

STO classified PL e using PMCprotego D.48 or PMCprotego D.72 and PNOZ mm0p



Product

Type: PMC
Name: PMCprotego D, PNOZ mm0p
Manufacturer: Pilz GmbH & Co. KG, Safe Automation

Document

Release Number: 02
Release Date: 17 February 2012

Document Revision History

Release	Date	Changes	Chapter
01	2012-02-16	Creation	all
02	2012-02-17	Revision circuit diagram	3.3

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We are grateful for any feedback on the contents.

February 2012

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Abbreviations

PMC	Pilz Motion Control
PNOZ	Pilz E-STOP Positive-Guided (DE: Pilz NOT-AUS-Zwangsgeführt)
PRG	Program
STO	Safe Torque Off
RTO	Ready To Operate (DE: BTB - Betriebsbereit)
FW	Firmware
PDrive	Setup software for setting parameters and configuring servo amplifiers of the PMCtendo DD4/5, PMCprimo Drive 2/3 and PMCprotego D series.

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 Manual PNOZ mm0p	1001274-EN-xx
3	Operating Manual PMCprotego D.48, PMCprotego D.72	1001735-EN-xx
4	Operating Manual PM Ctendo AC	21 706-EN-xx
5	User Manual Motion Control Tools	21 468-EN-xx
6		

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	PNOZ mm0p	772 000	-	1
2	PMC protego D.48/000/0	8176425	(from FW 5.24)	1
3	Cable Power DD4wire>ACPLUG15:L=XXQ10BrS	8176329	-	0,5m
4	Cable Hiperface DD4plug>ACplug:L=xx	0802932	-	0,5m
5	PNOZmulti Configurator	-	V8.0.1 build 8	1
6	PMCTools	-	V3.3	1

