FNC-APM

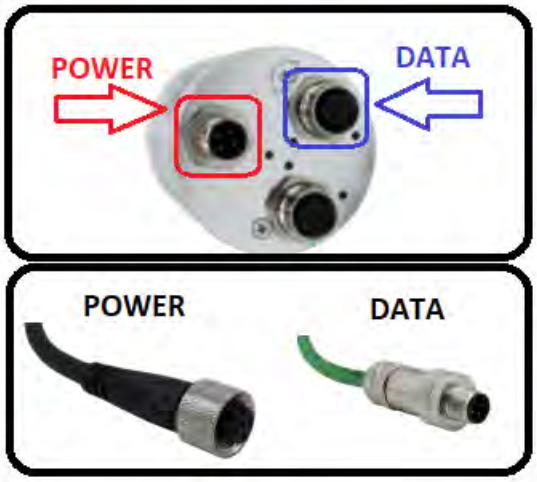
PROFINET ENCODER USER GUIDE

CONTENTS

FIGURES

TABLES

CABLES AND PORTS OF ENCODER



Power cable and data cable are correctly connected to the device. Details about the connection pinout structure are explained in the section "4.Connector & Pin Assignment". Power cable and data cable are indicated in the figure on the side. It is also specified to which input ports the power cable and data cable will be connected to the Fenac PROFINET encoder. The device can be supplied with DC voltage in the range of 10V to 30V. The other end of the data cable must be connected to an PROFINET master. Here we will talk about two methods. Defining a personal computer as an PROFINET master device and connect the data cable to the ethernet port of a PC is an easy method, as no external hardware is required. You can do your various tests in this way. The other method is to use a PLC device with PROFINET Master as traditionally.

HARDWARE INSTALLATION

In order to connect the Fenac PROFINET encoder and make its adjustments, a connection must be made as shown in the figure.

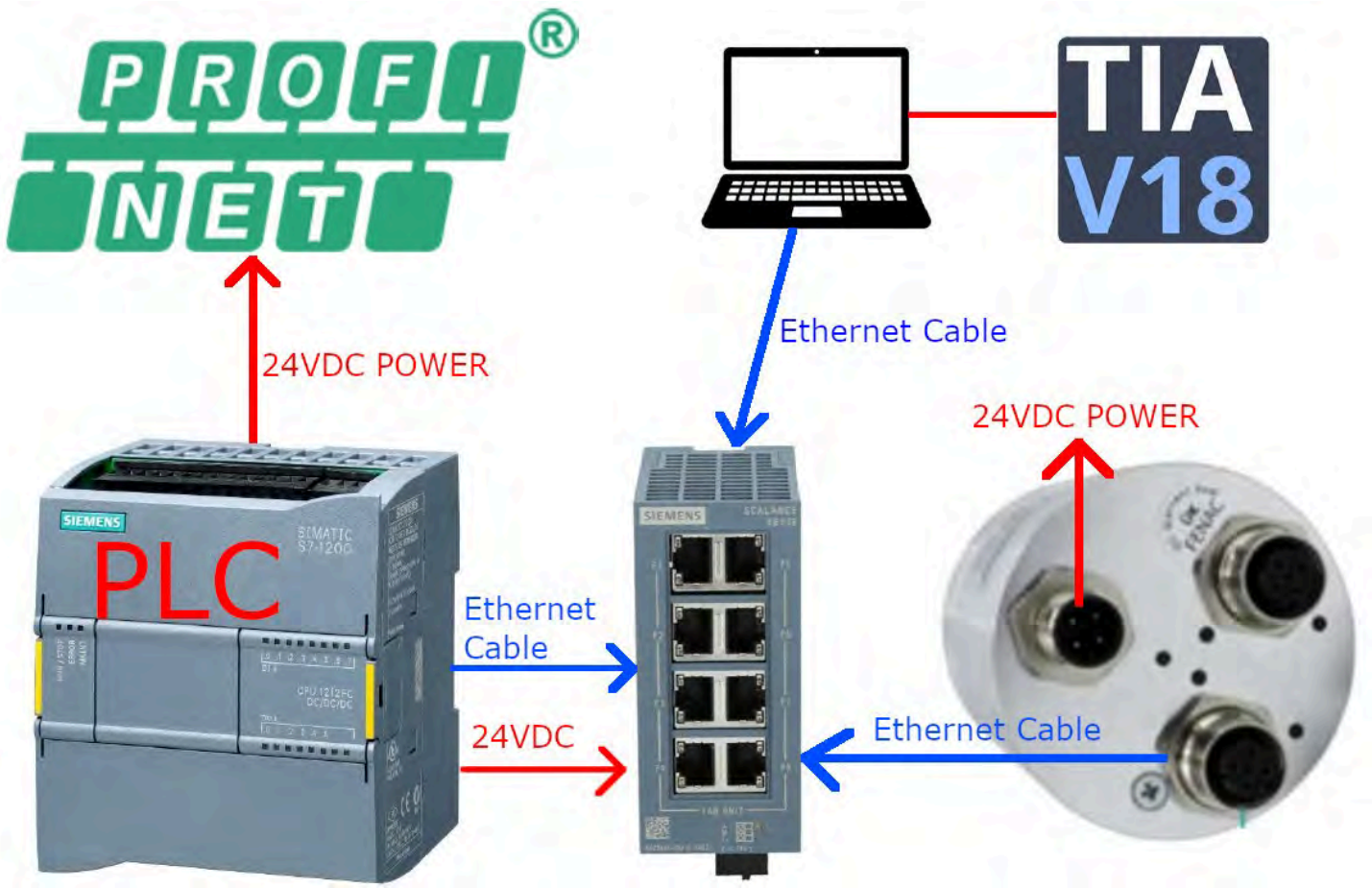


Figure 1: Connection

1. Communication Telegrams for Cyclic Process Data

1.1. I/O Signals

Different signals are processed in the different telegrams. Table 1 shows all the signals implemented in the APM PROFINET.

Signal Numbers	Meaning	Abbreviation	Length(bit)	Sign
6	Speed A	NIST_A	16	Yes
8	Speed B	NIST_B	32	Yes
9	Sensor 1 control word	G1_STW	16	No
10	Sensor 1 state word	G1_ZSW	16	No
11	Position 1	G1_XIST1	32	No
12	Position 2	G1_XIST2	32	No
39	Position 3	G1_XIST3	64	No
80	Encoder control word 2	STW2_ENC	16	No
81	Encoder state word 2	ZSW2_ENC	16	No

Table 1: Signal numbers of the I/O data

1.2. Structure Of Telegram 81 to 84

1.2.1. Structure of Telegram 81

- Output (PLC to slave)
- Input (slave to PLC): Position 1 and Position 2

Data Word	1	2
Value	STW2_ENC	G1_STW
Signal	80	9
Length	16 Bit	16 Bit
Meaning	Encoder control word 2	Sensor 1 control word

Table 2: Output data in the telegram 81

Data Word	1	2	3	4	5	6
Value	ZSW2_ENC	G1_ZSW	G1_XIST MSW	G1_XIST1 LSW	G1_XIST MSW	G1_XIST2 LSW
Signal	81	10	11		12	
Length	16 Bit	16 Bit	32 Bit		32 Bit	
Meaning	Encoder state word 2	Sensor 1 state word	Position 1		Position 2	

Table 3: Input data in telegram 81

1.2.2. Structure of Telegram 82

- Output (PLC to slave)
- Input (slave to PLC): Position 1 and position 2 as well as speed A

Data Word	1	2
Value	STW2_ENC	G1_STW
Signal	80	9
Length	16 Bit	16 Bit
Meaning	Encoder control word 2	Sensor 1 control word

Table 4: Output data in the telegram 82

Data Word	1	2	3	4	5	6	7
Value	ZSW2_ENC	G1_ZSW	G1_XIST1 MSW	G1_XIST1 LSW	G1_XIST2 MSW	G1_XIST2 LSW	NIST_A
Signal	81	10	11		12		6
Length	16 Bit	16 Bit	32 Bit		32 Bit		16 Bit
Meaning	Encoder state word 2	Sensor 1 state word	Position 1		Position 2		Speed A

Table 5: Input data in telegram 82

1.2.3. Structure of Telegram 83

- Output (PLC to slave)
- Input (slave to PLC): Position 1 and position 2 as well as speed B

Data Word	1	2
Value	STW2_ENC	G1_STW
Signal	80	9
Length	16 Bit	16 Bit
Meaning	Encoder control word 2	Sensor 1 control word

Table 6: Output data in the telegram 83

Data Word	1	2	3	4
Value	ZSW2_ENC	G1_ZSW	G1_XIST1 MSW	G1_XIST1 LSW
Signal	81	10	11	
Length	16 Bit	16 Bit	32 Bit	
Meaning	Encoder state word 2	Sensor 1 state word	Position 1	

Data Word	5	6	7	8
Value	G1_XIST2 MSW	G1_XIST2 LSW	NIST_B MSW	NIST_B LSW
Signal	12		8	
Length	32 Bit		32 Bit	
Meaning	Position 2		Speed B	

