



**PNOZ s30**

Safety relays



**pilz**

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SD means Secure Digital

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# 1 Introduction

## 1.1 Validity of documentation

This documentation is valid for speed monitors PNOZ s30 from version 2.2. It is valid until new documentation is published.

This operating manual explains the function and operation, describes the installation and provides guidelines on how to connect the product.

This documentation is intended for instruction and should be retained for future reference.

## 1.2 Using the documentation

This document is intended for instruction. Only install and commission the product if you have read and understood this document. The document should be retained for future reference.

## 1.3 Definition of symbols

Information that is particularly important is 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 product or devices could be damaged and also provides information on preventive measures that can be taken. It also highlights areas within the text that are of particular importance.

**INFORMATION**

This gives advice on applications and provides information on special features.

## 2 Overview

### 2.1 Unit structure

#### 2.1.1 Range

Scope of supply:

- ▶ Speed monitor PNOZ s30
- ▶ Terminator
- ▶ Connection terminals
- ▶ Chip card
- ▶ Chip card holder
- ▶ Documentation on data medium

#### 2.1.2 Unit features

Using the product PNOZ s30:

Speed monitor for safe monitoring of standstill, speed, speed range, position and direction.

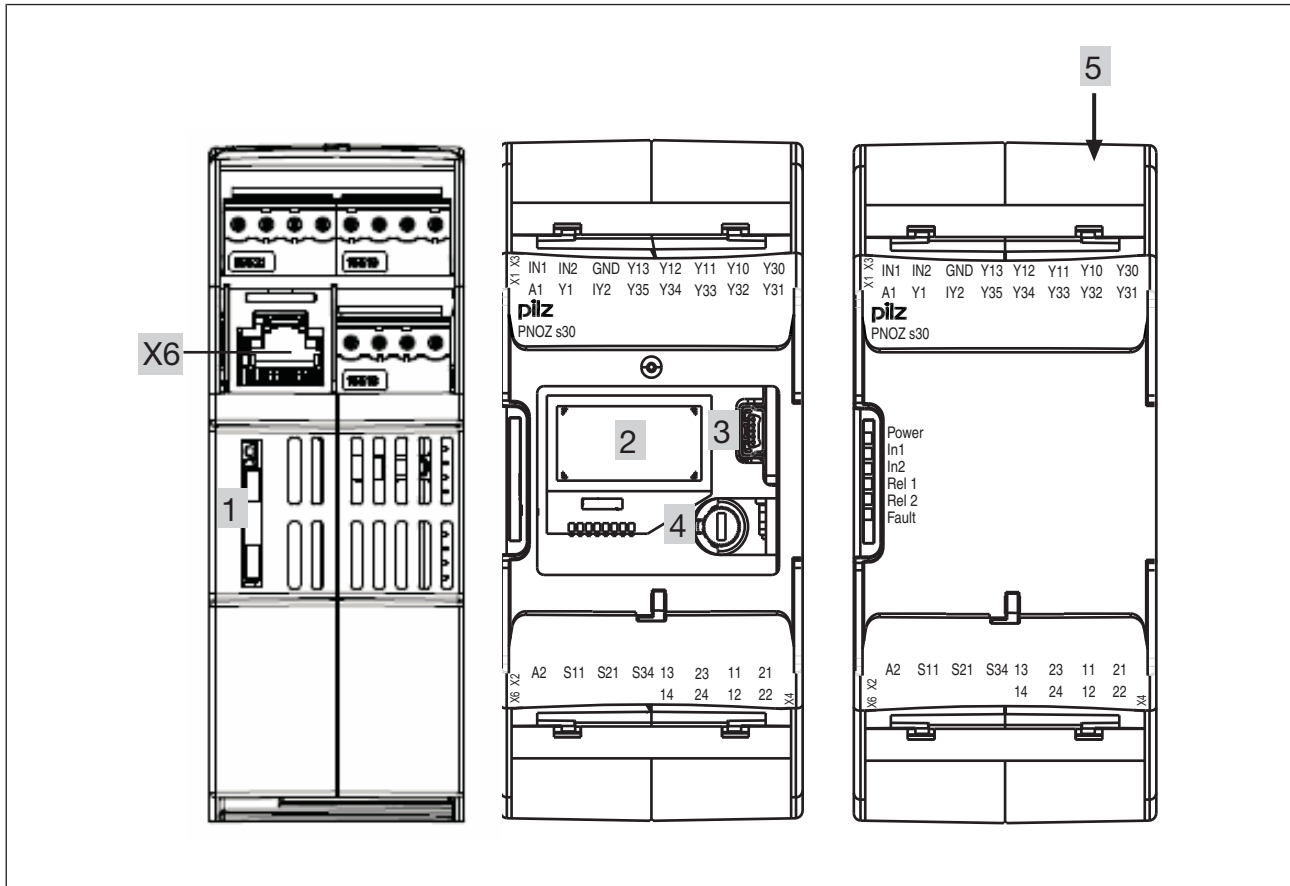
The product has the following features:

- ▶ Measured value recorded by
  - Incremental encoder
  - Proximity switch
- ▶ Measured variables
  - Standstill
  - Speed
  - Speed range
  - Position
  - Direction
  - Analogue voltage (track S)
- ▶ Positive-guided relay outputs
  - 2 safety contacts (NO)
  - 2 auxiliary contacts (NC)
- ▶ Semiconductor outputs
  - 4 auxiliary outputs
- ▶ Expansion interface for 2 more safe relay outputs that be controlled separately
- ▶ Can be configured via the display on the speed monitor
- ▶ Configuration is stored on a chip card
- ▶ Display
  - Current frequencies
  - Current position
  - Warning and error messages
- ▶ Status and fault LEDs



- ▶ Rotary encoder connection technology:  
RJ45 socket

## 2.2 Front/side view



### Legend:

- ▶ A1, A2:  
Supply connections
- ▶ In1, In2, GND:  
Proximity switch 1 - In1 (track A) and 2 - In2 (track B) and GND
- ▶ Y10 ... Y13:  
Select inputs (SEL1, SEL2, SEL4, SEL8)
- ▶ 13-14 and 23-24:  
Relay outputs (safety contacts)
- ▶ 11-12 and 21-22:  
Relay outputs (auxiliary contacts)
- ▶ Y32 ... Y35: Semiconductor outputs (auxiliary outputs)
- ▶ S11: +24 V / 30 mA (supply for S34, Y1 and Y2)
- ▶ S21: 0 V (GND for S11, S34, Y1 and Y2)
- ▶ S34: Start input
- ▶ Y30: 0 V ext (GND for select input and semiconductor outputs)
- ▶ Y31: 24 V ext (supply for semiconductor outputs)

- ▶ Y1, Y2:
  - Y1: Feedback input for Rel. 1
  - Y2: Feedback input for Rel. 2
- ▶ X6: RJ45 socket for connecting the encoder (tracks A, /A, B, /B, Z, /Z, S and GND). Proximity switches can be connected via RJ45 socket or connection terminals.
- ▶ 1: Chip card
- ▶ 2: Display format
- ▶ 3: USB connection (service only)
- ▶ 4: Rotary knob
- ▶ 5: Expansion interface for 2 more external relay outputs
- ▶ LEDs:
  - Power
  - In1
  - In2
  - Rel 1
  - Rel 2
  - Fault

## 3 Safety

### 3.1 Intended use

The speed monitor monitors standstill, speed, speed range, position and direction in accordance with EN ISO 13849-1 up to PL e and EN IEC 62061 up to SIL CL 3.



#### **WARNING!**

Users must take appropriate measures to detect or exclude errors (e.g. slippage or broken shearpin) which cause the frequency of the encoder signal to no longer be proportional to the monitored speed.

Appropriate measures are:

- Using the monitored encoder to also control the drive
- Mechanical solutions
- Z-frequency monitoring with an additional proximity switch (Ini pnp) on the same axis

### 3.2 Safety regulations

#### 3.2.1 Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decommissioned by competent persons.

A competent person is someone who, because of their training, experience and current professional activity, has the specialist knowledge required to test, assess and operate the work equipment, devices, systems, plant and machinery in accordance with the general standards and guidelines for safety technology.

It is the company's responsibility only to employ personnel who:

- ▶ Are familiar with the basic regulations concerning health and safety / accident prevention
- ▶ Have read and understood the information provided in this description under "Safety"
- ▶ And have a good knowledge of the generic and specialist standards applicable to the specific application.

#### 3.2.2 Warranty and liability

All claims to warranty and liability will be rendered invalid if

- ▶ The product was used contrary to the purpose for which it is intended
- ▶ Damage can be attributed to not having followed the guidelines in the manual
- ▶ Operating personnel are not suitably qualified
- ▶ Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering work etc.).

### 3.2.3 Disposal

- ▶ In safety-related applications, please comply with the mission time  $T_M$  in the safety-related characteristic data.
- ▶ When decommissioning, please comply with local regulations regarding the disposal of electronic devices (e.g. Electrical and Electronic Equipment Act).

### 3.2.4 For your safety

- ▶ The device is designed exclusively for use in an industrial environment. It is not suitable for use in a domestic environment, as this can lead to interference.
- ▶ The guarantee is rendered invalid if the housing is opened or unauthorised modifications are carried out.
- ▶ Sufficient fuse protection must be provided on all output contacts with capacitive and inductive loads.

## 4 Function description

### 4.1 Introduction

Proximity switches or rotary encoders record measured values, which are evaluated in the speed monitor PNOZ s30. There are 9 monitoring functions (F1 ... F9), which are performed simultaneously.

Up to 16 different parameter sets (P0 ... P15) for the monitoring functions can be selected via the select inputs.

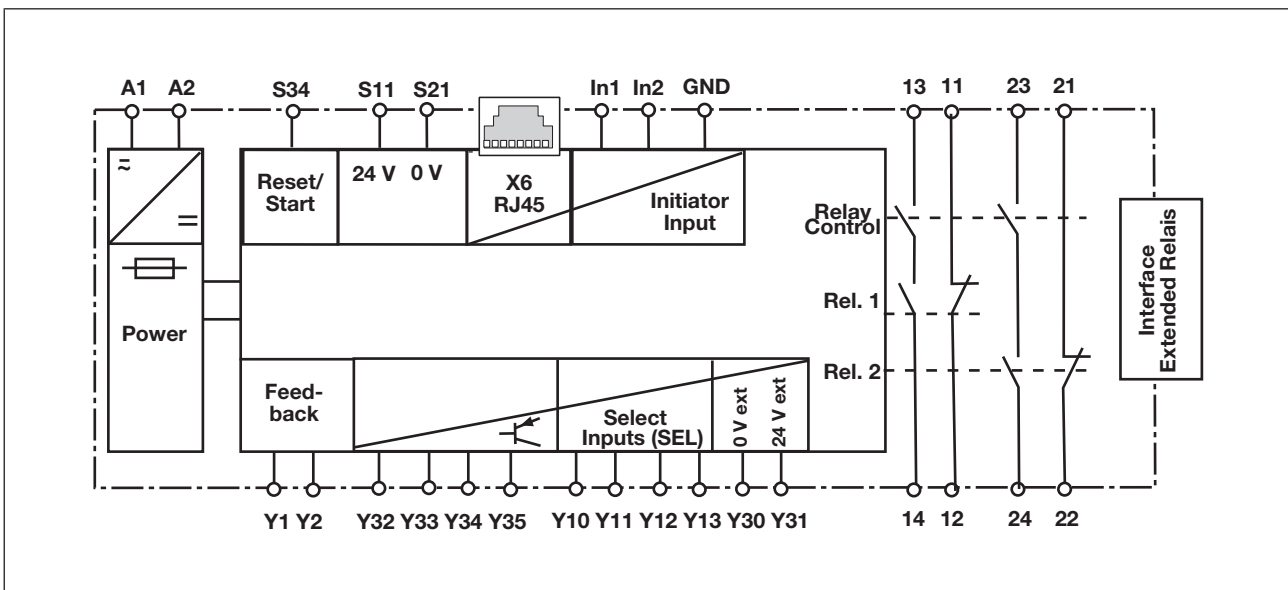
Configuration of the monitoring functions is menu-driven, using a rotary knob. The outputs switch depending on the configuration.

An interface is available to connect a contact expansion module PNOZsigma, enabling the number of outputs to be expanded.

The relay conforms to the following safety criteria:

- ▶ The circuit is redundant with built-in self-monitoring.
- ▶ The safety function remains effective in the case of a component failure.

### 4.2 Block diagram



**NOTICE**

The individual blocks are galvanically isolated from each other:

- Supply voltage: A1, A2
- Encoder and initiator inputs: GND, In1, In2, RJ45 socket and shield
- Start and feedback circuits: S21, S11, S34, Y1, Y2
- Semiconductor outputs and select inputs: Y30, Y31, Y32, Y33, Y34, Y35, Y10, Y11, Y12, Y13
- Relay output 13, 14
- Relay output 11, 12
- Relay output 23, 24
- Relay output 21, 22

If possible, the connections for the various earth potentials (GND, S21, Y30 und A2) should not be connected on the PNOZ s30 but should be connected directly to the GNDs on the connected units, otherwise noise susceptibility may be increased significantly (conductor loops are not permitted).

## 4.3 Functions

The following monitoring functions can be configured:

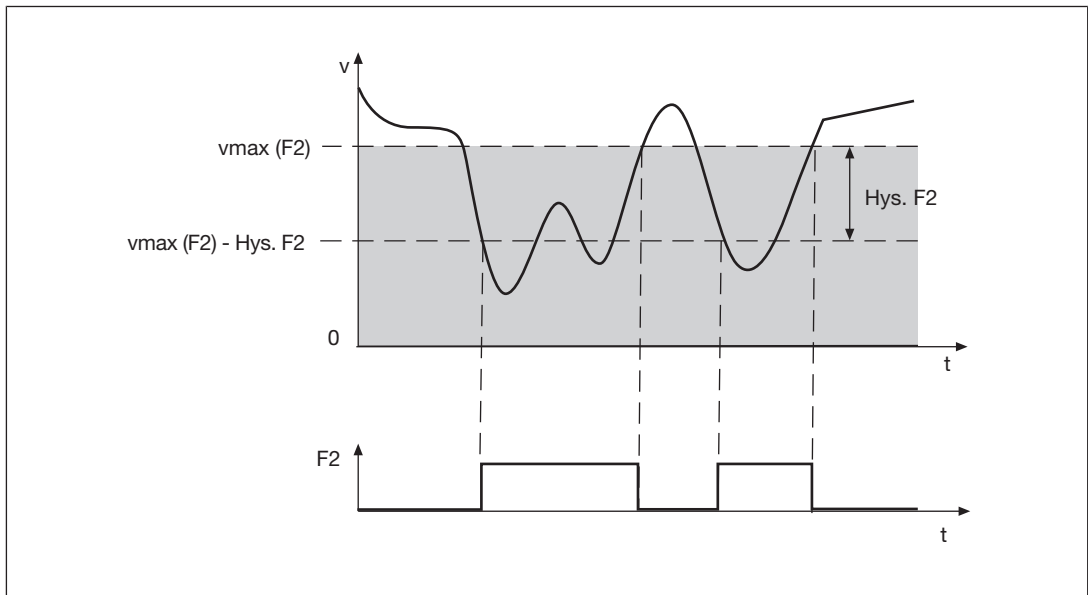
**Standstill**

With standstill monitoring, the output is switched on when the value falls below the stated standstill value; if the standstill value is exceeded, the output switches off.

**Speed**

With speed monitoring, the output switches off when the configured value is exceeded.

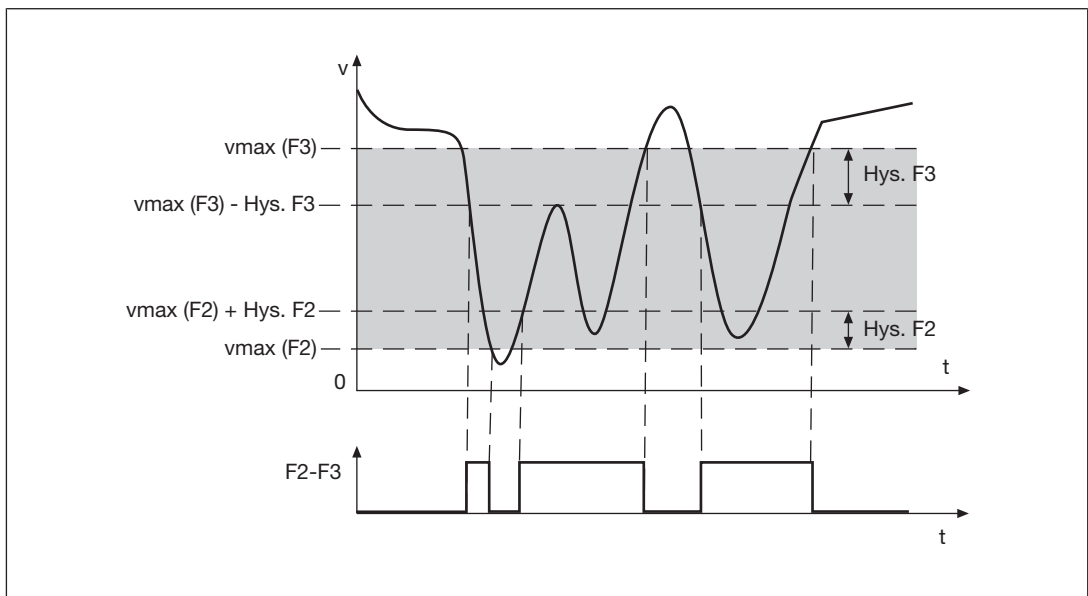
Timing diagram for standstill/speed monitoring:



**Speed range**

With range monitoring, the output switches off if the rotational speed (velocity, frequency) is outside the configured range.

Timing diagram for speed range monitoring:

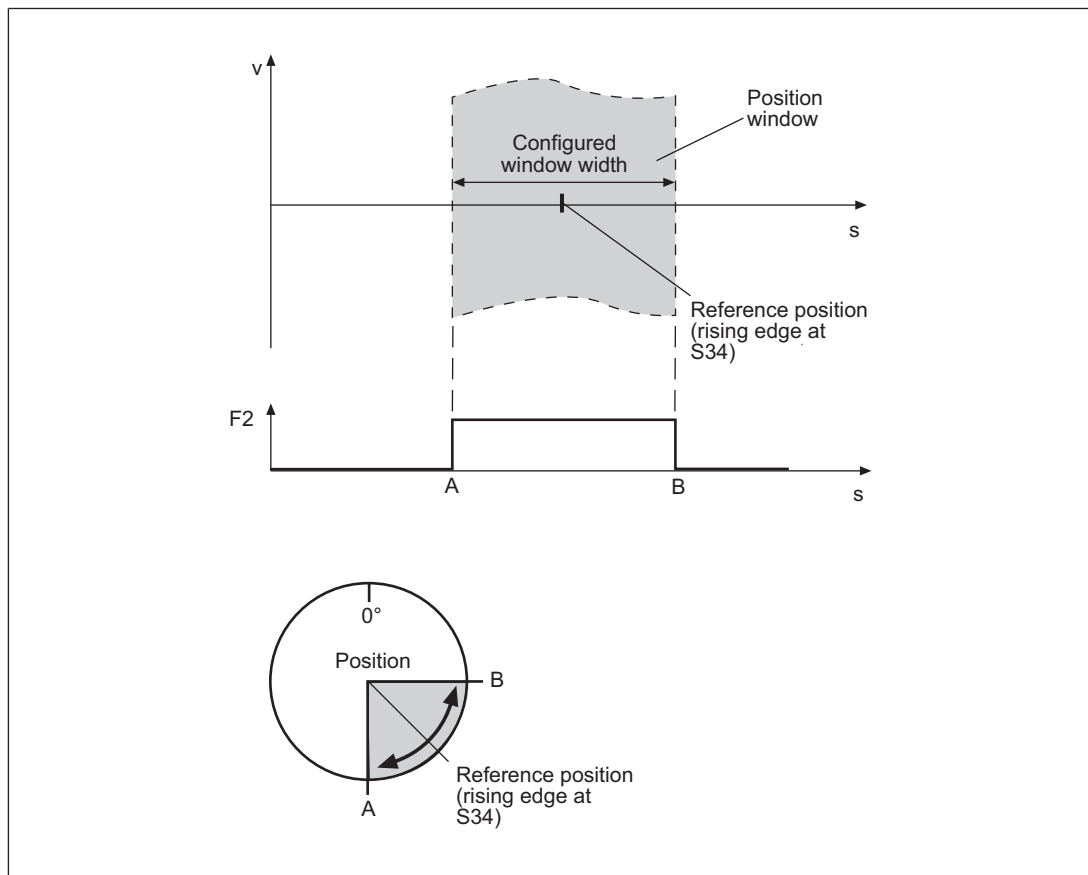


**Position**

Position monitoring is activated via a rising edge at the start input. The current position is adopted as a reference position in the middle of the position window (configured window width) and the assigned output is switched on.

The output will stay switched on provided the current position is within the position window.

Timing diagram for position monitoring:



If the position moves outside the configured range, position monitoring is reset and the assigned outputs are switched off. Position monitoring can be restarted via a rising edge at the start input

A max. of 4 positions can be configured to be monitored simultaneously.

Please note:

- ▶ Active position monitoring is not started again by another rising edge at the start input.
- ▶ Active position monitoring continues unchanged even if a different parameter set is selected, which also uses position monitoring. This also applies if position monitoring is used in a different switch function.
- ▶ Active position monitoring is reset if another parameter set is selected, which does not use position monitoring.
- ▶ Position monitoring cannot be used if proximity switches are employed.

### Direction

If the direction is to be detected safely, this function must be linked to a safety contact.

- ▶ If "Direct. Right" is configured, the safety output is switched on during normal operation in clockwise rotation.
- ▶ If "Direct. Left" is configured, the safety output is switched on during normal operation in anti-clockwise rotation.



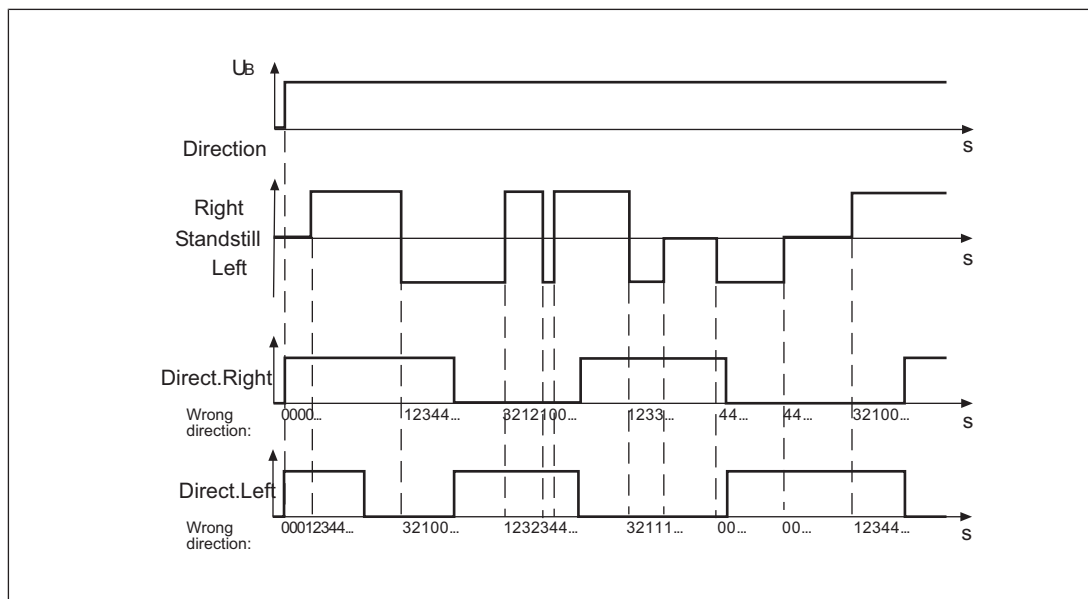
For both directions, a tolerance can be entered for the wrong direction. In other words, the drive can run in the wrong direction up to the set tolerance value, without the assigned output switching off.

If an output has been switched off, it cannot switch back on again until the drive has been run in the right direction up to the tolerance value.

Please note:

- ▶ Direction monitoring is always active, irrespective of whether it is used in the selected parameter set.
- ▶ Direct.Right and Direct.Left are active when the PNOZ s30 is started up.
- ▶ Direction cannot be detected if proximity switches are used.

Timing diagram for direction monitoring:



Configuration in the example:

- ▶ Wrong direction in anti-clockwise rotation  
Max. right: 3 pulses
- ▶ Wrong direction in clockwise rotation  
Max. left: 3 pulses

### Monitoring for broken shearpins

An additional proximity switch or an HTL signal from an additional rotary encoder can be connected to track Z to monitor for broken shearpins. These must both be configured as Z-frequency monitoring.

#### Please note:

Monitoring for broken shearpins does not become active until

- ▶ The minimum speed has been exceeded and
- ▶ The tolerance for detecting feasibility errors has elapsed.

The minimum speed and tolerance depend on the ratio of the frequency at tracks AB " $f_{AB}$ " to the frequency at track Z " $f_Z$ " in your configuration ( **$f_{AB}/f_Z$  Verh.** setting in the menu).

Minimum speed:

- ▶ when  **$f_{AB}/f_Z$  Verh.**  $\geq 1.0$   
 $f_Z = 70$  mHz or  $f_{AB} = (f_{AB}/f_Z) \times 70$  mHz
- ▶ when  **$f_{AB}/f_Z$  Verh.**  $< 1.0$   
 $f_{AB} = 70$  mHz or  $f_Z = 70$  mHz/ $(f_{AB}/f_Z)$

Tolerance for detecting feasibility errors:

- ▶ when  **$f_{AB}/f_Z$  Verh.**  $\geq 1.0$   
7.5 Z-pulses or  $7.5 \times (f_{AB}/f_Z)$  AB-pulses
- ▶ when  **$f_{AB}/f_Z$  Verh.**  $< 1.0$   
4.5 AB-pulses or  $4.5/(f_{AB}/f_Z)$  Z-pulses

### Hysteresis

For each switch function F1 ... F9 (with the exception of direction and position), a hysteresis can be configured. This prevents the outputs on the speed monitor from bouncing if there are fluctuations around the response value. The hysteresis becomes effective when the output is switched on:

Switch-on value = switching threshold – hysteresis

For the lower range limit:

Switch-on value = switching threshold + hysteresis

### Start modes

You can choose between the following start modes:

- ▶ **Automatic start**  
If an automatic start is configured, the output switches on automatically if the speed does not reach the limit value, for example.
- ▶ **Monitored start with rising edge**  
If a monitored start with rising edge is configured, the output switches on if the speed does not reach the limit value and then a rising edge was detected at S34.
- ▶ **Monitored start with falling edge**  
If a monitored start with falling edge is configured, the output switches on if the speed does not reach the limit value and then a falling edge was detected at S34.

### Switch delay

A delay time can be set for each output (see technical details). The outputs will not switch until the set time has elapsed. It is possible to configure whether the delay time is to be activated when switching on, switching off, or switching on and off.



#### **WARNING!**

Potential loss of safety function due to increased reaction time

The output switch-off delay ( $t_{do}$ , Off) when overspeed is reached will increase the speed monitor's reaction time by the stated value (see technical details). This must not delay the arrival of a safe condition by more than the permitted time. The configuration of the switch-off delay must be considered in the risk assessment as regards hazards, reaction time and safety distance.

### Feedback loops

Feedback loops are used to monitor external contactors or relays. The corresponding feedback loop must be closed before starting.

### Start-up delay

A start-up delay time can be configured, which prevents the evaluation of the encoder signals for the configured time period after the supply voltage is switched on.

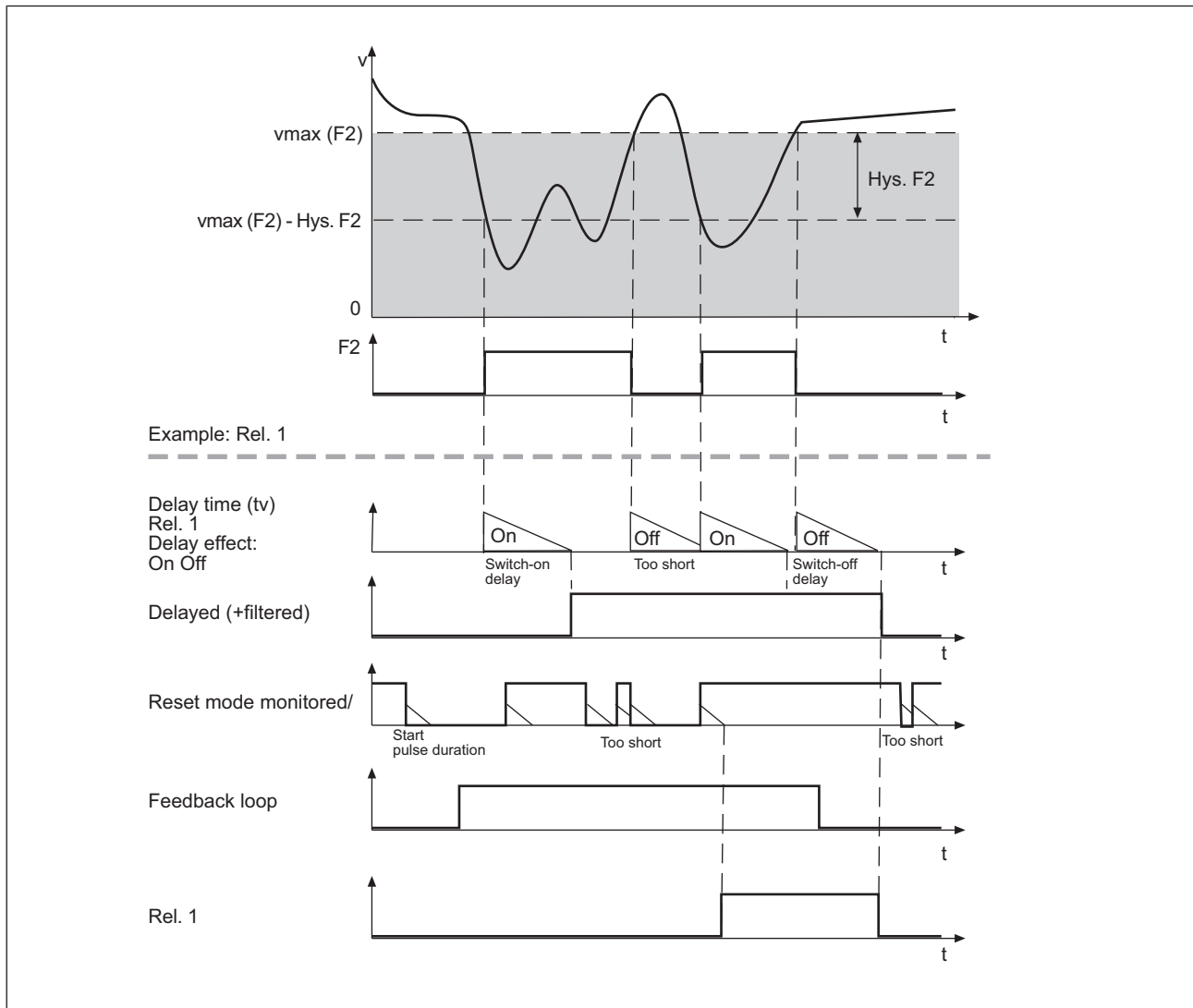
### Switching direction on semiconductor outputs

The semiconductor outputs can be operated in normally de-energised or normally energised mode.

### Units

The values to be configured can be entered in various units. Depending on the axis type (linear or rotational axis), various units can be selected for speed and distance (see chapter entitled "Menu overview").

### 4.3.1 Timing diagram for speed monitoring



Configuration in the example:

- ▶ Switch function: F2
- ▶ Assigned output: Rel. 1
- ▶ Delay effect on outputs: On + Off
- ▶ Reset mode: Monitored /

## 4.4 Speed configuration

The speed monitor is configured using the rotary knob on the device.

Up to 16 parameter sets (P0 ... P15), each with a max. of 9 switch functions (F1 ... F9) can be configured to monitor various operating modes, for example.

One of the 16 parameter sets is selected via 4 select inputs SEL1 (Y10), SEL2 (Y11), SEL4 (Y12), SEL8 (Y13).

The switch functions are monitored simultaneously.

Each of a switch function's 16 parameters can be configured as

- ▶ Standstill limit

- ▶ Speed limit
- ▶ Upper or lower limit of speed range
- ▶ Right-hand direction monitoring
- ▶ Left-hand direction monitoring
- ▶ Position monitoring 1 to 4 with width of position window 1 to 4

Exactly one switch function can be assigned to each output. The same switch function can be assigned to several outputs. With range monitoring, a range is assigned to an output (F2-F3, F4-F5, F6-F7 or F8-F9).

A switch delay and start mode can be configured for each output.

If only one parameter set is used, configure the mode "Select inputs: None". The select inputs will then be ignored.



#### INFORMATION

2 basic configurations are available for standard applications, for simple configuration within the display menu. A basic configuration contains limited menu functions adapted for standard applications, with partly pre-defined parameters. Further information about basic configurations can be found in this chapter, under "Basic configuration".

#### Example configuration:

2 parameter sets for 2 operating modes are configured:

- ▶ Set-up: P1
- ▶ Automatic mode: P2

The parameter set P1 is used to monitor a reduced speed.

The parameter set P2, "Automatic mode", is selected for speed monitoring (selection via the select inputs, see next chapter "Select inputs").

The following switch functions are configured for the parameter set P1:

- ▶ F1: Standstill 2 Hz
- ▶ F2: Overspeed: 50 Hz
- ▶ F3: Warning threshold: 50 Hz

The following switch functions are configured for the parameter set P2:

- ▶ F1: Standstill 2 Hz
- ▶ F2: Overspeed: 3000 Hz
- ▶ F3: Warning threshold: 2800 Hz

The following outputs are assigned to the switch functions:

- ▶ F1: Relay output Rel. 1
- ▶ F2: Relay output Rel. 2
- ▶ F3: Semiconductor output Out 1

The screenshot shows the configuration interface for a PNOZ s30 device. Key elements include:

- Language:** English
- Input device:** Sin/cos 1Vss
- Global standstill:** 2 Hz
- Input device settings:** f max (A/B) = 20 kHz, f max (Z)
- Hysteresis (0-50%):** A grid for parameter sets P0-P15 across functions F1-F9.
- Parameter set P1:** Standstill = 50 Hz, F2 = 50 Hz, F3 = 50 Hz
- Parameter set P2:** Standstill = 3000 Hz, F3 = 2800 Hz
- Ratio (0,0001-400,000:1):** f(A/B):f(Z)
- Position window width (1-24.900,000 Imp):** Pos. 1-4
- Incorrect direction (max. wrong):** direction (1-24.900,000 Imp)
- Assign outputs (functions):** F1, F2, F3, Out 1 (Y32), Out 2 (Y33), Out 3 (Y34), Out 4 (Y35)
- Reset mode:** automatic, automatic, automatic, normally off
- Name of configuration:** Example 2
- CRC of configuration:**

For documentation and a better overview of the device settings, we recommend that you fill in this configuration overview before setting the device parameters (link to form, see "Create configuration overview" chapter).

### 4.4.1 Select Inputs

The parameter sets are selected via the 4 select inputs SEL1 (Y10), SEL2 (Y11), SEL4 (Y12), SEL8 (Y13). Only one of the configured parameter sets can be selected.

One of the following modes can be selected in the "Select inputs mode" menu, depending on the application:

#### "None" mode

For applications up to PL e of EN ISO 13849-1 and SIL CL 3 of EN IEC 62061.

The select inputs are ignored. Only the parameter set P0 is configured and used. The lowest frequency (10 mHz) is automatically set for all other parameter sets.

#### "1 from 4" mode

For applications up to PL e of EN ISO 13849-1 and SIL CL 3 of EN IEC 62061.

A maximum of 4 parameter sets can be configured and used: P1, P2, P4 and P8.

Parameter set	Signal states of the select inputs			
	SEL 8 (Y13)	SEL 4 (Y12)	SEL 2 (Y11)	SEL 1 (Y10)
P1	0	0	0	1
P2	0	0	1	0
P4	0	1	0	0

Parameter set	Signal states of the select inputs			
P8	1	0	0	0

When using these 4 parameter sets, the following safety features are met:

If there is an error when activating the select inputs, such as

- ▶ Short circuits and shorts between contacts
- ▶ Open circuit
- ▶ Input drift

a parameter set other than P1, P2, P4 or P8 is selected.

The lowest frequency (10 mHz) is automatically set for the other parameter sets (P0, P3, P5 ... P7, P9 ... P15). If one of these parameter sets is selected, an error message appears and all outputs switch off.

### "All 16" mode

In this mode, the number of parameter sets can be increased to max. 16. This mode can only be used for applications up to max. PL d of EN ISO 13849-1 and up to SIL CL 2 of EN IEC 62061.

Parameter set	Signal states of the select inputs			
	SEL 8 (Y13)	SEL 4 (Y12)	SEL 2 (Y11)	SEL 1 (Y10)
P0	0	0	0	0
P1	0	0	0	1
P2	0	0	1	0
P3	0	0	1	1
P4	0	1	0	0
P5	0	1	0	1
P6	0	1	1	0
P7	0	1	1	1
P8	1	0	0	0
P9	1	0	0	1
P10	1	0	1	0
P11	1	0	1	1
P12	1	1	0	0
P13	1	1	0	1
P14	1	1	1	0
P15	1	1	1	1

### When using the expanded parameter sets, please note:

If an open circuit occurs when the select inputs are activated, the system will switch to a parameter set with a lower number (e.g. P7 -> P3 if an open circuit occurs at SEL4).

The limit values for the switch functions should therefore be entered in ascending order. (Parameter set P0 -> lowest values, parameter set P15 -> highest values).

**Delay on the select inputs**

A reaction time can be entered for the select inputs. That way it is possible to filter out invalid signals (e.g. contact bounce or an intermediate state) that occur when switching.

**4.4.2 Switch functions**

The following switch functions can be configured:

▶ **Standstill**

The standstill frequency is configured centrally. The standstill frequency should be the lowest frequency in the configuration.

All switch function parameters are pre-configured to the lowest frequency ex works.

▶ **Speed**

Limit values can be configured to monitor for overspeed.

Limit values should be entered in ascending order (Parameter set P0 -> lowest values, parameter set P15 -> highest values)

▶ **Speed range**

Up to 4 speed ranges can be monitored simultaneously.

Configure two switch functions to monitor a range:

- F2 and F3,
- F4 and F5,
- F6 and F7 or
- F8 and F9.

The switch function with the lower number (e.g. F2) operates as the lower range limit; the switch function with the higher number (e.g. F3) operates as the upper range limit.

Both switch functions can be assigned to one or more outputs.

▶ **Position**

Up to 4 different position windows can be monitored: Position 1 ... Position 4.

Each position to be monitored can be entered as often as necessary in parameter sets P0 to P15 and switch functions F1 to F9.

▶ **Direction**

The monitoring functions "Direct. Left" and "Direct. Right" can be configured as a switch function as often as necessary.

For both directions, a tolerance can be entered for the wrong direction.

**4.4.3 Basic configuration**

Two basic configurations are available for standard applications, for simple configuration within the display menu. A basic configuration contains limited menu functions adapted for standard applications, with partly pre-defined parameters.

The following basic configurations are available:

**Basic configuration 1: Ini pnp pnp (proximity switch)**

Pre-defined settings and configuration options:

▶ **Encoder type**

2 pnp type proximity switches



- ▶ **Switch functions**
  - **Standstill (F1)**
    - Standstill frequency configurable in Hz
  - **Speed (F2)**
    - Max. frequency (v max) configurable in Hz
- ▶ **Parameter set/select input**

P0, select inputs are ignored ("None" mode")
- ▶ **Hysteresis**

Standstill and speed, 2 % each
- ▶ **Output assignment**
  - Standstill: Relay output Rel. 1 and semiconductor output Out 1
  - Speed: Relay output Rel. 2 and semiconductor output Out 2
- ▶ **Reset mode**
  - Rel. 1, Rel. 2 Out 1, Out 2: Automatic reset
- ▶ **Switch delay**

None
- ▶ **Max. encoder frequency**

3.5 kHz

#### Basic configuration 2: Rotary encoder

- ▶ **Encoder type**

Rotary encoders

  - Rotary encoder type configurable
- ▶ **Switch functions**
  - **Standstill (F1)**
    - Standstill frequency configurable in Hz
  - **Speed (F2)**
    - Max. frequency (v max) configurable in Hz
  - **Direction (F3)**

Direction left  
Tolerance for wrong direction = 10 Imp
  - **Direction (F4)**

Direction right  
Tolerance for wrong direction = 10 Imp
- ▶ **Parameter set/select input**

P0, select inputs are ignored ("None" mode")
- ▶ **Hysteresis**

Standstill and speed, 2 % each
- ▶ **Output assignment**
  - Standstill: Relay output Rel. 1 and semiconductor output Out 1
  - Speed: Relay output Rel. 2 and semiconductor output Out 2
  - Direction left: External output Ext. 1 and semiconductor output Out 3

- Direction right: External output Ext. 2 and semiconductor output Out 4
- ▶ **Reset mode**
  - All outputs: Automatic reset
- ▶ **Switch delay**
  - None
- ▶ **Max. encoder frequency**
  - 1 MHz

For details of how to configure the basic configurations, see the chapter entitled Commissioning/Display Menu - Configuration.

#### 4.4.4 Chip card

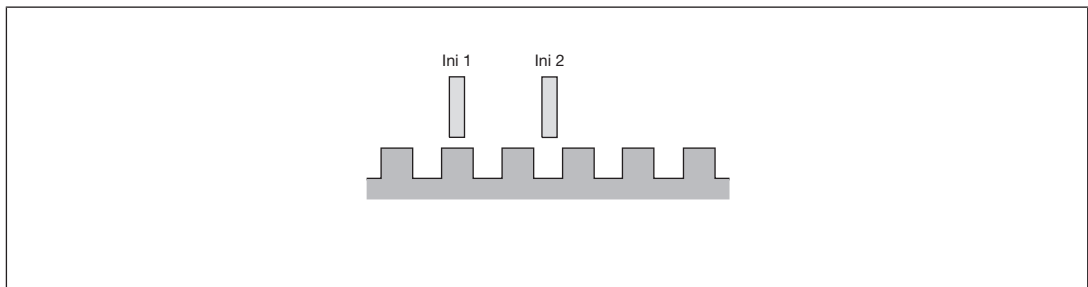
The set parameters, the name of the configuration, the check sum and the passwords are stored on the chip card (see section entitled "Using the chip card").

### 4.5 Input device types

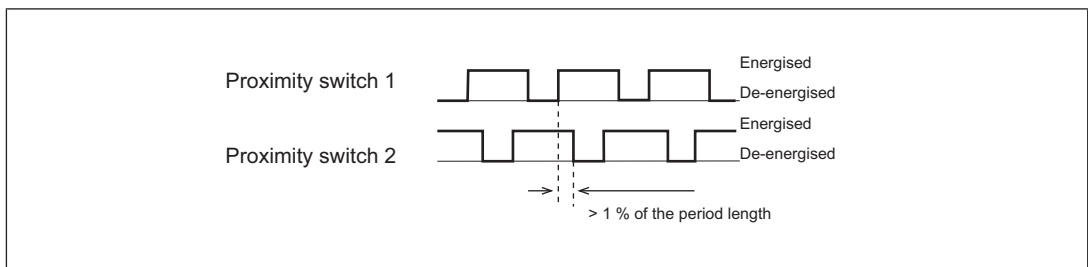
#### 4.5.1 Proximity switch

- ▶ The following proximity switches can be used:
  - pnp
  - npn
- ▶ The proximity switches must be fitted so that at least one is always activated. In other words, the proximity switches must be fitted so that the recorded signals always overlap.
- ▶ The cable used to connect the proximity switches must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ The supply voltage of the proximity switches should be monitored via track S.

Proximity switch assembly:



Example pnp – pnp:



**CAUTION!**

Appropriate installation measures should be taken to prevent a foreign body coming between the signal encoder and the proximity switch. If not, the foreign body could cause invalid signals.

- ▶ Please note the values stated in the technical details
- ▶ The maximum frequency of the used encoders must be entered for a complete configuration ("Encoder" Menu -> "Track AB" -> "Track AB fmax" / "Track Z" -> "Track Z fmax").

## 4.5.2 Rotary encoders

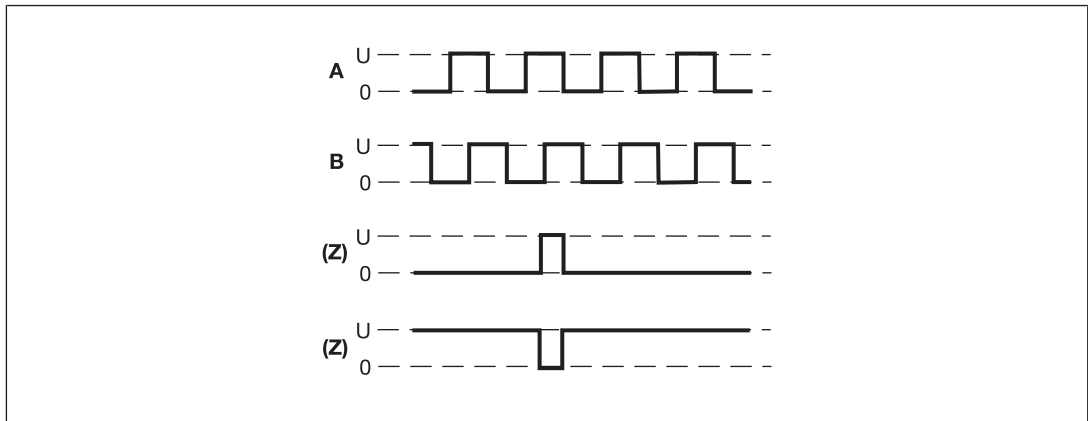
- ▶ The following rotary encoders can be used:
  - TTL, HTL (single-ended or differential signals)
  - sin/cos 1 Vss
  - Hiperface
- ▶ The rotary encoders can be connected with or without Z index (0 index)
- ▶ The cable used to connect the rotary encoders must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ A proximity switch can also be connected to track Z for monitoring broken shearpins
- ▶ Track S can be used:
  - To connect an encoder's error output
  - To monitor voltages between 0 V and 30 V for a permitted upper and lower limit. For example, the encoder's supply voltage can be monitored.
- ▶ The following must be entered for a complete configuration:
  - The maximum frequency of the used encoders ("Encoder Settings" menu -> "Track AB" -> "Track AB fmax" / "Track Z" -> "Track Z fmax").
  - The ratio fAB/fZ ("Encoder Settings" menu -> "Track Z" -> fAB/fZ Verh.)

Please note the values stated in the technical details

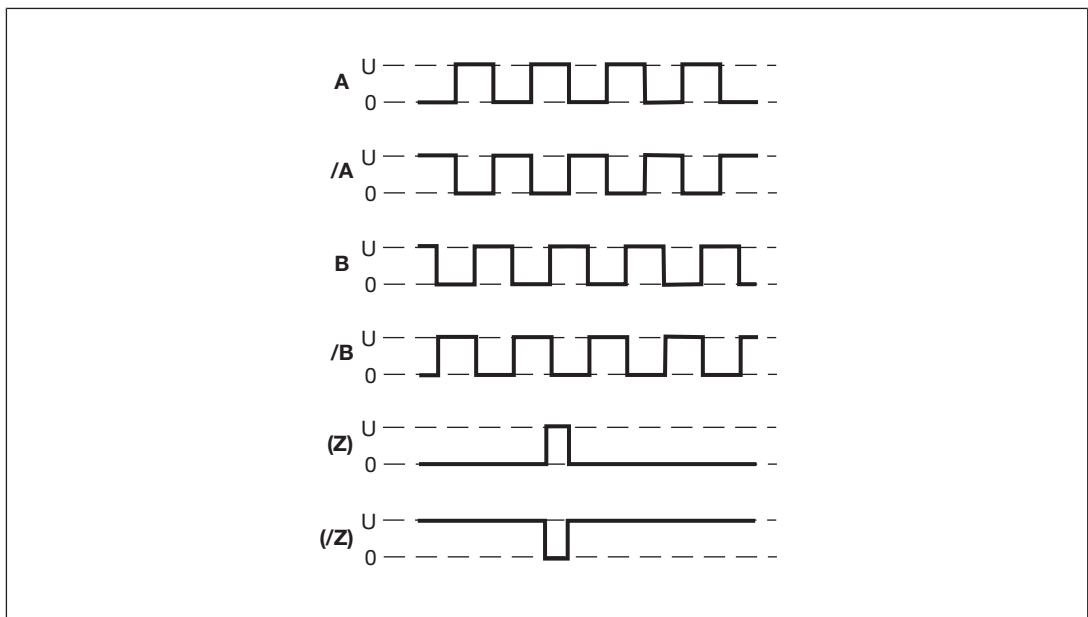
### 4.5.2.1 Output signals

#### Output signals TTL, HTL

- ▶ Single ended

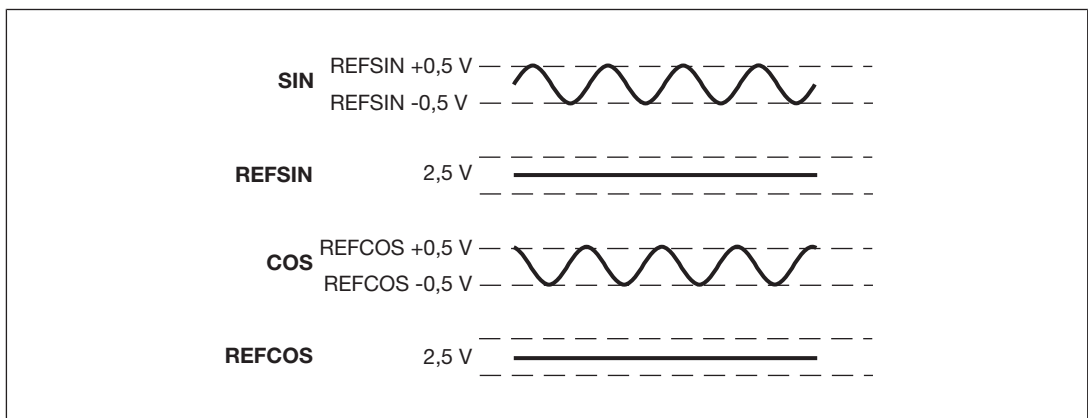


► Differential

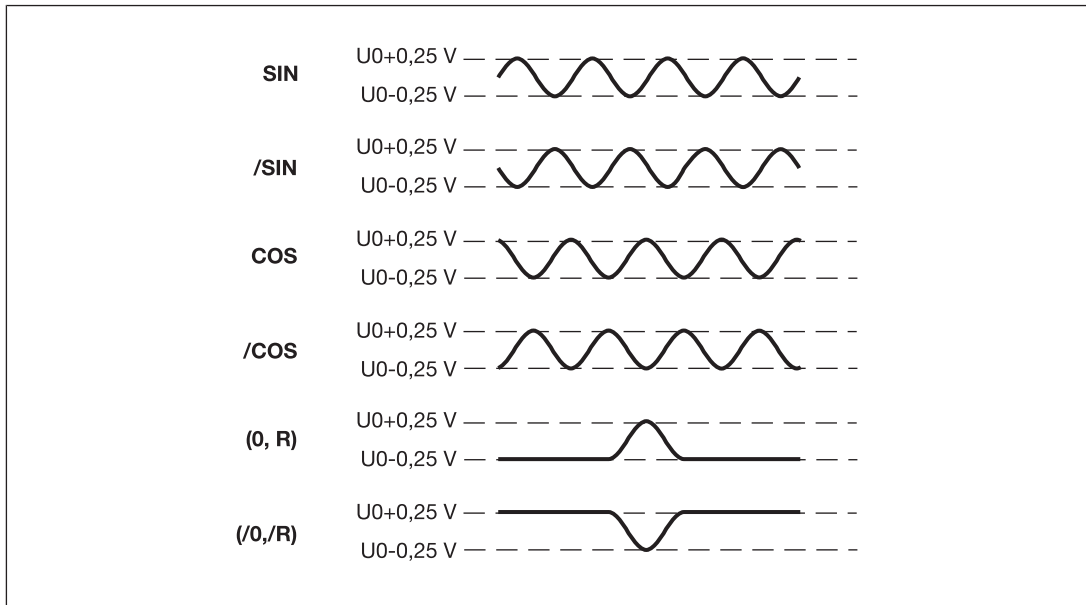


**Output signals Sin/Cos (1 Vss)**

► Single ended with reference track (e.g. Hiperface ®)



► Differential with/without Z index (e.g. Heidenhain 1 Vss)



#### 4.5.2.2 Adapter for incremental encoders

The adapter records the data between the encoder and the drive and makes it available to the PNOZ s30 via the RS45 socket.

Pilz supplies complete adapters as well as ready-made cable with RS45 connector, which can be used when making your own adapter. The range of products in this area is constantly being expanded. Please contact us about the range of adapters that is currently available.

## 5 Installation

### 5.1 General installation guidelines

#### Install base unit without contact expansion module:

- ▶ Ensure that the plug terminator is inserted at the side of the unit.

#### Connect base unit and PNOZsigma contact expansion module:

- ▶ Remove the plug terminator at the side of the base unit and at the contact expander module.
- ▶ Connect the base unit and the contact expander module to the supplied connector before mounting the units to the DIN rail.

#### Control cabinet installation

- ▶ The unit should be installed in a control cabinet with a protection type of at least IP54.
- ▶ It is preferable to install the device on a horizontal DIN rail in order to ensure the best possible convection.
- ▶ Use the notch on the rear of the unit to attach it to the DIN rail.
- ▶ Push the device upwards or downwards before lifting it from the DIN rail.



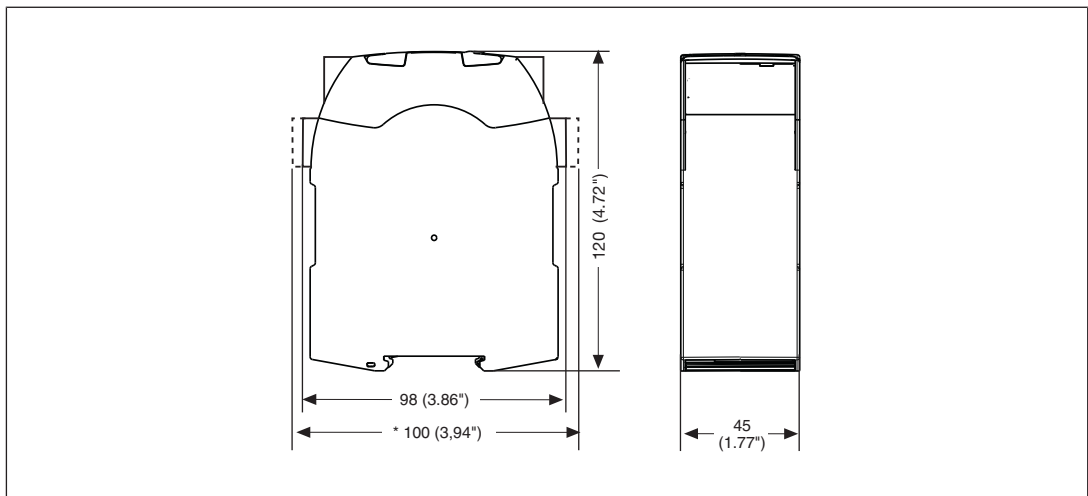
#### NOTICE

Damage due to electrostatic discharge!

Electrostatic discharge can damage components. Ensure against discharge before touching the product, e.g. by touching an earthed, conductive surface or by wearing an earthed armband.

### 5.1.1 Dimensions

\*with spring-loaded terminals



## 6 Commissioning

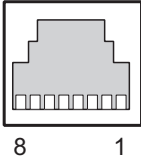
### 6.1 Wiring

#### 6.1.1 General wiring guidelines

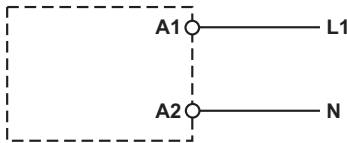
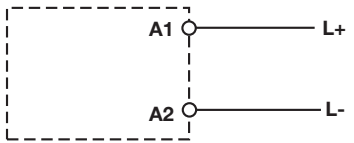
Note:

- ▶ Information given in the "Technical details" must be followed.
- ▶ Use copper wire that can withstand 75 °C.
- ▶ The cable used to connect the encoders and proximity switches must be shielded (see connection diagrams in the chapter entitled "EMC-compliant wiring").
- ▶ The shield may only be connected to earth at a single point.
- ▶ Earth loops should be avoided.
- ▶ If possible, the connections for the various earth potentials (GND, S21, Y30, A2 ) should not be connected on the PNOZ s30 but should be connected directly to the GNDs on the connected units, otherwise noise susceptibility may be increased significantly (conductor loops are not permitted).

#### 6.1.2 Pin assignment of RJ45 socket

RJ45 socket 8-pin	PIN	Track
	1	S
	2	GND
	3	Z
	4	A
	5	/A
	6	/Z
	7	B
	8	/B

#### 6.1.3 Supply voltage

Supply voltage	AC	DC
		

#### 6.1.4 Connection of proximity switches

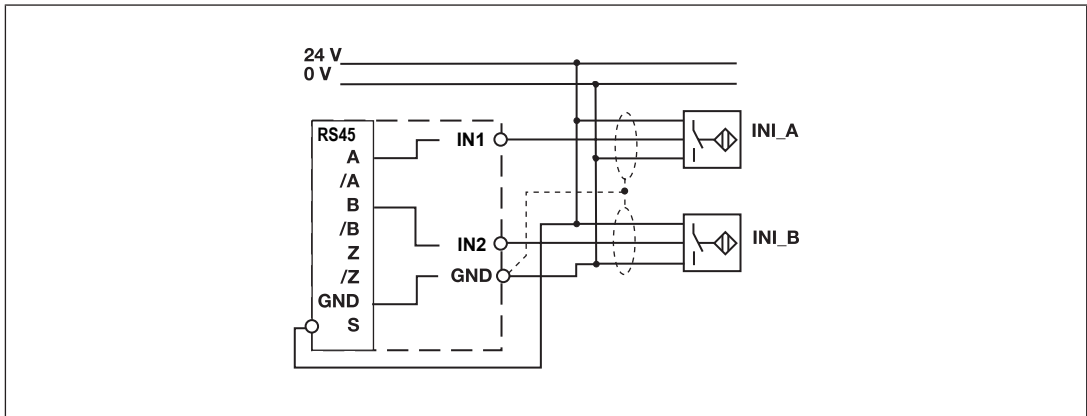
The following proximity switch combinations can be connected:

- ▶ A: npn, B: npn
- ▶ A: npn, B: pnp

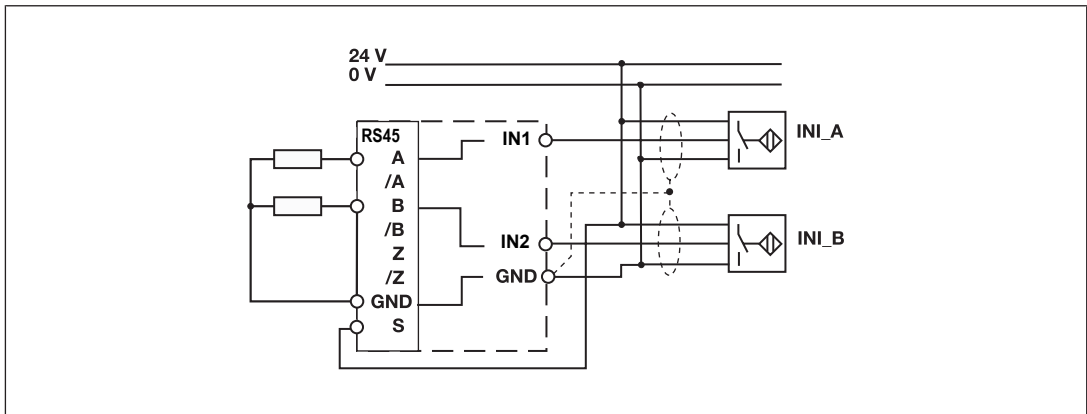
- ▶ A: pnp, B: npn
- ▶ A: npn, B: pnp

When connecting proximity switches please note:

- ▶ Proximity switches can either be connected to terminals IN1, IN2 and GND or to tracks A and B plus GND on the RJ45 socket.
- ▶ Track S should be used to monitor the supply voltage (see drawing). A permitted voltage range can be entered in the menu.
- ▶ Connect the proximity switch to 24 VDC of the power supply.
- ▶ When connecting the proximity switches, please refer to the chapter entitled "EMC-compliant wiring"
- ▶ Invalid signals may occur with cable lengths >50 m. In this case we recommend that you connect a resistor between the signal lines, as shown in the diagrams.

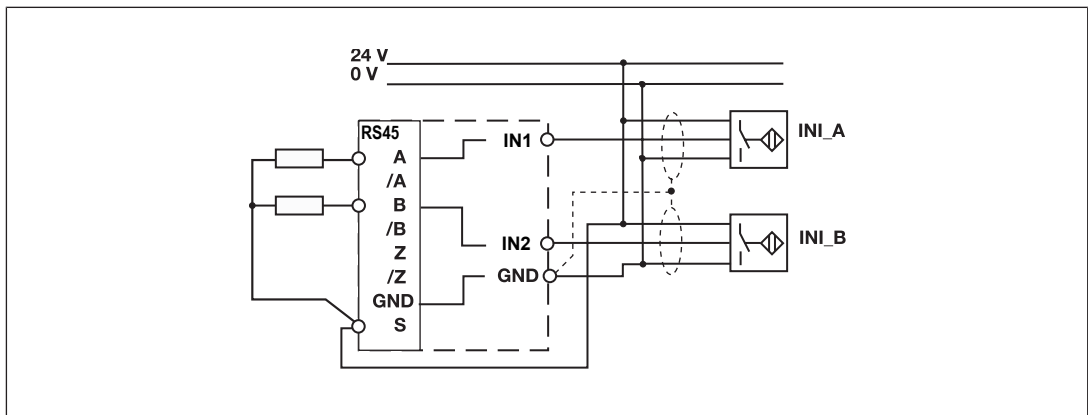


**pnp proximity switch with resistor R = 10 kOhm**





**npn proximity switch with resistor R = 47 kOhm**



**6.1.5 Connection of a rotary encoder**

Proceed as follows when connecting the encoder:

- ▶ The encoder can be connected via an adapter (e.g. ) or directly to the PNOZ s30.
- ▶ Use only shielded cables for all connections. Please refer to the chapter entitled "EMC-compliant wiring".
- ▶ Always connect GND on the encoder to GND on the RS45 connector.

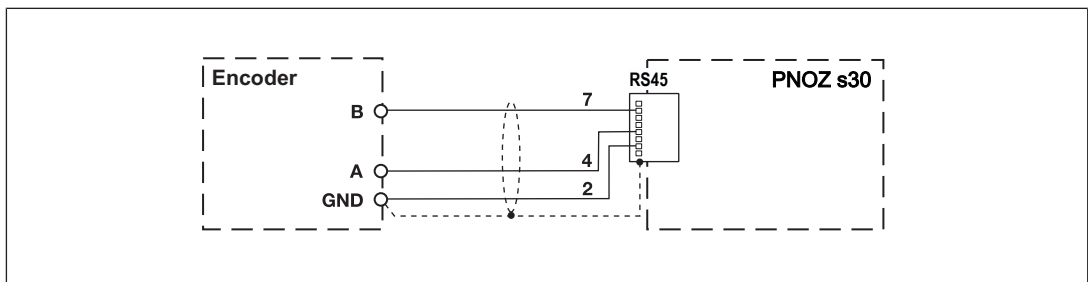
**6.1.5.1 Connect rotary encoder to speed monitor**

Encoder types:

- ▶ TTL single ended
- ▶ HTL single ended

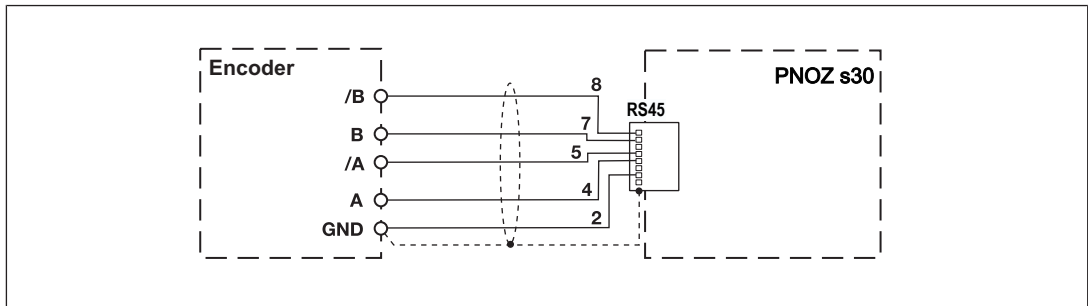
Please note:

- ▶ Tracks/A, /B, Z, and /Z must remain free



Encoder types:

- ▶ TTL differential
- ▶ HTL differential
- ▶ sin/cos 1 Vss
- ▶ Hiperface



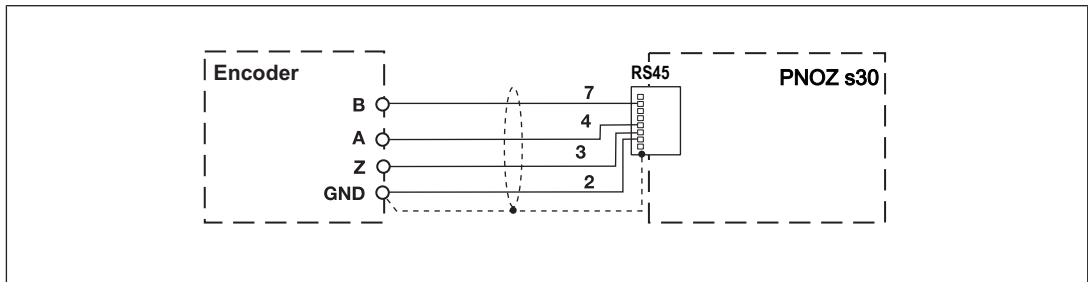
**6.1.5.2 Connect rotary encoder with Z index to speed monitor**

Encoder types:

- ▶ TTL single Z Index
- ▶ HTL single Z Index

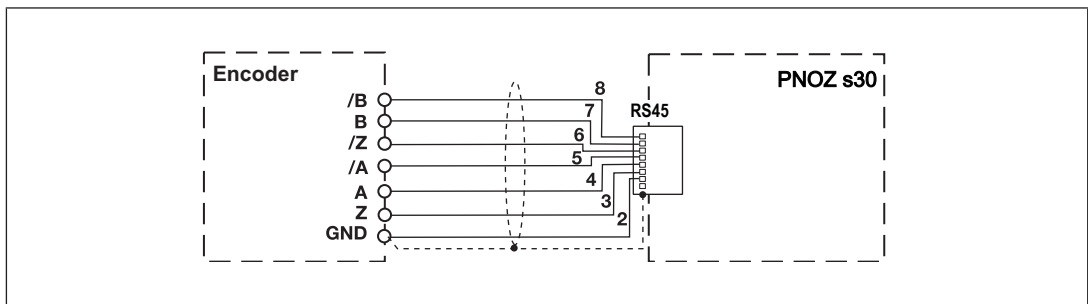
Please note:

- ▶ Tracks /A, /B and /Z must remain free



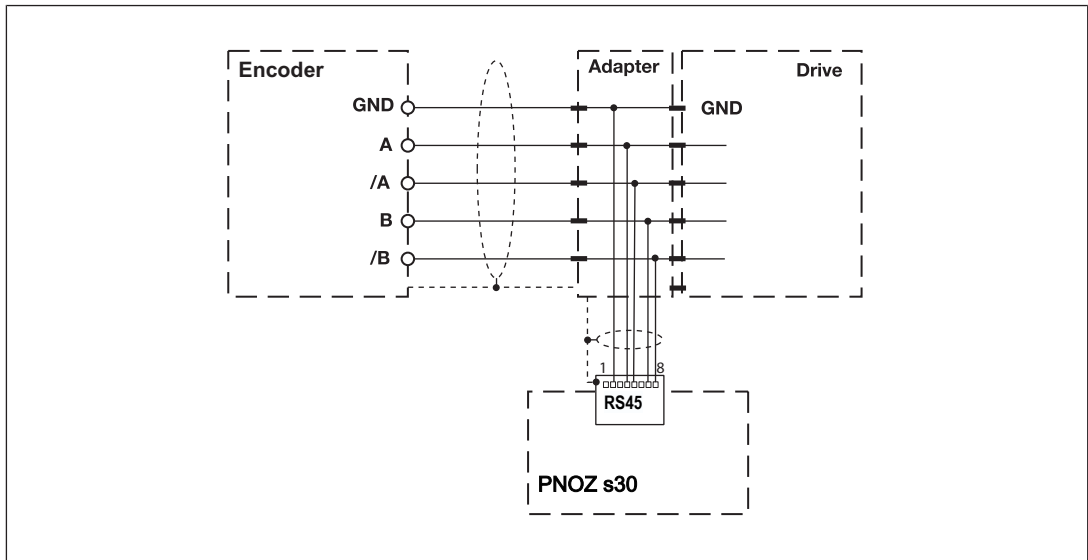
Encoder types:

- ▶ TTL diff. Z Index
- ▶ HTL diff. Z Index
- ▶ sin/cos 1 Vss Z Index



**6.1.5.3 Connect rotary encoder to the speed monitor via an adapter**

The adapter (e.g. ) is connected between the encoder and the drive. The output on the adapter is connected to the RS45 socket on the PNOZ s30.



### 6.1.6 Connection of proximity switch and rotary encoder

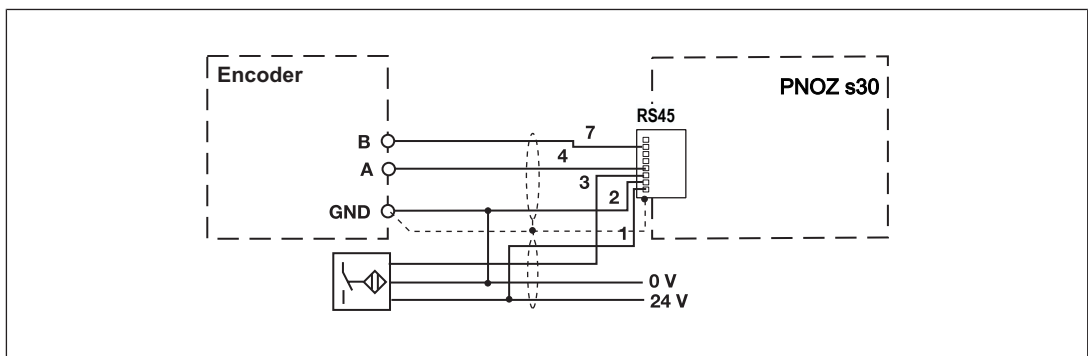
When connecting the encoders and proximity switches, please refer to the chapter entitled "EMC-compliant wiring".

Sensor types:

- ▶ Configuration: HTL single Z Freq. Ini pnp
  - HTL single ended (A,B) + Ini pnp (Z)
  - HTL single ended (A,B) + HTL differential (A as Z)
  - HTL single ended (A,B) + HTL single ended (A as Z)
- ▶ Configuration: TTL single Z Freq. Ini pnp
  - TTL single ended (A,B) + Ini pnp (Z)
  - TTL single ended (A,B) + HTL differential (A as Z)
  - TTL single ended (A,B) + HTL single ended (A as Z)

Please note:

Tracks /A, /B and /Z must remain free.



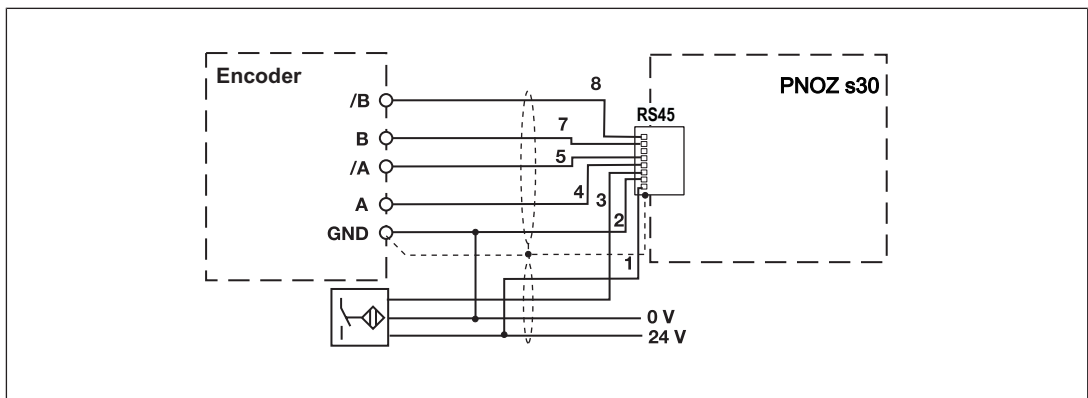
Sensor types:

- ▶ Configuration: TTL differential Z Freq. Ini pnp
  - TTL differential (A,/A,B,/B) + Ini pnp (Z)
  - TTL differential (A,/A,B,/B) + HTL differential (A as Z)

- TTL differential (A,/A,B,/B) + HTL single ended (A as Z)
- ▶ Configuration: HTL differential Z Freq. Ini pnp
  - HTL differential (A,/A,B,/B) + Ini pnp (Z)
  - HTL differential (A,/A,B,/B) + HTL differential (A as Z)
  - HTL differential (A,/A,B,/B) + HTL single ended (A as Z)
- ▶ Configuration: sin/cos 1 Vss Z Freq. Ini pnp
  - sin/cos 1 Vss (A,/A,B,/B) + Ini pnp (Z)
  - sin/cos 1 Vss (A,/A,B,/B) + HTL differential (A as Z)
  - sin/cos 1 Vss (A,/A,B,/B) + HTL single ended (A as Z)
- ▶ Configuration: Hiperface Z Freq. Ini pnp
  - Hiperface (A,/A,B,/B) + Ini pnp (Z)
  - Hiperface (A,/A,B,/B) + HTL differential (A as Z)
  - Hiperface (A,/A,B,/B) + HTL single ended (A as Z)

Please note:

Track /Z must remain free!!



### 6.1.7

#### Reset circuit

Automatic start	Monitored start
automatic start must only be configured No wiring necessary!	

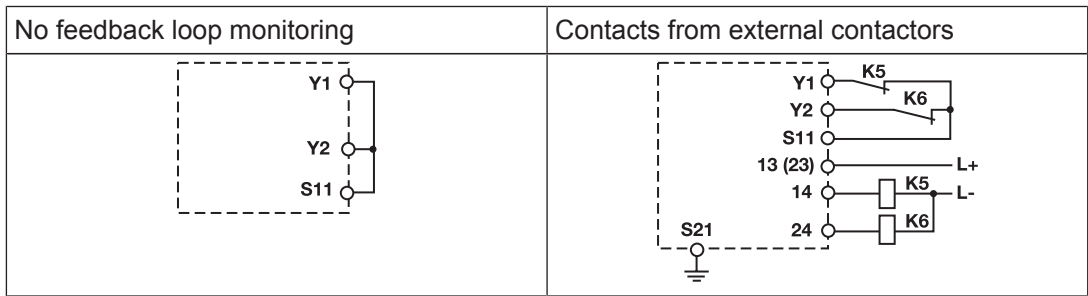


**NOTICE**

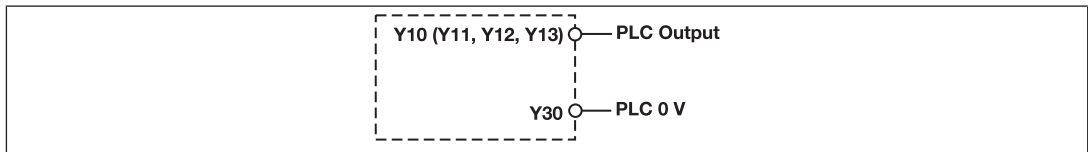
With automatic start

The unit starts up automatically when the safeguard is reset, e.g. when the E-STOP pushbutton is released. Use external circuit measures to prevent an unexpected restart.

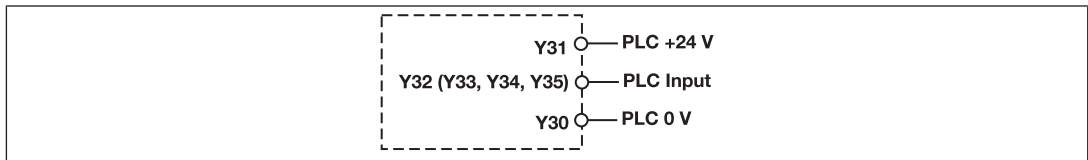
### 6.1.8 Feedback circuit



### 6.1.9 Select inputs

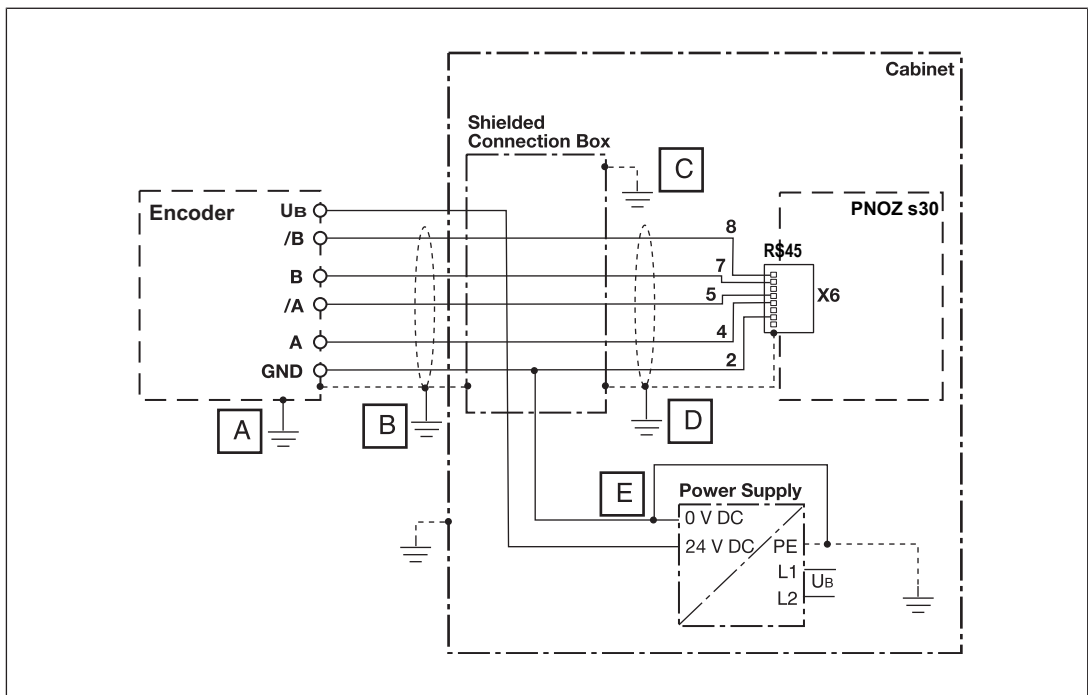


### 6.1.10 Semiconductor outputs



### 6.1.11 EMC-compliant wiring

#### EMC-compliant wiring for connecting an encoder



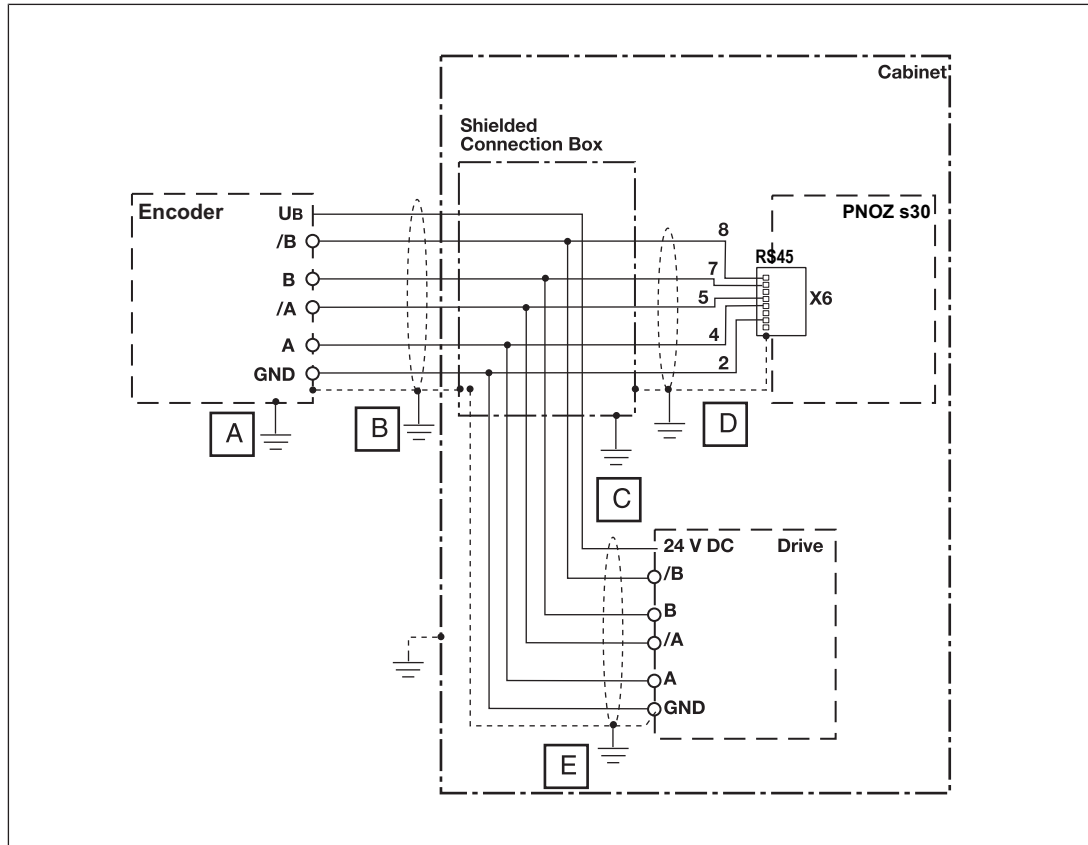
To avoid EMC interference we recommend that the shield on the sensor cables or the housing of the shielded junction box is only connected to earth at a single point:

**A or B or C or D or E**

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

### EMC-compliant wiring for connecting an encoder with drive



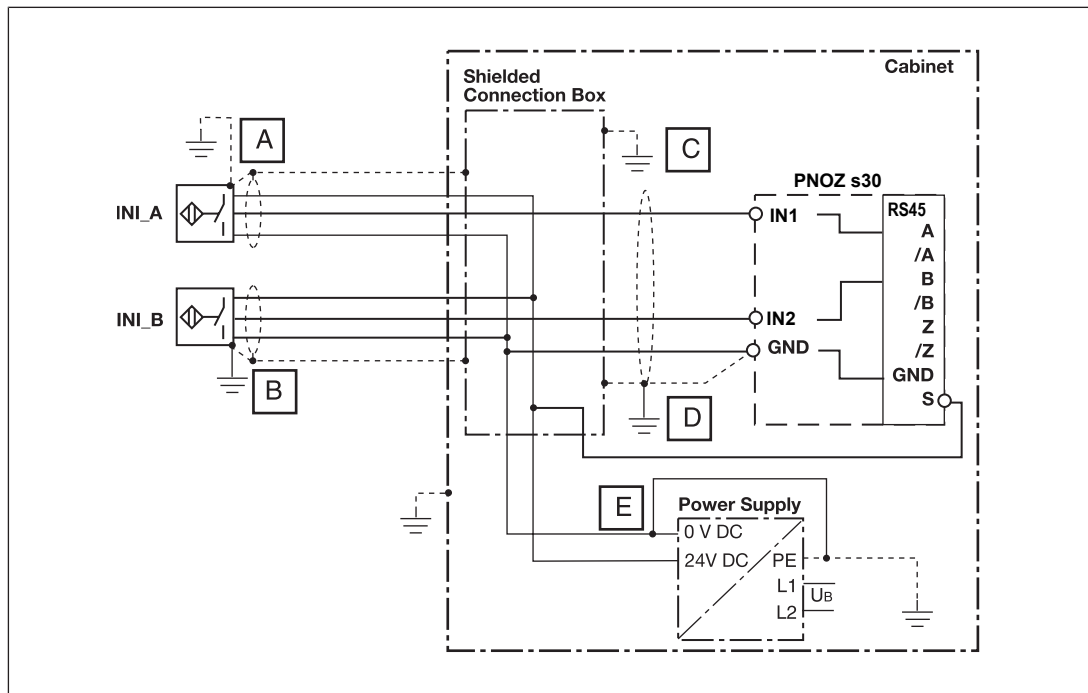
To avoid EMC interference we recommend that the shield on the sensor cables or the housing of the shielded junction box is only connected to earth at a single point:

**A or B or C or D or E**

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

### EMC-compliant wiring for connecting 2 proximity switches



To avoid EMC interference we recommend that the shield on the sensor cables or the housing of the shielded junction box is only connected to earth at a single point:

**A or B or C or D or E**

Conductor loops outside the shield must be avoided.

If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

## 6.2 Display menu - Configuration

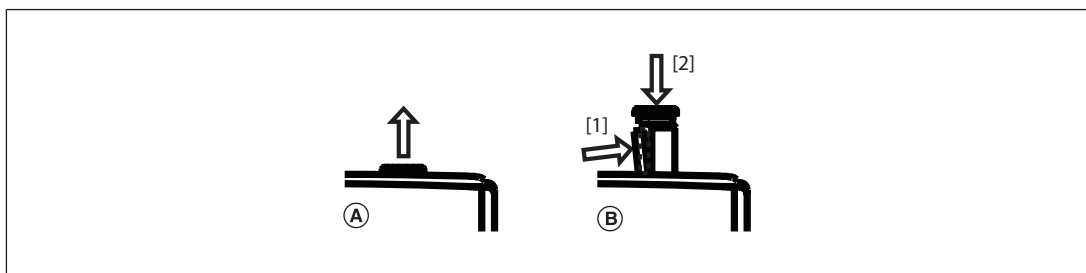
The menu settings are made on the unit's display via a rotary knob. You have the option to make the settings on the knob by hand or with a screwdriver. If you make the settings with a screwdriver, the knob can remain within the unit.

### 6.2.1 Create configuration overview

For a better overview, before entering the configuration values we recommend that they are entered in the attached form *PNOZ\_s30\_Config\_Overview*:

language	input device								global standstill (10 mHz - 1 MHz)		
delay time start-up (0-600s)	Hysteresis (0-50%)	F1	F2	F3	F4	F5	F6	F7	F8	F9	input device settings (10 mHz-1 MHz)
units	P0										f max (A/B)
conversion	P1										f max (Z)
mode select input	P2										ratio (0,0001-400.000:1)
Sel 1 (Y10) Sel 2 (Y11) Sel 3 (Y12) Sel 4 (Y13)	P3										f(A/B):f(Z)
	P4										position window width (1-24.900.000 Imp)
	P5										Pos. 1
	P6										Pos. 2
delay time select input (0-30s)	P7										Pos. 3
assign outputs (functions) delay time effect (outputs) delay time 0 - 30s (outputs) reset mode output out logic	P8										Pos. 4
	P9										incorrect direction (max. wrong) direction (1-24.900.000 Imp)
	P10										direction left max. right
	P11										direction right max. left
	P12										name of configuration
	P13										CRC of configuration
	P14										
	P15										
	Rel. 1 (13/14)	Rel. 2 (23/24)	Ext. 1	Ext. 2	Out 1 (Y32)	Out 2 (Y33)	Out 3 (Y34)	Out 4 (Y35)			

### 6.2.2 Operate rotary knob



Pull out knob (A):

- ▶ until it locks into position
- ▶ Release knob (B) and push it back into the unit:
  - Press the bar on the side of the knob [1] towards the centre of the knob. This releases the knob.
  - Press the knob downwards [2] while keeping the bar pressed in

### 6.2.3 Configure Speed Monitor

The settings are made via the rotary knob, as follows:



Press the knob

- ▶ Confirm selection/setting
- ▶ Switch to menu



Rotate knob

- ▶ Select menu level



- ▶ Set the parameter/numeric value

The speed with which you turn the knob affects the sequence of the menu and numeric values:

- ▶ Slowly: Units
- ▶ Quickly: Tens
- ▶ Very quickly:
  - Setting the numeric value: Hundreds
  - When switching the menu level: Jump to **ESCAPE**



#### NOTICE

Please note that all parameters are set to their default values on delivery. Please check all the safety-related parameters at least, and enter the values that correspond to your application.



#### INFORMATION

If no value is set or amended within 30 s of a menu action, the display reverts to the default display. The current setting remains unchanged. If the master password has been entered, this time increases to 5 minutes.

## 6.2.4 Password protection

The configuration is protected through passwords. There is a master password and a customer password.

Factory setting for both passwords: 0000

The password levels contain different authorisations:

- ▶ **Master password**
  - Display: All settings
  - Edit: All settings
- ▶ **Customer password**
  - Display: All settings
  - Edit:
    - The customer password can be changed.
    - The language can be changed.
    - The settings can be reset to the factory settings.
- ▶ **No password**
  - Edit:
    - The language can be changed.
    - The settings can be reset to the factory settings.

If the settings are reset to the factory settings, the passwords and the language will also be reset to the factory settings.

The passwords can be changed at any time in the menu.  
Enter a password containing 4 characters.

## 6.2.5 Use chip card

The parameters that are set on a unit can be stored on the chip card. The data is stored along with a device identifier, the passwords, the name of the configuration and the check sum. We recommend that you **always** operate the unit with a chip card.

- ▶ If the parameters on a device have been changed due to an error, they can be restored using the backup copy on the chip card.
- ▶ If a unit requires maintenance or needs to be exchanged, the chip card can be used to download the parameters to another unit.



### INFORMATION

If you operate the unit without a chip card, the "Fault" LED will light and the following message will appear once only: **Please Insert SIM Card!**. If you change the parameters, the **Please Insert SIM Card! message will re-appear.**

The message disappears after 30 s or by pressing the rotary knob.

When the chip card is inside the unit:

- ▶ The chip card is checked to verify the device identifier, valid parameters, and ensure that the data is identical.
- ▶ Unit parameters are automatically saved to the chip card during operation. As a result, the chip card always contains a copy of the unit's current internal data. Exception: If you select **Write configuration to SIM: No**.

