PIT m3.2p

Operator terminals

1 Introduction

1.1 Validity of documentation

This documentation is valid for the product PIT m3.2p. It is valid until new documentation is published.

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

1.1.1 Retaining the documentation

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

1.2 Definition of symbols

Information that is particularly important is identified as follows:

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

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

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

> **NOTICE**
> This describes a situation in which the product or devices could be damaged and also provides information on preventive measures that can be taken. It also highlights areas within the text that are of particular importance.

> **INFORMATION**
> This gives advice on applications and provides information on special features.

2   Overview

The operating mode selector switch may only be operated in conjunction with a transponder key. 5 transponder keys are available, each with different authorisations.
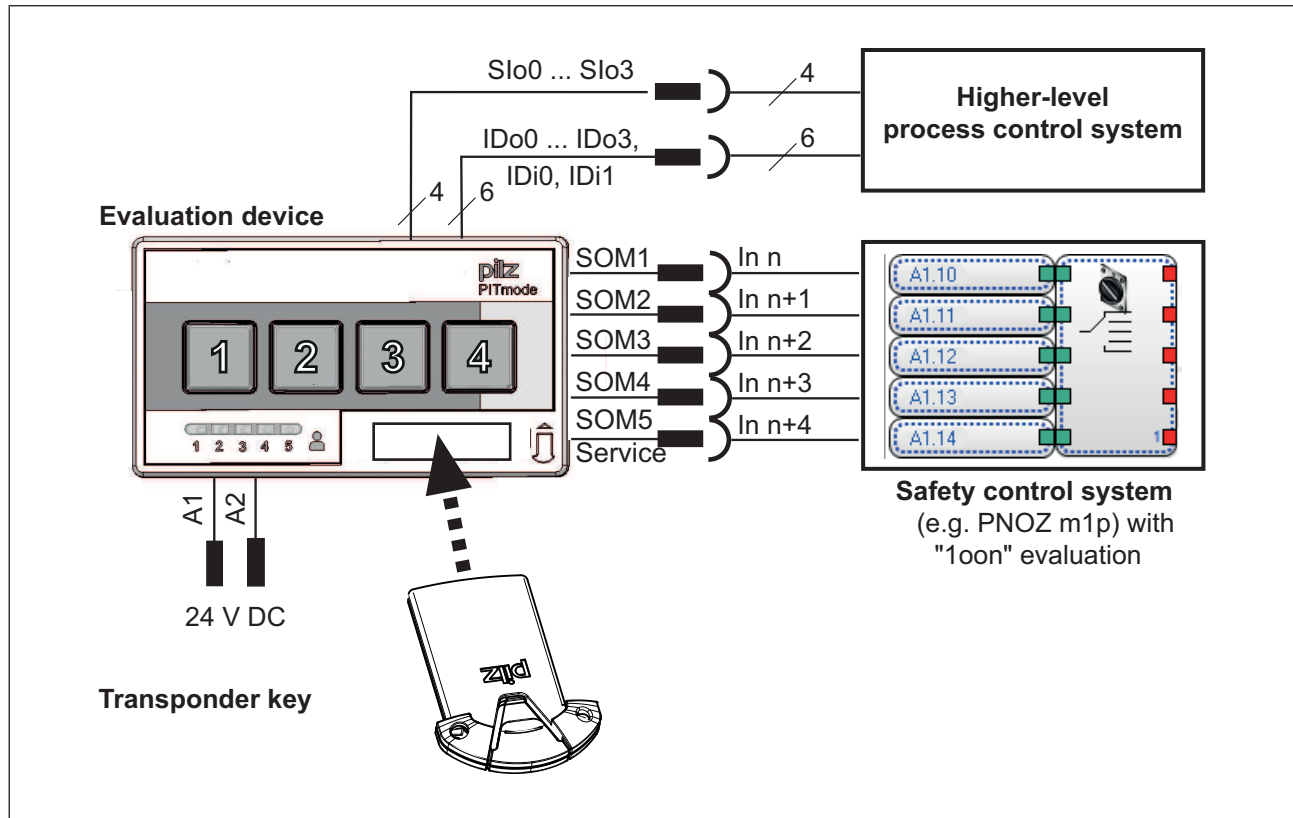
Fig.: Operating mode selector switch in an application (principle)

2.1 Features of the operating mode selector switch

The product has the following features:

▶ Supply voltage 24 V DC

▶ 4 pushbuttons for switching the operating mode

▶ Selected operating mode is displayed through pushbutton backlighting

▶ 4 operating modes OM1 ... OM4

▶ 1 special mode OM5 (Service)

▶ 5 monitored semiconductor outputs (24 V) in accordance with EN 61496-1; 1 semiconductor output per operating mode

▶ Interface for status information, consisting of 4 signal outputs (24 V)

▶ Status information is divided into information classes:
  – Operator actions
    - Select transponder key
    - Remove transponder key
    - Select operating mode
  – Messages (e.g. user error, fault)

▶ Interface (Key ID interface) for downloading the Key ID number of the transponder key you are using, consisting of
  – 4 semiconductor outputs (24 V)
  – 2 inputs

▶ Configurable communication mode for downloading the Key ID number
  – Transmitter-controlled communication mode
  – Handshake-controlled communication mode

▶ Authorisations of a transponder key are displayed via LEDs

2.2   Features of transponder key

A transponder key contains a Key ID number and the authorisations to which you can switch with that transponder key.

Features:

- ▸ Replaces the mechanical key
- ▸ Different authorisations
- ▸ Authorisations are identified via printed "Key Mode".

2.3 Control elements
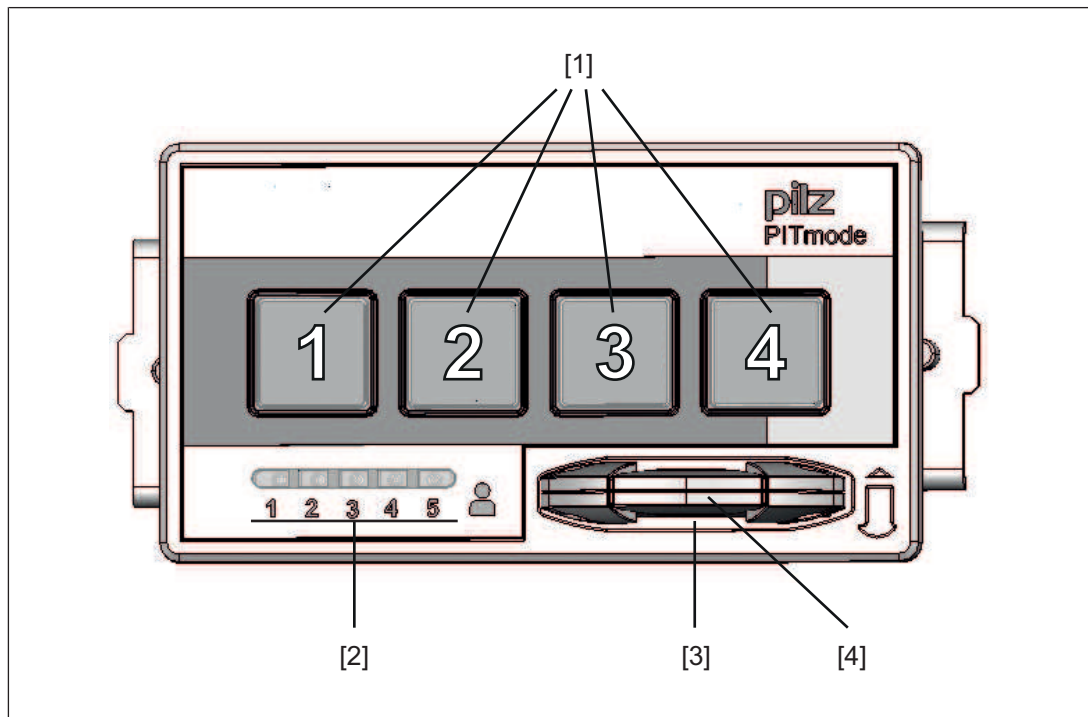
Fig.: Front view

Legend:

[1]   Button to select an operating mode
   1   Button for OM1 / OM5
   2   Button for OM2
   3   Button for OM3
   4   Button for OM4

[2]   Authorisation display – LEDs to display the authorisations for the relevant transpon-
       der key
   1   Authorisation for OM1
   2   Authorisation for OM2
   3   Authorisation for OM3
   4   Authorisation for OM4
   5   Authorisation for OM5

[3]   Slot for inserting the transponder key

[4]   Transponder key
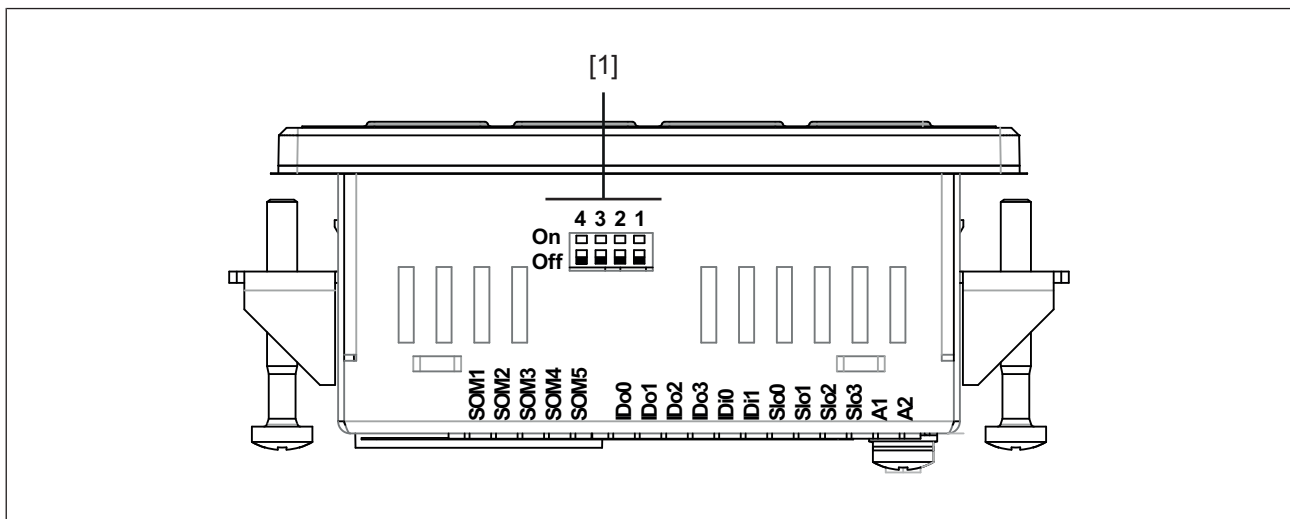
Fig.: View from above

Legend:

[1]   DIP switch for configuring the switching behaviour after the transponder key has been removed

3 Safety

3.1 Intended use

The operating mode selector switch is suitable for machines that can be operated in multiple operating modes with different protective measures and/or work procedures. It enables you to switch between defined operating modes, such as:

- Set-up mode
- Manual mode
- Automatic mode
- Service

The operating mode selector switch meets the following safety requirements:

- Interlock to protect against unauthorised switching
  Contact with a transponder key is required in order to switch to an operating mode.

- Access authorisations are restricted to certain groups
  A transponder key with the relevant authorisation is required in order to switch to a certain operating mode.

- Prevents unintentional switching
  The switch to a different operating mode is only recognised once the corresponding (selection) pushbutton has been operated for a defined period ("deliberate operator action"). Multiple operation of (selection) pushbuttons is detected.

- Safe "1 from n" circuit of the operating mode outputs
  The operating mode selector switch only ever leads to one operating mode output "1" signal.

Depending on the application area and its respective regulations, the operating mode selector switch can be used up to SIL CL 2 (EN IEC 62061) and up to PL d (EN ISO 13849-1), if the operating modes are evaluated by a safety control system with safe "1oon" evaluation.

Switching must not initiate a hazardous movement, nor can it cancel an existing control command.

3.2 Safety regulations

3.2.1 Use of qualified personnel

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

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

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

▶ Are familiar with the basic regulations concerning health and safety / accident prevention

▶ Have read and understood the information provided in this description under "Safety"

▶ And have a good knowledge of the generic and specialist standards applicable to the specific application.

3.2.2 Warranty and liability

All claims to warranty and liability will be rendered invalid if

▶ The product was used contrary to the purpose for which it is intended

▶ Damage can be attributed to not having followed the guidelines in the manual

▶ Operating personnel are not suitably qualified

▶ Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering work etc.).

3.2.3 Disposal

▶ In safety-related applications, please comply with the mission time T_M in the safety-related characteristic data.

▶ When decommissioning, please comply with local regulations regarding the disposal of electronic devices (e.g. Electrical and Electronic Equipment Act).

4 Function description

The operating mode selector switch enables you to switch between 5 different operating modes (operating modes OM1 ... OM4 and special operating mode OM5 (Service)).

