RedySmart & RedyIndustrial TwinCAT 3 & Profinet

Tutorial

Version: S-IM-Redy-TwinCat Rev A

PN:EN1.0

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Warnings and Cautions

“Warning,” “Caution,” and “Note” statements are used throughout this manual to draw your attention to important information.

Symbol Key		
Symbol	**Symbol Meaning**	**Description**
	Warning	“Warning” statements appear with information that is important to protect people and equipment from damage. Pay very close attention to all warnings that apply to your application. **Failure to comply with these instructions may damage the meter and cause personal injury.**
	Caution	“Caution” indicates that failure to comply with stated instructions **may result in damage or faulty operation of the meter.**
	Note	“Note” indicates that ignoring the relevant requirements or precautions may result in flow meter damage or malfunction.



Warning! Do not remove the black cover- it prevents damage to the system.

Warning! Removing the cover voids the warranty.

Warning! There are no serviceable parts under the cover.

Warning! Repairs must be performed by qualified Sierra personnel.

Warning! Connect the device to a protective ground conductor (earth).

Warning! The device must be grounded. The supply voltage is 18-30 VDC (typically ±50 mV).

Warning! Due to our policy of ongoing product development, we reserve the right to change the information in this manual without notice.

TwinCAT 3 & Profinet Sierra Redy Devices Tutorial

This document is for RedySmart and RedyIndustrial devices.

Receipt of System Components

When receiving a Sierra mass flow meter, carefully check the outside packing carton for damage incurred in shipment. If the carton is damaged, notify the local carrier and submit a report to the factory or distributor. Remove the packing slip and check that all ordered components are present. Make sure any spare parts or accessories are not discarded with the packing material. Do not return any equipment to the factory without first contacting Sierra Customer Service.

Technical Assistance

If you encounter a problem with your flow meter, review the configuration information for each step of the installation, operation, and setup procedures. Verify that your settings and adjustments are consistent with factory recommendations. Installation and troubleshooting information can be found in this manual. See Chapter 1 and 3 for installation and Chapter 7 for troubleshooting.

If the problem persists after following the troubleshooting procedures outlined in the RedySmart product manual, contact Sierra Instruments by fax or by E-mail (see inside front cover). For urgent phone support you may call (800) 866-0200 or (831) 373-0200 between 8:00 a.m. and 5:00 p.m. PST. In Europe, contact Sierra Instruments Europe at +31 20 6145810. In the Asia-Pacific region, contact Sierra Instruments Asia at +86-21-58798521. When contacting Technical Support, make sure to include this information:

- The flow range, serial number, and Sierra order number (all marked on the meter nameplate)
- The software version (visible at start up)
- The problem you are encountering, and any corrective action taken
- Application information (gas, pressure, temperature and piping configuration)

Recycling



Note the existing regulations of your country.

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TwinCAT 3 Profinet Tutorial

This tutorial will describe how a Sierra Redy Profinet device can be added to a TwinCAT soft PLC. The tutorial will start from scratch, it does not describe how to install TwinCAT.

The following version of TwinCAT is used in this tutorial:



Add GSDML to TwinCAT

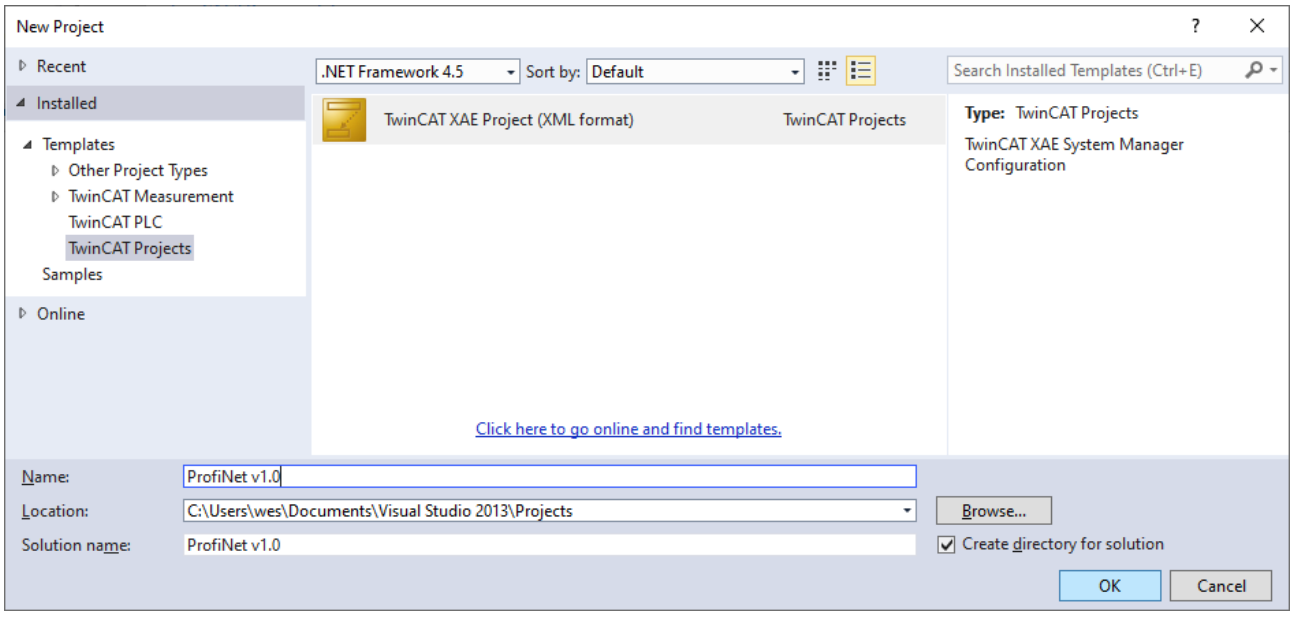
In order to be able to use the Sierra Redy device with TwinCAT, it is essential that the GSDML is stored. The GSDML file needs to be stored in the following location on the target PC:
..\TwinCAT\3.1\Config\Io\Profinet\
The GSDML has the following file name: GSDML-V2.33-Voegtlin Instruments-04AD-Red-y-20200605.xml

	Check the website for possible updates of the GSDML file.

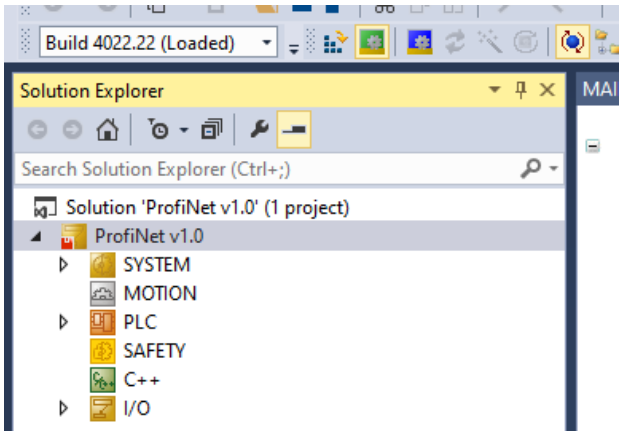
Create Project

Start TwinCAT and from the file menu start a new project. In the dialog box give the project a name.

1. Select the location where to store the project and press OK.



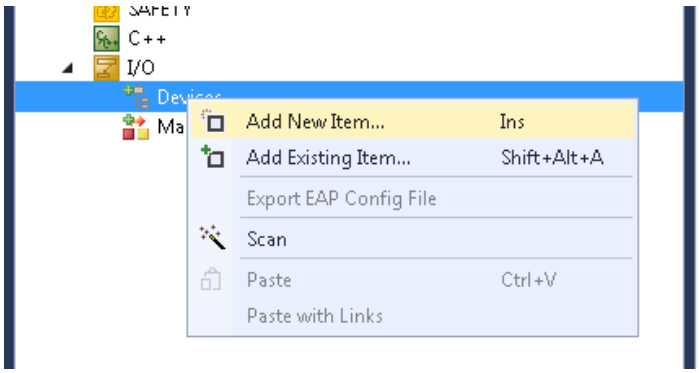
2. In the solution explorer (left side), only SYSTEM, PLC and I/O will be used. The other items can be switched off through the right mouse button context menu.



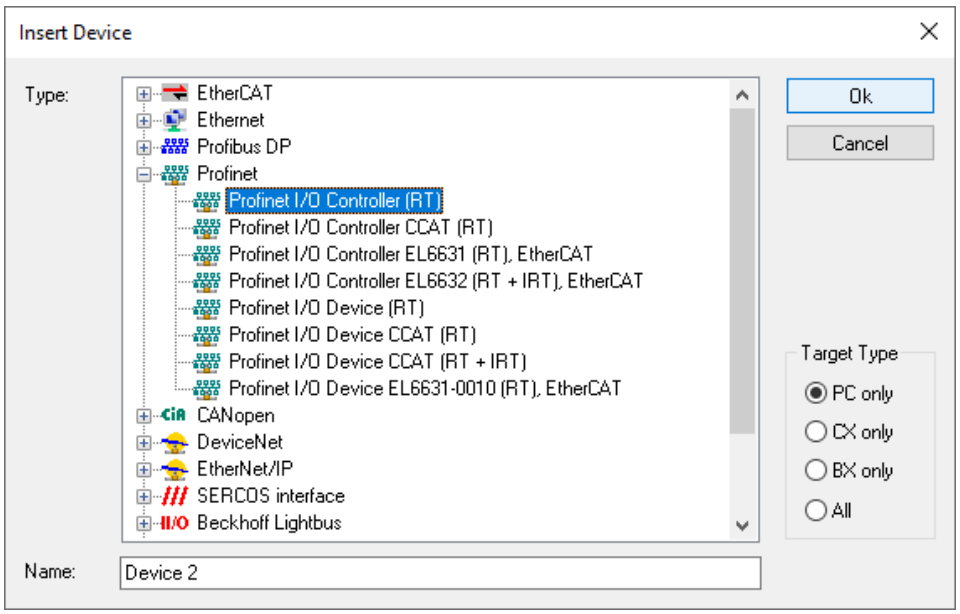
	In this tutorial MOTION, SAFETY and C++ will be hidden.

Add Profinet server

Expand the I/O item and right click on the devices item. Add a new item:



From the list which is presented go to the Profinet list and select the Profinet I/O Controller.