### 6.2.5.1 Insert chip card

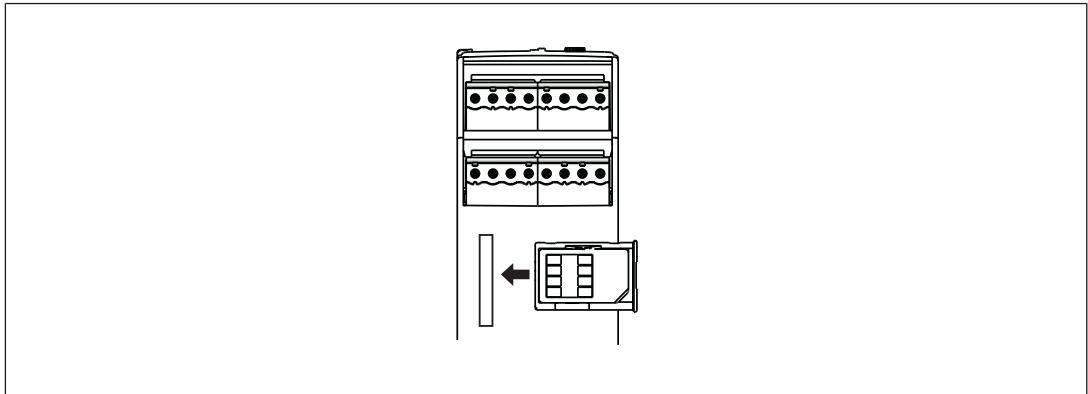


### NOTICE

The chip card contact is only guaranteed if the contact surface is clean and undamaged. For this reason please protect the chip card's contact surface from

- Contamination
- Contact
- Mechanical impact, such as scratches.

Make sure that you do not bend the chip card as you insert it into the chip card slot.



**6.2.5.2 Write data to chip card**

If you are inserting a chip card which has not yet been written by a PNOZ s30, you have the option to:

	Insert chip card	1.		2.	Data is written to the chip card
<b>Please insert SIM Card!</b>	<b>Write configuration to SIM: No?</b>		<b>Write configuration to SIM: Yes?</b>		<b>Current menu</b>

Allow data to be written to the chip card

	Insert chip card	1.	Data is <b>not</b> written to the chip card
<b>Please insert SIM Card!</b>	<b>Write configuration to SIM: No?</b>		<b>Insert rewritable SIM Card!</b>

Do not allow data to be written to the chip card

**6.2.5.3 Read data from chip card**

If you are inserting a chip card which has not yet been written by a PNOZ s30, you have the option to:

	Insert chip card (data on chip card different from device)	1.		2.	Data is read into the device
<b>Current menu</b>	<b>SIM: Name of the configuration (8 characters)</b> <b>CRC: 12345 (0 .. 65535)</b> <b>Load SIM: No?</b>		<b>SIM: Name of the configuration (8 characters)</b> <b>CRC: 12345 (0 .. 65535)</b> <b>Load SIM: Yes?</b>		<b>Current menu</b>

Allow data to be read from the chip card

	Insert chip card (Data on chip card different from device)	1.	Data is <b>not</b> read into the device, data is written to the chip card
<b>Current menu</b>	<b>SIM: Name of the configuration (8 characters)</b> <b>CRC: 12345 (0 .. 65535)</b> <b>Load SIM: No?</b>		<b>Write configuration to SIM: No?</b>  (for more details see "Write data to chip card")

Do not allow data to be read from the chip card

#### 6.2.5.4 Transfer device parameters

You can transfer device parameters from one device to another using the chip card.

Proceed as follows:

- ▶ Remove chip card containing the data from device 1.
- ▶ Insert chip card in device 2.
- ▶ Confirm the message **Load SIM Yes?**.  
The data is transferred.

#### 6.2.5.5 Duplicate chip card

You can also create copies of a chip card and its data.

Proceed as follows:

- ▶ Remove chip card containing the device data.
- ▶ Insert a new chip card into the device.
- ▶ Confirm the message **Write configuration to SIM Yes?**.
- ▶ The new chip card is written.

#### 6.2.6 Menu overview

The tables provide an overview of the menu settings.

The attached Excel file provides a detailed view of the setting options:

*PNOZ\_s30\_Menu\_Overview.*

### 6.2.6.1 Permanent display

If no settings are made, information regarding the configuration and current values are shown on the display.

You can change the permanent display on the display in the "Settings" menu.

### 6.2.6.2 Basic settings Ini pnp pnp

Settings for basic configuration 1

Level	Indication on the display	Description	Settings
1	<b>Load Basic Parameter</b> <b>Ini pnp pnp</b> Default: Load?	Select the default settings with which the basic configuration menu "Ini pnp pnp" is to be called: <b>-Load:</b> The basic parameters are loaded. Switches afterwards to the basic menu "Ini pnp pnp". The basic parameters should always be loaded when commissioning for the first time. <b>-Edit:</b> The basic parameters are not loaded, i.e. all parameters are retained. The basic menu parameters can be changed within the permitted boundaries. <b>-ESCAPE:</b> Exits the basic menu.	
2	<b>Standstill</b> <b>Rel.1 Out 1</b> Default: 2.00 Hz	Enter standstill frequency	100 mHz ... 10.0 Hz
2	<b>v max:</b> <b>Rel.2 Out 2</b> Default: 500 Hz	Enter the max. permitted speed	10 mHz ... 3.00 kHz

Other, pre-defined settings:

- ▶ **Encoder type**  
2 pnp type proximity switches
- ▶ **Parameter set/select input**  
P0, select inputs are ignored (Select inputs mode: "None")
- ▶ **Hysteresis**  
Standstill and speed, 2 % each
- ▶ **Output assignment**
  - Standstill: Relay output Rel. 1 and semiconductor output Out 1
  - Speed: Relay output Rel. 2 and semiconductor output Out 2
- ▶ **Reset mode**
  - Rel. 1, Rel. 2 Out 1, Out 2: Automatic reset

- ▶ **Switch delay**  
None
- ▶ **Max. encoder frequency**  
3.5 kHz

### 6.2.6.3 Basic settings for the rotary encoder

Settings for basic configuration 2

Level	Indication on the display	Description	Settings
1	<b>Load Basic Parameter</b> <b>Encoder:</b> Default: Load?	Select the default settings with which the basic configuration menu "Rotary encoder" is to be called:  - <b>Load:</b> The basic parameters are loaded. Switches afterwards to the basic menu "Rotary encoder".  The basic parameters should always be loaded when commissioning for the first time.  - <b>Edit:</b> The basic parameters are not loaded, i.e. all parameters are retained. The basic menu parameters can be changed within the permitted boundaries.  - <b>ESCAPE:</b> Exits the basic menu.	
2	<b>Encoder</b> Default: TTL differential	Select rotary encoder type	-TTL differential (A, /A, B, /B) -TTL single ended (A, B) -HTL differential (A, /A, B, /B) -HTL single ended (A, B) -sin/cos 1 Vss (A, /A, B, /B) -Hiperface (A, /A, B, /B)
2	<b>Standstill Rel.1 Out 1</b> Default: 100 Hz	Enter standstill frequency	10 mHz to 1.00 kHz
2	<b>v max: Rel.2 Out 2</b> Default: 5.00 kHz	Enter the max. permitted speed	10 mHz to 1.00 MHz

Other, pre-defined settings:

- ▶ **Switch functions**
  - **Direction (F3)**  
Direction left  
Tolerance for wrong direction = 10 Imp

- **Direction (F4)**  
 Direction right  
 Tolerance for wrong direction = 10 Imp
- ▶ **Parameter set/select input**  
 P0, select inputs are ignored (Select inputs mode: "None")
- ▶ **Hysteresis**  
 Standstill and speed, 2 % each
- ▶ **Output assignment**
  - Standstill: Relay output Rel. 1 and semiconductor output Out 1
  - Speed: Relay output Rel. 2 and semiconductor output Out 2
  - Direction left: External output Ext. 1 and semiconductor output Out 3
  - Direction right: External output Ext. 2 and semiconductor output Out 4
- ▶ **Reset mode**
  - All outputs: Automatic reset
- ▶ **Switch delay**  
 None
- ▶ **Max. encoder frequency**  
 1 MHz

**6.2.6.4 Settings**

Level	Indication on the display	Description	Settings
1	<b>Permanent display</b> Default: H : Min : Sec (system time) v (current speed of track AB) Position	Permanent display Current values and information regarding configuration are displayed. You can change the permanent display on the display	<b>Display combinations:</b> - vz (current speed of track Z) - v (current speed of track AB) - Position  - Switch functions F1 ... F9 - v (current speed of track AB) - Position  - Line 1/2: F1/F2, F3/F2, F5/F4, F7/F6 or F9/F8 (parameters selected via select inputs). v (current speed of track AB)  - H : Min : Sec (system time:) - v (current speed of track AB) - Position

Level	Indication on the display	Description	Settings
1	<b>Displ. Units</b> <b>Speed: Dist:</b> Default: Hz pulse	Select unit of speed and distance (position).	<b>Speed</b> (rotational speed) - <b>Pos.</b> (distance/position) Hz Imp (pulse) Hz Edg (edge) m/s m m/min m m/h m rps rot rpm rot
1	<b>Conversion</b> Default: 1Hz = 1 Imp / s	Unit conversion. Enter ratio of unit to pulses.	Display 1 Hz = 1 Imp/s 1 Hz = 4 Edg/s 1 m = x Imp (x = 1 ... 10.000.000 Imp) 1 rot = x Imp (x = 1 ... 10.000.000 Imp)
1	<b>Encoder Settings</b>	Create encoder configuration for the tracks A, /A, B, /B, Z, /Z, S	



Level	Indication on the display	Description	Settings
2	<b>Encoder</b> Default: Undefined	Select pre-defined encoder types for the tracks A, B and Z: Proximity switch Rotary encoder - with and without inverted signals - with or without Z index (0 index) - with proximity switch at track Z Note: If "Undefined" is selected, an error message is shown when you confirm the menu	<b>No encoder selected:</b> - Undefined  <b>Proximity switch (Ini):</b> - Initiator A: pnp B: pnp - Initiator A: npn B: npn - Initiator A: pnp B: npn - Initiator A: npn B: pnp  <b>Rotary encoder:</b> <b>TTL</b> - TTL differential (A, /A, B, /B) - TTL single ended (A, B) <b>TTL with Z index</b> - TTL diff. Z index (A, /A, B, /B, Z, /Z) - TTL single Z index (A, B, Z) <b>HTL</b> - HTL differential (A, /A, B, /B) - HTL single ended (A, B) <b>HTL with Z index</b> - HTL diff. Z index (A, /A, B, /B, Z, /Z) - HTL single Z index (A, B, Z) <b>Sin/Cos 1 Vss</b> - sin/cos 1 Vss (A, /A, B, /B) <b>Sin/Cos 1 Vss with Z index</b> - sin/cos 1 Vss Z Index (A, /A, B, /B, Z, /Z) <b>Hiperface</b> - Hiperface (A, /A, B, /B)

Level	Indication on the display	Description	Settings
			<p><b>Rotary encoder + pnp proximity switch</b></p> <p><b>TTL + pnp proximity switch *</b></p> <ul style="list-style-type: none"> <li>- TTL diff. (A, /A, B, /B), Z Freq Inipnp (Z)</li> <li>- TTL single (A, B), Z Freq Inipnp (Z)</li> </ul> <p><b>HTL + pnp proximity switch *</b></p> <ul style="list-style-type: none"> <li>- HTL diff. (A, /A, B, /B), Z Freq Inipnp (Z)</li> <li>- HTL single (A, B), Z Freq Ini pnp (Z)</li> </ul> <p><b>sin/cos 1 Vss + pnp proximity switch *</b></p> <ul style="list-style-type: none"> <li>- sin /cos 1 Vss (A, /A, B, /B), Z Freq Inipnp (Z)</li> </ul> <p><b>Hiperface + pnp proximity switch *</b></p> <ul style="list-style-type: none"> <li>- Hiperface (A, /A, B, /B), Z Freq Inipnp (Z)</li> </ul> <p>* Alternatively, a track from an HTL encoder can also be used instead of a pnp proximity switch</p> <p>The configuration is the same as with the pnp proximity switch as Z-frequency monitoring.</p>
2	<b>Track AB</b>	Settings for tracks A and B	
3	<b>Type AB</b>	For information only: Information on configured encoder type on tracks A and B	
3	<b>Track /A/B</b>	For information only: Information on the use of the inverted tracks /A and /B: No track /A /B or Inverted (inverted tracks /A and /B used) or U <sub>ref</sub> external (e.g. "Hiperface" encoder type)	
3	<b>AB Direction</b> Default: Normal	Select direction for tracks A and B Information: This function is used to display a forward movement as positive linear/rotational speed, irrespective of the installation of the rotary encoder.	- Normal - Inverted

Level	Indication on the display	Description	Settings
3	<b>Track AB fmax</b> Default: 10 mHz	Enter max. frequency of the encoder on tracks A and B Important: The frequency must be less than or equal to the max. encoder frequency specified in the encoder's data sheet and less than the max. speed of the monitored drive.	10 mHz ... 1,00 MHz
2	<b>Track Z</b>	Settings for track Z	
3	<b>Type Z</b>	For information only: Information on configured encoder type at track Z	
3	<b>Track /Z</b>	For information only: Information on the use of the inverted track /Z: No track /Z or Inverted (inverted track /Z used)	
3	<b>Track Z fmax</b> Default: 10 mHz	Enter max. frequency of the encoder on track Z Important: The frequency must be less than the max. encoder frequency specified in the encoder's data sheet	10 mHz ... 1,00 MHz
2	<b>fAB/fZ Ratio</b> Default: 1,0000 : 1	Enter the ratio of the frequency on tracks AB "fAB" to the frequency on track Z "fZ". Used to check the Z index or for frequency monitoring on track Z <b>About</b> Calculating the frequency ratio: Enter permanent display: "vz: v: Position:" Switch on drive Read vz and v Divide v/vz Enter result as ratio fAB to fZ	0,0001 ... 400.000 : 1
2	<b>Track S</b>	Settings for track S (error track)	
3	<b>Track S</b> Default: Not used	Use of track S: - Not used (track S is not used) - Evaluation (track S is used)	- Not used - Evaluation

Level	Indication on the display	Description	Settings
3	<b>Track S Umax</b> Default: 6.0 V	Enter max. voltage at track S. If the voltage is > Umax, an error is displayed and the outputs are switched off.	0.0 V ... 30.0 V
3	<b>Track S Umin</b> Default: 2.0 V	Enter min. voltage at track S. If the voltage is < Umin, an error is displayed and the outputs are switched off.	0.0 V ... 30.0 V
1	<b>Delay Time Start-up</b> Default: 0.00 s	Select start-up delay (The start-up phase of the PNOZ s30 is extended by this time. The encoder signals are not evaluated until after the start-up phase.)	0 ... 600 s
1	<b>Function Parameter</b>	Select function parameter	
2	<b>Standstill v max:</b> Default: 2.00 Hz	Select standstill frequency	10 mHz ... 1.00 MHz or the corresponding value in the selected unit
2	<b>(F1 ... F9) Parameter</b>	Enter parameter for the switch functions F1 ... F9	
3	<b>(F1 ... F9) (P0 ... P15) Parameter</b> Default: 10 mHz	For each switch function F1 ... F9, 16 parameters P0 ... P15 can be configured.	
4	<b>(F1 ... F9) (P0 ... P15) Teach v max:</b> Display: Current linear/rotational speed	The current linear/rotational speed is displayed and can be adopted as a limit value.	
4	<b>(F1 ... F9) (P0 ... P15) v max: Standstill</b>	"Standstill" is displayed and can be adopted Info: The standstill frequency is selected globally in the menu "Standstill v max:" (see above)	
4	<b>(F1 ... F9) (P0 ... P15) v max 2,00 kHz</b>	Select linear/rotational speed limit	10 mHz ... 1.00 MHz or the corresponding value in the selected unit

Level	Indication on the display	Description	Settings
4	(F1 ... F9) (P0 ... P15) Function Position (1 ... 4)	Select position monitoring 1 ... 4	
4	(F1 ... F9) (P0 ... P15) (Direct. Left, Direct. Right)	Select left-hand or right-hand direction monitoring	
1	Assign Outputs	Assign functions to outputs	
2	Output (Rel.1... Out 4) Default: Off	Each output can be assigned a switch function (F1 ... F9) or a range (F2-F3, F4-F5, F6-F7, F8-F9). Each output can also be used as an error output (error) or be switched off (off). When used as an error output, the following applies: Error: Output off No error: Output on For ranges, the following applies: The lower range limit is the switch function with the lower number (e.g. F2), The upper range limit is the switch function with the higher number (e.g. F3). Outputs: Rel.1: Relay output 1 Rel.2: Relay output 2 Ext.3: External output 1 Ext.4: External output 2 Out 1 ... Out 4: Semiconductor outputs 1 ... 4	- Off - F1 ... F9 - F2-F3 - F4-F5 - F6-F7 - F8-F9 - Error
1	Start mode	Select start behaviour	
2	Start mode (Rel.1... Out 4) Default: Monitored /	Select start mode for each output separately Automatic: Automatic start Monitored /: Monitored start with rising edge at S34 Monitored \: Monitored start with falling edge at S34	- Automatic - Monitored / - Monitored \

## 6.2.6.5 Advanced settings

Level	Menu designation	Description	Settings
1	<b>Positions Parameter</b>	Settings for position monitoring functions	
2	<b>Position (1 ... 4) Window width</b> Default: 1 Imp	Enter width of position window for position monitoring functions 1 ... 4	1 ... 24.900.000 Imp or the corresponding value in the selected unit
1	<b>Direction Parameter</b>	Settings for direction monitoring	
2	<b>(Direct. left max. right, Direct. right max. left)</b> Default: 0 Imp	Enter max. tolerated number of pulses (or Edg, m, rot) in the wrong direction.	1 ... 24.900.000 Imp or the corresponding value in the selected unit
1	<b>Mode Select Input</b> Default: none	Setting for using the select inputs	- All 16 - 1 from 4 - None
1	<b>Select Input Delay</b> Default: tdl: 0 ms	Enter delay time of the select inputs Y10 – Y13 Info: The states of the select inputs are only adopted if they were unchanged during the set time.	0 ... 30.0 s
1	<b>Function Hysteresis</b>		
2	<b>(F1 ... F9) Function Hysteresis</b> Default: 1 %	Enter hysteresis for the switch functions F1 ... F9 (not effective with position and direction monitoring)	0 ... 50 %
1	<b>Output Delay</b>	Setting for the delay effect and delay time for the outputs	
2	<b>Delay Output (Rel.1 ... Out 4)</b> Default: On 0 ms (display only)	Setting for the delay time effect and delay time for the respective output	

Level	Menu designation	Description	Settings
3	<b>Delay Effect (Rel.1 ... Out 4)</b> Default: On delay	Enter whether the delay time is to be activated when switching on, switching off, or switching on and off.	- On - Off - On Off
3	<b>Delay Time (Rel.1 ... Out 4)</b> Default: tdO: 0 ms	Select delay time for the respective output	0 ... 30.0 s
1	<b>Output Out Logic</b>	Setting for the switching direction of the semiconductor outputs	
2	<b>Output (Out 1 ... Out 4) Logic</b> Default: N/O contact	Select the switching direction of the semiconductor outputs Out 1 ... Out 4: N/O contact (normally energised mode) N/C contact (normally de-energised mode)	- N/O contact - N/C contact
1	<b>Name of Configuration</b> Default: Default	Enter name of the configuration The name may be a max. of 8 characters in length It is stored on the chip card	.....
1	<b>Password Settings</b>	Change passwords Please note: In the "Default Settings" menu, the passwords are reset to the default setting: 0000.	
2	<b>Master PW</b>	Change master password	0000 ... 9999
2	<b>Customer PW</b>	Change customer password	0000 ... 9999
2	<b>Language</b> Default: English	Select menu language	- English - German - French
1	<b>Default Settings</b>	Select whether the parameters are to be reset to the default settings YES: All parameters are reset to the default values. The language is set to English and all passwords are set to 0000.	- ESCAPE - YES

## 6.2.6.6 Information

Level	Menu designation	Description	Display/Settings
1	<b>System Time</b>	Time that the device is switched on	xxx.xxx h xx min xx s
1	<b>Max. Speed Track AB</b>	Max. measured linear/rotational speed at tracks A and B The value can be reset to 0	0 ... 4.29 MHz or the corresponding value in the set unit Reset: Reset: YES?
1	<b>Max. Speed Track Z</b>	Max. measured linear/rotational speed at track Z The value can be reset to 0	0 ... 4.29 MHz or the corresponding value in the set unit Reset: Reset: YES?
1	<b>Relay (Ctrl, 1, 2) Cycles</b>	Information: Total number of relay operations Relay Ctrl (root relay, common 2nd shutdown route) Relay 1 (relay output 1: 11-12, 13-14) Relay 2 (relay output 2: 21-22, 23-24)	0 ... 6.000.000 x, > 6.000.000 x
1	<b>CRC of Configuration</b>	Check sum of configuration parameters	0 ... 65535

