PNOZ s30

PILZ

THE SPIRIT OF SAFETY

▸ Safety relays

This document is the original document.

Where unavoidable, for reasons of readability, the masculine form has been selected when formulating this document. We do assure you that all persons are regarded without discrimination and on an equal basis.

 SD means Secure Digital

Contents

Contents

1 Introduction

1.1 Validity of documentation

This documentation is valid for the product PNOZ s30 from Version 3.1.

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

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.

1.4 Third-party manufacturer licence information

This product includes Open Source software with various licenses.

Further information is available in the document "Third-party manufacturer license information PNOZ s30" (document number 1006628) at www.pilz.com.

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

2.1.2 Unit features

Application of 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, one output configurable as an analogue output

▸ 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
- ▸ Encoder connection technology:
  RJ45 socket

2.2 Front/side view
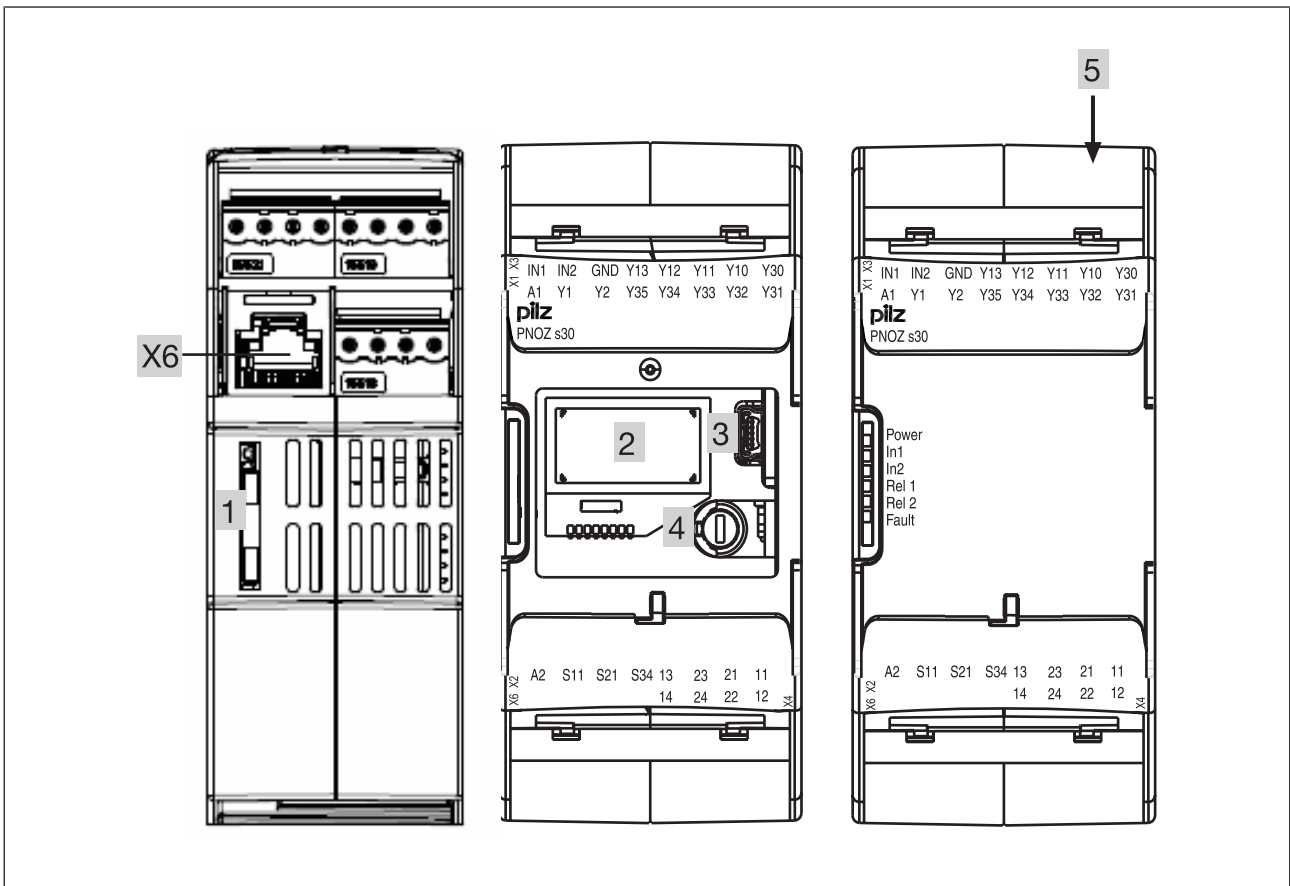
Fig.: Left: Side view, centre: Front view without cover, right: Front view with cover

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 REL 1 and REL 2 (safety contacts)

- ▸ 11-12 and 21-22:

  Relay outputs REL 1 and REL 2 (auxiliary contacts)

▸ Y32 ... Y34: Semiconductor outputs OUT 1 …- OUT 3 (auxiliary outputs)

▸ Y35: Semiconductor output OUT 4 (auxiliary output or analogue 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

▸ Y1, Y2:
  Y1: Feedback input for Rel. 1
  Y2: Feedback input for Rel. 2

▸ Y30: 0 V ext (GND for select input and semiconductor outputs)

▸ Y31: 24 V ext (supply for semiconductor outputs)

▸ 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

▸ 3: USB connection

▸ 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.

The safety controller should be installed in a protected environment that meets at least the requirements of pollution degree 2. Example: Protected inside space or control cabinet with protection type IP54 and appropriate air conditioning.

> **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

> **NOTICE**
>
> **EMC-compliant electrical installation**
>
> The product is designed for use in an industrial environment. The product may cause interference if installed in other environments. If installed in other environments, measures should be taken to comply with the applicable standards and directives for the respective installation site with regard to interference.

3.2 Safety regulations

3.2.1 Safety assessment

Before using a device, a safety assessment in accordance with the Machinery Directive is required.

The product as an individual component fulfils the functional safety requirements in accordance with EN ISO 13849 and EN 62061. However, this does not guarantee the functional safety of the overall plant/machine. To achieve the relevant safety level of the overall plant/machine's required safety functions, each safety function needs to be considered separately.

3.2.2 Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decommissioned by persons who are competent to do so.

A competent person is a qualified and knowledgeable person who, because of their training, experience and current professional activity, has the specialist knowledge required. To be able to inspect, assess and operate devices, systems and machines, the person has to be informed of the state of the art and the applicable national, European and international laws, directives and standards.

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 the section entitled Safety

▸ Have a good knowledge of the generic and specialist standards applicable to the specific application.

3.2.3 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.).

3.2.4 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).

3.2.5 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.

▸ Adequate protection must be provided on all output contacts with capacitive and inductive loads.

4 Security

▸ The product is not protected from physical manipulation or from reading of memory contents during physical access. Use appropriate measures to ensure that there is no physical access by unauthorised persons. You should also use security seals so that you can detect any manipulation of the product or interfaces. Installation inside a lockable control cabinet is recommended as a minimum measure.

▸ To protect against unauthorised access, no cable may be plugged into the USB connection during normal operation.

▸ The configuration computer that accesses the product has to be protected from attacks by a firewall or other suitable measures. We recommend that a virus scanner is used on this configuration computer and updated regularly.

5 Function description

5.1 Introduction

Proximity switches or encoders record measured values, which are evaluated in the speed monitor PNOZ s30. Up to 9 monitoring functions can be configured (F1 ... F9) which are run at a time.

Via the Select inputs, up to 16 different parameter sets (P0 ... P15) of the monitoring function can be chosen, e.g. to monitor various operating modes.

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 meets the following safety requirements:

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

5.2 Block diagram
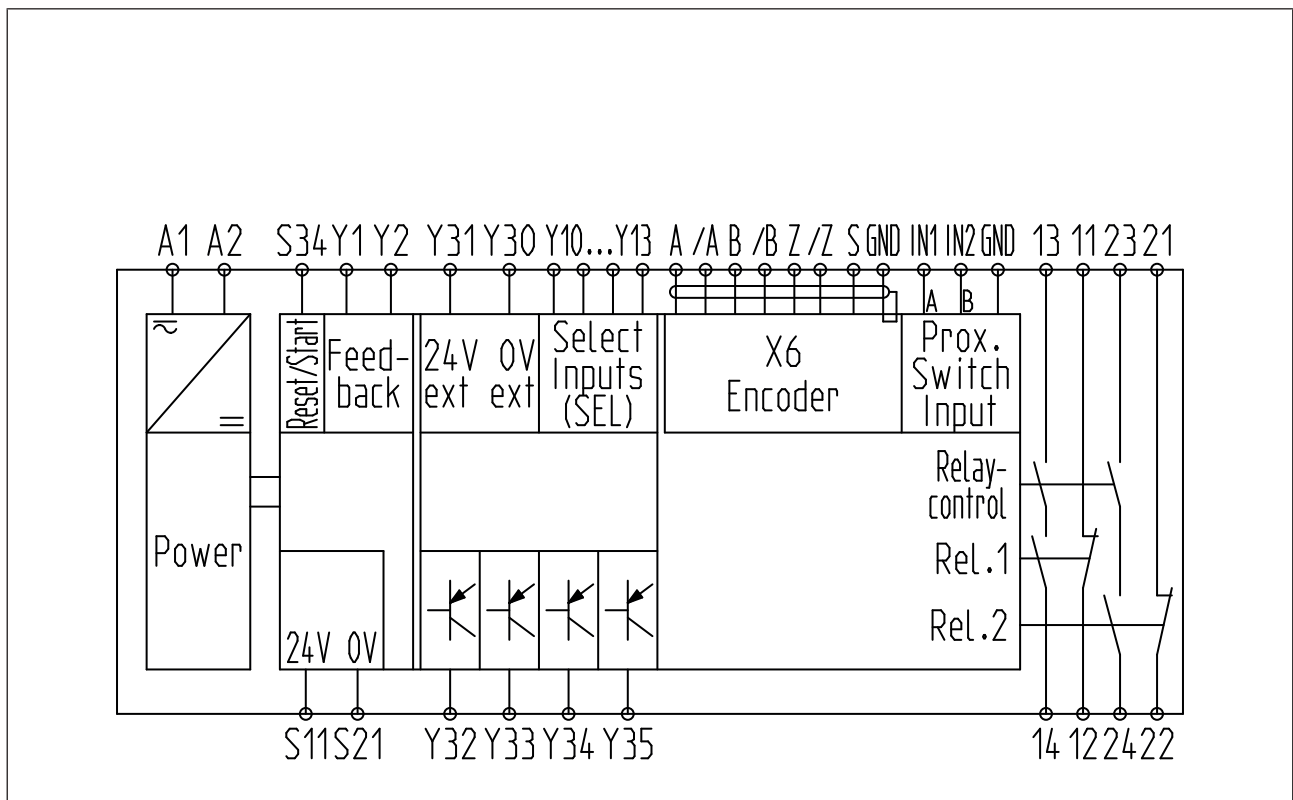
> **NOTICE**
>
> The individual blocks are galvanically isolated from each other:
>
> - Supply voltage: A1, A2
> - Encoder and initiator inputs: GND, In1, In2, RJ45 socket and shield
> - Start and feedback circuits: S21, S11, S34, Y1, Y2
> - Semiconductor outputs and select inputs: Y30, Y31, Y32, Y33, 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).

5.3 Functions

The following monitoring functions can be configured:

5.3.1 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.

5.3.2 Speed

With speed monitoring, the output switches off when the configured value is exceeded.
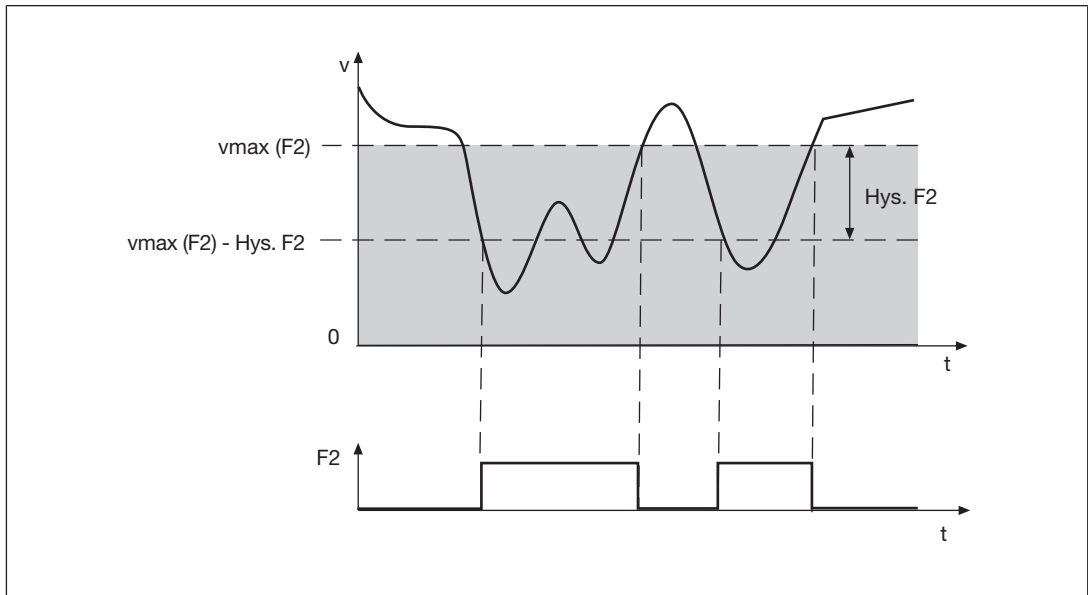
Fig.: Sequence of standstill and speed monitoring process

5.3.3 Speed range

With range monitoring, the output switches off if the rotational speed (velocity, frequency) is outside the configured range.
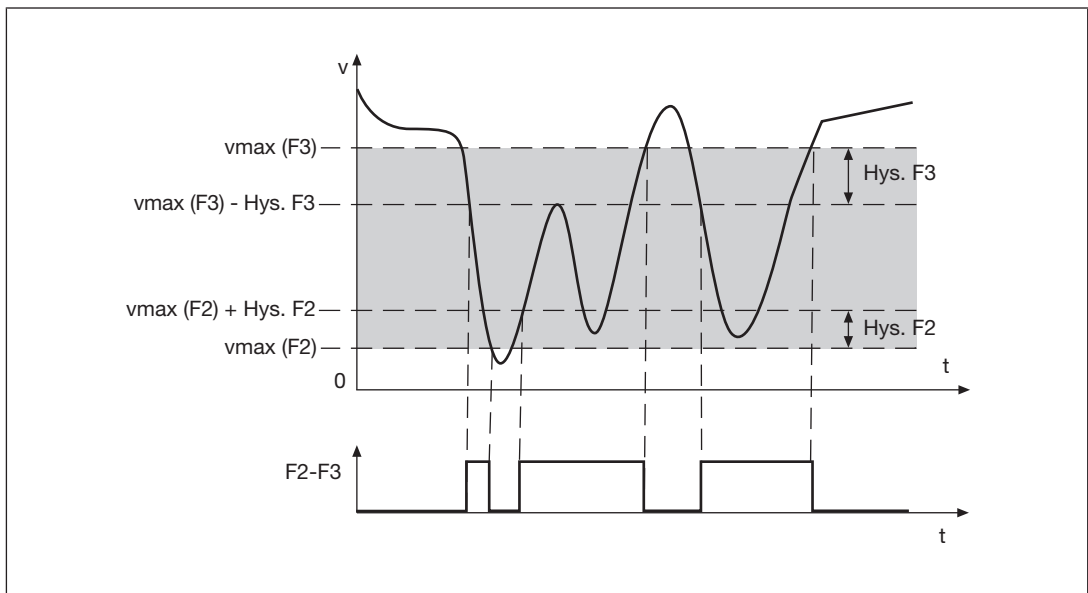
Fig.: Sequence of speed range monitoring process

5.3.4 Position

When position monitoring is active, the current position is taken 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. A max. 4 positions to be monitored can configured at the same time.

If the position moves outside the configured range, position monitoring is deactivated and the assigned outputs are switched off.

Position monitoring can be started (activated) automatically or monitored:

▶ **Monitored start (default)**

– Position monitoring is started when a rising edge has been detected at the start input.

– Active position monitoring is not started again by another rising edge at the start input (retriggering is not possible).

– 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.
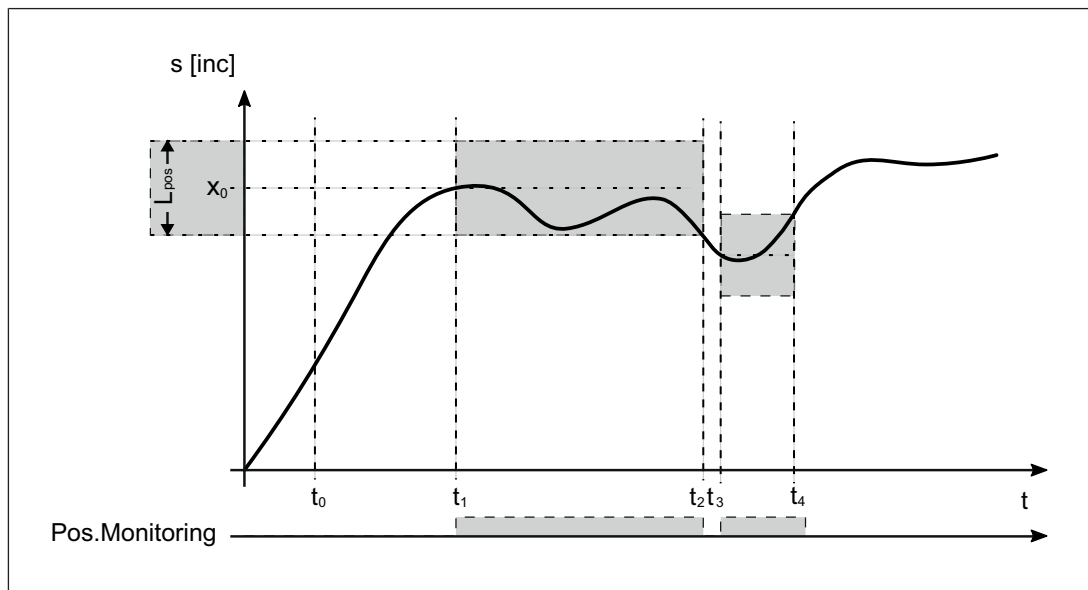
Fig.: Sequence of position monitoring with monitored start

Legend

x_0	Reference position
L_{pos}	Position window
t_0	Device on
t_1	Start of position monitoring by rising edge at the start input (S34)
t_2	Position leaves the position window, assigned outputs will switch off
t_3	Restart of position monitoring by rising edge at the start input (S34)
t_4	Position leaves the position window, assigned outputs will switch off

▸ **Automatic start**

- Position monitoring is started when a rising edge has been detected at the start input.

- Position monitoring is started when the parameter set has been switched over and position monitoring is used in the current parameter set.

- Position monitoring is restarted when the limit value has been exceeded and a rising edge has been detected at the start input.

- Active position monitoring is not started again by another rising edge at the start input.

- Active position monitoring is restarted if another 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 deactivated if another parameter set is selected, which does not use this position monitoring.
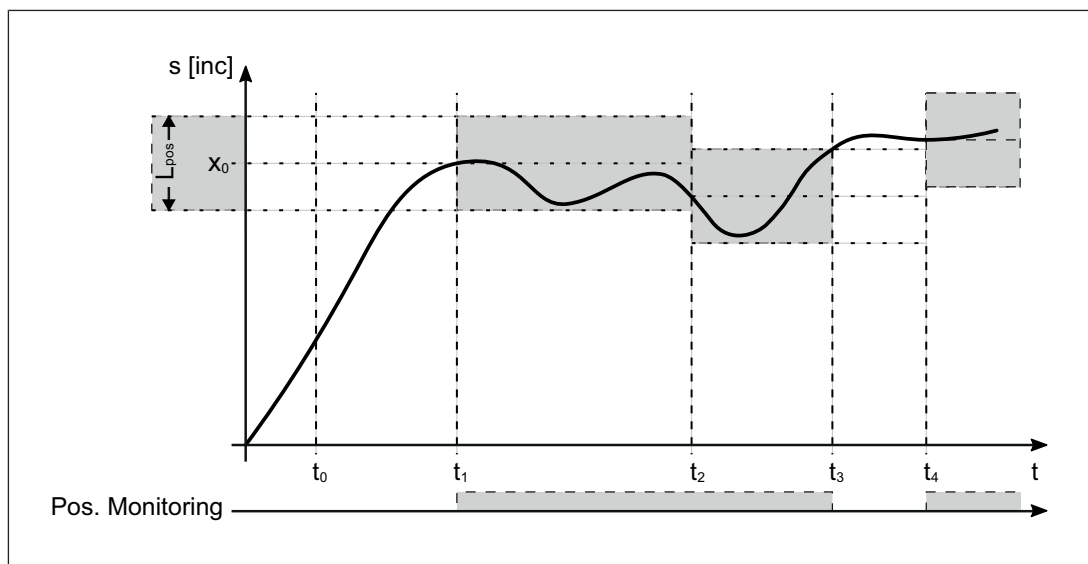
Fig.: Sequence of position monitoring with automatic start

Legend

x_0	Reference position
L_{pos}	Position window
t_0	Device on
t_1	Start of position monitoring by selecting a parameter set via the Select inputs
t_2	Position monitoring is restarted by selecting a different parameter set
t_3	Position leaves the position window, assigned outputs will switch off
t_4	Restart of position monitoring by rising edge at the start input (S34)

Please note:

▸ Position monitoring cannot be used if proximity switches are employed.

▸ Managing the start type of the outputs is independent of the start type of the position monitoring.

▸ In the event of an open circuit, position monitoring is automatically deactivated

5.3.5 Direction

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

▸ **Clockwise**

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

▸ **Counter-clockwise**

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

▸ **Tolerance**

For both directions, a tolerance can be entered for the wrong direction. This means that the drive may run in the incorrect direction until it reaches the set tolerance value without the assigned output switching off.
A switched off output cannot switch on again until the drive has moved up to the tolerance value in the correct direction.
The tolerance is also taken into account following an automatic reset.

▸ **Automatic reset**

For both directions, a joint automatic reset can be configured.

– If no automatic reset is configured, the direction monitoring is reset only by switching off the supply voltage.

– When automatic reset is configured, the direction monitoring is reset when a parameter set is switched over.

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:
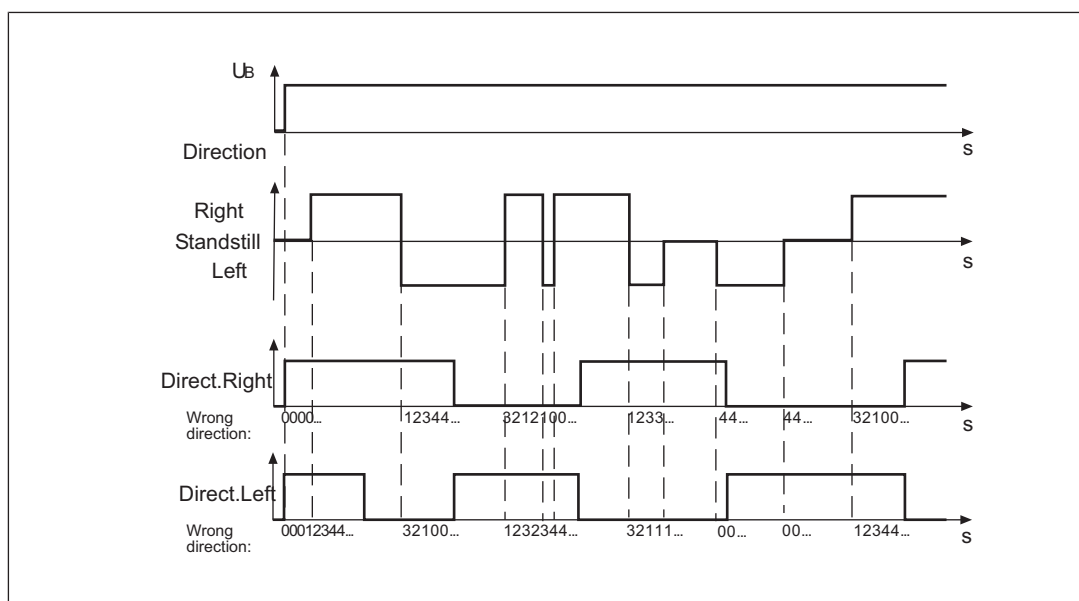
Configuration in the example:

▸ Wrong direction in anti-clockwise rotation

Max. right: 3 pulses

▸ Wrong direction in clockwise rotation

Max. left: 3 pulses

5.3.6 2 encoder diagnostics / broken shearpin monitoring

To increase the safety level of an encoder and for broken shearpin monitoring, an additional proximity switch or an HTL signal from an additional encoder can be connected to track Z. These must both be configured as Z-frequency monitoring.

A monitoring function checks than the frequency difference on the tracks AB "f_{AB}" to track Z "f_Z" is less than 10%.

Please note:

Monitoring for broken shearpins does not become active until

▸ The minimum speed has been exceeded and

▸ The tolerance for detecting plausibility errors has elapsed.

