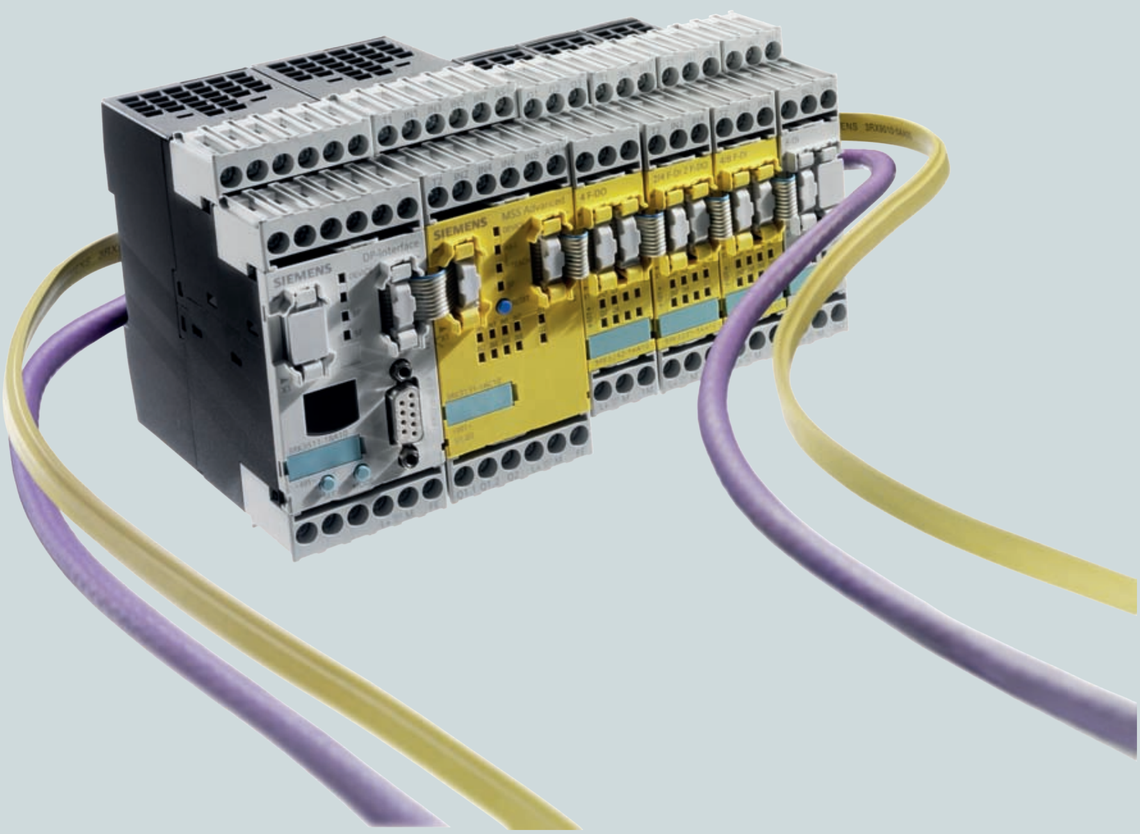
Safety systems

Modular Safety System 3RK3

System Manual · 06/2012



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Safety systems
Modular Safety System 3RK3

System Manual

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the relevant information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Order number: 3ZX1012-0RK31-1AC1
Ⓟ 06/2012 Technical data subject to change

Table of contents

About this manual 1

1.1 What's new?

Two new central units with AS-i interface

Two other 3RK3 central units with AS-i interface are available in addition to the MSS 3RK3 Advanced:

- 3RK3 ASIsafe basic
- 3RK3 ASIsafe extended

Both support the same function elements as the 3RK3 Advanced central unit. The differences between these three central units are listed in the table:

Feature	3RK3 ASIsafe basic	3RK3 ASIsafe extended	3RK3 Advanced
Safety-related, freely parameterizable sensor inputs	2	4	8
Digital standard inputs (single-channel)	6	4	0
Safety-related, redundant relay outputs	1	1	1
Safety-related, redundant semiconductor outputs	1	1	1
Expansion modules	0	2	9
Maximum number of simulated safety-related AS-i slaves	8	10	12
DP interface	Yes	Yes	Yes
Diagnostics module	Yes	Yes	Yes

Service Pack SP3 for MSS ES

A new SP3 is available for MSS ES, see Chapter "What's new? (Page 143)".

1.2 Purpose of this manual

This manual contains a detailed description of the 3RK3 Modular Safety System (abbreviated to MSS 3RK3) and its components. This manual provides you with the information you require for configuring, commissioning, operating, and diagnosing the MSS 3RK3. A typical safety application will provide you with a clear and practice-oriented introduction to the system.

1.3 Required basic knowledge

A general knowledge of the following areas is needed in order to understand this manual:

- Low-voltage switchgear
- Digital circuit logic
- Automation systems
- Safety systems

1.4 Topics dealt with

This manual consists of instructive chapters for reference purposes. The table below contains a list of the most important topics dealt with, along with their associated target groups.

Subject	Target group
Overview	Configuration engineers, planning engineers
Getting Started	Configuration engineers, planning engineers
Description of the hardware: • Mounting / installing / attaching • Connecting / wiring	Configuration engineers, planners, installation engineers, electricians, service and maintenance personnel
Description of the software (Parameterizing, configuring)	Configuration engineers
Operation (Response times, commissioning, tips and tricks, PROFIBUS connection, AS-i connection)	Configuration engineers, commissioning engineers, installation engineers, service and maintenance personnel
Diagnostics / service	Configuration engineers, service and maintenance personnel
Technical data	Configuration engineers
Dimension drawings	Configuration engineers

1.5 Validity range

This manual is valid for the MSS 3RK3 components listed below with their order numbers:

Component	Order No.
3RK3 Basic (central unit)	3RK3111-xAA10
3RK3 Advanced (central unit)	3RK3131-xAC10
3RK3 ASIsafe basic (central unit)	3RK3121-xAC00
3RK3 ASIsafe extended (central unit)	3RK3122-xAC00
4/8F-DI (expansion module)	3RK3211-xAA10
2/4F-DI 1/2F-RO (expansion module)	3RK3221-xAA10
2/4F-DI 2F-DO (expansion module)	3RK3231-xAA10
4F-DO (expansion module)	3RK3242-xAA10
4/8F-RO (expansion module)	3RK3251-xAA10
8DI (expansion module)	3RK3321-xAA10
8DO (expansion module)	3RK3311-xAA10
DP interface (interface module)	3RK3511-xBA10
Diagnostics display	3RK3611-3AA00
MSS ES (parameterization software)	3ZS1314-*

x = 1: Version with screw-type terminals:

x = 2: Version with spring-loaded terminals:

SIEMENS reserves the right of including a Product Information for each new component, and for each component of a later version.

1.6 Additional documentation

If you use products other than those described in this manual, you also require further documentation:

Note

Manuals for other products used

The manuals are available in the Internet (www.siemens.com/industrial-controls/manuals) for downloading free of charge.

Manual	Download / order number
AS-Interface System Manual	3RK2703-3BB02-1AA1
SIRIUS Safety Integrated Manual (SIAM)	L3-Z333
SIMATIC NET PROFIBUS Network Manual	C79000-G8900-C124-03

Note

Latest information

For the latest information on MSS 3RK3 (e.g. FAQ), see the Internet (http://support.automation.siemens.com/WW/view/en/4000024).

1.7 Evaluation of safety functions

Safety Evaluation Tool

The Safety Evaluation Tool from Siemens for EN 62061 and EN ISO 13849-1 supports you in evaluating the safety functions of your machine. The TÜV-tested online tool guides you step by step, from specifying the structure of the safety system and selecting the components to determining the achieved safety integrity (SIL /PL). The final result is a report in conformance with the standards that you can integrate as proof of safety into the documentation.

Safety Integrated

The Safety Evaluation Tool is part of Safety Integrated, the intelligent safety solution from Siemens featuring a complete product line. Our certified safety technology complies with all relevant standards and is already contained in the Safety Evaluation Tool.

Reference

The free Safety Evaluation Tool can be found at:

http://www.siemens.com/safety-evaluation-tool/

For more information on how to increase safety and productivity, go to:

www.siemens.com/safety-integrated

1.8 User responsibility for system design and function

The products described here were developed to perform safety-related functions as part of an overall installation or machine.

A complete, safety-related system is generally equipped with sensors, evaluation units, and signaling units, and uses reliable shutdown concepts.

It is the responsibility of the manufacturer to ensure that the system or machine is functioning properly as a whole.

Siemens AG, its regional offices, and associated companies (hereinafter referred to as "Siemens") cannot guarantee all the properties of a whole installation or machine that has not been designed by Siemens.

Nor can Siemens assume liability for recommendations that appear or are implied in the following description. No new guarantee, warranty, or liability claims beyond the scope of the Siemens general terms of supply are to be derived or inferred from the following description.

1.9 Definitions

"MSS 3RK3" always refers to all versions of the 3RK3 Modular Safety System.

1.10 Correction sheet

The appendix to this manual contains a correction sheet for evaluation and feedback. Please use it to record your suggestions for improvements, additions and corrections, and return the sheet to us. This will help us to improve the next edition of the manual.
Thank you.

Product-specific information 2

2.1 General safety notes

Note

SIL 3 as per EN 61508

PL e as per EN ISO 13849-1

The design of the 3RK3 modular safety system allows implementation of applications up to SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

CAUTION
Protection against electrostatic charge When handling and installing the MSS components, ensure that the components are protected from being electrostatically charged. Changes to the system configuration and wiring are only permissible while the supply voltage is switched off. The connection of MSS 3RK3 central units is only permissible when the power sections (PELV and SELV) are switched off.

WARNING
Hazardous voltage **Will Cause Death, Serious Injury or Property Damage** **Installing devices in control cabinets** Taking the ambient conditions into account, you must install the devices in control cabinets with the IP32, IP43 or IP54 degree of protection.

CAUTION
Noise immunity/grounding The following must be grounded in accordance with the regulations in order to ensure noise immunity of the MSS components: • MSS components • PELV / SELV power supply units (also note the documentation for the respective power supply unit in this regard). The PROFIBUS must be grounded in accordance with the installation guidelines for PROFIBUS networks (see the PROFIBUS manual).

NOTICE
Operational faults and malfunctions in communication
If the EMC Directive 2004/108/EC is not complied with when plants and devices are installed, communication breaks may occur.

Note

Cover all unused system interfaces.

2.2 Safety information for hazardous areas

WARNING
Hazardous Voltage.
Can Cause Death, Serious Injury, or Property Damage.
Installation of the MSS 3RK3 in hazardous areas
The components of the MSS 3RK3 are **not** suitable for the installation in hazardous areas. Please contact your explosion hazard specialist.

2.3 Guidelines for inductive loads

CAUTION
The outputs of the MSS 3RK3 do not feature internal inductive interference protection. If inductive loads are operated at the solid-state or relay outputs of the MSS 3RK3, they must be provided with inductive interference protection.

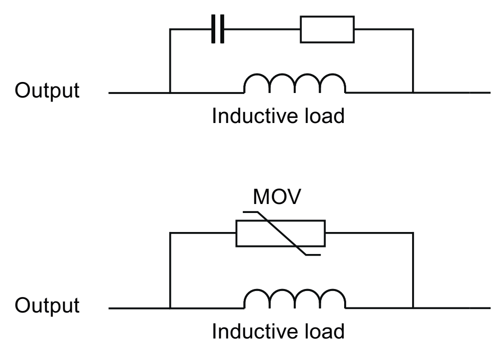
Inductive loads must be provided with protective circuits that limit the voltage rise when the controller output is switched off. Protective circuits protect the outputs against premature failure due to high inductive switched currents. They also limit the electrical faults that can occur when inductive loads are connected.

Note

The effectiveness of a protective circuit depends on the respective application and must always be checked on a case-by-case basis. The components in a protective circuit must always be rated in line with the relevant application.

Protective circuit for outputs that switch inductive loads

⚠ WARNING
Note that the system response time is made longer by the protective circuit.

The diagrams show examples of protective circuits for inductive loads. You will find details of protective circuits from SIEMENS in the catalog and the relevant documentation.	Example: Protective circuit for an inductive load 

⚠ WARNING
Hazardous Voltage. **Can Cause Death, Serious Injury, or Property Damage.** If you switch inductive loads with relay outputs of the MSS 3RK3, the external protective circuit must be installed parallel with the load. Connection in parallel with the relay contacts can prevent shutdown of the machine or process.

2.4 Intended use

WARNING
Hazardous voltage **Can Cause Death, Serious Injury, or Property Damage.** **Safe state (safety concept)** The basis of the safety concept is that a safe state exists for all process variables. In the case of the MSS 3RK3 modular safety system, this is the value "0". This applies to sensors and actuators. Note that the use of inverting functions either in the logic diagram or in the wiring outside the system may prevent the safe state from being reached.

WARNING
Hazardous voltage **Can Cause Death, Serious Injury, or Property Damage.** **Conduct a functional test of the system** To ensure the safety of the system, any changes to it or any replacement of defective components must be followed by a thorough and successfully completed function test of the system.

WARNING
Hazardous voltage **Will Cause Death, Serious Injury or Property Damage** **Test interval for safe AS-i input slaves** The calculated failure probabilities for safe transmission of AS-i input slaves is based on an actuation interval of one year. For this reason, all sensors that are recorded using safety-related AS-i input slaves must be actuated at least once every 12 months in order to test their function. If the mechanism of the safety-related AS-i input slaves is used for direct data exchange, a corresponding signal change must also take place here at least once every 12 months, same as for the safety-related AS-i input slaves.

WARNING

Hazardous voltage

Can Cause Death, Serious Injury, or Property Damage.

Proper use of hardware products

This equipment is only allowed to be used for the applications described in the catalog and in the technical description, and only in conjunction with non-Siemens equipment and components recommended by Siemens.

Correct transport, storage, installation and assembly, as well as careful operation and maintenance, are required to ensure that the product operates safely and without faults.

Before you run any sample programs or programs you have written yourself, make sure that running the plant cannot cause injury to anyone else or damage to the machine itself.

EU note regarding machine safety: Commissioning is absolutely prohibited until it has been ensured that the machine in which the component described here is to be installed complies with the stipulations of the Directive 2006/42/EC.

WARNING

Hazardous voltage

Can Cause Death, Serious Injury, or Property Damage.

Proper use of software products

The software may be used only for the applications described in the catalog or the technical description, and only in combination with the software products, components and devices of other manufacturers where recommended or permitted by Siemens.

Before you run any sample programs or programs you have written yourself, make sure that running the plant cannot cause injury to anyone else or damage to the machine itself.

2.5 Current information about operational safety

Important note for maintaining operational safety of your system

WARNING

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

Please take note of our latest information

Systems with safety-related characteristics are subject to special operational safety requirements on the part of the operator. The supplier is also obliged to comply with special product monitoring measures. For this reason, we publish a special newsletter containing information on product developments and features that are (or could be) relevant to operation of safety-related systems. By subscribing to the appropriate newsletter, you will ensure that you are always up-to-date and able to make changes to your system, when necessary:

SIEMENS newsletter (www.siemens.com/industrial-controls/newsletter)

Sign on to the following newsletter under "Products & Solutions":

- Control Components and System Engineering News
- Safety Integrated Newsletter

3 Overview

The 3RK3 Modular Safety System is a modular safety relay. Depending on the version of the external wiring with sensors and actuators, applications can be implemented up to SIL3 as per EN 61508 or PL e as per EN ISO 13849-1.

Application areas and use

- The MSS 3RK3 can be implemented in any protective application with three or more safety functions.
- The modular safety relay enables you to interconnect several safety applications with each other. In this way, you can set shutdown ranges, for example, and define other dependencies.
- With suitable safety-related expansion modules, you can adapt the system flexibly to the required safety application.
- With extensive fault diagnostic features and the provision of status information, faults can be quickly located and the commissioning and down times of the system reduced.
- Test operation for support during commissioning. Hier signals can be forced to test the logic processing or system sections already installed. That means that the signals in the logic can be set to 1 or 0, irrespective of the real signal.
- Fault diagnostics and status information can be transferred to higher-level bus systems (e.g., PROFIBUS DP) through an optional interface module.
- The 3RK3 central units with AS-i interface also perform the functions of an AS-i safety monitor. These central units can read in safety-related, standard, AB, and CTT3 data on the AS-i bus, control safe outputs on the AS-i bus, and simulate safety-related standard and AB slaves. Diagnostics of the system is possible through the AS-i using the CTT2 protocol.

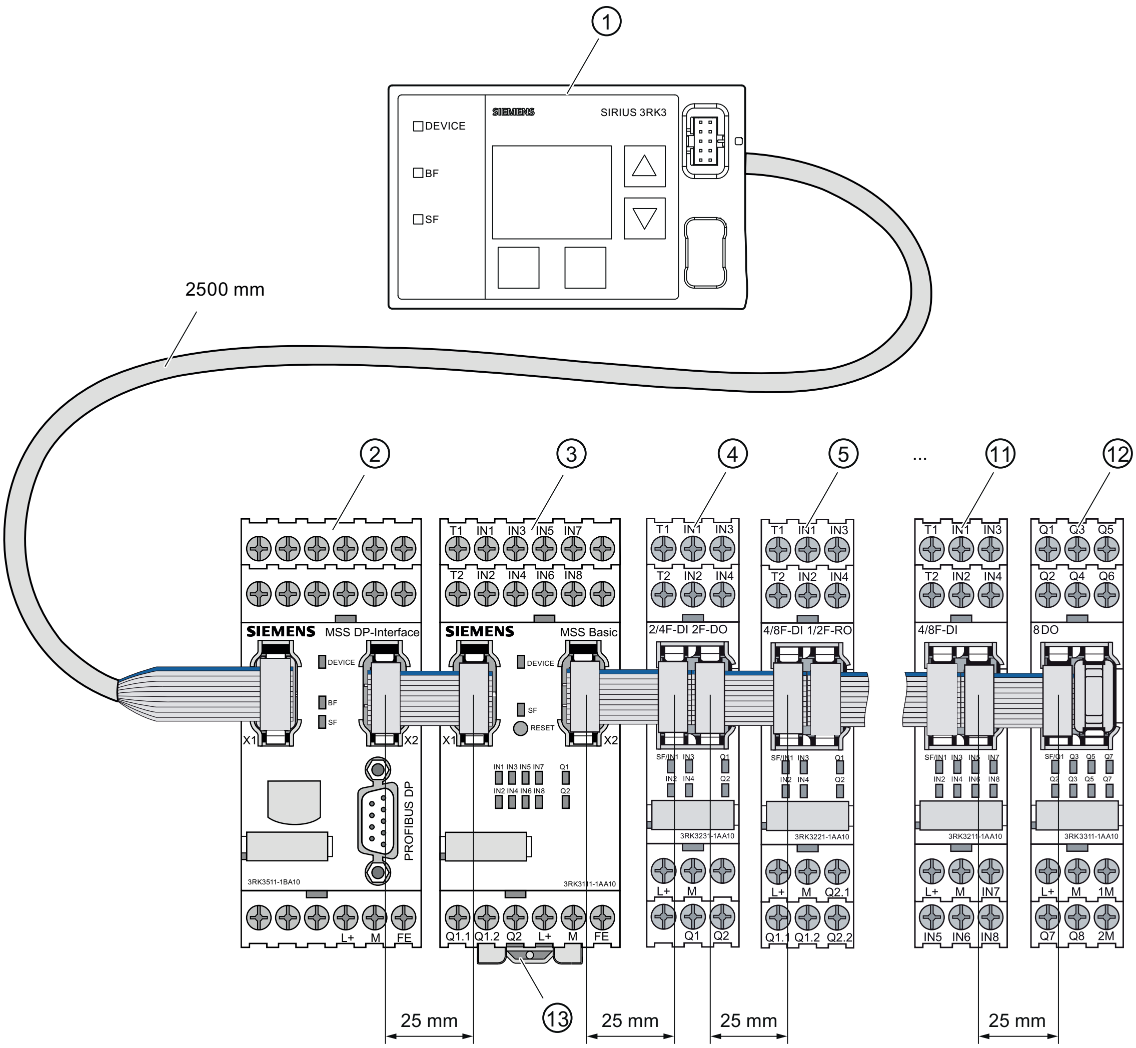
System components

The MSS 3RK3 consists of the following system components:

- Central unit
- Expansion modules
- Interface module
- Diagnostics display
- Parameterization software
- Accessories

3.1 A typical system configuration of the MSS 3RK3 main system

The following diagram shows a typical configuration of the MSS 3RK3 main system with the maximum cable lengths between individual modules. The system consists of a central unit, a number of expansion modules, an interface module, and a diagnostics display.



①	Diagnostics display
②	Interface module
③	Central unit
④ ... ⑫	Expansion modules:

- 0 for MSS 3RK3 ASIsafe basic
- Maximum of 2 for MSS 3RK3 ASIsafe extended
- Maximum of 7 for MSS 3RK3 Basic
- Maximum of 9 for MSS 3RK3 Advanced

⑬	Memory module

Figure 3-1 A typical system configuration of the MSS 3RK3 main system

3.2 A typical configuration of the subsystem with AS-Interface

The following central units can be integrated on the AS-i bus:

- MSS 3RK3 Advanced
- MSS 3RK3 ASIsafe basic
- MSS 3RK3 ASIsafe extended

In doing so the 3RK3 central unit can perform various functions:

- Monitoring of AS-i slaves
- Simulation of AS-i slaves
- Safety-related data exchange with other safety monitors (e.g., with further MSS 3RK3 units with AS-i interface)

Note

MSS 3RK3 bus load

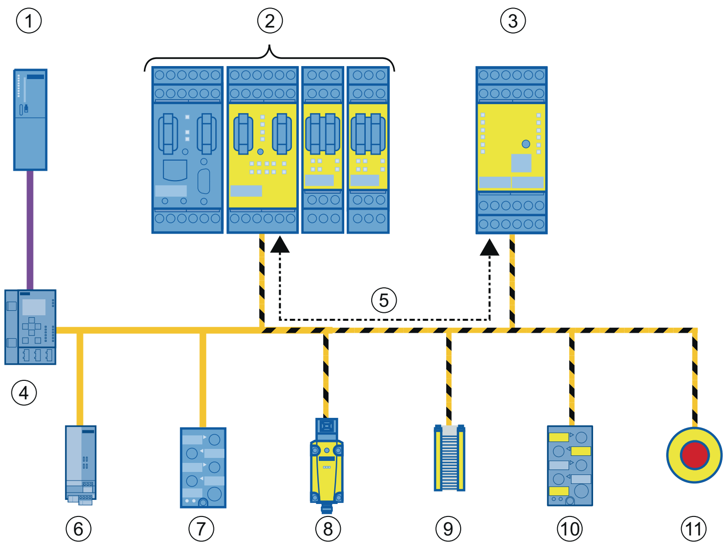
The MSS 3RK3 is always a bus load from an A/B slave on the AS-i bus. This bus load does not depend on how many slaves are simulated by the 3RK3 central unit or whether only AS-i slaves are monitored.

Some typical applications of the MSS 3RK3 with AS-i interface are described below. These examples are all represented with a 3RK3 Advanced central unit.. However, they apply equally to all other central units with AS-i interface. However, you must note the limitations on the number of expansion modules.

Integration of the MSS 3RK3 Advanced as an AS-i monitor on an AS-i bus

The MSS 3RK3 Advanced monitors the various safety-related and non-safety-related AS-i slaves as a safety monitor and exchanges up to 12 safety-related signals bidirectionally with an AS-i safety monitor.

Moreover, the MSS 3RK3 Advanced can mutually independently control up to 12 safety-related AS-i outputs (with up to 4 outputs).



(purple line)	PROFIBUS
(yellow line)	AS-Interface
(yellow/black line)	ASIsafe
①	CPU / PLC (optional)
②	MSS 3RK3 Advanced (The DP interface is optional.)
③	AS-i safety monitor
④	AS-i master
⑤	Data exchange with other safety monitors or MSS 3RK3 units with AS-i interface
⑥	AS-i power section
⑦ ... ⑪	Safety-related and non-safety-related AS-i slaves

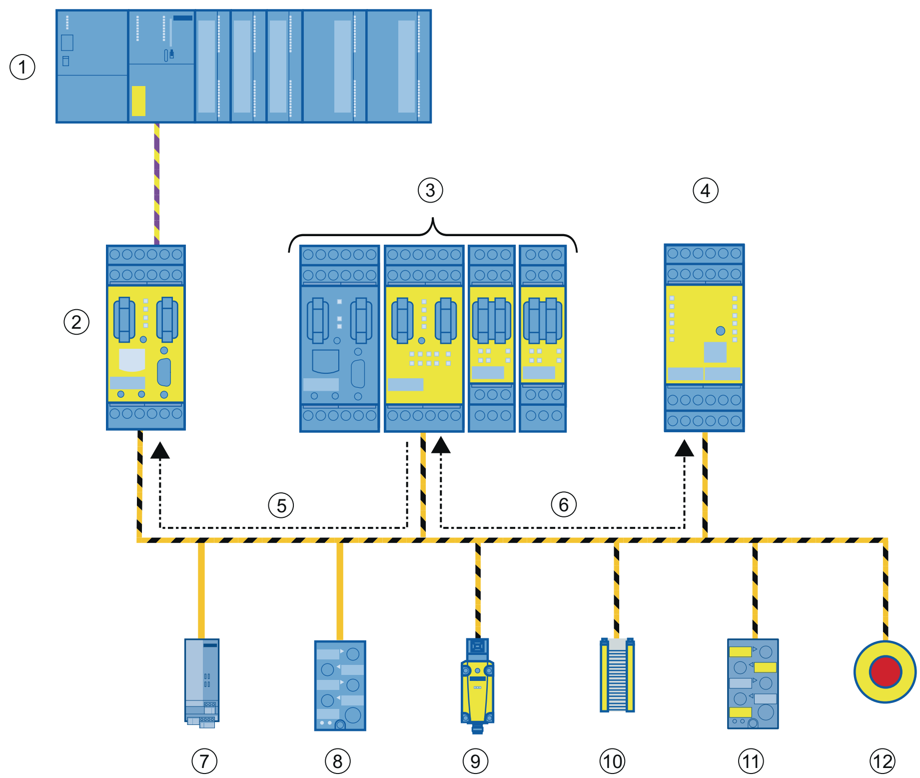
Figure 3-2 A typical system configuration with MSS 3RK3 Advanced as the safety monitor

Integration of the MSS 3RK3 Advanced into a higher-level, fail-safe control

The MSS 3RK3 Advanced monitors the various safety-related and non-safety-related AS-i slaves as a safety monitor and exchanges up to 12 safety-related signals bidirectionally with an AS-i safety monitor.

Moreover, the MSS 3RK3 Advanced can mutually independently control up to 12 safety-related AS-i outputs (with up to 4 outputs).

Up to 12 safety-related signals can be transmitted by the MSS 3RK3 Advanced to an F-PLC over the F-Link.



	AS-Interface
	PROFIBUS with PROFIsafe
	ASIsafe
①	F-PLC (optional)
②	DP / AS-i F-Link
③	MSS 3RK3 Advanced (The DP interface is optional)
④	AS-i safety monitor
⑤	Unidirectional data exchange between MSS 3RK3 Advanced and the F-Link
⑥	Data exchange between MSS 3RK3 Advanced and a safety monitor
⑦	AS-i power section
⑧ ... ⑫	Safety-related and non-safety-related AS-i slaves

Figure 3-3 A typical system configuration with MSS 3RK3 Advanced on an F-PLC

3.3 System components

Central units

For each system configuration, you require a 3RK3 central unit that you select appropriately for the specific application (e.g., 3RK3 Basic). For executing the safety functions, the 3RK3 central unit contains the parameterization data in a plug-in memory module. You can optionally connect the expansion modules and the interface module or the diagnostic display to the 3RK3 central unit.

The following table lists the properties of the 3RK3 central units:

Central unit	Inputs / outputs	Maximum number of expansion modules
3RK3 Basic Central unit with safety-related inputs and outputs	8 fail-safe digital inputs 1 two-channel fail-safe relay output 1 two-channel fail-safe digital output	7
3RK3 Advanced Central unit with safety-related inputs and outputs; AS-i connection; Monitor functionality; Simulation of AS-i slaves	8 fail-safe digital inputs 1 two-channel fail-safe relay output 1 two-channel fail-safe digital output Connection for AS-i bus	9
3RK3 ASIsafe basic Central unit with safety-related inputs and outputs; AS-i connection; Monitor functionality; Simulation of AS-i slaves	2 fail-safe digital inputs 6 digital standard inputs 1 two-channel fail-safe relay output 1 two-channel fail-safe digital output Connection for AS-i bus	0
3RK3 ASIsafe extended Central unit with safety-related inputs and outputs; AS-i connection; Monitor functionality; Simulation of AS-i slaves	4 fail-safe digital inputs 4 digital standard inputs 1 two-channel fail-safe relay output 1 two-channel fail-safe digital output Connection for AS-i bus	2

Expansion modules

You need expansion modules to adapt the MSS 3RK3 to the required application. You thereby supplement the 3RK3 central unit with additional safety-related inputs and outputs.

The following table lists the expansion modules and their properties:

Expansion module	Description	Inputs / outputs
4/8F-DI	Safety-related input module	8 fail-safe digital inputs
2/4F-DI 1/2F-RO	Safety-related mixed expansion module	4 fail-safe digital inputs 2 single-channel, fail-safe relay outputs
2/4F-DI 2F-DO	Safety-related mixed expansion module	4 fail-safe digital inputs 2 two-channel, fail-safe semiconductor outputs
4F-DO	Safety-related output module	4 fail-safe two-channel semiconductor outputs
4/8F-RO	Safety-related output module	8 fail-safe, single-channel relay outputs
8DI	Standard input module	8 digital standard inputs
8 DO	Standard output module	8 digital standard outputs

Interface modules

You need interface modules for exchanging data between the MSS 3RK3 and higher-level bus systems (e.g., PROFIBUS DP).

The DP interface has the following characteristics:

- The DP interface constitutes the interface between the MSS 3RK3 and an automation system over PROFIBUS DP.
- The interface module is connected to the 3RK3 central unit.
- A diagnostics display or a PC or programming device can be connected to the interface module.

Diagnostics display

With the diagnostics display, you can monitor and analyze the diagnostics and status data of the MSS 3RK3 and acknowledge errors locally or from a central location.

The diagnostics display has the following characteristics:

- The diagnostics display shows fault diagnostics and diagnostics information as plaintext on its display.
- The diagnostics display is intended to be installed in a control panel / control cabinet door and is connected to the 3RK3 central unit or, if there is one, to the interface module.
- If required, a PC or programming device can be connected to the diagnostics display.

Parameterization software

The MSS ES parameterization software is available in three license variants:

- Basic
- Standard
- Premium

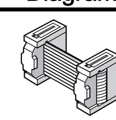
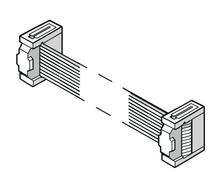
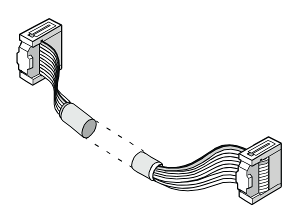
The MSS ES parameterization software provides a graphical editor (logic diagram) for entering, displaying, and performing diagnostics on the interconnection logic.

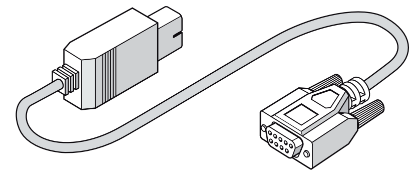
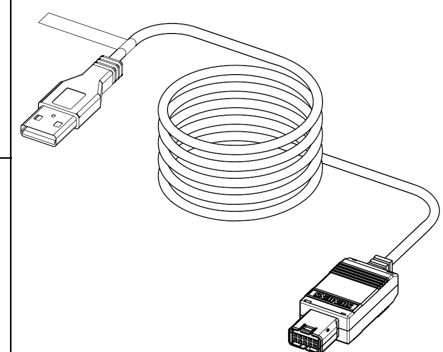
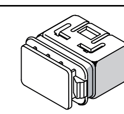
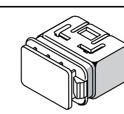
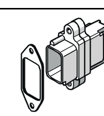
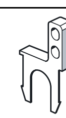
The MSS ES parameterization software provides the following functionalities:

- You use the logic diagram to parameterize the safety functions for the MSS 3RK3.
- The MSS 3RK3 is accessed for parameterization and diagnostics over a PC cable or by means of PROFIBUS-DP and DP interface (optional).
- You can also upload an existing configuration from the 3RK3 central unit to the PC or programming device.
- The diagnostics functionality of the software enables you to diagnose the MSS 3RK3 online.
- You can force outputs when commissioning the MSS 3RK3.

Accessories

You require the following accessories when using the modules:

Component	Description	Diagram
Connection cables	• Ribbon cable for data connection of system components via the system interfaces • Mechanically-coded and color-coded protection against reverse polarity • 0.025 m ("adjacent") • Order no. 3UF7930-0AA00-0	
Connection cable to the diagnostics display	• Ribbon cable for the data connection from the 3RK3 central unit to the diagnostic display • Mechanically-coded and color-coded protection against reverse polarity • Max. 2.5 m • Order numbers: – 3UF7931-0AA00-0: 0.1 m, (flat) – 3UF7935-0AA00-0: 0.3 m, (flat) – 3UF7932-0AA00-0: 0.5 m, (flat) – 3UF7932-0BA00-0: 0.5 m, (round) – 3UF7937-0BA00-0: 1 m, (round) – 3UF7933-0BA00-0: 2.5 m, (round)	Flat:  Round: 

Component	Description	Diagram
PC cable and adapter	• Connection cable for exchanging data between the PC or programming device and the 3RK3 central unit. The connection cable connects the interface of the PC/programming device to the system interface of the 3RK3 central unit. – COM port Order no. 3UF7940-0AA00-0, product version 2 – USB port Order no. 3UF7941-0AA00-0	 
	• USB-to-serial adapter for connection of an RS 232 PC cable to the USB interface of a PC, recommended for use in conjunction with 3RK3 • Order no. 3UF7946-0AA00-0	
Memory module	• External memory module of the 3RK3 central unit for storing configuration data • The slot for the memory module is located on the underside of the 3RK3 central unit • Order no. 3RK3931-0AA00 Note: One memory module each is included in the scope of supply of the 3RK3 central unit.	
System interfaces cover	• Cover for free system interfaces as protection against contamination and for compliance with EMC regulations • Order no. 3UF7950-0AA00-0	
Door adapter	• for bringing out the system interface, e.g., out of a cabinet • Order no. 3UF7920-0AA00-0	
Fixing lugs	• Fixing lugs for installing the device on a level surface, 2 required per device • Order no. 3RP1903	

3.4 Overview of the device functions

The following tables provide an overview of the features and the functions of the various 3RK3 central units. Basically, the 3RK3 central units are suitable for applications with at least 3 safety-related functions.

Features of the 3RK3 central units	MSS 3RK3			
	Basic	Advanced	ASIsafe basic	ASIsafe extended
General characteristics				
Certified acc. to • SIL 3 as per EN 61508 • PL e as per EN ISO 13849-1	✓	✓	✓	✓
Modularity / expansion capability with expansion modules	✓ (max. 7 EM)	✓ (max. 9 EM)	-	✓ (max. 2 EM)
Very simple parameterization with extensive MSS ES parameterization software	✓	✓	✓	✓
Low wiring effort and high connection depth using function combinations in the software	✓	✓	✓	✓
Safety-related, freely parameterizable sensor inputs	8	8	2	4
Digital standard inputs	-	-	6	4
Safety-related redundant relay output	1	1	1	1
Safety-related redundant solid-state output	1	1	1	1
Support with commissioning by forcing	✓	✓	✓	✓
Communication				
Data exchange over PROFIBUS with optional DP interface module	✓	✓	✓	✓
Integration into the automation environment through a GSD to each PROFIBUS-DP master irrespective of the programmable controller	✓	✓	✓	✓
Access with MSS ES				
Configuration and diagnostics through the device interface	✓	✓	✓	✓
Configuration and diagnostics over PROFIBUS	✓	✓	✓	✓

Features of the 3RK3 central units	MSS 3RK3			
	Basic	Advanced	ASIsafe basic	ASIsafe extended
AS-i functionality				
• Simulation of non-safety-related AS-i slaves	-	✓	✓	✓
• Simulation of safety-related AS-i input slaves	-	✓	✓	✓
• Control of safety-related AS-i outputs	-	✓	✓	✓
• Representation of safety-related AS-i outputs	-	✓	✓	✓
• Monitoring of non-safety-related AS-i slaves	-	✓	✓	✓
• Monitoring of safety-related AS-i input slaves	-	✓	✓	✓
Diagnostics				
Diagnostics using LEDs	✓	✓	✓	✓
Diagnostics using MSS ES	✓	✓	✓	✓
Diagnostics using PROFIBUS	✓	✓	✓	✓
Diagnosis using AS-Interface (CTT2 protocol)	-	✓	✓	✓
Diagnostics using the diagnostics display	✓[1)]	✓[2)]	✓[2)]	✓[2)]

1) Product version E01 and higher of the diagnostics display

2) Product version E03 or FW version V1.1.x and higher of the diagnostics display

Function elements in the logic diagram	MSS 3RK3			
	Basic	Advanced	ASIsafe basic	ASIsafe extended
Cell functions				
• Input cell	✓	✓	✓	✓
• Output cell	✓	✓	✓	✓
Monitoring functions				
• Monitoring Universal	-	✓	✓	✓
• EMERGENCY STOP	✓	✓	✓	✓
• ESPE (electro-sensitive protective equipment)	✓	✓	✓	✓
• Safety shutdown mat (NC principle)	✓	✓	✓	✓
• Safety shutdown mat (cross-circuit principle)	✓	✓	✓	✓
• Protective door	✓	✓	✓	✓
• Protective door with lock	-	✓	✓	✓
• Enabling button	✓	✓	✓	✓
• Two-hand operation	✓	✓	✓	✓
• Mode selector switch	✓	✓	✓	✓
• AS-i 2F-DI (safety-related AS-i input)	-	✓	✓	✓
Muting functions				
• Muting (2-sensor-parallel)	-	✓	✓	✓
• Muting (4-sensor-parallel)	-	✓	✓	✓
• Muting (4-sensor-sequential)	-	✓	✓	✓
Status functions				
• Device status	✓	✓	✓	✓
• Element status	-	✓	✓	✓
Control functions				
• Device command	✓	✓	✓	✓
Logic functions				
• AND	✓	✓	✓	✓
• OR	✓	✓	✓	✓
• XOR	✓	✓	✓	✓
• NAND	✓	✓	✓	✓
• NOR	✓	✓	✓	✓
• NEGATION (NEG)	✓	✓	✓	✓
Flip-flop				
• FF-SR	✓	✓	✓	✓

Function elements in the logic diagram	MSS 3RK3			
	Basic	Advanced	ASIsafe basic	ASIsafe extended
Counter functions				
• Counter (0 -> 1)	✓	✓	✓	✓
• Counter (1 -> 0)	✓	✓	✓	✓
• Counter (0 -> 1 / 1 -> 0)	✓	✓	✓	✓
Timer functions				
• With ON delay	✓	✓	✓	✓
• With ON delay (trigger)	✓	✓	✓	✓
• Passing make contact	✓	✓	✓	✓
• Passing make contact (trigger)	✓	✓	✓	✓
• With OFF delay	✓	✓	✓	✓
• With OFF delay (trigger)	✓	✓	✓	✓
• Clocking	✓	✓	✓	✓
Start functions				
• Monitored start	✓	✓	✓	✓
• Manual start	✓	✓	✓	✓
Output functions				
• Standard output	✓	✓	✓	✓
• F output	✓	✓	✓	✓
• AS-i 1..4F-DO	-	✓	✓	✓

4 Getting started with MSS 3RK3 Basic

4.1 Introduction

This chapter provides a step-by-step guide to commissioning a Modular Safety System 3RK3 (MSS 3RK3) using an example demonstrating **how to protect a metalworking press.**

The essential steps for commissioning the MSS 3RK3 are as follows:

1. Installation
2. Wiring
3. Configuring
4. Function test

4.2 Hardware and software requirements

To commission the MSS 3RK3 in this example, you will need the following hardware and software components:

Number	Device	Order No.
1	3RK3 Basic central unit	3RK3111-1AA10
1	Expansion module 2/4 F-DI 2 F-DO	3RK3231-1AA10
1	24V PELV power supply unit	6ES73071EA00-0AA0
1	Light curtain (ESPE)	-
1	Pushbutton (NO contact)	3SB3801-0DD3
1	EMERGENCY STOP control device	3SB3801-0EG3
1	Two-hand operator panel	3SB3863-4BB
2	Contactors	3RT1015-1BB42
1	0.025 m connection cable	3UF7930-0AA0-0
1	PC cable	3UF7940-0AA00-0, product version 2
1	MSS ES 2008 (software)	3ZS1314-5CC10-0YA5

To configure the modules, you need a programming device or PC with MS Windows XP Professional SP2/SP3 or MS Windows 7 Ultimate/Professional/Enterprise 32-bit operating system (SP3 and higher: 64-bit). You will find additional information in the attached README file of the software.

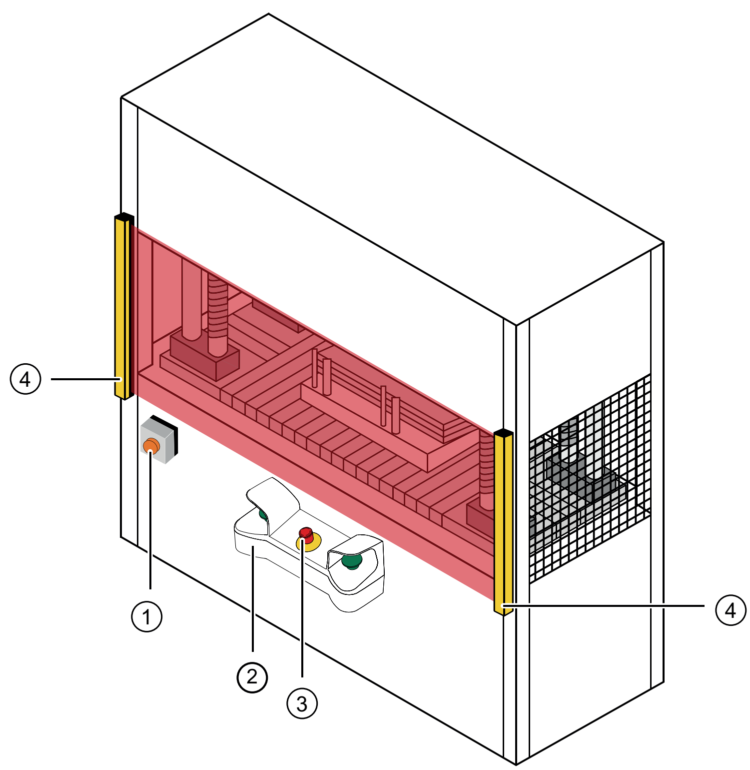
4.3 Task and structure of the example

Protecting a metalworking press

- The hazardous area is protected by permanent isolating protective equipment.
- The insertion point is additionally protected by electrosensitive protective equipment (ESPE).
- The working stroke of the press is triggered with a two-hand operator panel. If the zone protected by the electrosensitive protective equipment is entered during operation, or if the EMERGENCY STOP is activated, the press drive is immediately switched off (stop category 0).
- The press starts once the protective zone of the ESPE has been enabled and the two-hand operator panel has been actuated.

Note

To enable switch-on by two-hand operation, the start pushbutton must be pressed after unlocking the pressed EMERGENCY STOP.



① Start pushbutton
② Two-hand operator panel
③ EMERGENCY STOP control device
④ Light curtain (ESPE)

Figure 4-1 Typical system configuration

4.4 Installation of the MSS 3RK3 Basic

Installation

Step	Activity
1	Hang the device on the mounting rail or screw it onto a level surface using the fixing lugs.
2	Establish a connection between the 3RK3 Basic central unit (interface X2) and the expansion module (interface X1) by means of a connection cable (0.025 m).

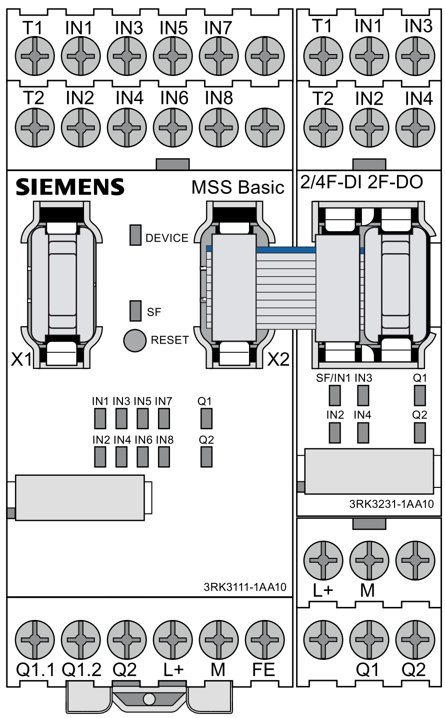
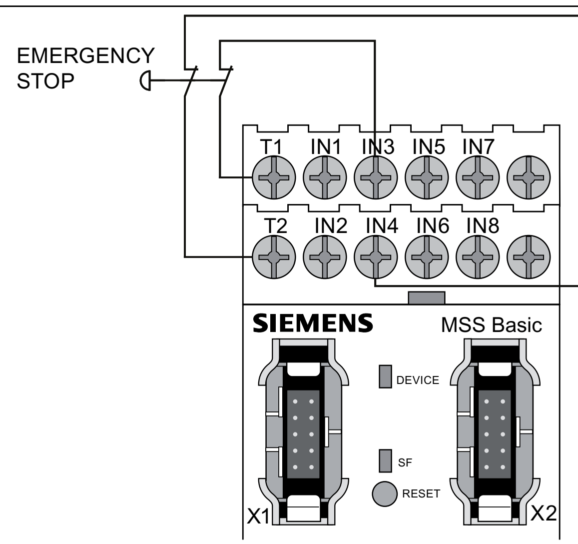


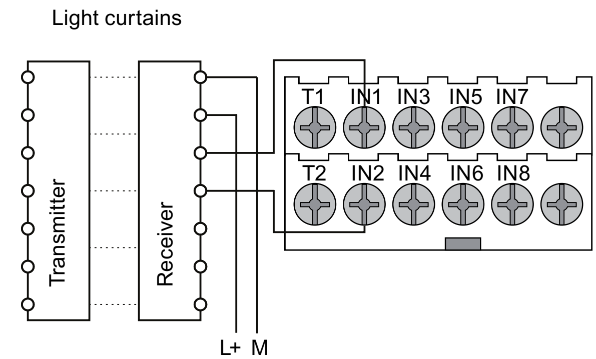
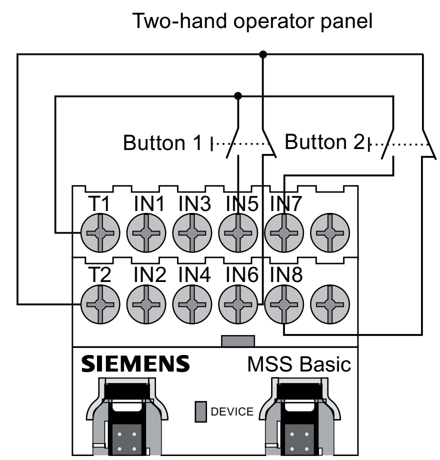
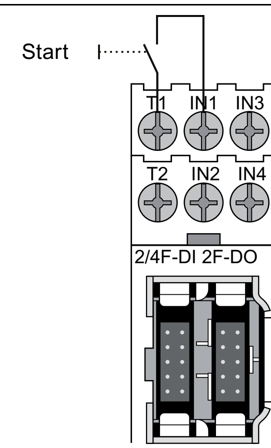
Figure 4-2 MSS 3RK3 configuration

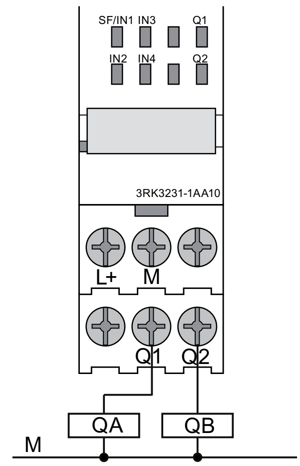
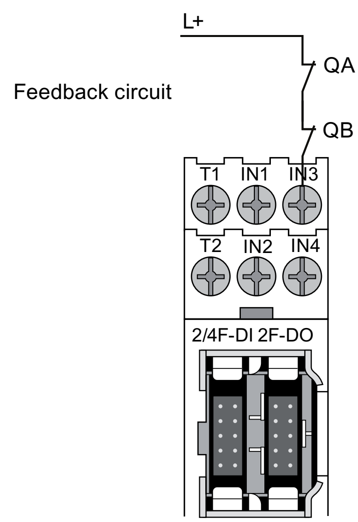
4.5 Wiring of the MSS 3RK3 Basic

Wiring

NOTICE
All components, including the light curtain, must be operated on the same power supply.

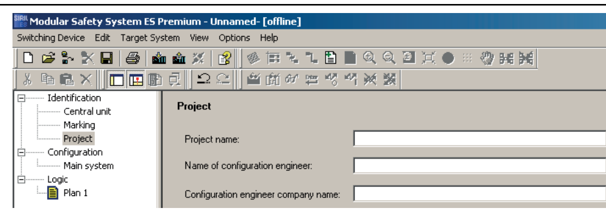
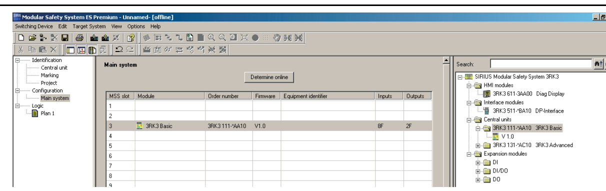
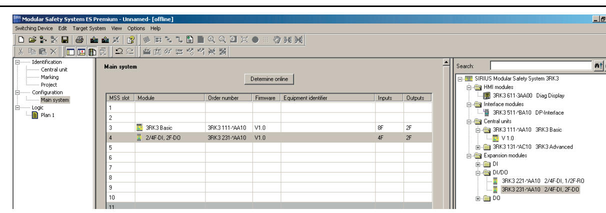
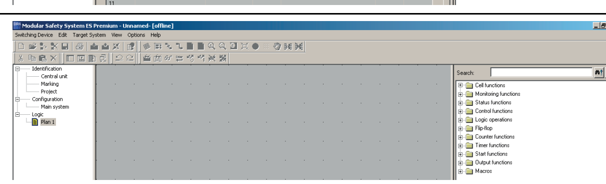
Step	Action	Result
1	Connect the 3RK3 Basic central unit to the power supply with: • + 24 V to terminal L+ • Ground to terminal M • Ground to terminal FE (see Chapter "Grounding (Page 141)")	The 3RK3 Basic central unit is supplied with power.
2	Connect the expansion module 2/4 F-DI 2F-DO to the power supply with: • + 24 V to terminal L+ • Ground to terminal M	The expansion module 2/4 F-DI 2F-DO is supplied with power.
3	Connect the light curtain to the power supply. **Note:** Please refer here to the operating instructions for the light curtain.	The light curtain is supplied with power.
4	Connect the EMERGENCY STOP control device to the 3RK3 Basic central unit, with: • NC 1: Terminal T1/IN3 • NC 2: Terminal T2/IN4	

Step	Action	Result
5	Connect the light curtain to the 3RK3 Basic central unit, with • Output 1 of the light curtain: Terminal IN1 • Output 2 of the light curtain: Terminal IN2 **Note:** Please refer here to the operating instructions for the light curtain.	
6	Connect the two-hand operator panel to the 3RK3 Basic central unit, with: • NC pushbutton 1: Terminal T2/IN6 NO pushbutton 1: Terminal T1/IN5 • NC pushbutton 2: Terminal T2/IN8 NO pushbutton 2: Terminal T1/IN7	
7	Connect the Start pushbutton on the expansion module 2/4 F-DI 2F-DO, with: • NO contact: Terminal T1/IN1	

Step	Action	Result
8	Connect the contactors QA and QB on the expansion module 2/4 F-DI 2F-DO, with: • Contactor / coil QA: Terminal Q1 • Contactor / coil QB: Terminal Q2	
9	Connect the feedback circuit of the contactors QA and QB on the expansion module 2/4 F-DI 2F-DO, with: • Contactor / NC QA / QB: Terminal IN3	

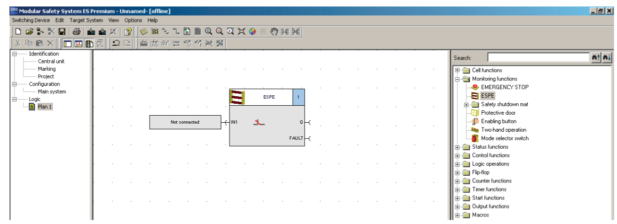
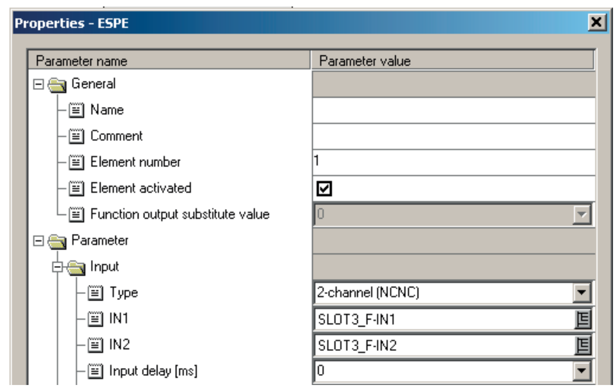
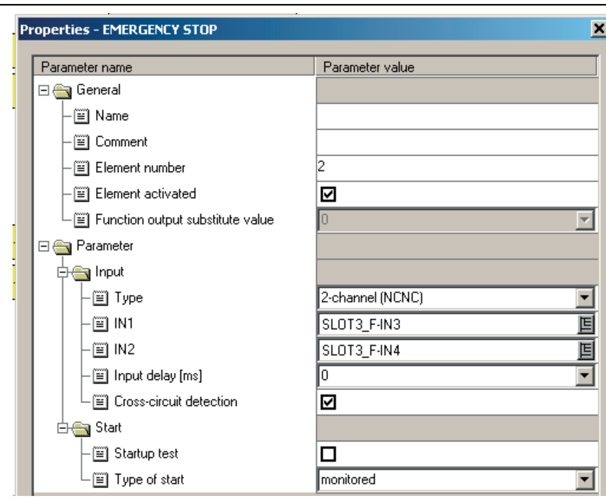
4.6 Configuration of the MSS 3RK3 Basic

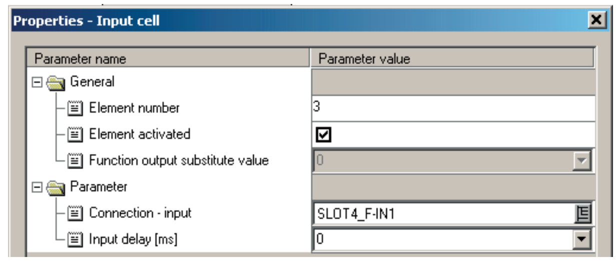
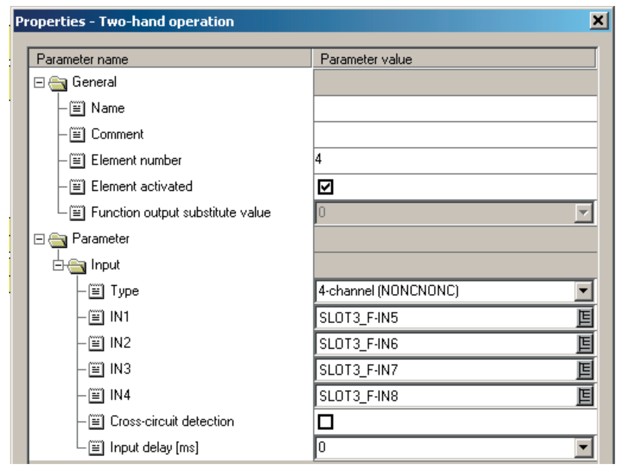
Configuration

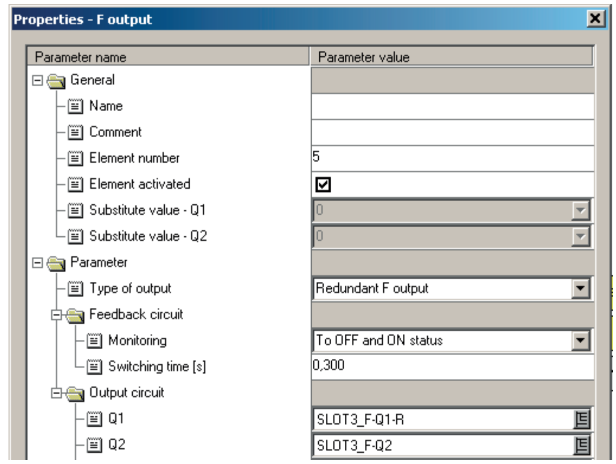
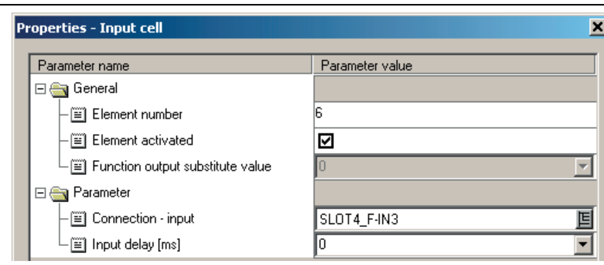
Step	Activity	Result
1	Switch on your PC/PG. Install the MSS ES software. Administrator rights are required here. For additional information, see Chapter "Description of the software (Page 143)"	The MSS ES software is installed on your computer.
2	Start the MSS ES software and choose "Switching device" > "New..." >"Safety relays" > "SIRIUS Modular Safety System 3RK3".	The MSS ES software opens.
3	Connect the 3RK3 Basic central unit to your PC / PG using the PC cable.	The MSS 3RK3 is connected to the PC / PG.
4	On the left of the navigation window, select the "Identification" directory and then the "Project" subdirectory.	
5	Make entries in the following lines of the work space: • Project name • Name of configuration engineer • Configuration engineer's company name	
6	On the left of the navigation window, select the "Configuration" directory and then the "Main system" subdirectory.	
7	Drag the 3RK3 Basic central unit from the catalog window to the first green-illuminated row in the work space for the hardware configuration.	
8	Drag the 2/4 F-DI 2F-DO expansion module from the catalog window to the next empty row (under the 3RK3 central unit added in Step 7) in the work space for the hardware configuration.	
9	On the left of the navigation window, select the "Logic" directory and then the "Diagram 1" subdirectory.	

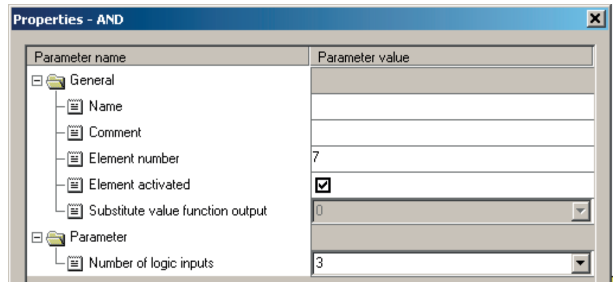
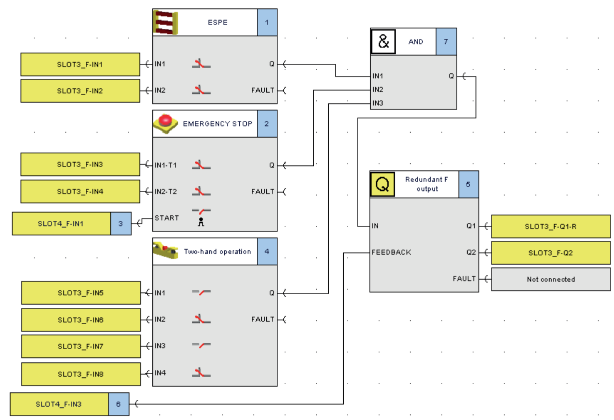
4.7 Creating the safety program

Parameter assignment

Step	Activity	Result
1	• Drag the "ESPE" element from the "Monitoring functions" folder to the work space.	
2	• Open the "Properties - ESPE" dialog box by double-clicking the block. • Select the following in the "Parameter > Input" directory: – The "Type" parameter, and define this as "2-channel (NCNC)". – The "IN1" parameter, and connect this to "SLOT3_F-IN1". – The "IN2" parameter is automatically set to "SLOT3_F-IN2". • Close the window by clicking "OK".	
3	• Drag the "EMERGENCY STOP" element from the "Monitoring functions" folder into the work space. • Open the "Properties - EMERGENCY STOP" dialog box by double-clicking the block. • Select the following in the "Parameter > Input" directory: – The "Type" parameter, and define this as "2-channel (NCNC)". – The "IN1" parameter, and connect this to "SLOT3_F-IN3". – The "IN2" parameter is automatically set to "SLOT3_F-IN4". – Activate cross-circuit detection. • Select the following in the "Parameter > Start" directory: – The "Type of start" parameter, and define this as "Monitored". • Close the window by clicking "OK".	

Step	Activity	Result
4	• Drag the "Input cell" element from the "Cell functions" folder into the work space. This cell function is required for acknowledging the EMERGENCY STOP control device. • Open the "Properties - Input cell" dialog box by double-clicking the block. • Select the following in the "Parameter" directory: – The "Connection - input" parameter, and connect this to "SLOT4_F-IN1". • Close the window by clicking "OK".	
5	• Drag the "Two-hand operation" element from the "Monitoring functions" folder into the work space. • Open the "Properties - Two-hand operation" dialog box by double-clicking the block. • Select the following in the "Parameter > Input" directory: – The "Type" parameter, and define this as "4-channel (NONCNONC)". – The "IN1" parameter, and connect this to "SLOT3_F-IN5". – The "IN2" parameter is automatically set to "SLOT3_F-IN6". – The "IN3" parameter, and connect this to "SLOT3_F-IN7". – The "IN4" parameter is automatically set to "SLOT3F-IN8". – Activate cross-circuit detection • Close the window by clicking "OK".	

Step	Activity	Result
6	• Drag the "F output" element from the "Output functions" > "Switching output" folder to the work space. • Open the "Properties - F output" dialog box by double-clicking the block. • Select the following in the directory "Parameter" > "Type of output: Redundant F output". • Select the following in the "Parameter" > "Feedback circuit" directory: – The "Monitoring" parameter, and define this as "To OFF and ON status". • Select the following in the "Parameter" > "Output circuit" directory: – The "Q1" parameter, and connect this to "SLOT4-F-Q1". – The "Q2" parameter, and connect this to "SLOT4-F-Q2". • Close the window by clicking "OK".	
7	• Drag the "Input cell" element from the "Cell functions" folder into the work space. This cell function is required for monitoring the feedback circuit. • Open the "Properties - Input cell" dialog box by double-clicking the block. • Select the following in the "Parameter" directory: – The "Connection - input" parameter, and apply this to "SLOT4_F-IN3". • Close the window by clicking "OK".	

Step	Activity	Result
8	• Drag the "AND" element from the "Logic operations" folder into the work space. • Open the "Properties - AND" dialog box by double-clicking the block. • Select the following in the "Parameter" directory: – The "Number of logic inputs" parameter, and define this as "3". • Close the window by clicking "OK".	
9	• Connect outputs "Q" of the monitoring functions with inputs "IN" of the AND function element by drag and drop. • Connect the output "Q" of the AND function with the input "IN" of the F output. • Connect the output of the input cell "SLOT4_F-IN3" with the input "FEEDBACK" (feedback circuit) of the F output. • Connect the output of the input cell "SLOT4_F-IN1" with the input "Start" of the EMERGENCY STOP monitoring function.	
10	For a clearer display, choose "Edit" > "Realign graphic".	

4.8 Function test of the MSS 3RK3 Basic

Download to 3RK3 Basic central unit

Step	Action	Result
1	Switch on the power supply.	The safety relay executes a self-test.
2	Choose "Edit" > "Check consistency".	If no message is displayed in the output window, the test was successful.
3	Choose "Target system" > "Load to switching device" and confirm the memory dialog with "Yes".	The "Save switching device as" dialog box opens.
4	Save the project.	The "Load to switching device" dialog box opens.
5	Set the interface via which you have access to the device (e.g., COM1) and confirm with "OK".	The configuration data is now downloaded. A message is displayed on completion of the download.
6	Confirm with "OK".	You are now online in configuring mode.
7	Choose "Target system" > "Test mode" and confirm the message "Activate test mode" with "Yes".	The "Change password for test mode" dialog box opens.
8	Assign a new password and confirm it. The default password is 0000.	The MSS 3RK3 changes from configuring mode to test mode.

Testing the functions

The MSS 3RK3 can be switched to "test mode" so that the full function test can be conducted. Outputs of function elements can be forced in this operating mode.

You can create printouts of the configuration to help you in the function test by choosing "Target system" > "Prepare configuration test".

Step	Action	Result
1	Check whether the EMERGENCY STOP has been unlocked and the protective field of the ESPE is free.	-
2	Press the Start button.	-
3	Press both buttons of the two-hand operator panel simultaneously.	The contactors QA and QB pick up.
4	Press EMERGENCY STOP.	If the two-hand operator panel is pressed again, contactors QA and QB do not pick up.
5	Unlock the EMERGENCY STOP and press the Start button.	The "EMERGENCY STOP" function element is acknowledged.
6	Place a suitable object in the protection zone of the ESPE.	If the two-hand operator panel is pressed again while the light curtain is interrupted, contactors QA and QB do not pick up.

Configuration release

Step	Action	Result
1	Select the menu command "Target system" > "Go offline".	The offline configuration is opened.
2	Choose "Target system" > "Approve configuration".	The "Approve configuration" dialog box is opened, thereby confirming that the configuration test has been performed properly.
3	Set the interface via which you have access to the device (e.g., COM1) and confirm with "OK".	The "Approve configuration" dialog box opens.
4	Enter the name and approving company and confirm with "OK".	The "Approve configuration" dialog box opens. The configuration has been successfully approved.
5	Acknowledge the message with "OK".	The printout of the release information is created.

Note

If the report could not be printed when the project was released, e.g., because no printer was available, the printout must be created at the latest by the time of acceptance by selecting "Options" > "Release information...".

Safety mode

Step	Action	Result
1	Establish an online connection with the MSS 3RK3 using the "Switching device" > "Open online" or "Target system" > "Load to PC" menu command.	The Set interface dialog box appears.
2	Set the interface and confirm with "OK".	The project opens online.
3	Activate the menu command "Target system" > "Safety mode".	The message "Activate safety mode" appears.
4	Confirm with "Yes".	The MSS 3RK3 switches to safety mode without password protection.

Description of the hardware 5

5.1 Description of the individual modules

Which device is supported by which software version?

Device	MSS ES 2008	MSS ES 2008 SP1	MSS ES 2008 SP2	MSS ES 2008 SP3
Central units				
Basic	✓	✓	✓	✓
Advanced	-	-	✓	✓
ASIsafe basic	-	-	-	✓
ASIsafe extended	-	-	-	✓
Interface modules				
DP interface	✓	✓	✓	✓
Expansion modules				
4/8 F-DI	✓	✓	✓	✓
2/4 F-DI 2 F-DO	✓	✓	✓	✓
2/4 F-DI 1/2 F-RO	✓	✓	✓	✓
8 DO	✓	✓	✓	✓
4 F-DO	-	✓	✓	✓
4/8 F-RO	-	✓	✓	✓
8 DI	-	✓	✓	✓
HMI modules				
Diagnostics display	-	-	✓ 1)	✓ 2)

1) Up to product version E02 or FW version V1.0.x

2) Product version E03 or FW version V1.1.x and higher

5.1.1 General information on 3RK3 central units

The application for 3RK3 central units are safety-related control functions. A 3RK3 central unit is required for each system configuration. The 3RK3 central unit contains the configuring data in an external memory module, and it handles all control tasks.

5.1.2 3RK3 Basic central unit

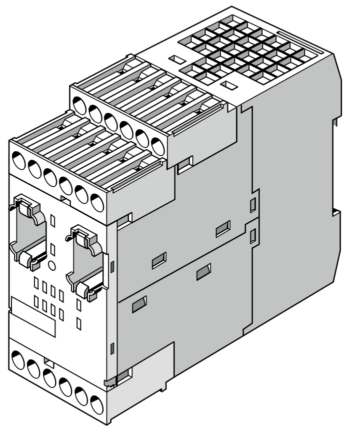


Figure 5-1 3RK3 Basic central unit

Properties

The 3RK3 Basic central unit is the basic component of an MSS 3RK3 configuration for safety-related control functions. It can be used up to SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

- Up to 7 expansion modules can be connected to the 3RK3 Basic central unit.
- An additional interface module (e.g., DP interface) can be used to exchange process data with a PLC. Diagnostic data of the MSS 3RK3 are also transmitted to the PLC.
- The 3RK3 Basic central unit can be parameterized using MSS ES.
- Connection of the diagnostic display is possible as an option.

Inputs and outputs

The 3RK3 Basic central unit has the following inputs and outputs:

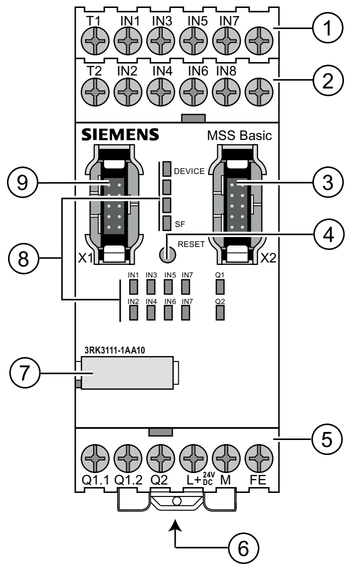
- 8 safety-related, freely parameterizable sensor inputs
- 1 safety-related redundant relay output
- 1 safety-related, redundant, solid-state output

Note

Safety-related outputs

If you use the safety-related outputs with a two-channel shutdown, a fault exclusion, such as a short-circuit to P or M, is required. This condition is met within a control cabinet or when the connection cables are installed in such a way that they are protected.

Structure of the 3RK3 Basic central unit

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	Connection for expansion module (X2)
	④	RESET button
	⑤	Removable terminal block A
	⑥	Connection of a memory module (X3)
	⑦	Label
	⑧	Display LEDs
	⑨	Connection of PC or programming device, interface module, diagnostics display (X1)

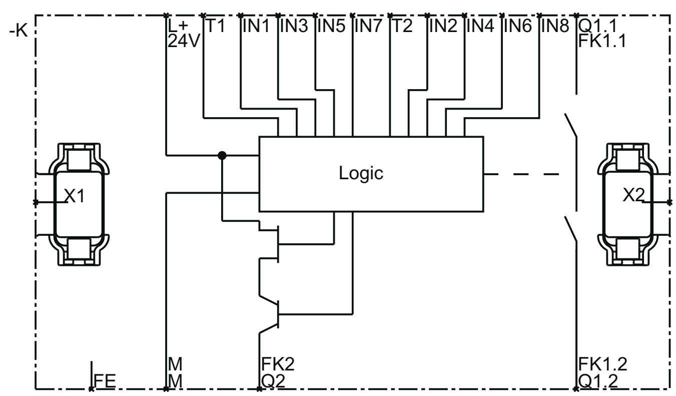


Figure 5-2 MSS 3RK3 Basic internal circuit diagram

Terminal names of the 3RK3 Basic central unit

Terminal	Meaning	Description
T1	Test output for inputs IN1, IN3, IN5, IN7	Test outputs with different test signals Connection for sensor contacts for detecting cross-circuits
T2	Test output for inputs IN2, IN4, IN6, IN8	
IN1 ... IN8	Safety-related sensor inputs	Connection for safety sensors Combinations for two-channel connection method: IN1-IN2, IN3-IN4, IN5-IN6, IN7-IN8
Q1.1, Q1.2	Safety-related relay output	Isolated, redundant output for connecting actuators
Q2	Safety-related solid-state output	Redundant semiconductor output for connecting actuators
L+	Power supply	24 V DC
M	Ground	Ground to 24 V DC
FE	Functional ground	Shielding, equipotential bonding

Interfaces of the 3RK3 Basic central unit

Interface	Meaning	Description
X1	System interface	Connection of PC or programming device, interface module, diagnostics display
X2	Interface	Interface for connecting expansion modules (e.g., I/O modules)
X3	External memory module	Slot for external memory module with parameterization data

Operator controls of the 3RK3 Basic central unit

Element	Meaning	Description
RESET button	• Error acknowledgment • Factory setting	• Confirm the acknowledgeable errors with this button. • Refer to Chapter "Restoring factory settings (Page 637)"

Displays of the 3RK3 Basic central unit

Element	Meaning
DEVICE	Device status
SF	Group error
IN1 ... IN8	Status of the sensor inputs
Q1, Q2	Status of the safety-related outputs

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting / wiring (Page 117)."

5.1.2.1 Startup / self-test of the MSS 3RK3 Basic

Once the power supply has been applied, the MSS 3RK3 runs a self-test. During the self-test phase, all the LEDs on the MSS 3RK3 central unit light up for two seconds (lamp test). Two-color LEDs light up yellow. The 3RK3 Basic central unit then loads the configuration from the external memory module and checks whether a valid configuration or parameterization is stored and automatically switches to safety mode (DEVICE LED lights up green).

Configuring mode

The 3RK3 Basic central unit enters configuring mode (the DEVICE LED lights up yellow) when:

- No configuration exists,
- The TARGET configuration differs from the ACTUAL configuration (the SF LED lights up red)
- The modules could not be parameterized (the SF LED lights up red)
- The existing configuration has not been released.
- The memory module is missing or defective. In this case, only diagnostics of the MSS 3RK3 is possible (DEVICE LED flashes red, SF LED lights up red).

5.1.3 3RK3 Advanced central unit

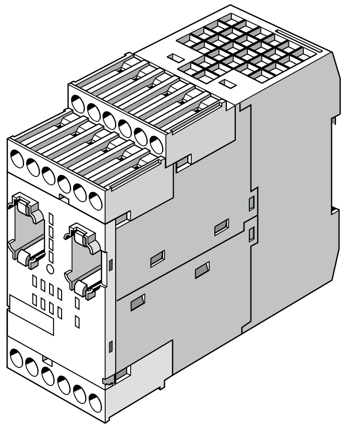


Figure 5-3 3RK3 Advanced central unit

Properties

The 3RK3 Advanced central unit is a basic component of an MSS 3RK3 configuration for safety-related control functions with use of AS-Interface. As an AS-i monitor, the 3RK3 Advanced central unit can monitor sensor inputs in the lower fieldbus level and also shut down safety circuits through its outputs. It can be used up to SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

- Up to 9 expansion modules can be connected to the 3RK3 Advanced central unit.
- An additional interface module (e.g., DP interface) can be used to exchange process data with a PLC. Diagnostic data of the MSS 3RK3 are also transmitted to the PLC.
- Connection to AS-Interface for safety-related and non-safety-related data exchange.
- The 3RK3 Advanced central unit can be parameterized using MSS ES.

Inputs and outputs

The 3RK3 Advanced central unit has the following inputs and outputs:

- 8 safety-related, freely parameterizable sensor inputs
- 1 safety-related redundant relay output
- 1 safety-related, redundant, solid-state output

Note

Safety-related outputs

If you use the safety-related outputs with a two-channel shutdown, a fault exclusion, such as a short-circuit to P or M, is required. This condition is met within a control cabinet or when the connection cables are installed in such a way that they are protected.

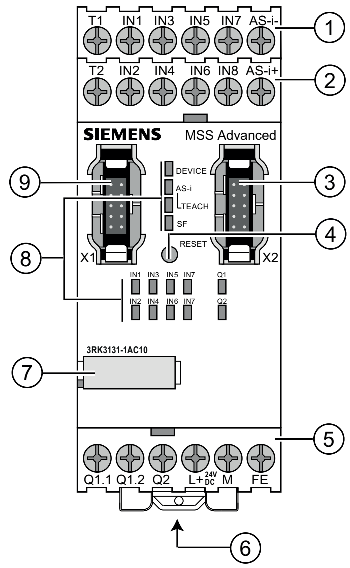
MSS 3RK3 Advanced on the AS-i bus

The MSS 3RK3 Advanced can perform various functions on the AS-i bus:

- Simulation of up to 4 non-safety-related AS-i slaves
- Simulation of up to 12 safety-related AS-i input slaves
- Control of up to 12 safety-related AS-i outputs
- Representation of of up to 31 safety-related AS-i outputs
- Monitoring of up to 14 non-safety-related AS-i slaves
- Monitoring of up to 31 safety-related AS-i input slaves

You will find additional information in Chapter "Integrating the 3RK3 modular safety system into the AS-i bus (Page 452)."

Structure of the 3RK3 Advanced central unit

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	Connection for expansion module (X2)
	④	RESET button
	⑤	Removable terminal block A
	⑥	External memory module (X3)
	⑦	Label
	⑧	Display LEDs
	⑨	Connection of PC or programming device, interface module, diagnostics display (X1)

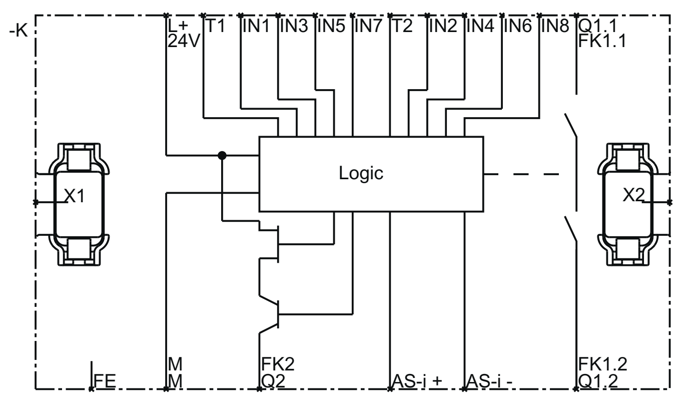


Figure 5-4 MSS 3RK3 Advanced internal circuit diagram

Terminal names of the 3RK3 Advanced central unit

Terminal	Meaning	Description
T1	Test output for inputs IN1, IN3, IN5, IN7	Test outputs with different test signals Connection for sensor contacts for detecting cross-circuits
T2	Test output for inputs IN2, IN4, IN6, IN8	
IN1 ... IN8	Safety-related sensor inputs	Connection for safety sensors Combinations for two-channel connection method: IN1-IN2, IN3-IN4, IN5-IN6, IN7-IN8
Q1.1, Q1.2	Safety-related relay output	Isolated, redundant output for connecting actuators
Q2	Safety-related solid-state output	Redundant semiconductor output for connecting actuators
AS-i+, AS-i-	AS-i terminals	Connection of the AS-i cable
L+	Power supply	24 V DC
M	Ground	Ground to 24 V DC
FE	Functional ground	Shielding, equipotential bonding

Interfaces of the 3RK3 Advanced central unit

Interface	Meaning	Description
X1	System interface	Connection of PC or programming device, interface module, diagnostics display
X2	Interface	Interface for connecting expansion modules (e.g., I/O modules)
X3	External memory module	Slot for external memory module with parameterization data

Operator controls of the 3RK3 Advanced central unit

Element	Meaning	Description
RESET button	• Error acknowledgment • Factory setting • Application of code sequences	• Confirm the acknowledgeable errors with this button • Refer to Chapter "Restoring factory settings (Page 637)" • Refer to Chapter "Teaching the code sequences (Page 482)"

Displays of the 3RK3 Advanced central unit

Element	Meaning
DEVICE	Device status
AS-i	AS-i error
TEACH	Status of the teaching of code sequences
SF	Group error
IN1 ... IN8	Status of the sensor inputs
Q1, Q2	Status of the safety-related outputs

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting safety-related inputs and outputs (Page 117)."

5.1.3.1 Startup / self-test of the MSS 3RK3 Advanced

Initially, startup is performed very much like startup of the MSS 3RK3 Basic, as described in Chapter "Startup / self-test of the MSS 3RK3 Basic (Page 62)." The AS-i function is activated during startup, depending on the configuration.

If no AS-i bus is detected within 30 s during startup, the MSS 3RK3 Advanced switches to safety mode. The missing AS-i slaves are then processed with substitute value "0" in the logic. (AS-i-BF-LED flashes red)

If safety-related AS-i slaves have been detected on the AS-i bus whose code sequence has not been acquired by teaching or whose code sequence does not match the existing code sequence, these are processed with the substitute value "0" in the interconnection logic. (AS-i-BF-LED flashes red)

If no AS-i is configured, the AS-i functionality and the AS-i-BF LED are not processed.

Configuring mode

The 3RK3 Advanced central unit enters configuring mode (the DEVICE LED lights up yellow) when:

- No configuration exists,
- The TARGET configuration differs from the ACTUAL configuration (the SF LED lights up red)

Note

Actual AS-i structure ≠ target AS-i structure

If the actual AS-i structure deviates from the target structure, substitute values will be used for the AS-i slaves affected and the MSS 3RK3 Advanced will change to safety mode after startup.

- The modules could not be parameterized (the SF LED lights up red)
- The existing configuration has not been released.
- The memory module is missing or defective. In this case, only diagnostics of the MSS 3RK3 is possible (DEVICE LED flashes red, SF LED lights up red).

Simulated slaves in configuration mode

If simulated AS-i slaves are contained in the configuration, they will already be simulated on the AS-i bus in configuration mode. The process data of the simulated slaves in configuration mode are always zero.

If the AS-i bus does not exist or if no data traffic is detected on the AS-i bus by the master, simulation of these AS-i slaves is not possible. (AS-i LED flashes red)

If configuration mode is entered by ending safety mode or test mode, the AS-i functionality remains, that is, the simulated slaves remain active on the AS-i bus. Teaching of safety-related AS-i slaves also remains active. Only when a new configuration is loaded onto the device will the period for transmission stop the simulation of AS-i slaves and it will not be started again until the new configuration has been evaluated and accepted.

5.1.4 3RK3 ASIsafe basic central unit

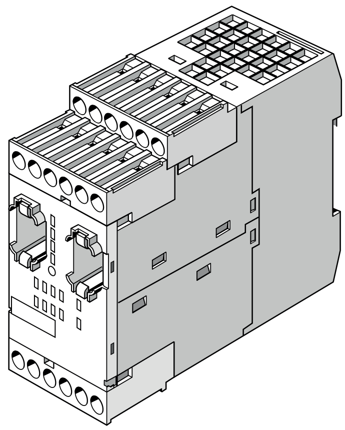


Figure 5-5 3RK3 ASIsafe basic central unit

Properties

The 3RK3 ASIsafe central unit is a basic component of an MSS 3RK3 configuration for safety-related control functions with use of AS-Interface. As an AS-i monitor, the 3RK3 ASIsafe basic central unit can monitor sensor inputs in the lower fieldbus level and also shut down safety circuits through its outputs. It can be used up to SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

- An additional interface module (e.g., DP interface) can be used to exchange process data with a PLC. Diagnostic data of the MSS 3RK3 are also transmitted to the PLC.
- Connection to AS-Interface for safety-related and non-safety-related data exchange.
- The 3RK3 ASIsafe basic central unit can be parameterized using MSS ES.

Note

No expansion modules can be connected to the 3RK3 ASIsafe basic central unit.

Inputs and outputs

The 3RK3 ASIsafe basic central unit has the following inputs and outputs:

- 2 safety-related, freely parameterizable sensor inputs
- 6 digital standard inputs
- 1 safety-related redundant relay output
- 1 safety-related, redundant, solid-state output

Note

Safety-related outputs

If you use the safety-related outputs with a two-channel shutdown, a fault exclusion, such as a short-circuit to P or M, is required. This condition is met within a control cabinet or when the connection cables are installed in such a way that they are protected.

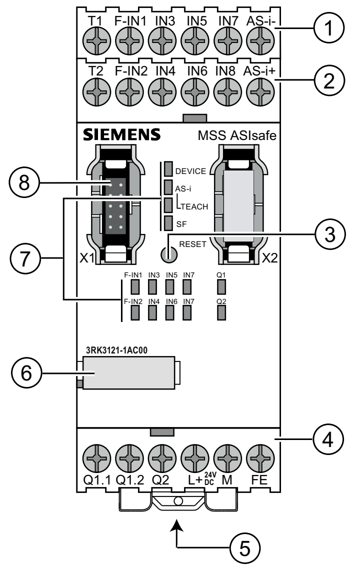
MSS 3RK3 ASIsafe basic on the AS-i bus

The MSS 3RK3 ASIsafe basic can perform various functions on the AS-i bus:

- Simulation of up to 4 non-safety-related AS-i slaves
- Simulation of up to 8 safety-related AS-i input slaves
- Control of up to 8 safety-related AS-i outputs
- Representation of of up to 31 safety-related AS-i outputs
- Monitoring of up to 14 non-safety-related AS-i slaves
- Monitoring of up to 31 safety-related AS-i input slaves

You will find additional information in Chapter "Integrating the 3RK3 modular safety system into the AS-i bus (Page 452)."

Structure of the 3RK3 ASIsafe basic central unit

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	RESET button
	④	Removable terminal block A
	⑤	External memory module (X3)
	⑥	Label
	⑦	Display LEDs
	⑧	Connection of PC or programming device, interface module, diagnostics display (X1)

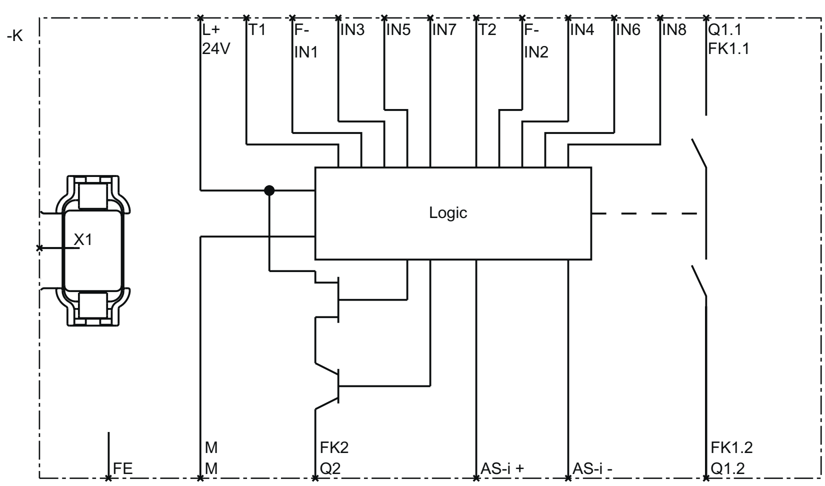


Figure 5-6 MSS 3RK3 ASIsafe basic internal circuit diagram

Terminal designations of the 3RK3 ASIsafe basic central unit

Terminal	Meaning	Description
T1	Test output for input F-IN1	Test outputs with different test signals Connection for sensor contacts for detecting cross-circuits
T2	Test output for input F-IN2	
F-IN1 ... F-IN2	Safety-related sensor inputs	Connection for safety sensors Combinations for two-channel connection method: F-IN1 ↔ F-IN2
IN3 ... IN8	Digital standard inputs	Connection for sensors
Q1.1, Q1.2	Safety-related relay output	Isolated, redundant output for connecting actuators
Q2	Safety-related solid-state output	Redundant semiconductor output for connecting actuators
AS-i+, AS-i-	AS-i terminals	Connection of the AS-i cable
L+	Power supply	24 V DC
M	Ground	Ground to 24 V DC
FE	Functional ground	Shielding, equipotential bonding

Interfaces of the 3RK3 ASIsafe basic central unit

Interface	Meaning	Description
X1	System interface	Connection of PC or programming device, interface module, diagnostics display
X3	External memory module	Slot for external memory module with parameterization data

Operator controls of the 3RK3 ASIsafe basic central unit

Element	Meaning	Description
RESET button	• Error acknowledgment • Factory setting • Application of code sequences	• Confirm the acknowledgeable errors with this button • Refer to Chapter "Restoring factory settings (Page 637)" • Refer to Chapter "Teaching the code sequences (Page 482)"

Displays of the 3RK3 ASIsafe basic central unit

Element	Meaning
DEVICE	Device status
AS-i	AS-i error
TEACH	Status of the teaching of code sequences
SF	Group error
F-IN1, F-IN2	Status of the sensor inputs
IN3 ... IN8	Status of the digital standard inputs
Q1, Q2	Status of the safety-related outputs

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting safety-related inputs and outputs (Page 117)."

5.1.4.1 Startup/self-test of the MSS 3RK3 ASIsafe basic

The startup process is similar to the startup of the MSS 3RK3 Advanced, as described in Chapter "Startup / self-test of the MSS 3RK3 Advanced (Page 68)."

5.1.5 3RK3 ASIsafe extended central unit

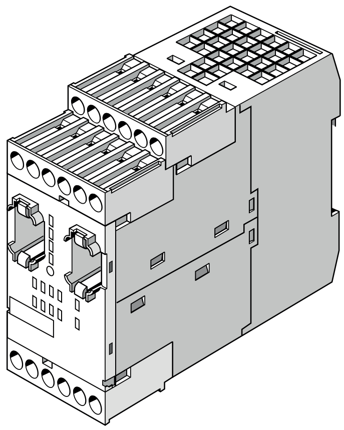


Figure 5-7 3RK3 ASIsafe extended central unit

Properties

The 3RK3 ASIsafe extended central unit is a basic component of an MSS 3RK3 configuration for safety-related control functions with use of AS-Interface. As an AS-i monitor, the 3RK3 ASIsafe extended central unit can monitor sensor inputs in the lower fieldbus level and also shut down safety circuits through its outputs. It can be used up to SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

- Up to 2 expansion modules can be connected to the 3RK3 extended central unit.
- An additional interface module (e.g., DP interface) can be used to exchange process data with a PLC. Diagnostic data of the MSS 3RK3 are also transmitted to the PLC.
- Connection to AS-Interface for safety-related and non-safety-related data exchange.
- The 3RK3 ASIsafe extended central unit can be parameterized using MSS ES.

Inputs and outputs

The 3RK3 ASIsafe extended central unit has the following inputs and outputs:

- 4 safety-related, freely parameterizable sensor inputs
- 4 digital standard inputs
- 1 safety-related redundant relay output
- 1 safety-related, redundant, solid-state output

Note

Safety-related outputs

If you use the safety-related outputs with a two-channel shutdown, a fault exclusion, such as a short-circuit to P or M, is required. This condition is met within a control cabinet or when the connection cables are installed in such a way that they are protected.

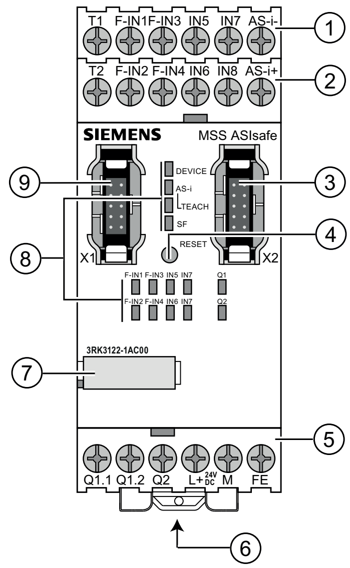
MSS 3RK3 ASIsafe extended on the AS-i bus

The MSS 3RK3 ASIsafe extended can perform various functions on the AS-i bus:

- Simulation of up to 4 non-safety-related AS-i slaves
- Simulation of up to 10 safety-related AS-i input slaves
- Control of up to 10 safety-related AS-i outputs
- Representation of of up to 31 safety-related AS-i outputs
- Monitoring of up to 14 non-safety-related AS-i slaves
- Monitoring of up to 31 safety-related AS-i input slaves

You will find additional information in Chapter "Integrating the 3RK3 modular safety system into the AS-i bus (Page 452)."

Structure of the 3RK3 ASIsafe extended central unit

<table>
<tr><th>Front view</th><th>No.</th><th>Meaning</th></tr>
<tr><td rowspan="9">
</td><td>①</td><td>Removable terminal block D</td></tr>
<tr><td>②</td><td>Removable terminal block C</td></tr>
<tr><td>③</td><td>Connection for expansion module (X2)</td></tr>
<tr><td>④</td><td>RESET button</td></tr>
<tr><td>⑤</td><td>Removable terminal block A</td></tr>
<tr><td>⑥</td><td>External memory module (X3)</td></tr>
<tr><td>⑦</td><td>Label</td></tr>
<tr><td>⑧</td><td>Display LEDs</td></tr>
<tr><td>⑨</td><td>Connection of PC or programming device, interface module, diagnostics display (X1)</td></tr>
</table>

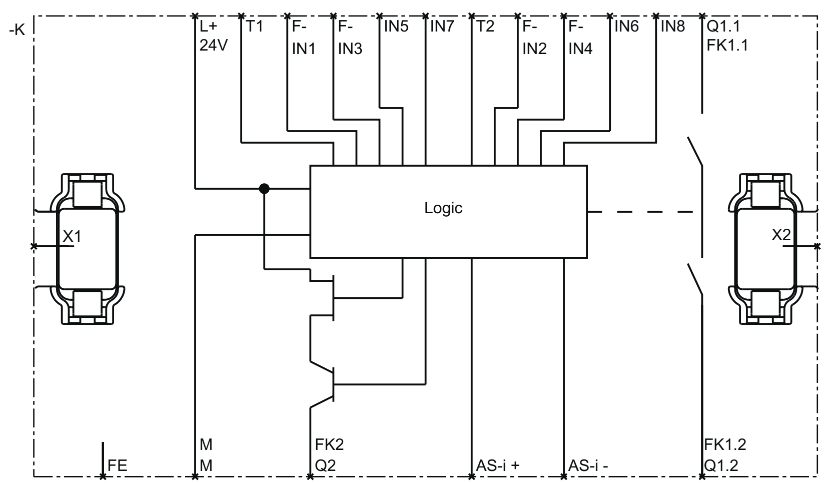


Figure 5-8 MSS 3RK3ASIsafe extended internal circuit diagram

Terminal designations of the 3RK3 ASIsafe extended central unit

Terminal	Meaning	Description
T1	Test output for inputs F-IN1, F-IN3	Test outputs with different test signals Connection for sensor contacts for detecting cross-circuits
T2	Test output for inputs F-IN2, F-IN4	
F-IN1 ... F-IN4	Safety-related sensor inputs	Connection for safety sensors Combinations for two-channel connection method: F-IN1 ↔ F-IN2, F-IN3 ↔ F-IN4
IN5 ... IN8	Digital standard inputs	Connection for sensors
Q1.1, Q1.2	Safety-related relay output	Isolated, redundant output for connecting actuators
Q2	Safety-related solid-state output	Redundant semiconductor output for connecting actuators
AS-i+, AS-i-	AS-i terminals	Connection of the AS-i cable
L+	Power supply	24 V DC
M	Ground	Ground to 24 V DC
FE	Functional ground	Shielding, equipotential bonding

Interfaces of the 3RK3 ASIsafe extended central unit

Interface	Meaning	Description
X1	System interface	Connection of PC or programming device, interface module, diagnostics display
X2	Interface	Interface for connecting expansion modules (e.g., I/O modules)
X3	External memory module	Slot for external memory module with parameterization data

Operator controls of the 3RK3 ASIsafe extended central unit

Element	Meaning	Description
RESET button	• Error acknowledgment • Factory setting • Application of code sequences	• Confirm the acknowledgeable errors with this button • Refer to Chapter "Restoring factory settings (Page 637)" • Refer to Chapter "Teaching the code sequences (Page 482)"

Displays of the 3RK3 ASIsafe extended central unit

Element	Meaning
DEVICE	Device status
AS-i	AS-i error
TEACH	Status of the teaching of code sequences
SF	Group error
F-IN1 ... F-IN4	Status of the sensor inputs
IN5 ... IN8	Status of the digital standard inputs
Q1, Q2	Status of the safety-related outputs

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting safety-related inputs and outputs (Page 117)."

5.1.5.1 Startup/self-test of the MSS 3RK3 ASIsafe extended

The startup process is similar to the startup of the MSS 3RK3 Advanced, as described in Chapter "Startup / self-test of the MSS 3RK3 Advanced (Page 68)."

5.1.6 General information on expansion modules

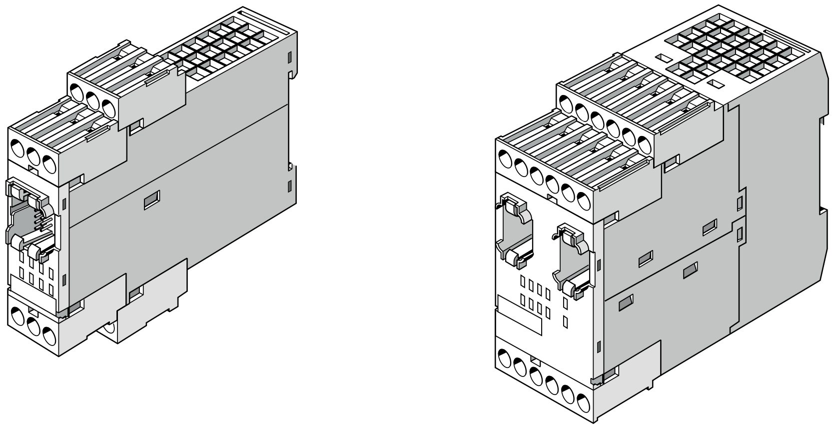


Figure 5-9 Expansion modules of the MSS 3RK3

Application

The expansion modules provide additional inputs and outputs for a 3RK3 central unit. The precondition for the use of expansion modules is always connection to a 3RK3 central unit and the corresponding software version MSS ES, see Chapter "Requirements (Page 150)."

Power-up/self-test

Once the power supply has been applied, all the devices perform a self-test. During this phase, the LEDs of the 3RK3 central unit and the expansion modules light up (lamp test). When the system has powered up, the self-test is complete, and the device is in safety or test mode, the LEDs light up in accordance with the pending signals.

5.1.7 Expansion module 4/8F-DI

Properties

With the expansion module 4/8F-DI, the 3RK3 central unit can be expanded with further safety-related inputs. It can be used up to SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

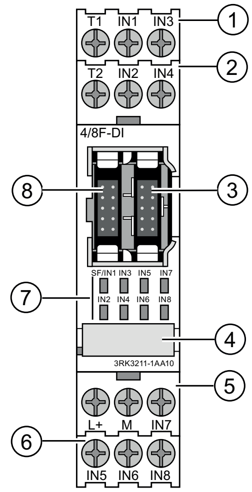
- Additional expansion modules can be connected to the expansion module 4/8F-DI.
- Parameterization is performed using the 3RK3 central unit with MSS ES.

Inputs and outputs

The expansion module 4/8F-DI has the following inputs and outputs:

- 8 safety-related, parameterizable sensor inputs

Design of the expansion module 4/8F-DI:

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	Interface (X2)
	④	Label
	⑤	Removable terminal block A
	⑥	Removable terminal block B
	⑦	Display LEDs
	⑧	Interface (X1)

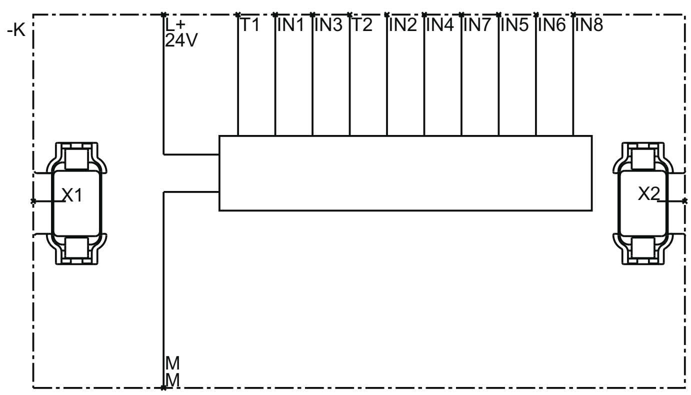


Figure 5-10 EM 4/8F-DI internal circuit diagram

Terminal designations of the expansion module 4/8F-DI:

Terminal	Meaning	Description
T1	Test output for inputs IN1, IN3, IN5, IN7	Test outputs with different test signals Connection for sensor contacts for detecting cross-circuits
T2	Test output for inputs IN2, IN4, IN6, IN8	
IN1 ... IN8	Safety-related sensor inputs	Connection for safety sensors Combinations for two-channel connection method: IN1-IN2, IN3-IN4, IN5-IN6, IN7-IN8
L+	Power supply	24 V DC
M	Ground	Ground to 24 V DC

Interfaces of the expansion module 4/8F-DI:

Interface	Meaning	Description
X1	Interface	Connection of central unit/expansion module
X2	Interface	Connection of expansion module

Displays of the expansion module 4/8F-DI

Element	Meaning
SF / IN1	Group error / status of the sensor input
IN2 ... IN8	Status of the sensor inputs

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting safety-related inputs and outputs (Page 117)."

5.1.8 Expansion module 2/4F-DI 1/2F-RO

Properties

With the 2/4F-DI 1/2F-RO expansion module, the 3RK3 central unit can be expanded with further safety-related inputs and outputs. In order to achieve SIL 3 as per EN 61508 or PL e as per EN ISO 13849-1, you must interconnect 2 relay outputs in a logic combination.

