Safety gate monitoring and guard locking using the safety gate system PSENsgate

pilz

Product
Type: Safety Gate, Guard Lock
Name: PSENsgate, PNOZmulti
Manufacturer: Pilz GmbH & Co. KG, Safe Automation

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the spirit of safety

Document Revision History

Release	Date	Changes	Chapter
01	2011-08-31	Creation	all

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We are grateful for any feedback on the contents.

August 2011

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Contents

Abbreviations

PNOZ	Pilz E-STOP Positive-guided	(DE: **P**ilz **NO**T-AUS-**Z**wangsgeführt)
PL	**P**erformance **L**evel	
SIL	**S**afety **I**ntegrity **L**evel	

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 sg1c	22 175-3FR-xx
3	Operating Manual PNOZ m1p	20 878-EN-xx
4	Operating Manual PNOZ ms2p	20 115-EN-xx
5		
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	PSEN sg1c	570 700	-	1
2	PNOZ m1p	773 100	5.6	1
3	PNOZ ms2p	773 810	-	1
4	PNOZmulti Configurator	-	v8.0.1 Build 8	1

2.2. 2.2. Hardware configuration

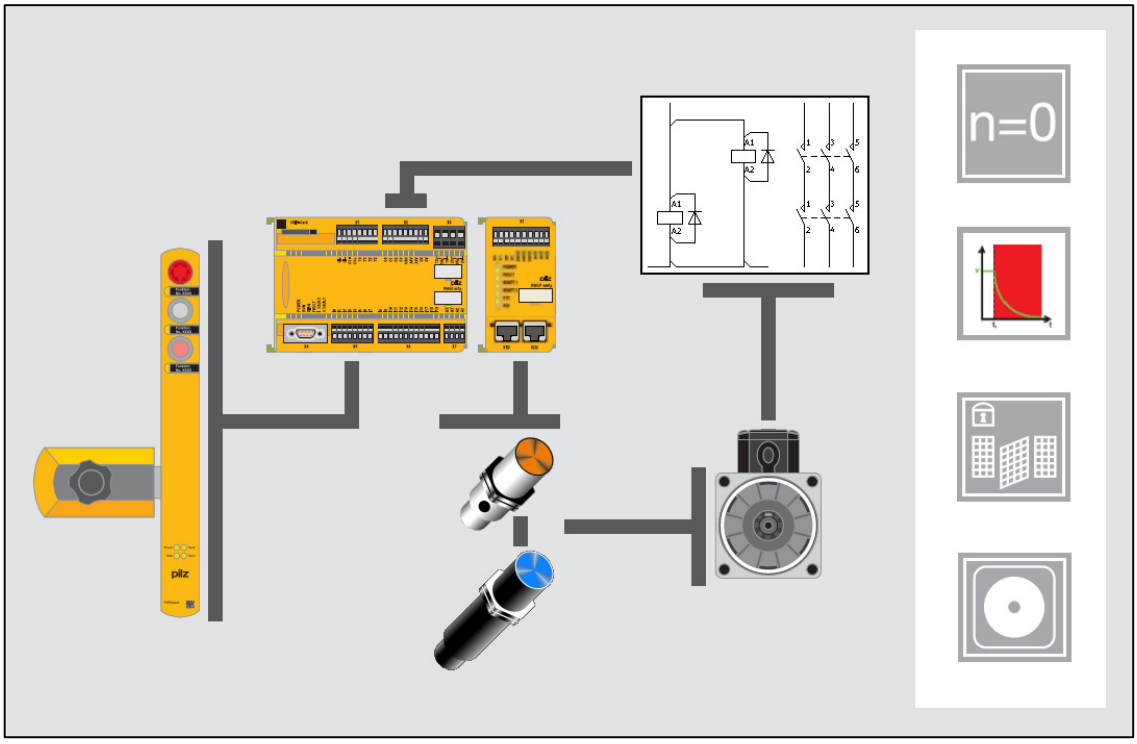


Fig. 1: Hardware configuration

3. Application Task

3.1. Description

The example shows the implementation of a PSENsgate (S1) for safe monitoring and guard locking of a safety gate.
The safe control and evaluation of the signals is taken over by a PNOZmulti m1p (A1).

A machine performs a dangerous movement within a protective housing (guard grid and safety gate).
To ensure that the operator can enter the operating area only when there is no longer any danger, the safety gate is secured by the PSENsgate. A PNOZms2p (A2) provides with two proximity switches (B1, B2) that standstill of the movement is achieved before the guard lock of the safety gate can be opened.

