

OPERATION MANUAL

2511 EtherCAT Integration into TwinCAT

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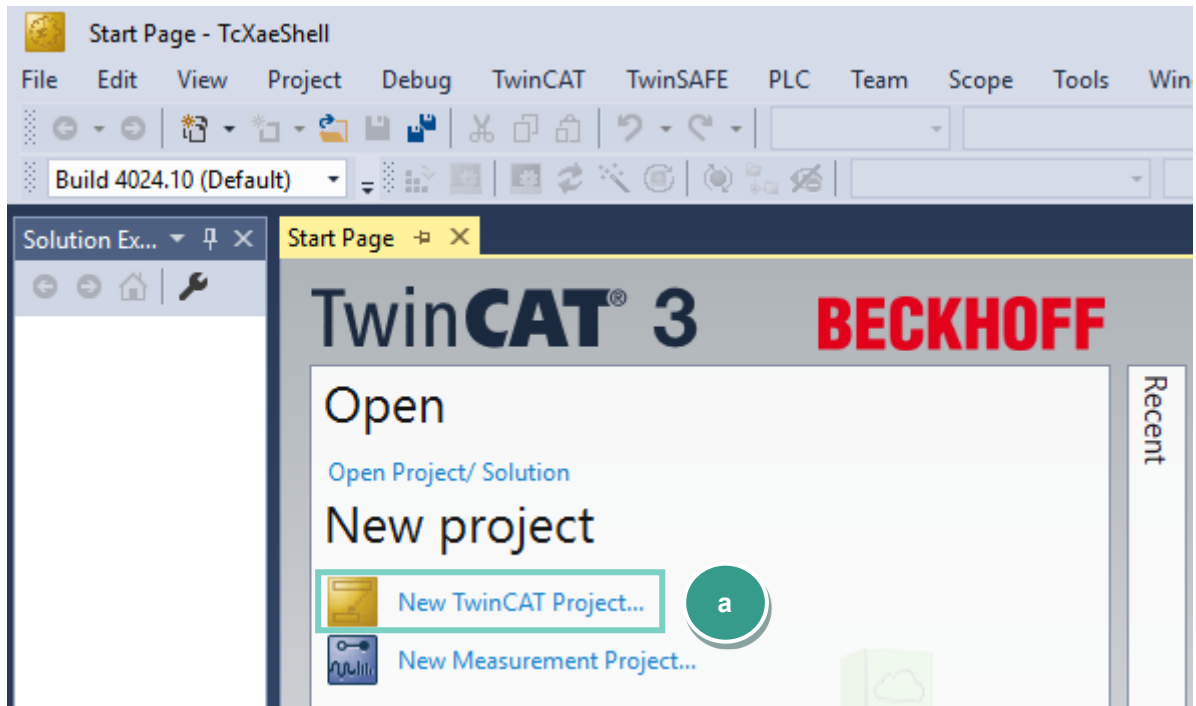
Introduction

This quick start guide describes an approach how you can configure the 2511 via Beckhoff TwinCAT using a Beckhoff PCI-Ethernet Card. Please note that the samples here cannot be directly used in your production line because they have been extremely simplified to reach a better understanding. Therefore, you may have to complete them by checking of status, error, length values etc.

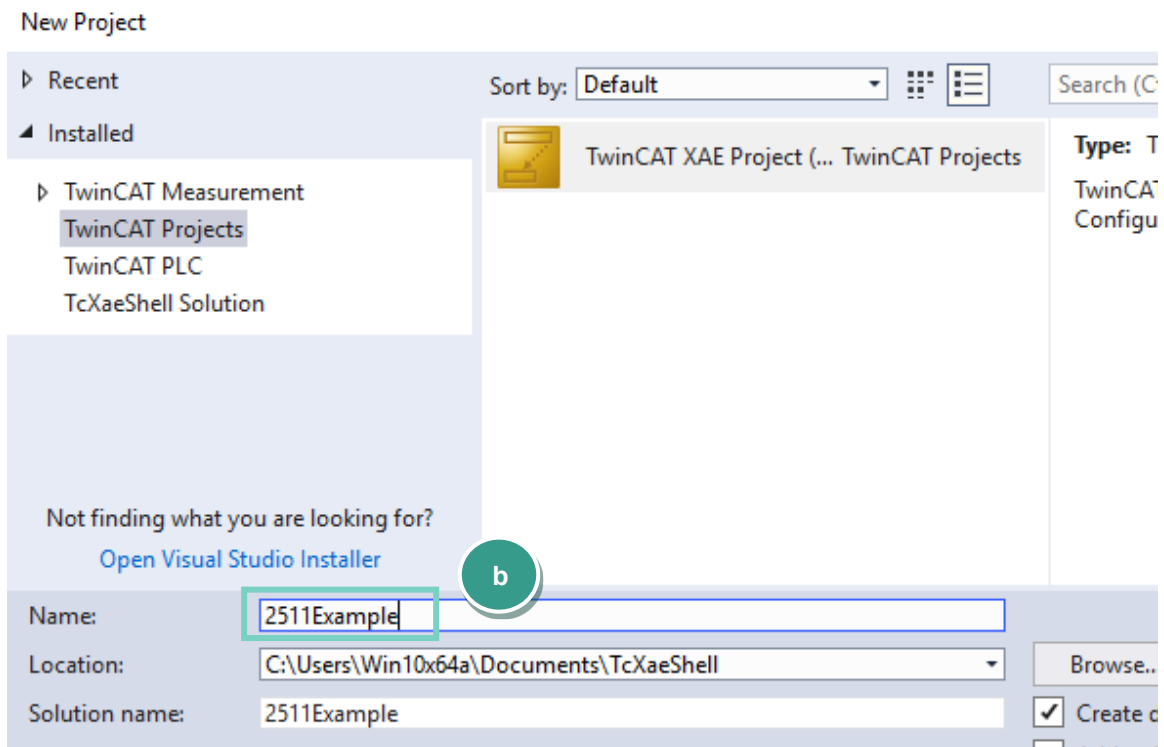
Please also note that you will have to use the 2511 manual to get further information about input and output parameters (cyclic as well acyclic data transfer)

