RedySmart & RedyIndustrial EtherCAT

Instruction Manual

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Intro

This manual describes how to use the RedySmart and/or RedyIndustrial EtherCAT interface with your EtherCAT system.

EtherCAT is a real-time Industrial Ethernet technology originally developed by Beckhoff Automation. The EtherCAT protocol which is disclosed in the IEC standard IEC61158 is suitable for hard and soft real-time requirements in automation technology, in test and measurement and many other applications.

Please visit www.EtherCAT.org for more information about EtherCAT.

Overview

- Standard Ethernet frame - IEEE 802.3
- Endianness type at Voegtlin Instruments device is **Little Endian**
- Power supply: 18 – 30 VDC / 340 mA (¼" Device) @ 24VDC
  560 mA (½" Device) @ 24VDC

About This Documentation

This documentation contains only descriptions of the communication protocol (EtherCAT).

IMPORTANT NOTE

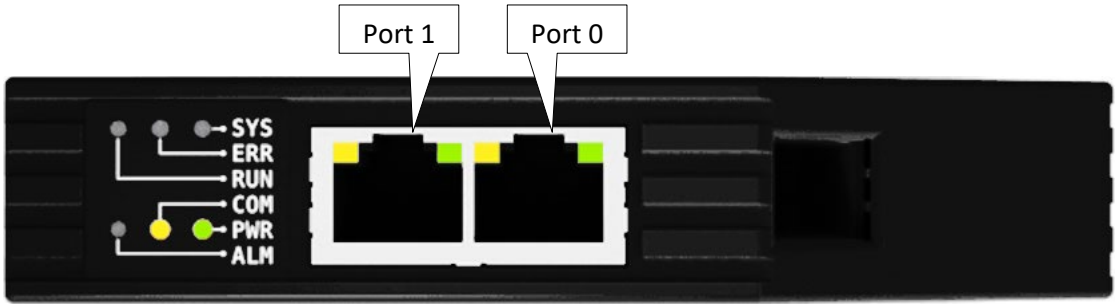
This documentation is a supplement of ***RedySmart Series Digital Communication Manual.*** *Download a copy of the manual here* https://www.sierrainstruments.com/products/downloads/redy-smart

The information in this documentation is valid for the following devices:

RedySmart Series and RedyIndustrial Series.

Connection

The EtherCAT device is equipped with two RJ45 connectors which both can be used to connect the device to an EtherCAT master or switch.



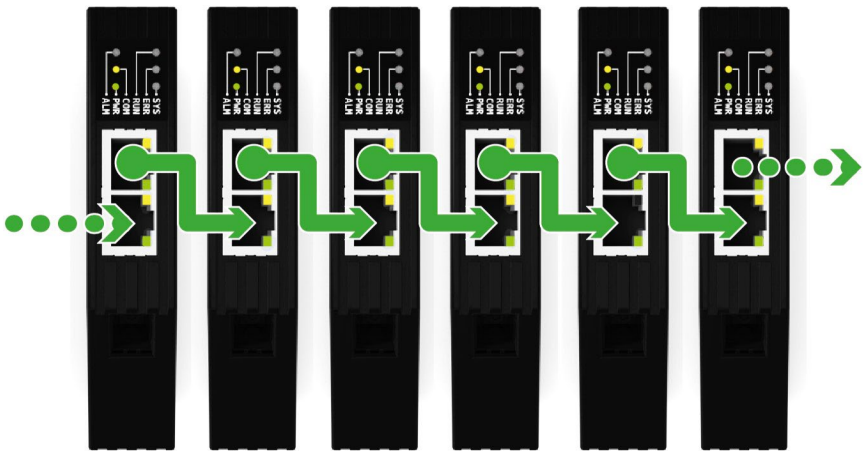
IMPORTANT NOTE

For reliable communication, it is advised to use CAT5E or higher graded cables.

IMPORTANT NOTE

For EtherCAT, “Port 0” acts as **Input**, and “Port 1” as **Output.**

The devices can be daisy-chained to optimize the cabling:



IMPORTANT NOTE

It is important that each device has a unique name assigned in order to hook-up the devices with each other.

More About Daisy Chain:

This configuration requires less cabling than alternative star topologies and thus is simpler and more cost-effective to implement. A daisy chain topology can be arranged in two ways:

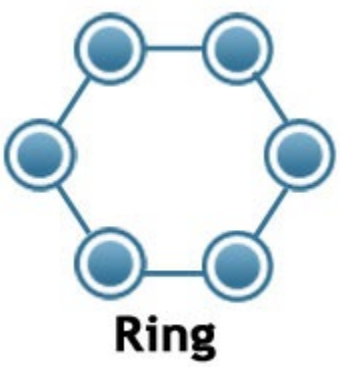
A linear topology:

Message must go from one device to another in one direction.

Inconvenient:
Communication failures in the case of a break in the chain

Ring topology:

It is formed by all the devices connected by each other through their ends.



Advantage:
This ensures that all the data is transmitted by the devices one after the other and if there is a broken link, then the data is transmitted in the reverse fashion ensuring that the signals are received.

EtherCAT Topology:

EtherCAT is very flexible when it comes to laying out the network.

However, Ring, line, or Tree and Star topologies comes with advantages and disadvantages that need to be considered at the design phase.

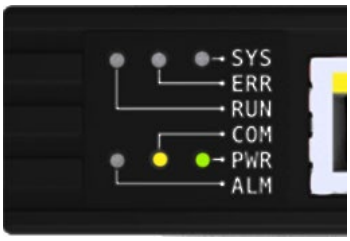
Device Network Setup

The device comes with the following network settings:

Name : Red-y
IP address : 192.168.0.50 or 0.0.0.0
Tips: Sierra uses following USB- to Ethernet Adapter: **D-Link DUB-E100.**

Status LED's

The status LED's are located on top of the device.



SYS – System Status

Color State		Description
	On (green)	EtherCAT Operating system running
	Blinking (red/green)	EtherCAT OS waiting for firmware
	On (red)	EtherCAT bootloader waiting for second stage loader
	Off	Power supply missing or hardware failure

ERR – Bus Status

Color State		Description
	Blinking at 2.5 Hz	**Invalid configuration:** General Configuration Error Possible reason: State change commanded by master is impossible due to register or object settings.
	Single flash	**Local error**: Slave device application has changed the EtherCAT state autonomously. Possible reason 1: A host watchdog timeout has occurred. Possible reason 2: Synchronization Error, device enters Safe Operational automatically.
	Double flash	**Application watchdog timeout:** An application watchdog timeout has occurred. Possible reason: Sync Manager Watchdog timeout.
	Off	**No error**

RUN – Run Status

Color State		Description
	Blinking 2.5 Hz	PRE-OPERATIONAL state
	Single flash	SAFE-OPERATIONAL state
	On	OPERATIONAL state
	Off	INIT state

COM – Modbus Communication Status

Color State		Description
	Flashing (yellow)	Modbus messages are being exchanged
	Off	No communication

PWR – Power Status

Color State		Description
	On	Device is powered and operational
	Off	Device is powered off

ALM – Alarm Status

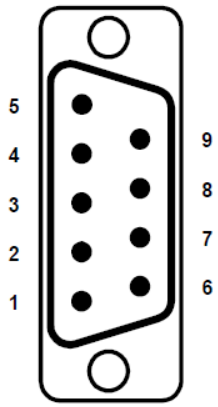
Color State		Description
	Blinking (red)	Alarm condition occurred. Check alarm status register for more info
	On (red)	Hardware failure. Disconnect the device from the power supply and connect it again. If the fault is still present, please send it to the responsible service center.
	Off	No alarm

Electrical Power Supply

The device can be powered through the Sub-D connector which is located on the side of the device.