2.2. Hardware-configuration

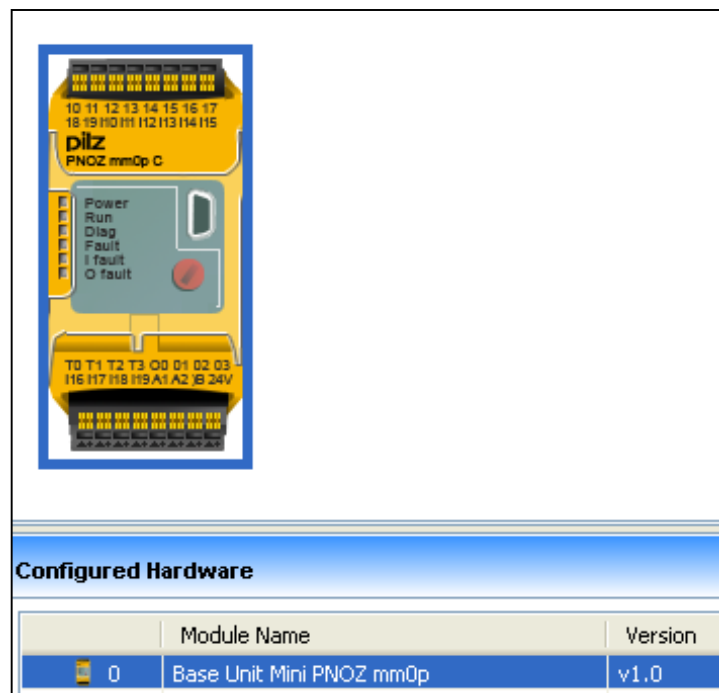


Fig. 1: Hardware configuration

3. Application Task

3.1. Description

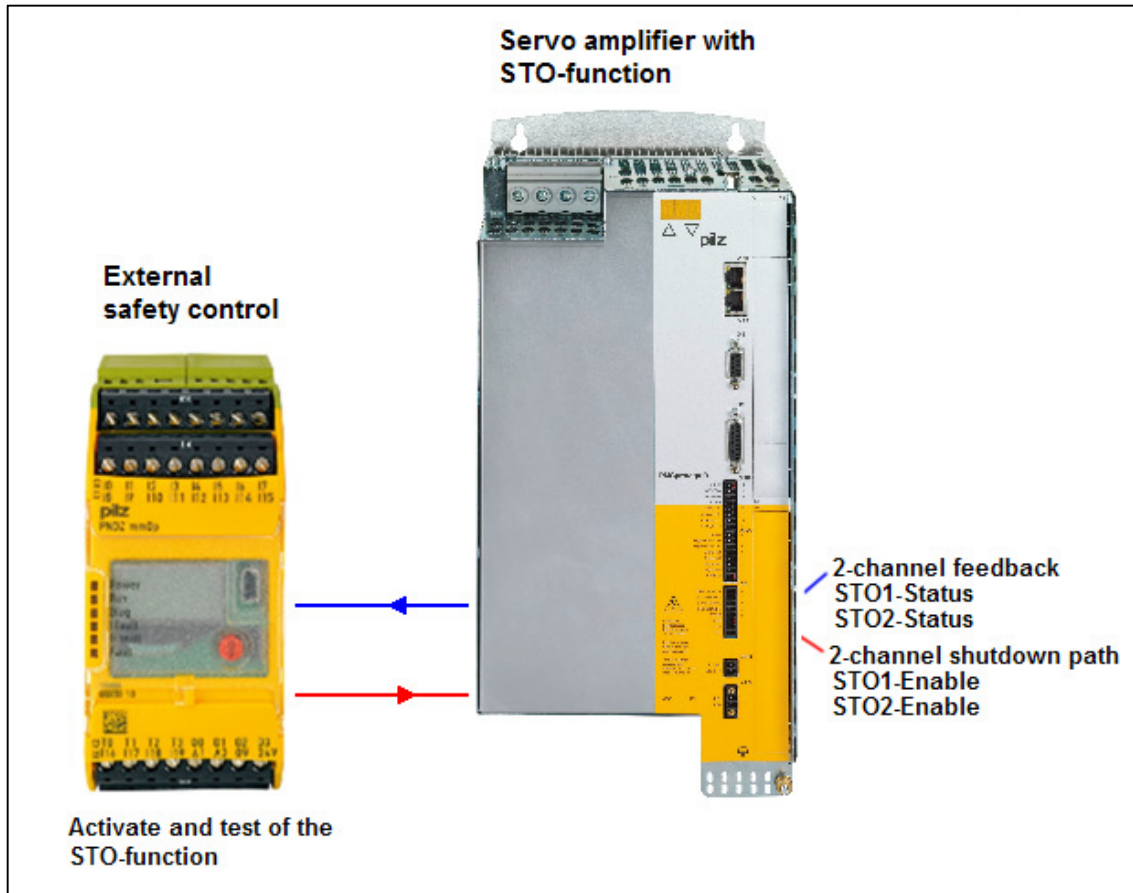


Fig. 2: Application composition

With the PMCprotego D (D.48/D.72), the highest safety level (PL_e / SIL3) can also be achieved for the STO function without an additional safety card (PMCprotego S1) if the shutdown paths of the PMCprotego D are tested by an external device (e.g. safety control) – referred to as “STO Feedback Loop Test” in the following.

This Application Note shows in principle the procedure for such a test.

The feedback signals of the PMCprotego D (D.48/D.72) necessary for this test are available on this as outputs.

3.1.1. Safe pulse disabler of servo amplifier

The safe pulse disabler of the servo amplifier consists of two shutdown paths that can, independently of each other, switch off the power supply to the motor using the inputs 'STO1-ENABLE' and 'STO2-ENABLE'. As a cyclical test of the pulse disabler during operation is inadvisable for availability reasons, a function test of the shutdown paths must be performed at least before the release of the drive, once the PMCprotego D has run up and, in addition, every 8 hours (see section 3.1.8 PMC safety assessment).

The control of the pulse disabler can be made via a block in the PNOZmulti Mini (e.g. emergency stop, safety gate or light curtain); for that the enable signal of the block is to be linked to the result of the STO feedback loop test for this purpose.

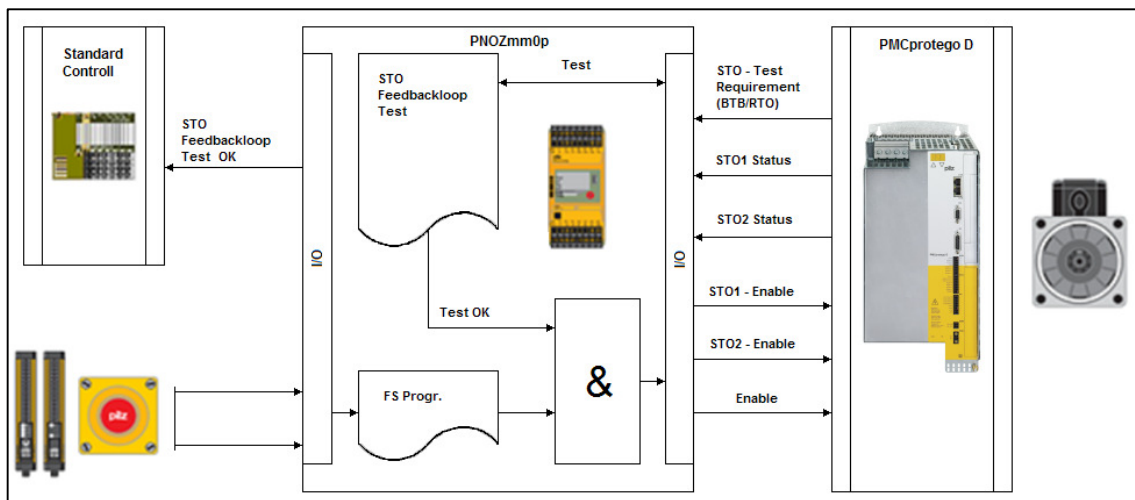


Fig. 3: Overview control safe pulse disabler

3.1.2. Testing the safe pulse disabler

When testing the safe pulse disabler, the two shutdown paths STO1-ENABLE and STO2-ENABLE are switched off independently of each other, and the relevant switching state of the pulse disabler checked using the read-back signals 'STO1-STATUS' respectively 'STO2-STATUS'.

