_ACCESSDENIED	Access denied.
0xFFFFDDE0	-8736	ADSERR_DEVICE_LICENSENOTFOUND	Missing license.
0xFFFFDDDF	-8737	ADSERR_DEVICE_LICENSEEXPIRED	License expired.
0xFFFFDDDE	-8738	ADSERR_DEVICE_LICENSEEXCEEDED	License exceeded.
0xFFFFDDDD	-8739	ADSERR_DEVICE_LICENSEINVALID	Invalid license.
0xFFFFDDDC	-8740	ADSERR_DEVICE_LICENSESYSTEMID	License problem: System ID is invalid.
0xFFFFDDDB	-8741	ADSERR_DEVICE_LICENSENOTIMELIMIT	License not limited in time.
0xFFFFDDDA	-8742	ADSERR_DEVICE_LICENSEFUTUREISSUE	License problem: Time in the future.
0xFFFFDDD9	-8743	ADSERR_DEVICE_LICENSETIMETOLONG	License period too long.
0xFFFFDDD8	-8744	ADSERR_DEVICE_EXCEPTION	Exception at system startup.
0xFFFFDDD7	-8745	ADSERR_DEVICE_LICENSEDUPLICATED	License file read twice.
0xFFFFDDD6	-8746	ADSERR_DEVICE_SIGNATUREINVALID	Invalid signature.
0xFFFFDDD5	-8747	ADSERR_DEVICE_CERTIFICATEINVALID	Invalid certificate.
0xFFFFDDD4	-8748	ADSERR_DEVICE_LICENSEOEMNOTFOUND	Public key not known from OEM.
0xFFFFDDD3	-8749	ADSERR_DEVICE_LICENSERESTRICTED	License not valid for this system ID.
0xFFFFDDD2	-8750	ADSERR_DEVICE_LICENSEDEMODENIED	Demo license prohibited.
0xFFFFDDD1	-8751	ADSERR_DEVICE_INVALIDFNCID	Invalid function ID.
0xFFFFDDD0	-8752	ADSERR_DEVICE_OUTOFRANGE	Outside the valid range.
0xFFFFDDCF	-8753	ADSERR_DEVICE_INVALIDALIGNMENT	Invalid alignment.
0xFFFFDDCE	-8754	ADSERR_DEVICE_LICENSEPLATFORM	Invalid platform level.
0xFFFFDDCD	-8755	ADSERR_DEVICE_FORWARD_PL	Context – forward to passive level.
0xFFFFDDCC	-8756	ADSERR_DEVICE_FORWARD_DL	Context – forward to dispatch level.
0xFFFFDDCB	-8757	ADSERR_DEVICE_FORWARD_RT	Context – forward to real-time.
0xFFFFDDC4	-8764	ADSERR_CLIENT_ERROR	Client error.
0xFFFFDDC3	-8765	ADSERR_CLIENT_INVALIDPARM	Service contains an invalid parameter.
0xFFFFDDC2	-8766	ADSERR_CLIENT_LISTEMPTY	Polling list is empty.
0xFFFFDDC1	-8767	ADSERR_CLIENT_VARUSED	Var connection already in use.
0xFFFFDDC0	-8768	ADSERR_CLIENT_DUPLINVOKEID	The called ID is already in use.
0xFFFFDDBF	-8769	ADSERR_CLIENT_SYNCTIMEOUT	Timeout has occurred – the remote terminal is not responding in the specified ADS timeout. The route setting of the remote terminal may be configured incorrectly.
0xFFFFDDBE	-8770	ADSERR_CLIENT_W32ERROR	Error in Win32 subsystem.
0xFFFFDDBD	-8771	ADSERR_CLIENT_TIMEOUTINVALID	Invalid client timeout value.
0xFFFFDDBC	-8772	ADSERR_CLIENT_PORTNOTOPEN	Port not open.
0xFFFFDDBB	-8773	ADSERR_CLIENT_NOAMSADDR	No AMS address.
0xFFFFDDB4	-8780	ADSERR_CLIENT_SYNCINTERNAL	Internal error in Ads sync.
0xFFFFDDB3	-8781	ADSERR_CLIENT_ADDHASH	Hash table overflow.
0xFFFFDDB2	-8782	ADSERR_CLIENT_REMOVEHASH	Key not found in the table.
0xFFFFDDB1	-8783	ADSERR_CLIENT_NOMORESYM	No symbols in the cache.
0xFFFFDDB0	-8784	ADSERR_CLIENT_SYNCRESINVALID	Invalid response received.
0xFFFFDDAF	-8785	ADSERR_CLIENT_SYNCPORTLOCKED	Sync Port is locked.