1. Creating new project

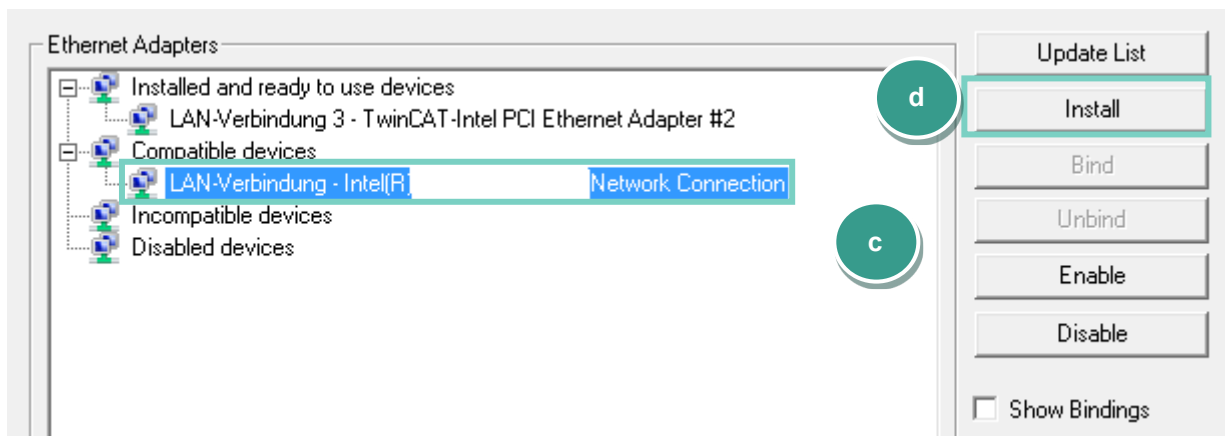
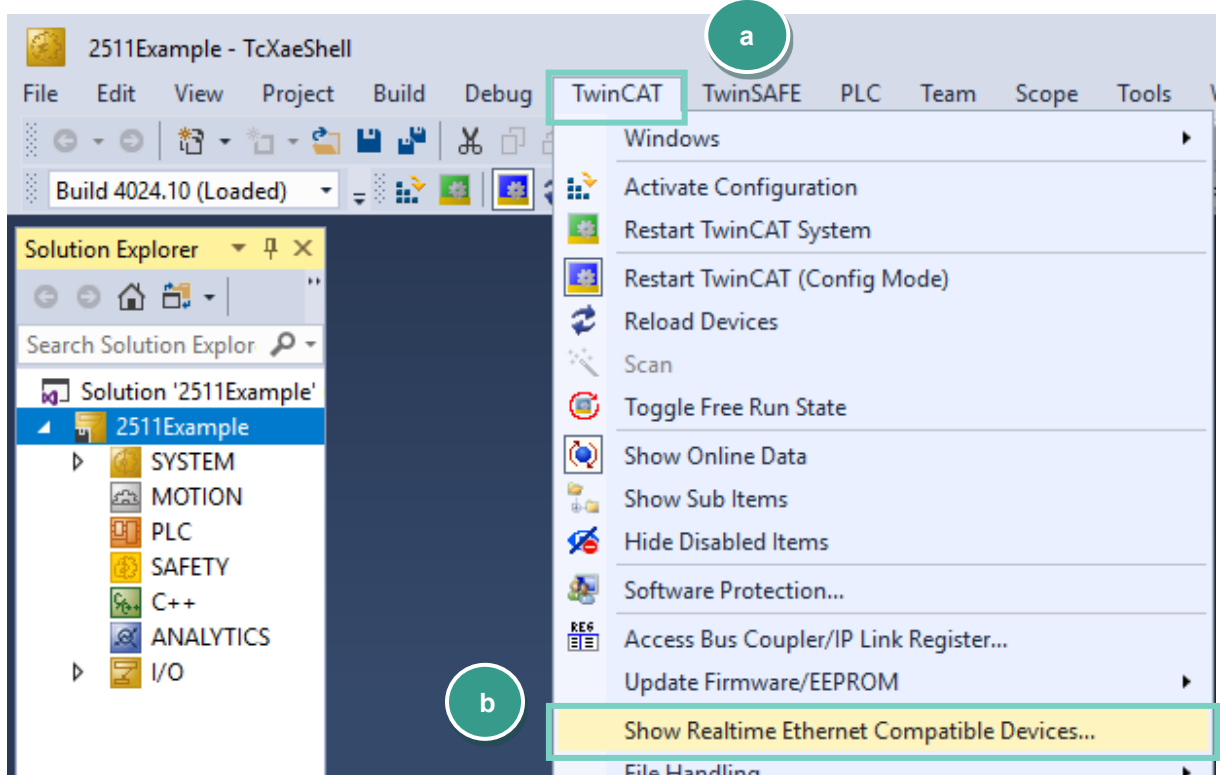
- Start the **TwinCAT XAE Shell** and click on **New TwinCAT Project** (or via **File** → **New Project**) (a)



- Select **TwinCAT XAE Project**, assign a project a name (b) and click **OK**



- Go to **TwinCAT** (a), select **Show Real Time Ethernet Compatible Devices...**(b) and look for you're a EtherCAT Master device under Compatible devices (c). Afterwards click the **Install** button (d).



2. Installation of ESI description files

Note: Please make sure that your ESI file is compatible to the field bus firmware in the 2511.

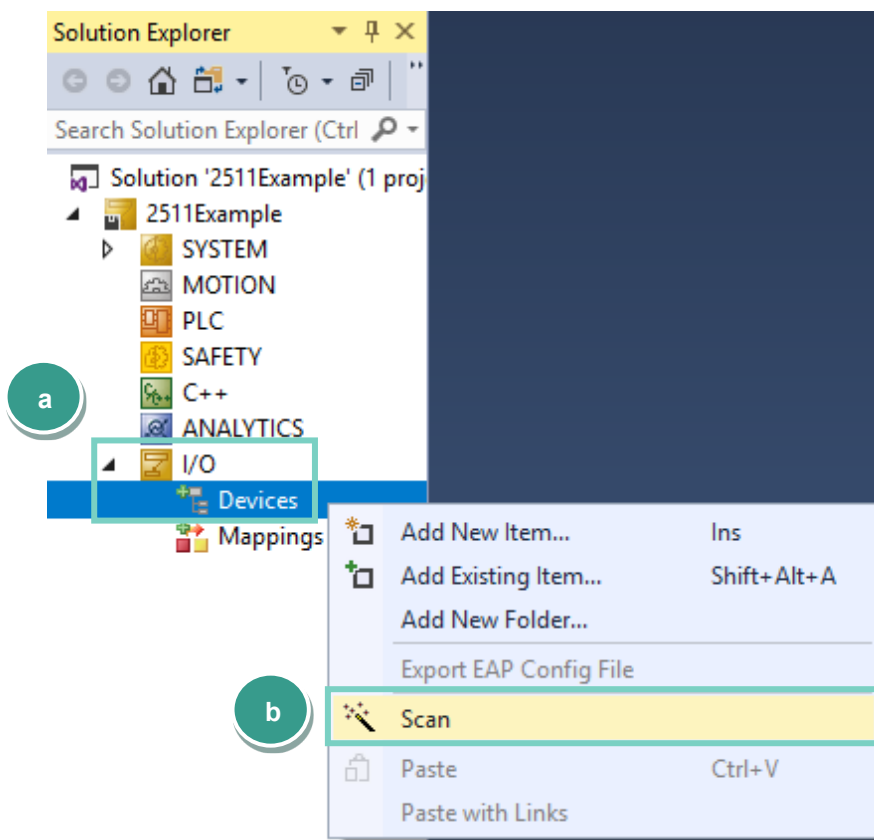
- Copy the ESI file into directory **C:\TwinCAT\3.1\Config\Io\OnboardIo** and additionally into **C:\TwinCAT\3.1\Config\Io\EtherCAT**

Note: you will find the corresponding ESI files on burster.com

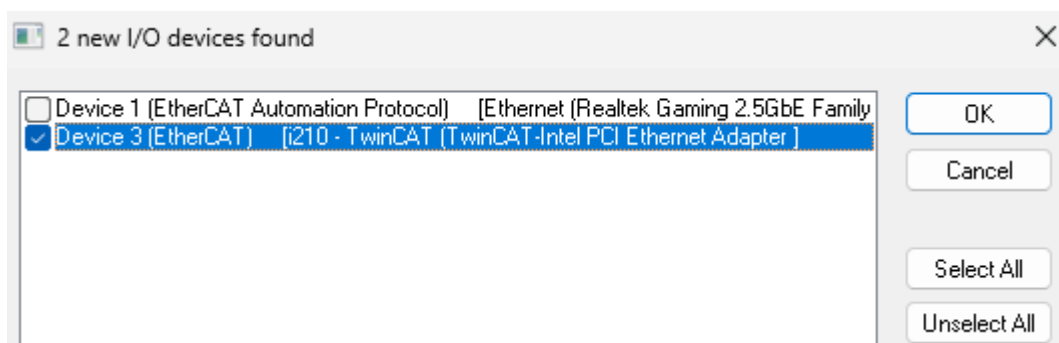
Note: If you use the TwinCAT 2 The ESI directory would be **C:\TwinCAT\Io\EtherCAT**