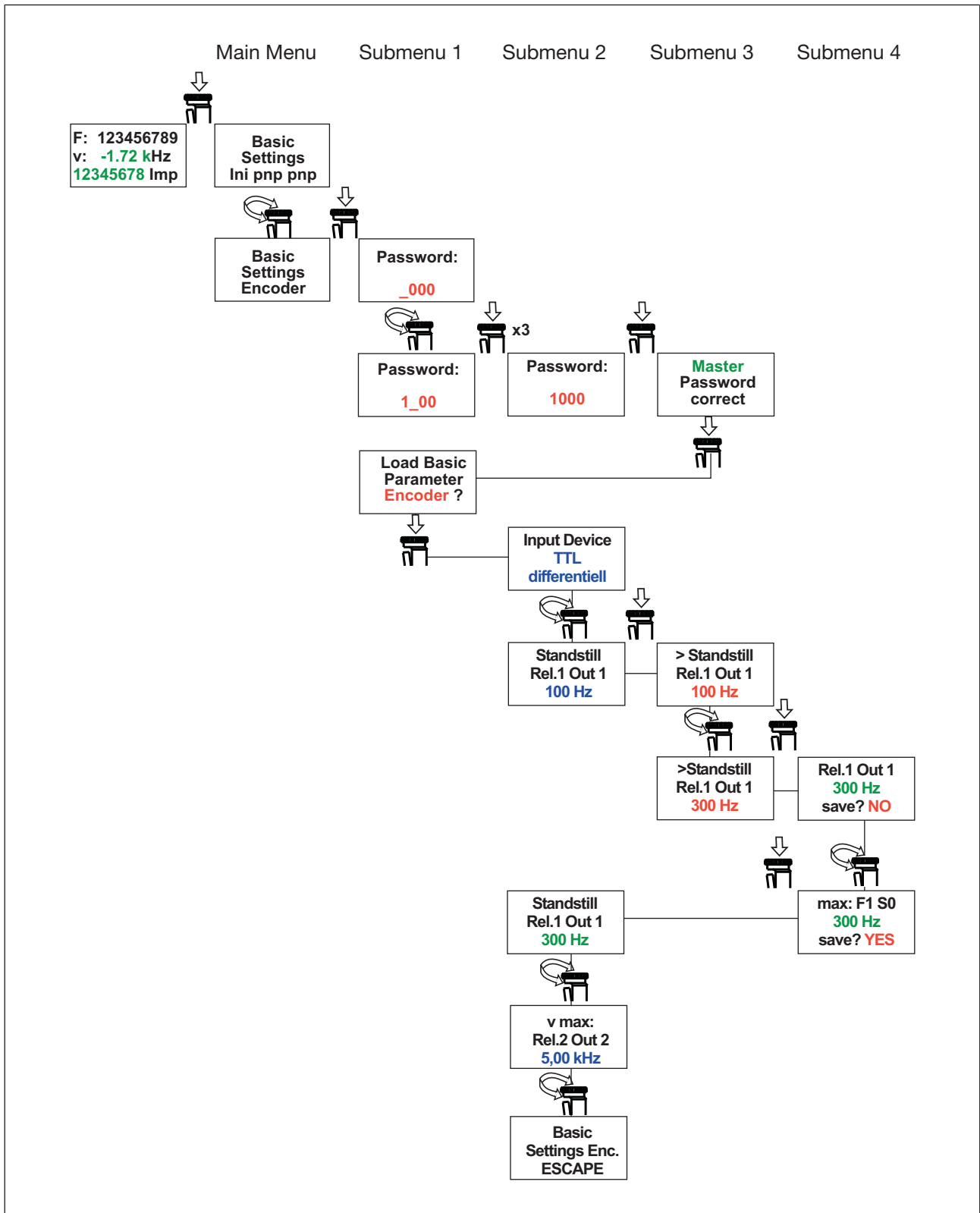


Level	Menu designation	Description	Display/Settings
1	<b>Error Stack Entries</b>	<p>Error stack entries</p> <p>Up to 20 error stack entries are displayed</p> <p>Repairable errors: Level 2, 3 and 4 (can be rectified by user)</p> <p>System errors: Level 2 and 3 (internal error, information for Pilz Service).</p> <p>See section entitled "Error stack entries"</p>	<p>Repairable error:</p> <p>Level 2:</p> <ol style="list-style-type: none"> <li>1. Line: Seq. No. "Err.:", error number</li> <li>2.+3. Line: Plain text to describe error for the user</li> </ol> <p>Level 3:</p> <ol style="list-style-type: none"> <li>1. Line: Seq. No. "repairable"</li> <li>2. Line: "System time:"</li> <li>3. Line: System time when the error occurred</li> </ol> <p>Level 4:</p> <p>Information for Pilz Service</p> <p>System errors:</p> <p>Level 2:</p> <ol style="list-style-type: none"> <li>1. Line: Seq. No. "Err.:", error number</li> <li>2. Line: "System Error"</li> <li>3. Line: System time when the error occurred</li> </ol> <p>Level 3:</p> <p>Information for Pilz Service</p>
1	<b>Input Module SW Version Va.b</b>	For internal purposes only	
1	<b>Main Unit SW Version Va.b</b>	For internal purposes only	

Level	Menu designation	Description	Display/Settings
-	<b>Actual Errors</b>	<p>Up to 8 errors are displayed.</p> <p>Repairable errors: Level 2, 3 and 4 (can be rectified by user)</p> <p>System errors: Level 2 and 3 (internal error, information for Pilz Service).</p> <p>The error messages can be hidden with "ESCAPE".</p>	<p>Repairable error:</p> <p>Level 2:</p> <ol style="list-style-type: none"> <li>1. Line: Seq. No. "Err.:", error number</li> <li>2.+3. Line: Plain text to describe error for the user</li> </ol> <p>Level 3:</p> <ol style="list-style-type: none"> <li>1. Line: Seq. No. "Repairable"</li> <li>2. Line: "System Time:"</li> <li>3. Line: System time when the error occurred</li> </ol> <p>Level 4:</p> <p>Information for Pilz Service</p> <p>System errors:</p> <p>Level 2:</p> <ol style="list-style-type: none"> <li>1. Line: Seq. No. "Err.:", error number</li> <li>2. Line: "System Error"</li> <li>3. Line: System time when the error occurred</li> </ol> <p>Level 3:</p> <p>Information for Pilz Service</p>
-	<b>Error Faulty Signal: A/A B/B Z/Z</b>	<p>Error message: Wrong signal at one or more tracks.</p> <p>The message</p> <ul style="list-style-type: none"> <li>- is continually updated.</li> <li>- can be ignored temporarily.</li> </ul>	
-	<b>AB frequency deviation</b>	<p>Error message: Frequency difference between the proximity switches on tracks A and B</p> <p>The message</p> <ul style="list-style-type: none"> <li>- is continually updated</li> <li>- can be ignored temporarily</li> </ul>	
-	<b>Chip card messages</b>		
-	<b>Please insert SIM Card!</b>	<p>Appears when the device is operated without a chip card or when a defective chip card is inserted, appears again when parameters are changed.</p> <p>Info:</p> <p>The message disappears after 30 s or by pressing the rotary knob</p>	

Level	Menu designation	Description	Display/Settings
-	<b>Please insert writable SIM Card!</b>	Appears when you answer "NO" to "Load SIM" and "Write Configuration to SIM"	
-	SIM: ..... CRC: ..... <b>Load SIM:</b> Default: NO?	Appears when device detects a chip card with a valid configuration.  -> Select whether the data on the chip card is to be transferred to the device.	- NO? - YES?
-	<b>Write Configuration to SIM:</b> Default: NO?	Appears - When a chip card has been used that does not yet contain data - When a chip card has been used that does not contain any valid data - When <b>Load SIM:NO?</b> has been selected  -> Select whether the data on the chip card is to be saved.	- NO? - YES?
-	<b>Password messages</b>		
-	<b>Master PW required:</b> Default: 0000	-> Enter master password	0000 ... 9999
-	<b>Password required:</b> Default: 0000	-> Enter customer password	0000 ... 9999

### 6.2.7 Example: Configure basic configuration 2



## 7 Operation

### 7.1 Display elements for device diagnostics

#### 7.1.1 LEDs

Key:

	LED on
	LED flashes

LED						Error
Power	In1	In2	Rel 1	Rel 2	Fault	
						Supply voltage is present
						At least one of the internal supply voltages is outside the permitted range.
						A high signal is present on track A (terminal In1 or RJ45).
						Error on track In1 or A
						A high signal is present on track B (terminal In2 or RJ45).
						Error on track In2 or B
						Relay output 1 is switched on
						Error on relay output 1
						Relay output 2 is switched on
						Error on relay output 2
						Fault that can be repaired by the user leading to safe condition.
						Internal error leading to a safe condition.

## 7.1.2 Display

### 7.1.2.1 Error stack entries

Up to 20 status and error messages are stored in the unit and can be called up via the display (see section entitled "Display Menu – Configuration – Menu Overview). They can also be called up if the error has been rectified and the unit has been restarted.

The following information is shown on the display:

- ▶ Sequential number of an error stack entry (1 ... 20).
- ▶ Error number (0 ... 65 535)
- ▶ Error category
  - Errors that can be rectified by the user are described in the following list  
Remedy: Rectify error; if necessary, contact Pilz
  - Internal errors (system errors, all errors that are not described in the list)  
Remedy: Switch device on and off, contact Pilz

### 7.1.2.2 Current error messages

If an error is detected, the "Fault" LED lights up on the device and an error message appears on the display (see error stack).

Up to 8 current error messages are shown on the display.

A message is shown until the error is rectified and the device has been switched off and then on again.

#### List of the errors that can be rectified by the user

Error no.	Error message	Description	Remedy
2	PNOZ s30 cold started	The unit is ready for operation (Error stack entry)	Purely for information
3	Brown Out occurred	Supply voltage too low	Check supply voltage
2000	Wrong signal A ... /Z	Unfeasible signal from encoder	-Ensure that there is no open circuit in the wiring of input A... / Z -Ensure that the correct encoder is configured and connected -Ensure that the encoder operates correctly
2001	AB frequency > fmax AB	The maximum frequency of the encoder at tracks AB was exceeded	-Enter a max. frequency for "Track AB fmax" that is not exceeded during normal operation -Ensure that a suitable encoder is connected

Error no.	Error message	Description	Remedy
2002	A frequency > fmax AB	The maximum frequency of the proximity switch at track A was exceeded	-Enter a max. frequency for "Track AB fmax" that is not exceeded during normal operation -Ensure that a suitable proximity switch is connected
2003	B frequency > fmax AB	The maximum frequency of the proximity switch at track B was exceeded	-Enter a max. frequency for "Track AB fmax" that is not exceeded during normal operation -Ensure that a suitable proximity switch is connected
2004	Z frequency > fmax Z	The maximum frequency of the encoder at track Z was exceeded	-Enter a max. frequency for "Track AB fmax" that is not exceeded during normal operation -Ensure that a suitable encoder is connected
2007	fAB / fZ does not fit !	The ratio of the AB frequency does not match the fAB/fZ ratio	-Change fAB/fZ in the menu -Ensure that there is no broken shear pin or slippage -Ensure that both encoders are operating correctly
4010	FL K1-K2 of Extens.Device	Feedback loop K1-K2 of expansion module open	-Ensure that the feedback loop is wired correctly -Ensure that the expansion module operates correctly
4011	FL K3-K4 of Extens.Device	Feedback loop K3-K4 of expansion module open	-Ensure that the feedback loop is wired correctly -Ensure that the expansion module operates correctly
4012	Extension Interface open	The terminator on the expansion interface is not connected	-Connect terminator -Ensure that the expansion module operates correctly
5000	Input Device undefined!	No encoder configured (delivery condition, default values)	-Create the encoder configuration in the "Encoder settings" menu
5003	Pos. or Dir. not with Ini	Position monitoring or direction monitoring configured, although "Initiator" is selected as the encoder	-Do not configure direction or position monitoring - Select rotary encoder
6000	AB frequency deviation	Frequency difference between proximity switches A and B e.g. due to edge jitter at standstill over an extended period	-Reset error via a valid signal above the standstill limit or with a falling edge at input S34 (Start) - Ensure that the proximity switches operate correctly

Error no.	Error message	Description	Remedy
7000	Select Input not 1 from 4 !	A parameter set other than P1, P2, P4 or P8 is selected in mode "1 from 4".	- Select a longer delay time for the select inputs in order to filter out invalid signals resulting from contact bounce or an intermediate state
10241	Stuck at High Track A or /A	A high signal is always present at track A or /A.	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that there is no short circuit in the wiring
10242	Stuck at Low Track A or /A	A low signal is always present at track A or /A.	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that there is no short circuit in the wiring
10243	Stuck at High Track B or /B	A high signal is always present at track B or /B.	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that there is no short circuit in the wiring
10244	Stuck at Low Track B or /B	A low signal is always present at track B or /B.	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that there is no short circuit in the wiring
10245	Signal Offset Track A	The signal at track A has a DC offset	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that the wiring is correct
10246	Signal Offset Track /A	The signal at track /A has a DC offset	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that the wiring is correct
10247	Signal Offset Track B	The signal at track B has a DC offset	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that the wiring is correct



Error no.	Error message	Description	Remedy
10248	Signal Offset Track /B	The signal at track /B has a DC offset	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that the wiring is correct
10249	Signal error AB: Sin2 Cos2	No feasible signal at the tracks AB	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that the wiring is correct -Check supply voltage
10250	Difference-Signal Error	No feasible signal at the tracks A and /A or B and /B	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that the wiring is correct -Ensure that there is not too much interference on the encoder signals
10251	Z-Index missing	No index signal at track Z	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that the wiring is correct - Check the configuration of the frequency ratio $f_{AB}$ to $f_Z$
10252	Z index at wrong posit.	No feasible signal at track Z	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that the wiring is correct - Check the configuration of the frequency ratio $f_{AB}$ to $f_Z$
10255	Signal on inverted track	The inverted tracks carry a voltage signal Target status: no signal (not connected)	-Ensure that the encoders are configured correctly -Ensure that the wiring is correct

Error no.	Error message	Description	Remedy
10256	Ini pnp pnp both inactive	Both proximity switches are inactive at the same time	<p>-Install proximity switches such that one proximity switch is always activated.</p> <p>-Ensure that the encoders are configured correctly</p> <p>-Ensure that the proximity switches operate correctly</p> <p>-Ensure that the supply voltage is present at the proximity switches</p> <p>Ensure that the proximity switches are wired correctly</p>
10257	Ini npn npn both inactive	Both proximity switches are inactive at the same time	<p>-Install proximity switches such that one proximity switch is always activated.</p> <p>-Ensure that the encoders are configured correctly</p> <p>-Ensure that the proximity switches operate correctly</p> <p>-Ensure that the supply voltage is present at the proximity switches</p> <p>Ensure that the proximity switches are wired correctly</p>
10258	Ini pnp npn both inactive	Both proximity switches are inactive at the same time	<p>-Install proximity switches such that one proximity switch is always activated.</p> <p>-Ensure that the encoders are configured correctly</p> <p>-Ensure that the proximity switches operate correctly</p> <p>-Ensure that the supply voltage is present at the proximity switches</p> <p>Ensure that the proximity switches are wired correctly</p>
10259	Ini npn pnp both inactive	Both proximity switches are inactive at the same time	<p>-Install proximity switches such that one proximity switch is always activated.</p> <p>-Ensure that the encoders are configured correctly</p> <p>-Ensure that the proximity switches operate correctly</p> <p>-Ensure that the supply voltage is present at the proximity switches</p> <p>Ensure that the proximity switches are wired correctly</p>

Error no.	Error message	Description	Remedy
10260	Ini Signal /A Not permitted	Invalid signal at track /A	-Ensure that the encoders are configured correctly -Ensure that the wiring is correct
10261	Ini Signal /B Not permitted	Invalid signal at track /B	-Ensure that the encoders are configured correctly -Ensure that the wiring is correct
10262	Ini Signal A invalid	The signal at track A is outside the permitted voltage range	-Ensure that the encoders are configured correctly -Ensure that the wiring is correct
10263	Ini Signal /B invalid	The signal at track B is outside the permitted voltage range	-Ensure that the encoders are configured correctly -Ensure that the wiring is correct
10264	Track S Error wrong voltage	The voltage at track S is outside of the permissible range (e.g. because the encoder has detected an internal error and signals this via track S)	-Check supply voltage of the encoders -Ensure that the wiring is correct -Check configuration of the min. and max. voltage at track S "Track S Umax / Umin" -Ensure that the encoder operates correctly
10266	Stuck at High Track Z or /Z	A high signal is always present at track Z or /Z.	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that there is no short circuit in the wiring
10267	Stuck at Low Track Z or /Z	A low signal is always present at track Z or /Z.	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that there is no short circuit in the wiring
10268	Signal error Track A or B	No feasible signal at the tracks AB	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that the wiring is correct -Check supply voltage.
10269	Signal error Track /A or /B	No feasible signal at the tracks /A/B	-Ensure that the encoders are configured correctly -Ensure that the encoder operates correctly -Ensure that the wiring is correct -Check supply voltage.

### 7.1.2.3 Open circuit message

If an open circuit error is detected, the "Fault" LED lights up on the device, the outputs are switched off and an error message appears on the display.

The error message is continually updated. It will be displayed until the error is rectified.

The outputs will not switch back on until all the start-up conditions are met.

Error message	Description	Remedy
Error Signal: A/A B/B Z/Z	No feasible signal at one or more tracks	- Ensure that there is no open circuit in the wiring of tracks A... /Z - Ensure that the correct encoder is configured and connected - Ensure that the encoder operates correctly.

### 7.1.2.4 Frequency difference message on proximity switch

If a frequency difference error is detected, the "Fault" LED lights up on the device and a warning message appears on the display: "AB frequency deviation".

The warning message disappears automatically once valid signals are again present for both proximity switches. The Fault LED also goes out.

If the warning message appears, it will no longer be possible to carry out configured frequency range monitoring. The output or outputs will react as if the configured range has been violated.

If the frequency difference is present for an extended period, without a valid signal, greater than the global standstill frequency, from the two proximity switches, error message 6000 will appear (see "Current error messages"), all outputs will switch off and the Fault LED will light up.

The error message disappears automatically if

- ▶ Valid signals, greater than the global standstill frequency, are detected from both proximity switches
- or
- ▶ A falling edge is detected at start input S34

The outputs will not switch back on until all the start-up conditions are met.

Warning message	Description	Remedy
AB frequency deviation	Frequency of the proximity switch at track A differs from the frequency of the proximity switch at track B for too long and by too much.	- Ensure that the proximity switches operate correctly - Check whether a proximity switch constantly switches due to the drive's edge jitter.

## 8 Technical details

<b>General</b>	<b>750330</b>	<b>751330</b>
Approvals	CCC, CE, GOST, TÜV, cULus Listed	CCC, CE, GOST, TÜV, cULus Listed
<b>Electrical data</b>	<b>750330</b>	<b>751330</b>
Supply voltage		
Voltage	<b>24 - 240 V</b>	<b>24 - 240 V</b>
Kind	<b>AC/DC</b>	<b>AC/DC</b>
Voltage tolerance	<b>-15 %/+10 %</b>	<b>-15 %/+10 %</b>
Output of external power supply (AC)	<b>9,0 VA</b>	<b>9,0 VA</b>
Output of external power supply (DC)	<b>5,5 W</b>	<b>5,5 W</b>
Frequency range AC	<b>50 - 60 Hz</b>	<b>50 - 60 Hz</b>
Residual ripple DC	<b>160 %</b>	<b>160 %</b>
Continuous duty	<b>100 %</b>	<b>100 %</b>
Max. inrush current impulse		
Current pulse, start circuit	<b>0,06 A</b>	<b>0,06 A</b>
Current pulse, feedback loop	<b>0,06 A</b>	<b>0,06 A</b>
Supply voltage for semiconductor output	<b>24,0 V</b>	<b>24,0 V</b>
Voltage tolerance	<b>-20% / +20%</b>	<b>-20% / +20%</b>
Voltage at		
Start circuit DC	<b>24,0 V</b>	<b>24,0 V</b>
Feedback loop DC	<b>24,0 V</b>	<b>24,0 V</b>
Current at		
Start circuit DC	<b>5,0 mA</b>	<b>5,0 mA</b>
Feedback loop	<b>5,0 mA</b>	<b>5,0 mA</b>
Number of output contacts		
Safety contacts (N/O), instantaneous	<b>2</b>	<b>2</b>
Auxiliary contacts (N/C)	<b>2</b>	<b>2</b>
Unit fuse protection min.	<b>1,00 A</b>	<b>1,00 A</b>
Unit fuse protection F1 max.	<b>Max. conductor cross section</b>	<b>Max. conductor cross section</b>
<b>Proximity switch input</b>	<b>750330</b>	<b>751330</b>
Number of inputs	<b>2</b>	<b>2</b>
Input signal level		
Signal level at "1"	<b>11 - 30 V</b>	<b>11 - 30 V</b>
Signal level at "0"	<b>-3 - 5 V</b>	<b>-3 - 5 V</b>
Input resistance	<b>22 kOhm</b>	<b>22 kOhm</b>
Input's frequency range	<b>0 - 1.000 kHz</b>	<b>0 - 1.000 kHz</b>
Configurable monitoring frequency		
Without hysteresis	<b>10 mHz - 1.000 kHz</b>	<b>10 mHz - 1.000 kHz</b>
<b>Incremental encoder input</b>	<b>750330</b>	<b>751330</b>
Number of inputs	<b>1</b>	<b>1</b>

<b>Incremental encoder input</b>	<b>750330</b>	<b>751330</b>
Connection type	RJ45 female connector, 8-pin	RJ45 female connector, 8-pin
Input signal level	0,5 - 30,0 Vss	0,5 - 30,0 Vss
Phase position for the differential signals A, /A and B,/B	90° ±30°	90° ±30°
Overload protection	-50 - 65 V	-50 - 65 V
Input resistance	20,0 kOhm	20,0 kOhm
Input's frequency range	0 - 1.000 kHz	0 - 1.000 kHz
Configurable monitoring frequency		
Without hysteresis	10 mHz - 1.000 kHz	10 mHz - 1.000 kHz
<b>Semiconductor outputs</b>	<b>750330</b>	<b>751330</b>
Number	4	4
Voltage	24,0 V	24,0 V
Current	50 mA	50 mA
<b>Relay outputs</b>	<b>750330</b>	<b>751330</b>
Utilisation category		
In accordance with the standard	<b>EN 60947-4-1</b>	<b>EN 60947-4-1</b>
AC1 at	240 V	240 V
Min. current	0,01 A	0,01 A
Max. current	4,0 A	4,0 A
Max. power	1000 VA	1000 VA
DC1 at	24 V	24 V
Min. current	0,01 A	0,01 A
Max. current	4,0 A	4,0 A
Max. power	100 W	100 W
AC1 at	240 V	240 V
Max. current	4,0 A	4,0 A
Min. current	0,01 A	0,01 A
Max. power	1000 VA	1000 VA
DC 1 at	24 V	24 V
Max. current	4,0 A	4,0 A
Min. current	0,01 A	0,01 A
Max. power	100 W	100 W
Utilisation category		
In accordance with the standard	<b>EN 60947-5-1</b>	<b>EN 60947-5-1</b>
AC15 at	230 V	230 V
Max. current	3,0 A	3,0 A
DC13 (6 cycles/min) at	24 V	24 V
Max. current	4,0 A	4,0 A
AC15 at	230 V	230 V
Max. current	3,0 A	3,0 A
DC13 (6 cycles/min) at	24 V	24 V
Max. current	4,0 A	4,0 A

