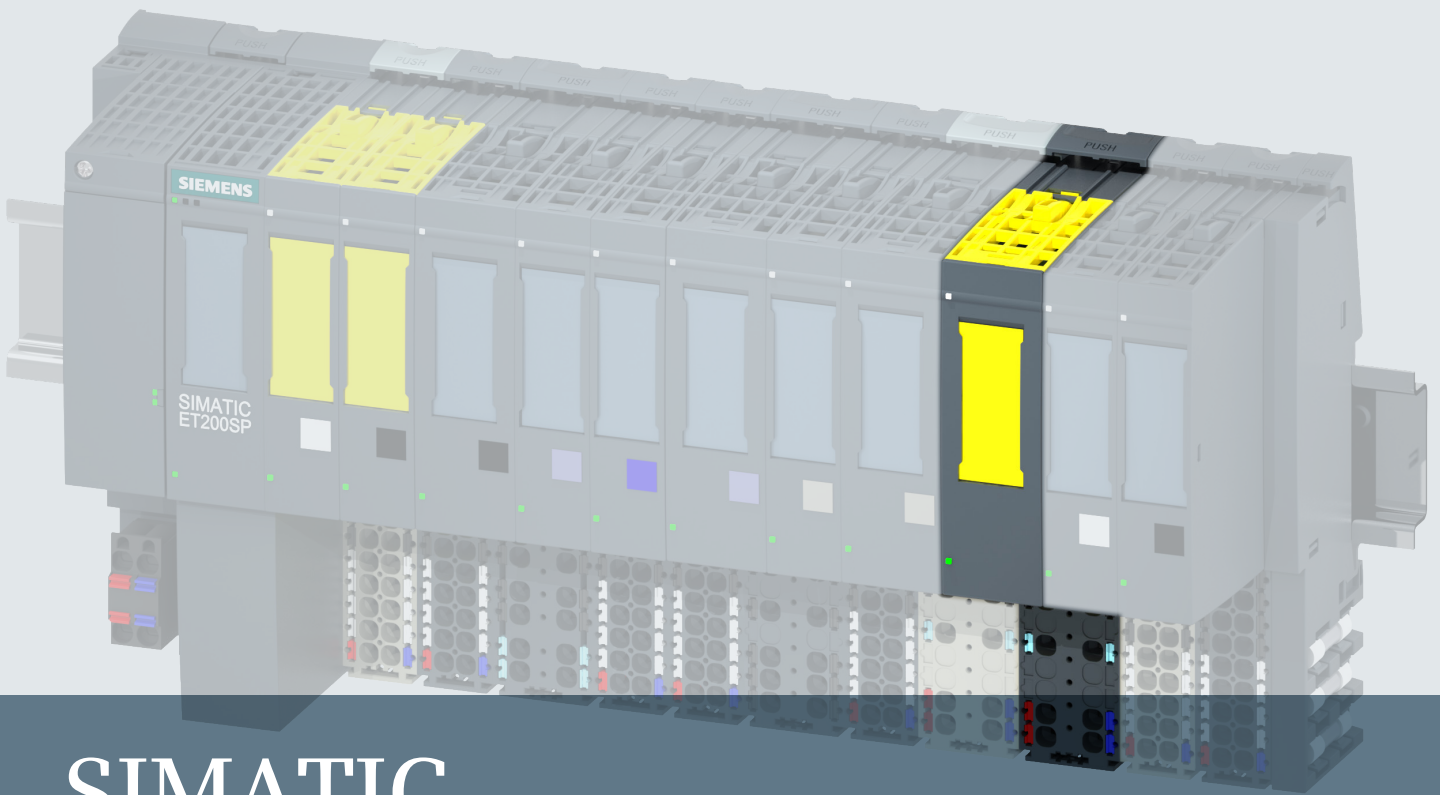


**SIEMENS**



# SIMATIC

## ET 200SP

Fail-safe Module F-CM AS-i Safety ST (3RK7136-6SC00-0BC1)

Manual

Edition

02/2014

Answers for industry.



# SIEMENS

## SIMATIC

### ET 200SP Fail-safe Module F-CM AS-i Safety ST (3RK7136-6SC00-0BC1) 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.

<b>⚠ DANGER</b>
indicates that death or severe personal injury <b>will</b> result if proper precautions are not taken.
<b>⚠ WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.
<b>⚠ CAUTION</b>
indicates that minor personal injury can result if proper precautions are not taken.
<b>NOTICE</b>
indicates that property damage can result if proper precautions are not taken.

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# Preface

## Purpose of the documentation

This manual complements the ET 200SP distributed I/O system system manual. General functions of the ET 200SP are listed in the system manual ET 200SP distributed I/O system (<http://support.automation.siemens.com/WW/view/en/58649293/0/en>).

The information provided in this device manual and the system manual enables you to commission the ET 200SP distributed I/O system.



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## Documentation guide

### Introduction

The following paragraph gives you an overview of the additional documentation you need to use the F-CM AS-i Safety ST.

### Documentation for the distributed I/O system ET 200SP with the F-CM AS-i Safety ST

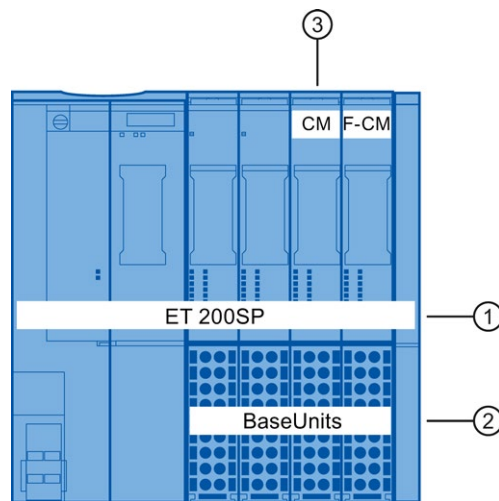


Figure 1-1 Example of a system structure

Table 1- 1 Documentation for the distributed I/O system ET 200SP with the F-CM AS-i Safety ST

No.	Component	Documentation	Most important contents
①	System	Fail-safe modules: Product Information ET 200SP Distributed I/O System <a href="http://support.automation.siemens.com/WW/view/en/78361093/0/en">http://support.automation.siemens.com/WW/view/en/78361093/0/en</a> ET 200SP distributed I/O system <a href="http://support.automation.siemens.com/WW/view/en/58649293/0/en">http://support.automation.siemens.com/WW/view/en/58649293/0/en</a>	<ul style="list-style-type: none"> <li>• Application planning</li> <li>• Installation</li> <li>• Connecting</li> <li>• Commissioning</li> <li>• Technical specifications</li> </ul>
		Fail-safe system: Programming and Operating Manual S7 Distributed Safety <a href="http://support.automation.siemens.com/WW/view/en/22099875/0/en">http://support.automation.siemens.com/WW/view/en/22099875/0/en</a> Programming and Operating Manual SIMATIC Safety <a href="http://support.automation.siemens.com/WW/view/en/54110126/0/en">http://support.automation.siemens.com/WW/view/en/54110126/0/en</a>	<ul style="list-style-type: none"> <li>• Configuration</li> <li>• Programming</li> </ul>

No.	Component	Documentation	Most important contents
②	BaseUnits	SIMATIC ET 200 SP BaseUnits ( <a href="http://support.automation.siemens.com/WW/view/en/59753521/0/en">http://support.automation.siemens.com/WW/view/en/59753521/0/en</a> )	<ul style="list-style-type: none"><li>• Connecting</li><li>• Technical specifications</li></ul>
③	CM AS-i Master ST	Manual CM AS-i Master ST for SIMATIC ET 200SP ( <a href="http://support.automation.siemens.com/WW/view/en/71756485">http://support.automation.siemens.com/WW/view/en/71756485</a> )	<ul style="list-style-type: none"><li>• Commissioning</li><li>• Technical specifications</li></ul>

# Safety instructions

## Important safety instructions

** WARNING**

**Failure to observe this information may result in death, severe injury, and serious property damage.**

For operation in Pollution Degree 2 environment.

** WARNING**

**Failure to observe this information may result in death, severe injury, and serious property damage.**

When used in hazardous environments corresponding to Class I, Division 2 or Class I, Zone 2, the device must be installed in a cabinet or an enclosure. To comply with EU Directive 94/9 (ATEX 95), this enclosure must meet the requirements of at least IP54 according to EN 60529.

** WARNING**

**Explosion hazard; failure to observe this information may result in death, severe injury, and serious property damage.**

Wires must not be connected to the device or disconnected from the device within a flammable or combustible environment.

** WARNING**

**Explosion hazard; failure to observe this information may result in death, severe injury, and serious property damage.**

Do not disconnect live wires from the device if it cannot be ensured that an explosive atmosphere is not present in the environment.

** WARNING**

**Explosion hazard; failure to observe this information may result in death, severe injury, and serious property damage.**

Replacement of components may impair suitability for Class I, Division 2 or Zone 2.

 **WARNING**

**Explosion hazard; failure to observe this information may result in death, severe injury, and serious property damage.**

Do not open the device when the supply voltage is switched on.

 **WARNING**

**Connection only to safety extra-low voltage with limiting of output voltage to max. 40 V under fault condition**

Connect the BaseUnit only to an AS-i power supply unit that meets the conditions indicated in "Power supply units for AS-Interface". Connection to a higher voltage may result in death, severe injury, and serious property damage.

For this reason, you are only permitted to connect safety extra-low voltage (SELV) with limited power source (LPS) according to IEC 60950-1, EN 60950-1, VDE 0805-1 to the supply connections.

The supply of the device must comply with NEC Class 2, as described by the National Electrical Code (r) (ANSI / NFPA 70).

 **WARNING**

**Failure to observe this information may result in death, severe injury, and serious property damage.**

Take measures to prevent transient overvoltages of more than 40% of the rated voltage. You can ensure this by using only AS-i power supply units that meet the requirements indicated in Section Terminal assignment (Page 27) in "Power supply units for AS-Interface". Transient overvoltages are not permitted to exceed 119 V under any circumstances. This will ensure compliance with an ATEX requirement.

 **CAUTION**

**Failure to observe this information may result in property damage and bodily injury**

This device is only suitable for use in areas defined as Class I, Division 2, Groups A, B, C, and D and is not suitable for use in hazardous areas.

 **WARNING**

**To be operated by experienced users only**

Improper operation may result in death, severe injury, and serious property damage. Users must be familiar with ASIsafe and the safety system used, e.g., SIMATIC, Distributed Safety, SIMATIC Safety Advanced.

Only an experienced user is permitted to teach the code sequences of safe AS-i slaves (organizational specification).

**⚠ CAUTION**

**Failure to observe this information may result in property damage and bodily injury**

This equipment is only suitable for use in areas defined as Class I, Zone 2, Group IIC and in non-hazardous areas.

**NOTICE****Checking parameters**

Check that all parameters are correctly set before final acceptance.

**NOTICE****Reaction to faults in fail-safe modules**

If you are using the module in safety-critical applications, the PROFIsafe mechanism of passivation and reintegration is enabled and must be used.

Observe the information concerning passivation and other fault reactions in the documentation for the ET 200SP Distributed I/O System, see Section Documentation guide (Page 9).

**NOTICE****Single-channel use of safe AS-i input slaves**

The values in the PROFIsafe process image input have Safety Integrity Level SIL 3.

If two-channel interconnection is not used for a safe AS-i input slave, the application has a maximum safety integrity level of SIL 2 or less. The configuration tool / STEP 7 cannot detect this.

You must ensure that the signals are correctly processed in the safety application.

**NOTICE****Ensure that the plant is functioning correctly in productive operation**

Carry out a function test before the system goes into productive operation.

## Important note for maintaining the operational safety of the system

---

### Note

#### Newsletter containing information on product development and product features

Owners of systems with safety-related characteristics must ensure compliance with special operational safety requirements. Suppliers are required to comply with special product monitoring measures. For this reason, Siemens publishes a special newsletter containing information on product developments and features that are (or could be) relevant to operation of systems from a safety perspective. A newsletter keeps you constantly up to date in this regard. A subscription to the newsletter is necessary so that you can make any needed changes to your system. To sign up for the newsletter, go to:

Internet (<https://www.industry.siemens.com/newsletter>)

Select "Service & Support" > "Industry Online Support" > "Automation Technology" > "AS-Interface". Select the "Update" entry type.

---

## See also

References (Page 97)

## Product overview

### 3.1 Properties of the F-CM AS-i Safety ST

#### Item number

3RK7136-6SC00-0BC1

#### View of the module



Figure 3-1 View of the F-CM AS-i Safety ST module

#### Use of the module

The F-CM AS-i Safety ST module is a communication module for use in the SIMATIC ET 200SP Distributed I/O System.

The F-CM AS-i Safety ST module features a 20 mm wide ET 200SP module housing. A BaseUnit (BU) is required for use in the ET 200SP. The F-CM AS-i Safety ST module can be plugged in to:

- BaseUnit Type C0
- BaseUnit Type C1

The F-CM AS-i Safety ST fail-safe communication module expands a standard AS-Interface network to include safety-related communication.

The F-CM AS-i Safety ST module reads the input states of safety-related AS-Interface input modules and provides these states to a fail-safe F-CPU for further evaluation.

In the opposite direction, the F-CM AS-i Safety ST module receives safe output states of an F-CPU and outputs them for control of safety-related outputs on AS-Interface.

### 3.1 Properties of the F-CM AS-i Safety ST

The F-CM AS-i Safety ST fail-safe module supports safety-related applications up to SIL 3 according to EN 62061 or safety category up to PL e according to EN 13849-1. The input and output values of the safety-related AS-i slaves are addressed using the safe cyclic process image. You need an F-CPU for safe processing.

The F-CM AS-i Safety ST module has no AS-i master functionality. For operation of the AS-i network, you need a CM AS-i Master ST module (3RK7137-6SA00-0BC1) or another AS-i master conforming to AS-i Specification V3.0.

You can plug several F-CM AS-i Safety ST modules into one SIMATIC ET 200SP station. An F-CM AS-i Safety ST occupies 16 input bytes and 8 output bytes in the I/O address space. The number of F-CM AS-i Safety ST modules that can be plugged in depends on:

- The maximum address space of the utilized interface module (IM) of the ET 200SP
- The amount of address space occupied by other modules

Up to five module combinations of CM AS-i Master ST (32 input bytes/32 output bytes) and F-CM AS-i Safety ST (16 input bytes/8 output bytes) can be plugged in to one SIMATIC ET 200SP station with standard interface module IM 155-6 PN ST having a maximum address space of 256 input bytes/256 output bytes. If other modules are present in the ET 200SP station, the available address space and the maximum number of AS-i modules are reduced.

In a SIMATIC ET 200SP station with High Feature Interface Module IM 155-6 PN HF and a maximum address space of 1 440 input bytes/1 440 output bytes, a correspondingly greater number of modules can be plugged in.

You can find additional information in ET 200SP System Manual (<http://support.automation.siemens.com/WW/view/en/58649293/0/en>).



## Properties

- Technical properties
  - Gateway between PROFIsafe and ASIsafe, without master functionality
  - Expands a standard AS-i network to include safety-related communication (ASIsafe)
  - Transfer of safety-related digital I/O values in the cyclic process image
  - Monitoring of up to 31 safety-related input slaves
  - Control of up to 16 safety-related AS-i output slaves or switch-off groups
  - Power supplied from the AS-i voltage
  - Use of various interconnection types (1oo1 and 1oo2) is possible
  - Input delay of 0 ms to 150 ms can be assigned for each channel
  - Startup test can be activated for each channel
  - Discrepancy monitoring can be configured for each channel
  - Sequence monitoring can be set for each channel
  - Channel-wise passivation
  - Test for 0 signal before reintegration
  - 8 LED displays for status and error diagnostics
- Supported functions
  - I&M identification data
  - PROFIsafe V2.4
  - Firmware update

<b>NOTICE</b>
<b>Max. proof test interval</b> When the proof test interval has expired, you must replace the device; see "Technical specifications (Page 87)".

## Accessories

The following components can be used with the module:

- Labeling strips
- Reference identification label

## Ease of maintenance

The following features support maintenance:

- Code sequences are saved in the coding element. As a result, teaching of the code sequences does not have to be repeated after an F-CM AS-i Safety ST module is replaced.
- Use is automated to the greatest extent possible. This applies, in particular, to the teaching of the code sequences of safe AS-i slaves.
- The module/BaseUnit concept allows you to easily replace defective hardware. Remove the defective module from the rack and plug in the new module.

## Certifications

More detailed information regarding certifications can be found in the ET 200SP System Manual (<http://support.automation.siemens.com/WW/view/en/58649293/0/en>).

## 3.2 Operating modes of the F-CM AS-i Safety ST

### 3.2.1 Standard mode

#### Self test during device startup

After the AS-i voltage is switched on, the F-CM AS-i Safety ST module performs a comprehensive self-test. During this test, all LEDs are lit for approximately 3 seconds. Exception: the "DIAG" LED is controlled directly by the ET 200SP backplane bus and indicates the communication status for the ET 200SP system.

#### Checking of the F-address

After the self-test, the module checks the F-address. If a valid F-address is not present, the "DIAG" LED flashes red and you must assign the F-address; see Section "F-parameters (Page 42).

#### Downloading of the module parameters

The F-CM AS-i Safety ST then begins to read in code sequences of the safe AS-i slaves on the connected AS-i bus. At the same time, the module downloads the module parameters that were stored in the PLC CPU. The module parameters can only be downloaded when the operating voltage is applied to the interface module of the ET 200SP and the parameters have been made available by the PLC CPU during startup of the ET 200SP station.

The "Status" LED flashes green until the module parameters are completely downloaded or the PLC CPU is in STOP state, or the PLC communication is interrupted.

#### Cyclic data exchange of safe input/output data

When a valid set of module parameters has been downloaded and the PLC CPU is in "RUN" state, the safe input/output data is evaluated according to the parameter assignment and exchanged with the PLC CPU.

The PROFIsafe protocol is used for the data exchange.

The "Status" LED is lit green during cyclic data exchange.

If the F-CM AS-i Safety ST module starts cyclic data exchange directly after startup, but communication cannot yet be established on the AS-i bus, the F-CM AS-i Safety ST module supplies the substitute value "0" in the input image. Passivation is delayed by approximately 30 s in this case. As a result, communication can start on the AS-i bus within this time window without passivation. After this time window, the input/output channels are passivated if there is no AS-i communication.

### 3.2.2 Error statuses

**Note**

**Statuses not considered to be errors**

The F-CM AS-i Safety ST module does not consider the following statuses to be errors:

- Waiting for start-up test
- Channel with value = 0 without error condition, e.g., when EMERGENCY STOP button is pressed

Other diagnostic functions can be read out using data records.

#### 3.2.2.1 Process signal error

**Description**

Examples of conditions that trigger a process signal error are:

- Discrepancy error at the inputs of a safe AS-i input slave
- Sequence error at the inputs of a safe AS-i input slave
- Code sequence error at a safe AS-i input slave, e.g., due to cross-circuit at the inputs or an EMC problem
- Failure of a safe AS-i input slave

You can read the following pattern on the LEDs:

Table 3- 1 LED display for discrepancy error or sequence error









LED	Display
"Status"	 Green "On"
"Error"	 "Off"
"CFG"	 "Off"
"PSF"	 Red "flashes"

Table 3- 2 LED display for code sequence errors, e.g., due to cross-circuit or slave failure

LED	Display
"Status"	 Green "On"
"Error"	 "Off"
"CFG"	 Red "flashes"
"PSF"	 Red "flashes"

In the event of a process signal error, the F-CM AS-i Safety ST module remains in cyclic data exchange. Communication with the F-CM AS-i Safety ST module is only possible. e.g., for reading out additional diagnostic information via data records. Only at the safe input slave involved in each case is the substitute value "0" processed and the channel passivated. After the cause of the error has been eliminated, the channel can be reintegrated via the safety program.

The "PSF" LED goes out only after all channels have been reintegrated.

### 3.2.2.2 Parameter assignment error

#### Description

In the event of invalid configuration data, the cyclic data exchange will not start.

You can read the following pattern on the LEDs:

Table 3- 3 LED display for parameter assignment errors

LED	Display
"Status"	* Green "flashing"
"Error"	□ "Off"
"CFG"	□ "Off"
"PSF"	* Red "flashes"

1. Check the hardware configuration in *STEP 7*.
2. Perform a compilation.
3. Download the configuration data to the PLC CPU.

### 3.2.2.3 Device fault

#### Description

Examples of conditions that trigger a device fault are:

- Intermittent data processing errors, e.g., an EMC problem
- A contact problem with the backplane bus
- An incorrect coding element in the Base Unit
- An incorrect firmware update

You can read the following pattern on the LEDs:

Table 3- 4 LED display for device faults

LED	Display
"Status"	<input type="checkbox"/> "Off"
"Error"	* Red "flashes"
"CFG"	<input type="checkbox"/> "Off"
"PSF"	<input type="checkbox"/> "Off"

In the event of a device fault of this type, communication with the F-CM AS-i Safety ST module is only possible. e.g., for reading out additional diagnostic information via data records. The substitute value "0" is processed for inputs and outputs, and all channels are passivated.

- Make sure that the station is properly grounded.
- Check whether the coding element is present or replace it if necessary.
- Plug the module into the BaseUnit in an untwisted position.

Switch off the module. If the error persists after the module is switched on and no external error cause can be found, the module must be replaced.

### 3.2.2.4 Serious device fault




#### Description

Examples of conditions that trigger a serious device fault are:

- Fault in the electronics
- Excessive temperature rise
- Overvoltage

You can read the following pattern on the LEDs:

Table 3- 5 LED display for a serious device fault

LED	Display
"Status"	<input type="checkbox"/> "Off"
"Error"	 Red "On"
"CFG"	 Red "On"
"PSF"	 Red "On"

In the event of a serious device fault, communication with the F-CM AS-i Safety ST module, e.g., reading a data record, is not possible. The substitute value "0" is processed for inputs and outputs, and all channels are passivated.

1. Switch off the module.
2. Wait for the module to cool down, if necessary.
3. Switch on the device again.
4. If the error persists after the module is switched on, the module must be replaced.



### 3.2.3 Firmware update

#### Performing a firmware update

Information about updating the firmware can be found in the ET 200SP System Manual.

---

**Note****Noting the firmware version**

After a firmware update, mark the current firmware version on the housing of the F-CM AS-i Safety ST.

---

**Note****Requirement for the firmware update**

Always perform the firmware update of the F-CM AS-i Safety ST in a separate ET 200SP rack. Ensure that no other modules besides the interface module (IM), the F-CM AS-i Safety ST, and the terminating server module are located in the ET 200SP rack.

---

**NOTICE****Checking the firmware version for F-permission**

Before using a new firmware version, always check whether it is permitted for use in the respective module.

The permissible firmware version is specified in the appendices of the SIMATIC Safety certificate.

**See also:**

Certificate (<http://support.automation.siemens.com/WW/view/en/49368678/134200>)

#### Handling of the F-address and the code sequences

---

**Note****Saving of the F-address in the coding element**

During a firmware update, the F-address that is saved in the coding element is retained. Observe the information in the description of the firmware version.

---

**Note****Saving of the code sequences in the coding element**

During a firmware update, the ASIsafe code sequences that are saved in the coding element are retained. Observe the information in the description of the firmware version.

---

### LED behavior during a firmware update

During a firmware update, the LEDs exhibit the following behavior:

- "DIAG" LED flashes red.
- "ADDR" LED flashes green.
- "PWR" LED lights up green.
- The rest of the LEDs are Off.

---

#### Note

##### Supply voltage during a firmware update

The AS-i voltage and the supply voltage of the ET 200SP station must not be switched off during a firmware update.

---

### LED behavior after a successfully completed firmware update

On successful completion of a firmware update, the module performs a hot restart. It is not necessary to switch off the voltage.

After the restart, the LEDs indicate the status of the F-CM AS-i Safety ST same as after a device startup.

### LED behavior in the event of an error during a firmware update

If an error occurred during the firmware update, a device fault is triggered (see Section (Page 20)). The LEDs take on the following status:

- "DIAG" LED flashes red.
- "Error" LED flashes red.
- "PWR" LED lights up green.
- The rest of the LEDs are Off.

In this case, switch the AS-i voltage off and back on again and repeat the firmware update.

# Connection

## 4.1 Terminal assignment

### Requirement

For connecting, you require a BaseUnit:

- Type C1 (dark BaseUnit, e.g., item number 6ES7193-6BP20-0BC1)
- Type C0 (light BaseUnit, e.g., item number 6ES7193-6BP20-0DC0)

Note that, within a BaseUnit group for AS-i consisting of light and dark BaseUnits, only the AS-i modules CM AS-i Master ST and F-CM AS-i Safety ST may be combined. Other module types of the ET 200SP must always be separated from the BaseUnit group for AS-i using light BaseUnits.

#### WARNING

**Connection of the BaseUnit only to safety extra-low voltage with limiting of output voltage to max. 40 V under fault condition**

Connect the BaseUnit only to an AS-i power supply unit that meets the conditions indicated in "Power supply units for AS-Interface". Connection to a higher voltage may result in death, severe injury, and serious property damage.

### Variants

#### Use with light BaseUnit Type C0

If the F-CM AS-i Safety ST module is connected to an AS-i network whose AS-i master is located outside the ET 200SP station, use the light BaseUnit Type C0.

If the AS-i master is located within the ET 200SP station, you can also use the light BaseUnit. However, you must wire the AS-i network explicitly using the connecting terminals.

The light BaseUnit Type C0 has no internal connection to the module plugged in on the left.

### **Use with dark BaseUnit Type C1**

If you are using a combination of CM AS-i Master ST and F-CM AS-i Safety ST on the same AS-i network, use the dark BaseUnit. In this case, plug the CM AS-i Master ST module into a light BaseUnit Type C0. Next to it on the right, plug the F-CM AS-i Safety ST module into a dark BaseUnit Type C1.

In this case, connect the AS-i network to the light BaseUnit. The dark BaseUnit does not have to be connected to the AS-i network because the connection is made automatically via the BaseUnit group.

In contrast to other BaseUnit types, for the BaseUnits Type C0 and Type C1, the P1 and P2 busbars of the BaseUnit are electrically isolated from the front panel connecting terminals 1L/2L (ASI+) and 1N/2N (ASI-). An electrical connection is made in each case via the plugged-in CM AS-i Master ST module or F-CM AS-i Safety ST module.

The AS-i voltage connected to the light BaseUnit Type C0 is applied through the plugged CM AS-i Master ST module to the busbars. The busbars of the BaseUnit group are connected-through. The F-CM AS-i Safety ST module is supplied with AS-i voltage via the busbars of the dark BaseUnit Type C1. It is not permitted to continue the AS-i voltage from the front panel connecting terminals 1L/2L (ASI+) and 1N/2N (ASI-) of the dark BaseUnit because this type of current draw can cause an overload in the modules.

If you want to maintain the voltage supply of the F-CM AS-i Safety ST module when the CM AS-i Master ST module is unplugged from the light BaseUnit, you can wire an external connection of the connecting terminals 1L/2L (ASI+) and 1N/2N (ASI-) between the light BaseUnit Type C0 and the dark BaseUnit Type C1.

### **Grouping of a light BaseUnit Type C0 with several dark BaseUnits Type C1**

The use of a single F-CM AS-i Safety ST module on an AS-i network is generally sufficient. If several F-CM AS-i Safety ST modules are being used on an AS-i network by means of series connected dark BaseUnits Type C1, you must wire an external connection of the connecting terminals 1L/2L (ASI+) and 1N/2N (ASI-) between the light BaseUnit Type C0 and a dark BaseUnit Type C1. This will prevent an overload of the modules. A current draw from the dark BaseUnit is not allowed. Additional information about this can be found in "Use with dark BaseUnit Type C1".

## General terminal assignment

Table 4- 1 Terminal assignment of the F-CM AS-i Safety ST

Terminal	Assignment	Description
1	TEACH1	Connection of the "TEACH" button (optional)
2	TEACH2	See Section Code sequences (Page 69).
3	RES	Reserved
4	RES	Reserved
5	RES	Reserved
6	RES	Reserved
1L, 2L <sup>1)</sup>	ASI+	Dark BaseUnit Type C1: optional connection of the AS-i cable, positive polarity Light BaseUnit Type C0: connection of the AS-i cable, positive polarity
1N, 2N <sup>1)</sup>	ASI-	Dark BaseUnit Type C1: optional connection of the AS-i cable, negative polarity Light BaseUnit Type C0: connection of the AS-i cable, negative polarity

1) The terminals are connected through in the BaseUnit.

### Connecting an external "TEACH" button

You can connect a "TEACH" button to the "TEACH1" and "TEACH2" terminals of the F-CM AS-i Safety ST module. The "TEACH" button enables the transfer of code sequences of the connected safe AS-i input slaves. This function is activated by closing the button contact on the TEACH1 and TEACH2 terminals.

The maximum cable length between the terminal and "TEACH" button is 0.5 m.

Use two wires routed in parallel for connecting the button (not included in the scope of delivery).

### Additional rules and instructions for operating the ET 200SP with fail-safe modules

Observe generally the information in Section "Connecting" in the following documentation:

- Manual ET 200SP distributed I/O system  
(<http://support.automation.siemens.com/WW/view/en/58649293/0/en>)
- Product Information ET 200SP Distributed I/O System  
(<http://support.automation.siemens.com/WW/view/en/78361093/0/en>)

The conditions for connecting sensors and actuators to the modules of the ET 200SP also apply generally to the connecting of sensors and actuators to the slaves and modules of the AS-i network.

In addition, the information in the documentation of the AS-i component applies.

Ensure that all components of the AS-i network are connected in such a way that the voltage applied to the safety-related AS-i modules is limited to a maximum of 40 V.

The ET 200SP modules CM AS-i Master ST and F-CM AS-i Safety ST have internal safe electrical isolation from the backplane bus of the ET 200SP.

### Power supply units for AS-Interface

A connected power supply unit must have the following properties:

- Rated output voltage 30 V DC (AS-Interface Standard) or 24 V DC (AS-i Power24V)
- PELV/SELV (Protective/Safety Extra-Low Voltage) standard
- Residual ripple < 250 mVpp
- Limiting of output voltage to a maximum of 40 V in the event of a fault, including a second fault.

The Siemens power supply units for AS-Interface meet these requirements. For additional information, refer to the operating instructions of the power supply unit.

Use an AS-Interface power supply unit with integrated data decoupling or a combination of a power supply unit that meets the above-indicated requirements and a data decoupling unit.

When AS-i Power24V is used, there are limitations on the cable length (max. 50 m AS-i cable) and usability of AS-i components and connected sensors/actuators due to the reduced voltage.

Additional notes:

- AS-Interface System Manual  
(<http://support.automation.siemens.com/WW/view/en/26250840/0/en>)
- FAQ "Compatibility for AS-i Power24V"  
(<http://support.automation.siemens.com/WW/view/en/20025980/133000>)

## 4.2 Schematic circuit diagram

### Schematic circuit diagram

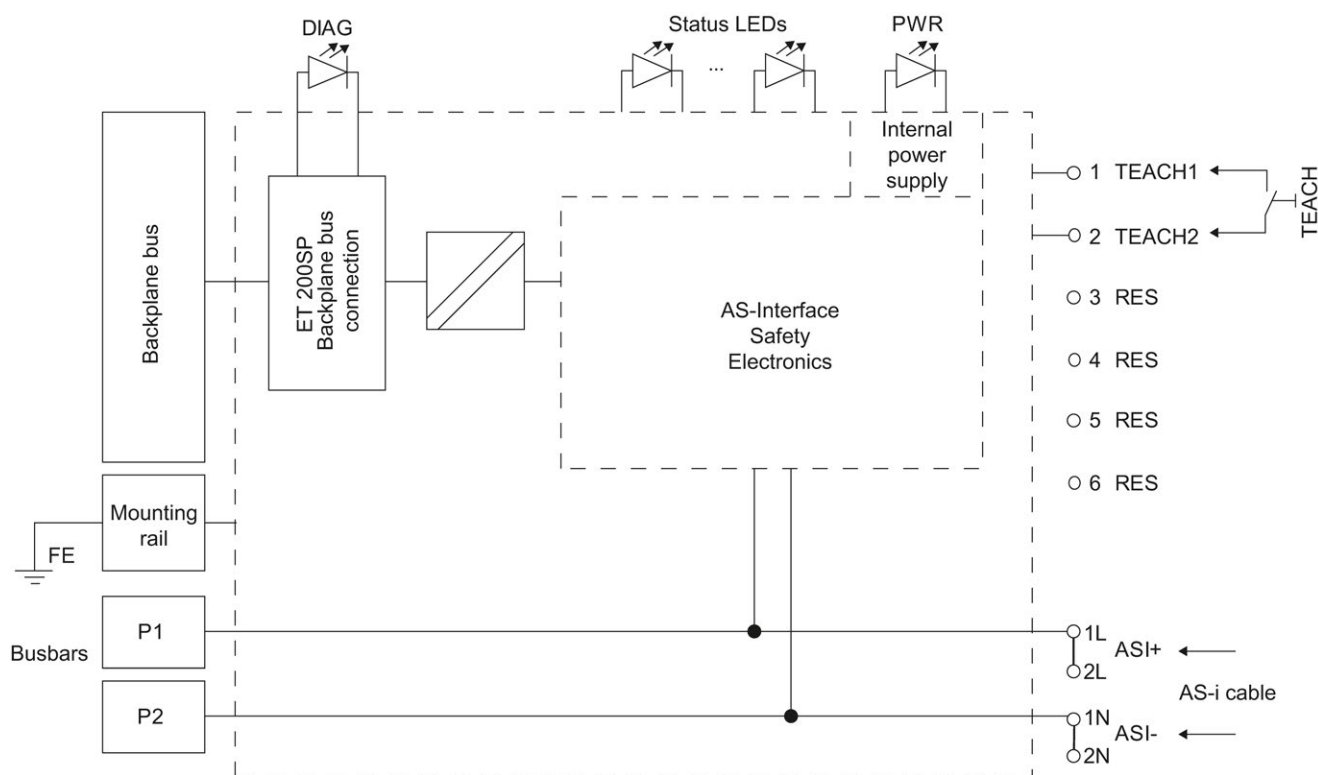


Figure 4-1 Schematic diagram of F-CM AS-i Safety ST

### Connection to busbars

Requirement:

- An AS-i power supply unit is connected to the light BaseUnit Type C0 of the BaseUnit group.
- A CM AS-i Master ST module is plugged into the light BaseUnit.

If you plug an F-CM AS-i Safety ST module into a dark BaseUnit Type C1, the F-CM AS-i Safety ST module will be automatically supplied with AS-i voltage via the busbars.

It is not permitted to continue the AS-i voltage from the front panel connecting terminals 1L, 2L (ASI+) and 1N, 2N (ASI-) of the dark BaseUnit because this type of current draw can cause an overload of the modules.

Note the additional explanations in Section Terminal assignment (Page 27).

4.2 Schematic circuit diagram



# Configuring

## 5.1 Requirements

### Configuration

You configure the ET 200SP station and its F-CM AS-i Safety ST module and assign their parameters with *STEP 7*.

There is currently no provision for configuration via a GSD file, because the GSD configuration procedure does not permit safety-related parameter assignment.

---

#### Note

#### F-CM AS-i Safety ST in the hardware catalog of *STEP 7*

If the F-CM AS-i Safety ST module is not listed in the hardware catalog of *STEP 7*, you will need a "Hardware Support Package". This HSP can be obtained from the Internet using the corresponding function in *STEP 7*.

---

### Configuring the F-CM AS-i Safety ST

Configuration software	Requirements	Installation information
<i>STEP 7</i> (classic) V5.5 SP4 or higher with Distributed Safety	–	<i>STEP 7</i> online help
<i>STEP 7</i> (classic) V5.5 SP3 HF4 or higher with Distributed Safety	Hardware Support Package HSP 2093 <sup>1)</sup> Internet ( <a href="http://support.automation.siemens.com/WW/view/en/23183356">http://support.automation.siemens.com/WW/view/en/23183356</a> )	

1) Download optional, if not already contained in the hardware catalog


Observe the online help on *STEP 7*.

The S7 F-Configuration Pack can be found at Internet  
(<http://support.automation.siemens.com/WW/view/en/15208817>).

### Procedure

1. Assign the parameters of the F-CM AS-i Safety ST module according to your safety application.
2. Configure the AS-i Master in such a way that it includes all AS-i slaves in the communication – including the control addresses for safe AS-i outputs that are activated in the F-CM AS-i Safety ST module.
3. Download the hardware configuration to the PLC-CPU.
4. Assign the associated F-address to the F-CM AS-i Safety ST module.
5. Start the teaching and transferring of the code sequences of the safe AS-i input slaves.
6. Create the safety program in the F-CPU.
7. Test your application.

Information concerning these steps can be found in the following sections and in the manuals of the utilized devices.

 <b>WARNING</b>
<b>Observing the instructions in the programming and operating manuals</b>
Observe the instructions in the manuals.
<ul style="list-style-type: none"><li>• Programming and Operating Manual SIMATIC Safety - Programming and Configuring (<a href="http://support.automation.siemens.com/WW/view/en/54110126/0/en">http://support.automation.siemens.com/WW/view/en/54110126/0/en</a>)</li><li>• Programming and Operating Manual S7 Distributed Safety (<a href="http://support.automation.siemens.com/WW/view/en/22099875/0/en">http://support.automation.siemens.com/WW/view/en/22099875/0/en</a>)</li></ul>
Failure to observe the instructions may result in death, severe injury, and serious property damage.

## 5.2 Safety-related communication with AS-Interface

### 5.2.1 Operating principle of code sequences of safe AS-i slaves

For realization of safety-related communication, each safe AS-i input slave sends a code sequence over the AS-i bus. To prevent a mix-up of the AS-i input slaves on an AS-i bus, each AS-i input slave sends a different code sequence. The code sequences are permanently stored in the AS-i input slave.

The F-CM AS-i Safety ST module checks every code sequence for correct data content. Depending on the result of the evaluation, the module sets the the safe input image.

During initial commissioning, the F-CM AS-i Safety ST module must teach the code sequences of all safe AS-i input slaves present on the AS-i bus and transfer them to non-volatile memory. In so doing, the module detects both the slaves for which input monitoring is activated as well as the other safe input slaves.

After replacement of a safe AS-i input slave, the new code sequence must be taught and saved.

If the code sequence is not saved for a safe AS-i input slave, or if the code sequence does not correspond to the saved code sequence, the input channel will be passivated and assigned the substitute value "0".

As soon as the F-CM AS-i Safety ST module detects a new code sequence, the code sequences are automatically taught. Confirm the transfer of the code sequences into the memory to prevent unauthorized changes to the AS-i component.

### 5.2.2 Operating principle of the safe AS-i outputs

Safety-related communication for safe AS-i outputs also uses code sequences. However, they have a different data structure compared to the code sequences of safe AS-i input slaves. The code sequences for safe AS-i outputs do not have to be taught and transferred.

For the function of a safe AS-i output, you need the following components:

- A control unit
- An evaluation unit

### Control unit

The control unit outputs safety-related IN or OUT control commands to the AS-i bus. The control unit is integrated in the F-CM AS-i Safety ST module. The control unit assumes an active position in the communication. It acts like an AS-i slave and has an AS-i address that must be called by the AS-i master. The values in the output data of the AS-i master are not relevant in this case. The F-CM AS-i Safety ST module inserts the safety-related control data into the communication data.

Besides controlling the OFF state according to specification, a control unit can control up to four different output switching states: F-OUT 1, F-OUT 2, F-OUT 3, and F-OUT 4. The F-CM AS-i Safety ST module, however, makes available only the output switching state F-OUT 1, i.e., The OFF and ON states are controlled.

In addition to the switching states, a control unit can send out two different auxiliary signals: AUX1 and AUX2. You can use these auxiliary signals for error acknowledgement in the evaluation unit. For technical reasons, the AUX1 and AUX2 signals are mapped in the safe process image output. The auxiliary signals are not safety-related signals, however. During control by the safety program, the F-CM AS-i Safety ST module sends a sequence from each auxiliary signal one after the other on the AS-i bus. Up to 16 different control units can be activated in the F-CM AS-i Safety ST module. The control units are managed in the F-CM AS-i Safety ST module as switching group 0 to switching group 15.

If you want to use more than 16 different control units, you can plug two F-CM AS-i Safety ST modules into the ET 200SP station.

Observe the information on the bus configuration in Section AS-i bus configuration with multiple F-CM AS-i Safety ST modules (Page 38).

<b>NOTICE</b>
<b>Uniqueness of the AS-i address on the AS-i bus</b>
Carefully check the AS-i addresses for the control of the safe AS-i outputs. Ensure that the assigned AS-i address exists only once on the AS-i bus. This is particularly important when you are using multiple devices that can control safe AS-i outputs on the same AS-i bus. If this is not observed, reliable shutdown of a safe output module is not guaranteed.

## Evaluation unit

The evaluation unit reads the safety-related control commands ON or OFF on the AS-i bus and passes corresponding switching commands, e.g., to switching contacts. In case of error, e.g., communication error on the AS-i bus, the evaluation unit switches off. The evaluation unit is integrated in the safe AS-i output module to which, for example, drive contactor coils are connected. The evaluation unit behaves as a passive unit in the AS-i communication. The master does not detect the evaluation unit and does not call it. The evaluation unit monitors the communication of the AS-i address of the control unit and reacts to its safety-related control signals.

You set the AS-i address (see Section "Control unit") the evaluation unit is to monitor.

You can set multiple evaluation units to the same address so that a control unit can control multiple safe output modules simultaneously.

### NOTICE

#### Bus cycle time for safe AS-i outputs

An evaluation unit requires a minimum AS-i bus cycle time. Ensure that at least 5 AS-i addresses are present on the AS-i bus. Otherwise, the control unit goes to error state. When A/B slaves are used, at least 5 different numerical AS-i addresses must be present. That is, a combination of slave addresses 1A and 1B count as 1 numerical address.

The F-CM AS-i Safety ST module does not have a monitoring function for this configuration rule.

### 5.3 AS-i bus configuration with multiple F-CM AS-i Safety ST modules

The F-CM AS-i Safety ST module generates an additional physical bus load on the AS-i cable.

To avoid faults due to too low levels of the communication signals on the AS-i cable, the entire bus load on the AS-i cable must not exceed a maximum value.

The following rules apply to the determination of the physical bus load on the AS-i cable:

Device type	Bus load value
Slave with A/B address	0.5
Slave with standard address	1.0
F-CM AS-i Safety ST module	2.5
-----	
Maximum value as sum of all devices	35.0
-----	

Determine the total bus load by adding the bus load values of the components connected to the AS-i cable. You do not have to include the standard AS-i master and AS-i power supply unit system components when calculating the bus load.

To avoid disturbances, the maximum bus load must not exceed the value 35.

The bus load value of the F-CM AS-i Safety ST module remains unchanged if switching groups are activated in the F-CM AS-i Safety ST module for control of safe outputs. In other words, the internally generated AS-i addresses do not influence the bus load value.

If you connect additional components, e.g., an MSS 3RK3 modular safety system, to the AS-i cable, you must take into consideration the bus load values of these components. For more detailed information, refer to the respective manual.

When a repeater is used, this yields multiple cable segments for which the bus load can be determined separately.

The following configuration examples result from the table:

In a fully expanded AS-Interface network configuration (with 31 slaves with standard address), you can install 1 F-CM AS-i Safety ST module.

In an AS-Interface network configuration with 30 slaves with standard address, you can install 2 F-CM AS-i Safety ST modules.

# Assigning parameters / Setting the address space

## 6.1 Parameters

### List of parameters

Table 6- 1 F-parameters

Parameter	Value range	Default setting	Parameter reassignment in RUN	Scope
F_Monitoring_Time (ms)	1 to 65 534 ms	150 ms	No	F-CM AS-i Safety ST
F_Source_Address	1 ... 65534	Assigned by the F-system	No	F-CM AS-i Safety ST
F_Destination_Address	1 ... 65534	-	No	F-CM AS-i Safety ST

For information on the F-parameters and the assignment of the F-address, refer to the Programming and Operating Manuals:

- SIMATIC Safety - Configuring and Programming (<http://support.automation.siemens.com/WW/view/en/54110126>).
- S7 Distributed Safety (<http://support.automation.siemens.com/WW/view/en/22099875/0/en>)

Table 6- 2 Potential group / AS-i network

Parameter	Value	Default setting	Parameter reassignment in RUN	Scope
BaseUnit with AS-i voltage supply	Potential group: The AS-i network of the left module (dark BaseUnit) is used  New potential group: New AS-i network (light BaseUnit)	The AS-i network of the left module (dark BaseUnit) is used	No	F-CM AS-i Safety ST

Table 6- 3 Module parameters: Behavior after channel faults

Parameter	Value	Default setting	Parameter reassignment in RUN	Scope
Behavior after channel faults	Passivate the channel (setting cannot be changed).	Passivate the channel	-	F-CM AS-i Safety ST

6.1 Parameters

**Safe inputs**

Up to 31 safe AS-i input slaves are monitored. Open the settings for each required AS-i address. Activate the input monitoring and assign the parameters.

Table 6-4 Module parameters: Safe inputs, AS-i address 1 to 31

Parameter	Value	Default setting	Parameter reassignment in RUN	Scope
Activate input monitoring	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Disable	No	If this parameter is not activated, none of the following settings are possible.
I address	Output field, value is calculated automatically	-	No	Channel / safe AS-i input slave
Input delay (ms)	0 ms, 50 ms ... 150 ms <sup>1)</sup>	0 ms	No	Channel / safe AS-i input slave
Sensor evaluation	<ul style="list-style-type: none"> <li>• 1oo1 evaluation</li> <li>• 1oo2 evaluation, equivalent</li> </ul>	1oo2 evaluation	No	Channel / safe AS-i input slave
Startup test	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Disable	No	Channel / safe AS-i input slave
Discrepancy monitoring	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	<ul style="list-style-type: none"> <li>• "Disable" if 1oo1 evaluation</li> <li>• "Enable" if 1oo2 evaluation</li> </ul>	No	Channel / safe AS-i input slave
Discrepancy behavior	Supply "0" value <sup>2)</sup>	Supply "0" value	-	Channel / safe AS-i input slave
Discrepancy time infinite	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Disable	No	Channel / safe AS-i input slave
Discrepancy time (ms)	0 ms ... 60 000 ms	500 ms	No	Channel / safe AS-i input slave



Parameter	Value	Default setting	Parameter reassignment in RUN	Scope
Sequence monitoring	<ul style="list-style-type: none"> <li>Deactivated</li> <li>In ascending order (input 1 before input 2 at HIGH state)</li> <li>In descending order (input 2 before input 1 at HIGH state)</li> </ul>	Deactivated	No	Channel / safe AS-i input slave
Reintegration after discrepancy error	Test 0 signal necessary on both channels <sup>2)</sup>	Test 0 signal necessary on both channels	-	F-CM AS-i Safety ST

1) In increments of 10 ms

2) The setting cannot be changed.

### Safe outputs

You can activate up to 16 safe AS-i switching groups. Open the settings for each required switching group. Activate the output control and set the associated AS-i address.

Table 6- 5 Safe outputs: Switching group 0 to 15

Parameter	Value	Default setting	Parameter reassignment in RUN	Scope
Activate output control	<ul style="list-style-type: none"> <li>Disable</li> <li>Enable</li> </ul>	Disable	No	If this parameter is not activated, none of the following settings are possible.
AS-i address	1 ... 31		No	Channel / safe AS-i output slave
AS-i address switching output	Output field, value is calculated automatically	-	No	Channel / safe AS-i output slave
AS-i address error acknowledgement	Output field, value is calculated automatically	-	No	Channel / safe AS-i output slave

You will find additional information in the Programming and Operating Manuals:

- SIMATIC Safety - Configuring and Programming  
(<http://support.automation.siemens.com/WW/view/en/54110126>)
- S7 Distributed Safety  
(<http://support.automation.siemens.com/WW/view/en/22099875/0/en>)

## 6.2 Explanation of the parameters

### 6.2.1 F-parameters

#### F\_Source\_Address

The F\_Source\_Address is the PROFIsafe start address of the assigned CPU. The F\_Source\_Address indicates the source relationship. The F\_Source\_Address is assigned automatically. This prevents an incorrect parameter assignment. Ensure that the F\_Source\_Address is unique within the network.

#### F\_Destination\_Address

The F\_Destination\_Address identifies the F-I/O uniquely.

Ensure that the F\_Destination\_Address is unique within the network.

When the F-I/O are placed in the HW Config, a unique F\_Destination\_Address within the station is automatically assigned. This prevents an incorrect parameter assignment.

A network-wide check of the addresses by *STEP 7* is only then automatically possible if the entire network is present in the project.

You must assign the F\_Destination\_Address to the F-I/O before you commission the F-I/O.

#### F\_Monitoring\_Time (ms)

For safety mode, you set the monitoring time for the safety-related communication between the F-CPU and the F-CM AS-i Safety ST module (PROFIsafe monitoring time).

Information on setting the PROFIsafe monitoring time can be found in the Programming and Operating Manuals:

- SIMATIC Safety - Configuring and Programming  
(<http://support.automation.siemens.com/WW/view/en/54110126/0/en>)
- S7 Distributed Safety  
(<http://support.automation.siemens.com/WW/view/en/22099875/0/en>)

## 6.2.2 Potential group / AS-i network

Here, you set:

- The BaseUnit you are using.
- How the F-CM AS-i Safety ST I/O module is connected to the AS-i network.

The module can be connected to the AS-i cable by external wiring or automatically via the module plugged in on the left.

- Enable new AS-i network (light BaseUnit)
- Use AS-i network of the left module (dark BaseUnit)

### BaseUnit with voltage supply

#### Enable new AS-i network (light BaseUnit)

Select this option if the module is plugged into a light BaseUnit.

Connect the module to the AS-i cable (ASI+ / ASI-) via the BaseUnit. The module is supplied with voltage from the AS-i cable. Connect the AS-i cable to an AS-i power supply unit or to a combination of a data decoupling unit and a suitable power supply unit.

There is no module-internal connection of the AS-i cable to the module plugged in on the left.

#### WARNING

**Connection of the BaseUnit only to safety extra-low voltage with limiting of output voltage to max. 40 V under fault condition**

Connect the BaseUnit only to AS-i power supply units that meet the requirements named in Section Terminal assignment (Page 27), "Power supply units for AS-Interface". Connection to higher voltage may result in death, severe injury, and serious property damage.

### Use AS-i network of the left module (dark BaseUnit)

Select this option if the module is plugged into the dark BaseUnit.

The module plugged in on the left must be an AS-i slave.

The module is connected to the AS-i cable of the module plugged in on the left and supplied with voltage via the module-internal connection.

The module-internal connection is designed only for supplying power to the F-CM AS-i Safety ST I/O module. If several dark BaseUnits are connected in series, a direct connection of the dark BaseUnits to the AS-i cable using external wiring is recommended.

Supplying power to AS-i modules, e.g., AS-i slaves, via the terminals of the dark BaseUnit is not permitted.



#### **WARNING**

**Connection of the BaseUnit only to safety extra-low voltage with limiting of output voltage to max. 40 V under fault condition**

Connect the BaseUnit only to AS-i power supply units that meet the requirements named in Section Terminal assignment (Page 27), "Power supply units for AS-Interface". Connection to higher voltage may result in death, severe injury, and serious property damage.

## 6.2.3 Module parameters - General

### Behavior after channel faults

This parameter is permanently set to "Passivate the channel".

After channel faults have occurred, only the faulty PROFIsafe channels are passivated. The PROFIsafe channel corresponds to the safe input and output address in the process image.

## 6.2.4 Module parameters - Safe inputs

### Input monitoring activated

With activation of the input monitoring, you activate the corresponding AS-i slave as an input channel for signal processing in the safety program. The AS-i address must be assigned to a safe AS-i input slave.

When the input monitoring is activated, the value of the input channel is calculated based on the input states of the assigned safe AS-i input slave and the evaluation conditions specified by the parameter assignment. If a fault occurs, the substitute value "0" is transferred and the channel is passivated.

If input monitoring is deactivated, the substitute value "0" is transferred. The channel is not passivated.

If required, the AS-i slave can be monitored by another evaluation module, e.g., by another F-CM AS-i Safety ST module, the 3RK3 Modular Safety System. This applies both when input monitoring is deactivated and when it is activated.

---

#### Note

##### Call of the AS-i slave

The AS-i slave must be called by the AS-i master. Set up the configuration of the AS-i master in such a way that the communication of the AS-i master with the AS-i address functions properly.

---

#### Note

##### Slave profile

A safe AS-i input slave has the slave profile (IO.ID) = 0.B or 7.B.

---

### I address

The input bit address of the input channel for the signal processing in the safety program is indicated here. It is calculated automatically from the start of the inputs entered on the "Addresses" tab.

## Input delay

To suppress coupled-in interference or brief switching pulses, you can set an input delay for each AS-i slave. This will suppress interference pulses whose pulse time is less than the set input delay, in ms. The input delay applies to both channels of the channel pair of the AS-i slave.

---

### Note

#### Time of fault suppression shortened by up to 75 ms

It can take 15 AS-i cycles until the valid code sequence is detected. As a result, the time of the fault suppression is shortened by up to 75 ms compared to the set value.

---

A long input delay suppresses longer interference pulses but results in a longer response time.

Range of values: 0 to 150 ms

Default 0 ms

The values 0, 50 to 150 ms can be selected in 10 ms increments.

**The input delay time acts in addition to the system response time. Suppressed interference pulses are not visible in the safety program.**

## Evaluation of the sensors

This parameter specifies how the connected sensors are to be evaluated.

### 1oo1 evaluation

In 1oo1 evaluation, the sensor exists once and is connected to the first input of the safe AS-i slave via a single channel. You jumper the second input of the AS-i slave. Instead of the jumper, you can also connect another single-channel sensor to the second input. Only when both inputs supply an ON signal does the F-CM AS-i Safety ST module transfer the "1" value to the safety program (the two inputs are ANDed).

The individual states of the two inputs of the AS-i slave are not visible in the safety program.

A discrepancy analysis is not performed in 1oo1 evaluation.

### 1oo2 evaluation, equivalent

In 1oo2 evaluation, equivalent, both inputs of the safe AS-i slave are occupied by one two-channel sensor or by two single-channel sensors. The two single-channel sensors then belong together functionally as a pair.

The input signals are compared internally for equivalence. The two inputs of the AS-i slave are combined to form a channel pair.

A discrepancy analysis is possible in 1oo2 evaluation, equivalent.

## Discrepancy analysis

If you are using a two-channel sensor or two single-channel sensors that acquire the same physical process variable, the sensors will, for example, respond with a delay due to the limited accuracy of their arrangement to each other. For fail-safe inputs, the discrepancy analysis for equivalence is used to infer errors from the time characteristic of two signals of the same functionality. For two associated input signals, if different levels are detected after the input delay time has expired, the discrepancy analysis is started. A check is made to determine if the difference has disappeared after expiration of an assignable time period, the so-called discrepancy time. If not, there is a discrepancy error.

## Startup test

If the "Startup test" parameter is activated, after startup of the channel or after a cross-circuit error (code sequence error), the value transferred to the safety program is kept at the substitute value "0" until the connected sensor has been correctly actuated at least once. Afterwards, the value of the input channel is calculated according to the set functionality.

The actuation of the sensor is defined to mean that both inputs of the safe AS-i slave must supply an ON signal, e.g., both switching contacts of the sensor are closed. Then, they must supply an OFF signal, e.g., switching contacts open. Finally, an ON signal must be supplied again, e.g., switching contacts closed. During the sensor actuation phase, none of the following errors may occur:

- Discrepancy error
- Sequence error
- Cross-circuit error (code sequence error)

After reintegration is complete, you must perform a startup test. For this purpose, you actuate the sensor to be monitored once.

A discrepancy error or a sequence monitoring error does not trigger a new startup test.

## Discrepancy monitoring

If the discrepancy monitoring is activated, a discrepancy analysis is performed. This is the normal setting for 1oo2 evaluation, equivalent, in order to achieve high error uncovering.

You can deactivate the discrepancy monitoring for special situations. This corresponds in principle to 1oo1 evaluation of sensors. Check whether the lower error uncovering is sufficient for the required safety level. You may possibly use a sensor with integrated error uncovering. If required, you can activate the sequence monitoring.

When 1oo2 evaluation of the sensors is set, discrepancies in signal states between input 1 and input 2 are monitored.

When discrepancy monitoring is activated, the discrepancy time starts to elapse as soon as a difference is detected between the signal on input 1 and the signal on input 2. If the set discrepancy time is exceeded and the difference continues to exist, a discrepancy error is triggered.

Before switch-on, the signal value 0 must be present at both inputs, even when a discrepancy error has not occurred or the discrepancy time has not been set to "infinite".

If the "Evaluation of the sensors" parameter has been assigned with 1oo1, discrepancy monitoring is not performed.

## Discrepancy behavior

This parameter is permanently set to "Supply 0 value".

The discrepancy behavior determines the value that is made available to the safety program in the F-CPU during the discrepancy, i.e., while the discrepancy time is running.

After expiration of the set input delay time, once an "OFF" signal is detected at one of the two input channels of the channel pair involved, this parameter setting causes the value "0" to be provided to the safety program in the F-CPU. This setting does not affect the sensor-actuator response time as a result of the discrepancy time.



## Discrepancy time infinite

If you activate "Discrepancy time infinite", the time period for the discrepancy analysis never expires. As a result, a time-related discrepancy error will not be detected.

Nevertheless, the following switch-on condition applies: After a channel has been switched off, a "0" signal must be read in simultaneously at both input channels of the relevant channel pair before the channel can be switched on again.

If this condition is not satisfied, especially in the event of a single-channel switch-off (i.e., signal OFF at only one of the two input channels of the relevant channel pair) followed by a change to signal ON at both input channels, a discrepancy error will be detected at the time of the change to signal ON (at both input channels) even though the time for the discrepancy analysis has not expired. In data record 202, the bit 0.2 "= 1" is set in the status of the input monitoring of AS-i address n.

A discrepancy error is only detected if both input channels of the affected channel pair have not received the "0" signal simultaneously.

If "Discrepancy time infinite" is deactivated, the discrepancy analysis uses the value set for the "Discrepancy time" parameter.

## Discrepancy time

You can specify the discrepancy time in the range of 0 to 60 000 ms for each channel pair.

The following settings are required:

- "Sensor evaluation": 1oo2 evaluation, equivalent
- "Discrepancy monitoring": Active
- "Discrepancy time infinite": Deactivated

In most cases, the discrepancy time is started but does not completely elapse, because the signal differences are evened out again after a short time.

Select a large enough discrepancy time so that in error-free cases, the difference between the two signals always disappears before the discrepancy time expires.

If the input signals do not match after expiration of the assigned discrepancy time, e.g., due to a mechanical defect of the sensor or sensor wire break, a discrepancy error is detected.

When discrepancy time is running, the switch-on condition also applies that after a channel has been switched off, a "0" signal must be read in simultaneously at both input channels of the relevant channel pair before the channel can be switched on again. If this condition is not satisfied, especially in the event of brief switch-off of a channel (due to signal OFF at only one of the two input channels) followed by a change to signal ON at both input channels, a discrepancy error will be detected at the time of the change to signal ON (at both input channels) if the time for the discrepancy analysis has not expired.

A detected discrepancy error indicates to the user that the switch-on condition is not satisfied.

Assign a discrepancy time that is greater than the input delay time.

## Sequence monitoring

### Overview

The sequence monitoring monitors the sequence of the signals of the channel pair when there is a signal change OFF >>> ON at the inputs of the safe AS-i slave.

The following settings are possible:

- Deactivated: The sequence is not a condition that has to be satisfied for switching on the function output.
- Ascending order: Input 1 before input 2 at "HIGH" state
- Descending order: Input 2 before input 1 at "HIGH" state

If the sequence is violated, the "Sequence condition violated" error is detected. The value transferred to the safety program is kept at "0" until the "OFF" signal is read in at both input channels. Switch-on condition is, for example, both switching contacts of the sensor open. The inputs must be switched on one after the other in the assigned sequence and must not switch on simultaneously.

You can activate the sequence monitoring if 1002 evaluation, equivalent, is set for the sensor evaluation. In this case, the discrepancy monitoring can be activated or deactivated.

### Deactivated

The sequence of the inputs is not monitored.

### Ascending order: Input 1 before input 2 at "HIGH" state

For switch-on of the channel, input channel 1 must first read in and hold an "ON" signal followed by input channel 2.

When the channel is switched off, the sequence of the input channels is not monitored.

### Descending order: Input 2 before input 1 at "HIGH" state

For switch-on of the channel, input channel 2 must first read in and hold an "ON" signal followed by input channel 1.

When the channel is switched off, the sequence of the input channels is not monitored.

## Reintegration after discrepancy error

This parameter is permanently set to: "Test 0-signal necessary on both channels".

A discrepancy error is not considered to be rectified until an "OFF" signal is present again at both input channels. Reintegration of the PROFIsafe channel is then possible.

## 6.2.5 Module parameters - Safe outputs

### Activate output control

With this parameter, you activate the corresponding switching group and the associated AS-i address of the control unit in the F-CM AS-i Safety ST module.

You will find additional information in Section Operating principle of the safe AS-i outputs (Page 35), "Operating principle of the safe AS-i outputs."

When output control is activated, the control unit in the F-CM AS-i Safety ST module is switched on so that the F-CM AS-i Safety ST module generates an additional AS-i address on the AS-i Bus. The associated value is output from the safe process image via this AS-i address.

When output control is deactivated, the corresponding control unit in the F-CM AS-i Safety ST module is switched off, and an AS-i slave is not emulated on the AS-i bus.

### AS-i address

Here, you set the AS-i address within the range of 1 to 31 that the F-CM AS-i Safety ST module is to use for control of a safe AS-i output.

#### WARNING

##### Uniqueness of the AS-i address on the AS-i bus

Carefully check the AS-i addresses for the control of the safe AS-i outputs. Ensure that the assigned AS-i address exists only once on the AS-i bus. This is particularly important when you are using multiple devices that can control safe AS-i outputs on the same AS-i bus. If this is not observed, reliable shutdown of a safe output module is not guaranteed.

#### Note

##### Communication of the AS-i master with the AS-i address

The AS-i address of the control unit must be called by the AS-i master. Set up the communication of the AS-i master in such a way that communication with the AS-i address of the control unit functions properly.

#### Note

##### Slave profile of the control unit in the F-CM AS-i Safety ST module (control of a safe AS-i output)

The AS-i address of the control unit corresponds to a slave with slave profile (IO.ID.ID2) = 6.B.D and ID1 = 0.

### Q address switching output

The output bit address is displayed here. It determines the switching state of the safe output (control signal F-OUT 1). Interconnect the "Q address switching output" in your safety program according to the required safety logic.

The output bit address is calculated automatically from the start of the outputs entered on the "Addresses" tab.

### Q address error acknowledgment

The output bit address that sends an acknowledgment signal to the safe output is displayed here.

The output bit address is calculated automatically from the start of the outputs entered on the "Addresses" tab.

A positive edge (0 >>> 1) triggers the F-CM AS-i Safety ST module to first send the AUX1 auxiliary signal to the safe output followed by the AUX2 auxiliary signal. Another positive edge is necessary for sending another sequence of auxiliary signals.

The auxiliary signals are used, in general, for acknowledging an error state at the safe output. Refer to the AS-Interface

(<http://support.automation.siemens.com/WW/view/en/26250840/0/en>) System Manual and the Operating Instructions of the safe output module

(<http://support.automation.siemens.com/WW/view/en/43666143/0/en>) used to find out which functions the auxiliary signals are used for.

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#### Note

#### "Q address error acknowledgment"

The "Q address error acknowledgment" does not trigger an error acknowledgment in the F-CM AS-i Safety ST module. Rather, as described above, it sends an acknowledgement signal to the safe output module on the AS-i bus.

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### See also

ET 200SP distributed I/O system

(<http://support.automation.siemens.com/WW/view/en/58649293/0/en>)

## 6.3 Address space

### 6.3.1 Address assignment for user data and value status of the F-CM AS-i Safety ST module

#### Input and output address assignment

Of the assigned addresses of the F-CM AS-i Safety ST module, the user data occupy the following addresses in the F-CPU:

Table 6- 6 Input address assignment in the F-CPU

Byte in the F-CPU	Assigned bits in the F-CPU per F-CM AS-i Safety ST module							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x + 0	DI0.7 AS-i address 7	DI0.6 AS-i address 6	DI0.5 AS-i address 5	DI0.4 AS-i address 4	DI0.3 AS-i address 3	DI0.2 AS-i address 2	DI0.1 AS-i address 1	DI0.0 Reserved
x + 1	DI1.7 AS-i address 15	DI1.6 AS-i address 14	DI1.5 AS-i address 13	DI1.4 AS-i address 12	DI1.3 AS-i address 11	DI1.2 AS-i address 10	DI1.1 AS-i address 9	DI1.0 AS-i address 8
x + 2	DI2.7 AS-i address 23	DI2.6 AS-i address 22	DI2.5 AS-i address 21	DI2.4 AS-i address 20	DI2.3 AS-i address 19	DI2.2 AS-i address 18	DI2.1 AS-i address 17	DI2.0 AS-i address 16
x + 3	DI3.7 AS-i address 31	DI3.6 AS-i address 30	DI3.5 AS-i address 29	DI3.4 AS-i address 28	DI3.3 AS-i address 27	DI3.2 AS-i address 26	DI3.1 AS-i address 25	DI3.0 AS-i address 24
x + 4	Value status for DI0.7	Value status for DI0.6	Value status for DI0.5	Value status for DI0.4	Value status for DI0.3	Value status for DI0.2	Value status for DI0.1	Reserved
x + 5	Value status for DI1.7	Value status for DI1.6	Value status for DI1.5	Value status for DI1.4	Value status for DI1.3	Value status for DI1.2	Value status for DI1.1	Value status for DI1.0
x + 6	Value status for DI2.7	Value status for DI2.6	Value status for DI2.5	Value status for DI2.4	Value status for DI2.3	Value status for DI2.2	Value status for DI2.1	Value status for DI2.0
x + 7	Value status for DI3.7	Value status for DI3.6	Value status for DI3.5	Value status for DI3.4	Value status for DI3.3	Value status for DI3.2	Value status for DI3.1	Value status for DI3.0
x + 8	Value status for DQ0.7	Value status for DQ0.6	Value status for DQ0.5	Value status for DQ0.4	Value status for DQ0.3	Value status for DQ0.2	Value status for DQ0.1	Value status for DQ0.0
x + 9	Value status for DQ1.7	Value status for DQ1.6	Value status for DQ1.5	Value status for DQ1.4	Value status for DQ1.3	Value status for DQ1.2	Value status for DQ1.1	Value status for DQ1.0

X = Module start address

6.3 Address space

**NOTICE**

**Process value "0" is transmitted as a non-safety related value**

Based on the transfer principle of the code sequences, the process value "1" is transferred via AS-Interface as a safe value, so that the enable for switching on a machine can be issued in a safety-related manner. If an error occurs during transfer of the value "1", this error is detected and substitute value "0" is used.

The process value "0" is transferred via AS-interface as an unsafe value. That is, a faulty transmission of the "0" value cannot be detected. The "0" value must therefore not be used as safety-related information that initiates a dangerous action (e.g., feedback "0" of a switch position).

Table 6-7 Output address assignment in the F-CPU

Byte in the F-CPU	Assigned bits in the F-CPU per F-CM AS-i Safety ST module							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
x + 0	DQ0.7 Switching group 7	DQ0.6 Switching group 6	DQ0.5 Switching group 5	DQ0.4 Switching group 4	DQ0.3 Switching group 3	DQ0.2 Switching group 2	DQ0.1 Switching group 1	DQ0.0 Switching group 0
x + 1	DQ1.7 Switching group 15	DQ1.6 Switching group 14	DQ1.5 Switching group 13	DQ1.4 Switching group 12	DQ1.3 Switching group 11	DQ1.2 Switching group 10	DQ1.1 Switching group 9	DQ1.0 Switching group 8
x + 2	Error acknowledgment for DQ0.7	Error acknowledgment for DQ0.6	Error acknowledgment for DQ0.5	Error acknowledgment for DQ0.4	Error acknowledgment for DQ0.3	Error acknowledgment for DQ0.2	Error acknowledgment for DQ0.1	Error acknowledgment for DQ0.0
x + 3	Error acknowledgment for DQ1.7	Error acknowledgment for DQ1.6	Error acknowledgment for D1.5	Error acknowledgment for DQ1.4	Error acknowledgment for DQ1.3	Error acknowledgment for DQ1.2	Error acknowledgment for DQ1.1	Error acknowledgment for DQ1.0
x + 4	Reserved							
x + 5	Reserved							
x + 6	Reserved							
x + 7	Reserved							

X = Module start address

The error acknowledgment bit initiates the AUX1 and AUX2 signals one after the other.

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**Note****Use of the error acknowledgment bit of a safe AS-i output**

The values in the PROFIsafe process output image have Safety Integrity Level SIL 3. In addition to the switching states, a control unit can transfer two different auxiliary signals to a safe AS-i output: AUX1 and AUX2. These auxiliary signals are not safety-related signals. You can use the auxiliary signals for error acknowledgement in the evaluation unit. For technical reasons, these error acknowledgment bits are mapped in the safe process output image. If error acknowledgment bits are sent to a safe AS-i output, the *STEP 7* or SIMATIC Manager configuration tool is unable to detect that the error acknowledgment bits are not safe. This means: No warnings or faults will be output for it when the safety application is generated. The user is responsible for the correct processing of these signals in the safety application.

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## 6.3.2 Value status

### Properties

For each input signal and output signal, the F-CM AS-i Safety ST module provides information about the signal's validity, i.e., the "value status". Like the input signal, the value status is stored in the process image.

### Value status for the digital input and output modules

The value status is binary supplementary information of a digital input or output signal. It is entered in the process input image simultaneously with the process signal. The value status provides information regarding the validity of the input or output signal.

The value status is influenced by the following:

- Code sequence errors, e.g, caused by a permanent fault on the AS-i bus, wiring error, etc.
- Missing safe AS-i input slaves
- Channel faults
- Replacement of a safe AS-i slave by a non-safe AS-i slave
- Discrepancy error
- Sequence error

Value status = 1: A valid process value is output for the channel.

Value status = 0: A substitute value is output for the channel or the channel is deactivated.

### **Assignment of the inputs and outputs to the value status in the process image**

A value status is assigned to each channel of the F-CM AS-i Safety ST module in the process input image.

### **Additional information**

A detailed description of the evaluation and processing of the value status can be found in the Programming and Operating Manual SIMATIC Safety - Programming and Configuring (<http://support.automation.siemens.com/WW/view/en/54110126/0/en>).

### **See also**

Address assignment for user data and value status of the F-CM AS-i Safety ST module (Page 53)



## 6.4 Data records for diagnostics

For diagnostic purposes, you can read out the following data records via your user program.

### 6.4.1 DS 92 Device-specific diagnostics

#### Meaning

All device-specific messages and information regarding the device function states are collected centrally and stored in the message memory of the F-CM AS-i Safety ST module. The message memory is read out using DS 92.

For some events, the F-CM AS-i Safety ST module generates a diagnostic alarm.

The "Error code" column in the table below indicates which events are relevant here. If the associated bit changes in the data record, a diagnostic alarm with the indicated error code is generated (incoming alarm when bit changes to value "1" and outgoing alarm when bit changes to value "0").

The text inside parentheses after the error code corresponds to the error text that is specified for the given error code according to the PROFIBUS Standard. Several error codes can be output. If no error code is specified ("-"), a diagnostic alarm is not generated.

Table 6- 8 DS 92 Device messages: Device status byte 12.0 to 199

Byte.Bit	Description	Error code <sup>1)</sup> (decimal value) in the diagnostic alarm	Remark
0.0 ... 0.7	Reserved	-	-
1.0 ... 1.7	Reserved	-	-
2.0 ... 2.7	Reserved	-	-
3.0 ... 3.7	Reserved	-	-
4.0 ... 4.7	Reserved	-	-
5.0 ... 5.7	Reserved	-	-
6.0 ... 6.7	Reserved	-	-
7.0 ... 7.7	Reserved	-	-
8.0 ... 8.7	Reserved	-	-
9.0 ... 9.7	Reserved	-	-
10.0 ... 10.7	Reserved	-	-
11.0 ... 11.7	Reserved	-	-

Byte.Bit	Description	Error code <sup>1)</sup> (decimal value) in the diagnostic alarm	Remark
12.0	Serious device fault	9 ("Error")	See Section Error statuses (Page 20)
12.1	Group error	24 ("Switch-off")	At least one error is present.
12.2	AS-i communication error	19 ("Communication error")	Failure of an AS-i slave configured in the F-CM AS-i Safety ST module or code sequence error
12.3	Group_Message_Device	-	At least one message about the device state is present, e.g., configuration missing.
12.4	Group_Message_Application	-	At least one message about the application state is present, e.g., startup test necessary, safety sensor tripped (Emergency Stop, protective door, etc.).
12.5 ... 12.7	Reserved	-	-
13.0	Reserved	-	-
13.1	Device fault	24 ("Switch-off") 27 ("Unclear error")	See Section Error statuses (Page 20)
13.2	Parameter assignment error	24 ("Switch-off") 16 ("Parameter assignment error")	Parameter not permitted in configuration.
13.3	Process signal error	24 ("Switch-off") 27 ("Unclear error")	See Section Error statuses (Page 20)
13.4	Code sequence error	24 ("Switch-off") 26 ("External error")	A code sequence error can occur, for example, in case of: <ul style="list-style-type: none"> <li>• Cross-circuit at the inputs</li> <li>• EMC problem</li> </ul> Bit 18.0 is additionally set.
13.5	Logic error	24 ("Switch-off") 25 ("Safety-related switch-off")	A logic error can occur, for example, in case of: <ul style="list-style-type: none"> <li>• Discrepancy error</li> <li>• Sequence error</li> </ul> Bit 18.0 is additionally set.
13.6 ... 13.7	Reserved	-	-
14.0	Downloading of module parameters is not yet complete	-	-
14.1	Reserved	-	-
14.2	Cyclic data exchange is active	-	-
14.3 ... 14.7	Reserved	-	-
15 ... 17	Reserved	-	-