For OM1 ... OM4, one button each is available. For the special operating mode (Service), button OM1 must be operated for a certain period (see Monitoring of operating time [50]). Each button is assigned a monitored semiconductor output. Operating the button changes the semiconductor output from a "0" signal to a "1" signal. The operating mode selector switch guarantees that only one of the semiconductor outputs has a "1" signal at any one time.
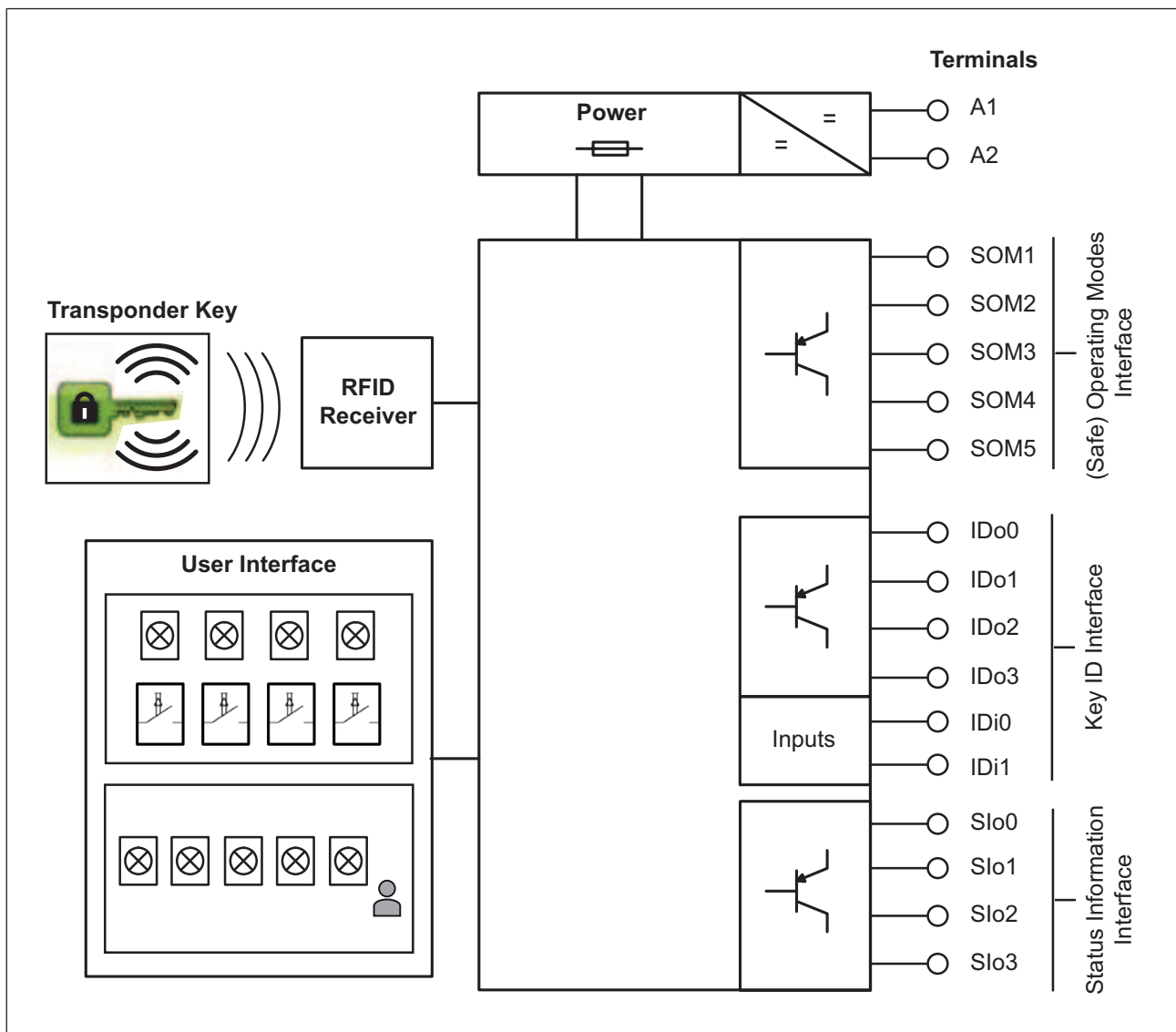
Fig.: Block diagram

Legend:

Transponder Key	Electronic key to enable a change of operating mode
User Interface	▸ Button to select the operating mode
	▸ Authorisation display (LEDs to display the authorisations for the relevant transponder key)

A1, A2	Supply voltage
SOM1 … SOM5	Operating mode interface Interface to display the operating mode that is currently selected, consisting of 5 monitored outputs
IDo0 … IDo3 and IDi0 … IDi1	Key ID interface Interface to download the Key ID number to a control system, consisting of 4 outputs and 2 inputs
SIo0 … SIo3	Interface for status information Interface to signal status information, consisting of 4 signal outputs

The operating mode selector switch is protected against unauthorised operation. A switch between operating modes must be enabled via a transponder key.

Authorisations of a transponder key

A total of 5 transponder keys are available for an operating mode selector switch. Each transponder key provides authorisation to switch up to 5 operating modes, including special authorisations. A transponder key can be identified via the printed key mode.

Assignment of key modes to authorisations

Designation	Marking on transponder key	Authorisation for operating mode
Key Mode 01	**1**	OM1
Key Mode 02	**2**	OM1 + OM2
Key Mode 03	**3**	OM1 + OM2 + OM3
Key Mode 04	**4**	OM1 + OM2 + OM3 + OM4
Key Service	**Service**	OM1 + OM2 + OM3 + OM4 + OM5 (Service)

4.1   Interface for status information

Various status information can be signalled via the interface for status information (see Block diagram [📖 14]). The status information can be evaluated through a control system.

The status information is subdivided into the following information classes:

▸ Operator actions
  – Insert transponder key
  – Remove transponder key
  – Select operating mode
▸ Messages (e.g. user error, fault)

> **NOTICE**
>
> When the operating mode is selected (SIo3 … SIo0 = 3h, 8h ... Bh) and when there is a device error (Dh) the information remains indefinitely present. All other information stays active for just **200 ms**. After that time the selected operating mode is again displayed.

Status information	Information class	SIo3 (MSB)	SIo2	SIo1	SIo0 (LSB)	Value (in Hex)
Reserved	- - -	0	0	0	0	0h
Reserved	- - -	0	0	0	1	1h
Transponder key 5 – Inserted [1]	Operator action	0	0	1	0	2h
OM5 selected	Operator action	0	0	1	1	3h
Transponder key 1 – Inserted [1]	Operator action	0	1	0	0	4h
Transponder key 2 – Inserted [1]	Operator action	0	1	0	1	5h
Transponder key 3 – Inserted [1]	Operator action	0	1	1	0	6h
Transponder key 4 – Inserted [1]	Operator action	0	1	1	1	7h
OM1 selected	Operator action	1	0	0	0	8h
OM2 selected	Operator action	1	0	0	1	9h
OM3 selected	Operator action	1	0	1	0	Ah
OM4 selected	Operator action	1	0	1	1	Bh
No authorisation [2]	User error	1	1	0	0	Ch
Device error [3]	Error	1	1	0	1	Dh
Pushbutton operated incorrectly [4]	User error	1	1	1	0	Eh
Transponder key removed	Operator action	1	1	1	1	Fh

[1] When a pushbutton is released, information as to which transponder key is used will be displayed for 200 ms (see Status information 2h and 4h … 7h). The selected operating mode is then displayed (see Status information 3h and 8h … Bh).
Please refer to the Timing diagrams for operator actions [18].

[2] The fault "No authorisation" (Ch) is registered in the following cases:

▶ Operating mode selected without transponder key

▶ Operating mode selected with a transponder key that is not authorised for the selected operating mode

▶ Transponder key is not authorised for the active operating mode

▶ Transponder key is not inserted in time before the operating mode is selected

Please refer to the Timing diagrams for user error: "No authorisation" [21].

[3] "Device error" (Dh) is signalled in the event of an internal device error or when one of the operating mode outputs SOM1... SOM5 are stuck because of external voltage (stuck-at-1 or stuck-at-0).

Remedy:

▶ Rectify error, switch supply voltage off and then on again

▶ Change the unit

Please refer to the Timing diagram for device error [20].

[4] The fault "Pushbutton operated incorrectly" (Eh) is displayed in the following cases:

▶ Multiple operation of pushbuttons

▶ Pushbutton operated for too long (timeout for OM1 to OM4 = 5 s and timeout for OM5 = 10 s)
   Note: If a key is operated for < 50 ms this will not be evaluated, so there will be no reaction.

▶ Pushbutton was released after the transponder key was removed

Please refer to the Timing diagrams for user error: "Button operated incorrectly" [23].

4.1.1 Timing diagrams for operator actions

The following timing diagram shows how status information is registered at outputs Slo0 ... Slo3, based on operator actions.

Legend:

�▭	Message is displayed constantly
▭	Message is displayed briefly (200 ms)

Select operating mode

1. Start position:
   – OM1 selected

   – DIP switch in default setting

2. Operator action: Insert transponder key
   (e.g. Authorisation Key Mode 02)

3. Operator action: Select operating mode
   (e.g. Press button "2" for OM2)

4. Operator action: Remove transponder key
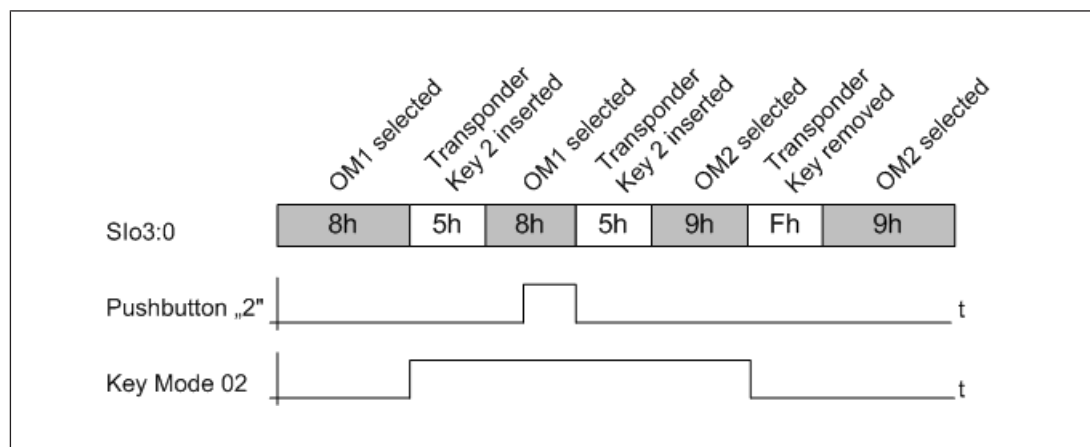
Fig.: Timing diagram for "Select operating mode" with DIP switch setting [1] (default setting)

Remove transponder key

1. Start position:

⇒ OM5 is selected and the transponder key "Key Service" is inserted

or

⇒ One of the operating modes OM1 ... OM4 is selected and a transponder key with the relevant authorisation is inserted

2. Operator action: Remove transponder key
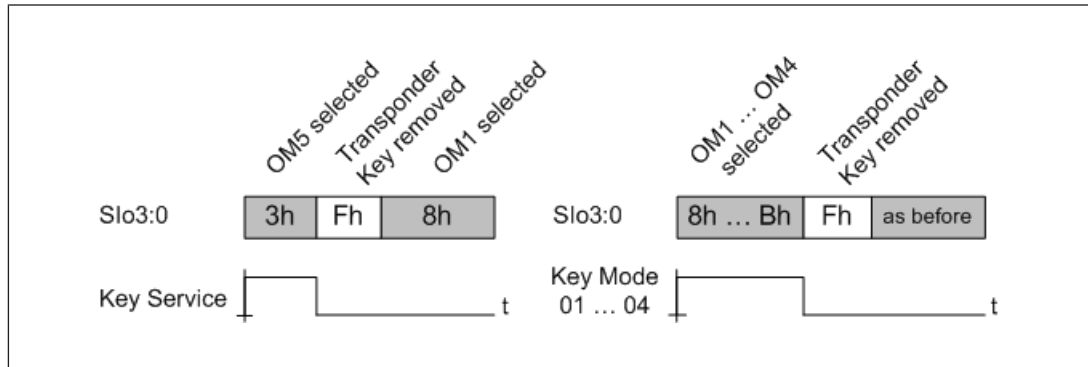
Fig.: Timing diagram for "Remove transponder key" with DIP switch setting [1] (default setting)
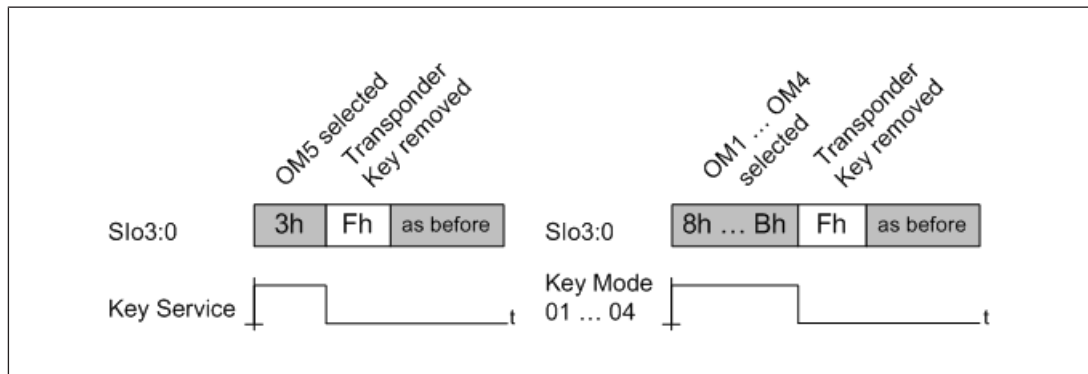
Fig.: Timing diagram for "Remove transponder key" with DIP switch setting [2]
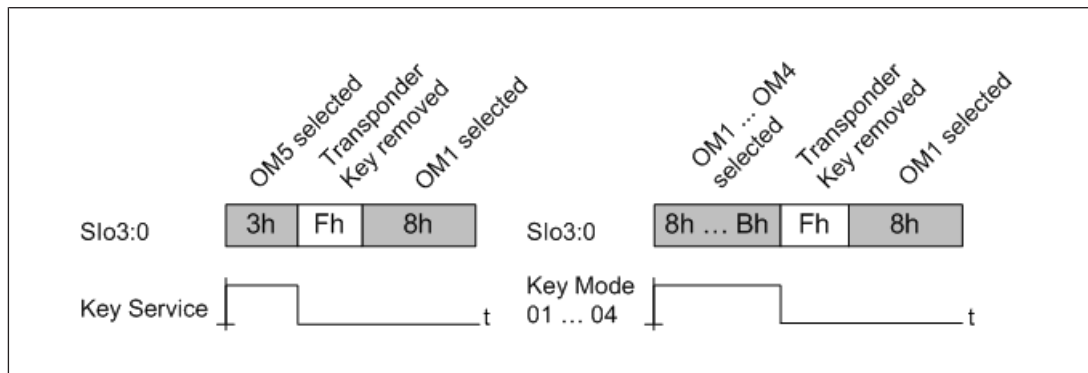
Fig.: Timing diagram for "Remove transponder key" with DIP switch setting [3]

4.1.2 Timing diagram for device error

The following timing diagram shows how status information is registered at outputs Slo0 ... Slo3, based on a device error.