Table 7: Input data in telegram 83

1.2.4. Structure of Telegram 84

- Output (PLC to slave),
- Input (slave to PLC): Position 2 and position 3 as well as speed B

Data Word	1	2
Value	STW2_ENC	G1_STW
Signal	80	9
Length	16 Bit	16 Bit
Meaning	Encoder control word 2	Sensor 1 control word

Table 8: Output data in the telegram 84

Data Word	1	2
Value	ZSW2_ENC	G1_ZSW
Signal	81	10
Length	16 Bit	16 Bit
Meaning	Encoder state word 2	Sensor 1 state word

Data Word	3	4	5	6
Value	G1_XIST3 MSW	G1_XIST3	G1_XIST3	G1_XIST3 LSW
Signal	39			
Length	64 Bit			
Meaning	Position 3			

Data Word	7	8	9	10
Value	G1_XIST2 MSW	G1_XIST2 LSW	NIST_B MSW	NIST_B LSW
Signal	12		8	
Length	32 Bit		32 Bit	
Meaning	Position 2		Speed B	

Table 9: Input data in the Telegram 84

2. Contents of The Signals

2.1. Signal 6: Speed Value (NIST_A)

The current speed value is transmitted in 16 bits **right-justified.**

NOTE: Ensure that you use a unit for the speed measurement suitable for the rotational speed of the encoder. Otherwise, the value that can be represented within the 16 bits may be exceeded.

2.2. Signal 8: Speed Value (NIST_B)

The current speed value is transmitted in 32 bits **right-justified.**

2.3. Signal 9: Sensor 1 Control Word (G1_STW)

Bit	Designation	Description
15	Acknowledging a sensor error	**0** = Encoder error message **not** acknowledged by PLC **1** = Encoder error message acknowledged by the PLC
14	Activate Park mode	**0** = Normal operation **1** = Activate Park mode
13	Request for the absolute position value	**0** = No request **1** = Request by the master Results in the cyclic output of the position values in **G1_XIST2**
12	Activate preset value	Defines that a configured preset value is used **0** = Preset value is **not** activated **1** = Preset value is activated
11	Preset mode	Defines how a configured preset value is used **0** = Preset value is used as a new absolute value **1** = Preset value is added to the previous value
10…0	Reserved	-

Table 10: Sensor 1 control word (G1_STW)

NOTE: To activate the preset value, bit 10 in control word STW2_ENC has to be set: STW2_ENC = 0400h

2.4. Signal 10: Sensor 1 State Word (G1_ZSW)

Bit	Designation	Description
15	Encoder Error	**0** = No Error **1** = Error The error code is output in **G1_XIST2**
14	Park Mode Activated	**0** = Normal operation **1** = Park mode activated Feedback based on G1_STW bit 14: No output of position data **G1_XIST1** and **G1_XIST2**
13	Transmission of absolute position value	**0** = No transmission **1** = Position value is output in G1_XIST2
12	Status of the Preset function (set/shift of home position executed)	**0** = No Preset function active **1** = Preset function is run Feedback based on G1_STW bit 12: • New position value is output in **G1_XIST1** and **G1_XIST2**. • On conclusion of the preset function the bit is set to 0.
11	Requirement of error acknowledgement detected	**0** = No return acknowledgement of encoder error **1** = Requirement of error acknowledgement detected Reaction to bit 15 in the sensor control word 1 G1_STW is acknowledged
10	Reserved	-
9…0	Not supported	-

Table 7: Sensor 1 state word (G1_ZSW)

2.5. Signal 11: Position Values in The Telegram Part (G1_XIST1)

The current position value is transmitted in 32 bits **shifted to left** by the shift factor in the two data words. The shift factor **always** has the following values:

- APSxx = 14
- APMxx = 2

The configuration of the parameter Total measuring range has an influence on this position value.

The following example shows the largest possible position value of 1,073,741,824 steps in 30 bits.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Value	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 8: Example for position values in G1_XIST1 MSW

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0

Table 9: Example for position values in G1_XIST1 LSW

NOTE: A preset value transmitted via acyclic process data only has an effect on G1_XIST1 if the parameter G1_XIST1 Preset Control is active.

2.6. Signal 12: Position Values in The Telegram Part (G1_XIST2)

The current position value is transmitted in 32 bits right-justified in the two data words. The configuration of the parameter **Total measuring range** and a configured preset value have always an influence on the position value.

The following example shows the largest possible position value of 1,073,741,824 steps in 30 bits.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Value	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 10: Example for position values in G1_XIST2 MSW

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 11: Example for position values in G1_XIST2 LSW

NOTE:

- If errors occur, an error code instead of the position value is output via G1_XIST2.
- To transmit the position value in the telegram part G1_XIST2, corresponding bits must be set in the control words:
    - G1_STW: 2000h
    - STW2_ENC: 0400h

2.7. Signal 39: Position Values in The Telegram Part (G1_XIST3)

The current position value is transmitted in 64 bits **right-justified**. The configuration of the parameter **Total measuring range** and a configured preset value have always an influence on the position value.

The following example shows the largest possible position value of 1,073,741,824 steps in 30 bits.

Bit	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Bit	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Value	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 12: Example for position values in G1_XIST3

2.8. Signal 80: Encoder Control Word 2 (STW2_ENC)

Bit	Designation	Description
15…12	Master's Sign of Life (not relevant)	-
10	Control by PLC	**0** = No control by the PLC **1** = Control by the PLC Enables the PLC by using control words to activate /
7	Fault acknowledge	Error-buffer handling not supported
11,9,8,6…0	Reserved	-

Table 13: Encoder control word 2 (STW2_ENC)

2.9. Signal 81: Encoder State Word 2 (ZSW2_ENC)

Bit	Designation	Description
15…12	Encoder's Sign-of-Life (not relevant)	-
11,10	Reserved	-
9	Control requested	**0** = No control by the PLC requested **1** = Control by the PLC requested
8…0	Reserved	-

Table 14: Encoder state word 2 (ZSW2_ENC)

3. Configurable Functions

The APMxx PROFINET is configured using the configuration tool for a PLC (e.g., Siemens TIA Portal V18).

The following figures illustrate how to access these parameters in the Siemens TIA Portal V18 program, respectively.

STEP 1: Open your project at TIA Portal V18. After that, double click the “Devices & networks” button that at the project tree.

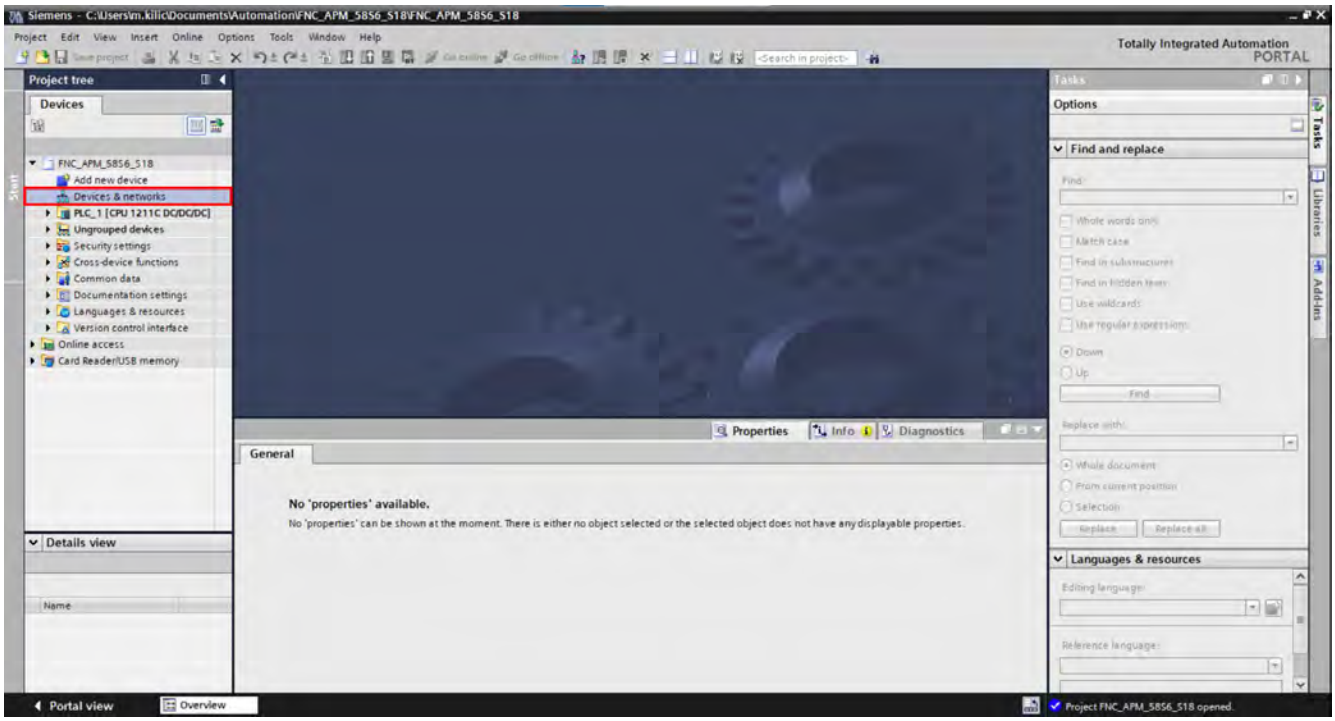


Figure 2: STEP 1

STEP 2: Now you’ll see the devices. Double click on the FENAC encoder.