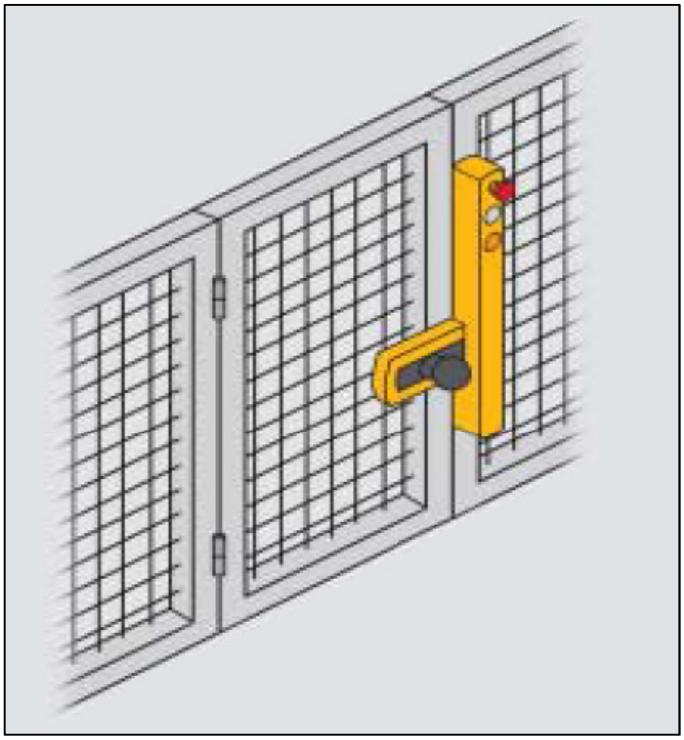


Fig. 2: Application with PSENsgate

The workflow is divided into the following functions:
- Monitoring Safety Gate
- Monitoring Guard Lock
- Monitoring Standstill and Overspeed
- Monitoring Emergency Stop
- Feedbackloop monitoring

3.1.1. Monitoring safety gate and guard locking

Open and close of the safety gate is reported to the base unit PNOZ m1p (A1) of the modular safety system PNOZmulti by the safety switch PSENsgate (S1).

The safety gate is closed by a movable bolt.
A locking pin keeps the bolt tongue from being opened unintentionally.
Pressing the pushbutton “Guard Lock” for interlocking engages the locking pin into the bolt tongue.
The OSSD safety outputs of S1 are switching to high signal.
The contactors KM1 and KM2 energise and the drive can be activated.
By operating the integrated switch “Access Request”, the guard lock can be unlocked when standstill is present.
If the drive is not at standstill, when pressing the switch “Access Request” the signal “Stop Request” is sent via the output “Stop After Cycle” to the standard control, which stops the drive process dependently.
After complete standstill, the guard lock is opened automatically (Unlock mode) or manually by afresh push of the switch “Access Request” (Normal mode).
(*For more information about the modies and switchover, see at Operating instruction of the PSENsgate*)
The OSSD safety outputs (S-Gate Ch.1 +Ch.2) were switching to low signal, as soon as the guard lock is unlocked. They are monitored by the function block “Safety Gate”.
Switching off the OSSD outputs stop the enabling of the drive and the safety outputs of A1 switch off.
The Contactors KM1 and KM2 de-energise and the motor (M1) is cut off.

3.1.2. Monitoring standstill and overspeed

The safety system PNOZmulti monitors the frequency of a drive’s rotary motion using two proximity switches whitch are connected to a PNOZ ms2p module.
The collected data is monitored by the function block “Speed Monitor”.
Monitoring Standstill
If the frequency comes below the limit of standstill, the signal “area safe” is given to the PSENsgate by releasing the solenoid.
Monitoring Overspeed
If the frequency exceeds the limit of overspeed, the drive’s enable will be interrupted and the safety outputs of A1 switch off.
The Contactors KM1 and KM2 de-energise and the motor (M1) is cut off.

3.1.3. Monitoring emergency stop

The operation of the integrated emergency stop switch is monitored by the function block “E-STOP”.
During operation, the drive’s enable is interrupted and the safety outputs of A1 switch off. The Contactors KM1 and KM2 de-energise and the motor (M1) is cut off.

3.1.4. Feedbackloop monitoring

The positive-guided N/C contacts on contactors KM1 and KM2 are monitored via the feedbackloop input “FBL1/FBL2” of A1.