3. Scan EtherCAT devices

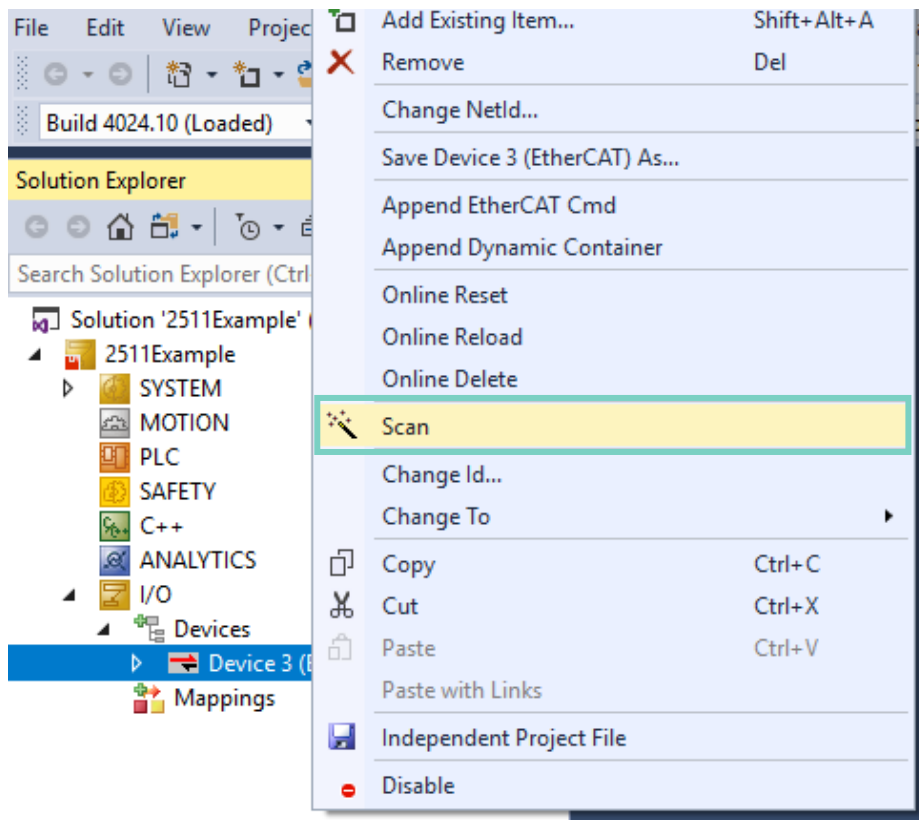
- Right click **I/O** → **Devices** (a) in the project tree und select **Scan** (b):



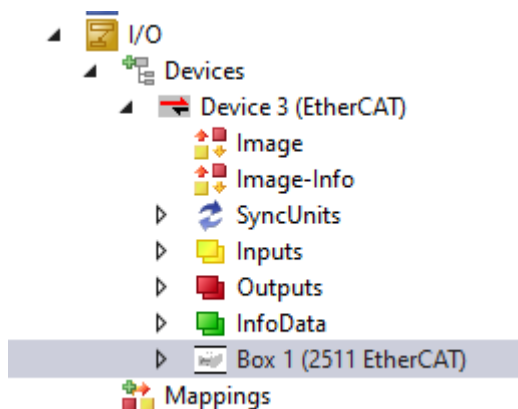
- Now, you can select an EtherCAT compatible device in the new window and click OK:



- At this point you are ready to connect the 2511 to your EtherCAT master and perform a device search by confirming the **Scan for boxes** request or later by right-clicking on the found EtherCAT device and selecting **Scan** in the context menu as shown below:



- If asked, confirm to use online description and after a while you should be able to see the 2511 device in the project tree:



- To see the process data, please click on the **2511 EtherCAT** in the project tree (a) and select the **Process Data** tab (b):

The screenshot shows the TwinCAT software interface for configuring a 2511 EtherCAT module. The Solution Explorer on the left (labeled 'a') shows the project structure with 'Box 1 (2511 EtherCAT)' selected. The main window (labeled 'b') displays the 'Process Data' tab for this device, showing Sync Manager, PDO List, PDO Assignment, and PDO Content settings.

Sync Manager:

SM	Size	Type	Flags
0	276	MbxOut	
1	276	MbxIn	
2	8	Outputs	
3	88	Inputs	

PDO List:

Index	Size	Name
0x1A00	88.0	Transmit PDO
0x1600	8.0	Receive PDO

PDO Assignment (0x1C12):

- 0x1600

PDO Content (0x1A00):

Index	Size	Offs	Nar
0x23E9:01	1.0	0.0	RE
0x23E9:02	1.0	1.0	DE
0x23E9:03	1.0	2.0	CH
0x23E9:04	1.0	3.0	CH

Download:

- PDO Assignment
- PDO Configuration

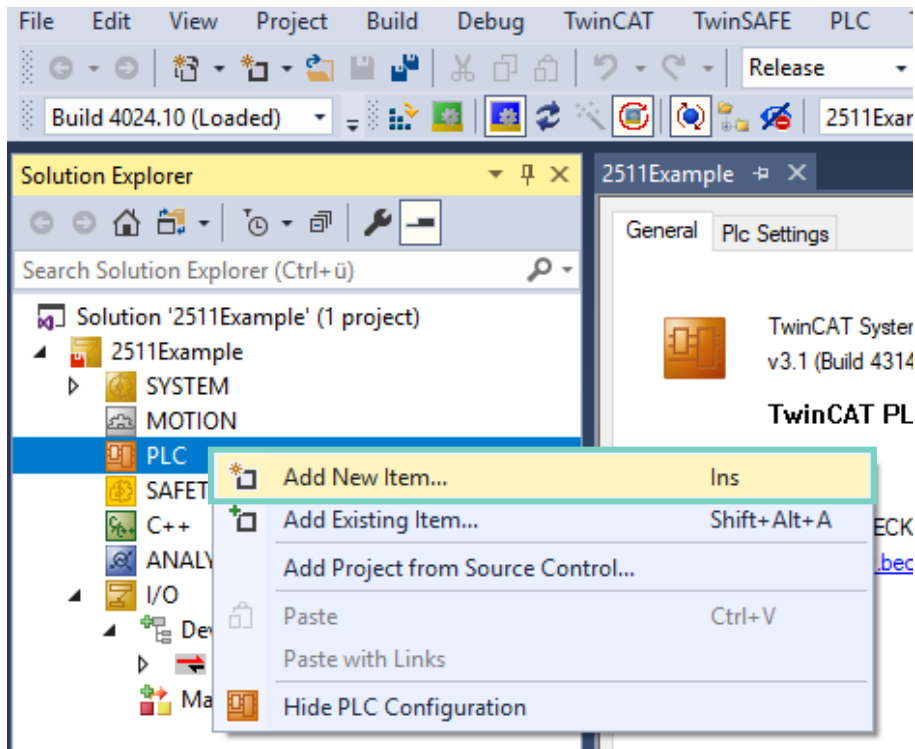
Predefined PDO Assignment: (none)

Load PDO info from device:

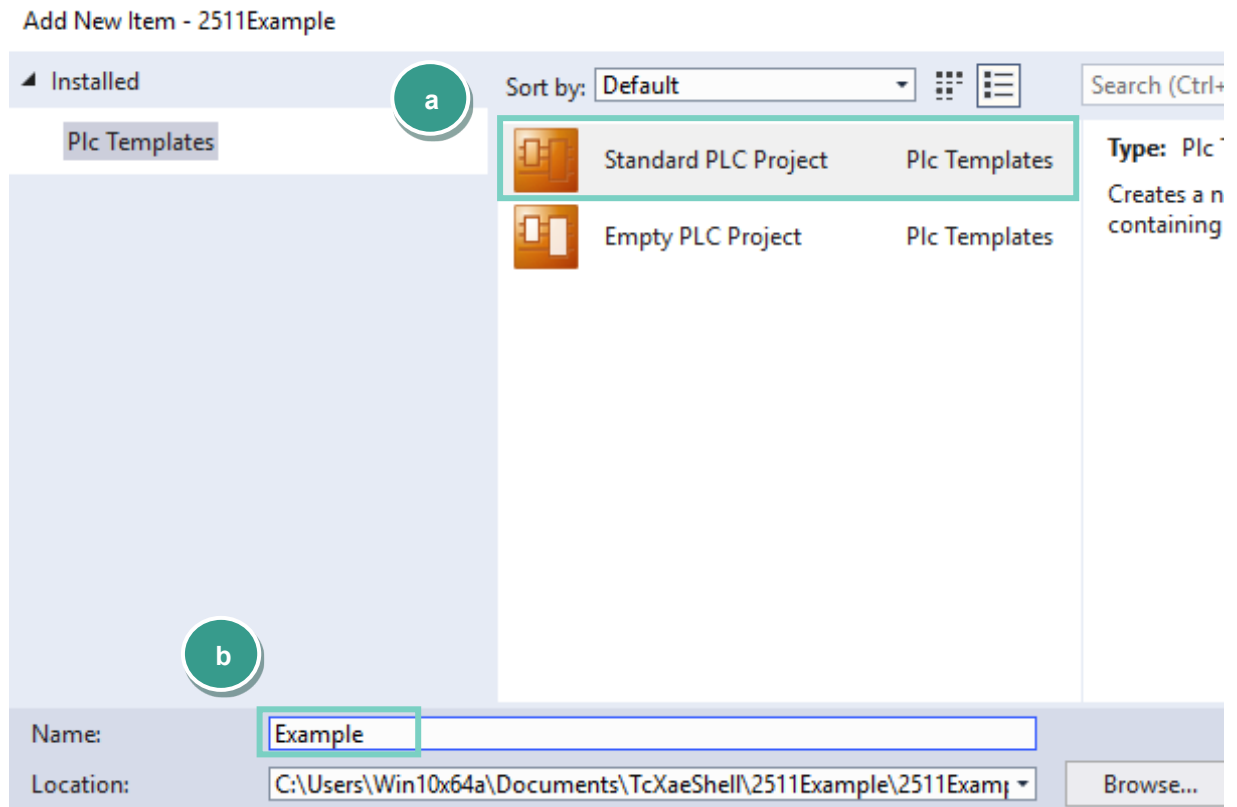
4. Create a sample program

In this section, you will learn how to create a simple PLC program to execute a measurement via PDO (Process Data Object). You will need to refer to **2511 EtherCAT Manual** documentation to understand the meaning of input bytes.

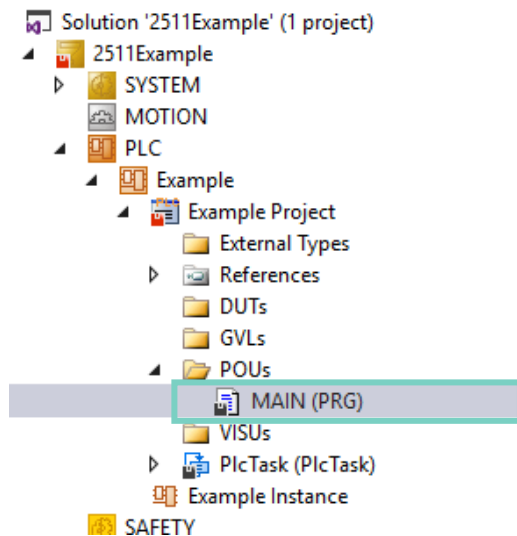
- Right-click **PLC** in the project tree and select **Add New Item...**



- Select **Standard PLC Project** (a) in the **Add New Item** dialog, enter **Example** as project name (b) and click **Add**



- Next, open the **MAIN (PRG)** file from **PLC** → **Example Project** → **POUs** with double click on it:



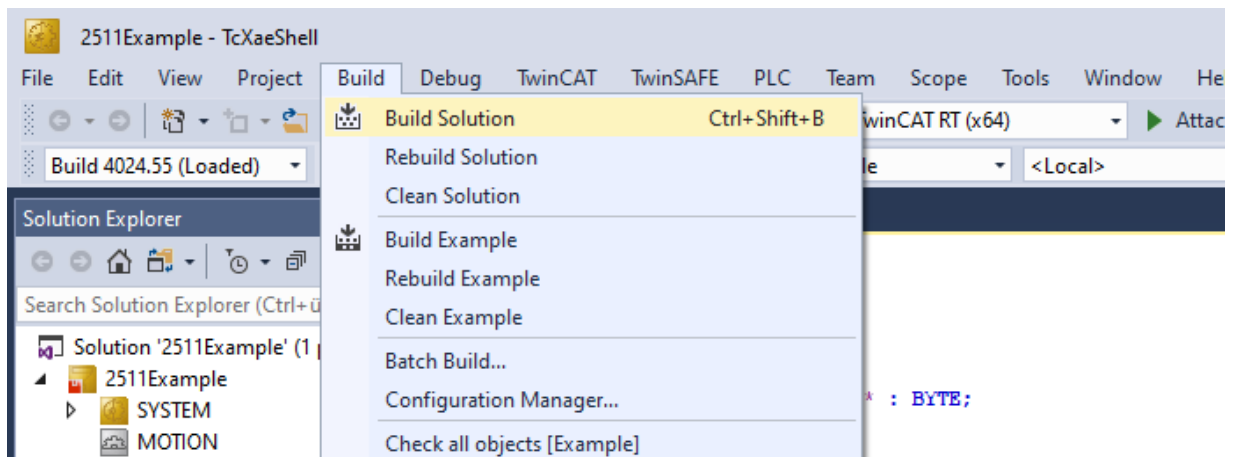
Example 1: Reading and Writing of PDOs

- Type in the following text in the **MAIN** block

```

2511Example  MAIN  X
1  PROGRAM MAIN
2  VAR
3  END_VAR
4
5  VAR_INPUT
6      statusByte AT%I* : BYTE;
7  END_VAR
8
9  VAR_OUTPUT
10     ctrlByteA AT%Q* : BYTE;
11     ctrlByteB AT%Q* : BYTE;
12 END_VAR
13
1  ctrlByteA.0 := FALSE; //reset "start measurement" Bit
2
3  IF statusByte.0 THEN //if "ready bit" is set
4      ctrlByteA.0 := TRUE; //start measurement
5  END_IF
    
```