The read-back signal 'STO1-STATUS' respectively 'STO2-STATUS' is available on the PMCprotego D (48A, 72A) in each case as output.

This enables the function of the safe pulse disabler to be tested from an external safety control and the drive safely operated if the highest safety level is to be achieved.

Testing the safe pulse disabler is done:

- ▶ at run up of the system (PNOZmulti Mini and PMCprotego D).
- ▶ on restart after a protection device has been triggered.
- ▶ after a periodic triggering (8-hour interval) by the operator
(see 3.1.8 Safety assessments – PMC safety assessment).

The test sequence is started by the BTB/RTO contacts of the PMCprotego D; this ensures that the test is always carried out when the PMCprotego D changes over into the operational readiness state (BTB or RTO).

This is the case after a restart or fault reset of the PMCprotego D.

If the test is successfully completed, an output on the PNOZmulti Mini is also set ("STO feedback loop test OK") which the user can employ for enabling the start of his sequence control system.

If the test is requested during operation of the inverter, it should first be ensured that the enable input and then the STO inputs of the PMCprotego D are switched off. If not, a fault F27 is triggered that has to be reset before the PMCprotego D can be restarted.

3.1.3. Circuitry and parameterisation

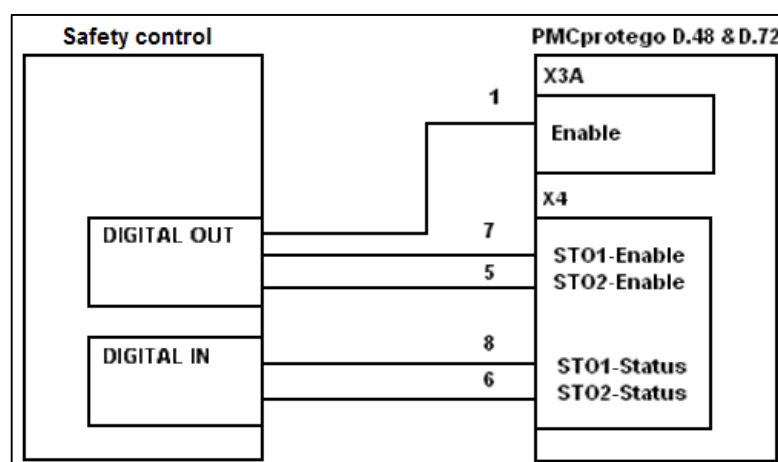


Fig. 4: Circuitry of PMCprotego D

3.1.4. Signal table

STO1-ENABLE	STO2-ENABLE	STO1-STATUS	STO2-STATUS
0	0	1	1
0	1	1	0
1	0	0	1
1	1	0	0

3.1.5. Timing diagram

Note

When evaluating the output signals STO1-STATUS and STO2-STATUS, please note the delay time $t_d = 47$ ms.

