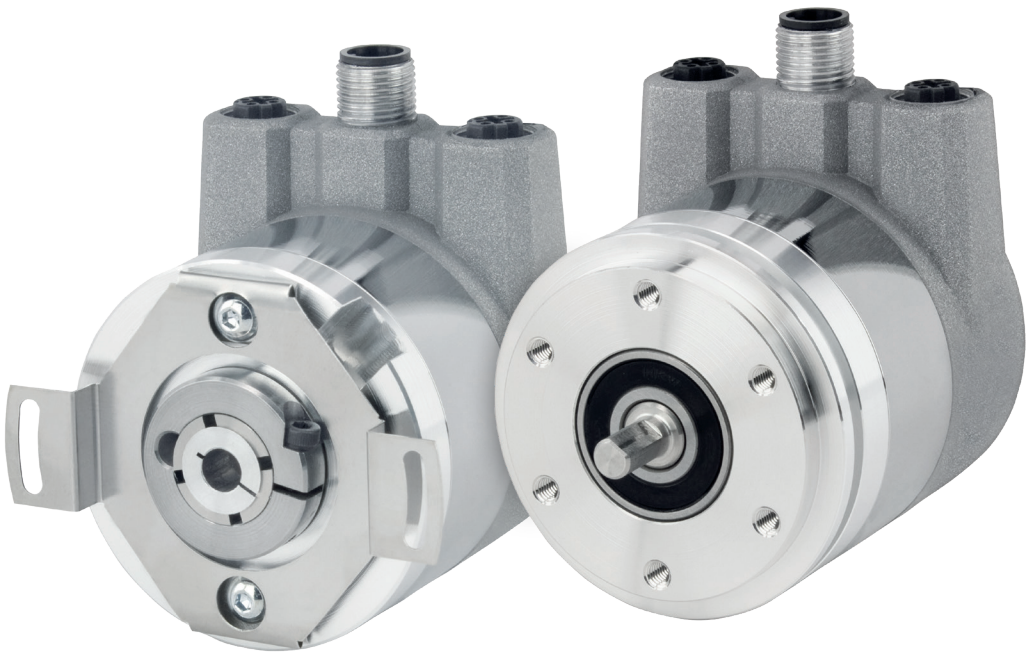
BRITISH ENCODER PRODUCTS COMPANY

PROFINET®

TECHNICAL REFERENCE MANUAL

PROFINET Interface

Absolute PROFINET® Encoders



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1. Introduction

1.1 About this manual

This technical manual describes the configuration and mounting possibilities for absolute-value encoders with a PROFINET interface produced by British Encoder Products Company (BEPC). It supplements the other publicly available BEPC documents, e.g. data sheets, assembly instructions, leaflets, catalogs and flyers.

Ensure that you read the manual before provisioning – check beforehand that you have the latest version of the manual.

When reading, pay particular attention to the information, important notices and warnings that are marked with the corresponding symbols (see 1.1.1).

This manual is intended for persons with technical knowledge in the handling of sensors, PROFINET IRT interfaces and automation elements. If you do not have any experience in this field, request the assistance of experienced personnel before proceeding.

Keep the information provided with our product in a safe place so that you can refer to it later as necessary.

- The contents of this manual are arranged with practical use in mind.
- All of the information in the following sections is required to get the best possible use out of the equipment, and should be read through thoroughly.

1.1.1 Explanation of symbols used in this manual

- The INFO symbol is placed next to a section of text that is particularly informative or important for what to do next with the equipment.

- The IMPORTANT symbol is shown next to a section of text that describes a method for solving a particular problem.

- The WARNING symbol is placed next to a section of text that should be paid particular attention to in order to ensure the correct use of the equipment and to protect against danger.

1.1.2 What is not in this manual:

- Basic information about automation technology
- System planning
- Risks (availability, safety)
- Shielding concepts
- Reflections
- Repeaters
- Network configuration
- Bus cycle times
- FMA management systems
- Transmission services
- Telegram types

1.2 Products supported

This manual relates to the following encoder types produced by Encoder Products Company:

- Model A58HE – PROFINET absolute blind hollow bore encoder with bus cover
- Model A58SE – PROFINET absolute shaft encoder, synchro or clamping flange, standard, heavy-duty, or compact, with bus cover

- EPC's PROFINET product range can be found on our website: encoder.com

1.3 Specifications

An encoder is a sensor that is designed to detect angular positions (single turn) and revolutions (multi-turn). The measured data and variables are processed by the encoder and provided as electrical output signals for the connected peripherals.

Patented technologies for single turn and for multi-turn are used in the A58SE and A58HE series encoders. As a result, these encoders from EPC are maintenance-free and environmentally friendly.

The encoders whose article descriptions are listed in Section 1.2 communicate via the PROFINET IRT interface.

1.4 Scope of delivery

The scope of delivery depends on the product variants and the details of your order. Before commissioning, check the contents of the delivery for completeness.

As a rule, the Model A58HE and A58SE products have a PROFINET IRT interface includes the following items:

- Model A58HE or A58SE with PROFINET IRT (with bus cover)
- Assembly instructions

2. Safety information

2.1 General

- When provisioning the encoder, ensure that you observe the assembly instructions, manual and data sheet.
- Failure to observe the safety instructions may lead to malfunctions, property damage and personal injury!
- Observe the operating instructions provided by the machine's manufacturer.

2.2 Intended use

Rotary encoders are components that are intended for installation in machines. Before commissioning (operation in accordance with the intended use), it must be determined that the machine as a whole corresponds to the EMC and Machine Directive.

A rotary encoder is a sensor that is designed to detect angular positions and revolutions and must only be used for this purpose. EPC Automation manufactures and distributes encoders for use in non-safety-relevant industrial applications.

- The encoder must not be operated outside the specified limit parameters (see product datasheet).

2.3 Safe working

The installation and mounting of the encoder must only be carried out by a qualified electrician. For the construction of electrical installations, all relevant national and international regulations must be strictly observed. Failure to commission the encoder correctly may result in malfunction or failure.

- All electrical components must be tested before commissioning.
- Appropriate safety measures must be taken to ensure that no persons are harmed and no damage to the system or operating equipment occurs in the event of a failure or malfunction.

2.4 Disposal

Devices that are no longer needed or are defective must be disposed by the user in proper compliance with the country-specific laws. It must be taken into consideration that this is a special waste of electronics and that disposal is not permitted via normal household waste.

3. Device description

3.1 General

Various mechanical variants of the Model A58SE and A58HE-series encoders with PROFINET IRT are available. The required variant is determined by the need for a bus cover, the flange design and the shaft type (solid or hollow). The size is specified as 58 mm by the diameter at the flange. The following figure shows examples of A58SE/HE-series encoders with PROFINET IRT.

The solid or hollow shaft is connected to the rotating component whose angular position or rotational speed is to be measured. Cable or plug outlets create the interface for connection to the PROFINET network. The status LEDs mounted in the cover signal the various encoder states during operation. They assist with configuration of the encoder and troubleshooting in the field. The flange holes or supplied spring sheets are used for attachment to the machine and during the respective application.

Figure 3.1: EPC EtherCAT-ready encoders with PROFINET IRT bus covers

From left to right: A58SE with clamping flange; A58SE with synchro flange; A58SE heavy-duty; A58SE compact; A58HE (blind hollow bore)

3.2 PROFINET

PROFINET is distributed by the PROFIBUS User Organization (PNO) as a successor to Profibus. PROFINET is the standard interface for industrial Ethernet. PROFINET provides similar functionality to Profibus, but extends these by firmware upgrades.

Established IT standards are used for the transfer of information. UDP, IP and XML form the basis for this. XML is used as a description language in the device profile (abbreviated to "GSDML file"). In order for the devices to exchange their data via IP – process data (cyclic) and parameter data (acyclic) – a unique name must be assigned to each PROFINET node during configuration. The control can only assign an IP address to the node via this name.

PROFINET supports the following three transmission types:

- **PROFINET NRT** (not real time), non-time-critical applications in automation, clock rates of around 100 milliseconds.
- **PROFINET RT** (real time), cyclic data traffic is used to achieve clock rates of 10 milliseconds.
- **PROFINET IRT** (isochronous real time), clock rates of 1 millisecond and jitter of less than 1 microsecond. This is suitable for use in motion-control applications (for example).

Further information about PROFINET is available via the homepage of the PROFIBUS User Organization (PNO) at: profibus.com/technology/profinet

3.3 Principles of EPC's A58E-series encoders

The following sections describe the basic functions of an absolute encoder.

Unlike incremental encoders, absolute-value encoders output their position value as a digital number via a fieldbus. A distinction is made here between single turn and multi-turn encoders.

In addition to simply outputting the position value, most encoders permit a certain degree of parameterization, such as selecting the positive direction of rotation, setting the position value to a reference value at a fixed physical position, and scaling the position value to an arbitrary resolution and a limited measuring range. This reduces the required complexity of the control program as well as the computational burden on the controller.

3.3.1 Single turn – ST

Measurement of the angle from 0° to 360° by means of a shaft represents the minimum functionality of a rotary encoder. The sensor system is based on optical or magnetic sampling of a measuring graduation on the encoder shaft.

The Model A58SE/HE encoders from EPC feature new magnetic technology, which provides maximum precision and resolution for a single turn encoder.

3.3.2 Multi-turn – MT

A multi-turn encoder allows the number of revolutions to be recorded. This is achieved via a rotation counter. The Model A58SE and A58HE encoders include technology, which ensures that the corresponding information is retained, even in a voltage-free state. This means that buffer batteries and gearboxes, which require a comparatively large installation space and a correspondingly high degree of maintenance, are no longer needed.

3.3.3 Direction of rotation

The positive direction of rotation can be reversed by a simple two's complement of the position value (invert every bit and add "1").

3.3.4 Preset

The desired position value can be assigned to the encoder at a specific physical position. This must be within the measuring range so that the position value is correlated with a physical reference position. For this purpose, the difference between the current position value and the desired value is calculated. The result is stored in non-volatile memory and added to the position value as an offset.

3.3.5 Scaling

For the precise matching of the position value with the parameter to be measured in physical terms, adjustments can be carried out using the scaling parameters. The scalable parameters are "Measuring units per revolution (MUPR)" and "Total measuring range in measuring units (TMR)."

The scaling parameters "Measuring units per revolution (MUPR)" – increments per revolution – indicates the resolution of the position value per revolution (also: ST resolution). The value equates to 360°. This means that, if a value of 3600 Cts is parametrized, the encoder outputs the position in 0.1° increments (see Equation #2).

Equation 1 $$MUPR = ST = 3600\ Cts$$

Equation 2 $$Angular\ steps = \frac{Angle\ of\ one\ revolution}{MUPR} = \frac{360°}{36{,}000\ Cts} = 0.1° / Cts$$

The scaling parameter "Total measuring range in measuring units (TMR)" – the maximum total measuring range of the position value (single turn and multi-turn multiplied) – indicates the total resolution of the encoder. When the position value reaches TMR -1, it jumps back to 0 and vice versa.

As a rule, the selected TMR parameter should be an integer multiple of the "Measuring units per revolution (MUPR)" (see equation #4), so that the zero point is always at the same position of the encoder shaft.

Equation 3 $$TMR = 36{,}000\ Cts$$

Equation 4 $$MT = \frac{TMR}{MUPR} = \frac{36{,}000\ Cts}{3600\ Cts} = 10$$

In exceptional cases, it is suitable that TMR is not an integer multiple of MUPR – for example, in a system in which a gear ratio ensures that the desired measured variable is moving 10% faster relative to the encoder shaft.

In this case, a setting of MUPR = 3960 Cts and TMR = 36,000 Cts would ensure that the faster (but not directly measurable) shaft can be measured with a resolution of 0.1° and over a range of 10 revolutions. Normally, the number of revolutions would be calculated by dividing the position value by MUPR. In this case, however, it must be divided by 3600 Cts, since the result would otherwise be the number of revolutions of the encoder shaft and not the faster shaft of the system.

- It should be noted that measurement errors will occur if the result of this formula is a decimal.

3.4 Connection assignments for PROFINET encoders

3.4.1 Bus cover with 3 x M12x1

The "RNB" code in the order key refers to an encoder with a bus cover. The electrical connection is made at the bus cover via the 2 x M12 plugs and 1 x M12 socket. The connection assignment of the plugs and sockets can be found in Table 3.1.

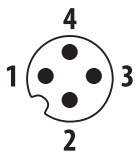
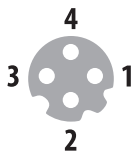
Female Connector			Power			Femail Connector	
Port1 (IN)						Port2 (OUT)	
							
Function	M12x1, 4-pin, D-coded		**Function**	M12x1, 4-pin, A-coded		**Function**	M12x1, 4-pin, D-coded
Tx+	1		**(+) Vcc**	1		**Tx+**	1
Rx+	2		**n. c.**	2		**Rx+**	2
Tx-	3		**GND**	3		**Tx-**	3
Rx-	4		**n. c.**	4		**Rx-**	4

Table 3.1: Pin connection assignment

3.5 LEDs and signaling

Four status LEDs on the bus cover signal the various encoder states and thus support error diagnosis and troubleshooting in the field (see Table 3.2). The two Link Activity LEDs (L/A) light up or flash green when the encoder is connected to another PROFINET node (PLC, switch, additional field device...) and data is being exchanged. The STAT LED indicates the status of the fieldbus, the MOD LED the status of the encoder.

STAT LED bicolor	MOD LED bicolor	Meaning	Cause
○	○	No voltage	
● red solid	● green solid	No connection; no data exchange	Bus disconnection or master not accessible or switched off
✹ red flashing	● green solid	Parameterization error, no data exchange Criterion: Data exchange correct. However, the slave does not switch to the data-exchange mode.	Slave is not configured yet. Incorrect station address, but not out of range. The actual configuration of the slave differs from the nominal configuration.
● green solid	● red solid	System error	Diagnosis exists, slave is in data-exchange mode.
● green solid	● green solid	Data exchange, slave and operation OK	

Table 3.2: LED signals

Explanation of symbols: ○ *LED off (no light)* ●/● *LED on/off (green/red light)* ✹/✹ *LED flashing (flashing green/red light)*

3.6 MAC address and IP address

EPC PROFINET encoders have three MAC addresses. These always start with D4-90-E0-xx-xx-xx. The number depends on the number of ports on the integrated three-port switch. There is one MAC address each for Port1 and Port2, as well as one MAC address for the "internal port" to which the encoder itself is connected.

In the delivered state, the PROFINET encoder has no IP address and no name. These are defined during configuration (e.g., TIA Portal).

4. PROFINET

4.1 Summary of functions

Our PROFINET encoders support the functions shown in Table 4.1, below.

Functions	Meaning
Conformance class	CC-C
Profile	Encoder Profile V4.1
Profile class	Encoder Profile Class 4, as well as compatibility with Class 3
Performance	Cycle time 250 µs (with clock synchronization) and fast start-up of 1 s
Redundancy	MPR and MRPD
Web server	Display and configuration parameters, firmware updates
Clock synchronization	RT, IRT, and IRT isochronous

Table 4.1: Functions

4.2 GSDML modules

The modules from the current GSDML file are listed in Table 4.2, below.

Designation	Meaning
ST0016	No multi-turn, single turn 16 bit
MT4316	Multi-turn 43 bit + single turn 16 bit = 59 bits in total

Table 4.2: GSDML modules

4.3 Signals

Table 4.3, below, shows the signals that are supported by EPC PROFINET encoders.

Signal	Description	Name	Length (bits)	Signed
6	Velocity A	NIST_A	16	Y
8	Velocity B	NIST_B	32	Y
9	Sensor 1 control word	G1_STW	16	–
10	Sensor 1 status word	G1_ZSW	16	–
11	Sensor 1 position 1	G1_XIST1	32	N

Signal	Description	Name	Length (bits)	Signed
12	Sensor 1 position 2	G1_XIST2	32	N
39	Sensor 1 position 3	G1_XIST3	64	N
80	Encoder control word 2	STW2_ENC	16	–
81	Encoder status word 2	ZSW2_ENC	16	–
238 (60000)	Sensor position preset control word	G1_XIST_PRESET_A	32	N
TBD	Sensor position preset control word	G1_XIST_PRESET_B1	32	N
TBD	Sensor position preset control word	G1_XIST_PRESET_C	64	N
60001	Debug control word	DEBUG_STW	16	N
60002	Debug status word	DEBUG_ZSW	16	N

Table 4.3: Signals

4.4 Structure of the signals

NIST_A: Velocity value A

This value includes the velocity, has a width of 16 bits and is signed.

Signal	NIST_A	
Bits	15 ... 0	
Contents		
15 ... 0	Velocity value A	Right-aligned, output in set unit (see Table 4.20, Velocity Measuring Units

Table 4.4: Structure of signal 6 NIST_A

NIST_B: Velocity value B

This value includes the velocity, has a width of 32 bits and is signed.

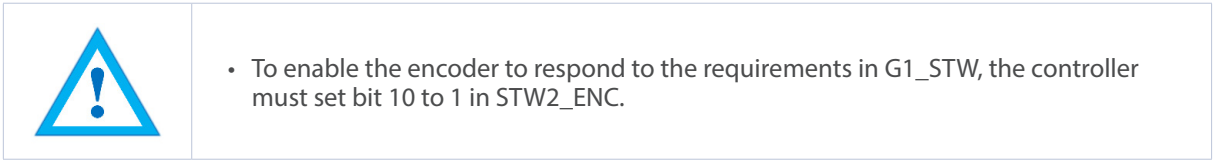
Signal	NIST_B	
Bits	31 ... 0	
Contents		
31 ... 0	Velocity value B	Right-aligned, output in set unit (see Table 4.20, Velocity Measuring Units

Table 4.5: Structure of signal 6 NIST_B

G1_STW: Sensor 1 control word

Signal	G1_STW					
Bits	15	14	13	12	11	10 ... 0
Contents						
15	Confirm sensor error			0 = Sensor error not confirmed by controller 1 = Sensor error confirmed by controller		
14	Park mode			0 = Normal operation 1 = Activate park mode		
13	Cyclically query absolute position value			0 = Do not interrogate 1 = Master performs query (cyclic output of G1_XIST2)		
12	Activate preset			0 = Preset not active 1 = Preset active		
11	Preset mode			0 = Set preset to absolute value 1 = Move preset by value (offset)		
10 ... 0				Reserved, currently not used		

Table 4.6: Structure of signal 9 G1_STW



- To enable the encoder to respond to the requirements in G1_STW, the controller must set bit 10 to 1 in STW2_ENC.