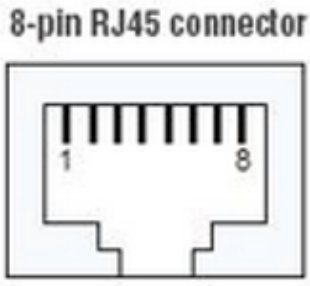
- Power supply: 18 – 30 VDC (15 VDC on request)
- Power consumption: ¼” valve - 300mA (max), ½” valve - 550mA (max)

Sub–D9 Pin Assignment for Modbus RTU, Power Supply, Analog Signals



Pin	Function
1	Analog ground
2	0VDC supply ground
3	+24 VDC supply voltage
4	Analog output
5	Analog input
6	Tx+ RS485-Output (Y)
7	Tx- RS485 Output (Z)
8	Rx- RS485 Input (B)
9	Rx+ RS485 Input (A)

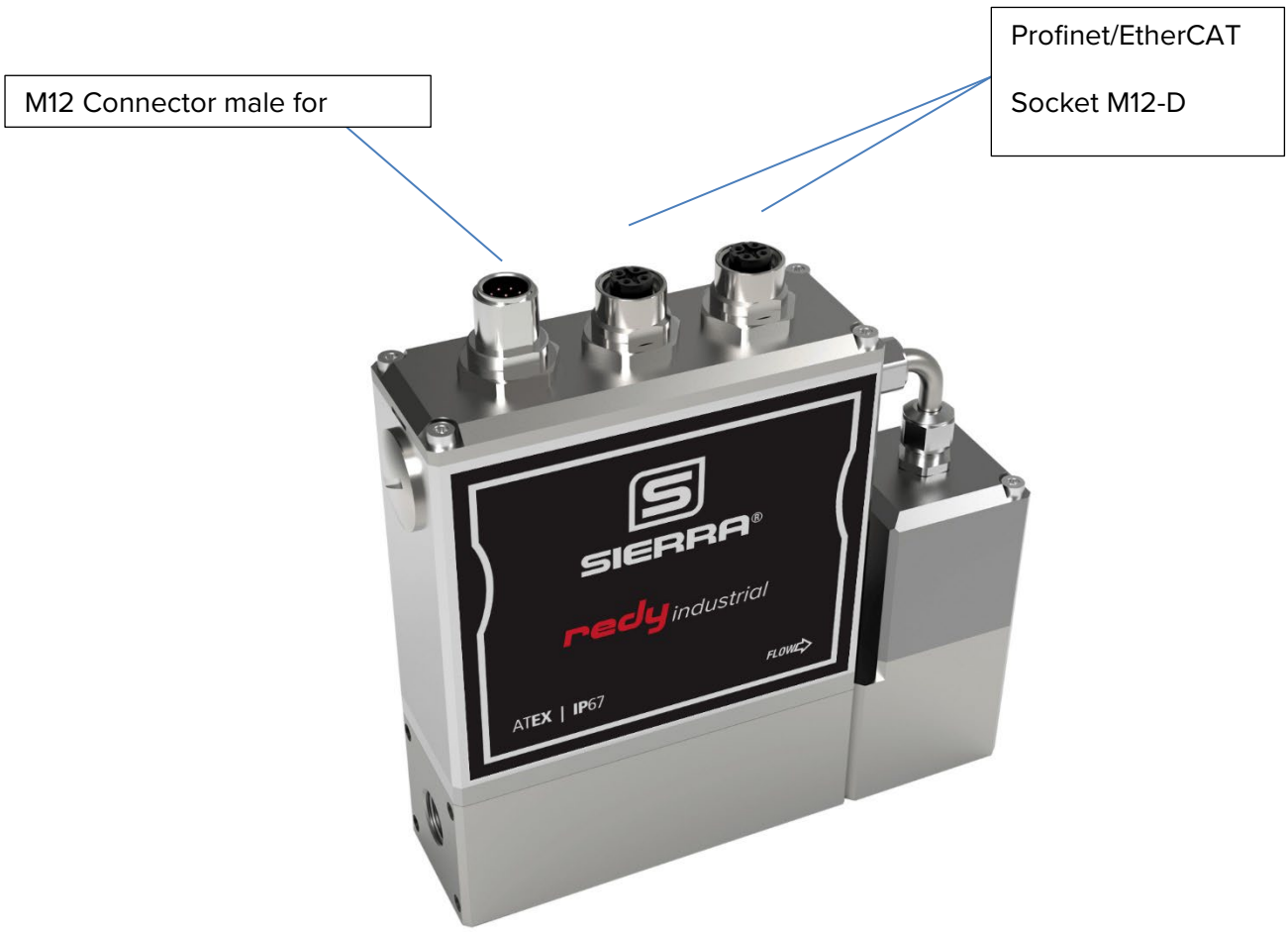
Ethernet RJ45 Pin Assignment (Profinet/EtherCAT)

RJ45 Connector	Socket version RJ45, female connector	Pin	Assignment	Wire Color
		1	Data (TX+)	Yellow
		2	Data (TX-)	Orange
		3	Data (RX+)	White
		4	Not used	
		5	Not used	
		6	Data (RX-)	Blue
		7	Not used	
		8	Not used	

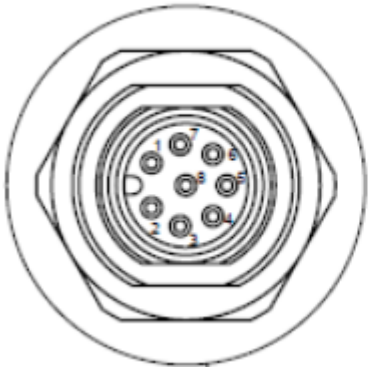
IMPORTANT NOTE

More information can be found In the ***RedySmart Product Manual go to*** https://www.sierrainstruments.com/products/downloads/redy-smart and look under the download section to find the manuals.