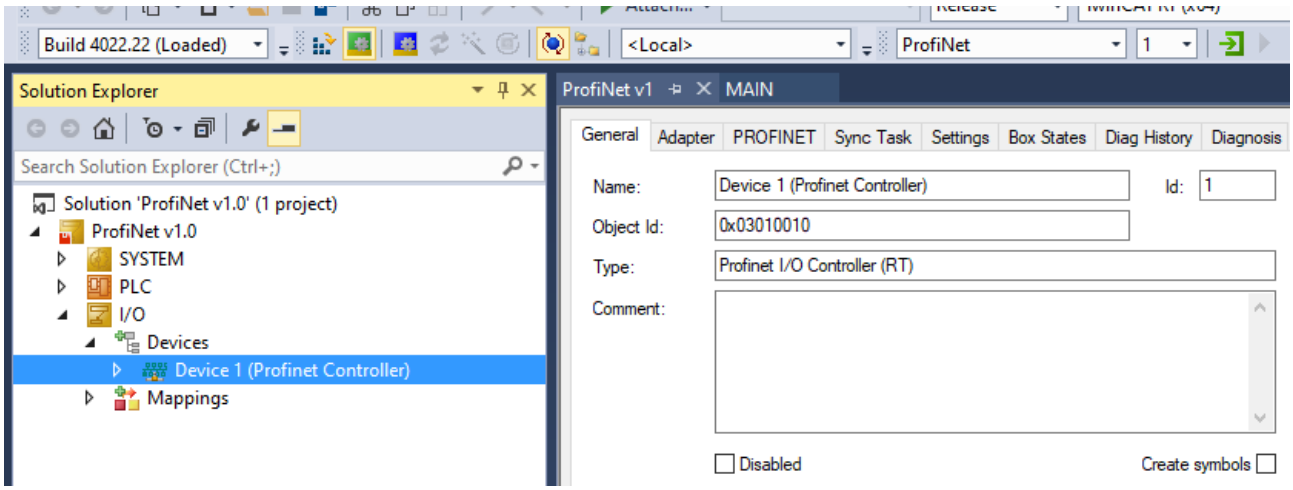


Add Ethernet port

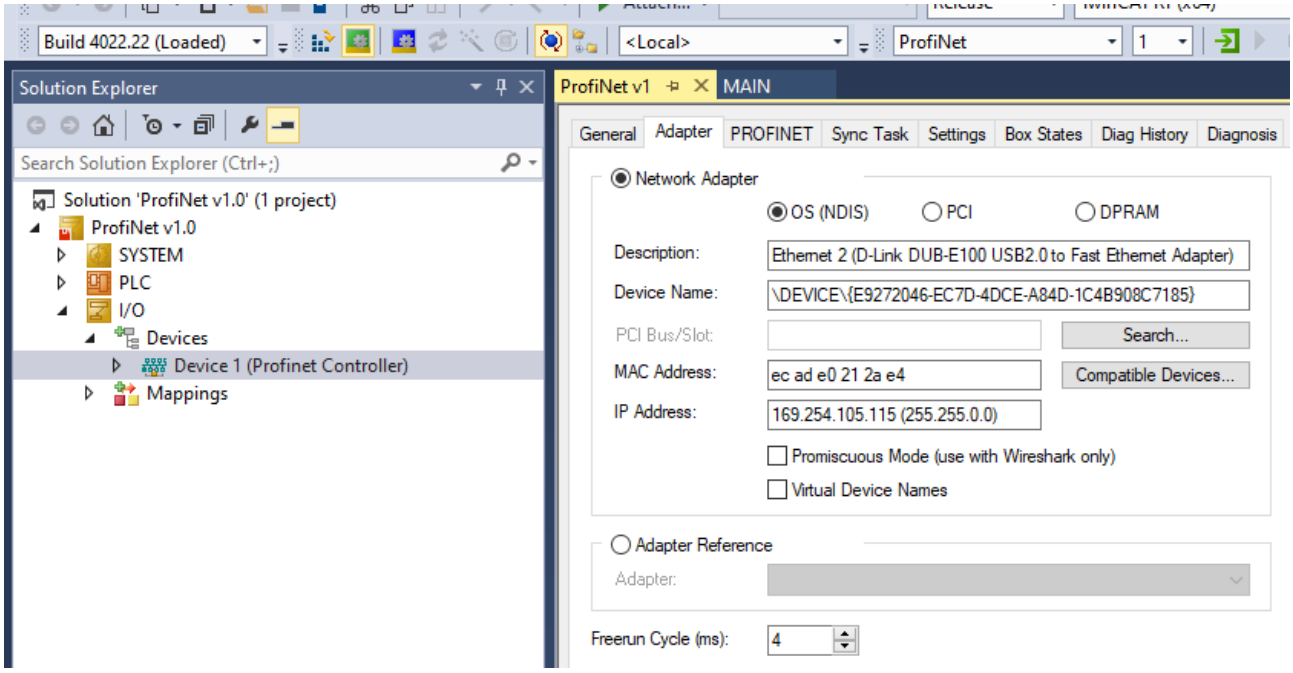
The Profinet controller needs an active Ethernet port, in order to work. In this tutorial the USB Ethernet dongle, DUB-E100 from D-Link, will be used as main adapter for TwinCAT.



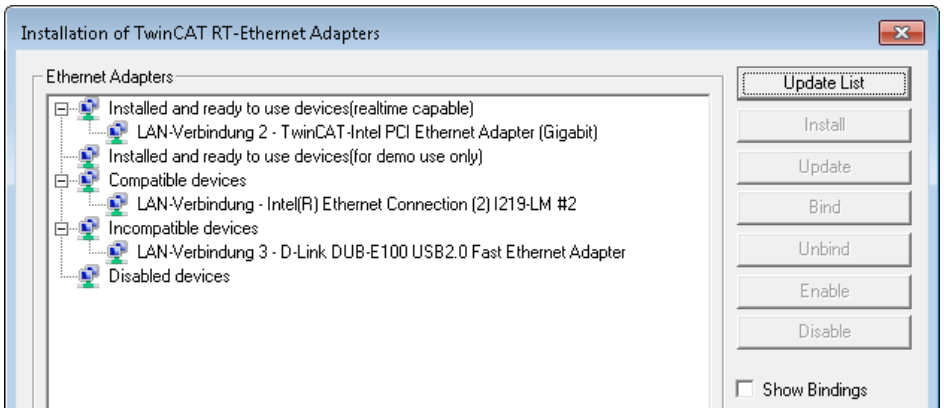
1. Double click on the controller to open the properties.



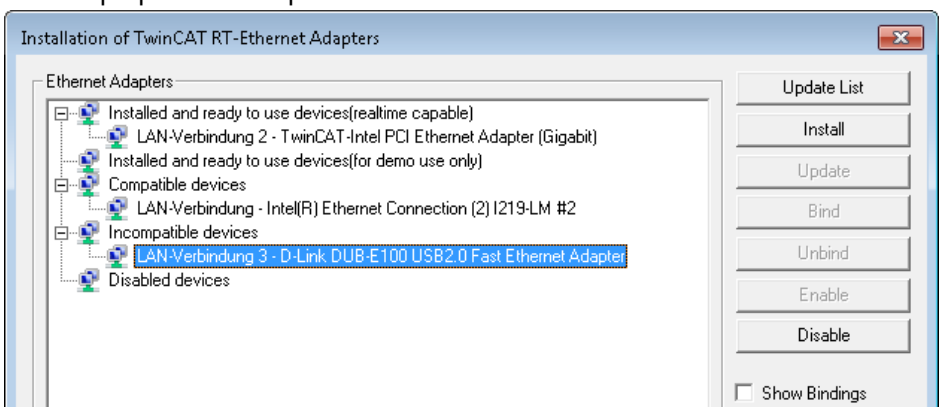
2. Go to the “Adapter” tab. Here a suitable Ethernet adapter can be selected.



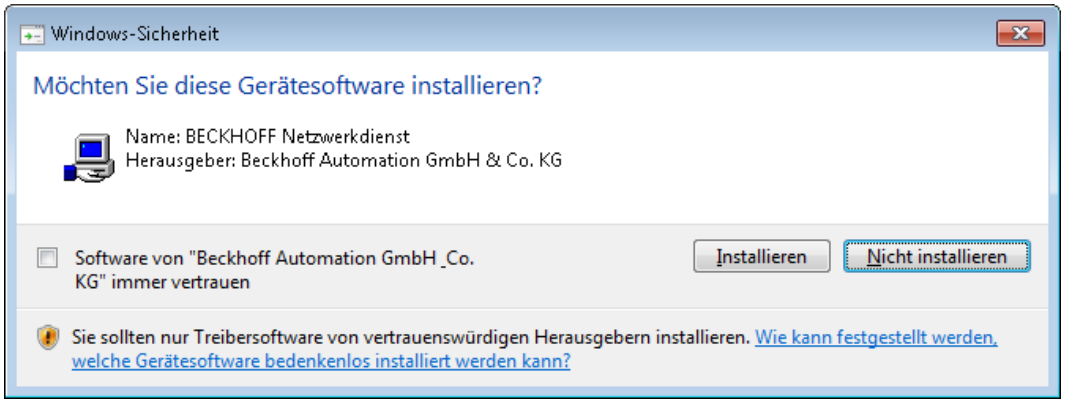
3. If no adapter is selected click on the “Compatible Devices” button to get an overview of all available adapters.



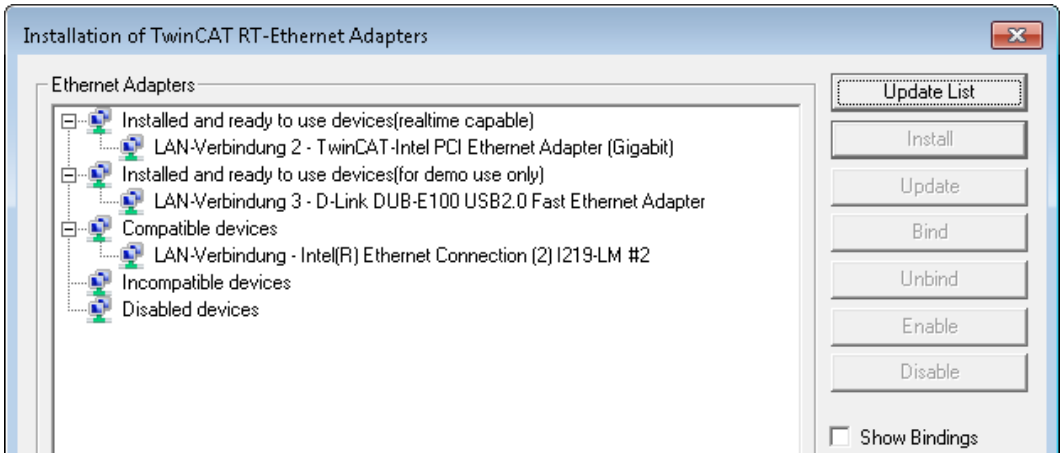
4. Here an adapter can be selected. Click on the adapter and then click on the “Install” button to prepare the adapter.



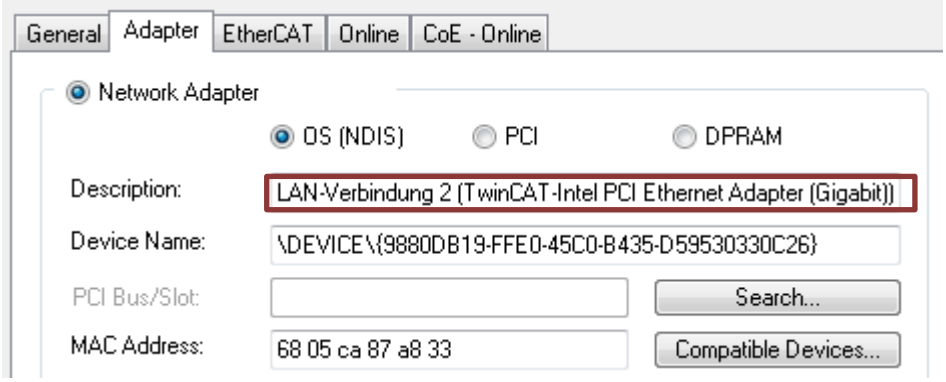
A pop-up may appear asking to install the Beckhoff driver.



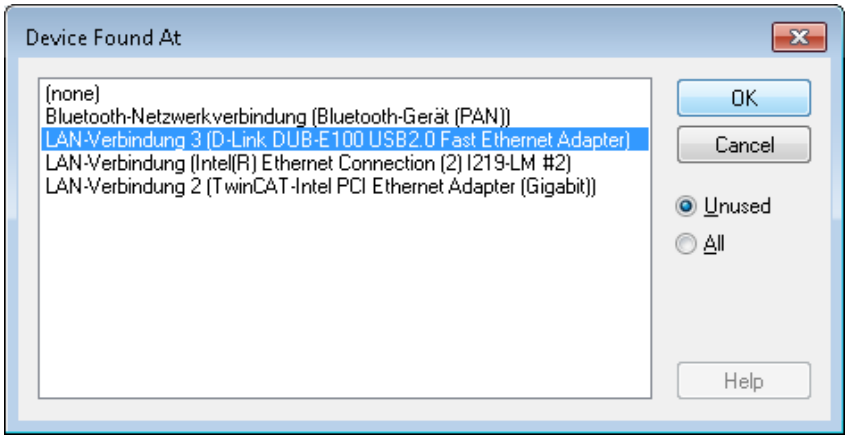
5. Press “Install” when ok. After the installation the list should show all the installed adapters.