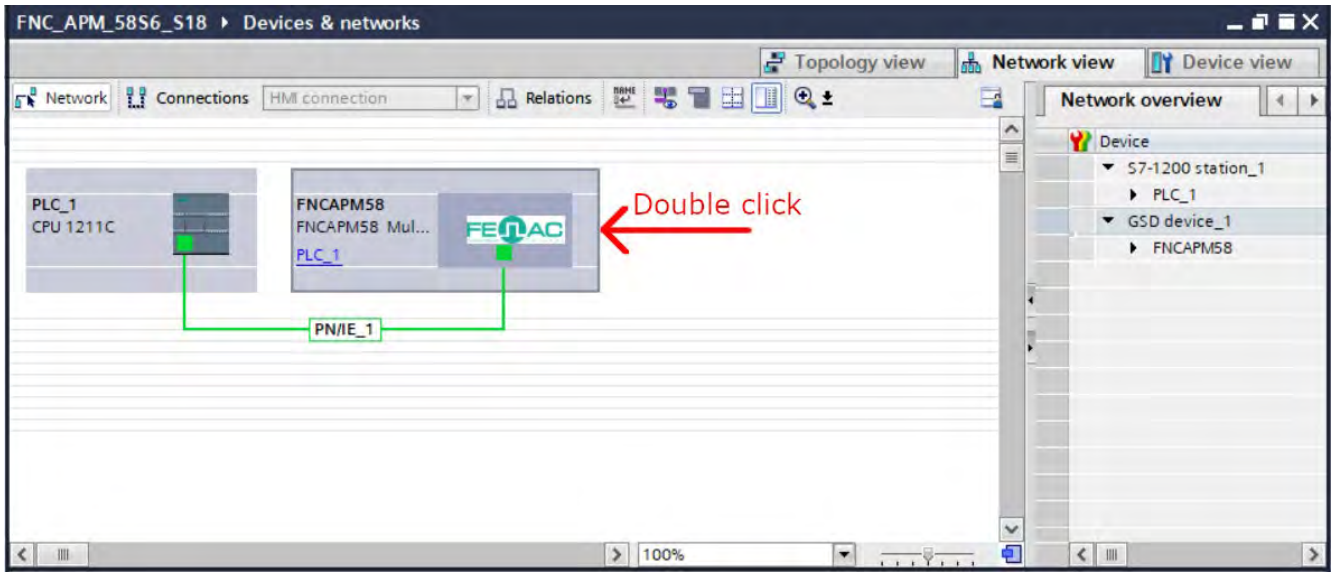


Figure 3: STEP 2

STEP 3: Under the “Device overview” tab, click the “Parameter Access Point” tab.

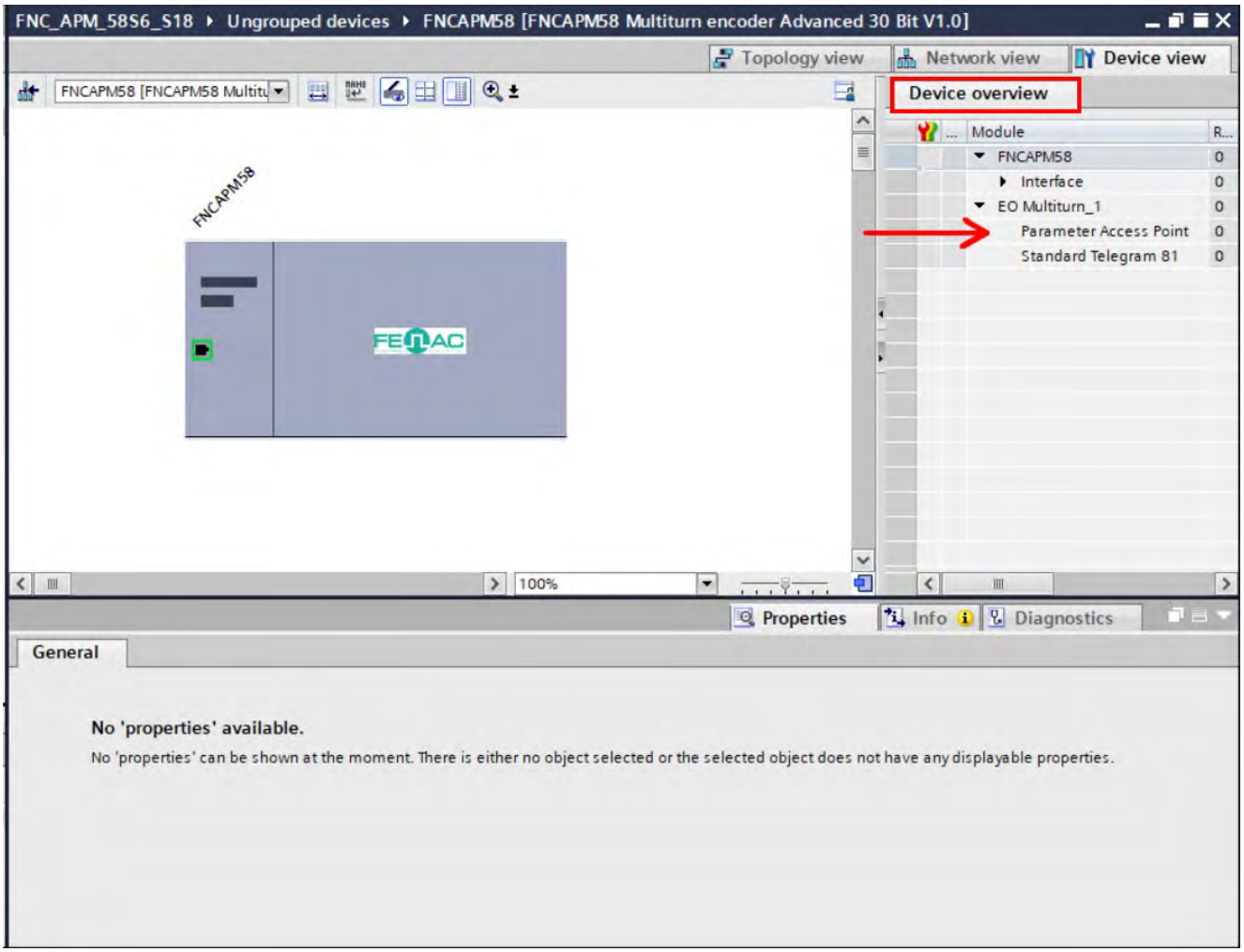


Figure 4: STEP 3

STEP 4: Click on the Properties tab. Now finally you'll see the "Vendor specific parameter data" and "Parameter data" under the "Module parameters".