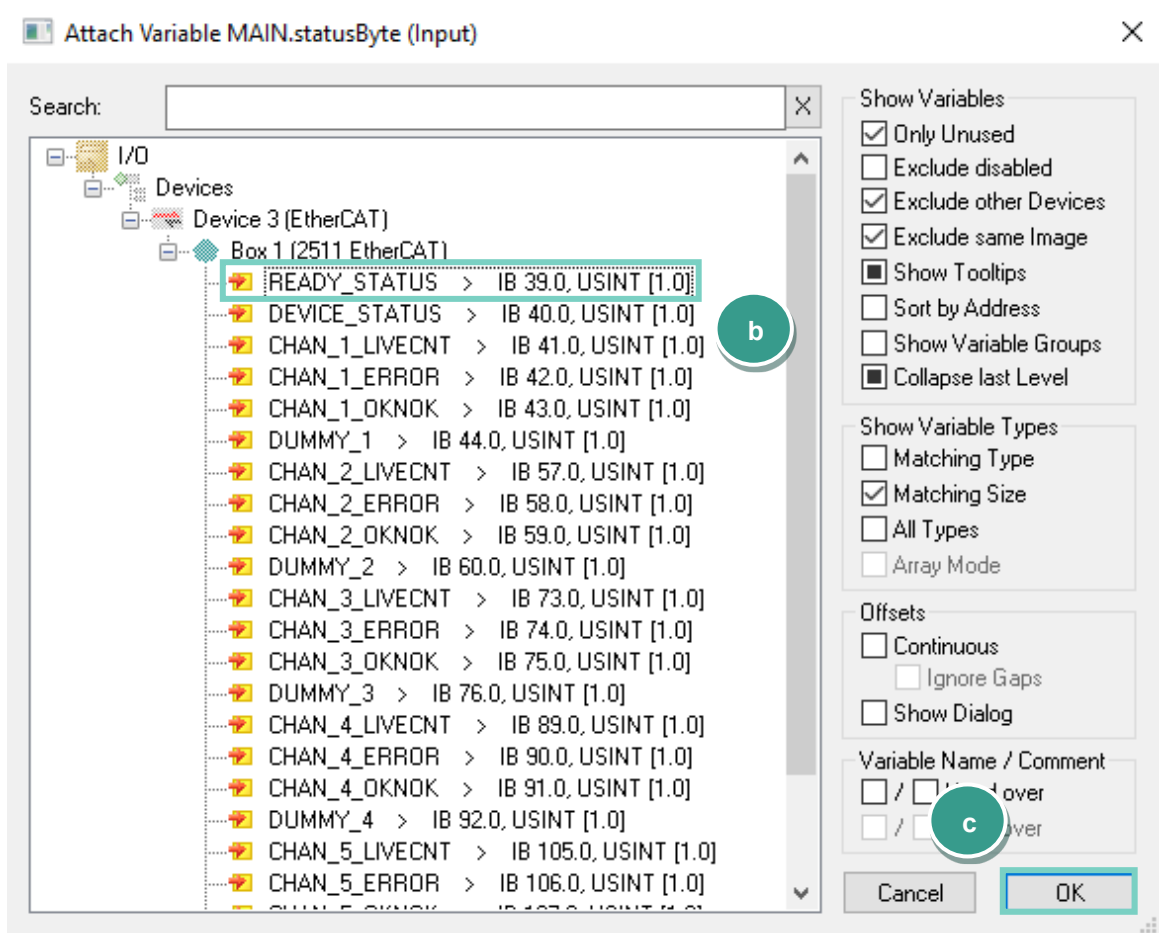
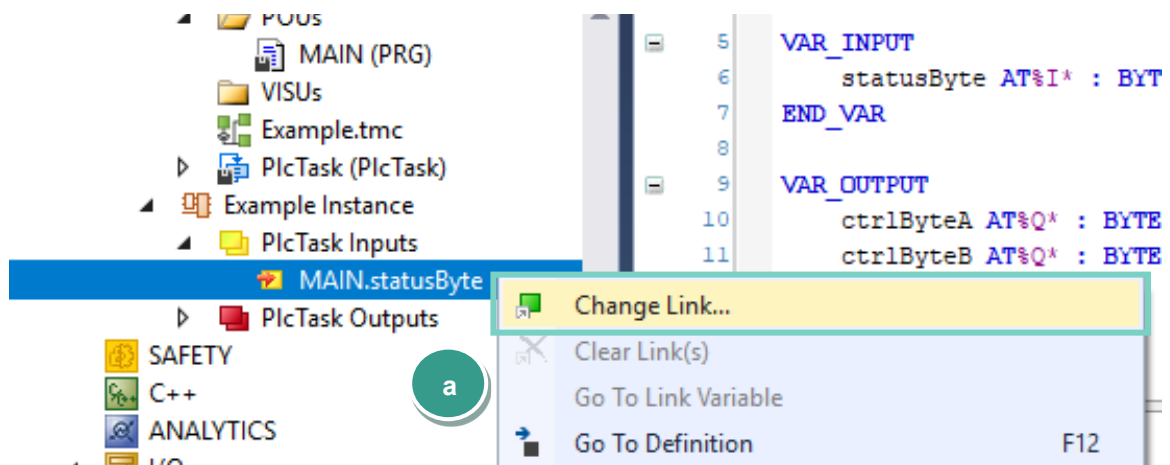
- Goto **Build** → **Build Solution**



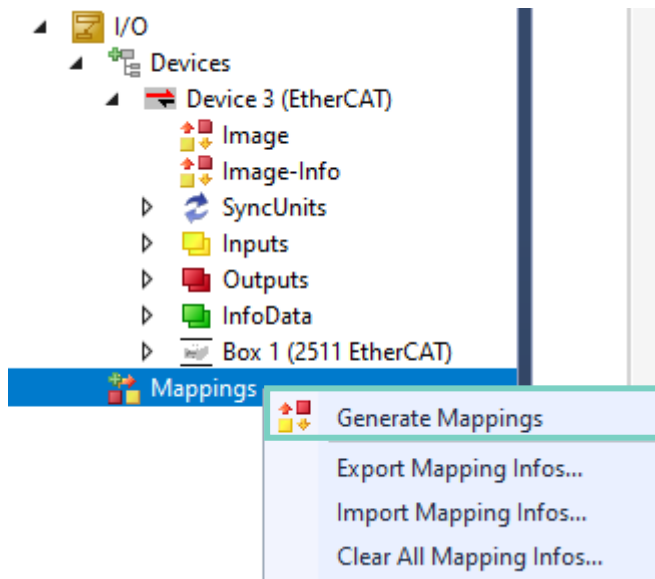
- Assign the **input** and **output** variables to the corresponded PDOs with the right-click on a variable and select **Change Link...**(a) from the context menu, select a corresponded PDO (b) and click OK (c):

Assignment:

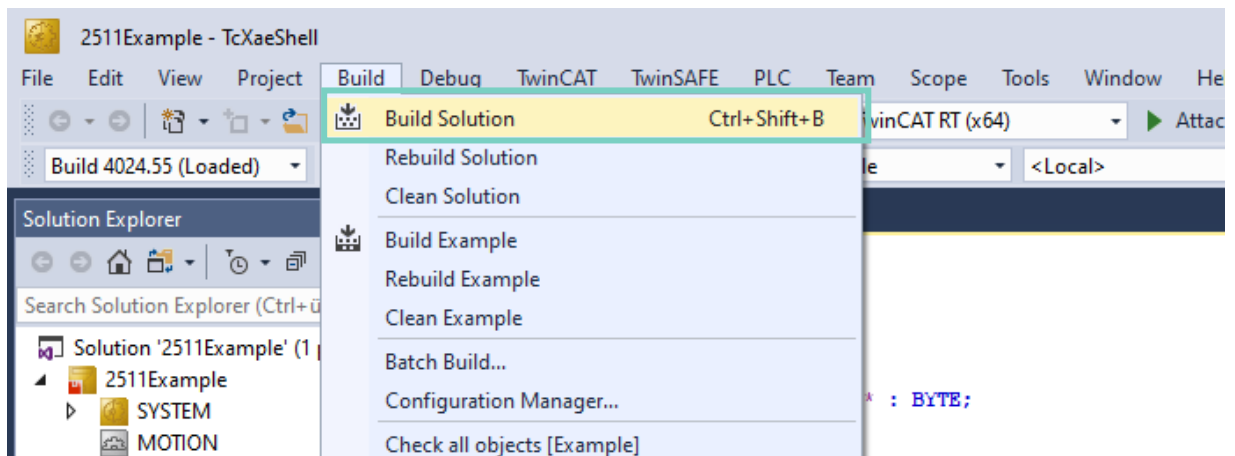
MAIN.statusByte → READY_STATUS
 MAIN.ctrlByteA → CONTROL_A
 MAIN.ctrlByteB → CONTROL_B