6. Close the window. Check if the desired Ethernet adapter is shown under the description.

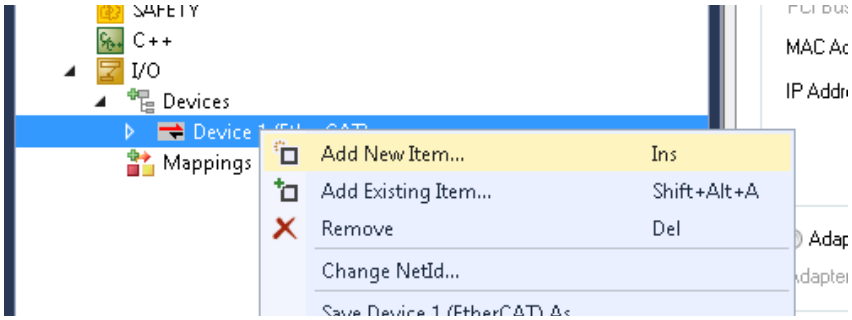


7. If not, then press the “Search” button and select the desired adapter.

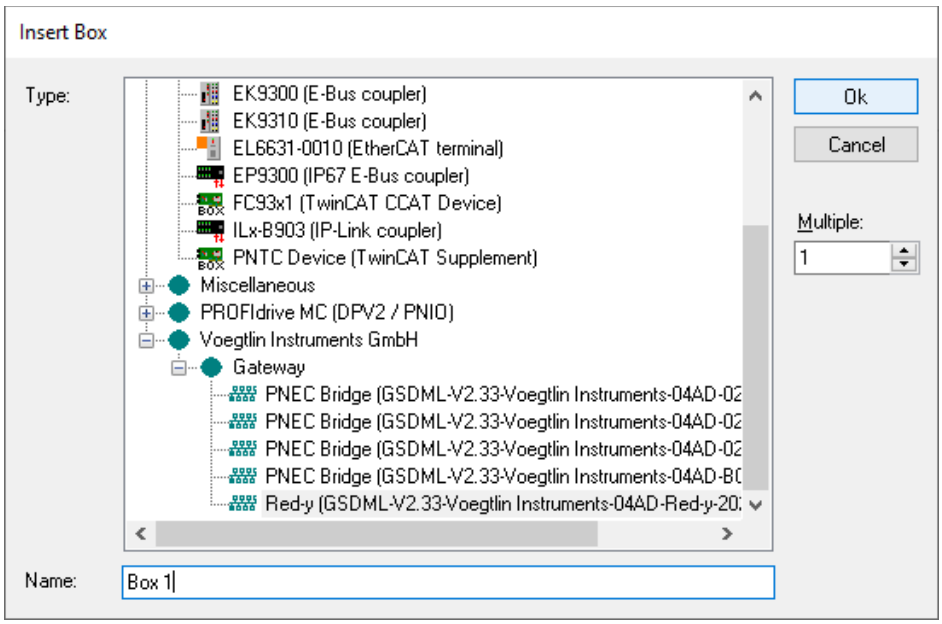


Add Vögtlin device

1. Right click on the Profinet Controller and from the context menu select “New Item.”



2. Find the Redy device in the list and select it.

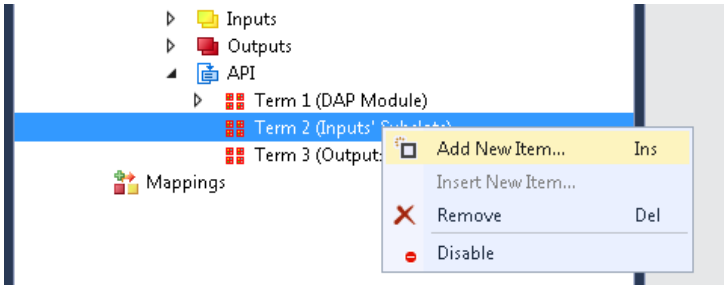


In this example the following GSDML file is used:

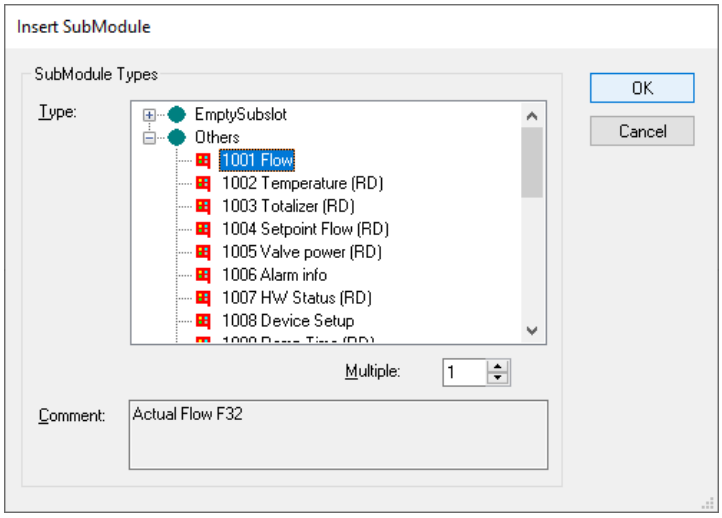
GSDML-V2.33-Voegtlin Instruments-04AD-Red-y-20200506.xml

In this GSDML it is possible to select various inputs and outputs depending on the need. In this tutorial all the modules will be selected.

1. On the left side expand the API item. Go to Term2 (Input's Subslots) and with a right mouse click, select "New Item" from the context menu.

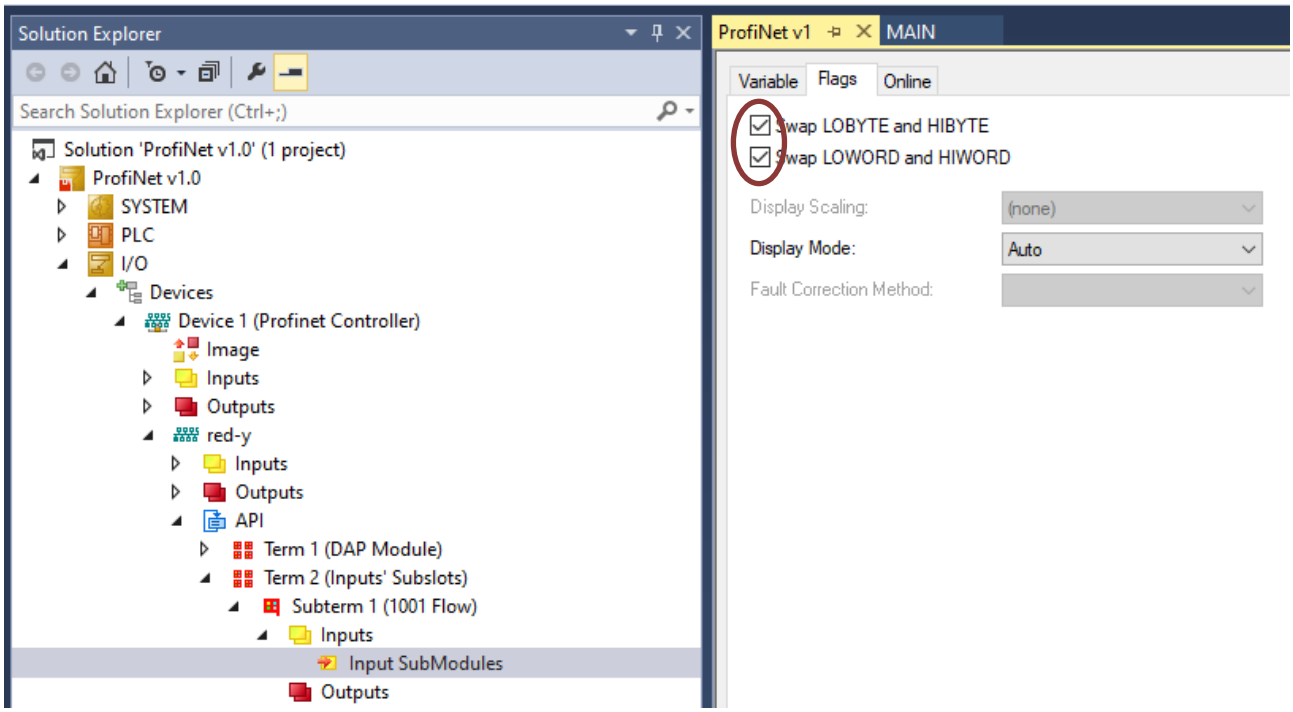


2. Expand "Other" and select a sub module and press "OK."



Profinet uses big Endian notation to represent data. TwinCAT uses default little Endian. This means that byte/word order for every sub module needs to be adjusted.

Expand the subterm and double click on the "input SubModules" to show the properties. Select the "Flags" tab:



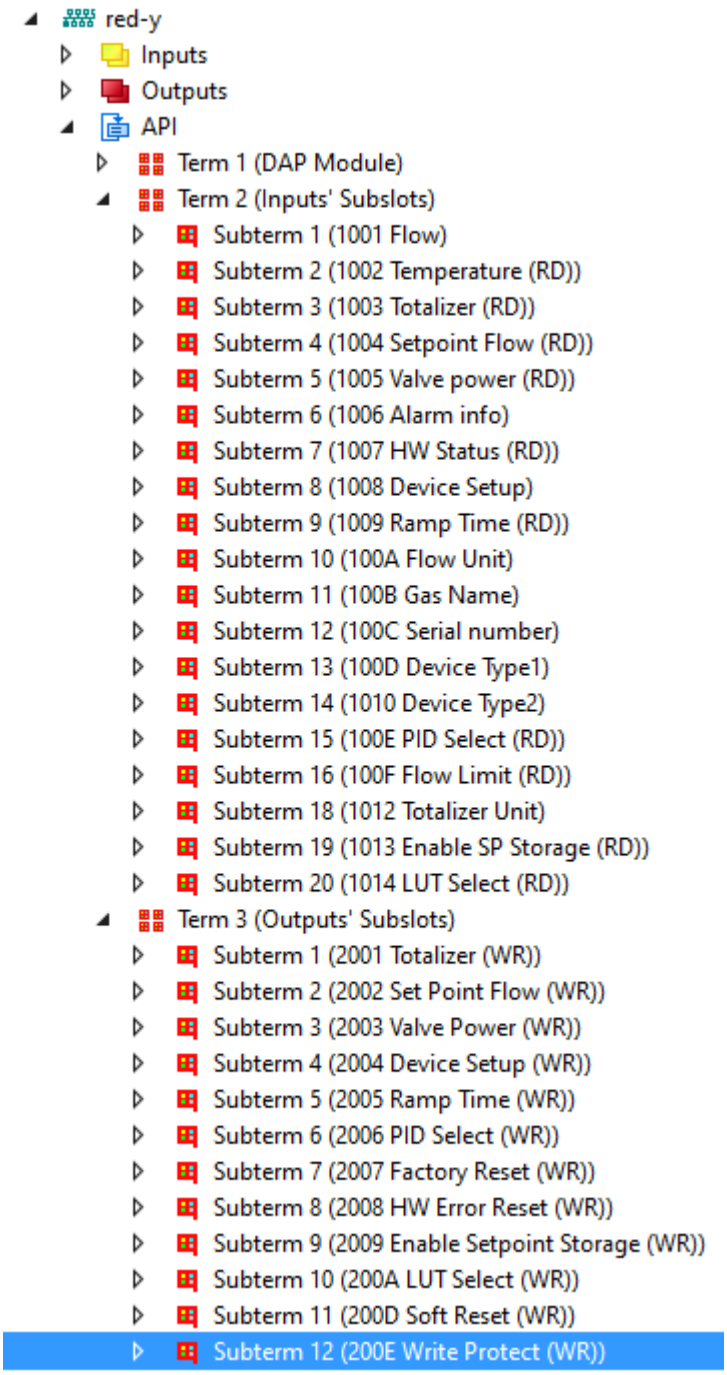
3. Check both the swap check boxes as shown above. Do this for all sub modules which will be added.