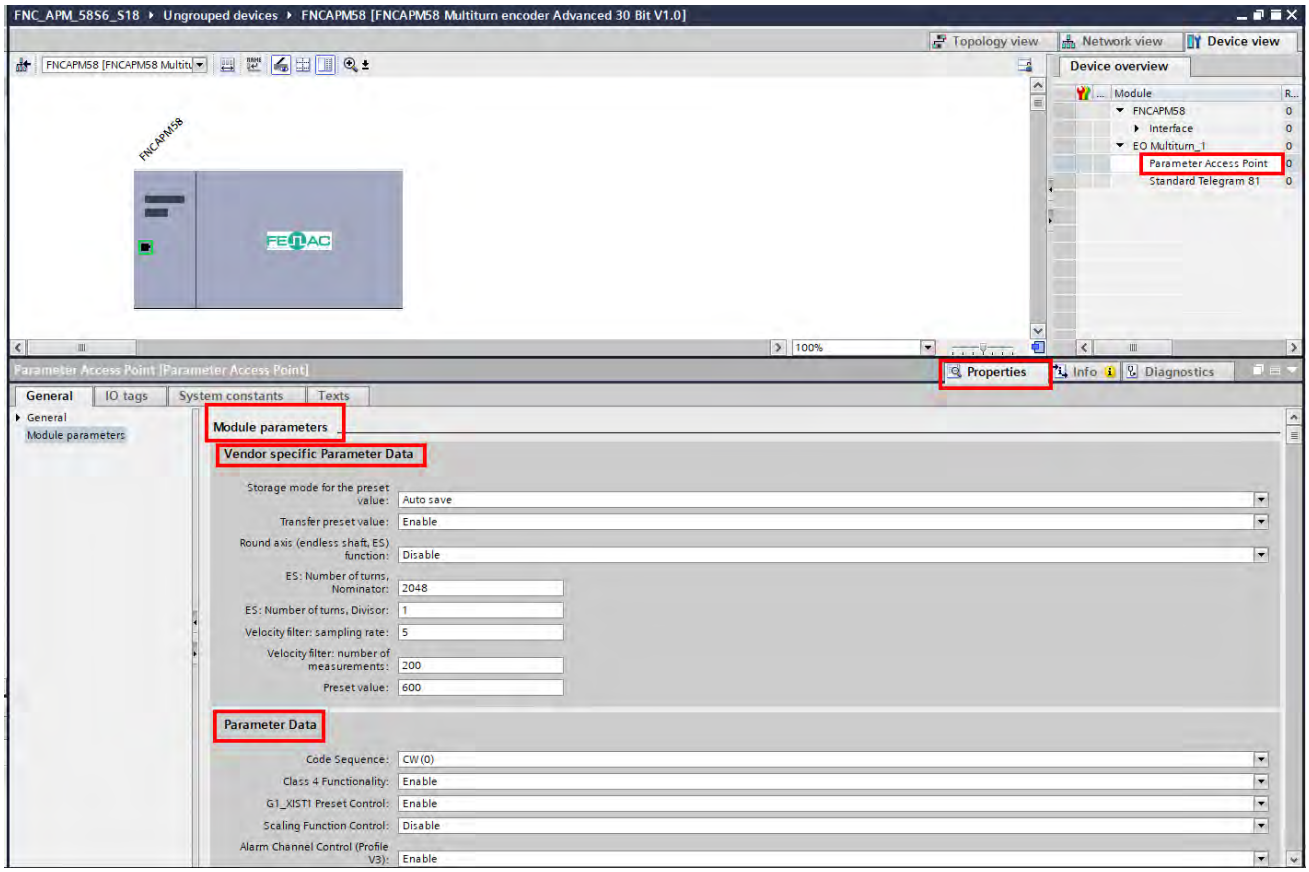


Figure 5: STEP 4

NOTE: After changing the parameter, the encoder must remain energized for at least 1 sec. to save the parameter change(s).

3.1. Code Sequence

The code sequence defines the direction of rotation, viewed on the shaft, in which the position value increases.

NOTE: The parameter can only be configured if the class 4 functionality is activated.

3.2. Class 4 Functionality

The **class 4 functionality** is activated from the factory. This parameter permits or prevents changes to the parameters **Code sequence**, **Scaling** and **Implementation of the preset**.

If the parameter is deactivated (disable), the settings for the following parameters are fixed:

- Code sequence = clockwise
- Scaling = off
- No preset via telegram or preset pushbutton possible

3.3. G1_XIST1 Preset Control

The parameter defines whether the preset function affects the telegram part G1_XIST1. Otherwise, the preset only acts on G1_XIST2.

NOTE: The parameter can only be configured if the class 4 functionality is activated.

3.4. Scaling

The parameter **Scaling** makes it possible to scale the resolution per revolution and the total resolution.

NOTE: Only if the Scaling parameter is activated (enable), the values entered for the resolution and total resolution are applied to the configuration. Otherwise, the values will be ignored!

3.5. Alarm Channel Control

NOTE: The parameter can only be deactivated (disable) if the parameter **Compatibility mode** is activated (enable).

- Alarm channel control – active
  The diagnostic data are transmitted as per encoder profile V4.1.
- Alarm channel control – inactive
  No “Alarms” are transmitted.

3.6. Compatibility Mode

Using this parameter, the encoder can be configured such that it operates as per encoder profile **V3.1** and not as per V4.1. This parameter also affects the following functions:

- Alarm channel control
  The parameter can be configured inactive in the compatibility mode.
- In addition, it is assumed that the bit Control by PLC in the telegram part STW2_ENC is permanently set to 1, as if the control system is constantly requesting control.

3.7. Measuring Range per Revolution

The measuring range per revolution is stated in two parameters, as Least Significant Double Word (LSDW) and as Most Significant Double Word (MSDW).

The resolution is max. 262,144 steps per revolution. The resolution can be scaled from 1 … 262,144 as an integer.

For example, if you are using an encoder to monitor the rotation of a motor and the encoder has a value of 1000 pulses per revolution (PPR), you will have 1000 pulses per revolution. In this case, you would have 1000 measurement units per revolution.

NOTE: The parameter is not used if the round axis functionality is activated.

3.8. Total Measuring Range

The total measuring range is stated in two parameters, as Least Significant Double Word (LSDW) and as Most Significant Double Word (MSDW).

3.9. Velocity Measuring Unit

Using this parameter, you can define the unit with which the speed is transmitted in telegrams 82, 83 and 84 (message 81 does not contain any speed values).

Possible units are:

- Steps/s
- Steps/100 ms
- Steps/ 10 ms
- Rpm

The factory setting is **rpm.**

3.10. Storage Mode for The Preset Value

Using this parameter, you can define the way in which the configuration parameters (1.006, 1.007, 65.000) are saved.

- Auto save: The values are written automatically to the EEPROM on each change.
- P971: The values must be written to the EEPROM using the parameter 971.

3.11. Transfer Preset Value

Using this parameter, you can define whether the preset is transmitted on switching on or initializing the encoder.

- **Enable:** The preset value is transmitted on switching on or initializing the encoder into the parameter 65.000. The preset value can be changed in operation via acyclic process data.
- **Disable:** The parameter is not transmitted on switching on or initializing the encoder.

The preset value is only used when the related bits of the sensor 1 control word G1_STW are set and bit 10 in control word STW2_ENC is set.

3.12. Round Axis Functionality

The round axis functionality removes the restriction that the total resolution must be 2^n times the Steps per revolution. The shaft is considered as an endless shaft.

The steps per revolution are not configured directly, instead the nominator and divisor for the number of revolutions are defined.

The total measuring range can be scaled from 1 … 1,073,741,824 as an integer.

3.13. Number of Turns (Nominator)

The nominator can be scaled from 1 … 2,048 as an integer. The default factory setting for the nominator is 2,048.

3.14. Number of Turns (Divisor)

The divisor can be scaled from 1 … 65,535 as an integer. The default factory setting for the divisor is 1.

3.15. Velocity Filter (Sampling Rate)

The speed value is calculated as an average value and output. The sampling interval defines the time between measurements and how measurements are made. It can be between 1 and 100 ms.

3.16. Velocity Filter (Number of Measurements)

The number of measurements defines the number of measured values from which the average speed is calculated. The number can be 1 to 200.

3.17. Preset Value

The Preset value parameter contains the value that is transmitted to the encoder with the parameter Transmit preset value.

4. Integration Into The PLC

NOTE: All software instructions relate to the Siemens TIA Portal V18.

