Inclination sensor NBT/S3
with PROFIsafe on PROFINET interface
Relevant data sheet NBT 13911

SUPREME SENSORING
TWK

Document no: NBT 13912 GE
Date: 29.06.2021

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. +49/211/96117-0 ■ 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 inclination sensor with PROFINET interface:

- NBTxx-xxx/x/xS3-x-xxTxx

1.2 Documentation

The following documents must be observed:

- The owner's system-specific operating instructions
- This user manual
- Data sheet number NBT 13911
- The connection assignment enclosed with the device

1.3 Proper use

The TWK-ELEKTRONIK GmbH sensors 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

The inclination sensor NBT/S3 is composed of a redundant sensor modul. The sensor chips are one, two or three axis acceleration sensors based on MEMS (Micro-Electro-Mechanical-System) technology which work with the gravitational force. Each sensor modul ist optimized for the dedicated measuring task.

The sensor modul is connected to the evaluation electronic which processes the measuring signal by filtering, plausibility check, linearisation and calibration and provides the measuring values via PROFIsafe/PROFINET protocol for the user.

The PROFINET interface according to IEC 61158 / 61784 or PNO specifications, order Nos. 2.712 and 2.722 version 2.3, 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, are integrated.

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

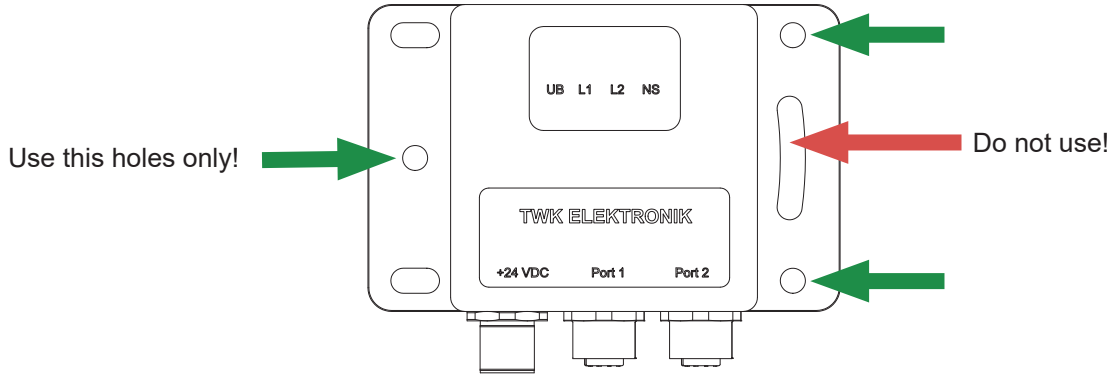
3. Installation

3.1 General information

- During installation, observe the profinet assembly guideline PNO order No.: 8.071 /3/ and the PROFIsafe Environmental Requirements related to PROFIsafe - Profile for Safety Technology on PROFIBUS DP and PROFINET IO /6/.
- Use only certified PROFINET cables, connectors and switches (see "PROFINET Cabling and Interconnec tion 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 inclination sensor NBT/S3 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 Installation

For safety reason the mechanical installation of the NBT65/S3 has to be done in such a way, that an accidental displacement of the device is not possible.This means that a form-locked installation has to be done and the use of the long hole of the mounting plate without any additional fixation is not permitted. The round holes shall be used instead.



3.3 Electrical connection

The inclination sensors "NBT...S3T01" with connector output 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. Only use shielded cable for power supply and PROFINET.

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. 13911 for connector assignment and ordering information.

3.4 Status LEDs

The inclination sensor has four LEDs. 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	See Chapter 7.2
			Fast red flashing	Device error
			red	Connection to the PROFINET controller disrupted

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

Flashing codes

Errors which lead to sensor 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

3.5 Project planning

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

File name of the GSD file: GSDML-V2.32-TWK-NBTS3-20190619.xml (The version and date may vary depending on the status of the GSD file)

File name of the bitmap: GSDML-0159-8000-TWK_NBTS.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 NBT/S3 inclination sensor into the PROFINET network of a Siemens S7 control system with Step 7 Professional V14 and Safety Advanced V14.

4.1.1 Prerequisites

You have installed and parameterized a F PLC under "Devices & networks" according to your equiment as well as a PROFINET subnet.

This is shown here using the example of a CPU1511F:

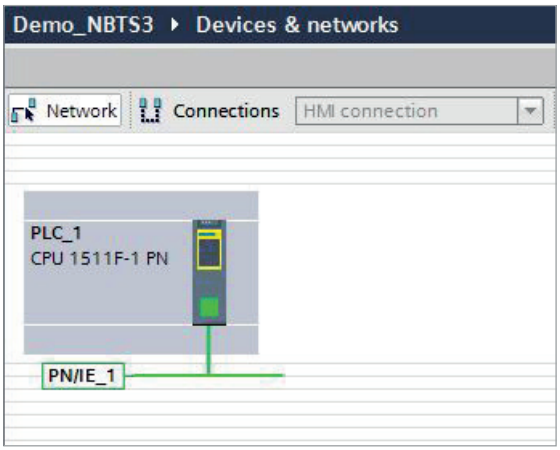


Fig.: 1

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 2).
- The inclination sensor symbol is also installed automatically, provided that it is in the same directory

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

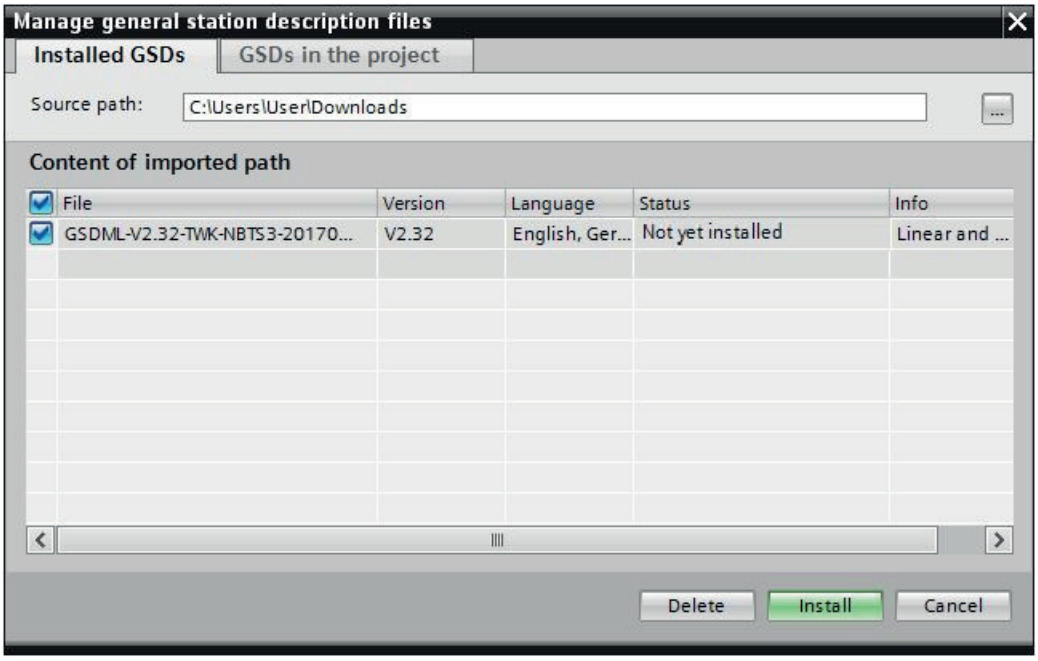


Fig.: 2

After installing the GSD file, the hardware catalogue is automatically updated. The inclination sensor NBT/S3 is located in **Other field devices, PROFINET IO, Sensors, TWK-ELEKTRONIK GmbH, TWK N-Series, NBT/S.**

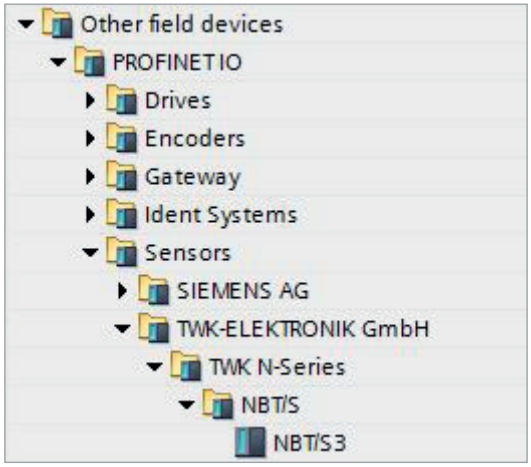


Fig.: 3

4.1.3 Installing the inclination sensor

Now drag the NBT/S3 from the hardware catalog in the netview of your project.

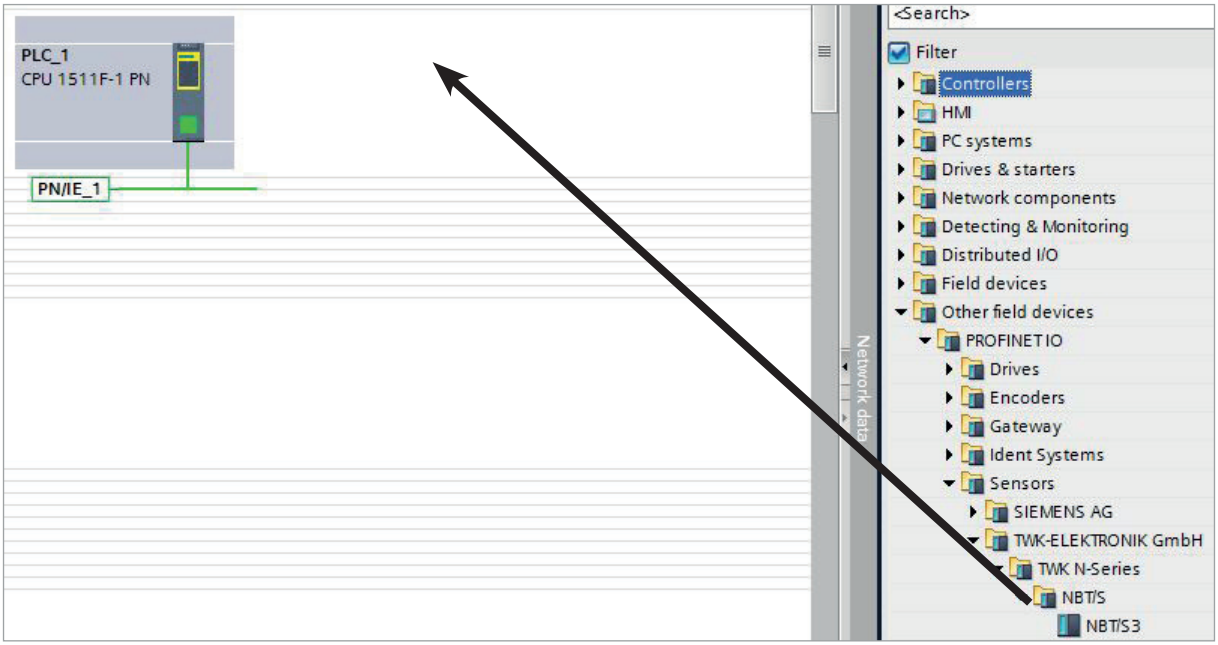


Fig.: 4

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

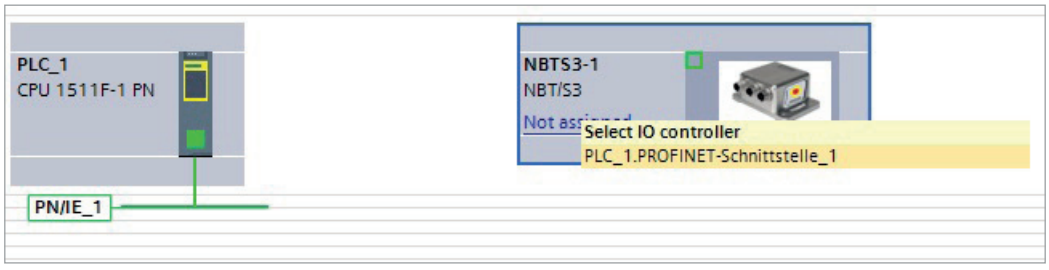


Fig.: 5

4.1.4 Install module

To install the inclination sensor module change to the **Device view** and drag the module "Inclination+status" to the first free slot of the module list.

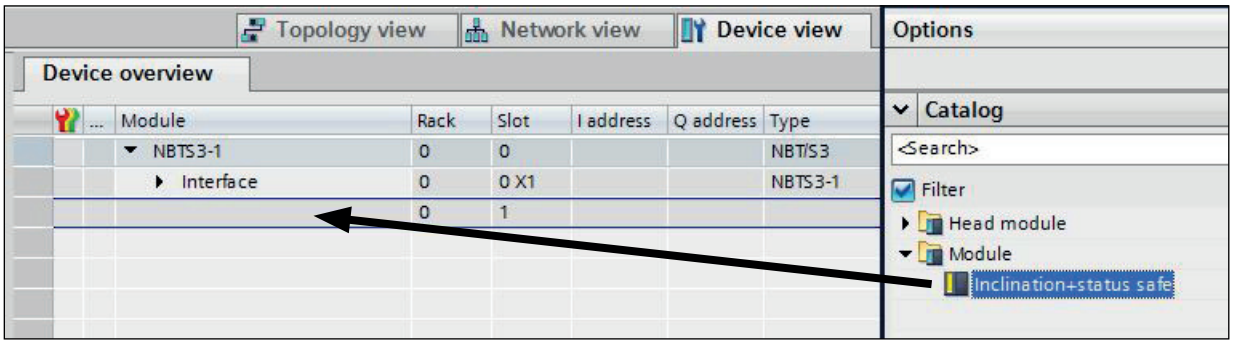


Fig.: 6

In the properties of the installed module we will set the I/O address and the sensor parameters later on.

4.1.5 Setting the network data

Select the inclination sensor in the Device view to show the properties of the PROFINET interface of the NBT/S3.

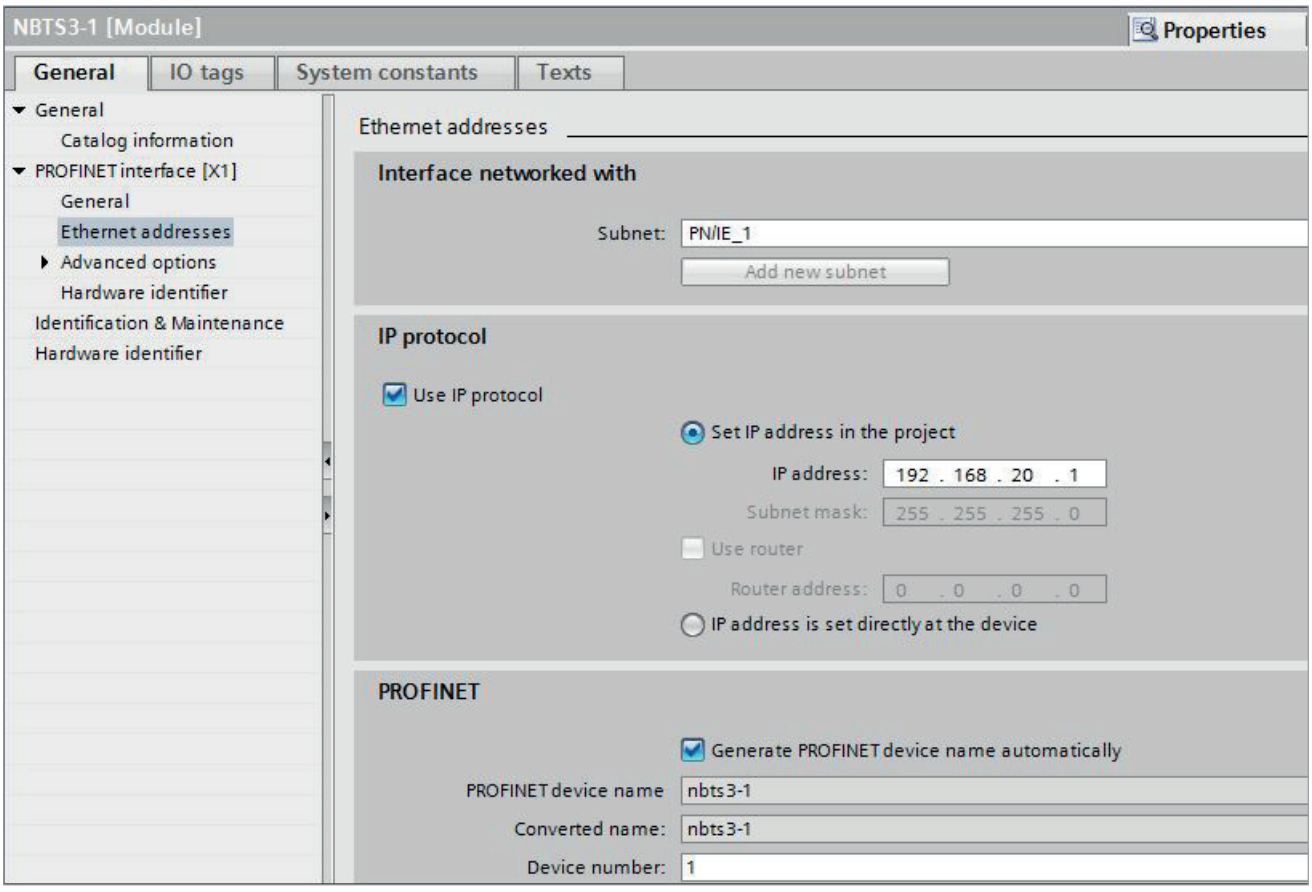


Fig.: 7

4.1.5.1 Setting the PROFINET / PROFIsafe address

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 NBTS3-1.

In the NBT/S3, the **Profisafe address** must be added to the PROFINET 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). The attached number must then be entered for F_Dest_Add under the F parameters (see Chapter 4.1.6.3).

The complete name assigned here must either be manually allocated to the inclination sensor (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 inclination sensor, 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 sensor by the controller. To do this, however, the prerequisites under Chapter 4.1.7 have to be met.

4.1.5.2 IP address

Under **PROFINET interface - Ethernet addresses - IP protocol** the boxes **Use IP protocol** and **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 NBT/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 NBT/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 NBT/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 NBT/S3 can be set. The possible values depend on the setting of the send clock of the CPU. The minimal update time for the NBT/S3 is 250 µs.

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

4.1.6 Setting the inclination sensor

4.1.6.1 Setting the I/O address

After switching to the device view of the NBT/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 (status word and position) and for the output data (control word and preset value) under I/O addresses (see Chapter 5 for the data format).

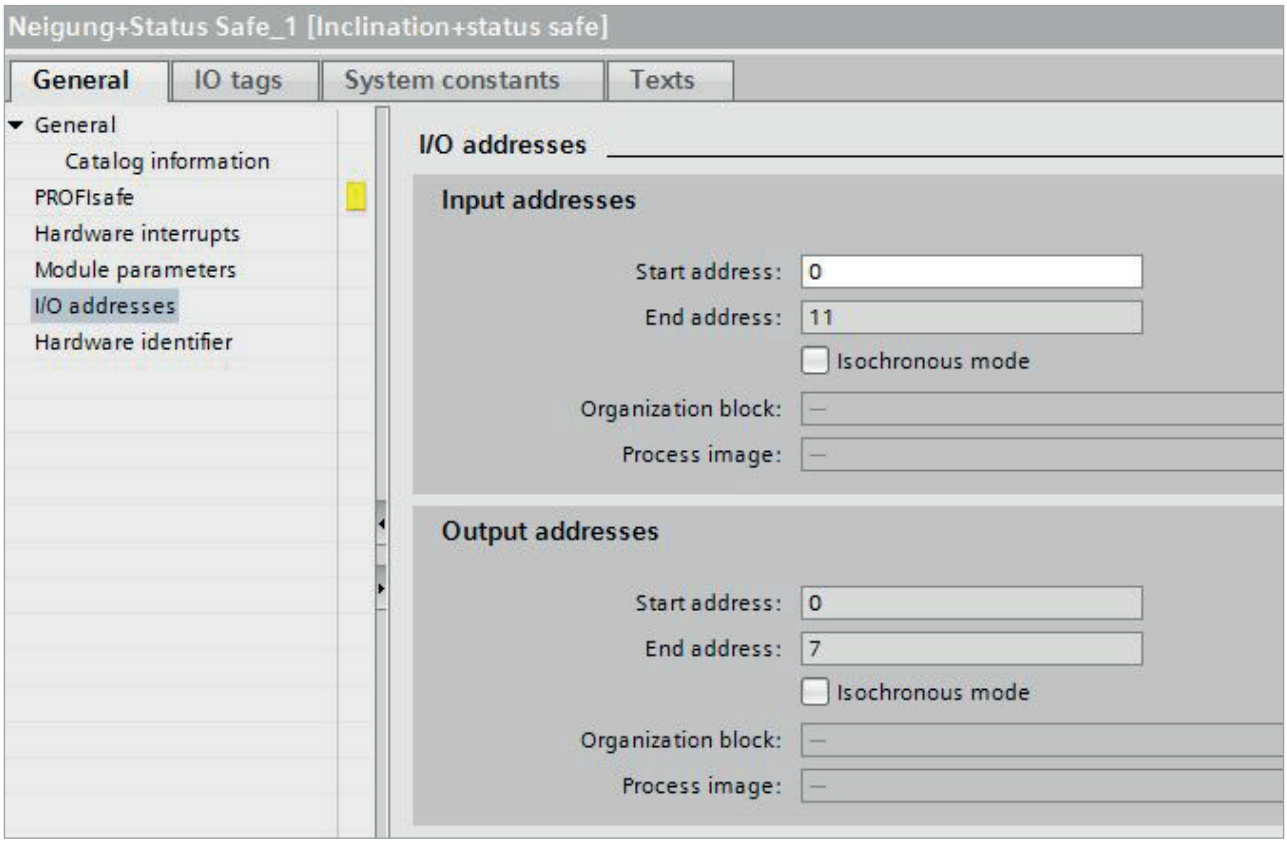


Fig.: 8

4.1.6.2 Parameterising the inclination sensor

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

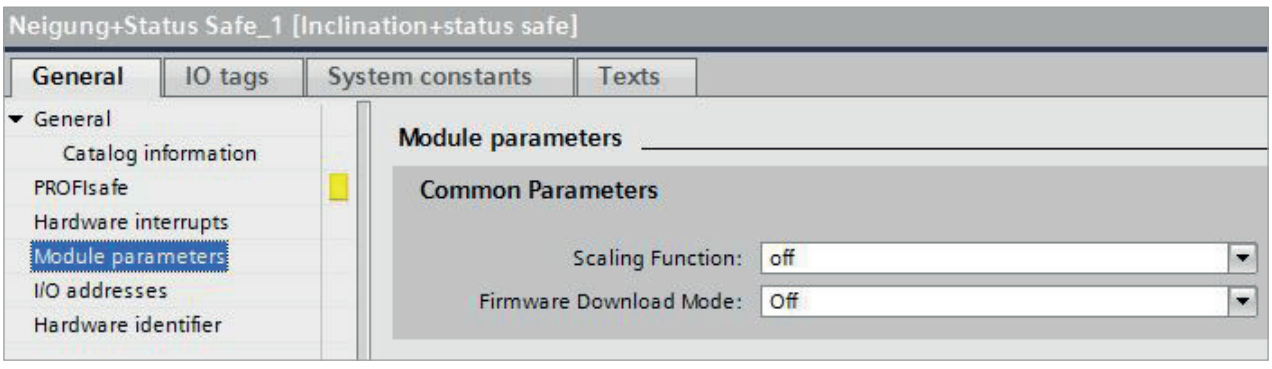


Fig.: 9

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.

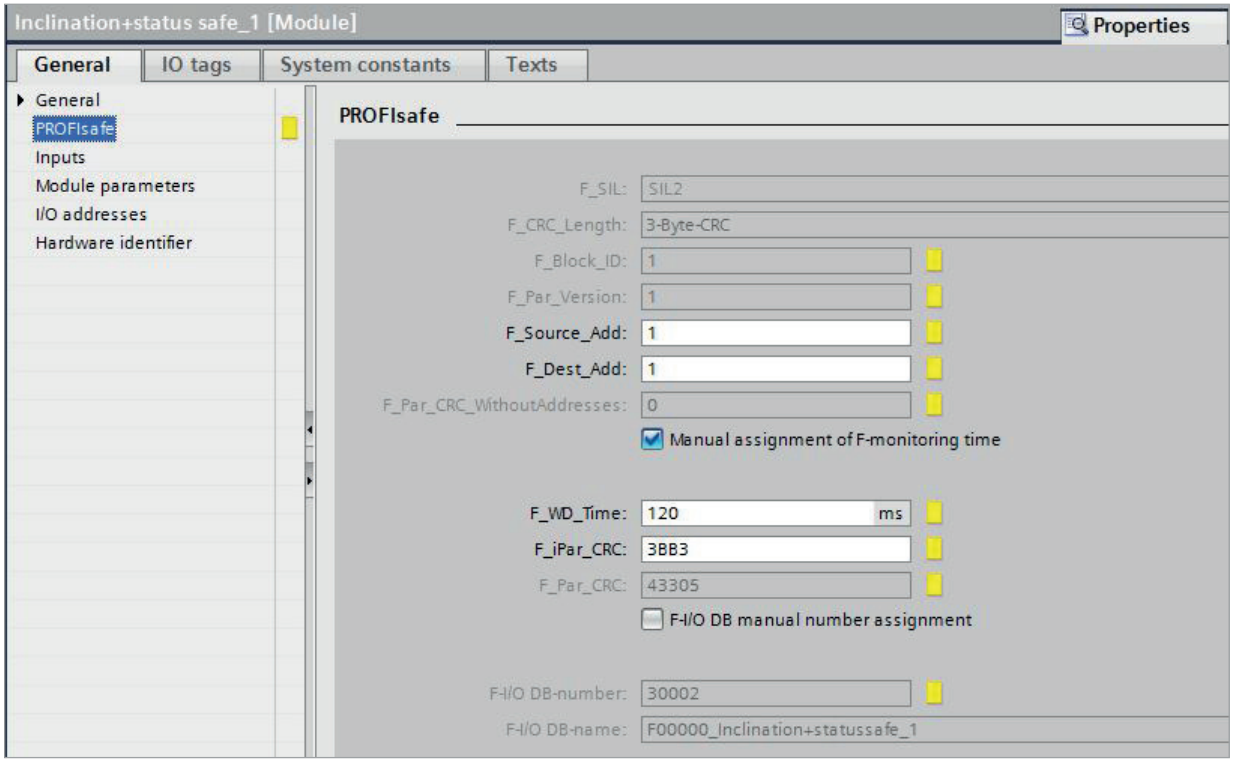


Fig.: 10

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

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 sesnor 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 NBT/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 inclination sensor name must be assigned manually. With the inclination sensor connected and the programming device connected to the control system, select "Assign device name" in the context menu of the PROFINET.

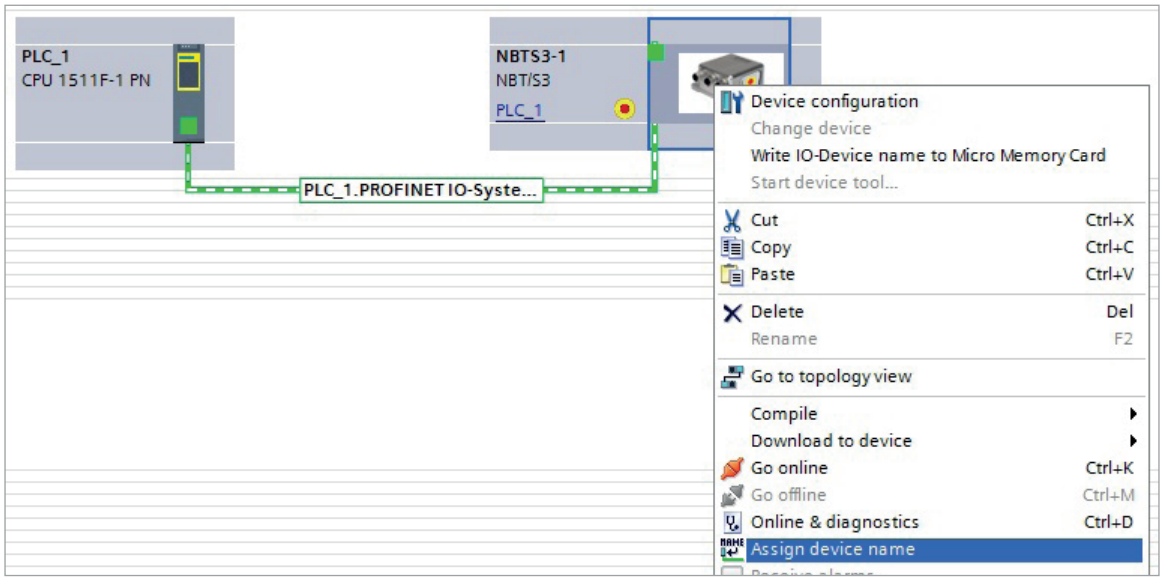


Fig.: 11

Subsequently the window "Assign PROFINET device name" appears. After selecting the correct online connection the accessible devices will be displayed. This for example could look like shown in figure 11.

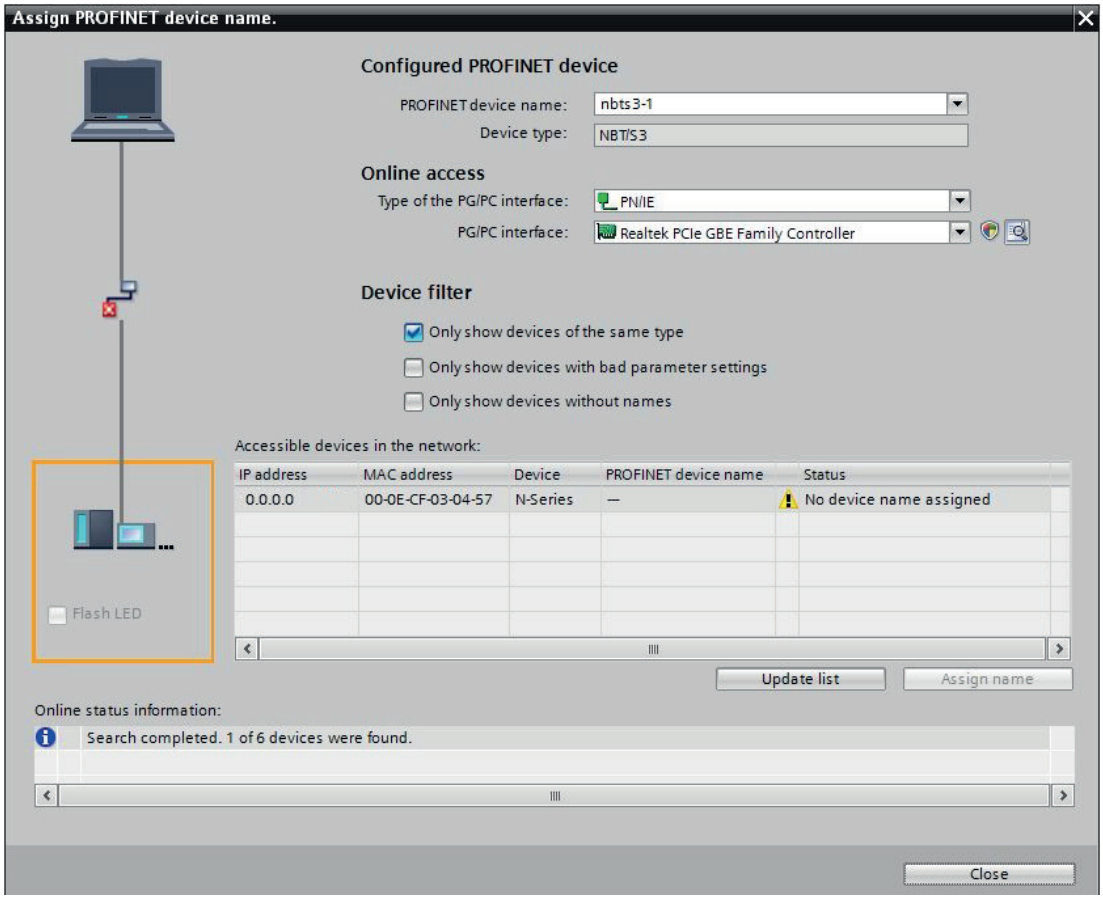


Fig.: 12

It can be seen that the inclination sensor device type "N series" does not possess either a valid IP address or a name. Now mark the sensor, check the name proposed at the top of the window and click on "assign name." The device name is then stored in the inclination sensor, where it is protected against zero voltage.

The inclination sensor now logs onto the controller with its device name and is then provided with a valid IP address by the controller. This is also stored in the inclination sensor, where it is protected against zero voltage.

4.1.9 Resetting to the factory settings

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

Fig.: 13

The following data will be reset as follows:

The following are reset	delivery condition
Parameters	see Chapter 6.1 for default values
Device name	empty
IP-parameters	All 0
I&M0-revision counter	0
I&M1-3	empty (only when choosing "Delete I&M data)

After resetting, the connection to the Profinet controller is closed and the NS LED lights up red. 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 NBT/S3 restarts automatically with the name assigned during project planning.

4.2 Application program

4.2.1 Remarks

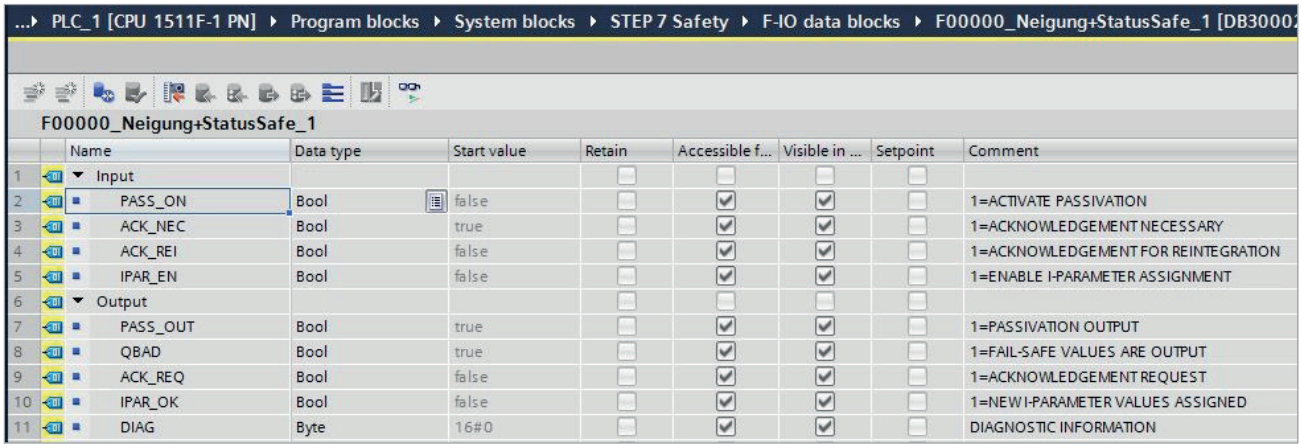
For a detailed documentation for project planning and programming of F programs in Safety Advance refer to::

SIMATIC Safety - Project Planning and Programming /7/ and SIMATIC Safety Getting Started /8/

4.2.2 F periphery DB

On translation of the hardware configuration, an **F periphery DB** is generated for the inclination sensor, 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 sensor necessary variables. It has the following appearance: (A detailed description can be found in the documentation mentioned above)



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

Fig.: 14

4.2.3 Accessing the inclination sensor in the F program

Important for the fail safe operation of the inclination sensor 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.

Note:

In the special version "V" the sensor does **not** enter the failsafe state when interferrence accelerations are to high. The user is required to ensure that the machine/system is in normal operating state during the period of time in which inclination measurement is not possible due to interference accelerations. Via his control system programme, the user must ensure that no dangers arise due to the application during this time. As soon as the interference occurs, the position output value is set to -180° and the bit "Position not valid" in the status word is set.

4.2.4 Example program

The following example shows how to access the position value and the F periphery DB of the PROFIsafe inclination sensor in the safety programme. Only the programming steps which refer to the TWK inclination sensor 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 Safety - Project Planning and Programming " /7/ and "SIMATIC Safety Getting Started" /8/

Devices required to operate the example program

- F CPU with PROFINET interface
- PROFIsafe inclination sensor NBT/S3
- optionally one digital input for the acknowledge and two digital outputs to monitor the acknowledge request and the failsafe status (here realized with a ET200S with IM151-3PN)
- Step 7 Professional V13 with Safety Advanced

Hardware structure of the example program

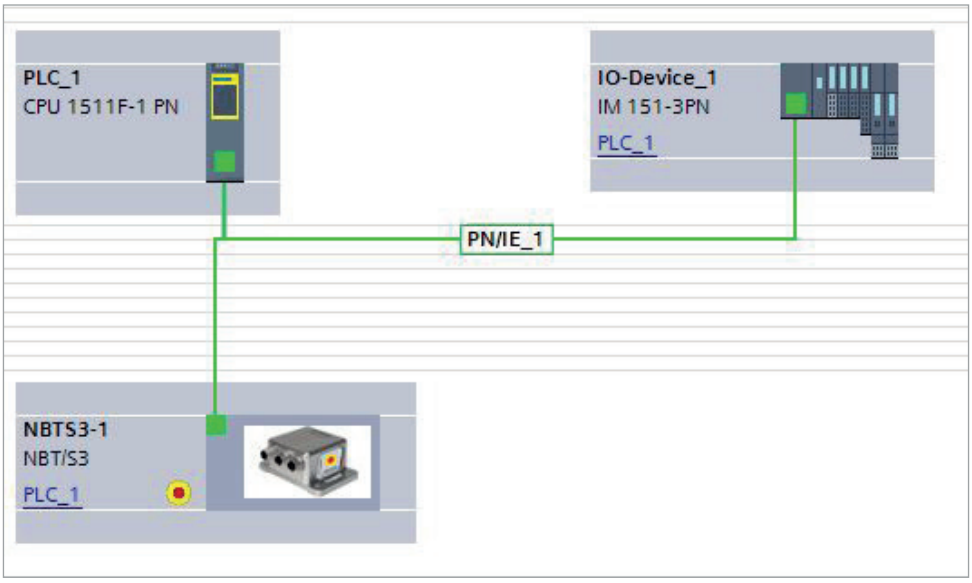


Fig.: 15

Inputs and outputs used in the program

IW	0	Inclination sensor status word
IW	2	Inclination sensor x axis
IW	4	Inclination sensor y axis
IW	6	Inclination sensor z axis
I	12.0	Acknowledgement and reintegration
I	12.1	Set preset x axis
I	12.2	Enable parametrisation
QW	0	Inclination sensor control word
QW	2	Preset value
Q	12.0	Acknowledgement necessary
Q	12.1	Failsafe status
Q	12.6	Positive limit exceeded
Q	12.7	Negative limit exceeded

Remarks to the program

Access to the inclination sensor is carried out in an F programme module (here FB100), which must be called up in F-runtime group. Calling the FB100 is not described here.

The following listing contains only the for the handling of the inclination sensor relevant part. Program blocks like clock OBs or peripheral data blocks are not listed.

OB1, NW 1 - 2: Show F error messages with the DIAG byte

Block title: "Main Program Sweep (Cycle)"

Comment

Network 1: Create true flag

Comment

Network 2: Evaluation Diag byte

Monitoring 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 /7/)

FB100, NW 1 - 3: Acknowledge and reading QBAD

Block title: F-programme example for the TWK inclination sensor NBT/S3

Comment

Network 1: Failsafe state QBAD

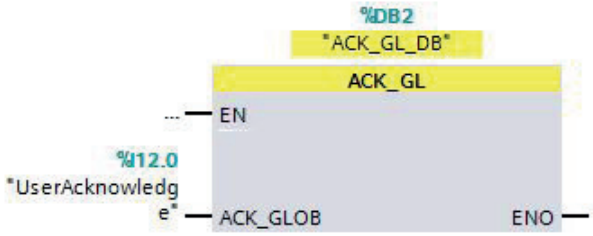
In a real system the QBAD signal of the sensor has to be polled. If QBAD = TRUE system has to go in the fail safe state.

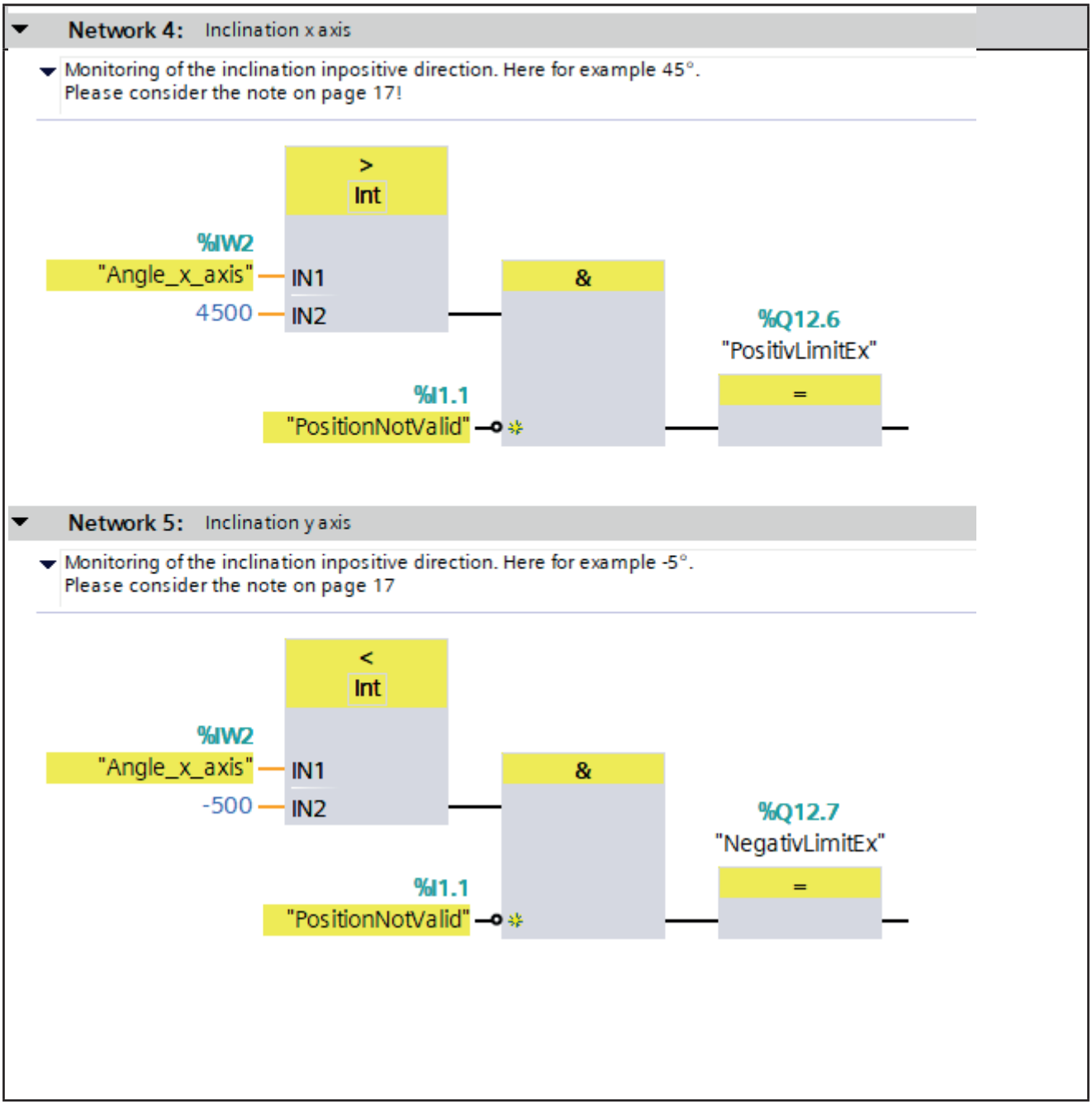
Network 2: Acknowledge request

Display necessary user acknowledgement

Network 3: Acknowledge and reintegration

Carry out user acknowledgement

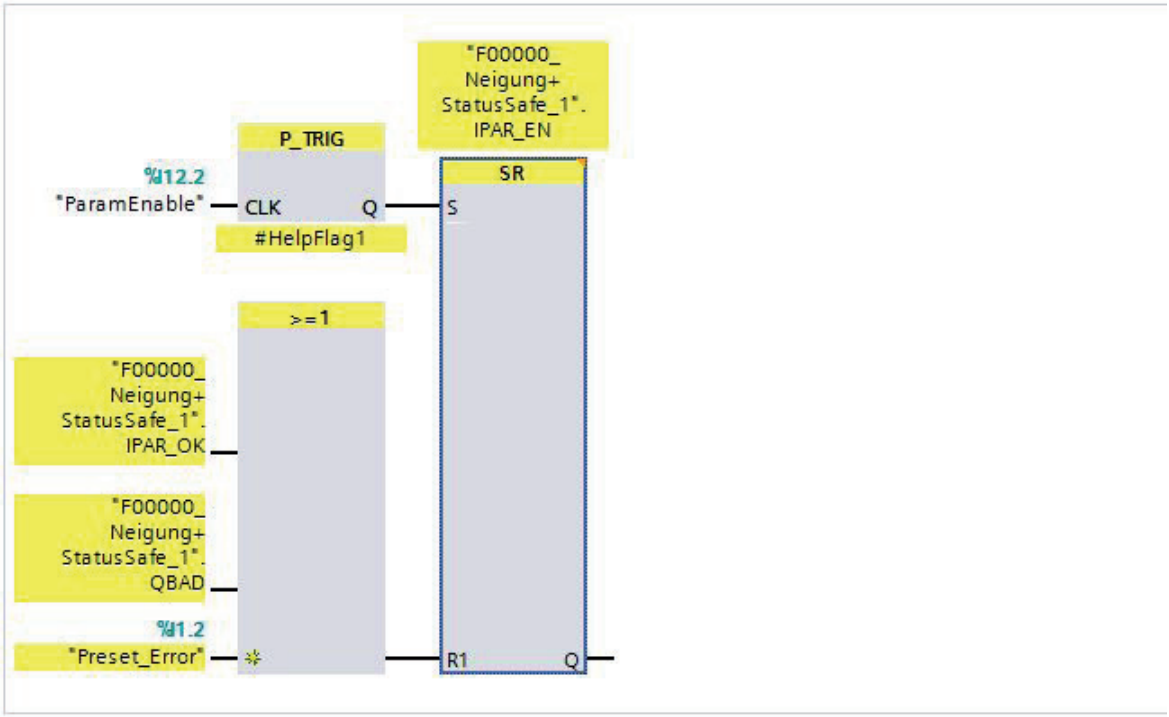



Network 4: Inclination x axis
Monitoring of the inclination inpositive direction. Here for example 45°.
Please consider the note on page 17!
>
Int
%IW2
"Angle_x_axis"
IN1
4500
IN2
&
%Q12.6
"PositivLimitEx"
%I1.1
"PositionNotValid"
=
Network 5: Inclination y axis
Monitoring of the inclination inpositive direction. Here for example -5°.
Please consider the note on page 17
<
Int
%IW2
"Angle_x_axis"
IN1
-500
IN2
&
%Q12.7
"NegativLimitEx"
%I1.1
"PositionNotValid"
=

FB100, NW 6 - 8: Preset setting

Network 6: Presetfunction

Set iPar_En bit



Network 7: Presetfunction

Copy preset value from e.g. HMI to the NBT

Network 8: Presetfunction

Set preset bit (Here for the x axis. The procedure is the same for all 3 axis. The simultaneous setting of multiple axis is not possible)

5. I/O data

5.1 Overview

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 x axis		position y axis		position z axis		F input data			

Output data: Controler -> Device

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

5.2 Input data

5.2.1 Status word

The status word contains error bits which have to be evaluated in the user 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	Out of range	The position is out of range or the cross tilt is too high
1	Position not valid	Because of to high interference accelarations the position value is not valid
2	Preset error	Error when setting the preset value. Possible error causes: parameter Scaling not set to on, zero offest ≥ ±5°, the inclination of the second axis (two axis sensor) exceeds 5°, wrong preset bit set.
3 - 15	not used	

5.2.2 Position data

The NBT/S3 has a 3 axis MEMS sensor. But only 2 of these can be output. The value of third axis is always 0. Which axis is used for a measuring task is selected via the order code.

The inclination value is output as a 16 bit signed integer value in Motorola format (Big Endian) for each axis. The resolution is 0,01°.

Octet 3,5,7								Octet 4,6,8							
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
inclination of axis x,y,z in 0,01°															

5.2.3 F input data

The 4-byte F input data consist of the 1-byte F status and the 3-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).

5.3 Output data

5.3.1 Control word

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 control word															

Bit	Name	Remarks
0	Set_Preset_X	Sets the x axis to the preset value. The preset value is accepted with the raising edge of the signal.
1	Set_Preset_Y	Sets the y axis to the preset value. The preset value is accepted with the raising edge of the signal.
2	Set_Preset_Z	Sets the z axis to the preset value. The preset value is accepted with the raising edge of the signal.
3 - 15	not used	

5.3.2 Preset value

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
Preset value															

To adapt the inclination sensor to the mounting conditions the zero point can be adjusted by maximum ±5°. For this purpose the preset value has to be transfered in the output octets 3 and 4. Afterwards or at the same time the preset bit (Set_Preset_X/Y/Z) has to be set in the control word. The preset value is accepted with the raising edge of the control bit.

The preset setting is only possible when the scaling function is switched to on (see chapter 6).

The preset value has to be entered as a 16 bit signed integer value in Motorola format (Big-Endian). The resolution is the same as the resolution of the position value 0,01°.

Example:

	output value	angle	deviation from raw value
Situation after installation	-147	-1,47°	0°
After preset setting with preset value 200	200	2,00°	3,47°

Before setting the preset value, the i parameterization must be enabled with the F control bit **iPar_EN**. The inclination sensor 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 to high preset value, 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 inclination sensor then resets its iPAR_OK to zero.

5.3.3 F output data

The 4-byte F output data consist of 1 control byte and the 3-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 inclination sensor 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 NBT/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 set
0xBF02	Inclination sensor parameter
0x64	F parameter

6.1 Inclination sensor parameter

6.1.1 Overview

Byte	Data type	Designation	Default
1	BYTE	Operating mode	0x0

6.1.2 Description of the inclination sensor parameters

Byte	Bit No.	Parameter	Value range	Default	Remark
1	0-2	not used			
	3	Scaling	off, on	off	Switches on the scaling function of the axis. Preset setting is only possible when scaling is on. By switching of the scaling, the preset respectively the offset value will be deleted.
	4-6	not used			
	7	FW download mode	off, on	off	Sets the sensor in the firmware download mode. Afterwards the sensor waits for the transfer of the new firmware via the PROFINET interface.

Note:
After changing of one of the inclination sensor parameters, the checksum F_iPar_CRC has to be changed also. See chapter 6.2.2.

6.2 F parameter

6.2.1 Overview

Overview			
Octet	**Data type**	**Description**	**Default**
1	Unsigned8	F_Prm_Flag1	See 6.2.2
2	Unsigned8	F_Prm_Flag2	See 6.2.2
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	15283 ($3BB3_{hex}$)
13-14	Unsigned16	F_Par_CRC	-----

6.2.2 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"
2-3	**F_SIL**	1: SIL2	SIL2	Fixed to "SIL2"
4-5	**F_CRC_Length**	0: 3-Byte-CRC (V2 Mode)	3-Byte-CRC	Checksum of the process data (CRC2).
6-7	not used			

Octet 2: F_Prm_Flag2				
Bit no.	**Parameter name**	**Value range**	**Default**	**Remarks**
0-2	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	200	Must correspond to the PROFIsafe address set in the PROFINET name. The NBT/S3 is a F device with PROFIsafe address type 1, i.e. the F_Dest_Add has be unique netwide and CPU-wide.

Parameterisation

7-8	**F_WD_Time**	120 - 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 NBT/S3 is 120 ms (for 4 ms actualisation time).
9-12	**F_iPar_CRC**	1 - 0xFFFF FFFF	15283 ($3BB3_{hex}$)	CRC checksum on the iParameters (inclination sensor parameters). After changing the inclination sensor parameters this default value has to be changed to: For FW download mode = "on" to $BA0C_{hex}$. For Scaling = "on" to $D3BD_{hex}$
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 inclination sensor NBT/S3 provides diagnostic data in 3 different ways.

- LEDs (see Chapter 3.4)
- 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	Status-LED (NS)	Remarks/remedy
0x001A	Internal communication error (TPS-1)	Input and F data = 0		Please switch power off/on or change the device
0x0040	Mismatch of safety destination address (F_Dest_Add)	Input and F data = 0	red flashing (1 Hz)	
0x0041	Safety destination address not valid (F_Dest_Add)	Input and F data = 0	red flashing (1 Hz)	
0x0042	Safety source address not valid (F_Source_Add)	Input and F data = 0	red flashing (1 Hz)	
0x0043	Safety watchdog time value is 0 ms(F_WD_Time)	Input and F data = 0	red flashing (1 Hz)	
0x0044	Parameter "F_SIL" exceeds SIL from specific device application	Input and F data = 0	red flashing (1 Hz)	
0x0045	Parameter "F_CRC_Length" does not match the generated values	Input and F data = 0	red flashing (1 Hz)	
0x0046	Version of F-Parameter set incorrect (F_Par_Version)	Input and F data = 0	red flashing (1 Hz)	
0x0047	F parameter CRC error (CRC1-Fault)	Input and F data = 0	red flashing (1 Hz)	
0x0048	Error in F parameterset	Input and F data = 0	red flashing (1 Hz)	
0x004B	Inconsistent iParameters (iPar-CRC error)	Input and F data = 0	red flashing (1 Hz)	Please check the value of the F parameter F-iPar-CRC.
0x1100 0x1101 0x1102 0x1104	Device error	F status word: FV_activated, Device_Fault	fast red flashing (10 Hz)	Please switch power off/on or change the device.

0x1140	Parameter error	F status word: FV_activated, Device_ Fault	red flashing (1 Hz)	Please switch power off/on or change the device.
0x1150	Supply voltage out of range	F status word: FV_activated, Device_ Fault	red flashing (1 Hz)	Please check the supply voltage and switch power supply off/on.
0x1160	Wrong Record Index on startup	F status word: FV_activated, Device_ Fault	red flashing (1 Hz)	Please check your GSD file.
0x1170	Sensor not ready	F status word: FV_activated, Device_ Fault	red flashing (1 Hz)	Please switch power off/on or change the device.
0x1180	Preset error	Status word: Error_preset	red flashing (1 Hz)	Possible error causes: parameter Scaling not set to on, zero offest ≥ ±5°, the inclination of the second axis (two axis sensor) exceeds 5°, wrong preset bit set.

7.3 Diagnostic data records

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

Record index	Data set
0xAFF0	I&M0 data (according to I&M-specification version 1.2 /9/)
0xBF02	Parameter data (see Chapter 6)

8. Scope of delivery

The scope of delivery includes:
- Inclination sensor 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 certificates
- 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 Safety - Project Planning and Programming (A5E02714440-AC) - http://support.automation.siemens.com

/8/ SIMATIC Safety - Getting Started (A5E02714463-01) - http://support.automation.siemens.com

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