4. Add more sub modules when needed following the steps above. Sub modules can be added in any random order.

5. Do the same for the outputs. Make sure to add the “Write Protect” sub module! Without it, it will not be possible to write any data.

	There is a limitation to the number of input and output sub modules: Input = 20 Sub modules Output = 12 Sub modules

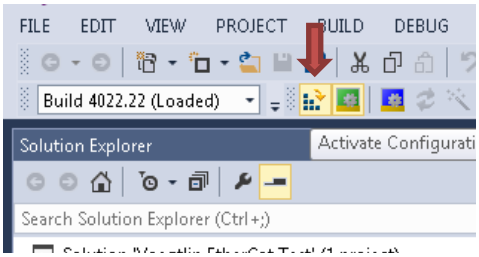
When all the sub modules have been added the list looks like this:



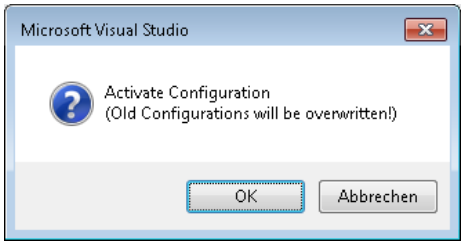
6. Save the project.

Starting the PLC

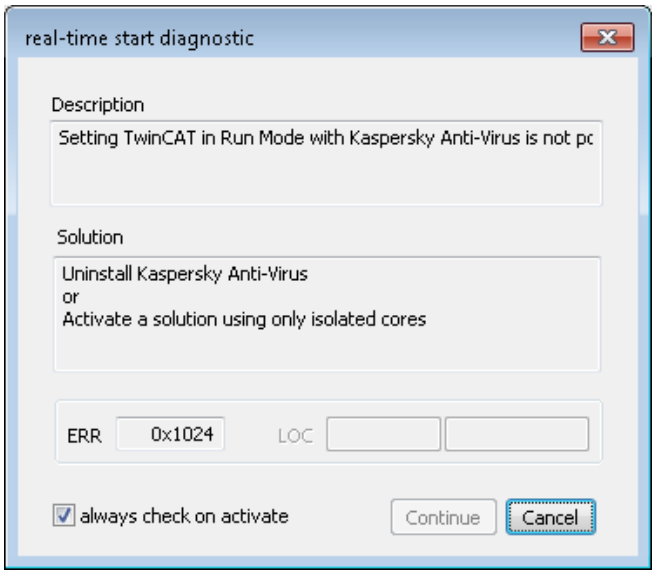
1. Activate the created configuration by pressing the “Activate Configuration” button.



2. A window will pop-up to confirm the action, proceed.



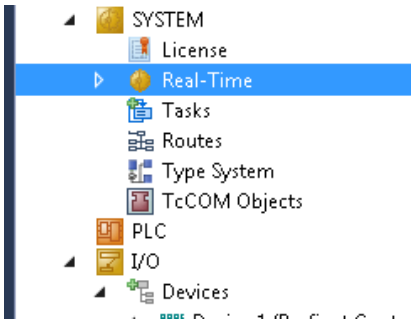
3. It is possible to receive the following error.



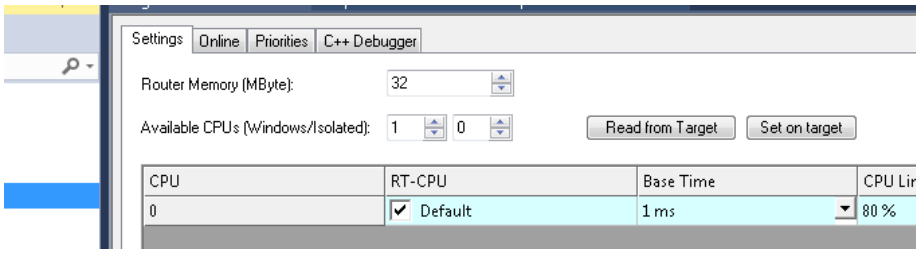
4. To solve this problem either uninstall the virus checker or assign a core to the PLC.

Assign Core

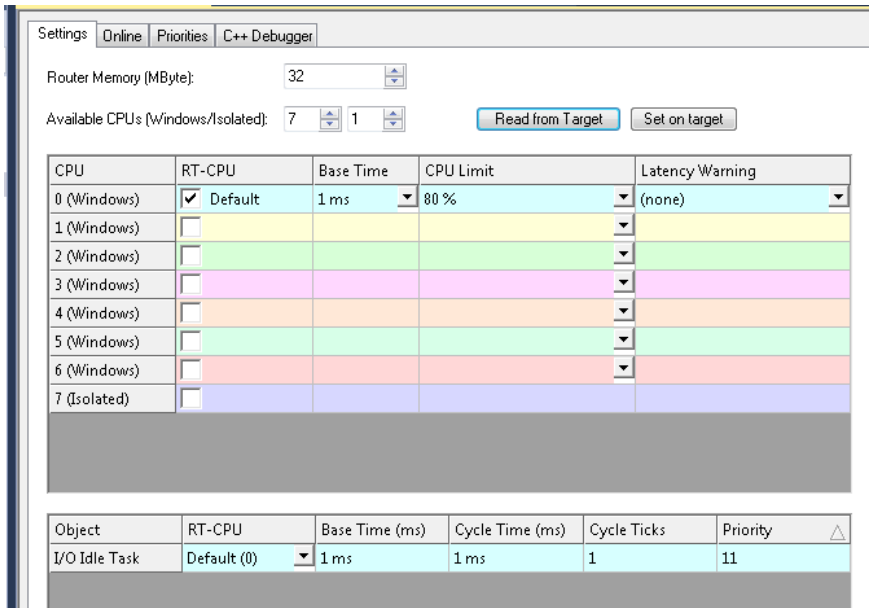
1. Expand the SYSTEM item and double click on the “Real Time” item.



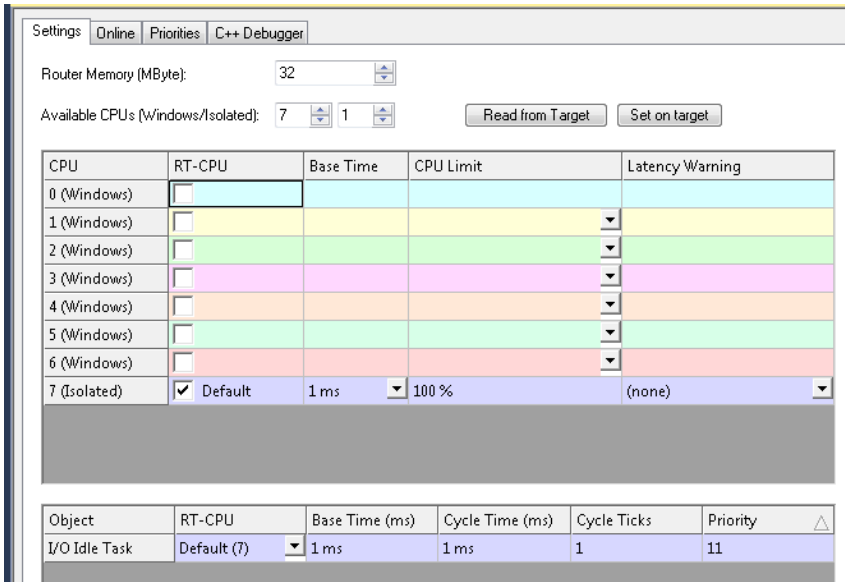
2. In the new window press the “Read from Target” button to get the current configuration.



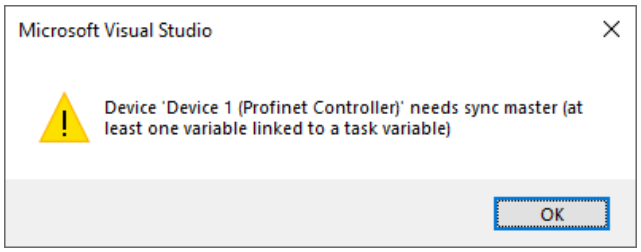
3. The actual core setup will be shown. On the machine where the tutorial runs, one core is assigned to the PLC.



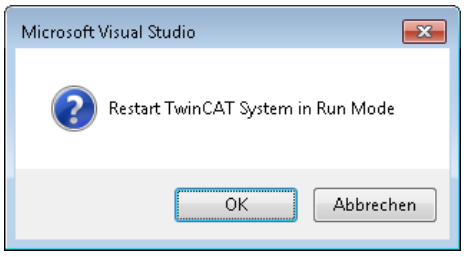
4. The numbers of cores can be set by pressing the “Set on Target” button.
Assign the PLC to the isolated core by setting the check box (uncheck the default core).



5. Activate the created configuration again. A new pop-up will appear informing that a sync master is needed. This can be ignored (for now).

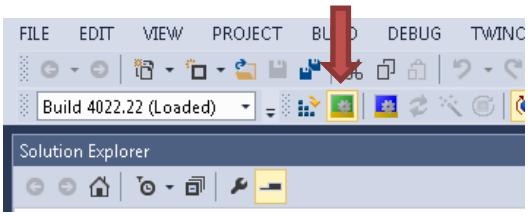


6. Press “OK”



7. Press “OK.”

The PLC is running now which can be seen by the TwinCAT System indicator turning green.

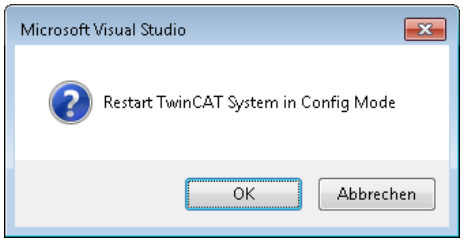


At this stage it might be that the Device isn’t online because the TwinCAT I/O system has not been linked to another device that can drive the I/O. See appendix A for a solution.

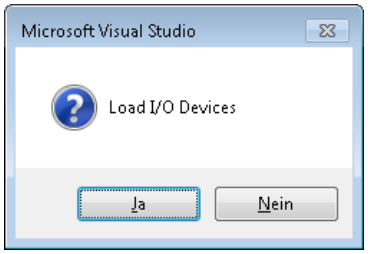
To view data from the device when it is not online, switched to “Config mode.”

