Selmo

Demo projects with Beckhoff TwinCAT3

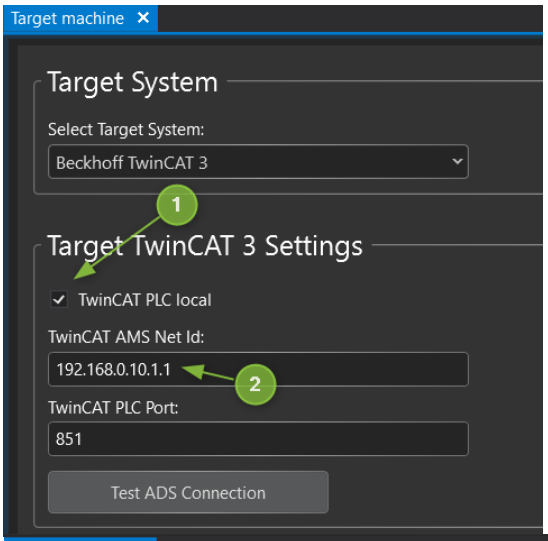
See also Selmo Help Center

Content

Customizing the Selmo Studio Project (SEO)

As part of a new Selmo Studio project, the decision has to be made in which control system the PLC program will be used. Although the main part of the program is identical, there are differences, especially in terms of communication and the use of internal libraries.

In Selmo Studio, the selection of the appropriate controller is done in the Target System section. In the present case, the Beckhoff TwinCAT 3 controller is used together with the communication interface for this purpose. This can be ADS or OPC-UA. With the Boris simulation software, ADS or OPC-UA must be used, with Twin ADS or OPC-UA and with FactoryIO OPC-UA must be used.

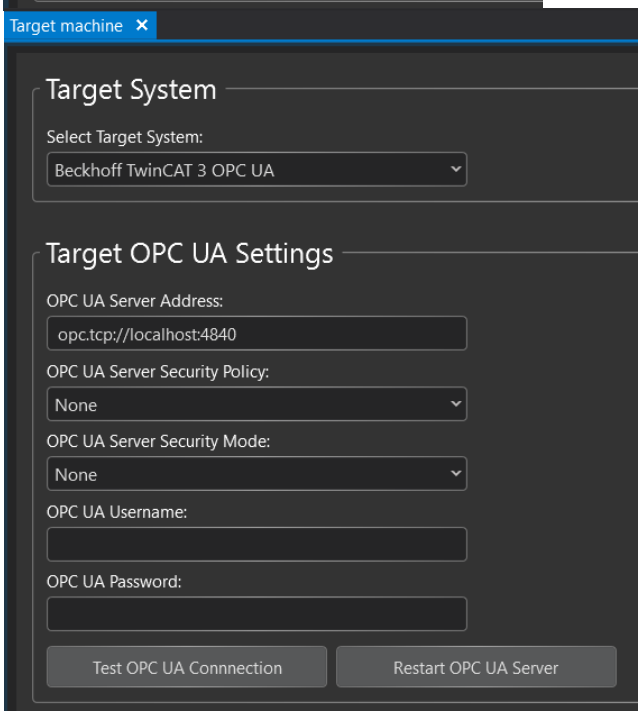


In the Beckhoff TwinCAT 3 target system (with ADS), it is possible to choose between a controller in the network or a runtime on the local computer.

In the case of a more remote control as well as the user runtime, the check mark (1) must be removed and the correct AMS Net Id selected (2).

For a classic runtime (XAR) on the local computer, the check mark (1) must be set. In this case, the AMS Net Id is irrelevant.

If the PLC is already active, communication can be tested via the button.

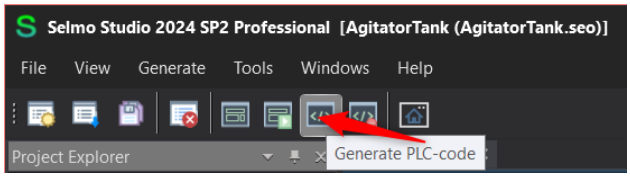


For OPC-UA communication, the server address and the login data must be provided. These are defined during the installation of the OPC-UA server (see below).

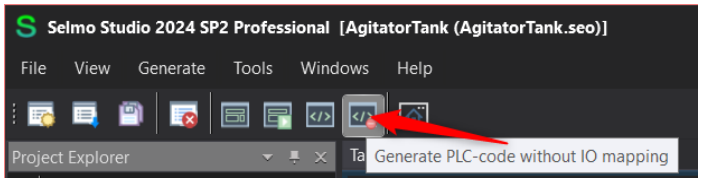
Here, too, the communication can then be tested or the OPC-UA server can be restarted.

When using the User Mode Runtime, please also refer to this section: Using User Mode Runtime

After completion of the modeling, the PLC code is generated and exported in an XML file. It should be noted that the entire PLC program must be exported during the first export.

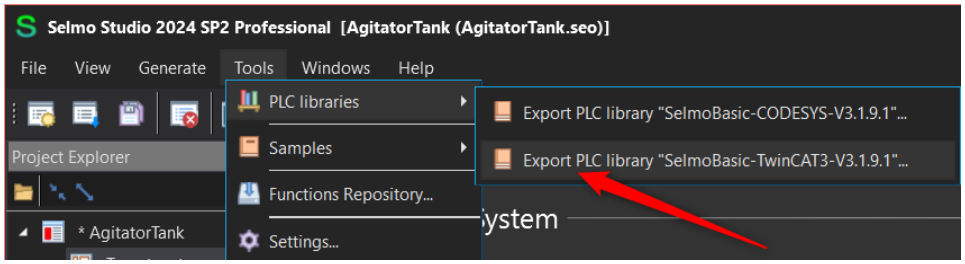


As a result, the export should be done without the building blocks of the IO mapping. The corresponding modules are edited in TwinCAT and could be overwritten in a complete export. It should be noted that any links will be lost.



Note that this export and subsequent import in the TwinCAT must take place in the Selmo Studio every time a change is made. For this reason, it is recommended not to make changes in the exported modules in TwinCAT, as they will be overwritten during the next import.

The SelmoBasic library is required to integrate the internal functions. This can be obtained via the export function in the Selmo Studio.



Please note that the version of the library used in TwinCAT must match the version of Selmo Studio. The corresponding procedures for import and activation are explained in the PLC documentation.

Installation and configuration of Beckhoff TwinCAT3

The Visual Studio development environment together with TwinCAT3 can be downloaded and installed on the Beckhoff homepage. The installation can be done with the default settings, but these requirements should be met:

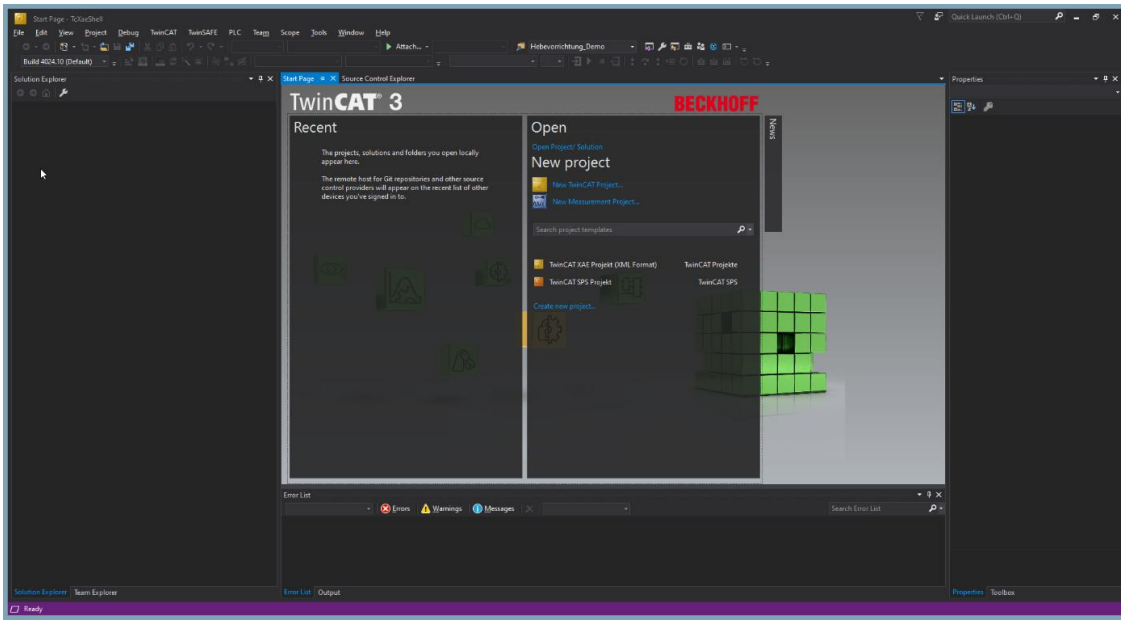
- MS Windows version 10 or 11. The version has an impact on the Beckhoff TwinCAT Runtime, as only UmRT can be run locally with newer versions
- Selmo Studio in the current version 2024 SP2
- The current version of Beckhoff TwinCAT is 3.1.4024.56 with TwinCAT XAE, XAR and UmRT.
- Optional OPC-UA configuration tool TF6100 in version 4.4.184.0 and TF6100 OPC-UA Server in version 4.4.73.0 if OPC-UA is used
- Optional UaExpert, software for diagnosing and monitoring OPC-UA communication

Please check which versions are current and the dependencies on the other components. It should also be ensured that the following ports are not blocked in the operating system:

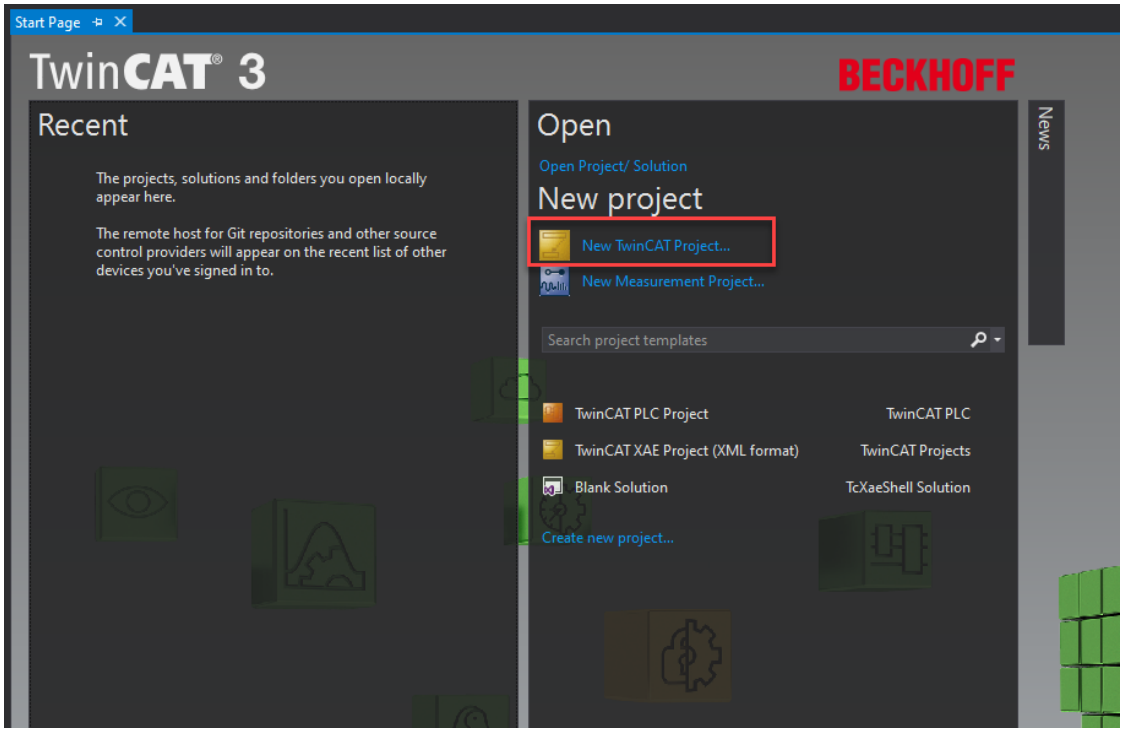
Service	Ports (Inbound)
IPC Diagnostics	https: 443 / tcp
Remote Desktop – RDP (nur Windows 7/10)	3389 / TCP
TwinCAT ADS	Discovery: 48899/udp (also outbound) Not secured: 48898 / tcp (also outbound) Secure ADS: 8016 / tcp (also outbound)
TF6100 OPC UA	4840/tcp (UA server, inbound), changeable 48050/tcp (UA gateway, inbound), changeable See also: TF6100 documentation

Import and Customize PLC Program

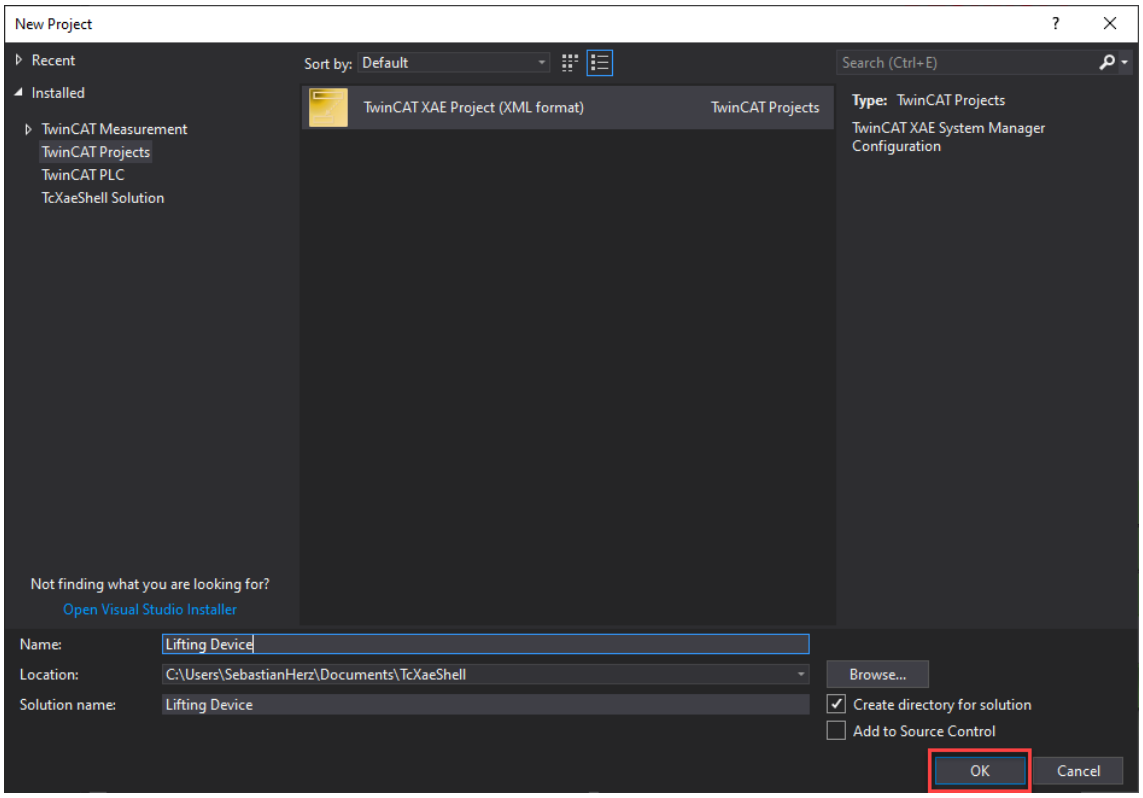
Start TwinCAT XAE:



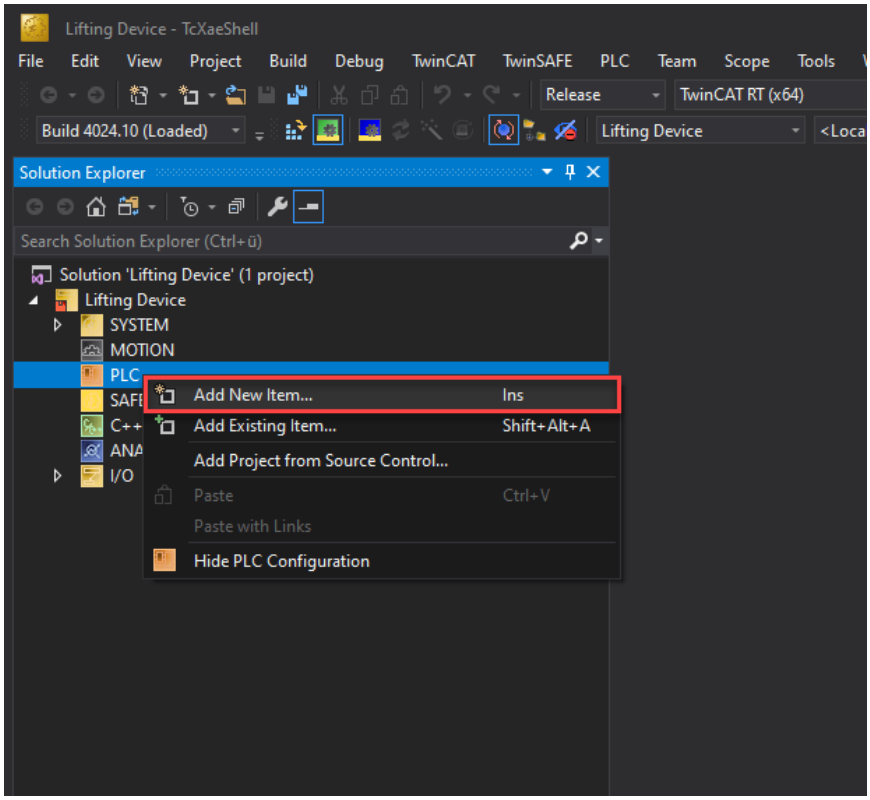
Create a new TwinCAT project:



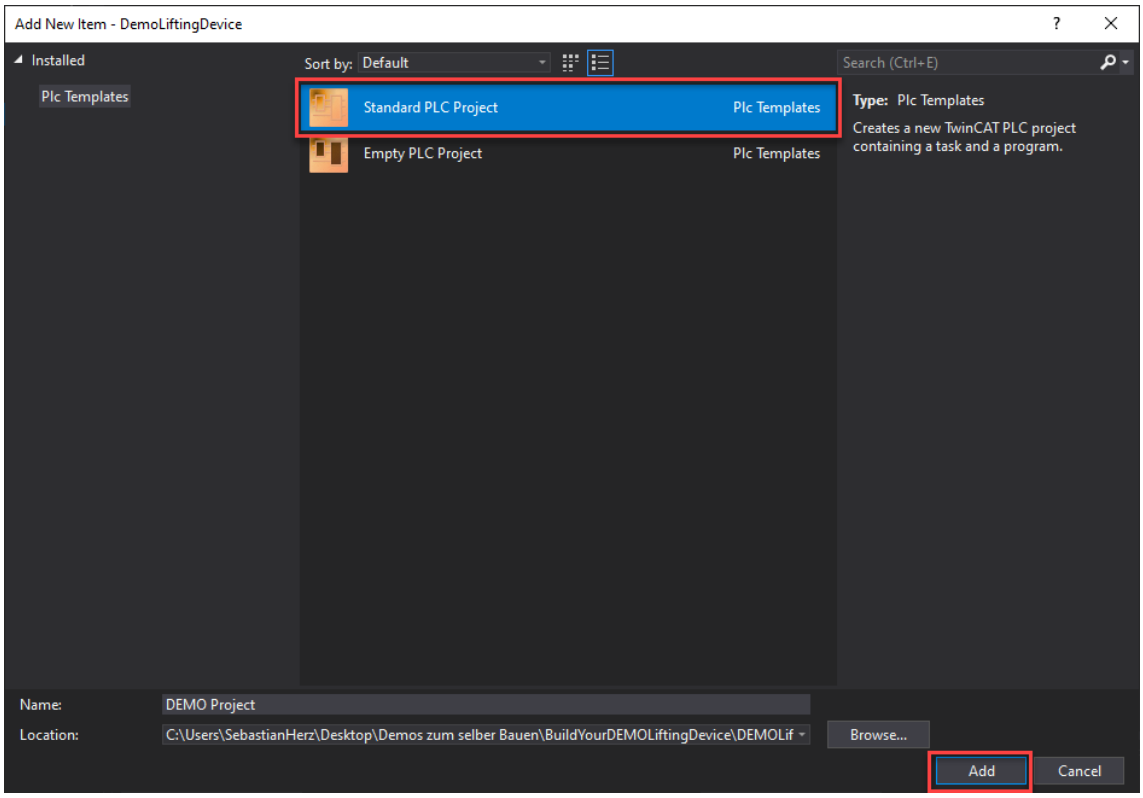
Create a new "TwinCAT XAE Project" and select the desired file path under "Location":



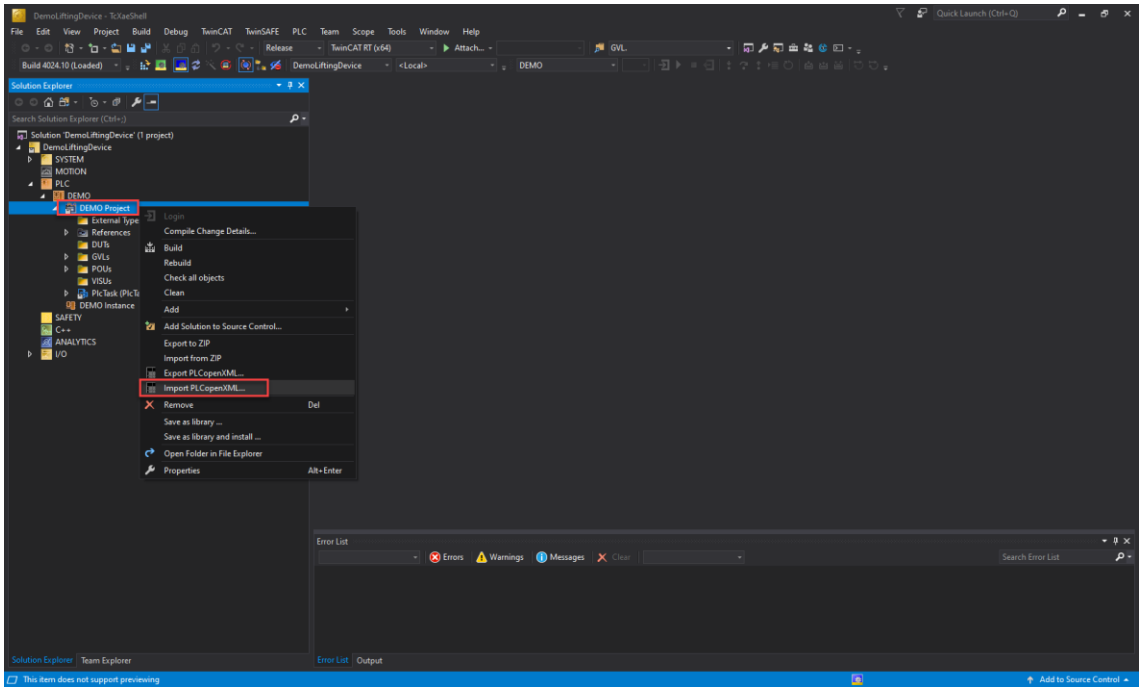
In the context menu, select the "Add New Item" option via the right mouse button.



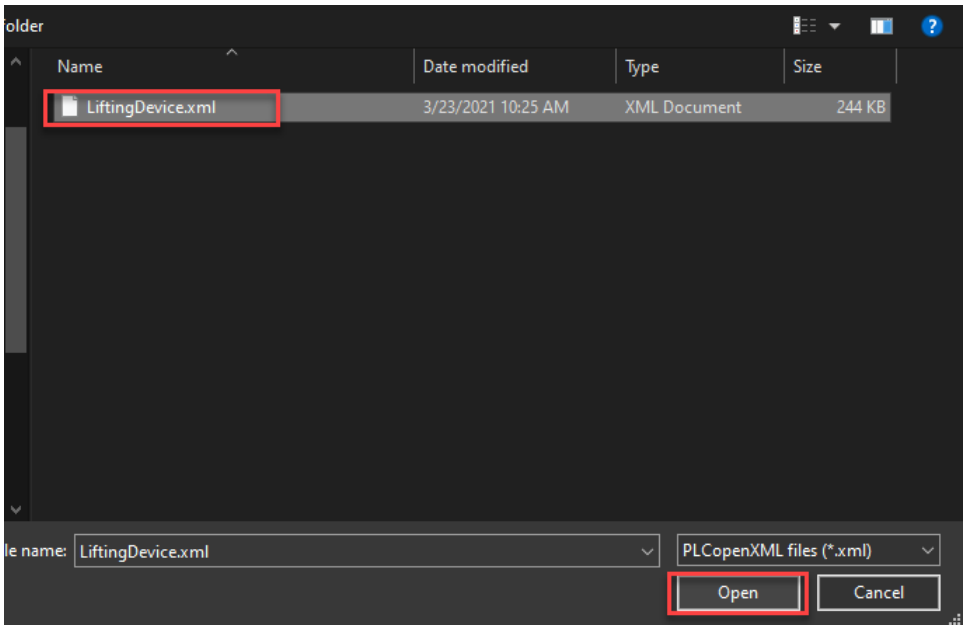
After that, a new "Standard PCL Project" is selected and inserted:



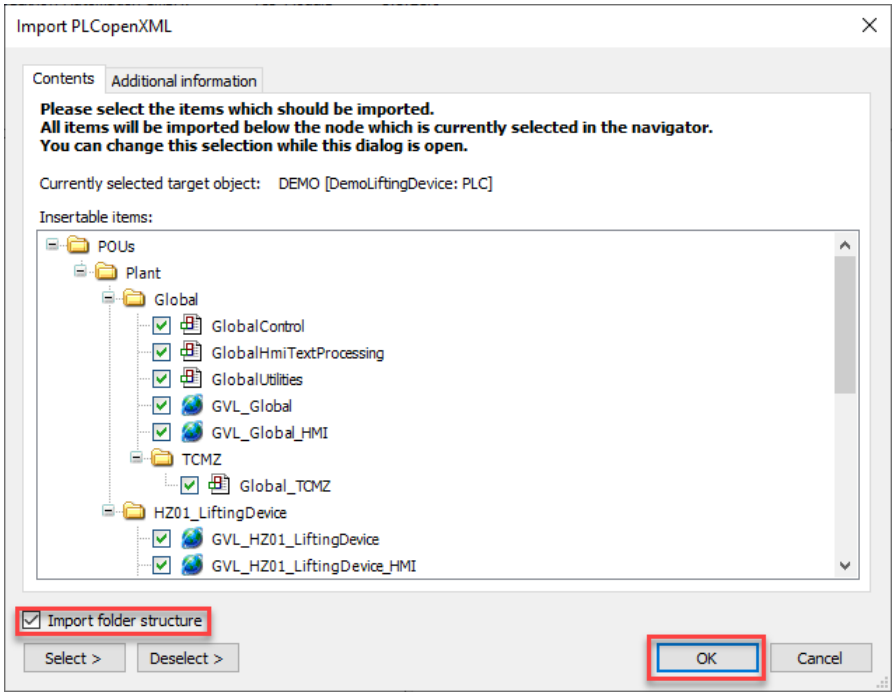
Now you need to import the already exported PLCopenXML file from the Selmo Studio:

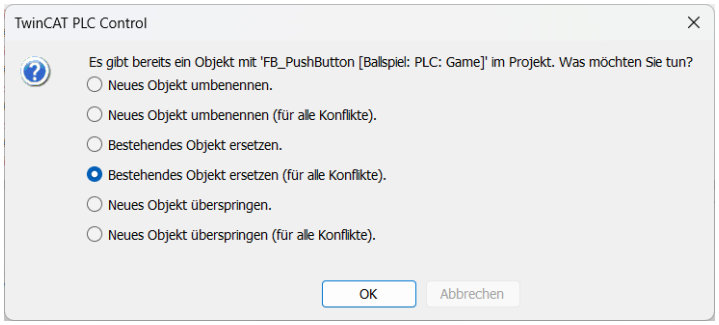


Open the exported XML file.

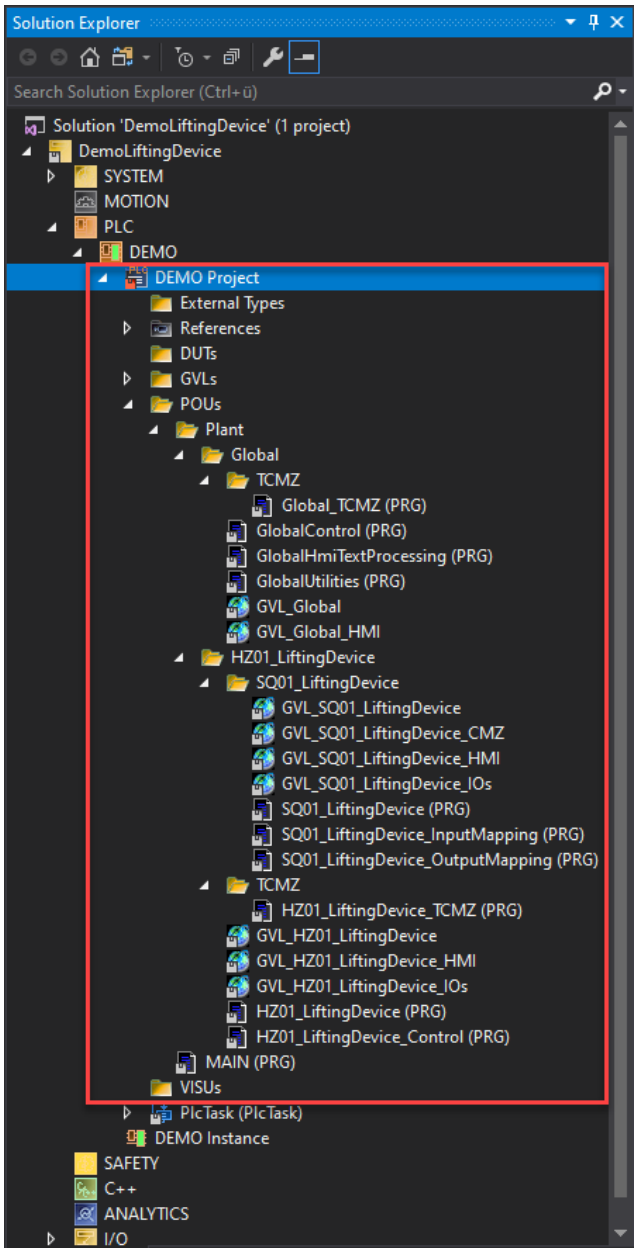


Click OK. For subsequent imports, in the event of changes, the option to replace the existing objects must be selected. Also make sure that the folder structure is also imported.

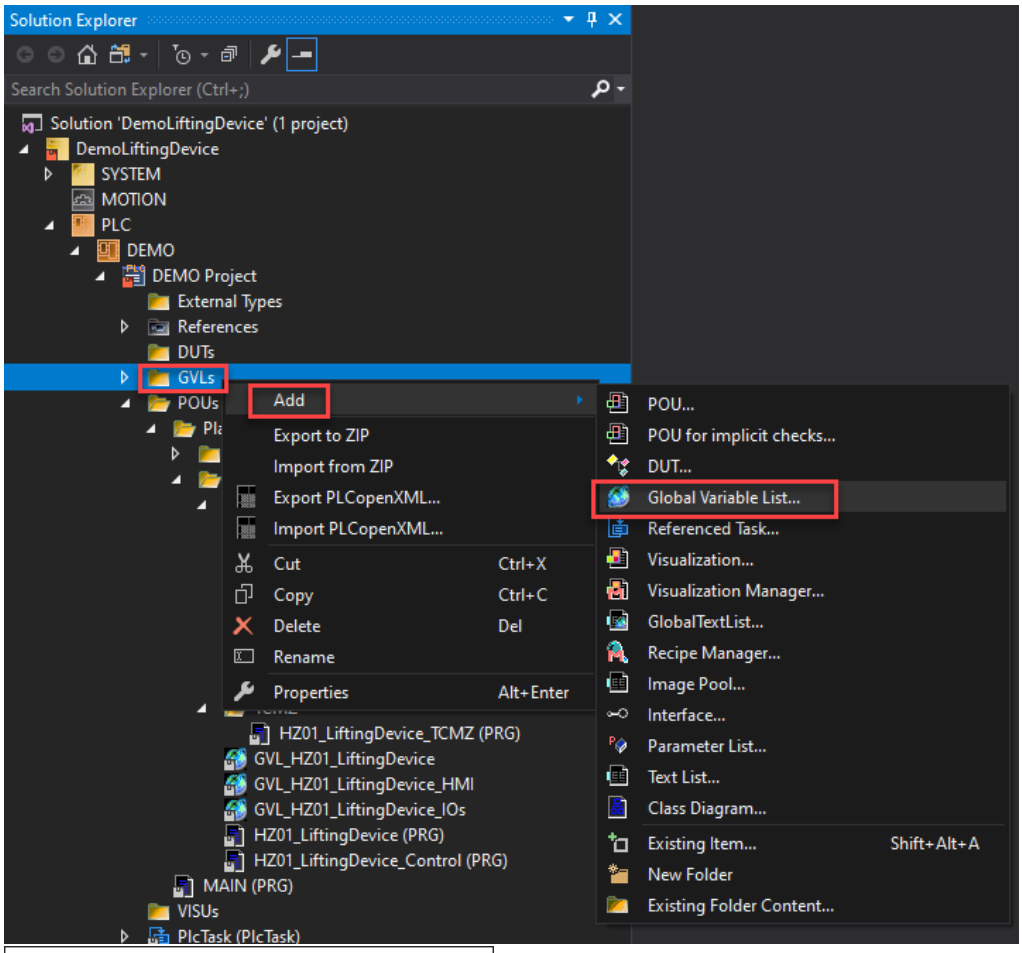


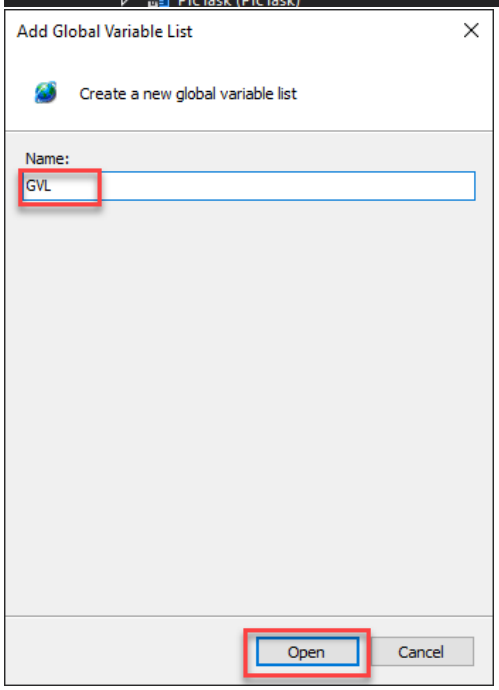


The project has now been opened and all exported blocks have been inserted:

