



PITmode flex

PILZ
THE SPIRIT OF SAFETY

- ▶ Control and signal devices

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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.

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SD means Secure Digital

1	Introduction	5
1.1	Definition of symbols	5
2	Overview of systems for safety-related operating mode selection	6
3	Safety	8
3.1	Intended use	8
3.2	Safety regulations	8
3.2.1	Additional documents that apply	8
3.2.2	Use of qualified personnel	8
3.2.3	Warranty and liability	9
3.2.4	Disposal	9
3.3	Application conditions	9
4	PITmode flex with PNOZmulti	11
4.1	Description	11
4.1.1	System overview	11
4.1.2	Safety features	12
4.1.3	Behaviour when the transponder is removed	13
4.1.4	Acknowledge	13
4.1.5	Lock input	13
4.1.6	Service mode	13
4.2	System expansion	14
4.3	Installation	14
4.3.1	Connect PITreader	14
4.3.2	Connect external pushbuttons and display elements	14
4.4	Configuration	15
4.4.1	Configure PITreader	15
4.4.2	Configure PNOZmulti	15
4.4.2.1	Configure hardware	15
4.4.2.2	Configure connection to the PITreader	15
4.4.2.3	Configure element MSO flex	15
4.4.2.4	Configure safety function	16
4.5	Operation	16
4.5.1	Select mode of safe operation MSO1 ... MSO8	16
4.5.2	Select safe service mode	16
4.5.3	Status and error messages	18
4.6	Examples for PITmode flex with PNOZ m B1	21
4.6.1	Example 1	21
4.6.2	Example 2	21
4.6.3	Example 3	22
5	PITmode flex with PSS 4000	23
5.1	Description	23
5.1.1	System overview	23
5.1.2	Safety features	25
5.1.3	Modes of safe operation	25
5.1.4	Service mode	25

5.1.5	Behaviour when the transponder is removed	25
5.1.6	Acknowledge	26
5.1.7	Lock input	26
5.1.8	Define the behaviour on restart	26
5.2	System expansion	26
5.3	Installation	27
5.3.1	Connect PITreader	27
5.3.2	Connect external pushbuttons and display elements	27
5.4	Configuration and programming	28
5.4.1	Configure PITreader	28
5.4.2	Configure and program safety controller	28
5.4.2.1	Configure hardware	28
5.4.2.2	Configure connection to the PITreader	28
5.4.2.3	Create user program	29
5.5	Operation	31
5.5.1	Select safe mode of operation MSO1 ... MSO8	31
5.5.2	Select service mode of safe operation	32
5.5.3	Pushbutton's operating time	33
5.5.4	Status information at "Output1" ... "Output8"	34
5.5.5	Diagnostics	37
5.6	Examples	38
5.6.1	Example 1: Configuration without Service mode of safe operation	38
5.6.2	Example 2: Evaluation with Service mode of safe operation	38
5.6.3	Example 3: I/O assignment of inputs for pushbuttons	39
5.6.4	Example 4: I/O assignment of outputs for external display elements	41
6	Calculating the safety-related characteristic data	43

1 Introduction

1.1 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 of systems for safety-related operating mode selection

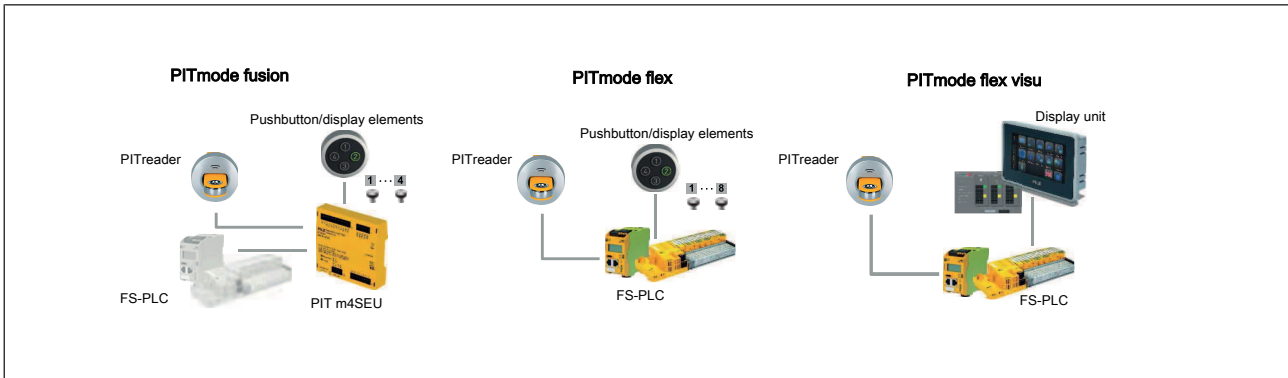


Fig.: Overview of systems for safety-related operating mode selection

PITmode fusion, PITmode flex and PITmode flex visu are systems for the safety-related selection of modes of safe operation (MSO). For example these include operating modes such as automatic, setting, test run, process monitoring and service. In all systems, access restrictions are guaranteed by the authentication system PITreader. Various devices are used to select and evaluate operating modes.

► PITmode fusion

comprises:

- Authentication system PITreader (PITreader Key or PITreader Card)
- Safe evaluation unit PIT m4SEU
- Pushbutton for selecting the operating mode (e.g. PIT oe 4S)
- Display elements for displaying the selected operating mode (as integrated in PIT oe 4S)
- Safety controller to evaluate and activate the selected operating mode

► PITmode flex

comprises:

- Authentication system PITreader (PITreader Key, PITreader Card or PIT gb with PITreader)
- Pushbutton for selecting the operating mode (e.g. PIT oe 4S)
- Display elements for displaying the selected operating mode (as integrated in PIT oe 4S)
- Safety controller to evaluate and activate the selected operating mode e.g. PNOZmulti or the safety controller from the automation system PSS 4000
- Elements/components from Pilz

► PITmode flex visu

comprises:

- Authentication system PITreader (PITreader Key, PITreader Card or PIT gb with PITreader)
- Display unit for selecting and displaying the operating mode
A PASvisu project with the "MSO flex visu" tile is used on the display unit.

- Safety controller to evaluate and activate the selected operating mode e.g. PNOZmulti or the safety controller from the automation system PSS 4000
- Elements/components from Pilz

The chapters that follow describe the system PITmode flex. There are separate documents for the other systems.

3 Safety

3.1 Intended use

PITmode flex is a system for the safety-related selection of modes of safe operation (MSO). For example these include operating modes such as automatic, setting, test run, process monitoring and service. Up to 8 modes of safe operation can be selected with PITmode flex.

With this safety-related selection system, an operating mode is selected safely using a selection device in conjunction with an access device. The access device itself does not fulfil any safety functions.

The system can be used for applications in accordance with

- ▶ EN ISO 13849-1:2015 up to Cat 3, PL d
- ▶ IEC/EN 61508-3:2010 up to SIL 2
- ▶ IEC/EN 62061:2005 + A1:2012 + A2:2015 up to SIL CL 2

3.2 Safety regulations

3.2.1 Additional documents that apply

Read and observe the following documents for the system PITmode flex with PNOZmulti:

- ▶ Operating manual PITreader, operating manual PIT gb RLLE y ETH
- ▶ Operating manuals for the PNOZmulti devices that are used
- ▶ If using PIT oe 4S: Operating manual PIT oe 4S
- ▶ Online Help PNOZmulti Configurator

Read and observe the following documents for the system PITmode flex with PSS 4000:

- ▶ Operating manual PITreader, operating manual PIT gb RLLE y ETH
- ▶ Operating manuals for the applied PSSu modules
- ▶ If using PIT oe 4S: Operating manual PIT oe 4S
- ▶ PAS4000 Online Help

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**

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

3.3 **Application conditions**



WARNING!

Hazardous state due to defective safety function

A failure of the safety function or a defective safety function may mean that the operating mode switches unexpectedly or fails to switch despite a new operating mode being selected.



NOTICE

Note the provisions of the type C standards (machinery safety standards) for the respective application with regard to selection of the mode of operation, such as section 5.2.4 of EN ISO 16090-1 for example.



NOTICE

Design your system so that MSO1 is the safest mode of operation.



NOTICE

The plant should undergo a complete function test after installation and each time the configuration is changed. This inspection may only be carried out by qualified personnel.



NOTICE

Please note:

- The active operating mode must always be visible to the operator.
- The operator must always ensure that the required operating mode is the one that is actually selected.
If the operating mode selected is not the one that is required, the system must be shut down immediately.
- You must check that the required operating mode is selected each time before starting the machine.



NOTICE

Check the following:

- The operator must have sufficient training for the selected operating mode.
- The operating mode displayed after the selection is made must match the operating mode that the operator selected.



NOTICE

The system does not check any interdependencies between the individual working areas.

If you are using more than one working area, check the interdependencies between the working areas and consider these in your customer application before activating the selected MSOs.



CAUTION!