3.1.5. General guidelines

Enable

Enable of the drive can be achieved when:

- the safety gate is closed and
- the inputs (X2-3) und (X2-4) of PSENsagte is high
- the bolt tongue is within the response range
- the escape/auxiliary release hasn't been operated
- the escape/auxiliary release pin is in the correct position
- contactors KM1 and KM2 are de-energised.
- emergency stop hasn't been operated
- overspeed was not identified

Settings

- The jumper between PNOZ m1p and PNOZ ms2p must be inserted.
- The terminator at PNOZ ms2p must be inserted.

Escape release

The PSENsgate comes with the option of manually unlocking of a guard lock to leave the danger zone without assistance from the escape side (from within the danger zone).

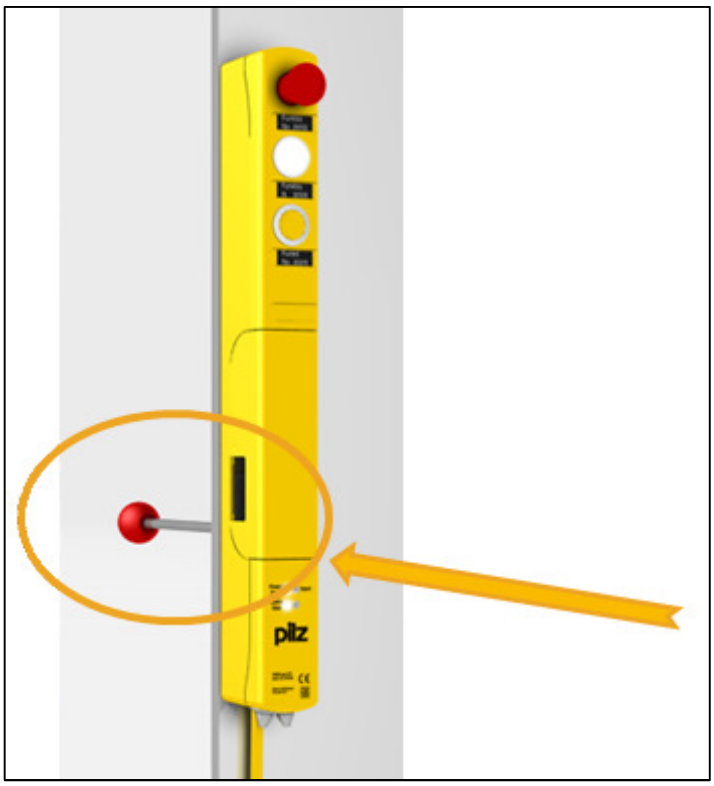


Fig. 3: Escape release

3.1.6. Safety assessment

- Detection of bolt tongue and locking pin breakage at PSENsgate (S1).
- The circuit of A1 (PNOZ m1p) is redundant with built-in self-monitoring
- The safety function of A1 remains effective in the case of a component failure.
- The relay contacts of A1meet the requirements for safe separation through increased insulation compared with all other circuits in the safety system.
- The safety outputs of A1 are tested periodically using a disconnection test.
- The circuit of A2 (PÜNOZ ms2p) is redundant with built-in self-monitoring.
- The safety function A2 remains effective in the case of a component failure.

- Test pulse outputs (A1) must exclusively be used to test the inputs. They must not be used to drive loads. Do not route the test pulse lines together with actuator cables within an unprotected multicore cable.
- Users must take appropriate measures to detect or exclude errors of A2 (e.g. slippage or broken shearpin) which mean that the frequency of the input device signal is no longer proportional to the monitored speed. Appropriate measures are:
  - mechanical solutions
- A single-channel open circuit/input device error is recognised at A2 and leads to safe condition of outputs at the relevant axis. For applications according to category 3, the "Overspeed" output must be integrated into the safety function in every operating mode and evaluated so that a shutdown occurs if the output switches to a safe condition ("Overspeed" output = "0").
- If there are frequency differences between the proximity switches on inputs I10 (I20) and I11 (I21), the PNOZmulti changes to the safe condition if frequency exceeds the configured standstill frequency.
- For applications according to category 3, the "Overspeed" output must be integrated into the safety function in every operating mode and evaluated so that a shutdown occurs if the output switches to a safe condition ("Overspeed" output = "0").
- The base unit PNOZ m1p (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.

