PSS u2 I/O PROFINET with PROFIsafe Profile on a SIMATIC S7-1500 with TIA Portal [328061]

PILZ
THE SPIRIT OF SAFETY

Product
Type: PSS u2 I/O
Name: PSS u2 P0 F/S PN, **328061**
Manufacturer: Pilz GmbH & Co. KG, Safe Automation

Document
Release Number: 03
Release Date: 22 July 2021

Important Note
There are two different Application Notes on this topic. The third page contains an overview for verification.
This document only describes the PSS u2 head module with PROFINET/PROFIsafe with order number 328061!

Application Note – 1004479_EN_03

Document Revision History

Release	Date	Changes	Chapter
01	28/06/2017	Creation	all
02	28/08/2018	Additions: HW version 02 / PN IRT; PASconfig version 2.1.0 Error corrections	1.1, 7.3, 8.2.1, 8.3.3, 9.3 all
03	22/07/2021	Reference to both AN documents Supplements / Error corrections	Document Guide all

Validity of Application Note

This present Application Note is valid until a new version of the document is published.
This and other Application Notes can be downloaded in the latest version and for free from www.pilz.com. For a simple search, use our content document (1002400) or the direct search function in the download area.

The Pilz newsletter is free of charge and keeps you up-to-date on all the latest issues and trends in safe automation.

Exclusion of Liability

We have taken great care in compiling our application note. It contains information about our company and our products. All statements are made in accordance with the current status of technology and to the best of our knowledge and belief.
While every effort has been made to ensure the information provided is accurate, we cannot accept liability for the accuracy and entirety of the information provided, except in the case of gross negligence. In particular, all information on applicable standards, safety-related classifications and time characteristics should be viewed as provisional. In particular it should be noted that statements do not have the legal quality of assurances or assured properties.
We are grateful for any feedback on the contents.

July 2021

Industrial Security

To secure plants, systems, machines and networks against cyberthreats it is necessary to implement (and continuously maintain) an overall Industrial Security concept that is state of the art.
Perform a risk assessment in accordance with VDI/VDE 2182 or IEC 62443-3-2 and plan the security measures with care. If necessary, seek advice from Pilz Customer Support.

Documentation guide

- Overview of the two Pilz solutions at system “PSS u2 I/O PROFINET with PROFIsafe profile”.
  - The internet links to download the two AN documents listed in the graphic are available at: Chapter 1.1 Documentation from Pilz GmbH & Co. KG [📖 7], No. 14 and 15

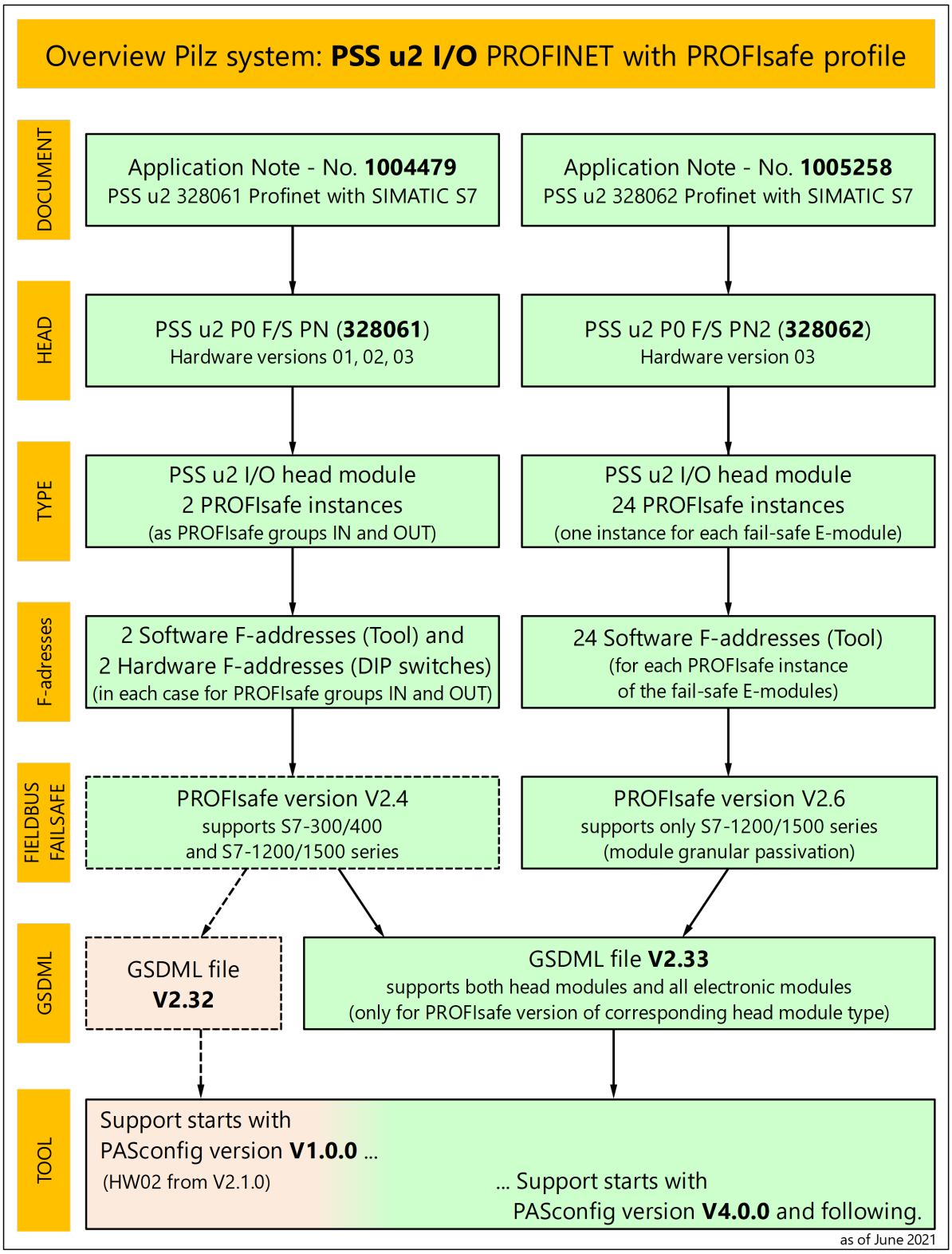


Figure 1: Application Notes – Documentation guide for ‘PSS u2 I/O PROFINET/PROFIsafe’

Abbreviations

Abbreviation / term	Description	Source
AN	**A**pplication **N**ote	www.pilz.com > AN content (1002400)
PNOZ	Pilz E-STOP positive-guided (DE: **P**ilz **NO**T-AUS-**Z**wangsgeführt)	www.pilz.com > PNOZ
PSS	Programmable control system (DE: **P**rogrammierbares **S**teuerungs**s**ystem)	www.pilz.com > PSS
PSS u2	**PSSu**niversal, **2**nd generation	www.pilz.com > PSS u2
POU	**P**rogram **O**rganisation **U**nit	
TIA	**T**otally **I**ntegrated **A**utomation (SIMATIC)	
TCI	**T**ool **C**alling **I**nterface (SIMATIC)	
PN	**P**ROFI**N**ET / **Pro**cess **Fi**eld **Net**work	en.wikipedia.org > PROFINET
PROFIenergy	Technology from PROFINET	en.wikipedia.org > PROFIenergy
PROFIsafe	Technology from PROFINET	www.profibus.com > PROFIsafe
PROFINET IRT	Technology from PROFINET: **I**sochronous **R**eal **T**ime	
NC	**N**ormally **C**losed	
NO	**N**ormally **O**pen	

Definition of symbols

- Information that is particularly important is identified as follows:

CAUTION!

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.

NOTICE

This describes a situation in which the product or devices could be damaged and also provides information on preventive measures that can be taken.
It also highlights areas within the text that are of particular importance.

INFORMATION

This gives advice on applications and provides information on special features.

Contents

1 Useful documentation

Reading the documentation listed below is necessary for understanding this Application Note. The availability of the software used and its safe handling are also presupposed for the user.

1.1 Documentation from Pilz GmbH & Co. KG

No.	Description	Item No. /Download
1	Pilz international homepage, download section	www.pilz.com > Support > Downloads
2	Software 'PASconfig', Online help Pilz international Webportal > Products and Industries > Controllers > I/O systems > I/O modules PSSuniversal 2 or the Head module under section "Software" **New: Software version 5.0.0 available.**	Products and Industries > Controllers > Overview I/O systems **328061** (Order number head module) www.pilz.com > Download 328061
3	System Description PSSuniversal 2	Not yet available.
4	Installation manual PSSuniversal 2	1004152-EN-xx www.pilz.com > Download 1004152
5	Operation manual PSS u2 P0 F/S PN Product modification PSS u2 P0 F/S PN Hardware version 02 GSD file under section "Device description file" **New: Use the updated GSD version 2.33!**	1003986-EN-xx www.pilz.com > Download 1003986 1004483-EN-xx www.pilz.com > Download 1004483 **328061** (Order number head module) www.pilz.com > Download 328061
6	Operation manual PSS u2 EF 8DI	1003619-EN-xx www.pilz.com > Download 1003619
7	Operation manual PSS u2 EF 8DO 0.5	1003621-EN-xx www.pilz.com > Download 1003621
8	Operation manual PSS u2 ES 8DID	1003612-EN-xx www.pilz.com > Download 1003612
9	Operation manual PSS u2 ES 8DOD 0.5	1003614-EN-xx www.pilz.com > Download 1003614
10	Operation manual PITes Set/1	1002542-EN-xx www.pilz.com > Download 1002542
11	Operation manual PNOZ pe2p	21035-EN-xx www.pilz.com > Download 21035
12	Operation manual PNOZ po3.3p	20678-EN-xx www.pilz.com > Download 20678
13	Application Note "PSSu 312043 Profinet with Simatic S7" Document for PSSu system (Generation 1) with SIMATIC **STEP 7 Classic**	1001907-EN-xx www.pilz.com > Download 1001907
14	Application Note "PSS u2 328061 Profinet with Simatic S7" Document for PSS u2 system with head module **PSS u2 P0 F/S PN**	1004479-EN-xx www.pilz.com > Download 1004479
15	Application Note "PSS u2 328062 Profinet with Simatic S7" Document for PSS u2 system with head module **PSS u2 P0 F/S PN2**	1005258-EN-xx www.pilz.com > Download 1005258

- Note
  Please refer to
  - the file 'Readme' belonging to the software version under number '2' and
  - the updated document 'Product modification' under number '5'.

1.2 Documentation from other sources of information

No.	Description	Item No. / Download
1	PI Portal (PROFIBUS and PROFINET International)	www.profinet.com
2	Siemens Homepage, Safety integrated	www.industry.siemens.com > Safety Integrated
3	Siemens Homepage, SCE Training Curriculums (TIA)	w3.siemens.com > MCMS/SCE
4	SIMATIC Industrial Software SIMATIC Safety - Configuring and Programming Programming and Operating Manual	A5E02714439-AL; 05/2021 support.industry.siemens.com > 54110126
5	Application example Emergency stop up to SIL 3 / PL e with a failsafe S7-1500 controller	21064024, 05/2017 support.industry.siemens.com > 21064024
6	Application example Monitoring the feedback circuit in the safety program	21331098, 08/2019 support.industry.siemens.com > 21331098

2 Used hardware and software

2.1 Pilz products

No.	Descriptions	Order number	Version	Number
1	Hardware head module PSS u2 P0 F/S PN	**328061**	02	1
2	Hardware terminal block 9-pin, 1 piece PSS u2 T 9 SD (1 pc.) Note: 1 piece is included on the head module	328830	--	0
3	Hardware backplane 4 Slots PSS u2 B 4	328810	01	2
4	Hardware backplane 1 Slot PSS u2 B 1 Note: Alternative backplane (8 pieces)	328811	--	0
5	Hardware electronic Module PSS u2 EF 8DI	328101	01	2
6	Hardware electronic Module PSS u2 EF 8DO 0.5	328131	01	2
7	Hardware electronic Module PSS u2 ES 8DID	328311	01	2
8	Hardware electronic Module PSS u2 ES 8DOD 0.5	328401	01	2
9	Hardware terminal block 8-pin, 1 piece PSS u2 T 8 (1 pc.) Note: Also available in packs of 10 and 50 pieces.	328840	--	0
10	Hardware terminal block 16-pin, 1 piece PSS u2 T 16 (1 pc.) Note: Also available in packs of 10 and 50 pieces.	328850	--	8
11	Hardware Ethernet-Plug 8-pin RJ45 male connector, straight, in accordance with the standard IEC 60603-7-1, Cat.6a RJ45 Connector	380401	--	2
12	Hardware Ethernet-cable SafetyNET p cable, Standard, 4-wire SafetyNET p Cable	380000	--	2 (x1 meter)
13	Software PASconfig	--	2.1.0	--
14	E-STOP/contact block set consisting of E-STOP and contact block with monitoring PIT es Set1s-5 s (2 N/C, terminals of screw type)	400447	--	1
15	Interface safety relay PNOZpower for external connection PNOZpe2p Bus-Interface	779125	--	1
16	Expansion module safety relay PNOZpower 3 safety contacts 5.5 KW (AC3 loads) PNOZ po3.3p 3n/o	773632	--	1

Figure 2: Pilz – Components used for the application (selection)

2.2 Third-party products

No.	Descriptions	Order number	Version	Number
1	Hardware Power Supply PS 60W 120/230VAC/DC	6ES7 507- 0RA00-0AB0	V1.0	1
2	Hardware PLC CPU 1516F-3 PN/DP	6ES7516- 3FN00-0AB0	V1.8	1
3	Hardware Digital input module SM 521 DI 32xDC 24V HF	6ES7521- 1BL00-0AB0	V2.0	1
4	Hardware Digital output module SM 522 DQ32xDC 24V/0,5A ST	6ES7522- 1BL00-0AA0	V2.0	1
5	Hardware Front connector 40polig, Screw-type	6ES7592- 1AM00-0XB0	--	2
6	Software SIMATIC STEP 7 Professional	--	V13.0 SP1 Upd8	--
7	Software SIMATIC STEP 7 Safety	--	V13.0 SP1 Upd5	--

2.3 Structure of the application (schematic)

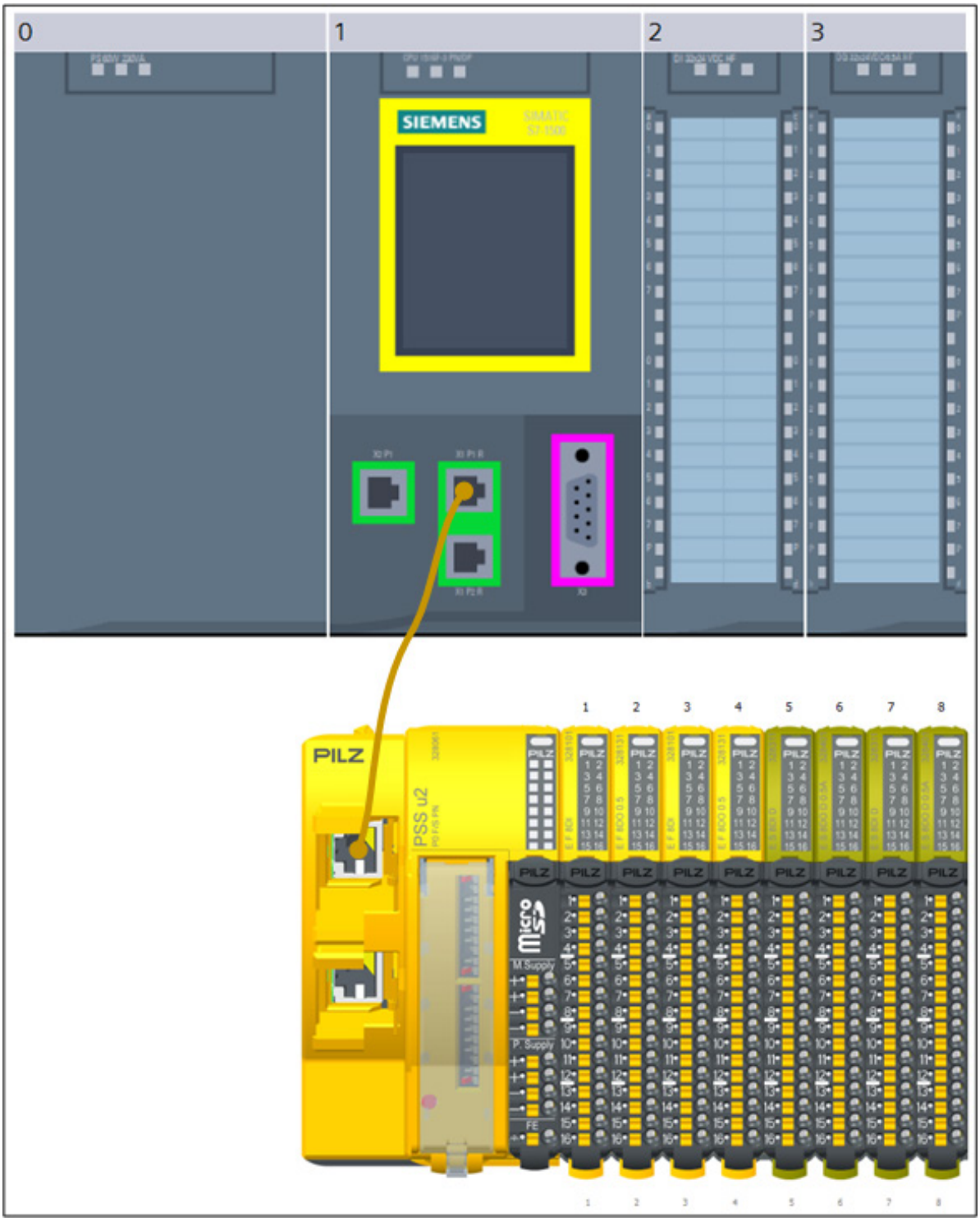


Figure 3: Application – Structure of the hardware (schematic)

3 Preface

This Application Note basically describes the commissioning of a PSSuniversal 2 Remote I/O system on a current SIMATIC F-CPU. They communicate via PROFINET/PROFIsafe, using the automation software TIA Portal.
In this case, its user program controls the failsafe input and output modules of the PSS u2 electronic modules for the safety functions.
The essential procedure for a successful basic configuration is shown step-by-step, usually with screenshots.

NOTICE

- A detailed explanation of safety functions used in the failsafe application and its evaluation regarding functional safety are not a part of this document.
- This document only describes the procedure for use of the Remote I/O-System PSS u2 with the order number **328061** and is not intended as a technical documentation for general use of the SIMATIC STEP 7 Professional for Siemens TIA Portal.

4 Technical notes for the PSS u2 system

A PSS u2 system is a modular system with PROFINET interface (PROFINET with PROFIsafe).

The 'PASconfig' system software is available for PSS u2 systems. The system software provides support as you select, configure and commission components.

- A PSS u2 system consists of:
  - One head module
  - Backplanes
  - Input/output modules for standard and failsafe applications
  - Terminal blocks

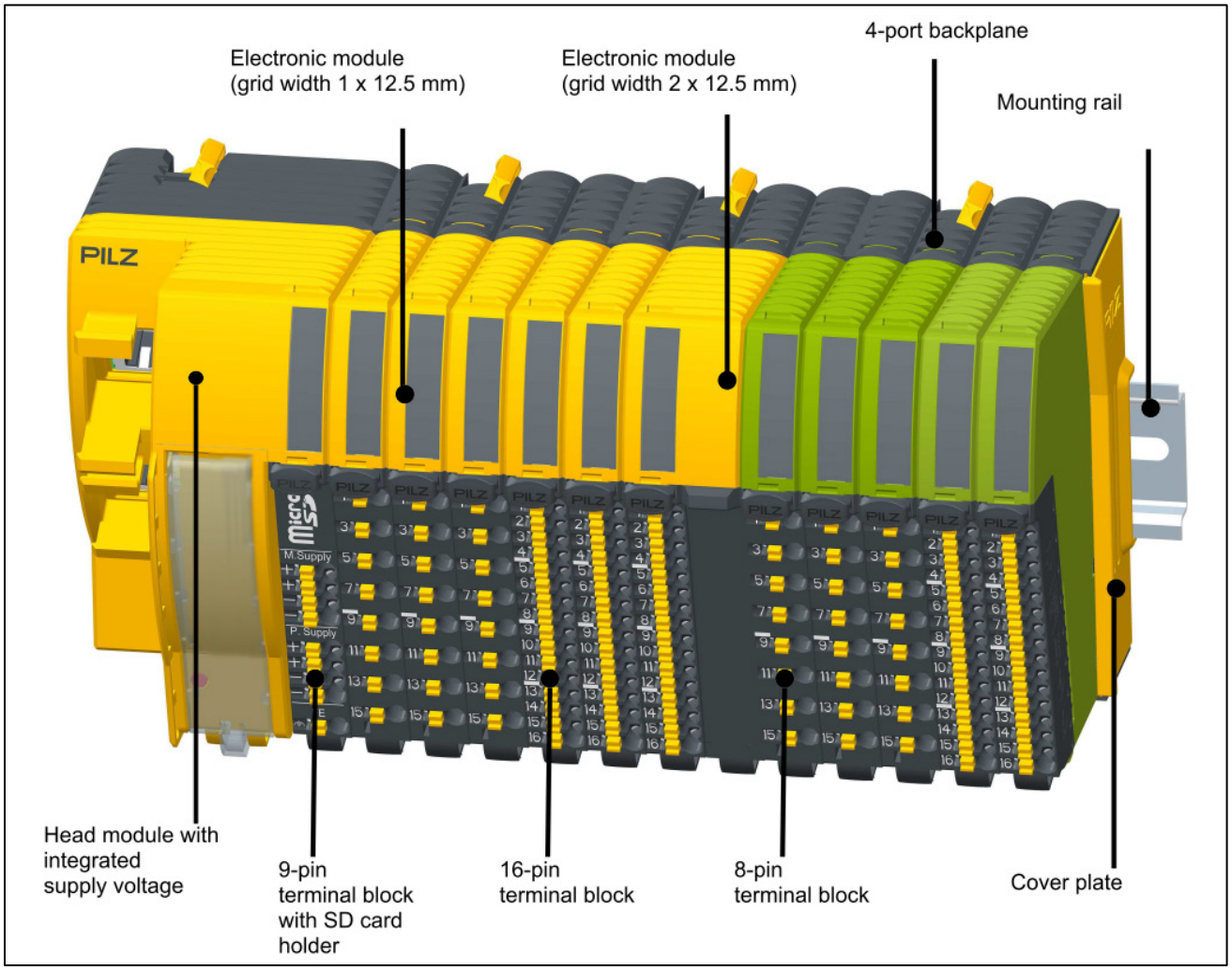


Figure 4: PSS u2 – Modular structure of the PSS u2 system

CAUTION!

Risk of material damage:
Backplanes and head module may only be inserted or removed when the supply voltage is switched off.

- Switch off the supply voltage before inserting or removing the backplane or head module.

5 Application description

The aim is to show how a basic PROFINET/PROFIsafe communication and Siemens S7-1500 PLC can be built up to form a remote I/O system PSS u2.
An example of this is the implementation of an emergency stop and feedback loop block (see Chapter 9.3. [📖 54ff]), connected to the failsafe digital input and output modules of the PSSuniversal 2 system (see Chapter 6.1.1 [📖 15]).

- Assigning the wiring to the devices
  - see Chapter 1.1 Documentation from Pilz GmbH & Co. KG [📖 7]
  - see Figure 112: PSS u2 – Wiring » Terminal assignment of PSS u2-modules (schematic) [📖 69]
  - For the assignment of addresses in the programming environment see Figure 39: TIA – Add electronic modules to the I/O system (Part 3, Finalization) [📖 31]
  - E-STOP/contact block set 'PIT es Set1s-5 s' is equipped with the following contact blocks: 'PIT esc1' (1x '400315') and 'PIT esc2' (1x '400320')

Slot 1	**PSS u2 EF 8DI**	**328101**		**Clamp**	**Device**	**Type**
Clamp 01	I0 FS-Input %I20.0		« wired to »	12	PIT esc1	ESTOP1 NC contact and NO contact
Clamp 02	T0		« wired to »	11		24 VDC
Clamp 03	I1 FS-Input %I20.1		« wired to »	22	PIT esc2	ESTOP1 NC contact
Clamp 04	T1		« wired to »	21		24 VDC
Clamp 09	I4 FS-Input %I20.4		« wired to »	14	Push button switch S1	START NO contact
Clamp 10	T0		« wired to »	13		24 VDC
Clamp 11	I5 FS-Input %I20.5		« wired to »	12	Push button switch S2	STOP NC contact
Clamp 12	T1		« wired to »	11		24 VDC
Clamp 13	I6 FS-Input %I20.6		« wired to »	14	Push button switch S3	RESET NO contact
Clamp 14	T2		« wired to »	13		24 VDC
Clamp 15	I7 FS-Input %I20.7		« wired to »	Y2	PNOZ pe2p / PNOZ po3.3.p	FBL NC contact
Clamp 16	T3		« wired to »	Y1		24 VDC
Slot 3	**PSS u2 EF 8DO 0.5A**	**328131**		**Clamp**	**Device**	**Type**
Clamp 01	O0 FS-Output %Q40.0		« wired to »	K1	PNOZ pe2p / PNOZ po3.3.p	Coil (actor)
Clamp 02	0V		« wired to »	A2		0 VDC
Slot 5	**PSS u2 ES 8DID**	**328311**		**Clamp**	**Device**	**Type**
Clamp 01	I0 ST-Input %I10.0		« wired to »	12	Push button switch S4	ACK NO contact
Clamp 02	S0		« wired to »	11		24 VDC

For basic fieldbus communication, the standard default parameters from the TIA portal are used. Only parameters for the addressing of the devices are adjusted.

The detailed hardware configuration for the S7-CPU is not part of this Application Note.
Detailed information on this subject can be found in the manual or online help for the TIA Portal.
- see Chapter 1.2 Documentation from other sources of information [📖 8]

6 Hardware configuration

6.1 Used hardware

6.1.1 Pilz devices

- The used Pilz modules are listed in the table of the following link:
  - Chapter 2.1 Pilz products [📖 9] und Chapter 10.2 Wiring diagram [📖 70ff]
- The relevant important documents are named and linked here:
  - Chapter 1.1 Documentation from Pilz GmbH & Co. KG [📖 7]

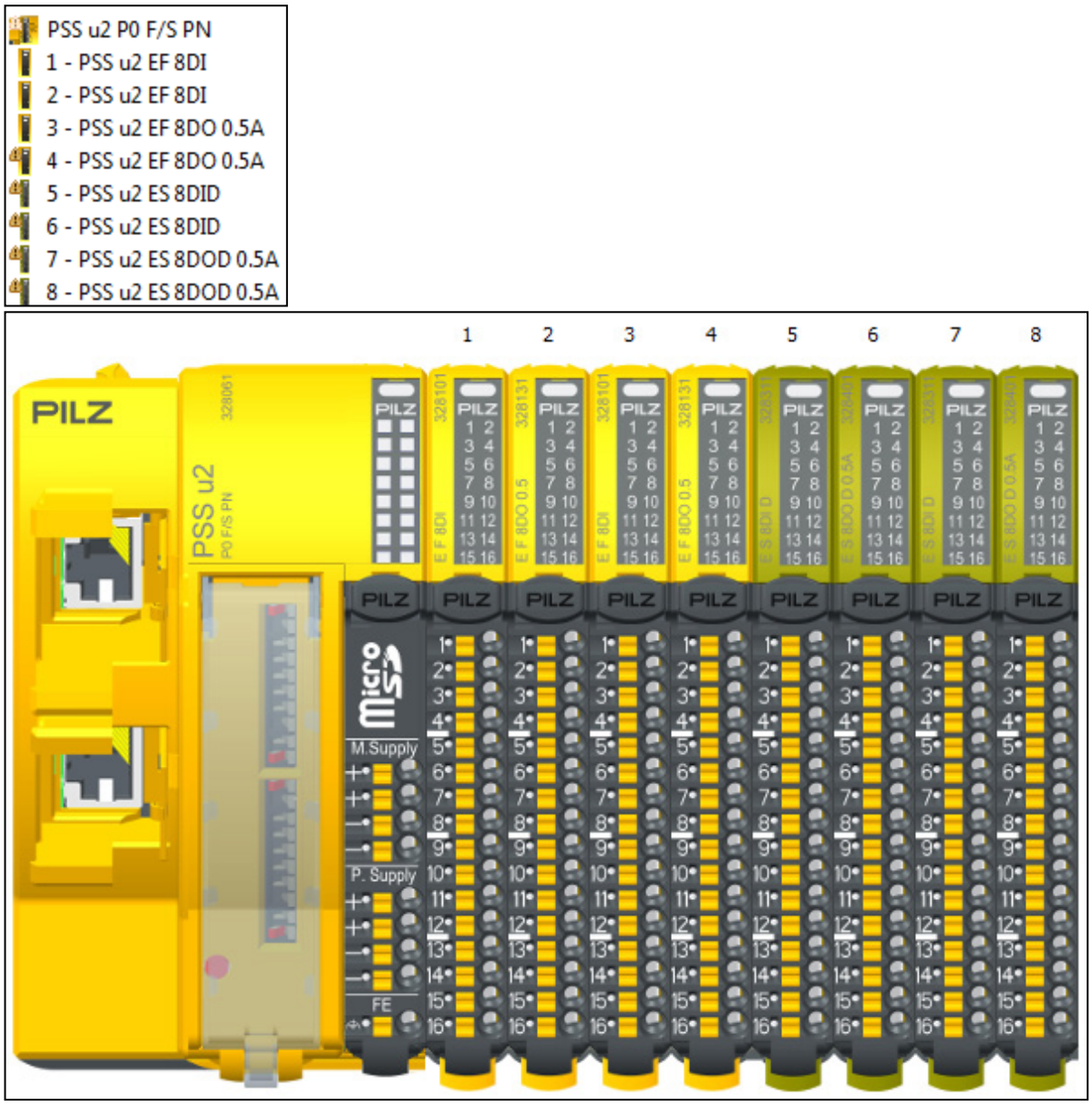


Figure 5: PSS u2 – Hardware » Overview of used modules

6.1.2 Siemens devices

- The used SIMATIC devices are listed in the table of the following link:
  - Chapter 2.1 Pilz products [📖 9]
- The relevant important documents are named and linked here:
  - Chapter 1.2 Documentation from other sources of information [📖 8]

6.2 Basic properties of the PSS u2 system

6.2.1 Maximum size of the PSS u2 failsafe and standard I/O process image

- PROFINET interface:
  - Input 1.440 Byte
  - Output 1.440 Byte
- PROFIsafe interface:
  - Input 12 Byte (= 8 Byte FS input payload + 4 Byte CRC/Status)
  - Output 12 Byte (= 8 Byte FS output payload + 4 Byte CRC/Status)

The PROFIsafe groups have a fixed process data length.

- PROFIsafe group for the FS inputs:
  4 bytes for FS input data (max. 32 FS inputs) and 4 bytes for valid bits
- PROFIsafe group for the FS outputs:
  8 bytes for FS output data (max. 64 FS outputs) and 8 bytes for valid bits

6.2.2 I/O address assignment (byte alignment)

The following two examples show the addresses of the PSS u2 modules, always a full byte per module and function is used.

- PSS u2 ES 4DID
  - The module occupies 2 Bytes in the process image of the standard inputs.

PII		Meaning	State
Byte 0	Bit 0	Input data I0	0: "0"-signal (0 V) at the input 1: "1"-signal (+ 24 V) at the input
	Bit 1	Input data I1	
	Bit 2	Input data I2	
	Bit 3	Input data I3	
	Bit 4 - 7	None	Constant "0"
Byte 1	Bit 0	Valid bit of voltage output S0	0: Error at the voltage output 1: No error at the voltage output
	Bit 1	Valid bit of voltage output S1	
	Bit 2 - 7	None	Constant "0"

- PSS u2 EF 2DO TP 2A
  - The module occupies 1 Byte in the process image of the failsafe outputs.

PIO	Meaning	State
Bit 0	Output data O0	0: "0" signal (0 V) at the output 1: "1" signal (+ 24 V) at the output
Bit 1	Output data O1	
Bit 2-7	None	Constant "0"

  - The same module also occupies 1 Byte in the process image of failsafe inputs:

PII	Meaning	State
Bit 0	Valid bit of output O0	0: Output error 1: The signal in the PIO corresponds to the output signal
Bit 1	Valid bit of output O1	
Bit 2	Open circuit at output O0	0: Open circuit at output 1: No open circuit at output
Bit 3	Open circuit at output O1	
Bit 4-7	None	Constant "0"

6.2.3 Failsafe I/O assignment

The following two examples are based on the following address assignment:

- PROFIsafe Group failsafe inputs:
  » First input address: %IB10 / %I10.0
  » First output address: %QB10 / %Q10.0
- PROFIsafe Group failsafe outputs:
  » First input address: %IB22 / %I22.0
  » First output address: %QB22 / %Q22.0

▸ Example with different failsafe input modules:

Slot 1		*Slot 2*	
PSS u2 EF 4DI		**PSS u2 EF 8DI**	
Addresses %IB10 %IB11	Identification	Addresses %IB12 %IB13	Identification
%I10.0	Failsafe-Input I0	%I12.0	Failsafe-Input I0
%I10.1	Failsafe-Input I1	%I12.1	Failsafe-Input I1
%I10.2	Failsafe-Input I2	%I12.2	Failsafe-Input I2
%I10.3	Failsafe-Input I3	%I12.3	Failsafe-Input I3
%I10.4	Bit has constant the value zero (= 0)	%I12.4	Failsafe-Input I4
%I10.5	Bit has constant the value zero (= 0)	%I12.5	Failsafe-Input I5
%I10.6	Bit has constant the value zero (= 0)	%I12.6	Failsafe-Input I6
%I10.7	Bit has constant the value zero (= 0)	%I12.7	Failsafe-Input I7
%I11.0	Valid bit of the failsafe input I0	%I13.0	Valid bit of the failsafe input I0
%I11.1	Valid bit of the failsafe input I1	%I13.1	Valid bit of the failsafe input I1
%I11.2	Valid bit of the failsafe input I2	%I13.2	Valid bit of the failsafe input I2
%I11.3	Valid bit of the failsafe input I3	%I13.3	Valid bit of the failsafe input I3
%I11.4	Bit has constant the value zero (= 0)	%I13.4	Valid bit of the failsafe input I4
%I11.5	Bit has constant the value zero (= 0)	%I13.5	Valid bit of the failsafe input I5
%I11.6	Bit has constant the value zero (= 0)	%I13.6	Valid bit of the failsafe input I6
%I11.7	Bit has constant the value zero (= 0)	%I13.7	Valid bit of the failsafe input I7

Figure 6: PSS u2 – Hardware Failsafe I/O assignment (FS inputs)

▸ Example with different failsafe output modules:

Slot 1		*Slot 2*		*Slot 3*		*Slot 4*	
PSS u2 EF 2DO 2A		**PSS u2 EF 2DO R 8A**		**PSS u2 EF 4DO 2A**		**PSS u2 EF 8DO 0.5A**	
Addresses %QB22 %IB22	Identification	Addresses %QB23 %IB23	Identification	Addresses %QB24 %IB24	Identification	Addresses %QB25 %IB25	Identification
%Q22.0	FS output O0	%Q23.0	FS output O0	%Q24.0	FS output O0	%Q25.0	FS output O0
%Q22.1	FS output O1	%Q23.1	FS output O1	%Q24.1	FS output O1	%Q25.1	FS output O1
%Q22.2	constant =0	%Q23.2	constant =0	%Q24.2	FS output O2	%Q25.2	FS output O2
%Q22.3	constant =0	%Q23.3	constant =0	%Q24.3	FS output O3	%Q25.3	FS output O3
%Q22.4	constant =0	%Q23.4	constant =0	%Q24.4	constant =0	%Q25.4	FS output O4
%Q22.5	constant =0	%Q23.5	constant =0	%Q24.5	constant =0	%Q25.5	FS output O5
%Q22.6	constant =0	%Q23.6	constant =0	%Q24.6	constant =0	%Q25.6	FS output O6
%Q22.7	constant =0	%Q23.7	constant =0	%Q24.7	constant =0	%Q25.7	FS output O7
%I22.0	Valid bit O0	%I23.0	Valid bit O0	%I24.0	Valid bit O0	%I25.0	Valid bit O0
%I22.1	Valid bit O1	%I23.1	Valid bit O1	%I24.1	Valid bit O1	%I25.1	Valid bit O1
%I22.2	constant =0	%I23.2	constant =0	%I24.2	Valid bit O2	%I25.2	Valid bit O2
%I22.3	constant =0	%I23.3	constant =0	%I24.3	Valid bit O3	%I25.3	Valid bit O3
%I22.4	constant =0	%I23.4	constant =0	%I24.4	constant =0	%I25.4	Valid bit O4
%I22.5	constant =0	%I23.5	constant =0	%I24.5	constant =0	%I25.5	Valid bit O5
%I22.6	constant =0	%I23.6	constant =0	%I24.6	constant =0	%I25.6	Valid bit O6
%I22.7	constant =0	%I23.7	constant =0	%I24.7	constant =0	%I25.7	Valid bit O7

Figure 7: PSS u2 – Hardware Failsafe I/O assignment (FS outputs)

New: please see also function **access point "FS I/O Mapping"** as of Figure 86 [🕮 55ff].

The used I/O system in the application project has the following addresses:
(see Figure 39: TIA – Add electronic modules to the I/O system (Part 3, Finalization) [📖 31])

- PROFIsafe Group failsafe inputs:
  » First input address: %IB20 / %I20.0 (assigned up to %IB31 / %I31.7)
  » First output address: %QB20.0 / %Q20.0 (assigned up to %QB23 / %Q23.7)
- PROFIsafe Group failsafe outputs:
  » First input address: %IB40.0 / %I40.0 (assigned up to %IB51 / %I51.7)
  v First output address: %QB40.0 / %Q40.0 (assigned up to %IB51 / %Q51.7)
- Standard inputs:
  » First input address: %IB10.0
- Standard outputs:
  » First output address: %QB15.0

▸ Configuration with the four failsafe input and output modules in this used AN setup:

Slot 1		*Slot 2*		*Slot 3*		*Slot 4*	
PSS u2 EF 8DI		**PSS u2 EF 8DI**		**PSS u2 EF 8DO 0.5A**		**PSS u2 EF 8DO 0.5A**	
Address %IB20	Identification	Address %IB22	Identification	Address %QB40 %IB40	Identification	Address %QB41 %IB41	Identification
%I20.0	FS input I0	%I22.0	FS input I0	%Q40.0	FS output O0	%Q41.0	FS output O0
%I20.1	FS input I1	%I22.1	FS input I1	%Q40.1	FS output O1	%Q41.1	FS output O1
%I20.2	FS input I2	%I22.2	FS input I2	%Q40.2	FS output O2	%Q41.2	FS output O2
%I20.3	FS input I3	%I22.3	FS input I3	%Q40.3	FS output O3	%Q41.3	FS output O3
%I20.4	FS input I4	%I22.4	FS input I4	%Q40.4	FS output O4	%Q41.4	FS output O4
%I20.5	FS input I5	%I22.5	FS input I5	%Q40.5	FS output O5	%Q41.5	FS output O5
%I20.6	FS input I6	%I22.6	FS input I6	%Q40.6	FS output O6	%Q41.6	FS output O6
%I20.7	FS input I7	%I22.7	FS input I7	%Q40.7	FS output O7	%Q41.7	FS output O7
%I21.0	Valid bit I0	%I23.0	Valid bit I0	%I40.0	Valid bit O0	%I41.0	Valid bit O0
%I21.1	Valid bit I1	%I23.1	Valid bit I1	%I40.1	Valid bit O1	%I41.1	Valid bit O1
%I21.2	Valid bit I2	%I23.2	Valid bit I2	%I40.2	Valid bit O2	%I41.2	Valid bit O2
%I21.3	Valid bit I3	%I23.3	Valid bit I3	%I40.3	Valid bit O3	%I41.3	Valid bit O3
%I21.4	Valid bit I4	%I23.4	Valid bit I4	%I40.4	Valid bit O4	%I41.4	Valid bit O4
%I21.5	Valid bit I5	%I23.5	Valid bit I5	%I40.5	Valid bit O5	%I41.5	Valid bit O5
%I21.6	Valid bit I6	%I23.6	Valid bit I6	%I40.6	Valid bit O6	%I41.6	Valid bit O6
%I21.7	Valid bit I7	%I23.7	Valid bit I7	%I40.7	Valid bit O7	%I41.7	Valid bit O7

Figure 8: PSS u2 – Hardware Failsafe I/O assignment (AN configuration FS modules)

6.2.4 Diagnostic information

▸ The status of the I/O modules is:
- displayed via the "Module status display" and "Terminal status display";
- this is signalled to the head module and
- any error is entered in the head module's diagnostic log.

The head module contains a number of status LEDs, which provide information on the status of various system sections.

7 Configuration of Siemens S7 F-CPU

7.1 Creation of new TIA project

- First you start the software TIA Portal and create a new project:

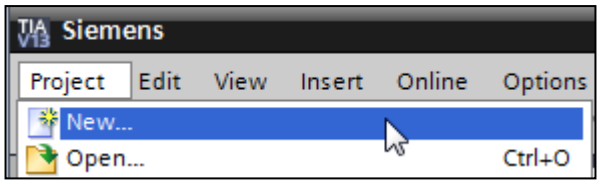


Figure 9: TIA – Create a new project (Part 1, Start)

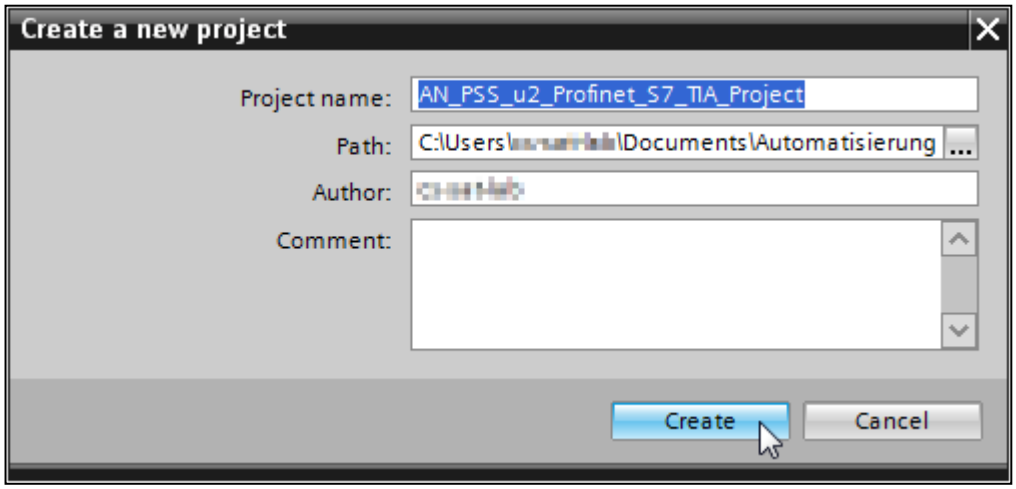


Figure 10: TIA – Create a new project (Part 2, Creation)

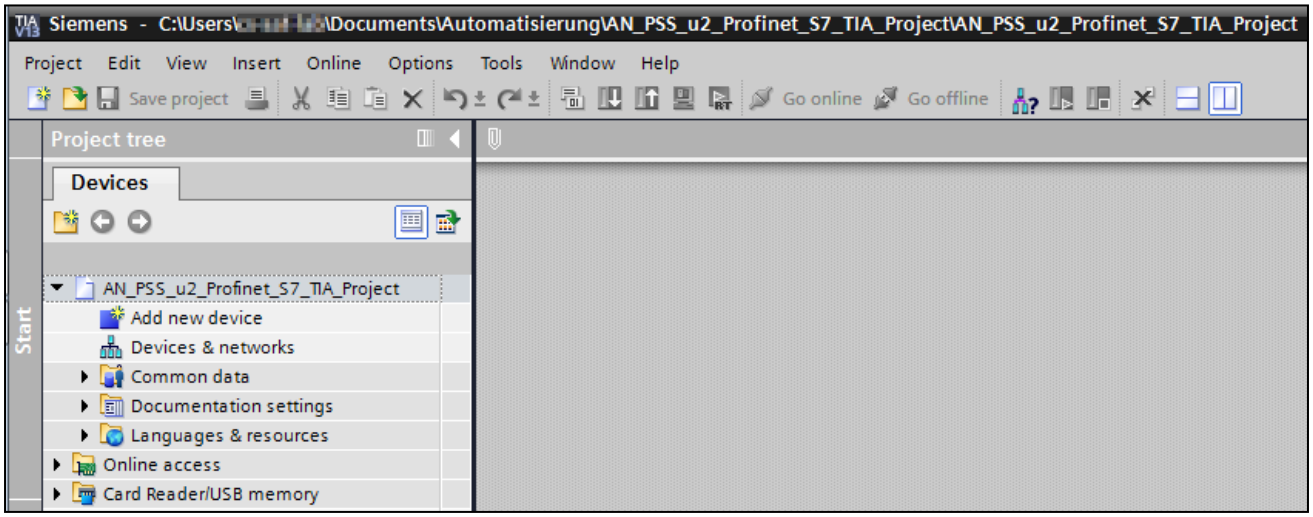


Figure 11: TIA – Create a new project (Part 3, Finalization)

- Now the F-CPU must be selected and configured. This is done in the next chapter.

7.2 Select and configure the S7 F-CPU

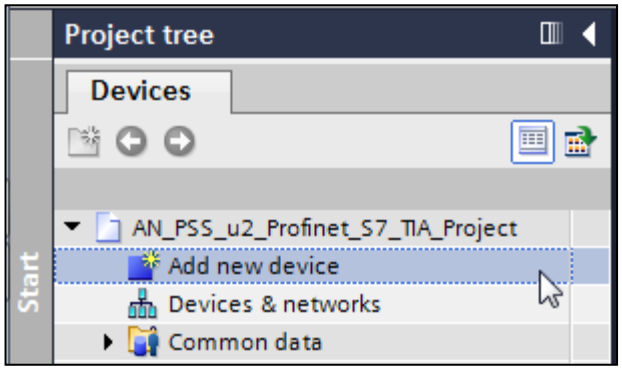


Figure 12: TIA – Add new device (Part 1, Start)

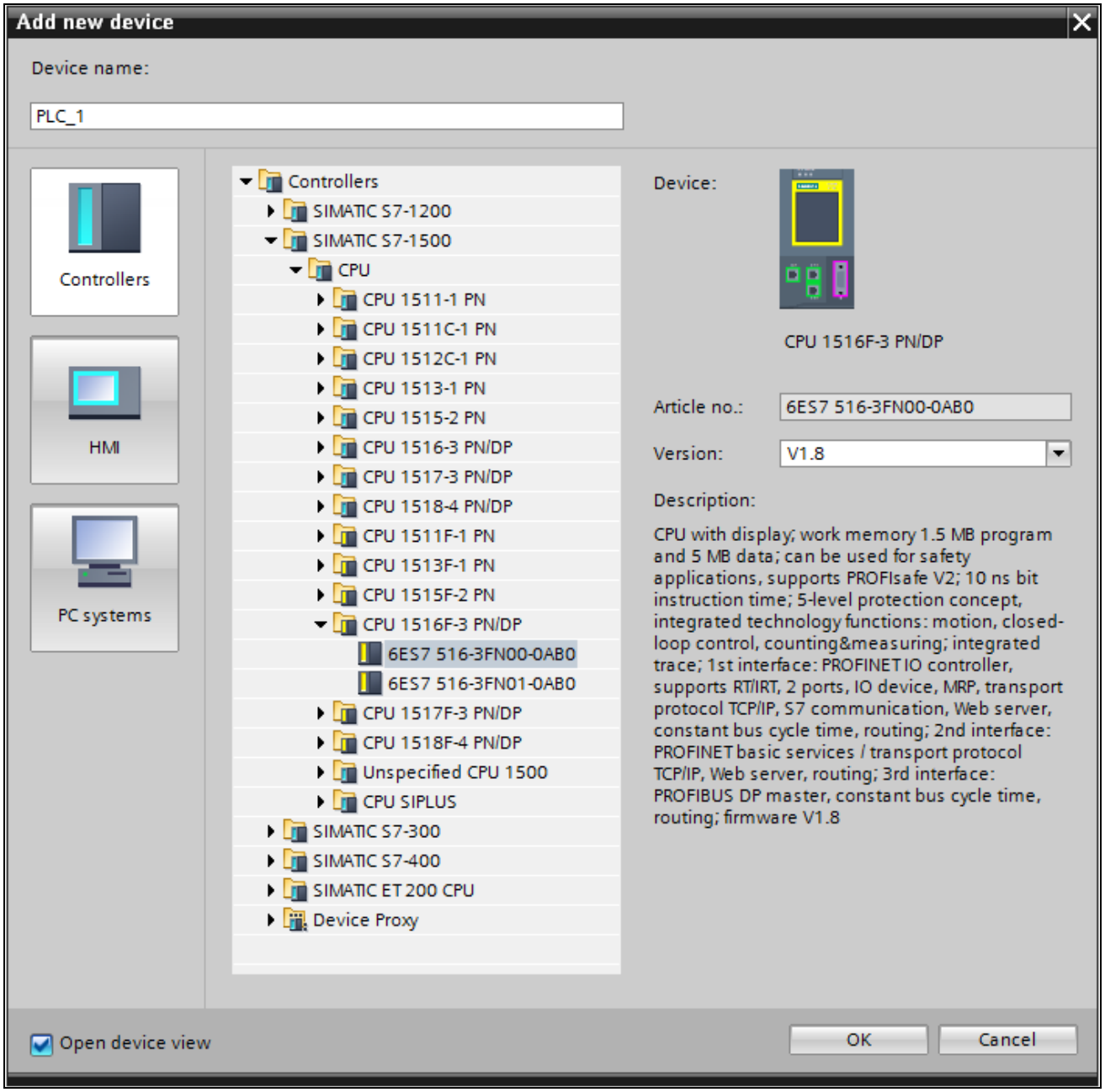


Figure 13: TIA – Add new device (Part 2, PLC 'CPU 1516F-3 PN/DP')

- Switch to “Device view” (if not previously selected) and select the device ‘PLC_1’:

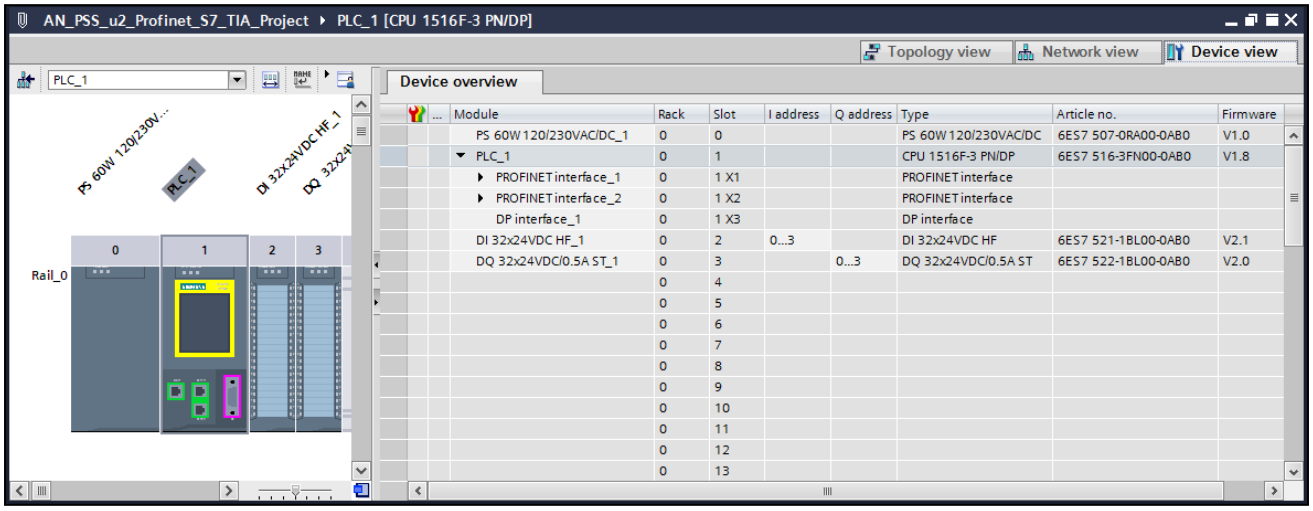
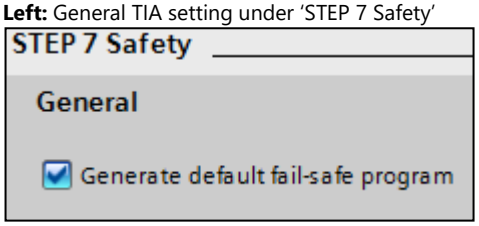


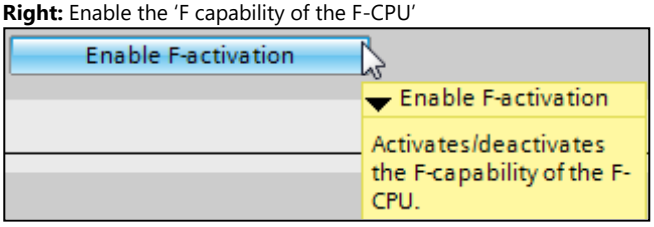
Figure 14: TIA – Add new device (Part 3, Finalization)

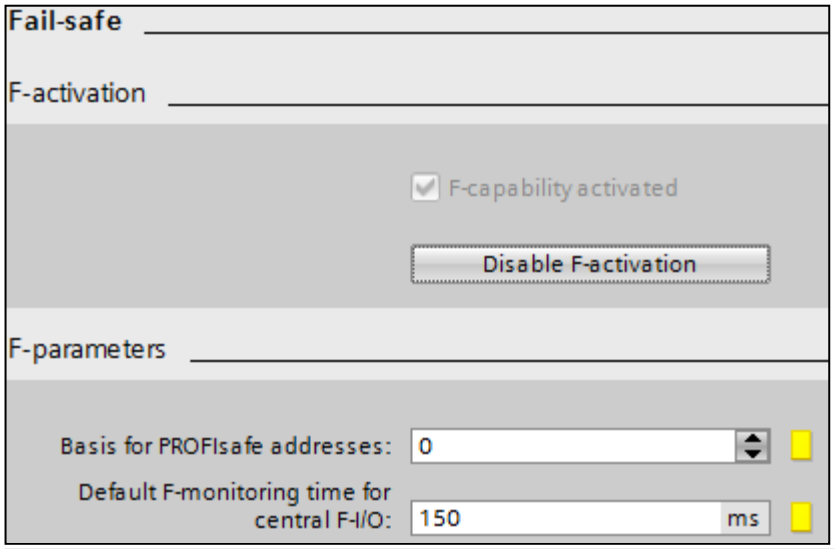
- Switch to “Fail-Safe” in the “General” tab.
- Enable the 'F-capability of the F-CPU' including selection of the 'Access level for the PLC':

Left: General TIA setting under ‘STEP 7 Safety’



Right: Enable the ‘F capability of the F-CPU’





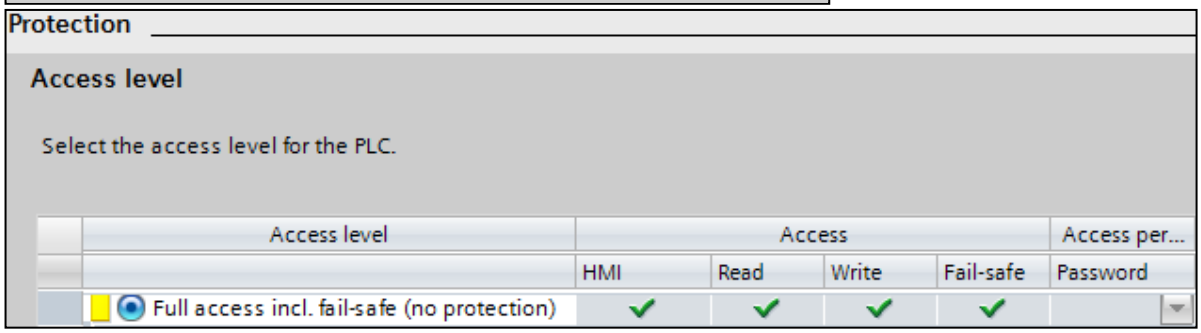


Figure 15: TIA – PLC » Enabling F-capability and select access level

7.3 Setting up the Ethernet adapter

- Top » 'S7 X1 P1' & 'X1 P2': **192.168.020.010** / 255.255.255.0 (MAC ADD1)
  - SIMATIC S7-PLC with PROFINET interface (X1) with 2 ports (F-CPU 1516F-3 PN/DP)
  - Connection to programming device with PG/PC interface (TIA Portal)
  - Connection to remote I/O System PSS u2 with PROFINET interface 'X3'

Note:
- Observe the (partly different) technical properties of the individual PROFINET interfaces for the SIMATIC CPUs (see SIMATIC CPU manual).

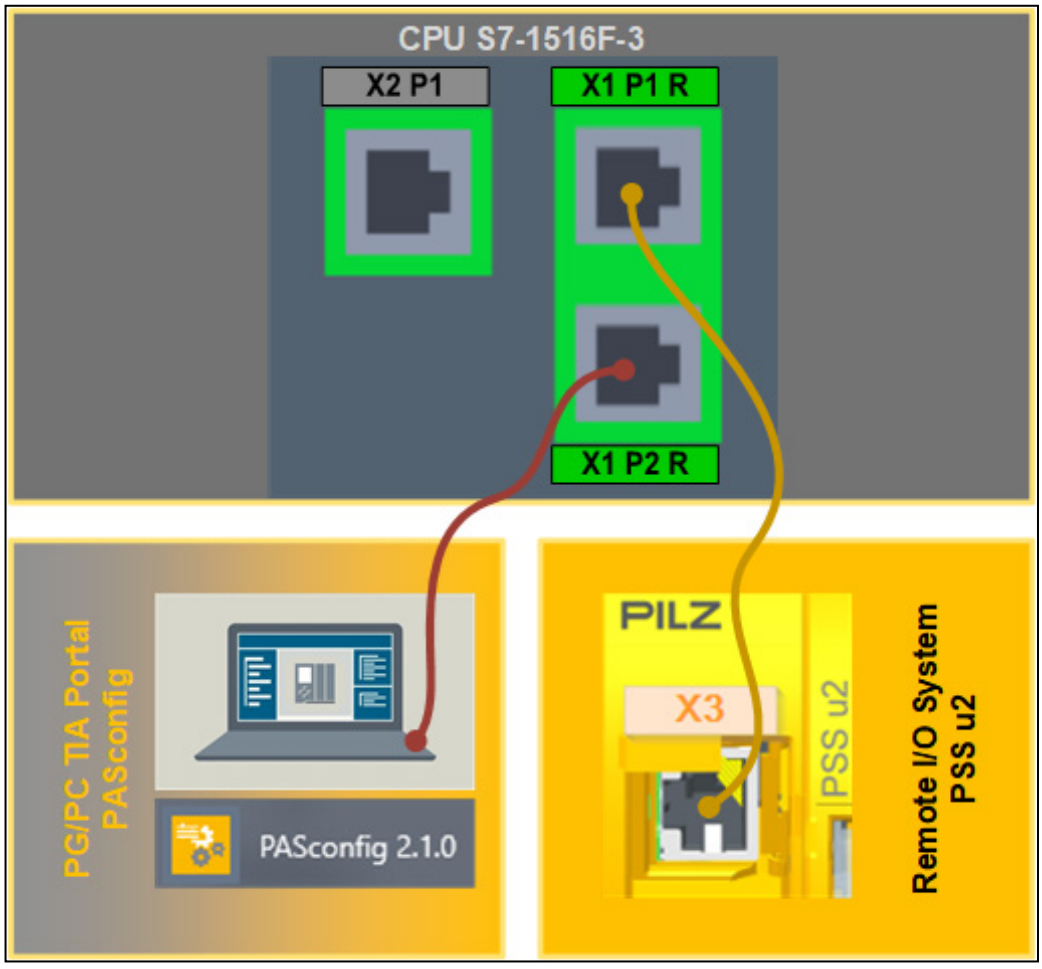


Figure 16: Application – Wiring of Ethernet connections (schematic)

- Bottom / Left » 'PC-ETH-Adapter': **192.168.020.013** / 255.255.0.0
  - Programming device with PG/PC interface (TIA Portal)
  - Connection to SIMATIC S7-PLC with PROFINET interface (X1 P2 R)
- Bottom / Right » 'PSS u2 X3': **192.168.020.011** / 255.255.255.0
  - Remote I/O system PSS u2 with PROFINET interface 'X3'
  - Connection to SIMATIC S7-PLC with PROFINET interface (X1 P1 R)

Notes:
- In TIA, you can first search and display the "Accessible devices …" in the network in order to change the configuration for the used F-CPU.
  In this example, the default network address is used for the F-CPU.
- The default IP address of the PSS u2 head modules when delivered: **0.0.0.0** (:18080 / 0.0.0.0). (applies only to the PROFINET version)

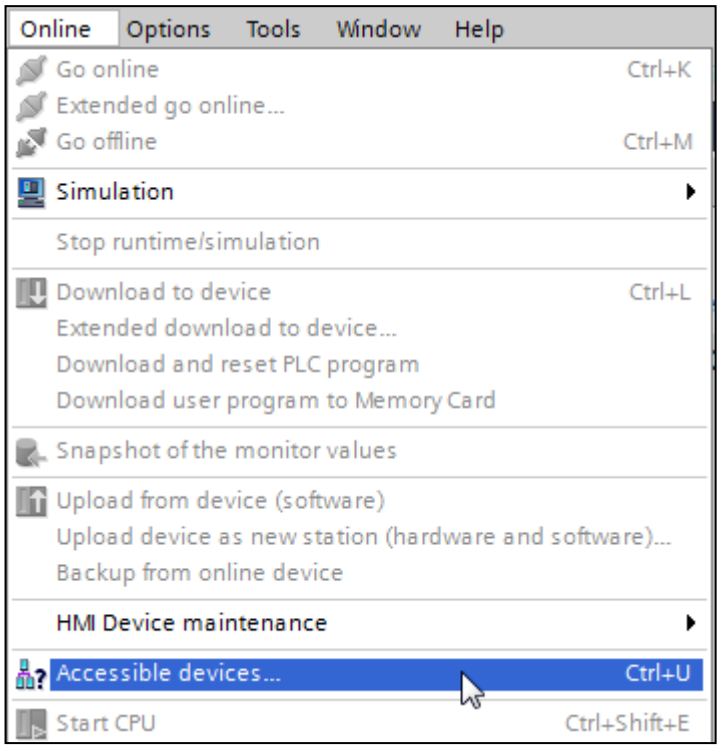


Figure 17: TIA – Search for 'Accessible devices ...' (Part 1, Start)

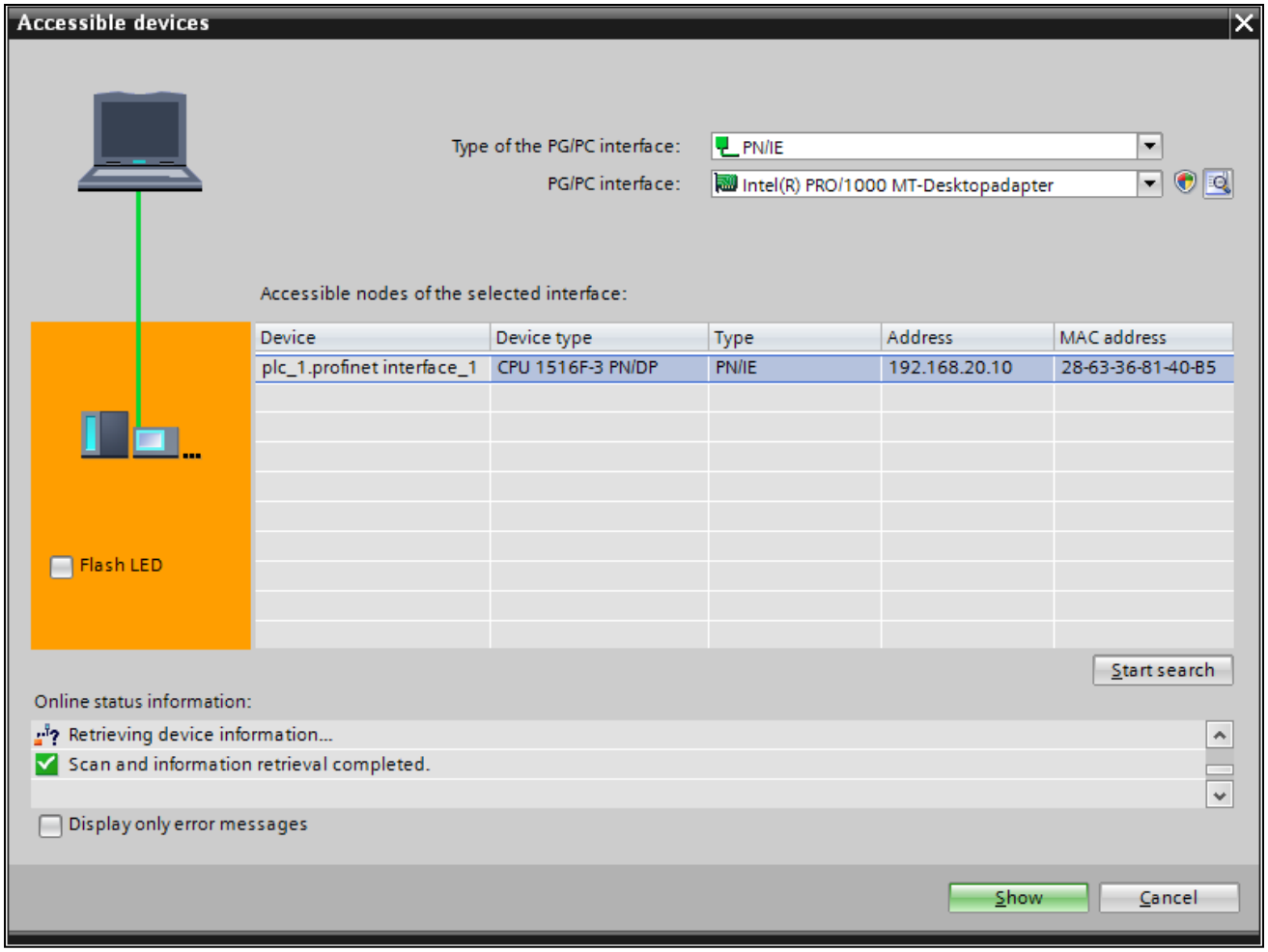


Figure 18: TIA – List of 'Accessible devices ...' (Part 2, Overview)

- Switch to “Device view” (if not previously selected) and select the device ‘PLC_1’:
- Open “Properties” window.
- Switch to the section “PROFINET Interface [X1]” in the ‘General’ tab and check its settings:

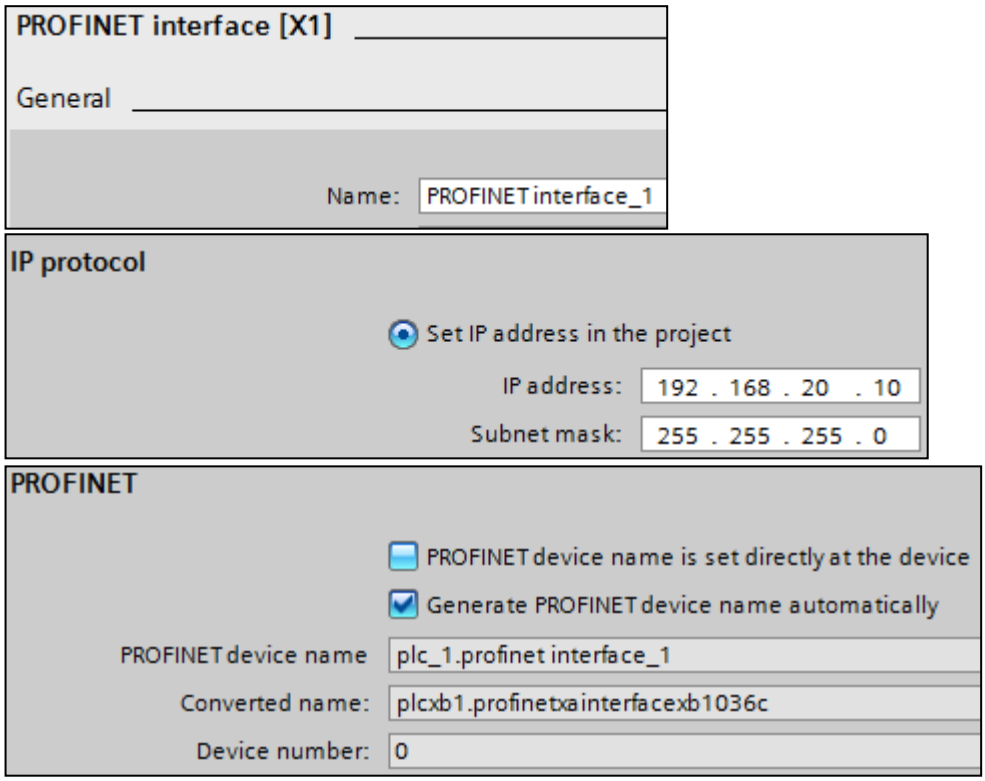


Figure 19: TIA – Properties of PLC-PROFINET interface [X1] » General

INFORMATION

The PSS u2 system must be directly connected to the PC. Normally, there is a switch on a PLC that automatically connects the network segments to each other.
The used F-CPU 1516F-3 PN / DP has two separate controllers.
Hence the Note:

- In your application, observe the requirements for commissioning (security), in particular the removal of the separation of networks with different IP address ranges.

Function: Activate IRT function “Sync master” (see also “Sync slave”, Figure 36 [🕮 29])

- Only use the IRT function when it is really needed; the default setting is "Unsynchronized".
- To activate the IRT function, select the synchronization role “Sync master” in the same section “PROFINET Interface[X1]” under “Real time Settings”:

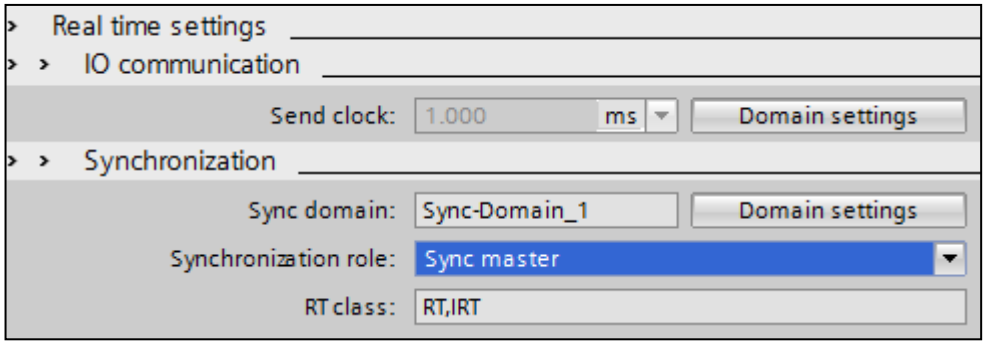


Figure 20: TIA – Properties of PLC-PROFINET interface [X1] » Real time (IRT)

8 Configuration of the PSS u2 failsafe system

8.1 GSDML file of PSS u2 head module

8.1.1 Download of the GSDML file and the 'PASconfig' tool

For the integration of the Pilz PROFINET input/output modules in the TIA tool, the installation of a device description file (GSDML file) and the 'PASconfig' tool for the configuration of PSS u2-System are necessary.

- Download the current GSDML file (in XML format) and the 'PASconfig' tool from the Pilz homepage. You can find it in the download area ('Support' » 'Downloads') at: https://www.pilz.com/en-INT/support/downloads
- Use the order number of the PSS u2-PN head module for the search: '**328061**'

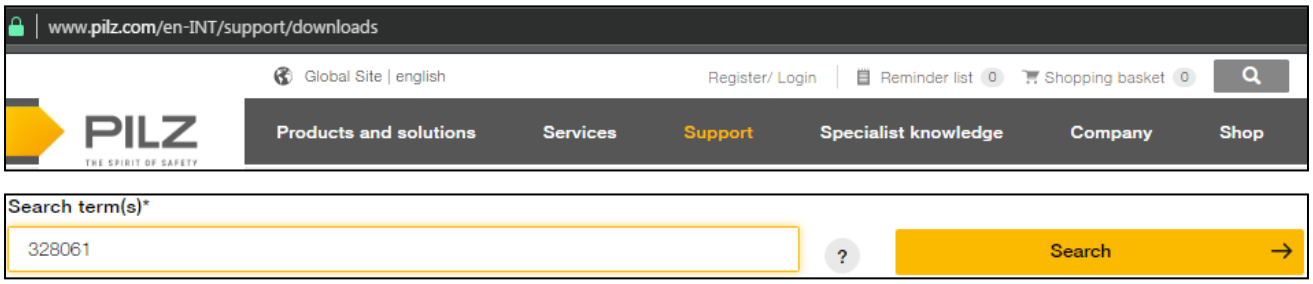


Figure 21: Pilz Homepage (www.pilz.com) – Search for "GSD(ML)" and "PASconfig"

- The GSDML file can be found in the section "*Device description file*" and the two files for the tool with its "Readme file" in the "*Software*" section.

There is currently no registration required to download the GSDML file, but for the download the 'PASconfig' software, for whose version 2.1.0 no license is required yet.

- Log in with your access data at 'Login':

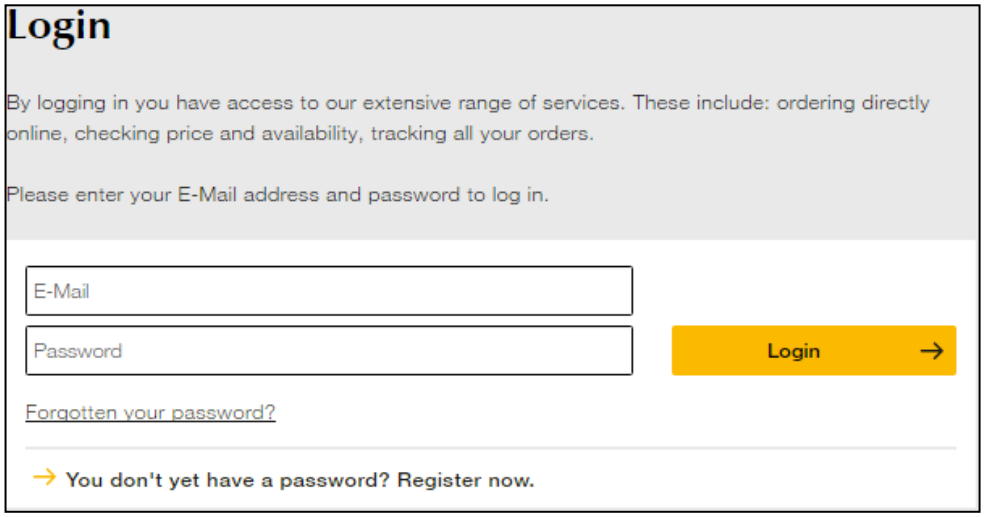


Figure 22: Pilz Homepage (www.pilz.com) – E-Shop Login

- The three ZIP files are downloaded to the computer and have to be unpacked.
- The software 'PASconfig' must be installed according to the Siemens software 'TIA Portal'.

8.1.2 Manage general station description files GSD(ML) in TIA

- Open the function "Manage general station description files (GSD)" in the menu "Options":

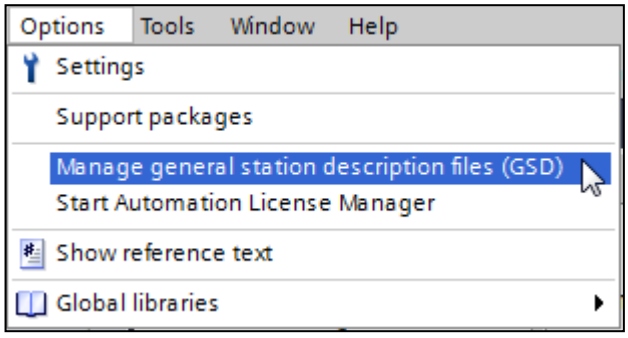


Figure 23: TIA – Manage general station description files GSD(ML) (Part 1, Start)

- Install the downloaded GSD(ML) file:

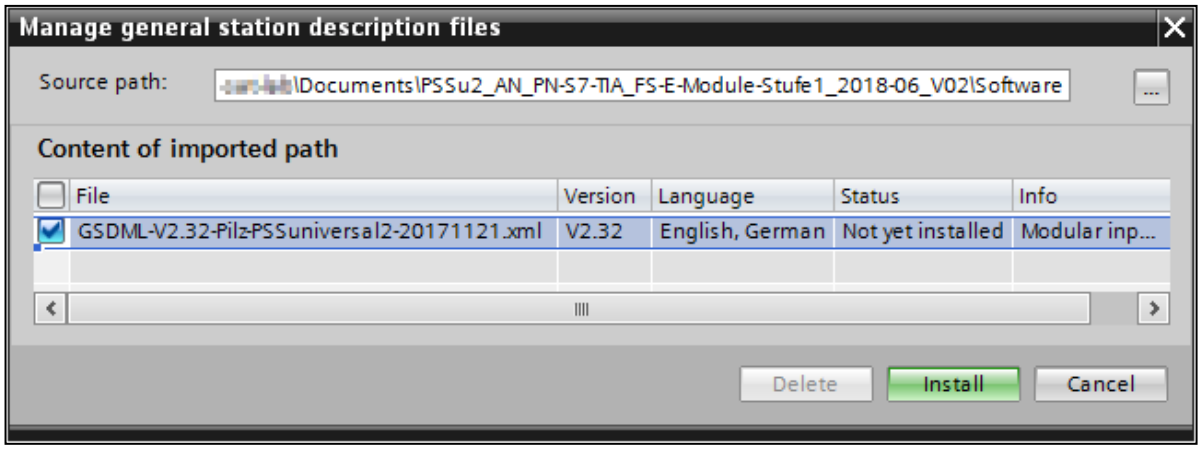


Figure 24: TIA – Manage general station description files GSD(ML) (Part 2, Installation)

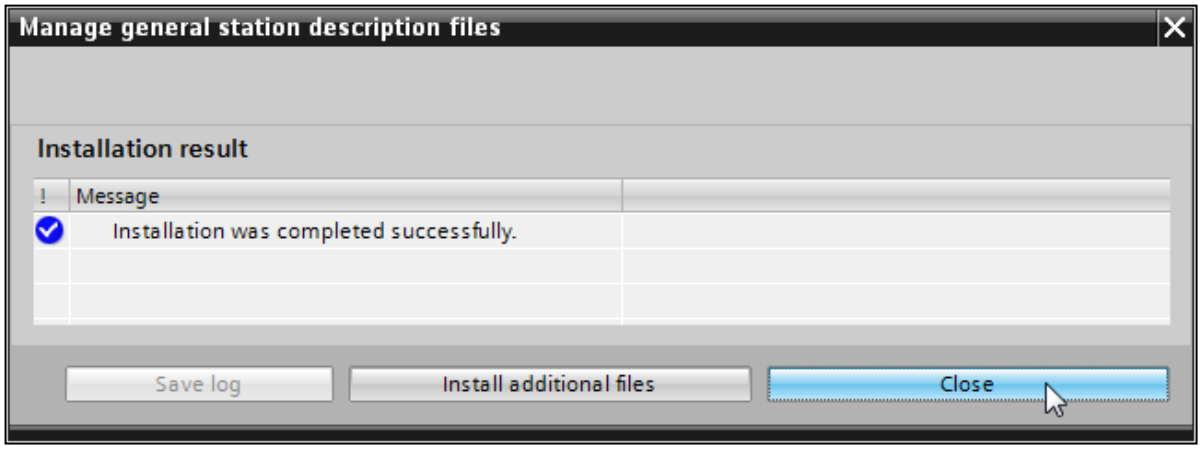


Figure 25: TIA – Manage general station description files GSD(ML) (Part 3, Finalization)

8.2 TIA – Device configuration of PSS u2 system

8.2.1 Create and configure the PSS u2 head module

- Open the function “Devices & networks” in “Project tree”:

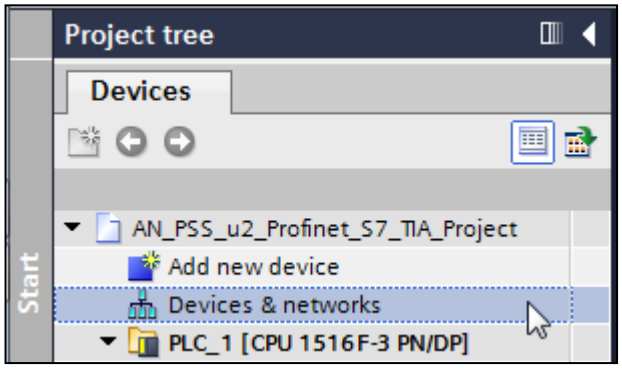


Figure 26: TIA – Open the function “Devices & networks” (Part 1, Start)

- Switch to the “Topology view”.
- Inserting the PSS u2 head module:
  Path: Catalog » Other field devices » PROFINET IO » I/O » Pilz GmbH u. Co. KG » PSSuniversal

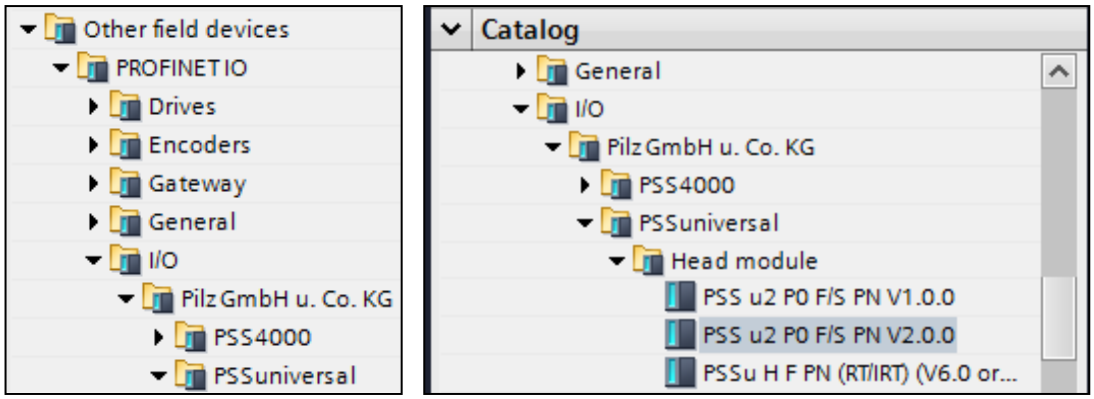


Figure 27: TIA – Inserting the PSS u2 head module (Part 2a, Selection)

Note:

- If several GSDs are installed, please select the desired one in the “Information” window.

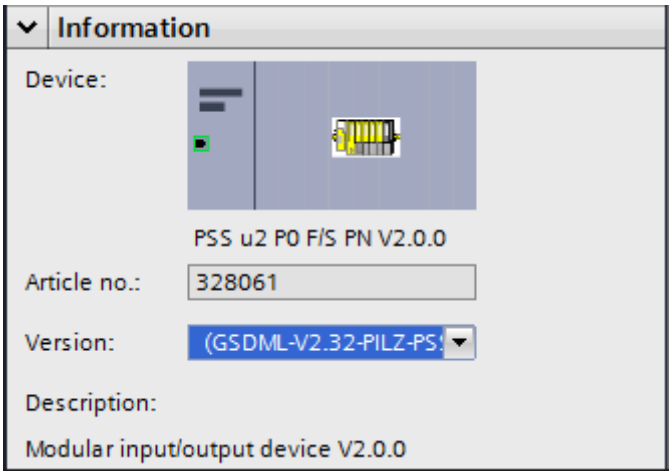


Figure 28: TIA – Inserting the PSS u2 head module (Part 2b, Information)

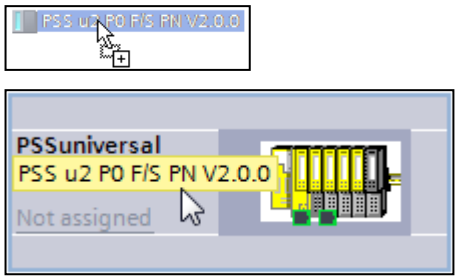


Figure 29: TIA – Inserting the PSS u2 head module (Part 2c, Finalization)

- The preset device name 'PSSuniversal' is still used, but it can also be changed in the properties of the system, e.g. in the Equipment identifying symbol (EIS):

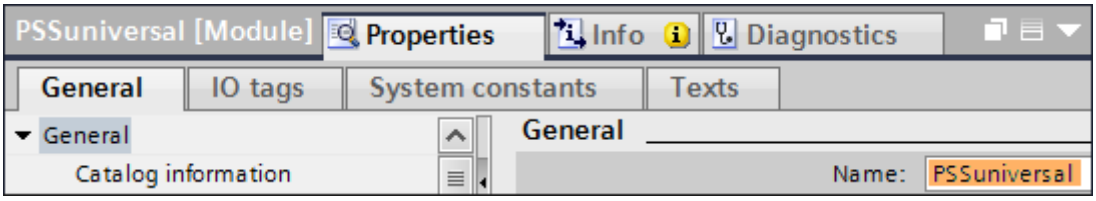


Figure 30: TIA – Assigning the device name 'PSSuniversal' of the PSS u2 head module

- Connect the S7-CPU and the I/O system in accordance with Figure 16 Application – Wiring of Ethernet connections (schematic) [📖 22]:

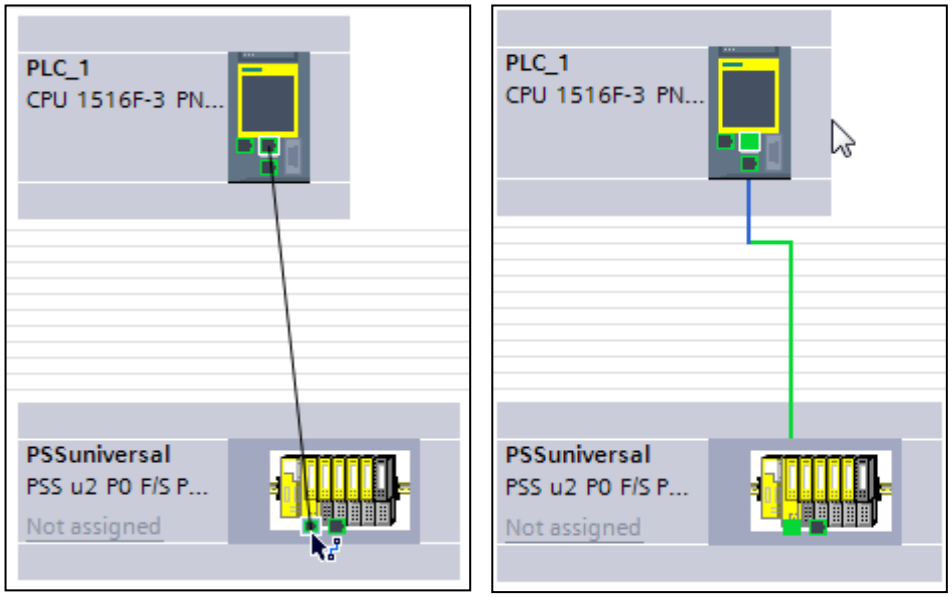


Figure 31: TIA – Connect the S7-CPU and the I/O system

- Switch to the "Network view":
  The two devices are networked in the subnet "PN/IE_1".

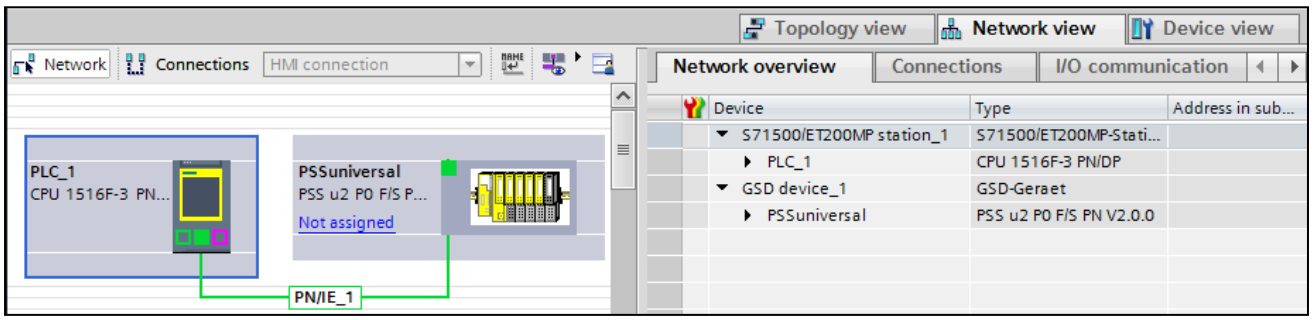


Figure 32: TIA – Assigning the I/O system to the S7 CPU (Part 1, Start)

- Assign the I/O system with the preset device name 'PSSuniversal' to the 'PLC_1':

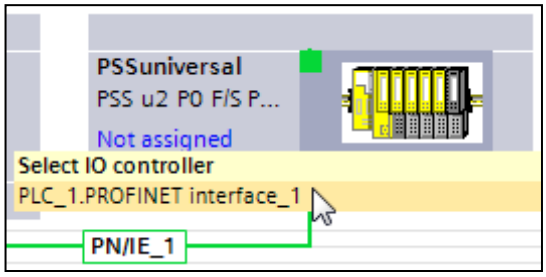


Figure 33: TIA – Assigning the I/O system to the S7 CPU (Part 3, Link-up)

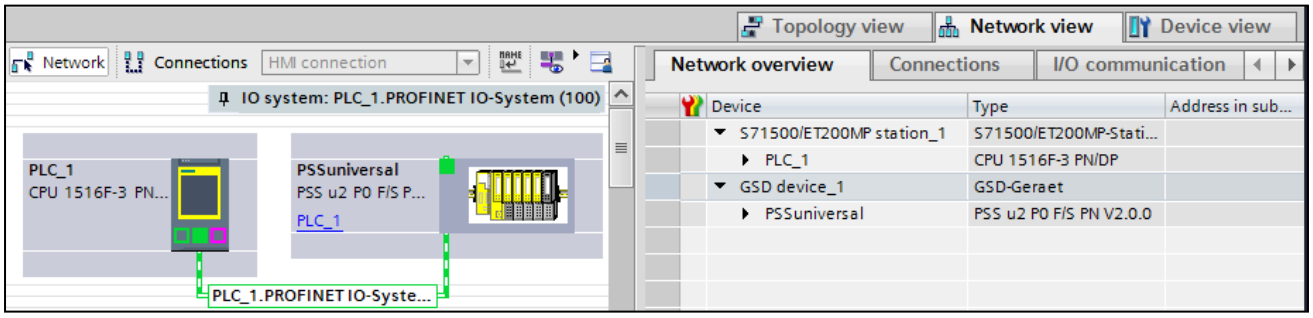


Figure 34: TIA – Assigning the I/O system to the S7 CPU (Part 3, Finalization)

- Switch to "Device view" (if not previously selected) and select the device 'PSSuniversal' (see Figure 37 [📖 30]).
- Switch to the section in the tab "General"
  - "PROFINET Interface [X1]" (corresponds to ETH port 'X3' on the PSS u2 head module):

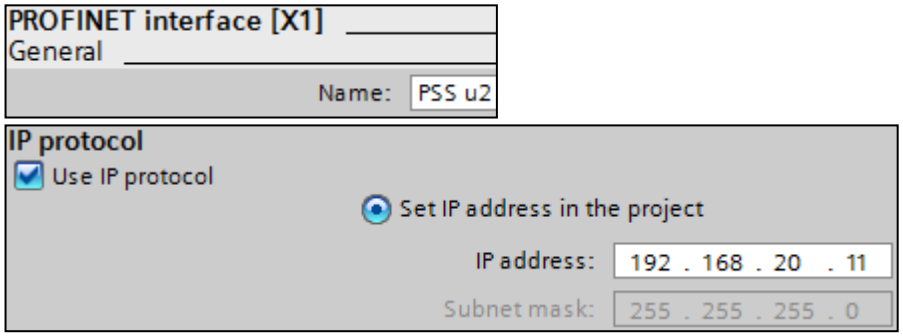


Figure 35: TIA – Properties of PSS u2-PROFINET interface [X1] to PLC

Note:

- The default IP address of the PSS u2 head modules when delivered: **0.0.0.0** (:18080/0.0.0.0). (applies only to the PROFINET version)

Function: Activate IRT function "Sync slave" (see also "Sync master", Figure 20 [📖 24])

- Only use the IRT function when it is really needed; the default setting is "RT"/"Unsynchronized".
- To activate the IRT function, the RT class "IRT" is selected under "Real-time settings"; the new synchronization role "Sync slave" is then automatically defined:

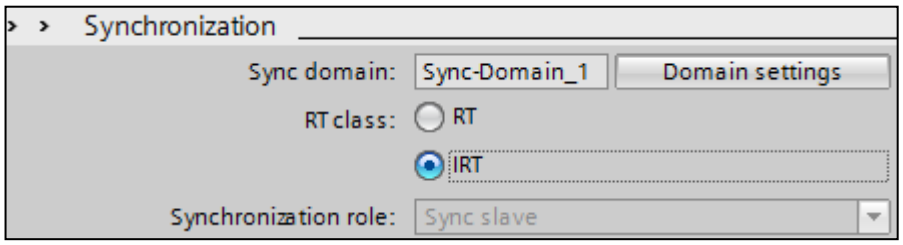


Figure 36: TIA – Properties of PSS u2-PROFINET interface [X1] » Real time (IRT)

8.2.2 Add the electronic modules to the PSS u2 system

- Switch to "Device view" and select the device 'PSSuniversal':

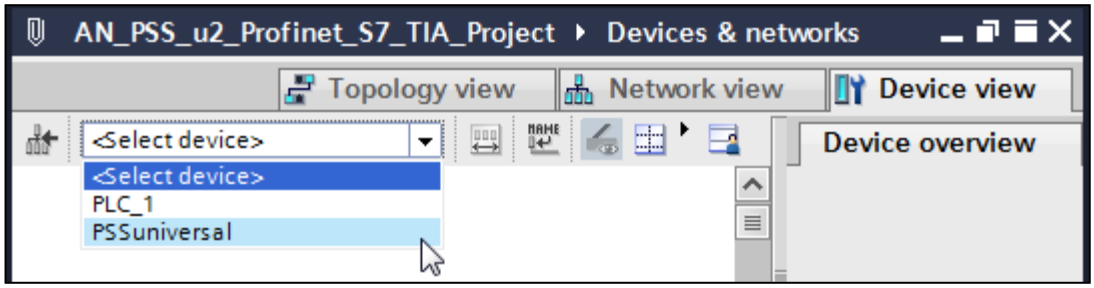
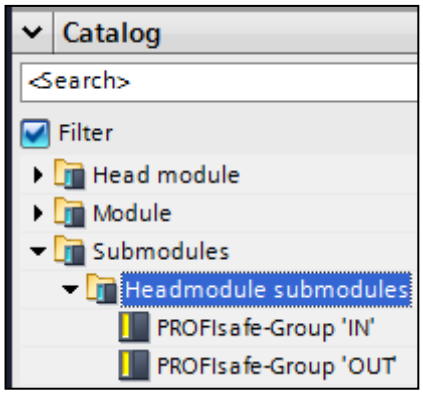


Figure 37: TIA – Add electronic modules to the I/O system (Part 1, Start)

- Open the section "Headmodule submodules" in the Catalog tree.
- Add the two PROFIsafe Groups that are necessary for failsafe operation:



...	Module	Ra...	Slot	I address	Q address	Type	Article no.	Firmware
	PSSuniversal	0	0			PSS u2 P0 F/S PN V2.0.0	328061	V2.0.0
	Modulares Ein-/Ausgabegerät	0	0			Modular input/output device		
	PROFIsafe-Gruppe IN	0	0 PROFIsafe group	20...31	20...23	PROFIsafe group IN		
	PROFIsafe-Gruppe OUT	0	0 PROFIsafe group	40...51	40...51	PROFIsafe group OUT		
	PSS u2	0	0 X1			PSSuniversal		
	PSS u2 EF 8DI_1	0	1			PSS u2 EF 8DI	328101	
	PSS u2 EF 8DI_2	0	2			PSS u2 EF 8DI	328101	
	PSS u2 EF 8DO 0.5A_1	0	3			PSS u2 EF 8DO 0.5A	328131	
	PSS u2 EF 8DO 0.5A_2	0	4			PSS u2 EF 8DO 0.5A	328131	
	PSS u2 ES 8DID_1	0	5	10...11		PSS u2 ES 8DID	328311	

Figure 38: TIA – Add PROFIsafe Groups to the head module (Part 2)

Note:

- It is possible to operate the PSS u2 system in one of three failsafe basic configurations:
  1. only with the PROFIsafe group 'IN'
     when using only FS input modules,
  2. only with the PROFIsafe group 'OUT'
     when using only FS output modules or
  3. with both PROFIsafe groups 'IN' and 'OUT'
     when using FS input and output modules.
     This last basic configuration is used in the application example of this AN.

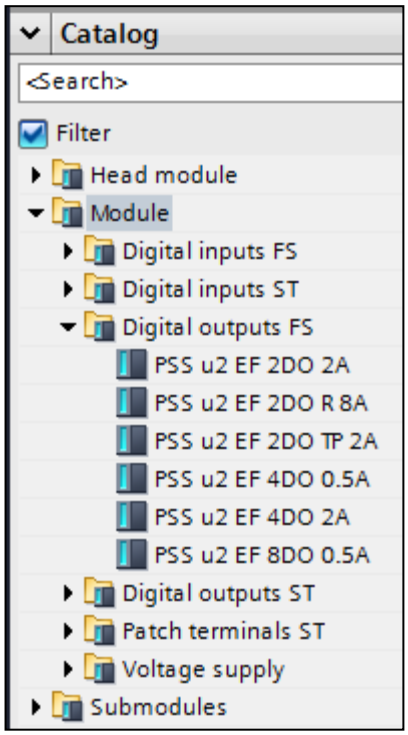
Comments on the second failsafe basic configuration (FS output modules only):

In the basic variant [2] an 'F-address' must be specified in the tool 'PASconfig' for the Connection Manager (Figure 55 [📖 40]). This must be in the range 1 ... 65534, i.e. it must have the value:

- from the DIP switch of the 'IN ADDRESS' for the head module (Figure 42 [📖 33]) or
- from the F address for PROFIsafe group 'IN' in the 'PASconfig' tool (Figure 60 [📖 42]).

This value must always be set, even if you have no FS-input modules are used.

- Open the section “Module” in the catalog tree.
- Add the input and output modules:
  - Figure 5: PSS u2 – Hardware » Overview of used modules [📖 15)



Device overview

...	Module	Ra...	Slot	I address	Q address	Type	Article no.	Firmware
	PSSuniversal	0	0			PSS u2 P0 F/S PN V2.0.0	328061	V2.0.0
	Modulares Ein-/Ausgabegerät	0	0			Modular input/output device		
	PROFIsafe-Gruppe IN	0	0 PROFIsafe group	20...31	20...23	PROFIsafe group IN		
	PROFIsafe-Gruppe OUT	0	0 PROFIsafe group	40...51	40...51	PROFIsafe group OUT		
	PSS u2	0	0 X1			PSSuniversal		
	PSS u2 EF 8DI_1	0	1			PSS u2 EF 8DI	328101	
	PSS u2 EF 8DI_2	0	2			PSS u2 EF 8DI	328101	
	PSS u2 EF 8DO 0.5A_1	0	3			PSS u2 EF 8DO 0.5A	328131	
	PSS u2 EF 8DO 0.5A_2	0	4			PSS u2 EF 8DO 0.5A	328131	
	PSS u2 ES 8DID_1	0	5	10...11		PSS u2 ES 8DID	328311	
	PSS u2 ES 8DID_2	0	6	12...13		PSS u2 ES 8DID	328311	
	PSS u2 ES 8D0D 0.5A_1	0	7	15	15	PSS u2 ES 8D0D 0.5A	328401	
	PSS u2 ES 8D0D 0.5A_2	0	8	16	16	PSS u2 ES 8D0D 0.5A	328401	

Figure 39: TIA – Add electronic modules to the I/O system (Part 3, Finalization)

8.2.3 Setting up the PROFIsafe address of the PSS u2 head module

The F-addresses ('F-destination addresses') can be set using:

- the tool 'PASconfig' (see 'PASconfig' online help under the section 'Working with systems' » 'Profinet' » 'Change the F-address')
  or
- the DIP switches.

The software F addresses must be an integer in the range 1 ... 65,534.
The DIP switches are binary coded, here the permissible F addresses are in the range 1_D ... $1{,}023_D$.

Here is an example of how to set the switches (Left-handed = Activated!):

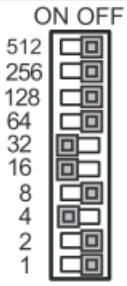
DIP switch "IN ADDRESS" and "OUT ADDRESS"	Meaning		Example
Switch designation	**ON**	**OFF**	**F-address 52_D**
512	512_D	0	
256	256_D	0	
128	128_D	0	
64	64_D	0	
32	32_D	0	
16	16_D	0	
8	8_D	0_D	
4	4_D	0	
2	2_D	0	
1	1_D	0	

Figure 40: PSS u2 – Setting of PROFIsafe addresses using DIP switch (example)

- The following PROFIsafe addresses are specified for this application:
  - **IN ADDRESS: 5**
  - **OUT ADDRESS: 6**

There are two ways to set the PROFIsafe addresses for the PSS u2 head module:

- **[Variant A]** Software: via the 'PASconfig' tool
  - Requirements:
    » F-addresses are not set on the DIP switches (Figure 41).
    » There is an online connection to the PSS u2 system.
    (see Chapter 8.3.2 Configure of PSS u2 system [📖 38ff])

Figure 41: PSS u2 – Head module » Setting of DIP switches for [Variant A]

- **[Variant B]** Hardware: via DIP switches
  - Requirement:
    » Both F-addresses are set on the DIP switch (Figure 42).

Figure 42: PSS u2 – Head module » Setting of DIP switches for [Variant B]

Summary Information:

- Each F-address may only be used once on a PROFINET system with PROFIsafe.
  The values of the two F addresses of a PSS u2 system do not have to be consecutive.
  - Permitted Software F-addresses are in the range: **1 ... 65,534**.
    These values are positive integers.
  - Permitted Hardware F-addresses are in the range: **1_D ... $1{,}023_D$**.
    The DIP switches are binary coded.
- The settings for the PROFIsafe addresses must be set in the following two places, otherwise fault-free operation is not possible:
  1. [Variant A] in the 'PASconfig' tool with the setting in Figure 41 [📖 32] or
     [Variant B] directly on the head module on the DIP switches as shown in Figure 42
     and
  2. in the TIA tool under the properties of the 'PROFIsafe' group(s) of the PSS u2 system (Figure 43 [📖 34]).
- The default F-addresses of the PSS u2 head modules when delivered:
  - IN ADDRESSS – Software: **1** IN ADDRESSS – DIP switches: 0
  - OUT ADDRESSS – Software: **0** OUT ADDRESSS – DIP switches: 0
    (applies only to the PROFINET version)
    Since both DIP switches are set to zero at the time of delivery, at the first start of head module the default stored software addresses are activated when the DIP switches are not changed before.
- The settings of the DIP switches, with F addresses greater than zero, have priority over the stored tool parameters on the head module (Software F-addresses).
- The head module reads the settings of the DIP switches only once during the start process after a (power) reset, changes of the values during normal operation are not evaluated.
  Should changed values of the F addresses are to be accepted; a reset must always be executed.
  This is done automatically in the tool 'PASconfig' when the software addresses are changed.
  If the DIP switches are modified, the reset button must be pressed (restart by warm reset).
- The head module stores always the F addresses programmed via software; these are also not changed or deleted, if in the meantime values are set via DIP switches.
  Therefore the head module has always both address pairs, the F addresses:
  - of the last download saved software addresses and
  - the hardware addresses currently set via the DIP switches.
- Due to the latter property, a head module can also be operated with "mixed F addresses", i.e. with one software and one hardware address each.
  However, this procedure is not recommended!

The two PROFIsafe addresses ('F_Dest_Add') for the head module in the TIA tool must be set for both variants [A] and [B].

- To do this, select the properties of the two PROFIsafe groups in the 'Device view' of 'PSSuniversal' (see Figure 38: TIA – Add PROFIsafe Groups to the head module (Part 2) [30])and
- set the value for 'F-destination addresses' under the section 'PROFIsafe':

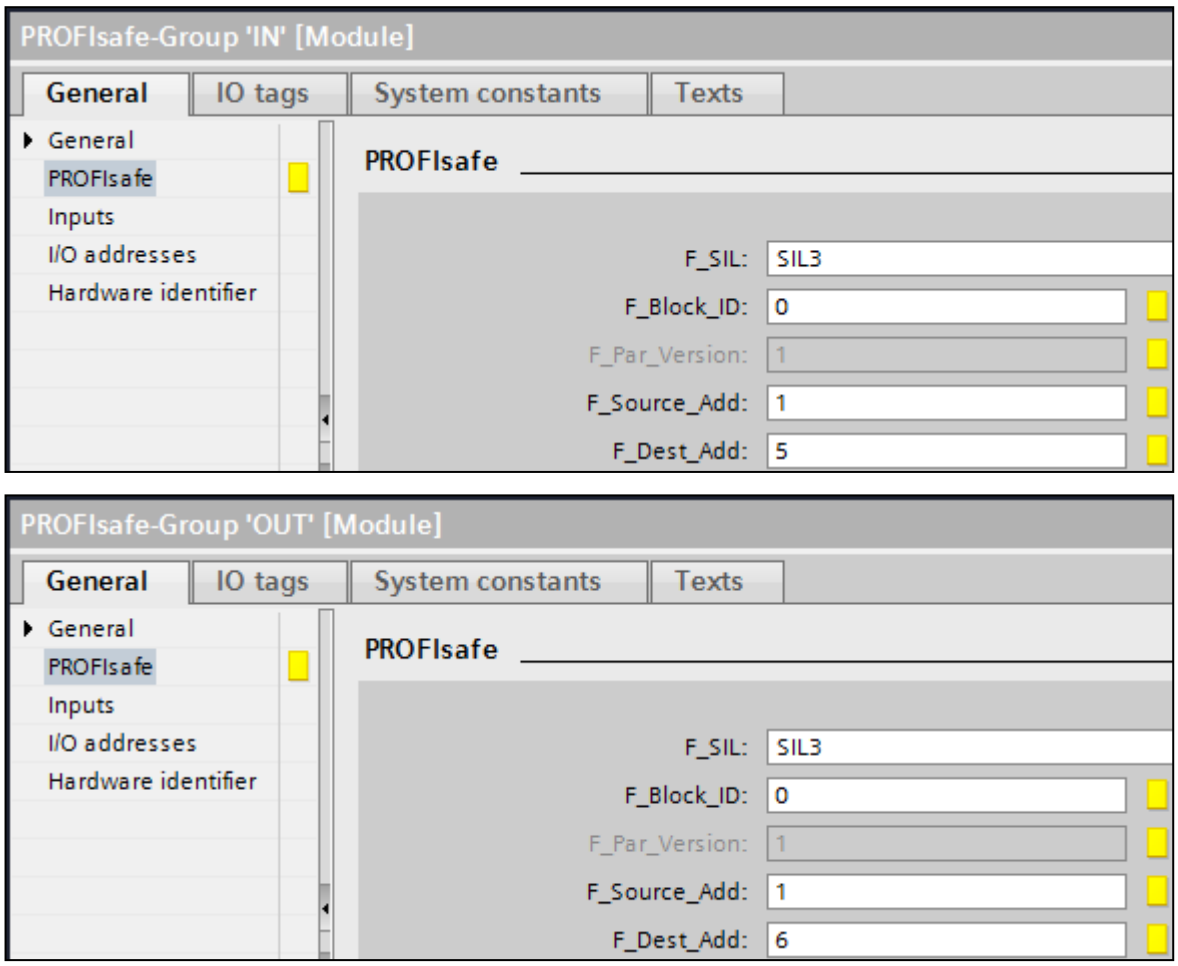


Figure 43: TIA – PROFIsafe-Groups » Setting up of PROFIsafe addresses 'F_Dest_Add'

8.2.4 Setting up the bus cycle times of fieldbus for the PSS u2 head module

- The default cycle time of the used S7 CPU is a minimum 1 ms.

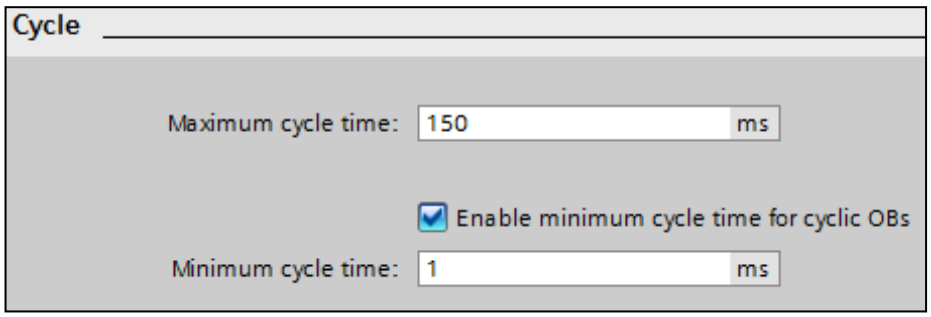


Figure 44: TIA – Bus cycle » Default cycle time of S7 CPU

- The default send clock of the I/O communication of S7 CPU is 1.000 ms.

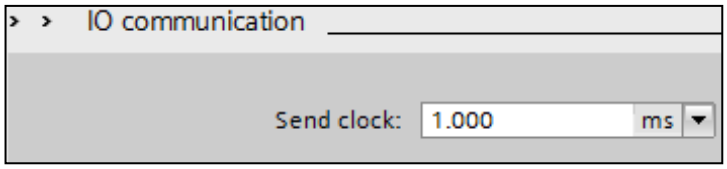


Figure 45: TIA – Bus cycle » Default send clock of the I/O communication

- The default bus cycle time of the PSS u2 head module is 2.000 ms.
- The (minimum) watchdog time is calculated automatically 6.000 ms.

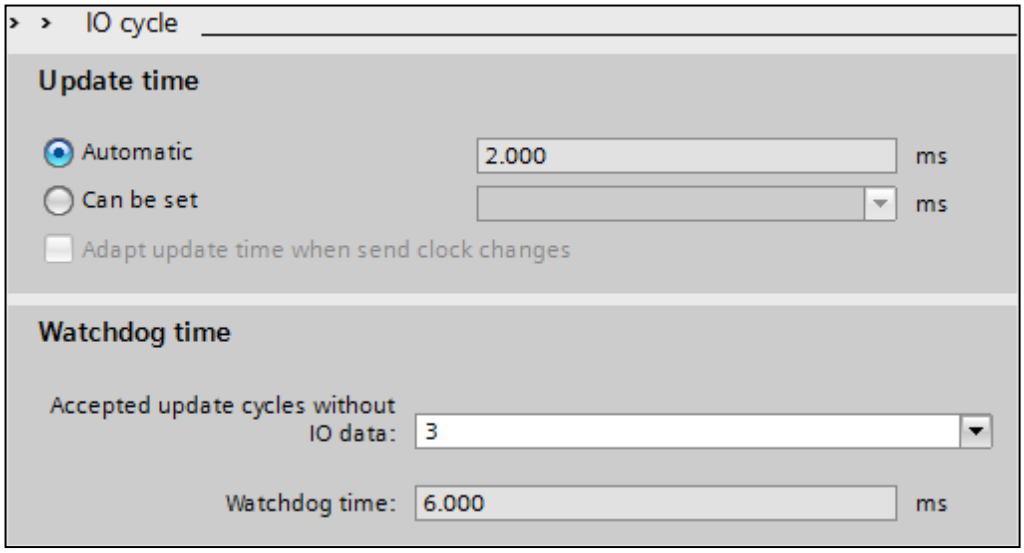


Figure 46: TIA – Bus cycle » Default Bus cycle time of PSS u2 head module

- You can adjust the bus cycle time of the head module:

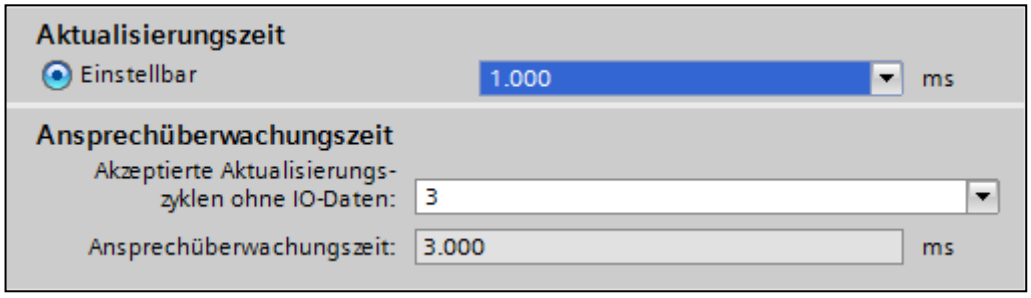


Figure 47: TIA – Bus cycle » Manual setting of bus cycle time of PSS u2 head module

8.2.5 Assign the device name to the PSS u2 system

For the used PROFINET system, a device name must be assigned to the PSSuniversal 2 Remote I/O system (IO device) so that the IO controller of the F-CPU can communicate with it.

- For further details, see the TIA online help, chapter “Addressing PROFINET devices”.

Now you can begin assigning the device name.

- Select the device 'PSSuniversal' under “Devices and networks” (see Figure 34 [📖 29]).
- Right click on the device icon and select the function ‘Assign device name …’:

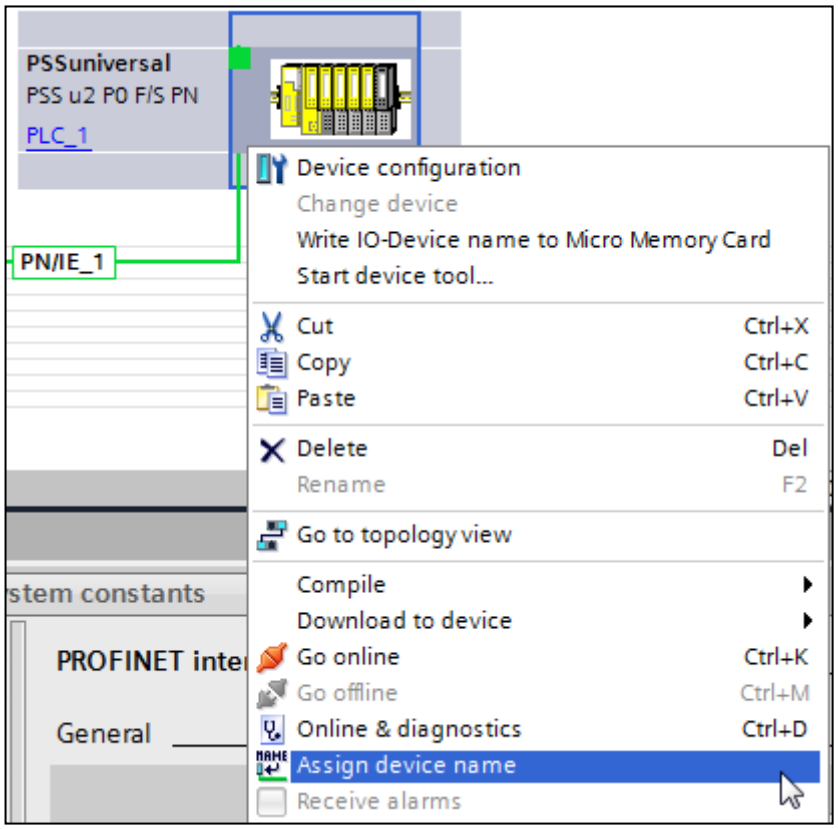


Figure 48: TIA – Assign device name » Select function (Part 1, Start)

- The PSS u2 system, that is to be named, can be uniquely identified by MAC address and IP address. The “Devices MAC address” is lasered on the front of the head module above the DIP switches to the right of the serial number (see left picture in Figure 49).
- For the unique device identification, the displayed device can be selected and the ‘LED flashing’ function can be activated.
  - Activated: LEDs ‘RUN’ and ‘DIAG’ flash green in the same mode
  - Deactivated: LEDs ‘RUN’ and ‘DIAG’ displayed the current system status

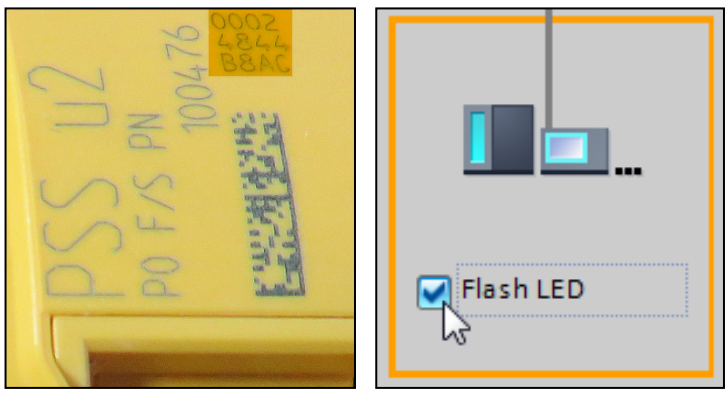


Figure 49: TIA – Assign device name » MAC / Function “Flash LED” (Part 2, Identification)

- The selected PSS u2 system must be marked in the table and you click on the button 'Assign name':

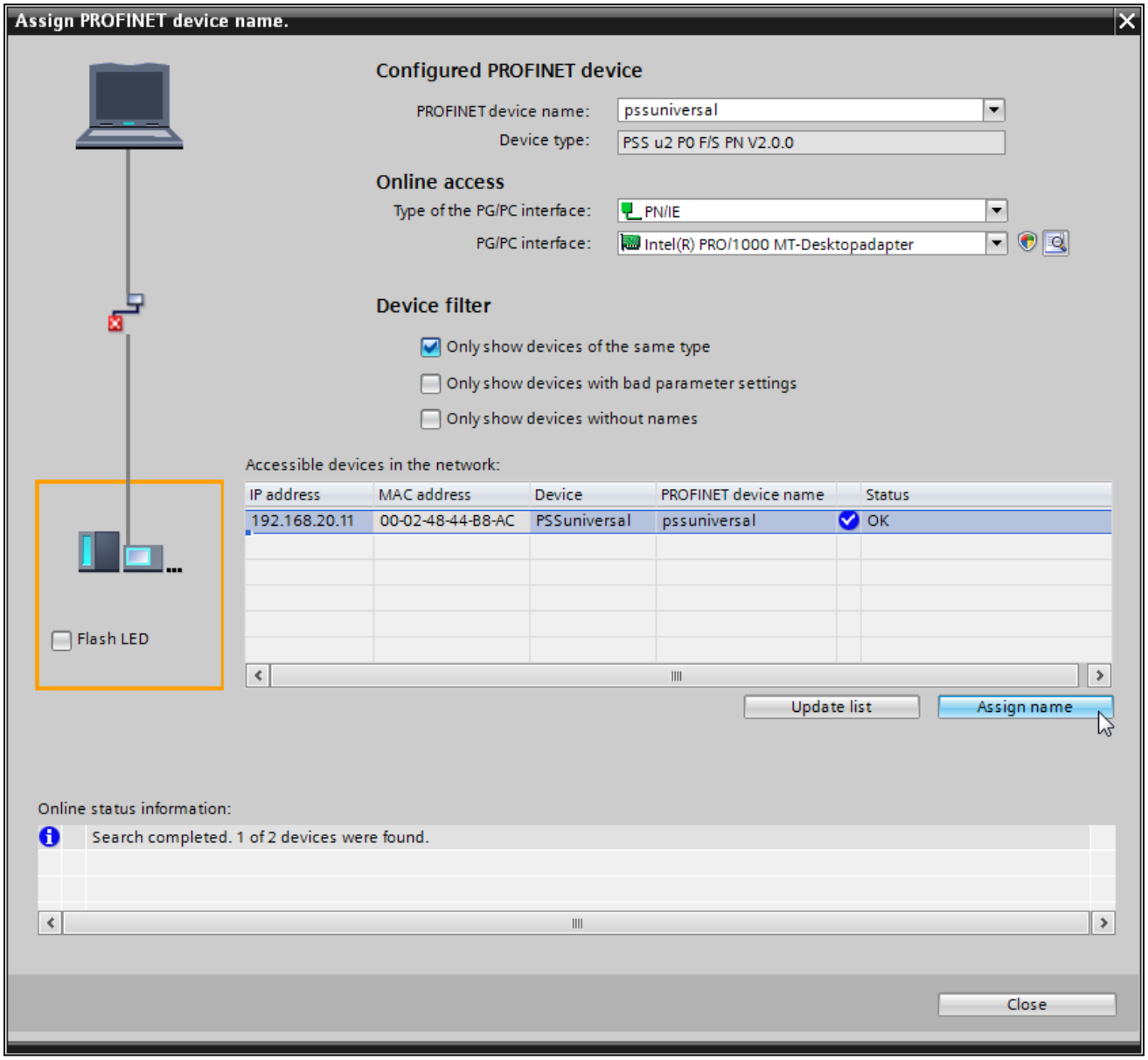


Figure 50: TIA – Assign device name » Select function (Part 3, Assignment)

- At the end, the 'Online status information' is used to indicate whether the operation was successful:

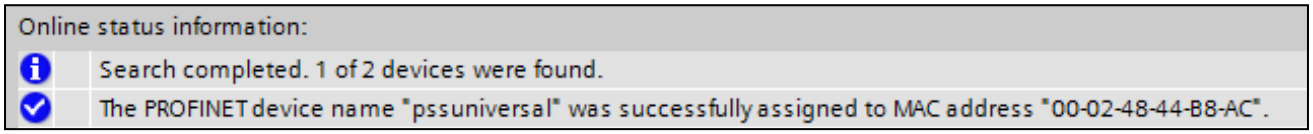


Figure 51: TIA – Assign device name » Select function (Part 4, Finalization)

- You can close the window now.

8.3 PASconfig – Device configuration of PSS u2 system

8.3.1 Start of PASconfig via TIA device configuration

- Open the function “Devices & networks” in “Project tree”.
- Switch to “Device view” and select the device ‘PSSuniversal’.
- Right click on the device icon and select the function ‘Start device tool …’ using the access point ‘Configuration’:

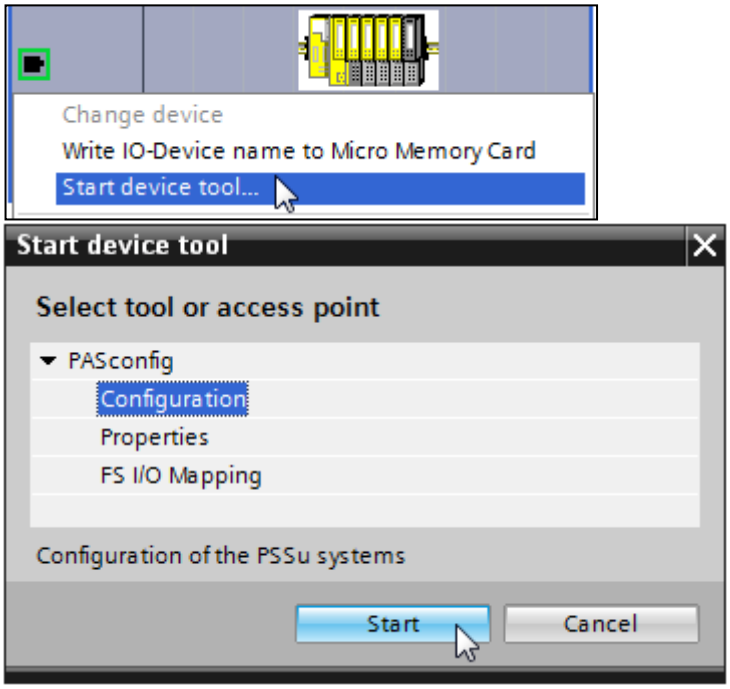


Figure 52: PASconfig – Start device tool from TIA » Access point “Configuration”

Note:

- The ‘PASconfig’ tool opens with the “User interface language” set in the TIA.
  In version 2.1.0, only the two languages ‘German’ and ‘English’ are supported.

8.3.2 Configure of PSS u2 system

The basic configuration is already available; the data is generated automatically by means of the previously made settings in the TIA.

– see Chapter 8.2 TIA – Device configuration of PSS u2 system [📖 27ff]

A network connection is required for the online connection between the PASconfig PC and the PSS u2 system (see Figure 16: Application – Wiring of Ethernet connections (schematic) [📖 22])
So you can run various online actions, e.g.:

– Firmware update,
– download of FS/ST configuration data,
– upload system data and
– display of error stack

Make sure that the IP address of the PASconfig-PC is in the same subnetwork as the IP address of the PSS u2 system.
In the Connection Manager, the ‘F address’, which has been configured in the TIA tool for the PROFIsafe group “IN”, must be set in addition to the IP address.

- The only enterable 'F-address' (see Figure 55) corresponds to the 'IN ADDRESS' on the head module, which must now be changed from default value '1' to the specified value'**5**'.
  - see Chapter 8.2.3 Setting up the PROFIsafe address of the PSS u2 head module [🕮 32ff]
- To do this, the function "Change head module" must be selected in the 'PASconfig' tool.

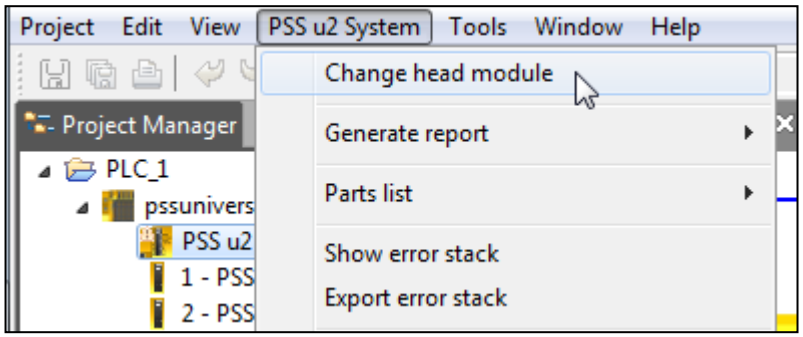


Figure 53: PASconfig – Head module » Function "Change head module" (Part 1, Start)

- The first window displays general data of the head module.

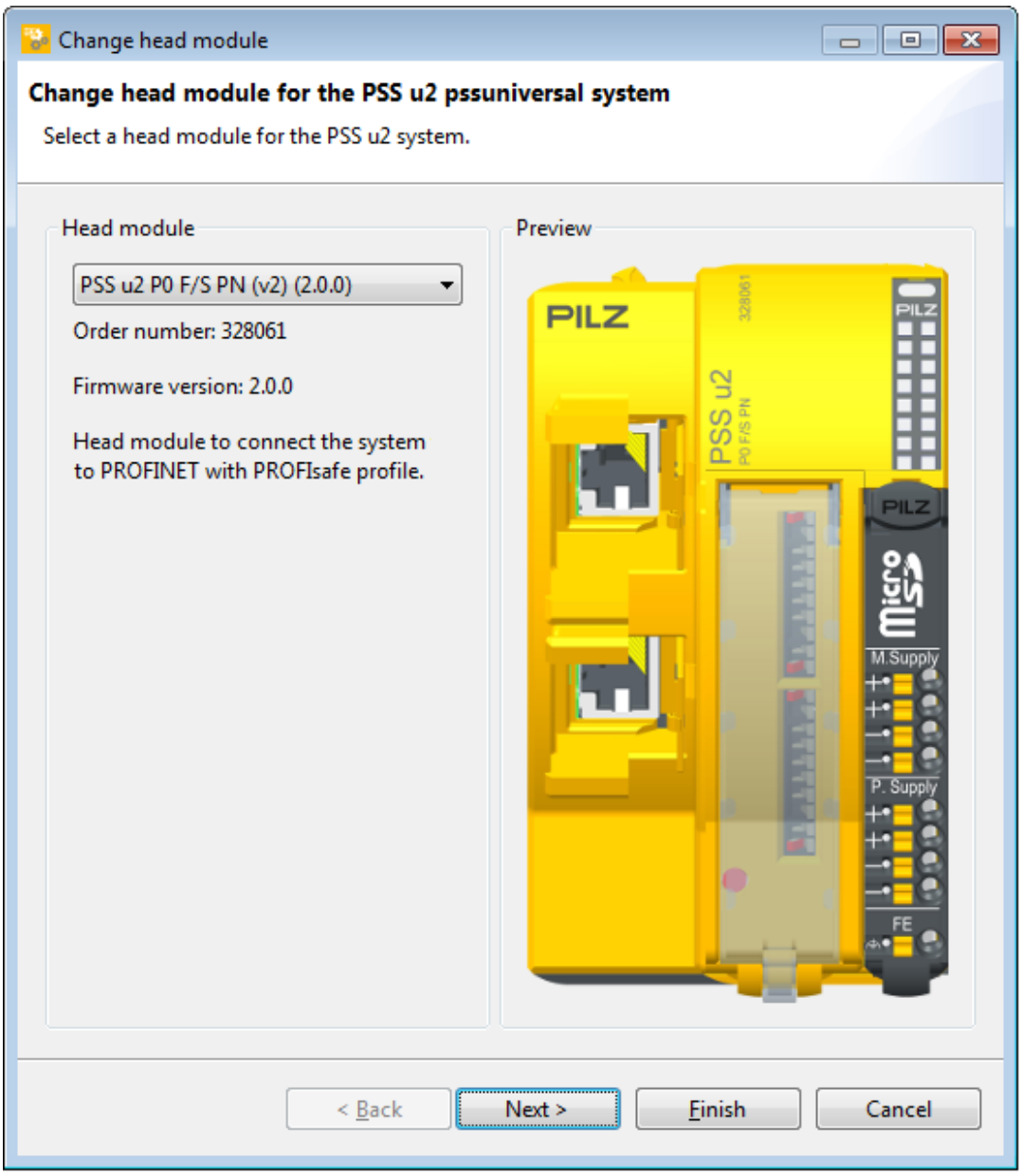


Figure 54: PASconfig – Head module » Function "Change head module" (Part 2, Version)

- Press ‘Next’ to enter the second window where the value ‘5’ has to be entered under “F-address”.
  - Follow the notes in the Chapter 8.2.3 Setting up the PROFIsafe address of the PSS u2 head module [📖 32]!

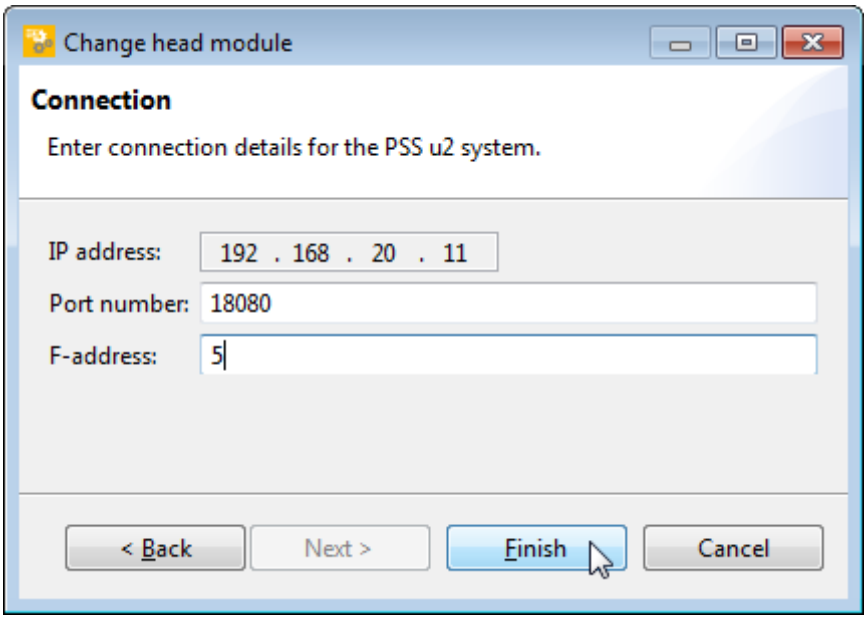


Figure 55: PASconfig – Head module » Function “Change head module” (Part 3, F-address)

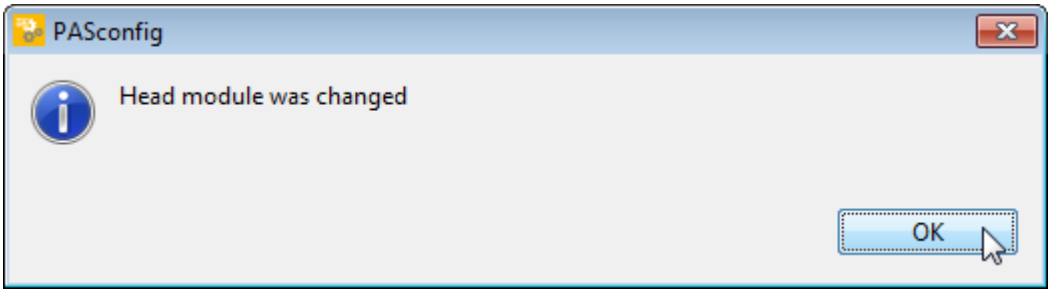


Figure 56: PASconfig – Head module » Function “Change head module” (Part 4, Finalization)

- The changed configuration can still be transferred to the head module.
  Normally, this is done at the end of the device configuration:
  - Chapter 8.3.6 Download the configuration to PSS u2 system [📖 45ff]

8.3.3 Setting up the PROFIsafe address of the PSS u2-Head module

The default PROFIsafe address in a PASconfig project is '1'.
– see Chapter 8.2.3 Setting up the PROFIsafe address of the PSS u2 head module [📖 32]

- There are two ways to set the PROFIsafe addresses for the PSS u2 header module:

[Variant A] Software: via the 'PASconfig' tool
- Start with Function "Set F-address":

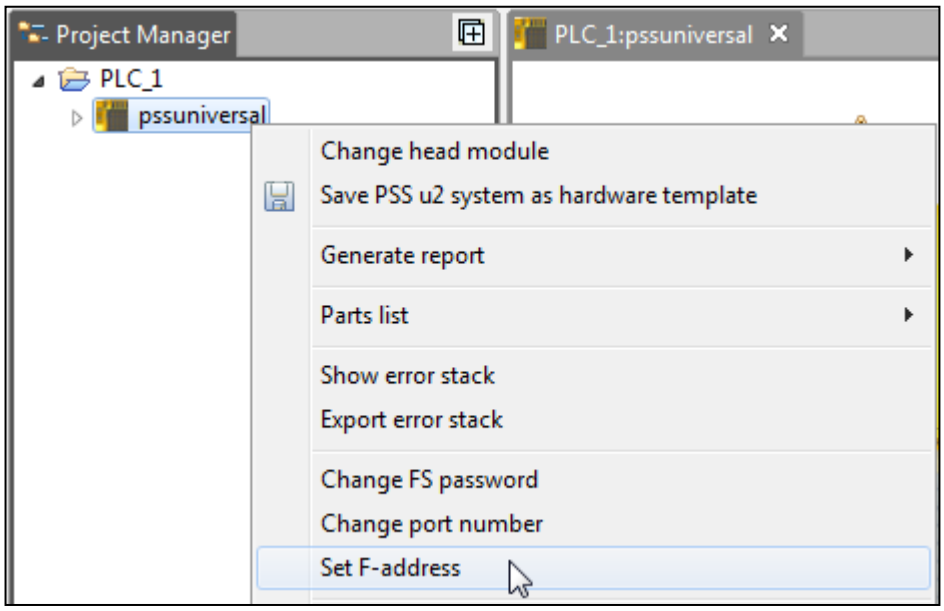


Figure 57: PASconfig – Head module » Function "Set F-address" ([A] Part 1, Start)

- The 'PASconfig' tool is now used for the first time to attempt to establish an online connection to the configured PSS u2 head module.

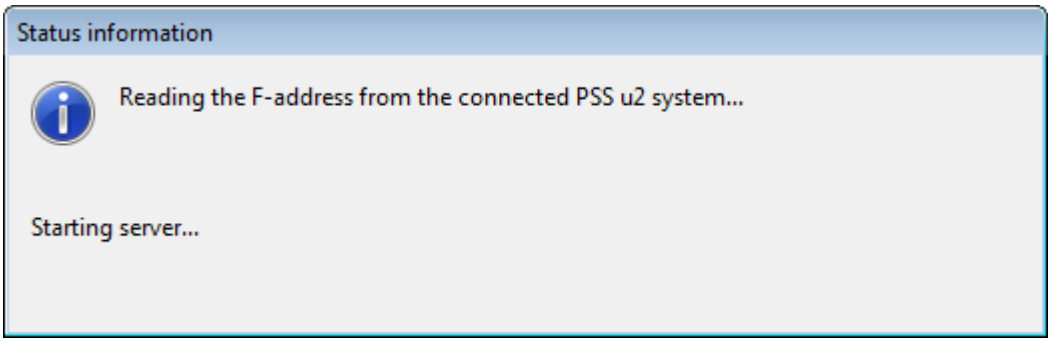


Figure 58: PASconfig – Head module » Function "Set F-address" ([A] Part 2, Online)

- If an online connection to the head module cannot be established, this message appears:

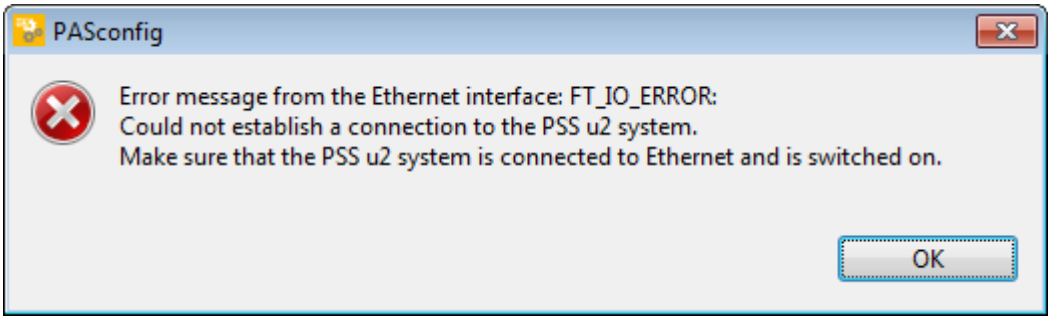


Figure 59: PASconfig – Head module » Error message 'No connection'

- Now you can change the values for both PROFIsafe groups “IN” and “OUT”:

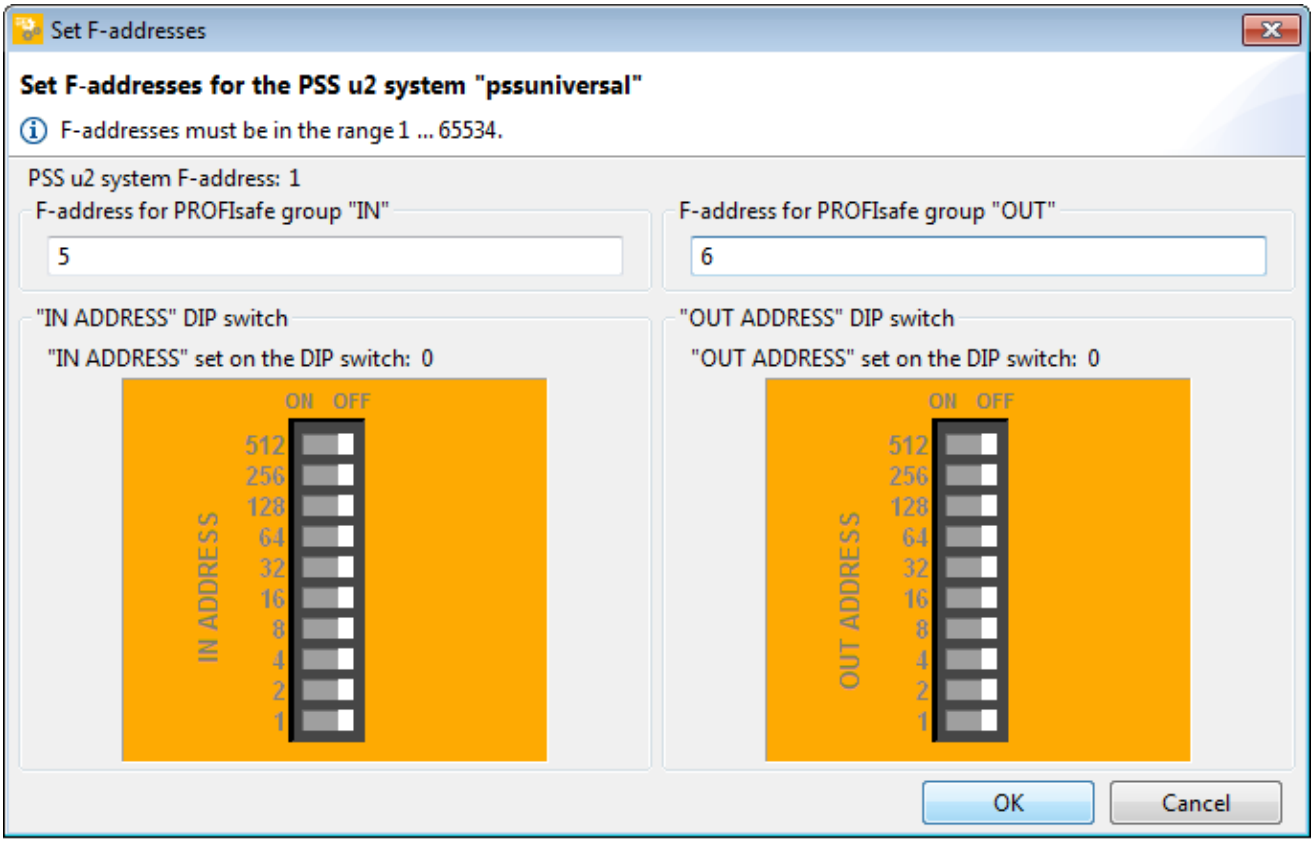


Figure 60: PASconfig – Head module » Function “Set F-addresses” ([A] Part 3, F-addresses)

- After this, the PSS u2 system must be restarted to accept the values:

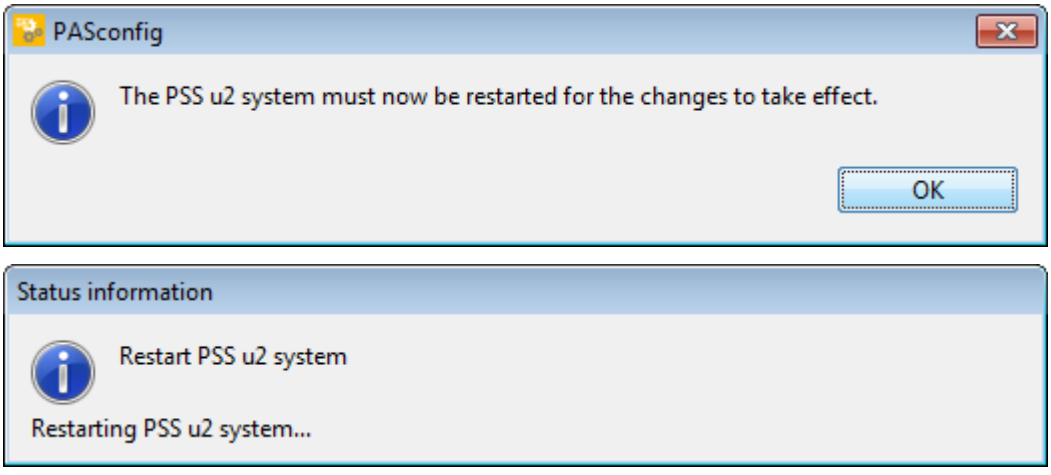


Figure 61: PASconfig – Head module » Function “Set F-addresses” ([A] Part 4, Restart)

- After restart, the changes will be displayed:

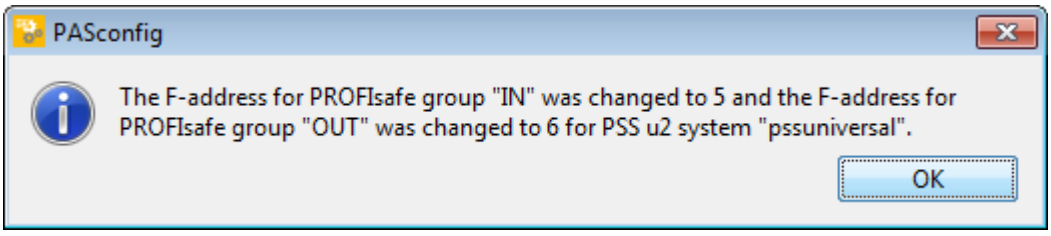


Figure 62: PASconfig – Head module » Function “Set F-addresses” ([A] Part 5, Finalization)

[Variant B] Hardware: via DIP switches
The setting has already been made:
- Figure 42 PSS u2 – Head module » Setting of DIP switches for [Variant B] [📖 33]

- In variant [B], a restart must also be executed for activating the modified PROFIsafe addresses, here by pressing the Reset button on the head module (restart by warm reset).
- In this window you can (additionally) enter the software addresses; now shown here with the preset factory settings at delivery and the corresponding range warning.
  The position of the DIP switches, read out from the head module, is also displayed here in the graphic:

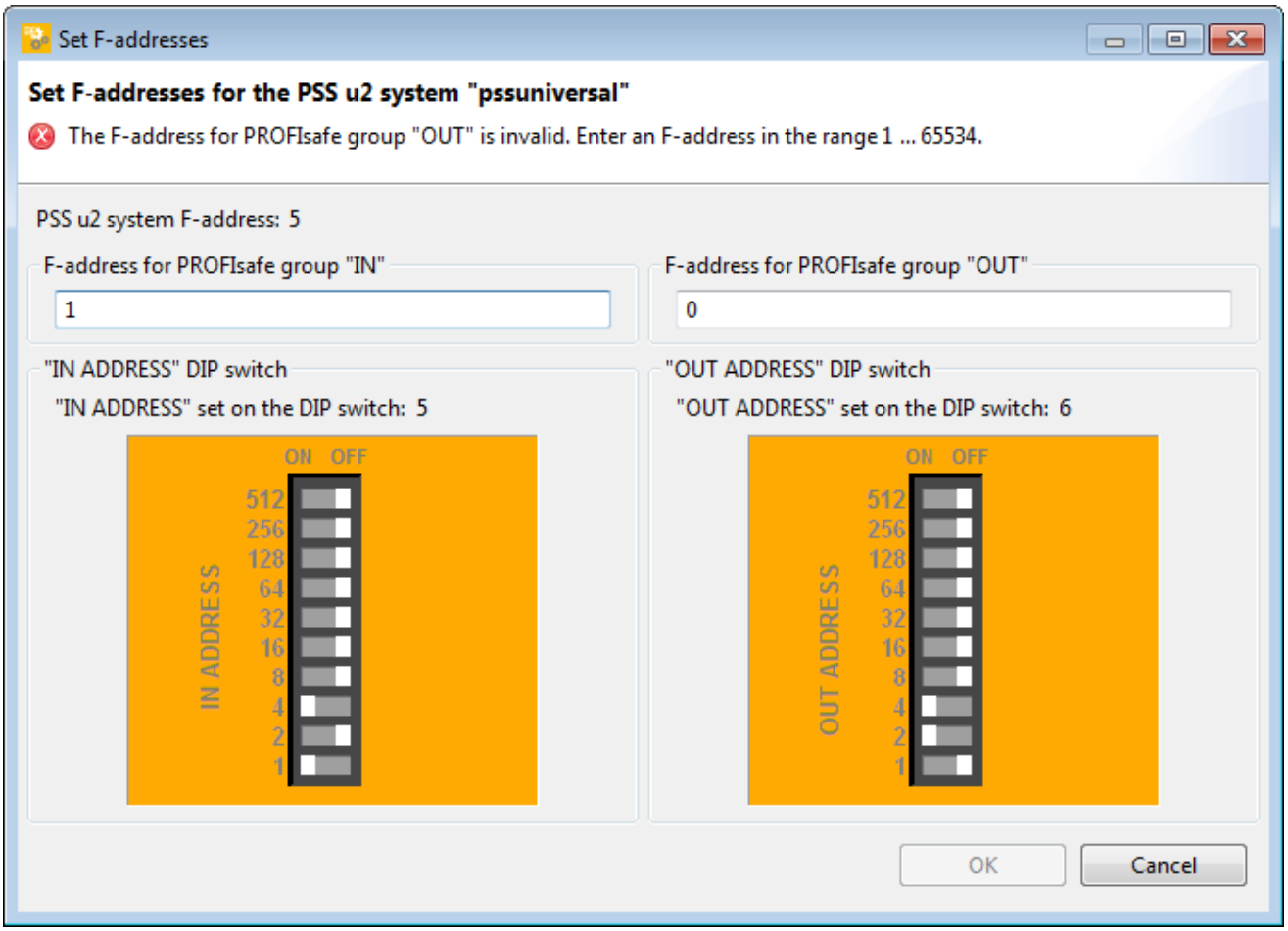


Figure 63: PASconfig – Head module » Function "Set F-addresses" ([B] F-addresses)

Notes:
- The 'Reset' is also possible in the 'PASconfig' tool: Menu 'PSS u2 System' » 'Restart system'
- Both DIP switches should have a different value in the range 1_D ... $1{,}023_D$.
- By the 'Reset' of the head module described above, the settings of the two DIP switches are always read out and activated. As a result, the (still stored) software settings for the F addresses are no longer evaluated, since then:
  - the values, set on the DIP switches, are greater than zero (Figure 42 [📖 33]) and
  - their defined hardware parameters take precedence over the software parameters (Figure 60 [📖 42]).

With this operation, one of the two existing pairs of the F addresses (software and hardware addresses) can be specifically set on the head module.
For example, during commissioning or when a device is replaced; the DIP switches can be deliberately set to greater than zero if an online connection can no longer be established between the 'PASconfig' PC and the PSS u2 system (you no longer remember the software F addresses).
With the hardware addresses then set, a corresponding '**Hardware template**', previously created in 'PASconfig', can be loaded and the configuration can be retrieved and corrected.

8.3.4 Default configuration of the electronic modules

The default configuration is used for all electronic modules, detailed information can be found in the operating manuals and the online help of tool 'PASconfig' in the section 'Hardware configuration'.

- Note: The following functions are always activated for the PSS u2 failsafe modules used:
  - FS input modules: Test pulse activated with test pulse duration of 3 ms
  - FS output modules: On and off tests activated with maximum duration of the tests of 3 ms
    Here is the first output on the electronic module 'PSS u2 EF 8DO 0.5A' (Slot 3):

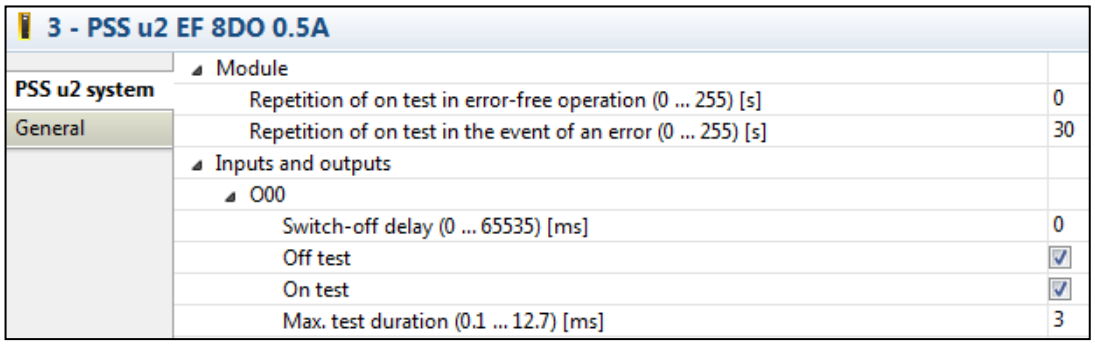


Figure 64: PASconfig – FS output module » Default configuration

- The following functions are always deactivated:
  - FS input modules: Pulse stretching with pulse stretch time of 0 ms
  - FS output modules: Switch-off delay with a duration of 0 ms

8.3.5 Activate discrepancy monitoring for the emergency stop button 'PIT es'

- Discrepancy monitoring is activated for the function of the emergency stop button 'PIT es'. This automatically deactivates the function 'Pulse stretching' on the two FS inputs 'I0' and 'I1' belonging to the function 'Discrepancy monitoring'.
  - see Chapter 5 Application [📖 14]

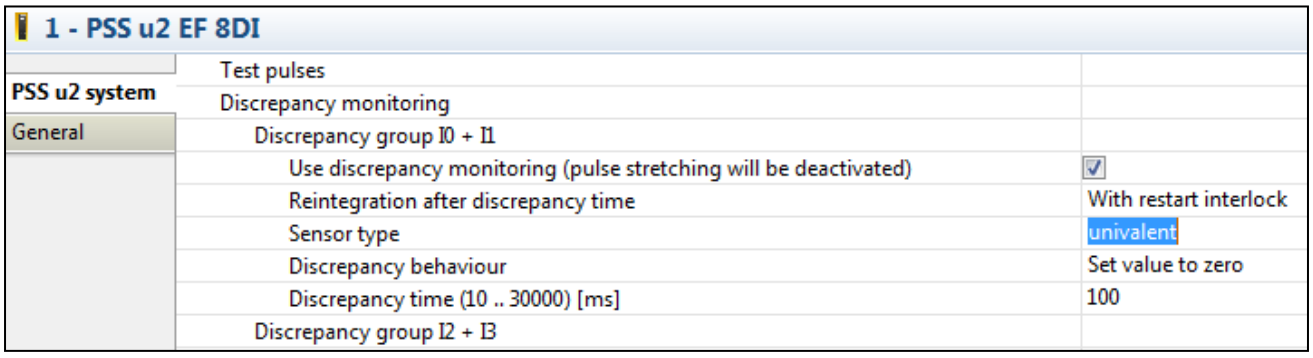


Figure 65: PASconfig – FS input module » Activate function "Discrepancy monitoring"

The test pulses are assigned to the following inputs in the default setting:
- T0: I0 and I4
- T1: I1 and I5
- T2: I2 and I6
- T3: I3 and I7

For the "With restart interlock" setting, an acknowledgement is required and both signals must be zero.

The following switching combinations applies to the definition of the "Sensor type":
- Univalent: Equal signals are expected.
  Combination of switch types are NC/NC or NO/NO
- Antivalent: Unequal signals are expected.
  Combination of switch types are NC/NO or NO/NC

8.3.6 Download the configuration to PSS u2 system

- The configuration you just created must be saved.

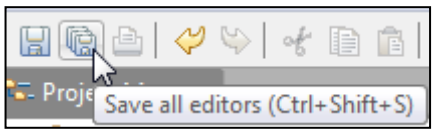


Figure 66: PASconfig – Save configuration » Save all editors

A password is required to transfer the FS configuration.
The default password is "**pssu**".

- It can be changed via the menu item 'PSS u2 System' » 'Change FS password ...'.

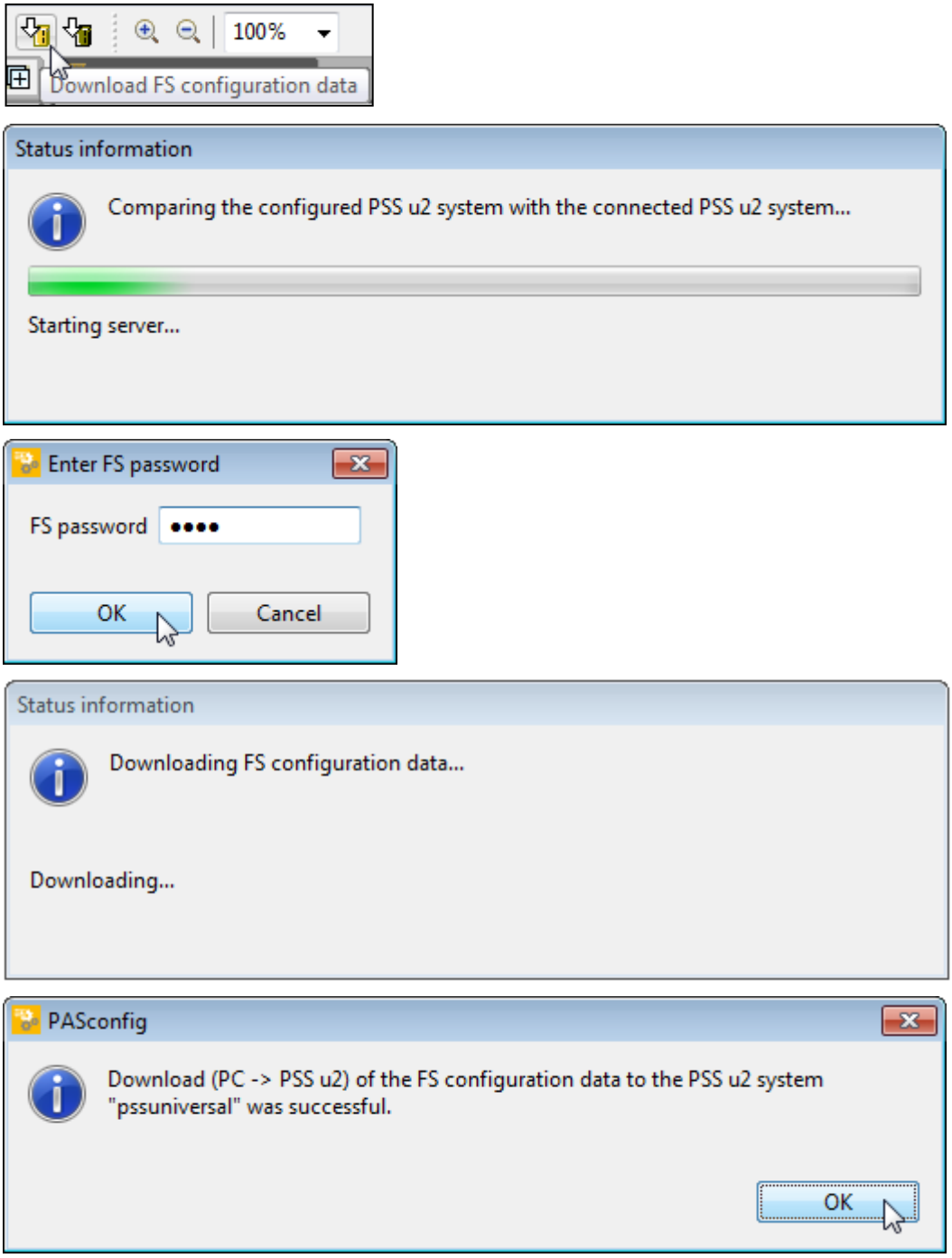


Figure 67: PASconfig – Download configuration » Download FS configuration data

If PSS u2 standard modules are used, the ST configuration must also be downloaded.

- In this case, the following dialog box should be confirmed with “Yes”.

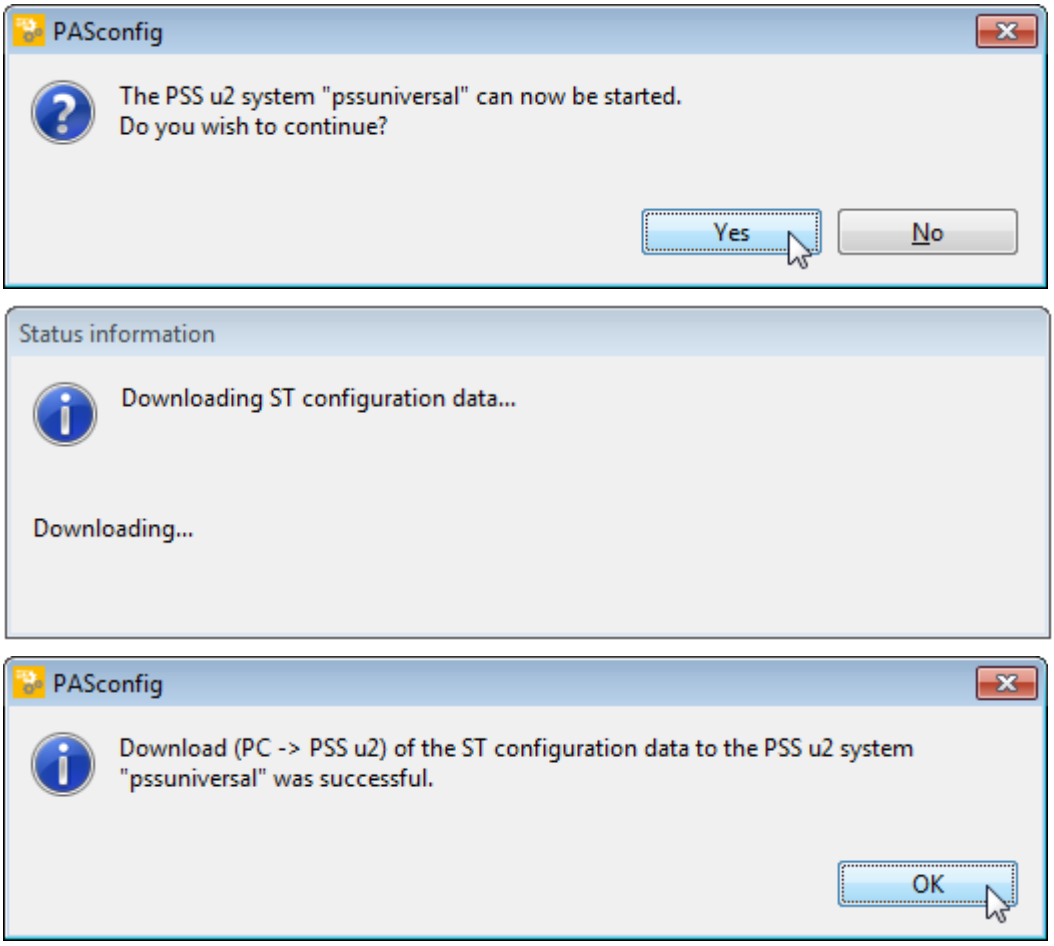


Figure 68: PASconfig – Download configuration » Download ST configuration data

- The PSS u2 system must now be restarted.

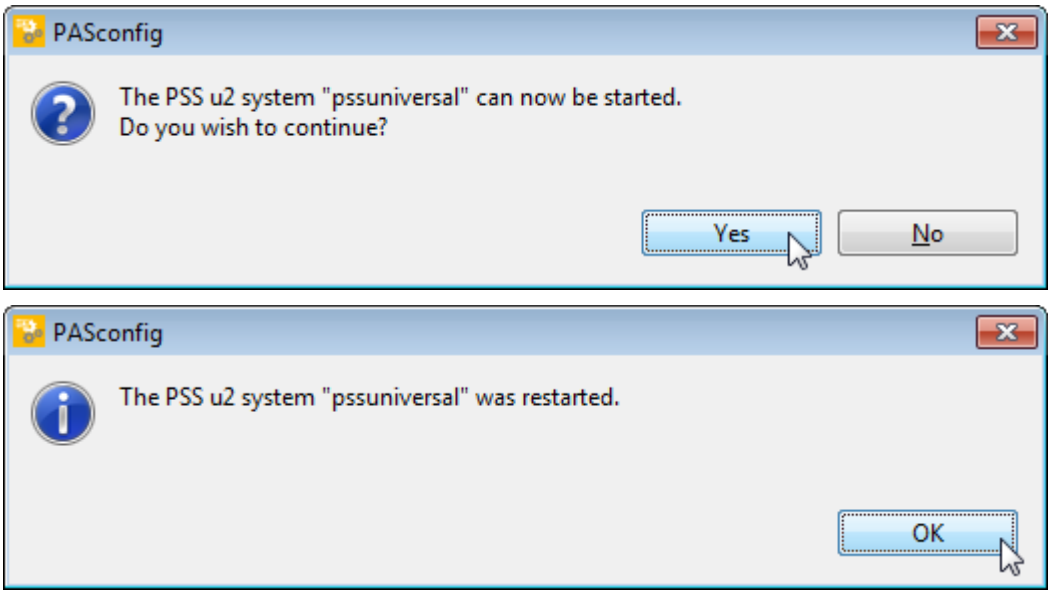


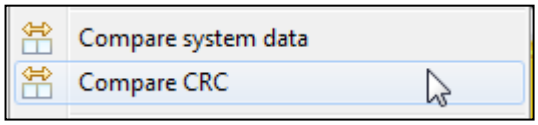
Figure 69: PASconfig – Download configuration » Restart PSS u2 system

8.3.7 Compare CRC for FS configuration data

The FS checksum for the PSS u2 system can be checked. If a project has been changed since the last download, this can be determined with this comparison. For this purpose, the device project in the offline project is compared with the one on the head module.

Note:

- The values of the checksums in the figures in this chapter are only examples.
- The CRC can be checked in two places:
  1. Still directly in the tool 'PASconfig' in the menu "PSS u2 system":



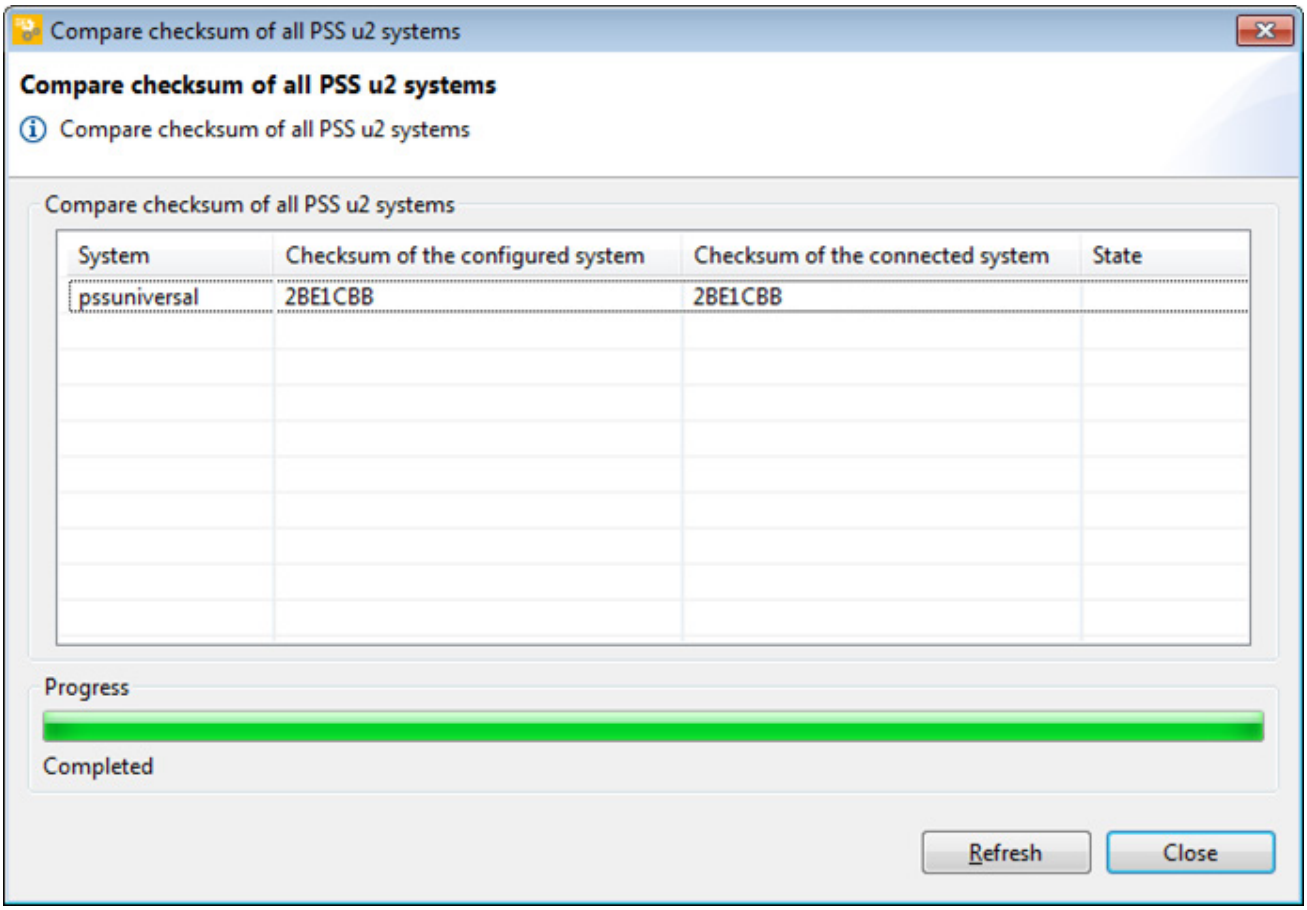


Figure 70: PASconfig – Compare CRC (Example)

- The 'PASconfig' tool can now be closed.

2. or in TIA via function “Start device tool …” using now the access point ‘Properties’:

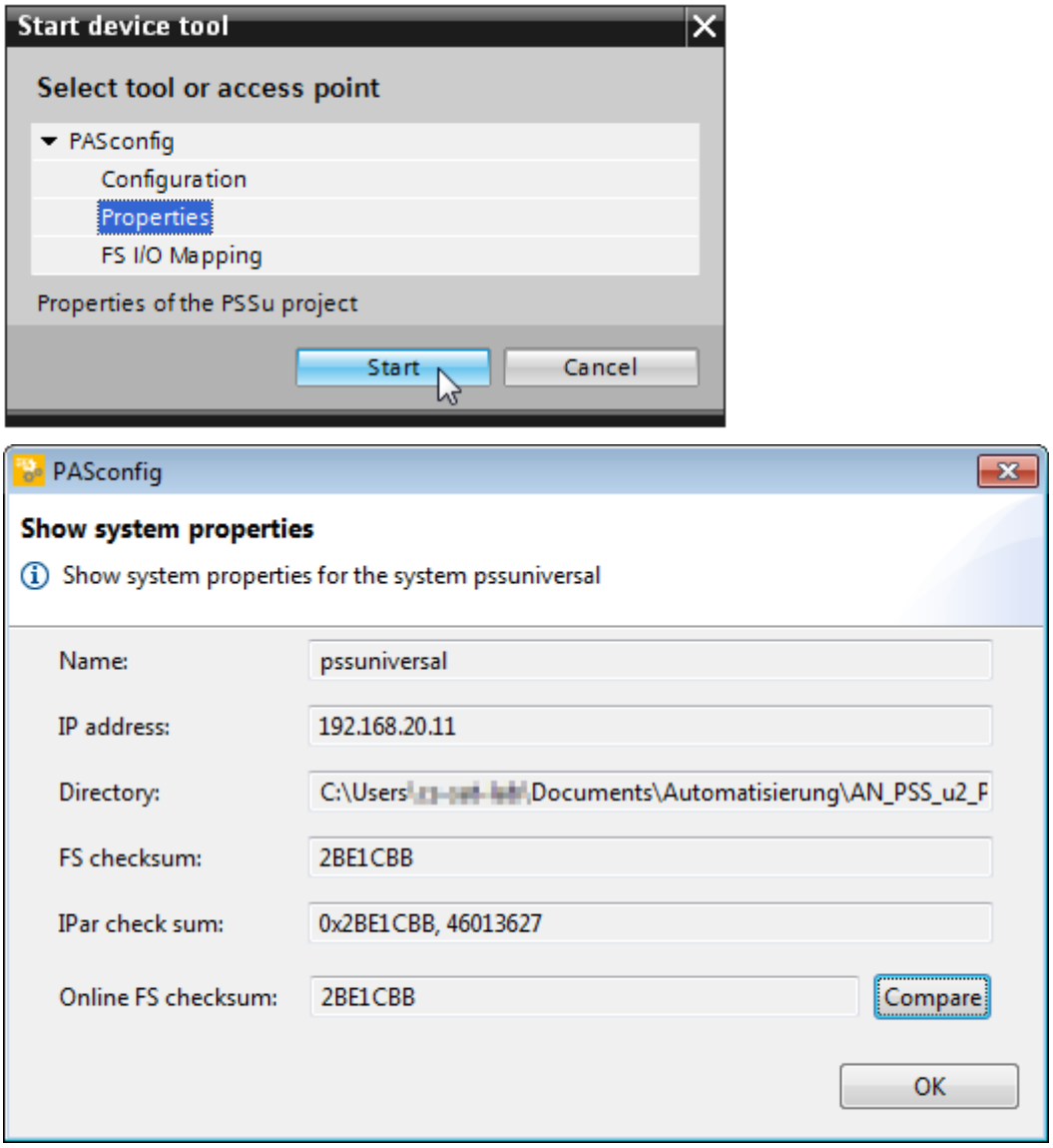


Figure 71: TIA – Compare CRC » Call access point ‘Properties’ (Example)

8.4 TIA – Download the configuration to S7 F-CPU

- After closing the 'PASconfig' tool, the TIA project is saved first:

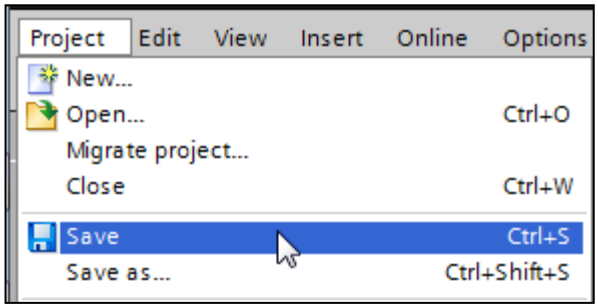


Figure 72: TIA – Download configuration » Save project (Part 1, Start)

- Now the F-CPU is selected in the project tree and the TIA project is compiled:

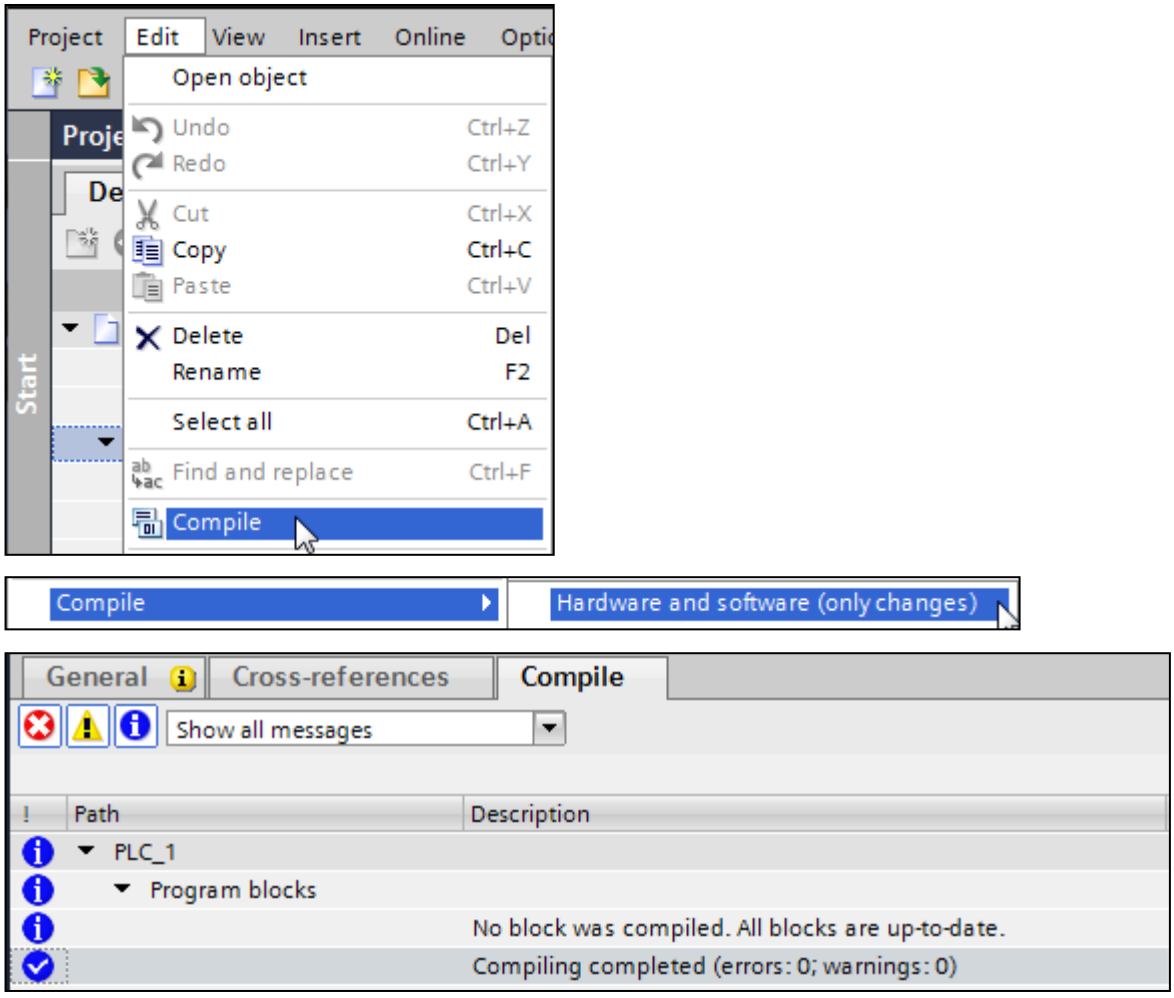


Figure 73: TIA – Download configuration » Compile project (Part 2)

- The TIA project is then loaded into the F-CPU:

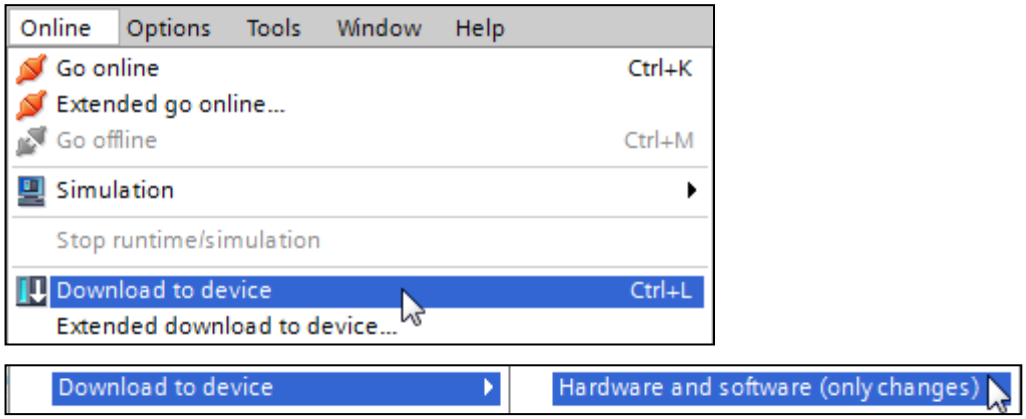


Figure 74: TIA – Download configuration » Download project to device (Part 3)

- The F-CPU can now be set to the operating mode "RUN".
  Now there should be no error messages in the PSS u2 system diagnostics:

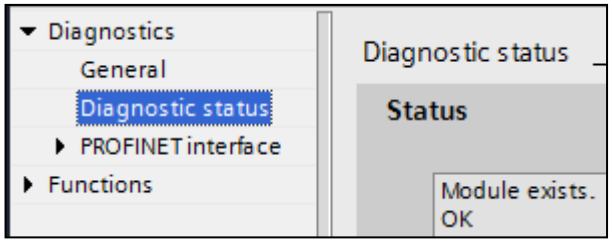


Figure 75: TIA – Download configuration » Check Diagnostic status (Part 4, Finalization)

- The error-free status of the two devices can be also recognized by their LEDs:

Figure 76: PSS u2 – Diagnostic status with error-free configuration

Figure 77: F-CPU – Diagnostic status with error-free configuration

9 SIMATIC STEP 7 Safety program in TIA Portal

NOTICE

This application example, in particular its configuration and programming in the used software tools of the Siemens AG company:
- 'TIA Portal / SIMATIC STEP 7 Professional' und
- 'SIMATIC STEP 7 Safety',

is *only an example* and is not a ready-to-customer solution.
It is *not-binding* and does *not claim to be complete*.

For the actual creation of a real customer application, the latest versions:
- of the documentation of the used SIMATIC components and
- their associated software tools

of the Siemens AG company must be used.
Observe the current product releases of the respective manufacturer.

A detailed explanation of safety functions used in the failsafe application and its evaluation regarding functional safety are not a part of this Application Note.
It is necessary therefore to adapt and to validate used parts for this purpose in the customer-specific application before using in a real-world application. It is then provided by qualified personnel a safety assessment in accordance with the Machinery Directive necessary to the functional safety of the overall machine/plant.

9.1 Activation of the F components of the F-CPU

On an S7 F-CPU, the “F-Activation” must be activated and the “Access level” for protection must be selected:

– see Figure 15: TIA – PLC » Enabling F-capability and select access level [📖 21]

In this case, certain components are automatically generated in the “Program blocks” section.

- Starting position after adding the F-CPU (Figure 14 [📖 21]):

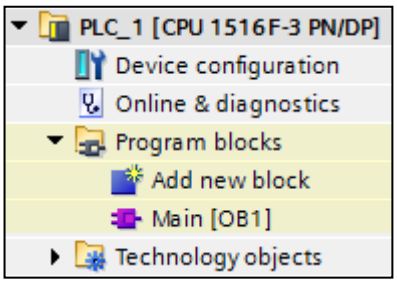


Figure 78: TIA – F-program » Basic standard program blocks of an S7-CPU

- F-Activation on the F-CPU (Figure 15 [📖 21]) » Automatic generation of components:

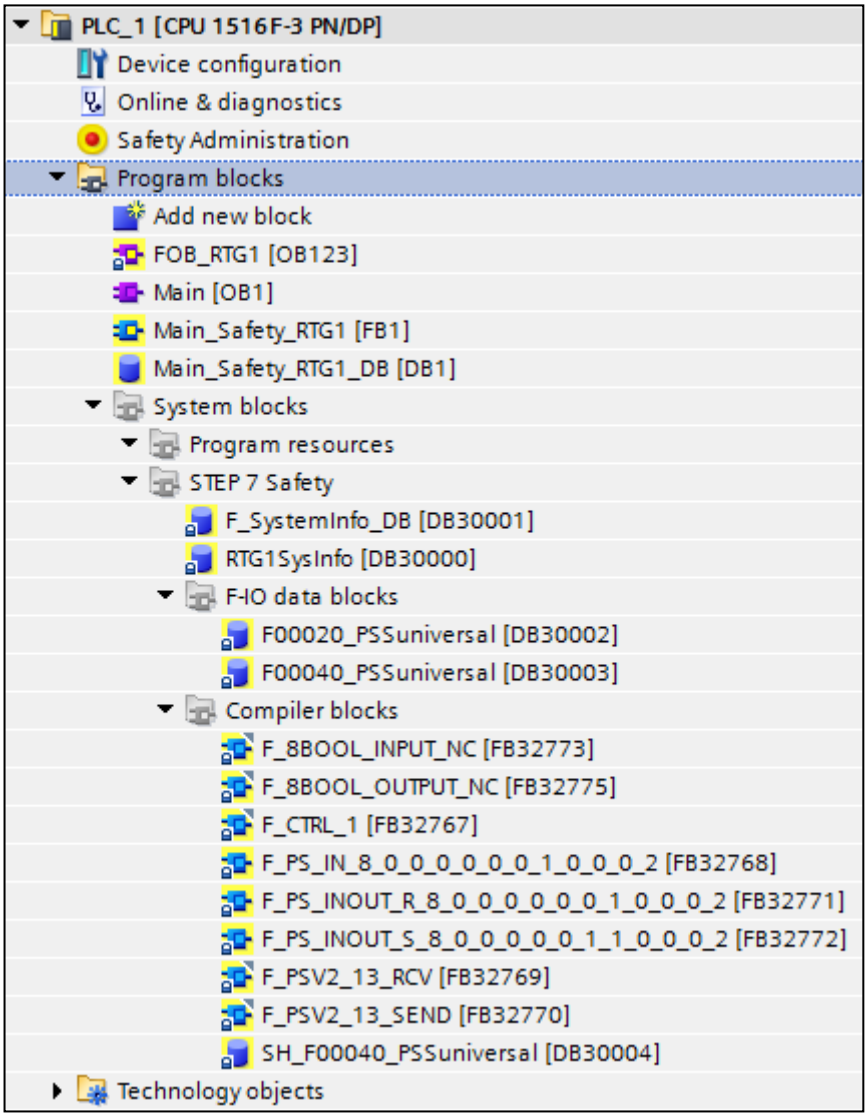


Figure 79: TIA – F-program » Automatic generation of components during F-activation

9.2 Creating the F-Runtime group

Through F-activation of the F-CPU (Figure 15 [📖 21]), certain F-blocks (see TIA settings » section 'STEP 7 Safety') are inserted for an F-runtime group in the Project tree (Figure 79).
These are the default three failsafe function blocks:

- FOB_RTG1 [OB123],
- Main_Safety_RTG1 [FB1] and the associated
- Main_Safety_RTG1_DB [DB1]

▸ Open the "Safety Administration" editor in the Project tree to create a F-runtime group:

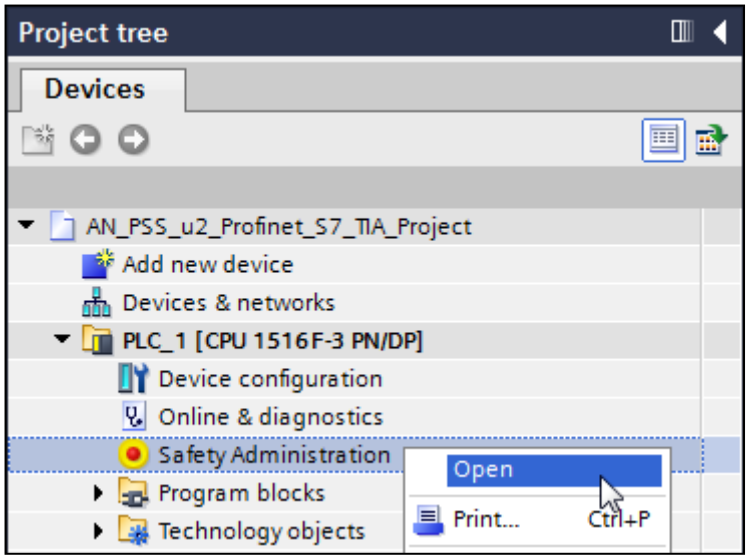


Figure 80: TIA – F-program » Create F-runtime group (Part 1, Start)

▸ By default, the required 'F-runtime group 1 [RTG1]' is already created here:

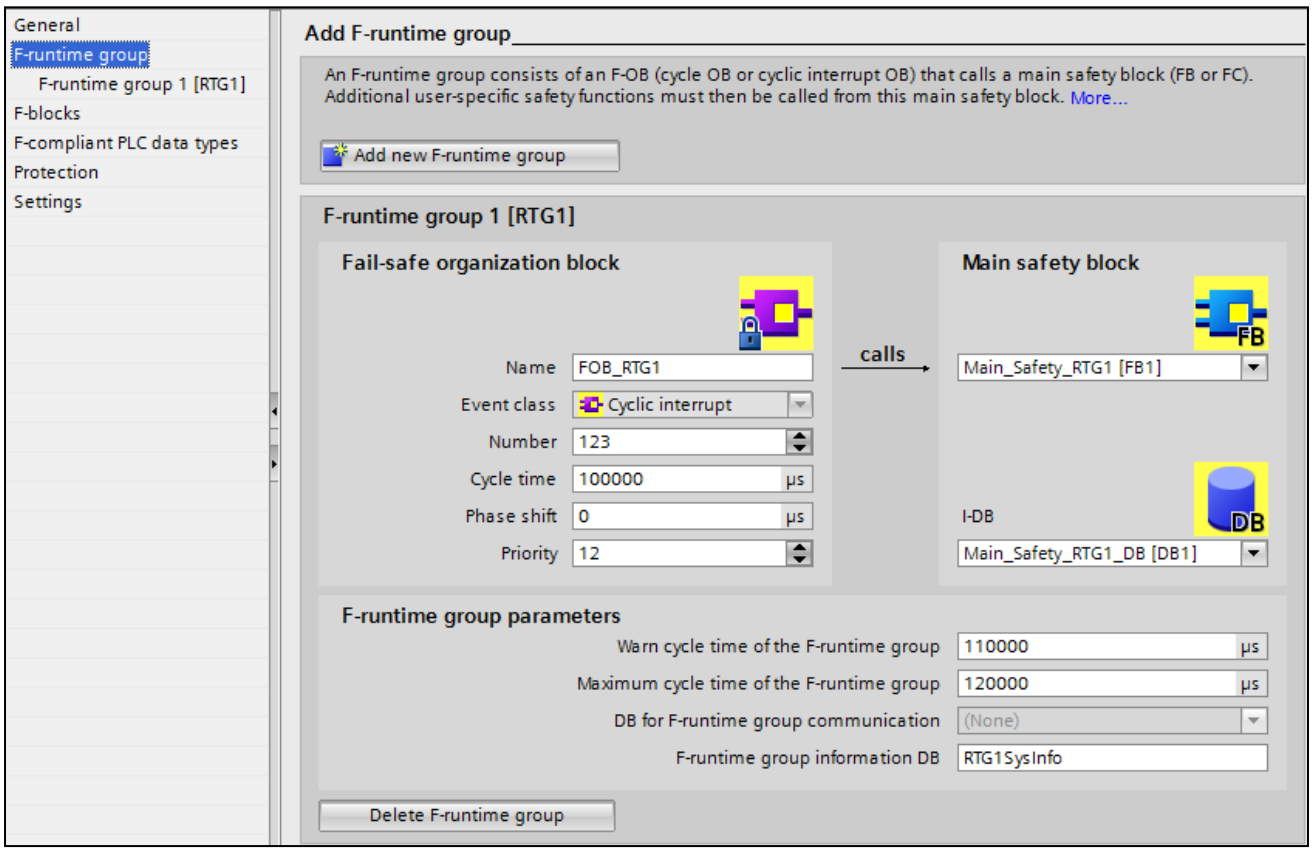


Figure 81: TIA – F-program » Create F-runtime group (Part 2, Default 'RTG1')

9.3 Creating and programming the F-Functions blocks

The integrated function blocks of the STEP 7 Safety Advanced optional package are used for the safety program. For this application example, the following instructions were used:

- ESTOP1: Emergency STOP / Emergency OFF safety function with acknowledgement up to stop category 1
- FDBACK: Feedback loop safety function
- ACK_GL: Simultaneous global acknowledgement of all F-periphery in an F-runtime group

▸ First switch to the programming language 'FBD' in the context menu of the function blocks:

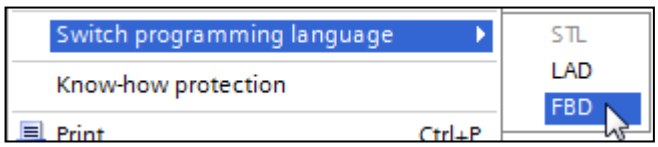


Figure 82: TIA – F-program » Switch programming language

▸ Open Function block 'Main_Safety_RTG1 [FB1]':

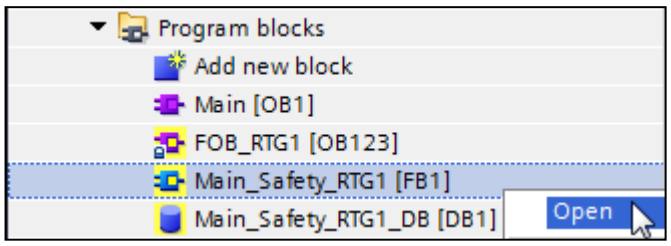


Figure 83: TIA – F-program » Creating and programming (Start)

In this function block 'Main_Safety_RTG1 [FB1]', internal variables of the types are created: '**Static**' (Static local data), '**Temp**' (Temporary local data) and '**Constant**' (Constants).
The respective type is specified in the prefix of the variable name.

Main_Safety_RTG1

	Name	Data type	Default value	Retain	Accessible from HMI	Visible in HMI	Setpoint	Comment
1	Input				☐	☐	☐	
2	Output				☐	☐	☐	
3	InOut				☐	☐	☐	
4	Static				☐	☐	☐	
5	Static_RisingEgde_1	Bool	false	Non-retain	☑	☑	☐	
6	Static_SR_1	Bool	false	Non-retain	☑	☑	☐	
7	Static_AlwaysTrue	Bool	false	Non-retain	☑	☑	☐	
8	Static_AlwaysFalse	Bool	false	Non-retain	☑	☑	☐	
9	Static_FaultDetection	Bool	false	Non-retain	☑	☑	☐	
10	Temp				☐	☐	☐	
11	Temp_EStop1_Q	Bool			☐	☐	☐	
12	Temp_EStop1_AckReq	Bool			☐	☐	☐	
13	Temp_FdBack_Error	Bool			☐	☐	☐	
14	Temp_FaultDetection	Bool			☐	☐	☐	
15	Temp_StartSignal	Bool			☐	☐	☐	
16	Temp_FdBack_AckReq	Bool			☐	☐	☐	
17	Temp_SystemEnabling	Bool			☐	☐	☐	
18	Constant				☐	☐	☐	
19	Const_FDB_Time_1	Time	T#150ms		☐	☐	☐	
20	Const_TimeDelay_1	Time	T#0ms		☐	☐	☐	

Figure 84: TIA – F-program » Internal variables of 'Main_Safety_RTG1 [FB1]'

Here is an overview of the used PLC variables:

PLC tags

	Name	...	Data type	Address	...	...	...	Comment
1	ST.ACK_NO_%I10.0	...	Bool	%I10.0		☑	☑	ST Input of Acknowledge Button NO
2	ST.Valid of_ACK.NO_%I11.0	...	Bool	%I11.0		☑	☑	ST Valid of signal Acknowledge Button NO
3	FS.PITesb2.2.I1_NC_%I20.0	...	Bool	%I20.0		☑	☑	FS Input of Emergency STOP1 Ch. 1 NC
4	FS.PITesb2.2.I2_NC_%I20.1	...	Bool	%I20.1		☑	☑	FS Input of Emergency STOP1 Ch. 2 NC
5	FS.START.NO_%I20.4	...	Bool	%I20.4		☑	☑	FS Input of Start Button NO
6	FS.STOP.NC_%I20.5	...	Bool	%I20.5		☑	☑	FS Input of Stop Button NC
7	FS.RESET.NO_%I20.6	...	Bool	%I20.6		☑	☑	FS Input of Reset Button NO
8	FS.FBL.NC_%I20.7	...	Bool	%I20.7		☑	☑	FS Input of FeedBackLoop Actor NC
9	FS.Valid of_PITesb2.2.I1.NC_%I21.0	...	Bool	%I21.0		☑	☑	FS Valid of signal EmergencySTOP1 Ch. 1
10	FS.Valid of_PITesb2.2.I2.NC_%I21.1	...	Bool	%I21.1		☑	☑	FS Valid of signal EmergencySTOP1 Ch. 2
11	FS.Valid of_START.NO_%I21.4	...	Bool	%I21.4		☑	☑	FS Valid of signal START.Button
12	FS.Valid of_STOP.NC_%I21.5	...	Bool	%I21.5		☑	☑	FS Valid of signal STOP.Button
13	FS.Valid of_RESET.NO_%I21.6	...	Bool	%I21.6		☑	☑	FS Valid of signal RESET.Button
14	FS.Valid of_FBL.NC_%I21.7	...	Bool	%I21.7		☑	☑	FS Valid of signal FBL.NC
15	FS.Valid of_PNOZp.Q1_%I40.0	...	Bool	%I40.0		☑	☑	FS Valid of signal Actor PNOZ power
16	ST.EStop1.Diag_%QB15	...	Byte	%QB15		☑	☑	ST Diagnostic byte of FB EmergencySTOP1
17	ST.FB_FDBACK1.Diag_%QB16	...	Byte	%QB16		☑	☑	ST Diagnostic byte of FB FeedBackLoop1
18	FS.PNOZp.Q1_%Q40.0	...	Bool	%Q40.0		☑	☑	FS Output of Actor PNOZ power

Figure 85: TIA – F-program » PLC tags

For the orientation of the defined I/O addresses for the PSS u2 system, see the following Figure 39: TIA – Add electronic modules to the I/O system (Part 3, Finalization) [📖 31].

- Only the I/O addresses of the configured standard modules can be read directly.
- The assignment of the I/O addresses of the failsafe modules can now be displayed using the **function "FS process image for the system** pssuniversal".
  For this purpose, the function "Start Device Tool ..." (Figure 52 [📖 38]) must be selected in the TIA for the currently used PSS u2 system:

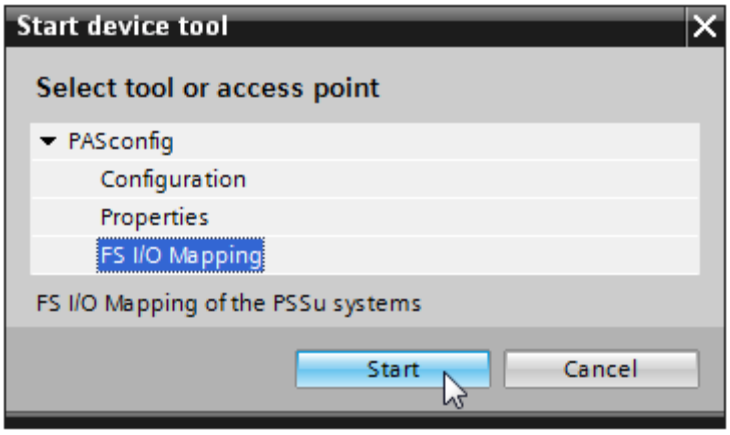


Figure 86: PASconfig – Start device tool from TIA » Access point "FS I/O Mapping"

- Then the access point 'FS I/O Mapping' provides the overview for the PROFIsafe groups 'IN' and 'OUT':

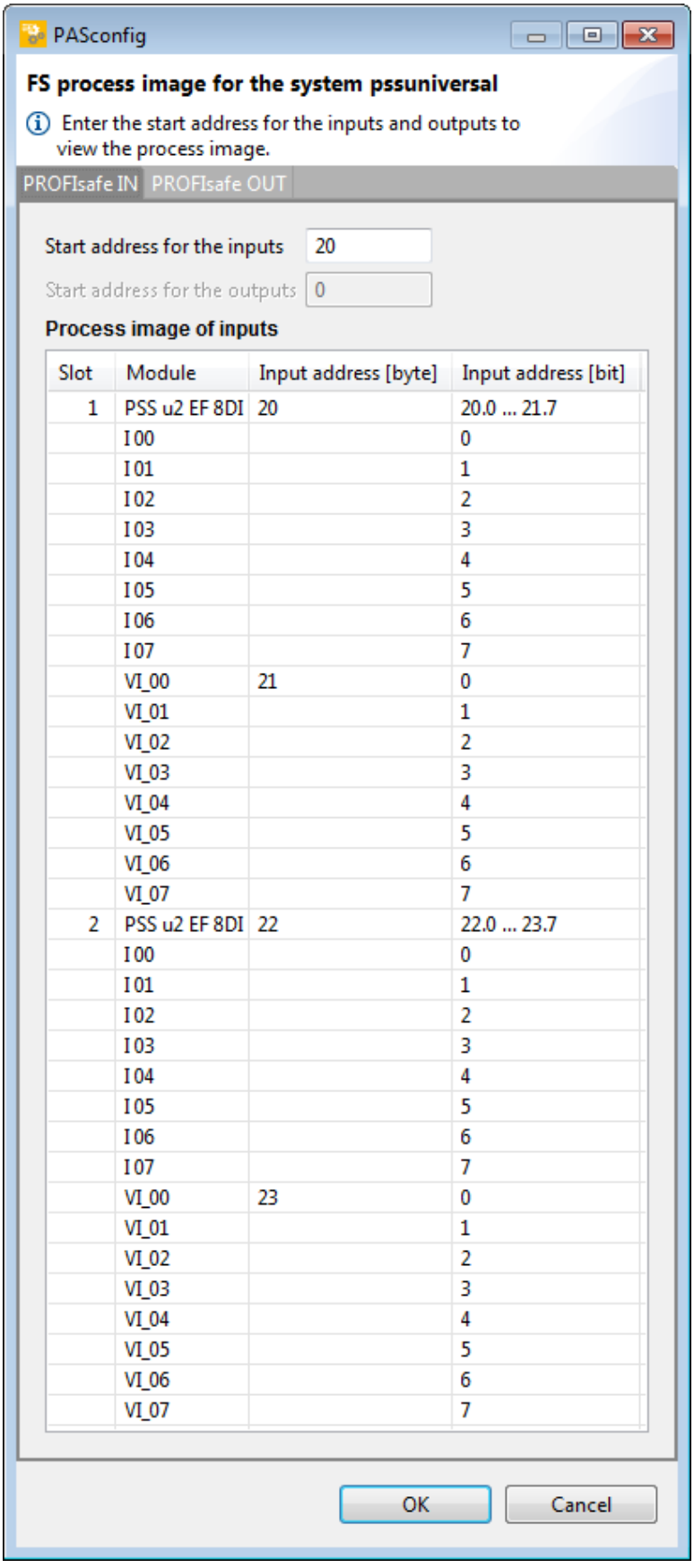


Figure 87: PASconfig – "FS I/O Mapping" for PROFIsafe group 'IN'

PASconfig

FS process image for the system pssuniversal

Enter the start address for the inputs and outputs to view the process image.

PROFIsafe IN | PROFIsafe OUT

Start address for the inputs: 40

Start address for the outputs: 40

Process image of inputs

Slot	Module	Input address [byte]	Input address [bit]
3	PSS u2 EF 8DO 0.5A	40	40.0 ... 40.7
	VO_00		0
	VO_01		1
	VO_02		2
	VO_03		3
	VO_04		4
	VO_05		5
	VO_06		6
	VO_07		7
4	PSS u2 EF 8DO 0.5A	41	41.0 ... 41.7
	VO_00		0
	VO_01		1
	VO_02		2
	VO_03		3
	VO_04		4
	VO_05		5
	VO_06		6
	VO_07		7

Process image of outputs

Slot	Module	Output address [byte]	Output address [bit]
3	PSS u2 EF 8DO 0.5A	40	40.0 ... 40.7
	O_00		0
	O_01		1
	O_02		2
	O_03		3
	O_04		4
	O_05		5
	O_06		6
	O_07		7
4	PSS u2 EF 8DO 0.5A	41	41.0 ... 41.7
	O_00		0
	O_01		1
	O_02		2
	O_03		3
	O_04		4
	O_05		5
	O_06		6
	O_07		7

OK | Cancel

Figure 88: PASconfig – "FS I/O Mapping" for PROFIsafe group 'OUT'

Now continue with the application example in the TIA program.

- In Network 1 the two failsafe signals '#Static_AlwaysTrue' and '#Static_AlwaysFalse' are generated:

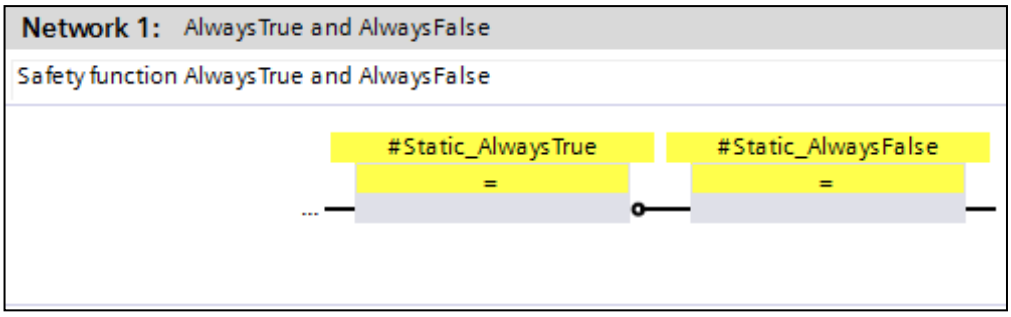


Figure 89: TIA – F-program » Signals 'AlwaysTrue' and 'AlwaysFalse' (Network 1)

- In the second network, valid information from the I/Os used on the electronic module is used to program a system enable '#Temp_SystemEnabling' for the PSS u2 system:

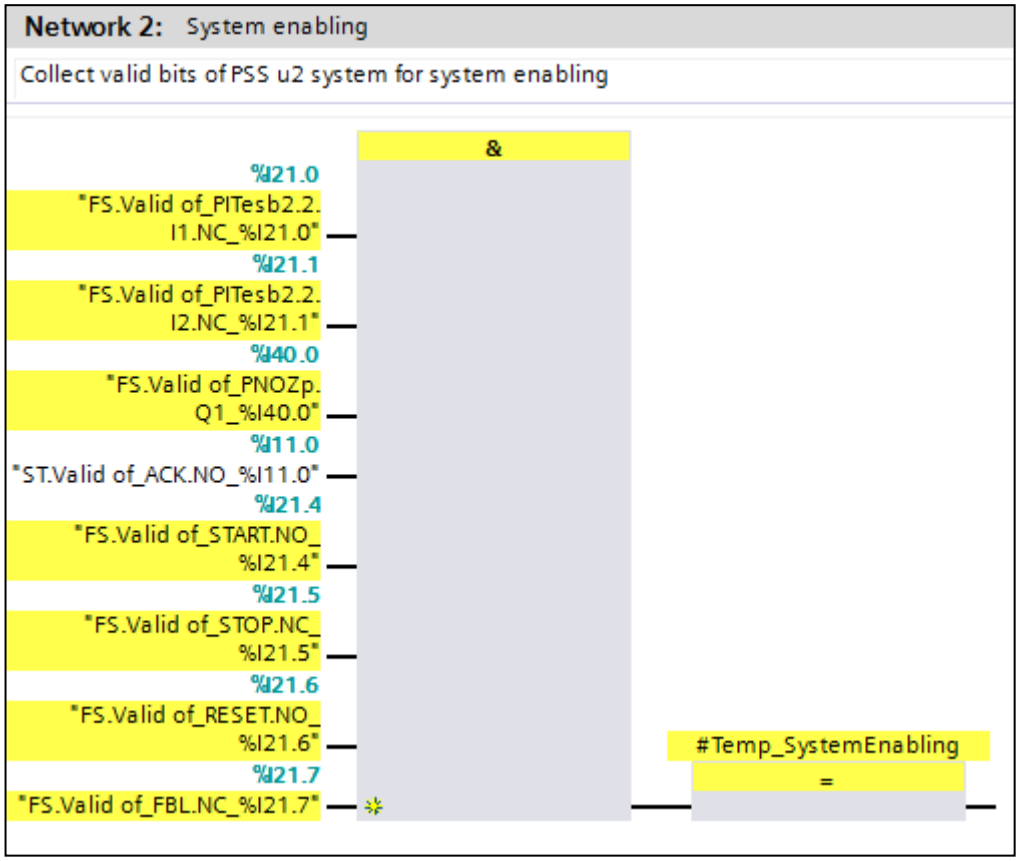


Figure 90: TIA – F-program » PSS u2 system enabling 'SystemEnabling' (Network 2)

- The third network contains the failsafe function block 'ESTOP1' of the software package "STEP 7 Safety V13 SP 1", which can be used to implement an emergency STOP shutdown up to stop category 1 (with acknowledgment). The FB is used with the following parameters:

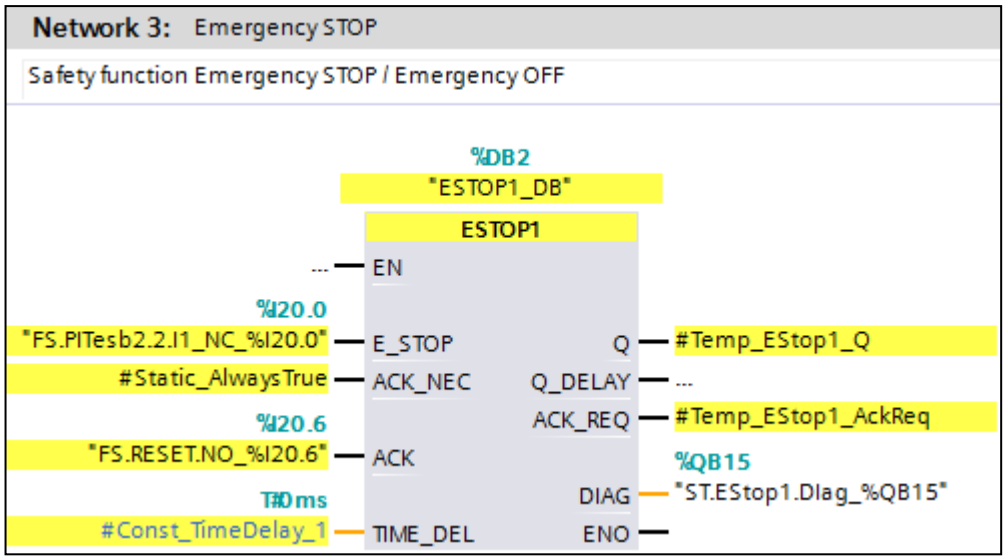


Figure 91: TIA – F-program » Emergency STOP shutdown ‚ESTOP1' (Network 3)

- In Network 4, the start and stop signal is evaluated.
  In addition, fault detection of network 6 acts on the reset input 'R1' and the enable of the FB 'ESTOP1' on the start signal ,#Temp_StartSignal':

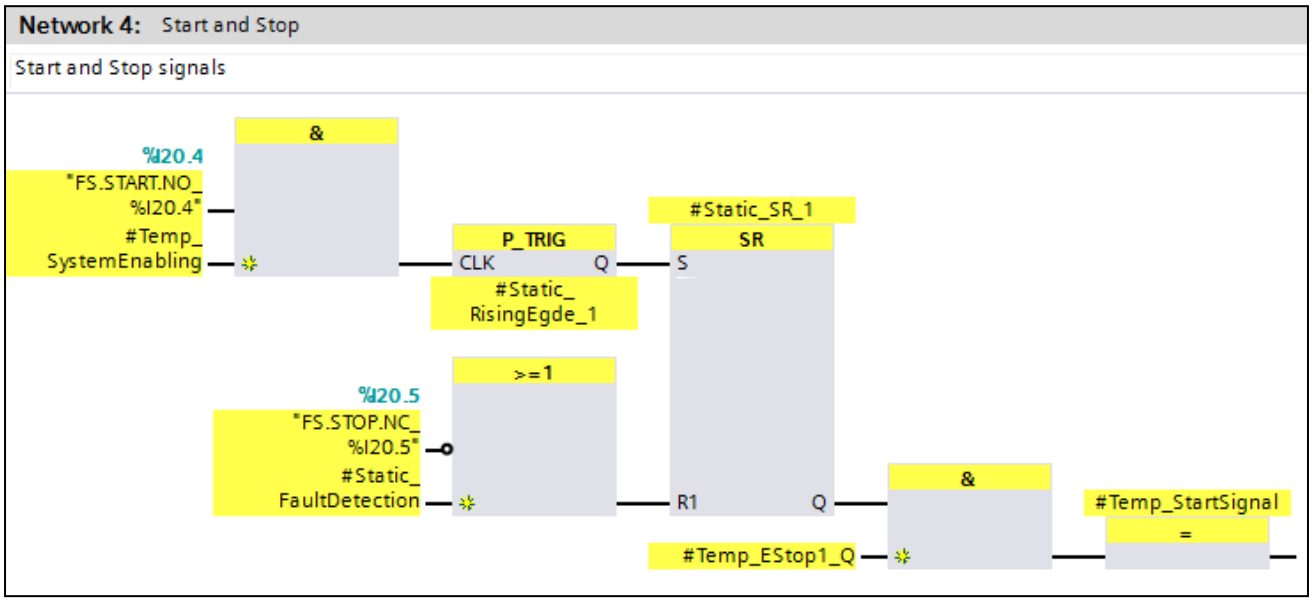


Figure 92: TIA – F-program » Signals 'Start' und 'Stop' (Network 4)

- The fifth network contains the failsafe function block 'FDBACK' of the software package "STEP 7 Safety V13 SP1", with which the feedback loop monitoring of the actuator PNOZpower controlled via the FS output '%Q40.0' is implemented. The FB is used with the following parameters:

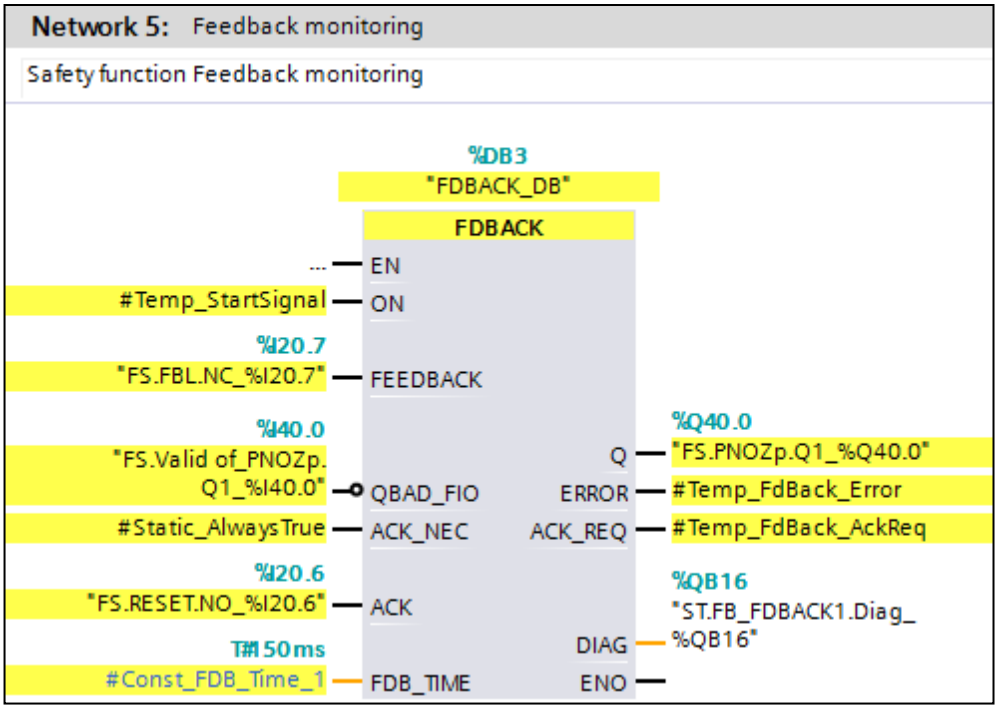


Figure 93: TIA – F-program » Feedback monitoring 'FDBACK' (Network 5)

- In the sixth network, fault detection of the two failsafe function blocks ‘E-STOP1’ and ‘FDBACK’ is executed:

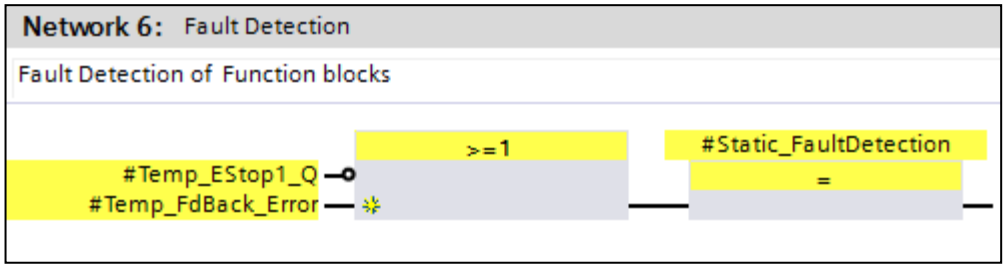


Figure 94: TIA – F-program » Fault detection of FB’s (Network 6)

- In network 7, global acknowledgment of the F-periphery is executed by the F-runtime group [RTG1] using the function block ‘ACK_GL’ of the software package “STEP 7 Safety V13 SP1”:

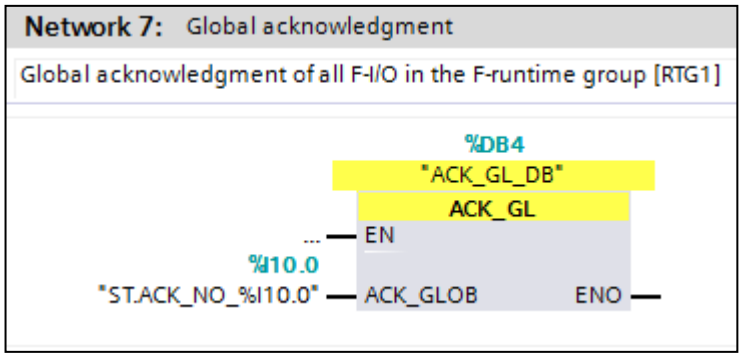


Figure 95: TIA – F-program » Global acknowledgment ‘ACK_GL’ (Network 7)

9.4 Compile and download the failsafe program to S7 F-CPU

- Now the TIA project is saved again.
  - see Figure 72: TIA – Download configuration » Save project (Part 1, Start) [📖 49]
- The F-CPU is then selected in the project tree and the TIA project is compiled.
  - see Figure 73: TIA – Download configuration » Compile project (Part 2) [📖 49]
- The TIA project is then loaded into the F-CPU.

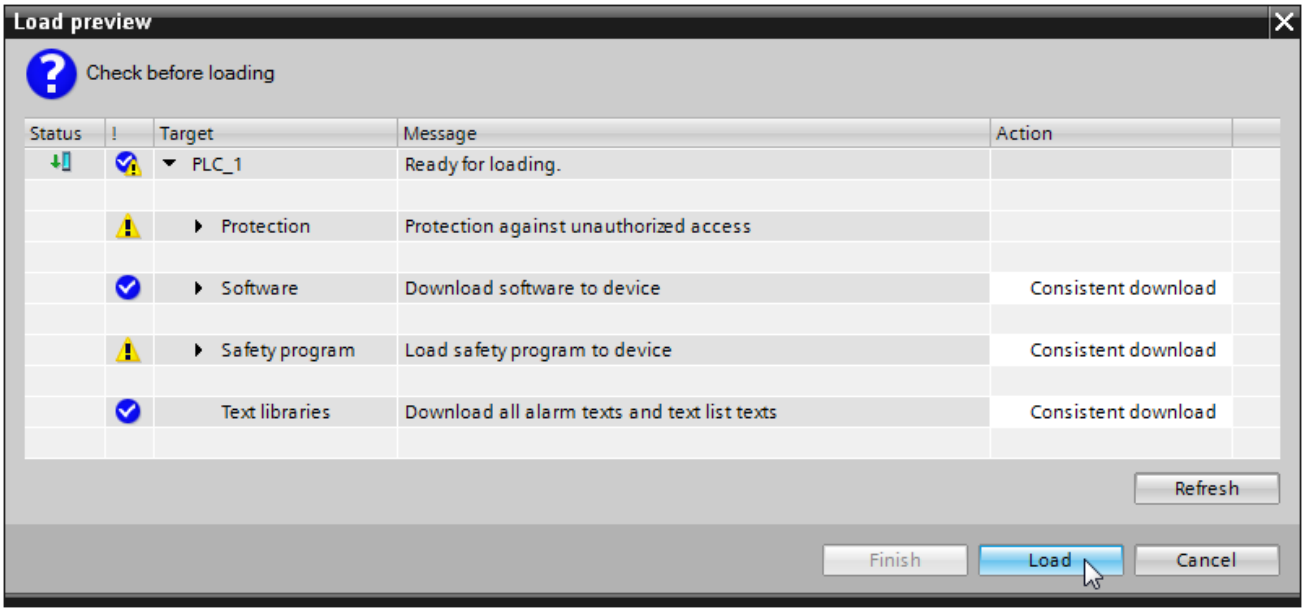


Figure 96: TIA – Download F-program » Download project to device

- The generated program is checked:

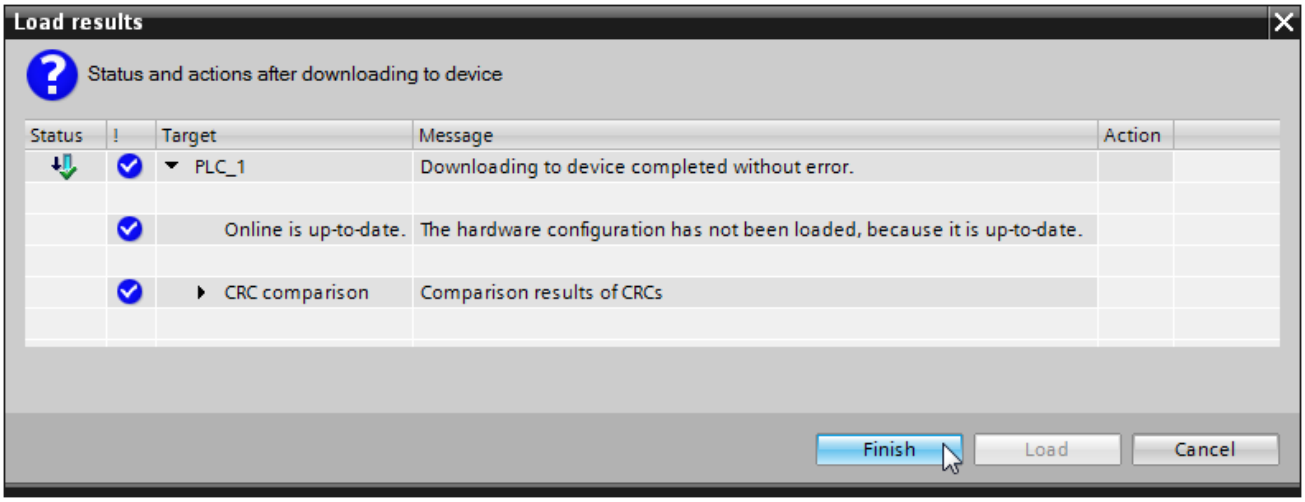


Figure 97: TIA – Download F-program » Load results

- The F-CPU can now be set to the operating mode "RUN".
- Then you can recognize the error-free status of the two devices by their LEDs, as in:
  - Figure 76: PSS u2 – Diagnostic status with error-free configuration und
  - Figure 77: F-CPU – Diagnostic status with error-free configuration on [📖 50].
- For the PSS u2 head module, however, the LED 'SO' must now also be green:

Figure 98: PSS u2 – Head module » LED signaling 'Safe Operation'

9.5 Commissioning of the system

- The above configurations and the F-program have been loaded onto the devices.
- The PROFINET system with the F-CPU and the PSS u2 system is switched on.
  - The executed "STOP-RUN start" starts the F-CPU, which is then in 'RUN' mode:

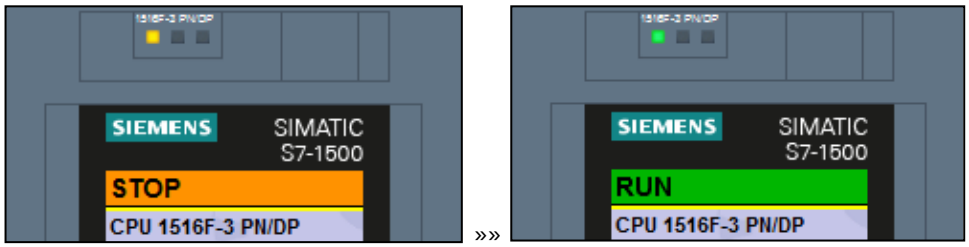


Figure 99: F-CPU – Warm start ("Stop-Run Startup")

  - The LED 'SO' of the PSS u2 head module also lights green accordingly:
    see Figure 98: PSS u2 – Head module » LED signaling 'Safe Operation' [🕮 61].

- Then a reset must be executed for the failsafe function blocks.
  The status can be recognized by the two "ACK bits" of the "ST Diagnostic bytes" of the FBs whose signals are additionally mapped to the two standard output modules:
  - Bit 6: Acknowledgment required (= state of ACK_REQ) [Addresses %Q15.6 and %Q16.6]

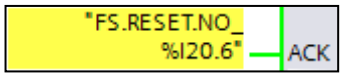


Figure 100: TIA – F-program » Reset of FB's (FS.RESET.NO_%I20.6)

- If the system runs error-free ('#Temp_SystemEnabling' =1), the application is in "**Good state**".
  This can now be started by pressing the 'Start button' (FS.START.NO_%I20.4 / Network 4):

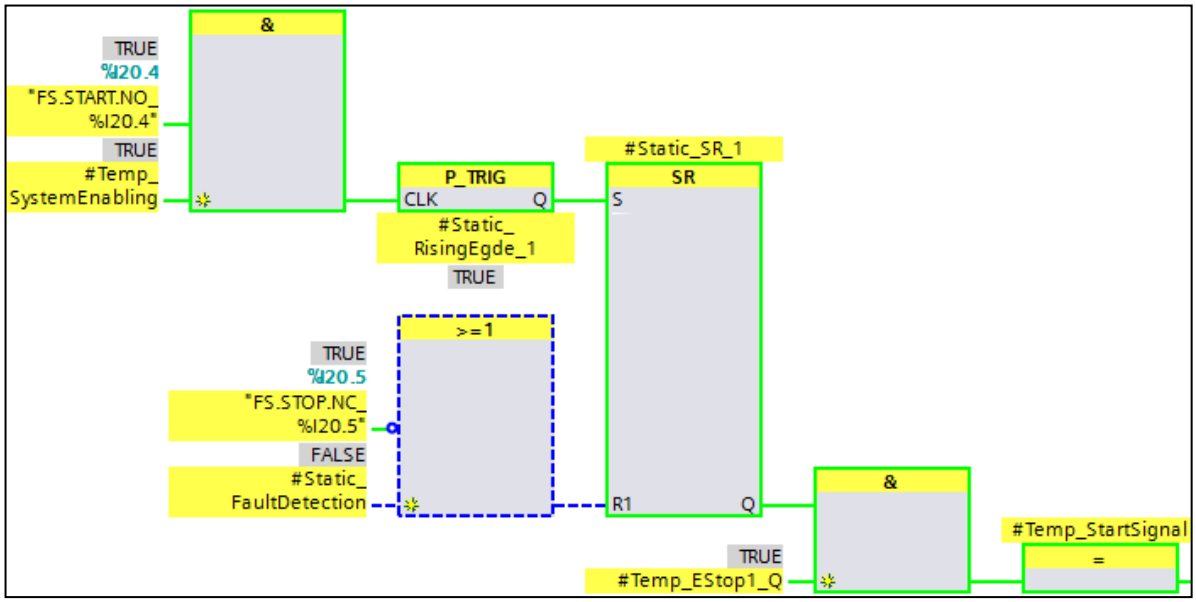


Figure 101: TIA – F-program » Start signal (FS.START.NO_%I20.4)

- The actuator is now switched on (FS.PNOZp.Q1_%Q40.0 / Network 5):

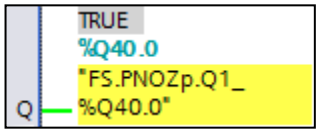


Figure 102: TIA – F-program » Actuator switched on (FS.PNOZp.Q1_%Q40.0)

9.6 Error simulations with remedy by means of diagnostics

The following error simulations explain the operation of the diagnostics of the PSS u2 system.
The following starting situation is repeated for each example:

- The PROFINET system with the F-CPU and the PSS u2 system has been started (chapter 9.5).
- The application runs error-free; the actuator is switched on (Figure 102 [62]).

Notes:

- The programmed functions, described in the following sections are shown:
  - in chapter 9.3 Creating and programming the F-Functions blocks [54ff],
  - in the diagrams of the networks 1-7 from Figure 89 to Figure 95 [57-60].
- The significance of the individual bits of the 'DIAG' outputs of the function blocks 'ESTOP1' and 'FDBACK' (%QB15 / %QB16) is described in the online help of the TIA portal.
- The following examples show diagnostic displays from the TIA tool. These two online functions for diagnostics are accessible via the context menu of the F-CPU:
  - 'Go online':
    This will include the activation of the function in the project navigation, which shows the operating status or diagnostic status of the online-connected devices with icons.

  - 'Online & diagnostics':
    This opens a system related window with information on the diagnostics and other online functions. In the 'Diagnostics' folder, you can select the group 'Diagnostic buffer', in which the 'Events' are tabulated as a log file for the F-CPU and the modules assigned to it.

The following figure shows the online display of the TIA project with the diagnostic symbols and the 'Diagnostic buffer' of the F-CPU:

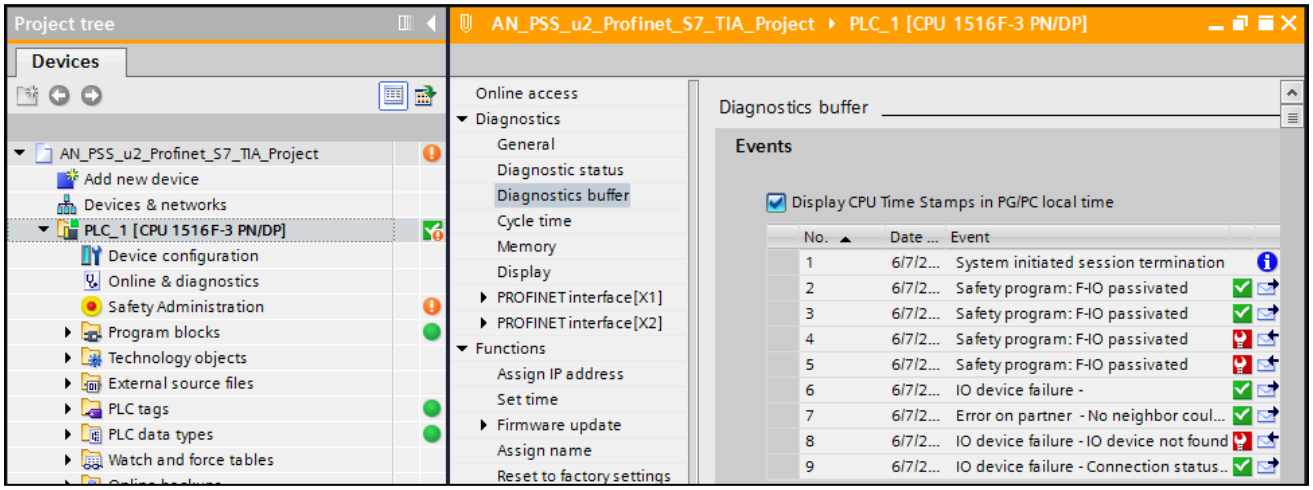


Figure 103: TIA – F-program » Online diagnostic display and 'Diagnostic buffer' of the F-CPU

- The more detailed error stack of the PSS u2 system can be accessed in the 'PASconfig' tool:

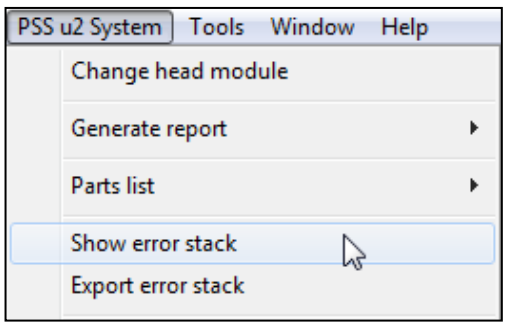


Figure 104: PASconfig – PSS u2 » Display of Error stack

9.6.1 Faulty switch on the second channel of the Emergency stop button

- The emergency stop button is pressed (FS.PITesb2.2.I1_NC_%I20.0).
  When the button is pressed, the switch of the second channel is not opened.
  - The Enable 'Q' (FB output with internal temporary local variable '#Temp_EStop1_Q' / Network 3 » Figure 91 [📖 58] from the emergency stop FB 'ESTOP1' is reset.
  - The error evaluation bit is set.
    ('#Static_FaultDetection' / Network 6 » Figure 94 [📖 60])
  - A stop is triggered, the start signal is reset.
    ('#Temp_StartSignal' / Network 4 » Figure 92 [📖 59]).
  - The actuator is switched off.
    ('FS.PNOZp.Q1_% Q40.0' / Network 5 » Figure 93 [📖 59]).

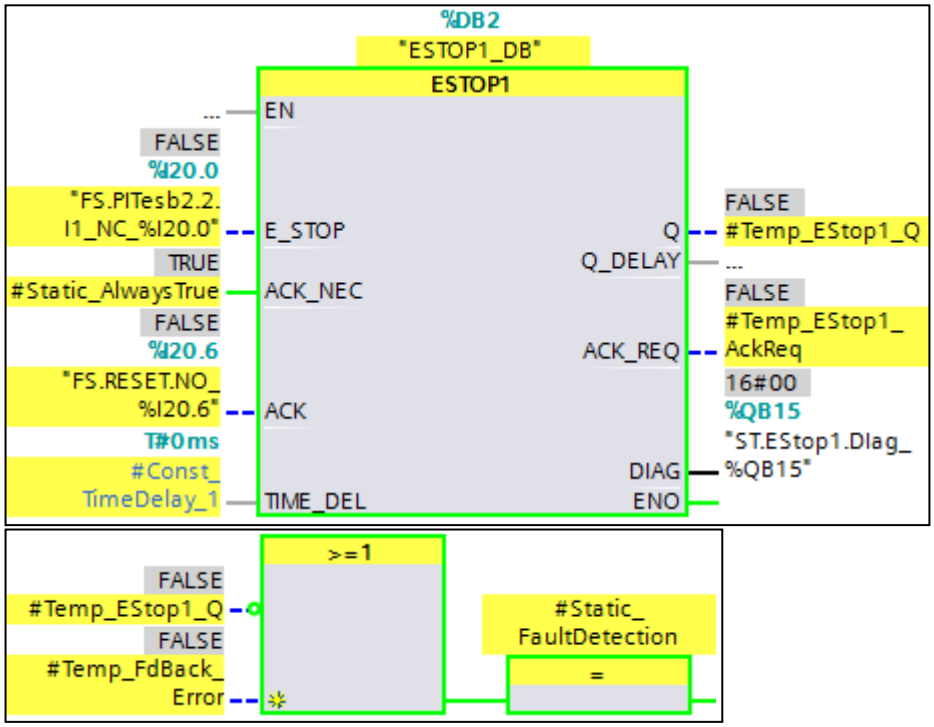


Figure 105: TIA – F-program » Error simulation "Emergency stop function"

- After pressing the Reset push button switch (FB input 'ACK', FS.RESET.NO_%I20.6) the enable remains reset, the following message is displayed via the 'Diagnostic byte' (FB output ‚DIAG', ST.EStop1.Diag_%QB15):
  - Bit 4: Acknowledgment not possible because emergency STOP is still active
    (Note:
    The significance of the individual bits of the 'DIAG' outputs of the function blocks 'ESTOP1' and 'FDBACK' (%QB15 / %QB16) is described in the online help of the TIA portal.)
- The wiring of the emergency stop circuit must be checked and the fault repaired.
- After this, the emergency stop button is released, and the following message is displayed:
  - Bit 6: Acknowledgment required (= state of FB output 'ACK_REQ')
- After the reset, the application is back in "**Good state**" (see Figure 101 [📖 62]),
  i.e. the enable 'Q' ('#Temp_EStop1_Q') from the emergency stop block 'ESTOP1' is now set and the actuator can be switched on again ('FS.PNOZp.Q1_%Q40.0' / Network 5).

9.6.2 0 VDC short circuit with test pulse T1 from emergency stop button

- At the emergency stop button, the second channel (FS.PITesb2.2.I2_NC_%I20.1) is connected to 0 VDC. The electrical wiring error is detected by the system:
  - The enable 'Q' ('#Temp_EStop1_Q' / Network 3 » Figure 91 [📖 58])
    from the Emergency stop block 'ESTOP1' is reset and the actuator is switched off ('FS.PNOZp.Q1_%Q40.0' / Network 5 » Figure 93 [📖 59]).
  - On the F-CPU, the LED 'ERROR' flashes red.
  - The following LEDs will change on the PSS u2 system:
    Head module: LED 'DIAG' lights red and LED 'SO' flashes green
    E-Module: LED 'MS' flashes red and LEDs '3'/'4' & '11'/'12' (Test pulse 'T1') are flashing green.

Flashing: LED's ON *Flashing: LED's OFF* *Flashing: LED's ON*

Figure 106: PSS u2 – Error simulation '0 VDC short circuit with test pulse T1' » LED displays

- In the TIA, the error is displayed when the online connection is established in the project tree and 'Diagnostics' window (see Figure 103 [📖 63]):

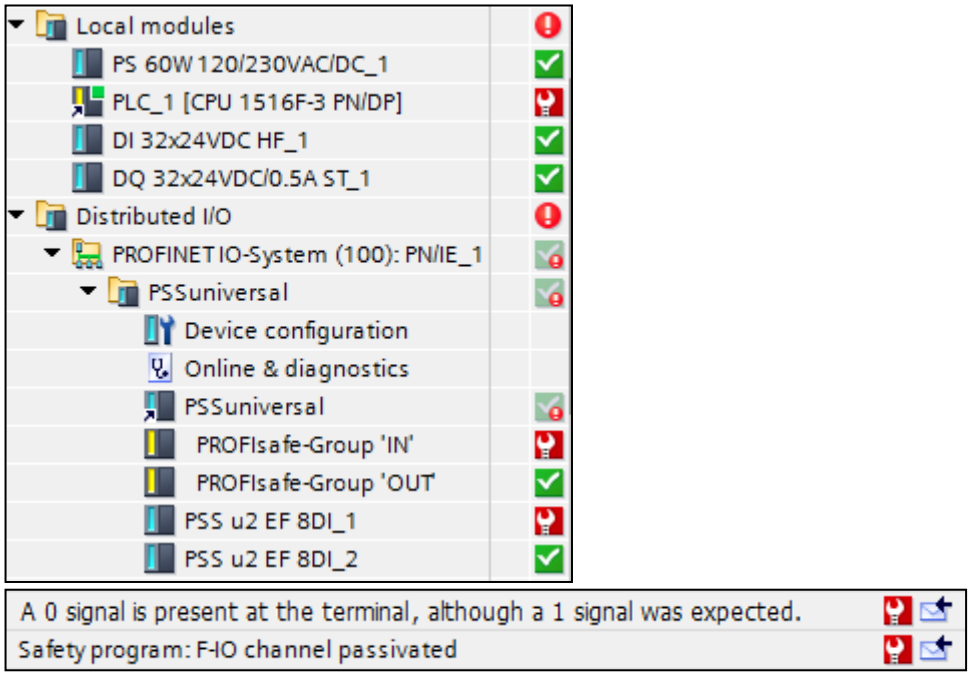


Figure 107: TIA – Error simulation '0 VDC short circuit with test pulse T1' » Online display

- If the wiring error has been fixed, in addition to the diagnostic buffer of the F-CPU only the following LED indications indicate to the previously existing fault:
  - On the F-CPU, the LED 'ERROR' still flashes red.
  - The following LEDs will change on the PSS u2 system:
    Head module: only LED 'SO' still flashes green ('DIAG' off and E-module with process display)
- The PSS u2 system must now be depassivated first (Network 7, see Figure 108 on next page):

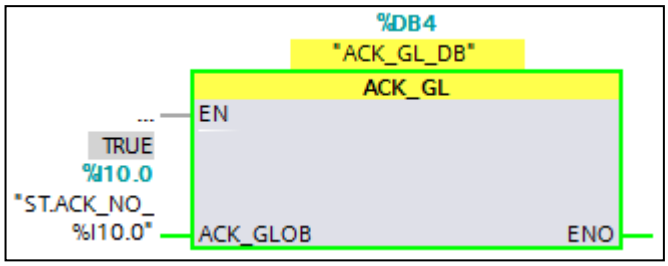
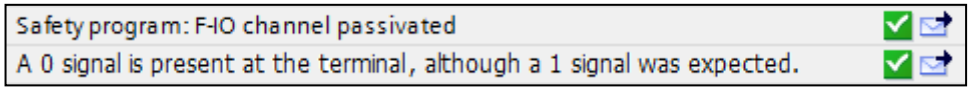


Figure 108: TIA – F-program » Depassivation by means of 'ACK_GL' (ST.ACK_NO_%I10.0)

- Afterwards, the safety program must be reset to the condition "**Good state**" as in the previous chapter (below outgoing event messages) in order to be able to switch on the actuator again:



- For a more detailed diagnosis, the 'PASconfig' tool can be started and the error stack of the relevant PSS u2 system can be displayed comprehensively there (see Figure 104 [🕮 63]). The error of the test pulse output 'T1' is indicated for both terminals '4' and '12':

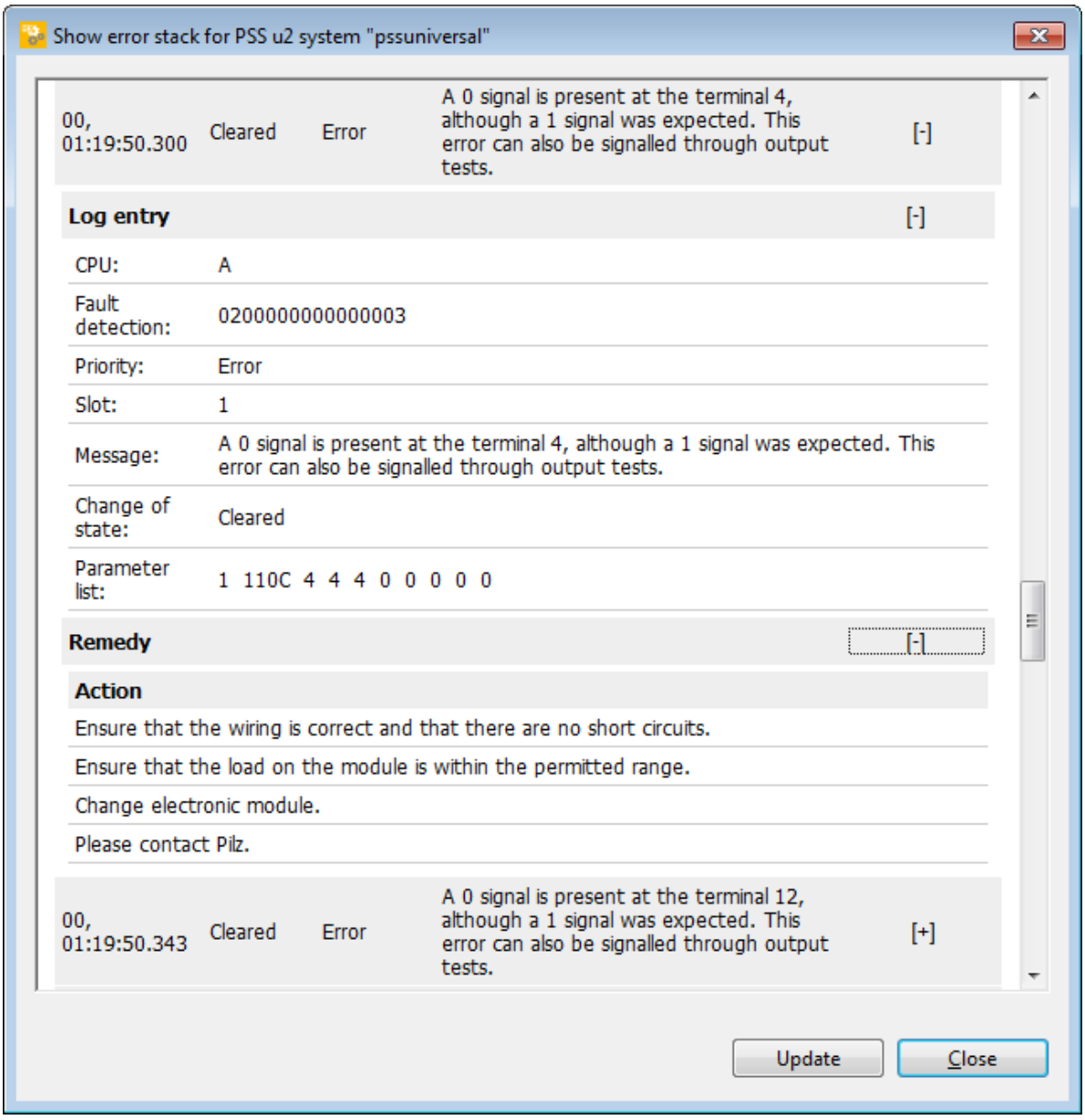


Figure 109: PASconfig – Error simulation '0 VDC short circuit with test pulse T1' » Error stack

9.6.3 24 VDC short circuit at output O0 of the actuator

- The actuator is switched off and terminal 1 from the FS output 'O0' of the third electronic module ('FS.PNOZp.Q1_%Q40.0') is connected to 24 VDC.
  The electrical wiring error is detected by the system:
  - In FB 'FDBACK' (Network 5 » Figure 93 [📖 59]), the bit for error evaluation is set:
    Bit 1: Passivation of F-periphery/channel controlled by output Q (= state of QBAD_FIO)
  - On the F-CPU, the LED 'ERROR' flashes red.
  - The following LEDs will change on the PSS u2 system:
    Head module: LED 'DIAG' lights red and LED 'SO' lights green.
    E-Module: LED 'MS' (module status) flashes red and LEDs '1' (output 'O0') flashes green.
- Here, too, the error is displayed online in the project tree and 'Diagnostics' window:

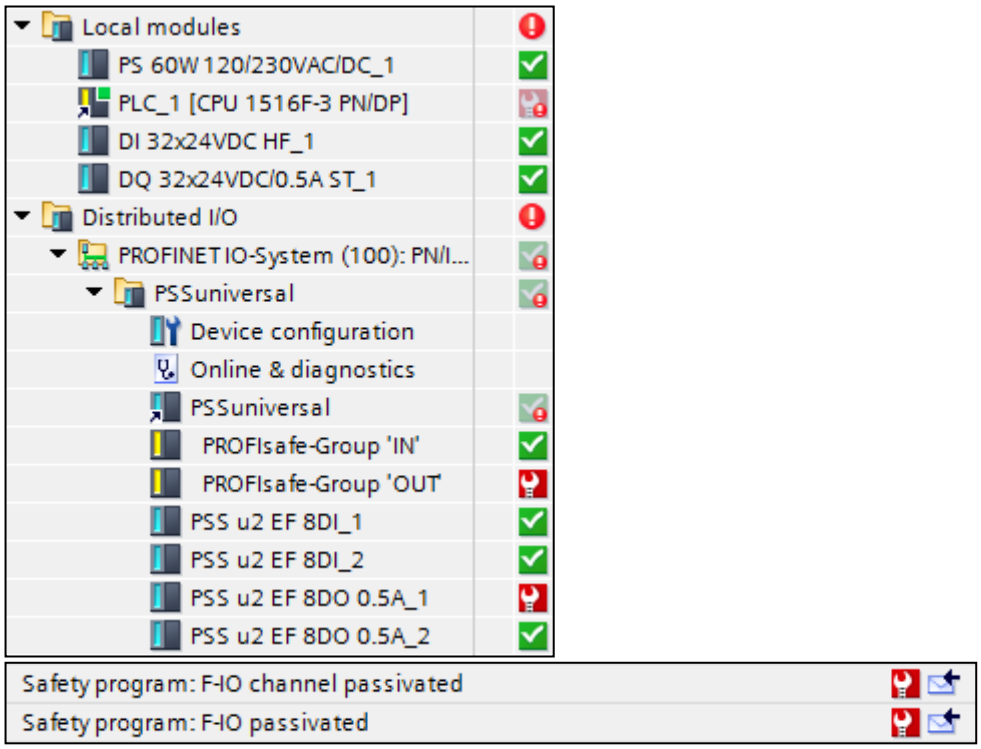


Figure 110: TIA – Error simulation '24 VDC short circuit at output O0' » Online display

- If the wiring error has been repaired, in addition to the diagnostic buffer of the F-CPU only the following LED indications indicate to the previously existing fault:
  Note: The LED display change may take some time because of the module-internal tests.
  - On the F-CPU, the LED 'ERROR' still flashes red.
  - The following LEDs will change on the PSS u2 system:
    Head module: only LED 'SO' still flashes green (LED 'DIAG' is off) and
    E-module: with process display (LED 'MS' lights green)
- The now green flashing LED 'SO' of the head module indicates:
  - The PROFIsafe group 'OUT' requires reintegration.
- Only now can the PSS u2 system be depassivated (see Figure 108 [📖 66]), then the head module LED 'SO' lights green again.

- Now the reset of the feedback loop monitoring function block 'FDBACK' is necessary.
- The safety program is then in "**Good state**" again (see Figure 101 [📖 62] / above outgoing event messages), so the actuator could be switched back on.

- Display the information about the error in the error stack of the 'PASconfig' tool (see Figure 104 [📖 63]):

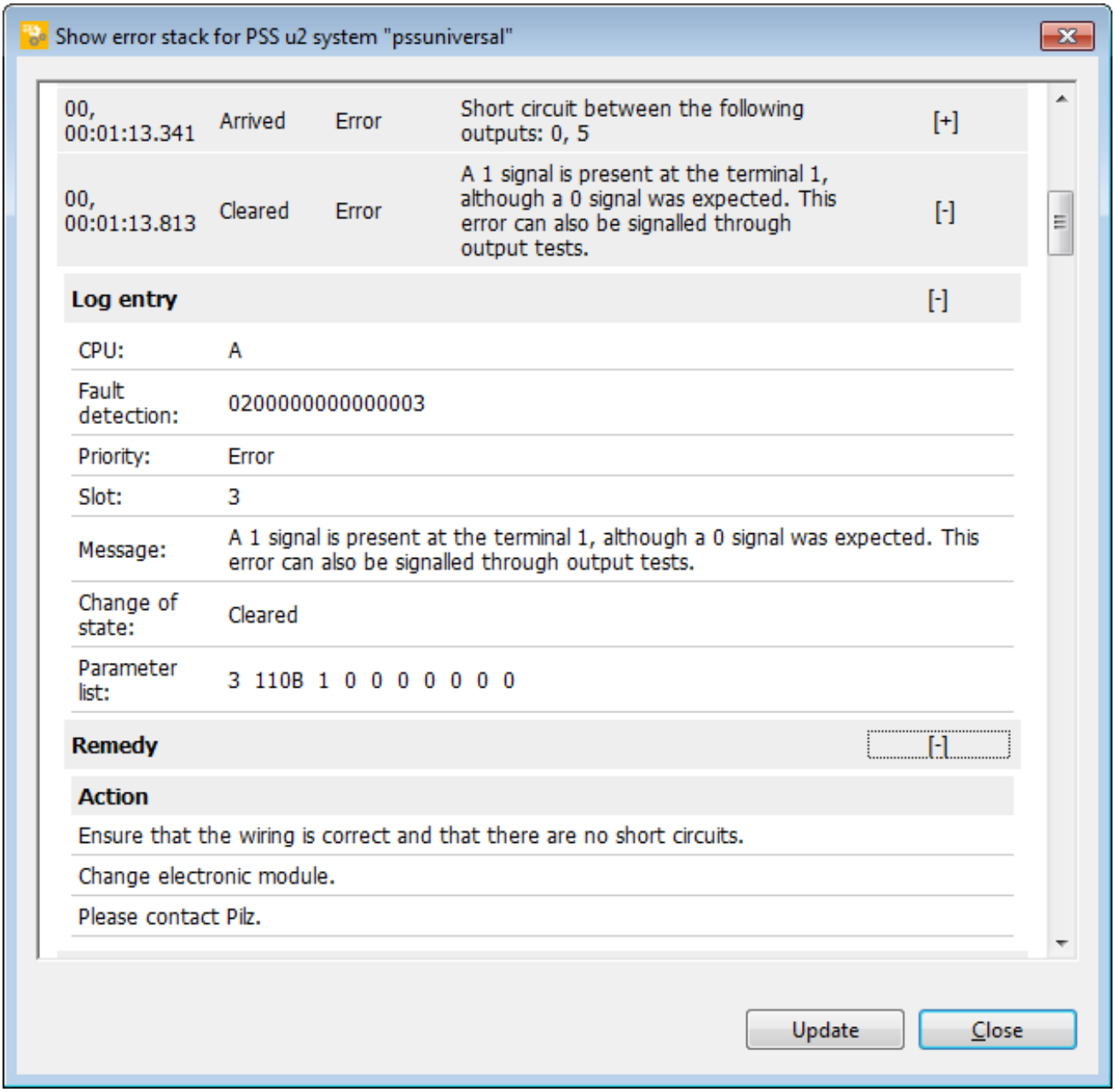


Figure 111: PASconfig – Error simulation '24 VDC short circuit at output O0' » Error stack

10 Appendix

10.1 Terminal assignment of the used PSS u2 electronic modules

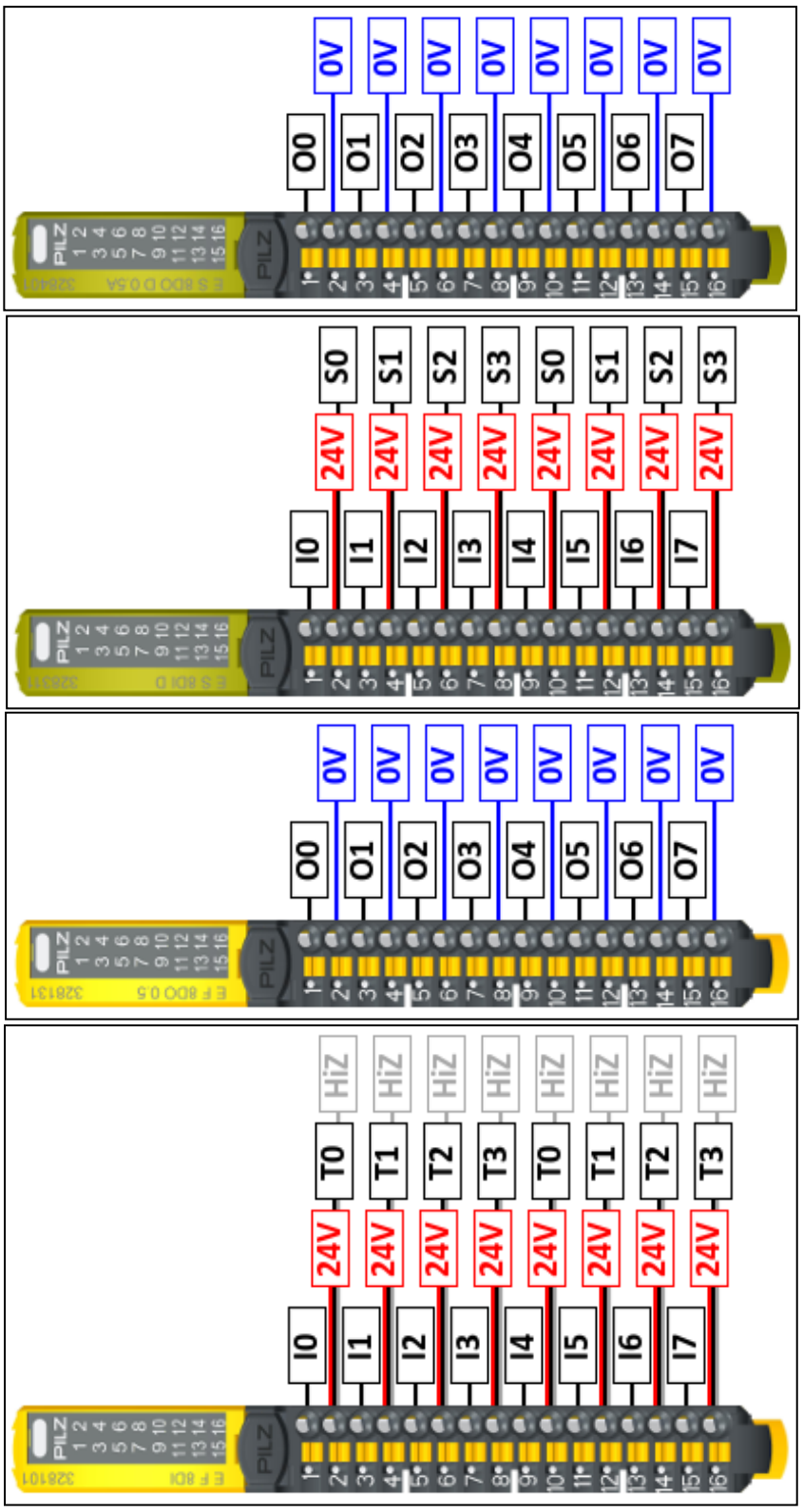
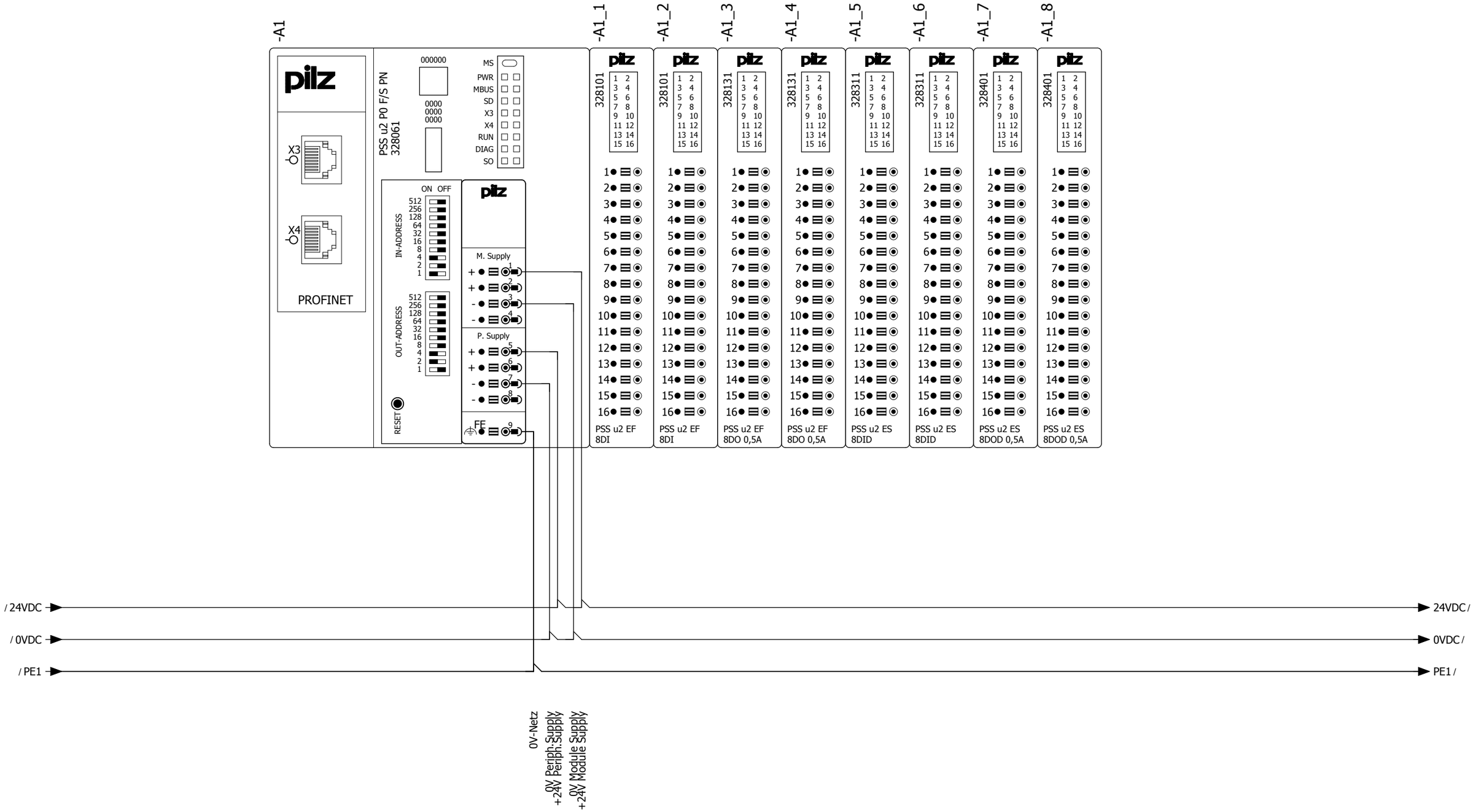


Figure 112: PSS u2 – Wiring » Terminal assignment of PSS u2-modules (schematic)

10.2 Wiring diagram

The following circuit diagram shows the basic wiring of the devices with the terminals of the electronic modules in order to be able to reconstruct the configuration and assignment of the addresses.

- The assignment to the program variables are listed under:
  - Chapter 5 Application description [📖 14] (table)
  - Figure 85: TIA – F-program » PLC tags [📖 55]
- The operating manuals of the used Pilz devices are listed under:
  - Chapter 1.1 Documentation from Pilz GmbH & Co. KG [📖 7]



Revision	07.06.2017	Date	26.04.2017			
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PSS u2 Module Overview

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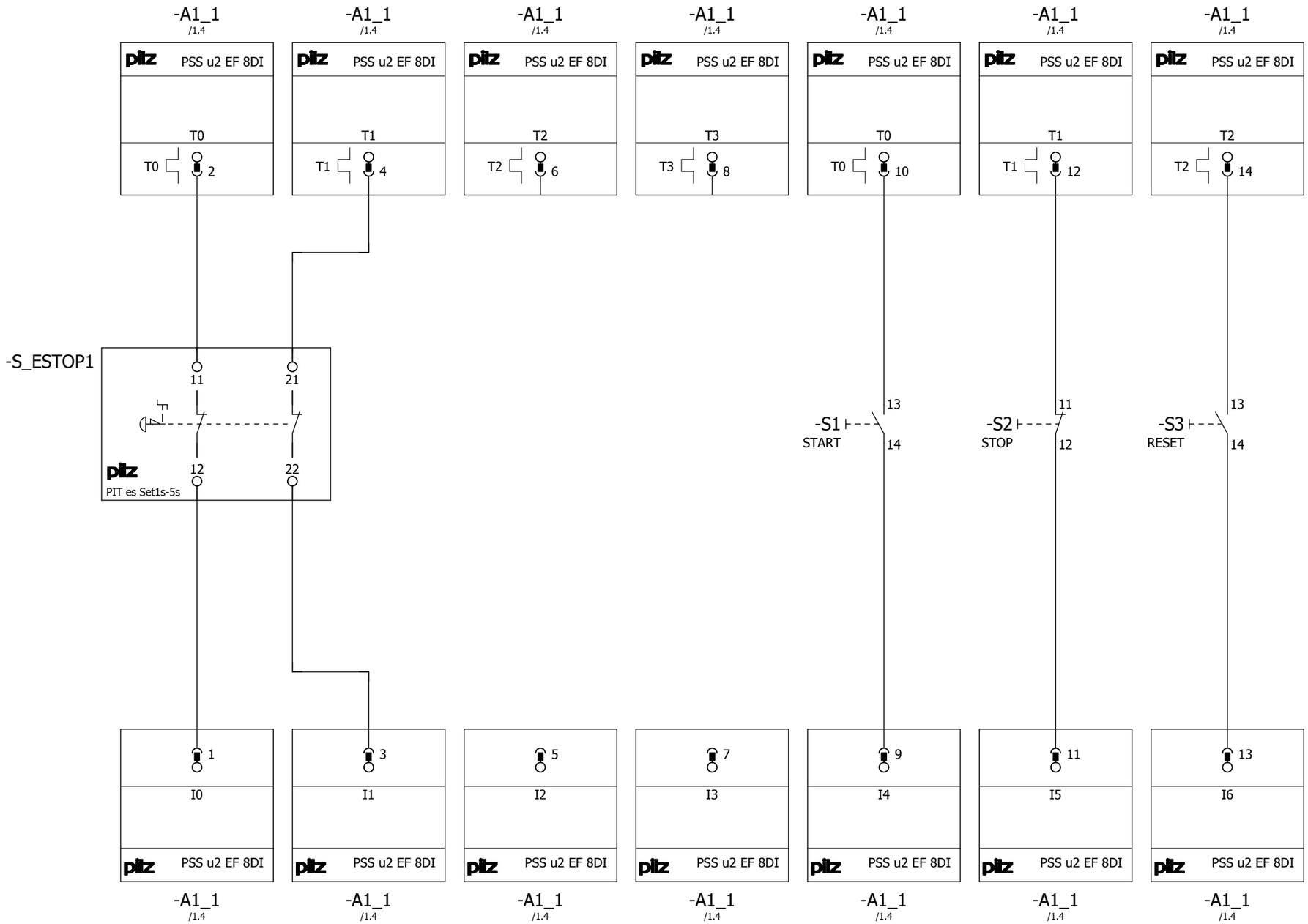

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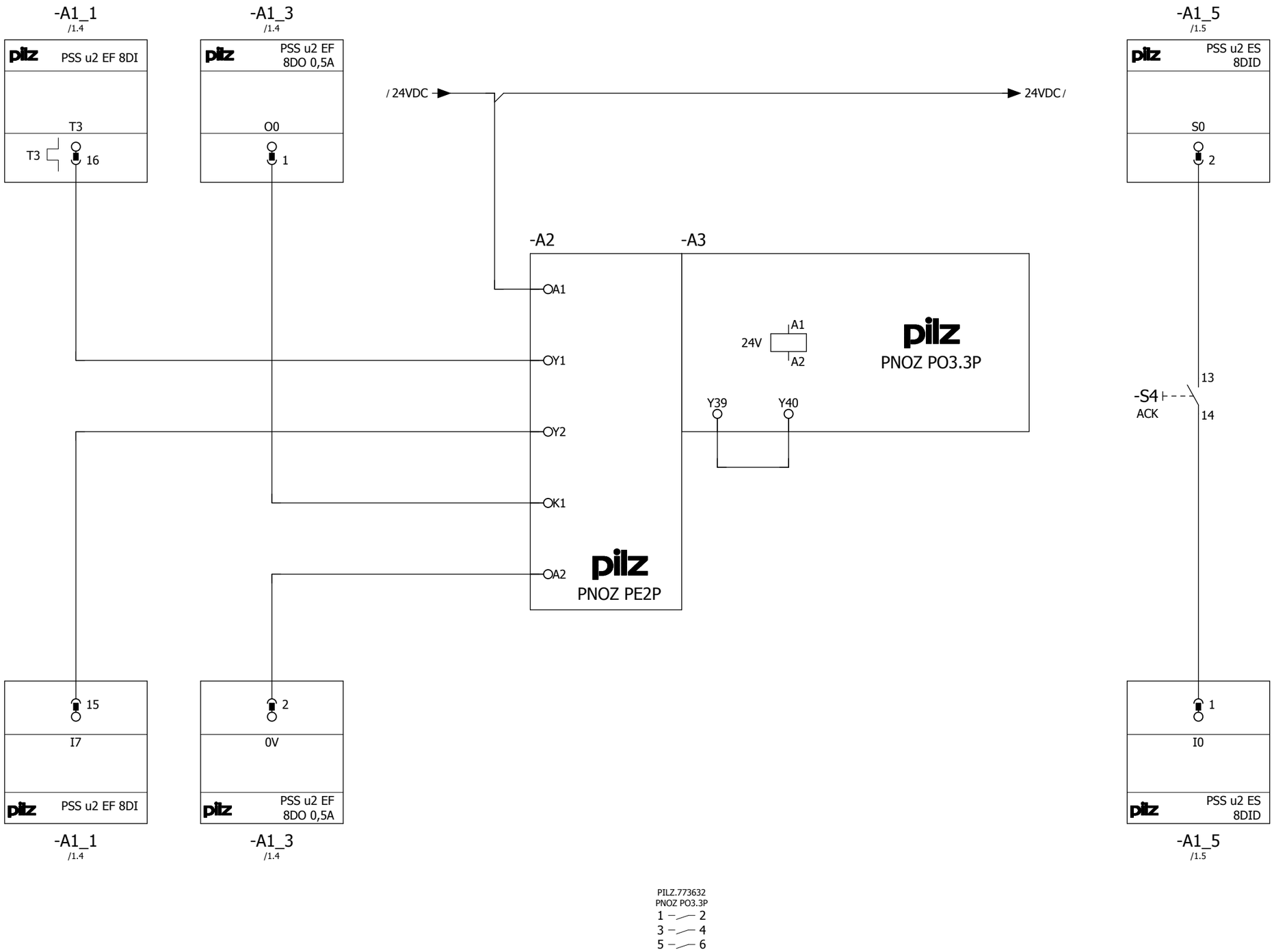

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		Dep.	CS			

10.3 Wiring of input/output modules

The wiring is **aligned horizontally** on the PSS u2-System, this applies in particular for function expansions. The system can be optimally configured for different requirements from the maximum packing density up to the maximum functional scope.
For reserve or subsequent function expansions (any) slots on the backplane can be left free. Therefor is no need for a "placeholder module" for PSSuniversal 2.

The following three examples show digital input/output modules for standard applications.

- 1-wire wiring with maximum packing density (Standard, Word alignment):

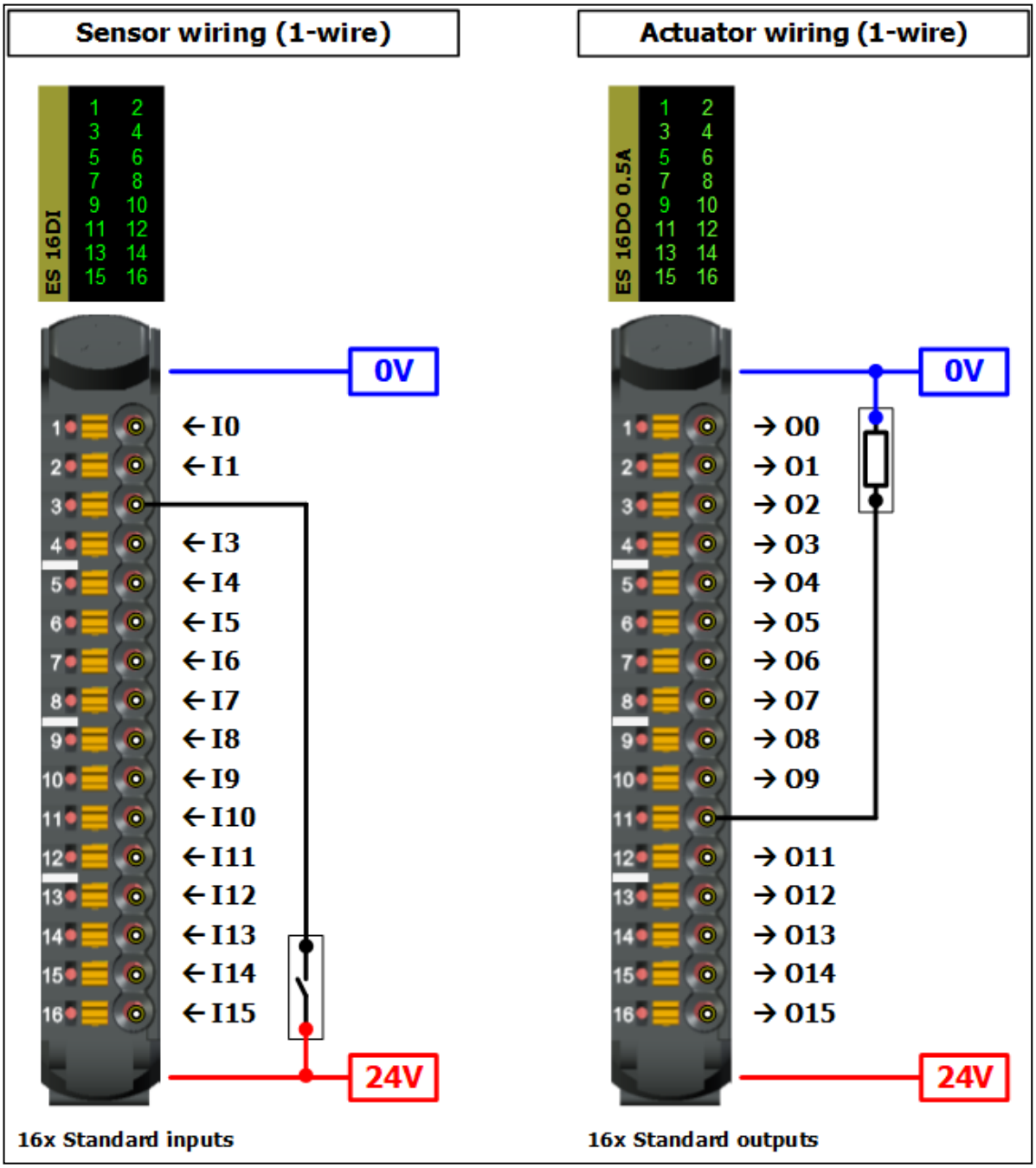

Figure 116: PSS u2 – Wiring » Standard digital (1-wire)

- 2-wire wiring with byte alignment per input/output module (standard):

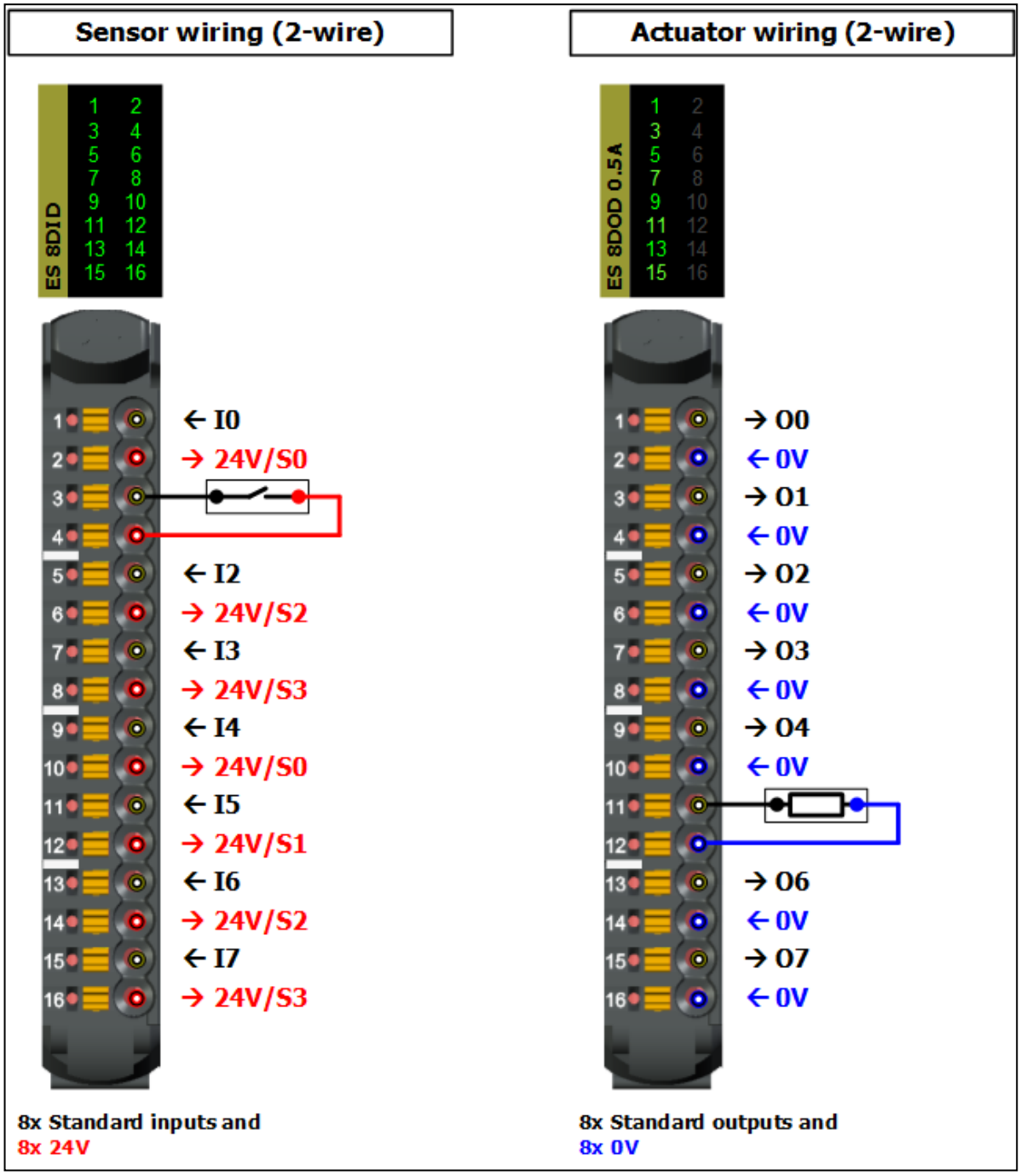

Figure 117: PSS u2 – Wiring » Standard digital (2-wire)

- 3-wire wiring with function expansion (standard):

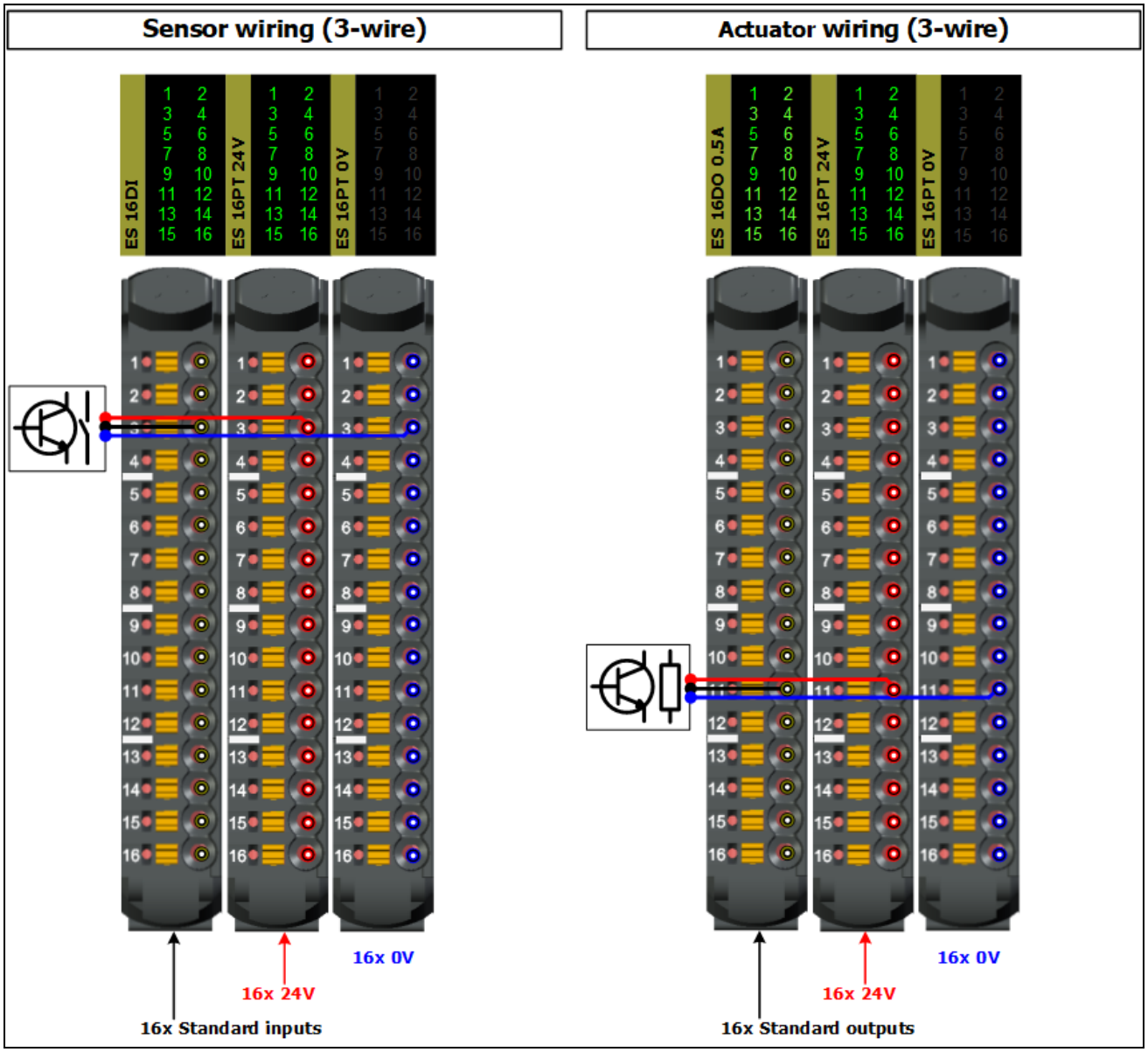

Figure 118: PSS u2 – Wiring » Standard digital (3-wire)

Here is an example with digital input/output modules for failsafe applications.

- 5-wire wiring with function expansion (failsafe):

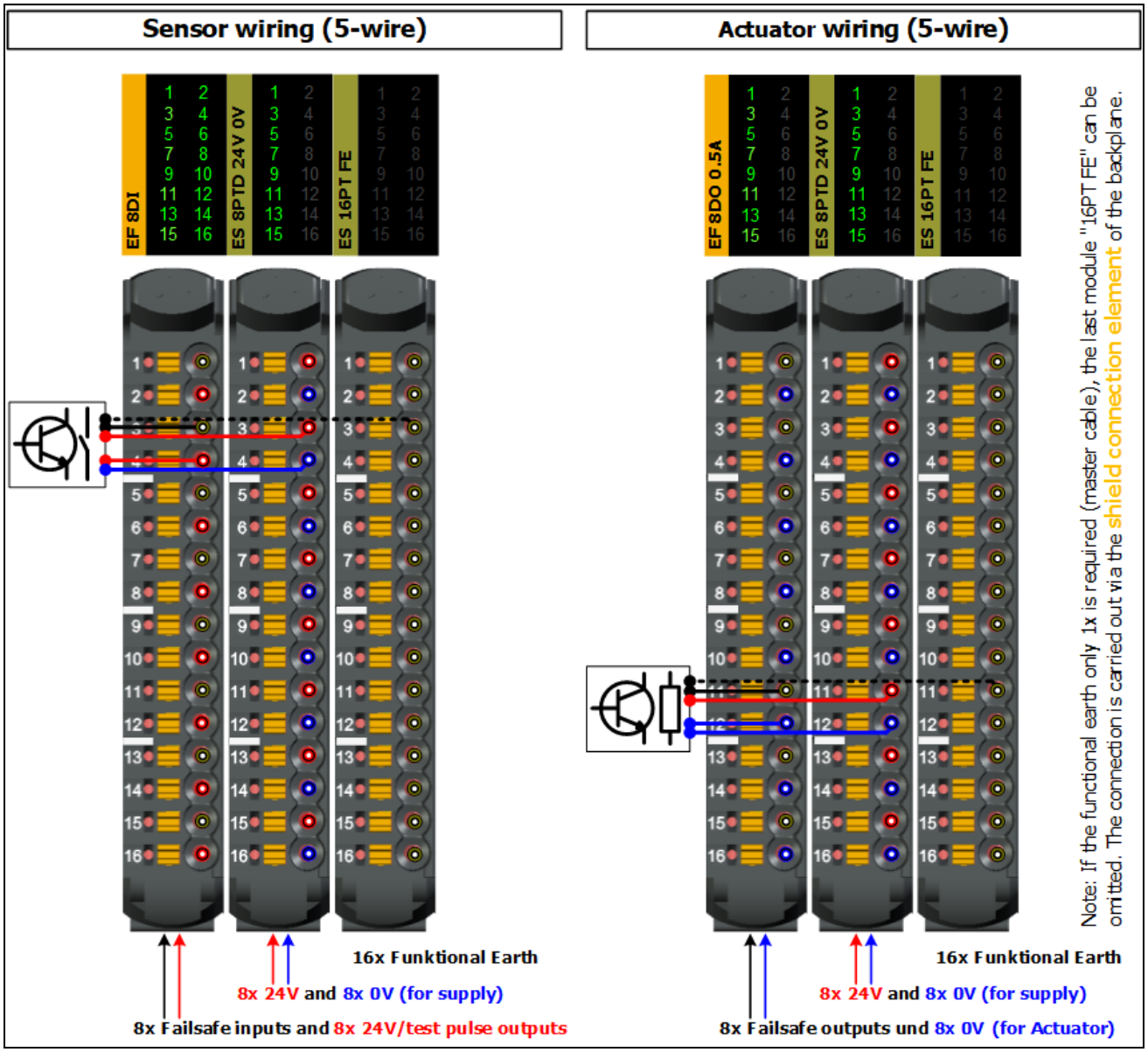

Figure 119: PSS u2 – Wiring » Failsafe digital (5-wire)

- **Shield connection element** for the backplane and head module:

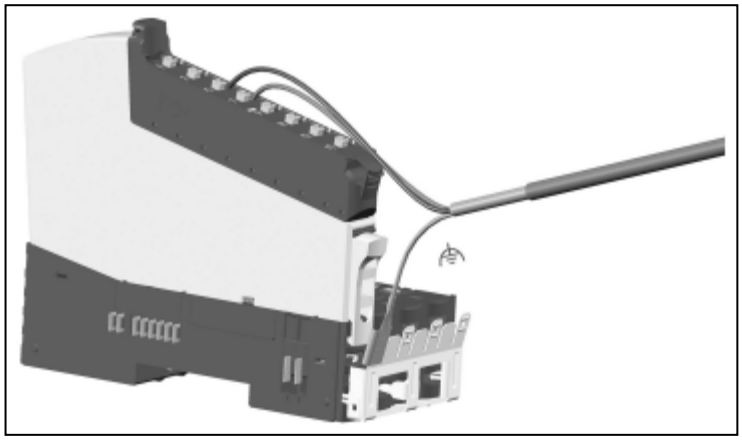

Figure 120: PSS u2 – Wiring » Shield connection element

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