G1_ZSW: Sensor 1 status word

Signal	G1_ZSW					
Bits	15	14	13	12	11	10 ... 0
Contents						
15	Sensor error			Signals a sensor error and outputs a device-specific error code in G1_XIST2		
14	Park mode active			Confirms "Park mode." No error messages are transmitted		
13	Cyclically query absolute position value			Confirms "cyclically query absolute position value"		
12	Preset activated			Confirms "activate preset"		

Signal	G1_ZSW	
11	Sensor error acknowledgement active	Signals processing of the requested sensor error acknowledgement
10 ... 0		Reserved, currently not used

Table 4.7: Structure of signal 10 G1_ZSW

G1_XIST1: Sensor 1 position 1

Signal	G1_XIST1	
Bits	31 ... 0	
Contents		
31 ... 0	Absolute position value 1	Right-aligned

Table 4.8: Structure of signal 11 G1_XIST1

Structure of G1_XIST1 using the example of a 16-bit multi-turn and a 16-bit single turn encoder:

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

M = multi-turn / S = single turn

This value includes the position, has a width of 32 bits, and is unsigned. The encoder parameter settings influence this position value if "Class 4 functionality" is activated. The influence of the preset functionality can be controlled with "G1_XIST1 Preset Control."

G1_XIST2: Sensor 1 position 2

Signal	G1_XIST2	
Bits	31 ... 0	
Contents		
31 ... 0	Absolute position value 2	Right-aligned

Table 4.9: Structure of signal 12 G1_XIST2

This value includes the position, has a width of 32 bits and is unsigned. The encoder parameter settings influence this position value if "Class 4 functionality" is activated. When activated, the preset functionality always has an influence on G1_XIST2.

- If an error occurs, G1_XIST2 contains the error register instead of the position value.

G1_XIST3: Sensor 1 position 3

Signal	G1_XIST3	
Bits	63 ... 0	
Contents		
63 ... 0	Absolute position value 3	Right-aligned

Table 4.10: Structure of signal 39 G1_XIST3

This value includes the position, has a width of 64 bits and is unsigned.

It can be used if the measuring range of the encoder is larger than 32 bits. The encoder parameter settings influence this position value if "Class 4 functionality" is activated.

STW2_ENC: Encoder control word 2

Signal	STW2_ENC			
Bits	15 ... 12	11	10	9 ... 0
Contents				
15 ... 12	Sign-of-life from the PLC		Receives a count value from 1 to 15 when isochronous transmission is activated	
11			Reserved, currently not used	
10	Control by PLC		0 = No control by PLC 1 = Control by PLC	
9 ... 1			Reserved, currently not used	
0			Controls the execution of the preset 1 = Preset executed	

Table 4.11: Structure of signal 80 STW2_ENC

ZSW2_ENC: Encoder status word 2

Signal	STW2_ENC			
Bits	15 ... 12	11 ... 10	9	8 ... 0
Contents				
15 ... 12	Sign-of-life from the encoder		Sends a count value of 1 to 15 when the isochronous transmission is activated and a sign-of-life has been received from the PLC	
11 ... 10			Reserved, currently not used	
9	Control by PLC		0 = No control by PLC 1 = Control by PLC	
9 ... 0			Reserved, currently not used	
3	Fault present		0 = No fault 1 = Fault present	
2	NIST_VALID		0 = Velocity not valid 1 = Velocity valid	
1	XIST_VALID		0 = Position value not valid 1 = Position value valid	
0	Preset Acknowledge		Confirms the execution of the preset	

Table 4.12: Structure of signal 81 ZSW2_ENC

G1_XIST1_PRESET_B: Sensor position preset control word

Signal	G1_XIST1_PRESET_B	
Bits	31	30 ... 0
Contents		
31	Trigger bit	Controls the transmission of the preset value 1 = Run preset
30 ... 0	Preset value without sign	Includes the 31-bit-wide preset value

Table 4.13: Structure of signal 238(60000) G1_XIST1_PRESET_B

- This signal is intended to ensure compatibility with Siemens products. As an alternative to 238, this signal can be assigned the number 60000.

G1_XIST1_PRESET_B1: Sensor position preset control word

Signal	G1_XIST1_PRESET_B1	
Bits	31 ... 0	
Contents		
31 ... 0	Preset value without sign	Includes the 32-bit-wide preset value

Table 4.14: Structure of signal G1_XIST1_PRESET_B1

G1_XIST1_PRESET_C: Sensor position preset control word

Signal	G1_XIST1_PRESET_C	
Bits	63	62 ... 0
Contents		
63	Trigger bit	Controls the transmission of the preset value 1 = Run preset
62 ... 0	Preset value without sign	Includes the 63-bit-wide preset value

Table 4.15: Structure of signal G1_XIST1_PRESET_C

DEBUG_STW: Debug control word

Signal	DEBUG_STW	
Bits	15 ... 1	0
Contents		
15 ... 1	0	Not used
0	Set test error	Triggers the test error when set to "0"

Table 4.16: Structure of signal 60001 DEBUG_STW

DEBUG_ZSW: Debug status word

Signal	DEBUG_ZSW	
Bits	15 ... 1	0
Contents		
15 ... 1	0	Not used
0	Test error active	Indicates that the test error is set

Table 4.17: Structure of signal 60002 DEBUG_ZSW

4.5 Telegrams

The supported standard telegrams and manufacturer-specific telegrams are described in Table 4.18, below.

- For telegram 860, the manufacturer signal 238 (alternatively 60000) is used.
- For telegram 59000, the manufacturer signals 60001 and 60002 are used.

Nr.	Dir.	Data Word									
		1	2	3	4	5	6	7	8	9	10
81	SPS -> ENC	STW2_ENC	G1_STW								
	ENC -> SPS	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2					
82	SPS -> ENC	STW2_ENC	G1_STW								
	ENC -> SPS	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		NIST_A			
83	SPS -> ENC	STW2_ENC	G1_STW								
	ENC -> SPS	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		NIST_B			
84	SPS -> ENC	STW2_ENC	G1_STW								
	ENC -> SPS	ZSW2_ENC	G1_ZSW	G1_XIST3				G1_XIST2		NIST_B	
86	SPS -> ENC	G1_XIST_PRESET_A									
	ENC -> SPS	G1_XIST1		NIST_B							
59000	SPS -> ENC	STW2_ENC	G1_STW	DEBUG_ STW							
	ENC -> SPS	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		DEBUG_ ZSW			

Table 4.18: Telegrams

4.6 Parameters

	PNU	Sub-Index	Bits	Function
	65000			Preset value
	65001	1	0	Code sequence
			1	Class 4 functionality
			2	G1_XIST1 preset control
			3	Scaling function control
			4	Alarm channel control
			5	Compatibility mode
		2		Faults
		3		Supported faults
		4		Warnings
		5		Supported warnings
		6		Encoder profile version
		8		offset value
		9		Measuring units per revolution
		10		Total measuring range in measuring units
		11		Velocity measuring unit
	65002			Preset value 64 bit
	65003	1		offset value 64 bit
		2		Measuring units per revolution 64 bit
		3		Total measuring range in measuring units 64 bit

	PNU	Sub-Index	Bits	Function
	922			Telegram selection
	925			Number of controller sign-of-life failures which may be tolerated
	964			Device identification
	965			Encoder profile number
	970			Load parameter set
	971			Transfer to non-volatile memory
	972			Encoder reset
	974			Base mode parameter access service identification
	975			Encoder object identification
	976			Load device parameter set
	977			Transfer in non-volatile memory (global)
	978			List of all DO-IDs
	979			Sensor format
	980...989			Number list of defined parameter
	2000			Hysteresis position
	2002			Extrapolation position
	2003			Filter max. RPM
	2004			Filter position
	2005			Filter speed

Table 4.19: Supported parameters

4.6.1 Description of the most important parameters

4.6.1.1 Code sequence

Defines the counting direction of the position value in relation to the encoder shaft.

"0" means a positive counting direction of the position value with clockwise rotation of the shaft; "1" means a positive counting direction with counter-clockwise rotation.

4.6.1.2 Class 4 functionality

Switches the scaling, preset, and code sequence functionality on and off. When switched on, the position values G1_XIST1, G1_XIST2 and G1_XIST3 are influenced by the scaling and the code sequence, and G1_XIST2 and G1_XIST3 by the preset. In addition, if "G1_XIST1 Preset control" is also activated, G1_XIST1 is also affected by the preset, otherwise it is not.

4.6.1.3 G1_XIST1 preset control

Controls whether a preset command affects G1_XIST1 and is switched on with "0" and off with "1." Has no function unless "Class 4 Functionality" is activated. Only affects G1_XIST1, i.e. if the preset function is activated and the "G1_XIST2 Preset control" is switched off, G1_XIST2 is nevertheless affected by the preset.

4.6.1.4 Scaling function control

This parameter turns the scaling functions on and off. If it is not activated, the position values G1_XIST1, G1_XIST2 and G1_XIST3 are not affected. The scaling of the velocity value is PROFIdrive-specific and is not influenced by the position scale. The current setting can be read by object P65001, sub-index 1, bit 3. To use the scaling functions, "Class 4 functionality" must be activated.

4.6.1.5 Preset value

The preset value is governed by the scaling and can be reset repeatedly and stored in non-volatile memory via P971. By default has the preset value has the value 0.

Setting a preset value has no effect on the position value for the time being. The preset function is only executed by setting bit 12 in G1_STW.

4.6.1.6 Measuring units per revolution

For encoders, this parameter defines the number of increments required to resolve one 360° rotation of the encoder shaft. This parameter must be set during parameterization (octets 5...8). The current setting can be read by object P65001, sub-index 9.

4.6.1.7 Total measuring range in measuring units

Defines the entire measuring range of the encoder, i.e. after how many increments the position value resets to 0. For example, if "Measuring units per revolution" is 100 and "Total measuring range" is 250, the position value will return to 0 after 2.5 revolutions of the encoder shaft.

4.6.1.8 Velocity measuring units

This parameter defines the unit of the velocity values NIST_A and NIST_B. The following units are possible:

Unit	Parameter value
Increments / s	0
Increments / 100 ms	1
Increments / 10 ms	2
Rotations / min	3

Table 4.20: Velocity measuring units

4.6.1.9 Offset value

The offset value is calculated during execution of the preset and is then added to the position value. It is stored in non-volatile memory and can be read by the encoder at any time. The offset value can assume values within the scaled measurement range.

4.6.1.10 Hysteresis position

Unit	Parameter value
Meaning	Hysteresis position
Data type	Unsigned 8
Access	RW
Values	0 … 255
Default	10
Explanation	Size of the hysteresis for the position value

Table 4.21: Hysteresis position

4.6.1.11 Extrapolation position

Parameters	2002
Meaning	Extrapolation position
Data type	Unsigned 16
Access	RW
Values	0 … 65535
Default	100
Explanation	Time to be compensated for in µs "Where will the position value be in X µs?"

Table 4.22: Extrapolation position

4.6.1.12 Filter max. RPM

Parameters	2003
Meaning	Filter max. RPM
Data type	Unsigned 16
Access	RW
Values	0 … 65535
Default	0
Explanation	0: Number of average values is constant > 0: Number of average values decreases linearly until the speed indicated here is reached

Table 4.23: Filter max. RPM

4.6.1.13 Filter position

Parameters	2004
Meaning	Filter position
Data type	Unsigned 8
Access	RW
Values	0 … 255
Default	5
Explanation	Number of average values for the position value

Table 4.24: Filter position

4.6.1.14 Filter speed

Parameters	2005
Meaning	Filter position
Data type	Unsigned 8
Access	RW
Values	0 … 255

Parameters	2005
Default	5
Explanation	Number of average values for the velocity value

Table 4.25: Filter speed

4.7 Warnings and errors

4.7.1 Errors

Bits	Meaning	Sensor system error code
0	Position error	All have invalid position values
5	Memory error	11

Table 4.26: Errors

4.7.2 Warnings

Bits	Meaning	Sensor system error code
0	Frequency exceeded	–

Table 4.27: Warnings

4.7.3 G1_XIST2 error codes

G1_XIST2	Meaning	Sensor system error code
0x0001	Sensor group error	All have invalid position values
0x0F01	Command not supported	–
0x0F02	PLC sign-of-life error	–
0X0F04	Synchronization error	13

Table 4.28: G1_XIST2 error codes

5. Web server

5.1 General

PROFINET encoders have a web server that lets you view specific information and configure certain settings. To access the web server, enter its IP address into a browser of your choice (Internet Explorer, Firefox, etc.). To do so, connect the encoder to your computer using an Ethernet cable (M12 connector on the encoder and RJ45 connector on the PC). Ensure that your PC is in the same IP address range as the encoder.

Example configuration:

IP address of the encoder:	192.168.0.1
IP address of the PC:	192.168.0.100
Subnet address of the PC:	255.255.255.0

Once this has been done, the encoder's homepage opens (information overview).

The following sub-sections cover the various views within the web server and the available functions.

5.2 Information

5.2.1 Overview

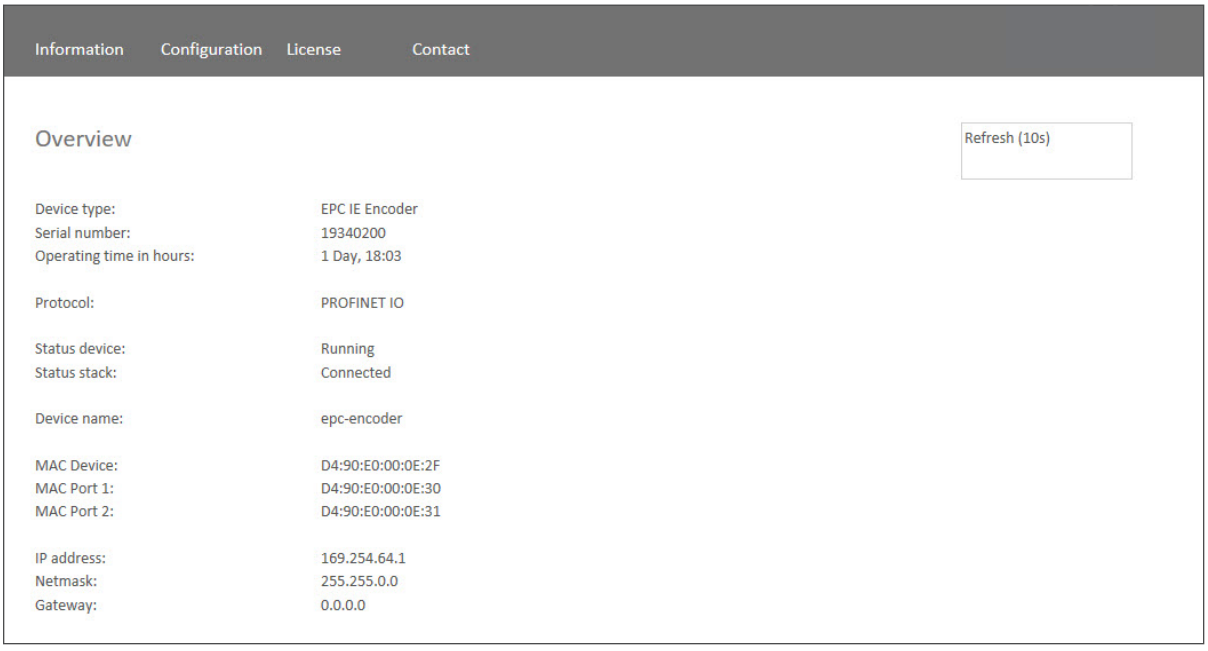


Figure 5.1: Web server – overview

The overview displays the following information:

- Device type: name of the encoder
- Serial number: device number of the encoder
- Operating time in hours: number of operating hours
- Protocol: PROFINET IO
- Device status: on or off state
- Status stack: Online or offline
- MAC devices: MAC address of the encoder
- MAC Port 1: MAC address of Ethernet port 1
- MAC Port 2: MAC address of Ethernet port 2
- IP address: IP address of your PROFINET encoder
- Network mask: the subnet mask of your PROFINET encoder
- Gateway: the gateway of your PROFINET encoder
- The update rate of the web page is fixed at 10 seconds and cannot be changed. The message "Updating Data" in the upper-right corner of the field in which the update time is displayed indicates that the data is being updated.

You can change the language of the web server after accessing it. After switching inside a sub-screen, the web server restarts from the start screen.