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	Dangerous movements must be stopped when the safety gate is opened; it must not be possible to restart if the safety gate is open. (SAFETY GATE)	PL e	Sensor (PSEN sg1c S1) Input (PNOZ m1p DI) Logic (PNOZ m1p A1) Output (PNOZ m1p DO) Actuator (contactors KM1, KM2)
2	A start must be prevented if the guard locking device is not closed. (GUARD LOCKING DEVICE - start-up)	PL e	Sensor (PSEN sg1c S1) Input (PNOZ m1p DI) Logik (PNOZ m1p A1) Output (PNOZ m1p DO) Actuator (contactors KM1, KM2)
3	It must not be possible to open the guard locking device while the safe state has not been reached. (GUARD LOCKING DEVICE - standstill)	PL e	Sensor (INI B1, B2) Input (PNOZ ms2p A2) Logik (PNOZ m1p A1) Output (PNOZ m1p DO) Actuator (PSEN sg1c S1)
4	Machine shut down via E-STOP	PL e	Sensor (PSEN sg1c ESTOP S1) Input (PNOZ m1p DI) Logic (PNOZ m1p A1) Output (PNOZ m1p DO) 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):	Sensor S1 - EStop	one operation per week
		Actuator KM1/2	23 operations per week
4	Characteristic data of sensors B1/B2:	MTTFd	>= 85 years for PL e
5	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	Dangerous movements must be stopped when the safety gate is opened; it must not be possible to restart if the safety gate is open. (SAFETY GATE)	SIL 3	Sensor (PSEN sg1c S1) Input (PNOZ m1p DI) Logic (PNOZ m1p A1) Output (PNOZ m1p DO) Actuator (contactors KM1, KM2)
2	A start must be prevented if the guard locking device is not closed. (GUARD LOCKING DEVICE - start-up)	SIL 3	Sensor (PSEN sg1c S1) Input (PNOZ m1p DI) Logik (PNOZ m1p A1) Output (PNOZ m1p DO) Actuator (contactors KM1, KM2)
3	It must not be possible to open the guard locking device while the safe state has not been reached. (GUARD LOCKING DEVICE - standstill)	SIL 3	Sensor (INI B1, B2) Input (PNOZ ms2p A2) Logik (PNOZ m1p A1) Output (PNOZ m1p DO) Actuator (PSEN sg1c S1)
4	Machine shut down via E-STOP	SIL 3	Sensor (PSEN sg1c ESTOP S1) Input (PNOZ m1p DI) Logic (PNOZ m1p A1) Output (PNOZ m1p DO) 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):	Sensor S1 - EStop	one operation per week
		Actuator KM1/2	23 operations per week
4	Characteristic data of sensors B1/B2:	MTTFd	>= 85 years for SIL 3
		Dangerous failure rate	100 %
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 area of application and the regulations applicable there, under EN 954-1 this connection example applies
up to category 4 for the safety gate SF
up to category 4 for the guard locking and start-up SF
up to category 3 for the guard locking and standstill SF
up to category 4 for the emergency stop SF