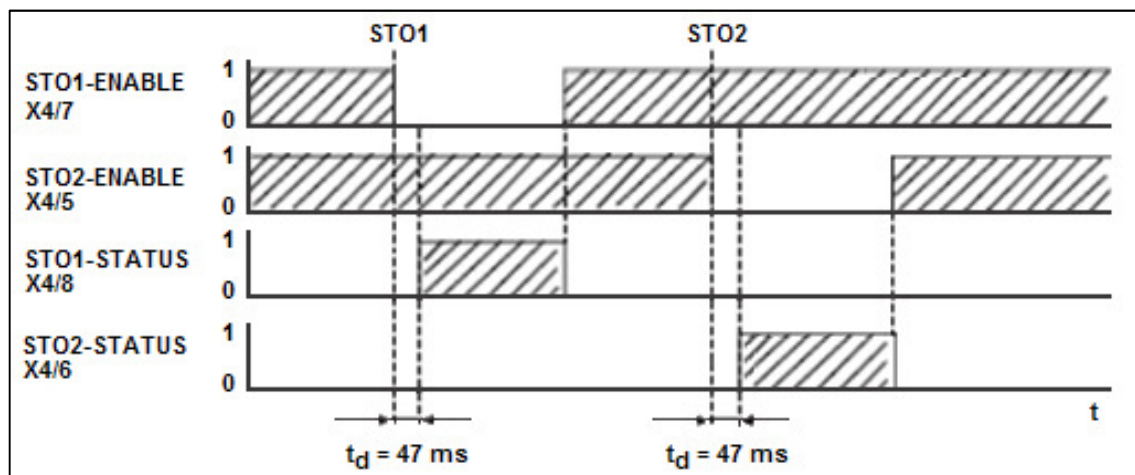


Fig. 5: Timing diagram

- ▶ STO1-ENABLE: Digital input, 1st shutdown route for shutting down the pulse disabler safely
- ▶ STO2-ENABLE: Digital input, 2nd shutdown route for shutting down the pulse disabler safely
- ▶ STO1-STATUS: Digital output, switch status STO1
- ▶ STO2-STATUS: Digital output, switch status STO2
- ▶ t_d : Delay time between 1/0 pulse edge of STO1-ENABLE/STO2-ENABLE and 1/0 pulse edge of output STO1-STATUS/ STO2-STATUS

3.1.6. STO feedback loop test sequence

This STO feedback loop test has to be integrated by the user into his PNOZmulti Mini project.

The test result in this must be connected by the user, e.g. with the enable signal of the emergency stop used or the safety gate block, and so control the inputs STO1-ENABLE or STO2-ENABLE of the PMCprotego D.

The user has to ensure that an enabling of the PMCprotego D can only take place when the test sequence has been successfully completed.

Generally, the user shall ensure that the STO feedback loop test is carried out in the PNOZmulti Mini at the times given in sub-section 3.1.2.

For the control of the STO's the function block 'safety valves' in the PNOZmulti can be used. This permits a monitoring of the feedback loop signal in the switched on condition.

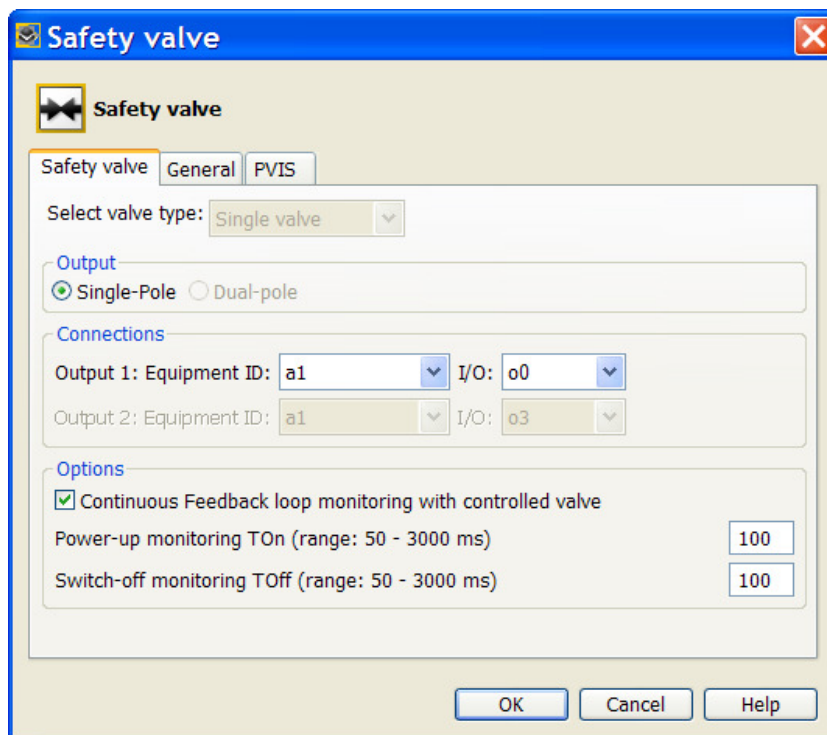


Fig. 6: Safety valve - parameterization

If it should come to a problem with one of the both monitored STO-STATUS signals (feedback loop signals), no release of the PMCprotego D may take place respectively the release of the STO's must be shut off in the case of a failure.

This can take place via the fact that within the element safety valve in the tab general the diagnosis is activated ...