5.2.2 Diagnosis

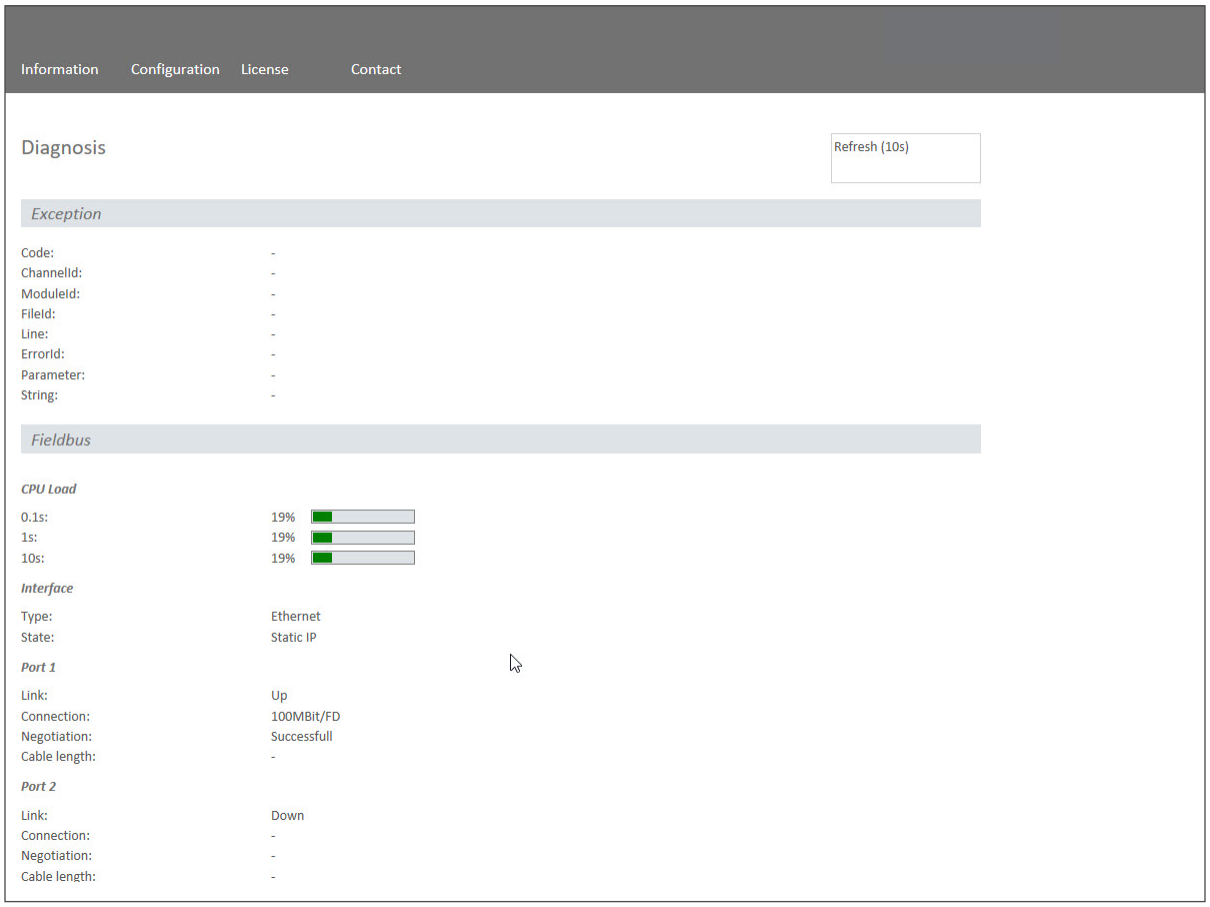


Figure 5.2: Diagnostic page

Exception

Possible causes of errors are displayed here. If you see an error here, please either contact us or refer to the manual for possible causes.

Fieldbus

- CPU Load: this shows the CPU utilization of the encoder during operation.
- Interface:
    - Type: the protocol is displayed here; Ethernet
    - State: the mode is specified here. Only static IP is specified. DHCP mode is not possible.

- Port 1 and Port 2
    - Link: indicates whether the port is active. Link=> up or down
    - Connection: max. speed 100Mbit/FD
    - Negotiation: allows two interconnected Ethernet ports to negotiate independently and configure the maximum possible speed.
    - Cable length: when using IRT mode, the cable length specified in the TIA Portal is displayed.

5.2.3 Versions

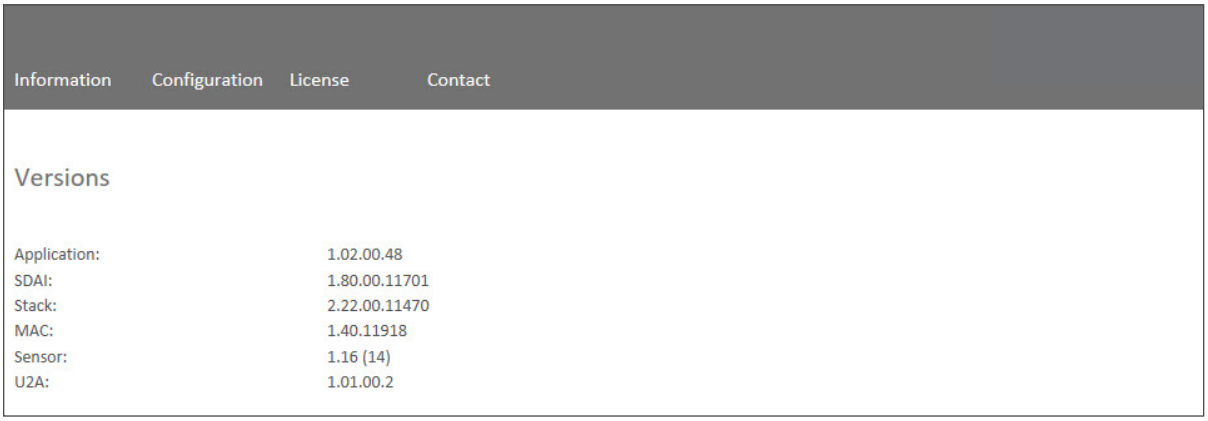


Figure 5.3: Versions

Here you can find information about the individual versions:

- Application
- SDAI
- Stack
- MAC
- Sensor
- U2A

5.3 Configuration

5.3.1 Network

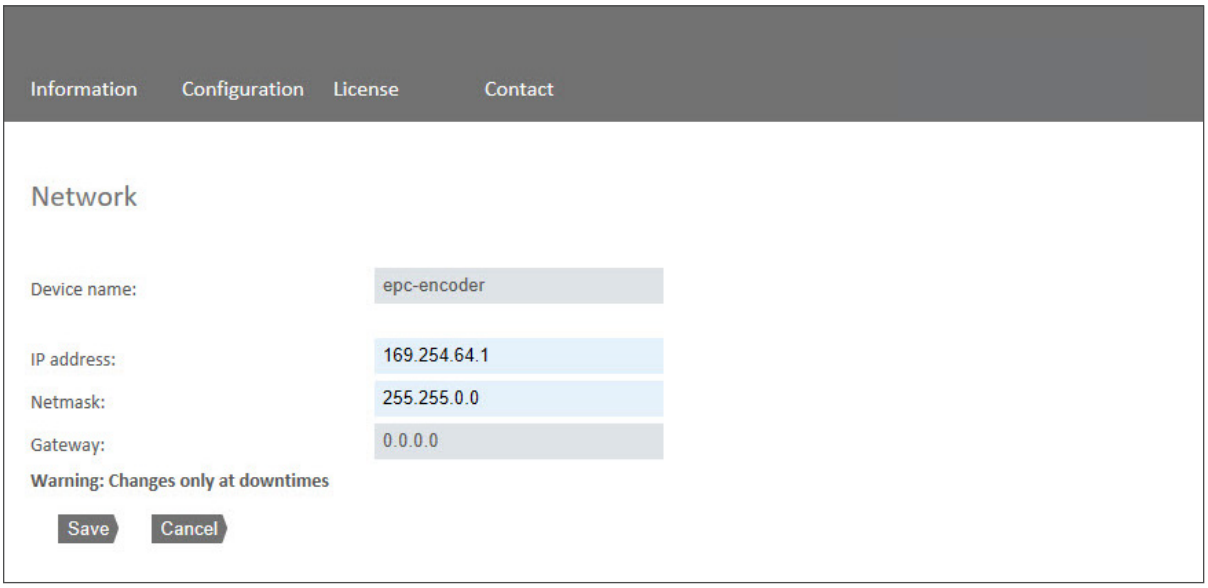


Figure 5.4: Network settings

- You can change the device name, IP address, network mask and gateway here.
- Please note that this data should only be modified when the system is not in operation.

5.3.2 Encoder

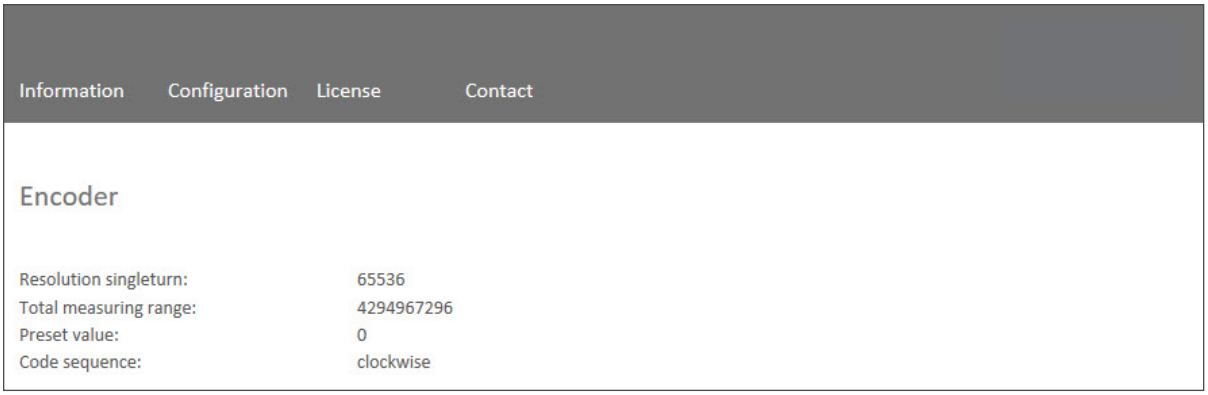


Figure 5.5: Encoder information

You can check the following parameterized values for the encoder here:

- Resolution single turn
- Total measuring range
- Preset value
- Code sequence

5.3.3 Firmware update

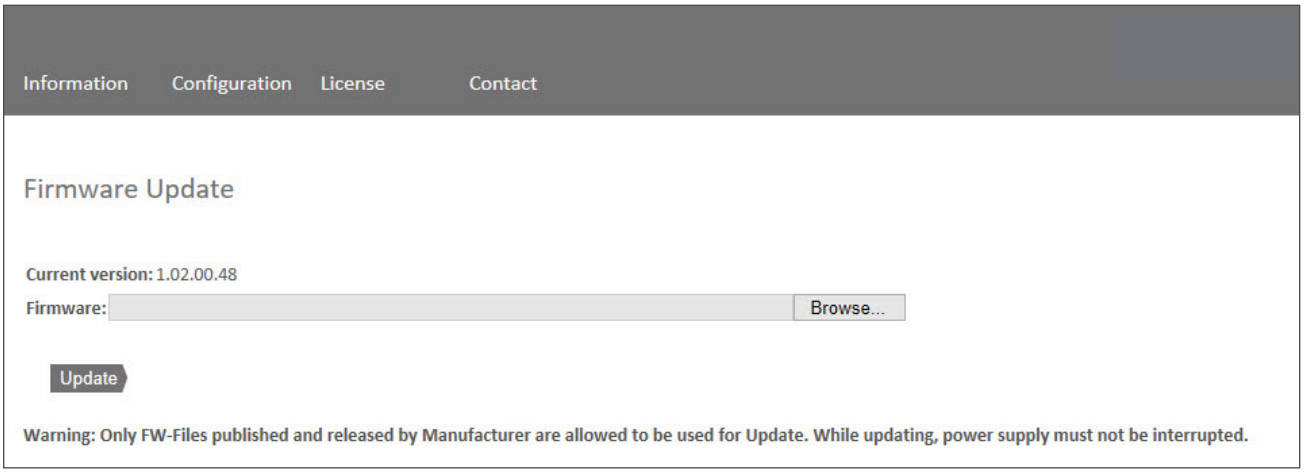


Figure 5.6: Firmware update

The current firmware version of the encoder is displayed. If a new firmware version is available, you can update the encoder's firmware here.

- Please note that the firmware must only be updated when the system is not in operation.
- Do not cut off the power supply or disconnect the network cable while performing a firmware update.

To update the firmware of the encoder, choose the correct .bin file by clicking the "Browse…"-Button (see Figure 5.7: Firmware update – choose file).

Figure 5.7: Firmware update – choose file

After you have chosen the correct file, click the "Update"- Button to start the firmware update. An animated icon will appear with the additional text: "Transferring file" (see Figure 5.8).

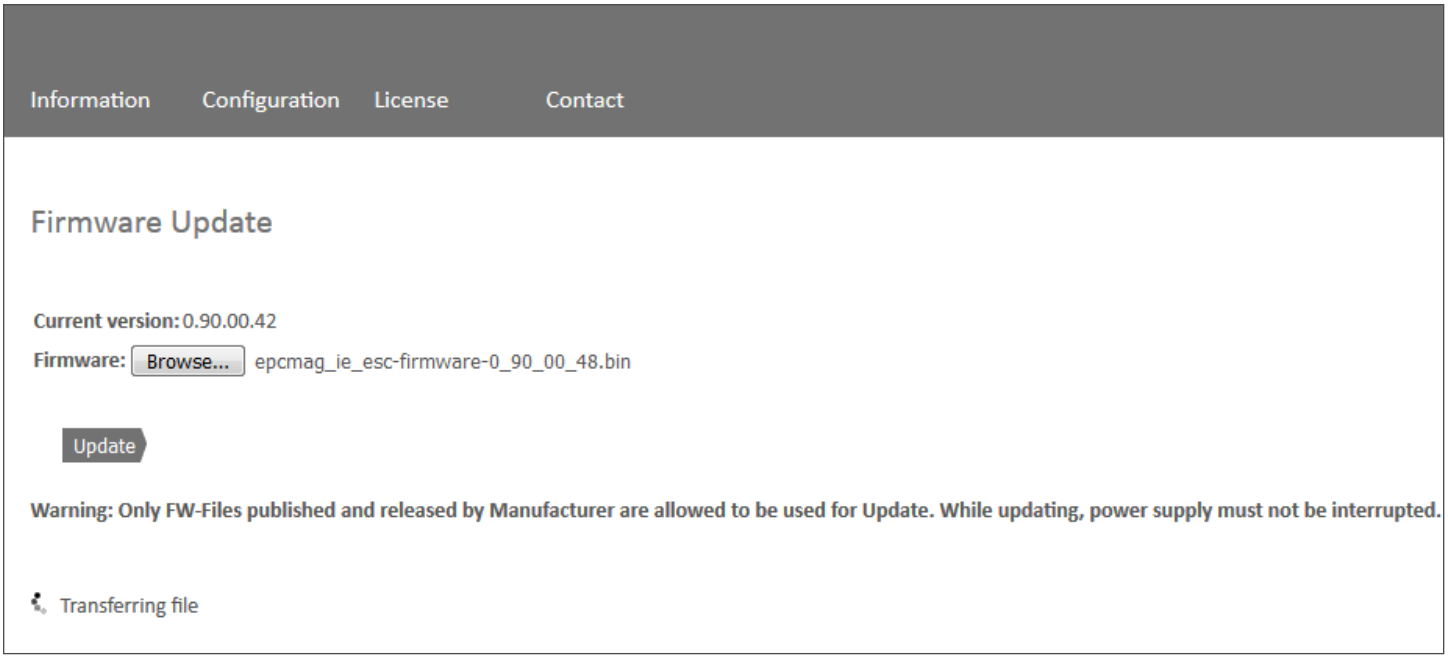


Figure 5.8: Firmware update – transferring file

After the firmware update is successfully finished, you will see it on the website like in Figure 5.9. Perform a power reset and check under "Information -> Versions" to confirm that the new firmware version is shown.

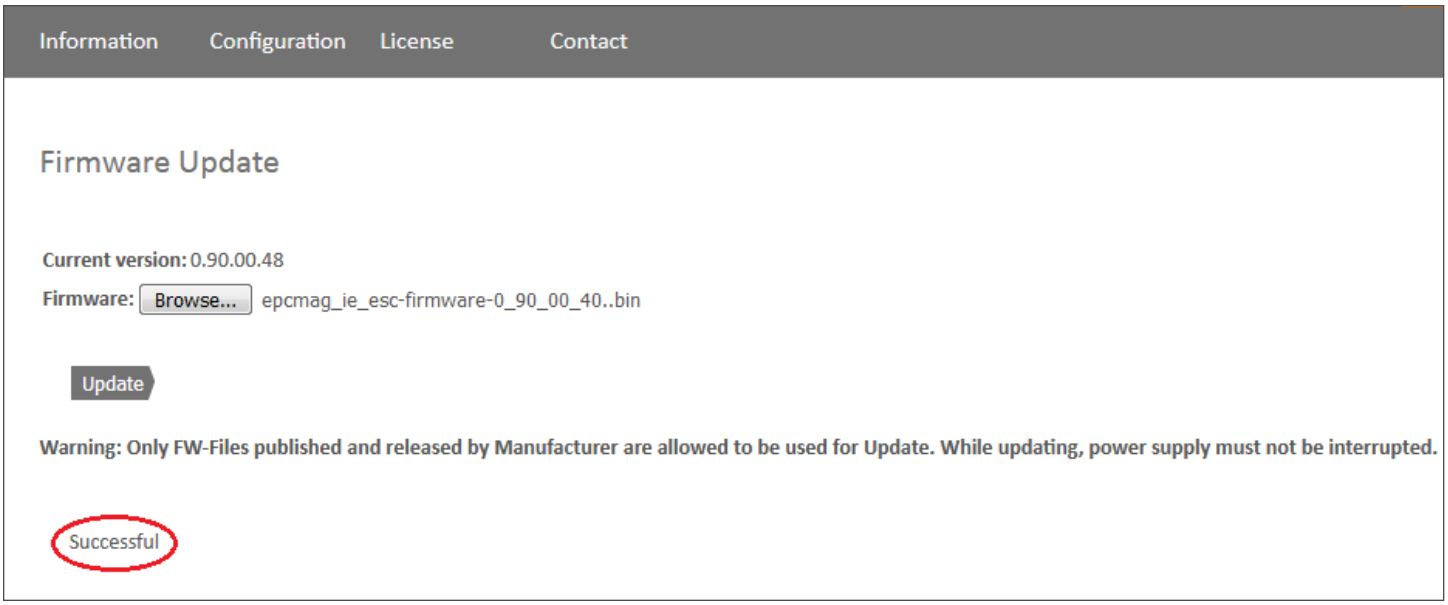


Figure 5.9: Firmware update – successful

In case of a failure during the firmware update process (see Figure 5.10) please double check that you chose the correct firmware file. Do a power reset and repeat the whole firmware update process. In case of a power loss during the update, the encoder may not respond to any request any more. If this happens, please contact our support team.