1. Press the blue button right next to the TwinCAT System indicator.

2. A pop-up window appears asking to confirm the action, confirm.

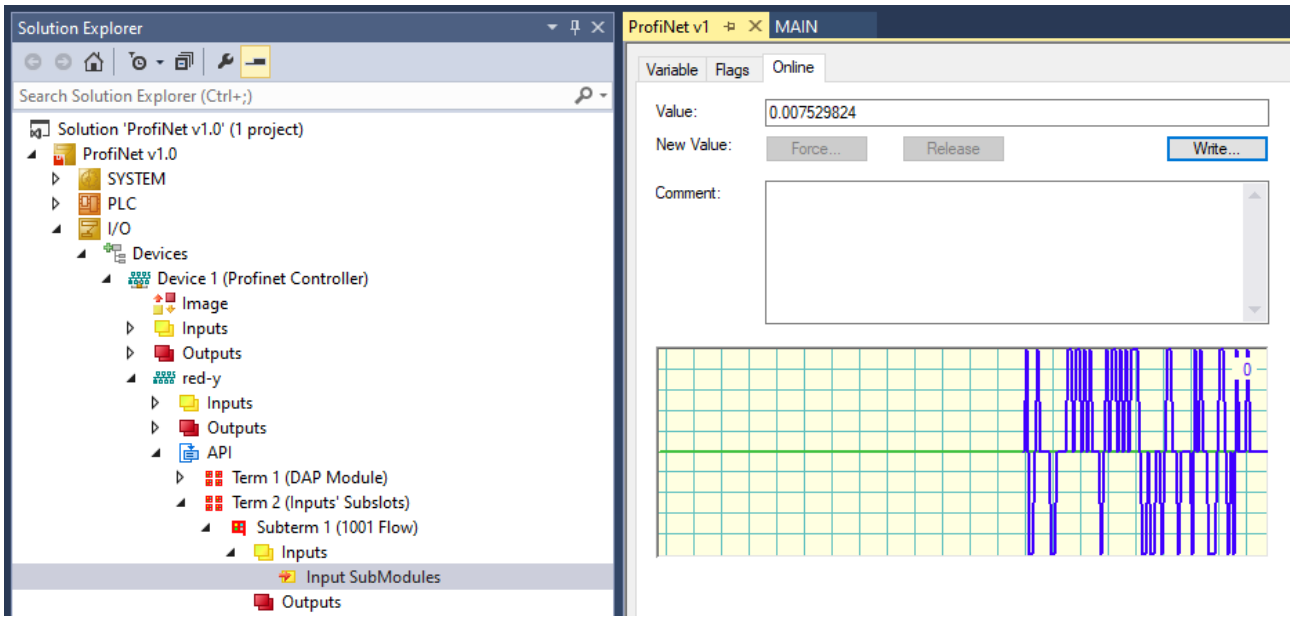


3. Press “OK.”



4. Press “Yes.”

5. Online data can now be viewed by expanding Subterm and double clicking on it. In the right window select the “Online” tab.



Viewing data in this way isn’t very comfortable so see appendix B for a better way to view data.

Writing data

At power-up the output PDO's are disabled. This means that any changes to the output PDO will not be executed by the Smart. In order to enable writing to the Smart, it is necessary to write PDO register "Write Protect (WR)". Each bit in this register corresponds to a specific register.

The table below gives an overview:

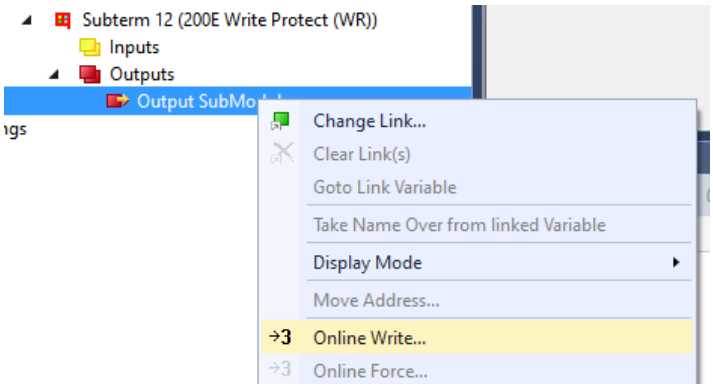
Bit	Selected output PDO register
0	Totalizer
1	Set point Flow
2	Valve Power
3	Device Setup
4	Ramp Time
5	PID Select
6	Factory Reset
7	HW Error Reset
8	Enable SP Storage
9	LUT Select
10	Set Point Pressure
11	Pressure PID select
12	Soft Reset

Once a bit is set it will remain set until cleared again. The bits could be set during start-up of the program.

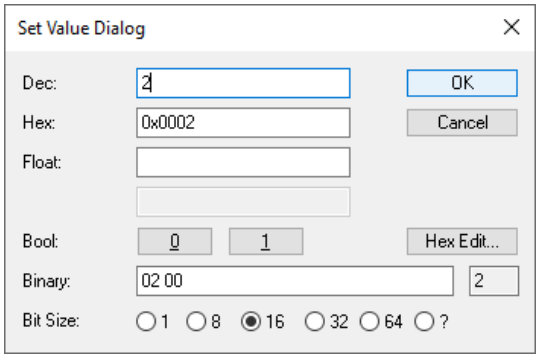
Example

Writing a set point

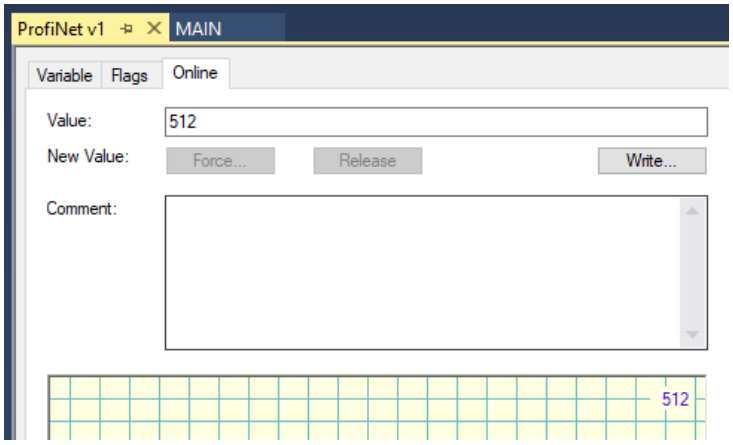
To write a set point, bit 1 in the “Write Protect (WR)” needs to be set. Expand the Subterm and right click on the “Output SubModules”. Select “Online Write”:



A dialog box will appear where a value can be entered in various formats. Set point is bit1 which means that the value “2” needs to be entered. Now things get a bit tricky. When entering a value of 2, actually a value of 512 will be written:



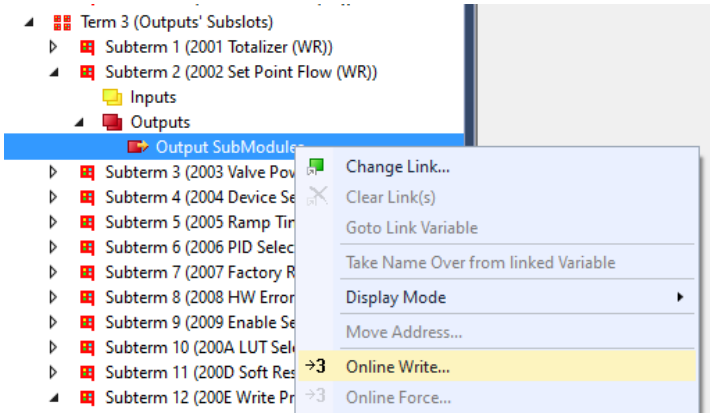
Result:



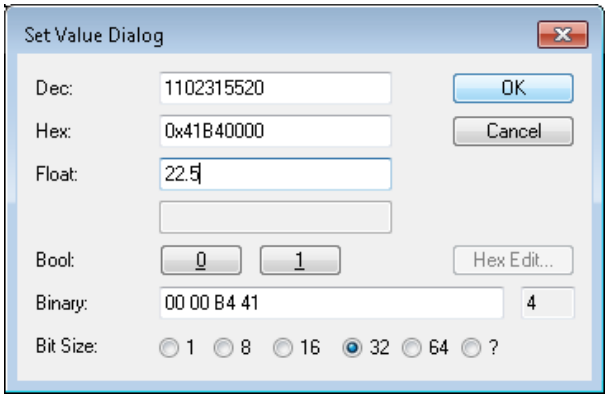
This is due to the fact that the although the bytes are in reversed, TwinCAT doesn't reverse it when writing a value (neither when reading), it sticks to little Endian format. Reversing the bytes using the flags won't work because then the Device will receive the bytes reversed.

So, write the value 512 to set the bit.

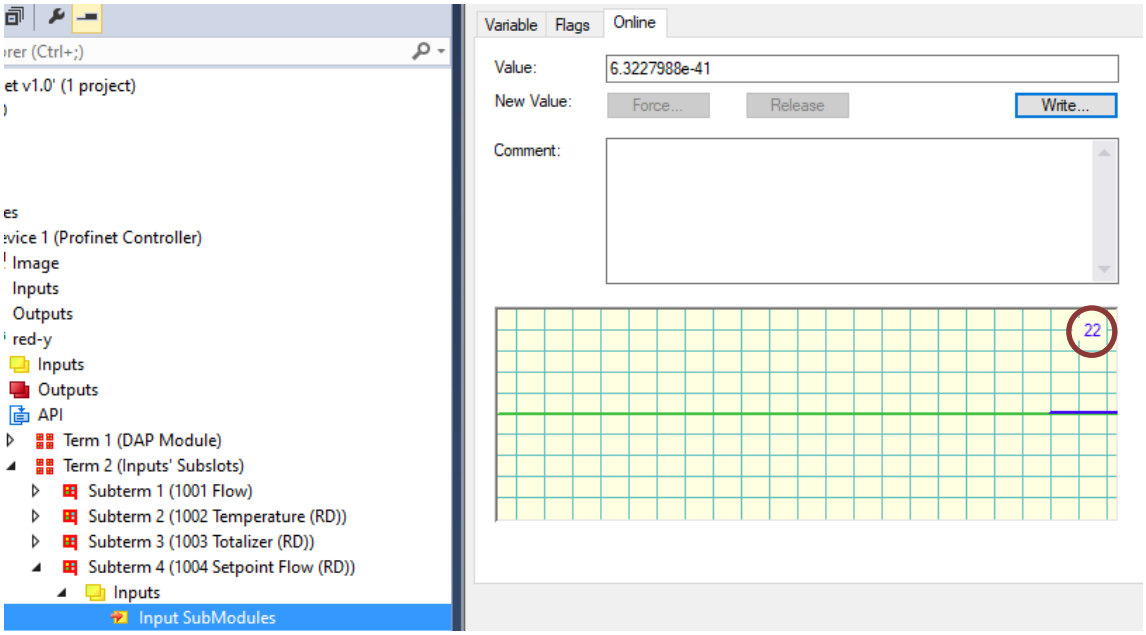
Expand the Subterm "Set Point Flow (WR)" and right click on the "Output SubModules". Select "Online Write."



A value of 22.5 will be entered.



The set point is now set and can be checked.

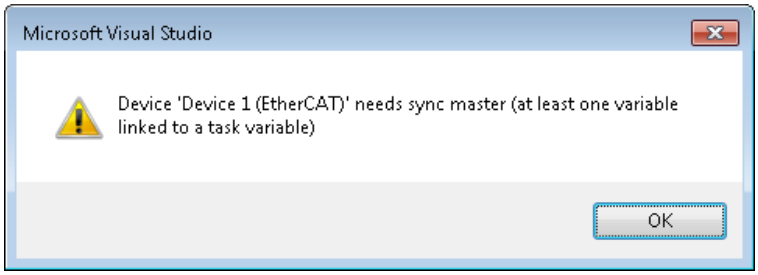


Not very elegant. Go to appendix B for a better and more comfortable way to view data.

Appendix A

Getting Device Online

When switching to run mode it is possible that the device will not come online. This is due to the warning which popped-up earlier.



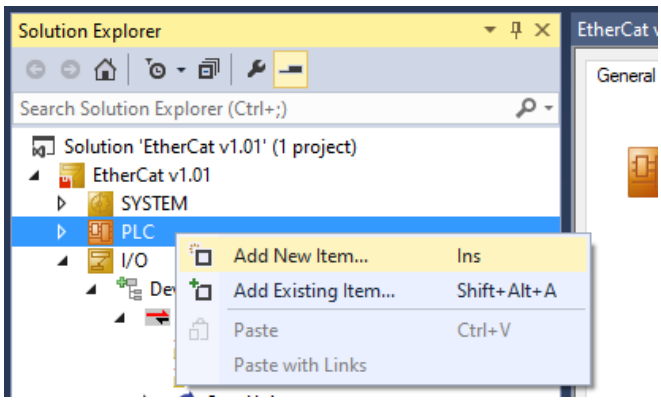
The warning indicates that the TwinCAT I/O system has not been linked to another device that can drive the I/O. This can be solved by using the integrated PLC of TwinCAT (see Appendix B).

