Technical Catalogue
PNOZmulti Product Range

pilz
more than automation
safe automation

System configuration manual
PNOZmulti modular safety system

March 2004 edition

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March 2004

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Our technical catalogue for the PNOZmulti has been compiled with great care. It contains information about our company and our PNOZmulti products. All statements are made in accordance with the current status of technology and to the best of our knowledge and belief. However, we cannot except liability for the accuracy and entirety of the information provided, except in the case of gross negligence. In particular it should be noted that statements do not have the legal quality of assurances or assured properties. We are grateful for any feedback on the contents of this manual.

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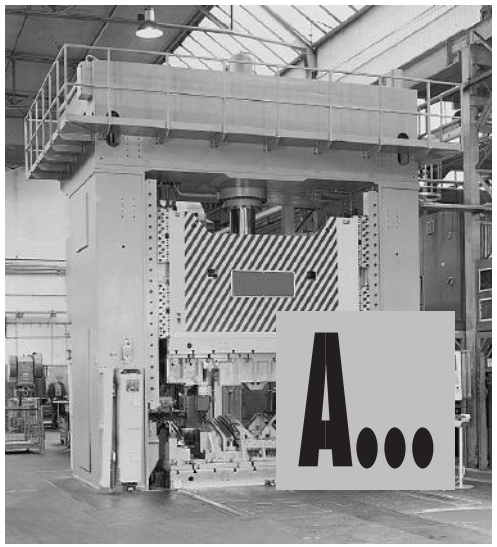
Introduction
Machinery directive



Extract from:
Machine safety –On the basis of the European safety standards/Winfried Grä

1. Machinery directive

This chapter is intended to shed light on the technical regulations included in the machinery directive and the corresponding European (EN) standards, designed to turn the European single market into a reality. According to the German safety equipment act (GSG), the introduction of the single European internal market on 1.1.93 meant that national standards and regulations of EU member states had to be harmonised. On account of the 9th ordinance of the GSGV, BGB1 Part I 5/93, all member states of the European Economic Area (EEA) are to accept the machinery directive as an internal market directive and adopt it, unamended, into their domestic law, so that plant and machinery regulations within the EEA can be unified. This means that a German DIN, an English BS or a French NF standard etc. is harmonised and converted into an EN standard, to be valid throughout Europe by law. As this can be a very prolonged process, draft copies of the standards are made available as prEN standards before they are ratified.
Where no EN or prEN standard is available, previous requirements for the design of machinery can be used for a transitional period.
The European standards for the machinery directive are subdivided into a hierarchy of A, B and C standards.

A standards:
Basic standards containing essential information on the design, strategy and operation of the European machinery directive standardisation.

B standards:
Group standards, subdivided into B1 and B2 standards. B1 standards detail the overriding safety aspects while B2 standards cover the actual safety devices.

C standards:
Product standards containing detailed requirements for specific machinery, with reference to the B standards.

Two institutions are responsible for drafting these standards, namely CEN for non-electrical standards and CENELEC for electrical standards.

Type A
- EN 292 Parts 1 and 2
  General principles for design
- EN 414
  Rules for the drafting and presentation of safety standards
- EN 1050
  Safety of machinery,
  Risk assessment

Type B1
- EN 294
  Safety distances to prevent danger zones being reached
- EN 349
  Minimum gaps to avoid crushing of parts of the body
- EN 954-1
  Safety-related parts of control systems
  General principles for design
- prEN 954-2
  Test, error lists
- EN 1037
  Prevention of unexpected start-up

Type B2
- EN 574
  Two-hand control devices
- EN 418
  E-STOP equipment (e.g. mushroom-headed stop buttons)
- EN 953
  Design of fixed and movable guards
- EN 1088
  Interlocking devices
- EN 60204
  Electrical equipment of machines
- EN 61496
  Electrosensitive protective equipment

Introduction
Risk analysis

Type C
- EN 201
  Injection moulding machines
- EN 422
  Blow moulding machines
- EN 415
  Packaging machines
- EN 692
  Mechanical presses
- EN 693
  Hydraulic presses
- EN 775
  Industrial robots

1.1 CE marking of machinery

According to EU directive 89/392/EEC, since 01.01.1995 it has been necessary to apply a CE mark not only on "complete machines" but also on "machines operating non-independently" and "interchangeable equipment". Since 01.01.1997, "individual safety components" have also required CE marking. This EU directive is binding for the whole internal market, i.e. including machinery that does not cross any international border. Even machinery made for a company's own use must carry the CE mark.

1.1.1 Recommended procedure

The following procedure is recommended for the approval of machinery within the EEA:

1. Check that the machine falls within the scope of the machinery directive
2. Check whether any additional directives that provide for CE marking need to be considered for this product; in this case you will need to check conformity to all the directives used
3. Classify the products under the terms of the machinery directive (machine, components, ...)
4. Check whether it is a "dangerous machine" as detailed in Annex IV; in this case you will need to contact an accredited body
5. Check which standards can be used to achieve the safety objectives
6. Carry out a hazard analysis
7. Generate the "Technical Documentation"
8. Design and build the machine in accordance with the hazard analysis and the "Technical Documentation"
9. Generate the declaration of conformity (Annex II A)
10. Affix the CE mark

1.1.2 Responsibility

The machinery directive is geared towards the machine manufacturer. Everyone involved in the design of the machine is therefore responsible for its safety. For safety, the hazard analysis represents an important link between the technologies and it should be carried out at or before the machine's design stage, in accordance with the directive.
The directive states: "The manufacturer is obliged to carry out a hazard analysis in order to determine all the hazards associated with the machine; the machine must then be designed and built in accordance with that analysis."
It is advisable and economical, therefore, for all designers to be informed about the requirements of the machinery directive.

2. Risk analysis

Designers should carry out a risk analysis in order to judge the regulations that need to be taken into account, and to what extent. Standard EN 292: "Safety of machinery. General principles for design", EN 1050: "Principles for risk assessment" and EN 954-1: "Safety-related parts of control systems" should be used for this purpose.

2.1 Risk limit

EN 1050, 11/96
The standard starts from the assumption that every machine constitutes a risk, that is to say, its risk without measurement and control safety measures. This risk is determined by assessing the machine before any safety components are employed. If the level of the risk is above the justifiable risk limit, measures must be taken to reduce the risk. These are the "measurement and control safety measures"; these should be used to reduce the actual residual risk to below the level of the justifiable risk limit.

- **Risk limit**
  This is the highest justifiable risk associated with a specific technical process or condition. In general, the risk limit cannot be quantified. It is normally defined indirectly on the basis of established technical principles.
- **Hazard**
  This is the condition in which the risk is greater than the risk limit.
- **Safety**
  This is the condition in which the risk is less than the risk limit
- **Residual risk**
  This is the risk that remains after all the risk reduction measures have been taken
- **Risk without safety measures**
  This is the risk involved when no risk reduction measures are taken on a machine.

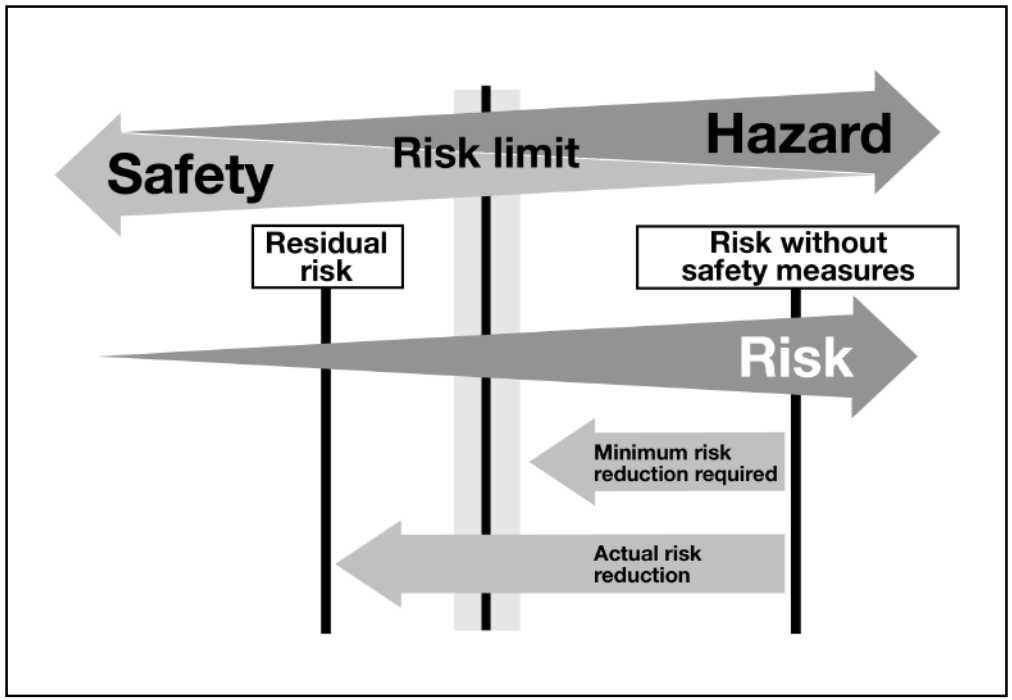
Introduction
Risk analysis

2.1.1 Risk assessment

Extracts from EN 1050, 11/96
The risk assessment of plant or machinery must include:
- The hazard, hazardous situation and events that could cause harm
- The foreseeable probability and severity of harm
- The complexity of the machine with regard to safety and
- The complexity of the interaction between man and machine during all operations, including foreseeable **misuse.**

2.1.2 Basic concept

EN 1050, 11/96 Section 4.1
Risk assessment is a series of logical steps to enable the hazards associated with machinery to be examined in a systematic way. Depending on the result, the risk assessment is followed by risk reduction in accordance with EN 292. Repeating this assessment results in an interactive process which is used to eliminate the hazard as far as possible and to implement safety measures.



The risk assessment includes:
- A risk analysis containing:
  a) determination of the machine's design (effective) limits (see EN 1050);
  b) hazard identification;
  c) risk estimation;
- Risk evaluation.

2.1.3 Information on risk assessment

EN 1050, 11/96 Section 4.2
The information for risk assessment and any qualitative and quantitative analysis shall include the following:
- The machine's design (effective) limits
- Safety requirements for the individual life phases of the machinery
- Design drawings and other means of establishing the nature of the machinery
- Type of energy supply
- Any accident and incident history (if available)
- Information about potential damage to health which can be attributed to operation of the machinery

This information shall be updated as the design develops and when modifications are required.

The absence of an accident history, a small number of accidents or low severity of accidents shall not be taken as an automatic presumption of a low risk.

Point 2.1.4 not shown.

2.1.5 Combination of elements of risk

EN 1050, 11/96 Section 7.2.1
The risk associated with a particular situation or technical process is derived from a combination of the following elements:
- Severity of harm
- Probability of occurrence of that harm, which is a function of:
  – the frequency and duration of the exposure of persons to the hazard
  – the probability of occurrence of a hazardous event and the technical and human possibilities to avoid or limit the harm

Introduction
Risk analysis

2.1.6 Elements of risk

Risk
related to the considered hazard

is a function of

Severity
of the possible harm for the considered hazard

and

Probability of occurrence of that harm in consideration of the

frequency and duration of exposure to the hazard

Possibility to avoid or limit the harm

Probability of occurrence of a hazardous event

Several methods have been developed for the systematic analysis of these elements of risk.
See EN 1050, 11/96 Annex B.

2.2 Harm

2.2.1 Severity

EN 1050, 11/96 Section 7.2.2
The degree of possible harm can be estimated by taking into account the following criteria:

- The nature of what is to be protected:
  a) persons
  b) property
  c) environment
- The severity of injuries or damage to health:
  a) slight, normally reversible
  b) serious, normally irreversible
  c) death
- The extent of harm, for each machine:
  a) one person affected
  b) several persons affected

2.2.2 Probability of occurrence of harm

EN 1050, 11/96 Section 7.2.3
The probability of harm occurring is the key factor. Experience shows that every conceivable unpleasant event can occur in reality. This rather general statement could be viewed as an exaggeration when referring to the design of a plant or machine. This is why the standard allows the frequency and duration of exposure to the hazard and the possibility of avoiding it to be included in the assessment. In certain circumstances this can result in optimum protection for personnel together with a reduction in costs.

2.2.3 Frequency and duration of exposure

EN 1050, 11/96 Section 7.2.3.1
Depending on the need to access the danger zone:

- The nature of access,
- The time spent in the danger zone and
- The number of people requiring access

must be assessed because they could increase the probability of an accident.

2.2.4 Probability of occurrence of a hazardous event

EN 1050, 11/96 Section 7.2.3.2
According to the standard, the probability of occurrence of a hazardous event can be derived from:

- The reliability of the technology used
- Other statistical data
- Accident history (if available)
- History of damage to health from similar plant or machinery
- Risk comparison (see EN 1050, 11/96)

Note: The occurrence of a hazardous event can be of technical or human origin.

2.3 Harm to people

2.3.1 Persons exposed

EN 1050, 11/96 Section 7.3.1
Risk estimation shall take into account all persons exposed to the hazards (see EN 292-1 Section 3.21).

2.3.2 Type, frequency and duration of exposure

EN 1050, 11/96 Section 7.3.2
The estimation of the exposure to the hazard requires analysis of and shall account for all modes of operation of the machinery. In particular this affects the need for access during setting, teaching, process changeover or correction, cleaning, fault finding and maintenance (see EN 292-1, section 3.11).

Introduction
Risk assessment and graph

3. Risk assessment

EN 954 -1, prEN 954 -2
The European standards EN 954 -1, prEN 954 -2 define categories and requirements and describe characteristics of safety functions and design principles for safety-related parts of control systems. This includes programmable systems for all types of machinery and related protective devices. They apply to all safety-related parts of control systems, regardless of the type of energy used, (e.g. electrical, hydraulic, pneumatic, mechanical). However, they do not specify which safety functions and which categories shall be used in a particular case.
EN 954-1 and prEN 954-2 contain details of safety requirements and orientation aids for the design, construction, programming, operation, maintenance and repair of safety-related parts of control systems for machinery.
They also apply to all machinery applications for professional and non-professional use. Where appropriate, they can also apply to the safety-related parts of control systems used in other technical applications with similar hazards.
The categories used in the standards are designed to allow for component faults and to accept fault exclusion. (Fault exclusion means that a fault can be excluded if the chances of it arising or occurring are improbable.) In order to have objective and verifiable criteria, EN 954 publishes lists of potential component faults which need to be taken into account when evaluating safety-related parts of control systems. These lists of faults do not claim to be exhaustive and, if necessary, additional faults should also be considered.

In general, the following observations on faults should be borne in mind:
- Two independent, random faults shall not occur simultaneously
- Should a fault cause other components to fail, the first fault and all consequent faults shall be viewed as a single fault
- Systematic multiple faults shall be viewed as single faults

The following faults should be considered on electrical/electronic components:
- Short circuit or open circuit, e.g. short circuit to the protective conductor or to any bare conductive part, open circuit of any conductor
- Short circuit or open circuit in single components, e.g. position switches
- Non drop-out or non pick-up of electromagnetic components, e.g. contactors, relays, solenoid valves
- Non-starting or non-stopping of motors
- Mechanical blocking of moving elements, e.g. position switches
- Drift beyond the tolerance values for analogue components, e.g. resistors, capacitors
- Oscillation of unstable output signals in integrated, non-programmable components
- Loss of entire function or partial functions in the case of programmable components (worst case behaviour)

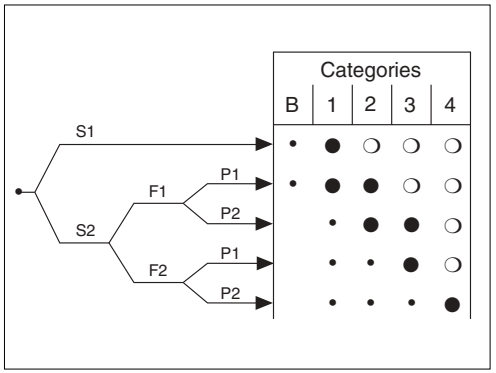
Note from the standards committee:

The categories are not intended to be used in any given order or in any given hierarchy in respect of safety requirements.

The risk assessment will indicate whether the total or partial loss of the safety function(s) arising from faults is acceptable. It is clear, therefore, that discussions over whether product XY should be category 2, 3 or 4 goes against the intentions of the standards committee and is not in the spirit of the standard. Most machines have a front and a back. The dangerous side is the front, because it is generally from there that the machine is assembled and operated. The back of the machine is less dangerous because it can usually be encased by metal plates and guard rails.

3.1 Risk graph

EN 954 -1, Annex B 12/96
This risk evaluation must be carried out separately for each application.
The graphic below may be helpful.



Starting point for risk estimation for the safety-related part of the control system

S Severity of injury
S1 Slight (normally) reversible) injury
S2 Serious (normally irreversible) injury, including death.

F- Frequency and/or exposure time to the hazard
F1 Seldom to quite often and/or the exposure time is short
F2 Frequent to continuous and/or the exposure time is long

Introduction
Categories

P- Possibility of avoiding the hazard
(generally related to the speed and frequency with which the hazardous part moves and to the distance from the hazardous part)
P1 Possible under specific conditions
P2 Scarcely possible

B, 1-4 Categories for safety-related parts of control systems
● Preferred category for reference points
● Possible categories which can require additional measures
○ Measures which can be over dimensioned for the relevant risk

The risk is a statement of probability that takes into account the anticipated frequency of a hazard occurring and the consequent severity of injury. Appropriate measures should be used to reduce the anticipated risk to the level of safety required for the application.

3.2 Overview of categories

The main point of this summary is to classify the safety requirements of control systems into five sensible categories, irrespective of the technology. These range from simple to complex requirements, such as single fault tolerance, redundancy, diversity and/or self-monitoring.

Cat.	Summary of requirements	System behaviour	Principles to achieve safety
B	Safety-related parts of control systems and/or their protective equipment, as well as their components, shall be designed, constructed, selected, assembled and combined in accordance with relevant standards, so that they can withstand the expected influence.	The occurrence of a fault can lead to the loss of the safety function	Mainly characterised by selection of components.
1	Requirements of B shall apply. Use of well-tried components and well-tried safety principles.	As for category B, but with greater safety-related reliability of the safety functions.	
2	Requirements of B and the use of well-tried safety principles shall apply. Safety function shall be checked at suitable intervals by the machine control system.	The occurrence of a fault can lead to the loss of the safety function between the checks. The loss of the safety function is detected by the check.	Mainly characterised by structure.
3	Requirements of B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed so that: – a single fault in any of these parts does not lead to a loss of the safety function; and – whenever reasonably practicable, the single fault is detected.	When the single fault occurs, the safety function is always performed. Some but not all faults will be detected. Accumulation of undetected faults can lead to the loss of the safety function.	
4	Requirements of B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed so that: – a single fault in the control system does not lead to a loss of the safety function; and – the single fault is detected at or before the next demand upon the safety function. If this is not possible, then an accumulation of faults shall not lead to a loss of the safety function.	When the faults occur the safety function is always performed. The faults will be detected in time to prevent the loss of the safety function.	Mainly characterised by structure.

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PNOZmulti product range

This system manual describes the PNOZm Config software and the units:
- PNOZ m1p
- PNOZ mi1p
- PNOZ mo1p
- PNOZ mo2p
- PNOZ mo4p
- PNOZ mc1p
- PNOZ ms1p
- PNOZ mc3p
- PNOZ mc4p
- PNOZ mc5p
- PNOZ mc6p

from the PNOZmulti modular safety system.

The first part of the manual contains information relating to the whole safety system. This is followed by descriptions of the specific units. The last chapter contains various application examples.

The manual is divided into the following chapters:

1 Introduction
The introduction is designed to familiarise you with the contents, structure and specific order of this manual.

2 Overview
This chapter provides information on the most important features of the safety system and provides a brief overview of the application range.

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

4 Description
The description contains information on the units' functionality and the PNOZm Config software.

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

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

7 Configuration and Wiring
This chapter describes the configuration and wiring options for the inputs and outputs, the reset modes and wiring with detection of shorts across contacts.

8 Operation and Fault Diagnostics
This chapter describes how the units react during operation and how faults are displayed.

9 Technical details of the PNOZmulti safety system
This chapter contains the technical details relevant for all units in the PNOZmulti safety system.

10 Unit-specific Descriptions
These descriptions refer exclusively to the specific features for the unit, such as intended use, description, parameter settings and wiring of individual units.

11 Applications
This chapter is a collection of application examples.

Definition of symbols

Information in this manual 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.

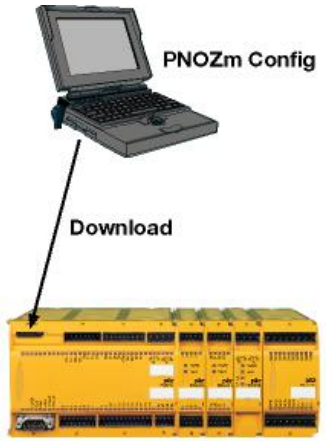
INFORMATION
This gives advice on applications and provides information on special features, as well as highlighting areas within the text that are of particular importance.

PNOZmulti modular safety system

The modular safety system consists of a base unit and several expansion modules. The base unit provides several inputs and outputs and is fully functional even without an expansion module. The expansion modules supplement the base unit with additional inputs or outputs.

Whereas the function of the PNOZ units is determined through the unit itself, the function of this safety system is defined through the configurator PNOZm Config. PNOZm Config is a graphic tool, which is used to define the functions of the units. Using predefined symbols, a simple circuit diagram shows how the units' inputs and outputs should be connected. This circuit diagram is then downloaded to the base unit. From this data, the base unit recognises the safety functions it is to perform. For example, safety functions such as E-STOP, two-hand monitoring and safety gate monitoring are available. With the correct circuitry it is possible to achieve categories 2, 3 and 4 in accordance with EN 954-1.

The fact that the system is modular and configurable guarantees the highest level of flexibility. The safety system can be expanded or the safety functions modified at any time.



Base unit + expansion modules

Fig. 2-1: Modular safety system

Units in the PNOZmulti modular safety system provide both semiconductor and relay safety outputs. The auxiliary outputs use semiconductor technology. The safety outputs use semiconductor technology, require no maintenance and are non-wearing; they are therefore suitable for applications with frequent operations or cyclical functions. They can be used for 24 VDC applications.
The relay safety outputs are suitable for less frequent operations, but they have a higher breaking capacity and can be used for AC applications.

PNOZmulti modular safety system

Safety assessments

Before using a unit it is necessary to perform a safety assessment in accordance with the Machinery Directive. The safety system guarantees 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 technical catalogue, 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 EN 60068-2-6, 01/00 (see general technical details).
- Adequate protection must be provided for all inductive loads.
- Do not open the housing or undertake 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.

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

Intended use

The PNOZm Config software is designed to configure units from the PNOZmulti modular safety system for use on E-STOP equipment and safety circuits, in accordance with EN 60204-1 (VDE 0113-1), 11/98 and IEC 60204-1, 12/97.

The units' intended use depends on the individual unit and is therefore explained in the chapter entitled "Unit-specific Descriptions".

PNOZmulti modular safety system

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.
- Safety outputs that are switched on are periodically tested via a disconnection test.

Hardware

Design of the modular safety system
The modular safety system consists of the base unit and up to 8 expansion modules. The base unit itself has 20 inputs, 2 relay outputs and 4 semiconductor outputs. The number of inputs and outputs can be increased at any time using the expansion modules. The modules are linked via a jumper. The system is configured using the PNOZm Config. For example, special expansion modules enable data exchange via a fieldbus (non-safety-related) or safe speed monitoring (see Chapter 10).

Operation of the units
The configurator PNOZm Config generates a project file which is downloaded to the PNOZ m1p base unit; there it defines:

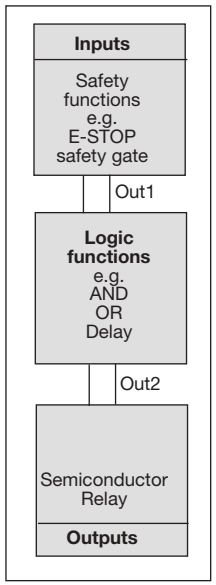


Fig. 4-1: Operation of the PNOZmulti units

- Which safety functions the inputs are to carry out, e.g. E-STOP monitoring, safety gate monitoring
- How the inputs are connected to the outputs via logic functions
- Which output is configured (semiconductor, relay)

The units react the same, irrespective of these functions: If the start-up condition of the specific safety function is met, there will be a high signal at the output "Out1" (see Fig. 4-1). The output signal can be linked via a logic function and is then present as the "Out2" signal at the output on the PNOZmulti unit.

RS 232 interface
The base unit has an RS 232 interface for downloading the project and reading the error stack (see operating manual for the PNOZmulti diagnostic interface).

Safety functions
The PNOZmulti safety system can be configured to monitor:
- E-STOP buttons
- Operating mode selector switches
- Enable switches
- Two-hand buttons
- Safety gates
- Light curtains

Various switch types are available for the required safety-related applications. With some switch types it is possible to monitor for simultaneity (see Chapter 7, "Configuration and Wiring").

Operating modes
The following operating modes are available, depending on the selected safety function:
- **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, with or without detection of shorts between the input contacts.
- **Triple-channel operation**: Redundant input circuit; earth faults in the input circuit are detected, with or without detection of shorts between the input contacts.
- **Automatic reset**: Unit is active as soon as the input circuit is closed.
- **Manual reset**: The unit is not active until the reset button has been operated.
- **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 in the input circuit:** Enabled by pulsing the input circuits. This operating mode is automatically detected on start-up.
- **Detection of shorts between contacts in the reset circuit**:
  Only on E-STOP, safety gate and light curtain
- **Start-up test:** 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 9P) or external contactors.

PNOZmulti modular safety system

Software

In the configurator PNOZm Config, the first step is to enter the units that are to be used in the safety system. Each unit must be given a resource label. When all the units are selected, the interface appears for entering the circuit diagram. The circuit diagram describes the application for which the safety system is to be used. It is here that you determine which inputs are assigned to which safety functions. The inputs and/or the results of the safety functions can be linked through logic functions. The results of the logic functions or the results of the safety functions are channelled to the outputs on the PNOZmulti units.
The circuit diagram is generated on a graphical interface. Symbols are provided for the safety functions, logic functions and the various output types. These are simply dragged on to a workspace, configured and interconnected.

Once the circuit diagram is complete, the data must be saved and downloaded to the base unit. The circuit diagram, unit configuration and all the data that has been entered are stored within a project. When the project is saved, various passwords can be used to protect it from unauthorised access.

Once it is saved, the project has to be downloaded to the base unit. To do this, the project data is transferred to a chip card. The data can either be downloaded via the RS 232 interface or via a chip card reader. After downloading it is necessary to check that the safety devices function correctly.

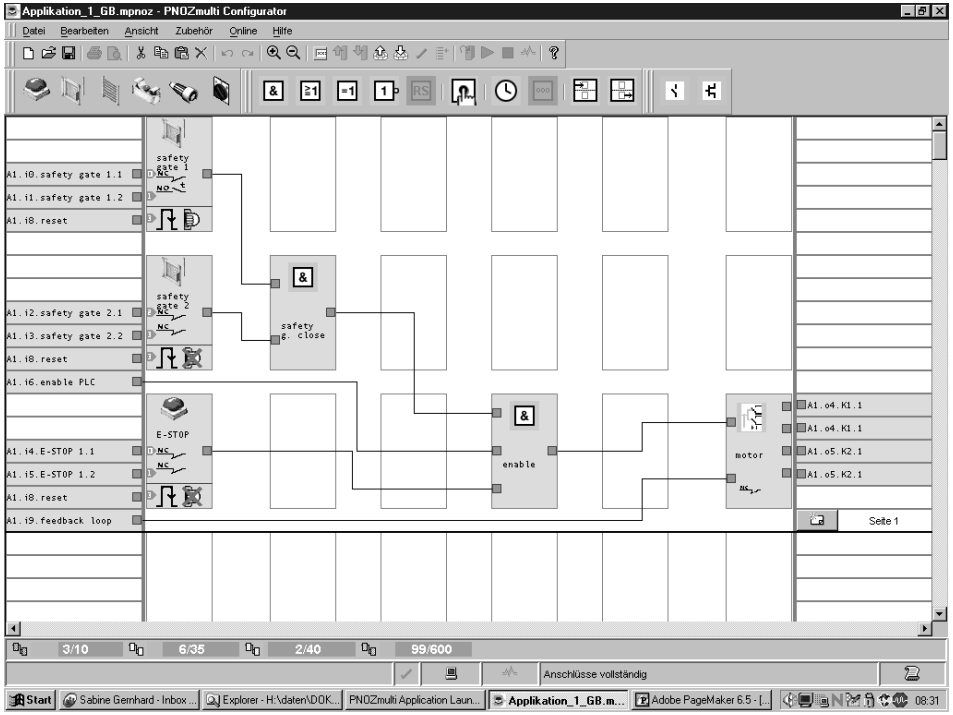


Fig. 4-2: PNOZmulti Config interface

PNOZmulti modular safety system

Connecting the base unit and expansion module
The modules are linked via jumpers. A max. of 8 expansion modules may be connected to one base unit.

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

There are 2 pin connectors on the back of the PNOZ m1p base unit. The right-hand pin connector contains a terminator.

- Remove the terminator from the right-hand pin connector.
- Connect the base unit and the expansion modules using the jumpers supplied (item no. 774639).

CAUTION!
The terminator must be fitted to the last expansion module. Only use terminators for the PNOZmulti modular safety system (item no. 779110).

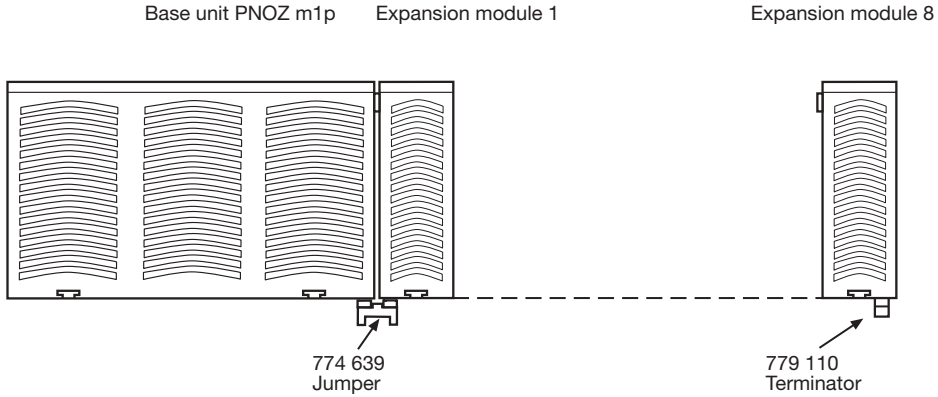


Fig. 5-1: Installing the PNOZmulti units

Installing the safety system in a control cabinet

CAUTION!
The safety system should be installed in a control cabinet with a protection type of at least IP54.
Fit the safety system to a horizontal DIN rail. Other mounting positions could damage the safety system.

- Use the notches on the back of the safety system to attach it to a DIN rail. Connect the safety system to the DIN rail in an upright position, so that the earthing springs on the safety system are pressed on to the DIN rail.
- To comply with EMC requirements, the DIN rail must have a conductive connection to the control cabinet housing.

PNOZmulti modular safety system

Requirements

Please note the following when preparing to commission the unit:
- The safety system and input circuits must always be supplied by a single power supply. The power supply must meet the regulations for extra low voltages with safe separation (SELV, PELV).
- The plug-in terminals for the inputs and outputs are not supplied with the system. You can select between a cage clamp connection or a screw connection.
- Use copper wire that will withstand temperatures of 60/75°C.
- Torque setting on the connection terminals (M3 slotted-head screws), see technical details.
- Test pulse wires should **not** be laid together with actuator wires within unprotected multicore cable.
- Test pulse outputs must only be used to test the inputs. It is **not permitted** to use them to drive loads.
- **Only** safety outputs should be used for safety-related applications.
- The auxiliary outputs can be used for communication with a PLC or text display, for example. Appropriate measures should be taken to protect the auxiliary outputs on the PNOZmulti units when driving contactors or relays.
- Only contactors with positive-guided contacts should be used on the PNOZmulti's safety outputs (see "Feedback loop" in Chapter 7).

Input devices

When selecting input devices, you must comply with the technical details of the input circuits on the PNOZmulti 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 barriers:
  - SICK FGS
  - SICK C4000
  - Honeywell MEYLAN
  - CEDES Safe 4
  - OMRON F3SN-A
  - Fiessler ULVT
  - STI Minisafe 4600 (from S/N: AC283791 or BA022933)
  - STI Optofence OF 4600
- 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 ENG-071990
  - Euchner NM11KB

The following may **not** be used:
- 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. It is not always possible to use input devices with semiconductor outputs when operating with detection of shorts across contacts.

Devices with OSSD semiconductor outputs
Devices with OSSD semiconductor outputs (e.g. self-testing light barriers) may only be used if the PNOZmulti is operated without detection of shorts across contacts.

ESPE
If the function of an ESPE (e.g. light barrier) is switched off via an operating mode selector switch, the supply voltage to the ESPE must be switched off at the same time.

Initial commissioning

The units must be wired and the project data must be downloaded:
- Connect the base unit and the expansion modules using the jumpers.
- Wire the inputs and outputs on the base unit and expansion modules in accordance with the circuit diagram.
- Transfer the current project on to the chip card in the base unit. To do this, either use the chip card reader or connect the computer containing PNOZmConfig to the base unit via the serial interface (see PNOZm Config online help).
- Connect the supply voltage:
  - Supply voltage for the units: Connect +24 VDC to the "A1" terminal and 0 V to the "A2" terminal on the base unit.
  - Supply voltage for the semiconductor outputs: Connect +24 VDC to the "24 V" terminal and 0 V to the "0 V" terminal on the base unit.
    Two terminals are available for each supply connection. This means that the supply voltage can be looped through several connections between the units. The current at each terminal must not exceed 9 A.

CAUTION!
After exchanging a chip card or downloading a project, it is necessary to check that the safety devices function correctly.

Recommissioning after modifications

The function of the modular safety system can be modified or expanded at any time. For example, you can add an expansion module or modify a safety function. Each time a change is made, the project data must be adapted accordingly. New units must be entered in the configurator. The

PNOZmulti modular safety system

circuit diagram must be adapted. The new project data can then be downloaded to the base unit.

CAUTION!
After exchanging a chip card or downloading a project, it is necessary to check that the safety devices function correctly.

Sequence:
If the project data is being downloaded via chip card, before commissioning you will need to make sure that the base unit on the modular safety system does not contain any project data. The project data must be cleared:

- Switch off the supply voltage.
- Remove all the connections to the terminals on the safety outputs and auxiliary outputs.
- Link terminals OA0 and I19.
- Connect the supply voltage:
  - Supply voltage for the units: Connect +24 VDC to the "A1" terminal and 0 V to the "A2" terminal on the base unit.
  - Supply voltage for the semiconductor outputs: Connect +24 VDC to the "24 V" terminal and 0 V to the "0 V" terminal on the base unit.
- Wait until the "DIAG" LED flashes.

The memory of the PNOZmulti safety system is now clear.

The units must now be wired and the project data downloaded:

- Switch off the supply voltage.
- Remove the chip card from the chip card slot.
- Remove the link between terminals OA0 and I19.
- If you wish to supplement the system using expansion modules: Connect the units using the jumpers.
- Wire the inputs and outputs on the base unit and expansion modules in accordance with the circuit diagram.
- Slide the chip card containing the current project into the card slot or insert the chip card and download the project via the RS 232 interface (see PNOZm Config. online help).
- Connect the supply voltage:
  - Supply voltage for the units: Connect +24 VDC to the "A1" terminal and 0 V to the "A2" terminal on the base unit.
  - Supply voltage for the semiconductor outputs: Connect +24 VDC to the "24 V" terminal and 0 V to the "0 V" terminal on the base unit.

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Function elements

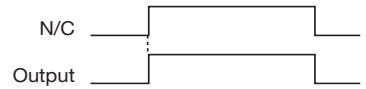
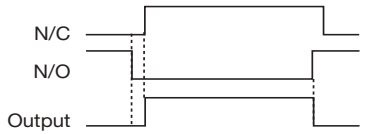
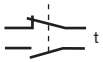
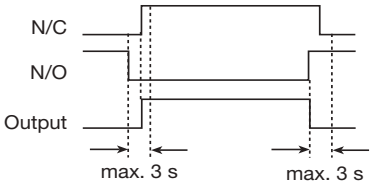
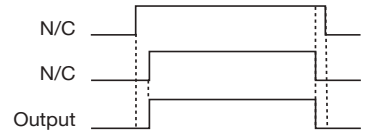
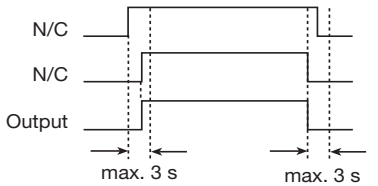
The inputs on the PNOZmulti units are configured in the PNOZmulti Configurator. You can define the following:

- Switch types for various safety functions
- Connection assignment
- Detection of shorts between contacts in the input circuit
- Reset modes
- Start-up test
- Detection of shorts between contacts in the reset circuit with test pulse assignment

Some configuration options can only be selected for particular safety functions (e.g. the start-up test can only be selected for the safety gate and light curtain safety functions).

Select switch type

The PNOZmulti Configurator provides the user with various switch types for safety-related applications. The switch types that can be selected will depend on the type of input element (e.g. E-STOP, safety gate). The switches drawn below are shown in an inactivated state, e.g. with the safety gate closed or E-STOP not operated.
On switches that are monitored for simultaneity, the values for maximum on-time and maximum off-time will be the same. These values can be found in the "Description" and "Timing diagram" columns.

Switch type	Application	Description	Switch symbol	Timing diagram
1	E-STOP Enable switch	Safety contacts: 1 normally closed (N/C) without switch on/off time		
2	Safety gate	Safety contacts: 1 normally closed (N/C) 1 normally open (N/O) without switch on/off time		
2 - Simultaneity	Safety gate	Safety contacts: 1 normally closed (N/C), 1 normally open (N/O) with switch on/off time 3 s		
3	E-STOP Safety gate Light curtain Enable switch	Safety contacts 2 normally closed (N/C) without switch on/off time		
3 - Simultaneity	E-STOP Safety gate Light curtain Enable switch	Safety contacts 2 normally closed (N/C) with switch on/off time 3 s		

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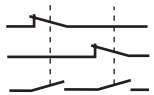
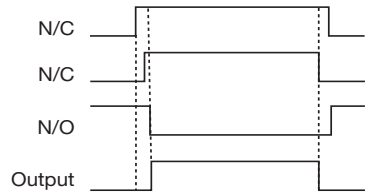
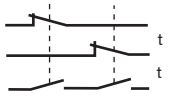
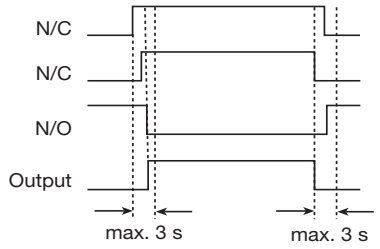
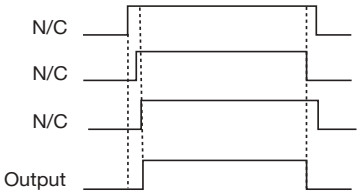
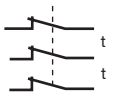
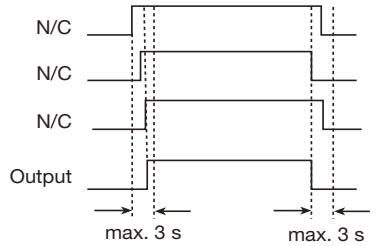
Switch type	Application	Description	Switch symbol	Timing diagram
4	Safety gate	Safety contacts: 2 normally closed (N/C), 1 normally open (N/O) without switch on/off time		
4 - Simultaneity	Safety gate	Safety contacts: 2 normally closed (N/C), 1 normally open (N/O) with switch on/off time 3 s		
5	Safety gate	Safety contacts: 3 normally closed (N/C) without switch on/off time		
5 - Simultaneity	Safety gate	Safety contacts: 3 normally closed (N/C) with switch on/off time 3 s		

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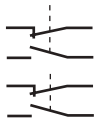
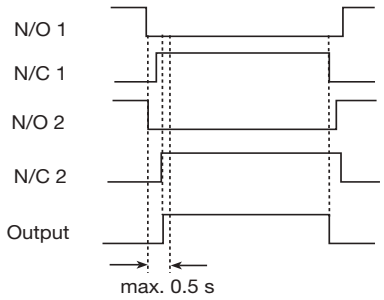
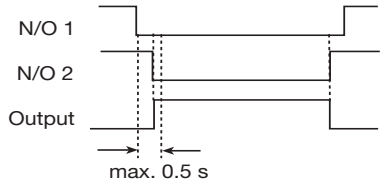
Switch type	Application	Description	Switch symbol	Timing diagram
6	Two-hand button	Safety contacts: 2 changeover contacts (C/O) with simultaneity monitoring 0.5 s, off-time not monitored		
7	Two-hand button ①	Safety contacts: 2 normally open (N/O) with simultaneity monitoring 0.5 s, off-time not monitored		
9	Operating mode	Safety contacts: Switch 1 from 2		
10	Operating mode	Safety contacts: Switch 1 from 3		
11	Operating mode	Safety contacts: Switch 1 from 4		
12	Operating mode	Safety contacts: Switch 1 from 5		

① Without test pulses: can only be used up to category 1 in accordance with EN 954-1

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Connection assignment
Inputs on the PNOZmulti units are assigned to particular safety functions (e.g. E-STOP, safety gate) in the PNOZm Config. The safety contacts must be connected to the inputs on the PNOZmulti units in accordance with their configuration.

Reset modes
A reset button triggers an enable for a safety device when all the corresponding safety switches (e.g. E-STOP) are closed. This prevents a machine starting up automatically after the supply has been interrupted or after a safety device has closed, for example.

When configuring inputs for E-STOPs, safety gates or light guards in the PNOZm Configurator, it is possible to define the reset mode:
- Automatic reset
- Manual reset
- Monitored reset

Automatic reset
With an automatic reset, the output on the function element goes to "1" when the safety switches on the input circuit are closed.

Manual reset
A N/O contact on the reset input generates the reset signal. The reset button must be operated after the safety switch has closed. The output on the function element is set to "1" when the reset button is operated (see Fig. 7-1).

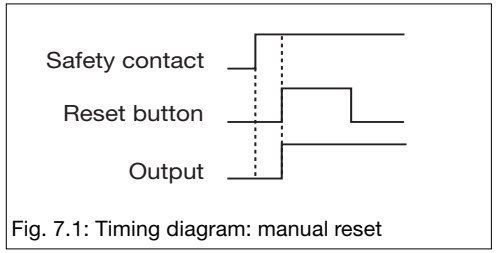

Fig. 7.1: Timing diagram: manual reset

Monitored reset
A N/O contact on the reset input generates the reset signal. The reset button must be operated after the safety switch has closed. The output on the function element is set to "1" when the reset button is released (see Fig. 7-1).

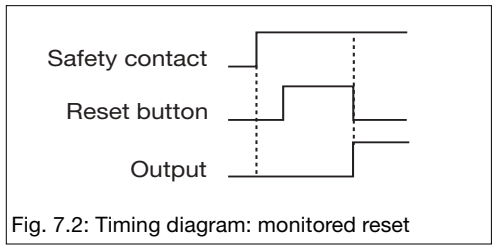

Fig. 7.2: Timing diagram: monitored reset

Reset element
The reset element in the PNOZm Configurator can be used to configure a reset button at logic level.
You can select between a monitored and a non-monitored (manual) reset. The timing diagram in Fig. 7-1 is valid for the manual reset, the timing diagram in Fig. 7-2 for the monitored reset.

Test pulses and detection of shorts across contacts
- Under certain circumstances, signal inputs with infrequent operation (constant signals) supply an unchanging signal over a long period of time. During this time, the function of the periphery devices can only be monitored to a limited extent. Faults that arise may remain undetected. Signal inputs with infrequent operation must therefore be checked via test pulses from category 2 onwards, in accordance with EN 954-1.
- Test pulses are assigned to inputs in the PNOZm Configurator. If "Detection of shorts between contacts in the input circuit" has been selected, the base unit provides 4 test pulses.
- Two-hand button: Switch type 6 contains a N/C / N/O combination per two-hand button.
  If switch type 7 is used, the two N/O contacts should use different test pulses. During configuration please refer to clause 4 of EN 574.
- Detection of shorts between contacts in the reset circuit: Monitored reset mode will detect a short across the contacts. For wiring reasons the reset circuit may also use test pulses.

CAUTION!
Test pulse outputs must only be used to test the inputs. It is **not permitted** to use them to drive loads.

Start-up test
A start-up test is available for the safety gate and light curtain safety functions. When supply voltage is removed and then re-applied, the safety gate is enabled (output on the safety gate input element = "1") only after the gate has been opened and then closed. In this way you are forced to check the correct function of the safety gate and safety gate switch.

INFORMATION
The PNOZmulti switches to a STOP condition after an error. The PNOZmulti switches back to a RUN condition when the supply voltages are switched on and off. For this reason the start-up test must be carried out again after each STOP.

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Output elements

The outputs on the PNOZmulti units are configured in the PNOZmulti Configurator. You can define the following:
- Relay
- Semiconductor
- Single-channel or redundant
- Feedback loop

INFORMATION
When establishing the reaction time of the safety device, the switch-off delay on the outputs must be taken into account (see Technical details). The switch-off delay indicates the time between the safety function on the input of the PNOZmulti unit being triggered and the output contacts switching over / the semiconductor outputs carrying a low signal.

Relays

The relay contacts meet the requirements for safe separation through increased insulation compared with all other circuits in the safety system.
Single-channel or redundant relay outputs are available. The redundant outputs are suitable for applications with a higher level of safety (for wiring options please see the chapter entitled "Unit-specific Descriptions").

NOTICE
Loads should be driven through 2 separate channels or, in the case of redundant relay outputs, shorts across contacts should be prevented e.g. by installing the safety system and its loads (contactors) in a control cabinet.
In terms of load on the relays, keep to the max. permitted operations stated in the technical details.

Semiconductors

Single-channel or redundant semiconductor outputs are available. The redundant outputs are suitable for applications with a higher level of safety (for wiring options please see the chapter entitled "Unit-specific Descriptions").

Feedback loop

The feedback loop is used to monitor the actuators that are being driven.
On a feedback loop, positive-guided N/C contacts on the driven contactors (actuators) are connected in series. If 24 VDC are present at the input on the feedback loop, all the connected contactors are de-energised. If the N/O contact on a contactor has welded, the feedback loop is not closed. The safety output will not be switched if the feedback loop is interrupted.

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Cascading

Base units on the modular safety system can be networked. The cascading output on one base unit is connected to the cascading input on another base unit. In this way, one base unit can have direct access to a logic output and/or an input on the connected base unit.
The base units can be connected in series or a tree structure can be built.

CAUTION!
A ring-shaped connection is not permitted.

PNOZelog units may also be included in the network.

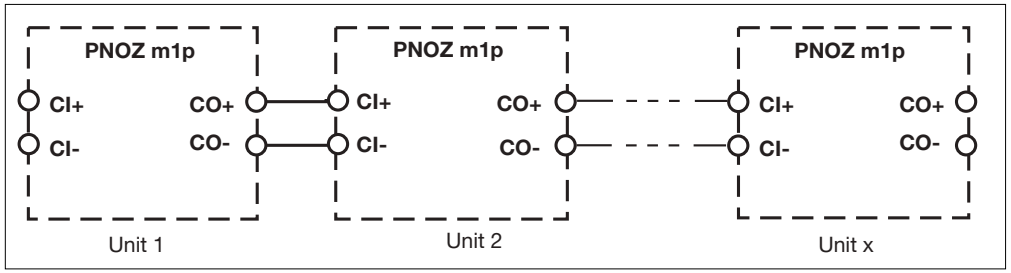
CAUTION!
The cascading outputs may not be used to drive loads. The same also applies to outputs on PNOZelog units that are connected to cascading inputs on PNOZmulti units.
If necessary, a reset lock must be provided on **each** cascaded unit.

System requirements:
PNOZmulti Configurator: from Version 3.0.0
Please contact Pilz if you have an older version.

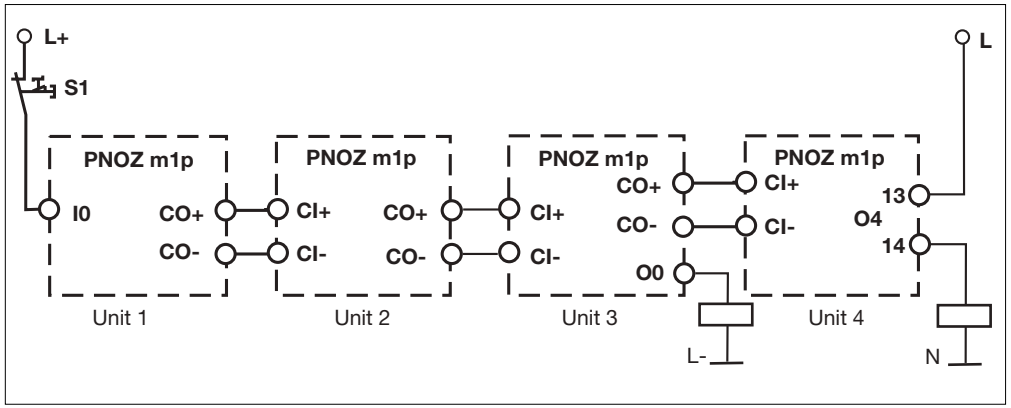
Series connection

As many PNOZ m1p base units as necessary may be connected in series. The number of units connected in succession will depend only on the reaction time required by the application. As the delay times on the individual units are added together, the reaction time increases with each unit.

Example:
Delay between input I0 - cascading output
Unit 1: 40 ms
Delay between input I0 - cascading output
Unit 2: 40 + 40 ms
Delay between input I0 - semiconductor o/p
Unit 3: 40 + 40 + 40 ms
Delay between input I0 - relay output
Unit 4: 40 + 40 + 40 + 60 ms



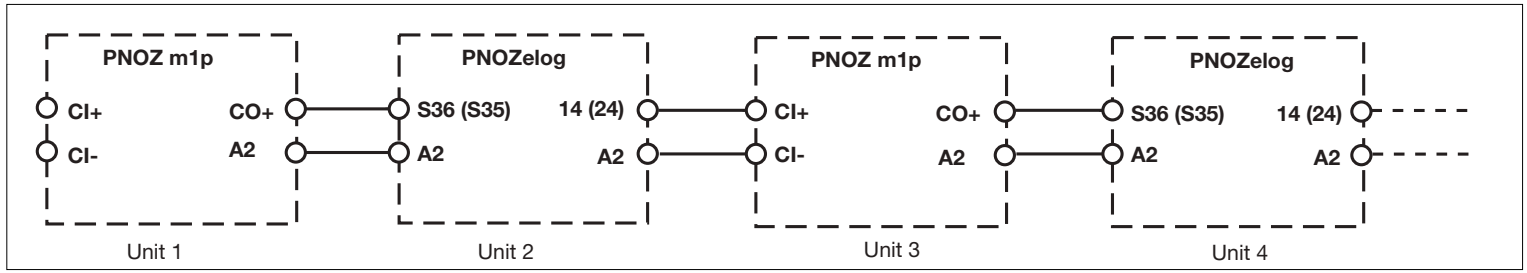
Delay time on the PNOZmulti	Switch-off delay	Switch-on delay
Between input and cascading output	max. 40 ms	typ. 100 ms
Between cascading input and a semiconductor output	max. 40 ms	typ. 100 ms
Between cascading input and a relay output	max. 60 ms	typ. 120 ms
Between cascading input and a cascading output	max. 40 ms	typ. 120 ms



PNOZmulti modular safety system

PNOZelog units may also be included in the series connection. The delay times on the individual units are also added together with this type of cascading. Remember to consider the switch-on delay and any potential delay time for the outputs on the PNOZelog units (see operating manual or PNOZelog technical catalogue).

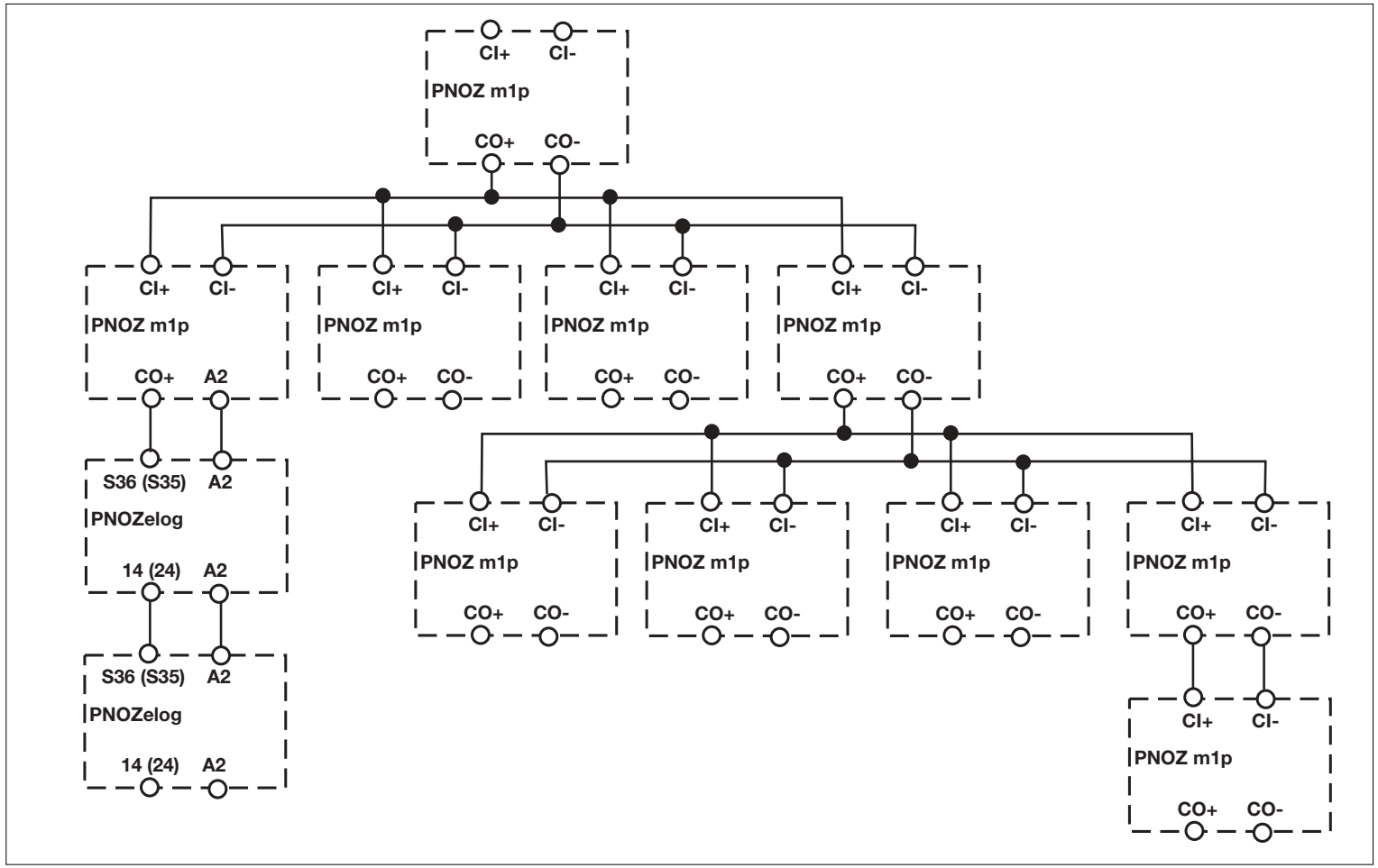
NOTICE
When connecting PNOZmulti - PNOZelog, the cascading output "CO-" is not connected.



PNOZmulti modular safety system

Tree structure
Tree structures may be designed with as many levels as necessary.
Conditions:

- On each level, a max. 4 PNOZmulti units may be connected in parallel.
- PNOZelog units may only be connected to the PNOZmulti units in series. A maximum of one PNOZelog unit is permitted on each level.



PNOZmulti modular safety system

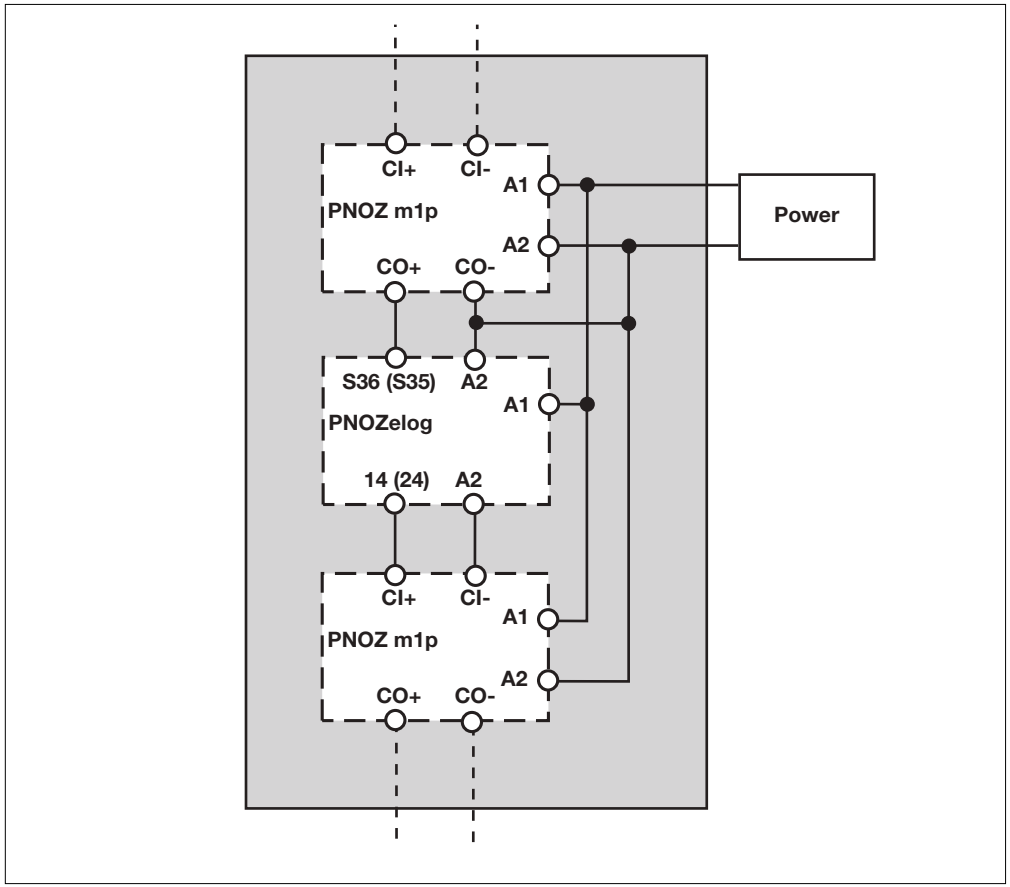
Supply voltage for the cascaded units
The cascaded PNOZmulti units may be supplied via a power supply. The power consumption of the individual units should be considered when deciding on the size of the power supply.

CAUTION!
Cascaded PNOZelog units and all PNOZmulti units connected directly to PNOZelog units must be supplied via a common power supply. The voltage tolerance on the power supply may be a maximum of +20% or -10%.

Installing the networked units
If PNOZmulti units alone are being networked, the networked units may be housed in separate control cabinets.
If PNOZelog units are integrated into the network, these PNOZelog units and their cascade cables must always be housed in the same control cabinet as the PNOZmulti units that are connected directly to the PNOZelog units.

Wiring
Please observe the following when wiring:
- Cable runs between the connected units:
  - PNOZmulti - PNOZmulti: max. 100 m
  - PNOZelog - PNOZmulti cascaded directly: max. 10 m
- Cable material: see technical details

CAUTION!
Outside the control cabinet, the two lines from the cascading input (CI+, CI-) and the lines from the cascading output (CO+, CO-) must be laid in separate multi-core cables.



PNOZmulti modular safety system

When the supply voltage is switched on, the PNOZmulti safety system copies the configuration from the chip card. While this is happening, the LEDs "POWER", "DIAG", "FAULT", "IFAULT" and "OFAULT" will light. The PNOZmulti safety system is **ready for operation** when the LEDs "POWER" and "RUN" are lit continuously.

Error
The "DIAG" LED flashes as soon as an error occurs. The "RUN" LED goes out if the error leads to a safe condition.
The "RUN" LED stays lit if the error does not lead to a safe condition. The auxiliary output is shut down.

In the safe condition, the semiconductor outputs carry a low signal and the relay outputs are open.

Remedy
If an error occurs on which the "RUN" LED is lit, the error indicated through the "FAULT", "IFAULT" or "OFAULT" LED must be rectified. If the "RUN" LED goes out, once the error has been rectified, the unit can only be restarted by switching the supply voltage off and then on again.

Base unit								Exp. module		
Input Ix	RUN	DIAG	FAULT	IFAULT	OFAULT	CI	CO	FAULT	In/Out	Error
		◐								The existing user program has been deleted.
	●		☼							External error on the base unit, leading to a safe condition, e.g. terminator not connected
◐	●			☼						External fault leading to a safe condition; the fault is at the inputs whose LEDs are flashing, e.g. short across the contacts
	●				☼					External error on the outputs of the base unit, e.g. short across the contacts, leading to a safe condition
	●							☼	◐	External error leading to a safe condition; the error is at the inputs/outputs whose LEDs are flashing, e.g. short across the contacts
								☼		External error at the output
	●	◐	◐							Internal error on the base unit
	●	◐		◐						Internal error on the base unit
	●	◐			◐					Internal error on the base unit
	●	◐						◐		Internal error on the expansion module
	☼			◐						External error on the inputs of the base unit, e.g. partially operated; outputs that are driven through these inputs will switch to a safe condition, the unit remains in a RUN condition
	☼				◐					External error on the inputs of the base unit, e.g. feedback input defective; outputs that are driven through these inputs will switch to a safe condition, the unit remains in a RUN condition
	☼							◐		External error on the inputs of the base unit, e.g. partically operated, feedback input defective; outputs that are driven through these inputs will switch to a safe condition, the unit remains in a RUN condition
		☼								The base unit was set to a STOP condition by the user.
		◐								The fieldbus module has not been recognised.
	☼			☼		◐				Error on cascading input; unit remains in a RUN condition
	☼				☼		◐			Error on cascading output; unit remains in a RUN condition

Legend:
● LED off
☼ LED on
◐ LED flashes

pilz
more than automation
safe automation

PNOZmulti modular safety system

Electrical data	
Supply voltage (U_B)	24 VDC
Voltage tolerance	85 ... 120%
Residual ripple U_B	+/- 5%
Power consumption at U_B without load	Max. 8 W + 2.5 W per expansion module
Times	
Switch-on delay	5 s (after U_B is applied)
Simultaneity channel 1/2/3	3 s, two-hand control device: 0.5 s
Supply interruption before de-energisation	Min. 20 ms
Reaction times PNOZ ms1p	
f≥100 Hz	10 ms + switch-off delay PNOZ m1p
f<100 Hz	1/f + 10 ms + switch-off delay PNOZ m1p
Inputs	
Number	See unit-specific data
Voltage and current	24 VDC/8 mA
Galvanic isolation	No
Cascading input	500 VAC
Signal level at "0"	-3 ... +5 VDC
Signal level at "1"	15 ... 30 VDC
Input delay	0.6 ... 4 ms
Status display	LED
Pulsed outputs	
Number	See unit-specific data
Voltage and current	24 VDC/0.5 A
Off time during self test	< 5 ms
Galvanic isolation	No
Short circuit protection	Yes
Status display	LED
Semiconductor outputs	
Number	
for EN 954-1, 12/96, Cat. 4	See unit-specific data
for EN 954-1, 12/96, Cat. 3	See unit-specific data
Switching capability	24 VDC/max. 2 A/max. 48 W
External supply voltage (U_B)	24 VDC
Voltage tolerance	85 ... 120 %
Off time during self test	< 300 µs
Galvanic isolation	Yes
Short circuit protection	Yes
Switch-off delay	< 30 ms
Residual current at "0"	< 0.5 mA
Signal level at "1"	U_B -0.5 VDC at 2 A
Status display	LED
Max. capacitive load	2 µF
Relay outputs	
Number	
for EN 954-1, 12/96, Cat. 4	See unit-specific data
for EN 954-1, 12/96, Cat. 2	See unit-specific data
Switching capability	
in accordance with EN 60947-4-1, 02/01	AC1: 240 V/6 A/1440 VA
	DC1: 24 V/6 A/144 W
in accordance with EN 60947-5-1, 11/97	AC15: 230 V/3 A/690 VA
	DC13: 24 V/3 A/72 W
Contact fuse protection to EN 60947-5-1, 08/00	
Blow-out fuse	6 A quick or 6 A slow
Circuit breaker 24 VDC	6 A (characteristic C)
Switch-off delay	50 ms
Status display	LED
Auxiliary outputs	
Number	See unit-specific data
Voltage and current	24 VDC, max. 0.5 A
External supply voltage (U_B)	24 VDC
Voltage tolerance	85 ... 120 %
Galvanic isolation	Yes
Short circuit protection	Yes
Residual current at "0"	< 0.5 mA
Signal level at "1"	U_B -0.5 VDC at 0.5 A
Status display	LED

PNOZmulti modular safety system

Environmental data	
Airgap creepage between	DIN VDE 0110-1, 04/97
Relay contacts	3 mm
Relay contacts and other circuits	5.5 mm
Climatic suitability	DIN IEC 60068-2-3, 12/86
EMC	EN 60947-5-1, 01/00 PNOZ mc3p: EN 61000-6-2, 10/01
Vibration to	EN 60068-2-6, 04/95
Frequency	10 ... 55 Hz
Amplitude	0.35 mm
Ambient temperature	0 ... + 55 °C Coated version: 0 ... + 50 °C
Storage temperature	-25 ... + 70 °C
Mechanical data	
Protection type	
Mounting (e.g. control cabinet)	IP54
Housing	IP20
Terminals	IP20
Maximum cable runs	
Per input	1 km
Sum of individual cable runs at the test pulse output	40 km
Cross section of external conductors	
Rigid single-core, flexible multi-core or multi-core with crimp connectors	
Power supply (X7), inputs (X5, X6), semiconductor outputs (X2), test pulse outputs (X1), auxiliary output (X2), cascading output	0.5 ... 1.5 mm²
Relay outputs (X3)	0.5 ... 2.5 mm²
Flexible multi-core with crimp connectors	
Relay outputs (X3)	0.5 ... 1.5 mm²

Torque setting for connection terminals (screws)	
Power supply (X7), inputs (X5, X6), semi-conductor outputs (X2), test pulse outputs (X1), auxiliary output (X2), cascading output	0.2 ... 0.25 Nm
Relay outputs (X3)	0.4 ... 0.5 Nm
Housing material	
Front	ABS UL 94 V0
Housing	PPO UL 94 V0
Dimensions H x W x D	See unit-specific data
Weight with connector	See unit-specific data

PNOZmulti modular safety system

Approvals

Type				
PNOZ m1p	●	●	●	●
PNOZ mi1p	●	●	●	●
PNOZ mo1p	●	●	●	●
PNOZ mo2p	●	●	●	●
PNOZ mo4p	●	●	●	●
PNOZ ms1p	●	●	●	-
PNOZ mc1p	●	●	●	●
PNOZ mc3p	-	●	●	-

*PNOZmulti coated version: units do not have TÜV approval!

Suitable for applications up to:

Type	EN 954-1	IEC 61508
PNOZ m1p	Cat. 4	SIL 3
PNOZ mi1p	Cat. 4	SIL 3
PNOZ mo1p	Cat. 4	SIL 3
PNOZ mo2p	Cat. 4	SIL 3
PNOZ mo4p	Cat. 4	SIL 3
PNOZ ms1p	Cat. 3	-
PNOZ mc1p	*	*
PNOZ mc3p	*	*

*Not a safety component

Units from the PNOZmulti modular safety system

The previous chapters have all described the common features of the base unit and expansion modules. This chapter will deal with the specific features of each unit. Table 10-1 shows the units' most important features. The pages that follow provide information on intended use, wiring and unit-specific data for each individual unit.

PNOZmulti coated version
On the "coated version", the PCB boards in the PNOZmulti units are varnished and therefore better protected against environmental influences. The environmental conditions under which the units may be used must be checked in each individual case.
The "coated version" of the units may be mixed with all the other PNOZmulti units within a safety system. Please note that the max. ambient temperature of the overall system will only correspond to that of the PNOZmulti "coated version".

Inputs and outputs	Base unit PNOZm1p	Signal module PNOZ mc1p	Input module PNOZ mi1p	Output module PNOZ mo1p	Output module PNOZ mo2p	Output module PNOZ mo4p
Inputs	20	-	8	-	-	-
Test pulse outputs	4	-	-	-	-	-
Safety outputs using semiconductor technology						
in accordance with EN 954-1 up to Cat. 3	4	-	-	4	-	-
in accordance with EN 954-1 up to Cat. 4	2	-	-	2	-	-
Safety outputs using relay technology						
in accordance with EN 954-1 up to Cat. 2	2	-	-	-	2	4
in accordance with EN 954-1 up to Cat. 4	1	-	-	-	1	2
Auxiliary outputs	1	16	-	-	-	-

Inputs and outputs	Speed monitor PNOZms1p	Fieldbus module PNOZ mc...
Inputs	2 axes	-
Outputs	-	Fieldbus interface

Tab. 10-1: Number and type of inputs and outputs

Base unit PNOZ m1p

Intended use

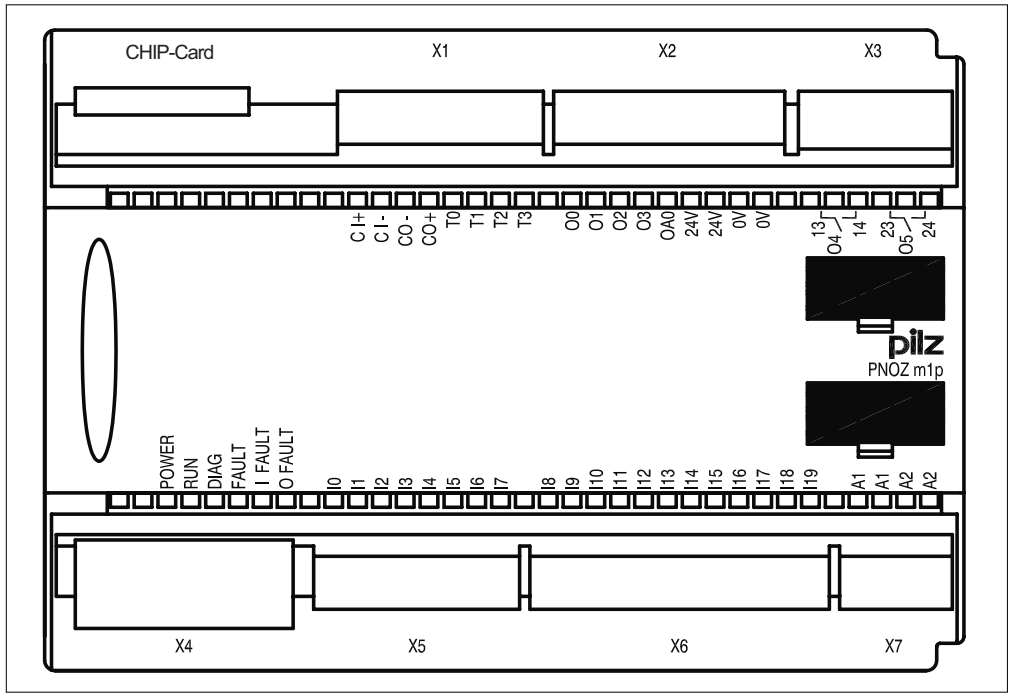
The PNOZ m1p base unit from the PNOZmulti modular safety system is used for the safety-related interruption of safety circuits.
The unit is designed for use on:
- E-STOP equipment
- Safety circuits in accordance with VDE 0113 Part 1, 11/98 and EN 60204-1, 12/97 (e.g. on movable guards)

INFORMATION
The unlabelled LEDs and the LEDs at terminals A1 and A2 have no function.

Description

The basic functions of the PNOZ m1p are described in Chapter 4. Specific features are:
- 20 inputs for connecting:
  - E-STOP buttons
  - Two-hand buttons
  - Safety gate limit switches
  - Light barriers
  - Scanners
  - Enable switches
  - PSEN
  - Operating mode selector switches
- Outputs using semiconductor technology:
  - 2 safety outputs in accordance with EN 954-1, 12/96, Cat. 4 or 4 safety outputs in accordance with EN 954-1, 12/96, Cat. 3
  - 1 auxiliary output
- Relay outputs:
  1 safety contact in accordance with EN 954-1, 12/96, Cat. 4 or
  2 safety contacts in accordance with EN 954-1, 12/96, Cat. 2
- 4 test pulse outputs
- Monitors shorts across contacts at the inputs
- Monitors shorts between the safety outputs
- Weight: 530 g

Terminal configuration



Wiring

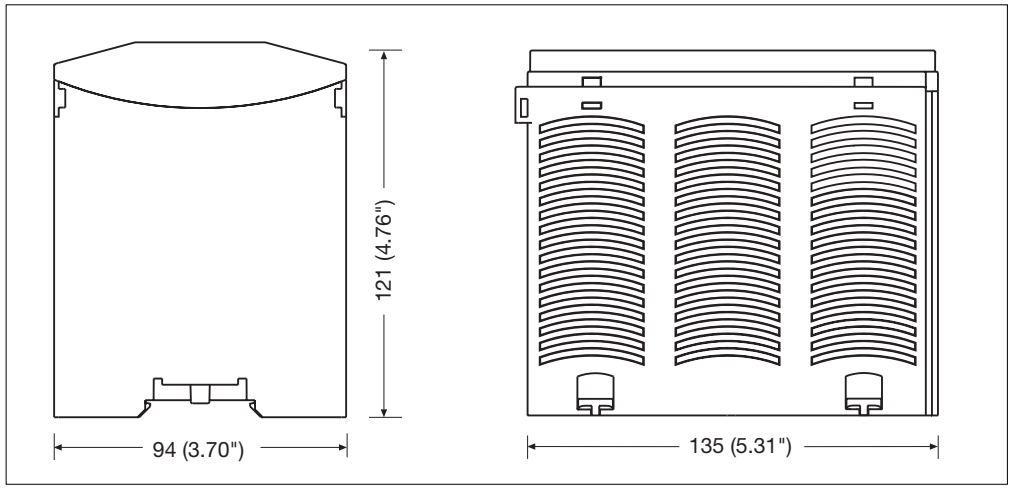
The wiring is defined in the circuit diagram in the Configurator. There you can select the inputs that are to perform a particular safety function and the outputs that will switch this safety function.

Inputs
Inputs I0 ... I19 include the input circuits for connecting the safety elements and also the reset circuits for connecting the reset buttons. The Configurator lists the connections that are available for a safety element or reset button. You can select the required inputs from the list or leave the selection to the Configurator.
The number and assignment of the inputs depends on the type of safety elements that are used.

Outputs
Outputs O4 and O5 are relay outputs, outputs O0 to O3 are semiconductor outputs, OA0 is an auxiliary output.

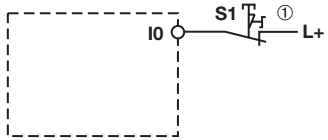
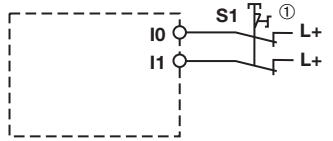
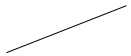
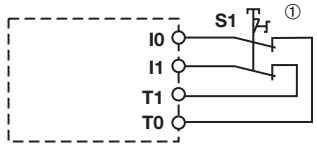
Base unit PNOZ m1p

Dimensions in mm (")



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 configuration and wiring. The input assignment is defined in the PNOZm Config.

- 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

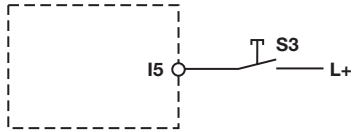
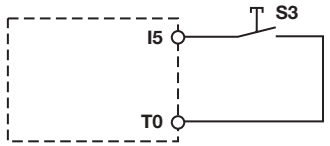
Base unit PNOZ m1p

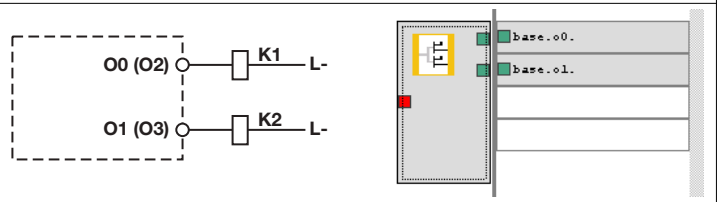
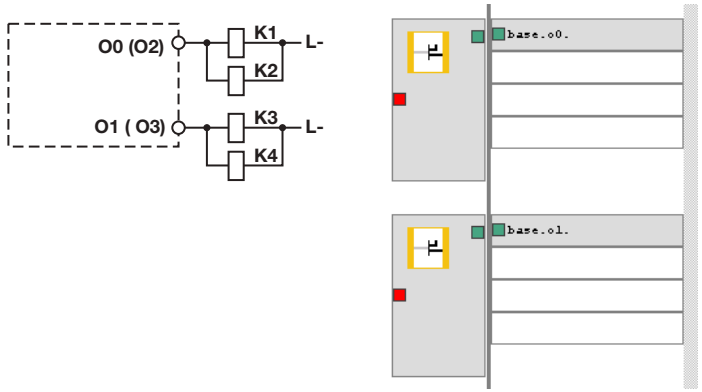
Reset circuit:
The unit can be reset automatically, manually or with monitoring. With a monitored or manual reset, detection of shorts across contacts can also be selected. The assignment of the reset circuit is defined in the PNOZm Config.

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

Outputs:
The unit has relay and semiconductor outputs. These may be configured as single-pole or redundant outputs. The output assignment is defined in the PNOZm Config.

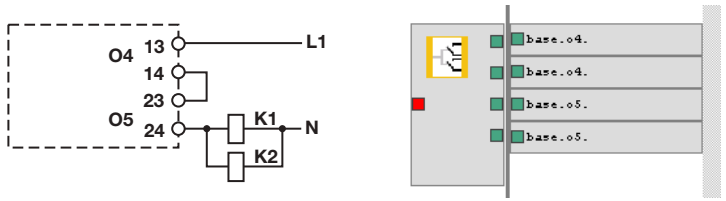
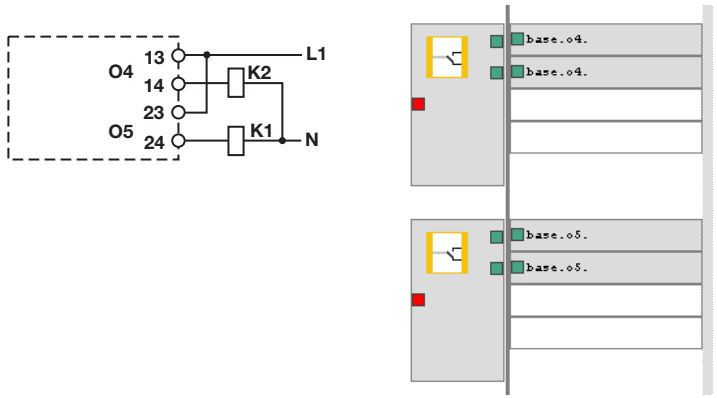
- The output circuit should be connected as described in the table

Input circuit	Reset circuit
Without detection of shorts across contacts	
With detection of shorts across contacts	

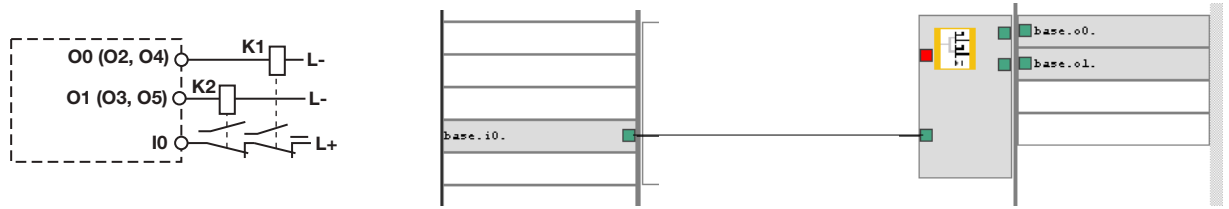
Output circuit	Semiconductor
Redundant output	
Single-pole output	

Base unit PNOZ m1p

NOTICE
Loads should be driven through 2 separate channels or, in the case of redundant relay outputs, shorts across contacts should be prevented e.g. by installing the safety system and its loads (contactors) in the same control cabinet.

Output circuit	Relay outputs
Redundant output	
Single-pole output	

Feedback loop:
On a feedback loop, positive-guided N/C contacts on the driven contactors (actuators) are connected in series.
The assignment of the feedback loop at the input is defined in the PNOZmulti Configurator.

Output circuit	Feedback loop
Redundant output	

PNOZ mo1p expansion module

Intended use

The PNOZ mo1p expansion module may only be connected to a base unit (e.g. PNOZ m1p) from the PNOZmulti modular safety system. The PNOZmulti modular safety system is used for the safety-related interruption of safety circuits and is designed for use on:

- E-STOP equipment
- Safety circuits in accordance with VDE 0113 Part 1, 11/98 and EN 60204-1, 12/97 (e.g. on movable guards)

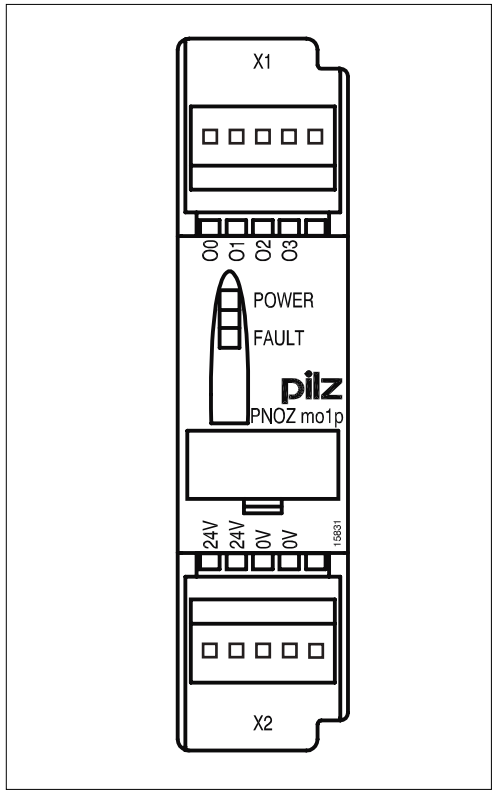
INFORMATION
The unlabelled LEDs and the LEDs at the 24 V and 0 V terminals have no function.

Description

The basic functions of the PNOZ mo1p are described in Chapter 4. Specific features are:

- Outputs using semiconductor technology:
  - 2 safety outputs in accordance with EN 954-1, 12/96, Cat. 4 or
    4 safety outputs in accordance with EN 954-1, 12/96, Cat. 3
- Max. 6 PNOZ mo1p units can be connected to the PNOZ m1p base unit
- Weight (with connector): 150 g

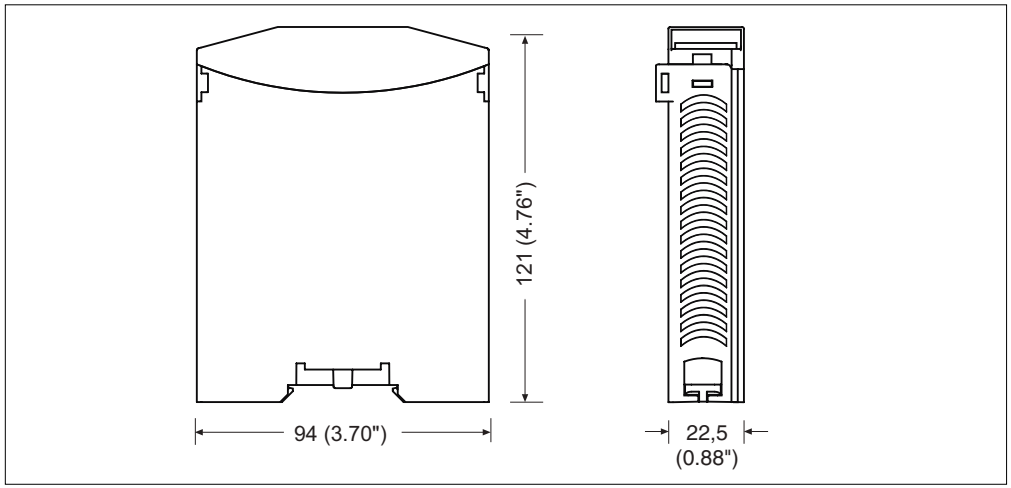
Terminal configuration



Wiring

The wiring is defined in the circuit diagram in the Configurator.

Dimensions in mm (")

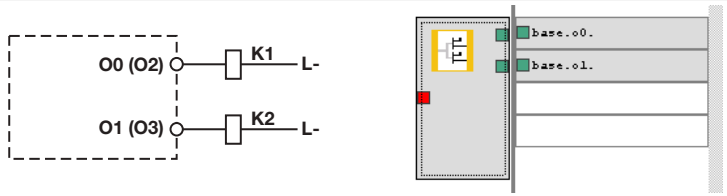
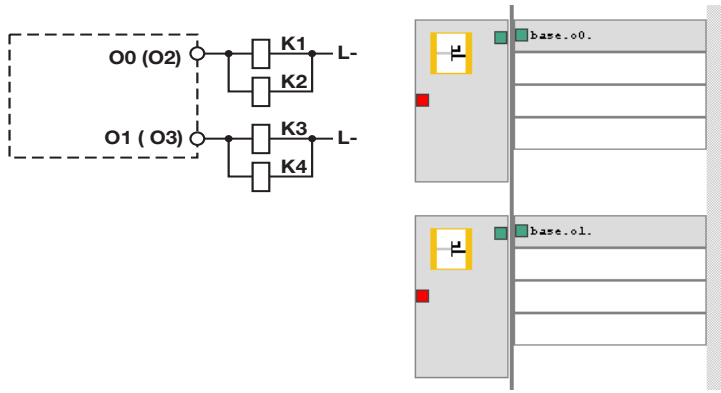


PNOZ mo1p expansion module

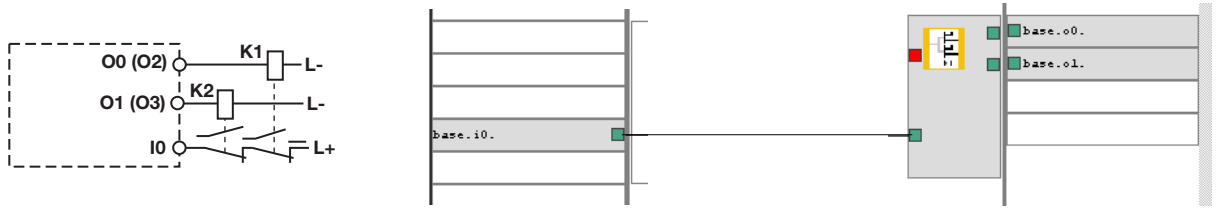
Supply voltage for outputs:
- Connect the supply voltage:
  24 V terminal: +24 VDC
  0 V terminal: 0V

Outputs:
The unit has 4 semiconductor outputs. These may be configured as single-pole or redundant outputs. The output assignment is defined in the PNOZm Config.

- The output circuit should be connected as described in the table

Output circuit	Semiconductor
Redundant output	
Single-pole output	

Feedback loop:
On a feedback loop, positive-guided N/C contacts on the driven contactors (actuators) are connected in series. The N/C contacts are connected to an input (e.g. on the base unit). The assignment is defined in the PNOZmulti Configurator.

Output circuit	Feedback loop
Redundant output	

PNOZ mo2p expansion module

Intended use

The PNOZ mo2p expansion module may only be connected to a base unit (e.g. PNOZ m1p) from the PNOZmulti modular safety system. The PNOZmulti modular safety system is used for the safety-related interruption of safety circuits and is designed for use on:

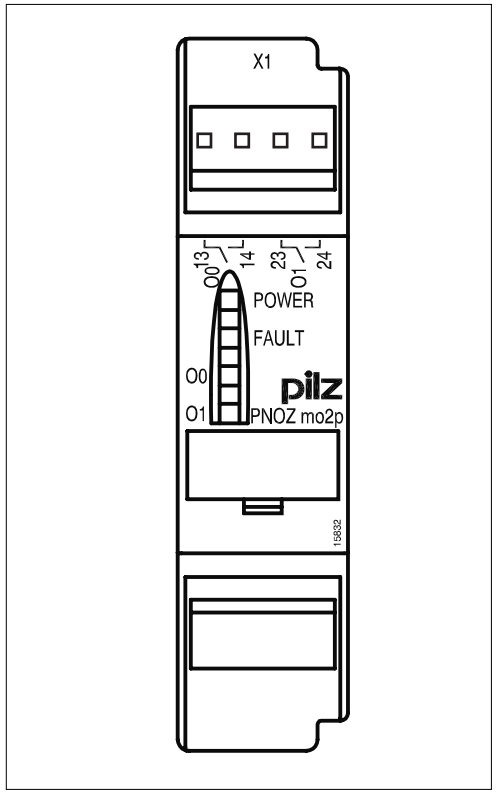
- E-STOP equipment
- Safety circuits in accordance with VDE 0113 Part 1, 11/98 and EN 60204-1, 12/97 (e.g. on movable guards)

Description

The basic functions of the PNOZ mo2p are described in Chapter 4. Specific features are:

- Relay outputs:
  - 1 safety output in accordance with EN 954-1, 12/96, Cat. 4 or
    2 safety outputs in accordance with EN 954-1, 12/96, Cat. 2
- Max. 6 PNOZ mo2p units can be connected to the PNOZ m1p base unit
- Weight: 170 g

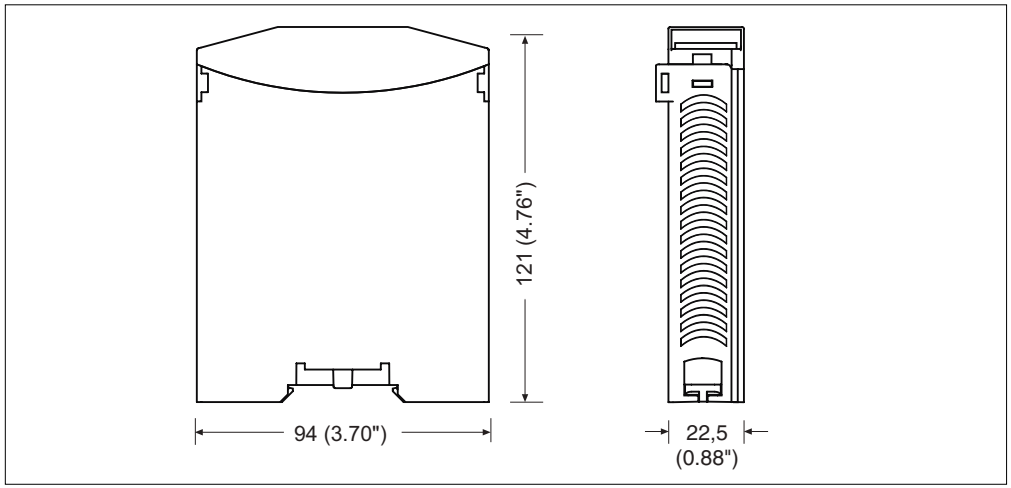
Terminal configuration



Wiring

The wiring is defined in the circuit diagram in the Configurator.

Dimensions in mm (")

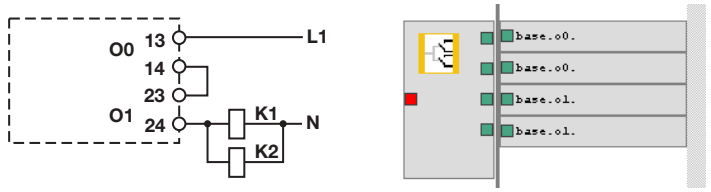
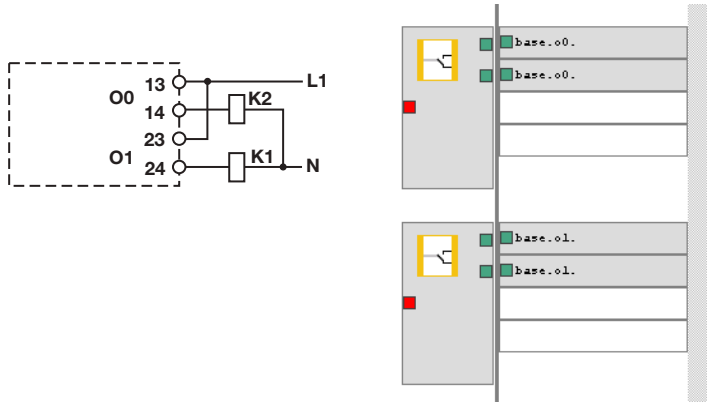


PNOZ mo2p expansion module

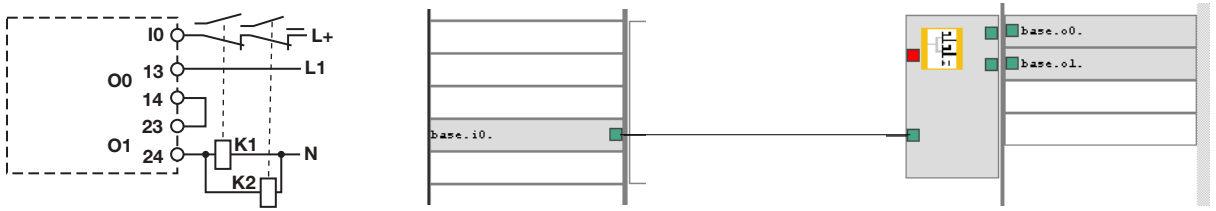
Outputs:
The unit has 2 relay outputs. These may be configured as single-pole or redundant outputs. The output assignment is defined in the PNOZm Config.

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

NOTICE
Loads should be driven through 2 separate channels or, in the case of redundant relay outputs, shorts across contacts should be prevented e.g. by installing the safety system and its loads (contactors) in a control cabinet.

Output circuit	Relay outputs
Redundant output	
Single-pole output	

Feedback loop:
On a feedback loop, positive-guided N/C contacts on the driven contactors (actuators) are connected in series. The N/C contacts are connected to an input (e.g. on the base unit). The assignment is defined in the PNOZmulti Configurator.

Output circuit	Feedback loop
Redundant output	

PNOZ mi1p expansion module

Intended use

The PNOZ mi1p expansion module may only be connected to a base unit (e.g. PNOZ m1p) from the PNOZmulti modular safety system. The PNOZmulti modular safety system is used for the safety-related interruption of safety circuits and is designed for use on:

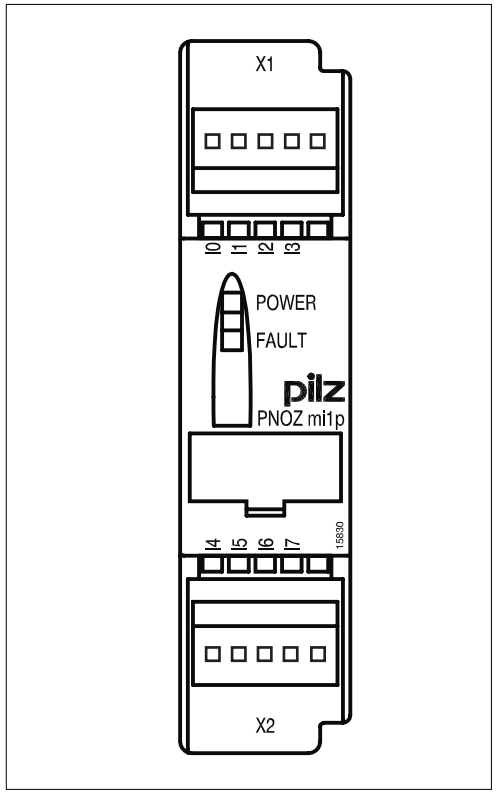
- E-STOP equipment
- Safety circuits in accordance with VDE 0113 Part 1, 11/98 and EN 60204-1, 12/97 (e.g. on movable guards)

Description

The basic functions of the PNOZ mi1p are described in Chapter 4. Specific features are:

- 8 inputs for connecting:
  - E-STOP buttons
  - Two-hand buttons
  - Safety gate limit switches
  - Light barriers
  - Scanners
  - Enable switches
  - PSEN
  - Operating mode selector switches
- Monitors shorts across contacts at the inputs
- Max. 8 PNOZ mi1p units can be connected to the PNOZ m1p base unit
- Weight (with connector): 130 g

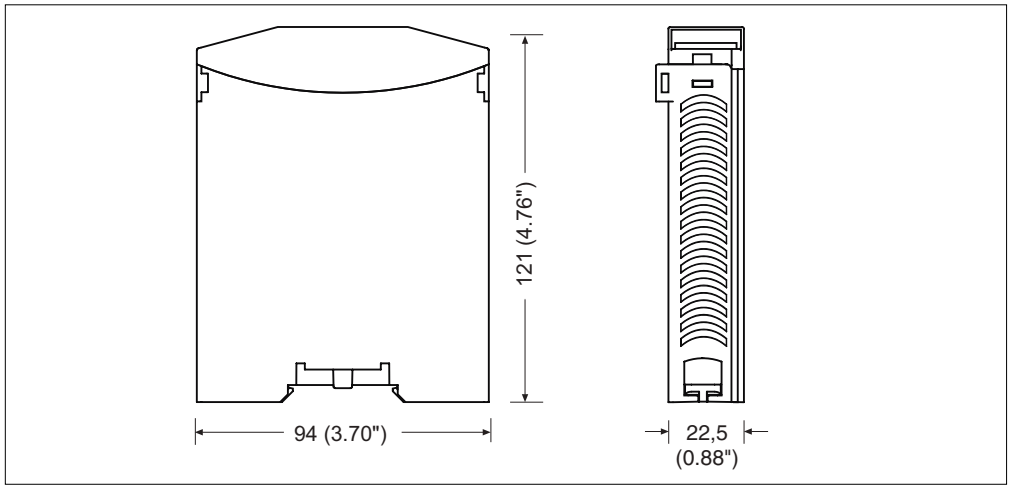
Terminal configuration



Wiring

The wiring is defined in the circuit diagram in the Configurator.

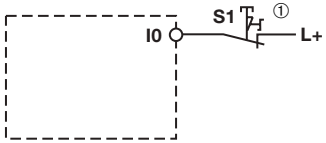
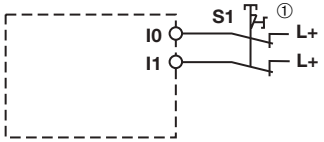
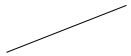
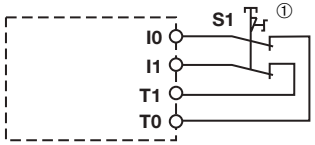
Dimensions in mm (")



PNOZ mi1p expansion module

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 configuration and wiring. The test pulse outputs on the base unit must be used to detect shorts across contacts. The input assignment is defined in the PNOZm Config.

- The input circuit should be connected as described in the table. The wiring at I0 and I1 is illustrated as an example; inputs I2 ... 17 are wired in a similar way.

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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PNOZ mc1p expansion module

Intended use

The PNOZ mc1p expansion module may only be connected to a base unit (e.g. PNOZ m1p) from the PNOZmulti modular safety system. The PNOZ mc1p exclusively provides auxiliary outputs.

CAUTION!
Auxiliary outputs may **not** be used for safety-related functions.

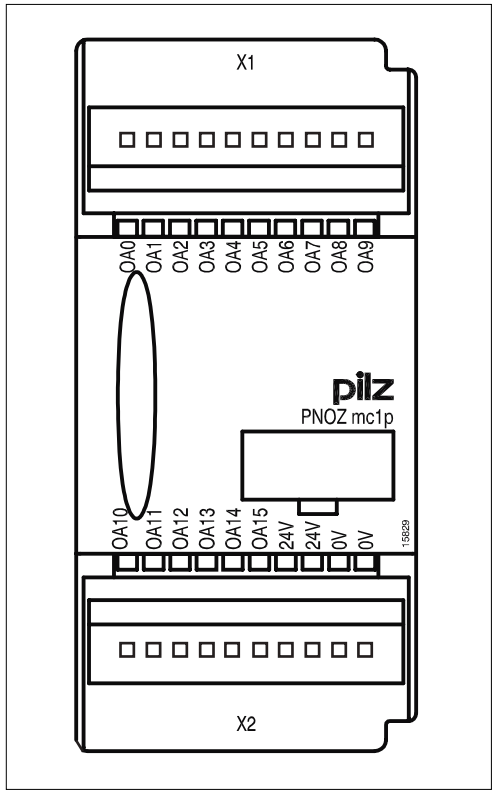
INFORMATION
The LEDs at the 24 V and 0 V terminals have no function.

Description

The basic functions of the PNOZ mc1p are described in Chapter 4. Specific features are:

- 16 auxiliary outputs
- Max. 8 PNOZ mc1p units can be connected to the PNOZ m1p base unit
- Weight (with connector): 185 g

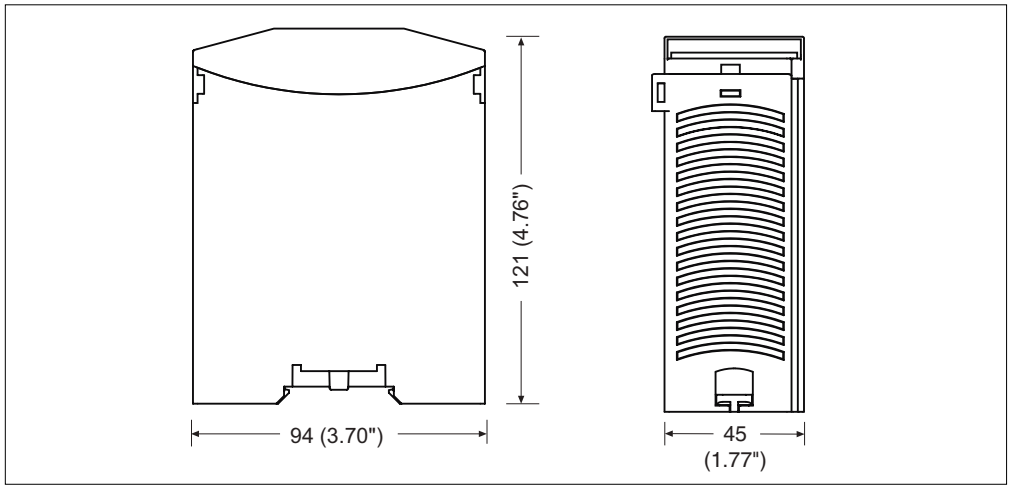
Terminal configuration



Wiring

The wiring is defined in the circuit diagram in the Configurator.

Dimensions in mm (")



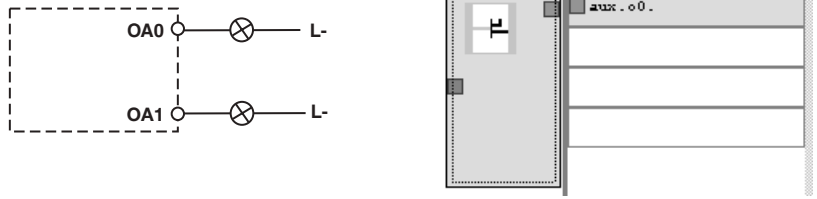
PNOZ mc1p expansion module

Supply voltage for auxiliary outputs:
- Connect the supply voltage:
  24 V terminal: +24 VDC
  0 V terminal: 0V

Auxiliary outputs:
The auxiliary outputs can be used for communication with a PLC or text display, for example. The output assignment is defined in the PNOZm Config.

- The output circuit should be connected as described in the table

Output circuit



PNOZ mo4p expansion module

Intended use

The PNOZ mo4p expansion module may only be connected to a base unit (e.g. PNOZ m1p) from the PNOZmulti modular safety system. The PNOZmulti modular safety system is used for the safety-related interruption of safety circuits and is designed for use on:

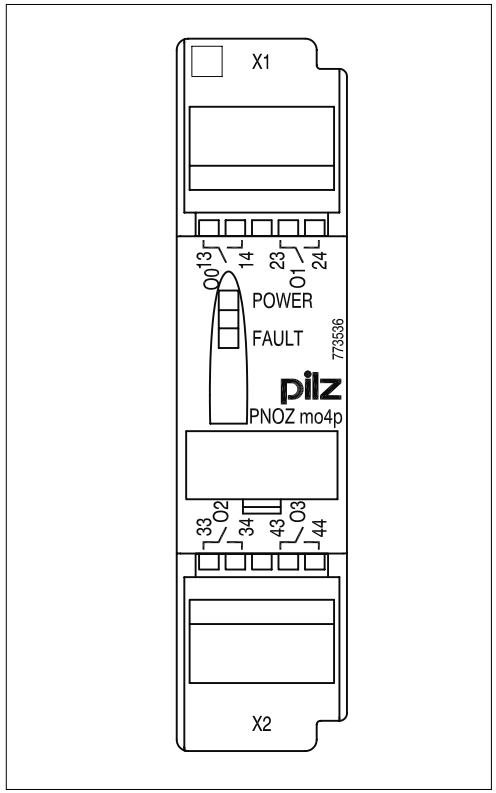
- E-STOP equipment
- Safety circuits in accordance with VDE 0113 Part 1, 11/98 and EN 60204-1, 12/97 (e.g. on movable guards)

Description

The basic functions of the PNOZ mo4p are described in Chapter 4. Specific features are:

- Relay outputs:
  - 2 safety outputs in accordance with EN 954-1, 12/96, Cat. 4 or
    4 safety outputs in accordance with EN 954-1, 12/96, Cat. 2
- Max. 6 PNOZ mo4p units can be connected to the PNOZ m1p base unit
- Weight: 205 g

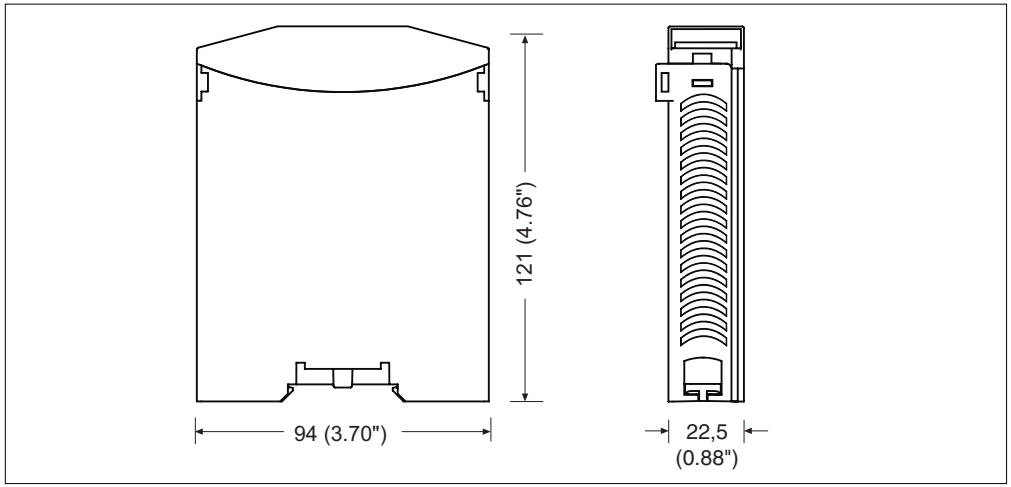
Terminal configuration



Wiring

The wiring is defined in the circuit diagram in the Configurator.

Dimensions in mm (")

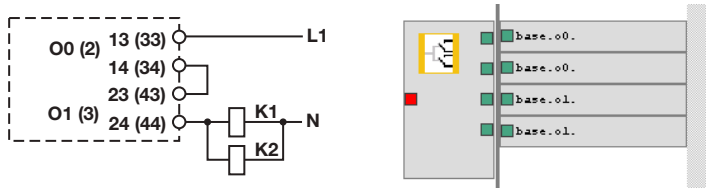
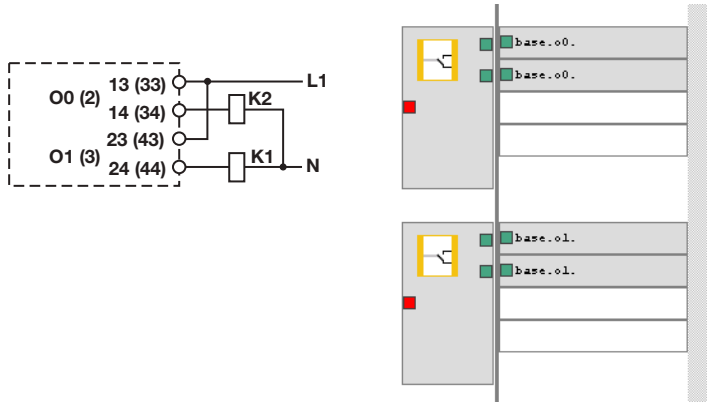


PNOZ mo4p expansion module

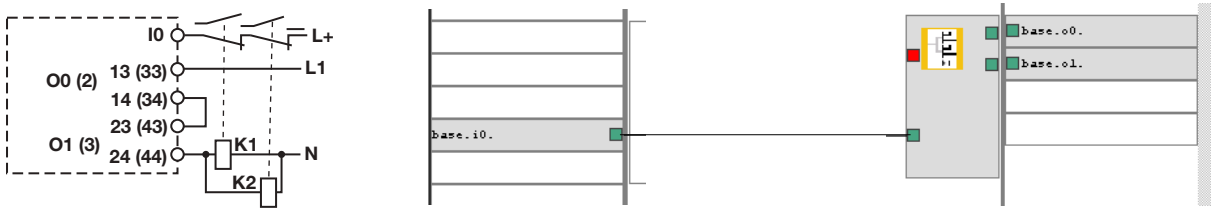
Outputs:
The unit has 4 relay outputs. These may be configured as single-pole or redundant outputs. The output assignment is defined in the PNOZm Config.

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

NOTICE
Loads should be driven through 2 separate channels or, in the case of redundant relay outputs, shorts across contacts should be prevented e.g. by installing the safety system and its loads (contactors) in a control cabinet.

Output circuit	Relay outputs
Redundant output	
Single-pole output	

Feedback loop:
On a feedback loop, positive-guided N/C contacts on the driven contactors (actuators) are connected in series. The N/C contacts are connected to an input (e.g. on the base unit). The assignment is defined in the PNOZmulti Configurator.

Output circuit	Feedback loop
Redundant output	

PNOZ ms1p expansion module

Intended use

The **PNOZ ms1p** speed monitor may only be connected to a base unit (e.g. PNOZ m1p) from the PNOZmulti modular safety system. It monitors standstill, speed and direction of rotation up to category 3 in accordance with EN 954-1.
The PNOZmulti modular safety system is used for the safety-related interruption of safety circuits and is designed for use on:
- Emergency stop equipment
- Safety circuits in accordance with VDE 0113 Part 1, 11/98 and EN 60204-1, 12/97 (e.g. on movable guards)

WARNING!
Users must take appropriate measures to detect or exclude errors (e.g. slippage or broken shearpin) which mean that the frequency of the input device signal is no longer proportional to the monitored speed.

System requirements
- PNOZmulti Configurator: from Version 3.0.0
- PNOZ m1p: from Version 3.0

Please contact Pilz if you have an older version.

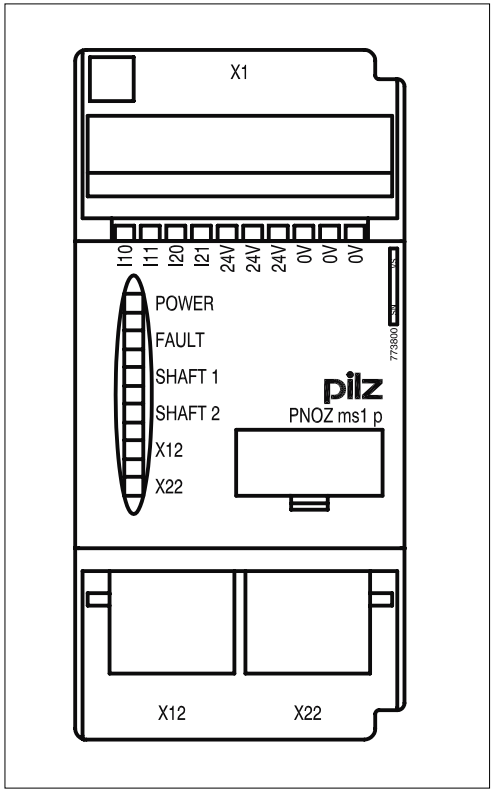
Description

The PNOZ ms1p speed monitor can monitor two axes independently for standstill, speed and direction of rotation. The PNOZ ms1p signals the status of the monitored values to the base unit. Depending on the safety circuit that is loaded, it may be possible to transmit the values from the base unit to a relay output on the safety system, for example.
Incremental encoders and/or proximity detectors can be used to record the values.

INFORMATION
Monitoring the direction of rotation: If an internal error occurs or there is an error due to a defective incremental encoder (LED "FAULT" is lit), an incorrect direction of rotation may be registered for ca. 500 ms.

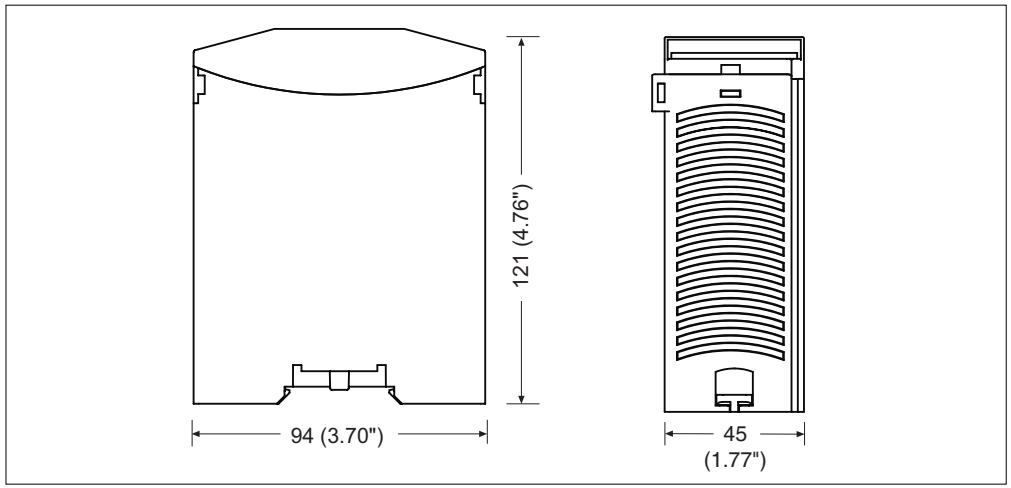
Module features:
- Monitors 2 independent axes
- Connection of
  - 2 incremental encoders
  - or
  - 4 proximity switches (2 proximity switches per axis)
  - or
  - 1 incremental encoder on axis 1 and 2 proximity switches on axis 2
  - or
  - 1 incremental encoder on axis 2 and 2 proximity switches on axis 1
- Measured variables:
  - standstill
  - speed (8 values can be set)
  - direction of rotation
- Axis types, input device types and reset mode can be selected in the PNOZm Config
- Status indicators for
  - supply voltage
  - incremental encoder
  - proximity switch
  - axis status, standstill and excess speed
  - error on the system
- Connection technology on proximity switch: plug-in terminals, either with cage clamp connection or screw connection
- Connection technology on incremental encoder: RJ-45 female connector
- Galvanic isolation of female connector and terminals
- Max. of 4 speed monitors can be connected to the PNOZ m1p base unit
- Weight (with jumpers): 250 g

Terminal configuration



PNOZ ms1p expansion module

Dimensions in mm (")



Wiring

The wiring is defined in the circuit diagram in the Configurator. Details of the input type, axis type and reset mode, plus the values for standstill, speed monitoring and direction of rotation are also defined in the PNOZm Config.

Proximity switches

- Only "pnp" type proximity switches may be used (N/O contact, positive-switching)
- The proximity switches must be positioned in such a way that at least one is energised (carries a high signal).
- The proximity switches must be offset in such a way that the recorded signals overlap.

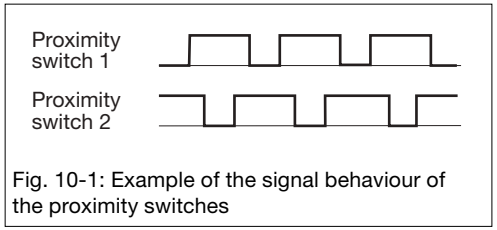


Fig. 10-1: Example of the signal behaviour of the proximity switches

Requirements of the proximity switches

Signal level at the outputs	
High signal	11 V 30 V
Low signal	-3 V ... +5 V
Input resistance at I10 ... I21	3 kOhm
Frequency range	0 ... 3 kHz
Connection technology	Cage clamp terminals or screw terminals
Cross section of external conductors	
Rigid single-core, flexible multi-core or multi-core with crimp connectors	0.5 ... 2.5 mm^2
Flexible multi-core with crimp connectors	0.5 ... 1.5 mm^2

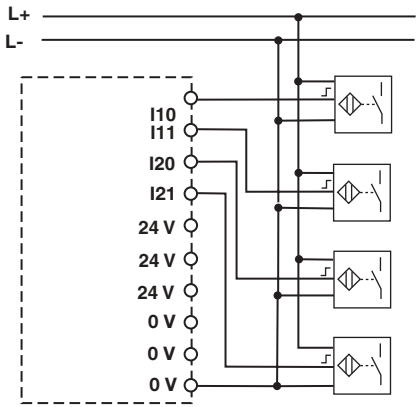
CAUTION!
Appropriate installation measures should be taken to prevent a foreign body coming between the signal input device and the proximity switch. The foreign body could cause one of the proximity switches to be constantly energised (constant high signal).

The outputs of both the proximity switches for axis 1 are connected to terminals I10 and I11; both the outputs of the proximity switches for axis 2 are connected to terminals I20 und I21. If only one axis is to be monitored, either terminals I10 and I11 or terminals I20 and I21 will remain free. The proximity switch must always be connected to a 0 V terminal on the PNOZ ms1p. The 0 V terminals are linked internally.

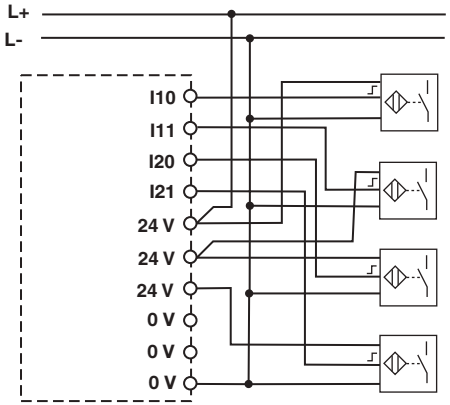
The proximity switches require a 24 VDC supply. To reduce the amount of wiring involved, this supply voltage can be connected to one of the "24 V" terminals on the PNOZ ms1p. As all 3 "24 V" terminals are linked internally, 24 V will be present at all 3 terminals. The proximity switches can therefore be connected directly to the 24 V terminals on the PNOZ ms1p, rather than the power supply.

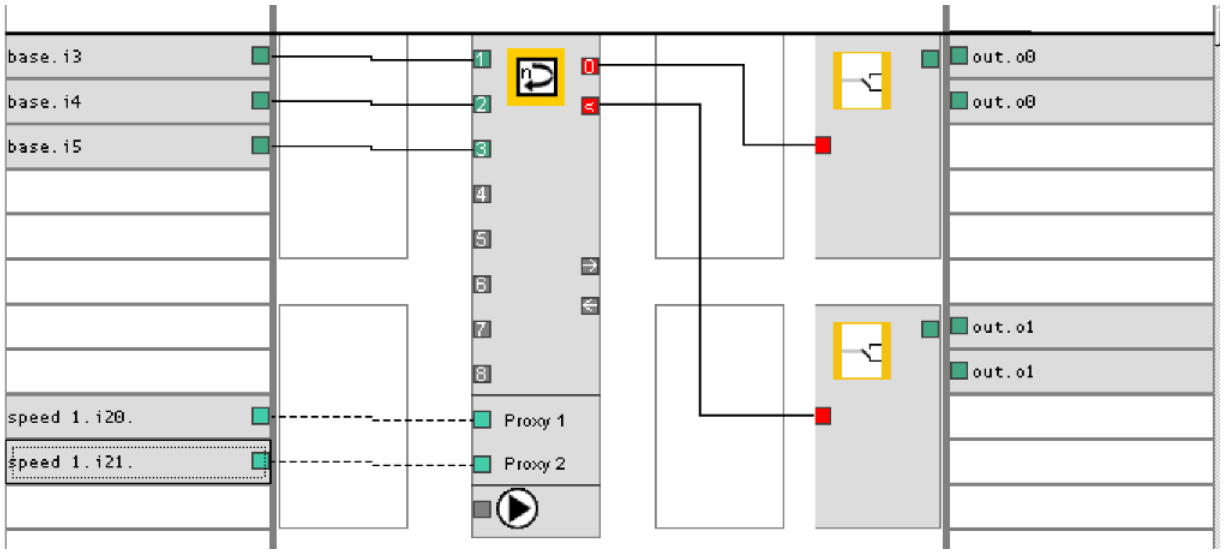
PNOZ ms1p expansion module

Connection of 4 proximity switches, central supply voltage



Connection of 4 proximity switches, supply voltage via PNOZ ms1p





PNOZ ms1p expansion module

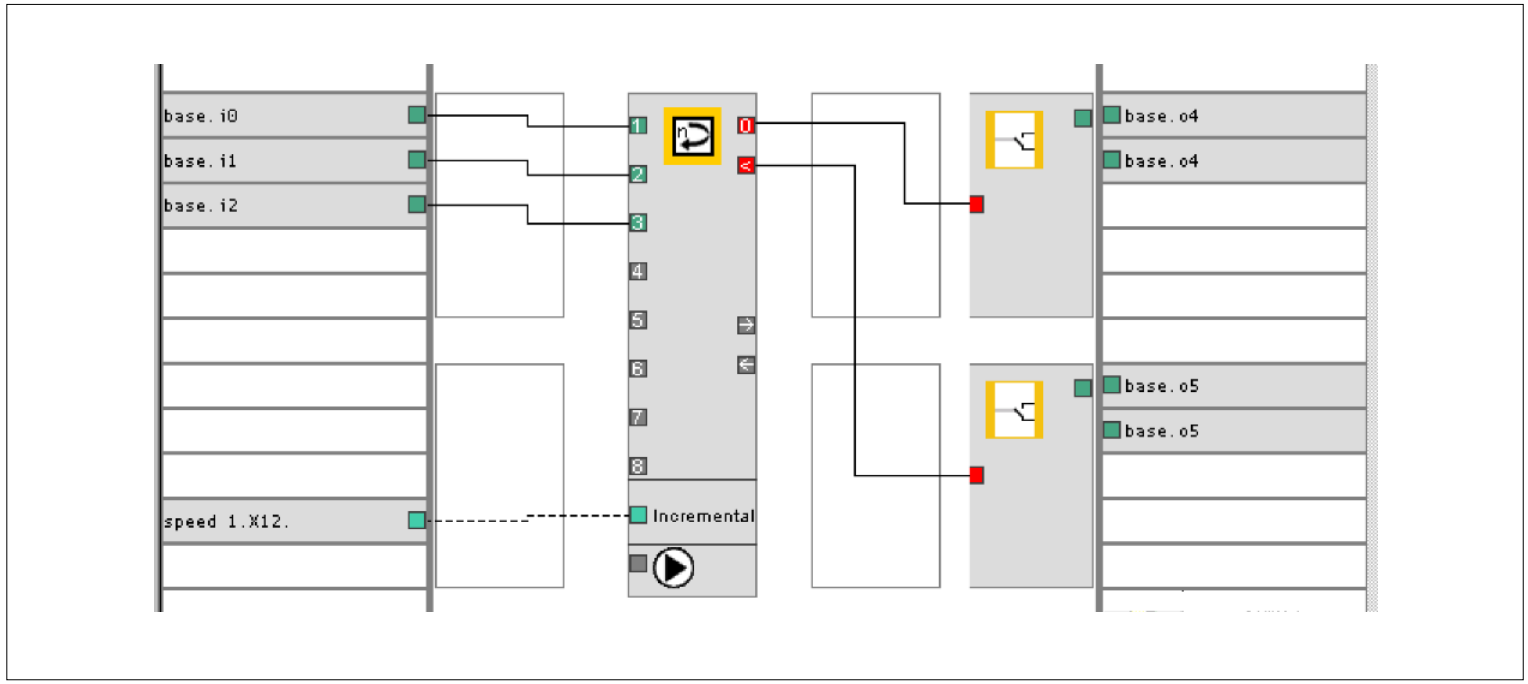
Incremental encoders

- Only incremental encoders with a differential output of the following type are permitted:
  - Sin/Cos
  - TTL (RS 422)
- Please note the values stated in the technical details.

The incremental encoders are connected via an adapter (e.g. PNOZ msi4p) or are connected directly to the PNOZ ms1p. The adapter is connected between the incremental encoder and the drive. The output on the adapter is connected to the RJ-45 female connector on the PNOZ ms1p. The incremental encoder on connector X12 monitors axis 1; the incremental encoder on connector X22 monitors axis 2.

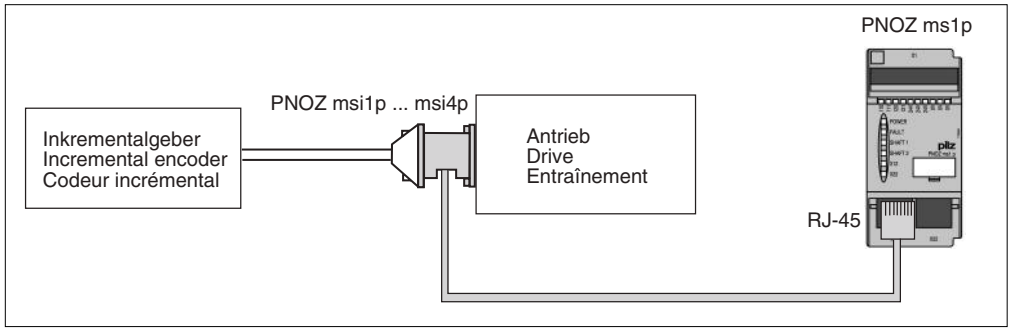
Pin assignment on connectors X12 and X22:

Pin	Assignment
1	+5 VDC
2	0 V
3	Not assigned
4	A
5	/A
6	Not assigned
7	B
8	/B
Screening	S



Requirements of the incremental encoders

Signal level at the inputs	0 ... +5 V, overload-proof up to -30 V .... +30 V
Differential signal	+/-0.2 V ... +/-5 V
Supply voltage	+5 V +/-10 %
Input resistance at X12, X22	10 kOhm
Frequency range	0 ... 500 kHz
Connection technology	RJ-45 female connector



PNOZ ms1p expansion module

Adapter for incremental encoders

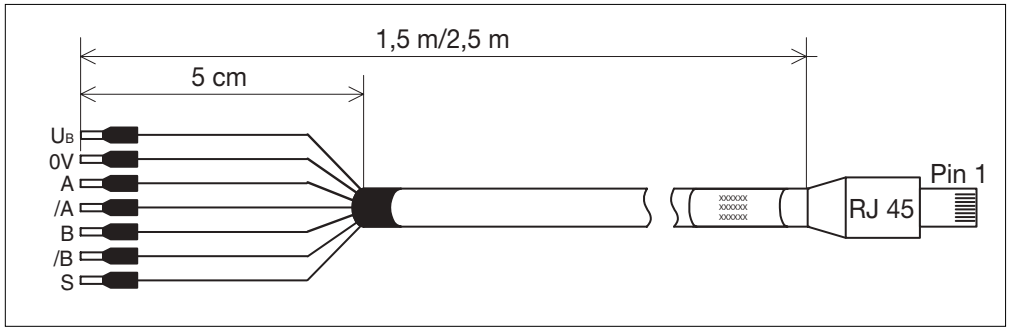
The adapter records the data between the incremental encoder and the drive and makes it available via the RJ-45 female connector on the PNOZms1p. Users can make this adapter themselves or use existing adapters. Pilz supplies complete adapters as well as ready-made cable with RJ-45 female connectors, which can be used when making an individual adapter. The range of products in this area is constantly being expanded. Please contact us about the range of adapters that is currently available.

PNOZ msi11p/msi10p cable

The cable connects the output on the incremental encoder to the RJ-45 connector on the PNOZ ms1p. The cable cores are strands with crimp connectors. The cable cores are labelled. An RJ-45 connector is used for connection to the PNOZ ms1p.

Pin assignment of the RJ-45 connector:

Pin	Assignment
1	UB
2	0 V
3	Not assigned
4	A
5	/A
6	Not assigned
7	B
8	/B
Screening	S



Technical details

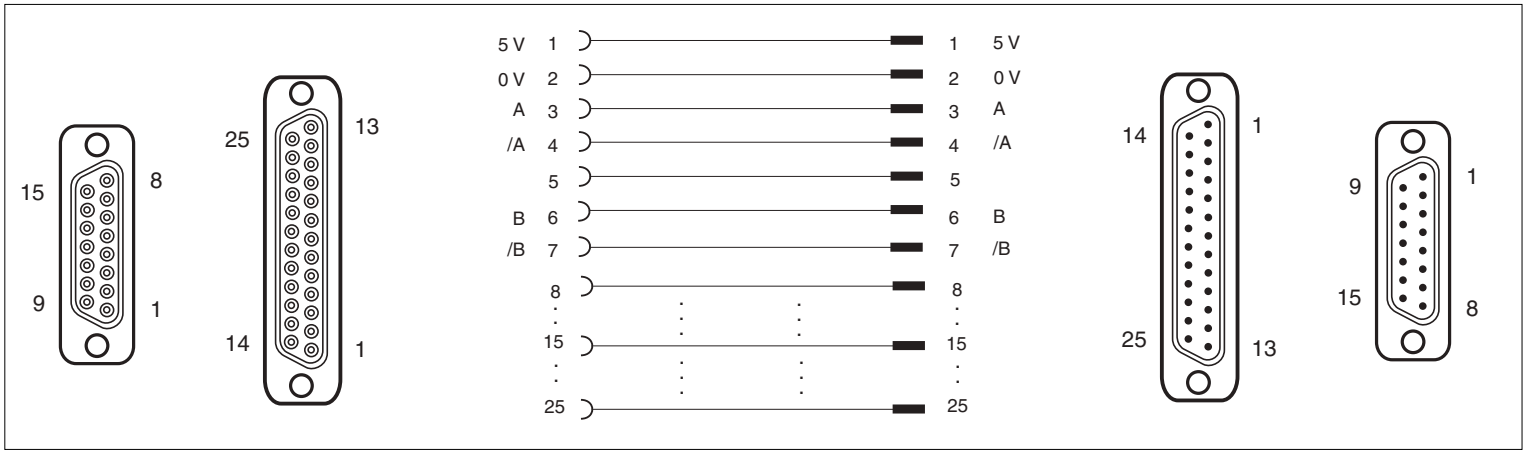
Cable runs	
PNOZ msi11p	1.5 m
PNOZ msi10p	2.5 m
Cable	CAT5 cable, flexible, silicone-free
Temperature resistance of insulation material	Max. 60 °C
Adapter connection	Strands with crimp connectors
PNOZ ms1p connection	RJ-45 connector, 8-pin

PNOZ ms1p expansion module

PNOZ msi1p ... PNOZ msi4p adapter for Siemens or Haidenhain

These adapters are designed for the drives from Siemens or Haidenhain (for further information please refer to the drives' documentation). One is connected via a female D-Sub connector, one via a male D-Sub connector. Various versions are available:

- PNOZ msi1p
  25-pin D-Sub connector and cable runs of 2.5 m
- PNOZ msi2p
  25-pin D-Sub connector and cable runs of 1.5 m
- PNOZ msi3p
  15-pin D-Sub connector and cable runs of 2.5 m
- PNOZ msi4p
  15-pin D-Sub connector and cable runs of 1.5 m



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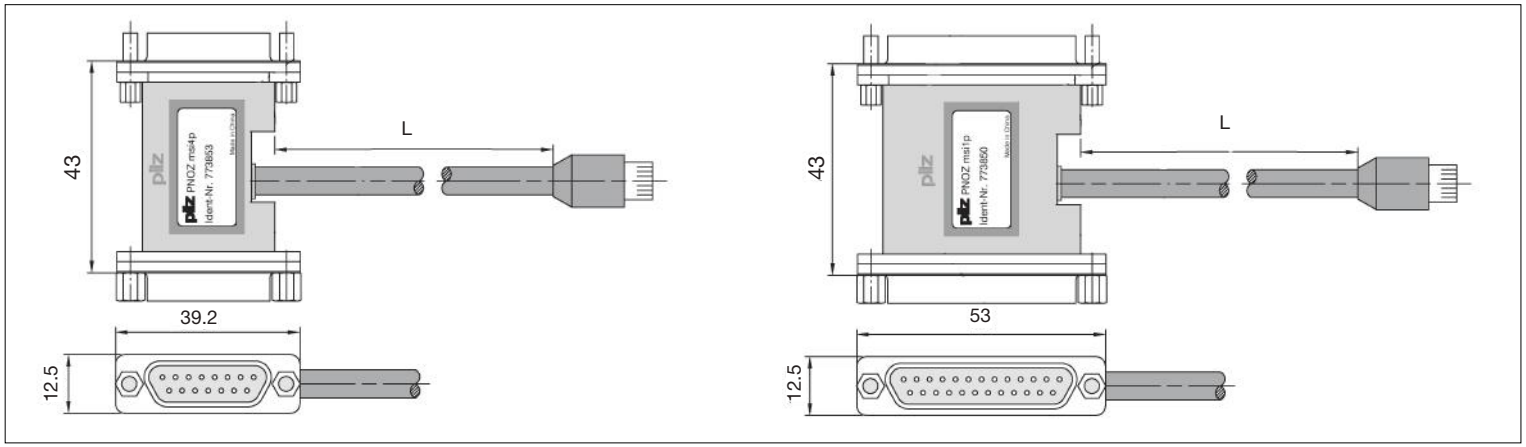
PNOZ ms1p expansion module

Technical details

Climatic suitability in accordance with EN 60068-2-78	40 °C, 93 % r.h.
Condensation	Not permitted
Ambient temperature	0 ... +60° C
Storage temperature	-25 ... 70 ° C
Protection type	IP20
Housing material	PBT
Dimensions H x W x D	See drawing
Length L	1.5 m or 2.5 m
Weight	PNOZ msi1p: 190 g PNOZ msi2p: 135 g PNOZ msi3p: 175 g PNOZ msi4p: 120 g

Dimensions



PNOZ mc3p expansion module

Intended use

The **PNOZ mc3p** expansion module may only be connected to a base unit (e.g. PNOZ m1p) from the PNOZmulti modular safety system. It is used for communication between the modular safety system and PROFIBUS-DP.

CAUTION!
The PNOZ mc3p expansion module may not be used for safety-related functions.

System requirements

- PNOZmulti Configurator: from Version 3.0.0
- PNOZ m1p: from Version 3.0

Please contact Pilz if you have an older version.

Description

PROFIBUS-DP is designed for fast data exchange at field level. The PNOZ mc3p expansion module is a passive PROFIBUS-DP subscriber (Slave). The basic functions of communication with PROFIBUS-DP conform to EN 50170. The central controller (Master) reads input information from the slaves and writes output information to the slaves as part of each cycle. As well as the cyclical transfer of usable data, PROFIBUS-DP can also be used for diagnostics and commissioning functions. Data traffic is monitored on the Master/Slave side.

Module features:

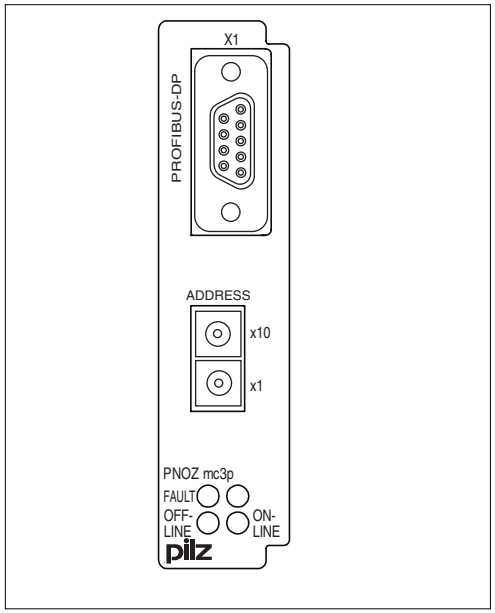
- Can be configured using the PNOZmulti Configurator
- Station addresses from 0 ... 99, selected via rotary switch
- Status indicators for communication with PROFIBUS-DP and for errors
- Max. 1 PNOZ mc3p can be connected to the PNOZ m1p base unit
- Weight (with jumper): 140 g

A maximum of 24 outputs on the PNOZmulti safety system can be defined in the PNOZm Config for communication with PROFIBUS-DP. These outputs can be connected to the outputs on

- Logic elements
- Time elements
- Event counters
- Connection points

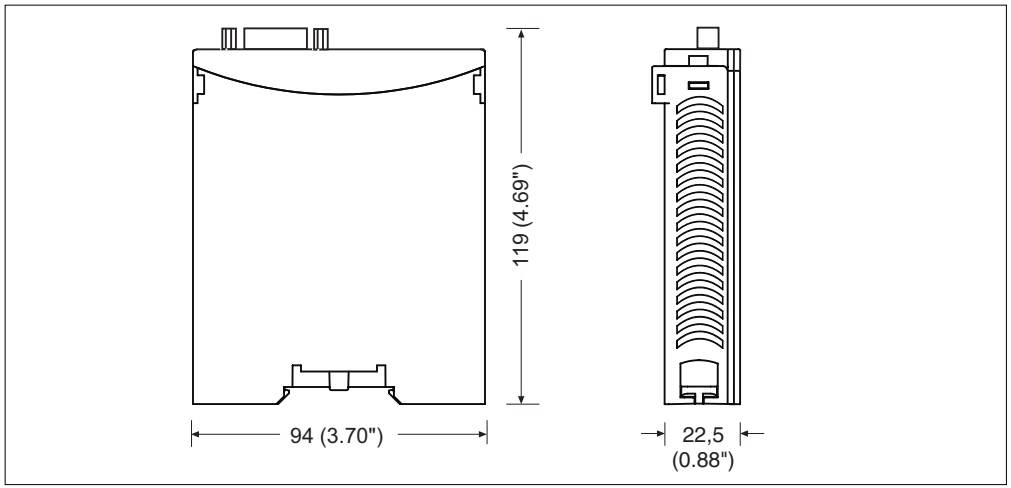
and to inputs on the safety system.

Terminal configuration



PNOZ mc3p expansion module

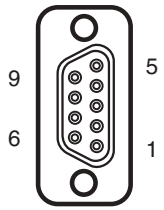
Dimensions in mm (")



CAUTION!
The PNOZ mc3p expansion module must always be installed to the left of the base unit.
A distance of at least 20 mm must be maintained between the PNOZ mc3p and any external heat sources.

Wiring

The wiring is defined in the circuit diagram in the Configurator. It is possible to define which outputs on the safety system will communicate with PROFIBUS-DP. The connection to PROFIBUS-DP is made via a female 9-pin D-Sub connector.



1: Not assigned
2: Not assigned
3: B (RxD/TxD-P)
4: CNTR-P
5: DGND
6: VP
7: Not assigned
8: A (RxD/TxD-N)
9: Not assigned

PNOZ mc3p technical details

Application range	Non-safety-related applications
Device type	Slave
Status display	LED
Station address	0 ... 99
Transmission rate	9.6 kBit/s ... 12 MBit/s
Connection	9-pin D-Sub connector (female)

PNOZ mc3p expansion module

Please note the following when connecting to PROFIBUS:
- Only use metal plugs or metallised plastic plugs.
- Twisted pair, screened cable must be used to connect the interfaces.

Setting the station address
Two rotary switches are used to set the station address (decimal) on the PNOZ mc3p.
- On the upper rotary switch, use a small screwdriver to set the tens digit for the address.


x10

- On the lower rotary switch, set the ones digit for the address (“6” in the example).


x1

Station address 36 is set in the diagrams as an example.

PNOZ mc4p expansion module

Intended use

The **PNOZ mc4p** expansion module may only be connected to a base unit (e.g. PNOZ m1p) from the PNOZmulti modular safety system. It is used for communication between the modular safety system and DeviceNet.

CAUTION!
The PNOZ mc4p expansion module may not be used for safety-related functions.

System requirements

- PNOZmulti Configurator: from Version 3.0.0
- PNOZ m1p: from Version 3.0

Please contact Pilz if you have an older version.

Description

DeviceNet is designed for fast data exchange at field level. The PNOZ mc4p expansion module is a passive DeviceNet subscriber (Slave). The basic communication functions meet the requirements of the DeviceNet specification, Release 2.0. The central controller (master) reads input information from the slaves and writes output information to the slaves as part of each cycle. As well as the cyclical transfer of usable data, the PNOZ mc4p can also be used for diagnostics and commissioning functions.

Module features:

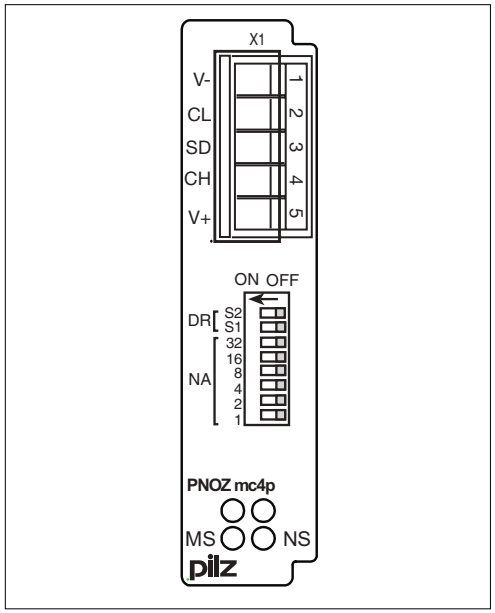
- Can be configured using the PNOZmulti Configurator
- Station addresses from 0 ... 63, selected via DIP switch
- Status indicators for communication with DeviceNet and for errors
- Max. 1 PNOZ mc4p can be connected to the PNOZ m1p base unit
- Weight (with jumper): 146 g

A maximum of 24 outputs on the PNOZmulti safety system can be defined in the PNOZm Config for communication with DeviceNet. These outputs can be connected to the outputs on

- Logic elements
- Time elements
- Event counters
- Connection points

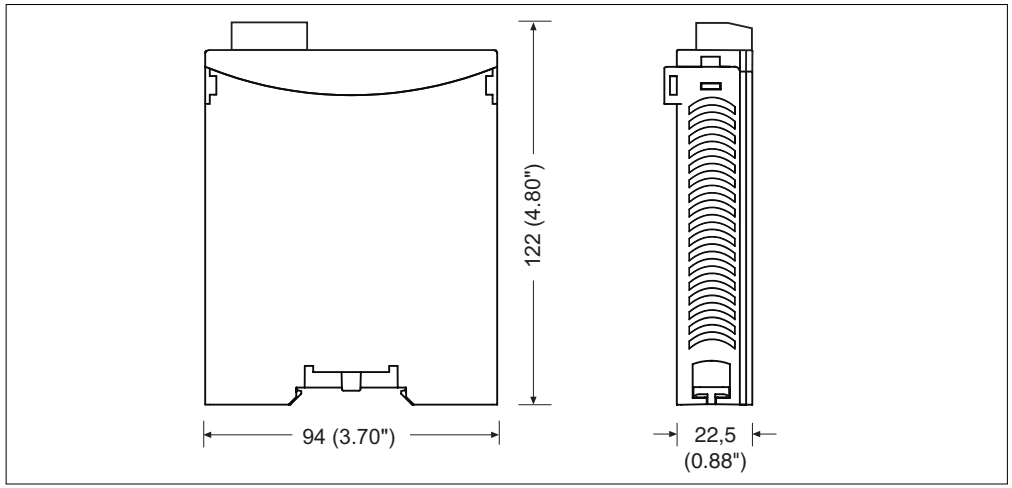
and to inputs on the safety system.

Terminal configuration



PNOZ mc4p expansion module

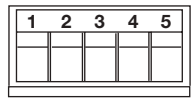
Dimensions in mm (")



CAUTION!
The PNOZ mc4p expansion module must always be installed to the left of the base unit.
A distance of at least 20 mm must be maintained between the PNOZ mc4p and any external heat sources.

Wiring

The wiring is defined in the circuit diagram in the Configurator. It is possible to define which outputs on the safety system will communicate with DeviceNet. The connection to DeviceNet is made via a 5-pin screw connector.



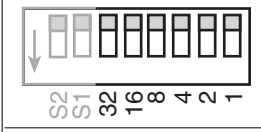
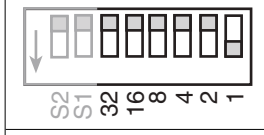
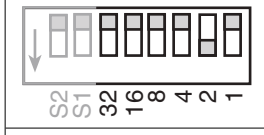
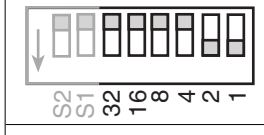
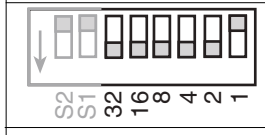
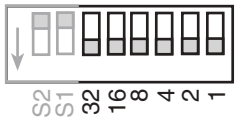
1: V-
2: CL (CAN_L)
3: SD (screen)
4: CH (CAN_H)
5: V+

PNOZ mc4p technical details

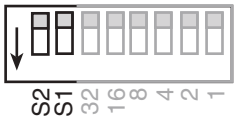
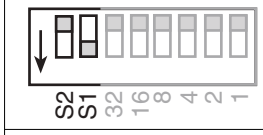
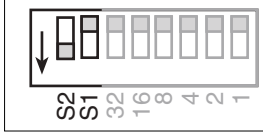
Application range	Non-safety-related applications
Device type	Slave
Status display	LED
Station address	0 ... 63
Transmission rate	125, 250, 500 kBit/s
Connection	5-pin screw connector

PNOZ mc4p expansion module

Setting the station address
The station address of the PNOZ mc4p is set via switches 1 ... 32 on the DIP switch:

Switch setting	Station address
	0
	1
	2
	3
. . .	
	62
	63

Set transmission rate
The transmission rate is set via switches S1 and S2 on the DIP switch:

Switch setting	Transmission rate
	125 KBit/s
	250 KBit/s
	500 KBit/s

PNOZ mc5p expansion module

Intended use

The **PNOZ mc5p** expansion module may only be connected to a base unit (e.g. PNOZ m1p) from the PNOZmulti modular safety system. It is used for communication between the modular safety system and INTERBUS.

CAUTION!
The PNOZ mc5p expansion module may not be used for safety-related functions.

System requirements

- PNOZmulti Configurator: from Version 3.0.0
- PNOZ m1p: from Version 3.0

Please contact Pilz if you have an older version.

Description

INTERBUS is designed for fast data exchange at field level. The PNOZ mc5p expansion module is a passive INTERBUS subscriber (Slave). The basic communication functions conform to EN 50254. The central controller (Master) reads input information from the slaves and writes output information to the slaves as part of each cycle. As well as the cyclical transfer of usable data, the PNOZ mc5p can also be used for diagnostics and commissioning functions.

Module features:

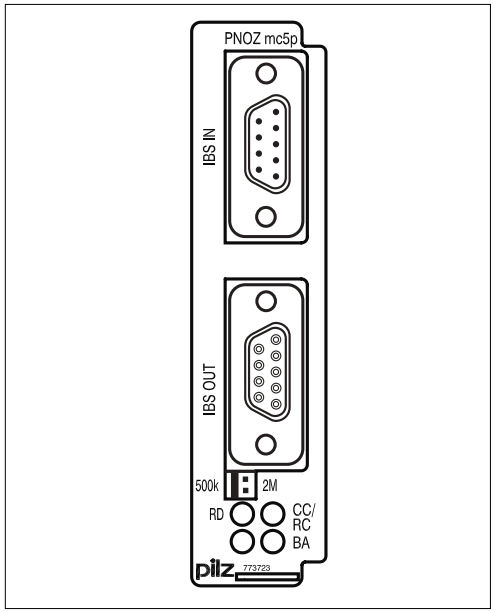
- Can be configured using the PNOZmulti Configurator
- Status indicators for communication with INTERBUS and for errors
- Max. 1 PNOZ mc5p can be connected to the PNOZ m1p base unit
- Weight (with jumper): 153 g

A maximum of 24 outputs on the PNOZmulti safety system can be defined in the PNOZm Config for communication with INTERBUS. These outputs can be connected to the outputs on

- Logic elements
- Time elements
- Event counters
- Connection points

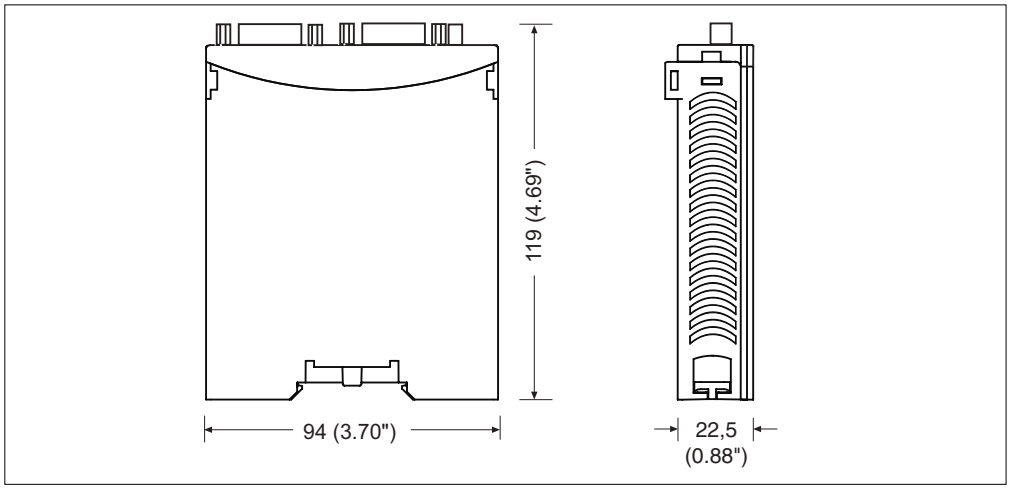
and to inputs on the safety system.

Terminal configuration



PNOZ mc5p expansion module

Dimensions in mm (")

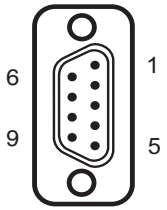


CAUTION!
The PNOZ mc5p expansion module must always be installed to the left of the base unit.
A distance of at least 20 mm must be maintained between the PNOZ mc5p and any external heat sources.

Wiring

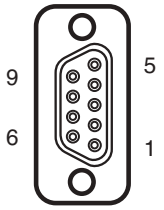
The wiring is defined in the circuit diagram in the Configurator. It is possible to define which outputs on the safety system will communicate with INTERBUS. The connection to INTERBUS is made via two 9-pin screw connectors.

IBS IN



1: DO1
2: DI1
3: GND
4: Not assigned
5: Not assigned
6: /DO1
7: /DI1
8: Not assigned
9: Not assigned

IBS OUT



1: DO2
2: DI2
3: GND
4: Not assigned
5: GND
6: /DO2
7: /DI2
8: Not assigned
9: RBST

PNOZ mc5p technical details

Application range	Non-safety-related applications
Device type	Slave
Status display	LED
Transmission rate	500 kBit/s, 2 MBit/s
Connections	9-pin female D-Sub connector plus male connector

PNOZ mc5p expansion module

Set transmission rate
The transmission rate is set with a jumper:

Jumper position	Transmission rate
500k  2M	500 KBit/s
500k  2M	2 MBit/s

PNOZ mc6p expansion module

Intended use

The **PNOZ mc6p** expansion module may only be connected to a base unit (e.g. PNOZ m1p) from the PNOZmulti modular safety system. It is used for communication between the modular safety system and CANopen.

CAUTION!
The PNOZ mc6p expansion module may not be used for safety-related functions.

System requirements

- PNOZmulti Configurator: from Version 3.0.0
- PNOZ m1p: from Version 3.0

Please contact Pilz if you have an older version.

Description

CANopen is designed for fast data exchange at field level. The PNOZ mc6p expansion module is a passive CANopen subscriber (Slave). The basic communication functions conform to CiA DS-301 V3.0. The central controller (Master) reads input information from the slaves and writes output information to the slaves as part of each cycle. As well as the cyclical transfer of usable data, the PNOZ mc6p can also be used for diagnostics and commissioning functions.

Module features:

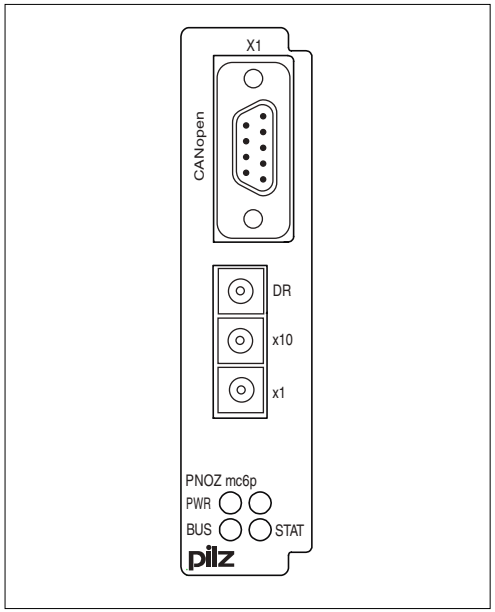
- Can be configured using the PNOZmulti Configurator
- Station addresses from 1 ... 99, selected via rotary switch
- Status indicators for communication with CANopen and for errors
- Max. 1 PNOZ mc6p can be connected to the PNOZ m1p base unit
- Weight (with jumper): 145 g

A maximum of 24 outputs on the PNOZmulti safety system can be defined in the PNOZm Config for communication with CANopen. These outputs can be connected to the outputs on

- Logic elements
- Time elements
- Event counters
- Connection points

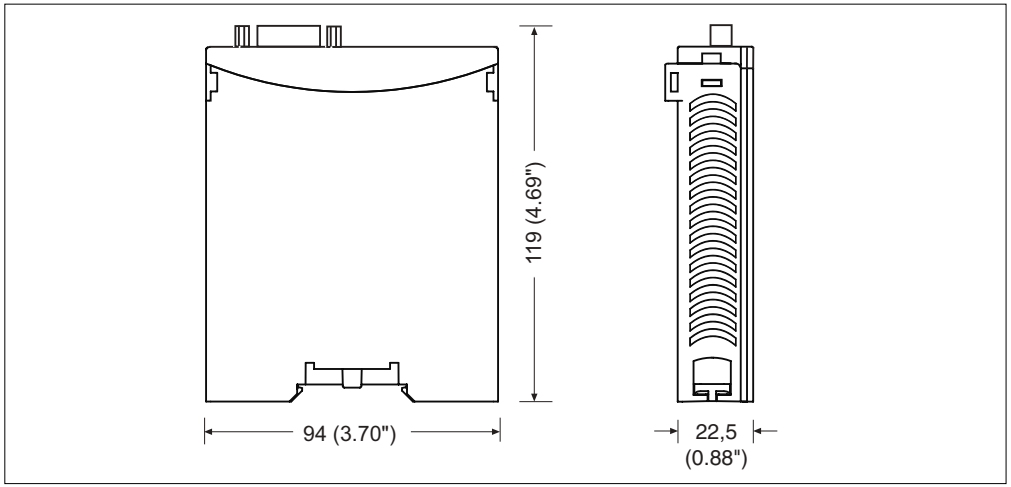
and to inputs on the safety system.

Terminal configuration



PNOZ mc6p expansion module

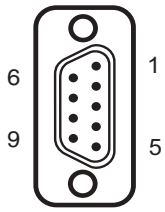
Dimensions in mm (")



CAUTION!
The PNOZ mc6p expansion module must always be installed to the left of the base unit.

Wiring

The wiring is defined in the circuit diagram in the Configurator. It is possible to define which outputs on the safety system will communicate with CANopen. The connection to CANopen is made via a female 9-pin D-Sub connector.



1: Not assigned
2: CAN_L
3: Not assigned
4: Not assigned
5: CAN_SHLD
6: Not assigned
7: CAN_H
8: Not assigned
9: Not assigned

PNOZ mc6p technical details

Application range	Non-safety-related applications
Device type	Slave
Status display	LED
Station address	1 ... 99
Transmission rate	10, 20, 50, 125, 250, 500, 800 kBit/s, 1 MBit/s
Connection	Male 9-pin D-Sub connector

PNOZ mc6p expansion module

Setting the station address
Two rotary switches are used to set the station address on the PNOZ mc6p.

- On the middle rotary switch, use a small screwdriver to set the tens digit for the address (“3” in the example).

- On the lower rotary switch, set the ones digit for the address (“6” in the example).

Station address 36 is set in the diagrams as an example.

Set transmission rate:
On the upper rotary switch DR, use a small screwdriver to set the transmission rate (in the example, “4” corresponds to 125 kBit/s)

Switch setting	Transmission rate
0	-
1	10 KBit/s
2	20 kBit/s
3	50 kBit/s
4	125 kBit/s
5	250 kBit/s
6	500 kBit/s
7	800 kBit/s
8	1 MBit/s
9	-

Communication with fieldbus modules PNOZ mc3p ... PNOZ mc6p

Communication with fieldbus systems

An area of 20 Bytes is reserved for communication via the fieldbus systems; this is updated approx. every 15 ms. The Master can process the information in bytes, words or in double words.

Double word	Word	Byte	Contents
0	0	0	Output status
		1	
	1	2	
		3	LED status
1	2	4	Table no.
		5	Segment no.
	3	6	Byte 0
		7	Byte 1
2	4	8	.
		9	.
	5	10	.
		11	.
3	6	12	.
		13	.
	7	14	.
		15	.
4	8	16	.
		17	.
	9	18	Byte 12
		19	Reserved

Note on the PNOZ mc6p (CANopen):
The output data on the PNOZmulti is stored as follows:

Byte	Object code	Sub-index	PDO	COB-ID
0	2000	1	TPDO 1	180 + node address
1	2000	2		
2	2000	3		
3	2000	4		
4	2000	5		
5	2000	6		
6	2000	7		
7	2000	8		
8	2000	9	TPDO 2	280 + node address
9	2000	A		
10	2000	B		
11	2000	C		
12	2000	D		
13	2000	E		
14	2000	F		
15	2000	10		
16	2000	11	TPDO 3	1C0 + node address
17	2000	12		
18	2000	13		
19	2000	14		

The input data on the PNOZmulti is stored as follows:

Byte	Object code	Sub-index	PDO	COB-ID
0	2100	1	RPDO 1	200 + node address
1	2100	2		
2	2100	3		
3	2100	4		
4	2100	5		
5	2100	6		
6	2100	7		
7	2100	8		
8	2100	9	RPDO 2	300 + node address
9	2100	A		
10	2100	B		
11	2100	C		
12	2100	D		
13	2100	E		
14	2100	F		
15	2100	10		
16	2100	11	RPDO 3	240 + node address
17	2100	12		
18	2100	13		
19	2100	14		

Communication with fieldbus modules PNOZ mc3p ... PNOZ mc6p

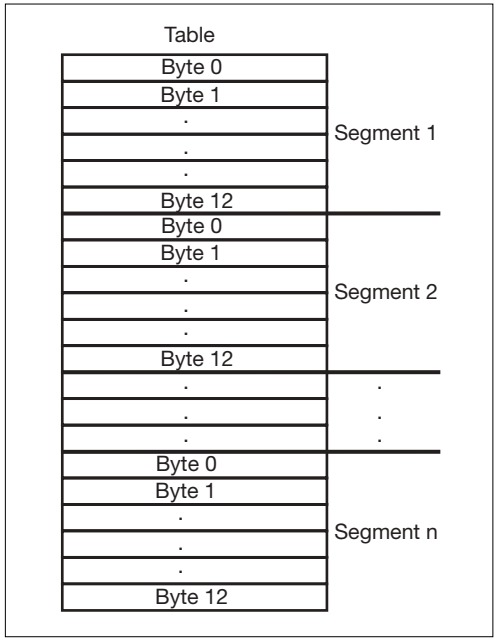
The current status of the outputs configured for the fieldbus plus the current LED status are always stored in Byte 0 ... Byte 3. All other information is stored in various tables.

Assignment of Byte 0 ... Byte 3
The outputs are defined in the PNOZmulti Config. Each output that is used is given a number there, e.g. o0, o5... . The status of output o0 is stored in Bit 0 of Byte 0; the status of output o5 is stored in Bit 5 of Byte 0 etc.

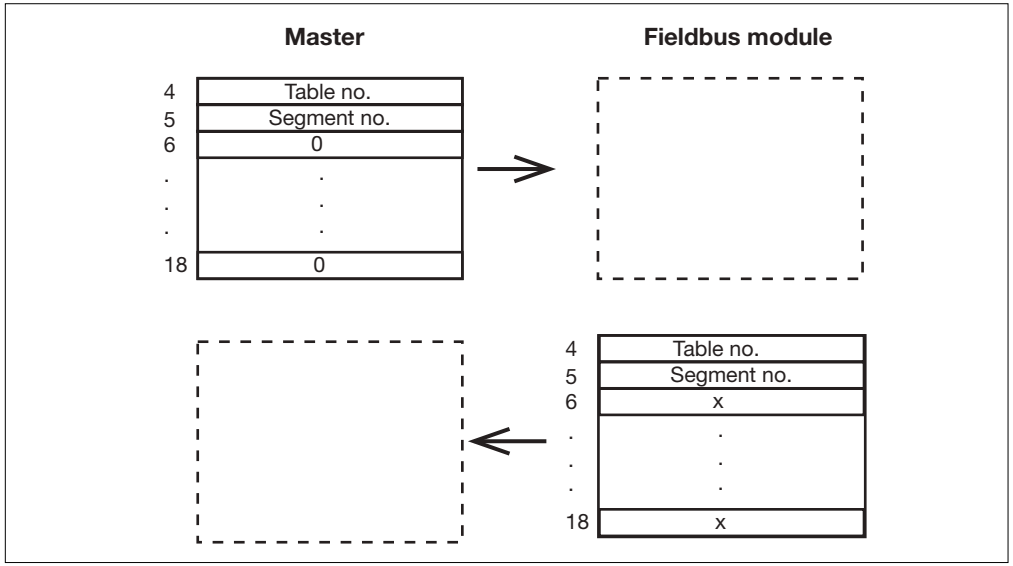
Byte								
0	o7	o6	o5	o4	o3	o2	o1	o0
1	o15	o14	o13	o12	o11	o10	o9	o8
2	o23	o22	o21	o20	o19	o18	o17	o16

The status of the LEDs is stored in Byte 3:
Bit 0 = 1: OFAULT LED is lit
Bit 1 = 1: IFAULT LED is lit
Bit 2 = 1: FAULT LED is lit
Bit 3 = 1: DIAG LED is lit
Bit 4 = 1: RUN LED is lit
Bit 5 = 1: If communication between the PNOZmulti and the fieldbus is working
Bit 6: Reserved
Bit 7: Reserved

Assignment of Byte 4 ... Byte 18
Each table consists of one or more segments. Each segment is made up of a max. 13 Bytes. There are 6 tables, whose assignment is fixed.

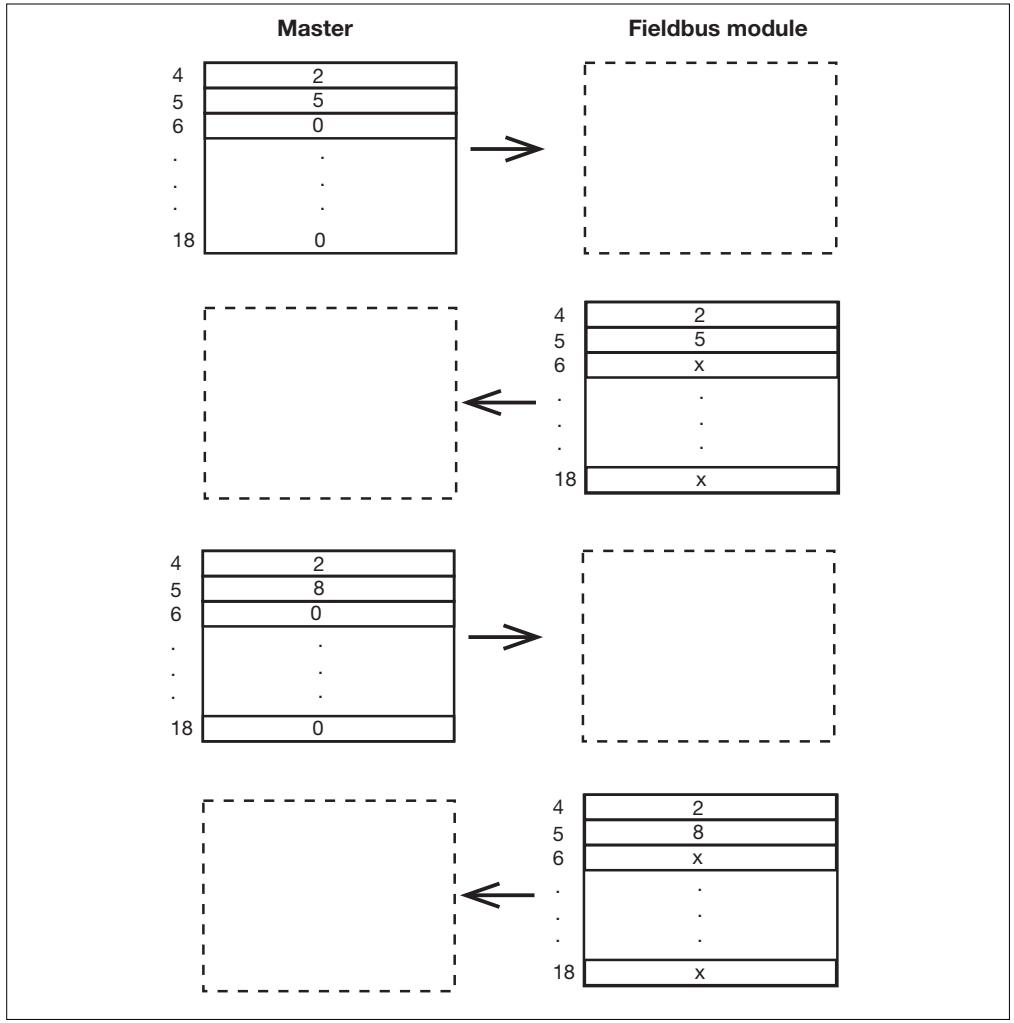


The Master must request the table number and segment number required. The Slave (e.g. PNOZ mc3p) repeats the two numbers and sends the requested data. If a number is requested that is not available, the Slave sends the error message "FF" instead of the segment number.
The segments may be requested in any sequence.



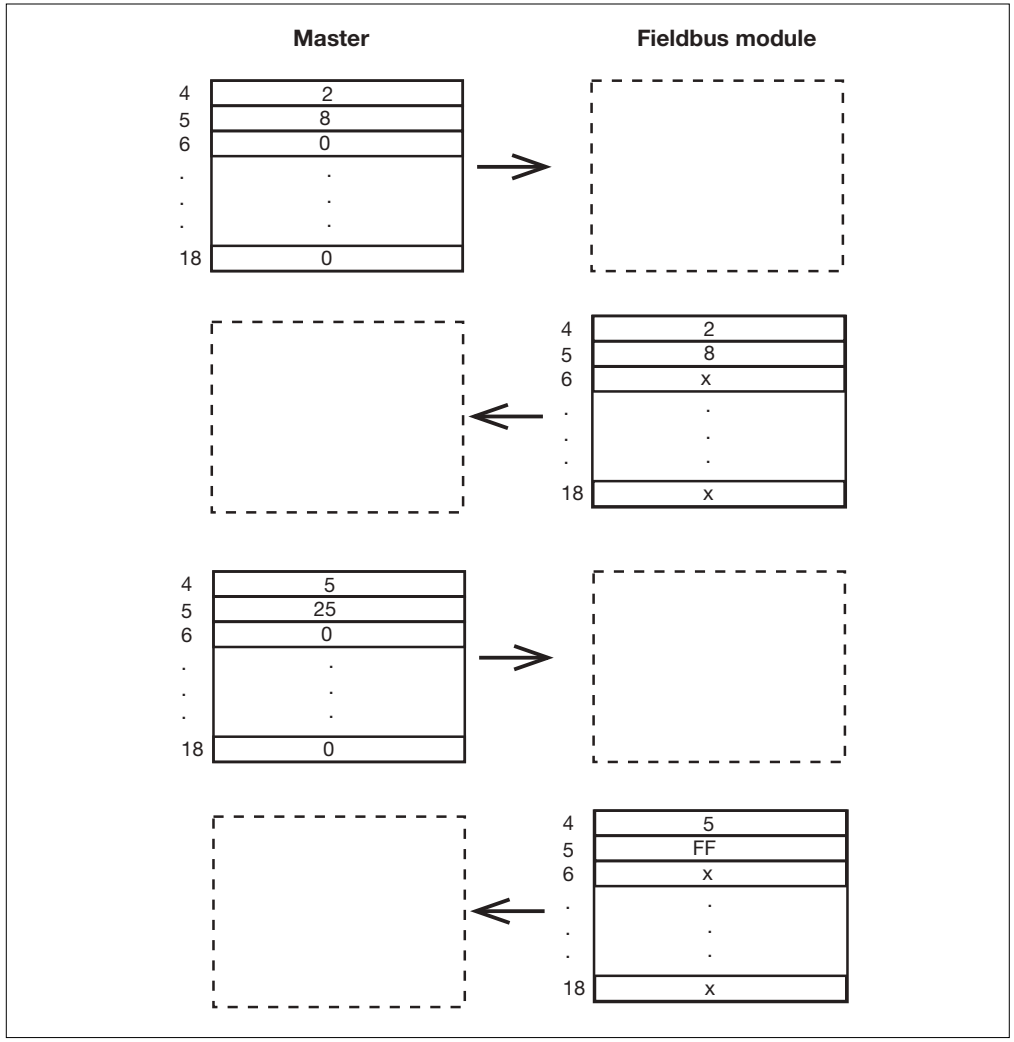
Communication with fieldbus modules PNOZ mc3p ... PNOZ mc6p

Example 1:
The Master requests segment 5 from table 2. The fieldbus module repeats both these details and sends segment 5. Then the data from segment 8 in table 2 is transmitted.



Communication with fieldbus modules PNOZ mc3p ... PNOZ mc6p

Example 2:
The Master requests segment 8 from table 2. The fieldbus module repeats both of these details and sends segment 8. Then the Master requests segment 25 from table 5. As this table does not contain a segment 25, the Slave registers an error and sends back "FF".



Communication with fieldbus modules PNOZ mc3p ... PNOZ mc6p

Table assignment

There are a total of 6 tables, with the following contents:

Table 1: Configuration
Table 2: Reserved
Table 3: Input status
Table 4: Output status
Table 5: LED status
Table 6: Reserved

Table 1
Table 1 consists of 6 segments, each of which has 13 Bytes. It contains device data from the base unit and the project data defined in the PNOZm Config.

Segment	Byte	Contents	Example/Comment
0	0	Product number (hex)	Product number 773 100: 000BCBEC hex Byte 0: 00, Byte 1: 0B, Byte 2: CB, Byte 3: EC
	1		
	2		
	3		
	4	Unit version (hex)	Unit version 20: 14 hex Byte 4: 00, Byte 5: 00, Byte 6: 00, Byte 7: 14
	5		
	6		
	7		
	8	Serial number (hex)	Serial number 123 456: 0001E240 hex. Byte 8: 00, Byte 9: 01, Byte 10: E2, Byte 11: 40
	9		
	10		
	11		
	12	Free	
1	0	Project check sum (hex)	Check sum A1B2 hex: Byte 0: A1, Byte 1: B2
	1		
	2	Chip card check sum (hex)	Check sum 3C5A hex: Byte 2: 3C, Byte 3: 5A
	3		
	4	Project creation date (hex)	Creation date : 28.11.2003 Byte 4: 1C, Byte 5: 0B, Byte 6: 07, Byte 7: D3
	5		
	6		
	7		
	8	Free	Free
	9	Free	Free
	10	Free	Free
	11	Free	Free
	12	Free	Free

Communication with fieldbus modules PNOZ mc3p ... PNOZ mc6p

Table 1, Segment 2 and 3

Segment	Byte	Contents	Example/Comment
2	0	Configuration, expansion left	Byte 0 ... 8 contains the Hex code of the expansion modules : PNOZ mi1p: 08 PNOZ mo1p: 18 PNOZ mo2p: 10 PNOZ mo4p: 28 PNOZ mc1p: 20 PNOZ ms1p: 88 Fieldbus module PNOZ mc...: 30 No expansion module: 00
	1	Configuration, 1st expansion right	
	2	Configuration, 2nd expansion right	
	3	Configuration, 3rd expansion right	
	4	Configuration, 4th expansion right	
	5	Configuration, 5th expansion right	
	6	Configuration, 6th expansion right	
	7	Configuration, 7th expansion right	
	8	Configuration, 8th expansion right	
	9	Free	
	10	Free	
	11	Free	
	12	Free	
3	0		Byte 0 ... 12 of the project name defined in the PNOZm Config under "Enter project data"; this is stored in UNICODE format, 2 Bytes contain the Hex code of the individual UNICODE characters
	1	1st character	
	2		
	3	2nd character	
	4		
	5	3rd character	
	6		
	7	4th character	
	8		
	9	5th character	
	10		
	11	6th character	
	12	7th character (High Byte)	

Table 1, Segment 4 and 5

	Byte	Contents	Example/Comment
Segment	0	7th character (Low Byte)	Project name Byte 13 ... 25
4	1		
	2	8th character	
	3		
	4	9th character	
	5		
	6	10th character	
	7		
	8	11th character	
	9		
	10	12th character	
	11		
	12	13th character	
5	0		Project name Byte 26 ... 31
	1	14th character	
	2		
	3	15th character	
	4		
	5	16th character	
	6	End character FF	The end of the character string is signalled with "FFFF".
	7	End character FF	
	8	Free	
	9	Free	
	10	Free	
	11	Free	
	12	Free	

Communication with fieldbus modules PNOZ mc3p ... PNOZ mc6p

Table 3
This table consists of just one segment. It contains the status of the inputs.

Segment	Byte	Contents	Example/Comment
0	0	I0 ... I7 base unit	The safety system consists of a base unit and one PNOZ mi1p.
	1	I8 ... I15 base unit	
	2	I16 ... I19 base unit	Byte 0: I7 I6 I5 I4 I3 I2 I1 I0 PNOZ m1p
	3	0	Byte 1: I15 I14 I13 I12 I11 I10 I9 I8 PNOZ m1p
	4	0	Byte 2: 0 0 0 0 I19 I18 I17 I16 PNOZ m1p
	5	I0 ... I7 1st expansion module	Byte 3: 0 0 0 0 0 0 0 0
	6	I0 ... I7 2nd expansion module	Byte 4: 0 0 0 0 0 0 0 0
	7	I0 ... I7 3rd expansion module	Byte 5: I7 I6 I5 I4 I3 I2 I1 I0 PNOZ mi1p
	8	I0 ... I7 4th expansion module	
	9	I0 ... I7 5th expansion module	If an input has a high signal, the corresponding Bit
	10	I0 ... I7 6th expansion module	will contain “1”; if the input is open (low signal), the
	11	I0 ... I7 7th expansion module	Bit will contain “0”.
	12	I0 ... I7 8th expansion module	

Table 4
This table consists of 2 segments. It contains the status of the outputs.

Segment	Byte	Contents	Example/Comment
0	0	0	Assignment of Bytes depends on the unit:
	1	0	PNOZ m1p
	2	0	Segment 0, Byte 3:
	3	O0 ... O3 of the base unit	0 0 1 1 O3 O2 O1 O0
	4	O4 and O5 of the base unit	Segment 0, Byte 4:
	5	O0 ... O7 1st expansion module	0 0 0 0 0 0 O5 O4
	6	O0 ... O7 2nd expansion module	PNOZ mo1p
	7	O0 ... O7 3rd expansion module	Segment 0, Byte 5 ... 12:
	8	O0 ... O7 4th expansion module	0 0 1 1 O3 O2 O1 O0
	9	O0 ... O7 5th expansion module	Segment 1, Byte 5 ... 12:
	10	O0 ... O7 6th expansion module	0 0 0 0 0 0 0 0
	11	O0 ... O7 7th expansion module	PNOZ mo2p
	12	O0 ... O7 8th expansion module	Segment 0, Byte 5 ... 12:
1	0	0	0 0 0 0 0 0 O1 O0
	1	0	Segment 1, Byte 5 ... 12:
	2	0	0 0 0 0 0 0 0 0
	3	0	PNOZ mo4p
	4	0	Segment 0, Byte 5 ... 12:
	5	O8 ... O15 1st expansion module	0 0 0 0 O3 O2 O1 O0
	6	O8 ... O15 2nd expansion module	Segment 1, Byte 5 ... 12:
	7	O8 ... O15 3rd expansion module	0 0 0 0 0 0 0 0
	8	O8 ... O15 4th expansion module	PNOZ mc1p
	9	O8 ... O15 5th expansion module	Segment 0, Byte 5 ... 12:
	10	O8 ... O15 6th expansion module	A7 A6 A5 A4 A3 A2 OA1 OA0
	11	O8 ... O15 7th expansion module	Segment 1, Byte 5 ... 12:
	12	O8 ... O15 8th expansion module	A15 A14 A13 A12 A11 A10 A9 A8
			If an output has a high signal, the corresponding Bit will contain “1”; if the output is open (low signal), the Bit will contain “0”.

Communication with fieldbus modules PNOZ mc4p ... PNOZ mc6p

Table 5
This table consists of 3 segments. It contains the LED status.

Segment	Byte	Contents	Example/Comment
0	0	RUN	
	1	DIAG	
	2	FAULT	
	3	IFAULT	Depending on the LED status, the following Hex code will be in Byte 0 ... 12:
	4	OFAULT	00 hex: LED off
	5	FAULT 1st expansion module	FF hex: LED on
	6	FAULT 2nd expansion module	30 hex: LED flashing
	7	FAULT 3rd expansion module	
	8	FAULT 4th expansion module	
	9	FAULT 5th expansion module	
	10	FAULT 6th expansion module	
	11	FAULT 7th expansion module	
	12	FAULT 8th expansion module	
1	0	LED I0 ... I7 base unit	The safety system consists of a base unit and one PNOZ mi1p.
	1	LED I8 ... I15 base unit	
	2	LED I16 ... I19 base unit	Byte 0 | I7 | I6 | I5 | I4 | I3 | I2 | I1 | I0 | PNOZ m1p
	3	0	Byte 1 | I15 | I14 | I13 | I12 | I11 | I10 | I9 | I8 | PNOZ m1p
	4	0	Byte 2 | 0 | 0 | 0 | 0 | I19 | I18 | I17 | I16 | PNOZ m1p
	5	LED I0 ... I7 1st expansion module	Byte 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
	6	LED I0 ... I7 2nd expansion module	Byte 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
	7	LED I0 ... I7 3rd expansion module	Byte 5 | I7 | I6 | I5 | I4 | I3 | I2 | I1 | I0 | PNOZ mi1p
	8	LED I0 ... I7 4th expansion module	
	9	LED I0 ... I7 5th expansion module	If the LED on an input is flashing, the
	10	LED I0 ... I7 6th expansion module	corresponding Bit will contain “1”; if the LED is not
	11	LED I0 ... I7 7th expansion module	flashing, the Bit will contain “0”.
	12	LED I0 ... I7 8th expansion module	

Segment	Byte	Contents	Example/Comment
2	0	LED1: Not assigned	Position of LED1 ... LED4:
	1	LED2: Status of fieldbus module	
	2	LED3: Status of fieldbus module	
	3	LED4: Status of fieldbus module	
	4	Free	
	5	Free	
	6	Free	
	7	Free	LED off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
	8	Free	LED green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
	9	Free	LED red | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
	10	Free	The functions of the LED are described in the
	11	Free	relevant operating manual.
	12	Free	

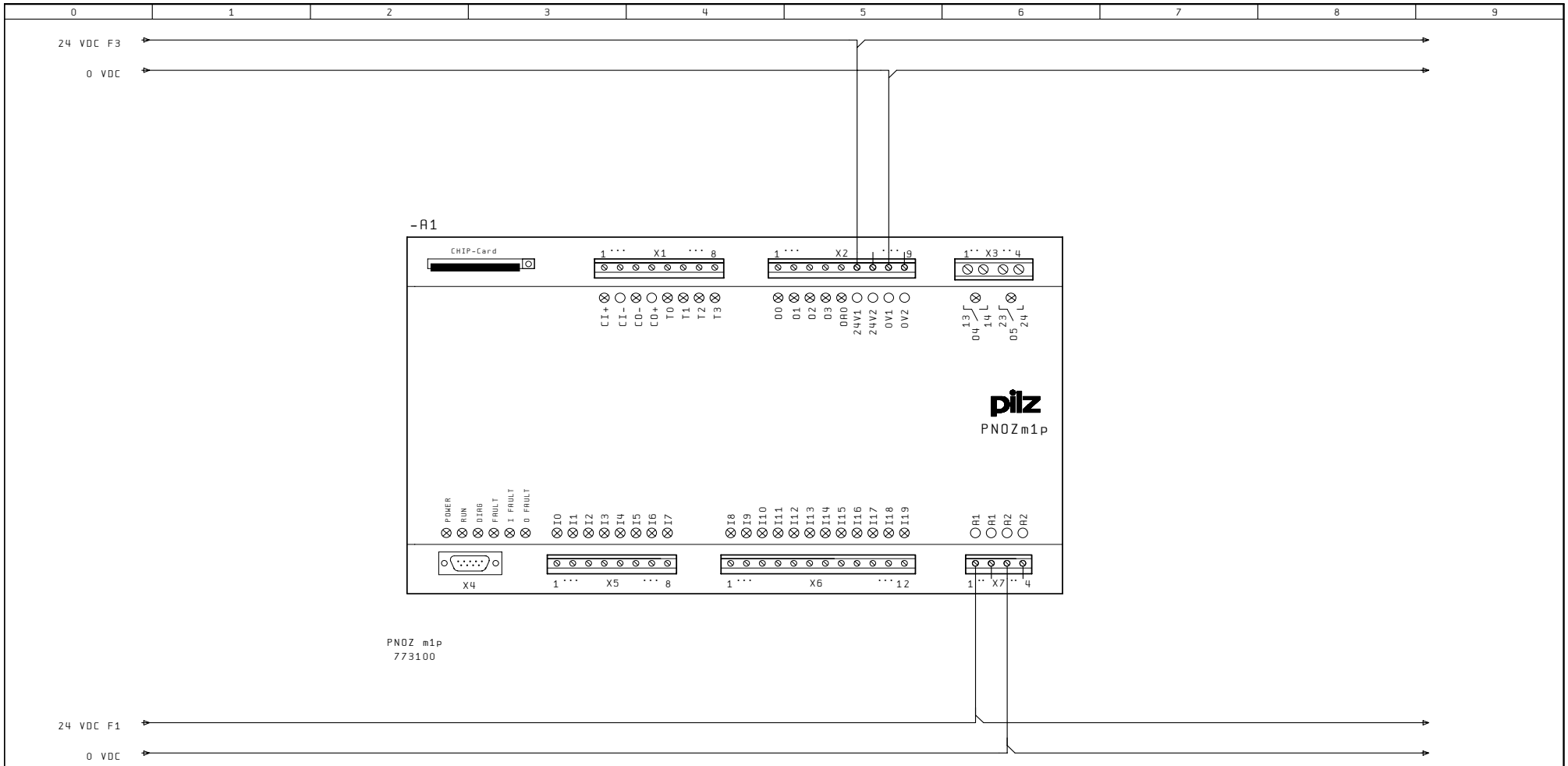
Safety

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 (e.g. refer to BIA [BG Institute for Occupational Safety] Report 6/97).

PNOZ m1p
Base unit configuration

All the applications use the PNOZ m1p.
Details of how the unit is wired are given
just once, at the start of the chapter.



Revision	31. Mär. 2004	Date	02. Jul. 2002	PNOZm1p basic unit	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	Application examples PNOZmulti	Directory: Version 1.1
Name	WIE	Name	WIE				
				PNOZmulti			Page: 4
		Dep.	CS				

PNOZ m1p
Using connection points

Features

- 3 E-STOP buttons
- 2 light guards
- Dual-channel with detection of shorts across contacts
- 3 instantaneous load shutdowns

Description
This example illustrates the use of connection points in the PNOZmulti Configurator. Connection point elements enable you to create wiring diagrams that extend over several pages in the PNOZmulti Configurator.
Three E-STOP buttons are AND-linked. If none of the buttons are operated, there will be a high signal at output A1.o0. The result of the AND operation is AND-linked to the signal from light guard 2 via a connection point. The signal at output A1.o2 will only be high if no E-STOP button has been operated and the light guard is not interrupted. Light guard 1 is AND-linked to E-STOP button 1 via a connection point. The signal at output A1.01 will only be high if E-STOP button 1 has not been operated and the light guard is not interrupted.

Feedback loop
The feedback loop is not used.

Reset
The unit is ready for operation when the conditions at the inputs have been met (automatic reset).

Safety assessment
- A short circuit between 24 VDC and inputs A1.i0 ... A1.i9 will be detected as an error. The safety outputs will carry a low signal.
- A short circuit between 24 VDC and a safety output will be detected and the safety outputs will carry a low signal.

Pilz units

Number	Type	Features	Order number
1	PNOZ m1p	24 VDC	773 100

Drawing file:

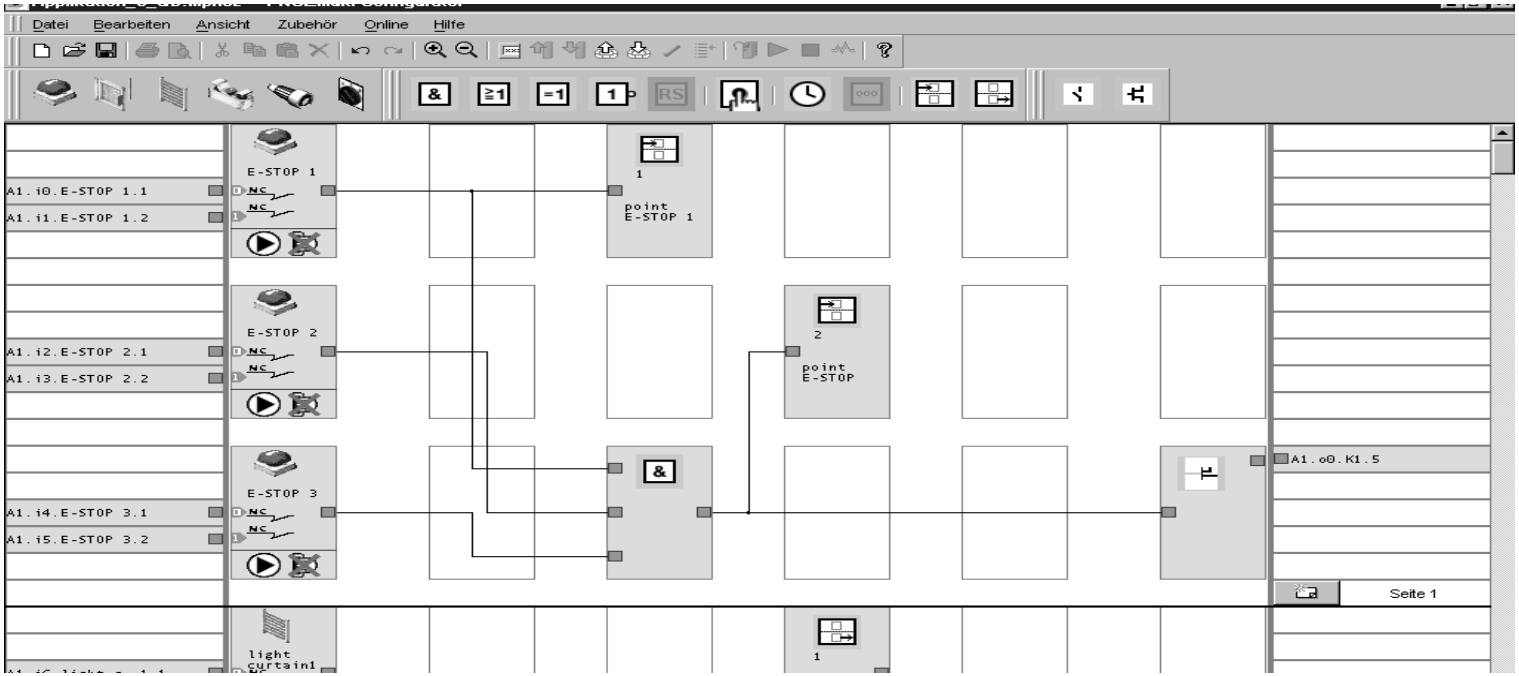
Page 14 ... 16 in the project EPLAN4/Pilz/PNOZ1002

PNOZ m1p
Using connection points

Configuration, page 1

- 3 E-STOPs
  - Switch type 3 (2 N/C)
  - Detection of shorts between contacts (A1.i0, A1.i2, A1.i4 - test pulse 0, A1.i1, A1.i3, A1.i5 - test pulse 1)
  - Automatic reset
- 2 connection point elements
  - Source connection point 1 and source connection point 2
- AND element
  - 3 inputs
- Output
  - Safety output, semiconductor type
  - Single-pole

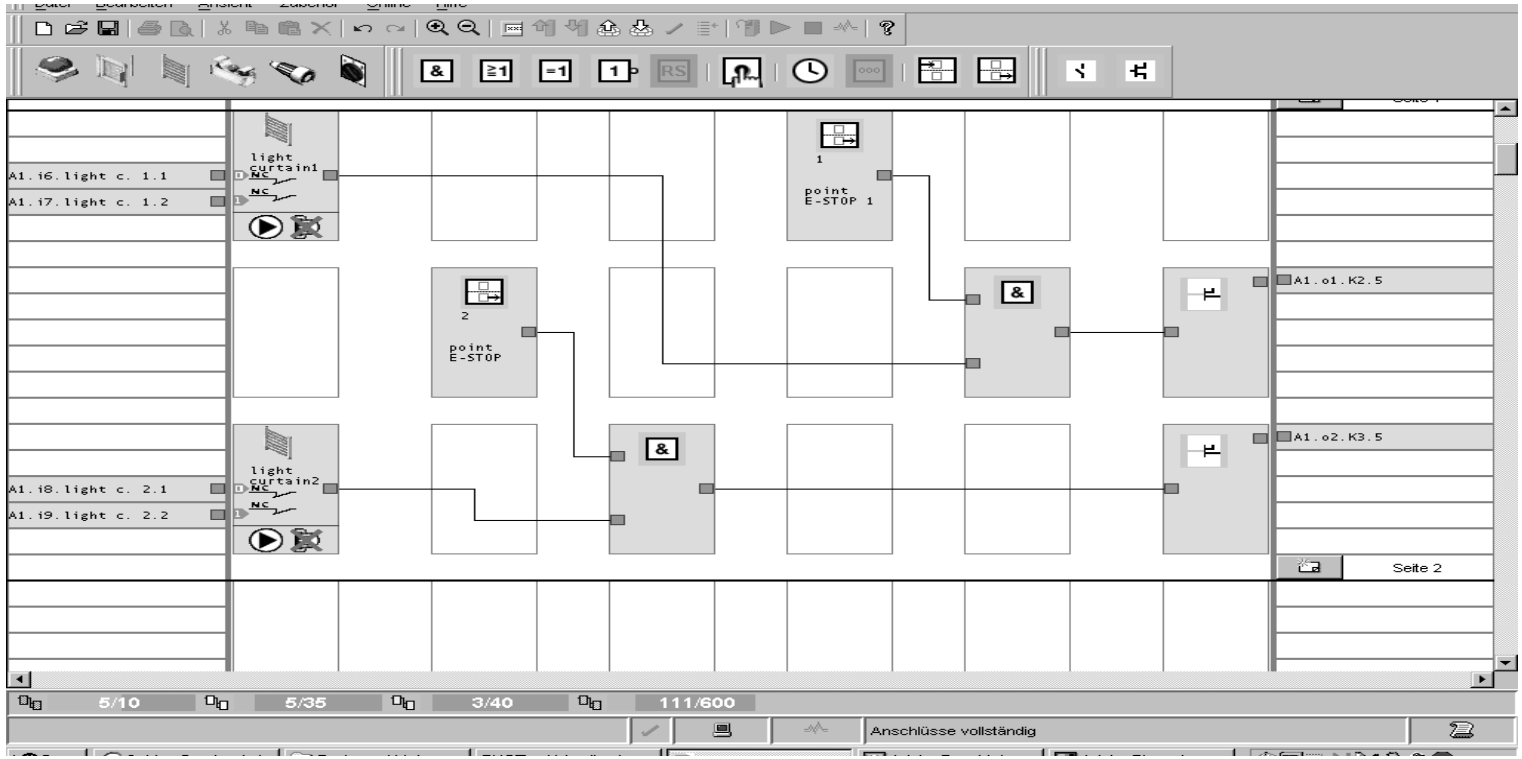
Continued overleaf

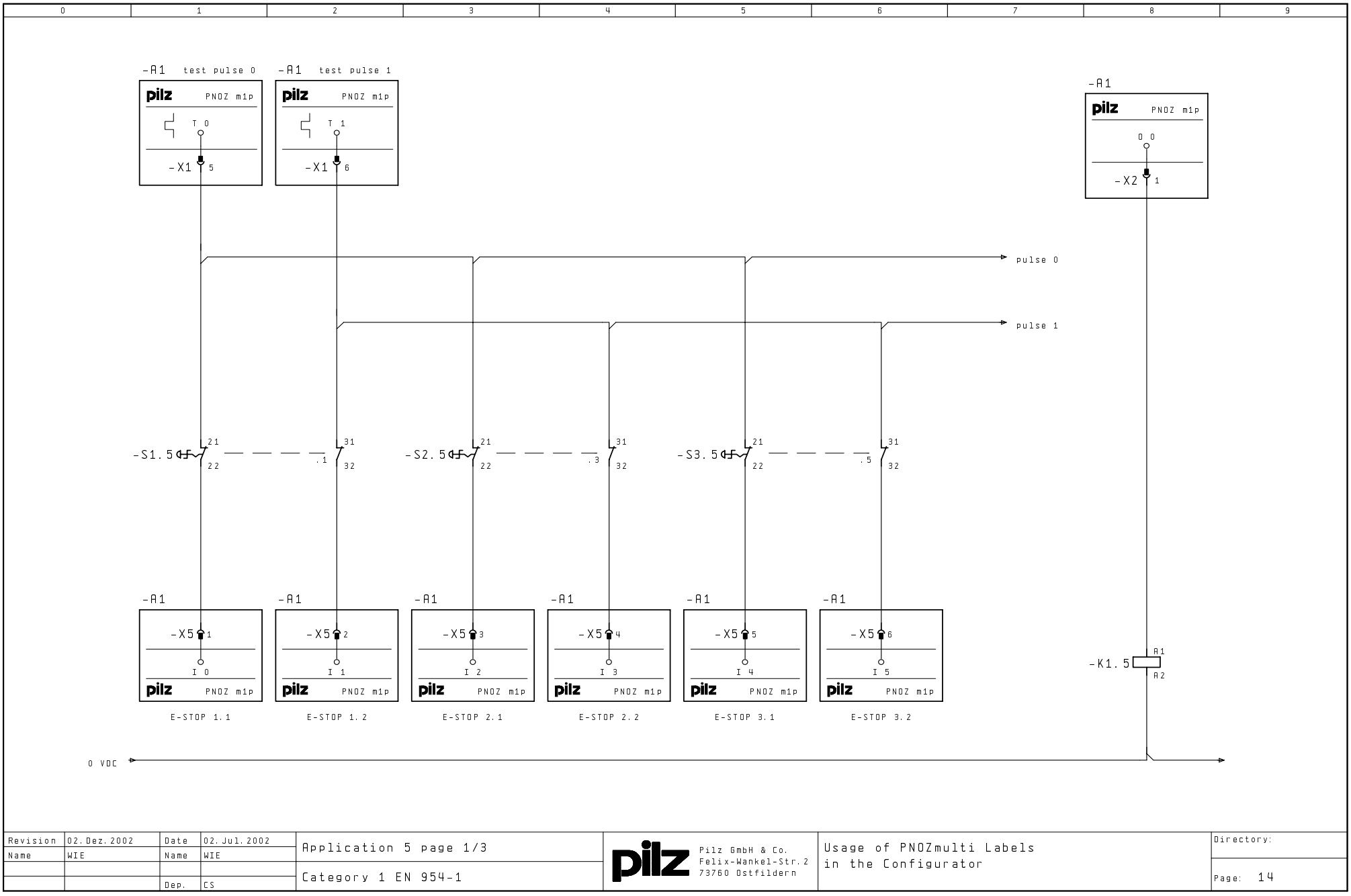


PNOZ m1p
Using connection points

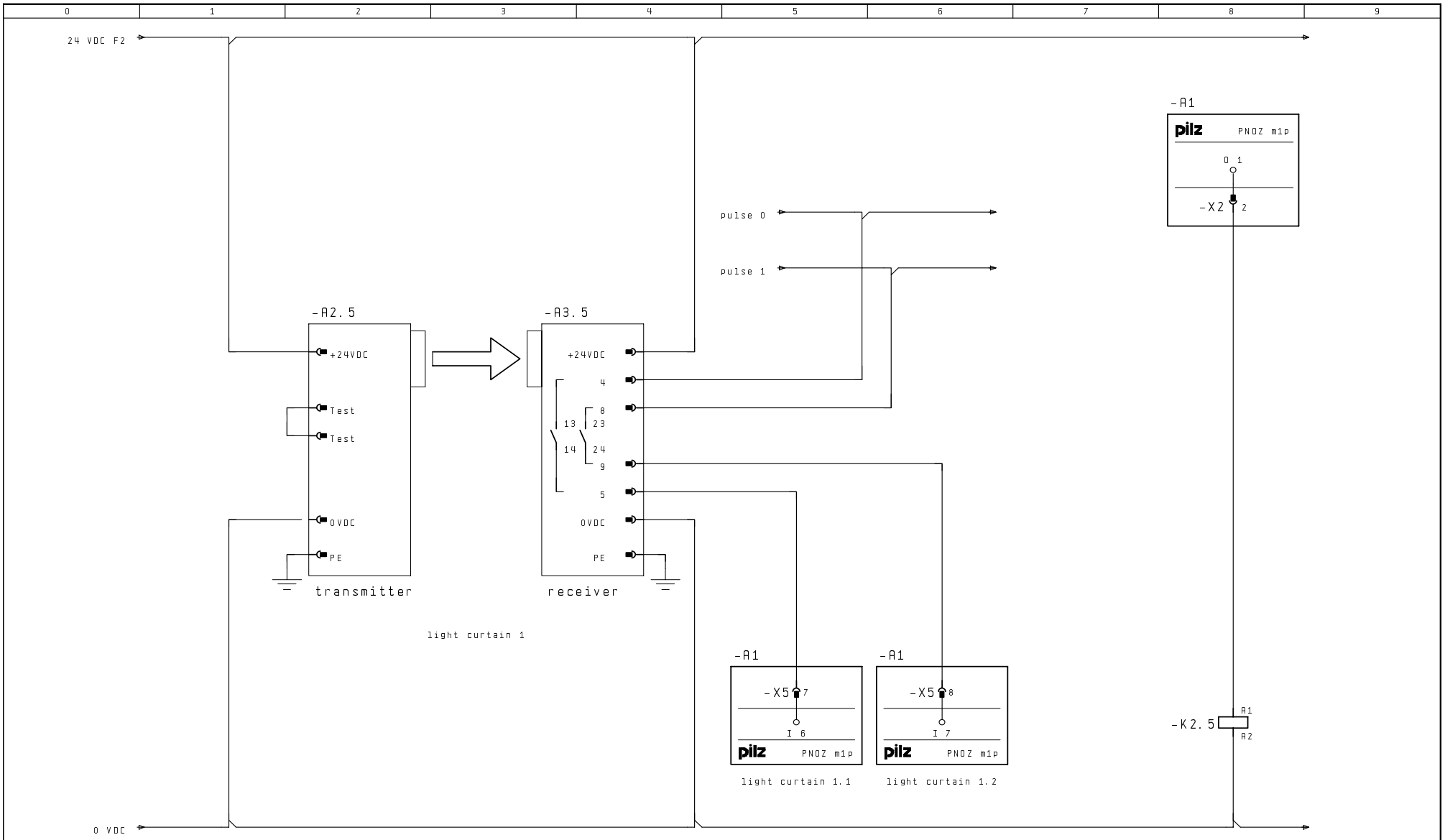
Configuration, page 2

- 2 light guards
  - Switch type 3 (2 N/C)
  - Detection of shorts between contacts (A1.i6, A1.i8 - test pulse 0, A1.i7, A1.i9 - test pulse 1)
  - Automatic reset
- 2 connection point elements
  - Destination connection point 1 and destination connection point 2
- 2 AND elements
  - 2 inputs
- 2 outputs
  - Safety output, semiconductor type
  - Single-pole

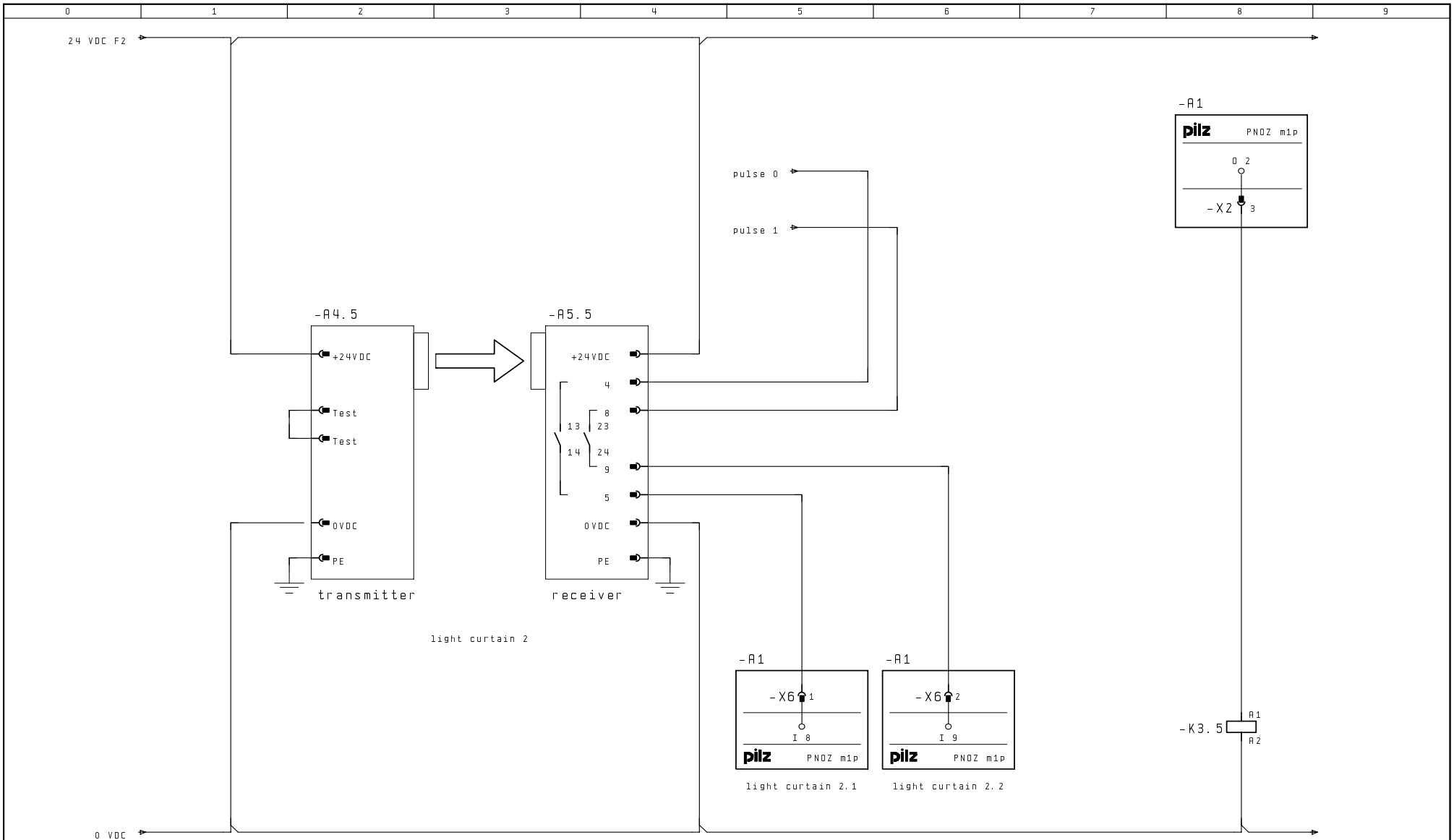




Revision	02. Dez. 2002	Date	02. Jul. 2002	Application 5 page 1/3	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	Usage of PNOZmulti Labels in the Configurator	Directory:
Name	WIE	Name	WIE	Category 1 EN 954-1			Page: 14
		Dep.	CS				



Revision	11. Feb. 2003	Date	02. Jul. 2002	Application 5 page 2/3	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	Usage of PNOZmulti Labels	Directory:
Name	WIE	Name	WIE				
				Category 1 EN 954-1			Page: 15
		Dep.	CS				



Revision	03. Dez. 2002	Date	02. Jul. 2002	Application 5 page 3/3	Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	Usage of Labels
Name	WIE	Name	WIE			
				Category 1 EN 954-1		
		Dep.	CS			

Directory:

Page: 16

PNOZ m1p

E-STOP and light guard, Category 4, EN 954-1

Features

- 1 E-STOP button
- 1 light guard
- Dual-channel with detection of shorts across contacts
- 1 PLC enabling signal
- 1 instantaneous controller enable
- 1 delayed load shutdown

Description

A light guard is used to protect a hazardous area. The machine's motor will only be switched on if:

- The light guard is not interrupted and
- The E-STOP button has not been operated.

If these safety conditions are met, a pulse (not safety-related) at the enable input will start the motor and the controller will be enabled. If the light guard is interrupted or the E-STOP button is operated, the signal at outputs A1.o0, A1.o4 and A1.o5 will switch from high to low. The controller enable will be interrupted and the motor will switch off after a delay of 0.5 s.

Feedback loop

The N/C contacts KM1.2 and KM2.2 on contactors KM1.2 and KM2.2 are connected to the feedback loop input A1.i8.

Reset

If the conditions for starting the motor have been met and the feedback loop is closed, the PLC enabling pulse must be sent. This pulse (monitored reset) enables plant operation.

Safety assessment

- The PNOZ m1p and contactors KM1.2 and KM2.2 must be installed in a single location.
- If a switch contact (A1.i0 ... A1.i3) is overridden, this will be detected as an error at the next operation. Safety outputs A1.o4 and A1.o5 will carry a low signal.
- A short circuit between 24 VDC and inputs A1.i0 ... A1.i3 will be detected as an error. All the safety outputs will carry a low signal.
- A short circuit between 24 VDC and a safety output will be detected and all the safety outputs will carry a low signal.

Pilz units

Number	Type	Features	Order number
1	PNOZ m1p	24 VDC	773 100

Drawing file:

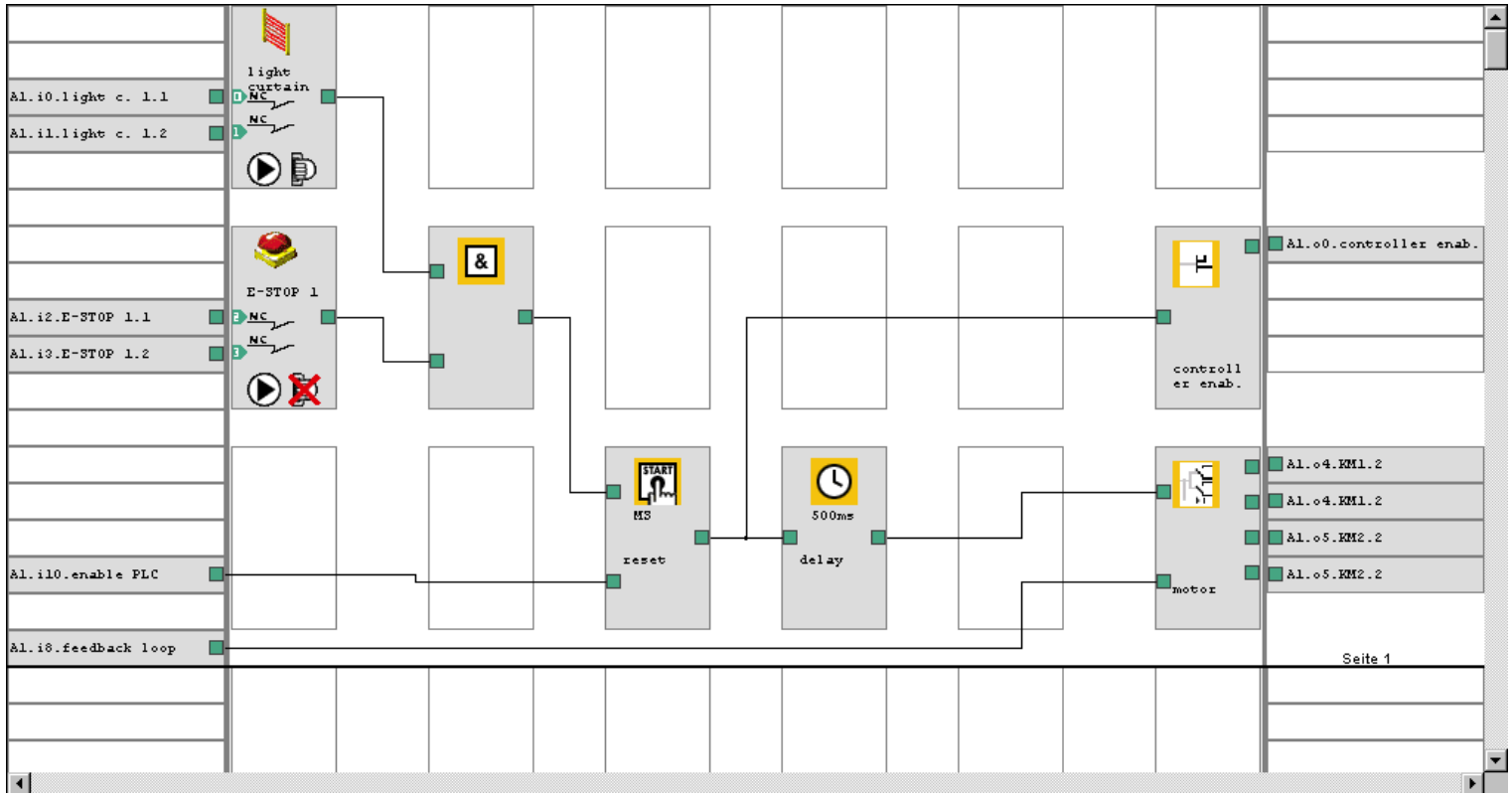
Page 7 ... 9 in the project EPLAN4/Pilz/PNOZ1002

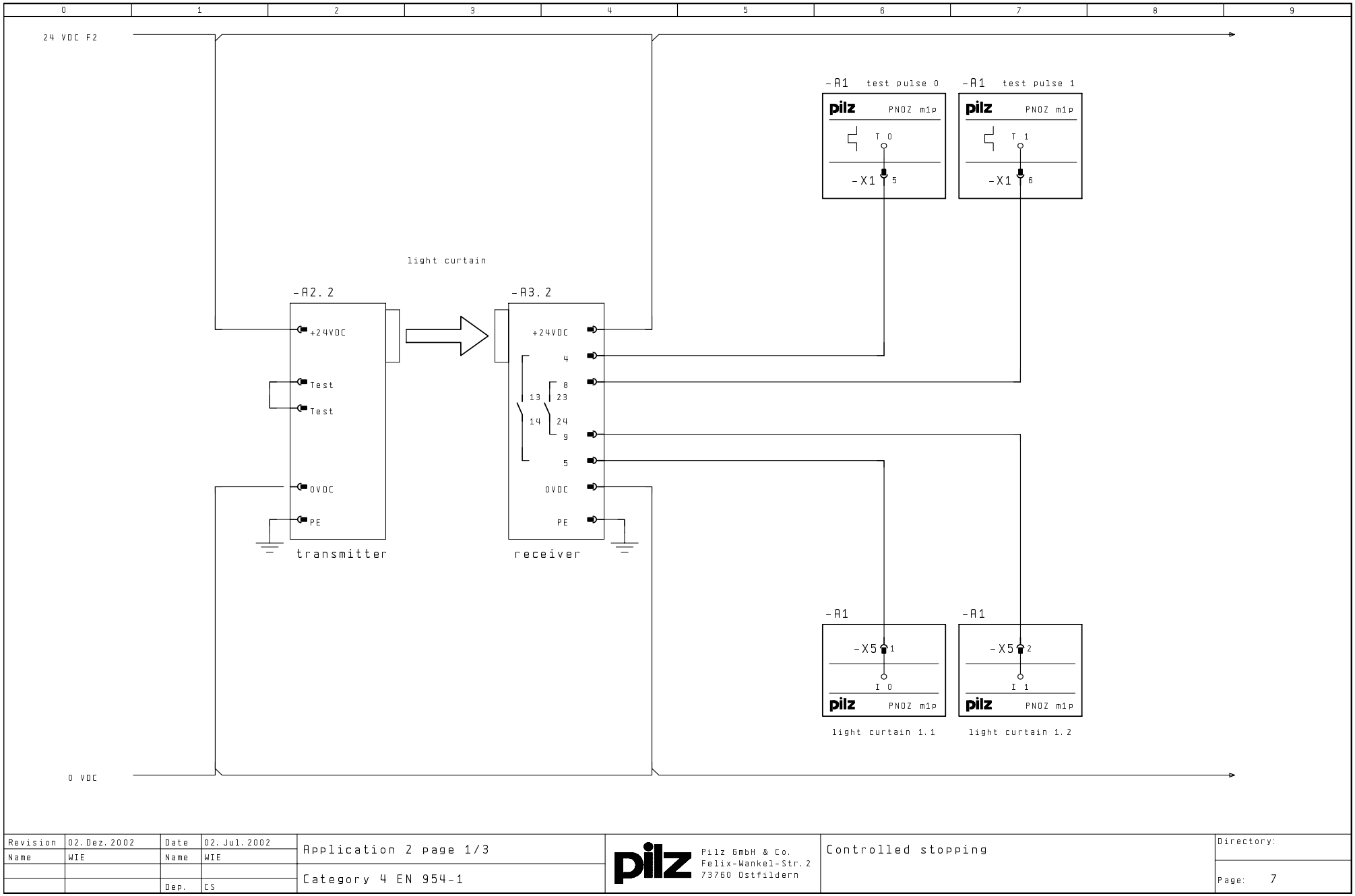
PNOZ m1p

E-STOP and light guard, Category 4, EN 954-1

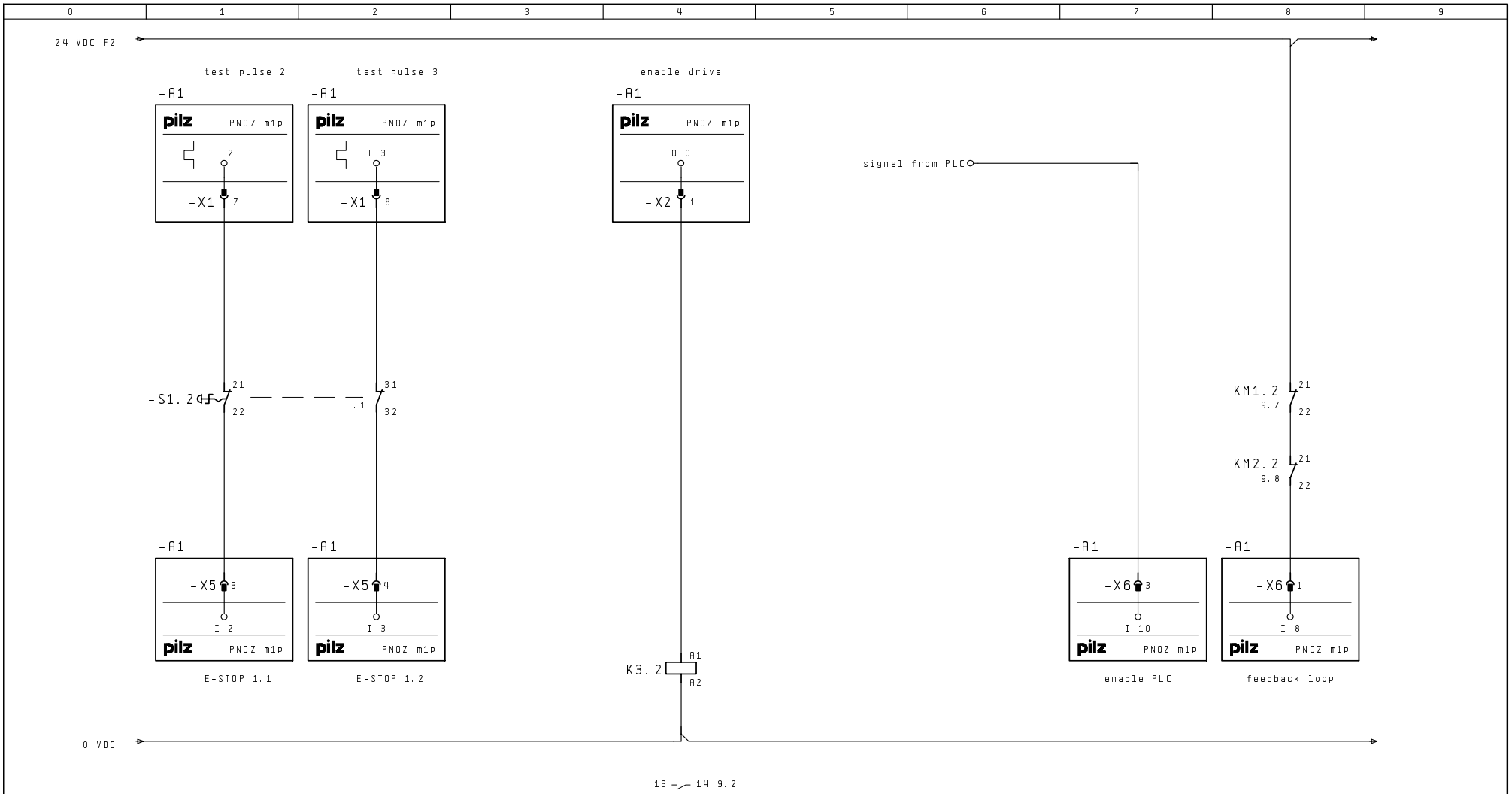
Configuration

- Light guard
  - Switch type 3 (2 N/C)
  - Detection of shorts between contacts (A1.i0 - test pulse 0, A1.i1 - test pulse 1)
  - Automatic reset
  - Start-up test
- E-STOP
  - Switch type 3 (2 N/C)
  - Detection of shorts between contacts (A1.i2 - test pulse 2, A1.i3 - test pulse 3)
  - Automatic reset
- AND element
  - 2 inputs
- Reset element
  - Monitored reset
- Delay element
  - 500 ms
- Motor output
  - Safety output, relay type
  - Redundant
  - Use feedback loop
- Controller enable output
  - Safety output, semiconductor type
  - Single-pole

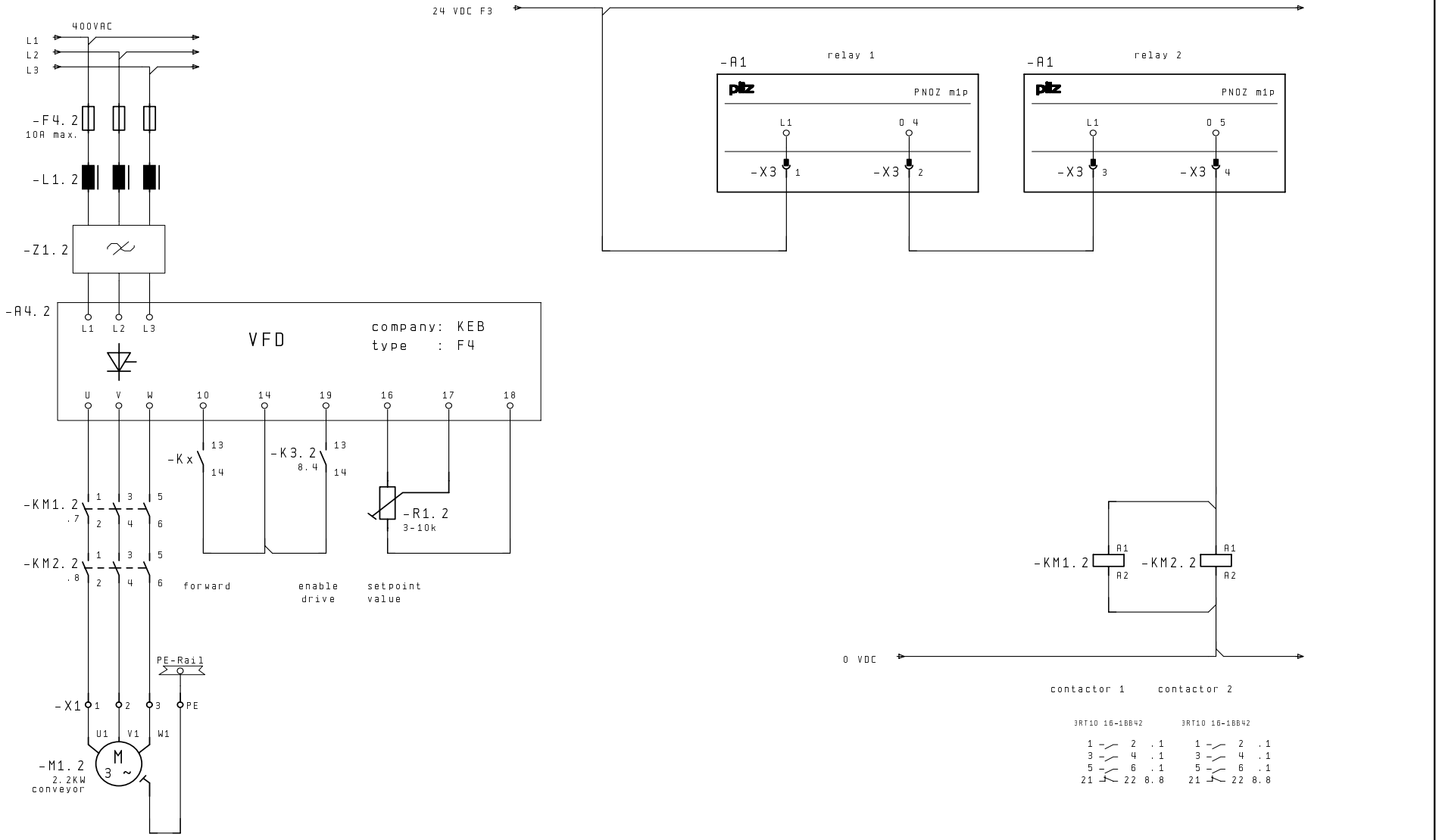




Revision	02. Dez. 2002	Date	02. Jul. 2002	Application 2 page 1/3	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	Controlled stopping	Directory:
Name	WIE	Name	WIE	Category 4 EN 954-1			Page: 7
		Dep.	CS				



Revision	11. Feb. 2003	Date	02. Jul. 2002	Application 2 page 2/3	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	Controlled stopping	Directory:
Name	WIE	Name	WIE				
				Category 4 EN 954-1			Page: 8
		Dep.	CS				



Revision	02. Dez. 2002	Date	02. Jul. 2002	Application 2 page 3/3	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	Controlled stopping	Directory:
Name	WIE	Name	WIE				
				Category 4 EN 954-1			Page: 9
		Dep.	CS				

PNOZ m1p

Two-hand with override, Category 4, EN 954-1

Features

- 1 operating mode selector switch
- 1 E-STOP button
- 2 two-hand controls
- Dual-channel with detection of shorts across contacts
- 1 instantaneous load shutdown

Description
A machine can be operated by one or two people. The machine is enabled via two-hand buttons.
The machine's motor is switched on if:

- The E-STOP button has not been operated and
- The operating mode selector switch is in position "0" and both two-hand buttons are operated or
  the operating mode selector switch is in position "1" and two-hand button 2 is operated.

If one of these conditions is not met, the signal at output A1.o0 will switch from high to low and the motor will be switched off. The status of the operating mode selector switch is signalled at outputs A1.o1 and A1.o3.

Feedback loop
The N/C contacts KM1.3 and KM2.3 on contactors KM1.3 and KM2.3 are connected to the feedback loop input A1.i11.

Reset
E-STOP monitoring must be activated through the reset button S6.3 (manual reset). If the conditions for starting the motor have been met and the feedback loop is closed, operation of the plant is enabled.

Safety assessment

- If a switch contact (A1.i0 ... A1.i14) is overridden, this will be detected as an error at the next operation. Safety outputs A1.o0 and A1.o2 will carry a low signal.
- A short circuit between 24 VDC and inputs A1.i0, A1.i1, A1.i3 ... A1.i10 will be detected as an error. The safety outputs will carry a low signal.
- A short circuit between 24 VDC and the reset input A1.i12 will be detected.
- A short circuit between 24 VDC and the override input A1.i13 or A1.i14 will be detected.
- A short circuit between 24 VDC and a safety output will be detected and the safety outputs will carry a low signal.
- It must be possible to protect the operating mode selector switch from unauthorised operation.

Pilz units

Number	Type	Features	Order number
1	PNOZ m1p	24 VDC	773 100

Drawing file:

Page 10 and 11 in the project EPLAN4/Pilz/PNOZ1002

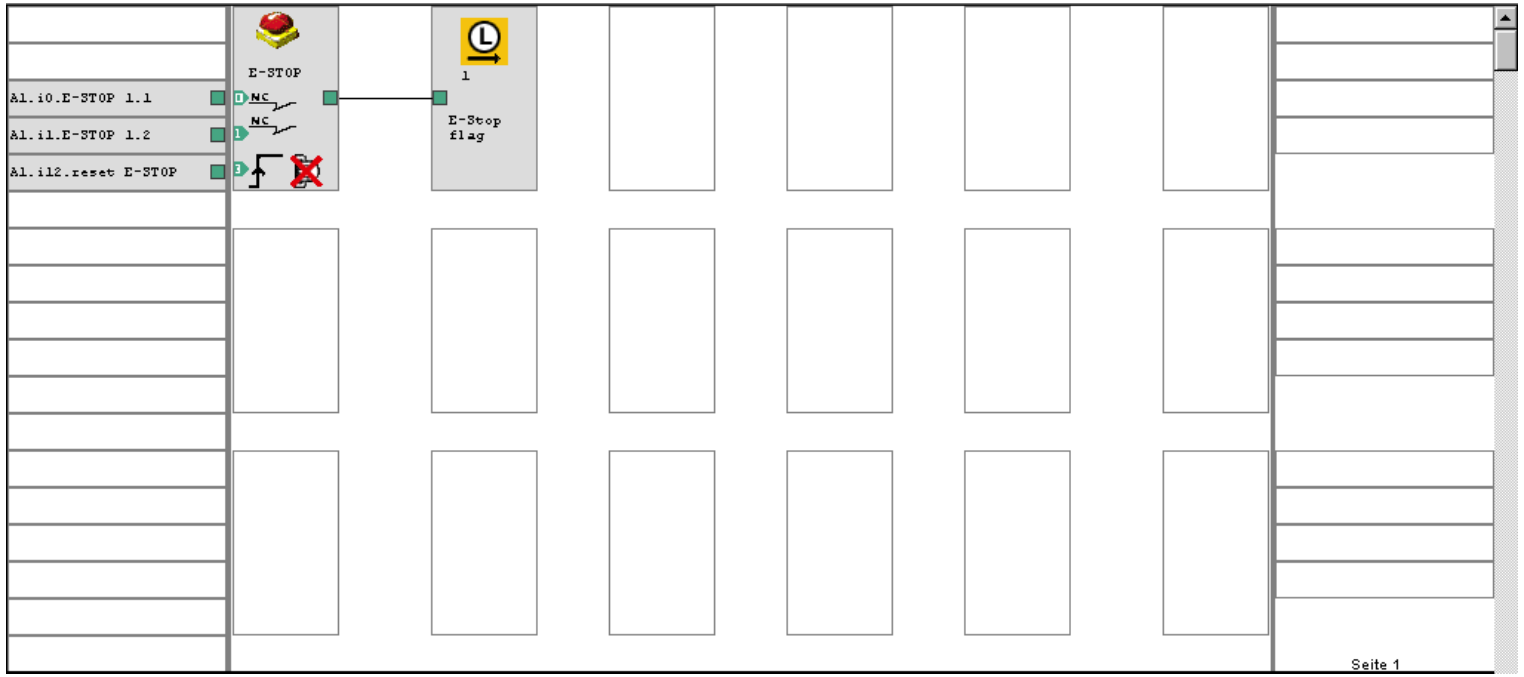
PNOZ m1p

Two-hand with override, Category 4, EN 954-1

Configuration, page 1

- E-STOP
  - Switch type 3 (2 N/C)
  - Detection of shorts between contacts (A1.i0 - test pulse 0, A1.i1 - test pulse 1)
  - Manual reset (A1.i12 - test pulse 3)
- Flag element
  - Flag input 1

Continued overleaf

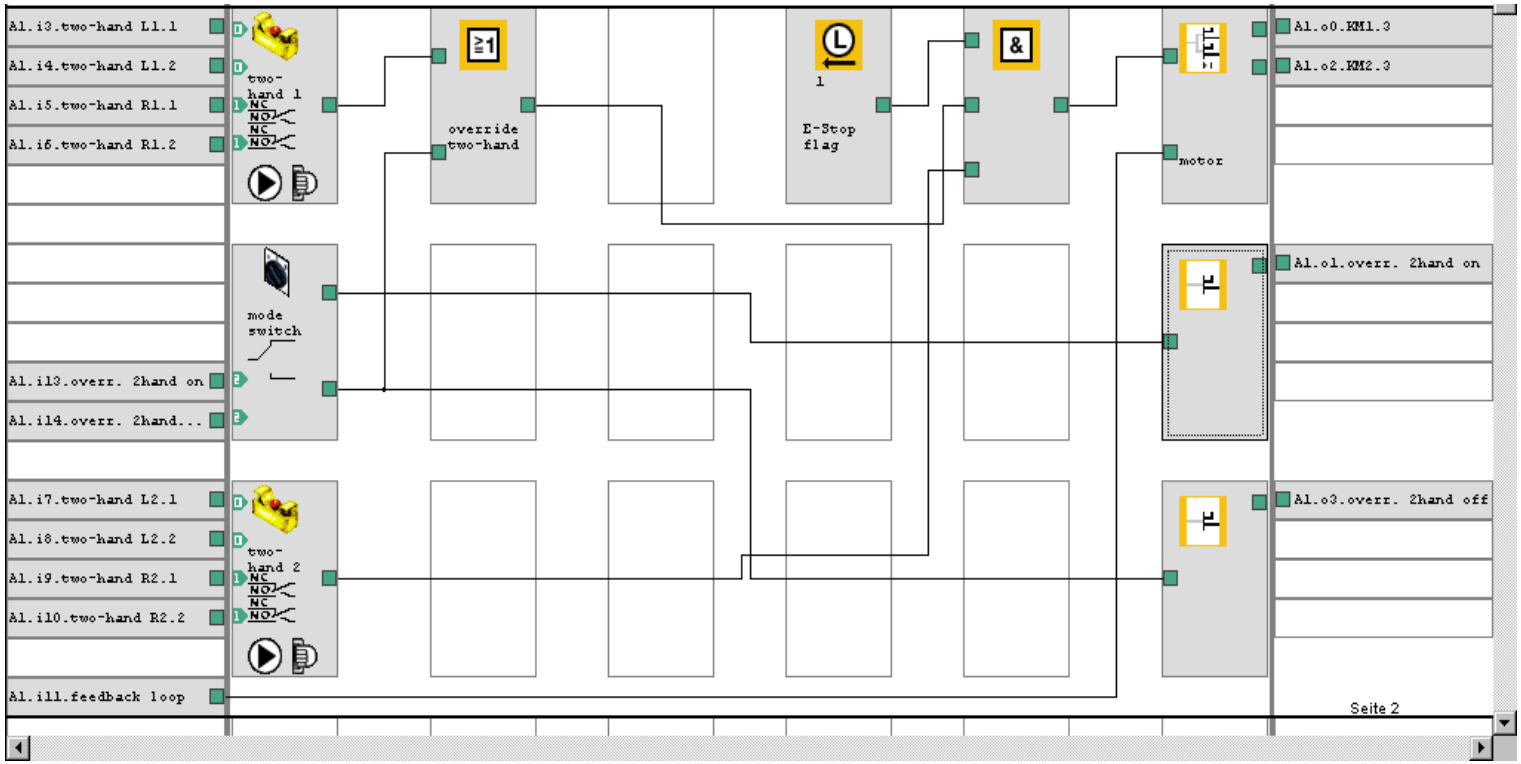


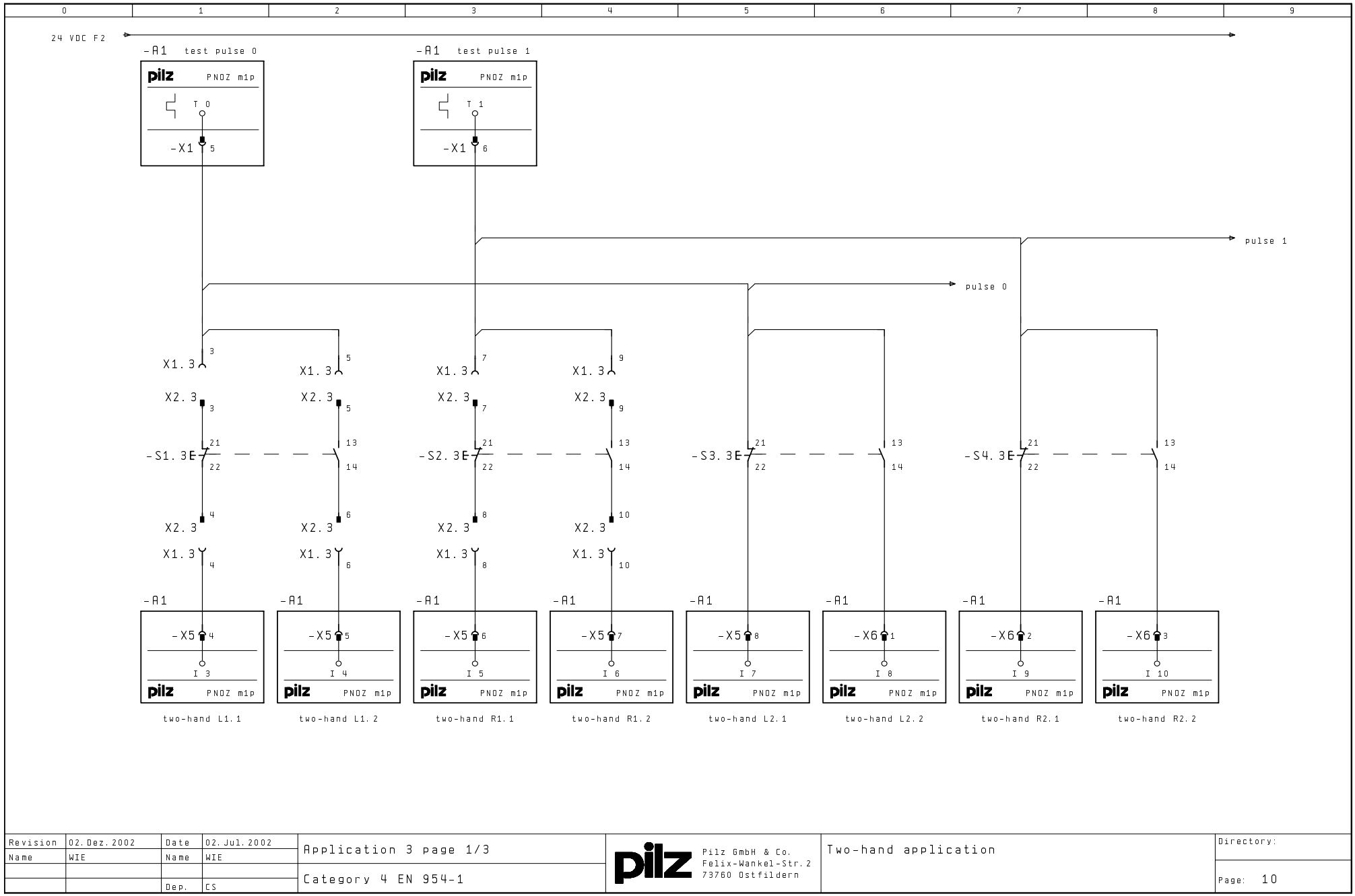
PNOZ m1p

Two-hand with override, Category 4, EN 954-1

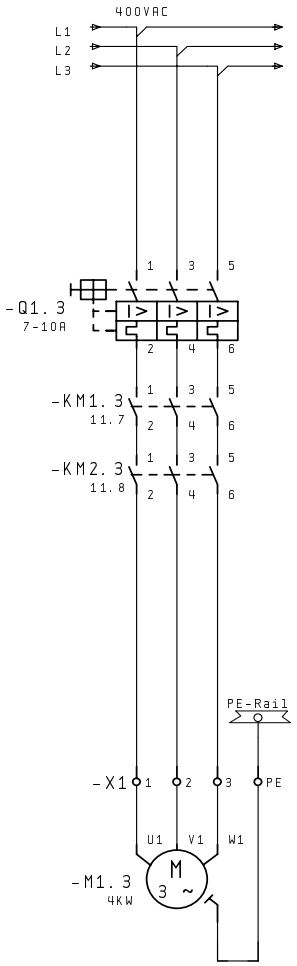
Configuration, page 2

- Two-hand buttons
  - Switch type 6 (N/O - N/C)
  - Detection of shorts between contacts (A1.i3, A1.i4 and A1.i7, A1.i8 - test pulse 0
    A1.i5, A1.i6 and A1.i9, A1.i10 - test pulse 1)
- Operating mode selector switch
  - Switch type 9
  - Detection of shorts between contacts (A1.i13, A1.i14 - test pulse 2)
- Flag element
  - Flag output 1
- OR element
  - 2 inputs
- AND element
  - 3 inputs
- Motor output
  - Safety output, semiconductor type
  - Redundant
  - Use feedback loop
- Two-hand on output
  - Safety output, semiconductor type
  - Single-pole
- Two-hand off output
  - Safety output, semiconductor type
  - Single-pole





Revision	02. Dez. 2002	Date	02. Jul. 2002	Application 3 page 1/3	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	Two-hand application	Directory:
Name	WIE	Name	WIE	Category 4 EN 954-1			Page: 10
		Dep.	CS				



motor 1

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Name	WIE	Name	WIE				
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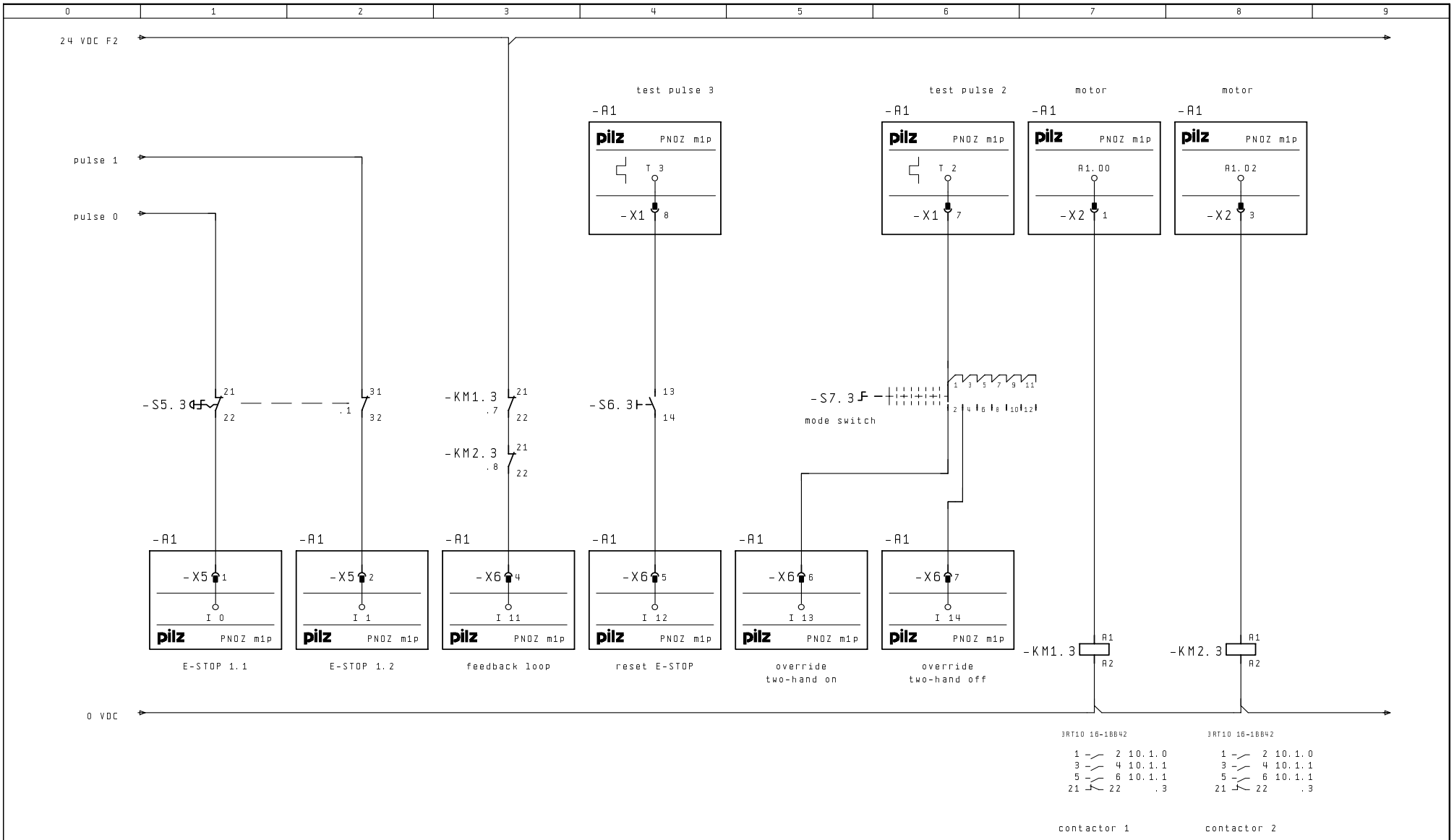

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				Category 4 EN 954-1		Page: 11
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DRAFT!

PNOZ m1p
Muting, Category 4, EN 954-1

Features

- 1 light guard
- 4 muting sensors for parallel muting
- Monitored muting lamp
- Button for overriding the muting area
- 1 instantaneous load shutdown

Description
Muting mode enables the safety function (light guard) to be suspended temporarily, in order to insert workpieces, for example. In normal mode, the drive is enabled when the light guard is clear. The "enable motor" connection point is set and the motor can be started via input i11. The muting sensors enable the light guard function to be suspended. The muting sensors (N/O) supply a low signal in an unoperated condition. In muting mode, a high signal is present at the muting sensor outputs. This means that the motor is enabled, despite the light barrier being interrupted. The time element "max. muting time" is started simultaneously (set time: 30 s). Once the set time has elapsed, the enable is reset via the "enable motor" connection point. Muting mode can be restarted for another 30 s by pressing the button "continue run_NO" at input i8.
Muting mode is displayed via a monitored lamp. The lamp is switched on as soon as the "muting active" connection point is set. The lamp's outputs are monitored via the inputs i0 and i1. If the lamp is defective, a low signal will be present on at least one of the two inputs. The "motor stop" connection point is set and the motor is stopped. The "100 ms" time element bridges the lamp's switch-on time.

Feedback loop
The N/C contacts K1.1 and K1.2 on contactors K1.1 and K1.2 are connected to the feedback loop input i10. The lamp's N/C contacts are connected to the feedback loop i0 and i1.

Reset
If the conditions for starting the motor have been met and the feedback loops are closed, operation of the plant is enabled (automatic reset).

Safety assessment
- If a switch contact (A10.i0 ... A10.i10 and A10.i13, A1.i14) is overridden, this will be detected as an error at the next operation. Safety outputs A10.o1 and A10.o2 will carry a low signal.
- A short circuit between 24 VDC and inputs A10.i6 and A10.i7 will be detected as an error by the light guard. The safety outputs will carry a low signal.
- A short circuit between the inputs A10.i6 and A10.i7 will be detected as an error by the light guard. The safety outputs will carry a low signal.
- A short between 24 VDC and the feedback loop input A10.i0 or A10.i1 will be detected as an error at the next operation.
- A short circuit between 24 VDC and a safety output will be detected and the safety outputs will carry a low signal.

Pilz units

Number	Type	Features	Order number
1	PNOZ m1p	24 VDC	773 100

Drawing file:

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PNOZ m1p

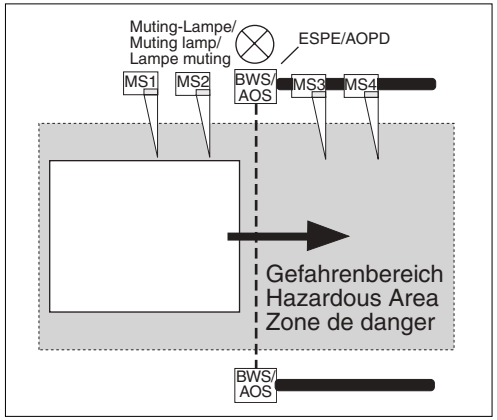
Muting, Category 4, EN 954-1

DRAFT!

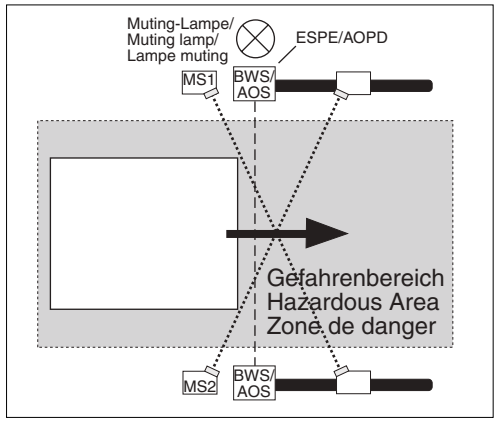
Examples for the muting sensor arrangement

The example can be used for parallel and sequential muting. Muting sensors MS3 and MS4 must be arranged in such a way that they energise while MS1 and MS2 are still active. Sensors MS1 and MS2 may not become inactive until MS3 and MS4 are active.

Sequential muting with 4 muting sensors:



Parallel muting with 2 muting sensors:



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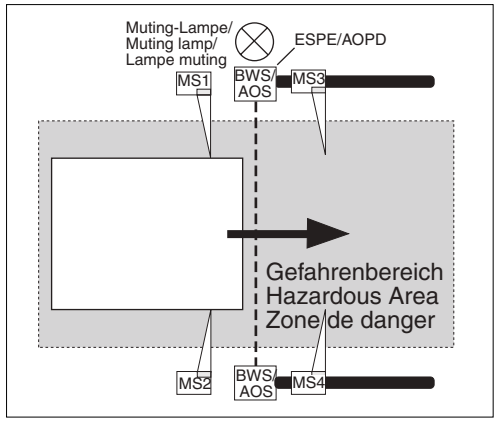

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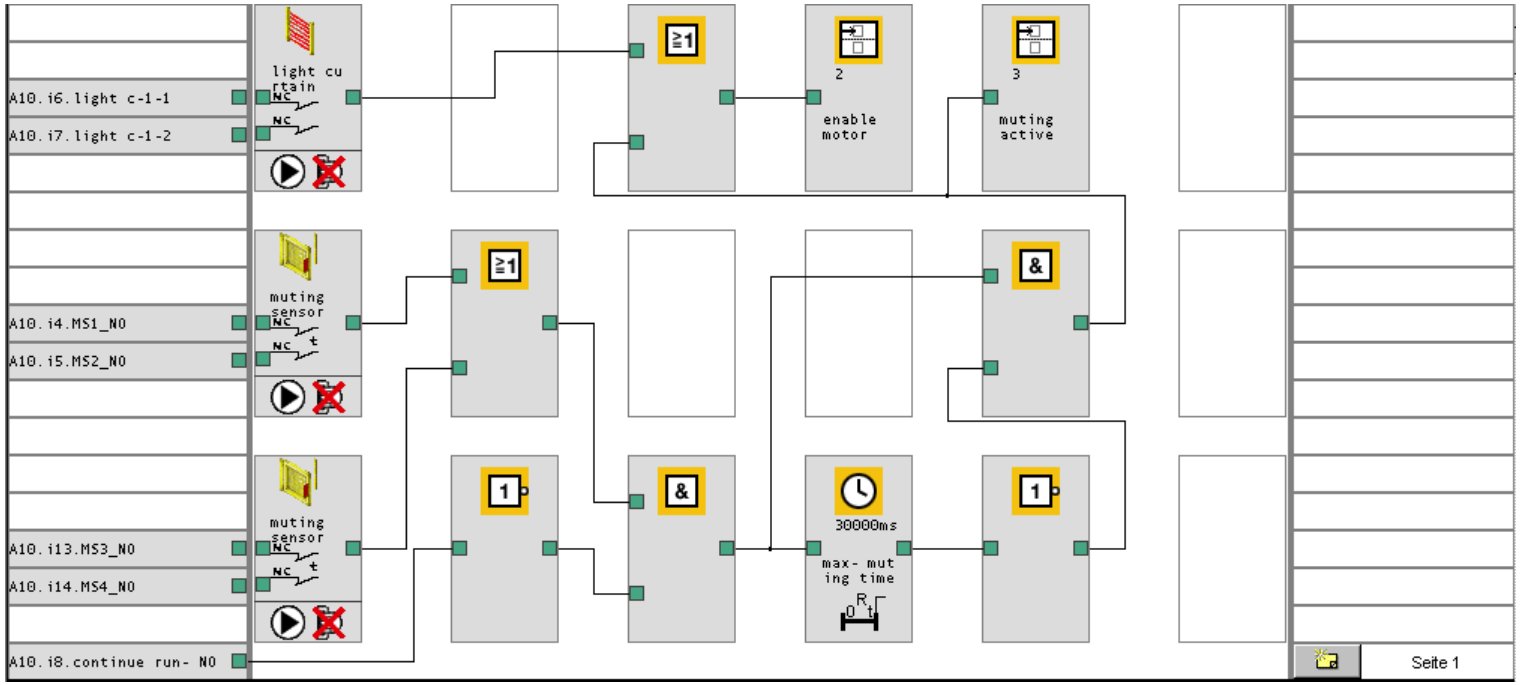
PNOZ m1p

Muting, Category 4, EN 954-1

Configuration, page 1

- Light guard
  - Switch type 3 (N/C - N/C)
  - Automatic reset
- Muting sensors
  - Connect N/O / N/O combination to switch type 3
  - Simultaneity: 3 s
  - Automatic reset
- Flag element
  - Flag input 2
  - Flag input 3
- OR elements
  - 2 inputs
- AND elements
  - 2 inputs
- Time element
  - Switch-on delay
  - 30 s
- Negation elements
  - 1 input



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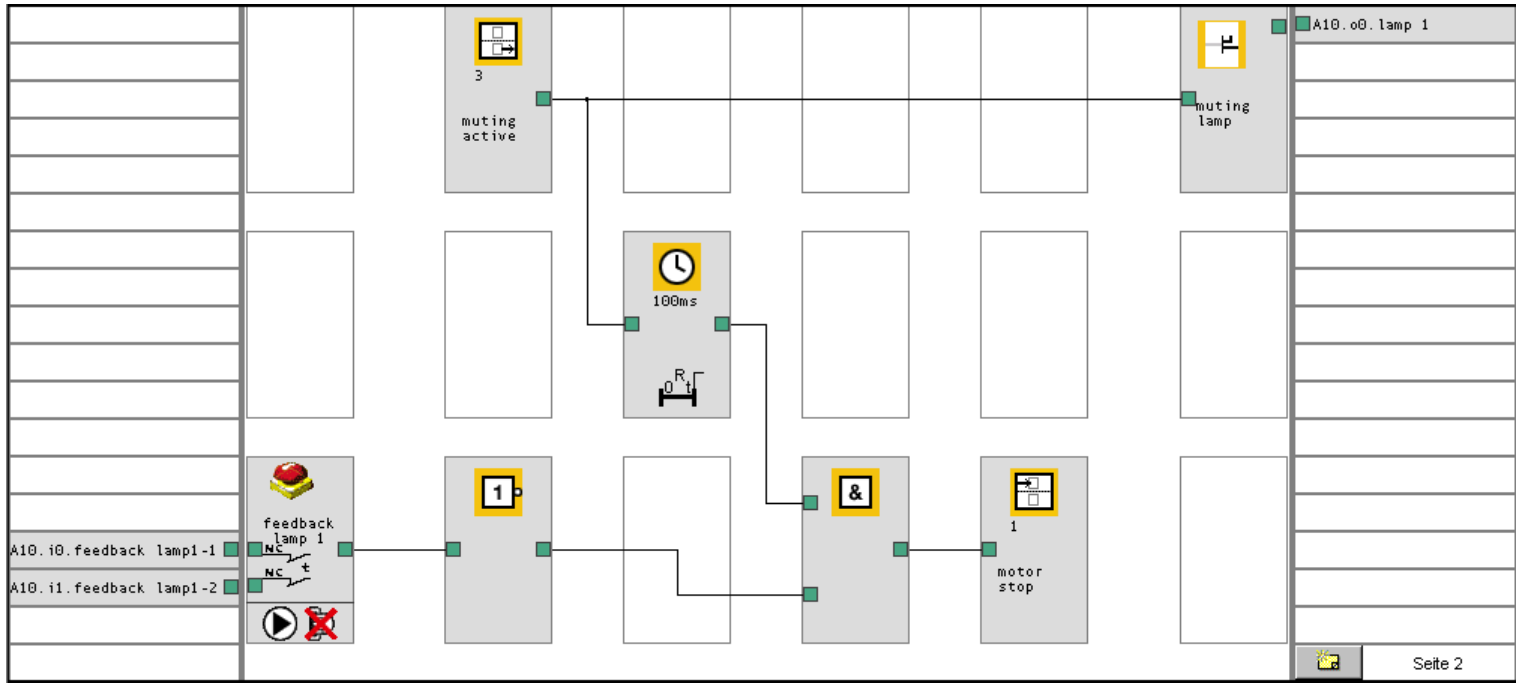
PNOZ m1p

Muting, Category 4, EN 954-1

Configuration, page 2

- E-STOP element
  - Switch type 3 (N/C - N/C) for monitoring the muting lamp
  - Simultaneity: 3 s
  - Automatic reset
- Flag elements
  - Flag output 3
  - Flag input 1
- AND element
  - 2 inputs
- Time element
  - Switch-on delay
  - 100 ms
- Negation element
  - 1 input
- Muting lamp output
  - Auxiliary output, semiconductor type

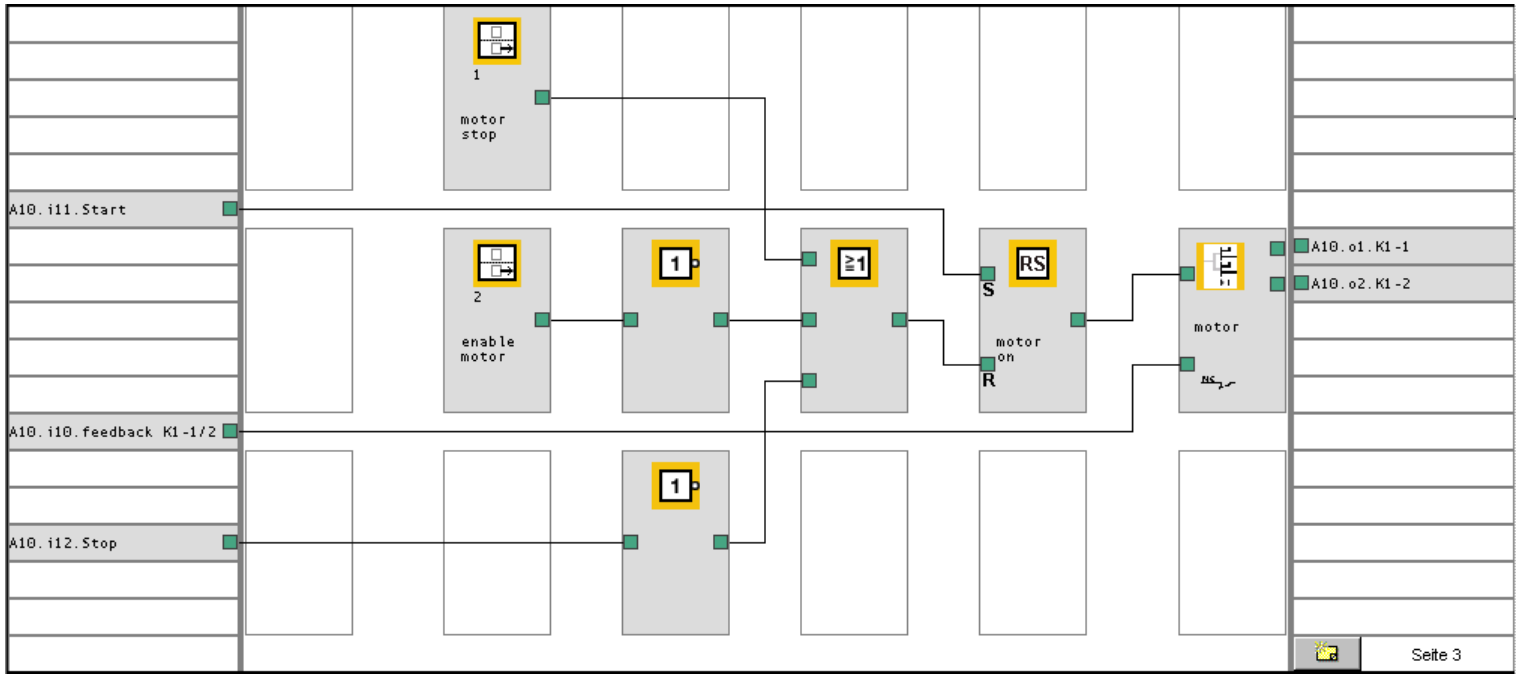


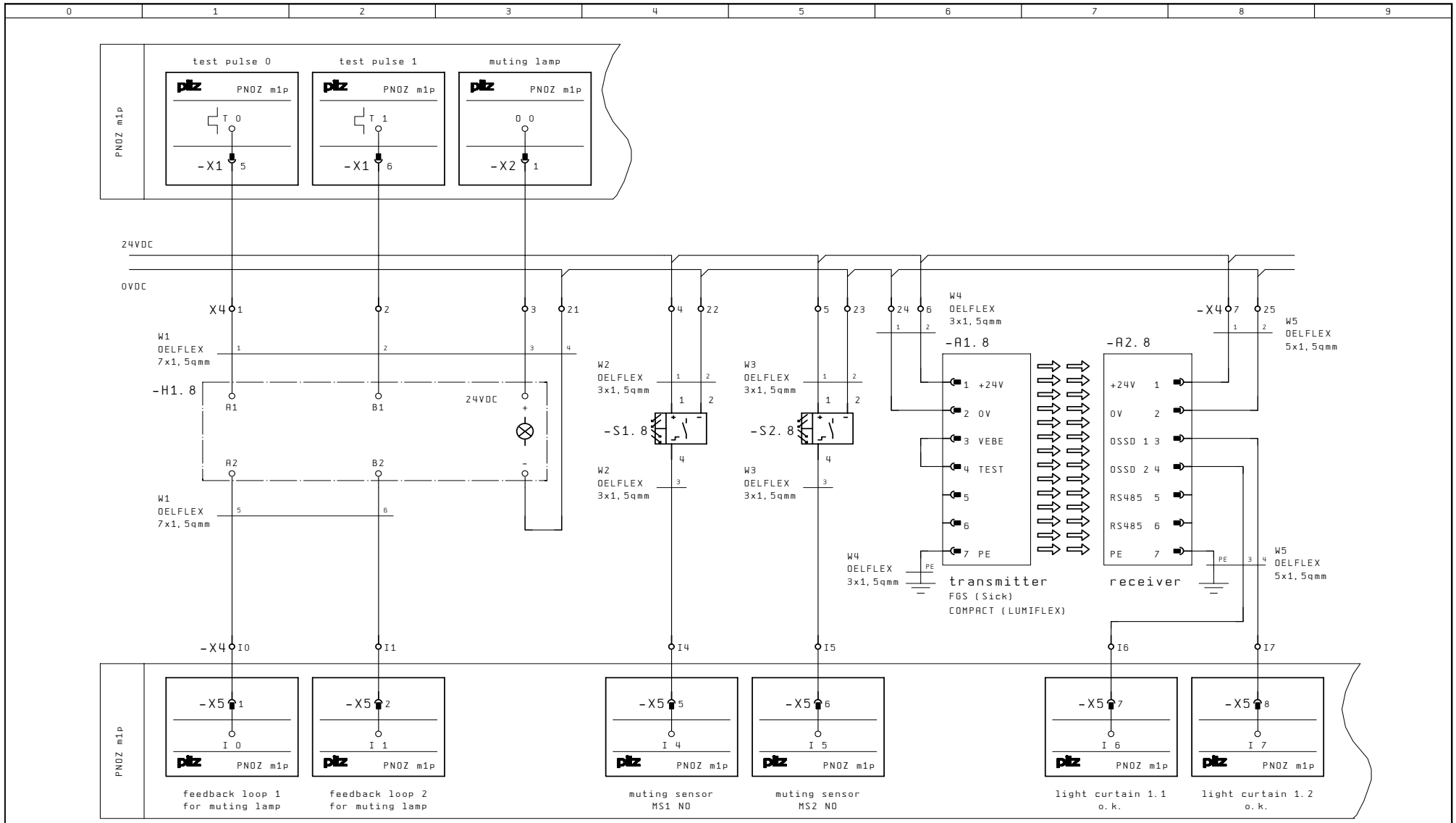
DRAFT!

PNOZ m1p
Muting, Category 4, EN 954-1

Configuration, page 3

- Flag elements
  - Flag output 1
  - Flag output 2
- OR element
  - 3 inputs
- RS-Flipflop element
  - 2 inputs
- Negation elements
  - 1 input
- Motor output
  - Safety output, relay type
  - Redundant
  - Use feedback loop





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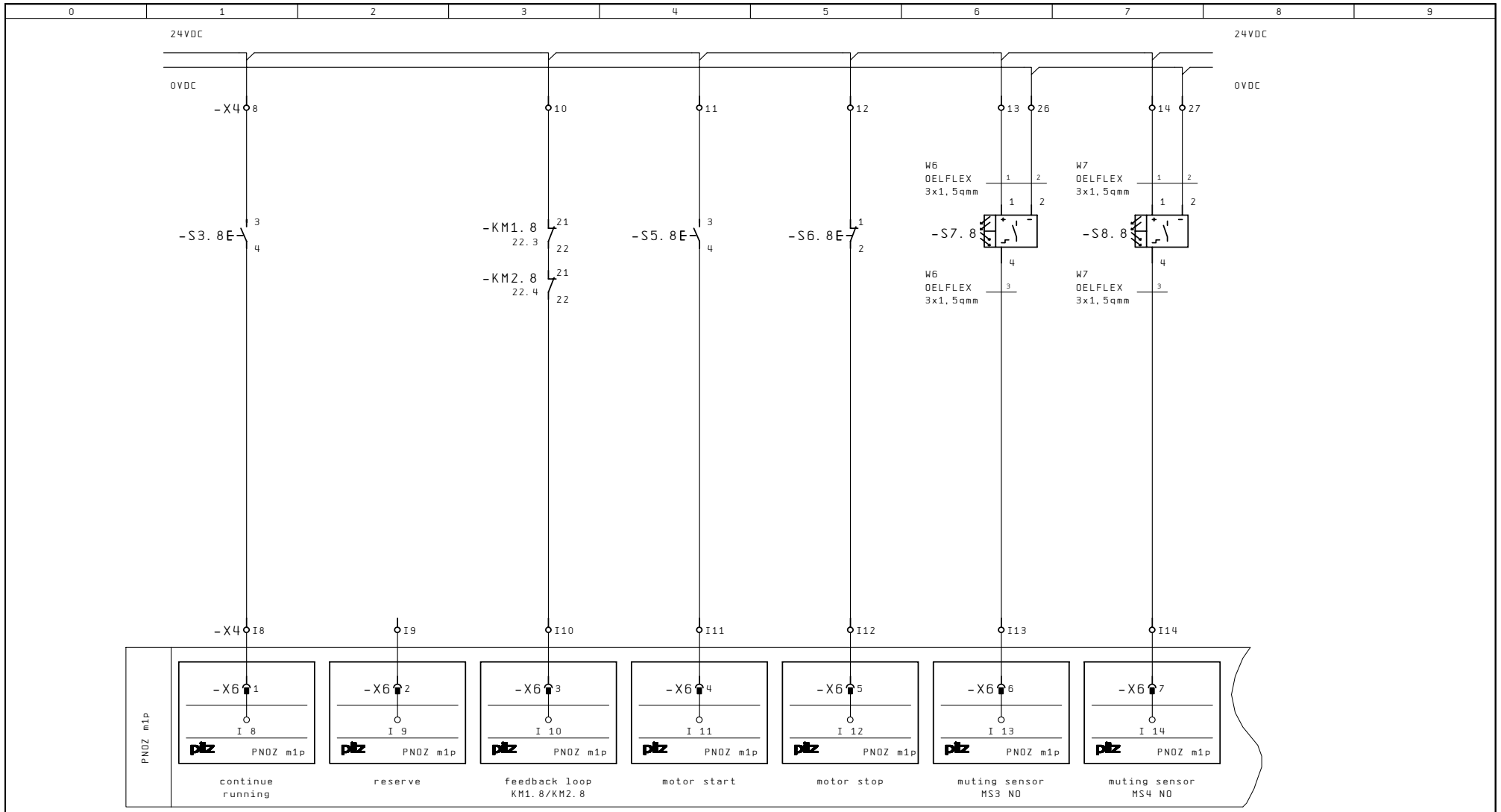

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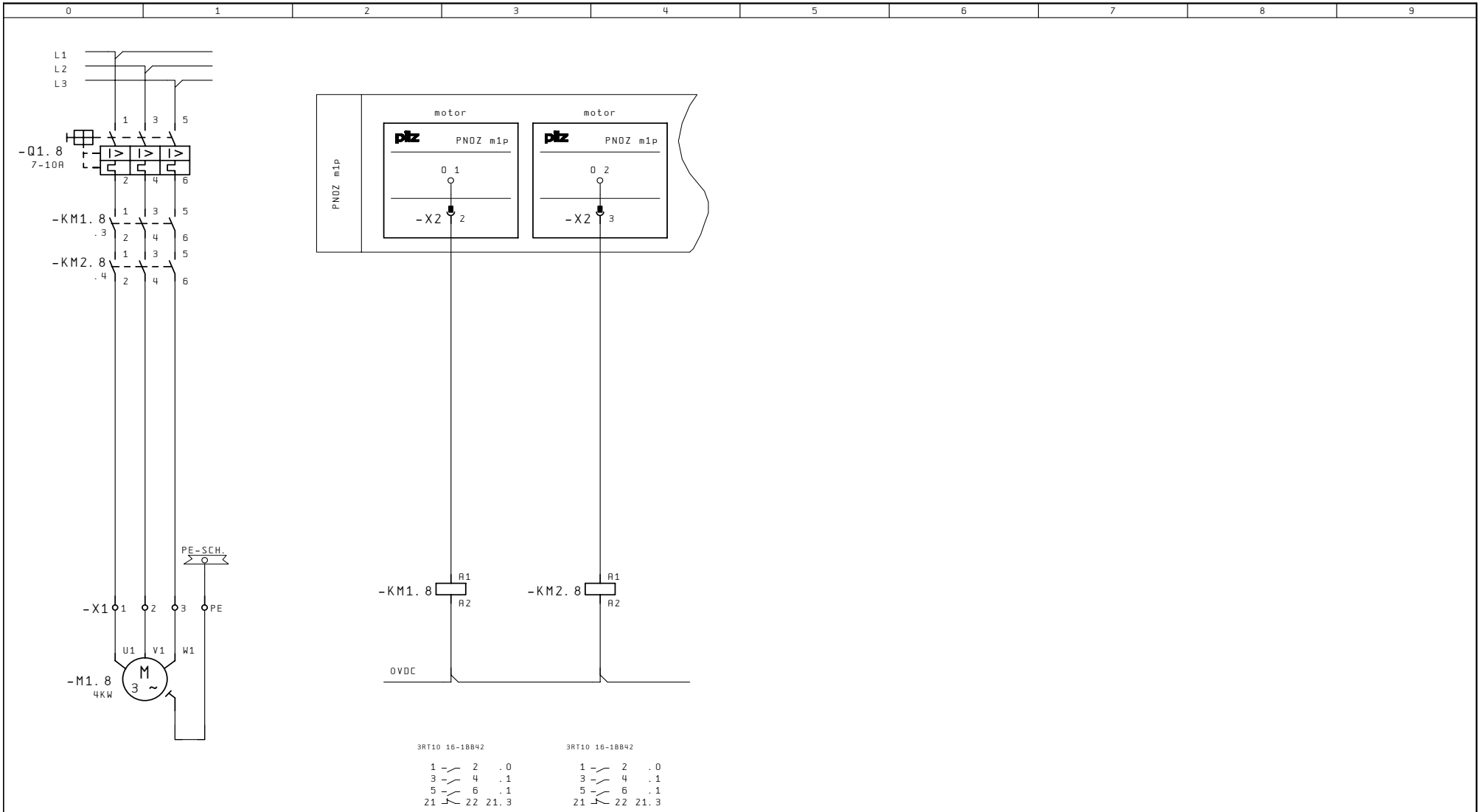

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PNOZ m1p

Star-delta start-up, Category B, EN 954-1

Features

- 1 reset module
- 2 logic connections
- 3 semiconductor outputs
- 1 instantaneous load shutdown
- 2 load shutdowns with a 5 s delay

Description

When the motor is switched on, after a 5 second delay it is possible to switch between a star and a delta connection. A high signal at input A1.i4 selects a star connection, a high signal at input A1.i5 selects a delta connection.

Feedback loop
The feedback loop is not used.

Reset
The PNOZ m1p is ready for operation once supply voltage is applied. If there is a high signal at input A1.i0, the application can be activated through a signal change from low to high at input A1.i1.

Pilz units

Number	Type	Features	Order number
1	PNOZ m1p	24 VDC	773 100

Drawing file:

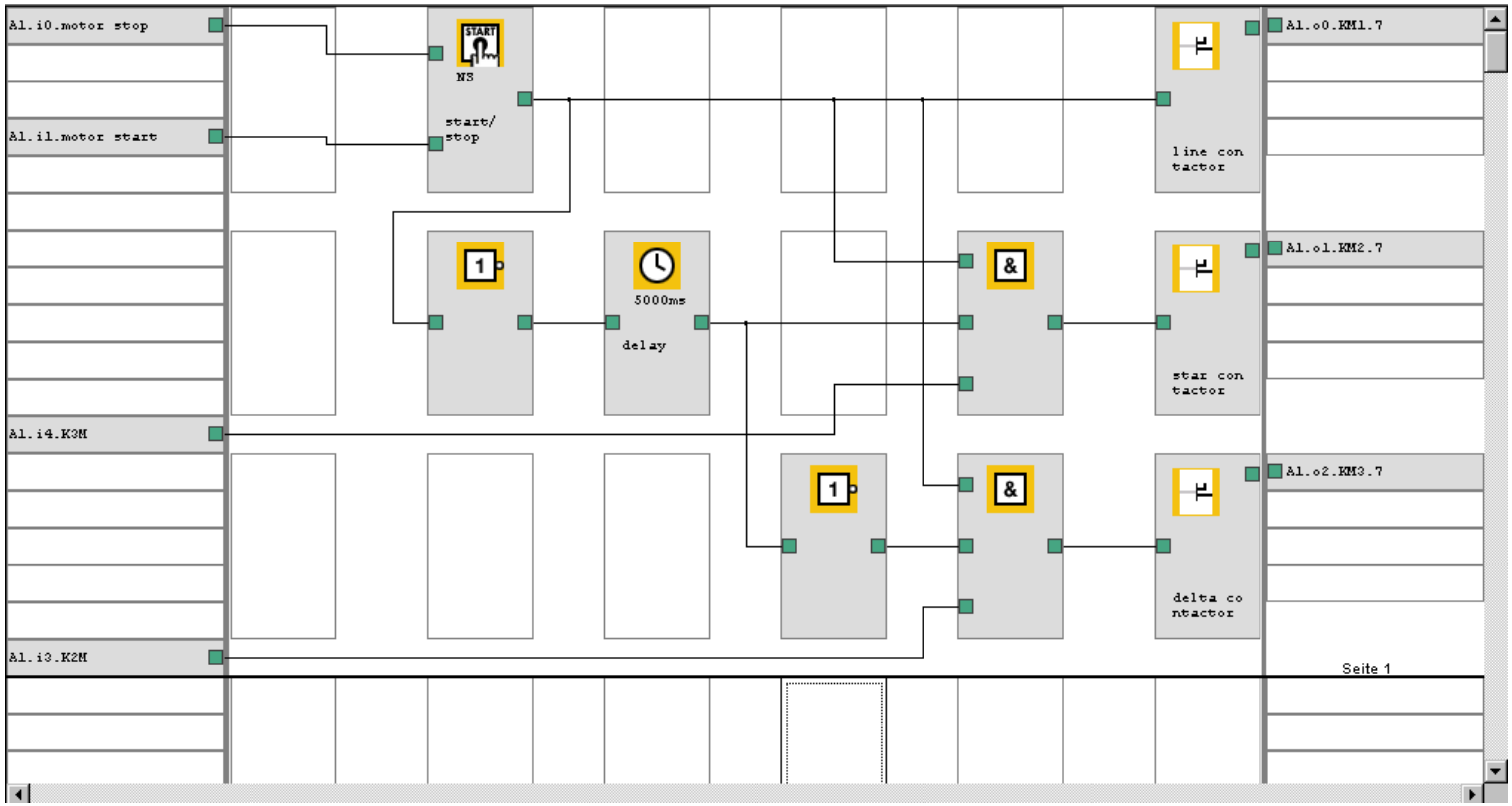
Page 18 and 19 in the project EPLAN4/Pilz/PNOZ1002

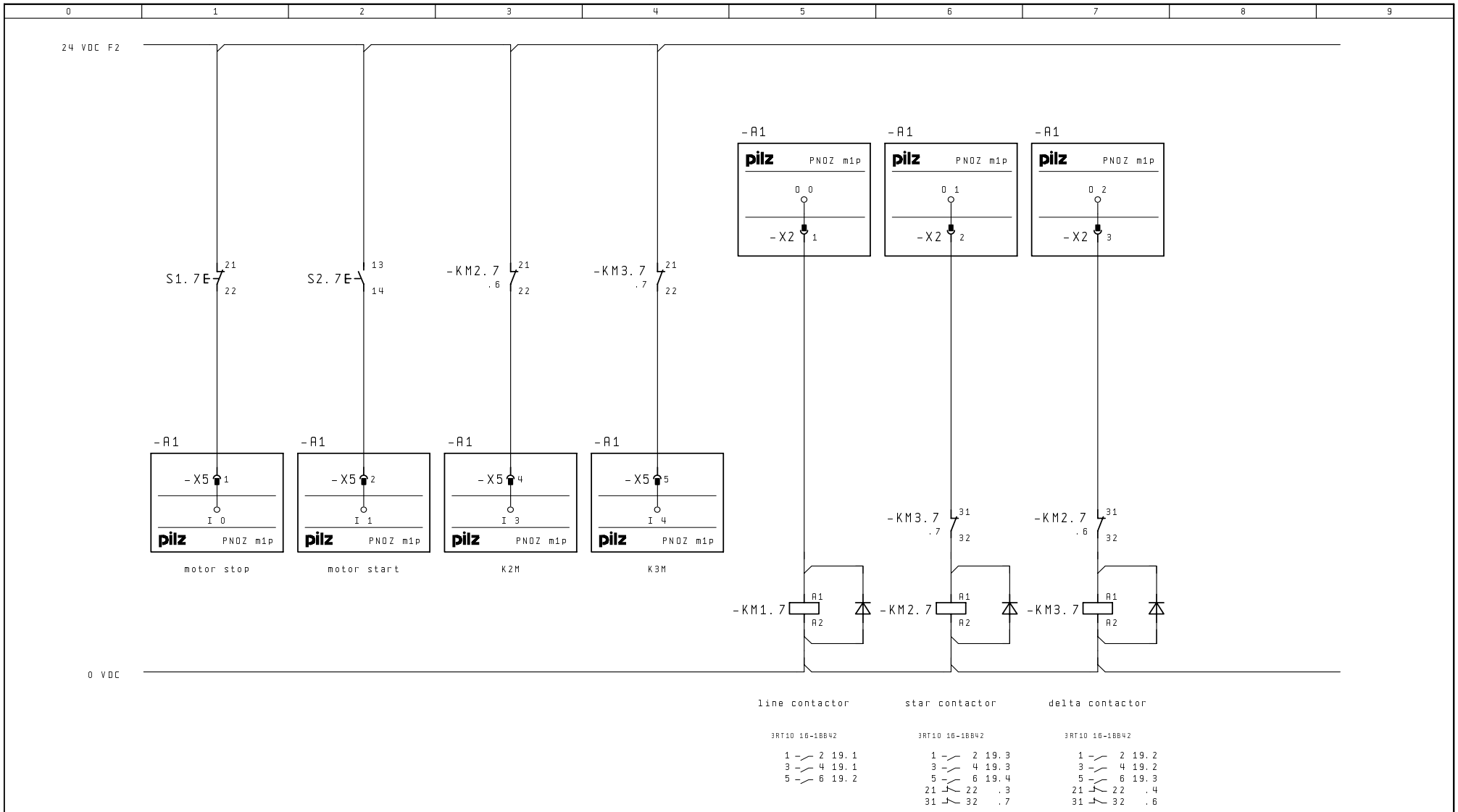
PNOZ m1p

Star-delta start-up, Category B, EN 954-1

Configuration

- 1 reset element
  - Non-monitored reset
- 1 delay element
  - 5000 ms
- 2 AND elements
  - 3 inputs
- 2 negation elements
  - 1 input
- 3 outputs
  - Safety output, semiconductor type
  - Single-pole





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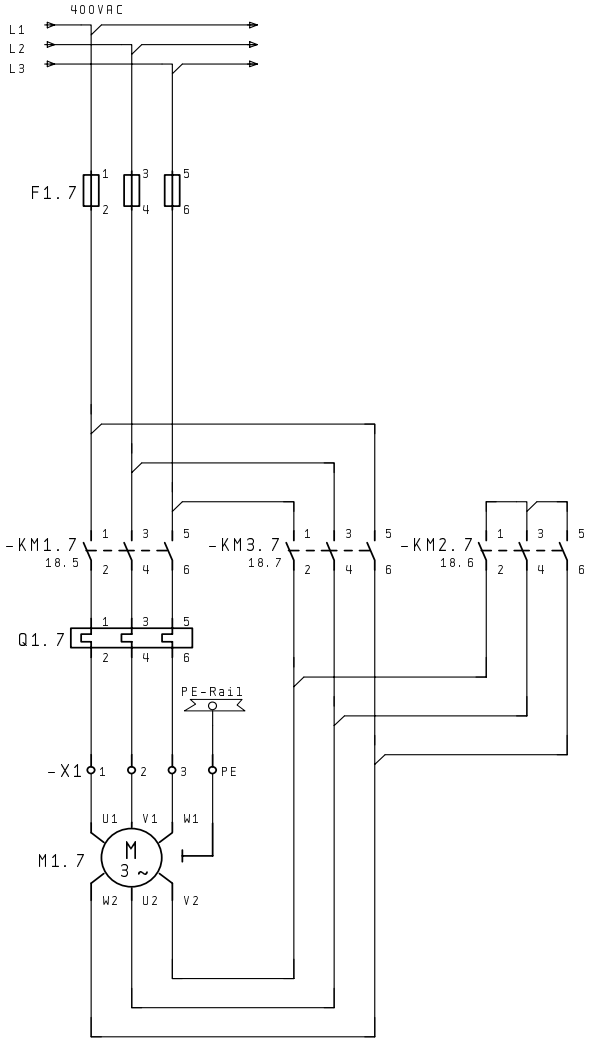

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Name	WIE	Name	WIE	Category B EN 954-1			Page: 19
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PNOZ m1p

Motor ON/OFF, Category B, EN 954-1

Features

- 1 E-STOP button
- 1 logic connection
- 2 instantaneous load shutdowns

Description
A motor can be switched on or off if the E-STOP button has not been operated. Pressing the E-STOP button stops the motor immediately.

Feedback loop
The feedback loop is not used.

Reset
If the E-STOP button has not been operated and there is a high signal at input A1.i2, the application can be activated through a pulse edge at input A1.i3.

Pilz units

Number	Type	Features	Order number
1	PNOZ m1p	24 VDC	773 100

Drawing file:

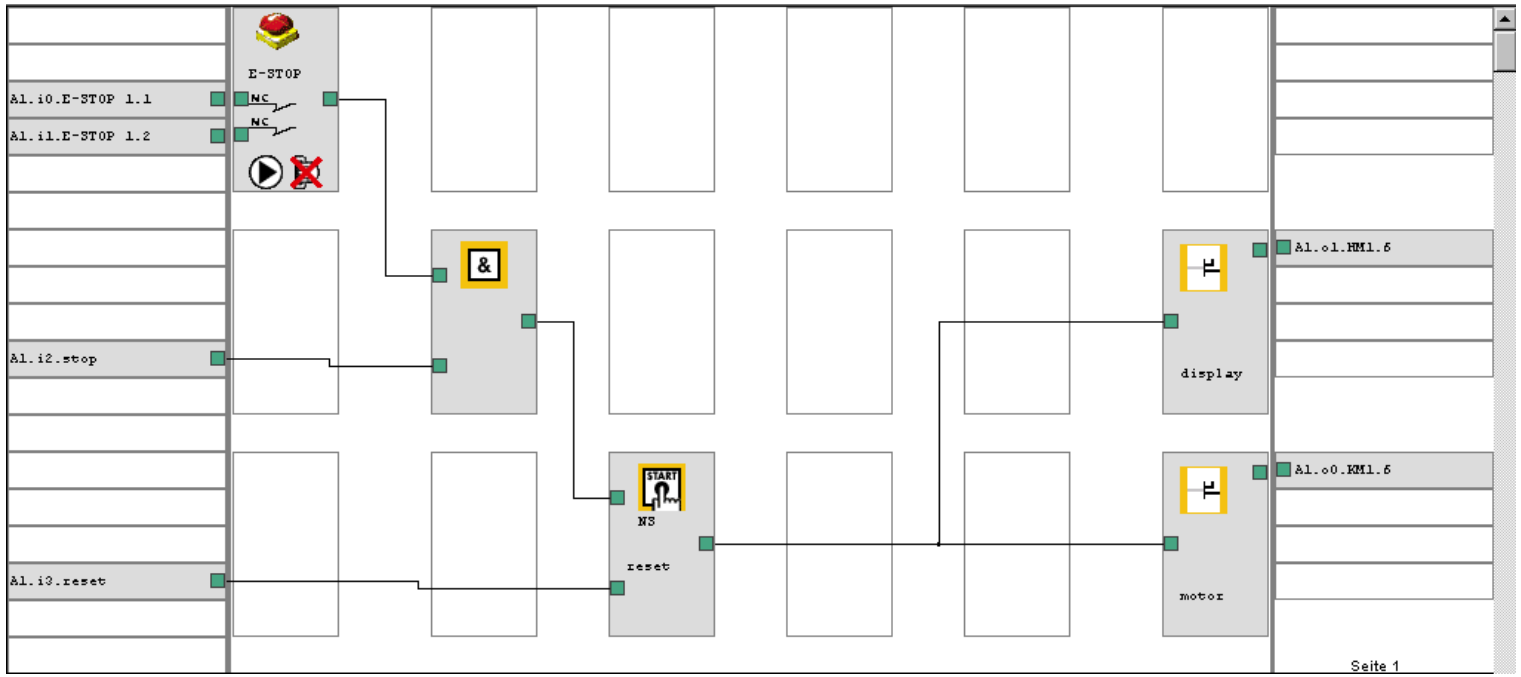
Page 17 in the project EPLAN4/Pilz/PNOZ1002

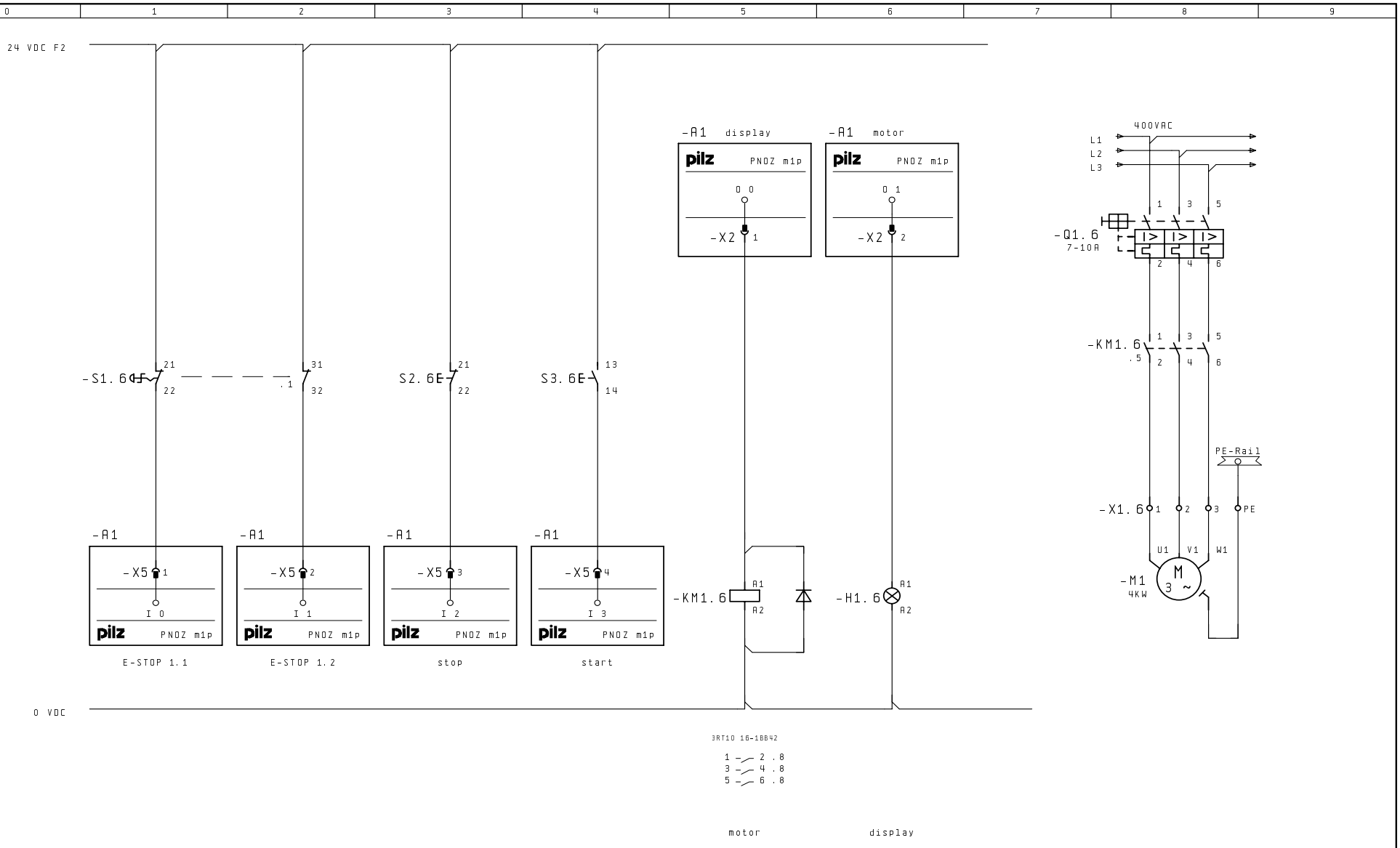
PNOZ m1p

Motor ON/OFF, Category B, EN 954-1

Configuration

- E-STOP
  - Switch type 3 (2 N/C)
  - Automatic reset
- AND element
  - 2 inputs
- Reset element
  - 2 inputs
- 2 outputs
  - Safety output, semiconductor type
  - Single-pole





Revision	02. Dez. 2002	Date	02. Jul. 2002	Application 6 page 1/1	pilz Pilz GmbH & Co. Felix-Wankel-Str. 2 73760 Ostfildern	Motor On/Off	Directory:
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Pre-sales/after sales
Services, concepts and solutions

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