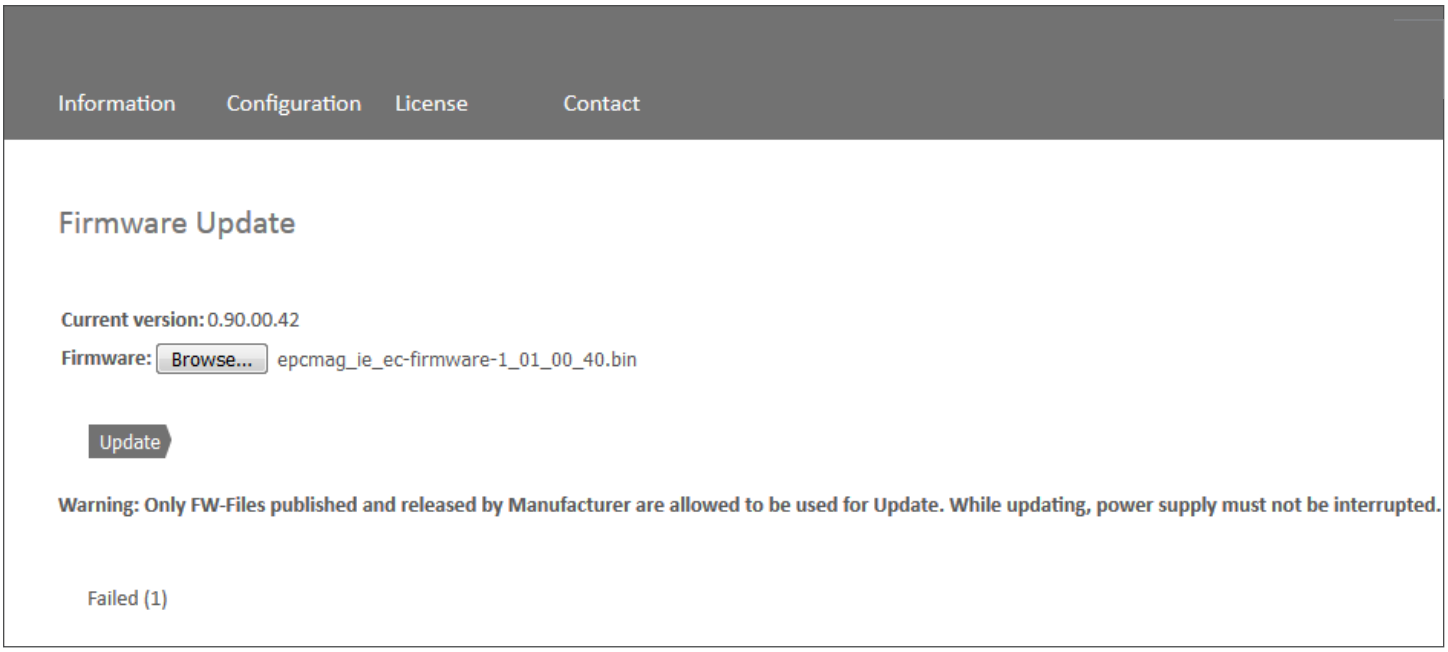


Figure 5.10: Firmware update – failed

5.4 License information

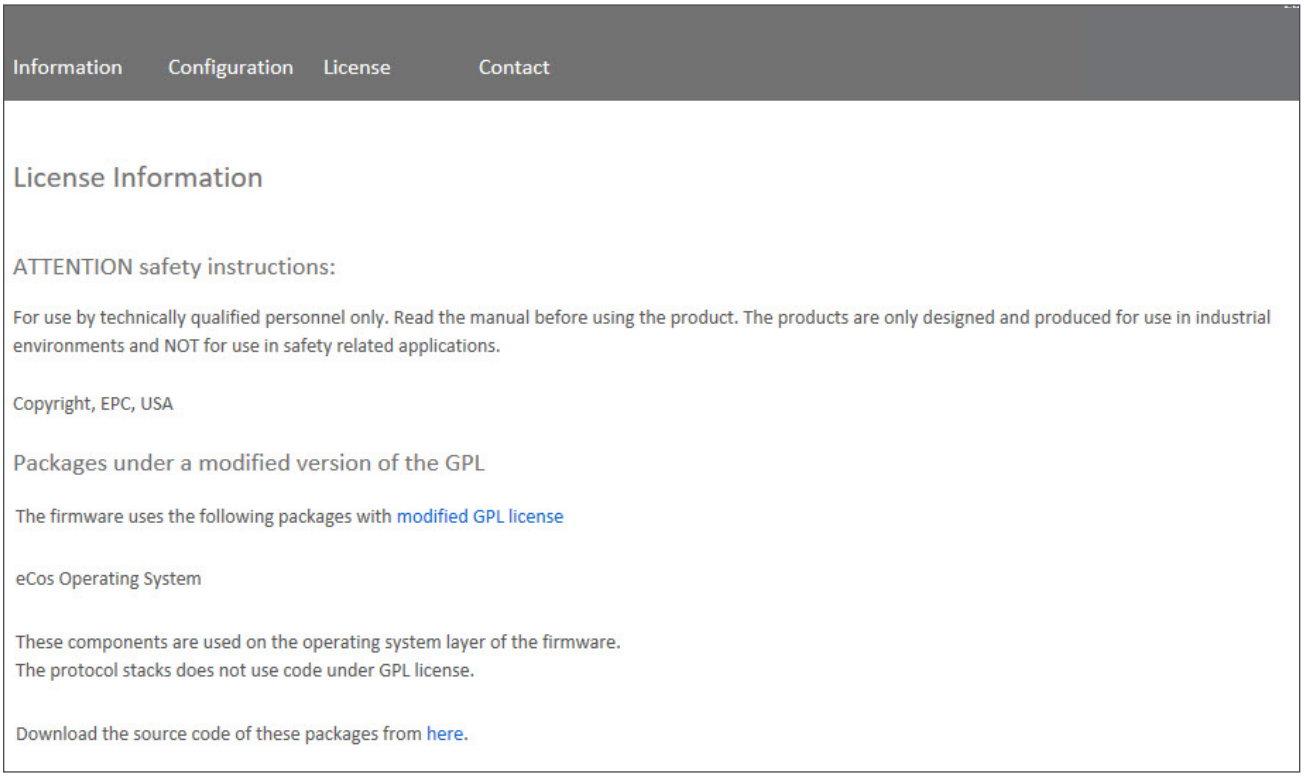


Figure 5.11: License information

This view contains the current safety instructions as well as software packages containing firmware. You can download the source code of these packages using the link on this website.

5.5 Contact

Product Information

For general information about the product, please contact Encoder Products Company:

Phone: (208) 263-8541
Fax: (208) 263-0541
Email: sales@encoder.com
Web: encoder.com

Technical Support

If you need technical support, please contact:

Phone: (208) 264-8541
Fax: (208) 263-0541
Email: support-epcmag@encoder.com
Other countries: encoder.com/contact-us

6. Commissioning

6.1 General information

This section contains two configuration examples for EPC PROFINET encoders. The first example is shown with version 14 of the TIA portal, the second with Step 7 V5.5 SP4.

6.2 Integrating into a TIA project

Connect the encoder to your controller.

Connect the encoder's power supply.

To integrate the encoder into your TIA portal project, start your TIA portal, open the required project and switch to the project view by pressing the "Project view" button (see Figure 6.1).

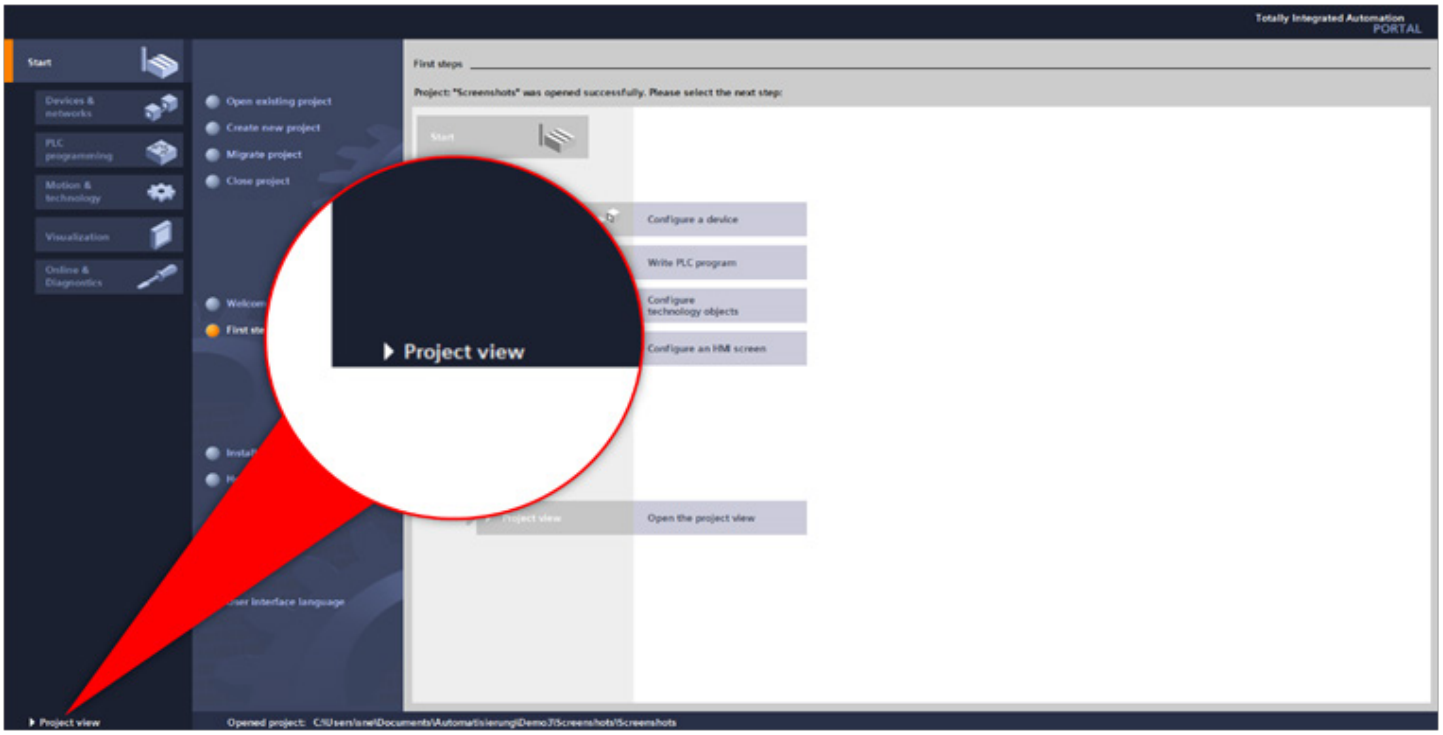


Figure 6.1: Switching to project view

Next, install the GSDML file. You can download these from the download area of our website. To do so, open the "Options" tab and select the menu "Manage general station description files (GSD)" (see Figure 6.2).

- The corresponding .bmp file must be located in the same directory as the GSDML file during installation and is included in the download.

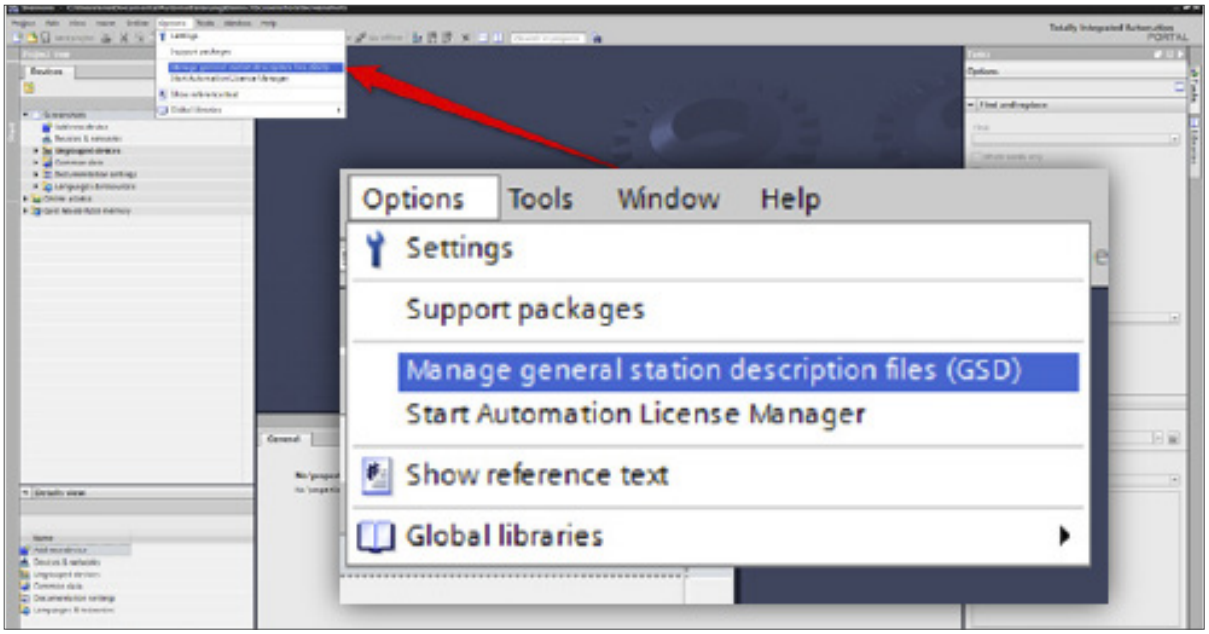


Figure 6.2: Manage device description file (GSD)

Now select the path for the GSDML file, activate the checkmark next to the desired GSDML file and confirm the installation via the "Install" button (see Figure 6.3). Then close the installation window.

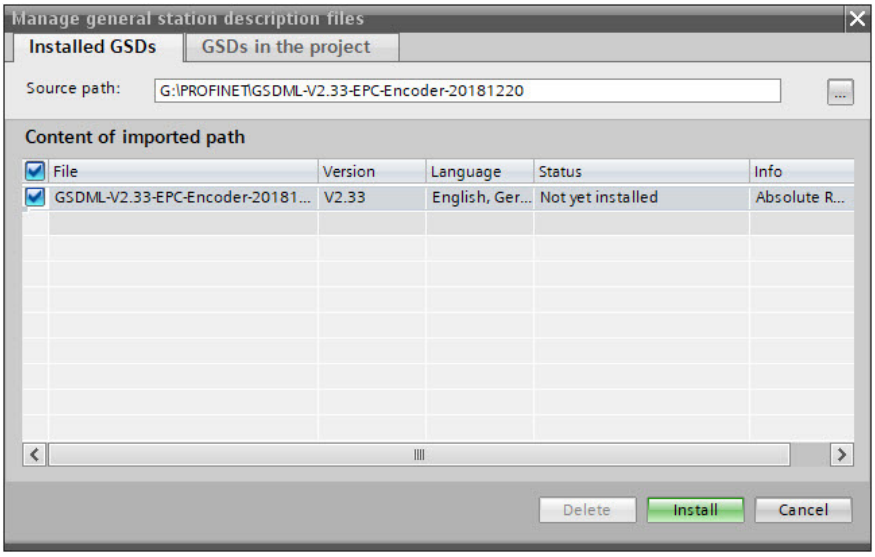


Figure 6.3: Installing GSDML

From the "Project tree" column on the left of the TIA portal, select the "Devices & networks" tab (see Figure 6.4). The hardware view opens and the hardware catalog is now visible in the right-hand column.

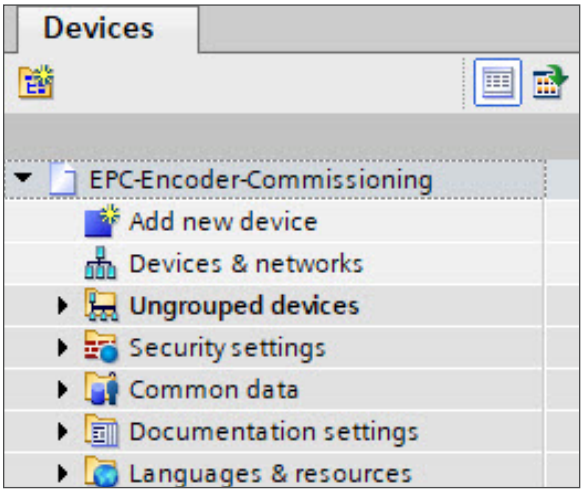


Figure 6.4: Switch to Devices & Network

Add the encoder to your hardware configuration. To do so, open the following path at the right edge of the screen: "Other field devices / PROFINET IO / Encoders / Encoder Products Company / Absolute Encoder / EPC Encoder" (see Figure 6.5).

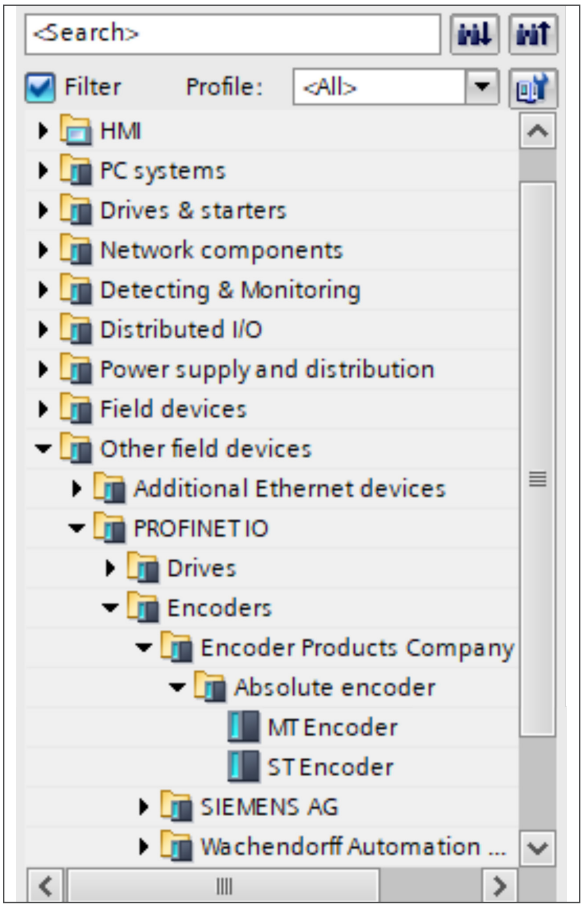


Figure 6.5: Hardware catalog

Now, "drag" the encoder onto the "PROFINET IO system." This encoder is now displayed in the hardware view. Connect the encoder to the controller by dragging the encoder port onto the appropriate controller port. The result is shown in Figure 6.6.