4.1. Installing the GSDML file (only once)

- **Start the TIA Portal on your PLC**

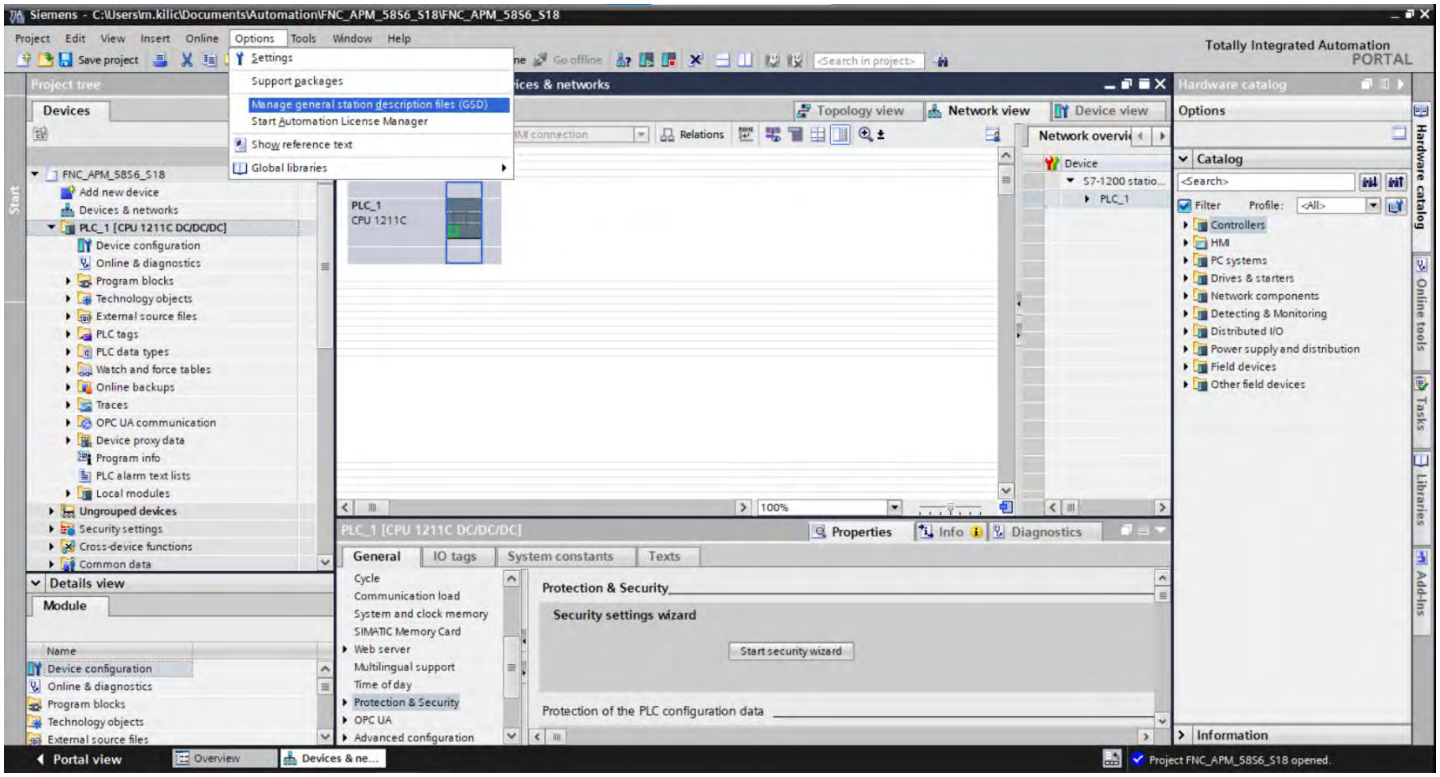


Figure 6: Installing device description file in the TIA portal

- Install the GSDML file GSDML-V2.25-FENAC-APx58-xxxxxxxx.xml for the APM58/APS58 PROFINET via the **Options** menu, **Install GSD file** command. The GSDML file for the encoder is available at www.fenac.com.tr for download.

4.2. Loading encoder in the user interface

- In the Hardware catalog open the **Other Field Devices**, **PROFINET IO**, **Encoders**, **FENAC**, **FENAC** folder again and finally the **FNCAPx58** folder. Here there is a dedicated icon for each of the two variants of the encoder.

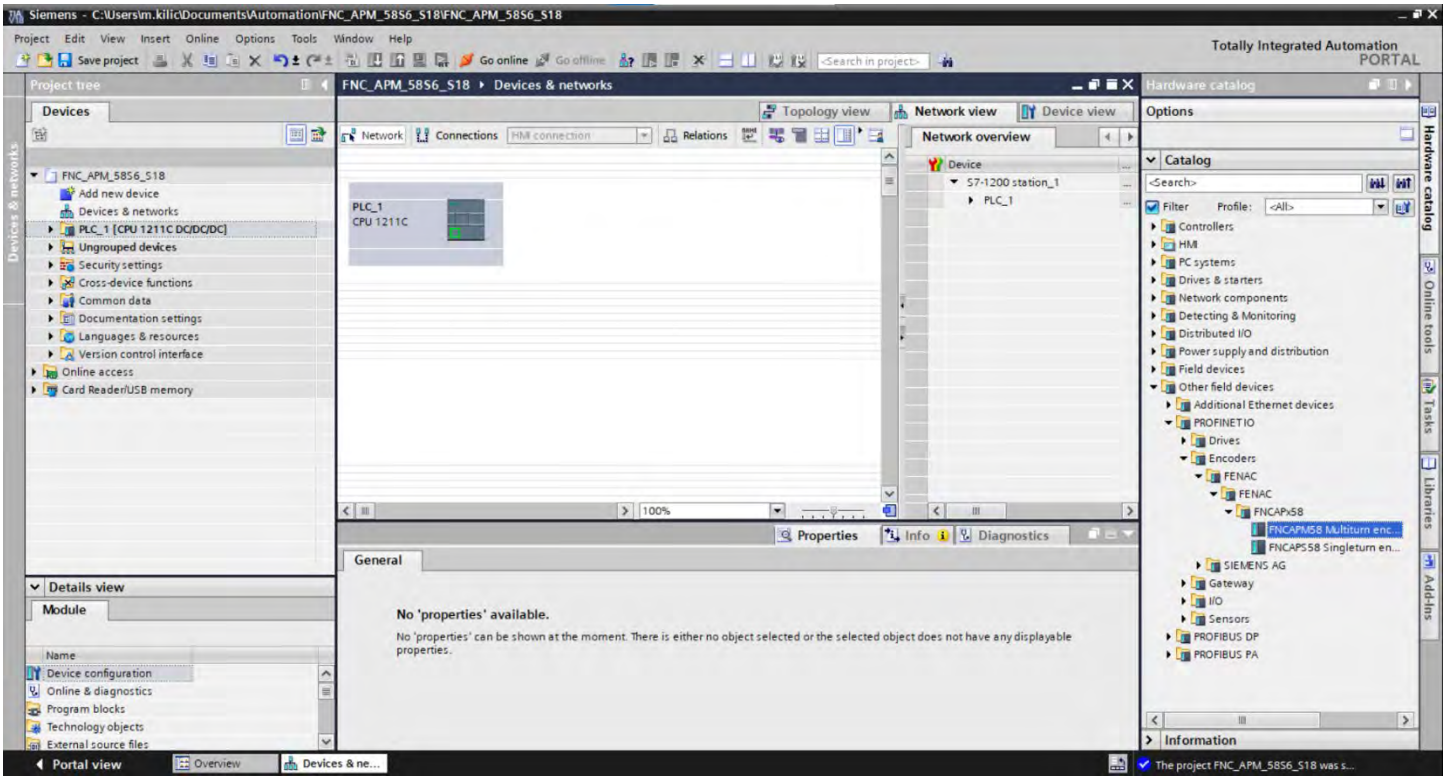


Figure 7: FNCAPS58/FNCAPM58 PROFINET in Other Field Devices

- Add the device **FNCAPM58** or **FNCAPS58** to the **Network view** using drag-and-drop.

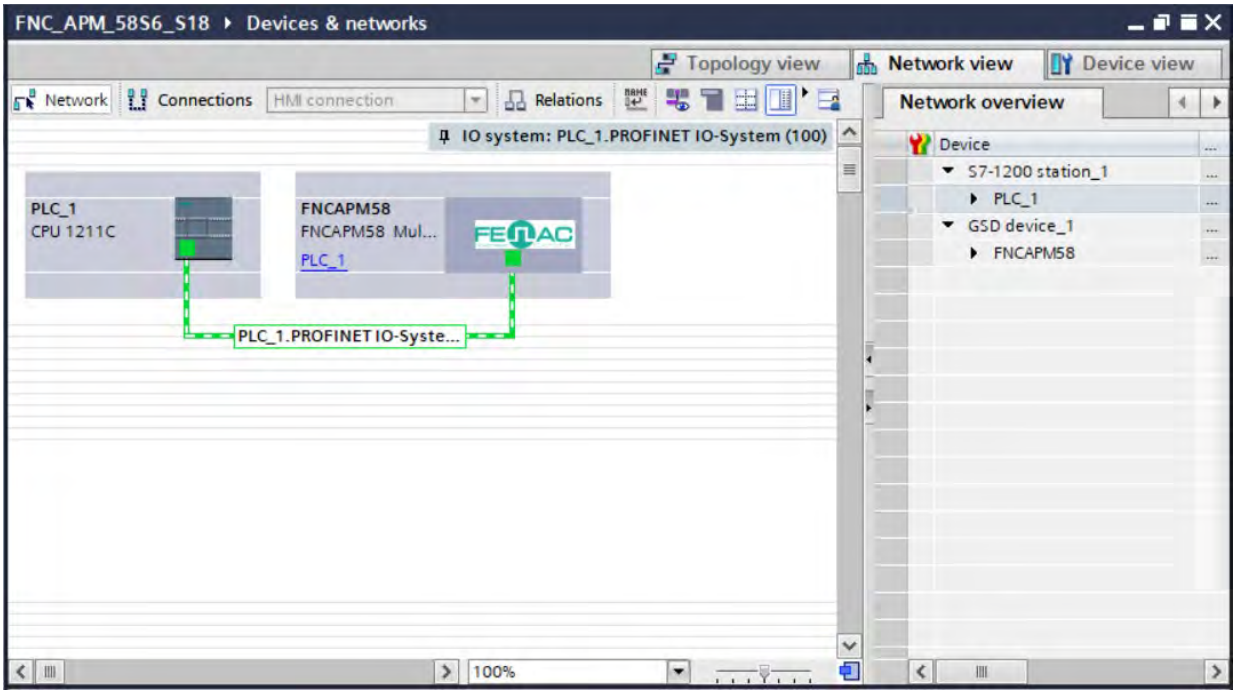


Figure 8: Connection from the PLC to FNCAP58S or FNCAP58M

- Using the mouse, drag a connection from the control system icon to the encoder icon.