RedyIndustrial Series with IP-67



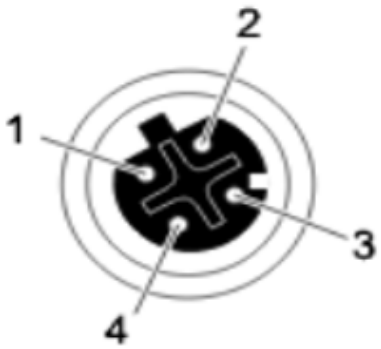
M12 Male pin assignments for Modbus RTU, power supply, analog signals



1	B (+)
2	Output +
3	Setpoint +
4	0 Vdc
5	not connected
6	A (-)
7	24 Vdc
8	Common

Remark:
B(+) = RX+, TX+ and A(-) = RX-, TX-

Ethernet M12-D Pin assignment (Profinet/EtherCAT)

M12-D coding	Socket version			
M12-D coding	M12-D coding , female connector	Pin	Assignment	Wire Color
		1	Data (TX+)	Yellow
		2	Data (RX+)	White
		3	Data (TX-)	Orange
		4	Data (RX-)	Blue

IMPORTANT NOTE

More information can be found In the ***RedySmart Product Manual go to*** https://www.sierrainstruments.com/products/downloads/redy-smart and look under the download section to find the manuals.

Serial Interface

In addition to the EtherCAT interface, the device has, as standard, a digital interface with the ModBus protocol. This interface enables access to numerous parameters.

IMPORTANT NOTE

Any changes to the settings through the standard interface Modbus RTU, are not reflected in the EtherCAT PDO's. Please apply a **power reset** after changing the settings through the standard interface.

ESI File

The ESI file contains the facilities/features which the device offers to the EtherCAT master. The file is called: **ESI_Voegtlin_Instruments_0B02_Red-y_Vx.xx.xml**

The latest ESI file can be downloaded at: https://www.sierrainstruments.com/products/downloads/redy-smart .

The ESI file is an xml file containing:

- Device identification info. This contains general information like:
  - Vendor (Voegtlin Instruments GmbH)
  - Vendor ID (0x0B02)
  - Product family (Red-y)
- Device Access Point (DAP) contains information about:
  - Used hardware
  - Ethernet related settings
  - Supported features

IMPORTANT NOTE

The EtherCAT interface only supports cyclic data exchange.

Alarms

To handle alarms, it is necessary to actively poll the available alarm PDO`s "**Alarms Info**" & "**HW Status**" in the PLC Program.

Process Data Objects (PDO's)

PDO's are variables continuously transferred between the Device (slave) and the PLC (master)
The EtherCAT interface supports only one slot for input and one slot for output.
Each slot has its own size. This document describes how the data is encoded in the PDO's.
The order of the registers are fixed.

The tables also show the Modbus registers which are linked to the PDO data. More information about the registers can be found on the Sierra website under the Docs and Download section, look for digital communication.

Read with Input PDO's (slave to master)

Register	Modbus Addr. (zero base)	Data Type	Description
Flow	0x0000	F32	Actual flow
Temp	0x0002	F32	Gas Temperature
Totalizer	0x0004	F32	Accumulated gas total
Set point Flow	0x0006	F32	Set point flow when in controller mode
Valve Power	0x000A	F32	Read valve PWM in %
Alarm Info	0x000C	UINT16	Indicates the alarm messages in a bit map
HW Status	0x000D	UINT16	Hardware error status register
Device setup	0x000E	UINT16	Setup control mode
Ramp Time	0x000F	UINT16	Changing time that it takes between set points
Flow Unit	0x0016	STR8	Flow unit
Gas Name	0x001A	STR8	Name of current gas
Serial Number	0x001E	UINT32	Serial number of the device
Device Type1	0x0023	STR8	Name of the instrument type / instrument code
PID Select	0x0035	UINT16	Select a PID preset for flow controller
Flow Limit	0x094F	F32	Maximum flow allowed
Device Type2	0x1004	STR8	Name of the instrument type / instrument code
Totalizer Unit	0x4048	STR8	Totalizer Unit
Enable SP storage	0x4050	UINT16	Enable the storing of the set point in EEPROM
LUT Select	0x4139	UINT16	Select a LUT from the calibrated list
Pressure	0x5F00	F32	Actual pressure (in pressure controller)
Pressure Min	0x5F02	F32	Minimum pressure set point
Pressure Max	0x5F04	F32	Maximum pressure set point
Set point pressure	0x5F06	F32	Set point pressure when in controller mode
Pressure Unit	0x5F08	STR8	Pressure Unit
Pressure PID select	0x5F10	UINT16	Select a PID preset for pressure controller

Write with Output PDO's (master to slave)

Register	Modbus Addr. (zero base)	Data Type	Description
Totalizer	0x0004	F32	Accumulated gas total
Set point Flow	0x0006	F32	Set point flow when in controller mode
Valve Power	0x000A	F32	Set valve PWM in %
Device Setup	0x000E	UINT16	Setup control mode
Ramp Time	0x000F	UINT16	Changing time that it takes between set points
PID Select	0x0035	UINT16	Select a PID preset for flow controller
Factory Reset	0x0037	UINT16	Restore unit to previous backup
HW Error Reset	0x404F	UINT16	Reset hardware errors in status register
Enable SP storage	0x4050	UINT16	Enable the storing of the set point in EEPROM
LUT Select	0x4139	UINT16	Select a LUT from the calibrated list
Set point pressure	0x5F06	F32	Set point pressure when in controller mode
Pressure PID select	0x5F10	UINT16	Select a PID preset for pressure controller
Soft Reset	0x0034	UINT16	Software reset of the device
Write Protect /Output Enable	--	UINT16	Enable output PDO's

Write Protect/Output Enable

At power-up the output PDO's are disabled. This means that any changes to the output PDO will not be executed by the Device. In order to enable writing to the Device, it is necessary to write "Bit weight or the sum of the Bit weight value into Write Protect / Output Enable register. Each bit in this register corresponds to a "Selected output PDO register". The table below gives an overview:

Bit	Selected output PDO register	Bit weight
0	Totalizer	1
1	Set point Flow	2
2	Valve Power	4
3	Device Setup	8
4	Ramp Time	16
5	PID Select	32
6	Factory Reset	64
7	HW Error Reset	128
8	Enable SP storage	256
9	LUT Select	512
10	Set Point pressure	1024
11	Pressure PID Select	2048
12	Soft Reset	4096

Divers Examples

Enable writing:

** Input PDO's = Read= Rd and ** Output's PDO's =Write = Wr*

- To **enable writing a value to the set point (flow)**, set bit 1 with "Bit weight = 2", in writing "Output enable /Write protect" with value = 2

- To **enable writing the Totalizer & set point (flow)**, add both Bit weight, and write "Output enable/Write Protect" with value = 3

IMPORTANT NOTE

Why the register does not react of values modification?
Nothing will happen, if the register has already value = "0" and you want again to update with this same value.
So we first need to modify the value. In this case it has to be different of "0", then we can write again value = "0".
This is currently happening when "reset of Totalizer" or "HW error reset".