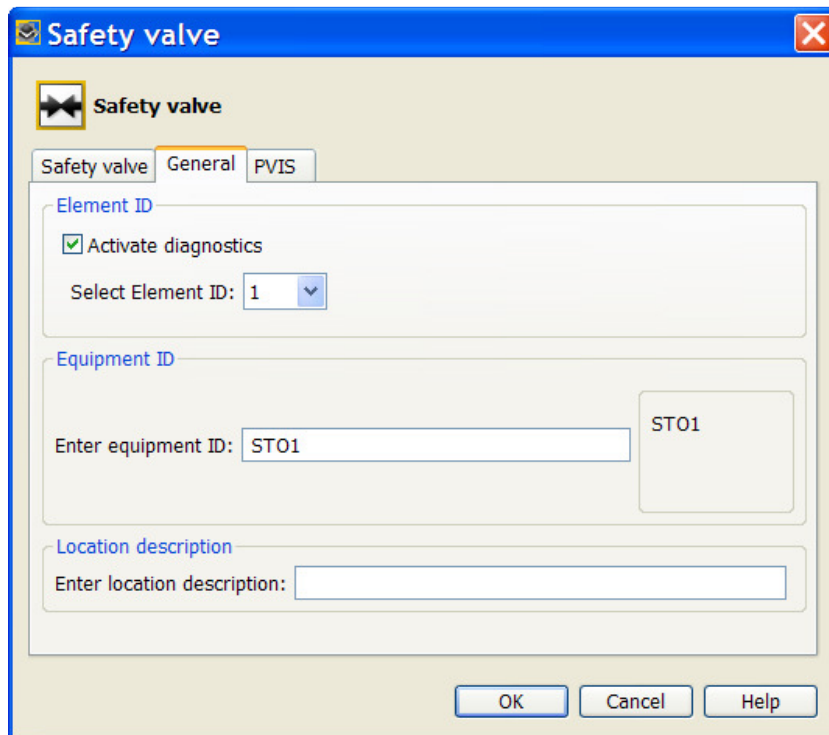


Fig. 7: Safety valve – diagnosis activate

... and in the tab PVIS the individual diagnostic elements are activated ...

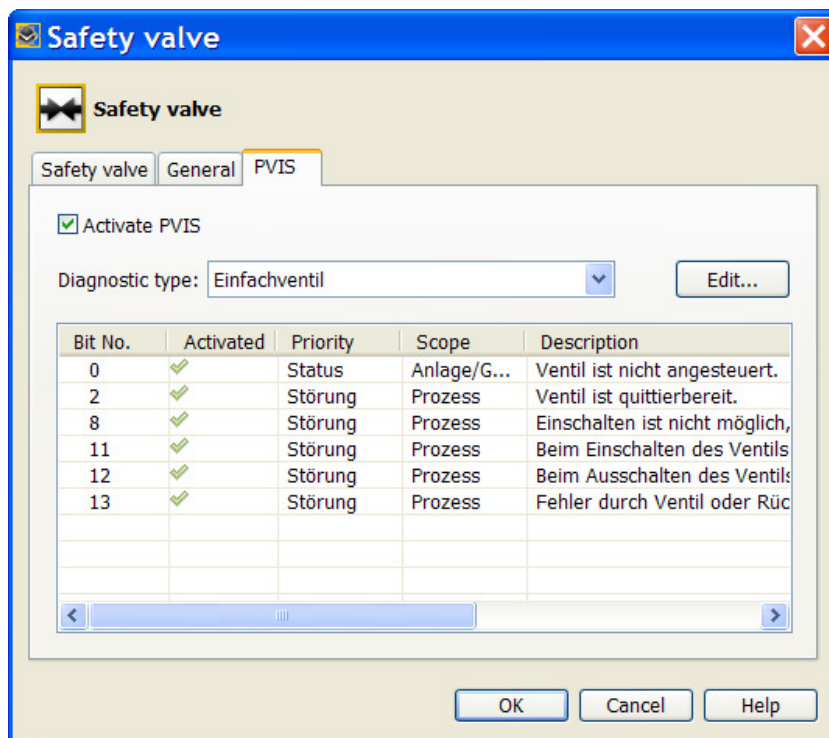


Fig. 8: Safety valve – diagnostic elements activate

... and evaluated in the project.

3.1.7. Inputs and outputs on PNOZmulti Mini

PNOZmulti outputs:

STO1-ENABLE

STO2-ENABLE

STO Feedbackloop Test OK

Enable

PNOZmulti inputs:

STO Test requirement (BTB/RTO)

STO1-STATUS (from PMCprotego D)

STO2-STATUS (from PMCprotego D)

Request1 STO

Request2 STO

3.1.8. Safety assessments

Input circuit safety assessment

- ▶ If the feedback loop test sequence result is negative, STO1-ENABLE and STO2-ENABLE in PNOZmulti Mini are set to low level and so activate the safe pulse disable of the inverter!
- ▶ The enable signals of a safety block used are only passed on to the PMCprotego D (STO1-ENABLE or STO2-ENABLE) when the feedback loop test sequence result is positive.

PMC safety assessment

The operating company must ensure that the function of the safe pulse disabler is tested, at least every 8 hours, by triggering safety functions.