<b>Relay outputs</b>	<b>750330</b>	<b>751330</b>
Contact fuse protection external, safety contacts		
In accordance with the standard	<b>EN 60947-5-1</b>	<b>EN 60947-5-1</b>
Blow-out fuse, quick	<b>6 A</b>	<b>6 A</b>
Blow-out fuse, slow	<b>4 A</b>	<b>4 A</b>
Circuit breaker, 24V AC/DC, characteristic B/C	<b>4 A</b>	<b>4 A</b>
Contact fuse protection external, auxiliary contacts		
Blow-out fuse, quick	<b>6 A</b>	<b>6 A</b>
Blow-out fuse, slow	<b>4 A</b>	<b>4 A</b>
Circuit breaker, 24 V AC/DC, characteristic B/C	<b>4 A</b>	<b>4 A</b>
Conventional thermal current	<b>4,0 A</b>	<b>4,0 A</b>
Contact material	<b>AgCuNi + 0,2 µm Au</b>	<b>AgCuNi + 0,2 µm Au</b>
<b>Times</b>	<b>750330</b>	<b>751330</b>
Switch-on delay		
With automatic start typ.	<b>15 ms</b>	<b>15 ms</b>
With automatic start max.	<b>50 ms</b>	<b>50 ms</b>
With automatic start after power on typ.	<b>3.920 ms</b>	<b>3.920 ms</b>
With automatic start after power on max.	<b>4 s</b>	<b>4 s</b>
With manual start typ.	<b>40 ms</b>	<b>40 ms</b>
With manual start max.	<b>100 ms</b>	<b>100 ms</b>
Delay-on de-energisation		
With power failure typ. UB 240 V	<b>100 ms</b>	<b>100 ms</b>
With power failure max. UB 240 V	<b>150 ms</b>	<b>150 ms</b>
After safety function is triggered typ.	<b>8 ms</b>	<b>8 ms</b>
After safety function is triggered max.	<b>15 ms</b>	<b>15 ms</b>
Recovery time at max. switching frequency 1/s		
After power failure	<b>4 s</b>	<b>4 s</b>
After safety function is triggered	<b>1 s</b>	<b>1 s</b>
Reaction time after limit value is exceeded	<b>1/f_ist + 16 ms</b>	<b>1/f_ist + 16 ms</b>
Waiting period with a monitored start		
With rising edge	<b>30 ms</b>	<b>30 ms</b>
With falling edge	<b>30 ms</b>	<b>30 ms</b>
Min. start pulse duration with a monitored start		
With rising edge	<b>30 ms</b>	<b>30 ms</b>
With falling edge	<b>30 ms</b>	<b>30 ms</b>

<b>Times</b>	<b>750330</b>	<b>751330</b>
Supply interruption before de-energisation	<b>20 ms</b>	<b>20 ms</b>
Switch delay (selectable)	<b>0 - 30 s</b>	<b>0 - 30 s</b>
Delay on the select inputs (selectable)	<b>0 - 30 s</b>	<b>0 - 30 s</b>
Start-up delay (selectable)	<b>0 - 600 s</b>	<b>0 - 600 s</b>
<b>Environmental data</b>	<b>750330</b>	<b>751330</b>
Climatic suitability	<b>EN 60068-2-78</b>	<b>EN 60068-2-78</b>
Ambient temperature		
Temperature range	<b>-20 - 55 °C</b>	<b>-20 - 55 °C</b>
Storage temperature		
Temperature range	<b>-40 - 85 °C</b>	<b>-40 - 85 °C</b>
EMC	<b>EN 60947-5-1, EN 61000-6-2, EN 61000-6-3</b>	<b>EN 60947-5-1, EN 61000-6-2, EN 61000-6-3</b>
Vibration		
In accordance with the standard	<b>EN 60068-2-6</b>	<b>EN 60068-2-6</b>
Frequency	<b>10,0 - 55,0 Hz</b>	<b>10,0 - 55,0 Hz</b>
Amplitude	<b>0,35 mm</b>	<b>0,35 mm</b>
Airgap creepage		
In accordance with the standard	<b>EN 60947-1</b>	<b>EN 60947-1</b>
Overvoltage category	<b>II</b>	<b>II</b>
Pollution degree	<b>2</b>	<b>2</b>
Rated insulation voltage	<b>250 V</b>	<b>250 V</b>
Rated impulse withstand voltage	<b>4,00 kV</b>	<b>4,00 kV</b>
Protection type		
Mounting area (e.g. control cabinet)	<b>IP54</b>	<b>IP54</b>
Housing	<b>IP30</b>	<b>IP30</b>
Terminals	<b>IP20</b>	<b>IP20</b>
<b>Mechanical data</b>	<b>750330</b>	<b>751330</b>
Mounting position	<b>Horizontal on top hat rail</b>	<b>Horizontal on top hat rail</b>
Mechanical life	<b>10,000,000 cycles</b>	<b>10,000,000 cycles</b>
Material		
Bottom	<b>PC</b>	<b>PC</b>
Front	<b>PC</b>	<b>PC</b>
Top	<b>PC</b>	<b>PC</b>
Conductor cross section with screw terminals		
1 core flexible	<b>0,25 - 2,50 mm<sup>2</sup>, 24 - 12 AWG</b>	–
2 core with the same cross section, flexible with crimp connectors, no plastic sleeve	<b>0,25 - 1,00 mm<sup>2</sup>, 24 - 16 AWG</b>	–
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	<b>0,20 - 1,50 mm<sup>2</sup>, 24 - 16 AWG</b>	–
Torque setting with screw terminals	<b>0,50 Nm</b>	–



Mechanical data	750330	751330
Connection type	Screw terminal	Spring-loaded terminal
Mounting type	plug-in	plug-in
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	–	0,20 - 2,50 mm <sup>2</sup> , 24 - 12 AWG
Spring-loaded terminals: Terminal points per connection	–	2
Stripping length	–	9 mm
Dimensions		
Height	98,0 mm	100,0 mm
Width	45,0 mm	45,0 mm
Depth	120,0 mm	120,0 mm
Weight	410 g	410 g

Where standards are undated, the 2009-06 latest editions shall apply.

## 8.1 Safety characteristic data

Operating mode	EN ISO 13849-1: 2008 PL	EN ISO 13849-1: 2008 Category	EN 62061 SIL CL	EN 62061 PFH <sub>D</sub> [1/h]	IEC 61511 SIL	IEC 61511 PFD	EN ISO 13849-1: 2008 T <sub>M</sub> [year]
Monitoring 1 encoder	PL d	Cat. 2	SIL CL 2	2,34E-08	SIL 2	2,05E-03	20
Monitoring 2 encoder	PL e	Cat. 4	SIL CL 3	1,44E-09	SIL 3	1,21E-04	20
–	PL e	Cat. 4	SIL CL 3	2,78E-09	SIL 3	2,40E-04	20

All the units used within a safety function must be considered when calculating the safety characteristic data.



### INFORMATION

A safety function's SIL/PL values are **not** identical to the SIL/PL values of the units that are used and may be different. We recommend that you use the PAScal software tool to calculate the safety function's SIL/PL values.



### CAUTION!

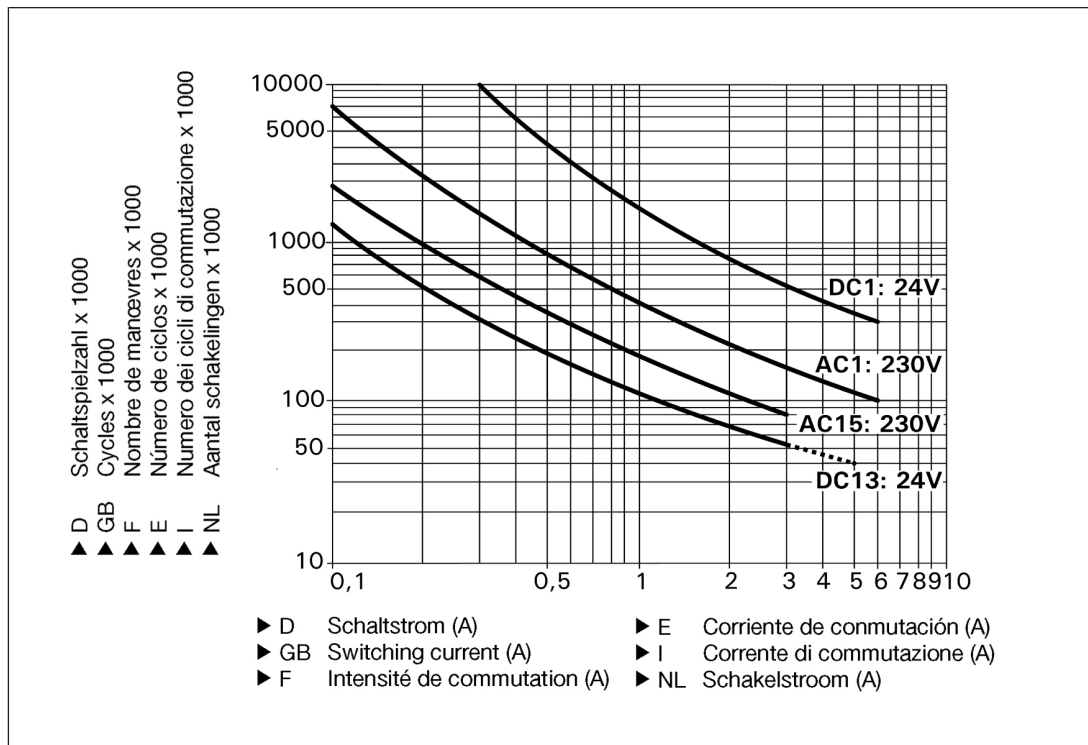
It is essential to consider the relay's service life graphs. The relay outputs' safety-related characteristic data is only valid if the values in the service life graphs are met.

The PFH value depends on the switching frequency and the load on the relay output. If the service life graphs are not accessible, the stated PFH value can be used irrespective of the switching frequency and the load, as the PFH value already considers the relay's B10d value as well as the failure rates of the other components.

## 9 Supplementary data

### 9.1 Service life graph of output relays

The service life graphs indicate the number of cycles from which failures due to wear must be expected. The wear is mainly caused by the electrical load; the mechanical load is negligible.



#### Example

- ▶ Inductive load: 0.2 A
- ▶ Utilisation category: AC15
- ▶ Contact service life: 1 000 000 cycles

Provided the application to be implemented requires fewer than 1 000 000 cycles, the PFH value (see Technical details) can be used in the calculation.

To increase the service life, sufficient spark suppression must be provided on all output contacts. With capacitive loads, any power surges that occur must be noted. With DC contactors, use flywheel diodes for spark suppression.

## 9.2 Categories

### 9.2.1 Safety level

The maximum achievable safety level depends on the encoder, the wiring and the operating mode of the PNOZ s30.

**INFORMATION**

The safety-related characteristic data of the PNOZ s30 and all other devices that are used must be taken into account when calculating the safety level. We recommend that you use the PASCAL software tool to calculate the safety function's SIL/PL values.

The safety assessments below only consider the subsystems *Sensor* and *PNOZ s30*. The *Actuator* subsystem depends on the application and must also be considered in the overall assessment.

Information on the safety-related characteristic data for the subsystems *Sensor* and *PNOZ s30*

Example:

Sensor subsystem			PNOZ s30 subsystem	
Category	MTTFd	DC	Operating mode	PFH [1/h]
2	Manufacturer-specific	90 %	Monitoring 1 encoder	3,28E-08

The values for *Category* and *DC* can be set for the sensor subsystem, bearing in mind the restrictions stated in the respective chapter. The MTTFd value must be stated by the device manufacturer.

Assuming that all faults are dangerous, MTTF = MTTFd can be set.

The characteristic value MTTF is a property of the sensor, which may only be stated by the manufacturer.

**Forced dynamisation:**

When monitoring sensors with square output signals (TTL, HTL) or safe sensors, the axis must be moved within 8 hours so that the signal changes on all the connected tracks.

Key:

SRP/CS = Safety-related part of a control system (EN 13849-1, Tab. 2)

**9.2.2****Safety functions**

The following safe monitoring functions are available:

- ▶ Standstill
- ▶ Position
- ▶ Speed
- ▶ Speed range
- ▶ Direction
- ▶ Monitoring for broken shearpins

The safety functions of the PNOZ s30 are monitoring functions, whereby a safe output signal is used to show if defined limit values are exceeded.

The reaction function that takes place (e.g. shutting down the drive, activating a mechanical brake) when exceeded limit values are detected during the normal operation of the safety function must be defined and implemented by the machine/plant developer and does not form part of the PNOZ s30.

The monitoring function of the PNOZ s30 can be used to implement safety functions defined in the standard EN 61800-5-2 for Adjustable speed electrical power drive systems.

Safety functions in accordance with EN 61800-5-2	Implementation with PNOZ s30 safety function
Safe Operating Stop (SOS)	Standstill, position
Safely Limited Speed (SLS)	Speed
Safe Speed Range (SSR)	Speed range
Safe Direction (SDI)	Direction
Safe Speed Monitor (SSM)	Speed, speed range

## 9.2.3 Safety-related characteristic data for operation with non-safety-related rotary encoder without additional requirements

### 9.2.3.1 Permitted encoder types and output signals

Permitted encoder types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1V<sub>ss</sub>, reference voltage
- ▶ Sin/Cos output signals 1V<sub>ss</sub>, differential

### 9.2.3.2 Safety-related architecture

To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
Category	MTTFd	DC	Operating mode	PFH (1/h)
1*	Manufacturer-specific	0 %	Monitoring 1 encoder	2,34-08

\*In accordance with EN ISO 13849-1, Category 1 is only met if the sensor is a "well-tried component".

**9.2.3.3 Achievable safety level**

Safety function	PL in accordance with EN ISO 13849-1: 2006	SIL CL in accordance with EN IEC 62061
Speed Speed range Direction Standstill Position	PL c (Cat. 1)	-

**9.2.4 Safety-related characteristic data for operation with non-safety-related rotary encoder with mechanical fault exclusion**

In accordance with EN 61800-5-2 : 2007, Table D.16 (Motion and position feedback sensors), fault exclusions are permitted for faults in the mechanical connection between the sensor (encoder) and motor.

**9.2.4.1 Permitted encoder types and output signals**

Permitted encoder types:

- ▶ Rotary non-safety-related encoders

Permitted output signals:

- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential



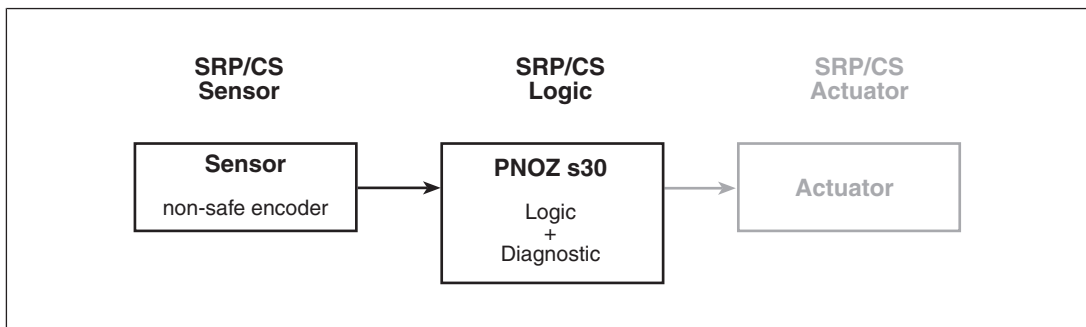
**NOTICE**

The signal tracks Cos and Sin must be generated independently. This means that the sine and cosine signals in the encoder must be conducted in independent channels, from the optics to the interface.

The two signal tracks must not be generated by a common processor

One signal may not be derived from the other signal via an electronic circuit.

**9.2.4.2 Safety-related architecture**



To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
Category	MTTFd	DC	Operating mode	PFH (1/h)
2	Manufacturer-specific	90 %	Monitoring 1 encoder	2,34E-08

### 9.2.4.3 Achievable safety level

Safety function	PL in accordance with EN ISO 13849-1: 2006	SIL CL in accordance with EN IEC 62061
Speed Speed range Direction Standstill Position	PL d (Cat. 2)	2

## 9.2.5 Safety-related characteristic data for operation with non-safety-related rotary encoder with diagnostics via the drive controller

The detection of encoder errors (diagnostics for the sensor subsystem via the evaluation device) can be supplemented with a drive controller.

### 9.2.5.1 Permitted encoder types and output signals

Permitted encoder types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders

Permitted output signals:

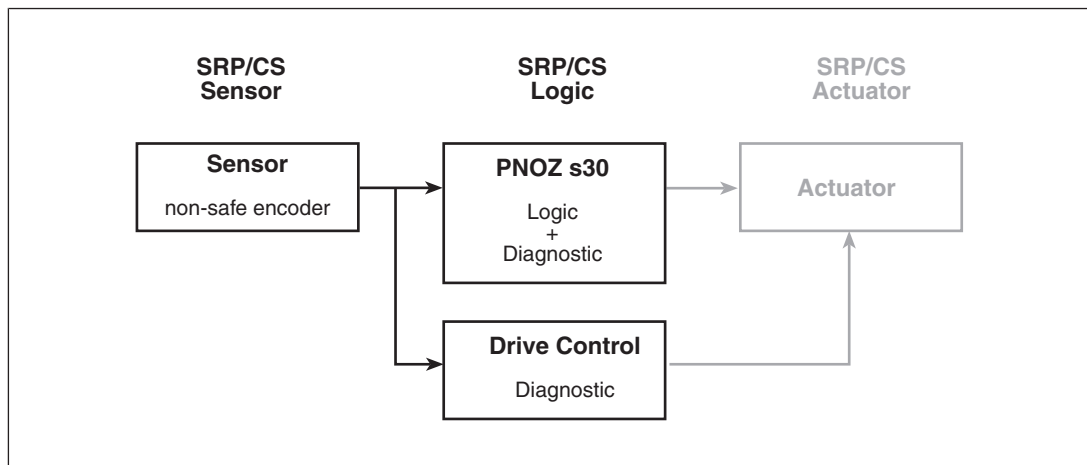
- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

### 9.2.5.2 Requirements of the drive controller

- ▶ Parameters for the control loops and motor control must be set in such a way as to guarantee stable operation.  
Drag error detection (see below) must be capable of operating in accordance with the requirements of the safety function.
- ▶ The motor must be operated with a current impressing control procedure, based on the rotor position (field-oriented control). If the analogue track signals are idle, field-oriented control will brake and/or stop the rotor.
- ▶ The drive controller must be in position control operating mode.

- ▶ If a maximum error variable is exceeded (set/true comparison) the drive controller must switch to a fault condition and stop the drive (drag error detection). The error reaction to drag error detection should be a controlled motor stop.
- ▶ Fault detection via the error variable with subsequent shutdown must meet the requirements of the safety function, with regard to reaction times for example.
- ▶ The drive controller must evaluate the same incremental/sincos signals from the encoder for control as are processed by the safe evaluation device (important on encoders with combined analogue/digital interface).

**9.2.5.3 Safety-related architecture**



To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
Category	MTTFd	DC	Operating mode	PFH (1/h)
2	Manufacturer-specific	90 %	Monitoring 1 encoder	2,34E-08

**9.2.5.4 Achievable safety level**

Safety function	PL in accordance with EN ISO 13849-1: 2006	SIL CL in accordance with EN IEC 62061
Speed Speed range Direction Standstill Position	PL d (Cat. 2)	2



## 9.2.6 Safety-related characteristic data for operation with a safe rotary encoder

Safe encoders are certified in accordance with EN 61508, EN 13849 and EN 62061. In order to achieve the safety level stated by the encoder, the safe evaluation device (PNOZ s30) must normally detect designated errors. Details of the safe encoder's requirements of the evaluation device can be found in the user documentation for the safe encoder. The encoder and evaluation device must be compatible.

### 9.2.6.1 Permitted encoder types and output signals

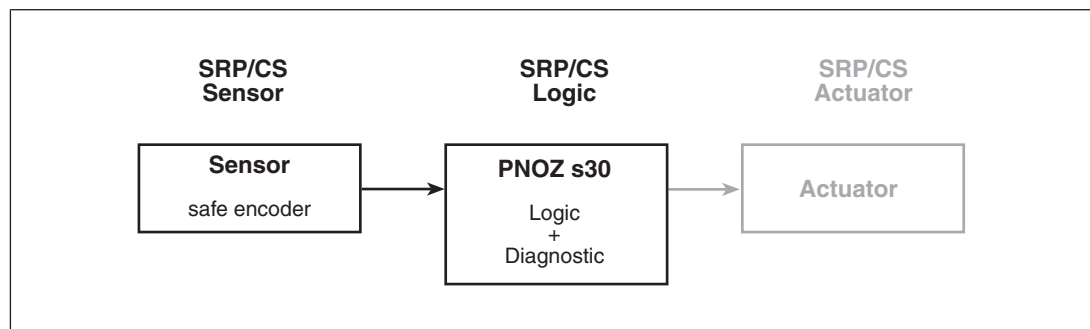
Permitted encoder types:

- ▶ Rotary safe encoder
- ▶ Linear safe encoder

Permitted output signals:

- ▶ Sin/Cos output signals 1Vss, reference voltage
- ▶ Sin/Cos output signals 1Vss, differential

### 9.2.6.2 Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
PL	SIL	PFH (1/h)	Operating mode	PFH (1/h)
See manufacturer			Monitoring Safe encoder	2,78E-09

### 9.2.6.3 Achievable safety level

Safety function	PL in accordance with EN ISO 13849-1: 2006	SIL CL in accordance with EN IEC 62061
Speed Speed range Direction Standstill Position	PL e (Cat.4)	3

## 9.2.7 Safety-related characteristic data for operation with a safe rotary encoder with Z index

Safe encoders are certified in accordance with EN 61508, EN 13849 and EN 62061. In order to achieve the safety level stated by the encoder, the safe evaluation device (PNOZ s30) must normally detect designated errors. Details of the safe encoder's requirements of the evaluation device can be found in the user documentation for the safe encoder. The encoder and evaluation device must be compatible.

### 9.2.7.1 Permitted encoder types and output signals

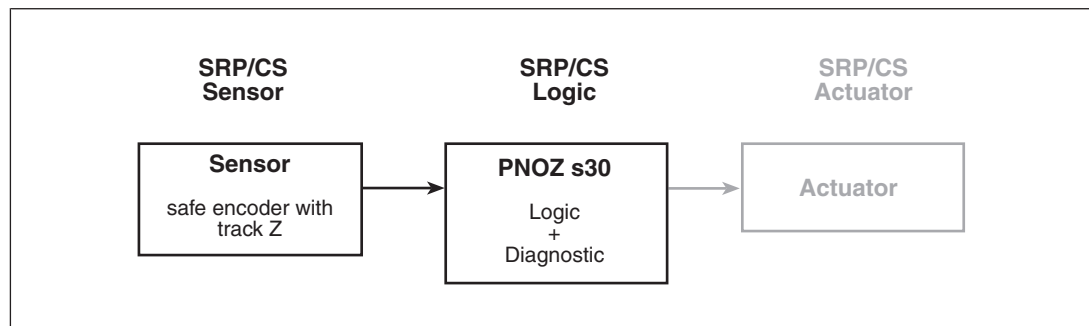
Permitted encoder types:

- ▶ Rotary safe encoder
- ▶ Linear safe encoder

Permitted output signals:

- ▶ Square output signals TTL, differential with Z index
- ▶ Square output signals HTL, differential with Z index
- ▶ Sin/Cos output signals 1Vss, reference voltage with Z index
- ▶ Sin/Cos output signals 1Vss, differential with Z index

### 9.2.7.2 Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
PL	SIL	PFH (1/h)	Operating mode	PFH (1/h)
See manufacturer			Monitoring 2 encoders	1,44E-09

**9.2.7.3 Achievable safety level**

Safety function	PL in accordance with EN ISO 13849-1: 2006	SIL CL in accordance with EN IEC 62061
Speed	PL e (Cat.4)	3
Speed range		
Direction		
Standstill		
Position		

**9.2.8 Safety-related characteristic data for operation with non-safety-related rotary encoder and proximity switch**

The speed monitoring of the non-safety-related encoder can be verified via an additional reference sensor.