Legend:

	Message is displayed constantly
	Message is displayed briefly (200 ms)

Device error
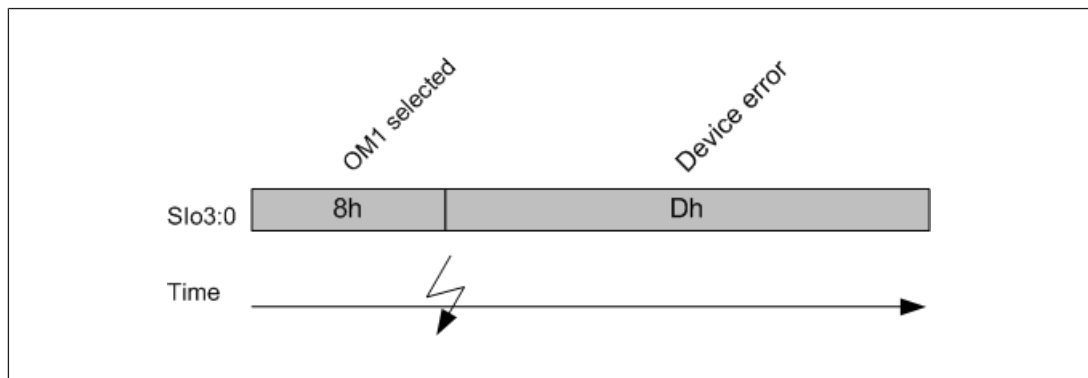
Fig.: Timing diagram in the event of a device error

4.1.3 Timing diagrams for user error: "No authorisation"

The following timing diagram shows how status information is registered at outputs Slo0 ... Slo3, based on the user error "No authorisation".

Legend:

		Message is displayed constantly
		Message is displayed briefly (200 ms)

Operating mode selected without transponder key
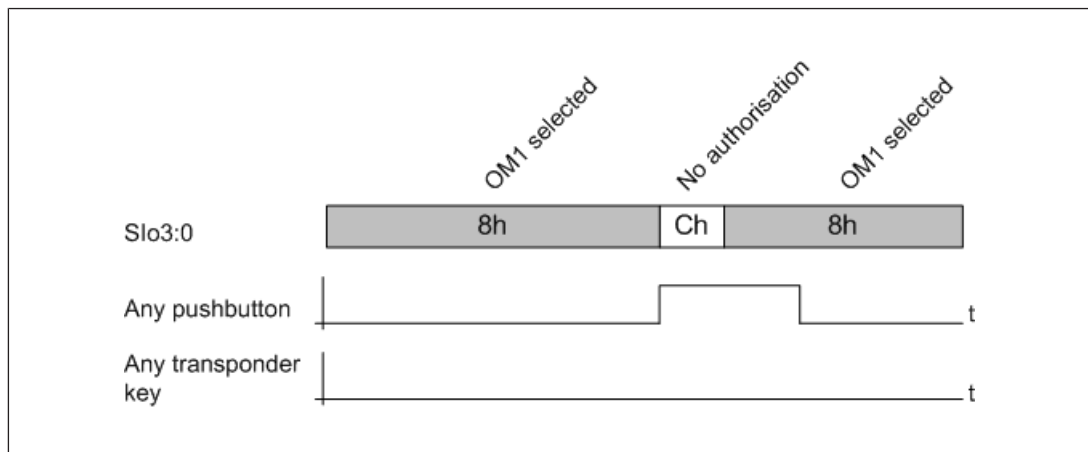
Fig.: Timing diagram for "Operating mode selected without transponder key"

Operating mode selected with a transponder key that is not authorised for the selected operating mode
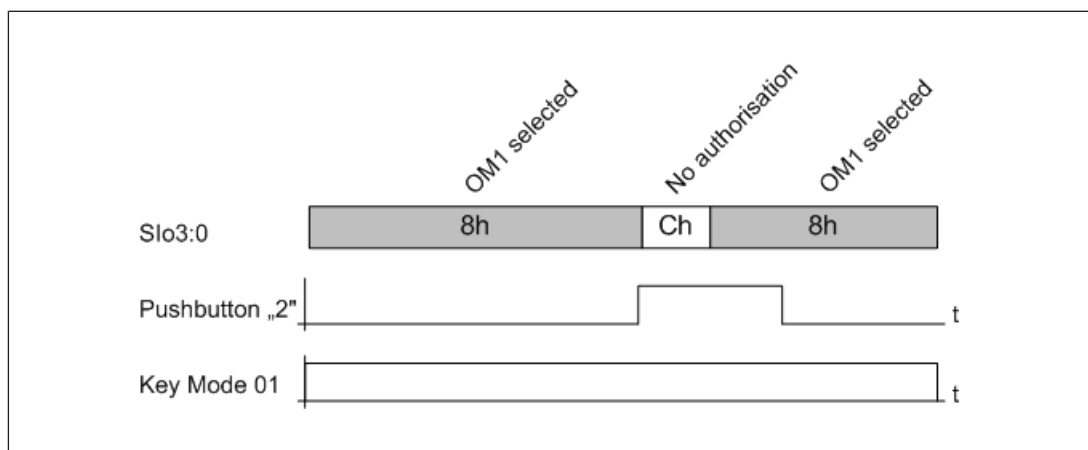
Fig.: Timing diagram for operating mode selection where there is insufficient authorisation for the operating mode requiring selection

Operating mode selected with a transponder key that is not authorised for the active operating mode
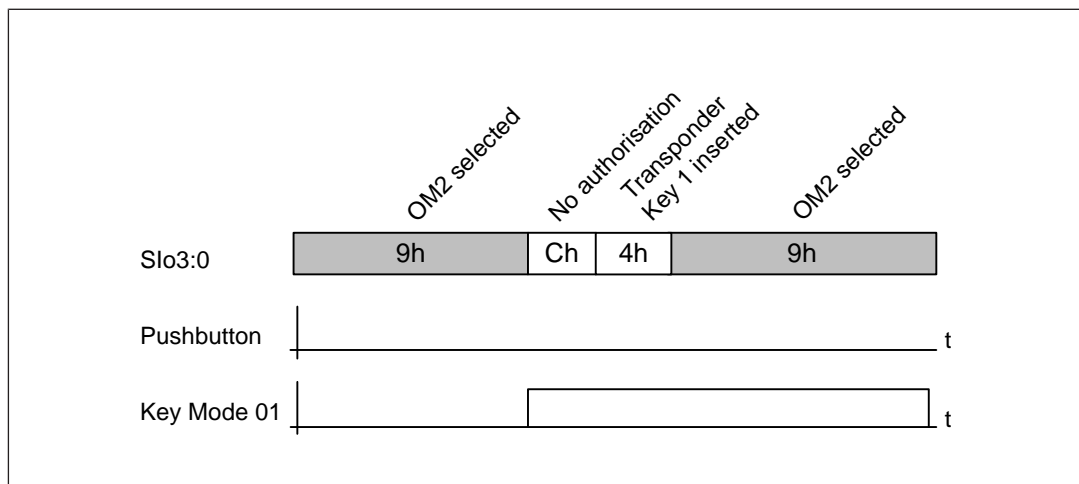
Fig.: Timing diagram for operating mode selection where there is insufficient authorisation for the active operating mode

Transponder key is not inserted in time before the operating mode is selected
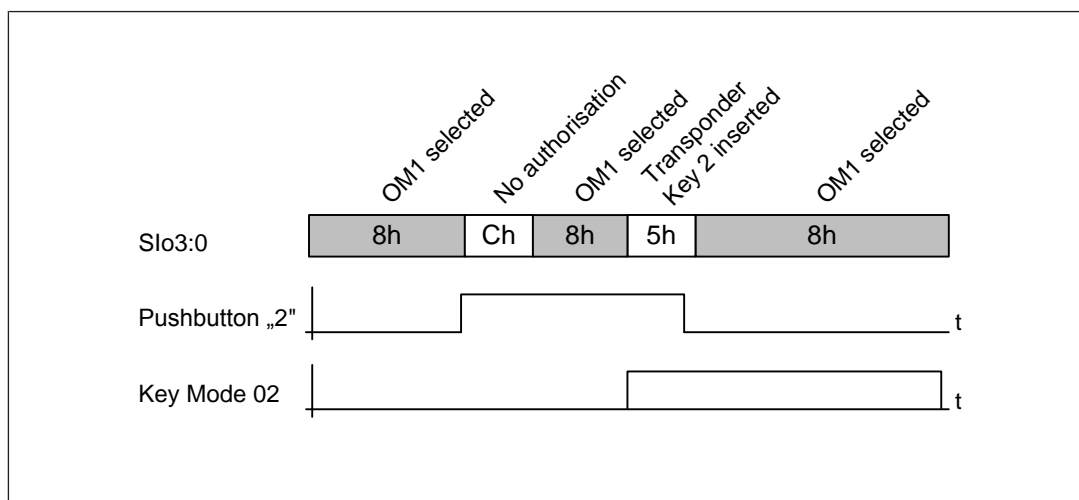
Fig.: Timing diagram for selecting the operating mode before the transponder key is inserted

4.1.4 Timing diagrams for user error: "Button operated incorrectly"

The following timing diagram shows how status information is registered at outputs Slo0 ... Slo3, based on the user error "Button operated incorrectly"

Legend:

	Message is displayed constantly
	Message is displayed briefly (200 ms)

Multiple operation of pushbuttons
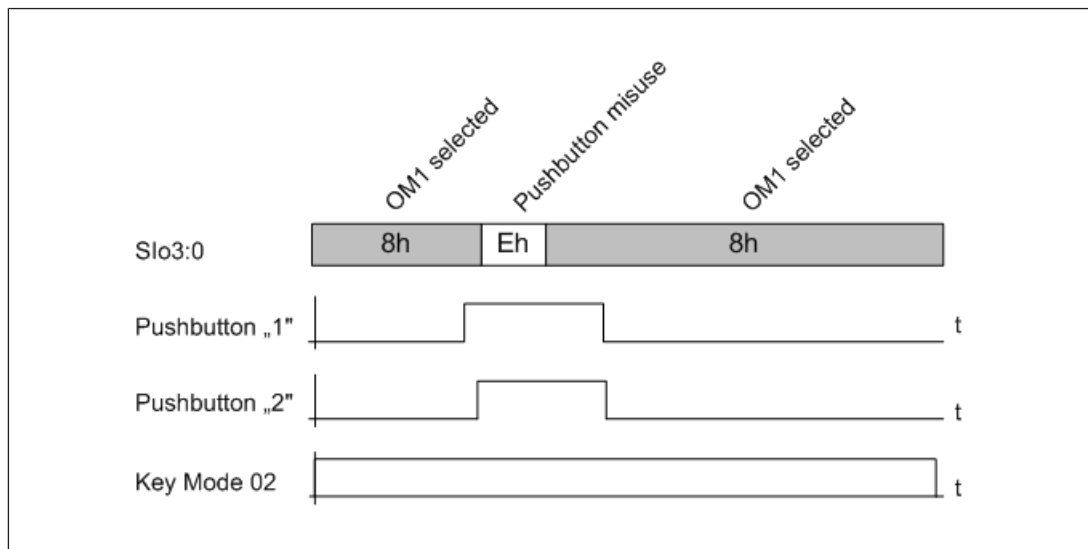
Fig.: Timing diagram for "Multiple operation of buttons"

Button operated for too long

▸ "Button operated for too long" with authorisations "Key Mode 01" … "Key Mode 04"

or

▸ "Button operated for too long" with authorisation "Key Service"
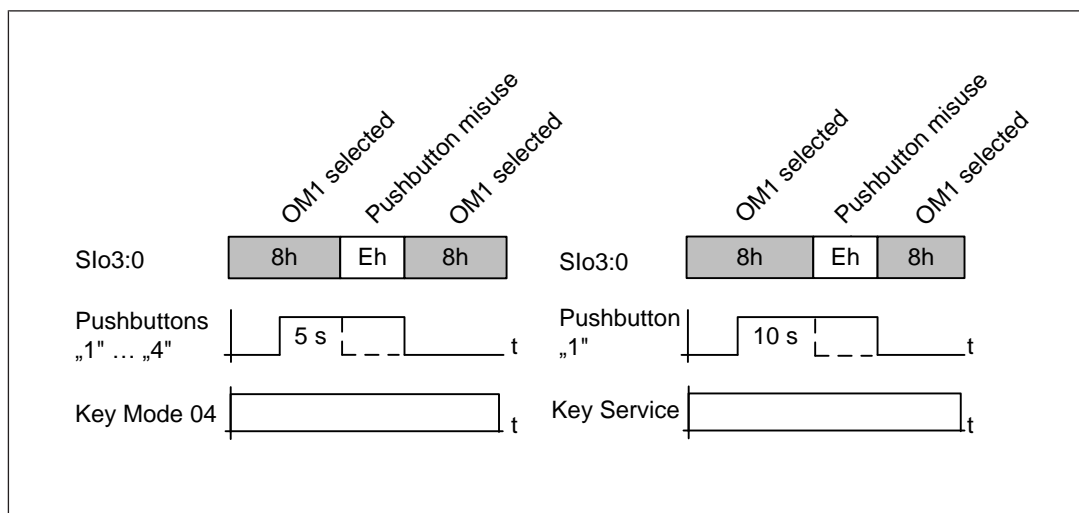
Fig.: Timing diagram for "Button operated for too long"