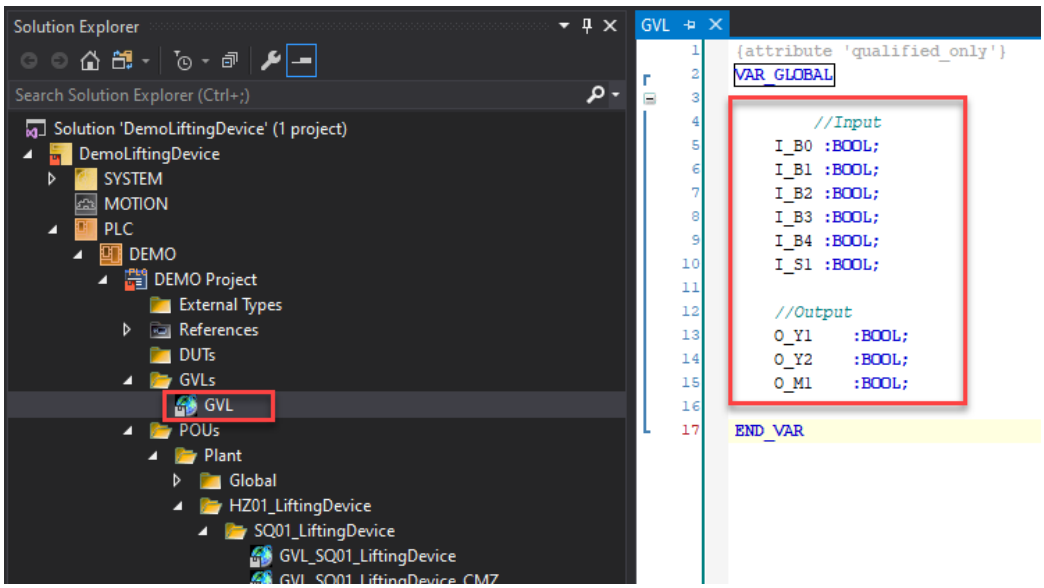


Add a global variable list for your inputs and outputs.

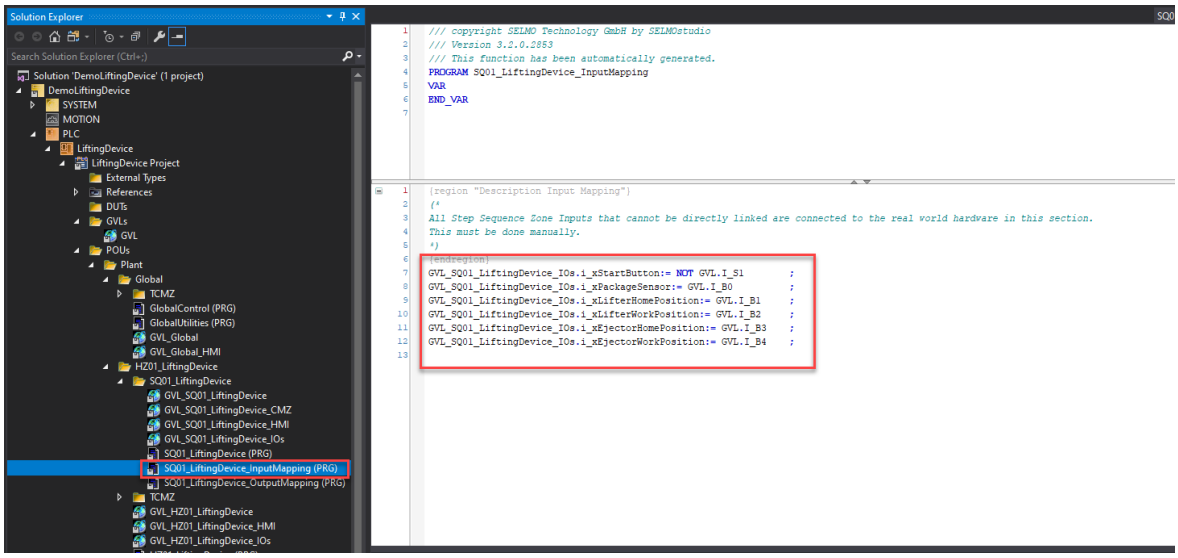




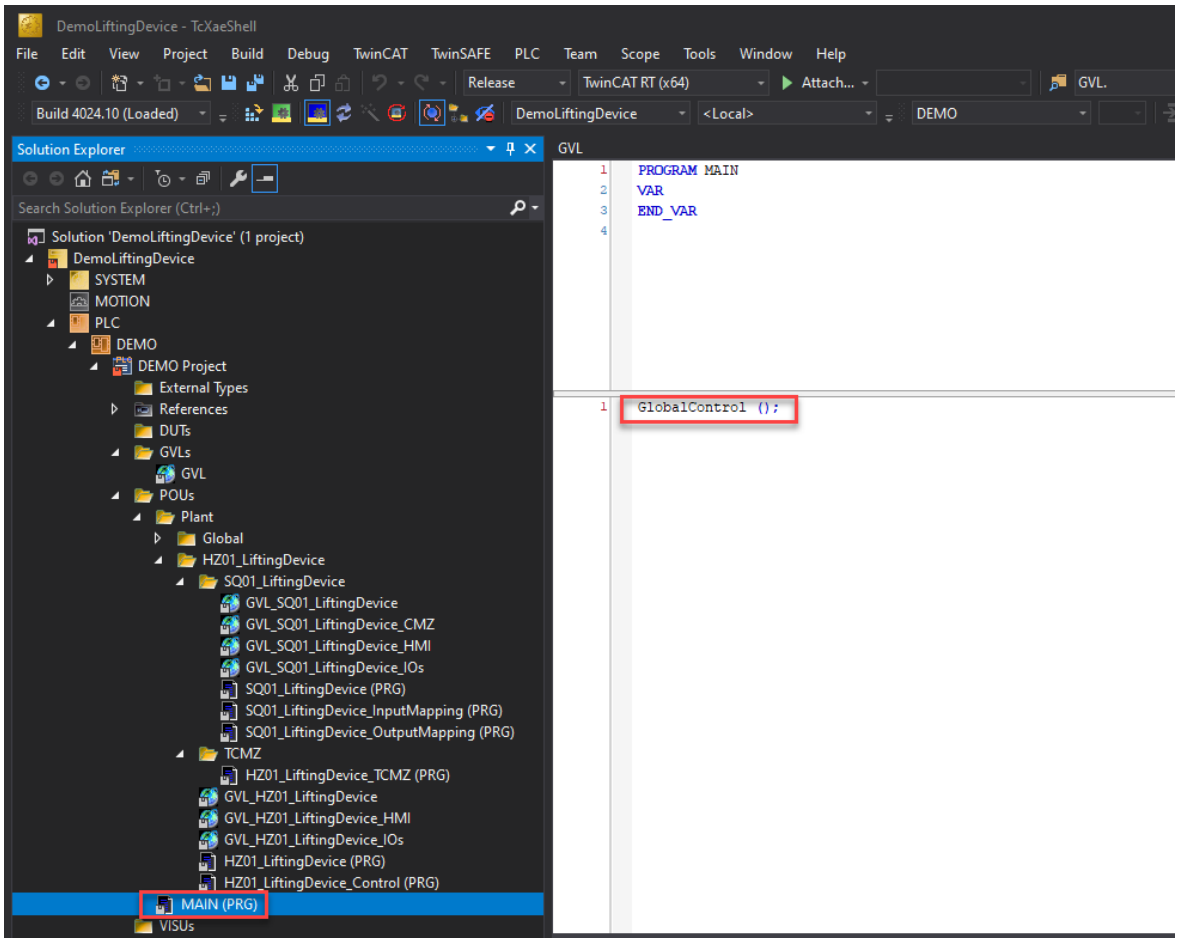
Write your inputs and outputs here. In this case, we used the I/O from our HMI. To ensure communication with the simulation, it is important that the names from the documentation are used.



The variables are linked to the prepared I/Os of the respective sequences in the corresponding "xxx_InputMapping" or "xxx_OutputMapping" modules. For this purpose, it is necessary to remove the comment of the lines and to read or write the variables from the GVL.

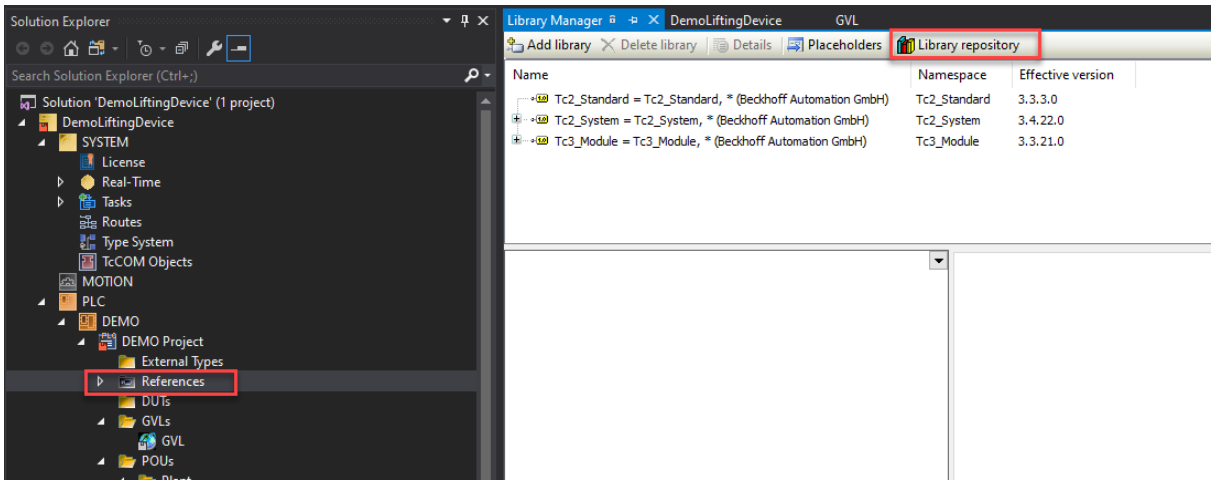


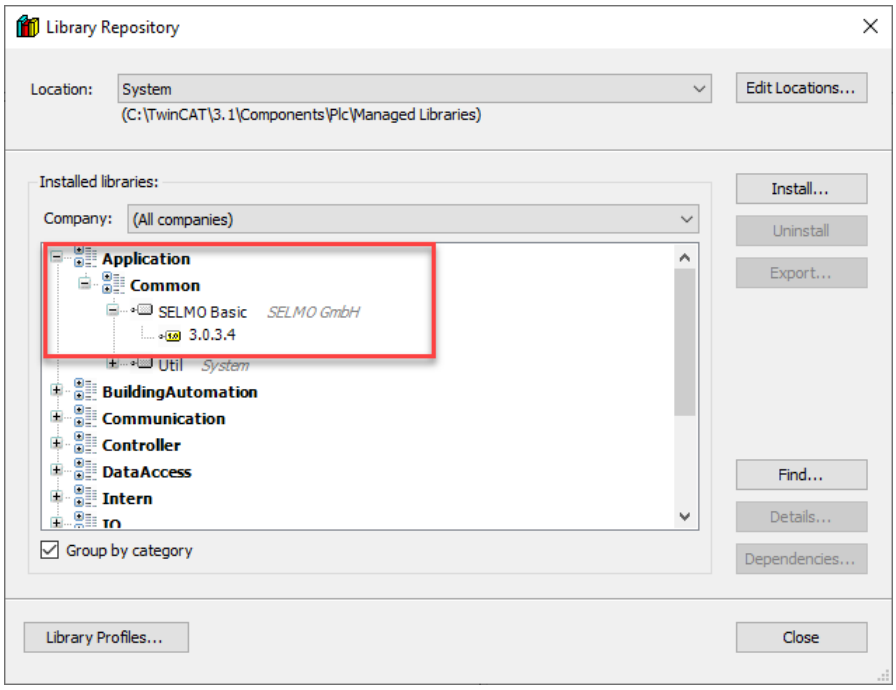
Open "MAIN (PRG)" and paste the call "GlobalControl();" there.



If you are using the local XAR runtime, you should also use the Preparation of PLC program for local runtime heed.

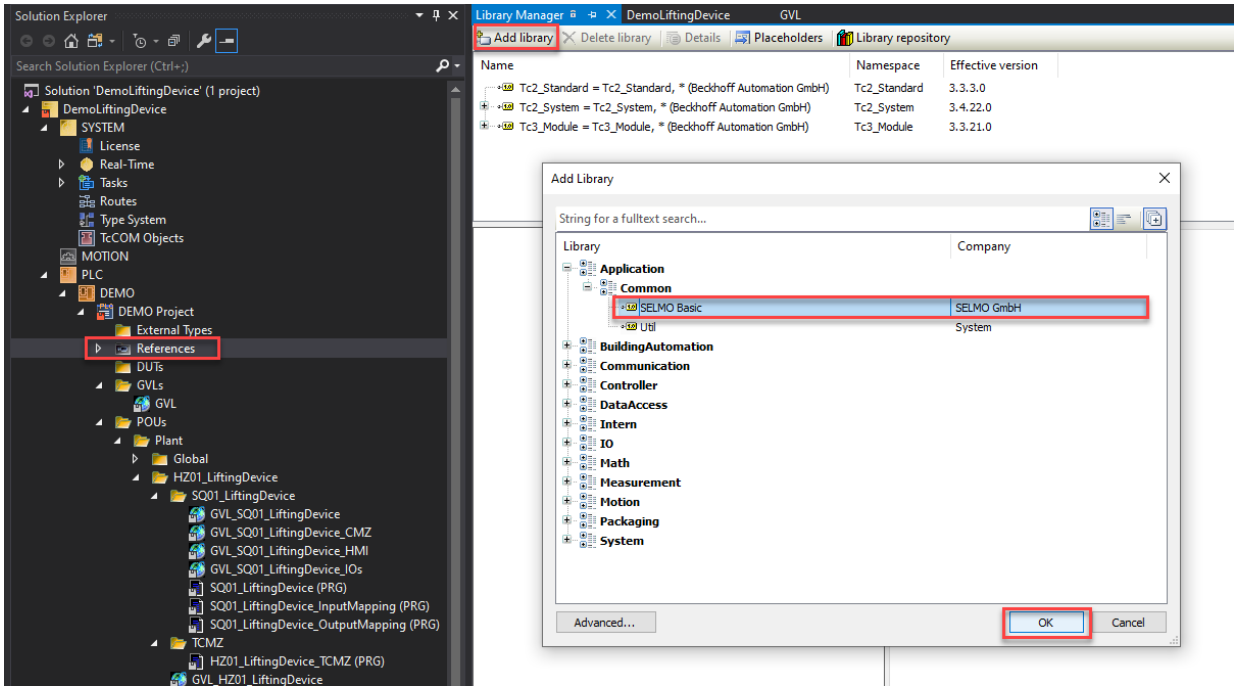
It should also be checked whether the current "Selmo Basic" library is already installed.



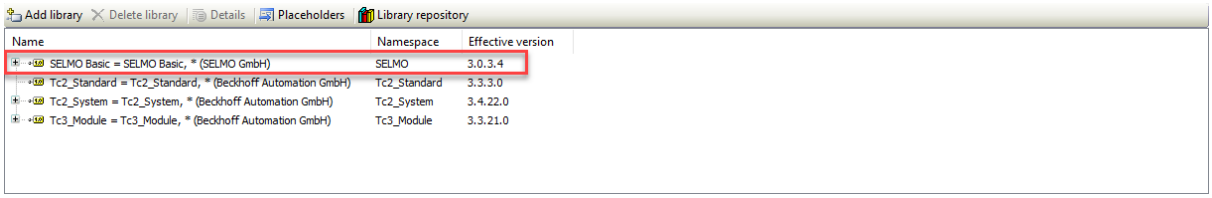


If you have not yet installed the Selmo Basic library, please follow the instructions at Customizing the Selmo Studio Project (SEO).

