Absolute single-/multi-turn encoder TRT/S3
with PROFIsafe over PROFINET interface
Relevant data sheet TRT 12845

SUPREME SENSORING
TWK

Document no.: **TRT** 12846 OE
Date: 17.08.2022

PROFIsafe

PROFINET®

SIL2 IEC 61508 FUNCTIONAL SAFETY SENSOR

User manual

Translation of the original instructions

TWK-ELEKTRONIK GmbH
Bismarckstraße 108
40210 Düsseldorf
Tel.: +49 211 961170
info@twk.de
visit us at | twk.de

POB 10 50 63 ■ 40041 Düsseldorf ■ Germany
Tel. +49/211/96 11 70 ■ Fax +49/211/63 77 05
info@twk.de ■ www.twk.de

Table of contents

Table of contents

1. Safety instructions

1.1 Scope

This user manual is valid exclusively for the following absolute encoders with PROFINET interface:

- TRTxx-xxxxxxxR4096S3xTxx(Multiturn)
- TRTxx-xxxxxxxxS3xTx (Singleturn)

It is valid for the hardware versions 1 and 2.

1.2 Documentation

The following documents must be observed:

- The owner's system-specific operating instructions
- This user manual
- Data sheet number TRT 12845
- The connection assignment enclosed with the device
- Assembly instructions TZY10206 enclosed with the device

1.3 Proper use

The TWK-ELEKTRONIK GmbH absolute encoders and linear transducers are used to register angular or linear positions and make their measured value available in the form of an electrical output signal. As part of a system, they have to be connected to the downstream electronics and must only be used for this purpose.

1.4 Commissioning

- The relevant device may only be set up and operated in combination with this and the documentation speci fied under point 1.2.
- Protect the device against mechanical damage during installation and operation.
- Device commissioning and operation may only be undertaken by a specialist electrician.
- Do not operate the device outside of the limit values specified in the data sheet.
- Check all electrical connections before commissioning the system.

2. General information

Model TRT/S3 is an electromagnetic rotary encoder with a PROFINET interface and PROFIsafe protocol. Thanks to additional internal monitoring measures, it is suitable for use in safety-technical applications up to SIL2 or PLd.

In addition to a safe position signal, the TRT/S3 also supplies a safe speed signal. It offers the same parameterisation and diagnostic options as the standard PROFINET and PROFIBUS rotary encoders.

The PROFINET interface according to IEC 61158 / 61784 or PNO specifications, order Nos. 2.712 and 2.722 version 2.2 (hardware version 2: 2.42), and the PROFIsafe protocol according to "PROFIsafe – Profile for Safety Technology on PROFIBUS DP and PROFINET IO", order Nos. 3.092 and 3.192 version 2.4 (HW version 2: 2.4 and 2.6), are integrated. PROFIsafe V2 mode is supported.

The specifications can be obtained from the profibus user organisation (www.profibus.com).

2.1 Notes on hardware version 2

Hardware version 2 is mechanically (flange and shaft), electrically and software compatible with the previous version. It can replace the previous version in existing systems without exchanging the GSD file. In addition, free module selection is now possible. I.e. the TRT/S3 automatically adapts to the module selected in the project planning. Reprogramming of the encoder is no longer necessary

The following are the changes compared to the predecessor model:

- the housing is approx. 15 mm shorter (depending on the flange version)
- the maximum operating voltage has been reduced by 1 V to 35 V
- the maximum resolution has been increased from 13 bits to 16 bits (65536 steps)
- the PROFINET/ProfiSAFE interface now complies with specification 2.42 respectively 2.6.
- improved safety characteristics
- the LED states have been adapted to the encoder profile 4.2 (see chapter 3.3)
- the maximum speed for protection class IP65 is now 5000 min-1 instead of 2000 min-1
- the maximum operating temperature had to be reduced to 70°C
- improved EMC measures, the standard IEC 61326-3-2:2018 is now also fulfilled
- the complete model is now UL certified
- the slewing ring function is supported

3. Installation

3.1 General information

- During installation, observe the profinet assembly guideline PNO order No.: 8.071
- Use only certified profinet cables, connectors and switches (see "PROFINET Cabling and Interconnection Technology" PNO order No.: 2.252 and "Installation Guideline PROFINET Part 2: Network Components" PNO order No.: 2.252 p2)
- Hubs are not permissible.
- The cable length between two subscribers may be max. 100 m.
- The TWK TRT absolute encoder possesses an integrated switch. This not only enables tree and star topologies but also the linear topology.
- Media redundancy protocol support enables the establishment of a redundant ring.
- The setting of addresses, the baud rate or terminating resistors on the device is not necessary.

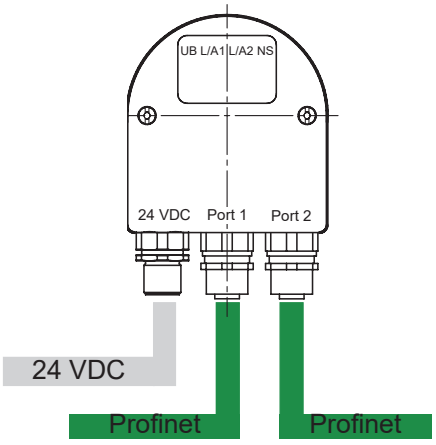
3.2 Electrical connection

The " ...MT01" or "...TT01" type absolute encoders have separate connectors for the supply and the PROFINET system. Port 1 or port 2 are optionally available for the PROFINET connection. Due to the integrated switch, it is irrelevant which port is used.

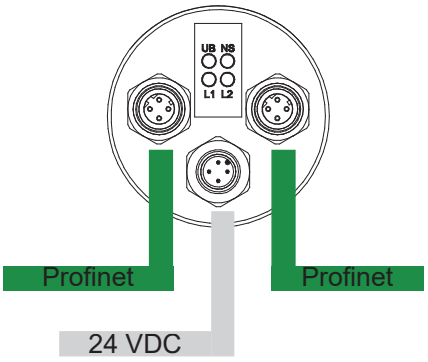
Connection	Designation	Connector type
PROFINET	Port 1	M12x4 D-coded socket
PROFINET	Port 2	M12x4 D-coded socket
Voltage supply	24 VDC	M12x4 A-coded pins

Refer to data sheet No. 12886 for connector assignment and ordering information.

Type ...MT01



Type ...TT01



3.3 Status LEDs

3.3.1 Hardware version 1

IFour LEDs are housed in the absolute encoder's connecting cap. These have the following meaning:

UB (VS)	Link 1 (L1)	Link 2 (L2)	Status (NS)	Description
green	**green**	**green**	**green/red**	
on				Operating voltage available
	on			Network connection established
		on		Network connection established
			green	Data exchange, device in operation and OK
			green flashing	Network connection o.k. but no connection to a PROFINET controler
			red, slow flashing	Firmware download mode
			red flashing	Impermissible parameter or preset value, velocity to high or wrong modul
			Fast red flashing	Device error
			red	Connection to the PROFINET controller disrupted

In Chapter 7 diagnosis you can find all diagnosis data of the TRT/S3.

Flashing codes

Errors which lead to encoder system standstill (hard errors) are indicated by a flashing code on the part of the red NS LED. Following introductory flickering by the red LED, a specific number of flashing cycles are output for the cause of the error.

	Number of flashing cycles (Duration approx. 1 s)	Error cause
Flashing code 1	1	F stack error
Flashing code 2	2	CRC error ROM
Flashing code 3	3	RAM/XRAM error
Flashing code 5	5	Programme sequence error
Flashing code 6	6	Power consumption too high

3.3.2 Hardware version 2

Four LEDs are housed in the absolute encoder's connecting cap. These have the following meaning:

UB (VS)	Link 1 (L1)	Link 2 (L2)	Status (NS)		Description
green	green	green	green	red	
on					Operating voltage available
	on				Network connection established
		on			Network connection established
			on	flashing	Connection to the Profinet controler, parameter error (Impermissible parameter or preset value, velocity to high or wrong modul
			on	on	No connection
			flashing	flashing	System failure
			flashing		System warning
			an		Normal operation

In Chapter 7 diagnosis you can find all diagnosis data of the TRT/S3.

Flashing codes

Errors which lead to encoder system standstill (hard errors) are indicated by a flashing code on the part of the red NS LED. Following introductory flickering by the red LED, a specific number of flashing cycles are output for the cause of the error.

	Number of flashing cycles (Duration approx. 1 s)	Error cause
Flashing code 1	1	F stack error
Flashing code 2	2	CRC error ROM
Flashing code 3	3	RAM/XRAM error
Flashing code 5	5	Programme sequence error
Flashing code 6	6	Power consumption too high

3.4 Project planning

A device description file (GSD file) in the XML format GSDML and an image (bitmap) to integrate the absolute encoder into a project planning tool are available in the internet under www.twk.de

File name of the GSD file: GSDML-V2.3-TWK-TRTS3-20171122.xml
Hardware version 2: GSDML-V2.41-TWK-TRTS3-xxxxxxxx.xml

File name of the bitmap: GSDML-0159-6300-TWK_TRTS.bmp
Hardware version 2: GSDML-0159-6300-TWK_TRTS3V2.bmp

Project planning using the example of Step7 is explained in the following chapter.

4. Project planning with Simatic Step7

4.1 Step7, Safety Advance - TIA-Portal

This chapter explains the procedure for integrating the TWK TRT/S3 (hardware version 2) absolute encoder into the PROFINET network of a Siemens S7 control system with Step 7 Professional V17 with Safety Advanced.

4.1.1 Prerequisites

You have created a hardware configuration in accordance with your control system structure and a PROFINET sub-network.

This is shown here using the example of a CPU1511F:

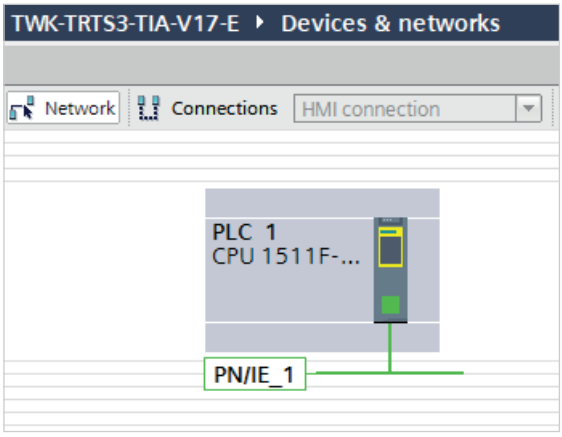


Fig.: 2

4.1.2 Installation of the GSD file

- In the main menu choose **Options**, **Install general station description file (GSD)**.
- Set the source path to your GSD file, check the GSD file and click on "Install" (see Figure 3).
- The absolute encoder symbol is also installed automatically, provided that it is in the same directory

Note: The GSD file and the encoder symbol (bitmap) are available for download under www.twk.de.

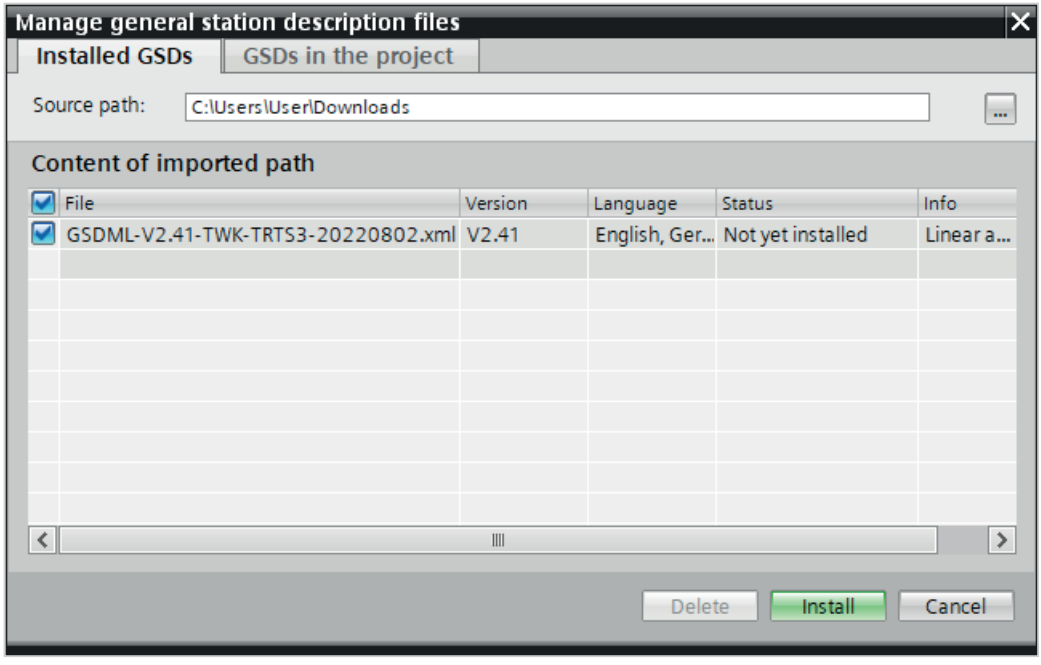


Fig.: 3

After installing the GSD file, the hardware catalogue is automatically updated. The TRT absolute encoder is located under **Further FIELD DEVICES, PROFINET IO, Encoders, TWK-ELEKTRONIK GmbH, TWK T series, TRT/S3**.