Appendix B

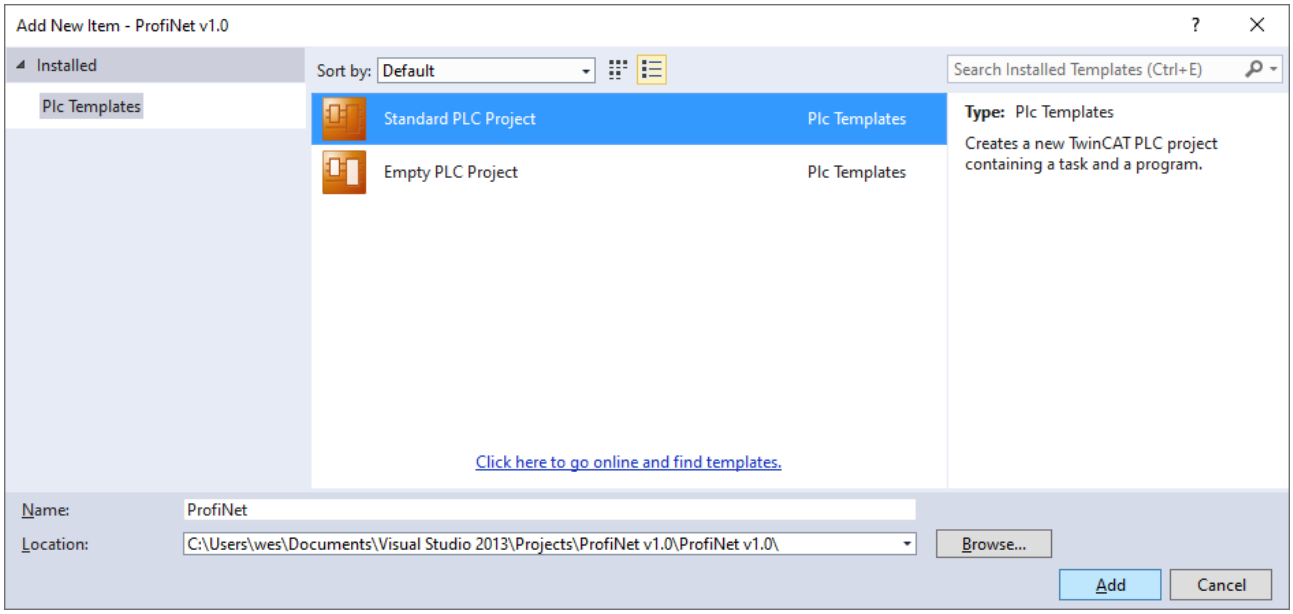
Viewing Online Data

Data can be viewed using the integrated PLC.

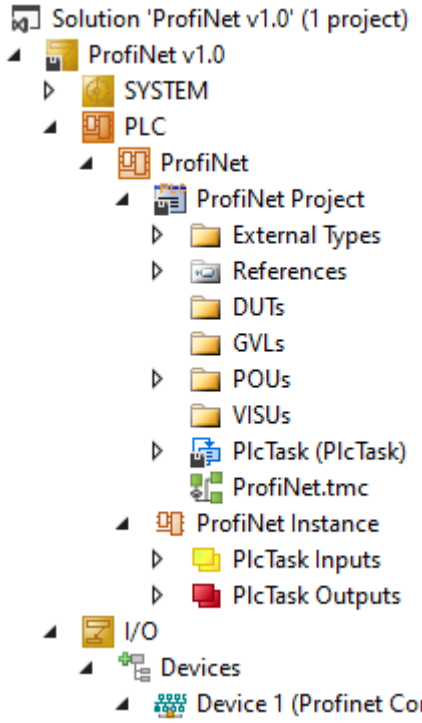
1. Go to the PLC tab and right click on it. Select “Add new item.”



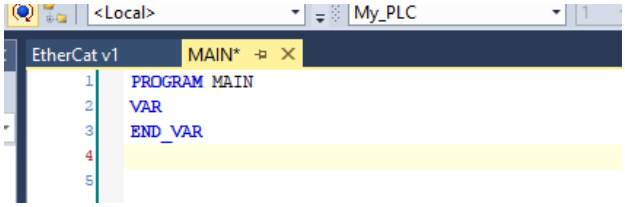
2. Create a new PLC project and give it a new name.



3. When the project has been created the following structure has been created.



4. Double click on “MAIN”. The MAIN window will open.



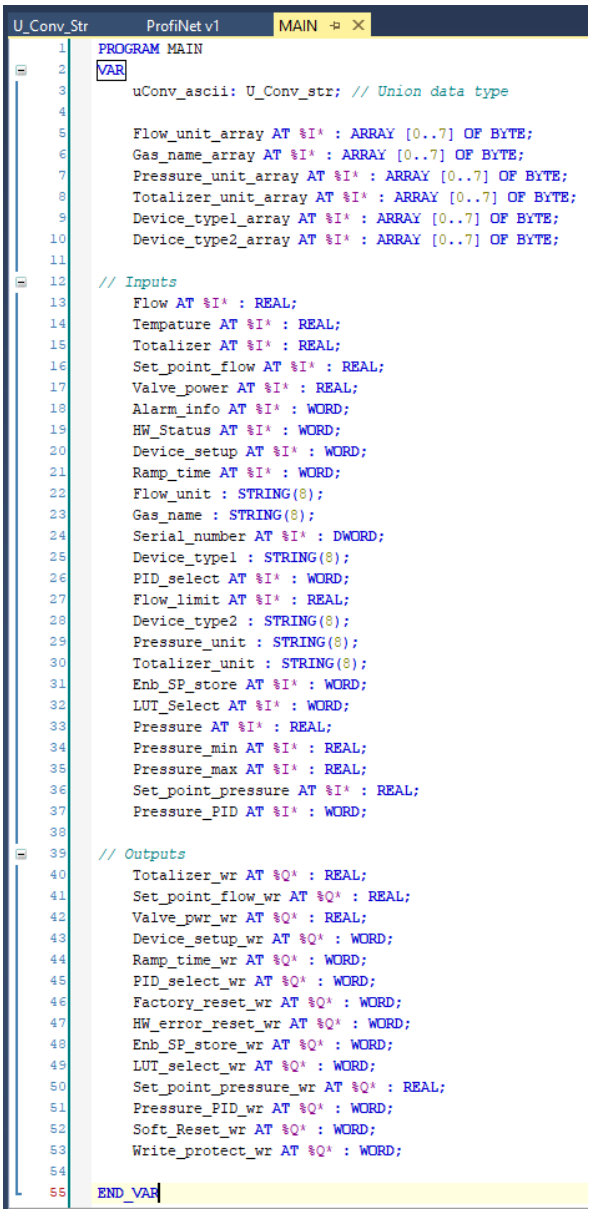
5. Add the following code between VAR and END_VAR (copy/paste from this document).

```
PROGRAM MAIN
VAR
        uConv_ascii: U_Conv_str; // Union data type

        Flow_unit_array AT %I* : ARRAY [0..7] OF BYTE;
        Gas_name_array AT %I* : ARRAY [0..7] OF BYTE;
        Pressure_unit_array AT %I* : ARRAY [0..7] OF BYTE;
        Totalizer_unit_array AT %I* : ARRAY [0..7] OF BYTE;
        Device_type1_array AT %I* : ARRAY [0..7] OF BYTE;
        Device_type2_array AT %I* : ARRAY [0..7] OF BYTE;

// Inputs
        Flow AT %I* : REAL;
        Tempature AT %I* : REAL;
        Totalizer AT %I* : REAL;
        Set_point_flow AT %I* : REAL;
        Valve_power AT %I* : REAL;
        Alarm_info AT %I* : WORD;
        HW_Status AT %I* : WORD;
        Device_setup AT %I* : WORD;
        Ramp_time AT %I* : WORD;
        Flow_unit : STRING(8);
        Gas_name : STRING(8);
        Serial_number AT %I* : DWORD;
        Device_type1 : STRING(8);
        PID_select AT %I* : WORD;
        Flow_limit AT %I* : REAL;
        Device_type2 : STRING(8);
        Pressure_unit : STRING(8);
        Totalizer_unit : STRING(8);
        Enb_SP_store AT %I* : WORD;
        LUT_Select AT %I* : WORD;
        Pressure AT %I* : REAL;
        Pressure_min AT %I* : REAL;
        Pressure_max AT %I* : REAL;
        Set_point_pressure AT %I* : REAL;
        Pressure_PID AT %I* : WORD;

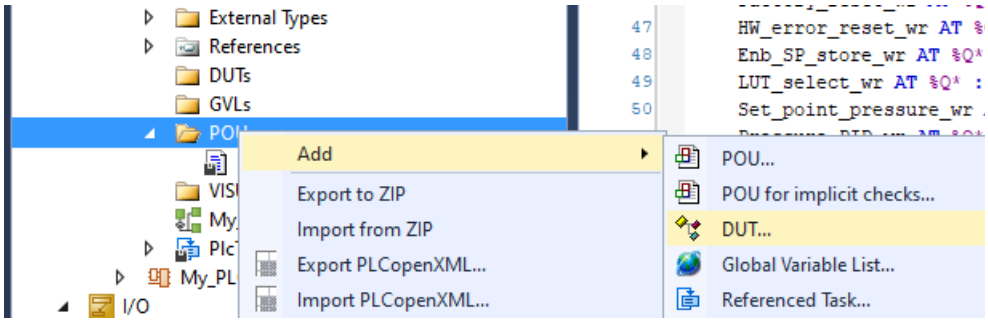
// Outputs
        Totalizer_wr AT %Q* : REAL;
        Set_point_flow_wr AT %Q* : REAL;
        Valve_pwr_wr AT %Q* : REAL;
        Device_setup_wr AT %Q* : WORD;
        Ramp_time_wr AT %Q* : WORD;
        PID_select_wr AT %Q* : WORD;
        Factory_reset_wr AT %Q* : WORD;
        HW_error_reset_wr AT %Q* : WORD;
        Enb_SP_store_wr AT %Q* : WORD;
        LUT_select_wr AT %Q* : WORD;
        Set_point_pressure_wr AT %Q* : REAL;
        Pressure_PID_wr AT %Q* : WORD;
```



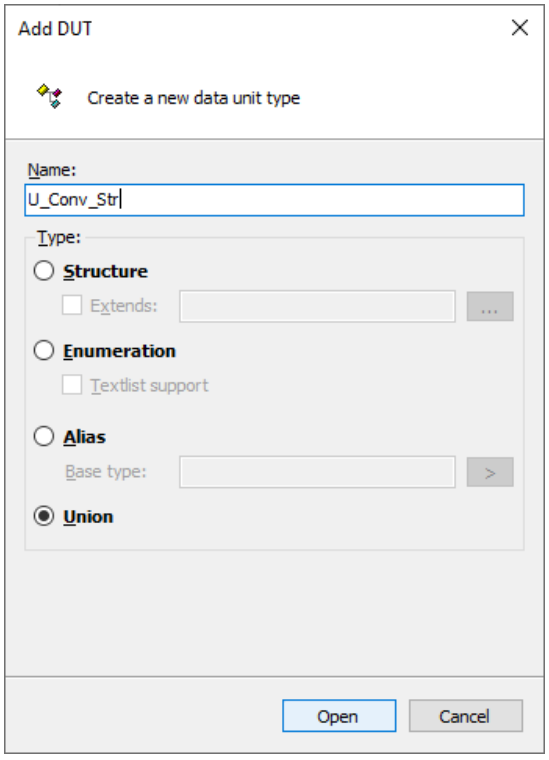
Soft_reset_wr AT %Q* : WORD;
Write_protect_wr AT %Q* : WORD;

VAR_END

6. To show strings a script is needed which converts the data into ASCII. The easiest way is to use a union data type for the conversion. Right click on the POUs tab (where MAIN is) and add a new DUT.