Specify Flow Rate

Registers used (Rd*): **Flow Limit**, **Flow**
Registers used (Wr**): **Write Protect**, **Set point Flow**

1. Determine final value: Query register(Rd) **Flow Limit** (Not mandatory if end value is known)
2. Enable flow: Register(Wr): **Write Protect** enter value 2 (= bit weight for **Set point Flow**), so that the Vögtlin device is ready for a set point.
3. Set flow: Register(Wr) **Set point Flow** e.g. enter the determined value of point 1
4. Read actual value flow: Register(Rd) **Flow**

Set Pressure Set Point

The device must already be set to pressure control.
Registers used (Rd): **Pressure, Pressure min, Pressure max**
Registers used (Wr): **Write Protect, Set point Pressure**

1. Determine max/minimum value: Register(Rd) Query **Pressure min**, **Pressure max** (Not mandatory if end value is known)
2. Enable pressure: Enter register(Wr) **Write Protect** the value 1024 (= bit weight for **Set point Pressure**), so that the Redy device is ready for a set point pressure.
3. Set point pressure: Register(Wr) **Set point Pressure** e.g., Enter the determined value of point 1.
4. Read actual value pressure: Register(Rd) **Pressure**

Control Valve Manually

Registers used (Rd): **Valve Power, Flow**
Registers used (Wr): **Write Protect, Device Setup, Valve Power**
Info: To be able to control the valve directly, the control mode (**Device Setup**) must first be changed.

1. Enable Device Setup and **Valve Power**: Enter the value 12 into Register(Wr) **Write Protect** (= bit weight 4 for **Valve Power** + 8 for **Device Setup**)
2. Changing the control mode: enter the value 10 in register (Wr) **Device Setup.**
3. Default control value valve: enter register (Wr) **Valve Power** e.g. 25 for 25%.
(Warning! 25% valve position does not mean 25% flow. Most valves only open at over 35%).
4. Control value of valve: Register (Rd) **Valve Power**
Or
5. Read actual value flow: Register (Rd) **Flow.**

WARNING!
In order to be able to control the set point via the register(Wr) **Set Point Flow** again, the register(Wr) **Device Setup** must be set to 1(=Digital) again.

Change Pressure Control and Flow Control

Registers used (Rd): **Flow, Pressure**
Registers used (Wr): **Write Protect, Device Setup, Set Point Flow, Set Point Pressure**

1. Enable **Device Setup**, **Set point Flow**, **Set point Pressure**: Register(Wr) **Write Protect** enter the value 1034 (= bit weight 8 for **Device Setup** + 2 for **Set point Flow** + 1024 for **Set Point Pressure**)
2. Change the control mode: Enter register (Wr) **Device Setup** value 5 for pressure control or value 1 for flow control.
3. Preset pressure set point: Register (Wr) **Set point Pressure** e.g. 2 for 2bar a (depending on the scaling of the pressure transmitter).
3.1 Presetting of flow setpoint: Register (Wr) **Set point Flow** e.g. 1 for 1 ln/min (depending on the scaling of the flow controller).
4. Read actual value pressure: Register (Rd) **Pressure**
Or
4.1 Read actual value flow: Register (Rd) **Flow**

WARNING!
If a value is entered for both set points flow and pressure, this value is taken over directly by switching over the control mode (using **Device Setup**) as long as the bit is properly set in **Write Protect**.

Detect and Acknowledge Alarms

Registers used (Rd): **HW Status**
Registers used (Wr): **Write Protect, HW Error Reset**

1. Enable **HW Error Reset**: Enter the value 128 into register (Wr) **Write Protect.**
2. Determine second alarm: Read register (Rd) **HW status**. A value between 0 and 11 is displayed here.
3. Acknowledge 3rd alarm: Register(Wr) **HW Error Reset** enter the value displayed at **HW Status**.

WARNING!
After an alarm has been acknowledged, it will not be displayed again until the device has been restarted, or **Soft Reset** has been performed.

Changing Flow/Pressure/Valve Position During Operation

IMPORTANT NOTE

For certain applications, it is useful to switch between different control modes. E.g. flushing processes without having to set to 0.

Used registers (Rd): **Flow, Pressure, Valve Power**
Registers used (Wr): **Write Protect, Device Setup, Set Point Flow, Set Point Pressure, Valve Power**

1. Enable **Device Setup, Set Point Flow, Valve Power, Set Point Pressure**: Register(Wr**) Write Protect** enter the value 1038 (2+4+8+1024).
2. Preset pressure set point: Register(Wr) **Set Point Pressure** e.g. 2 for 2bar a (depending on the scaling of the pressure transmitter).
2.1 Preset flow set point: Register(Wr) **Set Point Flow** e.g. 1 for 1 ln/min (depending on the scaling of the flow controller).
2.2 Default control value for valve: Enter register (Wr) **Valve Power** e.g. 100 for 100%.
3. Change the control modes: enter Register(Wr) **Device Setup** the value 5 for pressure control, 1 for flow control or 10 for manual valve control.

If a value is now entered for the **setpoints flow**, pressure and manual valve control, this value is taken over directly by switching over the control mode as long as the bit is set in **Write Protect**.

5. Read actual value pressure: Register (Rd) **Pressure**
5.1 Read actual value flow: Register (Rd) **Flow**
5.2 Read control value for valve: Register (Rd) **Valve Power**

WARNING!
With pressure regulators, it must be ensured that the overload limit of the pressure transmitter is not exceeded.

Register Description Input PDO's

Description: Gas Flow	Data type: FLOAT32
Measured gas flow	

Description: Totalizer	Data type: FLOAT32
Accumulated gas flow	

Description: Ramp	Data type: UINT16
Controls the changing time that it takes from the current nominal value to a new nominal value. 0: Function disabled 200.. 10000: time in ms	

Description: Device Type1	Data type: STRING
Name of the instrument type / instrument code	

Description: Device Type2	Data type: STRING
Name of the instrument type / instrument code	

Description: Set Point Flow	Data type: FLOAT32
Set point of the controller. To activate the set point, the controller mode (Output PDO: Device Setup) has to be in mode 0 (automatic) or in mode 1 (Digital).	

Description: HW Status (Hardware Status)	Data type: UINT16

Indicates eventual malfunctions during operation of the instrument. It indicates the alarm messages in a bit map. This Information persists even the problem has been solved and has to be reset with the parameter 'HW error reset.'