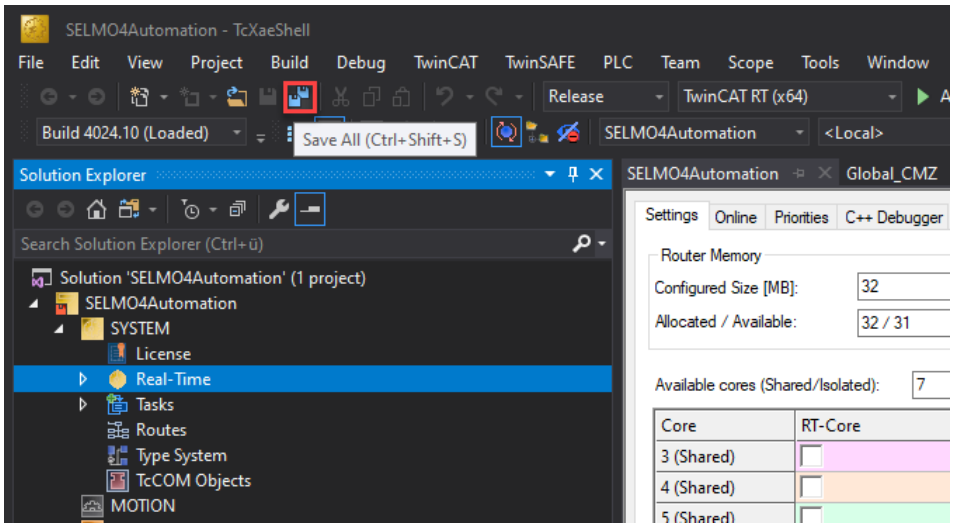
If you already have the library installed, add the Selmo Basic library to your project:



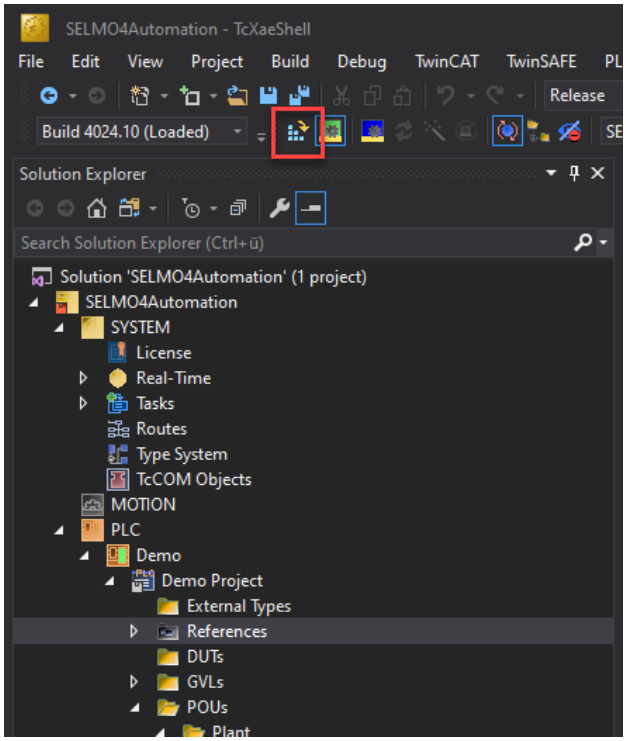
The library is loaded into your project. Always use the appropriate version for your Selmo Studio version.



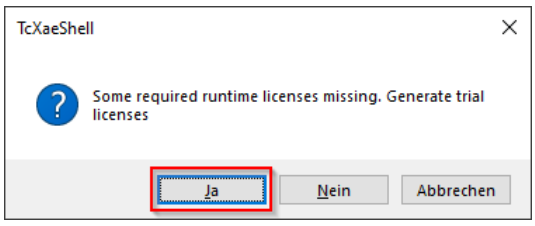
Save all changes:



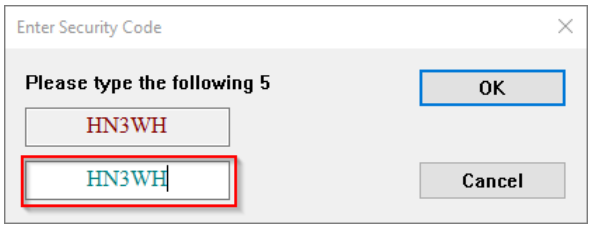
Load the project and start the PLC:

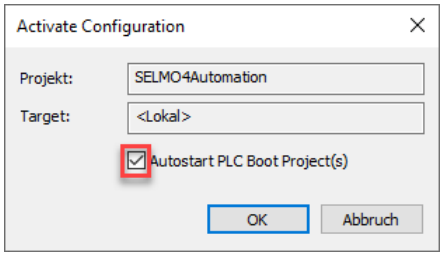


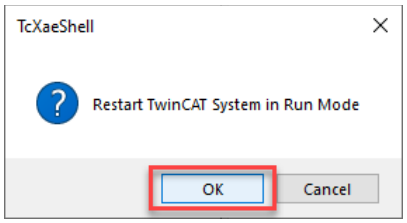
There is a possibility that you will be asked to activate a license. Beckhoff offers a 7-day trial license. This can be reactivated if necessary after expiration.



If you confirm with "YES", the following window will appear. Enter the displayed key in the field and confirm with "OK".

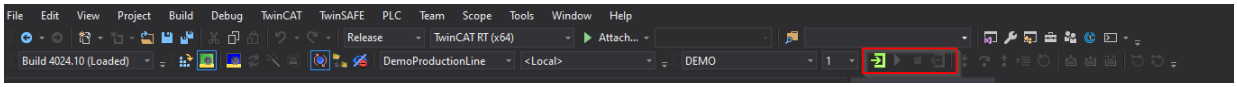






The project is now loaded and the PLC jumps into RUN mode.

This button is used to log in.

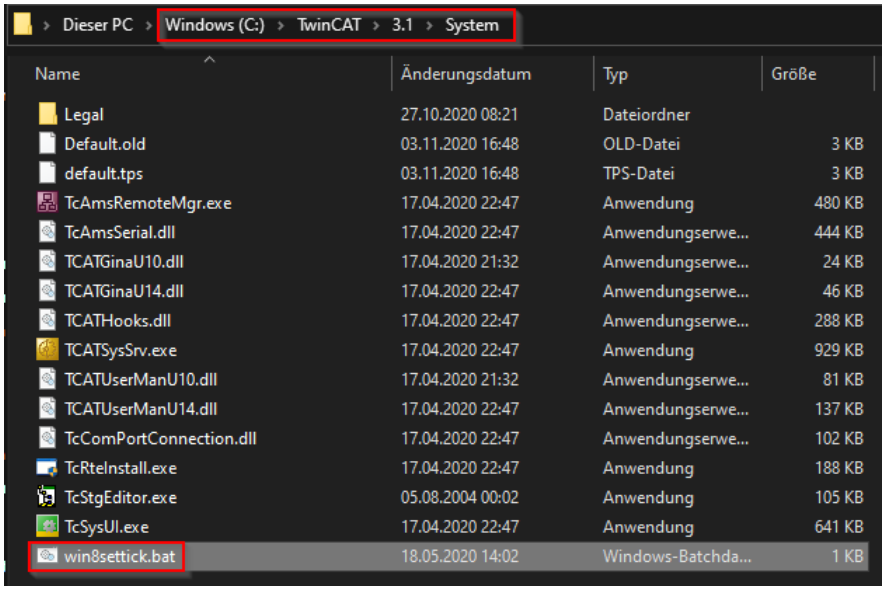


The application is now running on the controller.

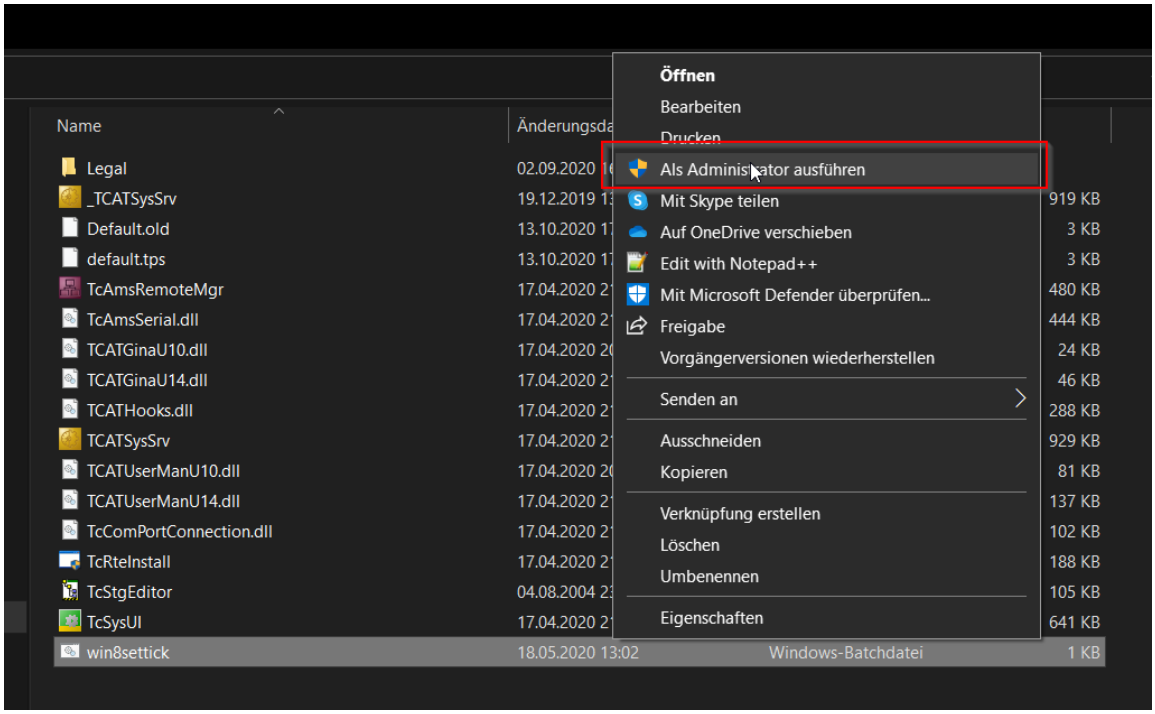
Preparation of PLC program for local runtime

If Windows 10 is installed on the development machine, TwinCAT 3 can be used locally. When loading the program, you may see a message that this is not possible. In this case, the User Mode Runtime (UmRT) is recommended. How these work is explained below.

In order for the local system to be executable for TwinCAT, the batch file "win8settick.bat" must be executed. The file can be found in the TwinCAT system folder under C:\TwinCAT\3.1\System.

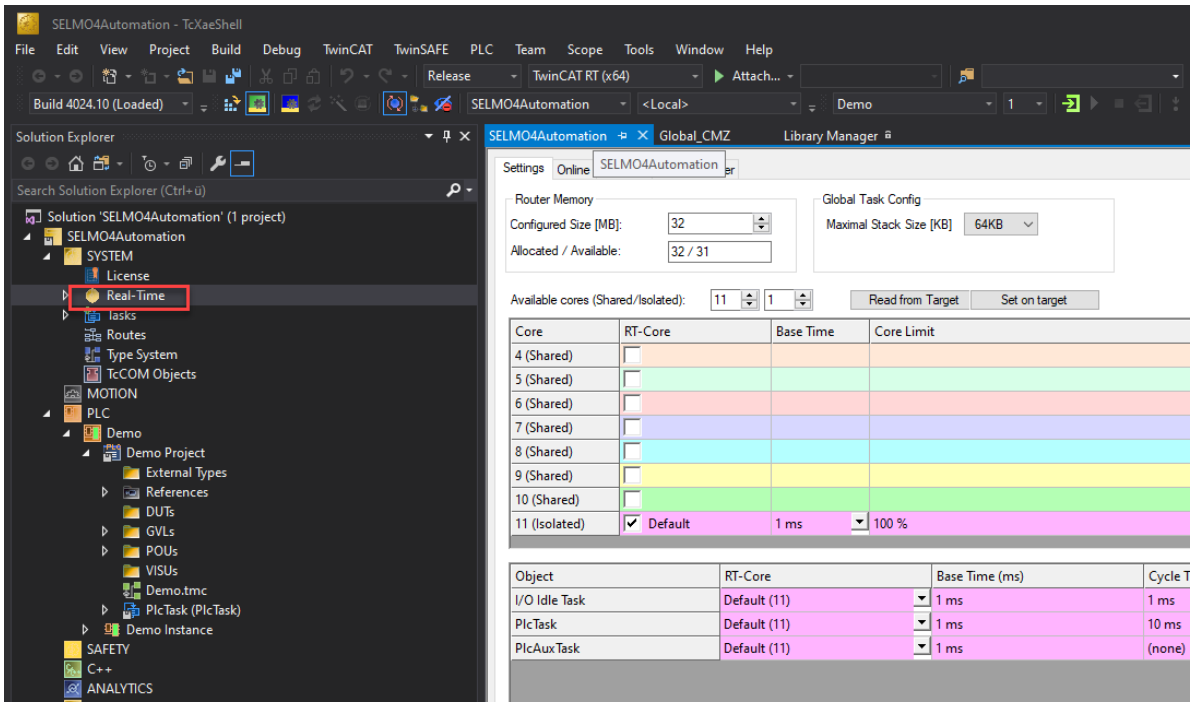


The win8settick.bat file should be run as administrator.

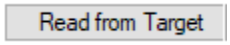


Then start the TwinCAT XAE software, if it is not already open, and open the demo project you want to start.

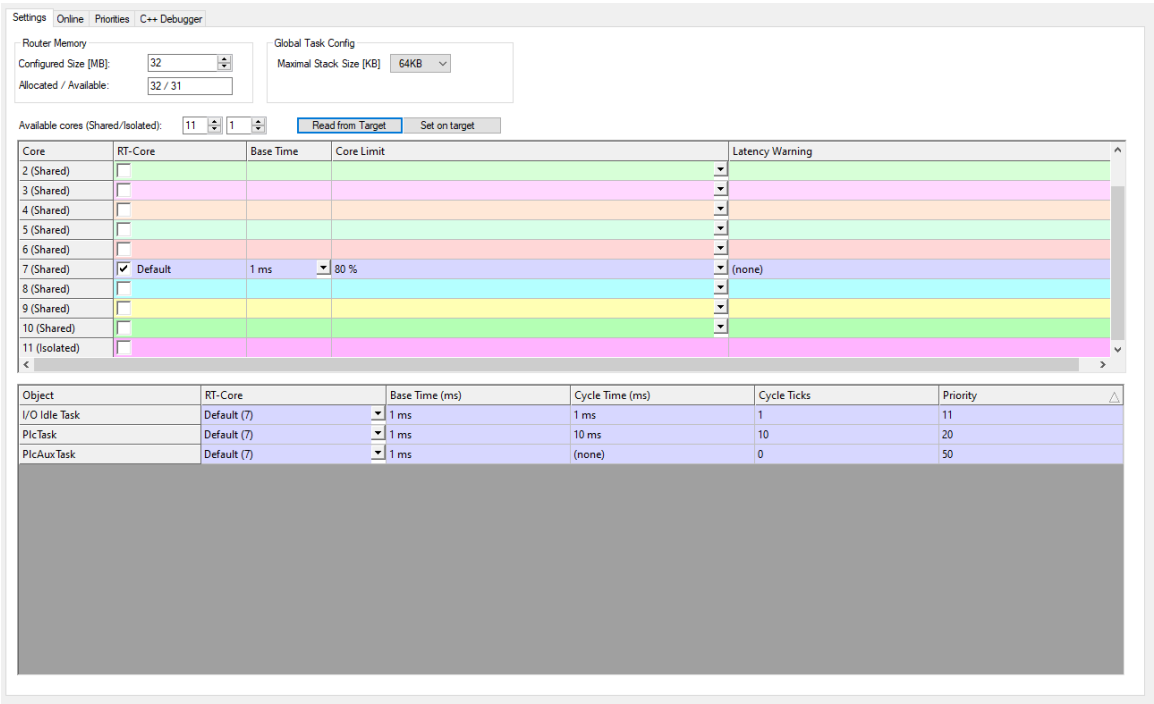
Then navigate to "System" and configure your local control.



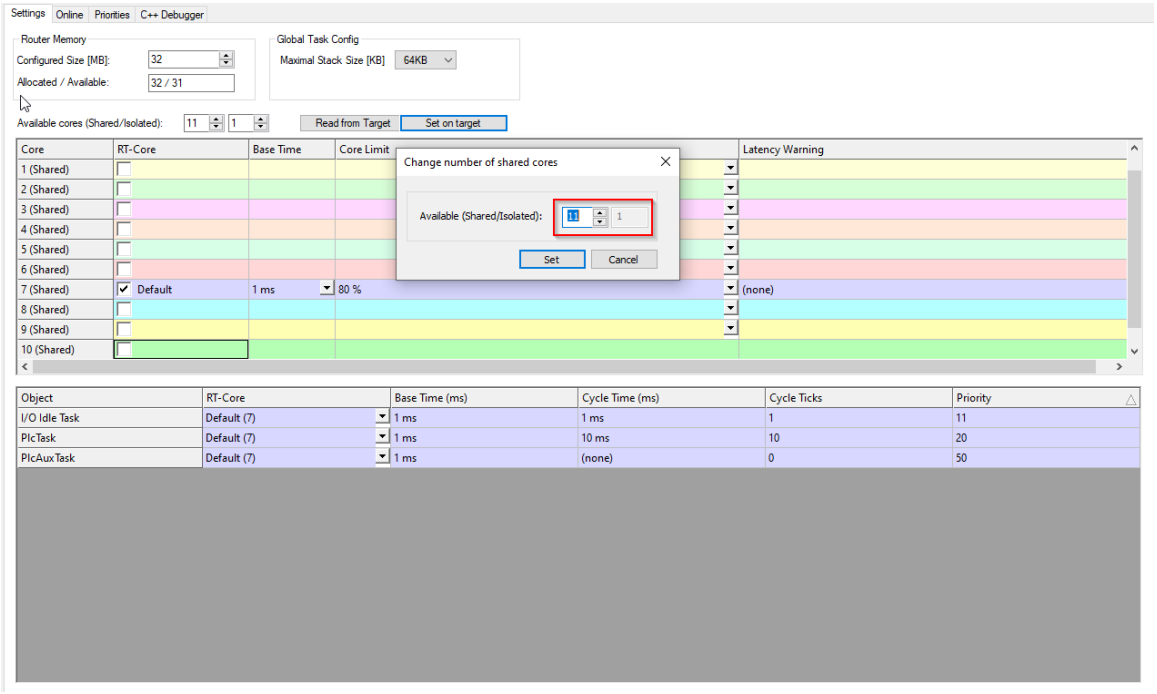
First, use the following button to read the number of available cores on your system.