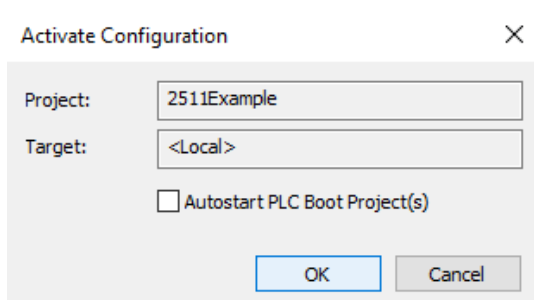
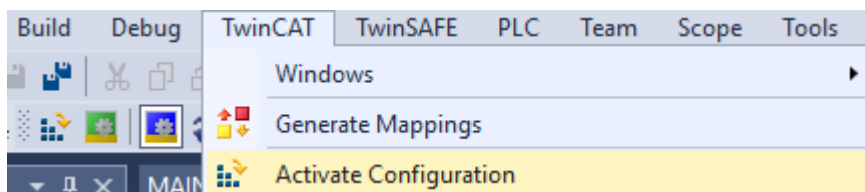
➤ Right-click **Mappings** → **Generate Mapping**:



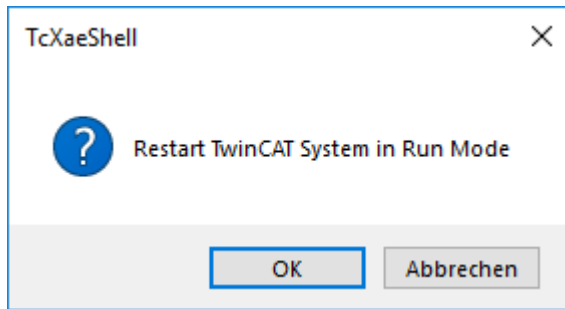
- Goto **Build** → **Build Solution** to build the project:



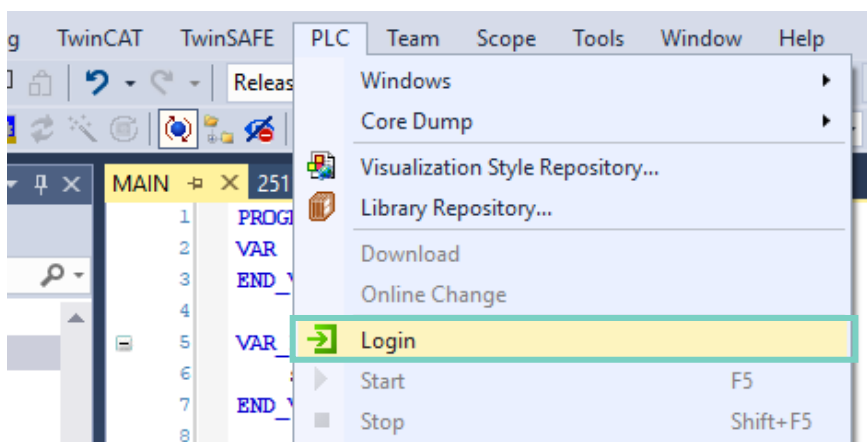
- Activate configuration via **TwinCAT** → **Activate Configuration**



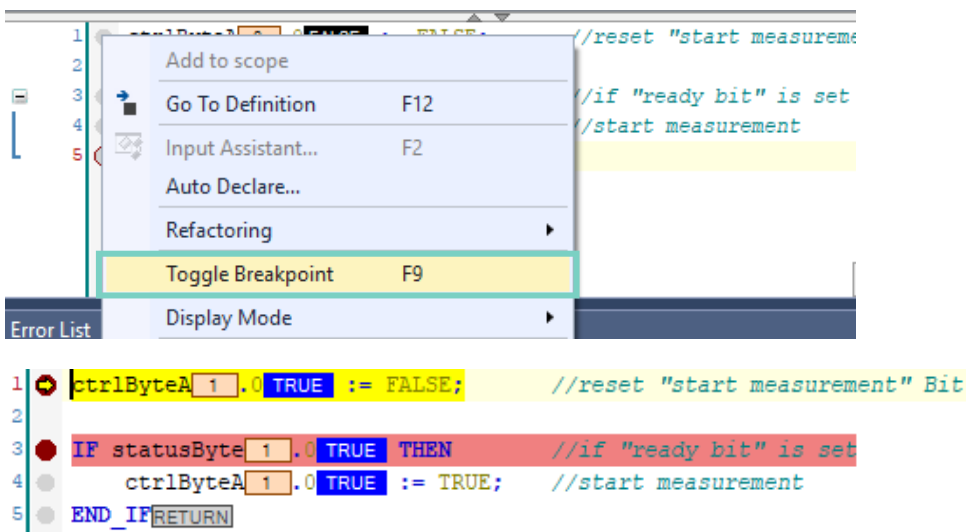
- Confirm starting in **Run Mode**:



- Goto **PLC** → **Login**: and if asked, confirm that program should be downloaded into the controller



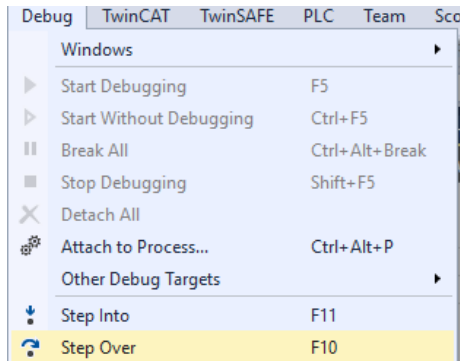
- Set a breakpoint (F9 or right-click → Toggle Breakpoint) to the first line to control the program execution step by step:



- Press the F5 key or click on the green start symbol to start the program execution:



- Execute the program line by line with the key **F10** oder via **Debug** → **Step over**



- The first bit of the control byte A will be set and a measurement will be started if the first bit of the status byte (ready bit) is set:

```

1  ● ctrlByteA 0 .0 FALSE := FALSE; //reset "start measurement" Bit
2
3  ● IF statusByte 1 .0 TRUE THEN //if "ready bit" is set
4      ctrlByteA 0 .0 FALSE := TRUE; //start measurement
5  END_IF RETURN

1  ● ctrlByteA 1 .0 TRUE := FALSE; //reset "start measurement" Bit
2
3  ● IF statusByte 1 .0 TRUE THEN //if "ready bit" is set
4      ctrlByteA 1 .0 TRUE := TRUE; //start measurement
5  END_IF RETURN
    
```

- To start another measurement the “start measurement” bit has to be reset (first line). Otherwise the “ready bit” will remain false and no measurement will be executed.
- In the project tree select **Box_1 (2511 EtherCAT)** → **Transmit PDO Mapping** (a) to control the results. The CHAN_1_LIVECNT increments with each measurement (b) and the current measurement values (c) are shown for each channel