4.3. Adding Telegram Modules

You should add the telegram module that you want to use before you go to watch table. Click the network view, then double click on the Fenac encoder. You'll jump to device view page. Then find the telegram modules from the hardware catalog tab and under the submodules folder. Probably first you'll see the Standard Telegram 81 module. It's added default. Delete the standard telegram 81 module from there if you want to use another telegram module. Then drag the telegram module you want to use and drop the place that you deleted previous module. In this example, we added standard telegram 84 instead of standard telegram 81.

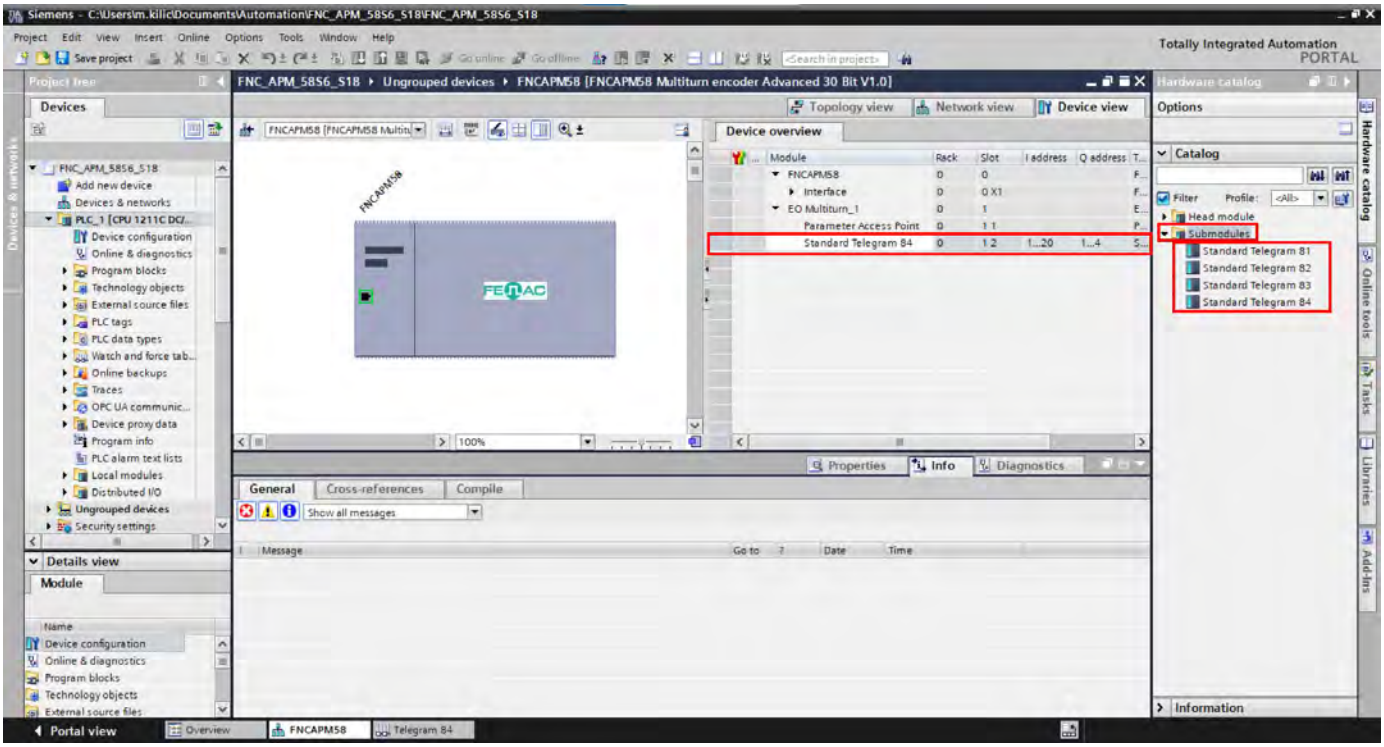


Figure 9: Adding Telegram Modules

4.4. Configuration of the encoder via the Parameter Access Point

Mark the encoder icon and in the **Device view**, change the configuration data and the vendor specific configuration data in the middle window at the bottom in **Parameter Access Point**. Do these configurations before you go online and do it only once.

Configuration data

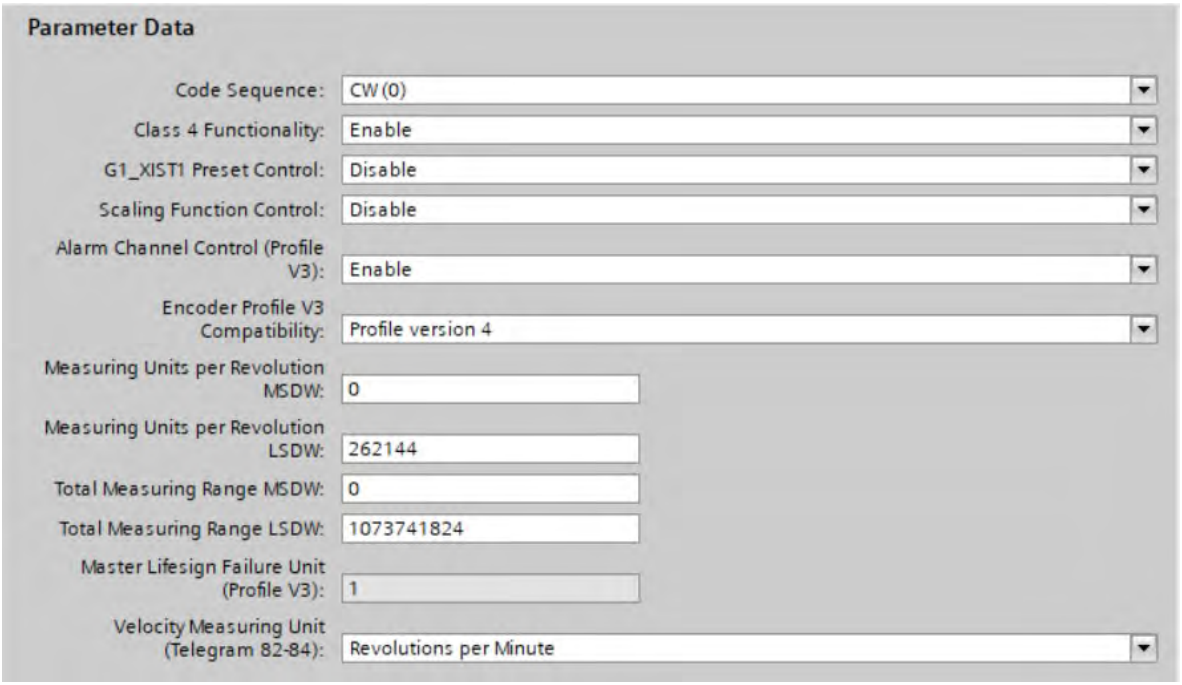
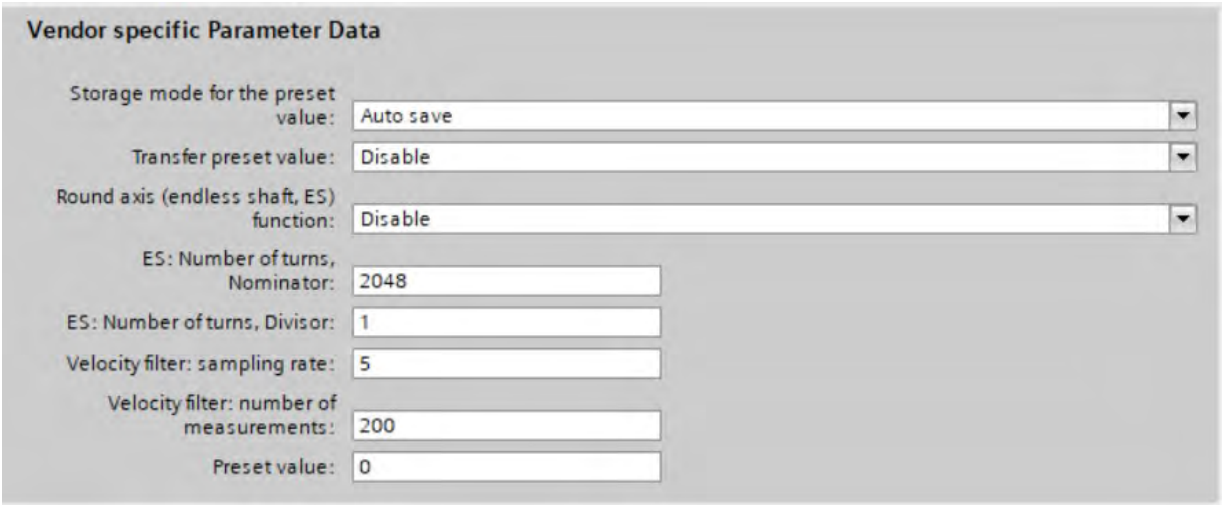


Figure 10: Configuration Data

The APM58/APS58 PROFINET is supplied with the configuration data shown.

