PNOZelog compact safety relays

Configuration guide

pilz

Technical Catalogue 3.4 –February 2008 edition

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February 2008

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Contents

Introduction

This technical catalogue describes the units in the PNOZelog product range:

- PNOZ e1p
- PNOZ e1.1p
- PNOZ e1vp
- PNOZ e2.1p
- PNOZ e2.2p
- PNOZ e3.1p
- PNOZ e3vp
- PNOZ e4.1p
- PNOZ e4vp
- PNOZ e5.11p
- PNOZ e5.13p
- PNOZ e6.1p
- PNOZ e6vp

The information at the beginning refers to the whole product range. This is followed by descriptions of the specific units. Various application examples are provided at the end.

The catalogue is divided into the following chapters:

1.1 Introduction
The introduction is designed to familiarise you with the contents, structure and specific order of this configuration guide.

1.2 Overview
This chapter provides information on the most important features of the product range and provides a brief overview of the application range.

1.3 Safety
This chapter **must be read** as it contains important information on safety regulations.

1.4 Description of the PNOZelog-range
The description contains information about the functions that are identical on all units.

1.5 Installing the units
This chapter describes how to install the units.

1.6 Commissioning
This chapter contains important guidance on wiring the units.

1.7 Logic connections on the units
This chapter describes how the units can be linked together logically. Real circuit diagrams can be found in the chapter entitled “Application examples”.

1.8 Operation and fault diagnostics
This chapter describes how the unit reacts during operation and how faults are displayed.

1.9 Technical details
This chapter contains the technical details relevant for all units in the PNOZelog-range.

2.0 Products
This chapter contains the unit-specific descriptions. These refer exclusively to the specific features for the unit, such as intended use, description, parameter settings and wiring of individual units.

3.0 Applications
This chapter is a collection of application examples.

Definition of symbols

Information in this configuration guide that is of particular importance can be identified as follows:

DANGER!
This warning must be heeded! It warns of a **hazardous situation that poses an immediate threat of serious injury and death**, and indicates preventive measures that can be taken.

WARNING!
This warning must be heeded! It warns of a **hazardous situation that could lead to serious injury and death** and indicates preventive measures that can be taken.

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

NOTICE
This describes a situation in which the unit(s) could be damaged and also provides information on preventive measures that can be taken.

INFORMATION
This gives advice on applications and provides information on special features, as well as highlighting areas within the text that are of particular importance.

Introduction

Definitions

AND connection: Connects two or more units. Start-up can only occur when all the start-up conditions are met.

Auxiliary output: Non-safety-related output using semiconductor technology

Danger zone: Zone within or around machinery in which a person is exposed to risk of injury or damage to health.

Delay-on de-energisation when the safety function is triggered: After a safety function is triggered at a device input, the period that elapses before the safety outputs carry a low signal.
On units which contain the letter “v” in their name, it is possible to set the delay-on de-energisation period.

Detection of shorts across contacts: Detection of a short circuit between the connection leads of two adjacent contacts (S12/S22).

Diagnostic function: Signal data from the PNOZelog which is stored at auxiliary output Y32, ready for download to the PLC, when Y32 has been switched to a diagnostic output.

Earth fault detection: Detection of a live connection between an external conductor, or conventionally insulated neutral conductor, and earth or earthed components, as the result of an error.

Feedback loop: Circuit for monitoring externally connected contactors or relays via a PNOZelog. The N/C contacts are used to check whether the relays or contactors have assumed their safe condition before they are re-operated.

OR connection: Connects two or more units. Start-up occurs when at least one of the start-up conditions is met.

Positive-guided contacts: Contacts which are mechanically connected in such a way that N/C and N/O contacts can never be closed at the same time.

PSS: The Pilz PSS-range comprises modular and compact programmable safety and control systems for use in plant and machinery safety circuits.

Reaction time: See “Delay-on de-energisation when the safety function is triggered”.

Redundancy: The application of more than one identical element, in order to ensure that if one element malfunctions, a second element is available to guarantee that the function is maintained.

Reset button actuation time (min): Period for which a reset button must be operated and then released to trigger a successful start.

Safety output: Safe output using semiconductor technology

Switch-on delay at S35/S36: After a signal is supplied to S35/S36, the period that elapses before the safety outputs change state.

Switch-on delay autom. reset:
After supply voltage is applied or the safety function is released, the period that elapses before the safety outputs change state.

Switch-on delay man. reset:
After the reset button has been operated, the period that elapses before the safety outputs change state.

Switch-on delay (on initial start after U_B is applied): After supply voltage is applied, the period that elapses before the unit is ready for operation.

Test pulse output: When wired appropriately, specific pulses are applied to the inputs via the test pulse outputs. This enables the detection of shorts across contacts.

Test pulses: Pulse signals specifically generated by the safety relay.

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Overview

Unlike conventional PNOZ units, units in the PNOZelog product range are predominantly electronic in structure. The safety and auxiliary outputs use semiconductor technology, which means they require no maintenance and are wear-free. For this reason, the PNOZelog-range is also suitable for applications with frequent operations or cyclical functions.

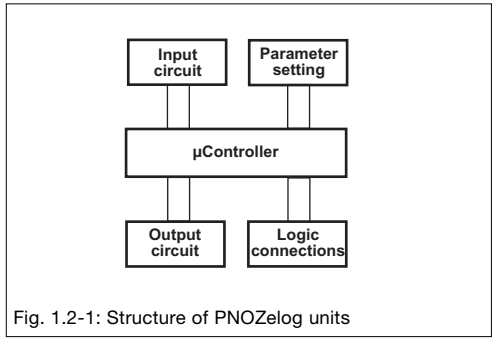


Fig. 1.2-1: Structure of PNOZelog units

The electronic structure makes the units flexible. Parameters on a unit can be set to suit a number of application areas. The parameters are set through the wiring (e.g. jumpers). With the correct circuitry it is possible to achieve categories 2, 3 and 4 in accordance with EN 954-1.

Units in the PNOZelog-range can be linked directly via the outputs and via special inputs, which enable both a logic AND and a logic OR connection between the units.

Safety

Safety assessments

Before using a unit it is necessary to perform a safety assessment in accordance with the Machinery Directive. The units as individual components guarantee functional safety, but not the safety of the entire application. You should therefore define the safety requirements for the plant as a whole, and also define how these will be implemented from a technical and organisational standpoint.

General safety requirements

Always ensure the following safety requirements are met:

- Only install and commission the unit if you are familiar with the information in the operating instructions or this system manual, as well as the relevant regulations concerning health and safety at work and accident prevention.
- Only use the unit for the purpose for which it is intended and comply with both the general and specific technical details.
- Transport, storage and operating conditions should all conform to the data specified in the general technical details.
- Sufficient fuse protection must be provided on all capacitive and inductive loads.
- Do **not** open the housing or make any unauthorised modifications.

You must observe the warning notes given in other parts of this manual. These are highlighted visually through the use of symbols.

NOTICE
Failure to keep to these safety regulations will render the warranty invalid.

Intended use

The intended use depends on the unit and is therefore explained in the chapter with the unit-specific descriptions.

Applications in accordance with EN 954-1, Category 4

Two loads may be connected to each safety output on a PNOZelog unit, even on Category 4 applications. Prerequisite: exclusion of shorts across contacts and external power sources (e.g. install in a control cabinet).

Safety distance

The following information is absolutely essential when using safety devices involved in area or access guarding:
When the safety device is triggered, there is a delay before the machine comes to a standstill.
The distance between the safety device and the nearest danger zone must be large enough for the hazardous movement to come to a standstill before the operator can reach the danger zone. All access directions must be taken into account.
According to EN 999, “Approach speed of parts of the body for the positioning of safety devices”, this minimum distance is calculated using the following formula:

S = K x T + C

S = Minimum distance from the danger zone to the detection point, detection line, detection plane or protected field
K = Approach speed of the body or parts of the body (depends on the detection capability)
T = System’s overall stopping performance:
Machine’s overrun time
+reaction time of the safety device
+reaction time of the safety relay
(release time/response time when safety function is triggered)
C = Additional distance in millimetres, based on intrusion towards the danger zone prior to actuation of the safety device (depends on the detection capability (resolution), type and position of the safety device)

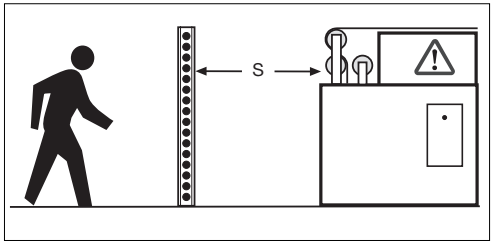
Example:
A machine has an overrun time of 500 ms. The danger zone is protected by a light guard with a reaction time of 20 ms and a detection capability of 30 mm. A PNOZe1.1p is used as the safety relay (release time 35 ms).

Calculating the safety distance between the machine and the outer edge of the safety mat:

Approach speed:	2000 mm/s
Machine’s overrun time:	500 ms
Reaction time of safety device:	20 ms
Reaction time of safety relay:	35 ms
Detection capability:	d = 30 mm

S ≥ 2000 mm/s (0.5 s + 0.02 s + 0.035 s) + 128

Safety distance≥ 1.238 m



Description

Safety features

The relay meets the following safety requirements:

- The circuit is redundant with built-in self-monitoring.
- The safety function remains effective in the case of a component failure.
- A disconnection test periodically checks the safety outputs, irrespective of the status of the outputs
- The unit has an electronic fuse.

Operation

Each unit has one or more specific basic functions, such as E-STOP monitoring, safety gate monitoring. The units react the same, irrespective of these basic functions: If the start-up condition of the specific basic function is met, there will be a high signal at the internal output (see Fig. 1.4-1).
The internal output is AND/OR-linked, depending on the wiring of the logic inputs S35 and S36 (not on the PNOZ e1p). The result of the logic operation can be found at safety outputs 14 and 24.
On units which contain the letter “v” in their name (e.g. PNOZ e1vp), the safety outputs can have delay-on de-energisation. The auxiliary output Y32 is always instantaneous.

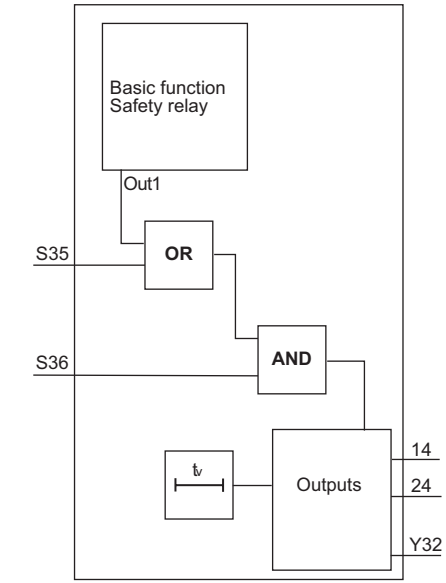


Fig. 1.4-1: Operation of PNOZelog units

Functions

- If there is a high signal (+24 VDC) at input **Y5** for at least 250 ms, output **Y32** will switch to the **diagnostic function.** It is controlled via a driver that is available as an accessory or that you can create yourself. If input **Y5** is open or low for more than 300 ms, **Y32** will operate as an auxiliary output.
- An **AND and an OR input** (not PNOZ e1p) enable several units to form a logic connection. The inputs have switch delays, which are added together with each unit that is linked.

Operating modes

The operating modes depend on the individual unit. Please refer to the unit-specific descriptions for details of which operating modes are available.

- **Single-channel operation**: Input wiring in accordance with EN 60204, no redundancy in the input circuit; earth faults in the input circuit are detected.
- **Dual-channel operation**: Redundant input circuit; earth faults in the input circuit are detected (exception: two-hand control devices), with or without detection of shorts between the input contacts.
- **Automatic reset**: Unit is active as soon as the input circuit and feedback loop are closed.
- **Monitored reset**: Unit is not active until the reset button has been operated and then released. This eliminates the possibility of the reset button being overridden, triggering automatic activation.
- **Detection of shorts between contacts** is enabled by pulsing the input circuits. This operating mode is automatically detected on start-up.
- **Start-up test** prevents an automatic restart when voltage is removed and reapplied. The unit checks whether safety gates that are closed are opened and then closed again when supply voltage is applied.
- **Increase in the number of safety contacts available** by connecting a contact block (e.g. PZE X4.1P) or external contactors.
- **Two-hand operation:** The two-hand control device must be activated by operating two buttons simultaneously. If one or both of the buttons are released, it interrupts the control command to close the press. The closing movement can only be restarted when both buttons have returned to their start position (released) and are operated again.

Installation

CAUTION! Electrostatic discharge can damage components on the safety system. Ensure against discharge before touching the safety system, e.g. by touching an earthed, conductive surface or by wearing an earthed armband.

- The safety relay should be installed in a control cabinet with a protection type of at least IP54.
- AND-/OR connection:
  - Install all the devices that are linked via the AND/OR inputs in the same control cabinet

  or
  - make sure that faults that occur from the connection of the devices can be excluded, e.g. by secure laying of connection cables.
- Use the notch on the back of the unit to attach it to a DIN rail.
- Secure the unit on a vertical DIN rail (35 mm) using a retaining bracket or end angle.

The unit can be installed in any position.

Dimensions

Units in the PNOZelog product range have a 22.5 mm housing, with the exception of the PNOZ e6.1p and PNOZ e6vp units with integrated contact expander module, which have 45 mm housing.

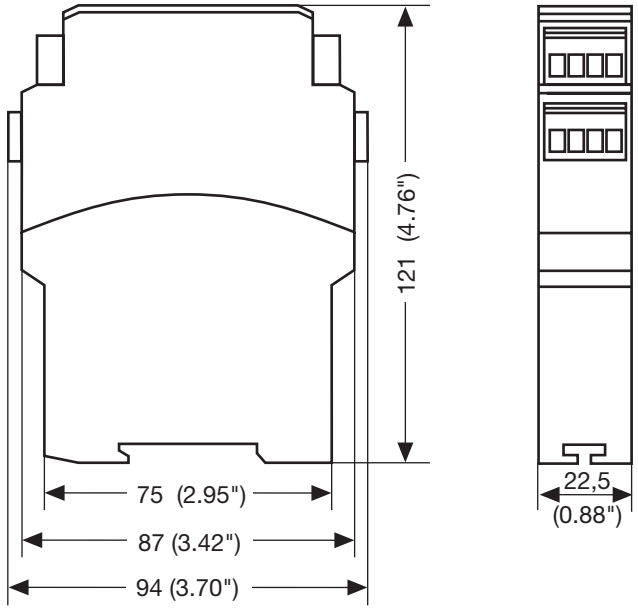


Fig. 1.5-1: Dimensions of the PNOZelog, unit with plug-in screw terminals

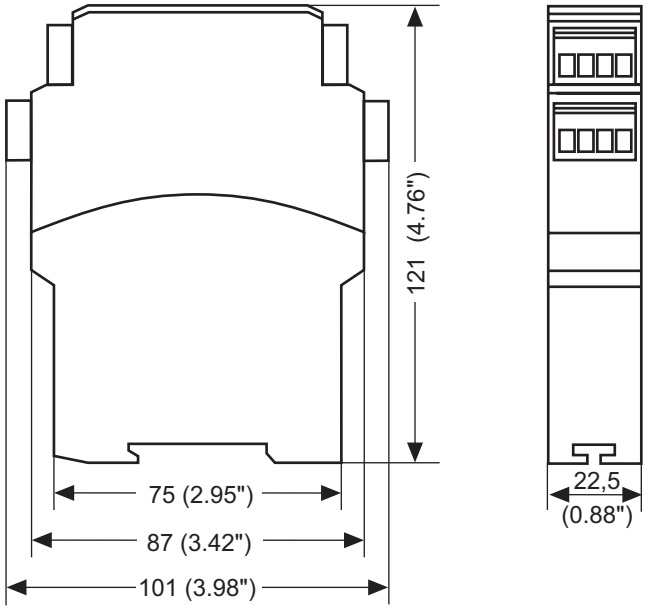


Fig. 1.5-2: Dimensions of the PNOZelog, unit with cage clamp terminals

Installation

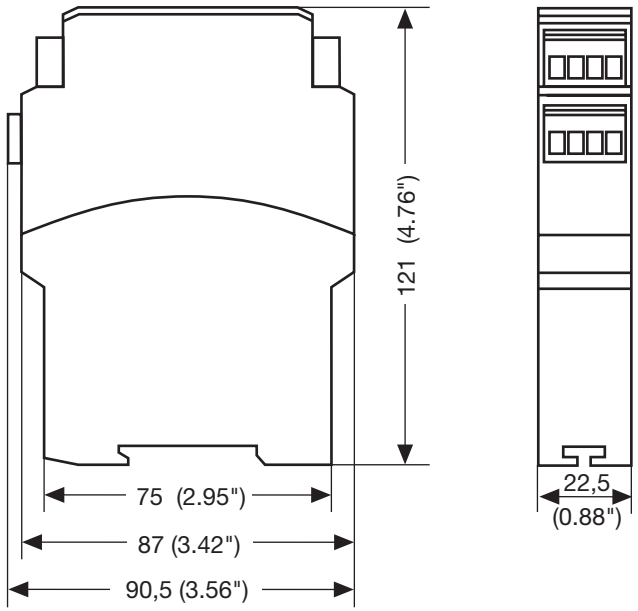


Fig. 1.5-3: Dimensions of the PNOZ e1p, unit with plug-in screw terminals

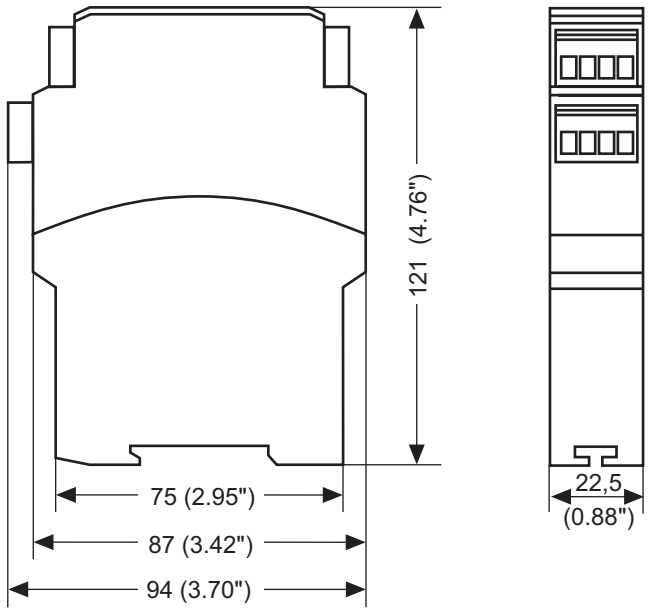


Fig. 1.5-4: Dimensions of the PNOZ e1p, unit with cage clamp terminals

Installation

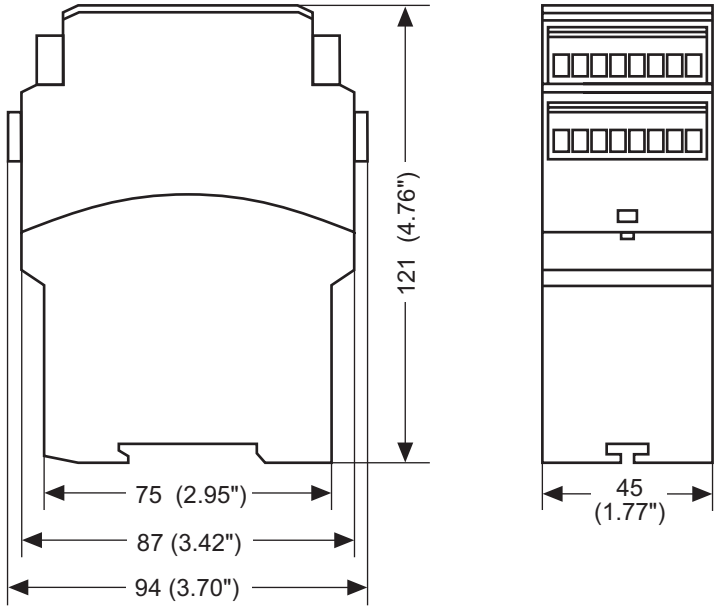


Fig. 1.5-5: Dimensions of the PNOZelog, unit with integrated contact expander module, with plug-in screw terminals

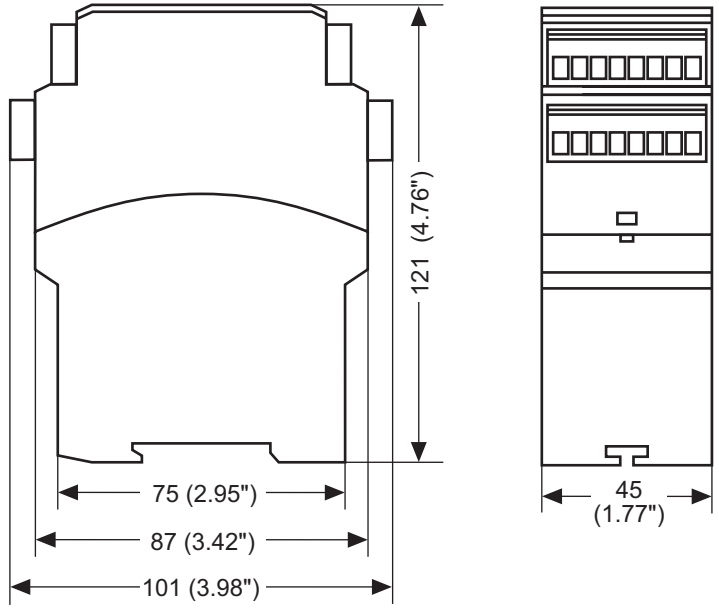


Fig. 1.5-6: Dimensions of the PNOZelog, unit with integrated contact expander module, with cage clamp terminals

Commissioning

Requirements

Please note the following when preparing to commission the unit:
- The unit and the input circuits must always be supplied by a single power supply.
- Use copper wiring that can withstand temperatures of 60/75°C.
- Calculating the max. cable runs I_{max} at the input, reset and feedback circuit:

$$I_{max} = \frac{R_{lmax}}{R_l / km}$$

R_{lmax} = max. overall cable resistance (see technical details)
R_l / km = cable resistance/km
- Cables that have to be laid outside the control cabinet must be protected from mechanical damage, e.g. by installing them in a conduit.
- Output 14, 24: at no-load, a capacitance of max. 2 nF can be driven.
- Safety outputs 14 and 24 should **exclusively** be used for safe applications. The safety outputs must **not** be connected to PLC inputs.
- Output Y32 is an auxiliary output, e.g. for communication with a PLC or text display.
- Safety outputs 14 and 24 may not be connected to PSS inputs (with the exception of the units PNOZ e4.1p and PNOZ e4vp).
- Use freewheel diodes to drive contactors or relays with the safety/auxiliary outputs
- Only contactors with positive-guided contacts should be used for safety functions.

When commissioning and during operation, please note the following:
The safety outputs are constantly checked via test pulses. This may generate a humming noise on the connected contactors, which does not affect the function (contactors are not damaged, contacts remain closed). The test pulses also mean that, when measured with a multimeter, the voltage at the safety outputs is less than 24 VDC.

Input devices for PNOZ e1p, PNOZ e1.1p, PNOZ e1vp, PNOZ e5.11p, PNOZ e5.13p, PNOZ e6.1p and PNOZ e6vp

When selecting input devices, you must comply with the technical details of the input circuits on the PNOZelog units. To help you in your selection, Pilz has performed application tests with a number of input devices. The following input devices have passed the application test:
- Light beam devices:
  - SICK FGS
  - SICK C4000
  - Honeywell MEYLAN
  - CEDES Safe 4
  - OMRON F3SN-A
- Limit switches:
  - Schmersal AZ 16-02
  - Guardmaster ferrocode
  - Euchner NP1-628AS
  - Euchner CES-A-C5E-01 (only when operating without detection of shorts across contacts)
  - Euchner CES-A-C5E-01 (only with test pulse wiring)
  - Euchner NM11KB

Please note:
- Euchner proximity switch operated with detection of shorts across contacts: Distance PNOZelog - Euchner proximity switch: max. 1 km

The following may **not** be used:
- Light beam devices:
  - STI Minisafe 4600
- Limit switches:
  - Euchner CES-A-C5E-01 with pulse signals

The following is generally valid: Input devices with mechanical contacts (relays) can be used in operating modes with or without detection of shorts across contacts, provided you comply with the technical details provided by the manufacturer. It is not always possible to use input devices with semiconductor outputs when operating with detection of shorts across contacts.

Self-testing light beam devices
Self-testing light beam devices are only permitted as input devices if the PNOZelog is operated without detection of shorts across contacts.

Input devices for PNOZ e2.1p and PNOZ e2.2p

Only two-hand buttons may be connected to the two-hand control devices. Please note that the devices are designed for different contacts:
- PNOZ e2.1p: Two-hand buttons with one N/C and one N/O contact
- PNOZ e2.2p: Two hand buttons each with one N/O contact

Input devices for PNOZ e3.1p, PNOZ e3vp, PNOZ e5.13p

Permitted input devices are:
- Pilz safety sensors PSEN 2.x
- Position switch with N/C / N/O combination

Input devices for PNOZ e4.1p and PNOZ e4vp
Only Mayser type SM/BK safety mats that operate according to a 4-wire technology principle (without monitoring resistor) may be used.
When using safety mats, please note the following:

Commissioning

- Where there are several safety mats, these should only be connected in series.
- It is essential to note the information given in Annex B.4 of EN 1760-1, regarding the installation of safety mats.
- If you are using a safety mat system with reset function, the reset must occur outside the danger zone, but with a view into the danger zone.
- The function of the safety system must be tested at regular intervals.

Commissioning

Logic connections

Units in the PNOZelog product range can be linked logically via special AND/OR inputs. One exception is the PNOZ e1p. This does not have any special logic inputs, but can be linked to other units via the safety outputs (from Version 3.0).
From Version 3, safety outputs from the PNOZmulti can also be AND/OR connected with PNOZelog units.

INFORMATION
The logic inputs exclusively recognise signals from the safety outputs on PNOZelog units and PNOZmulti units (from Version 3). These have a special pulse code which the logic inputs check.

When linking several units, please note:
- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked to the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units (Example 1).
- Up to 50 safety inputs from PNOZelog units can be connected to safety outputs with no load.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked PNOZelog units must be connected to the same supply voltage.
- The AND/OR inputs have switch delays, which are added together with each unit that is linked (Example 3).
- All units that are linked via the AND/OR inputs must be installed in the same control cabinet along with their connection leads.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits.

Muting function

The OR input can be used for the muting function. In doing so the safety device is knowingly suspended. Depending on the application area (see relevant C standard), this suspended status must be displayed via a lamp. This lamp must either be redundant in design or must be monitored for short circuit and open circuit.

Logic connections

Examples of logic connections

In all the application examples, 2 loads may also be connected to the safety outputs.

- Example 1:
  Prerequisite: All units must be in the same control cabinet.
  A load is connected to the safety output on Unit 1. An additional 4 PNOZelog units are also connected to this output via the AND input.

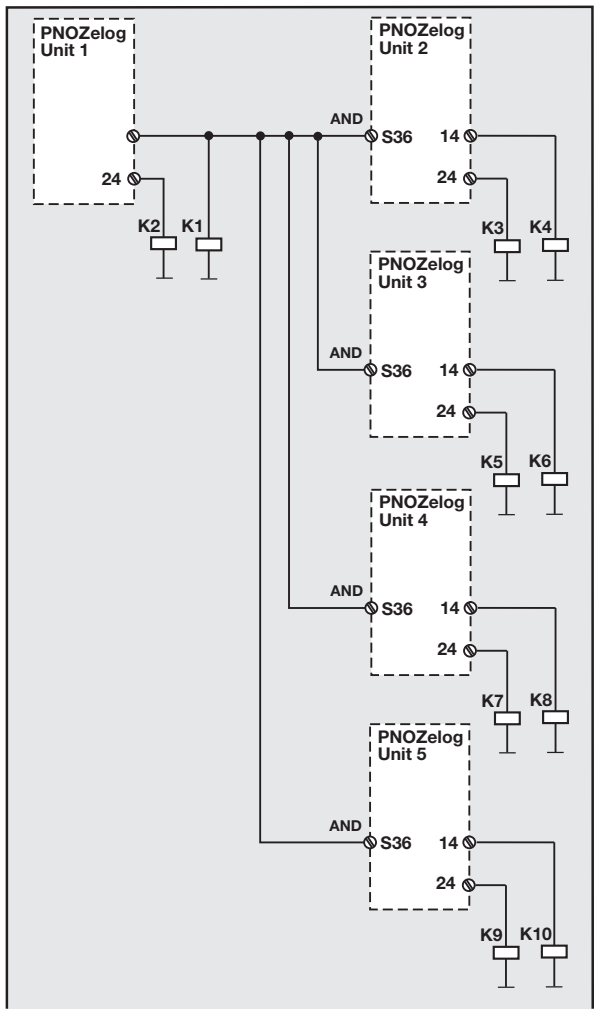


Fig. 1.7-1: Max. one load and 4 PNOZelog units at an output

Logic connections

- Example 2:
  Prerequisites:
  All units must be in the same control cabinet. The possibility of a short circuit between +24 VDC and a safety output must be eliminated!
  Two PNOZelog units are AND-linked. As both units are in the same control cabinet, loads may also be connected to the logic connection line (Fig. 7-2).

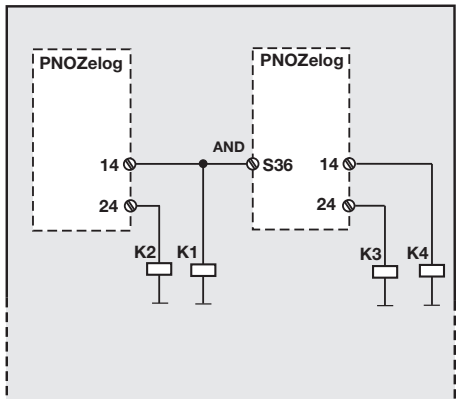


Fig. 1.7-2: Logic connection with additional loads in one control cabinet

- Example 3:
  Prerequisite:
  All units must be in the same control cabinet.
  Unit 3 is AND-linked to Unit 2, Unit 2 is AND-linked to Unit 1. If outputs 24 and 14 on Unit 1 switch from a high to a low signal, the signal from output 14 on Unit 2 will also switch from high to low via AND input S36. In turn this will switch off the AND input on Unit 3 (Fig. 7-3).
  The units' delay times are added together via the logic AND connection.

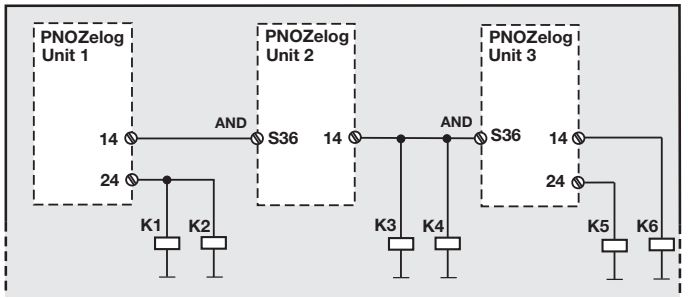


Fig. 1.7-3: Logic AND connection with 2 PNOZelog units

Logic connections

- Example 4:
  Prerequisite: All units must be in the same control cabinet.
  The logic connection line between Unit 1 and Unit 2 contains the contacts of the external contactors from Unit 4. This means that Unit 4 and Unit 1 can set the outputs on Unit 2 and Unit 3 to low (Fig. 7-4).

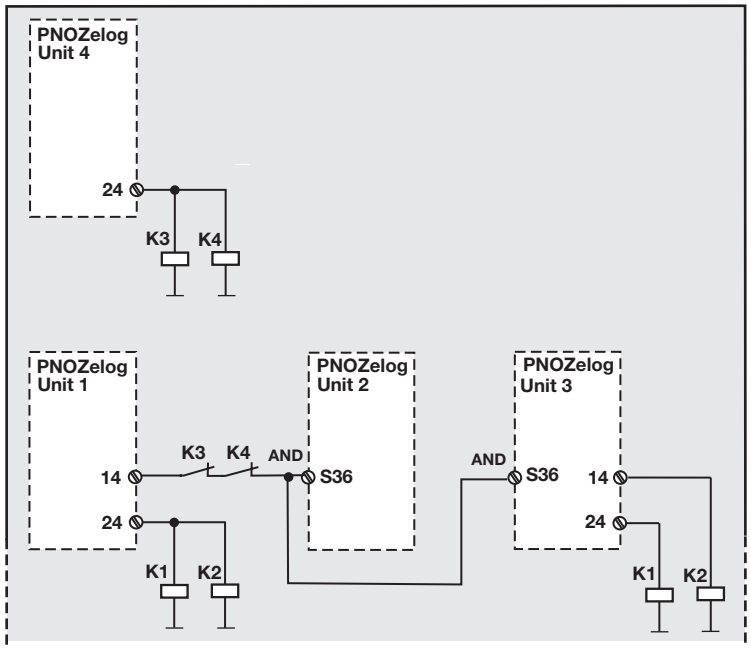


Fig. 1.7-4: External contacts in the logic connection line, all elements in one control cabinet

Logic connections

- Example 5:
  Prerequisite: All units must be in the same control cabinet.
  Unit 1 and Unit 2 are OR-linked. If the output from Unit 2 has a low signal, Unit 1 alone will control the status of the outputs on Unit 3. If Unit 2 sends a high signal to the OR input of Unit 3, a high signal will be present at the outputs of Unit 3, irrespective of the status of its input circuit.

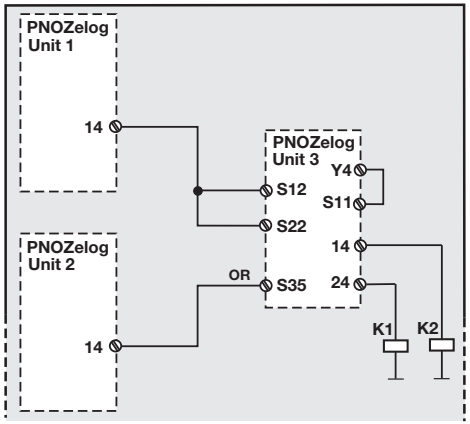


Fig. 1.7-5: Logic input can shut down outputs

Operation and fault diagnostics

During operation, 3 LEDs indicate the units' operating status and the fault conditions.
The unit is ready for operation when:
- The "POWER" LED lights up

and
- The LEDs "CH.1" and "CH.2" are both lit (high signal at the safety outputs)

or
- The LEDs "CH.1" and "CH.2" are both out (low signal at the safety outputs).

LED CH.1 is assigned to safety output 14, LED CH.2 to safety output 24.

INFORMATION
Supply interruptions lasting longer than 20 ms are detected as an error. The LEDs indicate an error and the safety outputs carry a low signal. The plant or machinery driven via the safety outputs will be shut down. The unit can only be restarted by switching the supply voltage off and then on again.

Errors

Fault conditions are indicated by flashing the LEDs. Some errors are displayed through periodic flashing (see Table 8-1); with other errors it is possible to establish an error code through the number of flashes (Table 8-2).
These errors are always indicated by three short flashes at LED CH.1 or CH.2. After a longer pause, the LED will then flash at one second intervals. The number of LED flashes corresponds to a digit in the error code. The error code can consist of up to 4 digits. The digits are separated by a longer period without flashing. The entire sequence is constantly repeated.

The error code can also be read into a PLC via the diagnostic output. In this case the error code will appear as a hexadecimal sequence. The process of reading and transferring data to a PLC is described in the PLC Drivers manual.

INFORMATION
Leading zeros are not transmitted.
Error code 0: 16 flashes

LED	Error	Remedy
LEDs unlit	Supply voltage is missing, too low, wrongly connected	Apply supply voltage: A1 - +24 VDC and A2 - 0 VDC Permitted voltage range: 19.2 ... 30 VDC
POWER flashing	Unknown operating mode, initialisation phase, start not executed	Depending on operating mode: Press reset button or perform start-up test
PNOZ e1p: CH.1 and Ch.2 periodically flash at the same time	Error in the wiring of input circuit S11, S12, S21, S22	Rectify wiring error, restart unit
All units **except** PNOZ e6.1p, PNOZ e6vp: CH.1 and CH.2 flash alternately	1.) Feedback loop open on start-up 2.) Only one channel of the input circuit is open or is partially operated	1.) Close feedback loop, open input circuit, start unit again 2.) Open both input circuit channels
PNOZ e6.1p, PNOZ e6vp: CH.1 and CH.2 flash alternately	1.) Feedback loop open on start-up 2.) Only one channel of the input circuit is open or is partially operated 3.) External feedback loop closed on start-up, but internal feedback loop faulty	1.) Close feedback loop, open input circuit, start unit again 2.) Open both input circuit channels 3.) No remedy available to user - send unit to Pilz
PNOZ e2.1p, PNOZ e2.2p: CH.1 **or** CH.2 flashes briefly (50 ms on, 250 ms off)	Simultaneity conditions not met	Release the two-hand button and press it again.
PNOZ e2.1p, PNOZ e2.2p: CH.1 **and** CH.2 flash briefly (50 ms on, 250 ms off)	A pushbutton is defective or there is a wiring error	Change pushbutton or rectify wiring error
CH.1 or CH.2 flash a code	Error coding, see Table 1.8-3	See Table 1.8-3

Table 1.8-1: Display of fault conditions

Operation and fault diagnostics

Examples

Error code 1, 3:
LED CH.1 or CH.2 flashes
- 3 times, briefly
- Pause
- Once for one second
- Pause
- 3 times for one second each

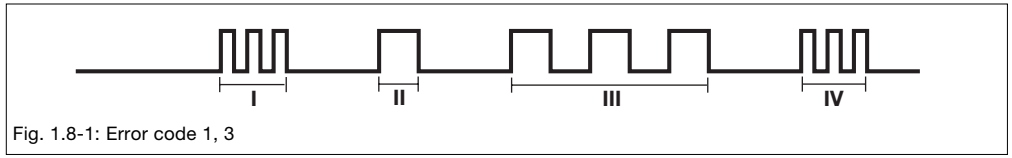


Fig. 1.8-1: Error code 1, 3

Error code 1:
LED CH.1 or CH.2 flashes
- 3 times, briefly
- Pause
- Once for one second

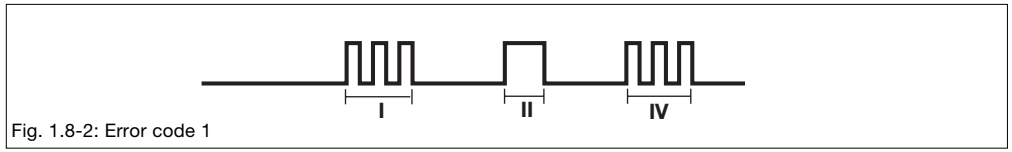


Fig. 1.8-2: Error code 1

Error code 1, 0:
LED CH.1 or CH.2 flashes
- 3 times, briefly
- Pause
- Once for one second
- Pause
- 16 times for one second each

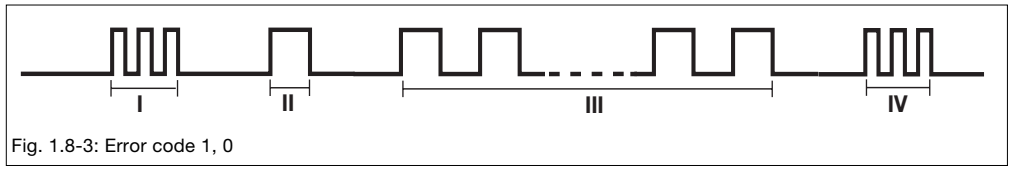


Fig. 1.8-3: Error code 1, 0

I Code for error message
II Code for 1st digit
III Code for 2nd digit
IV Code for error message repeated

Table 1.8-2 shows the relationship between the number of flashes and the error code. The key to the error code is described overleaf in Table 1.8-3.

Number of flashes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Decimal error code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0

Table 1.8-2: Relationship between number of flashes and decimal error code

Operation and fault diagnostics

Error codes

Decimal error code	Number of flashes	Description	Remedy
1 2	3x short - 1x long - 3x short 3x short - 2x long - 3x short	Faulty wiring, short circuit	Rectify wiring error at terminals S34, S11-S14, S21-S24, Y6 or Y4
3	3x short - 3x long - 3x short	Operating mode changed during operation	Rectify wiring error at terminal Y4, Y6, Y7, Y37 or S36
4 ... 9	3x short - 4x long - 3x short ... 3x short - 9x long - 3x short	In the initialisation phase, short circuit between the safety outputs and +24 VDC	Rectify wiring error at terminals 14, 24
10 ... 1, 0 1, 1 1, 9 10, 1 14, 5	3x short - 10x long - 3x short ... 3x short - 1x long - 16x long - 3x short 3x short - 1x long - 1x long - 3x short 3x short - 1x long - 9x long - 3x short 3x short - 10x long - 1x long - 3x short 3x short - 14x long - 5x long - 3x short	During operation, short circuit between the safety outputs and +24 VDC	Rectify wiring error at terminals 14, 24
1, 2 1, 3 1, 12 1, 13	3x short - 1x long - 2x long - 3x short 3x short - 1x long - 3x long - 3x short 3x short - 1x long - 12x long - 3x short 3x short - 1x long - 13x long - 3x short	During operation, short circuit between the safety outputs and 0 VDC or U_B<19.2 VDC	Rectify wiring error at terminals 14, 24; Keep within the supply voltage range of 19.2 ... 30 VDC
1, 4	3x short - 1x long - 4x long - 3x short	Operating mode changed during operation	Check wiring at terminals S23, Y6 or Y7
1, 5	3x short - 1x long - 5x long - 3x short	Unexpected status at S36	Check wiring at terminal S36
1, 6 1, 7	3x short - 1x long - 6x long - 3x short 3x short - 1x long - 7x long - 3x short	Wiring of operating mode “with detection of shorts across contacts” faulty	Rectify wiring error at terminal S12, S22 or S24
1, 8 1, 11	3x short - 1x long - 8x long - 3x short 3x short - 1x long - 11x long - 3x short	1.) Feedback loop open 2.) PNOZ e6.1p, PNOZ e6vp: External feedback loop closed, but internal feedback loop faulty	1.) Close feedback loop at terminal Y6 and Y7 2.) No remedy available to user - send unit to Pilz
1, 10	3x short - 1x long - 10x long - 3x short	Open circuit	Check the safety mat wiring
5, 10	3x short - 5x long - 10x long - 3x short	U_B<19.2 VDC	Keep within the supply voltage range of 19.2 ... 30 VDC

Table 1.8-3: Error code, part 1

Operation and fault diagnostics
Units with integrated contact expander module

Decimal error code	Number of flashes	Description	Remedy
8,1	3x short - 8x long - 1x long - 3x short	Invalid operating mode	Rectify wiring error at terminal S34, Y4, Y6 or Y7
8, 2 8, 3 14, 13	3x short - 8x long - 2x long - 3x short 3x short - 8x long - 3x long - 3x short 3x short - 14x long - 13x long - 3x short	Supply interrupted, possibly caused by a short to earth	Rectify wiring error at terminal A1 or check supply voltage
2, 0, 0 2, 0, 1	3x short - 2x long - 16x long - 16x long - 3x short 3x short - 2x long - 16x long - 1x long - 3x short	U_B<19.2 VDC	Keep within the supply voltage range of 19.2 ... 30 VDC
2, 0, 2	3x short - 2x long - 16x long - 2x long - 3x short	In the initialisation phase, short circuit between the safety outputs and +24 VDC	Rectify wiring error at terminals 14, 24
2, 0, 3	3x short - 2x long - 16x long - 3x long - 3x short	U_B<19.2 VDC	Keep within the supply voltage range of 19.2 ... 30 VDC

Table 1.8-3: Error code, part 2

Operation and fault diagnostics

Technical details

	PNOZ e1p	PNOZ e1.1p, PNOZ e1vp	PNOZ e2.1p, PNOZ e2.2p
Electrical data			
Supply voltage	24 V DC	24 V DC	24 V DC
Voltage tolerance	-20 %/+25 %	-20 %/+25 %	-20 %/+25 %
Power consumption at U_B without load	2 W	2 W	2 W
Residual ripple U_B	20 %	20 %	20 %
Switching capability, semiconductor			
2 outputs under load	$U_B \leq$ 26,5 V: 2,0 A/50W	$U_B \leq$ 26,5 V: 2,0 A/50W	$U_B \leq$ 26,5 V: 2,0 A/50W
	$U_B >$ 26,5 V: 1,5 A/45W	$U_B >$ 26,5 V: 1,5 A/45W	$U_B >$ 26,5 V: 1,5 A/45W
1 output under load	$U_B \leq$ 26,5 V: 2,7 A/70W	$U_B \leq$ 26,5 V: 2,7 A/70W	$U_B \leq$ 26,5 V: 2,7 A/70W
	$U_B >$ 26,5 V: 2,2 A/65W	$U_B >$ 26,5 V: 2,2 A/65W	$U_B >$ 26,5 V: 2,2 A/65W
Total power ext. load, Semiconductor	130 W	130 W	130 W
Voltage and current at			
Input circuit, feedback circuit	24 V/5 mA DC	24 V/5 mA DC	24 V/5 mA DC
Reset circuit	24 V/5 mA DC	24 V/5 mA DC	24 V/5 mA DC
Auxiliary output, test pulse outputs	24 V/0,5 A DC	24 V/0,5 A DC	24 V/0,5 A DC
AND/OR inputs		24 V/5 mA DC	24 V/5 mA DC
Unit fuse protection	max. 10 A quick max. 6 A slow acting	max. 10 A quick max. 6 A slow acting	max. 10 A quick max. 6 A slow acting
Max. overall cable resistance R_{lmax}			
Input, reset and feedback circuit			
Single-channel	1 kOhm	1 kOhm	
Dual-channel: detects shorts across contacts	2 kOhm	2 kOhm	2 kOhm
Dual-channel w/o detection of shorts across contacts	2 kOhm	2 kOhm	
Reset and feedback circuit:			
Dual-channel: detects shorts across contacts			
Input circuit, safety mat clear			
Max. safety mat resistance			

Technical details

	PNOZ e1p	PNOZ e1.1p, PNOZ e1vp	PNOZ e2.1p, PNOZ e2.2p
Safety-related characteristics of the safety outputs			
Probability of dangerous failure per hour (PFH_D)			
with AND connection		3,73E-09 1/h	3,73E-09 1/h
without AND connection	3,44E-09 1/h	3,44E-09 1/h	3,44E-09 1/h
SIL claim limit	3	3	3
Performance level (PL)			
with AND connection		d	d
without AND connection	e	e	e
Proof test interval in years	20	20	20
Times			
Supply interruption before de-energisation	≤ 20 ms	≤ 20 ms	≤ 20 ms
Switch-on delay			
Monitored reset	max. 260 ms, typ.180 ms	max. 260 ms, typ.180 ms	
Automatic reset	max. 180 ms, typ.100 ms	max. 180 ms, typ.100 ms	max. 180 ms, typ.100 ms
Delay-on de-energisation (= reaction time at e4 * p) at S35/S36 and when safety function is triggered			
Instantaneous safety outputs, Semiconductor	40 ms (not on S35/S36)	40 ms	40 ms
Delayed safety outputs, Semiconductor (e * vp 10)		0/0,15/0,5/1/2/3/5/7/10 s	
(e * vp 300)		0/15/25/50/100/150/200/250/300 s	
Accuracy	+/- 10% + max. 40ms	+/- 10% + max. 40ms	
Repetition accuracy	+/-5%	+/-5%	
Delay-on de-energisation after power failure	1 ms	1 ms	1 ms
Simultaneity of input circuits	∞	∞	500 ms
Switch-on delay (on initial start after U_B is applied)	3 s	3 s	3 s
Switch-on delay at S35/S36		max. 200 ms , typ. 120 ms	max. 200 ms , typ. 120 ms
Min. reset button actuation time closed/open	100 ms/100 ms	100 ms/100 ms	

Technical details

	PNOZ e1p	PNOZ e1.1p, PNOZ e1vp	PNOZ e2.1p, PNOZ e2.2p
Environmental data			
Airgap creepage	EN 60947-1	EN 60947-1	EN 60947-1
Climatic suitability	EN 60068-2-78	EN 60068-2-78	EN 60068-2-78
Ambient temperature	-10 ... + 55 °C	-10 ... + 55 °C	-10 ... + 55 °C
Storage temperature	-25 ... + 70 °C	-25 ... + 70 °C	-25 ... + 70 °C
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
Vibration in accordance with	EN 60068-2-6	EN 60068-2-6	EN 60068-2-6
Frequency	10 ... 55 Hz	10 ... 55 Hz	10 ... 55 Hz
Amplitude	0,35 mm	0,35 mm	0,35 mm
Protection type			
Mounting (e.g. control cabinet)	IP54	IP54	IP54
Housing	IP40	IP40	IP40
Terminals	IP20	IP20	IP20
Mechanical data			
Cross section of external conductors (screw terminals)			
1 core flexible	0,25 ... 2,5 mm^2/24-12 AWG	0,25 ... 2,5 mm^2/24-12 AWG	0,25 ... 2,5 mm^2/24-12 AWG
2 core with the same cross section flexible with crimp connectors, no plastic sleeve	0,25 ... 1 mm^2 /24-16 AWG	0,25 ... 1 mm^2 /24-16 AWG	0,25 ... 1 mm^2 /24-16 AWG
Flexible without crimp connectors or with TWIN crimp connectors	0,20 ... 1,5 mm^2/24-16 AWG	0,20 ... 1,5 mm^2/24-16 AWG	0,20 ... 1,5 mm^2/24-16 AWG
Max. cross section of external conductors (cage clamp terminals)			
Flexible without crimp connectors	0,20 ... 1,5 mm^2/24-16 AWG	0,20 ... 1,5 mm^2/24-16 AWG	0,20 ... 1,5 mm^2/24-16 AWG
Housing with cage clamp terminals			
Stripping length	8 mm	8 mm	8 mm
Terminal points per connection	2	2	2
Torque setting for connection terminals (screws)	0,5 Nm	0,5 Nm	0,5 Nm
Housing material			
Front	ABS UL 94 V0	ABS UL 94 V0	ABS UL 94 V0
Housing	PPO UL 94 V0	PPO UL 94 V0	PPO UL 94 V0

The standards current on 2005-08 apply.

Technical details

	PNOZ e3.1p, PNOZ e3vp	PNOZ e4.1p, PNOZ e4vp	PNOZ e5.11p, PNOZ e5.13p
Electrical data			
Supply voltage	24 V DC	24 V DC	24 V DC
Voltage tolerance	-20 %/+25 %	-20 %/+25 %	-20 %/+25 %
Power consumption at U_B without load	2 W	2 W	2 W
Residual ripple U_B	20 %	20 %	20 %
Switching capability, semiconductor			
2 outputs under load	$U_B \leq$ 26,5 V: 2,0 A/50W $U_B >$ 26,5 V: 1,5 A/45W	$U_B \leq$ 26,5 V: 2,0 A/50W $U_B >$ 26,5 V: 1,5 A/45W	$U_B \leq$ 26,5 V: 1,5 A/40W $U_B >$ 26,5 V: 1 A/30W
1 output under load	$U_B \leq$ 26,5 V: 2,7 A/70W $U_B >$ 26,5 V: 2,2 A/65W	$U_B \leq$ 26,5 V: 2,7 A/70W $U_B >$ 26,5 V: 2,2 A/65W	$U_B \leq$ 26,5 V: 2 A/50W $U_B >$ 26,5 V: 1,5 A/45W
Total power ext. load, Semiconductor	130 W	130 W	100 W
Voltage and current at			
Input circuit, reset circuit, Feedback circuit	24 V/5 mA DC	24 V/5 mA DC	24 V/5 mA DC
Auxiliary output, test pulse outputs	24 V/0,5 A DC	24 V/0,5 A DC	24 V/0,5 A DC
AND/OR inputs	24 V/5 mA DC	24 V/5 mA DC	24 V/5 mA DC
Unit fuse protection	max. 10 A quick max. 6 A slow acting	max. 10 A quick max. 6 A slow acting	max. 10 A quick max. 6 A slow acting
Max. overall cable resistance R_{lmax}			
Input, reset and feedback circuit			
Single-channel	1 kOhm		1 kOhm
Dual-channel: detects shorts across contacts	2 kOhm		
Dual-channel w/o detection of shorts across contacts			2 kOhm
Reset and feedback circuit:			
Dual-channel: detects shorts across contacts		2 kOhm	
Input circuit, safety mat clear		150 Ohm	
Max. safety mat resistance		150 Ohm	

Technical details

	PNOZ e3.1p, PNOZ e3vp	PNOZ e4.1p, PNOZ e4vp	PNOZ e5.11p, PNOZ e5.13p
Safety-related characteristics of the safety outputs			
Probability of dangerous failure per hour (PFH_D)			
with AND connection	3,73E-09 1/h	3,97E-09 1/h	3,73E-09 1/h
without AND connection	3,44E-09 1/h	3,68E-09 1/h	3,44E-09 1/h
SIL claim limit	3	2	3
Performance level (PL)			
with AND connection	d	d	d
without AND connection	e	d	e
Proof test interval in years	20	20	20
Times			
Supply interruption before de-energisation	≤ 20 ms	≤ 20 ms	≤ 20 ms
Switch-on delay			
Monitored reset	max. 260 ms, typ.180 ms	max. 260 ms, typ. 180 ms	max. 260 ms, typ.120 ms
Automatic reset	max. 180 ms, typ. 100 ms	max. 180 ms, typ. 50 ms	max. 210 ms, typ. 60 ms
Delay-on de-energisation (= reaction time at e4 * p) at S35/S36 and when safety function is triggered			
Instantaneous safety outputs,	40 ms	40 ms	30 ms
Semiconductor			35 ms after E-STOP
Delayed safety outputs,			
Semiconductor (e * vp 10)	0/0,15/0,5/1/2/3/5/7/10 s	0/0,15/0,5/1/2/3/5/7/10 s	
(e * vp 300)	0/15/25/50/100/150/200/250/300 s		
Accuracy	+/- 10% + max. 35ms	+/- 10% + max. 40ms	
Repetition accuracy	+/-5%	+/-5%	
Delay-on de-energisation after power failure	1 ms	1 ms	1 ms
Simultaneity input circuits	∞	∞	∞
Switch-on delay (on initial start after U_B is applied)	3 s	3 s	3 s
Switch-on delay at S35/S36	max. 200 ms , typ. 120 ms	max. 210 ms , typ. 60 ms	max. 200 ms , typ. 60 ms
Min. reset button actuation time closed/open	100 ms/100 ms	100 ms/100ms	100 ms/100 ms

Technical details

	PNOZ e3.1p, PNOZ e3vp	PNOZ e4.1p, PNOZ e4vp	PNOZ e5.11p, PNOZ e5.13p
Environmental data			
Airgap creepage	EN 60947-1	EN 60947-1	EN 60947-1
Climatic suitability	EN 60068-2-78	EN 60068-2-78	EN 60068-2-78
Ambient temperature	-10 ... + 55 °C	-10 ... + 55 °C	-10 ... + 55 °C
Storage temperature	-25 ... + 70 °C	-25 ... + 70 °C	-25 ... + 70 °C
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
Vibration in accordance with	EN 60068-2-6	EN 60068-2-6	EN 60068-2-6
Frequency	10 ... 55 Hz	10 ... 55 Hz	10 ... 55 Hz
Amplitude	0,35 mm	0,35 mm	0,35 mm
Protection type			
Mounting (e.g. control cabinet)	IP54	IP54	IP54
Housing	IP40	IP40	IP40
Terminals	IP20	IP20	IP20
Mechanical data			
Cross section of external conductors (screw terminals)			
1 core flexible	0,25 ... 2,5 mm^2/24-12 AWG	0,25 ... 2,5 mm^2/24-12 AWG	0,25 ... 2,5 mm^2/24-12 AWG
2 core with the same cross section flexible with crimp connectors, no plastic sleeve	0,25 ... 1 mm^2 /24-16 AWG	0,25 ... 1 mm^2 /24-16 AWG	0,25 ... 1 mm^2 /24-16 AWG
Flexible without crimp connectors or with TWIN crimp connectors	0,20 ... 1,5 mm^2/24-16 AWG	0,20 ... 1,5 mm^2/24-16 AWG	0,20 ... 1,5 mm^2/24-16 AWG
Max. cross section of external conductors (cage clamp terminals)			
Flexible without crimp connectors	0,20 ... 1,5 mm^2/24-16 AWG	0,20 ... 1,5 mm^2/24-16 AWG	0,20 ... 1,5 mm^2/24-16 AWG
Housing with cage clamp terminals			
Stripping length	8 mm	8 mm	8 mm
Terminal points per connection	2	2	2
Torque setting for connection terminals (screws)	0,5 Nm	0,5 Nm	0,5 Nm
Housing material			
Front	ABS UL 94 V0	ABS UL 94 V0	ABS UL 94 V0
Housing	PPO UL 94 V0	PPO UL 94 V0	PPO UL 94 V0

The standards current on 2005-08 apply.

Technical details

Units with integrated contact expander module

	PNOZ e6.1p	PNOZ e6vp
Electrical data		
Supply voltage	24 V DC	24 V DC
Voltage tolerance	-20 %/+25 %	-20 %/+25 %
Power consumption at U_B without load	4,5 W	4,5 W
Residual ripple U_B	20 %	20 %
Outputs, semiconductor		
Safety outputs (N/O)	2	2
Auxiliary output (S)	1	1
Switching capability, semiconductor		
2 outputs under load	$U_B \leq 26,5$ V: 2,0 A/50 W $U_B > 26,5$ V: 1,5 A/45 W	$U_B \leq 26,5$ V: 2,0 A/50 W $U_B > 26,5$ V: 1,5 A/45 W
1 output under load	$U_B \leq 26,5$ V: 2,7 A/70 W $U_B > 26,5$ V: 2,2 A/65 W	$U_B \leq 26,5$ V: 2,7 A/70 W $U_B > 26,5$ V: 2,2 A/65 W
Total power ext. load, Semiconductor	130 W	130 W
Safety contacts (N/O)	4	4
Utilisation category in accordance with EN 60947-4-1		
AC1 safety contacts	240 V/0,01 ... 6 A/1500 VA	240 V/0,01 ... 6 A/1500 VA
DC1 safety contacts	24 V/0,01 ... 6 A/150 W	24 V/0,01 ... 6 A/150 W
Utilisation category in accordance with EN 60947-5-1		
AC15 safety contacts	230 V/3 A	230 V/3 A
DC13 safety contacts (DC13: 6 cycles/min.)	24 V/4 A	24 V/4 A
Voltage and current at		
Input circuit, reset circuit, Feedback circuit	24 V/5 mA DC	24 V/5 mA DC
Auxiliary output, test pulse outputs	24 V/0,5 A DC	24 V/0,5 A DC
AND/OR inputs	24 V/5 mA DC	24 V/5 mA DC
Unit fuse protection	max. 10 A quick max. 6 A slow acting	max. 10 A quick max. 6 A slow acting

Technical details

Units with integrated contact expander module

	PNOZ e6.1p	PNOZ e6vp
Max. overall cable resistance R_{lmax}		
Input, reset and feedback circuit		
Single-channel	1 kOhm	1 kOhm
Dual-channel with detection of shorts across contacts	2 kOhm	2 kOhm
Safety-related characteristics of the safety outputs		
Probability of dangerous failure per hour (PFH_D)		
with AND connection, semiconductor output	3,73E-09 1/h	3,73E-09 1/h
with AND connection, relay output	6,04E-09 1/h	6,04E-09 1/h
without AND connection, semiconductor output	3,44E-09 1/h	3,44E-09 1/h
without AND connection, relay output	5,75E-09 1/h	5,75E-09 1/h
SIL claim limit	3	3
Performance level (PL)		
with AND connection	d	d
without AND connection	e	e
Proof test interval in years	20	20
Times		
Supply interruption before de-energisation A1/A2	max. 20 ms	max. 20 ms
Delay time t_v, safety outputs		
PNOZ e6vp 10 s		0/0,15/0,5/1/2/3/5/7/10 s
Accuracy		+/- 1 %
Repetition accuracy		+/- 3 %
Switch-on delay, semiconductor		
Monitored reset	max. 260 ms, typ. 180 ms	max. 260 ms, typ.180 ms
Automatic reset	max. 180 ms, typ. 100 ms	max. 180 ms, typ.100 ms
Switch-on delay, safety contacts		
Monitored reset	max. 280 ms, typ. 195 ms	max. 280 ms, typ. 195 ms
Automatic reset	max. 200 ms, typ. 115 ms	max. 200 ms, typ. 115 ms
Delay-on de-energisation, safety contacts		
After E-STOP	55 ms	55 ms + t_v
After power failure	max. 55 ms, typ. 45ms	max. 55 ms + t_v, typ. 45 ms + t_v

Technical details

Units with integrated contact expander module

	PNOZ e6.1p	PNOZ e6vp
Simultaneity of input circuits	∞	∞
Switch-on delay (on initial start after U_B is applied)	max. 3 s, typ. 3 s	max. 3 s, typ. 3 s
Switch-on delay, semiconductor at S35/S36	max. 200 ms , typ. 120 ms	max. 200 ms , typ. 120 ms
Delay-on de-energisation, semiconductor at S35/S36	40 ms	40 ms
Switch-on delay, semiconductor at S35/S36	max. 220 ms , typ. 135 ms	max. 220 ms , typ. 135 ms
Delay-on de-energisation, safety contacts at S35/S36	max. 60 ms , typ. 50 ms	max. 60 ms , typ. 50 ms
Environmental data		
Airgap creepage	EN 60947-1	EN 60947-1
Climatic suitability	EN 60068-2-78	EN 60068-2-78
Ambient temperature	-10 ... + 55 °C	-10 ... + 55 °C
Storage temperature	-25 ... + 70 °C	-25 ... + 70 °C
EMC	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4	EN 60947-5-1, EN 61000-6-2, EN 61000-6-4
Vibration in accordance with	EN 60068-2-6	EN 60068-2-6
Frequency	10 ... 55 Hz	10 ... 55 Hz
Amplitude	0,35 mm	0,35 mm
Protection type		
Mounting (e.g. control cabinet)	IP54	IP54
Housing	IP40	IP40
Terminals	IP20	IP20
Mechanical data		
Cross section of external conductors (screw terminals)		
1 core flexible	0,25 ... 2,5 mm^2/24-12 AWG	0,25 ... 2,5 mm^2/24-12 AWG
2 core with the same cross section		
Flexible with crimp connectors, no plastic sleeve	0,25 ... 1 mm^2 /24-16 AWG	0,25 ... 1 mm^2 /24-16 AWG
Flexible without crimp connectors or with TWIN crimp connectors	0,20 ... 1,5 mm^2/24-16 AWG	0,20 ... 1,5 mm^2/24-16 AWG

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Technical details
Units with integrated contact expander module

	PNOZ e6.1p	PNOZ e6vp
Max. cross section of external conductors (cage clamp terminals)		
Flexible without crimp connectors	0,20 ... 1,5 mm²/24-16 AWG	0,20 ... 1,5 mm²/24-16 AWG
Housing with cage clamp terminals		
Stripping length	8 mm	8 mm
Terminal points per connection	2	2
Torque setting for connection terminals (screws)	0,5 Nm	0,5 Nm
Housing material		
Front	ABS UL 94 V0	ABS UL 94 V0
Housing	PPO UL 94 V0	PPO UL 94 V0

The standards current on 2005-09 apply.

Technical details

Approvals

Type		
PNOZ e1p	◆	◆
PNOZ e1.1p	◆	◆
PNOZ e1vp	◆	◆
PNOZ e2.1p	◆	◆
PNOZ e2.2p	◆	◆
PNOZ e3.1p	◆	◆
PNOZ e3vp	◆	◆
PNOZ e4.1p	◆	◆
PNOZ e4vp	◆	◆
PNOZ e5.11p	◆	◆
PNOZ e5.13p	◆	◆
PNOZ e6.1p	Pending	◆
PNOZ e6vp	Pending	◆

Accessories

PLC drivers
Safety relays in the PNOZelog-range have a diagnostic interface for outputting diagnostic data to a PLC. The transmission of the diagnostic data is controlled by input Y5; the diagnostic data is issued at output Y32.
To read and evaluate the diagnostic data you will need to program a driver for the PLC.
Pilz supplies drivers for PLCs from various manufacturers. These are available on the “PLC Drivers” CD, under order number 874 130B.

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Comparison of PNOZelog units

Comparison of PNOZelog units

Common features were described in Chapters 2.2 … 2.9. Only the features specific to individual units are described here. Table 10-1 shows the differences between the units. The pages that follow provide information on intended use, wiring and unit-specific data for each individual unit.

Function	Feedback loop	Detection of shorts across contacts	Delayed outputs	Logic inputs	Applications
PNOZ e1p	In series to reset circuit, monitored	With terminal Y4 and A1	No	No	E-STOP Safety gates Light beam devices Scanners
PNOZ e1.1p, PNOZ e6.1p	At terminal Y6, monitored	With Y4 and A1/S11, depending on the logic AND/OR connection	No	One AND and one OR input	
PNOZ e1vp, PNOZ e6vp	At terminal Y6 and/or Y7, monitored	With Y4 and A1/S11, depending on the logic AND/OR connection	0, 1 or 2, depending on the AND wiring and feedback loops	One AND and one OR input	
PNOZ e2.1p	At terminal Y6 and/or Y7, monitored	Always with detection of shorts across contacts	No	One AND and one OR input	Two-hand buttons (N/C-N/O)
PNOZ e2.2p	At terminal Y6 and/or Y7, monitored	Always with detection of shorts across contacts	No	One AND and one OR input	Two-hand buttons (N/O)
PNOZ e3.1p	At terminal Y6, monitored	With Y4 and A1/S11/ S23, depending on the logic AND/OR connection	No	One AND and one OR input	Position switch
PNOZ e3vp	At terminal Y6 and/or Y7, monitored	With Y4 and A1/S11/ S23, depending on the logic AND/OR connection	0, 1 or 2, depending on the AND wiring and feedback loops	One AND and one OR input	Position switch
PNOZ e4.1p	At terminal Y6, monitored	Always with detection of shorts across contacts	No	One AND and one OR input	Mayser SM/BK safety mat Can be used to control a PSS
PNOZ e4vp	At terminal Y6 and/or Y7, monitored	Always with detection of shorts across contacts	Output 24	One AND and one OR input	Mayser SM/BK safety mat Can be used to control a PSS
PNOZ e5.11p	At terminal Y6 and/or Y7, monitored	Always without detection of shorts across contacts	No	One AND input	E-STOP Safety gates Light beam devices Scanners Position switches
PNOZ e5.13p	At terminal Y6 and/or Y7, monitored	Always without detection of shorts across contacts	No	One AND input	

Table 2.1-1: Differences between the PNOZelog units

Unit-specific description
PNOZ e1p

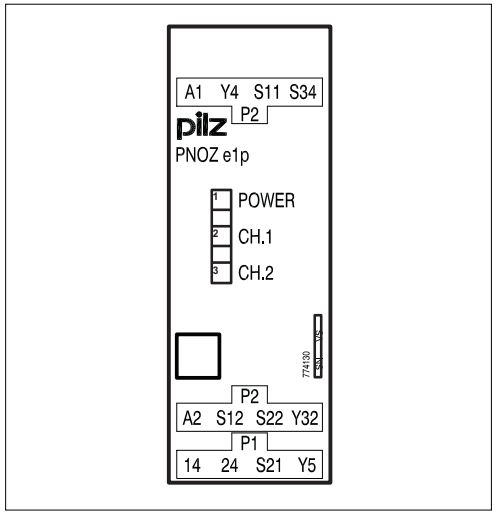
Intended use

The relay PNOZ e1p is used for the safety-related interruption of a safety circuit. The unit meets the requirements of EN 954-1 up to Category 4.
The unit is designed for use on:
- E-STOP equipment
- Safety circuits in accordance with VDE 0113 Part 1 and EN 60204-1 (e.g. on movable guards)

Description

The basic functions of the PNOZ e1p are described in Chapter 1.4. Specific features are:
- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**)
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- Feedback loop can be connected in series to the reset circuit
- Application options for:
  - E-STOP buttons
  - Safety gate limit switches
  - Safety mats and safe edges made by Haake (N/C principle)
  - Proximity switch evaluation devices
  - Used to process signals from output switching devices on safety mats (short circuit principle) or from output switching elements on light beam devices
- Weight: 125 g

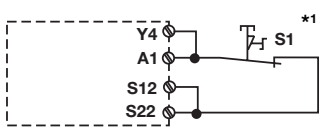
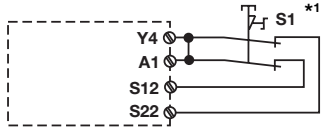
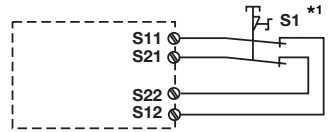
Terminal configuration



Wiring

Supply voltage:
- Connect the supply voltage to:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
The N/C contact on the trigger element (e.g. E-STOP) must be connected to the input circuit. A short circuit in the input circuit may or may not be detected, depending on the wiring of Y4.
- The input circuit should be connected as described in the table

Input circuit	Single-channel	Dual-channel
Without detection of shorts across contacts		
With detection of shorts across contacts		

*1 "E-STOP" symbolises the N/C contact on the trigger element

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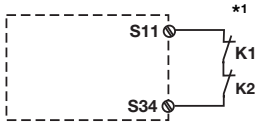
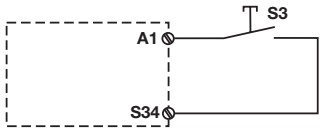
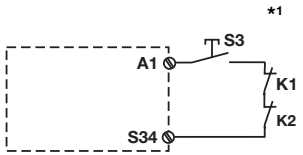
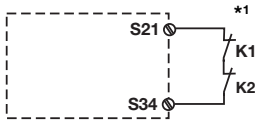
Unit-specific description
PNOZ e1p

Reset circuit:
The unit can be started automatically or manually with monitoring. With an automatic reset, an operating mode with start-up test can also be selected.

- The reset circuit should be connected as described in the table.

Feedback loop:
Contacts from external contactors can be connected in series to the reset circuit.

With automatic reset, the feedback loop contacts are checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing pulse (error code 1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Input circuit	Automatic reset		Monitored reset	
	w/o feedback loop	with feedback loop	without feedback loop	with feedback loop
E-STOP wiring				
Safety gate **without** start-up test				
Safety gate **with** start-up test				

*1 K1 and K2 symbolise the contacts of the external contactors

Unit-specific description
PNOZ e1.1p

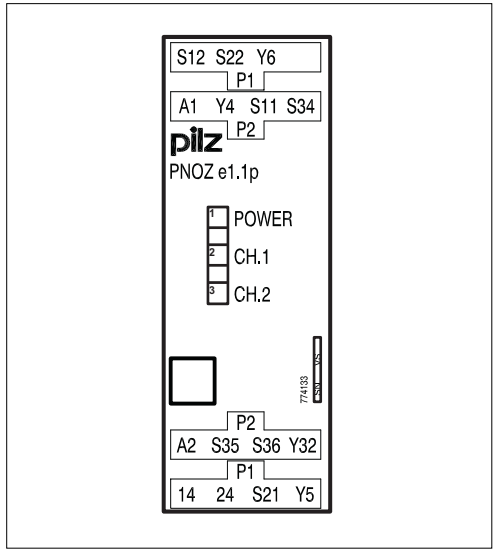
Intended use

The relay PNOZ e1.1p is used for the safety-related interruption of a safety circuit. The unit meets the requirements of EN 954-1 up to Category 4.
The unit is designed for use on:
- E-STOP equipment
- Safety circuits in accordance with VDE 0113 Part 1 and EN 60204-1 (e.g. on movable guards)

Description

The basic functions of the PNOZ e1.1p are described in Chapter 1.4. Specific features are:
- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**)
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- One AND and one OR input
- Separate connection for feedback loop (monitored)
- Application options for:
  - E-STOP buttons
  - Safety gate limit switches
  - Safety mats and safe edges made by Haake (N/C principle)
  - Proximity switch evaluation devices
  - Used to process signals from output switching devices on safety mats (short circuit principle) or from output switching elements on light beam devices
- Voltage and current at AND/OR inputs: 24 V/5 mA DC
- Weight: 135 g

Terminal configuration

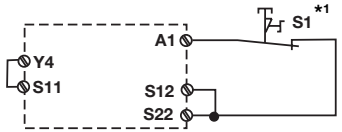
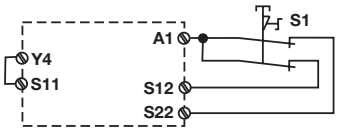
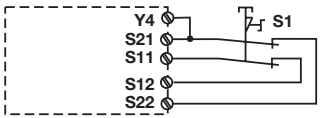


Wiring

Supply voltage:
- Connect the supply voltage to:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
The N/C contact on the trigger element (e.g. E-STOP) must be connected to the input circuit. A short circuit in the input circuit may or may not be detected, depending on the wiring of Y4.
- The input circuit should be connected as described in the table.

The table describes how the input circuit is wired when the unit is used individually (without AND input). If units are linked together logically, Y4 must be wired as described in the section entitled “Logic inputs”.

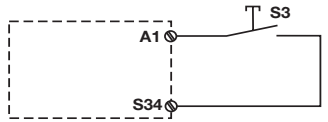
Input circuit	Single-channel	Dual-channel
Without detection of shorts across contacts		
With detection of shorts across contacts		

*1 “E-STOP” symbolises the N/C contact on the trigger element

Unit-specific description
PNOZ e1.1p

Reset circuit:
The unit can be started automatically or manually with monitoring. With an automatic reset, an operating mode with start-up test can also be selected.

- The reset circuit should be connected as described in the table.

Input circuit	Automatic reset	Monitored reset
E-STOP wiring		
Safety gate **without** start-up test		
Safety gate **with** start-up test		

Feedback loop:
The unit has a separate feedback loop. Contacts from external contactors can be connected between Y6 and A1.

- Close the feedback loop by linking**Y6-A1** or by connecting contacts from external contactors between **Y6** and **A1**.

CAUTION!
Do **not** connect the contacts from external contactors in series to the reset circuit.

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately. It will not be possible to switch the unit back on until the feedback loop is closed and the safety function has been triggered. At the same time, if the OR input is used, the signal at the OR input must be low.
The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Example:
Positive-guided contacts K1 and K2 on a 3-phase motor control the feedback loop (Fig. 2.2-1).

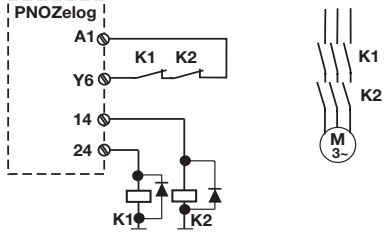


Fig. 2.2-1: Feedback loop with contacts from a motor

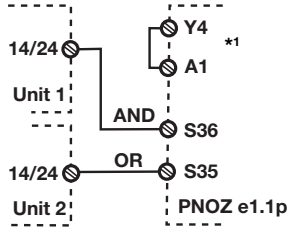
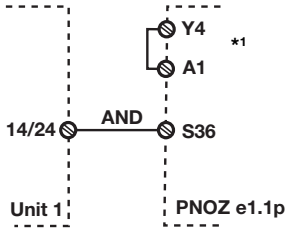
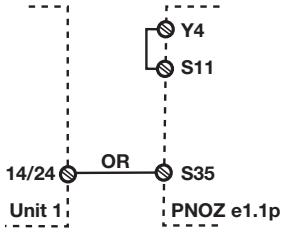
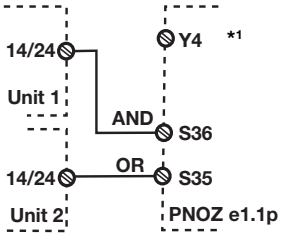
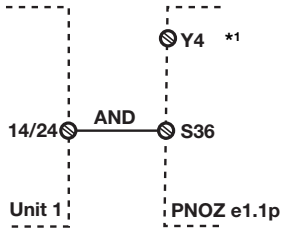
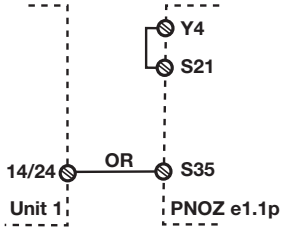
Unit-specific description
PNOZ e1.1p

Logic inputs

When linking several units, please note:

- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits (see also: “Muting function” on page 1.7-1).

Input circuit	**AND + OR connection**	**AND connection**	**OR/No connection**
Without detection of shorts across contacts			
With detection of shorts across contacts			

*1 Where units are linked logically, Y4 must be wired as shown here (differs from the portrayal on the input circuit).

Unit-specific description
PNOZ e1vp

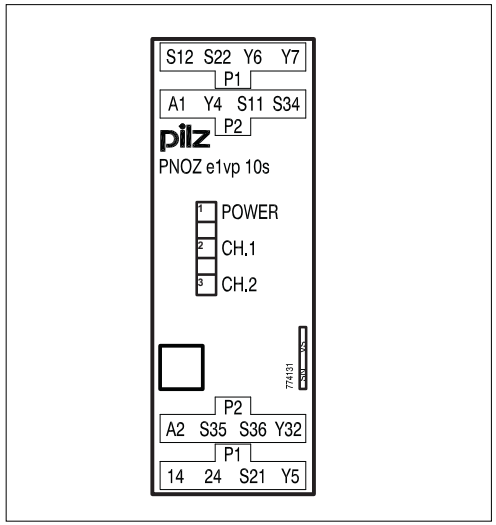
Intended use

The relay PNOZ e1vp is used for the safety-related interruption of a safety circuit. The unit meets the requirements of EN 954-1 up to Category 4.
The unit is designed for use on:
- E-STOP equipment
- Safety circuits in accordance with VDE 0113 Part 1 and EN 60204-1 (e.g. on movable guards)

Description

The basic functions of the PNOZ e1vp are described in Chapter 1.4. Specific features are:
- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**), delay-on de-energisation can be selected
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- One AND and one OR input
- Separate connections for feedback loops (monitored)
- Application options for:
  - E-STOP buttons
  - Safety gate limit switches
  - Safety mats and safe edges made by Haake (N/C principle)
  - Proximity switch evaluation devices
  - Used to process signals from output switching devices on safety mats (short circuit principle) or from output switching elements on light beam devices
- Voltage and current at AND/OR inputs: 24 V/5 mA DC
- Weight: 135 g

Terminal configuration

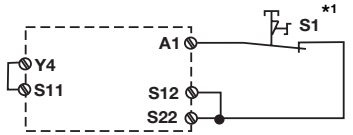
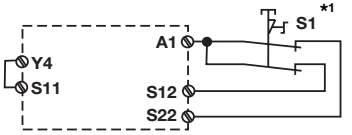
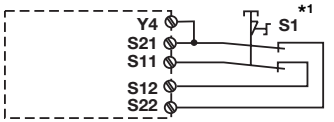


Wiring

Supply voltage:
- Connect the supply voltage to:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
The N/C contact on the trigger element (e.g. E-STOP) must be connected to the input circuit. A short circuit in the input circuit may or may not be detected, depending on the wiring of Y4.
- The input circuit should be connected as described in the table.

The table describes how the input circuit is wired when the unit is used individually (without AND input). If units are linked together logically, Y4 must be wired as described in the section entitled “Logic inputs”.

Input circuit	Single-channel	Dual-channel
Without detection of shorts across contacts		
With detection of shorts across contacts		

*1 “E-STOP” symbolises the N/C contact on the trigger element

Unit-specific description
PNOZ e1vp

Reset circuit:
The unit can be started automatically or manually with monitoring. Special wiring must be used for safety gate monitoring with start-up test.

- The reset circuit should be connected as described in the table.

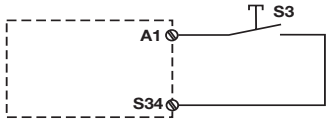
Delay-onde-energisation t_v :
Terminals **Y6** and **Y7** are used to connect the feedback loop and also to establish the delay-on de-energisation on the safety outputs. The signal for the delay time is connected to the contact on the feedback loop.

INFORMATION
Safety output 24 has **delay-on de-energisation**. If only the OR function is used, safety output **14** may also have delay-on de-energisation. The times are selectable.

Set delay-on de-energisation by connecting Y6 and Y7 to terminals A1, S11 and S21 in accordance with Table 2.2-2.

Examples:
PNOZ e1vp 10 with delay-on de-energisation of 1 s: connect Y6 to S11 and Y7 to A1.

PNOZ e1vp 300 with delay-on de-energisation of 250 s: connect Y6 to S21 and Y7 to S11.

Input circuit	Automatic reset	Monitored reset
E-STOP wiring		
Safety gate **without** start-up test		
Safety gate **with** start-up test		

Y6	A1	A1	A1	S11	S11	S11	S21	S21	S21
Y7	A1	S11	S21	A1	S11	S21	A1	S11	S21
tv [s] PNOZ e1vp 10	0	0.15	0.5	1	2	3	5	7	10
tv [s] PNOZ e1vp 300	0	15	25	50	100	150	200	250	300

Table 2.2-2: Setting delay-on de-energisation

Unit-specific description
PNOZ e1vp

Feedback loop:
The unit has two feedback loops, one (Y6) for safety output 14 and one (Y7) for safety output 24:

- Safety output 14 (instantaneous):
  Connect the contacts from external contactors to Y6.
- Safety output 24 (delay-on de-energisation):
  Connect the contacts from external contactors to Y7.
- Both safety outputs delayed or both instantaneous:
  Connect the contacts from external contactors in series to Y6 or Y7.
- Feedback loop unconnected:
  If you do not wish to connect any contacts to the feedback loop, Y6 and Y7 must be connected to A1 or S11/S21, depending on the required delay time.

CAUTION!
Do **not** connect the contacts from external contactors in series to the reset circuit.

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately. It will not be possible to switch the unit back on until the feedback loops are closed and the safety function has been triggered. At the same time, if the OR input is used, the signal at the OR input must be low.
The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Examples

- Example 1:
  Both outputs are delayed (A1-S36 linked):
  PNOZ e1vp 10s: tv = 5 s
  PNOZ e1vp 300 S: tv = 200 s
  Feedback loop is connected to Y7. Only a logic OR connection is possible with this wiring.

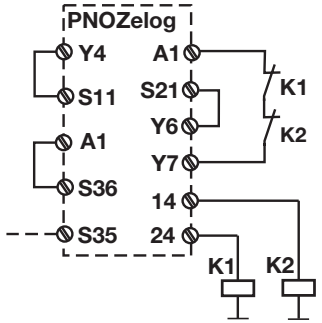


Fig. 2.2-2: Both outputs delayed

- Example 2:
  Both outputs are instantaneous, the feedback loop is connected to Y7. This wiring enables a logic AND and an OR connection.

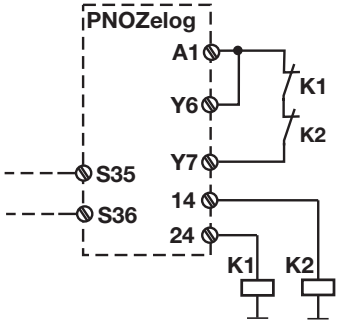


Fig. 2.2-3: Both outputs instantaneous

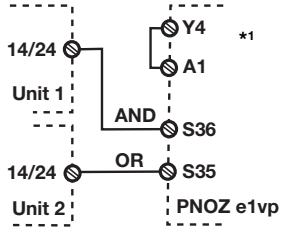
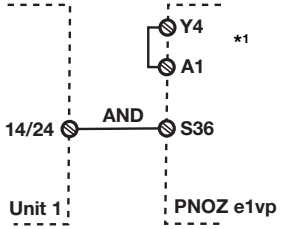
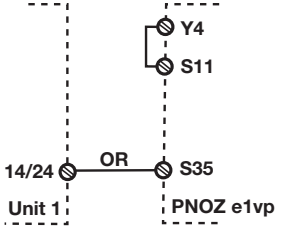
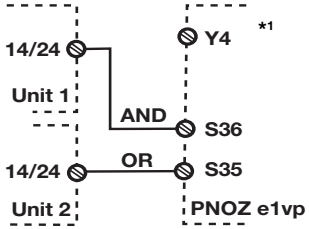
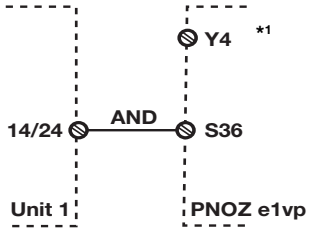
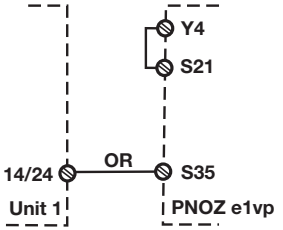
Unit-specific description
PNOZ e1vp

Logic inputs

When linking several units, please note:

- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits (see also: “Muting function” on page 1.7-1).

Input circuit	**AND + OR connection**	**AND connection**	**OR/No connection active**
Without detection of shorts across contacts			
With detection of shorts across contacts			
Safety output **14** delayed			

*1 Where units are linked logically, Y4 must be wired as shown here (differs from the portrayal on the input circuit).

Unit-specific description
PNOZ e2.1p

Intended use

The unit meets the requirements of EN 574, Type III C.
The two-hand control device forces a press operator to keep his hands outside the hazardous area during the dangerous closing movement, in order to avoid hand injuries.
The unit is suitable for use on controllers for metal processing presses as **a component for simultaneity.**
It can be used as a hand protection device to conform with the following technical regulations:

- Eccentric and related presses (EN 692)
- Hydraulic presses (EN 693)
- Fly presses (EN 692)

or in

- Safety circuits in accordance with EN 60204-1 (VDE 0113-1)

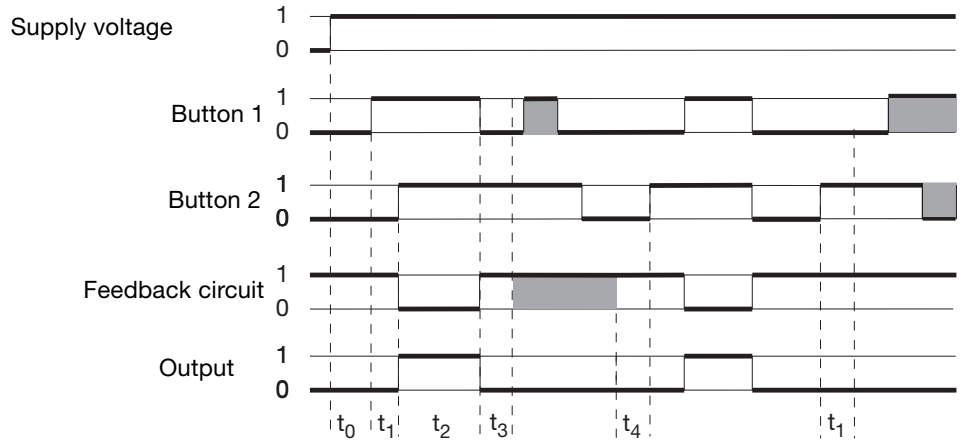
Description

The basic functions of the PNOZ e2.1p are described in Chapter 1.4. Specific features are:

- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**)
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- One AND and one OR input
- Separate connections for feedback loops (monitored)
- Application: Two-hand monitoring
- Voltage and current at AND/OR inputs: 24 V/5 mA DC
- Weight: 135 g

Sequence of two-hand operation:

- If both buttons are operated “simultaneously”, i.e. within 0.5 s, safety outputs 14 and 24 will carry high signals. The LEDs “CH.1” and “CH.2” will light.
- The safety outputs will carry a low signal if
  - Only one button is pressed,
  - The simultaneity time is exceeded,
  - The feedback control loop was not closed.
- If the buttons have been operated simultaneously but then one button is released, the safety outputs will carry a low signal. The LEDs “CH.1” and “CH.2” are off.
- To reactivate: The safety outputs will not return to a high signal until both operator elements have been released and are then operated simultaneously.

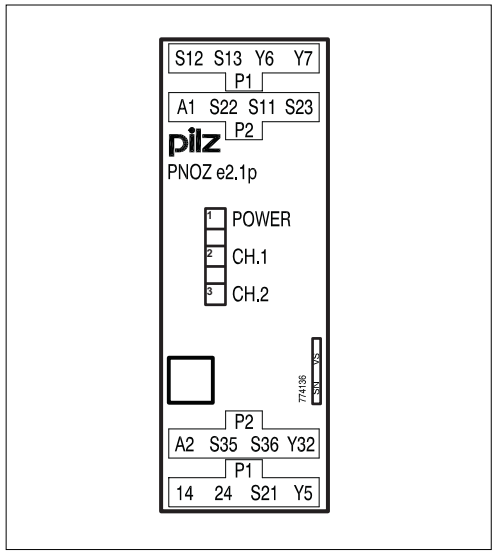


Irrelevant

Button operated: 1
Feedback control loop closed: 1
t_0: U_B must be present at least 3 s before button 1 is operated
t_1: Simultaneity < 0.5 s
t_2: Operating cycle ended through button 1 or 2
t_3: Y6 and Y7 must be closed for at least 150 ms after the operating cycle is complete
t_4: Y6 and Y7 must be closed for at least 50 ms before button is pressed

Unit-specific description
PNOZ e2.1p

Terminal configuration

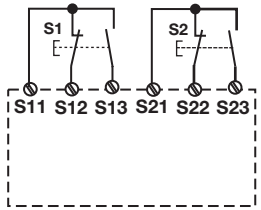


Wiring

Supply voltage:
- Connect the supply voltage to:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
The N/C and N/O contacts on the two-hand button must be connected to the input circuits. The input circuit may only be wired as shown in the following diagram.

Input circuit



Reset circuit:
The two-hand control unit is always reset automatically.

Feedback loop:
The unit has two feedback loops, one (Y6) for safety output 14 and one (Y7) for safety output 24.
The wiring of the feedback loop depends on the unit's logic connections:
- Unit used as single unit or only OR-linked:
  - Connect the contacts from external contactors on safety output **14** between **Y6** and **S11**.
  - Connect the contacts from external contactors on safety output **24** to **Y7** and **A1**.
- Unit is AND-linked:
  - Connect the contacts from external contactors on safety output **14** between **Y6** and **A1**.
  - Connect the contacts from external contactors on safety output **24** to **Y7** and **A1**.
- If you do not wish to connect any contacts to the feedback loop, **Y6 - A1/ S11** and/or **Y7 - A1** should be linked out.

The wiring is illustrated in the section entitled "Logic connections".

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately. It will not be possible to switch the unit back on until the feedback loops are closed and the safety function has been triggered. At the same time, if the OR input is used, the signal at the OR input must be low.
The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8/1,11).
It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

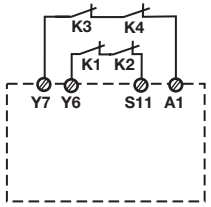
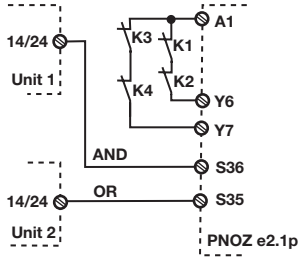
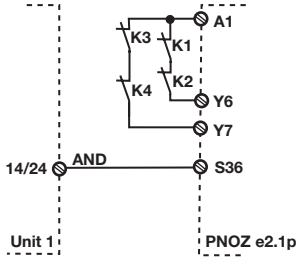
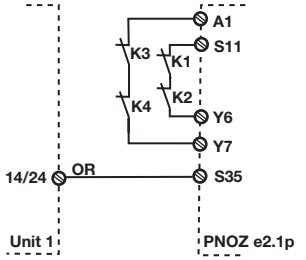
Unit-specific description
PNOZ e2.1p

Logic inputs

When linking several units, please note:

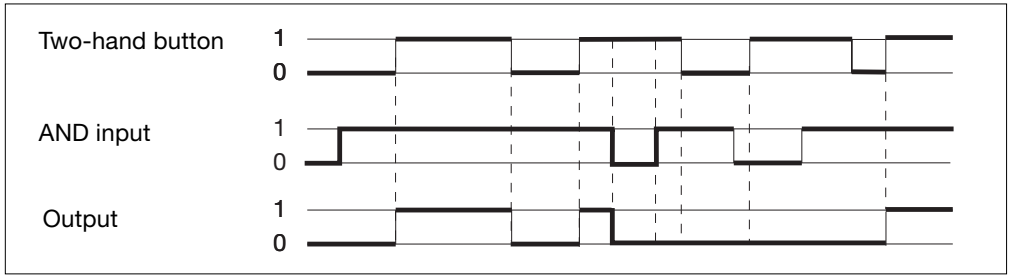
- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits (see also: “Muting function” on page 1.7-1).

Single unit	AND + OR connection	AND connection	OR/No connection
			

K1 ... K4 symbolise the contacts of the external contactors in the feedback loop; if a feedback loop is not used, links must be inserted instead of contacts.

AND connection
The high signal must always be present at the AND input before the two-hand button is operated. If the AND input switches from a low to a high signal while the two-hand button is operated, you will need to release the button and press it again.



Unit-specific description
PNOZ e2.2p

Intended use

The unit meets the requirements of **EN 574, Type III A**.

CAUTION!
The PNOZ e2.2p may **not** be used on **press controllers**. For these we recommend the PNOZ e2.1p. It is only suitable for use where the risk analysis has established a low level of risk (e.g. EN 954-1 Cat. 1 or 2).

The two-hand control unit is used as a Type IIIA hand protection device on plant and machinery, in accordance with EN 574.
The unit forces the operator to keep his hands outside the hazardous area during dangerous movements.
The PNOZ e2.2p is intended for use in two-hand control circuits. Please note the type of two-hand circuit as stated in the relevant C standard.

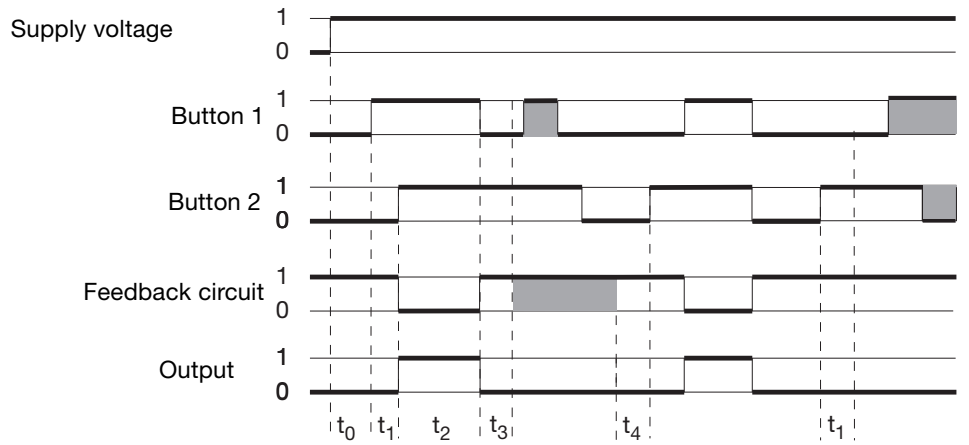
Description

The basic functions of the PNOZ e2.2p are described in Chapter 1.4. Specific features are:

- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**)
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- One AND and one OR input
- Separate connections for feedback loops (monitored)
- Application: Two-hand monitoring
- Voltage and current at AND/OR inputs: 24 V/5 mA DC
- Weight: 135 g

Sequence of two-hand operation:

- If both buttons are operated “simultaneously”, i.e. within 0.5 s, safety outputs 14 and 24 will carry high signals. The LEDs “CH.1” and “CH.2” will light.
- The safety outputs will carry a low signal if
  - Only one button is pressed,
  - The simultaneity time is exceeded,
  - The feedback loop is still open.
- If the buttons have been operated simultaneously but then one button is released, the safety outputs will carry a low signal. The LEDs “CH.1” and “CH.2” are off.
- To reactivate: The safety outputs will not return to a high signal until both operator elements have been released and are then operated simultaneously.



Irrelevant

Button operated: 1
Feedback control loop closed: 1
t_0: U_B must be present at least 3 s before button 1 is operated
t_1: Simultaneity < 0.5 s
t_2: Operating cycle ended through button 1 or 2
t_3: Y6 and Y7 must be closed for at least 150 ms after the operating cycle is complete
t_4: Y6 and Y7 must be closed for at least 50 ms before button is pressed

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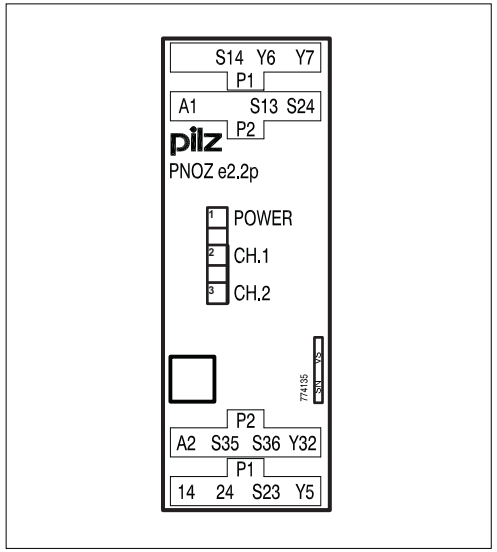
Unit-specific description
PNOZ e2.2p

Terminal configuration

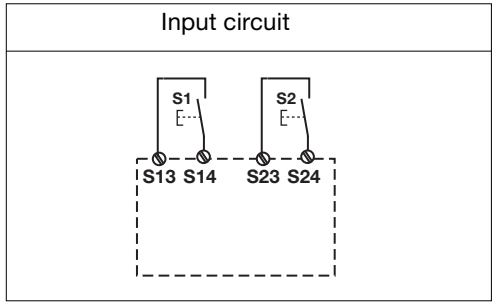


Wiring

Supply voltage:

- Connect the supply voltage to:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
The N/O contacts on the two-hand button must be connected to the input circuits. The input circuit may only be wired as shown in the following diagram.



Reset circuit:
The two-hand control unit is always reset automatically.

Feedback loop:
The unit has two feedback loops, one (Y6) for safety output 14 and one (Y7) for safety output 24.
The wiring of the feedback loop depends on the unit's logic connections:

- Unit used as single unit or only OR-linked:
  - Connect the contacts from external contactors on safety output **14** between **Y6** and **S11**.
  - Connect the contacts from external contactors on safety output **24** to **Y7** and **A1**.
- Unit is AND-linked:
  - Connect the contacts from external contactors on safety output **14** between **Y6** and **A1**.
  - Connect the contacts from external contactors on safety output **24** to **Y7** and **A1**.
- If you do not wish to connect any contacts to the feedback loop, **Y6** - **A1/ S11** and/or **Y7** - **A1** should be linked out.

The wiring is illustrated in the section entitled "Logic connections".

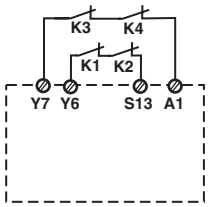
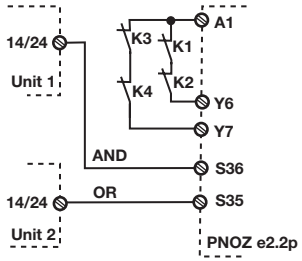
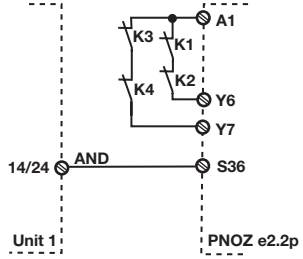
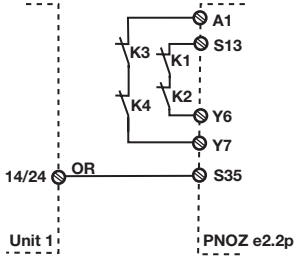
Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately. It will not be possible to switch the unit back on until the feedback loops are closed and the safety function has been triggered. At the same time, if the OR input is used, the signal at the OR input must be low.
The feedback loop contacts are checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8/1,11). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Unit-specific description
PNOZ e2.2p

Logic inputs

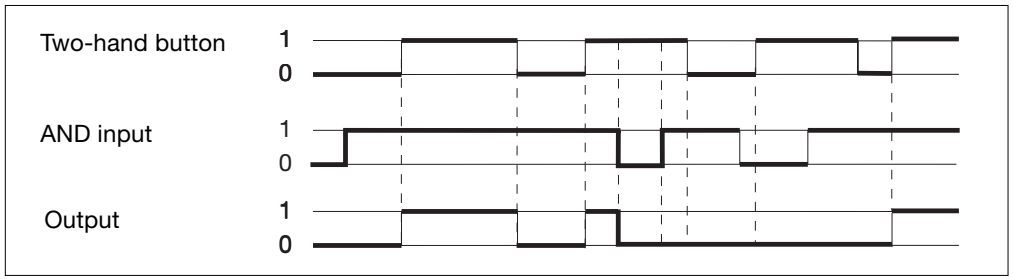
When linking several units, please note:
- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits (see also: “Muting function” on page 1.7-1).

Single unit	AND + OR connection	AND connection	OR/No connection active
			

K1 ... K4 symbolise the contacts of the external contactors in the feedback loop; if a feedback loop is not used, links must be inserted instead of contacts.

AND connection
The high signal must always be present at the AND input before the two-hand button is operated. If the AND input switches from a low to a high signal while the two-hand button is operated, you will need to release the button and press it again.



Unit-specific description
PNOZ e3.1p

Intended use

The relay PNOZ e3.1p is used for the safety-related interruption of a safety circuit. The unit meets the requirements of EN 954-1 up to Category 4. It may be used

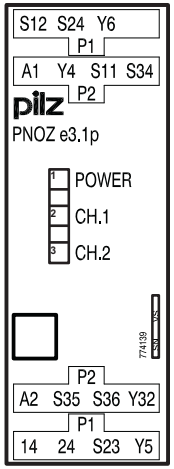
- With the safety sensors PSEN 2.1p-10 and PSEN 2.1p-11 in safety circuits in accordance with EN 60947-5-3, PDF-M
- As an evaluation device for position switches with N/C / N/O combination

Description

The basic functions of the PNOZ e3.1p are described in Chapter 1.4. Specific features are:

- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**)
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- One AND and one OR input
- Separate connection for feedback loop (monitored)
- Application options for:
  - Safety sensors PSEN 2.1p-10 and PSEN 2.1p-11
  - Position switch with N/C / N/O combination
- Only 2-channel operation is permitted
- Voltage and current at AND/OR inputs: 24 V/5 mA DC
- Weight: 135 g

Terminal configuration



Wiring

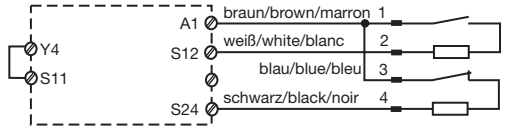
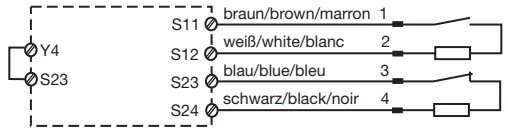
Supply voltage:

- Connect the supply voltage to:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
The N/C and N/O contacts on the trigger element must be connected to the input circuits. A short circuit in the input circuit may or may not be detected, depending on the wiring of Y4.

- The input circuit should be connected as described in the table.

The table describes how the input circuit is wired when the unit is used individually (without AND input). If units are linked together logically, Y4 must be wired as described in the section entitled “Logic inputs”.

Input circuit	Dual-channel
Without detection of shorts across contacts	
With detection of shorts across contacts	

Unit-specific description
PNOZ e3.1p

Reset circuit:
The unit can be started automatically or manually with monitoring. With an automatic reset, an operating mode with start-up test can also be selected.

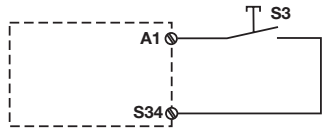
- The reset circuit should be connected as described in the table.

Feedback loop:
The unit has a separate feedback loop. Contacts from external contactors can be connected between Y6 and A1.

- Close the feedback loop by linking**Y6-A1** or by connecting contacts from external contactors between **Y6** and **A1**.

CAUTION!
Do **not** connect the contacts from external contactors in series to the reset circuit.

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately. It will not be possible to switch the unit back on until the feedback loop is closed and the safety function has been triggered. At the same time, if the OR input is used, the signal at the OR input must be low.
The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Input circuit	Automatic reset	Monitored reset
E-STOP wiring		
Safety gate **without** start-up test		
Safety gate **with** start-up test		

Example:
Positive-guided contacts K1 and K2 on a 3-phase motor contactor control the feedback loop (Fig. 2.2-2).

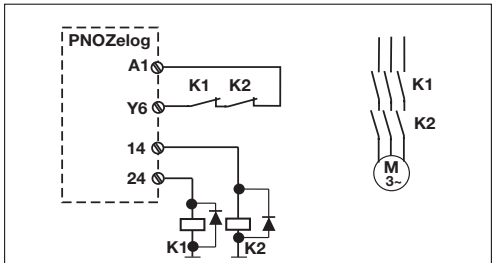


Fig. 2.2-4: Feedback loop with contacts from a motor

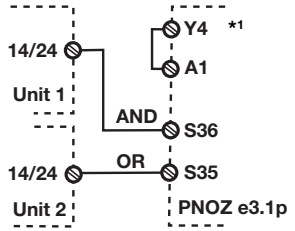
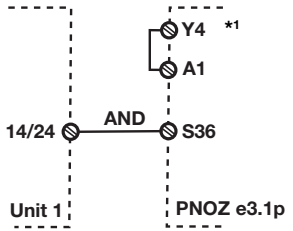
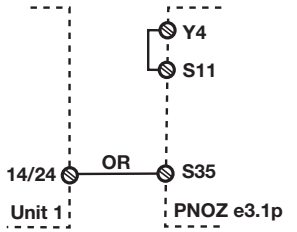
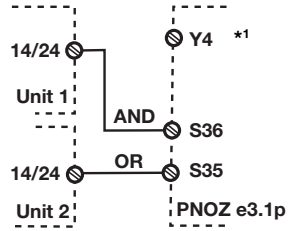
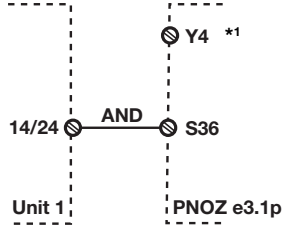
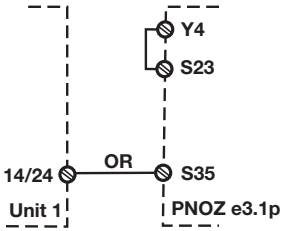
Unit-specific description
PNOZ e3.1p

Logic inputs

When linking several units, please note:

- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits (see also: “Muting function” on page 1.7-1).

Input circuit	**AND + OR connection**	**AND connection**	**OR/No connection active**
Without detection of shorts across contacts			
With detection of shorts across contacts			

*1 Where units are linked logically, Y4 must be wired as shown here (differs from the portrayal on the input circuit).

Unit-specific description
PNOZ e3vp

Intended use

The relay PNOZ e3vp is used for the safety-related interruption of a safety circuit. The unit meets the requirements of EN 954-1 up to Category 4. It may be used

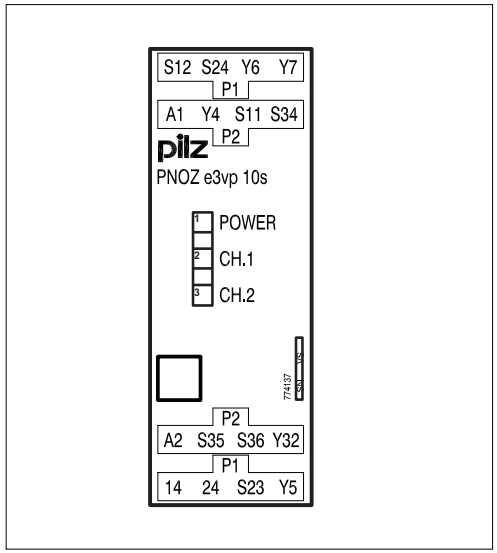
- With the safety sensors PSEN 2.1p-10 and PSEN 2.1p-11 in safety circuits in accordance with EN 60947-5-3, PDF-M
- As an evaluation device for position switches with N/C / N/O combination

Description

The basic functions of the PNOZ e3vp are described in Chapter 1.4. Specific features are:

- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**), delay-on de-energisation can be selected
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- One AND and one OR input
- Separate connections for feedback loops (monitored)
- Application options for:
  - Safety sensors PSEN 2.1p-10 and PSEN 2.1p-11
  - Position switch with N/C / N/O combination
- Only 2-channel operation is permitted
- Voltage and current at AND/OR inputs: 24 V/5 mA DC
- Weight: 135 g

Terminal configuration



Wiring

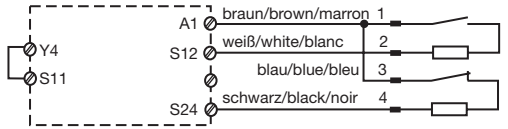
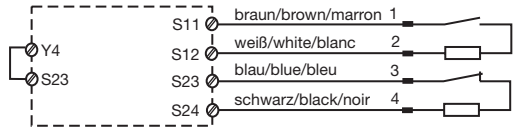
Supply voltage:

- Connect the supply voltage to:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
The N/C and N/O contacts on the trigger element must be connected to the input circuits. A short circuit in the input circuit may or may not be detected, depending on the wiring of Y4.

- The input circuit should be connected as described in the table.

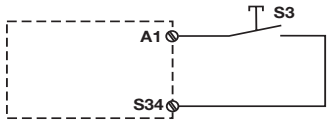
The table describes how the input circuit is wired when the unit is used individually (without AND input). If units are linked together logically, Y4 must be wired as described in the section entitled “Logic inputs”.

Input circuit	Dual-channel
Without detection of shorts across contacts	
With detection of shorts across contacts	

Unit-specific description
PNOZ e3vp

Reset circuit:
The unit can be started automatically or manually with monitoring. With an automatic reset, an operating mode with start-up test can also be selected.

- The reset circuit should be connected as described in the table.

Input circuit	Automatic reset	Monitored reset
E-STOP wiring		
Safety gate **without** start-up test		
Safety gate **with** start-up test		

Delay-on de-energisation t_v :
Terminals **Y6** and **Y7** are used to connect the feedback loop and also to establish the delay-on de-energisation on the safety outputs. The signal for the delay time is connected to the contact on the feedback loop.

INFORMATION
Safety output 24 has **delay-on de-energisation**. If only the OR function is used, **safety output 14** may also have delay-on de-energisation. The times are selectable.

Set delay-on de-energisation by connecting Y6 and Y7 to terminals A1, S11 and S21 in accordance with Table 2.2-3.

Examples:
PNOZ e3vp 10 with delay-on de-energisation of 1 s: connect Y6 to S11 and Y7 to A1.

PNOZ e3vp 300 with delay-on de-energisation of 250 s: connect Y6 to S23 and Y7 to S11.

Y6	A1	A1	A1	S11	S11	S11	S23	S23	S23
Y7	A1	S11	S23	A1	S11	S23	A1	S11	S23
tv [s] PNOZ e3vp 10	0	0.15	0.5	1	2	3	5	7	10
tv [s] PNOZ e3vp 300	0	15	25	50	100	150	200	250	300

Table 2.2-3: Setting delay-on de-energisation

Unit-specific description
PNOZ e3vp

Feedback loop:
The unit has two feedback loops, one (Y6) for safety output 14 and one (Y7) for safety output 24:

- Safety output 14 (instantaneous):
  Connect the contacts from external contactors to Y6.
- Safety output 24 (delay-on de-energisation):
  Connect the contacts from external contactors to Y7.
- Both safety outputs delayed or both instantaneous:
  Connect the contacts from external contactors in series to Y6 or Y7.
- Feedback loop unconnected:
  If you do not wish to connect any contacts to the feedback loop, Y6 and Y7 must be connected to A1 or S11/S21, depending on the required delay time.

CAUTION!
Do **not** connect the contacts from external contactors in series to the reset circuit.

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately. It will not be possible to switch the unit back on until the feedback loops are closed and the safety function has been triggered. At the same time, if the OR input is used, the signal at the OR input must be low.
The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Examples

- Example 1:
  Both outputs are delayed (A1-S36 linked):
  PNOZ e3vp 10s: tv = 5 s
  PNOZ e3vp 300 S: tv = 200 s
  Feedback loop is connected to Y7. Only a logic OR connection is possible with this wiring.

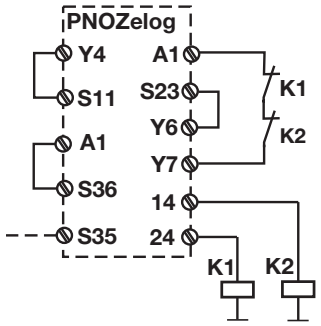


Fig. 2.2-5: Both outputs delayed

- Example 2:
  Both outputs are instantaneous, the feedback loop is connected to Y7. This wiring enables a logic AND and an OR connection.

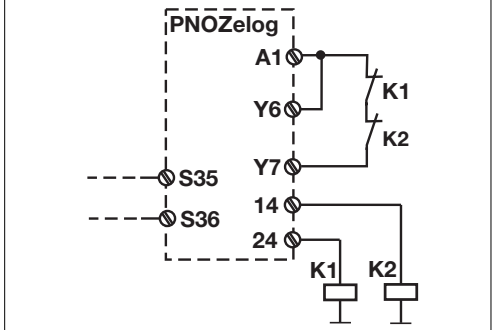


Fig. 2.2-6: Both outputs instantaneous

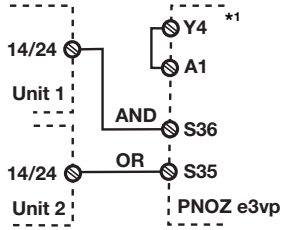
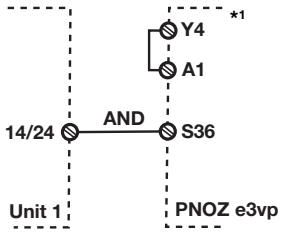
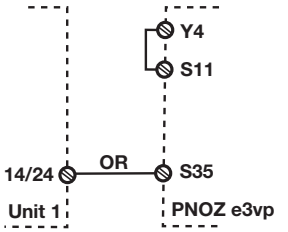
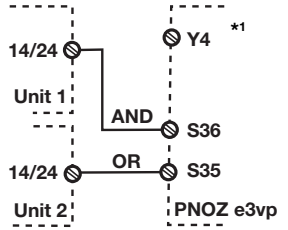
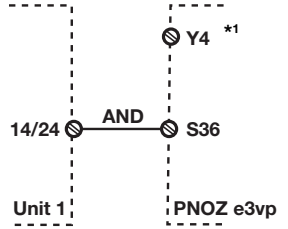
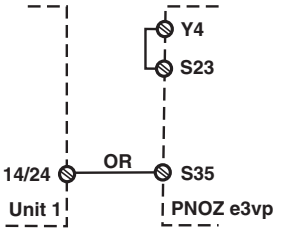
Unit-specific description
PNOZ e3vp

Logic inputs

Please note the following when linking several units:

- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits (see also: “Muting function” on page 1.7-1).

Input circuit	**AND + OR connection**	**AND connection**	**OR/No connection active**
Without detection of shorts across contacts			
With detection of shorts across contacts			
Safety output **14** delayed			

*1 Where units are linked logically, Y4 must be wired as shown here (differs from the portrayal on the input circuit).

Unit-specific description
PNOZ e4.1p

Intended use

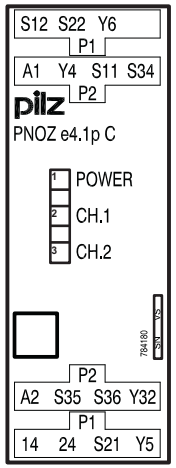
The safety relay **PNOZ e4.1p** is used for the safety-related interruption of a safety circuit. It may only be used as a safety system in conjunction with Mayser SM/BK type safety mats in accordance with the 4-wire technology operating principle (without monitoring resistor).
The safety relay is used for signal processing and as a shutdown device in accordance with EN 1760-1.
The safety mat is described in the documentation produced by Mayser.

Description

The basic functions of the PNOZ e4.1p are described in Chapter 1.4. Specific features are:

- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**)
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- One AND and one OR input
- Separate connections for feedback loops (monitored)
- Used exclusively as a safety system in conjunction with safety mats (see Intended use)
- Voltage and current at AND/OR inputs: 24 V/5 mA DC
- Weight: 135 g

Terminal configuration



Wiring

Supply voltage:

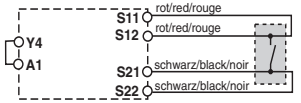
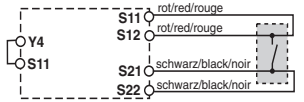
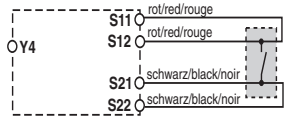
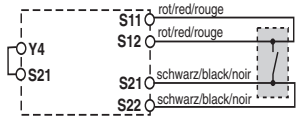
- Connect the supply voltage to:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
Connect the safety mat to the inputs and define via the wiring of Y4 whether you are:

- Using the AND/OR inputs of the PNOZ e4.1p
  and whether
- The PNOZ e4.1p is controlling a PSS or a PNOZelog unit with its safety outputs.

CAUTION!
No additional loads may be connected to outputs that are used to control a PSS.

If contactors alone are being controlled, we recommend the wiring for controlling a PSS.

Input circuit	AND input and OR input active	Only OR input active or no connection
Controlling a PSS		
Controlling a PNOZelog unit		

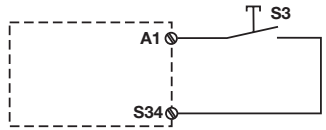
Pilz GmbH & Co. KG, Sichere Automation, Felix-Wankel-Straße 2, 73760 Ostfildern, Germany, Telephone: +49 711 3409-0, Telefax: +49 711 3409-133, E-Mail: pilz.gmbh@pilz.de

Unit-specific description
PNOZ e4.1p

Reset circuit:
The reset circuit defines the safety system's reset features:

- Automatic reset (start): Unit is active as soon as the input circuits are closed, i.e. the safety mat is **not** activated.
- Manual reset (start): The unit is not active until the reset button has been operated. This eliminates the possibility of the reset button being overridden, triggering automatic activation.

The reset circuit should be connected as described in the table.

Input circuit	Automatic reset (start)	Manual reset (start)
Safety mat **without** start-up test		
Safety mat **with** start-up test		

Feedback loop:
The unit has a separate feedback loop. Contacts from external contactors can be connected between Y6 and A1.

- Close the feedback loop by linking**Y6-A1** or by connecting contacts from external contactors between **Y6** and **A1**.

CAUTION!
Do **not** connect the contacts from external contactors in series to the reset circuit.

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately.
It will not be possible to switch the unit back on until the feedback loop is closed and the safety function has been triggered. At the same time, if the OR input is used, the signal at the OR input must be low.
The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Example:
Positive-guided contacts K1 and K2 on a 3-phase motor contactor control the feedback loop (Fig. 2.2-2).

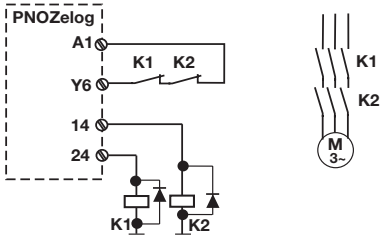


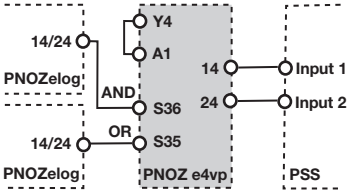
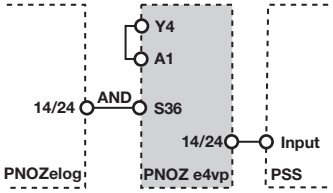
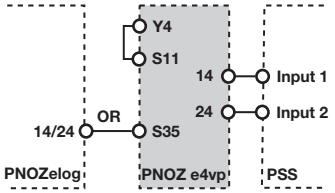
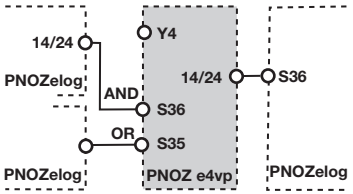
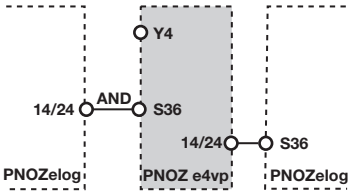
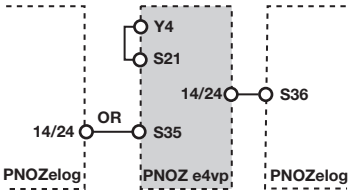
Fig. 2.2-7: Feedback loop with contacts from a motor

Unit-specific description
PNOZ e4.1p

Logic inputs

When linking several units, please note:
- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits (see also: “Muting function” on page 1.7-1).

Input circuit	**AND + OR connection**	**AND connection**	**OR/No connection active**
Controlling a PSS			
Controlling a PNOZelog unit			

Unit-specific description
PNOZ e4.1p

Connecting several safety mats

Several safety mats may be connected to each other (see Mayser documentation). When wiring, make sure to always connect together cable of the same colour!

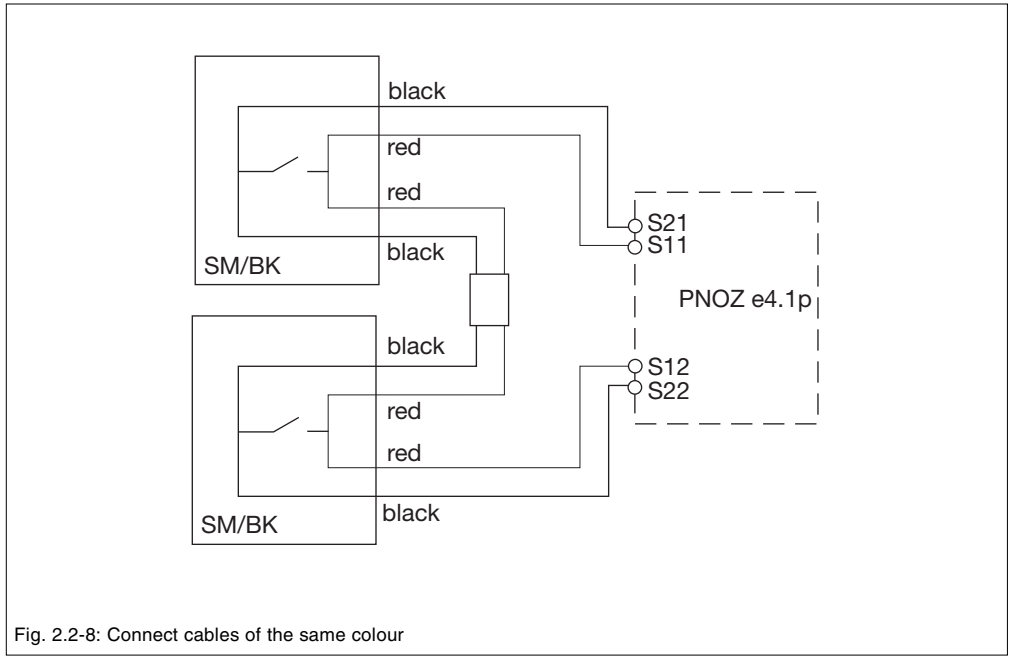


Fig. 2.2-8: Connect cables of the same colour

Unit-specific description
PNOZ e4vp

Intended use

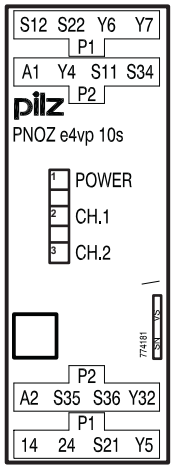
The safety relay PNOZ e4vp is used for the safety-related interruption of a safety circuit. The unit meets the requirements of EN 954-1 up to Category 4. It may only be used as a safety system in conjunction with Mayser SM/BK type safety mats in accordance with the 4-wire technology operating principle (without monitoring resistor). The safety relay is used for signal processing and as a shutdown device in accordance with EN 1760-1. The safety mat is described in the documentation produced by Mayser.

Description

The basic functions of the PNOZ e4vp are described in Chapter 1.4. Specific features are:

- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**), delay-on de-energisation can be selected
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- One AND and one OR input
- Separate connections for feedback loops (monitored)
- Used exclusively as a safety system in conjunction with safety mats (see Intended use)
- Voltage and current at AND/OR inputs: 24 V/5 mA DC
- Weight: 135 g

Terminal configuration



Wiring

Supply voltage:

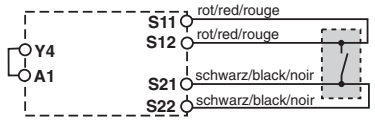
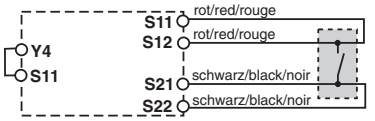
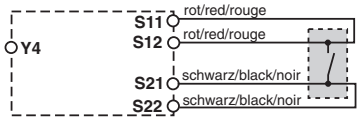
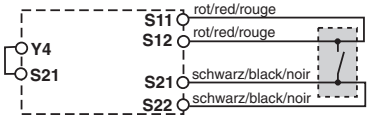
- Connect the supply voltage:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
Connect the safety mat to the inputs and define via the wiring of Y4 whether you are:

- Using the AND/OR inputs of the PNOZ e4vp
  and whether
- The PNOZ e4vp is controlling a PSS or a PNOZelog unit with its outputs.

CAUTION!
No additional loads may be connected to outputs that are used to control a PSS.

If contactors alone are being controlled, we recommend the wiring for controlling a PSS.

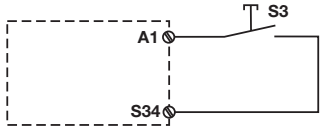
Input circuit	AND connection and OR connection active	No connection or only OR connection active
Controlling a PSS		
Controlling a PNOZelog unit		

Unit-specific description
PNOZ e4vp

Reset circuit:
The reset circuit defines the safety system's reset features:

- Automatic reset (start): Unit is active as soon as the input circuits are closed, i.e. the safety mat is **not** activated.
- Manual reset (start): The unit is not active until the reset button has been operated. This eliminates the possibility of the reset button being overridden, triggering automatic activation.

The reset circuit should be connected as described in the table.

Input circuit	Automatic reset (start)	Manual reset (start)
Safety mat **without** start-up test		
Safety mat **with** start-up test		

Delay-on de-energisation t_v :
Terminals **Y6** and **Y7** are used to connect the feedback loops and also to define the delay-on de-energisation on output 24. Both the signals for the delay time are connected to the contacts on the feedback loops.

Set delay-on de-energisation by connecting Y6 and Y7 to terminals A1, S11 and S21 in accordance with Table 2.2-4.

Example:
PNOZ e4vp 10 with delay-on de-energisation of 1 s: connect Y6 to S11 and Y7 to A1.

Y6	A1	A1	A1	S11	S11	S11	S21	S21	S21
Y7	A1	S11	S21	A1	S11	S21	A1	S11	S21
t_v [s] PNOZ e4vp 10	0	0.15	0.5	1	2	3	5	7	10

Table 2.2-4: Setting delay-on de-energisation

Unit-specific description
PNOZ e4vp

Feedback loop:
The unit has two feedback loops, one (Y6) for safety output 14 and one (Y7) for safety output 24:

- Safety output 14 (instantaneous):
  Connect the contacts from external contactors to Y6.
- Safety output 24 (delay-on de-energisation):
  Connect the contacts from external contactors to Y7.
- Both safety outputs instantaneous:
  Connect the contacts from external contactors in series to Y6 or Y7.
- Feedback loop unconnected:
  If you do not wish to connect any contacts to the feedback loop, Y6 and Y7 must be connected to A1 or S11/S21, depending on the required delay time.

CAUTION!
Do **not** connect the contacts from external contactors in series to the reset circuit.

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately. It will not be possible to switch the unit back on until the feedback loops are closed and the safety function has been triggered.
At the same time, if the OR input is used, the signal at the OR input must be low.
The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Examples

- Example 1:
  Output 24 with delay-on de-energisation:
  PNOZ e4vp 10s: tv = 5 s
  The feedback loop is connected to Y7 or Y6. Only a logic OR connection is possible with this wiring at Y4.

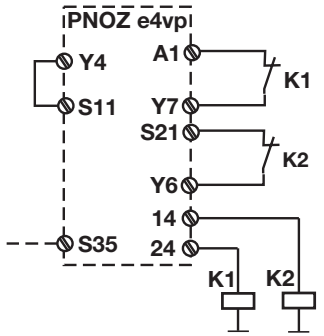


Fig. 2.2-9: Output 24 with delay-on de-energisation

- Example 2:
  Both outputs are instantaneous, the feedback loop is connected to Y7. This wiring enables a logic AND and an OR connection, as Y4 is not used.

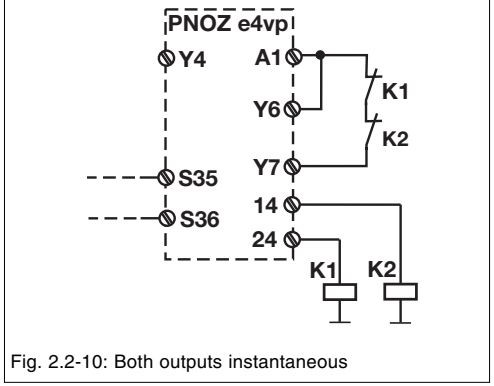


Fig. 2.2-10: Both outputs instantaneous

Unit-specific description
PNOZ e4vp

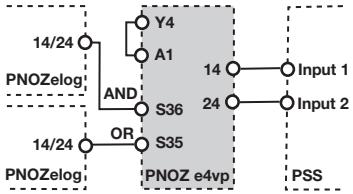
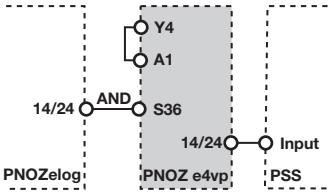
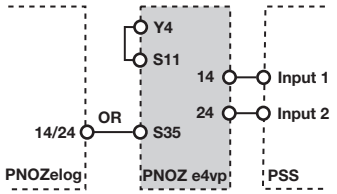
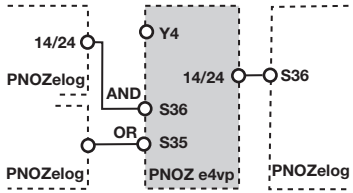
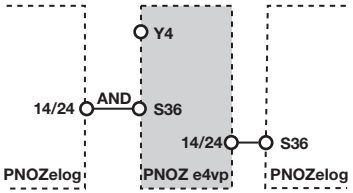
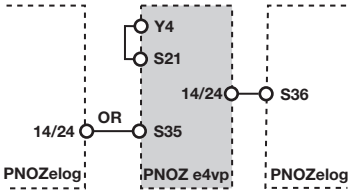
Logic inputs

Please note the following when linking several units:

- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.
- The PSS must always have a dual-channel connection.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits (see also: “Muting function” on page 1.7-1).

The PSS must always have a dual-channel connection.

Input circuit	**AND + OR connection**	**AND connection**	**OR/No connection active**
Controlling a PSS			
Controlling a PNOZelog unit			

Unit-specific description
PNOZ e4vp

Connecting several safety mats

Several safety mats may be connected to each other (see Mayser documentation). When wiring, make sure to always connect together cable of the same colour!

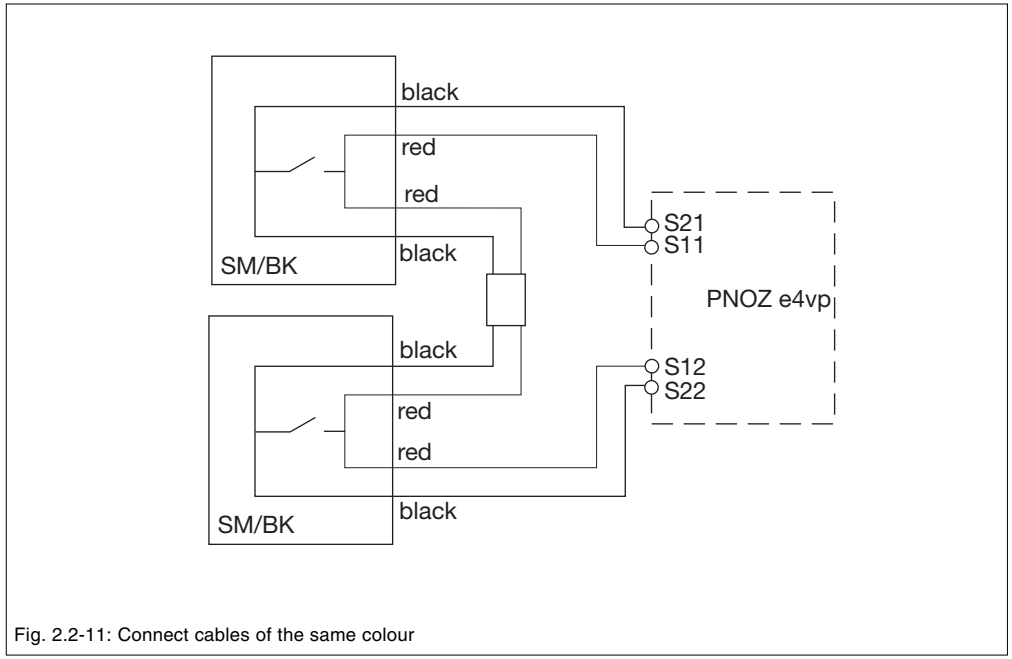


Fig. 2.2-11: Connect cables of the same colour

Pilz GmbH & Co. KG, Sichere Automation, Felix-Wankel-Straße 2, 73760 Ostfildern, Germany, Telephone: +49 711 3409-0, Telefax: +49 711 3409-133, E-Mail: pilz.gmbh@pilz.de

Unit-specific description
PNOZ e5.11p

Intended use

The relay PNOZ e5.11p is used for the safety-related interruption of two safety circuits. The unit meets the requirements of EN 954-1 up to Category 4. It may be used

- In E-STOP equipment
- In safety circuits in accordance with VDE 0113 Part 1 and EN 60204-1 (e.g. on movable guards)
- As an evaluation device for position switches with N/C / N/C combination

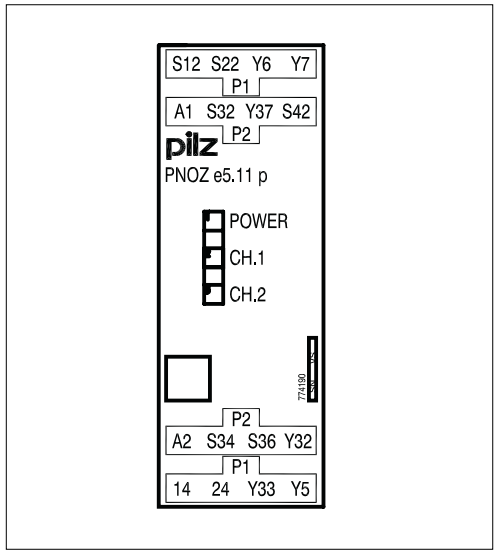
CAUTION!
This unit may only be used up to category 3 in accordance with EN 954-1!

Description

The basic functions of the PNOZ e5.11p are described in Chapter 1.4. Specific features are:

- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**)
  - 2 auxiliary outputs (**Y32** and **Y33**)
- One AND input
- Separate connections for feedback loops (monitored)
- Application options for:
  - E-STOP button
  - Safety gate limit switch
  - Reset button
  - Safety mats and safe edges made by Haake
  - Proximity switch evaluation devices
  - Position switch with N/C / N/C combination
- Used to process signals from output switching devices on safety mats or from output switching elements on light barriers
- Voltage and current at AND inputs: 24 V/ 5 mA DC
- Weight: 135 g

Terminal configuration



Wiring

Supply voltage:

- Connect the supply voltage:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Unit-specific description
PNOZ e5.11p

Input circuit:
The contacts on the trigger elements must be connected to the input circuits.
- The input circuits should be connected as described in the table.

The table describes how the input circuits are wired when the unit is used individually (without AND input).

NOTICE
The AND input **S36** must be connected. If the input is not being used, terminal **S36** must be connected to terminal **Y37**.

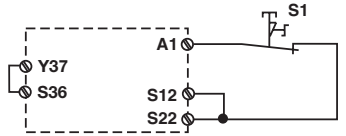
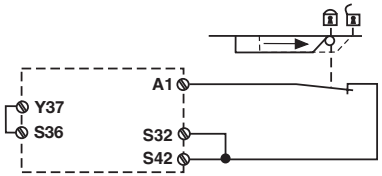
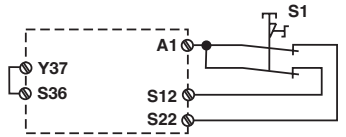
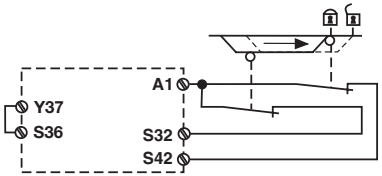
The input circuit **S12/S22** influences safety output **14**:
- Input circuit **S12/S22** closed (e.g. E-STOP button not operated):
  A high signal is present at safety output **14**.
- Input circuit **S12/S22** is open (e.g. E-STOP button operated):
  There will be a low signal at safety output **14**.

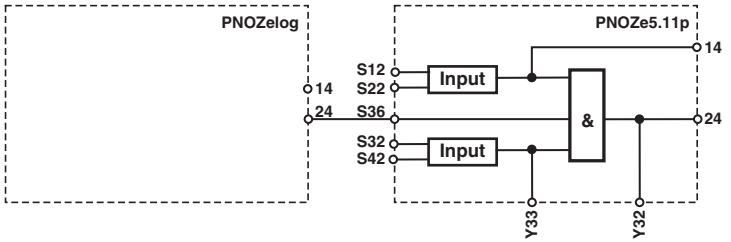
Input circuit **S32/S42** is AND-linked with input circuit **S12/S22** and AND input **S36**. The result of the logic operation can be viewed through safety output **24** and auxiliary output **Y32**.

Safety output **24** and auxiliary output **Y32** will only then have a high signal if:
- Input circuit **S12/S22** is closed (e.g. E-STOP button not operated) and
- Input circuit **S32/S42** is closed (e.g. safety gate closed) and
- There is a high signal at the AND input (if the AND input is active).

Auxiliary output **Y33** indicates the status of input circuit S32/S42.
If input circuit **S32/S42** is closed (e.g. safety gate closed), there will be a high signal at the auxiliary output.

Example:
Representation of a PNOZ e5.11p, AND-linked with another PNOZelog unit

Input circuit	Input circuit S12/S22	Input circuit S32/S42
Single-channel (without detection of shorts across contacts)		
Dual-channel (without detection of shorts across contacts)		



Unit-specific description
PNOZ e5.11p

Reset circuit/feedback loop:
Terminals **Y6** and **Y7** are used to connect the feedback loops and also to define the reset behaviour.

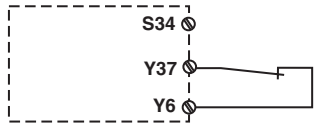
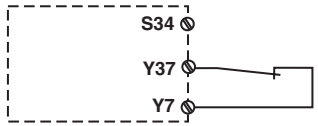
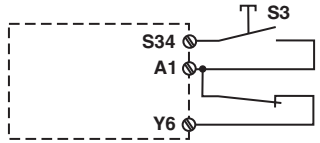
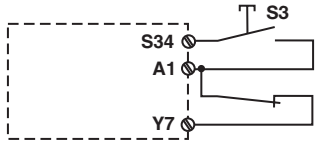
- Terminal **Y6** is used
  - to define the reset behaviour for input circuit **S12/S22** and
  - to connect the feedback loop for safety output **14**.
- Terminal **Y7** is used to:
  - to determine the reset mode for input circuit **S32/S42** and
  - connect the feedback loop for safety output **24**.

The unit can be started automatically or manually with monitoring.

- Automatic reset:
  Connect the contacts from external contactors between **Y6/Y7** and **Y37**.
- Monitored reset:
  Connect the contacts from external contactors between **Y6/Y7** and **A1**.

Feedback loop unused:
If you do not wish to connect any contacts to the feedback loop, replace the contacts at **Y6** or **Y7** with a link, depending on the required reset behaviour.

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately.

Reset mode	Input circuit S12/S22	Input circuit S32/S42
Automatic reset		
Monitored reset		

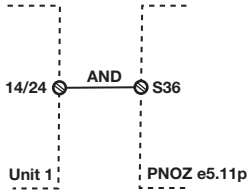
It will not be possible to switch the unit back on until the feedback loops are closed and the safety functions have been triggered. The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Unit-specific description
PNOZ e5.11p

Logic inputs

Please note the following when linking several units:

- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

	Inactive	Active
AND input		

Unit-specific description
PNOZ e5.13p

Intended use

The relay PNOZ e5.13p is used for the safety-related interruption of two safety circuits. It may be used

- In E-STOP equipment
- In safety circuits in accordance with VDE 0113 Part 1 and EN 60204-1 (e.g. on movable guards)
- With safety sensors from the PSEN 2.x series in safety circuits in accordance with EN 60947-5-3, PDF-M
- As an evaluation device for position switches with N/C / N/O combination

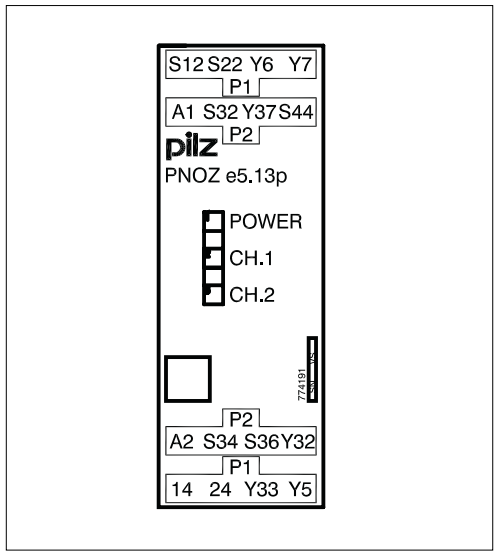
CAUTION!
This unit may only be used up to category 3 in accordance with EN 954-1!

Description

The basic functions of the PNOZ e5.11p are described in Chapter 1.4. Specific features are:

- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**)
  - 2 auxiliary outputs (**Y32** and **Y33**)
- One AND input
- Separate connections for feedback loops (monitored)
- Only 2-channel operation is permitted
- Application options for:
  - E-STOP button
  - Safety gate limit switch
  - Reset button
  - Safety mats and safe edges made by Haake
  - Proximity switch evaluation devices
  - Safety sensors from the PSEN 2.x series or position switches with N/C / N/O combination
- Used to process signals from output switching devices on safety mats or from output switching elements on light barriers
- Voltage and current at AND inputs: 24 V/5 mA DC
- Weight: 135 g

Terminal configuration



Wiring

Supply voltage:

- Connect the supply voltage:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Unit-specific description
PNOZ e5.13p

Input circuit:
The contacts on the trigger elements must be connected to the input circuits.
- The input circuit should be connected as described in the table.

The table describes how the input circuit is wired when the unit is used individually (without AND input).

NOTICE
The AND input **S36** must be connected. If the input is not being used, terminal **S36** must be connected to terminal **Y37**.

The input circuit **S12/S22** influences safety output **14**:
- Input circuit **S12/S22** closed (e.g. E-STOP button not operated):
  A high signal is present at safety output **14**.
- Input circuit **S12/S22** is open (e.g. E-STOP button operated):
  There will be a low signal at safety output **14**.

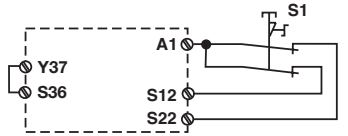
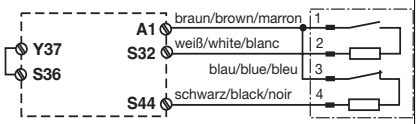
Input circuit **S32/S44** is AND-linked with input circuit **S12/S22** and AND input **S36**. The result of the logic operation can be viewed through safety output **24** and auxiliary output **Y32**.

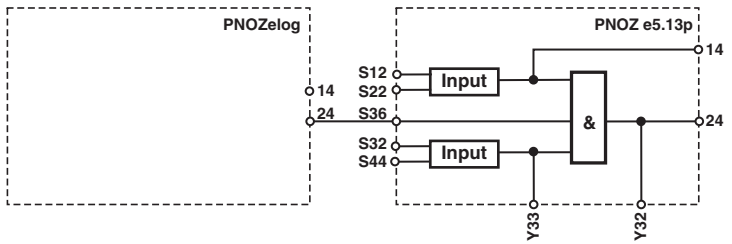
Safety output **24** and auxiliary output **Y32** will only then have a high signal if:
- Input circuit **S12/S22** is closed (e.g. E-STOP button not operated) and
- In input circuit **S32/S44**, the N/C contact is open and the N/O contact is closed (e.g. safety gate closed) and
- There is a high signal at the AND input (if the AND input is active).

Auxiliary output **Y33** indicates the status of input circuit **S32/S44**.

If the N/C contact is open and the N/O contact is closed (i.e. safety gate closed) in input circuit **S32/S44**, there will be a high signal at the auxiliary output.

Example:
Representation of a PNOZe5.13p, AND-linked with another PNOZelog unit

Input circuit	Input circuit S12/S22	Input circuit S32/S44
Dual-channel (without detection of shorts across contacts)		



Unit-specific description
PNOZ e5.13p

Reset circuit/feedback loop:
Terminals **Y6** and **Y7** are used to connect the feedback loop and also to define the reset behaviour.

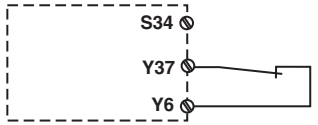
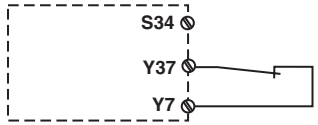
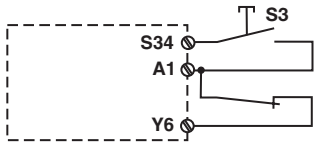
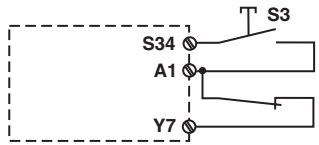
- Terminal **Y6** is used
  - to define the reset behaviour for input circuit **S12/S22** and
  - to connect the feedback loop for safety output **14**.
- Terminal **Y7** is used to:
  - to determine the reset mode for input circuit **S32/S44** and
  - connect the feedback loop for safety output **24**.

The unit can be started automatically or manually with monitoring.

- Automatic reset:
  Connect the contacts from external contactors between **Y6/Y7** and **Y37**.
- Monitored reset:
  Connect the contacts from external contactors between **Y6/Y7** and **A17**.

Feedback loop unused:
If you do not wish to connect any contacts to the feedback loop, replace the contacts at **Y6** or **Y7** with a link, depending on the required reset behaviour.

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately. It will not be possible to switch the unit back on until the feedback loops are closed and the safety function has been triggered.
The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

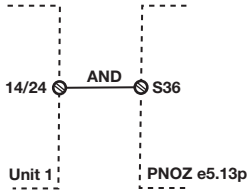
Reset mode	Input circuit S12/S22	Input circuit S32/S44
Automatic reset		
Monitored reset		

Unit-specific description
PNOZ e5.13p

Logic inputs

Please note the following when linking several units:

- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

	Inactive	Active
AND input		

Unit-specific description
PNOZ e6.1p

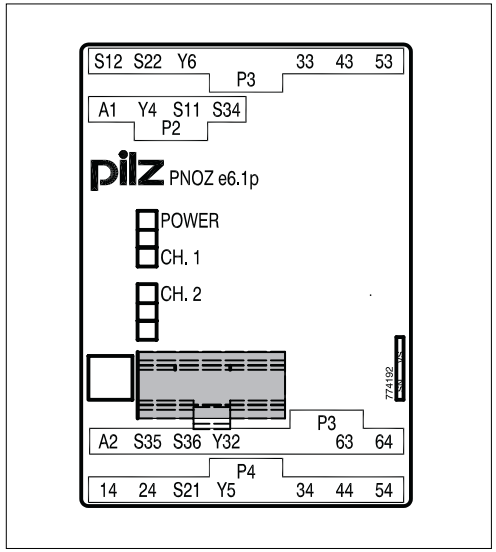
Intended use

The relay PNOZ e6.1p is used for the safety-related interruption of a safety circuit. It has an integrated safety contact block.
The unit is designed for use in:
- E-STOP equipment
- Safety circuits in accordance with VDE 0113-1:1998-11 and EN 60204-1:1997-12 (e.g. on movable guards)

Description

The basic functions of the PNOZ e6.1p are described in Chapter 1.4. Specific features are:
- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**)
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- Relay outputs:
  - 4 safety contacts (N/O), positive guided
- Safe separation of safety contacts 33-34, 43-44 and 53-54
- One AND and one OR input
- Separate connection for feedback loop (monitored)
- Application options for:
  - E-STOP buttons
  - Safety gate limit switches
  - Safety mats and safe edges made by Haake (N/C principle)
  - Proximity switch evaluation devices
  - Used to process signals from output switching devices on safety mats (short circuit principle) or from output switching elements on light beam devices
- Voltage and current at AND/OR inputs: 24 VDC/ 5 mA
- Weight: 280 g

Terminal configuration

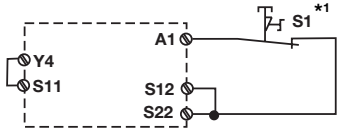
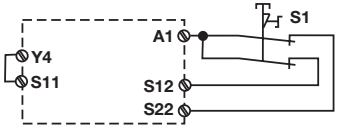
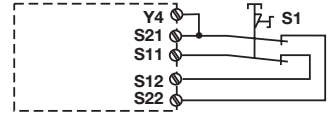


Wiring

Supply voltage:
- Connect the supply voltage to:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
The N/C contact on the trigger element (e.g. E-STOP) must be connected to the input circuit. A short circuit in the input circuit may or may not be detected, depending on the wiring of Y4.
- The input circuit should be connected as described in the table.

The table describes how the input circuit is wired when the unit is used individually (without AND input). If units are linked together logically, Y4 must be wired as described in the section entitled “Logic inputs”.

Input circuit	Single-channel	Dual-channel
Without detection of shorts across contacts		
With detection of shorts across contacts		

*1 “E-STOP” symbolises the N/C contact on the trigger element

Unit-specific description
PNOZ e6.1p

Reset circuit:
The unit can be started automatically or manually with monitoring. With an automatic reset, an operating mode with start-up test can also be selected.

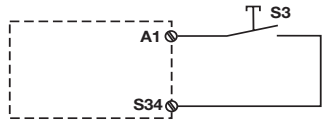
- The reset circuit should be connected as described in the table.

Feedback loop:
The unit has a separate feedback loop. Contacts from external contactors can be connected between Y6 and A1.

- Close the feedback loop by linking**Y6-A1** or by connecting contacts from external contactors between **Y6** and **A1**.

CAUTION!
Do **not** connect the contacts from external contactors in series to the reset circuit.

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately. It will not be possible to switch the unit back on until the feedback loop is closed and the safety function has been triggered. At the same time, if the OR input is used, the signal at the OR input must be low.
The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Input circuit	Automatic reset	Monitored reset
E-STOP wiring		
Safety gate **without** start-up test		
Safety gate **with** start-up test		

Example:
Positive-guided contacts K1 and K2 on a 3-phase motor control the feedback loop (Fig. 2.2-12).

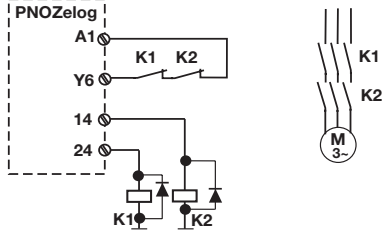


Fig. 2.2-12: Feedback loop with contacts from a motor

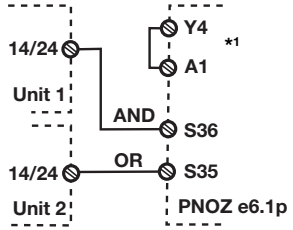
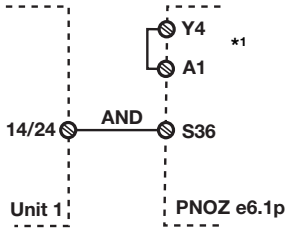
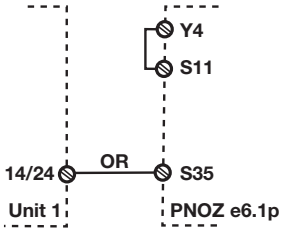
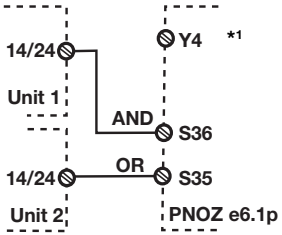
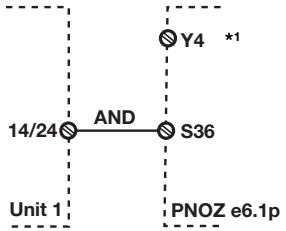
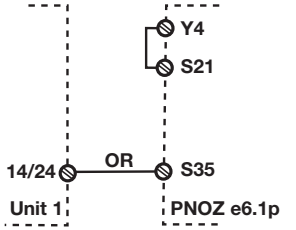
Unit-specific description
PNOZ e6.1p

Logic inputs

When linking several units, please note:

- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits (see also: “Muting function” on page 1.7-1).

Input circuit	**AND + OR connection**	**AND connection**	**OR/No connection active**
Without detection of shorts across contacts			
With detection of shorts across contacts			

*1 Where units are linked logically, Y4 must be wired as shown here (differs from the portrayal on the input circuit).

Unit-specific description
PNOZ e6vp

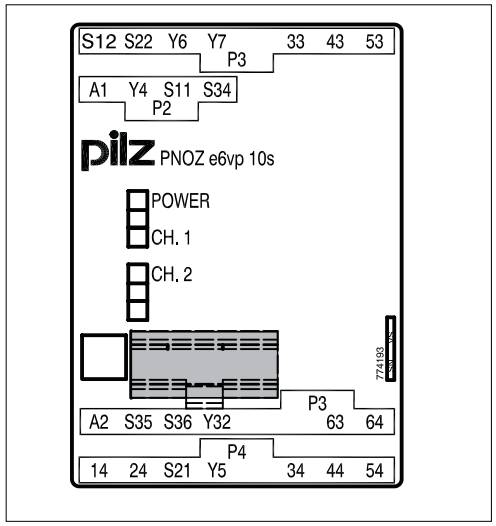
Intended use

The relay PNOZ e6vp is used for the safety-related interruption of a safety circuit. It has an integrated safety contact block.
The unit is designed for use in:
- E-STOP equipment
- Safety circuits in accordance with VDE 0113-1:1998-11 and EN 60204-1:1997-12 (e.g. on movable guards)

Description

The basic functions of the PNOZ e6vp are described in Chapter 1.4. Specific features are:
- Outputs using semiconductor technology:
  - 2 safety outputs (**14** and **24**), delay-on de-energisation can be selected
  - One auxiliary output (**Y32**)
  - 2 test pulse outputs
- Relay outputs:
  - 4 safety contacts (N/O), positive guided
- Safe separation of safety contacts 33-34, 43-44 and 53-54
- One AND and one OR input
- Separate connections for feedback loops (monitored)
- Application options for:
  - E-STOP buttons
  - Safety gate limit switches
  - Safety mats and safe edges made by Haake (N/C principle)
  - Proximity switch evaluation devices
  - Used to process signals from output switching devices on safety mats (short circuit principle) or from output switching elements on light beam devices
- Voltage and current at AND/OR inputs: 24 VDC/ 5 mA
- Weight: 170 g

Terminal configuration

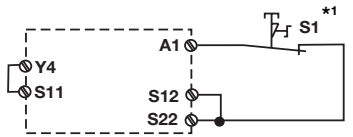
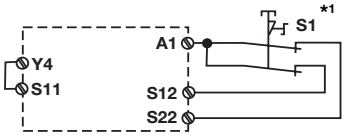
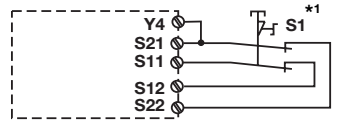


Wiring

Supply voltage:
- Connect the supply voltage to:
  Terminal A1(+) : + 24 VDC
  Terminal A2(-) : 0 V

Input circuit:
The N/C contact on the trigger element (e.g. E-STOP) must be connected to the input circuit. A short circuit in the input circuit may or may not be detected, depending on the wiring of Y4.
- The input circuit should be connected as described in the table.

The table describes how the input circuit is wired when the unit is used individually (without AND input). If units are linked together logically, Y4 must be wired as described in the section entitled “Logic inputs”.

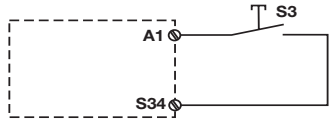
Input circuit	Single-channel	Dual-channel
Without detection of shorts across contacts		
With detection of shorts across contacts		

*1 “E-STOP” symbolises the N/C contact on the trigger element

Unit-specific description
PNOZ e6vp

Reset circuit:
The unit can be started automatically or manually with monitoring. Special wiring must be used for safety gate monitoring with start-up test.

- The reset circuit should be connected as described in the table.

Input circuit	Automatic reset	Monitored reset
E-STOP wiring		
Safety gate **without** start-up test		
Safety gate **with** start-up test		

Delay-on de-energisation t_v :
Terminals **Y6** and **Y7** are used to connect the feedback loop and also to establish the delay-on de-energisation on the safety outputs. The signal for the delay time is connected to the contact on the feedback loop.

INFORMATION
Safety output 24 has **delay-on de-energisation**. If only the OR function is used, safety output **14** may also have delay-on de-energisation. The times are selectable.

Set delay-on de-energisation by connecting Y6 and Y7 to terminals A1, S11 and S21 in accordance with Table 2.2-5.

Examples:
PNOZ e6vp 10 with delay-on de-energisation of 1 s: connect Y6 to S11 and Y7 to A1.

Y6	A1	A1	A1	S11	S11	S11	S21	S21	S21
Y7	A1	S11	S21	A1	S11	S21	A1	S11	S21
tv [s] PNOZ e6vp 10	0	0.15	0.5	1	2	3	5	7	10

Table 2.2-5: Setting delay-on de-energisation

Unit-specific description
PNOZ e6vp

Feedback loop:
The unit has two feedback loops, one (Y6) for safety output 14 and one (Y7) for safety output 24:

- Safety output 14 (instantaneous):
  Connect the contacts from external contactors to Y6.
- Safety output 24 (delay-on de-energisation):
  Connect the contacts from external contactors to Y7.
- Both safety outputs delayed or both instantaneous:
  Connect the contacts from external contactors in series to Y6 or Y7.
- Feedback loop unconnected:
  If you do not wish to connect any contacts to the feedback loop, Y6 and Y7 must be connected to A1 or S11/S21, depending on the required delay time.

CAUTION!
Do **not** connect the contacts from external contactors in series to the reset circuit.

Before a safety output is switched on, a test is carried out to check whether the contacts of the feedback loop are closed. If a contact is open, an error is detected and LEDs CH.1 and CH.2 will flash alternately. It will not be possible to switch the unit back on until the feedback loops are closed and the safety function has been triggered. At the same time, if the OR input is used, the signal at the OR input must be low.

The feedback loop contacts are also checked when the signal at the output changes from high to low. After this signal change, the feedback loop contacts must close within 150 ms. If a contact is still open after 150 ms, an error is detected and is displayed as a flashing code (1,8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Examples

- Example 1:
  Both outputs are delayed (A1-S36 linked):
  PNOZ e6vp 10s: tv = 5 s
  PNOZ e3vp 300 S: tv = 200 s
  Feedback loop is connected to Y7. Only a logic OR connection is possible with this wiring.

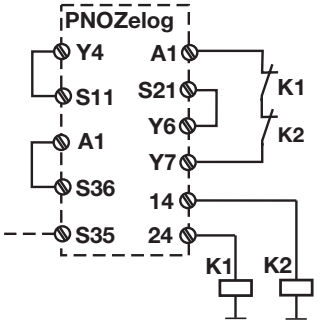


Fig. 2.2-13: Both outputs delayed

- Example 2:
  Both outputs are instantaneous, the feedback loop is connected to Y7. This wiring enables a logic AND and an OR connection.

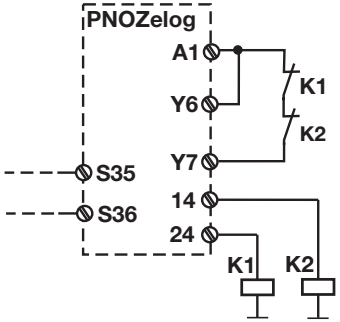


Fig. 2.2-14: Both outputs instantaneous

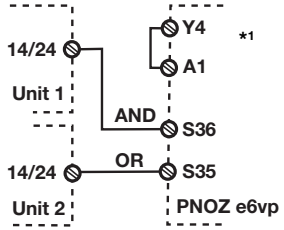
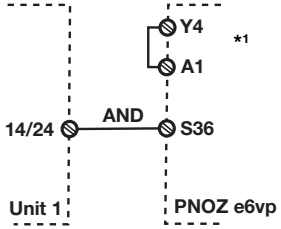
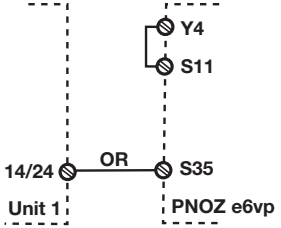
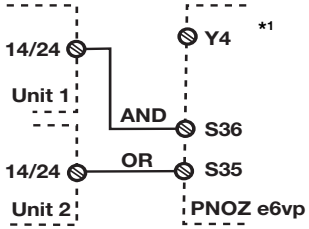
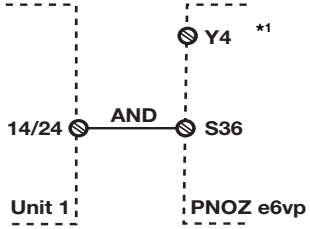
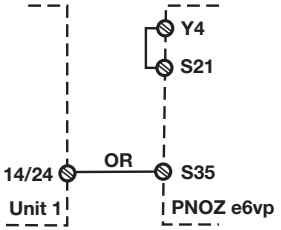
Unit-specific description
PNOZ e6vp

Logic inputs

Please note the following when linking several units:

- **PNOZ e1p:** From Version 3.0, safety outputs on the PNOZ e1p can be logically linked with the safety inputs on other PNOZelog units.
- Safety outputs to which loads are connected may also be linked to the safety inputs of a max. of 4 PNOZelog units.
- Only safety outputs from Pilz PNOZelog units and PNOZmulti units (from Version 3) may be AND/OR connected. The unit with the lowest category determines the category of the whole circuit in accordance with EN 954-1.
- All linked units must be connected to the same supply voltage.

WARNING!
A high signal at the OR input of a PNOZelog unit overrides its safety function. The safety outputs will then energise, irrespective of the status of the input circuits (see also: “Muting function” on page 1.7-1).

Input circuit	**AND + OR connection**	**AND connection**	**OR/No connection active**
Without detection of shorts across contacts			
With detection of shorts across contacts			
Safety output **14** delayed			

*1 Where units are linked logically, Y4 must be wired as shown here (differs from the portrayal on the input circuit).

Unit-specific description

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Safety assessments

Before using a unit it is necessary to perform a safety assessment in accordance with the Machinery Directive. The units as individual components guarantee functional safety, but not the safety of the entire application. You should therefore define the safety requirements for the plant as a whole, and also define how these will be implemented from a technical and organisational standpoint (e.g. refer to BIA [BG Institute for Occupational Safety] Report 6/97).

PNOZ e1p, PNOZ e1.1p, PNOZ e1vp

E-STOP, Category 4, EN 954-1

Features

- 3 E-STOP button
- Dual-channel with detection of shorts across contacts
- 3 instantaneous load shutdowns
- One load shutdown with a 2 s delay

Description

E-STOP function
In this example, an E-STOP function is implemented using a number of different PNOZelog units. The PNOZ e1p and PNOZ e1.1p are to use both contactors at safety outputs 14 and 24 to switch just a single load. PNOZ e1vp is to use contactors K5 and K6 at safety output 14 to switch load A and K7 and K8 at safety output 24 to switch load B.

PNOZ e1p, PNOZ e1.1p
Pressing the E-STOP button interrupts the supply voltage to the input circuits, a low signal is present at safety outputs 14 and 24, contactors K1 and K2 / K3 and K4 de-energise.

PNOZ e1vp
Pressing the E-STOP button interrupts the supply voltage to the input circuits, a low signal is present at safety output 14 and contactors K5 and K6 de-energise. A delay time of 2 s is set for safety output 24 by connecting the feedback loops Y6 and Y7 to S11. Contactors K7 and K8 de-energise after a 2 s delay.

Feedback loop
PNOZ e1p
N/C contacts K1 and K2 on the contactors are wired in series to the reset circuit. The feedback loop is tested during the start-up process. If one of the contacts K1 or K2 is open, the safety outputs will retain a low signal.

PNOZ e1.1p
The unit has a separate feedback loop. N/C contacts K3 and K4 on the contactors are connected to the feedback loop input Y6. When the reset button is operated, a test is carried out to check whether both N/C contacts K3 and K4 are closed, i.e. whether the contacts have de-energised. If one of the contacts is open, the safety outputs will retain a low signal. It will not be possible to restart the unit until the feedback loop is closed and the input circuits have been opened and then closed again.
If the signal at the safety outputs switches from high to low, the N/C contacts must close within a max. of 150 ms. If one contactor fails to de-energise, the corresponding N/C contact will remain open; an error is detected and is displayed as a flashing pulse (1, 8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

PNOZ e1vp
The unit has two feedback loops, one (Y6) for safety output 14 and one (Y7) for safety output 24. The feedback loop is monitored in the same way as on the PNOZ e1.1p.

Reset
PNOZ e1p, PNOZ e1.1p, PNOZ e1vp
If the E-STOP buttons have not been operated and the feedback loops are closed, the units can be started by pressing the reset button S1, S3 or S5 (monitored reset).

PNOZ e1p, PNOZ e1.1p, PNOZ e1vp

E-STOP, Category 4, EN 954-1

Safety assessment

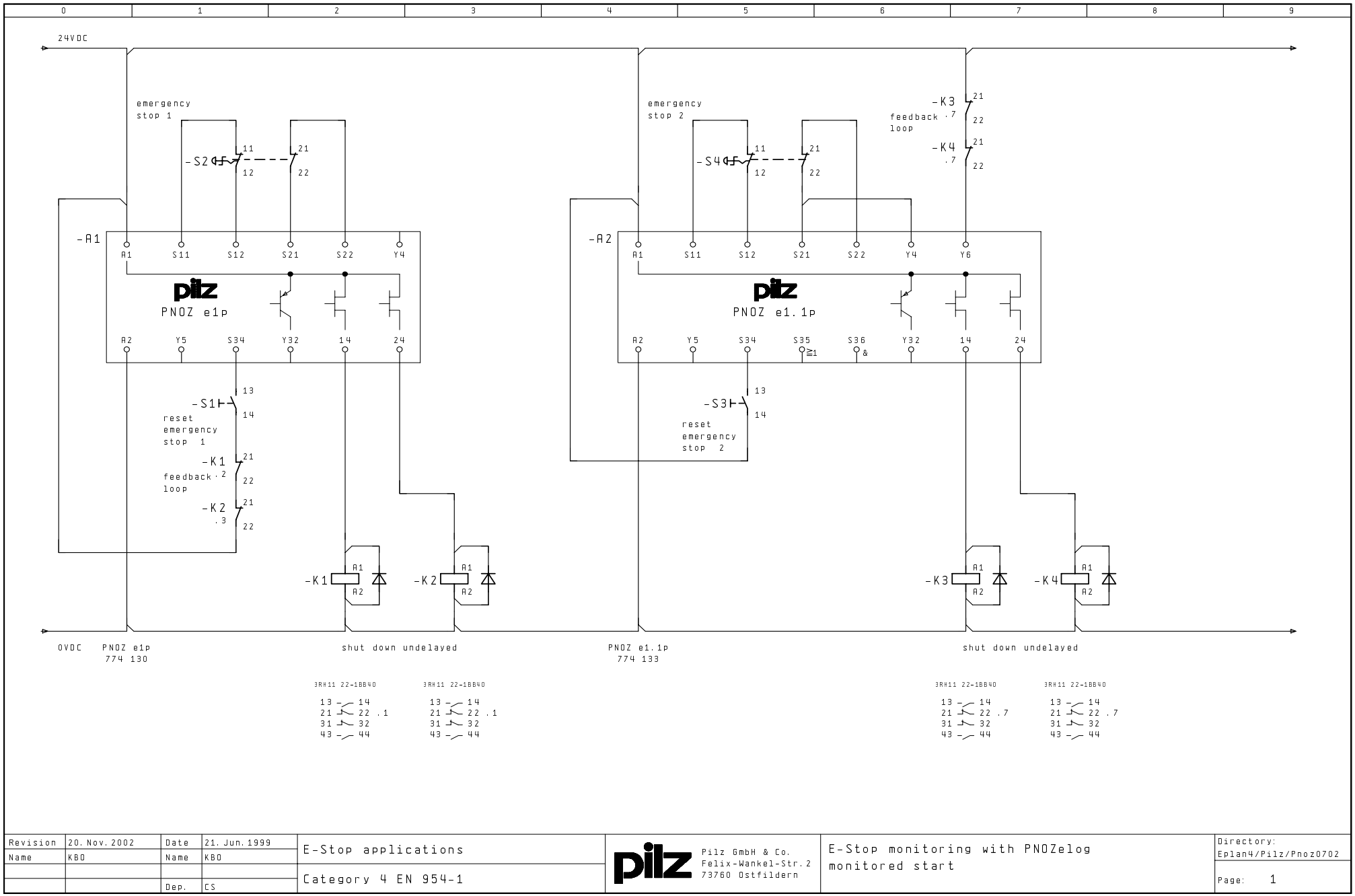
- The PNOZ e1vp and its respective contactors must be installed in a single location, as safety outputs 14 and 24 switch different loads.
- If a switch contact in the input circuit is overridden, this will be detected as an error the next time the affected PNOZelog is operated. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and the input circuits (S11-S12, S21-S22) will be detected as an error. Safety outputs 14 and 24 will carry a low signal.
- Provided the PNOZelog is still ready for operation, rectifying a short circuit between 24 VDC and the reset circuit input S34 will lead to a high signal at safety outputs 14 and 24.
- A short circuit between 24 VDC and the logic inputs S35 or S36 will not affect the connection logic.
- A short circuit between 24 VDC and a safety output on the PNOZ e1p or PNOZ e1.1p will be detected and the safety outputs will carry a low signal. The load will therefore be switched off via the second safety output. Although a short circuit between 24 VDC and a safety output is also detected on the PNOZ e1vp, it is not possible to shut down via the second safety output because different loads are being driven.

Pilz units

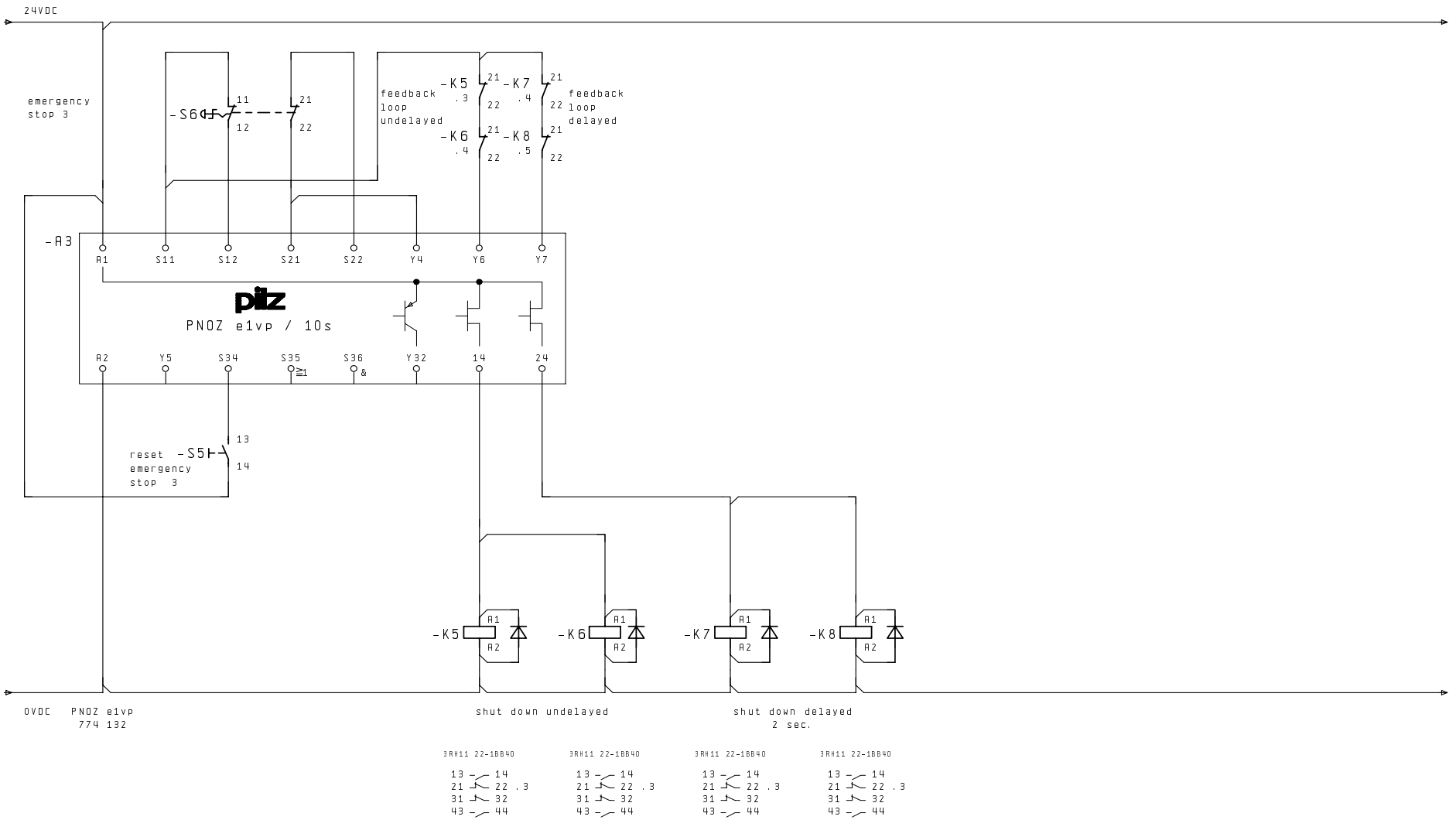
Number	Type	Features	Order number
1	PNOZ e1p	24 VDC	774 130
1	PNOZ e1.1p	24 VDC	774 133
1	PNOZ e1vp	24 VDC, 10s	774 131

Drawing file:

Page 1 and 2 in the project EPLAN4/Pilz/PNOZ0702



Revision	20. Nov. 2002	Date	21. Jun. 1999	E-Stop applications	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	E-Stop monitoring with PNOZelog monitored start	Directory: Eplan4/Pilz/Pnoz0702
Name	KBO	Name	KBO				
				Category 4 EN 954-1			Page: 1
		Dep.	CS				



Revision	20. Nov. 2002	Date	21. Jun. 1999	E-Stop applications	Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	E-Stop monitoring with PNOZelog monitored start	Directory: Eplan4/Pilz/Pnoz0702
Name	KBO	Name	KBO				
				Category 4 EN 954-1			Page: 2
		Dep.	CS				

PNOZ e1p, PNOZ e1.1p, PNOZ e1vp

Light beam devices, Category 4, EN 954-1

Features

- 3 light beam devices with semi-conductor output and integral output test
- Dual-channel without detection of shorts across contacts
- 2 logic connections
- One load shutdown with a 0.5 s delay

Description

Monitoring function
A light beam device is connected to each PNOZelog unit. The safety output on the PNOZ e1p is AND-linked to the PNOZ e1.1p. The safety output on the PNOZ e1.1p is AND-linked to the PNOZ e1vp.
Contactors K9 and K10 on safety output 24 of the PNOZ e1vp de-energise if one of the three light beam devices is interrupted. Both contactors energise when none of the three light beam devices is interrupted.

The status of the light beam devices for each unit can be transmitted instantaneously to a programmable logic controller via auxiliary output Y32.
The PNOZ e1vp is to use both contactors K9 and K10 on safety output 24 to switch a single load.

Feedback loop
PNOZ e1p, PNOZ e1.1p
The feedback loop is not used.
PNOZ e1vp
The unit has two feedback loops, one (Y6) for safety output 14 and one (Y7) for safety output 24. N/C contacts K9 and K10 on the contactors are connected to the feedback loop input Y7. When the reset button is operated, a test is carried out to check whether both N/C contacts K9 and K10 are closed, i.e. whether the contacts have de-energised. If one of the contacts is open, the safety outputs will retain a low signal. It will not be possible to restart the unit until the feedback loop is closed and the input circuits have been opened and then closed again.
If the signal at the safety outputs switches from high to low, the N/C contacts must close within a max. of 150 ms. If one contactor fails to de-energise, the corresponding N/C contact will remain open; an error is detected and is displayed as a flashing pulse (1, 8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Reset
PNOZ e1p, PNOZ e1.1p
If the light beam devices are not interrupted, the units can be started by pressing the reset button S1 (monitored reset).

PNOZ e1vp
If the light beam devices are not interrupted and the feedback loop is closed, the unit can be started by pressing the reset button S1 (monitored reset).

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PNOZ e1p, PNOZ e1.1p, PNOZ e1vp

Light beam devices, Category 4, EN 954-1

Safety assessment

- The PNOZelog relays and their respective contactors must be installed in a single location.
- The light beam device (Category 4) will detect a short circuit between 24 VDC and the input circuits (S12-S22). Safety outputs 14 and 24 will carry a low signal.
- Provided the PNOZelog is still ready for operation, rectifying a short circuit between 24 VDC and the reset circuit input S34 will lead to a high signal at safety outputs 14 and 24.
- A short circuit between 24 VDC and the logic inputs S35 or S36 will not affect the connection logic.
- A short circuit between 24 VDC and a safety output on the PNOZ e1vp will be detected and the safety outputs will carry a low signal. However, it is not possible to shut down via the second safety output because both contactors are driven via safety output 24.

Pilz units

Number	Type	Features	Order number
1	PNOZ e1p	24 VDC	774 130
1	PNOZ e1.1p	24 VDC	774 133
1	PNOZ e1vp	24 VDC, 10s	774 131

Drawing file:

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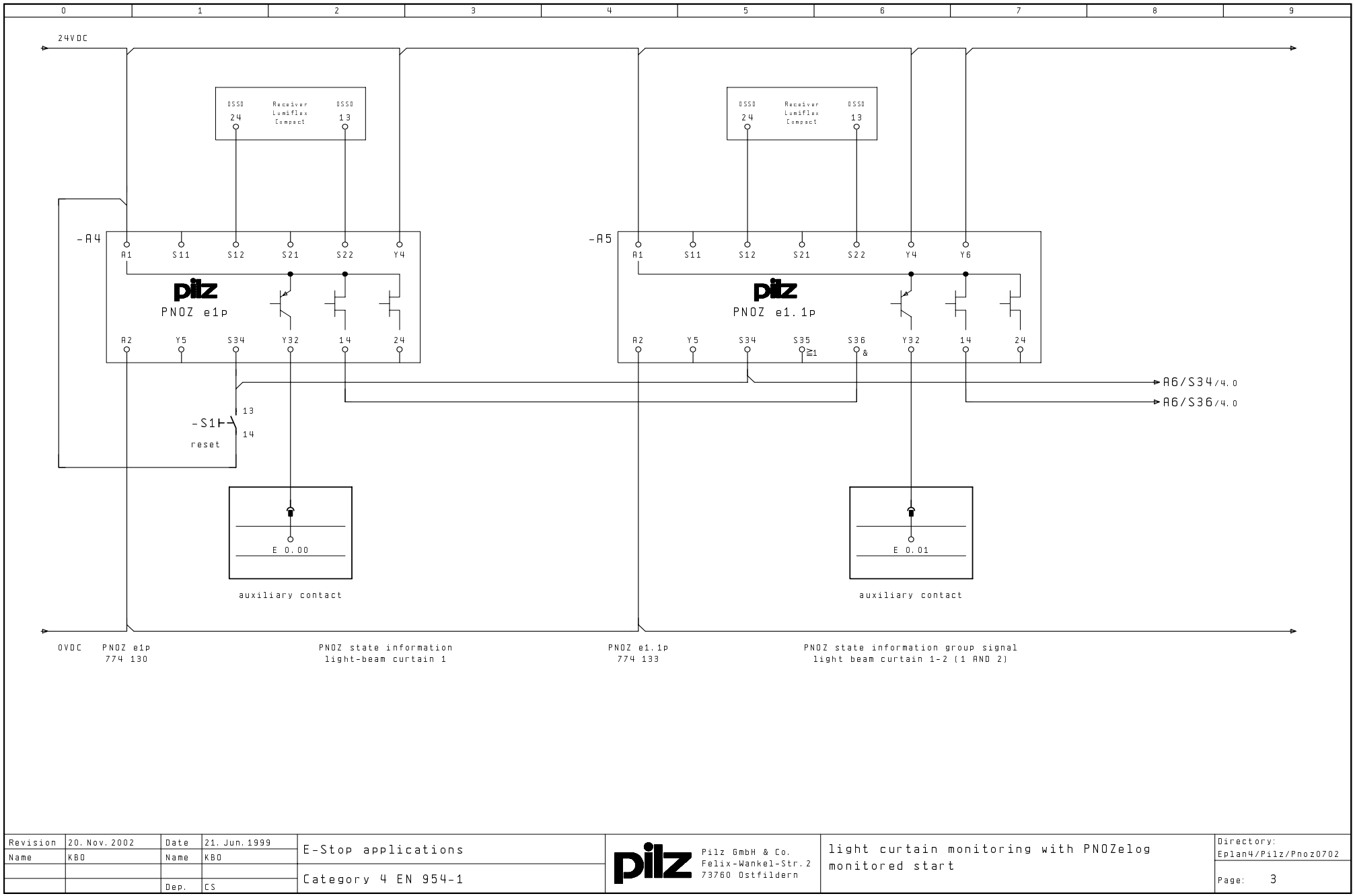

Revision	20. Nov. 2002	Date	21. Jun. 1999	E-Stop applications	Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	light curtain monitoring with PNOZelog monitored start
Name	KBO	Name	KBO			
				Category 4 EN 954-1		
		Dep.	CS			

Directory: Eplan4/Pilz/Pnoz0702

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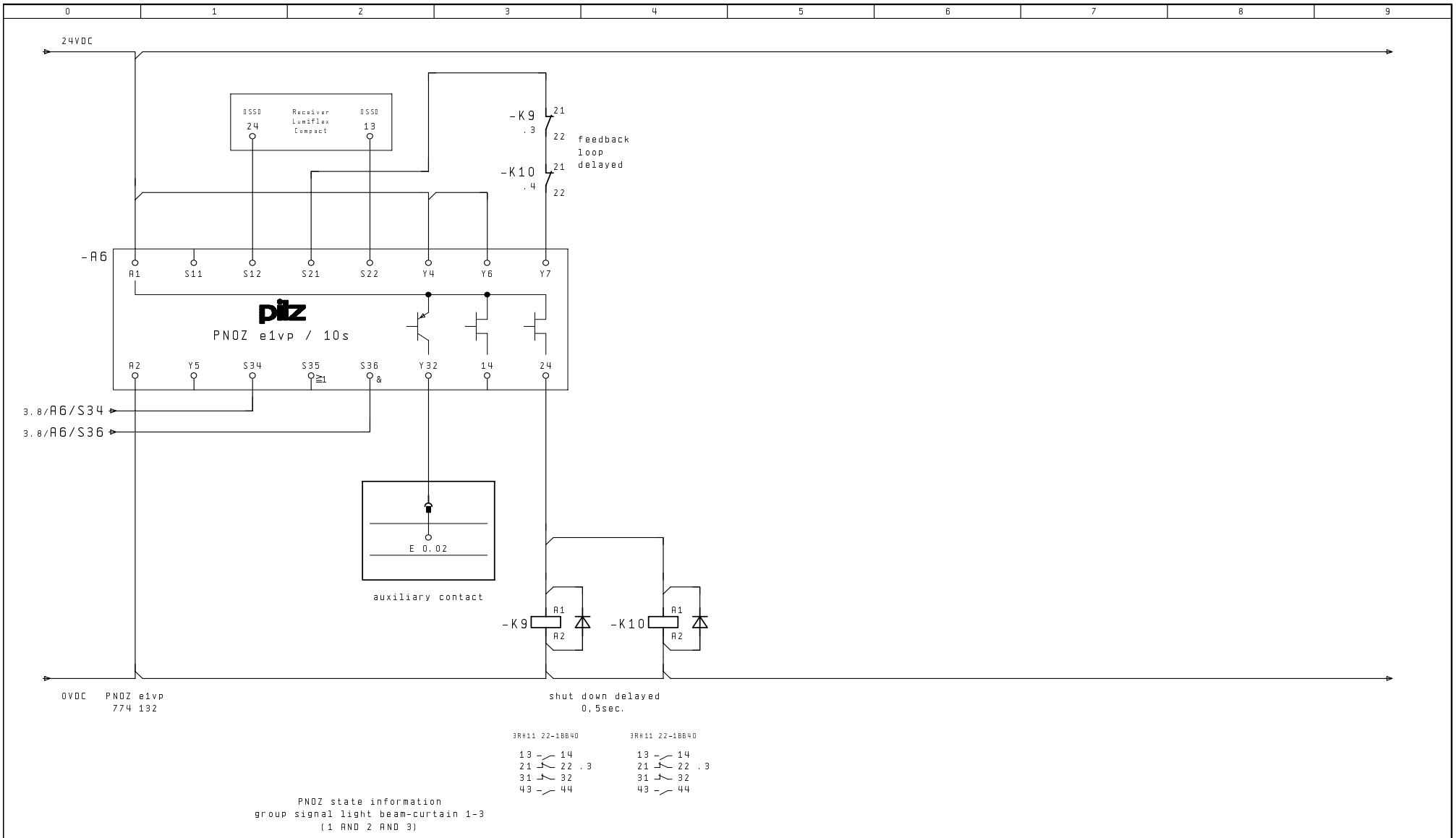

Revision	20. Nov. 2002	Date	21. Jun. 1999	E-Stop applications	Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	light curtain monitoring with PNOZelog monitored start
Name	KBO	Name	KBO			Directory: Eplan4/Pilz/Pnoz0702
				Category 4 EN 954-1		Page: 4
		Dep.	CS			

PNOZ e1p, PNOZ e1.1p, PNOZ e1vp

Zone control limit switch, Category 3, EN 954-1

Features

- 1 safety window without detection of shorts across contacts
- 2 zone control limit switches with detection of shorts across contacts
- 3 logic connections
- One load shutdown with a 0.5 s delay

Description

Monitoring function

At a feed station with safety window, the hazard arising from the movement of an industrial robot is to be avoided. The operator is to be able to feed in new parts when the industrial robot is not moving within the feed area.
The PNOZ e1p monitors the safety window. If the safety window is open, safety output 14 sends a low signal to the OR input of the PNOZ e1.1p and PNOZ e1vp. The PNOZ e1.1p and PNOZ e1vp monitor one zone control limit switch each. Safety output 14 of the PNOZ e1.1p is linked to the AND input of the PNOZ e1vp. A PZE X4 is connected to safety output 24 on the PNOZ e1vp.
Voltage is supplied to the PZE X4 when:

- The safety window is closed

or

- Both zone control limit switches are operated.

There is no supply voltage to the PZE X4 when:

- The safety window is open

and

- One of the two area limit switches is not operated.

The supply voltage is interrupted after a delay of 0.5 s.
The PZE X4 controls the industrial robot using the two safety contacts 13-14 and 23-24 (dual-channel).
The status of safety output 24 on the PNOZ e1vp is transmitted instantaneously to a programmable logic controller via auxiliary output Y32.

Feedback loop

PNOZ e1p, PNOZ e1.1p

The feedback loop is not used.

PNOZ e1vp

When the unit is started, a test is carried out to check whether the N/C contact on the feedback loop at Y7 is closed. If the contact is open, the safety outputs will retain a low signal. The unit will not be ready for operation again until the feedback loop is closed and the input circuits have been opened and then closed again.
If the signal at the safety outputs switches from high to low, the N/C contacts must close within a max. of 150 ms. If the relays on the PZE X4 fail to de-energise, the corresponding N/C contact will remain open, an error is detected and is displayed as a flashing pulse (1, 8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Reset

PNOZ e1p

If the safety window is closed, the unit will be active (automatic reset).

PNOZ e1.1p

If the safety window is closed or zone control limit switch 1 is operated, the unit will be active (automatic reset).

PNOZ e1vp

If the safety window is closed or both zone control limit switches are operated and the feedback loop is closed, the unit will be active (automatic reset).

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PNOZ e1p, PNOZ e1.1p, PNOZ e1vp

Zone control limit switch, Category 3, EN 954-1

Safety assessment

- The PNOZ e1p and PNOZ e1.1p must be installed in a single location. The PNOZ e1vp and PZE X4 must be installed in a single location.
- If a switch contact in the input circuit is overridden, this will be detected as an error the next time the affected PNOZelog is operated. Safety outputs 14 and 24 will carry a low signal.
- PNOZ e1p: A short circuit between 24 VDC and the input circuits (S12-S22) will be detected as an error after the next operation of the input circuits. Safety outputs 14 and 24 will carry a low signal.
  PNOZ e1.1p and PNOZ e1vp: A short circuit between 24 VDC and the input circuits (S11-S12, S21-S22) will immediately be detected as an error.
- A short circuit between 24 VDC and the reset circuit input S34 will be detected immediately. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and the logic inputs S35 or S36 will not affect the connection logic.
- A short circuit between 24 VDC and safety output 14 on the PNOZ e1p or PNOZ e1.1p will be detected and the safety outputs will carry a low signal. As no second shutdown route is available for the PZE X4 on safety output 24 of the PNOZ e1vp (safety output 14 unconnected), the PZE X4 cannot be shut down if there is a short circuit at this safety output.

Pilz units

Number	Type	Features	Order number
1	PNOZ e1p	24 VDC	774 130
1	PNOZ e1.1p	24 VDC	774 133
1	PNOZ e1vp	24 VDC, 10s	774 131

Drawing file:

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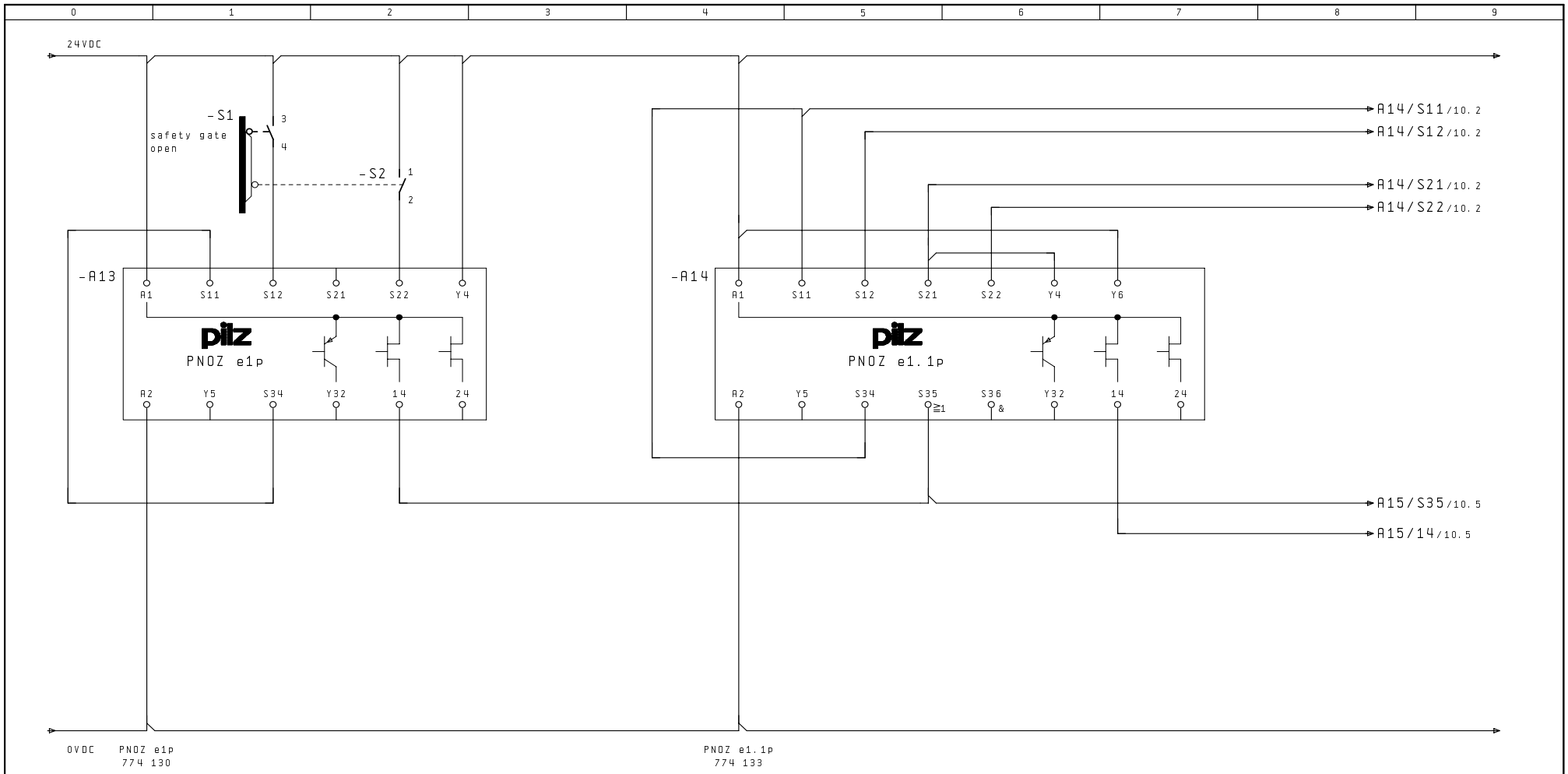
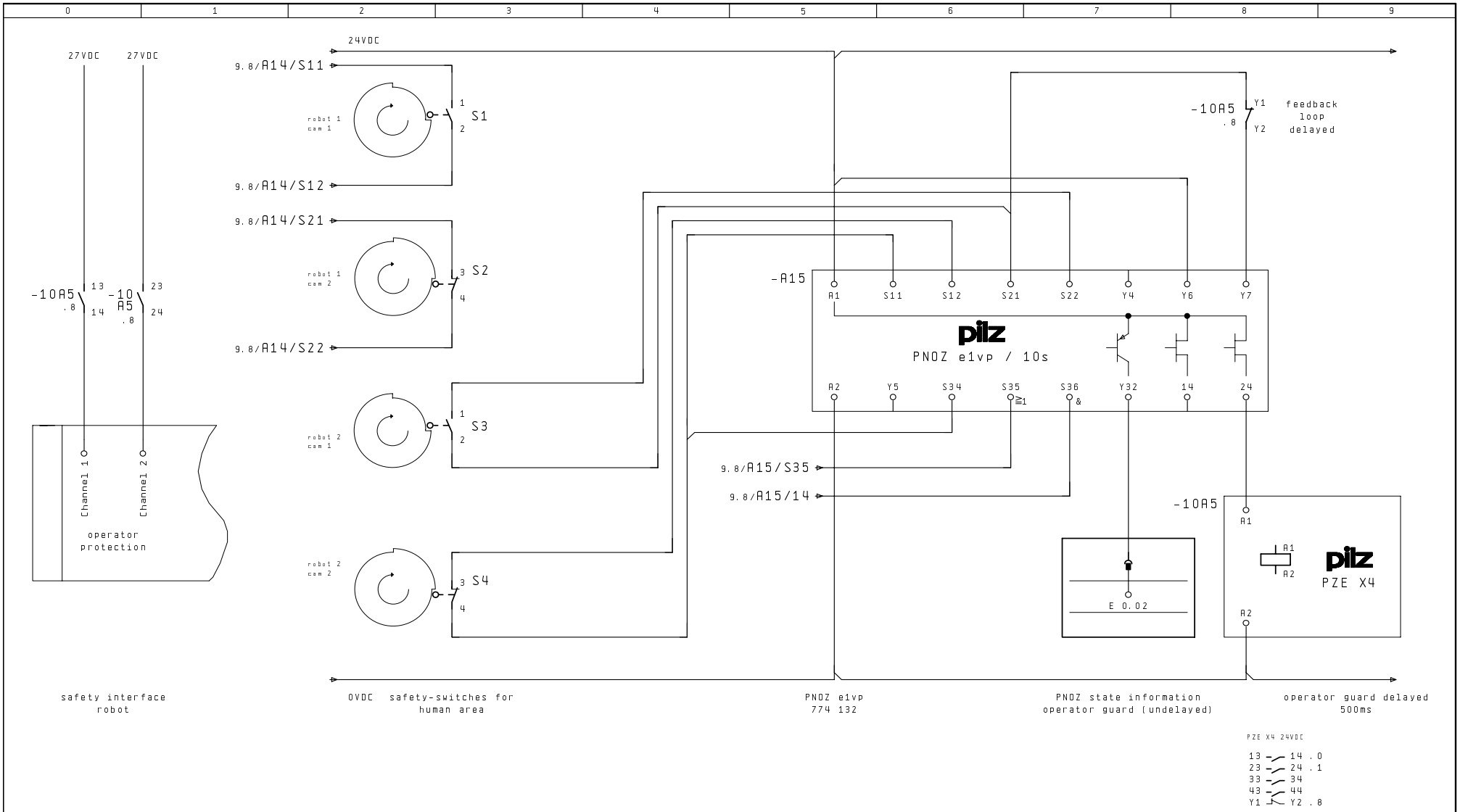


Revision	26. Nov. 2002	Date	21. Jun. 1999	E-Stop applications	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	operating range monitoring with PNOZelog automatic start	Directory: Eplan4/Pilz/Pnoz0702
Name	KBO	Name	KBO	Category 3 EN 954-1			Page: 9
		Dep.	CS				



Revision	26. Nov. 2002	Date	21. Jun. 1999	E-Stop applications	Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	operating range monitoring with PNOZelog automatic start	Directory: Eplan4/Pilz/Pnoz0702
Name	KBO	Name	KBO	Category 3 EN 954-1			Page: 10
		Dep.	CS				

PNOZ e1p, PNOZ e1.1p, PNOZ e1vp

Gate combination, Category 3, EN 954-1

Features

- 1 operating mode selector switch, automatic/manual
- 1 Enable switch
- 1 machine gate
- 1 machine loading hatch
- 3 E-STOP functions
- 1 machine controller (servo drive)
- No detection of shorts across contacts
- 6 logic connections
- One load shutdown with a 3 s delay

Description

Monitoring function

On a machine tool, the hazard arising from a loading system within the machine work area is to be prevented. The servo drive for the loading system is started and stopped via the PNOZ e1vp (A25). The S1 switch on both PNOZ e1p units (A19 and A20) can be used to select between manual and automatic mode.

- Automatic mode: The loading system is operational when:
  - The machine loading hatch S4 or the machine gate S6 is closed and
  - E-STOP buttons S8 ... S10 are not operated.
- Manual mode: The loading system is operational at reduced speed when:
  - The enabling switch S3 is operated and
  - E-STOP buttons S8 ... S10 are not operated.

A switch between the operating modes will not be detected until reset button S2 has been operated and then released.
The PNOZ e1vp (A 25) switches the contactors on the servo drive via the two contactors K27 and K28 at safety output 24.
The status of the PNOZelog devices is transmitted to a programmable logic controller via auxiliary output Y32.

Feedback loop
PNOZ e1p, PNOZ e1.1p
The feedback loop is not used.
PNOZ e1vp (A25)
When the unit is started, a test is carried out to check whether the N/C contacts on the feedback loop at Y7 are closed, i.e. whether the contactors have de-energised. If one of the contacts K27 or K28 is open, the safety outputs will retain a low signal. The unit will not be ready for operation again until the feedback loop is closed and the input circuit has been opened and then closed again.
If the signal at the safety outputs switches from high to low, the N/C contacts must close within a max. of 150 ms. If one contactor fails to de-energise, the corresponding N/C contact will remain open; an error is detected and is displayed as a flashing pulse (1, 8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Reset
PNOZ e1p (A19, A20, A24)
If the input circuit is closed, the units can be started by operating the reset button S2 or S11 (monitored reset).
PNOZ e1.1p (A21, A23), PNOZ e1p (A22)
If the enabling switch is operated or the machine gate or machine loading hatch is closed, the units will be active (automatic reset).
PNOZ e1vp (A25)
If the input circuit and feedback loop are closed, the unit will be active (automatic reset).

PNOZ e1p, PNOZ e1.1p, PNOZ e1vp

Gate combination, Category 3, EN 954-1

Safety assessment

- The PNOZelog units A21, A22 and A23 must be installed in a single location. Units A19, A20, A24 and A25, the wiring of the input circuits and the contactors on the safety output (A25) must be installed in a single location.
- A19 and A20: If a switch contact in the input circuit is overridden, this will remain undetected.
  A21, A22, A23 and A24: If a switch contact in the input circuit is overridden, this will be detected as an error the next time the E-STOP button from the affected PNOZelog is operated. Safety outputs 14 and 24 will carry a low signal.
  A24: The error is reset by operating another E-STOP button; after a restart the safety outputs will again carry a high signal.
- PNOZ e1p (A19, A20) and PNOZ e1vp (A25): A short circuit between 24 VDC and the input circuits (S12, S22) will not be detected.
  PNOZ e1p (A22, A24) and PNOZ e1.1p (A21, A23): A short circuit between 24 VDC and the input circuits (S12-S22) will be detected as an error after the next operation of the input circuits. Safety outputs 14 and 24 will carry a low signal.
- A19, A20, A24: Provided the PNOZelog is still ready for operation, rectifying a short circuit between 24 VDC and the reset circuit input S34 will lead to a high signal at safety outputs 14 and 24.
  A21, A22, A23, A25: A short circuit between 24 VDC and the reset circuit input S34 will be detected immediately. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and the logic inputs S35 or S36 will not affect the connection logic.
- A short circuit between 24 VDC and a safety output will be detected and the safety outputs will carry a low signal. Although a short circuit between 24 VDC and a safety output is also detected on the PNOZ e1vp, it is not possible to shut down via the second safety output because the servo drive is driven only via safety output 24.
- It must be possible to protect the operating mode selector switch from unauthorised operation. The possibility of a short occurring between the connection wires of the operating mode selector switch must be excluded.

Pilz units

Number	Type	Features	Order number
4	PNOZ e1p	24 VDC	774 130
2	PNOZ e1.1p	24 VDC	774 133
1	PNOZ e1vp	24 VDC, 10s	774 131

Drawing file:

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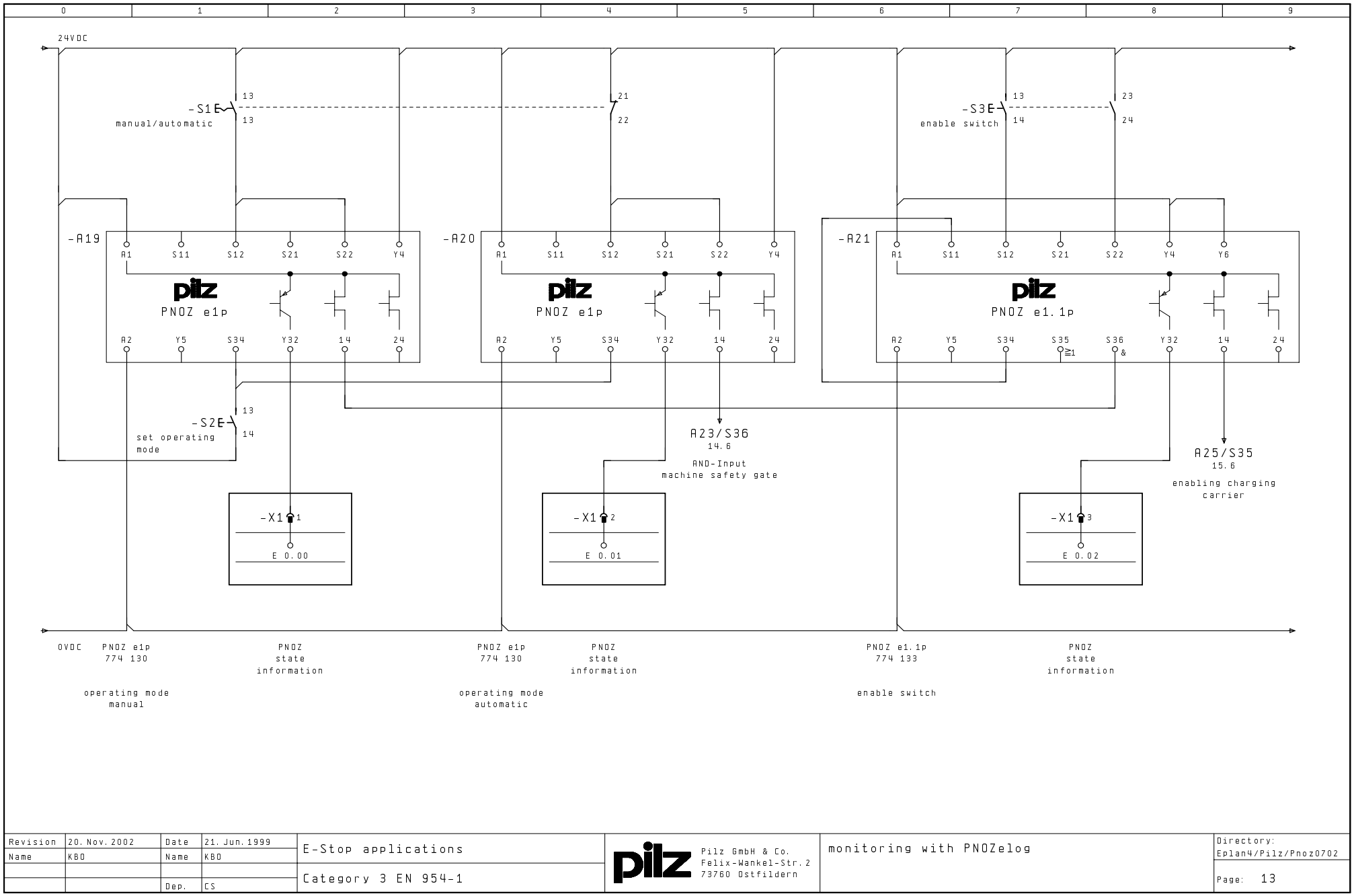
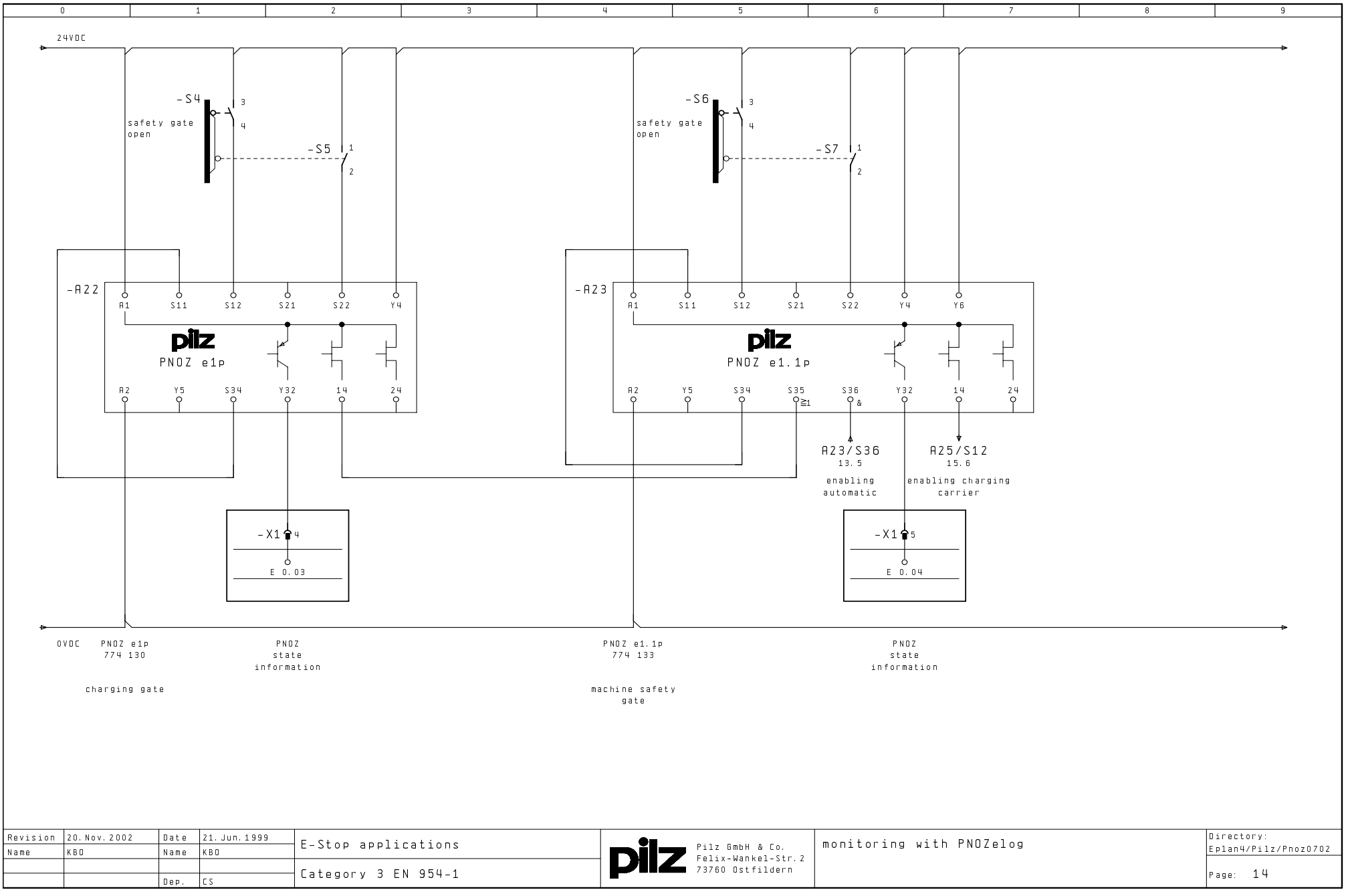
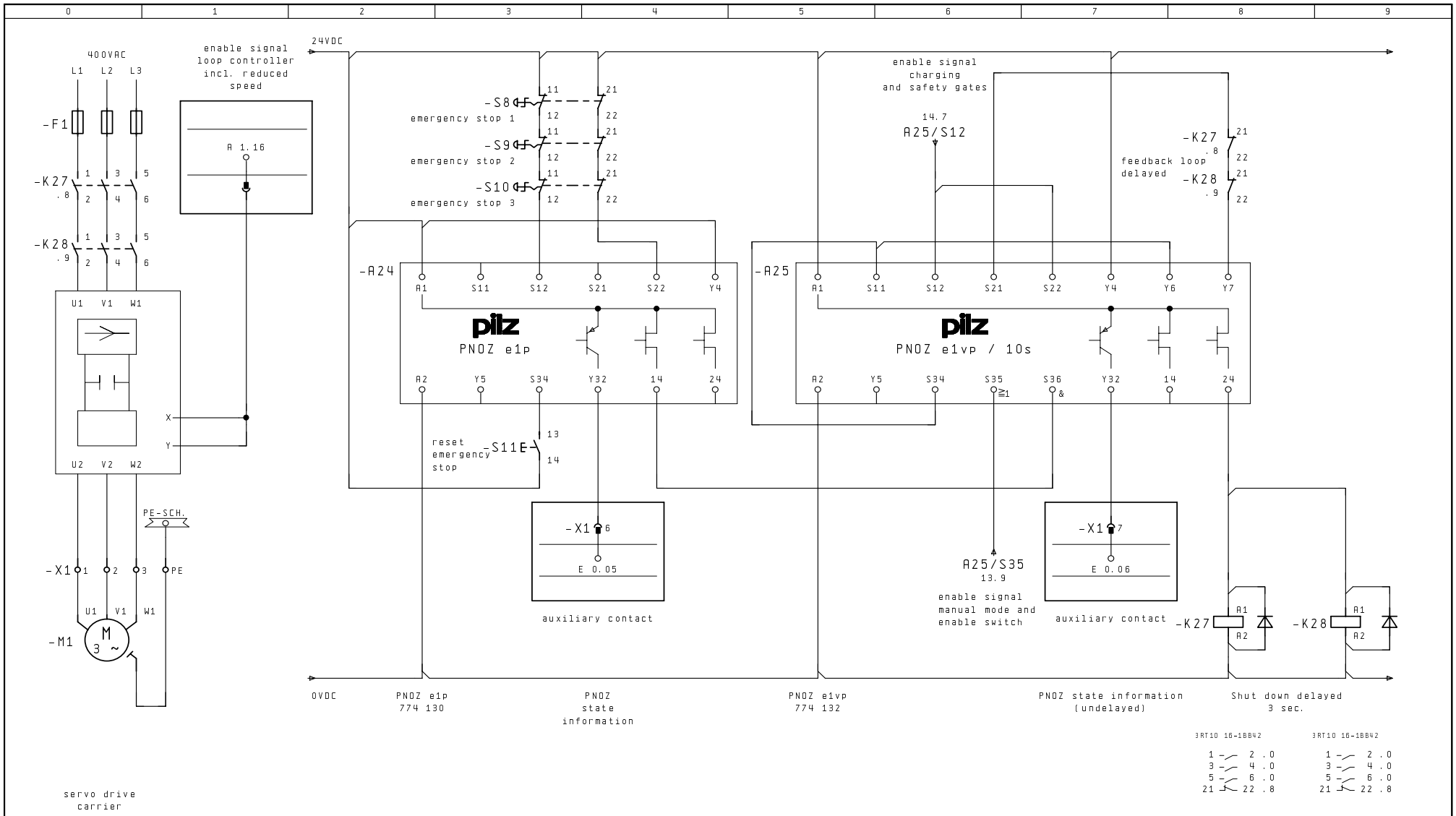


Revision	20. Nov. 2002	Date	21. Jun. 1999	E-Stop applications	Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	monitoring with PNOZelog
Name	KBO	Name	KBO			
				Category 3 EN 954-1		Directory: Eplan4/Pilz/Pnoz0702
		Dep.	CS			Page: 13



Revision	20. Nov. 2002	Date	21. Jun. 1999	E-Stop applications	pilz	monitoring with PNOZelog	Directory: Eplan4/Pilz/Pnoz0702
Name	KBO	Name	KBO		Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern		
				Category 3 EN 954-1			Page: 14
		Dep.	CS				



Revision	20. Nov. 2002	Date	21. Jun. 1999	E-Stop applications	Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	monitoring with PNOZelog
Name	KBO	Name	KBO			Directory: Eplan4/Pilz/Pnoz0702
				Category 3 EN 954-1		Page: 15
		Dep.	CS			

PNOZ e2.1p, PNOZ e1.1p

Operation with safety gate open, Category 4, EN 954-1

Features

- 1 dual-channel two-hand control with detection of shorts across contacts
- 3 safety gates with detection of shorts across contacts, without start-up test, dual-channel
- 1 operating mode selector switch for the two-hand function, with detection of shorts across contacts
- 5 logic connections

Description

Monitoring function
A machine's work area is protected with 3 safety gates. In set-up mode, the machine can be operated at reduced speed and with the safety gate open via the two-hand control function. The following operating options can be selected via the operating mode selector switch:

- All safety gates closed, two-hand control inactive
- Safety gate 1 may be open, two-hand control active
- Safety gate 2 may be open, two-hand control active
- Safety gate 3 may be open, two-hand control active

The PNOZ e1.1p (A30) is to use both contactors K29 and K30 at safety outputs 14 and 24 to switch a single load.

Feedback loop
PNOZ e2.1p, PNOZ e1.1p (A26, A27 and A28)
The feedback loop is not used.
PNOZ e1.1p (A29)
The unit has a separate feedback loop. N/C contacts K29 and K30 on the contactors are connected to the feedback loop input Y6. When the unit is started, a test is carried out to check whether both N/C contacts are closed, i.e. whether the contactors have de-energised. If one of the contacts K29 or K30 is open, the safety outputs will retain a low signal. The unit will not be ready for operation again until the feedback loop is closed and the input circuits have been opened and then closed again.
If the signal at the safety outputs switches from high to low, the N/C contacts must close within a max. of 150 ms. If one contactor fails to de-energise, the corresponding N/C contact will remain open; an error is detected and is displayed as a flashing pulse (1, 8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Reset
PNOZ e2.1p
If the two-hand buttons are operated simultaneously (within 0.5 s), the unit will be active (automatic reset).
PNOZ e1.1p (A27, A28)
If the input circuits / safety gate are closed, the units will be active (automatic reset).
PNOZ e1.1p (A29)
If the safety gate and feedback loop are closed, the unit will be active (automatic reset).

PNOZ e2.1p, PNOZ e1.1p

Operation with safety gate open, Category 4, EN 954-1

Safety assessment

- The PNOZelog relays must be installed in a single location.
- If a switch contact is overridden, this will be detected as an error the next time the affected PNOZelog is operated. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and the input circuits (S11-S12, S21-S22, S11-S12-S13, S21-S22-S23) will be detected as an error. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and the reset circuit input S34 will be detected immediately. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and the logic inputs S35 or S36 will not affect the connection logic.
- A short circuit between 24 VDC and a safety output on the PNOZ e1.1p (A29) will be detected and the safety outputs will carry a low signal. The load will be switched off via the second safety output.
- It must be possible to protect the operating mode selector switch from unauthorised operation. The possibility of a short occurring between the connection wires of the operating mode selector switch must be excluded.

Pilz units

Number	Type	Features	Order number
1	PNOZ e1p	24 VDC	774 130
3	PNOZ e1.1p	24 VDC	774 133
1	PNOZ e2.1p	24 VDC	774 136

Drawing file:

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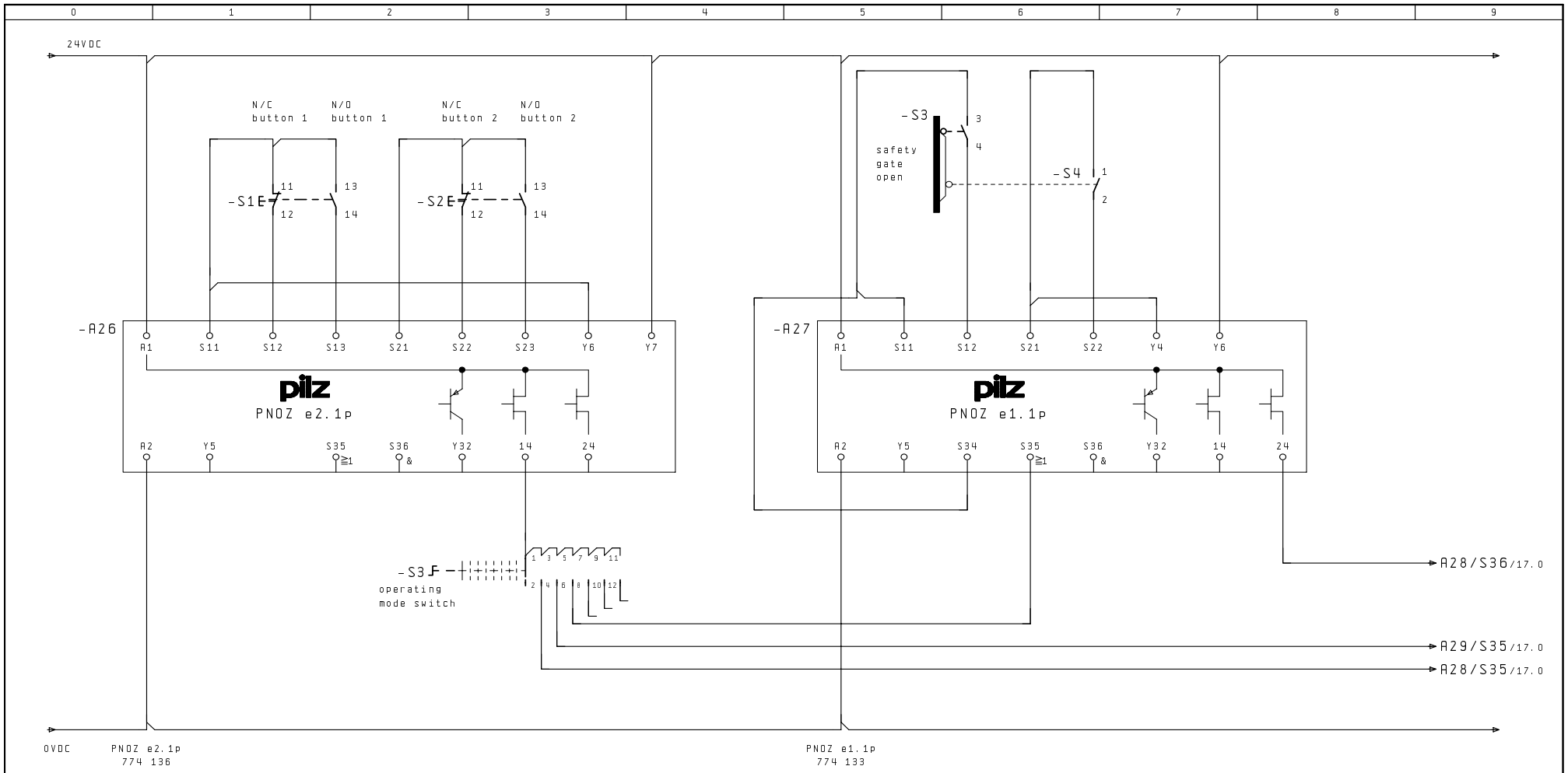
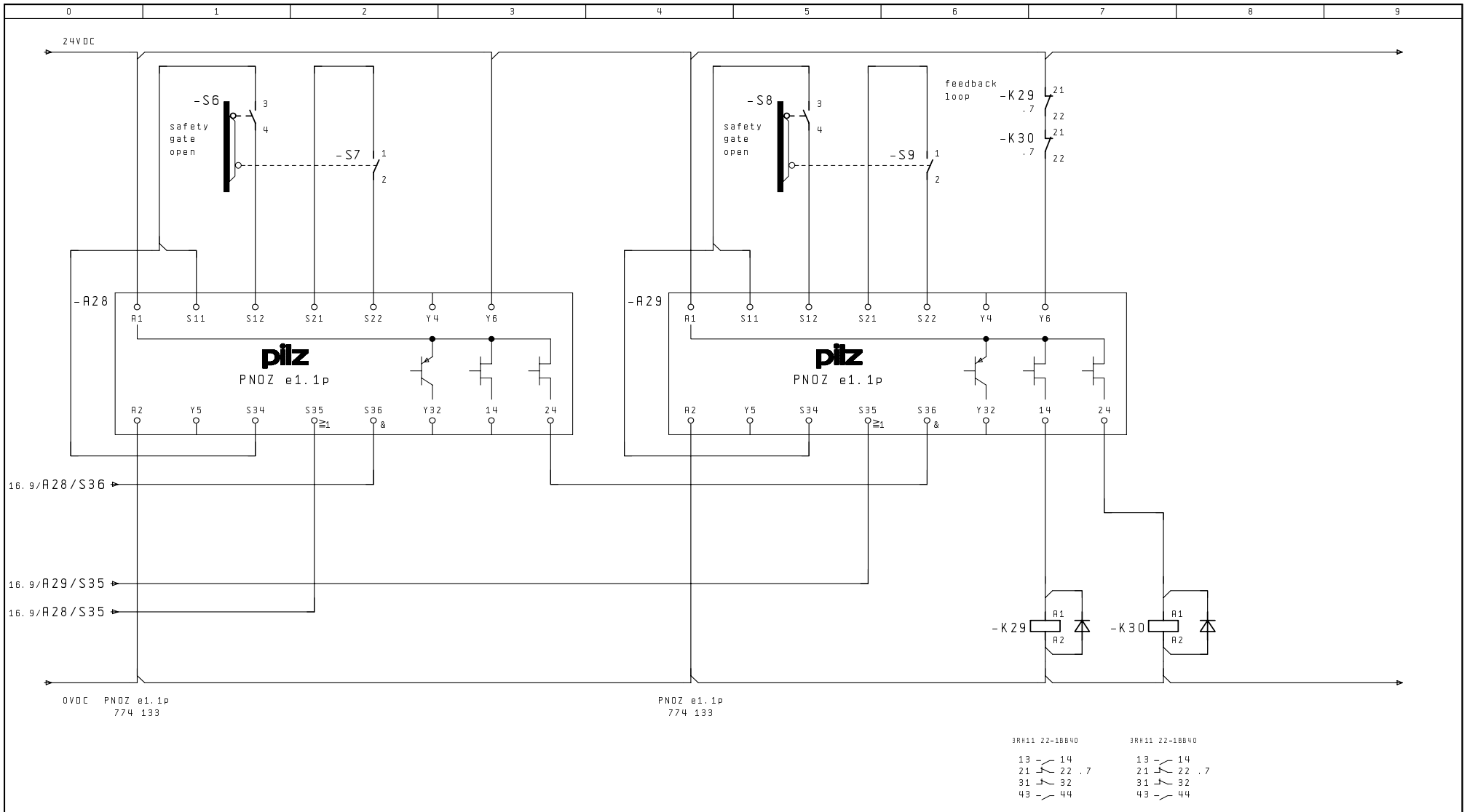
Pilz GmbH & Co. KG, Sichere Automation, Felix-Wankel-Straße 2, 73760 Ostfildern, Germany, Telephone: +49 711 3409-0, Telefax: +49 711 3409-133, E-Mail: pilz.gmbh@pilz.de



Revision	06. Dez. 2002	Date	21. Jun. 1999	E-Stop applications	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	monitoring with PNOZelog	Directory: Eplan4/Pilz/Pnoz0702
Name	KBO	Name	KBO	Category 4 EN 954-1			Page: 16
		Dep.	CS				



Revision	20. Nov. 2002	Date	21. Jun. 1999	E-Stop applications	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	monitoring with PNOZelog	Directory: Eplan4/Pilz/Pnoz0702
Name	KBO	Name	KBO	Category 4 EN 954-1			Page: 17
		Dep.	CS				

PNOZ e1.1p, PNOZ e2.1p

E-STOP - Two-hand control, Category 4, EN 954-1

Features

- 1 E-STOP button with detection of shorts across contacts
- 1 dual-channel two-hand control with detection of shorts across contacts
- 1 logic connection

Description

Monitoring function
A two-hand control is also protected through an E-STOP button.
The contactors on outputs 14 and 24 of the PNOZ e1.1p energise if
- The E-STOP button has not been operated and
- The two-hand button is operated.

Both contactors de-energise if:
- The E-STOP button has been operated or
- The two-hand button has not been operated.

The PNOZ e1.1p is to use both contactors at safety outputs 14 and 24 to switch a single load.

Feedback loop
PNOZ e1.1p
The unit has a separate feedback loop. N/C contacts K41 and K42 on the contactors are connected to the feedback loop input Y6. When the unit is started, a test is carried out to check whether both N/C contacts are closed, i.e. whether the contactors have de-energised. If one of the contacts K41 or K42 is open, the safety outputs will retain a low signal. The unit will not be ready for operation again until the feedback loop is closed and the input circuits have been opened and then closed again.
If the signal at the safety outputs switches from high to low, the N/C contacts must close within a max. of 150 ms. If one contactor fails to de-energise, the corresponding N/C contact will remain open; an error is detected and is displayed as a flashing pulse (1, 8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.
PNOZ e2.1p
The feedback loop is not used.

Reset
PNOZ e1.1p
If the E-STOP button S1 has not been operated, the unit will be active (automatic reset).
PNOZ e2.1p
If the two-hand buttons are operated simultaneously (within 0.5 s), the unit will be active (automatic reset).

PNOZ e1.1p, PNOZ e2.1p

E-STOP - Two-hand control, Category 4, EN 954-1

Safety assessment

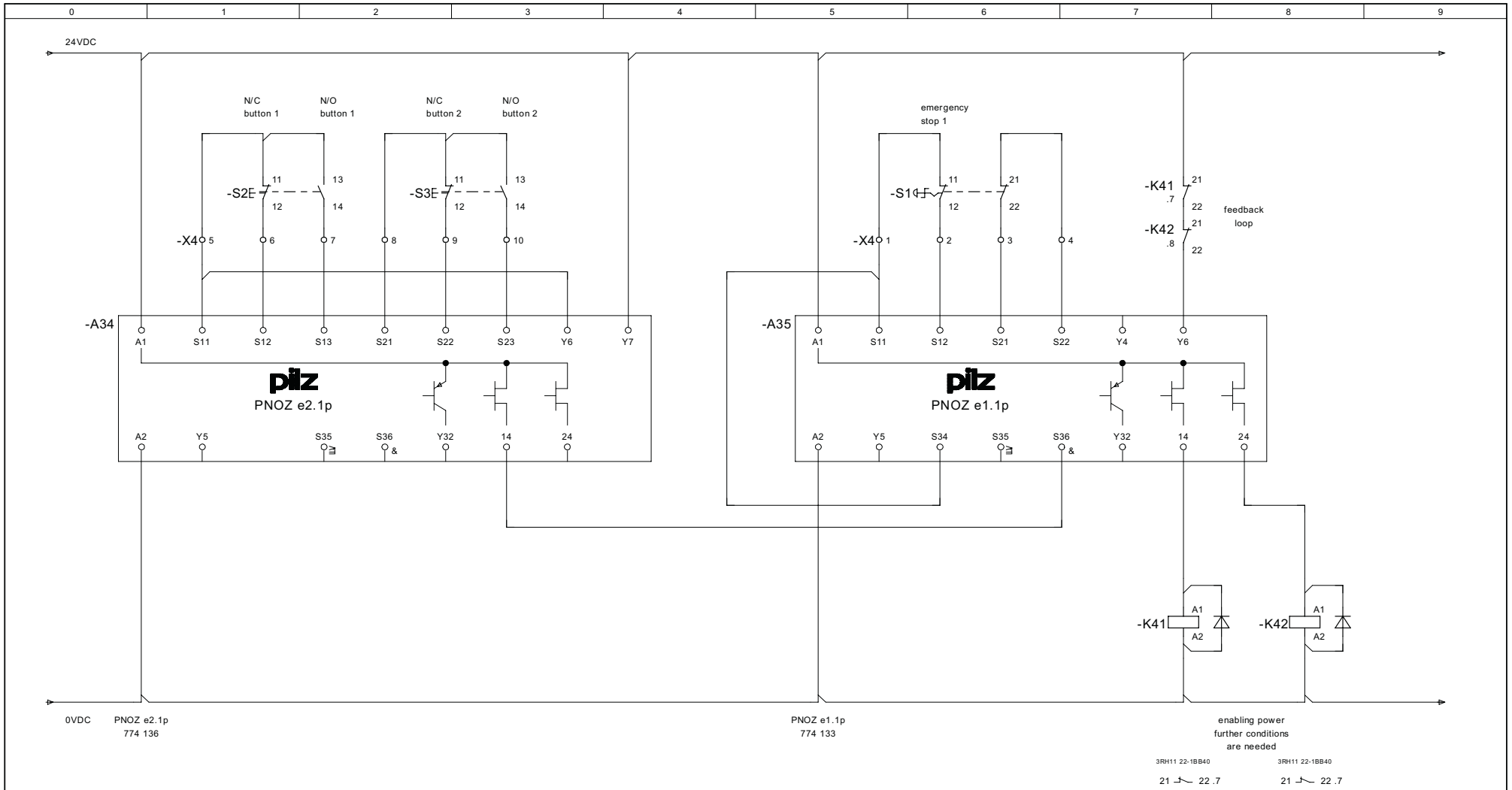
- The PNOZelog relays must be installed in a single location.
- If a switch contact in the input circuit is overridden, this will be detected as an error the next time the affected PNOZelog is operated. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and the input circuits will be detected as an error. Safety outputs 14 and 24 will carry a low signal.
- PNOZe1.1p: A short circuit between 24 VDC and the reset circuit input S34 will be detected immediately. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and the logic inputs S35 or S36 will not affect the connection logic.
- A short circuit between 24 VDC and safety output 14 or 24 will be detected and the safety outputs will carry a low signal. On the PNOZ e1.1p, the load is shut down via the second safety output.

Pilz units

Number	Type	Features	Order number
1	PNOZ e1.1p	24 VDC	774 133
1	PNOZ e2.1p	24 VDC	774 136

Drawing file:

Page 22 in the project EPLAN4/Pilz/PNOZ0702



Revision	20.Nov.2006	Date	21.Jun.1999	two hand application	Pilz GmbH & Co. Felix-Wankel-Str.2 73760 Ostfildern	two hand monitoring with pnozelog
Name	KBO	Name	KBO			Directory: ..PILZ\PNOZ\03PIL001
		Dep.	CS	Category 4 EN 954-1		Page: 22

PNOZ e1p, PNOZ e4vp

Guarding with the safety gate open, Category 3, EN 954-1

Features

- One Mayser SM/BK safety mat and one safety gate
- Dual-channel with detection of shorts across contacts
- 1 instantaneous load shutdown
- 1 load shutdown with a 0.15 s delay
- 1 logic connection

Description

Monitoring function
A safety gate monitors access to a machine with a potentially hazardous movement. A safety mat shuts down the machine as soon as the danger zone is accessed when the safety gate is open.
Opening the safety gate interrupts the input circuits on the PNOZ e1p; there is a low signal at safety outputs 14 and 24. Defined machine functions are shut down via contactors K37 and K38. If the safety mat is also activated, the input circuits on the PNOZ e4vp are short-circuited and there is a low signal at safety outputs 14 and 24. The potentially hazardous machine movement is shut down via contactors K39 and K40.

A delay time of 0.15 s is set for safety output 24 on the PNOZ e4vp by connecting feedback loop Y6 to A1 and Y7 to S11. Contactors K39 and K40 de-energise after a 0.15 s delay.

Feedback loop
PNOZ e1p
N/C contacts K37 and K38 on the contactors are wired in series to the reset circuit. The feedback loop is tested during the start-up process. If one of the contacts K39 or K40 is open, the safety outputs will retain a low signal.

PNOZ e4vp
The unit has two feedback loops, one (Y6) for safety output 14 and one (Y7) for safety output 24. N/C contacts K39 and K40 on the contactors are connected to the feedback loop input Y7. Before safety output 24 is switched on, a test is carried out to check whether both N/C contacts K39 and K40 are closed, i.e. whether the contactors have de-energised. If one of the contacts is open, the safety outputs will retain a low signal. It will not be possible to restart the unit until the feedback loop is closed and the safety functions have been triggered.
If the signal at the safety outputs switches from high to low, the N/C contacts must close within a max. of 150 ms. If one contactor fails to de-energise, the corresponding N/C contact will remain open; an error is detected and is displayed as a flashing pulse (1, 8 or 1,11). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Reset
PNOZ e1p
If the safety gate and the feedback loop are closed, the unit can be started by pressing the reset button S1 (monitored reset).
PNOZ e4vp
If the safety mat has not been activated and the feedback loop is closed, the unit will be active (automatic reset).

PNOZ e1p, PNOZ e4vp

Guarding with the safety gate open, Category 3, EN 954-1

Safety assessment

- The PNOZelog relays and their respective contactors must be installed in a single location.
- A short circuit between 24 VDC and the input circuits (S11-S12, S21-S22) will be detected as an error. Safety outputs 14 and 24 will carry a low signal.
- PNOZ e1p: If a switch contact in the input circuit is overridden, this will be detected as an error the next time the affected PNOZelog is operated. Safety outputs 14 and 24 will carry a low signal.
- PNOZ e1p: Provided the PNOZelog is still ready for operation, rectifying a short circuit between 24 VDC and the reset circuit input S34 will lead to a high signal at safety outputs 14 and 24.
- PNOZ e1p: A short circuit between 24 VDC and a safety output will be detected and the safety outputs will carry a low signal. The load will therefore be switched off via the second safety output.
- PNOZ e4vp: An interruption to the input circuit (S11-S12, S21-S22) will be detected as an error. Safety outputs 14 and 24 will carry a low signal.
- PNOZ e4vp: A short circuit between 24 VDC and the logic inputs S35 or S36 will not affect the connection logic.
- PNOZ e4vp: A short between 24 VDC and a safety output will be detected as an error. However, it is not possible to shut down via the second safety output because both contactors are driven via safety output 24.

Pilz units

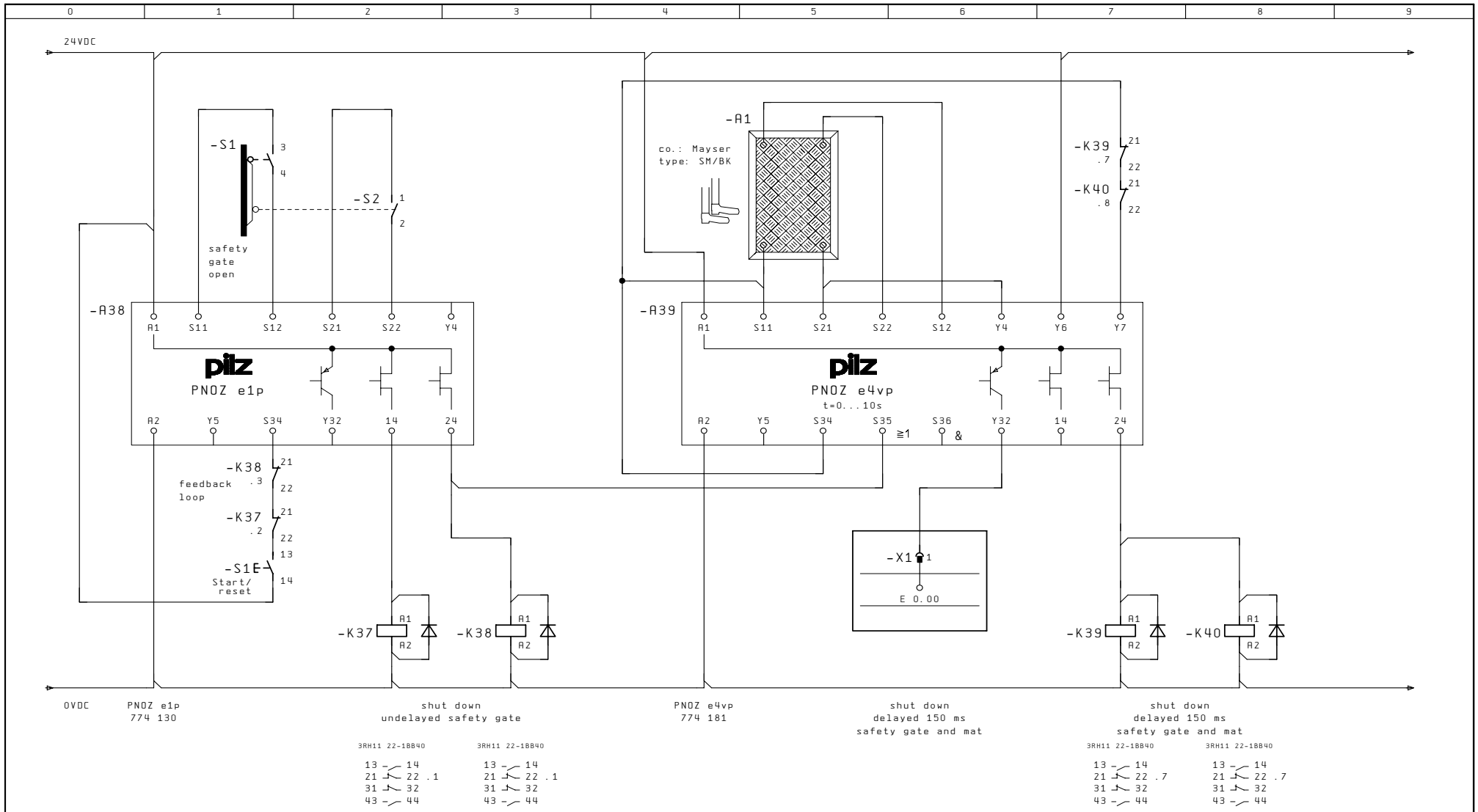
Number	Type	Features	Order number
1	PNOZ e1p	24 VDC	774 130
1	PNOZ e4vp	24 VDC	774 181

Products made by other manufacturers

Number	Designation	Manufacturer	Type
1	Safety mat	Mayser	SM/BK

Drawing file:

Page 24 in the project EPLAN4/Pilz/PNOZ0702



Revision	03. Sep. 2003	Date	21. Jun. 1999	safety mat application	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	safety gate and saftey mat monitoring with PNOZ e4vp	Directory: Eplan4/Pilz/Pnoz0702
Name	CLE	Name	CLE				
				Category 3 EN 954-1			Page: 24
		Dep.	CS				

PNOZ e1p, PNOZ e4.1p

Monitoring the work area, with signal lamp, Category 3, EN 954-1

Features

- One Mayser SM/BK safety mat
- One self-monitoring signal lamp with detection of shorts across contacts
- 2 zone control limit switches with detection of shorts across contacts
- 2 logic connections

Description

Monitoring function
At a feed station, the hazard arising from the movements of an industrial robot and mobile tools is to be avoided.
A safety mat is used to monitor the work area around the feed station.

The industrial robot should continue working during the feed process, provided it isn't within the feed area. If the industrial robot moves into the feed area, this will be indicated via a self-monitoring signal lamp. If the signal lamp should fail or the safety mat be activated, the drive movement will be shut down if the industrial robot enters the feed area.
The drive movement is only switched on when:

- The safety mat has not been activated and the signal lamp is lit

or

- Both zone control switches are operated.

The PNOZ e1p monitors the output switch status on the self-monitoring signal lamps. If the signal lamp is lit, safety output 14 will carry a high signal.
The PNOZ e1p is AND-linked to the PNOZ e4.1p. The PNOZ e4.1p monitors the status of the safety mat. If the safety mat has not been activated and the signal lamp is lit, safety output 14 will carry a high signal. The PNOZ e4.1p is OR-linked to the PNOZ e1.1p. The PNOZe1.1p monitors the actuation status of the zone control switches on its input circuits. If both zone control limit switches are operated or the signal lamp is lit and the safety mat has not been activated, there will be a high signal at safety outputs 14 and 24. Contactors K45 and K46 are switched on.

Feedback loop
PNOZ e1p, PNOZ e4.1p
The feedback loop is not used.
PNOZ e1.1p
The unit has a separate feedback loop. N/C contacts K45 and K46 on the contactors are connected to the feedback loop input Y6. When the unit is started, a test is carried out to check whether both N/C contacts K45 and K46 are closed, i.e. whether the contactors have de-energised. If one of the contacts is open, the safety outputs will retain a low signal. It will not be possible to restart the unit until the feedback loop is closed and the input circuits have been opened and then closed again.

If the signal at the safety outputs switches from high to low, the N/C contacts must close within a max. of 150 ms. If one contactor fails to de-energise, the corresponding N/C contact will remain open; an error is detected and is displayed as a flashing pulse (1, 8). It will not be possible to switch the unit back on until the error has been rectified and the supply voltage has been switched off and then on again.

Reset
PNOZ e1p
If the signal lamp is lit, the unit will be active (automatic reset).

PNOZ e4.1p
If the safety mat has not been activated and the signal lamp is lit, the unit will be active (automatic reset).
PNOZ e1.1p
If the safety mat has not been activated and the signal lamp is lit, or both zone control limit switches are operated, the unit will be active (automatic reset).

PNOZ e1p, PNOZ e4.1p

Monitoring the work area, with signal lamp, Category 3, EN 954-1

Safety assessment

- The PNOZ e1p, PNOZ e4.1p and PNOZ e1.1p must be installed in a single location. The PNOZe1.1p and its respective contactors are not tied to a common location.
- PNOZ e1p and PNOZ e1.1p: If a switch contact in the input circuit is overridden, this will be detected as an error the next time the affected PNOZelog is operated. Safety outputs 14 and 24 will carry a low signal.
  PNOZ e4.1p: An interruption to the input circuit (S11-S12, S21-S22) will be detected as an error. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and the input circuits (S11-S12, S21-S22) will be detected as an error. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and the logic inputs S35 or S36 will not affect the connection logic.
- A short circuit between 24 VDC and a safety output will be detected and the safety outputs will carry a low signal. On the PNOZ e1.1p, the load is then shut down via the second shutdown route.

Pilz units

Number	Type	Features	Order number
1	PNOZ e1p	24 VDC	774 130
1	PNOZ e1.1p	24 VDC	774 133
1	PNOZ e4.1p	24 VDC	774 180

Products made by other manufacturers

Number	Designation	Manufacturer	Type
1	Safety mat	Mayser	SM/BK
1	Signal lamp	Werma	826

Drawing file:

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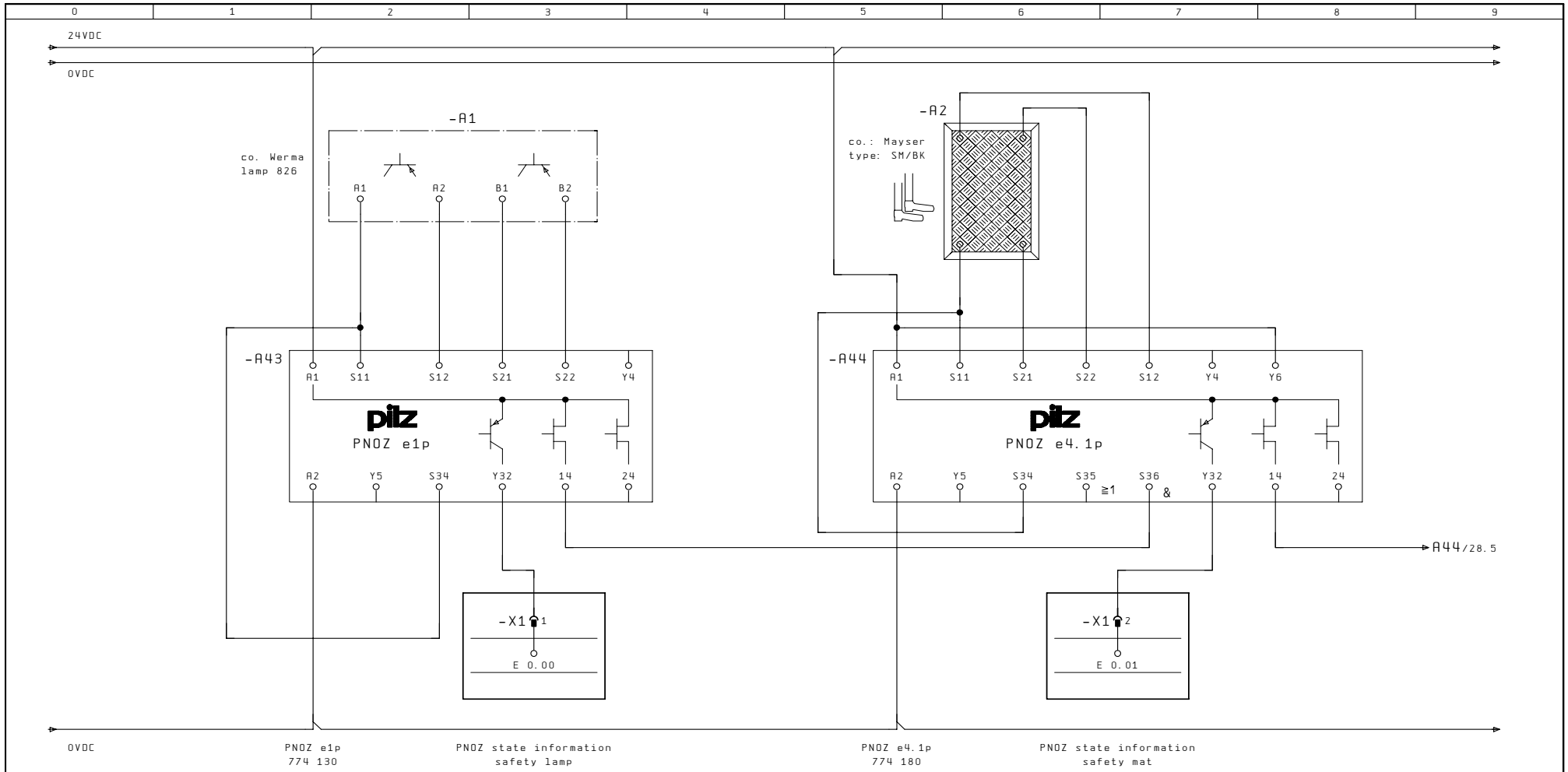
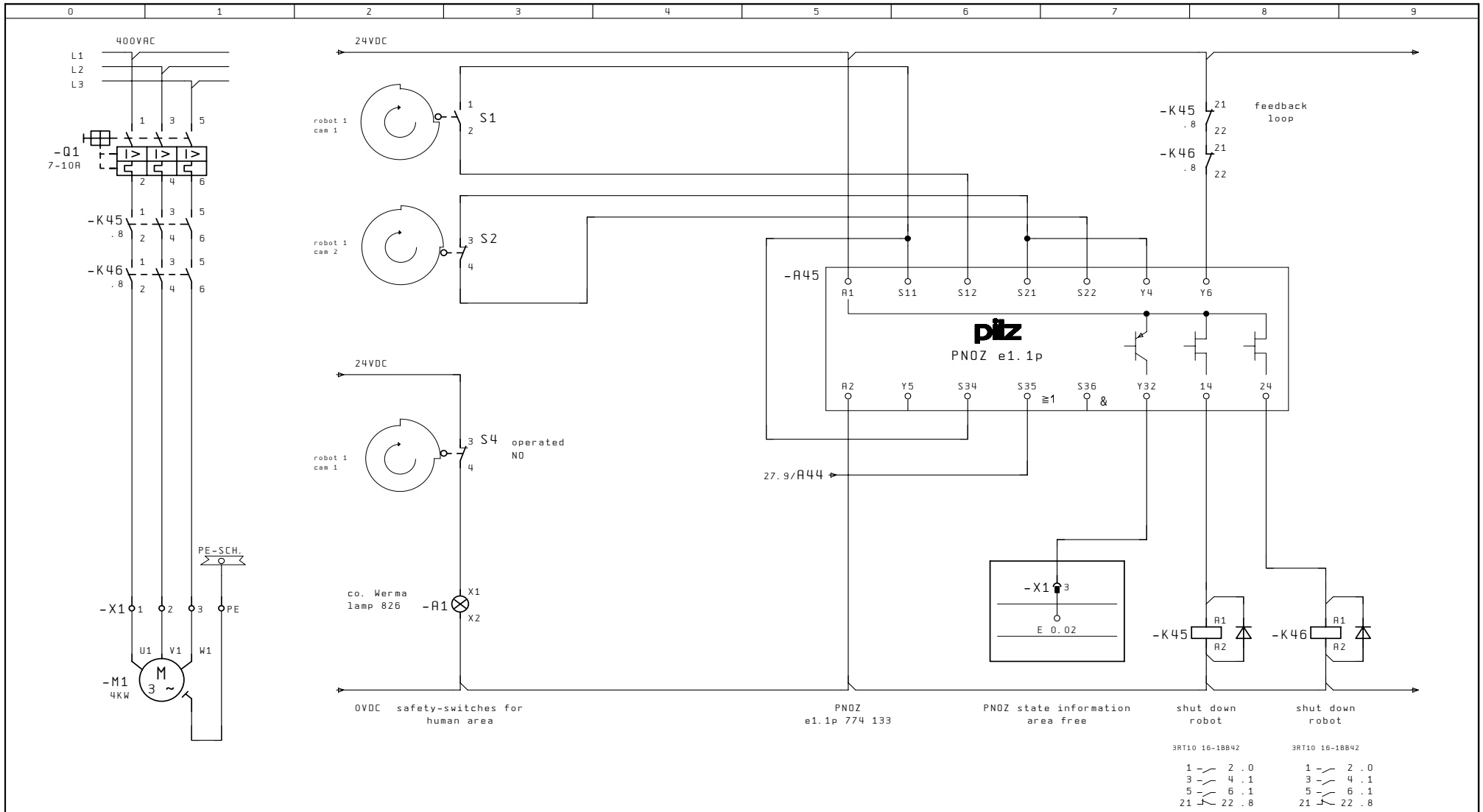


Revision	02. Sep. 2003	Date	21. Jun. 1999	safety mat application	pilz	safety mat and safety lamp monitoring with PNOZe4.1p	Directory: Eplan4/Pilz/Pnoz0702
Name	CLE	Name	CLE		Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern		
				Category 3 EN 954-1			Page: 27
		Dep.	CS				



Revision	02. Sep. 2003	Date	21. Jun. 1999	E-Stop applications	Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	safety mat and safety lamp monitoring with PNOZe4.1p
Name	CLE	Name	CLE			Directory: Eplan4/Pilz/Pnoz0702
				Category 3 EN 954-1		Page: 28
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PNOZ e4.1p

Safety mat monitoring with evaluation via a PSS, Category 3, EN 954-1

Features

- One Mayser SM/BK safety mat
- Dual-channel with detection of shorts across contacts
- 2 instantaneous load shutdowns
- Signal to master programmable safety system (PSS)
- Evaluation of safety mat via PSS (SB063 E-Stop)
- Feasibility test on the PSS input signals in SB063

Description

Monitoring function
A safety mat operating to the short circuit principle is used to monitor access to a machine with a potentially hazardous movement. The PNOZ e4.1p monitors the safety mat.
Safety outputs S14 and S24 are connected to the inputs on a PSS and are therefore integrated into the master programmable safety system.
If the safety mat is activated, the input circuits on the PNOZ 4.1p are short-circuited and there is a low signal at safety outputs 14 and 24. The low signal at PSS inputs E00.00 and E00.01 is evaluated by standard function block SB063 and the potentially hazardous movement is shut down via contactors K1 and K2.

Feedback loop
PNOZ e4.1p
The feedback loop is not used.

Reset
PNOZ e4.1p
If the safety mat has not been activated, the unit will be active (automatic reset).

PNOZ e4.1p

Safety mat monitoring with evaluation via a PSS, Category 3, EN 954-1

Safety assessment

- A short circuit between 24 VDC and the input circuits (S11-S12, S21-S22) will be detected as an error. Safety outputs 14 and 24 will carry a low signal.
- A short between the input circuits (S11-S12, S21-S22) will not be detected as an error but will cause the unit to shut down. Safety outputs 14 and 24 will carry a low signal.
- A short circuit between 24 VDC and a safety output will be detected and the safety output will carry a low signal. The load will be switched off via the second shutdown route.

Pilz units

Number	Type	Features	Order number
1	PNOZ e4.1p	24 VDC	774 180

Products made by other manufacturers

Number	Designation	Manufacturer	Type
1	Safety mat	Mayser	SM/BK

Drawing file:

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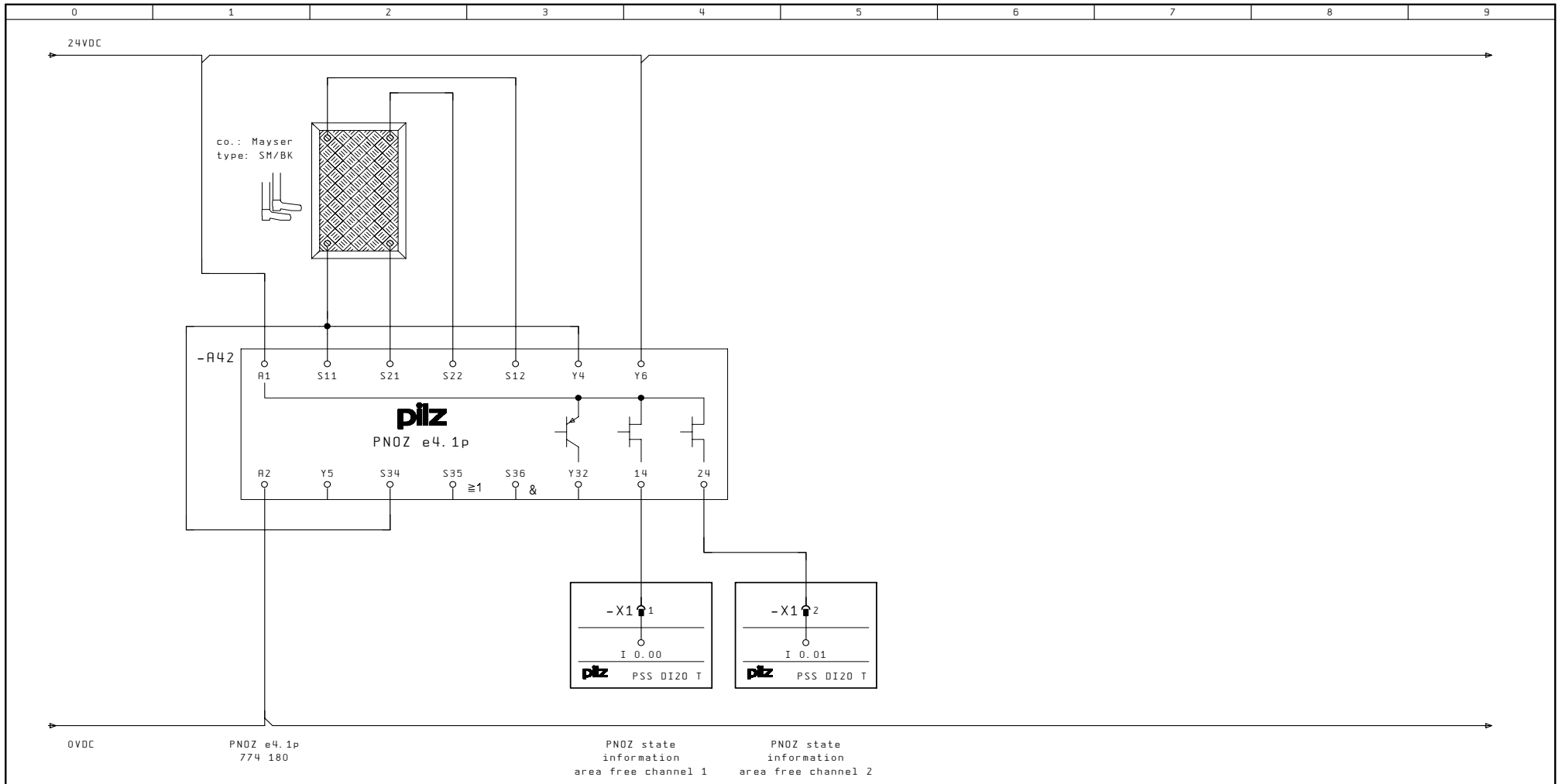
Pilz GmbH & Co. KG, Sichere Automation, Felix-Wankel-Straße 2, 73760 Ostfildern, Germany, Telephone: +49 711 3409-0, Telefax: +49 711 3409-133, E-Mail: pilz.gmbh@pilz.de

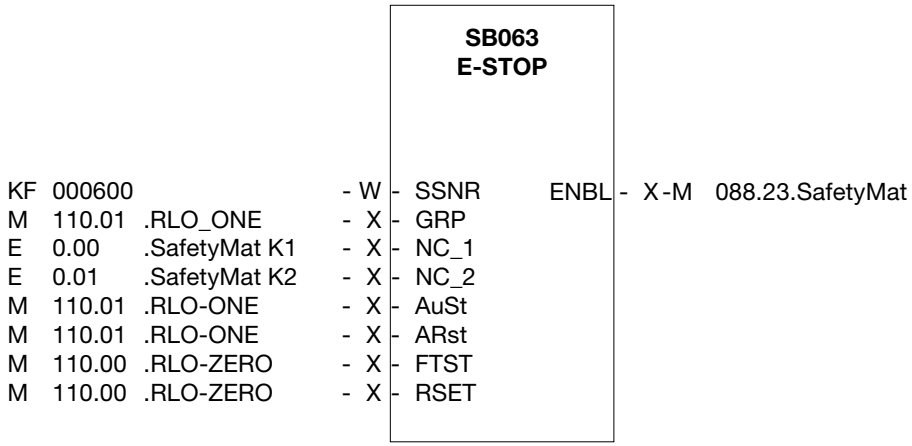


Revision	02. Sep. 2003	Date	21. Jun. 1999	safety mat application	Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	safety mat monitoring with pnoz e4.1p and PSS	Directory: Eplan4/Pilz/Pnoz0702
Name	CLE	Name	CLE				
				Category 3 EN 954-1			Page: 26
		Dep.	CS				

PNOZ e4.1p

Safety mat monitoring with evaluation via a PSS, Category 3, EN 954-1

Example for the PSS parameter settings



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European directives and position of the standards in Europe

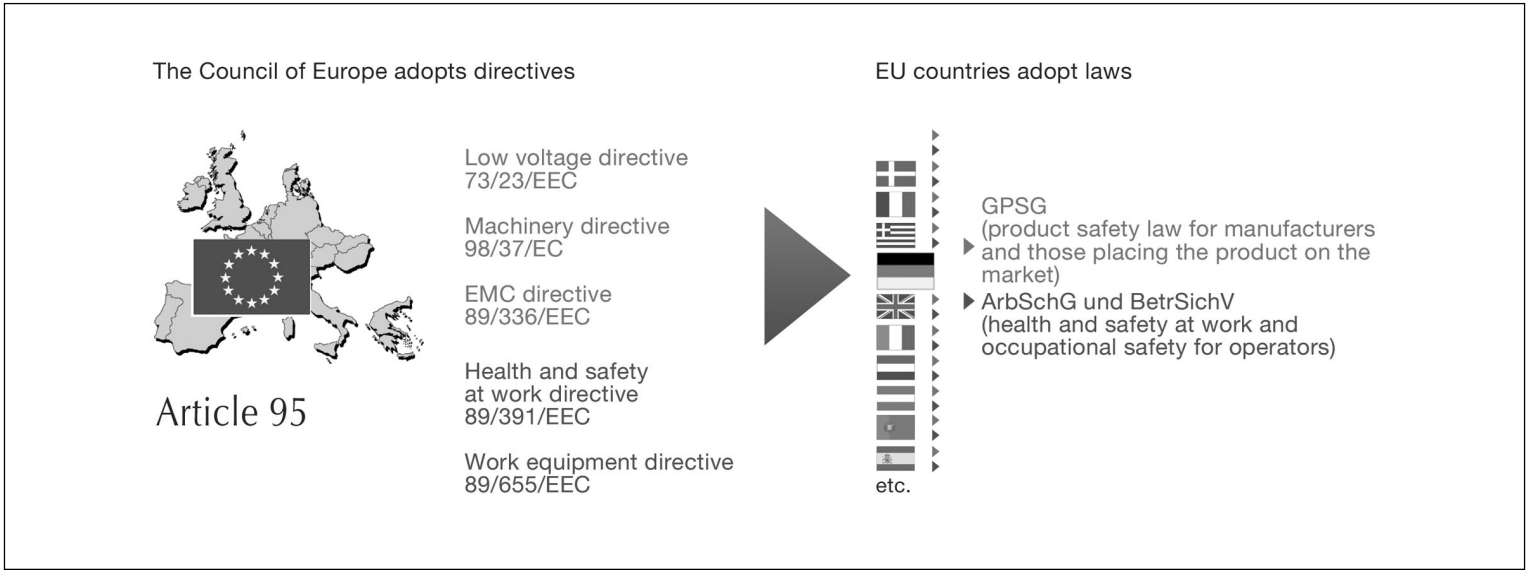

Fig. 1: Incorporation of the directives into domestic law (using Germany as an example)

European directives

The concept of a single European internal market in terms of the “New Approach” can be traced right back to the start of the 70s: The low voltage directive is the first piece of European legislation to take into account the approach towards harmonisation of a common single market.

Products that are covered by one or more of the following directives have to apply a CE-mark, i.e. the product must be accompanied by a declaration of conformity. With a declaration of conformity the manufacturer confirms that his product meets all the requirements of the European directives that relate to his product. This means he can launch and sell his product within the scope of the EU without consideration of any national regulations.

Lifts	95/16/EC
Construction products	89/106/EEC
Pressure equipment directive	97/23/EC
EMC directive	89/336/EEC
ATEX	94/9/EC
Appliances burning gaseous fuels	90/396/EEC
Machinery directive	98/37/EC
Medical device directive	93/42/EEC
Low voltage directive	73/23/EEC
Personal protective equipment	89/686/EEC
Safety of toys directive	88/378/EEC

The directives are addressed to member states, who are obliged to incorporate the European directives into domestic law. In Germany this is normally achieved through the device safety law.

European directives and position of the standards in Europe

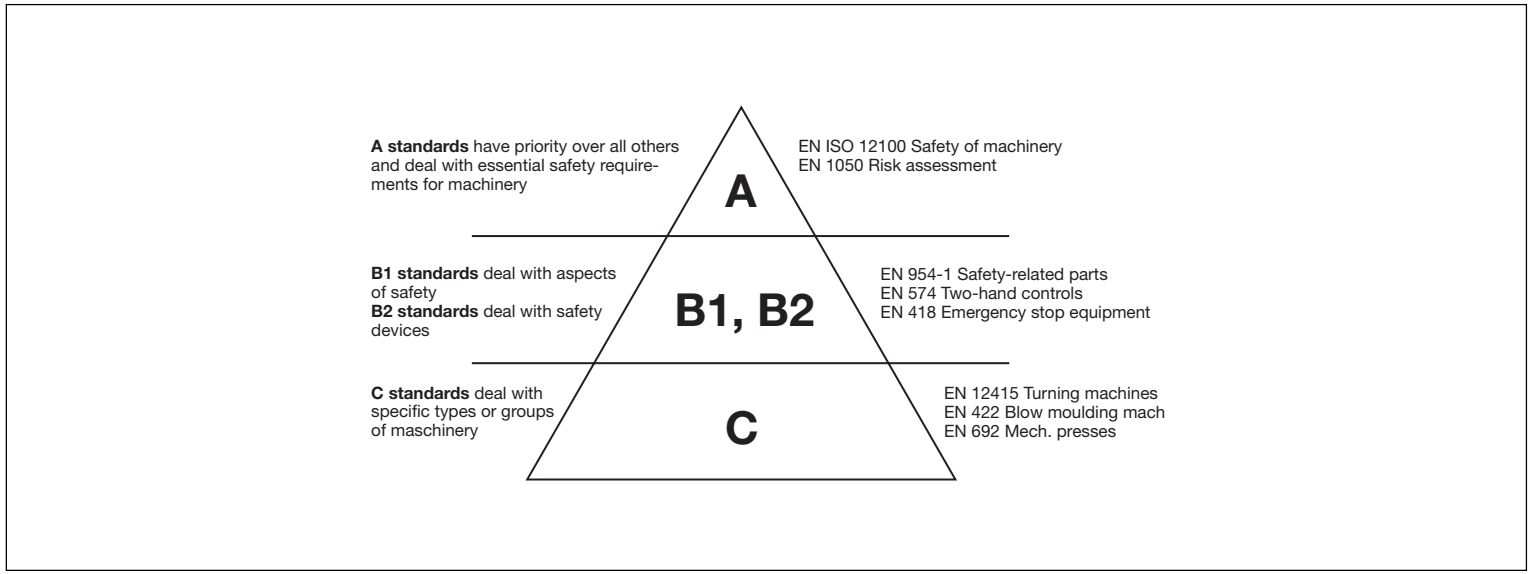

Fig. 2: Standards pyramid

Position of the standards in Europe

The legal status of standards is constantly under discussion. Inside Europe, i.e. within the scope of the European directives that are subject to the CE-marking obligation, a manufacturer is not bound by standards or other specifications. He simply needs to comply with the health and safety requirements of the directive(s). The associated benefits of a division between standards and legislation are obvious: It is easier for legislators to agree on the essential requirements than on technical details. Also, the directives do not regularly have to be adapted to the state of technology; member states can use their own legal system for incorporation and manufacturers are free to select the ways in which they implement the requirements of the directive.

So what are the benefits of applying the standards? With so-called harmonised standards with presumption of conformity, there is a shifting of the burden of proof, i.e. if manufacturers apply these standards, it is presumed that they will also comply with the specific requirements of the European directives. The regulatory authorities would therefore need to prove that a manufacturer did not meet the legal requirements.

However, should a manufacturer deviate from the harmonised standards, he himself must prove how he has met the essential safety requirements. This is generally done via a hazard analysis. In practice one would endeavour to apply the harmonised standards, unless the products concerned are highly innovative and no harmonised standards yet exist. The standards for which this “presumption effect” applies can be researched in the Official Journal of the EU (e.g. on the Internet). Standards in Europe are subdivided into what are termed A, B, and C standards.

Legal regulations outside Europe and standards for functional safety

Legal regulations outside Europe

The situation is somewhat different in the USA: people there are mainly familiar with two types of standards: ANSI (American National Standards Institute) and OSHA (Occupational Safety and Health Administration).
OSHA standards are published by the state and compliance is mandatory. ANSI standards, on the other hand, are developed by private organisations and their application is generally not absolutely essential. However, ANSI standards can still be found included as part of a contract. Beyond that ANSI standards are being taken over by OSHA. You can also still come across the NFPA (National Fire Protection Association), which developed NFPA 79 as a counterpart to EN 60204-1, for example. The OSHA standards can be compared with the European directives. Unlike the European directives, OSHA standards are more involved with formulating technical specifications than abstract requirements.

The legal basis in the USA can be seen as a mix of product standards, fire codes (NFPA), electrical codes (NEC) and national laws. Local government bodies have the authority to monitor that these codes are being enforced and implemented.

Russia and the CIS states have implemented GOST-R certification for some years now, in other words, technical devices that fall within a specific product area must undergo a certain certification process. Machinery and any corresponding technical accessories undergo a type approval test through a European notified body, for example. This test is generally recognised by a Russian-based approvals body. From the point of view of safety, the same requirements apply as in Europe.

China, on the other hand, has introduced CCC certification. Similar to the position in Russia, technical products are subject to mandatory certification through a national approvals body in China. In addition, production sites are inspected. If a technical device falls with the scope of the product list, which is subdivided into 19 categories, certification is mandatory, otherwise it will be necessary to supply a type of “declaration of no objection” from a national notified body.

Japan is currently in a transition period: The plan is for Japan to adopt the European “new approach” – in other words, to keep standards and legislation separate. At the moment the international ISO and IEC standards are being directly incorporated into national legislation, which is why people are currently confronted with frequent amendments to laws and lengthy implementation periods.

Standards for functional safety

Different standards may be called upon to observe functional safety on control systems, depending on the application. In the area of machine safety, EN 954-1 is the main standard named for safety-related control systems. Irrespective of the technology, this applies for the whole chain from the sensor to the actuator. The risk graphs and corresponding risk parameters can be used to estimate the potential risk for danger zones on machinery. The category is then established without the use of risk-reducing measures.

Risk parameters and categories in accordance with EN 954-1

Risk parameters

S = Severity of injury:
1 = Slight (normally reversible) injury
2 = Serious (normally irreversible) injury including death

F = Frequency and/or exposure time to the hazard
1 = Seldom to quite often and/or exposure time is short
2 = Frequent to continuous and/or exposure time is long

P = Possibility of avoiding the hazard
1 = Possible under specific conditions
2 = Scarcely possible

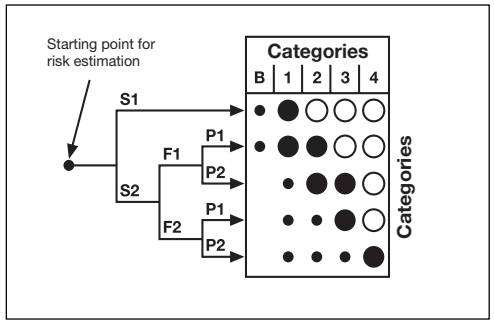

Fig. 3: Risk graph from EN 954

Categories in accordance with EN 954-1

The control system requirements derived from the risk graph are specified as follows:

Category B

Basic category with no special requirements = “good industrial standard”

Category 1

Safety-related parts must be designed and constructed using well-tried components and well-tried safety principles.
Well-tried means: the components have been widely used in the past with successful results in similar applications, or they have been manufactured using principles that demonstrate its suitability and reliability for safety-related applications.

Example: safety switch with forced-opening contacts.

Well-tried safety principles are circuits that are constructed in such a way that certain faults can be avoided by the appropriate arrangement or layout of components.

Example: avoiding a short circuit through appropriate separation, avoiding component failures that result from over-dimensioning, using the failsafe principle (on switching off).

Note: The occurrence of a fault can lead to the loss of the safety function.

Category 2

Safety-related parts of control systems must be designed so that their safety function(s) are checked at suitable intervals by the machine control system. The safety function(s) must be checked: at the machine start-up and prior to the initiation of any hazardous situation; periodically during operation, if the risk assessment and the kind of operation show that it is necessary.

This check may be initiated automatically or manually. Automatically, for example, the check may be initiated by a signal generated from a control system at suitable intervals. The automatic test should be provided by preference. The decision about the type of test depends on the risk assessment and the judgement of the end user or machine builder. If no fault is detected, operation may be approved as a result of the test. If a fault is detected, an output must be generated to initiate appropriate control action. A second, independent shutdown route is required for this.

Notes: In some cases Category 2 is not applicable because the checking of the safety function cannot be applied to all components and devices. Moreover, the cost involved in implementing Category 2 correctly may be considerable, so that it may make better economic sense to implement a different category. In general Category 2 can be realised with electronic techniques. The system behaviour allows the occurrence of a fault to lead to the loss of the safety function between checks; the loss of the safety function is detected by the check.

Category 3

Safety-related parts of control systems must be designed so that a single fault in any of these parts does not lead to the loss of the safety function.

Whenever reasonably practicable, the single fault shall be detected at or before the next demand upon the safety function. This does not mean that all faults will be detected. The accumulation of undetected faults can lead to an unintended output signal and a hazardous situation at the machine.

Category 4

Safety-related parts of control systems must be designed so that a single fault in any of these parts does not lead to a loss of the safety function; the single fault must be detected at or before the next demand upon the safety functions (e.g. immediately at switch on, at the end of a machine operating cycle).
If this detection is not possible, then an accumulation of faults shall not lead to a loss of the safety function.

Functional safety and legal position of EN/IEC 61508

Functional safety with EN/IEC 61508

EN/IEC 61508 is regarded as a generic safety standard, which deals with the functional safety of electrical, electronic and programmable electronic systems, irrespective of the application.

One of the main tasks of EN/IEC 61508 is to serve as a basis for the development of application-oriented standards. Standards' committees are currently busy in the areas of machine safety with EN/IEC 62061, and process safety with EN/IEC 61511. Also under revision is EN 954, the standard harmonised under the scope of the machinery directive, which in future will be listed as EN/ISO 13849.

These sector-specific standards are intended to continue the principle approaches of EN/IEC 61508 and to implement the requirements for the relevant application area in a suitably practical manner.

What is the legal status of EN/IEC 61508?

As EN/IEC 61508 is not listed in the Official Journal of the European Communities for implementation as a European directive, it lacks the so-called "presumption effect". If the standard is used on its own, a control system designer cannot presume that the relevant requirements of the specific European directive have been met.

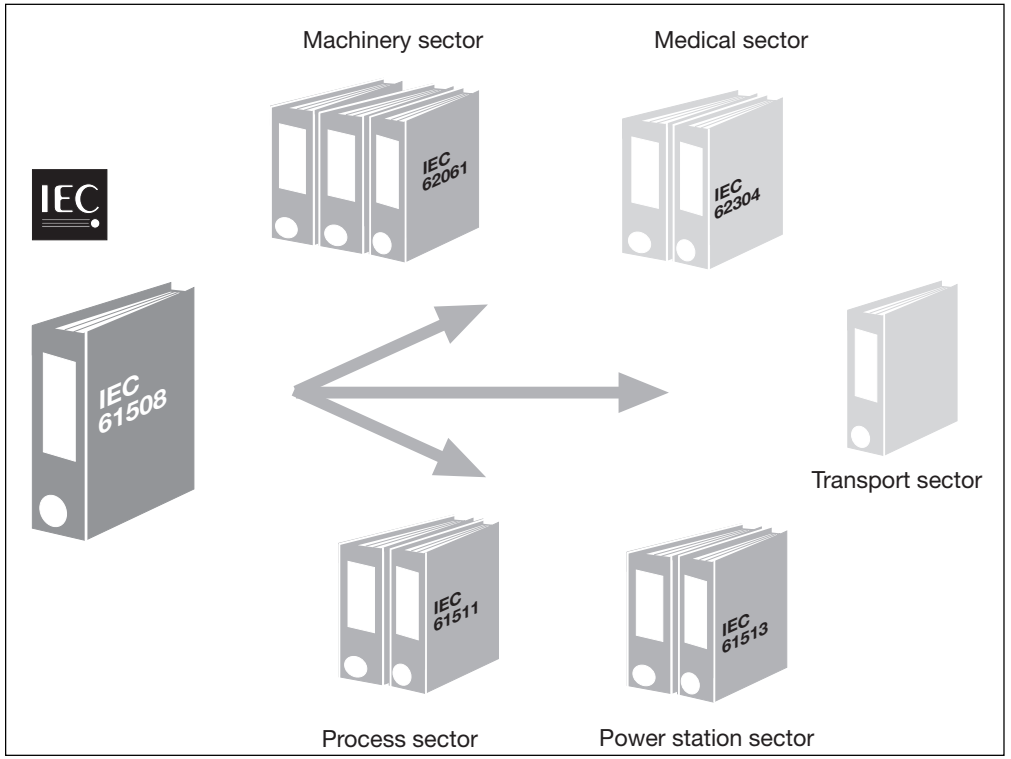

Fig. 4: Sector standards from IEC 61508

Risk analysis

Risk analysis

Under the terms of the machinery directive, a machine manufacturer must assess the hazards in order to identify all the hazards that apply to his machine. He must then design and construct the machine to take account of his assessment. This requirement also applies to operators who act as manufacturers under the terms of the machinery directive. For example, this may occur with machines that are interlinked or for machinery that has been upgraded and substantially modified.

EN 1050 contains “Principles for risk assessment” on machinery. These approaches can be called upon as part of a comprehensive analysis. EN 954-1 expands on EN 1050 with regard to the assessment of safety-related parts of control systems.

The hazards emanating from a machine may be many and varied, so for example, it is necessary to consider not just mechanical hazards through crushing and shearing, but also thermal and electrical hazards and hazards from radiation. Risk reduction is therefore an iterative process, i.e. it is carried out before and during the planning phase and after completion of the plant or machine.

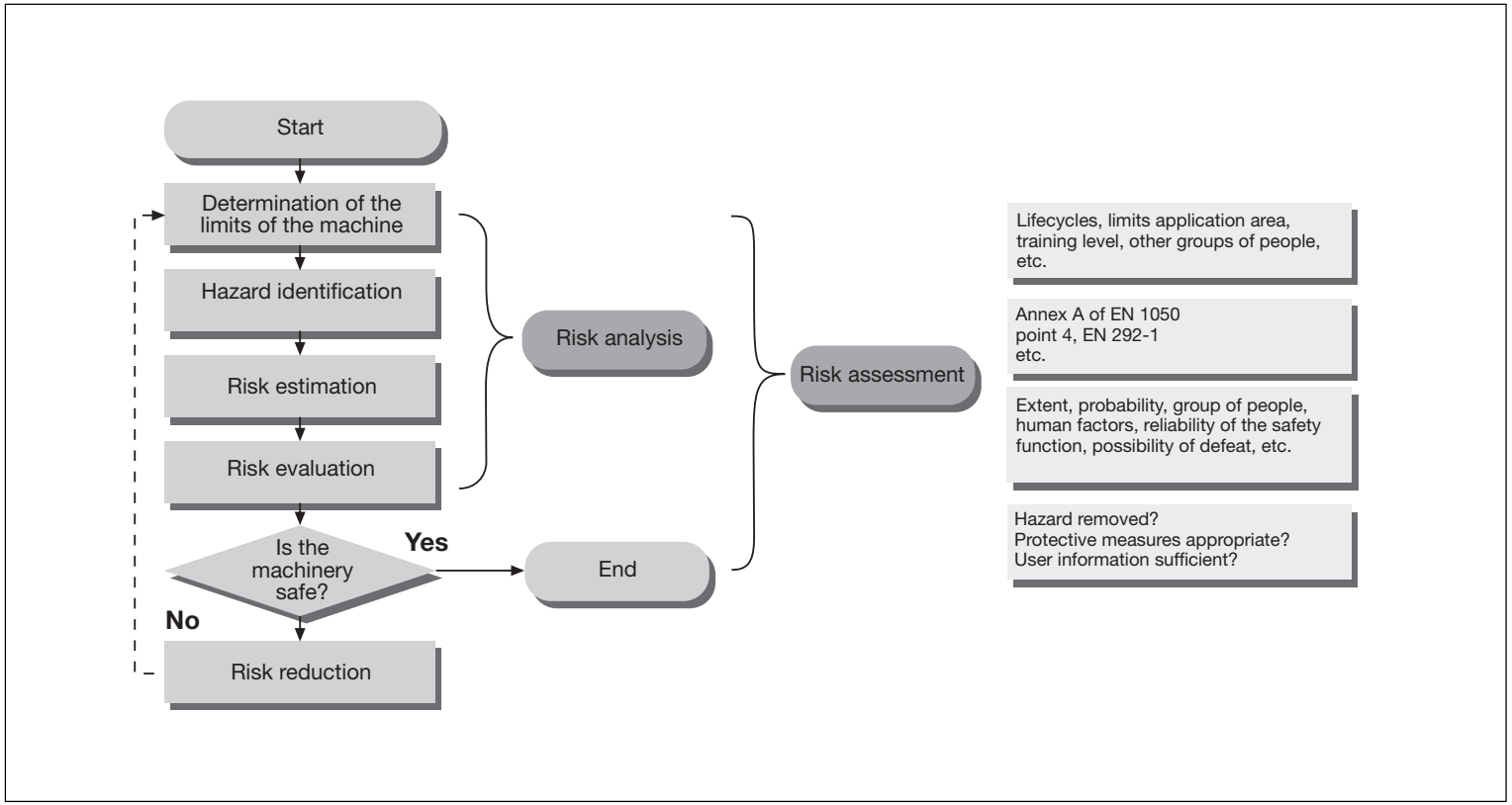

Fig. 5: Iterative process in accordance with EN 1050

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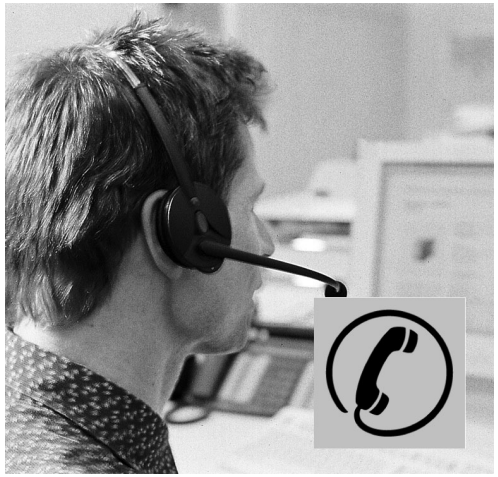
Pre-sales/after sales

Services, concepts and solutions



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