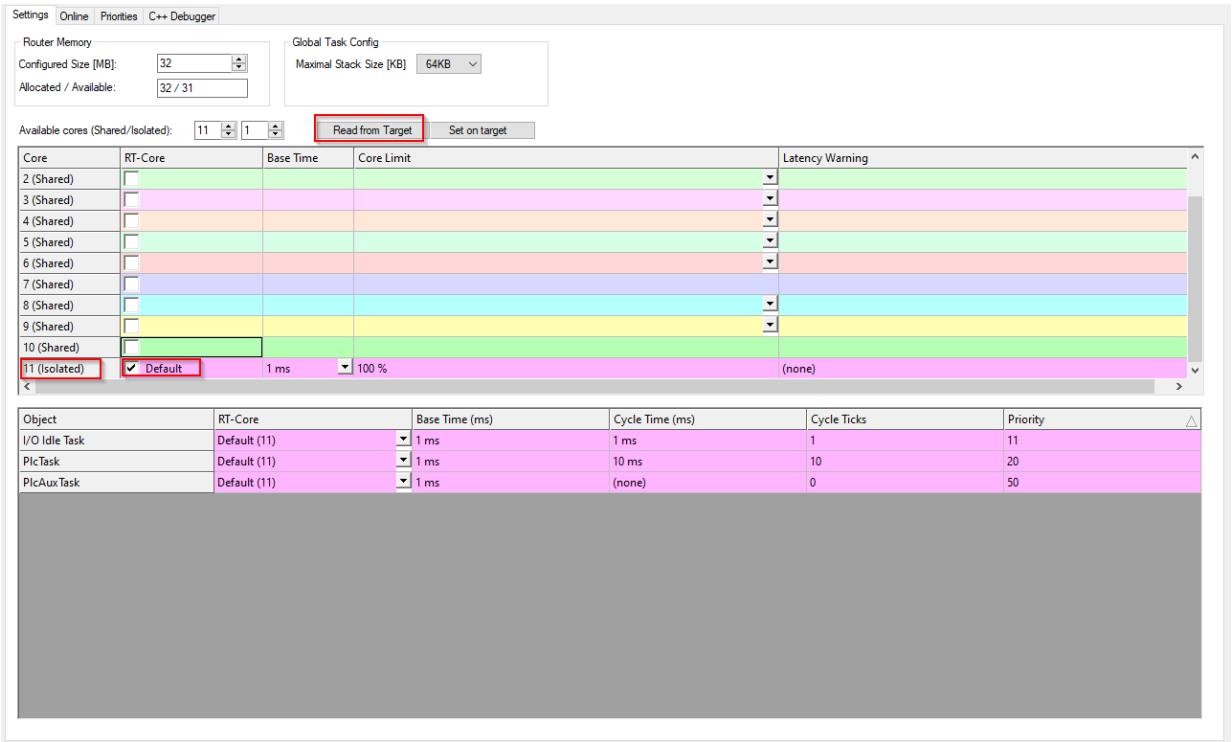
There should be at least 2 cores to maintain a stable runtime. In our case, the system has 12 cores from 0-11.



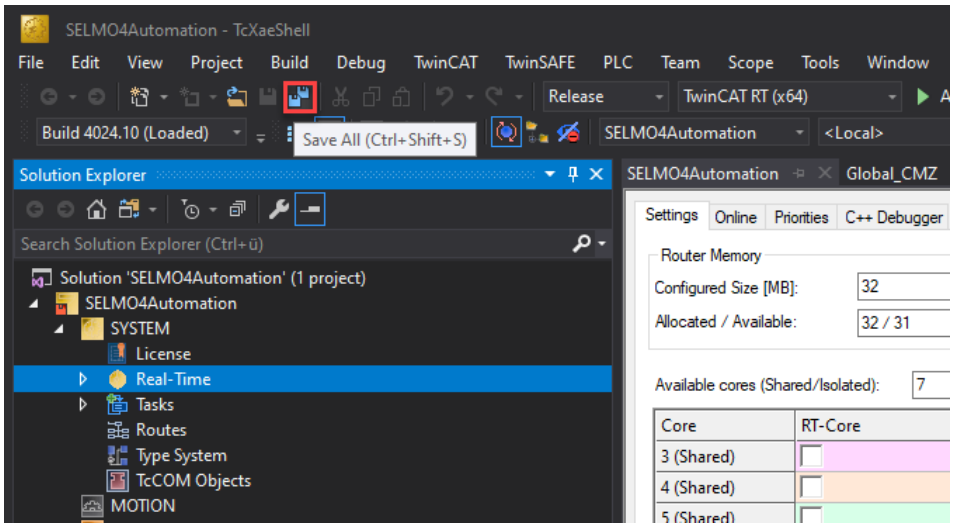
A core must be isolated from this with the following button.



After rebooting the system, the isolated core of TwinCAT must be set to the default value.



In order not to lose any settings, it is recommended to save the project here.



Using User Mode Runtime

Excerpts from Beckhoff Information System:

The TwinCAT 3 usermode runtime allows a TwinCAT program to be executed without the deep TwinCAT operating system integration that would be necessary to ensure real-time execution. This is difficult or impossible to do with newer operating systems, without affecting the other components.

For this purpose, the same program code of the customer project is executed, but without meeting the real-time requirements.

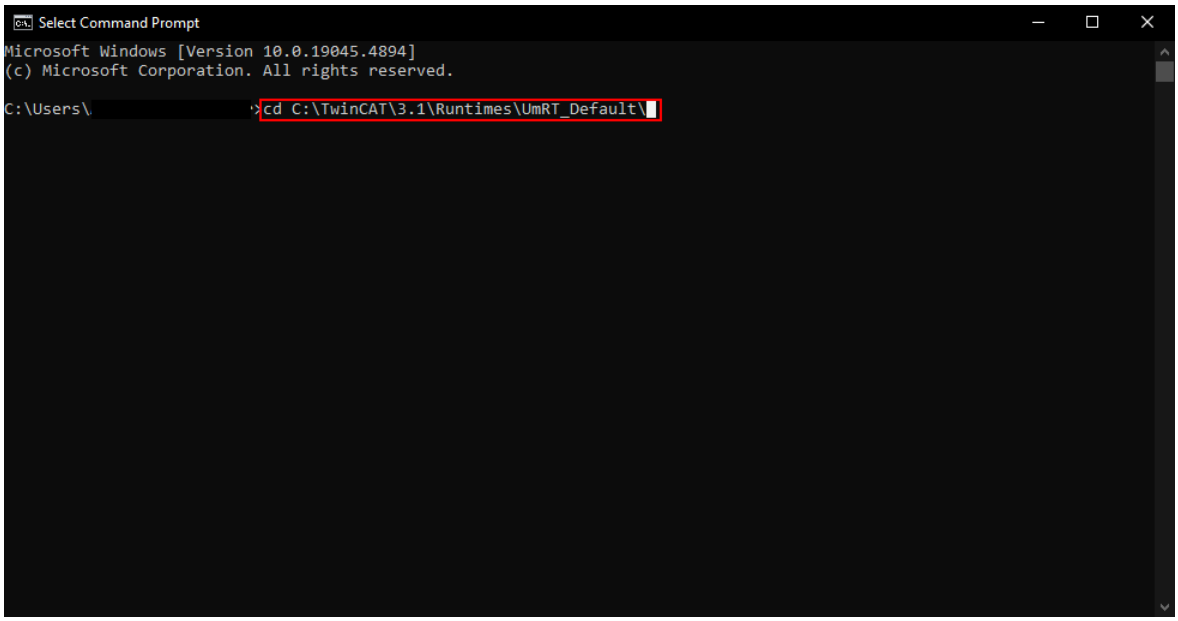
Limitations

- The TwinCAT 3 Usermode Runtime provides an execution environment for the same program code that is executed in the real-time runtime.
- The TwinCAT 3 Usermode Runtime has no guaranteed deterministic execution properties. The operating system is able to interrupt the usermode runtime at any time.
- The TwinCAT 3 usermode runtime does not have access to EtherCAT. So the IO part of the configuration is usually "disabled".
- Components based on the Realtime Ethernet driver can be executed. The execution times, as well as the jitter, can affect the function due to the principle.
- CCAT-based network cards cannot be used.
- The TwinCAT 3 Usermode Runtime cannot access USB, which means that the licensed USB stick cannot be used, for example.
- Due to the principle, it also does not make sense to use all TwinCAT functions under a TwinCAT 3 usermode runtime. Some TwinCAT functions, for example, require a constant real-time tick.
- Where appropriate, TwinCAT 3 Functions are extended to work with the TwinCAT 3 Usermode Runtime. In particular, if something has to be considered in terms of configuration for the TwinCAT 3 Usermode Runtime, this is documented for the respective products.
- The execution order between the tasks may differ in principle from the behavior in the real-time runtime.
- For this reason, it also makes sense not to make the execution sequence dependent on the task priorities.

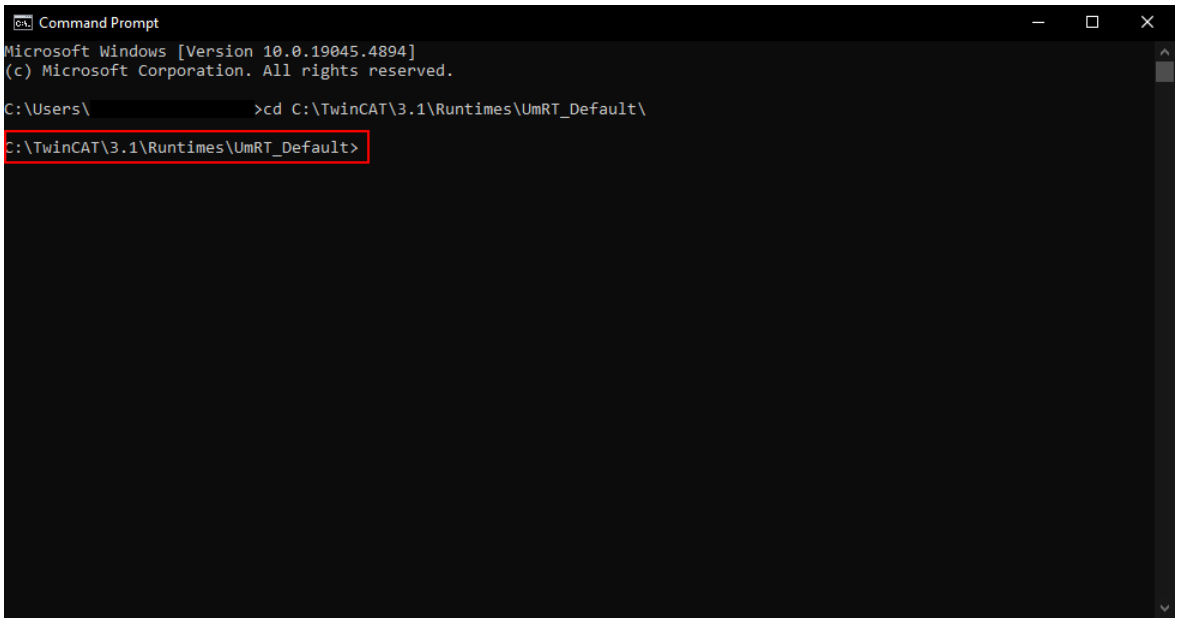
Starting the User Mode Runtime

In the current TwinCAT version 4024.56, the User Mode Runtime is started via a batch file. This is usually located under "C:\TwinCAT\3.1\Runtimes\UmRT_Default\Start.bat".

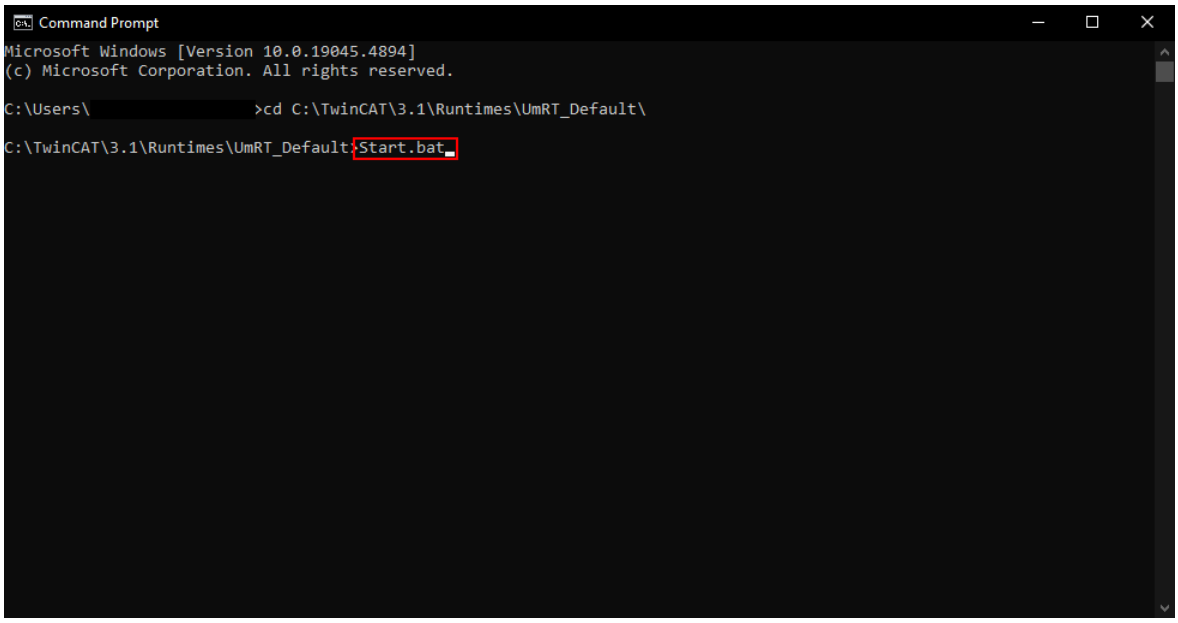
First, open the CMD window and then navigate to the corresponding directory. To do this, enter the command "cd C:\TwinCAT\3.1\Runtimes\UmRT_Default\" in the CMD window.