RTime error codes

Hex	Dec	Name	Description
0xFFFFD504	-11004	RTERR_INTERNAL	Internal error in the real-time system.
0xFFFDD503	-11005	RTERR_BADTIMERPERIODS	Timer value is not valid.
0xFFFFD502	-11006	RTERR_INVALIDTASKPTR	Task pointer has the invalid value 0 (zero).
0xFFFFD501	-11007	RTERR_INVALIDSTACKPTR	Stack pointer has the invalid value 0 (zero).
0xFFFFD500	-11008	RTERR_PRIOEXISTS	The request task priority is already assigned.
0xFFFFD4FF	-11009	RTERR_NOMORETCB	No free TCB (Task Control Block) available. The maximum number of TCBs is 64.
0xFFFFD4FE	-11010	RTERR_NOMORESEMAS	No free semaphores available. The maximum number of semaphores is 64.
0xFFFFD4FD	-11011	RTERR_NOMOREQUEUES	No free space available in the queue. The maximum number of positions in the queue is 64.
0xFFFFD4FC	-11012	RTERR_EXTIRQALREADYDEF	An external synchronization interrupt is already applied.
0xFFFFD4FB	-11013	RTERR_EXTIRQNOTDEF	No external sync interrupt applied.
0xFFFFD4FA	-11014	RTERR_EXTIRQINSTALLFAILED	Application of the external synchronization interrupt has failed.
0xFFFFD4F9	-11015	RTERR_IRQLNOTLESSOREQUAL	Call of a service function in the wrong context
0xFFFFD4F8	-11016	RTERR_VMXNOTSUPPORTED	Intel VT-x extension is not supported.
0xFFFFD4F7	-11017	RTERR_VMXDISABLED	Intel VT-x extension is not enabled in the BIOS.
0xFFFFD4F6	-11018	RTERR_VMXCONTROLSMISSING	Missing function in Intel VT-x extension.
0xFFFFD4F5	-11019	RTERR_VMXENABLEFAILS	Activation of Intel VT-x fails.

TCP Winsock error codes

Hex	Dec	Name	Description
0xFFFFBDB8	-16968	WSAETIMEDOUT	A connection timeout has occurred - error while establishing the connection, because the remote terminal did not respond properly after a certain period of time, or the established connection could not be maintained because the connected host did not respond.
0xFFFFBDB7	-16969	WSAECONNREFUSED	Connection refused - no connection could be established because the target computer has explicitly rejected it. This error usually results from an attempt to connect to a service that is inactive on the external host, that is, a service for which no server application is running.
0xFFFFBDB6	-16970	WSAEHOSTUNREACH	No route to host - a socket operation referred to an unavailable host.
More Winsock error codes: Win32 error codes			

9.3 Data types

TwinCAT data type	Memory requirement	LabVIEW™ data type
BIT	1 bit	LabVIEW™ Boolean
BOOL	8 bits	LabVIEW™ Boolean
BYTE/USINT	8 bits	LabVIEW™ U8
WORD/UINT	16 bits	LabVIEW™ U16
DWORD/UDINT	32 bits	LabVIEW™ U32
ULINT	64 bits	LabVIEW™ U64
SINT	8 bits	LabVIEW™ I8
INT	16 bits	LabVIEW™ I16
DINT	32 bits	LabVIEW™ I32
LINT	64 bits	LabVIEW™ I64
REAL	32 bits	LabVIEW™ Single (sgl)
LREAL	64 bits	LabVIEW™ Double (dbl)
String	-	LabVIEW™ String
TIME	-	LabVIEW™ Timestamp
DATE	-	LabVIEW™ Timestamp
TOD/ TIME_OF_DAY	-	LabVIEW™ Timestamp

TwinCAT data type	Memory requirement	LabVIEW™ data type
DT/DATE_AND_TIME	-	LabVIEW™ Timestamp
DCTIME	-	LabVIEW™ Timestamp
FILETIME	-	LabVIEW™ Timestamp
LTIME	-	LabVIEW™ Timestamp
ARRAY	-	LabVIEW™ ARRAY
STRUCT	-	LabVIEW™ Cluster
Enum	16 bits (Default)	LabVIEW™ Enum

9.4 Runtime Return Codes

Errors that occur during: initialization of the ADS client; establishing the connection; sending requests or receiving data packets; converting the LabVIEW™ data type to TC3 data type or vice versa are described as runtime errors.