Overall application safety assessment

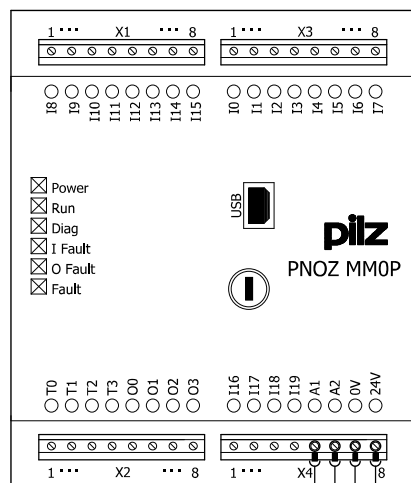
- ▶ The PNOZmulti Mini and the PMCprotego D must be installed in the same mounting area in order to exclude a short circuit between 24 VDC and a safety input of the modules.
- ▶ A fault in the PNOZmulti Mini or PMCprotego D does not lead to a loss of the safety function.

3.2. Functional safety

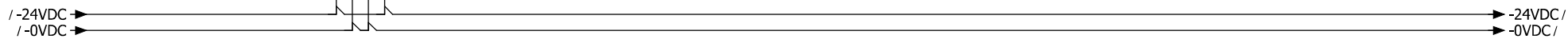
The fault-free execution of the STO feedback loop test (functional test of the safe pulse disabler) is the basic precondition that the safety function STO of the servo amplifier PMCprotego D can achieve PL e and SIL3.

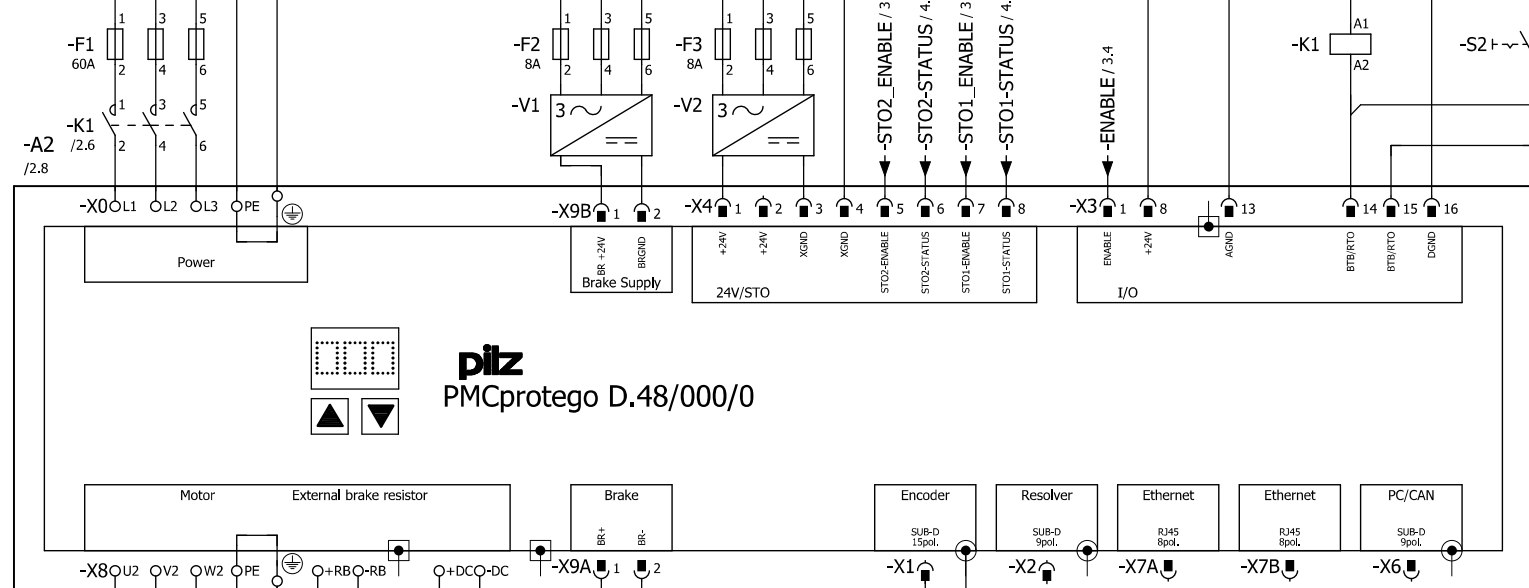
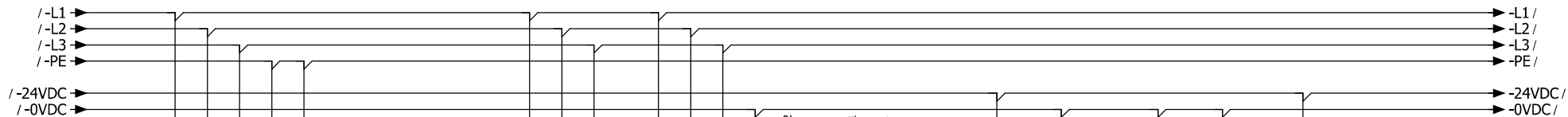
User-related safety functions (e.g. safety-related stop function, initiated by a safeguard) that can be executed with this, require its own classification (calculation) of the safety level for the overall safety chain.

