Light beam PSENop4S operated with PSS DI2O T

Product
Type: Light beam, AOPD
Name: PSS3000, PSENopt
Manufacturer: Pilz GmbH & Co. KG, Safe Automation

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Document Revision History

Release	Date	Changes	Chapter
01	2011-05-30	Creation	all

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May 2011

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Contents

Abbreviations

FBL **F**eed**b**ack **l**oop
AOPD **A**ctive **o**ptoelectronic **p**rotective **d**evice

1. Useful documentation

Reading the documentation listed below is necessary for understanding this application note. The availability of the indicated tools and safe handling are also presupposed with the user.

1.1. Documentation from Pilz GmbH & Co. KG

No.	Description	Item No.
1	Pilz international homepage, download section	www.pilz.com
2	Operating instructions PSEN op4S	1001182-3FR-xx
3	Operating Manual PSS PS 24	19 152-4NL-xx
4	Operating Manual PSS CPU 3	20 893-EN-xx
5	Operating Manual PSS DI2O T	19 958-EN-xx
6	Operating Manual PSS DI2O Z	20 126-EN-xx

1.2. Documentation from other sources of information

No.	Description	Item No.
1		
2		

2. Hardware configuration

2.1. Pilz products

No.	Description	Order number	Version	Number
1	PSEN op4S-1-1	630 381	-	1
2	PSS BMP 8	301 005	-	1
3	PSS PS 24	301 051	-	1
4	PSS CPU 3	301 064	-	1
5	PSS DI2O T	301 112	-	1
6	PSS DI2O Z	301 109	-	1
7	PSS SB TRA	301 175B	-	1
8	PSS WIN-PRO	-	V2.1.0	1

2.2. Hardware configuration

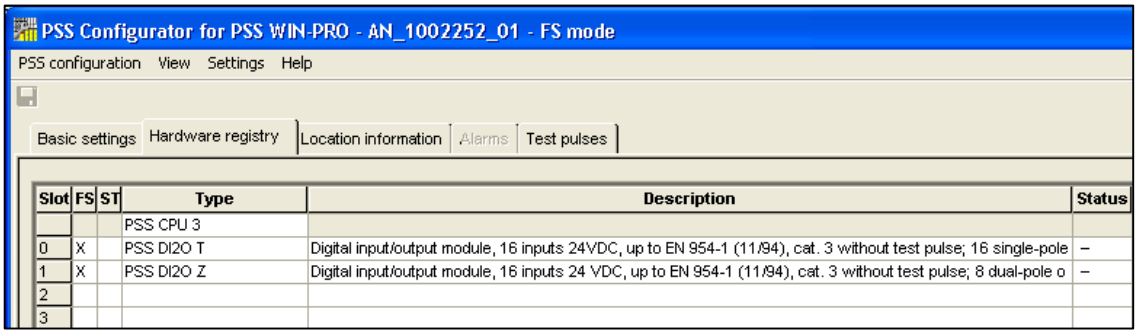


Fig. 1: Hardware configuration

CAUTION:
The safe pulse transfer used here can only be provided by the module PSS DI2O T.
Other modules with test pulses (e.g. PSS SB DI8O8, PSSu E F 4DI) are not released for this sensor.

3. Application Task

3.1. Description

The example shows the implementation of a protective device with a PSEN op4S-1-1.
The safe control and evaluation of the signals is taken over by a modular safety and control system PSS 3000.

Parts are transferred between two machines by passing through a tunnel.
For visual inspection, material testing or operational maintenance and cleaning work the tunnel is open on one side.
To minimize the risk of jamming for the operator, the conveyor belt inside the tunnel does not move when the light beam is interrupted.