Pushbutton was released after the transponder key was removed
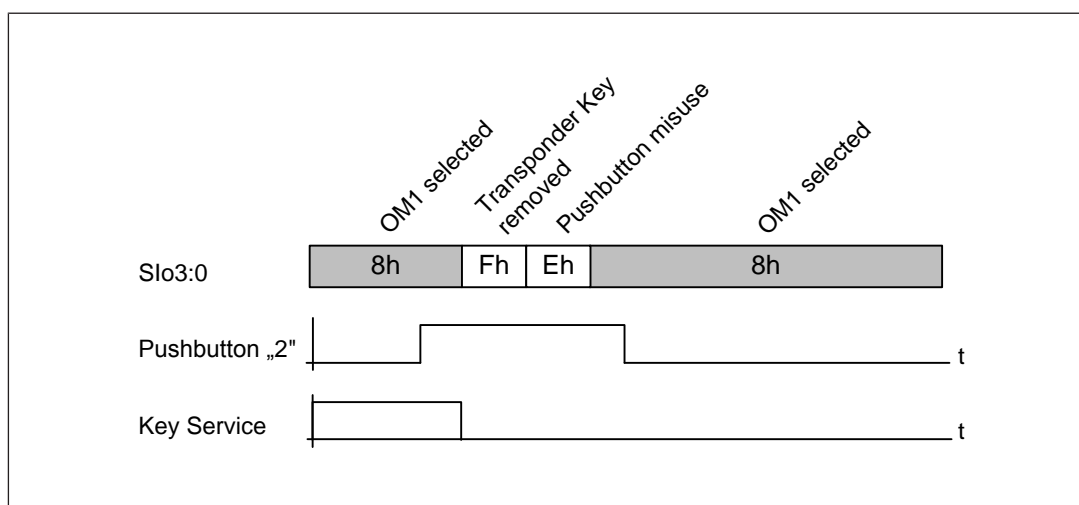
Fig.: Timing diagram for user errors when releasing the button

4.2 Operating mode interface

The operating mode interface consists of the monitored outputs SOM1 … SOM5 (seeBlock diagram [📖 14]). "SOM" stands for "Safe Operating Mode". The outputs are assigned to buttons, which can be used to select an operating mode if they have the relevant authorisation (transponder key):

Pushbutton	Output	Operating mode	
1	SOM1	OM1	The operating mode OM1/OM5 is selected based on the operating time of button 1 (see Monitoring of operating time [📖 50])
	SOM5	OM5	
2	SOM2	OM2	
3	SOM3	OM3	
4	SOM4	OM4	

4.2.1 Switch behaviour after a transponder key is removed

If the transponder key is removed after changing to a different operating mode, it is possible to configure the subsequent switch behaviour of SOM1 … SOM5. A DIP switch is available for this purpose (see Control elements [📖 10]).
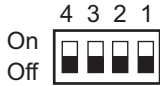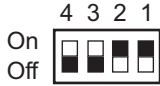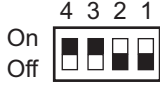
> **NOTICE**
>
> **Please note the following:**
>
> – The configuration may only be performed by a competent person.
> – The configuration must be performed when the supply voltage is switched off.
> – The configuration is adopted as the device is started up, provided the switch setting is valid. If not, the device switches to a "Device error" fault condition.
> – During operation, the DIP switch setting is monitored for any change. If the switch setting is changed during operation, the device switches to a "Device error" fault condition.

Configuration options via the DIP switch

DIP switch setting	Operating mode currently selected	Assigned output	Behaviour after the transponder key is removed
[1]: Default setting On Off 4 3 2 1	OM1	SOM1	▸ Operating mode currently selected is maintained ▸ The assigned button is backlit. ▸ The assigned output has a "1" signal
	OM2	SOM2	
	OM3	SOM3	
	OM4	SOM4	
	OM5	SOM5	▸ Switch to OM1 ▸ Button 1 is backlit ▸ SOM1 has a "1" signal
[2] On Off 4 3 2 1	OM1	SOM1	▸ Operating mode currently selected is maintained ▸ OM1 … OM4: The assigned button is backlit. OM5: All 4 buttons flash. ▸ The assigned output has a "1" signal
	OM2	SOM2	
	OM3	SOM3	
	OM4	SOM4	
	OM5	SOM5	
[3] On Off 4 3 2 1	OM1	SOM1	▸ Switch to OM1 ▸ Button 1 is backlit ▸ SOM1 has a "1" signal
	OM2	SOM2	
	OM3	SOM3	
	OM4	SOM4	
	OM5	SOM5	

> **NOTICE**
>
> Make **absolutely** sure that only the DIP switch settings described above are assessed as valid. With all other DIP switch settings, the device switches to a "Device error" fault condition.

4.2.2 Control program requirements

In order to achieve SIL CL 2 (EN IEC 62061)/PL d (EN ISO 13849-1) in an application, the evaluation must be carried out by a safety-related function block. The safety-related function block must meet the following requirements:

▶ The function block must enable safe "1oon" evaluation of the output signals at SOM1 ... SOM5.

▶ If two or more operating modes are present at the same time, this must be detected as an error.

INFORMATION

The function block must bridge the t1 switchover delay (see Switchover delay t1 [50]).

If a PNOZmulti (e.g. PNOZ m1p) is used as the safety control system in conjunction with an "operating mode selector switch" function element, then this requirement is met automatically.

4.3 Key ID interface

The Key ID interface (see Block diagram [📖 14]) is used to download the Key ID number to a control system.

4.3.1 Key ID number of the transponder key

The Key ID number is used to clearly identify the transponder key and is unique. It is printed on the transponder key's type label as a 9-digit decimal figure.

NOTICE

Please note:

The Key ID number is **not** printed on the transponder key packaging.

If the transponder key is lost, it is impossible to supply a replacement transponder key with an identical Key ID number.

The Key ID number consists of two parts:

▸ Bit 27 = 24: Key Mode (0 … 15_D)

▸ Bit 23 = 00: Consecutive number (0 … 999999999_D)

	Bit27 ... Bit24	Bit23 ... Bit16	Bit15 ... Bit08	Bit07 ... Bit00
	0 ... 15_D		0 ... 999999999_D	

Key Mode	Bit27	Bit26	Bit25	Bit24	
01	0	0	0	1	1_D
02	0	0	1	0	2_D
03	0	0	1	1	3_D
04	0	1	0	0	4_D
Service	1	1	0	1	13_D

Consecutive Number
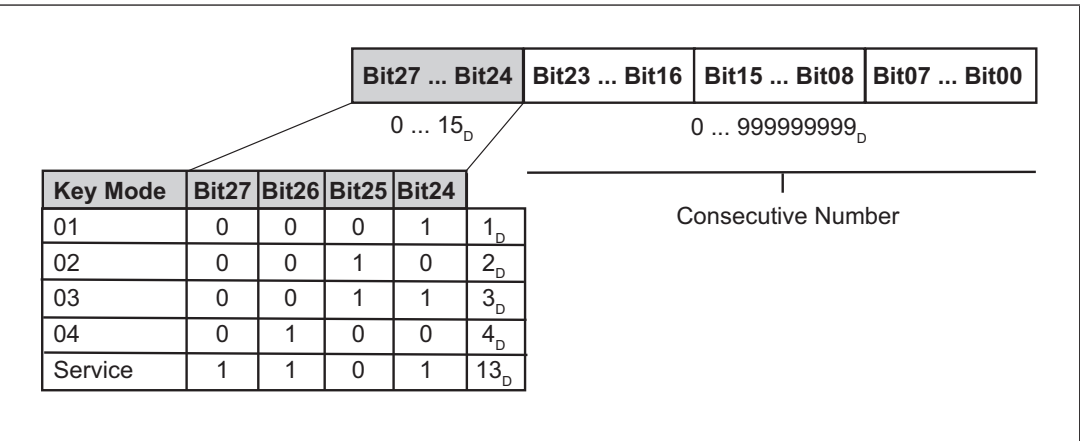
Fig.: Structure of the Key ID number

Examples:

Key-ID-Number: 130000044

1101	0000 0000	0000 0000	0010 1100

Key Mode Service   Consecutive number: 44_D

Key-ID-Number: 020000510

0010	0000 0000	0000 0001	1111 1110

Key Mode 02   Consecutive number: 510_D

4.3.2 Communication mode for downloading the Key ID number

The unique Key ID number for the relevant transponder key is downloaded to the higher-level process control system using a defined protocol, depending on the configured communication mode. The communication mode is configured on the Key ID interface of the operating mode selector switch (jumpers available/not available).

The operating mode selector switch detects the configured communication mode at each power-on. As long as voltage is applied to the operating mode selector switch, the configured communication mode will be active; the change in communication mode does not come into effect until the supply voltage is switched off and then on again.

It's possible to choose between the following communication modes:

▶ Transmitter-controlled communication mode

▶ Handshake-controlled communication mode

4.3.2.1 Transmitter-controlled communication mode

With transmitter-controlled communication mode, the download of the Key ID number is started by the operating mode selector switch (= transmitter).

Features of this communication mode:

▶ Download of Key ID number starts once the transponder key is connected

▶ Constant bit rate (100 ms)

▶ Download on 2 data lines

▶ Constant download time (typ. 1.8 s)

▶ Monitored data download

▶ Input/outputs required on the control system: 4 inputs and 2 outputs

▶ Download is repeated by reconnecting the transponder key

No special coding is required on the Key ID interface in order to download the Key ID number of a transponder key to the control system in transmitter-controlled communication mode. The terminals on the Key ID interface are used as follows:

Key ID interface	Brief description of application	Coding via jumpers
IDo0	IDsync	No configuration required
IDo1	IDclock	
IDo2	IDout0	
IDo3	IDout1	
IDi0	IDin0	
IDi1	IDin1	

4.3.2.2   Handshake-controlled communication mode

With handshake-controlled communication mode, the download of the Key ID number is started by the control system (Request).

Features of this communication mode:

▸ Download starts via a request to the control system, once the transponder key is connected

▸ Download is repeated by a renewed request to the control system

▸ Variable bit rate (min. 2 PLC cycles per bit)

▸ Download on 1 data line

▸ Min. download time: 28 Bit * (20 ms + 2 * PLC cycle)

▸ Identifier for ID end for feasibility check

▸ Input/outputs required on the control system: 3 inputs and 1 output

The Key ID interface must be coded with a jumper between IDo3 and IDi1 in order to download the Key ID number of a transponder key to the control system in handshake-controlled communication mode. The terminals on the Key ID interface are used as follows:

Key ID interface	Brief description of application	Coding via jumpers
IDo0	IDsync	
IDo1	IDresponse	
IDo2	IDdata	
IDo3	*Coding: OUT*	IDo3 *Coding: OUT*
IDi0	IDrequest	
IDi1	*Coding: IN*	IDi1 *Coding: IN*

In handshake-controlled communication mode, the operating mode selector switch can be operated in a functional variant. In this case the Key ID number of the transponder key is not downloaded to the control system. The control system is only used to evaluate IDo0 on the Key ID interface. In this case IDo0 is used as a signal output, enabling the control system to recognise whether the transponder key is valid/invalid. With this functional variant, only 1 input is required on the control system. The unused terminals on the Key ID interface (IDo1, IDo2 and IDi0) may remain unwired ("open").

4.3.3 Evaluation by a control system

4.3.3.1 Evaluation of the Key ID number with transmitter-controlled communication
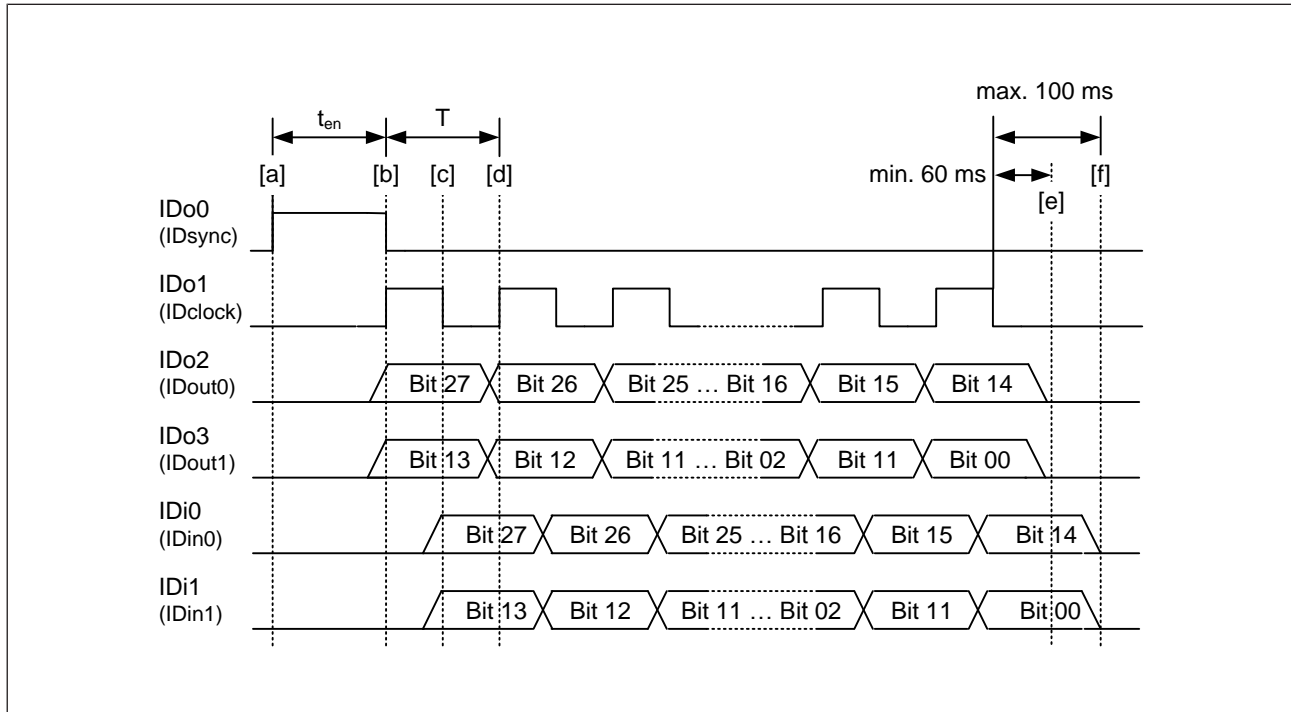
Fig.: Timing diagram for transmitter-controlled signal download

Legend:

The additional terminal designations (IDsync, IDclock, IDout0 etc.) are abbreviations for the terminal signal's application.

IDo0	Control line
	The signal is generated by the operating mode selector switch.

	"0" signal	No transponder key is connected or the transponder key that is connected is invalid.
	"1" signal	A valid transponder key is created. The operating mode selector switch signals to the control system when the download starts. The signal is present for 100 ms.

IDo1	Test pulse line
	The signal is generated by the operating mode selector switch and indicates the validity of the data bits at IDo2 and IDo3.