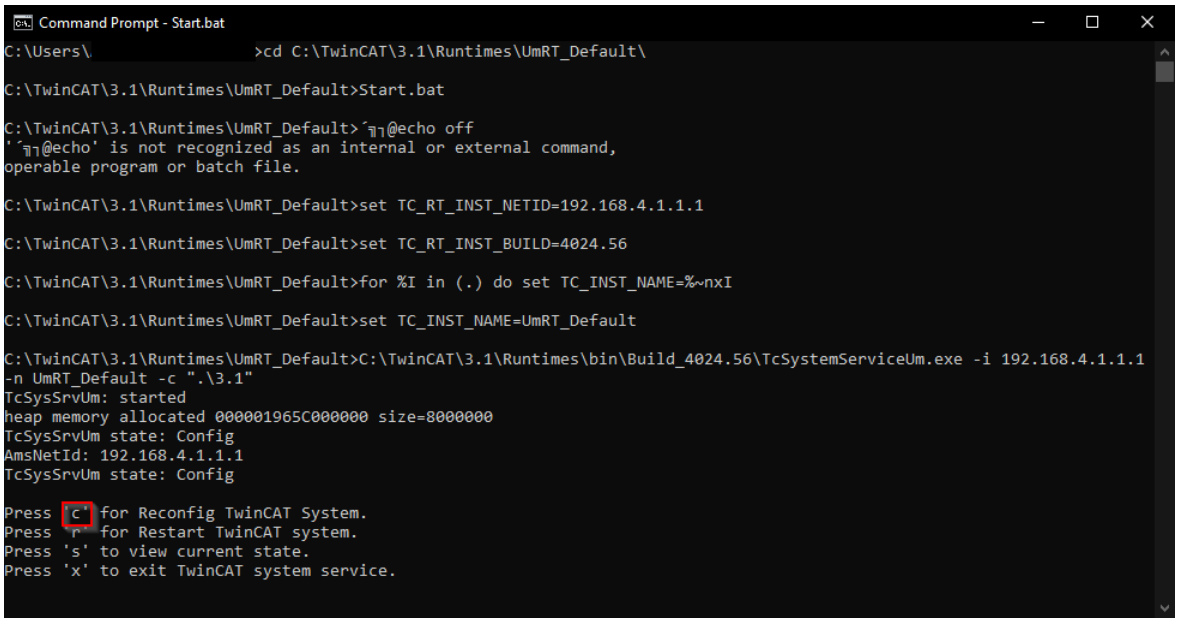
After pressing the Enter key, the path opens:



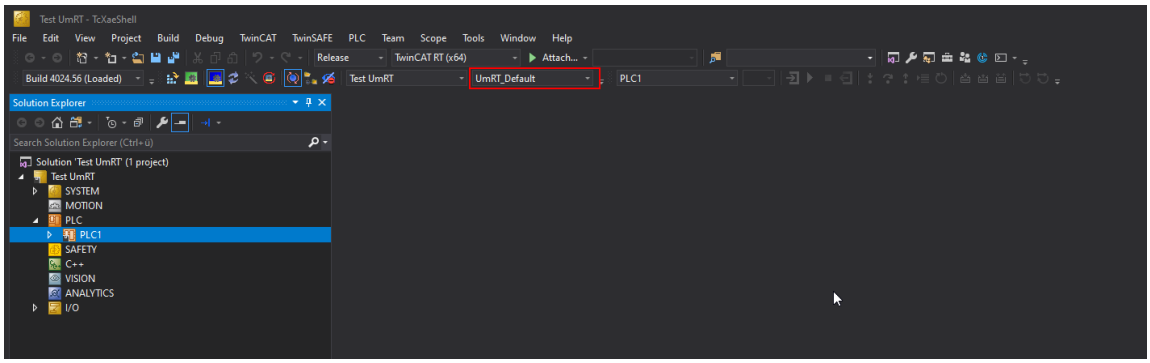
Start the batch file by typing "Start.bat" and Enter:



The batch file starts. The configuration mode still has to be switched with the input "c". However, this can also be activated in TwinCAT:



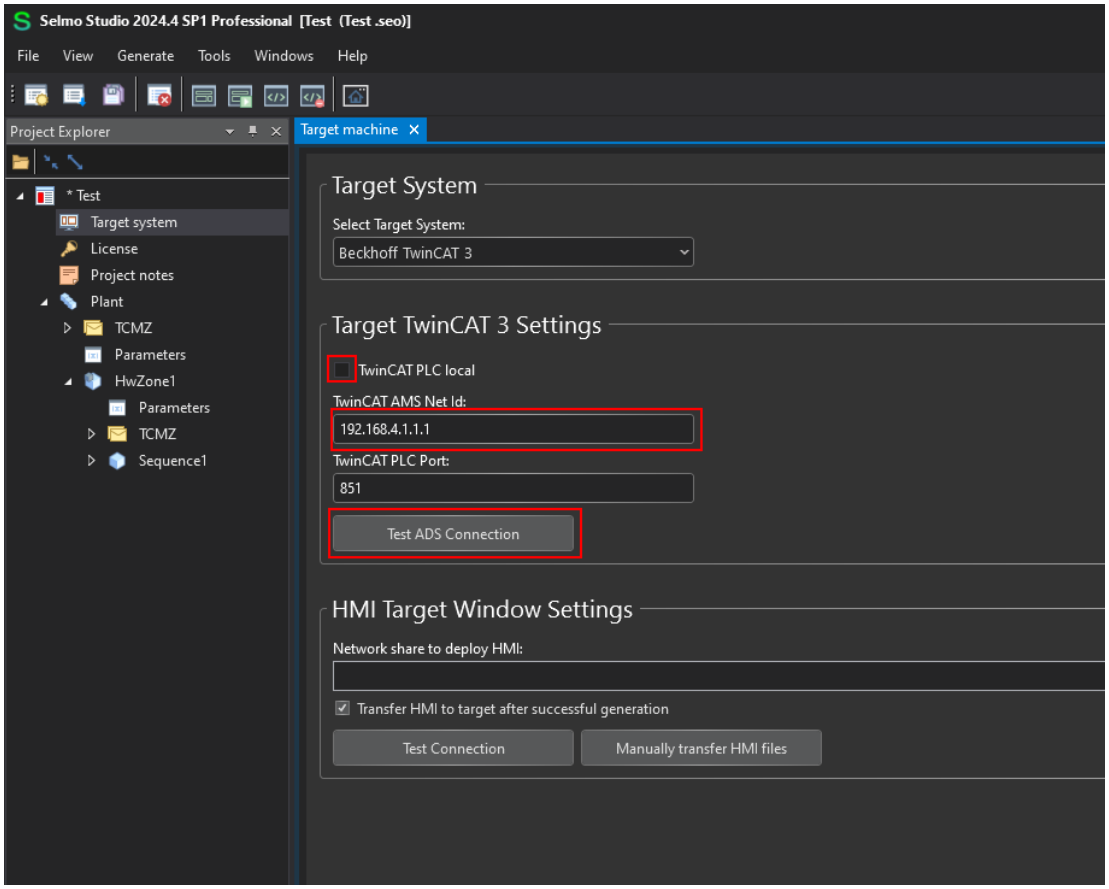
After that, the option "UmRT_Default" should be selectable in TwinCAT XAE under Target Systems:



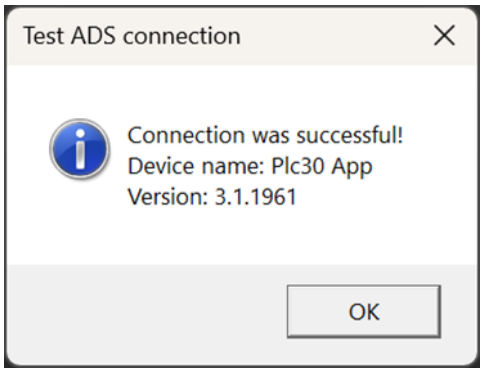
Then the configuration can be activated () and the runtime can be started.

The target system now has the NetId: 192.168.4.1.1.1

In Selmo Studio, this NetId must be entered under "Target System" in order to establish a successful connection with the HMI. In addition, the tick for "TwinCAT PLC local" must be removed.



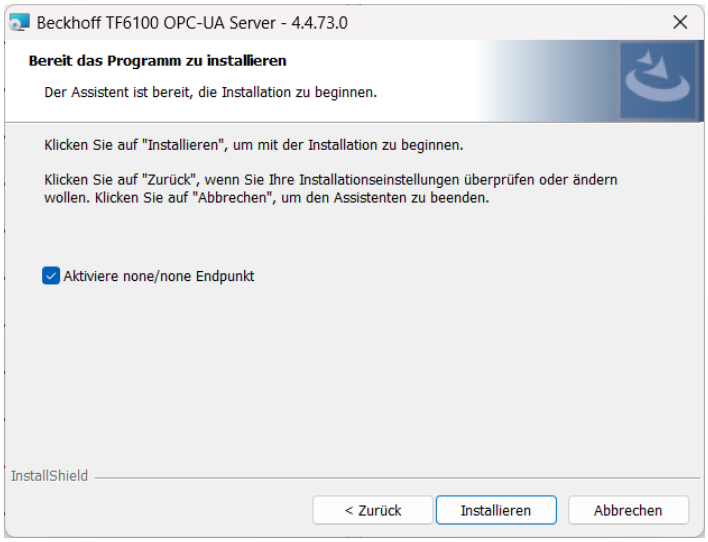
Afterwards, it is possible to check the connection by pressing the "Test ADS Connection" button. To do this, however, it is important to ensure that the runtime is in the RUN state. If a positive message is displayed, the HMI can be exported and started.



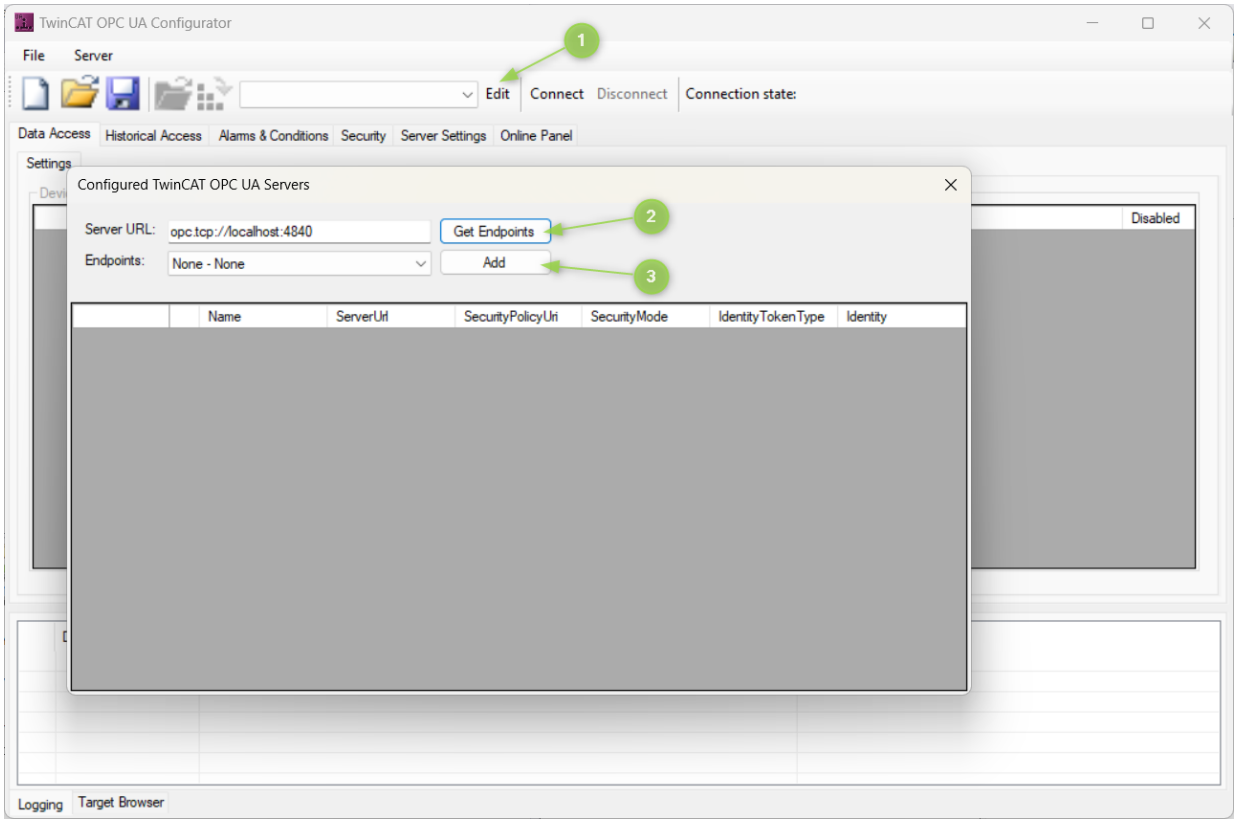
The Usermode Runtime can now be used with the limitations already mentioned.

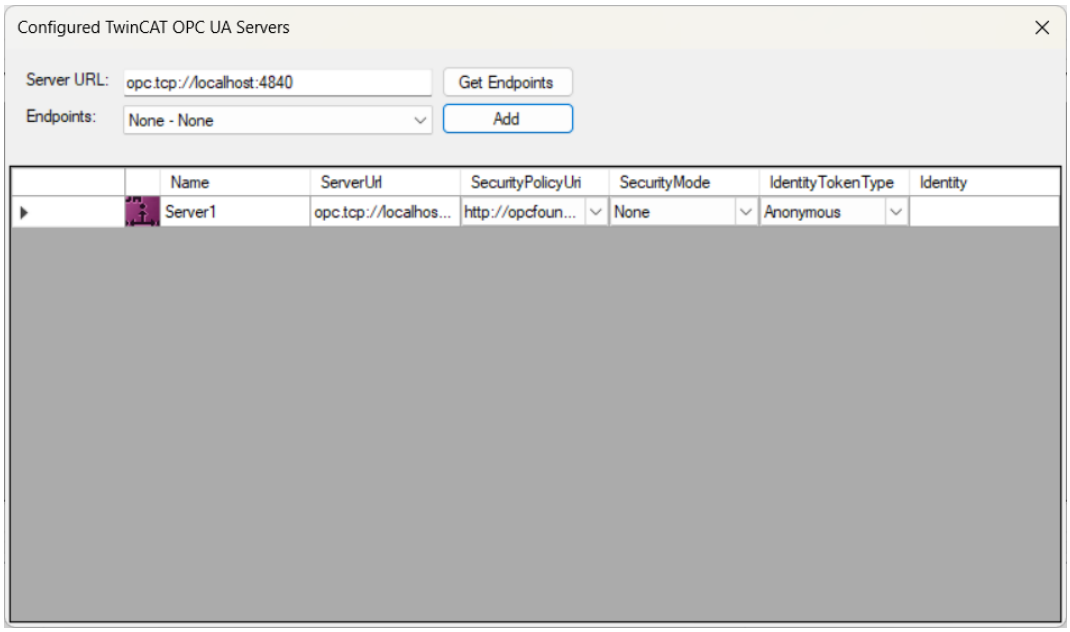
Installation and configuration of an OPC-UA server

The following section describes how to use an OPC-UA server. This can be installed on the local development computer as well as on the hardware PLC with Windows operating system.



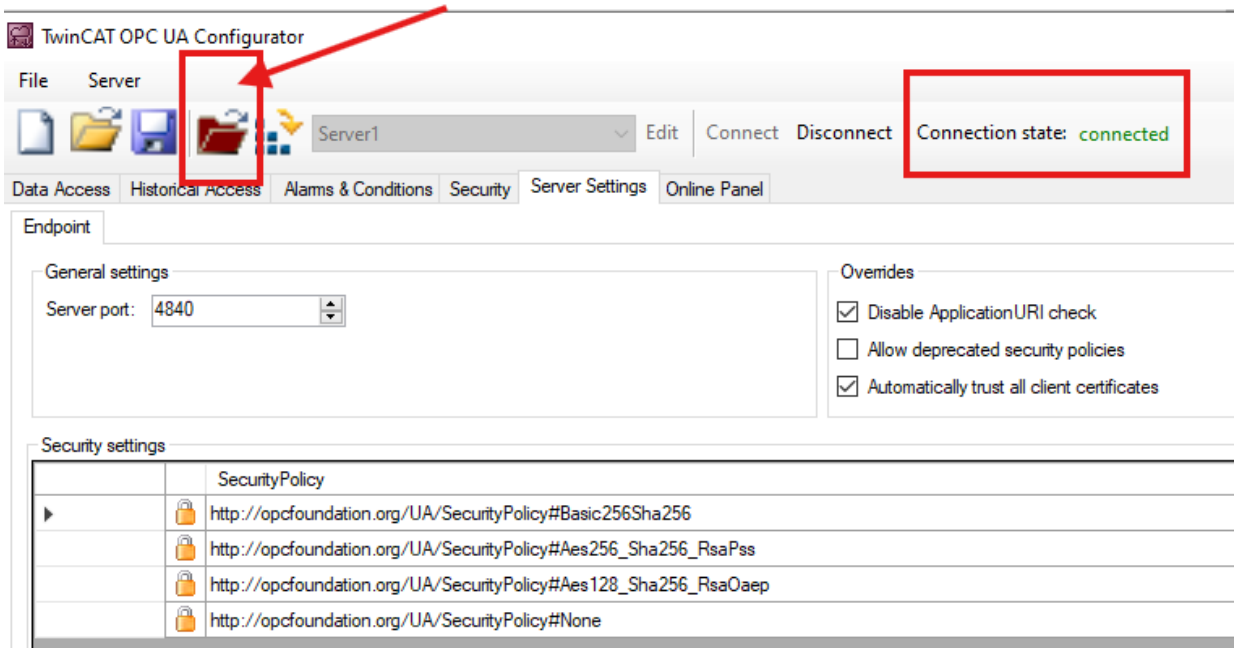
After completing the installation of the TF6100 OPC-UA server and the TF6100 OPC-UA configuration tool, the program is started and the endpoints are read out in the first step. First, a connection is established with the user admin and the password admin.