- If a single turn encoder is used, and a multi-turn encoder is configured by mistake, this leads to a configuration error and the STAT LED of the encoder flashes red.

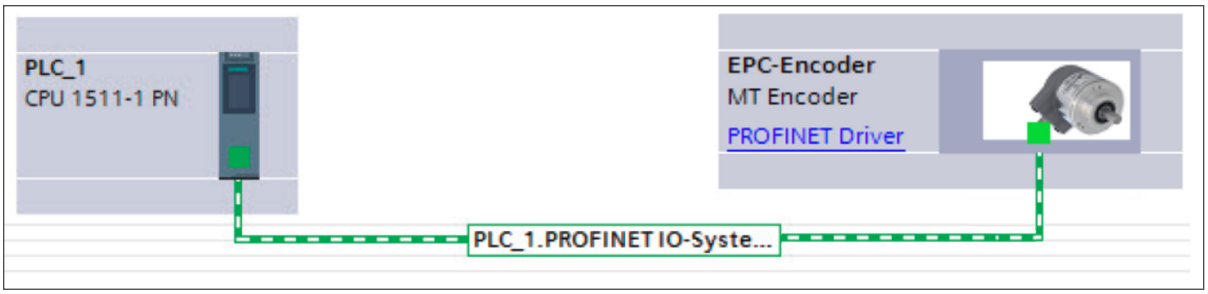


Figure 6.6: Network view

Select the encoder and switch to the "Device overview" tab. Enter a meaningful device name by double-clicking the default name (see Figure 6.7).

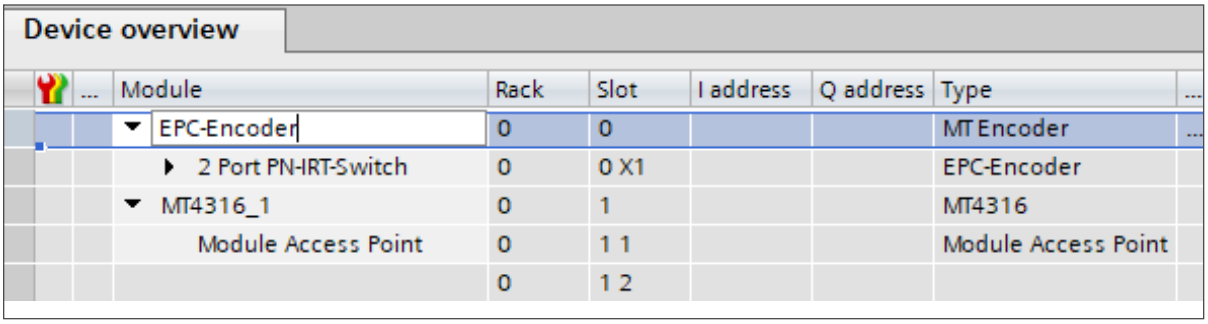


Figure 6.7: Change device name

Select the desired telegram for communication by dragging it from the hardware catalog under "Submodules > Profile" to "Slot 1 2" (see Figure 6.8).

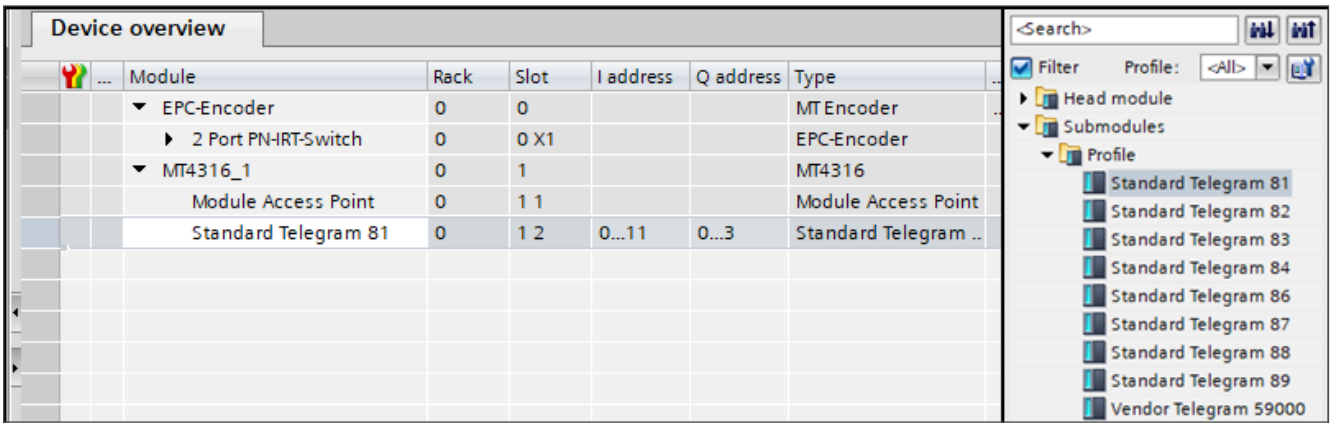


Figure 6.8: Select telegrams

You can also set the corresponding I/O addresses. To do so, double-click on the respective field and change the address (see Figure 6.9).

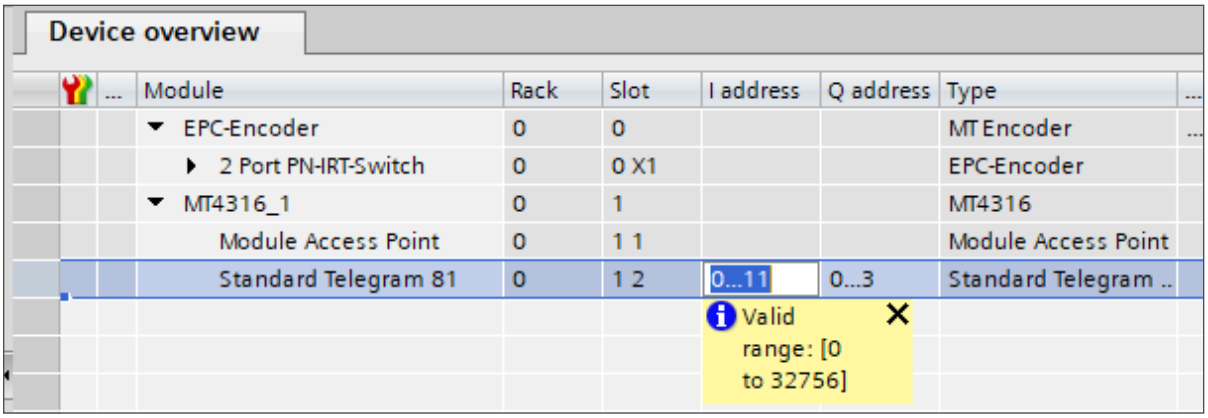


Figure 6.9: Change the I/O addresses

Click on your PLC in the project navigation window and load the configuration by clicking the "Download to device" button (see Figure 6.10).

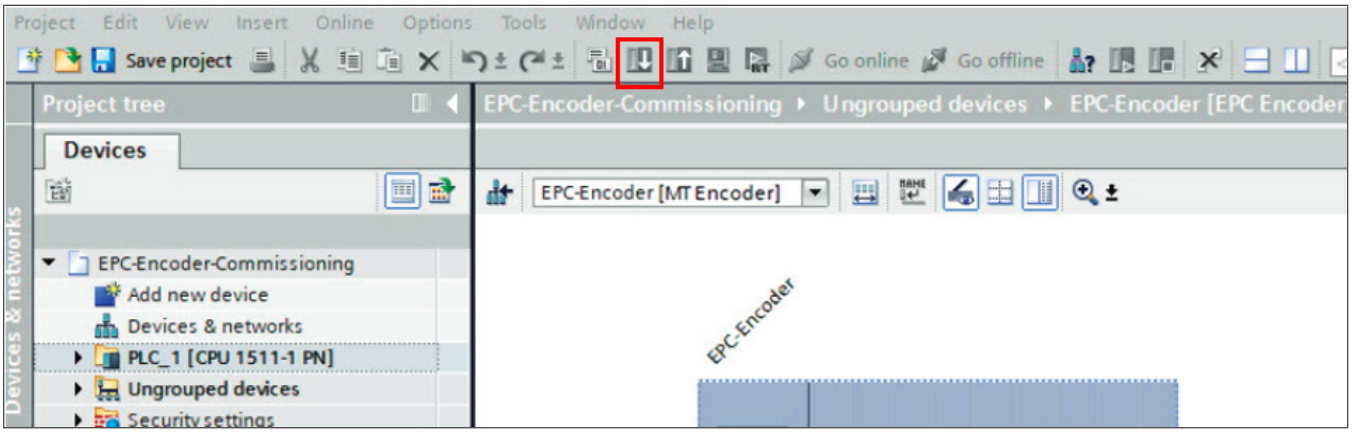


Figure 6.10: Download to device

Switch back to the "Devices and networks" view and assign the PROFINET device name to the encoder as shown in the configuration on page 39. To do so, select the encoder (single mouse click) and select the "Assign device name" option (see Figure 6.11).

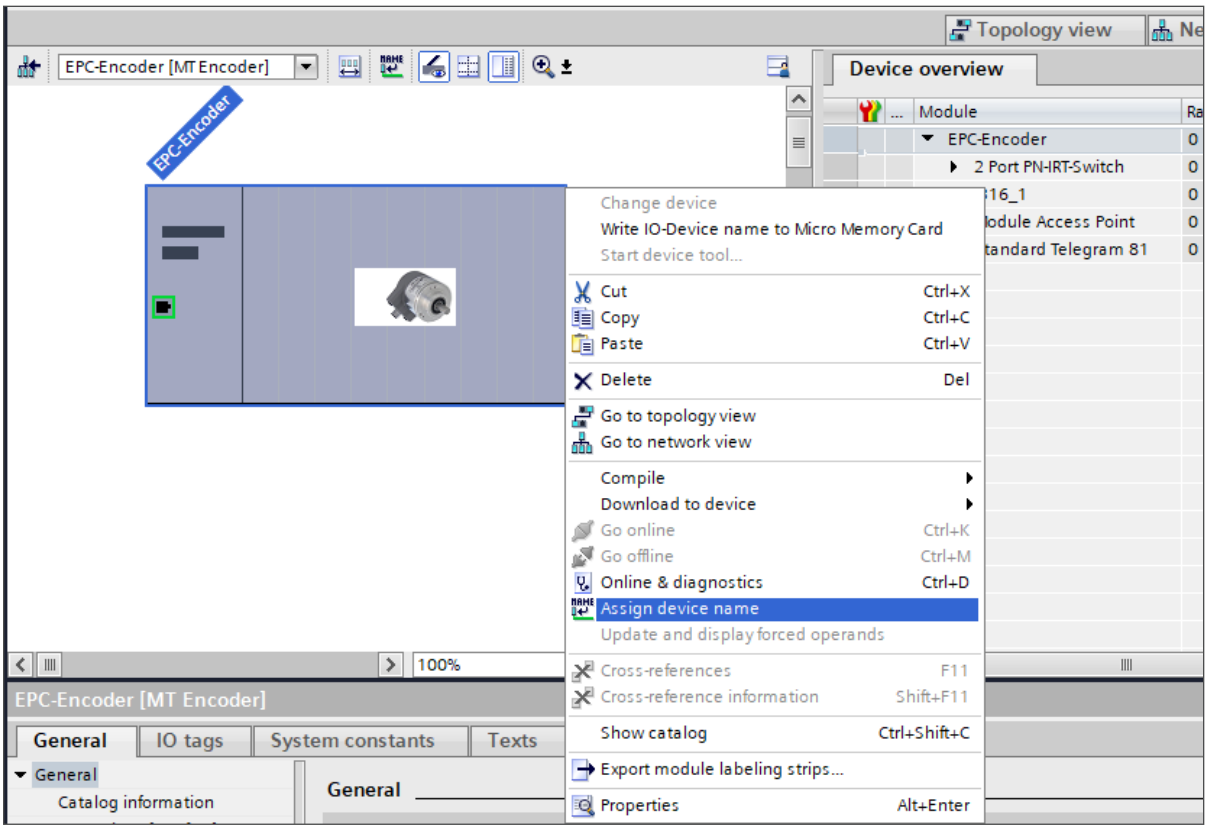


Figure 6.11: Assigning device names

Assign a name to the encoder. Then select your PG/PC interface and the type and click on "Update list" (see Figure 6.12)

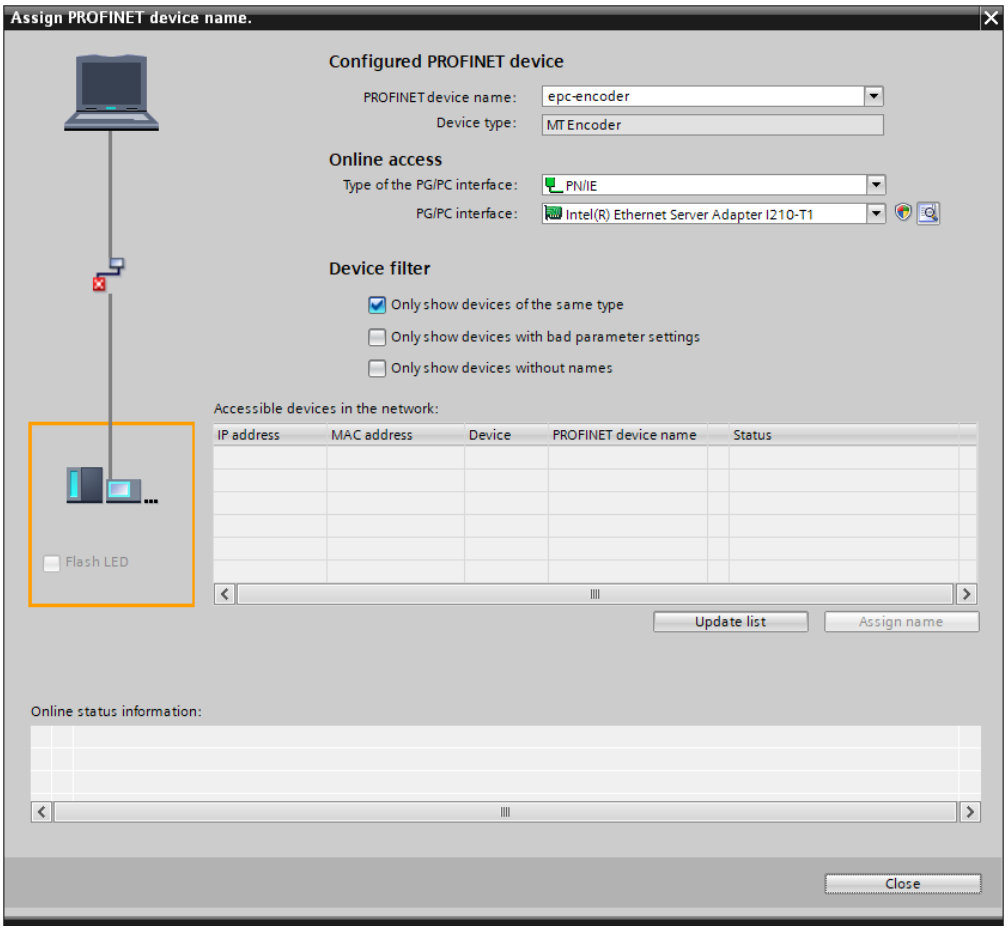


Figure 6.12: Name and PG interface

All devices are now displayed under "Accessible devices in the network." Select your encoder and click on "Assign name" (see Figure 6.13).