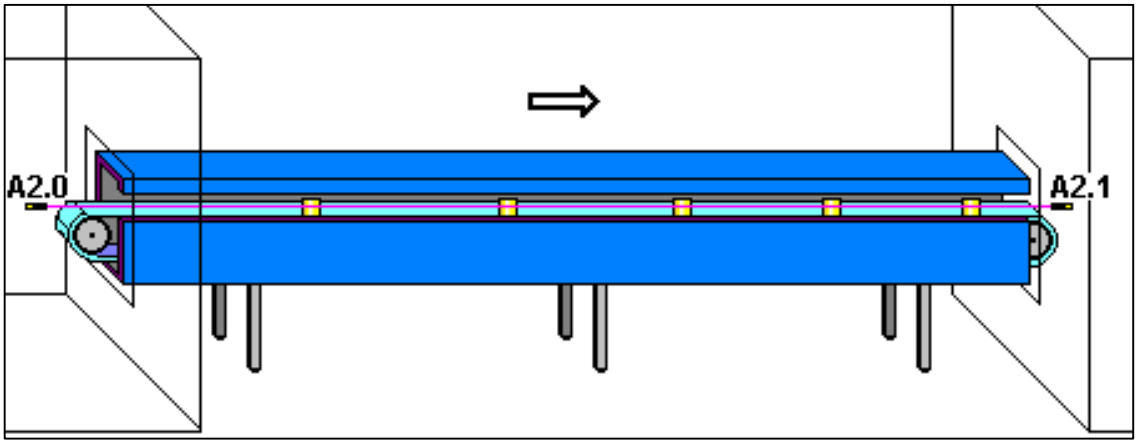


Fig. 2: Application chain-linking

The process is divided into the following main functions:
- Monitoring Light Beam
- Monitoring Feedback Loop

3.1.1. Monitoring Light Beam

The light beam (A2) is turned on safe, by connecting the pulse of the PSS DI2O T (A10) to the input „Test“.
The transmitter (A2.0) sends the pulse to the receiver (A2.1) that sends the signal further to the input of A10.

The output in the receiver of the safety light beam (A2.1) is shut off, once the beam of light beam device is interrupted.
Within the user program, the failsafe standard function block SB069 is assigned to the output of A2.1.
SB069 detects an interruption of the protective field, as well as detecting invalid input signals, such as a reset button that is constantly operated.
If the protective field is interrupted or an error occurs, the enable output ENBL at the SB069 will immediately be reset.
The enable output ENBL is also reset when the PSS is stopped and when the PSS is switched on.
The signal from the enable output ENBL must be evaluated by the user program and trigger an appropriate reaction.
SB069 stores information in DB015 (or DB016 / DB017), which can be used to determine why ENBL was reset.
The way in which the error is reset will depend on the operating mode set on SB069.
In this application example, parameters for SB069 have been set in such a way that it is necessary to carry out a reset by pressing S2 (0/1 pulse edge at RSET) in order to reset the output ENBL when the PSS is started (PSS transferring from STOP to RUN) or when the protective field is cleared (restart).
Parameter setting on SB069 also stipulates that the AOPD must not undergo a function test (interrupting and then clearing the protective field) during a cold and warm start.

Caution: If it is not possible to prevent the operator from passing completely beyond the sensitive area, it is necessary that a manual restart procedure is performed on the safety system.

3.1.2. Monitoring Feedback Loop

The system conditions are logically connected within the user program through various blocks (SBs).
Flag M90.00 contains the result of this logic operation and switches the motor on and off.
The control system monitors the N/C contacts on the two contactors KM1 and KM2. Within the user program, the failsafe standard function block SB065 is assigned to the N/C contacts KM1 and KM2. SB065 drives the contactors as well as monitoring the feedback loop.
A 0/1 pulse edge at input parameter ON of SB065 (M90.00) sets the outputs which drive the contactors, K1 and K2, to “1”; a 1/0 pulse edge sets them to “0”.
SB065 has extensive fault detection features. For example, SB065 automatically detects errors such as “FBL remains open” or “FBL remains closed”. If an error occurs, the enable output ENBL of SB065 will immediately be reset, along with the outputs that drive the contactors, K1 and K2. Both outputs are also reset when the PSS is stopped and when the PSS is switched on.
The signal at the enable output ENBL can be evaluated by the user program and trigger an appropriate reaction. SB065 stores information in DB015 (or DB016 / DB017); which can be used to determine why ENBL was reset. If an error occurs, reset can be carried out, once the error has been rectified. Reset is performed by pressing S3 (0/1 pulse edge at RSET) in order to also reset enable output ENBL of SB065.
Outputs K1 and K2 then also are resettable by setting flag M90.00.

3.1.3. Safety assessment

- A short between 24 VDC and the pulse signal path via the light beam will be detected as an error by the programmable control system.
- A short between 24 VDC and a safety output or a feedback loop input will be detected as an error by the programmable control system. The load can be switched off via the second shutdown route.
- The reaction time of light barrier and evaluation device when operated with PSS amounts to: 2 x set value of minimum scan time.

- The pulse signal to the transmitter (A2.0) and the output signal from the receiver (A2.1) are to be carried in separate cables over the entire signal route.
- The modular safety and control system PSS 3000 (A1) and contactors KM1 and KM2 must be installed in a single mounting area (control cabinet) in order to exclude a short across the output.
- The PSEN op4S must be installed in a way that it cannot be defeated.

3.2. Functional safety

3.2.1. Safety-related characteristics in accordance with EN ISO 13849-1

No.	Safety function	Achieved Performance Level	Safety-related parts of the control system
1	Machine shut down when the safety light beam is interrupted	PL e	Sensor (PSEN op4S-1-1 A2) Input (PSS DI2O T A10) Logic (PSS CPU 3 A1) Output (PSS DI2O Z A11) Actuator (contactors KM1, KM2)

Prerequisites:

No.	Description		Identification
1	Common cause failure (CCF):		Requirements are considered to be met (must be tested on implementation)
2	Mission time:		20 years
3	Operating interval (electromechanical components):	Actuator	Two operations per hour
4	Characteristic data of contactors KM1/KM2:	B10d	2,000,000

Please note the further requirements of EN ISO 13849-1, e.g. requirements for avoiding systematic faults.

3.2.2. Safety-related characteristics in accordance with EN 62061

No.	Safety-related control function (SRCF):	Achieved Safety Integrity Level	Subsystems
1	Machine shut down when the safety light beam is interrupted	SIL 3	Sensor (PSEN op4S-1-1 A2) Input (PSS DI2O T A10) Logic (PSS CPU 3 A1) Output (PSS DI2O Z A11) Actuator (contactors KM1, KM2)

Prerequisites:

No.	Description		Identification
1	Common cause failure (CCF):		ß = 2 % (must be tested on implementation)
2	Proof test interval:		20 years
3	Operating interval (electromechanical components):	Actuator	Two operations per hour
5	Characteristic data of contactors KM1/KM2:	B10d	2.000.000
		Dangerous failure rate	65 %

Please note the further requirements of EN 62061, e.g. requirements for systematic safety integrity.

3.2.3. Classification in accordance with EN 954-1

Depending on the application area and its respective regulations, this connection example is suitable for applications up to Category 4 of EN 954-1.

3.3. Program

```
//--- Safety light beam --------------------
CAL     SB069
```

			SB069 AOPD_GDO				
KF 000002	.	W	SSNR	ENBL	X	M 090.02	.AOPD_ENBL
M 116.01	.Group-01	X	GRP	Test	X	M 090.03	.Output_Test
E 000.00	.Lightbeam_OK	X	NO_1	PWR	X	M 090.04	.AOPD_On
E 000.00	.Lightbeam_OK	X	NO_2				
M 110.01	.TRUE	X	GdOn				
KB 150	.	B	MTD				
M 110.01	.TRUE	X	SSeq				
M 110.00	.FALSE	X	ARSt				
M 110.00	.FALSE	X	Test				
E 000.01	.Reset_LB	X	REST				

```
L   M 090.02      .AOPD_ENBL
U   M 088.00      .START
=   M 090.00      .ENBL_total

//--- Feedback  loop ----------------------
CAL     SB065
```

			SB065 FBL				
KF 000005	.	W	SSNR	ENBL	X	M 091.00	.ENBL_FBL
M 116.01	.Group-01	X	GRP	K1	X	A 001.16	.Contactor_1/2
M 090.00	.ENBL_total	X	ON	K2	X	A 001.16	.Contactor_1/2
E 001.01	.FBL_1	X	FBL1				
E 001.02	.FBL_2	X	FBL2				
KF 000100	.	W	TFbl				
E 0001.00	.Reset_FBL	X	RSET				

Please note:
A “Minimum scan time” must be specified in the configurator of the PSS WIN-PRO system software.

Global parameters used in administration data block DB015, DB016 and DB017

- DW1001: Number of cycles in the contact synchronisation time between 2 N/C contacts on the E-STOP button.
- DW1002: Number of cycles for the reaction time of the feedback loop with contactors.
- DW1022: Minimum scan time.

Global parameters may be set in OB120 using SB071.

Additional blocks required

- DB015, DB016, DB017: Administration data blocks DB015, DB016 and DB017 must consist of their total length of 1024 data words. DB015, DB016 and DB017 must be declared READ/WRITE.
- SB071: Initialisation of global parameters in DB015, DB016, DB017.
- SB255: Operating system call.

The configuration of test pulses is shown in figure 3:

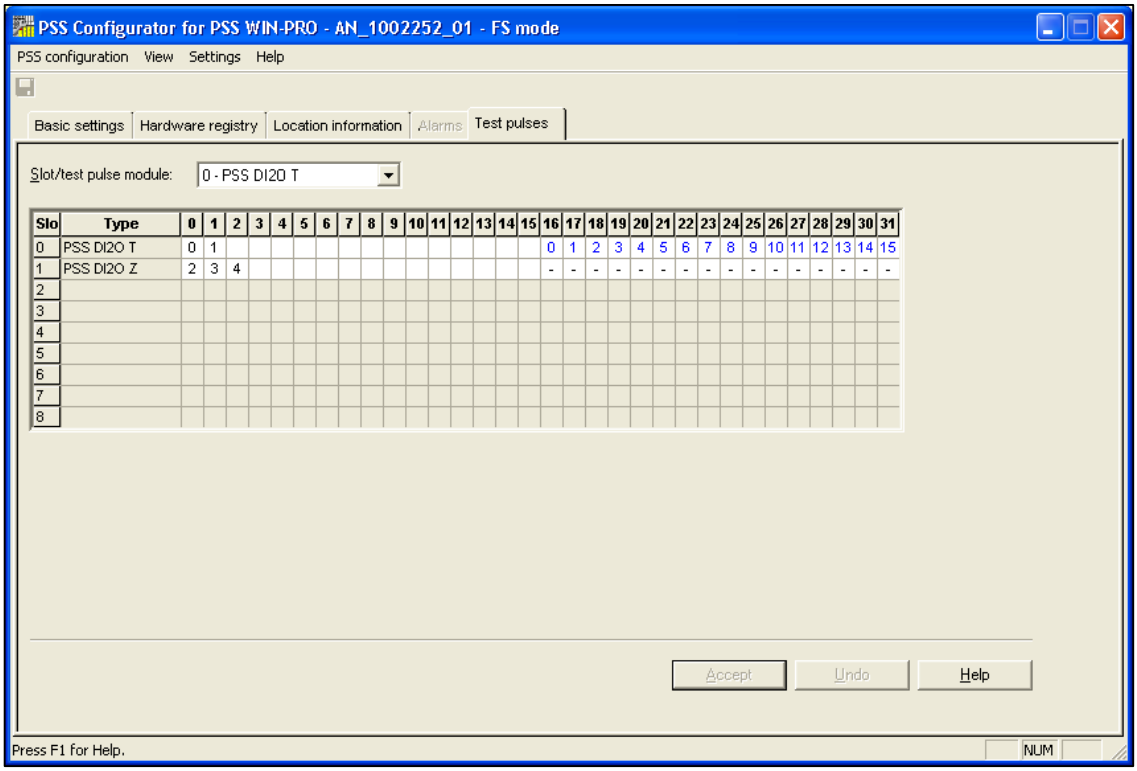
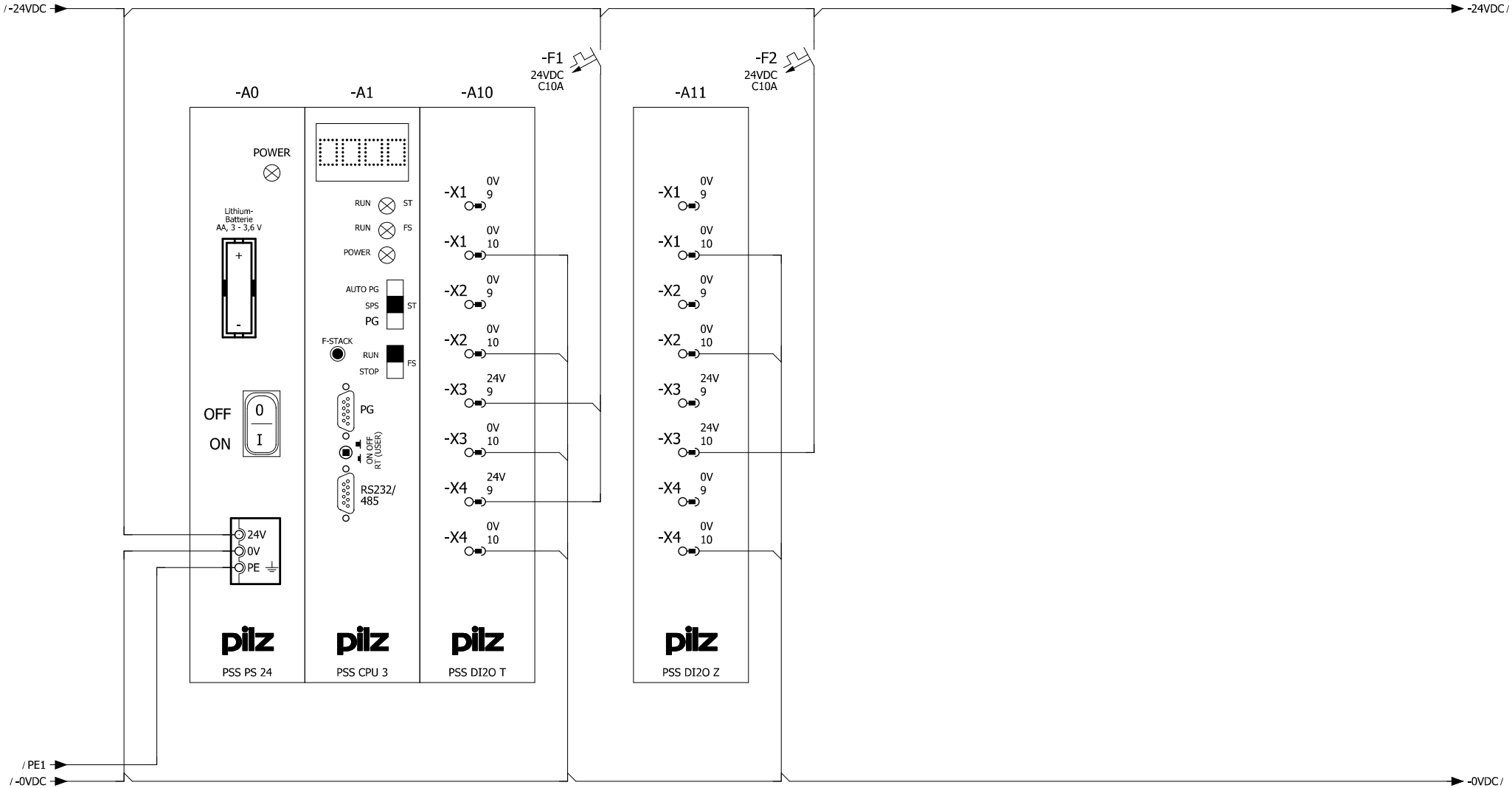
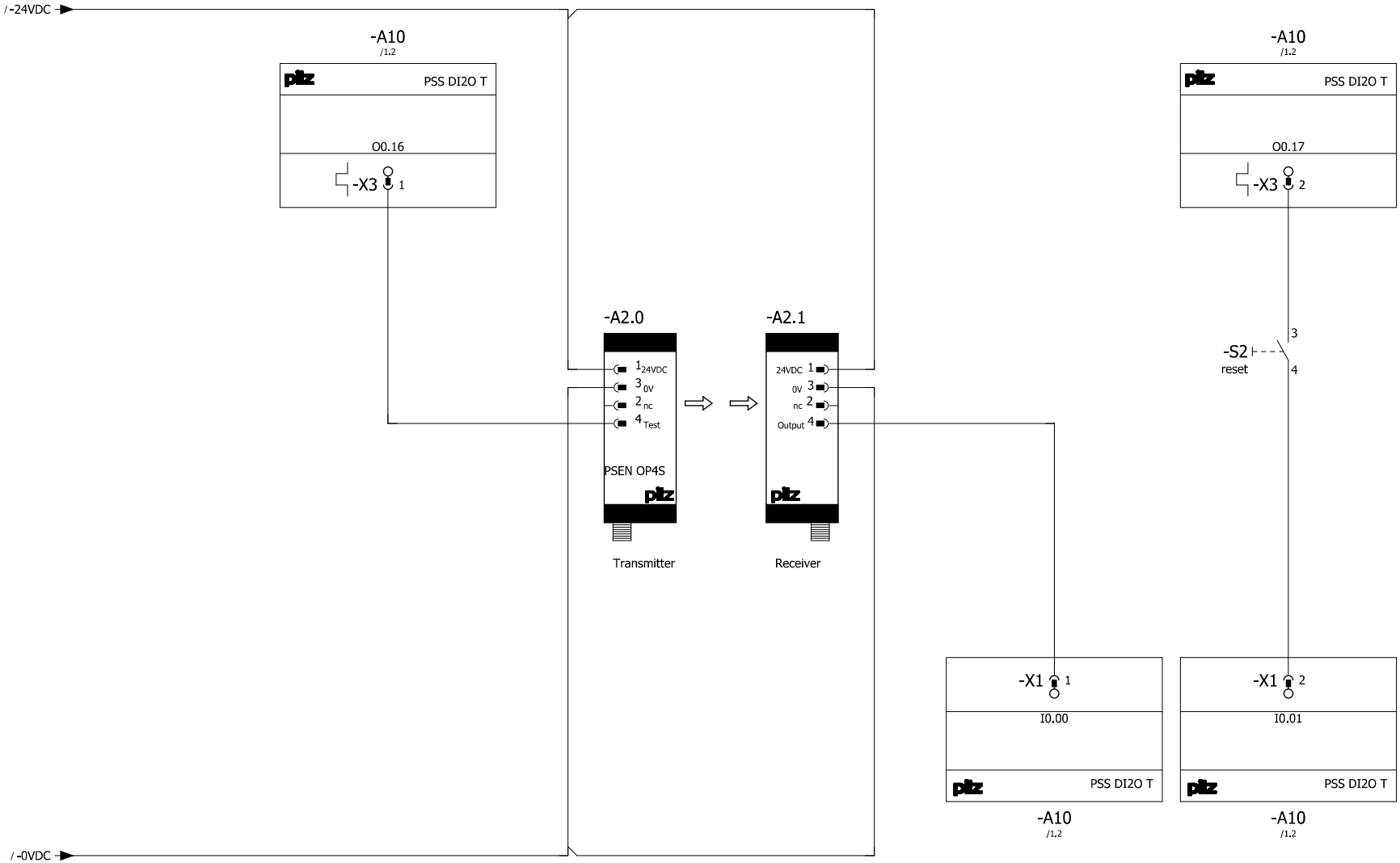


Fig. 3: Configuration of test pulses



Revision	30.05.2011	Date	24.03.2011	EN ISO 13849-1:2006 PL e	Pilz GmbH & Co.KG Felix-Wankel-Str.2 73760 Ostfildern	Light beam PSEN op4s operated with PSS DI2O T	Mounting place + AN_1002252_01
Name	RDS	Name	RDS				
				EN 62061:2005 SIL 3			Page: 1 / 3
		Dep.	CS				



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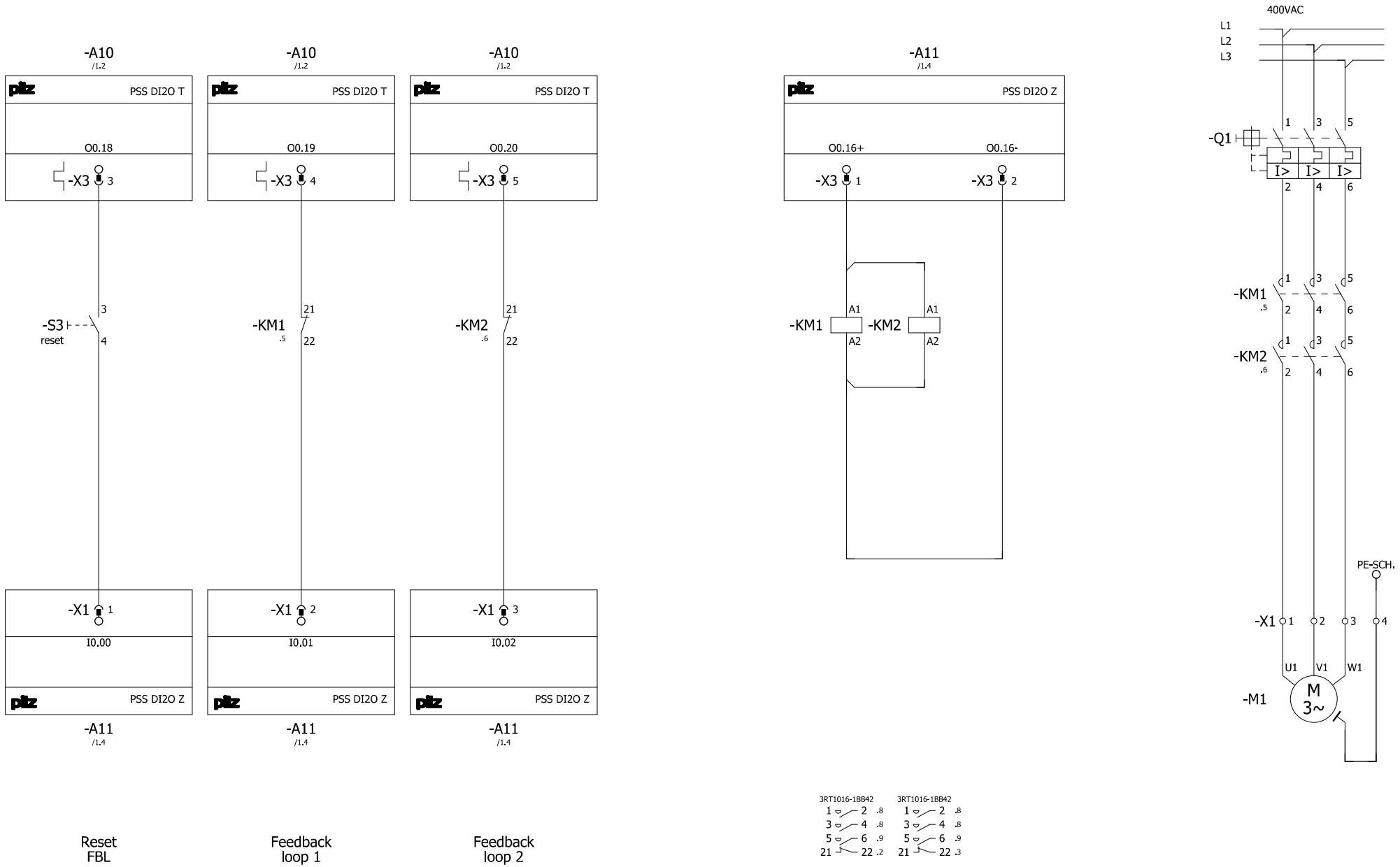
Name	RDS	Name	RDS			Mounting place + AN_1002252_01
				EN 62061:2005 SIL 3		Page: 2 / 3
		Dep.	CS			



Reset
FBL

Feedback
loop 1

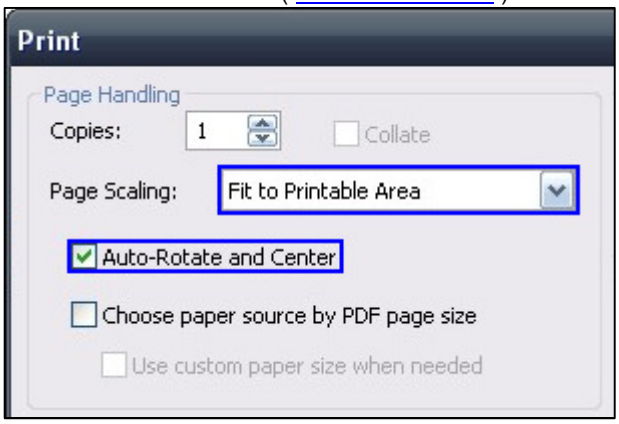
Feedback
loop 2

Revision	30.05.2011	Date	24.03.2011	EN ISO 13849-1:2006 PL e	Pilz GmbH & Co.KG Felix-Wankel-Str.2 73760 Ostfildern	Light beam PSEN op4s operated with PSS DI2O T	Mounting place + AN_1002252_01
Name	RDS	Name	RDS				
				EN 62061:2005 SIL 3			Page: 3 / 3
		Dep.	CS				

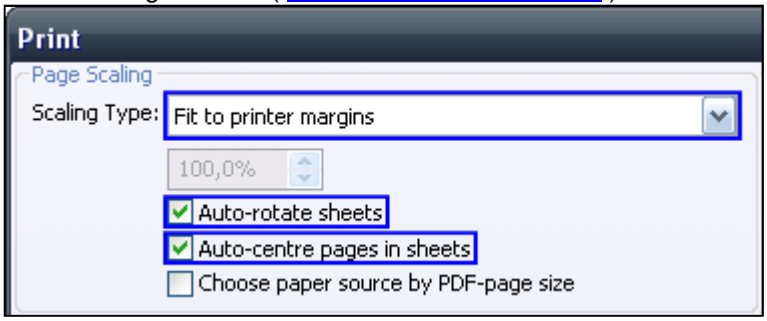
4. Table of figures

Recommended printer settings

Adobe Acrobat Reader (www.adobe.com)



PDF-XChange Viewer (www.tracker-software.com)



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