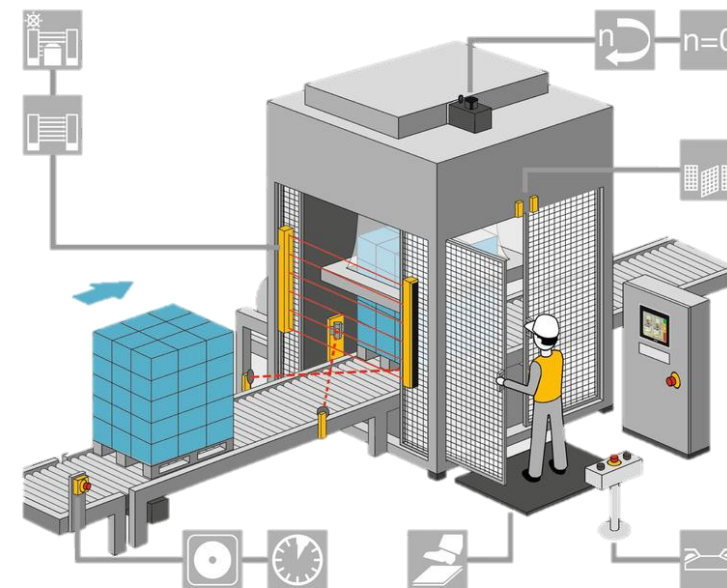


PNOZmulti Programmierung and Service

Chapter 4 „Software elements“





PILZ | 04-3

Input Elements

Logic Elements

Flags

Timer / Counter

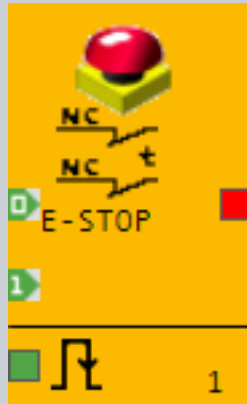
Output Elements

Press- & Burner Elements

Programming exercise

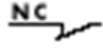


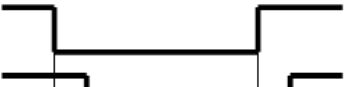
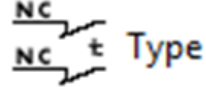
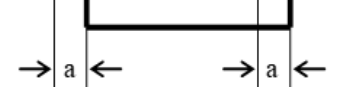
Print report

E-STOP



Safeguard

Ensures that a hazardous movement can be stopped easily and safely. The hazardous movement is stopped when the E-STOP pushbutton is operated. Switch types:

 Type 1	Category 1..2	
 Type 3	Category 3 ($a = \infty$)	
 Type 3- simultaneity	Category 3..4 ($a \leq 3$ s)	



PILZ | 04-4

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

Safety gate



Safeguard

Prevents people entering a danger zone. The safety gate interlock is equipped with a switch. When the safety gate is opened, the hazardous movement is stopped and automatic start up is prevented. **Switch type:**

Type 1	Category 1..2	
Type 2	Category 1..3 ($a = \infty$)	
Type 2- simultaneity	Category 1..3 ($a \leq 3$ s)	
Type 3	Category 3 ($a = \infty$)	
Type 3- simultaneity	Category 3..4 ($a \leq 3$ s)	



PILZ | 04-4

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

Safety gate



Safeguard

Prevents people entering a danger zone. The safety gate interlock is equipped with a switch. When the safety gate is opened, the hazardous movement is stopped and automatic start up is prevented. **Switch type**

<p>Type 4</p>	Category 4 ($a = \infty$)	
<p>Type 4- simultaneity</p>	Category 4 ($a \leq 3$ s)	
<p>Typ 5</p>	Category 4 ($a = \infty$)	
<p>Typ 5- Gleichzeitig</p>	Category 4 ($a \leq 3$ s)	



PILZ | 04-4

Input Elements

Logic Elements

Flags

Timer / Counter

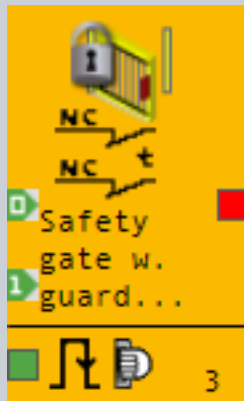
Output Elements

Press- & Burner Elements

Programming exercise

Print report

Safety gate with guard locking



Safeguard

A: Prevents people reaching into a danger zone and B: Protects assets such as tools or workpieces. The safety gate interlock is equipped with a switch. When the safety gate is opened, the hazardous movement is stopped and automatic start up is prevented. **Switch types:**

<p>Type 3</p>	Category 3 ($a = \infty$)	
<p>Type 3- simultaneity</p>	Category 3..4 ($a \leq 3$ s)	



PILZ | 04-4

Input Elements

Logic Elements

Flags

Timer / Counter

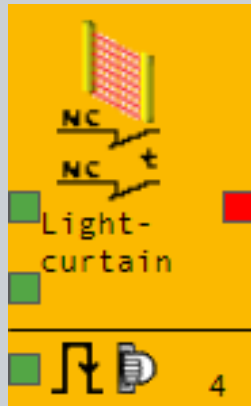
Output Elements

Press- & Burner Elements

Programming exercise

Print report

Light grid/ Light curtain



Safeguard

Prevents people entering a danger zone. The light curtain sends light beams to sensors. If the light beams are broken, the hazardous movement is stopped.

Switch types:

<p>Type 3</p>	LG/LV mit SIL 3 ($a = \infty$)	
<p>Type 3- simultaneity</p>	LG/LV mit SIL 3 ($a \leq 3 \text{ s}$)	



PILZ | 04-5

Input Elements

Logic Elements

Flags

Timer / Counter

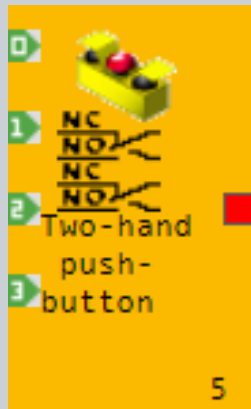
Output Elements

Press- & Burner Elements

Programming exercise

Print report

Two-hand pushbutton



Safeguard

Prevents people reaching into a danger zone. If two controls are operated with a high degree of simultaneity, the hazardous movement is performed. **Switch types:**

<p>Type 6</p>	<p>Category 3..4 ($a \leq 500 \text{ ms}$, $b = \infty$)</p>	
<p>Type 7</p>	<p>2Hand-Sensors with SIL 3 ($a \leq 500 \text{ ms}$, $b = \infty$)</p>	



PILZ | 04-5

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

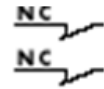
Safety mat



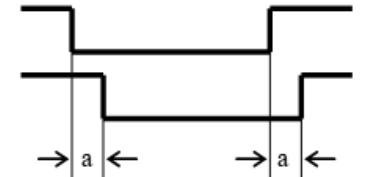
Safeguard

A safeguard that detects a person standing on it or stepping on to it. An input device reacts to pressure. (Safety mats that operate on the basis of a short circuit must use test pulses.)

Switch types:



Category 3 ($a = \infty$)





PILZ | 04-5

Input Elements

Logic Elements

Flags

Timer / Counter

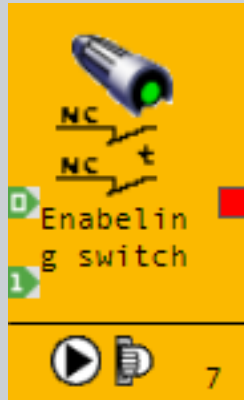
Output Elements

Press- & Burner Elements

Programming exercise

Print report

Enabling switch



Safeguard

Used during setup when the safety device is deactivated, for example, to allow commands for hazardous movements from other controls to be performed. However, enabling switches may not initiate any commands for hazardous states.

Switch types:

	Type 1	Category 1..2	
	Type 3	Category 3 ($a = \infty$)	
	Type 3- simultaneity	Category 3..4 ($a \leq 3$ s)	



PILZ | 04-6

Input Elements

Logic Elements

Flags

Timer / Counter

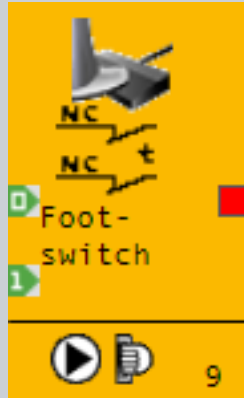
Output Elements

Press- & Burner Elements

Programming exercise

Print report

Foot switch



Safeguard

Used to start the plant through operation of a foot switch.

Switch types:

<p>Type 1</p>	Category 1..2	
<p>Type 2</p>	Category 1..3 ($a = \infty$)	
<p>Type 2- simultaneity</p>	Category 1..3 ($a \leq 3 \text{ s}$)	
<p>Type 3</p>	Category 3..4 ($a = \infty$)	
<p>Type 3- simultaneity</p>	Category 3..4 ($a \leq 3 \text{ s}$)	



PILZ | 04-6

Input Elements

Logic Elements

Flags

Timer / Counter

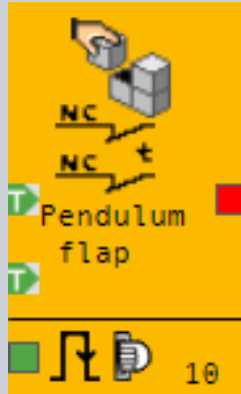
Output Elements

Press- & Burner Elements

Programming exercise

Print report


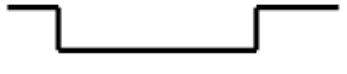

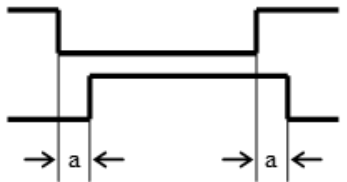


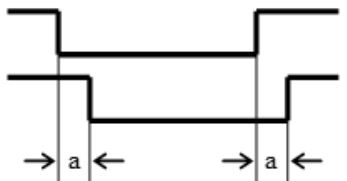

User-Defined element



Safeguard

Input element with a neutral symbol for the representation of the protective device to be monitored.

