Manual

Sendix 5858/5878 absolute singleturn
Sendix 5868/5888 absolute multiturn

For order code 8.58X8.XXCX.C2XX
as from firmware version 3.0

Manual

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1. General

Absolute encoder
The absolute encoder "Sendix 58xx PNIO" is intended for the acquisition of rotary movements of any kind. The acquired measuring values are transmitted via a Profinet interface (PN IO device).

The "Profinet" interface standard is considered as the successor of "Profibus" and is maintained by the "PROFIBUS Nutzerorganisation e.V. (PNO)" (PROFIBUS Users Organization). The PNO website www.profibus.com offers various information about the Profinet standard (e.g. introduction videos, standards, device profiles). The Kübler "Sendix 58xx PNIO" encoder passed successfully the Profinet conformity test defined by the PNO. The test report (by COMDEC, Siemens AG) and the corresponding certificate issued by the PNO are available for viewing on our Internet website www.kuebler.com.

The mechanical link with the object to be measured is achieved via a solid shaft/a hollow shaft. The shaft position (rotation angle) is acquired as a 16-bit value (=> singleturn resolution = 65536 positions). The multiturn version includes an additional revolution counter (12 bits) (=> multiturn resolution = 4096 revolutions).

Depending on configuration and parameterizing, the count direction (clockwise/counterclockwise), the required output resolution and the unit of the calculated rotational speed can be selected. The Preset function allows setting the current position as a reference point (e.g. zero point).

The cyclic input/output data can be arranged/formatted either in a manufacturer-defined format ("ManTel860") or in a standardized format ("StdTel81" acc. to encoder profile V4.1, with/without extensions).

The acyclic communication (e.g. parameterizing) takes place in compliance with the definitions in encoder profile V4.1 and in Profidrive profile V4.1.

Physically, the Profinet interface has 2 ports, allowing both star and line/ring structures without additional hardware (switches).

This manual refers to the encoder firmware V3.0.x and to GSDML file "GSDML-V2.32-KUEBLER-0198-Sendix58xxPNIO-20160217.xml".
The GSDML file (and the corresponding .bmp file) can be downloaded from www.kuebler.com.

The hardware configuration tool (e.g. SIMATIC STEP7 or TIA PORTAL) must support at least the GSDML scheme V2.2!
The minimum permissible STEP7 version is V5.4+SP4+HF1 (revision level K5.4.4.1)!

The Profinet configuration is represented in this manual as an example with the Siemens software "STEP7, V5.5" and "TIA Portal, V11". When using another software/version, proceed accordingly. In case of doubt, consult the documentation of the configuration software you use!

PROFINET
PROFINET – is an industrial Ethernet standard that connects the standard Ethernet of the office world with plant automation.
As an alternative for PROFIBUS, PROFINET offers in addition comfortable diagnostic tools and is based on established transmission standards such as UDP and IP.
Device profiles are used by means of GSDML files in the description language XML.
PROFINET offers transmissions adjustable according to the application.

- **PROFINET NRT** (non real time):
  For non- time-critical automation applications with clock rates of about 100 ms.

- **PROFINET RT** (real time):
  Offers cyclic data exchange with optimized performance with 10 ms clock rate.

- **PROFINET IRT** (isochronous real time):
  Supports cyclic data exchange at 1 ms and a jitter lower than 1 µs.

When designing a PROFINET network, basing on the MAC address of a PROFINET node, the latter is assigned a unique unambiguous name, the so-called "name baptism".
Based in this name, the controller can then assign the node an IP address via which a node can be addressed.
Data can be transmitted cyclically (process data) and acyclically (parameter data) between the controller and the node.
Acyclic parameter data can be transmitted during startup, but also during operation.

2. Technical data

2.1 Mechanics

Shock resistance acc. to EN 60068-2-27	2500 m/s², 6 ms for singleturn 2000 m/s², 6 ms for multiturn
Vibration resistance acc. to EN 60068-2-6	100 m/s², 10 … 2000 Hz
Working temperature range	-40…+85°C

2.2 Supply voltage and current consumption

10…30 VDC
200 mA at 10 VDC
80 mA at 24 VDC
60 mA at 30 VDC

2.3 Hardware characteristics

PROFINET IO ASIC: ERTEC 200
Auto-Negotiation
Auto-Polarity
Auto-Crossover
Function display and diagnostics by means of LEDs

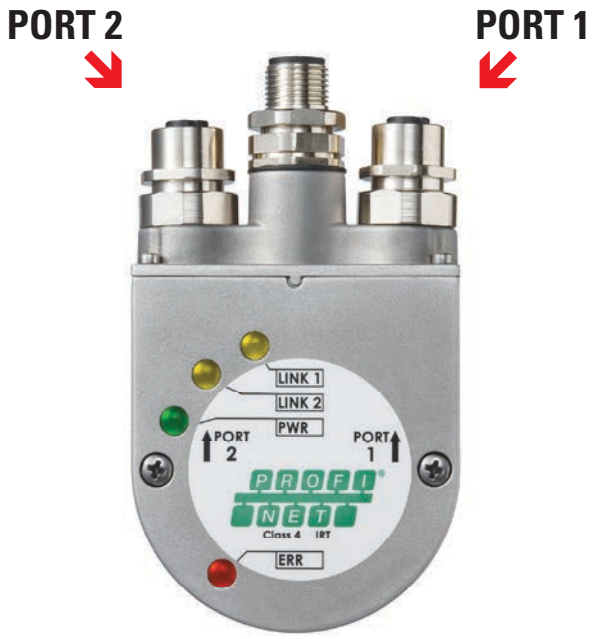
2.4 Supported standards

Profinet
RT_CLASS_1, RT_CLASS_2, RT_CLASS_3 (IRT), DCP, RTA, LLDP, SNMP, MIB-II, LLDP-MIB, PTCP, MRP, FSU, Conformance Class C, NetloadClass III, IM0 readable, IM1…4 readable/writeable, MinDeviceInterval=1ms
Encoder profile V4.1 and Profidrive profile V4.1

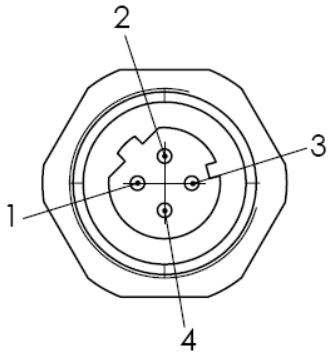
Conformity
EN 61000-4-2 :2001
EN 61000-4-3 :2006
EN 61000-4-4 :2005
EN 61000-4-5 :2007
EN 61000-4-6 :2008
EN 61000-4-7 :2004
EN 61000-6-4 :2007
EN 61000-6-2 :2006

3. Terminal assignment

3.1 Profinet data ports



The two external encoder connectors "PORT 1" and "PORT 2" serve for the Profinet communication (the encoder is here a Profinet device). One of the two ports is sufficient for a star structure. Both ports are required for a line or ring structure. In principle, the data ports are equivalent and can be chosen freely. However, when a determined topology has been defined for the hardware configuration (e.g. for LLDP, IRT, MRP), they shall not be interchanged any more!



D-coded female M12 encoder connector (view towards the encoder)

Signal name of an M12 D-coded female connector	Function	Strand color	Pin number
TD+	Transmit data +	Yellow	1
TD-	Transmit data -	Orange	3
RD+	Receive data +	White	2
RD-	Receive data -	Blue	4

Signal assignment of an RJ45 to M12 cable
M12 to RJ45 direct

Signal	M12 pin number	RJ45 pin number
TD+	1	1
TD-	3	2
RD+	2	3
RD-	4	6

M12 to RJ45 crossover

Signal	M12 pin number	RJ45 pin number
TD+	1	3
TD-	3	6
RD+	2	1
RD-	4	2

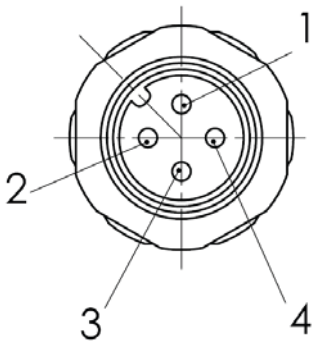
Recommended Profinet network cable (CAT5, shielded)
Siemens Industrial Ethernet FC TP flexible cable
GP 2x2 (PROFINET Type B), Twisted Pair Installation
Order code 6XV1870-2B

Recommended RJ45 connector
Siemens IE FC RJ45
Order code 6GK1901-1BB10-2AA0

Note:
Make sure that the single segments do in no case exceed 100 m. For cable lengths exceeding 100 m switches (Profinet-suitable) must be connected in between!

3.2 Voltage supply

The central encoder connector serves for the power supply.

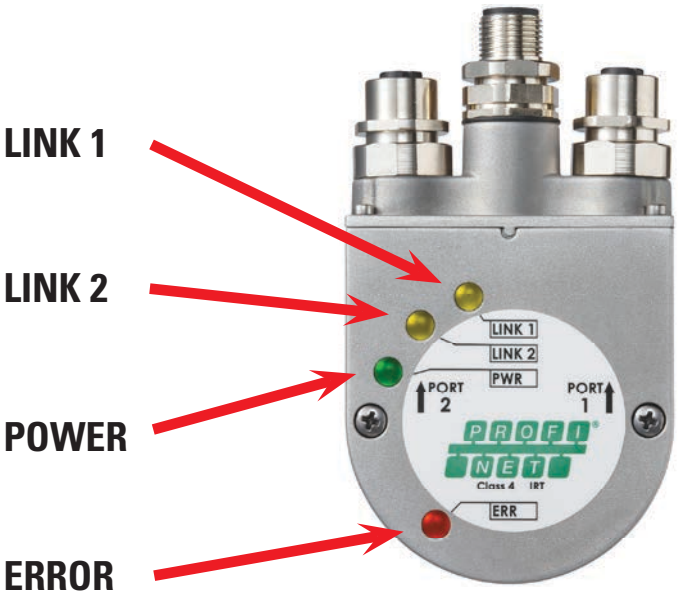


A-coded male M12 encoder connector (view towards the encoder)

Signal at the M12 connector A coded	Function	Pin number
PWR	Power supply +10…30 V DC	1
Reserve	Do not connect!	2
GND	Ground	3
Reserve	Do not connect!	4

Hint: Further information about Profinet wiring can be found in PNO document 2252 "PROFINET Cabling and Interconnection Technology", which can be downloaded from the Internet site www.profibus.com.

4. Status LEDs



4.1 LINK1 / LINK2 (green/yellow) Serve respectively for data ports 1 and 2:

LED status	Meaning
Green ●	Physical data connection (LINK) present
Green + Yellow (flickering) ●●	Data transmission active (ACTIVITY)

4.2 POWER (green)

LED status	Meaning
On ●	Normal case (power supply present)
Flashing ✳	Click on button "Flashing on“ (for device identification) in the HW configuration tool (e.g. in the dialog "PLC/Ethernet/Assign device name…)

4.3 ERROR (red)

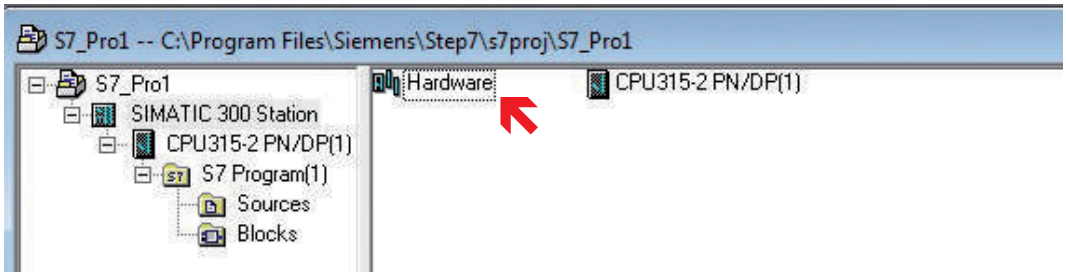
LED status	Meaning
On ●	No Profinet link established *-> Check wiring!* *-> Switch PN controller (PLC) on!* *-> Set device name as in "Hardware configuration"!* *-> Check "Hardware configuration"!*
Off ○	Profinet link properly established (this may require up to 10 seconds)

Flashing 0.5 Hz	Profinet link established, but the "User parameter data" is missing (BF00 telegram) *-> Use the good GSD file!* *-> "Insert" module in slot 1!*
Flashing 1 Hz	Internal memory error (FLASH or RAM) *-> Send device back for repair!*
Flashing 5 Hz	Internal position sensor (ICLG): No valid data available *-> Send device back for repair!*

5. Startup

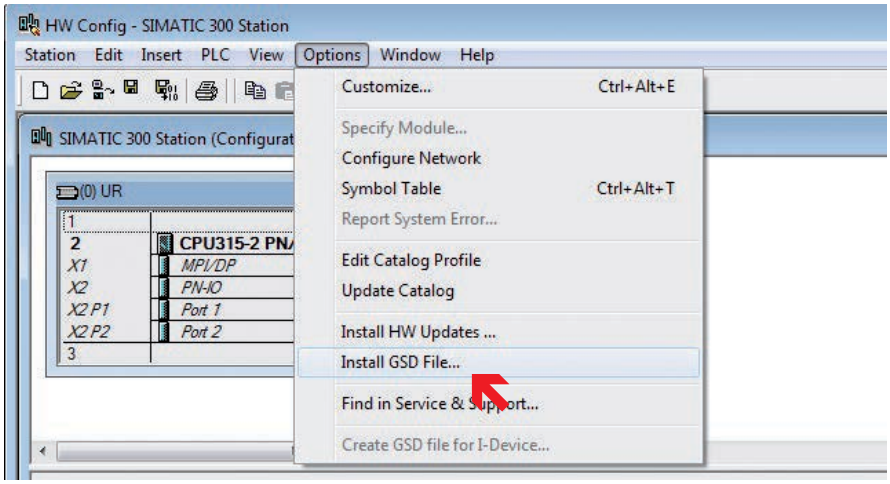
5.1 Example: SIMATIC STEP7

1. Mount the encoder in the system to be measured.
2. Establish the Profinet data link (see chapter "Terminal assignment").
3. Power the device (see chapter "Terminal assignment").
4. In the SIMATIC Manager, open your project (integrating the CPU or PN controller) and start configuration tool "HW Config": Double-click on "Hardware"!