All alarm messages are reset if the instrument is switched off and activated again at power on if an alarm persists.

Bit #	Description
0	Power-up alarm If the instrument is switched off with activated Power-up alarm and switched on again, then the active set point will be the readjusted power-up set point. (See parameter power-up alarm set point). This status will only be checked at power-up.
1	Alarm analog set point Raised if the analog set point is outside the valid range (21.6mA, 10.8V). This alarm is only active i the instrument is configured as a flow controller.
2	Zero point or leakage alarm Raised if at a valve control signal of 0% (Valve electrically closed) a flow is measured. Possible causes are: An incompletely closed valve, internal leakage or a zero drift. This alarm is only active if the instrument is a flow controller.
3	No gas / jammed valve alarm Raised if at a valve control signal of 100% (valve electrically fully open) no gas flow is measured. This alarm is only active if the instrument is configured as a flow controller. Warning!: After an alarm has been acknowledged, it will not be displayed again until the device has been restarted, or Soft Reset has been performed.
4	No reaction Raised if the valve control signal is raised or lowered and no variation of the gas flow is measured. Possible causes are: Jammed valve, changed pressure conditions or valve too small (after a change of gas). This alarm is only active if the instrument is configured as a flow controller.
5	Sensor communication error Raised if a communication problem occurs between the sensor and the electronic module. In this case the measurements are probably wrong.
6	Not used
7	EEPROM access check Raised if access errors to the EEPROM are detected. In this case the correct function of the instrument is no longer guaranteed.
8	Not used
9	Not used
10	Current input overload Raised if current at analog input exceeds 25mA.
11	The sensor serial number does not match the loaded gas data. The valve is closed, the actual value is set to 0.
12..15	Not used

Description: LUT Select	Data type: UINT16
Specifies, which gas data set is to be used. Up to 10 different calibration data sets can be saved in the instrument. They have to be created by the manufacturer.	

Description: Gas Temperature	Data type: FLOAT32
Measured value temperature [°C]. Note: Due to self-heating this temperature may be slightly higher range than the effective gas temperature at the device inlet.	

Description: Valve Power	Data type: FLOAT32
Contains the actual control value for the valve whether the control value is generated from the controller (automatic mode) or manually set via ModBus. If the register control mode (Output PDO: Device Setup) is defined as mode 10, the control value is immediately loaded into the register. In any other modes the value is stored in a buffer and becomes active when control mode 10 has been activated. It is possible to adjust directly the position of the control valve [0...100%].	

Description: Serial Number	Data type: UINT32
Clear and unique serial number of the electronic part of the measuring instrument (PCB).	

Description: Flow Limit	Data type: FLOAT32
Maximum allowed flow	

Description: Flow Unit	Data type: STRING
Name of the selected flow unit	

Description: Gas Name	Data type: STRING
Name of the selected gas	

Description: Pressure Units	Data type: STRING
Pressure units	

Description: Pressure	Data type: FLOAT32
Actual pressure (in Device Setup)	

Description: Set Point Pressure	Data type: FLOAT32
Set point pressure of the controller. To activate the set point, the controller mode (Output PDO: Device Setup) has to be in mode 0 (automatic) or in mode 1 (Digital).	

Description: Device Setup	Data type: UINT16

Selection of the controller mode and the source of the set point.
As example if you want to switch between flow or pressure control and vis versa, with value = “1” we would control flow, and with value =”5” we would regulate pressure

Value	Description
0	Automatic set point selection The source of set point is automatically selected, i.e.: As standard the analog set point (voltage or current signal) is active. If a digital set point is sent (via ModBus) automatically the red-y switches to ‘Digital mode’ and the analog set point is disabled.
1	Digital set point Activates the digital set point via digital communication (ModBus, PROFINET)
2	Analog set point (standard setting) Selects the analog signal as set point source.
5	Pressure controller activated
6	Back pressure controller activated
10	Direct adjustment of the valve signal Deactivates the automatic control mode. Sets the valve control to the value of register ‘valve power’
20	Set point 0% Sets the set point to 0%.
21	Set point 100% Sets the set point to 100%.
22	Valve fully closed Deactivates the automatic control mode. Sets the valve control to 0% (Valve fully closed).
23	Valve fully open Deactivates the automatic control mode. Sets the valve control signal to 100% (Valve fully open).

Description: Alarm Info	Data type: UINT16

Indicates the alarm messages in a bit map. The bit pattern depends on the status of the instrument and the detected alarms. If an alarm condition is no longer valid the corresponding bit is automatically erased.

Value	Description
0	Indicates a negative flow (flow value < 0)
1	Indicates a negative flow exceeding the backflow setpoint. The bit remains set until a positive flow is detected.
2..14	Not used
15	Indicates a hardware error (register HW Status). This bit is therefore an OR-function of all hardware errors.

Description: PID Select	Data type: UINT16

The controller consists of altogether five complete control parameter sets. Three of these sets were defined by the manufacturer and cannot be changed by the user (so-called manufacturer control parameter sets). **Two sets can be changed at wish by the user** (so-called user control parameter sets).

One of the set value (0 to 4) is used for the current control. This setting can be saved in EEPROM and is available again with the next activation. This set can be read, changed and re-written.
Afterwards, the controller immediately works with the modified set.

Function of the pre-defined control parameter sets (values 2 to 4):
Due to the flow end values, the correspondingly applied control valve and the pressure ratios, these sets receive different pre-defined parameters P, I, D and N.
The aim is to provide the controller with the following different manufacturer properties with the three sets (values 2 to 4):

Value	Type
0	**User control parameter set 1 (default)**
1	**User control parameter set 2**
2	Manufacturer control parameter fast: Fast response time with the corresponding overshooting (fast response)
3	Manufacturer control parameter set medium: Medium response time with a low overshooting tendency.
4	Manufacturer control parameter set slow: Slow response time without overshooting (slow response)

Function of customized control parameter sets (values 0 and 1):

*Remark dedicated for **Flow controller**:*
By using **User control parameter set 1** or **set 2**, customized PID-Parameter (also called Kp/Ki/Kd) for the Flow controller can be defined.
However, these will have to be set up via ModBus, or via our free software get red-y by using the Graph Tool. You can find more details in “smart series Operating Instructions SN>110000" in the section “Settings for control parameters".

*Remark dedicated for **Pressure controller**:*
Look in this manual for: “Description: Pressure PID Select.”