▸ Testing has not been deactivated via the parameter sets and input wiring.

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 (**fAB/fZ Verh.** setting in the menu)
and

▸ The configured activation speed (v_{ABZ} setting in the menu)

Minimum speed:

▸ when **fAB/fZ Verh.** ≥ 1.0
f_Z = 10 mHz or f_{AB} = (f_{AB}/f_Z) x 10 mHz

▸ when **fAB/fZ Verh.** < 1.0
f_{AB} = 10 mHz or f_Z = 10 mHz/(f_{AB}/f_Z)

▸ $f_{AB} \geq v_{ABZ}$ or $f_Z \geq v_{ABZ}$ / (f_{AB}/f_Z)

Tolerance for detecting plausibility errors:

▸ when **fAB/fZ Verh.** ≥ 1.0
7.5 Z-pulses or 7.5 x *(f_{AB}/f_Z)* AB-pulses

▸ when **fAB/fZ Verh.** < 1.0
4.5 AB-pulses or 4.5/*(f_{AB}/f_Z)* Z-pulses

5.3.7 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

5.3.8 Frequency filtering

Measurement value filtering can be configured to suppress rotational speed overshoots or EMC disturbances.

The measured rotational speed is then filtered before it is supplied to the monitoring functions standstill or speed monitoring.

The filter can be configured as slow, average or fast.

> **NOTICE**
>
> **Please note:**
>
> The reaction time after the limit value is exceeded, as specified in the technical details, is increased by filtering.

Effect of frequency filtering, as an example
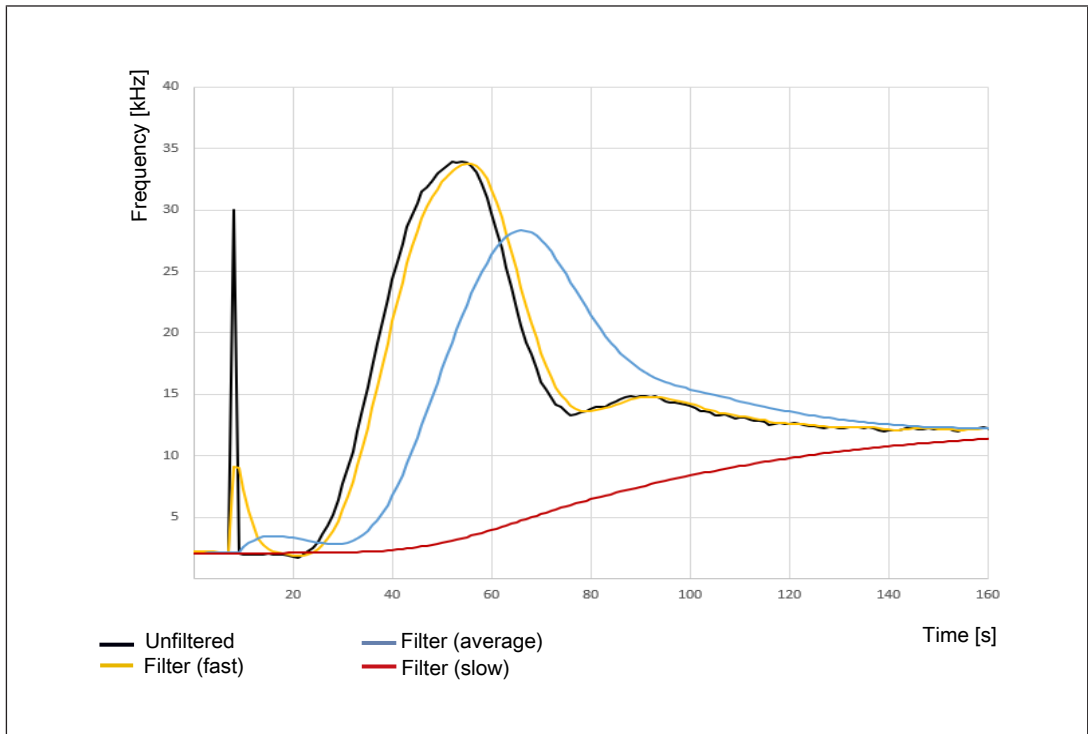
Step response of slow filter
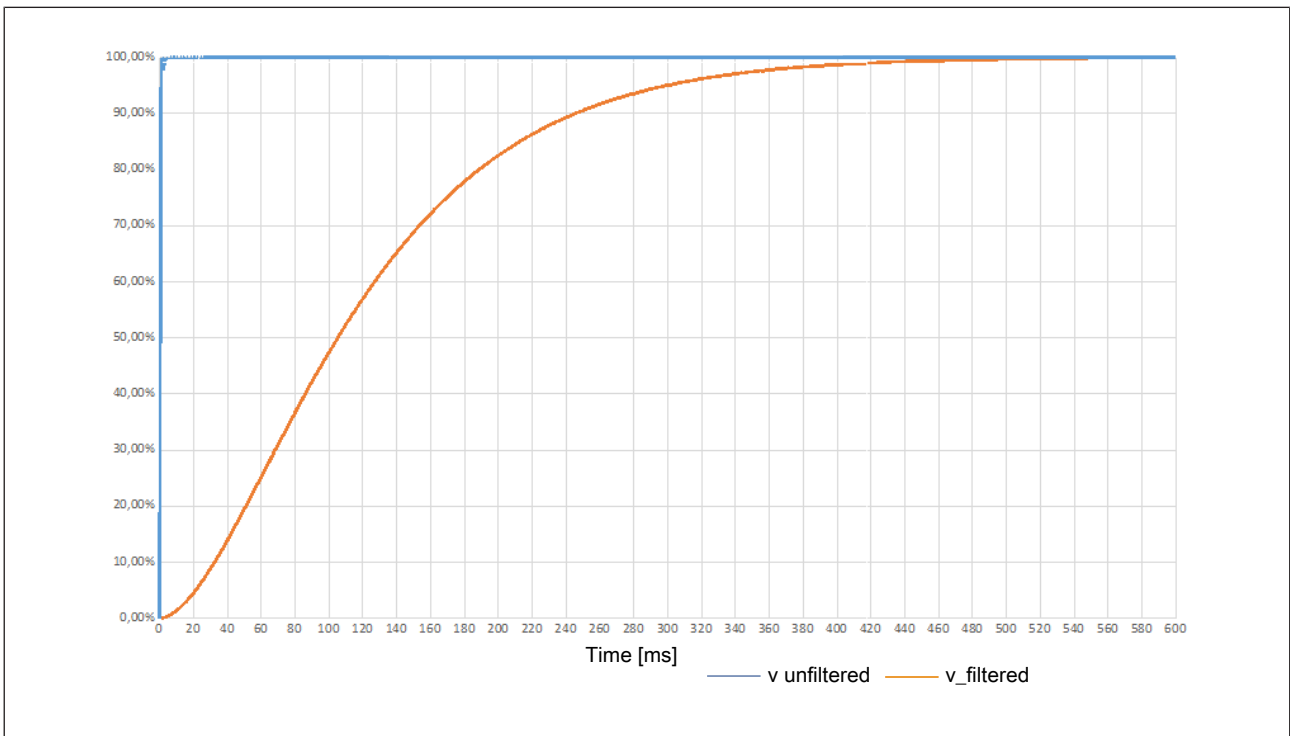
The diagram shows the reaction of the slow filter to a speed change at the input. The filter achieves 99% of the set end value after approx. 420 ms.

Step response of average filter
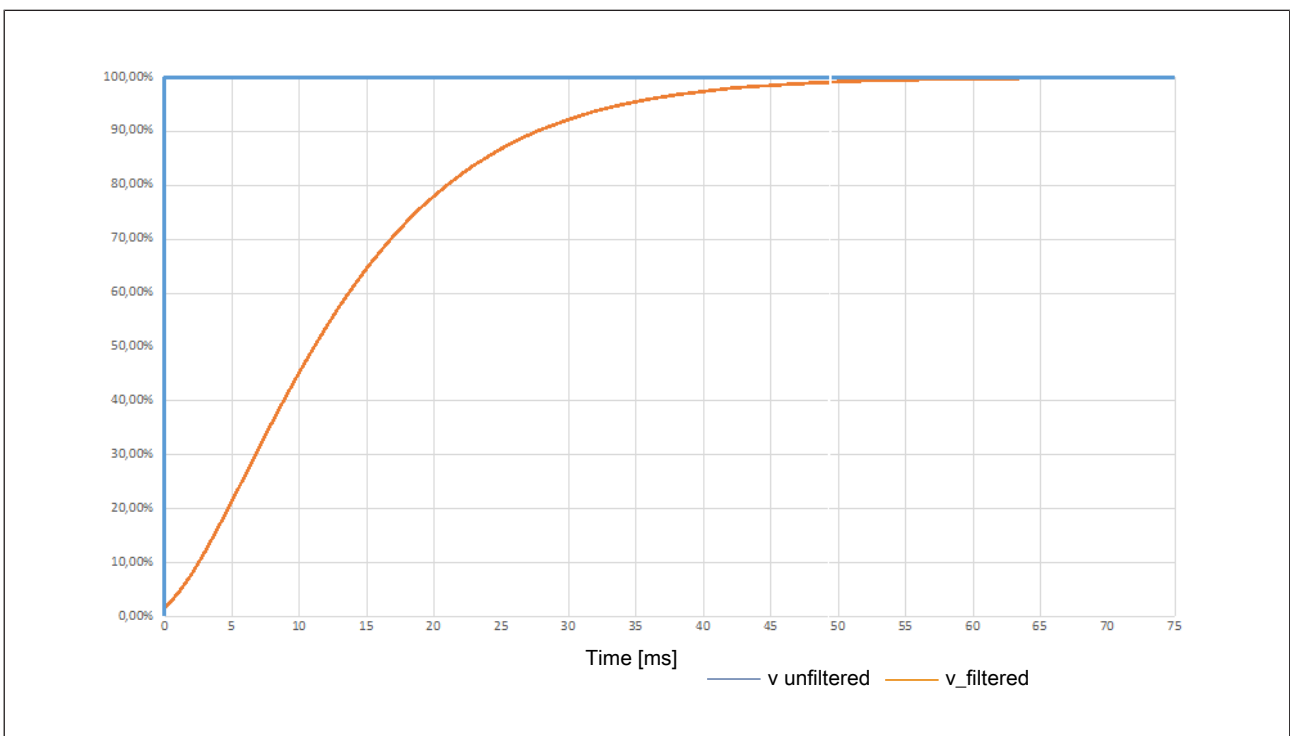
The diagram shows the reaction of the average filter to a speed change at the input. The filter achieves 99% of the set end value after approx. 47 ms.

Step response of fast filter
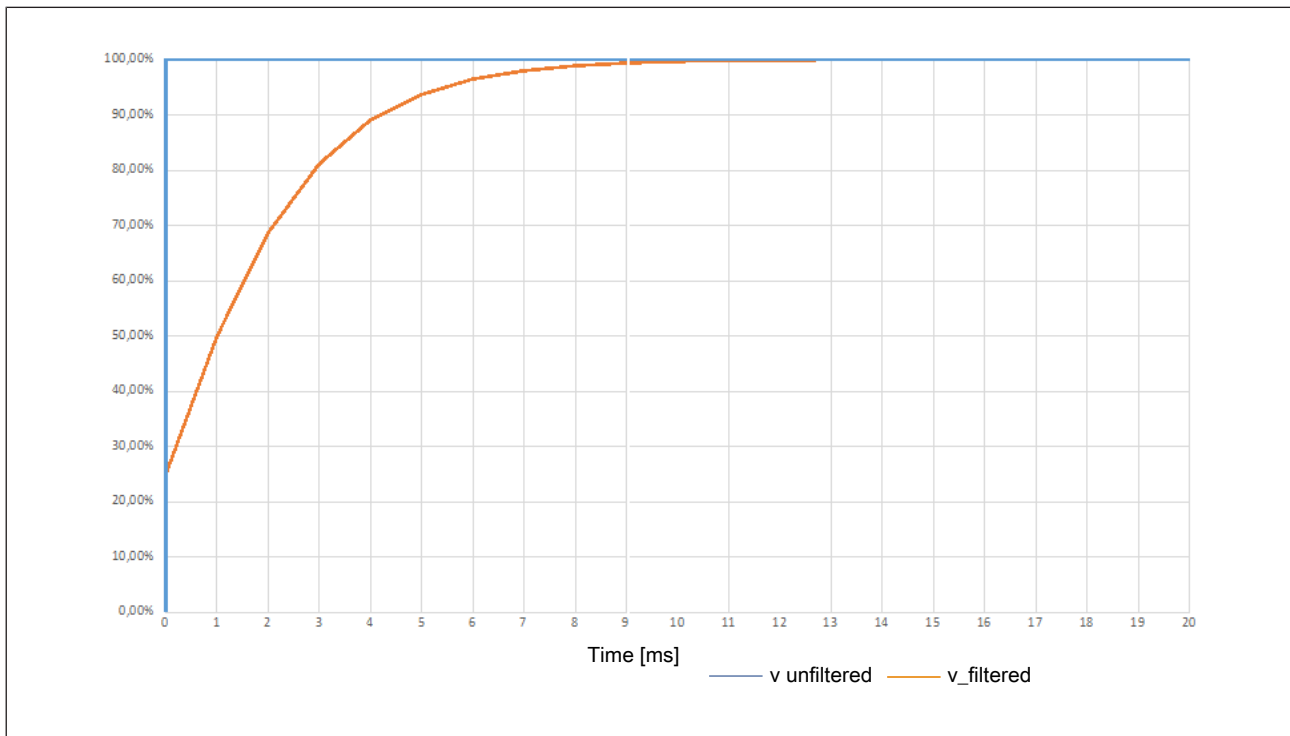
The diagram shows the reaction of the fast filter to a speed change at the input. The filter achieves 99% of the set end value after approx. 9 ms.

5.3.9   Start types

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.

5.3.10   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.

5.3.11 Synchronous start

Outputs can be combined into a group with the "Synchronous start" option.

It is ensured that all the outputs in this group must be switched off before an individual output in this group can be switched on again.

To switch on an output in this group, all the other start-up conditions for this output must be met. The outputs in the group are switched on independently of each other.

Please note:

▶ No switch-on delay may be configured for synchronous outputs (menu Output delay:Switch-on delay/switch-on and switch-off delay).

5.3.12 Outputs

The device has 2 relay outputs, four semiconductor outputs (auxiliary outputs) and an expansion interface for 2 more safe relay outputs, which can be controlled separately.

Relay outputs

The relay outputs Rel. 1 and Rel. 2 are safety outputs, which are designed diversely. The second shutdown route is via a common root relay (called "Relay control" in the block diagram). This means that, should an error occur, in the event of a welded relay contact for example, both relay outputs are shut down via the root relay.

Rel. 1: Terminals 13-14

Rel. 2: Terminals 23-24

Semiconductor outputs

The semiconductor outputs Out 1 to Out 4 are outputs for standard applications.

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

Out 1: Terminal Y32

Out 2: Terminal Y33

Out 3: Terminal Y34

Out 4: Terminal Y35

External outputs on the expansion interface

The external outputs Ext.1 and Ext. 2 can be used for more safe relay outputs. To do this, connect an appropriate expansion module to the expansion interface.

5.3.13 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.

The following delay types can be configured:

Switch-on delay retriggerable ⟫⌐

After a rising edge (e.g speed is in the permitted range) the output will switch on only when the configured time has elapsed. When there is another rising edge during the delay time, the delay time is restarted.

Switch-off delay retriggerable ⟫⌐

After a falling edge (e.g speed is exceeded) the output will switch off only when the configured time has elapsed. At a rising edge during the delay time, the time is reset without the output switching off.

Switch-on switch-off delay retriggerable ⟫⌐ ⟫⌐

After a rising edge the output will switch on only when the configured time has elapsed. After a falling edge (e.g speed is exceeded) the output will switch off only when the configured time has elapsed. When there is another rising or falling edge during the delay time, the delay time is restarted.

Switch-off delay not retriggerable ⌐⌐

After a falling edge (e.g speed is exceeded) the output will switch off only when the configured time has elapsed. A rising edge during the delay time has no effect. The output switches off when the time has elapsed.

5.3.14 Feedback loops

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

5.3.15 Analogue output

The semiconductor output OUT 4 (Y35) can be configured as 0 – 20 mA or 4 – 20 mA analogue output (burden 0 … 500 Ohm).

The currently applied frequency is output as a current value that is proportional to the currently applied frequency. Here, the current value rises to the maximum value 20 mA. The relevant frequency f_{max} can be configured for this maximum value (see "Expanded settings" menu). When the maximum frequency is exceeded, the current value will continue to rise proportionally to approx. 22 mA, and then remains constant.
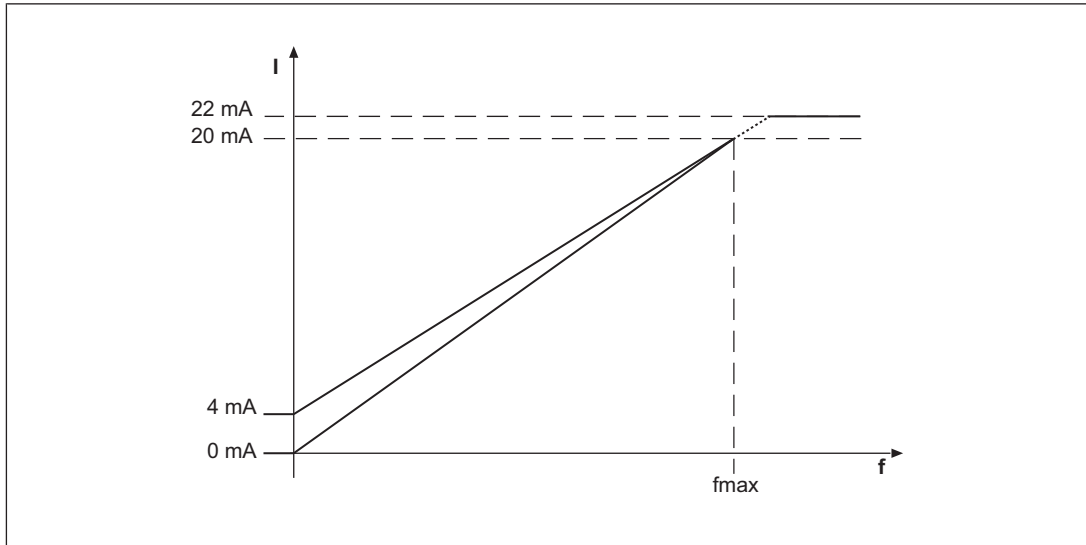
5.3.16 Units

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").

5.3.17 Timing diagram for speed monitoring
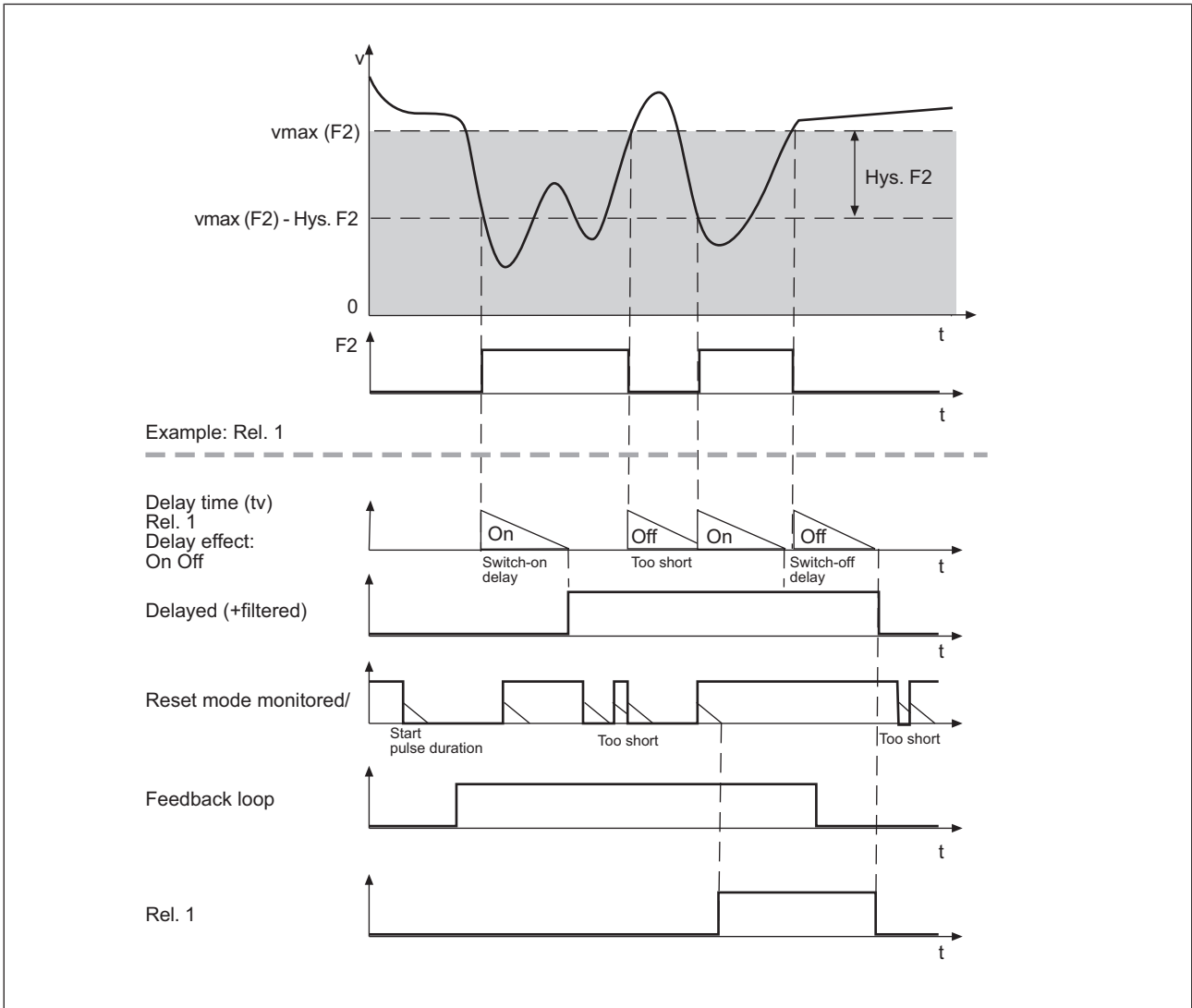
Configuration in the example:

▸ Switch function: F2

▸ Assigned output: Rel. 1

▸ Delay effect on outputs: On + Off

▸ Start type: Monitored /

5.4 Speed configuration

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

To monitor e.g. various operating modes you can configure up to 16 parameter sets (P0 ... P15) with a max. of 9 switch functions (F1 ... F9) each.
In addition, special functions may be configured for each parameter set (except in Select mode "None") (see chapter Special functions [📖 35]).
One of the 16 parameter sets is selected via 4 select inputs SEL1 (Y10), SEL2 (Y11), SEL4 (Y12), SEL8 (Y13).

The switching functions are monitored simultaneously.
Each of a switching 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

▸ Static value "On" or "Off"

Each output can be assigned a switch function or an area. The results of the switch functions can also be linked together logically. A switch function can be assigned to several outputs. A switch delay [📖 26], the start type [📖 24] and Synchronous start [📖 25] 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.

> **ℹ 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: P0

▸ Automatic mode: P1

The parameter set P0 is used to monitor a reduced speed.

The parameter set P1, "Automatic mode", is selected for speed monitoring (selection via the Select inputs, see next chapter "Select inputs").

The following switching functions are configured for the parameter set P0:

▸ F1: Standstill 2 Hz

▸ F2: Overspeed: 50Hz

▸ F3: Warning threshold: 50Hz

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

▸ F1: Standstill 2 Hz

▸ F2: Overspeed: 3000Hz

▸ F3: Warning threshold: 2000Hz

The following outputs are assigned to the switch functions:

▸ F1: Relay output Rel. 1

▸ F2: Relay output Rel. 2

▸ F3: Semiconductor output Out 1

language	English		input device	Sin/cos 1Vss

delay time start-up (0-600s)		Hysteresis (0-50%)

	F1	F2	F3	F4	F5	F6	F7	F8	F9
P0	Standstill	50 Hz	50 Hz						
P1	Standstill	3000 Hz	2000 Hz						
P2									
P3									
P4									
P5									
P6									
P7									
P8									
P9									
P10									
P11									
P12									
P13									
P14									
P15									

Left side controls:

- units
- conversion
- mode select input — 1 of 4
- Sel 1 (Y10)
- Sel 2 (Y11)
- Sel 3 (Y12)
- Sel 4 (Y13)
- delay time select input (0-30s) — 20 ms

Right side:

- global standstill (10 mHz - 1 MHz) — 2 Hz
- input device settings (10 mHz - 1 MHz): f max (A/B) = 20 kHz; f max (Z)
- ratio (0,0001-400.000:1): f(A/B):f(Z)
- position monitoring (SOS-M): reset mode; position window width (1-24.900.000 Imp); Pos. 1; Pos. 2; Pos. 3; Pos. 4
- direction monitoring (SDI-M): Auto reset; direction tolerance (max. wrong); direction left; max. right; direction right; max. left
- name of configuration — Example 2
- CRC of configuration

Outputs table:

	Rel. 1 (13/14)	Rel. 2 (23/24)	Ext. 1	Ext. 2	Out 1 (Y32)	Out 2 (Y33)	Out 3 (Y34)	Out 4 (Y35)
assign outputs (functions)	F1	F2			F3			
delay time effect (outputs)								
delay time 0 - 30s (outputs)								
reset mode	automatic	automatic			automatic			
Synchronous start	deactivated	deactivated			deactivated			
output out logic					normally on			
Ausgang Out 4 Analog fmax								

V. 15 - CS - TS - T.U.

For documentation and a better overview of the device settings, we recommend that you fill in this configuration overview before setting the device parameters (see under Create configuration overview [📖 56]).

From device version 2.2 you have the opportunity to create the settings with the software-tool from Pilz (see Create configuration in PNOZsigma Configurator [📖 87]).

5.4.1   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 up to SIL CL 3 in accordance with 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 up to SIL CL 3 in accordance with 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
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

▸ Drift in the inputs

This may mean that a parameter set other than P1, P2, P4 or P8 is selected. An error message appears and all the 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 the expanded parameter sets are used, please note the following:

An open circuit when activating the select inputs triggers a switch to a parameter set with a lower number (e.g. P7→ P3 with open circuit at SEL4).

Limit values for the switch functions should therefore be entered in ascending order (parameter set P0 → lowest values, parameter set P15 → highest values).

For this reason, a special function "No 2 encoder diagnostics" should be configured in a parameter set with a higher number, so that a potential open circuit cannot activate this function unintentionally.

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. The new parameter set will be activated only when the delay time has elapsed.

5.4.2 Switch functions

The following switch functions are available:

▸ **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 in the factory setting.

▸ **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 (speeds) 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.

▸ **Static value "On" or "Off"**

The static value "On" or "Off" can be configured as a switch function instead of a monitoring function. The assigned outputs are then switched on and/or off.

The static value "On" and "Off" can be configured as a switch function as often as necessary.

▸ **Logic operations**

The results of the switch functions F1 … F9 and the area operations F2-F3 … F8-F9 can be linked together logically (AND, OR). The following operations can be assigned:

F2 AND F3 (*F2* ∧ *F3*)

F4 AND F5 (*F4* ∧ *F5*)

F1 AND F6-F7 (*F1* ∧ *F6-F7*)

F1 AND F8-F9 (*F1* ∧ *F8-F9*)

F6 OR F7 (*F6* ∨ *F7*)

F8 OR F9 (*F8* ∨ *F9*)

F1 OR F2-F3 (*F1* ∨ *F2-F3*)

F1 OR F4-F5 (*F1* ∨ *F4-F5*)

▸ **Analogue output**

The semiconductor output OUT 4 (Y35) can be configured as 0 – 20 mA or 4 – 20 mA analogue output.

▸ **Error output**

Every output can be configured as an error output.

Error: Output switched off

No error: Output switched on

▸ **Output OFF**

Every output can be switched off permanently

Overview output assignments

Every assignment has a unique number.
The assignment options are available:

No.	On the display	Description
0	Off	
1	F1	Individual switch functions
…		
9	F9	
10	F2 - F3	Speed range
11	F4 - F5	
12	F6 - F7	
13	F8 - F9	
14	Err	Error output

No.	On the display	Description	
15	F2 ∧ F3	F2 AND F3	Logic operations
16	F4 ∧ F5	F4 AND F5	
17	F1 ∧ F6-F7	F1 AND F6-F7	
18	F1 ∧ F8-F9	F1 AND F8-F9	
19	F6 v F7	F6 OR F7	
20	F8 v F9	F8 OR F9	
21	F1 v F2-F3	F1 OR F2-F3	
22	F1 v F4-F5	F1 OR F4-F5	
23	0 – 20 mA Analogue	Analogue output	
24	4 – 20 mA Analogue		

5.4.3 Special functions

In Select mode "1 of 4" or "all 16", additional special functions can be configured in addition to the switching functions for each parameter set (P0 to P5).

Special functions cannot be configured in the select mode "none".

The following configuration options are available:

▸ **No special function (default)**

No special function is performed in the selected parameter set.

▸ **No 2 encoder diagnostics**

There is no plausibility check between fAB and fZ. This special function may only be used when one of the following encoder types in configured:

  – HTL single Z Freq. Ini pnp

  – TTL single Z Freq. Ini pnp

  – TTL differential Z Freq. Ini pnp

  – HTL differential Z Freq. Ini pnp

  – sin/cos 1 Vss Z Freq. Ini pnp

  – Hiperface Z Freq. Ini pnp

For a parameter set with the special function "No 2 encoder diagnostics" the operating mode without Z Freq. Ini pnp must be used for the safety assessment.
Please note that the "Select inputs mode" setting may reduce the safety level (see under Select Inputs [📖 31]).

▸ **Error acknowledgement**

When switching to the parameter set, the recoverable errors are acknowledged. Errors that occur while the parameter set is executed are not acknowledged. After error acknowledgement the device behaves in accordance with the switching functions configured in this parameter set. A new error acknowledgement by this parameter set can only be performed after selecting another parameter set.

A complete list of recoverable errors can be found under Current error messages [📖 92].

The error acknowledgement restarts the PNOZ s30.

▸ **Restart**

The device is restarted when switching to the parameter set.
After restart the device behaves in accordance with the switching functions configured in this parameter set. A new restart by this parameter set can only be performed after selecting another parameter set.

5.4.4 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
      Default: 2 Hz

   – **Speed (F2)**

      Max. frequency (v max) configurable in Hz
      Default: 500 Hz

‣ **Parameter set/select input**

   P0, select inputs are ignored ("None" mode")

‣ **Hysteresis**

   Standstill and speed, 2 % each

‣ **Output assignment**

   – Standstill (F1): Relay output Rel. 1 and semiconductor output Out 1

   – Speed (F2): Relay output Rel. 2 and semiconductor output Out 2

‣ **Start mode**

   – Rel. 1, Rel. 2 Out 1, Out 2: Automatic start

‣ **Switch delay**

   None

‣ **Max. encoder frequency**

   3.5 kHz

Basic configuration 2: Encoder

‣ **Encoder type**

   Encoder

   – Encoder type configurable

▸ **Switch functions**

– **Standstill (F1)**

Standstill frequency configurable in Hz
Default: 100 Hz

– **Speed (F2)**

Max. frequency (v max) configurable in Hz
Default: 5 kHz

– **Direction (F3)**

Left direction
Tolerance for wrong direction = 10 pulses

– **Direction (F4)**

Right direction
Tolerance for wrong direction = 10 pulses

▸ **Parameter set/select input**

P0, select inputs are ignored ("None" mode)

▸ **Hysteresis**

Standstill and speed, 2 % each

▸ **Output assignment**

– Standstill (F1): Relay output Rel. 1 and semiconductor output Out 1

– Speed (F2): Relay output Rel. 2 and semiconductor output Out 2

– Left direction (F1-F4): External output Ext. 1 and semiconductor output Out 3

– Right direction (F1-F4): External output Ext. 2 and semiconductor output Out 4

▸ **Start mode**

– All outputs: Automatic start

▸ **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

5.4.5 Chip card

The set parameters, the name of the configuration, the check sum and the passwords are stored on the chip card. The error list can also be saved to the chip card. (See chapter "Use chip card").

5.5 Input device types

5.5.1 Proximity switch

▸ The following proximity switches can be used:

  – pnp

  – npn

▸ The values stated under Safety characteristic data [📖 108] apply only when using proximity switches that are implemented as N/O contacts.

▸ 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:
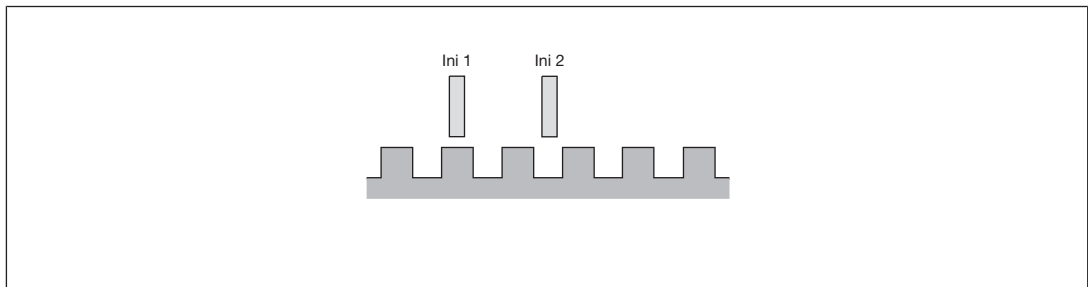
Example pnp – pnp:
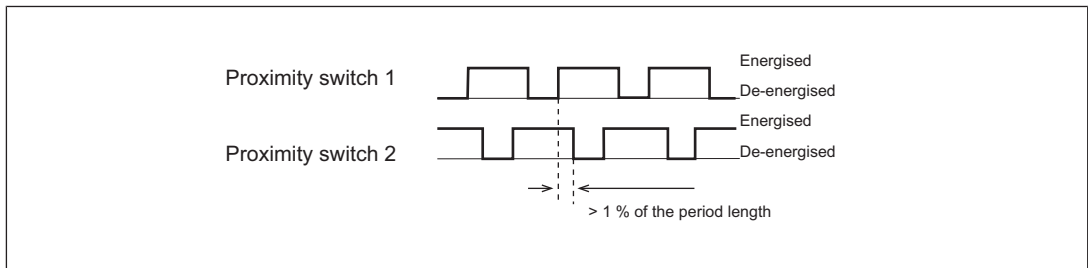
	CAUTION!
⚠	Appropriate installation measures should be taken to prevent a foreign body coming between the signal encoder and the proximity switch. If not, the foreign body could cause invalid signals.

▸ Please note the values stated in the technical details

▸ The maximum frequency of the used encoders must be entered for a full configuration ("Encoder" menu → "Track AB" → "Track AB fmax" / "Track Z" → "Track Z fmax").

▸ The following tolerance times can be configured for the proximity switches:

– Tolerance time for tracks A and B ("Encoder" menu → "Track AB" → "Track AB Tol.")

– Tolerance time for track S ("Encoder" menu → "Track S" → "Track S Tol.")

The tolerance time influences the sensitivity towards invalid signal levels (e.g. in the event of EMC interference). The greater the configured tolerance time, the less sensitive the system will be towards invalid signal levels.

> **CAUTION!**
>
> **Delayed reaction to invalid signal levels**
>
> Setting a tolerance time increases the reaction time of the feasibility check of the signal levels. The detection time can increase to a maximum of four times the set tolerance time as a result. This must be taken into account when the system is designed.

Proximity switch with reduce diagnostics

With the encoder type *2 proximity switches with reduced diagnostics*, the proximity switches can be arranged at will. This means that the signals from the proximity switches do not need to overlap. However, this leads to reduced diagnostics.

5.5.2 Rotary encoders

▸ The following encoders can be used:

– TTL, HTL (single-ended or differential signals)

– sin/cos 1 Vss

– Hiperface

▸ The encoders can be connected with or without Z index (0 index)

▸ The cable used to connect the 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").

– When monitoring broken shearpins: The ratio fAB/fZ ("Encoder Settings" menu → "Track Z" → fAB/fZ Verh.)

▸ The following tolerance times can be configured for the rotary encoders

– Tolerance time for tracks A and B ("Encoder" menu → "Track AB" → "Track AB Tol.")

– Tolerance time for track Z ("Encoder" menu → "Track Z" → "Track Z Tol.")

– Tolerance time for track S ("Encoder" menu → "Track S" → "Track S Tol.")

The tolerance time influences the sensitivity towards invalid signal levels (e.g. in the event of EMC interference). The greater the configured tolerance time, the less sensitive the system will be towards invalid signal levels. With encoder types with Z index the tolerance time for tracks A and B is also effective for track Z. The tolerance time for track Z is only effective for the encoder types "rotary encoder + pnp proximity switch".

> **CAUTION!**
>
> **Delayed reaction to invalid signal levels**
>
> Setting a tolerance time increases the reaction time of the feasibility check of the signal levels. The detection time can increase to a maximum of four times the set tolerance time as a result. This must be taken into account when the system is designed.

Please note the values stated in the technical details

5.5.2.1 Output signals

Output signals TTL, HTL

▸ Single ended
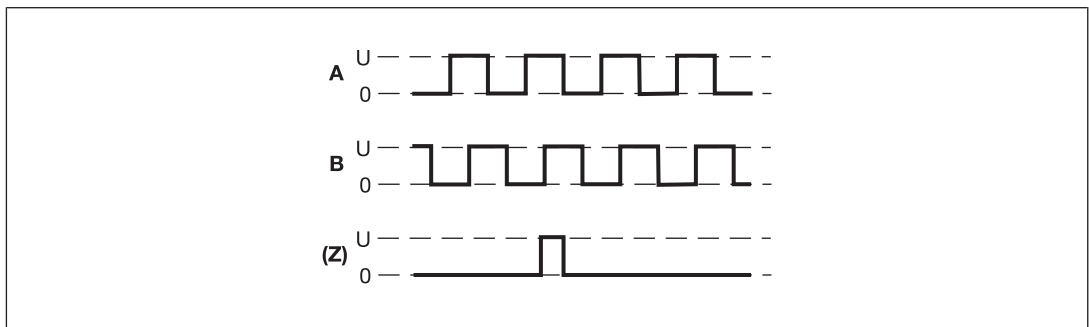
▸ Differential
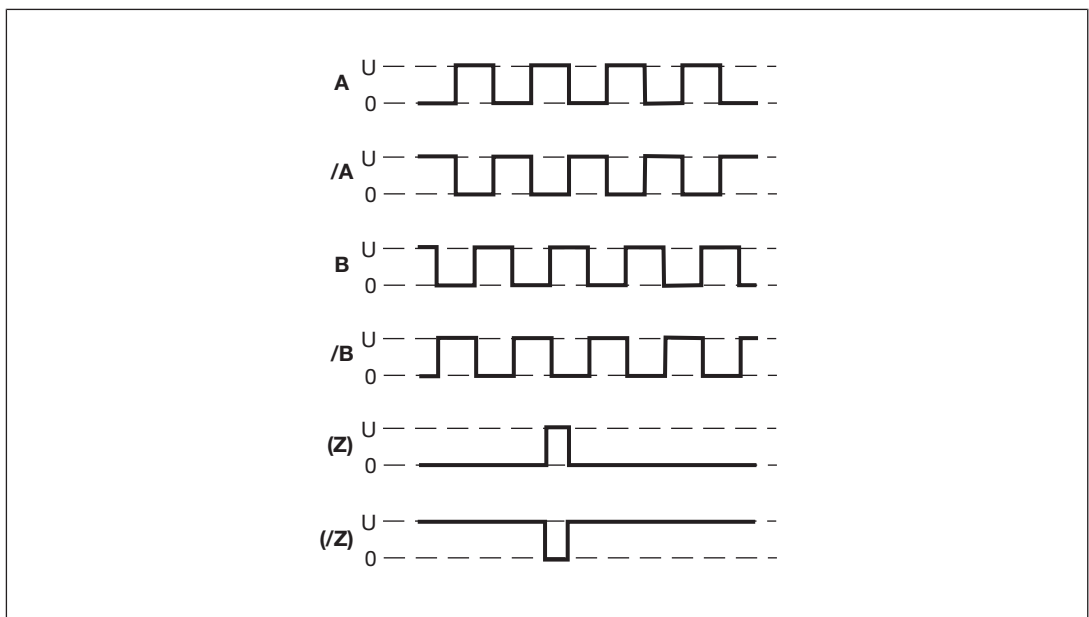
Output signals Sin/Cos (1 Vss)

▸ Single ended with reference track (e.g. Hiperface ®)
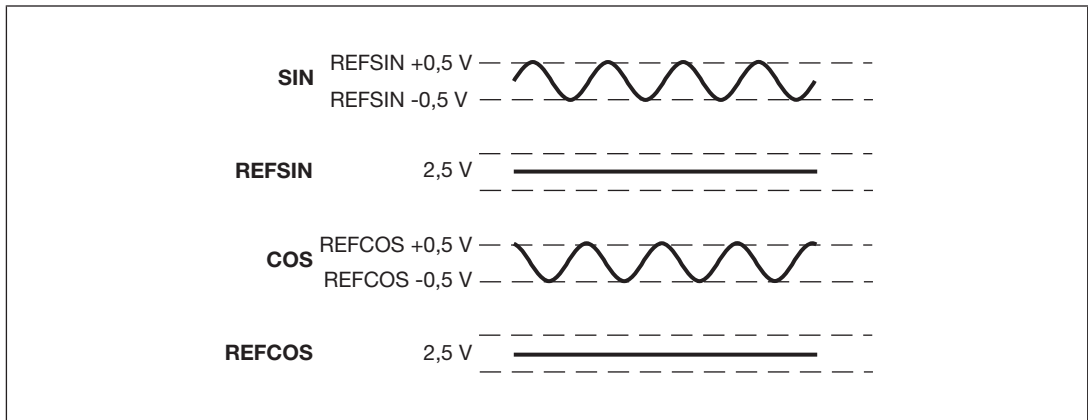
▸ Differential with/without Z index (e.g. Heidenhain 1 Vss)
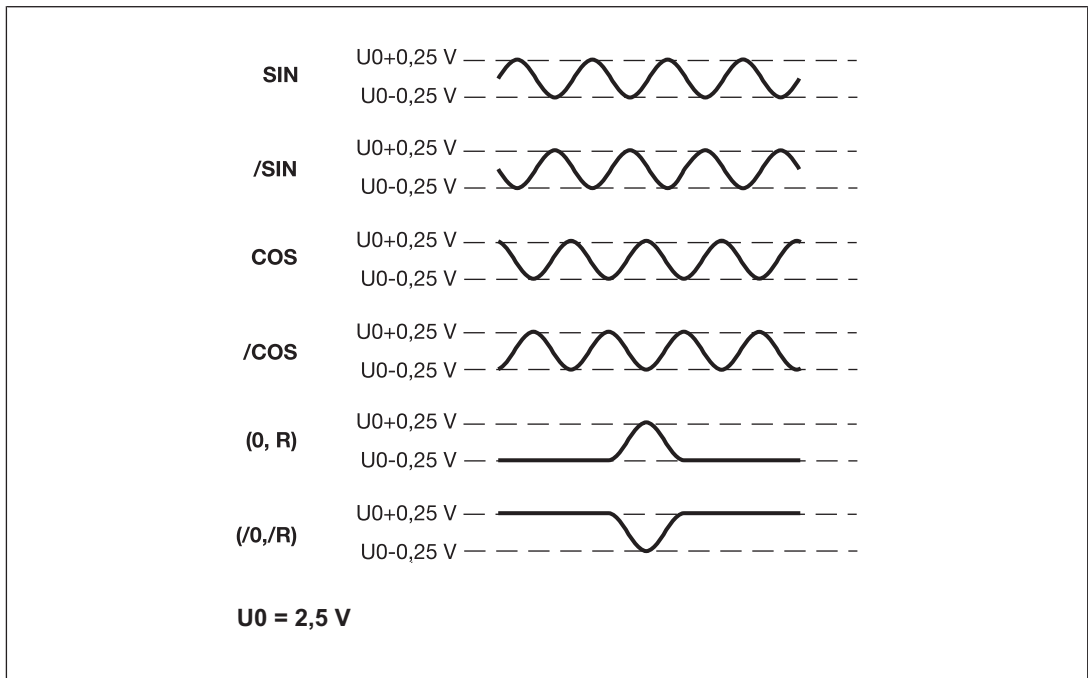
5.5.2.2 Adapter for incremental encoders

The adapter records the data between the encoder and the drive and makes it available to the PNOZ s30 via the RJ45 socket.

Pilz supplies complete adapters as well as ready-made cable with RJ45 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.

Adapters can also be found under Accessories [129].

6 Installation

6.1 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 expansion module.

▸ Connect the base unit and the contact expansion 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.

6.1.1 Dimensions

*with spring-loaded terminals
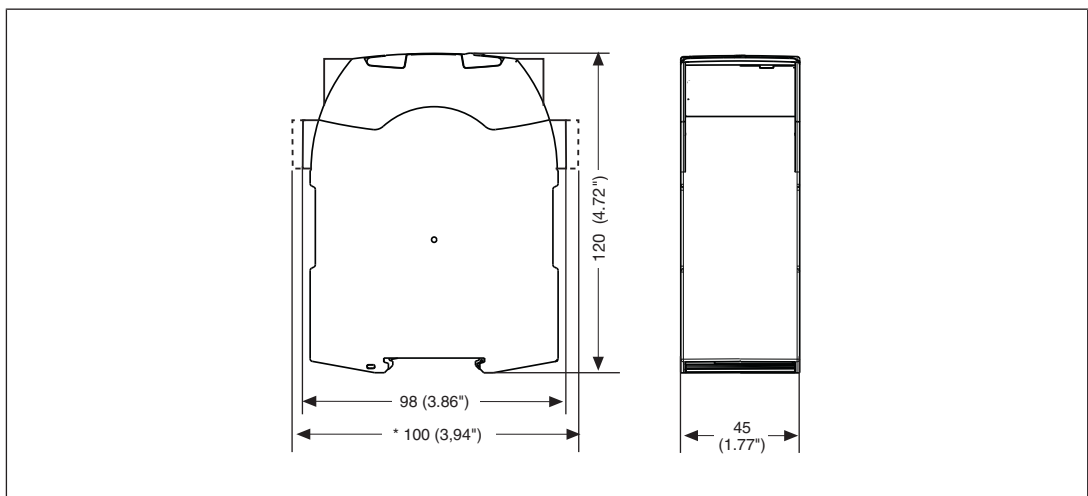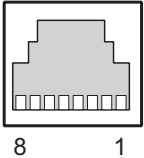
7 Wiring

7.1 General wiring guidelines
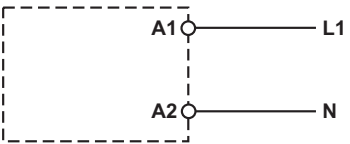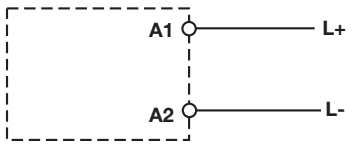
Please note:

▸ Information given in the Technical details [📖 102] must be followed.

▸ Use copper wiring with a temperature stability of 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).

▸ The cable at the analogue output must be shielded.

7.2 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

7.3 Supply voltage

Supply voltage	AC	DC
	A1 ○——— L1 A2 ○——— N	A1 ○——— L+ A2 ○——— L-

7.4 Connection of proximity switches

The following proximity switch combinations can be connected:

▸ A: pnp, B: pnp

▸ A: npn, B: npn

▸ A: pnp, B: npn

▸ A: npn, B: pnp

Connection for 2 proximity switches with reduced diagnostics:

▸ A: pnp, 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 V DC 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.

Special features when connecting 2 proximity switches with reduced diagnostics:

▸ The cables for connecting the proximity switches must be laid separately.