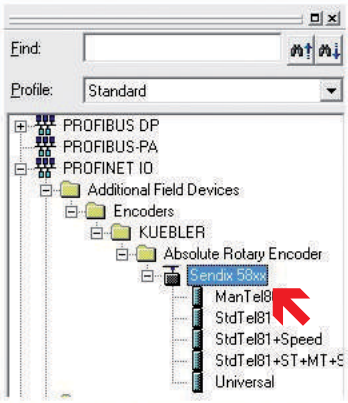


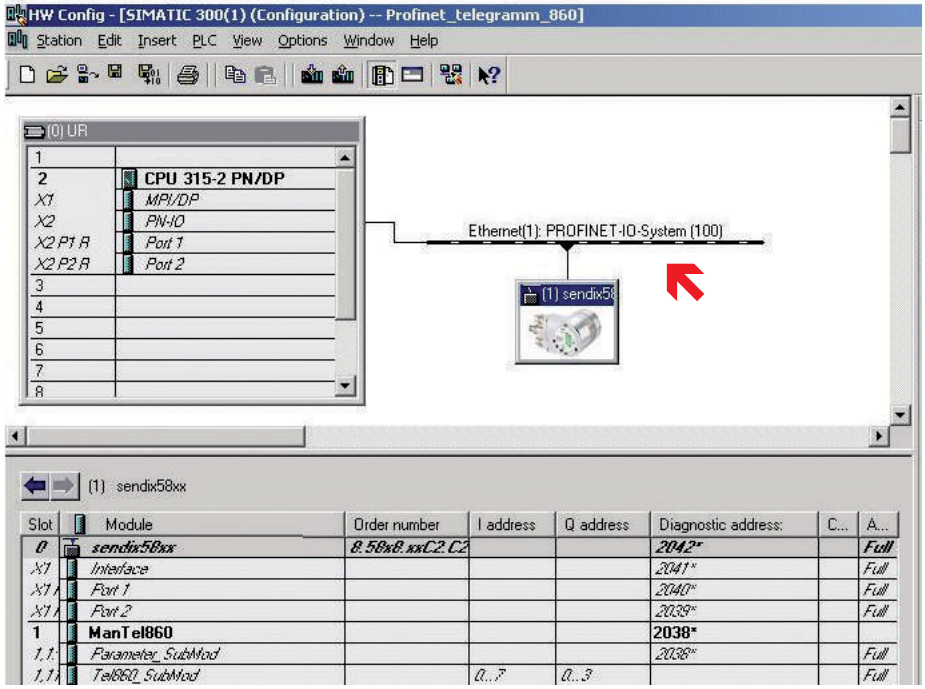
5. Install the up-to-date GSD file (see chapter "General information").

Caution:
During installation, the corresponding .bmp file must be in the same folder as the .xml file!

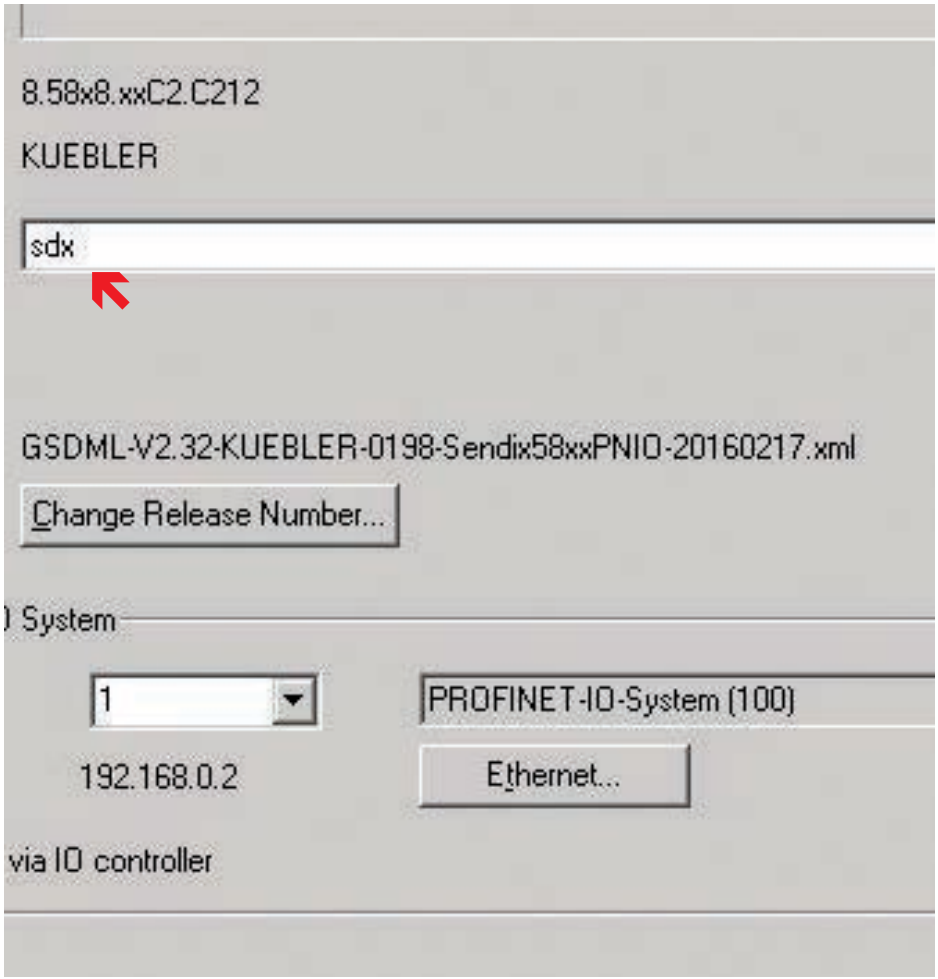


6. In the Hardware catalog, click on "PROFINET IO/Additional Field Devices/Encoders/KUEBLER/Absolute rotary encoder/Sendix 58xx and "drag" it with the mouse cursor on "PROFINET-IO-System". This creates a "sendix58xx" object, which represents our encoder.



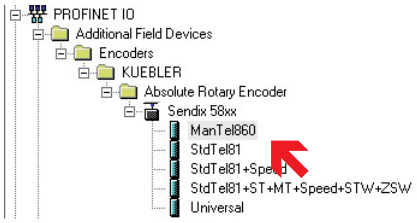


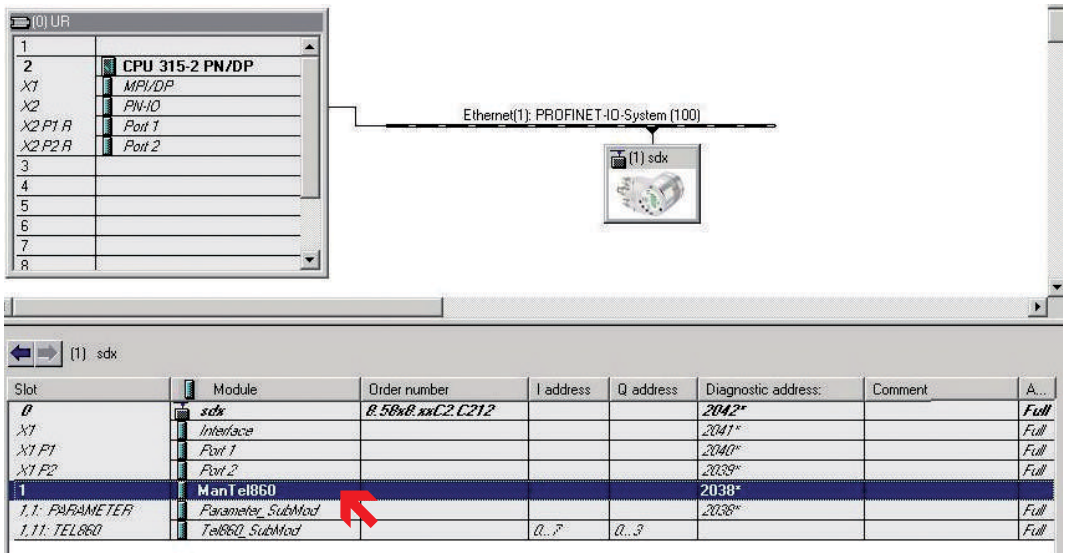
7. Double-click on this object, define a meaningful device name and confirm with "OK" (generally, the other settings require no change).



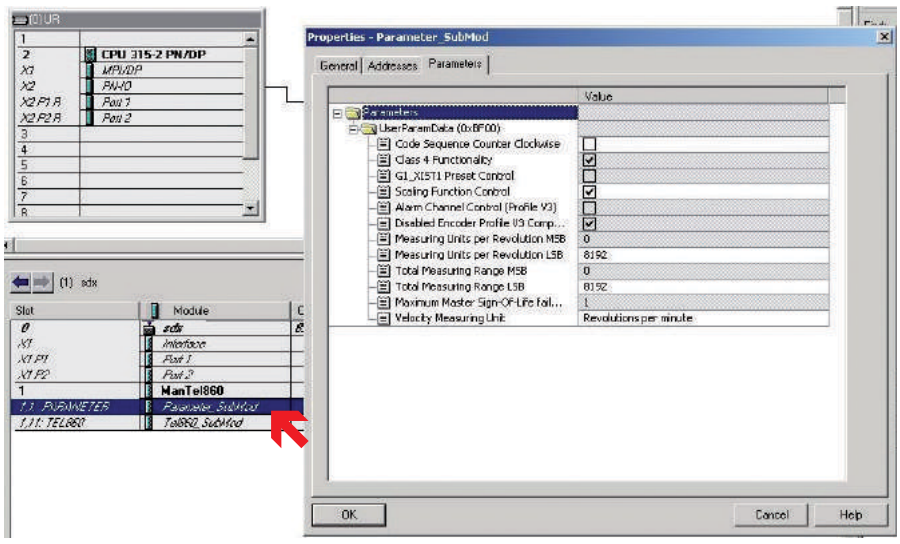
8. Mark our encoder object (single mouse click) and, according to the required "Input/output data format" (see corresponding chapter), draw one of modules "ManTel860", "StdTel81…" or "Universal" from the catalog to "Slot1".

   Example: Module "ManTel860“ (recommended because of its simple handling)

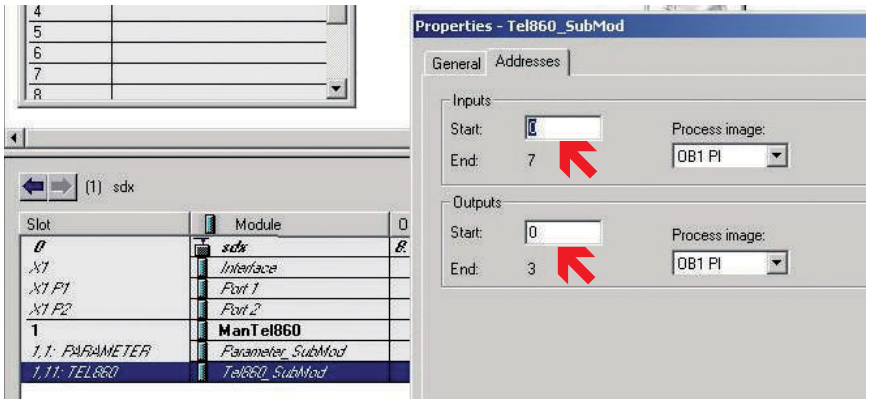




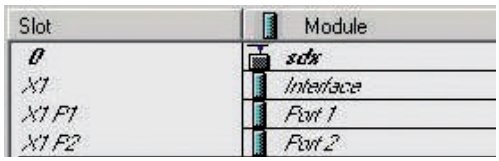
9. Double-click on sub-slot "1,1 = Parameter_SubMod", select register card Parameter, set the encoder parameters as required (see corresponding chapter) and confirm with "OK". For the first test, you can leave the standard settings (= Singleturn mode with MUR=TMR=8192) unchanged.



10. If necessary, adapt the I/O addresses for the cyclic data exchange as required.

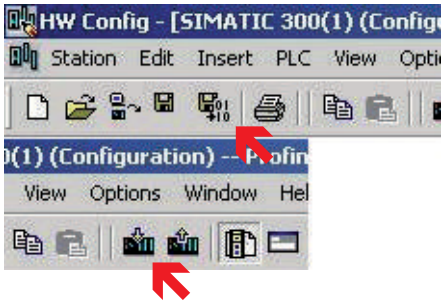


11. As an option, you also can carry out settings under Slot "0" ("X1= Interface“, "X1 P1 = Port 1“ and "X1 P2 = Port 2“).

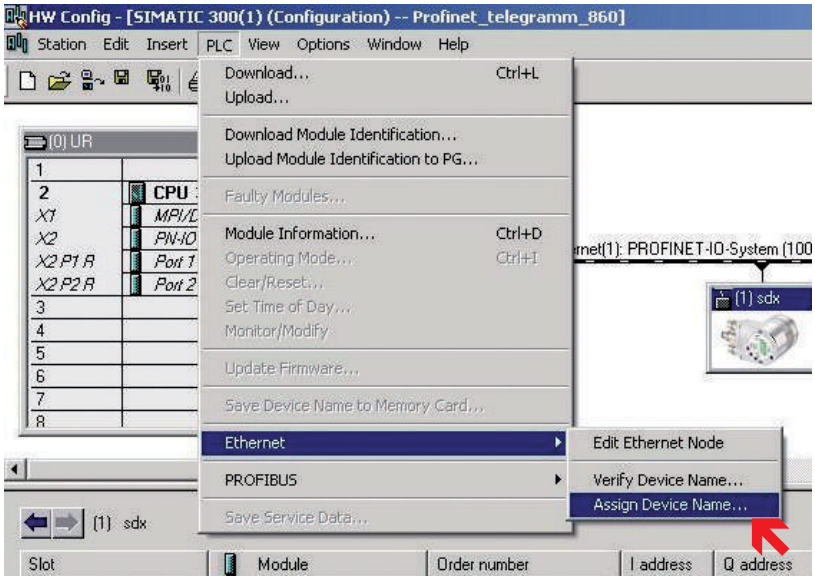


For a first startup, the standard settings are generally sufficient. The settings can be optimized later (e.g. for IRT or MRP operation). Further information about the different settings can be found with the "Help“ button of the Properties dialog window.

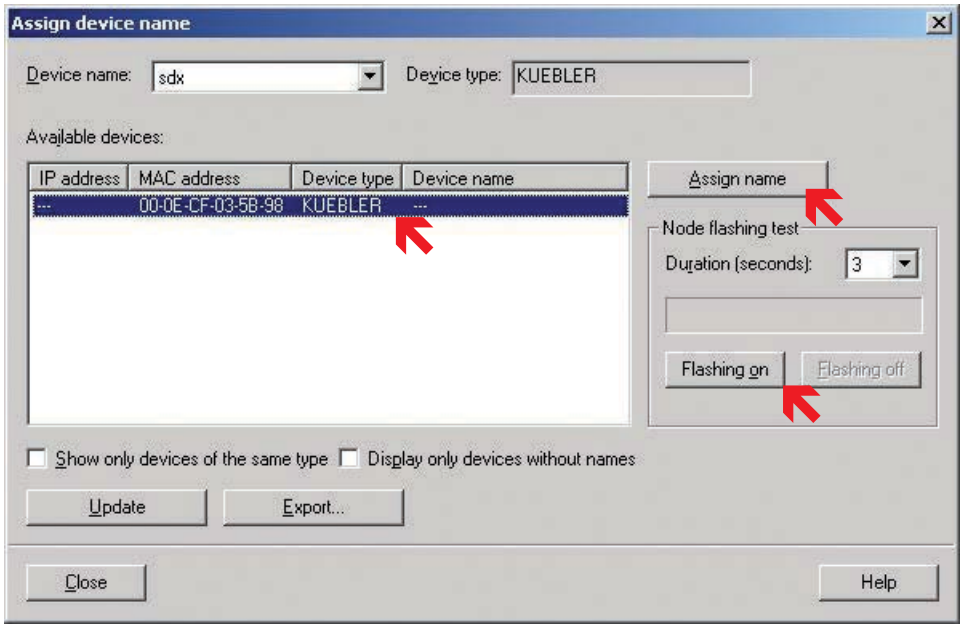
12. Finally, "save and translate" the configuration and load it in the PN controller (PLC) ("Load“).