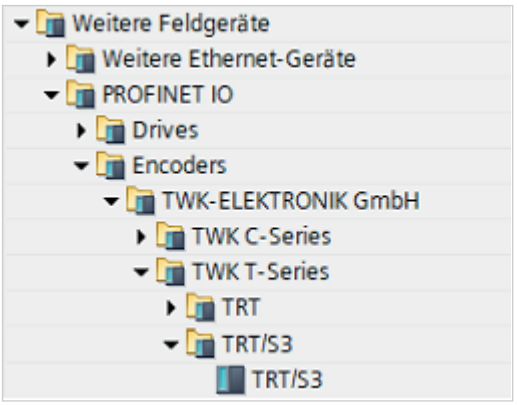


Fig.: 4

4.1.3 Installing the absolute encoder

Now drag the TRT/S3 encoder form the hardware catalog in the netview of your project.

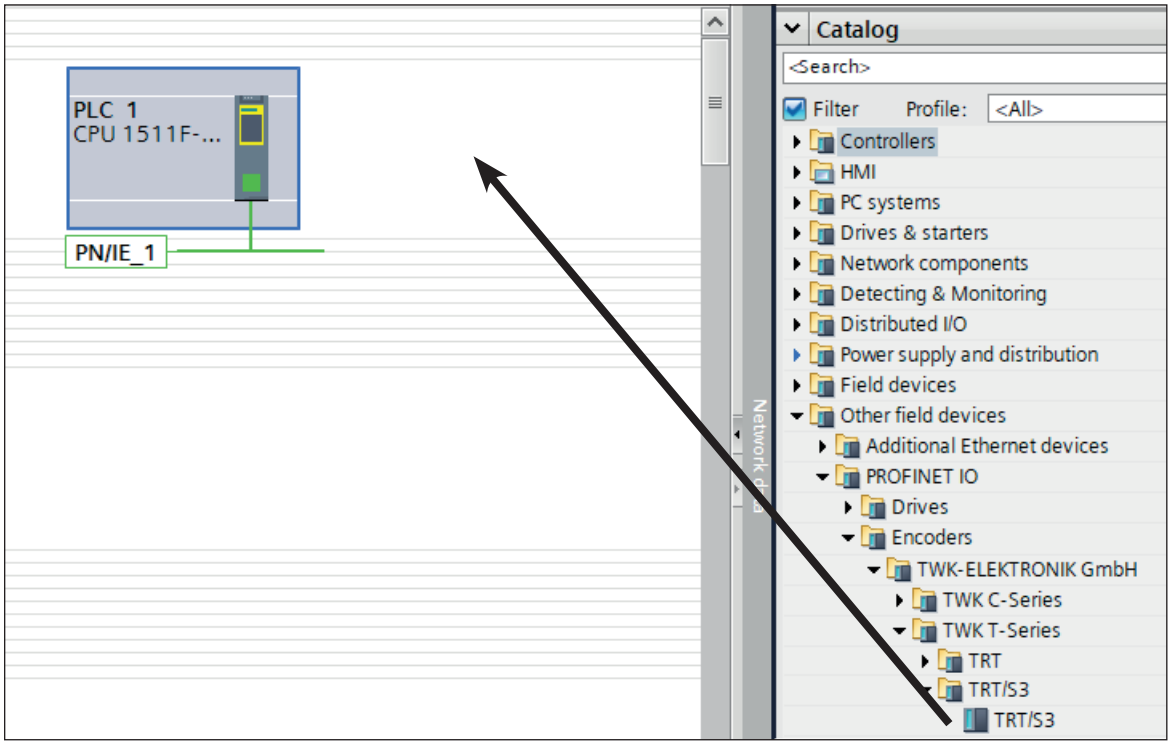


Fig.: 5

Afterwards click on "Not assigned" and assign the encoder to the PROFINET interface of your CPU or draw a network connection from the encoder to the CPU port with your mouse.

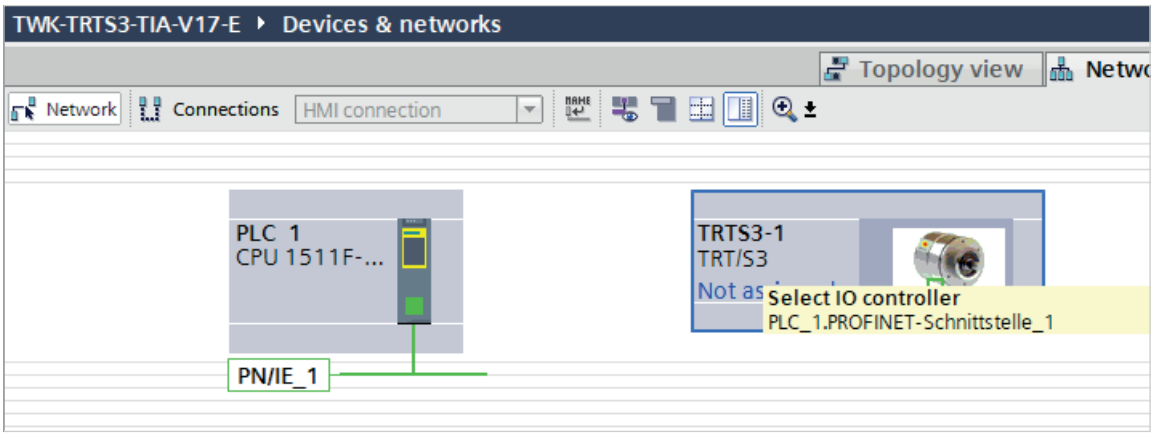


Fig.: 6

The encoder's PROFINET-Interface is now installed with its default values.

4.1.4 Install module

To install the encoder module change to the **Device view** of the TRT/S3 and drag the module corresponding to you encoder to the first free slot of the module list. It is also possible to use other modules. The TRT/S3 automatically adapts to the selected module.

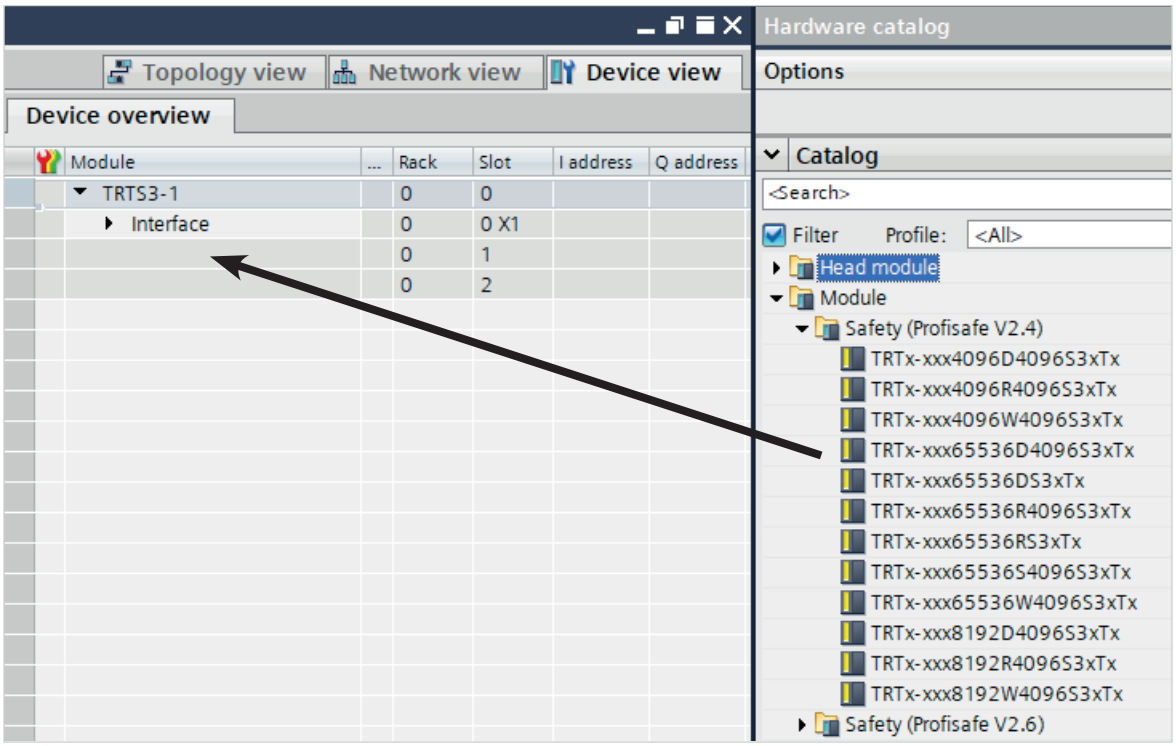


Fig.: 7

The TRT/S3 in hardware version 2 offers two slots. A non-safe module can be installed on the second slot. This offers the possibility to use the position and speed value of the safety module in the standard programme or a standard control. The module in slot 2 must have the same resolution as the safety module, but it can have a different code type. It only has input data to which the data of the safety module is mirrored.

Project planning with Simatic Step7, Advanced Safety - TIA Portal

The following modules are available for the TRT/S3 encoder for different resolutions and data formats as well as for singleturn and multiturn. They are available with Profisafe protocol versions 2.4 and 2.6.

Module	Resolution	MT/ST*	HW**	Functionality
TRTxx-xxx4096D4096S3xTx	12 bit	MT	1	Safe position (1x integer32), safe speed, preset (module not useable in Distributed Safety)
TRTxx-xxx4096R4096S3xTx	12 bit	MT	1	Safe position (2x integer16), safe speed, preset
TRTxx-xxx4096W4096S3xTx	12 bit	MT	1	Safe position (2x integer16, separated single and multi-turn data), safe speed, preset
TRTxx-xxx65536D4096S3xTx	16 bit	MT	2	Safe position (1x integer32), safe speed, preset (module not useable in Distributed Safety)
TRTxx-xxx65536DS3xTx	16 bit	ST	2	Safe position (1x integer32), safe speed, preset (module not useable in Distributed Safety)
TRTxx-xxx65536R4096S3xTx	16 bit	MT	2	Safe position (2x integer16), safe speed, preset
TRTxx-xxx65536RS3xTx	16 bit	ST	2	Safe position (2x integer16), safe speed, preset
TRTx-xxx65536S4096S3xTx	16 bit	MT	2	Safe slewing ring position (integer32), safe slewing ring speed, preset
TRTxx-xxx65536W4096S3xTx	16 bit	MT	2	Safe position (2x integer16, separated single and multi-turn data), safe speed, preset
TRTxx-xxx8192D4096S3xTx	13 bit	MT	1	Safe position (1x integer32), safe speed, preset (module not useable in Distributed Safety)
TRTxx-xxx8192R4096S3xTx	13 bit	MT	1	Safe position (2x integer16), safe speed, preset
TRTxx-xxx8192W4096S3xTx	13 bit	MT	1	Safe position (2x integer16, separated single and multi-turn data), safe speed, preset

* MT = Multiturn, ST = Singleturn

** available from hardware version

4.1.5 Setting the network data

Select the encoder in the Device view to show the properties of the PROFINET interface of the TRT/S3.

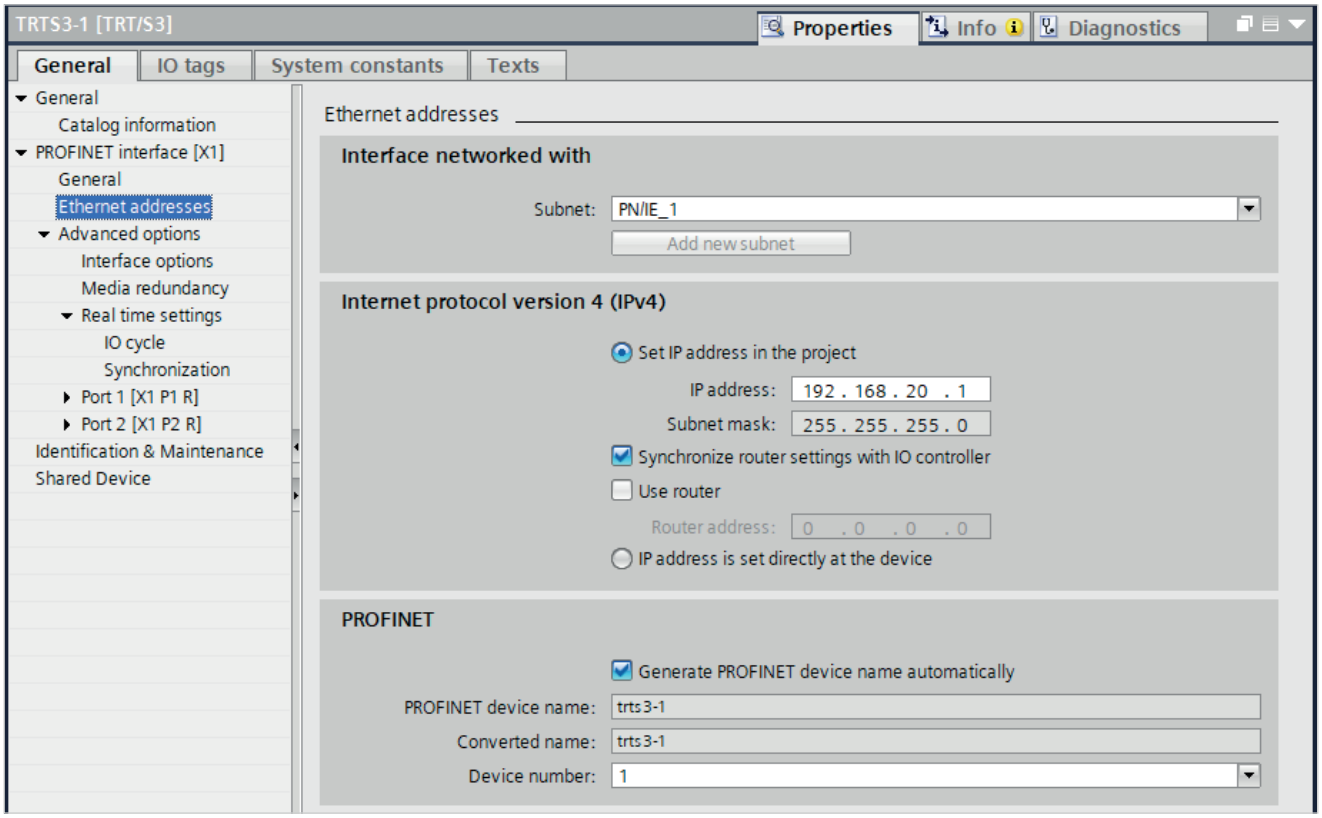


Fig.: 8

4.1.5.1 Setting the PROFINET / PROFIsafe Adresse

Under "General" enter the **PROFINET name** which must be unique throughout the network to identify the device. If **Generate PROFINET device name automatically** is selected the name which is entered under **PROFINET interface - General** will be registered here. The default name is TRTS3-1.

In the TRT/S3, the **Profisafe address** must be added to the name. To do this, attach a number between 1 and 65,535 to the end (a special separator between the Profinet name and Profisafe address is not necessary). This must then be entered for F_Dest_Add under the F parameters (see Chapter 4.1.6.3).

The name assigned here must either be manually allocated to the absolute encoder (see Chapter 4.1.8) or it can be assigned automatically by the controller using the topology editor (see Chapter 4.1.7 Planning of "Device exchange without programming device" and "Automatic commissioning").

The device name is stored in the absolute encoder, where it is protected against zero voltage. An installed device can be exchanged with a brand new device without a programming device or exchanging a memory card. The correct name is automatically assigned to the new absolute encoder by the controller. To do this, however, the prerequisites under Chapter 4.1.7 have to be met.

4.1.5.2 IP-Adresse

Under "PROFINET interface - Ethernet addresses - Internet protocol version 4" the box **Set IP address in the project** should be checked. Step7 automatically assigns an IP address when inserting the device in the project. Manually setting of the IP address is also possible.

4.1.5.3 Prioritized startup, media redundancy, update time and synchronisation

Via the interface option **Prioritized startup** the startup time of the TRT/S3 from power on until PROFINET I/O data exchange can be reduced from approx. 10s to 5s. However, this can only be achieved as of the second startup.

The TRT/S3 can be used as member (client) in a redundant ring. In case of a line topology one network cable from the last client to the controler (manager) is necessary only to achieve a redundant communication. Bevor setting the **media redundancy role** of the TRT/S3 a MRP domain has to be created and the MRP manager (normally the controler) to be assigned.

Under "PROFINET interface", "Advanced options", "Real time settings" the desired **Update time** of the TRT/S3 can be set. The possible values depend on the setting of the send clock of the CPU. The minimal update time for the TRT/S3 is 250 µs.

The desired real time class can be set under **Synchronisation**. The TRT/S3 supports the classes RT and IRT.

4.1.6 Setting the absolute encoder (properties of the module)

4.1.6.1 Setting the I/O address

After switching to the device view of the TRT/S3 and selecting slot 1 in the device overview the properties of the module can be accessed.

Set the PLC addresses for the input data (position, speed and status word) and for the output data (preset and control word) under I/O addresses (see Chapter 5 for the data format).

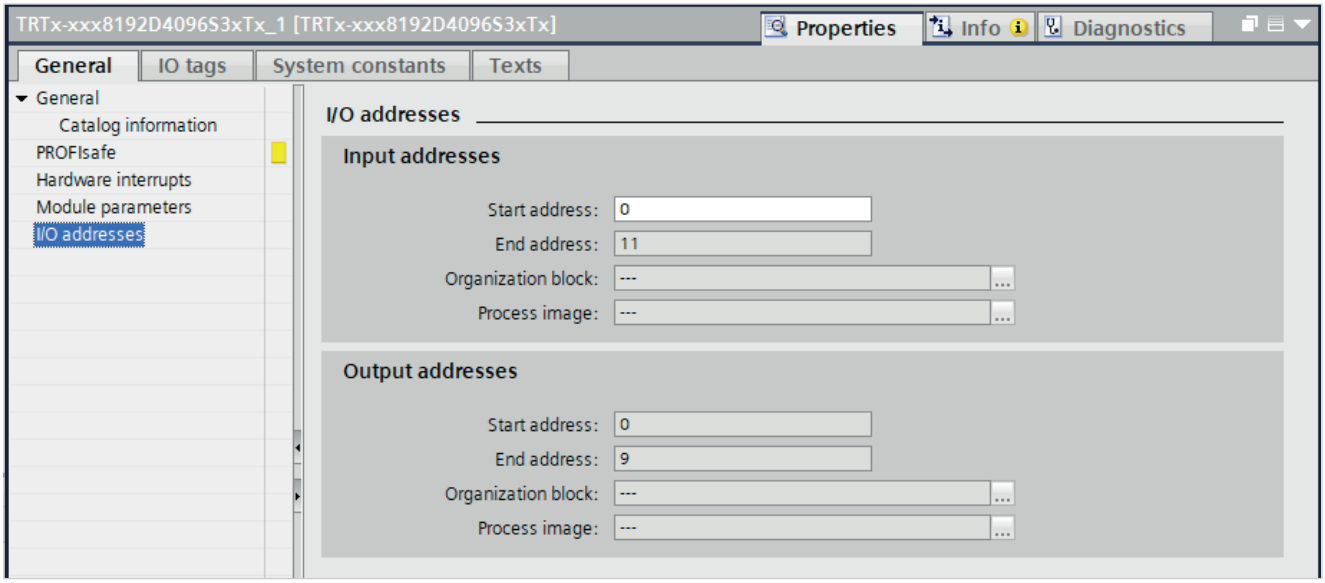


Fig.: 9

4.1.6.2 Parameterising the absolute encoder

The absolute encoder's parameters can be changed in the "Module parameters" tab. An explanation of the parameters can be found in Chapter 6. After changing the encoder parameters the checksum has to be re-calculated and entered under the F-parameters (see next chapter).

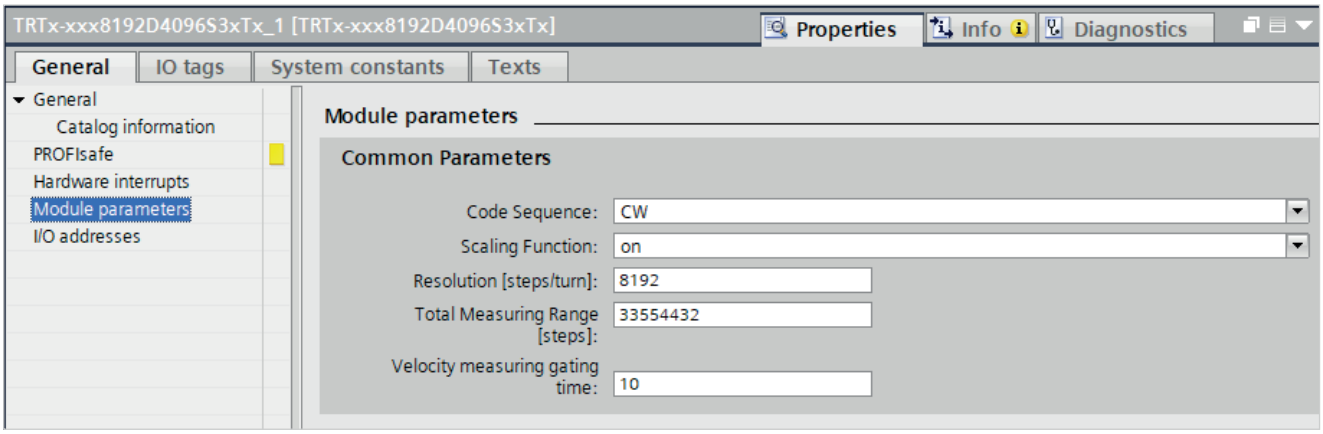


Fig.: 10

4.1.6.3 Setting the F parameters

The F parameters must be set in the "PROFIsafe" tab. Here, you have to set the Profisafe address attached to the Profinet name under "F_Dest_Add" and to specify a watchdog time corresponding to your system under "F_WD_Time"or you to take over the automatic setting . "F_Source_Add" is assigned automatically by the S7

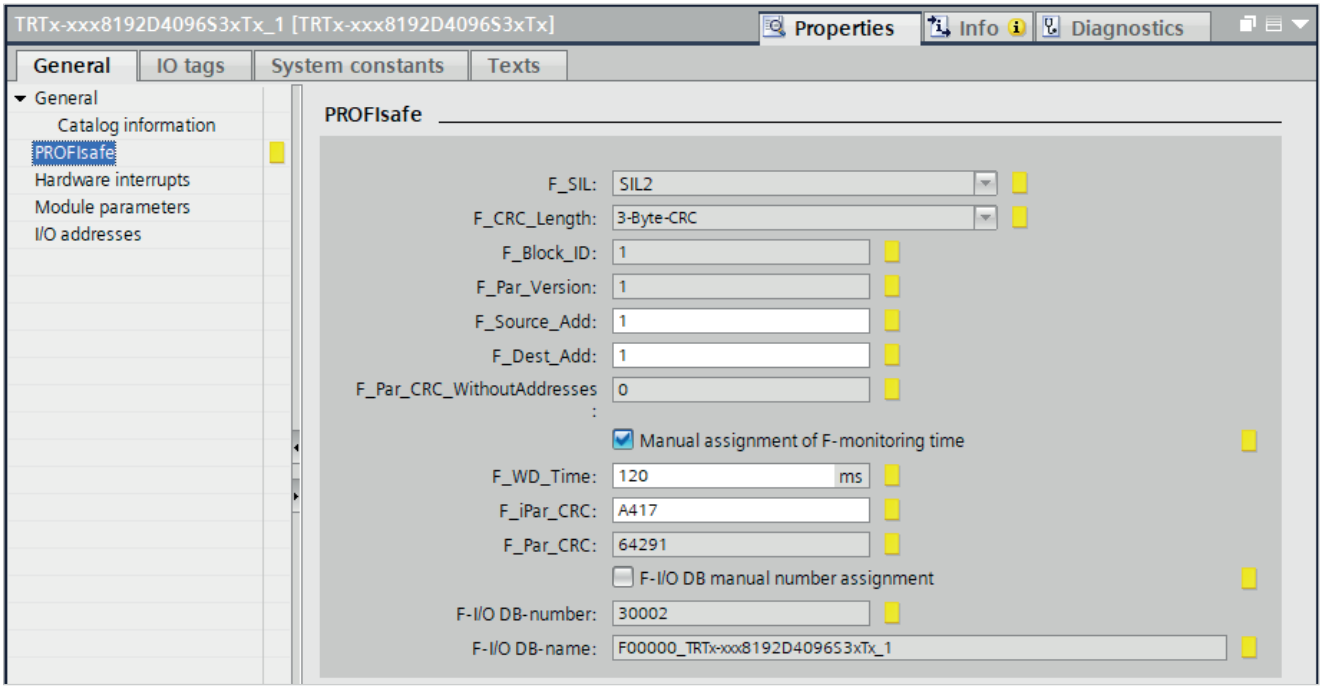


Fig.: 11

At the bottom of this window you can see the number and the symbolic name of the F-IO data block of this encoder assigned by Step7.

Once you have changed the rotary encoder parameters, the checksum must be recalculated using these so-called i parameters and must be entered under "F_iPar_CRC". TWK provides you with the PsCRC programme for calculating the F_iPar_CRC (see Fig. 27).

It can be downloaded from the internet under **www.twk.de** topic **Documentation** model **PsCRC**.

An explanation of all F parameters can be found in Chapter 6.2.

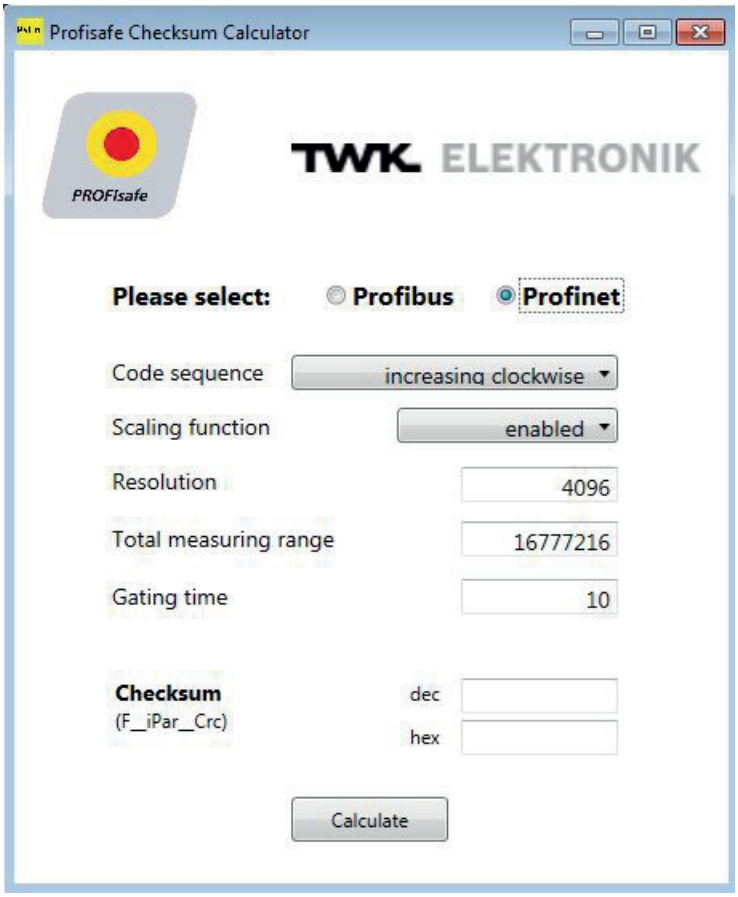


Fig.: 12

4.1.7 Planning of "Device exchange without programming device" and "Automatic commissioning"

If system restarting without the assignment of a new device name or the IP address is to be possible following the exchange of an installed absolute encoder with a mint condition device, this must be taken into consideration during project planning. This also applies to "Automatic commissioning", in which the manual and, in the case of larger projects, time-consuming assignment of the device name (as described in Chapter 4.1.8) is avoided during commissioning.

The following prerequisites have to be met:

- The controller and the devices must support the function "Device exchange without interchangeable medium or programming device" (for the latter, at least the device itself and its neighbouring devices). The TRT/S3 sup ports this function.
- The function "Device exchange without interchangeable medium" must be activated in the controller. This is the default setting.
- The devices must be in delivery condition, i.e. they must not yet possess any device name.

Now call the topology editor using the PROFINET system's context menu and define all PROFINET connections between the subscribers.

If the project is now loaded into the control system and the actual structure corresponds to the planned topology, all subscribers receive their planned names from the controller and device exchange succeeds without the reassignment of the device name.

4.1.8 Assignment of the device name

If a PROFINET topology has not been defined as described in Chapter 4.1.7 or if the prerequisites for automatic commissioning are not met, the absolute encoder name must be assigned manually.With the absolute encoder connected and the programming device connected to the control system, select "Assign device name" in the context menu of the encoder.

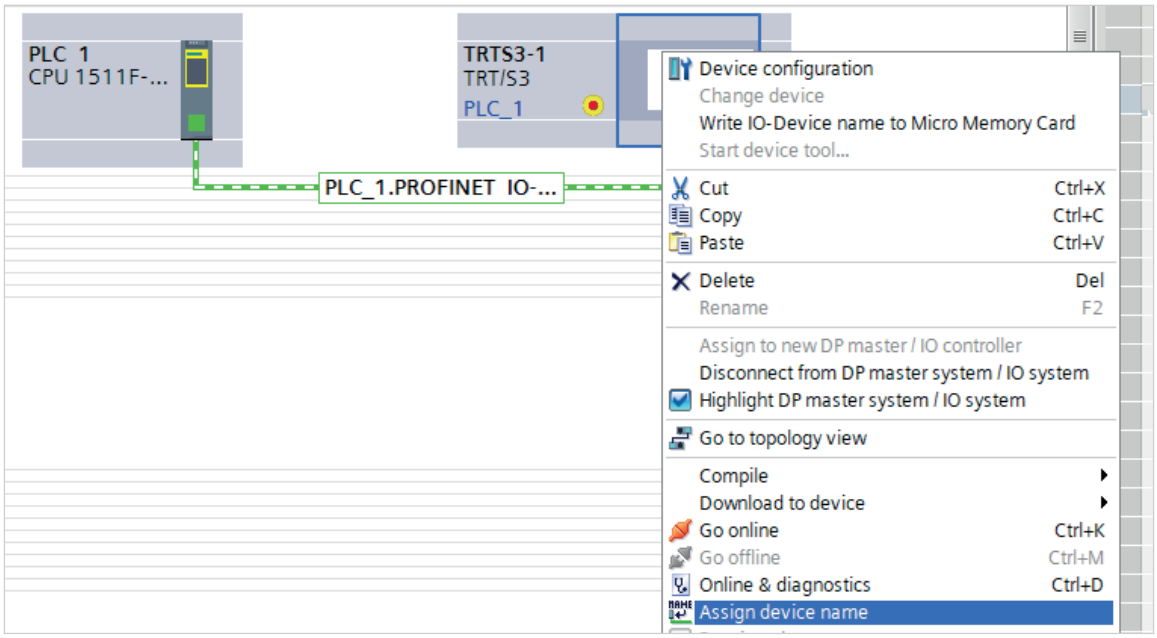


Fig.: 13

Subsequently the window "Assign PROFINET device name" appears. This for example could look like shown in figure 14.

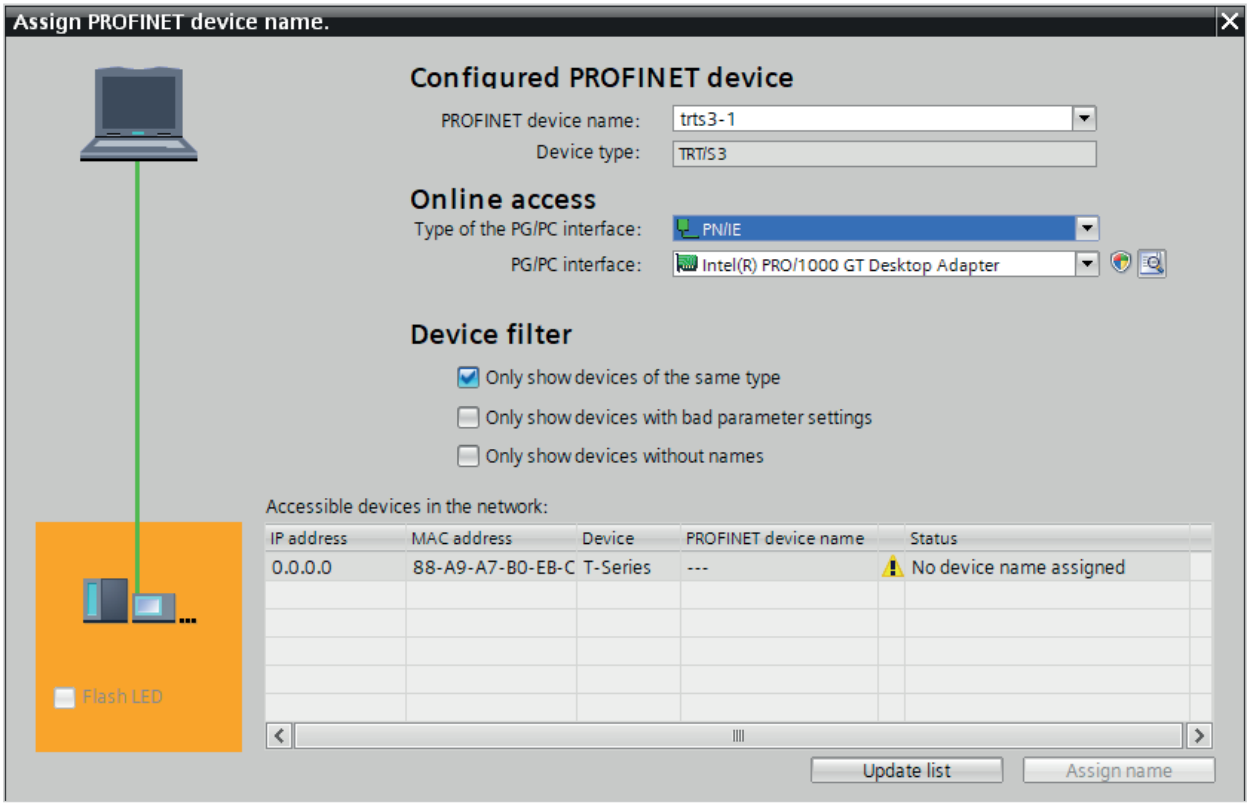


Fig.: 14

It can be seen that the absolute encoder device type "TWK T series" does not possess either a valid IP address or a name. Now mark the absolute encoder, check the name proposed at the top of the window and click on "assign name."

The device name is then stored in the absolute encoder, where it is protected against zero voltage.

The absolute encoder now logs onto the controller with its device name and is then provided with a valid IP address by the controller.

4.1.9 Resetting to the factory settings

After going online the online diagnosis is available via the context menu of the TRT/S3. Under "Functions" the function "Reset to factory settings" is available.

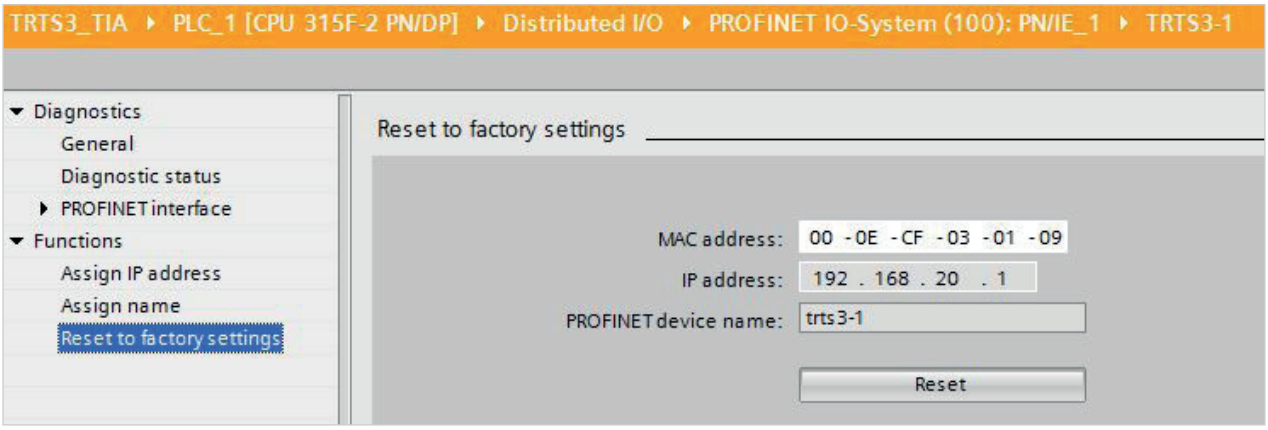


Fig.: 15

The following encoder data will be reset as follows:

The following are reset	Delivery condition
Device name	Empty
IP-parameters	All 0
I&M0-revision counter	0

After resetting, the connection to the profinet controller is closed. After switching the voltage off/on, the connection can be re-established by assigning the device name.

If the connections have been defined using the topology editor, the TRT/S3 restarts automatically with the name assigned during project planning.

4.2 Application program

4.2.1 Remarks

For a detailed documentation for project planning and programming of F programs refer to SIMATIC S7 Distributed Safety - Project Planning and Programming, Programming and Operating Manual (A5E00109536-03) /7/ and SIMATIC S7 Distributed Safety Getting Started /8/ respectivly SIMATIC Safety - Project Planning and Programming /9/ und SIMATIC Safety Getting Started /10/ when using Safety Advance in the TIA-Portal.

4.2.2 F-Peripherie-DB

On translation of the hardware configuration, an **F periphery DB** is generated for the absolulute encoder, as for each other Profisafe subscriber. The automatically generated name consists of the I/O address and the module name.

The F periphery DB contains the for the operation of the encoder necessary variables. It has the following appearance: (A detailed description can be found in the documentation mentioned above)

Safety Advance

F00000_TRTx-xxx8192D4096S3xTx

	Name	Data type	Offset	Start value	Retain	Visible in ...	Setpoint	Comment
1	Input							
2	PASS_ON	Bool	0.0	false		☑		1=ACTIVATE PASSIVATION
3	ACK_NEC	Bool	0.1	TRUE		☑		1=ACKNOWLEDGEMENT NECESSARY
4	ACK_REI	Bool	0.2	false		☑		1=ACKNOWLEDGEMENT FOR REINTEGRATION
5	IPAR_EN	Bool	0.3	false		☑		1=ENABLE I-PARAMETER ASSIGNMENT
6	Output							
7	PASS_OUT	Bool	2.0	TRUE		☑		1=PASSIVATION OUTPUT
8	QBAD	Bool	2.1	TRUE		☑		1=FAIL-SAFE VALUES ARE OUTPUT
9	ACK_REQ	Bool	2.2	false		☑		1=ACKNOWLEDGEMENT REQUEST
10	IPAR_OK	Bool	2.3	false		☑		1=NEW I-PARAMETER VALUES ASSIGNED
11	DIAG	Byte	3.0	16#0		☑		DIAGNOSTIC INFORMATION

4.2.3 Accessing the encoder in the F program

Important for the fail safe operation of the encoder are: reintegration after communication or F periphery errors by the variables „ACK_REQ“ and "ACK_REI" or "ACK_GL", evaluation of the failsafe status by the variable "QBAD" and the evaluation of the diagnostic data by the variable "DIAG". All mentioned variables are provided by the F periphery DB. An example can be found in the following example program.

The access to the I/O data of the encoder is different and depending on the output code of the encoder and on the S7 software package. Because in **Distributed Safety** the use of double words in the safety program is prohibited in this case, only word access to the 32 bit position and reference value is possible, that means the position and the reference value are devided into 2 words each and the evalutation has to be done seperately. For this use encoder with output code "R" and "W" are provided.

In the safety program of **TIA Safety Advanced** doublewords can be used now. Thus position and reference value in data type DINT32 can be treated in the same way as in the standard program. For this use encoder with output code "D" are provided. For a description of the data format see chapter 5.

4.2.4 Example program

The following example shows how to access the position and speed value as well as the F periphery DB of the Profisafe absolute encoder in the safety programme. Setting a preset value and reading the diagnosis data is also demonstrated.

Only the programming steps which refer to the TWK absolute encoder are shown here. Knowledge regarding the

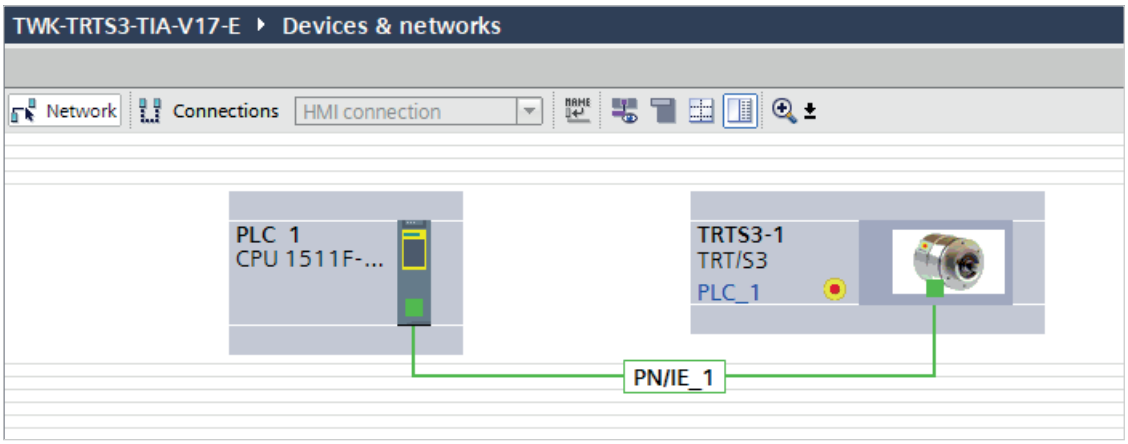
programming and sequence of the failsafe S7 programme is assumed. As an introduction to failsafe programming, we recommend „SIMATIC S7 Distributed Safety - Getting Started“ /8/ and „SIMATIC S7 Distributed Safety – Project Planning and Programming“ /7/ respectively SIMATIC Safety - Project Planning and Programming /9/ and SIMATIC Safety Getting Started /10/ when using Safety Advance under TIA-Portal.

All program blocks of the following example can be found in the internet under www.twk.de. The following documentation was created with TIA Portal V17 incl. Safety Advance and a CPU115F-1PN.

Devices required to operate the example program

- F CPU with PROFINET interface
- Profisafe encoder TRT/S3 with output code "D" (see "remarks to the program" on the next page)
- Step7 V17 with Safety Advanced V17

Hardware structure of the example program



Inputs and outputs used in the program

Standard-Variablentabelle

	Name	Data type	Address	Retain	Acces...	Writa...	Visibl...	Supervis...
1	TRT_ErrorPreset	Bool	%I1.0		☑	☑	☑	
2	TRT_SpeedValue	Int	%IW2		☑	☑	☑	
3	TRT_PositionsValue	DInt	%ID4		☑	☑	☑	
4	Set_Preset	Bool	%Q1.0		☑	☑	☑	
5	TRT_PresetValue	DInt	%QD2		☑	☑	☑	
6	TrueFlag	Bool	%M0.0		☑	☑	☑	
7	failsafestatus	Bool	%M0.1		☑	☑	☑	
8	AckRequest	Bool	%M0.2		☑	☑	☑	
9	Set_Preset_Pin	Bool	%M0.3		☑	☑	☑	
10	Parameter_Enable	Bool	%M0.4		☑	☑	☑	
11	UsrAck	Bool	%M0.5		☑	☑	☑	
12	Limit1	Bool	%M0.6		☑	☑	☑	
13	Diagnose_Request	Bool	%M11.0		☑	☑	☑	
14	DataValid	Bool	%M11.1		☑	☑	☑	
15	Busy	Bool	%M11.2		☑	☑	☑	
16	Error	Bool	%M11.3		☑	☑	☑	
17	LaddrValue	Hw_Any	%MW12		☑	☑	☑	
18	PresetValue	DInt	%MD100		☑	☑	☑	
19	Sensor_PresetValue	DInt	%MD104		☑	☑	☑	
20	Speed_Data	Int	%MW108		☑	☑	☑	

Remarks to the program

Access to the profisafe absolute encoder is carried out in a F programme module (here FB100), which must be called up in a F-runtime group (F call-up module F CALL when using Distributed Safety). Calling the FB100 in the F CALL is not described here.

When using Distributed Safety it should be noted that access to double words is not permitted (see chapter 4.2.3). An example program for Distributed Safety is available on our homepage.The examples show how to carry out the comparision between the position and the threshold values although the position value consists of two words and the compare operation needs integer values.

The following listing contains only the for the handling of the encoder relevant part. Program blocks like F-CALL, clock OBs or peripheral data blocks are not listed.

Project planning with Simatic Step7

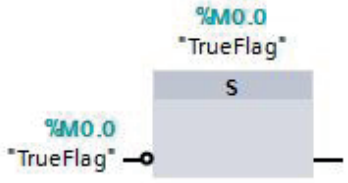
OB1, NW 1 - 3: Load preset value, show F error messages with the DIAG byte

Block title: Main program for TWK-PROFIsafe encoder TRT/S3

TrueFlag, DIAG-Byte and calling FB ReadDiagData. Calling up the safety program is done in the F runtime group.

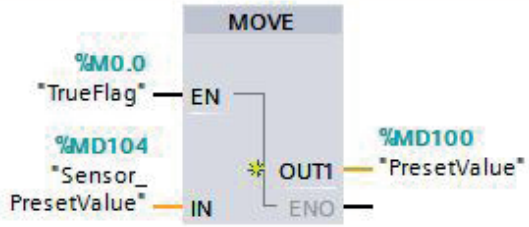
Network 1:

Generate true flag



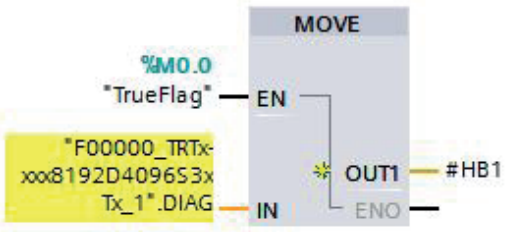
Network 2:

The preset value is stored in the MD104.

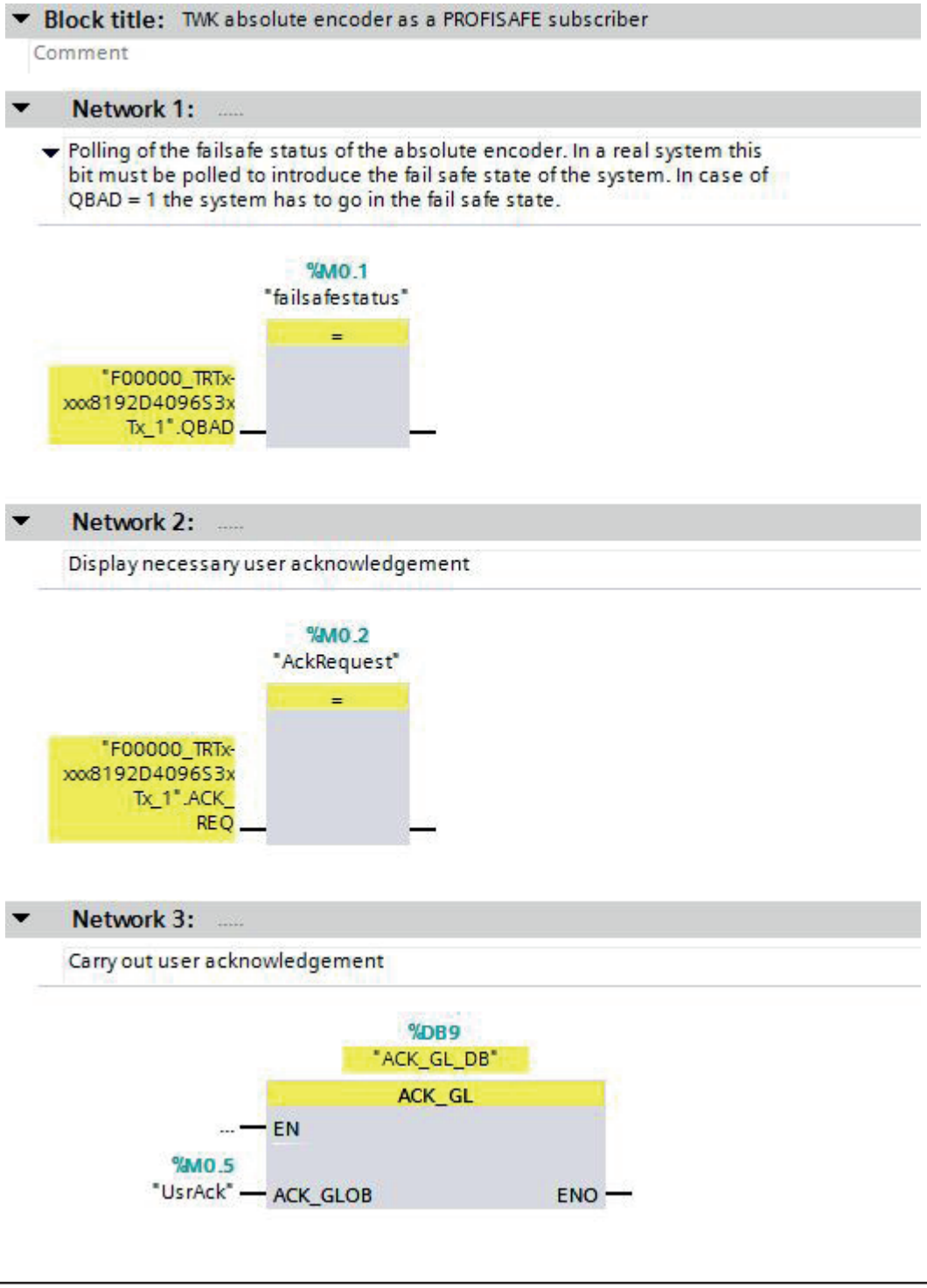


Network 3:

Display of F error messages (here in help byte 1; in a real system, this should be further processed in the error message system). Polling the DIAG variable in the safety programme is not permissible.
(Meaning of the individual bits in *I7.1*)

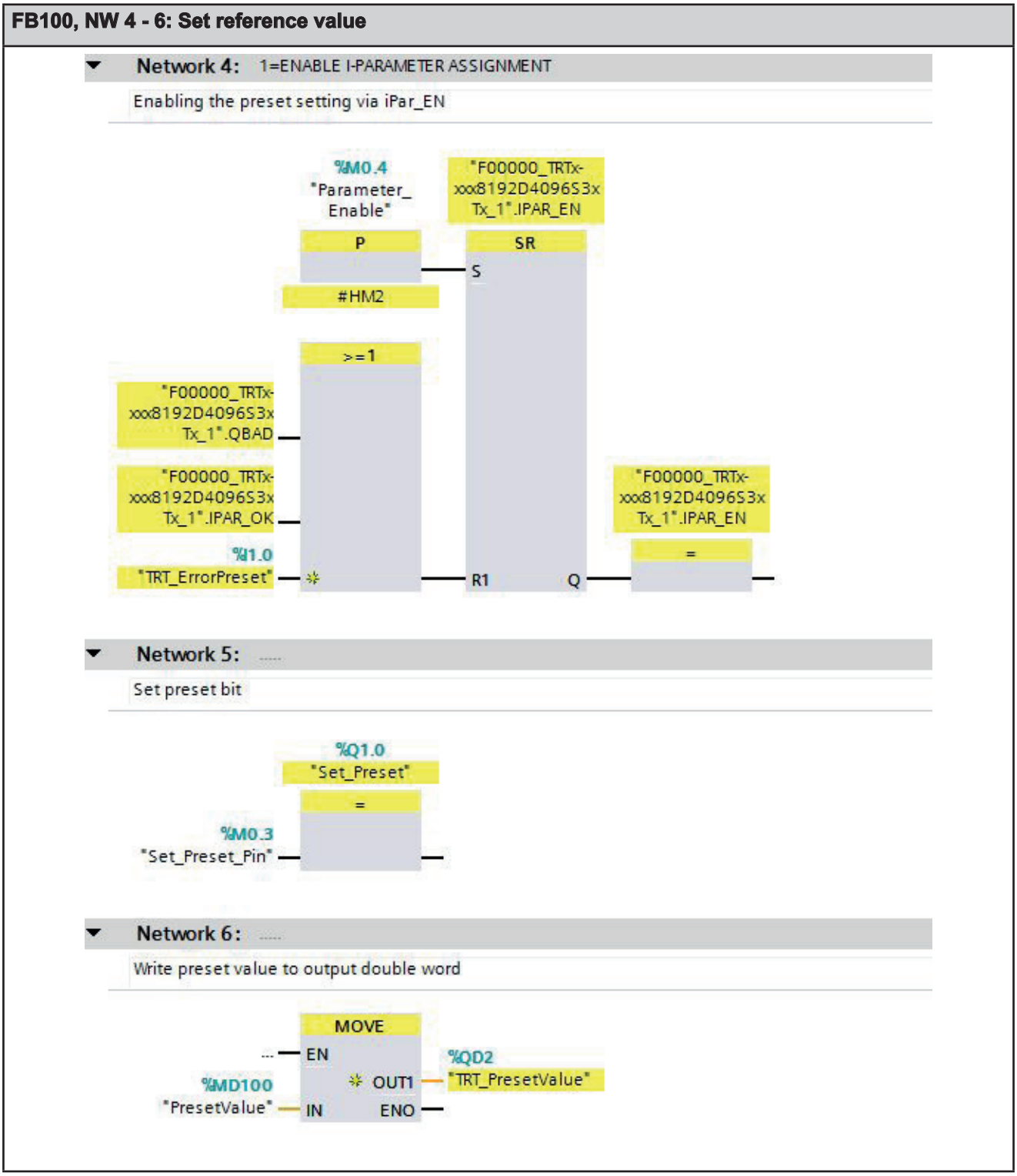


FB100, NW 1 - 3: Reading QBAD and Acknowledge



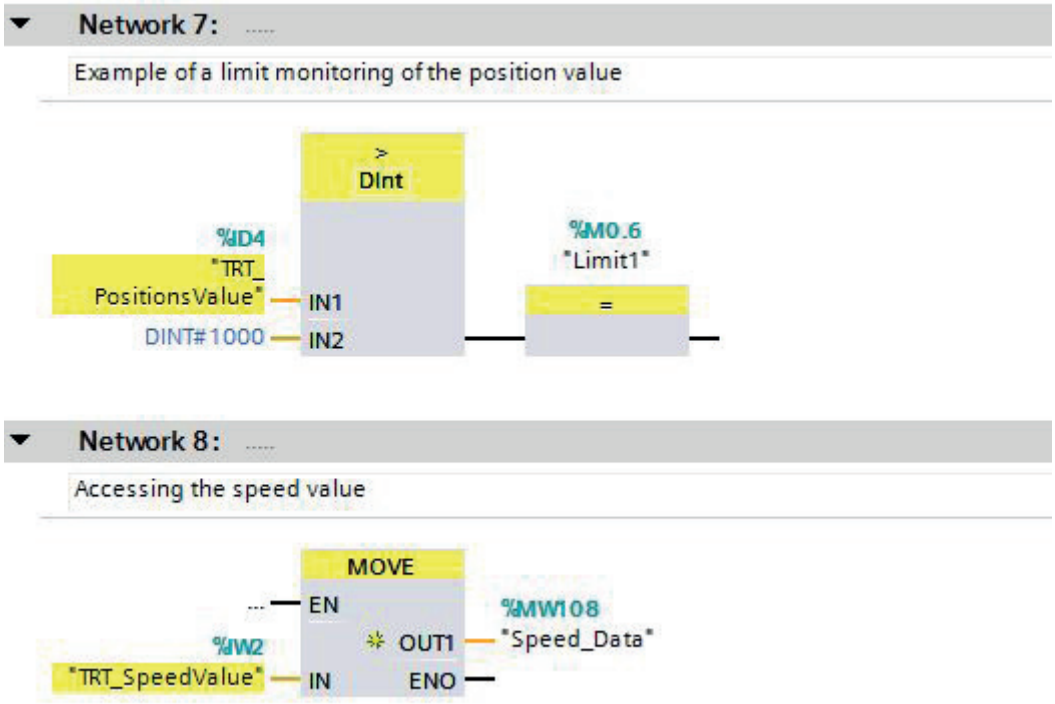
Project planning with Simatic Step7

FB100, NW 4 - 6: Set reference value



Project planning with Simatic Step7

FB100, NW 7 - 8: Accessing position and velocity

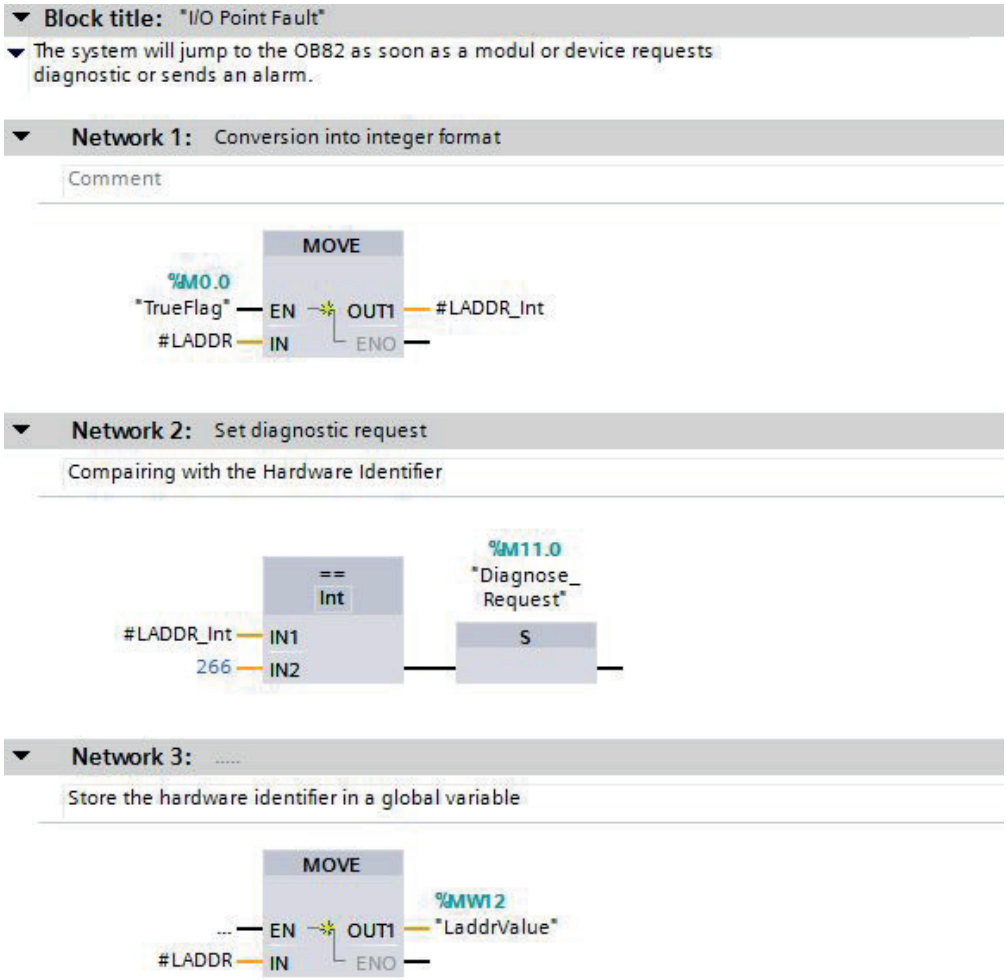


Reading the diagnosis data

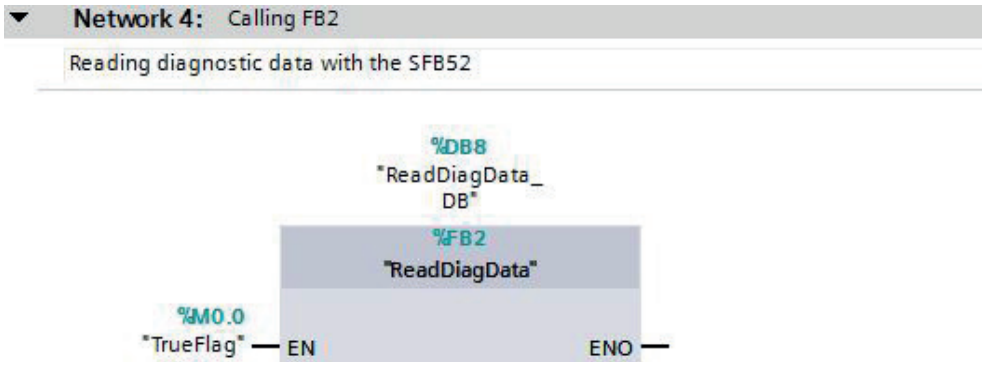
On occurrence of a PROFINET device diagnostic alarm, OB 82 is run through in S7. Amongst other aspects, the trigger for the diagnostic alarm can be ascertained in this. The diagnostic data can then be read-out with SFB52 which has to be called in the cyclic program. The events which trigger a diagnostic alarm in the absolute encoder can be found in Chapter 7.2.

The control system transfers the hardware identifier of the device which has transmitted the diagnostic alarm in the local variable LADDR.

OB 82: Evaluation of the local OB 82 data and initialisation of the read job



OB 1, NW 4: Calling the FB 1 to read the diagnostic data



Project planning with Simatic Step7

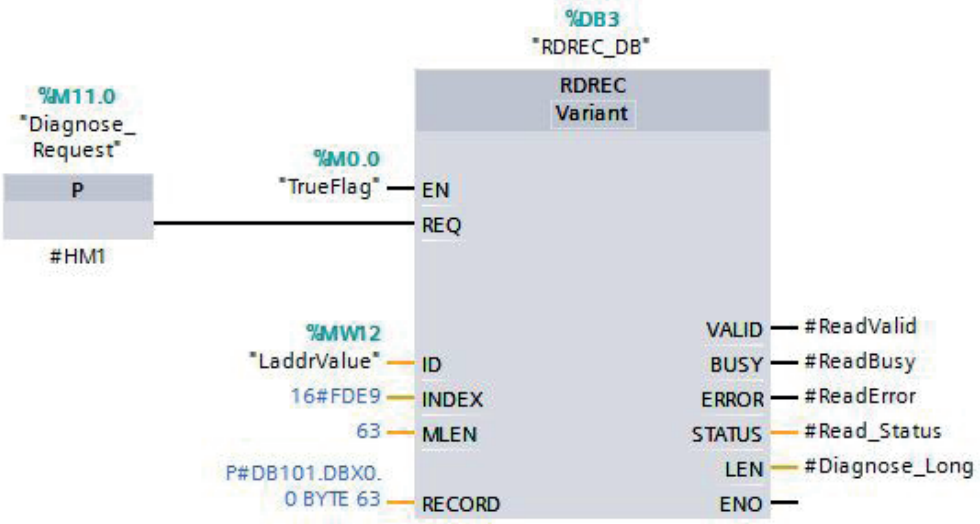
FB 2: Reading the diagnostic data with the SFB52 RDREC

Block title: Read diagnostic data

The data will be written to the DB101 starting with byte 0.

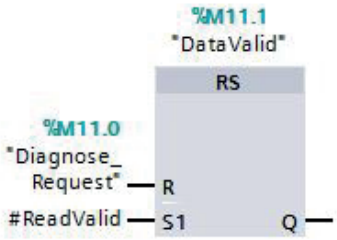
Network 1: Calling SFB52 (RDREC)

ID = Record Index
FDE9 hex - Encoder diagnostic data 63 byte (DB101), BF01 hex - Parameter data 11 byte (DB102)



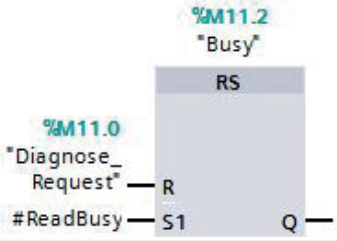
Network 2: Data Valid

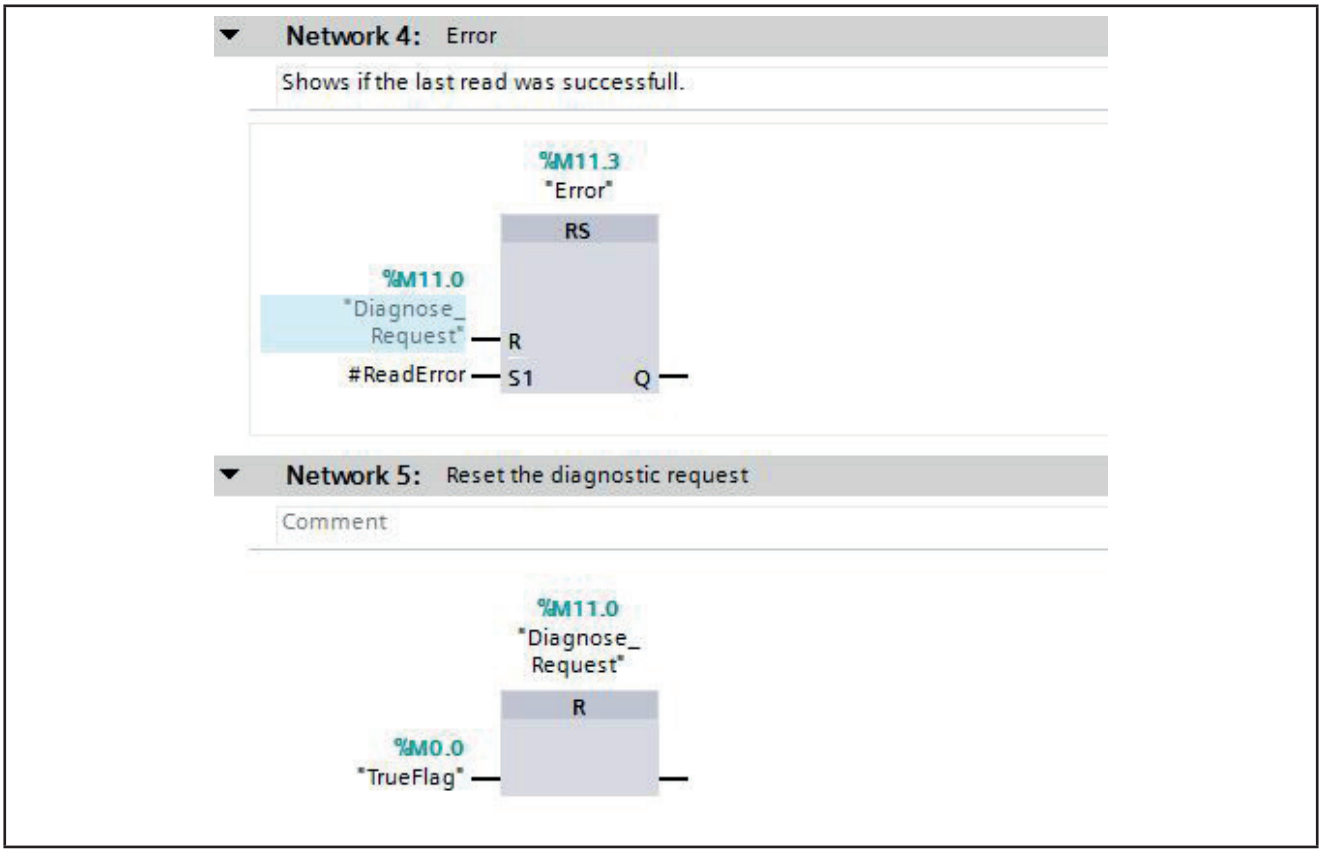
Shows if the last read was successfull and if the data are valid.



Network 3: Busy

Shows if the last reading was initiated.

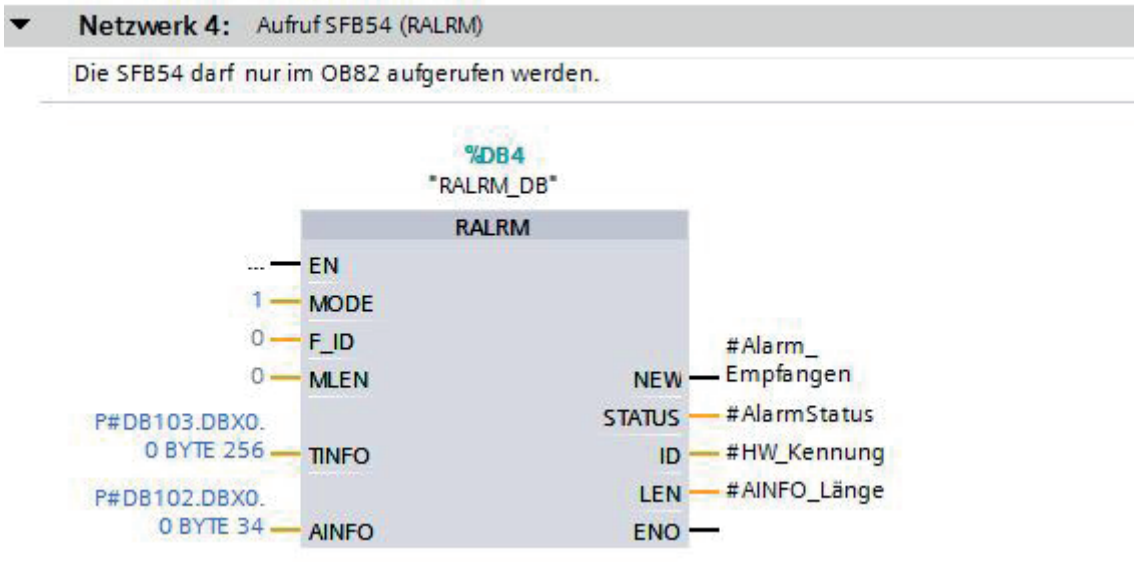




Evaluation of a Profinet alarm

The SFB54 (RALRM) has to be called in an alarm OB. In the output ID it delivers the hardware identifier of the device that has triggered the alarm. In the data block to which AINFO points amongst others the alarm number can be read.

OB 82: NW 4



5. I/O data

5.1 Overview

Note:
The illustrations of the data formats below show the Profisafe protocol of Profisafe version V2.4. The Profisafe 2.6 protocol contains a 4-byte CRC instead of a 3-byte CRC. This results in a one-byte longer protocol length.

5.1.1 Output code R and W

Input data: Device -> Controler

Octet 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8	Octet 9	Octet 10	Octet 11	Octet 12
status word		position data				velocity		F input data*			

Output data: Controler -> Device

Octet 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8	Octet 9	Octet 10
control word		preset value				F output data*			

5.1.2 Output code D and S

Input data: Device -> Controler

Octet 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8	Octet 9	Octet 10	Octet 11	Octet 12
status word		velocity		position data				F input data*			

Output data: Controler -> Device

Octet 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8	Octet 9	Octet 10
control word		preset value				F output data*			

5.2 Status word

The status word contains error bits which can be interpreted by the application program of the PLC.

Octet 1								Octet 2							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16 bit status word															

Bit	Name	Remarks/remedy
0	Error_Preset	Error during preset setting - the preset value has to be in the range of 0 ... total number of steps -1 - set the preset value only during standstill of the shaft - switch on scaling
1 - 15	not used	

* with Profisafe V2.6 the length of the F input and output data is 5 bytes

I/O data

5.3 Position data

The position value is output as a 2x 16 bit signed integer (output code R and W) or 1x 32 bit signed integer value (output code D) in Motorola format (Big Endian). The factory setting of the resolution of the position value is 4096 respectively 8192 steps / turn. When using devices with output code R and D it can be adjusted via the parameterization. For output code W it is fixed to the maximum value.

5.3.1 Data format coding R

Octet 3								Octet 4								Octet 5								Octet 6							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	position value* (singleturn)											
0	0	0	0	0	0	0	0	position value* (high)								position value (low)															

* At 12 bit resolution. With higher resolution correspondingly longer.

5.3.2. Data format coding W

The rotary encoders with code type W (TRTxx-xxxxxxxW4096S3xTxx) reveal deviating position and preset value representation. In these models, the number of revolutions (multiturn part) is output in the first word and the steps of the single-turn part in the second word

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

* At 12 bit resolution. With higher resolution correspondingly longer.

5.3.3 Data format coding D and S

Encoder with the output code D or S (TRTxx-xxxxxxxD/S4096S3xTxx) provide a position- und preset representation as double word (Integer32).

Octet 5								Octet 6								Octet 7								Octet 8							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	position value* (singleturn)											
0	0	0	0	0	0	0	0	position value* (multiturn) or slewing ring position																							

* At 12 bit resolution. With higher resolution correspondingly longer.

5.4 Velocity

The velocity value is determined via the cyclically read-in of the position data. The dimension is steps per gating time. The gating time (time interval for determining the change of position) is adjustable in the range of 10 - 1000 ms. The default value is 10 ms.

Coding R, W	Octet 7								Octet 8							
Coding D, S	Octet 3								Octet 4							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	16 bit velocity															

The speed value is output as a 16-bit signed integer value in Motorola format (Big-Endian). The following applies to the prefix:

positive for increasing position
negative for decreasing position

The refresh rate of the velocity signal is independent from the selected gating time always 1ms.

The speed measurement resolution is independent of the resolution set for the position value (resolution parameter). In devices with 12 or 13 bit resolution it is based on a resolution of 4096 otherwise on 65536 steps per revolution.

The steps/gating time unit can be converted to rpm as follows:

$$u = \frac{v \times 60000 / t}{r}$$

v = encoder output for speed value
t = gating time in ms
u = speed in rpm
r = resolution in steps (4096 or 65536)

5.5 F input data

The F input data consist of the 1-byte F status and the 3 or 4 byte CRC checksum. Their content is defined in the Profisafe profile /1/. The status of the F status bit must be evaluated in the F application programme (see programme example in Chapter 4.2.4).

5.6 Control word

Octet 7								Octet 8							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16 bit control word															

Bit	Name	Meaning
0	Set_Preset	The preset value is activated on the rising edge.
1 - 15	not used	

5.7 Preset value (reference value)

In certain cases, setting the reference value is unavoidable in order to compare the machine position values and the absolute position of the absolute encoder. The reference value is the position value which is displayed at the reference point. The user must note that the reference value must lie within the range of 0 to (total number of steps - 1). This particularly has to be taken into consideration when changing the total number of steps.

The set reference value (preset value) function can only be executed whilst the absolute encoder shaft is stationary! Setting the reference value is only possible when scaling is switched on (see Chapter 6)!

The preset value is set in the cyclical I/O data traffic by transferring the preset value in the output bytes (octets 3 - 6) and subsequently (or simultaneously) setting bit 0 of the control word (octets 1 - 2).

Before setting the preset value, the i parameterization must be enabled with the F control bit **iPar_EN**. The rotary encoder reports the completion of the process with the F status bit **iPar_OK**. If an error occurs on setting the preset value, e.g. due to a rotating rotary encoder shaft, this is reported via status bit 0 in the status word. In both cases, i.e. in the case of successful preset and in the event of an error, the iPar_EN bit must be reset. The rotary encoder then resets its iPAR_OK to zero. (See programme example in Chapter 4.2.4.)

The preset value is taken over with the rising edge of bit 0 of the contorl word. An offset value is calculated (from the current actual position and the reference value) by the absolute encoder in this case. This is stored in the absolute encoder, where it is protected against zero voltage, with the result that the new position is correctly output again even following voltage failure.

5.7.1 Data format coding R

Octet 3								Octet 4								Octet 5								Octet 6							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	preset value* (singleturn)											
0	0	0	0	0	0	0	0	preset value*								preset value															

* At 12 bit resolution. With higher resolution correspondingly longer.

5.7.2. Data format coding W

Octet 3								Octet 4								Octet 5								Octet 6							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	preset value number of turns												0	0	0	0	preset value steps*											

* At 12 bit resolution. With higher resolution correspondingly longer.

5.7.3 Data format coding D and S

Octet 3								Octet 4								Octet 5								Octet 6							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	preset value* (singleturn)											
0	0	0	0	0	0	0	0	preset value* (multiturn)																							

* At 12 bit resolution. With higher resolution correspondingly longer.

5.8 F output data

The F output data consist of 1 control byte and the 3 or 4 byte CRC checksum. Their content is defined in the Profisafe profile /1/. The F control bits are made available by the F control system and must be implemented in the F application program (see programme example Chapter 4.2.4).

6. Parameterisation

Parameterisation of the absolute encoder is carried out using the acyclical PROFINET services. In the case of the Simatic S7 control system, this is carried out during starting as default. Changing the parameter of the TRT/S3 during cyclic I/O data exchange is not possible.

Attention: Never change the parameterisation whilst a system or machine is in operation! A complete function test has to be performed after each parameter change befor returning to normal operation.

Record index	Data
0xBF02	Encoder parameter
0x64	F parameter

6.1 Encoder parameter Class2 (encoder profile 1.1)

6.1.1 Overview

Byte	Data type	Designation	Default
1	BYTE	Operating mode	0x08
2 - 5	UINT32	Single turn resolution [steps/turn]	4096*
6 - 9	UINT32	Total measuring steps [steps]	16.777.216 or 4096* for Singleturn
10 - 11	INT16	Gating time [ms]	10

6.1.2 Description of the absolute encoder parameters Class2 (encoder profile 1.1)

Byte	Bit No.	Parameter	Value range	Default	Remark
1	0	Code path	0: clockwise (cw) 1: counter clockwise (ccw)	clockwise (cw)	Ascending values on rotation clockwise (CW) or counter clockwise (CCW). (When looking towards the shaft)
	1-2	Not used			
	3	Scaling function	0: off 1: on	on	Enables/disables scaling of the position value via the resolutioin, the total number of steps and the preset.
	4-7	Not used			
2 - 5		Resolution [steps/revolution]	1 - 4096*	4096*	To change this, the parameter "Scaling function" must be set to "on"
6 - 9		Total number of steps [steps]	1 - 16,777,216* or 4096* for Singleturn	16,777,216*	To change this, the parameter "Scaling function" must be set to "on"
10 - 11		Gating time [ms]	10 - 1000	10	

* The maximum values depend on the encoder type. The values specified here apply to an encoder with 12 bit resolution.

Notes:

Coding:

All values in Motorola format (Big Endian)

Resolution

The resolution of encoders with **coding W** is not changeable and factory set to 4096 respectivly 8192 for the 25 bit encoder.

Total number of steps:

It must be noted that the number of revolutions is calculated in powers of 2n internally in the encoder. Irrespective of this requirement, the user can programme the desired total number of steps and the desired resolution according to the application. During calculation, the absolute encoder uses the next highest power of 2n if necessary. In this case, the values are designated as the effective resolution or the effective total number of steps and are displayed as the output values.

Example :	Desired total number of steps:	20,480
	Desired resolution:	4096
	Desired number of revolutions:	5
	Internal absolute encoder calculation	
	Effective total number of steps:	32,768
	Effective resolution:	4096
	Calculated number of revolutions:	8

(Note: The above notice is to be taken into consideration in the case of non-reversible operation. In the listed example, position 0 is only reached after 32,767 steps and not after 20,479 steps as desired.)

Checksum:

After changing the encoder parameters, the checksum must be recalculated and entered under the F-parameter "F_iPar_CRC". TWK provides the program PsCRC for calculating the F_iPar_CRC. You can download this program from the Internet at **www.twk.de**, **Documentation** area, **PsCRC**.

6.2 Encoder parameter slewing ring function (code S)

6.2.1 Overview

Byte	Data type	Designation	Default
1	BYTE	Operation byte	0
2 - 3	UINT16	Number of teeth slewing ring	100
4 - 5	UINT16	Number of teeth encoder pinion	10
6 - 9	UINT32	Resolution position	36000
10 - 11	UINT16	Gate time	100
12 - 15	UINT32	Resolution for speed calculation	36000

6.2.2 Description of the slewing ring parameter (code S)

Byte	Bit No	Parameter	Value range	Default	Remark
1	0	Code sense	0: clockwise (cw) 1: counter clockwise (ccw)	clockwise (cw)	Ascending values on rotation clockwise (CW) or counter clockwise (CCW). (When looking towards the shaft)
	1-7	Not used			
2 - 3		Number of teeth slewing ring	1 - 65535	100	The number of teeth of the machines slewing ring has to be great or equal the number of teeth of the encoder pinion.
4 - 5		Number of teeth encoder pinion	1 - 65535	10	Number of teeth of the encoder pinion which gears in the slewing ring.
6 - 9		Resolution position [steps]	1 ... 8192 x i	36000	Desired resolution of the slewing ring position (see notes).
10 - 11		Gate time [ms]	10 - 1000	100	Time basis of the speed measurement
12 - 15		Resolution for speed calculation [steps]	1 ... 8192 x i	36000	The resolution of the slewing ring used for the speed calculation (see notes).

Notes:

Coding:

All values in Motorola format (Big Endian)

Resolution position:

The maximum possible resolution of the slew ring is 8192 steps x gear ratio i.

Example:

Gear ratio 1:4

=> max. resolution 8192 steps x 4 = 32768 steps

To get a position value in degree you can set the parameter resolution position to:

- 360 steps for a resolution of 1°
- or 3600 steps for a resolution of 0,1°

If you enter 32768 steps the maximum number of steps is output.

Depending on the gear ratio resolutions up to 0,001° can be achieved. The following applies:

Parameter "Resolution position"	Slewing ring resolution
360	1°
3600	0,1°
36000	0,01°
360000	0,001°

Resolution for speed calculation:

The resolution of the slewing ring used for the velocity calculation can be adjusted independendly of the parameter "Resolution position".

To get a speed value in degree/time one of the following values should be entered for the parameter "Resolution for speed calculation":

Parameter "Resolution for speed calculation"	Slewing ring speed
360	1° / gate time
3600	0,1° / gate time
36000	0,01° / gate time
360000	0,001° / gate time

All intermediate values are possible.

Gate time:

The steps/gate time unit can be converted to rpm as follows:

$$u = \frac{v \times 60000 / t}{r}$$

v = encoder output for speed value
t = gate time in ms
u = speed in rpm
r = resolution for speed calculation

6.3 F parameter

6.3.1 Overview

Overview			
Octet	**Data type**	**Description**	**Default**
1	Unsigned8	F_Prm_Flag1	
2	Unsigned8	F_Prm_Flag2	
3-4	Unsigned16	F_Source_Add	0
5-6	Unsigned16	F_Dest_Add	1
7-8	Unsigned16	F_WD_Time	120
9-12	Unsigned32	F_iPar_CRC	7100
13-14	Unsigned16	F_Par_CRC	-----

6.3.2 Description of the F parameters

Octet 1: F_Prm_Flag1				
Bit no.	**Parameter name**	**Value range**	**Default**	**Remarks**
0	**F_Check_SeqNr**	0: NoCheck	NoCheck	Fixed to "No Check"
1	**F_Check_iPar**	0: NoCheck	NoCheck	Fixed to "No Check"

Parameterisation

2-3	**F_SIL**	1: SIL2	SIL2	Fixed to "SIL2"
4-5	**F_CRC_Length**	0: 3 byte CRC (V2.4) 2: 4 byte CRC (V2.6)	depending on Profisafe version	Checksum of the process data (CRC2).
6	**F_CRC_Seed**	0: CRC-Seed16 1: CRC-Seed24/32	depending on Profisafe version	Starting value of the CRC calculation
7	not used			

Octet 2: F_Prm_Flag2				
Bit no.	**Parameter name**	**Value range**	**Default**	**Remarks**
0	F_Passivation	0	0	Not supported
1-2	not used			
3-5	**F_Block_ID**	0 - 7	1	1 = F parameter block contains F_ iPar_CRC
6-7	**F_Par_Version**	1: V2-Mode	1	Parameter version

Octet 3-14				
Octet	**Parameter name**	**Value range**	**Default**	**Remarks**
3-4	**F_Source_Add**	1 - 65534		Automatically assigned by the SIMATIC manager
5-6	**F_Dest_Add**	1 - 65535	1	Must correspond to the Profisafe address set in the Profinet name. The TRT/S3 is a F device with PROFIsafe address type 1, i.e. the F_Dest_Add has be unique netwide and CPU-wide.
7-8	**F_WD_Time**	1 - 65534	120	Monitoring time in the failsafe slave. Within the monitoring time, a valid, current safety message must be received from the F CPU. Otherwise, the device goes to the safe state. Set the monitoring time long enough to ensure not only that the communication functions tolerate telegram delays, but also that the fault response is triggered quickly enough if a fault occurs (e.g. interruption of the communication connection). The minimum watchdog time for the TRT/S3 is 120 ms (for 4 ms actualisation time).
9-12	**F_iPar_CRC**	1 - 0xFFFF FFFF	0x1BBC	CRC checksum on the iParameters (encoder parameters). A checksum calculation program is availabe for download on www.twk.de menu documentaton.
13-14	**F_ParCRC (CRC1)**	0 - 65535		CRC checksum on the F parameters. Is generated from the SIMATIC Manager.

7. Diagnostic

7.1 Overview

The encoder TRT/S3 provides diagnostic data in 3 different ways.

- LEDs (see Chapter 3.3)
- PROFINET alarms (see Chapter 7.2)
- Diagnostic data (see Chapter 7.3)

7.2 PROFINET alarms

The following alarms are send via the PROFINET alarm mechanism. In the PROFINET controler they are displayed in plain text and partially with a help text.

Erro no. (hex)	Error text	Reaction	LED failure type	Remarks/remedy
0x001A	Internal communication error (TPS-1)	Input and F data = 0	System failure	Please switch power off/on or change the device
0x0040	Mismatch of safety destination address (F_Dest_Add)	Diagnostic data: F parameter error	Parameterisation failure	
0x0041	Safety destination address not valid (F_Dest_Add)	Diagnostic data: F parameter error	Parameterisation failure	
0x0042	Safety source address not valid (F_Source_Add)	Diagnostic data: F parameter error	Parameterisation failure	
0x0043	Safety watchdog time value is 0 ms(F_WD_Time)	Diagnostic data: F parameter error	Parameterisation failure	
0x0044	Parameter "F_SIL" exceeds SIL from specific device application	Diagnostic data: F parameter error	Parameterisation failure	
0x0045	Parameter "F_CRC_ Length" does not match the generated values	Diagnostic data: F parameter error	Parameterisation failure	
0x0046	Version of F-Parameter set incorrect (F_Par_Version)	Diagnostic data: F parameter error	Parameterisation failure	
0x0047	F parameter CRC error (CRC1-Fault)	Diagnostic data: F parameter error	Parameterisation error	
0x0048	Error in F parameterset	Diagnostic data: F parameter error	Parameterisation failure	
0x004B	Inconsistent iParameters (iPar-CRC error)	Diagnostic data: F parameter error	Parameterisation failure	Please check the value of the F parameter F-iPar-CRC.

Diagnostic

0x1100	Device error	Diagnostic data: device error F status word: FV_activated, Device_ Fault	System failure	Please switch power off/on or change the device.
0x1110	Preset error	Diagnostic data: Preset error Status word: Error-Preset	Parame-terisation failure	The preset value has to be in the range of 0 ... total number of steps -1. Setting the preset is only allowed when the shaft is in standstill. Scaling has to be on.
0x1120	Velocity measuring range exceeded	Diagnostic data: velocity error F status word: FV_activated	Parame-terisation failure	Please reduce the velocity or decrease the gating time.
0x1140	Parameter error	Diagnostic data: Parameter error	Parame-terisation failure	The value for the total measuring range has to be in the range of: resolution ... (resolution x max. number of turns (4096)).
0x1150	Supply voltage out of range	F status word: FV_activated, Device_ Fault	System warning	Please check the supply voltage and switch power supply off/on.
0x1160	Wrong Record Index on startup	F status word: FV_activated, Device_ Fault	Parame-terisation failure	Please check your GSD file.
0x1170	Sensor not ready	F status word: FV_activated, Device_ Fault	System failure	Please switch power off/on or change the device.

7.2.1 Additional alarms of hardware version 2

Erro no. (hex)	Error text	Reaction	LED failure type	Remarks/remedy
0x1102	Synchronisation error	Input data = 0, F status word: FV_activated, De-vice_Fault	System failure	Please switch power off/on or change the device.
0x1105	Sensor error	Input data = 0, F status word: FV_activated, De-vice_Fault	System failure	Please switch power off/on or change the device.
0x1106	Gear error	Input data = 0, F status word: FV_activated, De-vice_Fault	System failure	Please switch power off/on or change the device.
0x1151	Operating temperature exceeded/undershot		System warning	Please switch off power until the ambi-ent temperature is within the permissi-ble range again.

0x1190	Other hardware error	Input data = 0, F status word: FV_activated, Device_Fault	System failure	Please switch power off/on or change the device.
0x1191	Error in temparature sensor	Input data = 0, F status word: FV_activated, Device_Fault	System failure	Please switch power off/on or change the device.
0x1192	Error in intertial sensor	Input data = 0, F status word: FV_activated, Device_Fault	System failure	Please switch power off/on or change the device.
0x1200	Error in slewing ring calculation	Input data = 0, F status word: FV_activated, Device_Fault	System failure	Please switch power off/on or change the device.
0x1210	Not supported module or module combination		Parameterisation failure	Please change the module or the module combination

7.3 Diagnostic data records

The following diagnostic records are available in the TRT/S3. They can be read out with the PROFINET acyclic read services.

Record index	Data
0xAFF0	I&M0 data (according to I&M-specification version 1.2 /9/)
0xBF02	Parameter data (see Chapter 6)
0xFDE9	Diagnostic data according to Encoder Class 2 Profile (see below)

7.3.1 Diagnostic data according to Encoder Class 2 Profile

Diagnosis data in data record 0xFDE9					
Byte	**Datatyp**	**Diagnostic function**	**Default (values in hex)**	**Diagnostic alarm**	**Remark**
1 - 8	BYTE	Reserved	00		
9	BYTE	Operating status	08	No	CW, Scaling on
10	BYTE	Encoder typ	01	No	Absolute multiturn encoder
11 - 14	UINT32	Maximum resolution	0000.1000*	No	Maximum possible steps/ revolution of the present encoder typ.
15 - 16	UINT16	Maximum measuring range	1000	No	4096 revolutions
17	UINT8	Additional alarm messages	00	No	Not supported
18 - 19	UINT16	Supported alarm messages	0000	No	Not supported
20 - 21	UINT16	Warning messages	0000	No	Not supported

Diagnostic

22 - 23	UINT16	Supported warning messages	0000	No	Not supported
24 - 25	UINT16	Profile version	0101	No	Current encoder profile version
26 - 27	UINT16	Software version	xx.xx	No	Current firmware version
28 - 31	UINT32	Operating time	FFFF.FFFF	No	Not supported
32 - 35	UINT32	Offset value	0000.0000	No	Current internally calculated offset value
36 - 39	UINT32	Manufacturer offset value	0000.0000	No	Not supported
40 - 43	UINT32	Resolution	0000.1000*	No	Currently set resolution
44 - 47	UINT32	Total number of steps	01.000.0000*	No	Current total number of steps
48 - 57	BYTE	Serial number		No	Serial number of the device
58 - 59	BYTE	Reserved	0000	No	
60 - 63	BYTE	Manufacturer specific diagnostic data	00000000	Yes	See below

*Depending on the encoder type.

Encoder specific diagnostic data

Byte	Bit	Error message	Diagnostic alarm	Status-LED (NS)	Remarks/remedy (see Profinet alarms)
60		reserviert			
61		reserviert			
62	0	Flash error	yes	fast red flashing (10 Hz)	
	1	not used			
	2	F parameter error	yes	red flashing (1 Hz)	
	3 - 7	not used			
63	0	not used			
	1	Device error	yes	fast red flashing (10 Hz)	
	2	Parameter error	yes	red flashing (1 Hz)	
	3	Scaling error	yes	red flashing (1 Hz)	
	4	Supply voltage out of range	yes	red flashing (1 Hz)	
	5	not used			
	6	Preset error	yes	red flashing (1 Hz)	
	7	Velocity error	yes	red flashing (1 Hz)	

Scope of delivery, Literature

8. Scope of delivery

The scope of delivery includes:

- Absolute encoder with PROFIsafe interface
- Connection assignment TY XXXXX (depending on the device variant)

Available for download on www.twk.de are:

- the corresponding datasheet
- this user manual
- the checksum calculation program PsCrc
- the certificates
- example programmes
- GSD file and bitmap

9. Literature

/1/ PROFIsafe-Profile for Safety Technology, Order No. 3.092 und 3.192, PROFIBUS Nutzerorganisation e. V., Haid-und-Neu-Str. 7, D-76131 Karlsruhe, www.profibus.com

/2/ PROFINET - Interface nach IEC 61158 / 61784 bzw. PNO-Spezifikation, Order No. 2.712 und 2.722, PRO FIBUS Nutzerorganisation e. V., Haid-und-Neu-Str. 7, D-76131 Karlsruhe, www.profibus.com

/3/ PROFINET Installation guidline, Order No. 8.071, PROFIBUS Nutzerorganisation e. V., Haid-und-Neu-Str. 7, D-76131 Karlsruhe, www.profibus.com

/4/ PROFINET Cabling and Interconnection Technology, Order No.: 2.252, PROFIBUS Nutzerorganisation e. V., Haid-und-Neu-Str. 7, D-76131 Karlsruhe, www.profibus.com

/5/ Installation Guideline PROFINET Part2: Network Components, Order No.: 2.252 p2, PROFIBUS Nutzeror ganisation e. V., Haid-und-Neu-Str. 7, D-76131 Karlsruhe, www.profibus.com

/6/ PROFIsafe - Environmental Requirements related to PROFIsafe - Profile for Safety Technology on PROFI-BUS DP and PROFINET IO (IEC 61784-3-3), Order No. 2.232, PROFIBUS Nutzerorganisation e. V., Haid-und-Neu-Str. 7, D-76131 Karlsruhe, www.profibus.com

/7/ SIMATIC S7 Distributed Safety - Project Planning and Programming, Programming and Operating Manual (A5E00109536-03) - http://support.automation.siemens.com

/8/ SIMATIC S7 Distributed Safety Getting Started (A5E00320725-01) - http://support.automation.siemens.com

/9/ Profile Guidelines Part 1: Identification & Maintenance Functions, Order No. 3.502, www.profibus.com

/10/ SIMATIC Safety - Project Planning and Programming (A5E02714440-AC) - http://support.automation.siemens.com

/11/ SIMATIC Safety - Getting Started (A5E02714463-01) - http://support.automation.siemens.com