Name	[X]	Online	Type
READY_STATUS	X	1	USINT
DEVICE_STATUS		0	USINT
CHAN_1_LIVECNT		5	USINT
CHAN_1_ERROR		0	USINT
CHAN_1_OKNOK		0	USINT
DUMMY_1		0	USINT
CHAN_1_MEAS_RAC		54.622101	REAL
CHAN_1_MEAS_RDC		64.699501	REAL
CHAN_1_MEAS_UBAT		3.8487799	REAL
CHAN_2_LIVECNT		0	USINT
CHAN_2_ERROR		255	USINT
CHAN_2_OKNOK		0	USINT
DUMMY_2		0	USINT
CHAN_2_MEAS_RAC		909089.0	REAL
CHAN_2_MEAS_RDC		909089.0	REAL
CHAN_2_MEAS_UBAT		909089.0	REAL
CHAN_3_LIVECNT		0	USINT
CHAN_3_ERROR		255	USINT

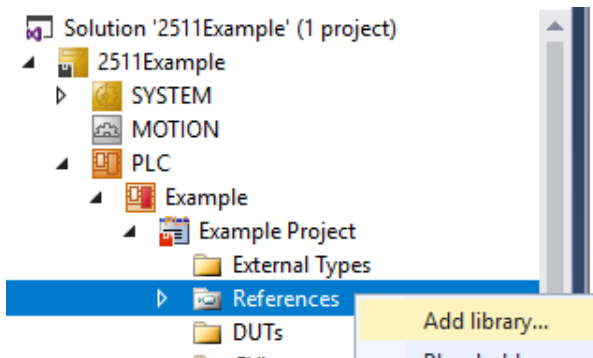
5. Further Examples

5.1 Read and Write of 'real' data types

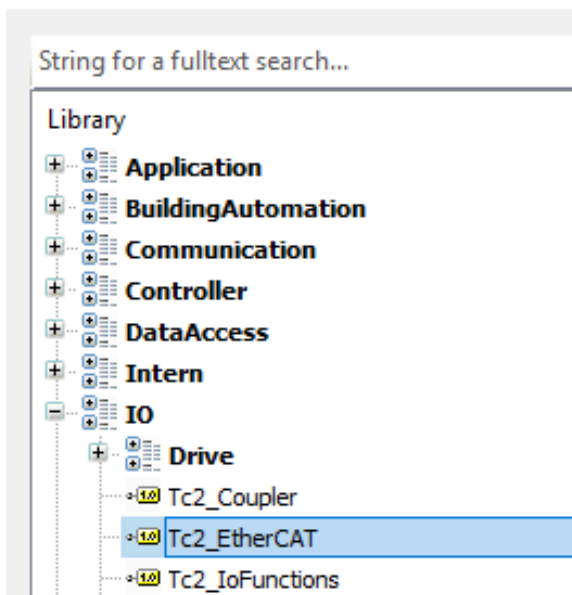
Example 2: Set and Get the Lower Limit R_{DC} for Channel 1

This example shows you how to write and read the Lower Limit R_{DC} for Channel 1

- Add the **Tc2_EtherCAT** library to your project to be able to use *FB_EcCoESdoRead* and *FB_EcCoESdoWrite* function blocks via **References** → **Add library**



Add Library



- Add a new **POU** (Program Organization Unit)



- Rename it to **WriteReadLimitRdcLowCh1** and click **OK**:

Add POU [X]

Create a new POU (Program Organization Unit)

Name:

Type

Program

Function Block

Extends: ...

Implements: ...

Final Abstract

Access specifier:

Method implementation language:

Function

Return type: ...

Implementation language:

- Insert the call of the **WriteReadLimitRdcLowCh1** in the **MAIN** POU:

```

10     ctrlByteA AT%Q* : BYTE;
11     ctrlByteB AT%Q* : BYTE;
12     END_VAR
13
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```

- Type in the following code into the created **WriteReadLimitRdcLowCh1** POU

Source code:

```

PROGRAM WriteReadLimitALow
VAR
    fbSdoWrite      : FB_EcCoESdoWrite;
    fbSdoRead       : FB_EcCoESdoRead;
    sNetId          : T_AmsNetId := '169.254.20.111.3.1'; // see note 1 below
    nSlaveAddr      : UINT := 1001; // see note 2 below
    nIndex          : WORD := 16#2409; // CoE Object - Limit A Lower Value
    nSubIndex       : BYTE := 0; // is always 0
    fLimitRdcLowCh1 : REAL := 1.23; // data to be written to 2511
    bExecute        : BOOL := TRUE;
    bError          : BOOL;
    nErrId          : UDINT;
END_VAR

fbSdoWrite(
    sNetId      := sNetId,
    nSlaveAddr := nSlaveAddr,
    nIndex      := nIndex,
    nSubIndex   := nSubIndex,
    pSrcBuf     := ADR(fLimitRdcLowCh1),
    cbBufLen    := SIZEOF(fLimitRdcLowCh1),
    bExecute    := bExecute
);

IF NOT fbSdoWrite.bBusy THEN
    bExecute := FALSE;
    IF NOT bError THEN
        (* write successful *)
        bError := FALSE;
        nErrId := 0;
    ELSE
        (* write failed *)
        bError := fbSdoWrite.bError;
        nErrId := fbSdoWrite.nErrId;
    END_IF

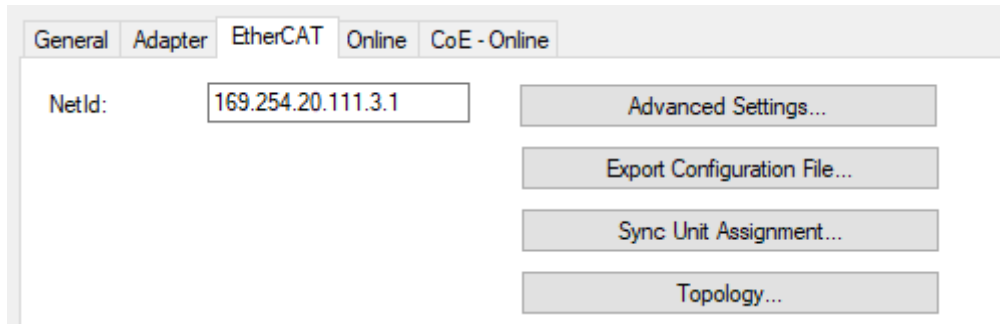
    fbSdoWrite(bExecute := FALSE);
END_IF

fLimitRdcLowCh1 := 0.0;