13. Set the Profinet device name of the encoder according to the setting in the configuration:
    to that purpose, select the encoder (single mouse click) and select menu item "PLC/Ethernet/Assign device name…“ .

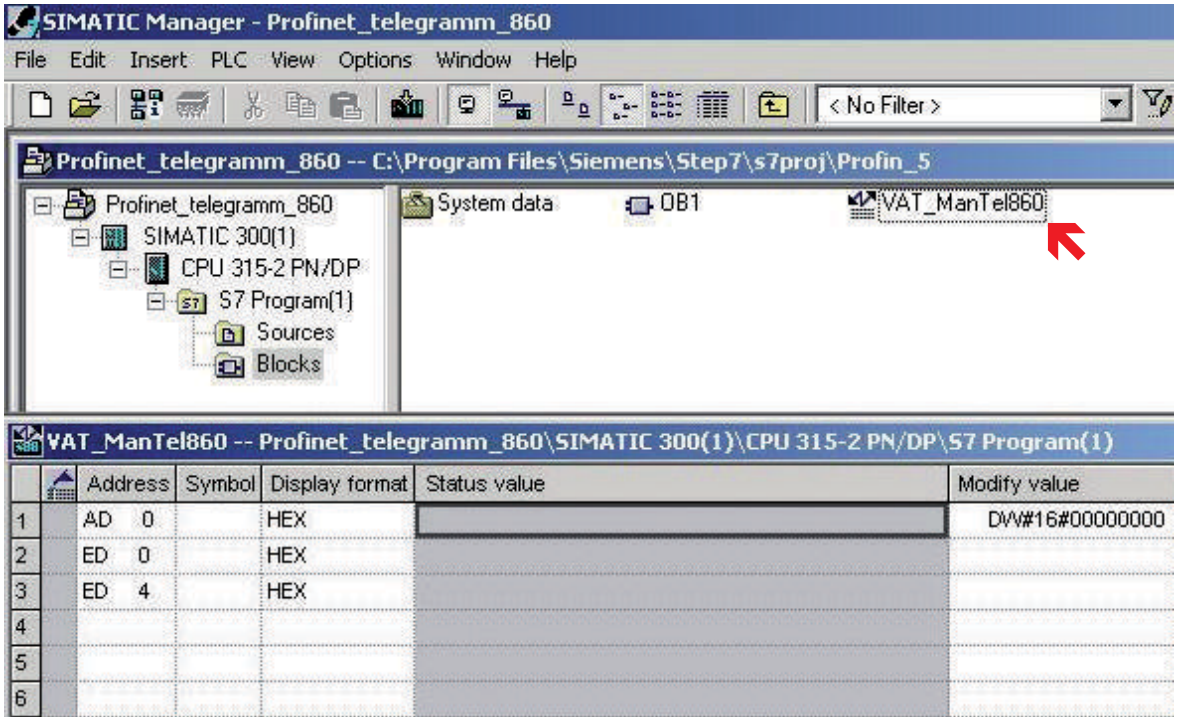


Now, in the displayed list, mark the line with device type "KUEBLER", the file name is still missing. Click on "Flashing on“ and make sure that the green PWR LED is flashing in the encoder. Finally, click on "Assign name".



14. Wait until the PN controller (PLC) has established the connection with the encoder
    (=> red ERR-LED OFF in the encoder).

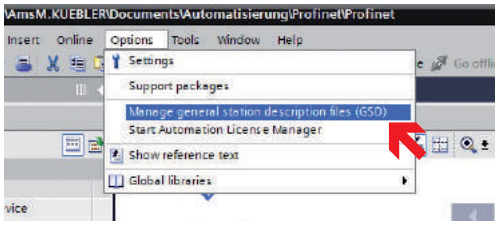
15. For test purposes, you can read or set the I/O data e.g. using a "variables table". Example:



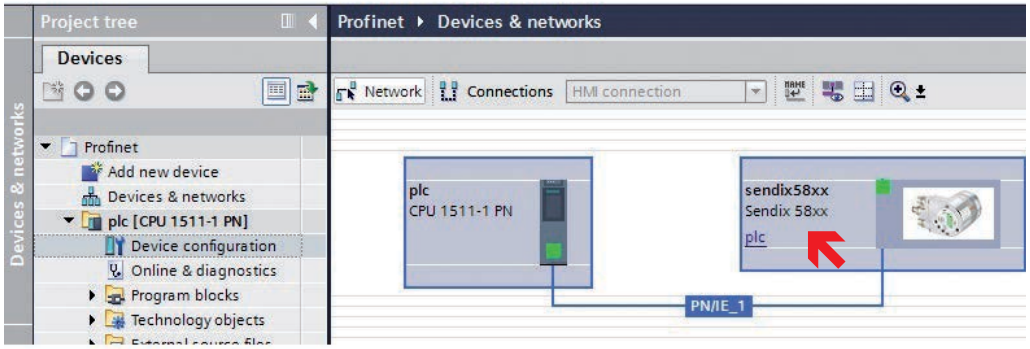
5.2 Example: SIMATIC TIA Portal

1. Mount the encoder in the system to be measured.
2. Establish the Profinet data link (see chapter "Terminal assignment").
3. Power the device (see chapter "Terminal assignment").
4. Start the SIMATIC TIA Portal and open your project (with integrated CPU or PN controller). Select "Project view".
5. Install the up-to-date GSD file (see chapter "General information").

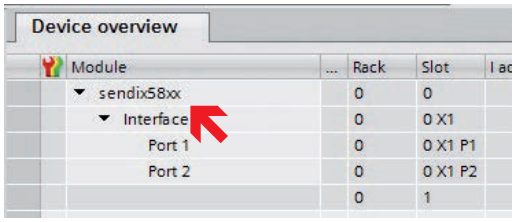
Caution:
During installation, the corresponding .bmp file must be in the same folder as the .xml file!



6. Double-click on "Project tree/Project…/Devices & Networks“ to call up the "Network view". Then, in the "Hardware catalog“, click on "Other field devices/PROFINET IO/Encoders/Fritz Kuebler GmbH/KUEBLER/Absolute rotary encoders/Sendix 58xx“ and "draw“ it with the mouse cursor in the "Network view". This creates a "sendix58xx" object, which represents our encoder. Finally, "connect" the encoder to your PLC, using "…PROFINET IO.Syste…“).

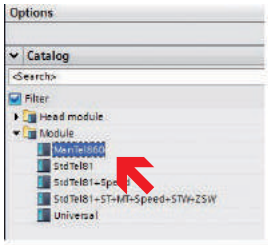


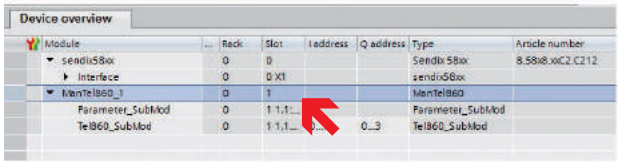
7. Mark our encoder object and click on register card "Device overview“. There, input a meaningful device name



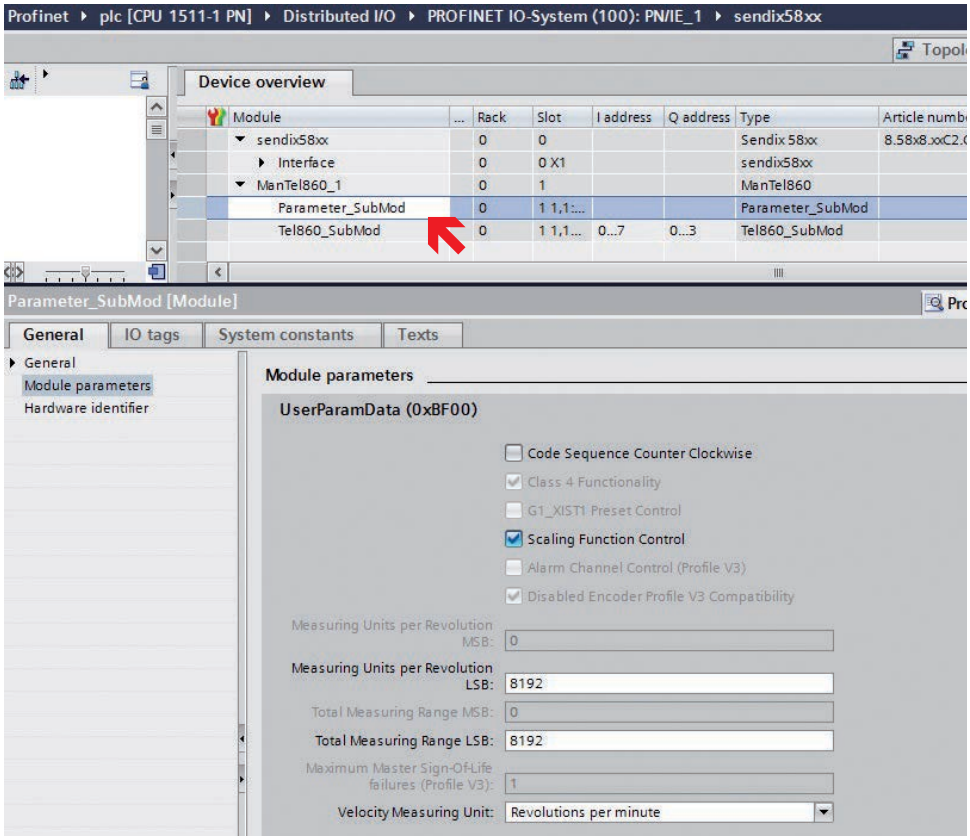
8. According to the required "Input/output data format" (see corresponding chapter), draw one of modules "ManTel860", "Std-Tel81…" or "Universal" from the hardware catalog in the "Device overview"to "Slot 1" of the encoder.

   Example: Module "ManTel860“ (recommended because of its simple handling)

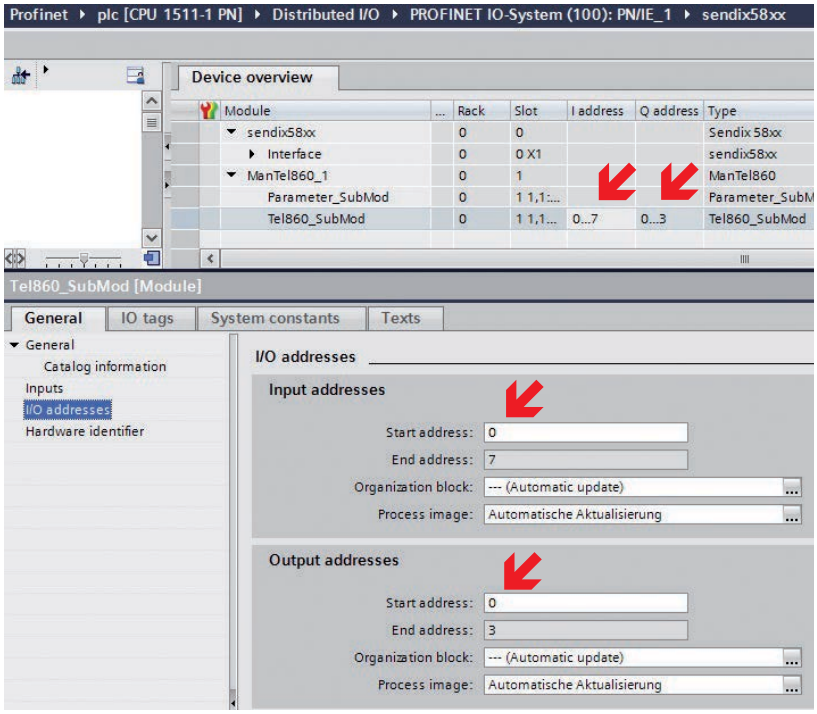




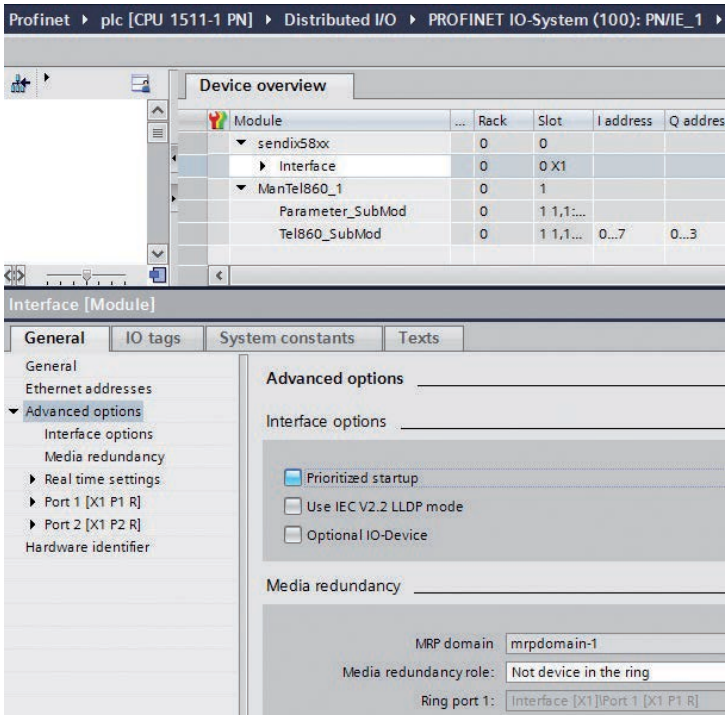
9. Click on Sub-slot "1,1 = Parameter_SubMod“, select item "Module parameters“ in register card "Properties“ and set the encoder parameters as required (see corresponding chapter). For the first test, you can leave the standard settings (= Singleturn mode with MUR=TMR=8192) unchanged.



10. If necessary, adapt the I/O addresses for the cyclic data exchange as required.

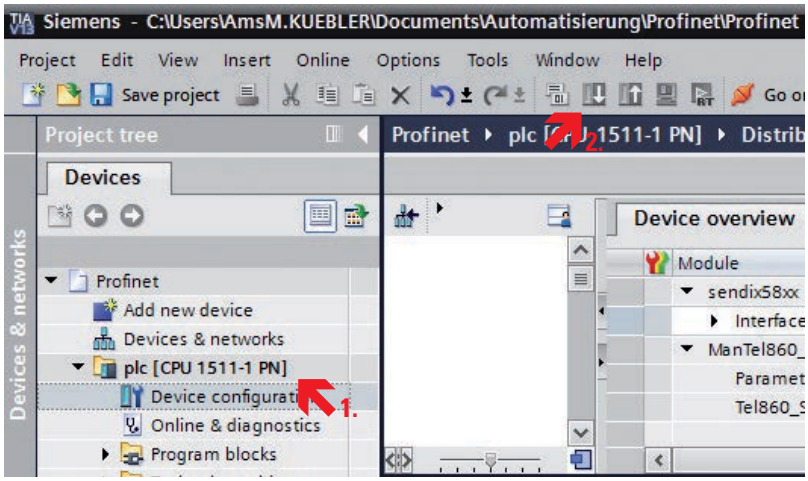


11. As an option, you also can carry out settings under Slot "0" ("X1= Interface", "X1 P1 = Port 1" and "X1 P2 = Port 2").