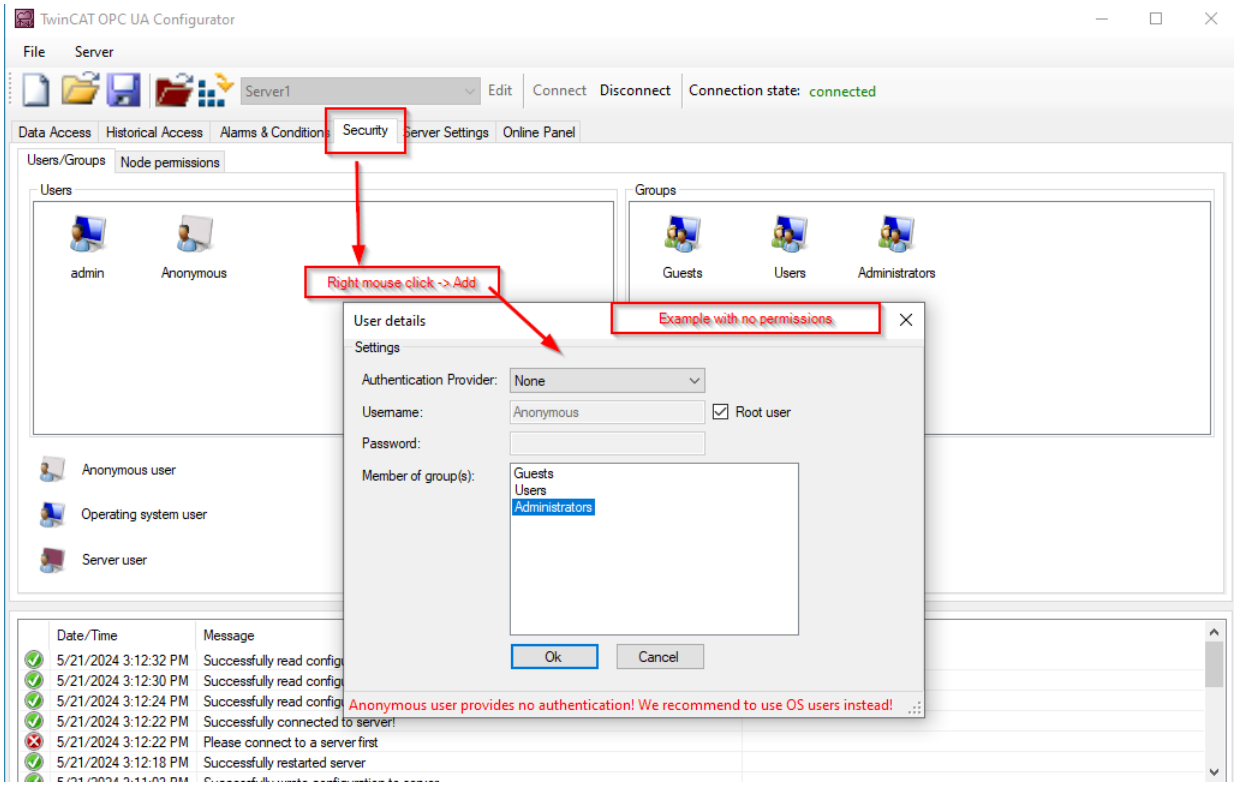


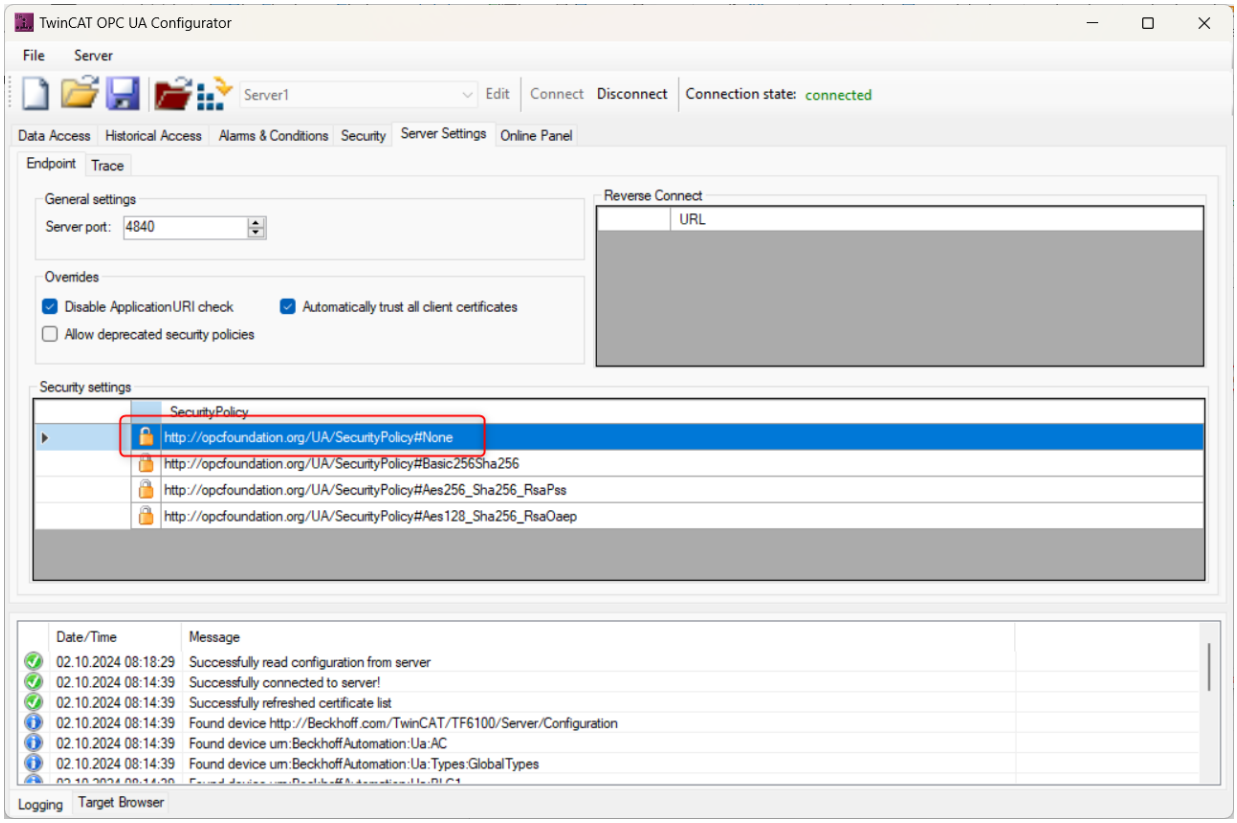
Read configuration from the device

- only works when connected to the server.
- reads the current settings from the running server.

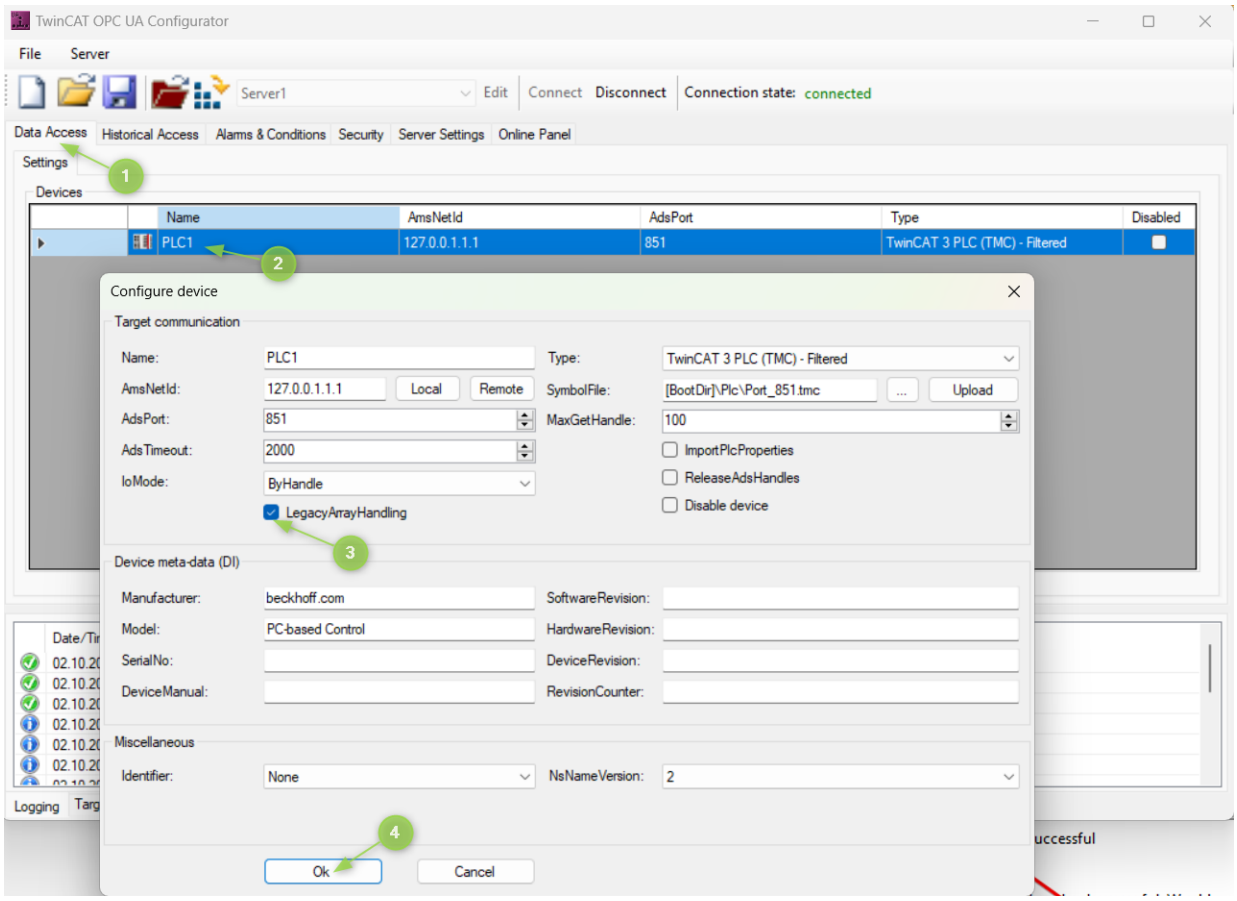


This is followed by an adjustment of the security guidelines. First the user Anonymous is created and then the user admin is removed. Afterwards, the menu item "Server settings" is supplemented by the option "None" and the corresponding line is moved up in the hierarchy.



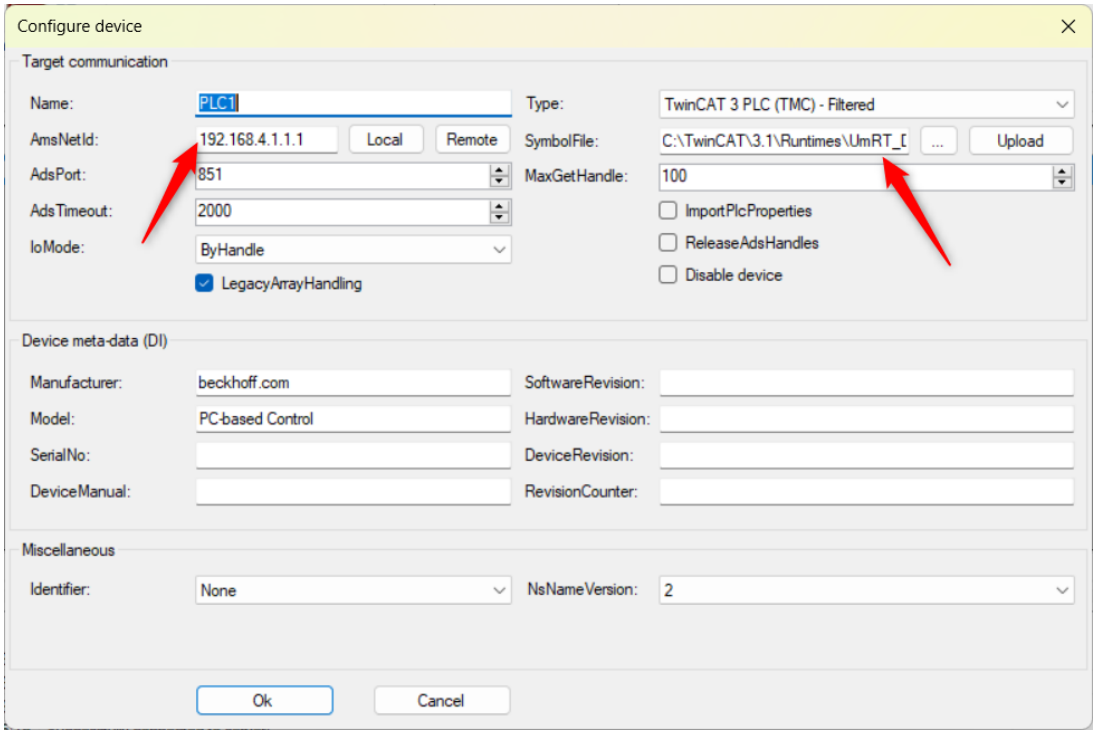


Under Settings → Data Access → Legacy/Array Handling, a check mark must be set.

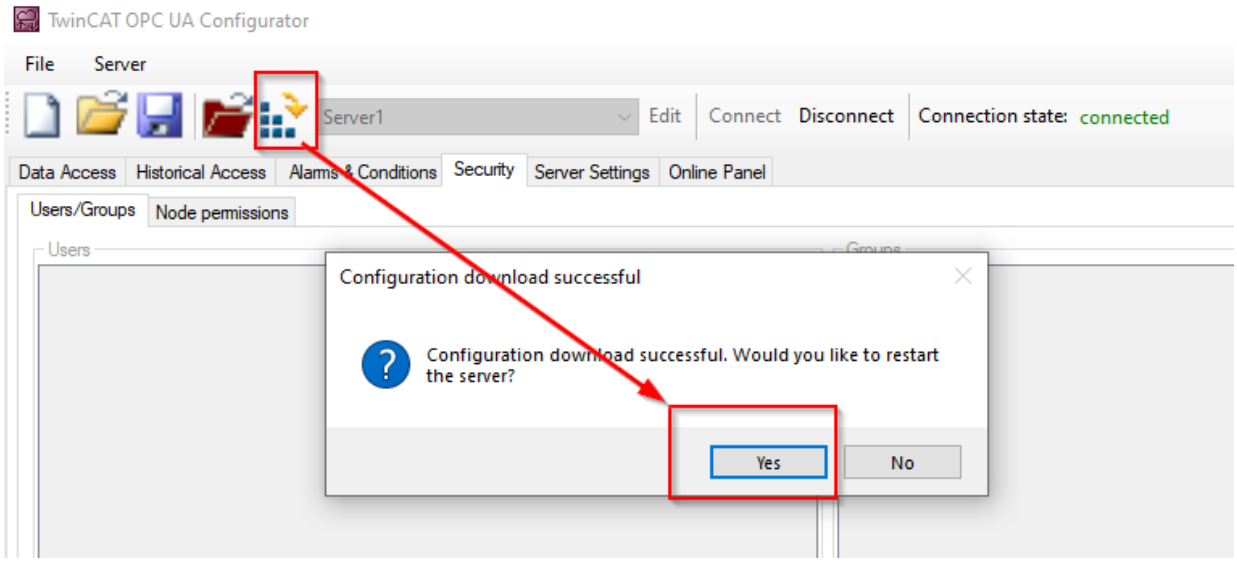

TwinCAT OPC UA Configurator
File
Server
Server1
Edit
Connect
Disconnect
Connection state: connected
Data Access
Historical Access
Alarms & Conditions
Security
Server Settings
Online Panel
Settings
Devices
Name
AmsNetId
AdsPort
Type
Disabled
PLC1
127.0.0.1.1.1
851
TwinCAT 3 PLC (TMC) - Filtered
Configure device
Target communication
Name:
PLC1
Type:
TwinCAT 3 PLC (TMC) - Filtered
AmsNetId:
127.0.0.1.1.1
Local
Remote
SymbolFile:
[BootDir]\Plc\Port_851.tmc
Upload
AdsPort:
851
MaxGetHandle:
100
AdsTimeout:
2000
ImportPlcProperties
IoMode:
ByHandle
ReleaseAdsHandles
LegacyArrayHandling
Disable device
Device meta-data (DI)
Manufacturer:
beckhoff.com
SoftwareRevision:
Model:
PC-based Control
HardwareRevision:
SerialNo:
DeviceRevision:
DeviceManual:
RevisionCounter:
Miscellaneous
Identifier:
None
NsNameVersion:
2
Ok
Cancel
1
2
3
4

ⓘ Note!!

When using User Mode Runtime on the local computer, an adjustment of the AmsNetId and the path to the TMC file is required. C:\TwinCAT\3.1\Runtimes\UmRT_Default\3.1\Boot\Plc\Port_851.tmc



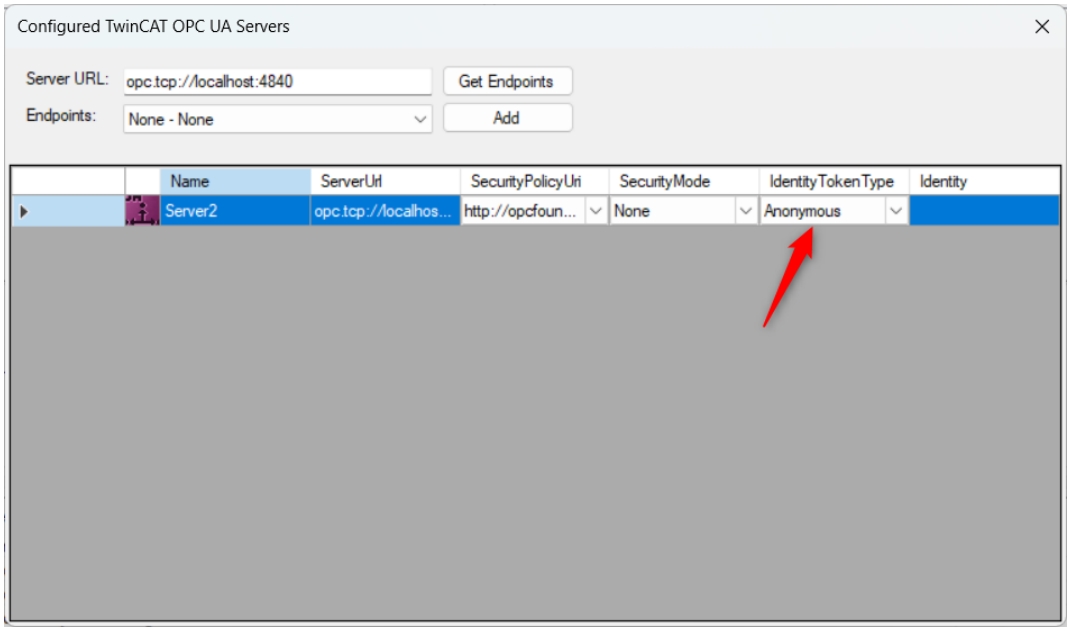
After that, the new configuration will be activated.