Switch types:

 Typ 1	Category 1	
 Typ 2	Category 1..3 (a = ∞)	
 Typ 2- Gleichzeitigkeit	Category 1..3 (a ≤ 3 s)	
 Typ 3	Category 3 (a = ∞)	
 Typ 3- Gleichzeitigkeit	Category 3..4 (a ≤ 3 s)	



PILZ | 04-7

Input Elements

Logic Elements

Flags

Timer / Counter

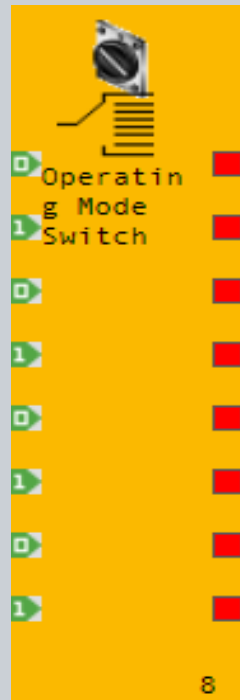
Output Elements

Press- & Burner Elements

Programming exercise

Print report

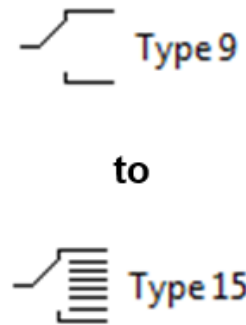
Operating mode selector switch



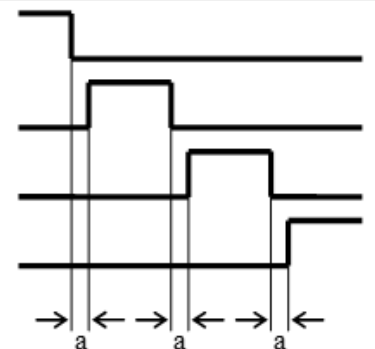
Safeguard

Enables the operation of a system to be divided under defined conditions (setting up, taking out of operation, automatic operation etc.). Operating mode selector switches must be configured in such a way that they do not initiate any hazardous movement and do not override any control commands that have already been given (Reset). On this element, an operating mode selector switch can have up to 8 different operating modes.

Switch types:



Category 3..4
($a > 15 \text{ ms} \leq 1 \text{ s}$)
Hint: no two operating modes at the same time





PILZ | 04-7

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

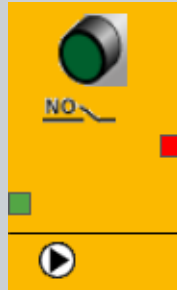
Press- & Burner Elements

Programming exercise

Print report

Switches / Push Buttons

Button/Switch

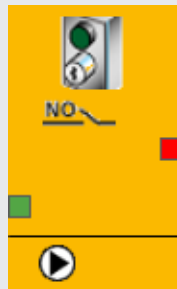


Switch type:

NC Typ 16

NO Typ 17

Key switch



Switch type:

NC Typ 16

NO Typ 17



PILZ | 04-7

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

Schalter/Taster

Limit switch



Switch type:

NC Typ 16

NO Typ 17

FS-Input Elements

Detection of shorts between contact in the input circuit



PILZ | 04-8

Input Elements

- Logic Elements
- Flags
- Timer / Counter
- Output Elements
- Press- & Burner Elements
- Programming exercise
- Print report

Connections:

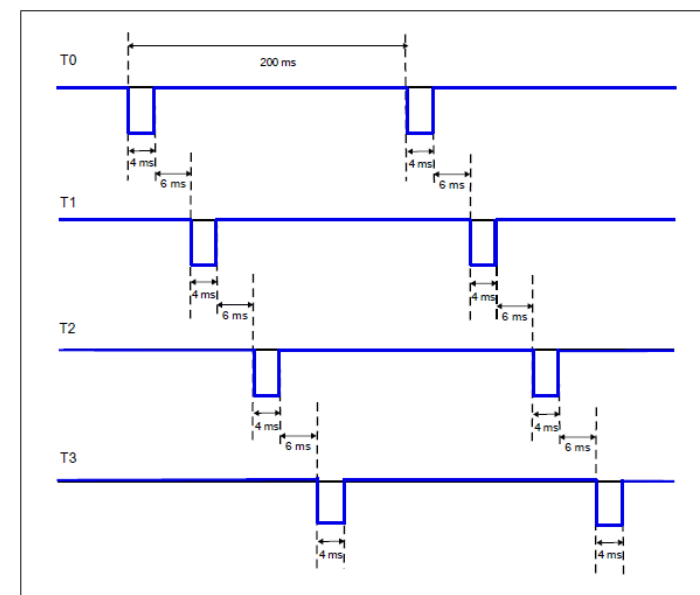
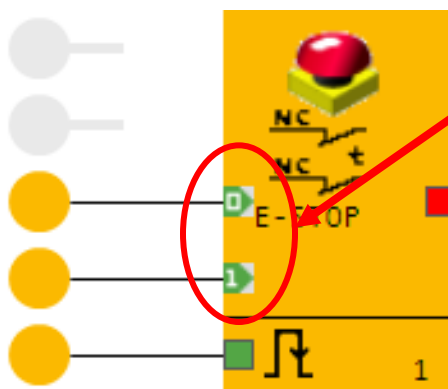
Test Pulse Suppression on inputs

Centralised I/Os Decentralised I/Os

Input 1: Equipment ID: -3A2 I/O: i0.Not-Ha uses: Test Pulse 0

Input 2: Equipment ID: -3A2 I/O: i1.Not-Ha uses: Test Pulse 1

Detection of shorts between contacts in the input circuit



► FS-Input Elements

Test clock suppression at the inputs



PILZ | 04-9

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

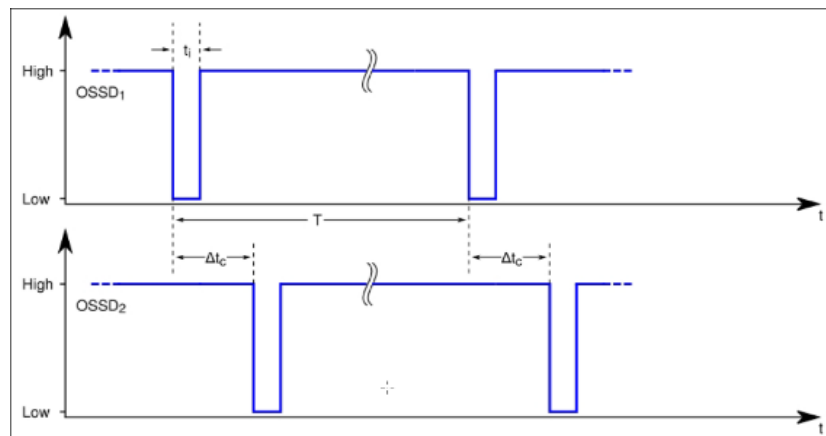
Connections:

Test Pulse Suppression on inputs

Input 1: Equipment ID: I/O: uses:

Condition:

- Sensors with OSSD outputs from third-party devices with a test pulse duration t_i of $> 300 \mu\text{s}$



- PNOZmulti from 2nd generation
- Switch type 3 or switch type 3 with simultaneity
- Increase of the reaction time by up to 15 ms is permissible



PILZ | 04-10

Input Elements

Logic Elements

Flags

Timer / Counter

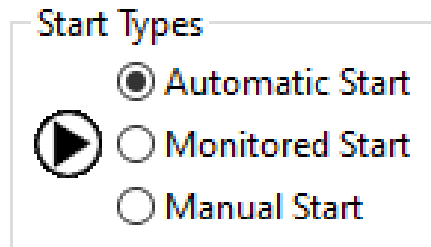
Output Elements

Press- & Burner Elements

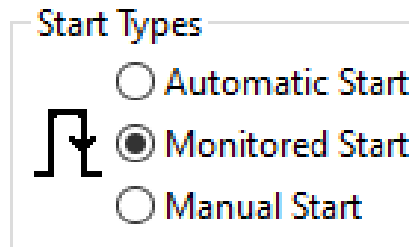
Programming exercise

Print report

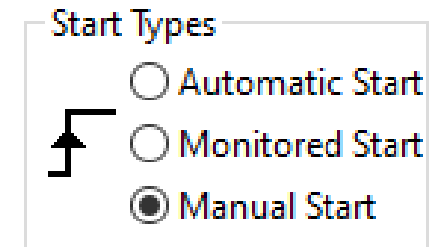
▶ Automatic Start



▶ Monitored Start



▶ Manual Start



Automatic restart is only permitted for automatic doors or for guards with rear pedal protection.

For a manual reset function, the standard requires:

- ▶ by a separate, manually operated device in which SRP/CS must be provided,
- ▶ may only be achieved if all safety functions and protective devices are functional,
- ▶ must not itself initiate any movement or hazardous situation,
- ▶ must be an intentional act,
- ▶ must enable the controller to accept a separate start command,
- ▶ may only be performed by releasing the drive element in its actuated on-position.

► Speed- and Threshold Monitoring Elements



PILZ | 04-11

Input Elements

Logic Elements

Flags



Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

	Protection type	Standard	Level
	Speed/standstill monitoring	IEC 62061: ISO 13849-1:	SIL CL 2 ... 3* PL d ... e*
	Threshold value monitoring	IEC 62061: ISO 13849-1:	SIL CL 2 ... 3* PL d ... e*

► Speed- and Threshold Monitoring Elements „1st generation“



PILZ | 04-11

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

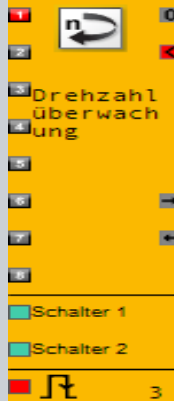
Press- & Burner Elements

Programming exercise

Print report

Hardware-based blocks (1st generation)

Motion Monitoring



The speed monitor logic element is used to configure the speed monitor PNOZ ms1p ... ms4p.

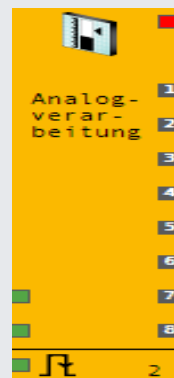
The speed monitor monitors:

Standstill, up to 8 overspeed values (16 on the ms4p), hysteresis and direction of rotation (note: direction of rotation is not monitored on proximity switches).