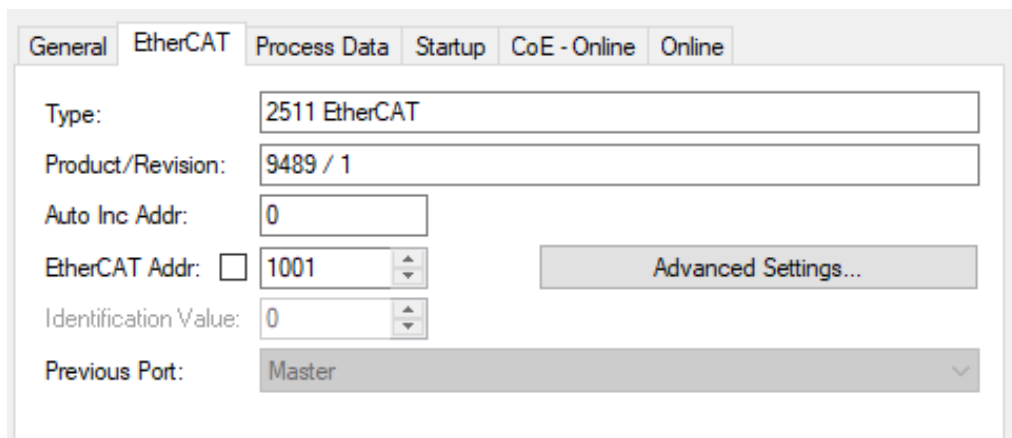
fbSdoRead(sNetId:= sNetId,nSlaveAddr :=nSlaveAddr, nIndex:=nIndex, nSubIndex :=nSubIndex,
pDstBuf:= ADR(fLimitRdcLowCh1), cbBufLen:=SIZEOF(fLimitRdcLowCh1), bExecute:=TRUE);
bError:=fbSdoRead.bError;
nErrId:=fbSdoRead.nErrId;

```

Note 1: You will find the **NetId** if you click your EtherCAT master device in the project tree and select the tab **EtherCAT**:



Note 2: You will find the EtherCAT slave address if you click the 2511 device in the project tree and select the tab **EtherCAT**:



- Build the project via **Build** → **Build Solution**, click on the **Login** symbol and set a break point (F9) in the first code line:

```

1  ● fbSdoWrite (
2      sNetId '169.254.96' := sNetId '169.254.96',
3      nSlaveAddr 1001 := nSlaveAddr 1001,
4      nIndex 9225 := nIndex 9225,
5      nSubIndex 0 := nSubIndex 0,
6      pSrcBuf 16#FFFF9B82EB17BBEC := ADR(fLimitRdcLowChl 1.23),
7      cbBufLen 4 := SIZEOF(fLimitRdcLowChl 1.23),
8      bExecute TRUE := bExecute TRUE
9  );
    
```

- Start the program execution with the **F5** key or via **PLC** → **Start** and go step for step (**F10**) through the whole program until you reach the last line. Check if the written und read values are identical:

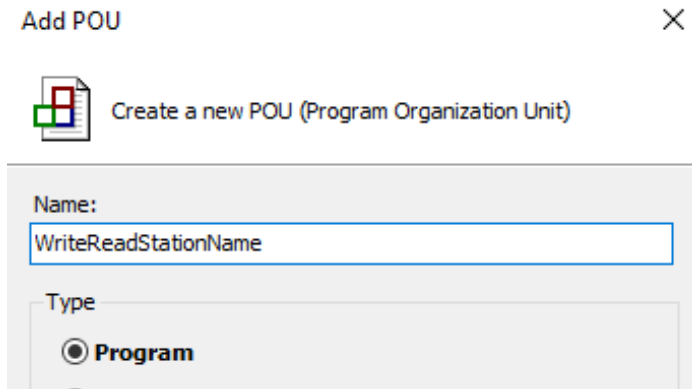
```

26 ● fLimitRdcLowChl 1.23 := 0.0;
27
28 ● fbSdoRead(sNetId '169.254.96' := sNetId '169.254.96', nSlaveAddr 1001
29 ● bError FALSE := fbSdoRead.bError FALSE;
30 ➔ nErrId 0 := fbSdoRead.nErrId 0;
    
```

5.2 Read and Write of 'string' data types

Example 3: Write and read the station name of the 2511:

- Create a new POU as described above and name it **WriteReadStationName**:



- Write or copy the following source code into the new POU:

```

PROGRAM ReadSerial
VAR
    fbSdoWrite      : FB_EcCoESdoWrite;
    fbSdoRead       : FB_EcCoESdoRead;
    sNetId          : T_AmsNetId := '169.254.20.111.3.1'; // see note 1 in the previous section
    nSlaveAddr      : UINT := 1001; // see note 2 in the previous section
    nIndex          : WORD := 16#246A; // CoE Object – Station Name
    nSubIndex       : BYTE := 0; // is always 0
    abStationName   : STRING := 'New Name'; // station name to write
    bExecute        : BOOL := TRUE;
    bError          : BOOL;
    nErrId          : UDINT;
END_VAR

fbSdoWrite( //write new station name
    sNetId      := sNetId,
    nSlaveAddr := nSlaveAddr,
    nIndex      := nIndex,
    nSubIndex   := nSubIndex,
    pSrcBuf     := ADR(abStationName),
    cbBufLen    := 20,
    bExecute    := bExecute);

IF NOT fbSdoWrite.bBusy THEN
    bExecute := FALSE;
    IF NOT bError THEN
        bError := FALSE;
        nErrId := 0;
    ELSE
        bError := fbSdoWrite.bError;
        nErrId := fbSdoWrite.nErrId;
    END_IF
    fbSdoWrite(bExecute := FALSE);
END_IF

abStationName := 'CleartoReadAgain'; //clear variable to read again
    
```

```

fbSdoRead(                                     //read current station name
  sNetId := sNetId,
  nSlaveAddr := nSlaveAddr,
  nIndex := nIndex,
  nSubIndex := nSubindex,
  pDstBuf := ADR(abStationName),
  cbBufLen := 20,
  bExecute := bExecute);

bError := fbSdoRead.bError;
nErrId := fbSdoRead.nErrId;

```

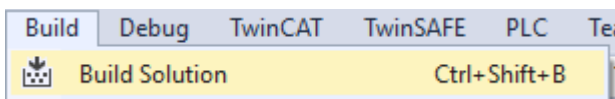
- Insert a call for the POU in the **MAIN** block:

```

5 | END_IF
6 |
7 | WriteReadStationName ();

```

- Build the Project via **Build** → **Build Solution**:



- Log in **PLC** → **Login**, set a break point to the first line and click **PLC** → **Start (F5)** to run the program. Press **F10** to execute the program step by step

```

1 | ● fbSdoWrite( //write new station name
2 |   sNetId '169.254.96' := sNetId '169.254.96',
3 |   nSlaveAddr 1001 := nSlaveAddr 1001,
4 |   nIndex 9322 := nIndex 9322,
5 |   nSubIndex 0 := nSubIndex 0,
6 |   pSrcBuf 16#FFFFFFC5864C4A2A08 := ADR(abStationName 'New Name'),
7 |   cbBufLen 20 := 20,
8 |   bExecute TRUE := bExecute TRUE);
9 |
10 | IF NOT fbSdoWrite.bBusy TRUE THEN
11 |   bExecute TRUE := FALSE;

```

- First the new station name “New Name” will be written in the device (line 1 – 8)

```

20 | END_IF
21 |
22 | ● abStationName 'CleartoRea' := 'CleartoReadAgain'; //clear station :
23 |
24 | IF fbSdoRead( //read current station name
25 |   sNetId '' := sNetId '169.254.96',

```

- The variable “abStationName” will be overwritten in line 22

- Now the station name will be read again. Make sure the station name on line 29 is the same as in line 6 to confirm that the task was successful

```

24 ● fbSdoRead(                                     //read current station name
25     sNetId '169.254.96 ▶ := sNetId '169.254.96 ▶,
26     nSlaveAddr 1001 := nSlaveAddr 1001,
27     nIndex 9322 := nIndex 9322,
28     nSubIndex 0 := nSubIndex 0,
29     pDstBuf 16#FFFC5864C4A2A08 := ADR(abStationName 'New Name'),
30     cbBufLen 20 := 20,
31     bExecute TRUE := bExecute TRUE);
32
33 ● bError FALSE := fbSdoRead.bError FALSE;
34 ↪ nErrId 0 := fbSdoRead.nErrId 0; RETURN
    
```