3.3. Program

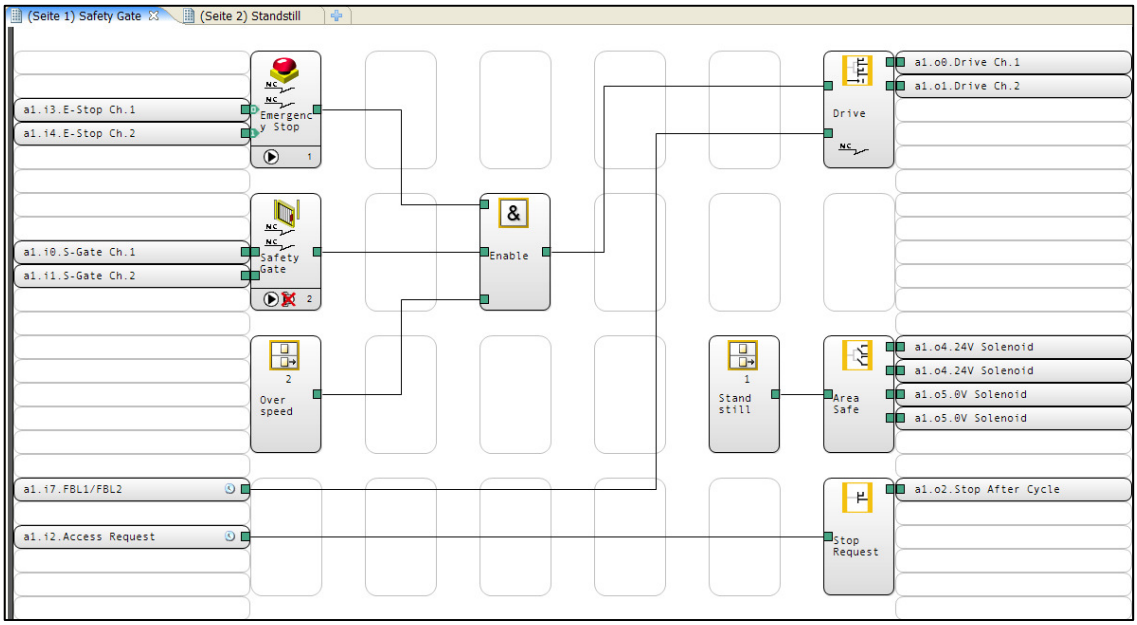


Fig. 4: User