The following input devices can be evaluated:

- Incremental encoders (TTL, HTL and SinCos)
- Proximity switches

Analog



The analogue element is used to monitor the range and threshold of analogue input devices as current or voltage.

► Motion Monitoring Elements „2nd generation“



PILZ | 04-12

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

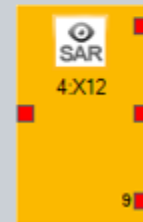
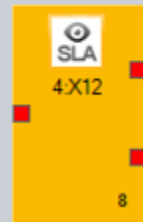
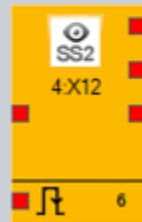
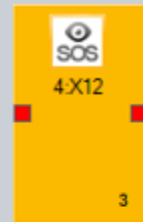
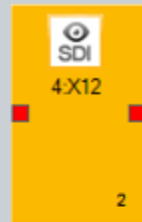
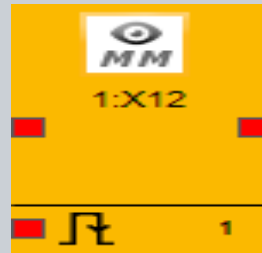
Press- & Burner Elements

Programming exercise

Print report

Hardware-based blocks (2nd generation)

Motion monitoring



The motion monitoring element serves as the basis for the configuration of the speed monitor module:

- PNOZ m EF 1MM
- PNOZ m EF 2MM

The following elements are available for safe monitoring functions:

- SDI: Safe Direction Monitoring
- SOS: Safe Operating Stop
- SSR: Safe Speed Range
- SS1: Safe Stop 1
- SS2: Safe Stop 2
- SSM: Safe Speed Monitoring
- SLA: Safe Limited Acceleration
- SAR: Safe Acceleration Range

► Analog Monitoring Elements „2nd generation“



PILZ | 04-12

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

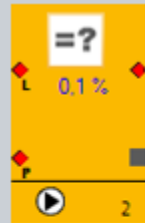
Press- & Burner Elements

Programming exercise

Print report

Hardware-based blocks (2nd generation)

Analog modules



The analog element is used for range monitoring of analog encoders in current or voltage.

The following elements are available for safe monitoring functions:-

- Plausibility
- Scaling
- Mathematical operations
- constant
- Threshold value monitoring
- Area monitoring
- Diagnosis

► Input Elements for Special Functions „PSEnini and PITreader“



PILZ | 04-13

Input Elements

Logic Elements

Flags

Timer / Counter

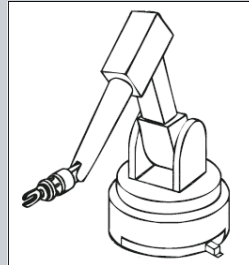
Output Elements

Press- & Burner Elements

Programming exercise

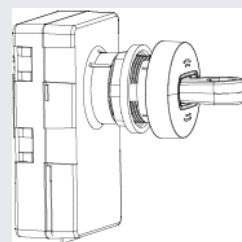
Print report

PSEnini



In connection with the safety switch PSEnini, this element is used for safe position monitoring at cams for max. 3 positions (3 PSEnini).

PITreader



Access authorisation:

The input element PITreader authorisation is used to configure authorisation with the PITreader on the PNOZmulti. In authentication mode Transponder data, a user can log in by inserting a transponder key in the reading range of the Authenticate PITreader. Authentication is based on the authorization stored on the transponder key. The PNOZ m B1 reads out the transponder key that is currently authenticated via Modbus/TCP.

Note: This element is only supported by the PNOZ m B1.

► Input Elements for Special Functions „MSO flex“



PILZ | 04-13 +

Input Elements

Logic Elements

Flags

Timer / Counter

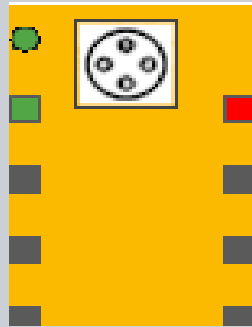
Output Elements

Press- & Burner Elements

Programming exercise

Print report

MSO flex

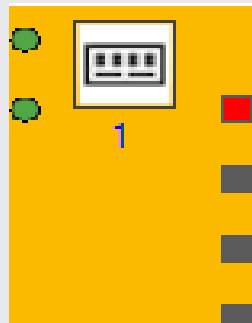


The input element "MSO flex" is used to monitor the safety-related selection of safe operating modes in conjunction with the PITreader and a button or keypad.

- 2 to 8 operating modes can be configured
- Operating mode 1 is always configured and must be the safest operating mode
- Optionally, operating modes can be configured as service operating mode
- An element output is assigned to each configured operating



MSO flex visu



The input element "MSO flex visu" is used to monitor the safety-related selection of safe operating modes in conjunction with the PITreader and a visual display unit (HMI).

- 2 to 8 operating modes can be configured
- Operating mode 1 is always configured and must be the safest operating mode
- Optionally, operating modes can be configured as service operating mode
- An element output is assigned to each configured operating mode



► Input Elements for Special Functions „Muting“



PILZ | 04-14

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

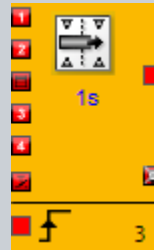
Press- & Burner Elements

Programming exercise

Print report

Muting

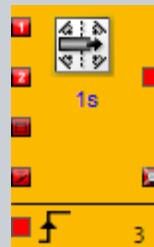
Parallel muting



Sequential muting



Cross muting



The following operating modes are available:

- Parallel muting
- Sequential muting
- Cross muting

The muting function element is used to temporarily suspend safety functions (ESPE/AOPD) without interrupting the process (muting).

For a limited period of time, and for a specific operational phase (e.g. when feeding materials), it will suspend the effect of safety devices during the working process. Once completed, it will reset the safety function.

Features:

- Muting via light beam devices or limit switches
- Override option in case of fault
- Max. muting time monitoring can be set
- Muting sensors can be monitored for simultaneity
- Configuration of bounce time for muting sensors that use contacts
- Sequence of the muting sensors can be monitored



PILZ | 04-16

Input Elements

Logic Elements

Flags

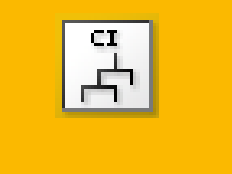
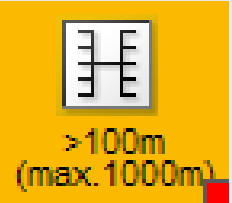
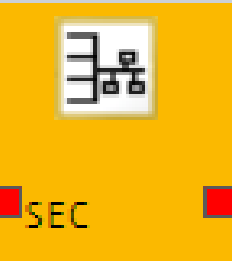
Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

PSENini			
<p>Cascading</p> 	<p>The cascading element combines two PNOZmulti using the cascading inputs/outputs (CI+/CI- and CO+/CO-).</p> <table border="1"> <tr> <td>1 Bit connection</td> <td>Category 4</td> </tr> </table>	1 Bit connection	Category 4
1 Bit connection	Category 4		
<p>Link module</p> 	<p>The link module element combines two PNOZmulti base units, using the Safe-Link modules ml1p, mml1p and/or m EF Multi Link.</p> <table border="1"> <tr> <td>32-bit connection</td> <td>Category 4</td> </tr> </table>	32-bit connection	Category 4
32-bit connection	Category 4		
<p>Safe Ethernet Connection (SEC)</p> 	<p>The safe Ethernet connection SEC (Safe Ethernet Connection) enables a point-to-point connection of 48 virtual inputs and 48 virtual outputs between a PNOZmulti base unit and a PSS 4000 device. The inputs and outputs are safety-related.</p> <table border="1"> <tr> <td>48-bit connection</td> <td>Category 4</td> </tr> </table>	48-bit connection	Category 4
48-bit connection	Category 4		



PILZ | 04-17

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

Nr.	Fill in the blanks	Possible answers
1	<p>To achieve Category 4, switch type <i>Typ3-Simultaneity</i> must be selected on the E-STOP element.</p> <p>Also, to achieve Category 4 on the PNOZmulti and therefore achieve PL e, all 2-channel contact-based sensors that do not exhibit any dynamic change must be checked for short circuits and shorts across contacts using two different <i>Test pulses</i></p> <p>This measure allows you to achieve a DC value (diagnostic coverage) of <i>99 %</i></p> <p>Sensors with OSSD outputs, such as light grids for example, can achieve PL e of ISO 13849-1 <i>without</i> test pulses, depending on the sensor's safety characteristic values.</p>	<p>Type 1 Type 3 Type 3-Simultaneity</p> <p>test pulses differential voltages additional voltage</p> <p>< 60 % ≥ 60 % ≥ 99 %</p> <p>without with 2</p>



PILZ | 04-17

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

Nr.	Fill in the blanks	Possible answers
2	Safeguards that need to be reset are to be started by disengaging the actuator. This is recommended in ISO 13849-1 under start type. Three start types are available on the PNOZmulti. For these safeguards to satisfy ISO 13849-1, the following start type should be selected: <i>Monitored start</i>	Automatic start Monitored start Manual start
3	The muting function suspends the effect of <i>one</i> machine safeguard(s) for a time <i>limited</i> operational phase (e.g. when feeding materials). Once completed, it resets the safety function.	one more all limited unlimited



PILZ | 04-18

Input Elements

Logic Elements

Flags


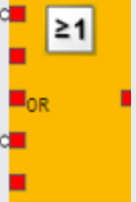

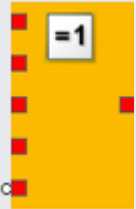
Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

Logic gate	
<p>UND</p> 	<p>This element has 2 to 5 inputs and one output. The output will not be "1" until all inputs are "1". The inputs and outputs can be <u>negated</u>. The <u>lower</u> of two inputs can be configured as a standard input. The second input must be a safe input.</p>
<p>ODER</p> 	<p>This element has 2 to 5 inputs and one output. If at least one of the inputs is "1", the output will be "1". The inputs and outputs can be negated.</p>
<p>Negation</p> 	<p>This element has one input and one output. When the input is "1", the output will be "0".</p>
<p>EXKLUSIV-ODER</p> 	<p>This element has 2 to 5 inputs and one output. Only one of the inputs needs to be "1" for the output to be "1". The inputs and outputs can be negated.</p>



PILZ | 04-18

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

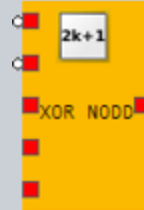
Press- & Burner Elements

Programming exercise

Print report

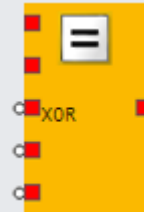
Logic gate

EXKLUSIV-ODER ($2k+1$)



The non-equivalence element has 2 to 5 inputs and one output. An odd number of inputs must be "1" for the output to be "1".