error value	symbol	Error description	Remedy option
16#00001464	5220	TF3710_ERR_E_POINTER	Invalid pointer 0 (null).
16#00001465	5221	TF3710_ERR_E_OUT_OF_RANGE	The value is not in the range
16#00001466	5222	TF3710_ERR_E_INVALID_ARG	The parameters are invalid
16#00001467	5223	TF3710_ERR_E_OUT_OF_MEMORY	The memory is full
16#00001468	5224	TF3710_ERR_E_NOT_A_NUMBER	Is not a number
16#00001469	5225	TF3710_ERR_E_BAD_ALLOCATION	Wrong allocation
16#0000146A	5226	TF3710_ERR_E_NOT_A_STRING	Is not a string
16#0000146B	5227	TF3710_ERR_E_UNINITIALIZED_TIMESTAMP	Timestamp is not initialized
16#0000146D	5229	TF3710_ERR_E_CONFIGURATION_NON_EXISTENT	The configuration was not found
16#0000146E	5230	TF3710_ERR_E_FLOATING_OBJECT	Floating/Non-saved object (VI, Project, ...)
16#0000146F	5231	TF3710_ERR_E_INVALID_CONFIGURATION	The configuration is incorrect
16#0000146C	5228	TF3710_ERR_E_LOCKFAILED	Lock has failed
16#00001479	5241	TF3710_ERR_FAILED_WAIT_ON_A_REQUEST	Waiting for the request has failed
16#00001483	5251	TF3710_ERR_INVALID_PORT_GROUP	Invalid ADS port type
16#00001484	5252	TF3710_ERR_NEW_NODE_FAILED	The new node has failed
16#00001485	5253	TF3710_ERR_APPEND_BUFFER_FAILED	Writing to the node has failed
16#00001486	5254	TF3710_ERR_MISSING_NODE	Node missing
16#00001487	5255	TF3710_ERR_PARSE_ERROR	Parsing has failed
16#0000148D	5261	TF3710_ERR_PORT_ALREADY_EXIST	ADS port is still present

error value	symbol	Error description	Remedy option
16#0000148E	5262	TF3710_ERR_PORT_OPEN_FAILED	Opening the ADS port has failed
16#0000148F	5263	TF3710_ERR_INVALID_TARGET_ID	AmsNetID of the target system is invalid
16#00001490	5264	TF3710_ERR_UNDEFINED_TARGET_PORT	ADS port of the target system is invalid
16#00001491	5265	TF3710_ERR_CONNECTION_FAILED	Failed to connect to the router
16#00001492	5266	TF3710_ERR_NO_PORT_OPENED	Port is not open
16#00001493	5267	TF3710_ERR_DISCONNECT_FAILED	Disconnect from router has failed
16#00001494	5268	TF3710_ERR_READ_STATE_REQUEST_FAILED	Read state request has failed
16#00001495	5269	TF3710_ERR_VARHANDLE_FAILED	Loading var handler has failed
16#00001496	5270	TF3710_ERR_VARHANDLE_ALREADY_EXIST	Var handler is already present
16#00001497	5271	TF3710_ERR_VARHANDLE_RELEASE_FAILED	Releasing var handler has failed
16#00001498	5272	TF3710_ERR_VARHANDLE_ALREADY_RELEASED	Var handler has already been released
16#00001499	5273	TF3710_ERR_INVALID_VAR_HANDLER	Var handler is invalid
16#0000149A	5274	TF3710_ERR_MISSING_ROUTE	ADS route is not available
16#0000149B	5275	TF3710_ERR_CONNECTION_ALREADY_EXISTS	The connection is already established
16#000014A6	5286	TF3710_ERR_EMPTY_SYMBOL_TABLE	Currently no symbols available in table
16#000014A7	5287	TF3710_ERR_MISSING_TARGETS	Target systems are missing
16#000014A8	5288	TF3710_ERR_TYPESYSTEM_PROVIDER_FAILED	The TypeSystem provider has failed
16#000014A9	5289	TF3710_ERR_TYPERESOLVERPROXY_FAILED	The TypeResolverProxy has failed
16#000014AA	5290	TF3710_ERR_TYPERESOLVERPROXY_LOAD_GUID_FAILED	Loading of TC-GUID has failed.
16#000014AB	5291	TF3710_ERR_TYPERESOLVERPROXY_LOAD_TYPE_COLLECTION_FAILED	Loading of TypeCollection has failed.
16#000014AC	5292	TF3710_ERR_TYPERESOLVERPROXY_SYMBOL_GUID_ERROR	GUID is invalid
16#000014AD	5293	TF3710_ERR_LVTYPEDESCRIPTOR_INVALID_ELEMENT_RANGE	Number of elements in the TypeResolver do not match.
16#000014AE	5294	TF3710_ERR_LVTYPEDESCRIPTOR_TYPE_NOT_SUPPORTED	Data type is not currently supported
16#000014AF	5295	TF3710_ERR_LVTYPEDESCRIPTOR_INVALID_ARRAY_SYMBOLINFO	Elements are missing in the array data type