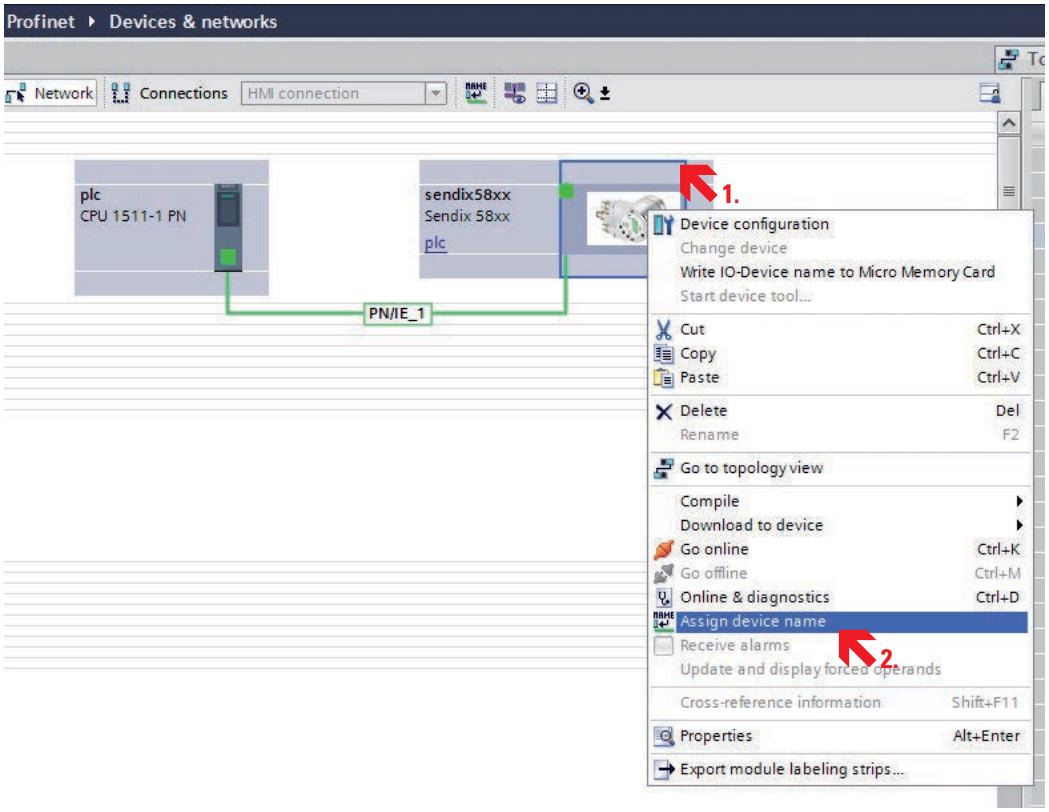
For a first startup, the standard settings are generally sufficient. The settings can be optimized later (e.g. for IRT or MRP operation). Further information about the various settings can be found in the "Tool tips" if you leave the mouse cursor for some seconds on the input fields without moving it.

12. Click on your CPU (e.g. under "Project tree/Devices" and then on symbol "Load in device". This loads the hardware configuration in the PLC.

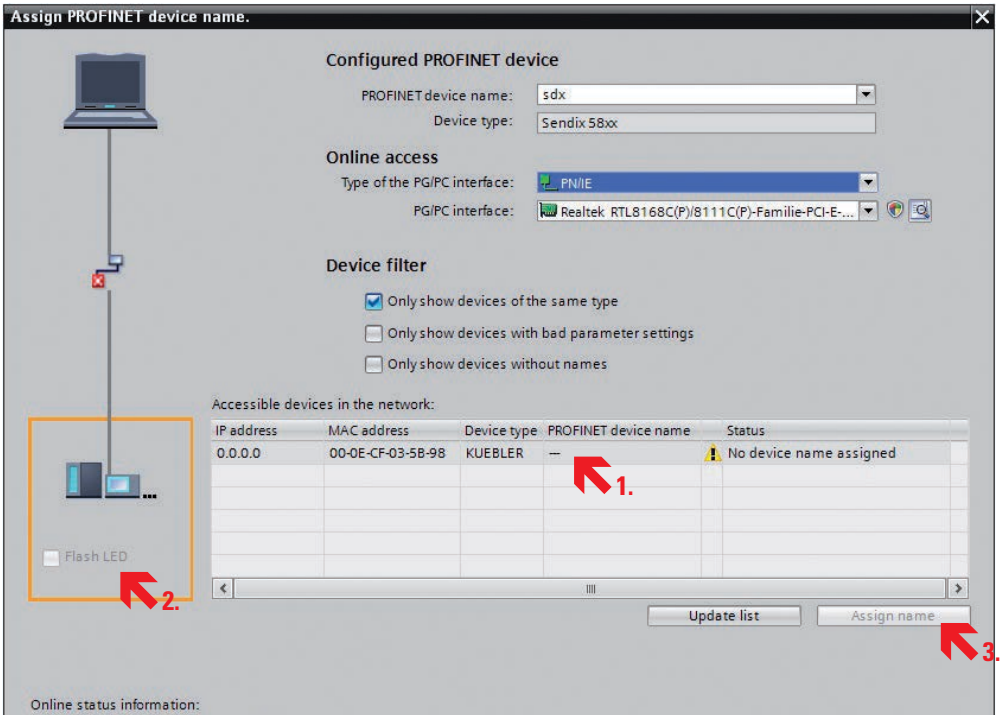


<u>In case of any connection problems:</u> Make sure that the IP address of the CPU set in the device configuration corresponds to the actual IP address (the latter can be found via "Project tree/Online accesses/*Network card*/Update accessible nodes".

13. Set the Profinet device name of the encoder according to the setting in the configuration: To do so, select the encoder (single mouse click on the encoder symbol in the network overview) and select the contextual menu item "Assign device name".

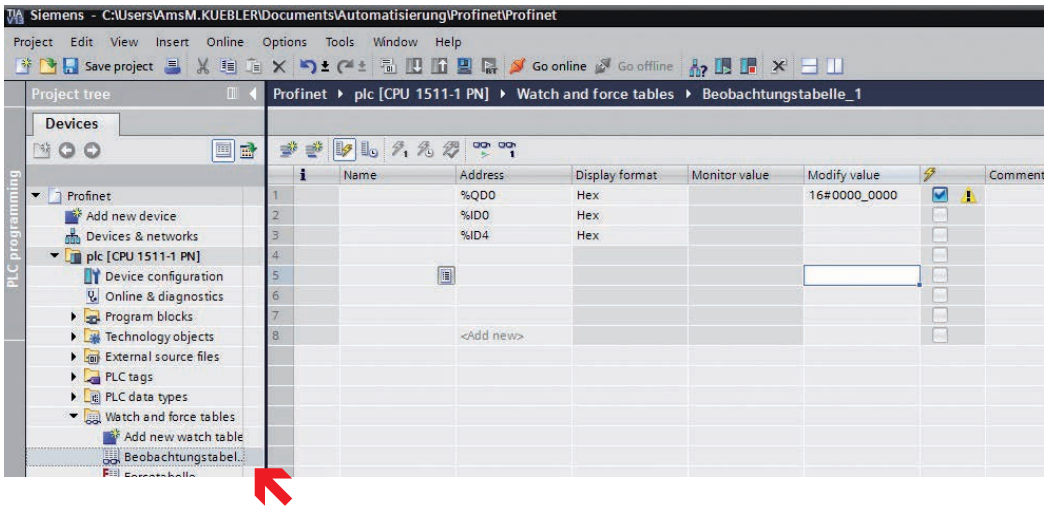


Now, in the displayed list, mark the line with device type "KUEBLER", the file name is still missing. Click on "Flash LED" and make sure that the green PWR LED is flashing in the encoder. Finally, click on "Assign name".



14. Wait until the PN controller (PLC) has established the connection with the encoder (=> red ERR-LED OFF in the encoder).

15. For test purposes, you can read or set the I/O data e.g. using an "observation table". Example:



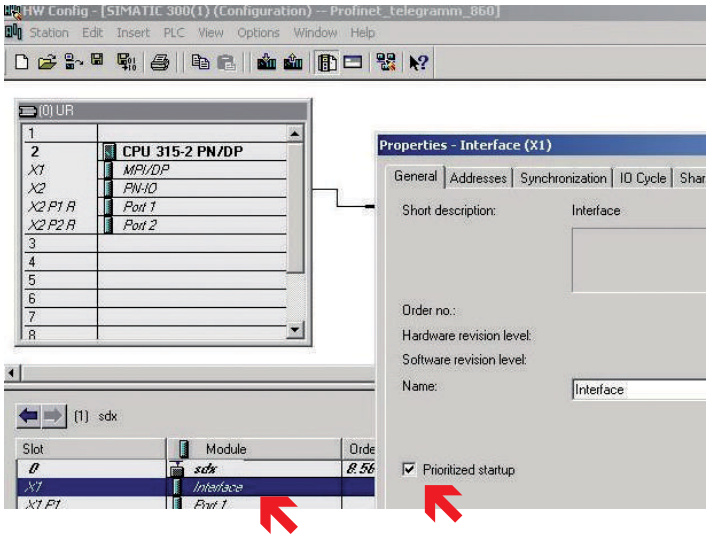
6. Profinet options

6.1 FSU (Fast Startup)

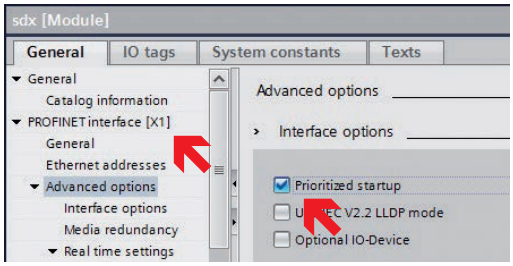
"FSU“ accelerates the set-up of the Profinet connection.

Activation of "FSU“:
For the PN devices, check the interface feature "Prioritized startup“.

Step7:



TIA:

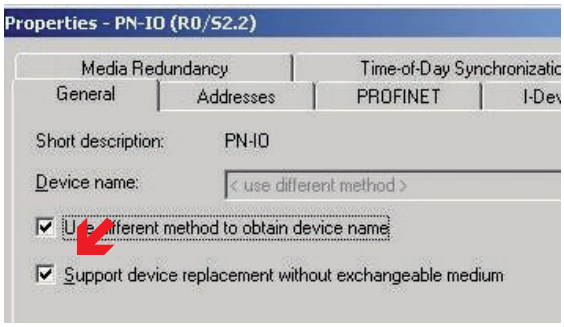


6.2 LLDP (Link Layer Discovery Protocol)

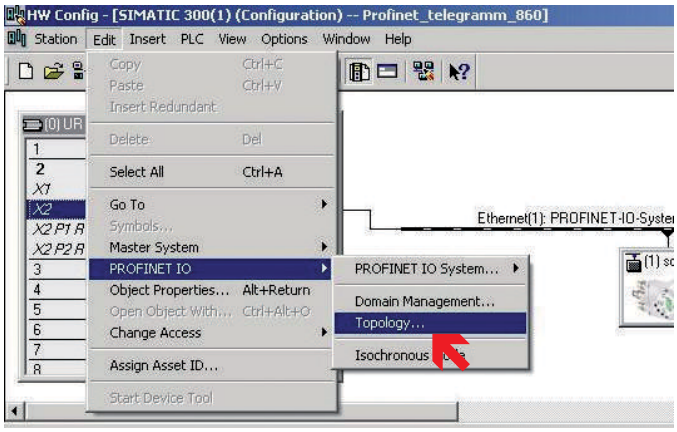
"LLDP" facilitates the replacement of defective devices.

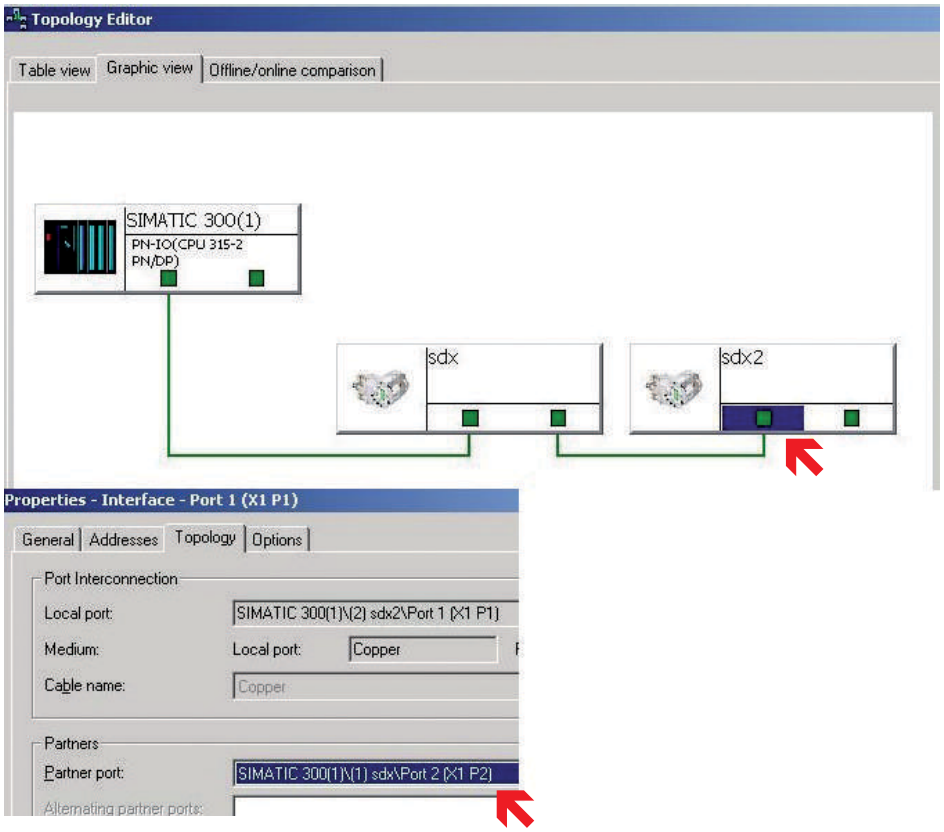
When a defective Profinet participant is replaced with a brand new device, it must first be assigned the suitable "device name". This can be done either manually with the hardware configuration tool ("Assign device name…") or automatically with "LLDP". When starting a PN controller (PLC) with active LLDP and correctly configured topology, all "brand new" **(unnamed)** PN devices are "baptized" automatically.