ÄQUIVALENZ



The equivalence element has 2 to 5 inputs and one output. The output will not be "1" until all inputs are either "1" or "0".

► Logic Elements „Memorizing logic“



PILZ | 04-19

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

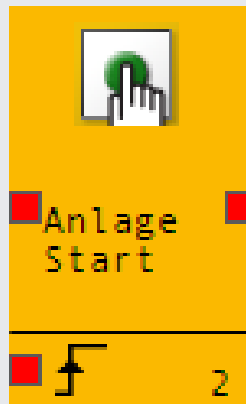
Print report

RS-Flipflop

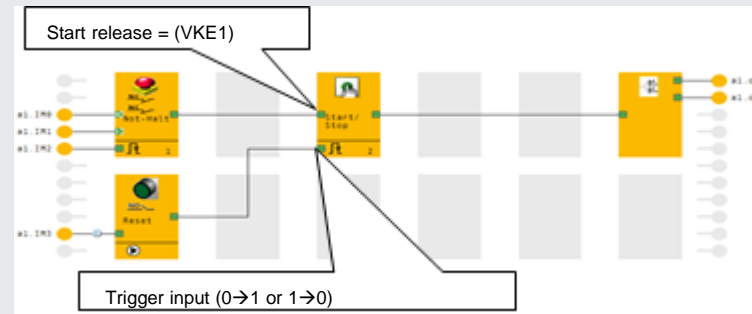


This element has 2 inputs (Set S, Reset R) and one output, Q. The RS flipflop is reset dominant. The output cannot be set to "1" if the reset input is "1".

Start



The start element has one input, one trigger input and one output. The start release for the start element is connected to the input. A start button for enabling the safety circuit is connected to the trigger input. Only if the start enable has a '1'.the output can be set to '1' with an edge at the trigger input. The output remains at '1' as long as the start enable remains at '1' (self-holding principle).



► Logic Elemente „Special functions“



PILZ | 04-19

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

Edge detection

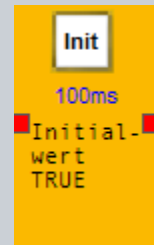
Edge



Evaluation of a rising or falling edge.

Initialization

Initial Value



The initial value "0" or "1" is effective only once after Power ON. This value is switched to the output for a configured period. Once the time has elapsed, the status of the input is copied directly to the output.

Note: Can only be used on PNOZ m B1.

► Logic Elements

„Connection points“ and „loops“



PILZ | 04-20

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

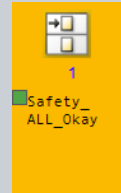
Press- & Burner Elements

Programming exercise

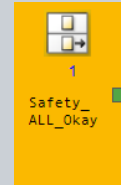
Print report

Connection Points

Source
Connection Point



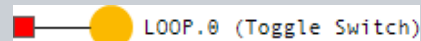
Destination
Connection Point



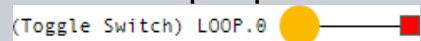
A connection point can be used to continue wiring in a different place. This is necessary when a piece of wiring cannot be continued. For example, if a circuit has to be continued on another workspace page. The output of a function element or logic element is linked to a “source connection point”. The “source connection point” is given a number (1 ... 255) and an Equip-ID. At a different place in the workspace, a “destination connection point” with the same number and Equip-ID is inserted and the wiring is continued from there.

Loop

Loop-Output



Loop-Input



With the loop, wiring can be continued at another point as with the connection points. In contrast to those here, a feedback is allowed. The output of a function element or logic element is linked to a loop output. It receives a number (1 ... 253) and an Equip-ID. At a different place in the workspace, a loop input with the same number and Equip-ID is inserted in order to continue the wiring.

► Logic Elements „Connection points“ and „loops“



PILZ | 04-21

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

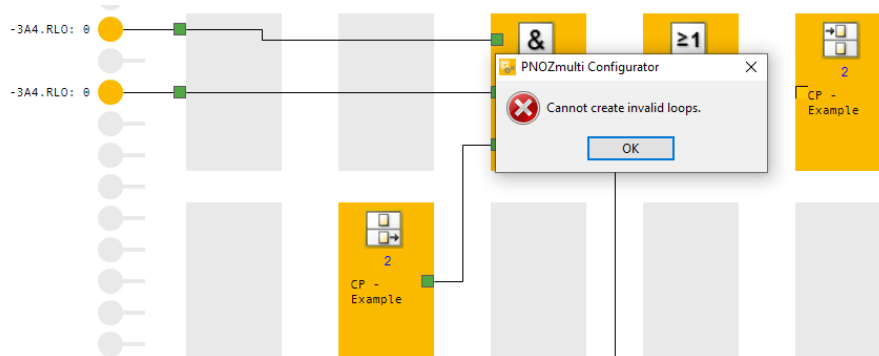
Press- & Burner Elements

Programming exercise

Print report

Rules:

- Target to source is not allowed

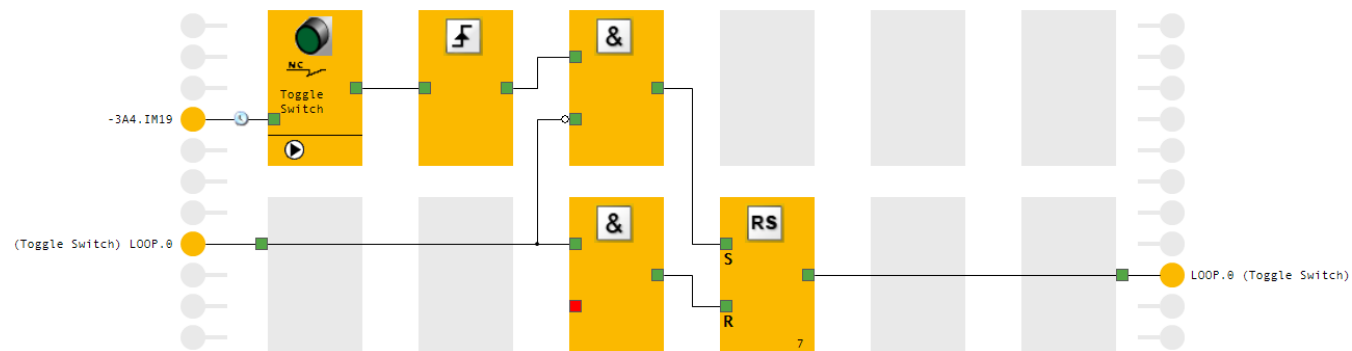


Rules:

- A loop input can not be connected to a loop out.



- Example:
– Toggle switch





PILZ | 04-22

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

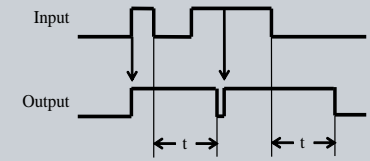
Zeitglied

Switch-Off Delay

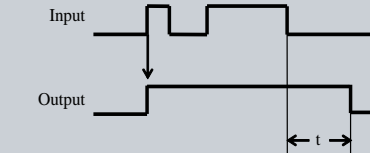


If the status of the element's input changes from "0" to "1", the output will switch to "1". If the input switches from "1" to "0", the delay time is started. The element can be configured with or without retriggering. The permissible delay time is between: 20 ... 655350 ms in 10 ms steps, 1 ... 655 seconds in 1 s steps, 1 ... 10 minutes in 1 minute steps.

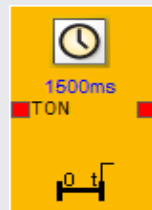
Without retriggering:



With retriggering:

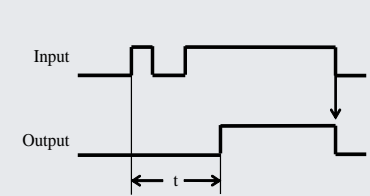


Switch-On Delay



If the status of the element's input changes from "0" to "1", the output remains at "0". The delay time will start. The element can only be configured with retriggering. The permissible delay time is between: 20 ... 655350 ms in 10 ms steps, 1 ... 655 seconds in 1 s steps, 1 ... 10 minutes in 1 minute steps.

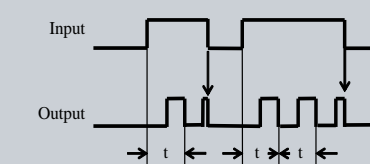
With retriggering:



Pulse Generator



The pulse generator is not started until the input is "1". The output supplies pulses at intervals which can be set within the element. The permissible pulse duration is between: 20 ... 655350 ms in 10 ms steps, 1 ... 655 seconds in 1 s steps, 1 ... 10 minutes in 1 minute steps.





PILZ | 04-23

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

Even Counter

Forward Counter



When the status at the input has changed from "0" to "1" a preset number of times, the output on the event counter will switch to "1".
It may be reset automatically or via the reset input.

Forward/Backward Counter



When the status at input 1 changes from "0" to "1", the counter is incremented by one; when the status at input 2 changes from "0" to "1", the counter is decremented by one. The output on the event counter switches to "1" when the specified value has been reached.
It can be reset automatically or via the reset input.