- ▶ T = 100 ms
- ▶ Duty cycle = 50%

IDo2, IDo3	Data lines for transmitting the Key ID number
	The operating mode selector switch sends the Key ID number to the control system via these two data lines.
	IDo2: Send Bit 27 … Bit 14
	IDo3: Send Bit 13 … Bit 00

IDi0, IDi1	Data line for reading back the Key ID number
	The control system sends the previously received Key ID number back to the operating mode selector switch via these two data lines.
	IDi0: Receive Bit 27 … Bit 14
	IDi1: Receive Bit 13 … Bit 00

Download procedure

[a]   The operating mode selector switch sets the signal at IDo0 (IDsync: control line) to "1" for 100 ms, thereby signalling to the control system that transmission has started.

[b]   A rising edge at IDo1 (IDclock: test pulse line) indicates that the data at data lines IDo2 and IDo3 is present and valid and can be read by the control system.

[c]   By the time there is a falling edge at IDo1 (IDclock: test pulse line), the control system must have sent the previously read bit back to the operating mode selector switch via the data lines IDi0 and IDi1.

[d]   Before the rising edge at IDo1 (IDclock: test pulse line), the operating mode selector switch reads the bits sent back to IDi0 and IDi1 by the control system and checks it for equivalence.

[e]   At least 60 ms after the falling edge at IDo1 (IDclock: test pulse line), the last bit sent back by the control system must be present at data lines IDi0 and IDi1.

[f]   A maximum of 100 ms after the falling edge at IDo1 (IDclock: test pulse line), the last bit sent back by the control system must be present at data lines IDi0 and IDi1; in other words, by this point at the latest, data transfer must be completed and the data lines must have a "0" signal.

> **INFORMATION**
>
> If the control system does not feed back the previously read Bits correctly, the download is aborted and restarted. The "IDsync" signal is set once again. The download is repeated until the Key ID number is downloaded completely.
>
> The download of the Key ID number typically takes 1.8 s.

Flowchart for evaluating the Key ID interface

```
                          ┌──────────────┐
                          │    Start     │
                          └──────────────┘
                                 │
                          ╱──────────────╲        No
                         <  <IDsync> = 1   >─────────────┐
                          ╲──────────────╱               │
                                 │                        │
                          ╱──────────────╲        No      │
                         <  <IDsync> = 0   >─────────────┤
                          ╲──────────────╱               │
                                 │                        │
                          ┌──────────────┐                │
                          │Clear Bit     │                │
                          │Counter       │                │
                          └──────────────┘                │
                                 │                    Yes │
              ┌──────────╱──────────────╲─────────────────┘
              │         <  <IDsync> = 1   >
              │          ╲──────────────╱
              │                 │
              │  No      ╱──────────────╲
              │◄────────<  <IDclock> = 1  >
              │          ╲──────────────╱
              │                 │
              │          ┌──────────────┐
              │          │Read          │
              │          │<IDout0> AND   │
              │          │<IDout1>      │
              │          └──────────────┘
              │                 │
              │          ┌──────────────┐
              │          │Increment Bit │
              │          │Counter       │
              │          └──────────────┘
              │                 │
              │          ┌──────────────┐
              │          │Set <IDin0> = │
              │          │<IDout0>      │
              │          └──────────────┘
              │                 │
              │          ┌──────────────┐
              │          │Set <IDin1> = │
              │          │<IDout1>      │
              │          └──────────────┘
              │                 │
              │          ╱──────────────╲    No
              │         <  <IDclock> = 0  >───┐
              │          ╲──────────────╱     │
              │                 │◄────────────┘
              │  No      ╱──────────────╲
              └─────────<  Bit Counter = 14 >
                         ╲──────────────╱
                                 │
                          ┌──────────────┐
                          │Start Last Bit│
                          │Timer         │
                          └──────────────┘
                                 │
                          ╱──────────────╲   No
                         < Last Bit Timer  >──┐
                         < >= 60ms         >  │
                          ╲──────────────╱     │
                                 │◄────────────┘
                          ┌──────────────┐
                          │Clear         │
                          │<IDin0> AND    │
                          │<IDin1>       │
                          └──────────────┘
                                 │
                          ┌──────────────┐
                          │Store ID-     │
                          │Number        │
                          └──────────────┘
                                 │
                          ┌──────────────┐
                          │     End      │
                          └──────────────┘
```

See Fig. „Timing Diagramm of sender controlled signal transfer"
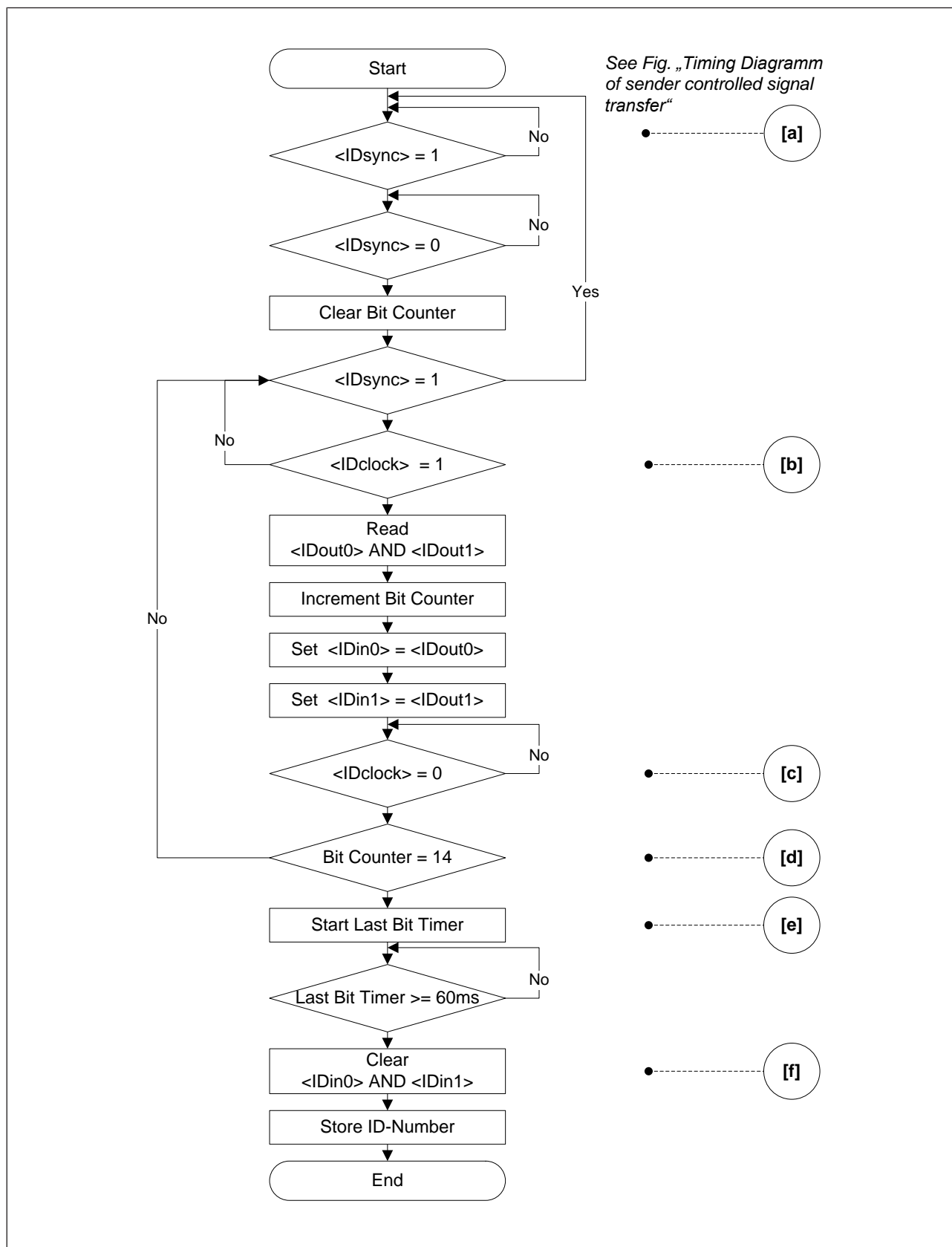
[a]

[b]

[c]

[d]

[e]

[f]

Fig.: Evaluation of the Key ID number via a control system (principle)

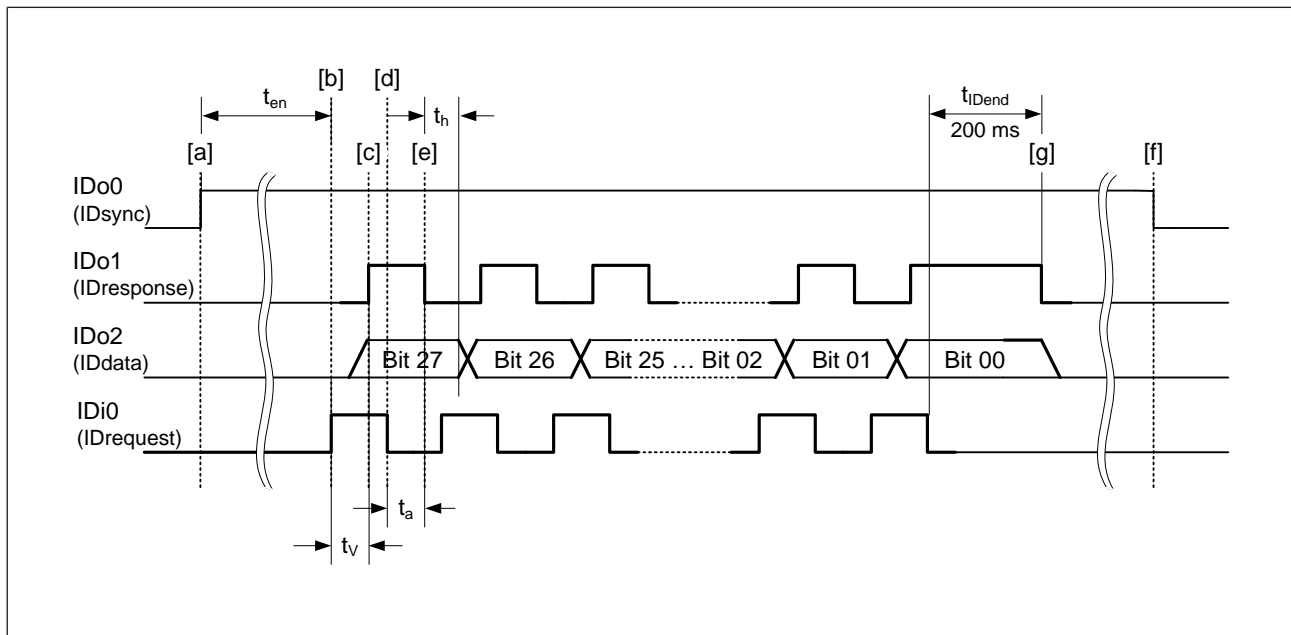**4.3.3.2 Evaluation of the Key ID number with handshake-controlled communication**

Fig.: Timing diagram for handshake-controlled signal download

Legend:

The additional terminal designations (IDsync, IDresponse, IDdata and IDrequest etc.) are abbreviations for the terminal signal's application.

IDo0 Control line
The signal is generated by the operating mode selector switch.

"0" signal No transponder key is connected or the transponder key that is connected is invalid. The control system cannot request the Key ID number.

"1" signal A valid transponder key is connected and the control system can request the Key ID number.

IDo1 Handshake line (Response)
The signal is generated by the operating mode selector switch and indicates whether a data bit at IDo2 is valid/invalid.

"0" signal The data bit at IDo2 is invalid and may not be evaluated.

"1" signal The data bit at IDo2 is valid and may be evaluated.

IDo2 Data line for downloading the Key ID number
The Key ID number (28 Bit) is generated by the operating mode selector switch. The download begins with MSB (Bit27 … Bit00).

IDi0 Handshake line (Request)
The signal is generated by the control system.

"0" signal No bit is requested at IDo2

"1" signal A new bit is requested at IDo2.

t_{en} IDsync Enable Time (min. 0 ms)
t_v Data Output Valid Time (max. 10 ms)
t_h Data Output Hold Time (min. 0 ms)
t_a Data Output Access Time (max. 10 ms)

t_{IDend} End of Key ID Number Transfer (200 ms)
After the last falling edge at IDi0, the operating mode selector switch still has a "1" signal at output IDo1 for 200 ms. In this way, the end of the Key ID number and therefore the end of the download (End of Key ID Number Transfer) is displayed. This can be used for the feasibility check.

Download procedure

[a]   "1" signal at IDo0 (control line):
A valid transponder key is present at the operating mode selector switch.

[b]   "1" signal at IDi0 (handshake line):
The control system requests a data bit at data line IDo2 an (= Request).

[c]   "1" signal at IDo1 (handshake line):
The operating mode selector switch confirms the validity of the data bit at data line IDo2 (= Response).

[d]   "0" signal at IDi0 (handshake line):
The control system confirms that it has read the requested data bit without error.

[e]   "0" signal at IDo1 (handshake line):
The operating mode selector switch is ready to issue a new data bit at data line IDo2.

[f]   "0" signal at IDo0 (control line):
The transponder key has been removed.

[g]   The control system must request all the data bits of a Key ID number (Bit27 … Bit00). Only then is it possible to start downloading a new Key ID number. The end of the download is indicated by the signal extension (t_{IDend}) at IDo1.