Activation of "LLDP":
STEP7:
1. Make sure that "Support device replacement without exchangeable medium" is checked in the Properties dialog window of the PN controller interface under "General".



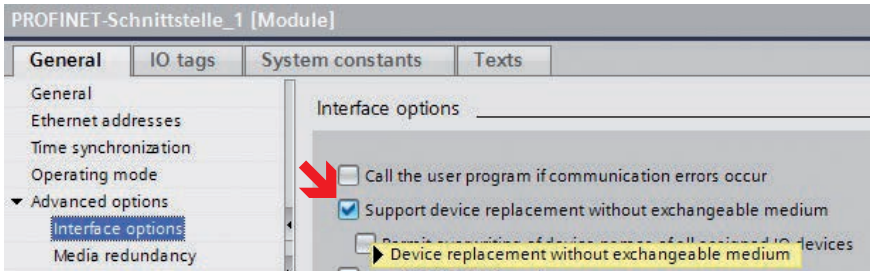
2. In the hardware configuration, define the "Partner port" of the participating ports (according to the actual wiring) (concerns PN controllers and PN devices):



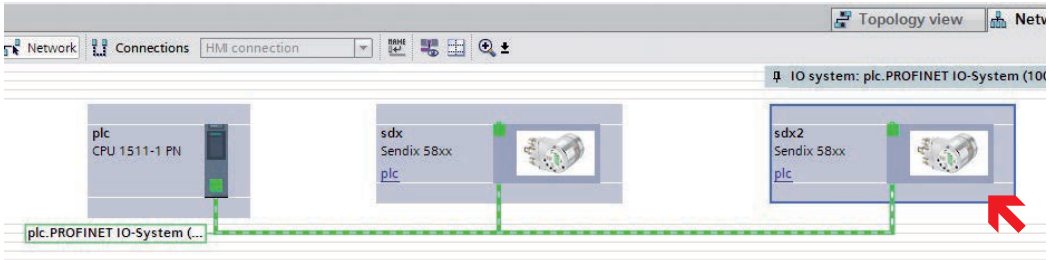


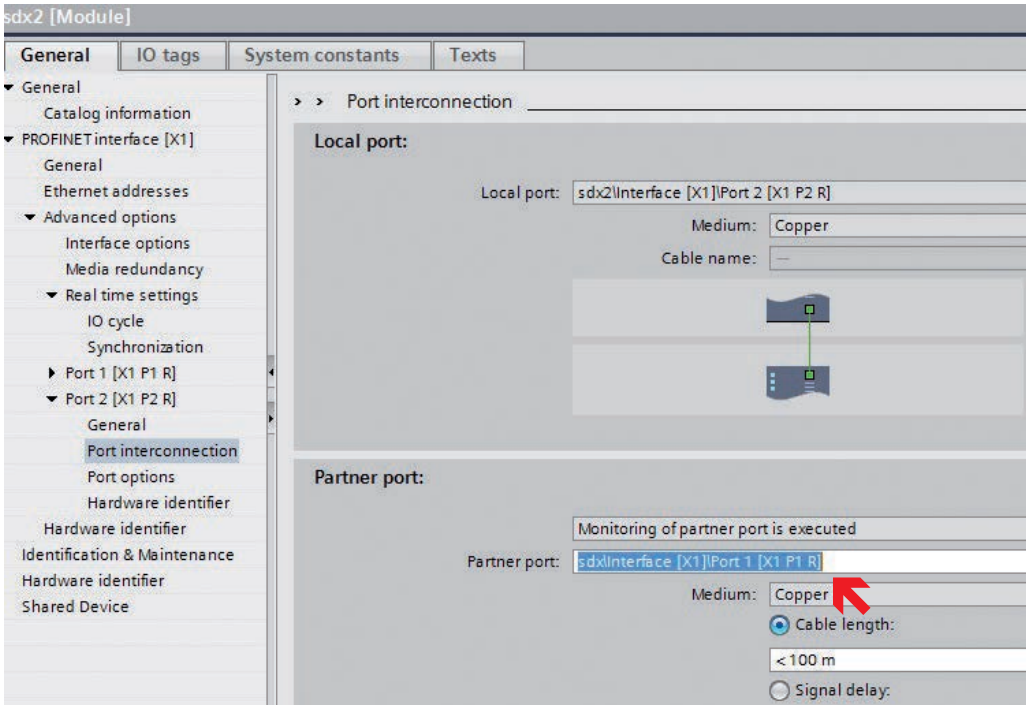
TIA:

1. Make sure that "Support device replacement without exchangeable medium" is checked in the Properties dialog window of the PROFINET interface under "Advanced options/Interface options“.



2. In the hardware configuration, define the "Partner ports“ of the participating ports (according to the actual wiring) (concerns PN controllers and PN devices):

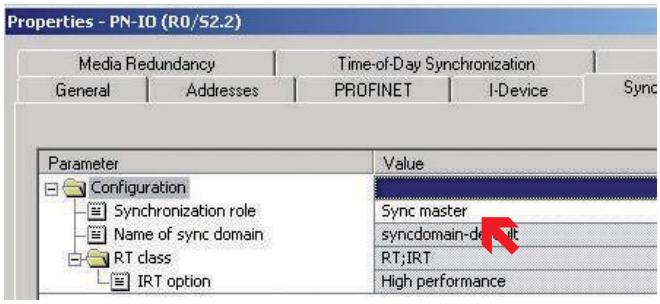




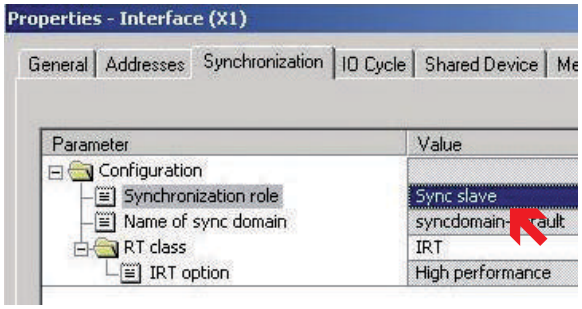
6.3 IRT (Isochronous Real Time)

If several encoders are operated in a system, it may make sense to synchronize them with "IRT". This way, position acquisition takes place (all 1 ms) for the various encoders (almost) at the same moment

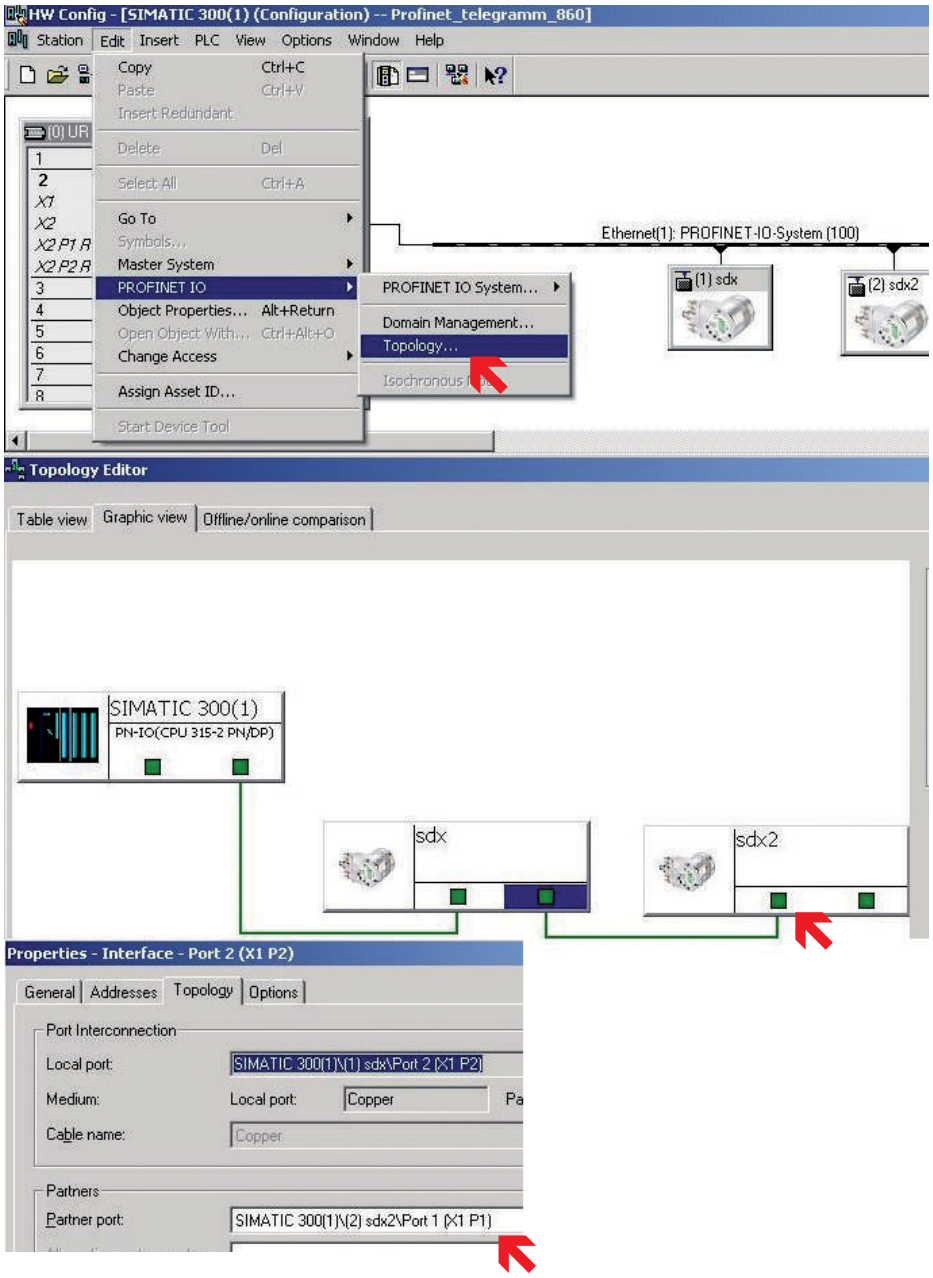
Activation of "IRT":
STEP7:
1. Set up the PN controller (PLC) as "Sync-Master" (IRT, high performance).



2. Set up all PN devices (encoders) as "Sync-Slaves" (IRT, high performance).

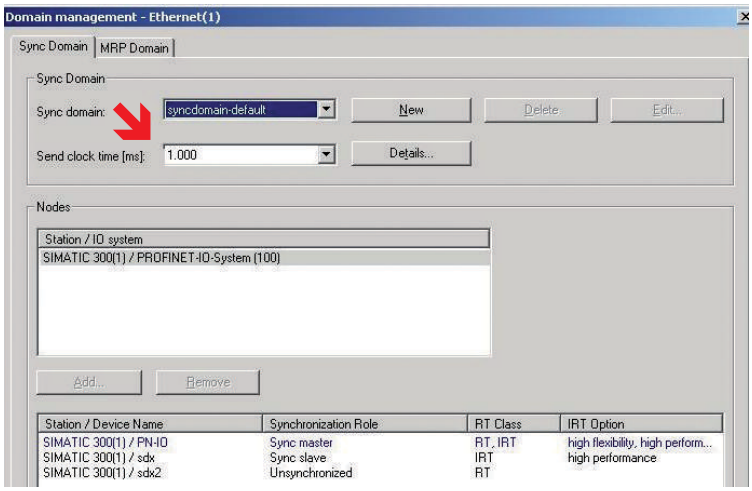


3. Define the topology: For all ports taking part in the synchronous operation (on the PN controller and on the PN devices), define the respective "partner ports" as a fix setting.

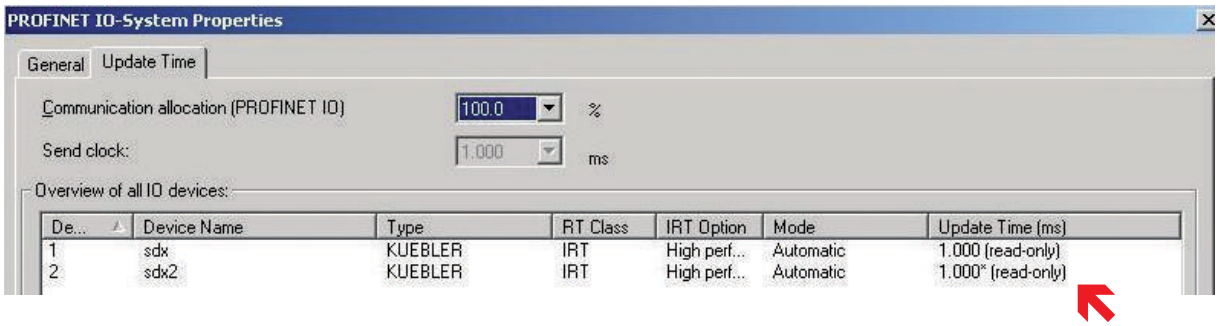


4. Set the transmission clock and the update time(s).

Open menu item "Edit/PROFINET IO/Domain Management…“ , register card "Sync-Domain“. Set the transmission clock to 1 ms.

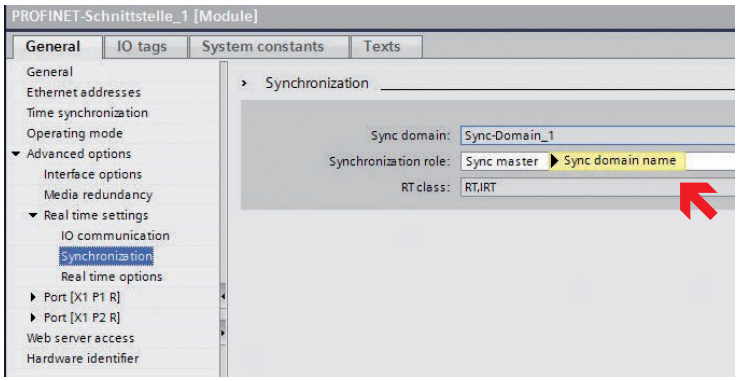


Double-click on "PROFINET-IO-System“:
Set the respective update time(s) to 1 ms.