▸ The supply voltage to the proximity switches must be monitored, via track S for example.
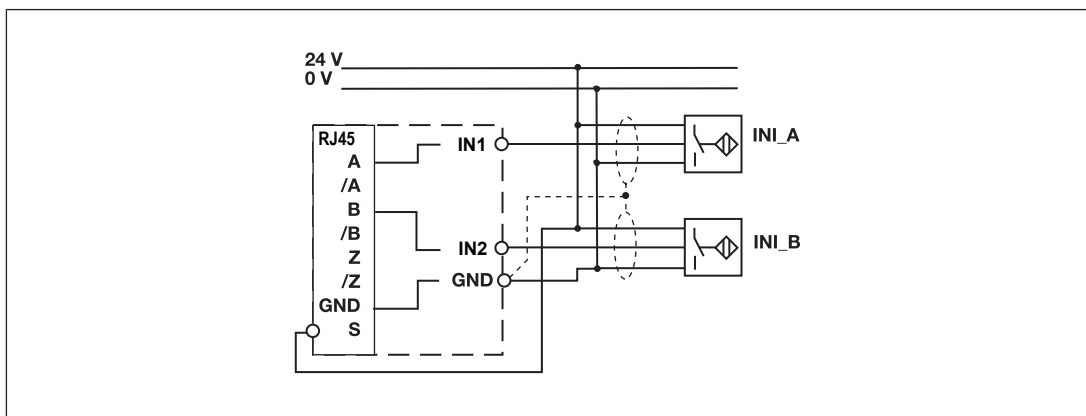
pnp proximity switch with resistor R = 10 kOhm
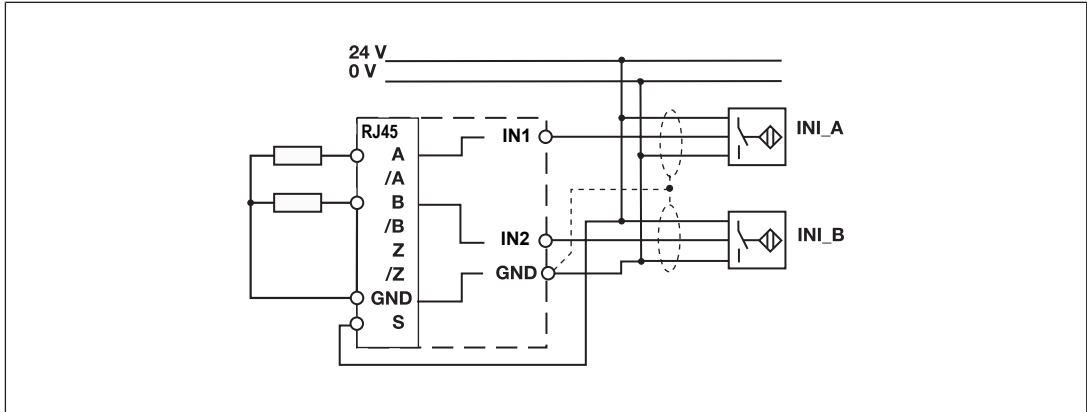
npn proximity switch with resistor R = 47 kOhm
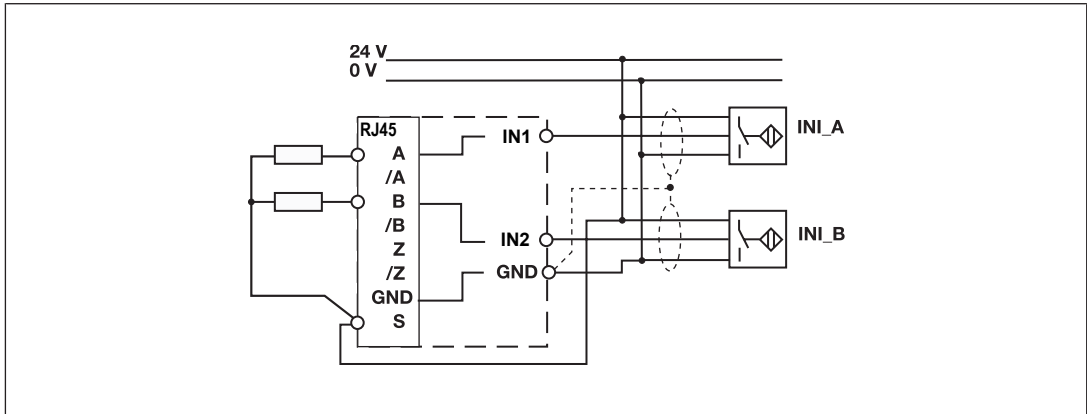
7.5 Connection of a rotary encoder

Proceed as follows when connecting the encoder:

▸ The encoder can be connected via an adapter (e.g. PNOZ msi6p) 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 RJ45 connector.

> **INFORMATION**
>
> The following diagrams are principle connection diagrams. For better clarity, the shielding and supply voltage are not shown.

7.5.1 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
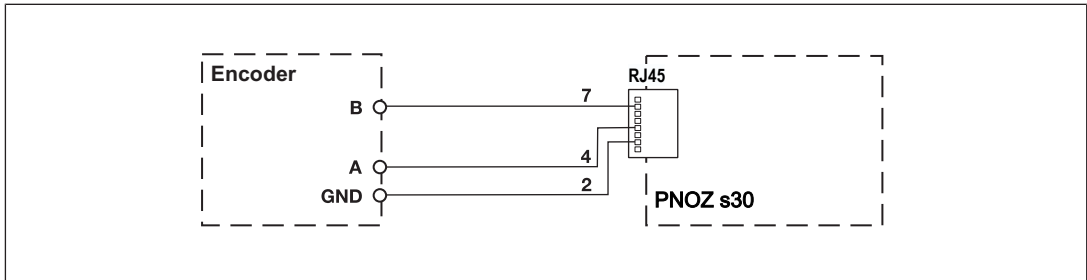
Encoder types:

▸ TTL Differential

▸ HTL differential

▸ sin/cos 1 Vss

▸ Hiperface
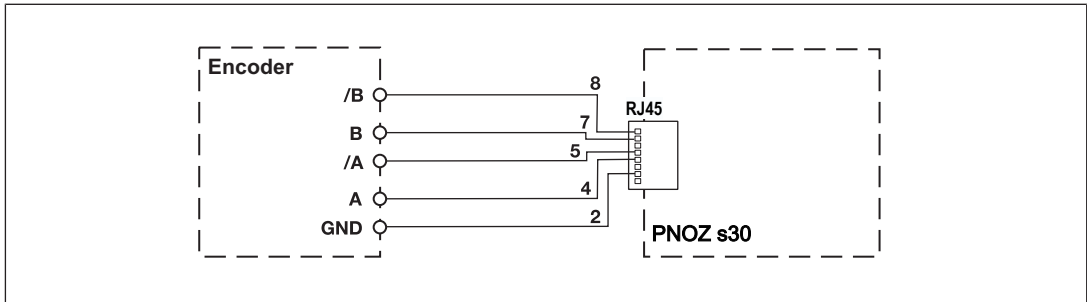
7.5.2 Connect rotary encoder with Z index to speed monitor

Encoder types:

▸ TTL single ended Z Index

▸ HTL single ended Z Index

Please note:

▸ Tracks /A, /B and /Z must remain free
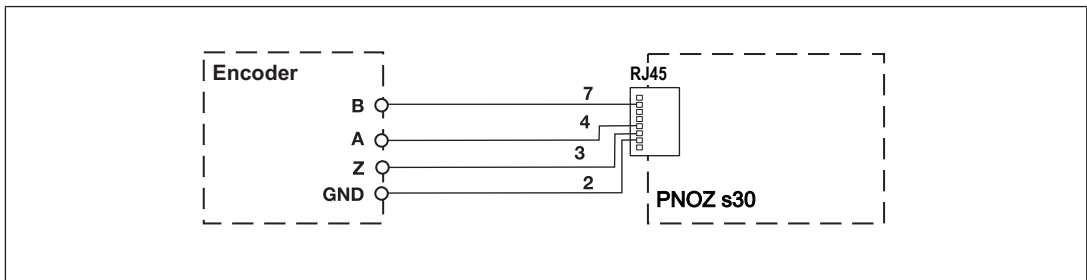
Encoder types:

▸ TTL differential + Z Index

▸ HTL differential + Z Index

▸ sin/cos 1 Vss Z Index

Please note:

▸ When using the encoder type sin/cos 1 Vss Z Index, the length of the encoder cable may be max. 30 m.
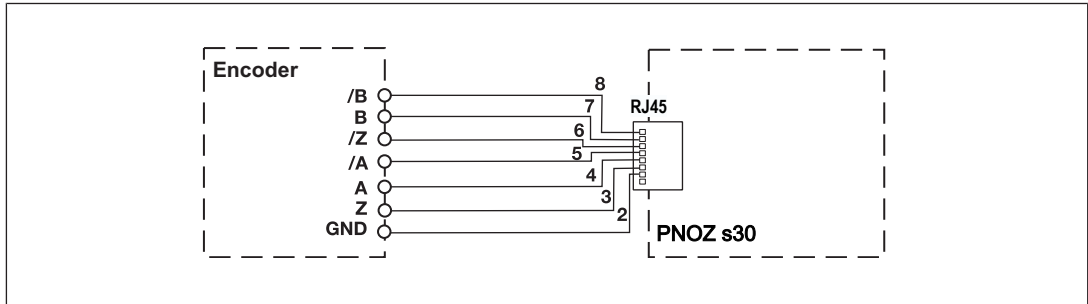
7.5.3 Connect rotary encoder to the speed monitor via an adapter

The adapter (see Accessories) is connected between the encoder and the drive. The output on the adapter is connected to the RJ45 socket on the PNOZ s30.
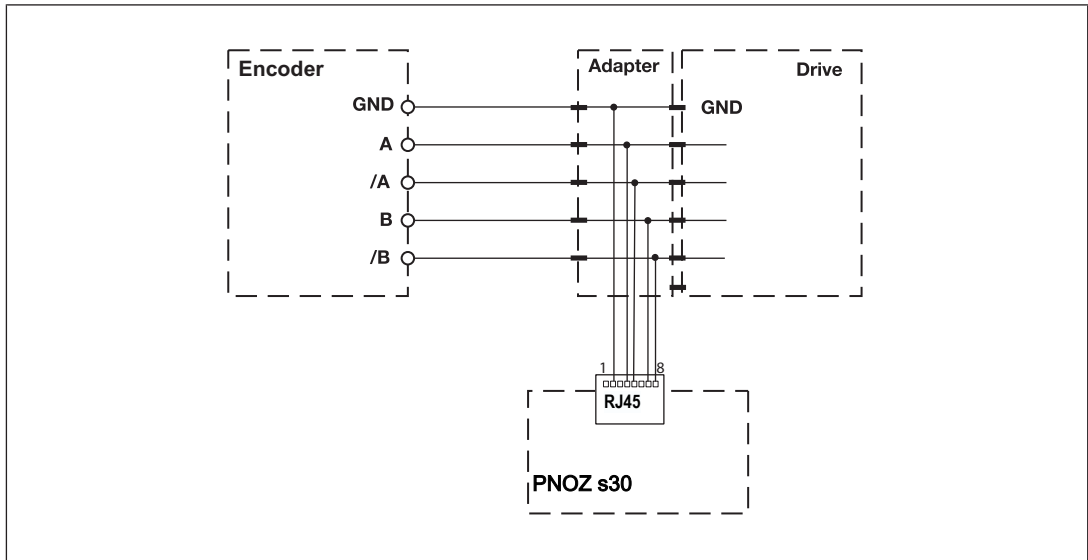
7.6 Connection of proximity switch and rotary encoder

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

> **INFORMATION**
>
> The following diagrams are principle connection diagrams. For better clarity, the shielding and supply voltage are not shown.

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.
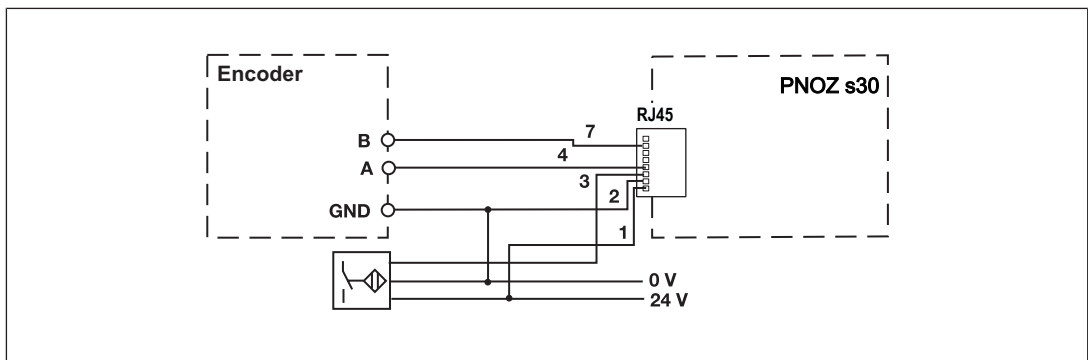
Sensor types:

▸ 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!!
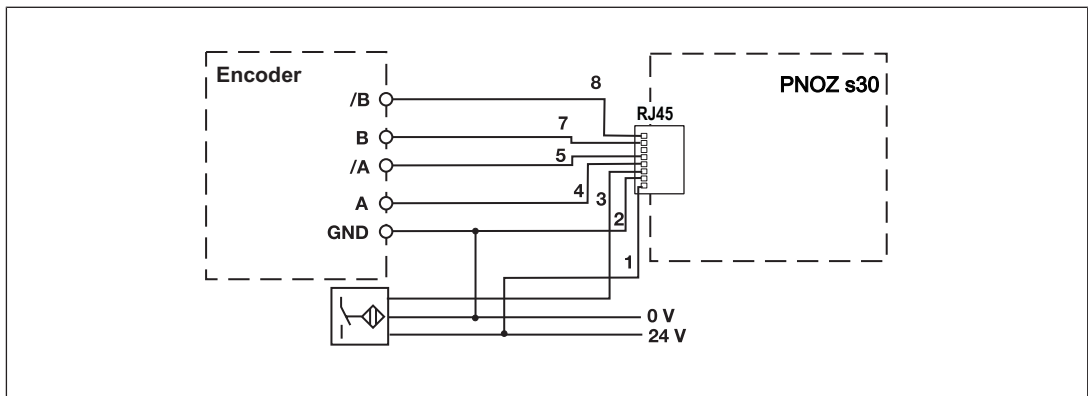
7.7 Reset circuit

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.

7.8 Feedback circuit

No feedback loop monitoring	Contacts from external contactors

Please note:

When using the feedback loop, the cable run at S34, Y1, Y2 and S11 may be max. 30 m.

For greater cable runs, shielded cables with earthing at either end must be used.

7.9   Select inputs

| Y10 (Y11, Y12, Y13) ○—— PLC Output |
| Y30 ○—— PLC 0 V |

7.10   Semiconductor outputs

Y31 ○—— PLC +24 V
Y32 (Y33, Y34, Y35) ○—— PLC Input
Y30 ○—— PLC 0 V
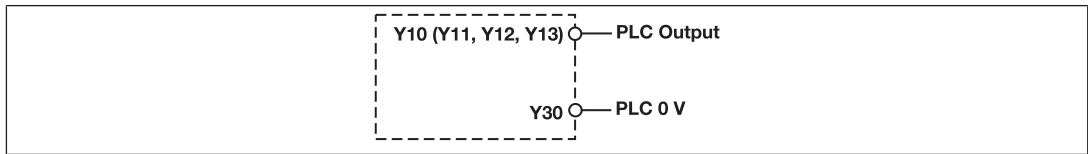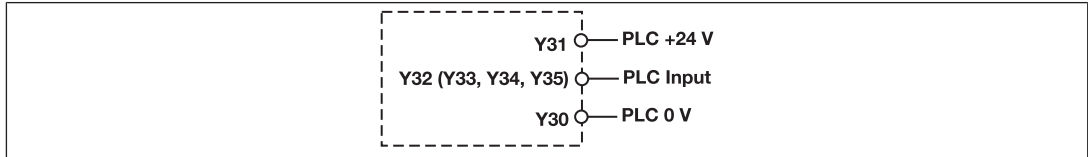
7.11   Analogue output

Y31
Y35
Y30
PLC +24 V
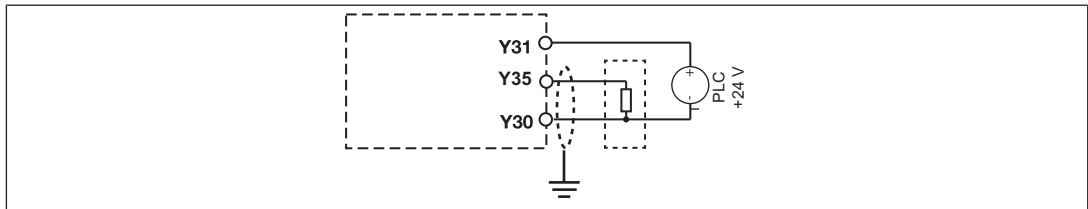
7.12   EMC-compliant wiring

EMC-compliant wiring for connecting an encoder
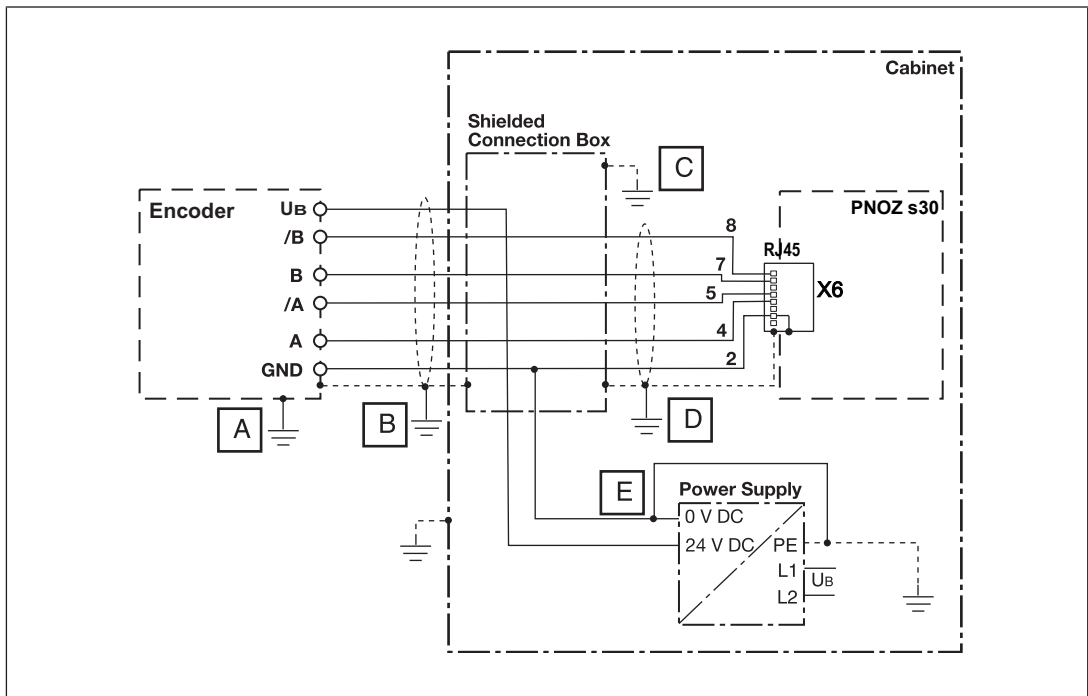
To avoid EMC interference we recommend that the shield on the sensor cables or the housing of the shielded junction box is only connected to earth at a single point:
A **or** B **or** C **or** D **or** E

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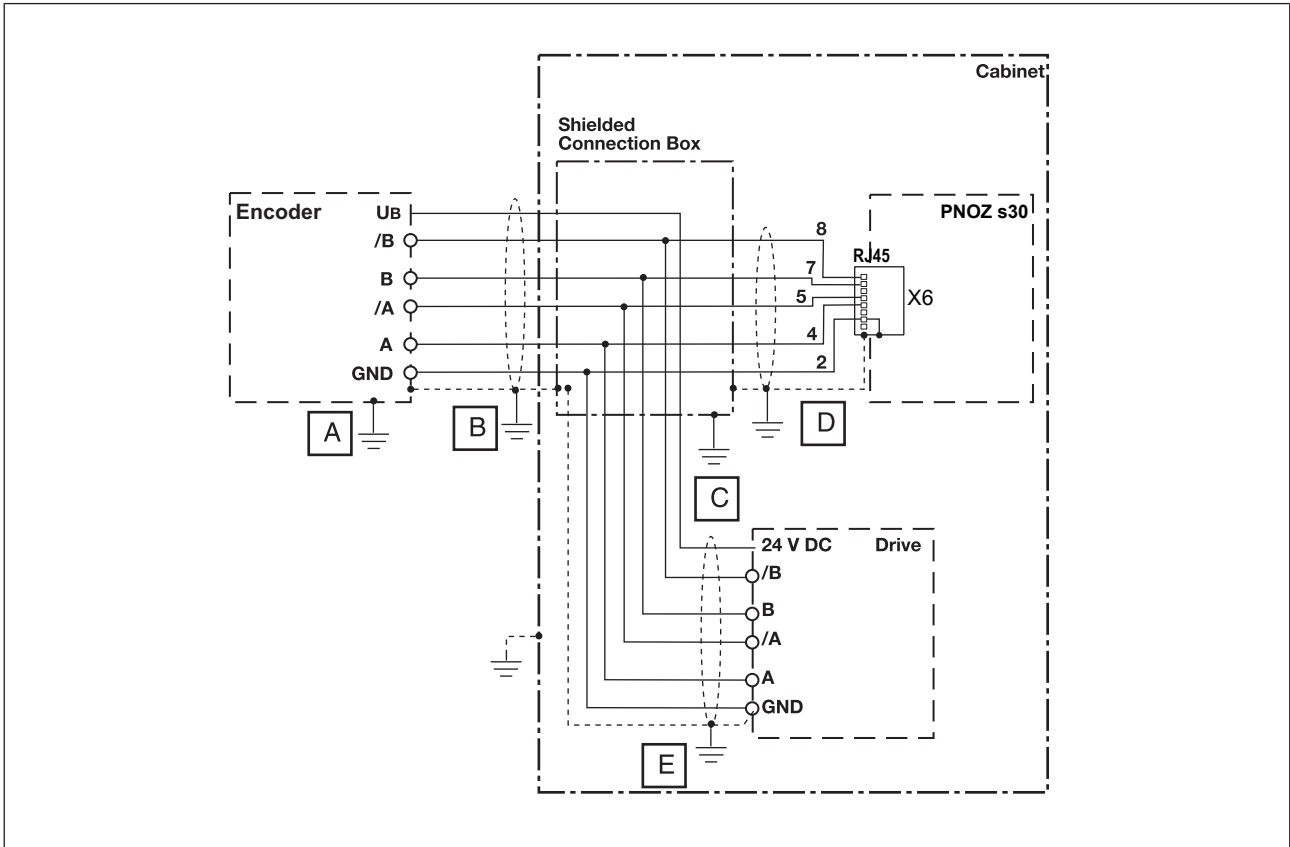
To avoid EMC interference we recommend that the shield on the sensor cables or the housing of the shielded junction box is only connected to earth at a single point:

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
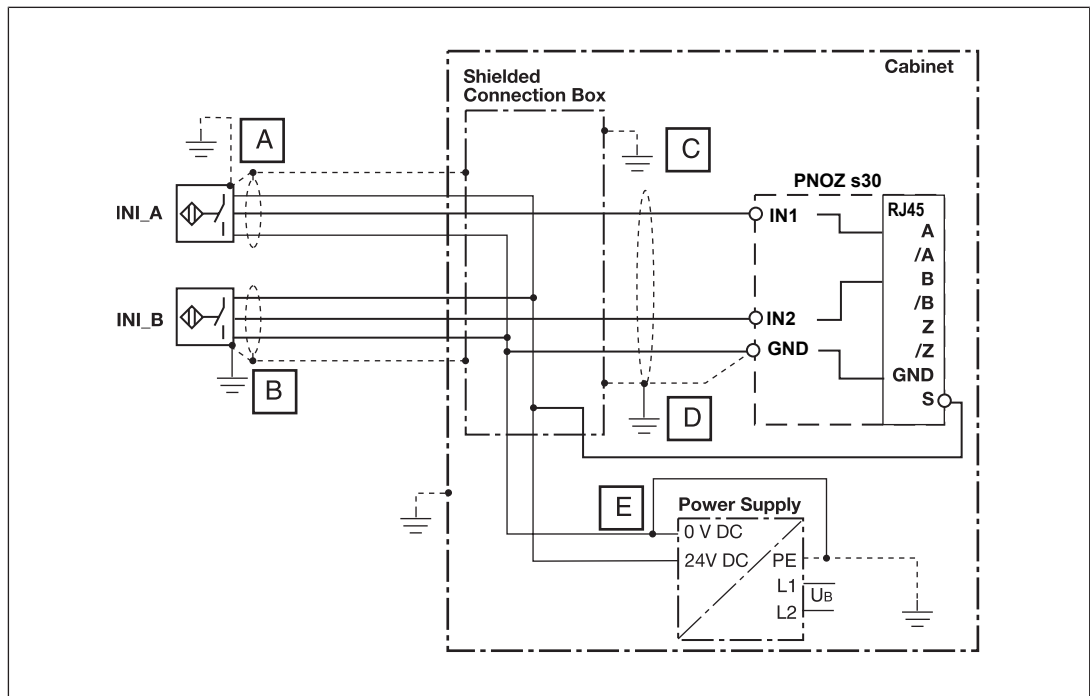
To avoid EMC interference we recommend that the shield on the sensor cables or the housing of the shielded junction box is only connected to earth at a single point:
A **or** B **or** C **or** D **or** E
Conductor loops outside the shield must be avoided.
If a shielded junction box is not used, the shield must run continuously from the sensor to the evaluation device.