Status diagram for handshake-controlled signal download
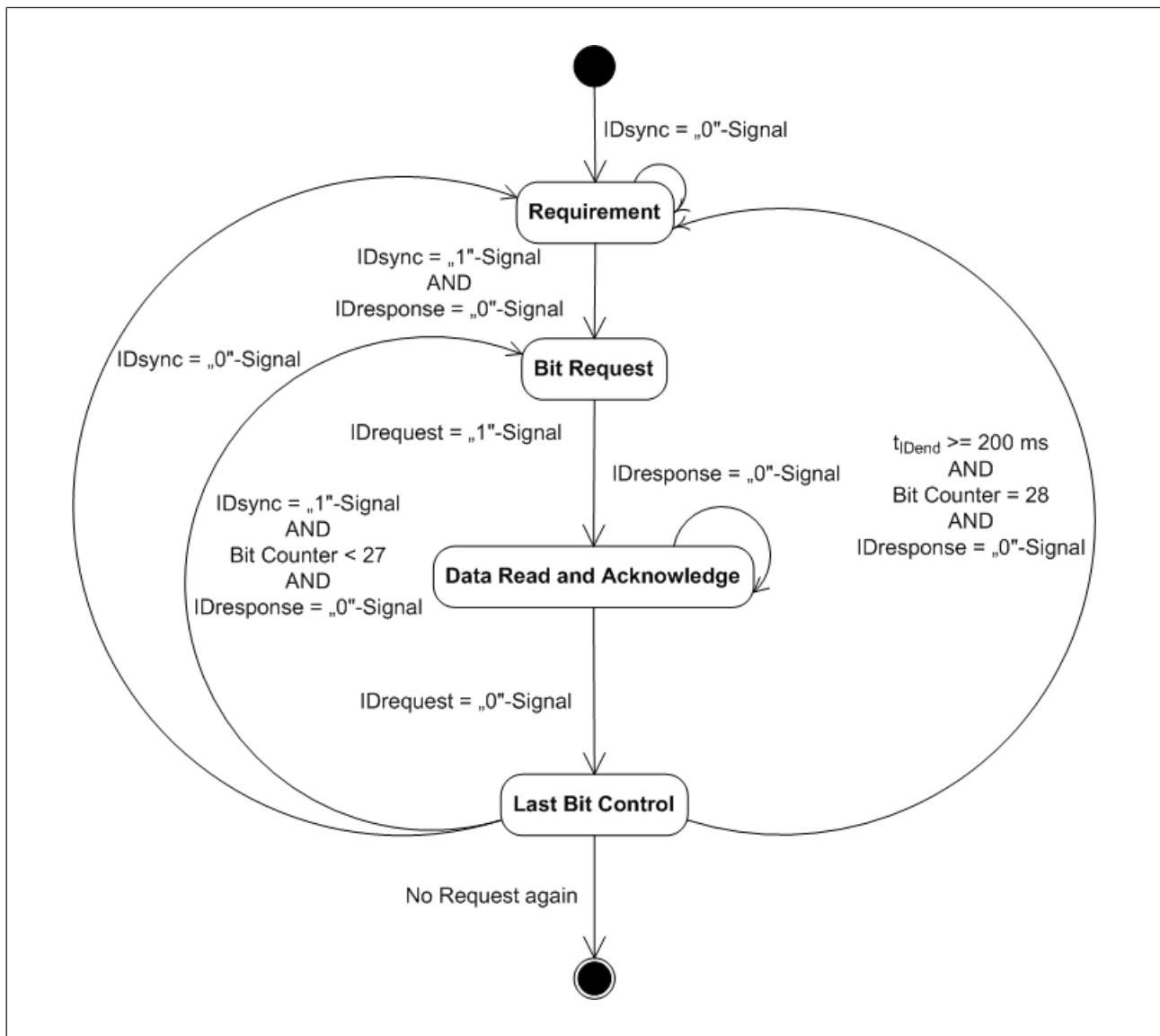
Fig.: Status diagram for handshake-controlled signal download

Flowchart for evaluating the Key ID interface

See Fig. „*State diagram of handshake controlled signal transfer*":

See Fig. „*Timing diagram of handshake controlled signal transfer*":

Start

Set Bit Counter = 0

[a] •······• No

<IDsync> = 1 AND <IDresponse> = 0

• ········ **Requirement**

[b] •······• Set <IDrequest> = 1

• ········ **Bit Request**

• ········ **Data Read and Acknowledge**

<IDresponse> = 1   No

[c] •······•

Yes

Read Bit <IDdata>

Set <IDrequest> = 0

[d] •······•

Start Timer

Increment Bit Counter

No

• ········ **Last Bit Control**

[f] •······• <IDsync> = 0

No

<IDresponse> = 0

[e] •······•

Time Control <t_{IDend}> >= 200ms

[g] •······•

Bit Counter = 28   No

Store ID Number
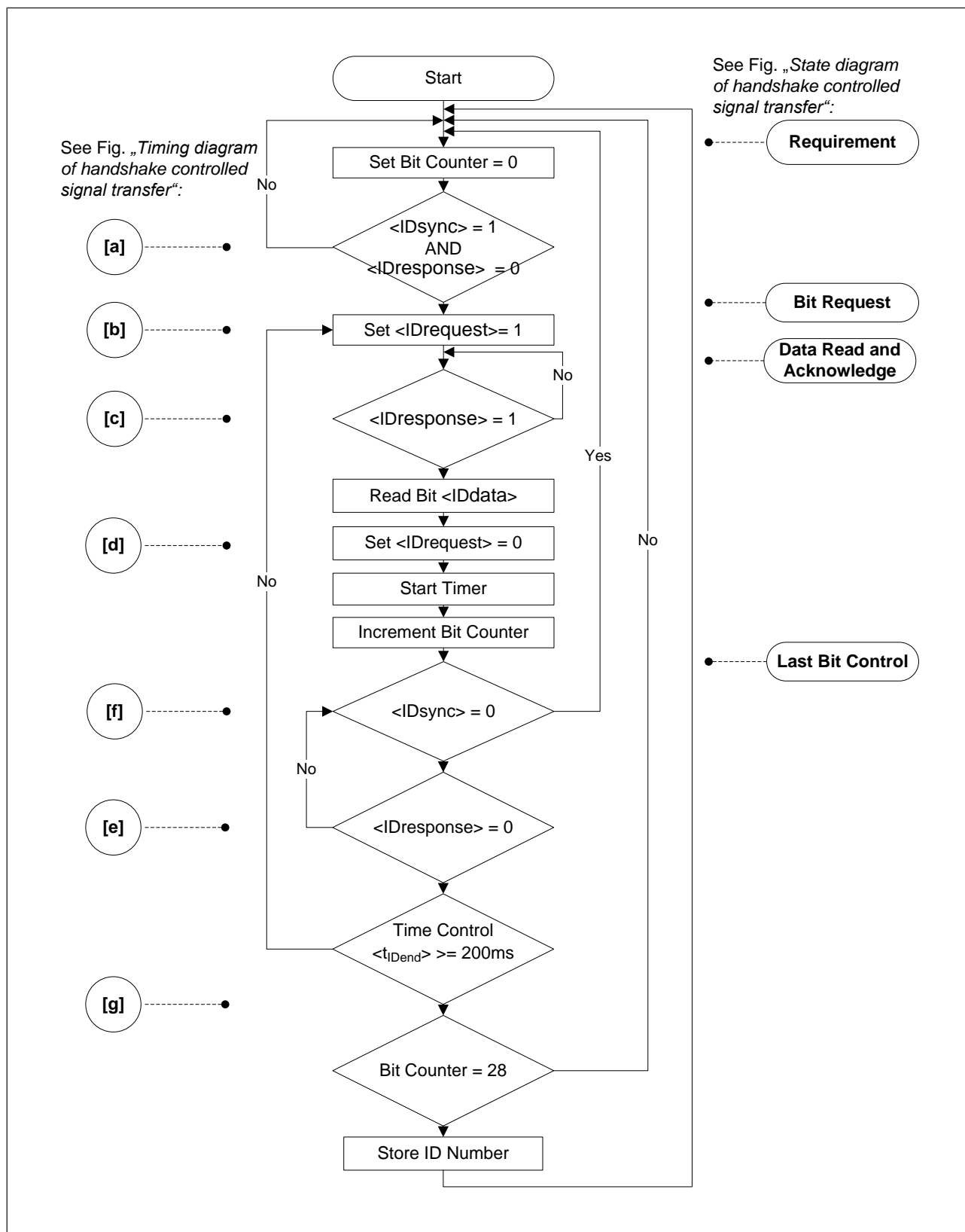
Fig.: Evaluation of the Key ID number via a control system (principle)

5 Installation

5.1 General installation guidelines

▶ The installation site must conform to the protection type IP54.

▶ Ensure that the operating mode selector switch has sufficient ventilation.

▶ Attach the operating mode selector switch using the brackets provided.

▶ Make sure that the gasket is seated correctly.

5.2 Dimensions

Front view
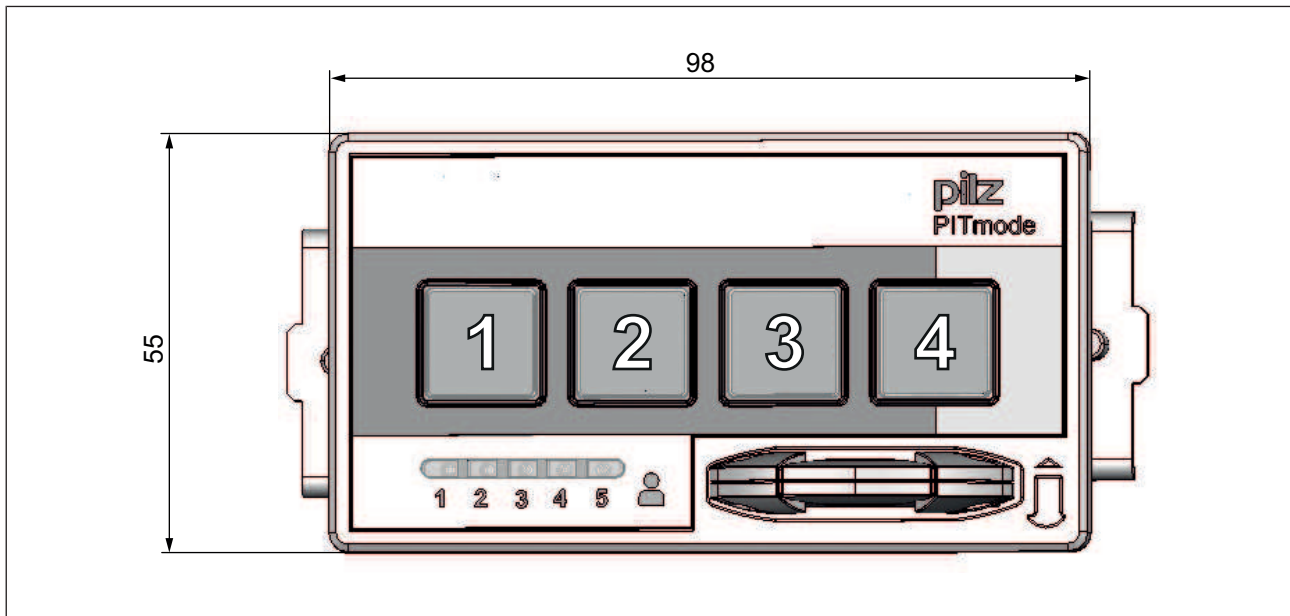
View from below
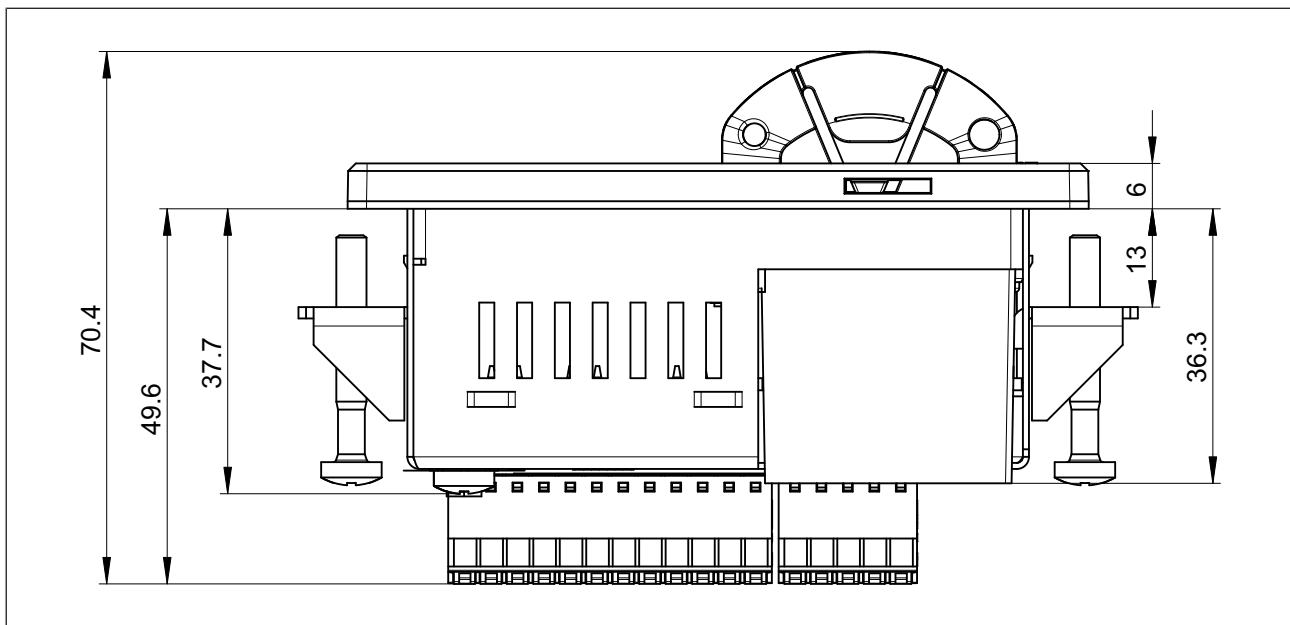
5.3 Mounting cutout
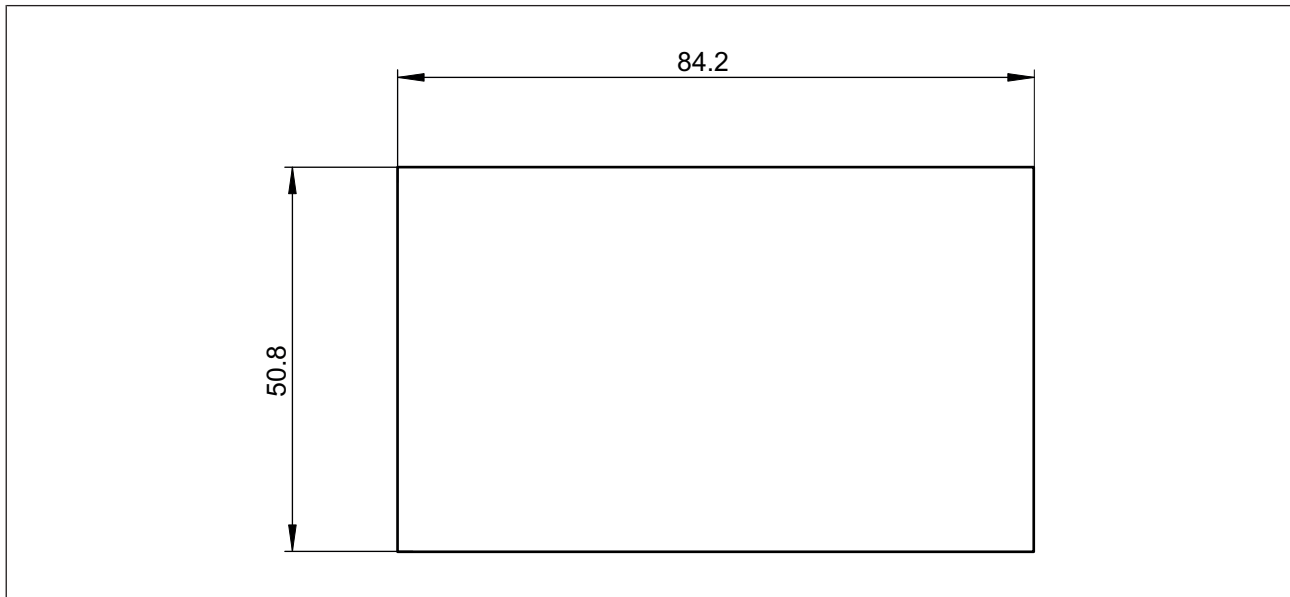
6 Wiring