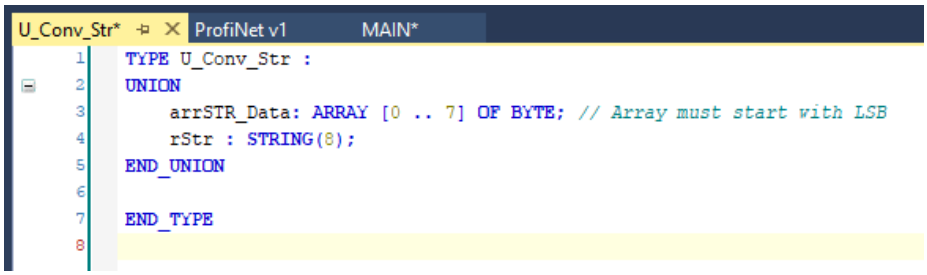
7. In the pop-up window select “Union” and give it a useful name, press “Open.”



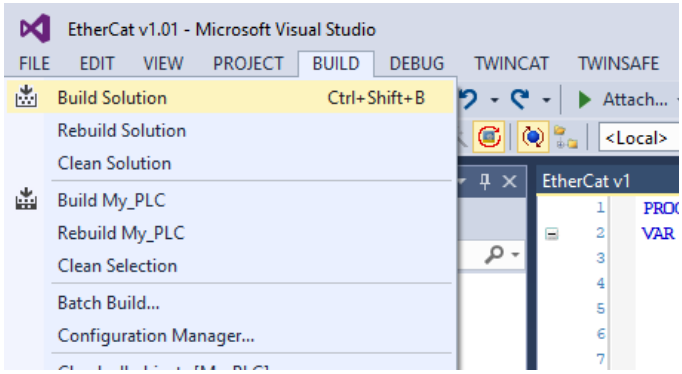
8. A window will open showing the script for the union. Replace the code for the code below (copy/paste).

```
TYPE U_Conv_Str :
UNION
        arrSTR_Data: ARRAY [0 .. 7] OF BYTE; // Array must start with LSB
        rStr : STRING(8);
END_UNION

END_TYPE
```



9. To check the code, build the solution.

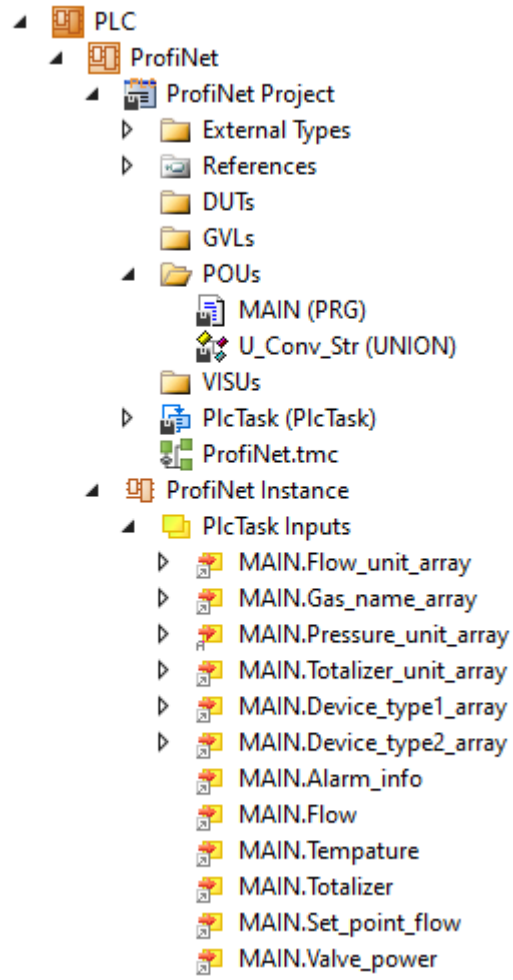


10. Check the output window for errors and fix if any found.

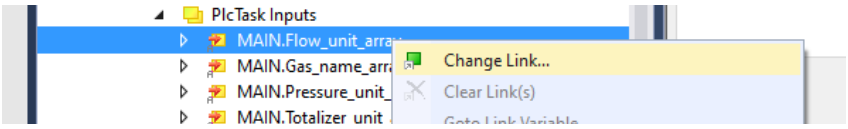
Link variable

The variables created in MAIN need to be linked to the variables of the device (PDO).

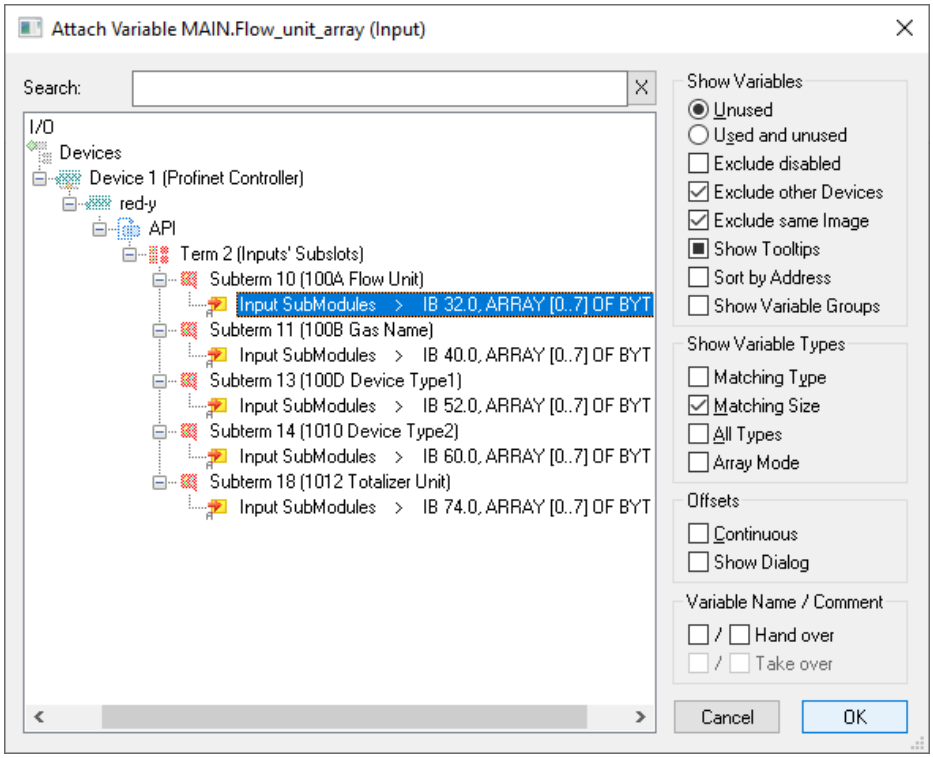
Expand “Plc Task Inputs” in Profinet Instance:



All the input variables created in MAIN are shown. Right click on MAIN.Flow_unit_array and from the sub menu select “Change Link…”

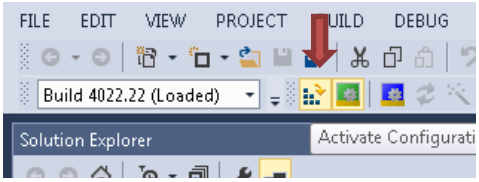


A new window will open showing all the input variables from the device which have the same data type.



Select the appropriate input, in this case “Flow Unit”. Press “OK”. Do this for all the Plc Task Inputs. Same can be done for the Plc Task Outputs. Link all the data.

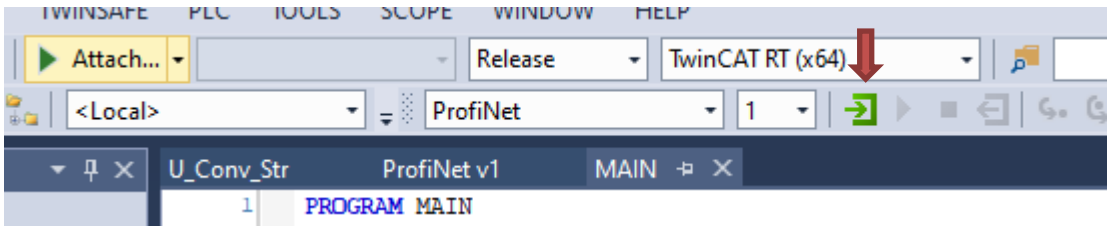
Activate the configuration by pressing the “Activate Configuration” button:



TwinCAT will be restarted in Run mode and the device should be online now. There should be no warning anymore about a sync master.

To view the online data the PLC needs to be loaded and started.

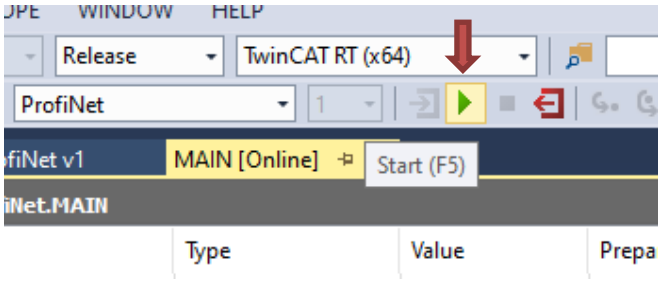
1. Start the PLC (login).



2. Press “Yes” in the following pop-up.



3. The MAIN window is shown but no data is presented yet. Start the PLC.



4. In the MAIN window the data will be shown.

U_Conv_Str | MAIN [Online] | ProfiNet v1

ProfiNet_v1_0.ProfiNet.MAIN

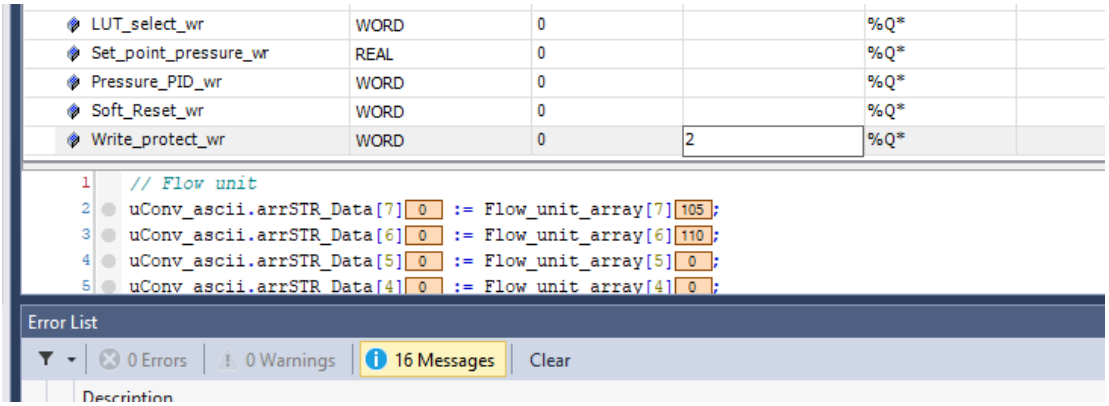
Expression	Type	Value	Prepared value	Address	Comment
uConv_ascii	U_Conv_str				Union data type
Flow_unit_array	ARRAY [0..7] OF BYTE			%I*	
Gas_name_array	ARRAY [0..7] OF BYTE			%I*	
Pressure_unit_array	ARRAY [0..7] OF BYTE			%I*	
Totalizer_unit_array	ARRAY [0..7] OF BYTE			%I*	
Device_type1_array	ARRAY [0..7] OF BYTE			%I*	
Device_type2_array	ARRAY [0..7] OF BYTE			%I*	
Flow	REAL	0.010184343		%I*	Inputs
Tempature	REAL	24.18235		%I*	
Totalizer	REAL	118.484711		%I*	
Set_point_flow	REAL	0		%I*	
Valve_power	REAL	0		%I*	
Alarm_info	WORD	0		%I*	
HW_Status	WORD	0		%I*	
Device_setup	WORD	5		%I*	
Ramp_time	WORD	0		%I*	
Flow_unit	STRING(8)	'm/nl'			
Gas_name	STRING(8)	'Air'			
Serial_number	DWORD	163194		%I*	
Device_type1	STRING(8)	'CCSG'			
PID_select	WORD	0		%I*	
Flow_limit	REAL	60		%I*	
Device_type2	STRING(8)	'21BB'			
Pressure_unit	STRING(8)	''			
Totalizer_unit	STRING(8)	''			
Enb_SP_store	WORD	0		%I*	
LUT_Select	WORD	2		%I*	
Pressure	REAL	0		%I*	
Pressure_min	REAL	0		%I*	
Pressure_max	REAL	0		%I*	
Set_point_pressure	REAL	0		%I*	
Pressure_PID	WORD	0		%I*	
Totalizer_wr	REAL	0		%Q*	Outputs
Set_point_flow_wr	REAL	0		%Q*	
Valve_pwr_wr	REAL	0		%Q*	
Device_setup_wr	WORD	0		%Q*	
Ramp_time_wr	WORD	0		%Q*	
PID_select_wr	WORD	0		%Q*	
Factory_reset_wr	WORD	0		%Q*	
HW_error_reset_wr	WORD	0		%Q*	
Enb_SP_store_wr	WORD	0		%Q*	
LUT_select_wr	WORD	0		%Q*	
Set_point_pressure_wr	REAL	0		%Q*	
Pressure_PID_wr	WORD	0		%Q*	
Soft_Reset_wr	WORD	0		%Q*	
Write_protect_wr	WORD	0		%Q*	