Vendor specific configuration data



The APM58/APS58 PROFINET is supplied with the vendor specific configuration data shown.

4.4.1. Reading the position

To read from position 2 (the right-justified position value) in the input data for telegrams 81 to 84, select **STW2_ENC** (encoder control word 2) and **G1_STW** (sensor 1 control word)

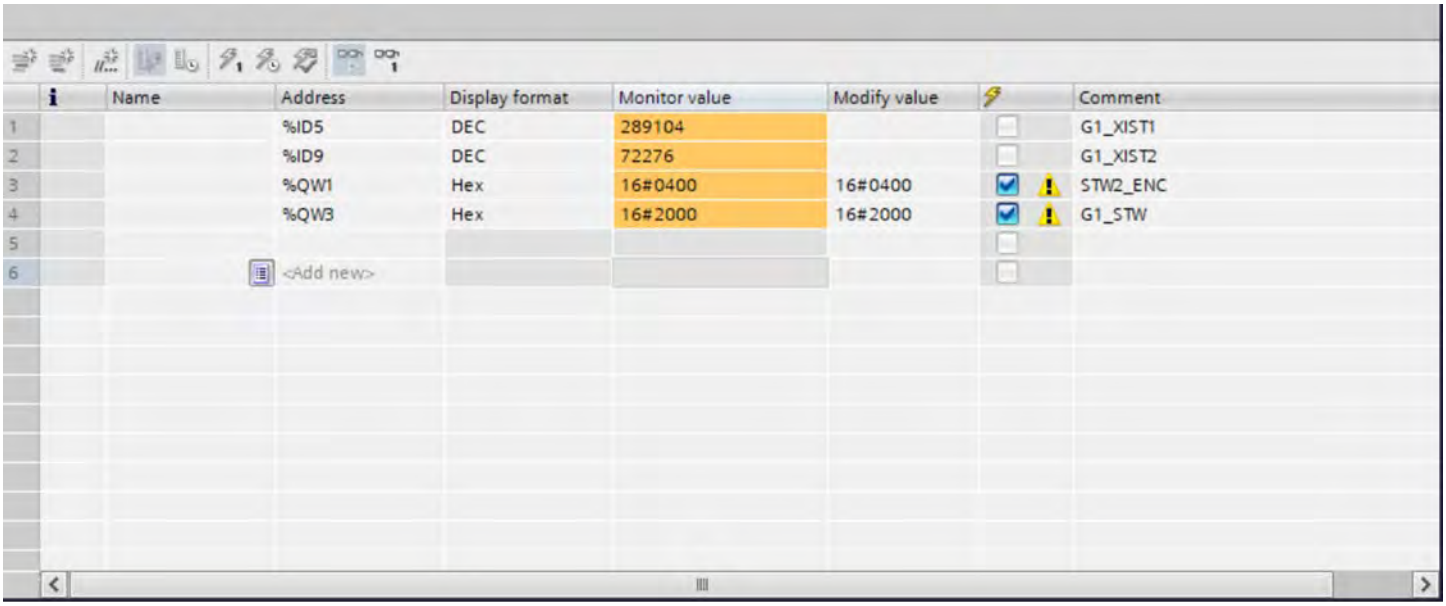


Figure 11: Reading the position

- Set bit 10 of the control word STW2_ENC to 1 (= 0400h).
- Set bit 13 of the control word G1_STW to 1 (= 2000h). This results in the cyclic output of the position value in G1_XIST2

4.4.2. Setting preset value

A preset value only affects G1_XIST1 if the related parameters are set. For G1_XIST1 this is position 1 in the input data for telegrams 81 to 84

Configuration data

- Set the parameter **Class 4 functionality** to **Enable.**
- Set the parameter **G1_XIST1 Preset control** to **Enable**

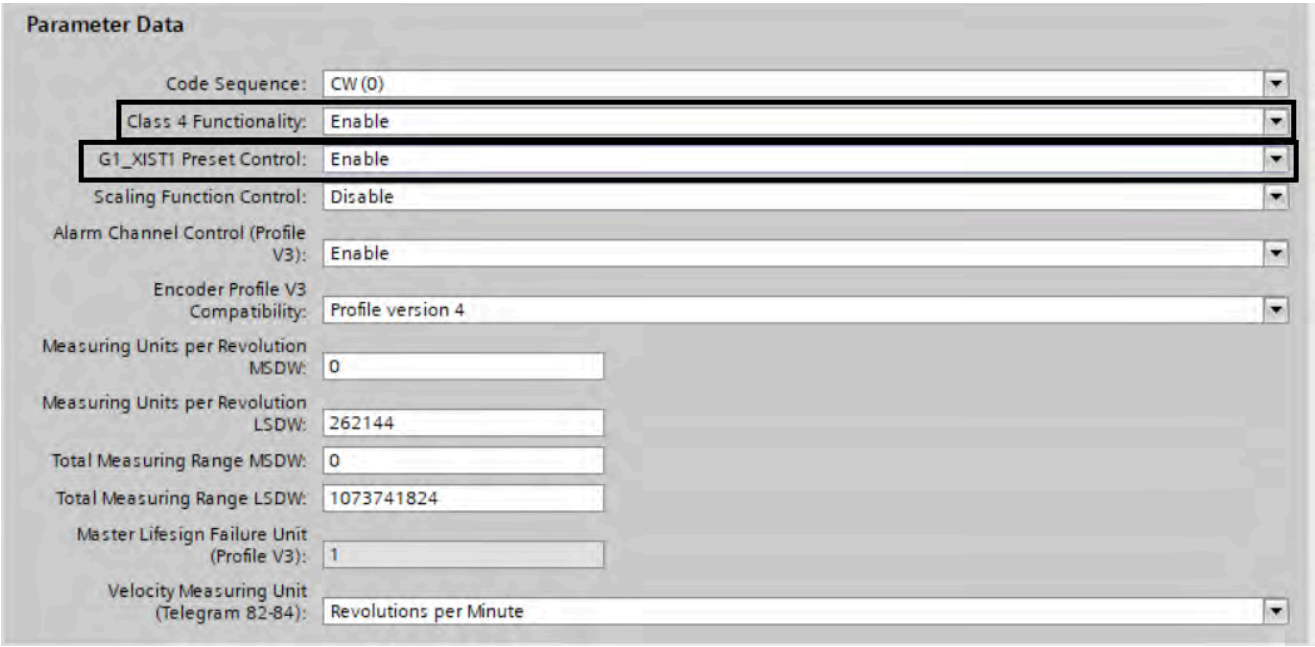


Figure 12: Configuration data for a preset value

Vendor specific configuration data

- Set the parameter **Transmit preset value** to **Enable.**
- Set the parameter **Preset value** e.g. to 600.

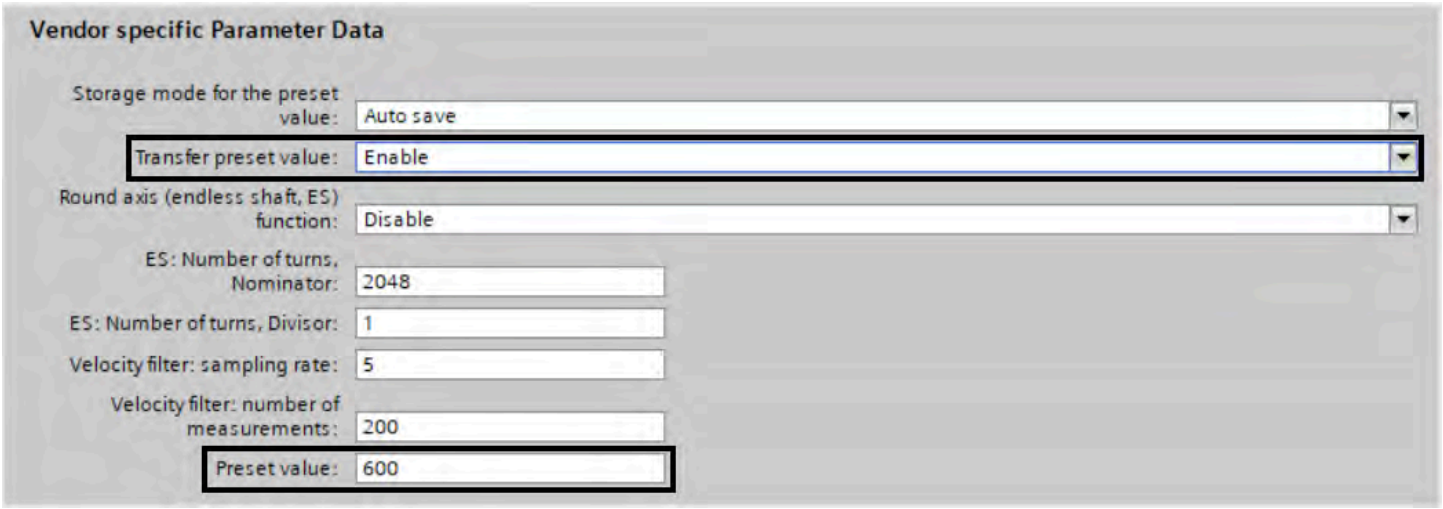


Figure 13: Vendor specific configuration data for a preset value

Control words

- Set Bit 10 of the control word STW2_ENC on 1 (=400h).
- Set Bit 12 of the control word G1_STW to 1 (= 1000h) (1)