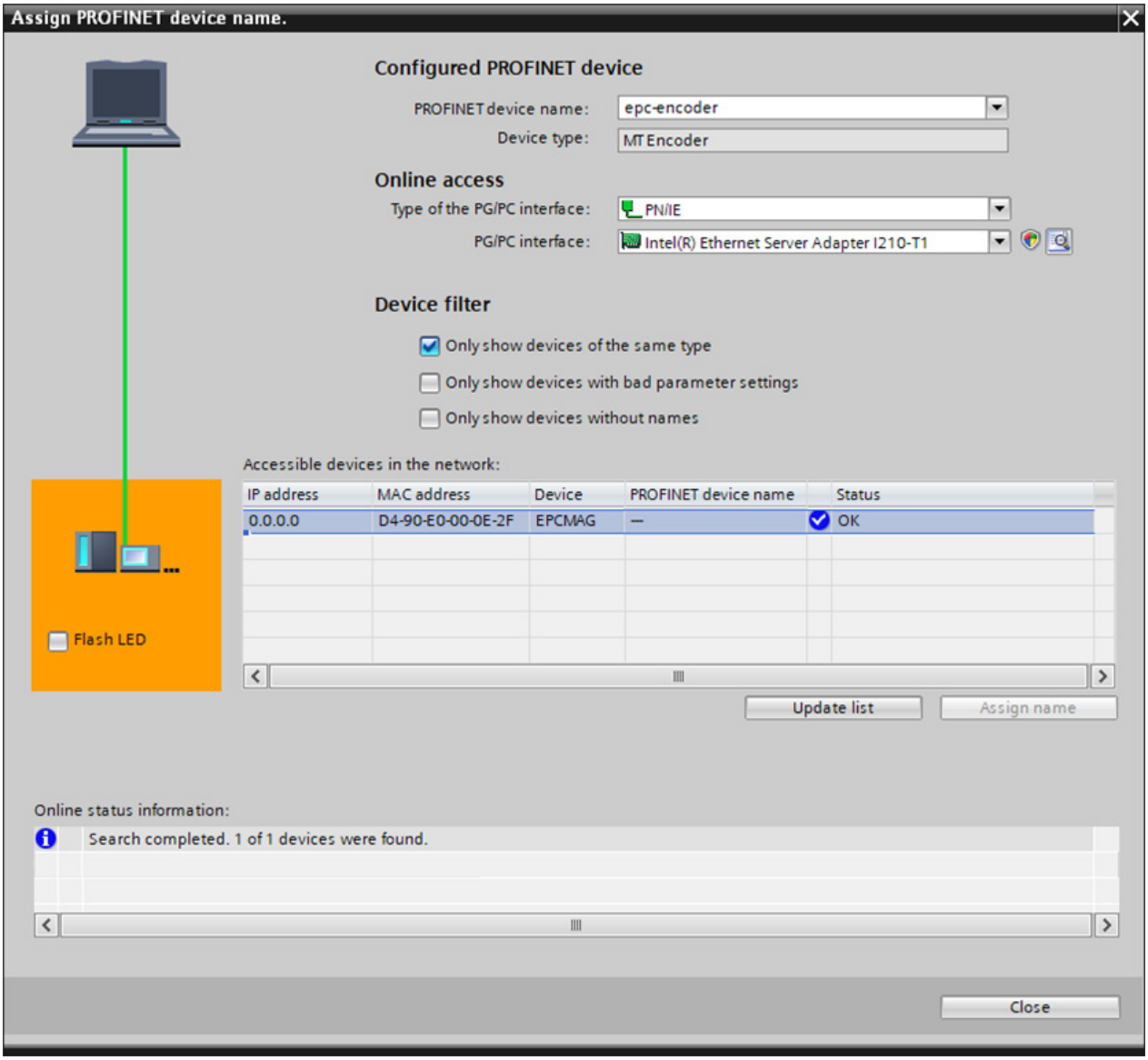


Figure 6.13: Accessible nodes

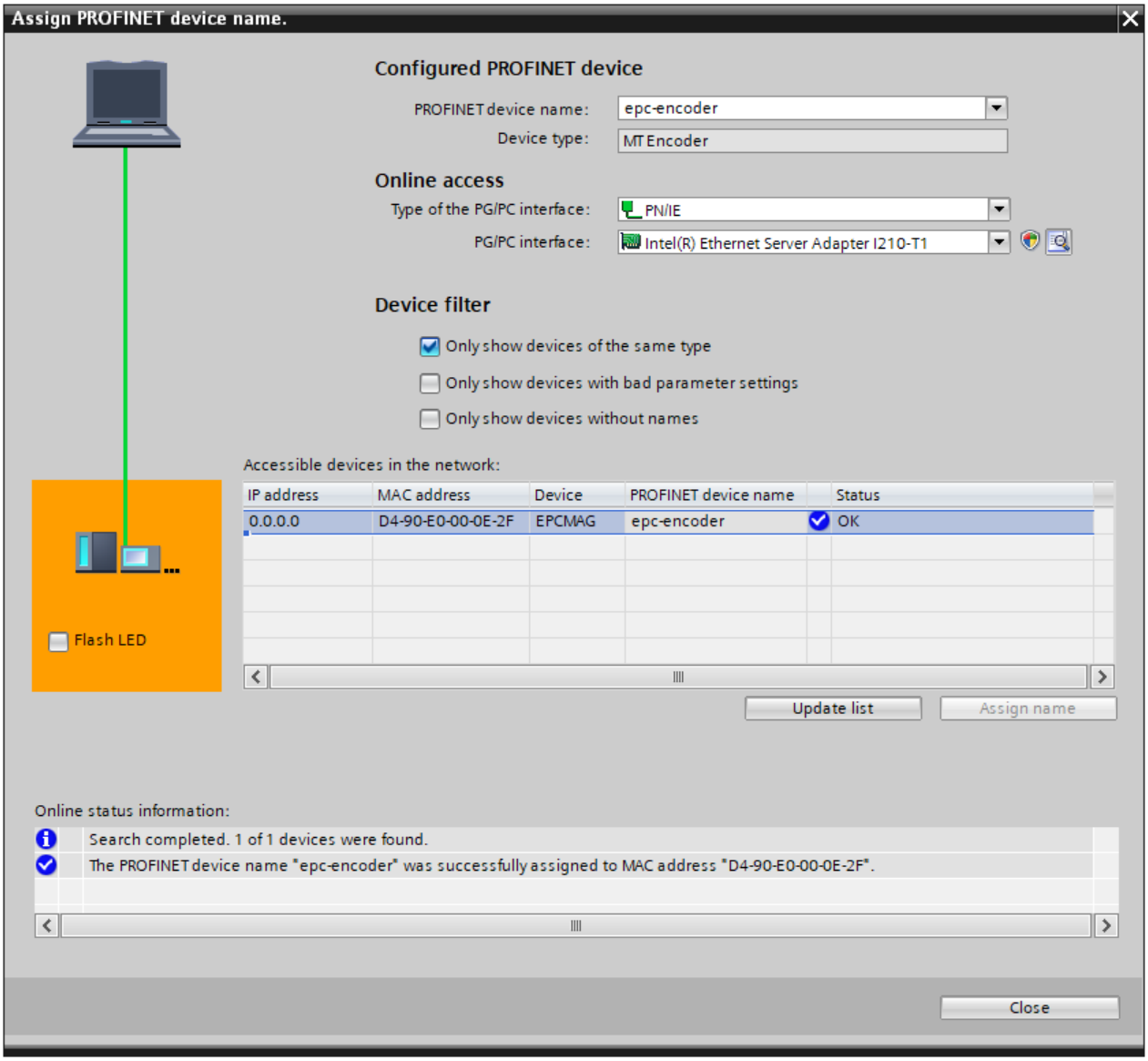


Figure 6.14: Online status information

You can use a variable table to display the encoder's I/O data for test purposes. To do so, open the default tag table (see Figure 6.15) and enter the corresponding address for the position value. You can then click on "Show all" to see the position value (see Figure 6.16 and Figure 6.17).

Example:

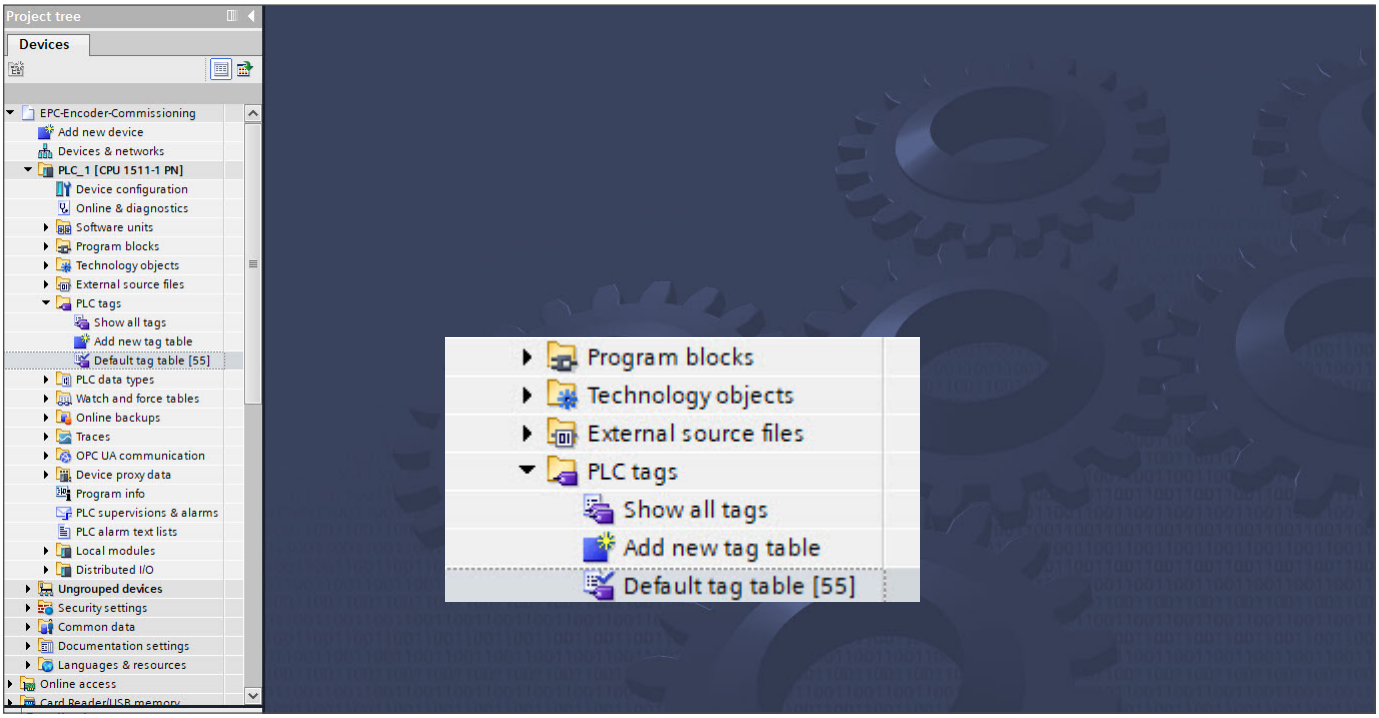


Figure 6.15: PLC variables

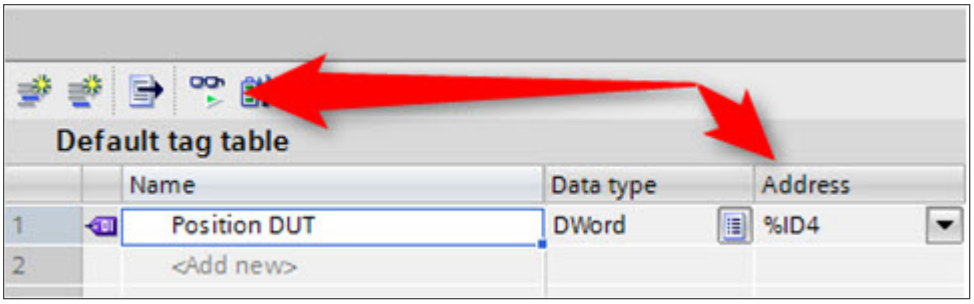


Figure 6.16: Show all

Figure 6.17: Default tag table

6.3 Scaling function

In order to set a different number of steps / revolutions or revolutions than the one given in the GSDML file, the scaling function must be activated. The following two examples explain this for a single turn and a multi-turn encoder. It is assumed that you have already configured the encoder and your PLC in the TIA portal.

6.3.1 Example scaling function single turn 16-bit to 12-bit

Double-click on the image of the encoder in the network view of "Devices and Networks" (see Figure 6.18).

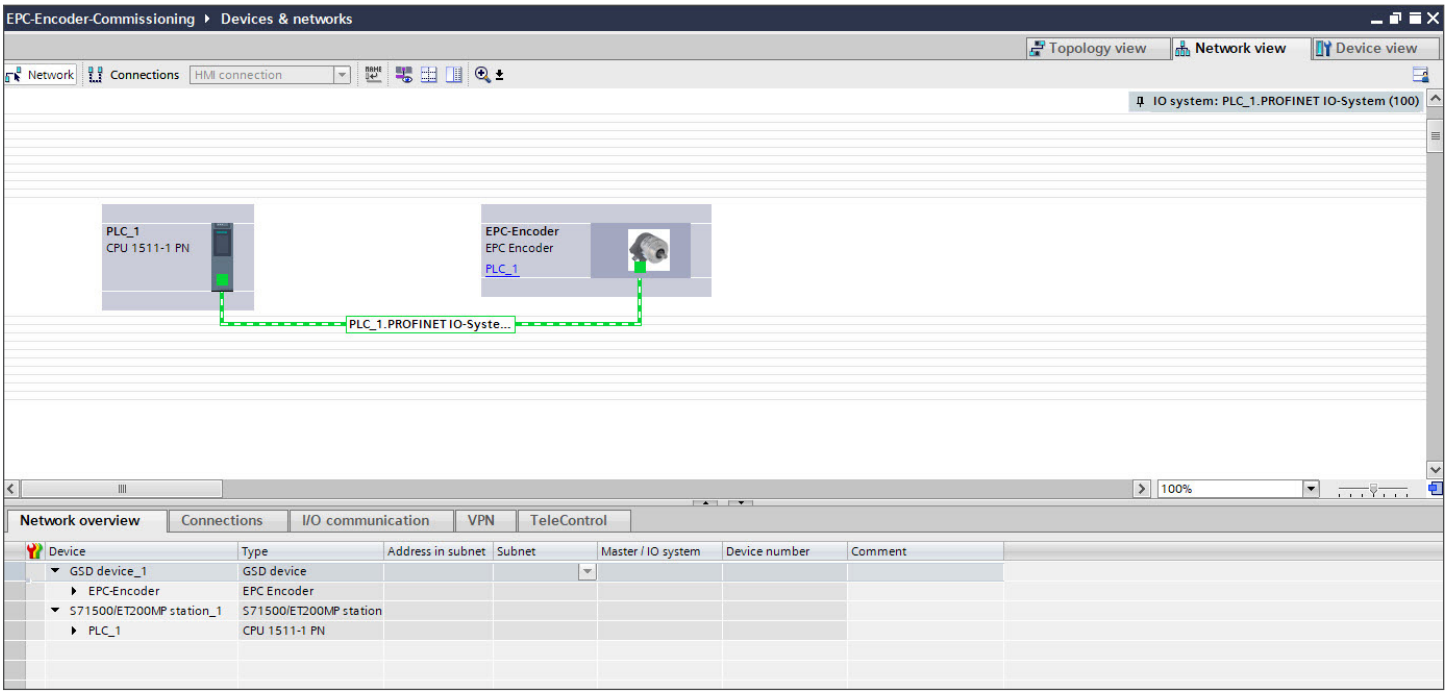


Figure 6.18: Example of commissioning

Open the device overview for the encoder and click on the "MAP" field. The "Module Parameters" appear in the "Properties" under "Device Overview" in the "General" tab, which we will click on (see Figure 6.18).

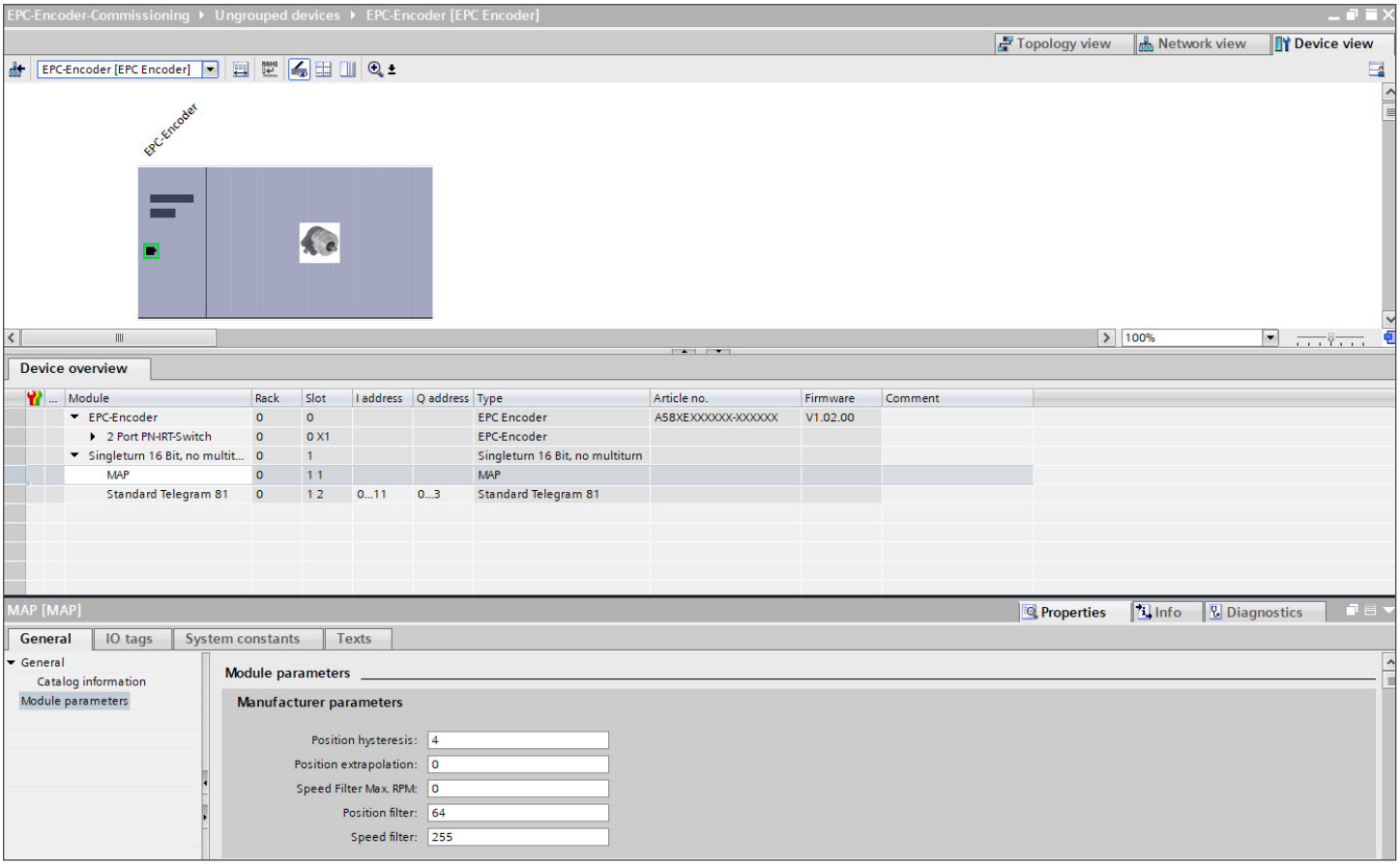


Figure 6.19: Assembly parameters

The default settings of the 16-bit single turn encoder are shown in Figure 6.20.