Writing data

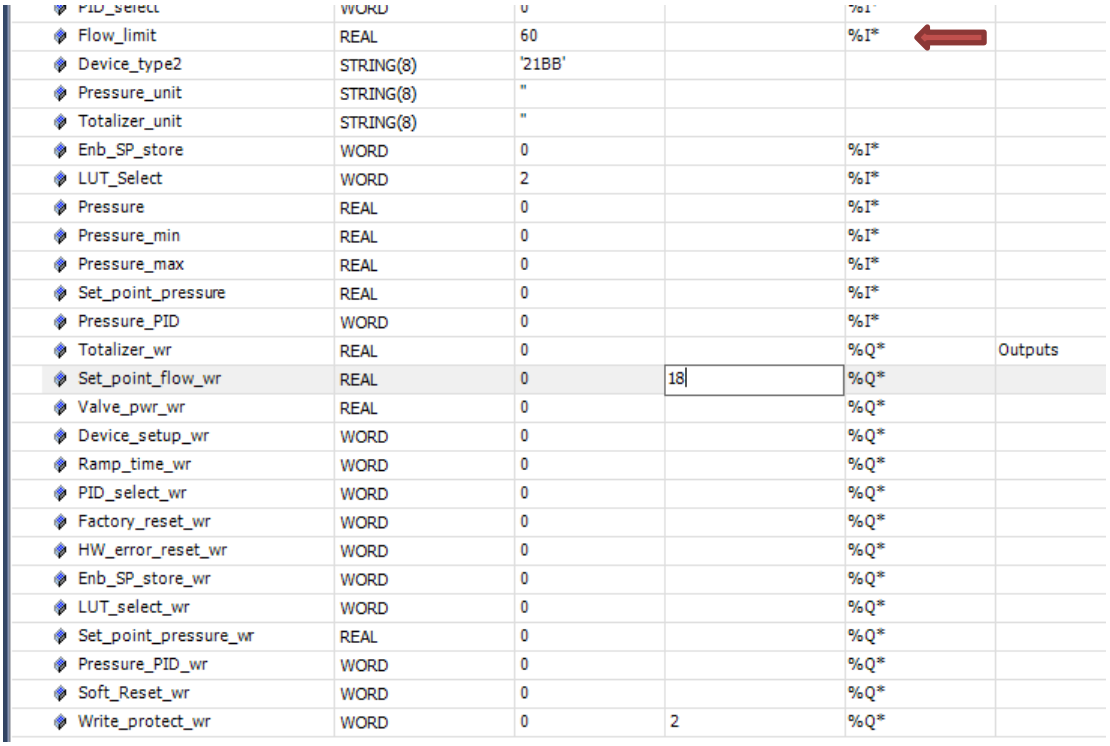
It is possible to write data to the device from the PLC. Here some examples.

Set point

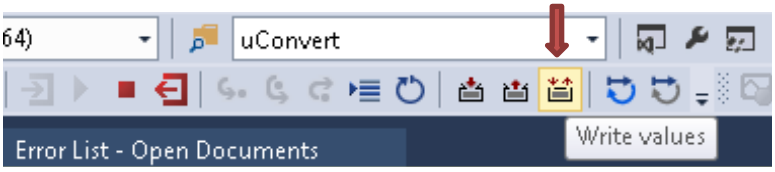
1. Enter the value “2” in the prepared value box for write protect.



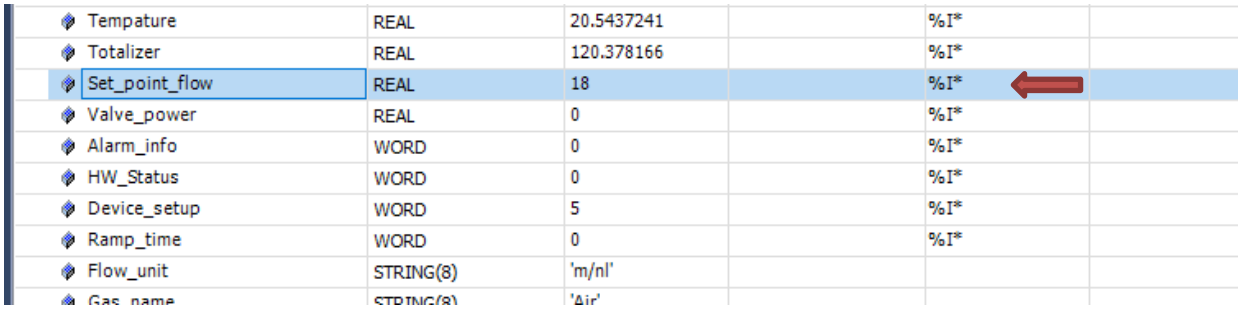
2. Enter a value in “Set_point_flow_wr”. Make sure that the entered value is not bigger than the value indicated by the “Flow_limit.”



3. Press the “Write value” button to write the new values.



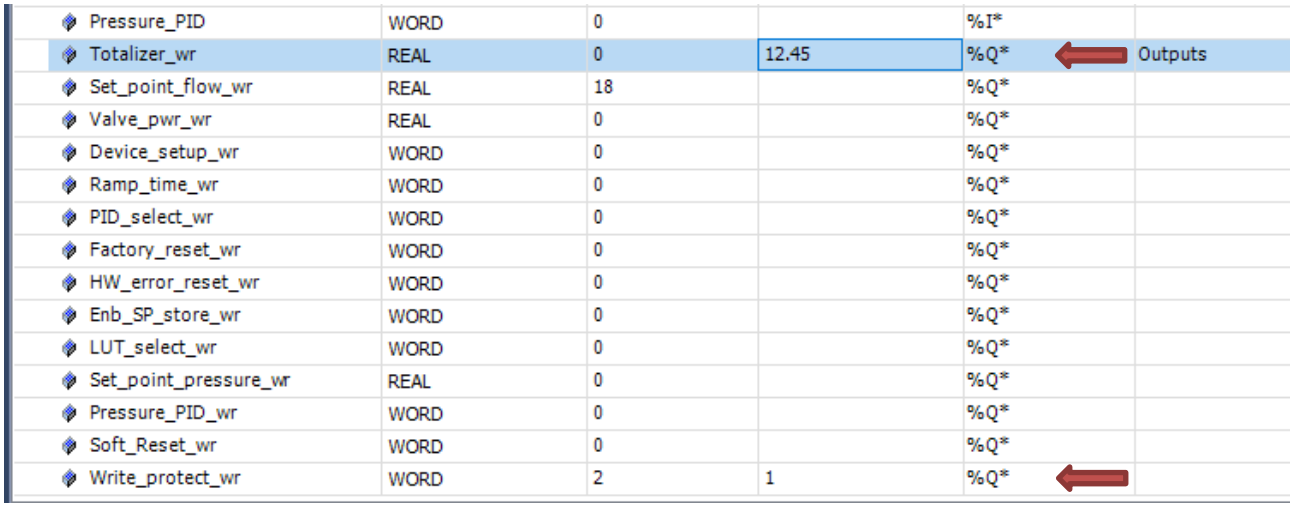
4. The set point will be updated in the device and the change is reflected in the values.



Tempature	REAL	20.5437241		%I*	
Totalizer	REAL	120.378166		%I*	
Set_point_flow	REAL	18		%I*	
Valve_power	REAL	0		%I*	
Alarm_info	WORD	0		%I*	
HW_Status	WORD	0		%I*	
Device_setup	WORD	5		%I*	
Ramp_time	WORD	0		%I*	
Flow_unit	STRING(8)	'm/nl'			
Gas_name	STRING(8)	'Air'			

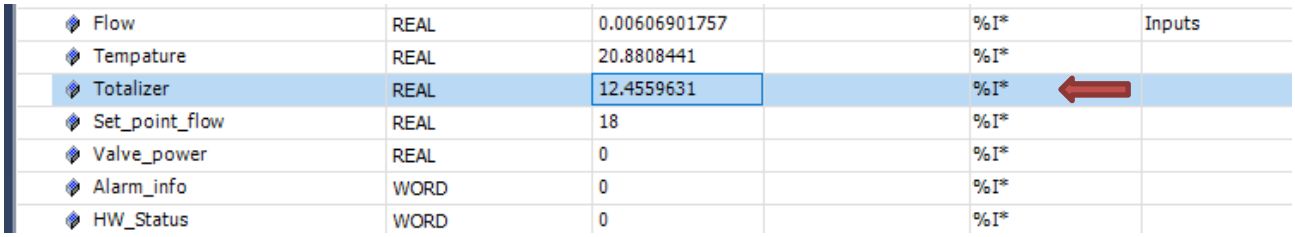
The set point can be changed as often as possible, as long as the write protect bit is set correctly.

5. To write the Totalizer, bit0 needs to be set. Write value “1” to “Write_protect_wr” and enter a value for the Totalizer at “Totalizer_wr”:



Pressure_PID	WORD	0		%I*	
Totalizer_wr	REAL	0	12.45	%Q*	Outputs
Set_point_flow_wr	REAL	18		%Q*	
Valve_pwr_wr	REAL	0		%Q*	
Device_setup_wr	WORD	0		%Q*	
Ramp_time_wr	WORD	0		%Q*	
PID_select_wr	WORD	0		%Q*	
Factory_reset_wr	WORD	0		%Q*	
HW_error_reset_wr	WORD	0		%Q*	
Enb_SP_store_wr	WORD	0		%Q*	
LUT_select_wr	WORD	0		%Q*	
Set_point_pressure_wr	REAL	0		%Q*	
Pressure_PID_wr	WORD	0		%Q*	
Soft_Reset_wr	WORD	0		%Q*	
Write_protect_wr	WORD	2	1	%Q*	

6. Press the “Write value” button and the Totalizer will be set.



Flow	REAL	0.00606901757		%I*	Inputs
Tempature	REAL	20.8808441		%I*	
Totalizer	REAL	12.4559631		%I*	
Set_point_flow	REAL	18		%I*	
Valve_power	REAL	0		%I*	
Alarm_info	WORD	0		%I*	
HW_Status	WORD	0		%I*	

	To write to Set point and Totalizer, set to “Write_protect_wr” to “3.”