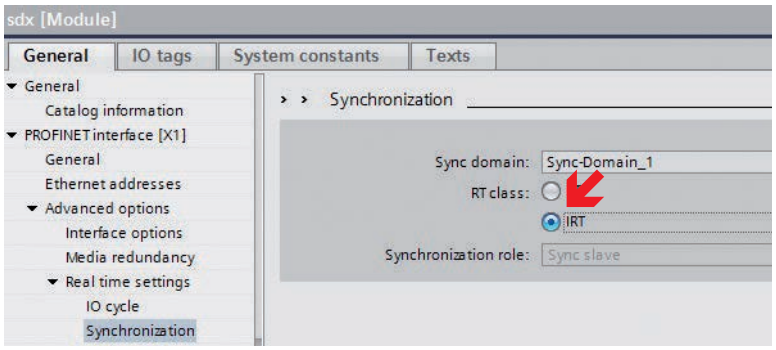


TIA:

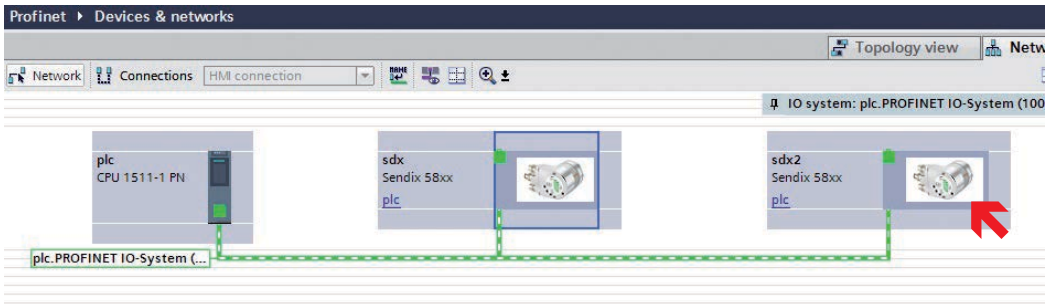
1. Set up the PN controller (PLC) as "Sync master“ (IRT, high performance).

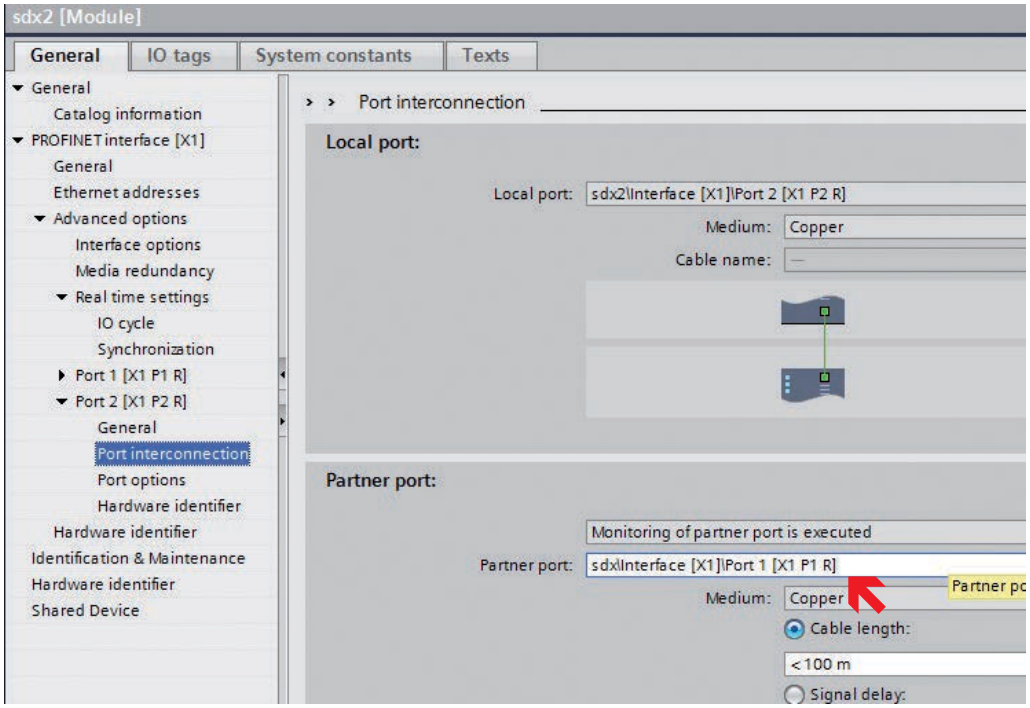


2. Set up all PN devices (encoders) as "Sync slaves“ (IRT, high performance).



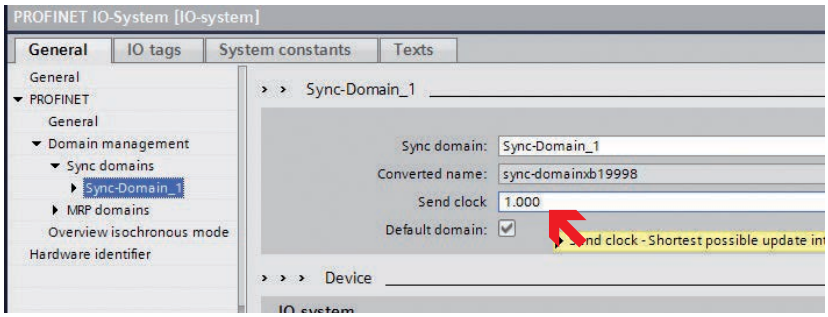
3. Define the topology: For all ports taking part in the synchronous operation (on the PN controller and on the PN devices), define the respective "partner ports" as a fixed setting.



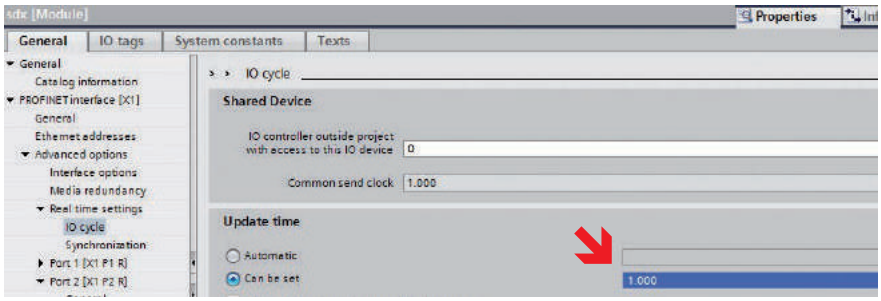


4. Set the send clock and the update time(s).

Open the Properties dialog window for the "Sync-Domain“ of the PN network.
Set the send clock to 1 ms.



Set the respective update time(s)of all PN devices to 1 ms.

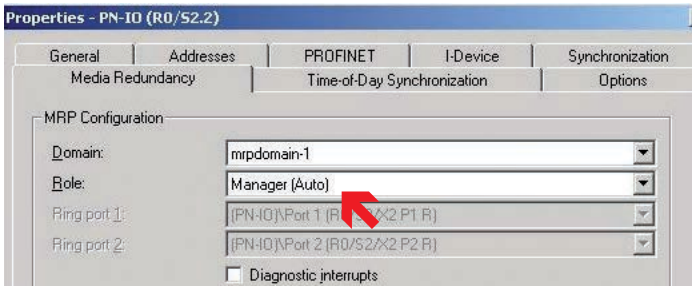


6.4 MRP (Media Redundancy Protocol)

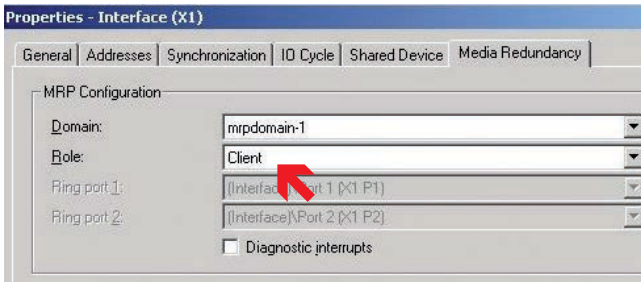
"MRP" is available for enhancing failure safety

To that purpose, the Profinet data lines are connected in a "ring".
Leaving from a port of the PN controller, the data link runs from one PN device to the following. The (actually unnecessary) second port of the last PN device is connected back to a port of the PN controller, resulting in a "ring" The redundancy thus created allows continuation of the communication in case of an interruption (e.g. cable breakage). In the worst case, there will be a short pause before the link is re-established (passing through the until now redundant path).
Note: FSU (Fast Startup) cannot be used together with MRP!

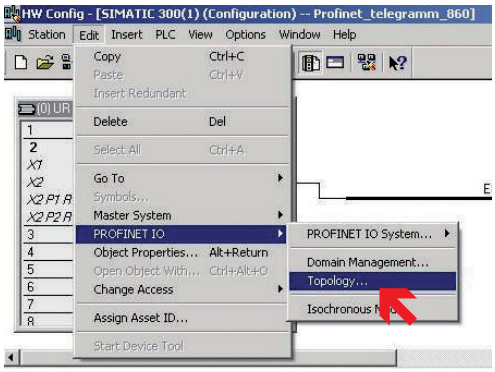
Activation of "MRP":
STEP7:
1. Set up the PN controller (PLC) as "MRP Manager"

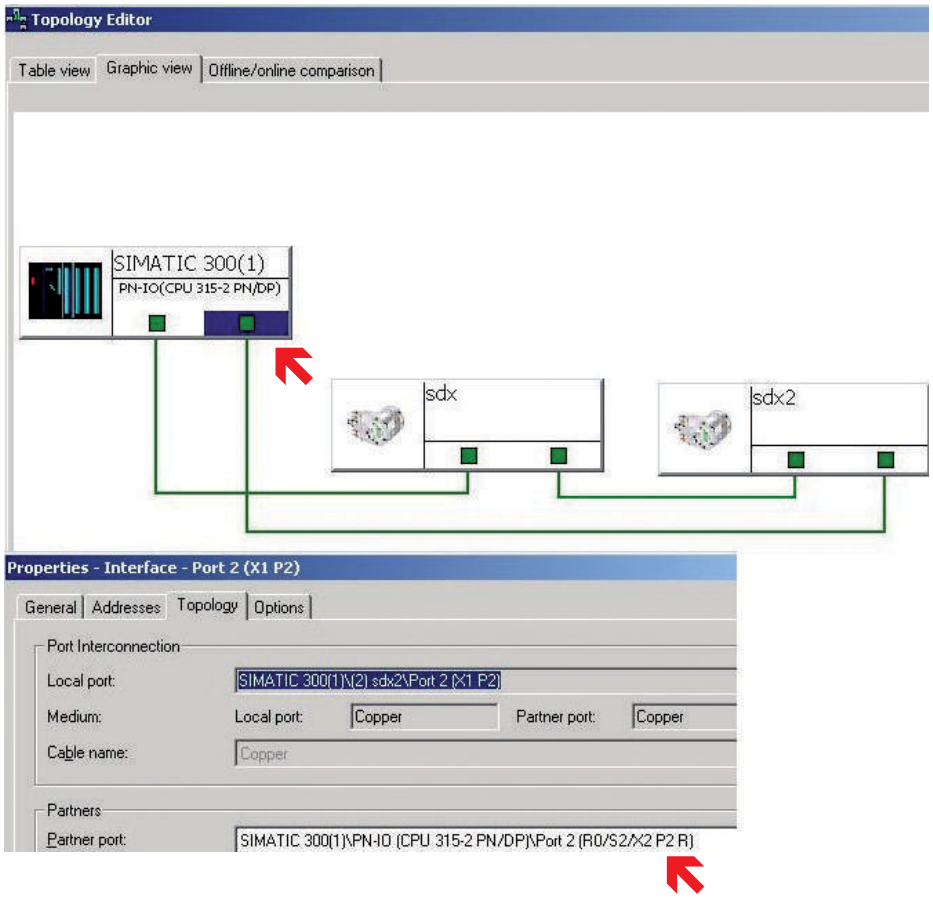


2. Set up the PN devices (encoders) as "MRP Clients"



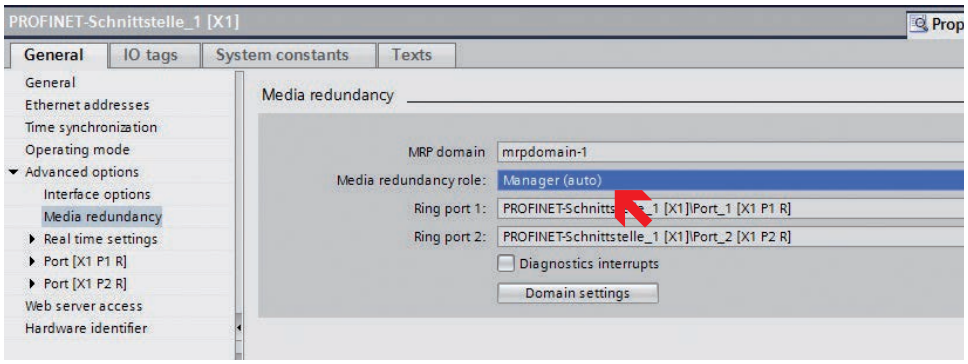
3. Define the topology: For all ports taking part in the "MRP ring" (on the PN controller and on the PN devices), define the respective "partner ports" as a fixed setting.



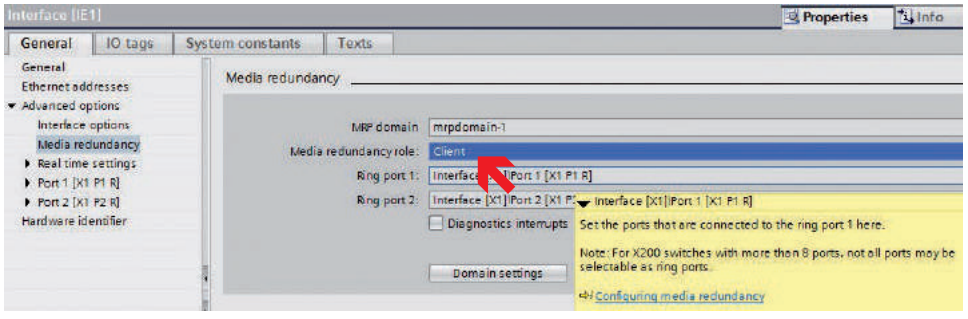


TIA:

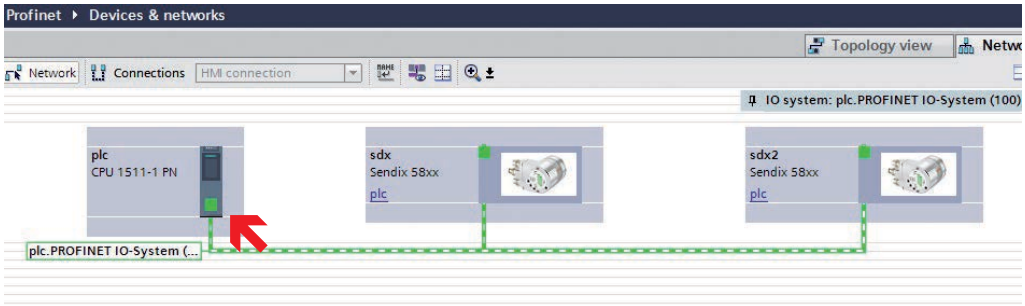
1. Set up the PN controller (PLC) as "MRP Manager“