PILZ | 04-24

Input Elements

Logic Elements

Flags



Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

	Type	Standard	Level
	Monitoring of Relay	ISO 13849-1: Kategorie 1 ... 4 => PL a ... e	
	Monitoring of valves	ISO 13849-1: Kategorie 1 ... 4 => PL a ... e	



PILZ | 04-24

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

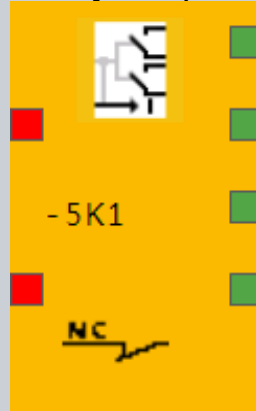
Press- & Burner Elements

Programming exercise

Print report

Outputs

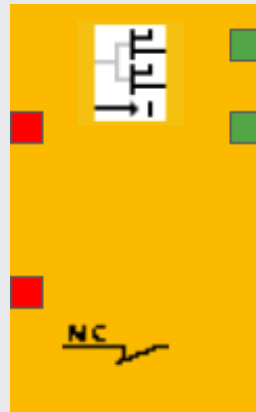
Relay-Output



This element activates the relay outputs of the PNOZmulti output O4 and O5 on the base unit (Classic) / on the expansion modules PNOZ mo2p or mo4p. It can be configured as a single or dual-pole output.

The feedback loop can be selected and deselected. This is connected on the lower contact point. (NC)

Semiconductor-Output



This element activates both the safe outputs and the auxiliary outputs (PNOZ mc1p). The safety outputs can be configured as a single or dual-pole output. The feedback loop can be selected. This is connected on the lower contact point (NC).

Number of outputs

Single output Dual output Single output with advanced fault detection

- Configurable for base units of the Mini and 2nd generation
- Increase of the PL value of the single-pole outputs from PLd to PLe



PILZ | 04-25

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

SICHERHEITS- VENTIL



Outputs

The output element safety valve is intended for the control and monitoring of valves.

This element is suitable for:

- single valves (single solenoid valve, 1-channel)
- - double valves (single solenoid valve, 2-channel)
- - directional valves (bistable valve, 1-channel)

In contrast to a semiconductor output or relay output, the switch-on and switch-off monitoring can be individually set on the output element safety valve. (TOn and TOff). Thus, the control of indirectly controlled valves is also possible. The values for the switch-on and switch-off monitoring (TOn/TOff) are freely adjustable: Permissible value range: 50 ... 3000 ms

Options

Continuous Feedback loop monitoring with controlled valve

Power-up monitoring TOn (range: 50 - 3000 ms)

100

Switch-off monitoring TOff (range: 50 - 3000 ms)

150

FS-Output Elements: Feedback Loop



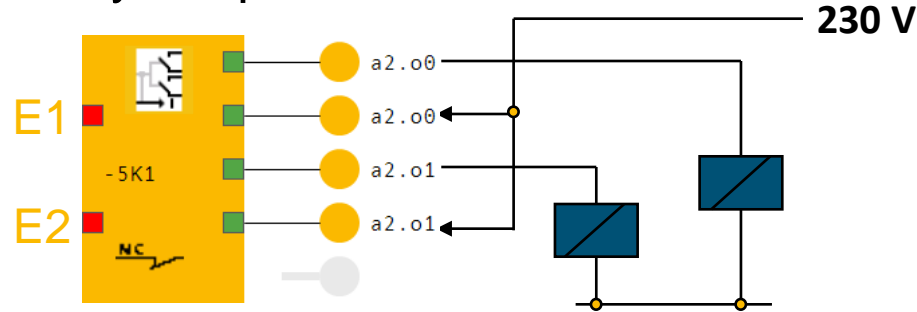
PILZ | 04-25

- Input Elements
- Logic Elements
- Flags
- Timer / Counter

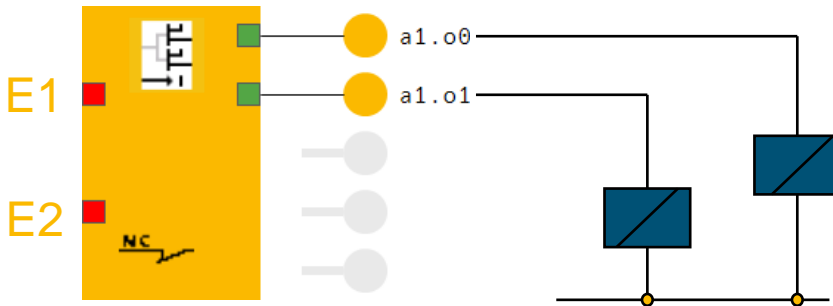
Output Elements

- Press- & Burner Elements
- Programming exercise
- Print report

Relay Output



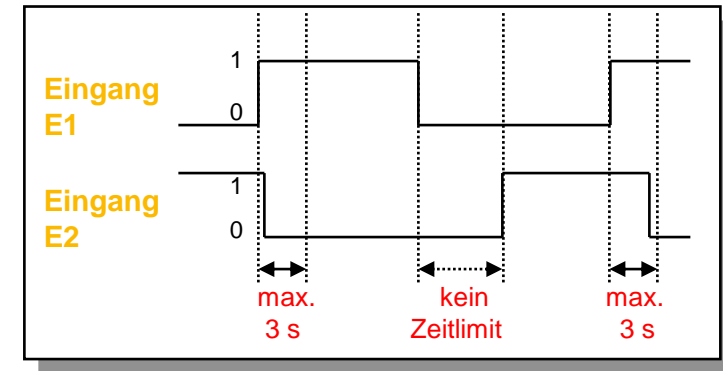
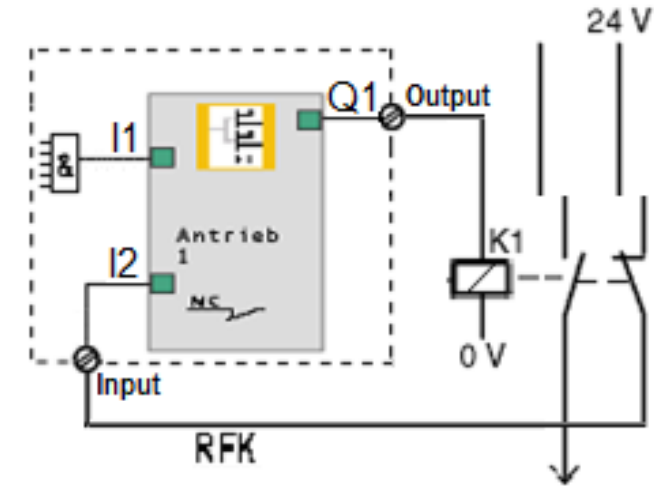
Semiconductor Output



Used to poll and monitor a control element.

Signals required at the FBL input (feedback loop):

- ▶ **High signal.** Before the output can be set.
- ▶ Changes to **Low Signal** within **3 sec**, once the control element has been activated.



► Errors within the Feedback Loop



PILZ | 04-26

Input Elements

Logic Elements

Flags

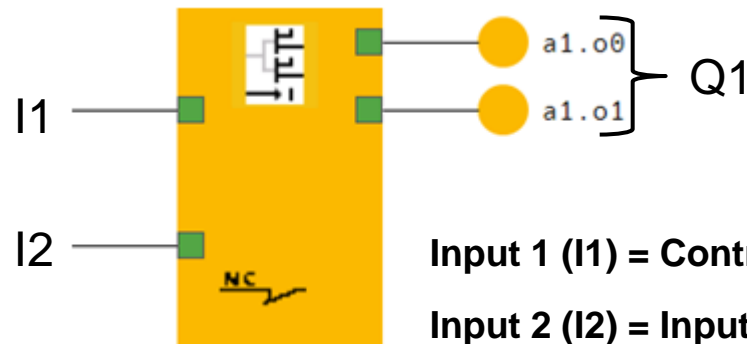
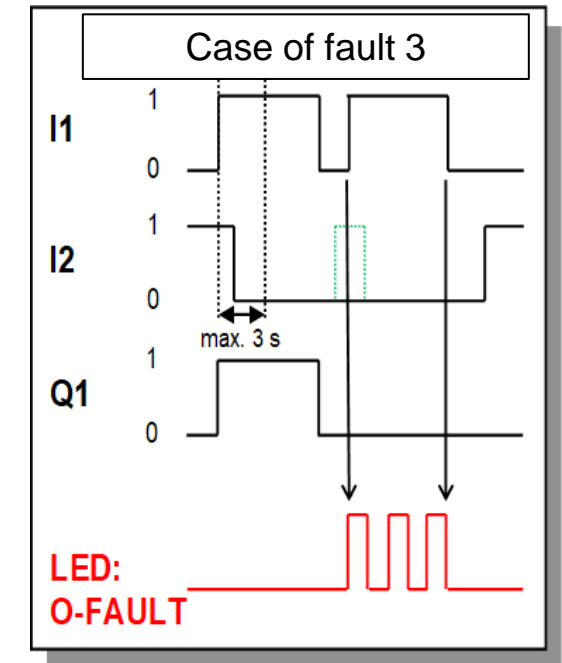
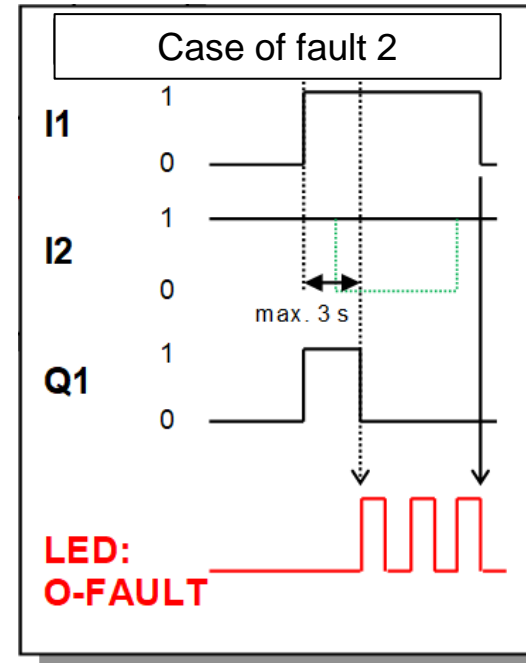
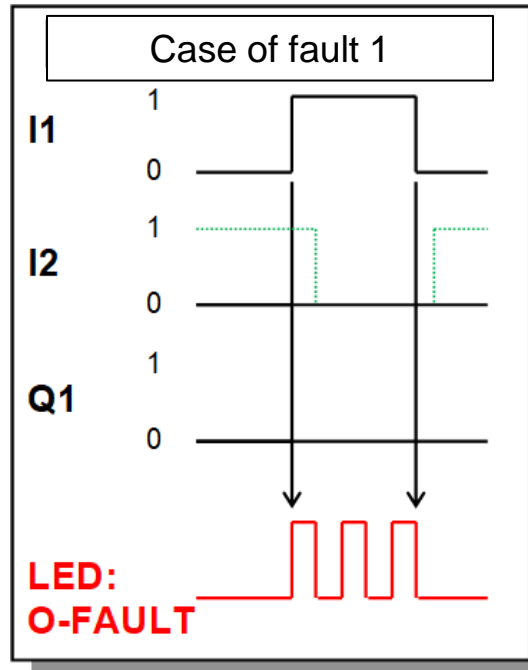
Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report