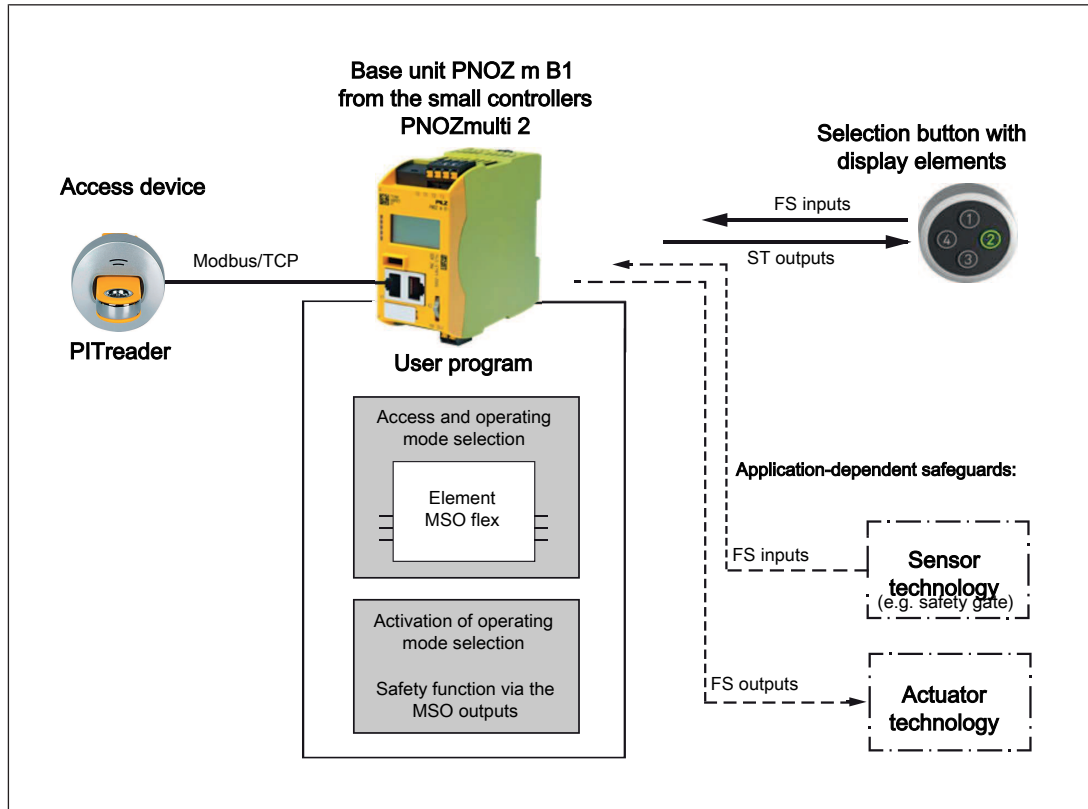
It is essential to note:

- The operating mode may only ever be selected from outside the danger zone
- The selected operating mode itself must not cause the machine to start.
- The operating mode may not be selected while the machine is running.

4 PITmode flex with PNOZmulti

4.1 Description

4.1.1 System overview



PITmode flex is a system for the safety-related selection of modes of safe operation (MSO). For example these include operating modes such as automatic, setting, test run, process monitoring and service. Up to 8 modes of safe operation can be selected with PITmode flex.

With this safety-related selection system, an operating mode is selected safely using a selection device in conjunction with an access device. The access device itself does not fulfil any safety functions.

Hardware and software components for the overall system:

► Access device

The access device consists of the authentication system PITreader with transponder for restricting access. A user can authenticate himself on the PNOZmulti by positioning a transponder on the PITreader, and is thereby authorised for certain actions. The permission on the transponder must be greater than or equal to the selection on the operating mode selector switch (MSO number).

Several PITreader units can be connected to a base unit PNOZ m B1 (see [System expansion](#) [14]).

▶ **Selection device**

The selection device may consist of individual pushbuttons or a keypad. The selection device is used to select the modes of safe operation. Display elements can either be integrated within the selection device or may consist of separate elements. The display elements are used to display the selected mode of safe operation. The selection device must be evaluated on the safety controller.

▶ **Base unit PNOZ m B1 from the system PNOZmulti 2**

The PNOZmulti is used to evaluate and monitor the access and selection device; it is also used for safety-related control of the system's overall safety function, which is application-dependent. A user program must be created in the PNOZmulti Configurator for this purpose.

The MSO flex function element performs the following tasks:

- Reads the checked permission from the PITreader
- Evaluates the keys that are operated
- Outputs display information via the diagnostic bits
- Generates and outputs diagnostic messages
- Outputs the mode of safe operation (MSO)

For the actual activation of the operating mode, the safety functions required for the selected operating mode are subsequently activated, depending on the application and the selected operating mode (e.g. light curtains or safety gates).

4.1.2 Safety features

- ▶ If no data or invalid data is received from the PITreader, the behaviour is the same as if no transponder is present or the transponder has been removed.
- ▶ The operating mode can only be selected under the following conditions:
 - Besides the pushbuttons, a PITreader is connected, a transponder is positioned and the transponder contains the relevant permission.
- or
- The system is configured to automatically switch to the operating mode MSO1 when the transponder is removed.
- ▶ An operating mode can only be selected with the required permission from the assigned PITreader. The permission on the transponder must be greater than or equal to the selection on the operating mode selector switch.
- ▶ Operating mode selection will only be carried out if a pushbutton is operated for a certain time and several pushbuttons are not operated simultaneously.
- ▶ Operating mode 1 is always selected after a restart.
- ▶ While operating the operating mode selector switch, there must be a LOW signal at the inputs "Lock Input" and "Acknowledge".

4.1.3 Behaviour when the transponder is removed

In the PNOZmulti Configurator there are various options to configure the reaction that should occur when the transponder has been removed:

- ▶ Hold mode
The operating mode currently selected is retained.
- ▶ Fall back to mode 1
After the fall back delay (configurable) has elapsed, operating mode 1 will be selected instead of the operating mode currently selected.
- ▶ Fall back to mode 1 on service mode
After the fall back delay (configurable) has elapsed, operating mode 1 will only be selected if a service mode is currently selected. Otherwise, the currently selected operating mode is retained.

The fall back delay time is started when the transponder is removed. If a transponder with appropriate permission is positioned before the fall back delay time elapses, then fall back is prevented.

If **Acknowledge** is configured, the operating mode must also be acknowledged during fall back.

Fall back is prevented while the lock input (configurable) is active.

4.1.4 Acknowledge

As an option, an input on the controller can be used to acknowledge the operating mode selection.

After the selection is confirmed in the display unit, the selected operating mode is not adopted until there is also acknowledgement via the acknowledgement input on the controller.

4.1.5 Lock input

As an option, an input on the controller can be used to lock the operating mode selection.

While there is a high signal at the input configured for the lock input, the lock input is active and the operating mode cannot be changed.

4.1.6 Service mode

There are 2 different configuration options for selecting service mode.


- ▶ "Service mode from" configuration

A maximum of 7 of the 8 operating modes can be configured as service mode. The number of the first service mode is stated; all subsequent operating modes are then automatically service modes.

Operating modes 5 to 8 are configured as service modes in the default setting.

If service modes are configured, the option **Fall back to mode 1 on service mode** should also be selected.

- ▶ "Service mode on input 1 (special mode)" configuration

In this case the pushbutton for operating mode 1 has a double assignment. Either operating mode 1 or service mode is selected, depending on how long it is operated (see [Select safe service mode](#) [ 16]).

On the element, a separate output each is available for operating mode 1 and service mode.

4.2 System expansion

Maximum system expansion for a base unit PNOZ m B1:

- ▶ 4 PITreaders can be connected
- ▶ 10 MSO flex elements can be configured.

4.3 Installation

4.3.1 Connect PITreader

The PITreader is connected to the base unit PNOZ m B1 via an Ethernet cable.

A max. of 4 PITreaders may be connected to a base unit PNOZ m B1.

Please refer to the information and requirements in the operating manual for the PITreader.

4.3.2 Connect external pushbuttons and display elements

You can use components as external pushbuttons and display elements in the following formats:

- ▶ Pushbuttons and display elements as separate components (one display element per pushbutton)
- ▶ Pushbutton with integrated display elements
- ▶ Pushbutton unit (e.g. PIT oe 4S) with up to 8 pushbuttons and integrated display elements

The pushbuttons must have single-channel N/O contacts.

Connect external pushbuttons

Depending on the application you can evaluate up to 8 external pushbuttons to switch to modes of safe operation. Use safe, digital input modules from the PNOZmulti 2 system (e.g. PNOZ m EF 8DI4DO) to connect the pushbuttons to the safety controller. Please refer to the information and technical details stated in the operating manual of the expansion module you are using.

- ▶ Connect the external pushbuttons to the inputs on the PNOZmulti.

Connect external display elements

The states of up to 8 modes of safe operation can be displayed via external display elements (e.g. LEDs, display units) using a logic link to the MSO outputs or via the diagnostic words from PVIS diagnostics (see Online Help for the PNOZmulti Configurator). To connect the display elements to the PNOZmulti you should use either safe digital output modules or digital output modules for standard applications. Please refer to the information and technical details stated in the operating manual of the modules you are using.

- ▶ Connect the external display elements to the outputs on the PNOZmulti.

4.4 Configuration

4.4.1 Configure PITreader

The PITreader is configured using a web application, see PITreader operating manual.

4.4.2 Configure PNOZmulti

4.4.2.1 Configure hardware

Add the following devices to the hardware configuration:

- ▶ Base unit PNOZ m B1,
- ▶ Input and output modules
- ▶ Connected PITreader device

4.4.2.2 Configure connection to the PITreader

- ▶ The connection to the PITreader is established via Modbus/TCP.

The Modbus/TCP Client connection between PNOZmulti and PITreader must be configured in the PNOZmulti Configurator.

Prerequisite

- ▶ PITreader and base unit PNOZ m B1 are connected via an Ethernet cable.
- ▶ A connected PITreader device has been added to the hardware configuration.

Procedure

- ▶ Configure the following network settings for the connection.
To do this, go to the hardware configuration and double-click on the PITreader you wish to configure under **Configured hardware**.
 - **IP address**: Enter the PITreader's IP address. The factory default setting is 192.168.0.12.
 - **Port**: 502

4.4.2.3 Configure element MSO flex

This element is used to evaluate the information from the access device and to evaluate, monitor and acknowledge the operating mode selection.

Add the MSO flex element to the user program and configure:

- ▶ Operating mode 1 ... 8
- ▶ Acknowledge input (optional)
- ▶ Lock input (optional)
- ▶ Service modes
- ▶ Behaviour once the transponder is removed (potentially with fall back delay).

4.4.2.4 Configure safety function

The actual activation of the safety functions required for the selected operating mode may depend on the application (e.g. light curtain or safety gates).

Assign the safety functions required for the various modes of safe operation using outputs *MSO1 ... MSO8*.

4.5 Operation

4.5.1 Select mode of safe operation MSO1 ... MSO8

Prerequisites

- ▶ A transponder with the corresponding permission must be positioned on the PITreader.
- ▶ The PITreader must recognise the transponder as valid.
- ▶ The transponder must be positioned on the PITreader for the whole time a button is operated.
- ▶ Suitable pushbuttons and display elements must be connected.
- ▶ Several pushbuttons may **not** be operated simultaneously when selecting an operating mode.

Procedure

- ▶ Select mode of safe operation

Select the required operating mode by pressing the relevant pushbutton. The pushbutton must be pressed for between 50 ms and 5000 ms.

If "Acknowledge" is configured, the mode of safe operation will not be adopted until the selection is acknowledged (1-signal at "Acknowledge" input).

Please note: A selected but as yet unacknowledged mode of safe operation will be reset to the current mode of safe operation if a 1-signal occurs at the "Lock input" before acknowledgement is received.

The mode of safe operation has been selected correctly when the corresponding display element is lit.



INFORMATION


You can switch at will between the individual operating modes MSO1 ... MSO8; i.e. it is possible to switch from MSO1 to MSO3 or from MSO4 to MSO2, for example.

4.5.2 Select safe service mode

Prerequisites

- ▶ A transponder with the corresponding permission must be positioned on the PITreader.
- ▶ The PITreader must recognise the transponder as valid.
- ▶ The transponder must be positioned on the PITreader for the whole time a button is operated.
- ▶ Suitable pushbuttons and display elements must be connected.

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

The way in which a service mode is selected will vary depending on the configuration in the PNOZmulti Configurator (see [Service mode](#)  13]).

Select service mode when “Service mode from” is configured

With this configuration, an operating mode **2+ ... 8** is selected as service mode. All subsequent operating modes in ascending order will also be defined as service operating modes.

Operating mode 5+ to 8 is configured as the service mode in the default setting.

The option **Fall back to mode 1 on service mode** should also be selected.

Procedure

- ▶ Select mode of safe operation

Select the required operating mode by pressing the relevant pushbutton. The pushbutton must be pressed for between 50 ms and 5000 ms.

If "Acknowledge" is configured, the mode of safe operation will not be adopted until the selection is acknowledged (1-signal at "Acknowledge" input).

Please note: A selected but as yet unacknowledged mode of safe operation will be reset to the current mode of safe operation if a 1-signal occurs at the “Lock input” before acknowledgement is received.

The service mode has been selected correctly when the corresponding display element is lit.

Select service mode when “Service mode on input 1 (special mode)” is configured

In this configuration the button for operating mode 1 has a double assignment. Either operating mode 1 or service mode is selected, depending on how long it is operated. A separate output each is available on the element for the operating modes.

Procedure


- ▶ Select service mode

- Press the button on input 1 for >50 ms to <5000 ms, to select operating mode 1.

- Press the button on input 1 for >5000 ms and <10000 ms, to select service mode.

If "Acknowledge" is configured, the service mode will not be adopted until the selection is acknowledged (1-signal at "Acknowledge" input).

Please note: A selected but as yet unacknowledged service mode will be reset to the current mode of safe operation if a 1-signal occurs at the “Lock input” before acknowledgement is received.

The service mode has been selected correctly when the corresponding display element is lit (see [Connect external pushbuttons and display elements](#)  14]).



INFORMATION

The service mode can be selected from any of the modes of safe operation.

4.5.3 Status and error messages

The status of the operating modes can be displayed using a logic link to the MSO outputs or via the diagnostic words.

2 diagnostic words are available for the element MSO flex. These can be displayed via a display unit. For more information refer to the section on "Diagnostic configuration PVIS" in the Online Help for the PNOZmulti Configurator.


Diagnostic word 1

Bit No.	Description	Cause and remedy
0 ... 7	Outputs operating mode 1 ... 8	For information only, no remedy required.
9	Error in the test pulse wiring	<p>Possible causes:</p> <ul style="list-style-type: none"> ▶ Short between contacts in the input wiring to 24 V or other signal cables <p>Remedy:</p> <ul style="list-style-type: none"> ▶ Ensure that there are no shorts between contacts in the test pulse wiring. ▶ Ensure that the input is wired in accordance with the configuration and circuit diagram. ▶ Contact Pilz.
10	The transponder does not have the required permission	<p>Possible causes:</p> <ul style="list-style-type: none"> ▶ The permission is not greater than or equal to the mode of safe operation that is being selected. <p>Remedy:</p> <p>For information only, no remedy required.</p> <p>Note: The diagnostic message is output for as long as the error is present and for 2 seconds after the error condition has ended.</p>

Bit No.	Description	Cause and remedy
11	Incorrect user entry	<p>Possible causes:</p> <ul style="list-style-type: none"> ▶ Lock input is active ▶ More than one pushbutton was operated simultaneously <p>Note: Prior to a new selection and to reset the diagnostic message, no button may be operated.</p> <ul style="list-style-type: none"> ▶ One of the buttons was operated for longer than 5 s. <p>Remedy:</p> <p>For information only, no remedy required.</p> <p>Note: The diagnostic message is output for as long as the error is present and for 2 seconds after the error condition has ended. The current operating mode is maintained.</p>
12	There is no transponder present.	<p>Possible causes:</p> <ul style="list-style-type: none"> ▶ No transponder positioned on the PITreader ▶ PITreader cannot read the transponder <p>Remedy:</p> <ul style="list-style-type: none"> ▶ Change transponder.
13	The transponder does not have permission (permission = 0)	<p>Possible causes:</p> <ul style="list-style-type: none"> ▶ The transponder does not contain any valid data ▶ The transponder was not assigned any permission for this working area <p>Remedy:</p> <p>For information only, no remedy required.</p>
14	Cannot authenticate because the data from the PITreader is invalid.	<p>Possible causes:</p> <ul style="list-style-type: none"> ▶ Connection to the PITreader is configured incorrectly ▶ Modbus registers are overwritten by another controller <p>Remedy:</p> <p>For information only, no remedy required.</p>

Bit No.	Description	Cause and remedy
15	Communication with the PITreader is interrupted	<p>Possible causes:</p> <ul style="list-style-type: none"> ▶ Cable connection broken between PNOZmulti and PITreader ▶ IP address is configured incorrectly <p>Remedy:</p> <ul style="list-style-type: none"> ▶ Check the connection between the PITreader and the PNOZmulti.

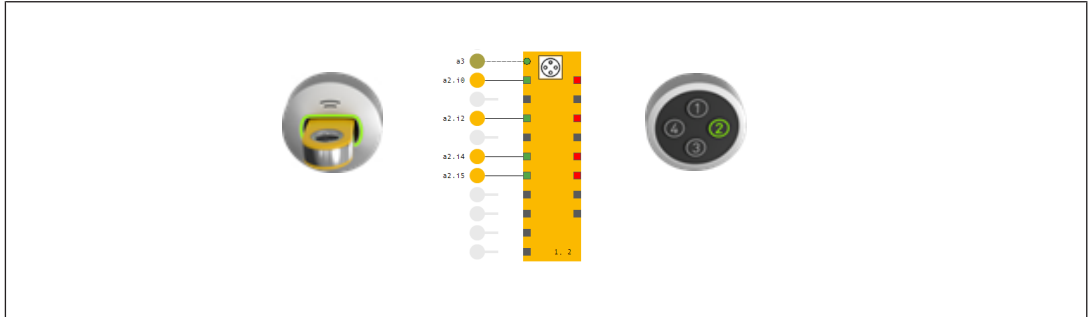
Diagnostic word 2

Bit No.	Description	Cause and remedy
0 ... 7	The controller has not yet acknowledged the selected operating mode 1 ... 8.	<p>Possible causes:</p> <ul style="list-style-type: none"> ▶ The operating mode was changed, but the selection has not yet been acknowledged. <p>Remedy:</p> <p>The diagnostic message is for information purposes only.</p>
10	The controller has not yet acknowledged the selected operating mode.	<p>Possible causes:</p> <ul style="list-style-type: none"> ▶ The operating mode was changed, but the selection has not yet been acknowledged. <p>Remedy:</p> <p>For information only, no remedy required.</p>
11	Operating mode selection is locked	<p>Possible causes:</p> <ul style="list-style-type: none"> ▶ Lock input is active <p>Remedy:</p> <p>For information only, no remedy required.</p>
12	Delay time is running for fall back to mode 1.	<p>For information only, no remedy required.</p> <p>Please also refer to the information under Behaviour when the transponder is removed [ 13]</p>

4.6 Examples for PITmode flex with PNOZ m B1

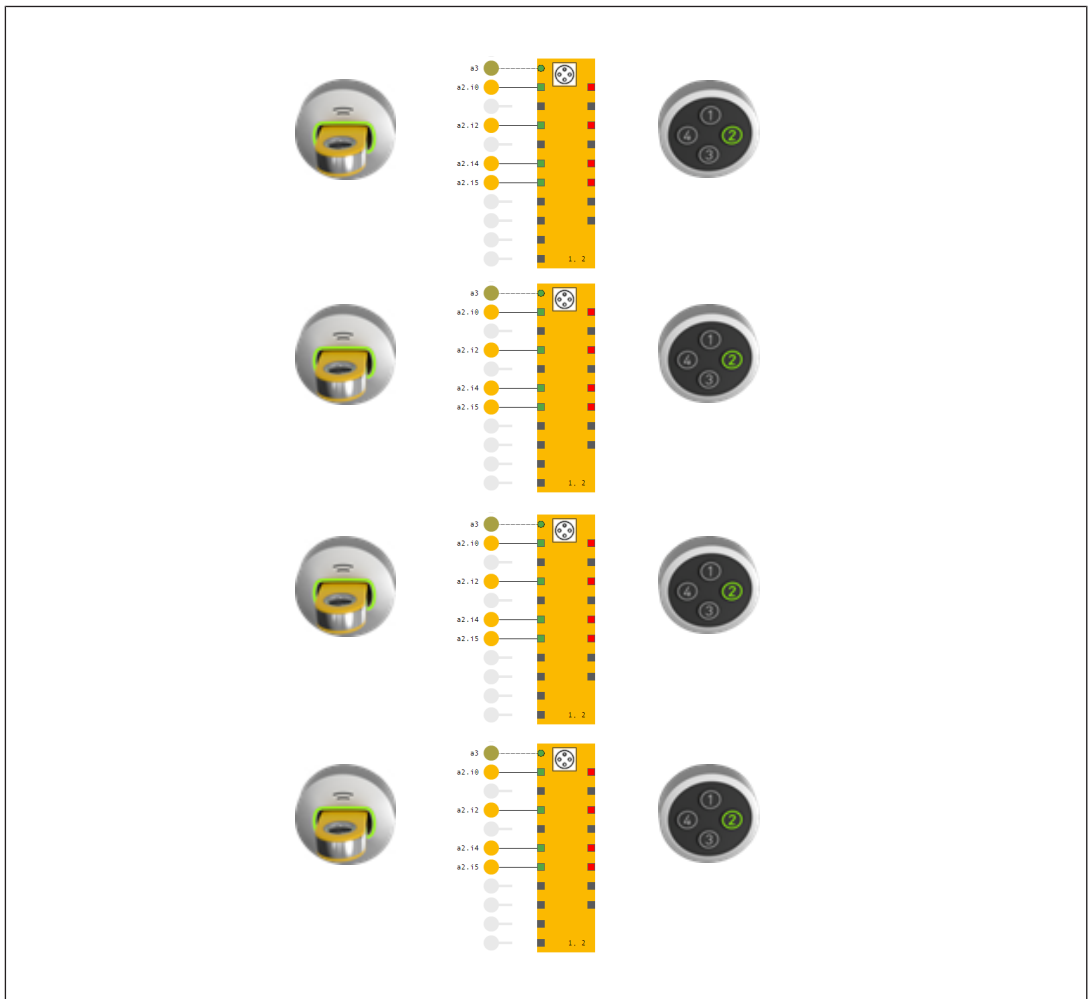
4.6.1 Example 1

1 PITreader with 1 MSO flex element for keypad PIT oe 4S



4.6.2 Example 2

4 PITreaders, each with 1 MSO flex element. Each has 1 keypad PIT oe 4S

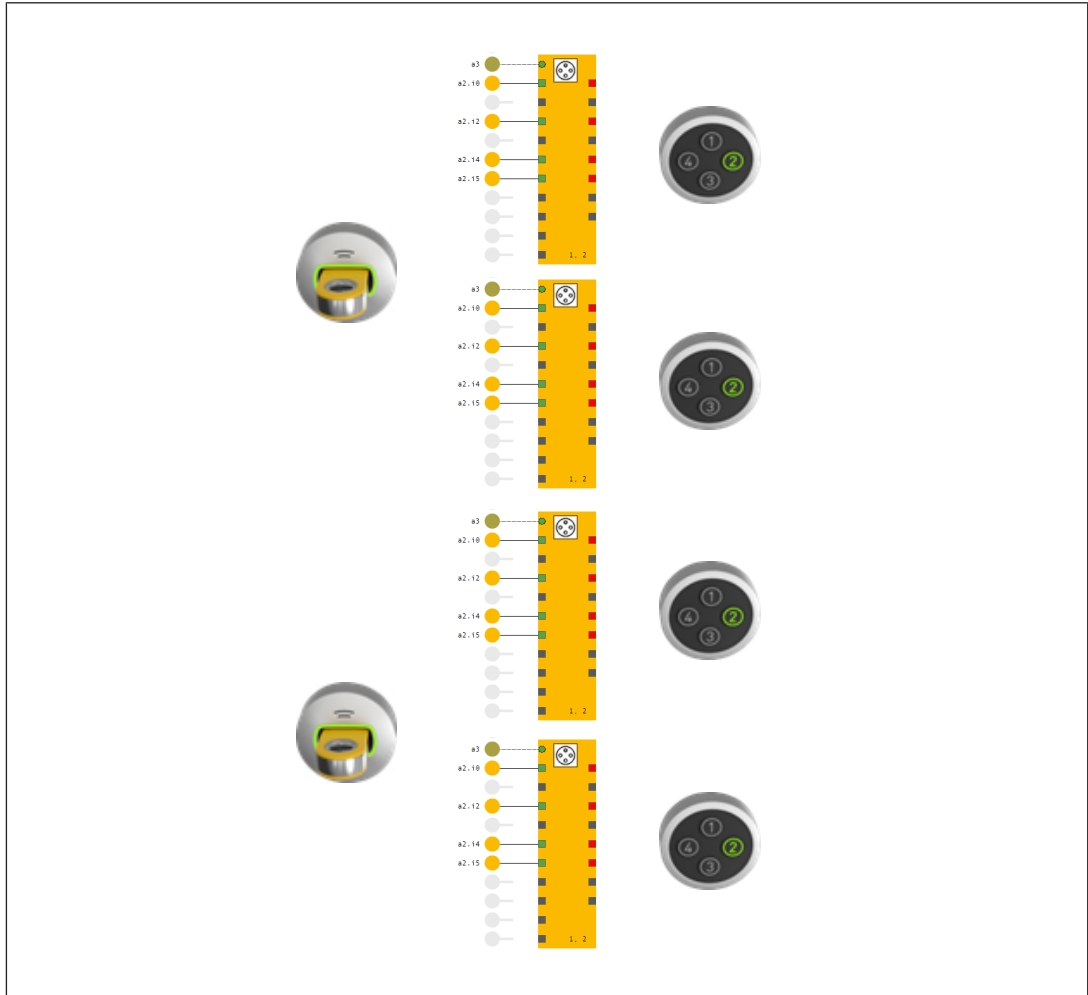


4.6.3

Example 3

2 PITreaders, each with 2 MSO flex elements. Each has 1 keypad PIT or 4S

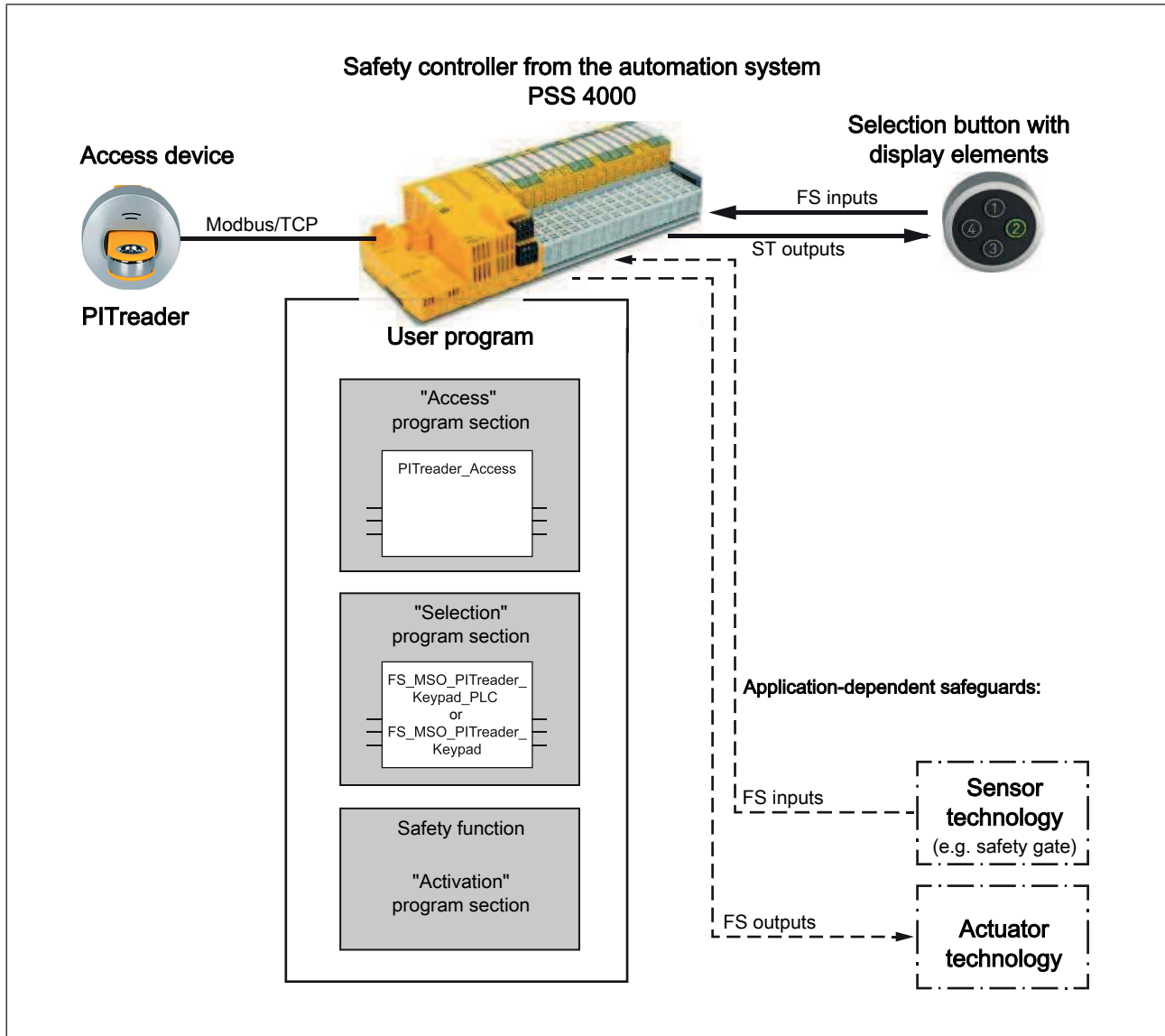
1 PITreader with 2 MSO flex elements for each keypad PIT or 4S



5 PITmode flex with PSS 4000

5.1 Description

5.1.1 System overview




PITmode flex is a system for the safety-related selection of modes of safe operation (MSO). For example these include operating modes such as automatic, setting, test run, process monitoring and service. Up to 8 modes of safe operation can be selected with PITmode flex.

With this safety-related selection system, an operating mode is selected safely using a selection device in conjunction with an access device. The access device itself does not fulfil any safety functions.

Hardware and software components for the overall system:

▶ **Access device**

The access device consists of the authentication system PITreader with transponder for restricting access. A user can authenticate himself on the safety controller by positioning a transponder on the PITreader and is thereby authorised for certain actions. The permission on the transponder must be greater than or equal to the selection on the operating mode selector switch (MSO number).

Several PITreader units can be connected to a safety controller (see [System expansion](#) [ 26]).

▶ **Selection device**

The selection device may consist of individual pushbuttons or a keypad. The selection device is used to select the modes of safe operation. Display elements can either be integrated within the selection device or may consist of separate elements. The display elements are used to display the selected mode of safe operation. The selection device must be evaluated on the safety controller.

▶ **Safety controller from the automation system PSS 4000**

The safety controller is used to evaluate and monitor the access device and selection device, and also for safety-related control of the application-dependent safety function of the overall system. To do this, an application-dependent user program must be created in the safety controller.

The user program generally consists of the following program sections:

– "Access" program section

The information from the access device is evaluated in the "Access" program section. The PITreaderAccess block is required to do this. The current access permission is available as an evaluation result.

– Program section "Selection"

In the "Selection" program section, the result from the "Access" program section is evaluated and the operating mode selected via the selection device is evaluated and monitored. Depending on the application, either the block FS_MS0_PITreader_Keypad or FS_MS0_PITreader_Keypad_PLC is required. If there is sufficient access permission and the selection is correct, the selected operating mode is available as an evaluation result.

– "Activation" program section

The result from the "Selection" program section is evaluated in the "Activation" program section. Depending on the application and the selected operating mode., the safety functions required for the selected operating mode are activated in this program section (light guards or safety gates, for example).

5.1.2 Safety features

- ▶ If no data or invalid data is received from the PITreader, the behaviour is the same as if no transponder is present or the transponder has been removed.
- ▶ The operating mode can only be selected under the following conditions:
 - Besides the pushbuttons, a PITreader is connected, a transponder is positioned and the transponder contains the relevant permission.
- or
- The system is configured to automatically switch to the operating mode MSO1 when the transponder is removed.
- ▶ An operating mode can only be selected with the required permission from the assigned PITreader. The permission on the transponder must be greater than or equal to the selection on the operating mode selector switch.
- ▶ Operating mode selection will only be carried out if a pushbutton is operated for a certain time and several pushbuttons are not operated simultaneously.
- ▶ It is ensured that only one mode of safe operation is selected at a time.
- ▶ When restarting, the block will either output the mode of safe operation 1 (MSO1) or the most recently selected mode of safe operation, depending on the configuration.

5.1.3 Modes of safe operation

The overall system enables the selection of up to 8 safe operating modes. You can configure the number of required operating modes.

5.1.4 Service mode

The overall system enables the selection of up to 8 safe operating modes. A maximum of 1 out of the 8 operating modes can be configured as service mode. If the relevant permission is present, the service operating mode can be selected by operating the pushbutton 1 for a longer period.

5.1.5 Behaviour when the transponder is removed

The behaviour when the transponder is removed is configurable. The following options are available:

- ▶ Hold mode
The operating mode currently selected is retained.
- ▶ Fall back to mode 1
After the fall back delay (configurable) has elapsed, operating mode 1 will be selected.
- ▶ Fall back to mode 1 on service mode
After the fall back delay (configurable) has elapsed, operating mode 1 is selected if service mode is currently selected. If not, the currently selected operating mode is retained.

The fall back delay time is started when the transponder is removed. If a transponder with appropriate permission is positioned before the fall back delay time elapses, then fall back is prevented.

If "Acknowledge" is configured, the operating mode must also be acknowledged during fall back.

Fall back is prevented while the lock input (configurable) is active.

5.1.6 Acknowledge

As an option, a confirmation can be configured for the operating mode selection.

The selected operating mode is taken only when the confirmation has been made via the reset input of the safety controller.

5.1.7 Lock input

As an option, a lock can be configured for the operating mode selection.

If a high signal is at the input of the safety controller for the lock input, the lock input is active and the operating mode cannot be changed.

5.1.8 Define the behaviour on restart

The behaviour on control system restart (switch on supply voltage) is configurable. The following options are available:

- ▶ The safe operating mode 1 is output.
- ▶ The last internally saved safe operating mode is output.

5.2 System expansion

Maximum system expansion for a safety controller of the PSS 4000 automation system:

- ▶ PSS 4000 device with IP connections system section
- ▶ The maximum number of PITreaders that can be connected to a safety controller depends on the maximum number of IP connections that a safety controller can manage. Please also refer to the information on IP connections in the PAS4000's online help.

5.3 Installation

5.3.1 Connect PITreader

The PITreader is connected to the safety controller from the automation system PSS 4000 via an Ethernet cable. Please refer to the information and requirements in the operating manual for the PITreader.

5.3.2 Connect external pushbuttons and display elements

You can use components as external pushbuttons and display elements in the following formats:

- ▶ Pushbuttons and display elements as separate components (one display element per pushbutton)
- ▶ Pushbutton with integrated display elements
- ▶ Pushbutton unit with up to 8 pushbuttons and integral display elements (PIT or 4S with 4 pushbuttons and integral display elements, for example)

The pushbuttons must have single-channel N/O contacts.

Connect external pushbuttons

Depending on the application you can evaluate up to 8 external pushbuttons to switch to modes of safe operation. To connect the pushbuttons to the safety controller, use digital FS input modules (e.g. PSSu E F 4DI). Please refer to the information and technical details stated in the operating manual of the respective FS input module.

- ▶ Connect the external pushbuttons to the FS inputs on the safety controller.

Connect external display elements

Depending on the application, the block can be used to display the states of up to 8 safe operating modes using external display elements (e.g. LEDs). Use either digital FS output modules or digital ST output modules (e.g. PSSu E F 4DO 0.5, PSSu E S 4DO 0.5) to connect the display elements to the safety controller. Please refer to the information and technical details stated in the operating manual of the FS/ST output module you are using.

- ▶ Connect the external display elements to the ST or FS outputs of the safety controller.

5.4 Configuration and programming

5.4.1 Configure PITreader

The PITreader is configured using a web application, see PITreader operating manual.

5.4.2 Configure and program safety controller

All the configurations and the user program creation are made in PAS4000.

5.4.2.1 Configure hardware

In the PAS4000 Project Manager, add the following devices under **Hardware configuration**:

- ▶ PSS 4000 device (e.g. PSSu) of the PSS 4000 performance class PLC.
- ▶ Input and output modules

5.4.2.2 Configure connection to the PITreader

The connection to the PITreader is established via Modbus/TCP.

In PAS4000, a Modbus/TCP Client connection between the safety controller and PITreader must be configured in a PSS 4000 project.

Prerequisite

- ▶ PITreader and safety controller are connected via an Ethernet cable.

Procedure

- ▶ Open the IP Connections Editor in PAS4000.
- ▶ Create a new Modbus/TCP Client connection.
- ▶ Configure the following network settings for the connection:
 - **Remote IP address**: Enter the PITreader's IP address. The factory default setting is 192.168.0.12.
 - **Local port number**: 0
 - **Remote port number**: 502
 - **Unit-ID**: 255
 - **Keep alive settings**: Deactivate checkbox
 - **Connection timeout**: Activate checkbox
 - **Connection cycles**: 10
 - **Connection cycle time**: Activate checkbox "Calculate automatically"
- ▶ Configure the following data settings for the connection:
 - **Function code**: Read Input Register 3x
 - Start address and data length for receive:
 - **Start address**: 24
 - **Data length**: 14

5.4.2.3 Create user program

Please note the following when creating the user program:

▶ Resource assignment of the user program

Assign the user program to a task on the FS resource.

▶ Reaction times

– The general statements on the reaction times in the PSS 4000 system description or in the PAS4000 online help apply.

– We recommend that you configure a task cycle time < 50 ms. This is the only way to guarantee an error-free activation of the display elements.

▶ Create and call up the "Access" program section

In the "Access" program section, the access device (PITreader) must be evaluated using the PITreaderAccess block.

– Create an instance of the PITreaderAccess block for the access device.

– Call up the block instance of PITreaderAccess before the instances of the selection block FS_MS0_PITreader_Keypad or FS_MS0_PITreader_Keypad_PLC; that is, call up the program section "Access" before the program section "Selection".

▶ Create and call up "Selection" program section

In the program section "Selection" the operating mode must be evaluated and monitored, depending on the application, with the block FS_MS0_PITreader_Keypad or FS_MS0_PITreader_Keypad_PLC.

– For operating mode selection create either an instance of block FS_MS0_PITreader_Keypad or of FS_MS0_PITreader_Keypad_PLC.

– Depending on the application, configure the I-variables *NumberOfMSO*, *EnableServiceMSO*, *ServiceMSO*, *StoredMSO_AtStartup*, *MSO_AtKeyRemoval*, *FallbackDelayTime*. Further information on the I-variables can be found in the block description in the section "Input interface" (see online help of PAS4000).

NumberOfMSO: Specify the number of modes of safe operation that are to be available for selection.

EnableServiceMSO and *ServiceMSO*: Specify whether a service mode is to be used, and which MSO the service mode is to be.

StoredMSO_AtStartup: When the safety controller is restarted, specify whether MSO1 is to be selected or the last mode of safe operation to be active before switching off.

MSO_AtKeyRemoval: Determine the behaviour when the transponder is removed.

FallbackDelayTime: If necessary, enter a value for the fall back delay time when the transponder is removed.

Note: The values at the named I-variables must already be present and correct the first time the block instance is called.

▶ I-variable *Permission*

Assign the I-variable *Permission* from the block instance of the FS_MS0_PITreader_Keypad or FS_MS0_PITreader_Keypad_PLC with the O-variable *Permission* from the block instance of PITreaderAccess.

▶ I-variables *Acknowledge* and *Lock*

The assignment of the I-variables *Acknowledge* and *Lock* is optional.

- You can lock the selection completely using *Lock*.
- You can use *Acknowledge* to ensure that any new selection that is made only becomes valid once any process that is still active has been completed. If you do not need this function, assign the I-variable *Acknowledge* with a high signal.


▶ Transfer of the selected operating mode to the "Activation" program section

The safety functions required for the selected operating mode (e.g. light guards or safety gates) must actually be activated in the "Activation" program section, depending on the application.

- After the "Selection" program section, call up the "Activation" program section.
- In the "Activation" program section, assign the safety functions required for the various modes of safe operation with the O-variables *MSO1* ... *MSO8*. The O-variables must form the enable for the actuators together with the safety functions.

▶ I/O mapping

The I/O assignment must be made in the I/O Mapping Editor of PAS4000.

- Assign the I/O variables to the inputs and outputs where the external pushbuttons and display elements are connected. Further information on I/O assignment can be found under [Examples](#) [ 38].

5.5 Operation


5.5.1 Select safe mode of operation MSO1 ... MSO8

Prerequisites

- ▶ A transponder with the corresponding permission must be positioned on the PITreader.
- ▶ The PITreader must recognise the transponder as valid.
- ▶ The transponder must be positioned on the PITreader for the whole time a button is operated.
- ▶ Suitable pushbuttons and display elements must be connected.
- ▶ Several pushbuttons may **not** be operated simultaneously when selecting an operating mode.

Procedure

- ▶ Select mode of safe operation

Select the required mode of operation by pressing the relevant pushbutton. The pushbutton must be pressed for between 50 ms and 5 ms (see [Pushbutton's operating time](#) [ 33]).

Note:

- Acknowledgement (*Acknowledge*) was configured:
The selected but not yet acknowledged mode of safe operation is accepted as soon as the selection is acknowledged (I-variable *Acknowledge* = TRUE).
- Lock input (*Lock*) and acknowledgement (*Acknowledge*) were configured:
The selected but not yet acknowledged mode of safe operation is reset to the current mode of safe operation if the I-variable *Lock* = TRUE prior to acknowledgement.

The mode of safe operation has been selected correctly when the corresponding display element is lit.



INFORMATION

You can switch at will between the individual modes of operation MSO1 ... MSO8; i.e. it is possible to switch from MSO1 to MSO3 or from MSO4 to MSO2, for example.


5.5.2 Select service mode of safe operation

Prerequisites

- ▶ A transponder with the corresponding permission must be positioned on the PITreader.
- ▶ The PITreader must recognise the transponder as valid.
- ▶ The transponder must be positioned on the PITreader for the whole time a button is operated.
- ▶ Suitable pushbuttons and display elements must be connected.
- ▶ Several pushbuttons may **not** be operated simultaneously when selecting an operating mode.
- ▶ The service operating mode was enabled via the FS_MSO_PITreader_Keypad(_PLC) block (I-variable *EnableServiceMSO*) and an output (*MSO1 ... MSO8*) for the service operating mode was specified (I-variable *ServiceMSO*), depending on the application.

Procedure

- ▶ Select service mode

Operate pushbutton T1 (MSO1). The pushbutton must be pressed for between 5 s and 10 s (see [Pushbutton's operating time](#) [ 33]).

Note:

- Acknowledgement (*Acknowledge*) was configured:
The selected but not yet acknowledged mode of safe operation is accepted as soon as the selection is acknowledged.
- Lock input (*Lock*) and acknowledgement (*Acknowledge*) were configured:
The selected but not yet acknowledged mode of safe operation is reset to the current mode of safe operation if the lock input is activated prior to acknowledgement.

The mode of operation has been selected correctly if all the display elements flash when pushbutton 1 is released. The display elements flash for as long as they are in service mode.



INFORMATION

Service mode can be selected from any of the modes of safe operation.

5.5.3 Pushbutton's operating time

A switch to a different mode of operation is only detected if the relevant pushbutton has been operated for the required time period.

I-variable or I-PI variable	Operating mode	O-variable	Operating time
<i>Input1</i>	MSO1	<i>MSO1</i>	>50 ms and ≤5 s
	MSO-Service	Prerequisite: The service operating mode has been activated (<i>EnableServiceMSO</i>). Note: The relevant O-variable <i>MSO1 ... MSO8</i> depends on the configuration (<i>ServiceMSO</i>)	>5 s and ≤10 s
<i>Input2</i>	MSO2	<i>MSO2</i>	>50 ms and ≤5 s
<i>Input3</i>	MSO3	<i>MSO3</i>	
<i>Input4</i>	MSO4	<i>MSO4</i>	
<i>Input5</i>	MSO5	<i>MSO5</i>	
<i>Input6</i>	MSO6	<i>MSO6</i>	
<i>Input7</i>	MSO7	<i>MSO7</i>	
<i>Input8</i>	MSO8	<i>MSO8</i>	

5.5.4 Status information at "Output1" ... "Output8"

The O-variables *Output1* ... *Output8* are designed to activate display elements (e.g. LEDs) to provide visual feedback to the operator. The O-variables can be used to show what operating mode is active.



INFORMATION

When using the FS_MSO_PITreader_Keypad, the O-PI variables *Output1_PI* ... *Output8_PI* can be used as an alternative to the O-variables *Output1* ... *Output8*. The status information at the O-variables and O-PI variables is identical.

Example of evaluating the display elements without service mode





The status information at the O-variables is explained using the following example.

The following configuration applies for this example:

- ▶ *EnableServiceMSO* = FALSE; no service mode
- ▶ *NumberOfMSO* = 4; it is possible to switch between 4 modes of operation (*Input1* ... *Input4*).
- ▶ Acknowledgement is used (I-variable *Acknowledge*)

Note: The status information is shown via the display elements, which in this example are activated via the O-variables *Output1* ... *Output4*.

Legend

-  "Static 1-signal" state (*Output<x>* = TRUE)
Meaning: Display on
-  FLASHING state
Meaning: Display flashes at 1 Hz and 50% duty cycle
-  QUICK FLASHING state
Meaning: Display flashes quickly at 1 Hz and 5% duty cycle
-  "Static 0-signal" state (*Output<x>* = FALSE)
Meaning: Display off

LED at Output1	LED at Output2	LED at Output3	LED at Output4	Meaning
●	●	●	●	<ul style="list-style-type: none"> ▶ No supply voltage ▶ When the safety controller is reset (switch on supply voltage)
☀	●	●	●	<ul style="list-style-type: none"> ▶ MSO1 is active; i.e. MSO1 is the current selected and acknowledged mode of safe operation ▶ O-variable <i>MSO1</i> = TRUE ▶ O-variable <i>Output1</i> = TRUE
●	☀	●	●	<ul style="list-style-type: none"> ▶ MSO2 is active; i.e. MSO2 is the current selected and acknowledged mode of safe operation ▶ O-variable <i>MSO2</i> = TRUE ▶ O-variable <i>Output2</i> = TRUE
●	●	☀	●	<ul style="list-style-type: none"> ▶ MSO3 is active; i.e. MSO3 is the current selected and acknowledged mode of safe operation ▶ O-variable <i>MSO3</i> = TRUE ▶ O-variable <i>Output3</i> = TRUE
●	●	●	☀	<ul style="list-style-type: none"> ▶ MSO4 is active; i.e. MSO4 is the current selected and acknowledged mode of safe operation ▶ O-variable <i>MSO4</i> = TRUE ▶ O-variable <i>Output4</i> = TRUE
☀	☀	●	●	<ul style="list-style-type: none"> ▶ MSO1 is the current active mode of operation ▶ MSO2 was selected but not yet acknowledged, (O-variable <i>SelectedMSO</i> = 2, <i>Acknowledge</i> = TRUE expected) ▶ O-variable <i>MSO1</i> = TRUE ▶ O-variable <i>Output1</i> = TRUE ▶ O-variable <i>MSO2</i> = FALSE
☀	●	●	⚡	<ul style="list-style-type: none"> ▶ MSO1 is the current active mode of operation ▶ An operating error was detected while switching to the mode of operation MSO4 (e.g. <i>DiagUserInputIncorrect</i> = TRUE, <i>DiagPermissionDenied</i> = TRUE). ▶ O-variable <i>MSO1</i> = TRUE ▶ O-variable <i>Output1</i> = TRUE ▶ O-variable <i>MSO4</i> = FALSE

Example of evaluating the display elements with service mode

The status information at the O-variables is explained using the following example.





The following configuration applies for this example:







- ▶ *EnableServiceMSO* = TRUE; service mode available

- ▶ *ServiceMSO* = 4; service mode is controlled via the O-variable *MSO4*.
- ▶ Acknowledgement is used (I-variable *Acknowledge*)
- ▶ *NumberOfMSO* = 4; it is possible to switch between modes of operation MSO1, MSO2, MSO3 and service mode.

Note: The status information is shown via the display elements, which in this example are activated via the O-variables *Output1* ... *Output3*. Service mode is displayed via a light pattern and not via O-variable *Output4*. *Output4* is always in a “static 0-signal” state.

Legend

-  "Static 1-signal" state (*Output<x>* = TRUE)
Meaning: Display on
-  FLASHING state
Meaning: Display flashes at 1 Hz and 50% duty cycle
-  QUICK FLASHING state
Meaning: Display flashes at 1 Hz and 5% duty cycle
-  "Static 0-signal" state (*Output<x>* = FALSE)
Meaning: Display off

LED at <i>Output1</i>	LED at <i>Output2</i>	LED at <i>Output3</i>	Meaning
●	●	●	<ul style="list-style-type: none"> ▶ No supply voltage ▶ When the safety controller is reset (switch on supply voltage)
	●	●	<ul style="list-style-type: none"> ▶ MSO1 is active; i.e. MSO1 is the current selected and acknowledged mode of safe operation ▶ O-variable <i>MSO1</i> = TRUE ▶ O-variable <i>Output1</i> = TRUE
●		●	<ul style="list-style-type: none"> ▶ MSO2 is active; i.e. MSO2 is the current selected and acknowledged mode of safe operation ▶ O-variable <i>MSO2</i> = TRUE ▶ O-variable <i>Output2</i> = TRUE
●	●		<ul style="list-style-type: none"> ▶ MSO3 is active; i.e. MSO3 is the current selected and acknowledged mode of safe operation ▶ O-variable <i>MSO3</i> = TRUE ▶ O-variable <i>Output3</i> = TRUE
			<ul style="list-style-type: none"> ▶ Service mode is active; i.e. MSO4 is the current selected and acknowledged mode of safe operation ▶ O-variable <i>MSO4</i> = TRUE

LED at Output1	LED at Output2	LED at Output3	Meaning
			<ul style="list-style-type: none"> ▶ MSO1 is the current active mode of operation ▶ Service mode was selected but not yet acknowledged (O-variable <i>SelectedMSO</i> = 4, <i>Acknowledge</i> = TRUE expected). ▶ O-variable <i>MSO1</i> = TRUE ▶ O-variable <i>Output1</i> = TRUE ▶ O-variable <i>MSO4</i> = FALSE
			<ul style="list-style-type: none"> ▶ Service mode is the current active mode of operation. ▶ Mode of operation MSO1 was selected but not yet acknowledged. [1]: The O-variable <i>Output1</i> is in FLASHING state with a 180° phase shift to <i>Output2</i> and <i>Output3</i>. ▶ O-variable <i>MSO1</i> = FALSE ▶ O-variable <i>MSO4</i> = TRUE
			<ul style="list-style-type: none"> ▶ MSO1 is the current active mode of operation ▶ An operating error was detected while switching to the mode of operation MSO3 (e.g. <i>DiagUserInputIncorrect</i> = TRUE, <i>DiagPermissionDenied</i> = TRUE). ▶ O-variable <i>MSO1</i> = TRUE ▶ O-variable <i>Output1</i> = TRUE ▶ O-variable <i>MSO3</i> = FALSE

5.5.5 Diagnostics

You find the descriptions of diagnostic information at the O-variables *Diag...* in the block descriptions (Online help of PAS4000). Detailed information on system diagnostics and process diagnostics can also be found in the online help for PAS4000.

5.6 Examples

5.6.1 Example 1: Configuration without Service mode of safe operation

The following is valid for the example:

- ▶ Using the block FS_MSO_PITreader_Keypad_PLC
- ▶ Configuration without service operating mode: *EnableServiceMSO* = FALSE
- ▶ Configuration for 8 safe operating modes: *NumberOfMSO* = 8

Variable		Meaning
I-variable	<i>Input1</i>	Assignment with the signal from pushbutton 1
	... <i>Input8</i>	... Assignment with the signal from pushbutton 8
O-variable	<i>Output1</i>	Output for display element 1 of safe operating mode 1
	... <i>Output8</i>	... Output for display element 8 of safe operating mode 8
	<i>MSO1</i>	Output for the safe operating mode MSO1
	... <i>MSO8</i>	... Output for the safe operating mode MSO8

5.6.2 Example 2: Evaluation with Service mode of safe operation

The following is valid for the example:

- ▶ Using the block FS_MSO_PITreader_Keypad
- ▶ Using the O-PI variable for activating the display elements
- ▶ Configuration with service mode: *EnableServiceMSO* = TRUE
- ▶ Configuration for 5 modes of safe operation: *NumberOfMSO* = 5
- ▶ Configuration of the output *MSO3* for service mode: *ServiceMSO* = 3
- ▶ Fall back to the mode of safe operation MSO1 after the delay time has elapsed when the transponder is removed, when service mode is selected: *MSO_AtKeyRemoval* = 2

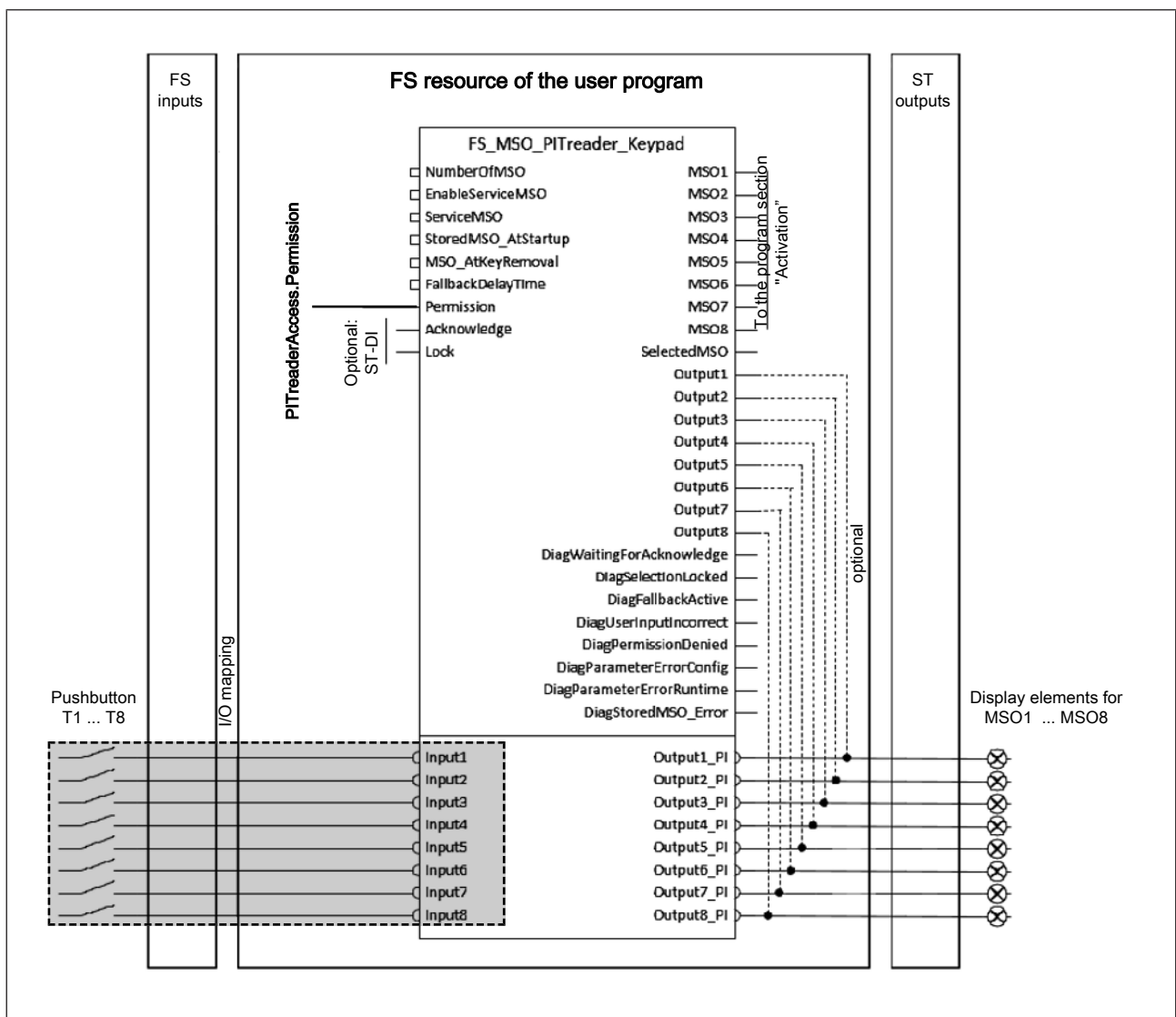
I-PI variable	O-PI variable	O variable <i>MSO<x></i>	Meaning
<i>Input1:</i> Assignment with pushbutton 1	<i>Output1_PI:</i> Output for display element 1 (only for MSO1)	<i>MSO1</i> (only for MSO1)	Switching to the operating mode MSO1 or to service mode is performed depending on the operating time of pushbutton 1 (see Pushbutton's operating time [33])
<i>Input2:</i> Assignment with pushbutton 2	<i>Output2_PI:</i> Output for display element 2	<i>MSO2</i>	Operating mode MSO2 is switched with pushbutton 2.
<i>Input3 is not assigned</i>	<i>Output3_PI always carries "static O-signal"</i>	<i>MSO3</i>	<i>MSO3</i> is the output for safe service mode. Service mode is displayed via a light pattern.

I-PI variable	O-PI variable	O variable MSO<x>	Meaning
<i>Input4:</i> Assignment with pushbutton 3	<i>Output4_PI:</i> Output for display element 3	MSO4	Operating mode MSO4 is switched with pushbutton 3.
<i>Input5:</i> Assignment with pushbutton 4	<i>Output5_PI:</i> Output for display element 4	MSO5	Operating mode MSO5 is switched with pushbutton 4.

5.6.3 Example 3: I/O assignment of inputs for pushbuttons

In the example 8 external pushbuttons are connected to the FS inputs of input modules. This means that 8 safe operating modes can be selected. The FS inputs are assigned to the I-PI variables *Input1* ... *Input8*.

The example uses the block FS_MSOPITreader_Keypad.



Prerequisites

- ▶ Use of 2 FS input modules PSSu E F 4 DI for connection to 8 external pushbuttons
- ▶ Configuration for 8 safe operating modes: *NumberOfMSO* = 8
- ▶ Configuration without service operating mode: *EnableServiceMSO* = FALSE

Procedure

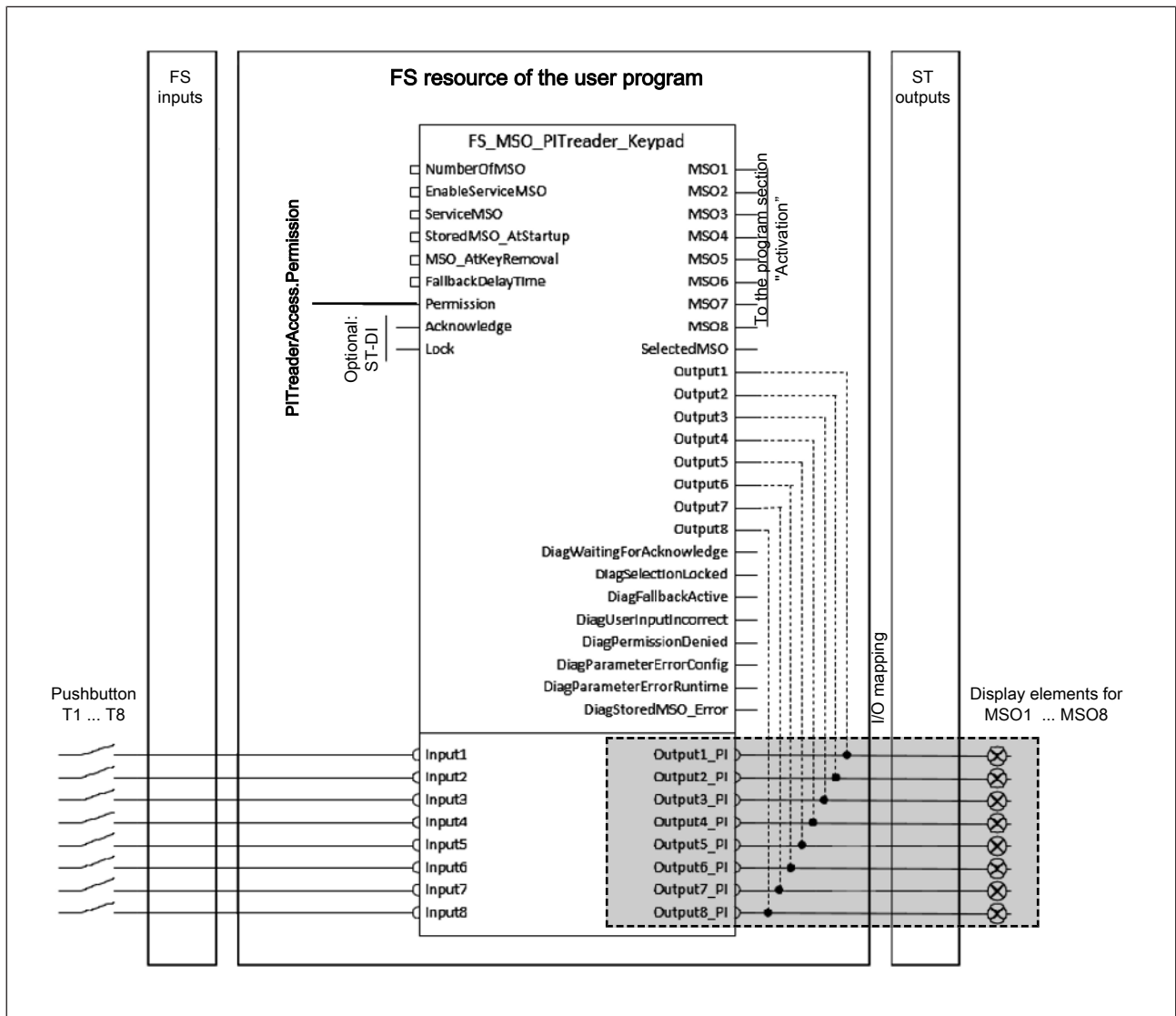
- ▶ In the I/O editor the I-PI variables *Input1* ... *Input8* must be mapped to the inputs of the FS input module where the pushbuttons are connected.

Overview:

Pushbutton	FS input module e.g. PSSu E F 4 DI	I-PI variable (block)	Meaning
T1	Module 1: I0	<i>Input1</i>	I/O mapping for operating mode MSO1
T2	Module 1: I1	<i>Input2</i>	I/O mapping for operating mode MSO2
T3	Module 1: I2	<i>Input3</i>	I/O mapping for operating mode MSO3
T4	Module 1: I3	<i>Input4</i>	I/O mapping for operating mode MSO4
T5	Module 2: I0	<i>Input5</i>	I/O mapping for operating mode MSO5
T6	Module 2: I1	<i>Input6</i>	I/O mapping for operating mode MSO6
T7	Module 2: I2	<i>Input7</i>	I/O mapping for operating mode MSO7
T8	Module 2: I3	<i>Input8</i>	I/O mapping for operating mode MSO8

5.6.4 Example 4: I/O assignment of outputs for external display elements

In the example 8 external display elements are connected to the ST outputs of output modules. The ST outputs are assigned to the O-PI variables *Output1_PI ... Output8_PI*. The example uses the block *FS_MSO_PITreader_Keypad*.



Prerequisites

- ▶ Connection and I/O assignment of 8 external pushbuttons for selecting the safe operating modes
- ▶ Use of 2 ST output modules PSSu E S 4DO 0.5 for activating 8 external display elements
- ▶ Configuration for 8 safe operating modes: *NumberOfMSO* = 8
- ▶ Configuration without service operating mode: *EnableServiceMSO* = FALSE

Procedure

- ▶ In the I/O Mapping Editor the O-PI variables *Output1_PI ... Output8_PI* must be assigned to the outputs of the ST output module where the display elements are connected.

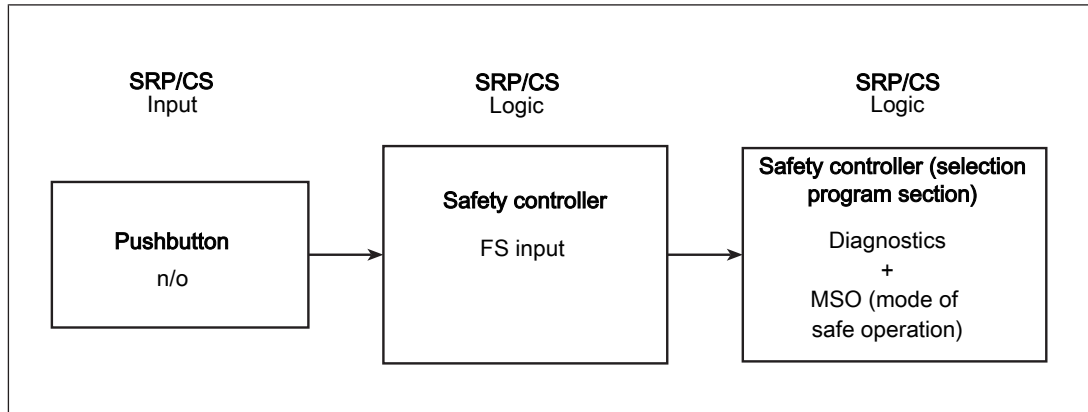
Overview:

Operating mode	Output module for example PSSu E S 4DO 0.5	O-PI variable (block)	Meaning
MSO1	Module 1: O0	<i>Output1_PI</i>	I/O mapping for the display element of the operating mode MSO1
MSO2	Module 1: O1	<i>Output2_PI</i>	I/O mapping for the display element of the operating mode MSO2
MSO3	Module 1: O2	<i>Output3_PI</i>	I/O mapping for the display element of the operating mode MSO3
MSO4	Module 1: O3	<i>Output4_PI</i>	I/O mapping for the display element of the operating mode MSO4
MSO5	Module 2: O0	<i>Output5_PI</i>	I/O mapping for the display element of the operating mode MSO5
MSO6	Module 2: O1	<i>Output6_PI</i>	I/O mapping for the display element of the operating mode MSO6
MSO7	Module 2: O2	<i>Output7_PI</i>	I/O mapping for the display element of the operating mode MSO7
MSO8	Module 2: O3	<i>Output8_PI</i>	I/O mapping for the display element of the operating mode MSO8

6 Calculating the safety-related characteristic data

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

Safety-related architecture, "Pushbutton" subsystem and "Selection" program section



INFORMATION

In accordance with EN ISO 13849-1, the following parameters may be applied for the external pushbuttons with N/O contact:

- ▶ For the "operating mode selection" safety function it is sufficient for a safety level to be calculated for just one pushbutton.
- ▶ Cat. 2 can be estimated for the pushbutton subsystem; the following conditions are met:
 - Demand rate = Test rate (1 to 1) – Testing occurs immediately upon demand of the safety function and the overall time to detect the fault and to bring the machine to a non-hazardous condition is shorter than the time to reach the hazard.
 - $MTTF_{D,TE}$ (Test equipment) > $0.5 \cdot MTTF_{D,L}$ (Logic)
- ▶ DC 90 % (shorts between contacts in the wiring are also detected)
- ▶ Measures against CCF (min. score of 65 in accordance with Table F.1 (EN ISO 13849-1) can be considered to have been fulfilled if the user can confirm that the items marked "Customer" have been fulfilled (see table below).

No.	Measures against CCF	Score	Confirmed by
1	Physical separation between signal paths, for example: <ul style="list-style-type: none"> ▶ separation in wiring/piping; ▶ detection of short circuits and open circuits in cables by dynamic test; ▶ separate shielding for the signal path of each channel; ▶ sufficient clearances and creepage distances on printed-circuit boards. 	15	Pilz
3.1	Protection against over-voltage, over-pressure, over-current, over-temperature, etc.	15	Customer
6.1	For electric/electronic systems, prevention of contamination and electromagnetic disturbances (EMC) to protect against common cause failures in accordance with appropriate standards (e.g. IEC 61326-3-1). Fluidic systems: filtration of the pressure medium, prevention of dirt intake, drainage of compressed air, e.g. in compliance with the component manufacturers' requirements concerning purity of the pressure medium. NOTE: For combined fluidic and electric systems, both aspects should be considered.	25	Pilz
6.2	Other influences: Consideration of the requirements for immunity to all relevant environmental influences such as, temperature, shock, vibration, humidity (e.g. as specified in relevant standards).	10	Customer
	Total	65	

Extract from Table F.1 (EN ISO 13849-1)

- ▶ The user must provide the following data:
 - The pushbutton must meet Cat. B
 - To calculate the $MTTF_D$ of the pushbutton:
 - B_{10D} value
 - n_{op} (average number of operations per year) of the pushbutton



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.



INFORMATION

The number of pushbutton operations n_{op} (average number of operations per year) is a maximum of half the operating mode changes that are anticipated because, as a maximum, the same pushbutton is operated only every second change of operating mode.

► Support

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PILZ
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