-A1

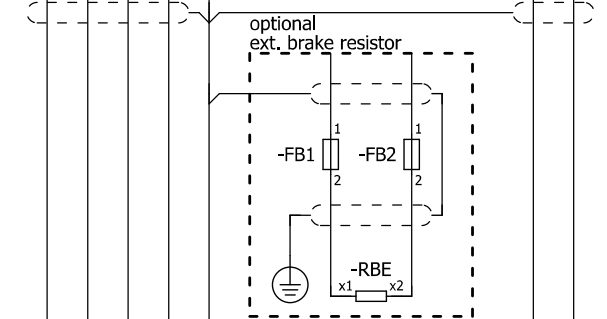


The classification in the specified safety level PLe and SIL3 refers to the safety function STO of the PMCprotego D and can be reached only under the following condition:
 - The function test, described in this application note, of the PMCprotego D was performed correct and passed.





pilz
PMCprotego D.48/000/0

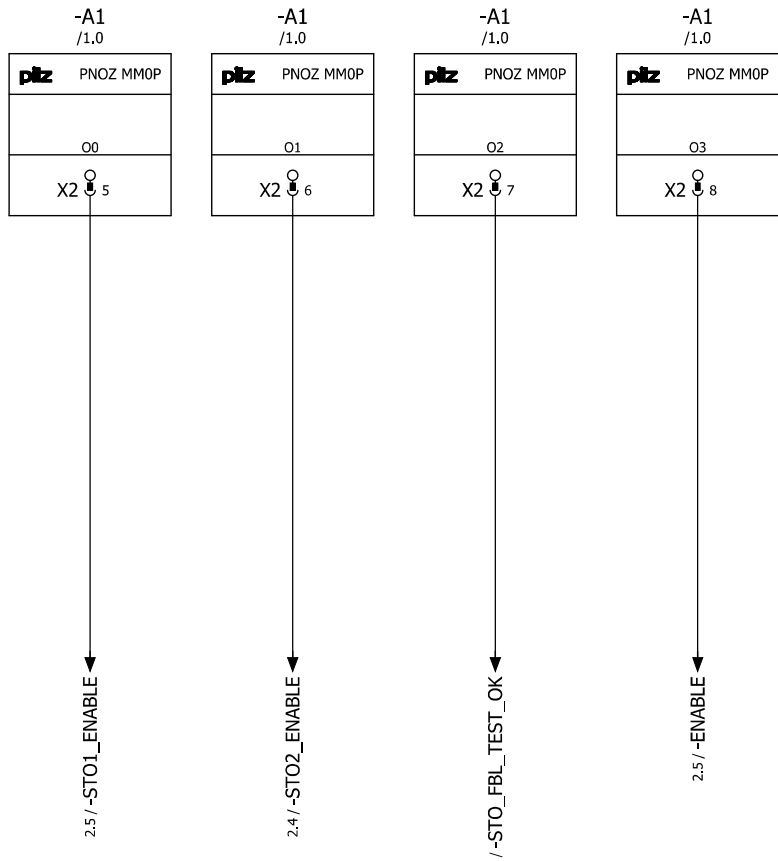


optional control with a PMC Primo for extended movements

4.1 / -STO_TEST_REQUIREMENT