Input 1 (I1) = Control input for driving the output

Input 2 (I2) = Input for feedback loop

Output (O0/O1) = Output Terminals



PILZ | 04-28

Input Elements

Logic Elements

Flags

Timer / Counter

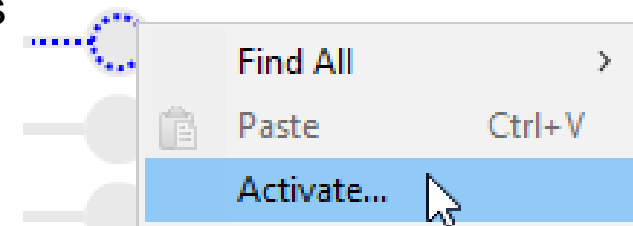
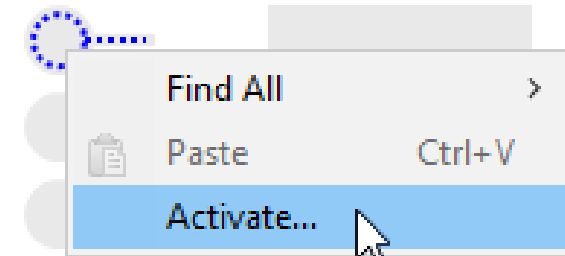
Output Elements

Press- & Burner Elements

Programming exercise

Print report

- ▶ Inputs and Outputs can be activated manually.
- ▶ Reasons (Inputs):
 - ▶ For virtual inputs/outputs of the communications and link modules.
 - ▶ Outputs whose status must be polled.
 - ▶ For inputs connected to elements which are however not positioned at the input fields (e.g. logic, speed, output elements with FL monitoring).
 - ▶ Loop inputs
- ▶ Reasons (Outputs):
 - ▶ Virtual outputs of the fieldbus and link modules
 - ▶ Virtual outputs of the serial interface
 - ▶ Decentralised standard outputs



► Press Elements

„PNOZ m2p“ and „PNOZ m EF 8DI2DOT“



PILZ | 04-29

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

Press elemente (1st and 2nd generation)

Operating Modes



The "Operating modes" press element is designed for the sequence control of eccentric presses. Operating modes:

- ▶ Setup: Jog mode
- ▶ Single-stroke: Single stroke protection operation
- ▶ Automatic: Continuous stroke

Performance features:

Evaluation of the signals run-up and overrun cam of the rotary cam arrangement press element

Rotary Cam Arrangement



The "Rotary cam arrangement" press element is intended to activate and monitor the mechanical rotary cam arrangements.

- ▶ The rotary cam arrangement press element includes three functions:
- ▶ Rotary cam arrangement monitoring
- ▶ Pulse detection for run monitoring
- ▶ Run monitoring

Light Curtain



The "Light curtain" press element supports the following function:

- ▶ Counts interventions into the detection zone.
- ▶ MODE activates the element, enable condition for press movement through input parameter Reset (1. stroke)
- ▶ Standard or Sweden mode
- ▶ Resetting the press element when there is no press start after 30 seconds
- ▶ Works in connection with the light curtain function element

► Press Elements „PNOZ m EF 8DI2DOT“



PILZ | 04-29

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

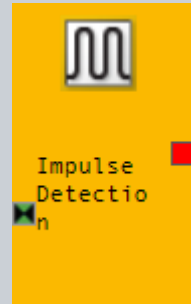
Press- & Burner Elements

Programming exercise

Print report

Press elemente (2nd generation)

Impulse Detection



The press element "impulse detection" supports the following function:

- Monitors the edge change of the pulse encoder input
- Generates the input signal for the run monitor control
- For use with mechanical presses

► Burner Elements

„PNOZ m3p“ and „PNOZ m B1 Brenner“



PILZ | 04-29

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report

Burner elements (1st and 2nd generation)

Burner



The burner element supports the following burner types:

- Master burner, direct ignition
- Master burner, indirect ignition, joint flame monitoring
- Master burner, indirect ignition, separate flame monitoring
- Slave burner, direct ignition
- Slave burner, indirect ignition, joint flame monitoring
- Slave burner, indirect ignition, separate flame monitoring

► Programming Exercise 2

Input elements of the education system



PILZ | 04-30

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

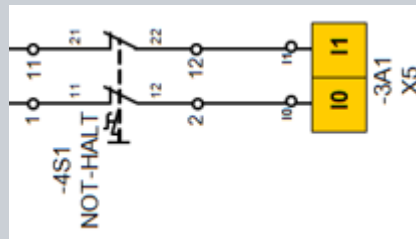
Press- & Burner Elements

Programming exercise

Print report

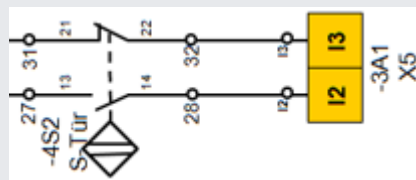
Training Cube

E-Stop

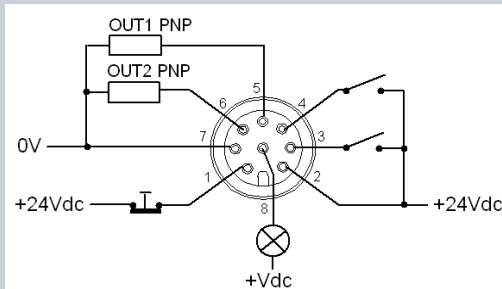


Safety-Gate

PSENmag „PSEN 2.1p-10“

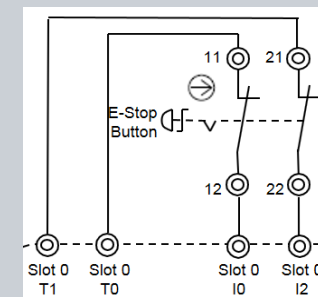


Light Curtain „PSEN op...“



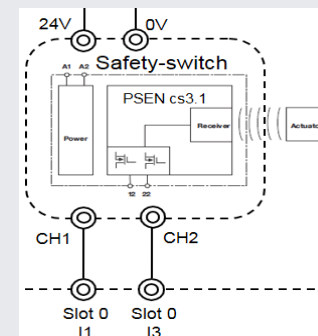
PES

E-Stop

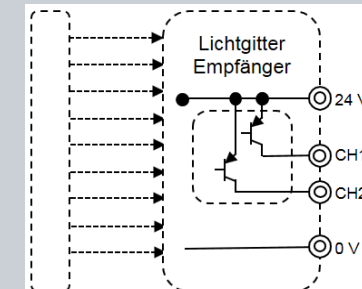


Safety-Gate

PSENcode „PSEN cs3.1“



Light Curtain „PSEN op...“



► Programming Exercise 2

Input elements of the education system



PILZ | 04-31

Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

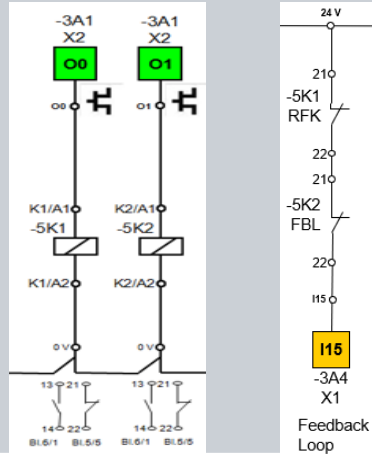
Press- & Burner Elements

Programming exercise

Print report

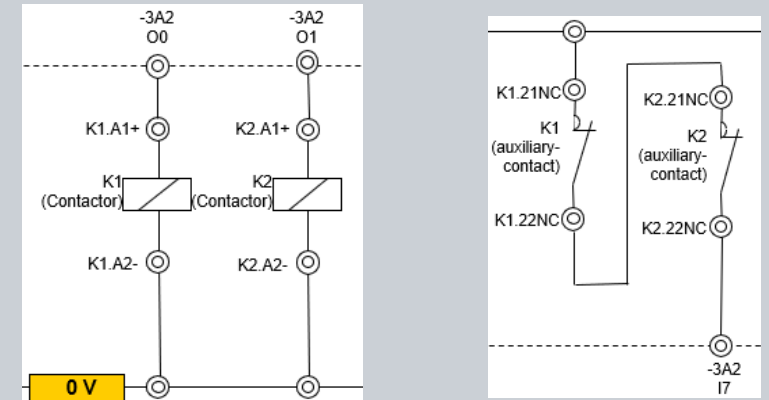
Training Cube

Relay with Feedback Loop (FBL)



PES

Relay with Feedback Loop (FBL)



► Programming Exercise 2

Specification



PILZ | 04-31

Input Elements
Logic Elements
Flags
Timer / Counter
Output Elements
Press- & Burner Elements
Programming exercise
Print report

No.	Description	PLr	Max. reaktion time	Priority
SF1	When E-STOP (-4S1) is operated, the drive contactors (K1 and K2) are switched off. Reset with neg. edge required.	d	100 ms	High
SF2	When E-STOP (-6S1) is operated, the drive contactors (K1 and K2) are switched off. Reset with neg. edge required.	d	100 ms	High
SF3	When safety gate is open, switch off the drive contactors (K1 and K2). Reset with neg. edge required.	d	100 ms	Med.
SF4	When light grid is open, switch off the drive contactors (K1 and K2). Protection against encroachment behind permits an automatic start. Function test required on restart.	d	40 ms	Med.
ZF1	System-Stop (like programmin exercise 1)	-	100 ms	Low_2
ZF2	System-Start (like programmin exercise 1)	-	100 ms	Low_2
ZF3	Lamp in the Start-Button (like programmin exercise 1)	-	100 ms	Low_3