EMC-compliant wiring for connecting an encoder and a proximity switch
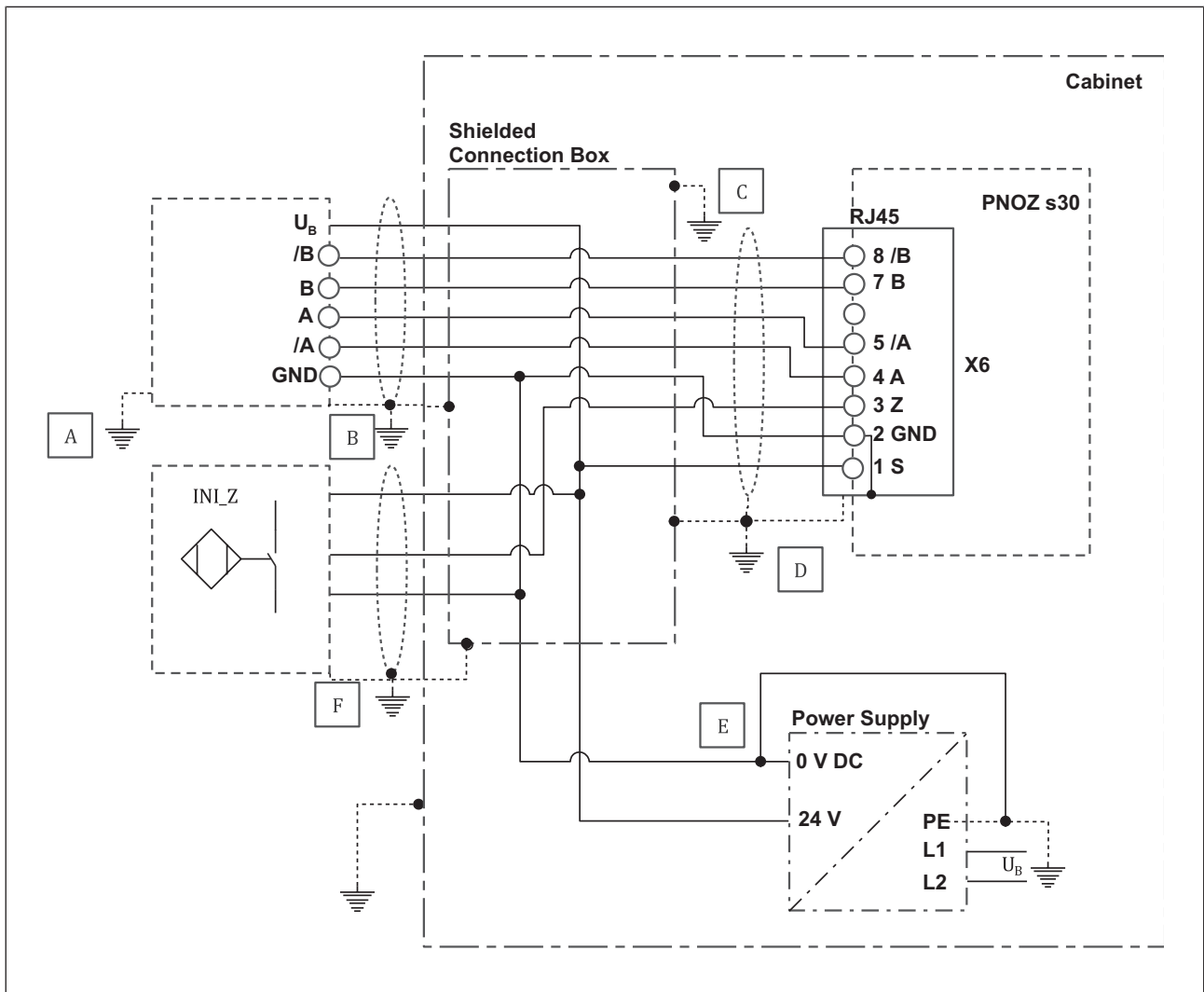
To avoid EMC interference we recommend that the shield on the sensor cables or the housing of the shielded connection box is connected to earth at a single point:

A **or** B **or** C **or** D **or** E **or** F
Conductor loops outside of the shield must be avoided.
If a shielded connection box is not used, the shield must run uninterrupted from the sensor to the evaluation device.

EMC-compliant wiring for connecting an encoder and an HTL encoder
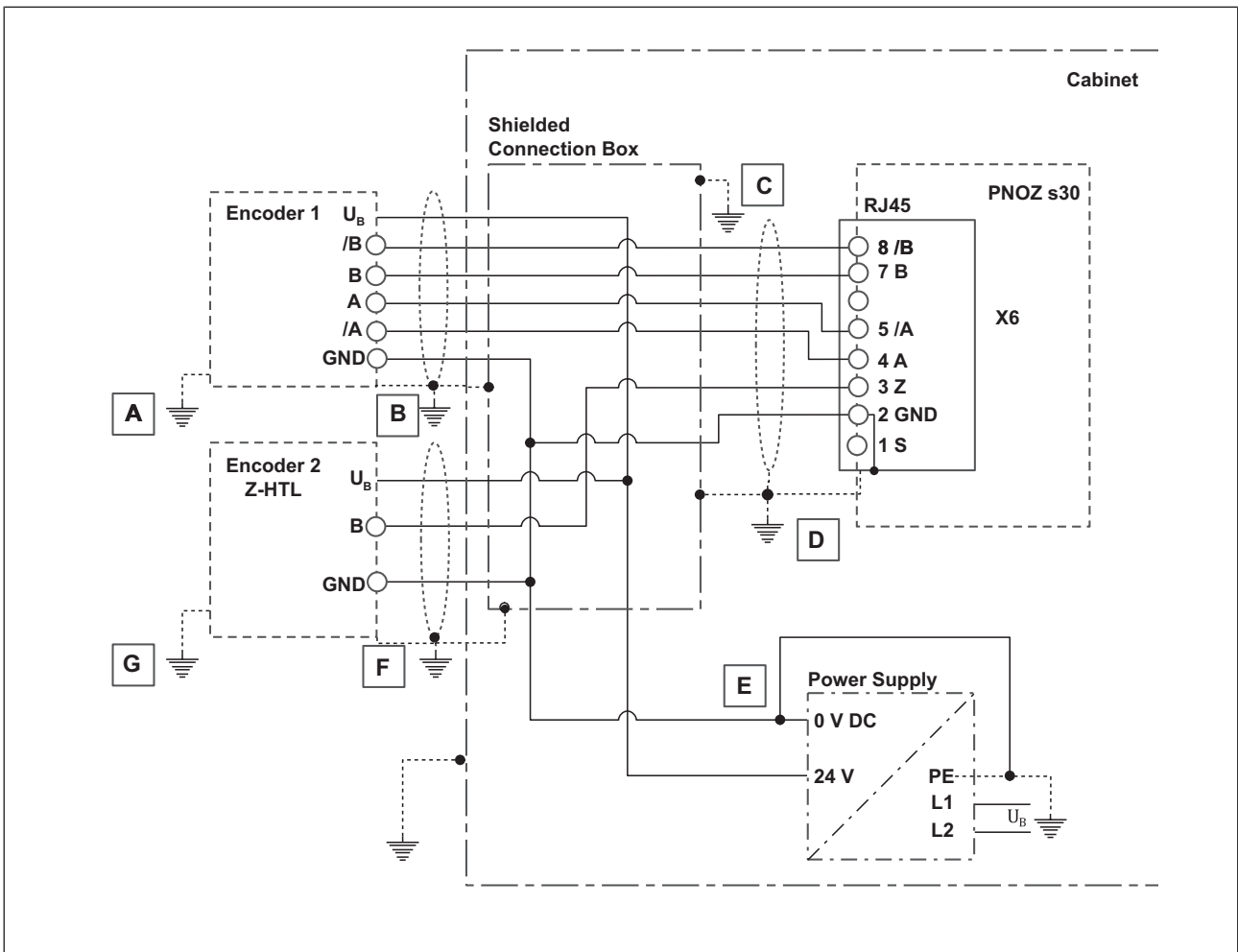
To avoid EMC interference we recommend that the shield on the sensor cables or the housing of the shielded connection box is connected to earth at a single point:

A **or** B **or** C **or** D **or** E **or** F **or** G

Conductor loops outside of the shield must be avoided.

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

8 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.

From device version 2.2 you have the opportunity to create the settings with the software-tool from Pilz (see Create configuration in PNOZsigma Configurator [📖 87]).

8.1 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	English					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)
		P1									f max (Z)
		P2									
conversion		P3									ratio (0,0001-400.000:1)
		P4									f(A/B):f(Z)
		P5									
mode select input		P6									position monitoring (SOS-M)
		P7									reset mode: monitored (default)
		P8									position window width (1-24.900.000 Imp)
		P9									Pos. 1
Sel 1 (Y10)		P10									Pos. 2
Sel 2 (Y11)		P11									Pos. 3
Sel 3 (Y12)		P12									Pos. 4
Sel 4 (Y13)		P13									
		P14									direction monitoring (SDI-M)
		P15									Auto reset: deactivated (default)
delay time select input (0-30s)											direction tolerance (max. wrong)

	Rel. 1 (13/14)	Rel. 2 (23/24)	Ext. 1	Ext. 2	Out 1 (Y32)	Out 2 (Y33)	Out 3 (Y34)	Out 4 (Y35)	
assign outputs (functions)									direction left
delay time effect (outputs)									max. right
delay time 0 - 30s (outputs)									direction right
reset mode	monitoring \ deactivated	monitoring \ deactivated	monitoring \ deactivated	monitoring \ deactivated	monitoring \ deactivated	monitoring \ deactivated	monitoring \ deactivated	monitoring \ deactivated	max. left
Synchronous start									
output out logic					normally on	normally on	normally on	normally on	name of configuration
Ausgang Out 4 Analog fmax									
									CRC of configuration

V. 1.5 - CS-TS - T.U.

8.2 Operate rotary knob
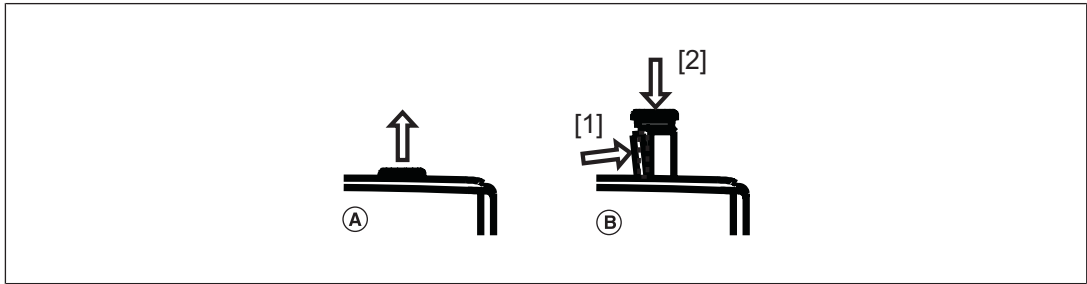
Knob :

▸ (A) pull out until it locks into position

▸ (B) release 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

8.3 Configure Speed Monitor

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

Press 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.

8.4 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 4-figure password.

8.5 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**.

8.5.1 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.
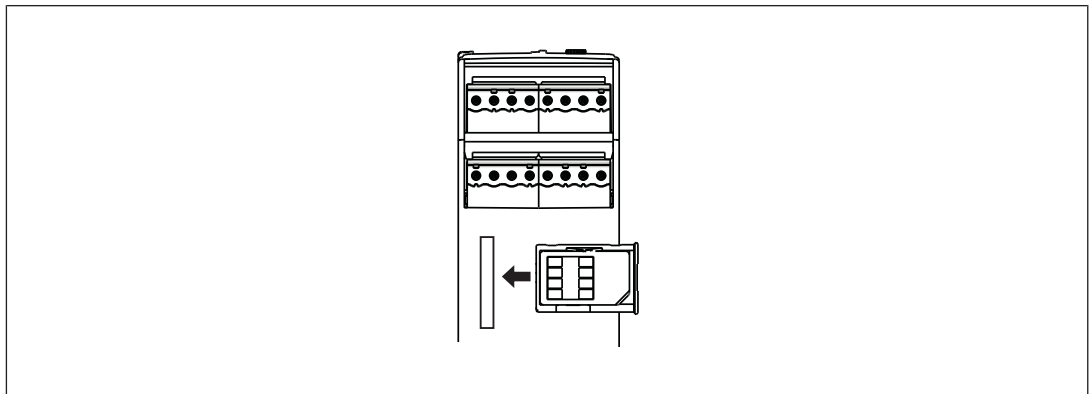
8.5.2 Write data to chip card

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
Please insert SIM Card!	**Write configuration to SIM: No?**		**Write configuration to SIM: Yes?**		**Current menu**

Allow data to be written to the chip card

	Insert chip card	**1.**		Data is **not** written to the chip card
Please insert SIM Card!	**Write con-figuration to SIM: No?**		⇩🪑	**Insert rewritable SIM Card!**

Do not allow data to be written to the chip card

8.5.3 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 unit
Current menu	**SIM: Name of the configuration (8 characters)** **CRC: 12345 (0 .. 65535)** **Load SIM: No?**	↻🪑	**SIM: Name of the con-figuration (8 charac-ters)** **CRC: 12345 (0 .. 65535)** **Load SIM: Yes?**	⇩🪑	**Current menu**

Allow data to be read from the chip card

Note:

After the chip card is loaded, all the outputs are switched off. The device must be restarted (switch off and on or software restart) to start up again.

	Insert chip card (Data on chip card different from device)	**1.**		Data is **not** read into the device, data is written to the chip card
Current menu	**SIM: Name of the con-figuration (8 charac-ters)** **CRC: 12345 (0 .. 65535)** **Load SIM: No?**		⇩🪑	**Write configuration to SIM: No?** (for more details see "Write data to chip card)

Do not allow data to be read from the chip card

8.5.4 Transfer device parameters

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

> **NOTICE**
> **Please note:**
>
> If you transfer the device parameters from one device to a device with an older device version, then it cannot be guaranteed that the safety functions on the older device will behave in the same way. If device parameters are used that do not exist in that device version, then these parameters will not be recognised and, accordingly, this behaviour will be missing.
> From devices with Version 3.1, the transfer of device parameters to older devices is prevented.

To transfer the device parameters, proceed as follows:

Make a note of the configuration's CRC in the PNOZ s30. It is shown on the display in the **Information/ Configuration CRC** menu. This will be needed later, to check whether the correct configuration is saved on the device.

1. Remove the chip card containing the data from device 1.

2. Insert the chip card into device 2.

3. Confirm the message **Load SIM Yes?**.

4. The data is downloaded.

5. To ensure that the configuration has been transferred correctly, check that the CRC for the configuration in the PNOZ s30 matches the configuration CRC you noted down.

8.5.5 Duplicate chip card

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

Follow the instructions below:

▸ 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.

With configurations from devices with an older device version, it may not be possible to create a compatible copy of the original chip card.

The message appears: **Config.Upgrade?**

		1.		2.	A configuration with identical function is generated, with a new CRC. This is not compatible with devices with an older version.
Current menu	Config. upgrade: New CRC: 12345 (0… 65535) No?		Config. upgrade: New CRC: 12345 (0… 65535) Yes?		Current menu

Update configuration

		2.	The configuration is not updated and is not written to the chip card.
Current menu	Config. upgrade: New CRC: 12345 (0… 65535) No?		Insert rewritable SIM Card!

Do not update configuration

8.5.6 Compatibility with older device versions

Chip cards from devices with an older device version can be loaded.

The configuration CRC remains unchanged.
Note:
If you wish to ensure that the chip card can still be read in the device with an older device version, you must not change the configuration.

If you load and change an old configuration, then this configuration will be incompatible for devices with an older device version. You have the option to confirm or prevent this.

The message appears: **Upgrade SIM?**

		1.		2.	A new configuration, incompatible with older device versions, is written to the chip card
Current menu	Upgrade SIM: New CRC: 12345 (0…65535) No?		Upgrade SIM: New CRC: 12345 (0… 65535) Yes?		Current menu

Allow the new configuration to be written to the chip card

		1.	The changed configuration exists only in the device memory. The chip card is locked for write access and all parameter changes are made only in the internal device memory. The current configuration can be stored on the chip card by inserting a new chip card.
Current menu	**Upgrade SIM:** **New CRC: 12345 (0…** **65535)** **No?**	⇩	**Insert rewritable SIM Card!**

Do not allow the new configuration to be written to the chip card

If a chip card from a PNOZ s30 with an older device version was loaded and afterwards a new chip card was inserted, it may also be necessary to update the configuration. See Duplicate chip card [📖 62].

8.5.7 Special cases and problem solving

Outputs do not switch on correctly, although the same configuration works in another device

Prerequisite:

▸ Chip card from a PNOZ s30 <v3.0

▸ Device PNOZ s30 v3.0

Error

When loading the stated chip card into the device, under certain conditions the "Synchronous start" function can be activated unintentionally. In device versions <v3.0, this function is not available.

Solution

Deactivate the "Synchronous start" option on all outputs (see Synchronous start [📖 25]).

When a chip card is loaded, once the load process has been confirmed, the same question is asked again in a continuous loop

Prerequisite:

▸ Chip card from a PNOZ s30 <v3.0

▸ Device PNOZ s30 v3.0

Error

The contents of the chip card were already loaded into the device memory after the initial confirmation (see Read data from chip card [📖 61]), but the CRC does not match the original CRC.

Solution

Check all the parameters to make sure that the configuration is functionally identical and make a note of the new CRC.

Then insert a new chip card and save the configuration on the chip card (see Write data to chip card [📖 60]).

If you no longer need the chip card data from the older version, then this can also be used.

8.6 Save configuration with Software SmartCardCommander

You have the option to save a PNOZ s30 configuration from the chip card to your computer. The configuration can be saved on the computer and then downloaded to other chip cards.

To do this you will need the chip card reader **PNOZ Chip Card Reader** with the corresponding **SmartCardCommander** software. Both are available from Pilz as accessories, individually or as part of a set (see Accessories [📖 129]).

Save PNOZ s30 configuration on the computer

1. Make a note of the configuration's CRC in the PNOZ s30. It is shown on the display in the **Information/ Configuration CRC** menu. This will be needed later to check whether the correct configuration is saved on the device.

2. Remove the chip card from the PNOZ s30 and insert it into the holder for the chip card reader.

3. Start the **SmartCardCommander** software.

4. Insert the holder containing the chip card into the chip card reader.

5. The **Memory Card** directory is displayed in a list under **Hardware** on the software interface of the **SmartCardCommander** .
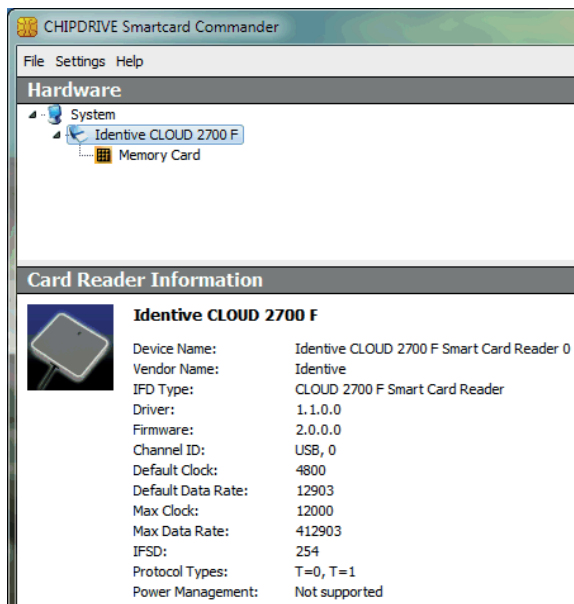
6. To read the data on the chip card, click on the **Memory Card** directory and then select **Read Data from Card**.

7. When **Data read successfully** is displayed on the software interface, the data can be saved as a hex file in any directory on the computer.

8. Make sure that the corresponding configuration CRC, which you noted down, is saved in the same directory.

Download configuration from the computer to the PNOZ s30

1. Insert a chip card into the holder for the chip card reader and insert this into the chip card reader.

2. Start the **SmartCardCommander** software.

3. To write the chip card, select **Write Data to Card** and confirm with **Yes**.

4. Insert the chip card in the PNOZ s30 and proceed as described under Read data from chip card [61].

5. To ensure that the configuration has been transferred correctly, check that the CRC for the configuration in the PNOZ s30 matches the configuration CRC you noted down on the computer.

> **CAUTION!**
>
> With each transfer, you must check that the appropriate configuration for an application is transferred to a device!

8.7 Menu overview

The tables provide an overview of the menu settings.

8.7.1 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.

8.7.2 Basic settings Ini pnp pnp

Settings for basic configuration 1

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

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

▸ **Start mode**

– All outputs: Automatic start ("Automatic")

▸ **Switch delay**

None

▸ **Max. encoder frequency**

3.5kHz

8.7.3 Basic settings for the rotary encoder

Settings for basic configuration 2

Level	Designation on the display	Description	Settings
1	**Basic Parameter Encoder:** Default: Load?	Select the default settings with which the basic configuration menu "**Rotary encoder:**" is to be called: - Load: The basic parameters are loaded. Then it switches to the basic menu "**Rotary encoder:**". The basic parameters should always be loaded when commissioning for the first time. - Edit: The basic parameters are not loaded, i.e. all parameters are retained. The basic menu parameters can be changed within the permitted boundaries. -Escape: Exits the basic menu.	
2	**Encoder** 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)

Level	Designation on the display	Description	Settings
2	**Standstill** **Rel.1 Out 1** Default: 100 Hz	Enter standstill frequency	10 mHz to 1.00 kHz
2	**v max** **Rel.2 Out 2** Default: 5.00 kHz	Enter the max. permitted speed	10 mHz to 1.00 MHz

Other, pre-defined settings:

▸ **Switch functions**

  – **Direction (F3)**

  Left direction
  Tolerance for wrong direction = 10 pulses

  – **Direction (F4)**

  Right direction
  Tolerance for wrong direction = 10 pulses

▸ **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

  – Left direction: External output Ext. 1 and semiconductor output Out 3

  – Right direction: External output Ext. 2 and semiconductor output Out 4

▸ **Start mode**

  – All outputs: Automatic start ("Automatic")

▸ **Switch delay**

  None

▸ **Max. encoder frequency**

  1 MHz

8.7.4 Settings

Level	Designation on the display	Description	Settings
1	**Permanent Display** Default: Std Min : Sek (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	**Display combinations:** ▶ vz (current speed of track Z) ▶ v (current speed of track AB) ▶ Position ▶ Switch functions 1 ... 9: 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) ▶ Std Min : Sek (system time) ▶ v (current speed of track AB) ▶ Position
1	**Displ. Units** **Speed: Dist: Pos.:** Default: Hz Imp	Select unit of speed and distance (position).	**Speed:** (speed) **- Pos.** (distance/position) ▶ Hz Imp (pulse) ▶ Hz Edg (edge) ▶ m/s m ▶ m/min m ▶ m/h m ▶ rps rot ▶ rpm rot
1	**Conversion** Default: 1 Hz= 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 pulses) ▶ 1 rot = x Imp (x = 1 ... 10,000,000 pulses)
1	**Encoder Settings**	Create encoder configuration for tracks A, /A, B, /B, Z, /Z, S	

Level	Designation on the display	Description	Settings

2	**Encoder**
	Default:
	Undefined
		Select pre-defined encoder types for the tracks A, B and Z:
		Proximity switch
		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
			No encoder selected:
			▸ Undefined
			
			Proximity switch (Ini):
			▸ Initiator A: pnp B: pnp
			▸ Initiator A: npn B: pnp
			▸ Initiator A: pnp B: npn
			▸ Initiator A: npn B: npn
			▸ Initiator A/B: pnp r.D. (with reduced diagnostics)
			
			Encoder:
			▸ **TTL**
			  – TTL differential (A, /A, B, /B)
			  – TTL single ended (A, B)
			▸ **TTL with Z-Index**
			▸ TTL diff. Z index (A, /A, B, /B, Z, /Z)
			▸ TTL single Z index (A, B, Z)
			▸ **HTL**
			  – HTL differential (A, /A, B, /B)
			  – HTL single ended (A, B)
			▸ **HTL with Z index**
			HTL diff. Z index (A, /A, B, /B, Z, /Z)
			HTL single Z index (A, B, Z)
			▸ **Sin/Cos 1 Vss**
			  – sin/cos 1 Vss (A, /A, B, /B)
			▸ **Sin/Cos 1 Vss with Z index**
			  – sin/cos 1 Vss Z Index (A, /A, B, /B, Z, /Z)
			▸ **Hiperface**
			  – Hiperface (A, /A, B, /B)

Level	Designation on the display	Description	Settings

			Rotary encoder + pnp proximity switch
			▸ **TTL + pnp proximity switch ***
			   – TTL diff. (A, /A, B, /B), Z Freq Inipnp (Z)
			   – TTL single (A, B), Z Freq Inipnp (Z)
			▸ **HTL + pnp proximity switch ***
			   – HTL diff. (A, /A, B, /B), Z Freq Inipnp (Z)
			   – HTL single (A, B),Z Freq Inipnp (Z)
			▸ **sin/cos 1 Vss + pnp proximity switch ***
			   – sin/cos 1 Vss (A, /A, B, /B), Z Freq Inipnp (Z)
			▸ **Hiperface + pnp proximity switch ***
			   – Hiperface (A, /A, B, /B), Z Freq Inipnp (Z)
			
			* Alternatively, a track from an HTL encoder can also be used instead of a pnp proximity switch
			
			The configuration is the same as with the pnp proximity switch as Z-frequency monitoring.

2	**Track AB**	Settings for tracks A and B	
3	**AB Direction** 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
3	**Track AB fmax** Default: 10mHz	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

Level	Designation on the display	Description	Settings
3	**Track AB Tol** Default: Off	Enter tolerance time for invalid signal level on tracks A and B. On encoder types with Z-index, this tolerance time is also effective on track Z.	▸ Off ▸ 50 ms … 2500 ms
2	**Track Z**	Settings for track Z	
3	**Track Z fmax** Default: 10mHz	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	**AB/fZ Ratio** Default: 1.0000: 1	**Only required with 2 encoder diagnostics/broken shearpin monitoring or rotary encoder with Z-index.** ▸ **2 encoder diagnostics and broken shearpin monitoring** Enter the ratio of the frequency on tracks AB "fAB" to the frequency on track Z "fZ". Used for frequency monitoring on track Z **Information** Calculation of the ratio of the frequencies: Enter permanent display: "vz: v: Position:" Switch on drive Read vz and v Divide v/vz Enter result as fAB to fZ ratio ▸ **Rotary encoder with Z index** The value **fAB/fZ Verh.** corresponds to the number of lines (resolution) on the encoder you are using (lines/revolution). Used to check the Z-index.	0.0001 ... 400,000: 1

Level	Designation on the display	Description	Settings
3	**Track Z Tol.** Default: Off	Enter tolerance time for invalid signal level on track Z. This tolerance time is only effective on encoder types "rotary encoder + pnp proximity switch".	▸ Off ▸ 50 ms … 2500 ms
2	**Track S**	Settings for track S (error track)	
3	**Track S** Default: Not used	Use of track S: -Not used (track S is not used) -Evaluation (track S is used)	▸ Not used ▸ Evaluation
3	**Track S Umax** 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	**Track S Umin** 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
3	**Track S Tol.** Default: Off	Enter tolerance time for invalid signal level on track S.	▸ Off ▸ 50 ms … 2500 ms
1	**Delay Time Startup** 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	**Function Parameter**	Select function parameter	

Level	Designation on the display	Description	Settings
2	**Standstill vmax:** Default: 2.00Hz	Select standstill frequency Validation cut-off frequency: As implausible signals may arise due to edge jitter on the encoders around the standstill position, a validation cut-off frequency must be configured for "proximity switch" encoder types (without rotary encoder) (edge jitter is caused by the position control of the drive frequency converter or by external interference signals). If the value of the validation cut-off frequency falls below the configured value, the plausibility check of the sensors will no longer be run.	10 mHz ... 1.00MHz or the corresponding value in the selected unit
2	**(F1 ... F9) Parameter**	Enter parameter for the switch functions F1 ... F9	
3	**(F1 ... F9) (P0 ... P15) Parameter** Default: 10mHz	For each switch function F1 ... F9 up to 16 parameters P0 ... P15 can each be configured.	
4	**(F1 ... F9) (P0 ... P15) Teach v max:** Display: Current linear/rotational speed	The current linear/rotational speed is displayed and can be adopted as a limit value.	
4	**(F1 ... F9) (P0 ... P15) vmax: Standstill**	**"Standstill"** is displayed and can be adopted Info: The standstill frequency is selected globally in the menu **"Standstill vmax: "** (see above)	

Level	Designation on the display	Description	Settings
4	**(F1 ... F9)** **(P0 ... P15)** **vmax:** **2.00kHz**	Select linear/rotational speed limit	10 mHz ... 1.00MHz or the corresponding value in the selected unit
4	**(F1 ... F9)** **(P0 ... P15)** **Function** Position**(1 … 4)**	Select position monitoring 1 ... 4	
4	**(F1 ... F9)** **(P0 ... P15)** **Function** **(Direct. Left, Direct. Right)**	Select left-hand or right-hand direction monitoring	
4	**(F1 ... F9)** **(P0 ... P15)** **Fixed value** **(On/Off)**	Select static value On or Off	
2	**Special Functions**	A special function can be configured for each parameter set (except in select mode "None")	
3	**(P0 ... P15)** Default: none	A special function can be configured for each parameter set (except in select mode "None") The special functions are activated via the select inputs.	▸ none ▸ No2-Enc-Diag. With this setting, please also refer to the guidelines stated under 2 encoder diagnostics / broken shearpin monitoring [📖 21] ▸ ErrorAcknowledge ▸ Restart
1	**Assign Outputs**	Assign functions to outputs	

Level	Designation on the display	Description	Settings
2	**Output** (**Rel.1 ... Out 4**) Default: 0: Off	Each output can be assigned a switch function, an area or a logic operation. Each output can also be used as an error output or can be switched off. Outputs: Rel.1: Relay output 1 Rel.2: Relay output 2 Ext.1: External output 1 Ext.2: External output 2 Out 1 ... Out 4: Semiconductor outputs 1 ... 4 Out 4 : can also be configured as an analogue output	0: Off **Switch function (1 .. 9)** 1 ... 9: F1 ... F9 **Scope** 10: F2-F3 11: F4-F5 12: F6-F7 13: F8-F9 **Error output** 14: error **Logic operation** (Log. Conn) 15: F2 ∧ F3 16: F4 ∧ F5 17: F1 ∧ F6-F7 18: F1 ∧ F8-F9 19: F6 ∨ F7 20: F8 ∨ F9 21: F1 ∨ F2-F3 22: F1 ∨ F4-F5 **Analogue output** (Analog) 23: 0 - 20 mA 24: 4 - 20 mA
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 \

8.7.5 Advanced settings

Level	Menu designation	Description	Settings
1	**Positions Parameters**	Settings for position monitoring functions	
2	**Position (1 ... 4)** Start mode Default: Monitored /	Enter start type for position monitoring	▸ Monitored / ▸ Automatic
2	**Position (1 ... 4)** **Window width** Default: 1 pulse	Enter width of position window for position monitoring functions 1 ... 4	1 ... 24,900,000 pulses or the corresponding value in the selected unit
1	**Direction Parameter**	Settings for direction monitoring	
2	**Direction** **Autoreset** Default: deactivated	Activate/deactivate automatic reset of the direction monitoring	▸ deactivated ▸ activated
2	**(Direct. Left max. right, Direct. Right max. left)** Default: 0 pulses	Enter max. tolerated number of pulses (or Edg, m, rot) in the wrong direction.	1 ... 24,900,000 pulses or the corresponding value in the selected unit
1	**Mode** **Select Input** Default: None	Setting for using the select inputs	▸ All 16 ▸ 1 from 4 ▸ None
1	**Delay** **Select Input** 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	**2-Encoder diagnostics**	Comparison of f_{AB} and f_Z	
2	**Activation speed**	On both encoders, speed v_{ABZ} from which the check is carried out.	$v_{ABZ} = 0$ (check is always carried out) $v_{ABZ} = 10$ mHz … 1MHz
1	**Frequency filter** Default: Off	Filtering of the measured speed	▸ Off ▸ Fast ▸ Moderate ▸ Slow

Level	Menu designation	Description	Settings
1	**Function Hysteresis**		
2	**(F1 ... F9) Function Hysteresis** Default: 1 %	Enter hysteresis for the switch functions F1 ... F9 (not effective with position and direction monitoring)	0 ... 50 %
1	**Output Delay**	Setting for the delay effect and delay time for the outputs	
2	**Delay Output** **(Rel.1 ... Out 4)** Default: On 0 ms (display only)	Setting for the delay time effect and delay time for the respective output	
3	**Delay Effect** **(Rel.1 ... Out 4)** Default: ≫⌐	Enter whether the delay time is to be activated when switching on, switching off, or switching on and off.	▸ Switch-on delay retriggerable ≫⌐ ▸ Switch-off delay retriggerable ≫⌐ ▸ Switch-on switch-off delay retriggerable ≫⌐ ≫⌐ ▸ Switch-off delay not retriggerable ⌐⌐
3	**Delay Time** **(Rel.1 ... Out 4)** Default: tdO: 0 ms	Select delay time for the respective output	0 ... 30.0 s
1	**Output Out Logic**	Setting for the switching direction of the semiconductor outputs	
2	**output** **(Out 1 ... Out 4)** **Logic** Default: N/O contact	Select the switching direction of the semiconductor outputs Out 1 ... Select Out 4: N/O contact (normally energised mode) N/C contact (normally de-energised mode)	▸ N/O contact ▸ N/C contact
1	**Outputs Synchronous start**	Setting for synchronous start	

Level	Menu designation	Description	Settings
2	**Sync. Start** **(Rel. 1 ... Out 4)** Default: deactivated	Set whether outputs are to be started synchronously.	▸ deactivated ▸ activated
1	Outputs Out 4 Analog	Scaling of analogue input	
1	**Out 4 Analog** f at 20 mA Default: 1MHz	Enter maximum frequency f_{max} for 20mA	Frequency f_{max}: 10 mHz … 1 MHz
1	**Name of Configuration** 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	**Password Settings**	Change passwords Note: In the "Default Settings" menu, the passwords are reset to the default setting: 00000.	
2	**Master PW**	Change master password	0000 ... 9999
2	**Customer PW**	Change customer password	0000 ... 9999
2	**Language** Default: English	Select menu language	▸ English ▸ German ▸ French
1	**Default Settings**	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

8.7.6 Information

Level	Menu designation	Description	Display/Settings
1	**System Time**	Time that the device is switched on	xxx.xxx h xx min xx s
1	**Max. Speed Track AB**	Max. measured linear/rotational speed at tracks A and B The value can be reset to 0	0 … 1 MHz or the corresponding value in the set unit Reset: Reset: - Yes? - No
1	**Max. Speed Track Z**	Max. measured linear/rotational speed at track Z The value can be reset to 0	0 … 1 MHz or the corresponding value in the set unit Reset: Reset: - Yes? - No?
1	**Relay (Ctrl, 1, 2) Cycles**	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	**CRC of Configuration**	Check sum of configuration parameters	0 ... 65535

Level	Menu designation	Description	Display/Settings
1	**Error Stack Entries**	Error stack entries Up to 20 error stack entries are displayed See chapter Error stack entries [📖 92] Further information can be displayed by pressing the rotary knob.	Repairable error: Level 2: 1st line: Seq. No. "**Err.:**", error number 2nd + 3rd line: Plain text to describe error for the user Level 3: 1st line: Seq. No. "**Repairable**" 2nd line: "**System Time**" 3rd line: System time when the error occurred Level 4: Information for Pilz Service System error: Level 2: 1st line: Seq. No. "**Err.:**", error number 2nd line: "**System Error**" 3rd line: System time when the error occurred Level 3: Information for Pilz Service
1	**Safe Error Stack Entries?**	The error list can be saved to the chip card.	
2	**Safe Error Stack Entries:** 100%	Appears when the error list is saved	
1	**Input Module SW Version** Va.b	For internal purposes only	
1	**Main Unit SW Version** Va.b	For internal purposes only	

8.7.7 Restart

Level	Menu designation	Description	Settings
1	ErrorAcknowledge	Restart PNOZ s30	

8.7.8 Menu messages

Level	Menu designation	Description	Display/Settings
-	**Actual error messages**	Up to 8 errors are displayed. Recoverable errors: Level 2, 3 and 4 (user-recoverable) System error: Level 2 and 3 (internal error, information for Pilz Service). The error messages can be hidden with "Escape".	Repairable error: Level 2: 1st line: Seq. No. "**Err.:**", error number 2nd + 3rd line: Plain text to describe error for the user Level 3: 1st line: Seq. No. "**Repairable**" 2nd line: "**System Time**" 3rd line: System time when the error occurred Level 4: Information for Pilz Service System error: Level 2: 1st line: Seq. No. "**Err.:**", error number 2nd line: "**System Error**" 3rd line: System time when the error occurred Level 3: Information for Pilz Service
-	**Error Faulty Signal: A/A B/B Z/Z**	Error message: Incorrect signal at one or more tracks. The message - is continually updated. - can be ignored temporarily.	
-	**AB frequency deviation**	Error message: Frequency difference between the proximity switches on tracks A and B The message - is continually updated - can be ignored temporarily	
-	**Chip card messages**		

Level	Menu designation	Description	Display/Settings
-	**Please insert SIM Card!**	Appears when the device is operated without a chip card or when a defective chip card is inserted, appears again when parameters are changed. Info: The message disappears after 30 s or by pressing the rotary knob	
-	**Please insert writable SIM Card!**	Appears when the answer to "**Load SIM**" and "**Write Configuration to SIM:**" is "No"	
-	SIM: .... CRC: ..... **Load SIM** Default: No?	Appears when device detects a chip card with a valid configuration. -> Select whether the chip card data is to be transferred to the device.	- No? - Yes?
-	**Write Configuration to SIM:** 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 **Load SIM** No was selected -> Select whether the data is to be saved to the chip card.	- No? - Yes?
-	**Upgrade config?** **New CRC:** Default: No?	Appears when a configuration from devices with an older version are to be copied (see Duplicate chip card [🕮 62]).	
-	**Upgrade SIM?** **New CRC:** Default: No?	Appears when an old configuration has been loaded and changed (see Compatibility with older device versions [🕮 63]).	

Level	Menu designation	Description	Display/Settings
-	**SIM loaded!** **Internal CRC changes!**	Appears when the data has been transferred to the device and therefore the CRC has changed.	
-	**Password messages:**		
-	**Master PW:** Default: 0000	-> Enter master password **Password:**	0000 ... 9999
-	**Password:** Default: 0000	-> Enter customer password	0000 ... 9999
1	**System Time**	Time that the device is switched on	xxx.xxx h xx min xx s

8.8 Example: Configure basic configuration 2

Main Menu   Submenu 1   Submenu 2   Submenu 3   Submenu 4
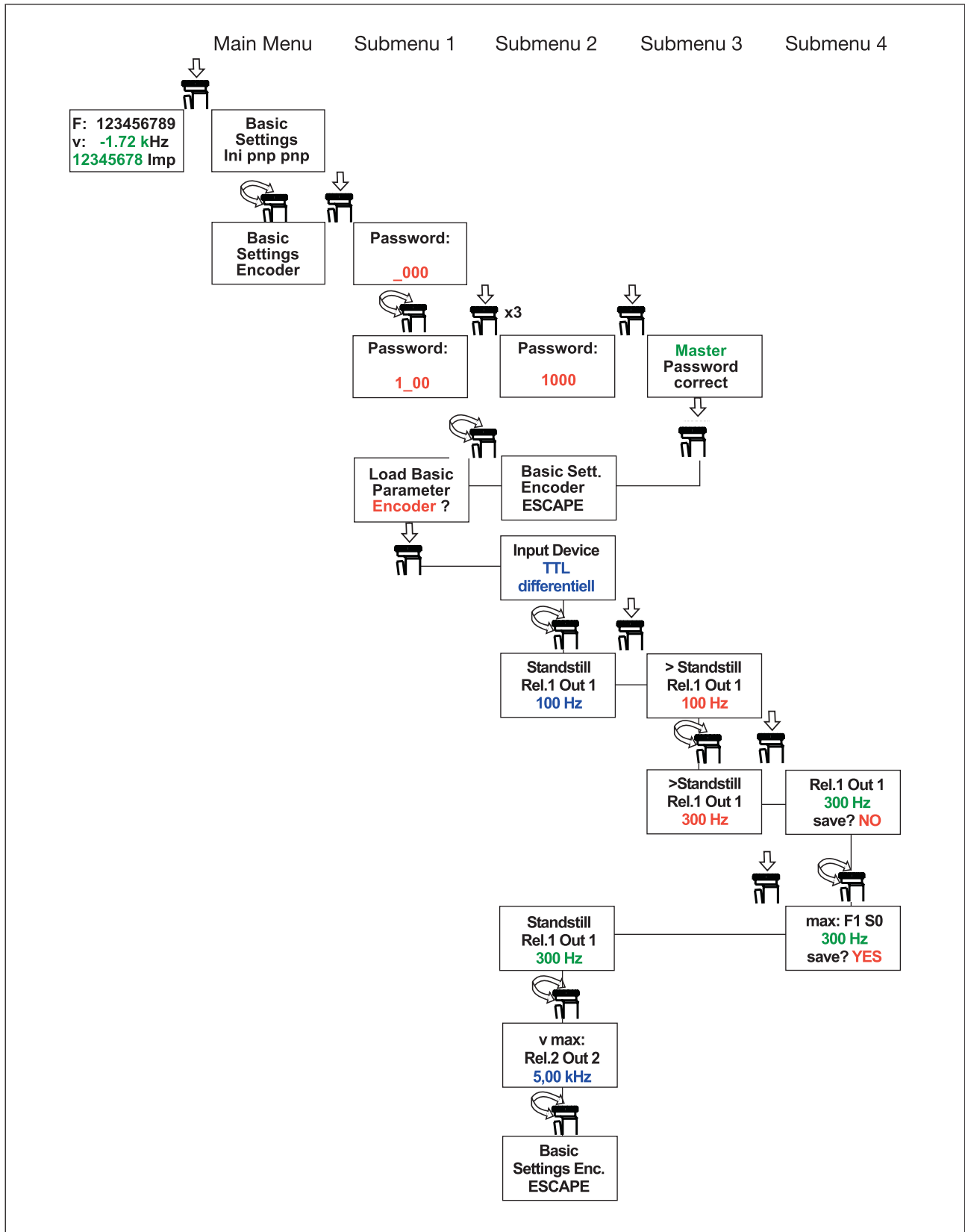
9 Create configuration in PNOZsigma Configurator

For devices PNOZ s30 from Version 2.2 you have the opportunity to perform the configuration in the software tool PNOZsigma Configurator.

The PNOZsigma Configurator can be downloaded from the Internet in the download area of the Pilz website.

With the PNOZsigma Configurator you can configure all the functions that are described in the function description.

In Version 1.0. and 1.1 of the PNOZsigma Configurator the configuration is downloaded via the chip card reader **PNOZ Chip Card Reader**. From Version 1.2 of PNOZsigma Configurator you can perform the download alternatively via the cable **PNOZ s30 USB-configuration-cable**. Both are available from Pilz as accessories [📖 129].

9.1 Download project from the PNOZsigma Configurator to the PNOZ s30

> ⚠️ **CAUTION!**
>
> Perform a commissioning test every time that you download a project to the PNOZ s30.

> ⚠️ **CAUTION!**
>
> With each transfer, you must check that the appropriate configuration for an application is transferred to a device!

Download project via the chip card from the PNOZsigma Configurator to the PNOZ s30

1. Open the PNOZsigma Configurator and create your configuration.

2. Remove the chip card from the PNOZ s30 and insert it into the holder for the chip card reader.

3. In the PNOZsigma Configurator, click on the project to be downloaded in the *Project Overview* and click on the ⬇ button in the project to download the configuration to the chip card.

4. When the download is complete, remove the chip card from the chip card reader and insert it into the PNOZ s30 again.

5. To save the configuration on the PNOZ s30 follow the instructions given in chapter Read data from chip card [📖 61].

6. To ensure that the configuration has been transferred correctly, check that the Configuration CRC in the PNOZ s30 matches the CRC that is shown in the title bar in the PNOZsigma Configurator.

Download project via cable from the PNOZsigma Configurator to the PNOZ s30

1. Connect the PNOZ s30 with a free USB interface of your computer. To do this, use the cable **PNOZ s30 USB-configuration-cable** (order no.: 750 040), which is available at Pilz as an accessory [129].

2. In the PNOZsigma Configurator, click on the project to be downloaded in the **Project Overview** and click on the button in the project to download the configuration to the PNOZ s30.
   Please note: Existing data on the PNOZ s30 is overwritten.

3. To ensure that the configuration has been transferred correctly, check that the Configuration CRC in the PNOZ s30 matches the CRC that is shown in the title bar in the PNOZsigma Configurator.

Note: Download mode can be cancelled using the rotary knob.

	1.		2.
DOWNLOAD MODE		**Cancel DOWNLOAD MODE?**	

9.2 Transfer project from PNOZ s30 to the PNOZsigma Configurator

It is possible to download a configuration from PNOZ s30 to the PNOZsigma Configurator and to create a new project there.

Transfer project via chip card from PNOZ s30 to the PNOZsigma Configurator

1. Ensure that the required configuration is saved to the chip card (see chapter Write data to chip card [60]).

2. Remove the chip card from the PNOZ s30 and insert it into the holder for the chip card reader.

3. In the PNOZsigma Configurator, click on the start page on the button to download the configuration to the chip card.

When the download is complete, the configuration is created in PNOZsigma Configurator as a project.

Transfer project via cable from PNOZ s30 to the PNOZsigma Configurator

1. Connect the PNOZ s30 with a free USB interface of your computer. To do this, use the cable **PNOZ s30 USB-configuration-cable** which is available at Pilz as an accessory [📖 129].

2. In the PNOZsigma Configurator, click on the start page on the button ⬆ to download the configuration to the PNOZ s30.
   Please not when downloading from a PNOZ s30 Version 2.2:
   When transferring the configuration from a PNOZ s30 with device version 2.2, the CRC of the PNOZ s30 configuration must be entered into the PNOZsigma Configurator, before you create the project in PNOZsigma Configurator.

When the download is complete, the configuration is created in PNOZsigma Configurator as a project.

Replace project in PNOZsigma Configurator

If a project with the same name already exists in the PNOZsigma Configurator, you can write over the existing project or open the new project and save it under a different name. By changing the project name, the configuration CRC is also changed.

> **NOTICE**
>
> **Please note:**
>
> Identical project configurations have the same check sum when the project name has not been changed.

10 Function test during commissioning

> **CAUTION!**
>
> It is essential to check that the safety devices operate correctly
>
> – After changing the configuration
>
> – After downloading a project from the PNOZsigma Configurator to the PNOZ s30

11 Operation and diagnostics

11.1 LED indicators

Legend

☼	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.

11.2 Display

11.2.1 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 recovered 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

  – User-recoverable errors
    are described in the following list
    Remedyrecover 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

▸ System time

▸ Additional information for support

  – Error source (GG A/ GG B/ EM A/ EM B)

  – Error parameters 1 ... 4

Please note:

In many cases, one error can lead to subsequent errors. For this reason, start troubleshooting with the first error that occurred.
If recoverable errors and internal errors have been entered at the same system time, internal errors can be ignored because in this case, the causes of the error are always recoverable errors.

11.2.2 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 recovered and the device has been switched off and then on again, the software is restarted or an error acknowledgement has been carried out.

Errors can be acknowledged via the select inputs, by configuring the special function "Error acknowledgement". User-recoverable errors can be acknowledged via this function; the following errors are an exception:

Error numbers 2, 4, 5 as these are purely informative.

Error number 2000, as this is acknowledged automatically during recovery.

Error numbers 3, 5003, 10268 and 10269.

All errors with a number ≥ 30000

List of errors

Error no.	Error message	Description	Remedy
2	PNOZ s30 cold started	The unit is ready for operation (Error stack entry)	For information only
3	Brown Out occurred	Supply voltage too low	Check supply voltage
4	Softwarerestart	The PNOZ s30 has been restarted via a software restart. This can be caused by one of the following reasons: ▸ Restart via the Restart menu ▸ Restart via the PNOZsigma Configurator ▸ Restart using the special function "Error acknowledgement" ▸ Restart using the special function "Restart"	For information only
5	SIM loaded	Device parameters have been transferred from the chip card	For information only
2000	Wrong signal A ... /Z	Implausible signal from the 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
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

Error no.	Error message	Description	Remedy
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 operate correctly
4010	FL K1K2 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 K3K4 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	Expansion connector is missing	The terminator on the expansion interface is not connected	▸ Ensure that the appropriate yellow terminator is connected. ▸ 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 over the standstill limit, a falling edge at input S34 (Start) or via the special function "Error acknowledgement". ▸ Ensure that the proximity switches operate correctly
7000	Select Input not 1 v .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

Error no.	Error message	Description	Remedy
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
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

Error no.	Error message	Description	Remedy
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 fAB to fZ
10252	Z-Index at wrong position	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 fAB to fZ
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
10256	Ini pnp pnp both inactive	Both proximity switches are inactive at the same time	▶ Install proximity switches so that one proximity switch is always activated. ▶ Ensure that the encoders are configured correctly ▶ Ensure that the proximity switches operate correctly ▶ Ensure that the supply voltage is present at the proximity switches ▶ Ensure that the proximity switches are wired correctly

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

Error no.	Error message	Description	Remedy
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) For calculation of the measured voltage see [1]	▸ Check the encoders' supply voltage ▸ 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.
31014	System error	An error was detected while monitoring the internally generated 24 V voltage.	▸ Check whether device immediately recognises the error again after a restart ▸ Device defective, exchange

Error no.	Error message	Description	Remedy
31015	System error	An error was detected while monitoring the internally generated 5 V voltage.	▸ Check whether device immediately recognises the error again after a restart ▸ Device defective, exchange
31016	System error	An error was detected while monitoring the internally generated 3.3 V voltage.	▸ Check whether device immediately recognises the error again after a restart ▸ Device defective, exchange
31017	System error	An error was detected while monitoring the internally generated VCC voltage.	▸ Check whether device immediately recognises the error again after a restart ▸ Device defective, exchange
32003	System error	A difference was detected when comparing the process image of the outputs with the adjacent channel	▸ Under Settings/Permanent display, select no time display ▸ Note all the additional parameters and contact Support
32004	System error	The fed-back state of the "Relay Control" root relay does not correspond to the target state	▸ Device defective, exchange
32005	System error	The fed-back state of the relay Rel1 does not correspond to the target state	▸ Device defective, exchange ▸ Use another, functioning relay output
32006	System error	The fed-back state of the relay Rel2 does not correspond to the target state	▸ Device defective, exchange ▸ Use another, functioning relay output
35043	System error	An output for synchronous start was selected at the same time as an output assignment that is not compatible with a synchronous start. This can happen when the configuration of a PNOZ s30 device version <v3.0 was loaded	▸ Deactivate synchronous start setting ->see Synchronous start [📖 25] ▸ Or, if a synchronous start is necessary ▸ Deactivate analogue output, as it is not compatible with a synchronous start ->see Analogue output [📖 27] ▸ Deactivate error output switch function on outputs assigned to a synchronous start ->see Switch functions [📖 33]
41215	System error	The device was switched to the stop state. This is a subsequent error that occurs only in combination with other errors.	For information only

Error no.	Error message	Description	Remedy
65535	System error	No error present. The empty error memory was wrongly interpreted as an error.	For information only

(1) $U_{Track S}$ [mV] = (2^8 x P1 + P2 – 170) x (10000/1204)

P1: Value of error parameter 1

P2: Value of error parameter 2

11.2.3   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.