Description: Enable SP (Set Point) Storage	Data type: UINT16
To activate the Set Point Storage, the controller mode (Output PDO: Device Setup) **has to be** in mode 1 (Digital). Specifies whether the set value is automatically stored in the EEPROM. The service life of an EEPROM depends on the number of write cycles. The guaranteed number of write cycles is 1 million. If the set value is set every 10 minutes, the resulting service life is 19 years. If the set value is set at significantly shorter intervals, automatic storage should be disabled. 0 = Manual save mode 1 = Automatic save mode	

Description: Pressure PID Select	Data type: UINT16
PID set selection for the pressure controller	

Register Description Output PDO's

Description: Totalizer	Data type: FLOAT32
Accumulated gas flow	

Description: Set Point Flow	Data type: FLOAT32
Set point of the controller. To activate the set point, the controller mode (Output PDO: Device Setup) has to be in mode 0 (automatic) or in mode 1 (digital).	

Description: Factory reset	Data type: FLOAT32
Restore unit to previous backup Create or restore a backup. Performing the restore/backup will trigger a reset of the device. During start-up the restore/backup is performed.	

Value	Type
1	Backup of the EEPROM is made
2	Restore the EEPROM from a backup
3	Remove the backup. A backup has to be made first in order to do a restore.

Description: Hardware Error Reset	Data type: UINT16
Resets the alarm states of the instrument that occurred during operation. The meaning of the individual error bits are described in the register hardware status (Input PDO: HW Status). Error bits cannot be set manually as they are always a consequence of faulty operating states. If you want to reset an error bit in the register hardware status, the corresponding bit is set in register Output PDO: HW Error Reset. If a bit remains on zero, the error bit is also not changed. **Warning!:** After an alarm has been acknowledged, it will not be displayed again until the device has been restarted, or soft reset has been performed.	

Description: LUT Select	Data type: UINT16
Specifies, which gas data set is to be used. Up to 10 different calibration data sets can be saved in the instrument. They have to be created by the manufacturer.	

Description: Valve Power	Data type: FLOAT32
Contains the actual control value for the valve whether the control value is generated from the controller (automatic mode) or manually set via ModBus. If the register control mode (Output PDO: Device Setup) is defined as mode 10 the control value is immediately loaded into the register. In any other modes the value is stored in a buffer and becomes active when control mode 10 has been activated. It is possible to adjust directly the position of the control valve [0...100%].	

Description: Device Setup	Data type: UINT16
Selection of the controller mode and the source of the set point. As example if you want to switch between flow or pressure control and vis versa, with value = “1” we would control flow, and with value =”5” we would regulate pressure	

Value	Description
0	Automatic set point selection The source of set point is automatically selected, i.e.: As standard the analog set point (voltage or current signal) is active. If a digital set point is sent (via ModBus) automatically the red-y switches to ‘Digital mode’ and the analog set point is disabled.
1	Digital set point Activates the digital set point via digital communication (ModBus, PROFINET)
2	Analog set point (standard setting) Selects the analog signal as set point source.
5	Pressure controller activated
6	Back pressure controller activated
10	Direct adjustment of the valve signal Deactivates the automatic control mode. Sets the valve control to the value of register ‘valve power´
20	Set point 0% Sets the set point to 0%.
21	Set point 100% Sets the set point to 100%.
22	Valve fully closed Deactivates the automatic control mode. Sets the valve control to 0% (Valve fully closed).
23	Valve fully open Deactivates the automatic control mode. Sets the valve control signal to 100% (Valve fully open).

Description: PID Select	Data type: UINT16

The controller consists of altogether five complete control parameter sets. Three of these sets were defined by the manufacturer and cannot be changed by the user (so-called manufacturer control parameter sets). **Two sets can be changed at wish by the user** (so-called user control parameter sets).

One of the set value (0 to 4) is used for the current control. This setting can be saved in EEPROM and is available again with the next activation. This set can be read, changed and re-written.
Afterwards, the controller immediately works with the modified set.

Function of the pre-defined control parameter sets (values 2 to 4):
Due to the flow end values, the correspondingly applied control valve and the pressure ratios, these sets receive different pre-defined parameters P, I, D and N.
The aim is to provide the controller with the following different manufacturer properties with the three sets (values 2 to 4):

Value	Type
0	**User control parameter set 1 (default)**
1	**User control parameter set 2**
2	Manufacturer control parameter fast: Fast response time with the corresponding overshooting (fast response)
3	Manufacturer control parameter set medium: Medium response time with a low overshooting tendency.
4	Manufacturer control parameter set slow: Slow response time without overshooting (slow response)

Function of customized control parameter sets (values 0 and 1):

*Remark dedicated for **Flow controller**:*
By using **User control parameter set 1** or **set 2**, customized PID-Parameter (also called Kp/Ki/Kd) for the Flow controller can be defined.
However, these will have to be set up via ModBus, or via our free software get red-y by using the Graph Tool. You can find more details in “smart series Operating Instructions SN>110000" in the section “Settings for control parameters".

*Remark dedicated for **Pressure controller**:*
Look in this manual for: “Description: Pressure PID Select”

Description: Enable SP (Set Point) Storage	Data type: UINT16
To activate the Set Point Storage, the controller mode (Output PDO: Device Setup) **has to be** in mode 1 (Digital). Specifies whether the set value is automatically stored in the EEPROM. The service life of an EEPROM depends on the number of write cycles. The guaranteed number of write cycles is 1 million. If the set value is set every 10 minutes, the resulting service life is 19 years. If the set value is set at significantly shorter intervals, automatic storage should be disabled. 0 = Manual save mode 1 = Automatic save mode	