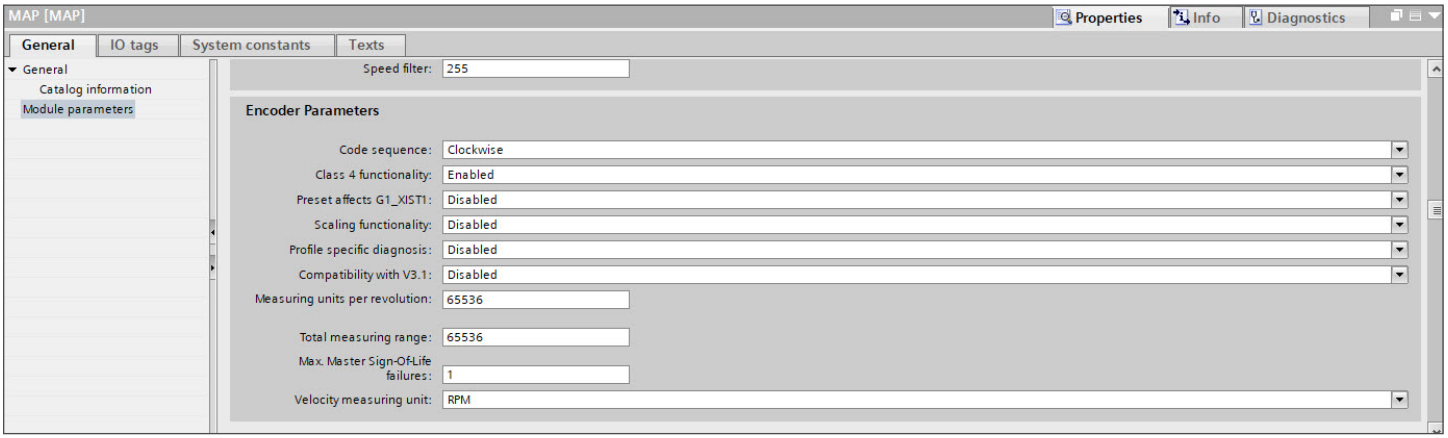


Figure 6.20: Default assembly parameters 16-bit single turn

In this example we want to set a resolution of 12-bit. To do this, turn on the scaling function by setting it to "Enabled." In the fields "Rotation resolution" and "Total resolution," enter the value for 12-bit (212 = 4096) (see Figure 6.21).

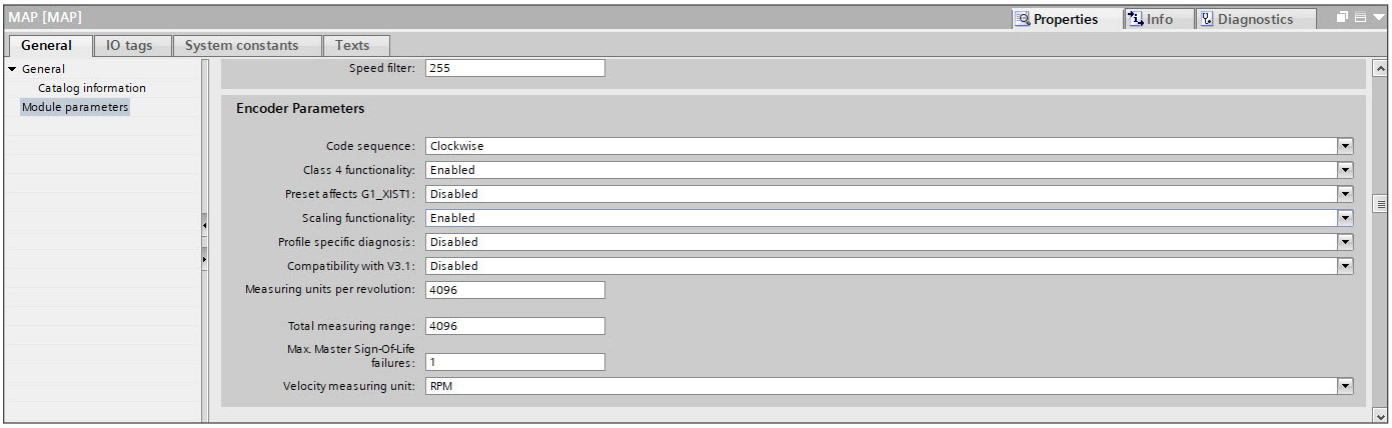


Figure 6.21: Configuration of 12-bit single turn with scaling

- If a new project is created and the scaling function is set up, a "Load into device" is sufficient to activate this function.
- If an existing project is changed in order to add the scaling function, the change must be transferred to the controller with "Load into device" -> "Hardware configuration."

6.3.2 Example scaling function multi-turn

Double-click on the image of the encoder in the network view of "Devices and Networks" (see Figure 6.22).

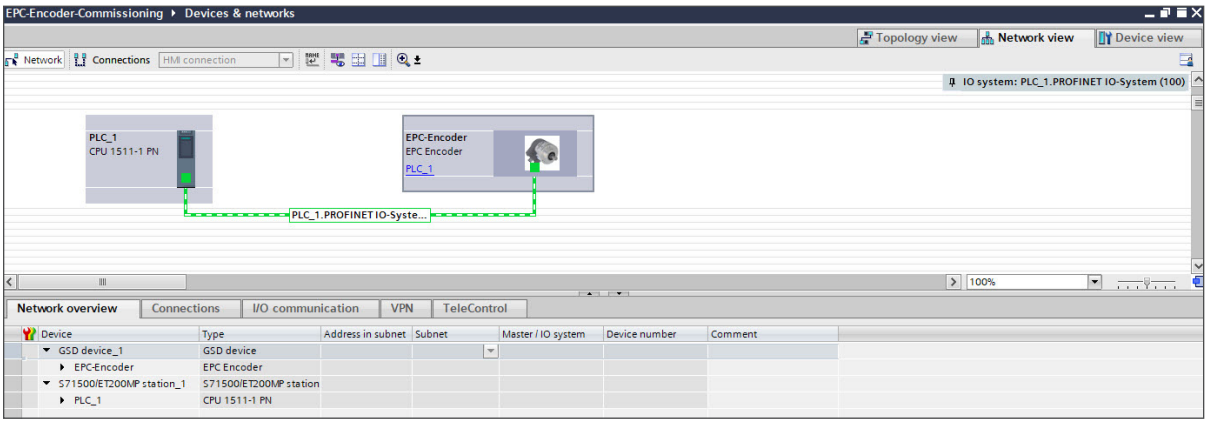


Figure 6.22: Example of commissioning

Figure 6.23 now shows a rotary encoder configured as 16-bit single turn and 43-bit multi-turn. In the "Device overview" we click on the field "MAP."

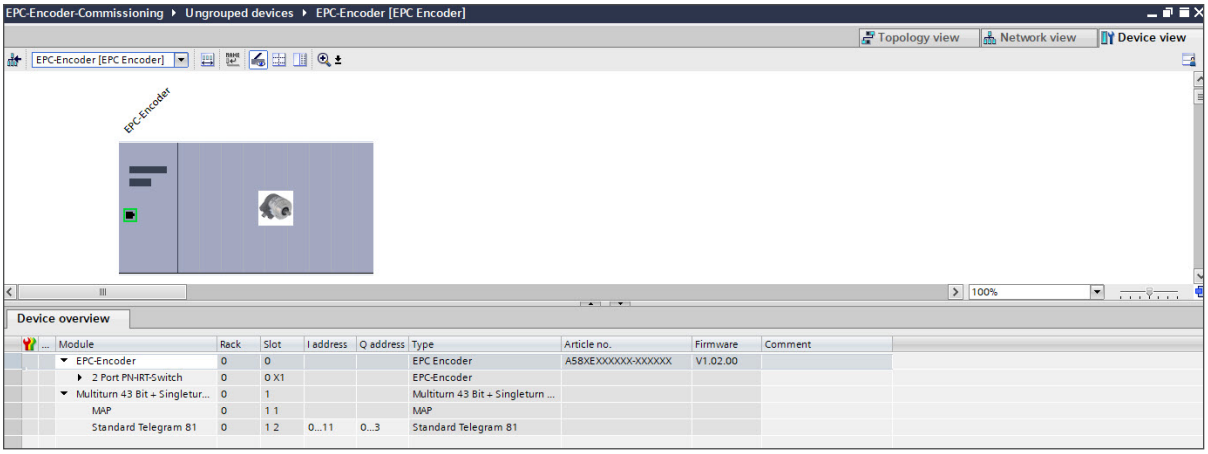


Figure 6.23: Device overview – MAP

The "Assembly parameters" which we click on will then appear in the "Properties" under "Device overview" in the "General" tab (see Figure 6.24).

Here you can also see the default settings of a 43-bit multi-turn and 16-bit single turn encoder.

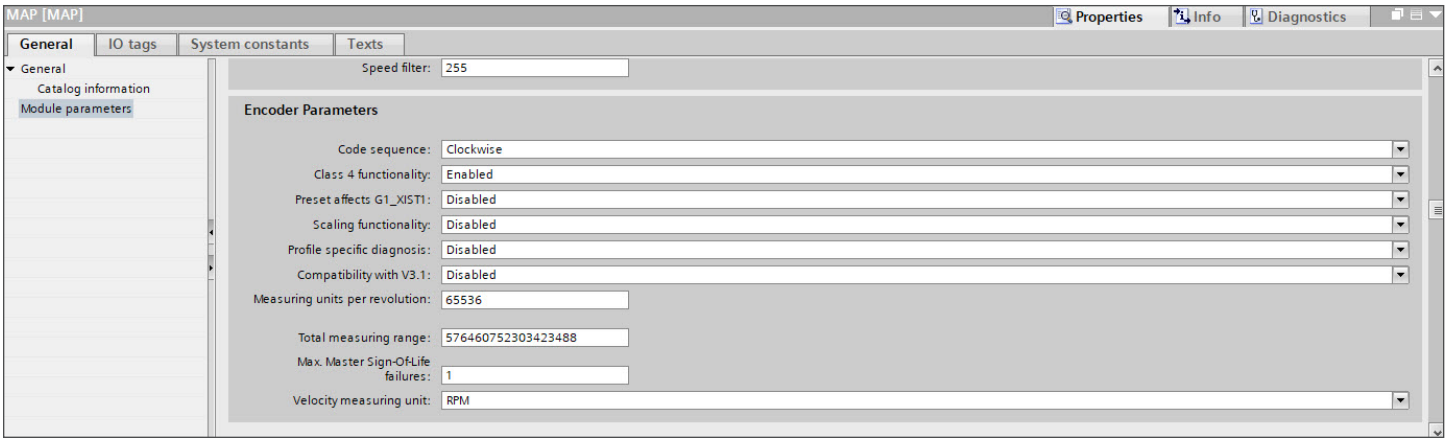


Figure 6.24: Assembly parameters

In this example we want to set a resolution of 360 steps/revolution and 10 countable revolutions (10 x 360 steps = 3600 steps total resolution).

To do this, turn on the scaling function by setting it to "Enabled." Enter 360 in the field "Revolution resolution" and 3600 in the field "Total resolution" (see Figure 6.25).

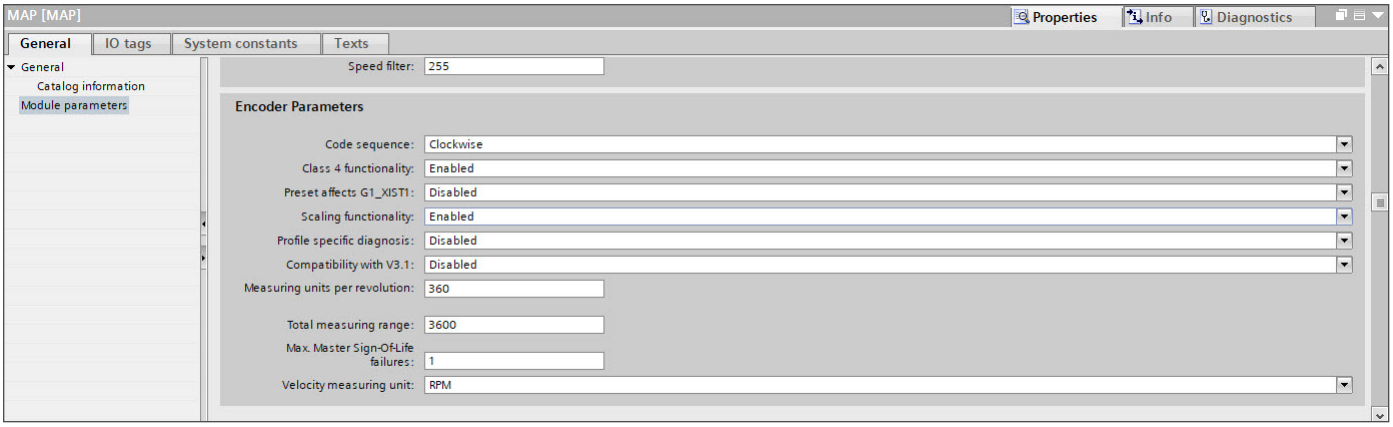


Figure 6.25: Configuration of 360 Steps/revolution and 10 revolutions

- If a new project is created and the scaling function is set up, a "Load into device" is sufficient to activate this function.
- If an existing project is changed in order to add the scaling function, the change must be transferred to the controller with "Load into device" -> "Hardware configuration."

6.3.3 Executing a preset (Telegram 81-84 + 59000)

First set whether the preset should also act on G1_XIST1. For the following explanations it is assumed that telegram 81 is used and that the input data (from the view of the controller) are present at input addresses 0…11 and the output data at output addresses 0…3. In this case the following data contents exist:

Data	Type		Address	Addressing
STW2_ENC	W	Encoder control word	Q0..Q1	QW0
G1_STW	W	Axis control word	Q2..Q3	QW2
ZSW2_ENC	W	Status word of the encoder	I0..I1	IW0
G1_ZSW	W	Status word of the axis	I2..I3	IW2
G1_XIST1	DW	Processdata	I4..I7	ID4
G1_XIST2	DW	Processdata or error register	I8..I11	ID8

Table 6.1: Data content for Example

Set the encoder to normal, controlled operation during start-up or manually via an observation table. To do this, set STW2_ENC bit 10 "Control by PLC" to TRUE.

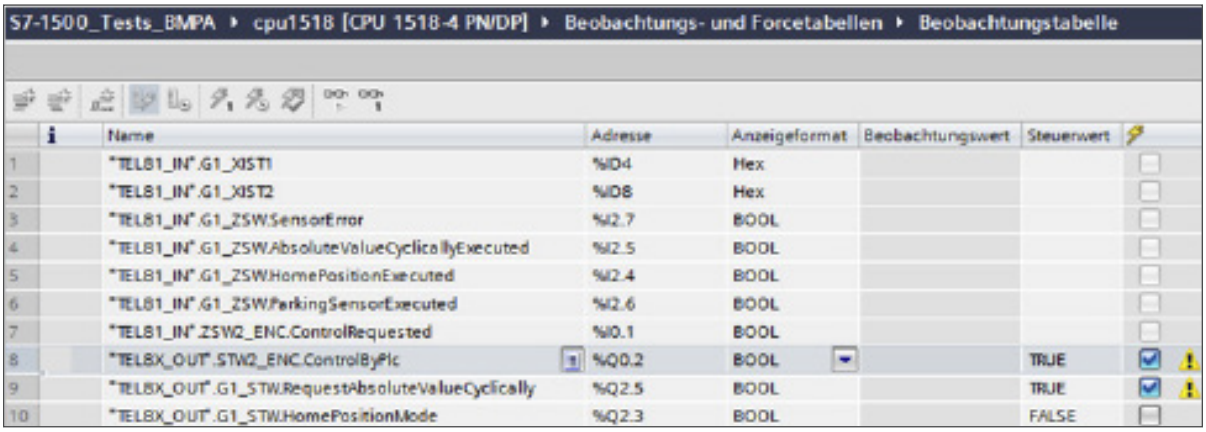


Figure 6.26: Set STW2_ENC bit 10 to TRUE

If successful, the encoder sets the flag ZSW2_ENC Bit 9 "Control requested." Then set G1_STW bit 13 "Request absolute value cyclically" to TRUE.

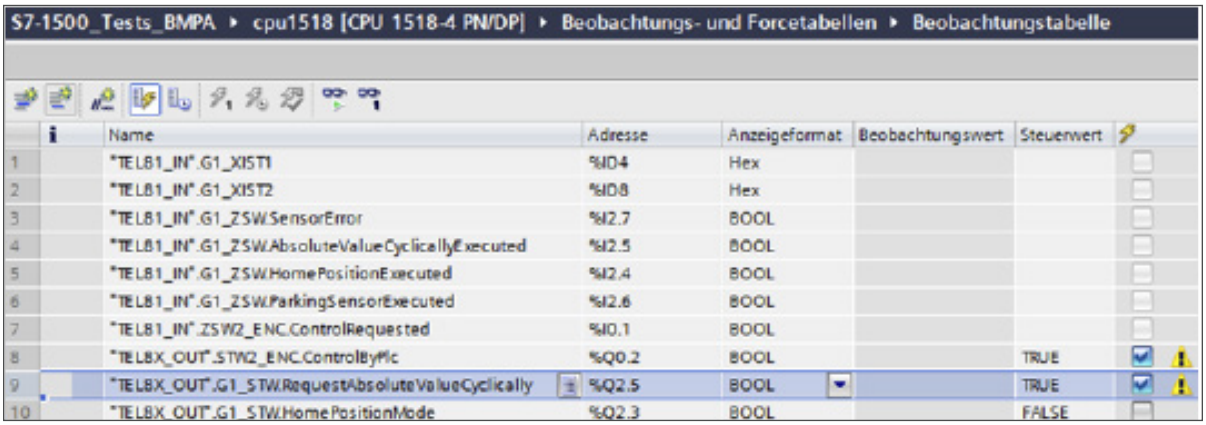


Figure 6.27: Set G1_STW bit 13 to TRUE

If successful, the encoder sets the flag G1_ZSW Bit 13 "Transmit absolute value cyclically" and G1_XIST2 contains the same value as G1_XIST1.

Finally, you can select the preset mode via G1_STW Bit 11 "Home position mode" (default 0 = absolute, 1 = relative).