- 1 ⚡ 2 / 2.1
- 3 ⚡ 4 / 2.1
- 5 ⚡ 6 / 2.1



to
standard
control

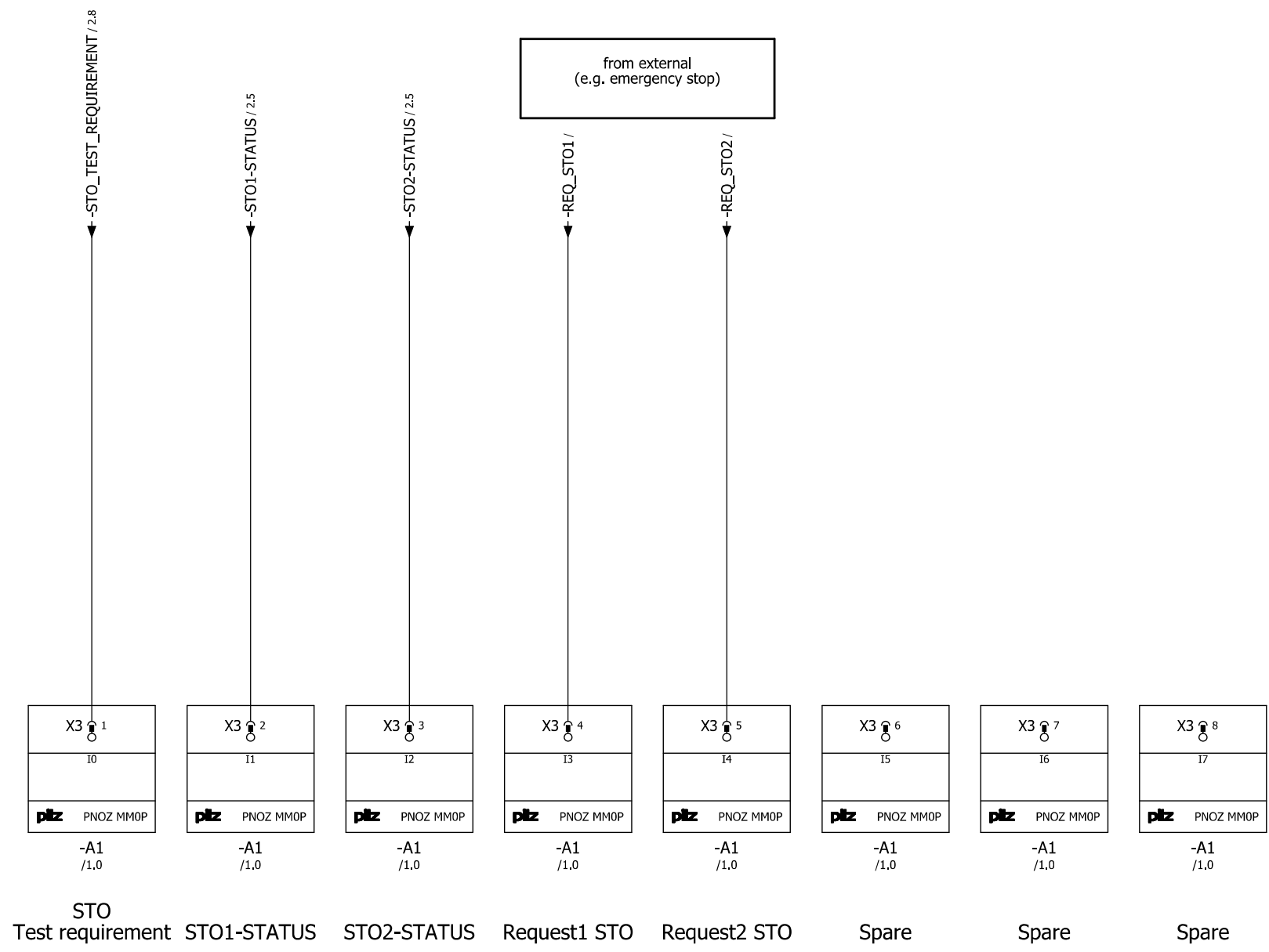
STO1-ENABLE STO2-ENABLE STO Feedbackloop Test OK Enable

Revision	17.02.2012	Date	18.10.2011
Name	RDS	Name	RDS
		Dep.	CS

EN ISO 13849-1:2006	PL e
EN 62061:2005	SIL 3

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PNOZmulti Mini OUT

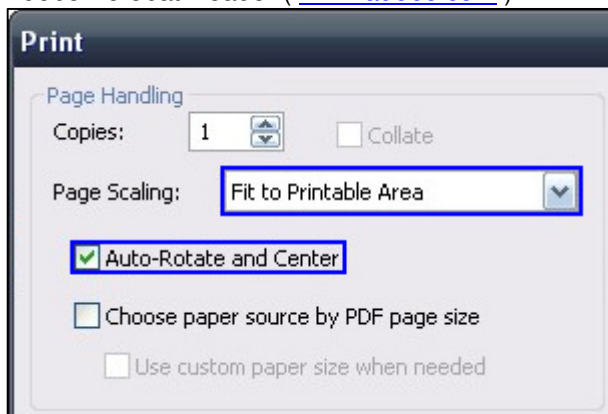


4. Table of figures

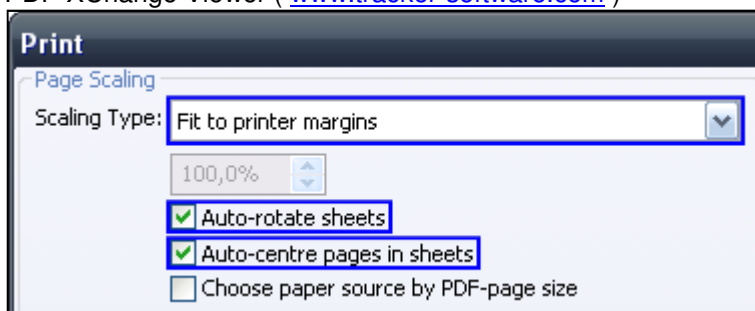
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