6.1 Terminal configuration

> **INFORMATION**
>
> The connection terminals are not supplied with the unit.
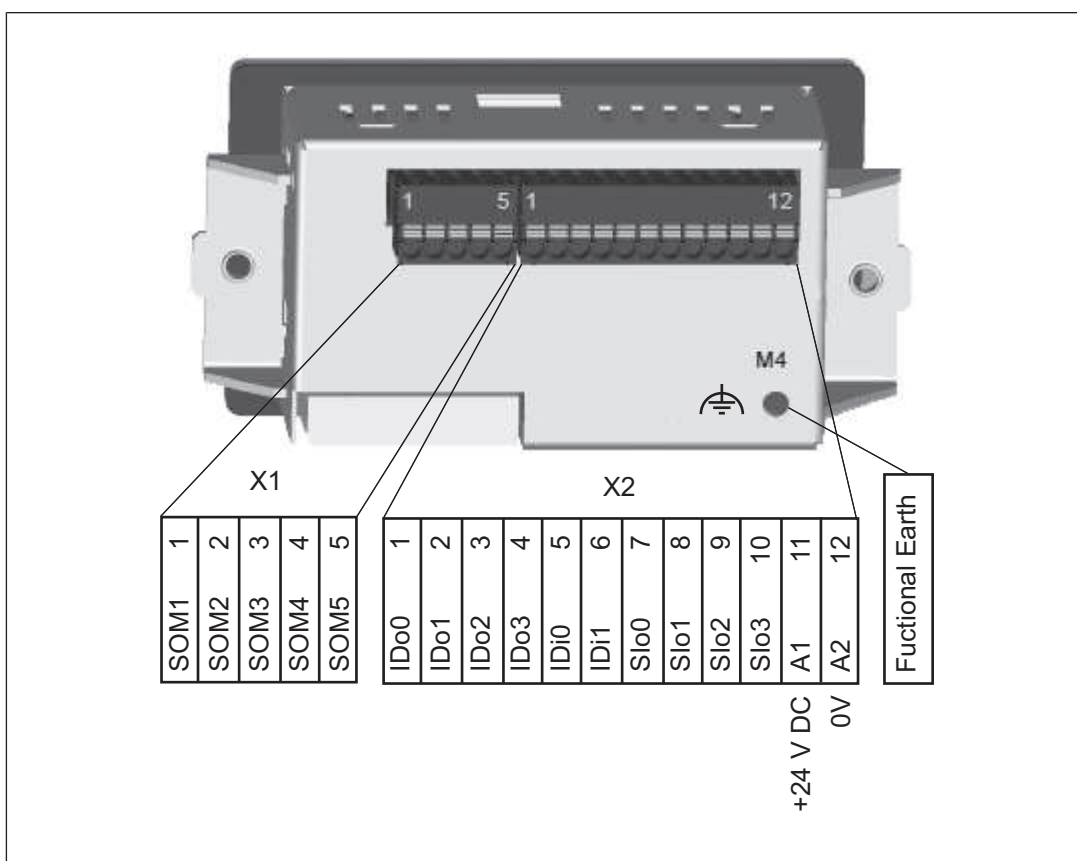
Fig.: Terminal configuration

Legend

SOM1 .. SOM5	Operating mode interface: Monitored semiconductor outputs for the operating modes OM1 … OM5
IDo0 … IDo3	Key ID interface: Semiconductor outputs for sending the output signals to the control system The function of the terminals depends on the communication mode that has been configured.
IDi0 … IDi1	Key ID interface: Inputs for receiving the input signals from the control system The function of the terminals depends on the communication mode that has been configured.
SIo0 … SIo3	Interface for status information Evaluation of status information
A1, A2	Terminals for connecting the supply voltage
⏚	Functional earth

6.2 Connecting the unit

Proceed as follows:

1. Connecting the supply voltage

    ⇨ Connect the supply voltage to (A1, A2).

    Please note the following:
    The power supply must meet the regulations for extra low voltages with protective separation (SELV, PELV).
    The cables for the unit's supply voltage (A1, A2) must be fitted with a 4 A fuse, characteristic B/C.

2. Connecting the operating mode interface's semiconductor outputs

    ⇨ Connect the operating mode interface's semiconductor outputs to a control system that supports "1ooN" evaluation.
    You must read the information concerning intended use (see Intended use [📖 12]).

3. Connecting the interface's terminals for status information

    ⇨ Connect the terminals (SIo0 ... SIo3) to a control system that supports evaluation of the status information.

4. Configure communication mode for downloading the Key ID number

    ⇨ To download the Key ID number in handshake-controlled communication mode, connect terminals IDo3 and IDi1 of the Key ID interface.
    No configuration is required for transmitter-controlled communication mode.

5. Connecting the terminals of the Key ID interface

    ⇨ Depending on the selected communication mode, connect the terminals of the Key ID interface to a control system that supports the download of the Key ID number.

    or

    ⇨ Connect IDo0 to a control system, if all you wish to do in handshake-controlled communication mode is evaluate whether the transponder key is valid/invalid. In this case you will only use IDo0 as a signal output. The unused terminals on the Key ID interface (IDo1, IDo2 and IDi0) may remain unwired ("open").

6.3 Connection to a control system

Depending on the application area and its respective regulations, the operating mode selector switch can be used up to SIL CL 2 (EN IEC 62061) and up to PL d
(EN ISO 13849-1), if the operating modes are evaluated by a safety control system with safe "1oon" evaluation.

The examples below meet the following conditions:

▸ A PNOZ m1p is used as a safety control system.

▸ An "operating mode selector switch" function element is configured in the PNOZmulti Configurator for safe "1oon" evaluation.

▸ The Key ID interface and the interface for status information are evaluated via a higher-level process control system.

▸ The cables for the unit's supply voltage (A1, A2) contain a 4 A fuse, characteristic B/C.

Connection for transmitter-controlled communication mode
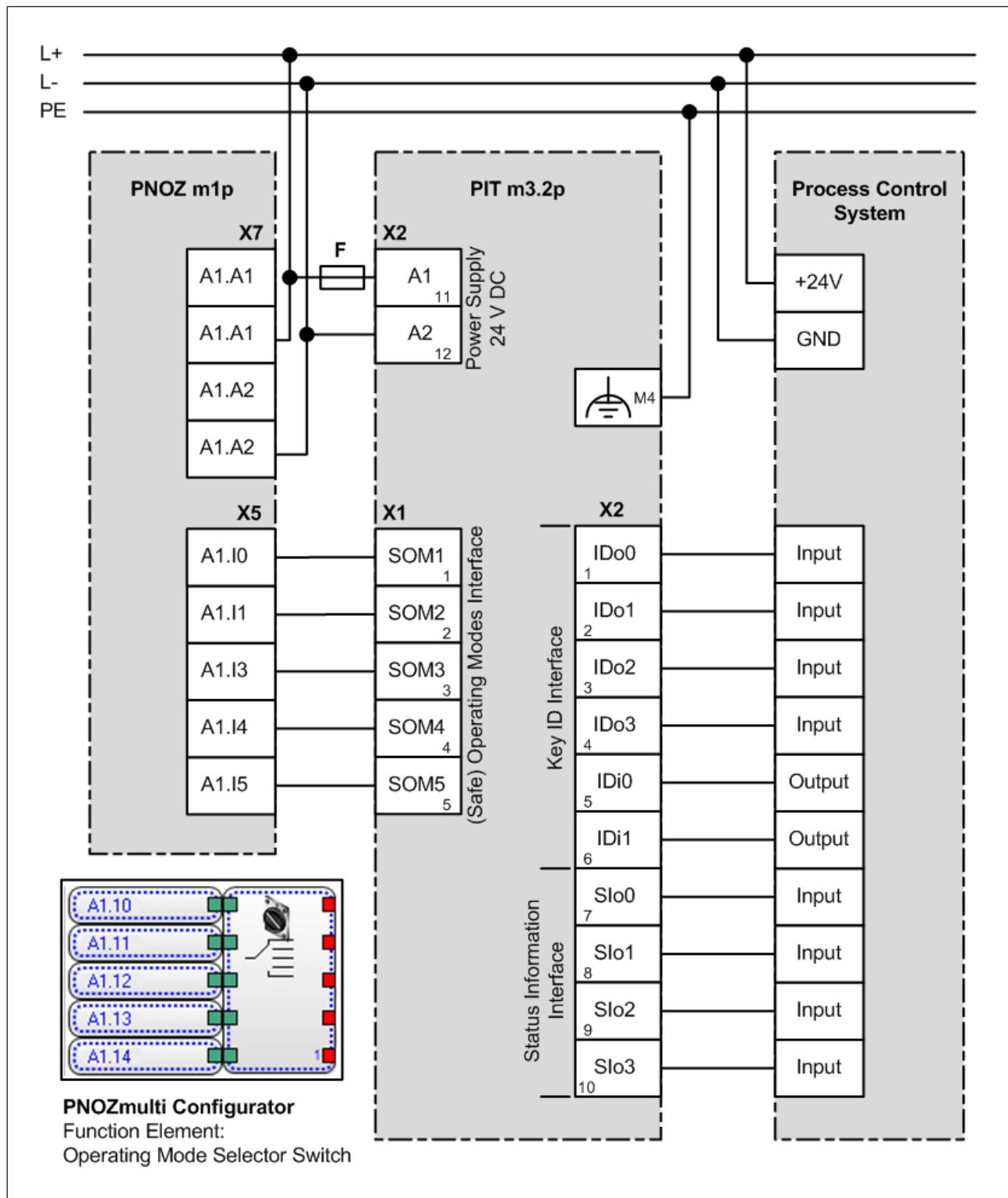
Fig.: Connection for transmitter-controlled communication mode (example)

Connection for handshake-controlled communication mode
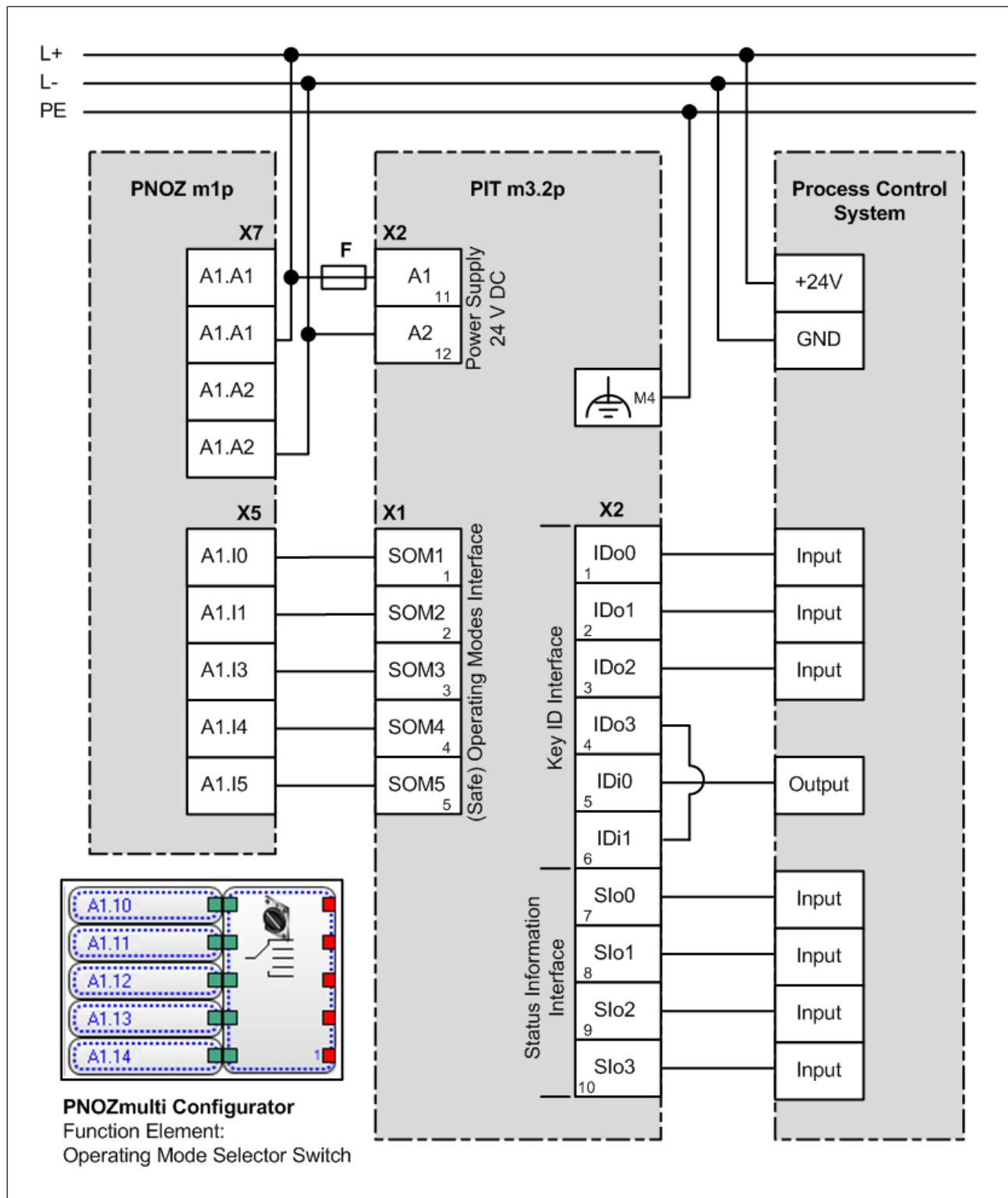
Fig.: Connection for handshake-controlled communication mode (example)

7   Operation

Switch-on behaviour

> **INFORMATION**
>
> After the operating mode selector switch is switched on (Power ON) or after voltage is returned (reset), operating mode OM1 is selected automatically. This also applies if no transponder key is connected, or a transponder key is detected but is invalid.