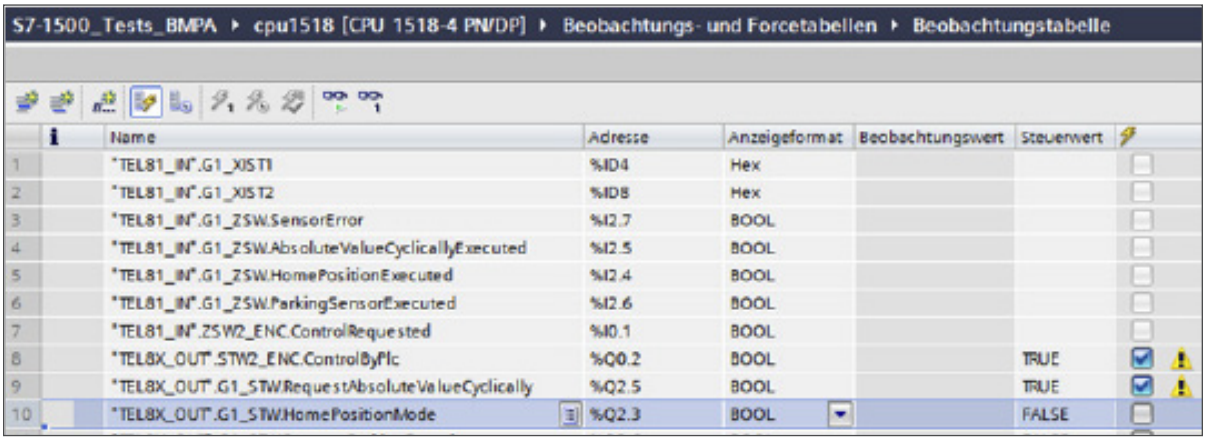


Figure 6.28: G1_STW Bit 11 default 0 = absolute

The preset to the predefined preset value (0 by default, adjustable via PNU 65000 or PNU 65002) can now be executed with a pulse to G1_STW Bit 12 "Request of home position" (set and reset).

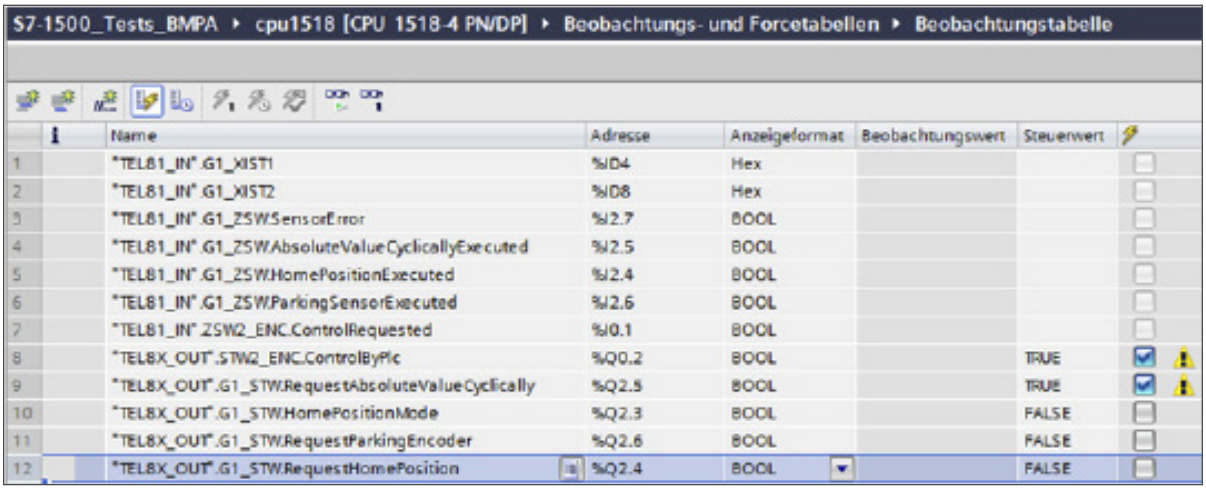


Figure 6.29: Set and reset G1_STW Bit 12

G1_XIST2 then contains the predefined preset value. If "Preset affects G1_XIST1," this also applies to G1_XIST1.

- When the preset is executed, an offset value is calculated and stored in the rotary encoder. This value is loaded with each reset so that this setting is retained even after a reset. The offset value is reset as soon as the scaling of the encoder changes or another module is selected. This ensures that an offset value is not used that may not match the set scaling.

- The preset is executed by the encoder on a rising edge to G1_STW bit 12; it is confirmed on the following falling edge. Only then the preset can be executed again.

6.3.4 Resetting a preset (Telegram 81-84 + 59000)

To undo or reset the preset, simply set the preset with the preset value 0 and G1_STW bit 11 “Home position mode” to 1 = relative. This sets the internal offset value to 0.

6.3.5 Executing a preset (Telegram 86-89)

Telegram 86 + 87 Preset

Preset is triggered by the PresetTrigger Bit (Bit 31) in G1_XIST_PRESET_B. Preset Value is taken from G1_XIST_PRESET_B (Bits 30-0). Preset always has effect on G1_XIST1.

Telegram 88 Preset

Preset is triggered by the PresetTrigger Bit (Bit 63) in G1_XIST_PRESET_C. Preset Value is taken from G1_XIST_PRESET_C (Bits 62-0). Preset always has effect on G1_XIST3.

Telegram 89 Preset

Preset is triggered by the PresetTrigger Bit (Bit 0) STW2_ENC. Preset Value is taken from G1_XIST_PRESET_B1. Preset always has effect on G1_XIST1. Preset execution is signaled in the Preset Acknowledge Bit in ZSW2_ENC.

6.4 Integration into a Step 7 project

Connect the encoder to your controller.

Connect the encoder's power supply.

To integrate the encoder into your SIMATIC Manager project, double-click the "Hardware" button to start the hardware configuration tool (see Figure 6.30).

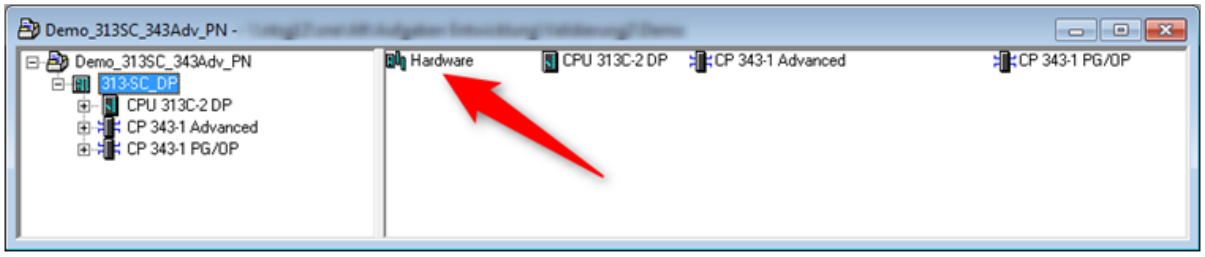


Figure 6.30: SIMATIC Manager

Next, install the GSDML file. You can download this from encoder.com. To do so, open the "Extras" tab and select "Install GSD file" (see Figure 6.31).

- The corresponding .bmp file must be located in the same directory as the GSDML file during installation and is included in the download.

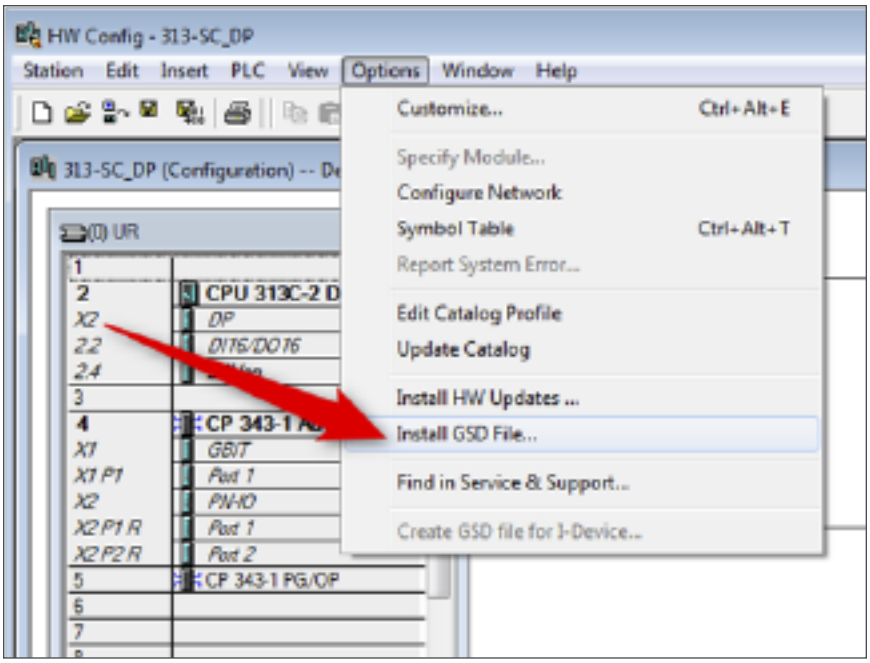


Figure 6.31: Installing the GSDML file

Now select the path for the GSDML file, select the desired GSDML file and confirm the installation via the "Install" button. Then close the installation window.

Add the encoder to your hardware configuration. To do so, open the following path at the right edge of the screen (see Figure 6.34): "PROFINET IO/Additional Field Devices/Encoders/Encoders Product Company/Absolute Encoder/EPC Encoder."

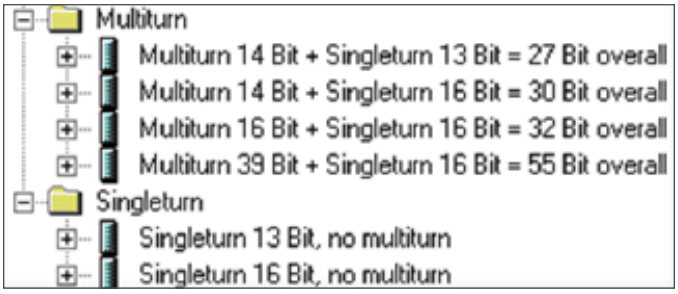


Figure 6.32: Hardware catalog

Now "drag" the encoder onto the "PROFINET IO system." The encoder is then displayed in the hardware view (see Figure 6.33). Enter a meaningful device name for the configured encoder by double-clicking the encoder symbol.

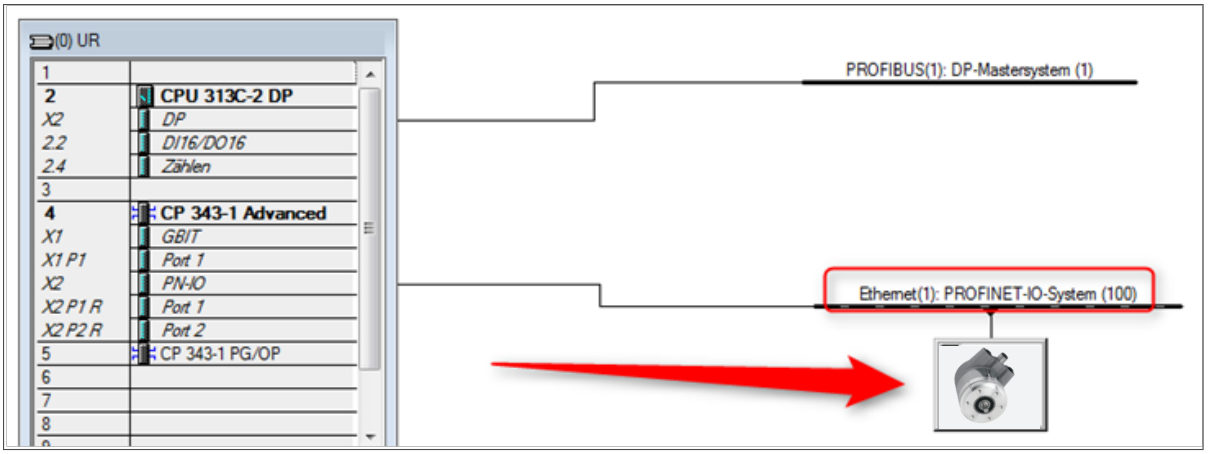


Figure 6.33: Hardware view

Now select the encoder's "Properties." To do this, single-click on the encoder (see Figure 6.34) and drag the desired properties via drag-and-drop from the hardware catalog to "Slot 1," which is now highlighted green, (see Figure 6.35). Select the desired telegram for communication. The various telegrams can be found in the "Profiles" sub-menu. Drag the telegram to slot 1.2 (see Figure 6.36).

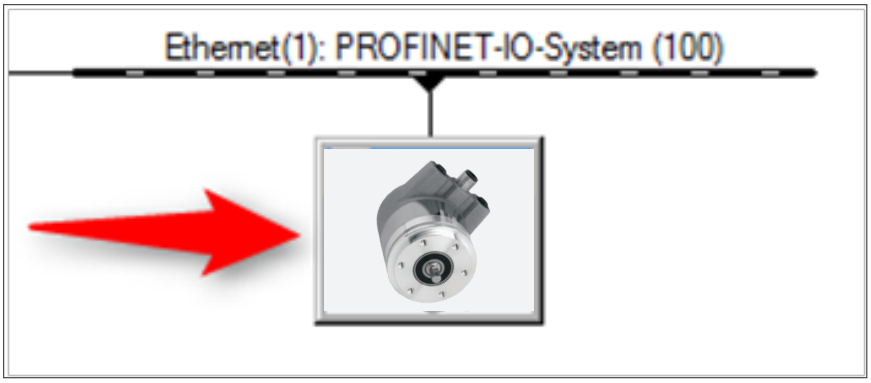


Figure 6.34: Select via single mouse click

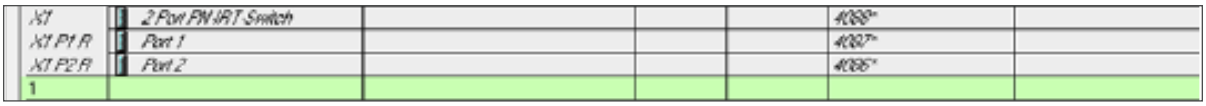


Figure 6.35: Slot 1, highlighted green

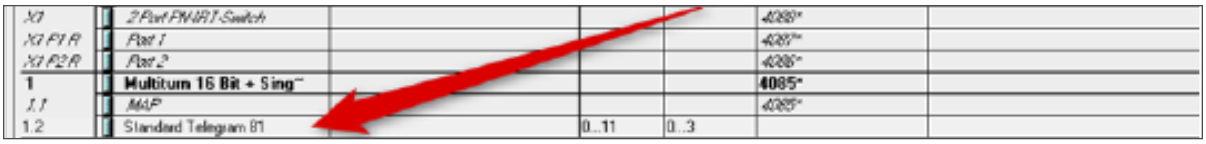


Figure 6.36: Slot 1.2 with inserted telegram 81

You can also set the corresponding I/O addresses. To do so, double-click on the respective field (see Figure 6.37) and change the addresses in the "Addresses" tab (see Figure 6.38).

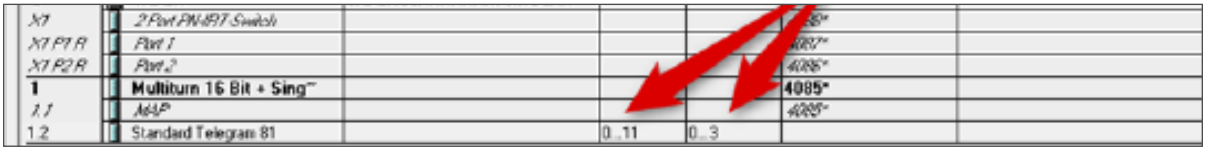


Figure 6.37: Change the I/O addresses

Figure 6.38: "Addresses" tab

Save the configuration by clicking the "Save and transmit" button and load it into your PLC ("Download to module").

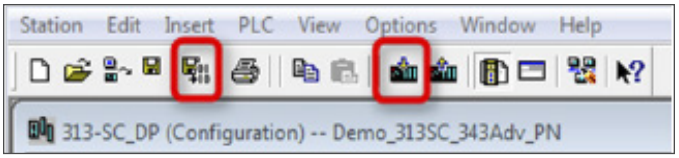


Figure 6.39: Save and transmit – Download to module

You can use a variable table to display the encoder's I/O data for test purposes (see Figure 6.40 and Figure 6.41).

Figure 6.40: Variable table

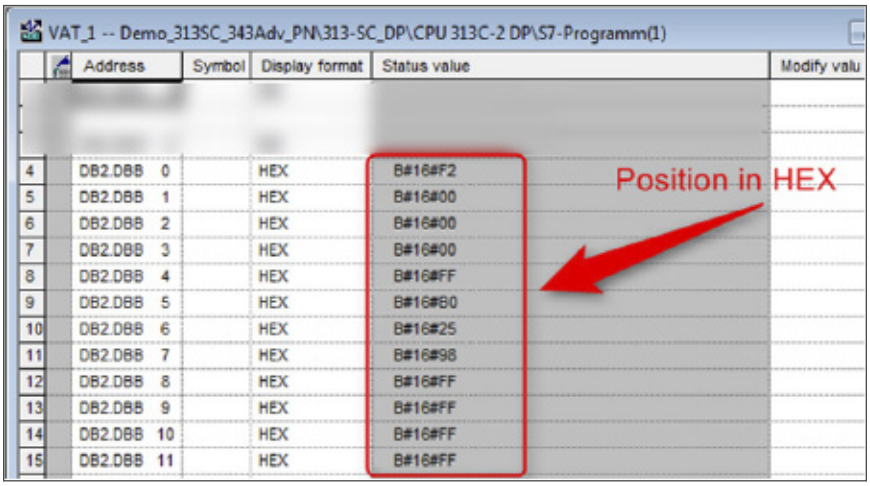


Figure 6.41: HEX position value

7. Technical Data

7.1 Properties

Interfaces	**2x M12 ports 4-pole D-coded**	
	1x M12 connector 4-pole A-coded	
PROFINET data rate	Max. 100 Base-TX	
Diagnostic LEDs	Data traffic and connection monitoring:	L/A1: Port 1, L/A2: Port 2
Status LEDs	Status display for encoder and bus	STAT, MOD
Operating temperature	-40°C to 85°C	
Storage temperature	-40°C to 125 °C	
Operating voltage	10 VDC to 32 VDC	
Current consumption	typ. 125 mA	
Power consumption	typ. 3 W	
Weight	Model A58SE	approx. 700 g
	Model A58HE	approx. 410 g
Housing	Flange material:	Aluminum
	Flange material (rear):	Steel housing, chromium-plated, magnetically shielded
	Connection hood:	Die-cast aluminum, powder-coated

7.2 Dimensions

For product dimensions, please see the appropriate product drawings at encoder.co.uk.

8. Technical support

Do you have any questions about this product? Our technical application support engineers will be happy to help you.

Phone: +44(0)1978 262100
Fax: +44(0)1978 262101
Email: sales@encoder.co.uk