► Programming Exercise 2

Cause and effect matrix



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		Cause										Effect					Verification	Validation	
		Involved Inputs								Safety Funktionen		Outputs					Verification	Validation	
Operating mode	Previous state no. during test	State-No..	4S1.E-Stop_Ch1 (SF1)	4S1.E-Stop_Ch2 (SF1)	6S1.E-Stop_Ch1 (SF2)	6S1.E-Stop_Ch2 (SF2)	Safety-Gate_Ch1 (SF3)	Safety-Gate_Ch2 (SF3)	Light-Curtain_Ch1 (SF4)	Light-Curtain_Ch2 (SF4)		Quittierung (Reset Plant)	Quittierung (Reset Safety gate)	Antriebschutz K1	Antriebschutz K2	Lampe in der Start-Taste			
-	1	1	1	1	1	1	1	1	1	1	ALL_OK: All safety devices are in order. System startup is complete.			ON	ON	ON		checked (ok / not ok)	checked (ok / not ok)
1	2	0	0	1	1	1	1	1	1	1	NOT-HALT (SF1) at control panel operated	YES	NO	OFF	OFF	OFF			
1	3	1	1	0	0	1	1	1	1	1	NOT-HALT (SF2) at danger point operated	YES	NO	OFF	OFF	OFF			
1	4	1	1	1	1	0	0	1	1	1	Safety gate (SF3) open	NO	YES	OFF	OFF	OFF			
1	5	1	1	1	1	1	1	0	0	1	Light Curtain (SF4) interrupted	NO	NO	OFF	OFF	OFF			
V1	Verification done (ok / not ok):																		
	Date:																		
	Name:																		
D1	Validation done (ok / not ok):																		
	Date:																		
	Name:																		

► Programming Exercise 2

Side structure



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Input Elements

Logic Elements

Flags

Timer / Counter

Output Elements

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Main programm	Functional description	Graphic
Page 1 (SF)	Safety function: When one of the emergency stop devices is actuated, when the protective door is opened or when the light grid is actuated, the release for switching on the drive contactors is switched off.	
Page 2 (Start-Stop)	<p>The machine drive can be switched on with the start button and switched off again with the stop button.</p> <p>The prerequisite is that the safety functions have been enabled.</p> <p>The drive contactors are monitored with a feedback loop (FBL).</p>	

► Programming Exercise 2

Display of the program – page 1 (NEW)



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Input Elements

Logic Elements

Flags

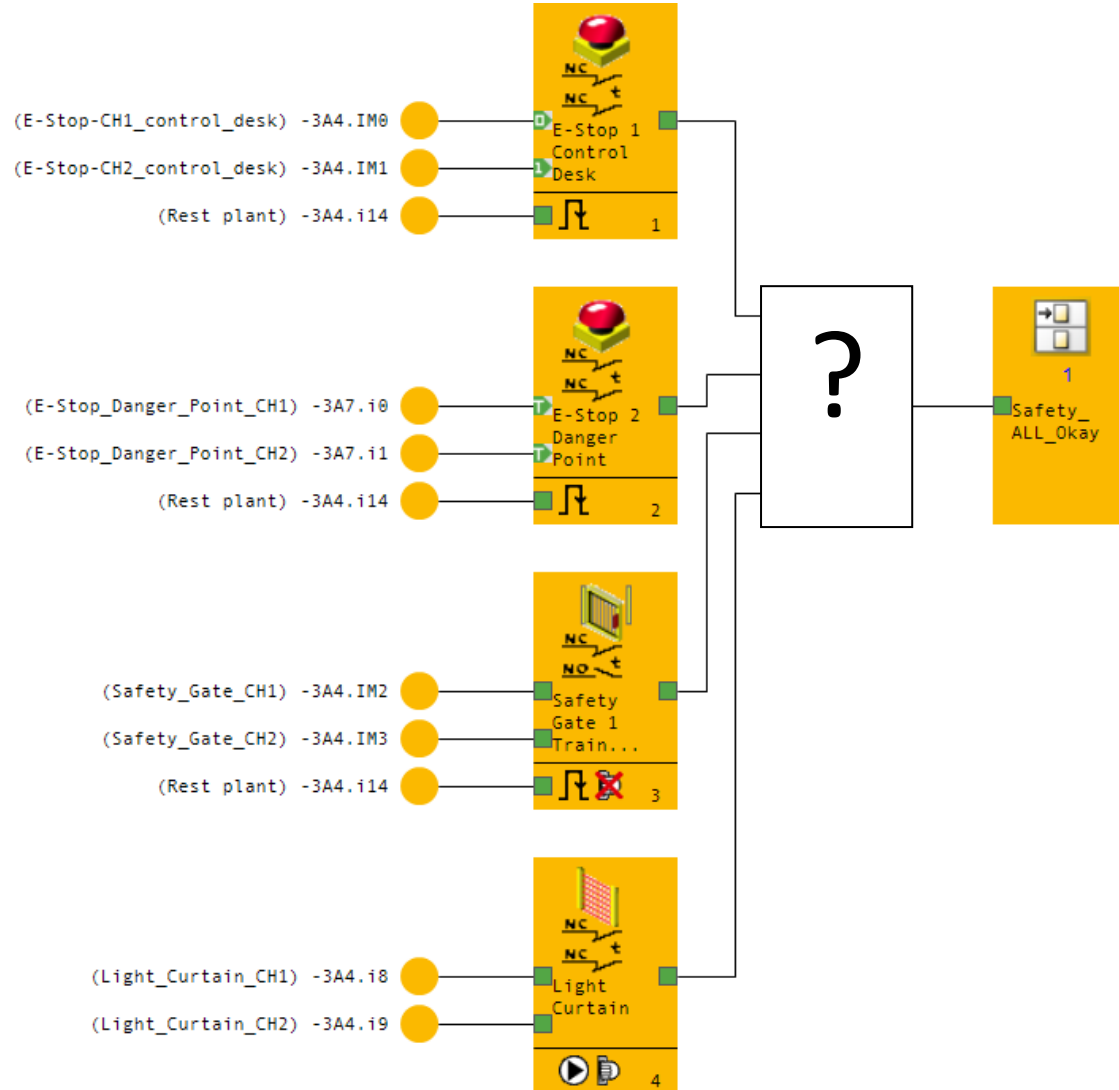
Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report



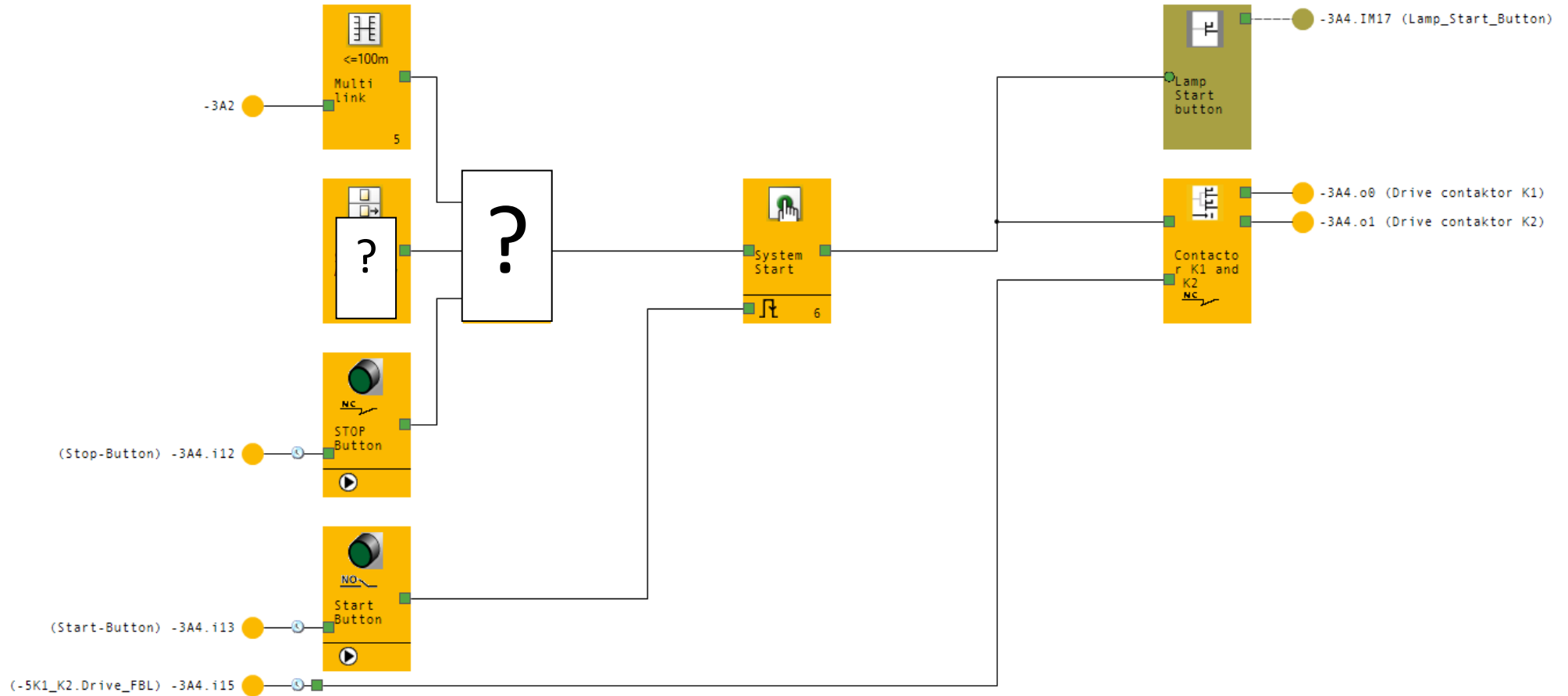
► Programming Exercise 2

Display of the program – page 2 (MODIFIED)



PILZ | 04-33

- Input Elements
- Logic Elements
- Flags
- Timer / Counter
- Output Elements
- Press- & Burner Elements
- Programming exercise**
- Print report