Behaviour in the event of an error in operating modes OM1 … OM4

> **NOTICE**
>
> In the event of an error, the unit does **not** change operating mode. The active operating mode (OM1, OM2, OM3 or OM4) is displayed via the backlit button and the assigned semiconductor output has a 1 signal.

Behaviour in the event of an error in special operating mode OM5 (Service)

> **NOTICE**
>
> In the event of an error, the unit does **not** change operating mode. Faulty operation is indicated by the fact that all buttons are either all lit or all out. The assigned semiconductor output has a 1 signal.

7.1   Select operating modes OM1 ... BA4

Prerequisites

▶ A transponder key with the relevant authorisations must be present.

▶ The operating mode selector switch must recognise the transponder key as valid.

▶ The transponder key must be present at the operating mode selector switch for the whole time the button is operated.

▶ Several buttons may **not** be operated simultaneously when selecting an operating mode.

Procedure

1. Establish the connection with the transponder key

   ⇨ Insert the transponder key into the slot.
   Note: The transponder key must support the operating mode/operating modes into which you wish to switch. The authorisation display LEDs provide information about the authorisations available with the relevant transponder key (see Control elements [📖 10]).

2. Select operating mode

   ⇨ Select the required operating mode by pressing the relevant button.
   Please note the required operating time (see Monitoring of operating time [📖 50]). The operating mode has been selected correctly if the button is rear lit once it is released.

3. Complete operating mode selection

   ⇨ Complete the operating mode selection by removing the transponder key.
   Once you have removed the transponder key, the operating mode selector switch behaves in accordance with the configuration (see Switch behaviour after a transponder key is removed [📖 25]).

INFORMATION

You can switch at will between the individual operating modes OM1, OM2, OM3 and OM4; i.e. it is possible to switch from OM1 to OM3 or from OM4 to OM2, for example.

7.2   Select special mode (service)

Prerequisites

▶ A transponder key must be available with authorisation for special operating mode OM5 (Service).

▶ The operating mode selector switch must recognise the transponder key as valid.

▶ The transponder key must be present at the operating mode selector switch for the whole time the button is operated.

▶ Several buttons may **not** be operated simultaneously when selecting an operating mode.

Procedure

1. Establish the connection with the transponder key

    ⇨ Insert the transponder key "Key Service" into the slot.
       Note: All authorisation display LEDs must light (see Control elements [📖 10]).

2. Select special mode OM5 (Service)

    ⇨ Press button 1 (OM1).
       Please note the required operating time (see Monitoring of operating time [📖 50]). The operating mode has been selected correctly if all the buttons flash when button 1 is released. The buttons flash for as long as they are in special operating mode OM5 (Service).

3. Complete operating mode selection

    ⇨ Complete the operating mode selection by removing the transponder key. Once you have removed the transponder key, the operating mode selector switch behaves in accordance with the configuration (see Switch behaviour after a transponder key is removed [📖 25]).

ℹ **INFORMATION**

Special operating mode OM5 (Service) can be selected from any of the operating modes.

7.3 Monitoring of operating time

A change of operating modes is only detected if the relevant button has been operated for a defined time period.

Button's operating time

Pushbut-ton	Operating mode	Output	Operating time
1	OM1	SOM1	> 50 ms and < 5 s
2	OM2	SOM2	
3	OM3	SOM3	
4	OM4	SOM4	
1	OM5 (Service)	SOM5	> 5 s and < 10 s

7.4 Switchover delay t1

Once a button has been released, the assigned output on the operating mode interface switches to a "1" signal after the switchover delay t1 has elapsed (see Technical details [54]). This defined switchover delay guarantees that only one operating mode at a time has a "1" signal at the assigned output.
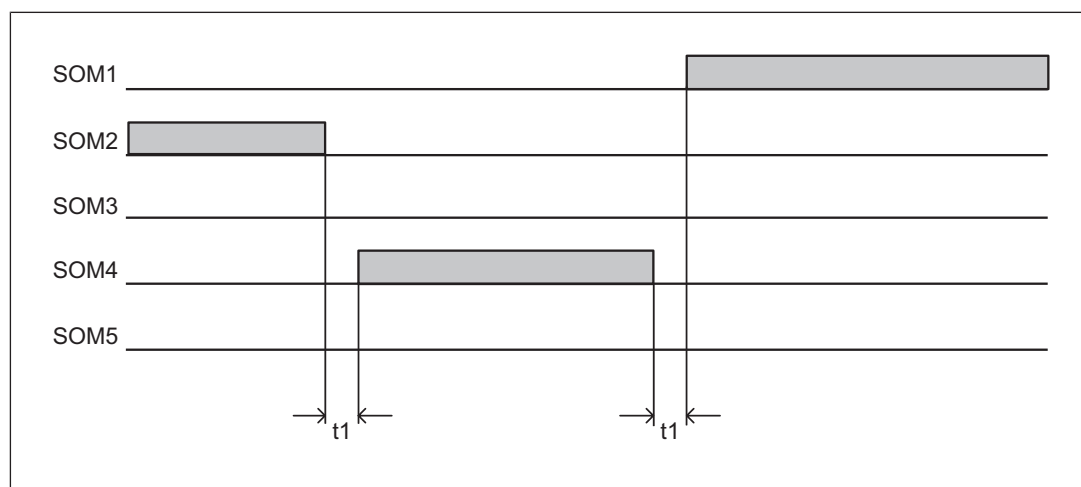
Fig.: Time behaviour when switching operating mode

7.5   Troubleshooting

If an error occurs on the operating mode selector switch, the last operating mode to be set will be retained.

Error	Possible cause	Remedy
Unable to switch the operating mode	Multiple operation of buttons	Make sure that only one button is operated
	Operating time too long or too short	Make sure that the period of operation is observed.
	Transponder key is not detected	Make sure that the transponder key is connected to the operating mode selector switch or inserted correctly.
	No valid authorisation	Make sure that you use a transponder key that has the required authorisation

7.6 Diagnostics

The operating mode selector switch has various options for displaying status information:

▸ Interface for status information (SIo0 … SIo3)

▸ Button backlighting

▸ Authorisation display (LEDs 1 … 5)

7.6.1 Status information about the interface for status information

Various status information can be signalled via the interface for status information (see Block diagram [14]). The status information can be evaluated through a control system (see Interface for status information [16]).

7.6.2 Status information about button backlighting

Pushbuttons 1 … 4 (see Control elements [10]) have pushbutton backlighting. Pushbutton backlighting is used to indicate which operating mode is active; in other words, which output (SOM 1 ... SOM5) has a "1" signal.

Evaluation of pushbutton backlighting

Legend:

☀	LED on
◑	LED flashes
●	LED off

LED pushbutton 1	LED pushbutton 2	LED pushbutton 3	LED pushbutton 4	Meaning
●	●	●	●	▸ No supply voltage
◑	◑	◑	◑	▸ OM 5 (Service) is active ▸ SOM1 has a "1" signal
☀	●	●	●	▸ OM 1 is active ▸ SOM1 has a "1" signal
●	☀	●	●	▸ OM 2 is active ▸ SOM2 has a "1" signal
●	●	☀	●	▸ OM 3 is active ▸ SOM3 has a "1" signal
●	●	●	☀	▸ OM 4 is active ▸ SOM4 has a "1" signal

7.6.3 Status information via authorisation display

If a transponder key is inserted in the slot of the operating mode selector switch, its authorisations are displayed via the authorisation display LEDs (see Control elements [📖 10]).

Evaluation of LED signals

Legend:

☼	LED on
●	LED off

LED	Status	Meaning
All LEDs	●	▸ No transponder key connected or ▸ Authorisation not recognised, or not recognised fully
	☼	Authorisation available for OM1 ... OM5
LED "1"	●	No authorisation for OM1
	☼	Authorisation available for OM1
LED "2"	●	No authorisation for OM2
	☼	Authorisation available for OM2
LED "3"	●	No authorisation for OM3
	☼	Authorisation available for OM3
LED "4"	●	No authorisation for OM4
	☼	Authorisation available for OM4
LED "5"	●	No authorisation for OM5
	☼	Authorisation available for OM5

8 Technical details

General	
Approvals	**CE, FCC, IC, TÜV, cULus Listed**
Sensor's mode of operation	**Transponder**
Transponder interface	
Energy supply to transponder	**passive (battery free)**
Operating frequency	**125 kHz**
Electrical data	
Supply voltage	
Voltage	**24,0 V**
Kind	**DC**
Voltage tolerance	**-15 %/+10 %**
Output of external power supply (DC)	**1,0 W**
Residual ripple DC	**20 %**
Continuous duty	**100 %**
Status indicator	**LED**
Inputs	
Number	**2**
Signal level at "0"	**-3 - +5 V DC**
Signal level at "1"	**15 - 30 V DC**
Voltage at inputs	**24 V DC**
Input current range	**2,0 mA**
Galvanic isolation	**No**
Semiconductor outputs	
Overall performance ext. loading, semiconductor	**3,5 W**
Number of positive-switching single-pole semiconductor outputs	**13**
Switching capability	
Voltage	**24 V**
Current	**20,0 mA**
Signal level at "1"	**UB - 0,5 V DC**
Residual current at "0"	**0,4 mA**
Short circuit-proof	**Yes**
Times	
Switch-on delay	
after UB is applied	**1,0 s**
Supply interruption before de-energisation	**20 ms**
Switchover delay t1	**50 ms**
Operating time pushbutton 1 ... 4	**50 ms ... 5 s**
Operating time, service pushbutton	**5 s ... 10 s**
Environmental data	
Climatic suitability	**DIN IEC 60068-2-3**
Ambient temperature	
Temperature range	**0 - 55 °C**

Environmental data	
Storage temperature	
Temperature range	**-25 - 70 °C**
Climatic suitability	
In accordance with the standard	**EN 60068-2-78**
Humidity	**95 % r. h. at 40 °C**
EMC	**EN 60947-5-1**
Vibration	
In accordance with the standard	**EN 60068-2-6**
Frequency	**10,0 - 55,0 Hz**
Amplitude	**0,35 mm**
Airgap creepage	
In accordance with the standard	**EN 60664-1**
Overvoltage category	**II**
Pollution degree	**2**
Rated insulation voltage	**60 V**
Rated impulse withstand voltage	**0,80 kV**
Protection type	
Mounting area (e.g. control cabinet)	**IP64**
Housing	**IP20**
Terminals	**IP20**
Mechanical data	
Operating distances	
Typical operating distance So	**5,0 mm**
Max. cable length	**1000 m**
Material	
Bottom	**ST + 10µ Zn**
Front	**ABS**
Conductor cross section with screw terminals	
1 core flexible	**0,25 - 1,50 mm², 28 - 16**
Fixing screws torque settings	**0,30 Nm**
Torque setting with screw terminals	**0,25 Nm**
Connection type	**Spring-loaded terminal, plug-in, screw terminal, plug-in**
Conductor cross section with spring-loaded terminals: Flexible with/without crimp connector	**0,20 - 2,50 mm², 24 - 12 AWG**
Spring-loaded terminals: Terminal points per connection	**1**
Stripping length	**9,0 mm**
Dimensions	
Height	**55,0 mm**
Width	**98,0 mm**
Depth	**43,0 mm**
Weight	**160 g**

Where standards are undated, the 2010-02 latest editions shall apply.

8.1 Safety characteristic data

Operating mode	EN ISO 13849-1: 2008 PL	EN ISO 13849-1: 2008 Category	EN 62061 SIL CL	EN 62061 PFH$_D$ [1/h]	IEC 61511 SIL	IEC 61511 PFD	EN ISO 13849-1: 2008 T$_M$ [year]
–	PL d	Cat. 3	SIL CL 2	1,10E-08	SIL 2	5,28E-04	20

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

INFORMATION

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

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9 Supplementary data

9.1 Radio approval

FCC/IC approval

USA/Canada
FCC ID: VT8- PITM3 **IC: 7482A- PITM3** FCC/IC-Requirements: This product complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standards. Operation is subject to the following two conditions: 1) this product may not cause harmful interference, and 2) this product must accept any interference received, including interference that may cause undesired operation. Changes or modifications made to this product not expressly approved by Pilz may void the FCC authorization to operate this equipment. NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Le présent produit est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) le produit ne doit pas produire de brouillage, et (2) l'utilisateur de le produit doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

10 Order reference

10.1 Product

Type	Features	Order no.
PIT m3.2p	Operating mode selector switch	402 230
PIT m3.2p machine tools pic-togram	Operating mode selector switch	402 231

10.2 Accessories

Terminals

Type	Features	Order no.
Spring-loaded terminals	1 set	402 302
Angled screw terminals	1 set	402 303
Screw terminals	1 set	402 305

Transponder key

Type	Features	Order no.
PIT m3 key mode 1	Transponder Key Mode 01	402 211
PIT m3 key mode 2	Transponder Key Mode 02	402 212
PIT m3 key mode 3	Transponder Key Mode 03	402 213
PIT m3 key mode 4	Transponder Key Mode 04	402 214
PIT m3 key service	Transponder Key Service	402 215

▶ Support

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