**9.2.8.1 Permitted encoder types and output signals****Non-safety-related rotary encoder**

Permitted encoder types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders

Permitted output signals:

- ▶ Square output signals TTL, single ended
- ▶ Square output signals TTL, differential
- ▶ Square output signals HTL, single ended
- ▶ Square output signals HTL, differential
- ▶ Sin/Cos output signals 1V<sub>ss</sub>, reference voltage
- ▶ Sin/Cos output signals 1V<sub>ss</sub>, differential

**Reference sensor**

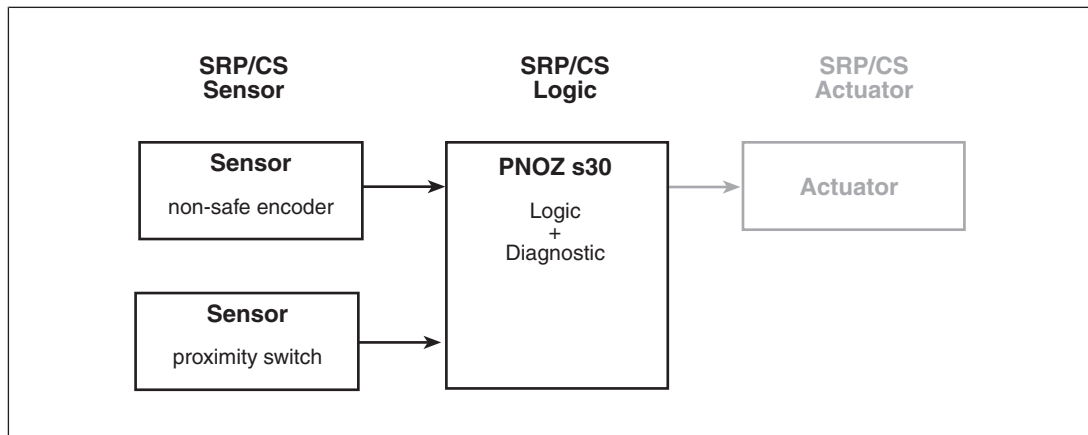
Permitted encoder types:

- ▶ Rotary non-safety-related encoders
- ▶ Linear non-safety-related encoders
- ▶ Inductive proximity switches

Permitted output signals:

- ▶ Square output signals HTL, single ended
- ▶ Square output signal 24 V, pnp

### 9.2.8.2 Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
Category	MTTFd	DC	Operating mode	PFH (1/h)
4	Manufacturer-specific	90 %	Monitoring 2 encoders	1,44E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

### 9.2.8.3 Achievable safety level

Safety function	PL in accordance with EN ISO 13849-1: 2006	SIL CL in accordance with EN IEC 62061
Direction Position	PL c (Cat. 1)	-
Speed Speed range Standstill	PL e (Cat.4)	3

#### Please note:

For the "sensor" subsystem, a minimum speed must be exceeded within forced dynamisation.

The minimum speed depends on the ratio of the frequency at tracks AB " $f_{AB}$ " to the frequency at track Z " $f_Z$ " in your configuration ( $f_{AB}/f_Z$  *Verh.* setting in the menu) and is calculated as follows:

- ▶ when  $f_{AB}/f_Z$  *Verh.*  $\geq 1.0$   
 $f_Z = 70$  mHz or  $f_{AB} = (f_{AB}/f_Z) \times 70$  mHz
- ▶ when  $f_{AB}/f_Z$  *Verh.*  $< 1.0$   
 $f_{AB} = 70$  mHz or  $f_Z = 70$  mHz/ $(f_{AB}/f_Z)$

At the very latest, a feasibility error will be detected when a tolerance expires. The tolerance level depends on the ratio of the frequency at tracks AB " $f_{AB}$ " to the frequency at track Z " $f_Z$ " in your configuration ( $f_{AB}/f_Z$  *Verh.* setting in the menu) and is calculated as follows:

- ▶ when  **$f_{AB}/f_Z$  Verh.  $\geq 1.0$**   
7.5 Z-pulses or  $7.5 \times (f_{AB}/f_Z)$  AB-pulses
- ▶ when  **$f_{AB}/f_Z$  Verh.  $< 1.0$**   
4.5 AB-pulses or  $4.5/(f_{AB}/f_Z)$  Z-pulses

## 9.2.9 Safety-related characteristic data for operation with 2 proximity switches

### 9.2.9.1 Permitted encoder types and output signals

#### Non-safety-related rotary encoder

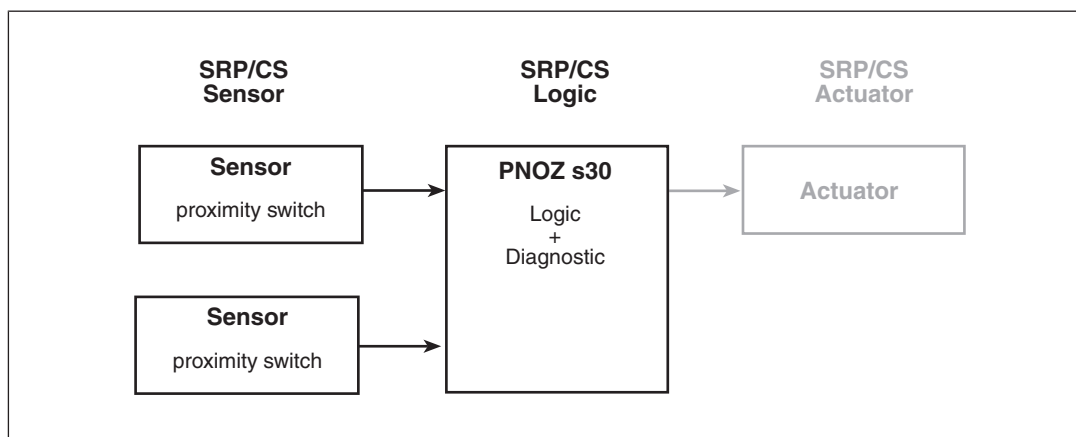
Permitted encoder types:

- ▶ Inductive proximity switches

Permitted output circuits:

- ▶ pnp
- ▶ npn

### 9.2.9.2 Safety-related architecture



To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
Category	MTTFd	DC	Operating mode	PFH (1/h)
4	Manufacturer-specific	90 %	Monitoring 2 encoders	1,44E-09

In a worst case scenario, the sensor subsystem's characteristic value MTTFd is calculated from the inferior (lower) value of the two sensors.

**9.2.9.3 Achievable safety level**

Safety function	PL in accordance with EN ISO 13849-1: 2006	SIL CL in accordance with EN IEC 62061
Direction Position	-	-
Speed Speed range Standstill	PL e (Cat.4)	3

Please note:

Common cause failures (CCF) are possible for the sensor subsystem. An appropriate analysis must be carried out.

To use proximity switches 1 and 2 we recommend that you:

- ▶ Use different technologies/design or physical principles (e.g. different manufacturers) and
- ▶ Evaluate the encoder supply via track S

**9.3 Examples****9.3.1 Connection of proximity switch****9.3.1.1 Features****PNOZ s30**

- ▶ Standstill monitoring for enabling the safety gate via Rel. 1:  
Standstill is detected at  $\leq 2$  Hz, the output Rel. 1 switches on and the safety gate can be released with the pushbutton S3.
- ▶ Monitoring for overspeed via Rel. 2:  
Overspeed is detected at  $\geq 500$  Hz and the output Rel. 2 switches off.
- ▶ Feedback loop monitoring for Rel.1 via feedback loop input Y1,  
Feedback loop monitoring for Rel.2 via feedback loop input Y2
- ▶ Automatic reset

**Encoder**

The measured values are detected by two proximity switches (pnp).

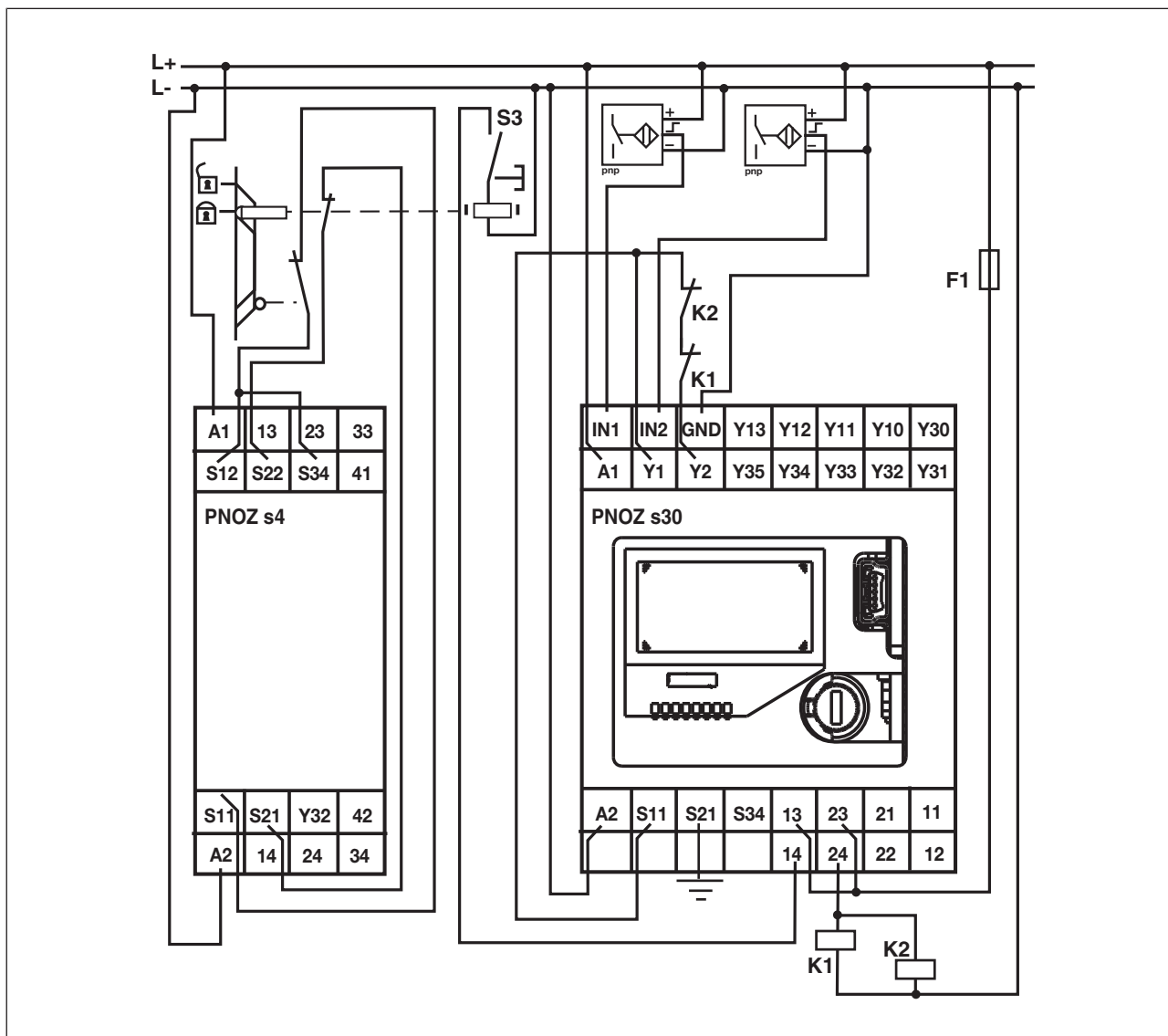
**PNOZ s4**

- ▶ Safety gate monitoring

### 9.3.1.2 Configuration overview

language	English	input device		A: pnp / B: pnp				global standstill (10 mHz-1 MHz)		2 Hz	
delay time start-up (0-600s)	Hysteresis (0-50%) P0 P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15	F1	F2	F3	F4	F5	F6	F7	F8	F9	
units		Standstill	500 Hz								
conversion											
mode select input											
Sel 1 (Y10) Sel 2 (Y11) Sel 3 (Y12) Sel 4 (Y13)											
delay time select input (0-30s)											
assign outputs (functions)		Rel. 1 (13/14)	Rel. 2 (23/24)	Ext. 1	Ext. 2	Out 1 (Y32)	Out 2 (Y33)	Out 3 (Y34)	Out 4 (Y35)		
delay time effect (outputs)											
delay time 0 - 30s (outputs)											
reset mode		automatic	automatic								
output out logic											
		input device settings (10 mHz-1 MHz)		f max (A/B)		3000 kHz		ratio (0,0001-400,000:1)		f(A/B):f(Z)	
		position window width (1-24.900.000 Imp)		Pos. 1				incorrect direction (max. wrong) direction (1-24.900.000 Imp)		direction left max. right	
				Pos. 2						direction right max. left	
				Pos. 3						name of configuration	
				Pos. 4						Example 1	
										CRC of configuration	

### 9.3.1.3 Connection



## 9.3.2 Incremental encoder connection

### 9.3.2.1 Features

#### PNOZ s30

##### ► Speed monitoring:

Monitoring for overspeed for the operating modes "Setup" and "Automatic", which are selected with the switch S1.

- The operating mode "Setup" is selected if the select input SEL1 is activated. Overspeed is detected during setup at  $\geq 50$  Hz and the output Rel. 2 switches off.
- The operating mode "Automatic" is selected if the select input SEL2 is activated. Overspeed is detected during automatic mode at  $\geq 3000$  Hz and the output Rel. 2 switches off.
- If a speed of 2800 Hz is exceeded, the semiconductor output Out1 switches in automatic mode and a message (advance warning) is output via the PLC.



- ▶ Standstill monitoring:  
Standstill is detected at  $\leq 2$  Hz for both operating modes and the output Rel. 1 switches on.
- ▶ Feedback loop monitoring via feedback inputs Y1 and Y2

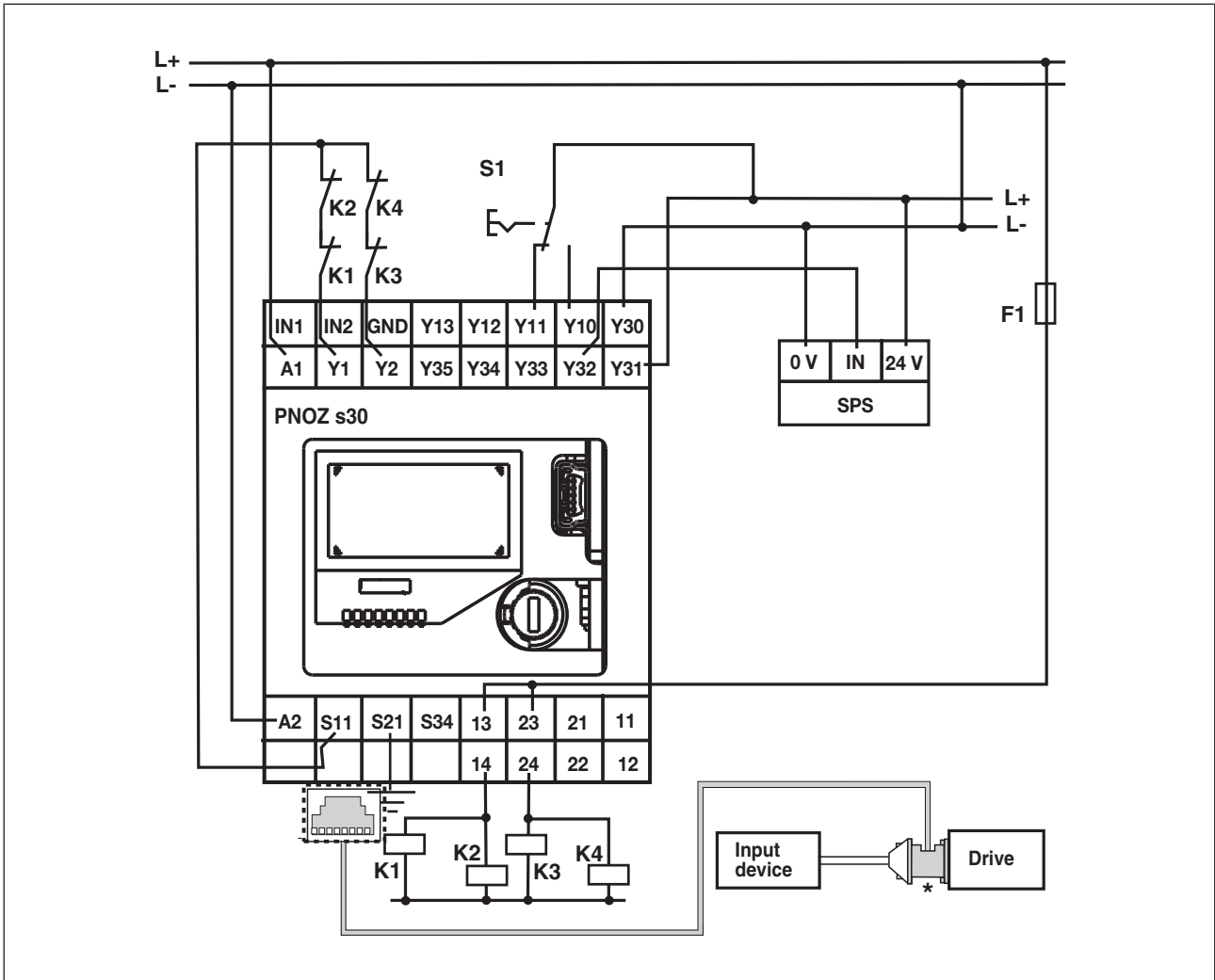
**Encoder:**

The measured values are detected by an incremental encoder (sin/cos)

**9.3.2.2 Configuration overview**

language	English	input device		Sin/cos 1Vss									
delay time start-up (0-600s)		Hysteresis (0-50%)										global standstill (10 mHz-1 MHz)	2 Hz
units		P0	F1	F2	F3	F4	F5	F6	F7	F8	F9	input device settings (10 mHz-1 MHz)	
conversion		P1	Standstill	50 Hz	50 Hz							f max (A/B)	20 kHz
mode select input	1 of 4	P2	Standstill	3000 Hz	2800 Hz							f max (Z)	
Sel 1 (Y10)		P3										ratio (0,0001-400.000.1)	
Sel 2 (Y11)		P4										f(A/B):f(Z)	
Sel 3 (Y12)		P5										position window width (1-24.900.000 Imp)	
Sel 4 (Y13)		P6										Pos. 1	
delay time select input (0-30s)	20 ms	P7										Pos. 2	
assign outputs (functions)		P8										Pos. 3	
delay time effect (outputs)		P9										Pos. 4	
delay time 0 - 30s (outputs)		P10										incorrect direction (max. wrong) direction (1-24.900.000 Imp)	
reset mode		P11										direction left	
output out logic		P12										max. right	
		P13	Rel. 1 (13/14)	Rel. 2 (23/24)	Ext. 1	Ext. 2	Out 1 (Y32)	Out 2 (Y33)	Out 3 (Y34)	Out 4 (Y35)		direction right	
		P14	F1	F2			F3					max. left	
		P15										name of configuration	
													Example 2
												CRC of configuration	

9.3.2.3 Connection



\* The PNOZ msi adapters are available from Pilz as accessories

## 10 Order reference

Order reference			
Product type	Features	Terminals	Order no.
PNOZ s30	24 - 240 VAC/DC	With screw terminals	750 330
PNOZ s30 C	24 - 240 VAC/DC	With spring-loaded terminals	751 330
Accessories			
Product type	Features	Order no.	
PNOZ s terminator plug	Terminator, x10	750 010	
PNOZmulti Chipcard	Chip card, 8 kB	779 201	
PNOZmulti Chipcard Set	Chip card, 8 kB, x10	779 200	
PNOZmulti Chipcard	Chip card, 32 kB	779 211	
PNOZmulti Chipcard Set	Chip card, 32 kB, x10	779 212	
Chipcard Holder	Chip card holder	779 240	
PNOZmulti Seal	Chip card seal, x10	779 250	
PNOZ s Set3 Screw Loaded Terminals	Set of plug-in screw terminals, x1	750 014	
PNOZ s Set3 Spring Loaded Terminals	Set of plug-in spring terminals, x1	751 014	
PNOZ msi1Ap	Adapter and cable 25-pin, 2.5 m	773 840	
PNOZ msi1Ap	Adapter and cable 25-pin, 5.0 m	773 844	
PNOZ msi1Bp	Adapter and cable 25-pin, 2.5 m	773 841	
PNOZ msi1Bp	25-pin, 5.0 m	773 839	
PNOZ msi3Ap	Adapter and cable 15-pin, 2.5 m	773 842	
PNOZ msi3Bp	Adapter and cable 15-pin, 2.5 m	773 843	
PNOZ msi5p	Adapter and cable Bos/Rex 15-pin, 2.5 m	773 857	
PNOZ msi5p	Adapter and cable Bos/Rex 15-pin, 1.5 m	773 858	
PNOZ msi6p	Adapter and cable Elau 9-pin, 7.5 m	773 859	
PNOZ msi6p	Adapter and cable Elau 9-pin, 2.5 m	773 860	
PNOZ msi6p	Adapter and cable Elau 9-pin, 1.5 m	773 861	
PNOZ msi7p	Adapter and cable SEW 15-pin, 2.5 m	773 864	
PNOZ msi7p	Adapter and cable SEW 15-pin, 1.5 m	773 865	
PNOZ msi8p	Adapter and cable Lenze 9-pin, 2.5 m	773 862	
PNOZ msi8p	Adapter and cable Lenze 9-pin, 1.5 m	773 863	
PNOZ msi9p	Adapter cable 5.0 m	773 856	
PNOZ msi10p	Adapter cable 2.5 m	773 854	

<b>Product type</b>	<b>Features</b>	<b>Order no.</b>
PNOZ msi11p	Adapter cable 1.5 m	773 855
PNOZ msi19p	Connection cable, 1.5 m	773 846
PNOZ msi19p	Connection cable, 2.5 m	773 847
PNOZ msi S09	9-pin adapter, connector set	773 870
PNOZ msi S15	15-pin adapter, connector set	773 871
PNOZ msi S25	25-pin adapter, connector set	773 872

# ► Support

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