error value	symbol	Error description	Remedy option
16#000014B0	5296	TF3710_ERR_LVTYPEDESCRIPTOR_MISSING_ARRAY_SYMBOLINFO_ELEMENTS	Symbol info for array data type is invalid
16#000014B1	5297	TF3710_ERR_LVTYPEDESCRIPTOR_MISSING_ARRAY_BASE_TYPE	Array data type has no base type
16#000014B2	5298	TF3710_ERR_LVTYPEDESCRIPTOR_LOAD_FAILDED	Loading of TypeResolver has failed
16#000014B3	5299	TF3710_ERR_LVTYPEDESCRIPTOR_INVALID_PRIMARY_TYPE	The primary data type is invalid
16#000014B4	5300	TF3710_ERR_LVTYPEDESCRIPTOR_TYPE_UNINITIALIZED	TypeResolver is not initialized
16#000014C4	5316	TF3710_ERR_LVTYPEDESCRIPTOR_INVALID_CLUSTER_SYMBOLINFO	Symbol info for cluster data type is invalid
16#000014C5	5317	TF3710_ERR_LVTYPEDESCRIPTOR_NON_CLUSTER_TYPE	Data type is not of the LabVIEW™ cluster data type
16#000014C6	5318	TF3710_ERR_LVTYPEDESCRIPTOR_INVALID_CLUSTER_SYMBOLPOSITION	Elements are missing in the cluster data type
16#000014D4	5331	TF3710_ERR_LVTYPEDESCRIPTOR_INVALID_TIMESTAMP_VALUE	Invalid TC timestamp value
16#000014D5	5332	TF3710_ERR_LVTYPEDESCRIPTOR_UNSUPORTED_TIMESTAMP	This TC timestamp data type is currently not supported
16#000014D9	5337	TF3710_ERR_LVTYPEDESCRIPTOR_TYPE_SIZE_MISMATCH	Data types are not identical
16#000014DA	5338	TF3710_ERR_LVTYPEDESCRIPTOR_TYPE_MISMATCH	Data types are not identical
16#000014DB	5339	TF3710_ERR_LVTYPEDESCRIPTOR_DATA_SIZE_MISMATCH	Data type content does not match
16#00001504	5380	TF3710_ERR_TYPEGENERATOR_SUBTYPE_NOT_FOUND	TypeGenerator cannot find the SubType or the BaseType
16#00001519	5401	TF3710_ERR_READ_REQUEST_FAILED	Read request has failed
16#0000151A	5402	TF3710_ERR_INVALID_READ_BUFFER	ADS raw data incorrectly packed
16#0000151B	5403	TF3710_ERR_INVALID_READ_DATA_FORMAT	ADS raw data invalid
16#0000151C	5404	TF3710_ERR_NOTIFICATION_HANDLER_FAILED	Notification handler has failed
16#0000151D	5405	TF3710_ERR_ATLEAST_ONE_MISSED_NOTIFICATION	At least one/several notifications is/are not received correctly
16#0000151E	5406	TF3710_ERR_NOTIFICATION_REQUEST_FAILED	Notification request has failed

error value	symbol	Error description	Remedy option
16#0000151F	5407	TF3710_ERR_UNSUPPORTED_NOTIFICATION_MODE	Notification mode is currently not supported
16#00001520	5408	TF3710_ERR_NOTIFICATION_BUFFER_FAILED	Buffered notification has failed
16#00001534	5428	TF3710_ERR_WRITE_REQUEST_FAILED	Write request has failed
16#00001565	5429	TF3710_ERR_WRITE_BUFFER	Write buffer invalid
16#FFFFE05C	-8100	TF3710_ERR_INVALID_HANDLE	Invalid handle
16#FFFFE05B	-8101	TF3710_ERR_HANDLE_IN_USE	The handle is still in use
16#FFFFE052	-8110	TF3710_ERR_INVALID_ARRAY	Invalid array
0xFFFFE051	-8111	TF3710_ERR_INVALID_ARRAY_SIZE	Array size invalid
0xFFFFE050	-8112	TF3710_ERR_SYMBOL_NOT_FOUND	Symbol not found
0xFFFFE04F	-8113	TF3710_ERR_LVBUFFER_NOT_REGISTERED	LVBuffer was not registered

9.5 Support Return Codes

error value	symbol	Error description	Remedy option
16#00001414	5140	TF3710_ERR_INVALID_REQUEST	The request is not currently supported
16#00001415	5141	TF3710_ERR_BETA_TRIAL_EXPIRED	Beta trial period has expired
16#00001416	5142	TF3710_ERR_LICENSE_STATE_ISSUE	The license state is invalid

More Information:
www.beckhoff.com/TF3710

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com