11.2.4   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.

11.3　Function test of the relay outputs

When the relay outputs are switched on, the mechanical contact on the relay cannot be tested automatically. Depending on the operational environment, measures to detect the non-opening of switching elements may be required under some circumstances.

When the product is used in accordance with the European Machinery Directive, a check must be carried out to ensure that the safety contacts on the relay outputs open correctly. Open the safety contacts (switch off output) and start the device again, so that the internal diagnostics can check that the safety contacts open correctly

▸ for SIL CL 3/PL e at least 1x per month

▸ for SIL CL 2/PL d at least 1x per year

12 Technical details

General	750330	751330
Certifications	CCC, CE, EAC, TÜV, UKCA, cU-Lus Listed	CCC, CE, EAC, TÜV, UKCA, cU-Lus Listed
Electrical data	**750330**	**751330**
Supply voltage		
Voltage	24 - 240 V	24 - 240 V
Kind	AC/DC	AC/DC
Voltage tolerance	-15 %/+10 %	-15 %/+10 %
Output of external power supply (AC)	9 VA	9 VA
Output of external power supply (DC)	5,5 W	5,5 W
Frequency range AC	50 - 60 Hz	50 - 60 Hz
Residual ripple DC	160 %	160 %
Duty cycle	100 %	100 %
External unit fuse protection F1 min.	1 A	1 A
External unit fuse protection F1 max.	Max. conductor cross section	Max. conductor cross section
Proximity switch input	**750330**	**751330**
Number of inputs	2	2
Input signal level		
Signal level at "1"	11 - 30 V	11 - 30 V
Signal level at "0"	-0,5 - 3 V	-0,5 - 3 V
Input resistance	22 kOhm	22 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
Incremental encoder input	**750330**	**751330**
Number of inputs	1	1
Connection type	RJ45 female connector, 8-pin	RJ45 female connector, 8-pin
Input signal level	0,5 - 30 Vss	0,5 - 30 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 kOhm	20 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
Inputs	**750330**	**751330**
Voltage at		
Start circuit DC	24 V	24 V
Feedback loop DC	24 V	24 V

Inputs	750330	751330
Current at		
Start circuit DC	5 mA	5 mA
Feedback loop DC	5 mA	5 mA
Max. inrush current impulse		
Current pulse, feedback loop	0,06 A	0,06 A
Pulse duration, feedback loop	0,8 ms	0,8 ms
Current pulse, start circuit	0,06 A	0,06 A
Pulse duration, start circuit	0,8 ms	0,8 ms
Reset input	**750330**	**751330**
Number	4	4
Low signal	-3 - 5 V	-3 - 5 V
High signal	15 - 30 V	15 - 30 V
Current	5 mA	5 mA
Analogue outputs	**750330**	**751330**
Number of analogue outputs	1	1
Type of analogue outputs	Current	Current
Output range	0 .. 20 mA, 4 .. 20 mA	0 .. 20 mA, 4 .. 20 mA
Max. open circuit voltage	22 V	22 V
Max. permitted resistive load	500 Ohm	500 Ohm
Typ. processing time of the analogue output	8 ms	8 ms
Accuracy of analogue output	1,5 % (bei 25 °C)	1,5 % (bei 25 °C)
Semiconductor outputs	**750330**	**751330**
Number	4	4
Voltage	24 V	24 V
Current	50 mA	50 mA
External supply voltage	24 V	24 V
Voltage tolerance	-20 %/+20 %	-20 %/+20 %
Residual current at "0" signal	0,5 mA	0,5 mA
Max. internal voltage drop	0,2 V	0,2 V
Conditional rated short circuit current	100 A	100 A
Utilisation category in accordance with EN 60947-1	DC-12	DC-12
Relay outputs	**750330**	**751330**
Number of output contacts		
Safety contacts (N/O), instantaneous	2	2
Auxiliary contacts (N/C)	2	2
Max. short circuit current IK	1 kA	1 kA
Utilisation category		
In accordance with the standard	EN 60947-4-1	EN 60947-4-1

Relay outputs	750330	751330
Utilisation category of safety contacts		
AC1 at	240 V	240 V
Min. current	0,01 A	0,01 A
Max. current	4 A	4 A
Max. power	1000 VA	1000 VA
DC1 at	24 V	24 V
Min. current	0,01 A	0,01 A
Max. current	4 A	4 A
Max. power	100 W	100 W
Utilisation category of auxiliary contacts		
AC1 at	240 V	240 V
Min. current	0,01 A	0,01 A
Max. current	4 A	4 A
Max. power	1000 VA	1000 VA
DC1 at	24 V	24 V
Min. current	0,01 A	0,01 A
Max. current	4 A	4 A
Max. power	100 W	100 W
Utilisation category		
In accordance with the standard	EN 60947-5-1	EN 60947-5-1
Utilisation category of safety contacts		
AC15 at	230 V	230 V
Max. current	3 A	3 A
DC13 (6 cycles/min) at	24 V	24 V
Max. current	4 A	4 A
Utilisation category of auxiliary contacts		
AC15 at	230 V	230 V
Max. current	3 A	3 A
DC13 (6 cycles/min) at	24 V	24 V
Max. current	4 A	4 A
Utilisation category in accordance with UL		
Voltage	240 V AC G.U. (same polarity)	240 V AC G.U. (same polarity)
With current	4 A	4 A
Voltage	24 V DC G. U.	24 V DC G. U.
With current	4 A	4 A

Relay outputs	750330	751330
External contact fuse protection, safety contacts		
In accordance with the standard	**EN 60947-5-1**	**EN 60947-5-1**
Max. melting integral	**66 A²s**	**66 A²s**
Blow-out fuse, quick	**6 A**	**6 A**
Blow-out fuse, slow	**4 A**	**4 A**
Blow-out fuse, gG	**6 A**	**6 A**
Circuit breaker 24V AC/DC, characteristic B/C	**4 A**	**4 A**
External contact fuse protection, auxiliary contacts		
Max. melting integral	**66 A²s**	**66 A²s**
Blow-out fuse, quick	**6 A**	**6 A**
Blow-out fuse, slow	**4 A**	**4 A**
Blow-out fuse, gG	**6 A**	**6 A**
Circuit breaker 24 V AC/DC, characteristic B/C	**4 A**	**4 A**
Conventional thermal current	**4 A**	**4 A**
Contact material	**AgCuNi + 0,2 µm Au**	**AgCuNi + 0,2 µm Au**
Times	**750330**	**751330**
Switch-on delay		
With automatic start typ.	**15 ms**	**15 ms**
With automatic start max.	**50 ms**	**50 ms**
With automatic start after power on typ.	**3.920 ms**	**3.920 ms**
With automatic start after power on max.	**4 s**	**4 s**
With manual start typ.	**40 ms**	**40 ms**
With manual start max.	**100 ms**	**100 ms**
Delay-on de-energisation		
With power failure typ. UB 240 V	**100 ms**	**100 ms**
With power failure max. UB 240 V	**150 ms**	**150 ms**
With power failure typ. UB 24 V	**25 ms**	**25 ms**
With power failure max. UB 24 V	**50 ms**	**50 ms**
After safety function is triggered typ.	**8 ms**	**8 ms**
After safety function is triggered max.	**15 ms**	**15 ms**
Recovery time at max. switching frequency 1/s		
After power failure	**4 s**	**4 s**
After safety function is triggered	**1 s**	**1 s**
Reaction time after limit value is exceeded	**1/f_ist + 16 ms**	**1/f_ist + 16 ms**

Times	750330	751330
Waiting period with a monitored start		
With rising edge	**30 ms**	**30 ms**
With falling edge	**30 ms**	**30 ms**
Min. start pulse duration with a monitored start		
With falling edge	**30 ms**	**30 ms**
With rising edge	**30 ms**	**30 ms**
Supply interruption before de-energisation	**20 ms**	**20 ms**
Switch delay (selectable)	**0 - 30 s**	**0 - 30 s**
Delay on the select inputs (selectable)	**0 - 30 s**	**0 - 30 s**
Start-up delay (selectable)	**0 - 600 s**	**0 - 600 s**
Environmental data	**750330**	**751330**
Climatic suitability	**EN 60068-2-78**	**EN 60068-2-78**
Ambient temperature		
Temperature range	**-20 - 55 °C**	**-20 - 55 °C**
Storage temperature		
Temperature range	**-40 - 85 °C**	**-40 - 85 °C**
Climatic suitability		
Humidity	**93 % r. h. at 40 °C**	**93 % r. h. at 40 °C**
Condensation during operation	**Not permitted**	**Not permitted**
EMC	**EN 60947-5-1, EN 61000-6-2, EN 61000-6-3, EN 61326-3-1**	**EN 60947-5-1, EN 61000-6-2, EN 61000-6-3, EN 61326-3-1**
Vibration		
In accordance with the standard	**EN 60068-2-6**	**EN 60068-2-6**
Frequency	**10 - 55 Hz**	**10 - 55 Hz**
Amplitude	**0,35 mm**	**0,35 mm**
Airgap creepage		
In accordance with the standard	**EN 60947-1**	**EN 60947-1**
Overvoltage category	**II**	**II**
Pollution degree	**2**	**2**
Rated insulation voltage	**250 V**	**250 V**
Rated impulse withstand voltage	**4 kV**	**4 kV**
Protection type		
Housing	**IP30**	**IP30**
Terminals	**IP20**	**IP20**
Mounting area (e.g. control cabinet)	**IP54**	**IP54**
Mechanical data	**750330**	**751330**
Mounting position	**horizontally on mounting rail**	**horizontally on mounting rail**
Mechanical life	**10,000,000 cycles**	**10,000,000 cycles**

Mechanical data	750330	751330
Material		
Bottom	**PC**	**PC**
Front	**PC**	**PC**
Top	**PC**	**PC**
Connection type	**Screw terminal**	**Spring-loaded terminal**
Mounting type	**plug-in**	**plug-in**
Conductor cross section with screw terminals		
1 core flexible	**0,25 - 2,5 mm², 24 - 12 AWG**	–
2 core with the same cross section, flexible with crimp connectors, no plastic sleeve	**0,25 - 1 mm², 24 - 16 AWG**	–
2 core with the same cross section, flexible without crimp connectors or with TWIN crimp connectors	**0,2 - 1,5 mm², 24 - 16 AWG**	–
Torque setting with screw terminals	**0,5 Nm**	–
Stripping length with screw terminals	**8 mm**	–
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	–	**0,2 - 2,5 mm², 24 - 12 AWG**
Spring-loaded terminals: Terminal points per connection	–	**2**
Stripping length with spring-loaded terminals	–	**9 mm**
Dimensions		
Height	**98 mm**	**100 mm**
Width	**45 mm**	**45 mm**
Depth	**120 mm**	**120 mm**
Weight	**405 g**	**400 g**

Where standards are undated, the 2021-12 latest editions shall apply.

12.1   Safety characteristic data

> **NOTICE**
>
> You must comply with the safety characteristic data in order to achieve the
> required safety level for your plant/machine.

Operating mode	EN ISO 13849-1: 2015 PL	EN ISO 13849-1: 2015 Category	EN IEC 62061 SIL CL/ maximum SIL	EN IEC 62061 PFH$_D$ [1/h]	EN/IEC 61511 SIL	EN/IEC 61511 PFD	EN ISO 13849-1: 2015 T$_M$ [year]
Monitoring 1 encoder	PL d	Cat. 2	SIL CL 2	2,88E-08	SIL 2	2,53E-03	20
Monitoring 2 encoder	PL e	Cat. 4	SIL CL 3	1,74E-09	SIL 3	1,46E-04	20
Monitoring safe encoder	PL e	Cat. 4	SIL CL 3	3,08E-09	SIL 3	2,66E-04	20

Explanatory notes for the safety-related characteristic data:

▸ Safety characteristic data in accordance with EN IEC 62061 and EN/IEC 61511 was calculated based on EN/IEC 61508.

▸ T$_M$ is the maximum mission time in accordance with EN ISO 13849-1. The value also applies as the retest interval in accordance with EN/IEC 61508-6 and EN/IEC 61511 and as the proof test interval and mission time in accordance with EN IEC 62061.

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 switch frequency and the load of the relay output.
If the service life graphs are not accessible, the stated PFH value can be used irrespective of the switch 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.

12.2   Signal level of the encoders

Encoder type	"0" signal	"1" signal
HTL	-1.0 - 3.0 V	12.0 - 30.0 V
TTL	-0.5 - 0.8 V	3.5 - 5.5 V
PNP	-0.5 - 3.0 V	11.0 - 30.0 V
NPN	-0.5 - 3.0 V	11.0 - 30.0 V

Encoder type	DC offset	Amplitude differential	Reference voltage
Sin/Cos	2.5 V	1.0 Vss	-
Hiperface	2.5 V	1.0 Vss	2.5 V

13 Supplementary data

13.1 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.
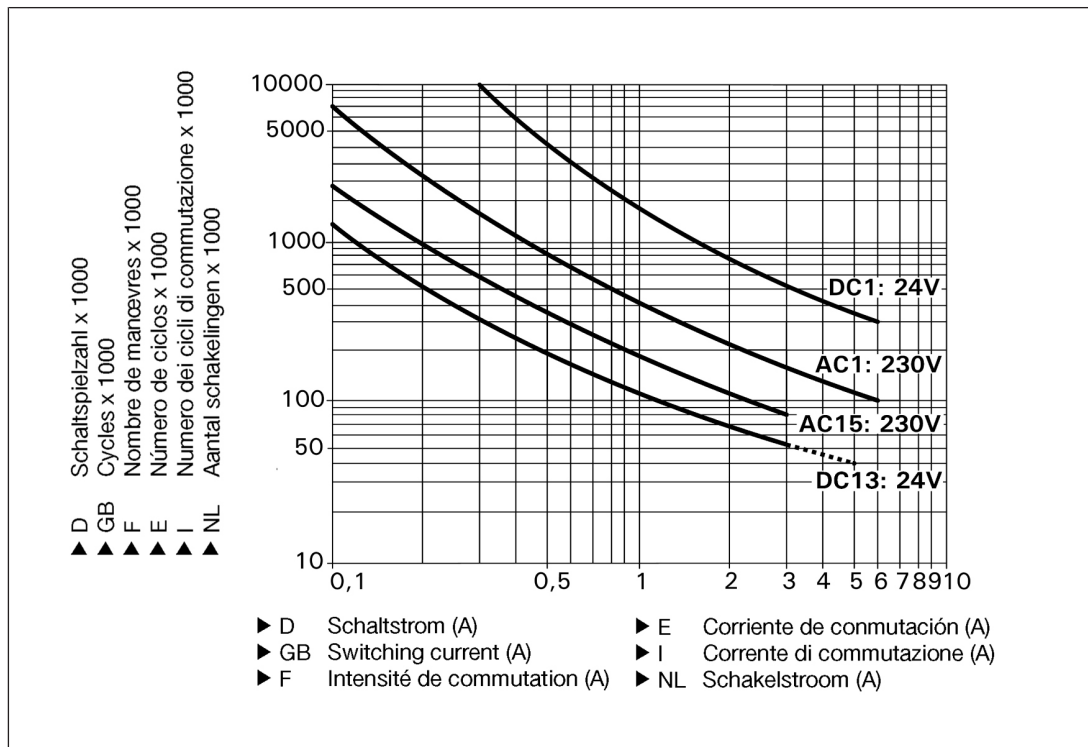
Example

▸ 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 [📖 102]) can be used in the calculation.

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

13.2 Permitted operating height

The values stated in the technical details apply to the use of the device in operating heights up to max. 2000 m above sea level. When used in greater heights, constraints have to be taken into account:

▸ Permitted maximum operating height 5000 m

▸ Reduction of rated insulation voltage and rated impulse withstand voltage for applications with safe separation:

Maximum operation height	Rated insulation voltage	Overvoltage category	Max. rated impulse withstand voltage
3000 m	150 V	II	2.5 kV
	100 V	III	2.5 kV
4000 m	150 V	II	2.5 kV
	100 V	III	2.5 kV
5000 m	100 V	II	1.5 kV
	24 V	III	0.8 kV

▸ Reduction of rated insulation voltage and rated impulse withstand voltage for applications with basic insulation:

Maximum operation height	Rated insulation voltage	Overvoltage category	Max. rated impulse withstand voltage
3000 m	250 V	II	2.5 kV
	150 V	III	2.5 kV
4000 m	250 V	II	2.5 kV
	150 V	III	2.5 kV
5000 m	150 V	II	1.5 kV
	100 V	III	1.5 kV

▸ From an operating height of 2000 m the max. permitted ambient temperature is reduced by 0.5 °C/100 m

Operating height	Permitted ambient temperature
3000 m	50 °C
4000 m	45 °C
5000 m	40 °C

13.3 Categories

13.3.1 Safety level

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

In accordance with EN ISO 13849-1, values for the following characteristic data is needed to determine the performance level (PL):

▸ Category: Structure: single or dual channel, single fault safety

▸ MTTFd: Mean time to dangerous failure

▸ DC: Diagnostic coverage

▸ CCF: Quantification of measures against common cause failure (necessary for Cat.2 to 4)

> **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	2,88E-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 errors are dangerous, MTTF = MTTFd can be set.
The characteristic data MTTF is a property of the sensor, which can 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.

If forced dynamisation of the signals cannot be carried out every 8 hours, then the average frequency of a dangerous failure (PFH) is increased.
If the forced dynamisation time is increased, the stated PFH value must be multiplied by the following correction factors:

Forced dynamisation within 4 weeks → Correction factor 1.01

Forced dynamisation within 8 weeks → Correction factor 1.02

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

13.3.2 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 monitoring (SSM)	Speed, speed range

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

13.3.3.1 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 1Vss, reference voltage

▸ Sin/Cos output signals 1Vss, differential

13.3.3.2 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	2,88E-08

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

13.3.3.3 Achievable safety level

Safety function	PL in accordance with EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
Speed Speed range Direction Standstill Position	PL c (Cat. 1)	-

13.3.4 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.

13.3.4.1 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.

13.3.4.2 **Safety-related architecture**
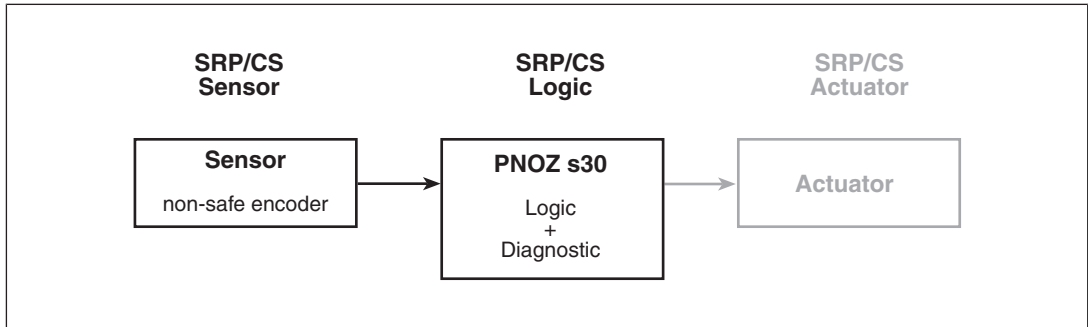
To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
Category	MTTFd	DC	Operating mode	PFH (1/h)
2	Manufacturer-specific	90 %	Monitoring 1 encoder	2,88E-08

13.3.4.3 **Achievable safety level**

Safety function	PL in accordance with EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
Speed Speed range Direction Standstill Position	PL d (Cat. 2)	2

13.3.5 **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.

13.3.5.1 **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

13.3.5.2   **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).

13.3.5.3   **Safety-related architecture**
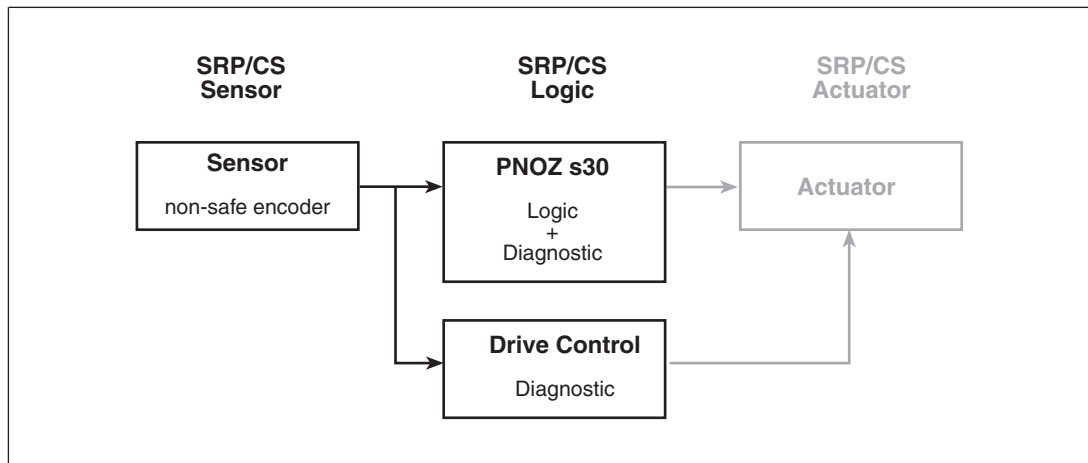
To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
Category	MTTFd	DC	Operating mode	PFH (1/h)
2	Manufacturer-specific	90 %	Monitoring 1 encoder	2,88E-08

13.3.5.4 Achievable safety level

Safety function	PL of EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
Speed Speed range Direction Standstill Position	PL d (Cat.2)	2

13.3.6 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.

13.3.6.1 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

13.3.6.2 Safety-related architecture
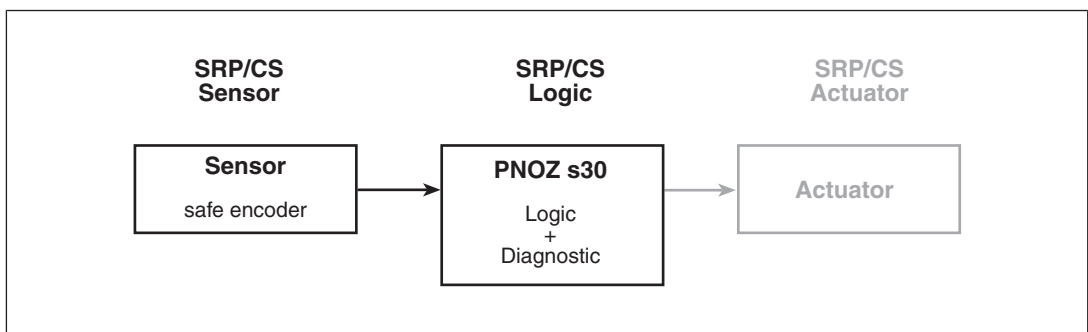
To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
PL	SIL	PFH (1/h)	Operating mode	PFH (1/h)
See manufacturer			Monitoring safe encoder	3,08E-09

13.3.6.3 Achievable safety level

Safety function	PL in accordance with EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
Speed Speed range Direction Standstill Position	PL e (Cat.4)	3

13.3.7 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.

### 13.3.7.1 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

13.3.7.2 Safety-related architecture
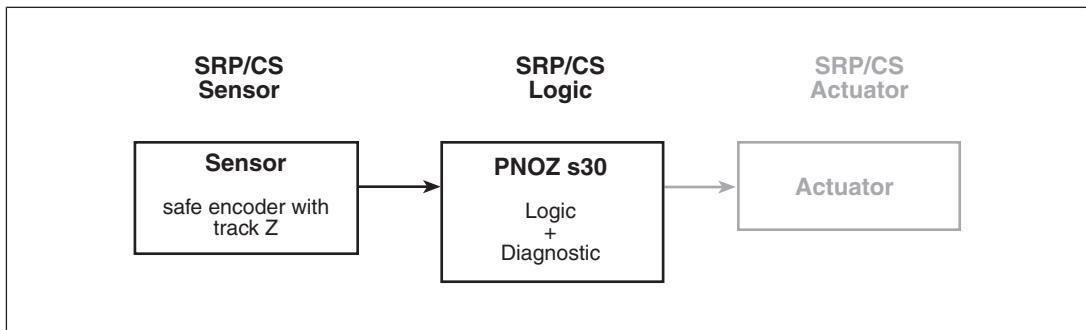
To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
PL	SIL	PFH (1/h)	Operating mode	PFH (1/h)
See manufacturer			Monitoring 2 encoder	1,74E-09

13.3.7.3 Achievable safety level

Safety function	PL in accordance with EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
Speed Speed range Direction Standstill Position	PL e (Cat.4)	3

13.3.8 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.