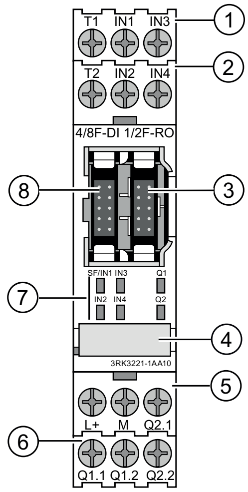
- Additional expansion modules can be connected to the expansion module 2/4F-DI 1/2F-RO.
- Parameterization is performed using the 3RK3 central unit with MSS ES.

Inputs and outputs

The expansion module 2/4F-DI 1/2F-RO has the following inputs and outputs:

- 4 safety-related, freely parameterizable sensor inputs
- 2 single-channel, safety-related relay outputs.

Design of the expansion module 2/4F-DI 1/2F-RO

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	Interface (X2)
	④	Label
	⑤	Removable terminal block A
	⑥	Removable terminal block B
	⑦	Display LEDs
	⑧	Interface (X1)

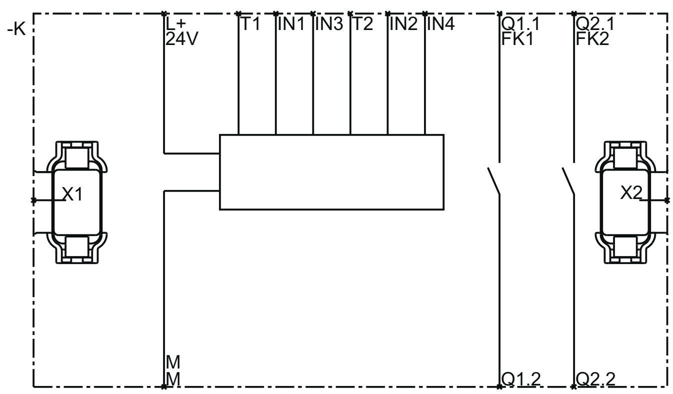


Figure 5-11 2/4F-DI 1/2F-RO internal circuit diagram

Terminal designations of the expansion module 2/4F-DI 1/2F-RO

Terminal	Meaning	Description
T1	Test output for inputs IN1, IN3	Test outputs with different test signals Connection for sensor contacts for detecting cross-circuits
T2	Test output for inputs IN2, IN4	
IN1 ... IN4	Safety-related sensor inputs	Connection for safety sensors Combinations for two-channel connection method: IN1-IN2, IN3-IN4
Q1.1, Q1.2	Safety-related relay output	Isolated output for connecting actuators
Q2.1, Q2.2	Safety-related relay output	
L+	Power supply	24 V DC
M	Ground	Ground to 24 V DC

Interfaces of the expansion module 2/4F-DI 1/2F-RO

Interface	Meaning	Description
X1	Interface	Connection of central unit/expansion module
X2	Interface	Connection of expansion module

Displays of the expansion module 2/4F-DI 1/2F-RO

Element	Meaning
SF / IN1	Group error / status of the sensor input
IN2, IN3, IN4	Status of the sensor inputs
Q1, Q2	Status of the relay outputs

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting safety-related inputs and outputs (Page 117)."

5.1.9 Expansion module 2/4F-DI 2F-DO

Properties

With the 2/4F-DI 2F-DO expansion module, the 3RK3 central unit can be expanded with further safety-related inputs and outputs. It can be used up to SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

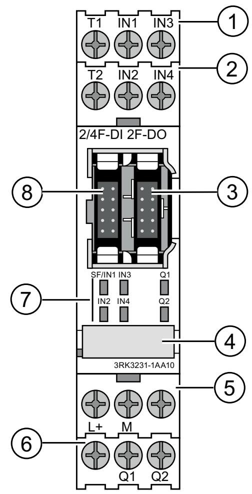
- Additional expansion modules can be connected to the expansion module 2/4F-DI 2F-DO.
- Parameterization is performed using the 3RK3 central unit with MSS ES.

Inputs and outputs

The expansion module 2/4F-DI 2F-DO has the following inputs and outputs:

- 4 safety-related, freely parameterizable sensor inputs
- 2 two-channel, safety-related, solid-state outputs.

Design of the expansion module 2/4F-DI 2F-DO

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	Interface (X2)
	④	Label
	⑤	Removable terminal block A
	⑥	Removable terminal block B
	⑦	Display LEDs
	⑧	Interface (X1)

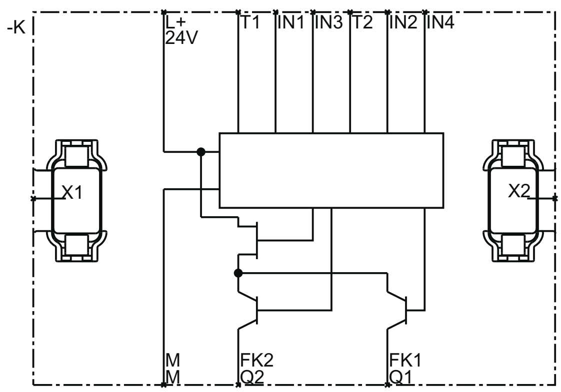


Figure 5-12 2/4F-DI 2F-DO internal circuit diagram

Terminal designations of the expansion module 2/4F-DI 2F-DO

<table>
<tr><th>Terminal</th><th>Meaning</th><th>Description</th></tr>
<tr><td>T1</td><td>Test output for inputs IN1, IN3</td><td rowspan="2">Test outputs with different test signals
Connection for sensor contacts for detecting cross-circuits</td></tr>
<tr><td>T2</td><td>Test output for inputs IN2, IN4</td></tr>
<tr><td>IN1 ... IN4</td><td>Safety-related sensor inputs</td><td>Connection for safety sensors
Combinations for two-channel connection method: IN1-IN2, IN3-IN4</td></tr>
<tr><td>Q1, Q2</td><td>Safety-related solid-state outputs</td><td>Redundant semiconductor outputs for connecting actuators</td></tr>
<tr><td>L+</td><td>Power supply</td><td>24 V DC</td></tr>
<tr><td>M</td><td>Ground</td><td>Ground to 24 V DC</td></tr>
</table>

Interfaces of the expansion module 2/4F-DI 2F-DO

Interface	Meaning	Description
X1	Interface	Connection of central unit/expansion module
X2	Interface	Connection of expansion module

Displays of the expansion module 2/4F-DI 2F-DO

Element	Meaning
SF / IN1	Group error / status of the sensor input
IN2, IN3, IN4	Status of the sensor inputs
Q1, Q2	Status of the solid-state outputs

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting safety-related inputs and outputs (Page 117)."

5.1.10 Expansion module 4F-DO

Properties

With the expansion module 4F-DO, the 3RK3 central unit can be expanded with further safety-related outputs. It can be used up to SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

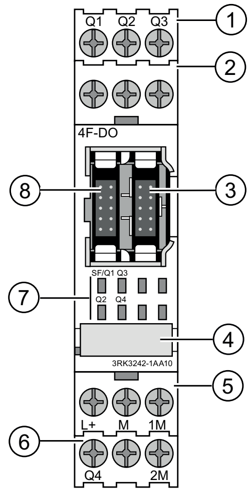
- Additional expansion modules can be connected to the expansion module 4F-DO.
- Parameterization is performed using the 3RK3 central unit with MSS ES.

Inputs and outputs

The expansion module 4F-DO has the following inputs and outputs:

- 4 two-channel, safety-related solid-state outputs

Structure of the expansion module 4F-DO



Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	Interface (X2)
	④	Label
	⑤	Removable terminal block A
	⑥	Removable terminal block B
	⑦	Display LEDs
	⑧	Interface (X1)

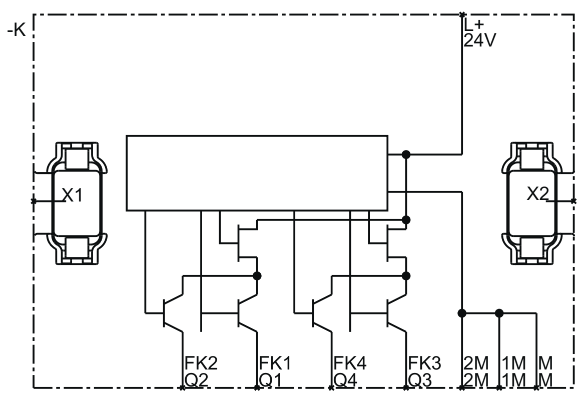


Figure 5-13 4F-DO internal circuit diagram

Terminal designations of the expansion module 4F-DO

Terminal	Meaning	Description
Q1, Q2, Q3, Q4	Safety-related solid-state outputs	Redundant semiconductor outputs for connecting actuators
L+	Power supply	24 V DC
M, 1M, 2M	Ground	Ground to 24 V DC

Interfaces of the expansion module 4F-DO

Interface	Meaning	Description
X1	Interface	Connection of central unit/expansion module
X2	Interface	Connection of expansion module

Displays of the expansion module 4F-DO

Element	Meaning
SF/Q1	Group error / status of the solid-state output
Q2, Q3, Q4	Status of the solid-state outputs

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting safety-related inputs and outputs (Page 117)."

5.1.11 Expansion module 4/8F-RO

Properties

With the expansion module 4/8F-RO, the 3RK3 central unit can be expanded with further safety-related outputs. In order to achieve SIL 3 as per EN 61508 or PL e as per EN ISO 13849-1, you must interconnect 2 relay outputs in a logic combination.

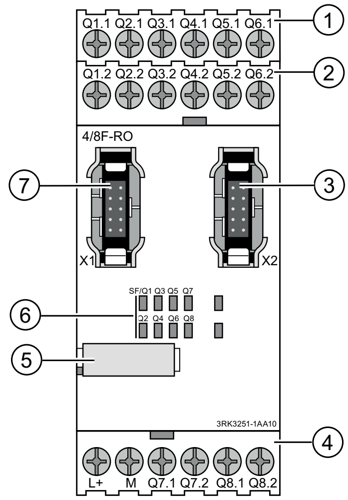
- Additional expansion modules can be connected to the expansion module 4/8F-RO.
- Parameterization is performed using the 3RK3 central unit with MSS ES.

Inputs and outputs

The expansion module 4/8F-RO has the following inputs and outputs:

- 8 single-channel, safety-related relay outputs.

Design of the expansion module 4/8F-RO

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	Interface (X2)
	④	Removable terminal block A
	⑤	Label
	⑥	Display LEDs
	⑦	Interface (X1)

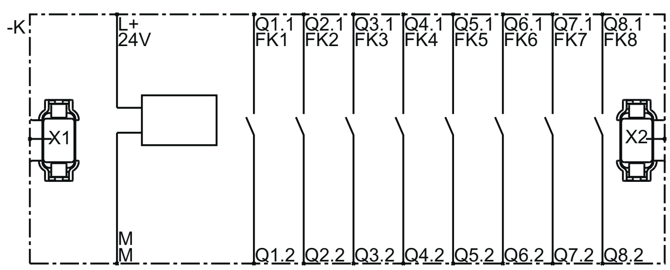


Figure 5-14 4/8F-RO internal circuit diagram

Terminal designations of the 4/8F-RO expansion module

Terminal	Meaning	Description
Q1.1, Q1.2	Safety-related relay output	Isolated output for connecting actuators
Q2.1, Q2.2	Safety-related relay output	
Q3.1, Q3.2	Safety-related relay output	
Q4.1, Q4.2	Safety-related relay output	
Q5.1, Q5.2	Safety-related relay output	
Q6.1, Q6.2	Safety-related relay output	
Q7.1, Q7.2	Safety-related relay output	
Q8.1, Q8.2	Safety-related relay output	
L+	Power supply	24 V DC
M	Ground	Ground to 24 V DC

Interfaces of the expansion module 4/8F-RO

Interface	Meaning	Description
X1	Interface	Connection of central unit/expansion module
X2	Interface	Connection of expansion module

Operator controls and displays of the expansion module 4/8F-RO

Element	Meaning
SF/Q1	Group error / status of the relay output
Q2 ...Q8	Status of the relay outputs

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting safety-related inputs and outputs (Page 117)."

5.1.12 Expansion module 8DI

Properties

With the 8DI expansion module, the 3RK3 central unit can be expanded by further (non-safety-related) inputs. The 8DI expansion module supplements a 3RK3 central unit.

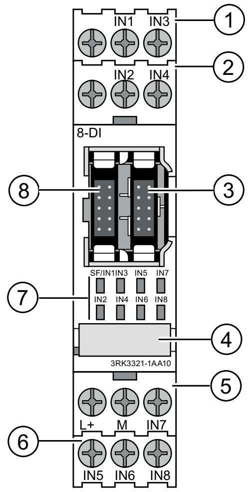
- It is suitable as an input module with non-safety-related sensor inputs, e.g. for:
  - Displaying process statuses for operational switching.
  - Detecting start buttons.
- Additional expansion modules can be connected to the expansion module 8DI.
- Parameterization is performed using the 3RK3 central unit with MSS ES.

Inputs and outputs

The expansion module 8DI has the following inputs and outputs:

- 8 sensor inputs (non-safety-related)

Design of the expansion module 8-DI

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	Interface (X2)
	④	Label
	⑤	Removable terminal block A
	⑥	Removable terminal block B
	⑦	Display LEDs
	⑧	Interface (X1)

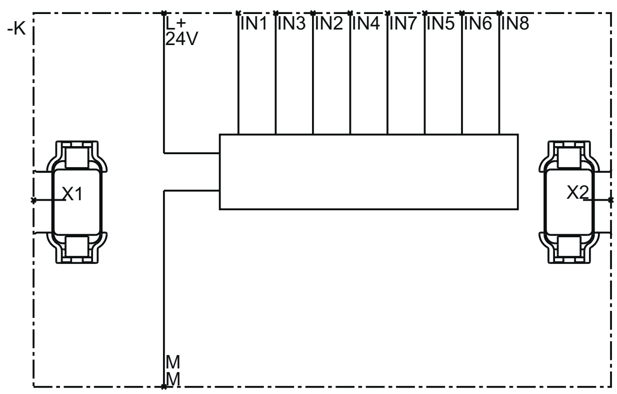


Figure 5-15 8-DI internal circuit diagram

Terminal designations of the expansion module 8-DI

Terminal	Meaning	Description
IN1 ... IN8	Sensor inputs	Connection for sensors
L+	Power supply	24 V DC
M	Ground	Ground to 24 V DC

Interfaces of the expansion module 8-DI

Interface	Meaning	Description
X1	Interface	Connection of central unit/expansion module
X2	Interface	Connection of expansion module

Displays of the expansion module 8-DI

Element	Meaning
SF / IN1	Group error / status of the sensor input
IN2 ... IN8	State of the sensor inputs

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting safety-related inputs and outputs (Page 117)."

5.1.13 Expansion module 8DO

Properties

With the 8DO expansion module, the 3RK3 central unit can be expanded by further (non-safety-related) outputs. It is suitable as an output module with non-safety-related outputs, e.g. for messages.

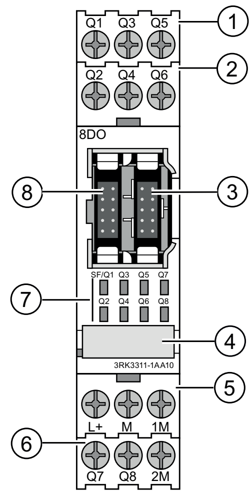
- Additional expansion modules can be connected to the expansion module 8DO.
- Parameterization is performed using the 3RK3 central unit with MSS ES.

Inputs and outputs

The expansion module 8DO has the following inputs and outputs:

- 8 semiconductor outputs (non safety related)

Design of the expansion module 8DO

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	Interface (X2)
	④	Label
	⑤	Removable terminal block A
	⑥	Removable terminal block B
	⑦	Display LEDs
	⑧	Interface (X1)

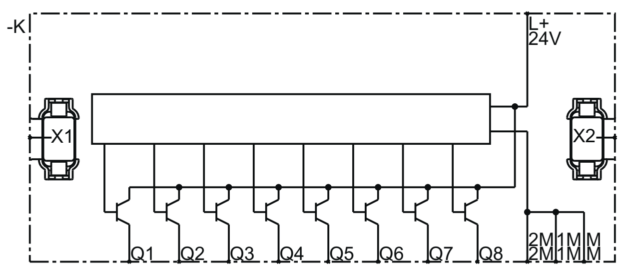


Figure 5-16 8DO internal circuit diagram

Terminal designations of the expansion module 8DO

Terminal	Meaning	Description
Q1 ...Q8	Solid-state outputs	Semiconductor outputs (non safety related)
L+	Power supply	24 V DC
M, 1M, 2M	Ground	Ground to 24 V DC

System interfaces of the expansion module 8DO

Interface	Meaning	Description
X1	Interface	Connection of central unit/expansion module
X2	Interface	Connection of expansion module

Displays of the expansion module 8DO

Element	Meaning
SF/Q1	Group error / state of the solid-state output
Q2 ...Q8	State of the semiconductor outputs (non-safety-related)

Connecting inputs and outputs

You will find more information on connecting inputs and outputs in Chapter "Connecting safety-related inputs and outputs (Page 117)."

5.1.14 DP interface module

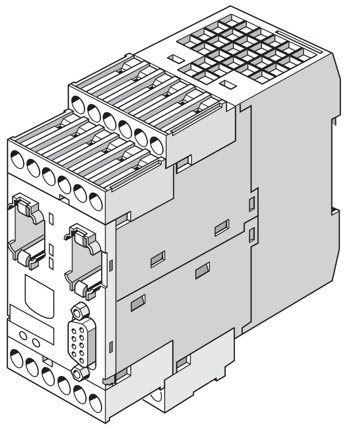


Figure 5-17 DP interface module

Application

Interface modules are the interface between the MSS 3RK3 and a higher-level bus system, e.g. PROFIBUS DP. The MSS 3RK3 uses them to make diagnostics and status information available to a higher-level controller. Non-safety-related input and output signals can be exchanged between the MSS 3RK3 and a higher-level controller (PLC).

Device power-up of DP interface

Once the hardware has been successfully initialized, the LED and display test is carried out. Then the connection between the DP interface and the 3RK3 central unit is established.

After successful startup, the DP interface appears as a PROFIBUS slave on the bus and starts data exchange if the configuration is correct.

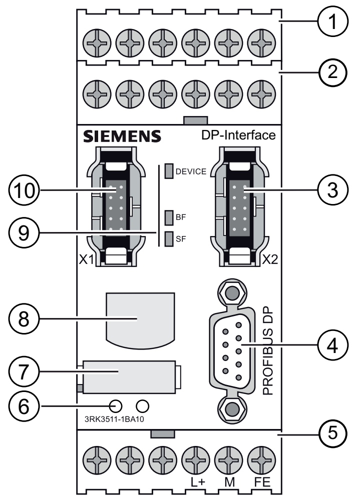
Properties

The DP interface module has the following properties:

- The DP interface connects the MSS 3RK3 to PROFIBUS DP and thus with a higher-level programmable controller.
- Integration into the higher-level control is performed by means of a GSD file.
- The properties of the DP interface are set with MSS ES.
- The DP interface is equipped with one system interface for connecting the 3RK3 central unit and one system interface for connecting a PC / PG.
- The DP interface can be used to link non-safety-related signals of a higher-level controller with the MSS 3RK3 logic.
- The DP interface has a baud rate of up to 12 MBit.
- Process and diagnostics data can be exchanged through the DP interface:
  - Cyclic: The PLC can exchange 32-bit or 64-bit process data with the MSS 3RK3 depending on the central unit.
  - Acyclic: The PLC can query diagnostic data from the MSS 3RK3. With MSS ES, the diagnostic information can be displayed graphically.

  Both options can be used at the same time.
- The DP interface supports DPV1 and DPV0 mode.

Design of the DP interface module

Front view	No.	Meaning
	①	Removable terminal block D
	②	Removable terminal block C
	③	System interface (X2)
	④	PROFIBUS DP connection
	⑤	Removable terminal block A
	⑥	Button (SET / MODE)
	⑦	Label
	⑧	LCD display
	⑨	Display LEDs
	⑩	System interface (X1)

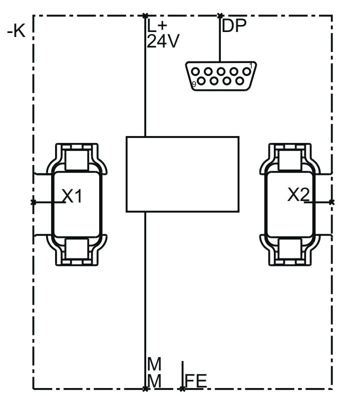


Figure 5-18 DP-Interface internal circuit diagram

Terminal designations of the DP interface module

Terminal	Meaning	Description
L+	Power supply	24 V DC
M	Ground	Ground to 24 V DC
FE	Functional ground	Shielding, equipotential bonding

Interfaces of the DP interface module

Interface	Meaning	Description
X1	System interface	Connection of PC / PG, diagnostics display
X2	System interface	Connection of central unit
PROFIBUS DP	9-pin sub D socket	Connection to PROFIBUS DP

Operating elements of the DP interface

Element	Meaning	Description
SET	Pushbutton	For navigating through the menu
MODE	Pushbutton	For navigating through the menu

Display elements of the DP interface module

Element	Meaning
DEVICE	Status
BF	Bus error
SF	Group error

Operating the DP interface

See Chapter "DP interface device statuses (Page 443)."

5.1.15 Diagnostics display

Application

A diagnostics display is available for the MSS 3RK3 that displays the current messages, diagnostics data, and status information of the monitored system directly on the control cabinet, enabling elementary diagnostics without PC and MSS ES. The diagnostics display has a connection to the 3RK3 central unit (rear) and a connection to the PC or programming device (front).

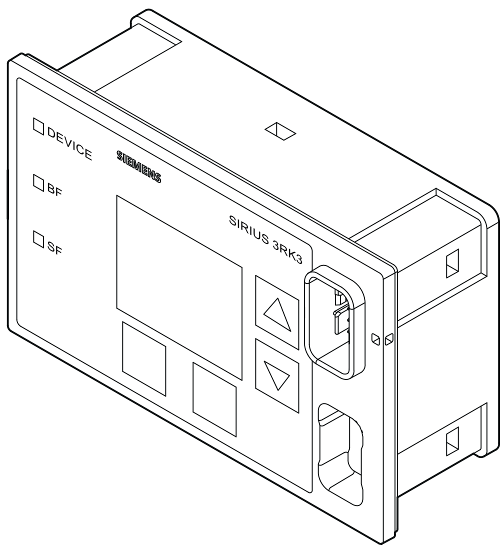


Figure 5-19 Diagnostics display of the MSS 3RK3

Note

MSS 3RK3 Advanced/ MSS 3RK3 ASIsafe basic/ MSS 3RK3 ASIsafe extended

These three 3RK3 central units are supported by the diagnostics display with product version E03 and firmware version V1.1.x and higher.

MSS 3RK3 Basic is supported by the diagnostics display with product version E01 and higher.

Note

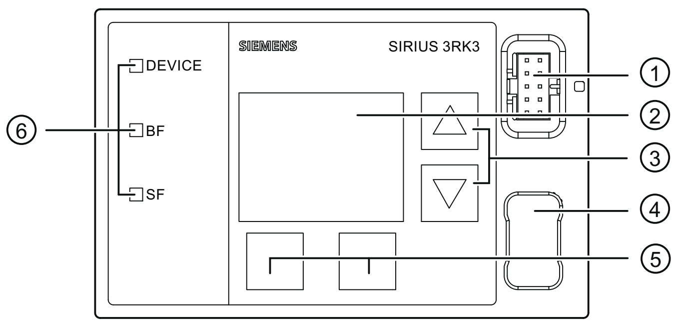
Access from MSS ES via PROFIBUS and diagnostics display

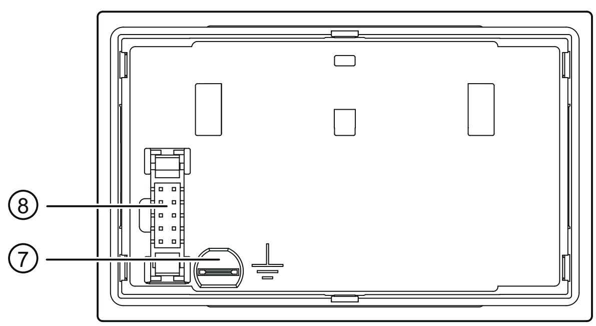
If the access from MSS ES to the MSS 3RK3 is by means of PROFIBUS, the diagnostics display must have, at a minimum, product version 3 (E03) or firmware version[1)] V1.1.x, as well as the MSS ES 2008 SP3.

If an access path is established by the MSS ES over an extended period or the device is switched to test mode, the display is disabled and outputs a corresponding message. The display restarts automatically once this status ends.

[1)] The firmware version can be read at the startup of the display or at the bottom left when the display is disabled. In addition, it is shown by selecting menu command "Display settings / Identification". (see also Chapter "Display settings (Page 633)")

Design of the diagnostics display

<table>
<tr><th>Front view</th><th>No.</th><th>Meaning</th></tr>
<tr><td rowspan="8">Front view:


Rear view:

</td><td>①</td><td>System interface (X1)</td></tr>
<tr><td>②</td><td>Display</td></tr>
<tr><td>③</td><td>Arrow keys</td></tr>
<tr><td>④</td><td>Park position for interface cover</td></tr>
<tr><td>⑤</td><td>Keys for menu navigation</td></tr>
<tr><td>⑥</td><td>Display LED</td></tr>
<tr><td>⑦</td><td>Functional ground</td></tr>
<tr><td>⑧</td><td>System interface (X2)</td></tr>
</table>

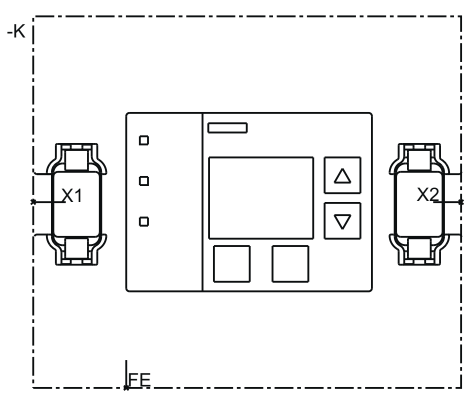


Figure 5-20 Diagnostic display internal circuit diagram

Terminal designations of the diagnostics display

Terminal	Meaning	Description
FE	Functional ground	Shielding, equipotential bonding

Interfaces of the diagnostics display

Interface	Meaning	Description
X1	System interface	Connection to the PC or programming device
X2	System interface	Connection to the central unit

Operator controls

Element	Meaning
Keys	Navigation in the operator control menu/error acknowledgement

Displays

Element	Meaning
DEVICE	Device status
BF	Bus error
SF	Group error

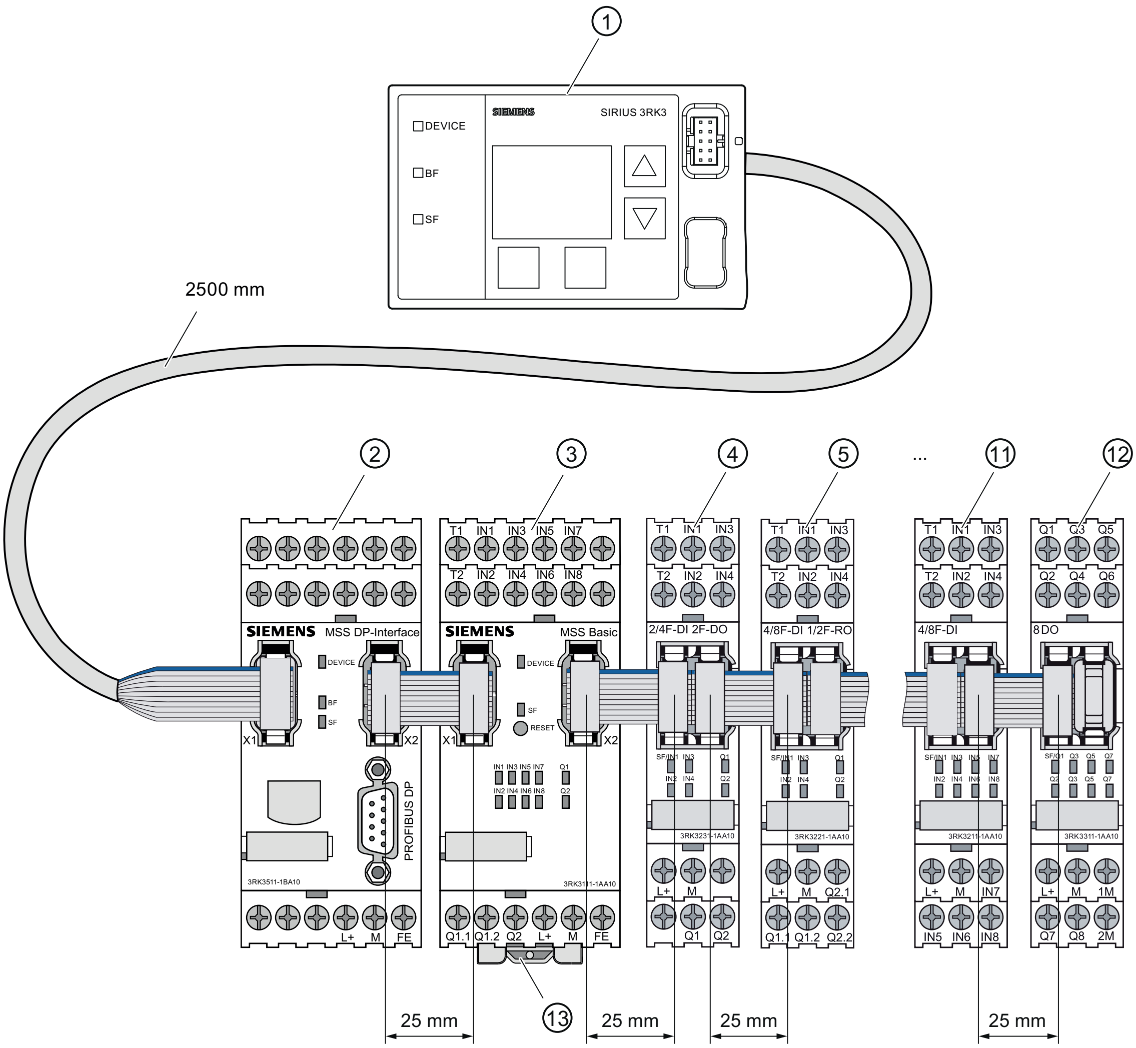
Operating the diagnostics display

See Chapter "Diagnostics with diagnostics display (Page 615)."

5.2 Mounting / installing / attaching

5.2.1 General note

During installation, pay attention to the maximum cable lengths to be complied with between the modules:



①	Diagnostics display
②	Interface module
③	Central unit
④ ... ⑫	Expansion modules

- 0 for MSS 3RK3 ASIsafe basic
- Maximum of 2 for MSS 3RK3 ASIsafe extended
- Maximum of 7 for MSS 3RK3 Basic
- Maximum of 9 for MSS 3RK3 Advanced

⑬	Memory module

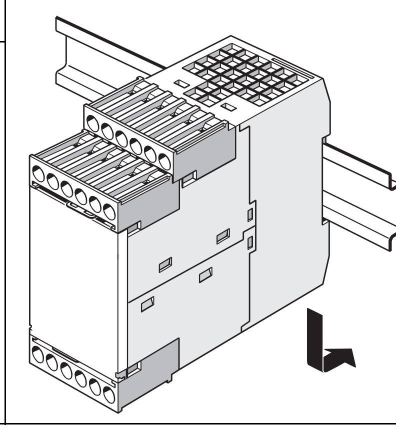
Figure 5-21 Maximum cable lengths of the MSS 3RK3

5.2.2 Mounting the central unit, expansion module, or interface module on a DIN rail

Requirements

- At the installation location, a horizontal 35-mm wide mounting rail per DIN EN 60715 is properly secured.
- Pay attention to the information on the mounting position in Chapter "General technical data (Page 655)."

DIN rail mounting procedure

Step	Operating instruction	Figure
1	Place the back of the device onto the upper edge of the standard mounting rail.	
2	Press the lower half of the device against the DIN rail until the device engages.	

5.2.3 Mounting the central unit, expansion module, or interface module on a level surface

Requirements

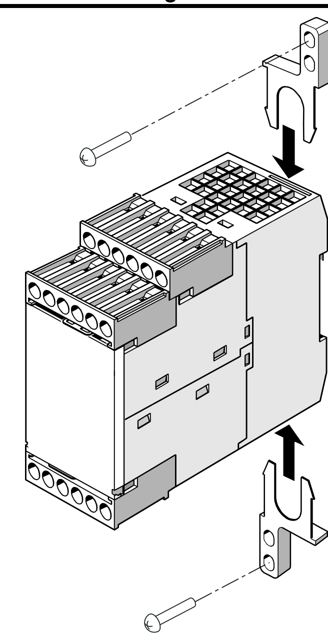
Please note the following requirements for mounting on a level surface:

- Pay attention to the information on the mounting position in Chapter "General technical data (Page 655)."
- Two properly executed drill holes with thread or plug on the level surface

  Refer to the relevant dimension drawings in the appendix for the distances between the drill holes "Dimension drawings (Page 675)."
- Two screws with a maximum thread diameter of 4.8 mm
- Two plastic securing brackets

  Refer to the accessories list in Chapter "System components (Page 34)" for the relevant order number.

Procedure for mounting on a level surface

Step	Operating instruction	Figure
1	Insert the securing brackets into the openings provided on the device until they engage.	
2	Hold the device up to the surface prepared for screw fastening.	
3	Insert the screws through the oblong holes in the securing brackets.	
4	Screw the device onto the level surface so that it is secure.	

5.2.4 Installing the diagnostics display in a control cabinet door / switchboard

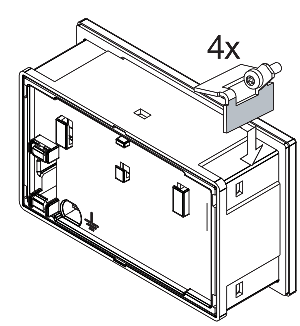
Requirements

- A mounting cut-out measuring H x W 55 x 92 mm must be available.
- The control cabinet door/control panel must be no more than 16 mm thick.

NOTICE
Overall depth
Please observe the installation depth of 41 mm for the device.

NOTICE
Degree of protection IP54
The degree of protection IP54 on the front is only guaranteed if: • The device has been properly installed with the fixing elements supplied. • The system interface on the front has been protected with a system interface cover.

Procedure for installing in a control cabinet door / control panel

Step	Operating instruction	Figure
1	Insert the diagnostics display in the mounting cut-out from the front.	
2	Take appropriate measures to ensure the diagnostics display does not fall out of the control cabinet door/control panel.	
3	Snap the four fixing brackets on the rear into the oblong holes of the diagnostics display.	
4	Tighten the screws of the fixture bracket slightly so that the diagnostics display cannot fall out of the installation opening.	
5	Align the diagnostics display.	
6	Gently tighten the screws of the fixing brackets with 0.15 + 0.05 Nm.	

5.2.5 Removing the central unit, expansion module, or interface module

WARNING

Hazardous Voltage.

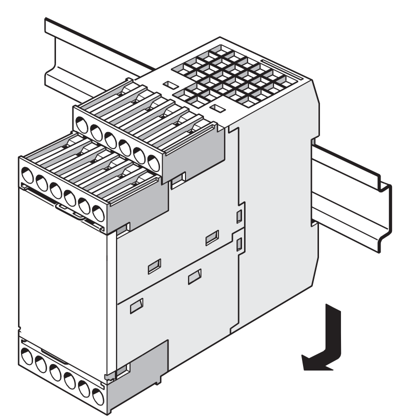
Can Cause Death, Serious Injury, or Property Damage.

Before starting work, therefore, disconnect the system and devices from the power supply.

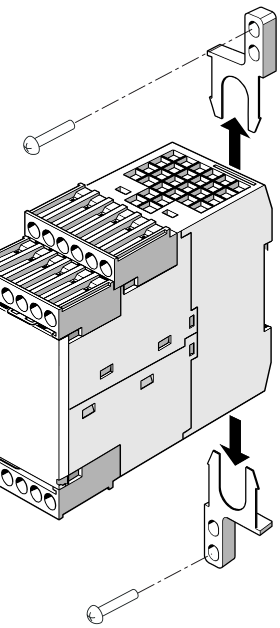
Requirements

- All system interface connections are terminated.
- If applicable, the PROFIBUS DP connection or AS-i bus is terminated.
- The terminal blocks have been removed or disconnected.

Removing the central unit, expansion module, or interface module from a DIN rail

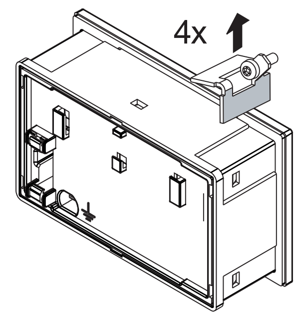
Step	Operating instruction	Figure
1	Pull the device down until the lower half can be pulled away from the DIN rail.	
2	Pull the lower half of the device away from the DIN rail.	
3	Lift the device from the upper edge of the DIN rail.	

Removing the central unit, expansion module, or interface module from a level surface

Step	Operating instruction	Figure
1	Hold the device firmly.	
2	Unscrew the cap screws.	
3	Lift the device from the level surface.	
4	Remove the securing brackets from the device.	

5.2.6 Removing the diagnostics display

Removing the diagnostics display from a control cabinet door / control panel

Step	Operating instruction	Figure
1	Take appropriate measures to ensure the diagnostics display does not fall out of the control cabinet door/control panel.	
2	Unscrew the screws of the four fixing brackets on the rear.	
2	Remove the fixing brackets.	
3	Pull the diagnostics display out of the mounting cut-out from the front.	

5.3 Connecting / wiring

5.3.1 Connecting safety-related inputs and outputs

Inputs

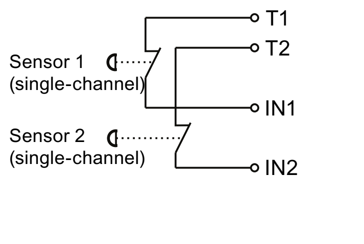
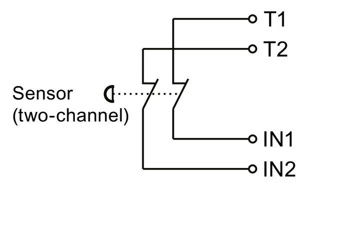
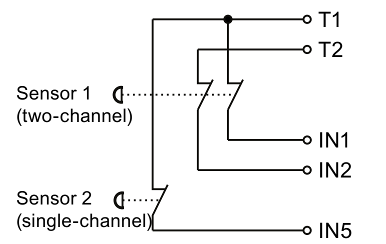
To achieve the required performance level or SIL, single-channel or two-channel interconnection of the inputs of the MSS 3RK3 is possible. The following connection methods are possible:

- In the case of the single-channel connection method, only one input terminal is assigned for each sensor.
- In the case of the two-channel connection method, two input terminals are assigned for each sensor. In mixed operation, both single-channel and two-channel sensors can be interconnected on one module.
- Cross-circuit detection is possible when the test cycle outputs are used with two-channel sensors.

The number of connectable sensors thus varies according to the connection method. Up to 4 two-channel sensors or 8 single-channel sensors can be connected to the 3RK3 central unit.

The safety-related inputs can also be used to read standard signals (non-safety-related).

Connection methods of the safety-related inputs with cross-circuit detection

2 x single-channel sensor	1 x two-channel sensor	Single-channel and two-channel sensor mixed
		

T1 test output for IN1, 3, 5, 7

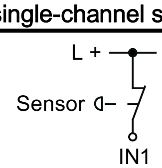
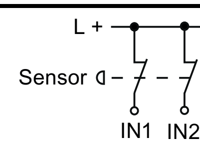
T2 test output for IN2, 4, 6, 8

IN1 ... IN5 sensor inputs

Non-floating sensors

When sensors with non-floating outputs (e.g., light curtains, laser scanners) are used, they must not be supplied with power through test outputs T1/T2. With this function element, cross-circuit detection must be deactivated in the MSS ES tool.

Connection methods of the safety-related inputs without cross-circuit detection

1 x single-channel sensor	1 x two-channel sensor
	

IN1, IN2 sensor inputs

Relay outputs

Safety-related outputs of the 3RK3 central unit are configured with two channels; those of the expansion modules, with one channel. To achieve PL d/e or SIL 2/3 of the expansion modules, two relay outputs must be interconnected in a logic combination.

WARNING

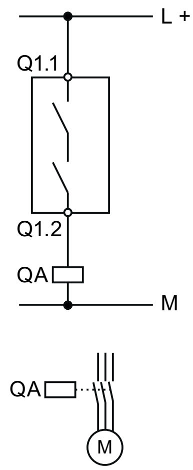
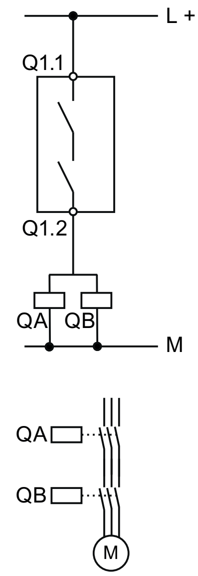
Overload

The relay contacts may weld if an overload occurs. The system cannot then shut down. To prevent relay contact welding, the switched loads must be protected accordingly, see Chapter "Technical data (Page 655)."

Note

When inductive loads are controlled through a relay output, the load must be equipped with inductive interference protection.

Main connection methods of the safety-related relay outputs of the 3RK3 central unit

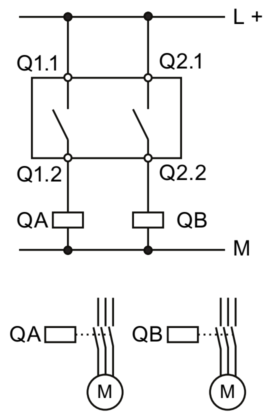
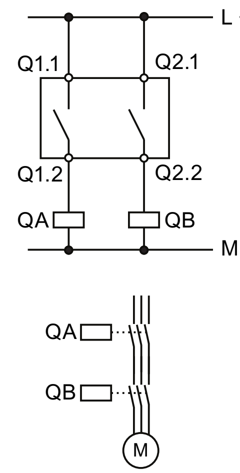
1 x single-channel actuator shutdown	1 x two-channel actuator shutdown
	

QA, QB contactors

Qx.1, Qx.2 safety-related relay outputs

> **⚠ WARNING**
>
> To achieve SIL 2/3 as per IEC 61508 or PL d/e as per EN ISO 13849-1, a fault exclusion such as a short-circuit to P or M is required. This can, for example, be implemented within a control cabinet or by installing the connection cables in such a way that they are protected. If that is not possible, the outputs must be implemented redundantly. For this purpose, separate cables must be laid to actuators/contactors. In the associated function element "F output," the output type "F output redundant" must be chosen.

Main connection methods of the safety-related relay outputs of the expansion modules 2/4F-DI 1/2F-RO and 4/8F-RO

<table>
<tr><th>2 x single-channel actuator shutdown</th><th>1 x two-channel actuator shutdown</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

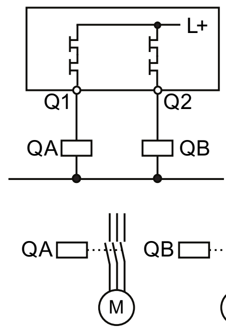
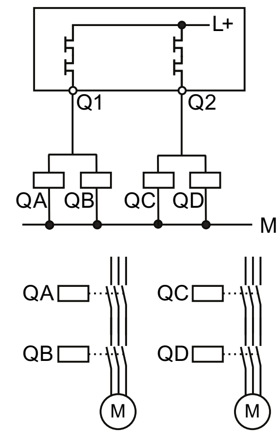
QA, QB contactors

Qx.1, Qx.2 safety-related relay outputs

Solid-state outputs

Internally, safety-related solid-state outputs always have a two-channel structure. As a result, each of these outputs can be used for applications up to PL e or SIL 3.

Connection methods of the safety-related solid-state outputs

2 x single-channel actuator shutdown	2 x two-channel actuator shutdown
	

QA ... QD contactors

Q1, Q2 safety-related solid-state outputs

WARNING

To achieve SIL 2/3 as per IEC 61508 or PL d/e as per EN ISO 13849-1, a fault exclusion such as a short-circuit to P or M is required. This can, for example, be implemented within a control cabinet or by installing the connection cables in such a way that they are protected. If that is not possible, the outputs must be implemented redundantly. For this purpose, separate cables must be laid to actuators/contactors. In the associated function element "F output," the output type "F output redundant" must be chosen.

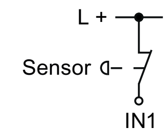
Note

When inductive loads are controlled through a solid-state output, the load must be equipped with inductive interference protection.

5.3.2 Connecting non-safety-related inputs and outputs

Connection methods of the non-safety-related inputs

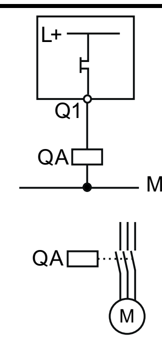
1 x single-channel sensor



IN1 sensor input

Connection methods of the non-safety-related solid-state outputs

Single-channel actuator shutdown



QA contactors

Q1 safety-related solid-state outputs

Note

When inductive loads are controlled through a solid-state output, the load must be equipped with inductive interference protection.

5.3.3 Guidelines for wiring the MSS 3RK3

WARNING
Hazardous voltage **Can Cause Death, Serious Injury, or Property Damage.** To minimize any risk to humans or the environment, you must not bypass any safety functions or implement measures that cause such safety functions to be bypassed. The manufacturer is not liable for the consequences of any such manipulation or for any damage resulting if this warning is not observed.

WARNING
Hazardous voltage **Can Cause Death, Serious Injury, or Property Damage.** If a two-channel evaluation is carried out via a module comprising two single-channel function elements, the input signals must each be read by a linear and non-linear sensor input. If these specifications are not observed, the requirements of the highest protection class are not fulfilled.

WARNING
Hazardous voltage **Can Cause Death, Serious Injury, or Property Damage.** When safe outputs or inputs are used on a single channel, a cable cross-circuit or the reaction of loads can result in a dangerous malfunction. When stringent requirements regarding safety must be fulfilled, the risk of dangerous malfunctions must be minimized by implementing appropriate measures (e.g., protected cable installation).

Cross-circuit detection

To ensure reliable cross-circuit detection, note the following points when wiring the individual modules:

1. All components (i.e., all modules including the sensors) must be operated on the same power supply.
2. Cross-circuit detection is not possible with single-channel sensors.
3. A two-channel sensor must only be connected to a single (expansion) module.
4. A two-channel sensor must be connected to test outputs T1/T2 to ensure cross-circuit detection.
   If a cross-circuit is detected, this applies to the entire module.
5. Test output T1 must always be combined with an odd-numbered sensor input (IN1, IN3, IN5, IN7).
6. Test output T2 must always be combined with an even-numbered sensor input (IN2, IN4, IN6, IN8).
7. Non-floating sensors cannot be connected to test outputs T1/T2. Cross-circuit detection of non-floating sensors with MSS 3RK3 is therefore not possible.
8. Cross-circuit detection is not possible with non-floating sensors. In this case, cross-circuit detection must be deactivated in MSS ES. See also Chapter "Properties across function elements (Page 271)."
9. Cross-circuit detection between three, four, or more inputs on one sensor is not possible. For this reason, the cables for the two buttons must be routed separately to prevent a cross-circuit (in two-hand operation, for example).
10. If a safety shutdown mat (cross-circuit principle) is connected to a module, cross-circuit detection must be deactivated for the remaining inputs on this module because otherwise the monitoring functions configured for these inputs will also signal a cross-circuit when somebody steps on the safety shutdown mat.

Outputs

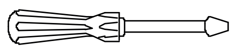
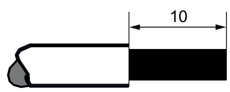
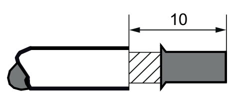
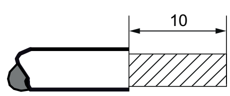
1. If outputs are used as redundant outputs, the two outputs do not have to be on the same module.
2. Safety-related solid-state outputs can be used for safety-related shutdown to SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1, if the cables are installed in a protected manner or routed inside the control cabinet.

Reference

For examples of how to wire sensors, see Chapter "Wiring of the MSS 3RK3 Basic (Page 46)."

5.3.4 Connection data for terminal blocks

The following connection data apply dependent on the removable terminal block:

	Specification and value in the case of removable terminal blocks with screw-type terminals	Specification and value in the case of removable terminal blocks with spring-loaded terminals
Screwdriver 	Cross-tip screwdriver Size: PZ 2 (⌀ 5 … 6 mm) Torque: 0.8 … 1.2 Nm	Screwdriver Size: 0 or 1 (width to 3 mm) for raising the terminal springs
Rigid cable 	Maximum number of cables x cable cross-section: 1 x 0.5 … 4.0 mm² or 2 x 0.5 … 2.5 mm²	Maximum number of cables x cable cross-section: 2 x 0.25 … 1.5 mm²
Flexible cable with end sleeve/cable lug 	Maximum number of cables x cable cross-section: 1 x 0.5 … 2.5 mm² or 2 x 0.5 … 1.5 mm²	Maximum number of cables x cable cross-section: 2 x 0.25 … 1.5 mm²
Flexible cable 	Not allowed	Maximum number of cables x cable cross-section: 2 x 0.25 … 1.5 mm²

5.3.5 Connecting terminal blocks

WARNING

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

Before starting work, therefore, disconnect the system and devices from the power supply.

Note

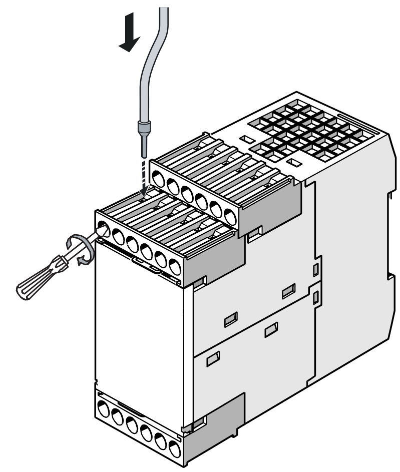
Functional ground - protective ground conductor

Terminal FE must be connected to functional ground with a low-resistance connection.

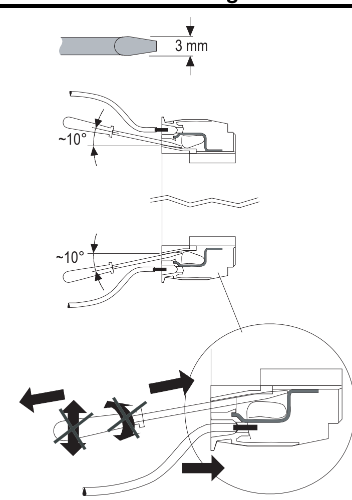
Requirements

- The insulation on the connection cables must be properly stripped to a length of 10 mm.
- Flexible cables must be fitted with end sleeves or cable lugs for connection to screw-type terminal blocks.

Procedure for screw-type terminal blocks

Step	Operating instruction	Figure
1	Insert the relevant cable into square on the screw-type terminal until it engages.	
2	Hold the cable in the screw-type terminal.	
3	Tighten the screw of the terminal in which the cable is inserted.	
4	Pull on the cable to ensure it is screwed tight.	

Procedure for spring-loaded terminal blocks

Step	Operating instruction	Figure
1	To release the terminal spring, insert the 3-mm flat-head screwdriver into the square opening of the spring-loaded terminal until it engages. Please observe a 10° horizontal angular deviation of the screwdriver to the oval opening.	
2	Insert the cable into the oval opening as far as it will go.	
3	Hold the cable in the spring-loaded terminal.	
4	Remove the screwdriver.	
5	Pull on the cable to ensure it is tight.	

5.3.6 Connecting the system interfaces

⚠ CAUTION

Protection against electrostatic charge

Unused system interfaces must be closed using system interface covers.

CAUTION

Off-circuit installation

Connect the system interfaces only in a voltage-free state!

If you connect system interfaces while the system is connected to the power supply, this can damage the safety components which, in turn, means that the safety function is no longer available.

Note

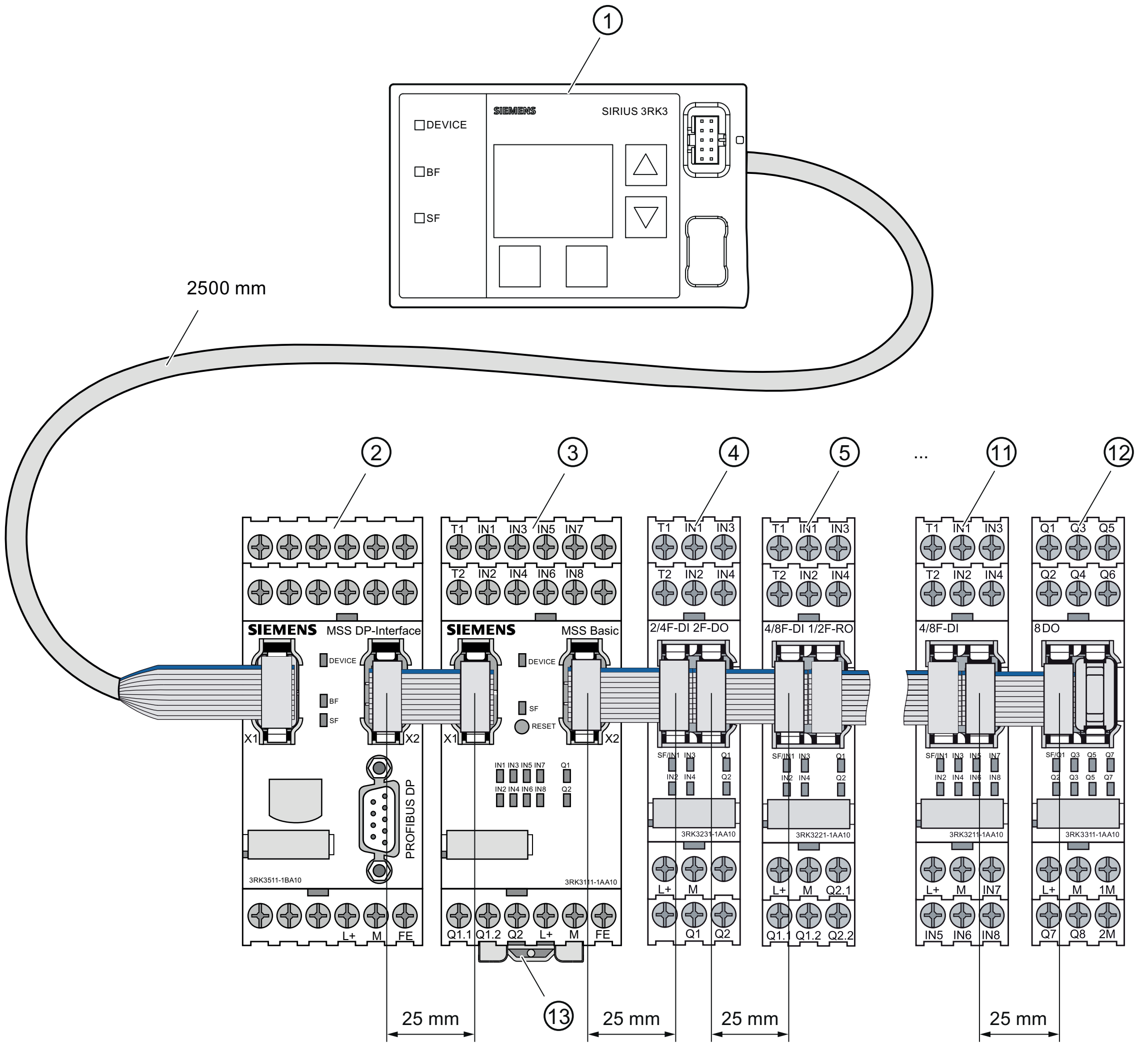
Connection cables

- MSS components are connected through the system interfaces using connection cables.
- The connection cables are available as adjacent versions (0.025 m). Connection cables up to max. 2.5 m in length are available for connecting to the diagnostics display.

Note

Reverse polarity protection

Observe the color coding and mechanical coding on the connection cables.



① Diagnostics display

② Interface module

③ Central unit

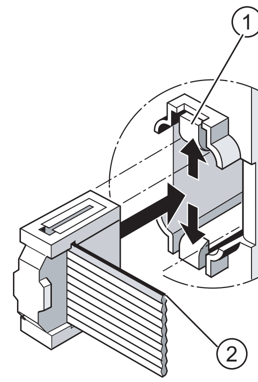
④ ... ⑫ Expansion modules:

- Maximum of 7 for MSS 3RK3 Basic
- Maximum of 9 for MSS 3RK3 Advanced
- 0 for MSS 3RK3 ASIsafe basic
- Maximum of 2 for MSS 3RK3 ASIsafe extended

⑬ Memory module

Figure 5-22 Maximum cable lengths of the MSS 3RK3

Procedure for connecting the system interfaces

Step	Operating instruction	Figure
1	Observe the color coding ② and mechanical coding. Insert the cable connector into the connector slot. Engage the locking mechanisms ①.	
2	Pull on the connection cable to ensure the locking element has engaged.	
3	Close unused interfaces with system interface covers. Observe the mechanical coding.	

5.3.7 Connecting a diagnostics display

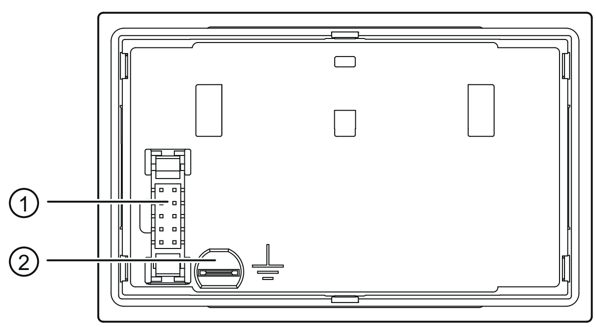
Note

Cable length

The connection cable between the diagnostics display and the central unit/interface module must not exceed 2.5 m.

Every diagnostics display has three connections:

Connections on the rear



① System interface X2

② Functional ground

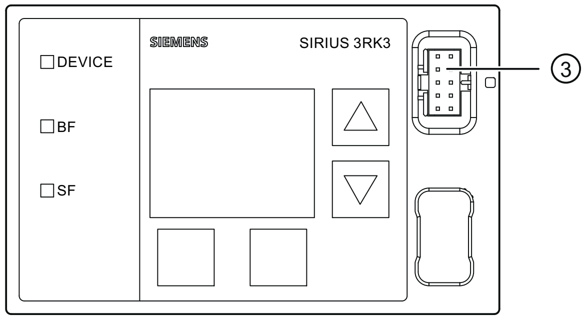
The rear is normally not accessible if the diagnostics display is installed. The connection cable from the central unit / interface module is connected to the system interface X2 ② there. The diagnostics display also has to be grounded at the functional ground ①.

You will find additional information in Chapter " Grounding (Page 141)."

Note

Only the central unit or the interface module may be connected to the system interface X2 ② on the rear of the diagnostics display.

Connections on the front



③ System interface X1

The front is normally accessible if the diagnostics display is installed. Components are only directly inserted in the system interface X1 ③ as required and removed after use. These can be:

- PC cable for connecting a PC/PG
- Cover (when the system interface is not used)

Note

Only one PC / PG may be connected to the system interface X1 ③ on the front of the diagnostics display.

CAUTION

EMC measures

If the system interface X1 is not used, it must be closed with the interface cover supplied to retain the degree of protection of the diagnostics display and to prevent damage due to electrostatic charge.

5.3.8 Establishing a PROFIBUS DP connection

PI installation guidelines

In the case of electric PROFIBUS networks, note also the PROFIBUS DP/FMS installation guidelines defined by the PROFIBUS user organization. These contain important information about installing cables and commissioning PROFIBUS networks.

Publisher:

PROFIBUS-Nutzerorganisation e. V.
Haid-und-Neu-Straße 7
76131 Karlsruhe, Germany

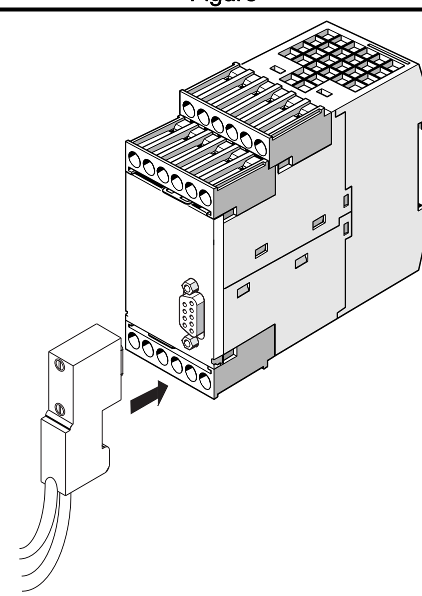
Tel.: ++721 / 9658 590
Fax: ++721 / 9658 589
Internet (http://www.profibus.com)
guidelines, order no. 2.111

See also "SIMATIC NET PROFIBUS Network Manual (http://support.automation.siemens.com/WW/view/de/35222591/0/en)" (order number: C79000-G8900-C124-03)

Requirement

PROFIBUS DP connection cable with 9-pin sub-D connector is available.

Connection to PROFIBUS DP

Step	Operating instruction	Figure
1	Connect the PROFIBUS DP connector to the PROFIBUS DP interface.	
2	Tighten the screws on the PROFIBUS DP connector.	
3	If the device is located at the end of the PROFIBUS DP cable, switch on the terminating resistor on the PROFIBUS DP connector.	

5.3.9 Connecting the AS-i bus

Requirements

The MSS 3RK3 can only be connected to the following central units on the AS-i bus:

- 3RK3 Advanced
- 3RK3 ASIsafe basic
- 3RK3 ASIsafe extended

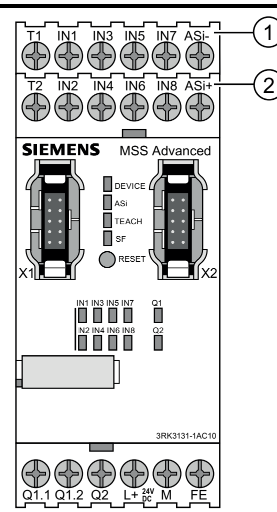
When connecting the AS-i cables, pay attention to the general information in Chapter "Connecting terminal blocks (Page 127)."

Note

Bus load of MSS 3RK3

The MSS 3RK3 is always a bus load from an A/B slave on the AS-i bus. This bus load does not depend on how many slaves are simulated by the 3RK3 central unit or whether only AS-i slaves are monitored.

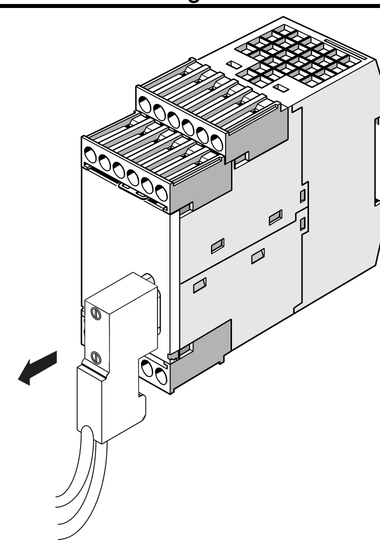
How to connect to the AS-i bus

Step	Operating instruction	Figure
1	Connect AS-Interface to the AS-i terminals ① / ② on the 3RK3 central unit. The blue conductor of the AS-i cable is connected to the terminal "ASi-" ① and the brown conductor to the terminal "ASi+" ②.	

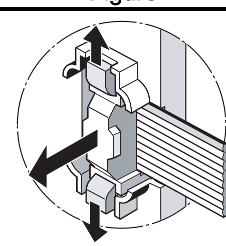
5.3.10 Disconnecting

WARNING
Hazardous Voltage. **Can Cause Death, Serious Injury, or Property Damage.**
Before starting work, therefore, disconnect the system and devices from the power supply.

Disconnecting PROFIBUS DP connection (if applicable)

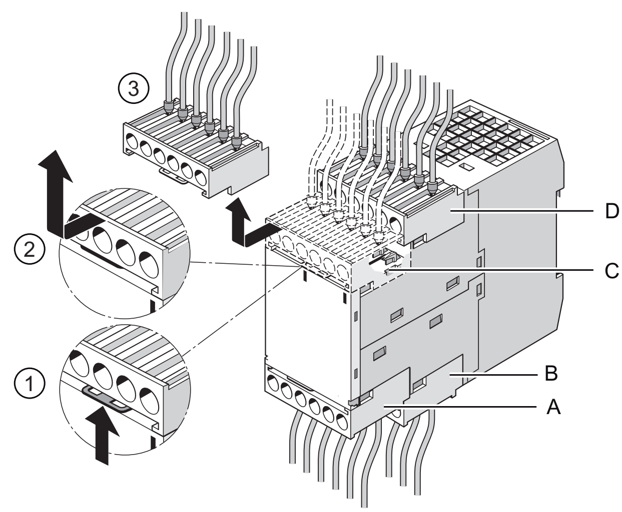
Step	Operating instruction	Figure
1	Loosen the screws of the PROFIBUS DP connector.	
2	Remove the PROFIBUS DP connector.	

Disconnecting system interfaces

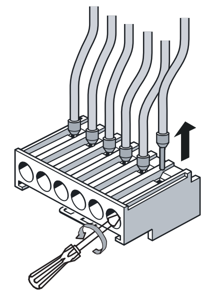
Step	Operating instruction	Figure
1	Press the locking element apart and simultaneously pull the connection cable out of the connector slot of the system interface.	

Removing terminal blocks from the device

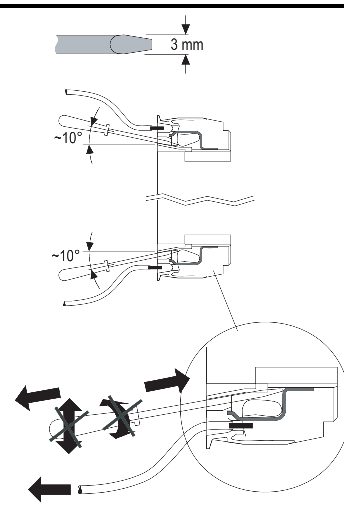
NOTICE
Order of removal
Remove terminal block A before terminal block B, and C before D.

Step	Operating instruction	Figure
1	Insert a flat-head screwdriver between the clip of the terminal block and the front panel ①.	
2	Pull the terminal block out to the front ②.	
3	Lift the terminal block out of the mechanically coded guiderail of the device ③.	

Disconnecting screw-type terminals

Step	Operating instruction	Figure
1	Unscrew the screw of the screw-type terminal.	
2	Remove the cable from the unscrewed screw terminal.	

Disconnecting spring-loaded terminals

Step	Operating instruction	Figure
1	Insert the flat-head screwdriver into the square opening of the spring-loaded terminal until it engages. Please observe a 10° horizontal angular deviation of the screwdriver to the oval opening.	
2	Remove the cable from the oval opening.	
3	Remove the screwdriver.	

5.3.11 Plugging in terminal blocks

WARNING
Hazardous Voltage.
Can Cause Death, Serious Injury, or Property Damage.
Before starting work, therefore, disconnect the system and devices from the power supply.

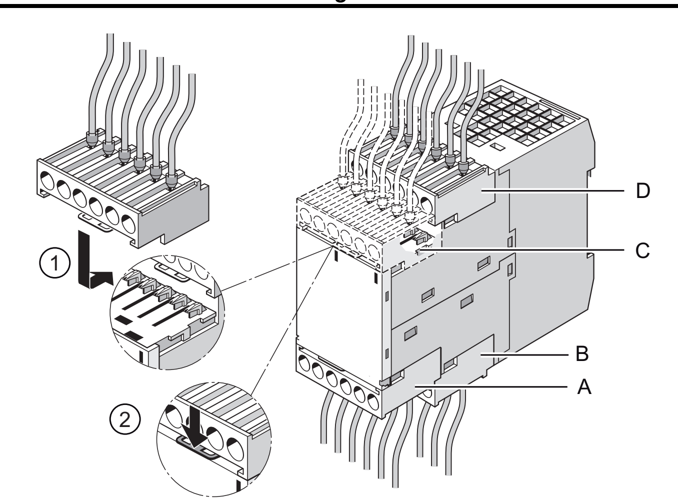
Requirement

You must have removed the terminal blocks, for the purpose of replacing a device, for example.

Procedure when plugging in the terminal blocks

NOTICE
Removable terminal blocks are mechanically coded to prevent polarity reversal
The removable terminal blocks are mechanically coded to prevent polarity reversal and are labeled with A, B, C or D on the inside. Only use the slots shown in the diagram below.

NOTICE
Plug-in sequence
Connect terminal block B before terminal block A, and D before C.

Step	Operating instruction	Figure
1	Insert the removable terminal block into the mechanically coded guiderail of the device ①.	
2	Slide the removable terminal block back until it audibly engages.	
3	Check that the clip of the removable terminal block closes flush with the front panel ②.	

5.3.12 Connecting the memory module

The memory module is included in the scope of delivery of the 3RK3 central unit. Program the memory module in the 3RK3 central unit that is connected to a configuring PC or programming device.

Connecting the memory module

NOTICE
The memory module must only be connected/disconnected when the 3RK3 central unit is disconnected from the power supply.

NOTICE
Do not connect a memory module with released configuration to a 3RK3 central unit of another type. The released configuration on the memory module depends on the 3RK3 central unit. For example, the configuration released on an MSS 3RK3 Basic cannot be interpreted by an MSS 3RK3 Advanced, or vice versa. The same applies to all other 3RK3 central units. When the memory module is plugged into a 3RK3 central unit of another type, the configuration release is canceled. The configuration may have to be adapted and released again.

Connect the memory module to the interface on the underside of the 3RK3 central unit ①. Engage the locking mechanisms ②.

The memory module can be sealed.

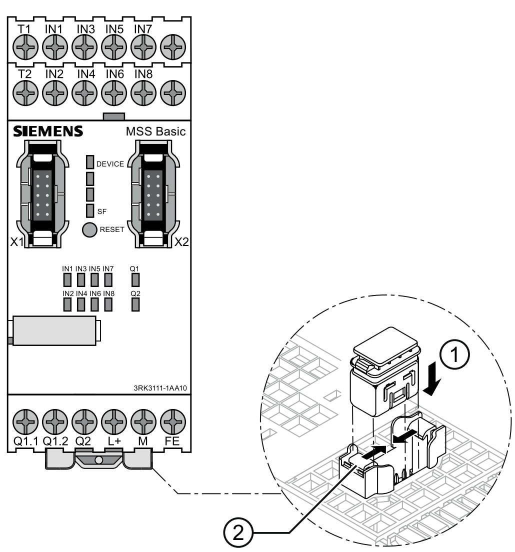


Figure 5-23 Connecting the memory module

Note

Correct position of the memory module

Make sure that the memory module is positioned correctly on the 3RK3 central unit (the locking elements must be locked ②).

5.3.13 Grounding

WARNING

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

Before grounding or wiring an electrical device, you must ensure that the power supply for the device is switched off. Ensure that all the connected devices are also switched off.

Grounding measures

All electrical devices must be grounded and wired properly not only to ensure that your system functions as smoothly as possible but also to provide additional noise immunity for your application.

The following components must be grounded:

- FE contacts of the module, if present
- Shield of the PROFIBUS cable
- Tab connector of the diagnostics display
- The shield, if shielded sensor and actuator cables are used

All ground cables must be as short as possible and have the largest possible cable cross-section.

Description of the software 6

6.1 Introduction

6.1.1 What's new?

Function expansion as from 2008 + SP3

The new Modular Safety System ES 2008 SP3 contains a few new features, which are listed below:

- The software is additionally released for the following 64-bit operating systems and service packs:
  - Windows 7 Professional SP1 (64-bit)
  - Windows 7 Enterprise SP1 (64-bit)
  - Windows 7 Ultimate SP1 (64-bit)
  - Windows 7 Professional (64-bit)
  - Windows 7 Enterprise (64-bit)
  - Windows 7 Ultimate (64-bit)
- Adobe Reader

  Modular Safety System ES 2008 SP3 no longer uses Adobe Reader for the "Print" and "Print Preview" functions. Therefore, product setup no longer includes Adobe Reader.
- The new Modular Safety System ES 2008 SP3 supports the two new central units:
  - 3RK3 ASIsafe basic
  - 3RK3 ASIsafe extended

These support the same function elements as the 3RK3 Advanced central unit. The differences between these three central units are listed in the table:

Feature	3RK3 ASIsafe basic	3RK3 ASIsafe extended	3RK3 Advanced
Safety-related, freely parameterizable sensor inputs	2	4	8
Digital standard inputs (single-channel)	6	4	0
Safety-related, redundant relay outputs	1	1	1
Safety-related, redundant semiconductor outputs	1	1	1
Expansion modules	0	2	9
Maximum number of simulated safety-related AS-i slaves	8	10	12
DP interface	Yes	Yes	Yes
Diagnostics module	Yes	Yes	Yes

6.1.2 Overview

The engineering system (ES)

SIRIUS ES is the shared software platform for different communication-enabled switching devices.

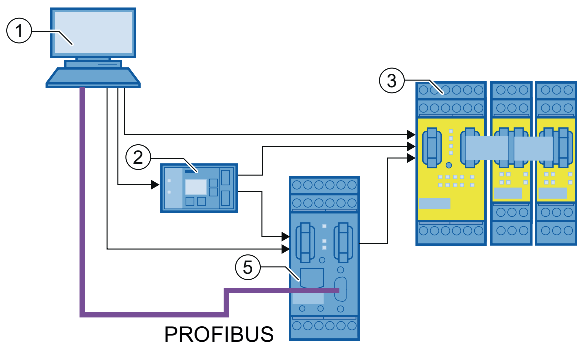
The Modular Safety System ES 2008 (MSS ES) engineering system is the software for configuring and parameterizing and diagnosis of the Modular Safety System 3RK3 (MSS 3RK3).

It provides the following functions:

- Simple configuration of the modules of an MSS 3RK3, including the graphical parameterization of the function elements, e.g., monitoring functions
- Test and startup functions, e.g., device diagnostics, monitoring of logic elements, forcing of logic elements
- Tool for creating the system documentation, e.g., documentation of the circuits, device comments, module names

Communication

MSS ES communicates with the MSS 3RK3 through the system interface of the 3RK3 central unit or over PROFIBUS.



① PC or programming device through the device interface on the MSS 3RK3
② PC/device interface with diagnostics display on the MSS 3RK3
③ MSS 3RK3
④ PLC over PROFIBUS and DP-Interface
⑤ DP interface

Figure 6-1 Communication options of MSS ES

WARNING
To prevent unauthorized access to the MSS 3RK3 through the PROFIBUS network, you assign a password for device access.

Delivery form

The MSS ES parameterization software is available in three different license versions with different functional scopes:

- Basic license
  - CD with a license on a USB stick (order number: 3ZS1 314-4CC10-0YA5)
  - License download (order number: 3ZS1 314-4CE10-0YB5)
- Standard license
  - CD with a license on a USB stick (order number: 3ZS1 314-5CC10-0YA5)
  - License download (order number: 3ZS1 314-5CE10-0YB5)
  - Software Update Service (order number: 3ZS1 314-5CC10-0YL5)
  - Powerpack (Basic → Standard) (order number: 3ZS1 314-5CC10-0YD5)
- Premium license (new)
  - CD with a license on a USB stick (order number: 3ZS1 314-6CC10-0YA5)
  - License download (order number: 3ZS1 314-6CE10-0YB5)
  - Software Update Service (order number: 3ZS1 314-6CC10-0YL5)
  - Powerpack (Standard → Premium) (order number: 3ZS1 314-6CC10-0YD5)

For the functional scope of each license version, see Chapter "License-dependant available menu commands (Page 147)."

The software package contains:

Software	Application
MSS ES	Configuration of the MSS 3RK3
Automation License Manager	License management
.NET Framework	Required for generating the printout or print preview
MSI	Execution of the setup
Readme (Readme.rtf)	Important information you require before installation.

Note

The licenses are implemented exclusively as a floating license. You will find additional information in Chapter "Installing the Automation License Manager (Page 153)."

6.1.3 License-dependant available menu commands

3 different license versions of the "Modular Safety System ES 2008+SP3" software are available:

- Basic license: This license contains a reduced functional scope and is suitable for commissioning engineers and service personnel.
- Standard license: This license contains a full range of functions for creating configurations. The functional scope is that of the previous Software Modular Safety System ES 2008.
- Premium license: In contrast to the standard license, this license enables MSS ES to communicate with MSS 3RK3 additionally via PROFIBUS. This license version also features macro functionality.

Not all functions are available with all licenses. If a function is not available with your license version, the associated menu option is always grayed out.

Overview: Availability of menu options

The following table provides an overview of which commands are available with which license version:

Menu option		Basic license	Standard license	Premium license
Switching device	New...	✓	✓	✓
	Open...	✓	✓	✓
	Import...	-	✓	✓
	Open Online...	✓	✓	✓
	Save	✓	✓	✓
	Save as...	-	✓	✓
	Export...	-	✓	✓
	Close	✓	✓	✓
	Print...	✓	✓	✓
	Page Setup...	-	✓	✓
	Print Preview...	-	✓	✓
	Most recently used files	-	✓	✓
	Exit	✓	✓	✓

Menu option		Basic license	Standard license	Premium license
Edit	Undo	-	✓	✓
	Restore	-	✓	✓
	Cut	-	✓	✓
	Copy	-	✓	✓
	Paste	-	✓	✓
	Delete	✓	✓	✓
	Select all	-	✓	✓
	Go to	-	✓	✓
	Insert comment	-	✓	✓
	Realign graphic	-	✓	✓
	Interrupt connection	-	✓	✓
	Redraw partial connection	-	✓	✓
	Add diagram	-	✓	✓
	Remove diagram	-	✓	✓
	Create macro	-	-	✓
	Edit terminal identifier	-	✓	✓
	Object properties	✓	✓	✓
	Check consistency	✓	✓	✓
	Password for project access	✓	✓	✓
	Reset password for project access	✓	✓	✓
	Password for test mode	✓	✓	✓
	Password for device access	✓	✓	✓
	Compare with File	-	✓	✓
	Compare with switching device	-	✓	✓

Menu option		Basic license	Standard license	Premium license
Target system	Load to switching device...	✓	✓	✓
	Load to PC...	✓	✓	✓
	Go Offline	✓	✓	✓
	Undo the fixed assignment of the interface	✓	✓	✓
	PROFIBUS DP line view	-	-	✓
	Learn ASIsafe code tables...	✓	✓	✓
	Prepare configuration test...	✓	✓	✓
	Approve configuration...	✓	✓	✓
	Cancel configuration release	✓	✓	✓
	Configuring mode	✓	✓	✓
	Test mode	-	✓	✓
	Safety mode	✓	✓	✓
	Commands...	-	✓	✓
	Diagnostics configuration	✓	✓	✓
	Diagnostics logic	✓	✓	✓
View	Toolbar	-	✓	✓
	Status bar	-	✓	✓
	Zoom in	✓	✓	✓
	Zoom out	✓	✓	✓
	Zoom dialog	-	✓	✓
	Overall view	-	✓	✓
	Display settings	✓	✓	✓
	Grid properties	✓	✓	✓
	Move diagram	✓	✓	✓
	Highlight signal flow	-	✓	✓
	Delete highlighting	-	✓	✓
	Navigation window	✓	✓	✓
	Output window	✓	✓	✓
	Catalog window	✓	✓	✓
	Minimize / restore online dialog	-	✓	✓

Menu option		Basic license	Standard license	Premium license
Options	Basic Settings...	✓	✓	✓
	Modular Safety System ES settings	✓	✓	✓
	Cross references	-	✓	✓
	Symbol list	-	✓	✓
	Terminal list	-	✓	✓
	Release information	✓	✓	✓
	Export macro	-	-	✓
	Import macro	-	-	✓
	Set the PG/PC interface...	-	-	✓
Help	Help topics	✓	✓	✓
	Info	✓	✓	✓

6.1.4 Requirements

To be able to work with MSS ES, you must meet the following requirements:

Software requirements

To configure the modules, you need a programming device or PC with MS Windows XP Professional SP2/SP3 or MS Windows 7 Ultimate/Professional/Enterprise 32-bit operating system (SP3 and higher: 64-bit). The readme file (Readme.rtf) contains the current software requirements.

- You need administrator rights to install MSS ES. To be able to work with MSS ES under MS Windows XP Professional SP2/SP3 or MS Windows 7 Ultimate/Professional/Enterprise 32-bit (SP3 and higher: 64-bit), at least the main user rights are required.
- When MSS ES is installed, the administrator must grant full access rights to the MSS ES setup directory to all users wishing to work with MSS ES on this computer. You can find information on assigning access rights in the documentation of your operating system.

Hardware requirements

- A programming device or PC is required for using the MSS ES:

  Refer to the readme file (Readme.rtf) in which the current hardware requirements are listed.
- PC cable for serial communication via local device interface, see Chapter "System components (Page 34)."
- PROFIBUS interface, e.g., CP5512 in the PC or programming device for access via PROFIBUS (only possible for MSS ES Premium)
- CD-ROM drive (for software installation from CD-ROM only)

Required knowledge

Understanding of this documentation and software requires the following:

- General knowledge of the operating system used.
- Basic knowledge of parameterizing, configuring, and commissioning safety relays.

Which device is supported by which software version?

Device	MSS ES 2008	MSS ES 2008 SP1	MSS ES 2008 SP2	MSS ES 2008 SP3
Central units				
Basic	✓	✓	✓	✓
Advanced	-	-	✓	✓
ASIsafe basic	-	-	-	✓
ASIsafe extended	-	-	-	✓
Interface modules				
DP interface	✓	✓	✓	✓
Expansion modules				
4/8 F-DI	✓	✓	✓	✓
2/4 F-DI 2 F-DO	✓	✓	✓	✓
2/4 F-DI 1/2 F-RO	✓	✓	✓	✓
8 DO	✓	✓	✓	✓
4 F-DO	-	✓	✓	✓
4/8 F-RO	-	✓	✓	✓
8 DI	-	✓	✓	✓
HMI modules				
Diagnostics display	-	-	✓[1)]	✓[2)]

1) Up to product version E02 or FW version V1.0.x

2) Product version E03 or FW version V1.1.x and higher

6.2 Installation and program start

6.2.1 Usage authorizations via the Automation License Manager

Automation License Manager

To use the programming software, you need a product-specific license key (usage authorization), which is installed using the Automation License Manager.

The Automation License Manager is a software product developed by Siemens AG that is used to manage license keys (technical representation of licenses) on a system-wide basis.

The Automation License Manager is available:

- On the product CDs of MSS ES
- As a download on the Internet pages for IA&DT Customer Support at Siemens AG.

The Automation License Manager features an online help function that you can use to call up context-specific information via the F1 key, or via "Help" > "Help on License Manager". This help function contains detailed information about how to use the Automation License Manager and the functions it offers.

License keys

The license key acts as the technical representation of a license (electronic license stamp).

SIEMENS AG issues a license key for all license-protected software. The software can only be used in accordance with the license and usage conditions associated with the license key once the system has established that a valid license key has been installed on the computer when the software is launched.

License keys can be stored as follows and transferred from one storage medium to another:

- On license key data carriers
- On local hard disks
- On the hard disks of computers in the network

For more information about using license keys, please refer to the online help for the Automation License Manager.

Note

- MSS ES cannot be used without a license key.
- To familiarize yourself with the operator interface and the range of functions, you can activate one Trial License, allowing you to work with the system for 14 days. Following this period, you must acquire a valid license. Otherwise you cannot continue to work with MSS ES.

6.2.2 Installing the Automation License Manager

Installing Automation License Manager

Automation License Manager is installed by a setup program. You will find the installation software for the Automation License Manager on the MSS ES product CD.

You can install the Automation License Manager together with MSS ES or later.

Note

- For detailed information on the setup procedure for the Automation License Manager, read the latest readme file (Readme.rtf).
- The online help for the Automation License Manager contains all the information you need about using license keys and the functions they offer.

Installing license keys at a later date

When you start the MSS ES software without installed license keys, the system displays a corresponding message.

You can install license keys later in the following ways:

- Install license keys from a USB stick
- Install license keys downloaded from the Internet (license keys must be ordered first)
- Using floating license keys available on the network.

Refer to the online help for the Automation License Manager for detailed information on installing license keys. To access this context-sensitive help function, press F1 or select the menu command "Help" > "Help on Automation License Manager".

Note

- License keys will only be operational if they are installed on a hard disk on which write access is allowed.
- Floating licenses can also be used within a network ("remote" use).

6.2.3 Rules for using license keys

Additional information

You can open the context-sensitive online help for the Automation License Manager by pressing F1 or by selecting the menu command "Help" > "Help on Automation License Manager".

This help contains all the information you need about the functions and handling of license keys.

CAUTION
Read the information on handling license keys contained in the online help and readme file for the Automation License Manager. If you do not follow these instructions, the license keys may be irretrievably lost.

6.2.4 Installation

Requirement

Note

You require administrator rights to install MSS ES.

Before installing:

Note

Read the "readme.rtf" file on the CD ROM before installing MSS ES.

Installing the software

The installation program starts automatically after you insert the CD ROM, if this function is activated on your computer.

If the installation program does not start automatically, proceed as follows:

- Open the main directory on the CD ROM.
- Double click on the "setup.exe" file to start the setup program. The setup program guides you step by step through the entire process of installing MSS ES.

6.2.5 Starting the program

Starting the MSS ES program on the PC

After terminating the installation program and after restarting your computer (if prompted to do so during setup), you can start MSS ES as follows:

- By double-clicking on the "Modular Safety System ES " icon on the desktop.
- MS Windows XP Professional SP2/SP3: Clicking on the "Start" button in the Windows task bar under "SIRIUS engineering" > "Modular Safety System ES"
- MS Windows 7 Ultimate/Professional/Enterprise 32-bit (SP3 and higher: 64-bit): Clicking on the "Start" button in the Windows task bar under "All Programs" > "Siemens Automation" > "SIRIUS engineering"

Start wizard

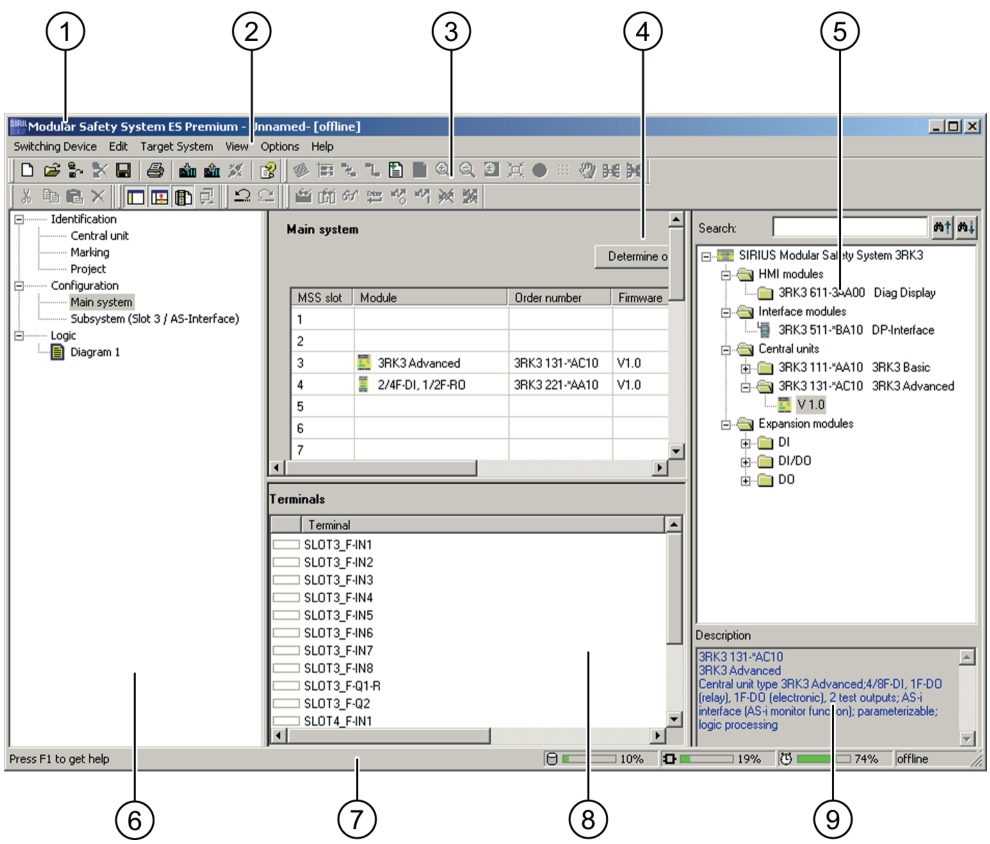
After the program has been started, a deactivatable Start wizard appears with which you can execute the following actions:

- Create a new configuration ("New")
- Open an existing configuration file ("Open")
- Read out a configuration online from an MSS 3RK3 ("Open online")

6.3 User interface

6.3.1 Design of the user interface

If you start the software of the 3RK3 (MSS ES) Modular Safety System and create a new project using the menu command "Switching device" > "New", then the user interface opens in the "Configuration" - "Main system" setting. The central work space of this setting is the configuration table.



① Title line
② Menu bar
③ Toolbar
④ Work space
⑤ Catalog window
⑥ Navigation window
⑦ Status bar
⑧ Output window
⑨ Information window

Figure 6-2 User interface with configuration table

Number	Description	Function
①	Title line	Contains general information: • The type of license: Basic / Standard / Premium • "Unnamed": Project not yet saved • <File name>: Project already saved • The connection status: [Online] / [Offline]
②	Menu bar	Providing all of the functions required for program control.
③	Toolbar	Contains buttons for frequently used program commands.
④	Work space	Depending on the selected view in the navigation window, this contains tables or diagrams for editing the project: • Identification parameters • Configuration table • Logic diagram
⑤	Catalog window	Depending on the selected view in the navigation window, this contains the components needed for the configuration: • Configuration: Modules for hardware configuration • Logic diagram: Function elements for the safety logic
⑥	Navigation window	Allows the various views of the open project to be selected: • Identification: Central unit, marking, project • Configuration: Main system • Logic: Diagram 1 / diagram n
⑦	Status bar	Contains information on the program status of MSS ES for selected menu commands and buttons.
⑧	Output window	Contains information on the project which does not appear in dialog boxes, e.g. cross reference lists and symbol lists.
⑨	Information window	Contains information on the components selected in the catalog window.

6.3.2 Toolbar

Menu option		Basic license	Standard license	Premium license
View	Toolbar	-	✓	✓

Actions

To display or hide the toolbar at the top of the application screen, choose "View" > "Toolbar".

Properties of the toolbar

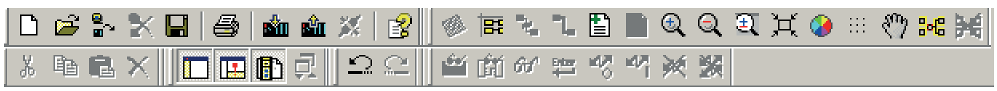


Figure 6-3 Toolbar in MSS ES

- The toolbar has icons that make the most important menu functions directly accessible. If you allow the mouse pointer to rest on an icon for about one second, its function is briefly displayed as a tool tip and in the status bar in plain text.
- To print data, click on the printer icon. All other icons correspond to the function of the associated menu command.
- You cannot change the number or assignment of the icons for the individual menu commands.

6.3.3 Status bar

Menu option		Basic license	Standard license	Premium license
View	Status bar	-	✓	✓

Actions

To display or hide the status bar at the bottom of the application screen, choose "View" > "Status bar".

Properties of the status bar

The status bar contains the standard information and the additional MSS-specific information.

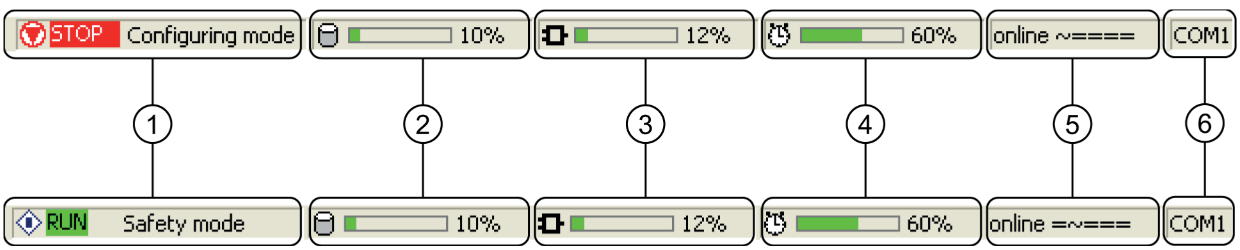


Figure 6-4 Status bar in MSS ES

No.	Meaning
①	Displays the operating mode of the MSS 3RK3 and the status of the user program STOP: Circuit is not being processed RUN: Circuit is being processed
②	Shows the current utilization of the memory module.
③	Displays of the current utilization of the internal MSS 3RK3 memory (depends on the type and number of function elements used).
④	Shows the current utilization of the parameterized program cycle time.
⑤	Connection status (online / offline).
⑥	Type of online connection (e.g. COM1 (= serial interface), DP 42 (= PROFIBUS connection to a switching device with address 42)

6.4 Description of the menu commands

6.4.1 Switching device menu

6.4.1.1 New...

Menu option		Button	Basic license	Standard license	Premium license
Switching device	New...	🗋	✓	✓	✓

Actions

To create a new project, choose "Switching device" > "New."

A list containing the short codes for the available switching devices is displayed. You can select one of these switching devices for processing or you can search for a specific switching device for further processing.

In the display window underneath a short description of the selected switching device is displayed. If you install SIRIUS engineering for other switching devices, the new switching devices are added to the hardware catalog.

Searching for a switching device

To search for a specific switching device, proceed as follows:

1. Enter the name or order number (MLFB) of the switching device in the search dialog box either in full or in part.
2. Click on the up and down search buttons to look for the switching device.

If the switching device could not be found the following error message appears:

"The device being searched does not exist in catalog."

As a remedy, change the search text and click on the search buttons again.

Selecting a switching device

To choose the switching device, select it and then click "OK" or simply double-click the required device name.

To open or close the sub-directories of the switching device tree displayed, click [+] or [-].

6.4.1.2 Open...

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Open...		✓	✓	✓

Actions

To open parameter files that were generated with MSS ES and that have the file extension *.sdp (switching device parameters), choose the "Switching device" > "Open..." menu command. When a file is selected, the directory that was last used is always displayed from which you can navigate to the required file.

6.4.1.3 Import...

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Import...	-	-	✓	✓

Actions

You can overwrite the currently displayed diagram with the values from a file by choosing the "Switching device" > "Import..." menu command. The current focus of the program does not change (i.e. if you make changes, for example, these will not be saved in the device from which the data was imported).

Error message when parameters are overwritten

The current parameters are overwritten with those from the file.

If the content of the file is not compatible with the current safety relay, an error message is displayed (Example: You are processing the parameters of an MSS and have opened the parameter file for a motor starter.)

Note

Overwriting parameters

When you choose this menu command, the parameters in the main memory are overwritten without you being prompted to confirm this.

Storage directory display

When a file is selected, the directory that was last used is always displayed from which you can navigate to the required file.

6.4.1.4 Open online...

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Open online...		✓	✓	✓

Actions

The "Switching device" > "Open online..." menu command establishes a data connection betweeen the PC and a switching device through the local device interface or over PROFIBUS DP and loads the data from the switching device once into the PC's RAM. The data connection remains in place,

Local device interface

To load the data from a switching device into the working memory of the PC through the local device interface, proceed as follows:

- Specify the COMx interface.
- Confirm the dialog with "OK".
- The program establishes a connection with the specified safety relay, checks whether the parameters that are currently displayed are compatible with this safety relay, and then reads all the parameters from the device.
  - If no configuration is open when the "Open online..." action is performed, a graphical diagram will be created in which the function elements are arranged automatically according to the signal flow.
  - If a configuration is open when the "Open online..." action is performed, the offline configuration will be compared with the online data. The graphical arrangement of the function elements of the offline parameters is retained as far as possible.

PROFIBUS DP

> ⚠ **WARNING**
>
> To prevent unauthorized access to the MSS 3RK3 through the PROFIBUS network, you assign a password for device access.

The preconditions for access over PROFIBUS are the use of the DP interface module, a PROFIBUS interface in the PC / PG and a Premium license.

Perform the following steps:

- Connect the DP interface to the PC / PG using a PROFIBUS cable.
- Start MSS ES.
- Open the "Switching device" > "Open online..." menu.
- Select the access point.
- Enter the DP address under "Preferred address," or select the corresponding address under "Available stations."
- Click OK to confirm.

Note

Without configuration or with the factory settings, the MSS 3RK3 logs on to the PROFIBUS with address 126.

6.4.1.5 Save

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Save		✓	✓	✓

Actions

With the "Switching device > Save" menu command, you save existing parameters in the standard format (*.sdp) on a data medium.

If no file is open at this point (e.g. because you have selected "Switching device" > "New" to select a new safety relay for processing), the "Save as..." dialog box will open instead.

6.4.1.6 Save as...

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Save as...	-	-	✓	✓

Actions

With the menu command "Switching device" > "Save as...", you save the current data under a new name.

6.4.1.7 Export ...

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Export...	-	-	✓	✓

Actions

With the "Switching device" > "Export..." menu command, you can copy the currently displayed parameters to a parameter file.

6.4.1.8 Close

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Close	-	✓	✓	✓

Actions

With the menu command "Switching device" > "Close", you exit the function for processing the current parameters. The menu command has the following effect:

- An opened parameter file is closed.
- An existing online connection to a safety relay is terminated.
- Before you exit the function, you are asked if you want to save any changes you may have made to parameters or if you want to load them to the safety relay.

6.4.1.9 Information about the print options

Required settings

A default printer must be set up on the target system.

Print on DIN A3

To print on DIN A3, a DIN A3-capable printer must be installed and defined as the default printer. To select the DIN A3 format, choose "Switching device" > "Page setup...".

6.4.1.10 Page Setup...

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Page Setup...	-	-	✓	✓

Actions

To call up a dialog in which you can set the print options, select "Switching device" > "Page setup...". These settings are copied for a specific project (*.sdp file) or device.

Setting options

The Wizard contains the following four pages:

- Page 1 - General settings: choosing the page format
- Page 2 - Header: maintaining the header fields
- Page 3 - Footer: maintaining the footer fields
- Page 4 - Contents: selecting the data to be printed, paper orientation, margins

Page 1 - General settings

Settings on the 1st page

On page 1 of the "Page setup" dialog, you can define the general settings. These functions include:

- The paper format for the entire report (default: A4)
- What happens when you close a dialog (print preview is displayed, printout is triggered)
- Display of initial page

Note

Further format settings

You can define further format settings (e.g. page margins and document alignment) on page 4 of the "Page setup" dialog.

Page 2 - Header

Maintaining the header

On page 2 of the "Page setup" dialog (header), you can maintain the header fields.

Inserting elements in the header

You can insert the following elements left justified, centrally, or right justified via the context menu (can be selected using the "+" pushbuttons):

Element	Note
Date short	Date in short format as defined in the control panel under "Regional and Language Options".
Date	Date in long format as defined in the control panel under "Regional and Language Options".
System time	Time as defined in the control panel under "Regional and Language Options".
Time 24h	Time 24 hour clock format.
Path	Path of the *.sdp file that is currently open.
Document name	Name of the current *.sdp file / DP address / COM port
Page (curr.)	Current number of pages.
Pages (tot.)	Total number of pages.
My text	When you select "My text", the system displays a field in which you can enter your own text.
My image	You can add a picture or logo here.

To remove any elements, choose "-".

Page 3 - Footer

Maintaining the footer

On page 3 of the "Page setup" dialog (footer), you can maintain most of the fields in the (tabular) footer.

Standard DIN EN ISO 7200

The tabular footer is structured in accordance with DIN EN ISO 7200.

Overview of all the fields in the footer:

Footer field	Meaning	Maintaining
MSS-specific part of the footer		
Diagram	Number of the logic diagram	Automatic
Diagram name	Configured name of the logic diagram	Automatic
Diagram sheet	Page and pages, including the logic diagram	Automatic
Last change	Date and time of last change saved	Automatic
Configuration CRC	Cyclic Redundancy Check which saves all safety-relevant configuration data (4 bytes).	Automatic
Standard-compliant part of the footer		
Department responsible	Name of the department which, at the time the document is released, is responsible for the technical content and updating the document.	In the "Page setup" dialog
Technical reference	Company contact for technical queries regarding the content of the document.	In the "Page setup" dialog
Document type	Indicates the content and format of the document (intended specifically for searching for documents).	In the "Page setup" dialog
Document status	Status of the document within the lifecycle (e.g. "Being processed", "Released", "Withdrawn").	In the "Page setup" dialog
Owner	Name of the company that is the legal owner of the document (an abbreviated trade name or logo can also be entered). With Modular Safety System ES: Configuration engineer's company name:	in the "Identification" > "Project" output window
Created by	Name of the person who created or revised the document. With Modular Safety System ES: Name of configuration engineer	in the "Identification" > "Project" output window
Approved by	For approvals/releases with signature (e.g. releases required for acceptance inspections performed by certification centers).	handwritten on the printout
Title	Unique name for the parameters or project With Modular Safety System ES: Project name	in the "Identification" > "Project" output window
Item number	Establishes a unique reference to the document.	In the "Page setup" dialog
Modification	Indicates the different versions with combinations of letters and/or numbers.	In the "Page setup" dialog
Release date	Date on which the document was approved/released.	handwritten on the printout
Language	Indicates the document language (in max. 4 characters).	In the "Page setup" dialog
Sheet	Current page / total number of pages	Automatic

Page 4 - Contents

Selecting the configuration data to be printed.