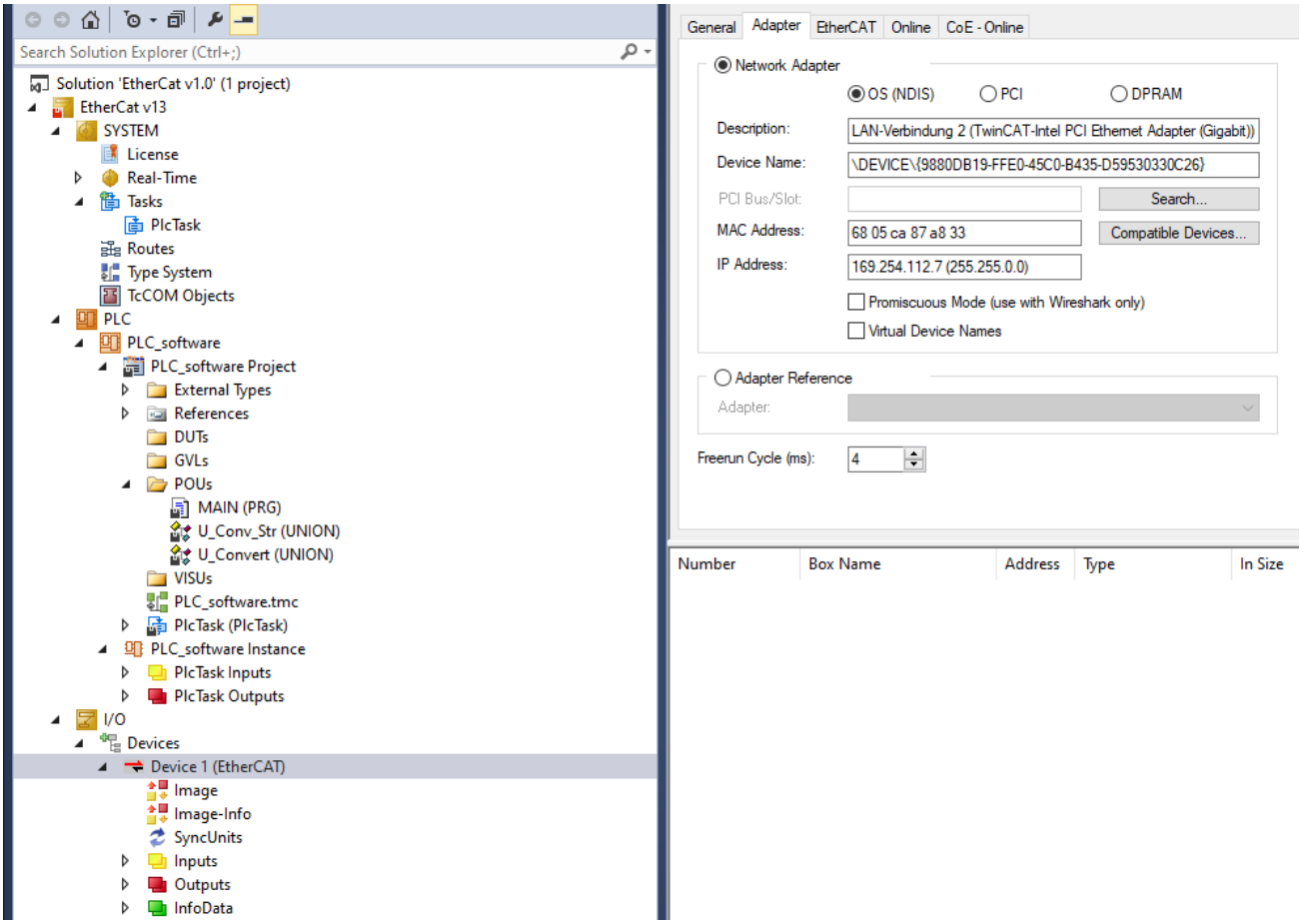
Description: Set Point Pressure	Data type: FLOAT32
Set point of the pressure controller. To activate the set point, the controller mode (Output PDO: Device Setup) has to be in mode 0 (automatic) or in mode 1(Digital).	

Description: Pressure PID Select	Data type: UINT16
See “PID Select” description, as both have the same operating principle. *Remark dedicated for **Pressure controller**:* Using **User control parameter set 1** or **set 2**, customized PID-Parameter (also called Kp/Ki/Kd) for the pressure controller can be defined. However, these will have to be setup with our free software get red-y. You can find more details in the manual “Software get red-y Operating Instructions" in the section "Pressure controller" and by searching for "PID-parameter".	

Description: Soft Reset	Data type: UINT16
A software reset of the measuring or control instrument takes place if a value bigger than zero is written in this register.	

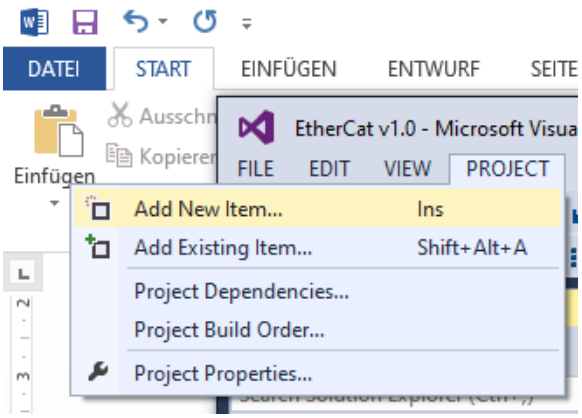
Appendix A – Adding an EtherCAT device in TwinCAT 3.1

After adding the ESI file on the PC, add an EtherCAT driver and configure it.