program safety gate

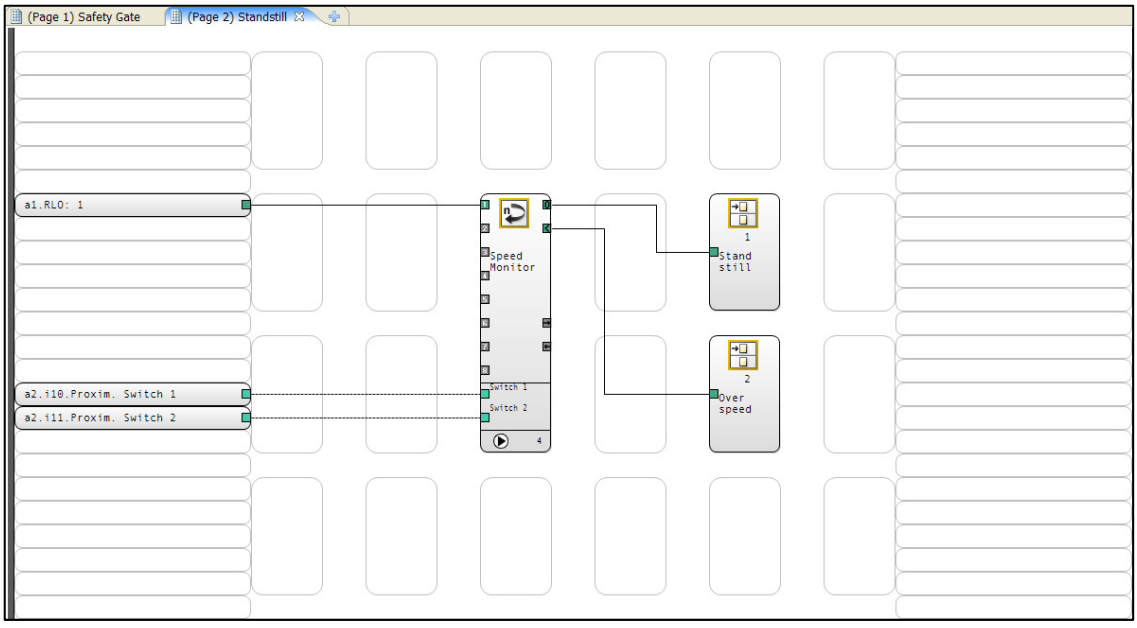