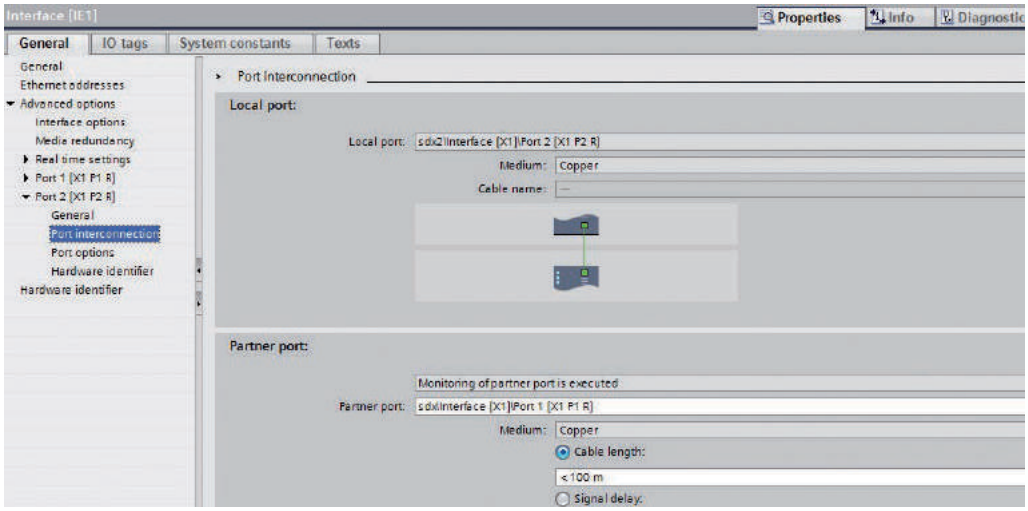


2. Set up the PN devices (encoders) as "MRP Clients“



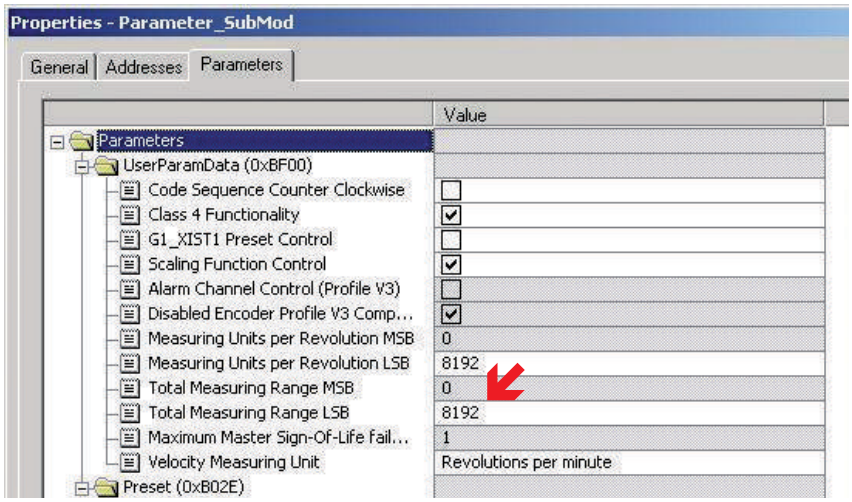
3. Define the topology: For all ports taking part in the "MRP ring" (on the PN controller and on the PN devices), define the respective "partner ports" as a fixed setting.





7. Adjustable encoder parameters

The encoder features the following setting options/parameters:



*Screenshot with standard settings = **singleturn** mode with MUR=TMR=8192.*
"Greyed out" fields cannot be modified (profile V3 is not supported)!

Note:
For a multiturn encoder, the TMR value must be set to MUR x number of required revolutions.

Maximal MUR x 4096

Here for example: 8192 x 4096 = 33554432

"Code Sequence Counter Clockwise"
Looking at the shaft side of the encoder:
☐ The encoder position increases for clockwise shaft rotation
☑ The encoder position increases for counter-clockwise shaft rotation

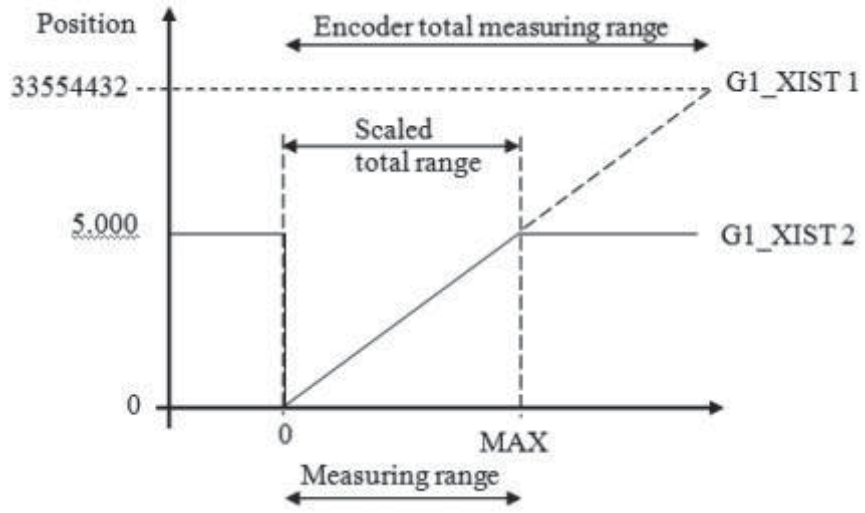
"Class 4 Functionality"
☐ Application class 3: Scaling, preset and direction of rotation setting blocked
☑ Application class 4: Scaling, preset and direction of rotation setting allowed

"G1_XIST1 Preset Control"
☐ G1_XIST1 displays the current position (= G1_XIST2, but without possible error code).
☑ G1_XIST1 displays the current position without taking into consideration the last preset operation.

Preset control G1_XIST1 = Disabled
If G1_XIST1 is disabled and if the position value increases above the maximum value or falls below 0, the device outputs the maximum position value within the scaled total range as position value G1_XIST2.

Position value G1-XIST1 is not limited to the scaled total range. For position value G1-XIST1, the device goes on issuing a scaled position value within the total measuring range. (e.g. max. 33554432 position for 25 bits).

Example of a non-cyclic scaling with disabled preset control G1_XIST1:
MUR (Measuring units per revolution) = 100
TMR (Total measuring range) = 5000
= Number of revolutions = 50



"Scaling Function Control"
☐ The position is represented in the physical resolution of the encoder.
☑ The encoder position is represented scaled (according to "MUR" and "TMR").

"MUR = Measuring Units per Revolution"
1…2^{16} : Number of different positions per revolution (ideally a power of two).

"TMR = Total Measuring Range"
1…2^{28} : For a multiturn encoder:
1…2^{16} : For a singleturn encoder:

Total number of different positions to be issued (over all revolutions to be differentiated).

Here:
- TMR / MUR = max. 2^{12} (multiturn) or 1 (singleturn)
- TMR / MUR = power of 2 (e.g. ¼, ½, 1, 2, 4, 8, …, 4096)

Example: MUR=8192, TMR=65536
=> Positions 0 to 65535 are repeated all 8 revolutions!

"Velocity Measuring Unit"
0 = Steps (positions) / second or
1 = Steps (positions) / 0.1 second or
2 = Steps (positions) / 0.01 second or
3 = revolutions / minute

This setting only affects the unit of the calculated speed.
As a general rule, calculation takes place once per second!

"Preset value" (not with "ManTel860")
Allows defining an absolute or relative position that is to be used by the **"StdTel81"** (standard telegram 81) when carrying out a "PRESET".

Permissible values range:
a) Absolute preset: 0…("TMR"-1)
b) Relative preset: 0…+/-(„TMR"-1)

The preset value defined here is set automatically by the Profinet controller (PLC) when establishing the Profinet link. If necessary, the preset value can also be modified later (see chapter "Acyclic data transmission").

In contrast, if the preset operation is triggered by the **"ManTel860"** (Manufacturer telegram 860), the preset value is set directly via the cyclic output data!

Hint: Using the "Universal module" also allows combining "ManTel860" and "StdTel81"!

8. Input/output data formats

8.1 ManTel860 submodule = Manufacturer Telegram 860

Very simple manufacturer-defined data format (suitable for a wide range of applications). Allows direct setting of the preset value via the cyclic output data.

Index (byte)	**0 … 3**	**4 … 7**
Input	**Position** Actual position	**Velocity** Actual speed or actual rotary speed
Output	**Preset value** Preset position and trigger bit	

Input data (8 bytes)

Position Unit 32				**Speed SINT 32**			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
MSB			LSB	MSB			LSB

Meaning	**Details**
Position	**Current encoder position:** - Representation = 32 bits (unsigned) - Values range = 0 … („TMR"-1) - "MUR" positions per revolution
Speed	**Current encoder speed** - Representation = 32 bits (signed) - Units according to the parameter "Velocity Measuring Unit"

1. Example (hex.): 00 00 12 34 00 00 05 CD
=> Position = 1234h = 4660dec
=> Speed = 05CDhex = +1485dec (position increases)

2. Example (hex.): 00 00 12 34 FF FF FA 33
=> Position = 1234h = 4660dec
=> Speed = FFFFFA33hex = -1485dec (position decreases)

Output data (4 bytes)

Preset Unit 32	
Bit 31	Bit 30 … Bit 0
Preset control	Preset value < Total Measuring Range (TMR)

Meaning	**Details**
Preset control	**- Bit 31 = Trigger bit:** Switching from 0 to 1 triggers a preset operation (duration up to 40 ms). Position is not updated during this period of time (=> to be carried only during standstill!) The new calculated offset value is saved in a non-volatile memory. The trigger bit must then immediately be reset to 0 (in order to prevent any accidental triggering in the case a Profinet link interruption occurs in the meantime).
Preset value	**- Bit 30…28 = 0** **- Bit 27…0 = Preset position (unsigned) =** Position upon conclusion of the preset operation performed during standstill Values range = 0…(„TMR“-1) (limited to ("TMR-1") if range is exceeded)

Example (hex.): 80 00 12 34
=> Preset on position = 1234_{h} = 4660_{dec}

8.2 StdTel81 submodule = Standard Telegram 81

Standard data format according to Encoder profile V4.1.

Index (byte)	**0 … 1**	**2 … 3**	**4 … 7**	**8 … 11**
Input	**ZSW2_ENC** Encoder status word	**G1_ZSW** Sensor status word	G1_XIST1 Actual position 1	G1_XIST2 Actual position 2
Output	**STW2_ENC** Encoder control word	G1_STW Sensor control word		

Input data (12 bytes)

ZSW2_ENC		**G1_ZSW**		**G1_XIST1**				**G1_XIST2**			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
MSB	LSB	MSB	LSB	MSB			LSB	MSB			LSB

Meaning	Details
ZSW2_ENC	- Bit 15…12 : "Encoder Sign-Of-Life“ = 1…15, 1…15, … "Sign of life" of the encoder. Changes with every PN send clock signal (1 ms) - Bit 9 : "Control Requested“ = 1 Switches permanently to 1 after PN link set-up - Bit 3 : "Fault Present“ = 0/1 Switches to 1 is a hardware error is detected
G1_ZSW	- Bit 15 : "Sensor Error“ = 0/1 Switches to 1 is a hardware error is detected G1_XIST2 then contains the error code (=> bit 13 = 0). - Bit 14 : "Parking Sensor Active“ = 0/1 Switches to 1 when the corresponding bit in G1_STW is set. In this case, the reported position is fixed. - Bit 13 : "Transmit Absolute Value Cyclically“ = 0/1 Set to 1 when a valid position is present in G1_XIST2 (=> bit 15 = 0) - Bit 12 : "Set/Shift Of Home Position Executed“ = 0/1 Is set to 1 after completion of a preset operation until the corresponding bit in G1_STW is erased again. - Bit 11 : "Requirement Of Error Ack. Detected“ = 0/1 Is set to 1 when an error is present and an attempt is made to reset it with bit 15 of G1_STW (there are no resettable errors at the moment)
G1_XIST1	Current encoder position: - Representation = 32 bits (unsigned) - Values range = 0 … ("TMR“-1) - "MUR“ positions per revolution - Possibly without considering the last preset operation (according to parameter "G1_XIST1 Preset Control")
G1_XIST2	Current encoder position (as G1_XIST1, but always taking into consideration the last preset operation) or error code (if G1_ZSW, bit 15 = 1) : 0001_h = Position error (e.g. sensor IC defective) 0020_h = Memory error (FLASH or RAM defective) 1002_h = Parameterizing error (BF00-Tel. missing or invalid)

1. Example (hex.): F2 00 20 00 00 00 12 34 00 00 12 34
=> Position (valid) = 1234h = 4660dec

2. Example (hex.): F2 00 30 00 00 00 12 34 00 00 12 34
=> Position (valid) = 1234h = 4660dec
=> Preset performed!

3. Example (hex.): F2 08 80 00 00 00 12 34 00 00 00 20
=> Position (invalid) = 1234h = 4660dec
=> Error = 0020h (memory error)

Output data (4 Bytes)

STW2_ENC		**G1_STW**	
Byte 0	Byte 1	Byte 2	Byte 3
MSB	LSB	MSB	LSB

Meaning	**Details**
STW2_ENC	- Bit 15…12 : "Controller Sign-Of-Life“ = 1…15 Is currently ignored, but should change constantly (e.g. incrementing from 1 ... 15) (for future compatibility). - Bit 10 : "Control By PLC“ = 1 Must be set permanently to 1 after set-up of the link (otherwise G1_STW will not be evaluated).
G1_STW	- Bit 15 : "Acknowledge Sensor Error“ = 0 There are no resettable errors at the moment. - Bit 14 : "Activate Parking Sensor“ = 0/1 Fixes the reported position - Bit 13 : "Request Absolute Value Cyclically“ = 1 Is currently ignored, should nevertheless be set to 1 (for future compatibility. - Bit 12 : "Request Set/Shift Of Home Position“ = 0/1 Switching from 0 to 1 triggers a preset operation (duration up to 40 ms). Position is not updated during this period of time (=> to be carried only during standstill!) The new calculated offset value is saved in a non-volatile memory. This bit must then immediately be reset to 0 (in order to prevent any accidental triggering in the case a Profinet link interruption occurs in the meantime). Caution: Only to be activated if necessary ("wear" of the non-volatile memory)! - Bit 11 : "Home Position Mode“ = 0/1 Preset mode: 0 = Absolute preset (new position = preset value) 1 = Relative preset (new position = old position + preset value)

1. Example (hex.): F4 00 20 00
=> Normal case (request only position data)

2. Example (hex.): F4 00 30 00
=> Trigger absolute preset (to the parameterized preset position)

8.3 SPEED submodule

Input data (2 bytes)

Velocity	
Byte 0	Byte 1
MSB	LSB

Meaning	**Details**
Speed	Current encoder speed - Representation = 16 bits (signed) - Limitation to +32767 or -32768 - Units according to the parameter "Velocity Measuring Unit“

1. Example (hex.): 05 CD
=> Speed = $05CD_{hex}$ = $+1485_{dec}$ (position increases)

2. Example (hex.): FA 33
=> Speed = $FA33_{hex}$ = -1485_{dez} (position decreases)

8.4 ST_POS submodule

Input data (4 bytes)

Singleturn position			
Byte 0	Byte 1	Byte 2	Byte 3
MSB			LSB

Meaning	**Details**
Singleturn position	Current singleturn position: - Position within a revolution - Values range = 0…(MUR-1)

Example: Position = 3456hex, MUR=1000hex, TMR=4000hex
=> Singleturn position (hex): 00 00 04 56

8.5 MT_POS submodule

Input data (4 bytes)

Multiturn position			
Byte 0	Byte 1	Byte 2	Byte 3
MSB			LSB

Meaning	**Details**
Multiturn position	Current multiturn position - = "revolution counter“ - Values range = 0…((TMR/MUR)-1)

Example: Position = 3456_{hex}, MUR=1000_{hex}, TMR=4000_{hex}
=> Multiturn position (hex): 00 00 00 03

8.6 G1_STW submodule

Output data (2 bytes)

G1_STW	
Byte 0	Byte 1
MSB	LSB

Meaning	Details
G1_STW	Not (yet) used for the moment! => Set both bytes to 0!