13.3.8.1 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 1Vss, reference voltage

▸ Sin/Cos output signals 1Vss, 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

13.3.8.2 Safety-related architecture
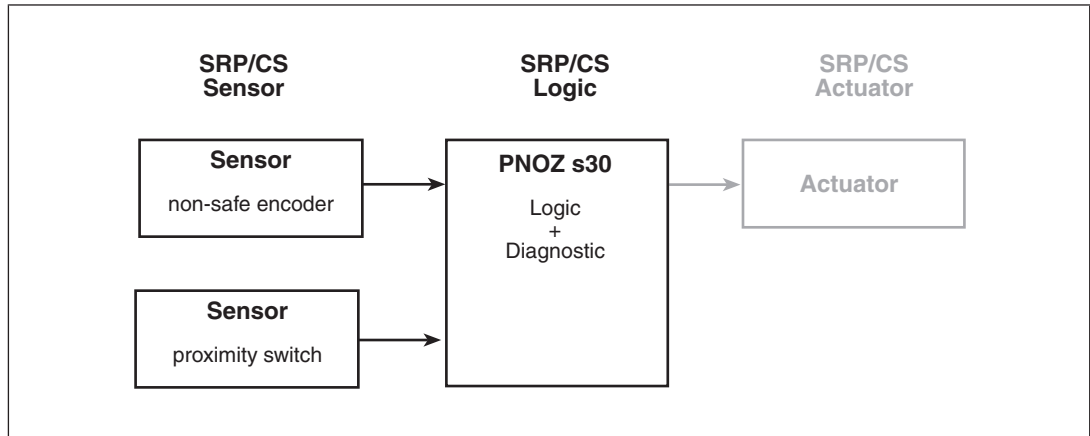
To calculate the safety function you will need the following data for the "sensor" subsystem and "PNOZ s30" subsystem:

Sensor			PNOZ s30 subsystem	
Category	MTTFd	DC	Operating mode	PFH (1/h)
3	Manufacturer-specific	90 %	Monitoring 2 encoder	1,74E-09

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

13.3.8.3 Achievable safety level

Safety function	PL in accordance with EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
Direction Position	PL c (Cat.1)	-
Speed Speed range Standstill	PL e (Cat. 3)	3

Please note:

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

See under 2 encoder diagnostics / broken shearpin monitoring [📖 21].

13.3.9 Safety-related characteristic data for operation with 2 proximity switches

13.3.9.1 Permitted encoder types and output signals
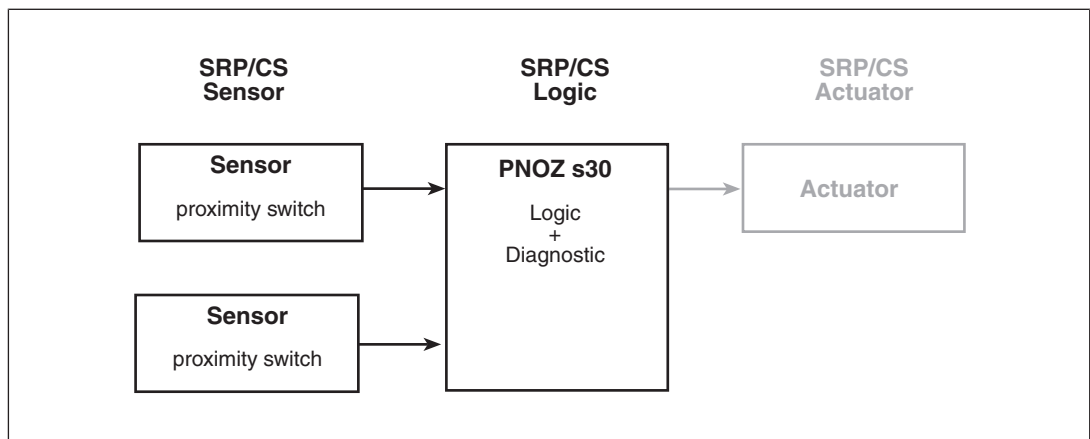
Non-safety-related rotary encoder

Permitted encoder types:

▸ Inductive proximity switches

Permitted output circuits:

▸ pnp - N/O contact

▸ npn - N/O contact

13.3.9.2 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)
3	Manufac-turer-specific	90 % PNP/PNP NPN/NPN	Monitoring 2 encoder	1,74E-09
4		99% PNP/NPN NPN/PNP		

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

13.3.9.3 Achievable safety level

Safety function	PL in accordance with EN ISO 13849-1: 2015	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

13.3.10 Safety characteristic data for operation with 2 proximity switches with reduced diagnostics

13.3.10.1 Permitted encoder types and output signals

Non-safety-related rotary encoder

Permitted encoder types:

▸ Inductive proximity switches

Permitted output circuits:

▸ pnp

13.3.10.2 Safety-related architecture
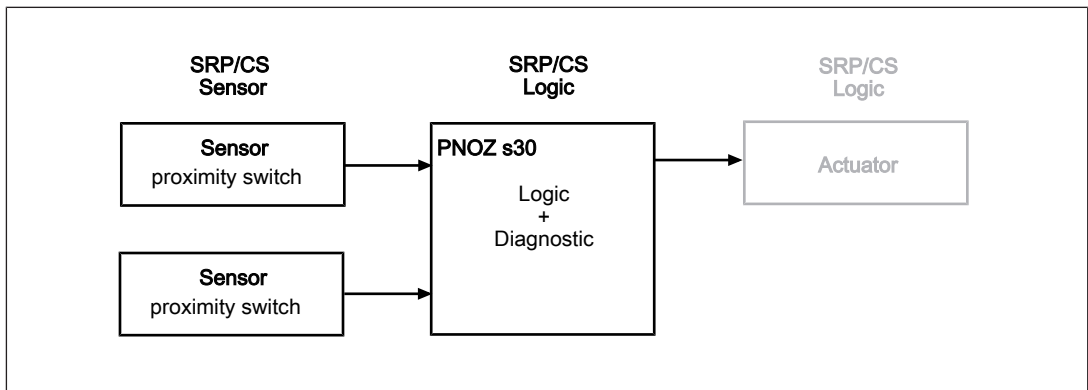
The supply voltage of the proximity switches must be monitored as a measure against systemic failure.

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

Sensor			Subsystem PNOZ s30	
Category	MTTFd	DC	Operating mode	PFH (1/h)
3	Manufacturer-specific	60 %	Monitoring 2 encoder	1,74E-09

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

13.3.10.3 Achievable safety level

Safety function	PL in accordance with EN ISO 13849-1: 2015	SIL CL in accordance with EN IEC 62061
Direction Position	-	-
Speed Speed range Standstill	PL d (Cat. 3)	2

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

13.4 Examples

13.4.1 Connection of proximity switch

13.4.1.1 Features

PNOZ s30

▸ Standstill monitoring to enable safety gate via Rel. 1:
Standstill is detected at ≤ 2 Hz, the output Rel. 1 switches on and the safety gate can be unlocked with pushbutton S3.

▸ Monitoring for overspeed via Rel. 2:
Overspeed is detected at > 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 start

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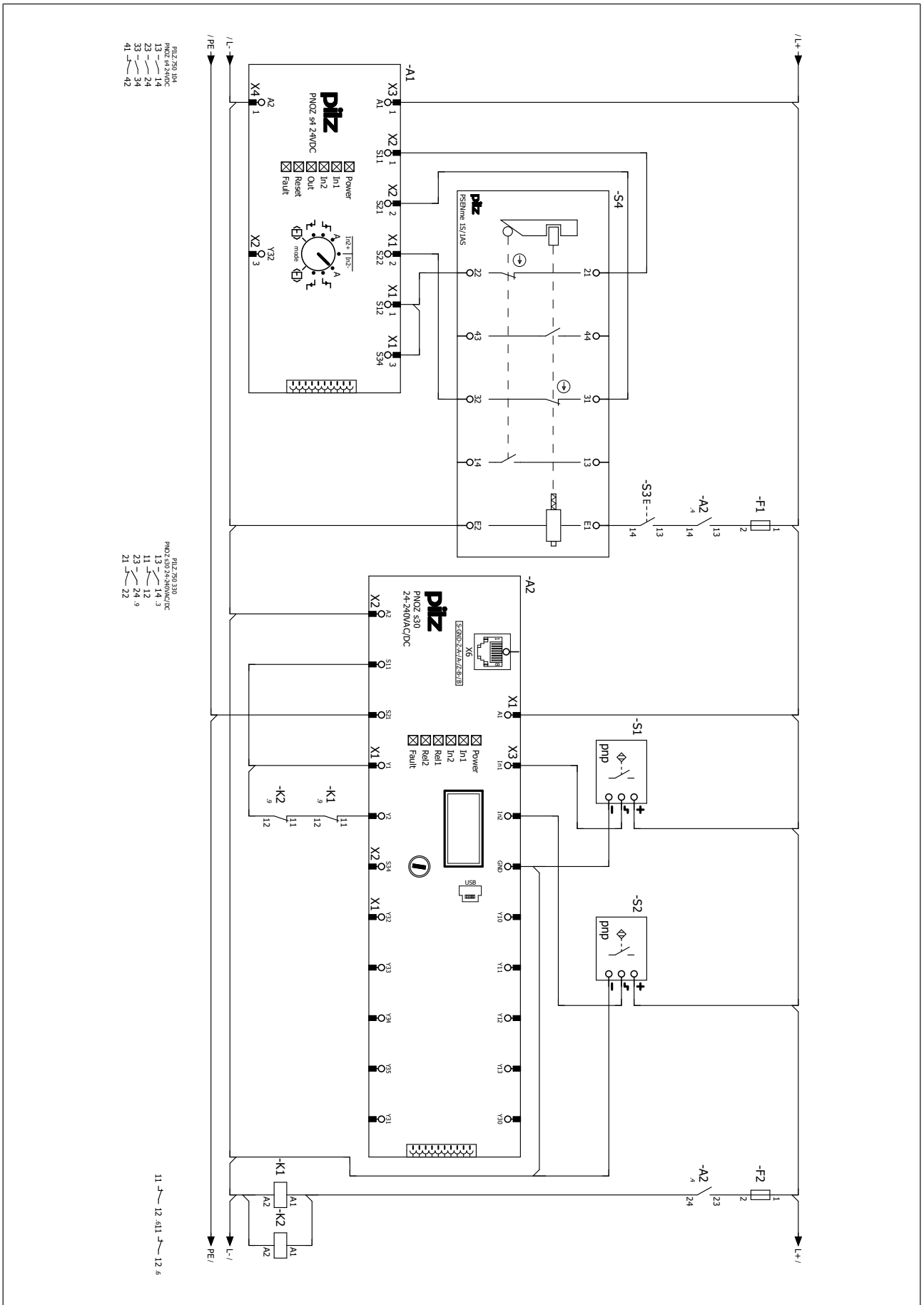The measured values are detected by two proximity switches (pnp).

PNOZ s4

▸ Safety gate monitoring

13.4.1.2 Configuration overview

language	English

delay time start-up (0-600s)	Hysteresis (0-50%)

units

conversion

mode select input	none

Sel 1 (Y10)
Sel 2 (Y11)
Sel 3 (Y12)
Sel 4 (Y13)

delay time select input (0-30s)

input device	A: pnp / B: pnp

	F1	F2	F3	F4	F5	F6	F7	F8	F9
P0	Standstill	500 Hz							
P1									
P2									
P3									
P4									
P5									
P6									
P7									
P8									
P9									
P10									
P11									
P12									
P13									
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)
assign outputs (functions)	F1	F2						
delay time effect (outputs)								
delay time 0 - 30s (outputs)								
reset mode	automatic	automatic						
Synchronous start	deactivated	deactivated						
output out logic								
Ausgang Out 4 Analog fmax								

global standstill (10 mHz - 1 MHz)	2 Hz

input device settings (10 mHz-1 MHz)	
f max (A/B)	3000 Hz
f max (Z)	

ratio (0,0001-400.000:1)	
f(A/B):f(Z)	

position monitoring (SOS-M)	
reset mode:	monitored (default)
position window width (1-24.900.000 Imp)	
Pos. 1	
Pos. 2	
Pos. 3	
Pos. 4	

direction monitoring (SDI-M)	
Auto reset:	deactivated (default)
direction tolerance (max. wrong)	
direction left	
max. right	
direction right	
max. left	

name of configuration	Example 1

CRC of configuration	

V. 1.5 - CS-TS - T.U.

13.4.2 Incremental encoder connection

13.4.2.1 Features

PNOZ s30

▸ Speed monitoring:
Monitoring for overspeed for both 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 > 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 > 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 for both operating modes at ≤ 2 Hz and the output Rel. 1 switches on.
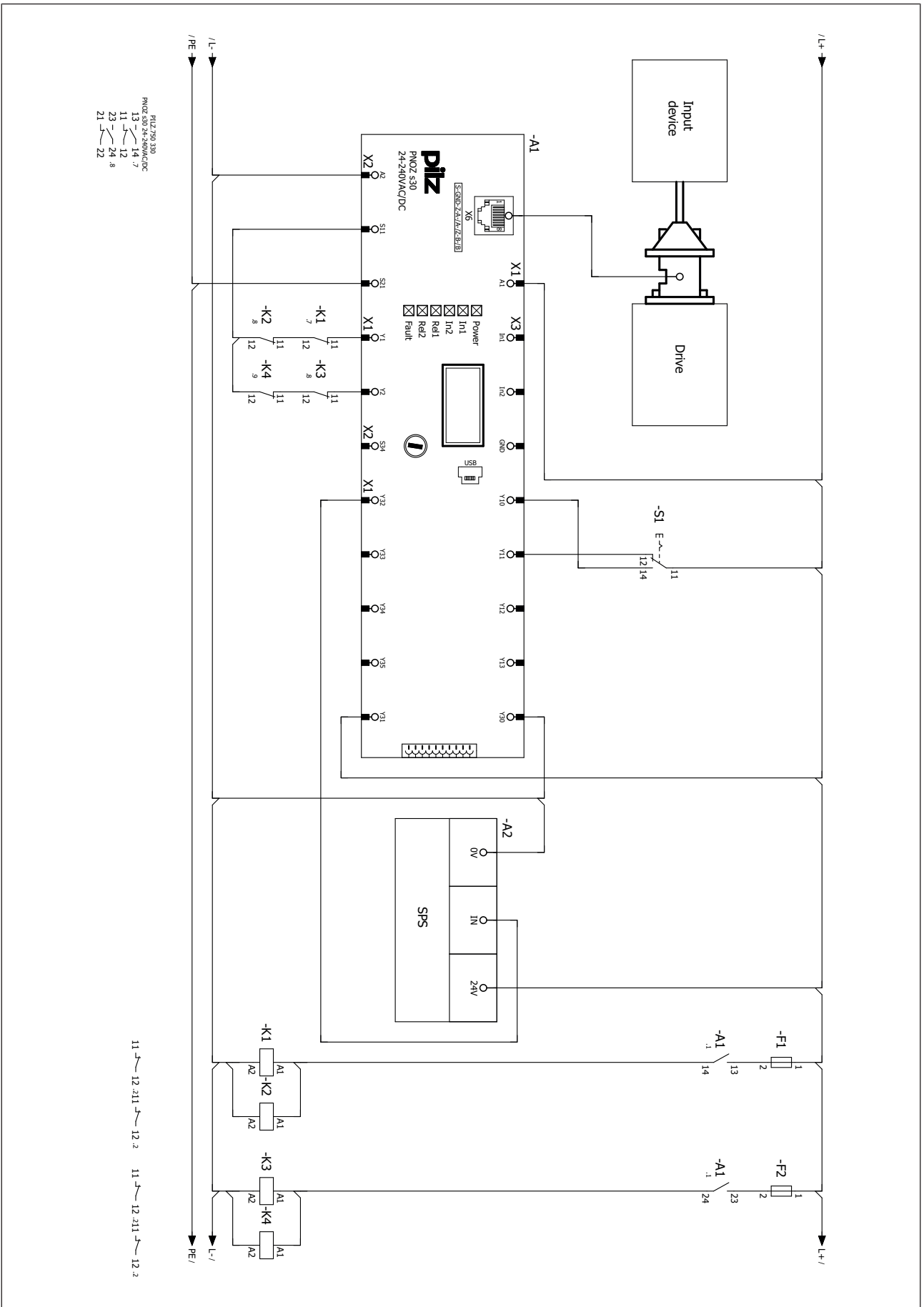
▸ Feedback loop monitoring via feedback inputs Y1 and Y2

Encoder:

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

13.4.2.2 Configuration overview

14 Order reference

14.1 Product

Product type	Features	Terminals	Order no.
PNOZ s30	24 - 240 VAC/DC	With screw terminals	750330
PNOZ s30 C	24 - 240 VAC/DC	With spring-loaded terminals	751330

14.2 Accessories

Configuration accessories

Product type	Features	Order no.
PNOZsigma Configurator	Software tool for configuration of the PNOZ s30 on the PC	
PNOZ s30 USB configuration cable	USB cable for downloading the configuration from PNOZ s30 to PNOZsigma Configurator and vice versa	750040

Chip card accessories

Product type	Features	Order no.
PNOZsigma Chip Card manager set	Set consisting of the PNOZ Chip Card Reader and SmartCardCommander with SIM card adapter (779 230 and 750 031)	750030
SmartCardCommander with SIM card adapter	Software for the chip card reader 779 230, for saving the configuration on the computer	750031
PNOZmulti Chipcard Set	Chip card, 8 kB, x10	779200
PNOZmulti Chipcard	Chip card, 8 kB	779201
PNOZmulti Chipcard	Chip card, 32 kB	779211
PNOZmulti Chipcard Set	Chip card, 32 kB, x10	779212
PNOZ Chip Card Reader	Chip card reader for saving the configuration on the computer	779230
Chipcard Holder	Chip card holder	779240
PNOZmulti Seal	Chip card seal, x10	779250

Terminals

Product type	Features	Order no.
PNOZ s Set3 Screw Loaded Terminals	Set of plug-in screw terminals, x1	750014
PNOZ s Set3 Spring Loaded Terminals	Set of plug-in spring terminals, x1	751014

Terminating plug

Product type	Features	Order no.
PNOZ s terminator plug (10 pieces)	Connector for terminating a PNOZsigma base unit or PNOZsigma expansion module, 10 pieces	750010

Cable

Product type	Features	Order no.
PNOZ msi1Ap	Adapter and cable 25-pin, 2.5 m	773840
PNOZ msi1Ap	Adapter and cable 25-pin, 5.0 m	773844
PNOZ msi1Bp	Adapter and cable 25-pin, 2.5 m	773841
PNOZ msi1Bp	25-pin, 5.0 m	773839
PNOZ msi3Ap	Adapter and cable 15-pin, 2.5 m	773842
PNOZ msi3Bp	Adapter and cable 15-pin, 2.5 m	773843
PNOZ msi5p	Adapter and cable Bos/Rex 15-pin, 2.5 m	773857
PNOZ msi5p	Adapter and cable Bos/Rex 15-pin, 1.5 m	773858
PNOZ msi6p	Adapter and cable Elau 9-pin, 7.5 m	773859
PNOZ msi6p	Adapter and cable Elau 9-pin, 2.5 m	773860
PNOZ msi6p	Adapter and cable Elau 9-pin, 1.5 m	773861
PNOZ msi7p	Adapter and cable SEW 15-pin, 2.5 m	773864
PNOZ msi7p	Adapter and cable SEW 15-pin, 1.5 m	773865
PNOZ msi8p	Adapter and cable Lenze 9-pin, 2.5 m	773862
PNOZ msi8p	Adapter and cable Lenze 9-pin, 1.5 m	773863
PNOZ msi9p	Adapter cable 5.0 m	773856
PNOZ msi10p	Adapter cable 2.5 m	773854
PNOZ msi11p	Adapter cable 1.5 m	773855
PNOZ msi12p	Adapter cable 2.5 m	773868
PNOZ msi13p	Adapter cable 2.5 m	773869
PNOZ msi14p	Adapter cable 2.5 m	773878
PNOZ msi15p	Adapter cable 2.5 m	773874
PNOZ msi16p	Adapter cable 2.5 m	773867
PNOZ msi17p	Adapter cable 5.0 m	773875
PNOZ msi18p	Adapter cable 1.5 m	773888
PNOZ msi19p	Connection cable, 1.5 m	773846
PNOZ msi19p	Connection cable, 2.5 m	773847
PNOZ msi20p	Connection cable, 2.5 m	773879
PNOZ msi21p	Connection cable, 1.5 m	773886
PNOZ msi21p	Connection cable, 2.5 m	773885
PNOZ msi b4 Box	Connection box	773845

Product type	Features	Order no.
PNOZ msi S09	9-pin adapter, connector set	773870
PNOZ msi S15	15-pin adapter, connector set	773871
PNOZ msi S25	25-pin adapter, connector set	773872
PNOZ msi S25	25-pin adapter, connector set	773872
PNOZ s30 USB configuration cable	USB cable for downloading the configuration from PNOZ s30 to PNOZsigma Configurator and vice versa	750040

PNOZsigma expansion modules

Product type	Features	Order no.
PNOZ s7	1 safe relay output	750107
PNOZ s7 C	1 safe relay output	751107
PNOZ s7 C (coated version)	1 safe relay output	751187
PNOZ s7.1	1 safe relay output (+ 1 PNOZ s7, PNOZ s10 or PNOZ s11 can be connected as a contact expansion module)	750167
PNOZ s7.1 C	1 safe relay output (+ 1 PNOZ s7, PNOZ s10 or PNOZ s11 can be connected as a contact expansion module)	751167
PNOZ s7.2	1 safe relay output (+ 1 expansion module PNOZ s7, PNOZ s10 or PNOZ s11 can be connected)	750177
PNOZ s7.2 C	1 safe relay output (+ 1 expansion module PNOZ s7, PNOZ s10 or PNOZ s11 can be connected)	751177
PNOZ s10	1 safe relay output	750110
PNOZ s10 C	1 safe relay output	751110
PNOZ s11	1 safe relay output	750111
PNOZ s11 C	1 safe relay output	751111
PNOZ s22	2 safe relay outputs	750132
PNOZ s22 C	2 safe relay outputs	751132

15 EC declaration of conformity

This product/these products meet the requirements of the directive 2006/42/EC for machinery of the European Parliament and of the Council. The complete EC Declaration of Conformity is available on the Internet at www.pilz.com/downloads.

Authorised representative: Norbert Fröhlich, Pilz GmbH & Co. KG, Felix-Wankel-Str. 2, 73760 Ostfildern, Germany

16 UKCA-Declaration of Conformity

This product(s) complies with following UK legislation: Supply of Machinery (Safety) Regulation 2008.

The complete UKCA Declaration of Conformity is available on the Internet at www.pilz.com/downloads.

Representative: Pilz Automation Technology, Pilz House, Little Colliers Field, Corby, Northamptonshire, NN18 8TJ United Kingdom, eMail: mail@pilz.co.uk

▶ Support

Technical support is available from Pilz round the clock.

Americas

Brazil
+55 11 97569-2804

Canada
+1 888 315 7459

Mexico
+52 55 5572 1300

USA (toll-free)
+1 877-PILZUSA (745-9872)

Asia

China
+86 21 60880878-216

Japan
+81 45 471-2281

South Korea
+82 31 778 3300

Australia and Oceania

Australia
+61 3 95600621

New Zealand
+64 9 6345350

Europe

Austria
+43 1 7986263-0

Belgium, Luxembourg
+32 9 3217570

France
+33 3 88104003

Germany
+49 711 3409-444

Ireland
+353 21 4804983

Italy, Malta
+39 0362 1826711

Scandinavia
+45 74436332

Spain
+34 938497433

Switzerland
+41 62 88979-32

The Netherlands
+31 347 320477

Turkey
+90 216 5775552

United Kingdom
+44 1536 462203

You can reach our international hotline on:
+49 711 3409-222
support@pilz.com

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BRANDS OF THE CENTURY
PILZ
THE SPIRIT OF SAFETY
2019
GERMAN STANDARDS

Quality Management
DQS
ISO 9001:2015
REG. NO. 2462

Environmental Management
DQS
ISO 14001
REG. NO. 2462

Energy Management
DQS
ISO 50001
REG. NO. 2462

We are represented internationally. Please refer to our homepage www.pilz.com for further details or contact our headquarters.

Headquarters: Pilz GmbH & Co. KG, Felix-Wankel-Straße 2, 73760 Ostfildern, Germany
Telephone: +49 711 3409-0, Telefax: +49 711 3409-133, E-Mail: info@pilz.com, Internet: www.pilz.com

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