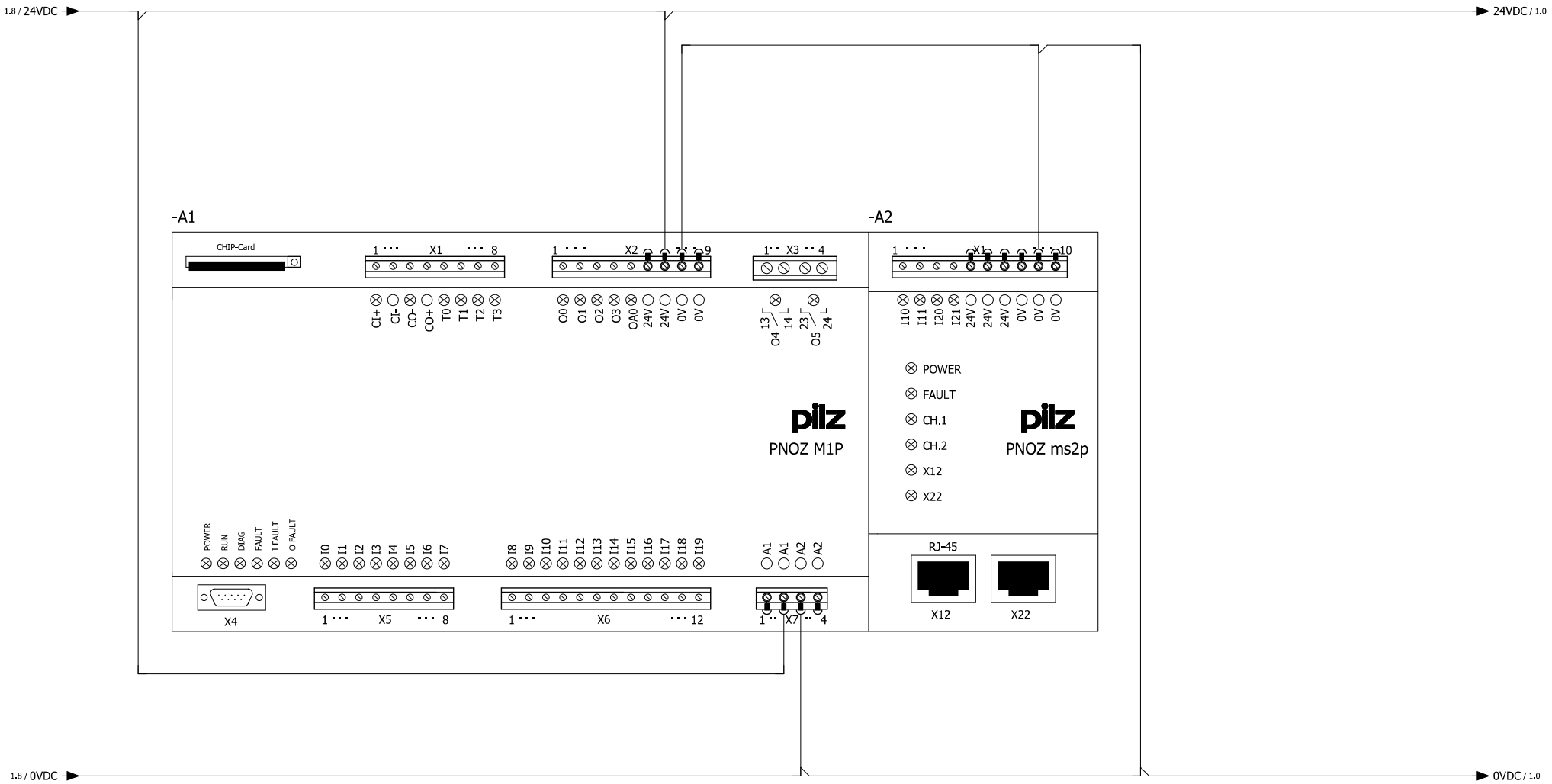
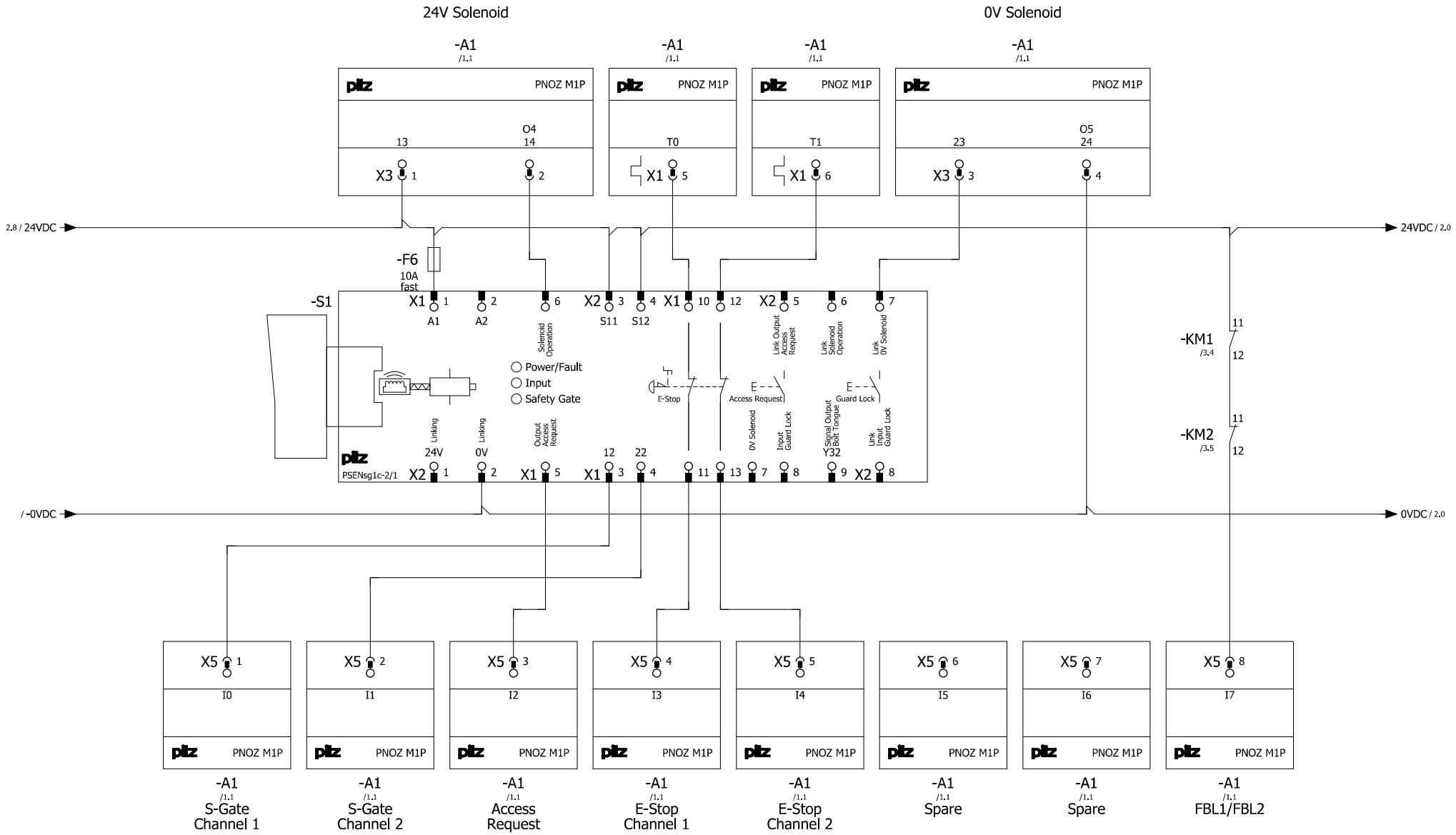