On page 4 of the "Page setup" dialog, you can select which configuration data is to be printed. In the selection tree, select the checkbox in front of the data you want to print out. You can either select individual elements or higher-level elements with all the associated sub-elements. You must select at least one element before you can close the dialog.

Separate page layout for level 2 elements

In the various tab dialog boxes on the right, you can define a separate page layout for level 2 elements (e.g. parameters). This layout is valid for all levels below this. You can also select the paper orientation (portrait/landscape) and the margins. You have already set the paper format (e.g. A4) on page 1 of the "Page setup" dialog. This setting applies to the entire report.

Applying the settings

Once you have made all the required settings, you can exit the dialog and apply all your settings by choosing "Finish".

6.4.1.11 Print preview...

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Print Preview...	-	-	✓	✓

Actions

To call up a print preview that displays the document with the current settings, choose "Switching device" > "Print preview...". On page 1 of the "Page setup" dialog, you can specify that the print preview is displayed automatically when you close the dialog.

Export from print preview

You have the option of saving the contents of the print preview as a PDF. To do so, click on the diskette icon in the toolbar in the Print Preview window.

6.4.1.12 Print...

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Print...		✓	✓	✓

Actions

To open the standard Windows "Print" dialog, choose the "Switching Device" > "Print..." menu command. You can make the following settings in this dialog, for example:

- Printer selection
- Select the pages to be printed (e.g., pages 1 to 11)
- Number of copies
- Printer driver settings

Further print options

You can also print a document by selecting the "Printer" icon in the toolbar. The document is then printed with the current print settings. You can also print documents from page 1 of the "Page setup" dialog box (General settings) by closing the dialog box.

Note

Setting the language

This is a standard Windows dialog. The language is determined by the operating system and cannot be changed via SIRIUS engineering!

6.4.1.13 List of the files last used

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Most recently used files	-	-	✓	✓

Actions

With the "Switching device" > "List of the files last used" menu command, you can list the nine files last used.

When you click one of the files, it is displayed.

6.4.1.14 Exit

Menu option		Button	Basic license	Standard license	Premium license
Switching device	Exit	-	✓	✓	✓

Actions

To exit the program, select "Switching device" > "Exit". If you have changed any parameters, you are asked if you want to save the changes before you exit the program.

6.4.2 Edit menu

6.4.2.1 Undo

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Undo		-	✓	✓

Actions

The menu command "Edit" > "Undo" performs the following actions:

- You can undo changes to parameters and changes in the logic diagram (moving blocks, changing connections, etc.).

  Position changes (e.g. dialog selection, scroll, select) cannot be undone.
- Once you have executed this menu command, the system displays the view that was active before the action you have just undone.
- File functions (e.g. "Save," "Load," "Download," "Open Online") delete the entire undo history ("Undo" can no longer be used).

6.4.2.2 Redo

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Restore		-	✓	✓

Actions

The menu command "Edit" > "Redo" cancels one (or more) previous undo actions.

6.4.2.3 Cut

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Cut		-	✓	✓

Actions

The menu command "Edit" > "Cut" transfers selected objects to the clipboard which can then be pasted using the "Edit" > "Paste" menu command. The selected objects are deleted at the source location.

6.4.2.4 Copy

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Copy		-	✓	✓

Actions

The menu command "Edit" > "Copy" transfers selected objects to the clipboard which can then be pasted using the "Edit" > "Paste" menu command.

6.4.2.5 Paste

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Paste		-	✓	✓

Actions

The menu command "Edit" > "Paste" pastes objects that were copied to the clipboard by the menu command "Edit" > "Copy".

6.4.2.6 Delete

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Delete		✓	✓	✓

Actions

The menu command "Edit" > "Delete" removes selected objects.

6.4.2.7 Select all

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Select all	-	-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active.

Actions

The "Edit" > "Select all" menu command selects all of the graphical objects (circuit elements, connections, comments and reference points).

6.4.2.8 Go to...

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Go to...	-	-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active.

Actions

The "Edit" > "Go to..." menu command opens a dialog box in which you can select and enter the search criteria:

Action	Result
Searching by "Element number"	The chosen function element is selected.
Searching by "Name"	The function element to which the specified element identifier is assigned is selected.
Searching by "Page"	The page with the page number selected by you in the current diagram is displayed. The page number is structured as follows: <Diagram name:H1V1>. This page number is indicated in the logic diagram view and on every printout at the bottom right.

6.4.2.9 Insert comment

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Insert comment		-	✓	✓

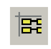
Requirements

This menu command can only be selected if you are in the offline mode and the logic diagram is active.

Actions

Using the "Edit" > "Insert comment" menu command, you can insert a comment anywhere in the logic diagram.

6.4.2.10 Realign graphic

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Realign graphic		-	✓	✓

Requirements

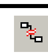
This menu command can only be selected if you are in the offline mode and the logic diagram is active.

Actions

Using the "Edit" > "Realign graphic" menu command, you can optimize the arrangement of the safety circuit in the graphical view (in the logic diagram):

- Overlaps are removed.
- Function elements that overlap connections, each other, or page limits are moved.
- Connections that overlap each other are moved.
- The function elements are arranged according to the signal flow.

6.4.2.11 Interrupt connection

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Interrupt connection		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active and an interrupted connection is selected.

Actions

The "Edit" > "Interrupt connection" menu command replaces the connecting line between two function elements with arrows to keep the configuration in the logic diagram clear. The connection is retained.

6.4.2.12 Redraw partial connection

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Redraw partial connection		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active and an interrupted connection is selected.

Actions

The "Edit" > "Redraw partial connection" menu command undoes the "Interrupt connection" command. The connecting line reappears.

6.4.2.13 Add diagram

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Add diagram		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active and the "Online" connection to the safety relay is not available.

Actions

Using the "Edit" > "Add diagram" menu command, you can insert another diagram for your safety logic.

Naming / renaming a diagram

You can modify the diagram name by double-clicking on "Diagram 1" in the navigation window. Enter the desired name in the "Properties - Diagram" dialog box.

6.4.2.14 Remove diagram

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Remove diagram		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active.

Actions

The "Edit" > "Remove diagram" menu command deletes the current diagram from the navigation window.

Note

It is only possible to split up the safety logic in connection with an offline project.

If you have not created an offline configuration for a safety relay that is configured online, you can read the configuration from the safety relay and create a diagram using "Switching device > Open online" or "Download to PC". This automatically positions all of the function elements in the diagram.

NOTICE

Remove diagram

If you delete a diagram, all of the connections, function elements, and comments will also be deleted with it.

6.4.2.15 Create macro...

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Create macro	-	-	-	✓

Requirements

This menu command can only be selected if the logic diagram is active and at least one function element is selected.

Actions

With the "Edit" > "Create macro" menu command, you create a macro from the selected function elements that you can reuse as a block in other projects.

6.4.2.16 Edit terminal identifier...

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Edit terminal identifier...	-	-	✓	✓

Requirements

This menu command can only be selected if a module or a real AS-i slave has been selected in the main system or subsystem. Only terminal identifiers of AS-i slaves that are monitored by MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended can be edited.

Actions

The "Edit" > "Edit terminal identifier..." menu command opens a dialog box for entering the identifiers for the terminals.
The result only appears in the logic diagram when the relevant checkbox on the "Logic" tab under "Options" > "Settings of Modular Safety System ES" is selected.

6.4.2.17 Object properties...

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Object properties	-	✓	✓	✓

Requirements

This menu command can only be selected if a module or a real AS-i slave has been selected in the main system or subsystem.

Actions

Using the "Edit" > "Object properties" menu command, you can call up the parameter assignment dialogs for the circuit elements of the safety circuit or for the modules.

6.4.2.18 Check consistency

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Check consistency	-	✓	✓	✓

Actions

The "Edit" > "Check consistency" menu command is used to check the configuration for consistency.

Note

A consistency check is carried out every time the configuration is saved.

The errors found during this check appear in the output window "Consistency check results" below the work space.

6.4.2.19 Password for project access...

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Password for project access...	-	✓	✓	✓

Requirements

This menu command can only be selected if an offline configuration is opened in MSS ES.

Actions

Using the "Edit" > "Password for project access..." menu command, you can perform the following actions:

- Assigning the password for project access for the first time.
- To modify the password for project access: enter the old password and then enter the new password twice.
- To reset the password protection for project access: enter the old password and then leave the new password empty (do not enter any content) and confirm with "OK."
- If the password for project access is lost: create a code for release with the "Forgotten password" button.

Password prompt

This password prompt appears in the "Enter password" dialog box when you open an offline configuration.

6.4.2.20 Forgot password

Actions

With the "Edit" > "Password for project access..." menu command, you can request a file for releasing the password from the Siemens hotline if the password is lost.

Activate password

If lost, activate the password as follows:

- Under the "Password for project access..." menu command, click on the "Forgot password..." button.

  In the dialog box, enter "Forgot password":
  - Your name
  - Company name
  - The name of the file in which your password is encoded and saved
- Send this file with the activation information to the Siemens hotline.

  technical-assistance@siemens.com
- The Siemens hotline will send you a file with an activation code.
- Import the file with the activation code using the "Edit" > "Password for project access..." menu command. This menu command can only be selected if you have previously created the activation data.
- Assign a new project access password.

Note

The activation code is only valid once.

6.4.2.21 Reset password for project access...

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Reset password for project access	-	✓	✓	✓

Requirements

This menu command can only be selected if you have previously created the file for resetting forgotten passwords in the "Forgot password" dialog box using the "Password for project access" menu command.

Actions

Reset the password as follows:

- In the "Reset password for project access" dialog box, click on the "Import" button.
- In the "Open" window that follows, open the file containing the data saved for resetting the passwords, which you received from the Siemens hotline.
- When prompted, assign a new password for project access.
- After the password has been correctly assigned, you will receive confirmation that the access password has been successfully reset.

6.4.2.22 Password for device access...

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Password for device access	-	✓	✓	✓

Requirements

This menu command can only be selected if there is a connection with the safety relay.

Actions

Using the "Edit" > "Password for device access..." menu command, you can carry out the following actions:

- Assign/change/reset the password for device access
- Set the protection level

Password prompt

This password prompt appears in the "Enter password" dialog box when you open a password-protected device access or when you open an online configuration.

Note

If you have forgotten the password for device access, you must restore the factory settings of the MSS 3RK3. You must do this on the safety relay because commands in MSS ES are password-protected. You must then load the required configuration into the MSS 3RK3 again.

6.4.2.23 Password for test mode...

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Password for test mode...	-	✓	✓	✓

Requirements

This menu command can only be selected if there is a connection with the safety relay.

Actions

With the "Edit" > "Password for test mode..." menu command, you can assign and change a password for switching to test mode.

Password prompt

This password is prompted when you switch to test mode using the "Target system" > "Test mode" menu command.

Note

If you have forgotten the password for changing to test mode, you must restore the factory settings of the MSS 3RK3. You can do this on the safety relay or by means of a command in the MSS ES. You must then load the required configuration into the MSS 3RK3 again.

6.4.2.24 Compare with file...

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Compare with file...	-	-	✓	✓

Actions

The "Edit" > "Compare with file..." menu command compares the parameters in the current configuration with the parameters of a selected file.

Result

the system lists any differences.

6.4.2.25 Compare with switching device...

Menu option		Symbol	Basic license	Standard license	Premium license
Edit	Compare with switching device...	-	-	✓	✓

Actions

The "Edit" > "Compare with switching device..." menu command compares the parameters in the current configuration with the parameters of a safety relay that has been opened online.

Result

the system lists any differences.

6.4.3 Target system menu

6.4.3.1 Load to switching device...

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Load to switching device...		✓	✓	✓

Actions

The "Target system" > "Load to switching device..." menu command saves the parameters of the current configuration to a safety relay over an online connection.

Note

Overwriting the parameters

When you choose this menu command, the parameters in the safety relay are overwritten without you being prompted to confirm this.

Transferring the parameters

Transfer the parameters as follows:

- Open an online connection to a safety relay via the connection dialog box.
- Click "OK" to close the dialog box.
- The program establishes a connection with the specified safety relay, checks whether the parameters that are currently displayed are compatible with this safety relay, and then loads all the parameters to the safety relay.

6.4.3.2 Load to PC...

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Load to PC...		✓	✓	✓

Actions

The "Target system" > "Load to PC..." menu command downloads the parameters currently stored in the safety relay to the PC over an online connection.

Note

Overwriting the parameters

When you choose this menu command, the parameters in the main memory are immediately overwritten.

Transferring the data

Transfer the data as follows:

- Open an online connection to a safety relay via the connection dialog box.
- Click "OK" to close the dialog box.
- The program establishes a connection with the specified switching device and reads all parameters from the device to the PC.

6.4.3.3 Go offline

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Go Offline		✓	✓	✓

Actions

The menu command "Target system" > "Go offline" terminates an existing online connection to a switching device. Before the connection is terminated, the system asks whether the current parameters are to be first downloaded to the switching device.

The application remembers the status it was in prior to setting up the online connection. It does this by taking a snapshot of all important information in the background. (Which SIRIUS engineering product was launched? Is a file open? What values do the individual parameters have? …)

After the online connection has been terminated, you are asked whether you want to keep the parameters that are currently displayed now that you are offline.

- If you answer "No", the snapshot is restored.
- If you answer "Yes", nothing happens (except that the online connection has been terminated).

Exception:

If the parameter values stored in the snapshot are identical to the parameter values that are currently displayed, the above question is skipped because both answers would have the same effect.

6.4.3.4 Undo the fixed assignment of the interface

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Undo the fixed assignment of the interface		✓	✓	✓

Actions

The "Target system" > "Undo the fixed assignment of the interface" menu command undoes the assignment set in the "Load to switching device" dialog box. By clicking the menu option or the corresponding icon in the toolbar, you reopen the connection dialog the next time the software attempts to establish an online connection.

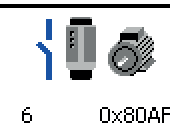
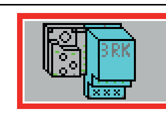
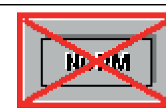
6.4.3.5 PROFIBUS DP line view

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	PROFIBUS DP line view...	-	✓	✓	✓

Displaying all the existing switching devices

To display all the devices in the PROFIBUS segment, choose "Target System" > "Line view."

Device representation

Kind	Representation	Example
Devices that can be edited with SIRIUS engineering.	Device icon	
Devices that cannot be edited with SIRIUS engineering.	Standard graphic: "Standard"	
Devices that signal a fault.	Graphic with a gray background and a red border.	
Devices that were previously available but can no longer be accessed via PROFIBUS.	Graphic with a gray background, a red border, and a red strike-through.	

Functions of the buttons

To find the slaves in the bus segment, choose "Search for slaves". The PROFIBUS DP address and the PNO number are displayed. With some switching devices, the item designation (AKZ) is displayed too.

To update the bus segment, choose "Update diagnosis". If some slaves are no longer available since the last time the bus segment was updated, these are crossed out.

Display variants

You can choose between two display variants:

- Line topology
- Meander

Other buttons

To close the dialog, choose "Close".

To call up an overview of device-specific data, choose "Identification".

Note

With modular devices, you are prompted to specify the slot number of the slave (for more information, see "Slot number"). In this case, you must type in the slot number of the slave about which you want to see more information.

To open a second SIRIUS engineering screen in which the device opens online, choose "Device Diagnostics". Alternatively, double-click the icon for a switching device with an AKZ.

Note

With modular devices, you must specify the slot number of the device you want to diagnose.

To open a dialog in which you can set various display options for the line view, choose "Options".

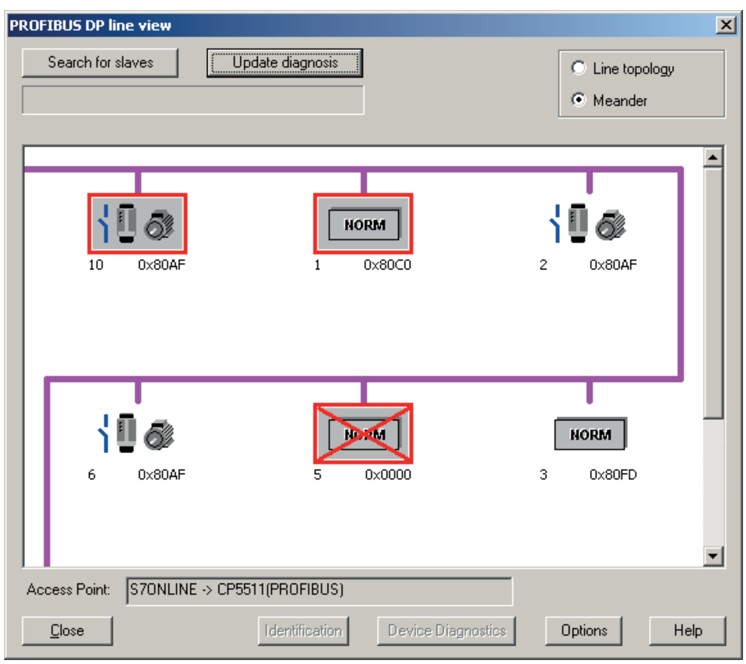


Figure 6-5 PROFIBUS DP line view

Slot numbers

Entering the slot number

You can enter a slot number for a modular device in the "Slot number" dialog. This dialog is displayed if a modular device is marked in the PROFIBUS DP line view and you click "Identification" or "Device diagnostics".

You are prompted to type the slot number in an input field. In this case, the higher-level process refers to the device at the specified slot number.

If there is no device at the specified slot number, you see an error message. If you select "Device diagnostics", you must specify the slot number of a SIRIUS device or the diagnosis will be terminated with an error message.

Buttons

- If you click "OK", the selected slot is saved.
- To abort the higher-level process, click "Cancel". In this case, no identification data is displayed or the device is not diagnosed.
- "Help" activates the context sensitive help.

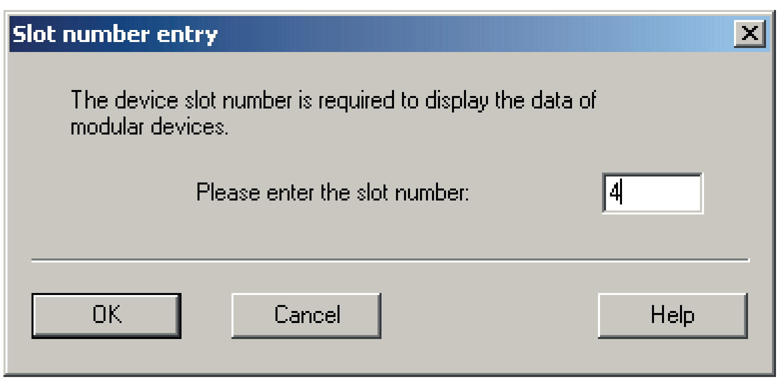


Figure 6-6 Slot numbers

Identification

Device-specific data

To call up an overview of device-specific data, choose "Identification". The overview can be used for system documentation purposes, for example.

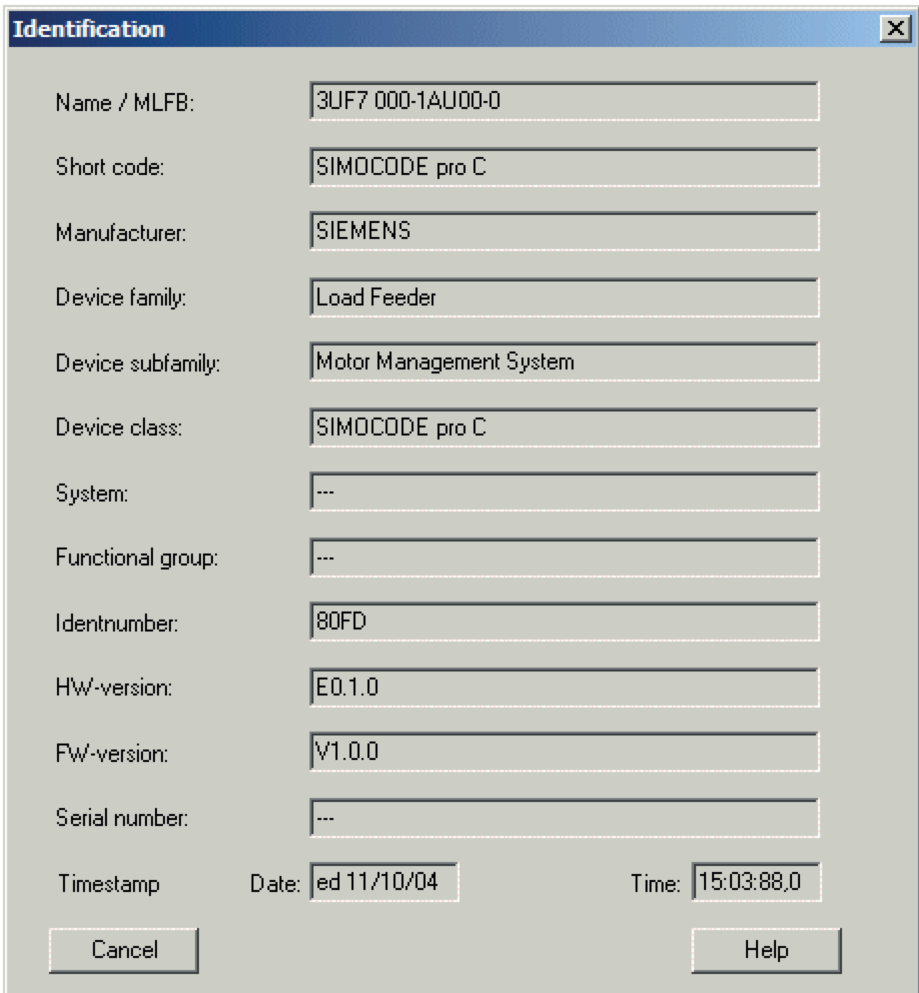


Figure 6-7 Overview of device-specific data

Options

Setting options

Access point:
the scroll box contains the current access point for the application.

Circular update:
the "Circular update" checkbox allows you to set whether or not the line view is to be updated on a regular basis.

Circular update interval:
the circular update interval allows you to define the interval between two updates.

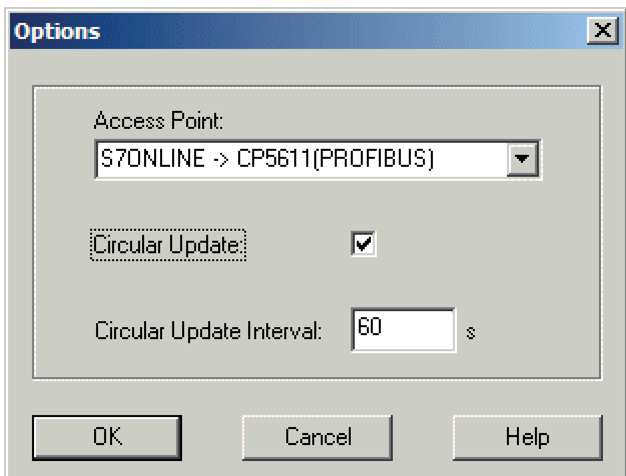


Figure 6-8 "Options" dialog

6.4.3.6 Learn ASIsafe code tables...

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Learn ASIsafe code tables...	--	✓	✓	✓

Requirements

This menu command can only be selected if the 3RK3 Advanced, 3RK3 ASIsafe basic or 3RK3 ASIsafe extended central unit is configured and an online connection exists with a device.

Actions

With the "Target system" > "Learn ASIsafe code tables..." menu command, you can open the dialog box for teaching and diagnosing the code tables of the safety-related AS-i input slaves.

Slave status 0..15 / slave status 16..31

Status	Color	Meaning
Addr. 0 ... 31	--	Address of F slave
Slave	red	One configured AS-i slave is missing.
	yellow	An AS-i slave that does not correspond to the target configuration has been detected.
	green	A new AS-i slave has been detected. The AS-i slave has not be configured in MSS ES.
	Green with check mark	The configured AS-i slave has been detected. The structure corresponds to the set configuration.
	gray	No AS-i slave exists at this address and no AS-i slave has been configured.
Code table	red	The code table is missing or is unknown.
	yellow	At least 2 AS-i slaves have the same code table.
	green	A new code table has been detected; the code tables can be learned. The code tables can be applied using the "Apply code tables" button.
	Green with check mark	The configured code table has been detected. The structure corresponds to the set configuration.
	gray	No slave exists at this address and no slave has been configured.
F-IN1 / 2	red	The signal is erroneous.
F-OUT 1 ... 4	yellow	A safety-related AS-i slave has been detected, but no code sequence transmitted.
	green	The signal is 1.
	White	The signal is 0.
	gray	This terminal does not exist.

Teach

- Start teaching
  If the MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended detects missing code sequence tables during startup or after changes to the AS-i bus, an automatic attempt is made to teach these.

NOTICE
Each slave only transmits the code sequence if the inputs are closed. For that reason, you must set and reset all input contacts of the safety-related input slaves during the teaching phase and control the safety-related outputs, so that all code sequences can be determined.

- Progress bar "Teaching in progress":

  The active teaching operation is displayed with a continuous progress bar.
- Slaves after teaching:

  The slaves whose code sequence has been acquired by teaching and the total number of safety-related slaves with a code sequence are displayed. The progress is additionally displayed as a percentage.
- "Apply code table" button:

  To apply the determined code tables and store them as targets, click the "Apply code tables" button.

The code sequences are stored in the memory module. No reteaching of code sequences is therefore necessary when devices are replaced.

6.4.3.7 Prepare configuration test...

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Prepare configuration test...	-	✓	✓	✓

The prerequisite for approving a configuration is a successfully carried out configuration test.

Requirements

This menu command can only be selected if offline configuration is opened.

Actions

Using the "Target system" > "Prepare configuration test..." menu command, you can create the printouts that you can use to support the configuration test.

Create configuration data

- Call up the "Target system" > "Prepare configuration test..." menu command.
- In the dialog box that now opens, define the access path (local device interface, COM or PROFIBUS).
- Confirm with "OK". A connection to the safety relay is established.
- Then the following actions are carried out:
  - Comparison to see whether the opened configuration matches the online configuration in the MSS 3RK3. If the comparison reveals differences, it is aborted and an error message is displayed.
  - Consistency check (also of the logic diagram)
  - If an error is detected, the process is aborted.
  - The online configuration is opened.
  - Print preview in which you can decide whether the configuration data should be printed out or saved as a PDF file.

Additional information

You can find additional information on this topic in the "*3RK3 Modular Safety System*" manual in Chapter "*Operation*."

6.4.3.8 Approve configuration...

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Approve configuration...	-	✓	✓	✓

Requirements

This menu command can only be selected under the following conditions:

- An offline configuration is open.
- A connection to the safety relay exists.
- MSS 3RK3 is in configuring mode.

⚠ WARNING
Hazardous Voltage. **Can Cause Death, Serious Injury, or Property Damage.** **Release of the configuration only after completed function test**
A configuration may only be released if a complete function test of the configuration has been successfully completed.

Actions

Using the "Target system" > "Approve configuration..." menu command, you create a file with the release data for a configuration.

Approve configuration

To create a printout with the required configuration release specifications, proceed as follows:

- Call up the "Target system" > "Approve configuration..." menu command.
- In the dialog box that now opens, define the access path (local device interface, COM or PROFIBUS).
- Confirm with "OK". A connection to the safety relay is established.
- Then the following actions are carried out:
  – Comparison to see whether the opened configuration matches the online configuration in the MSS 3RK3. If not, an error message is displayed.
  – Displaying the dialog box

    The CRC is displayed. Check whether this matches the CRC of the system documentation.

    Then enter the following data:

    - Your name
    - Your company name
  – Password prompt for device access, if assigned.
  – Print preview in which you can decide whether the release data should be printed out or saved as a PDF file.

Result

After the configuration is released, you can switch the MSS 3RK3 to safety mode.

6.4.3.9 Cancel configuration release

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Cancel configuration release	-	✓	✓	✓

Requirements

This menu command can only be selected under the following conditions:

- A safety relay is opened online
- The safety relay is in "configuring mode."

Actions

The "Target system" > "Cancel configuration release" menu command cancels the release of the configuration on the MSS 3RK3.

6.4.3.10 Configuring mode

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Configuring mode	-	✓	✓	✓

Actions

Using the "Target system" > "Configuring mode" menu command, you switch the operating mode of the MSS 3RK3 to configuring mode.

Result

In configuring mode, the MSS 3RK3 will be in the following condition:

- The safety relay is ready to accept new configuration data.
- No logic processing is performed.

6.4.3.11 Test mode

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Test mode	-	-	✓	✓

Requirements

This menu command can only be selected under the following conditions:

- A safety relay is opened online
- The safety relay is in "configuring mode."
- The configuration must be error-free. However, the configuration does not have to be released.
- To switch to test mode, you must enter the password for "Switching to test mode".

> ⚠ WARNING
>
> **Hazardous Voltage.**
>
> **Can Cause Death, Serious Injury, or Property Damage.**
>
> In this operating mode, the safety program is executed and the outputs are controlled according to the safety program.
>
> For this reason, you must ensure that the safety of your system is ensured by means of organizational measures.

Actions

Using the "Target system" > "Test mode" menu command, you switch the operating mode of the target system to test mode.

Application

You can use this operating mode for support when conducting the prescribed function test of the safety circuit. For example, you can force the outputs of function elements in test mode.

6.4.3.12 Safety mode

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Safety mode	-	✓	✓	✓

Requirements

This menu command can only be selected under the following conditions:

- A safety relay is opened online.
- The safety relay is in "configuring mode."
- The configuration must be fault-free and released.

Actions

Using the "Target system" > "Safety mode" menu command, you switch the operating mode of the target system to safety mode.

Result

In safety mode, the MSS 3RK3 will be in the following condition:

- The configured safety circuit is active.
- The outputs are controlled according to the "Circuit parameter assignment" (= circuit diagram).

6.4.3.13 Commands...

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Commands...	-	-	✓	✓

Requirements

This menu command can only be selected under the following conditions:

- A safety relay is opened online.
- The available commands also depend on the mode; see the table below.

Actions

Using the "Target system" > "Commands" menu command, you can activate device commands as additional functions on the safety relay.

The procedure is as follows:

- Select the "Target system" > "Commands" menu command. The "Commands" dialog box opens.
- Select a command from the drop down list.
- Send the command to the safety relay using the "Send" button.

You can start another command once the previous command is executed and the "Send" button is active again.

Monitoring command processing

A list in the "Commands" dialog box shows the current status of the command processing and the feedback messages from the diagnostics data memory determined by the MSS ES safety relay. The list is expanded with each sent command. It is deleted when the dialog box is closed.

Device commands

The following device commands are available:

Device commands	Description	Can be activated in	Feedback
Factory settings	All of the parameter values are reset to their default values. After the factory settings have been restored, the device executes a restart autonomously, the connection to the safety relay is interrupted, and the configuration is closed.	• Configuring mode	• Factory settings restored • The restart is executed.
Reset	Tripping, i.e., a shutdown due to a protection violation, can be acknowledged using this command. All of the errors whose causes have been eliminated are acknowledged together	• Configuring mode • Test mode • Safety mode	• Reset implemented. • Reset not possible.
Restart	Causes a "hardware reset" of the safety relay.	• Configuring mode • Test mode • Safety mode	• The restart is carried out.
Delete memory module	Deletes the data on the memory module of the connected safety relay. Note: With this command, the connection to the safety relay is interrupted and the configuration is closed. After the memory module has been deleted, a reset (using the RESET button) or a complete restart of the safety relay has to be performed as otherwise an online connection to the safety relay is not possible.	• Configuring mode	• Memory module not plugged in • Memory module defective • Programming active • Programming successful • Programming error
Cancel access rights	Cancels all passwords, i.e., all access rights are revoked.	• Configuring mode • Safety mode	• Access authorization exists: No
Apply code tables	The determined code tables are applied and stored as the target setting.	• Configuring mode • Test mode • Safety mode	• Code tables missing • 8x4-bit code sequence errors • Multiple code tables • New codes tables • Code tables known

Device commands	Description	Can be activated in	Feedback
Open access path	The required access path is opened by the safety relay (if no other access path is already open): Write/controlling access	• Configuring mode • Safety mode	• Access path to fieldbus control is open • Access path to fieldbus MSS ES is open • Access path to device interface is open
Close access path	The open access path is closed	• Configuring mode • Safety mode	• Access path is closed

6.4.3.14 Diagnostics configuration

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Diagnostics configuration	-	✓	✓	✓

Actions

Using the "Target system" > "Diagnostics configuration" menu command, activate the following submenu options:

Module status

- Module status: You activate the module status display which is displayed in color in the configuration table.
- This menu command can only be selected if the following conditions are met:
  – A safety relay is opened online.
  – The main system / subsystem is activated in the navigation window.

Device messages

- Device messages: You activate the "Device messages" dialog box.
- This menu command can only be selected if the following conditions are met:
  – A safety relay is opened online.

6.4.3.15 Diagnostics logic

Menu option		Symbol	Basic license	Standard license	Premium license
Target system	Diagnostics logic	-	✓	✓	✓

Actions

Using the "Target system" > "Diagnostics logic" menu command, activate the following submenu options:

Monitoring

- The "Target system" > "Diagnostics logic" > "Monitor" menu command shows the statuses of the inputs and outputs, of the function elements and of the connections between the function elements according to their status.
- This menu command can only be selected if the following conditions are met:
  - A safety relay is opened online.
  - The device is in safety or test mode.
  - The logic diagram with the safety circuit is activated.

Element messages...

- The "Target system" > "Diagnostics logic" > "Element messages" menu command shows the status messages for a function element that is selected in the logic diagram. You can monitor status messages of several function elements simultaneously.
- This menu command can only be selected if the following conditions are met:
  - The safety relay is opened online.
  - The device is in safety or test mode.
  - The logic diagram with the safety circuit is active.
  - At least one function element must be selected.

Element reset

- The "Target system" > "Diagnostics logic" > "Element reset" menu command acknowledges the errors of one or several selected function elements.
- This menu command can only be selected if the following conditions are met:
  - A safety relay is opened online.
  - The device is in safety or test mode.
  - The logic diagram with the safety circuit is activated.
  - One or more function elements are selected.

Forcing

- The "Target system" > "Diagnostics logic" > "Force" menu command preassigns fixed values to the outputs of function elements (= forcing). You can select the following assignments:
  - Force to "0"
  - Force to "1"
  - Cancel forcing
  - Cancel forcing (all)
- This menu command can only be selected if the following conditions are met:
  - The "test mode" is activated.
  - The logic diagram with the safety circuit is activated.
  - An online connection is available.
  - At least one connection of a function element is selected.

6.4.4 View menu

6.4.4.1 Zoom in

Menu option		Symbol	Basic license	Standard license	Premium license
View	Zoom in		✓	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active.

Actions

The "View" > "Zoom in" command enlarges the current view by one zoom level.

6.4.4.2 Zoom out

Menu option		Symbol	Basic license	Standard license	Premium license
View	Zoom out		✓	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active.

Actions

The "View" > "Zoom out" command reduces the current view by one zoom level.

6.4.4.3 Zoom dialog

Menu option		Symbol	Basic license	Standard license	Premium license
View	Zoom dialog		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active.

Actions

The "View" > "Zoom dialog" menu command opens the zoom dialog box of the logic diagram. A zoom level can be selected there.

6.4.4.4 Overall view

Menu option		Symbol	Basic license	Standard license	Premium license
View	Overall view		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active.

Actions

Using the "View" > "Overall view" menu command, you can set the zoom level in such a way that the entire diagram is visible on the screen.

6.4.4.5 Display settings

Menu option		Symbol	Basic license	Standard license	Premium license
View	Display settings		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active.

Actions

With the "View" > "Display properties" menu command, you open the "Display properties" dialog box. You can set the display properties there.

6.4.4.6 Grid settings

Menu option		Symbol	Basic license	Standard license	Premium license
View	Grid setting		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active.

Actions

With the "View" > "Grid settings" menu command, you open the "Screen grid" dialog box. You can set the grid there.

6.4.4.7 Move diagram

Menu option		Symbol	Basic license	Standard license	Premium license
View	Move diagram		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active.

Actions

With the "View" > "Move diagram" menu command, you switch to move mode. The diagram can only be moved with the mouse.

6.4.4.8 Highlight signal flow

Menu option		Symbol	Basic license	Standard license	Premium license
View	Highlight signal flow		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active and an element (e.g. a function element or connection) is selected.

Actions

The "View" > "Highlight signal flow" menu command visually highlights all of the elements located in the signal flow to the left (input side) and right (output side) of the selected element.

6.4.4.9 Delete highlighting

Menu option		Symbol	Basic license	Standard license	Premium license
View	Delete highlighting		-	✓	✓

Requirements

This menu command can only be selected if the logic diagram is active and a signal flow is highlighted.

Actions

The "View" > "Delete highlighting" menu command deletes all markings that resulted from the "Highlight signal flow" menu command.

6.4.4.10 Navigation window

Menu option		Symbol	Basic license	Standard license	Premium license
View	Navigation window		✓	✓	✓

Actions

The "View" > "Navigation window" menu command shows/hides the navigation window.

6.4.4.11 Output window

Menu option		Symbol	Basic license	Standard license	Premium license
View	Output window		✓	✓	✓

Actions

The "View" > "Output window" menu command shows/hides the output window.

6.4.4.12 Catalog window

Menu option		Symbol	Basic license	Standard license	Premium license
View	Catalog window		✓	✓	✓

Actions

The "View" > "Catalog window" menu command shows/hides the catalog window.

6.4.4.13 Minimize / restore online dialogs

Menu option		Symbol	Basic license	Standard license	Premium license
View	Minimize / restore online dialogs		-	✓	✓

Requirements

A safety relay is opened online and at least one online dialog box is open.

Actions

Use the "View" > "Minimize/restore online dialogs" menu command to collectively minimize or restore the display of all open online dialog boxes.

Which commands are executed?

- If an online dialog box is open, the menu command executes the function: "Minimize all open online dialog boxes".
- If all open online dialog boxes are minimized, the menu command executes the function: "Restore all minimized online dialog boxes".

6.4.5 Options menu

6.4.5.1 Basic settings...

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Basic Settings...	-	✓	✓	✓

Changing the basic settings

The menu command "Options" > "Basic settings..." starts a dialog box in which you can change the basic behavior and appearance of SIRIUS engineering. Any changes you make do not become effective until you choose "OK" or "Apply".

Change options

You can make the following settings in this dialog box:

- "Language"

  All available languages are shown in the selection list. When you change the language, this affects all the displayed texts in MSS ES (menu texts, dialog texts, parameter names, etc.). Other installed SIRIUS engineering products are not affected. Switching to a different language does not in any way affect how SIRIUS engineering functions.
- "Show picture at startup of SIRIUS engineering"

  If you activate this checkbox, SIRIUS engineering displays a picture for a few seconds in the middle of the screen when the program starts.

- In "Offline" state: Automatic "Online" after “Load to switching device”

  This setting is only effective if you choose "Target system" > "Load to switching device" before an online connection to a safety relay has been established. In this case, the program establishes a new connection, transfers the parameters to the device, and then terminates the connection immediately afterwards.

  The behavior at this point depends on whether you have activated the checkbox: In "Offline" state: Automatic "Online" after "Load to switching device":

  – Activated: the program reestablishes a connection with the same device, loads its parameters to the PC, and maintains the online connection. You can check the parameters and determine how they affect the behavior of the device.

  – Deactivated: no further automatic actions are carried out. The program has the same status as it did before the action "Load to switching device".

- "Show startup wizard"

  If you activate this checkbox, a startup wizard opens when you start MSS ES. With the help of this startup wizard, you can:

  – Create a new project

  – Open an existing project

  – Open a project online with an existing connection to the safety relay

6.4.5.2 Settings of Modular Safety System ES - "General settings" tab

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Modular Safety System ES settings	-	✓	✓	✓

Actions

Using the "Options" > "Settings of Modular Safety System ES" menu command, you can set the desired behavior of the MSS ES.

"General settings" tab

The "General settings" tab contains the following settings:

- "Display object properties automatically on insert":

  If you select "Display object properties automatically on insert," a dialog box for the properties of the respective object (in which you can set the parameters) will immediately appear after a module is inserted in the hardware configuration tables or after a function element is inserted in the logic diagram.
- "Show consistency check messages when saving"
- "Cyclic data updates in online dialogs every ... seconds":

  The data sets required for open online dialog boxes are read from the safety relay in this time interval.

6.4.5.3 Settings of Modular Safety System ES - "Download settings" tab

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Modular Safety System ES settings	-	✓	✓	✓

Actions

Using the "Options" > "Settings of Modular Safety System ES" menu command, you can set the desired behavior of the MSS ES.

"Download settings" tab

In the "Download settings" tab, you can define which parts of the system documentation are to be loaded to the safety relay when the configuration is downloaded:

- Equipment identifier (BMK)
- Element name
- Element comment
- Terminal identifier

Save memory space

You do not have to load the system documentation to the safety relay because the system documentation is not evaluated by the safety relay and is therefore not needed for the safety relay to function.

6.4.5.4 Settings of Modular Safety System ES - "Logic" tab

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Modular Safety System ES settings	-	✓	✓	✓

Actions

Using the "Options" > "Settings of Modular Safety System ES" menu command, you can set the desired behavior of the MSS ES.

"Logic" tab

The "Logic" tab contains the following settings for the display options:

- "Label page transitions of connections also on screen":

  Defines whether the labels of the connections on the page transitions will be visible on the screen.
- "Displaying element comments"

  The comments of the function elements are visible in the logic diagram.
- "Display terminal identifiers":

  Here you can set whether the terminal identifiers are to be displayed.
- "Retain element numbers in macros if possible"

  If the element number is not yet used in the current diagram, the element number that the function element had when the macro was created (and that is stored in it) will be assigned to the function element again when it is reused.

  If this setting is deactivated, the next free element number will be assigned to the function element, starting at 1.
- "Display settings" button:
  - Select a display element.
  - The current color of the selected element is specified.
  - You can change the color of the selected element.
  - You can restore the basic settings.
  - Confirm with "OK," to apply your changes.
  - You will find additional information in Chapter "Display settings (Page 211)."

- "Realign graphic" button:
  - Here, you can define the layout strategy by selecting whether and how to "Avoid connections crossing function elements."
    - Interrupt connections if possible
    - Move function elements down
  - You can also apply a "Standard column grid across all subnetworks of a function diagram" if you select the corresponding checkbox.
  - You can position the output cells in a separate column on the far right (for each subnetwork) if you select the lowermost checkbox.
  - Confirm with "OK," to apply your changes.
- "Screen grid" button:
  - The graphical grid influences the moving of graphical elements. You can choose whether objects are to be aligned to the grid and / or whether objects are to be aligned to other objects. Select the appropriate checkboxes for this.
  - You can set the grid size (mm) in "Distance."
  - You can define how the grid will be displayed by setting which grid points will be shown.
  - You can activate or deactivate display of the grid by selecting the relevant checkboxes.
  - Confirm with "OK," to apply your changes.
  - You will find additional information in Chapter "Grids and lines (Page 261)."

6.4.5.5 Cross references

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Cross references	-	-	✓	✓

Actions

The "Options" > "Cross references" menu command shows the cross references in tabular form in the output window.

Structure of the cross reference list

Operand	Kind	Type	Usage location	Diagram	Page
Module Channel Terminal identifier Device status function	Access: WR = write RO = read	Type of operand	Element type and element number of the function element.	Name of the diagram in which the function element is located.	Page on which the function block that is connected to the function element is located.

Note

The cross reference list only displays the operands used in the safety circuit.

Edit cross references

With the context menu (right mouse button) or by double-clicking on the item, you can go to the position where the cross reference is used in order to edit it.

6.4.5.6 Symbol list

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Symbol list	-	-	✓	✓

Actions

The "Options" > "Symbol list" menu command shows the plant identifier you assigned in the form of a table in the output window.

To improve the legibility of the configuration, you can assign identifiers for parts of your configuration data within the context of the system documentation. The symbol list gives an overview of the identifiers assigned by you, their assignments, and the type.

Example of a symbol list

Identifier	Assignment	Type
Anna	SLOT5	Equipment identifier (BMK)
Terminal_1	SLOT3_F-IN1	Terminal identifier
Terminal_2	SLOT4_Q6	Terminal identifier
Press	-	Plant identifier
Hall 1	-	Location identifier
EMERGENCY STOP_1	EMERGENCY STOP [35]	Name

Editing entries in the symbol list

You can perform the following actions in the context menu (right mouse button):

- Delete: The selected identifier is deleted.
- Editing: The selected identifier can be changed (can also be activated if the identifier is selected and you click on it again or press F2).

  If you change or delete identifiers, then the display in the respective view is immediately updated.
- Go to: You jump to the corresponding icon, which is then selected (can also be activated by double-clicking).

Sorting:

- If you click on the column header in the columns "Identifier" and "Assignment," the items will be sorted alphabetically by this column.
- Clicking on the "Type" column header sorts the column as follows: Equipment identifier, Name, Comment, Terminal identifier, Location identifier, Plant identifier.

Note

Editing rules

You cannot assign the same identifier twice.

6.4.5.7 Terminal list

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Terminal list	-	-	✓	✓

Actions

The "Options" > "Terminal list" menu command lists all available terminals of the slot and subslot (AS-i-) modules in the output window with the relevant terminal identifier (right-hand column) and the interconnection status in the logic diagram (left-hand column).

The terminals are also shown for which no identifier has been assigned and also those terminals that are not yet interconnected.

Example of a terminal list

Terminal	Terminal marking
ASi#02_IN1	Pushbutton_1
SLOT3_F-IN1	Terminal_1

Editing entries in the terminal list

You can perform the following actions in the context menu (right mouse button):

- Delete: The selected terminal identifier is deleted.
- Editing: The selected terminal identifier can be changed (can even be activated if the identifier is selected and you click on it again or press F2).

  If you change or delete identifiers, then the display in the respective view is immediately updated.
- Go to: Interconnecting terminal is in the logic will take you to the corresponding function element and select it (can also be activated by double-clicking).

Sorting:

- Clicking on the column header of the first column sorts the items of this column by their interconnection status.
- Clicking on the relevant column header sorts the items of the "Terminal" and "Terminal identifier" columns alphabetically.

Note

Editing rules

You cannot assign the same terminal identifier twice.

6.4.5.8 Export macros...

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Export macros...	-	-	-	✓

Actions

With the "Options" > "Export macro..." menu command, you can save the existing macros on any data medium to make it available to other users.

See also Chapter "Macro functionality (Page 263)."

6.4.5.9 Import macros...

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Import macros...	-	-	-	✓

Actions

With the "Options" > "Import macro..." menu command, you can import exported macros from other users to use them in your project.

See also Chapter "Macro functionality (Page 263)"

6.4.5.10 Release information...

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Release information...	-	✓	✓	✓

Requirements

This menu command can only be activated if the configuration has been released.

Actions

The "Options" > "Release information..." menu command displays the following release data in the "Display release information" dialog box for the configuration currently in the MSS ES:

- Name of the person releasing
- Name of the company of the person releasing
- Release status
- Configuration CRC
- Release time stamp

  The release information can be printed out via the "Print" button.

6.4.5.11 Set PG/PC interface...

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Set the PG/PC interface...	-	-	-	✓

Actions

The "Options" > "Set the PG/PC interface..." menu command opens a dialog box in which you can set the PG/PC interface.

More detailed information in the help file

You will find detailed information in the S7DOS help file s7epatda.chm in the Windows system directory. Depending on the configuration of your operating system, you will find the help file either in C:\Windows\system32\s7epatda.chm or in C:\Winnt\system32\s7epatda.chm.

This can only be set if communication with SIRIUS engineering is supported via PROFIBUS DP, PROFINET IO or the SIMATIC network.

6.4.6 Help Menu

6.4.6.1 Help topics

Menu option		Symbol	Basic license	Standard license	Premium license
Help	Help topics		✓	✓	✓

Actions

The menu command "Help" > "Help Topics" starts the online help for MSS ESS.

The online help is structured as follows:

- The left window contains the table of contents, index, and find function of the online help.
- The main window contains the individual help topics.
- You can find topics of relevance to all SIRIUS engineering products in the higher-level online help.

6.4.6.2 Info

Menu option		Symbol	Basic license	Standard license	Premium license
Help	Info	-	✓	✓	✓

Actions

The "Help" > "Info" menu command provides information about the following:

- All the SIRIUS engineering products that have been installed
- Copyright
- Technical assistance

6.5 Identification and configuration

6.5.1 Identification

6.5.1.1 Central unit

"Central unit" view

The "Identification" > "Central unit" view contains an overview of the device-specific information. You can read from the file using the "Switching device" > "Open" menu command or from the central unit using the "Switching device" > "Open online" command.

Note

When you create a new safety relay, the content will be empty.

If no 3RK3 central unit is configured, all the fields are gray in offline mode.
If a central unit is configured, the contents are partially available in offline mode. They are all available in online mode.

Information in the "Central unit" dialog box

The "Identification" > "Central unit" view contains the following information:

Information	Meaning
Order No.	Order number of the safety relay.
Short designation	Short designation of the safety relay, e.g. 3RK3 Basic.
System	Designation of the line of products, e.g. "3RK3 Modular Safety System".
Manufacturer	Name of manufacturer, e.g. "Siemens AG"
PI profile	Gives information about the PROFIBUS profile supported by the safety relay and the line of products belonging to the safety relay. This field is gray in offline mode.
Device family	Designation of the overall device family, e.g. safety-related switching device.
Device subfamily	Designation of the subfamily that is subordinate to the switching device family, devices with the same process view and data sets of identical content, e.g. safety relays.
Device class	Designation of the device class that is subordinate to the subfamily, e.g. modular.
Function group	Describes the device-specific, identical characteristics within a device subfamily, e.g. use of the same parameters from the parameter data set.
Fieldbus interface	Information on the fieldbus interface (e.g. "PROFIBUS DP") supported by the safety relay. This field is gray in offline mode.

Information	Meaning
System interface	Information on the internal system interface supported by the safety relay. This field is gray in offline mode.
Device interface	Information on the local interface supported by the safety relay. This field is gray in offline mode.
ID no.	Specifies the communication ID number of the safety relay. This field is gray in offline mode.
HW revision level	Product version which is entered prior to delivery. This field is gray in offline mode.
FW revision level	Information on the version of the device firmware. This field is gray in offline mode.
Revision counter	Labels changes of HW-related parameters and cannot be edited. This field is gray in offline mode.
I&M version	Version of the I&M (Identification & Maintenance) function in the safety relay. This field is gray in offline mode.
Supported I&M data	Specify which I&M blocks are supported by the safety relay. This field is gray in offline mode.
Serial number	Contains a production label with production information. This field is gray in offline mode.
Time stamp	The time stamp is written to the safety relay when the safety relay is named in the factory and specifies the date and time of production. This field is gray in offline mode.

6.5.1.2 Marking

"Identification" view

In the "Identification" > "Marking" view, you can enter descriptions about the safety relay or system.

The descriptions are part of the plant documentation. You can read from the file using the "Switching device" > "Open" menu command or from the safety relay using the "Switching device" > "Open online" menu command.

Information	Meaning
Plant identifier	The plant identifier specifies in which part of the plant a safety relay will be installed and operated. Max length: 32 characters.
Location identifier	The location identifier specifies at which location in the plant a safety relay will be installed and operated. Max length: 22 characters.
Installation date	Enter the date the safety relay was installed in the plant here. Max. length: 16 characters.
Description	You can enter additional information here. Max length: 54 characters
Author	You can enter the name of the author of the entries here.
Comment	Here you can store additional information in the system or in the safety relay. Max. length for the Author and Comment input fields, taken together: 187 characters.

Note

This view cannot be edited in the online view.

6.5.1.3 Project

"Project" view

In the "Identification" > "Project" view, you can enter the following descriptions:

- Project name
- Name of configuration engineer
- Configuration engineer's company name

Information	Meaning
Project name	Enter at least one character
Name of configuration engineer	Enter at least one character
Configuration engineer's company name	Enter at least one character
Configuration CRC	Cyclic Redundancy Check which saves all safety-relevant configuration data (4 bytes). The transfer of safety-relevant configuration data through insecure communication channels must be secured for the MSS 3RK3 safety relay.
Configuration time stamp	The MSS ES enters the current time stamp when a configuration is saved.
Configuration released	Release status of the configuration. Details can be determined via "Options" > "Release information".
Configuring tool	Specifies the software with which the opened configuration was created, e.g. Modular Safety System ES
Version of the configuring tool	Specifies the version of the software with which the opened configuration was created, e.g. K1.0.2.0
Number of slot modules	Number of slot modules in the device configuration
Number of subslot modules	Number of subslot modules (AS-i slaves) in the device configuration
Number of function elements	Number of function elements in the device parameter assignment.

6.5.1.4 Messages during the consistency check - Identification

The consistency check is used to check whether the configuration is correct and complete.

A consistency check is carried out for the following actions:

- With the "Edit" > "Check consistency" menu command
- When a configuration is saved
- With the "Target system" > "Prepare configuration test..." menu command

The messages are displayed in the output window. By clicking on a message in the output window, you can jump to the corresponding error location.

The following messages may appear during the consistency check:

Message	Kind	Message text	Remedy
Name of configuration engineer is missing	Error	"General configuration: Name of configuration engineer is missing."	Enter the name of the configuration engineer in the "Project" parameter assignment view
Name of the the configuration engineer's company is missing	Error	"General configuration: Name of configuration engineer's company is missing."	Enter the name of the company of the configuration engineer in the "Project" parameter assignment view
Project name is missing	Error	"General configuration: Project name is missing."	Enter the project name in the "Project" parameter assignment view
The memory module is full	Error	"General configuration: The memory of the memory module is full. Reduce the plant documentation or optimize the logic (if applicable).	Reduce the memory requirements on the memory module You will find more information in Chapter "Settings of Modular Safety System ES - "Download settings" tab (Page 219)"

6.5.2 Configuration

6.5.2.1 Main system

Configuration

The hardware of the MSS 3RK3 is configured in the "Main system" configuration table. The rows represent the slots of the MSS 3RK3: The fixed slots 1 to 3 and the maximum number of expansion modules supported by the selectable 3RK3 central unit.

Note

Procedures for the configuration

The procedure for configuration in MSS ES has an effect on various functions.

There are two ways of configuring in MSS ES:

1. You start with configuration of the hardware structure and then configure the logic. Once you have configured an MSS 3RK3 Basic, all non-supported function elements will no longer be available in the catalog window of the logic diagram.
2. You start with configuration of the logic and then configure the hardware configuration. If you use the function elements in the logic diagram that are not supported by MSS 3RK3 Basic, the MSS 3RK3 Basic will no longer be available in the hardware catalog of the configuration.

Slot assignment

Slots are assigned to the following modules:

- MSS slot 1: HMI modules (optional)
- MSS slot 2: Interface module (optional)
- MSS slot 3: Central units
- MSS slot 4 or higher: Expansion module (optional)

Modules can be assigned to slots in 2 different manners:

- Drag the module out of the catalog window and drop it into the table.
  When a module is selected in the catalog window, the rows in the table where the module can be positioned are highlighted in color.
- Select the row in the table where the module is to be inserted.
  Double-click on the module in the catalog window that you want to add to the table. If no row is selected, the module is inserted in the first possible row.

Changing and editing entries in the configuration table

You can edit positioned modules directly in the configuration table:

- You can delete modules unless their inputs/outputs are already connected in the safety circuit. In this case, all interconnections must first be removed. If you confirm the message with "Yes", this occurs automatically.
- You can drag and drop modules from one row to another.
- When you switch or move modules, the assignment of the affected inputs/outputs in the safety circuit is adapted accordingly.
- You can copy and paste expansion modules including their parameters or swap their slots using the command "Swap slot".

Note

An equipment identifier must not exist twice. Therefore a number is added to the equipment identifier when copying. If the maximum number of characters is exceeded by adding the number, the equipment identifier is shortened.

Editing the configuration table using the context menu

By pressing the right mouse button and selecting a module in the configuration table, a context menu pops up with which you can edit the entries in the table.

"Swap slot" command

You can swap slots of modules.

"Delete blank rows automatically" command

With this command you can correct an erroneous configuration in the main system. There will be no more blank rows between modules in the table.

The assignment of the affected inputs/outputs in the safety circuit is adapted accordingly, just as it is when modules are moved.

"Edit terminal identifier" command

The dialog box shows you the existing terminals in the "Terminal" column and you can edit the following:

- "Terminal identifer" column: A terminal designation can be entered (max. 32 characters).
- "Supplement identifiers" button: Inserts the terminal identifiers in the unassigned fields.
- "Delete identifiers" button: Deletes the terminal identifiers in the selected fields.

"Object properties" command

Information on the selected module is displayed in this properties window, and you can define parameters in it.

"Optimize column width" command

Adapts the column width optimally to the column contents.

Further editing options in the configuration view

In the configuration view, you have the following editing options:

- Determine online

  When an MSS 3RK3 is connected, you can adopt the actual configuration, i.e. the hardware configuration of the MSS 3RK3, by clicking the "Determine online" button. The user is asked if the current configuration is to be replaced.

  Note

  Diagnostics display

  The connected diagnostic display is not recognized by "Determine online."

- Show hardware configuration

  When the checkbox "Show hardware configuration" is selected, an image with the modules and their required arrangement is shown in the area below the checkbox.

- Consistency check

  The user can execute a consistency check by means of the menu command "Edit" > "Check consistency" to determine whether the configuration is possible.

6.5.2.2 Swap slots

If, for example, all the slots are assigned and you want to reorganize your configuration, you can swap the position of two expansion modules by means of the dialog "Swap slots":

- Select the slot in the configuration table where one of the two expansion modules is positioned.
- Click the right mouse button.
- Select "Swap slot" from the context menu.
- The "Swap slot" dialog is opened.
- Select the slot in the drop-down list where the other expansion module is positioned.

Result

The slots of the two modules will be swapped.

6.5.2.3 Properties of the HMI module

Description

You can open the "Properties of HMI module" dialog box as follows:

- Double-click on the module in the configuration table.
- Choose the "Object properties" menu option from the context menu (right mouse button).
- In the "Options" > "Settings of Modular Safety System ES" menu under the "General settings" tab, select the "Display object properties automatically on insert" checkbox. The properties dialog box will then pop up automatically when you drag the module from the catalog window into the configuration table of the project window.

Parameters

The parameters are described in the following table:

Parameter name	Parameter value
Configuration	
Module	The designation of the selected module is displayed here. The field has a gray background and cannot be changed by the user.
Order No.	The order number of the selected module is shown here. The field has a gray background and cannot be changed by the user.
Firmware	The firmware of the selected module is shown here. The field has a gray background and cannot be changed by the user.
Equipment identifier	Here you can specify a user-defined equipment identifier (max. 32 characters) for the selected module and assign it to inputs and outputs.
Inputs	The number of inputs of the selected module is shown here.
Outputs	The number of outputs of the selected module is shown here.

6.5.2.4 Properties of interface module

Description

You can open the "Properties of interface module" dialog box as follows:

- Double-click on a module in the configuration table.
- Choose the "Object properties" menu option from the context menu (right mouse button).
- In the "Options" > "Settings of Modular Safety System ES" menu under the "General settings" tab, select the "Display object properties automatically on insert" checkbox. The properties dialog box will then pop up automatically when you drag a module from the catalog window into the configuration table of the project window.

Parameters

The parameters are described in the following table:

Parameter name	Parameter value
Configuration	
Module	The designation of the selected module is displayed here. The field has a gray background and cannot be changed by the user.
Order No.	The order number of the selected module is shown here. The field has a gray background and cannot be changed by the user.
Firmware	The firmware of the selected module is shown here. The field has a gray background and cannot be changed by the user.
Equipment identifier	Here you can specify a user-defined equipment identifier (max. 32 characters) for the selected module and assign it to inputs and outputs.
Inputs	The number of inputs of the selected module is shown here.
Outputs	The number of outputs of the selected module is shown here.
Parameter assignment - PROFIBUS DP	
Baud rate	The baud rate is automatically detected by the safety relay. The field has a gray background and cannot be changed by the user.
Station address	This is where you define the station address.
Station address - Change authorizations	Here you can define the following change authorizations at the station address: • Changes possible without restrictions (e.g. by means of the fieldbus command "SET_SLAVE_ADD," DS 160, or setting element). • Can only be changed by means of data set (DS 160), which can be sent from the controller or from the MSS ES, or by means of the setting element (on the safety relay). • Can only be changed by means of data set (DS 160).
Group diagnostics	Here you select whether the group diagnostics is blocked or released. If this parameter is set to "block," the "Group error diagnostics," "Group warning diagnostics," and "Group prewarning diagnostics" parameters are not significant, i.e. they are ignored by MSS 3RK3.
Group error diagnostics	Here you select whether the group error diagnostics is blocked or released.
General warning diagnostics	Here you select whether the group warning diagnostics is blocked or released.
Group prewarning diagnostics	Here you select whether the group prewarning diagnostics is inhibited or released.

6.5.2.5 Central unit properties

Description

You can open the "Central unit properties" dialog box as follows:

- Double-click on a module in the configuration table.
- Choose the "Object properties" menu option from the context menu (right mouse button).
- In the menu "Options" > "Settings of Modular Safety System ES" under the tab "General settings", activate the checkbox "Display object properties automatically on insert". The properties dialog box will then pop up automatically when you drag a module from the catalog window into the configuration table of the project window.

Parameters

The parameters are described in the following table:

Parameter name	Parameter value
Configuration	
Module	The designation of the selected module is displayed here. The field has a gray background and cannot be changed by the user.
Order No.	The order number of the selected module is shown here. The field has a gray background and cannot be changed by the user.
Firmware	The firmware of the selected module is shown here. The field has a gray background and cannot be changed by the user.
Equipment identifier	Here you can specify a user-defined equipment identifier (max. 32 characters) for the selected module and assign it to inputs and outputs.
Inputs	The maximum number of available inputs is indicated here.
Outputs	The maximum number of available outputs is indicated here.
Parameter assignment - Device response	
Program cycle time [ms]	Here you define the program cycle time within a range of 10 to 60 ms in steps of 5 ms. On the MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic and MSS 3RK3 ASIsafe extended, a program cycle time of 15 to 60 ms is possible when the AS-Interface is used.
DP process data structure	Here you specify the process data width that is processed by MSS 3RK3. The following values are available: • MSS: 32DI/32DO • MSS: 64DI/64DO (MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic, and MSS 3RK3 ASIsafe extended only) **Note:** Note that the GSD file version si02814d.gsg or higher must be installed in HW Config or in the engineering software of the PLC. For additional information on the GSD file, see the "*3RK3 Modular Safety System*" manual, Chapter "*7.5.2.4 Configuring with GSD file*."

Parameter name	Parameter value
Parameter assignment - AS-Interface	
AS-Interface (MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic and MSS 3RK3 ASIsafe extended only)	Activate the AS-i interface in order to be able to use standard and safety-related AS-i slaves in your configuration. If AS-i slaves are already used in the logic diagram, the AS-i interface can no longer be deactivated.
Parameter assignment - AS-Interface - Simulated slaves	
Slave profile to address (MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic and MSS 3RK3 ASIsafe extended only)	Here you can specify whether the MSS 3RK3 is to simulate AS-i slaves on the AS-i bus. The 3RK3 central unit supports various profiles, which can be selected. The simulated slaves determined here are entered in the subsystem and can no longer be processed there. If you have allocated an address to a slave, the MSS 3RK3 will assign the corresponding selected profile to this address on the AS-Interface. Addresses at which a slave is already configured in the subsystem can no longer be assigned and are therefore displayed grayed out.

6.5.2.6 Properties of expansion module

Description

You can open the "Properties of expansion module" dialog box as follows:

- Double-click on a module in the configuration table.
- Choose the "Object properties" menu option from the context menu (right mouse button).
- In the "Options" > "Settings of Modular Safety System ES" menu under the "General settings" tab, select the "Display object properties automatically on insert" checkbox. The properties dialog box will then pop up automatically when you drag a module from the catalog window into the configuration table of the project window.

Parameters

The parameters are described in the following table:

Parameter name	Parameter value
Configuration	
Module	The designation of the selected module is displayed here. The field has a gray background and cannot be changed by the user.
Order No.	The order number of the selected module is shown here. The field has a gray background and cannot be changed by the user.
Firmware	The firmware of the selected module is shown here. The field has a gray background and cannot be changed by the user.
Equipment identifier	Here you can specify a user-defined equipment identifier (max. 32 characters) for the selected module and assign it to inputs and outputs.
Inputs	The number of inputs of the selected module is shown here.
Outputs	The number of outputs of the selected module is shown here.

6.5.2.7 AS-i subsystem

Configuration

You configure the AS-Interface hardware of the MSS 3RK3 in the "Subsystem AS-i" configuration table.

Determining the AS-i subslot configuration online

If a 3RK3 Advanced, 3RK3 ASIsafe basic or 3RK3 ASIsafe extended central unit with an AS-i connection is used in a 3RK3 Modular Safety System, you can apply the actual configuration, i.e. the hardware configuration of the AS-i subslot configuration, by clicking on the "Determine online" button.

The result will depend on the master and slaves used. Slave profile values that cannot be determined or calculated are shown as "?" and have to be adjusted manually.

Note

Determine online

If the AS-i master is running and the MSS 3RK3 is connected, only the ID codes of the slaves on the AS-i bus can be determined.

If the MSS 3RK3 is running and the AS-i master is connected, all available information concerning the slave profiles can be determined.

The user is asked if the current configuration is to be replaced.

Determining an existing subslot configuration online

- If the ID code at an address determined online is identical tp the configured code, the parameter assignment entered will remain unchanged, even if the other values of the slave profile differ.
- If the ID code is different, the value determined online will be applied.
- If an entered AS-i slave cannot be determined online, the configured value will be retained.

AS-i slaves

The catalog window contains slaves that you can use in your configuring:

- Safety-related slaves:

  Slaves that read the safety-related "On" or "Off" status of the connected sensor or the control device and transfer it to the master or safety monitor. The latter then switches outputs off if applicable (e.g. EMERGENCY STOP).
- AS-i standard slaves
- AS-i A/B slaves

Simulated slaves

No more than four non-safety-related AS-i slaves can be simulated, including one as a CTT2 slave. This enables diagnostics using the CTT2 protocol. In so doing, the CTT2 protocol data are interconnected via the "Slot3_ASi#xx_Sx.y" and "Slot3_ASi#xx_Qy.z" terminals in the logic diagram. Up to 12 safety-related AS-i slaves can additionally be simulated. The number of safety-related AS-i slaves depends on the central unit used:

	MSS 3RK3 ASIsafe basic	MSS 3RK3 ASIsafe extended	MSS 3RK3 Advanced
Maximum number of simulated safety-related AS-i slaves	8	10	12

A simulated slave is provided by the 3RK3 central unit on the AS-i bus. With this function, signals from the logic diagram can be exchange with other stations on the AS-i bus.

You assign parameters to the simulated slaves in the "Central unit properties - MSS slot 3" dialog box. They will then be shown (in italics) in the "Subsystem AS-i" table.

Rules for slot allocation

- The table for the AS-i subsystem contains 62 rows. According to AS-i Spec as from Version 2.11, you can configure no more than the following:
  - 31 standard slaves or safety-related input slaves
  - 62 A/B slaves
  - a mixture of the above
- Standard or safety-related slaves can only be inserted at A addresses. If an A address is allocated, the corresponding B address is no longer available.
- Simulated slaves are determined in the Properties dialog box of the corresponding 3RK3 Advanced, 3RK3 ASIsafe basic or 3RK3 ASIsafe extended central unit and inserted at A/B addresses (addressing of the simulated AS-i slaves). Simulated slaves are shown in italics and provided with the icon of the 3RK3 central unit. They cannot be edited.
- Entries can be inserted, deleted, or cut out in any way, i.e. gaps between addresses are permitted.

Module catalog for subsystem AS-i

This catalog contains all AS-i slaves marketed by Siemens AG that were known at the time of publication of this version of MSS ES. A universal slave must be used to incorporate more recent slaves from Siemens AG or to incorporate slaves from other manufacturers.

6.5.2.8 Properties of AS-i slaves

Description

You can open the "Slave properties" dialog box as follows:

- Double-click on a module in the configuration table.
- Choose the "Object properties" menu option from the context menu (right mouse button).
- In the "Options > Settings of Modular Safety System" menu under the "General settings" tab, select the "Display object properties automatically on insert" checkbox. The properties dialog box will then pop up automatically when you drag a module from the selection window into the configuration table of the project window.

Parameters

The parameters are described in the following table:

Parameter name	Parameter value
Configuration	
Slave type	The designation of the selected module is displayed here. The field has a gray background and cannot be changed by the user.
Order No.	The order number of the selected module is shown here. The field has a gray background and cannot be changed by the user.
Equipment identifier	Here you can specify a user-defined equipment identifier (max. 16 characters) for the selected module and assign it to inputs and outputs.
IO code	If you use a universal slave, set the profile for this slave here.
ID code	If you use a universal slave, set the profile for this slave here.
ID1 code	If you use a universal slave, set the profile for this slave here.
ID2 code	If you use a universal slave, set the profile for this slave here.
Monitor non-safety-related I/Os	Select the checkbox for monitoring non-safety-related slaves or the non-safety-related information items of a safety-related AS-i slave. You can then interconnect the terminals in the logic diagram. The "Monitor non safe I/O" option can be set up to 14 times in one configuration.

6.5.2.9 Messages during the consistency check - Configuration

The consistency check is used to check whether the configuration is correct and complete.

A consistency check is carried out for the following actions:

- With the "Edit" > "Check consistency" menu command
- When a configuration is saved
- With the "Target system" > "Prepare configuration test..." menu command

The messages are displayed in the output window. By clicking on a message in the output window, you can jump to the corresponding error location.

The following messages may appear during the consistency check:

Message	Kind	Message text	Remedy
The expansion modules must be configured in succession.	Error	"Configuration: There is a gap in front of an expansion module."	Correct the configuration "manually," possibly using the "Delete blank rows automatically" function from the context menu.
The central unit must be available.	Error	"Configuration: A central unit always needs to be configured at slot 3."	Drag the central unit from the catalog window to slot 3 in the configuration table.

6.6 Logic diagram

You can switch to the logic diagram view by selecting a diagram in the navigation window.

6.6.1 Features of the logic diagram

The logic diagram has the following features:

- Graphical connection of the function elements used and representation as a function diagram:
  - Representation of the switching elements as function elements with input connections and output connections
  - Representation of physical and logic addresses in the form of address elements
  - Representation of interconnections as connecting lines between function elements
  - Display of relevant function element parameters
- Documentation management:
  - The pages are divided automatically.
  - The individual pages are displayed on the screen as they are printed.
- Current states (e.g. digital outputs of function elements) of the MSS 3RK3 can be monitored in the diagnostics mode.
- Working with the logic diagram:
  - The user can switch between languages during operation.
  - Optimization functions (e.g. arranging the function elements according to the signal flow).
  - Placing and connecting the function elements by drag & drop.
  - Function elements and connections can be moved as required.
  - Comments can be placed in the screen and printout as required.
  - Structuring of the logic by generating partial diagrams (e.g. one output circuit per diagram).
  - The clarity of a diagram can be enhanced by interrupting connections and replacing them by freely movable reference points.

Note

Procedures for the configuration

The procedure for configuration in MSS ES has an effect on various functions.

There are two ways of configuring in MSS ES:

1. You start with configuration of the hardware structure and then configure the logic. Once you have configured an MSS 3RK3 Basic, all non-supported function elements will no longer be available in the catalog window of the logic diagram.
2. You start with configuration of the logic and then configure the hardware configuration. If you use the function elements in the logic diagram that are not supported by MSS 3RK3 Basic, the MSS 3RK3 Basic will no longer be available in the hardware catalog of the configuration.

6.6.2 Working with the logic diagram

6.6.2.1 Selecting function elements and using them in the diagram

Inserting function elements

Insert the function elements by selecting them in the catalog window and then drag and drop them into the work space.

Defining parameters

When you drag a function element into the work space, a dialog box pops up where you can define the function element parameters. For this you must activate the checkbox "Display object properties automatically on insert" in the menu "Options" > "Settings of Modular Safety System ES" under the tab "General settings".

You can also open the dialog box subsequently by double-clicking the function element on the work space, or by choosing "Object properties" from the context menu (right mouse button).

You will find more information about the parameters in Chapter "Function elements (Page 271)."

Finding function elements in the diagram

To display a function element already inserted in the diagram, double-click the entry of this function element in the catalog window. The first function element that is found in the diagram will be displayed. By double-clicking on this function element in the catalog window again, the next function element of this type is selected in the diagram.

6.6.2.2 Connecting function elements

Rules for drawing connections

- Several connections can originate from an output of a function element.
- Only one connection can be connected to an input of a function element.

Drawing a connection between functions

To interconnect connections of function elements, perform the following steps:

- Move the mouse pointer over an unconnected input. It is then highlighted in blue.
- Press the left mouse button and keep it pressed.
- Keep the mouse button pressed and draw a connection to an output until it is highlighted in blue.
- Release the mouse button.

  Result: A connection is established between the two terminals.

Note

You can also draw the connection from the output to the input.

Connections between function elements in different diagrams

To connect function elements in different diagrams, proceed as follows:

- Select the connection point of the function element in the first diagram.
- In the context menu (right mouse button), select the command "Begin drawing connection".
- Switch to the second diagram.
- Select the connection point of the second function element.
- In the context menu (right mouse button), select the command "Finish drawing connection".

Crossover points of connections

- Crossover points of connections are not specifically marked. The route of the lines is usually apparent.
- If due to the high number of connections the route of the lines is not immediately apparent, then select the connection and its exact route will be highlighted.

Branches

- Branches are identified by a point.
- The system automatically sets the branch points. They cannot be selected and moved directly.
- You can move branch points indirectly by moving connections.

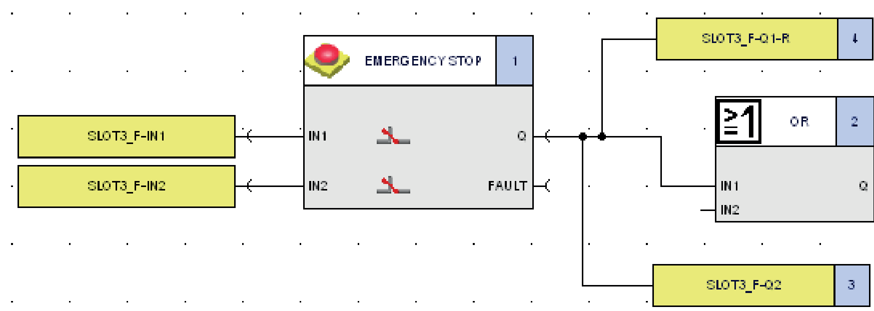


Figure 6-9 Branches

Rerouting of connections

If you want to reroute the end (or beginning) of an existing connection to a different terminal, then draw a new connection as follows:

- Click on the corresponding connection (line) to select it.
- Keep the mouse button pressed and drag one of the end points to another terminal.

Alternatively, you can reroute several connections to a terminal simultaneously:

- Move the mouse pointer to the end point of a connection line until it is highlighted in blue.
- Click into the blue rectangle.
- Keep the mouse button pressed and reroute the connections to the respective terminal.

Moving a function element/connection

- Keep the mouse button pressed to move function elements and connections.
- When function elements are moved, the start and end points of connections are fixed, since they are linked to the terminals of function elements.

6.6.2.3 Selecting

Select all

Use the "Edit" > "Select all" menu command to select all function elements, connections, and comments.

Lasso function

Use the lasso function to select all objects within a specific area:

Keep the left mouse button pressed and drag open a rectangle.

All objects that are completely within the rectangle are automatically marked.

Multiple selection

- You can select more than one element at once by pressing the "<Ctrl>" key and selecting individual elements successively.

6.6.2.4 Delete

Use the menu command "Edit" > "Delete" to delete one or several selected objects and connections.

You can also delete objects/connections via the context menu (right mouse button) and the "Delete" command or by pressing the "<Del>" key.

Call:

Button	Command
	"Edit" > "Delete"

NOTICE
Deleting an object
When you delete an object, you also delete all connections or interrupted connections that are linked to this function element.

6.6.2.5 Display of graphical conflicts

Graphical conflicts (part of a connection line/block is on top of another, connection lines that cross over blocks, blocks on top of page margins) are automatically highlighted in red.

Use the "Edit" > "Realign graphic" menu command to arrange the objects in succession according to the signal flow.

Note

After the "Realign graphic" command, existing comments are positioned below the interconnections on the logic diagram.

Types of conflict

The following types of conflict are shown in the figure below:

- Part of a connection line is on top of another connection line
- Part of a block is on top of another block
- Connection lines cross over blocks
- Blocks on top of page margins

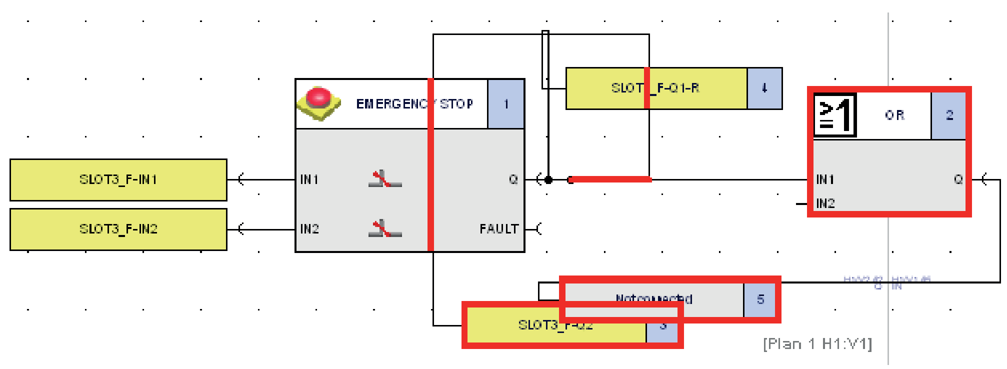


Figure 6-10 Graphical conflicts in the logic diagram

Note

Please note the following:

- Graphical conflicts can also occur at reference points.
- During graphical configuration, it is continuously checked whether graphical conflicts occur.
- During the consistency check, graphical conflicts are listed as warning messages in the output window.

6.6.2.6 Realign graphic

Use the "Edit" > "Realign graphic" menu command to arrange the function elements and connections according to the signal flow.

Call:

Button	Command
	"Edit" > "Realign graphic"

Defining options

- In the menu "Options" > "Settings of Modular Safety System ES" > "Logic", click on the button "Realign graphic".

  The window "Options - Realign graphic" is opened.

  – Select the "Avoid connections crossing functions" checkbox if you want to prevent connections from crossing function elements.

  – If the checkbox is selected, you can choose whether connections will be interrupted or whether the affected function elements will be moved down until there is no longer a conflict with connections.

  – You can also apply a "Standard column grid across all subnetworks of a function diagram" if you select the corresponding checkbox.

  – You can position the output cells in a separate column on the far right (for each subnetwork) if you select the lowermost checkbox.

Realignment principles

- Only a graphical realignment of the objects is implemented. The configuration remains unchanged.
- Graphical conflicts are automatically eliminated.
- Automatic arrangement is also possible when the configuration is read from the safety relay (open online).
- After automatic arrangement, function elements and connections can be moved and adjusted.
- Use the menu command "Edit" > "Undo" to undo the new arrangement.

Note

After the "Realign graphic" command, existing comments are positioned below the interconnections on the logic diagram.

6.6.2.7 Move diagram

Activating and deactivating the move mode

With the "View" > "Change grid settings" menu command, you can switch to move mode. In the move mode, you can move the diagram using the mouse if it is larger than the current window.

Call:

Button	Command
	"View" > "Change grid settings"

Click the button again or choose "View" > "Change grid settings" to deactivate move mode.

Note

Special features in the move mode

- When the move mode is activated, you cannot select and move objects or draw connections.
- The mouse pointer is represented by a hand symbol when the move mode is activated.

Alternately, the diagram can also be moved with the cursor keys even while move mode is not active.

6.6.2.8 Zooming

You can zoom in or zoom out in a diagram step by step using the menu command "View" > "Zoom in" or "View" > "Zoom out". The zoom factor is increased or decreased by a fixed value.

Zooming in and out can also be executed as follows:

- Mouse click on the graphical work space > Keep the key "<Ctrl>" pressed > Use the mouse wheel.
- Mouse click on the graphical work space > Click on the "+" or "-" key.

Call:

Button	Command
	"View" > "Zoom in"
	"View" > "Zoom out"
	"View" > "Zoom dialog"

Zoom dialog

With the menu command "View" > "Zoom dialog", you can open a zoom dialog where you can directly set a zoom factor:

Zoom center point

If no object is selected in the diagram, the center point of the screen is selected for zooming.

If one or several objects are selected in the diagram, the center point of the selected object/area is selected for zooming.

If the zoom function is carried out repeatedly this zoom center point is moved step by step to the center of the screen.

6.6.2.9 Overall view

Network overview

Use the menu command "View" > "Overall view" to obtain an overview of the network.

Call:

Button	Command
	"View" > "Overall view"

6.6.2.10 Insert comment

Use the menu command "Edit" > "Insert comment" to insert comments in the diagram wherever required.

Call:

Button	Command
	"Edit" > "Insert comment"

Procedure

- Select "Insert comment" at the current mouse position in the context menu. The mouse pointer then becomes a symbol that represents a comment.
- Or click on the "Insert comment" button.
- Left-click on the required position in the diagram.
- A dialog box opens in which you can enter the comment.

Editing a comment element

You can edit a comment element:

- Edit the comment text:
  - "Edit comment" context menu (double-click on the comment)
  - A dialog field for entering the text pops up.
- Move by means of drag and drop
- Change the size. Line breaks are automatically inserted to adapt the text to the size.
- Delete
- Print

6.6.2.11 Interrupt connection

Clear representation of large diagrams

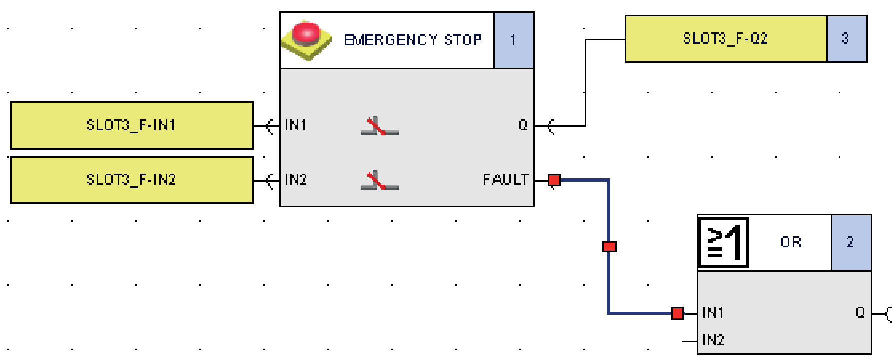
With the "Edit" > "Interrupt connection" menu command, you can interrupt connections to achieve clearer representation of large diagrams with many function elements and connections.

Call:

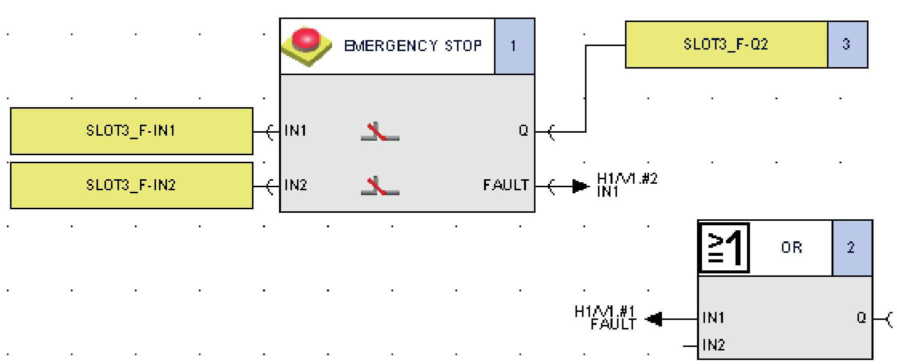
Button	Command
	"Edit > "Interrupt connection"

Procedure

- 1. Select the connection:



- 2. Click the button or choose "Interrupt connection" from the context menu (right mouse button).
- 3. The connection is interrupted. Reference points are generated that indicate to which function element each connection is routed.



Reference points

A reference point indicates to which function element and terminal of the function element the connection is routed (with any relevant diagram name).

You cam select, move, and delete a reference point:

- Selecting a reference point
  - Single mouse click (on the tip of the arrow):

    The reference point and the corresponding reference point are selected:

  - Double mouse click (on the tip of the arrow):

    The corresponding reference point is selected (if necessary, the window is scrolled down so that the corresponding reference point becomes visible):

- Deleting a reference point
  - Select the reference point.
  - Delete the reference point and thus the entire connection between the respective function elements with the "Edit" > "Delete" menu command.
  - You can also "Delete" using the context menu (right mouse button), "Delete" command or by selecting the reference point and pressing the "<Del>" key.

Note

When a reference point or an individual partial connection is deleted, the entire connection (including the second partial connection) is deleted.

6.6.2.12 Redraw partial connection

Restoring an interrupted connection

Use the menu command "Edit" > "Redraw partial connection" to restore an interrupted connection.

Call:

Button	Command
	"Edit" > "Redraw partial connection"

Procedure

- Select the partial connection.

  Alternatively, you can also select the reference point.
- Select the menu command "Edit" > "Redraw partial connection" or click on the button "Redraw partial connection". Alternately, you can connect the partial connection using the context menu (right mouse button).

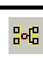
6.6.2.13 Highlight signal flow

Highlight objects in color

With the menu command "View" > "Highlight signal flow", you highlight the following objects in the logic diagram in color:

- All function elements and connections that indirectly send signals to an input of the selected block (signal flow on the input side).
- All function elements and connections to which the signals of all outputs of the selected function element are sent directly or indirectly (signal flow on the output side).

Call:

Button	Command
	"View" > "Highlight signal flow"

Highlighted elements

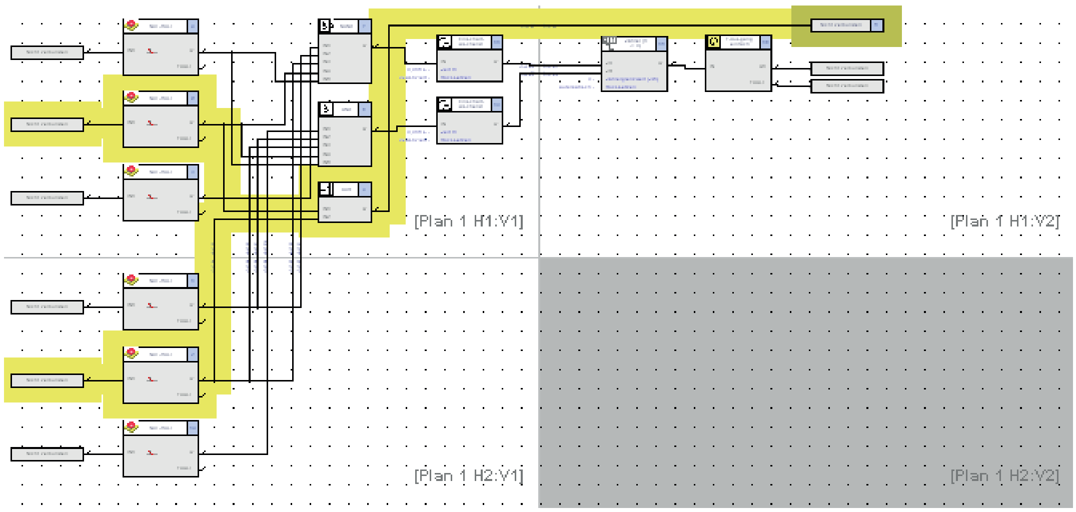


Figure 6-11 Highlight signal flow

Delete highlighting

The highlighting is independent of the selection of the objects and is retained until one of the following events occurs:

- Another element is graphically highlighted.
- The structure of the diagram is changed, for example, by deleting an element or inserting a connection.
- A reference point is selected (in the case of an interrupted connection).
- The menu command "View" > "Delete highlighting" is executed.

6.6.2.14 Delete highlighting

The menu command "View" > "Delete highlighting" cancels the graphical highlighting of the selected objects.

Call:

Button	Command
	"View" > "Delete highlighting"

6.6.2.15 Display settings

Selection of the display category

In the "View" > "Display settings" dialog box, you can set how function elements will be displayed.

You can also call up this dialog with the menu command "Options" > "Settings of Modular Safety System ES" under the tab "Logic" by clicking on the "Display settings" button.

Call:

Button	Command
	"View" > "Display settings"

Selecting a display element

All changeable display elements are entered in the "Display element" list.

When you select an element, its current color is shown in the box "Current color" below it:

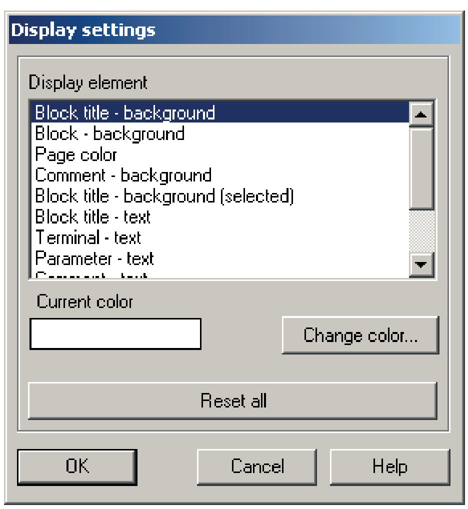


Figure 6-12 Display settings

Change color

- Click on the "Change color" button.
- The standard Windows color dialog is opened.
- Select a predefined basic color.
- Define user-specific colors:
  - Expand the window with the button "Define colors".
  - In the expanded window, use the mouse to either select a color from the colors offered or define a corresponding color using the keyboard (tone, saturation, brightness, red, green, blue color components).
  - Click the "Add colors" button and your self-defined color will be added to the range of user-defined colors.
  - The color settings are stored and are available for further sessions. They apply for all projects.

Reset settings

Use the button "Reset all" to restore the state after installation.

6.6.2.16 Grids and lines

Screen grid button

With the "View" > "Grid settings" command or the "Change grid settings" button, you can manually optimize the graphical display in the "Screen grid" dialog box.

You can also call up this dialog with the menu command "Options" > "Settings of Modular Safety System ES" under the tab "Logic" by clicking on the "Screen grid" button.

Call:

Button	Command
	"View" > "Change grid settings"

"Screen grid" dialog box

Align objects	Grid settings
Align objects with grid	The distance between the individual grid points can be set from 5 to 50 mm in steps of 5 mm.
Align objects with other objects	You can choose whether every first, second, third, fourth, fifth, or sixth grid point is to be shown.
Both options together	Activate the option "Display grid on the screen" to display a screen grid.
	Basic settings The grid settings are preassigned: • Distance: 40 mm • Show every first grid point, display grid on the screen

6.6.2.17 Errors and system callbacks

If you execute impermissible actions when working with the logic diagram, error messages are displayed.

Meaning of the error messages and system callbacks

Error message	Meaning
It is not permitted to connect inputs to each other.	You have tried to interconnect two inputs. This is not permitted. It is only possible to connect one input to one output and vice versa.
Connection of two outputs not possible.	You have tried to interconnect two outputs. This is not permitted. It is only possible to connect one input to one output and vice versa.
This connection is prohibited.	You have tried to create a connection that is not possible. Inputs and outputs cannot be interconnected at will (see above).
Inputs can only be used once.	You have tried to connect to an input that is already assigned. An input can only be the output point of one connection.
Feedbacks are not permissible.	You have tried to establish a connection between outputs and inputs with the same function element. Note that this does not have to be a direct connection, the feedback can be established across multiple function elements. Check the signal flow.

6.6.2.18 Macro functionality

You can use the macrofunction as follows:

- To put together a library of function units that you use particularly.
- To combine blocks (= macros) from function elements and interposed connections, partial diagrams, or whole diagrams.
- To export and import macros out of your project or into other projects.
- To reuse the macros in other projects.

Properties of macrofunctionality

- All macros are stored in a file in a user-specific area on the hard disk.
- Each user sees his or her own macros. Macros can be made available to other users using the export function (e.g. through a central storage location on a server).
- The number of elements in a macro is not limited.
- A macro can only be created from the elements of a single diagram.
- Freely positioned comments can be included in a macro.
- Interrupted connections are stored as such in the macro and will be interrupted when the macro is used.
- When a macro is created, connections are only included if they have a defined start and end point.
- Macros can be deleted using the context menu (right mouse button).
- Name and description of the macros can be modified subsequently using the context menu (right mouse button).
- The following actions cannot be undone:
  - Importing and exporting macros
  - Creation and deletion of macros
  - Modifying the properties of a macro

Creation of a macro

To create a macro perform the following steps:

- In the diagram, select the function elements from which you want to assemble the macro, being sure to select the required connection lines, too.
- Choose "Create macro..." from the context menu using the right mouse button.
- The properties dialog box of the newly create macro will be shown. Enter the following details:
  - Name: Name of the macro, with which the macro will be stored in the "Macros" folder in the catalog window.
  - Description: You can enter a description of the macro here.

Using macros

If you want to use an existing macro in your diagram, please proceed as follows:

- Define the type of element number assignment in the "Options" > "Settings" menu:
  - Assign a new element number: Starting at 1, the next free element number is assigned to the function element.
  - Retain old element numbers if possible: If the element number is not yet used in the current diagram, the element number that the function element had when the macro was created (and that is stored in it) will be assigned to the function element again when it is reused.
- Drag the macro out of the "Macros" folder in the function catalog into the diagram. This breaks down the macro into individual connections and function elements. You can modify the individual components.

  The following rules apply when inserting function elements:
  - Interconnections to input/output terminals are reset (to avoid duplicate assignments).
  - The elements of the macro are inserted at the current mouse position.
  - All elements of the macro are selected after insertion (for example, to be able to move them afterward).
  - The element parameters of each individual element are retained. (They are stored in the macro.)

Storing macros

The macros you created and imported are stored in the "Macros" folder in the function catalog with the name you assigned to them.

Export macros

- To export macros, choose the "Export macros..." menu command from the "Options" menu. The "Export macros" dialog box opens.
- Choose the macros from the "Existing macros" list (identical with the list of the macros in the function catalog) that you wish to export.
- Insert the selected macros into the "Macros to be exported" list using the "Add" button.
- Click the "Export" button.
- In the "Save macro file as" dialog box, enter the path and filename of the macro file to be created.

Import macros

- To import macros, choose the "Import macros..." menu command from the "Options" menu. The "Import macros" dialog box opens.
- Choose the macros you want to import from the "Importable macros" list.
- Insert the selected macros into the "Macros to be imported" list using the "Add" button.
- Click the "Import" button.

6.6.3 Connection rules

Because of the hardware properties or safety regulations, there are connection rules that must be checked or monitored when function elements are edited.

General

- Signals must not be connected recursively, i.e. "backward."
- Non-fail-safe input signals (= standard inputs) can only be added to a safety circuit if they are ANDed with a safe signal.
- Input terminals (fail-safe/non-fail-safe) can only be used once as an input (input cell or monitoring functions).
- Output terminals (fail-safe/non-fail-safe) can only be used once as an output (output cell / switching output), However, each output terminal can also be used once as an input terminal with an input cell.

Monitoring functions

- Only fail-safe signals must be connected to a signal input (INx) of a monitoring function.
- "Mixed connection" of signals is not possible, i.e. for multi-channel function elements capable of cross-circuit detection, only channels of the same module can be connected. (Exception: mode selector switch).

Note

For cross-circuit detection, channels are assigned to "channel groups" on 3RK3 central units or expansion modules:

Channel group 1: IN1/IN2

Channel group 2: IN3/IN4

Channel group 3: IN5/IN6

Channel group 4: IN7/IN8

- The following rules apply for interconnecting channels on these modules to multi-channel monitoring functions with the exception of the mode selector switch:
  - If an input in a channel group is used with one channel, the assigned second input must no longer be used with two channels. It can still be used with one channel.
  - If an input of a channel group is used with two channels, the second associated input is automatically configured to the still unused input of the element (e.g. emergency stop: IN1 is configured to SLOT3_F-IN1, IN2 is automatically assigned to SLOT3_F-IN2).

    The test cycle inputs for detecting cross-circuits are assigned as follows:

    T1: IN1 IN3 IN5 IN7

    T2: IN2 IN4 IN6 IN8

Note

A 2-channel enabling button can only be connected via the test cycle.

NOTICE
If a safety shutdown mat (cross-circuit principle) is connected to a slot (expansion module or central unit), cross-circuit detection must be deactivated for the remaining inputs on this slot because otherwise the monitoring functions configured for these inputs will also signal a cross-circuit when somebody steps on the safety shutdown mat.

Cell functions can be placed by the user

- Fail-safe and non-fail-safe input signals as well as fail-safe and non-fail-safe output signals can be connected once to an input cell function.
- Only fail-safe and non-fail-safe output signals can be connected to an output cell function.

Note

If you do not observe the rules described above, you are either guided through editing, i.e. incorrect connections are not possible, or a corresponding error or warning message is displayed.

Interconnection of AS-i slaves

- Safety-related AS-i input slaves

  When safety-related AS-i input slaves are used, only the "two-channel" and "2xsingle-channel" input type parameters are permissible for monitoring functions. It is not permitted to use a safety-related AS-i input slave with one channel.

  AS-i terminals may only be used together with the "NCNC" input type parameter for the following monitoring functions: "Monitoring Universal", "EMERGENCY STOP", "Protective door", "Protective door with lock", and "Safety shutdown mat (NC principle)".

  For enabling-type input functions (two-hand operation and enabling button), AS-i terminals may only be used together with the "NONO" input type parameter.

  The "NCNO" input type parameter must not be used.

  – Two-hand operation

    When safety-related AS-i input slaves are used with two-hand operation, only the "2x2xsingle-channel (NONONONO)" and "four-channel (NONONONO)" input type parameters are permissible.

    The "four-channel (NONCNONC)" input type parameter is not permitted for AS-i since the transferred value 0 is not safe.

- The two safety-related input signals of a monitoring function (F-IN1 and F-IN2) must originate from the same safety-related AS-i input slave.

- Discrepancy monitoring and sequence monitoring

  If the input signal is present at an AS-i slave and the "2xsingle-channel" input type parameter is assigned, the discrepancy and sequence monitoring parameters are automatically deactivated.

  This applies to the following function elements:

  – Monitoring Universal
  – EMERGENCY STOP
  – Safety shutdown mat with NC principle
  – Protective door
  – Protective door with lock
  – Enabling button
  – Two-hand operation

- Safety shutdown mat with cross-circuit principle

  There must not be any AS-i terminals connected to the "Safety shutdown mat with cross-circuit principle" function element.

- Setting/resetting of safety-related AS-i outputs using "AS-i 1..4F-DO"

  Only the terminals of one safety-related AS-i output may be connected to the outputs of the "AS-i 1..4F-DO" output function.

  Connection of other terminals and the distribution among several safety-related AS-i outputs are not permitted.

  An output cell sets/resets only the first channel Q1 of a safety-related AS-i output. Outputs Q2 ... Q4 and AUX1 and AUX2 are set/reset only using the "AS-i 1..4F-DO" output function.

- Representation of safety-related AS-i outputs

  The received Q1 ... Q4, AUX1, and AUX2 signals of another MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended may only be wired to input cells.

- Monitoring of safety-related input slaves

  The IN1 and IN2 receive signals may only be interconnected to input elements. Interconnecting to input cells is not permitted. Only the safety-related F-IN1&2 receive signal may be interconnected to an input cell.

  The monitoring function "AS-i 2F-DI" is used instead of an input cell if you want to diagnose both of the input terminal signals of the ASIsafe input slave.

- Representation of safety-related input slaves

  The send signals for a safety-related AS-i input slave may be interconnected only via an output cell.

6.6.4 Messages during the consistency check - Logic

The consistency check is used to check whether the configuration is correct and complete.

A consistency check is carried out for the following actions:

- With the "Edit" > "Check consistency" menu command
- When a configuration is saved
- With the "Target system" > "Prepare configuration test..." menu command

The messages are displayed in the output window. By clicking on a message in the output window, you can jump to the corresponding error location.

Logic diagram

The following messages exist for the logic diagram:

Rule	Kind	Message	Remedy
All address elements must be assigned to valid addresses. (Exception: FAULT output)	Error	Logic: Terminal not connected <[element type]> (no. [element number]).	Assign a valid address in the object properties dialog of the address element or of the associated input/output element.
Non-fail-safe input signals can only be added to a safety circuit if they are ANDed with a safe signal.	Warning	Logic: Signal flow terminal <[element type]> (no. [element number]): Non-safety-relevant signal is connected with a safety-relevant signal to a safety output without ANDing.	Change the safety circuit accordingly.
Inputs of logic elements must be connected. (Exceptions: • STOP and RESTART of the muting functions • AUX1/2 for AS-i 1 to 4F-DO)	Error	Logic: Input <[element type]> (no. [element number]) not connected.	Change the safety circuit accordingly.
Outputs of logic elements must be connected. (Exception: FAULT output)	Error	Logic: Output <[element type]> (no. [element number]) not connected.	Change the safety circuit accordingly.
A function element must not overlap a page limit.	Warning	Logic: The function element <function name> (no. [element number]) overlaps the page limit.	Move the function element or execute the "Realign graphic" command.
A function element must not overlap a connection.	Warning	Logic: The function element <\1> [no. \2] overlaps a connection.	Move the function element or execute "Realign graphic."
A function element must not overlap another function element.	Warning	Logic: The function element <function name> (no. [element number]) overlaps another function element.	Move the function element or execute "Realign graphic."
A connection must not overlap another one.	Warning	Logic: A connection overlaps another connection.	Move the connection or associated function element, or execute "Realign graphic."
A comment field overlaps a page limit.	Warning	Logic: A comment field overlaps the page limit.	Move the comment.

Rule	Kind	Message	Remedy
A comment field overlaps another comment field.	Warning	Logic: A comment field overlaps another comment field.	Move the comment.
A comment field overlaps a connection.	Warning	Logic: A comment field overlaps a connection.	Move the comment/connection.
A function element overlaps a comment field.	Warning	Logic: The function element <\1> [no. \2] overlaps a comment field.	Move the function element/comment field.
A reference point of an interrupted connection overlaps a connection.	Warning	Logic: A reference point of an interrupted connection overlaps another connection.	Move the connection or execute "Realign graphic".
A reference point of an interrupted connection overlaps another reference point.	Warning	Logic: A reference point of an interrupted connection overlaps with another reference point.	Change the safety circuit accordingly or execute "Realign graphic."
A function element overlaps a reference point of an interrupted connection.	Warning	Logic: The function element <\1> [no. \2] overlaps a reference point of an interrupted connection.	Change the safety circuit accordingly or execute "Realign graphic."
A reference point of an interrupted connection overlaps the page limit.	Warning	Logic: A reference point of an interrupted connection overlaps the page limit.	Change the safety circuit accordingly or execute "Realign graphic."
A comment field element overlaps a reference point of an interrupted connection.	Warning	Logic: A comment field overlaps a reference point of an interrupted connection.	Change the safety circuit accordingly or execute "Realign graphic."
The set program cycle time has been exceeded	Error	Logic: The set program cycle time has been exceeded. Reduce the number of function elements.	Alter safety circuit accordingly or increase program cycle time
If the channels of a module are wired to the "Safety shutdown mat (cross-circuit principle)" monitoring function, the other channels of this module should not be used with: • another monitoring function "Safety shutdown mat (cross-circuit principle)" • another monitoring function with activated cross-circuit.	Warning	Logic: <[element type]> (no. [element number]) - cross-circuit detection activated (channels of <[BMK/slot/subslot no.]> are wired to the monitoring function <safety shutdown mat (cross-circuit principle)> <[element type]> (no. [element number]> wired).	Change the safety circuit accordingly.
The internal memory on the MSS 3RK3 is full	Error	"General configuration: The internal memory of the MSS ES is full. Reduce the scope of the logic"	Reduce the scope of the logic (by optimization, for example).
A function element has an interconnection level larger than 255 (parameter is only 1 byte in size)	Error	Logic: No more than 255 function elements can be connected one behind the other. The rule is violated by the function element with the number \1.	Optimize the logic in such a way that no more than 255 interconnection levels are required (e.g. by use of output and input cells in pairs).

6.7 Function elements

6.7.1 Properties across function elements

WARNING
Can cause death, serious injury, or property damage.
The value of each time setting must always be selected at the lowest possible value that the application requires (permits). The selection of the times must comply with the requirements resulting from the risk evaluation for the respective hazardous situation. Otherwise additional measures have to be taken to avoid circumventing the safety application.

Input delay

The input delay is required for bouncing contacts (protective door) to stabilize the signals before they can be processed further by the function elements.

The input delay can be set to anywhere between 0 to 150 ms for all function elements.

If the inputs of the PROFIBUS process image are used, no input delay times can be set.

If safety-related AS-Interface inputs are used, the input delay time can be deactivated (= 0 s) or set to a value between 50 ...150 ms.

For master calls on the AS-i bus, an input delay time cannot be set.

For logic-driven signals that are read back, it is also not possible to set an input delay time; this pertains to all terminal types.

WARNING
Can cause death, serious injury, or property damage.
If the input delay increases, the overall response time of the safety program increases.

Start conditions

The following start conditions must be fulfilled before the output of a function element is set:

- When the startup test is active, the sensor that is being monitored must be actuated once. Faults must not occur here.
- If any faults do occur, they must be rectified and acknowledged.

Monitored / manual start

During a monitored start, the start pulse of the safety equipment must be between 150 and 2000 ms.

A monitored start can be carried out with the following function elements:

- Monitoring Universal
- EMERGENCY STOP
- ESPE (electro-sensitive protective equipment)
- Safety shutdown mat (NC principle)
- Safety shutdown mat (cross-circuit principle)
- Protective door
- Protective door with lock
- Standard output
- Start functions
- F output
- AS-i 1..4F-DO

In the case of a manual start, a rising edge 0->1 is required as the start condition at the START input.

Discrepancy monitoring

The discrepancy monitoring tolerates, within a defined time window, that associated signals are not available at the same time. If this time is exceeded, an enable signal is not output. The following table provides an overview of discrepancy monitoring for the monitoring functions when they are connected to two-channel sensors:

Monitoring function	Discrepancy monitoring	Discrepancy time
Monitoring Universal	can be set to on/off	∞ or can be set from/to: 0 to 60000 ms,
EMERGENCY STOP	On	5000 ms
ESPE (electro-sensitive protective equipment)	On	∞
Safety shutdown mat (NC principle)	On	5000 ms
Safety shutdown mat (cross-circuit principle)	off (cross-circuit same as with single channel)	∞
Protective door	can be set to on/off	∞ or can be set from/to: 0 to 60000 ms,
Protective door with lock	can be set to on/off	∞ or can be set from/to: 0 to 60000 ms,
Enabling button	On	∞
Two-hand operation	On	5000 ms
Mode selector switch	off	-
AS-i 2F-DI	off	-

NOTICE

The configured discrepancy time of the "protective door" and "protective door with lock" monitoring functions must be greater than the configured input delay because otherwise a discrepancy time violation may occur with bouncing contacts, e.g. when the protective door is closed.

Note

The combination of "Discrepancy time monitoring on" and "Discrepancy time ∞" means that no discrepancy time violation exists and, as such, no fault is triggered. The system cannot be switched on, however, until after the discrepancy condition violation has been rectified.

Cross-circuit detection

A cross-circuit, which is a short-circuit between channels, can only occur with multi-channel device controllers. Cross-circuit detection is only possible when the sensor is operated on T1 / T2 of the relevant expansion module or central unit, see also "Guidelines for wiring the MSS 3RK3 (Page 124)."

Since a cross-circuit is an error requiring acknowledgment, a cross-circuit that has been rectified must be acknowledged by means of a reset.

Note

AS-i slaves

If AS-i slaves are used, cross-circuit detection is not possible.

The following table provides an overview of cross-circuit detection for the monitoring functions:

Monitoring function	Cross-circuit detection	Note
Monitoring Universal	can be set to on/off	-
EMERGENCY STOP	can be set to on/off	-
ESPE (electro-sensitive protective equipment)	can be set to on/off	If the ESPE is equipped with solid-state outputs, cross-circuit detection must be deactivated.
Safety shutdown mat (NC principle)	can be set to on/off	-
Safety shutdown mat (cross-circuit principle)	On	Cross-circuit detection must not be activated for any other sensor on the expansion module used. A cross-circuit is not an error for this monitoring function and does not need to be acknowledged.
Protective door	can be set to on/off	-
Protective door with lock	can be set to on/off	-
Enabling button	On	-
Two-hand operation	can be set to on/off	A two-hand control of type III C (Cat. 4) can only be implemented if cross-circuit detection is activated.
Mode selector switch	off	-
AS-i 2F-DI	off	-

Parameter - input type

The "2xsingle-channel (NCNC)" and "2x2xsingle-channel (NONONONO)" types of the "Input" parameter are only available for AS-i terminals.

Note

Parameter "Type" 2xsingle-channel

With this input circuit type, the discrepancy monitoring, sequence monitoring, and cross-circuit detection are deactivated.

Fault signaling output (FAULT)

The fault signaling output (FAULT) is activated for all monitoring and output functions and does not need to be wired. The fault signaling output indicates wiring and logic errors.

6.7.2 Cell functions

6.7.2.1 Input cell

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Cell functions	Input cell		✓	✓

Description

The input cell provides signal states for further processing in the safety logic. The signal states can be read in, for example, from the terminals of the input modules or also through a bus system.

The signal of an input cell can be used multiple times in the safety logic.

Parameters

Parameter name		Description/parameter value
General	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameters	Terminal - Input	Select the input to be processed by the function element.
	Input delay [ms]	Select here when the function elements further process the signals: • Input delay = "0" The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0" This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Ch. "*Response times*."

6.7.2.2 Output cell

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Cell functions	Output cell	-□	✓	✓

Description

The output cell forwards the signal states from the safety logic to an output. The signal states can be output, for example, at the terminal of an output module or also through a bus system.

Note

Setting/resetting of a safety-related AS-i output

For interconnection of multiple outputs of a safety-related AS-i output or auxiliary signals (AUX), you can use the output function "AS-i 1..4F-DO."

Parameters

Parameter name		Description/parameter value
General	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameter	Terminal - Output	Select the output to be processed by the function element.

6.7.3 Monitoring functions

6.7.3.1 Monitoring Universal

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	Monitoring Universal		-	✓

Note

The function element is available in MSS ES only when using an MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended. If an MSS 3RK3 Basic is configured in the configuration, the function element will be hidden in the catalog window.

Description

With the "Monitoring Universal" function element, you evaluate signals of any sensors using contacts with a positive opening operation, normally-open contacts, or a normally-closed/normally-open combination.

When the sensor is actuated, function output Q is deactivated, i.e., set to "0."

> ⚠ **WARNING**
>
> **Erroneous start on transmission error at fieldbus inputs**
>
> **Will Cause Death, Serious Injury or Property Damage**
>
> Transmission errors at the fieldbus inputs can result in an erroneous start in which the system starts accidentally. To prevent this, the start type must be parameterized as "monitored." This is necessary to achieve SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

Parameters

Parameter name		Description parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number. This number ensures a unique reference to the function element during diagnostics.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameters	Discrepancy monitoring	This parameter is only available with Parameter - Input > Type "two-channel." You can choose whether this function will be deactivated or whether the discrepancy time between the inputs will be monitored.
	Discrepancy time infinite	You can set the discrepancy time to infinite.
	Discrepancy time [ms]	You can set the discrepancy time between 0 and 60000 ms. Note that the discrepancy time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*."
	Sequence monitoring	You can deactivate the sequence monitoring of the inputs or define whether they will be monitored in ascending (IN1 > IN2) or descending (IN2 > IN1) order.

Parameter name		Description parameter value
Parameter - Input	Type	Use these parameters to determine the input type of the function element: • single-channel (NC) IN1 is monitored for "1," i.e., function output Q is deactivated when there is a "0" signal. • single-channel (NO) IN1 is monitored for "0," i.e., function output Q is deactivated when there is a "1" signal. • two-channel (NCNC) IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. • two-channel (NONO) IN1 and IN2 are monitored for "0," i.e., function output Q is deactivated when there is at least one "1" signal. • two-channel (NCNO) IN1 (NC) is monitored for "1" and IN2 (NO) is monitored for "0" (antivalent), i.e., function output Q is deactivated when there is a signal change at IN1 or IN2. • 2xsingle-channel (NCNC) IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. There are no further dependencies between the two signals.
	IN1	Select the input to be processed by the function element.
	IN2	This parameter is only available if the following selection is made under parameter - Input > Type: • two-channel • 2xsingle-channel IN2 is automatically assigned depending on the selected input IN1.
	Input delay [ms]	Select here when the function elements further process the signals: • Input delay = "0" The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0" This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*."
	Cross-circuit detection	When this parameter is activated, cross-circuits are detected with the aid of test outputs at the inputs. If AS-i slaves are used, cross-circuit detection is not possible.

Parameter name		Description parameter value
Parameter - Start	Startup test	• Activated: After the switch from substitute value to real value or after the switch to safety or test mode, a start test must be conducted. For this purpose, the sensor to be monitored must be actuated once. Only then can function output Q be activated depending on the type of start. • Deactivated: A start test is not required.
	Start type	• Automatic: The function output is set as soon as all start conditions are fulfilled. • Monitored: Function output Q is set as soon as all start conditions are fulfilled and the start signal has changed from "0 → 1 → 0." • Manual: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1."

6.7.3.2 EMERGENCY STOP

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	EMERGENCY STOP		✓	✓

Description

With the "EMERGENCY STOP" function element, signals from the EMERGENCY STOP control devices with forcibly guided contacts are evaluated.

After the EMERGENCY STOP control device has been operated, function output Q is deactivated, i.e., set to "0."

> **WARNING**
>
> **Erroneous start on transmission error at fieldbus inputs**
>
> **Will Cause Death, Serious Injury or Property Damage**
>
> Transmission errors at the fieldbus inputs can result in an erroneous start in which the system starts accidentally. To prevent this, the start type must be parameterized as "monitored." This is necessary to achieve SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameter - Input	Type	This parameter defines the input type of the function element. • single-channel (NC): IN1 is monitored for "1," i.e., function output Q is deactivated when there is a "0" signal. • two-channel (NCNC): IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. • 2xsingle-channel (NCNC) IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. There are no further dependencies between the two signals.
	IN1	Select the input to be processed by the function element.
	IN2	Only available with the parameter - Input > Type two-channel (NCNC) or 2xsingle-channel (NCNC). IN2 is automatically assigned depending on the selected input IN1.
	Input delay [ms]	Select here when the function elements further process the signals: • Input delay = "0": The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0": This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*."
	Cross-circuit detection	When this parameter is activated, cross-circuits are detected with the aid of test outputs at the inputs. If AS-i slaves are used, cross-circuit detection is not possible.

Parameter name		Description/parameter value
Parameter - Start	Startup test	• Activated: After the switch from substitute value to real value or after the switch to safety or test mode, a start test must be conducted. For this purpose, the sensor to be monitored must be actuated once. Only then can function output Q be activated depending on the type of start. • Deactivated: A start test is not required.
	Start type	• Automatic: The function output is set as soon as all start conditions are fulfilled. • Monitored: The function output is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1 → 0." • Manual: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1."

6.7.3.3 ESPE (electro-sensitive protective equipment)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	ESPE		✓	✓

Description

With the function element "ESPE" (electro-sensitive protective equipment) signals from, for example, light curtains and laser scanners are evaluated.

When something enters the protective field of the ESPE, the function output Q is deactivated, i.e., set to "0".

> **WARNING**
>
> **Erroneous start on transmission error at fieldbus inputs**
>
> **Will Cause Death, Serious Injury or Property Damage**
>
> Transmission errors at the fieldbus inputs can result in an erroneous start in which the system starts accidentally. To prevent this, the start type must be parameterized as "monitored." This is necessary to achieve SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameter - Input	Type	Use these parameters to determine the input type of the function element. • single-channel (NC): IN1 is monitored for "1," i.e., function output Q is deactivated when there is a "0" signal. • two-channel (NCNC): IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. • 2xsingle-channel (NCNC) IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. On restart, the other channel must not have passed through zero.
	IN1	Select the input to be processed by the function element.
	IN2	This parameter is available with parameter - Input > Type two-channel (NCNC) and with 2xsingle-channel (NCNC). IN2 is automatically assigned depending on the selected input IN1.
	Input delay [ms]	Select here when the function elements further process the signals: • Input delay = "0": The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0": This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*."

Parameter name		Description/parameter value
	Cross-circuit detection	When this parameter is activated, cross-circuits are detected with the aid of test outputs at the inputs. If you use ESPE with electronic outputs you must deactivate cross-circuit detection. If AS-i slaves are used, cross-circuit detection is not possible.
Parameter - Start	Startup test	• Activated: After the switch from substitute value to real value or after the switch to safety or test mode, a start test must be conducted. For this purpose, the sensor to be monitored must be actuated once. Only then can function output Q be activated depending on the type of start. • Deactivated: A start test is not required.
	Start type	• Automatic: The function output is set as soon as all start conditions are fulfilled. • Monitored: The function output is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1 → 0." • Manual: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1."

6.7.3.4 Safety shutdown mat (NC principle)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	Safety shutdown mat (NC principle)		✓	✓

Description

With the "Safety shutdown mat (NC principle)" function element, the signals from the safety shutdown mats with NC contacts are evaluated.

When the safety shutdown mat is actuated, function output Q is deactivated, i.e., set to "0."

> **WARNING**
>
> **Erroneous start on transmission error at fieldbus inputs**
>
> **Will Cause Death, Serious Injury or Property Damage**
>
> Transmission errors at the fieldbus inputs can result in an erroneous start in which the system starts accidentally. To prevent this, the start type must be parameterized as "monitored." This is necessary to achieve SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameter - Input	Type	Use these parameters to determine the input type of the function element: • single-channel (NC): IN1 is monitored for "1," i.e., function output Q is deactivated when there is a "0" signal. • two-channel (NCNC): IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. • 2xsingle-channel (NCNC) IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. There are no further dependencies between the two signals.
	IN1	Select the input to be processed by the function element.
	IN2	This parameter is available with parameter - Input > Type two-channel (NCNC) and with 2xsingle-channel (NCNC). IN2 is automatically assigned depending on the selected input IN1.
	Input delay [ms]	Select here when the function elements further process the signals: • Input delay = "0": The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0": This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*."

<table>
<tr><th colspan="2">Parameter name</th><th>Description/parameter value</th></tr>
<tr><td></td><td>Cross-circuit detection</td><td>When this parameter is activated, cross-circuits are detected with the aid of test outputs at the inputs.
If AS-i slaves are used, cross-circuit detection is not possible.</td></tr>
<tr><td rowspan="2">Parameter - Start</td><td>Startup test</td><td>• Activated:
After the switch from substitute value to real value or after the switch to safety or test mode, a start test must be conducted.
For this purpose, the sensor to be monitored must be actuated once. Only then can function output Q be activated depending on the type of start.
• Deactivated:
A start test is not required.</td></tr>
<tr><td>Start type</td><td>• Automatic:
The function output is set as soon as all start conditions are fulfilled.
• Monitored:
The function output is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1 → 0."
• Manual:
Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1."</td></tr>
</table>

6.7.3.5 Safety shutdown mat (cross-circuit principle)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	Safety shutdown mat (cross-circuit principle)		✓	✓

Description

With the "Safety shutdown mat (cross-circuit principle)" function element, the signals from the safety shutdown mats with cross-circuit detection are evaluated.

When the safety shutdown mat is actuated, function output Q is deactivated, i.e., set to "0."

> **WARNING**
>
> **Erroneous start on transmission error at fieldbus inputs**
>
> **Will Cause Death, Serious Injury or Property Damage**
>
> Transmission errors at the fieldbus inputs can result in an erroneous start in which the system starts accidentally. To prevent this, the start type must be parameterized as "monitored." This is necessary to achieve SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

Note

If the safety shutdown mat with cross-circuit principle is used, cross-circuit detection must be deactivated in the monitoring functions for the remaining inputs of the module used because otherwise the monitoring functions configured with the remaining inputs also signal a cross-circuit when the safety shutdown mat is stepped on.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameter - Input	Type	The input type of the function element is defined: • two-channel (NCNC): IN1 and IN2 are monitored for "1," i.e., shutdown on operation of the safety shutdown mat.
	IN1	Select the input to be processed by the function element.
	IN2	IN2 is automatically assigned depending on the selected input IN1.
	Input delay [ms]	Select here when the function elements further process the signals: • Input delay = "0": The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0": This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*."

Parameter name		Description/parameter value
Parameter - Start	Startup test	• Activated: After the switch from substitute value to real value or after the switch to safety or test mode, a start test must be conducted. For this purpose, the sensor to be monitored must be actuated once. Only then can function output Q be activated depending on the type of start. • Deactivated: A start test is not required.
	Start type	• Automatic: The function output is set as soon as all start conditions are fulfilled. • Monitored: The function output is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1 → 0." • Manual: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1."

6.7.3.6 Protective door

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	Protective door		✓	✓

Description

With the "Protective door" function element, the signals from the protective doors or safety flaps are evaluated by means of positive opening contacts or an NC/NO combination.

When the protective door is actuated, function output Q is deactivated, i.e., set to "0."

WARNING

Erroneous start on transmission error at fieldbus inputs

Will Cause Death, Serious Injury or Property Damage

Transmission errors at the fieldbus inputs can result in an erroneous start in which the system starts accidentally. To prevent this, the start type must be parameterized as "monitored." This is necessary to achieve SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

Parameters

Parameter name		Description parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameters	Discrepancy monitoring	This parameter is only available with Parameter - Input > Type "two-channel." You can choose whether this function will be deactivated or whether the discrepancy time between the inputs will be monitored.
	Discrepancy time infinite	You can set the discrepancy time to infinite.
	Discrepancy time [ms]	You can set the discrepancy time between 0 and 60000 ms. Note that the discrepancy time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*."
	Sequence monitoring	You can deactivate the sequence monitoring of the inputs or define whether they will be monitored in ascending (IN1 > IN2) or descending (IN2 > IN1) order.
Parameter - Input	Type	Use these parameters to determine the input type of the function element: • single-channel (NC) IN1 is monitored for "1," i.e., function output Q is deactivated when there is a "0" signal. • two-channel (NCNC) IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. • two-channel (NCNO) IN1 (NC) is monitored for "1" and IN2 (NO) is monitored for "0" (antivalent), i.e., function output Q is deactivated when there is a signal change at IN1 or IN2. • 2xsingle-channel (NCNC) IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. There are no further dependencies between the two signals.
	IN1	Select the input to be processed by the function element.

Parameter name		Description parameter value
	IN2	This parameter is only available if the following selection is made under parameter - Input > Type: • two-channel • 2xsingle-channel IN2 is automatically assigned depending on the selected input IN1.
	Input delay [ms]	Select here when the function elements further process the signals: • Input delay = "0" The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0" This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*."
	Cross-circuit detection	When this parameter is activated, cross-circuits are detected with the aid of test outputs at the inputs. If AS-i slaves are used, cross-circuit detection is not possible.
Parameter - Start	Startup test	• Activated: After the switch from substitute value to real value or after the switch to safety or test mode, a start test must be conducted. For this purpose, the sensor to be monitored must be actuated once. Only then can function output Q be activated depending on the type of start. • Deactivated: A start test is not required.
	Start type	• Automatic: The function output is set as soon as all start conditions are fulfilled. • Monitored: Function output Q is set as soon as all start conditions are fulfilled and the start signal has changed from "0 → 1 → 0." • Manual: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1."

NOTICE
The configured discrepancy time of the "protective door" monitoring function must be greater than the configured input delay because otherwise a discrepancy time violation may occur with bouncing contacts, e.g., when the protective door is closed.

6.7.3.7 Protective door with lock

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	Protective door with lock		-	✓

Note

The function element is available in MSS ES only when using an MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended. If an MSS 3RK3 Basic is configured in the configuration, the function element will be hidden in the catalog window.

Description

With the "Protective door with lock" function element, you evaluate signals from protective doors. You can control the door lock and monitor its status.

For this purpose, the element has the following inputs:

- two function inputs IN1 and IN2 for position detection of the protective door.
- a "FEEDBACK_LOCK" function input for acquiring the locking status of the lock.
- an "IN_LOCK" function input for controlling the lock.

The element provides the following signals as the result:

- The switch-off signal for the system is output through function output "Q."
- The control signal for the lock is output through function output "LOCK."
- Error messages are output through function output "FAULT."

Functional principle

Function output Q of this element is only set to the value "1" if the protective door is closed and locked.

When an unlocking command (= value "1") is applied to function input "IN_LOCK," function output Q is immediately set to "0" and the lock is unlocked after a settable unlocking time through function output LOCK.

If the unlocking command is applied to function input "IN_LOCK" before the unlocking time has elapsed, the lock will remain closed and the system can restart.

To lock a disengaged lock again, it is not necessary for the protective door to have been opened in the meantime. It can remain closed and be relocked immediately.

Start override

The start override enables function output Q to be set to the value "1" although an unlocking command is pending. This function can be used if the locking or unlocking command comes from a standstill monitor. (The standstill monitor only transmits the locking command when standstill is no longer detected.)

You can define the length of the start time in the "Start time" parameter.

This setting has the following properties:

- When the START command is applied to function input START, the lock of the element is automatically engaged if the unlocking command is pending at function input IN_LOCK and the protective door is closed. Function output Q is set to "1." Concurrently with this, the start time is started and the "Start override active" message is set.

  If the protective door is open, locking is only performed if this is permitted in the "Lock with open protective door" parameter.
- You can adapt the length of the start time to the application using the "Start time" parameter. At the latest after the start time has elapsed, the "Start override active" message will be reset. The locking command must then be pending at function input IN_LOCK. If no locking command is pending, function output Q will be set to value "0" again and the lock will be disengaged after the unlocking time has elapsed. If the locking command is detected before the start time has elapsed, the start time will be interrupted. The lock remains locked and the function output retains the value "1."
- If another start command is detected at function input START while the start time is running, the start time is "retriggered," i.e., started from the beginning without the signal state of function inputs Q and LOCK being changed.
- This function is deactivated if the "start time" parameter is parameterized to value "0." A value not equal to "0" activates the function.

Interlock types

The "protective door with lock" function element can be used for spring-locked or solenoid-locked position switches.

- Spring-locked according to closed-circuit current principle

  The lock is locked passively and unlocked actively, i.e., spring tension keeps the lock engaged. On a power failure, the lock remains engaged.
- Solenoid-locked according to open-circuit current principle

  The lock has to be locked actively, i.e., magnetic force (solenoid energized) keeps the lock engaged. On a power failure, the lock is automatically unlocked and thus allows the service personnel to enter the system while it is de-energized.

WARNING

Protective door unlocking on power failure

Can Cause Death, Serious Injury, or Property Damage.

Note that this variant of the locking on power failure takes no account of possible run-down times of the system. If this can result in a hazard for persons, locking must not be implemented in this way.

WARNING

Erroneous start on transmission error at fieldbus inputs

Will Cause Death, Serious Injury or Property Damage

Transmission errors at the fieldbus inputs can result in an erroneous start in which the system starts accidentally. To prevent this, the start type must be parameterized as "monitored." This is necessary to achieve SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

NOTICE

The configured discrepancy time of the "protective door with lock" monitoring function must be greater than the configured input delay because otherwise a discrepancy time violation may occur with bouncing contacts, e.g., when the protective door is closed.

Note

On a signal change at the FEEDBACK_LOCK function input, an error is generated immediately, if the signal at function output LOCK has not changed.

Parameters

Parameter name		Description parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. If this parameter is deactivated, the set substitute value is made available at outputs Q and LOCK.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
	Substitute value LOCK	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output LOCK = 0 substitute value "1" means output LOCK = 1
Parameters	Discrepancy monitoring	This parameter is only available with Parameter - Input > Type "two-channel." You can choose whether this function will be deactivated or whether the discrepancy time between the inputs will be monitored.
	Discrepancy time infinite	You can set the discrepancy time to infinite.
	Discrepancy time [ms]	You can set the discrepancy time between 0 and 60000 ms. Note that the discrepancy time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*."
	Sequence monitoring	You can deactivate the sequence monitoring of the inputs or define whether they will monitored in ascending (IN1 > IN2) or descending (IN2 > IN1) order.

<table>
<tr><th colspan="2">Parameter name</th><th>Description parameter value</th></tr>
<tr><td rowspan="5">Parameter - Input</td><td>Type</td><td>Use these parameters to determine the input type of the function element:
single-channel (NC)
IN1 is monitored for "1," i.e., function output Q is deactivated when there is a "0" signal.
two-channel (NCNC)
IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal.
two-channel (NCNO)
IN1 (NC) is monitored for "1" and IN2 (NO) is monitored for "0" (antivalent), i.e., function output Q is deactivated when there is a signal change at IN1 or IN2.
2xsingle-channel (NCNC)
IN1 and IN2 are monitored for "1," i.e., function output Q is deactivated when there is at least one "0" signal. There are no further dependencies between the two signals.</td></tr>
<tr><td>IN1</td><td>Select the input to be processed by the function element.</td></tr>
<tr><td>IN2</td><td>This parameter is only available if the following selection is made under parameter - Input > Type:
two-channel
2xsingle-channel
IN2 is automatically assigned depending on the selected input IN1.</td></tr>
<tr><td>Input delay [ms]</td><td>Select here when the function elements further process the signals:
Input delay = "0"
The input signals are further processed by the function element without time delay when there is a signal change.
Input delay not "0"
This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed.
Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit.
For additional information on the program cycle time, see the "3RK3 Modular Safety System" manual, Chapter "Response times."</td></tr>
<tr><td>Cross-circuit detection</td><td>When this parameter is activated, cross-circuits are detected with the aid of test outputs at the inputs.
If AS-i slaves are used, cross-circuit detection is not possible.</td></tr>
</table>

Parameter name		Description parameter value
	Lock with the open protective door	The lock can only be engaged while the protective door is closed or open, depending on the "lock with open protective door" parameter. You can set the following parameters: • not lockable The lock cannot be engaged while the protective door is open. • lockable The lock can be locked or unlocked irrespective of the position of the protective door. **Note:** When position switches whose door and lock contacts act on the same slave are used, "lockable" must always be chosen in order to enable proper operation.
	Interlock type	Define the type of lock here: • Spring locking • Solenoid locking
	Unlocking time [s]	Here, you can define the unlocking time from 0 to 655 seconds. This parameter permits time-delayed unlocking of the protective door after the system has been shut down.
Parameters - Feedback circuit	Feedback circuit monitoring	The feedback circuit permits monitoring of the lock connected to the LOCK function output for correct locking. You can set the following parameters: • Deactivated • Enabled While the feedback circuit monitoring is activated, the following values are expected at the feedback input FEEDBACK_LOCK: • Protective door unlocked: expected feedback circuit signal = "1" • Protective door locked: expected feedback circuit signal = "0"
	Feedback circuit switching time [s]	Parameter only available if parameter - Feedback circuit - Monitoring is active. If the feedback circuit signal FEEDBACK_LOCK does not match the output signal LOCK no later than after the switching time has elapsed, function output "Q" will be switched off. Note that the entered feedback circuit switching time is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*."

Parameter name		Description parameter value
Parameter - Start	Startup test	You can set the following parameters: • Activated: After the switch from substitute value to real value or after the switch to safety or test mode, a start test must be conducted. For this purpose, the sensor to be monitored must be actuated once. Only then can function output Q be activated depending on the type of start. • Deactivated: A start test is not required.
	Startup time [s]	Here you can define a time between 0 and 60000 ms, during which the "IN_LOCK" locking command is to be overridden.
	Start type	• Automatic: The function output is set as soon as all start conditions are fulfilled. • Monitored: Function output Q is set as soon as all start conditions are fulfilled and the start signal has changed from "0 → 1 → 0." • Manual: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1."

6.7.3.8 Enabling button

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	Enabling button		✓	✓

Description

With the "Enabling button" function element, the signals from the enabling buttons are evaluated by means of an NO contact.

An enabling button is always monitored for cross-circuit. This is achieved using test cycle outputs.

When the enabling button is actuated, function output Q is activated, i.e. set to "1."

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

Parameter name		Description/parameter value
Parameter - Input	Type	Use these parameters to determine the input type of the function element: • single-channel (NO) IN1 is monitored for "1," i.e. function output Q is activated when there is a "1" signal. • two-channel (NONO) IN1 and IN2 are monitored for "1," i.e. function output Q is activated when there are two "1" signals. • 2xsingle-channel (NONO) IN1 and IN2 are monitored for "1," i.e. function output Q is activated when there are two "1" signals. There are no further dependencies between the two signals.
	IN1	Select the input to be processed by the function element.
	IN2	Only available with the parameter - Input > Type two-channel type (NONO) or 2xsingle-channel (NONO). IN2 is automatically assigned depending on the selected input IN1.
	Input delay [ms]	Select here when the function elements further process the signals: • Input delay = "0" The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0" This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Ch. "*Response times*."

6.7.3.9 Two-hand operation

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	Two-hand operation		✓	✓

Description

With the "Two-hand operation" function element, the signals from the two-hand control unit are evaluated.

When both buttons of the two-hand operator panel are operated, the function output Q is activated within 500 ms (synchronous operation time), i.e. set to "1".

The following table shows the type as defined by EN 574 that is achieved for the various requirements.

Input type	Input	Cross-circuit	Achievable type according to EN 574
NONO	Fail-safe input terminal on MSS	X	III a
NONO	Fail-safe AS-i input slave	-	III a
NONCNONC	Fail-safe input terminal on MSS	X	III c
NONCNONC	Fail-safe input terminal on MSS	-	III c
NONONONO	Fail-safe input terminal on MSS	X	III c
NONONONO	Fail-safe input terminal on MSS	-	III a
NONONONO	Fail-safe AS-i input slave	-	III c

X: enabled

Parameters

<table>
<tr><th colspan="2">Parameter name</th><th>Description/parameter value</th></tr>
<tr><td rowspan="5">General</td><td>Name</td><td>You can enter a name for the element here.</td></tr>
<tr><td>Comment</td><td>This text appears above the function element in the diagram. This may, for example, be information about this function element.</td></tr>
<tr><td>Element number</td><td>Consecutive number that is automatically assigned. You can change the number.</td></tr>
<tr><td>Element activated</td><td>When this parameter is active, the function element is processed in the safety logic.
When this parameter is deactivated, the set substitute value is made available at output Q.</td></tr>
<tr><td>Function output substitute value</td><td>"0" or "1" can be assigned to the substitute value when the element is deactivated.
Substitute value "0" means output Q = 0
substitute value "1" means output Q = 1</td></tr>
<tr><td rowspan="5">Parameter - Input</td><td>Type</td><td>Use these parameters to determine the input type of the function element:
two-channel (NONO)
IN1 and IN2 are monitored for "1," i.e. function output Q is activated when there are two "1" signals.
four-channel (NONONONO)
IN1 / IN2 and IN3 / IN4 are monitored for "1," i.e. function output Q is activated when there are four "1" signals.
four-channel (NONCNONC)
IN1 / IN3 (NC) are monitored for "1", and IN2 / IN4 (NO) are monitored for "0" (antivalent), i.e. function output Q is activated when there is a signal change at IN1 / IN2 and IN3 / IN4.
2x2xsingle-channel (NONONONO)
IN1 / IN2 and IN3 / IN4 are monitored for "1," i.e. function output Q is activated when all four signals are "1." There are no further dependencies between the two signals.</td></tr>
<tr><td>IN1</td><td>Select the input to be processed by the function element.</td></tr>
<tr><td>IN2</td><td>IN2 is automatically assigned depending on the selected input IN1.</td></tr>
<tr><td>IN3</td><td>This parameter is only available if the following selection is made under parameter - Input > Type:
four-channel
2x2xsingle-channel
Select the input to be processed by the function element.</td></tr>
<tr><td>IN4</td><td>This parameter is only available if the following selection is made under parameter - Input > Type:
four-channel
2x2xsingle-channel
IN4 is automatically assigned depending on the selected input IN3.</td></tr>
</table>

Parameter name		Description/parameter value
	Cross-circuit detection	When this parameter is activated, cross-circuits are detected with the aid of test outputs at the inputs. If AS-i slaves are used, cross-circuit detection is not possible.
	Input delay [ms]	Select here when the function elements further process the signals: • Input delay = "0" The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0" This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. A two-hand control of type III C (Cat. 4) can only be implemented if cross-circuit detection is activated. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Ch. "*Response times*."

6.7.3.10 Mode selector switch

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	Mode selector switch		✓	✓

Description

With the "Mode selector switch" function element, the signals from the mode selector switch are evaluated by means of NO contacts. Up to 5 operating modes can be defined. In the downstream logic, you can parameterize the operating mode to be implemented as required.

The outputs Q1 to Q5 are assigned to the inputs IN1 to IN5. When the input IN1 is activated, the function output Q1 is activated, i.e. set to "1." Further input and output pairs respond analogously.

If a start function is required for releasing an operating mode, this can be implemented with the "Start functions".

The contact switchover time is 1000 ms, that is, a switch must be made between the operating modes within this time.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	The substitute value "1" can only be assigned to one output at a time. "0" is automatically assigned to all others.
Parameter	Type of switch	Select the required step switch: 1 out of 2, 1 out of 3, 1 out of 4, 1 out of 5
Parameter - Input	Type	The input type of the function element is defined: • single-channel (NO) INx is monitored for "1," i.e. the function output Qx is deactivated when there is a "0" signal.
	IN1	Select the input to be processed by the function element.
	IN2	Select the input to be processed by the function element.
	IN3	This parameter is available for switch type 1 out of 3; 1 out of 4, or 1 out of 5. Select the input that is to be processed by the function element.

Parameter name		Description/parameter value
	IN4	This parameter is available for switch type 1 of 4 or 1 of 5. Select the input to be processed by the function element.
	IN5	This parameter is available for switch type 1 of 5. Select the input to be processed by the function element.
	Input delay [ms]	Select here when the function elements further process the signals: • Input delay = "0" The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0" This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Ch. "*Response times*."

6.7.3.11 AS-i 2F-DI

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Monitoring functions	AS-i 2F-DI		-	✓

Note

The function element is available in MSS ES only when using an MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended. If an MSS 3RK3 Basic is configured in the configuration, the function element will be hidden in the catalog window.

Description

The monitoring function "AS-i 2F-DI" is used instead of an input cell if you want to diagnose both of the input terminal signals of the ASIsafe input slave.

The ANDed signal from both input terminal signals is provided at function output Q, which can be further connected in the user program.

RLO = 1 when all logic inputs have the state "1."

Background

The ASIsafe transmission protocol specifies that both the safety-related inputs of an AS-i slave must have the state "1" for the transmitted signal to be considered safe. If only one of the two states is "0," the system must enter the safe state.

Parameters

Parameter name		Description/parameter value
General	Name	Enter a name for the element.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the substitute value is used.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated.
Parameter - Input	IN1	IN1 and IN2 are monitored for "1," i.e. function output Q is deactivated when there is at least one "0" signal.
	IN2	IN2 is automatically assigned depending on the selected input IN1.
	Input delay [ms]	Select here when the function element will further process the signals: • Input delay = "0": The input signals are further processed by the function element without time delay when there is a signal change. • Input delay not "0": This parameter can be used to suppress signal interference. The signal state that was pending for most of the duration of the input delay is further processed. Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Ch. "*Response times*."

6.7.4 Muting functions

6.7.4.1 Muting safety circuit

Application

If materials have to be conveyed into or out of a hazardous zone for further processing, the openings of the access paths can be large enough to enable a person to reach into or enter the hazardous zone. The requirement is to protect persons who may attempt to enter the hazardous zone from harm while allowing the materials to pass automatically unhindered. This is achieved with a special safety circuit that monitors the opening to the hazardous zone with electro-sensitive protective equipment (ESPE) and deactivates or "overrides" the protective equipment briefly when the material is conveyed. This safety circuit is known as "muting" and is described in the standard EN 61496-1-A.7.

Properties

The function element has the following inputs:

- Function input "FREE" for acquiring the signal of the protection equipment (e.g. ESPE)
- 2 or 4 function inputs "MS1" ... "MS4" for acquiring the signals of the muting sensors
- a "STOP" function input for acquiring the system status
- a function input "RESTART" for clearing the muting section

The function element provides the following signals as the result:

- The switch-on/off signal for the system is output through function output "Q."
- The "Muting active" or "Muting restart possible" status (0.5-Hz flashing) is output through function output "MUT."
- Error messages are output through function output "FAULT"

Note

The sensors for starting and ending muting operation must be mutually independent and permanently wired.

Description

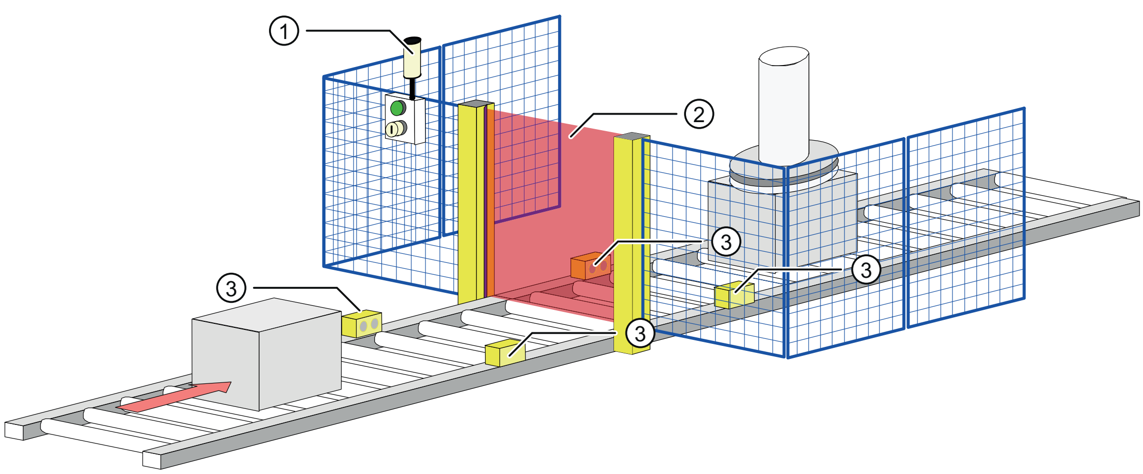
The "Muting" function element permits temporary suppression (muting) of a protective field safety function for a specific purpose, e.g. for conveying materials through the protective field.

This muting mode has the following properties:

- Muting cannot be disabled from the application.
- Muting is time-monitored and is possible for no longer than the parameterized "max. muting time."
- The signal of the protective field safety function is read in by the function element at function input FREE.
- If the value "1" is applied to function input FREE (protective field free), function output Q is set to the value "1" (system running), provided that the "Muting" function element has not detected an error.
- If muting operation has been started, the value at function input FREE will be suppressed, i.e. the value "1" is still output at function output Q despite the protective field violation. The safety function is suppressed and the system continues to run.
- After muting has ended, the value at function input FREE is evaluated again. The overridden safety function is activated again.

Muting operation

The following figure shows a typical muting arrangement



① Muting display lamp
② Light array
③ Muting sensors

Figure 6-13 Typical muting equipment

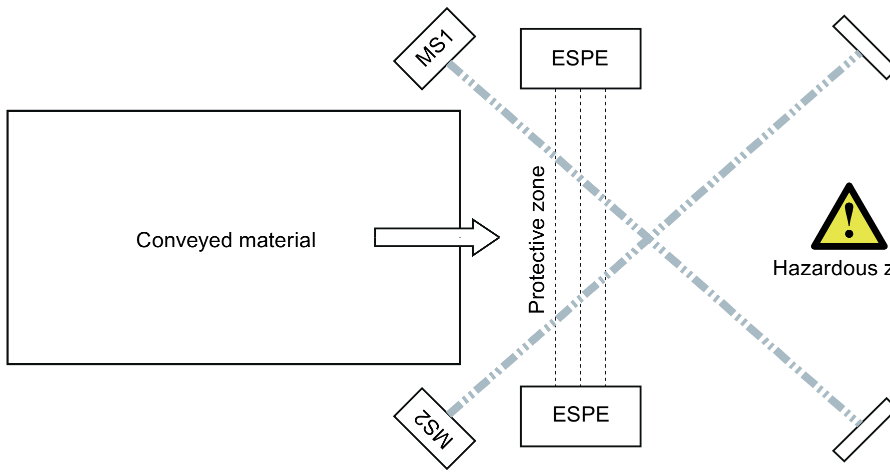
Muting can be divided into five "muting phases":

- Phase 1 (= muting off)
  - The muting section is free
  - The material is in front of the opening or still in front of the muting sensors.
  - The protective equipment is still active and the muting display lamp is off.
- Phase 2 (= start muting)
  - The material is moving into the muting section and the material triggers the muting sensors for starting muting.
  - The protective equipment is now overridden and the muting display lamp is on.
- Phase 3 (= in muting)
  - The material moves from the input to the output area of the muting section and the material triggers both the muting sensors for starting muting and the muting sensors for ending muting.
  - The protective equipment is overridden and the muting display lamp is on.
- Phase 4 (= stop muting)
  - The material moves out of the muting section.
  - The material has passed the muting sensor for starting muting. Now only the muting sensors for stopping muting are triggered.
  - The protective equipment is still overridden and the muting display lamp is still on.
- Phase 5 (= end muting)
  - The material exits the muting section.
  - The material has passed the muting sensors for ending muting.
  - The protective equipment is active again and the muting display lamp is off.

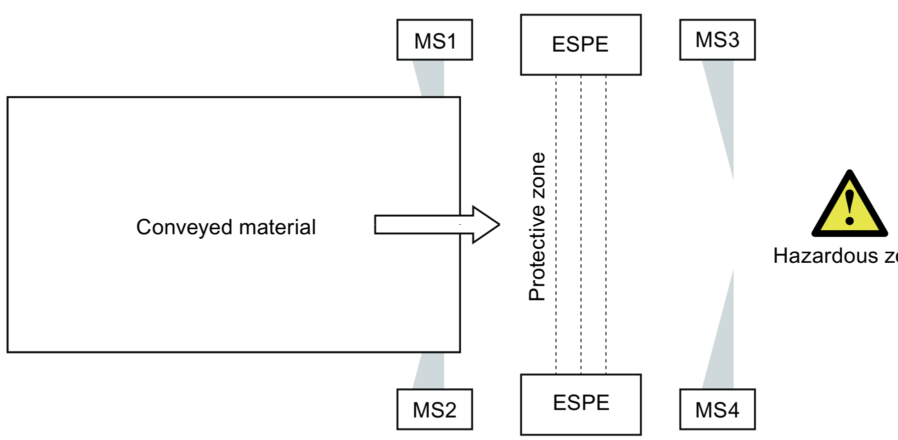
Muting modes

Two mode groups are used for the "muting" function element with up to four muting sensors (= two pairs of sensors) at function inputs MS1 to 4:

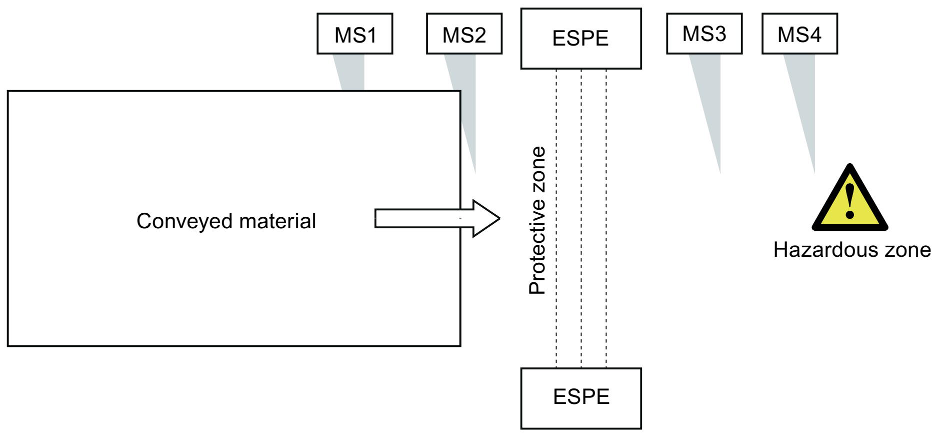
- Parallel muting
  - 2-sensor parallel muting is possible if the dimensions of the conveyed material are not constant or too little space is available. This muting type must be operated with two muting sensors whose beams cross behind the protective field in the hazardous zone. To prevent tampering, the point where the muting sensor light barriers cross must be far enough inside the hazardous zone. No direction monitoring is possible because it is not possible to detect from which side the conveyed material is coming.



  - 4-sensor parallel muting is used for very small conveyed materials. This type of muting is the functional equivalent to 2-sensor parallel muting but the activation and deactivation signal is obtained from two pairs of sensors each. Material conveying is possible in both directions.



- Sequential (= serial) muting
  - 4-sensor sequential muting is used, above all, if the material to be conveyed into the hazardous zone always has the same dimensions and there is no lack of space. Material conveying is possible in both directions.



6.7.4.2 Description of the "muting" function

The signals of the muting sensors are monitored for signal discrepancy and signal sequence, depending on the muting mode.

Discrepancy monitoring

Signal discrepancy

For the duration of the discrepancy time, different signal states are accepted at the two muting sensors forming a sensor pair without an error being signaled. On a signal discrepancy, only the signals of the muting sensor belonging to a muting sensor pair are monitored. In the case of muting sensor pair 1, these are the muting sensors MS1 and MS2; for muting sensor pair 2, muting sensor MS3 and MS4. For a definable max. time (= "Discrepancy time" parameter), the signal states of the associated muting sensors must be different. On violation of the signal discrepancy condition, muting is ended and a discrepancy error (= logic error) is signaled. This error is automatically acknowledged as soon as the corresponding muting sensors have the value "0," i.e. they are no longer being triggered. While a discrepancy error is pending, the muting section can be cleared using the RESTART function. This is indicated, e.g. by the flashing muting display lamp.

Discrepancy monitoring is not performed in "4-sensor sequential" muting mode.

Signal dropout

The discrepancy time also allows signal dropouts of muting sensors, e.g. due to "gaps in conveyed materials", to be overridden for a period of time. Signal dropouts that are shorter than the assigned discrepancy time do not terminate muting.

The signal dropout suppression action of the "Discrepancy time" parameter affects all muting sensors, even in "4-sensor sequential" muting mode.

Sequence monitoring

Signal sequence monitoring is only possible in muting modes with more than 2 muting sensors. In the case of 4-sensor sequential muting, the signals of all four muting sensors and, in the case of 4-sensor parallel muting, the signals of the muting sensor pairs are monitored for their sequence. On violation of the sequence condition, muting is ended and a sequence error (= logic error) is signaled. This error is automatically acknowledged as soon as all muting sensors have the value "0," i.e. they are no longer being triggered. While a sequence error is pending, the muting section can be cleared using the RESTART function. This is indicated, e.g. by the flashing muting display lamp.

Muting time limit

Correctly started muting is only possible for a defined maximum duration. Muting is ended no later than when the max. muting time has elapsed. Muting can only be restarted after a valid muting sensor sequence has been detected or, if the muting section is still occupied, after the RESTART command has been detected.

The muting time limit has no effect in the following cases:

- During clearance of the muting section with the RESTART command.
- If function input STOP is providing the information "System stopped."

Note

If it is possible that the conveyed material may remain in the muting section for a long time, for example, because the conveyor belt has been stopped, the answer is not to set the muting time limit to a very large value or to deactivate it. Instead, function input STOP should be linked with the "belt drive signal."

- If the time limit has been deactivated by parameter assignment.

WARNING

The muting time limit must only be shut down in justified cases, e.g. if the flow of materials is not normally interrupted in the muting section and if this does not pose a hazard to any person. If the muting time limit is deactivated, access to the hazardous locations must be prevented by suitable means.

System status "STOP"

If the system is operationally shut down while muting is active, this results in a (muting) error, e.g. because of a discrepancy error of the muting sensor signals or because the maximum muting time has elapsed. To avoid this (muting) error, the system status must be acquired and evaluated.

The "muting" element acquires the state of the system using function input STOP:

- STOP = 0: System running. All monitoring functions of the "muting" element are processed according to their parameter assignment.
- STOP = 1: System stopped. While muting operation is active, the time monitoring functions "muting time limit" and "discrepancy time monitoring of the muting sensors" are deactivated automatically. This prevents muting error messages due to elapsed times resulting from system shutdown.

  The signal sequence and signal discrepancy evaluation (but without discrepancy time monitoring) of the muting sensor signals remains active. The value of function output Q is not changed. When the system is started again, the timers of the time monitoring function are reset or restarted. The signal sequence and signal discrepancy monitoring of the muting sensors is continued normally.

If the STOP function input is not connected, the system status will not be evaluated, i.e. the time monitoring functions are not affected.

Muting - RESTART function

A valid muting sequence can be interrupted operationally, e.g. on a power failure, while materials are being conveyed through the muting section. On power recovery, muting is not automatically resumed because the expected muting sensor sequence is not provided by the muting sensors already triggered. It may also be necessary to clear the muting section, for example, if the load of a pallet is unfavorably distributed so that only one muting sensor was triggered. To be able to remove conveyed material from the muting section without danger, the "muting" element provides the RESTART function for clearing the muting section.

Function input FEEDBACK_MUT

See "Muting display lamp" section

Function output MUT

The "muting active" state is output through a dedicated function output MUT at which, for example, a muting display lamp or a logical output terminal (e.g. PROFIBUS) can be connected.

Muting display lamp

- The muting display lamp signals the following states:
  - Steady light: muting has been correctly started and the protective equipment for monitoring the protective field is overridden.
  - Flashing: clearance of the muting section is possible.
- Properties:
  - To be able to control a muting display lamp, the "muting" element sets function output MUT to the value "1" if muting is active. This function output can be connected to a hardware or logical output terminal (e.g. PROFIBUS).
  - It is optionally possible to monitor a muting display lamp connected to function output MUT using function input FEEDBACK_MUT. Depending on the available information about the status of the display lamp, e.g. directly from the display lamp itself or from a higher-level PLC, the evaluation logic of the signal can be selected at function input FEEDBACK_MUT using parameter "Monitoring - Muting display lamp." This parameter also enables deactivation of the monitoring function.
- Parameter "Monitoring - Muting display lamp"
  - Deactivated: The muting display lamp is not monitored.
  - statically for "1" = OK:

    With this parameter assignment, for example, the feedback signals of a "self-monitoring muting display lamp" can be monitored.

    FEEDBACK_MUT value "0": => Muting display lamp defective

    FEEDBACK_MUT value "1": => Muting display lamp OK
  - dynamically for MUT:

    Signal evaluation at the FEEDBACK_MUT function input is performed by comparison with the output signal of function output MUT. On a signal change at function output MUT, the inverted signal from function output MUT is expected no later than after the parameterized "switching time muting display lamp" has elapsed.

    When the 0.5-Hz flashing signal is output, the feedback signal is not monitored, i.e. the signal at function input FEEDBACK_MUT, can have any value. On deactivation of the flashing signal, however, the feedback signal corresponds to the inverted value of function output MUT no later than after the "switching time" has elapsed. Otherwise, an error will be generated.
- If a display lamp is defective, function output Q is set to the value "0" and the "muting display lamp defective" error message is set. This error message must be acknowledged with reset after the error has been corrected.

6.7.4.3 Clearing the muting section

Prerequisites

Clearance of the muting section can only be started if all the following conditions have been fulfilled:

- At least one muting sensor is being triggered.
- Function input RESTART is connected.

  If function input RESTART is not connected, the protective equipment cannot be cleared.
- The "muting restart possible" message is set.
- A 0.5-Hz flashing signal is output at function output MUT. The muting display lamp flashes.

Starting clearance

WARNING
The clearance operation must be observed. It must be possible to respond to a hazardous situation by releasing the RESTART button at any time. The button must be installed in a location from which the entire hazardous area can be seen.

To start clearance of the muting section, the following steps (1 to 3) must be completed within 4 s.

- Press the RESTART button connected to the function input for at least 0.15 s.
- Then release the RESTART button for at least 0.15 s.
- Press the RESTART button again and hold it down.
- The following messages will then appear:
  - The "muting restart possible" message is reset.
  - The "muting active" message is set.
  - Function output MUT outputs a 1 signal.

Duration of muting with the RESTART button

Muting remains active if one of the following conditions applies:

- As long as the button remains pressed with an invalid muting sensor signal combination.
- Until the muting sensors end muting while the button is pressed.
- If a valid muting sensor signal combination is detected when the button is released the second time, assuming there are no other errors such as a signal discrepancy.

6.7.4.4 Muting (2-sensor-parallel)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Muting functions	Muting (2-sensor-parallel)		-	✓

Note

The function element is available in MSS ES only when using an MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended. If an MSS 3RK3 Basic is configured in the configuration, the function element will be hidden in the catalog window.

Description

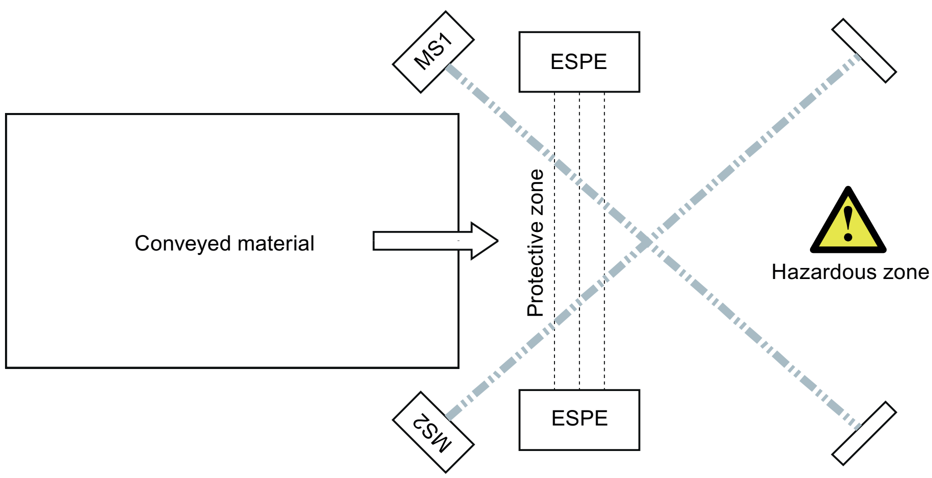


Figure 6-14 Muting 2-sensor parallel scheme

With the "Muting (2 sensor-parallel)" function element, you monitor an override circuit (= muting) with the following properties using signals from a pair of sensors:

- Muting can be performed at very short intervals without incurring a muting error.
- When a gap is detected between two conveyed items, muting is ended correctly and started again immediately when the next conveyed item is detected.
- If no gap is detected, muting is not ended. Only the maximum permissible muting time ends muting.
- The muting sensors are monitored for signal discrepancy.

WARNING

To prevent tampering, the beams of the two muting sensors must cross far enough behind protective field. If possible, the beams should point downward at different heights.

Note

On a signal change at the FEEDBACK_MUT function input, an error is generated immediately, if the signal at function output MUT has not changed.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	If this parameter is active, the function element is processed in the safety logic. If the parameter is deactivated, the set substitute values are made available at outputs Q and MUT.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
	Substitute value for function output MUT	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output MUT = 0 substitute value "1" means output MUT = 1
Parameters	Muting time infinite	You can set the muting time to infinite. See the safety instructions in the "*3RK3 Modular Safety System*" manual, Ch. "*Description of the "muting" function*."
	Max. muting time [s]	Enter the time after which operational muting will have ended at the latest. You can set the max. muting time between 1 and 10800 s [3 h] in steps of 1 ms. The muting time is started when muting is correctly started by the muting sensors.
	Discrepancy time [ms]	You can set the discrepancy time between 0 and 60000 ms. • For the duration of the discrepancy time, different signal states are accepted at the two muting sensors forming a sensor pair without an error being signaled. • During active muting, signal dropouts of muting sensors are accepted for the duration of the discrepancy time without ending muting. Note that the discrepancy time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Ch. "*Response times*." While a discrepancy error is pending, you can clear the muting section using the RESTART function. This is indicated (e.g. flashing muting display lamp).
	Monitoring of the muting display lamp	You can activate the monitoring function for the muting display lamp and choose the desired evaluation logic of the feedback signal at function input FEEDBACK_MUT: • Deactivated • statically for "1" = OK • dynamically for MUT
	switching time muting display lamp [s]	You can adapt the monitoring function for the display lamp to the switching time depending on the display lamp. You can set the switching time between 0.01 and 30 s.

6.7.4.5 Muting (4-sensor-sequential)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Muting functions	Muting (4-sensor-sequential)		-	✓

Note

The function element is available in MSS ES only when using an MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended. If an MSS 3RK3 Basic is configured in the configuration, the function element will be hidden in the catalog window.

Description

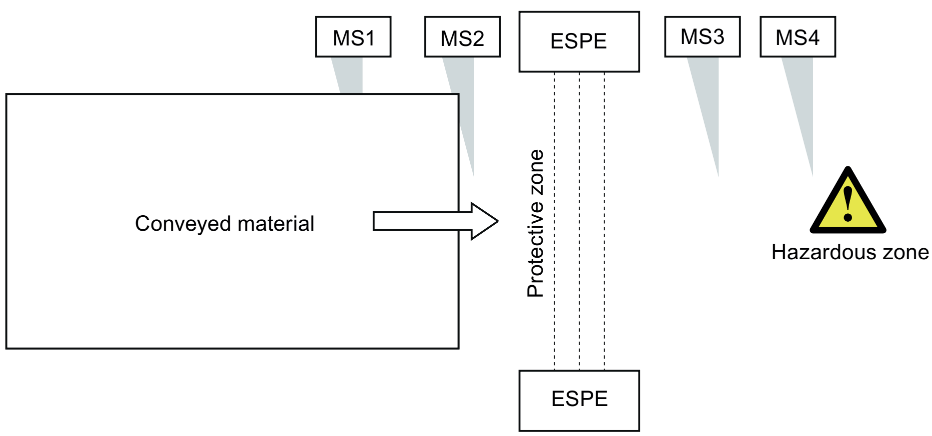


Figure 6-15 Muting 4-sensor-sequential scheme

With the "Muting (4 sensor-sequential)" function element, you monitor an override circuit (= muting) with the following properties using signals from four independent sensors (MS1 to MS4):

- This muting mode is used if there is sufficient space for entry into and exit from the hazardous zone and the conveyed material always has the same dimensions.
- The muting sensors are only monitored for sequence of triggering and non-triggering.

  The following are possible as a sequence:

  – triggering of "MS1 -> MS2 -> MS3 -> MS4" and ending triggering of "MS1 -> MS2 -> MS3 -> MS4"

  – triggering of "MS4 -> MS3 -> MS2 -> MS1" and ending triggering of "MS4 -> MS3 -> MS2 -> MS1"
- For the sequence conditions to be fulfilled, the conveyed material must be as long as the distance between MS1 and MS4. On deviation from the permissible sequence, muting is ended and a sequence error is output.
- The time interval between the sensor signals is not relevant.
- Muting is not specific to a direction.

Note

STOP function

When STOP is activated, the interference suppression is deactivated automatically. This results in limited usability of the STOP function for conveyed material with gaps. In this case, 4-sensor parallel muting must be used.

⚠ WARNING

If the conveyed material feed is stopped in muting phase 2 (see the "Muting safety circuit (Page 314)" chapter) and the conveyed material is moved again in the opposite direction, muting remains active initially. After ending triggering of the last muting sensor and expiration of the assigned discrepancy time in which signal dropouts are accepted, muting is deactivated. Monitoring of the protective field is resumed only afterwards. For this reason, the shortest possible discrepancy time must be chosen.

Note

On a signal change at the FEEDBACK_MUT function input, an error is generated immediately, if the signal at function output MUT has not changed.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	If this parameter is active, the function element is processed in the safety logic. If the parameter is deactivated, the set substitute values are made available at outputs Q and MUT.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
	Substitute value for function output MUT	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output MUT = 0 substitute value "1" means output MUT = 1
Parameters	Muting time infinite	You can set the muting time to infinite. See the safety instructions in the "*3RK3 Modular Safety System*" manual, Ch. "*Description of the "muting" function*."
	Max. muting time [s]	Enter the time after which operational muting will have ended at the latest. You can set the max. muting time between 1 and 10800 s [3 h] in steps of 1 ms. The muting time is started when muting is correctly started by the muting sensors.
	Discrepancy time [ms]	You can set the discrepancy time between 0 and 60000 ms. • During active muting, signal dropouts of muting sensors are accepted for the duration of the discrepancy time without ending muting. Note that the discrepancy time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Ch. "*Response times*."
	Monitoring of the muting display lamp	You can activate the monitoring function for the muting display lamp and choose the desired evaluation logic of the feedback signal at function input FEEDBACK_MUT: • Deactivated • statically for "1" = OK • dynamically for MUT
	switching time muting display lamp [s]	You can adapt the monitoring function for the display lamp to the switching time depending on the display lamp. You can set the switching time between 0.01 and 30 s.

6.7.4.6 Muting (4-sensor-parallel)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Muting functions	Muting (4-sensor-parallel)		-	✓

Note

The function element is available in MSS ES only when using an MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended. If an MSS 3RK3 Basic is configured in the configuration, the function element will be hidden in the catalog window.

Description

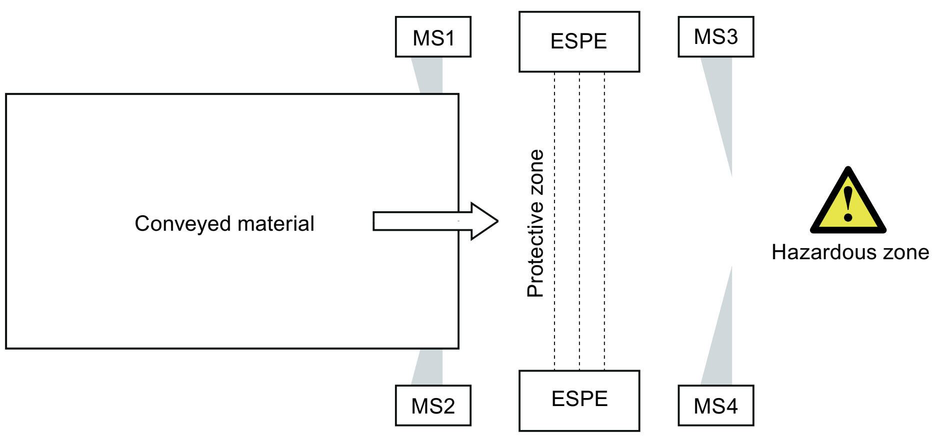


Figure 6-16 4-sensor-parallel scheme

With the "Muting (4 sensor-parallel)" function element, you monitor a override circuit (= muting) with the following properties using signals from two pairs of sensors (MS1 & MS2 and MS3 & MS4):

- This muting mode is used where there is little space.
- The muting sensors are time-monitored in pairs for signal discrepancy.
- The muting is triggered if either sensors MS1 and MS2 (= sensor pair 1) or MS3 and MS4 (= sensor pair 2) are activated within a certain discrepancy time.

- The muting sensors are monitored for sequence. The following are possible as a sequence:
  - activation of "MS1 & MS2 → MS3 & MS4" and then deactivation of "MS1 & MS2 → MS3 & MS4"
  - activation of "MS3 & MS4 → MS1 & MS2" and then deactivation of "MS3 & MS4 → MS1 & MS2"
- For the sequence conditions to be fulfilled, the conveyed material must be as long as the distance between MS1 & MS2 and MS3 & S4.
- On deviation from the permissible sequence, muting is ended and a sequence error is output.
- Muting is not specific to a direction.

Note

On a signal change at the FEEDBACK_MUT function input, an error is generated immediately, if the signal at function output MUT has not changed.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	If this parameter is active, the function element is processed in the safety logic. If the parameter is deactivated, the set substitute values are made available at outputs Q and MUT.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
	Substitute value for function output MUT	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output MUT = 0 substitute value "1" means output MUT = 1
Parameters	Muting time infinite	You can set the muting time to infinite. See the safety instructions in the "*3RK3 Modular Safety System*" manual, Ch. "*Description of the "muting" function.*"
	Max. muting time [s]	Specify the time after which operational muting will have ended at the latest. You can set the max. muting time between 1 and 10800 s [3 h] in steps of 1 ms. The muting time is started when muting is correctly started by the muting sensors.

<table>
<tr><th colspan="2">Parameter name</th><th>Description/parameter value</th></tr>
<tr><td rowspan="3"></td><td>Discrepancy time [ms]</td><td>You can set the discrepancy time between 0 and 60000 ms.
• For the duration of the discrepancy time, different signal states are accepted at the two muting sensors forming a sensor pair without an error being signaled.
• During active muting, muting sensor signal dropouts are accepted for the duration of the discrepancy time without ending muting.
Note that the discrepancy time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit.
For additional information on the program cycle time, see the "3RK3 Modular Safety System" manual, Ch. "Response times."
While a discrepancy error is pending, you can clear the muting section using the RESTART function. This is indicated (e.g. flashing muting display lamp).</td></tr>
<tr><td>Monitoring of the muting display lamp</td><td>You can activate the monitoring function for the muting display lamp and choose the desired evaluation logic of the feedback signal at function input FEEDBACK_MUT:
• Deactivated
• statically for "1" = OK
• dynamically for MUT</td></tr>
<tr><td>switching time muting display lamp [s]</td><td>You can adapt the monitoring function for the display lamp to the switching time depending on the display lamp.
You can set the switching time between 0.01 and 30 s.</td></tr>
</table>

6.7.5 Status functions

6.7.5.1 Device status

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Status functions	Device status	$\boxed{i}$	✓	✓

Description

The "Device status" function element provides status information about the MSS 3RK3 safety relay. When the status activated in the parameter "Status type" exists, the function output Q is set to "1".

With the "Device status" function element, defined responses can be implemented in the downstream logic by connecting the function output Q in the logic diagram.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameter	Status type	Select the status message to be displayed at the function output Q. Your options are: • No status information • Group error • Group warning (MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic and MSS 3RK3 ASIsafe extended) • Group prewarning (MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic and MSS 3RK3 ASIsafe extended) • Logic error • Test mode active • Safety mode active For further information on the status message, see the manual entitled "*Modular Safety System 3RK3*", section entitled "*Diagnostics/Service*" > "*Diagnostics via PROFIBUS*" > "*Data set 92*".

6.7.5.2 Element status

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Status functions	Element status	i	-	✓

Note

The function element is available in MSS ES only when using an MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended. If an MSS 3RK3 Basic is configured in the configuration, the function element will be hidden in the catalog window.

Description

The "Element status" function element allows you to connect certain messages of a function element in the safety circuit. For example, a specific error can be displayed on the system by means of a signal lamp.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameters	Status element no.	The parameter specifies the function element from which the element status will be provided.
	Status type	You can select a status information item for a particular function element, which will then be output at the function output: • No status information This parameter setting enables, for example, use of this element as a space holder. The function output outputs the value "0." • Timer is active • Function waiting for startup test • Logic error • Wiring error • Substitute input value active

6.7.6 Control functions

6.7.6.1 Device command

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Control functions	Device command		✓	✓

Description

With the "Device command" function element, commands can be integrated into the safety relay and connected device-specifically. For example, a reset can be triggered through an external button or over PROFIBUS.

When there is a positive edge "0 → 1" at the input IN, the command is executed.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	If this parameter is active, the function element is processed in the safety logic. If the parameter is deactivated, the command is not executed.
Parameter	Command type	• Execute no command • Reset • Apply code tables (MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic and MSS 3RK3 ASIsafe extended)

6.7.7 Logic functions

6.7.7.1 AND

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Logic functions	AND	&	✓	✓

Description

The logic function "AND" has 1 to 5 logic inputs IN and one function output Q for the result of logic operation (RLO).

RLO = 1 when all logic inputs have the status "1".

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameters	Number of logic inputs	1 to 5 elements can be parameterized for the element.

6.7.7.2 OR

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Logic functions	OR	≥1	✓	✓

Description

The logic function "OR" has 1 to 5 logic inputs and one function output Q for the result of logic operation (RLO).

RLO = 1 when at least one logic input has the status "1."

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameter	Number of logic inputs	1 to 5 elements can be parameterized for the element.

6.7.7.3 XOR

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Logic functions	XOR	=1	✓	✓

Description

The logic function "XOR" has 1 to 5 logic inputs and one function output Q for the result of logic operation (RLO).

RLO = 1 when only one logic input has the status "1" at the same time.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameter	Number of logic inputs	1 to 5 elements can be parameterized for the element.

6.7.7.4 NAND

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Logic functions	NAND	&	✓	✓

Description

The logic function "NAND" has 1 to 5 logic inputs and one function output Q for the result of logic operation (RLO).

RLO = 0 when all logic inputs have the status "1".

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameter	Number of logic inputs	1 to 5 elements can be parameterized for the element.

6.7.7.5 NOR

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Logic functions	NOR	≥1	✓	✓

Description

The logic function "NOR" has 1 to 5 logic inputs and one function output Q for the result of logic operation (RLO).

RLO = 0 when at least one logic input has the status "1".

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameters	Number of logic inputs	1 to 5 elements can be parameterized for the element.

6.7.7.6 NEGATION (NEG)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Logic functions	NEGATION	1	✓	✓

Description

The logic operation "NEGATION" has one input IN and one function output Q for the result of logic operation (RLO).

An inverted input signal is output at the function output Q.

RLO = 1 when input IN has the status "0".

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

6.7.8 Flip-flop

6.7.8.1 FF-SR

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Flip-flop	FF-SR	SR	✓	✓

Description

The safety relay supports the reset-dominant function "FF-SR".
"Reset-dominant" means that the result of logic operation (RLO) cannot be set to "1" when the reset input R is "1".

The function element has:

- 2 inputs: Input for setting S, input for resetting R
- A function output Q for the RLO

The RLO is formed according to the following truth table:

Input for setting S	Input for resetting R	RLO
0	0	-
0	1	0
1	0	1
1	1	0

0 = low level

1 = high level

- no change in the output status

RLO = 1, when the input for setting S = "1" and the input for resetting R = "0".

RLO = 0, when the input for resetting R = "1".

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

6.7.9 Counter functions

6.7.9.1 Counter (0 -> 1)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Counter functions	Counter (0 → 1)		✓	✓

Description

Note

The count value is not stored. At the start of safety or test mode, all counters begin with their initial values.

The safety relay supports the counter function "Counter (0 → 1)". The counter value is only changed when there is a positive edge at the counter inputs. The current counter value can be counted up or down via one proprietary counter input each. When a parameterizable counter limit value is achieved or overshot, the function output Q is set.

The counter function has:

- 3 inputs: CU - Counter input up, CD - Counter input down, R - Reset (parameterizable)
- A function output Q for the result of logic operation (RLO)

Functional principle

- The counter value is increased by 1 with every positive edge at the "Counter input up", except when the counter value reaches the maximum value 65535.
- The count value is decreased by 1 with every positive edge at the "Count input down", except when the count value reaches the value 0.
- The counter value remains unchanged when there is a positive edge simultaneously at both counter inputs.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameters	Counter limit value (CV)	Set a counter limit value which is to be monitored (between 0 and 65535): • Function output Q = "1" when the current counter value reaches this limit value. • Function output Q = "0" when the current counter value falls below this limit value.
	Reset	You can select whether the counter value is set to "0" automatically or manually: • Automatic When the function output Q = "1", the counter value and function output Q are set to "0" after one program cycle of the safety relay. • Manual The counter value is set to "0", irrespective of the state of the function output Q. If the counter value is not deleted after the limit value is exceeded, counting will continue. • Automatic with manual reset When the function output Q = "1", the counter value and function output Q are set to "0" after one program cycle of the safety relay. The counter value can be reset to "0" when the function output Q = "0".

6.7.9.2 Counter (1 -> 0)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Counter functions	Counter (1 → 0)		✓	✓

Description

Note

The count value is not stored. At the start of safety or test mode, all counters begin with their initial values.

The safety relay supports the counter function "Counter (1 → 0)". The counter value is only changed when there is a negative edge. The current counter value can be counted up or down via one proprietary counter input each. When a parameterizable counter limit value is achieved or overshot, the function output Q is set.

The counter function has:

- 3 inputs: CU - Counter input up, CD - Counter input down, R - Reset (parameterizable)
- A function output Q for the result of logic operation (RLO)

Functional principle

- The counter value is increased by 1 with every negative edge at the "Counter input up", except when the counter value reaches the maximum value 65535.
- The counter value is decreased by 1 with every negative edge at the "Counter input down", except when the counter value reaches the value 0.
- The counter value remains unchanged when there is a positive edge simultaneously at both counter inputs.

Parameters

<table>
<tr><th colspan="2">Parameter name</th><th>Description/parameter value</th></tr>
<tr><td rowspan="5">General</td><td>Name</td><td>You can enter a name for the element here.</td></tr>
<tr><td>Comment</td><td>This text appears above the function element in the diagram. This may, for example, be information about this function element.</td></tr>
<tr><td>Element number</td><td>Consecutive number that is automatically assigned. You can change the number.</td></tr>
<tr><td>Element activated</td><td>When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.</td></tr>
<tr><td>Function output substitute value</td><td>"0" or "1" can be assigned to the substitute value when the element is deactivated.
Substitute value "0" means output Q = 0
substitute value "1" means output Q = 1</td></tr>
<tr><td rowspan="2">Parameters</td><td>Counter limit value (CV)</td><td>Set a counter limit value which is to be monitored (between 0 and 65535):
• Function output Q = "1" when the current counter value reaches this limit value.
• Function output Q = "0" when the current counter value falls below this limit value.</td></tr>
<tr><td>Reset</td><td>You can select whether the counter value is set to "0" automatically or manually:
• Automatic
When the function output Q = "1", the counter value and function output Q are set to "0" after one program cycle of the safety relay.
• Manual
The counter value is set to "0," irrespective of the state of function output Q.
If the counter value is not deleted after the limit value is exceeded, counting will continue.
• Automatic with manual reset
When the function output Q = "1", the counter value and function output Q are set to "0" after one program cycle of the safety relay.
The counter value can be reset to "0" when the function output Q = "0".</td></tr>
</table>

6.7.9.3 Counter (0 -> 1 / 1 -> 0)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Counter functions	Counter (0 → 1 / 1 → 0)		✓	✓

Description

Note

The count value is not stored. At the start of safety or test mode, all counters begin with their initial values.

The safety relay supports the counter function "Counter (0 → 1 / 1 → 0)". The counter value is only changed when there is a positive and negative edge. The current counter value can be counted up or down via one proprietary counter input each. When a parameterizable counter limit value is achieved or overshot, the function output Q is set.

The counter function has:

- 3 inputs: CU - Counter input up, CD - Counter input down, R - Reset (parameterizable)
- A function output Q for the result of logic operation (RLO)

Functional principle

- The counter value is increased by 1 with every positive and negative edge at the "Counter input up", except when the counter value reaches the maximum value 65535.
- The counter value is decreased by 1 with every positive and negative edge at the "Counter input down", except when the counter value reaches the value 0.
- The counter value remains unchanged when there is a positive edge simultaneously at both counter inputs.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameters	Counter limit value (CV)	Set a counter limit value which is to be monitored (between 0 and 65535): • Function output Q = "1" when the current counter value reaches this limit value. • Function output Q = "0" when the current counter value falls below this limit value.
	Reset	You can select whether the counter value is set to "0" automatically or manually: • Automatic When the function output Q = "1", the counter value and output Q are set to "0" after one program cycle of the safety relay. • Manual The counter value is set to "0", irrespective of the state of the function output Q. If the counter value is not deleted after the limit value is exceeded, counting will continue. • Automatic with manual reset When the function output Q = "1", the counter value and function output Q are set to "0" after one program cycle of the safety relay. The counter value can be reset to "0" when the function output Q = "0".

6.7.10 Timer functions

6.7.10.1 With ON delay

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Timer functions	With ON delay		✓	✓

Description

Note

The time value is not stored. At the start of safety or test mode, all time values begin with their initial values.

The safety relay supports the timer function "With ON delay". The function output Q is activated after the input (with a parameterizable delay time).

The timer function has:

- 2 inputs: IN, R - Reset
- A function output Q for the result of logic operation (RLO)

Note

MSS 3RK3 Basic limitation

MSS 3RK3 Basic does not support a reset input for this function element.

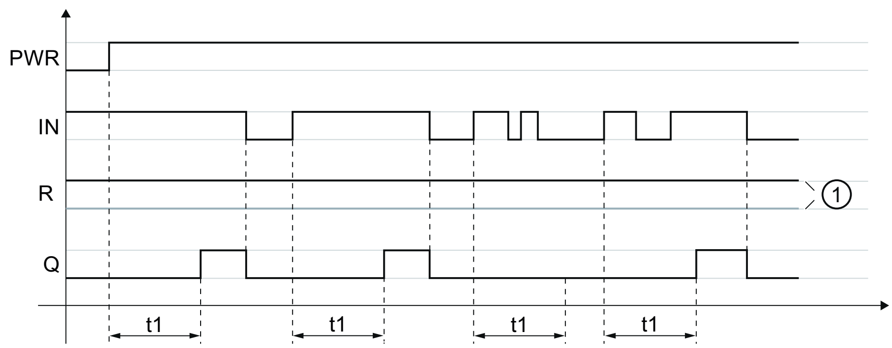
The MSS 3RK3 Basic responds as if the "Reset" parameter has "deactivated" the value.

Functional principle

- If a "1" is detected at input IN and no reset is active, the delay time "t1" starts.
- After the delay time, function output Q is activated, i.e. set to "1", as long as there is a "1" at input IN.
- When there is an edge change at input IN before the the end of delay time "t1", the delay time continues. The function output Q remains deactivated, i.e. "0", if there is a "0" at input IN after the end of the delay time.

"Reset" = "deactivated" and "Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "deactivated". It also applies for "Reset" = "with positive edge" or "with negative edge", if there is no edge change at input R.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
①	Either "1" or "0" is present.

Figure 6-17 Timer function "With ON delay" when "Reset" = "deactivated", "with negative edge", or "with positive edge".

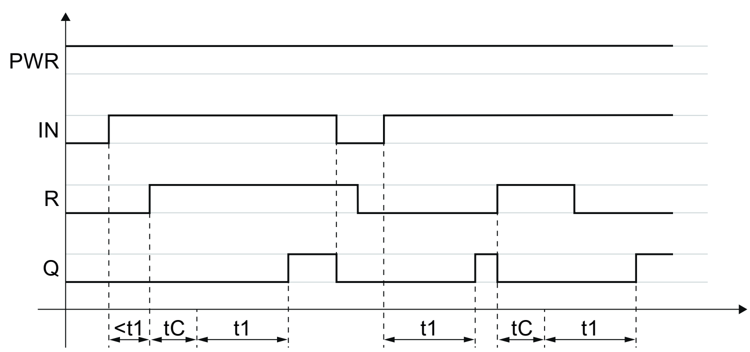
"Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "with positive edge".

Note

"Reset" = "with negative edge"

The behavior of the function element when "Reset" = "with negative edge" is exactly the same as when "Reset" = "with positive edge", except that the signal from R is inverted. Negative edge "1" > "0" is evaluated here.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
tC	Program cycle time

Figure 6-18 Timer function "With ON delay" when "Reset" = "with positive edge"

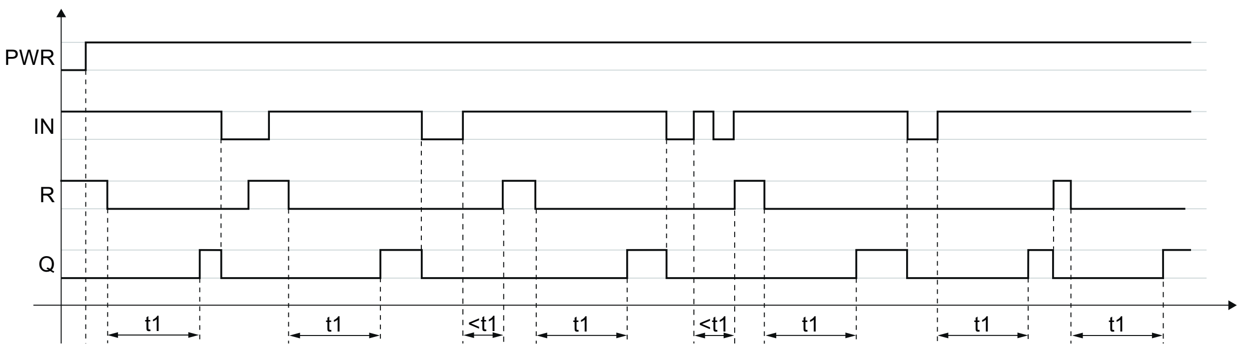
"Reset" = "with level 1"

The following diagram shows the behavior of the function element when "Reset" = "with level 1".

Note

Value "0" is present at function input R

If the value "0" is present at function input R, the behavior of the function element is the same as for the edge evaluation shown in the first diagram.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time

Figure 6-19 Timer function "With ON delay" when "Reset" = "with level 1"

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

<table>
<tr><th colspan="2">Parameter name</th><th>Description/parameter value</th></tr>
<tr><td rowspan="2">Parameters</td><td>t1[s]</td><td>You enter the delay time here.
The maximum value is 655 s, increment: 5 ms
Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit.
For additional information on the program cycle time, see the "3RK3 Modular Safety System" manual, Ch. "Response times."</td></tr>
<tr><td>Reset
(not in the case of MSS 3RK3 Basic)</td><td>deactivated
The timer cannot be reset selectively to the "initial position".
The RLO is set/reset according to the input signal and the timer function.
with positive edge
When a positive edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle.
Afterwards, the element starts over with its functionality.[1)] The value of the reset input only becomes irrelevant when a positive edge is detected again.
with negative edge
When a negative edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle.
Afterwards, the element starts over with its functionality.[1)] The value of the reset input only becomes irrelevant when a negative edge is detected again.
with level 1
When the value "1" is detected at the reset input, all timers and the RLO are reset to the value "0" as long as the value "1" is present. The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle.
The element starts over with its functionality only when the value "0" is detected again at the reset input. [1)]</td></tr>
</table>

[1)] "Starts over" applies to timer functions that are started by level 1 at the timer trigger input: The timers are started if the value "1" is present at the timer trigger input.

6.7.10.2 With ON delay (trigger)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Timer functions	With ON delay (trigger)		✓	✓

Description

Note

The time value is not stored. At the start of safety or test mode, all time values begin with their initial values.

The safety relay supports the timer function "With ON delay (trigger)". The function output Q is activated after the input (with a parameterizable delay time).

The timer function has:

- 2 inputs: IN, R - Reset
- A function output Q for the result of logic operation (RLO)

Note

MSS 3RK3 Basic limitation

MSS 3RK3 Basic does not support a reset input for this function element.

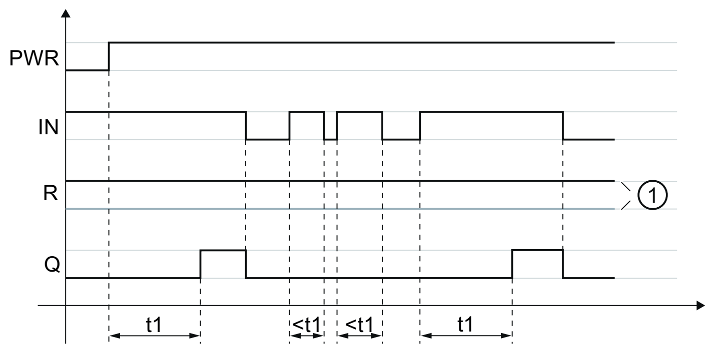
The MSS 3RK3 Basic responds as if the "Reset" parameter has "deactivated" the value.

Functional principle

- If a "1" is detected at input IN and no reset is active, the delay time "t1" starts.
- After the delay time, function output Q is activated, i.e. set to "1", as long as there is a "1" at input IN.
- The delay time is stopped on a 1 → 0 edge change at input IN On another 0 → 1 edge change, the delay time will restart. The function output Q remains deactivated, i.e. "0", if there is a "0" at input IN after the end of the delay time.

"Reset" = "deactivated" and "Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "deactivated". It also applies for "Reset" = "with positive edge" or "with negative edge", if there is no edge change at input R.



PWR Power supply
IN Function input
Q Function output
R Reset
t1 Delay time
① Either "1" or "0" is present.

Figure 6-20 Timer function "With ON delay (trigger)" when "Reset" = "deactivated", "with negative edge", or "with positive edge".

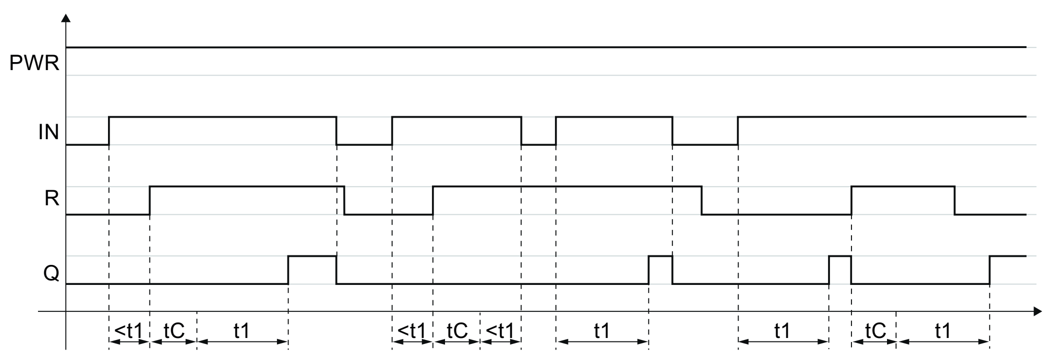
"Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "with positive edge".

Note

"Reset" = "with negative edge"

The behavior of the function element when "Reset" = "with negative edge" is exactly the same as when "Reset" = "with positive edge", except that the signal from R is inverted. Negative edge "1" > "0" is evaluated here.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
tC	Program cycle time

Figure 6-21 Timer function "With ON delay (trigger)" when "Reset" = "with positive edge"

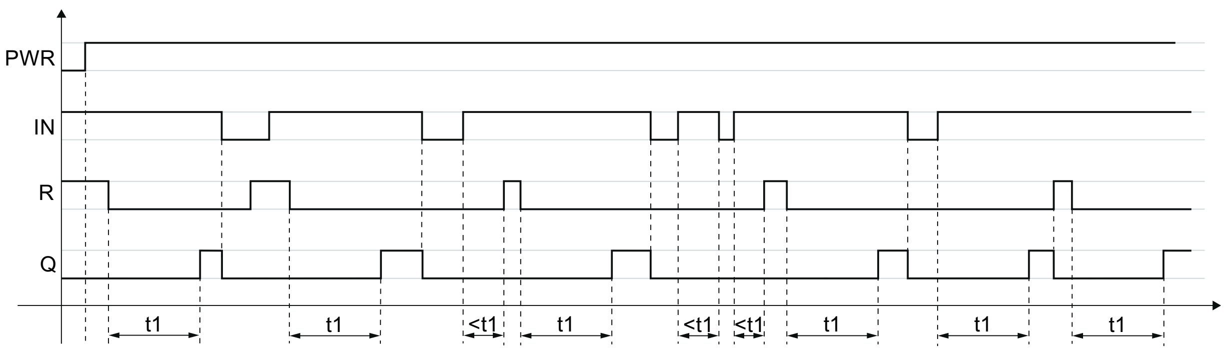
"Reset" = "with level 1"

The following diagram shows the behavior of the function element when "Reset" = "with level 1".

Note

Value "0" is present at function input R

If the value "0" is present at function input "R", the behavior of the function element is the same as for the edge evaluation shown in the first diagram.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time

Figure 6-22 Timer function "With ON delay (trigger)" when "Reset" = "with level 1"

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

Parameter name		Description/parameter value
Parameters	t1[s]	• You enter the delay time here. • The maximum value is 655 s, increment: 5 ms Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, ch. "*Response times*".
	Reset (not in the case of MSS 3RK3 Basic)	• deactivated The timer cannot be reset selectively to the "initial position". The RLO is set/reset according to the input signal and the timer function. • with positive edge When a positive edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. Afterwards, the element starts over with its functionality.1) The value of the reset input only becomes irrelevant when a positive edge is detected again. • with negative edge When a negative edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. Afterwards, the element starts over with its functionality.1) The value of the reset input only becomes irrelevant when a negative edge is detected again. • with level 1 When the value "1" is detected at the reset input, all timers and the RLO are reset to the value "0" as long as the value "1" is present. The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. The element starts over with its functionality only when the value "0" is detected again at the reset input. 1)

1) "Starts over" applies to timer functions that are started by level 1 at the timer trigger input: The timers are started if the value "1" is present at the timer trigger input.

6.7.10.3 Passing make contact

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Timer functions	Passing make contact		✓	✓

Description

Note

The time value is not stored. At the start of safety or test mode, all time values begin with their initial values.

The safety relay supports the timer function "Passing make contact". An input signal generates a signal with parameterizable duration at function output Q.

The timer function has:

- 2 inputs: IN, R - Reset
- A function output Q for the result of logic operation (RLO)

Note

MSS 3RK3 Basic limitation

MSS 3RK3 Basic does not support a reset input for this function element.

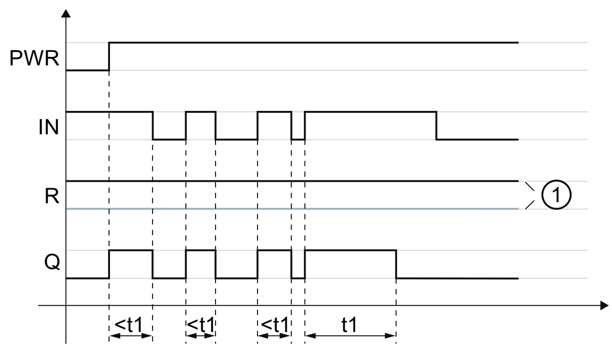
The MSS 3RK3 Basic responds as if the "Reset" parameter has "deactivated" the value.

Functional principle

- If a "1" is detected at input IN and no reset is active, the delay time "t1" starts and function output Q is switched to "1".
- When there is a negative edge "1 → 0" at input IN before the the end of the time "t1", the time is reset. Function output Q is deactivated, i.e. set to "0".
- After the time period "t1", function output Q is deactivated, i.e. set to "0".

"Reset" = "deactivated" and "Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "deactivated". It also applies for "Reset" = "with positive edge" or "with negative edge", if there is no edge change at input R.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
①	Either "1" or "0" is present.

Figure 6-23 Timer function "Passing make contact" when "Reset" = "deactivated", "with negative edge", or "with positive edge".

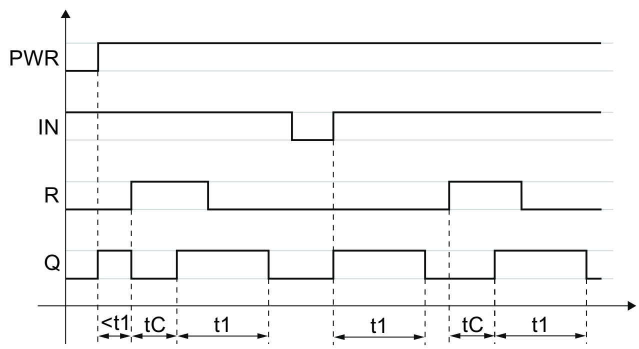
"Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "with positive edge".

Note

"Reset" = "with negative edge"

The behavior of the function element when "Reset" = "with negative edge" is exactly the same as when "Reset" = "with positive edge", except that the signal from R is inverted. Negative edge "1" > "0" is evaluated here.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
tC	Program cycle time

Figure 6-24 Timer function "Passing make contact" when "Reset" = "with positive edge"

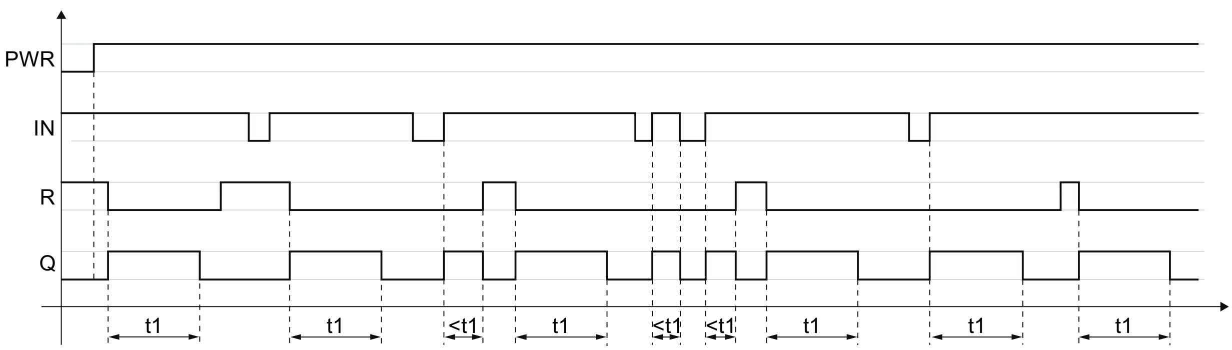
"Reset" = "with level 1"

The following diagram shows the behavior of the function element when "Reset" = "with level 1".

Note

Value "0" is present at function input R

If the value "0" is present at function input R, the behavior of the function element is the same as for the edge evaluation shown in the first diagram.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time

Figure 6-25 Timer function "Passing make contact" when "Reset" = "with level 1"

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

Parameter name		Description/parameter value
Parameters	t1[s]	• You enter the make time here. • The maximum value is 655 s, increment: 5 ms Please note that the delay time specified by you can be a multiple of the program cycle time specified by you in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, ch. "*Response times*".
	Reset (not in the case of MSS 3RK3 Basic)	• deactivated The timer cannot be reset selectively to the "initial position". The RLO is set/reset according to the input signal and the timer function. • with positive edge When a positive edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. Afterwards, the element starts over with its functionality.1) The value of the reset input only becomes irrelevant when a positive edge is detected again. • with negative edge When a negative edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. Afterwards, the element starts over with its functionality.1) The value of the reset input only becomes irrelevant when a negative edge is detected again. • with level 1 When the value "1" is detected at the reset input, all timers and the RLO are reset to the value "0" as long as the value "1" is present. The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. The element starts over with its functionality only when the value "0" is detected again at the reset input. 1)

1) "Starts over" applies to timer functions that are started by level 1 at the timer trigger input: The timers are started if the value "1" is present at the timer trigger input.

6.7.10.4 Passing make contact (trigger)

Function element		Icons	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Timer functions	Passing make contact (trigger)		✓	✓

Description

Note

The time value is not stored. At the start of safety or test mode, all time values begin with their initial values.

The safety relay supports the timer function "Passing make contact (trigger)". An input signal generates a signal with parameterizable delay time at function output Q.

The timer function has:

- 2 inputs: IN, R - Reset
- A function output Q for the result of logic operation (RLO)

Note

MSS 3RK3 Basic limitation

MSS 3RK3 Basic does not support a reset input for this function element.

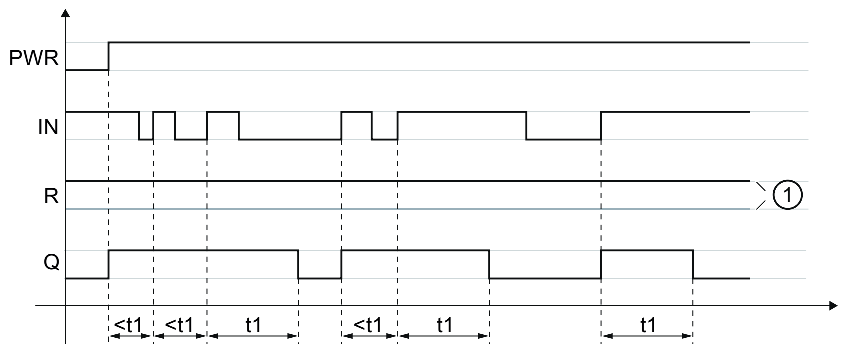
The MSS 3RK3 Basic responds as if the "Reset" parameter has "deactivated" the value.

Functional principle

- If a "1" is detected at input IN and no reset is active, the delay time "t1" starts and function output Q is switched to "1".
- When there is a negative edge "1 → 0" at input IN before the the end of the time "t1", the time continues to elapse. Function output Q remains active, i.e. set to "1", during the time period "t1". When there is another positive edge "0 → 1" at input IN, time "t1" begins again.
- After the time period, function output Q is deactivated, i.e. set to "0".

"Reset" = "deactivated" and "Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "deactivated". It also applies for "Reset" = "with positive edge" or "with negative edge", if there is no edge change at input R.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
①	Either "1" or "0" is present.

Figure 6-26 Timer function "Passing make contact (trigger)" when "Reset" = "deactivated", "with negative edge", or "with positive edge".

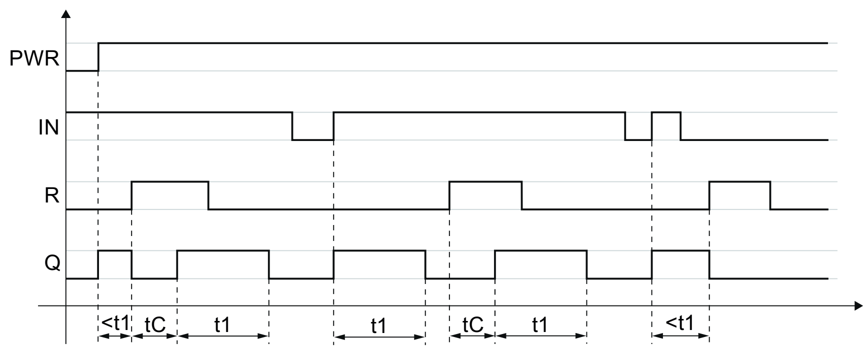
"Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "with positive edge".

Note

"Reset" = "with negative edge"

The behavior of the function element when "Reset" = "with negative edge" is exactly the same as when "Reset" = "with positive edge", except that the signal from R is inverted. Negative edge "1" > "0" is evaluated here.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
tC	Program cycle time

Figure 6-27 Timer function "Passing make contact (trigger)" when "Reset" = "with positive edge"

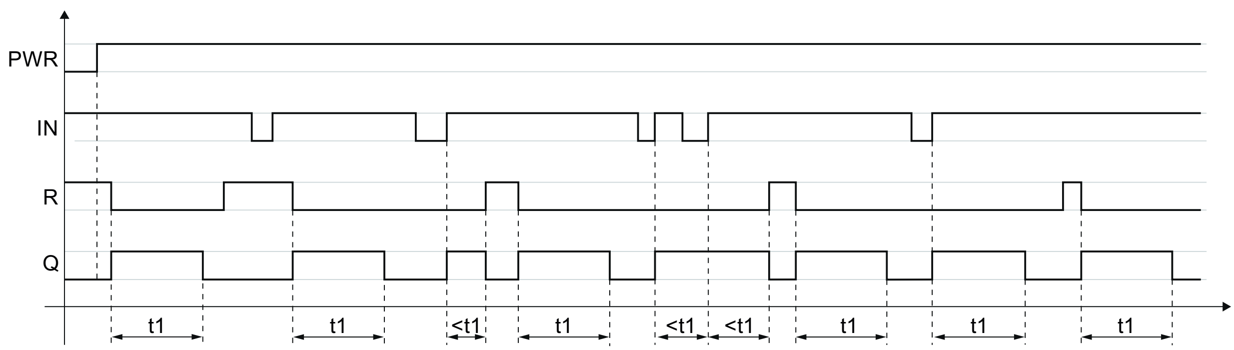
"Reset" = "with level 1"

The following diagram shows the behavior of the function element when "Reset" = "with level 1".

Note

Value "0" is present at function input R

If the value "0" is present at function input R, the behavior of the function element is the same as for the edge evaluation shown in the first diagram.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time

Figure 6-28 Timer function "Passing make contact (trigger)" when "Reset" = "with level 1"

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

Parameter name		Description/parameter value
Parameters	t1[s]	• You enter the make time here. • The maximum value is 655 s, increment: 5 ms Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, ch. "*Response times*".
	Reset (not in the case of MSS 3RK3 Basic)	• deactivated The timer cannot be reset selectively to the "initial position". The RLO is set/reset according to the input signal and the timer function. • with positive edge When a positive edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. Afterwards, the element starts over with its functionality.[1)] The value of the reset input only becomes irrelevant when a positive edge is detected again. • with negative edge When a negative edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. Afterwards, the element starts over with its functionality.[1)] The value of the reset input only becomes irrelevant when a negative edge is detected again. • with level 1 When the value "1" is detected at the reset input, all timers and the RLO are reset to the value "0" as long as the value "1" is present. The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. The element starts over with its functionality only when the value "0" is detected again at the reset input. [1)]

1) "Starts over" applies to timer functions that are started by level 1 at the timer trigger input: The timers are started if the value "1" is present at the timer trigger input.

6.7.10.5 With OFF delay

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Timer functions	With OFF delay		✓	✓

Description

Note

The time value is not stored. At the start of safety or test mode, all time values begin with their initial values.

The safety relay supports the timer function "With OFF delay". The function output Q is deactivated after the input (with a parameterizable delay time).

The timer function has:

- 2 inputs: IN, R - Reset
- A function output Q for the result of logic operation (RLO)

Note

MSS 3RK3 Basic limitation

MSS 3RK3 Basic does not support a reset input for this function element.

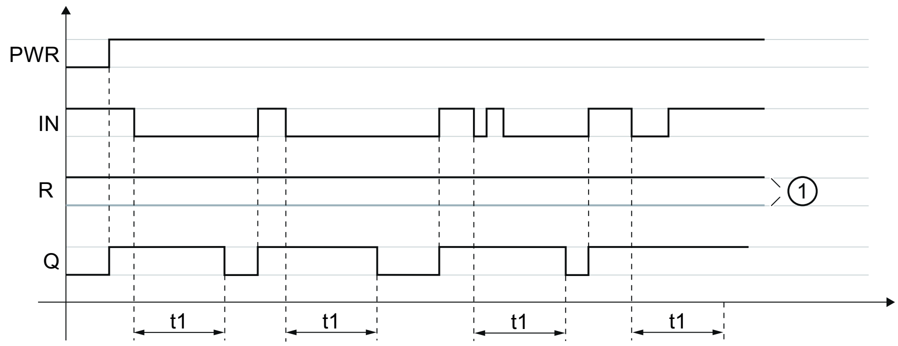
The MSS 3RK3 Basic responds as if the "Reset" parameter has "deactivated" the value.

Functional principle

- If a "1" is detected at input IN and no reset is active, function output Q is set to "1".
- When there is a negative edge "1 → 0" at input IN, delay time "t1" begins.
- After the delay time, function output Q is deactivated, i.e. set to "0".
- When there is a positive edge "0 → 1" at input IN before the the end of the delay time "t1", the delay time continues. Function output Q remains active, i.e. set to "1".

"Reset" = "deactivated" and "Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "deactivated". It also applies for "Reset" = "with positive edge" or "with negative edge", if there is no edge change at input R.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
①	Either "1" or "0" is present.

Figure 6-29 Timer function "With OFF delay" when "Reset" = "deactivated", "with negative edge", or "with positive edge".

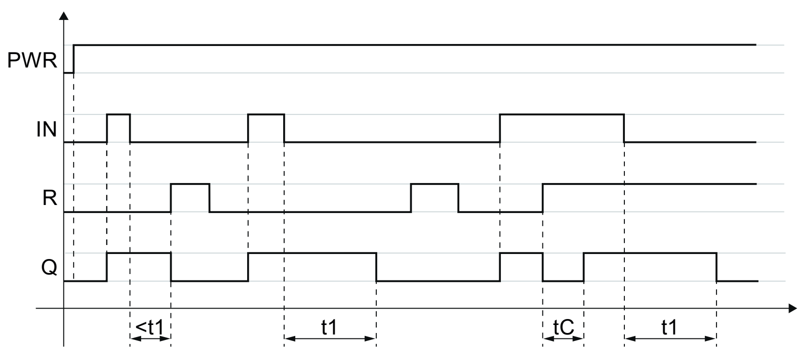
"Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "with positive edge".

Note

"Reset" = "with negative edge"

The behavior of the function element when "Reset" = "with negative edge" is exactly the same as when "Reset" = "with positive edge", except that the signal from R is inverted. Negative edge "1" > "0" is evaluated here.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
tC	Program cycle time

Figure 6-30 Timer function "With OFF delay" when "Reset" = "with positive edge"

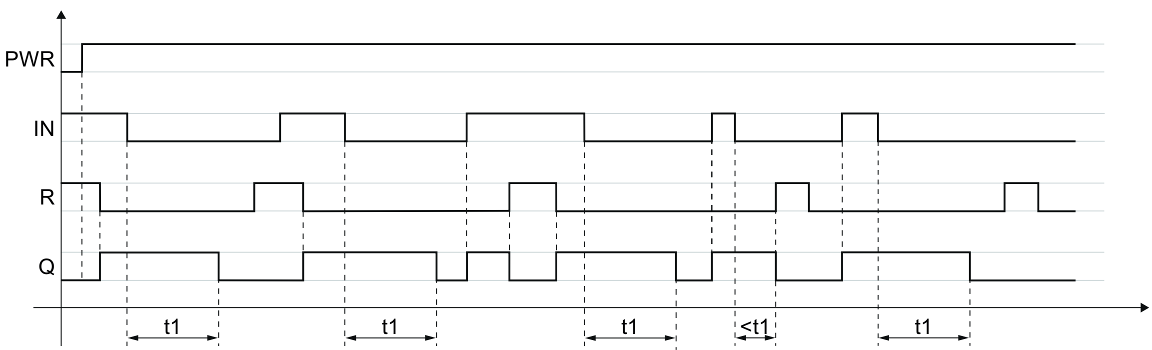
"Reset" = "with level 1"

The following diagram shows the behavior of the function element when "Reset" = "with level 1".

Note

Value "0" is present at function input R

If the value "0" is present at function input R, the behavior of the function element is the same as for the edge evaluation shown in the first diagram.



PWR Power supply
IN Function input
Q Function output
R Reset
t1 Delay time

Figure 6-31 Timer function "With OFF delay" when "Reset" = "with level 1"

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

<table>
<tr><th colspan="2">Parameter name</th><th>Description/parameter value</th></tr>
<tr><td rowspan="2">Parameters</td><td>t1[s]</td><td>• You enter the delay time here.
• The maximum value is 655 s, increment: 5 ms
Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit.
For additional information on the program cycle time, see the "3RK3 Modular Safety System" manual, ch. "Response times".</td></tr>
<tr><td>Reset
(not in the case of MSS 3RK3 Basic)</td><td>• deactivated
The timer cannot be reset selectively to the "initial position".
The RLO is set/reset according to the input signal and the timer function.
• with positive edge
When a positive edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle.
Afterwards, the element starts over with its functionality.[1)] The value of the reset input only becomes irrelevant when a positive edge is detected again.
• with negative edge
When a negative edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle.
Afterwards, the element starts over with its functionality.[1)] The value of the reset input only becomes irrelevant when a negative edge is detected again.
• with level 1
When the value "1" is detected at the reset input, all timers and the RLO are reset to the value "0" as long as the value "1" is present. The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle.
The element starts over with its functionality only when the value "0" is detected again at the reset input. [1)]</td></tr>
</table>

1) "Starts over" applies to timer functions that are started by level 1 at the timer trigger input: The timers are started if the value "1" is present at the timer trigger input.

6.7.10.6 With OFF delay (trigger)

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Timer functions	With OFF delay (trigger)		✓	✓

Description

Note

The time value is not stored. At the start of safety or test mode, all time values begin with their initial values.

The safety relay supports the timer function "With OFF delay (trigger)". The function output Q is deactivated after the input (with a parameterizable delay time).

The timer function has:

- 2 inputs: IN, R - Reset
- A function output Q for the result of logic operation (RLO)

Note

MSS 3RK3 Basic limitation

MSS 3RK3 Basic does not support a reset input for this function element.

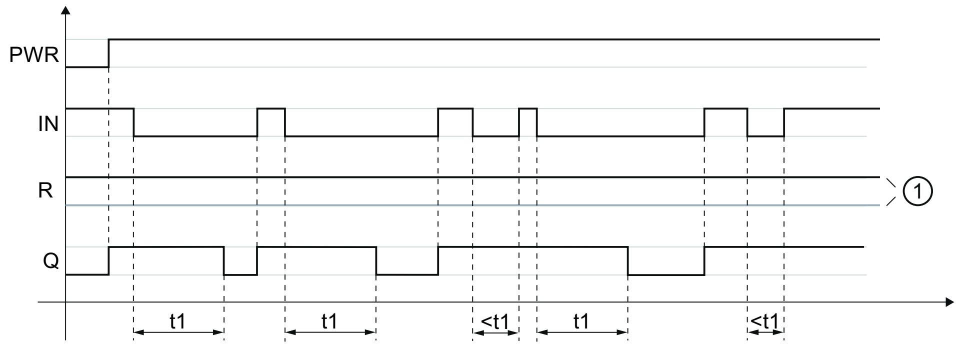
The MSS 3RK3 Basic responds as if the "Reset" parameter has "deactivated" the value.

Functional principle

- If a "1" is detected at input IN and no reset is active, function output Q is set to "1".
- When there is a negative edge "1 → 0" at input IN, delay time "t1" begins.
- When there is a positive edge "0 → 1" at input IN before the the end of delay time "t1", the delay time is reset. Function output Q remains active, i.e. set to "1".
- After the delay time, function output Q is deactivated, i.e. set to "0".

"Reset" = "deactivated" and "Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "deactivated". It also applies for "Reset" = "with positive edge" or "with negative edge", if there is no edge change at input R.



PWR Power supply
IN Function input
Q Function output
R Reset
t1 Delay time
① Either "1" or "0" is present.

Figure 6-32 Timer function "With OFF delay (trigger)" when "Reset" = "deactivated", "with negative edge", or "with positive edge".

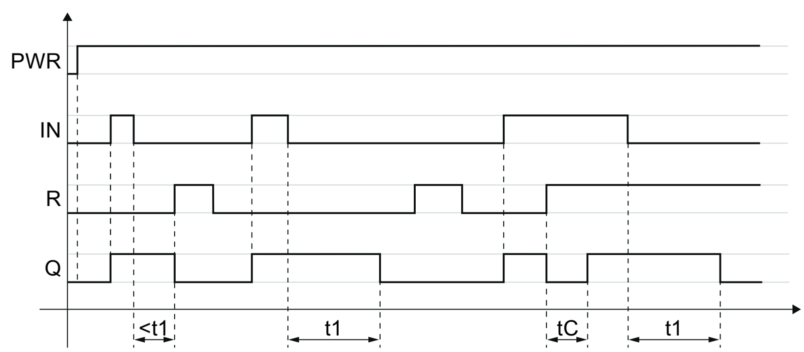
"Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "with positive edge".

Note

"Reset" = "with negative edge"

The behavior of the function element when "Reset" = "with negative edge" is exactly the same as when "Reset" = "with positive edge", except that the signal from R is inverted. Negative edge "1" > "0" is evaluated here.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
tC	Program cycle time

Figure 6-33 Timer function "With OFF delay (trigger)" when "Reset" = "with positive edge"

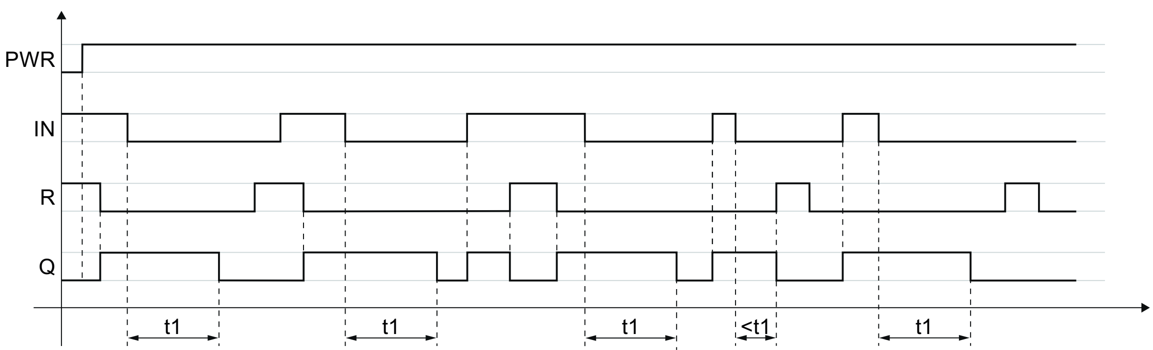
"Reset" = "with level 1"

The following diagram shows the behavior of the function element when "Reset" = "with level 1".

Note

Value "0" is present at function input R

If the value "0" is present at function input R, the behavior of the function element is the same as for the edge evaluation shown in the first diagram.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time

Figure 6-34 Timer function "With OFF delay (trigger)" when "Reset" = "with level 1"

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

Parameter name		Description/parameter value
Parameters	t1[s]	• You enter the delay time here. • The maximum value is 655 s, increment: 5 ms Note that the delay time you specified is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, ch. "*Response times*".
	Reset (not in the case of MSS 3RK3 Basic)	• deactivated The timer cannot be reset selectively to the "initial position". The RLO is set/reset according to the input signal and the timer function. • with positive edge When a positive edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. Afterwards, the element starts over with its functionality.[1] The value of the reset input only becomes irrelevant when a positive edge is detected again. • with negative edge When a negative edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. Afterwards, the element starts over with its functionality.[1] The value of the reset input only becomes irrelevant when a negative edge is detected again. • with level 1 When the value "1" is detected at the reset input, all timers and the RLO are reset to the value "0" as long as the value "1" is present. The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle. The element starts over with its functionality only when the value "0" is detected again at the reset input. [1]

[1] "Starts over" applies to timer functions that are started by level 1 at the timer trigger input: The timers are started if the value "1" is present at the timer trigger input.

6.7.10.7 Clocking

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Timer functions	Clocking		✓	✓

Description

Note

The time value is not stored. At the start of safety mode, all time values begin with their initial values.

The safety relay supports the timer function "Clocking". The output is switched on and off periodically based on a parameterizable pulse/interval ratio.

The timer function has:

- 2 inputs: IN, R - Reset
- A function output Q for the result of logic operation (RLO)

Note

MSS 3RK3 Basic limitation

MSS 3RK3 Basic does not support a reset input for this function element.

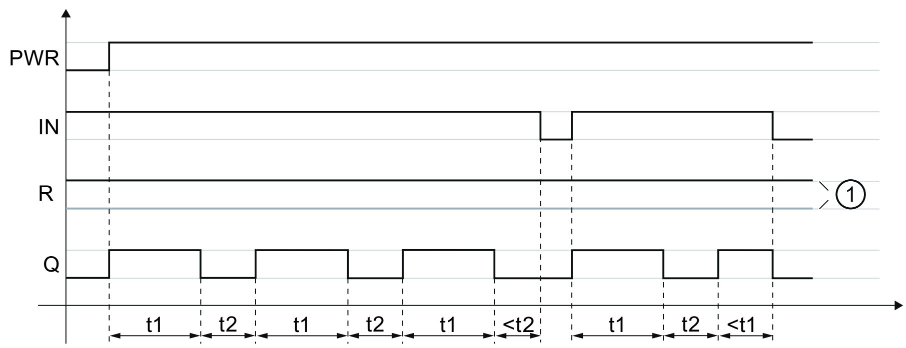
The MSS 3RK3 Basic responds as if the "Reset" parameter has "deactivated" the value.

Functional principle

- If a "1" is detected at input IN and no reset is active, the clock pulse generator starts. The function output Q sends pulses as long as the input is set to "1".
- When there is a negative edge "1 → 0" at input IN, the clock pulse generator stops and sets the function output Q to "0".

"Reset" = "deactivated" and "Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "deactivated". It also applies for "Reset" = "with positive edge" or "with negative edge", if there is no edge change at input R.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
①	Either "1" or "0" is present.

Figure 6-35 Timer function "Clocking" when "Reset" = "deactivated", "with negative edge", or "with positive edge".

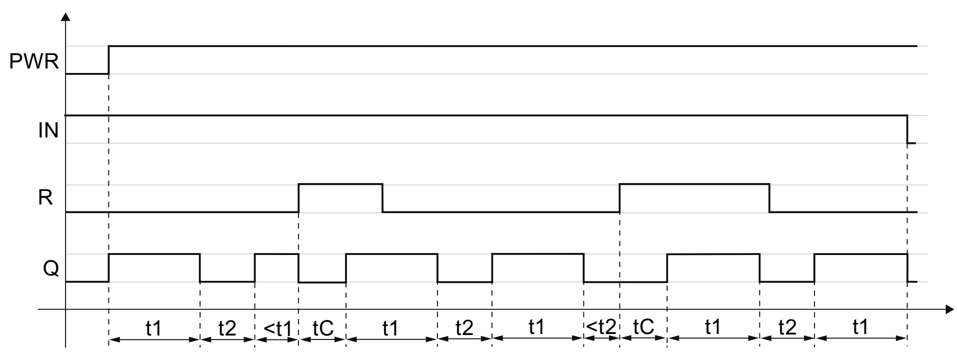
"Reset" = "with positive edge" or "with negative edge"

The following diagram shows the behavior of the function element when "Reset" = "with positive edge".

Note

"Reset" = "with negative edge"

The behavior of the function element when "Reset" = "with negative edge" is exactly the same as when "Reset" = "with positive edge", except that the signal from R is inverted. Negative edge "1" > "0" is evaluated here.



PWR	Power supply
IN	Function input
Q	Function output
R	Reset
t1	Delay time
tC	Program cycle time

Figure 6-36 Timer function "Clocking" when "Reset" = "with positive edge"

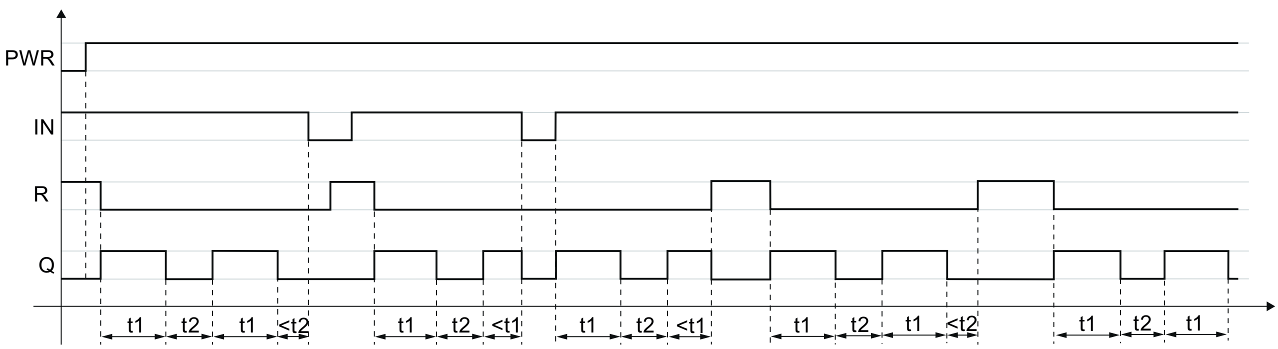
"Reset" = "with level 1"

The following diagram shows the behavior of the function element when "Reset" = "with level 1".

Note

Value "0" is present at function input R

If the value "0" is present at function input R, the behavior of the function element is the same as for the edge evaluation shown in the first diagram.



PWR Power supply
IN Function input
Q Function output
R Reset
t1 Delay time

Figure 6-37 Timer function "Clocking" when "Reset" = "with level 1"

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

<table>
<tr><th colspan="2">Parameter name</th><th>Description/parameter value</th></tr>
<tr><td rowspan="3">Parameters</td><td>t1[s]</td><td rowspan="2">• Enter the pulse time t1 and the pause time t2 for the clock-pulse generator.
• The maximum value is 655 s, increment: 5 ms
Please note that the times you specified are a multiple of the program cycle time you specified in the properties of the 3RK3 central unit.
For additional information on the program cycle time, see the "3RK3 Modular Safety System" manual, ch. "Response times".</td></tr>
<tr><td>t2[s]</td></tr>
<tr><td>Reset
(not in the case of MSS 3RK3 Basic)</td><td>• deactivated
The timer cannot be reset selectively to the "initial position".
The RLO is set/reset according to the input signal and the timer function.
• with positive edge
When a positive edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle.
Afterwards, the element starts over with its functionality.[1)] The value of the reset input only becomes irrelevant when a positive edge is detected again.
• with negative edge
When a negative edge is detected at the reset input, all timers and the RLO are reset once to the value "0". The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle.
Afterwards, the element starts over with its functionality.[1)] The value of the reset input only becomes irrelevant when a negative edge is detected again.
• with level 1
When the value "1" is detected at the reset input, all timers and the RLO are reset to the value "0" as long as the value "1" is present. The signal status at the timer trigger input is ignored in this process. The RLO assumes the value "0" for at least one program cycle.
The element starts over with its functionality only when the value "0" is detected again at the reset input. [1)]</td></tr>
</table>

[1)] "Starts over" applies to timer functions that are started by level 1 at the timer trigger input: The timers are started if the value "1" is present at the timer trigger input.

6.7.11 Start functions

6.7.11.1 Monitored start

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Start functions	Monitored start		✓	✓

Description

The "Monitored start" function element requires as start condition status "1" at input IN and input START. When this condition is fulfilled, the function output Q is activated, i.e. set to "1".

The start signal at the START input is only valid when the following applies:

- The time sequence of the START signal corresponds to the values "0 → 1 → 0".
- Value "1" must be present for 0.15 to 2 s.

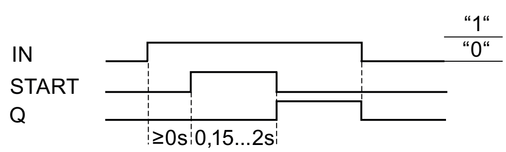


Figure 6-38 Start function "Monitored start"

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

6.7.11.2 Manual start

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Start functions	Manual start		✓	✓

Description

The "Manual start" function element requires as start condition status "1" at input IN and input START. When this condition is fulfilled, the function output Q is activated, i.e. set to "1".

The start signal at the START input is only valid when the following applies:

The time sequence of the START signal corresponds to the values "0 → 1".

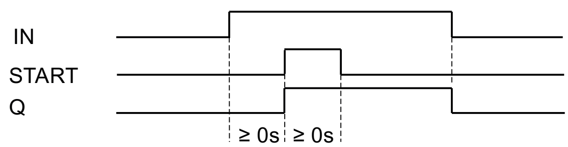


Figure 6-39 Manual start

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1

6.7.12 Output functions

6.7.12.1 Standard output

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Output functions	Standard output	Q	✓	✓

Description

The "Standard output" function element is required to switch the hardware outputs of the standard output group.

> **WARNING**
>
> **Erroneous start on transmission error at fieldbus inputs**
>
> **Will Cause Death, Serious Injury or Property Damage**
>
> Transmission errors at the fieldbus inputs can result in an erroneous start in which the system starts accidentally. To prevent this, the start type must be parameterized as "monitored."

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When the parameter is deactivated, the set substitute value is made available at output Q.
	Substitute value - Q1	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
Parameters - Output circuit	Q1	Select the output for the processed signal.
	Auxiliary outputs	Select whether auxiliary outputs are to be activated: • No • One auxiliary output • Two auxiliary outputs
	AUX1	Only available when at least one auxiliary output is activated: Select the output to which the processed signal is to be output. The auxiliary output AUX1 supplies the same signal as Q. It can be switched with safe or standard modules.
	AUX2	Only available when two auxiliary outputs are activated: Select the output for the processed signal. The auxiliary output AUX2 supplies the same signal as Q. It can be switched with safe or standard modules.
Parameter - Start (not in the case of MSS 3RK3 Basic)	Start type	• Automatic: The function output is set as soon as all start conditions are fulfilled. • Monitored: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1 → 0." • Manual: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1."

6.7.12.2 F output

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Output functions	F output	Q	✓	✓

Description

The "F output" function element can be used to switch the hardware outputs of the safety-related modules on one or two channels.

> **WARNING**
>
> **Erroneous start on transmission error at fieldbus inputs**
>
> **Will Cause Death, Serious Injury or Property Damage**
>
> Transmission errors at the fieldbus inputs can result in an erroneous start in which the system starts accidentally. To prevent this, the start type must be parameterized as "monitored." This is necessary to achieve SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

Note

On a signal change at function input FEEDBACK, an error is generated immediately if the signal at function output FAULT has not changed.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Substitute value - Q1	"0" or "1" can be assigned to the substitute value when the element is deactivated. Substitute value "0" means output Q = 0 substitute value "1" means output Q = 1
	Substitute value - Q2	Only available with output type "Redundant F output": "0" or "1" can be assigned to the substitute value when the element is deactivated.
Parameters	Output type	Select the output type: • Single F output • Redundant F output
Parameters - Feedback circuit	Monitoring	The signal at the feedback circuit input is monitored with time delay by comparing it with the current status of the function output. Select the type of feedback circuit monitoring: • Deactivated • For OFF and ON status • For OFF status
	Switching time [s]	Parameters are only available when Parameters - Feedback circuit monitoring "For OFF and ON status" or "For OFF status" is activated. Select the switching time of the "auxiliary contacts" that depends on the function element. Note that the entered feedback circuit switching time is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the *"3RK3 Modular Safety System" manual,* Chapter *"Response times."*

Parameter name		Description/parameter value
Parameters - Output circuit	Q1	Select the output for the processed signal. Q1 can only be interconnected with the output of a safe module of the main system.
	Q2	Only available with output type "Redundant F output": Select the output for the processed signal. Q2 can only be interconnected with the output of a safe module of the main system.
	Auxiliary outputs	Select whether auxiliary outputs are to be activated: • No • One auxiliary output • Two auxiliary outputs
	AUX1	Only available when at least one auxiliary output is activated: Select the output to which the processed signal is to be output. The auxiliary output AUX1 supplies the same signal as Q. It can be switched with safe or standard modules.
	AUX2	Only available when two auxiliary outputs are activated: Select the output for the processed signal. The auxiliary output AUX2 supplies the same signal as Q. It can be switched with safe or standard modules.
	FAULT	Select the output for the processed signal.
Parameter - Start (not in the case of MSS 3RK3 Basic)	Start type	• Automatic: The function output is set as soon as all start conditions are fulfilled. • Monitored: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1 → 0." • Manual: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1."

6.7.12.3 AS-i 1..4F-DO

Function element		Symbol	MSS 3RK3 Basic	MSS 3RK3 Advanced MSS 3RK3 ASIsafe
Output functions	AS-i 1..4F-DO	AS-i	-	✓

Note

The function element is available in MSS ES only when using an MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended. If an MSS 3RK3 Basic is configured in the configuration, the function element will be hidden in the catalog window.

Description

With the "AS-i 1..4F-DO" function element, safety-related AS-i outputs can be switched. A safety-related AS-i output module can contain up to four safe outputs, wherein only one fail-safe output can be active at any given time.

Up to 12 safety-related AS-i-outputs can be set/reset independently. The element can be placed multiple times for this purpose. You connect the F-OUT1 ... 4 signals from the safety-related AS-i output with the corresponding AS-i address to the "output terminals" of the individual function elements.

Properties

The "AS-i 1..4F-DO" function element has the following properties:

- 4 function outputs for setting/resetting the 4 safety-related F-OUT1..4 outputs of an ASIsafe output slave. The equipment identifier (BMK) in the terminal address is that of the safety relay and not that of the ASIsafe output slave.
- One function input each for setting/resetting the 4 safety-related AS-i outputs. These function inputs are monitored in such a way that only one of the function inputs can have the value "1" at any one time. If this condition is violated, all safety-related outputs of this function element will be shut down and an error message to this effect is generated.
- 2 function inputs with which you can set and reset the two non-safety-related auxiliary control signals AUX1 and AUX2.

Note

Non-safety-related auxiliary control signals (AUX1/AUX2)

In addition to the safety-related control signals (code sequences) of the AS-i outputs, non-safety-related auxiliary control signals (AUX1, AUX2) can also be transmitted. These are used, for example, to acknowledge a restart inhibit or to release errors at AS-i outputs. Additional information can be found in the relevant documentation of the safety-related AS-i output.

The auxiliary control signals AUX1 and AUX2 are defined as pulses. That is why these terminals must not be used for static signals. This pulse is generated as soon as an edge change from zero to one is detected at the respective AUX input (an edge change from one to zero is not taken into consideration).

If a simultaneous edge change is detected for both inputs, the pulse for AUX2 is output after the pulse for AUX1.

Note

Forcing

Only one of the function outputs can have the value "1" at any one time. The other outputs are automatically forced to the value "0." If forcing of an output is canceled, forcing of all other outputs will also be canceled. If multiple outputs are forced to "1," the code sequence of the output with the lowest number will be output.

WARNING

Erroneous start on transmission error at fieldbus inputs

Will Cause Death, Serious Injury or Property Damage

Transmission errors at the fieldbus inputs can result in an erroneous start in which the system starts accidentally. To prevent this, the start type must be parameterized as "monitored." This is necessary to achieve SIL 3 as per EN 61508 and PL e as per EN ISO 13849-1.

Note

On a signal change at function input FEEDBACK_1 ... 4, an error is generated immediately if the signal at function output FAULT has not changed.

Parameters

Parameter name		Description/parameter value
General	Name	You can enter a name for the element here.
	Comment	This text appears above the function element in the diagram. This may, for example, be information about this function element.
	Element number	Consecutive number that is automatically assigned. You can change the number.
	Element activated	When this parameter is active, the function element is processed in the safety logic. When this parameter is deactivated, the set substitute value is made available at output Q.
	Function output substitute value	The substitute value "1" can only be assigned to one output at a time. "0" is automatically assigned to all others. "0" or "1" can be assigned to the substitute value when the element is deactivated.
Parameters	Output type	Select the number of safety-related outputs required: • 1F-DO • 2F-DO • 3F-DO • 4F-DO
Parameter - Feedback circuit - for outputs 1 to 4	Monitoring	The signal at the feedback circuit input is monitored with time delay by comparing it with the current status of the function output. Select the type of feedback circuit monitoring: • Deactivated • For OFF and ON status • For OFF status
	Switching time [s]	Parameters are only available when Parameters - Feedback circuit monitoring "For OFF and ON status" or "For OFF status" is activated. Select the switching time of the "auxiliary contacts" that depends on the function element. Note that the entered feedback circuit switching time is a multiple of the program cycle time you specified in the properties of the 3RK3 central unit. For additional information on the program cycle time, see the "*3RK3 Modular Safety System*" manual, Chapter "*Response times*".
Parameters - Output circuit	Q1	Select the output for the processed signal.
	Q2-Q4	The fields are activated by the Output type parameter. The outputs are assigned automatically according to the selected output Q1. All 4 outputs must be on the same slave.
	FAULT	Select the output for the processed signal.

Parameter name		Description/parameter value
Parameter - Start	Start type	• Automatic: The function output is set as soon as all start conditions are fulfilled. • Monitored: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1 → 0." • Manual: Function output Q is set as soon as all start conditions are fulfilled and the start signal is changed from "0 → 1."

7 Operation

7.1 Response times

Verification of response times in the case of safety circuits

When safety equipment is commissioned, steps must be taken to verify that a safety-related output will switch off within a maximum permissible response time if the input signal changes at the relevant input.

To provide this verification, you must determine the total response time of the application you have configured.

WARNING
Note that the calculation of the response time affects the level of safety and governs the overall design of the system.

Note

If field bus and EM signals are logically combined, runtime synchronism must be considered. It is the responsibility of the manufacturer to ensure that the system or machine is functioning properly as a whole.

7.1.1 Response time of the logic of the MSS 3RK3

When calculating the response time of the logic of the MSS 3RK3, the following times configured in the MSS ES must be considered:

- Program cycle time of the central unit
  - Without AS-i interface (3RK3 Basic): 10 ... 60 ms
  - With AS-i interface (3RK3 Advanced, 3RK3 ASIsafe basic, and 3RK3 ASIsafe extended):

	Program cycle time		
	3RK3 Advanced	3RK3 ASIsafe basic	3RK3 ASIsafe extended
AS-i interface activated	15 ... 60 ms	15 ... 60 ms	15 ... 60 ms
AS-i interface deactivated	10 ... 60 ms	10 ... 60 ms	10 ... 60 ms

- Relevant input delay times for monitoring functions and input cells at the inputs of the expansion modules
- Relevant timer functions in the logic (timer)

Maximum response time t_{RL} of the logic of the MSS 3RK3

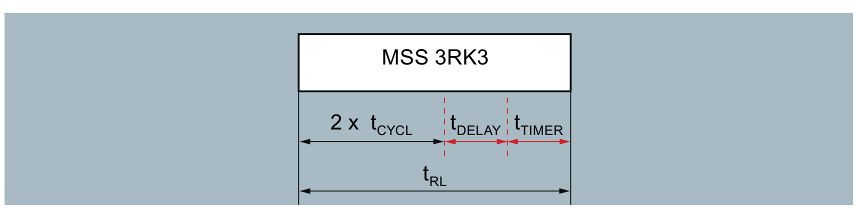


Figure 7-1 Maximum response time of the logic of the MSS 3RK3

Calculation formula for the maximum response time of the logic of the MSS 3RK3

$$t_{RL} = (2 \times t_{CYCL}) + t_{DELAY} + t_{TIMER}$$

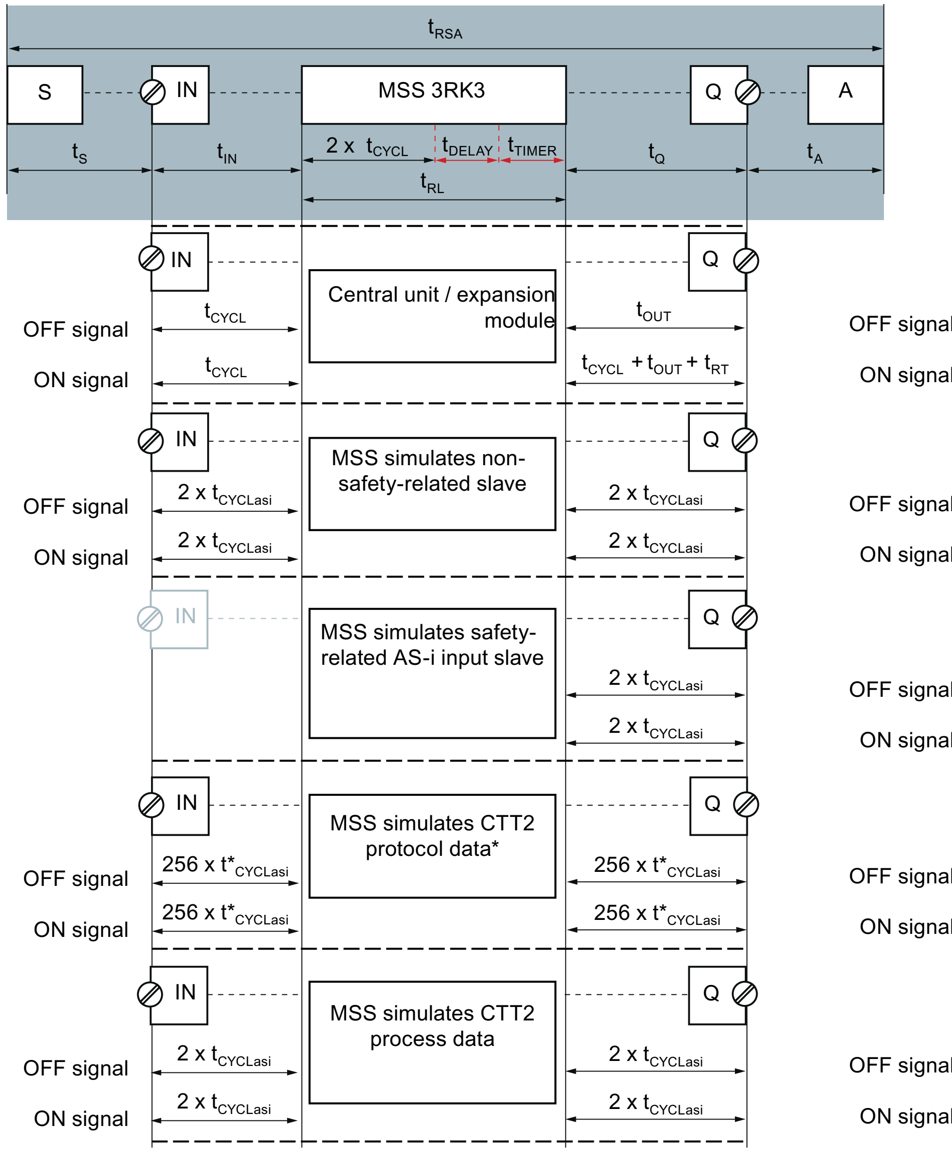
Formula	Description
t_{RL}	Maximum response time of the logic of the MSS 3RK3
t_{CYCL}	Program cycle time of the MSS 3RK3
t_{DELAY}	Input delay for monitoring functions and input cells at the inputs
t_{TIMER}	Timer functions in the logic (timer)

7.1.2 Total response time "sensor - actuator"

The total response time of the MSS 3RK3 is dependent on the functions that the MSS 3RK3 performs in the respective case. In both graphics below, all times that can occur are shown in compact form.

These times are dependent on two factors:

- Type of terminals used to connect the sensor or actuator to the logic of MSS 3RK3, e.g., terminal on the device or via AS-i bus
- Signal change:
  - "OFF signal" means the change from the ON state to the OFF state (1 > 0).
  - "ON signal" means the change from the OFF state to the ON state (0 > 1).



* This response time only applies if transmission of the cyclic data is not delayed by acyclic data transfer. In this case, the response time of input terminals t_{IN} or the response time of the output terminals t_Q is 256 x $t_{CYCLasi}$ + 16 s.

Figure 7-2 Total response time "sensor - actuator" - part 1

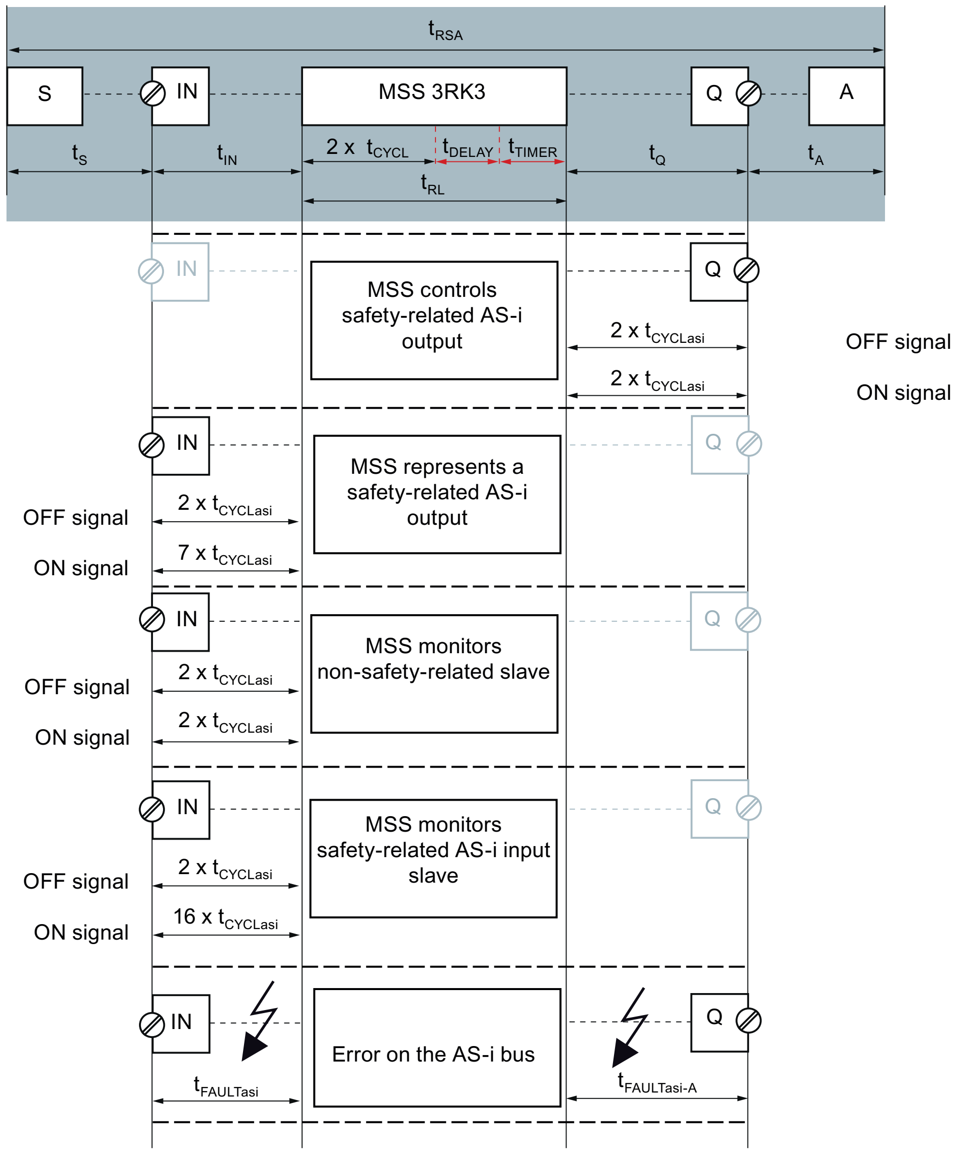


Figure 7-3 Total response time "sensor - actuator" - part 2

S	Sensor (provides an OFF or ON signal)
IN	Input terminal
Q	Output terminal
A	Actuator
t_{RSA}	Total response time of the system from a sensor (S) to an actuator (A)
t_S	For the response time of the sensor (S), see the documentation of the sensor
t_{IN}	Transmission duration from signal acquisition at the input terminal (IN) to the logic of the MSS 3RK3; depending on the signal
t_{RL}	Response time of the logic of the MSS 3RK3, see Chapter "Response time of the logic of the MSS 3RK3 (Page 398)"
t_{DELAY}	Input delay for monitoring functions and input cells at the inputs
t_{TIMER}	Timer functions in the logic (timer)
t_Q	Transmission duration from the logic of the MSS 3RK3 to the output terminal (Q); depending on the signal; for values, see the graphic above
t_A	For the response time of the actuator (A) including the time until the signal has been received and processed by the actuator, see the documentation of the actuator.
t_{CYCL}	Program cycle time of the MSS 3RK3, configured in MSS ES
$t_{CYCLasi}$	AS-i cycle time, max. 5 ms
t_{OUT}	Response time of the output terminal on the expansion module (EM Q) • Solid-state outputs: 10 ms • Relay outputs: 20 ms
t_{RT}	Restart standby time of the • safe outputs: 420 ms • non-safety-related outputs: 0 ms
$t_{FAULTasi}$	Response time of the MSS 3RK3 in case of an error on the AS-i bus: Max. 32 ms
$t_{FAULTasi-A}$	Response time of the AS-i actuator in case of an error on the AS-i bus: see the documentation of the AS-i actuator

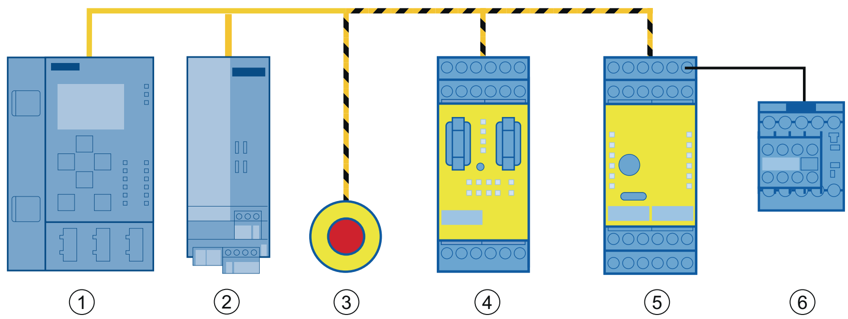
Calculation formula for the overall response time of the system

$t_{RSA} = t_S + t_{IN} + t_{RL} + t_Q + t_A$

Formula	Description
t_{RSA}	Total response time of the system from a sensor (S) to an actuator (A)
t_S	For the response time of the sensor (S), see the documentation of the sensor
t_{IN}	Transmission duration from signal acquisition at the input terminal (IN) to the logic of the MSS 3RK3; depending on the signal
t_{RL}	Response time of the logic of the MSS 3RK3
t_Q	Transmission duration from the logic of the MSS 3RK3 to the output terminal (Q); depending on the signal; for values, see the graphic above
t_A	For the response time of the actuator (A), see the documentation of the actuator

7.1.3 Examples of the total response time with MSS 3RK3 Advanced

Example 1



① AS-i master
② AS-i power section
③ Fail-safe AS-i EMERGENCY STOP
④ MSS 3RK3 Advanced
⑤ Safety-related AS-i output
⑥ Contactor

Figure 7-4 Configuration MSS 3RK3 Advanced - example 1

This case considers the signal flow from a safety-related AS-i sensor (AS-i EMERGENCY STOP) to a safety-related AS-i output. The EMERGENCY STOP transmits an OFF signal to the MSS 3RK3 Advanced. The MSS 3RK3 monitors this safety-related AS-i input slave. After taking input delay times and timer functions in the logic into account, the MSS 3RK3 Advanced transmits a signal to the safety-related AS-i output that shuts down the system. In this way, MSS 3RK3 controls a safety-related AS-i output.

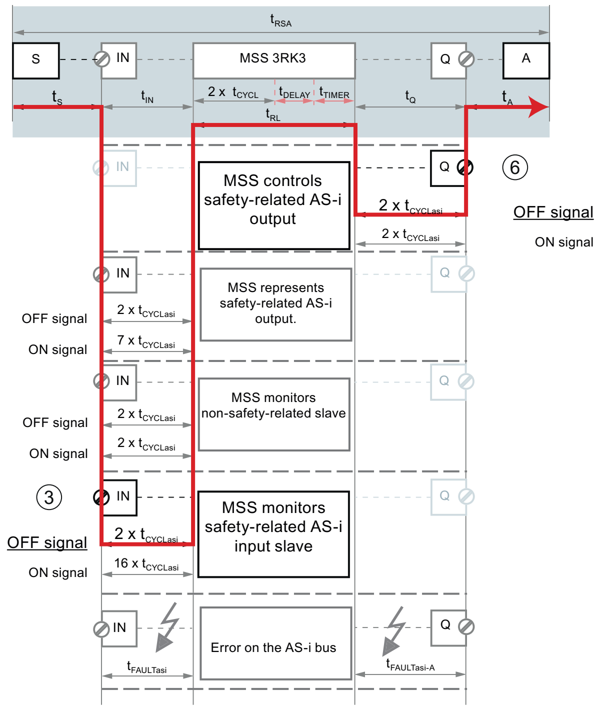


Figure 7-5 Signal flow of example 1

The total response time is calculated as follows:

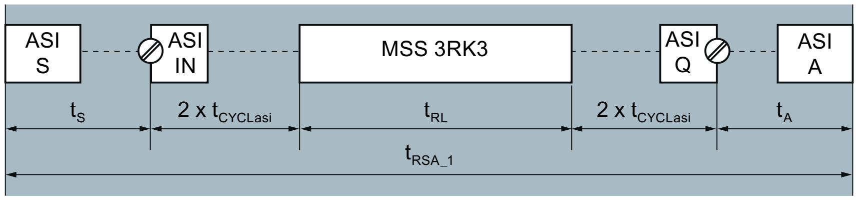
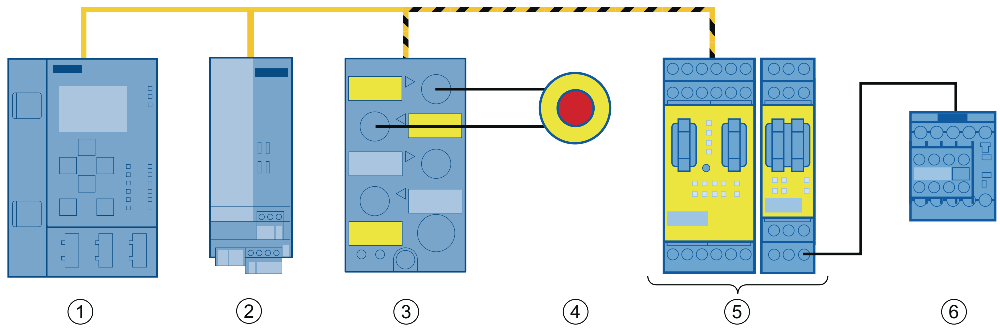


Figure 7-6 Total response time MSS 3RK3 Advanced - example 1

$$t_{RSA\_1} = t_S + (2 \times t_{CYCLasi}) + t_{RL} + (2 \times t_{CYCLasi}) + t_A$$
$$= t_S + (4 \times t_{CYCLasi}) + t_{RL} + t_A$$

Formula	Description
t_{RSA_1}	Total response time of the system from a safety-related AS-i sensor (ASI S) to a safety-related AS-i output (ASI A)
t_S	Response time of the AS-i sensor (ASI S), see the documentation of the sensor
$t_{CYCLasi}$	• Transmission duration from signal acquisition on the safety-related AS-i input slave (ASI IN) to the logic of the MSS 3RK3 • Transmission duration from the logic of the MSS 3RK3 to the input terminal on the safety-related AS-i output (ASI Q) AS-i cycle time, max. 5 ms
t_{RL}	For the response time of the logic of the MSS 3RK3, see Chapter "Response time of the logic of the MSS 3RK3 (Page 398)"
t_A	Response time of the AS-i output (ASI A), see the documentation of AS-i output

Example 2



① AS-i master
② AS-i power section
③ Safety-related AS-i input slave
④ Fail-safe EMERGENCY STOP
⑤ MSS 3RK3 Advanced
⑥ Contactor

Figure 7-7 Configuration MSS 3RK3 Advanced - example 2

This case considers the signal flow from an EMERGENCY STOP on a safety-related AS-i input slave to an actuator (contactor) via the output terminal of an expansion module.

The EMERGENCY STOP transmits an OFF signal to the input slave. The slave transfers the signal via the AS-i bus in a safety-related manner. MSS 3RK3 monitors this safety-related AS-i input slave and processes the information in the logic. After taking input delay times and timer functions in the logic into account, the MSS 3RK3 Advanced shuts the system down by means of a contactor.

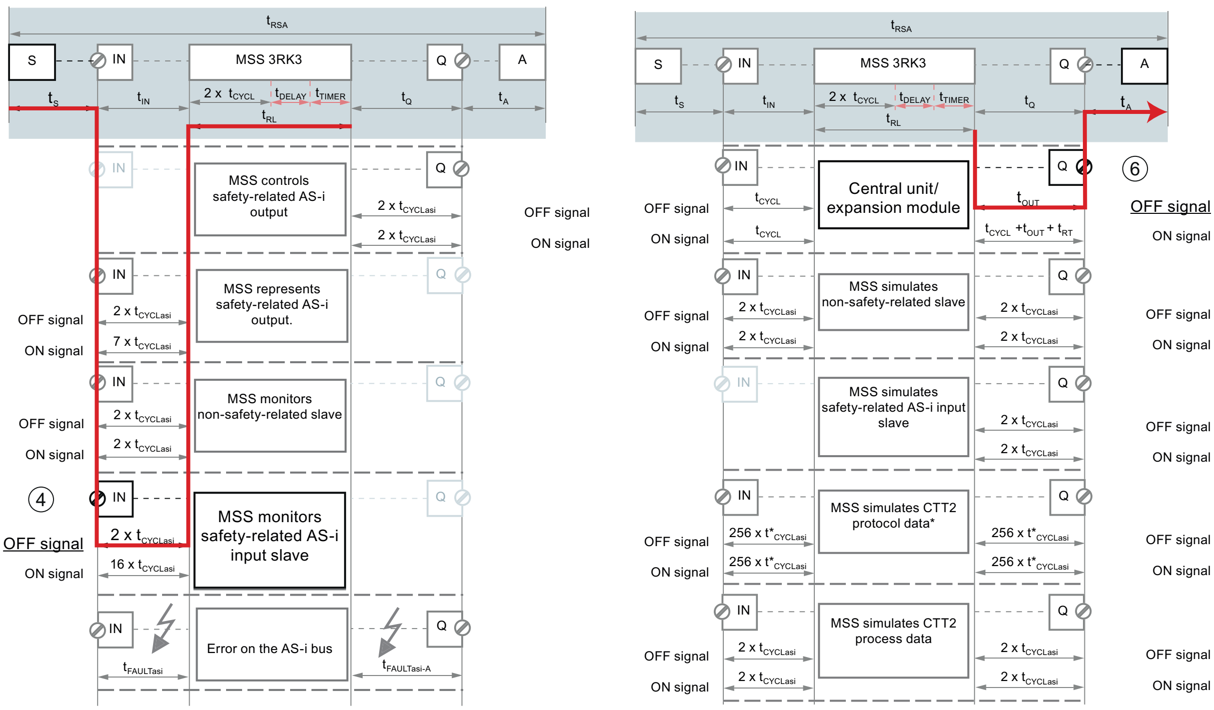


Figure 7-8 Signal flow of example 2

The total response time is calculated as follows:

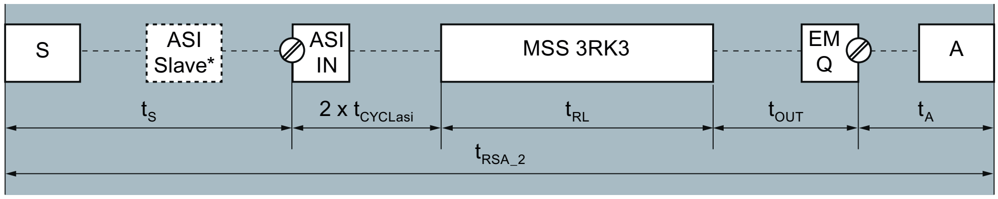


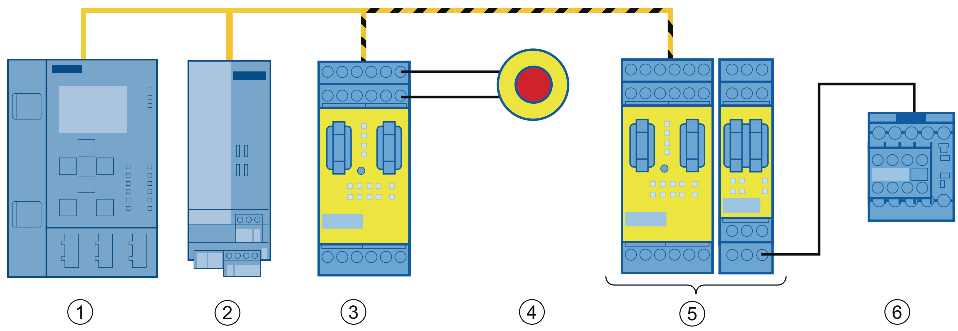
Figure 7-9 Total response time MSS 3RK3 Advanced - example 2

*The AS-i slave only has to be considered if the utilized slave does not forward the changed input signal directly to the bus and its signal processing thus contributes to the system response time. Refer to the documentation of the input slave for the appropriate value.

$$t_{RSA\_2} = t_S + (2 \times t_{CYCLasi}) + t_{RL} + t_{OUT} + t_A$$

Formula	Description
t_{RSA_2}	Total response time of the system from an EMERGENCY STOP (S) on a safety-related AS-i input slave to an actuator (A)
t_S	For the response time of the sensor (S), see the documentation of the sensor. (If an immediate response cannot be assumed for the AS-i slave, the response time of the AS-i slave must also be considered at this point. Note also example 3.)
$t_{CYCLasi}$	Transmission duration of the signals evaluated by the AS-i input slave (ASI IN) via the AS-i bus up until the logic of the MSS 3RK3: AS-i cycle time, max. 5 ms
t_{RL}	For the response time of the logic of the MSS 3RK3, see Chapter "Response time of the logic of the MSS 3RK3 (Page 398)"
t_{OUT}	Transmission duration from the logic of the MSS 3RK3 to the output terminal on the expansion module (EM Q) • Solid-state outputs: 10 ms • Relay outputs: 20 ms
t_A	For the response time of the actuator (A), see the documentation of the actuator

Example 3



① AS-i master
② AS-i power section
③ MSS 3RK3 Advanced No. 1
④ Fail-safe EMERGENCY STOP
⑤ MSS 3RK3 Advanced No. 2
⑥ Contactor

Figure 7-10 Configuration MSS 3RK3 Advanced - example 3

This case considers the signal flow from an EMERGENCY STOP on an input of an MSS 3RK3 Advanced via the AS-i bus (direct data exchange) to another MSS 3RK3 Advanced and then to an actuator (contactor) via the output terminal of an expansion module.

The EMERGENCY STOP transmits an OFF signal to the first MSS 3RK3 Advanced. This unit processes the signal in its logic. After taking input delay times and timer functions in the logic into account, it forwards the information to the AS-i bus via a simulated AS-i input slave. The second MSS 3RK3 monitors this safety-related AS-i input slave and, in turn, processes the information in its logic. After taking input delay times and timer functions in the logic into account, the second MSS 3RK3 Advanced shuts the system down by means of a contactor.

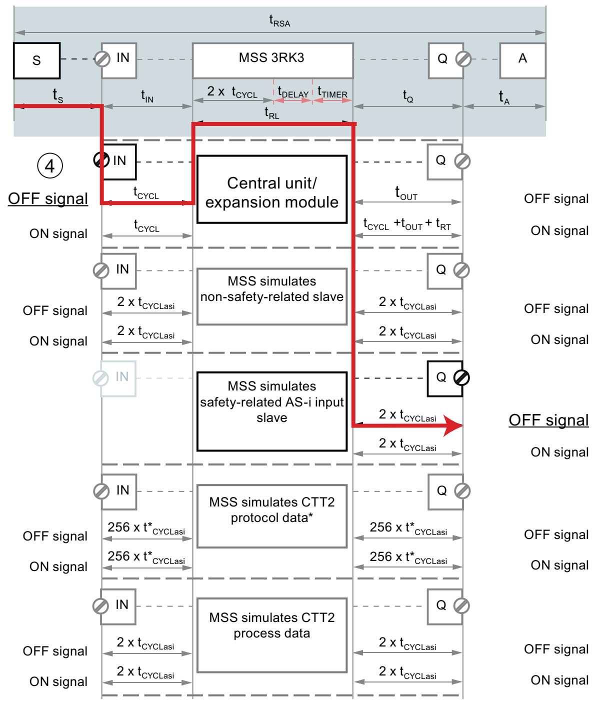


Figure 7-11 Signal flow of example 3 for MSS 3RK3 Advanced No. 1

The total response time of subsystem 1 is calculated as follows:

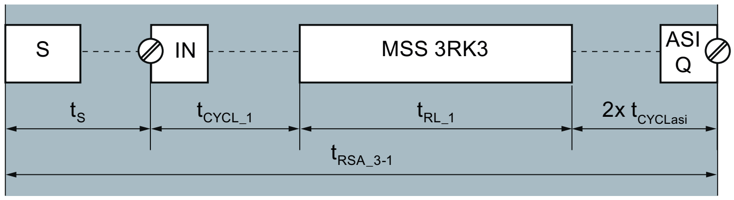


Figure 7-12 Total response time MSS 3RK3 Advanced No. 1 - example 3

$$t_{RSA\_3-1} = t_S + t_{CYCL\_1} + t_{RL\_1} + (2x\ t_{CYCLasi})$$

Formula	Description
t_{RSA_3-1}	Total response time of the subsystem from a safety-related EMERGENCY STOP (S) to transmission of the switching status to the AS-i bus. Only subsystem 1 is considered.
t_S	For the response time of the sensor (EMERGENCY STOP), see the documentation of the sensor.
t_{CYCL_1}	Set cycle time of MSS 3RK3 Advanced No. 1 When AS-i is used, values between 15 ms and 60 ms can be set.
t_{RL_1}	For the response time of the logic of the MSS 3RK3, see Chapter "Response time of the logic of the MSS 3RK3 (Page 398)"
$t_{CYCLasi}$	AS-i cycle time, max. 5 ms

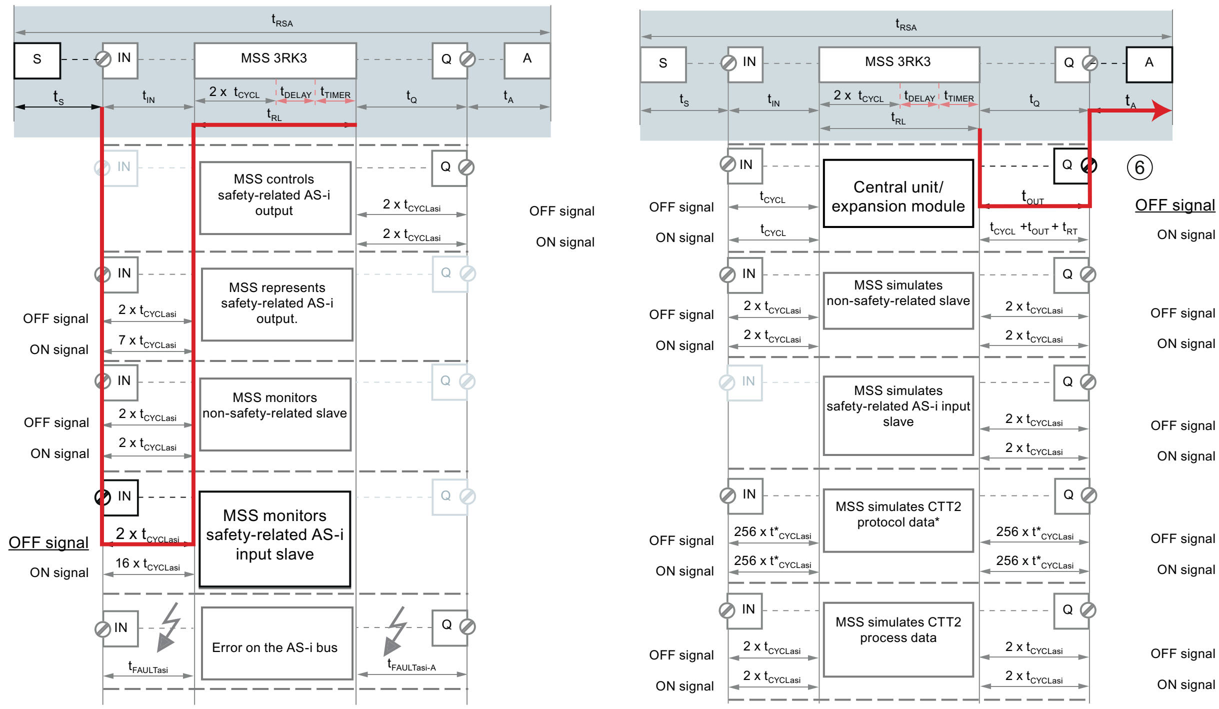


Figure 7-13 Signal flow of example 3 for MSS 3RK3 Advanced No. 2

The total response time of subsystem 2 is calculated as follows:

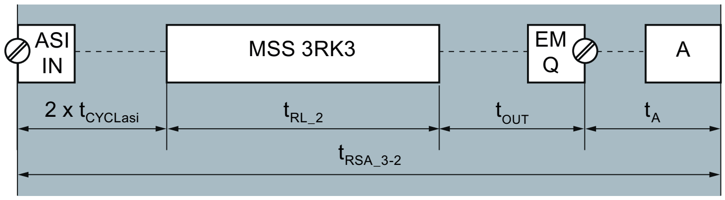


Figure 7-14 Total response time MSS 3RK3 Advanced No. 2 - example 3

$$t_{RSA\_3\text{-}2} = (2x\ t_{CYCLasi}) + t_{RL\_2} + t_{OUT} + t_A$$

Formula	Description
$t_{RSA\_3\text{-}2}$	Total response time of the subsystem from a safety-related EMERGENCY STOP (S) to transmission of the switching status to the AS-i bus. Only subsystem 1 is considered.
t_{RL_2}	For the response time of the logic of the MSS 3RK3, see Chapter "Response time of the logic of the MSS 3RK3 (Page 398)"
$t_{CYCLasi}$	AS-i cycle time, max. 5 ms
t_A	For the response time of the actuator (A), see the documentation of the actuator

The total response time is calculated as follows:

To calculate the total response time from the sensor up to the actuator, the two sub-response times must be added. Because no sensor or actuator hangs between the two MSS 3RK3 units, t_S and t_A do not have to be considered at this point.

$$t_{RSA\_3} = t_{RSA\_3\text{-}1} + t_{RSA\_3\text{-}2}$$
$$= (t_S + t_{CYCL\_1} + t_{RL\_1} + (2 \text{ x } t_{CYCLasi})) + ((2 \text{ x } t_{CYCLasi}) + t_{RL\_2} + t_{OUT} + t_A)$$
$$= t_S + t_{CYCL\_1} + t_{RL\_1} + (4 \text{ x } t_{CYCLasi}) + t_{RL\_2} + t_{OUT} + t_A$$

Note

It must be noted that t_{CYCL} and t_{RL} may differ for the two systems. They must each be assigned to the correct system.

7.1.4 Time settings in MSS ES

Parameterizing the program cycle time t_{CYCL} of the MSS MSS 3RK3 in MSS ES

The parameter for the program cycle time can be defined as follows:

1. In the "Configuration > Main system" work window, double-click the configured 3RK3 central unit.
2. Enter a value for "Program cycle time [ms]" that is suitable for the scope of your configuration in the "Central unit properties - MSS Slot 3" dialog box.
   - 3RK3 Basic: 10 ... 60 ms
   - 3RK3 Advanced/ 3RK3 ASIsafe basic/ 3RK3 ASIsafe extended: 15 ... 60 ms

     (without AS-Interface: 10 ... 60 ms)

Note

Support by MSS ES

MSS ES helps you configure the program cycle time. The "Status bar (Page 159)" displays the current utilization of the parameterized program cycle time.

Parameterization of the input delay time t_{DELAY} in MSS ES

WARNING
If the input delay increases, the overall response time of the safety program increases.

The parameter for the input delay time can be defined as follows:

1. Double-click the monitoring function/input cell in the work window of the logic diagram for which an input delay time is to be parameterized.
2. Enter a value between 0 ms and 150 ms for "Input delay [ms]" that is suitable for the scope of your configuration in the "Central unit properties" dialog box.

Note

Input delay

The input delay time must be an integer multiple of the program cycle time. If that is not the case, MSS 3RK3 rounds the input delay time to an integer multiple of the program cycle time for safety reasons and MSS ES outputs a warning. If you use safety-related AS-i input terminals, the smallest settable input delay time is 50 ms.

Parameterization of the delay time t_{TIMER} in MSS ES

In MSS ES there are various timer functions with which delay times can be parameterized in the logic:

- With ON delay
- With ON delay (trigger)
- Passing make contact
- Passing make contact (trigger)
- With OFF delay
- With OFF delay (trigger)
- Clocking

Note

Response time when powering down

Not every delay time has to be considered in the response time of the MSS 3RK3 For example, for calculating of the response time when powering down, a parameterized start delay time can be ignored because it does not apply in this case.

The parameter for the delay time can be defined as follows:

1. Double-click on the timer function in the work window of the logic diagram for which a delay time is to be parameterized.
2. Enter an integer multiple of the program cycle time that is suitable for the scope of our configuration for "Time t1 [ms]" in the "Properties ..." dialog box. Setting range: 10 ms ... 655 s.

Note

Delay time

The delay time must be an integer multiple of the program cycle time. If that is not the case, MSS 3RK3 rounds the delay time to an integer multiple of the program cycle time for safety reasons and MSS ES outputs a warning.

7.1.5 Minimum actuating duration at the inputs

The minimum actuating duration at the input is the length of time for which a signal must be present at the input to ensure that it can be reliably detected.

Calculation formula for minimum actuating duration t_{MIN} at the inputs of the MSS 3RK3 (central unit and expansion modules)

$$t_{MIN} = 2 \times t_{CYCL}$$

t_{MIN} Minimum actuating duration at the input terminals of the MSS 3RK3
t_{CYCL} Program cycle time of the MSS 3RK3

Note

Minimum actuating duration of AS-i sensors

The minimum actuating duration of the AS-i sensors depends on the AS-i slave used.

7.2 Passwords

Configuration of and access to the MSS 3RK3 are subject to special password protection because of the safety technology. You can assign three passwords:

- Password for device access (optional)
- Password for project access (optional)
- Password for changing to test mode (mandatory)

WARNING
To prevent unauthorized access to the MSS 3RK3 through the PROFIBUS network, you assign a password for device access.

Passwords - Overview

	Password for device access	Password for project access	Password for changing to test mode
Description	• This password prevents unauthorized access to the MSS 3RK3. The password is assigned when the protection level is set. • You can control access to the MSS 3RK3 by setting a protection level. For the MSS 3RK3, the following protection levels can be set: – Write protection – Project write/read protection	• This password protects an offline configuration from unauthorized access. • If you do not enter a password, the configuration is opened as "read only", i.e. you cannot change the configuration	• This password prevents an unauthorized change to "test mode". • It is only possible to change to "test mode" if a valid password has been entered. If no password has yet been assigned for test mode, you have to assign one when changing to test mode. • The default password is "0000".
Assigning / Changing	In MSS ES, via the "Edit" > "Password for device access" menu command. Requirement: You are now in configuring mode and are online.	In MSS ES, via the "Edit" > "Password for project access" menu command. Requirement: You are offline.	In MSS ES, via the "Edit" > "Password for test mode" menu command. Requirement: You are now in configuring mode and are online.

	Password for device access	Password for project access	Password for changing to test mode
Prompt	• Independently of the set protection level: – When changing the device access password. • "Write protection" protection level: – For write access to a safety relay (e.g. when loading), if no access rights exist. • Protection level "Project write protection/read protection": – Just as for the "Write protection" protection level – When opening an online configuration	• When opening an offline configuration • When changing the project access password.	• When switching to test mode via the "Target system" > "Test mode" menu command.
Validity	As long as an access authorization for the safety relay exists.	As long as the offline configuration is open.	The password must be re-entered for each change to test mode.

Note

If you change the passwords, this has no effect on the release status of a configuration.

Deactivate password protection (only password for project access and password for device access)

You can deactivate the password protection again by entering a blank password. To do this, you must first enter the old password. The fields "New password" and "Confirm password" must remain empty.

Forgot password

- The password for project access can be reset.
- Both the password for device access and the password for switching to test mode can only be reset by restoring the factory settings.

Dialog box "Edit" > "Password for project access"

- This password prompt appears in the "Enter password" dialog box when you open an offline configuration.
- If you have still not assigned a password for project access, enter a new password at the prompt "New password" and enter it again to "Confirm password".
- Change the project access password by entering the old password and then entering the new password twice
- Deactivate the password protection for the project by first entering the old password and then entering a blank password twice.
- Use the "Forgot password" button to create a file with the encrypted password if you lose the project access password. Send this file with the activation information to the Siemens hotline. The Siemens hotline will send you a file with an activation code. You will find additional information in Chapter " Forgot password (Page 182)."

Dialog box "Edit" > "Password for device access"

- This password is requested in the case of password-protected write device access (e.g. loading new configuration) or when going online (only in the case of protection level "Project write/read protection").
- You can assign/change/reset the password for device access.
- You can set the protection level with this menu command.

Note

If you have forgotten the password for device access, you must restore the factory settings of the MSS 3RK3. You must do this on the safety relay because commands in MSS ES are password-protected.

Dialog box "Edit" > "Password for test mode"

- This password is requested every time you switch to test mode via the "Target system" > "Test mode" menu command.
- You can assign/change the password for changing to test mode.

Note

If you have forgotten the password for changing to test mode, you must restore the factory settings of the MSS 3RK3. You can do this on the safety relay or by means of a command in the MSS ES.

Prompt for passwords

- Enter password
  - The "Enter password" dialog appears if you open a password-protected configuration, for example.
  - Enter the password and confirm with "OK".
- Password forgotten:
  - If you have forgotten the project access password, you can open the configuration write-protected. To do this, click on the "Cancel" button. An online configuration can only be opened if the protection level has been set to "Write protection".

7.3 Planning/configuring

7.3.1 Modes

The MSS 3RK3 always differentiates between three operating modes:

- Configuring mode
- Test mode
- Safety mode

Configuring mode (DEVICE LED: yellow)

The monitoring functions are not active in configuring mode. No signals are output at the terminals. In configuring mode, you can modify existing parameters. This is done by creating a configuration in the PC / PG with MSS ES and downloading this to the 3RK3 central unit. It is also possible to upload and edit a configuration available in the 3RK3 central unit.

The 3RK3 central unit enters configuring mode after switch-on if	LED display	
	DEVICE	SF
There is no configuration in the device.	yellow	off
The configuration in the device has not been released.	yellow	off
The configuration in the device is incorrect.	yellow	red
A configuration error was identified in test mode.	yellow	red
The connection is interrupted in test mode.	yellow	red
A Category 1 error occurs in safety or test mode. Only diagnosis and reset possible; see Chapter " Diagnostics / service (Page 489)."	Flashing red	red

Test mode (DEVICE LED: flickering green)

Test mode can only be accessed online from configuring mode using a password-protected command. You can switch to test mode even if the configuration has not been released.

The user program is processed in test mode. All monitoring functions are active in accordance with the set parameterization. Logical outputs of function elements can be set, see Chapter "Forcing (Page 431)." This makes it easier to carry out troubleshooting in the application and check the wiring.

Safety mode (DEVICE LED: green)

In safety mode, all monitoring functions are active in accordance with the set parameterization. Safety mode can only be exited by means of a command.

The 3RK3 central unit changes to safety mode:	Display	
	DEVICE	SF
Once the system has been switched on and if the configuration has been released and the test results of the device startup are OK.	green	off
From configuring mode by means of the relevant command.	green	off

7.3.2 Creating a configuration in MSS ES

Requirements

Before you start configuring in MSS ES, you require the following information:

- Structure/wiring of the system
- Required safety functions
- Expanded configuration/wiring of the main system (MSS 3RK3)
- Expanded configuration of the AS-i bus (= subsystems) (not for 3RK3 Basic)

Procedures for configuring in MSS ES

The procedure for configuring in MSS ES has an effect on various functions.

There are basically two ways of configuring:

1. You start with configuring the expanded hardware configuration and then configure the logic. Once you have configured an MSS 3RK3 Basic, all non-supported function elements will no longer be available in the catalog window of the logic diagram.
2. You start with configuring the logic and then configure the expanded hardware configuration. If you use the function elements in the logic diagram that are not supported by MSS 3RK3 Basic, the MSS 3RK3 Basic will no longer be available in the hardware catalog of the configuration.

Configuration

Main system

In MSS ES, the various modules from the hardware catalog are assigned to their slot. Drag each module into the central work space and onto the slot that they really occupy in the expanded configuration.

The minimum expanded configuration consists of one 3RK3 central unit on slot 3. Up to 7 expansion modules can be added for MSS 3RK3 Basic, while MSS 3RK3 Advanced supports up to 9 expansion modules and 3RK3 ASIsafe extended supports a maximum of 2 expansion modules.

An interface module for connection to a higher-level bus system can be optionally configured in slot 2.

An operator control and monitoring module can be configured for MSS 3RK3 Basic in slot 1.

Sub-system

In the subsystem, the real AS-i slaves and AS-i components are configured at their respective AS-i addresses. The hardware catalog contains all supported AS-i components from SIEMENS. Just like in the main system, they can be dragged into the work space and have their AS-i address assigned. Using the universal modules, the profiles of standard and A/B slaves can be defined independently of manufacturer.

Note

Configuration of simulated slaves

Simulated slaves are allocated their AS-i addresses in the properties of the 3RK3 central unit, and the profile is selected. The simulated slaves are displayed in italics in the subsystem.

You will find additional information in Chapter "Configuration (Page 235)."

Logic

The safety logic is created in the logic diagram. The inputs and outputs of the modules of the main system and of the AS-i slaves of the subsystem are combined with function elements. Drag the required function elements onto the work space. Parameterize the individual elements in the relevant element properties that you can open by double-clicking the element. Here, you can set the various parameters and connect the inputs and outputs of the function elements with the inputs and outputs of the modules.

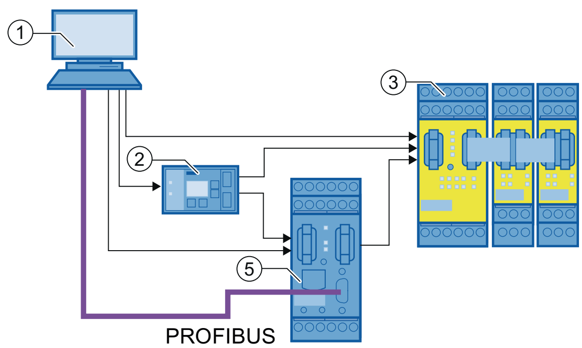
You will find additional information in Chapters "Logic diagram (Page 246)" and "Function elements (Page 271)."

7.3.3 Commissioning

NOTICE
Since commissioning of the MSS 3RK3 is an important, safety-related step, it must be carried out by qualified personnel.

Options for access to the MSS 3RK3

The following graphic shows the various ways of accessing the MSS 3RK3.



① PC or programming device via device interface on the MSS 3RK3 or DP interface
② PC/device interface with diagnostics display on the MSS 3RK3 or DP interface
③ MSS 3RK3
④ PLC over PROFIBUS and DP-Interface
⑤ DP interface

Figure 7-15 Options for access to the MSS 3RK3

Requirements

The following requirements must be met for commissioning:

- The device is mounted.

  You will find additional information in Chapter "Mounting / installing / attaching (Page 110)."

  Check all the latches to ensure that they are properly engaged.
- The device is correctly wired.

  You will find additional information in Chapter "Connecting / wiring (Page 117)."
- The MSS ES software is installed on your PC or programming device with the correct license.

  You will find additional information in Chapter "Installation and program start (Page 152)."
- The configuration is available in a consistent form and saved.
- The utilization of the memory module, of the internal memory, and the program cycle time were monitored.

  You will find additional information in the following chapters:
  - "Status bar (Page 159)"
  - "Settings of Modular Safety System ES - "Download settings" tab (Page 219)"
  - "Response times (Page 397)".

Note

Number of function elements

The number of function elements that can be processed by one MSS 3RK3 depends on the type of function elements. A typical value is 250.

- The power supply unit for the MSS 3RK3 is connected.
- Programming device or PC and MSS 3RK3 are connected.

⚠ WARNING
To prevent unauthorized access to the MSS 3RK3 through the PROFIBUS network, you assign a password for device access.

- The consistency check must only output warnings. Error messages must be remedied.

Load to switching device...

Note

If there is already a released configuration on the 3RK3 central unit, cancel this configuration release with the "Target system" > "Cancel configuration release" menu command.

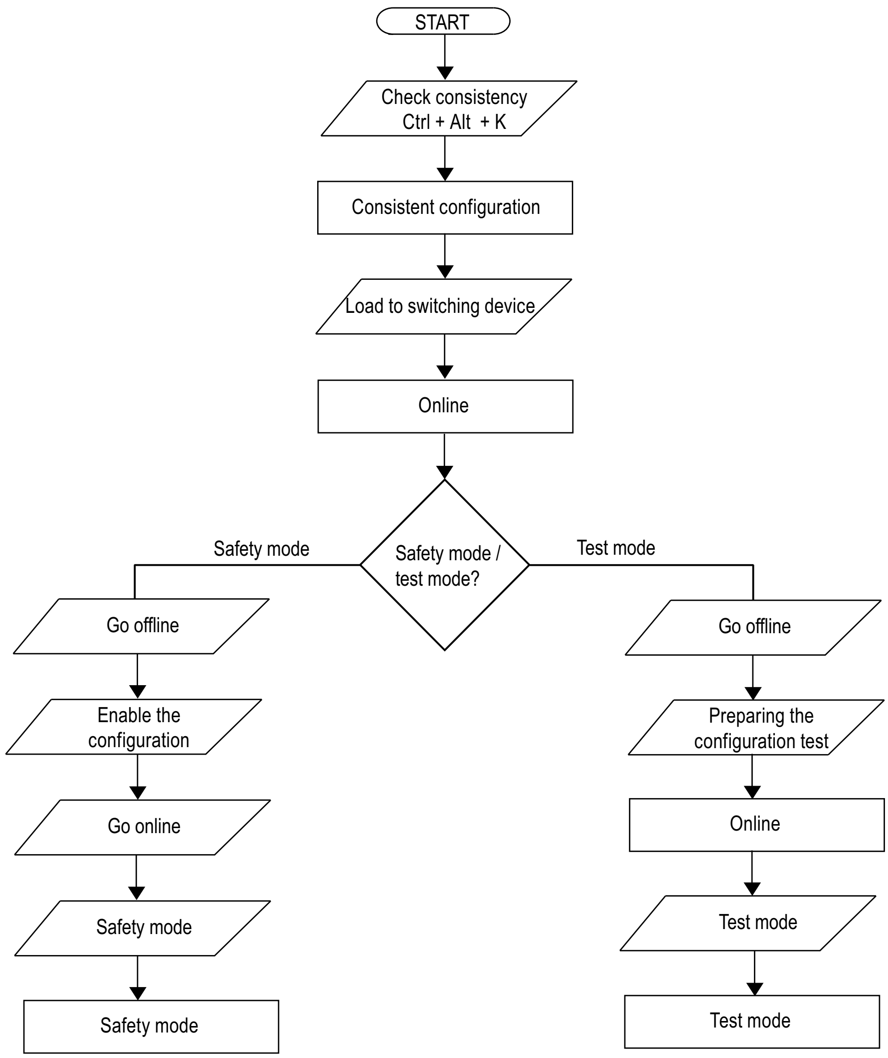


Figure 7-16 Main procedure for commissioning the MSS 3RK3 with factory settings

Perform the following steps to load a configuration into the MSS 3RK3:

Step	Action	Result
1	Switch on the power supply.	The central unit executes a self-test.
2	Open the project in MSS ES.	-
3	Choose the "Target system" > "Load to switching device" menu command and confirm the memory dialog box with "Yes" if you have changed the configuration.	The "Load to switching device" dialog box opens.
4	Set the interface and confirm with "OK".	The configuration data is now downloaded. A message is displayed on completion of the download.
5	Confirm with "OK".	You are now online in configuring mode.

7.3.4 Testing the configuration

Before you can switch the MSS 3RK3 to safety mode, you must conduct a full function test and then release the configuration.

WARNING

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

Carrying out a function test of the configuration

A configuration can only be released if a complete function test of the configuration has been successfully completed (hardware configuration and parameterization of the safety functions).

Project printouts for the test

Use the printouts of the project to support the test.

Step	Action	Result
1	Open the parameter file containing the configuration that you downloaded to the MSS 3RK3.	The configuration is displayed. You are offline.
2	Activate "Target system" > "Prepare configuration test".	The "Prepare configuration test" dialog box opens.
3	Set the interface via which you have access to the device (e.g. COM1) and confirm with "OK".	The project printouts are generated as PDFs. The project switches to online mode.

- The printout contains all the configuration data stored in the safety relay.
- The configuration CRC is given on each page of the printout in the tabular footer. The printout is thus always uniquely assigned to one configuration and can later be used for the plant documentation.
- If deviations or errors occur in these checks, test the configuration and wiring and start commissioning again.

> **WARNING**
>
> **Hazardous Voltage.**
>
> **Can Cause Death, Serious Injury, or Property Damage.**
>
> **Testing the configuration on the MSS 3RK3**
>
> It is not enough just to check the printout; the configuration must also be tested on the MSS 3RK3 of the system.

Switching to test mode

The MSS 3RK3 can be switched to "test mode" so that the full function test can be conducted. Outputs of function elements can be forced in this operating mode.

> **WARNING**
>
> **Hazardous Voltage.**
>
> **Can Cause Death, Serious Injury, or Property Damage.**
>
> In this operating mode, the safety program is executed and the outputs are controlled according to the safety program.
>
> For this reason, organizational measures must be taken to ensure the safety of your system.

Note

A consistent configuration is the requirement for switching to test mode.

Note

If you have not yet assigned a password, you must assign one now.
The default password is: 0000

Execute the following steps to switch to test mode:

Step	Action	Result
1	Go online with the menu command "Switching device" > "Open online".	
2	Choose "Target system" > "Test mode" and confirm the message "Activate test mode" with "Yes".	The "Change password for test mode" dialog box opens.
3	Enter the password for test mode or assign a password.	The MSS 3RK3 changes from configuring mode to test mode.

7.3.5 Forcing

Forcing means that an output of a function element can be preset to a certain value ("0" or "1"), for example, to make it easier to perform troubleshooting.

Requirements

The following requirements must be met to activate the icons in the toolbar:

- The online view is activated.
- Test mode is activated on the safety relay.
- The logic diagram with the safety circuit is active.
- At least one connection of a function element is selected.

Forcing

WARNING

Hazardous Voltage.

Can Cause Death, Serious Injury, or Property Damage.

In this operating mode, the safety program is executed and the outputs are controlled according to the safety program.

For this reason, you must ensure that the safety of your system is ensured by means of organizational measures.

With the "Target system" >Diagnostics logic" > "Force" > "Force to 0" and "Target system" > "Diagnostics logic" > "Force" > "Force to 1" menu commands or the corresponding icons in the toolbar, you can set the values "0"  or "1"  for selected outputs of function elements.

If a connection is forced, an icon above the connection shows the value "0" (blue symbol) or "1" (green symbol) in the logic diagram.

Cancel forcing

You can cancel forcing for an individual forced output as follows:

- Using the "Target system" > "Diagnostics logic" > "Force" > "Cancel forcing" menu command.
- By clicking on the icon  in the toolbar.

Cancel forcing (all)

You can cancel forcing for all forced outputs as follows:

- Using the "Target system" > "Diagnostics logic" > "Force" > "Cancel forcing (all)" menu command.
- By clicking on the icon in the toolbar.

Interruption of the online connection

If the online connection is interrupted in test mode, e.g. by removing the PC cable, it can take up to 10 s before forcing of an output to "1" is canceled.

7.3.6 Configuration release

Follow these instructions:

WARNING

Hazardous voltage

Can Cause Death, Serious Injury, or Property Damage.

Before the safety equipment is released for safety mode, you must ensure that all function elements are working correctly in accordance with the safety regulations. This encompasses the I/Os connected to the MSS 3RK3 (sensors and actuators) as well as the entire configuration of the MSS 3RK3.

When the configuration is released, you can (as an "authorized person") confirm that the system is correctly installed and that all the safety-relevant regulations and standards for the application are observed.

Note

The release procedure described below refers only to the configuration of the MSS 3RK3 and not to the system test. The system test must be documented separately and is not an integral part of this documentation.

Once the function test has been successfully carried out, you can release the configuration. To do so, proceed as follows:

Step	Action	Response
1	Select the menu command "Target system" > "Go offline".	The offline configuration is opened.
2	Choose "Target system" > "Approve configuration".	The "Approve configuration" dialog box is opened, thereby confirming that the system has been configured properly.
3	Set the interface via which you have access to the device (e.g., COM1) and confirm with "OK".	The "Approve configuration" dialog box opens.
4	Acknowledge the message text.	The "Approve configuration" dialog box opens.
5	Enter the name and approving company and confirm with "OK".	The "Approve configuration" dialog box opens. The configuration has been successfully approved.
6	Acknowledge the message with "OK".	The printout of the release information is created.

Note

If the report could not be printed when the project was released, e.g., because no printer was available, the printout must be created at the latest by the time of acceptance by selecting "Options" > "Release information."

Printout of the release information

The printout of the release information contains the following information.

- Name of the person releasing
- Name of the company of the person releasing
- Release status
- Release timestamp
- Configuration CRC
  This must match the configuration CRC in the footer on the printout of the configuration. The release printout is thus always uniquely assigned to one configuration and can later be used for the plant documentation.

Result of the release

Once the MSS 3RK3 has been released, the device is in configuring mode and can be switched to safety mode.

7.3.7 Safety mode

Requirements

If the 3RK3 central unit of the MSS 3RK3 contains a valid, released configuration, you can switch the MSS 3RK3 from configuring mode to safety mode.

Note

Before switching the system to safety mode, ensure that the printout containing the release information is available.

DANGER

Danger of death!

When the system is switched on it switches to safety mode and the safety program is executed as soon as a valid, released configuration is available.

Take appropriate measures (e.g. start button) to guarantee a defined start of the system.

Switching to safety mode

Step	Action	Response
1	Establish up an online connection with the MSS 3RK3 using the "Switching device" > "Open online" menu command.	The Set interface dialog box appears.
2	Set the interface and confirm with "OK".	The project opens online.
3	Activate the menu command "Target system" > "Safety mode".	If a password has been assigned for device access, the "Enter password" dialog box appears. If a password for accessing the device has not yet been assigned, a message is displayed indicating that the switching device is not protected against unauthorized access.
4	Enter the password for device access and confirm this with "OK," or acknowledge the message with "Yes" if you have not assigned a password for device access.	The safety relay changes to safety mode.

"Safety mode"

- When the system is switched on, it automatically switches to safety mode if a valid and released configuration already exists in the 3RK3 central unit.
- After starting safety mode, the status bar in MSS ES informs you of the change to the new operating mode. The operating mode is only displayed when a project is open online.
- In safety mode, the created safety circuit is processed. Safety mode does not allow you to force function outputs.

7.4 Tips and tricks for working with MSS ES

7.4.1 Comparison function

Menu option		Basic license	Standard license	Premium license
Edit	Compare with switching device	-	✓	✓
Edit	Compare with file	-	✓	✓

MSS ES provides a function for comparing two configurations. The configuration that is currently open in MSS ES (source configuration) is compared to a configuration to be defined by you. This can either be online in the safety relay or offline in an *.sdp file.

You can call up the comparison function with the following menu commands:

- "Edit" > "Compare with switching device"
- "Edit" > "Compare with file"

The "Comparison of configurations" dialog box displays the results.

Compare with switching device

Requirement: You must load the first configuration.

Carry out the comparison as follows:

1. Open the first configuration.
2. Select the "Edit" > "Compare with switching device" menu command. The "Compare with switching device" dialog box appears.
3. Select the safety relay that you would like to compare with the open configuration.
4. Click on the "OK" button.

Result: The source configuration is compared with the configuration in the safety relay.

Compare with file

Requirement: You must load the first configuration.

Carry out the comparison as follows:

1. Open the first configuration.
2. Select the "Edit" > "Compare with file" menu command. The "Compare with file" dialog box appears.
3. Select the file that you would like to compare with the open configuration.
4. Click on the "Open" button.

Result: The source configuration is compared with the configuration in the *.sdp file.

"Comparison of configurations" dialog box

The "Comparison of configurations" dialog box contains any deviating results from the comparison in tabular form:

- "Parameter name" column: Contains the names of the parameters with deviations, these are displayed in a tree structure:
  Configuration > Data structure > Element > Individual parameter
- "Source configuration" column: Contains the parameter value belonging to the parameter name in the open configuration.
- "Comparison configuration" column: Contains the parameter value belonging to the parameter name in the comparison configuration.

"Go to" button

If you click on the "Go to" button in the "Comparison of configurations" dialog box, the respective view opens in the work space in which the object belonging to the selected parameter can be edited.

The prerequisite is that an element be selected in the tree structure in the table of differences.

Example: A function element is selected in the "Comparison of configurations" dialog box. "Go to" takes you to the relevant function element in the logic diagram.

"Print" button:

Using the "Print" button in the "Comparison of configurations" dialog box, open a print preview of the results of the comparison. Define whether you want to print out the results of the comparison or to save them in PDF format.

7.4.2 Cross references

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Cross references	-	-	✓	✓

Actions

The "Options" > "Cross references" menu command shows the cross references in tabular form in the output window.

Structure of the cross reference list

Operand	Kind	Type	Usage location	Diagram	Page
Module Channel Terminal identifier Device status function	Access: WR = write RO = read	Type of operand	Element type and element number of the function element.	Name of the diagram in which the function element is located.	Page on which the function block that is connected to the function element is located.

Note

The cross reference list only displays the operands used in the safety circuit.

Edit cross references

With the context menu (right mouse button) or by double-clicking on the item, you can go to the position where the cross reference is used in order to edit it.

7.4.3 Symbol list

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Symbol list	-	-	✓	✓

Actions

The "Options" > "Symbol list" menu command shows the plant identifier you assigned in the form of a table in the output window.

To improve the legibility of the configuration, you can assign identifiers for parts of your configuration data within the context of the system documentation. The symbol list gives an overview of the identifiers assigned by you, their assignments, and the type.

Example of a symbol list

Identifier	Assignment	Type
Anna	SLOT5	Equipment identifier (BMK)
Terminal_1	SLOT3_F-IN1	Terminal identifier
Terminal_2	SLOT4_Q6	Terminal identifier
Press	-	Plant identifier
Hall 1	-	Location identifier
EMERGENCY STOP_1	EMERGENCY STOP [35]	Name

Editing entries in the symbol list

You can perform the following actions in the context menu (right mouse button):

- Delete: The selected identifier is deleted.
- Editing: The selected identifier can be changed (can also be activated if the identifier is selected and you click on it again or press F2).

  If you change or delete identifiers, then the display in the respective view is immediately updated.
- Go to: You jump to the corresponding icon, which is then selected (can also be activated by double-clicking).

Sorting:

- If you click on the column header in the columns "Identifier" and "Assignment," the items will be sorted alphabetically by this column.
- Clicking on the "Type" column header sorts the column as follows: Equipment identifier, Name, Comment, Terminal identifier, Location identifier, Plant identifier.

Note

Editing rules

You cannot assign the same identifier twice.

7.4.4 Terminal list

Menu option		Symbol	Basic license	Standard license	Premium license
Options	Terminal list	-	-	✓	✓

Actions

The "Options" > "Terminal list" menu command lists all available terminals of the slot and subslot (AS-i-) modules in the output window with the relevant terminal identifier (right-hand column) and the interconnection status in the logic diagram (left-hand column).

The terminals are also shown for which no identifier has been assigned and also those terminals that are not yet interconnected.

Example of a terminal list

Terminal	Terminal marking
ASi#02_IN1	Pushbutton_1
SLOT3_F-IN1	Terminal_1

Editing entries in the terminal list

You can perform the following actions in the context menu (right mouse button):

- Delete: The selected terminal identifier is deleted.
- Editing: The selected terminal identifier can be changed (can even be activated if the identifier is selected and you click on it again or press F2).

  If you change or delete identifiers, then the display in the respective view is immediately updated.
- Go to: Interconnecting terminal is in the logic will take you to the corresponding function element and select it (can also be activated by double-clicking).

Sorting:

- Clicking on the column header of the first column sorts the items of this column by their interconnection status.
- Clicking on the relevant column header sorts the items of the "Terminal" and "Terminal identifier" columns alphabetically.

Note

Editing rules

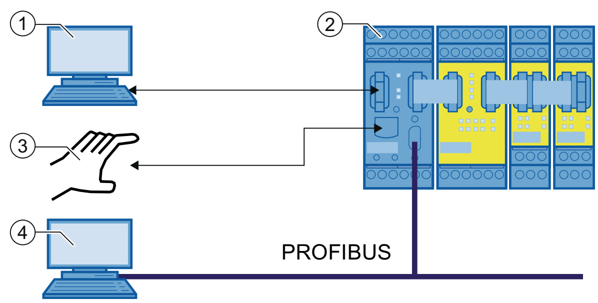
You cannot assign the same terminal identifier twice.

7.5 Integrating the Modular Safety System 3RK3 in DP master systems

7.5.1 Setting and changing the DP address

The DP interface offers three ways of setting and changing the DP address:

- Assignment in MSS ES during configuration ①
- Setting on the DP interface using the pushbuttons and display ③
- Setting using the PROFIBUS service SET_SLAVE_ADD, e.g. in SIMATIC Manager: "Target system" > "PROFIBUS" > "Assign PROFIBUS address" ④



① PC / PG with MSS ES through the device interface on the DP interface
② MSS 3RK3 with DP interface
③ Manual setting on the DP interface using the pushbuttons and display
④ PC / PG with PROFIBUS interface

Figure 7-17 Options for setting the DP address

The DP address can in principle be changed using all three access channels. The DP address last written or set in the DP interface is the valid address.

Individual access paths for changing the DP address can also be disabled. This can be carried out via the parameterization of the DP interface in MSS ES.

WARNING
To prevent unauthorized access to the MSS 3RK3 through PROFIBUS DP, you assign a password for device access.

Setting and disabling the DP address in MSS ES

In MSS ES, the DP address is set in the object properties of the DP interface module during configuration (see also Chapter "Properties of interface module (Page 238)." When downloading the entire configuration, the DP address (station address) is transferred to the device.

In MSS ES, individual methods of changing the DP address can also be disabled. The following protection levels are available for this purpose:

- Can be changed without restriction
  The DP address can be changed by downloading the configuration to the device (data set) by means of MSS ES, on the DP interface itself using the pushbuttons and display, and using the PROFIBUS service SET_SLAVE_ADD.
- Can only be changed using MSS ES or a setting element on the device
  The DP address can only be changed using MSS ES and on the device itself using the pushbuttons and display.
  The DP address cannot be changed using SET_SLAVE_ADD.
- Can only be changed via the data set
  The DP address can only be changed with MSS ES.
  The "DP-Adr" menu command is still available, but the DP address cannot be changed and is rejected with the message "Lock".

Setting the DP address on the DP interface

The DP address can be set and changed on the DP interface itself using the pushbuttons and display. The DP interface displays the current DP address.

Example

In SIMATIC Manager, you can assign a new DP address using the "Target system" > "PROFIBUS" > "PROFIBUS address" menu command (PROFIBUS service SET_SLAVE_ADD). If the 3RK3 central unit does not yet have a configuration, the DP interface will display the default address 126.

Further changes to the DP address can be blocked via the PROFIBUS service SET_SLAVE_ADD. This block can only be revoked as follows:

- By restoring the factory settings of the 3RK3 central unit (deleting the configuration).
- By downloading the new configuration to the device.

7.5.2 DP interface

7.5.2.1 DP interface device statuses

The display has two display statuses:

- Standard mode with status display
  In standard mode, different status messages are output. To scroll through the messages, choose "MODE."
  With error messages, the first line flashes and displays the type of error. If more than one error type is present, the cursor will appear on this line as a chaser.
  The second line may contain a parameter providing information about the type of error. If more than one error type is present, the cursor appears in this line as a chaser.
  This indicates that you can call additional messages or parameters by choosing "MODE."
  If more than one error type is present and these have more than one parameter, you can scroll through the parameters by choosing "MODE" (cursor on the second line). The next error type is then displayed (cursor on the first line). The sequence of messages is defined by a prioritization indicator. Parameters are sorted in ascending order within an error type.
  An error that has been rectified is immediately deleted from the display (you do not need to refresh the screen).
  If you do not press any buttons for 30 seconds, the display automatically returns to the error with the highest priority.
- Menu mode with user control
  In menu mode, a menu system can be used to call up or change different settings. To switch from standard mode to menu mode, choose "SET". The system returns to standard mode when you choose the relevant menu option or after an extended period of inactivity (30 s).

7.5.2.2 DP interface menu navigation

The menu navigation tree is displayed below:

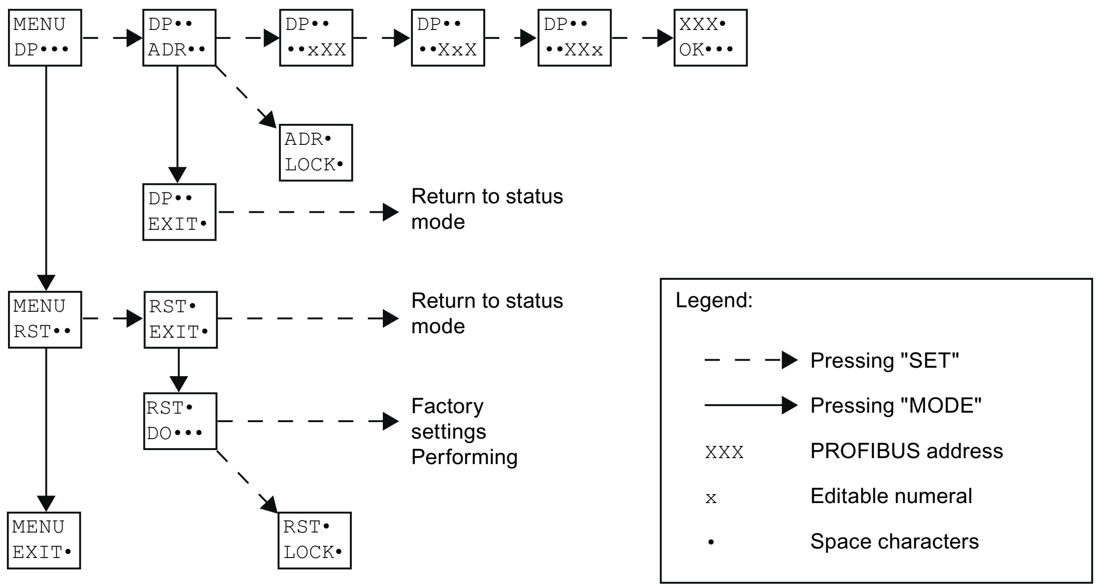


Figure 7-18 DP interface menu

7.5.2.3 Menu mode with user control

In menu mode, the title of each menu appears on the first line on the display.

The second line may contain a menu entry or a parameter providing information about the type of error. If this line is flashing, you can call up additional options by choosing "MODE".

When you press "SET", this either confirms a selection or executes an action.

When you press "MODE" and "SET" at the same time, the entry "`EXIT`" is always selected and the current action is interrupted. You then have to release both buttons and confirm with "SET".

When you double-click "MODE", the previous entry is selected.

If you do not press any buttons for 30 seconds, the display automatically switches to standard mode with status display.

Main menu

To switch from standard mode to menu mode (main menu), choose "SET". Various sub-menus can be selected in the main menu. To switch between the various sub-menus, choose "MODE". To confirm a selection, choose "SET".

Display	
`MENU` `DP•••`	1. row: not flashing 2nd row: flashing

The following submenus are available (2nd line of the display):

- `DP` (change the PROFIBUS address)
- `RST` (restore factory settings)
- `EXIT` (exit)

To switch between the sub-menus, choose "MODE".

When you confirm "`EXIT`" with "SET", the system switches to standard mode.

When you confirm the other entries with "SET", the system switches to the relevant sub-menu.

DP sub-menu

This menu option is used to change the PROFIBUS address.

Display	
`MENU` `DP•••`	1st line: not flashing 2nd line: flashing

The following submenus are available (2nd line of the display):

- "`ADR`" (change address)
- "`EXIT`" (exit)

To switch between the sub-menus, choose "MODE".

When you confirm "`EXIT`" with "SET", the system switches to standard mode.

When you confirm "`ADR`" with "SET", the system switches to the sub-menu.

Changing the DP address

Note

Only addresses 1 to 126 can be set. Other addresses are not possible.

Display	
`DP••` `ADR••`	1st line: not flashing 2nd line: flashing

When you press "SET", the system switches to the editing screen 1:

When you press "MODE" and "SET" at the same time, editing screen 1 with the entry "`EXIT`" is selected. "When you press "`EXIT`", this must then be confirmed by pressing "SET".

If the DP address cannot be changed on a device, the following message is displayed when you choose "`ADR`":

Display	
`ADR•` `LOCK•`	1st line: not flashing 2nd line: flashing

You can acknowledge this message by choosing "SET" or "MODE". After 30 seconds of inactivity, the display automatically returns to standard mode.

Display (editing screen 1)	
`DP••` `••126`	1st line: not flashing 2nd line: 1st digit in DP address flashing

The 2nd row in the display contains the current DP address (0 ... 126; right-justified). If an address has not yet been set, the default address 126 is displayed.

When you choose "MODE", the hundreds are incremented (sequence: 0, 1, 0, etc.).

When you choose "SET", this digit is confirmed and the system switches to the tens. When you double-click "SET", you can go back one digit (i.e. from the hundreds to the ones). The address is not applied when you do this.

Display (editing screen 2)	
DP•• ••X26	1st line: not flashing 2nd line: 2nd digit in DP address flashing

When you press "MODE", the tens are incremented (sequence: 0, 1, 2, to 9); double-clicking "MODE" counts back one digit.

When you choose "SET", this digit is confirmed and the system switches to the next digit. When you double-click "SET", you can go back one digit (i.e. from the tens to the hundreds).

Display (editing screen 3)	
DP•• ••XX6	1st line: not flashing 2nd line: 3rd digit in DP address flashing

When you press "MODE", the ones are incremented (sequence: 0, 1, 2, to 9); double-clicking "MODE" counts back one digit.

When you press "SET", this digit is applied and the set PROFIBUS address (indicated here by "•xxx") is displayed. When you double-click "SET", the system goes back one digit (i.e. from the ones to the tens).

Display	
•XXX OK•••	1st line: not flashing 2nd line: flashing

The message above indicates that the PROFIBUS address was successfully saved. You can acknowledge this message by choosing "SET" or "MODE". The display then returns to standard mode.

The set PROFIBUS address is applied immediately on the bus side. You do not need to switch the power OFF and then ON again.

If the set address cannot be transferred to the 3RK3 central unit, the following message will be output:

Display	
•XXX NOK••	1st line: not flashing 2nd line: flashing

You can acknowledge this message by choosing "SET" or "MODE". The display then returns to standard mode.

RST sub-menu

You can use this menu option to restore the device factory settings.

Display	
RST• XXX•	1st line: not flashing 2nd line: flashing

The following entries can appear in the second row:

- "EXIT" (exit)
- "DO" (restore factory settings)

You can use the "MODE" button to switch between the two menu options.

To confirm a selection, choose "SET".

When you choose "EXIT", the process of restoring the factory settings is interrupted and the display returns to standard mode.

To restore the factory settings, choose "DO".

If you are not permitted to restore the factory settings because the DP interface is currently exchanging data cyclically with a DP master, the following message is displayed when you choose "RST":

Display	
RST• LOCK	1st line: not flashing 2nd line: flashing

You can acknowledge this message by choosing "SET" or "MODE". After 30 seconds of inactivity, the display automatically returns to standard mode.

7.5.2.4 Configuration with a GSD file

Introduction

Once the the system has been configured with MSS-ES, the DP interface must be configured as a PROFIBUS DP slave using the configuration tool of the PROFIBUS master (e.g., STEP 7). The slave properties (PROFIBUS address, DP process data structure width 32-bit/64-bit) set in the configuring tool must be identical to the properties set in MSS ES. Otherwise, the configuration is rejected by the DP interface.

Requirements

You require a GSD file for the DP interface. You can download this file from the following Internet address: http://support.automation.siemens.com/WW/view/en/113630

- SI0x814D.GSG is the German language version of the GSD file (x: version of file)
- SI0x814D.GSD is the English language version of the GSD file (x: version of file)

You also require a configuration tool that supports configuration using the GSD file (GSD version 5 or higher).

Installation of the GSD file with STEP 7

Install the GSD file, e.g., in STEP 7, as follows:

1. Start the SIMATIC Manager and select "Options" > "Install GSD Files" in "HW Config."
2. Use the "Search" button to select the path containing the GSD file for the DP interface.
3. Select the appropriate GSD file in the list and confirm with the "Install" button.
4. In the menu bar, select "Options" > "Update catalog".
   Result: You will find the newly installed device in the catalog under "PROFIBUS DP" > "Additional field devices."
5. Acknowledge the installation with "Close".
   Result: You can now integrate the DP slave into your project.

Configuring the DP interface on the PROFIBUS DP with STEP 7

1. Open your STEP 7 project.
2. Open the HW Config of the PROFIBUS DP master.
3. Select the DP interface in the "Hardware Catalog" window.

   Path: "PROFIBUS-DP" > "Additional FIELD DEVICES" > "Switching devices" > "Safety relays" > "Modular Safety System 3RK3" > "DP interface MSS V1.0"
4. Set the properties of the PROFIBUS sub-network.
   DP alarm mode must be set for operation behind a Y link on DPV1. You can select various PROFIBUS diagnoses in the device-specific parameters. The length of the diagnostics frame must be adjusted accordingly. If all diagnoses are transmitted, the length of the diagnostics frame is 42 bytes. The diagnoses must only be deselected from bottom to top in the hierarchy. For example, it is not permissible to deselect on the module status; the channel-specific diagnosis must then also be deactivated.
5. Save your settings with "OK".
6. Select the appropriate DP process data structure (32 DI/32 DO or 64 DI/64 DO). The standard value is 32 DI/32 DO.
7. Select the PROFIBUS address for the DP interface.

The following table shows the length of the DP diagnosis to be set when deselecting diagnoses:

Diagnostic type	Activated	Deactivated	Length
ID-specific diagnosis	X	-	42
Module status	X	-	
Channel-specific diagnosis	X	-	
ID-specific diagnosis	X	-	24
Module status	X	-	
Channel-specific diagnosis	-	X	
ID-specific diagnosis	X	-	12
Module status	-	X	
Channel-specific diagnosis	-	X	
ID-specific diagnosis	-	X	6
Module status	-	X	
Channel-specific diagnosis	-	X	

Changing the PROFIBUS address in STEP 7 SIMATIC Manager

DP slaves connected to the PROFIBUS sub-network must have a unique PROFIBUS address. If the DP slave to be connected supports the function SET_SLAVE_ADD, you can assign the address using HW Config:

In HW Config, you can assign a new PROFIBUS address using the menu command "Target system" > "PROFIBUS" > "Assign PROFIBUS address".

Note

If the current DP addresses are not completely certain, connect the DP slaves individually to the programming device/PC and re-address the DP slaves.

7.5.2.5 Failure and restoration in the case of PROFIBUS

PROFIBUS failure

The DP interface reports a PROFIBUS interruption to the 3RK3 central unit. The 3RK3 central unit then uses the substitute value "0" for the PROFIBUS logic inputs. Safety mode is not exited. The bus failure can be diagnosed in MSS ES.

Indication failure PROFIBUS			
LED	**DP-IF**	**Display DP-IF**	**Central unit**
DEVICE	Green	BF DPXXX	Green
BF	Red		-
SF	off		off

Restoration of PROFIBUS

Once the PROFIBUS connection has been re-established, the 3RK3 central unit will work with real values again.

Indication of PROFIBUS restoration			
LED	**DP-IF**	**Display DP-IF**	**Central unit**
DEVICE	Green	RUN DPXXX	Green
BF	Off		-
SF	off		off

XXX stands for the set PROFIBUS address.

7.6 Integrating the 3RK3 modular safety system into the AS-i bus

7.6.1 3RK3 central unit with AS-i interface

Three central units with an AS-i interface are available for integrating the 3RK3 modular safety system on the AS-i bus.

- 3RK3 Advanced
- 3RK3 ASIsafe basic
- 3RK3 ASIsafe extended

Note

Name

References to "MSS 3RK3" or "3RK3 central units" in Chapter "Central unit with AS-i interface" always mean "MSS 3RK3 with AS-i interface" and "3RK3 central units with AS-i interface". Exceptions are explicitly identified.

The differences between these 3RK3 central units are listed in the table:

Feature	3RK3 ASIsafe basic	3RK3 ASIsafe extended	3RK3 Advanced
Safety-related, freely parameterizable sensor inputs	2	4	8
Digital standard inputs (single-channel)	6	4	0
Single-channel safety-related relay outputs	1	1	1
Two-channel safety-related solid-state outputs	1	1	1
Expansion modules	0	2	9
Maximum number of simulated safety-related AS-i slaves	8	10	12
DP interface	Yes	Yes	Yes
Diagnostics module	Yes	Yes	Yes

Note

Examples

The examples in this chapter are all represented with a 3RK3 Advanced central unit. However, they apply equally to all other central units with AS-i interface. However, you must note the limitations on the number of expansion modules.

7.6.2 Communication of MSS 3RK3 with AS-i interface

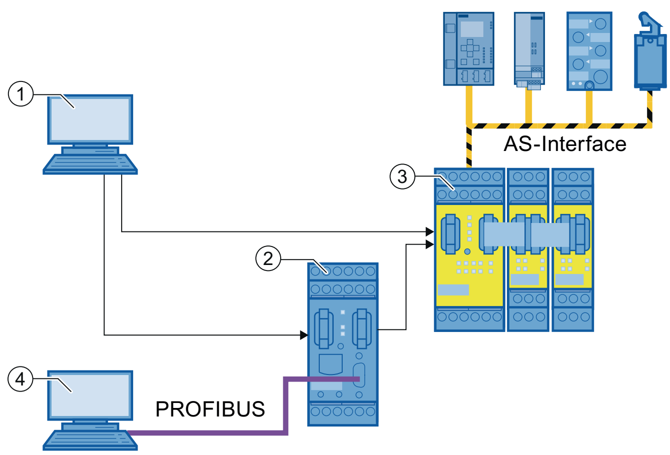
Requirements

The MSS 3RK3 is an AS-i safety monitor and/or an AS-i slave on the AS-i bus. You therefore additionally need an AS-i master and an AS-i power section on the AS-i bus to operate the AS-i network. MSS 3RK3 also supports conventional AS-i components as well as AS-i Power24V components.

Before the MSS 3RK3 can participate in AS-i communication, it must be informed by means of configuration in the MSS ES as to which AS-i slaves on the AS-i line are relevant for MSS 3RK3 and which AS-i slaves the MSS 3RK3 is to represent/simulate.

Communication

Unlike MSS 3RK3 Basic, the 3RK3 central units with AS-i interface can be connected to an AS-i bus. Otherwise, the same interfaces are available as on the MSS 3RK3 Basic.



① PC or programming device via device interface on MSS 3RK3 with AS-i interface or DP interface
② DP interface
③ MSS 3RK3 with connection to the AS-Interface
④ PC or programming device over PROFIBUS and DP-Interface

Figure 7-19 Communication of MSS 3RK3 Advanced

Reference

You will find additional information on AS-Interface in " AS-Interface system manual (edition 11/2008) with expansions (edition 09/2010 - for displaying and configuring see Entry ID 44365425) (http://support.automation.siemens.com/WW/view/en/26250840)."

7.6.3 ASIsafe

The ASIsafe (AS-Interface Safety at Work) concept allows the integration of safety-related components in an AS-Interface network. The use of safety-related AS-i input slaves, safety monitors and safety-related AS-i outputs enables the transfer and evaluation of safety-related data and the safety-related control of actuators on the bus level.

ASIsafe principle of operation

Safety-related signals from sensors (8 x 4-bit code sequences)

Each safety-related AS-i input slave has its own, unique 8 x 4-bit code sequence to be able to transmit safety-related signals to a safety monitor. These code sequences must be made known to the MSS 3RK3 by teaching. The integrated safety monitor listens in to the 8 x 4-bit code sequences of all safety-related AS-i input slaves as a passive participant and evaluates them safely.

You will find more information about teaching code sequences in Chapter "Teaching the code sequences (Page 482)."

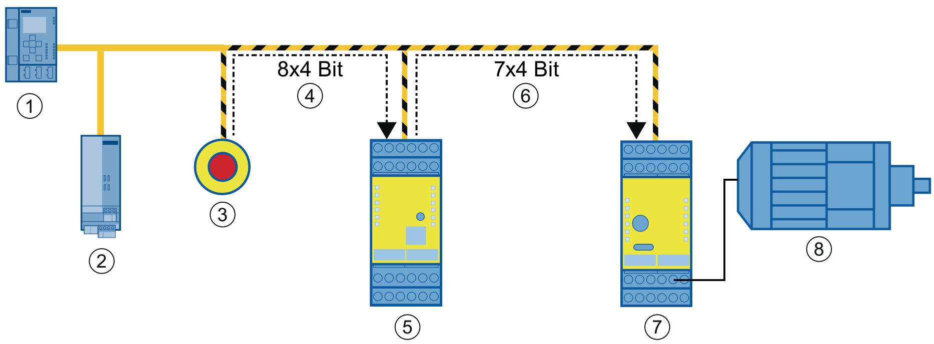
Safety-related signals to actuators (7 x 4-bit code sequences)

These safety-related signals are transmitted to the safety-related AS-i outputs as 7 x 4-bit code sequences. For this purpose, the safety monitor simulates a safety-related AS-i slave with an AS-i address and a special 7 x 4-bit code sequence. The safety-related output listens out for this 7 x 4-bit code sequence without having an address assigned to it, that is, it behaves like a monitor. The safety-related output evaluates the 7 x 4-bit code sequences and switches the connected actuators on or off as required.

Example

The graphic shows a typical structure of an AS-i-Bus. A safety monitor monitors the 8 x 4-bit code sequences of an EMERGENCY-STOP (safety-related AS-i input slave) and evaluates the safety information. A safety-related AS-i slave is integrated in the safety monitor. This slave controls a safety-related AS-i output using 7 x 4 bit sequences. The safety-related AS-i output responds to the address of the integrated slave and switches the system on or off based on the safety information using an actuator.

An MSS 3RK3 with AS-i interface can perform any function of these safe AS-i components:



① AS-i master
② AS-i power section
③ Safety-related AS-i input slave
④ Transmission of the 8 x 4 bit-code sequences
⑤ AS-i-safety monitor with integrated safety-related AS-i slave
⑥ Transmission of the 7 x 4 bit-code sequences
⑦ Safety-related AS-i output
⑧ Actuator

Figure 7-20 Example ASIsafe

An MSS 3RK3 with AS-i interface can perform the functions of the components "safety-related AS-i input slave" ③, "AS-i safety monitor with integrated safety-related AS-i Slave" ⑤, and "safety-related AS-i output" ⑦ in the AS-i network.

Reference

You will find more information about ASIsafe and safety-related AS-i output in the "AS-Interface System Manual (11/2008 Edition) with Supplements (09/2010 Edition)" (http://support.automation.siemens.com/WW/view/en/26250840) order number 3RK2703-3AB02-1AA1.

7.6.4 Functions of the MSS 3RK3 on the AS-i bus

The MSS 3RK3 with AS-i interface can perform various functions on the AS-i bus:

- Simulation of slaves
  - Simulation of non-safety-related AS-i slaves

    The MSS 3RK3 with AS-i interface can simulate up to 4 non-safety-related AS-i slaves.
  - Simulation of safety-related AS-i slaves

    The MSS 3RK3 with AS-i interface can simulate safety-related AS-i slaves and perform one of the following functions on the AS-i bus in each case:
    - Simulation of safety-related AS-i input slaves
    - Setting/resetting of safety-related AS-i outputs

    The MSS 3RK3 ASIsafe basic can simulate up to 8 safety-related AS-i slaves.

    The MSS 3RK3 ASIsafe extended can simulate up to 10 safety-related AS-i slaves.

    The MSS 3RK3 Advanced can simulate up to 12 safety-related AS-i slaves.
- Representation of safety-related AS-i outputs

  The MSS 3RK3 with AS-i interface can represent up to 31 safety-related AS-i outputs on the AS-i bus, where each of these AS-i outputs can have up to 4 safety-related output functions.
- Monitoring slaves

  The MSS 3RK3 with AS-i interface is configured as an AS-i safety monitor and can monitor and evaluate all frames on the AS-i bus.
  - Monitoring of non-safety-related AS-i slaves

    MSS 3RK3 evaluates up to 14 non-safety-related AS-i slaves.
  - Monitoring of safety-related AS-i input slaves

    MSS 3RK3 evaluates up to 31 safety-related AS-i input slaves.

Note

Maximum expanded configuration of the AS-Interface

Up to 31 standard addresses can be assigned on an AS-i bus. Once all standard addresses are assigned, maximum 4 safety monitors without an address can be additionally installed.

If fewer than 31 standard addresses are assigned, an additional safety monitor or another AS-i component without an address (e.g., ground fault monitoring modules) can be installed for every unassigned standard address.

You will find more information in the "AS-Interface System Manual (11/2008 edition) with Supplements (09/2010 edition) (http://support.automation.siemens.com/WW/view/de/26250840/0/en)" (order number: 3RK2703-3AB02-1AA1).

Note

MSS 3RK3 bus load

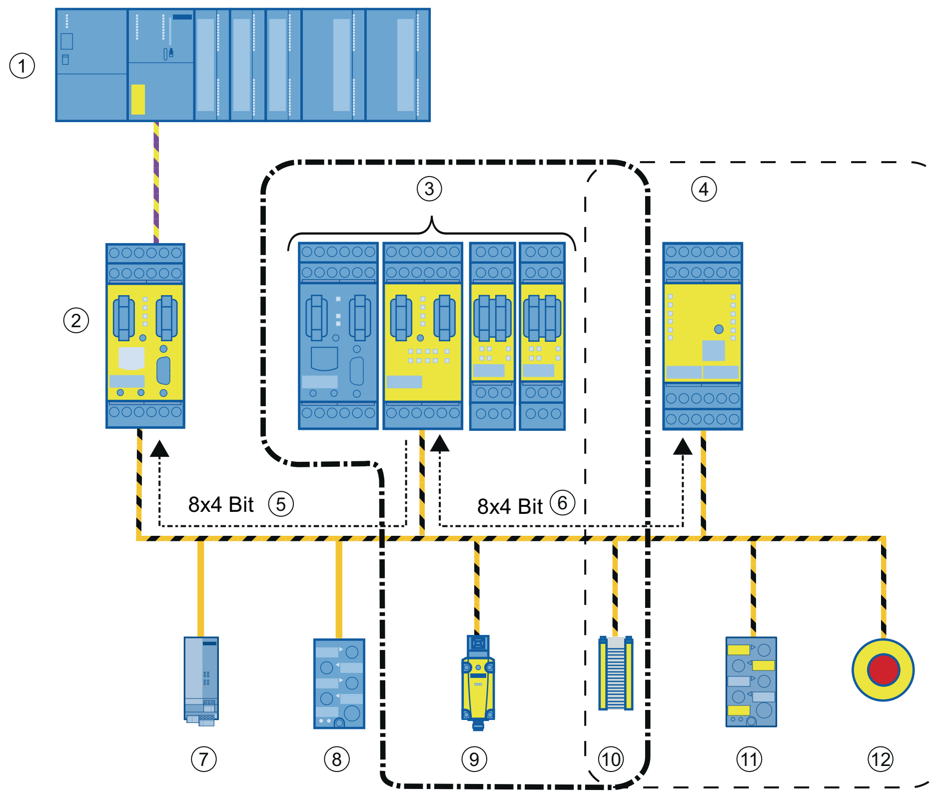
The MSS 3RK3 is always a physical bus load from an A/B slave on the AS-i bus. This bus load does not depend on how many slaves can be simulated by the MSS 3RK3 or whether only AS-i slaves are monitored.

Reference

Examples of various applications of the MSS 3RK3 with AS-i interface and combinations can be found in the following chapter.

7.6.5 Safety-related data exchange, for example, in multiple subnetworks

Combination of multiple MSS 3RK3 units with AS-i interface in various subnets.



	AS-Interface
	PROFIBUS with PROFIsafe
	ASIsafe
①	F-PLC
②	DP/AS-i F-Link
③	MSS 3RK3 Advanced monitors ⑨ and ⑩
④	AS-i-safety-related monitor monitors ⑩, ⑪, and ⑫
⑤	Unidirectional data exchange from the MSS 3RK3 Advanced to the F-Link
⑥	Data exchange between MSS 3RK3 Advanced and the safety monitor
⑦	AS-i power section
⑧ ... ⑫	Safety-related and non-safety-related AS-i slaves

Figure 7-21 AS-Interface with different subnetworks

It is possible to operate multiple AS-i devices with monitor functionality on one AS-i line. That way, they can monitor different groups of AS-i slaves on the same AS-i line (subnets) that contain no restrictions, that is, the groups may contain the same AS-i slaves, or only subsets, or no common AS-i slaves. The individual 3RK3 central units with AS-i interface can also monitor one another and communicate with one another.

Note

Exchange of up to 12 safety-related signals

The MSS 3RK3 with AS-i interface can simulate multiple safety-related AS-i slaves on the AS-i bus. These can be either safety-related input slaves for controlling an F-link or safety monitors, or safety-related output slaves for controlling safety-related AS-i outputs or a combination of the two.

The number of simulated safety-related AS-i slaves depends on the type of central unit:

- The MSS 3RK3 ASIsafe basic can simulate up to 8 safety-related AS-i slaves.
- The MSS 3RK3 ASIsafe extended can simulate up to 10 safety-related AS-i slaves.
- The MSS 3RK3 Advanced can simulate up to 12 safety-related AS-i slaves.

7.6.6 Addressing and configuring AS-i components in MSS ES

Configuration of real AS-i slaves

In MSS ES, the real AS-i slaves are communicated to the MSS 3RK3 in the subsystem (navigation window). The hardware catalog contains all supported SIEMENS AS-i components. Just like in the main system they can be dragged into the work space and have their AS-i address assigned. Using the universal modules, the profiles of AS-i slaves can be defined independently of their manufacturers.

Alternately, it is also possible to determine the expanded configuration of the AS-Interface in the subsystem online: The actual configuration, that is, the hardware configuration of the AS-i subslot expanded configuration can be applied by clicking the "Determine online" button. The result will depend on the master and slaves used. You will find additional information in Chapter "AS-i subsystem (Page 242)."

Configuration and addressing of simulated AS-i slaves

The addresses of the simulated non-safety-relevant AS-i slaves can be freely assigned. The AS-i slave addresses are assigned in the MSS ES in the properties for the 3RK3 central unit. This is also where the profile of the simulated slave is selected. The simulated slaves are displayed in italics in the subsystem.

Note

The addresses cannot be changed during runtime because it would require modification of the configuration data. That is why no addressing and no address changes can be performed on the MSS 3RK3 using the addressing device.

Configuring the safety logic

The parameterizable safety logic of the MSS 3RK3 with AS-i interface allows the following signals to be interconnected in MSS ES via input and output terminals:

- Inputs and outputs of expansion modules, if supported by the 3RK3 central unit
- Inputs and outputs of the DP interface
- Inputs and outputs of real, non-safety-related AS-i slaves
- Inputs and outputs of real, safety-related AS-i slaves
- Inputs and outputs of simulated, non-safety-related AS-i slaves
- Inputs and outputs of simulated, safety-related AS-i slaves

Reference

You will find additional information in Chapter "Creating a configuration in MSS ES (Page 423)."

7.6.7 Simulation of AS-i slaves

7.6.7.1 Simulated AS-i slaves

AS-i slave function - simulated slaves

Simulated slaves are required for transmitting bit information to other devices on the AS-i bus, for example, to the safety monitor or to an additional MSS 3RK3 unit with AS-i interface. In principle, they have the same properties as real slaves, in particular regarding their AS-i address, process data exchange, terminal identifiers, and equipment identifier (BMK).

The following must be noted for simulated slaves:

- The MSS 3RK3 does not monitor its own simulated AS-i slaves with its monitoring function.

  Where values from output terminals of simulated slaves are used again as an input in the logic, the input value is not derived using the monitor function but the value of the output terminal is used. This means that the value will be available to the safety logic in the next processing cycle of the MSS 3RK3. There are no asynchronous dependencies between the cycle time of the MSS 3RK3 and the cycle time of the AS-i bus.
- Simulated AS-i slaves are also visible on the AS-i bus outside safety mode and test mode.

  However, only zeros are returned as output values in configuration mode. All received input values are ignored.

  One exception to this is the simulated AS-i slave with CTT2 profile, as this is used for device diagnostics of the MSS 3RK3 and therefore supplies correct diagnostics data using the CTT2 protocol in configuration mode, too.

  You will find additional information in Chapter "Diagnosis using AS-Interface (CTT2 protocol) (Page 582)."
- Downloading a new configuration

  No AS-i slaves are simulated while a new configuration is being downloaded. Therefore no simulated slaves are visible. Only after the correctness of the configuration has been evaluated are the AS-i slaves in the new configuration simulated on the bus again.

7.6.7.2 Simulation of non-safety-related AS-i slaves

An MSS 3RK3 with AS-i interface can identify itself as a slave on the AS-i bus. For this, a maximum of 4 non-safety-related standard slaves or a maximumb of 4 A/B slaves are simulated on the bus. One of these AS-i slaves can be configured as a CTT2 diagnostics slave.

The following non-safety-related slaves can be simulated:

- Standard slaves type S-7.F.F (Std 4I/4O)
- A/B slaves type S-7.A.E (A/B 4I/3O)
- CTT2 diagnostic slave type S-7.5.5 (CTT2 + 2I/2O)

With a simulated non-safety-related AS-i slave, master calls to the simulated slave can be incorporated in the safety logic and signals sent to the master.

CTT2 slave

With a simulated CTT2 slave, diagnostic data can be exchanged with the AS-i master via the CTT2 protocol (message and control data). The CTT2 slave also has 2 non-fail-safe inputs and outputs.

Terminal designation in the MSS ES

Input terminals for non-safety-related signals can have input signals of the simulated slaves assigned to them in the interconnection logic in MSS ES.

Terminal designation in the input cell	Explanation
SLOT3_ASI#xx(AB)_Qc	Master call from AS-i master to simulated non-safety-related AS-i slave of the MSS 3RK3
SLOT3_ASI#xx_Qy.z	Master call (CTT2 protocol) from AS-i master to simulated non-safety-related AS-i slave (CTT2) of the MSS 3RK3 (see Chapter "Diagnosis using AS-Interface (CTT2 protocol) (Page 582)")

Output terminals for non-safety-related signals can be configured as output signals of the simulated slaves in the interconnection logic in MSS ES.

Terminal designation in the output cell	Explanation
SLOT3_ASI#xx(AB)-Sc	Sensor signal from MSS 3RK3 to AS-i master: Non-safety-related AS-i output data range of the simulated AS-i slave designates "non-safety-related" output
SLOT3_ASI#xx-Sy.z	Signal from simulated CTT2 slave of MSS 3RK3 to AS-i master (see Chapter "Diagnosis using AS-Interface (CTT2 protocol) (Page 582)").

xx: AS-i address

(AB): A or B can be entered here if the monitored slave is an A/B slave. This identifier is omitted for standard slaves. MSS 3RK3 supports only standard slaves for CTT2.

c: Channel number of AS-i slave process image

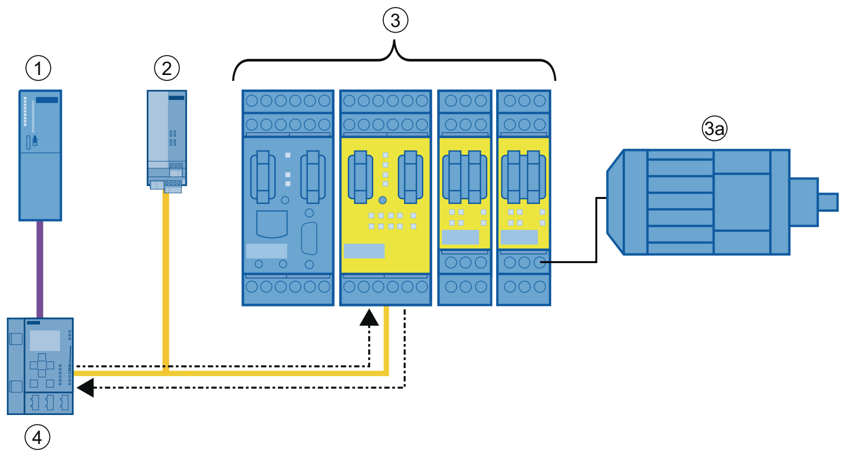
y.z: Defines bit position in CTT2 frame

Note

The signals of the output cells can be included in the logic again through input cells.

Example

The MSS 3RK3 Advanced simulates a non-safety-related AS-i slave on the AS-i bus. The signals from and to the master can be fed into and processed in the logic of the MSS 3RK3 Advanced. The sensor signals from the simulated, non-safety-related AS-i slaves to the master are output to the AS-i bus through the output terminals in the logic.



① CPU/PLC
② AS-i power section
③ MSS 3RK3 Advanced (AS-i address #01) with connected motor (3a)
④ AS-i master

Figure 7-22 Simulation of non-safety-related AS-i slaves

In this case, the input and output terminals of the logic diagram in MSS ES are designated as follows:

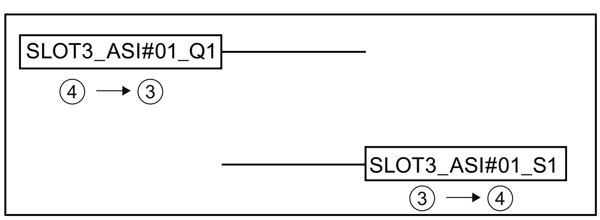


Figure 7-23 Simulation of non-safety-related AS-i slaves in the logic diagram

7.6.7.3 Simulation of safety-related AS-i input slaves

An MSS 3RK3 with AS-i interface can simulate safety-related AS-i input slaves on the AS-i bus in order to send safety-related signals to the AS-i bus:

- The MSS 3RK3 ASIsafe basic can simulate up to 8 safety-related AS-i input slaves.
- The MSS 3RK3 ASIsafe extended can simulate up to 10 safety-related AS-i input slaves.
- The MSS 3RK3 Advanced can simulate up to 12 safety-related AS-i input slaves.

These signals can be monitored and evaluated by other safety monitors.

Note

Exchange of safety-related signals

If safety-related output slaves for controlling safety-related AS-i outputs are simulated simultaneously, the number of simulated safety-related AS-i input slaves are reduced accordingly.

Terminal designation in the MSS ES

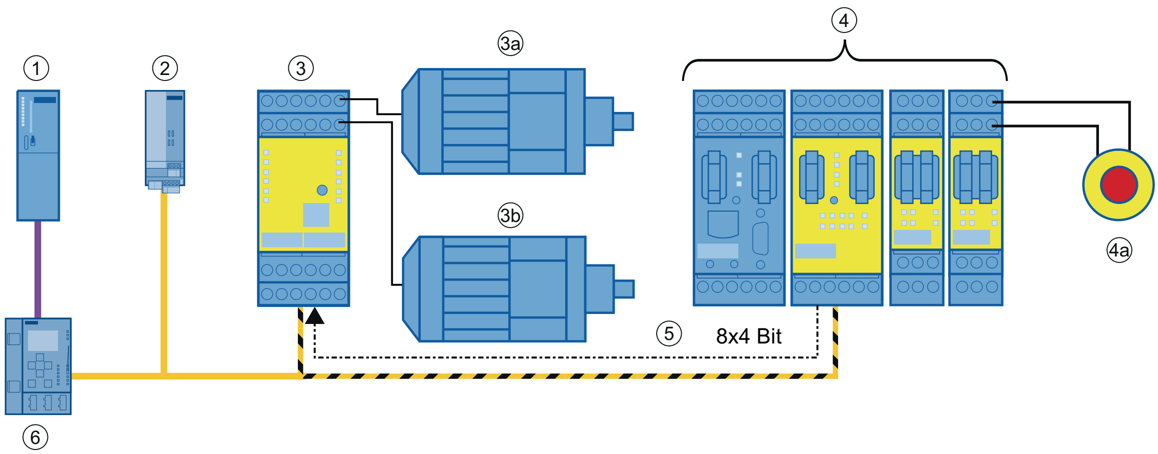
The input signals of the expansion modules of the MSS 3RK3 can be wired in the interconnection logic in MSS ES to logical terminals, which provide their values as simulated safety-related AS-i input slaves on the AS-i bus.

Terminal designation of the output cell	Explanation
SLOT3_ASI#xx-F-S1&2	Sensor signal from MSS 3RK3 to AS-i master that can be evaluated by an AS-i safety monitor

xx: AS-i address

Example

The MSS 3RK3 Advanced simulates a safety-related AS-i input slave on the AS-i bus. The signals of terminals of the expansion modules can be entered in the logic of the MSS 3RK3 Advanced as AS-i signals on the AS-i bus. A safety monitor, for example, an AS-i safety monitor, can evaluate these signals and shut down the motors safely.



① CPU/PLC
② AS-i power section
③ As-i safety monitor with connected motors on Q1/Q2
④ MSS 3RK3 Advanced (AS-i address #01) with emergency stop on IN1/IN2
⑤ Data exchange between MSS 3RK3 Advanced and the AS-i safety monitor
⑥ AS-i master

Figure 7-24 Simulation of safety-related AS-i input slaves

In this case, the input and output terminals of the logic diagram in MSS ES are designated as follows:

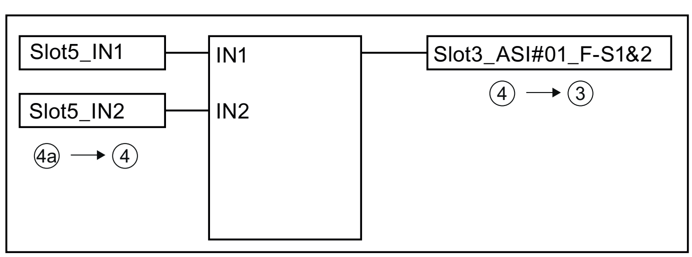


Figure 7-25 Simulation of safety-related AS-i input slaves in the logic diagram

7.6.7.4 Control of safety-related AS-i outputs

The MSS 3RK3 with AS-i interface can control safety-related AS-i outputs. Safety-related AS-i output slaves are simulated on the AS-i bus for this purpose.

- The MSS 3RK3 ASIsafe basic can simulate up to 8 safety-related AS-i output slaves.
- The MSS 3RK3 ASIsafe extended can simulate up to 10 safety-related AS-i output slaves.
- The MSS 3RK3 Advanced can simulate up to 12 safety-related AS-i output slaves.

These AS-i output slaves are each assigned an AS-i address to which the safety-related AS-i output being set or reset responds.

Note

Exchange of safety-related signals

If safety-related AS-i input slaves are simulated simultaneously, the number of simulated safety-related AS-i output slaves for controlling safety-related AS-i outputs is reduced accordingly.

Safety-related AS-i outputs can be set or reset using the "AS-i1..4F-DO" output function and "Output cell" cell function.

Up to four fail-safe signals can be transmitted for each AS-i address using output functions "AS-i1..4F-DO." At any one time, only one of these fail-safe signals may be active.

If the output is set and reset using the "Output cell" cell function, only the first of the four fail-safe signals can be used.

7 x 4 bit code sequences of the safety-related AS-i output slaves

These slaves send 7 x 4 bit code sequences, which are permanently assigned for each address, on the address configured for this. The safety-related AS-i outputs to be set and reset behave like safety monitors and monitor the address assigned to them on the AS-i bus.

Non-safety-related auxiliary control signals (AUX1/AUX2)

In addition to the safety-related control signals (code sequences) of the AS-i outputs, non-safety-related auxiliary control signals (AUX1, AUX2) can also be transmitted. These are used, for example, to acknowledge a restart inhibit or to release errors at AS-i outputs. Additional information can be found in the relevant documentation of the safety-related AS-i output.

The auxiliary control signals AUX1 and AUX2 are defined as pulses. That is why these terminals must not be used for static signals. This pulse is generated as soon as an edge change from zero to one is detected at the respective AUX input (an edge change from one to zero is not taken into consideration).

If a simultaneous edge change is detected for both inputs, the pulse for AUX2 is output after the pulse for AUX1.

Interconnection in the logic diagram

The AS-i outputs are set or reset in the interconnection logic either by means of an "output cell" (Q1 only) or by means of the function element "AS-i 1..4F-DO."

Terminal designation in the MSS ES

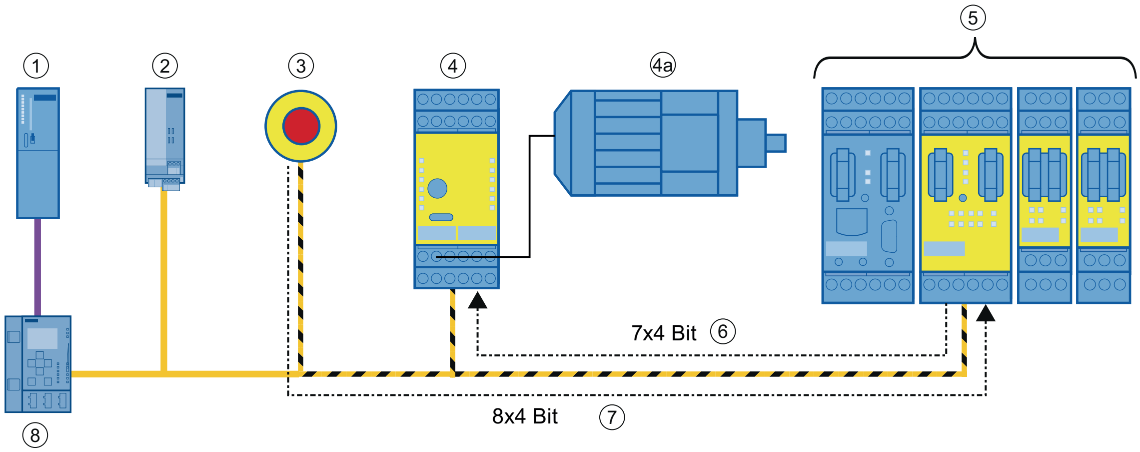
Terminal designation BMK.OUT	Explanation
SLOT3_ASI#xx-F-Qc	Sensor signal from MSS 3RK3 to AS-i master that can be evaluated by an AS-i output.

xx: AS-i address

c: Number of the output (1 ... 4)

Example

The MSS 3RK3 monitors the safety-related AS-i input slave "EMERGENCY STOP" and sets and resets the safety-related AS-i output, which switches the motor off.



① CPU/PLC
② AS-i power section
③ Safety-related AS-i input slave (AS-i address #01)
④ Safety-related AS-i output (responds to AS-i address #02) with motor (4a) connected to Q1
⑤ MSS 3RK3 Advanced sets and resets the AS-i output at address #02
⑥ Data exchange between MSS 3RK3 Advanced and the safety-related AS-i output
⑦ Data exchange between safety-related AS-i input slave and MSS 3RK3 Advanced
⑧ AS-i master

Figure 7-26 Setting/resetting of safety-related AS-i output

In this case, the input and output terminals of the logic diagram in MSS ES are designated as follows:

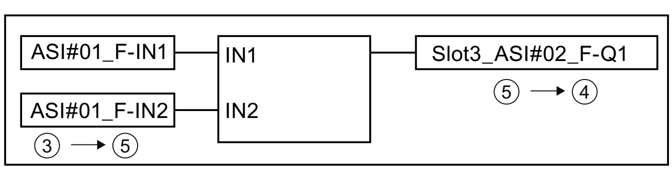


Figure 7-27 Setting/resetting of safety-related AS-i output in the logic diagram

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Note

Setting/resetting of a safety-related AS-i output

If a safety-related AS-i output is set and reset using the "Output cell" cell function, only the first of the four fail-safe signals can be used.

You can use output function "AS-i1..4F-DO" to interconnect multiple outputs of a safety-related AS-i output or auxiliary signals (AUX) and to monitor the switching status.

Another method of interconnecting the signals in the logic is demonstrated below:

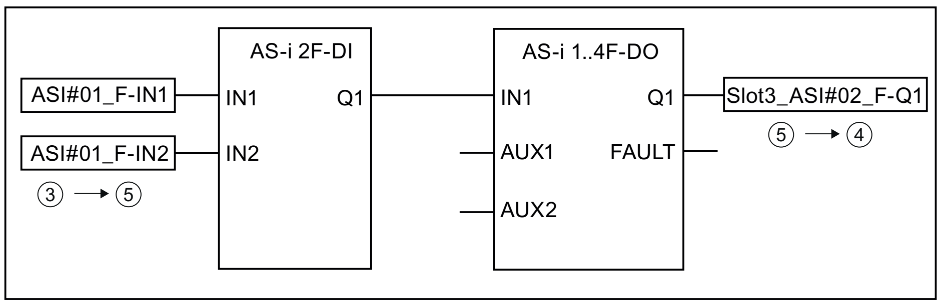


Figure 7-28 Controlling safety-related AS-i outputs using function element AS-i 1..4F-DO

7.6.8 Representation of safety-related AS-i outputs

The MSS 3RK3 with AS-i interface can represent a maximum of 31 safety-related AS-i outputs. Safety-related AS-i outputs do not have an explicit address on the AS-i bus. A safety-related AS-i output behaves like a safety monitor that responds to a 7 x 4 bit code sequence of an AS-i address. In this way, actuators can be switched safely.

Switching response of safety-related output signals

No zero signal has to be transferred in order to switch between two output signals of an AS-i output slave. The active output stays on until the full code sequence of another output of this output slave has been received. If an error occurs while the new code sequences are being transmitted or if a zero sequence is transmitted, all outputs will be deactivated.

Terminal designation in the MSS ES

The signal source (e.g., a safety monitor or an additional MSS 3RK3 with AS-i interface) transmits a 7 x 4-bit code sequence depending on the AS-i address, which is received and evaluated by the MSS 3RK3. The input values are available for processing on the logical terminals in the logic and can be configured as required in the MSS ES. In this way, the MSS 3RK3 controls its own outputs. The terminal designations of the input cells for this are as follows:

Terminal designation of the input cells	Explanation
ASI#xx_F-OUTc	Signal, for example, from an AS-i safety monitor V3.0 or from another MSS 3RK3 with AS-i interface
ASI#xx_AUXm	Modulated, non-safety-related auxiliary control signal

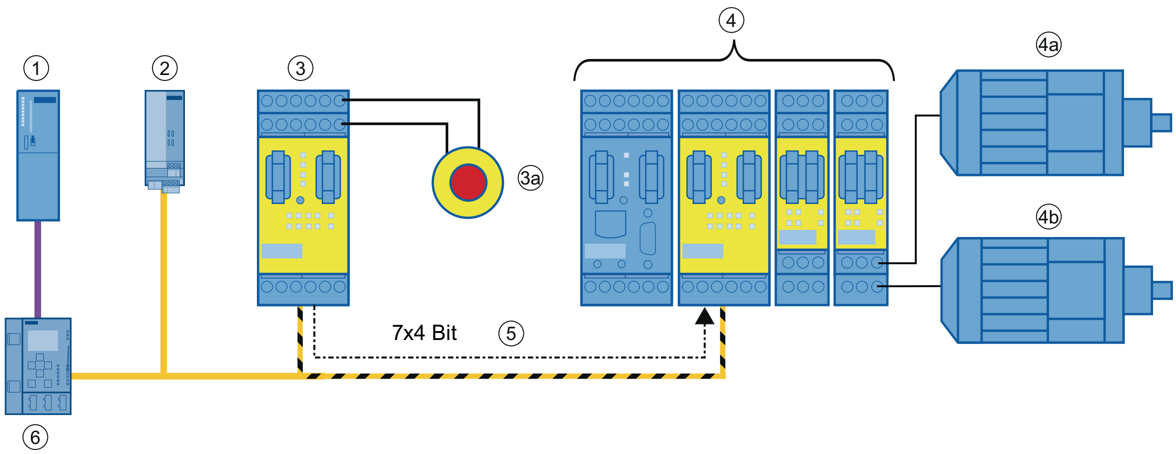
m: Auxiliary signal 1 or 2

xx: AS-i address

c: Channel number of the AS-i slave process image, here the identifier OUT is selected as it is not a sensor value but a preprocessed signal.

Example

The left MSS 3RK3 Advanced responds to an EMERGENCY STOP and passes a signal for a safety-related AS-i output to the right-hand MSS 3RK3 Advanced. The right-hand MSS 3RK3 Advanced behaves like a safety-related AS-i output and can read and process the signal. Both motors are shut down safely through a safety-related output of an expansion module.



① CPU/PLC
② AS-i power section
③ MSS 3RK3 Advanced (controlling a safety-related AS-i output slave on AS-i address #01) with connected EMERGENCY STOP
④ MSS 3RK3 Advanced (safety-related AS-i output slave monitors AS-i address #01; no AS-i address is assigned) with motors connected to Q1/Q2
⑤ Data exchange between MSS 3RK3 Advanced ③ and MSS 3RK3 Advanced ④
⑥ AS-i master

Figure 7-29 MSS 3RK3 Advanced as a safety-related AS-i output

In this case, the input and output terminals of the logic diagram in MSS ES of the right-hand MSS 3RK3 Advanced are designated as follows:

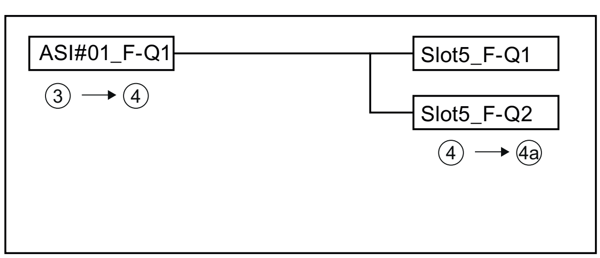


Figure 7-30 Evaluation of safety-related AS-i output in the logic diagram

7.6.9 Monitoring slaves

Function

The MSS 3RK3 with AS-i interface also performs the function of a safety monitor. The safety monitor is at the heart of ASIsafe. It monitors the information transmitted through the AS-Interface (master call, response from AS-i slave).

Note

Minimum expanded configuration of the AS-i bus

At least four AS-i slaves must be connected to the AS-i bus to ensure that the safety-related AS-i input slaves are correctly evaluated. It does not matter whether the additional slaves are safety-related or standard slaves. If fewer than four real AS-i slaves exist, the other slaves that are needed can be simulated by MSS 3RK3.

Evaluation in the logic of the MSS 3RK3

The evaluation of the information produces the values in the input cells. These are subsequently further processed in the processing logic of the MSS 3RK3.

To be able to interconnect a non-safety-related AS-i slave, the "Monitor non safe I/O" checkbox must be selected in the subsystem (navigation window) in the properties of the AS-i slave.

The signals of a safety-related AS-i input slave are composed partly of safety-related signals and partly of non-safety-related signals. To be able to interconnect the non-safety-related information of a safety-related slave, the "Monitor non safe I/O" checkbox must be selected in the subsystem (navigation window) in the properties of the slave, like for the non-safety-related slave.

Note

Simulated AS-i slaves

Where values from output terminals of simulated slaves are used again as an input in the logic, the input value is not derived using the monitor function but the value of the output terminal is used. This means that the value will be available to the safety logic in the next processing cycle of the MSS 3RK3. There are no asynchronous dependencies between the cycle time of the MSS 3RK3 and the cycle time of the AS-i bus.

Reference

You will find additional information on ASIsafe on the Internet (http://support.automation.siemens.com/WW/view/en/12834652/133300).

7.6.9.1 Monitoring of non-safety-related AS-i slaves

The MSS 3RK3 with AS-i interface can monitor up to 14 non-safety-related AS-i slaves of type "standard slave," "A/B slave," or "CTT3 slave." In this way, non-safety-related signals that are exchanged between the master and the non-safety-related AS-i slaves can be fed into the logic of the MSS 3RK3.

The following CTT3 profiles are supported:

- IO-Code 0x7, ID-Code 0xA, ID2-Code 0x7 (S-7.A.7):

  A/B slave with 4-bit input and 4-bit output image
- IO-Code 0x7, ID-Code 0xA, ID2-Code 0xA (S-7.A.A):

  A/B slave with 8-bit input and 8-bit output image

Note

Further AS-i slave profiles:

All slave profiles that are not supported are interpreted as "4I / 4O standard slaves" or as "4I / 3O A/B slaves."

Terminal designation in the MSS ES

Signals from the AS-i-master to the AS-i slave (Q) or from the AS-i slave to the AS-i-master (IN) can be incorporated in the interconnection logic via an input cell and interconnected in the MSS ES.

Note

To be able to interconnect a non-safety-related AS-i slave, the "Monitor non safe I/O" checkbox must be selected in the subsystem (navigation window) in the properties of the slave.

The designations of the input cells for this are as follows:

Terminal designation in the input cell	Explanation
ASI#xx(AB)_INc	Sensor input
ASI#xx(AB)_Qc	Output (master call)
ASI#xx(AB)_Qc*	Master call to the channel that is not part of the slave profile

xx: AS-i address

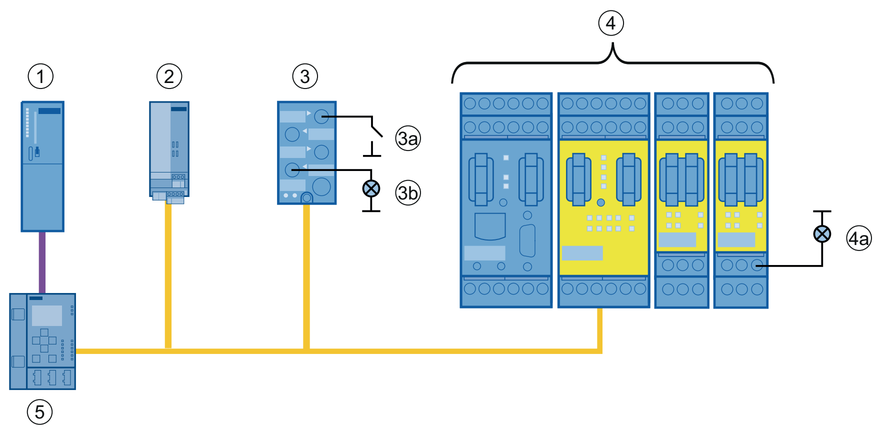
(AB): A or B can be entered here if the monitored slave is an A/B slave. This identifier is omitted for standard slaves.

c: Channel number of AS-i slave process image

c*: The process image of the master call may contain more channels than the slave profile of the corresponding AS-i slave. The channels addressed here are not processed on the AS-i slave but can be used in the logic.

Example

The MSS 3RK3 Advanced monitors a non-safety-related AS-i slave. A release and an indicator light are connected to this AS-i slave. The data traffic between the AS-i master and the non-safety-related AS-i slave can be fed into the logic of the MSS 3RK3 Advanced and processed. An additional indicator light is connected via an expansion module.



① CPU/PLC
② AS-i power section
③ Non-safety-related AS-i slave (AS-i address #01) with release (3a) connected to IN1 and indicator light (3b) to Q4
④ MSS 3RK3 Advanced with additional indicator light (4a) on expansion module (slot 5) connected to Q2
⑤ AS-i master

Figure 7-31 Evaluation of a non-safety-related AS-i slave

In this case, the input and output terminals of the logic diagram in MSS ES are designated as follows:

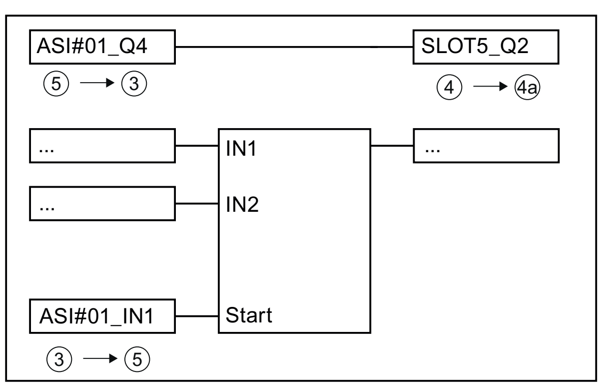


Figure 7-32 Evaluation of the non-safety-related AS-i slave in the logic diagram

7.6.9.2 Monitoring of safety-related AS-i input slaves

The MSS 3RK3 with AS-i interface can monitor up to 31 safety-related AS-i input slaves. These can be simulated by real input slaves or by other devices such as additional MSS 3RK3 units with AS-i interface, safety monitors, etc.

Terminal designation in the MSS ES

Signals from the safety-related AS-i input slave to the AS-i master (IN) can be incorporated into the interconnection logic as in input and configured in MSS ES.

If the AS-i input slave also has non-safety-related outputs, these master calls to the AS-i slave (Q) can also be monitored and incorporated in the logic.

The terminal designations of the input cells and the monitoring function "AS-i 2F-DI" for this are named:

Terminal designation in the input cell	Explanation
ASi#xx_F-IN1&2	Sensor value: Safety-related signal from the code sequence of a two-channel sensor
ASi#xx_F-INc	Input terminal signal of the ASIsafe input slave for the monitoring functions. If monitoring function "AS-i 2F-DI" is used: The monitoring function "AS-i 2F-DI" is used instead of an input cell if you want to diagnose both of the input terminal signals of the ASIsafe input slave.

xx: AS-i address

c: Number of the safety-related input

Note

Non-safety-related data with combined AS-i slaves

The signals of combined AS-i slaves with safety-related AS-i inputs and standard AS-i outputs are composed partly of safety-related signals and partly of non-safety-related signals. To be able to interconnect the non-safety-related information of these slaves, the "Monitor non safe I/O" checkbox must be selected as for the non-safety-related slave in the subsystem (navigation window) in the properties of the slave.

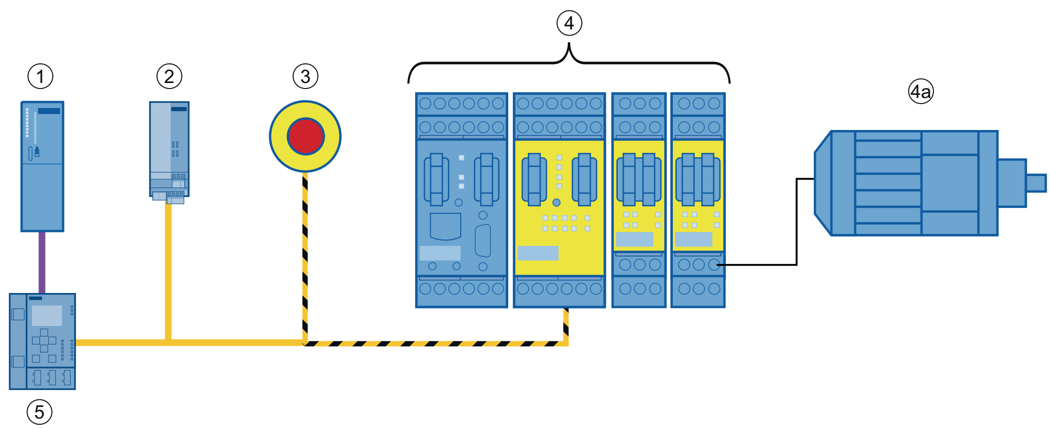
Note

Single-channel use of safety-related AS-i input slaves

The safety-related AS-i input slaves have two inputs that cannot be used independently of each other, so that a safety-related AS-i input slave can only be used in two channels. If a safety-related AS-i input slave is nevertheless to be used in one channel only, the second input must be bridged or assigned two single-channel sensors so that the entire code sequence can be viewed.

Example 1

The MSS 3RK3 Advanced monitors the AS-i EMERGENCY STOP, a safety-related AS-i input slave. The safe data traffic can be fed into the logic of the MSS 3RK3 Advanced through input cells and processed. A motor is shut down safely through a safety-related output of an expansion module.



① CPU/PLC
② AS-i power section
③ Safety-related AS-i input slave (AS-i address #02)
④ MSS 3RK3 Advanced with motor (4a) connected to Q2
⑤ AS-i master

Figure 7-33 Evaluation of a safety-related AS-i input slave

In this case, the input and output terminals of the logic diagram in MSS ES are designated as follows:

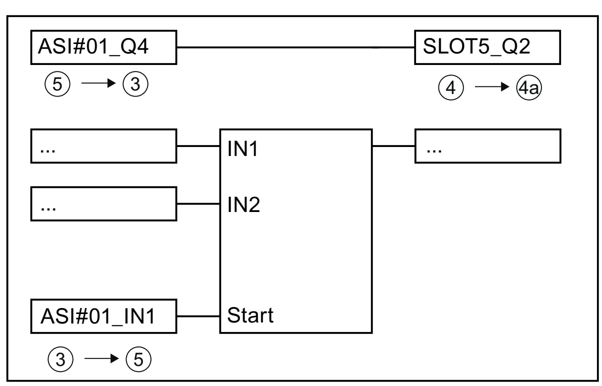


Figure 7-34 Evaluation of the safety-related AS-i input slave in the logic diagram

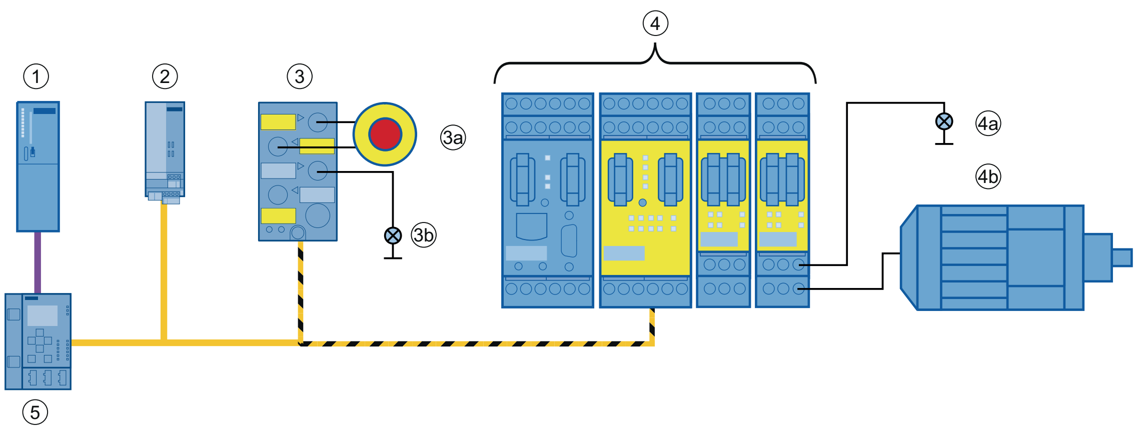
Example 2

The MSS 3RK3 Advanced monitors the safety-related AS-i input slave to whose inputs an EMERGENCY STOP is connected. An indicator light is connected to a standard output of the AS-i slave, which is switched by the AS-i master. The MSS 3RK3 Advanced acquires the status of the indicator light with "monitoring standard slaves" functionality. This status can be fed into the logic of the MSS 3RK3 Advanced via input cells.

Note

The standard output can only be interconnected in the logic if the "Monitor non safe I/O" checkbox is selected in the subsystem in the slave properties.

The motor of the system is safely shut down through a safety-related output of an expansion module and a further indicator light indicates release of the EMERGENCY STOP.



① CPU/PLC
② AS-i power section
③ Safety-related AS-i input slave (AS-i address #02) with standard outputs
An EMERGENCY STOP is connected to the safety-related inputs (IN1/IN2), and an indicator light is connected to the standard output (OUT1)
④ MSS 3RK3 Advanced with connected indicator light (4a) to Q4 and motor (4b) to Q2
⑤ AS-i master

Figure 7-35 Evaluation of a safety-related AS-i input slave

In this case, the input and output terminals of the logic diagram in MSS ES are designated as follows:

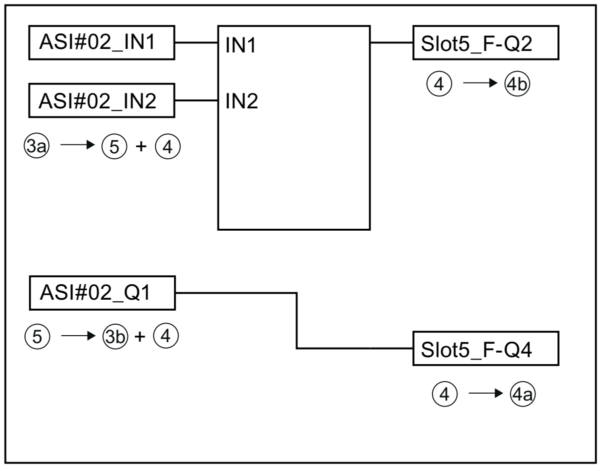


Figure 7-36 Evaluation of the safety-related AS-i input slaves and of the standard outputs in the logic diagram

7.6.10 Overview of possible incoming and outgoing AS-i signals

The information that can be read by the AS-i bus or written to the AS-i bus is displayed in the logic interconnection in the MSS ES software through terminals.

Note

Terminal list in MSS ES

For an overview of all terminals configured in MSS ES, you can have them displayed as a list: "Options" > "Terminal list"

Terminal designation input cells in MSS ES	Explanation	Function of MSS 3RK3
ASI#xx(AB)_INc	Sensor input	Monitoring of non-safety-related AS-i slaves
ASI#xx(AB)_Qc	Output (master call)	
ASI#xx(AB)_Qc*	Master call to the channel that is not part of the slave profile	
ASi#xx_F-IN1&2	Sensor value: Safety-related signal from the code sequence of a two-channel sensor	Monitoring of safety-related AS-i input slaves
ASi#xx_F-INc	Input terminal signal of the ASIsafe input slave for the monitoring functions. If monitoring function "AS-i 2F-DI" is used: Monitoring function "AS-i 2F-DI" is used instead of an input cell if you want to diagnose both the input terminal signals of the ASIsafe input slave.	
ASI#xx_F-OUTc	Signal, for example, from an AS-i safety monitor or from another MSS 3RK3	Representation of a safety-related AS-i output
ASI#xx_AUXm	Modulated, non-safety-related auxiliary control signal	
Slot3_ASI#xx(AB)-Qc	Master call from AS-i master to the simulated non-safety-related AS-i slave of the MSS 3RK3	Simulation of non-safety-related AS-i slaves
Slot3_ASI#xx-Qy.z	Master call from AS-i master to the simulated non-safety-related AS-i slave (CTT2) of the MSS 3RK3	

Function of MSS 3RK3	Explanation	Terminal designation of output cells in MSS ES
Simulation of non-safety-related AS-i slaves	Sensor signal from MSS 3RK3 to AS-i master: Non-safety-related AS-i output data range of the simulated AS-i slave designates "non-safety-related" output	Slot3_ASI#xx(AB)-Sc
	Sensor signal from MSS 3RK3 to AS-i master: Determines bit position in CTT2 frame for device diagnostics (see Chapter "Diagnosis using AS-Interface (CTT2 protocol) (Page 582)").	Slot3_ASI#xx-Sy.z
Simulation of safety-related AS-i input slaves	Sensor signal from MSS 3RK3 to AS-i master that can be evaluated by an AS-i safety monitor	Slot3_ASI#xx-F-S1&2
Setting/resetting of safety-related AS-i outputs	Sensor signal from MSS 3RK3 to AS-i master that can be evaluated by an AS-i output.	Slot3_ASI#xx-F-Qc

m: Auxiliary signal 1 or 2

xx: AS-i address

(AB): A or B can be entered here if the monitored slave is an A/B slave. This identifier is omitted for standard slaves. MSS 3RK3 supports only standard slaves for CTT2.

c: Channel number of AS-i slave process image

c*: The process image of the master call may contain more channels than the slave profile of the corresponding AS-i slave. The channels addressed here are not processed on the AS-i slave but can be used for special solutions.

y.z: Defines bit position in CTT2 frame

7.6.11 Teaching the code sequences

7.6.11.1 Code sequences

Code sequences of safety-related AS-i input slaves

Code sequences are acquired by a safety monitor As soon as the MSS 3RK3 with AS-i interface detects that at least one safety-related AS-i input slave requires processing, the monitor functionality is automatically started. That is possible both during startup and after transmission of a new configuration in configuring mode. Teaching of 8 x 4 bit code sequences is therefore possible in configuring mode, safety mode and test mode.

Code sequences of safety-related AS-i outputs

As part of the development of safety-related AS-i outputs new 7 x-4 bit code sequences have been added to the 8 x 4 bit code sequences of the safety-related AS-i input slaves. These code sequences which uniquely apply to the safety-related AS-i outputs do not have to be retaught but are specified for every possible address on the AS-i bus.

7.6.11.2 Teaching code sequences

To be able to monitor safety-related AS-i input slaves, they must be made known to the system. This means that the code sequences of all safety-related AS-i input slaves located on the AS-i bus must be known so that they can be identified as safety-related information on the AS-i bus. The process of recording, checking, and storing these code sequences is referred to as "teaching code sequences."

Determining the actual expanded configuration on the AS-i bus and comparing it with the target configuration

The actual expanded configuration on the AS-i bus can only be determined once the AS-i master has completed its power-up phase and all AS-i slaves on the bus have been addressed correctly and are active. The MSS 3RK3 with AS-i interface determines all slaves. The list of recognized safety-related slaves is derived from this information. Finally, a check is made to see whether matching code sequences exist for all safety-related AS-i input slaves.

Note

Important requirement

During the teaching process the contacts of the safety-related AS-i input slaves must be closed at least once to allow the code sequences to be retaught.

If the contacts are not closed, calculation continues in the logic diagram with the substitute value "0." The current status of the AS-i slaves is displayed in the "Target system" > "Learn ASIsafe code tables" dialog box.

Once the actual expanded configuration has been determined, it is compared with the predefined target configuration. AS-i slaves that were not found or that have been stored with a non-matching code sequence are calculated in the logic processing with the substitute value "0." For all others, the current process value is fed into the logic. Then the MSS 3RK3 enters safety mode.

Automatic teaching of code sequences in the background

Irrespective of the current operating status, code sequence teaching is started in the background if the code sequence table is empty or incomplete.

In the following cases, the code sequences are not taught:

- During power-up
- During switchover from safety mode to configuring mode due to an error
- When the system stops
- If the factory settings apply

LED display during teaching of code sequences

LED	Behavior	Explanation
DEVICE	yellow/green/flickering green	Device in configuring mode/safety mode/test mode
AS-i	flashing red	AS-i bus not ok, code table incomplete
TEACH	yellow flashing	Teaching of code sequences in progress
SF	off	No error

Note

Missing code sequences are not interpreted as configuration errors.

LED display when code sequences are complete

LED	Behavior	Explanation
DEVICE	yellow/green/flickering green	Device in configuring mode/safety mode/test mode
AS-i	off	AS-i bus ok, code table complete
TEACH	yellow	The code sequences have been recorded and checked and can now be stored.
SF	off	No error

Apply code tables

The code sequence table can be transferred into the memory of the MSS 3RK3 in three different ways:

- Pressing the RESET button for 3 s
- Pressing the "Apply code tables" button in the "Target system" > "ASIsafe code tables" dialog box in MSS ES
- Controlling a device command function element with the "Adopt code tables" command

The TEACH-LED goes off after the code sequences have been successfully stored.

If saving was started by pressing the reset button, this button can now be released

After completion of the teach process, the device remains in its operating state. In test or safety mode, the real values of the safety-related AS-i input slaves are now used in the logic.

The code sequences are stored in the memory module. No reteaching of code sequences is therefore necessary when devices are replaced.

Note

Deleting code sequences

The stored code sequences are deleted by restoring the factory settings or clearing the memory module.

Note

Applying the actual expanded configuration on the AS-i bus

When the code sequence table is stored, the actual state of all safety-related AS-i slaves on the AS-i bus is applied irrespective of the target configuration that is configured. For example, an existing code table of a previously taught safety-related AS-i slave is deleted for the address of a non-safety-related slave.

LED display after successful teaching of code sequences

LED	Behavior	Explanation
DEVICE	yellow/green/flickering green	Device in configuring mode/safety mode/test mode
AS-i	off	AS-i bus ok, all safety-related AS-i slaves have been taught
TEACH	off	Teaching over
SF	off	No error

7.6.11.3 Canceling teaching of code sequences

Teaching can be canceled in two ways, for example, if not enough time is available to complete teaching of code sequences:

- Cancel without storage in buffer with power OFF

  In this case no code sequences are saved, i.e., the code sequences will have to be retaught completely the next time the device is started up.

- Cancel with storage in buffer

  The taught code sequences are saved. Any missing code sequences can be taught when the device is next started up. The actual status of the AS-i slaves can be read out to ascertain which AS-i slaves still require teaching of code sequences.

  Code sequence teaching can be canceled by:

  – Pressing the RESET buttons for 3 s

  – Pressing the "Apply code tables" button in the "Target system" > "ASIsafe code tables" dialog box in MSS ES

  – Controlling a device command function element with the "Adopt code tables" command

LED display after canceling teaching of code sequences

LED	Behavior	Explanation
DEVICE	yellow/green/flickering green	Device in configuring mode/safety mode/test mode
AS-i	flashing red	AS-i bus ok, but no code sequences or missing code sequences
TEACH	yellow flashing	Teaching continues
SF	Off	No group error

7.6.11.4 Missing / incorrect code sequences

Missing code sequences

If a code sequence for a safety-related AS-i slave is missing from the code sequence table, it is calculated by the logic processing with the substitute value "0" in safety mode and in test mode.

Note

While the code sequences are being taught, all input contacts of the safety-related AS-i slaves must be actuated so that all code sequences can be determined. The resulting code sequence is checked for correctness. As soon as all code sequences have been determined, they are checked for uniqueness.

Incorrect code sequences

Note

Important requirement

During the teaching process the contacts of the safety-related AS-i input slaves must be closed at least once to allow the code sequences to be retaught.

If the contacts are not closed, calculation continues in the logic diagram with the substitute value "0." The current status of the AS-i slaves is displayed in the "Target system" > "Learn ASIsafe code tables" dialog box.

Safety-related AS-i input slaves and safety-related AS-i outputs can be distinguished using the IO code. However, as this cannot be monitored on the AS-i bus by the monitor, the MSS 3RK3 with AS-i interface analyzes the incoming code sequences and recognizes the different safety-related slave types based on the identified code sequence type. The MSS 3RK3 interprets the data of the safety-related AS-i input slaves as code sequences based on its configuring and the detected ID code. If a comparison with the taught code sequence fails, for example, due to the replacement of an input slave with another type, the safety-related AS-i slave in question is calculated in the interconnection logic using the substitute value "0."

Note

Incorrect code sequence table during startup

During startup, the MSS 3RK3 with AS-i interface checks the consistency of the code sequence tables stored in the device. If any of the code sequences are shown to be invalid, all the stored code sequences are rejected and all safety-related AS-i input slaves on the bus have to be retaught. The code sequence table might be invalid, for example, if the voltage supply of the device failed during storage of the code sequence table.

Error during teaching of code sequences

If there are errors in a received code sequence or the code sequence table is not clear, the device remains in teach phase until it is successful. Code sequence errors are indicated by a red AS-i LED that lights up and can be more precisely defined with the MSS ES software.

Note

Incorrect code sequences and an unclear code sequence table are not interpreted as a configuration error and do not generate a group error (SF).

Double code sequences on the AS-i bus

If the code sequence that a newly inserted safety-related AS-i slave outputs is identical to an existing code sequence, the substitute value "0" is used for both slaves.

Error on replacement of a safety-related AS-i slave

During a routine replacement of a safety-related AS-i slave, the yellow-lit TEACH-LED of the MSS 3RK3 indicates that new code sequences have been detected and can be applied. There are cases where new code sequences cannot be taught:

- Replacement of a safety-related AS-i slave with a non-safety-related AS-i slave

  If a safety-related AS-i slave is replaced by a non-safety-related AS-i slave, this is detected by the MSS 3RK3 and the substitute value "0" for this AS-i slave will be retained and the taught code sequence of the removed safety-related AS-i slave will be deleted.

- Incorrect code sequence when replacing a safety-related AS-i slave

  If the replaced AS-i slave sends an incorrect code sequence, it cannot be used. The TEACH-LED does not light up or flash.

> **WARNING**
>
> **Additional safety-related AS-i slave on AS-i bus**
>
> For safety reasons, the code sequences of all safety-related slaves must be known to every monitor on the AS-i bus. If an additional safety-related AS-i input slave is added to the AS-i bus, the code sequence of this slave must be taught or every MSS 3RK3 or safety monitor located on the AS-i bus, irrespective of whether or not this new safety-related AS-i slave is monitored by the corresponding MSS 3RK3 or safety monitor.

Acknowledging a code sequence error

When a new slave with a correct new code sequence has been inserted, the existing code sequence error must be acknowledged with the RESET button. Only then can the new code sequence be stored.

8 Diagnostics / service

Diagnostics options

A number of methods are available for diagnosing errors:

- Diagnostics with MSS ES (Page 525)
- Diagnostics with LEDs (Page 494)
- Diagnostics using PROFIBUS (Page 564)
- Diagnostics with diagnostics display (Page 615)
- Diagnosis using AS-Interface (CTT2 protocol) (Page 582)

8.1 Diagnostics concept

The diagnostics concept of the MSS 3RK3 is illustrated in the following diagram:

The various device messages result in an entry in DS92. Some of the messages then trigger a higher-level error, for example, group errors (SF), bus faults (BF), group warnings (SW), and group prewarnings (SVW) in the group status.

Messages output by the function elements initially result in a certain element status, which itself can result in an entry in DS92.

This status is then indicated by the LEDs. Data set 92 can be read out via the diagnostics via PROFIBUS.

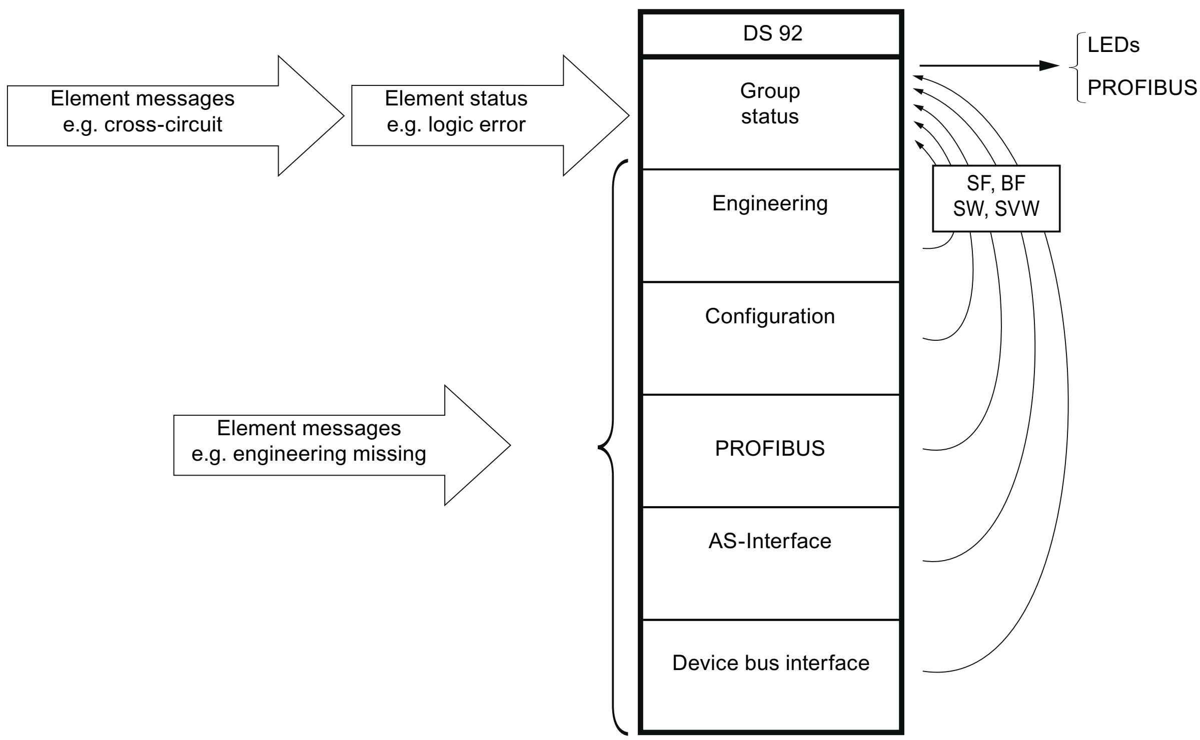


Figure 8-1 MSS 3RK3 diagnostics concept

8.1.1 Display philosphy

In error management, the following display concept applies:

- Errors requiring acknowledgment are displayed by a *red* SF LED.
- Self-acknowledging errors are displayed by a *red* flashing SF LED.
- If more than one error is present at the same time, *red* has priority over *red flashing*.
- The LEDs of the real inputs on the MSS 3RK3 to which the error refers also indicate the error by a *green flashing* LED.

8.1.2 Error management

Error categories

Error management makes a distinction between five different error categories:

- Device error
- System error
- Logic or wiring error
- Parameterization or configuration error
- Handshake error

Device error

A device error causes the system to stop. Communication between the modules is not possible. The cause of such an error is either internal system error or a defective 3RK3 central unit.

This error category can occur in any operating mode.

Display on the central unit		Remedy
LED	Display	The 3RK3 central unit can only exit the system stop by means of a restart initiated by switching the power supply off and on. If the error is still present after the system has restarted, you must replace the 3RK3 central unit. **Exception:** In the event of overvoltage or undervoltage, the device LED and SF LED do not light up:
DEVICE	red	
SF	red	

Note

Diagnostics not possible

In this state, no diagnostics information can be queried.

System error

If a system error occurs, the 3RK3 central unit switches from safety or test mode into a safe state (configuring mode) and switches off all the outputs. Communication with the expansion modules continues, however, ensuring that status and diagnostics messages can still read out. The causes of such errors are device errors on modules connected to the central unit (e.g., expansion module defective), configuration errors, and bus errors. If an expansion module has caused this error, the SF LED of the affected expansion module lights up.

Display on the central unit		Remedy
LED	Display	Perform a reset or restart the computer.
DEVICE	• flashing red (in safety mode) • yellow (in test mode)	
SF	red	

Logic or wiring error

A logic or wiring error does not cause the mode to change; the 3RK3 central unit remains in safety/test mode. This error category can have the following causes:

- Wiring error

  (e.g., feedback circuit switching time violation, cross-circuit between cables):

Display on the central unit		Remedy
LED	Display	Resolve the cause and then acknowledge the error with reset.
SF	red	
The warning is signaled when the LEDs of the corresponding inputs start flashing.		

- Logic error

  (e.g., discrepancy time violation, violation of a signal sequence):

Display on the central unit		Remedy
LED	Display	Acknowledgment is not necessary. When the logic is correct, the error is automatically canceled.
SF	flashing red	
The warning is signaled when the LEDs of the corresponding inputs start flashing.		

- Group warning (for MSS 3RK3 Basic only)

  (e.g., wait for startup test)

Display on the central unit		Remedy
LED	Display	Acknowledgment is not necessary. When the logic is correct, the warning is automatically canceled.
The warning is signaled when the LEDs of the corresponding inputs start flashing.		

- Group prewarning (not in the case of MSS 3RK3 Basic)

  (e.g., wait for startup test)

Display on the central unit		Remedy
LED	Display	Acknowledgment is not necessary. When the logic is correct, the warning is automatically canceled.
The warning is signaled when the LEDs of the corresponding inputs start flashing.		

(e.g., safety sensor triggered)

Display on the central unit		Remedy
LED	Display	Acknowledgment is not necessary. When the logic is correct, the warning is automatically canceled.
The LEDs of the relevant inputs do not light up.		

Parameterization or configuration error

This category of error only occurs in configuring mode. This error is caused if the configuration is either not available or is incorrect, for example.

Display on the central unit		Remedy
LED	Display	Acknowledgment is not necessary. When the parameterization is correct, the error is automatically canceled.
SF	red	

Handshake error

This category of error only occurs in test mode. This error is caused by an interruption in the connection between the MSS ES and the MSS 3RK3. The MSS 3RK3 changes from test mode to configuring mode.

Display on the central unit		Remedy
LED	Display	Acknowledgment is not necessary. The error is automatically canceled when a connection is re-established.
DEVICE	yellow	
SF	red	

8.2 Diagnostics with LEDs

When performing diagnosis of the MSS 3RK3 via LEDs, you must observe all the LEDs on every module. The interpretation of the errors depends on how the function element is wired to the inputs.

Requirements

To be able to diagnose an error, it must be known which function element is wired to the flashing IN inputs.

The following table shows the possible cause of error for a particular LED response on the function elements:

LED response		Sensor connected to responding IN inputs	Meaning/Causes
SF-LED on central unit	Input LEDs on central unit or expansion module		
red	The IN LEDs of a sensor are flashing green.	• Monitoring Universal • EMERGENCY STOP • ESPE • Protective door • Safety shutdown mat with NC principle • Two-hand operation • Enabling button	Cross-circuit at input x
		• Protective door with lock	• Cross-circuit at input x • Protective door opened when interlock was active
		• Safety shutdown mat with cross-circuit principle	• Wire break at input x • Short circuit to P at input x
		• Mode selector switch	Invalid operating mode selection
		• Muting functions Note: To allow diagnosis by LED, only function elements with one input and one output can be interconnected between the input cell and the function input.	Muting indicator light defective
		• Output functions Note: To allow diagnosis by LED, only function elements with one input and one output can be interconnected between the input cell and the function input.	Feedback circuit signal and switching status do not match In case of inconsistencies, the output function immediately switches off all its outputs.

LED response		Sensor connected to responding IN inputs	Meaning/Causes
SF-LED on central unit	**Input LEDs on central unit or expansion module**		
flashing red	The IN LEDs of a sensor are flashing green.	• Monitoring Universal • EMERGENCY STOP • ESPE • Protective door • Safety shutdown mat with NC principle	Discrepancy condition violated For additional information, see "MSS ES"
		• Two-hand operation	Discrepancy condition violated For additional information, see "MSS ES" **Other meanings for Advanced/ASIsafe:** button stuck, both buttons not released
		• Enabling button	Discrepancy condition violated For additional information, see "MSS ES" **Other meanings for Advanced/ASIsafe:** button stuck
		• Protective door with lock	• Discrepancy condition violated • Interlock not possible because the protective door is open
		• Muting functions	Discrepancy condition sensor pair x not fulfilled
	--	• Muting functions	Max. muting time exceeded
	Basic: The IN LEDs of a sensor are flashing green. **Advanced/ASIsafe**: The sensor that triggered the sequence violation is flashing green.	• Monitoring Universal • Protective door • Protective door with lock	Sequence condition not fulfilled The sequence condition was not fulfilled in accordance with the parameter assignment.
	One or more IN LEDs flashing green. The error was detected at this input.	• Muting functions	Sequence condition not fulfilled (muting) The sequence condition was not fulfilled in accordance with the parameter assignment.

LED response		Sensor connected to responding IN inputs	Meaning/Causes
SF-LED on central unit	Input LEDs on central unit or expansion module		
--	The IN LEDs of a sensor are flashing green.	• Monitoring Universal • EMERGENCY STOP • ESPE • Protective door • Protective door with lock • Safety shutdown mat with NC principle • Safety shutdown mat with cross-circuit principle	Startup test required When startup test is parameterized, this message is set at every change to safety/test mode and at every change from substitute value to real value and remains set until the connected sensor is actuated at least once. After the sensor has been operated correctly this message is automatically reset.
	The IN LEDs of a sensor are off.	• Monitoring Universal • EMERGENCY STOP • ESPE • Protective door • Protective door with lock • Safety shutdown mat with NC principle	Safety sensor triggered The safety sensor has been actuated. This message is automatically reset if the value "1" is present for all function inputs monitored (set as part of configuring).

Note

SF on the expansion module lights up red

The cause of errors that result in a red-lit SF-LED on the expansion module are explained in Chapter ""SF" on the expansion module lights up red (Page 497)."

Note

Response of IN LEDs

The way the IN LEDs flash depends on the signal that is present at the input:

- Input signal present: 1.75 s ON/0.25 s OFF
- Input signal not present: 0.75 s ON/1.25 s OFF

8.2.1 "SF" on the expansion module lights up red

Error during startup

After power-up, the modules of the MSS 3RK3 respond as follows:

LED display on the faulty EM	LED display on the following EMs	LED display on the central unit	Meaning / Remedy
• "SF" lights up red • "IN" or "Q" are off	• "SF" lights up yellow • "IN" or "Q" lights up green	• "SF" lights up red • "DEVICE" lights up yellow	**Interruption on the system bus** Interruption in the connection **upstream of** the faulty expansion module with the red "SF" LED. Check the connection cables.
• "SF" lights up red • "IN" or "Q" are off	• "SF" lights up yellow • "IN" or "Q" Lights up green	• "SF" lights up red • "DEVICE" flashes red	The first EM downstream from the 3RK3 central unit on which the "SF" LED lights up is defective and must be replaced.

Error during test mode

In test mode, the modules of the MSS 3RK3 respond as follows:

LED display on the faulty EM	LED display on the following EMs	LED display on the central unit	Meaning / Remedy
• "SF" lights up red • "IN" or "Q" are off	• "SF" lights up red • "IN" or "Q" are off	• "SF" lights up red • "DEVICE" lights up yellow	**Interruption on the system bus** Interruption in the connection **upstream of** the expansion module with the red "SF" LED. Check the connection cables.
• "SF" lights up red • "IN" or "Qx" are off	• "SF" are off • "IN" or "Q" are off	• "SF" lights up red • "DEVICE" lights up yellow	The first EM on which the "SF" LED lights up is defective and must be replaced.

Error in safety mode

In safety mode, the modules of the MSS 3RK3 respond as follows:

LED display on the faulty EM	LED display on the following EMs	LED display on the central unit	Meaning / Remedy
• "SF" lights up red • "IN" or "Q" are off	• "SF" lights up red • "IN" or "Q" are off	• "SF" lights up red • "DEVICE" flashes red	**Interruption on the system bus** Interruption in the connection **upstream of** the expansion module with the red "SF" LED. Check the connection cables.
• "SF" lights up red • "IN" or "Qx" are off	• "SF" are off • "IN" or "Q" are off	• "SF" lights up red • "DEVICE" flashes red	The first EM on which the "SF" LED lights up is defective and must be replaced.

8.2.2 LEDs on the modules

8.2.2.1 Displays on the 3RK3 Basic central unit

LED	Display	Explanation
DEVICE	off	No voltage, undervoltage, overvoltage
	green	Device OK, user program in safety mode
	green flashing 0.5 Hz (ratio 1:1)	System power-up
	flickering green	Device OK, user program in test mode
	yellow	User program stopped; device in safe state (configuring mode; configuration not released; no configuration)
	yellow flashing 0.5 Hz (ratio 1:1)	Factory settings restored
	flickering yellow	See Chapter "Restoring factory settings (Page 637)"
	red	Device defective or wiring error
	red flashing 0.5 Hz (ratio 1:1)	Error in configuration
	flickering red	See Chapter "Restoring factory settings (Page 637)"
SF	off	No group error
	red	Group error (communications error, etc.)
	red flashing 0.5 Hz (ratio 1:1)	Group error: logic error (sequence, etc.)

LED	Display	Explanation
IN1, IN2, IN3, IN4, IN5, IN6, IN7, IN8	off	Input signal not present
	green	Input signal present
	green flashing (1.75 s on / 0.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal present
	green flashing (0.75 s on / 1.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal not present
Q1, Q2	off	Output signal not present
	green	Output signal present

Reference

You will find more information on the LED display during startup in Chapter "Startup / self-test of the MSS 3RK3 Basic (Page 62)"

8.2.2.2 Displays on the 3RK3 Advanced central unit

LED	Display	Explanation
DEVICE	off	No voltage, undervoltage, overvoltage
	green	Device OK, user program in safety mode
	green flashing 0.5 Hz (ratio 1:1)	System power-up
	flickering green	Device OK, user program in test mode
	yellow	User program stopped; device in safe state (configuring mode; user program not released; no user program)
	yellow flashing 0.5 Hz (ratio 1:1)	Factory settings restored
	flickering yellow	See Chapter "Restoring factory settings (Page 637)"
	red	Device defective or wiring error
	red flashing 0.5 Hz (ratio 1:1)	Error in configuration
	flickering red	See Chapter "Restoring factory settings (Page 637)"
AS-i	off	AS-i bus OK, code table complete
	red	AS-i bus OK, but code sequence error
	red flashing 0.5 Hz (ratio 1:1)	AS-i bus not OK, code table either missing or incomplete; TARGET ≠ ACTUAL AS-i configuration

LED	Display	Explanation
TEACH	off	Code sequences complete
	flashing yellow	Teaching of code sequences in progress
	yellow	Teaching of code sequences successfully completed, code sequence tables can now be applied
SF	off	No group error
	red	Group error (communications error, etc.)
	red flashing 0.5 Hz (ratio 1:1)	Group error: logic error (sequence, etc.)
IN1, IN2, IN3, IN4, IN5, IN6, IN7, IN8	off	Input signal not present
	green	Input signal present
	green flashing (1.75 s on / 0.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal present
	green flashing (0.75 s on / 1.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal not present
Q1, Q2	off	Output signal not present
	green	Output signal present

Reference

You will find more information on the LED display during startup in Chapter "Startup / self-test of the MSS 3RK3 Advanced (Page 68)"

8.2.2.3 Displays on the 3RK3 ASIsafe basic central unit

LED	Display	Description
DEVICE	Off	No voltage, undervoltage, overvoltage
	green	Device OK, user program in safety mode
	green flashing 0.5 Hz (ratio 1:1)	System power-up
	flickering green	Device OK, user program in test mode
	yellow	User program stopped; device in safe state (configuring mode; user program not released; no user program)
	yellow flashing 0.5 Hz (ratio 1:1)	Factory settings restored
	flickering yellow	See Section "Restoring factory settings (Page 637)"
	red	Device defective or wiring error
	red flashing 0.5 Hz (ratio 1:1)	Error in configuration
	flickering red	See Section "Restoring factory settings (Page 637)"
AS-i	Off	AS-i bus OK, code table complete
	red	AS-i bus OK, but code sequence error
	red flashing 0.5 Hz (ratio 1:1)	AS-i bus not OK, code table either missing or incomplete; TARGET ≠ ACTUAL AS-i configuration
TEACH	Off	Code sequences complete
	Flashing yellow	Teaching of code sequences in progress
	yellow	Teaching of code sequences successfully completed, code sequence tables can now be applied
SF	Off	No group error
	red	Group error (communications error, etc.)
	red flashing 0.5 Hz (ratio 1:1)	Group error: logic error (sequence, etc.)
F-IN1, F-IN2	Off	Input signal not present
	green	Input signal present
	green flashing (1.75 s ON/0.25 s OFF)	Error detected (cross-circuit at input/wirebreak/short-circuit to P/discrepancy error/feedback circuit error/sequence error/error during startup test) Input signal present
	green flashing (0.75 s ON/1.25 s OFF)	Error detected (cross-circuit at input/wirebreak/short-circuit to P/discrepancy error/feedback circuit error/sequence error/error during startup test) Input signal not present

LED	Display	Description
IN3, IN4, IN5, IN6, IN7, IN8	Off	Input signal not present
	green	Input signal present
	green flashing (1.75 s ON/0.25 s OFF)	Error detected (feedback circuit error/sequence error) Input signal present
	green flashing (0.75 s ON/1.25 s OFF)	Error detected (feedback circuit error/sequence error) Input signal not present
Q1, Q2	Off	Output signal not present
	green	Output signal present

Reference

You will find more information on the LED display during startup in Chapter "Startup / self-test of the MSS 3RK3 Advanced (Page 68)"

8.2.2.4 Displays on the 3RK3 ASIsafe extended central unit

LED	Display	Description
DEVICE	Off	No voltage, undervoltage, overvoltage
	green	Device OK, user program in safety mode
	green flashing 0.5 Hz (ratio 1:1)	System power-up
	flickering green	Device OK, user program in test mode
	yellow	User program stopped; device in safe state (configuring mode; user program not released; no user program)
	yellow flashing 0.5 Hz (ratio 1:1)	Factory settings restored
	flickering yellow	See Section "Restoring factory settings (Page 637)"
	red	Device defective or wiring error
	red flashing 0.5 Hz (ratio 1:1)	Error in configuration
	flickering red	See Section "Restoring factory settings (Page 637)"
AS-i	Off	AS-i bus OK, code table complete
	red	AS-i bus OK, but code sequence error
	red flashing 0.5 Hz (ratio 1:1)	AS-i bus not OK, code table either missing or incomplete; TARGET ≠ ACTUAL AS-i configuration
TEACH	Off	Code sequences complete
	Flashing yellow	Teaching of code sequences in progress
	yellow	Teaching of code sequences successfully completed, code sequence tables can now be applied

LED	Display	Description
SF	Off	No group error
	red	Group error (communications error, etc.)
	red flashing 0.5 Hz (ratio 1:1)	Group error: logic error (sequence, etc.)
F-IN1, F-IN2, F-IN3, F-IN4	Off	Input signal not present
	green	Input signal present
	green flashing (1.75 s ON/0.25 s OFF)	Error detected (cross-circuit at input/wirebreak/short-circuit to P/discrepancy error/feedback circuit error/sequence error/error during startup test) Input signal present
	green flashing (0.75 s ON/1.25 s OFF)	Error detected (cross-circuit at input/wirebreak/short-circuit to P/discrepancy error/feedback circuit error/sequence error/error during startup test) Input signal not present
IN5, IN6, IN7, IN8	Off	Input signal not present
	green	Input signal present
	green flashing (1.75 s ON/0.25 s OFF)	Error detected (feedback circuit error/sequence error) Input signal present
	green flashing (0.75 s ON/1.25 s OFF)	Error detected (feedback circuit error/sequence error) Input signal not present
Q1, Q2	Off	Output signal not present
	green	Output signal present

Reference

You will find more information on the LED display during startup in Chapter "Startup / self-test of the MSS 3RK3 Advanced (Page 68)"

8.2.2.5 Displays on the expansion module 4/8F-DI

LED	Display	Explanation
SF / IN1	off	Input signal not present
	green	Input signal present
	green flashing (1.75 s on / 0.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal present
	green flashing (0.75 s on / 1.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal not present
	red	Device defective or error on the system bus (see also Chapter ""SF" on the expansion module lights up red (Page 497)")
IN2, IN3, IN4, IN5, IN6, IN7, IN8	off	Input signal not present
	green	Input signal present
	green flashing (1.75 s on / 0.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal present
	green flashing (0.75 s on / 1.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal not present

8.2.2.6 Displays on expansion module 2/4F-DI 1/2F-RO

LED	Display	Explanation
SF / IN1	off	Input signal not present
	green	Input signal present
	green flashing (1.75 s on / 0.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal present
	green flashing (0.75 s on / 1.25 s off)	Error detected (cross-circuit at input / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal not present
	red	Device defective or error on the system bus (see also Chapter ""SF" on the expansion module lights up red (Page 497)")
IN2, IN3, IN4,	off	Input signal not present
	green	Input signal present
	green flashing (1.75 s on / 0.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal present
	green flashing (0.75 s on / 1.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal not present
Q1, Q2	off	Output signal not present
	green	Output signal present

8.2.2.7 Displays on expansion module 2/4F-DI 2F-DO

LED	Display	Explanation
SF / IN1	off	Input signal not present
	green	Input signal present
	green flashing (1.75 s on / 0.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal present
	green flashing (0.75 s on / 1.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal not present
	red	Device defective or error on the system bus (see also Chapter ""SF" on the expansion module lights up red (Page 497)")
IN2, IN3, IN4,	off	Input signal not present
	green	Input signal present
	green flashing (1.75 s on / 0.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal present
	green flashing (0.75 s on / 1.25 s off)	Error detected (cross-circuit at input / wirebreak / short-circuit to P / discrepancy error / feedback circuit error / sequence error / error during startup test) Input signal not present
Q1, Q2	off	Output signal not present
	green	Output signal present

8.2.2.8 Displays on expansion module 4F-DO

LED	Display	Explanation
SF / Q1	off	Output signal not present
	green	Output signal present
	red	Device defective or error on the system bus (see also Chapter ""SF" on the expansion module lights up red (Page 497)")
Q2, Q3, Q4,	Off	Output signal not present
	Green	Output signal present

8.2.2.9 Displays on expansion module 4/8F-RO

LED	Display	Explanation
SF / Q1	off	Output signal not present
	green	Output signal present
	red	Device defective or error on the system bus (see also Chapter ""SF" on the expansion module lights up red (Page 497)")
Q2, Q3, Q4, Q5, Q6, Q7, Q8	off	Output signal not present
	green	Output signal present

8.2.2.10 Displays on expansion module 8DI

LED	Display	Explanation
SF / IN1	Off	Input signal not present
	Green	Input signal present
	Red	Device defective or error on the system bus (see also Chapter ""SF" on the expansion module lights up red (Page 497)")
IN2, IN3, IN4, IN5, IN6, IN7, IN8	Off	Input signal not present
	Green	Input signal present

8.2.2.11 Displays on expansion module 8DO

LED	Display	Explanation
SF / Q1	off	Output signal not present
	green	Output signal present
	red	Device defective or error on the system bus (see also Chapter ""SF" on the expansion module lights up red (Page 497)")
Q2, Q3, Q4, Q5, Q6, Q7, Q8	off	Output signal not present
	green	Output signal present

8.2.2.12 Displays on the DP interface

LED	Display	Description
DEVICE	Off	No voltage
	Green	Device OK
	green flashing 0.5 Hz (ratio 1:1)	Device is in power-up phase
	Red	Device defective
	yellow flashing 0.5 Hz (ratio 1:1)	Factory settings restored, see Chapter "Menu mode with user control (Page 444)"
BF	Off	PROFIBUS bus communication OK
	Red	• DP interface in device power-up • PROFIBUS error, e.g. wrong PROFIBUS address (DP interface module not addressed)
	red flashing 0.5 Hz (ratio 1:1)	PROFIBUS parameterization/configuration error
SF	Off	No group error
	Red	Group error (error on communication to 3RK3 central unit, ...)

8.2.2.13 Displays on diagnostic display

The LEDs on the diagnostic display show the same states as the corresponding LEDs of the MSS configuration.

LED	Display	Description
DEVICE	Off	• No voltage, undervoltage, overvoltage • Device error
	green	Device OK, user program in safety mode
	flickering green	Device OK, user program in test mode
	yellow	User program stopped; device in safe state (configuring mode; configuration not released; no configuration)
BF	Off	No bus error
	red	Error, e.g., incorrect PROFIBUS address (DP interface not addressed)
	red flashing 0.5 Hz (ratio 1:1)	Parameterization or configuration error
SF	Off	No group error
	red	Group error (communications error, etc.)
	red flashing 0.5 Hz (ratio 1:1)	Group error: logic error (sequence, etc.)

8.2.3 LED response for various element functions

8.2.3.1 Monitoring Universal

The table below lists all the messages and corresponding LED responses to the "Monitoring Universal" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once. After the sensor has been operated correctly this message is automatically reset.	-	The IN LEDs of the sensor are flashing green.
Sequence condition not fulfilled	The sequence condition was not fulfilled in accordance with the parameter assignment. This message is automatically reset if the value "0" is detected for all function inputs monitored.	flashes red	The IN LEDs of the sensor are flashing green.
Discrepancy condition violated	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	flashes red	The IN LEDs of the sensor are flashing green.
Safety sensor triggered	The safety sensor has been actuated. This message is automatically reset if the value "1" is present for all function inputs monitored (set as part of configuring).	-	The IN LEDs of the sensor are off. The IN2-LED is green on input type NCNO.
Cross-circuit at input x	A cross-circuit was detected at input x.	red	The IN LEDs of the sensor are flashing green.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-
Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A signal sequence violation is present • A cross-circuit is present in the case of cross-circuit monitoring	-	-

8.2.3.2 EMERGENCY STOP

The table below lists all the messages and corresponding LED responses to the "EMERGENCY STOP" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	-	The IN LEDs of the sensor are flashing green.
Discrepancy condition violated	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	flashes red	The IN LEDs of the sensor are flashing green.
Safety sensor triggered	The safety sensor has been actuated. This message is automatically reset if the value "1" is present for all function inputs monitored (set as part of configuring).	-	The IN LEDs of the sensor are off.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Cross-circuit at input x	A cross-circuit was detected at input x.	red	The IN LEDs of the sensor are flashing green.
Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-
Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A cross-circuit is present in the case of cross-circuit monitoring	-	-

8.2.3.3 ESPE

The table below lists all the messages and corresponding LED responses to the "ESPE" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	-	The IN LEDs of the sensor are flashing green.
Discrepancy condition violated	is set if: • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	flashes red	The IN LEDs of the sensor are flashing green.
Safety sensor triggered	The safety sensor has been actuated. This message is automatically reset if the value "1" is present for all function inputs monitored (set as part of configuring).	-	The IN LEDs of the sensor are off.
Cross-circuit at input x	A cross-circuit was detected at input x.	red	The IN LEDs of the sensor are flashing green.
Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-
Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A cross-circuit is present in the case of cross-circuit monitoring	-	-

8.2.3.4 Protective door

The table below lists all the messages and corresponding LED responses to the "Protective Door" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	-	The IN LEDs of the sensor are flashing green.
Sequence condition not fulfilled	The sequence condition was not fulfilled in accordance with the parameter assignment.	flashes red	**Basic:** The IN LEDs of the sensor are flashing green. **Advanced/ASIsafe:** The sensor that triggered the sequence violation is flashing.
Discrepancy condition violated	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	flashes red	The IN LEDs of the sensor are flashing green.
Safety sensor triggered	The safety sensor has been actuated. This message is automatically reset if the value "1" is present for all function inputs monitored (set as part of configuring).	-	The IN LEDs of the sensor are off. The IN2-LED is green on input type NCNO.
Cross-circuit at input x	A cross-circuit was detected at input x.	Red	The IN LEDs of the sensor are flashing green.
Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A signal sequence violation is present • A cross-circuit is present in the case of cross-circuit monitoring	-	-

8.2.3.5 Protective door with lock

The table below lists all the messages and corresponding LED responses to the "Protective Door with Lock" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	-	The IN LEDs of the sensor are flashing green.
Sequence condition not fulfilled	The sequence condition was not fulfilled in accordance with the parameter assignment.	flashes red	The sensor that triggered the sequence violation is flashing.
Discrepancy condition violated	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	flashes red	The IN LEDs of the sensor are flashing green.
Safety sensor triggered	The safety sensor has been actuated. This message is automatically reset if the value "1" is present for all function inputs monitored (set as part of configuring).	-	The IN LEDs of the sensor are off. The IN2-LED is green on input type NCNO.
Protective door closed	The protective door is closed.	-	The IN LEDs of the sensor are green. The IN2-LED is off on input type NCNO.
Lock engaged	The lock is engaged.	-	-
Lock released	The lock is released	-	-
Cross-circuit at input x	A cross-circuit was detected at input x.	red	The IN LEDs of the sensor are flashing green.
Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A signal sequence violation is present • A cross-circuit is present in the case of cross-circuit monitoring	-	-
Start override active	The start override time is running.	-	-
Feedback circuit signal and switching status do not match	The feedback circuit signal does not match the interlock status	red	The corresponding IN LED of the input that is connected on the FEEDBACK_LOCK function input flashes green if in the logic there is no more than one negation between the element input and the input cell.
Protective door opened when interlock was active	The protective door opened when interlock was active.	red	The corresponding IN LEDs of the sensor (protective door monitoring) are flashing green.
Interlock not possible because the protective door is open	Interlock not possible because the protective door is open.	flashes red	The corresponding IN LEDs of the sensor (protective door monitoring) are flashing green.

8.2.3.6 Safety shutdown mat with NC principle

The table below lists all the messages and corresponding LED responses to the "Safety shutdown mat with NC principle" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	-	The IN LEDs of the sensor are flashing green.
Discrepancy condition violated	is set if: • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	flashes red	The IN LEDs of the sensor are flashing green.
Safety sensor triggered	The safety sensor has been actuated. This message is automatically reset if the value "1" is present for all function inputs monitored (set as part of configuring).	-	The IN LEDs of the sensor are off.
Cross-circuit at input x	A cross-circuit was detected at input x.	red	The IN LEDs of the sensor are flashing green.
Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-
Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A cross-circuit is present in the case of cross-circuit monitoring	-	-

8.2.3.7 Safety shutdown mat with cross-circuit principle

The table below lists all the messages and corresponding LED responses to the "Safety shutdown mat with cross-circuit principle" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	-	The IN LEDs of the sensor are flashing green.
Safety sensor triggered	The safety sensor has been actuated. This message is automatically reset if the value "1" is present for all function inputs monitored (set as part of configuring).	-	The IN LEDs of the sensor are off.
Wire break at input x	A wire break was detected at input x.	red	The IN LEDs of the sensor are flashing green.
Short circuit to P at input x	A short-circuit to P was detected at input x.	red	The IN LEDs of the sensor are flashing green.
Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-
Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A cross-circuit is present	-	-

8.2.3.8 Two-hand operation

The table below lists all the messages and corresponding LED responses to the "two-hand operation" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Discrepancy condition violated	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different within one or between to two pushbuttons. • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	flashes red	The IN LEDs of the sensor are flashing green.
Cross-circuit at input x	A cross-circuit was detected at input x.	red	The IN LEDs of the sensor are flashing green.
Start condition not fulfilled	is set if: • If both pushbuttons were not pressed "synchronously," that is, they were pressed with a time offset greater than 0.5 s • A discrepancy condition violation is present • The value "1" is not present simultaneously at IN1 ... 2 / 4 • A cross-circuit is present	-	-
Pushbutton stuck (not in the case of 3RK3 Basic)	The pushbutton is stuck.	flashes red	The IN LEDs of the sensor are flashing green.
Do not release both pushbuttons simultaneously (not in the case of 3RK3 Basic)	The two pushbuttons were not released simultaneously.	flashes red	The IN LEDs of the sensor are flashing green.

8.2.3.9 Enabling button

The table below lists all the messages and corresponding LED responses to the "enabling button" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Discrepancy condition violated	is set if: • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	flashes red	The IN LEDs of the sensor are flashing green.
Enabling button OFF	The enabling button has the status OFF.	-	-
Enabling button ON	The enabling button has the status ON.	-	-
Cross-circuit at input x	A cross-circuit was detected at input x.	red	The IN LEDs of the sensor are flashing green.
Start condition not fulfilled	is set if: • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A cross-circuit is present	-	-
Pushbutton stuck (not in the case of 3RK3 Basic)	The pushbutton is stuck.	flashes red	The IN LEDs of the sensor are flashing green.

8.2.3.10 Mode selector switch

The table below lists all the messages and corresponding LED responses to the "Mode Selector Switch" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Switchover time exceeded	The "1 out of 2...5 selection monitoring" has detected the value "0" at all inputs after the contact switchover time has elapsed.	-	-
Invalid operating mode selection	The "1 out of 2...5 selection monitoring" has detected after the contact switchover time has elapsed: The value "1" is present at more than one input.	red	The IN LEDs of the sensor are flashing green.

8.2.3.11 Muting functions

The table below lists all the messages and corresponding LED responses to the "Muting" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Muting operation active	Muting mode is activated.	-	-
Muting operation not active	Muting mode is not activated.	-	-
Muting restart possible	Muting mode was not terminated correctly, i.e. at least one muting sensor is still being triggered.	flashes red	The corresponding IN-LED of the muting display lamp flashes green if only single-channel elements (negation) have been placed between the input cell and the element input in the logic.
Restart signal duration invalid	The "Muting restart possible" message is set and, the first time the RESTART button is pressed, the expected operating sequence does not follow.	flashes red	The corresponding IN-LED of the muting display lamp flashes green if only single-channel elements (negation) have been placed between the input cell and the element input in the logic.
Protective field not free	The value "0" is present at the "FREE" function input.	-	-
System not running	The value "1" is present at the "STOP" function input.	-	-
Start muting condition not met	Not all conditions for operational starting of muting using muting sensors are met.	-	-
Max. muting time exceeded	Muting operation terminated because "max. muting time" expired.	flashes red	-
Discrepancy condition sensor pair x not fulfilled	A discrepancy violation was detected in the signals of muting sensor pair x.	flashes red	The corresponding IN LEDs of the sensors are flashing green.
Sequence condition not fulfilled	The sequence condition was not observed.	flashes red	The LED(s) on whose input the error was detected are flashing green.
Muting display lamp defective	The muting display lamp - monitoring function has detected an error.	red	The corresponding IN-LED of the muting display lamp flashes green if only single-channel elements (negation) have been placed between the input cell and the element input in the logic.

8.2.3.12 Output functions

The table below lists all the messages and corresponding LED responses to the "standard output" and "F output" function elements.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Output x active	Function output 1 is switched on.	-	-
Feedback circuit signal and switching status do not match	The signal at the feedback circuit input does not match the switching status of the function outputs. The output function immediately deactivates all its outputs in case of inconsistencies.	red	The corresponding IN LED of the sensor flashes green if there is no more than one negation between the element input and the input cell in the logic.
Start condition not fulfilled	is set if: • there is a feedback circuit error when feedback circuit monitoring is activated. • the value "0" is pending at the function input (IN).	-	-
Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-

8.2.3.13 Messages for AS-i 1...4F-DO

The table below lists all the messages and corresponding LED responses to the "AS-i1..4F-DO" function element.

Message	Meaning	LED response	
		SF-LED on central unit	Input LEDs on central unit or expansion module
Output x active	Function output x is switched on.	-	-
Feedback circuit signal x and switching status do not match	The signal at feedback circuit input x and the switching status of the corresponding function output x do not match. In case of inconsistencies, the output function immediately switches off all its outputs.	red	The corresponding IN LED of the sensor flashes green if there is no more than one negation between the element input and the input cell in the logic.
Invalid output selection	The value "1" was detected on more than one input IN1 ... 4 by the "1 out of 4 - selection monitoring."	flashing red	The corresponding IN LEDs of the sensors are flashing green.
Start condition not fulfilled	is set if: • there is a feedback circuit error when feedback circuit monitoring is active. • the logic error "Invalid output selection" is pending. • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...).	-	-
Auxiliary control signal x sent	The auxiliary control signal x was transmitted completely by the code sequence that is currently active.	-	-
Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-

8.3 Diagnostics with MSS ES

This diagnostics can be used to read the status of each system function element. Diagnostics with MSS ES is divided into "Diagnostics configuration" and "Diagnostics logic".

The diagnostics configuration provides users with an overview of the module status and the device messages.

Diagnostics logic allows users to monitor system components. It also permits forcing.

Depending on the existing license variant of MSS ES, the diagnostics can be accessed by means of PROFIBUS and the device interface (see Chapter "What's new? (Page 15)").

Note

A description of the diagnostics of older software versions of MSS ES is given in the online help.

8.3.1 Diagnostics configuration

8.3.1.1 Module status

Requirements

The "Target system" > "Diagnostics configuration" > "Module status" menu command can only be selected if the main system or the subsystem (MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic, MSS 3RK3 ASIsafe extended) is activated in the navigation window and if an online connection is established between MSS ES and the safety relay.

Module status

When you choose "Target system" > "Diagnostics configuration" > "Module status", the status of the modules is shown in an additional column in the configuration table.

A red square indicates either a faulty module or a module that does not actually exist.

Note

In the main system, all modules after the first defective module can no longer be addressed.

Note

Diagnostics display

The status of the diagnostics display is not displayed.

8.3.1.2 Dialog "Device messages" > "Overview" tab

The configuration supports the following messages:

General

Status	Symbol	Meaning
Group error	red	At least one error is present.
Bus error	red	Communication to the fieldbus master is disturbed.
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present (e.g. "Safety sensor triggered").

Problem / Message - Possible remedial measures

In this window, problems / messages and possible remedial measures for these are shown in two columns.

Examples:

Problem / Message	Possible remedial measures
Initialization error	• Switch off and switch on again the voltage supply of the device. • The next time a device error is indicated, the device must be replaced.
Group error	• The safety relay has detected at least one application-specific error. • More detailed messages will give the precise cause of the error.
Error in configuration	• Check the actual device configuration against the configured target configuration. • Acknowledge after remedying the error.
AS-i code sequence error	• An incorrect AS-i code sequence was received from at least one safety-related AS-i slave. • Check the system for EMC interference and start up the system again. • If code sequence errors occur again, replace the AS-i slave in question.
Disconnect	• Restore the connection again. • Check whether another program is using and therefore blocking the interface.
Logic error	• The monitored sensor outputs an invalid signal sequence. • Operate the monitored sensor in such a way that the start condition is fulfilled.

Legends

The meaning of the symbols used in the Problem / Message - Possible remedial measures section and the urgency level of the colors used is explained in the legends.

8.3.1.3 "Device messages" dialog box > "Status" tab

The configuration supports the following messages:

General

Status	Symbol	Meaning
Group error	red	At least one error is present.
Bus error	red	Communication to the fieldbus master is disturbed.
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present (e.g. "Safety sensor triggered").

Group error

Status	Symbol	Meaning
Device error	red	• Faulty input or output • Defective module
Configuring error	red	An error occurred during the configuration phase.
Error in configuration	red	TARGET slot configuration not equal ACTUAL slot configuration.
Safety protocol error	red	• Communication with a safety-relevant communications partner is disrupted; for example, communications disrupted due to effects of EMC. • Code sequence error (MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic and MSS 3RK3 ASIsafe extended)
Group error from user program	red	At least one error is present.
Wiring error	red	Faulty wiring of a sensor connection or in the sensor itself.
Logic error	red	Protection fault: Processing sequence on the sensor not coherent.
For an element number		Issues the number of the lowest element on which the group error is pending.

Bus error

Status	Symbol	Meaning
SC bus error	red	Communication via the device bus interface is interrupted.
AS-i bus error	red	The message is displayed for up to 30 s during startup if no AS-i bus is detected.
DP bus error	red	Communication via the fieldbus interface PROFIBUS DP is interrupted.

Group warning

Status	Symbol	Meaning
Group warning from user program	yellow	At least one warning is present.
For an element number		Issues the number of the lowest element on which the group warning is pending.

Group prewarning

Status	Symbol	Meaning
Group prewarning from user program	yellow	At least one prewarning is present.
For an element number		Issues the number of the lowest element on which the group prewarning is pending.

Error acknowledgment

Status	Symbol	Meaning
Reset implemented	green	All error sources were eliminated and could be acknowledged.
Reset not possible	yellow	At least one error cannot be acknowledged since the error cause still exists.

Operating status

Status	Symbol	Meaning
Configuring mode	green	The safety relay is in configuring mode.
Test mode	green	The safety relay is in test mode.
Safety mode	green	The safety relay is in safety mode.
User program is active	green	The safety relay is actively processing the safety circuit.
User program stopped.	yellow	The safety relay is processing the safety circuit.
Operating mode change rejected	yellow	No valid password has been entered for switching to test mode. There is a configuring or device error that is preventing operating mode change.

Access path

Status	Symbol	Meaning
Access path closed	green	No access path is open.
Access path to fieldbus control is open	green	The access path over the fieldbus interface for a control is open.
Access path fieldbus ES tool is open	green	The access path over the fieldbus interface for an ES tool is open.
Access path to device interface is open	green	The access path over the device interface is open
Disconnect	yellow	The monitoring time has been exceeded During monitoring time, the safety relay has not received any data set from the communication partner with write access to the safety relay.
Handshake error	red	An error was detected during connection monitoring in test mode.

Password protection

Status	Symbol	Meaning
Device access authorization exists	green	Device access authorization exists.
Password protection for device access is inactive	yellow	There is no protection against access from a higher-level controller or other users.
Incorrect password entry	yellow	A password was received that does not match any device access password stored in the safety relay.

Device self-test

Status	Symbol	Meaning
Self-test active	blue	Device self-test running.
Self-test ok	green	The device self-test was finished without an error.
Self-test error	red	The device self-test has detected an error

Legends

The meaning of the symbols used in the Problem / Message - Possible remedial measures section and the urgency level of the colors used is explained in the legends.

8.3.1.4 Dialog "Device messages" > "Engineering" tab

The configuration supports the following messages:

General

Status	Symbol	Meaning
Group error	red	At least one error is present.
Bus error	red	Communication to the fieldbus master is disturbed.
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present (e.g. "Safety sensor triggered").

Status	Symbol	Meaning
Configuring error	red	An error occurred during the configuration phase.

Engineering

Status	Symbol	Meaning
Configuration missing	yellow	No valid configuration is stored in the safety relay.
Configuration not released	yellow	A valid configuration is stored but not released yet in the safety relay.
Release canceled	yellow	An already released configuration was canceled by means of the configuration release command.
Release canceled due to incorrect configuration release CRC	red	The configuration release CRC in the release data has a value other than "0" and deviates from the value calculated by the safety relay.
Release denied due to incorrect configuration CRC	red	The user tried to release a configuration whose configuration CRC does not match the configuration CRC to be released.
Configuration released	green	A valid and released configuration is stored in the safety relay.
Release denied, already released	yellow	The user is trying to release an already released configuration by means of the configuration release command.
Factory settings restored	green	The factory settings were successfully restored.

Element error

Status	Symbol	Meaning
Invalid parameter value	red	A parameter value is not within the permissible value range.
Interconnection rule violated	red	At least 1 interconnection rule is violated.
Data structure incorrect	red	While receiving new configuring data, an inconsistency was detected by the safety relay in the structure and content of at least one data structure.
For an element number		Specifies the number of the lowest element whose parameters were not accepted by the device.

Device resources

Status	Symbol	Meaning
Max. number of elements exceeded	red	More elements than the maximum number of elements were transferred to the safety relay.
Max. size of memory exceeded	red	More element parameters were transferred to the device than can be stored in the safety relay memory .
Program cycle time exceeded	red	The program cycle time set by the user is exceeded, MSS 3RK3 changes to configuring mode.

Legends

The meaning of the symbols used in the Problem / Message - Possible remedial measures section and the urgency level of the colors used is explained in the legends.

8.3.1.5 "Device messages" dialog box > "Configuration" tab

The configuration supports the following messages:

General

Status	Symbol	Meaning
Group error	red	At least one error is present.
Bus error	red	Communication to the fieldbus master is disturbed.
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present (e.g. "Safety sensor triggered").

Status	Symbol	Meaning
Error in configuration	red	A problem has occurred in the memory module.

Device configuration

Status	Symbol	Meaning
TARGET configuration equal ACTUAL configuration	green	The specified TARGET configuration of the safety relay corresponds to the current function and module configuration.
TARGET configuration not equal ACTUAL configuration	red	The specified TARGET configuration of the safety relay does not correspond to the current function and module configuration.
TARGET slot configuration not equal ACTUAL slot configuration	red	The specified TARGET slot configuration of the safety relay does not correspond to the ACTUAL slot configuration.
Target subslot configuration not equal to actual subslot configuration	red	The specified target subslot configuration (AS-i configuration) of the safety relay does not match the actual subslot configuration.

Memory module

Status	Symbol	Meaning
Memory module not plugged in	red	No memory module is plugged in the safety relay.
Memory module defective	red	Memory module is defective.
Programming successful	green	Programming of the memory module was successful.
Programming error	red	Programming of the memory module was not successful.
Memory module too small	red	More configuration data were transferred to the safety relay than can be stored in the memory module.
Memory module deleted	green	The memory module was deleted by command beforehand.

Legends

The meaning of the symbols used in the Problem / Message - Possible remedial measures section and the urgency level of the colors used is explained in the legends.

8.3.1.6 Dialog "Device messages" > "PROFIBUS DP" tab

The "PROFIBUS DP" tab is only available when there is a configured DP interface module.

The configuration supports the following messages:

General

Status	Symbol	Meaning
Group error	red	At least one error is present.
Bus error	red	Communication to the fieldbus master is disturbed.
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present (e.g. "Safety sensor triggered").

DP status

Status	Symbol	Meaning
CPU/Master STOP	yellow	• CPU STOP: The user program in the PLC is not processed any more. • Master STOP: A disturbed communication with the fieldbus master was detected.
DP bus error	red	Communication via PROFIBUS DP has been interrupted.
DP parameter assignment error	red	During parameter assignment in existing communication connection a parameter assignment error occurred.
DP configuration error	red	The actual configuration of an existing communication connection does not match the target configuration. This resulted in an error.
DP process data exchange stopped	yellow	Process data exchange with the DP master has stopped, for example, because the controller is in the "STOP" state (= CPU STOP) or because the user program in the MSS 3RK3 is not running.
DP communication ok	green	The communication connection to the fieldbus master is set up. Configuration and parameter assignment of the safety relay have been executed successfully.

Legends

The meaning of the symbols used in the Problem / Message - Possible remedial measures section and the urgency level of the colors used is explained in the legends.

8.3.1.7 Dialog "Device messages" > "Device bus interface" tab

The configuration supports the following SC status messages (SC = system interface):

General

Status	Symbol	Meaning
Group error	red	At least one error is present.
Bus error	red	There is at least one communication fault of a bus system.
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present (e.g. "Safety sensor triggered").

SC status

Status	Symbol	Meaning
SC communication ok	green	The internal communication link is set up.
SC bus error	red	Communication via the device bus interface is interrupted.
SC parameter assignment error	red	An error occurred during parameter assignment in existing communication connection.
SC configuration error	red	The actual configuration of an existing communication connection does not match the target configuration. This resulted in an error.
SC process data exchange stopped	yellow	No more process data is exchanged.

Legends

The meaning of the symbols used in the Problem / Message - Possible remedial measures section and the urgency level of the colors used is explained in the legends.

8.3.1.8 "Device messages" dialog box > "AS-Interface" tab

Requirements

The "AS-Interface" tab appears only if AS-Interface is configured for MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic or MSS 3RK3 ASIsafe extended.

The configuration supports the following messages:

General

Status	Symbol	Meaning
Group error	red	At least one error is present.
Bus error	red	Communication to the fieldbus master is disturbed.
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present (e.g. "Safety sensor triggered").

AS-i interface

Status	Symbol	Meaning
AS-i communication ok	green	• The communications link to the AS-i slaves exists. • The AS-i slaves have been successfully configured and parameterized.
AS-i configuration error	red	The actual configuration of an existing communication connection does not match the target configuration. This resulted in an error. Communication via the AS-i fieldbus interface is interrupted.
For AS-i address		States the lowest of the affected addresses.
AS-i parameterization error	red	A simulated AS-i slave was not included in the data traffic by the AS-i master.
For AS-i address		States the lowest of the affected addresses.
AS-i bus error	red	The message is displayed for up to 30 s during startup if no AS-i bus is detected.

AS-i slave function

Status	Symbol	Meaning
AS-i slave function active	green	The AS-i slave function is active, i.e. non-safety-related AS-i slaves are simulated by the safety relay.

AS-i monitor function

Status	Symbol	Meaning
AS-i monitor function active	green	The AS-i monitor function is active, i.e. non-safety-related AS-i slaves are monitored.

ASIsafe

Status	Symbol	Meaning
Safety protocol error	red	Fault in safety-related communication, for example, resulting from ASIsafe code sequence error due to effects of EMC.
ASIsafe 7x4-bit code sequence monitor active	green	At least one 7x4-bit code sequence monitor is monitoring data on the AS-i bus.
ASIsafe 7x4-bit code sequence error	red	During data transmission, an error in the 7x4-bit code sequence was detected in at least one AS-i address.
For AS-i address		States the lowest of the affected addresses.
ASIsafe 8x4-bit code sequence monitor active	green	At least one 8x4-bit code sequence monitor is active.
ASIsafe 8x4-bit code sequence error	red	During data transmission, an error in the 8x4-bit code sequence was detected in at least one AS-i address.
ASIsafe code table teaching active	blue	Monitoring of ASIsafe code sequences that have not yet been taught is active.
Code tables missing	red	The code table is missing for at least one of the configured safety-related input slaves.
Multiple code tables	red	At least two safety-related AS-i slaves with the same code table have been detected.
New codes tables	yellow	The code table of at least one configured safety-related input slave has not yet been transferred.
Code tables known	green	A valid code table has been taught and applied for all configured safety-related AS-i input slaves detected on the AS-i bus.
For AS-i address		States the lowest of the affected addresses.
ASIsafe 7x4-bit code sequence generator active	green	At least one 7x4-bit code sequence generator is involved in the AS-i communication, i.e. it is transmitting a certain 7x4-bit code sequence for a particular parameterized AS-i address.
ASIsafe 8x4-bit code sequence generator active	green	At least one 8x4-bit code sequence generator is involved in the AS-i communication, i.e. it is transmitting a certain 8x4-bit code sequence for a particular parameterized AS-i address.

Legends

The meaning of the symbols used in the Problem / Message - Possible remedial measures section and the urgency level of the colors used is explained in the legends.

8.3.2 Diagnostics logic

8.3.2.1 Monitoring

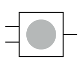
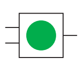
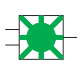
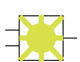
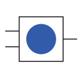
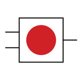
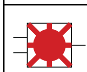
The "Target system" > "Diagnostics logic" > "Monitor" menu command shows the status of the inputs / outputs, of the function elements, and of the connections between the functions.

The status of the connections is determined based on the result of logic operation (RLO) of the respective function output.

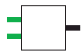
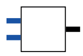
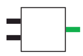
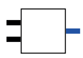
Requirements

- The safety relay is opened online.
- The logic diagram with the safety circuit is active.
- The MSS 3RK3 is in safety mode or test mode

General element status

Symbol	Color	Meaning
	gray	Function element is deactivated
	green	At least one function output is active
	green flashing	Function element is ready and is waiting for a start signal.
	yellow flashing	Function element waiting for startup test
	blue	Timer is active
	red	Wiring error **Note** For input cells this means that the input substitute value is active.
	flashing red	Logic error, e.g. status of the feedback contact, does not match the setpoint value

Status of the function inputs/function outputs

Symbol	Color	Meaning
	green	Function input active
	blue	Function input inactive
	green	Function output active
	blue	Function output inactive

8.3.2.2 Messages for Monitoring Universal

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General," "Sensor," and "Start."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A signal sequence violation is present • A cross-circuit is present in the case of cross-circuit monitoring

Sensor

Status	Symbol	Meaning
Safety sensor triggered	yellow	The safety sensor has been actuated. This message is automatically reset if the value "1" is pending at all IN1 / 2 function inputs monitored.
Startup test required	yellow	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the user has actuated the connected sensor at least once.
Sequence condition not fulfilled	red	The sequence condition was not fulfilled in accordance with the parameter assignment.
Discrepancy condition violated	red	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"
Cross-circuit at input x	red	A cross-circuit was detected at input x.

Start

Status	Symbol	Meaning
Start signal duration invalid	yellow	Only with start type "Monitored start": The start signal time monitoring element detected a violation.

8.3.2.3 EMERGENCY STOP messages

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General," "Sensor," and "Start."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • A cross-circuit is present in the case of cross-circuit monitoring • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...)

Sensor

Status	Symbol	Meaning
Safety sensor triggered	yellow	The safety sensor has been actuated. This message is automatically reset if the value "1" is pending at all IN1 / IN2 function inputs monitored.
Startup test required	yellow	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.
Discrepancy condition violated	red	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"
Cross-circuit at input x	red	A cross-circuit was detected at input x.

Start

Status	Symbol	Meaning
Start signal duration invalid	yellow	Only with start type "Monitored start": The start signal time monitoring element detected a violation.

8.3.2.4 Messages for ESPE

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General," "Sensor," and "Start."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • A cross-circuit is present in the case of cross-circuit monitoring • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...)

Sensor

Status	Symbol	Meaning
Safety sensor triggered	yellow	The safety sensor has been actuated. This message is automatically reset if the value "1" is pending at all IN1 / IN2 function inputs monitored.
Discrepancy condition violated	red	is set if: • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"
Startup test required	yellow	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.
Cross-circuit at input x	red	A cross-circuit was detected at input x.

Start

Status	Symbol	Meaning
Start signal duration invalid	yellow	Only with start type "Monitored start": The start signal time monitoring element detected a violation.

8.3.2.5 Messages for safety shutdown mat (NC principle)

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General," "Sensor," and "Start."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • A cross-circuit is present in the case of cross-circuit monitoring • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...)

Sensor

Status	Symbol	Meaning
Safety sensor triggered	yellow	The safety sensor has been actuated. This message is automatically reset if the value "1" is pending at all IN1 / IN2 function inputs monitored.
Startup test required	yellow	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.
Discrepancy condition violated	red	is set if: • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"
Cross-circuit at input x	red	A cross-circuit was detected at input x.

Start

Status	Symbol	Meaning
Start signal duration invalid	yellow	Only with start type "Monitored start": The start signal time monitoring element detected a violation.

8.3.2.6 Messages for safety shutdown mat (cross-circuit principle)

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General," "Sensor," and "Start."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • A sensor test was not executed in the case of an active startup test function • A cross-circuit is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...)

Sensor

Status	Symbol	Meaning
Safety sensor triggered	yellow	The safety sensor has been actuated. This message is automatically reset if the value "1" is pending at all IN1 / IN2 function inputs monitored.
Startup test required	yellow	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.
Wire break at input x	red	Value "0" detected at input x.
Short circuit to P at input x	red	A short-circuit to P was detected at input x.

Start

Status	Symbol	Meaning
Start signal duration invalid	yellow	Only with start type "Monitored start": The start signal time monitoring element detected a violation.

8.3.2.7 Messages for protective door

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General," "Sensor," and "Start."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A signal sequence violation is present • A cross-circuit is present in the case of cross-circuit monitoring

Sensor

Status	Symbol	Meaning
Safety sensor triggered	yellow	The safety sensor has been actuated. This message is automatically reset if the value "1" is pending at all IN1 / IN2 function inputs monitored.
Startup test required	yellow	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.
Sequence condition not fulfilled	red	The sequence condition was not fulfilled in accordance with the parameter assignment.
Discrepancy condition violated	red	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of all inputs to be monitored had not all previously been reset simultaneously to the value "0" when they are set to "1."
Cross-circuit at input x	red	A cross-circuit was detected at input x.

Start

Status	Symbol	Meaning
Start signal duration invalid	yellow	Only with start type "Monitored start": The start signal time monitoring element detected a violation.

8.3.2.8 Messages for protective door with lock

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General," "Sensor / Protective Door," "Lock," and "Start."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A signal sequence violation is present • A cross-circuit is present in the case of cross-circuit monitoring

Sensor

Status	Symbol	Meaning
Safety sensor triggered	yellow	The safety sensor has been actuated. This message is automatically reset if the value "1" is pending at all IN1 / IN2 function inputs monitored.
Protective door closed	green	The protective door is closed.
Startup test required	yellow	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.
Sequence condition not fulfilled	red	The sequence condition was not fulfilled in accordance with the parameter assignment.
Discrepancy condition violated	red	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"
Cross-circuit at input x	red	A cross-circuit was detected at input x.

Lock

Status	Symbol	Meaning
Lock engaged	green	The lock is engaged.
Lock released	green	The lock is released.
Feedback circuit signal and switching status do not match	red	The feedback circuit signal does not match the interlock status.
Protective door opened when lock was active	red	The protective door opened when lock was active.
Locking not possible because the protective door is open	red	Locking not possible because the protective door is open.
Start override active	blue	The start override time is running.

Start

Status	Symbol	Meaning
Start signal duration invalid	yellow	Only with start type "Monitored start": The start signal time monitoring element detected a violation.

8.3.2.9 Messages for enabling button

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General" and "Sensor."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • A discrepancy condition violation is present • A cross-circuit is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...)

Sensor

Status	Symbol	Meaning
Enabling button OFF	green	The enabling button has the status OFF.
Enabling button ON	green	The enabling button has the status ON.
Bushbutton stuck	red	The pushbutton is stuck.
Discrepancy condition violated	red	is set if: • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"
Cross-circuit at input x	red	A cross-circuit was detected at input x.

8.3.2.10 Messages for two-hand operation

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General" and "Sensor."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • A discrepancy condition violation is present • A cross-circuit is present • If both pushbuttons were not pressed "synchronously", that is, they were pressed with a time offset greater than 0.5 s • The value "1" is not present simultaneously at IN1 / 3, IN2 / 4 • The two pushbuttons were not released simultaneously • A stuck button error is present

Sensor

Status	Symbol	Meaning
Bushbutton stuck	red	The pushbutton is stuck.
Do not release both pushbuttons	red	The two pushbuttons were not released simultaneously.
Discrepancy condition violated	red	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different within one or both pushbuttons • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"
Cross-circuit at input x	red	A cross-circuit was detected at input x.

8.3.2.11 Messages for mode selector switch

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is contains the sections "General" and "Mode selector switch."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Mode selector switch

Status	Symbol	Meaning
Switchover time exceeded	yellow	The "1 out of 2 ... 5 selection monitoring" detected the value "0" at all inputs after the contact switchover time had elapsed.
Invalid operating mode selection	red	The "1 out of 2 ... 5 selection monitoring" detected after the contact switchover time had elapsed: The value "1" is present at more than one input.

8.3.2.12 Messages for the muting functions

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General", "Muting sensors", and "Restart."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. faulty muting display lamp).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start muting condition not met	yellow	Not all conditions for operational starting of muting using muting sensors are met.

Muting sensors

Status	Symbol	Meaning
Muting operation active	green	Muting mode is activated.
Muting operation not active	green	Muting mode is not activated.
Protective field not free	yellow	The value "0" is present at the "FREE" function input.
System not running	yellow	The value "1" is present at the "STOP" function input.
Sequence condition not fulfilled	red	The sequence condition was not observed.
Discrepancy condition sensor pair x not fulfilled	red	A discrepancy violation was detected in the signals of muting sensor pair x.
Max. muting time exceeded	red	Muting operation terminated because "max. muting time" expired.
Muting display lamp defective	red	The muting display lamp - monitoring function has detected an error.

Restart

Status	Symbol	Meaning
Muting restart possible	green	Muting mode was not terminated correctly, i.e. at least one muting sensor is still being triggered.
Restart signal duration invalid	yellow	The "Muting restart possible" message is set and, the first time the RESTART button is pressed, the expected operating sequence does not follow.

8.3.2.13 Messages for counter functions

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is contains the sections "General" and "Counter function."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Counter function

Status	Symbol	Meaning
Counter limit value exceeded	yellow	The parameterized counter limit value was exceeded.
Counter limit value undershot	green	The parameterized counter limit value was undershot.
Last count pulse was up	green	Last count pulse was up
Last count pulse was down	green	Last count pulse was down.

8.3.2.14 Messages for timer functions

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is contains the sections "General" and "Timer function."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Time function

Status	Symbol	Meaning
OFF delay active	blue	The parameterized time t1 runs "with OFF delay".
ON delay active	blue	The parameterized time t1 runs "with ON delay".
Passing make pulse contact active	blue	The parameterized time t1 runs "with ON delay."
Clock-pulse generator active	green	The parameterized times t1 and t2 run "with clocking".

8.3.2.15 Messages for start functions

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is contains the sections "General" and "Start."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	The value "0" is present at the "Start condition input (IN)".

Start

Status	Symbol	Meaning
Start signal duration invalid	yellow	Only with start type "Monitored start": The start signal time monitoring element detected a violation.

8.3.2.16 Messages for output functions

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General," "Output," "Feedback circuit," and "Start."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. cross-circuit).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • there is a feedback circuit error when feedback circuit monitoring is activated. • the value "0" is pending at the function input (IN).

Output

Status	Symbol	Meaning
Output x active	green	Function output x is switched on.

Feedback circuit

Status	Symbol	Meaning
Feedback circuit signal and switching status do not match	red	The message at the feedback circuit input does not match the switching status of the function outputs. The output function immediately deactivates all its outputs in case of inconsistencies.

Start

Status	Symbol	Meaning
Start signal duration invalid	yellow	Only with start type "Monitored start": The start signal time monitoring element detected a violation.

8.3.2.17 Messages for AS-i 1..4F-DO

The "Element Messages" dialog box contains two tabs named "Overview" and "Messages" and provides information, remedial measures, and messages about pending problems and errors.

"Overview" tab

The view of the "Overview" tab is divided into the following sections:

Section	Content and meaning
General	The color indicates the type of error.
Problem / Message Possible remedial measures	Defines remedial measures for the displayed problem.
Legend	Explains the meaning of the symbols used in the Problem / Message - Possible remedial measures section.

"Messages" tab

The view of the "Messages" tab is divided into the sections "General," "Output," "Start," and "Feedback circuit."

General

Status	Symbol	Meaning
Logic error	red	At least one logic error is present (e.g. discrepancy error / sequence error).
Wiring error	red	At least one wiring error is present (e.g. feedback circuit error).
Group warning	yellow	At least one warning is present.
Group prewarning	yellow	At least one prewarning is present.

Status	Symbol	Meaning
Start condition not fulfilled	yellow	is set if: • there is a feedback circuit error when feedback circuit monitoring is active • the logic error "Invalid output selection" is present • the value "1" is present at more than one of the existing (parameterized) function inputs

Output

Status	Symbol	Meaning
Output x active	green	Function output x is switched on.
Auxiliary control signal x sent	green	The auxiliary control signal x was transmitted completely by the code sequence that is currently active.
Invalid output selection	red	The value "1" was detected on more than one input IN1 ... 4 by the "1 out of 4 - selection monitoring."

Start

Status	Symbol	Meaning
Start signal duration invalid	yellow	Only with start type "Monitored start": The start signal time monitoring element detected a violation.

Feedback circuit

Status	Symbol	Meaning
Feedback circuit signal x and switching status do not match	red	The signal at feedback circuit input x and the switching status of function output x do not match. In case of inconsistencies, the output function immediately switches off all its outputs.

8.4 Diagnostics using PROFIBUS

8.4.1 Using data sets

Diagnostics of the MSS 3RK3 using PROFIBUS is an important part of the Diagnostics concept (Page 490) of MSS 3RK3.

Note

Diagnostics block

An MSS-specific diagnostics block is available for diagnostics using PROFIBUS. You will find more information on the Internet under FAQs (http://support.automation.siemens.com/WW/view/de/40631654).

This section contains information about the data sets of the 3RK3 central unit and the DP interface and how to handle those data sets.

Target groups

This section is aimed at the following target groups:

- Configuration engineers
- PLC programmers

Required knowledge

You need to have a sound knowledge of writing/reading data sets using PROFIBUS.

Data sets: overview

Module	Data set no.	Description	Read/write
Central unit	0 / 1	System diagnostics	Read
DP interface			
Central unit	92	Device diagnostics (faults, warnings, messages)	Read

Reading data sets

Accessing data sets via slot:

- Access to data set from DP interface via Slot_0
- Access to data set from the central unit via Slot_1

Reading data sets with STEP 7

You can access the data sets from the user program.

Reading data sets:

- S7-DPV1 master: by calling SFB 52 "RDREC" or SFC 59 "RD_REC
- S7 master: by calling SFC 59

Additional information

You will find more information about the SFCs and SFBs

- Reference manual "System Software for S7-300/400, System and Standard Functions"
- In the STEP7 online help

Byte arrangements

When data longer than one byte is stored, the bytes are arranged as follows ("big endian"):

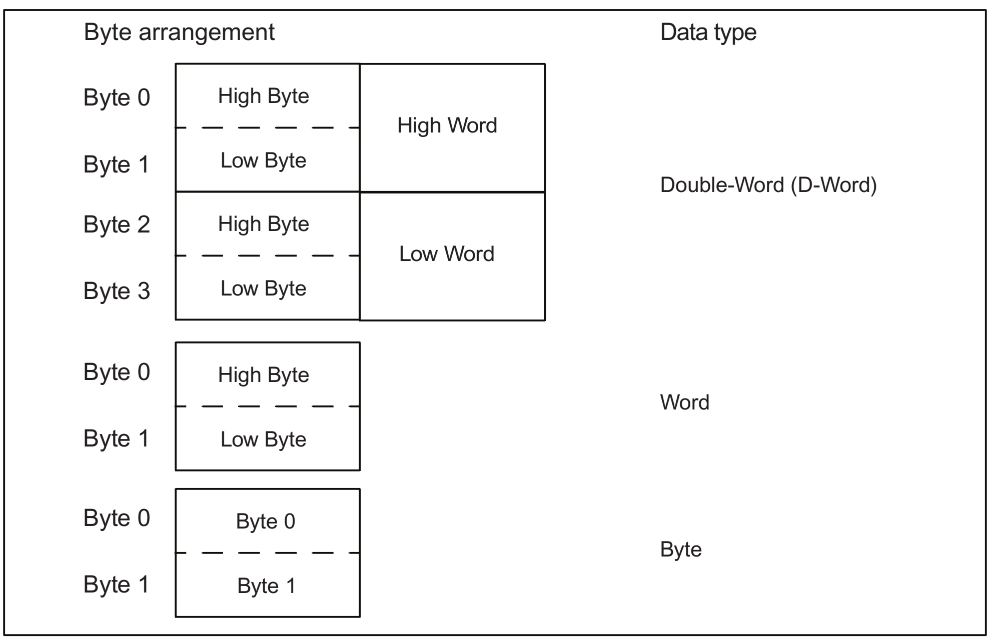


Figure 8-2 Byte arrangement

8.4.2 Structure of the diagnostics frame

Diagnostics concept via PROFIBUS

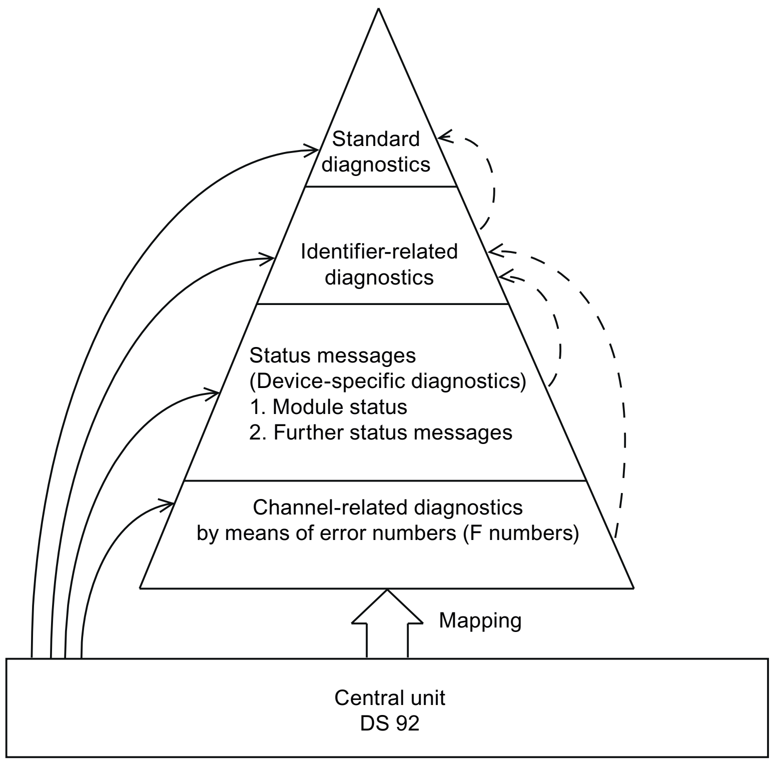


Figure 8-3 Diagnostics pyramid

Byte	Length	Diagnostics block
0 ... 5	6 bytes	Standard diagnostics DPV0 standard
6 ... 11	6 bytes	ID-related diagnosis
12 ... 23	12 bytes	Status messages Device-related diagnostics
24...x (max. 41)	0 ... 18 bytes	Channel-related diagnostics (max. 6 channels of 3 bytes each) Error numbers

Channel-related diagnostics

Channel-related diagnostics contains the error number from DS92. Up to six errors can be transferred simultaneously. The MSS 3RK3 uses the following error numbers:

Note

Difference between the 3RK3 central units

The error numbers of the 3RK3 central units are not all identical.

DP error numbers			
Error no.	**Description**	**Explanation**	**Remedy**
7	Upper limit exceeded	Memory module too small	Reduce configuring
8	Lower limit undershot	• Max. number of elements exceeded • Max. size of memory exceeded • Program cycle time exceeded	Adapt configuring
9	Error	• Device error • Self-test error	Replace device
16	Parameterization error	Configuring error: • Release denied due to incorrect configuration CRC • Release canceled due to incorrect configuration release CRC • Invalid parameter value • Interconnection rule violated (not in the case of MSS 3RK3 Basic) • Data structure incorrect (not in the case of MSS 3RK3 Basic)	• Correct configuring • Update engineering software
19	Communication error	Bus error: • Error on PROFIBUS • Error on AS-i bus (MSS 3RK3 Basic only) • Multiple ASIsafe code tables (not for MSS 3RK3 Basic) • ASIsafe 8x4-bit code sequence errors (not for MSS 3RK3 Basic) • ASIsafe 7x4-bit code sequence errors (not for MSS 3RK3 Basic) • Error on the system interface • Handshake error (MSS 3RK3 Basic)	• Check bus systems • Check device configuration

DP error numbers			
Error no.	Description	Explanation	Remedy
23	Actuator warning	Group warning (MSS 3RK3 Basic) or group prewarning (MSS 3RK3 Advanced, MSS 3RK3 ASIsafe) from the user program	Eliminate cause of warning and acknowledge
24	Actuator disconnection	Group error: • Error in configuration • Configuring error • Protocol error on a safety-related bus (not for MSS 3RK3 Basic) • Handshake error • Group error from user program • Wiring error • Logic error • Release denied due to incorrect configuration CRC • Release canceled due to incorrect configuration release CRC • Max. number of elements exceeded • Max. size of memory exceeded • Program cycle time exceeded • TARGET≠ACTUAL configuration • TARGET≠ACTUAL slot expanded configuration • Invalid parameter value • Interconnection rule violated (not in the case of MSS 3RK3 Basic) • Data structure incorrect (not in the case of MSS 3RK3 Basic) • Memory module not plugged in • Memory module defective • Programming error • Memory module too small • Self-test error (device error) • Multiple ASIsafe code tables (not for MSS 3RK3 Basic) • ASIsafe 8x4-bit code sequence errors (not for MSS 3RK3 Basic) • ASIsafe 7x4-bit code sequence errors (not for MSS 3RK3 Basic) • System interface configuration error	Eliminate cause of error and acknowledge
25	Safety-related shutdown	Logic error (user program)	Eliminate cause of message

DP error numbers			
Error no.	Description	Explanation	Remedy
26	External error	• Wiring error (user program) • Memory module not plugged in	• Eliminate cause of message • Insert the memory module
27	Unclear error	Unclear errors include errors that have no equivalent in the other error numbers. • Error in configuration • Safety protocol error (not in the case of MSS 3RK3 Basic) • Handshake error • TARGET≠ACTUAL configuration • TARGET≠ACTUAL slot expanded configuration • Memory module defective • Programming error • System interface configuration error	Eliminate cause of error

8.4.3 Data set 0

8.4.3.1 General data set 0

This DS is available for both the 3RK3 central unit and the DP interface. DS0 in the 3RK3 central unit can be queried through DP slot number 1 on the PROFIBUS slot model, and DS0 in the DP interface can be queried through DP slot number 0.

8.4.3.2 Data set 0 in 3RK3 central unit

The content of DS0 for the 3RK3 central unit is described below:

Byte	Meaning	Note
0^0	Module fault	SF on 3RK3 central unit
0^1	Internal error	Device error on 3RK3 central unit
0^2	External error	Logic or wiring error
0^3 ... 0^5	Reserved=0	
0^6	Module not parameterized	No configuration saved in device
0^7	Incorrect parameters in device	Incorrect configuration saved in device
1^0 ... 1^3	Type class	0000 CPU
1^4	Channel information available	DS1 exists
1^5	User information available	Always 1 for MSS 3RK3 because diagnostics information is available via DS92
1^6	Diagnostic interrupt from substitute	Not set by MS 3RK3.
1^7	Reserved=0	
2^0	No user module / user module incorrect	Configuration error in MSS 3RK3 TARGET / ACTUAL
2^1	Communication fault	Bus error or safety protocol error
2^2	[0]: RUN mode [1]: STOP mode	RUN: MSS 3RK3 in safety/test mode STOP: MSS 3RK3 in configuring mode
2^3	Time monitoring	Cycle time violation of MSS 3RK3
2^4 ... 2^6	Reserved=0	
3^0	Rack failure	System interface failed
3^1	Reserved=0	
3^2	Memory module error	Error in external memory module
3^3 ... 3^7	Reserved=0	

8.4.3.3 Data set 0 in DP interface

The content of DS0 for DP interface is described below:

Coding	Meaning	Note
0^0	Module fault	SF on expansion module
0^1	Internal error	e.g. error mode, int. EEP
0^2 ... 0^7	Reserved=0	
1^0... 1^3	Type class	0011 DP slave
1^4	Reserved=0	
1^5	User information available	Always 1 for MSS 3RK3 because no diagnostics information is available via DS92
1^6 ... 2^0	Reserved=0	
2^1	Communication fault	DeviceConnect failed
2^2	[0]: RUN mode [1]: STOP mode	RUN: Process data exchange with master
2^3 ... 2^7	Reserved=0	
3^0	Rack failure	DeviceConnect failed
3^1 ... 3^7	Reserved=0	

8.4.4 Data set 1

8.4.4.1 Data set 1 in the 3RK3 central unit

The content of DS1 for the 3RK3 central unit is described below:

Byte	Meaning
Diagnostics data part 1	
0^0 ... 3^7	Same as DS0
Diagnostics data part 2	
4^0 ... 4^7	$7D_H$ channel type
5^0 ... 5^7	20_H number of diagnostics bits per channel
6^0 ... 6^7	01_H number of channels (1 channel)
7^0	[1] (channel 0) module faulty (error present) [0] module OK
7^1 ... 8^0	Reserved=0
8^1	Short-circuit
8^2	Undervoltage
8^3	Overvoltage
8^4	Overload
8^5	Overtemperature
8^6	Line break
8^7	Upper limit exceeded (memory module too small)
9^0	Lower limit exceeded (no. of elements / memory exceeded)
9^1	Error (device error present)
9^2 ... 9^7	Reserved=0
10^0	Parameterization error
10^1	No encoder or load voltage
10^2	Fuse faulty
10^3	Reserved=0
10^4	Ground error
10^5	Reference channel error
10^6	Process alarm lost
10^7	Actuator alarm (e.g. group warning)
11^0	Actuator shutdown (e.g. group error)
11^1	Safety-related shutdown (e.g. logic error)
11^2	External fault (e.g. memory module not connected)
11^3	Unclear error (e.g. configuration error)
11^4	Reserved=0
11^5	Wiring error
11^6	Logic error
11^7	Configuring / test mode active
12^0 ... 15^7	Reserved=0

8.4.4.2 Data set 1 in DP interface

The content of DS1 for DP interface contains the same information as DS0 because certain CPUs first request DS1 for diagnostic purposes. If DS1 is rejected by DP interface, the CPU does not request any further diagnoses. Diagnostics bits that are not within the scope of DS0 always remain set to 0.

Byte	Meaning
Diagnostics data part 1	
0^0 ... 3^7	Same as DS0
4^0 ... 4^7	$7D_H$ channel type
5^0 ... 5^7	20_H number of diagnostics bits per channel
6^0 ... 6^7	01_H number of channels (1 channel)
7^0	[1] (channel 0) module faulty (error present) [0] module OK
7^1 ... 11^2	Reserved=0
11^2	Unclear error (e.g. configuration error)
11^4 ... 15^7	Reserved=0

8.4.5 Data set 92

All device-specific messages and information about the individual device function states are collected centrally and stored in the message memory of the 3RK3 central unit. The message memory can be read via DS92. The current device status is stored as of byte 12.

The content of DS92 is described below:

DS92 (device messages)						
Byte	Meaning	Note	3RK3 Basic		3RK3 Advanced 3RK3 ASIsafe	
			Error category	DP error number	Error category	DP error number
Header						
0 … 11	Reserved = 0					
Device status						
12^0	Device error (GF/DEVICE)	Device defective	GF	F9	GF	F9
12^1	Group error (SF)	at least 1 group error pending.	SF	F24	SF	F24
12^2	Bus error (BF)	at least 1 bus error pending.	BF	F19	BF	F19
12^3	Group warning (SW)	at least 1 warning pending.	SW	F23	SW	F23
12^4	Group prewarning (SVW)	at least 1 group prewarning pending.	-		SVW	F23
12^5 ... 13^0	Reserved = 0					
13^1	Configuration error (**KF**)	Memory module not detected; change to configuring mode.	SF	F24, F27	SF	F24, F27
13^2	Configuring error (**PF**)	The configuring contains at least 1 error.	SF	F24, F16	SF	F24, F16
13^3	Safety protocol error (**SPF**)	Protocol error at a safety-related bus, e.g., ASIsafe	-	-	SF	F24, F27
13^4	Wiring error (**VF**)	A wiring error is present.	SF	F24, F26	SF	F24, F26
13^5	Logic error (**LF**)	A logic error is pending (e.g., discrepancy or sequence violation).	SF	F24, F25	SF	F24, F25
13^6 ... 13^7	Reserved = 0					
14^0	Configuring mode active	Device is in configuring mode.	✓		✓	
14^1	Test mode active	Device is in test mode.	✓		✓	
14^2	Safety mode active	Device is in safety mode.	✓		✓	
14^3	User program is active	Device is in test or safety mode. The safety program is executed.	✓		✓	
14^4	User program stopped.	The safety program is executed.	✓		SVW	-
14^5 ... 14^6	Reserved = 0					
14^7	Operating mode change rejected	The operating status could not be changed.	✓		✓	
15^0	Access path closed	An access path in the device is not open.	✓		✓	
15^1	Access path to fieldbus control is open	Access path via the fieldbus interface is open.	✓		✓	

DS92 (device messages)						
Byte	Meaning	Note	3RK3 Basic		3RK3 Advanced 3RK3 ASIsafe	
			Error category	DP error number	Error category	DP error number
15^{2}	Reserved = 0					
15^{3}	Access path fieldbus ES tool is open	Access path through the ES tool is open.	✓		✓	
15^{4}	Reserved = 0					
15^{5}	Access path to device interface is open	Access path through the device interface is open.	✓		✓	
15^{6} ... 15^{7}	Reserved = 0					
16^{0}	Disconnect	Access monitoring has detected a communication break.	SW	-	SW	-
16^{1}	Handshake error	Connection monitoring has detected an error.	SF	F24, F19	SF	F24, F27
16^{2} ... 16^{7}	Reserved = 0					
17^{0}	Device access authorization exists	An access path with a valid password has been opened.	✓		✓	
17^{1} ... 17^{3}	Reserved = 0					
17^{4}	Password protection for device access is inactive	Password protection for device access is inactive.	✓		✓	
17^{5} ... 17^{6}	Reserved = 0					
17^{7}	Incorrect password entry	The wrong password was entered	✓		✓	
18^{0}	Group error from user program	At least 1 configured function element has a wiring or logic error.	SF	F24	SF	F24
18^{1}	Group warning from user program	At least 1 configured function element has a group warning.	SW	F23	-	
18^{2}	Group prewarning from user program	At least 1 configured function element has a group warning.	-		SVW	-
18^{3} ... 19^{7}	Reserved = 0					

DS92 (device messages)						
Byte	Meaning	Note	3RK3 Basic		3RK3 Advanced 3RK3 ASIsafe	
			Error category	DP error number	Error category	DP error number
Configuration status:						
20^0 ... 20^7	Reserved = 0					
21^0	Configuration missing	The system does not contain a valid configuration.	SW	-	SW	-
21^1	Configuration not released	The configuration has not been released or the release has been canceled.	✓		✓	
21^2	Configuration released	The configuration has been released.	✓		✓	
21^3	Reserved = 0					
21^4	Release denied due to incorrect configuration CRC	Incorrect configuring CRC, or other incorrect entries, e.g., no time stamp, name or description of company	SF	F24, F16	SF, PF	F24, F16
21^5	Release denied, already released	The configuration cannot be released because it has already been released.	✓		✓	
21^6	Release canceled	The release of a configuration has been canceled.	✓		✓	
21^7	Release canceled due to incorrect configuration release CRC	The configuration release has been canceled because the configuration contains errors.	SF	F24, F16	SF, PF	F24, F16
22^0	Max. number of elements exceeded	The max. no. of system elements has been exceeded.	SF	F24, F8	SF, PF	F24, F8
22^1	Max. size of memory exceeded	The maximum size of the system memory has been exceeded.	SF	F24, F8	SF, PF	F24, F8
22^2	Program cycle time exceeded	The set cycle time has been exceeded.	SF	F24, F8	SF, PF	F24, F8
22^3	Reserved = 0					
22^4	TARGET = ACTUAL configuration	The expanded system configuration matches the target configuration	✓		✓	
22^5	TARGET≠ACTUAL configuration	The expanded system configuration does not match the target configuration (e.g., modules swapped)	SF	F24, F27	SF, PF	F24, F27
22^6	TARGET≠ACTUAL slot expanded configuration	The expanded system configuration does not match the target configuration (e.g., different number of modules)	SF	F24, F27	SF, PF	F24, F27
22^7	TARGET≠ACTUAL subslot expanded configuration	The expanded configuration of the AS-i system does not match the configuration (e.g., different number of AS-i slaves)	-		✓	

DS92 (device messages)						
Byte	Meaning	Note	3RK3 Basic		3RK3 Advanced 3RK3 ASIsafe	
			Error category	DP error number	Error category	DP error number
23^0	Reserved = 0					
23^1	Invalid parameter value	A parameter in the configuration contains an invalid value.	SF	F24, F16	SF, PF	F24, F16
23^2	Reserved = 0					
23^3	Interconnection rule violated	At least 1 interconnection rule is violated.	-		SF, PF	F24, F16
23^4	Data structure incorrect	Data has errors, e.g., data structure header or element data block header or element CRC non-matching.	-		SF, PF	F24, F16
23^5	Factory settings restored	The device contains the factory settings.	✓		✓	
23^6 ... 23^7	Reserved = 0					
24 ... 25	Reserved = 0					
26^0	Memory module not plugged in	A memory module has not been plugged in.	SF	F24, F26	SF, KF	F24, F26
26^1	Memory module defective	The memory module is defective.	SF	F24, F27	SF, KF	F24, F27
26^2	Reserved = 0					
26^3	Memory module programming successful	The configuration data was successfully saved in the memory module.	✓		✓	
26^4	Programming error	The configuration data could not be saved in the memory module.	SF	F24, F27	SF, KF	F24, F27
26^5	Memory module too small	The volume of configuration data is too large for the memory module.	SF	F24, F7	SF, KF	F24, F7
26^6	Reserved = 0					
26^7	Memory module deleted	The configuring data has been deleted.	✓		✓	
27^0	Reset implemented	Reset implemented.	✓		✓	
27^1	Reset was not possible	Reset was not possible	✓		✓	
27^2 ... 29^3	Reserved = 0					
29^4	Self-test active	The system is executing a self-test.	✓		✓	
29^5	Self-test OK	The self-test was successful.	✓		✓	
29^6	Self-test error (device error)	A self-test error occurred.	GF	F24, F9	GF, SF	F24, F9
29^7 ... 33	Reserved = 0					

DS92 (device messages)						
Byte	Meaning	Note	3RK3 Basic		3RK3 Advanced 3RK3 ASIsafe	
			Error category	DP error number	Error category	DP error number
34 ... 35	Incorrect element number	Element number of first element to be found for the parameter in the configuring not accepted by the device: • [0]: no incorrect element exists • [1..32767]: (unsigned int) element no.	-		✓	
DP fieldbus interface:						
36^0	CPU/master STOP	The DP master is in STOP state.	✓		✓	
36^1	DP bus error	PROFIBUS error, connection interrupted	BF	F19	BF	F19
36^2	DP parameterization error	Erroneous or incorrect parameterization frame	✓		BF	-
36^3	DP configuration error	Erroneous or incorrect configuration frame	✓		BF	-
36^4	DP process data exchange stopped	Process data exchange with DP master stopped.	✓		✓	
36^5	DP communication OK	DP communication OK	✓		✓	
36^6 ... 37^7	Reserved = 0					
AS-i fieldbus interface						
38^0	AS-i bus error	AS-i data exchange interrupted, substitute values in process image	-		BF	F19
38^1	AS-i parameterization error	Simulated slave is not incorporated in the communication of the AS-i master	-		BF	F19
38^2	AS-i configuration error	In addition, the AS-i address of the affected AS-i slave with the lowest address is entered in byte 39. For example, set for TARGET ≠ ACTUAL subslot expanded configuration	-		BF	-
38^3 ... 38^4	Reserved = 0					
38^5	AS-i communication OK	AS-i communication is OK	-		✓	
38^6 ... 38^7	Reserved = 0					

DS92 (device messages)						
Byte	Meaning	Note	3RK3 Basic		3RK3 Advanced 3RK3 ASIsafe	
			Error category	DP error number	Error category	DP error number
39	Incorrect AS-i address	AS-i address of AS-i slave identified as faulty by the device • [0x00]: no AS-i address exists • Bit 0... 4: address 1 ... 31[1 ... 31] • Bit 5: A address [0] B address [1] • Bit 6: Standard slave [0] A/B slave [1] • Bit 7: reserved [0]	-		BF	-
40 ... 43						
44^{0}	AS-i slave function active	at least one AS-i slave is being simulated	-		✓	
44^{1} ... 44^{7}	Reserved = 0					
45	Reserved = 0					
46^{0}	AS-i monitor function active	at least one AS-i slave is being monitored	-		✓	
46^{1} ... 47	Reserved = 0					
ASIsafe:						
48^{0}	ASIsafe 8x4-bit code sequence monitor active	at least one safety-related AS-i slave is being monitored	-		✓	
48^{1}	ASIsafe 7x4-bit code sequence generator active	at least one safety-related AS-i output is being monitored	-		✓	
48^{2}	ASIsafe 8x4-bit code sequence generator active	at least one safety-related AS-i sensor is being simulated	-		✓	
48^{3}	ASIsafe 7x4-bit code sequence monitor active	at least one safety-related AS-i output is being simulated	-		✓	
48^{4} ... 48^{7}	Reserved = 0					
49^{0}	ASIsafe code tables missing	ASIsafe code tables missing. In addition, the (lowest) AS-i address is entered in byte 50	-		✓	
49^{1}	Multiple ASIsafe code tables	More than one ASIsafe code table exists. In addition, the (lowest) AS-i address is entered in byte 50.	-		SPF	F24, F19
49^{2}	ASIsafe code tables new	A new correct code sequence was received for at least one AS-i F slave. In addition, the (lowest) AS-i address is entered in byte 50.	-		✓	

DS92 (device messages)						
Byte	Meaning	Note	3RK3 Basic		3RK3 Advanced 3RK3 ASIsafe	
			Error category	DP error number	Error category	DP error number
49^3	ASIsafe code tables known	Code tables have been taught and stored in the memory module.	-		✓	
49^4	ASIsafe 8x4-bit code sequence error	Error occurred while evaluating input slaves. In addition, the AS-i address is entered in byte 50.	-		SF, SPF	F24, F19
49^5	ASIsafe code table teaching active	ASIsafe code table teaching active	-		✓	
49^6 ... 49^7	Reserved = 0					
50	AS-i address with 8x4-bit code sequence problem	Lowest AS-i address in which an 8x4-bit code sequence problem occurred. Code sequence problems are: Priority 1: Multiple ASIsafe code tables byte: 49^1 Priority 2: ASIsafe 8x4-bit code sequence error byte: 49^4 Priority 3: ASIsafe code tables missing byte: 49^0 Priority 4: ASIsafe code tables new byte: 49^2	-		✓	
51^0	ASIsafe 7x4-bit code sequence error	Error in 7x4-bit code sequences (MSS 3RK3 as safety-related AS-i output). In addition, the AS-i address is entered in byte 52.	-		SF, SPF	F24, F19
51^1 ... 51^7	Reserved = 0					
52	AS-i address with 7x4-bit code sequence problem	A problem has occurred on a safety-related AS-i output	-		✓	
53 ... 57	Reserved = 0					
Device bus interface: (SC = System Interface)						
58^0	SC bus error	Communication error	SF, BF	F24, F19	SF, BF	F24, F19
58^1	SC parameterization error	Error occurred during the transfer of parameters to expansion module.	✓		BF	-
58^2	SC configuration error	An expansion module cannot be addressed, or an unaddressed expansion module is installed.	SF	F24, F27	SF, BF	F24, F27
58^3	SC process data exchange stopped	Expansion modules are not involved in cyclic data exchange (e.g., system in configuring mode)	✓		✓	
58^4	SC communication OK	Expansion modules in cyclic data exchange	✓		✓	
58^5 ... 89	Reserved = 0					

DS92 (device messages)						
Byte	Meaning	Note	3RK3 Basic		3RK3 Advanced 3RK3 ASIsafe	
			Error category	DP error number	Error category	DP error number
Diagnosed elements						
90 ... 91	Element number for group error from user program	Element number of the first detected element of the processing sequence for which a group error is pending: • [0]: for now error • [1 ... 32.767]: element no.	-		✓	
92 ... 93	Reserved = 0					
94 ... 95	Element number for group prewarning from user program	Element number of the first detected element of the processing sequence for which a group error is present: • [0]: for now error • [1 ... 32.767]: element no.	-		✓	
96 ... 199	Reserved = 0					

✓: Supported

-: Not supported

8.5 Diagnosis using AS-Interface (CTT2 protocol)

8.5.1 Diagnostics concept using the CTT2 protocol

For the 3RK3 central units with AS-interface, the diagnostics concept of the MSS 3RK3 Basic is supplemented to include diagnostics of elements via AS-Interface using the CTT2 protocol. For this purpose, the MSS 3RK3 simulates a CTT2 slave, which is interconnected in the logic. The diagnostics concept using the CTT2 protocol is shown in the following graphic: The device messages result in an entry in the cyclic data, the message data. The acyclic data can then be read out using a command. In these acyclic data, all elements are entered with their pending messages.

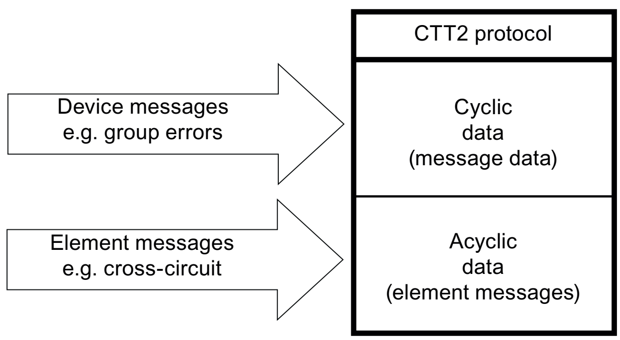


Figure 8-4 Diagnostics concept of MSS 3RK3 with AS-i interface using CTT2

8.5.2 Diagnostics using the CTT2 protocol

Diagnostics over an AS-i CTT2 channel provides access to the elements that have an error or whose safety sensor has been triggered. Device diagnostics using AS-i is possible with a simulated AS-i slave of type CTT2. This is able to process AS-i frames of type "Combined Transaction Type 2."

Because both the cyclic and the acyclic "CTT2 data" are transmitted over the same CTT2 channel, the cyclic CTT2 data transmission from the AS-i master is interrupted for transmission of the acyclic CTT2 data and resumed by the AS-i master automatically after acyclic data transmission has been completed.

Cyclic CTT2 data transmission

The cyclic CTT2 data transmission provides 8 bytes of input data and 8 bytes of output data per AS-i standard slave, which are cyclically exchanged over the CTT2 channel between the AS-i master and the AS-i slaves. Message data are sent by the AS-i slave to the AS-i master and control data are sent by the AS-i master to the AS-i slave.

For the simulated CTT2 slave of the MSS 3RK3, the message data consist of 2 bytes of diagnostics data and 6 bytes of freely interconnectable signals that can be interconnected in the logic via terminals. The diagnostic data signal the status and the operating state of the MSS 3RK3 to a higher-level control.

The MSS 3RK3 can be acknowledged with RESET via the control data.

The transmission duration of the cyclic data transmission depends on the number of AS-i slaves and can be up to 1.31 s.

Acyclic CTT2 data transmission

The cyclic CTT2 data transmission can be interrupted by the acyclic data transmission to permit a precise diagnosis of the individual elements. In this way, function elements with errors and function elements with prewarnings can be read out.

The acyclic CTT2 data transmission consists of up to 200 bytes of input and output data.

The transmission duration of the acyclic data transmission depends on the number of AS-i slaves and can be up to 16 s.

8.5.3 Cyclic data

Message data:

For diagnostics purposes, the device provides message data through a simulated AS-i slave with a CTT2 channel via the cyclic CTT2 data transmission channel. These message data are a subset of data set 92. The following messages can be diagnosed:

Byte	Process data block "device diagnostics"		Note
	Description	DS92	
0^0	Device error	12^0: device error	Device diagnostics messages Bit=[0]: Message not set Bit=[1]: Message set
0^1	Group error	12^1: group error	
0^2	Bus error	12^2: bus error	
0^3	Group warning	12^3: group warning	
0^4	Group prewarning	12^4: group prewarning	
0^5	TARGET≠ACTUAL	ORing of: 22^5: TARGET≠ACTUAL configuration 22^6: TARGET≠ACTUAL slot expanded configuration 22^7: TARGET≠ACTUAL subslot expanded configuration	
0^6	Group error code tables/sequences	ORing of: 49^0: code tables missing 49^1: multiple code tables 49^4: 8x4bit code sequence error 51^0: 7x4bit code sequence error	
0^7	Reserved = 0	[0]: fix	
1^0	Configuring mode active	14^0: configuring mode active	
1^1	Test mode active	14^1: test mode active	
1^2	Safety mode active	14^2: safety mode active	
1^3	User program is active	14^3: user program is active	
1^4 ... 1^7	Reserved = 0	[0]: fix	
2^0 ... 7^7	SLOT3_ASI#xx-S2.0 SLOT3_ASI#xx-S7.7	-	Signal from simulated CTT2 slave of MSS 3RK3 to AS-i master

xx: AS-i address

Note

Substitute values on failure of a slave

Depending on the AS-i master used, on failure of the AS-i bus or CTT2 slave different substitute values are generated by the master and transferred to the controller (0x7FFF or 0x0000). This must be considered in the programming of the controller because otherwise messages will be interpreted that are not present. The same applies to the freely interconnectable protocol data (SLOT3_ASI#xx-Sy.z).

If the corresponding master is used, the input data are checked word by word for the value 0x7FFF. If the value 0x7FFF is received, the value 0x0000 must be used in the program.

The corresponding substitute value response can be taken from the documentation of the master.

The data in the MSS are not affected by this. The substitute value 0x00 is always generated in this case.

Control data:

Through a simulated AS-i slave with a CTT2 channel, an AS-i master or a controller connected to it can write data to the safety relay. The following data can be written to the safety relay through the cyclic CTT2 data transmission channel:

Byte	Process data block "control data device"		Note
	Description	Description	
0^0	Reset	[->]: On pos. edge 0 -> 1, the command is executed once. [0,1]:constant value: does not cause command processing	Device commands
0^1 ... 1^7	Reserved=0	[0]: fix	
2^0 ... 7^7	SLOT3_ASI#xx-Q2.0 SLOT3_ASI#xx-Q7.7	-	Master call (CTT2 protocol) from AS-i master to simulated non-safety-related AS-i slave (CTT2) of the MSS 3RK3

xx: AS-i address

8.5.4 Acyclic data transmission with function block

The process of transferring CTT2 data from the CPU to AS-i master is dependent on the master. The section that follows describes the process using the example of the DP/AS-i Link Advanced. If you are working with SIEMENS AS-i masters and SIMATIC S7 controllers, FC ASI_3422 offers a user-friendly command interface.

Note

This FC ASi_3422 is not supported by all SIEMENS AS-i masters. You will find additional information in the documentation of the FC ASi_3422.

If you are not using the FC ASi_3422, refer to the documentation of the master used and the following chapter on CTT2..

Block FC ASi_3422

Calling block FC ASI_3422 enables you to both transfer commands and accept response data. For this purpose, FC ASi_3422 administers the calls Write_data_set and Read_data_set autonomously.

When the command interface is called using command 44_H, a byte string can be used to send a CTT2 request to the AS-i master. The master forwards the string bytes to the AS-i slave address specified in the transmit buffer. The AS-i master determines the number of string bytes to be sent to the AS-i slave (number depends on the data set to be transferred) on the basis of byte 2 of the transmit buffer (number of string bytes).

The addressed AS-i slave responds to the CTT2 request with a CTT2 response. The AS-i master communicates this response as a byte string in the receive buffer. The structure of the CTT2 request or CTT2 response (code, index, etc.) begins with string byte 1 in each case and is not dependent on the master.

The extended process image with the addressed AS-i slave is not transferred while string transfers to the AS-i are taking place.

Depending on the type of protocol, the process of transmitting a data set to a slave may take up to 19 s:

- Read DS3: up to 17 s
- Write DS3: up to 2 s

Reference

You will find more details in the manual for the DP/AS-Interface Link Advanced (order number: C79000-G8900-C209-03) in the Internet (http://support.automation.siemens.com/WW/view/en/22710305).

8.5.5 CTT2 data exchange

Using CTT2 code 29 ($1D_H$), data sets can be read out from the AS-i through the CTT2 channel while carrying useful data. The read request must be acknowledged positively (= CTT2 code $5D_H$) or negatively (= CTT2 code $9D_H$) by the AS-i slave within a certain time. Transmission of the data set requested by the AS-i slave with the specified length is evaluated as a positive acknowledgment.

Diagnostics with CTT2 codes

The "Write/Read a data set" command is provided in the transmit buffer. The first three bytes (command header) contain the command code, slave address, and number of CTT2 bytes. The CTT2 data set follows this. The CTT2 data set starts with the CTT2 command code, the data set number, and the data set length, followed by the data set bytes DS byte 0 to DS byte 13.

The DP command interface for the AS-i master accepts the data set bytes and forwards them to the addressed slave. These data are transmitted using the CTT2 protocol. MSS 3RK3 processes the CTT2 data set and prepares the requested data and answers using the CTT2 protocol. The AS-i master accepts the response and forwards it to the receive buffer of the CPU via the DP command interface. The response is decoded in the receive buffer of the CPU and the program is executed accordingly.

The following responses are possible:

- $5D_H$: Transmission without error (see Chapter "Element messages (Page 596)")
- $9D_H$: Transmission with error, (CTT2 code that is not supported, see Chapter "Error codes "CTT2 error code" (Page 592)")
- $5A_H$: Transmission with error (CTT2 error data set error, see Chapter "Error codes "CTT2 error code" (Page 592)")

1. Example of transmission without error

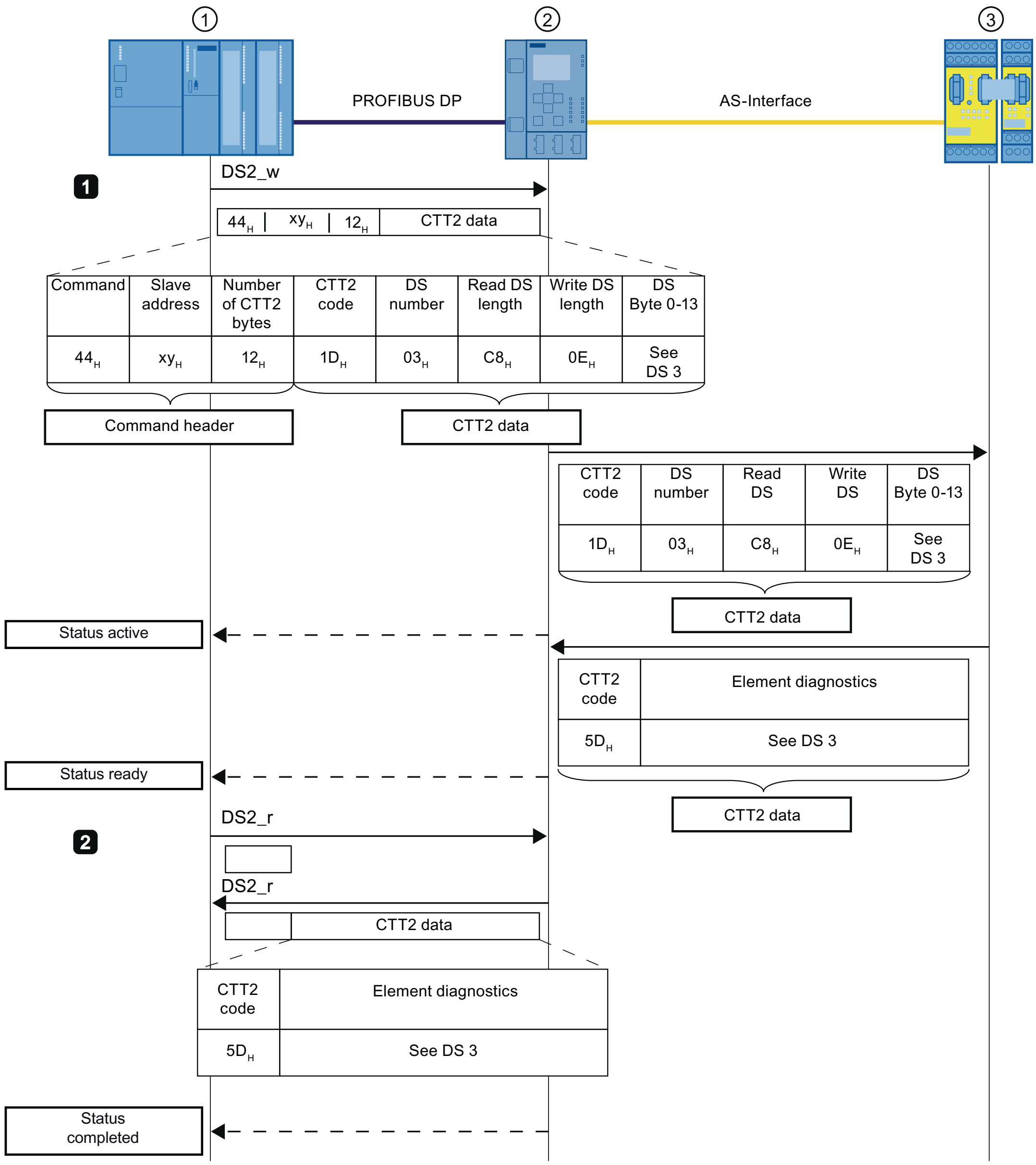
The first example below demonstrates the writing of a data set using data set DS3 "Command interface: Element accesses," with error-free transmission.

2. Example of transmission with error because of incorrect DS number

The second example below demonstrates the writing of a data set using data set DS3 "Command interface: element accesses" when there is a transmission error due to incorrect data set number (DS 4).

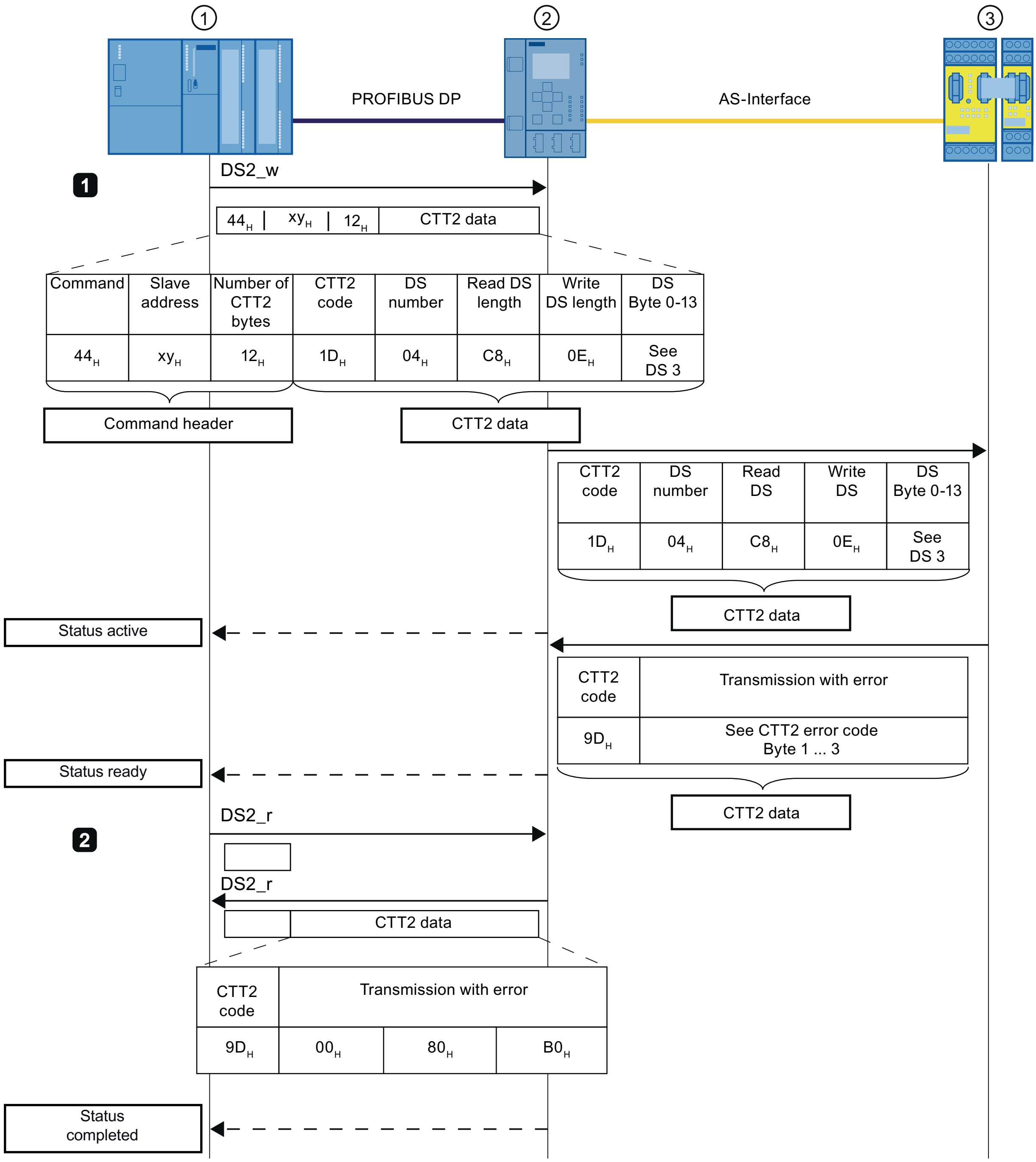
3. Example of transmission with error because of incorrect CTT2 code

The third example below demonstrates the writing of a data set using data set DS3 "Command interface: element accesses" when an unknown CTT2 code ($1E_H$) has been rejected:



① F-PLC
② AS-i master
③ MSS 3RK3 with AS-i interface
1 Write DS2
2 Read DS2

Figure 8-5 Example of transmission without error



① F-PLC

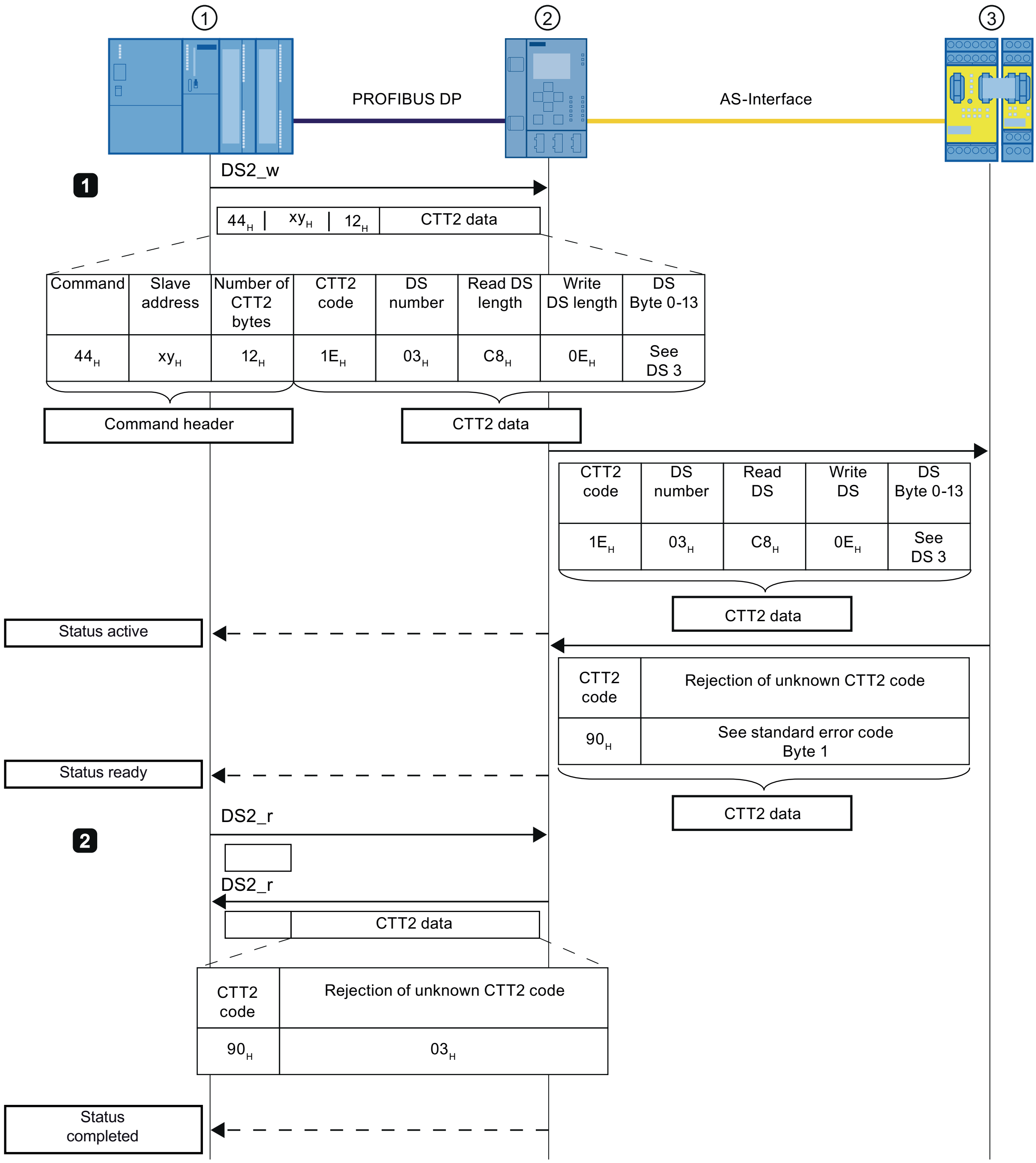
② AS-i master

③ MSS 3RK3 with AS-i interface

1 Write DS2

2 Read DS2

Figure 8-6 Example of transmission with error because of incorrect DS number



① F-PLC
② AS-i master
③ MSS 3RK3 with AS-i interface
1 Write DS2
2 Read DS2

Figure 8-7 Example of transmission with error because of incorrect CTT2 code

8.5.6 Structure of the transfer protocol

CTT2 codes and feedback messages (request/response)

The CTT2 slave supports the following CTT2 codes and feedback messages for transferring data sets:

Code	Meaning according to AS-i spec. V3.0	Followed by
144_{dec} (90_H)	Read response not OK	Standard error code
29_{dec} ($1D_H$)	Exchange request	index, read length, write length, write data
93_{dec} ($5D_H$)	Exchange request OK	read data
157_{dec} ($9D_H$)	Exchange request not OK	Standard error code, data set error code

index: Data set number; for MSS 3RK3 always 3

read length: expected returned data; $C8_H$

write length: length of the data to be written $0E_H$

write data: data to be transmitted, see Chapter "Diagnostics using the CTT2 protocol (Page 594)"

This CTT2 data structure is defined in the AS-i specification V3.0 and therefore has the same structure for all AS-i masters. The various manufacturers of AS-i masters use different mechanisms for transferring this CTT2 data to the master, however (command interface or comparable methods). Please refer to the user documentation for the AS-i master for detailed information on this.

The complete transmission protocol consists of the master-specific component of the protocol and the non-master-specific CTT2 data.

Acyclic CTT2 data transmission (code 29_{dec} ($1D_H$))

The acyclic CTT2 data transmission makes precise diagnostics of the individual elements possible. If an event is signaled through the cyclic diagnostics data, the cyclic CTT2 data transmission can be interrupted. The AS-i Master can read all messages of the elements with errors or a prewarning. The command is entered in DS3 to distinguish which error type is pending. You will find additional information in Chapter " Reading / writing data set 3 (Page 594)."

CTT2 code	Data set	Command	Byte
exchange 29_{dec}	DS3 - command interface "element accesses"	Elements with errors: Read messages	52_H
		Elements with prewarnings: Read messages	72_H

8.5.7 Error codes "CTT2 error code"

If a data set is transferred with an error or rejected by the MSS 3RK3, the negative acknowledgment is accompanied by an "error code" explaining the reason for the negative acknowledgment.

<table>
<tr><td>Byte 1</td><td>Byte 2</td><td>Byte 3</td></tr>
<tr><td>Standard error code</td><td colspan="2">Data set error code</td></tr>
</table>

Figure 8-8 Error code

Standard error code (CTT2 transmission error)

CTT2 error	Meaning
0	No error, pay attention to the data set error code
2	Impermissible length
3	Request not implemented

MSS 3RK3 data set error code

DS error	Error message	Possible causes	Remedial measures
0000_H	No error, pay attention to the standard error code		
$80B0_H$	Unknown data set number	• DS no. not supported by device	• None, since the device does not recognize this data set no.
$80B1_H$	Incorrect data set length when writing	• DS length ≠ specified DS length	• Change DS length to match specified length and send DS again
$80B4_H$	Incorrect data set length when reading	• DS length ≠ specified DS length	• Request DS with the correct length
$80B6_H$	Device has rejected data transfer	• Due to incorrect mode • Data set is read-only • Parameter change not permissible in current device/system operating mode	Check whether • The correct mode is set on the device for the data sent • A data set that can only be read is to be written • A parameter has been changed even though it may only be changed in a particular operating mode
$80B7_H$	Invalid value range	• Value is not in the valid range	• Correct the value and transmit again.
$80B8_H$	Invalid parameter	• Incorrect/invalid parameter values were received	• Read out diagnosis DS 92 and ascertain the incorrect parameter using the "number of the parameter with error." • Change the parameter value to a valid one and resend.

8.5.8 Diagnostics using the CTT2 protocol

8.5.8.1 Reading / writing data set 3

Writing data set 03

The following table shows the structure of Writing data set 03:

Byte	Value	Explanation
0 ... 3	21_H / 00_H / 00_H / 00_H	Data set header
4 ... 5	$0A_H$ / 00_H	Data structure length
6 ... 7	00_H / 00_H	Start position
8 ... 9	00_H / 00_H	Data structure CRC
10	Command	• 51_H: The messages of the elements with errors are read • 71_H: The messages of the elements with prewarnings are read
11 ... 12	Fix 00_H	All elements that have a message are read.
13	Reserved = 0	

Reading data set 03

The following table shows the structure of Reading data set 03:

Byte	Value	Explanation
0 ... 3	00_H / 00_H / 00_H / 00_H	Data set header
4 ... 5	Variable	Data structure length
6 ... 7	00_H / 00_H	Start position
8 ... 9	CRC	Data structure CRC
10 ... 11	Number of the elements with a message	Number of elements with an error or a prewarning, depending on what was requested.
12 - x	1. Element data block	Net (useful) data: The structure of the element data blocks is written in Chapter "Structure of the element data blocks (Page 595)."
x+1 to x+y	2. Element data block	

8.5.8.2 Structure of the element data blocks

The following table shows the structure of the element data block:

Byte	Value	Explanation
Data block header		
0 ... 1	Element data block length	The length of the element data block, including the data block header
2 ... 3	Element number	The element number is assigned by the MSS ES according to the configuration sequence.
4 ... 5	Function element	This object contains a number that uniquely identifies the function element, see Table below.
Useful data		
6	Data 1	Net (useful) data: All pending messages about the element are entered here.
7 to 5+x-1	Data 2 to x-1	
5+x	Data x	

Number		Function element
Decimal	Hexadecimal	
4001	$0FA1_H$	Monitoring Universal
4010	$0FAA_H$	EMERGENCY STOP
4020	$0FB4_H$	ESPE
4030	$0FBE_H$	Protective door
4031	$0FBF_H$	Protective door with lock
4040	$0FC8_H$	Safety shutdown mat with NC principle
4041	$0FC9_H$	Safety shutdown mat with cross-circuit principle
4050	$0FD2_H$	Two-hand operation
4060	$0FDC_H$	Enabling button
4070	$0FE6_H$	Mode selector switch
12540	$30FC_H$	Counter functions
12550	3106_H	Timer functions
12560	3110_H	Start functions
13002	$32CA_H$	Muting functions
16501	4075_H	Switching output
17002	$426A_H$	AS-i 1...4F-DO

8.5.8.3 Element messages

Messages for Monitoring Universal

The following table shows the messages with the associated byte arrangement in the element data block of the "Monitoring Universal" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0	Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once. After the sensor has been operated correctly this message is automatically reset.	SVW	SVW
6^1	Sequence condition not fulfilled	The sequence condition was not fulfilled in accordance with the parameter assignment. This message is automatically reset if a correct sequence / the value "0" is detected at all function inputs monitored.	Logic error	SF
6^2	Discrepancy condition violated	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	Logic error	SF
6^3	Safety sensor triggered	The safety sensor has been actuated. This message is automatically reset if the value "1" is pending at all function inputs IN1 ... 4 monitored.	SVW	SVW
6^4 ... 6^7	Reserved=0			
7^0	Cross-circuit at input 1	A cross-circuit was detected at input 1.	Wiring error	SF
7^1 ... 7^3	Reserved=0			
7^4	Cross-circuit at input 2	A cross-circuit was detected at input 2.	Wiring error	SF
7^5 ... 7^7	Reserved=0			
8^0	Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	--	-

Byte position	Message	Meaning	Element status	Cyclic data
8^1	Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A signal sequence violation is present • A cross-circuit is present in the case of cross-circuit monitoring	-	-
8^2 ... 8^7	Reserved=0			

EMERGENCY STOP messages

The following table shows the messages with the associated byte arrangement in the element data block of the "EMERGENCY STOP" function element.

Byte position	Message	Meaning	Element status	Cyclic data
0^0	Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	SVW	SVW
0^1	Reserved=0			
0^2	Discrepancy condition violated	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	Logic error	SF
0^3	Safety sensor triggered	The safety sensor has been actuated.	SVW	SVW
0^4 ... 0^7	Reserved=0			
1^0	Cross-circuit at input 1	A cross-circuit was detected at input 1.	Wiring error	SF
1^1 ... 1^3	Reserved=0			
1^4	Cross-circuit at input 2	A cross-circuit was detected at input 2.	Wiring error	SF
1^5 ... 1^7	Reserved=0			
2^0	Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-
2^1	Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A cross-circuit is present in the case of cross-circuit monitoring	-	-
2^2 ... 2^7	Reserved=0			

Messages for ESPE

The following table shows the messages with the associated byte arrangement in the element data block of the "ESPE" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0	Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	SVW	SVW
6^1	Reserved = 0			
6^2	Discrepancy condition violated	is set if: • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	Logic error	SF
6^3	Safety sensor triggered	The safety sensor has been actuated.	SVW	SVW
6^4 ... 6^7	Reserved=0			
7^0	Cross-circuit at input 1	A cross-circuit was detected at input 1.	Wiring error	SF
7^1 ... 7^3	Reserved=0			
7^4	Cross-circuit at input 2	A cross-circuit was detected at input 2.	Wiring error	SF
7^5 ... 7^7	Reserved=0			
8^0	Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-
8^1	Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A cross-circuit is present in the case of cross-circuit monitoring	-	-
8^2 ... 8^7	Reserved=0			

Messages for protective door

The following table shows the messages with the associated byte arrangement in the element data block of the "protective door" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0	Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	SVW	SVW
6^1	Sequence condition not fulfilled	The sequence condition was not fulfilled in accordance with the parameter assignment.	Logic error	SF
6^2	Discrepancy condition violated	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	Logic error	SF
6^3	Safety sensor triggered	The safety sensor has been actuated.	SVW	SVW
6^4 ... 6^7	Reserved=0			
7^0	Cross-circuit at input 1	A cross-circuit was detected at input 1.	Wiring error	SF
7^1 ... 7^3	Reserved=0			
7^4	Cross-circuit at input 2	A cross-circuit was detected at input 2.	Wiring error	SF
7^5 ... 7^7	Reserved=0			
8^0	Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-

Byte position	Message	Meaning	Element status	Cyclic data
8^{1}	Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A signal sequence violation is present • A cross-circuit is present in the case of cross-circuit monitoring	-	-
8^{2} ... 8^{7}	Reserved=0			

Message for protective door with lock

The following table shows the messages with the associated byte arrangement in the element data block of the "protective door with lock" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0	Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	SVW	SVW
6^1	Sequence condition not fulfilled	The sequence condition was not fulfilled in accordance with the parameter assignment.	Logic error	SF
6^2	Discrepancy condition violated	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	Logic error	SF
6^3	Safety sensor triggered	The safety sensor has been actuated.	SVW	SVW
6^4	Protective door closed	The protective door is closed.	-	-
6^5	Reserved=0			
6^6	Lock engaged	The lock is engaged.	-	-
6^7	Lock released	The lock is released.	-	-
7^0	Cross-circuit at input 1	A cross-circuit was detected at input 1.	Wiring error	SF
7^1 ... 7^3	Reserved=0			
7^4	Cross-circuit at input 2	A cross-circuit was detected at input 2.	Wiring error	SF
7^5 ... 7^7	Reserved=0			
8^0	Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-

Byte position	Message	Meaning	Element status	Cyclic data
8^1	Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A signal sequence violation is present • A cross-circuit is present in the case of cross-circuit monitoring	-	-
8^2	Start override active	The start override time is running.	-	-
8^3 ... 9^3	Reserved=0			
9^4	Feedback circuit signal and switching status do not match	The feedback circuit signal does not match the interlock status	Wiring error	SF
9^5	Protective door opened when lock was active	The protective door opened when lock was active.	Wiring error	SF
9^6	Locking not possible because the protective door is open	Locking not possible because the protective door is open.	Logic error	SF
9^7	Reserved=0			

Messages for safety shutdown mat (NC principle)

The following table shows the messages with the associated byte arrangement in the element data block of the "safety shutdown mat with NC principle" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0	Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	SVW	SVW
6^1	Reserved = 0			
6^2	Discrepancy condition violated	is set if: • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	Logic error	SF
6^3	Safety sensor triggered	The safety sensor has been actuated.	SVW	SVW
6^4 ... 6^7	Reserved=0			
7^0	Cross-circuit at input 1	A cross-circuit was detected at input 1.	Wiring error	SF
7^1 ... 7^3	Reserved=0			
7^4	Cross-circuit at input 2	A cross-circuit was detected at input 2.	Wiring error	SF
7^5 ... 7^7	Reserved=0			
8^0	Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-
8^1	Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A cross-circuit is present in the case of cross-circuit monitoring	-	-
8^2 ... 8^7	Reserved=0			

Messages for safety shutdown mat (cross-circuit principle)

The following table shows the messages with the associated byte arrangement in the element data block of the "safety shutdown mat with cross-circuit principle" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0	Startup test required	This message is set in a parameterized startup test on each restart and each time the substitute value is changed to a real value until the connected sensor is actuated at least once.	SVW	SVW
6^1 ... 6^2	Reserved=0			
6^3	Safety sensor triggered	The safety sensor has been actuated.	SVW	SVW
6^4 ... 6^7	Reserved=0			
7^0	Wire break at input 1	A cross-circuit was detected at input 1.	Wiring error	SF
7^1	Short circuit to P at input 1	A short-circuit to P was detected at input 1.	Wiring error	SF
7^2 ... 7^3	Reserved=0			
7^4	Wire break at input 2	A cross-circuit was detected at input 2.	Wiring error	SF
7^5	Short circuit to P at input 2	A short-circuit to P was detected at input 2.	Wiring error	SF
7^6 ... 7^7	Reserved=0			
8^0	Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-
8^1	Start condition not fulfilled	is set if: • A sensor test was not executed in the case of an active startup test function • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A cross-circuit is present	-	-
8^2 ... 8^7	Reserved=0			

Messages for two-hand operation

The following table shows the messages with the associated byte arrangement in the element data block of the "two-hand operation" function element.

Byte position	Message	Meaning	Element status	Cyclic data
$6^0 ... 6^1$	Reserved=0			
6^2	Discrepancy condition violated	is set if: • After the discrepancy time has elapsed, the signal states at the inputs monitored are different within one or between to two pushbuttons. • The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	Logic error	SF
6^3	Bushbutton stuck	The pushbutton is stuck.	Logic error	SF
6^4	Do not release both pushbuttons	The two pushbuttons were not released simultaneously.	Logic error	SF
$6^5 ... 6^7$	Reserved=0			
7^0	Cross-circuit at input 1	A cross-circuit was detected at input 1.	Wiring error	SF
$7^1 ... 7^3$	Reserved=0			
7^4	Cross-circuit at input 2	A cross-circuit was detected at input 2.	Wiring error	SF
$7^5 ... 8^0$	Reserved=0			
8^1	Start condition not fulfilled	is set if: • If both pushbuttons were not pressed "synchronously," that is, they were pressed with a time offset greater than 0.5 s • A discrepancy condition violation is present • The value "1" is not present simultaneously at IN1 ... 2 / 4 • A cross-circuit is present	-	-
$8^2 ... 8^7$	Reserved=0			
9^0	Cross-circuit at input 3	A cross-circuit was detected at input 3.	Wiring error	SF
$9^1 ... 9^3$	Reserved=0			

Byte position	Message	Meaning	Element status	Cyclic data
9^4	Cross-circuit at input 4	A cross-circuit was detected at input 4.	Wiring error	SF
9^5 ... 9^7	Reserved=0			

Messages for enabling button

The following table shows the messages with the associated byte arrangement in the element data block of the "enabling button" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0 ... 6^1	Reserved=0			
6^2	Discrepancy condition violated	is set if: The signal states of the inputs monitored had not all previously been reset simultaneously to the value "0" when they are set to "1"	Logic error	SF
6^3	Bushbutton stuck	One pushbutton on the operating console is stuck.	Logic error	SF
6^4	Enabling button OFF	The enabling button has the status OFF.	-	-
6^5	Enabling button ON	The enabling button has the status ON.	-	-
6^6 ... 6^7	Reserved=0			
7^0	Cross-circuit at input 1	A cross-circuit was detected at input 1.	Wiring error	SF
7^1 ... 7^3	Reserved=0			
7^4	Cross-circuit at input 2	A cross-circuit was detected at input 2.	Wiring error	SF
7^5 ... 8^0	Reserved=0			
8^1	Start condition not fulfilled	is set if: • A discrepancy condition violation is present • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...) • A cross-circuit is present	-	-
8^2 ... 8^7	Reserved=0			

Messages for mode selector switch

The following table shows the messages with the associated byte arrangement in the element data block of the "mode selector switch" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0	Reserved=0			
6^1	Switchover time exceeded	The "1 out of 2...5 selection monitoring" has detected the value "0" at all inputs after the contact switchover time has elapsed.	-	-
6^2	Invalid operating mode selection	The "1 out of 2...5 selection monitoring" has detected after the contact switchover time has elapsed: The value "1" is present at more than one input.	Wiring error	SF
6^3 ... 8^7	Reserved=0			

Messages for the muting functions

The following table shows the messages with the associated byte arrangement in the element data block of the "muting" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0	Muting operation active	Muting mode is activated.	-	-
6^1	Muting operation not active	Muting mode is not activated.	-	-
6^2	Muting restart possible	Muting mode was not terminated correctly, i.e. at least one muting sensor is still being triggered.	-	-
6^3	Restart signal duration invalid	The "Muting restart possible" message is set and, the first time the RESTART button is pressed, the expected operating sequence does not follow.	-	-
6^4	Protective field not free	The value "0" is present at the "FREE" function input.	-	-
6^5	System not running	The value "1" is present at the "STOP" function input.	-	-
6^6	Start muting condition not met	Not all conditions for operational starting of muting using muting sensors are met.	-	-
6^7	Max. muting time exceeded	Muting operation terminated because "max. muting time" expired.	Logic error	SF
7^0	Discrepancy condition sensor pair 1 violated	A discrepancy violation was detected in the signals of muting sensor pair 1.	Logic error	SF
7^1	Discrepancy condition sensor pair 2 violated	A discrepancy violation was detected in the signals of muting sensor pair 2.	Logic error	SF
7^2	Sequence condition not fulfilled	The sequence condition was not observed.	Logic error	SF
7^3	Reserved=0			
7^4	Muting display lamp defective	The muting display lamp - monitoring function has detected an error.	Wiring error	SF
7^5 ... 7^7	Reserved=0			

Messages for output functions

The following table shows the messages with the associated byte arrangement in the element data block of the "switching output" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0	Output 1 active	Function output 1 is switched on.	-	-
6^1 ... 6^2	Reserved=0			
6^3	Output 2 active	Function output 2 is switched on.	-	-
6^4 ... 6^5	Reserved=0			
6^6	Feedback circuit signal and switching status do not match	The message at the feedback circuit input does not match the switching status of the function outputs. The output function immediately deactivates all its outputs in case of inconsistencies.	Wiring error	SF
6^7 ... 7^2	Reserved=0			
7^3	Start condition not fulfilled	is set if: • there is a feedback circuit error when feedback circuit monitoring is activated. • the value "0" is pending at the function input (IN).	-	-
7^4 ... 7^6	Reserved=0			
7^7	Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-

Messages for AS-i 1..4F-DO

The following table shows the messages with the associated byte arrangement in the element data block of the "AS-i 1...4F-DO" function element.

Byte position	Message	Meaning	Element status	Cyclic data
6^0	Output 1 active	Function output 1 is switched on.	-	-
6^1	Output 2 active	Function output 2 is switched on.	-	-
6^2	Output 3 active	Function output 3 is switched on.	-	-
6^3	Output 4 active	Function output 4 is switched on.	-	-
6^4	Feedback circuit signal 1 and switching status do not match	The signal at feedback circuit input 1 and the switching status of function output 1 do not match. In case of inconsistencies, the output function immediately switches off all its outputs.	Wiring error	SF
6^5	Feedback circuit signal 2 and switching status do not match	The signal at feedback circuit input 2 and the switching status of function output 2 do not match. In case of inconsistencies, the output function immediately switches off all its outputs.	Wiring error	SF
6^6	Feedback circuit signal 3 and switching status do not match	The signal at feedback circuit input 3 and the switching status of function output 3 do not match. In case of inconsistencies, the output function immediately switches off all its outputs.	Wiring error	SF
6^7	Feedback circuit signal 4 and switching status do not match	The signal at feedback circuit input 4 and the switching status of function output 4 do not match. In case of inconsistencies, the output function immediately switches off all its outputs.	Wiring error	SF

Byte position	Message	Meaning	Element status	Cyclic data
7^0	Invalid output selection	The value "1" was detected on more than one input IN1 ... 4 by the "1 out of 4 - selection monitoring."	Logic error	SF
7^1 ... 7^2	Reserved=0			
7^3	Start condition not fulfilled	is set if: • there is a feedback circuit error when feedback circuit monitoring is active. • the logic error "Invalid output selection" is pending. • The value "1" is not present simultaneously at all available (parameterized) function inputs (IN1, ...).	-	-
7^4	Auxiliary control signal 1 transmitted*	Auxiliary control signal 1 was transmitted with value "1."	-	-
7^5	Auxiliary control signal 2 transmitted*	Auxiliary control signal 2 was transmitted with value "2."	-	-
7^6	Reserved=0			
7^7	Start signal duration invalid	Only with start type "Monitored start": The start signal time monitoring element detected a violation.	-	-

* The message is active if the auxiliary signal has been transmitted and a "1" is present at the corresponding auxiliary signal input of the element.

8.5.8.4 Element status

The following table explains each element status with the associated byte position element data block:

Byte position	Message	Meaning / Remedy	DS 92
6^0	At least one function output active	At least one function output is active.	-
6^1	Function element ready and waiting for a start signal	The function element is ready and is waiting for a start signal.	-
6^2	Timer is active	Is set if at least one of the timers identified with the clock icon is running. The input delay time is an exception to this because this timer is always active.	-
6^3	Function element waiting for startup test	A startup test is required for the corresponding function element. Read the element messages.	-
6^4	Logic error	At least one logic error is pending, e.g.: • Discrepancy error • Sequence error Read the element messages.	Logic error
6^5	Wiring error	At least one wiring error is pending, e.g.: • Cross-circuit fault Read the element messages.	Wiring error
6^6 ... 6^7	Reserved=0		
7^0	(Element) group error	There is at least one error message among the element messages. Read the element messages.	SF from user program
7^1	(Element) group warning	There is at least one warning message among the element messages. Read the element messages.	SW from user program
7^2	(Element) group prewarning	There is at least one prewarning message among the element messages. Read the element messages.	SVW from user program
7^3 ... 7^4	Reserved=0		
7^5	Substitute input value active	At least one input terminal has failed, e.g. because of: • Module / terminal is missing / defective • Module / terminal is incorrectly configured • Code sequence error • Missing code table If an element has multiple input terminals, work continues with the substitute value for the failed terminal only. The real value is used for all the other input terminals. Read the element messages.	-
7^6 ... 7^7	reserved		
8^0 to x^7	reserved		

8.6 Diagnostics with diagnostics display

8.6.1 Diagnostics display

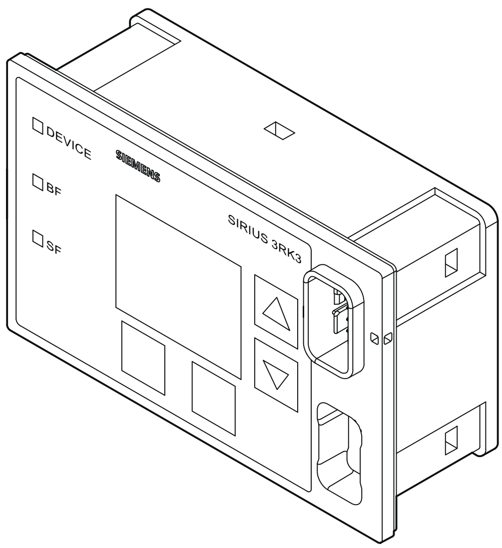


Figure 8-9 Diagnostics display of the MSS 3RK3

A diagnostics display is available for the MSS 3RK3 that is able to display the current messages, diagnostics data, and status information of the monitored system. It also contains all status LEDs present on the basic unit and makes the system interface easily accessible outside of the control cabinet.

Note

MSS 3RK3 Advanced/ MSS 3RK3 ASIsafe basic/ MSS 3RK3 ASIsafe extended

These three 3RK3 central units are supported by the diagnostics display with product version E03 and firmware version V1.1.x and higher.

MSS 3RK3 Basic is supported by the diagnostics display with product version E01 and higher.

Note

Access from MSS ES via PROFIBUS and diagnostics display

If the access from MSS ES to the MSS 3RK3 is by means of PROFIBUS, the diagnostics display must have, at a minimum, product version 3 (E03) or firmware version[1)] V1.1.x, as well as the MSS ES 2008 SP3.

If an access path is established by the MSS ES over an extended period or the device is switched to test mode, the display is disabled and outputs a corresponding message. The display restarts automatically once this status ends.

[1)] The firmware version can be read at the startup of the display or at the bottom left when the display is disabled. In addition, it is shown by selecting menu command "Display settings / Identification". (see also Chapter "Display settings (Page 633)")

The pending messages/errors can be read and acknowledged with the keys, current status information is shown on the display. The display can also be set for different ambient conditions.

All of the following is available:

- 4 keys for navigating the display menu, 2 keys are softkeys with different functions (e.g., test/reset)
- 1 graphical display
- 3 LEDs (DEVICE, BF, SF)

The diagnostic display can be connected directly to the central unit/interface module through the rear system interface. It is powered from the 3RK3 central unit. Via the system interface on the front (with a cover cap for IP54), a PC or programming device can be connected to MSS ES with a PC cable.

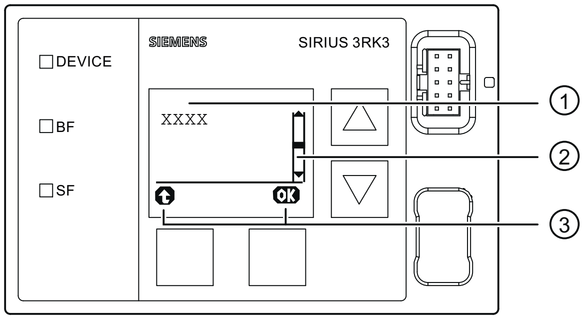
CAUTION
The diagnostics display must only be removed or connected when the system is de-energized!

"Park position" for cover

The cover can be "parked" on the front of the diagnostics display under the system interface.

8.6.2 Displays

On the display, you can read current operating and diagnostics data as well as status information of the MSS 3RK3 in plaintext.



Display on the diagnostic display

Display ①

Messages and status information of the MSS 3RK3 can be displayed in plaintext here. Short values (e.g.: plant identifiers) are displayed directly under the heading, long texts (e.g. the comment) are shown in a submenu. It can be seen on the (OK) key that a submenu can be launched.

Scrollbar ②

As shown in the graphic, this bar shows whether there are any more menu items or messages. These items can be selected and displayed using the arrow keys.

If no other entries are present, the inside of the bar is black.

Function of the softkeys ③

Displays the current function of the two softkeys.

Possible displays:

Key left (meaning)	Key right (meaning)
⇑ (moves you one menu level higher)	OK (selects / confirms)
	Reset (acknowledges error)

8.6.3 Operator controls and displays

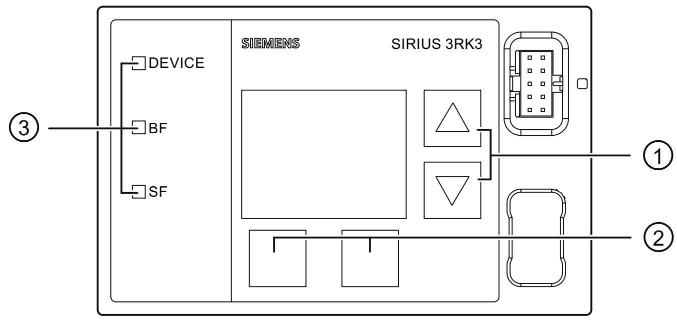


Figure 8-10 Display and operating elements on the diagnostics display

Two arrow keys ①

They serve to navigate the menu or change the display settings, e.g. to change the contrast setting or to scroll through displayed content.

Two softkeys ②

They can have different functions depending on the menu displayed (e.g. open menu, exit menu, reset). The current assigned functions are displayed on the bottom left or right of the display.

LED displays ③

LED	Meaning
DEVICE	Status
BF	Bus error
SF	Group error

Reference

You will find additional information in Chapter " Displays on diagnostic display (Page 508)."

8.6.4 Menus

You can navigate the menu with the arrow keys and softkeys. Any menu option may have additional sub-menus. The menu structure and display are in part directly dependant on the device parameterization (e. g. selected control function) and hardware configuration (e.g. type and number of expansion modules used).

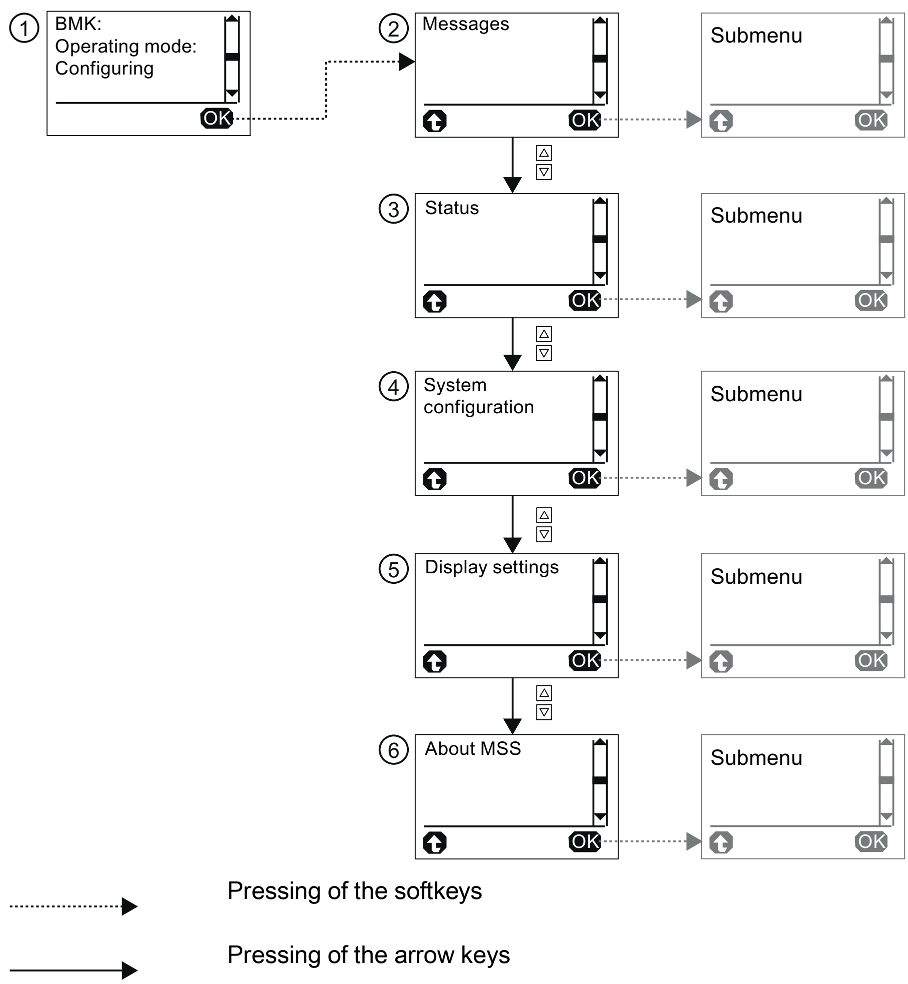


Figure 8-11 First level of the menu of the diagnostics display

Status display ①

The "status display" is the standard display of the diagnostics display. It displays the equipment identifier, the operating status and the status of the configuration.

You can navigate to the individual menus via the right softkey (OK). With the left softkey (reset), pending errors can be acknowledged directly.

If messages are pending, they are displayed directly, that is, the diagnostics menu switches directly to the message menu and to the message with the highest priority. This function can be deactivated via the display settings. If multiple messages are pending, they are displayed as a list that is visible on the scrollbar on the right side of the display. You can scroll to the individual messages with the arrow keys.

Messages ②

The "Messages" menu provides an overview of all current pending error messages and warnings for the entire system.

You will find detailed information in Chapter "Messages (Page 621)"

Status ③

The "Status" menu displays all relevant status information and messages for the configured function elements. Pending messages can be acknowledged after they are dealt with.

You will find detailed information in Chapter "Status (Page 626)"

System configuration ④

The "System configuration" menu provides all relevant information for configuration and for the individual modules.

You will find detailed information in Chapter "System configuration (Page 630)"

Display settings ⑤

All settings affecting the diagnostics display can be made via the "Display settings" menu. In addition to selecting the language and adjusting contrast and brightness, it is also possible to reset to the default settings.

You will find detailed information in Chapter "Display settings (Page 633)"

About MSS ⑥

The "About MSS" menu option provides more information on MSS 3RK3.

8.6.4.1 Messages

The "Messages" menu option provides an overview of all current pending error messages and warnings for the entire system.

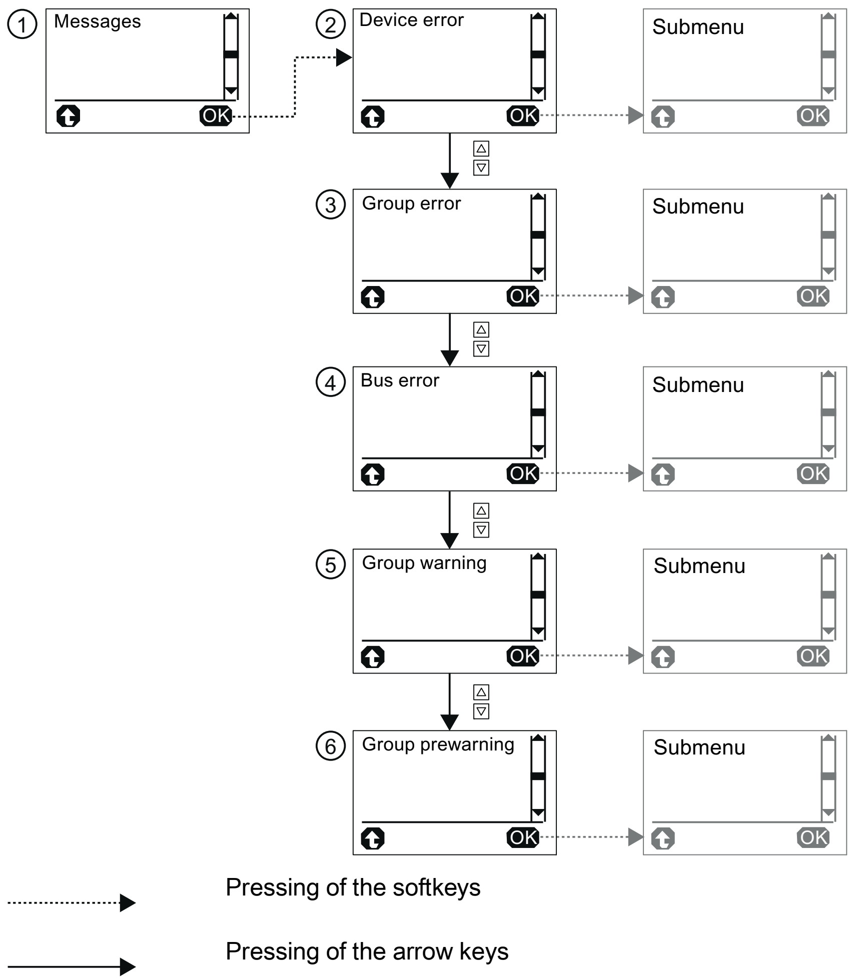


Figure 8-12 Second level of the menu of the diagnostics display - "Messages" menu option

Message categories

The following message categories may be displayed, according to the cause of error:

- Device errors ②
- Group errors ③
- Bus errors ④
- Group warning ⑤
- Group prewarning ⑥

If multiple errors from different categories are pending, you can switch between the individual error categories with the arrow keys.

Errors and error causes

You can access the pending error messages by pressing the right key (OK).

With some errors, a distinction is made between different causes, e.g., in the case of group errors. In this case, the cause can be displayed as a plaintext message with the right key (OK):

If multiple errors/error causes from different categories are pending, you can switch between the individual messages categories with the arrow keys.

With the left key, the display moves up one menu level.

Acknowledging errors

For individual errors, you can switch directly to the applicable function element in the status menu by marking the error message with the arrow keys and by pressing the right key (OK).

You can switch to the status display for the affected function element when the following messages occur:

- Group prewarning from user program
- Group warning from user program
- Wiring error
- Logic error
- Group error from user program

In the "Status" menu, you can acknowledge the error after having dealt with it with the right key (reset).

Device errors ②

Possible causes for device errors/self-test errors are:

- Faulty input or output
- Defective module

Group errors ③

The following group errors can be diagnosed:

Message	Meaning(s)
Configuration error[1)]	• Memory module not plugged in • SC configuration error (Basic) • Memory module defective (Advanced/ASIsafe) • Memory module too small (Advanced/ASIsafe)
Configuration error[1)]	An error occurred during the configuration phase: • Release denied due to incorrect configuration CRC • Release canceled due to incorrect configuration release CRC • Max. number of elements exceeded • Max. size of memory exceeded • Program cycle time exceeded • TARGET≠ACTUAL configuration • TARGET≠ACTUAL slot expanded configuration • Invalid parameter value • Interconnection rule violated • Data structure incorrect You will find more information in Chapter "Diagnostics with MSS ES (Page 525)"
Safety protocol error	• Multiple ASIsafe code tables • ASIsafe 8x4-bit code sequence error • ASIsafe 7x4-bit code sequence error
Wiring error[2)]	Faulty wiring of a sensor connection or in the sensor itself.
Logic error[2)]	Protection fault: Processing sequence on the sensor not coherent.
Handshake error	An error was detected during connection monitoring in test mode.
Group error from user program[2)]	At least one error from the user program is present.
SC bus error	Communication via the device bus interface is interrupted.
SC configuration error (Advanced/ASIsafe)	The actual configuration of an existing communication connection does not match the target configuration. This resulted in an error.
Memory module defective (Basic)	Memory module is defective.
Memory module too small (Basic)	More configuration data were transferred to the safety relay than can be stored in the memory module.

1) Different error causes are possible. The cause is displayed by pressing the right key (OK).

2) Pressing the right key (OK) switches the diagnostics display directly to the relevant function element in the status menu.

Bus errors ④

The following bus errors can be diagnosed:

Message	Meaning
DP bus error	Communication via the fieldbus interface PROFIBUS DP is interrupted.
DP parameterization error	An error occurred during parameterization for an existing communication connection.
DP configuration error	The actual configuration of an existing communication connection does not match the target configuration. This resulted in an error.
ASi bus error	Communication via the AS-i interface is interrupted.
ASi parameterization error	An error occurred during parameterization for an existing communication connection.
ASi configuration error	The actual configuration of an existing communication connection does not match the target configuration. This resulted in an error.
SC bus error	Communication via the device bus interface is interrupted.
SC parameterization error	An error occurred during parameter assignment for an existing communication connection.
SC configuration error	The actual configuration of an existing communication connection does not match the target configuration. This resulted in an error.

Group warning ⑤

The following group warnings can be diagnosed:

Message	Meaning
Disconnect	The monitoring time has been exceeded During monitoring time, the safety relay has not received any data set from the communication partner with write access to the safety relay.
Group warning from user program1)	At least one warning from the user program is present.
Configuration missing	No valid configuration is stored in the safety relay.

1) Pressing the right key (OK) switches the diagnostics display directly to the element in the status menu.

Group prewarning ⑥

The following group prewarnings can be diagnosed:

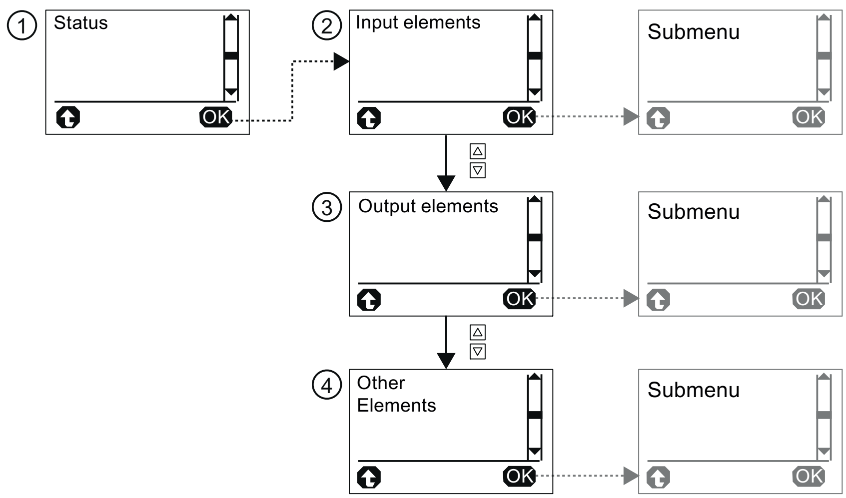
Message	Meaning
User program stopped.	The safety relay is not processing the safety circuit.
Group prewarning from user program [1)]	At least 1 configured function element has a group prewarning.

1) Pressing the right key (OK) switches the diagnostics display directly to the element in the status menu.

8.6.4.2 Status

Selection of the individual functions

The status display makes a distinction between input elements ②, output elements ③, and other elements ④.



Pressing of the softkeys

Pressing of the arrow keys

Figure 8-13 Second level of the menu of the diagnostics display - "Status" menu option

In the respective submenu, either

- all function elements,
- function elements with an error, or
- function elements without an error

can be displayed as a list.

To differentiate between like function elements, the function elements are each displayed with their name, number, and element type in MSS ES. The name remains in the first line when navigating the submenu.

Status information and error acknowledgment

You can select the marked function element with the right key (OK) to display status information and any pending messages.

If several error messages are pending, you can scroll up and down to the individual information via the arrow keys. The error can be acknowledged with the right key (reset) after the cause of the error has been remedied.

Note

In the process, some of the information directly depends on the parameterized function element of the individual inputs and outputs, as well as the hardware configuration of MSS 3RK3, and may vary.

Possible status information

The following status information can be diagnosed:

- Substitute input value active
- At least one function output active
- Waiting for start signal
- Timer is active
- Waiting for startup test
- Logic error
- Wiring error
- Hardware fault
- Group error
- Group warning
- Group prewarning

Possible element messages

The following element messages can be diagnosed:

- Pushbutton stuck
- Do not release both pushbuttons
- Safety sensor triggered
- Protective door closed
- Lock engaged
- Lock released
- Start override active
- Protective door opened when interlock was active
- Interlock not possible because the protective door is open
- Muting operation active
- Muting operation not active
- Muting restart possible
- Restart signal duration invalid
- Protective field not free
- System not running
- Start muting condition not met
- Max. muting time exceeded
- Discrepancy condition sensor pair n violated
- Muting indicator light defective
- Output n active
- Invalid output selection
- Auxiliary control signal n active
- Reset active
- Startup test required
- Sequence condition not fulfilled
- Discrepancy condition violated
- Cross-circuit at input n/output n
- Start signal duration invalid
- Start condition not fulfilled
- Wire break at input n
- Synchronous operation time exceeded
- Enabling button OFF/ON
- Switchover time exceeded

- Invalid operating mode selection
- Incoming/outgoing alarm
- Counter limit value exceeded/undershot
- Last count pulse was up/down
- OFF delay active
- ON delay active
- Passing make pulse contact active
- Clock-pulse generator active
- Standby time is ON
- Control mode selection invalid
- Output n active
- Output n overloaded
- Output n defective
- Feedback circuit signal n and switching status do not match

Reference

You will find additional information about the meaning of the messages in Chapter "Diagnostics with MSS ES (Page 525)"

8.6.4.3 System configuration

Structure of the menu

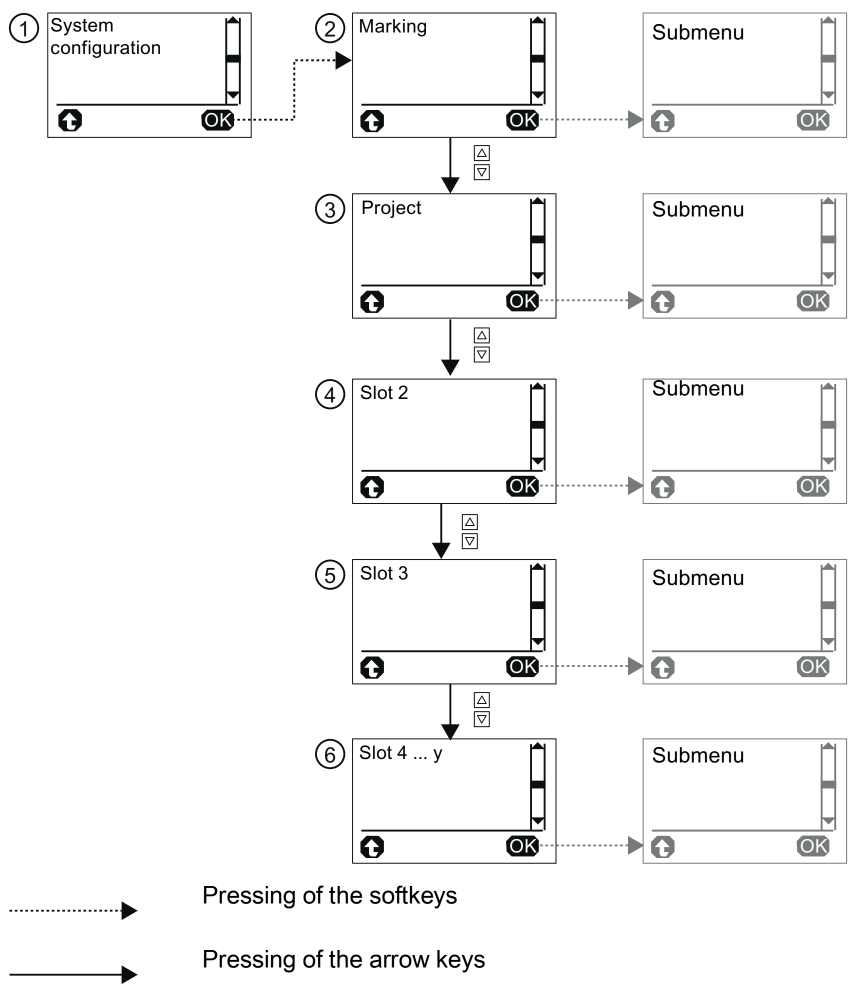


Figure 8-14 Second level of the menu of the diagnostics display - "System configuration" menu option

Information on the following topics is provided in the "System configuration" menu:

- Marking ②
- Project ③
- Slot 2 (DP interface if present) ④
- Slot 3 (central unit) ⑤
- Slot 4 ... n (max. 12) ⑥

You can select the marked menu with the right key (OK), thereby displaying information.

With the left key, the display moves back one menu level.

Marking

The following plant information is available:

- Plant identifier
- Location identifier
- Installation date
- Description
- Author
- Comment

Project

The following project information is available:

- Project name
- Name of configuration engineer
- Company name
- Config CRC
- Time stamp
- Configuration released
- Cycle time
- Number of slot modules
- Number of elements

Slot 2 (DP interface)

The following information on the DP interface is available:

- Equipment identifier (BMK)
- Order No. (MLFB)
- DP address
- Short designation
- HW revision level
- FW revision level
- Time stamp

Slot 3 (central unit)

The following project information about the 3RK3 central unit is available:

- Equipment identifier (BMK)
- Order No. (MLFB)
- Short designation
- HW revision level
- FW revision level
- Time stamp

Slot 4 ... y

The following information on the expansion modules is available:

- Equipment identifier (BMK)
- Order No. (MLFB)
- FW revision level

8.6.4.4 Display settings

All settings affecting the diagnostics display can be made via the display settings.

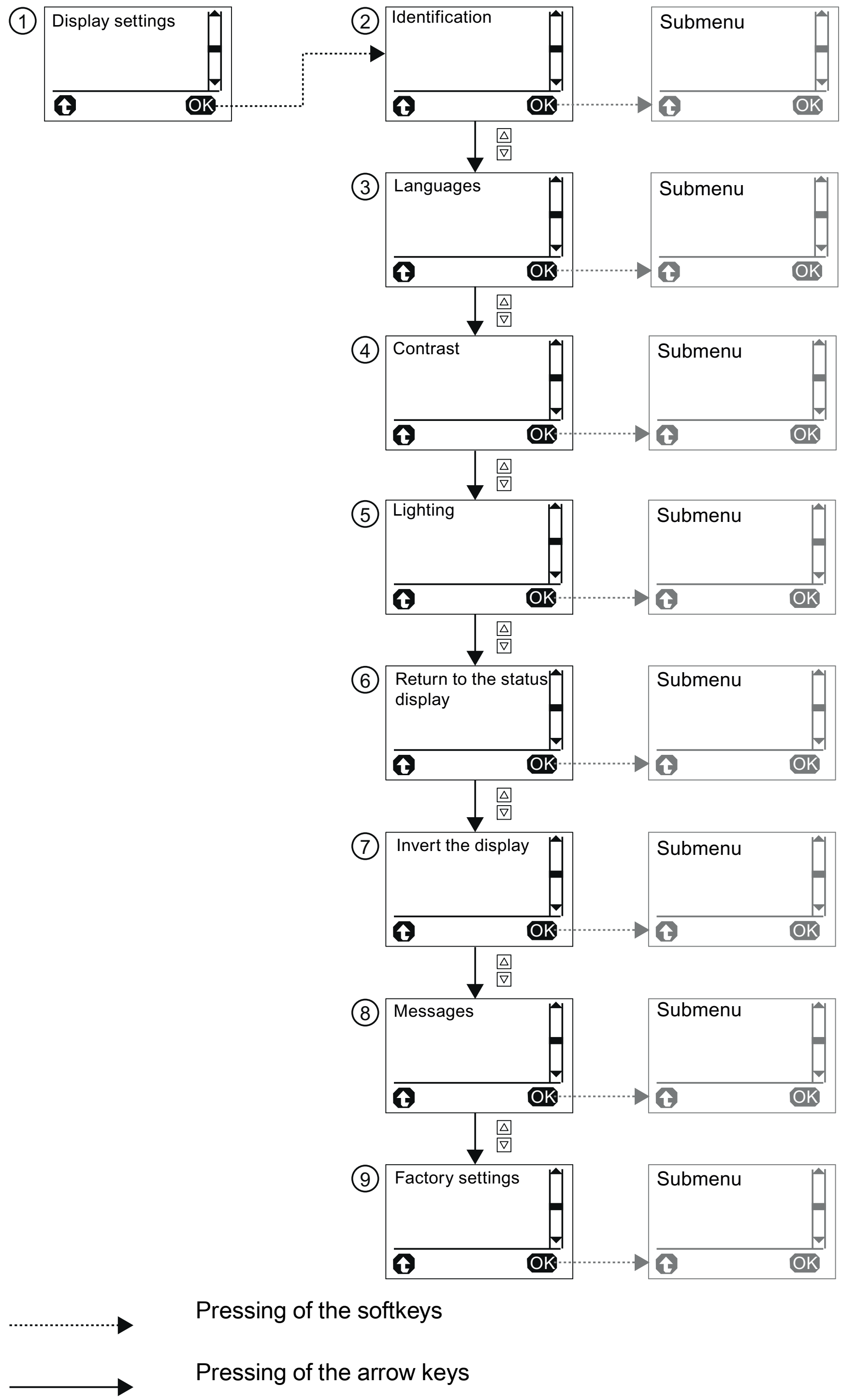


Figure 8-15 Second level of the menu of the diagnostics display - "Display settings" menu option

In this menu, you will also find information on the diagnostics display itself. The display settings can be reset to the default setting in the "Factory settings" menu option.

You can access the individual submenus by pressing the right key (OK):

- Identification ②
- Languages ③
- Contrast ④
- Lighting ⑤
- Return to the status display ⑥
- Invert display ⑦
- Messages ⑧
- Factory settings ⑨

With the left key, the display moves back one menu level.

Identification ②

The following information for identifying the diagnostics display is to be found here:

- MLFB (order number)
- Hardware version (HW revision level)
- Firmware version (FW revision level)

Languages ③

The following languages can be selected:

- English (default setting)
- German
- French
- Spanish
- Italian
- Portuguese

The desired language can be marked with the arrow keys. The right key (OK) selects the marked language.

Contrast ④

You can set the desired contrast of the display with the arrow keys and with the right key (OK).

- Setting range: 10% ... 90% (default setting: 50%)
- Increment: 5%

Lighting ⑤

This menu option specifies how long the backlit display will remain on after the last keystroke and enables permanent activation or deactivation of the backlit display.

The following settings are possible:

- Off
- 3 s
- 10 s (default setting)
- 1 min
- 5 min
- On

The desired setting can be marked with the arrow keys. The right key (OK) selects the marked setting.

Return to the status display ⑥

This menu option specifies whether and at what time to switch back to the status display from the current menu.

The following settings are possible:

- Manual
- 3 s
- 10 s
- 1 min
- 5 min

The desired setting can be marked with the arrow keys. The right key (OK) selects the marked setting.

Invert display ⑦

This setting makes it possible to specify whether the display should be displayed normally or inverted. The readability of the display can be improved in the event of difficult lighting conditions.

The desired setting can be marked with the arrow keys. The right key (OK) selects the marked setting.

Messages ⑧

This setting makes it possible to specify whether to automatically switch to the "Messages" menu if messages are pending and to display the messages (default setting) or whether the status display should remain.

The desired setting can be marked with the arrow keys. The right key (OK) selects the marked setting.

Factory settings ⑨

The factory setting makes it possible to reset the display settings to the default settings.

The desired setting can be marked with the arrow keys. The right key (OK) selects the marked setting. A prompt for confirmation then follows that also has to be confirmed with the right key (OK).

8.7 Restoring factory settings

To restore the factory settings of the safety relay, proceed as follows:

Step	Action
①	Switch the 24 V DC power supply off.
②	Hold down the "RESET" key.
③	Switch the 24 V DC power supply on again.
④	Release the "RESET" key only when the DEVICE LED flickers yellow.
⑤	Keep holding down the "RESET" key if the DEVICE LED flickers red.
⑥	Release the "RESET" key when the DEVICE LED flickers yellow.
⑦	Keep holding down the "RESET" key if the DEVICE LED flickers red.
⑧	When the DEVICE LED goes out, release the "RESET" key within 10 s. The DEVICE LED starts to flash yellow.
⑨	Once the factory settings have been restored, the 3RK3 central unit automatically restarts and switches to configuring mode.

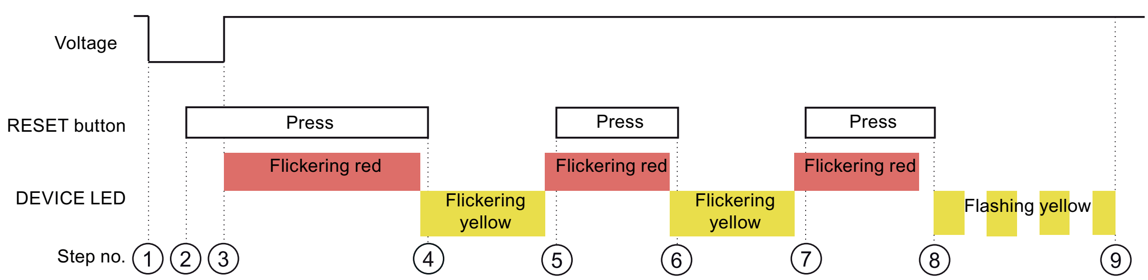


Figure 8-16 Factory settings

Result

When the factory settings are restored, all the LEDs on the inputs and outputs light up.

The procedure for restoring the factory settings has the following effects:

- All configuring information in the internal memory of the 3RK3 central unit is deleted.
- If the external memory module is plugged in, all the existing data is deleted.
- For 3RK3 central units with AS-i interface, the saved code sequence table is also deleted.

Note

Alternately, the factory settings can be restored by means of MSS ES; see also Chapter "Commands... (Page 204)."

Note

Since communication is interrupted when the factory settings are being restored, you must reboot the DP interface (power OFF/ON) once the factory settings have been restored or switch the entire system off and then on again.

Note

Factory settings for DP interface

The factory settings for the DP interface can also be restored; see also Chapter "Menu mode with user control (Page 444)."

Note

Factory settings of the diagnostics display

The factory settings for the diagnostics display can also be restored; see also Chapter "Display settings (Page 633)."

8.8 Module replacement

WARNING

Hazardous voltage

Can Cause Death, Serious Injury, or Property Damage.

Before starting work, therefore, disconnect the system and devices from the power supply.

Note

When replacing a module, you do not need to re-wire it. The terminal blocks can be disconnected from the defective module and then connected to the new module.

Replacing the central unit

WARNING

Hazardous voltage

Can Cause Death, Serious Injury, or Property Damage.

Conduct a functional test of the system

To ensure the safety of the system, any changes to it or any replacement of defective components must be followed by a thorough and successfully completed function test of the system.

NOTICE

Data loss

Connect or disconnect the external memory module only when the power is switched off!

1. Disconnect the defective 3RK3 central unit.
   See also Chapter "Disconnecting (Page 136)."
2. Remove the defective 3RK3 central unit.
   See also Chapter "Removing the central unit, expansion module, or interface module (Page 114)."
3. Remove the memory module with the device configuration.
4. Install the new 3RK3 central unit.
   See also Chapter "Mounting the central unit, expansion module, or interface module on a DIN rail (Page 111)" or Chapter "Mounting the central unit, expansion module, or interface module on a level surface (Page 112)."

5. Connect the module.
   See also Chapter "Plugging in terminal blocks (Page 139)."
6. Insert the memory module with the existing configuration data.
   See also Chapter "Connecting the memory module (Page 140)."

NOTICE
Do not connect a memory module with released configuration to a 3RK3 central unit of another type. The released configuration on the memory module depends on the 3RK3 central unit. For example, the configuration released on an MSS 3RK3 Basic cannot be interpreted by an MSS 3RK3 Advanced, or vice versa. The same applies to all other 3RK3 central units. When the memory module is plugged into a 3RK3 central unit of another type, the configuration release is canceled. The configuration may have to be adapted and released again.

After the supply voltage has been applied, the new 3RK3 central unit checks whether the expanded hardware configuration matches the device configuration.

If there are no deviations, the system re-enters safety mode.

Replacing expansion modules/DP interface

⚠ WARNING
Hazardous voltage **Can Cause Death, Serious Injury, or Property Damage.** **Conduct a functional test of the system** To ensure the safety of the system, any changes to it or any replacement of defective components must be followed by a thorough and successfully completed function test of the system.

NOTICE
Only replace a defective module with a module of an identical type.

1. Disconnect the defective module.
   See also Chapter "Disconnecting (Page 136)."
2. Remove the defective module.
   See also Chapter "Removing the central unit, expansion module, or interface module (Page 114)."
3. Install the new module.
   See also Chapter "Mounting the central unit, expansion module, or interface module on a DIN rail (Page 111)" or "Mounting the central unit, expansion module, or interface module on a level surface (Page 112)."
4. Connect the module.
   See also Chapter "Plugging in terminal blocks (Page 139)."

After the supply voltage has been applied, the 3RK3 central unit checks whether the expanded hardware configuration matches the device configuration.

If there are no deviations, the system re-enters safety mode.

8.9 Creation, modification, and release of the configuration without the actual system

A configuration can created, modified, and released without the actual system. Transfer of the configuration into the memory module and release of the configuration do not have to be performed on the actual system. All that is required is a 3RK3 central unit of the same type and a link to the PC / PG with MSS ES.

Creation, modification, and release of the configuration without the actual system

With the following steps, you can modify the configuration remotely away from the system:

- Open the current configuration with "Load to switching device" or by opening the configuring file or creating a new configuration.
- Modification of the configuration
- Save
  - Confirm cancellation of the configuration release
  - Consistency is checked
- "Target system" > "Load to switching device"
  - Choose an access path and confirm
  - Confirm cancellation of the configuration release
  - Confirm the message "Loading successfully completed"
- "Target system" > "Go offline" (may not be necessary, depends on settings in MSS ES)
- "Target system" > "Prepare configuration test"
  - Choose an access path and confirm
  - Save and print out the PDF file
- "Target system" > "Go offline"
- "Target system" > "Approve configuration"
  - Choose an access path and confirm
  - Confirm release
  - Enter the name and name of the company of the person releasing and confirm
  - Confirm configuring released message
  - Save and print the release information
- Switch off the 3RK3 central unit
- Remove the memory module

Apply the configuration to the actual system

The following steps must be performed on the system:

- Switch off the MSS 3RK3 on the system
- Replace / insert the memory module
- Switching on
  - The MSS 3RK3 performs a target/actual comparison of the hardware configuration.
  - The MSS 3RK3 checks whether there is a released project on the memory module.
  - If this is the case, the MSS 3RK3 will load the project into its main memory and switch to safety mode.
- A function test must be conducted.

WARNING
Hazardous Voltage. **Can Cause Death, Serious Injury, or Property Damage.** **Commissioning of the system only after a full functional test** The system must not be commissioned until a full functional test of the configuration has been successfully completed.

- Normal operation of the system is now possible.

8.10 Failure of AS-i components

8.10.1 Acknowledgement behavior

Responses in the event of an error

On failure of a component on the AS-i bus, calculation in the logical processing is always performed with the substitute value "0."

⚠ WARNING
Hazardous Voltage. **Can Cause Death, Serious Injury, or Property Damage.** **Recovery of an AS-i slave after failure** As soon as the failed AS-i slave returns to the AS-i bus, its real value is immediately processed in the logic and the corresponding partial path of the logic is active again. To prevent this, you must activate the "Startup test" parameter for the relevant function elements in MSS ES, or secure the system by other suitable means.

For the monitoring functions (e.g. EMERGENCY STOP), a startup test is required on recovery of the safety-related slaves if any have been parameterized in the function element.

On failure of an AS-i component, the AS-i-LED flashes red and a warning is generated.

If errors are pending on the AS-i bus (e.g. code sequence errors), the AS-i-LED lights up red. The error must be acknowledged once it has been rectified.

8.10.2 Failure of an AS-i slave

The AS-i master cyclically scans all AS-i addresses to ascertain whether new slaves have been added. These scans are detected and evaluated by the AS-i monitor functionality. In this way, the MSS 3RK3 can determine what slaves are on the bus and can independently detect the absence of an AS-i slave on the bus or the absence of the monitored AS-i subnet.

Substitute value on missing slave/erroneous code sequence

If the MSS 3RK3 detects that a configured AS-i slave is missing, or that a safety-related AS-i slave is transmitting an erroneous code sequence, the logic processing at the relevant terminals continues with the substitute value "0" for the terminals affected.

It is possible to ascertain which slaves are missing or defective by reading out the actual status of the AS-i slaves by online diagnostics in MSS ES.

Note

If the missing or defective AS-i slave is a device that is not contained in the configuration of the MSS 3RK3, there is no response.

Recovery of an AS-i slave

When the removed safety-related AS-i slave (identical code sequence) is reinserted or when a non-safety-related slave is plugged in with the corresponding slave profile, work is resumed with the received process value.

For the monitoring elements (e.g., EMERGENCY STOP), a startup test is required on recovery of the safety-related slaves if any have been parameterized in the function element.

8.10.3 Failure of the AS-i bus

Entering safety mode even without the AS-i bus

When the system enters safety or test mode, if it is detected that the AS-i bus is not running or is missing completely, the system enters safety mode nevertheless. This can take up to 30 s. In this case, the process values of all configured AS-i slaves are assigned the substitute value "0."

Failure of the total AS-i bus

In protection or test mode, the device evaluates the bus failure as a TARGET ≠ ACTUAL error, but remains in safety mode. Calculation continues with the substitute value "0" for all AS-i slaves.

Note

Simulated AS-i slaves

On bus failure, the substitute value 0 is assumed for all slaves at the input of the logic in safety or test mode.

Where values from output terminals of simulated slaves are used again as an input in the logic, the input value is not derived using the monitor function but the value of the output terminal is used. In this case, no substitute value is assumed.

Recovery / switch-on of the AS-i bus while safety mode is running

If the AS-i bus is switched on in safety or test mode or recovers after a failure, the substitute values of the AS-i slaves are shut down and the received process image is transferred.

Because this procedure can be performed without informing the user and can therefore result in safety-critical conditions, "restart" of the AS-i bus is controlled so that a startup test (if configured) is performed in the input elements of the logic not only on entering safety mode but also on the transition from the substitute value to the real value.

You will find additional information in Chapter " Failure of an AS-i slave (Page 645)."

8.11 Replacement of AS-i components

8.11.1 Replacement of an AS-i slave during running operation

An AS-i slave is considered faulty or defective if it is no longer addressed by the AS-i master. MSS 3RK3 detects this configuration error and uses the substitute value "0" in the interconnection logic.

Replacement of a non-safety-related slave

WARNING

Hazardous voltage

Can Cause Death, Serious Injury, or Property Damage.

Conduct a functional test of the system

To ensure the safety of the system, any changes to it or any replacement of defective components must be followed by a thorough and successfully completed function test of the system.

If a non-safety-related slave of the same type is plugged in at the corresponding address and if MSS 3RK3 detects that this slave matches the data in the configuration of the target expanded configuration, the configuration error will automatically be reset. The sensor value is input to the logic processing again instead of the substitute value.

Replacing a safety-related AS-i slave

WARNING

Hazardous voltage

Can Cause Death, Serious Injury, or Property Damage.

Conduct a functional test of the system

To ensure the safety of the system, any changes to it or any replacement of defective components must be followed by a thorough and successfully completed function test of the system.

Addressing the new slave

If the newly inserted, safety-related AS-i slave already has the correct address, it is enough to close the contacts on the safety-related AS-i slave in order for the MSS 3RK3 to be able to receive the new code sequence.

If the new safety-related AS-i slave has to be included on the bus by the AS-i master, it is first necessary to wait for the autoadressing phase of the AS-i master. During the autoaddressing phase, the new AS-i slave is addressed through address "0." This is not monitored by the MSS 3RK3. The system does not detect the new AS-i slave until it is provided with a correct address.

Teaching the new code sequences

If a safety-related AS-i slave is replaced, the MSS 3RK3 detects that the code sequence transmitted by the AS-i slave is not contained in the code sequence table. This initially results in the substitute value "0" being used in the interconnection logic for this slave.

Note

Important requirement

Before the code sequences are taught, both contacts of the safety-related AS-i input slaves must be closed to enable the code sequences to be taught.

If the contacts are not closed, calculation in the logic diagram continues with the substitute value "0." The current status of the AS-i slave is displayed in the "Learn ASIsafe code tables" dialog box.

If MSS 3RK3 has ascertained after a monitoring period has elapsed that the new code sequence is unique, the TEACH-LEDs will indicate that the new code sequence can be used instead of the originally used code sequence. The new code sequence is applied and saved if you press the RESET button for 3 s or use the "Apply learned AS-i code tables" command.

You will find additional information in Chapter " Teaching the code sequences (Page 482)."

LED display during teaching of code sequences

LED	Display	Explanation
DEVICE	green	Device in safety mode
	flickering green	Device in test mode
AS-i	flashing red	Other code sequence on the AS-i bus
TEACH	yellow flashing	Teaching of code sequences active: The code sequences are being taught.
SF	off	No group error

LED display if the code tables can be applied

LED	Display	Explanation
DEVICE	green	Device in safety mode
	flickering green	Device in test mode
AS-i	flashing red	Other code sequence on the AS-i bus
TEACH	yellow	Code sequences can be applied
SF	off	No group error

8.11.2 Replacing an AS-i slave in different subnetworks

WARNING

Hazardous voltage

Can Cause Death, Serious Injury, or Property Damage.

Conduct a functional test of the system

To ensure the safety of the system, any changes to it or any replacement of defective components must be followed by a thorough and successfully completed function test of the system.

To ensure that the code sequences are unique, the code sequences of all safety-related AS-i slaves on every device must be saved with monitor functionality. If a safety-related AS-i slave of another subnet is replaced, the code sequence will change. This is detected by each AS-i monitor on the AS-i bus and it is treated just like an AS-i slave of the same subnet. When it lights up yellow, the TEACH-LED on the MSS 3RK3 indicates that a new code sequence has been detected that can be applied.

Applying the new code sequence

The new code sequence can be applied and saved by pressing the reset button for 3 s or by pressing the "Adopt code tables" button in the "Target system" > "ASIsafe code tables" dialog box in MSS ES. The code sequence of MSS 3RK3 is applied and saved in this way.

You will find additional information in Chapter " Teaching the code sequences (Page 482)."

LED display on replacement of an AS-i slave in different subnets in safety mode

LED	Display	Explanation
DEVICE	green	Device in safety mode
AS-i	off	Another code sequence in another subnet is not evaluated as an error
TEACH	yellow	Code sequences can be applied
SF	off	No group error

8.11.3 Replacement of multiple AS-i slaves during running operation

> **WARNING**
>
> **Hazardous voltage**
>
> **Can Cause Death, Serious Injury, or Property Damage.**
>
> **Conduct a functional test of the system**
>
> To ensure the safety of the system, any changes to it or any replacement of defective components must be followed by a thorough and successfully completed function test of the system.

When multiple defective AS-i slaves are replaced, the defective AS-i slaves can be replaced by any new slaves if they are of the same type and have already been assigned the same address.

If the new AS-i slaves have not yet been addressed, each must be addressed in succession through an AS-i master with the autoadressing function to apply them to the system.

In the case of safety-related AS-i input slaves, the sensor must be operated once to teach the new code sequence. Non-safety-related slaves are interpreted according to the configuration.

Automatic teaching of code sequences in the background

The transmitted code sequences are learned in the background by the system. The TEACH-LED light up yellow when all code sequences have been taught. The code sequences of all taught slaves can be saved in the code sequence table by pressing the reset button for 3 s or by pressing the "Adopt code tables" button in the "Target system" > "ASIsafe code tables" dialog box in MSS ES.

You will find additional information in Chapter " Teaching the code sequences (Page 482)."

8.11.4 Additional AS-i slave in running operation

Additional non-safety-related AS-i slave

An additional non-safety-related slave on the AS-i bus is ignored.

Additional safety-related AS-i slave

WARNING

Additional safety-related AS-i slave on AS-i bus

For safety reasons, the code sequences of all safety-related slaves must be known to every monitor on the AS-i bus. If an additional safety-related AS-i slave is added to the AS-i bus, the code sequence of this slave must be taught on every MSS 3RK3 or safety monitor located on the AS-i bus, irrespective of whether or not this new safety-related AS-i slave is monitored by the respective MSS 3RK3 or safety monitor.

Consider the following when adding a further safety-related slave:

- If a new safety-related AS-i slave is connected to the AS-i bus and its contacts are closed, the MSS 3RK3 detects a new code sequence, the AS-i BF-LED flashes red, and the TEACH-LED lights up yellow. The code sequence table can be transferred into the memory of the MSS 3RK3 in three different ways:
  - Pressing the RESET buttons for 3 s
  - Pressing the "Apply code tables" button in the "Target system" > "ASIsafe code tables" dialog box in MSS ES
  - Controlling a device command function element with the "Adopt code tables" command

  The TEACH-LED goes off after the code sequences have been successfully stored.
- As long as the contacts of the safety-related input slave are not closed, it will be ignored by the MSS 3RK3.
- As soon as teaching in the background has detected that the code sequence that provides a newly inserted safety-related AS-i slave is identical to an existing slave, the substitute value "0" will be used for both slaves.

You will find additional information in Chapter "Teaching the code sequences (Page 482)."

8.11.5 Replacement of MSS 3RK3 with AS-i interface

Replacement of all 3RK3 central units is identical. Because the code sequences are stored on the memory module, the code sequences do not have to be taught as new.

Reference

You will find a description of how to replace the 3RK3 central units in Chapter "Module replacement (Page 639)."

Technical data 9

9.1 General technical data

Table 9- 1

Device data	
Shock resistance (half-sine pulse)	15 g/11 ms
Shock-hazard protection to DIN EN 60529	IP20
Pollution degree	2
Permitted mounting position	Vertical securing surface (+10°/ -10°)
Minimum clearances	for heat dissipation by convection from the devices: 25 mm from the ventilation openings (top and bottom)
Ambient conditions	
Ambient temperature during operation	-20 ... +60℃[1)]
Ambient temperature during storage	-40 ... +85℃[2)]
Installation altitude	max. 2000 m above sea level
Pressure	70 ... 106 kPa; < 90 kPa with restrictions
Relative humidity	10% 95%
Safety data	
SIL claim limit SIL CL in accordance with EN 61508	3
Performance Level PL in accordance with EN ISO 13849-1	e
Safety category in accordance with EN ISO 13849-1	4
Requirement class to EN 574	III C
Proof-Test Interval T1	20 years
Setting accuracy of times	± 0.6%
Environmental data	
EMC EMC emitted interference	according to IEC 60947-5-1 Severity level A (industry)
Vibrations in accordance with EN 60068-2-6 • Frequency • Amplitude	5 ... 500 Hz 0.75 mm

1) Diagnostics display: 0 ... 60 ℃

2) Diagnostics display: -20 ... 70 ℃

9.2 3RK3 Basic central unit

Technical data of the 3RK3 Basic

Device data	
Number of sensor inputs (1-channel), fail-safe	8
Number of test outputs	2
Number of outputs	1 redundant relay output 1 redundant semiconductor output
Height • Screw terminals • Spring-loaded terminals	 111 mm 113 mm
Width	45 mm
Depth	124 mm
Weight	300 g
Typical number of function elements to be processed[1)]	250
Electrical data	
Supply voltage/ rated control supply voltage Us	Device power supply via power supply unit in accordance with IEC 60 536 protection class III (SELV or PELV) 24 V DC
Operating range	0.85 to 1.15 x Us
Rated insulation voltage U_i	300 V
Rated impulse voltage U_{imp}	2.5 kV[2)]
Total power consumption	185 mA + 1.5 A semiconductor output
Rated power at Us	4.5 W
Utilization category in accordance with EN 60947-5-1 (relay outputs) • AC-15 at 230 V • DC-13 at 24 V (semiconductor outputs) • DC-13 at 24 V	 2 A 1 A 1.5 A; short-circuit-proof up to 10 A
Resetting time[3)] of the safety-related outputs t_{RT}	420 ms
Mechanical durability[4)]	10 x 10^6 switching cycles (relay)
Max. switching frequency z at rated operational current	1000 1/h
Conventional thermal current I_{th} (relay/semiconductor)	2/1.5 A

Max. protection of relay contacts with fuses NH type 3NA, DIAZED type 5SB, NEOZED type 5SE • Operating class gL/gG • Operating class quick response	 4 A 6 A
Safety data according to EN ISO 13849-1	
Probability of a dangerous failure per hour (PFH_D)	5.14 x 10^{-9} 1/h
Probability of a dangerous failure on demand (PFD)	1.28 x 10^{-5}
Characteristic values for cables	
Max. permissible cable resistance	100 Ω
Max. permissible cable length from device to sensor (for CU 1.5 mm^2 and 150 nF/km)	1000 m (i.e., max. total cable length of 2000 m)
Max. permissible cable capacitance	330 nF
Dark period of solid-state outputs	< 1 ms

1) The number of function elements that can be processed by one MSS 3RK3 depends on the type of function elements.

2) Protective separation, reinforced insulation 4 kV between input circuit and output contact current paths.

3) Time from instant an output is switched off to the instant the output reaches a state that permits it to be switched on again.

4) The mechanical durability may be reduced, depending on the contact load.

9.3 3RK3 Advanced central unit

Technical data of the 3RK3 Advanced

Device data	
Number of sensor inputs (1-channel), fail-safe	8
Number of test outputs	2
Number of outputs	1 redundant relay output 1 redundant semiconductor output
Height • Screw terminals • Spring-loaded terminals	 111 mm 113 mm
Width	45 mm
Depth	124 mm
Weight	300 g
Typical number of function elements to be processed[1)]	250
Electrical data	
Supply voltage/ rated control supply voltage Us	Device power supply via power supply unit in accordance with IEC 60 536 protection class III (SELV or PELV) 24 V DC
Operating range	0.85 to 1.15 x Us
Rated insulation voltage U_i	300 V
Rated impulse voltage U_{imp}	2.5 kV[2)]
Total power consumption	185 mA + 1.5 A semiconductor output
Rated power at Us	4.5 W
Utilization category in accordance with EN 60947-5-1 (relay outputs) • AC-15 at 230 V • DC-13 at 24 V (semiconductor outputs) • DC-13 at 24 V	 2 A 1 A 1.5 A; short-circuit-proof up to 10 A
Resetting time[3)] of the safety-related outputs t_{RT}	420 ms
Mechanical durability[4)]	10 x 10^6 switching cycles (relay)
Max. switching frequency z at rated operational current	1000 1/h
Conventional thermal current I_{th} (relay/semiconductor)	2/1.5 A

Max. protection of relay contacts with fuses NH type 3NA, DIAZED type 5SB, NEOZED type 5SE • Operating class gL/gG • Operating class quick response	 4 A 6 A
Safety data according to EN ISO 13849-1	
Probability of a dangerous failure per hour (PFH_D)	2.8×10^{-9} 1/h (without use of AS-i) 3.8×10^{-9} 1/h (with use of AS-i)
Probability of a dangerous failure on demand (PFD)	1.7×10^{-4}
Characteristic values for cables	
Max. permissible cable resistance	100 Ω
Max. permissible cable length from device to sensor (for CU 1.5 mm² and 150 nF/km)	1000 m (i.e., max. total cable length of 2000 m)
Max. permissible cable capacitance	330 nF
Dark period of solid-state outputs	< 1 ms
AS-Interface data	
AS-i voltage	18.5 V DC ... 31.6 V DC
AS-i power consumption	< 45 mA
AS-i bus load	like A/B slave
AS-i slave profiles (simulated slaves)	• S-7 F.F (4I/4O): standard slave (max. 4) • S-7 A.E (4I/3O): AB slave (max. 4) • S-6 B.D: safety-related output slave for controlling a safety-related AS-i output (maximum of 12) • S-0 B.F: safety-related input slave for AS-i link (maximum of 12) • S-7 5.5: (standard CTT2 + 2I/2O) CTT2 slave for transmission of diagnostics information (maximum of 1)
Number of devices per AS-Interface line	In the maximum configuration of the AS-Interface network in which 31 standard addresses are used, you can install up to four additional safety monitors without addresses. If fewer than 31 standard addresses are used, a further monitor can be installed for each unused standard address. If you install additional nodes without an address (e.g., ground fault monitoring modules), this reduces the number of safety monitors that can be installed accordingly. When repeaters are used, this definition applies to each segment.

1) The number of function elements that can be processed by one MSS 3RK3 depends on the type of function elements.

2) Protective separation, reinforced insulation 4 kV between input circuit and output contact current paths.

3) Time from instant an output is switched off to the instant the output reaches a state that permits it to be switched on again.

4) The mechanical durability may be reduced, depending on the contact load.

9.4 3RK3 ASIsafe basic central unit

Technical data of the 3RK3 ASIsafe basic

Device data	
Number of sensor inputs (1-channel), fail-safe	2
Number of digital standard inputs	6
Number of test outputs	2
Number of outputs	1 redundant relay output 1 redundant semiconductor output
Height • Screw terminals • Spring-loaded terminals	 111 mm 113 mm
Width	45 mm
Depth	124 mm
Weight	300 g
Typical number of function elements to be processed[1)]	250
Electrical data	
Supply voltage/ rated control supply voltage Us	Device power supply via power supply unit in accordance with IEC 60 536 protection class III (SELV or PELV) 24 V DC
Operating range	0.85 to 1.15 x Us
Rated insulation voltage U_i	300 V
Rated impulse voltage U_{imp}	2.5 kV[2)]
Total power consumption	185 mA + 1.5 A semiconductor output
Rated power at Us	4.5 W
Utilization category in accordance with EN 60947-5-1 (relay outputs) • AC-15 at 230 V • DC-13 at 24 V (semiconductor outputs) • DC-13 at 24 V	 2 A 1 A 1.5 A; short-circuit-proof up to 10 A
Resetting time[3)] of the safety-related outputs t_{RT}	420 ms
Mechanical durability[4)]	10 x 10^6 switching cycles (relay)
Max. switching frequency z at rated operational current	1000 1/h
Conventional thermal current I_{th} (relay/semiconductor)	2/1.5 A

Max. protection of relay contacts with fuses NH type 3NA, DIAZED type 5SB, NEOZED type 5SE • Operating class gL/gG • Operating class quick response	4 A 6 A
Safety data according to EN ISO 13849-1	
Probability of a dangerous failure per hour (PFH_D)	2.8×10^{-9} 1/h (without use of AS-i) 3.8×10^{-9} 1/h (with use of AS-i)
Probability of a dangerous failure on demand (PFD)	1.7×10^{-4}
Characteristic values for cables	
Max. permissible cable resistance	100 Ω
Max. permissible cable length from device to sensor (for CU 1.5 mm^2 and 150 nF/km)	1000 m (i.e., max. total cable length of 2000 m)
Max. permissible cable capacitance	330 nF
Dark period of solid-state outputs	< 1 ms
AS-Interface data	
AS-i voltage	18.5 V DC ... 31.6 V DC
AS-i power consumption	< 45 mA
AS-i bus load	like A/B slave
AS-i slave profiles (simulated slaves)	• S-7 F.F (4I/4O): standard slave (max. 4) • S-7 A.E (4I/3O): AB slave (max. 4) • S-6 B.D: safety-related output slave for controlling a safety-related AS-i output (maximum of 8) • S-0 B.F: Safety-related input slave for AS-i link (maximum of 8) • S-7 5.5: (standard CTT2 + 2I/2O) CTT2 slave for transmission of diagnostics information (maximum of 1)
Number of devices per AS-Interface line	In the maximum configuration of the AS-Interface network in which 31 standard addresses are used, you can install up to four additional safety monitors without addresses. If fewer than 31 standard addresses are used, a further monitor can be installed for each unused standard address. If you install additional nodes without an address (e.g., ground fault monitoring modules), this reduces the number of safety monitors that can be installed accordingly. When repeaters are used, this definition applies to each segment.

1) The number of function elements that can be processed by one MSS 3RK3 depends on the type of function elements.

2) Protective separation, reinforced insulation 4 kV between input circuit and output contact current paths.

3) Time from instant an output is switched off to the instant the output reaches a state that permits it to be switched on again.

4) The mechanical durability may be reduced, depending on the contact load.

9.5 3RK3 ASIsafe extended central unit

Technical data of the 3RK3 ASIsafe extended

Device data	
Number of sensor inputs (1-channel), fail-safe	4
Number of digital standard inputs	4
Number of test outputs	2
Number of outputs	1 redundant relay output 1 redundant semiconductor output
Height • Screw terminals • Spring-loaded terminals	 111 mm 113 mm
Width	45 mm
Depth	124 mm
Weight	300 g
Typical number of function elements to be processed[1)]	250
Electrical data	
Supply voltage/ rated control supply voltage Us	Device power supply via power supply unit in accordance with IEC 60 536 protection class III (SELV or PELV) 24 V DC
Operating range	0.85 to 1.15 x Us
Rated insulation voltage U_i	300 V
Rated impulse voltage U_{imp}	2.5 kV[2)]
Total power consumption	185 mA + 1.5 A semiconductor output
Rated power at Us	4.5 W
Utilization category in accordance with EN 60947-5-1 (relay outputs) • AC-15 at 230 V • DC-13 at 24 V (semiconductor outputs) • DC-13 at 24 V	 2 A 1 A 1.5 A; short-circuit-proof up to 10 A
Resetting time[3)] of the safety-related outputs t_{RT}	420 ms
Mechanical durability[4)]	10 x 10^6 switching cycles (relay)
Max. switching frequency z at rated operational current	1000 1/h
Conventional thermal current I_{th} (relay/semiconductor)	2/1.5 A

Max. protection of relay contacts with fuses NH type 3NA, DIAZED type 5SB, NEOZED type 5SE • Operating class gL/gG • Operating class quick response	 4 A 6 A
Safety data according to EN ISO 13849-1	
Probability of a dangerous failure per hour (PFH_D)	2.8×10^{-9} 1/h (without use of AS-i) 3.8×10^{-9} 1/h (with use of AS-i)
Probability of a dangerous failure on demand (PFD)	1.7×10^{-4}
Characteristic values for cables	
Max. permissible cable resistance	100 Ω
Max. permissible cable length from device to sensor (for CU 1.5 mm^2 and 150 nF/km)	1000 m (i.e., max. total cable length of 2000 m)
Max. permissible cable capacitance	330 nF
Dark period of solid-state outputs	< 1 ms
AS-Interface data	
AS-i voltage	18.5 V DC ... 31.6 V DC
AS-i power consumption	< 45 mA
AS-i bus load	like A/B slave
AS-i slave profiles (simulated slaves)	• S-7 F.F (4I/4O): standard slave (max. 4) • S-7 A.E (4I/3O): AB slave (max. 4) • S-6 B.D: safety-related output slave for controlling a safety-related AS-i output (maximum of 10) • S-0 B.F: Safety-related input slave for AS-i link (maximum of 10) • S-7 5.5: (standard CTT2 + 2I/2O) CTT2 slave for transmission of diagnostics information (maximum of 1)
Number of devices per AS-Interface line	In the maximum configuration of the AS-Interface network in which 31 standard addresses are used, you can install up to four additional safety monitors without addresses. If fewer than 31 standard addresses are used, a further monitor can be installed for each unused standard address. If you install additional nodes without an address (e.g., ground fault monitoring modules), this reduces the number of safety monitors that can be installed accordingly. When repeaters are used, this definition applies to each segment.

1) The number of function elements that can be processed by one MSS 3RK3 depends on the type of function elements.

2) Protective separation, reinforced insulation 4 kV between input circuit and output contact current paths.

3) Time from instant an output is switched off to the instant the output reaches a state that permits it to be switched on again.

4) The mechanical durability may be reduced, depending on the contact load.

9.6 EM 4/8F-DI

Technical data of the expansion module 4/8F-DI

Device data	
Number of sensor inputs (1-channel), fail-safe	8
Number of test outputs	2
Height • Screw terminals • Spring-loaded terminals	 102 mm 105 mm
Width	22.5 mm
Depth	124 mm
Weight	160 g
Electrical data	
Supply voltage/ rated control supply voltage Us	24 V DC
Operating range	0.85 to 1.15 x Us
Rated insulation voltage U_i	50 V
Rated impulse voltage U_{imp}	500 V
Total power consumption	60 mA
Rated power at Us	1.5 W
Safety data according to EN ISO 13849-1	
Probability of a dangerous failure per hour (PFH_d)	1.89×10^{-9} 1/h
Probability of a dangerous failure on demand (PFD)	4.29×10^{-6}
Characteristic values for cables	
Max. permissible cable resistance	100 Ω
Max. permissible cable length from device to sensor (for CU 1.5 mm^2 and 150 nF/km)	1000 m
Max. permissible cable capacitance	330 nF

9.7 EM 2/4F-DI 1/2F-RO

Technical data of the expansion module 2/4F-DI 1/2F-RO

Device data	
Number of sensor inputs (1-channel), fail-safe	4
Number of test outputs	2
Number of outputs	2
Height • Screw terminals • Spring-loaded terminals	 102 mm 105 mm
Width	22.5 mm
Depth	124 mm
Weight	160 g
Electrical data	
Supply voltage/ rated control supply voltage Us	24 V DC
Operating range	0.85 to 1.15 x Us
Rated insulation voltage U_i	300 V
Rated impulse withstand voltage U_{imp}	2.5 kV[1)]
Total power consumption	85 mA
Rated power at Us	2.0 W
Utilization category in accordance with EN 60947-5-1 (relay outputs) • 15 V AC at 230 V AC • 13 V DC at 24 V DC	 2 A 1 A
Resetting time[2)] of the safety-related outputs t_{RT}	420 ms
Mechanical durability	10 x 10^6 switching cycles
Max. switching frequency z at rated operational current	1000 1/h
Conventional thermal current I_{th}	2 A
Output contacts protected with fuses NH type 3NA, DIAZED type 5SB, NEOZED type 5SE • Operating class gL/gG • Operating class quick response	 4 A 6 A
Safety data according to EN ISO 13849-1	
Probability of a dangerous failure per hour (PFH_d)	3.79 x 10^{-9} 1/h
Probability of a dangerous failure on demand (PFD)	5.85 x 10^{-6}

Characteristic values for cables	
Max. permissible cable resistance	100 Ω
Max. permissible cable length from device to sensor (for CU 1.5 mm^2 and 150 nF/km)	1000 m
Max. permissible cable capacitance	330 nF

1) Protective separation, reinforced insulation 4 kV between input circuit and output contact current paths.

2) Time from instant an output is switched off to the instant the output reaches a state that permits it to be switched on again.

9.8 EM 2/4F-DI 2F-DO

Technical data of the expansion module 2/4F-DI 2F-DO

Device data	
Number of sensor inputs (1-channel), fail-safe	4
Number of test outputs	2
Number of outputs	2 redundant semiconductor outputs
Height • Screw terminals • Spring-loaded terminals	 102 mm 105 mm
Width	22.5 mm
Depth	124 mm
Weight	160 g
Electrical data	
Supply voltage/ rated control supply voltage Us	24 V DC
Operating range	0.85 to 1.15 x Us
Rated insulation voltage U_i	50 V
Rated impulse withstand voltage U_{imp}	500 V
Total power consumption	85 mA + 1.2 A per semiconductor output
Rated power at Us	2.0 W
Utilization category in accordance with EN 60947-5-1 (semiconductor outputs) • 13 V DC at 24 V DC	 1.2 A; short-circuit-proof up to 10 A
Resetting time[1)] of the safety-related outputs t_{RT}	420 ms
Max. switching frequency z at rated operational current	1000 1/h
Conventional thermal current I_{th}	1.2 A
Safety data according to EN ISO 13849-1	
Probability of a dangerous failure per hour (PFH_d)	2.70×10^{-9} 1/h
Probability of a dangerous failure on demand (PFD)	8.34×10^{-6}
Characteristic values for cables	
Max. permissible cable resistance	100 Ω
Max. permissible cable length from device to sensor (for CU 1.5 mm² and 150 nF/km)	1000 m
Max. permissible cable capacitance	330 nF
Dark period of solid-state outputs:	< 1 ms

1) Time from instant an output is switched off to the instant the output reaches a state that permits it to be switched on again.

9.9 EM 4F-DO

Technical data of the expansion module 4F-DO

Device data	
Number of outputs	4 redundant semiconductor outputs
Height • Screw terminals • Spring-loaded terminals	 102 mm 105 mm
Width	22.5 mm
Depth	124 mm
Weight	135 g
Electrical data	
Supply voltage/ rated control supply voltage Us	24 V DC
Operating range	0.85 to 1.15 x Us
Rated insulation voltage U_i	50 V
Rated impulse withstand voltage U_{imp}	500 V
Total power consumption	100 mA + 2 A per semiconductor output
Rated power at Us	4.8 W
Utilization category in accordance with EN 60947-5-1 (semiconductor outputs) • 13 V DC at 24 V DC	 2 A; short-circuit-proof up to 10 A
Resetting time[1)] of the safety-related outputs t_{RT}	420 ms
Max. switching frequency z at rated operational current	1000 1/h
Conventional thermal current I_{th}	2 A
Safety data according to EN ISO 13849-1	
Probability of a dangerous failure per hour (PFH_d)	3.18×10^{-9} 1/h
Probability of a dangerous failure on demand (PFD)	2.20×10^{-5}
Dark period of solid-state outputs:	< 1 ms

1) Time from instant an output is switched off to the instant the output reaches a state that permits it to be switched on again.

9.10 EM 4/8F-RO

Technical data of the expansion module 4/8F-RO

Device data	
Number of outputs	8
Height • Screw terminals • Spring-loaded terminals	 102 mm 105 mm
Width	45 mm
Depth	124 mm
Weight	400 g
Electrical data	
Supply voltage/ rated control supply voltage Us	24 V DC
Operating range	0.85 to 1.15 x Us
Rated insulation voltage U_i	300 V
Rated impulse withstand voltage U_{imp}	2.5 kV[1)]
Total power consumption	140 mA
Rated power at Us	3.0 W
Utilization category in accordance with EN 60947-5-1 (relay outputs) • 15 V AC at 230 V AC • 13 V DC at 24 V DC	 2 A 1 A
Resetting time[2)] of the safety-related outputs t_{RT}	420 ms
Mechanical durability	10 x 10^6 switching cycles
Max. switching frequency z at rated operational current	360 1/h
Conventional thermal current I_{th}	3 A
Output contacts protected with fuses NH type 3NA, DIAZED type 5SB, NEOZED type 5SE • Operating class gL/gG • Operating class quick response	 4 A 6 A
Safety data according to EN ISO 13849-1	
Probability of a dangerous failure per hour (PFH_d)	7.15 x 10^{-9} 1/h
Probability of a dangerous failure on demand (PFD)	4.36 x 10^{-5}

1) Protective separation, reinforced insulation 4 kV between input circuit and output contact current paths.

2) Time from instant an output is switched off to the instant the output reaches a state that permits it to be switched on again.

9.11 EM 8DI

Technical data of the expansion module 8DI

Device data	
Number of standard inputs	8
Height • Screw terminals • Spring-loaded terminals	 102 mm 105 mm
Width	22.5 mm
Depth	124 mm
Weight	125 g
Electrical data	
Supply voltage/ rated control supply voltage Us	24 V DC
Operating range	0.85 to 1.15 x Us
Rated insulation voltage U_i	50 V
Rated impulse voltage U_{imp}	500 V
Total power consumption	78 mA
Rated power at Us	1.9 W
Characteristic values for cables	
Max. permissible cable resistance	100 Ω
Max. permissible cable length from device to sensor (for CU 1.5 mm^2 and 150 nF/km)	1000 m
Max. permissible cable capacitance	330 nF

9.12 EM 8DO

Technical data of the expansion module 8DO

Device data	
No. of outputs	8
Height • Screw terminals • Spring-loaded terminals	102 mm 105 mm
Width	22.5 mm
Depth	124 mm
Weight	160 g
Electrical specifications	
Supply voltage / rated control supply voltage Us	24 V DC
Work area	0.85 to 1.15 x Us
Rated insulation voltage U_i	50 V
Rated impulse withstand voltage U_{imp}	500 V
Total power consumption	60 mA + 0.5 A per semiconductor output
Rated power at Us	1.5 W
Utilization category to EN 60947-4-1 (semiconductor outputs) • DC 13 at 24 V	0.5 A; short-circuit-proof up to 10 A
Max. switching frequency z at rated operational current	1000 1/h
Conventional thermal current I_{th}	0.5 A

9.13 DP interface module

Technical data of the DP interface module

Device data	
Height • Screw terminals • Spring-loaded terminals	 111 mm 113 mm
Width	45 mm
Depth	124 mm
Weight	approx. 270 g
Electrical specifications	
Power supply / rated control supply voltage Us (to IEC 61131-2)	24 V DC
Work area	0.85 to 1.15 x Us
Rated insulation voltage U_i	50 V
Rated impulse voltage U_{imp}	500 V
Total power consumption	100 mA
Rated power at U_s	2.4 W

9.14 Diagnostics display

Technical data of the diagnostics display

Device data	
Height	60 mm
Width	96 mm
Depth	44 mm
Weight	91 g
Electrical specifications	
Supply voltage / rated control supply voltage U_S	via a connection cable from the 3RK3 central unit U_s = 24 V DC
Work area	0.85 to 1.15 x U_s
Rated insulation voltage U_i	50 V
Rated impulse voltage U_{imp}	500 V
Total power consumption	24 mA
Rated power at U_S	0.6 W

9.15 Memory module

Technical data of the memory module

Device data	
Electronic supply	From the 3RK3 central unit
EEPROM	
Data storage	> 40 years
Deletion/write cycles	100 000

Dimension drawings

A

A.1 Dimension drawings

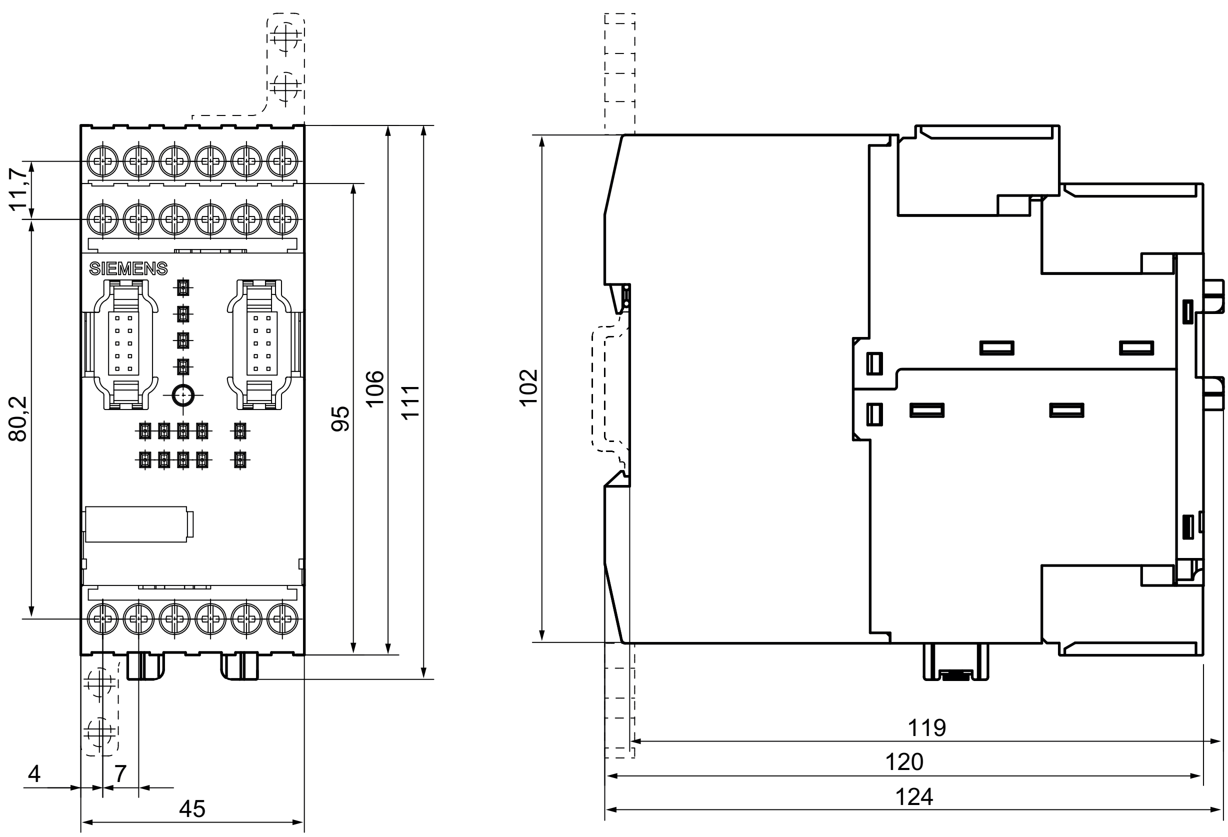


Figure A-1 Dimension drawing: Enclosure 45 mm with screw terminals

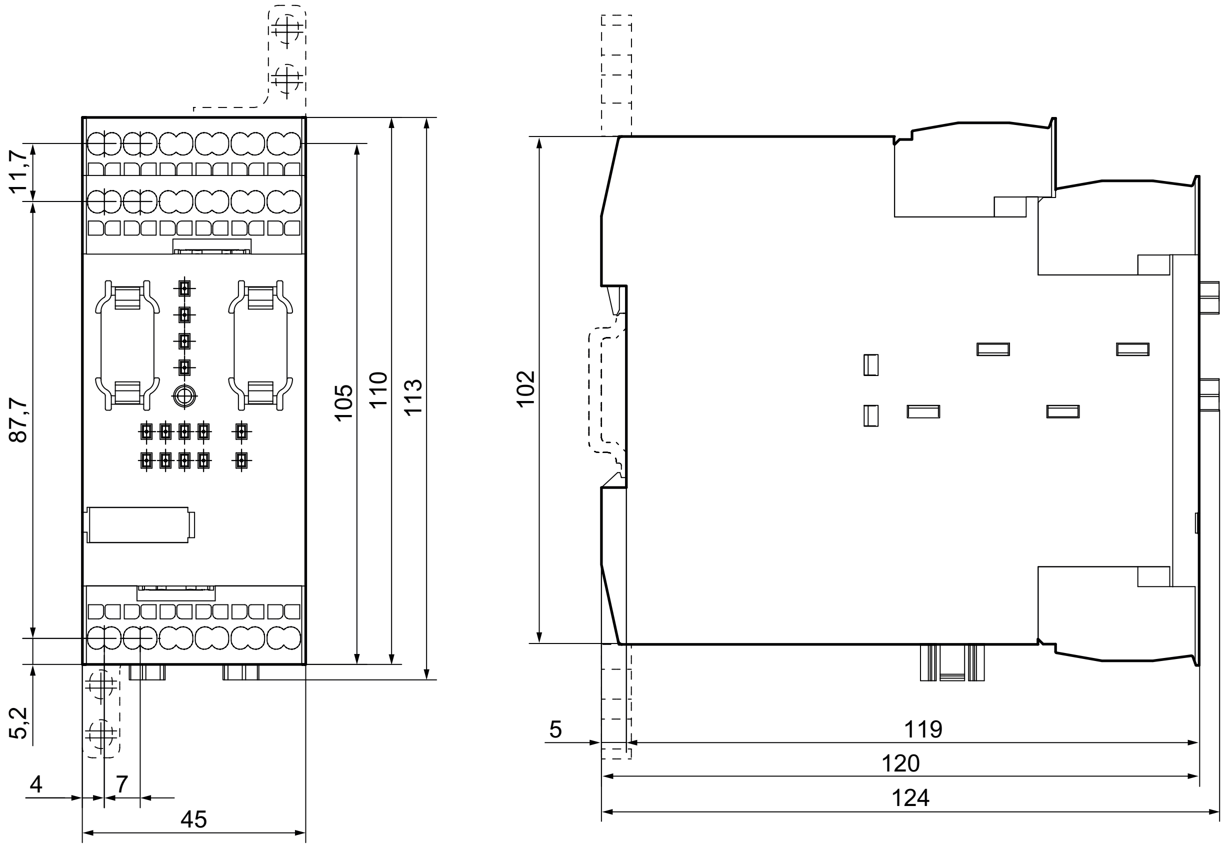


Figure A-2 Dimension drawing: Enclosure 45 mm with spring-loaded terminals

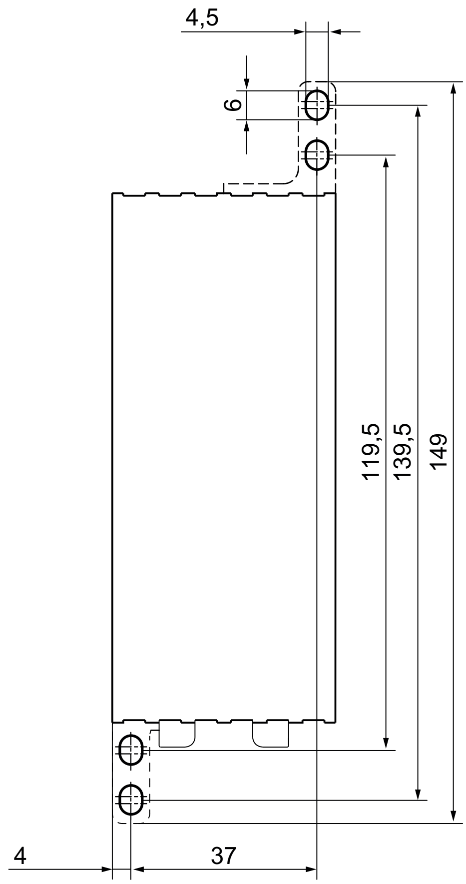


Figure A-3 Drilling plan: Enclosure 45 mm

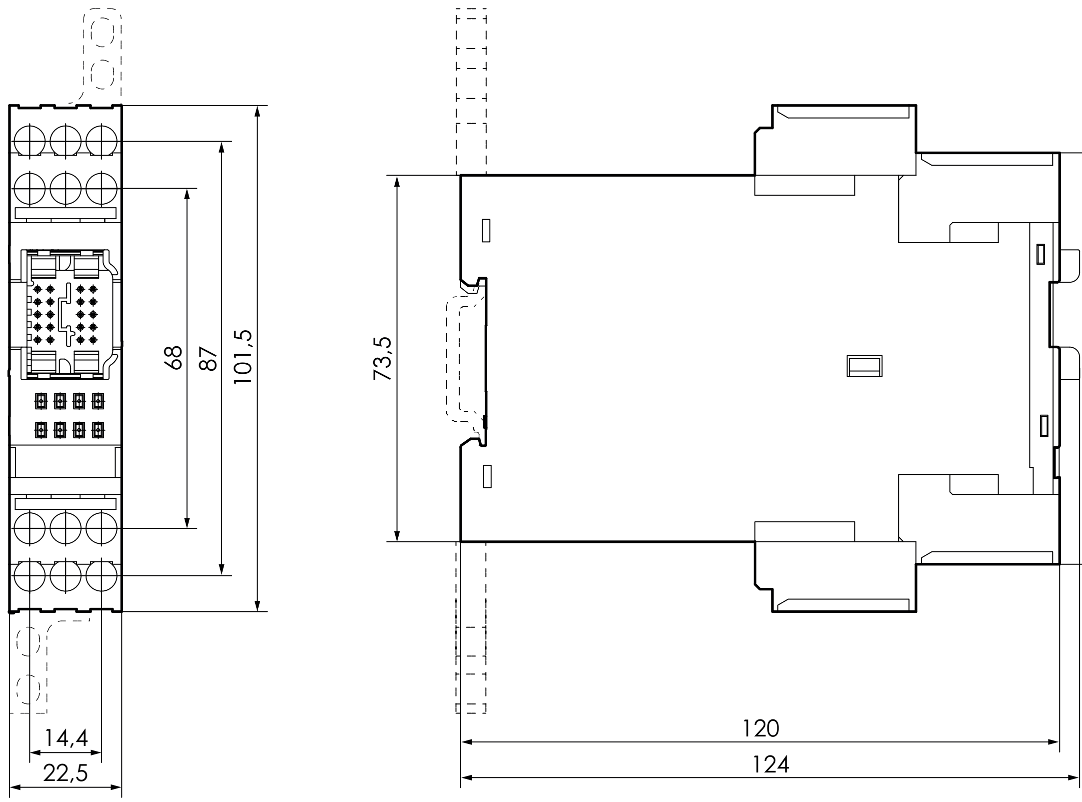


Figure A-4 Dimension drawing: Enclosure 22.5 mm with screw terminals

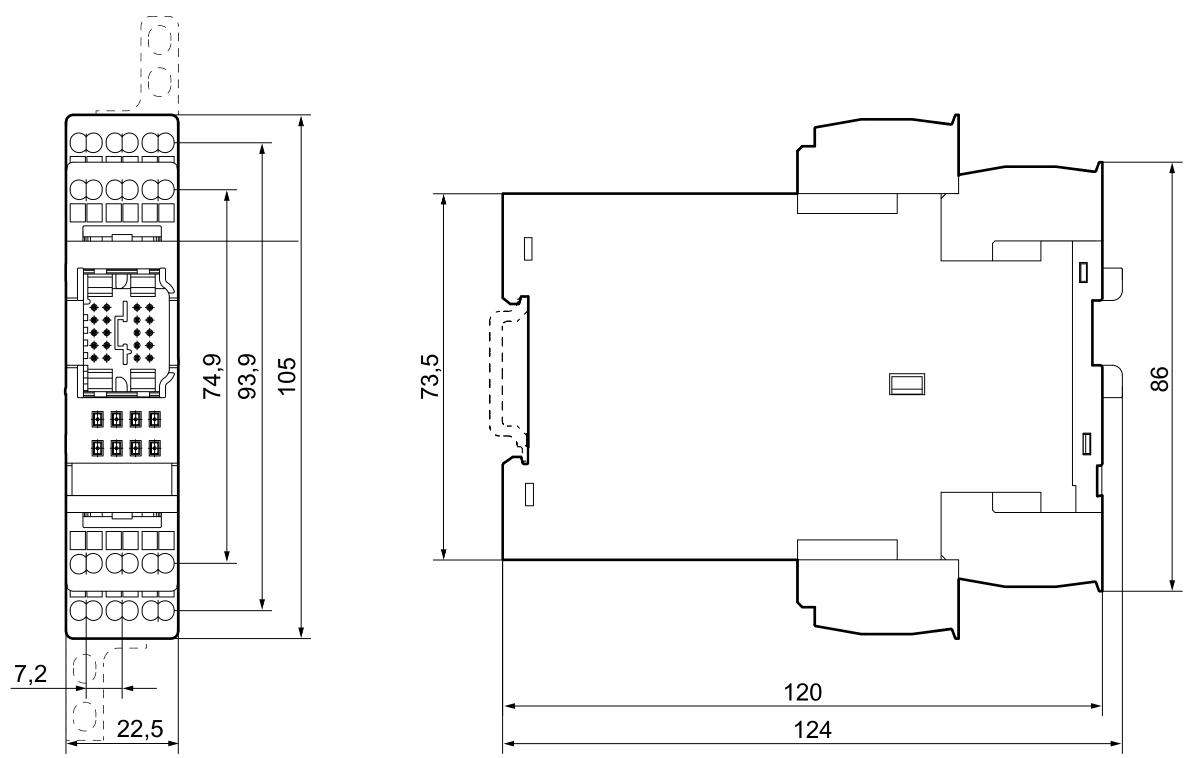


Figure A-5 Dimension drawing: Enclosure 22.5 mm with spring-loaded terminals

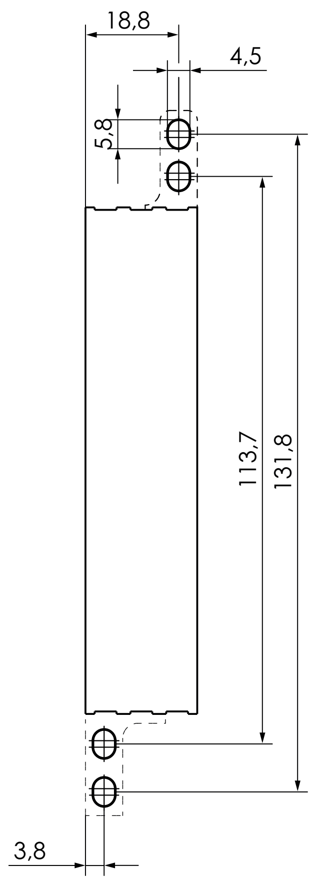


Figure A-6 Drilling plan: Enclosure 22.5 mm

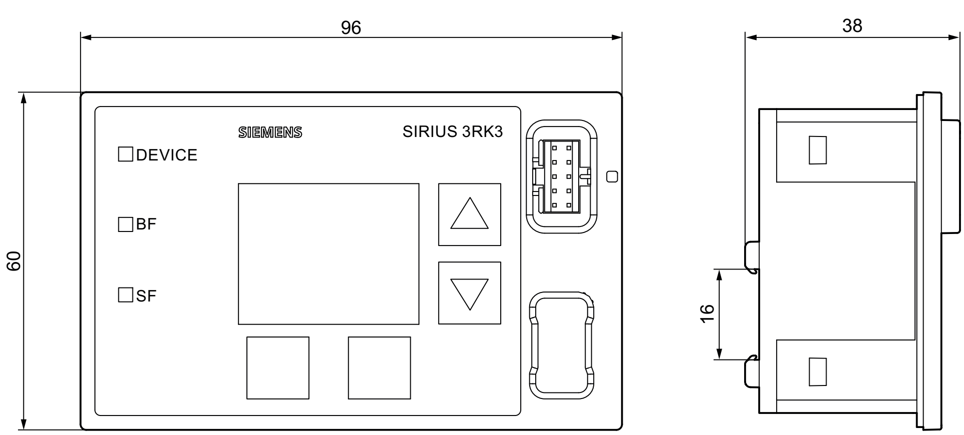


Figure A-7 Dimension drawing: Diagnostics display

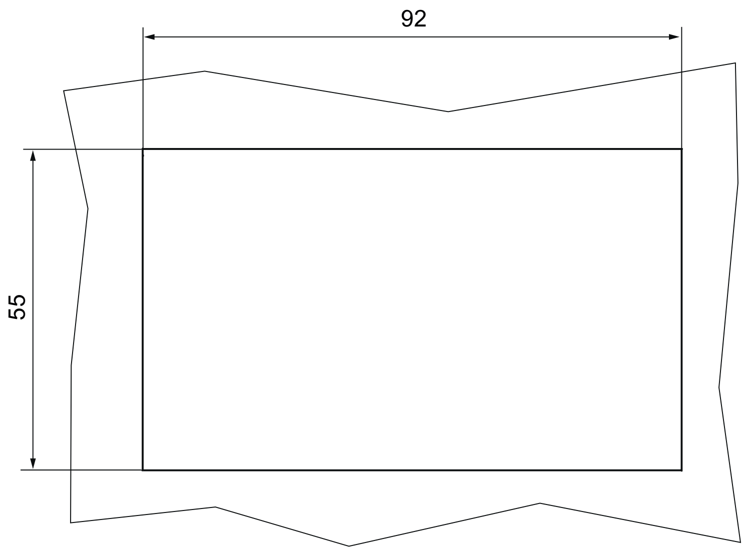


Figure A-8 Cut-out for diagnostics display

Evaluation/Feedback

B

B.1 Correction sheet

Correction sheet

Have you noticed any errors while reading this manual? If so, please use this form to tell us about them. We welcome comments and suggestions for improvement.

Fax response

	From (please complete):
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SIEMENS AG	
I IA CE MK&ST 3	Company/Department
92220 Amberg / Germany	Address

Fax: +49 (0)9621-80-3337

Manual title:

Table B- 1 Errors, comments, and suggestions for improvements

Certificates

C

C.1 Certificates

You will find all valid conformity and approval certificates for the MSS 3RK3 on the Internet (http://support.automation.siemens.com/WW/view/de/26412499/134200).

Index

2

3

7

8

A

B

C

E

F

G

H

I

L

M

N

O

P

R

S

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