8.7 G1_ZSW submodule

Input data (2 bytes)

G1_ZSW	
Byte 0	Byte 1
MSB	LSB

Meaning	Details
G1_ZSW	Content as StdTel81 (see there)

8.8 Universal module

The "universal module“ contains all defined submodules.

This way, the various data formats of the single submodules can be used in parallel.

It must be noted here that the preset operation **shall not be triggered simultaneously** with "ManTel860“ and with "StdTel81“!
With "ManTel860“, the preset position is transferred directly in the cyclic output data, while with "StdTel81“, the parameterized or acyclically transferred preset position is used.

8.9 Note about the behavior of the output data

The output data bytes processed internally by the encoder are set to 0x00 (erased) ...
… when powering (applying the supply voltage)
… at every PN link interruption (e.g. disconnecting the PN data line)
… when the PN controller sets "IOPS=BAD“ (e.g. when the PLC switches to "STOP“)

9. Acyclic data transmission ("PNIO Record Read/Write")

Note: The "standard blocks" **SFB52=RDREC** ("Read Record“) and **SFB53= WRREC** ("Write Record“) can be used with a Siemens PLC (S7) for the acyclic communication described in this chapter!

9.1 "Write User Parameter Data“ (0xBF00 telegram)

This telegram is sent automatically when establishing the Profinet link (depending on the adjustable encoder parameters "UserParamData" of the hardware configuration). If necessary, the settings can also be modified while the Profinet link is in operation.

API: 0x3D00, Slot/Subslot: 0x1/0x1, Index:0xBF00 (48896dec)
Data: 31 bytes according to Encoder profile V4.1 (page 52, table 53):

Parameter	Data type	Value	Comments	User data Octet number
Code sequence	Bit			0 Bit 0
Class 4 functionality	Bit			0 Bit 1
G1_XIST 1 Preset control	Bit			0 Bit 2
Scaling function control	Bit			0 Bit 3
Alarm channel control	Bit		Only supported in compatibility mode	0 Bit 4
Compatibility mode	Bit			0 Bit 5
Reserved		0	Set to zero	0 Bit 6-7
Measuring units / Revolution 64 bits*	Unsigned 64			1 – 8
Total measuring range 64 bits*	Unsigned 64			9 – 16
Maximum Master Sign-Of-Life failures	Unsigned 8		Only supported in compatibility mode	17
Velocity measuring unit	Unsigned 8			18
Reserved		0x00	Set to zero	19 – 30

Meaning of the data: See chapter "Adjustable encoder parameters“ (a checked box means 1). Values are to be sent in the "MSBfirst“ byte sequence.

Example Write User Parameter:
Code Sequence = Clockwise
Class 4 = ON
G1_XIST1 Preset = normal
Scaling = ON
MUR = 0x2000
TMR = 0x8000
Speed unit = 3 = RPM

⇨ The resulting byte sequence
Example (hex.): 2A 00 00 00 00 00 00 20 00 00 00 00 00 00 00 80 00 01 03 00 00 00 00 00 00 00 00 00 00 00 00

9.2 "Base Mode Parameter Access" (0xB02E telegram): setting preset value

This telegram is sent automatically when establishing the Profinet link ("Preset" parameter of the hardware configuration; not for "ManTel860"). If necessary, the preset value can also be modified while the Profinet link is in operation.

API: 0x3D00, Slot/Subslot: 0x1/0x1, Index:0xB02E (45102_{dec})
Data: 16 bytes according to Profidrive profile V4.1 (page 59ff, table 24):

Block definition	**Byte n+1**	**Byte n**	**n**
Request Header	Request Reference	Request ID	0
	Axis-No. / DO-ID	No. of Parameter = n	2
1st Parameter Address	Attribute	No. of Elements	4
	Parameter Number (PNU)		
	Subindex		
nth Parameter Address	…		4 + 6 x (n^{-1})
1st Parameter Value(s) (only for request "Change parameter")	Format	No. of Values	4 + 6 x n
	Values		
	…		
nth Parameter Values	…		
			4 + 6 x n + (Format_n x Qty_n)

Req.-ID = 02(Change)
Req.-Ref. = AB
NoOfPar. = 01
DO-ID = CD
NoOfElem. = 00
Attr. = 10(Value)
PNU = $FDE8_{hex} = 65000_{dec}$
Subidx. = 0000_{hex}
NoOfVal. = 01
Format = 43(DWORD)
Value **(preset value)**=$00001234_{hex}(MSB_{first})$

⇨ The resulting byte sequence
Example (hex.): 02 AB 01 CD 00 10 FD E8 00 00 01 43 00 00 12 34

9.3 "Read Operating Status/Parameter" (0xBF00 telegram)

This allows requesting, besides the current settings, also possible present errors and warnings.

API: 0x3D00, Slot/Subslot: 0x1/0x1, Index:0xBF00 (48896_{dec})
Answer data: 48 bytes = 12 long words (MSB_{first}):

Index (byte)	Meaning	Details
0	Header	= 0x000B0101, acc. to encoder profile V4.1, table 25
4	Operating Status	Acc. to encoder profile V4.1, table 29 As for bit 0.0…5 of "Write User Parameter Data“ (see above)
8	Faults	Current errors (acc. to encoder profile V4.1, table 36): Bit 0 = 1: Position error (e.g. sensor IC defective) Bit 5 = 1: Memory error (FLASH or RAM defective) Note: When an error occurs, it is also recorded in G1_XIST2 of StdTel81 (see above)!
12	Supported Faults	Supported errors = 0x00000021 (bit 0 and bit 5)
16	Warnings	Current warnings (acc. to encoder profile V4.1, table 38): Bit 0 = 1: Inadmissible rotary speed (> 9000 RPM) Bit 1 = 1: Inadmissible temperature (internal) Bit 2 = 1: Inadmissible LED current (internal)
20	Supported Warnings	Supported Warnings = 0x00000007 (bit 0, 1 and 2)
24	Encoder profile version	= 0x00000401
28	Operating Time	= 0xFFFFFFFF (not used)
32	Preset-Offset	Offset value calculated (internally) for the last preset.
36	"MUR“	"Measuring Units per Revolution“: Number of different positions per revolution
40	"TMR“	"Total Measuring Range“ Number of different positions over all revolutions that can be differentiated
44	Speed measuring unit	0 = Steps (positions) / second 1 = Steps (positions) / 0.1 second 2 = Steps (positions) / 0.01 second 3 = revolutions / minute

10. Resetting to factory settings

The Profinet interface of the encoder can be reset to the "factory settings". This erases among others the device name and the IP address.

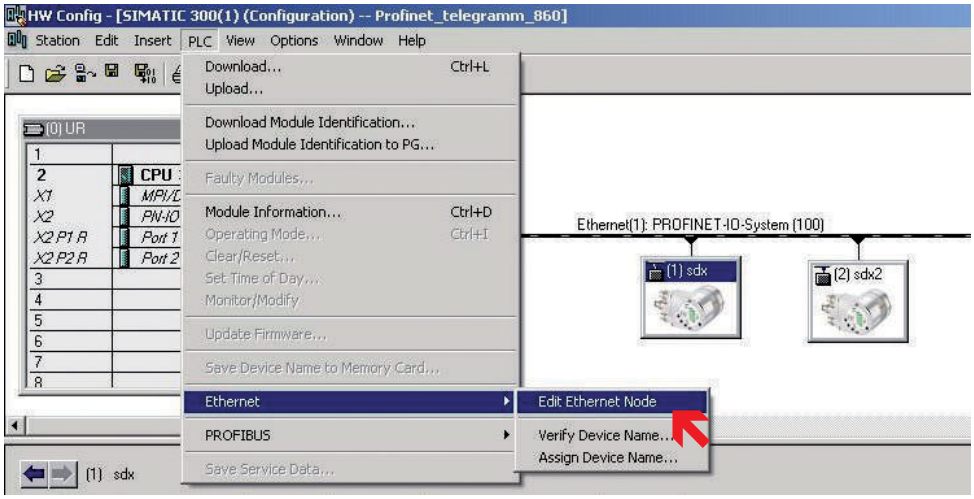
Note: "Resetting to factory settings" only relates to the PN interface.
The preset position of the encoder is not affected.

If a defective device is to be replaced in a Profinet network, it is recommended to mount a new replacement device or a device reset to factory settings. It will then automatically be assigned the correct Profinet device name (if LLDP is enabled).

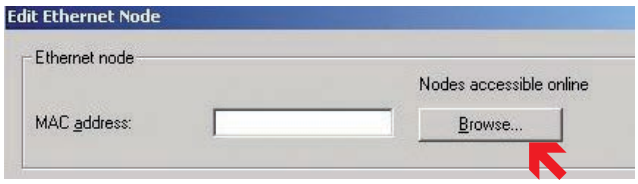
Caution: If the PN controller (PLC) is currently in operation and contains a LLDP configuration corresponding to the current topology, the configured name is assigned to the device just reset to "factory settings“ (and if necessary the PN link is set up) after some seconds!

Proceed as follows to "reset to factory settings":

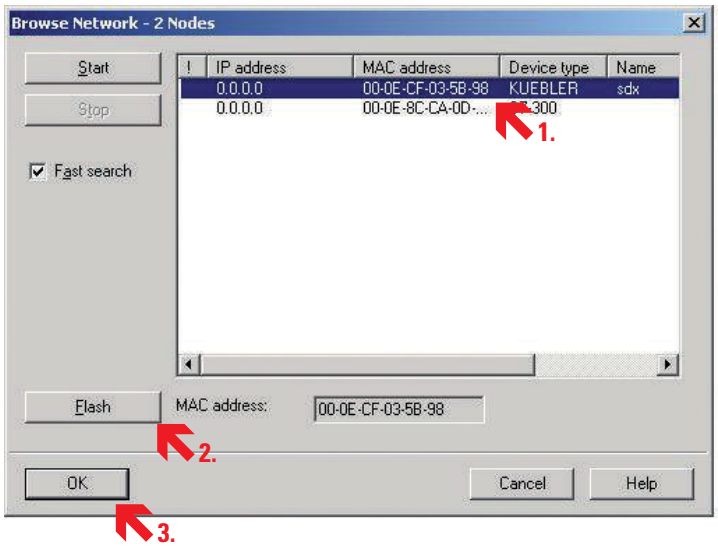
STEP7:
1. Open the "Edit Ethernet nodes“ dialog window.



2. Click on "Browse under "Nodes accessible online“



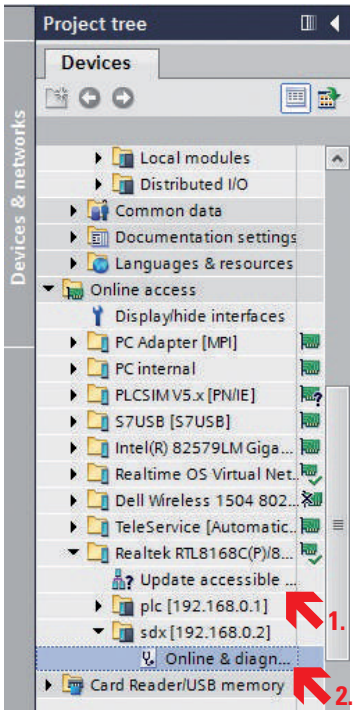
3. Mark the line with the concerned device. Click on "Flash“ and check whether the "PWR“ LED (green) of the encoder to be reset is flashing.
   Close the dialog window with "OK“.



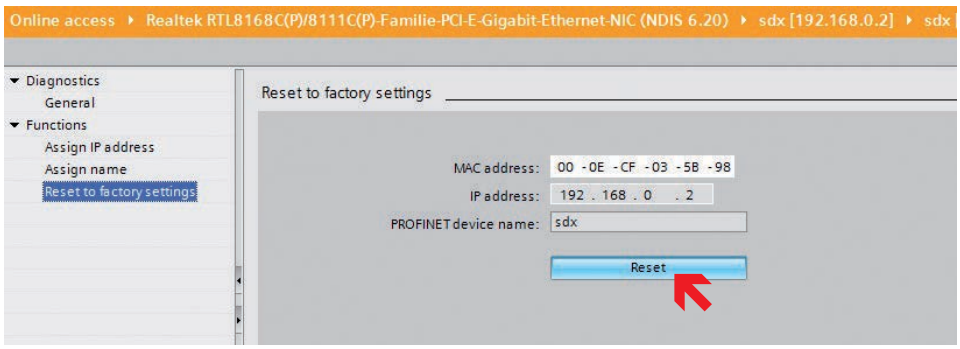
4. Under "Reset to factory settings“, click on "Reset“

TIA:

1. Open branch "Project tree/Devices/Online access/{Your PN network card}“. Double-click on "Update accessible nodes" Wait some seconds until the search process is completed and the list of the accessible PN devices is displayed. Double-click on "Online & Diagnostics“ of the encoder to be reset.



2. Under "Functions/Reset to factory settings“, click on "Reset“.



11.Certificate

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Certificate

PROFIBUS Nutzerorganisation e.V. grants to

Fritz Kübler GmbH
Schubertstrasse 47, 78054 Villingen-Schwenningen, Germany

the Certificate No: **Z10569** for the PROFINET IO Device:

Model Name:	**SENDIX Absolute**
Revision:	**SW/FW: V3.0.0; HW: 2**
Identnumber:	**0x0198; 0x0001**
GSD:	**GSDML-V2.32-KUEBLER-0198-Sendix58xxPNIO-20160217.xml**
DAP:	**DAP3: Sendix 58xx, 0x00000003**

This certificate confirms that the product has successfully passed the certification tests with the following scope:

☑ PNIO_Version	V2.32
☑ Conformance Class	C Optional Features: FSU, MRP, Legacy
☑ Netload Class	III
☑ PNIO_Tester_Version	V2.3.5
☑ Tester	SIEMENS AG, Fürth, Germany PN211-2

This certificate is granted according to the document:
"Framework for testing and certification of PROFIBUS and PROFINET products".
For all products that are placed in circulation by March 24, 2019 the certificate is valid for life.

(Official in Charge)

Board of PROFIBUS Nutzerorganisation e. V.

(Karsten Schneider)

(K.-P. Lindner)