ⓘ Attention!!

Please note that special care should be taken when creating a configuration for the server. A faulty security configuration can result in you being locked out of the server.

The user "admin" is now deleted and the endpoints are re-imported. A new server is created with the login "Anonymous".



① Note!!

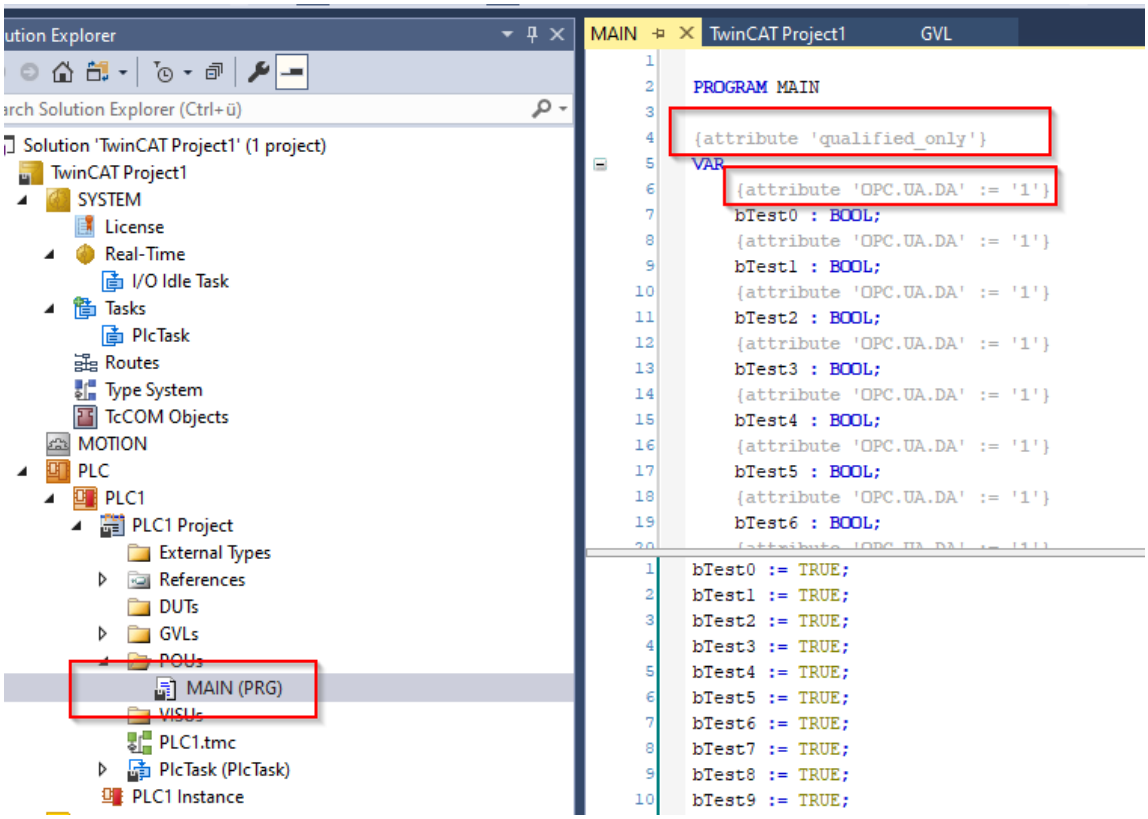
In some cases, it is necessary to restart the OPC UA server. In the worst case, a restart of the PC is necessary.

① Note!!

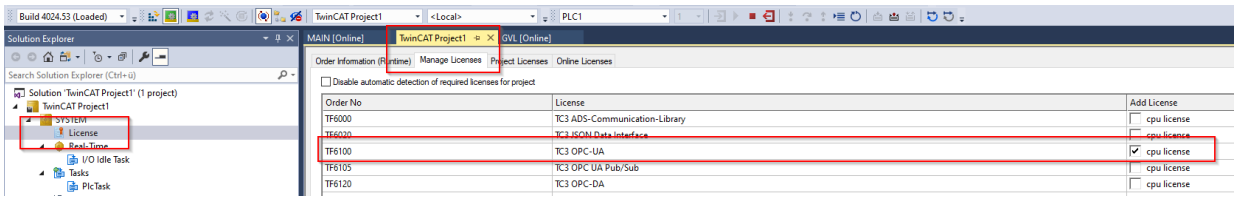
If a connection cannot be established by the OPC UA server, a new installation is recommended. After a successful reinstallation of the PC, it is advisable to restart the PC.

Adapting the PLC program for communication via OPC-UA

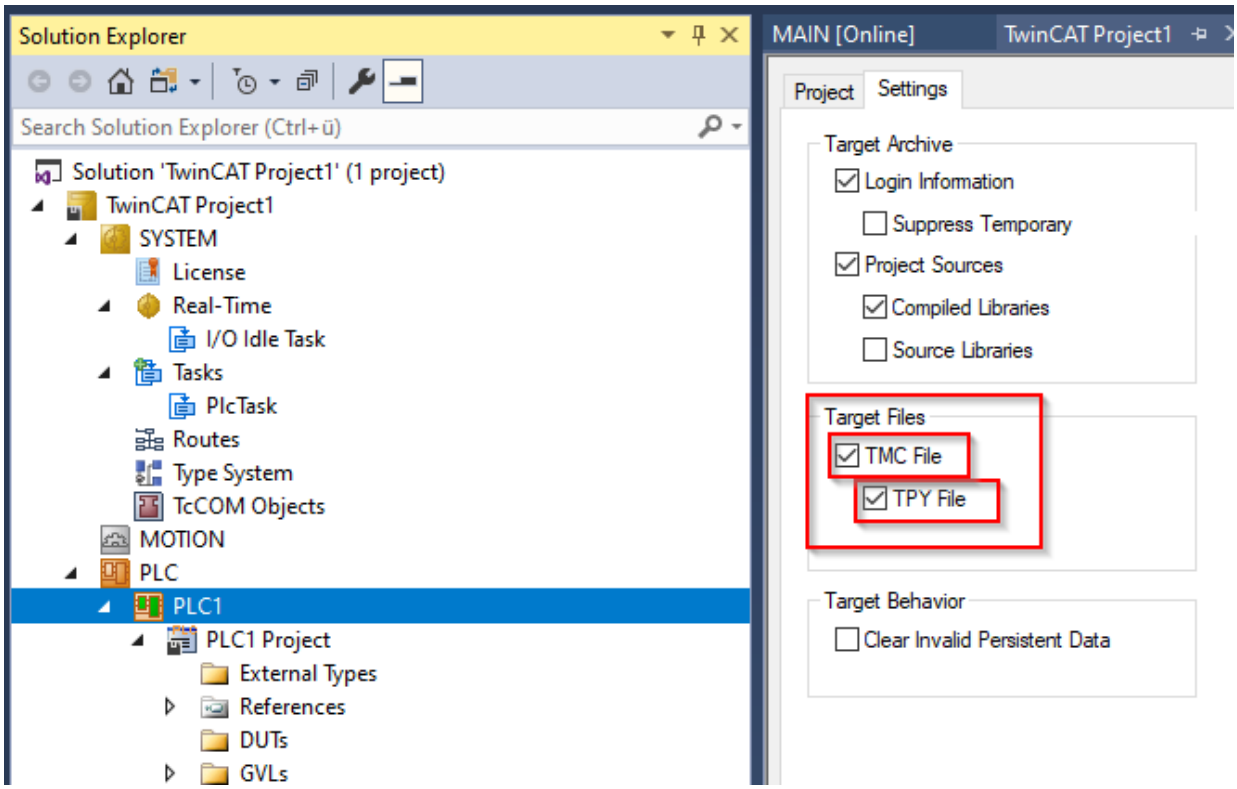
For each variable that is to be reachable via OPC-UA, the pragma *code {attribute 'OPC. UA.DA' := '1'}*.



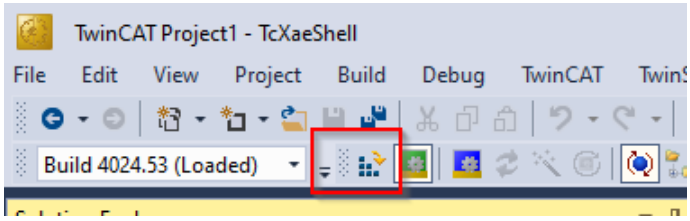
The TF6100 TC3 OPC-UA license must be added. Here, as with all others, the 7-day trial period applies.



In the settings of the PLC, under Settings → Target Files, check the box for TMC-File.

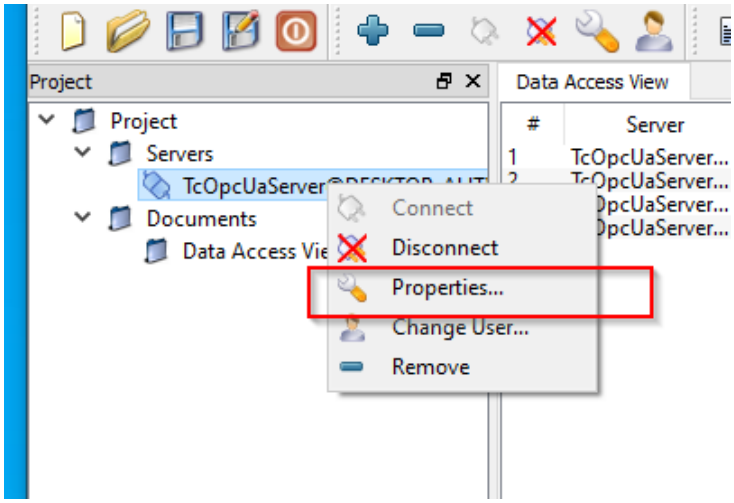


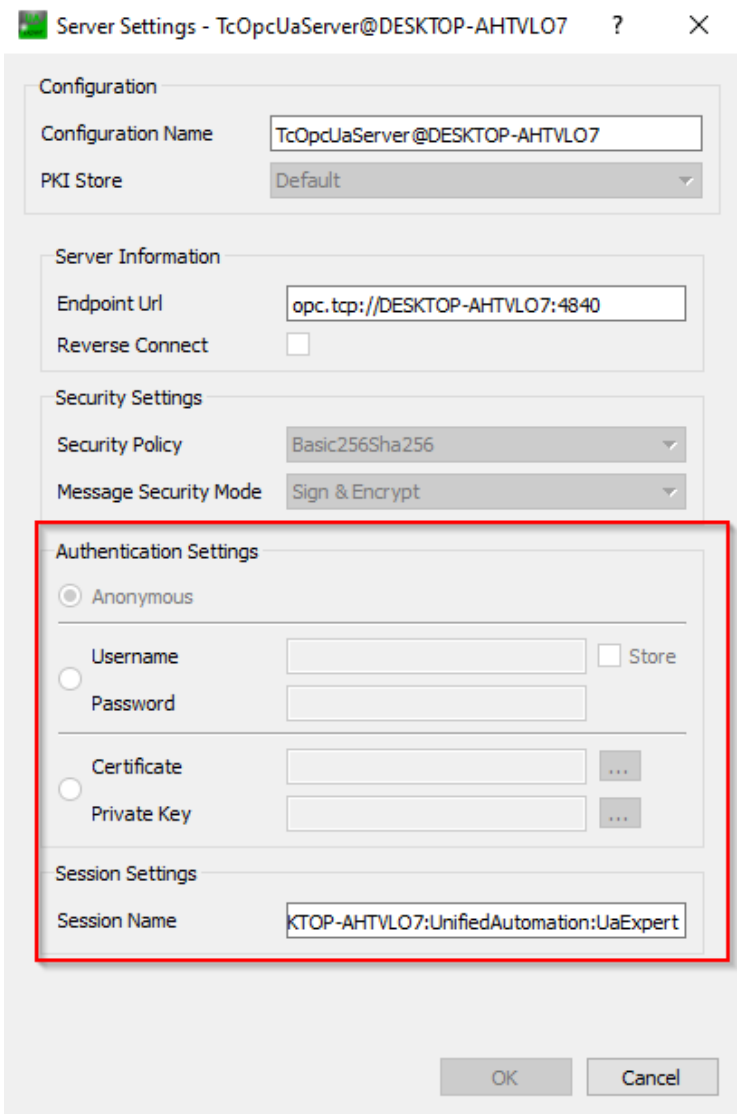
Now the program can be transferred to the runtime via "Activate configuration".



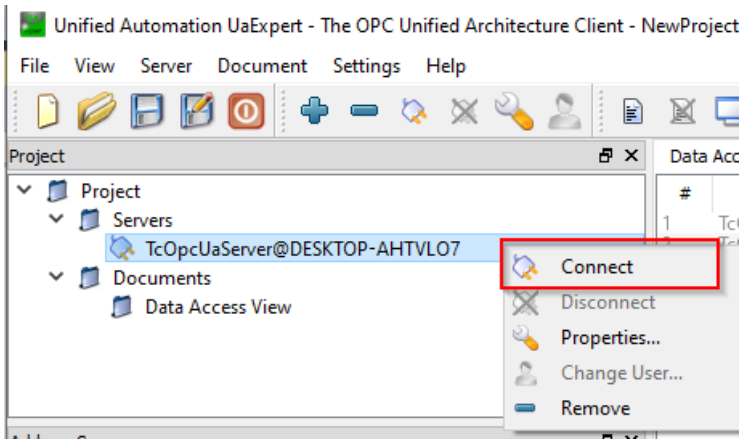
Checking the server with uaExpert

Settings login server:

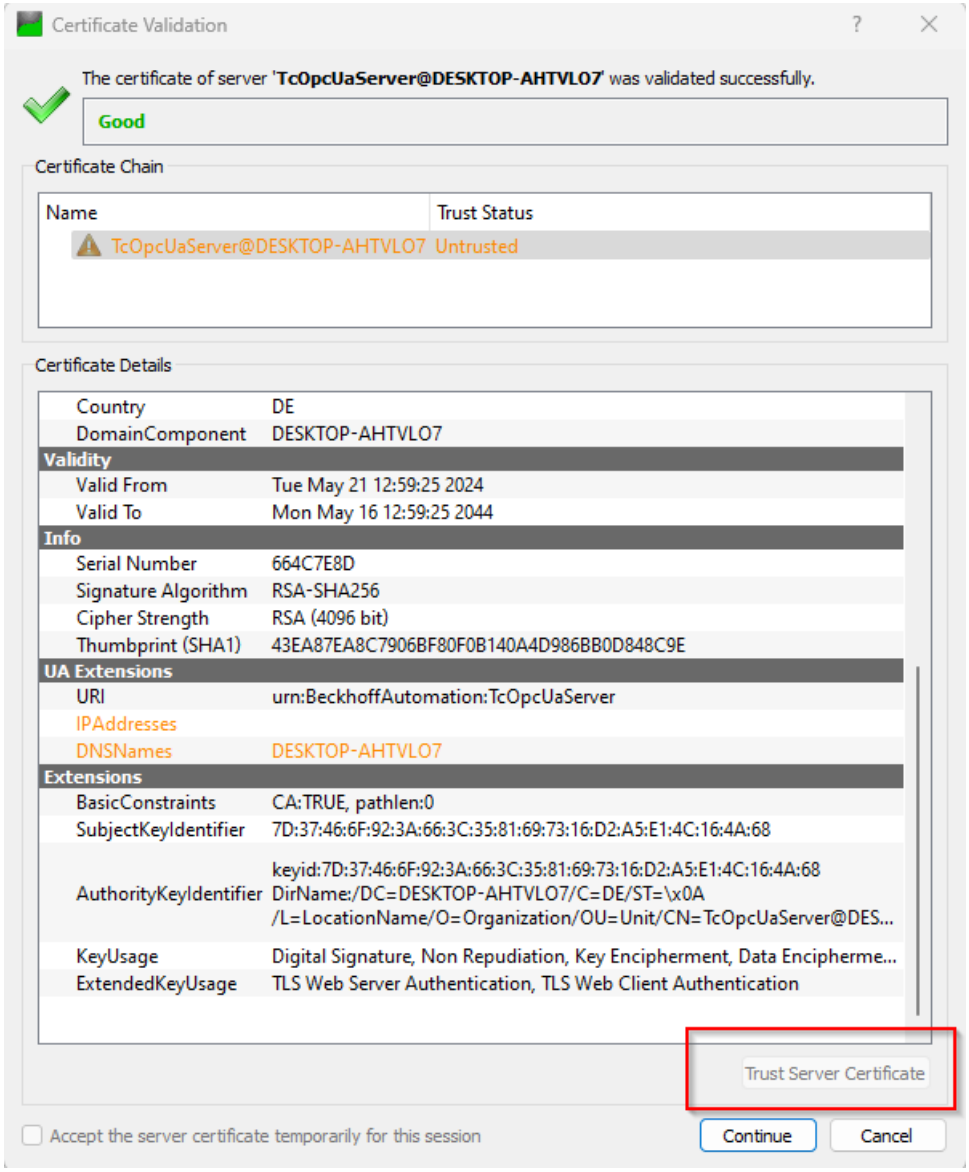




Connecting to the server:



Validate certificate:



Drag variables to the main window for viewing: