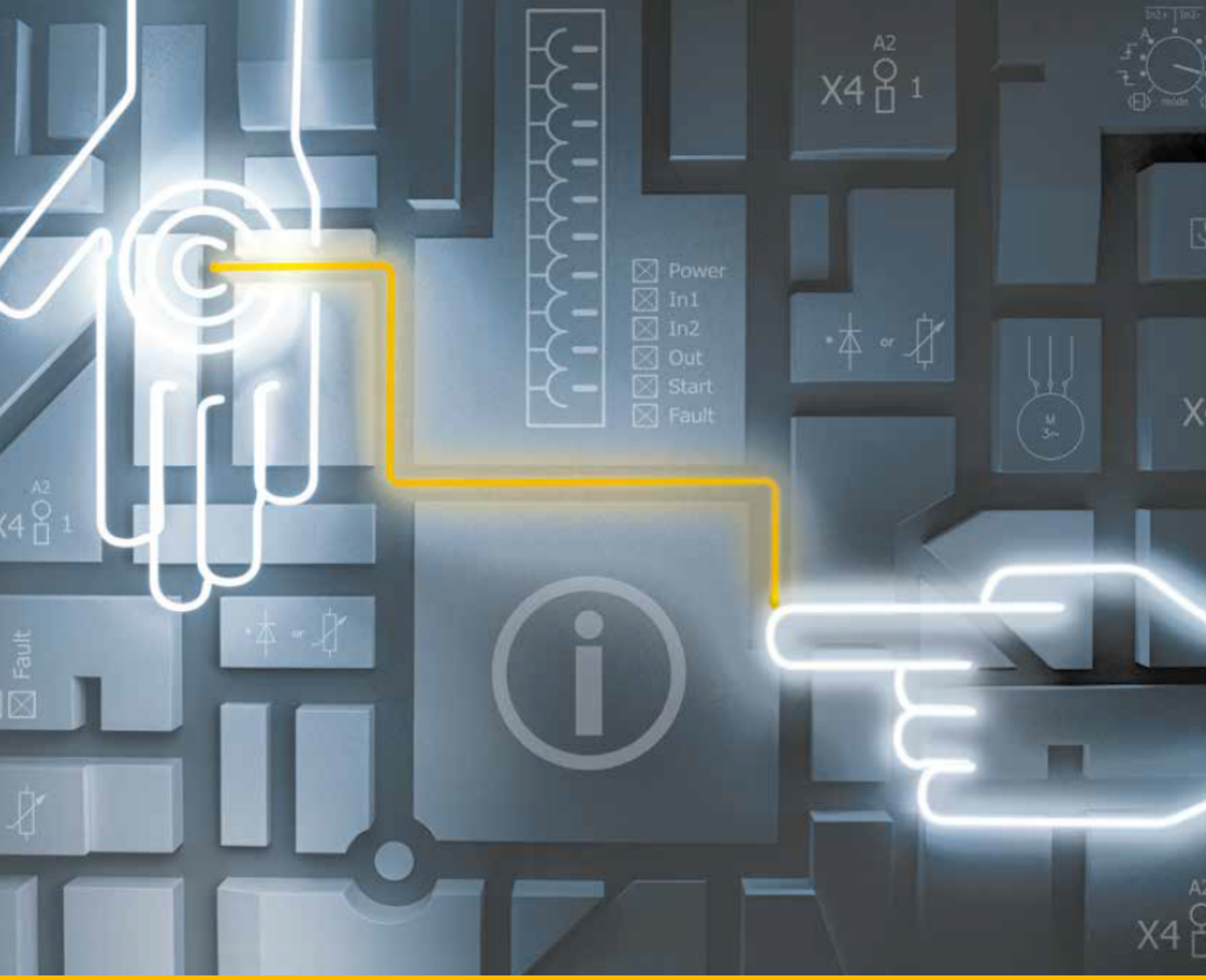


PITmode flex visu

PILZ
THE SPIRIT OF SAFETY

System Description-1005364-EN-09
- Control and signal devices




This document is the original document.

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

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 the systems for safety-related operating mode selection

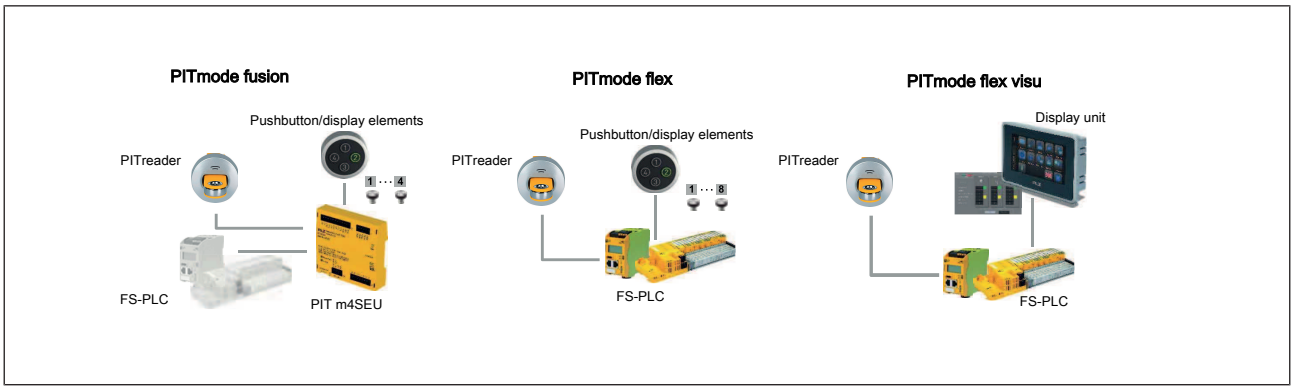


Fig.: Overview of the systems for safety-related operating mode selection

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

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, setup, 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**
  Consists of:
  - 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**
  Consists of:
  - Authentication system PITreader (PITreader Key, PITreader Card, PIT gb with PITreader Key or PIT gb with PITreader Card)
  - 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**
  A distinction is made between PITmode flex visu Pilz and PITmode flex visu Custom

PITmode flex visu Pilz consists of:

– Authentication system PITreader (PITreader Key, PITreader Card, PIT gb with PITreader Key or PIT gb with PITreader Card)

– Visualisation software PASvisu from Pilz for selecting and displaying the operating mode

  To select and display the operating mode, the visualisation software PASvisu from Pilz is used on an appropriate display unit from Pilz or from any manufacturer. The "MSO flex visu" tile is used in a PASvisu project.

– 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 Custom consists of:

– Authentication system PITreader (PITreader Key, PITreader Card, PIT gb with PITreader Key or PIT gb with PITreader Card)

– Visualisation software for selecting and displaying the operating mode

  To select and display the operating mode, an appropriate visualisation software package from any manufacturer can be used on an appropriate display unit from Pilz or from any manufacturer. It is the customer’s responsibility to provide an appropriate display unit and to create or provide a customised visualisation application.

– 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

Further information is available under Requirements of an appropriate visualisation system [📖 59].

3 Safety

3.1 Intended use

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

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.

When using display units from Pilz in conjunction with the visualisation software PASvisu from Pilz, the following display units from Pilz are equipped for safety-related operating mode selection:

- PMI v704e, order number 266704
- PMI v707e, order number 266707
- PMI v807, order number 266807
- PMI v812, order number 266812
- PMI v815, order number 266815

When using display units from a third-party manufacturer in conjunction with the visualisation software PASvisu from Pilz, a 64 Bit version of the Microsoft Windows operating system must be installed on the display unit. Further information can be found in the PASvisu Readme.

When using PITmode flex visu Custom, the customised visualisation application must meet various requirements (see Requirements of an appropriate visualisation system [📖 59]).

The system can be used for applications in accordance with

- EN ISO 13849-1:2023 up to Cat 4, PL e
- EN IEC 61508-3:2010 up to SIL 3
- EN IEC 62061:2021 up to max. SIL 3

3.2 Safety regulations

3.2.1 Additional documents that apply

Please read and take note of the following documents for the system PITmode flex visu with PNOZmulti:

- Operating manual PITreader (1004806), operating manual PIT gb with PITreader (1005249)
- Operating manual PMI v704e/707e (1003980), operating manual PMI v807/v812/v815 (1005199)
- Operating manuals for the PNOZmulti devices you are using
- PNOZmulti Configurator Online Help
- Online Help PASvisu Builder

Please read and take note of the following documents for the system PITmode flex with PSS 4000:

- Operating manual PITreader (1004806), operating manual PIT gb with PITreader (1005249)
- Operating manual PMI v704e/707e (1003980), operating manual PMI v807/v812/v815 (1005199)
- Operating manuals for the applied PSSu modules
- PAS4000 Online Help
- Online Help PASvisu Builder

3.2.2 Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, decommissioned and maintained 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. In order to inspect, assess and handle products, devices, systems, plant and machinery, this person must be familiar with 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, such as the 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

Document:

- Which transponders (Security ID) are assigned to the respective users. This means that activities can be documented on a personalised basis.
- Which working area for safety-related operating mode selection is assigned to which machine safety system, e.g. infeed, processing, outfeed.
  Further information on the working areas is available under Working areas [📖 20] for PNOZmulti and under Working areas [📖 39] for PSS 4000.

NOTICE

When using PITmode flex visu Pilz for safety-related operating mode selection, only the display units listed under Intended use [📖 9] may be used for visualisation.

NOTICE

Note the provisions of the type C standards (machinery safety standards) for the respective application with regard to operating mode selection, 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

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.
- After an operating mode has been selected, the safety functions must not be switched while the machine is running.

Please also note:

- Visualisation software PASvisu
  - With PIT mode flex visu Pilz, the PASvisu Server must be on the display unit and not on an external device. The PASvisu Client is pre-installed on the documented display units from Pilz.
  - When using PITmode flex visu Custom with an appropriate display unit from a third-party manufacturer and the visualisation software PASvisu from Pilz, both the PASvisu Server and the Visu Client must be installed on the same display unit.
- The working area must be unique within a Modbus/TCP network and may not be assigned twice.
- If you need more than 10 working areas, the connected Modbus/TCP network must be segmented (e.g. using firewalls).

For the system PITmode flex visu with PNOZmulti please note:

- PITmode flex visu Pilz
  - The visualisation software PASvisu from Pilz must be used for selecting and displaying the operating mode. A PASvisu project must be created for safe operating mode selection. The "MSO flex visu" tile is used in the PASvisu project. The PASvisu project can be run on an appropriate display unit from Pilz or from any manufacturer.
  - A separate MSO flex visu element must be configured in the PNOZmulti project for each working area. Exactly one "MSO flex visu" tile must be available for this element in the PASvisu project. The PASvisu project may be run on exactly one display unit. Particular care must be taken if remote access to the display unit is possible. The PASvisu project may contain tiles for several working areas. However, all working areas must be visible from the display unit.
  - You will need to ensure that the PASvisu project matches the PNOZmulti project. Changes must be made on both sides.
- PITmode flex visu Custom
  - An appropriate visualisation software package from any manufacturer can be used to select and display the operating mode. It is the customer’s responsibility to use the visualisation software to create or provide an appropriate customised visualisation application. The visualisation application can be run on an appropriate display unit from Pilz or from any manufacturer.
  - A separate MSO flex visu element must be configured in the PNOZmulti project for each working area. Exactly one evaluation logic must be available for this element in the customer’s visualisation. Each working area may be run on exactly one display unit. Particular care must be taken if remote access to the display unit is possible. The customer visualisation may contain evaluation logics for multiple working areas. However, all working areas must be visible from the display unit.
  - You will need to ensure that the evaluation logic for the customer visualisation matches the PNOZmulti project. Changes must be made on both sides.

For the system PITmode flex visu with PSS 4000 please note:

- PITmode flex visu Pilz
  - The visualisation software PASvisu from Pilz must be used for selecting and displaying the operating mode. A PASvisu project must be created for safe operating mode selection. The "MSO flex visu" tile is used in the PASvisu project. The PASvisu project can be run on an appropriate display unit from Pilz or from any manufacturer.
  - A separate instance of the block FS_MSO_PITreader_Visu must be used and configured in the PSS 4000 project for each working area. Just one "MSO flex visu" tile must be available for this instance of the block in the PASvisu project. The PASvisu project may be run on exactly one display unit. Particular care must be taken if remote access to the display unit is possible. The PASvisu project may contain tiles for several working areas. However, all working areas must be visible from the display unit.
  - You must ensure that the PASvisu project matches the PSS 4000 project. Changes must be made on both sides.
- PITmode flex visu Custom
  - An appropriate visualisation software package from any manufacturer can be used to select and display the operating mode. It is the customer’s responsibility to use the visualisation software to create or provide an appropriate customised visualisation application. The visualisation application can be run on an appropriate display unit from Pilz or from any manufacturer.
  - A separate instance of the block FS_MSO_PITreader_Visu must be used and configured in the PSS 4000 project for each working area. Exactly one evaluation logic must be available for this block instance in the customer’s visualisation. Each working area may be run on exactly one display unit. Particular care must be taken if remote access to the display unit is possible. The customer visualisation may contain evaluation logics for multiple working areas. However, all working areas must be visible from the display unit.
  - You will need to ensure that the evaluation logic for the customer visualisation matches the PSS 4000 project. Changes must be made on both sides.

4 Security

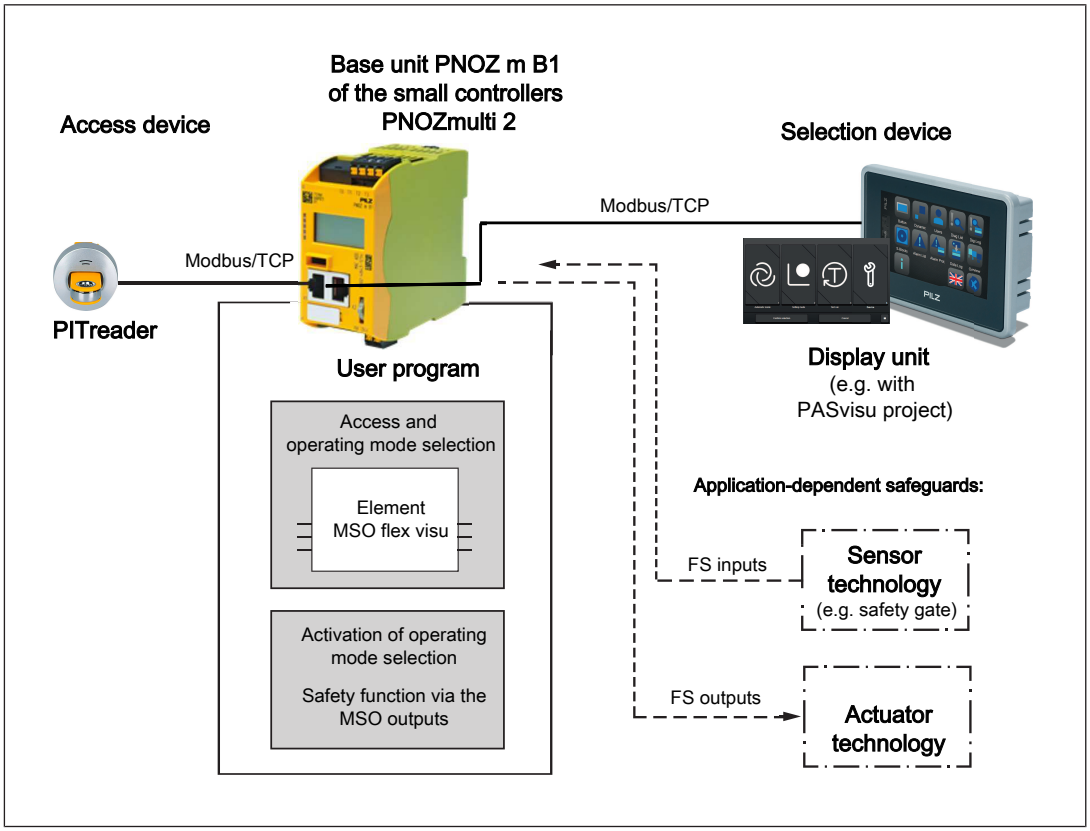
4.1 Required security measures

- Modbus/TCP has no security mechanisms. Use a firewall to protect the product from unauthorised access.
- The products' communication interfaces should be protected against physical manipulation.
- Protect the 24 V inputs and outputs on the safety controller against physical manipulation through protected wiring, e.g. by installing the safety controller in a lockable control cabinet.
- Protect the configuration and log data from unauthorised changes. Configure the display device so as to prevent unauthorised access to the file system.

5 PITmode flex visu with PNOZmulti

5.1 Description

5.1.1 System overview



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

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 themself 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 (MSO number) on the operating mode selection button.
  Multiple PITreaders can be connected to a base unit PNOZ m B1 (see System expansion [📖 22]).

Selection device

Operating modes are selected using a display unit (Visu panel).

– PITmode flex visu Pilz:

Either an appropriate display unit from Pilz or an appropriate display unit from any manufacturer is used as a selection device for safety-related operating mode selection (see Intended use [9]).

A project from the visualisation software PASvisu is operated on the display unit. The "MSO flex visu" tile is used in the process.

A tile must be created for each working area (e.g. infeed, machining, outfeed). The operating mode is selected on the tile; the status of the operating mode selection is also displayed.

The selection device / display unit must be evaluated on the safety controller.

– PITmode flex visu Custom:

Either an appropriate display unit from Pilz or an appropriate display unit from any manufacturer is used as a selection device for safety-related operating mode selection (see Intended use [9]).

Appropriate visualisation software from any manufacturer is used on the display unit. Customers can use this to create or make available a customised visualisation application. The visualisation application created or made available by the customer must meet the requirements stated under Requirements of an appropriate visualisation system [59].
It is the customer's responsibility to ensure that both the display unit and the customised visualisation application are suitable.

The selection device / display unit must be evaluated on the safety controller.

Multiple display units can be connected to a base unit PNOZ m B1 (see System expansion [22]).

Base unit PNOZ m B1 from the system PNOZmulti 2

The PNOZmulti 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. A user program must be created in the PNOZmulti Configurator for this purpose.
The plant can be divided into working areas, e.g. infeed, machining, outfeed (see Working areas [20]).

The MSO flex visu function element performs the following tasks:

– Reads the verified permission from the PITreader

– Evaluates the selection made from the display unit and acknowledgement

– Outputs display information via the diagnostic bits

– Generates and outputs diagnostic messages

– Outputs the mode of safe operation (MSO)

For the actual activation, 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).

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.

  The lock input must not be activated while an operating mode selection button is operated, otherwise the buttons will be deactivated.
- 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 selection button (MSO number).
- Operating mode selection will only be carried out if the relevant button is operated for a certain time and several buttons are not operated simultaneously.
- The user must also check the selection that is reported back and confirm it via a separate button. Confirmation is only valid if the button is operated for a certain time and several buttons are not operated simultaneously.
- It is ensured that only one safe operating mode is selected at any time.
- Operating mode 1 is always selected after a restart.

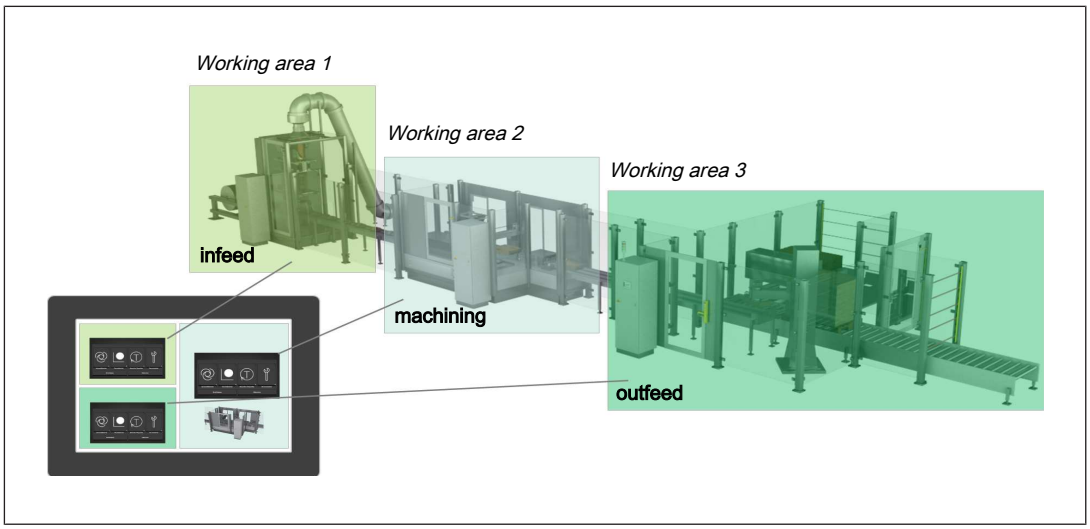
5.1.3 Working areas

A plant can be divided into different working areas. Working areas may be "infeed", "machining" and "outfeed" for example.

Separate operating modes may be assigned to each working area.

In the PNOZmulti Configurator, a working area is assigned to each MSO flex visu element. A working area may only be assigned once. Up to 8 working areas can be created for one base unit PNOZ m B1.

When using the visualisation software PASvisu from Pilz, one "MSO flex visu" tile is used in the PASvisu Builder for each working area.



5.1.4 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.

5.1.5 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.

5.1.6 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.

5.1.7 Service mode

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.

5.1.8 Audit trail

When using the visualisation software PASvisu from Pilz, the "MSO flex visu" tile logs the following events:

- A user changing the operating mode
- The controller acknowledging an operating mode
- Fallback to operating mode MSO1

In the tile properties it is possible to configure whether the log should contain personal data (currently only the transponder’s SID). Personal data is used to identify the person who performed the action.

If logging is required when using the PITmode flex visu Custom, the customer must implement logging in their customised application.

5.2 System expansion

Maximum system expansion for a base unit PNOZ m B1:

- 8 working areas can be configured
- 8 MSO flex visu elements can be configured.
- 4 PITreaders can be connected
- 4 display units can be connected

  However, the visualisation for a working area may only be displayed on exactly one display unit.
- Maximum 10 working areas for one display unit.

5.3 Installation

5.3.1 Connect PITreader

The PITreader is connected to the base unit PNOZ m B1 via an Ethernet cable (for the number of PITreaders that can be connected see System expansion [📖 22]). Please refer to the information and requirements in the operating manual for the PITreader.

5.3.2 Connect display unit

The display unit is connected to the base unit PNOZ m B1 via an Ethernet cable (for details of the display units that can be connected see Intended use [📖 9], for the number of display units see System expansion [📖 22]).

5.4 Configuration

5.4.1 Configure display unit with visualisation software PASvisu

The description presumes that the system PITmode flex visu Pilz is used with the visualisation software PASvisu from Pilz.

Information on the configuration of a display unit operated using customised visualisation can be found under Configure display unit with customised visualisation application [📖 24].

The display on the display unit is configured using the software tool PASvisu Builder.

A PASvisu project is created and an "MSO flex visu" tile is added for each working area. The tile contains the buttons for selecting operating modes.

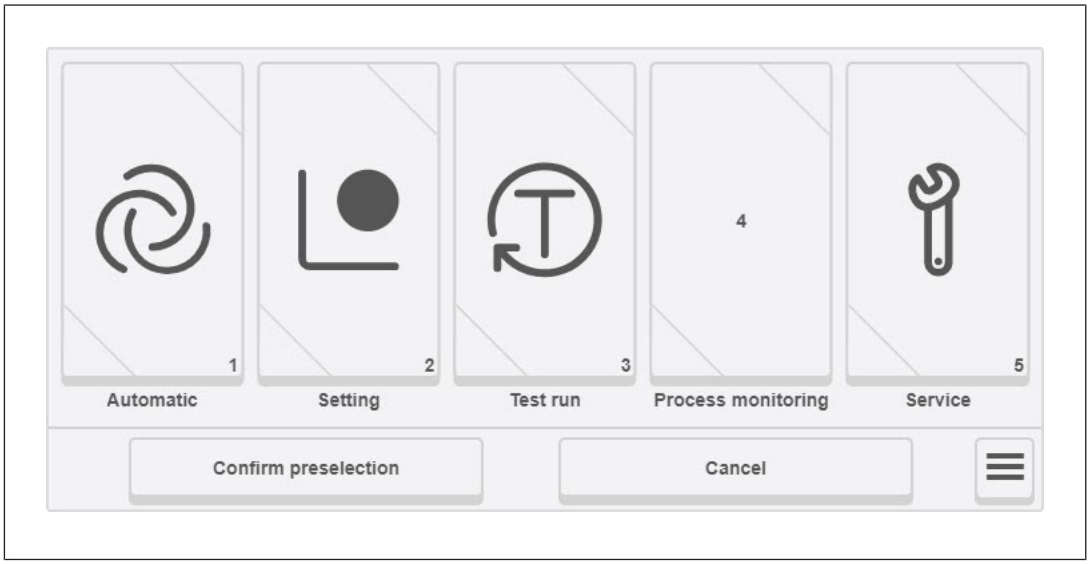


Fig.: Example for an "MSO flex visu" tile

A tile contains a maximum of 8 buttons. In the default configuration the buttons have the following labels:

MSO1 = Automatic mode

MSO2 = Setting mode

MSO3 = Manual intervention

MSO4 = Process monitoring

MSO5 = Service

MSO6 = Service 2

MSO7 = Service 3

MSO8 = Service 4

The labels on the buttons and icons can be changed. You can configure which buttons you use.

The buttons for the service modes are only visible on the display unit if a transponder with permission for the service modes is positioned and the lock input is not activated. The button with the active operating mode is always visible.

Procedure

1. Create PASvisu project

   Create a project in the PASvisu Builder.

2. Select data source

   The operating mode selection configured on the connected PNOZmulti base unit and in the PASvisu project must match. This is guaranteed if the PNOZmulti project is used as the data source.
   Select the PNOZmulti project as the data source.

3. Insert tiles

   Insert an "MSO flex visu" tile in the PASvisu project for each working area.

4. Configure tiles

   Configure the tiles. For details of the configuration please refer to the Online Help for the PASvisu Builder.

5. Perform download

   Download the PASvisu project to the display unit.

Notes

- Positioning of tiles
  Ensure that an "MSO flex visu" tile is not covered by any other tiles. The operator must be able to see the whole tile.
- Consistent configuration of operating mode selection
  The operating mode selection configured in the controller and PASvisu project must match. This is checked at the PASvisu project's runtime. If the configurations do not match, the tile is marked as faulty and no operating mode can be selected.
  The best method for guaranteeing that the configurations in the controller and PASvisu project match is as follows: in the tile properties in the PASvisu project, select the corresponding element from the PNOZmulti project. That way the configuration will be copied from the PNOZmulti project and cannot be edited.
- One tile per working area
  It is the user's responsibility to ensure that there is no more than one "MSO flex visu" tile per working area and that this tile is displayed on just one display unit.
  Note: If the following error message is displayed: "Button was not pressed for long enough", even though the button was pressed for a sufficient amount of time, this may indicate that more than one tile is present for the working area.
- Labels for the buttons and icons
  Adapt the label on the buttons and icons to suit your own application. Clear labelling and good icons help the operator to select the required button.

5.4.2 Configure display unit with customised visualisation application

If a customised visualisation application is used on a display unit, then the visualisation application must meet various requirements. It is the customer's responsibility to implement the customised visualisation application. Further information is available under Additional information when using PITmode flex visu Custom [📖 57].

5.4.3 Configure PITreader

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

5.4.4 Configure PNOZmulti

All the configurations are performed and the user program created in the PNOZmulti Configurator.

5.4.4.1 Configure hardware

Add the following devices to the hardware configuration:

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

5.4.4.2 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

5.4.4.3 Configure connection to the display unit

The connection to the display unit is established via Modbus/TCP.

The connection is established automatically and does not need to be configured.

5.4.4.4 Configure MSO flex visu element

This element is used to evaluate the information from the access device and to evaluate, monitor and acknowledge the operating mode selection.
Insert the element MSO flex visu in 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).

5.4.4.5 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*.

5.5 Operation

5.5.1 Select safe mode of operation MSO1 ... MSO8

The description presumes that the system PITmode flex visu Pilz is used with the visualisation software PASvisu from Pilz.

A similar procedure must be present when using a customised visualisation application (see Additional information when using PITmode flex visu Custom [📖 57]).

Operating modes are selected via a display unit (Visu panel), on which a project from the visualisation system PASvisu is operated. The "MSO flex visu" tile is used in the process. The tile contains the buttons for selecting operating modes.

The buttons for the service modes are only visible on the display unit if a transponder with permission for the service modes is positioned and the lock input is not activated. The button with the active operating mode is always visible.

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.
- The display unit must be connected.
- Several pushbuttons may **not** be operated simultaneously when selecting an operating mode.

Procedure

1. Select mode of safe operation

   Select the required operating mode by pressing the relevant button on the tile. The button must be pressed for between 500 ms and 5000 ms.

   The button lights up yellow.

2. Confirm operating mode selection

   Press the "Confirm preselection" button on the tile.

   The button flashes green. 
   The preselection is now confirmed, but as yet unacknowledged by the PNOZmulti.
   If "Acknowledge" is configured, the mode of safe operation will not be adopted until the selection is acknowledged (1-signal at "Acknowledge" input).

   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 button is continuously lit green. 

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.

5.5.2 Button status indicators

The description presumes that the system PITmode flex visu Pilz is used with the visualisation software PASvisu from Pilz.

A similar procedure must be present when using a customised visualisation application (see Additional information when using PITmode flex visu Custom [📖 57]).

A tile in PASvisu contains a maximum of 8 buttons for selecting operating modes. Each button has triangles on the bottom left and top right to indicate the status.

Status indicator	Description
Top right triangle lights up green 	Operating mode is selected
Bottom left triangle lights up yellow	Operating mode is preselected, but the preselection must still be confirmed by pressing the “Confirm preselection” button on the tile.
Top right triangle flashes green 	Operating mode is preselected. It must still be acknowledged by the controller.

5.5.3 Status and error messages through the PNOZmulti

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 visu. These can be displayed via a display unit. For more information refer to the "Diagnostic configuration PVIS" section 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.
8	Cannot select operating mode because the controller has received invalid data from the visualisation.	Possible causes: ▸ Different configuration in PNOZmulti and PASvisu ▸ Corresponding Modbus registers are overwritten by another controller. Remedy: ▸ Check Modbus configuration
9	Error in the test pulse wiring	Possible causes: ▸ Short between contacts in the input wiring to 24 V or other signal cables Remedy: ▸ 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	Possible causes: ▸ The permission is not greater than or equal to the mode of safe operation that is being selected. Remedy: For information only, no remedy required. Note: The diagnostic message is output for as long as the error is present and for 2 seconds after the error condition has ended.

Bit No.	Description	Cause and remedy
11	Incorrect user entry	Possible causes: ▸ Lock input is active ▸ More than one pushbutton was operated simultaneously Note: No button may be pressed before making a new selection or resetting the diagnostic message. ▸ One of the buttons was operated for longer than 5 s. Remedy: For information only, no remedy required. 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.
12	There is no transponder present.	Possible causes: ▸ No transponder positioned on the PITreader ▸ PITreader cannot read the transponder Remedy: ▸ Change transponder.
13	The transponder does not have permission (permission = 0)	Possible causes: ▸ The transponder does not contain any valid data ▸ The transponder was not assigned any permission for this working area Remedy: For information only, no remedy required.
14	Cannot authenticate because the data from the PITreader is invalid.	Possible causes: ▸ Connection to the PITreader is configured incorrectly ▸ Modbus registers are overwritten by another controller Remedy: For information only, no remedy required.

Bit No.	Description	Cause and remedy
15	Communication with the PITreader is interrupted	Possible causes: ▸ Cable connection broken between PNOZmulti and PITreader ▸ IP address is configured incorrectly Remedy: ▸ Check the connection between the PITreader and PNOZmulti.

Diagnostic word 2

Bit No.	Description	Cause and remedy
0 … 7	The controller has not yet acknowledged the selected operating mode 1 … 8.	Possible causes: ▸ The operating mode was changed, but the selection has not yet been acknowledged. Remedy: The diagnostic message is for information purposes only.
10	The controller has not yet acknowledged the selected operating mode.	Possible causes: ▸ The operating mode was changed, but the selection has not yet been acknowledged. Remedy: For information only, no remedy required.
11	Selection of mode of operation is locked	Possible causes: ▸ Lock input is active Remedy: For information only, no remedy required.
12	Delay time is running for fall back to mode 1.	For information only, no remedy required. You should also refer to the information provided under Behaviour when the transponder is removed [📖 20]

5.6 Version query for the "MSO flex visu" tile

In a PASvisu project (PASvisu Builder), an "MSO flex visu" tile must be added and configured for each working area. The "MSO flex visu" tile on the PASvisu Builder is versioned. However, the version of the "MSO flex visu" tile is independent of the version of the PASvisu Builder that is used.

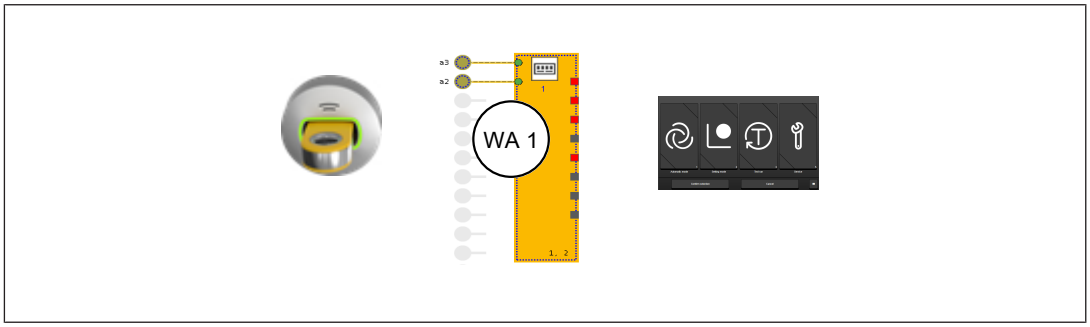
You can have the tile version displayed on the display unit:

- Click on the  button on the "MSO flex visu" tile (working area) and select ***Display version***.

5.7 Examples for PITmode flex visu with PNOZ m B1

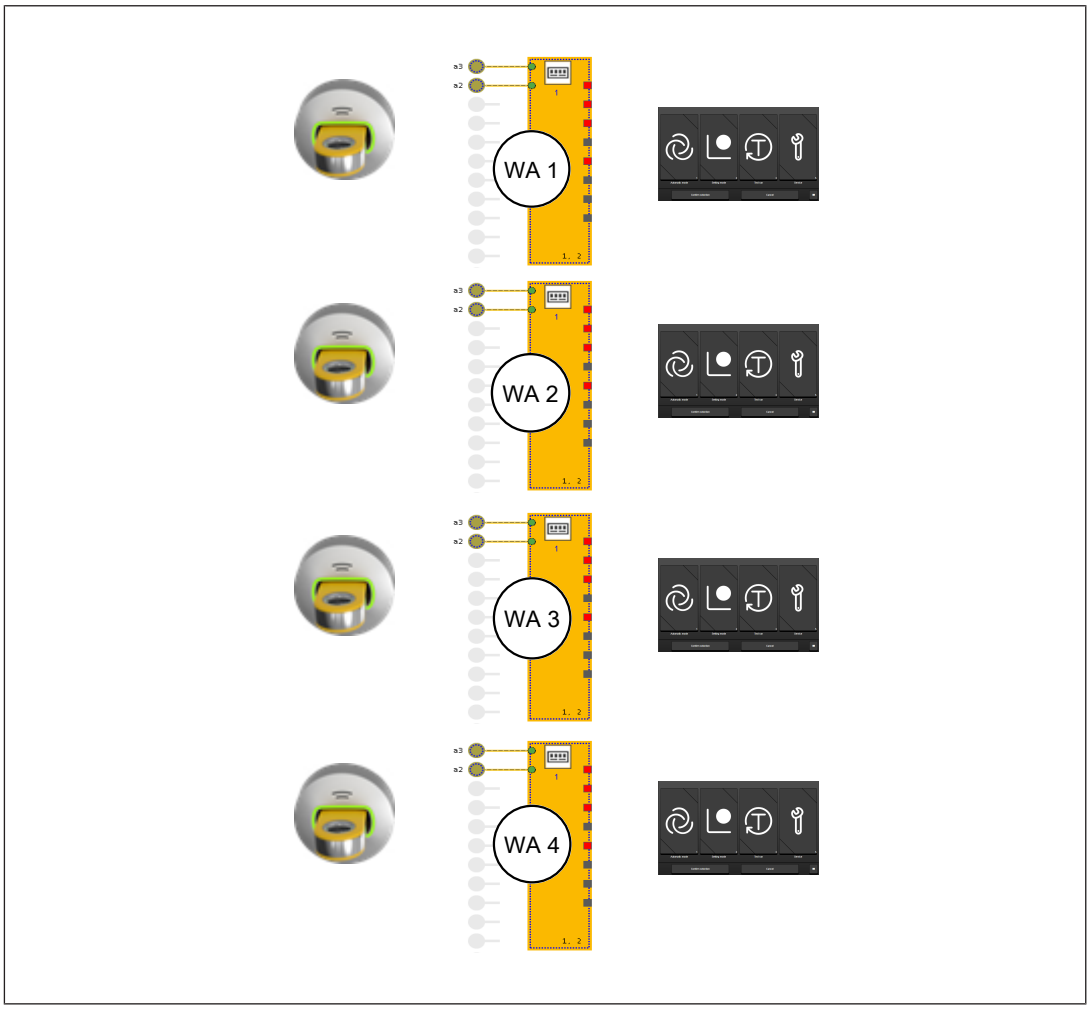
5.7.1 Example 1

1 PITreader for 1 working area (WA) and display on a display unit.



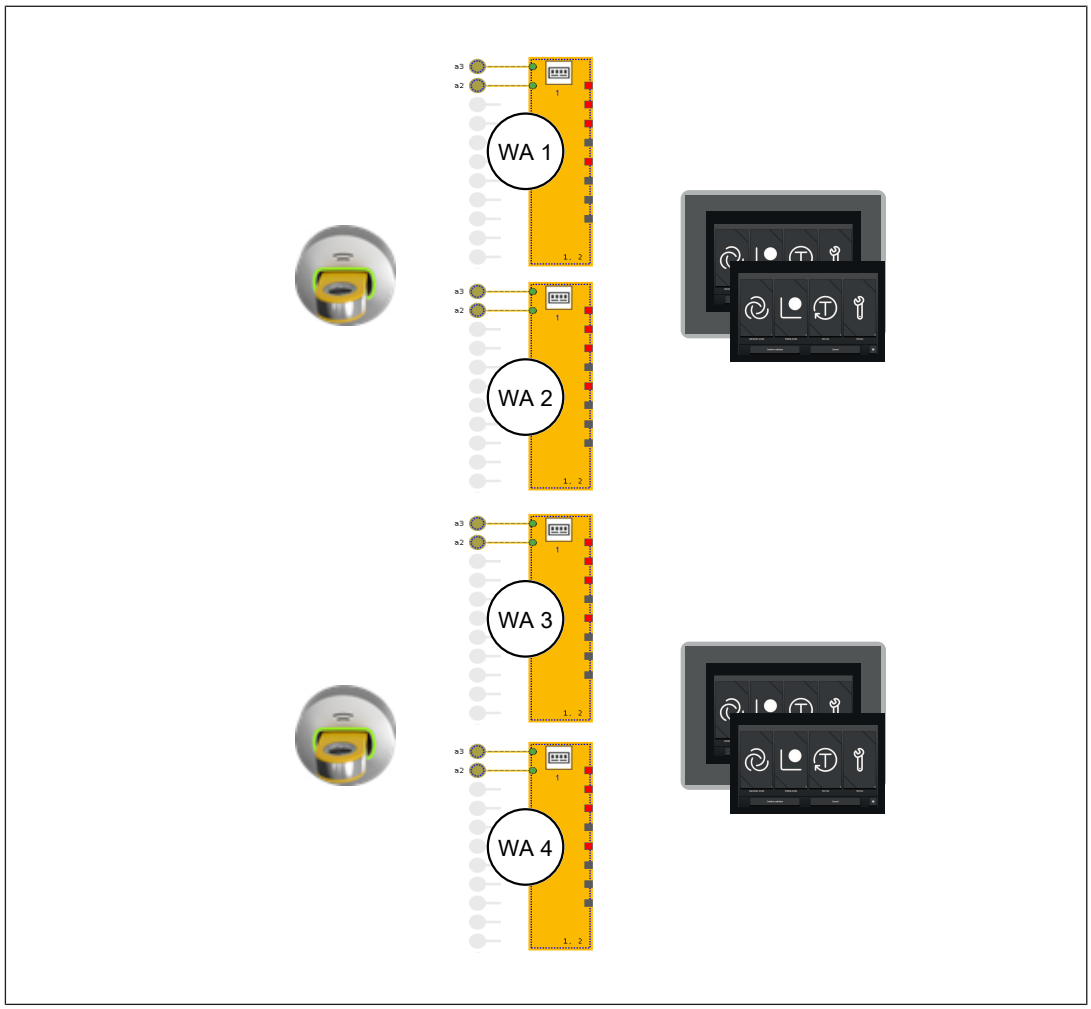
5.7.2 Example 2

4 PITreaders, 1 for each working area (WA). Separate display on a display unit per working area.



5.7.3 Example 3

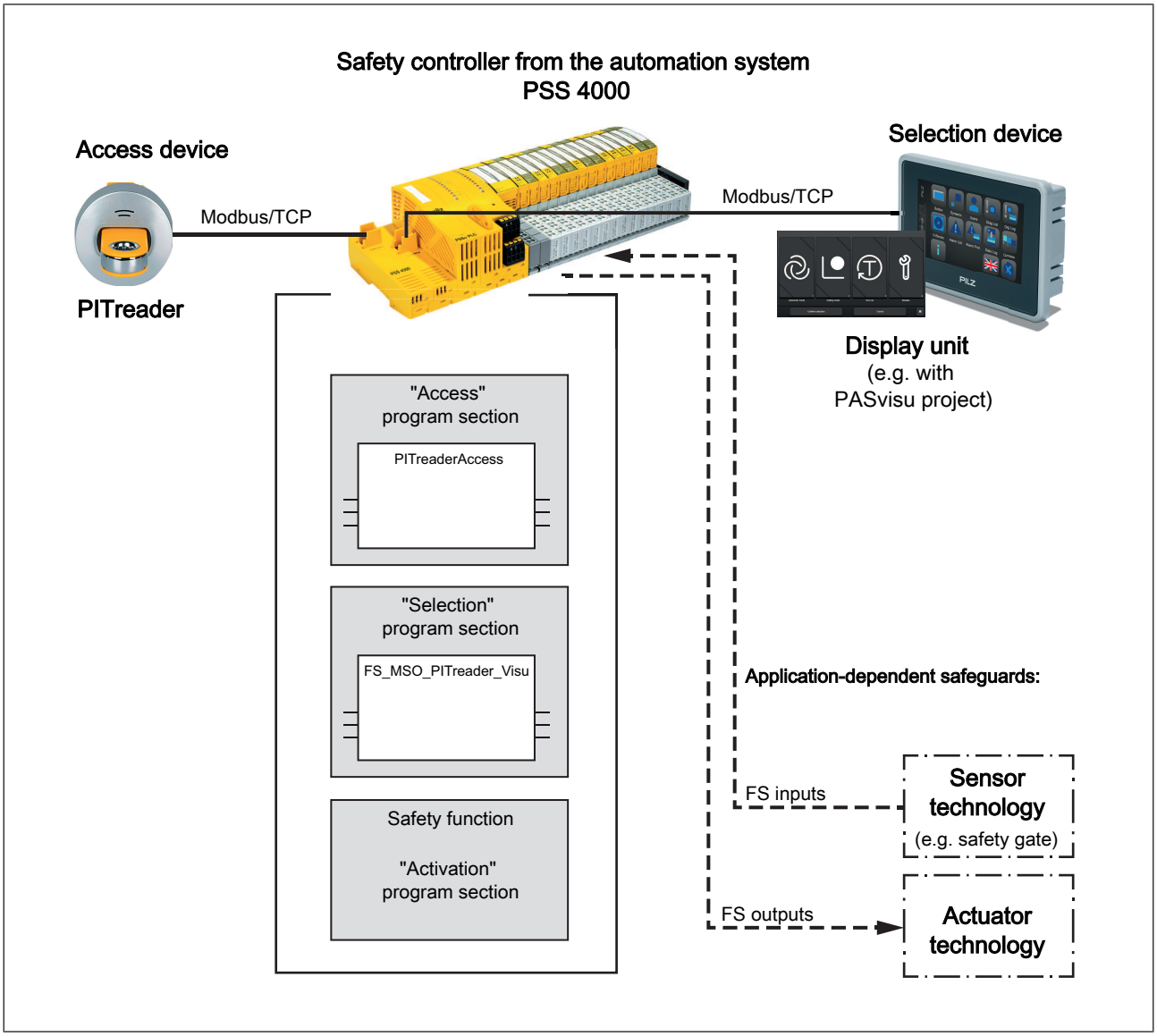
2 PITreaders, each covering 2 working areas (WA). 2 working areas covered by one display on a display unit.



6 PITmode flex visu with PSS 4000

6.1 Description

6.1.1 System overview



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

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 themself 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 (MSO number) on the operating mode selector switch.
  Multiple PITreaders can be connected to a safety controller (see System expansion [41]).

- **Selection device**

  Operating modes are selected using a display unit (Visu panel).

  – PITmode flex visu Pilz:

    Either an appropriate display unit from Pilz or an appropriate display unit from any manufacturer is used as a selection device for safety-related operating mode selection (see Intended use [9]).

    A project from the visualisation system PASvisu is operated on the display unit. The "MSO flex visu" tile is used in the process.

    A tile must be created for each working area (e.g. infeed, machining, outfeed). The operating mode is selected on the tile; the status of the operating mode selection is also displayed.

    The selection device / display unit must be evaluated on the safety controller.

  – PITmode flex visu Custom:

    Either an appropriate display unit from Pilz or an appropriate display unit from any manufacturer is used as a selection device for safety-related operating mode selection (see Intended use [9]).

    Appropriate visualisation software from any manufacturer is used on the display unit. Customers can use this to create or make available a customised visualisation application. The visualisation application created or made available by the customer must meet the requirements stated under Requirements of an appropriate visualisation system [59].
    It is the customer's responsibility to ensure that both the display unit and the customised visualisation application are suitable.

    The selection device / display unit must be evaluated on the safety controller.

  Multiple display units can be connected to a safety controller from the automation system PSS 4000 (see System expansion [41]).

- **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 plant can be divided into working areas, e.g. infeed, machining, outfeed (see Working areas [39]).

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 in order to do this. The current access permission is available as an evaluation result.

– "Selection" program section

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. The block FS_MSO_PITreader_Visu is required in order to do this. 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. The safety functions required for the selected operating mode (e.g. light curtains or safety gates) are activated in this program section, depending on the application, the selected working area and the selected operating mode.

6.1.2 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.

  The lock input must not be activated while an operating mode selection button is operated, otherwise the buttons will be deactivated.
- 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 selection button (MSO number).
- Operating mode selection will only be carried out if the relevant button is operated for a certain time and several buttons are not operated simultaneously.
- The user must also check the selection that is reported back and confirm it via a separate button. Confirmation is only valid if the button is operated for a certain time and several buttons are not operated simultaneously.
- It is ensured that only one safe operating mode is selected at any 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.

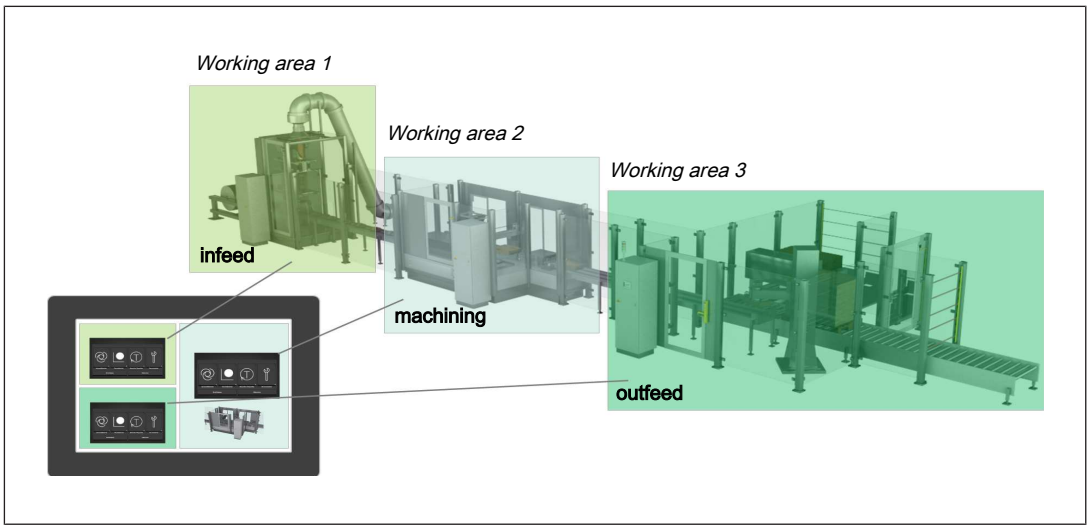
6.1.3 Working areas

A plant can be divided into different working areas. Working areas may be "infeed", "machining" and "outfeed" for example.

Separate operating modes may be assigned to each working area.

If there are several working areas, an instance of the block FS_MSO_PITreader_Visu is assigned to each working area in the PSS 4000 project. A working area may only be assigned once. Up to 10 working areas can be created for a safety controller.

When using the visualisation software PASvisu from Pilz, one "MSO flex visu" tile is used in the PASvisu Builder for each working area.



6.1.4 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.

6.1.5 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.

6.1.6 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.

6.1.7 Service mode

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.

If service modes are configured, the block FS_MSO_PITreader_Visu should be configured in such a way that a fall back to operating mode 1 occurs when the transponder is removed.

6.1.8 Audit trail

When using the visualisation software PASvisu from Pilz, the "MSO flex visu" tile logs the following events:

- A user changing the operating mode
- The controller acknowledging an operating mode
- Fallback to operating mode MSO1

In the tile properties it is possible to configure whether the log should contain personal data (currently only the transponder’s SID). Personal data is used to identify the person who performed the action.

If logging is required when using the PITmode flex visu Custom, the customer must implement logging in their customised application.

6.2 System expansion

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

- The maximum number of PITreader devices 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 Online Help.
- 10 working areas can be configured
- 10 display units can be connected

  However, the visualisation for a working area may only be displayed on exactly one display unit.
- Maximum 10 working areas for one display unit

6.3 Installation

6.3.1 Connect PITreader

The PITreader is connected to the safety controller from the automation system PSS 4000 via an Ethernet cable (for the number of PITreaders that can be connected see System expansion [📖 41]). Please refer to the information and requirements in the operating manual for the PITreader.

6.3.2 Connect display unit

The display unit is connected to the safety controller via an Ethernet cable (for display units that can be connected see Intended use [📖 9], for the number of display units see System expansion [📖 41])

6.4 Configuration and programming

6.4.1 Configure display unit with visualisation software PASvisu

The description presumes that the system PITmode flex visu Pilz is used with the visualisation software PASvisu from Pilz.

Information on the configuration of a display unit operated using customised visualisation can be found under Configure display unit with customised visualisation application [📖 43].

The display on the display unit is configured using the software tool PASvisu Builder.

A PASvisu project is created and an "MSO flex visu" tile is added for each working area. The tile contains the buttons for selecting operating modes.

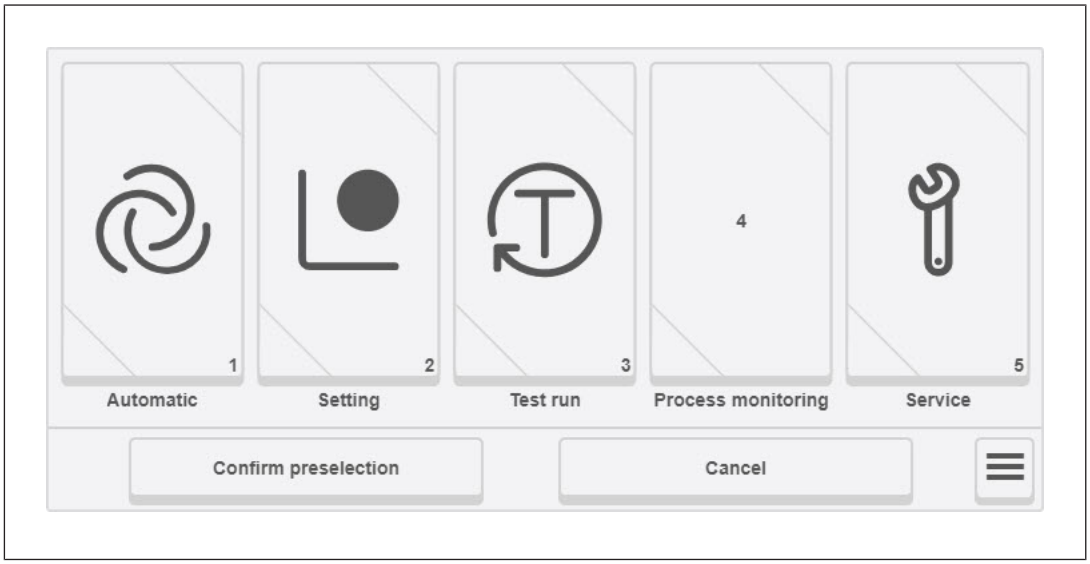


Fig.: Example for an "MSO flex visu" tile

A tile contains a maximum of 8 buttons. In the default configuration the buttons have the following labels:

MSO1 = Automatic mode

MSO2 = Setting mode

MSO3 = Manual intervention

MSO4 = Process monitoring

MSO5 = Service

MSO6 = Service 2

MSO7 = Service 3

MSO8 = Service 4

The labels on the buttons and icons can be changed. You can configure which buttons you use.

The buttons for the service modes are only visible on the display unit if a transponder with permission for the service modes is positioned and the selection lock is not activated. The button with the active operating mode is always visible.

Procedure

1. Create PASvisu project

   Create a project in the PASvisu Builder.

2. Insert tiles

   Insert an "MSO flex visu" tile in the PASvisu project for each working area.

3. Configure tiles

   Configure the tiles. For details of the configuration please refer to the Online Help for the PASvisu Builder.
   The operating mode selection configured on the connected safety controller and in the PASvisu project must match.

4. Perform download

   Download the PASvisu project to the display unit.

Notes

- Positioning of tiles
  Ensure that an "MSO flex visu" tile is not covered by any other tiles. The operator must be able to see the whole tile.
- Consistent configuration of operating mode selection
  The operating mode selection configured in the safety controller and PASvisu project must match. This is checked at the PASvisu project's runtime. If the configurations do not match, the tile is marked as faulty and no operating mode can be selected.
- One tile per working area
  It is the user's responsibility to ensure that there is no more than one "MSO flex visu" tile per working area and that this tile is displayed on just one display unit.
  Note: If the following error message is displayed: "Button was not pressed for long enough", even though the button was pressed for a sufficient amount of time, this may indicate that more than one tile is present for the working area.
- Labels for the buttons and icons
  Adapt the label on the buttons and icons to suit your own application. Clear labelling and good icons help the operator to select the required button.

6.4.2 Configure display unit with customised visualisation application

If a customised visualisation application is used on a display unit, then the visualisation application must meet various requirements. It is the customer's responsibility to implement the customised visualisation application. Further information is available under Additional information when using PITmode flex visu Custom [📖 57].

6.4.3 Configure PITreader

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

6.4.4 Configure and program safety controller

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

6.4.4.1 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

6.4.4.2 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

1. Open the IP Connections Editor in PAS4000.
2. Create a new Modbus/TCP Client connection.
3. 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***: Deselect checkbox "Enable keep alive"
   - ***Connection timeout***: Select "Enable connection timeout" checkbox
   - ***Connection cycles***: 10
   - ***Connection cycle time***: Enable "Calculate automatically" checkbox
4. 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

6.4.4.3 Configure connection to the display unit

The connection to the display unit is established via Modbus/TCP.

PITmode flex visu Pilz:

When using the visualisation software PASvisu, a Modbus/TCP Server connection between the safety controller and display unit must be configured for each "MSO flex visu" tile in the PSS 4000 project, in PAS4000.

PITmode flex visu Custom:

When using customised visualisation, a Modbus/TCP Server connection between the safety controller and display unit must be configured for each working area in the PSS 4000 project, in PAS4000.

Prerequisites

- Display unit and safety controller are connected via an Ethernet cable.

Procedure

1. Open the IP Connections Editor in PAS4000.
2. Create a new Modbus/TCP Server connection for each "MSO flex visu" tile or working area.
3. Change the default values for the network settings of each connection:
   - ***Remote IP address***: 0.0.0.0
   - ***Local port number***: 502
   - ***Remote port number***: 0
   - ***Keep alive settings***: Select "Enable keep alive" checkbox
   - ***Keep alive time [ms]***: 1000
   - ***Keep alive interval [ms]***: 1000
   - ***Connection timeout***: Deselect "Enable connection timeout" checkbox
   - ***Data update cycle time***: Activate "Calculate automatically" checkbox
4. Configure the server mapping table:

Data area	Start address	Data length
3xRead	1	12
4xWrite	1	22

Notes:

- The lower limit for the start address is 1.
- The table contains example values for 1 working area. If you are using multiple "MSO flex visu" tiles or working areas, the server mapping table must be expanded accordingly. For each working area, configure 12 words in the data area 3xRead for send data to the display unit and 22 words in the data area 4xWrite for receive data from the display unit.

  Example: With 3 working areas, a data length of at least 36 must be entered in the data area 3xRead and a data length of at least 66 must be entered in the data area 4xWrite.

6.4.4.4 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.

- 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.

    Note: If you are using more than one PITreader, then you can create several instances of the PITreaderAccess block.

  – Call up the block instance of PITreaderAccess before the instances of the selection block FS_MSO_PITreader_Visu; i.e. call up the "Access" program section before the "Selection" program section.

- Create and call up "Selection" program section

  In the "Selection" program section, the operating mode selection must be evaluated and monitored using the block FS_MSO_PITreader_Visu, depending on the application.

  – Create an instance of the block FS_MSO_PITreader_Visu for operating mode selection.

    Note: If various working areas are to be available in your customer application and the modes of safe operation in the working areas can be selected independently from each other, an "MSO flex visu" tile must be configured in the selection device for each working area and an instance of the block FS_MSO_PITreader_Visu must be created for each working area in the "Selection" program section. It is essential that you refer to the information under "Selection" program section with several working areas [📖 48].

  – Depending on the application, configure the I-variables *EnableSelectionMSO<2 … 8>, StoredMSO_AtStartup, MSO_AtKeyRemoval, FallbackDelayTime, EnableServiceMSO, FirstServiceMSO.* Further information on the I-variables can be found in the block description under "Input interface" (see PAS4000 Online Help).

- I-variables *SecurityID, Permission* and *PITreaderAccessError*

  Assign the I-variables of the block instances of the FS_MSO_PITreader_Visu to the corresponding O-variables of the block instance of the PITreaderAccess

  – *SecurityID*: *<Instance name of the PITreaderAccess>*.SecurityID

  – *Permission*: *<Instance name of the PITreaderAccess*.Permission

  – *PITreaderAccessError: <Instance name of the PITreaderAccess>*.DiagSystemError

- 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 a high signal to the I-variable *Acknowledge*.

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

  The safety functions required for the selected operating mode (e.g. light curtains 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.

- In the PAS4000 I/O Mapping Editor, map the receive data (block's I-PI variables) to the corresponding addresses on the server mapping table (Modbus/TCP):

I-PI variables	**I/O mapping to:**	**Addresses in the data area 4xWrite**
ReceiveDataFromVisu_00	->	4x00001
…	…	…
ReceiveDataFromVisu_21	->	4x00022

  Note: The stated I/O mapping is an example for 1 working area. The I/O mapping for receive data must be performed for each instance of the block FS_MSO_PITreader_Visu and depends on the configured server mapping table (see Configure connection to the display unit [📖 45]).

- In the PAS4000 I/O Mapping Editor, map the send data (block's O-PI variables) to the corresponding addresses on the server mapping table (Modbus/TCP):

O-PI variables	**I/O mapping to:**	**Addresses in the data area 3xRead**
SendDataToVisu_00	->	3x00001
…	…	…
SendDataToVisu_11	->	3x00012

  Note: The stated I/O mapping is an example for 1 working area. The I/O mapping for send data must be performed for each instance of the block FS_MSO_PITreader_Visu and depends on the configured server mapping table (see Configure connection to the display unit [📖 45]).

- In the PAS4000 I/O Mapping Editor, map the I-PI variables of the PITreaderAccess block to the corresponding addresses of the client connection (Modbus/TCP):

I-PI variables	I/O mapping to:	Addresses in the data area 3xRead
PITreaderAccessData[0]	->	3x00024
…	…	…
PITreaderAccessData[13]	->	3x00037

6.4.4.5 "Selection" program section with several working areas

If various working areas are to be available for a machine in your customer application and the modes of safe operation in the working areas can be selected independently from each other, an "MSO flex visu" tile must be configured in the selection device for each working area and an instance of the block FS_MSO_PITreader_Visu must be created for each working area in the "Selection" program section.

The I-variable *WorkingArea* of each block instance must be assigned a different value (value range 1 ... 10). Executing several block instances with the same value at the I-variable *WorkingArea* is deemed improper use.

WARNING!

Hazardous state due to incorrect configuration of the working areas

If there are several working areas where the modes of safe operation are selected independently, the I-variable *WorkingArea* must be assigned a different value on each instance of the block FS_MSO_PITreader_Visu. Failure to comply with this requirement is deemed improper use and can cause the operating mode to switch unexpectedly or to fail to change despite selecting a new mode.

Ensure that the I-variable *WorkingArea* is assigned a different value on each block instance of the block FS_MSO_PITreader_Visu.

Configure each instance of the block FS_MSO_PITreader_Visu via the I-variables *EnableSelectionMSO<2 …8>, StoredMSO_AtStartup, MSO_AtKeyRemoval, FallbackDelayTime, EnableServiceMSO, FirstServiceMSO* in accordance with the requirements of the respective working area in your customer application.

6.5 Operation

6.5.1 Select safe mode of operation MSO1 ... MSO8

The description presumes that the system PITmode flex visu Pilz is used with the visualisation software PASvisu from Pilz.

A similar procedure must be present when using a customised visualisation application (see Additional information when using PITmode flex visu Custom [📖 57]).

Operating modes are selected via a display unit (Visu panel), on which a project from the visualisation system PASvisu is operated. The "MSO flex visu" tile is used in the process. The tile contains the buttons for selecting operating modes.

The buttons for the service modes are only visible on the display unit if a transponder with permission for the service modes is positioned and the lock input is not activated. The button with the active operating mode is always visible.

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.
- The display unit must be connected.
- Several pushbuttons may **not** be operated simultaneously when selecting an operating mode.

Procedure

1. Select mode of safe operation

   Select the required operating mode by pressing the relevant button on the tile. The button must be pressed for between 500 ms and 5000 ms.

   The button lights up yellow.

2. Confirm operating mode selection

   Press the "Confirm preselection" button on the tile.

   The button flashes green. 
   The preselection is now confirmed, but as yet unacknowledged by the safety controller. If "Acknowledge" is configured, the mode of safe operation will not be adopted until the selection is acknowledged (I-variable Acknowledge = TRUE).

   Note: If the lock input (I-variable *Lock*) is configured, then the selected but as yet unacknowledged 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 button is continuously lit green. 

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.

6.5.2 Button status indicators

The description presumes that the system PITmode flex visu Pilz is used with the visualisation software PASvisu from Pilz.

A similar procedure must be present when using a customised visualisation application (see Additional information when using PITmode flex visu Custom [📖 57]).

A tile in PASvisu contains a maximum of 8 buttons for selecting operating modes. Each button has triangles on the bottom left and top right to indicate the status.

Status indicator	Description
Top right triangle lights up green 	Operating mode is selected
Bottom left triangle lights up yellow	Operating mode is preselected, but the preselection must still be confirmed by pressing the “Confirm preselection” button on the tile.
Top right triangle flashes green 	Operating mode is preselected. It must still be acknowledged by the controller.

Special features

The FS resource of a safety controller can switch to various operating states in the event of an error. In these operating states, substitute values are used for a variety of data due to the error. The data (O-PI variables) that is transmitted to the display unit via a Modbus/TCP Server connection is also impacted; i.e. as the data is no longer updated and the substitute value is used instead, the last valid value is shown on the display unit.
In this case, the status indicator for a button may show the status "Operating mode is selected", even though there is an error present and the output is switched off or is in a safe state.

These operating states include, for example:

- FS resource in RUN state with error: Task in TERMINATED state
- FS resource in RUN state with error: Task in STOP state
- Major FS error

Further information on the substitute values and operating states is available in the System Description PSS 4000.

6.5.3 Diagnostics

The block FS_MSO_PITreader_Visu sends various user errors, system information and system errors to the display unit (Visu panel).

When using the visualisation software PASvisu from Pilz, this information is shown on the display unit, directly on the relevant tile.
If this behaviour is required and customised visualisation is used, the customer will need to implement this on the display unit (HMI) (see Structure and content of the input register (3x) [📖 67]).

The block FS_MSO_PITreader_Visu signals a variety of diagnostic information to the O-variables *Diag<…>*. These O-variables can be used to continue processing diagnostic information in the user program. A description of the diagnostic information can be found in the block description (PAS4000 Online Help). Under the default setting, all diagnostic information also appears in the safety controller's diagnostic list and diagnostic log. If individual or all diagnostic messages are unwanted, then the corresponding basic diagnostic items in PAS4000's Diagnostic Editor can be deactivated (deactivate "Enable" checkbox). When using the visualisation software PASvisu from Pilz, parameter errors are not shown on the corresponding tile of the display unit and so should not be deactivated.
When customised visualisation is used, only the diagnostic information registered in the safety controller’s input register can be displayed (see Structure and content of the input register (3x) [📖 67]).

Detailed information on system diagnostics and process diagnostics can be found in the PAS4000 Online Help.

6.6 Version query for the "MSO flex visu" tile

In a PASvisu project (PASvisu Builder), an "MSO flex visu" tile must be added and configured for each working area. The "MSO flex visu" tile on the PASvisu Builder is versioned. However, the version of the "MSO flex visu" tile is independent of the version of the PASvisu Builder that is used.

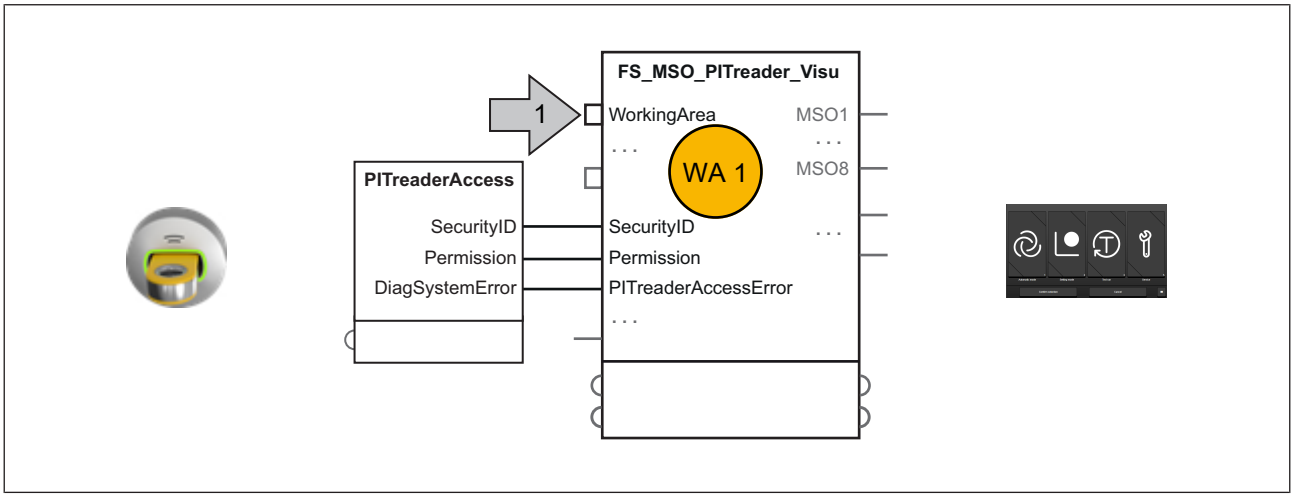
You can have the tile version displayed on the display unit:

- Click on the  button on the "MSO flex visu" tile (working area) and select ***Display version***.

6.7 Examples for PITmode flex visu with PSS 4000

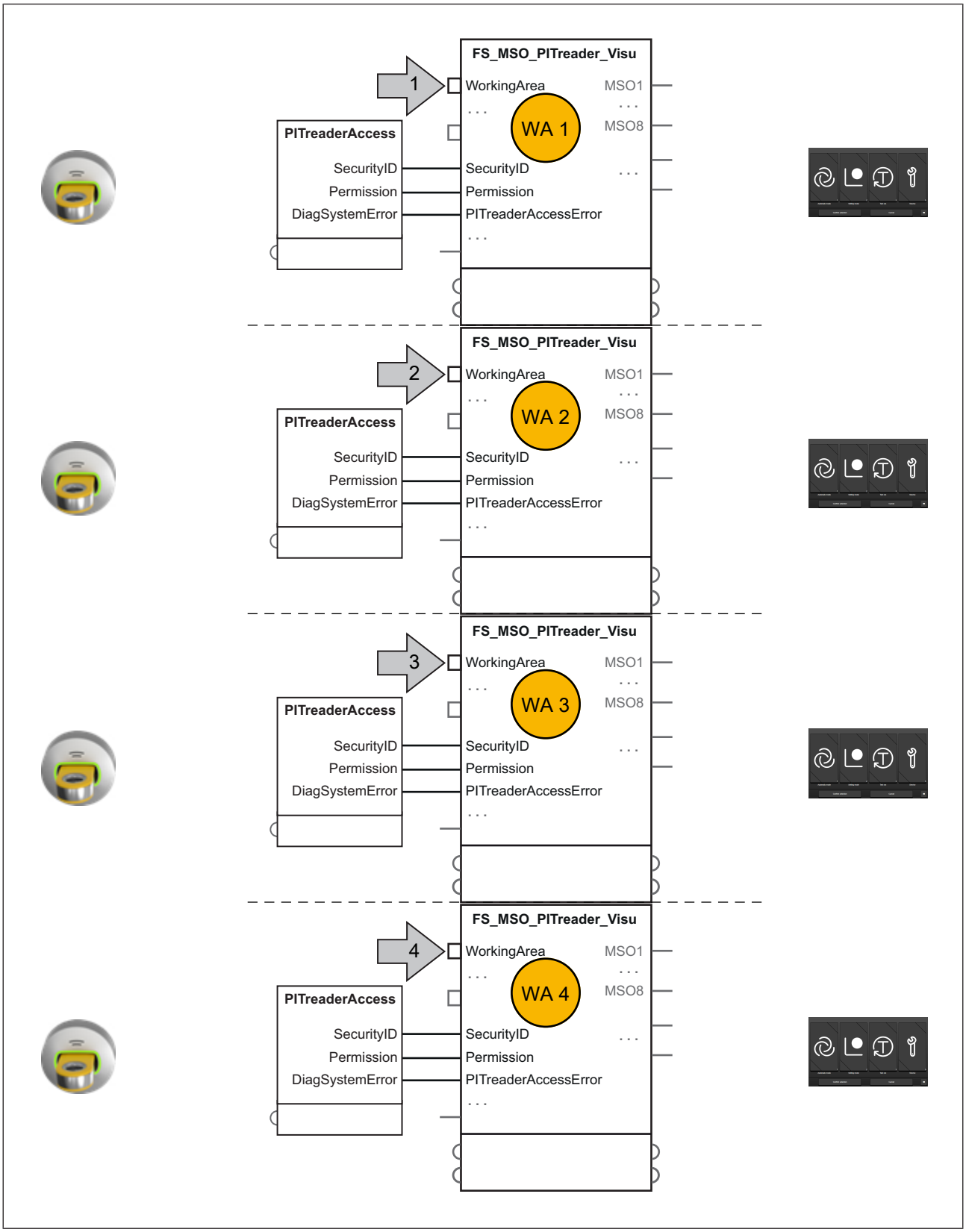
6.7.1 Example 1

1 PITreader for 1 working area (WA) and display on a display unit.



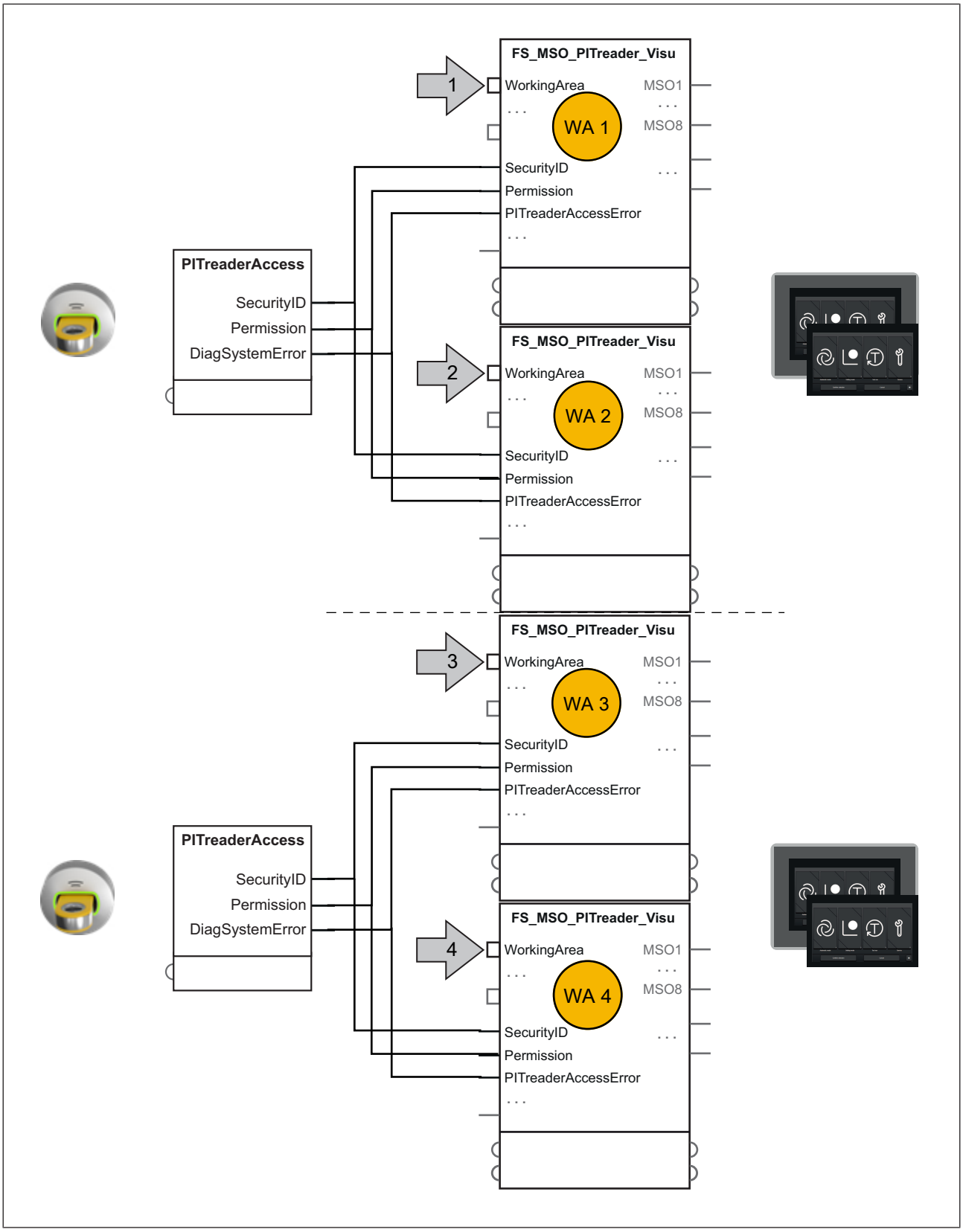
6.7.2 Example 2

4 PITreaders, 1 for each working area (WA). Separate display on a display unit per working area.



6.7.3 Example 3

2 PITreaders, each covering 2 working areas (WA). 2 working areas covered by one display on a display unit

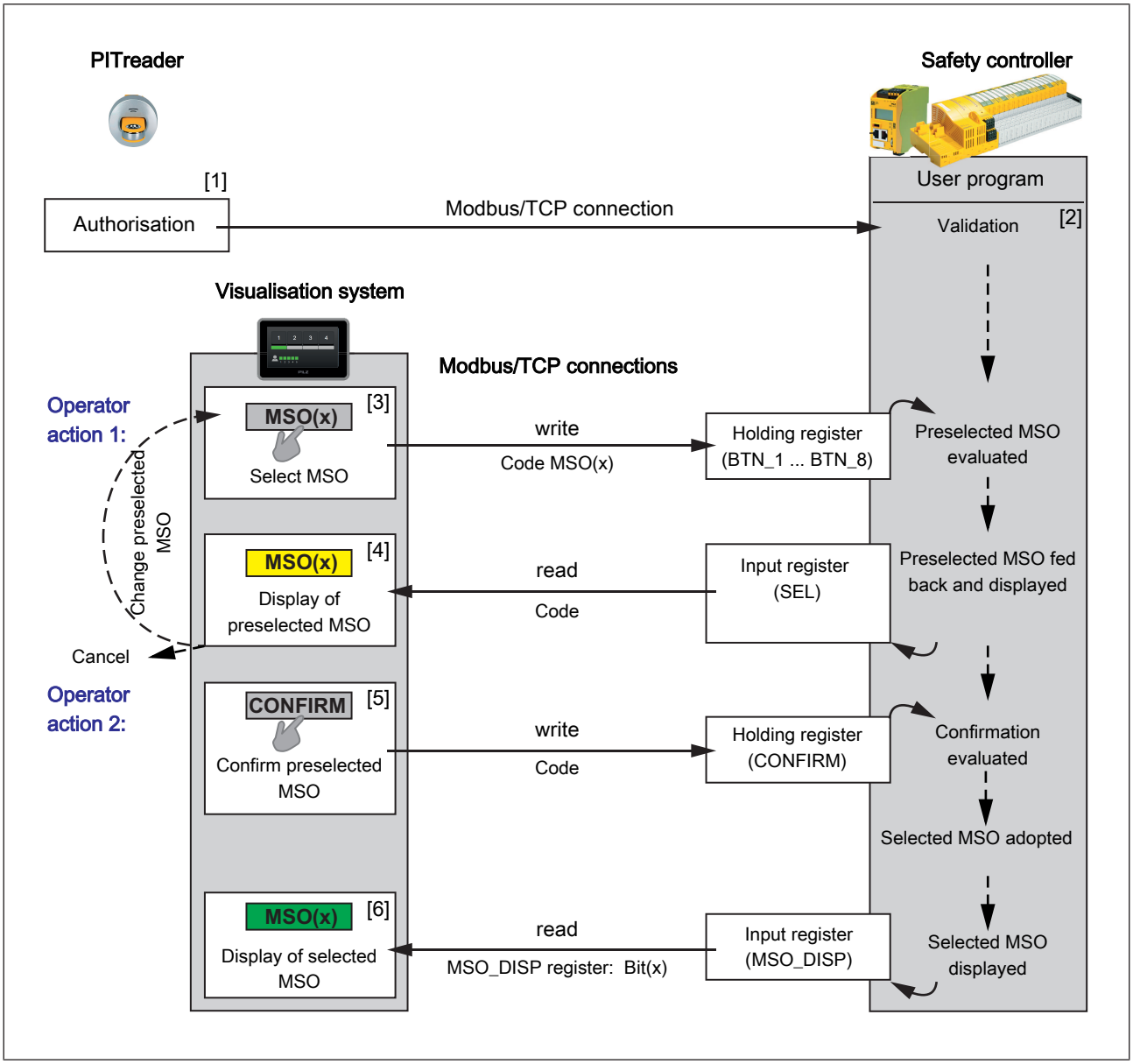


7 Additional information when using PITmode flex visu Custom

7.1 Safe operating mode selection with PITmode flex visu Custom (principle)

When PITmode flex visu Custom is used with an appropriate visualisation system, various requirements are implemented in the visualisation system by the user (see Requirements of an appropriate visualisation system [📖 59]).

Principle sequence for selecting modes of safe operation



Legend

[1] Access device (PITreader with transponder)

The first step when selecting operating modes is authorisation on the PITreader. From this point, the transponder must be positioned for the whole duration of an operating mode selection process.

[2] User program with elements/blocks to

- Monitor and evaluate authorisation
- Monitor and evaluate operating mode selection
- Feedback various data and information to the visualisation system for evaluation

[3] Selection of a mode of safe operation (MSO(x))

When an operator selects a mode of safe operation, the visualisation system enters the relevant code into the corresponding BTN register of the holding register (Start address + offset 0 … Start address + offset 14_D).

The operating mode selection is evaluated in the user program. If there are no errors, the operating mode selection is considered to be "preselected" until it is operated. The user program enters the relevant code as feedback into the input register's SEL register (start address + offset 0).

[4] Evaluation of the data fed back via the visualisation system

The visualisation system reads the data fed back from the input register and evaluates the data. The light element belonging to the preselected operating mode changes colour.

At this point, either another operating mode can be selected, the preselected operating mode can be confirmed or the operating mode selection can be cancelled.

[5] Confirm preselected mode of safe operation

To confirm a preselected operating mode, the operator must press the button provided on the display unit. The visualisation system enters the relevant code into the holding register's CONFIRM register (Start address + offset 16_D).

[6] The selected mode of safe operation is displayed on the display unit of the visualisation system

If there are no errors, the safety controller adopts the selected operating mode. The user program sets the relevant bit in the input register's MSO_DISP register (Start address + offset 3_D). The visualisation system reads the feedback from the input register and displays the selected mode of safe operation until the next change of operating mode.

7.2 Requirements of an appropriate visualisation system

A visualisation system, consisting of a display unit and a customised visualisation application, created using visualisation software, must meet various requirements in order for it to be labelled "appropriate".

- With each release, the measures required for T3 offline software tools must be met in accordance with IEC 61508-3.
- The customised visualisation application must have a unique title. The unique title may consist of a name and version, for example.
- Logging of operating mode selection

  The customised visualisation application must log all the actions involved in operating mode selection. Recommendations for the procedure can be found under Logging [📖 80].
- Data exchange via Modbus/TCP

  Modbus/TCP is used to exchange data between the visualisation system and safety controller.
  When a button is operated on the display unit, this event must be entered in the safety controller's holding register. The visualisation system must read data signalled by the safety controller from the safety controller's input register. Further information is available under Configure Modbus/TCP connections to the safety controller [📖 63].
- Behaviour when the visualisation system is started

  When started, the visualisation system must calculate a check sum via the safety-related parameters and enter the check sum in the holding register's CHECKSUM register. Further information is available under Structure and content of the holding register (4x) [📖 64] - Start address + Offset 21_D.
- Display of system information

  We recommend that the system information provided by the safety controller is displayed on the display unit.
  The safety controller enters the system information in the input register's SYS_INFO register (see Structure and content of the input register (3x) [📖 67] - Start address + offset 5_D).
- Display of system errors

  We recommend that system errors provided by the safety controller are displayed on the display unit.
  The safety controller enters the system errors in the input register's SYS_ERROR register (see Structure and content of the input register (3x) [📖 67] - Start address + offset 4_D).

- Display of operating errors

  We recommend that operating errors provided by the safety controller are displayed on the display unit.
  The safety controller enters the operating errors in the input register's USER_ERROR register (see Structure and content of the input register (3x) [📖 67] - Start address + offset 6_D).

- Components for selecting the operating mode

  The components for selecting the operating mode (buttons) are controlled via the input register's BTN_EN register on the safety controller.
  (see Structure and content of the input register (3x) [📖 67] - Start address + offset 2_D: Bit 0 … Bit 7).

  Note:

  – Buttons for selecting operating modes

    The bit associated with a button must be evaluated on the display unit. While the bit is at "0", the button must be disabled to the operator, as in this case the operator does not have permission to select the operating mode. The safety controller (element/block) registers an error if the button is operated in this case.

    Bit(x) = "0", the button is disabled

    Bit(x) = "1", the button is enabled

  – Option for buttons for selecting service modes

    With buttons used to select a service mode, it may be helpful to disable and hide the buttons while the corresponding bit is set to "0".

    In this case, the buttons can be enabled and shown as soon as the corresponding bit is set to "1".

- Separate components for selecting an operating mode (button) and for displaying a selected operating mode (light element)

  Different components must be available for selecting a mode of safe operation (MSO) and for the corresponding display of the selected mode of safe operation. This requirement can be met, for example, through selection buttons and separate indicator lights for displaying the selected operating mode.

- Light elements for displaying the selected operating mode

  – There should be a light element on the display unit, close to the respective button.

  – The light elements are controlled by the input register's MSO_DISP register (see Structure and content of the input register (3x) [📖 67] - Start address + offset 3_D) and are read and evaluated by the visualisation system:

    Bit 0 … 7: Static illumination of the corresponding light element

    Bit 8 ... 15: Flashing of the corresponding light element

- Prevention of unintended operating mode selection

  Prevent unintended operating mode selection by providing sufficient distance between the buttons, for example.

- Codes when selecting operating modes

  When a button is operated to select an operating mode, the visualisation system must write the established code for the assigned mode of safe operation into the holding register's corresponding BTN_<*x*> register (see Structure and content of the holding register (4x) [📖 64] - Start address + offset 0 … Start address + offset 14_D and Codes in the holding register (4x): Selected operating mode [📖 73]).

  When the button is released, the visualisation system must reset the content of the corresponding BTN_<*x*> register to "0".

- Codes when resetting a preselected mode of safe operation

  An operating mode is considered to be "preselected" when the operating mode has been selected but not confirmed, or the operating mode selection has been cancelled.

  After a mode of safe operation has been selected and the code has been transmitted to the safety controller, the safety controller enters a relevant code into the input register's SEL register as feedback (see Structure and content of the input register (3x) [📖 67] - Start address + offset 0). The visualisation system must evaluate this code that is fed back (see Codes in the input register (3x): Feedback on the selected operating mode [📖 77]). If there are no errors, the light element for the preselected operating mode must assume a different background colour.

  Note: The light element for the active operating mode must not change its state.

- Buttons for confirming and cancelling a preselected operating mode

  A "Confirmation" button and "Cancel" button for a preselected operating mode must be available on the display unit. The buttons are controlled via the input register's BTN_EN register (see Structure and content of the input register (3x) [📖 67] - Start address + offset 2_D: Bit 8 … Bit 9).

  Please note the following requirements:

  – The "Confirmation" and "Cancel" buttons must be hidden when the relevant bit is set to "0"; i.e. the button is hidden when

    - "Confirmation" button: Start address + offset 2_D, Bit 8 = 0

    - "Cancel" button: Start address + offset 2_D, Bit 9 = 0

  – The "Confirmation" and "Cancel" buttons must be shown when the relevant bit is set to "1"; i.e. the button is shown when

    - "Confirmation" button: Start address + offset 2_D, Bit 8 = 1

    - "Cancel" button: Start address + offset 2_D, Bit 9 = 1

- Codes when confirming

  When the "Confirmation" button is operated, the visualisation system enters the relevant code into the holding register's CONFIRM register (see Structure and content of the holding register (4x) [📖 64] - Start address + offset 23_D and Codes in the holding register (4x): Confirmation of the selected operating mode [📖 76]).

  When the button is released, the visualisation system must reset the content of the CONFIRM register to "0".

▶ Cancel procedure

Buttons for "Cancel YES" and "Cancel NO" must be available when selecting the operating mode. The buttons are controlled via the input register's BTN_EN register (see Structure and content of the input register (3x) [📖 67] - Start address + offset 2_D: Bit 10 … Bit 11).

Please note the following requirements:

– The "Cancel YES" and "Cancel NO" buttons must be hidden when the relevant bit = 0; i.e. the button is hidden when
  - "Cancel YES" button: Start address + offset 2_D, Bit 10 = 0
  - "Cancel NO" button: Start address + offset 2_D, Bit 11 = 0

– The "Cancel YES" and "Cancel NO" buttons must be shown when the relevant bit = 1; i.e. the button is shown when
  - "Cancel YES" button: Start address + offset 2_D, Bit 10 = 1
  - "Cancel NO" button: Start address + offset 2_D, Bit 11 = 1

– When the buttons are shown, a message must also be displayed, which asks the operator for their consent. For example, the message may say: "Are you sure you want to cancel?".

– When the "Cancel YES" button is operated, the visualisation system must enter "1" into the holding register's CANCEL_YES register (Start address + offset 19_D.

– When the "Cancel NO" button is operated, the visualisation system must enter "1" into the holding register's CANCEL_NO register (Start address + offset 20_D.

7.3 Configure Modbus/TCP connections to the safety controller

Data is exchanged between the visualisation system and safety controller via Modbus/TCP connections.

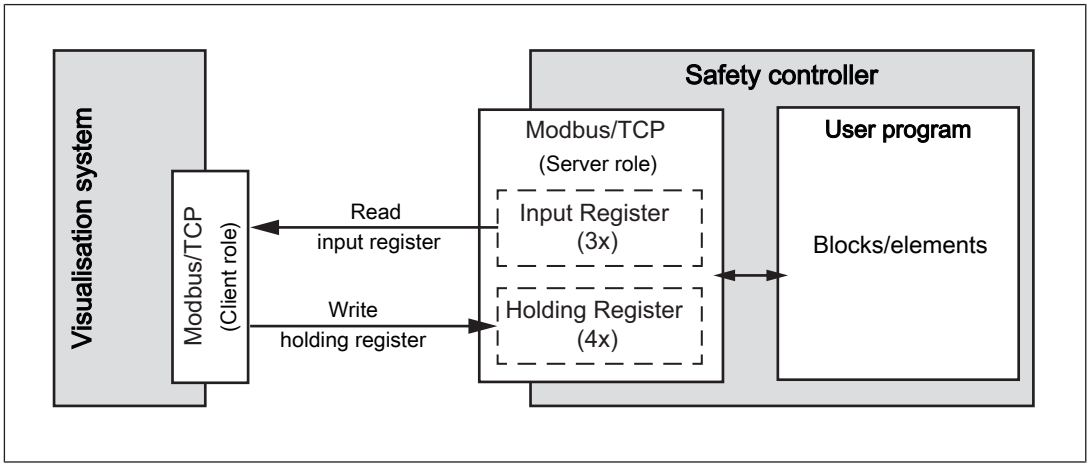


Fig.: Communication via Modbus/TCP (principle for 1 working area)

Requirements of Modbus/TCP connections

A Modbus/TCP send connection and Modbus/TCP receive connection must be configured on the visualisation system for each working area. The Modbus/TCP connections must have the following properties:

- When sending and receiving data, the visualisation system always has the Client role in the respective Modbus/TCP connection.
- Visualisation system's send data to the safety controller

  When various buttons are operated on the visualisation system's display unit (e.g. operating mode selection, confirmation, cancel), the visualisation system writes data to the safety controller's holding register (4x) via a Modbus/TCP connection. To ensure that the safety controller can evaluate the data correctly, the prescribed structure and content of the holding register must be observed (see Structure and content of the holding register (4x) [📖 64]).
- Visualisation system's receive data from the safety controller

  After a mode of safe operation has been selected, the visualisation system reads the feedback data from the safety controller's input register (3x) via a Modbus/TCP connection. Errors and further system information are also reported in the input register (3x). To ensure that the visualisation system can evaluate the data correctly, the prescribed structure and content of the input register must be observed (see Structure and content of the input register (3x) [📖 67]).

Maximum cycle time of a Modbus/TCP connection

The safety controller monitors a button's actuation time. During cyclical data exchange with the safety controller, a Modbus/TCP connection on the visualisation system must not exceed the maximum cycle time of 250 ms.

7.4 Structure and content of the holding register (4x)

NOTICE

Processing rules

- The byte sequence in the register is Big Endian; i.e. on all values, the most significant byte is in the least significant memory address
- After a reset, all data words with coded content contain the value 0 (0x0000)

Start addresses in the holding register

The start address is a relative address.

- Safety controller PNOZmulti

  The start address is defined by the PNOZmulti Configurator. Information about determining the start address can be found under Start addresses when a safety controller PNOZmulti is used. [71].

- Safety controller from the automation system PSS 4000

  The start address can be configured. Information about determining the start address can be found under Start addresses when using a safety controller from the automation system PSS 4000 [72].

Safety controller's holding register

<table>
<tr><th rowspan="2">Offset for start address</th><th colspan="2">Data length</th><th rowspan="2">Register name</th><th rowspan="2" colspan="2">Meaning/content</th></tr>
<tr><th>WORD</th><th>BYTE</th></tr>
<tr><td>00_D</td><td>2</td><td>4</td><td>BTN_1</td><td colspan="2">Button for "Mode of safe operation 1"</td></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td>Action</td><td>Content</td></tr>
<tr><td>  </td><td>Code for "Mode of safe operation 1", while the button is operated
(see [1])</td></tr>
<tr><td>  </td><td>0</td></tr>
<tr><td>02_D
. . .
12_D</td><td>2
. . .
2</td><td>4
. . .
4</td><td>BTN_2
. . .
BTN_7</td><td colspan="2">Button for "Mode of safe operation 2"
. . .
Button for "Mode of safe operation 7"
(see [1])</td></tr>
</table>

Offset for start address	Data length		Register name	Meaning/content	
	WORD	BYTE			
14_D	2	4	BTN_8	Button for "Mode of safe operation 8"	
				Action	**Content**
					Code for "Mode of safe operation 8", while the button is operated (see [1])
					0
16_D	2	4	CONFIRM	Button for "Confirmation"	
				Action	**Content**
					Code for "Confirmation", while the button is operated (see [2])
					0
18_D	1	2	CANCEL	Button for "Cancel"	
				Action	**Content**
					1 (not coded), while the button is operated
					0
19_D	1	2	CANCEL_YES	Button for "Cancel YES"	
				Action	**Content**
					1 (not coded), while the button is operated
					0

<table>
<tr><th rowspan="2">Offset for start address</th><th colspan="2">Data length</th><th rowspan="2">Register name</th><th rowspan="2">Meaning/content</th></tr>
<tr><th>WORD</th><th>BYTE</th></tr>
<tr><td rowspan="4">20_D</td><td rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">CANCEL_NO</td><td colspan="2">Button for "Cancel NO"</td></tr>
<tr><td>Action</td><td>Content</td></tr>
<tr><td>  </td><td>1 (not coded), while the button is operated</td></tr>
<tr><td>  </td><td>0</td></tr>
<tr><td>21_D</td><td>1</td><td>2</td><td>CHECKSUM</td><td colspan="2">Check sum via the safety-related configuration values
A CRC16 algorithm must be used to calculate the check sum (polynomial: 0xC86C).
The check sum is formed via the following safety-related configuration values:
▸ Enabled MSOs (1 Byte)
Content: Bit 0 (MSO1) ... Bit 7 (MSO8)
▸ Working area (1 Byte)
▸ First service mode (1 Byte);
Content:
– 0 (no service modes used) or
– Number of the first service mode
For example see [3]</td></tr>
</table>

[1] The codes entered in the register BTN_1 … BTN_8 when selecting an operating mode can be found under Codes in the holding register (4x): Selected operating mode [📖 73]

[2] The codes entered in the CONFIRM register in order to confirm an operating mode selection can be found under Codes in the holding register (4x): Confirmation of the selected operating mode [📖 76]

[3] Calculation of a check sum (example)

Defaults for the safety-related configuration values:

- Enabled MSOs: 1 … 5

  i.e. Bit 0 (MSO1) ... Bit 7 (MSO8): 00011111 (0x1F)
- Working area (WA): 1 (0x01)
- First service mode: 5 (0x05)

These defaults result in the check sum:

$CRC16_{0xC86C}$ (0x1F 0x01 0x05) = 0xC7E0

7.5 Structure and content of the input register (3x)

NOTICE

Processing rules

- The byte sequence in the register is Big Endian; i.e. on all values, the most significant byte is in the least significant memory address
- After a reset, all data words with coded content contain the value 0 (0x0000)

Start addresses in the input register

The start address is a relative address.

- Safety controller PNOZmulti

  The start address is defined by the PNOZmulti Configurator. Information about determining the start address can be found under Start addresses when a safety controller PNOZmulti is used. [📖 71].

- Safety controller from the automation system PSS 4000

  The start address can be configured. Information about determining the start address can be found under Start addresses when using a safety controller from the automation system PSS 4000 [📖 72].

Safety controller's input register

Offset for start address	Data length (WORD)	Register name	Meaning/content	
00_D	2	SEL	Feedback from the preselected mode of safe operation	
			Content	**Meaning**
			0	No mode of safe operation preselected
			>0	Code for the preselected mode of safe operation (see [1])
02_D	1	BTN_EN	Enable buttons for selection and confirmation	
			Bit No.	**Meaning** (Bit = 1: Enable)
			0…7	Button for MSO(x) enabled; x: 1…8
			8	Button for "Confirmation" enabled
			9	Button for "Cancel" enabled
			10	Button for 2nd step, "Cancel: YES" enabled
			11	Button for 2nd step, "Cancel: NO" enabled
			12…15	*<Reserved>*
03_D	1	MSO_DISP	Selected mode of safe operation for the display	
			Bit No.	**Meaning** (Bit = 1: Display active)
			0…7	Static display for the selected mode of safe operation, with acknowledgement
			8…15	Flashing display for the selected mode of safe operation, without acknowledgement

Offset for start address	Data length (WORD)	Register name	Meaning/content	
04_D	1	SYS_ERROR	System error	
			Bit No.	**Meaning** (Bit = 1: Error present)
			0	Authentication error (from PITreader)
			1	*<Reserved>*
			2	Coding error when selecting the MSO
			3	Coding error when confirming
			4	Coding error when cancelling
			5…15	*<Reserved>*
05_D	1	SYS_INFO	System information	
			Bit No.	**Meaning** (Bit = 1: Information available)
			0	Transponder was removed
			1	Please remove transponder
			2	Fallback to mode of operation 1 will occur in a few seconds. Fallback can be prevented by positioning the transponder
			3	Acknowledgement missing
			4	System locked
			5	Configuration invalid (check sum error)
			6…15	*<Reserved>*

Offset for start address	Data length (WORD)	Register name	Meaning/content	
06_D	1	USER_ERROR	User error	
			Bit No.	**Meaning** (Bit = 1: Error present)
			0	The transponder does not have permission.
			1…7	*<Reserved>*
			8	Several buttons were operated when selecting, confirming or cancelling.
			9	The button was operated for too short a time when selecting, confirming or cancelling.
			10	The button was operated for too long a time when selecting, confirming or cancelling.
			11…15	*<Reserved>*
07_D	4	SID register	Security ID, 64 Bit	
11_D	1	CONFIRM_Counter	Counter with confirmed changes of the mode of operation Note: The counter is initialised with the value 0 and increased by 1 each time a change of the mode of operation has been confirmed. In the event of a counter overflow, the value 0 is skipped.	

[1] The codes fed back in the SEL register when an operating mode is selected can be found under Codes in the input register (3x): Feedback on the selected operating mode [📖 77]

7.6 Start addresses when a safety controller PNOZmulti is used.

With a safety controller PNOZmulti, the start address of a working area is defined by the PNOZmulti Configurator. This applies to both the input register (3x) and the holding register (4x).

Determine the respective start address as follows:

1. Switch to the project directory of the PNOZmulti Configurator.
2. Use a text editor to open the file ***visuModel.json*** in the file system under ***bin\pmimicro\visu***.
   - There is a section for each working area used within the project. You will recognise the section by the entry ***"blockType": "PITMODE_TOUCH_BLOCK".***
   - In the respective block there is a ***workingAreaINAddress*** (= Start address in the holding register (4x)) and a ***workinAreaOUTAddress*** (= Start address in the Input Register (3x)).
   - The address is a Modbus PDU address; i.e. start at "0".

Example:

Fig.: Extract from a ***visuModel.json*** file

Data length for a working area

Register	Data length per working area
Input register (3x)	12 words
Holding register (4x)	22 words

7.7 Start addresses when using a safety controller from the automation system PSS 4000

On a safety controller from the automation system PSS 4000, the start address for a working area is freely configurable. The lower limit for the start address is 1. This applies to both the input register (3x) and the holding register (4x).

Data length for a working area

Register	Data length per working area
Input register (3x)	12 words
Holding register (4x)	22 words

Example of determining start addresses

In the example, the start addresses are defined for 3 working areas on consecutive data areas and the register's minimum overall data length is determined.

Input register (3x):

Working area	Start address (lowest start address = 1)	Minimum overall data length
WA1	*<Start address WA1>*	36 words
WA2	*<Start address WA1>* + 12_D	
WA3	*<Start address WA1>* + 24_D	

Holding register (4x):

Working area	Start address (lowest start address = 1)	Minimum overall data length
WA1	*<Start address WA1>*	66 words
WA2	*<Start address WA1>* + 22_D	
WA3	*<Start address WA1>* + 44_D	

7.8 Codes in the holding register (4x): Selected operating mode

Depending on the configured working area, the safety controller expects one of the following codes from the visualisation system when an operating mode is selected (see Holding register (4x): BTN_1 register … BTN_8 register).

Working area	Mode of safe operation	Code (hexadecimal)
WA 1	MSO 1	0x0144C486
	MSO 2	0x0144C579
	MSO 3	0x0144FA89
	MSO 4	0x0144FB76
	MSO 5	0x014502B5
	MSO 6	0x0145034A
	MSO 7	0x01453CBA
	MSO 8	0x01453D45
WA 2	MSO 1	0x014E502C
	MSO 2	0x014E51D3
	MSO 3	0x014E6E23
	MSO 4	0x014E6FDC
	MSO 5	0x014F961F
	MSO 6	0x014F97E0
	MSO 7	0x014FA810
	MSO 8	0x014FA9EF
WA 3	MSO 1	0x017488EC
	MSO 2	0x01748913
	MSO 3	0x0174B6E3
	MSO 4	0x0174B71C
	MSO 5	0x01754EDF
	MSO 6	0x01754F20
	MSO 7	0x017570D0
	MSO 8	0x0175712F
WA 4	MSO 1	0x017E1C46
	MSO 2	0x017E1DB9
	MSO 3	0x017E2249
	MSO 4	0x017E23B6
	MSO 5	0x017FDA75
	MSO 6	0x017FDB8A
	MSO 7	0x017FE47A
	MSO 8	0x017FE585

Working area	Mode of safe operation	Code (hexadecimal)
WA 5	MSO 1	0x01848A1E
	MSO 2	0x01848BE1
	MSO 3	0x0184B411
	MSO 4	0x0184B5EE
	MSO 5	0x01854C2D
	MSO 6	0x01854DD2
	MSO 7	0x01857222
	MSO 8	0x018573DD
WA 6	MSO 1	0x018E1EB4
	MSO 2	0x018E1F4B
	MSO 3	0x018E20BB
	MSO 4	0x018E2144
	MSO 5	0x018FD887
	MSO 6	0x018FD978
	MSO 7	0x018FE688
	MSO 8	0x018FE777
WA 7	MSO 1	0x01B4C674
	MSO 2	0x01B4C78B
	MSO 3	0x01B4F87B
	MSO 4	0x01B4F984
	MSO 5	0x01B50047
	MSO 6	0x01B501B8
	MSO 7	0x01B53E48
	MSO 8	0x01B53FB7
WA 8	MSO 1	0x01BE52DE
	MSO 2	0x01BE5321
	MSO 3	0x01BE6CD1
	MSO 4	0x01BE6D2E
	MSO 5	0x01BF94ED
	MSO 6	0x01BF9512
	MSO 7	0x01BFAAE2
	MSO 8	0x01BFAB1D

Working area	Mode of safe operation	Code (hexadecimal)
WA 9	MSO 1	0x0256520B
	MSO 2	0x025653F4
	MSO 3	0x02566C04
	MSO 4	0x02566DFB
	MSO 5	0x02579438
	MSO 6	0x025795C7
	MSO 7	0x0257AA37
	MSO 8	0x0257ABC8
WA 10	MSO 1	0x025CC6A1
	MSO 2	0x025CC75E
	MSO 3	0x025CF8AE
	MSO 4	0x025CF951
	MSO 5	0x025D0092
	MSO 6	0x025D016D
	MSO 7	0x025D3E9D
	MSO 8	0x025D3F62

7.9 Codes in the holding register (4x): Confirmation of the selected operating mode

Depending on the configured working area, the safety controller expects one of the following codes from the visualisation system to confirm the selected operating mode (see Holding register (4x): CONFIRM register).

Working area	Confirmation code (hexadecimal)
WA 1	0x00F1C4C1
WA 2	0x00F1C53E
WA 3	0x00F1FACE
WA 4	0x00F1FB31
WA 5	0x00F648A7
WA 6	0x00F64958
WA 7	0x00F676A8
WA 8	0x00F67757
WA 9	0x00F78E94
WA 10	0x00F78F6B

7.10 Codes in the input register (3x): Feedback on the selected operating mode

Depending on the configured working area, the safety controller provides one of the following codes to the visualisation system as feedback, after an operating mode has been selected (see Input register (3x): SEL register).

Working area	Selected mode of safe operation	Feedback code (hexadecimal)
WA 1	MSO 1	0x01481A79
	MSO 2	0x01481B86
	MSO 3	0x01482476
	MSO 4	0x01482589
	MSO 5	0x0149DC4A
	MSO 6	0x0149DDB5
	MSO 7	0x0149E245
	MSO 8	0x0149E3BA
WA 2	MSO 1	0x0172C2B9
	MSO 2	0x0172C346
	MSO 3	0x0172FCB6
	MSO 4	0x0172FD49
	MSO 5	0x0173048A
	MSO 6	0x01730575
	MSO 7	0x01733A85
	MSO 8	0x01733B7A
WA 3	MSO 1	0x01785613
	MSO 2	0x017857EC
	MSO 3	0x0178681C
	MSO 4	0x017869E3
	MSO 5	0x01799020
	MSO 6	0x017991DF
	MSO 7	0x0179AE2F
	MSO 8	0x0179AFD0

Working area	Selected mode of safe operation	Feedback code (hexadecimal)
WA 4	MSO 1	0x0182C04B
	MSO 2	0x0182C1B4
	MSO 3	0x0182FE44
	MSO 4	0x0182FFBB
	MSO 5	0x01830678
	MSO 6	0x01830787
	MSO 7	0x01833877
	MSO 8	0x01833988
WA 5	MSO 1	0x018854E1
	MSO 2	0x0188551E
	MSO 3	0x01886AEE
	MSO 4	0x01886B11
	MSO 5	0x018992D2
	MSO 6	0x0189932D
	MSO 7	0x0189ACDD
	MSO 8	0x0189AD22
WA 6	MSO 1	0x01B28C21
	MSO 2	0x01B28DDE
	MSO 3	0x01B2B22E
	MSO 4	0x01B2B3D1
	MSO 5	0x01B34A12
	MSO 6	0x01B34BED
	MSO 7	0x01B3741D
	MSO 8	0x01B375E2
WA 7	MSO 1	0x01B8188B
	MSO 2	0x01B81974
	MSO 3	0x01B82684
	MSO 4	0x01B8277B
	MSO 5	0x01B DEB8
	MSO 6	0x01B9DF47
	MSO 7	0x01B9E0B7
	MSO 8	0x01B9E148

Working area	Selected mode of safe operation	Feedback code (hexadecimal)
WA 8	MSO 1	0x0250185E
	MSO 2	0x025019A1
	MSO 3	0x02502651
	MSO 4	0x025027AE
	MSO 5	0x0251DE6D
	MSO 6	0x0251DF92
	MSO 7	0x0251E062
	MSO 8	0x0251E19D
WA 9	MSO 1	0x025A8CF4
	MSO 2	0x025A8D0B
	MSO 3	0x025AB2FB
	MSO 4	0x025AB304
	MSO 5	0x025B4AC7
	MSO 6	0x025B4B38
	MSO 7	0x025B74C8
	MSO 8	0x025B7537
WA 10	MSO 1	0x02605434
	MSO 2	0x026055CB
	MSO 3	0x02606A3B
	MSO 4	0x02606BC4
	MSO 5	0x02619207
	MSO 6	0x026193F8
	MSO 7	0x0261AC08
	MSO 8	0x0261ADF7

7.11 Logging

It is possible to log certain events and store them in a log memory. The log entries can be created by evaluating various register entries from the input register.

The following events can be logged, for example:

- Change of operating mode without additional acknowledgement of the selected operating mode
- Change of operating mode with additional acknowledgement of the selected operating mode
- Fallback to operating mode 1

NOTICE

Implementation of a log memory and logging

It is the customer's responsibility to implement a log memory and evaluate register entries correctly in order to generate a log entry.

Where possible, we recommend that the log memory and the log entries meet the following requirements:

- Log memory with a storage capacity of at least 10000 log entries
- Log entries protected against manipulation
- If possible, only changes of operating mode should be logged in the log memory.
- Log entries that are generated simultaneously are prioritised

  Example:

  – Priority 1: Logging of a change of operating mode without additional acknowledgement
  – Priority 2: Fallback to operating mode 1
  – Priority 3: Logging of a change of operating mode with additional acknowledgement

7.11.1 Logging of a change of operating mode without additional acknowledgement

If additional acknowledgement is not activated, a change of operating mode is adopted immediately after it is confirmed ("Confirmation" button).

The input register's CONFIRM_Counter register is evaluated for logging (see Input register: Start address + offset 11_D). In this register, a confirmed change in operating mode ("Confirmation" button) is displayed by incrementing a counter.

NOTICE

Generate log entry when there is a change in operating mode

Each time a change in operating mode is confirmed ("Confirmation" button), the counter in the CONFIRM_Counter register is increased by 1. By evaluating the counter, a log entry can be generated with each increment.

If the CONFIRM_Counter register contains the value 0, it is not an intended change of operating mode. In this case, a log entry should not be generated. For example, the CONFIRM_Counter register contains the value 0 during initialisation and when the Modbus/TCP connection is lost. In the event of a counter overflow, the value 0 is skipped.

The MSO_DISP register and the SID register can be evaluated for the content of a log entry. The input register's MSO_DISP register contains the selected operating mode. The input register's SID register contains the security ID of the transponder that is used.

We recommend that a log entry is generated with the following information:

Information	Information source
Selected mode of safe operation (MSO)	Input register (3x): MSO_DISP (Start address + offset 3_D) Evaluation: ▸ Bit 0 … 7 (without acknowledgement), if none of the Bits 8 … 15 is set; otherwise ▸ Bit 8 ... 15 (with acknowledgement)
Working area (WA)	See configuration of elements/blocks
Security ID	Input register: SID register (Start address + offset 7_D)
Time stamp	Use of local system time (e.g. visualisation system's time)

7.11.2 Logging of a change of operating mode with additional acknowledgement

You can use an additional acknowledgement to ensure that a new operating mode selection only takes effect once any process that is still running has been completed.

- PNOZmulti: see Acknowledge [21]
- PSS 4000: see Acknowledge [40]

The input register's MSO_DISP register is evaluated for logging. As soon as the acknowledgement signal is present, the register switches to the selected, acknowledged operating mode; i.e. Bits 0 … 7 of the MSO_DISP register change depending on the selected mode of safe operation.

The MSO_DISP register can be evaluated for the content of a log entry, as the register contains the selected, acknowledged operating mode.

We recommend that a log entry is generated with the following content:

Information	Information source
Selected mode of safe operation (MSO)	Input register: MSO_DISP (Start address + Offset 3_D) Evaluation: - Bit 0 ... 7 (with acknowledgement)
Working area (WA)	See configuration of elements/blocks
Time stamp	Use of local system time (e.g. visualisation system's time)

Note:

Acknowledgement does not take place until the current process has been completed, and is independent of the operator. When the acknowledgement signal appears, the SID register may be empty, or may contain another Security ID.

7.11.3 Logging a fallback to mode 1

The behaviour when a transponder is removed can be configured so that a fallback to operating mode MSO1 takes place.

- PNOZmulti: see Behaviour when the transponder is removed [📖 20]
- PSS 4000: see Behaviour when the transponder is removed [📖 39]

The input register's SID register and MSO_DISP register are evaluated for logging. A log entry can take place when all the following conditions are met:

Input register	Content
SID register (Start address + 7_D)	0
MSO_DISP (Start address + 3_D)	Bits 8 … 15 or Bits 0 … 7 switch to the mode of safe operation MSO1. Note: Neither Bits 8 … 15 nor Bits 0 … 7 can have been set to the mode of safe operation MSO1 immediately prior to the fallback to MSO1.

We recommend that a log entry is generated with the following content:

Information	Information source
Working area (WA)	See configuration of elements/blocks
Time stamp	Use of local system time (e.g. visualisation system's time)

7.12 Check lists

The following check lists are intended as an aid. The check lists contain minimum requirements and do not claim to be exhaustive. You can create your own check lists or documents with equivalent content at any time.

NOTICE

The structure and content of the check lists depend on the application. In principle, the check lists or the documents you create yourself must cover the requirements and subject areas resulting from the application-dependent risk analysis. The customer has sole responsibility for implementing safety-related applications carefully, in compliance with the standards.

7.12.1 Check operating mode selection and working areas

When commissioning it is essential to check the selection of all modes of safe operation (MSOs) and working areas. The check must cover all changes of operating modes and working areas.

Check	confirmed:
Does the check use a transponder that has permission for all changes of operating mode?	☐
Does commissioning include a check in which, depending on the application, all modes of safe operation (MSOs) are selected and confirmed ("Confirmation" button)?	☐
Does this check include the following test requirements in particular?	
▸ Is the preselected mode of safe operation displayed correctly to the operator?	☐
▸ Can each preselected mode of safe operation be confirmed ("Confirmation" button)?	☐
▸ Acknowledgement is not configured: Is the selected mode of safe operation displayed correctly to the operator?	☐
▸ Acknowledgement is configured: – Is the selected but unacknowledged mode of safe operation displayed correctly to the operator? – Is the selected and acknowledged mode of safe operation displayed correctly to the operator?	☐

7.12.2 Check cancellation of an operating mode selection

When commissioning it is essential to check the cancellation of an operating mode selection.

Check	confirmed:
Does commissioning include a check in which a mode of safe operation is selected and the preselected operating mode is cancelled ("Cancel" button)?	☐
Does this check include the following test requirements in particular?	
▸ After a mode of safe operation is selected, is the "Cancel" button displayed close to the "Confirmation" button?	☐
▸ After the "Cancel" button is operated, are the "Cancel Yes" and "Cancel No" buttons displayed in a second step?	☐
▸ Does operation of the "Cancel No" button lead back to the enabling of the "Confirmation" and "Cancel" buttons?	☐
▸ When the "Cancel Yes" button is operated, is the preselected mode of safe operation reset and are the "Confirmation" and "Cancel" buttons hidden?	☐

7.12.3 Check the ergonomics of the visualisation

When commissioning it is essential to check the ergonomics of the visualisation system.

Check	confirmed:
Does commissioning include a check that examines the ergonomics of the visualisation system?	☐
Does this check include the following test requirements in particular?	
▸ Is a check carried out to ensure that there is sufficient distance between the buttons? Note: During application-specific interaction with the visualisation system, it must be guaranteed that other buttons are not operated unintentionally. Example: When selecting an operating mode, several buttons must **not** be operated simultaneously.	☐

7.12.4 Monitoring of the operation period Check

When commissioning it is essential to check whether implementation of the visualisation system compromises the monitoring function of the safety controller, when a button is operated.

Check	confirmed:
Does commissioning include a check that examines a button's operation period?	☐
Does this check include the following test requirements in particular?	
▸ Is there a check to establish whether the safety controller sets Bit 9 in the USER_ERROR register (Input register: Start address + 06_D) if a button is operated for less than 500 ms?	☐
▸ Is there a check to establish whether the safety controller sets Bit 10 in the USER_ERROR register (Input register: Start address + 06_D) if a button is operated for more than 5 s?	☐

7.12.5 Check logging of the change of operating mode

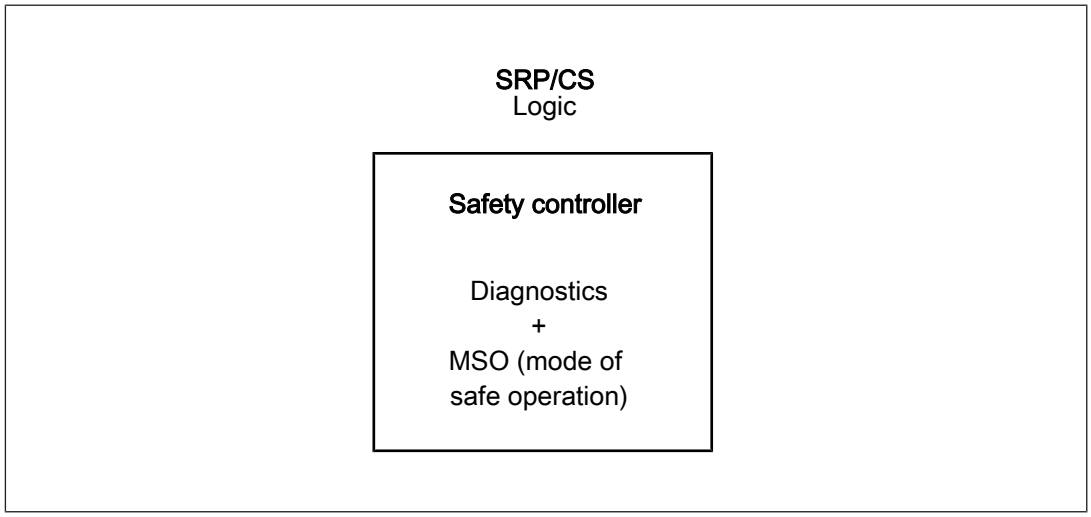
When logging is implemented in the visualisation system, it is essential to check during commissioning whether the log entries are generated correctly.

Check	confirmed:
Does commissioning include a check that examines the generation of log entries?	☐
Does this check include the following test requirements in particular?	
▸ When switching to a different mode of safe operation, is there a check to establish whether confirmation of the selection ("Confirmation" button) generates a corresponding log entry?	☐
▸ Acknowledgement is configured: When switching to a different mode of safe operation, is there a check to establish whether the acknowledgement generates a corresponding log entry?	☐
▸ Fallback to mode 1 is configured: Is there a check to establish whether the fallback to mode 1 generates a corresponding log entry?	☐

8 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, “Access and operating mode selection” subsystem



INFORMATION

As the residual error rate Λ of the communication system (Modbus/TCP) contributes to no more than 1 % of the safety function's total probability of failure, it can be ignored when calculating the safety characteristic data for the "operating mode selection" safety function and does not need to be added to the SRP/CS.

INFORMATION

The probability of failure of the access device and the visual selection device does not need to be included in the calculation of the safety function's probability of failure.

INFORMATION

A safety function's SIL/PL values are **not** identical to the SIL/PL values of the products used and may differ from these.

Support

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1005364-EN-09, 2025-11 Printed in Germany

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