► Project Properties



PILZ | 04-45

Input Elements

Logic Elements

Flags

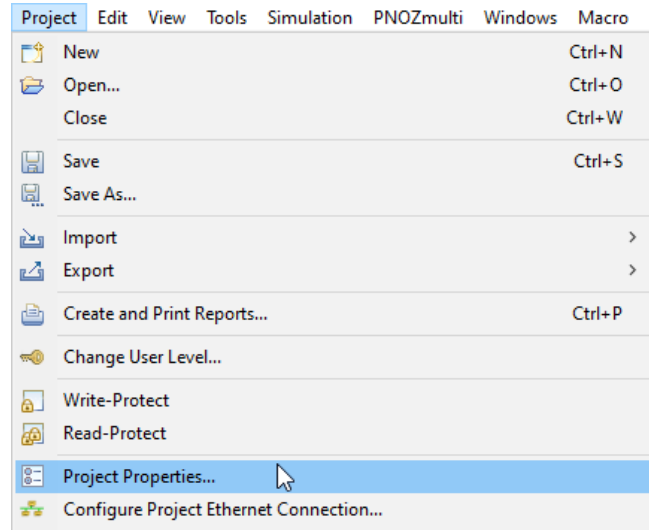
Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

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Project Properties

Project Name:

Project Location:

Main Program

Created by:

Reviewed by:

Company:

Name:

User Text:

Locked Project

Details

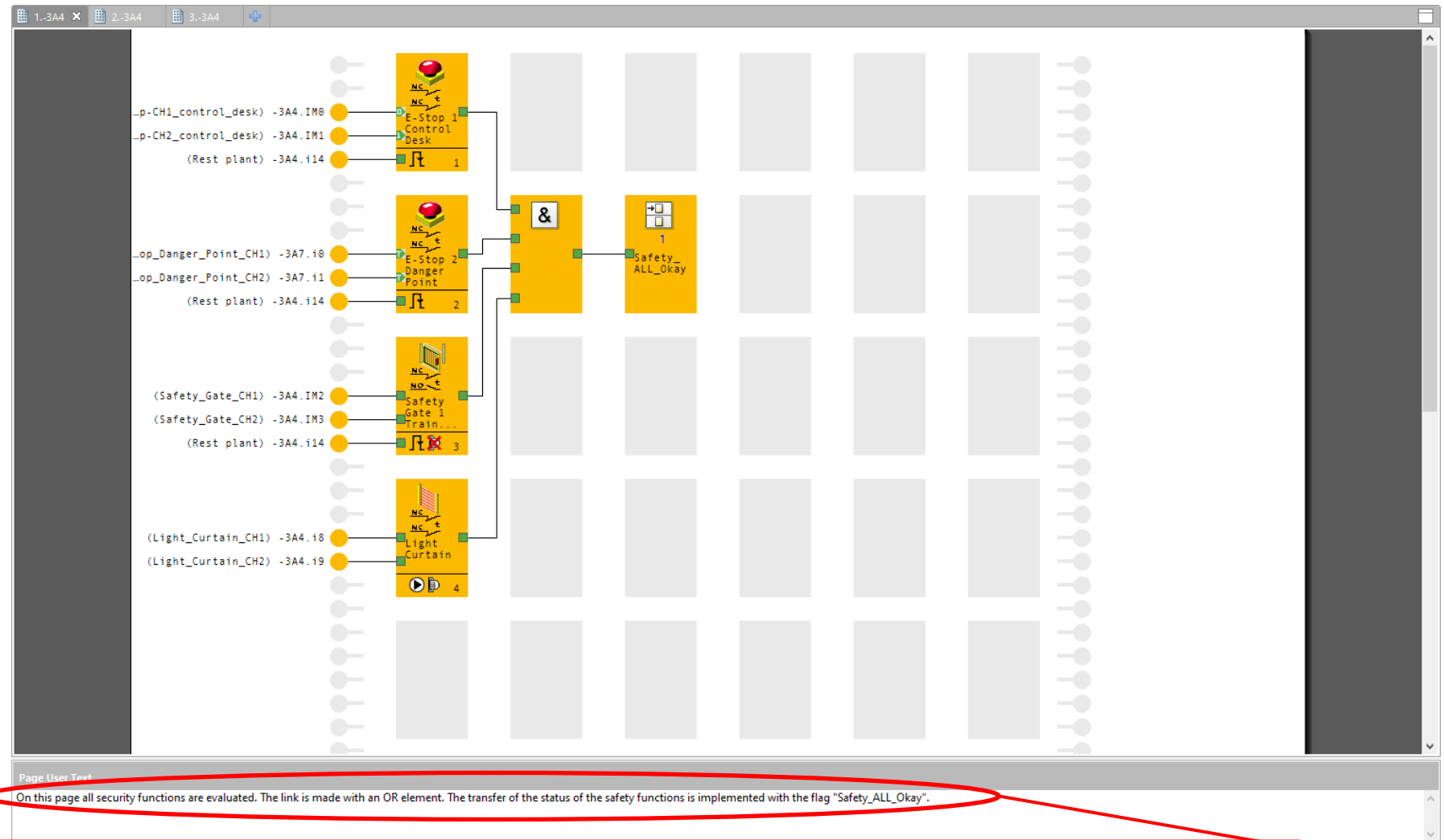
Hardware:	Base Unit PNOZ m B0 v1.3
Software:	v10.12.0
Checksum safe:	7078
Checksum safe without Level 3:	7078
Checksum Level 3:	0
Total project checksum:	1088
Checksum Diagnostic Texts:	0



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- Input Elements
- Logic Elements
- Flags
- Timer / Counter
- Output Elements
- Press- & Burner Elements
- Programming exercise

Print report



On this page all security functions are evaluated. The link is made with an OR element. The transfer of the status of the safety functions is implemented with the flag "Safety_ALL_Okay".

Page User Text
On this page all security functions are evaluated. The link is made with an OR element. The transfer of the status of the safety functions is implemented with the flag "Safety_ALL_Okay".



PILZ | 04-47

Input Elements

Logic Elements

Flags

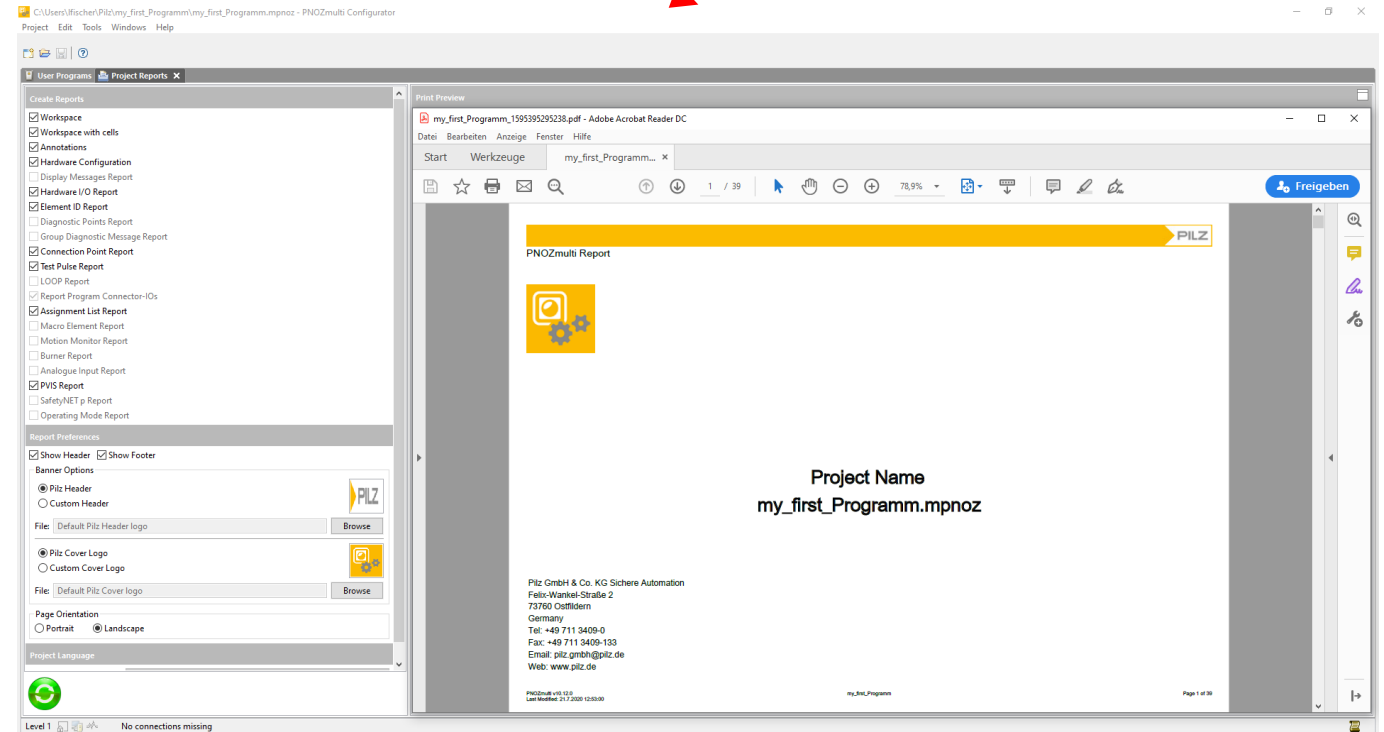
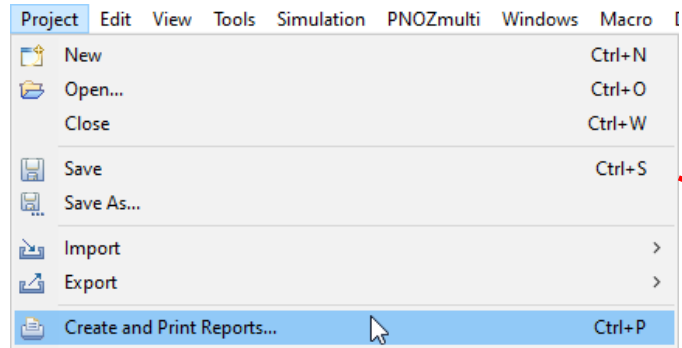
Timer / Counter

Output Elements

Press- & Burner Elements

Programming exercise

Print report



Automatisierungs- technik

COMPONENTS
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innovativ ökologisch
sicher wirtschaftlich

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