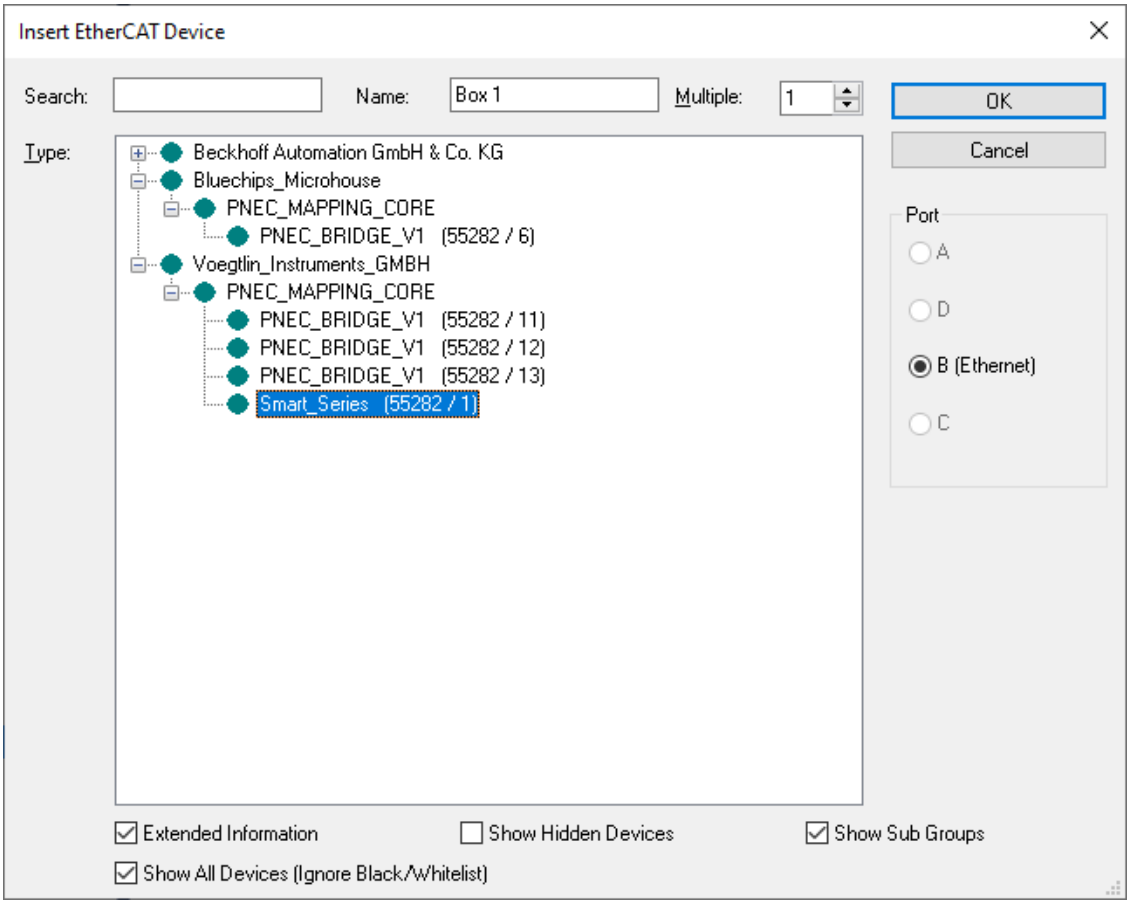


Add Device

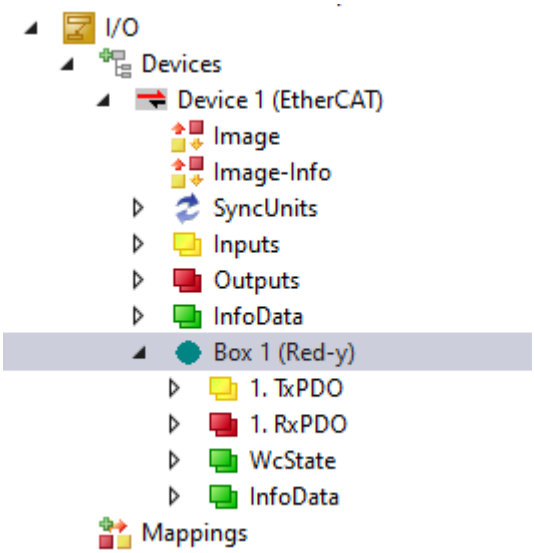
Run TwinCAT in configuration mode and add a new device:



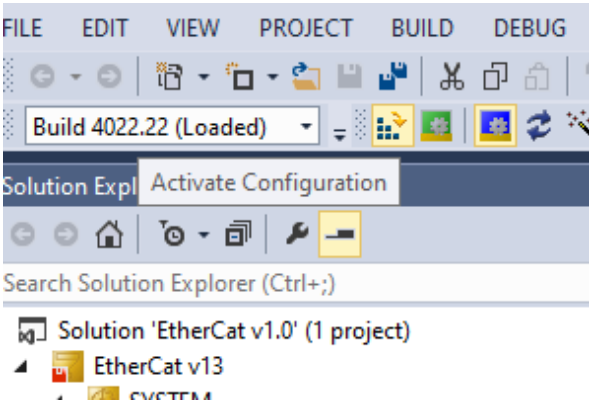
Select the appropriate device from the list. It could be that the options “Extended Information” and/or “Show all devices” needs to be selected:



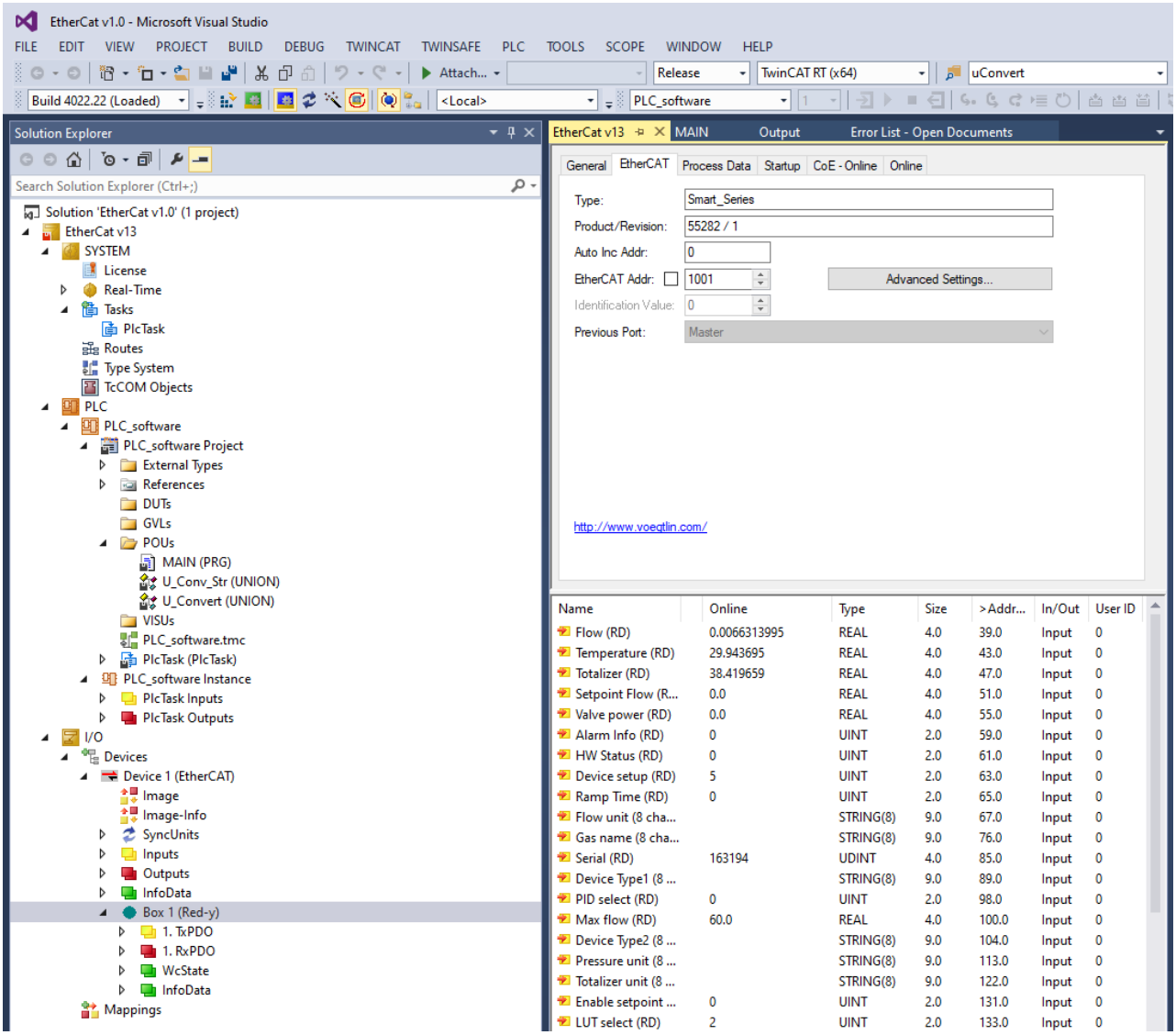
The device is added to the server:



The new configuration can be activated:



When returning to the Config mode, double clicking on the device will access the online data:



More information about TwinCAT can be found at: [https://www.beckhoff.com/TwinCAT/.](https://www.beckhoff.com/TwinCAT/)

IMPORTANT NOTE

The TwinCAT configuration can be made available on request.