Fig. 5: User program standstill



Revision	29.08.2011	Date	09.08.2011	EN ISO 13849-1:2006 PL e	Pilz GmbH & Co.KG Felix-Wankel-Str.2 73760 Ostfildern	PSEN sg1c with PNOZ m1p and standstill monitoring by PNOZ ms2p	Mounting place + AN_1002385_01
Name	RDS	Name	RDS				
				EN 62061:2005 SIL 3			Page: 1 / 3
		Dep.	CS				



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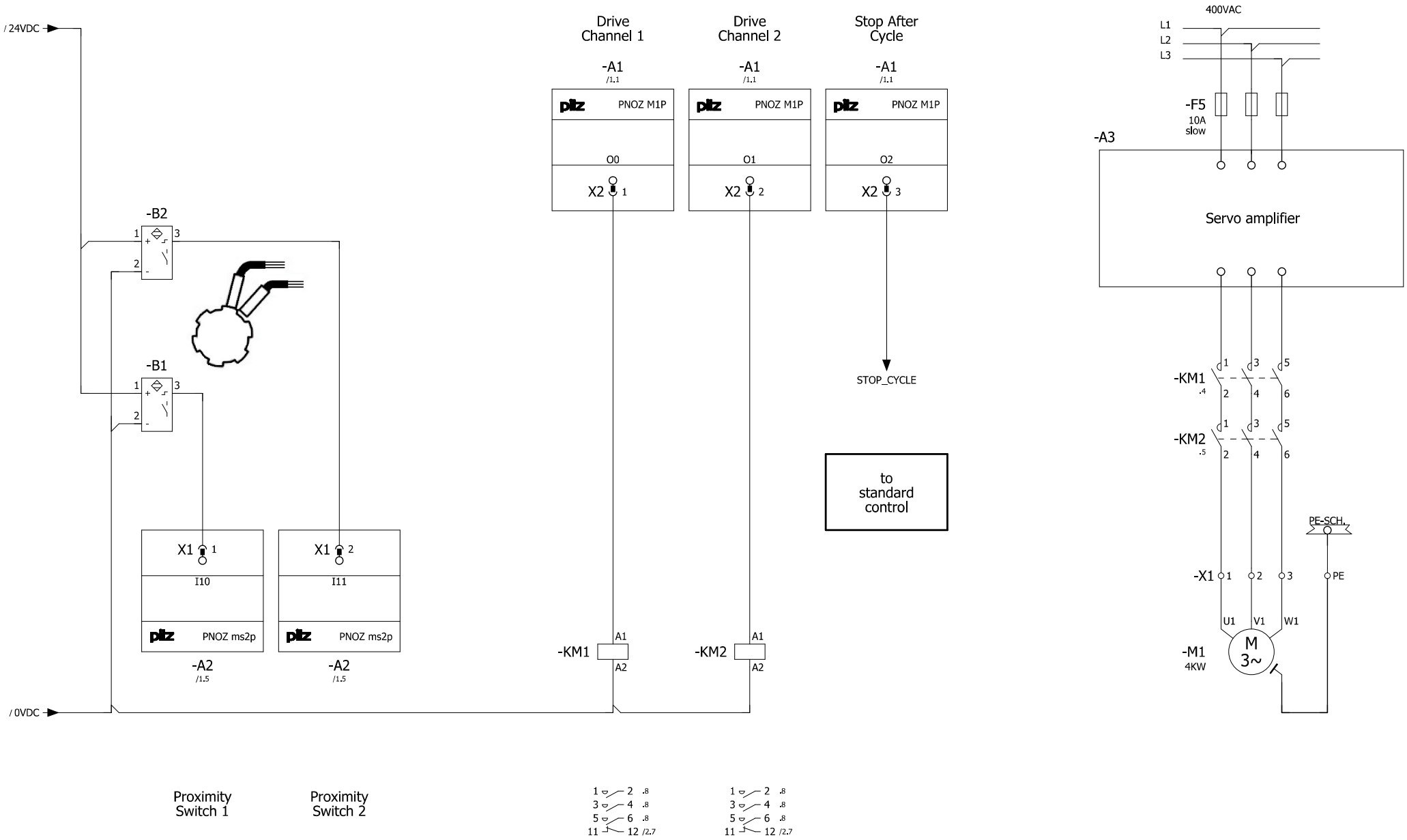
Name	RDS	Name	RDS			
				EN 62061:2005 SIL 3		
		Dep.	CS			

Mounting place
+ AN_1002385_01



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Name	RDS	Name	RDS				
				EN 62061:2005 SIL 3			Page: 3 / 3
		Dep.	CS				

4. Table of figures

Recommended printer settings

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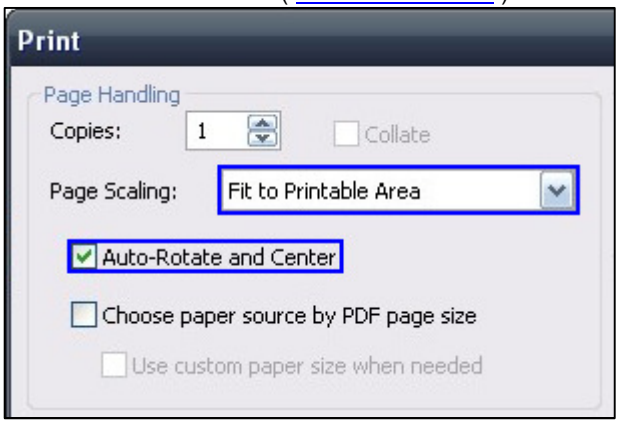

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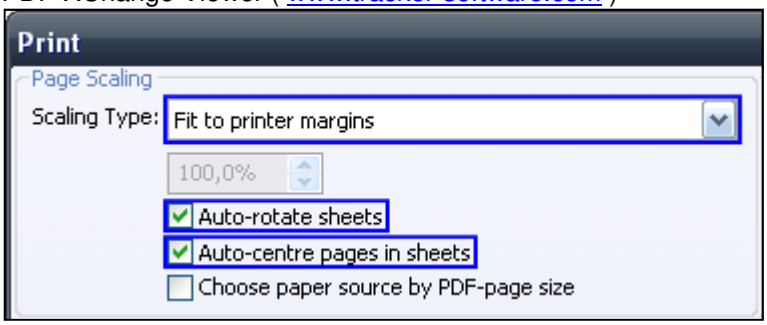

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