With the edge change on bit 12 of G1_STW from 0 to 1, the preset value is set8) and initially output only in **Position 1** (G1_XIST1 – left-justified) (2)

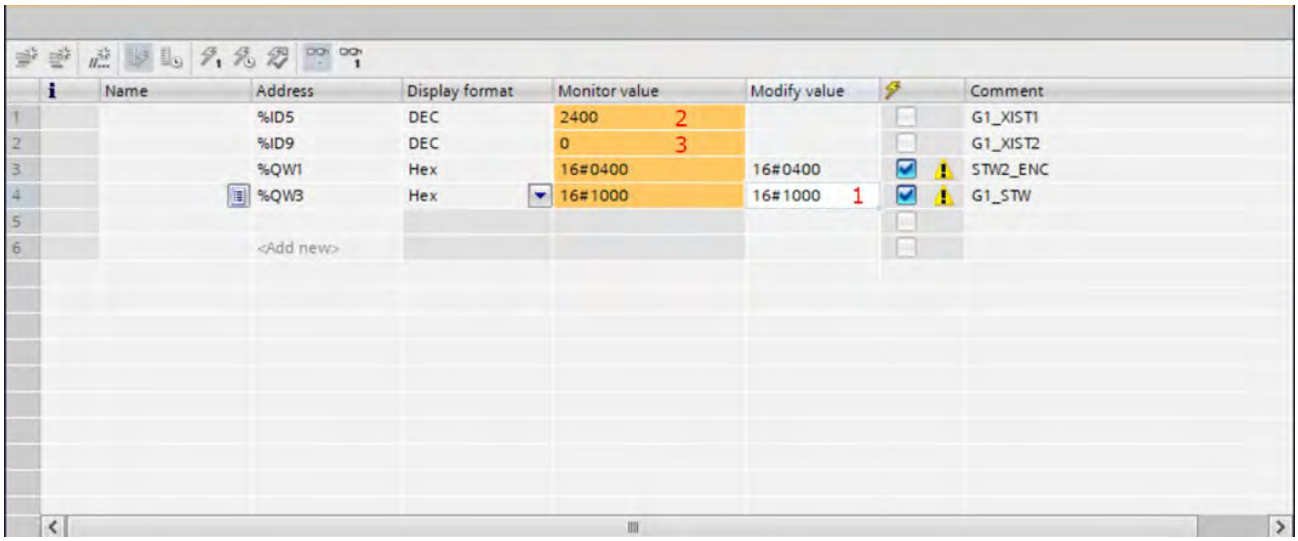


Figure 14: Setting bit 12 of G1_STW

Initially a position value is not output in Position 2 (G1_XIST2 – right-justified) (3)

- To output the position value in **Position 2** (G1_XIST2), you must set bit 12 to 0 and bit 13 of the control word G1_STW to 1 (= 2000h) (4)

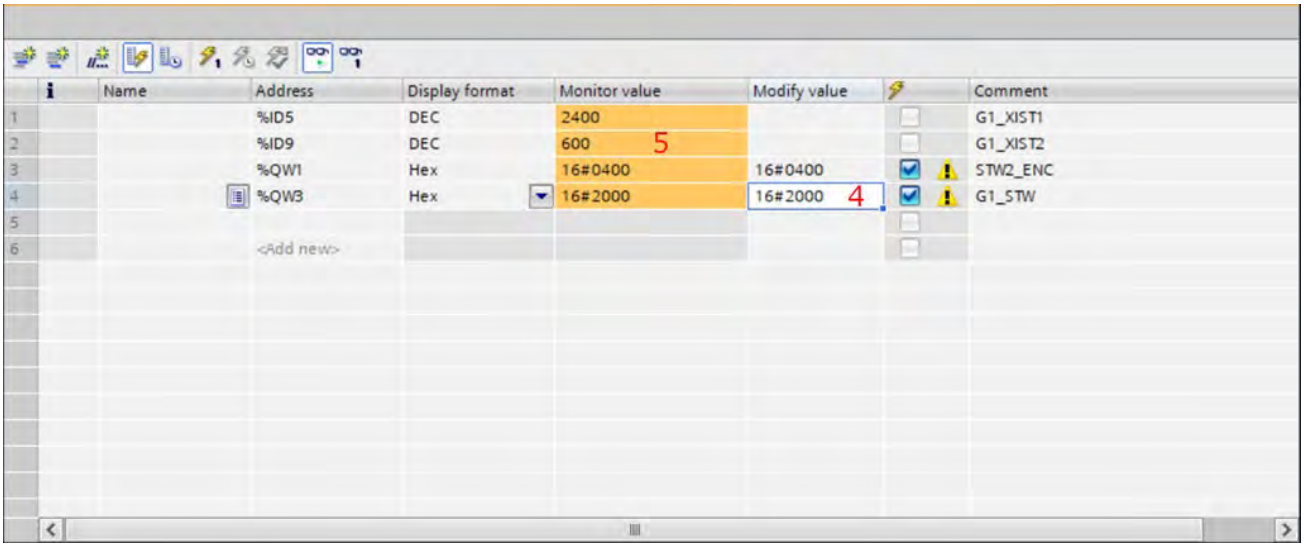
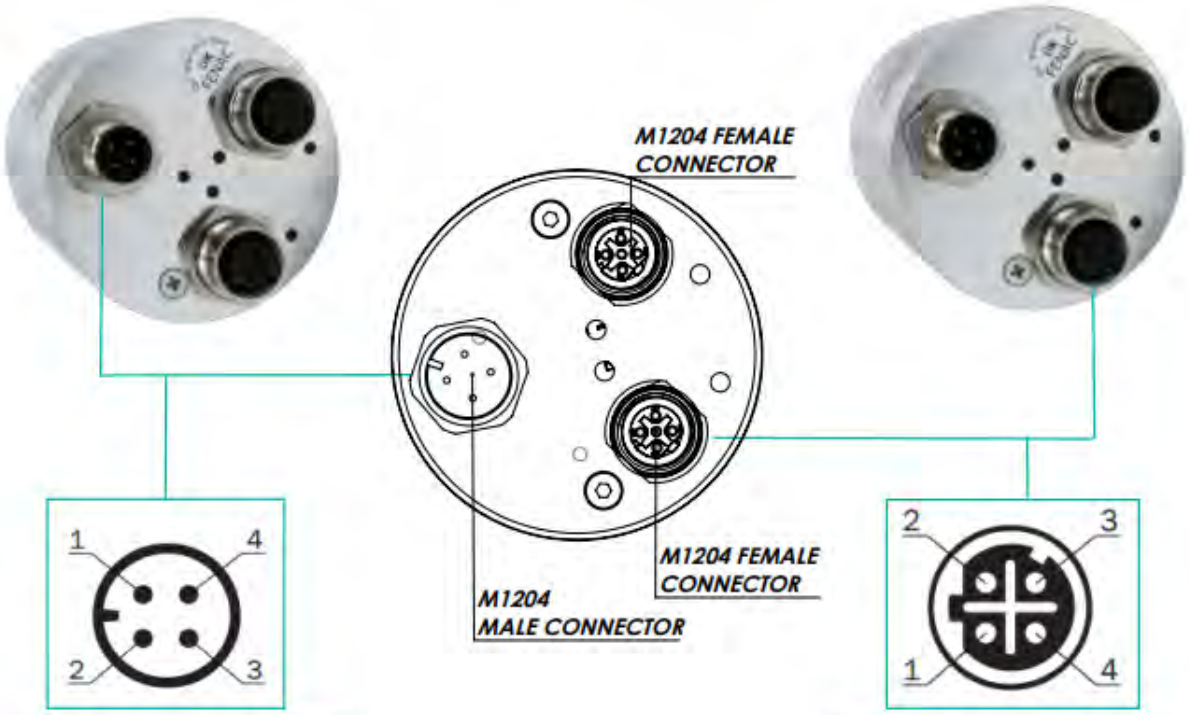


Figure 15: Setting bit 13 of G1_STW

The preset value set is then output in **Position 2** (G1_XIST2) (5)

4. Connector & Pin Assignment

Pin Assignment



PIN	Signal
1	U_s 10 V...30V
2	Not assigned
3	GND
4	Not assigned

PIN	Signal
1	T x D+
2	R x D+
3	T x D-
4	R x D-

Counter Connector Part Number
FCSF M1204 : M1204 Female Connector
FCSF M1204 R200 : M1204 Female Connector with 2 meter cable

Counter Connector Part Number
FCSM DTM1204 : D Type M1204 Female Connector
FCSM DTM1204 R200 : D Type M1204 Female Connector with 2 meter cable