Byte.Bit	Description	Error code <sup>1)</sup> (decimal value) in the diagnostic alarm	Remark
18.0	Group error code sequence_Logic	24 ("Switch-off")	A code sequence error or logic error is present for at least one safe input. Byte 90 ... 91 contains the AS-i address of the first safe input for which the error is present.
18.1	Reserved	-	-
18.2	Group_Message_Input_Triggered	-	At least one monitored safe input has value status "0". Possible cause: <ul style="list-style-type: none"> <li>• Startup test necessary</li> <li>• Safety sensor triggered</li> </ul> Byte 94 ... 95 contains the AS-i address of the first safe input for which the value status "0" is present.
18.3 ... 18.7	Reserved	-	-
19 ... 21	Reserved	-	-
22.0 ... 22.1	Reserved	-	-
22.2	Timeout	24 ("Switch-off") 8 ("Lower limit undershot")	An internal data processing error has occurred. The F-CM AS-i Safety ST module signals a device fault. Bit 13.2 is additionally set.
22.3 ... 22.6	Reserved	-	-
22.7	AS-i slave failure	26 ("External error")	No communication is detected in the case of at least one monitored safe input slave or control unit for a safe AS-i output.
23.0 ... 23.7	Reserved	-	-
24 ... 25	Reserved	-	-
26.0 ... 26.3	Reserved	-	-
26.4	Coding element error	24 ("Switch-off") 27 ("Unclear error")	A data error occurred or coding element is missing when a coding element is accessed. The F-CM AS-i Safety ST module signals a device fault.
26.5 ... 26.7	Reserved	-	-
27 ... 28	Reserved	-	-
29.0 ... 29.7	Reserved	-	-
30 ... 33	Reserved	-	-

Byte.Bit	Description	Error code <sup>1)</sup> (decimal value) in the diagnostic alarm	Remark
34 ... 35	Parameter assignment error object	-	Object number for which a parameter assignment error was detected.
			0 = No error
			1 ... 31 = The number corresponds to the AS-i address of a safe input.
			32 ... 47 = A number 32 ... 47 corresponds to the number of the switching group 0 ... 15
36 ... 37	Reserved	-	-
38.0	AS-i bus error	26 ("External error")	The AS-i data communication is interrupted, substitute values in the interconnection logic
38.1	AS-i parameter assignment error	26 ("External error")	In addition, the AS-i address of the affected AS-i slave with the lowest address is entered in byte 55. If an AS-i address of an output switching group is not included by the AS-i master in the data communication, this bit is set. A substitute value will be used instead.
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. This bit is set when SET ≠ ACTUAL on the AS-i bus, when, for example, an AS-i slave is missing. A substitute value will be used instead.
38.3	AS-i voltage too low	-	If the AS-i voltage is too low during operation, a serious device fault results.
38.4	Reserved	-	-
38.5	AS-i communication okay	-	-
38.6 ... 38.7	Reserved	-	-
39	Incorrect AS-i address	-	AS-i address of the AS-i slave that the device has identified as faulty:
			0 = No error
			1 ... 31 = AS-i slave address
40 ... 47	Reserved	-	-

Byte.Bit	Description	Error code <sup>1)</sup> (decimal value) in the diagnostic alarm	Remark
48.0	ASIsafe safe input active	-	As soon as safe AS-i slaves become monitored, this bit is set.
48.1	ASIsafe safe output active	-	If safe AS-i outputs are controlled, this bit is set.
48.2 ... 48.7	Reserved	-	-
49.0	ASIsafe code sequences missing	26 ("External error")	Safe input In addition, the AS-i address is entered in byte 50.
49.1	ASIsafe code sequences duplicated	24 ("Switch-off") 19 ("Communication error")	In addition, the AS-i address is entered in byte 50.
49.2	ASIsafe code sequences new	-	New code sequences are available for transfer. In addition, the AS-i address is entered in byte 50.
49.3	ASIsafe code sequences known	-	The code sequences are taught and saved in the coding element.
49.4	ASIsafe code sequence error	24 ("Switch-off") 19 ("Communication error")	In addition, the AS-i address is entered in byte 50.
49.5	ASIsafe code sequence teaching active	-	The code sequences are being collected. When the code sequences for all safe AS-i input slaves detected on the bus are taught, this bit is reset.
49.6 ... 49.7	Reserved	-	-
50	Code sequence error object	-	This bit contains the lowest AS-i address for which a code sequence problem has occurred. Code sequence problems are: <ul style="list-style-type: none"> <li>• 49.0 ASIsafe code sequences missing (Prio 3)</li> <li>• 49.1 ASIsafe code sequences duplicated (Prio 1)</li> <li>• 49.2 ASIsafe code sequences new (Prio 4)</li> <li>• 49.4 ASIsafe code sequence error (Prio 2)</li> </ul>
51 ... 54	Reserved	-	-
55	Switching group error object	-	This byte contains the lowest AS-i address that is configured for an output switching group but is not addressed by the master. Correct the slave configuration of the master.
56 ... 61	Reserved	-	-

Byte.Bit	Description	Error code <sup>1)</sup> (decimal value) in the diagnostic alarm	Remark
62.0	F_Dest_Adr does not match	24 ("Switch-off") 19 ("Communication error") 64 ("Different destination address")	-
62.1	F_Dest_Adr invalid	24 ("Switch-off") 19 ("Communication error") 65 ("Invalid destination address")	The coding element does not contain an F-address.
62.2	F_Source_Adr invalid	24 ("Switch-off") 19 ("Communication error") 66 ("Invalid source address")	-
62.3	F_WD-Time_0	24 ("Switch-off") 19 ("Communication error") 67 ("Watchdog time is 0 ms")	F_WD-Time value is 0 ms.
62.4	F_SIL value	24 ("Switch-off") 19 ("Communication error") 68 ("Parameter 'F_SIL' exceeds the appl. SIL")	F_SIL value exceeds SIL value of the specified device application
62.5	F_CRC_Length	24 ("Switch-off") 19 ("Communication error") 69 ("Parameter 'F_CRC_Length' does not match ...")	F_CRC_Length value does not match the actual CRC length.
62.6	F_Par_Version	24 ("Switch-off") 19 ("Communication error") 70 ("Incorrect F-parameter version or F_Block_ID")	F_Par_Version does not match the F-parameter set or F-Block_ID is invalid Block_ID
62.7	CRC1 error	24 ("Switch-off") 19 ("Communication error") 71 ("CRC1 error")	-
63.0 ... 63.2	Reserved	-	-
63.3	iPAR_CRC error	24 ("Switch-off") 19 ("Communication error") 75 ("Inconsistent I-parameters [iParCRC error]")	-
63.4	Operator acknowledge requested	-	Channel is ready for reintegration
63.5 ... 63.7	Reserved	-	-
64 ... 65	Reserved	-	-
70 ... 89	Reserved	-	-

Byte.Bit	Description	Error code <sup>1)</sup> (decimal value) in the diagnostic alarm	Remark
90 ... 91	Object_Code_Sequence_Logic	-	AS-i address of the first safe AS-i slave for which a code sequence error or logic error is present. See also bit 18.0. 0 = No error 0 = No error 1 ... 31 = AS-i slave address ≥32 = Internal error numbers
92 ... 93	Reserved	-	-
94 ... 95	Object_input_triggered	-	AS-i address of the first safe AS-i slave for which the input_triggered message is present. See also bit 18.2. 0 = No error 1 ... 31 = AS-i slave address ≥32 = Internal error numbers
96 ... 199	Reserved	-	-

1) Error code (decimal value) in the diagnostic alarm = also set "Fieldbus diagnostic bit"

## 6.4.2 DS 202 Status safe inputs/outputs

### Description

DS 202 contains non-safety-related status information for the safe input slaves and for the control of the safe output slaves.

The status information for the control of the safe output slaves relates either to the control units activated in the F-CM AS-i Safety ST module or to data of external control units for safe output slaves that is also read on the AS-i bus.

Table 6-9 DS 202 Status safe inputs/safe outputs

Byte	Description
0 ... 1	Reserved
2 ... 5	Status input monitoring AS-i address 1
6 ... 9	Status input monitoring AS-i address 2
10 ... 13	Status input monitoring AS-i address 3
14 ... 17	Status input monitoring AS-i address 4
18 ... 21	Status input monitoring AS-i address 5
22 ... 25	Status input monitoring AS-i address 6
26 ... 29	Status input monitoring AS-i address 7

Byte	Description
30 ... 33	Status input monitoring AS-i address 8
34 ... 37	Status input monitoring AS-i address 9
38 ... 41	Status input monitoring AS-i address 10
42 ... 45	Status input monitoring AS-i address 11
46 ... 49	Status input monitoring AS-i address 12
50 ... 53	Status input monitoring AS-i address 13
54 ... 57	Status input monitoring AS-i address 14
58 ... 61	Status input monitoring AS-i address 15
62 ... 65	Status input monitoring AS-i address 16
66 ... 69	Status input monitoring AS-i address 17
70 ... 73	Status input monitoring AS-i address 18
74 ... 77	Status input monitoring AS-i address 19
78 ... 81	Status input monitoring AS-i address 20
82 ... 85	Status input monitoring AS-i address 21
86 ... 89	Status input monitoring AS-i address 22
90 ... 93	Status input monitoring AS-i address 23
94 ... 97	Status input monitoring AS-i address 24
98 ... 101	Status input monitoring AS-i address 25
102 ... 105	Status input monitoring AS-i address 26
106 ... 109	Status input monitoring AS-i address 27
110 ... 113	Status input monitoring AS-i address 28
114 ... 117	Status input monitoring AS-i address 29
118 ... 121	Status input monitoring AS-i address 30
122 ... 125	Status input monitoring AS-i address 31
126 ... 129	Status output control switching group 0
130 ... 133	Status output control switching group 1
134 ... 137	Status output control switching group 2
138 ... 141	Status output control switching group 3
142 ... 145	Status output control switching group 4
146 ... 149	Status output control switching group 5
150 ... 153	Status output control switching group 6
154 ... 157	Status output control switching group 7
158 ... 161	Status output control switching group 8
162 ... 165	Status output control switching group 9
166 ... 169	Status output control switching group 10
170 ... 173	Status output control switching group 11
174 ... 177	Status output control switching group 12
178 ... 181	Status output control switching group 13
182 ... 185	Status output control switching group 14
186 ... 189	Status output control switching group 15
190 ... 199	Reserved



Table 6- 10 Input monitoring: Structure of the status information

Byte.Bit	Message bit		Remark
0.0	Value = 1:	Startup test necessary	-
0.1	Value = 1:	Sequence condition violated	-
0.2	Value = 1:	Discrepancy condition violated	-
0.3	Value = 1:	Safety sensor triggered	-
0.4 ... 0.7	Reserved		-
1.0	Value = 1:	Code sequence error	Cross-circuit at input
1.1 ... 1.7	Reserved		-
2.0	Reserved		-
2.1	Value = 1:	Switch-on condition not met	-
2.2 ... 2.7	Reserved		-
3.0 ... 3.7	Reserved		

Table 6- 11 Output control: Structure of the status information

Byte.Bit	Message bit	Remark
0.0	Output active	The control unit of the switching group sends the "F-OUT 1" control signal.
0.1 ... 0.7	Reserved	-
1.0 ... 1.3	Reserved	-
1.4	Auxiliary signal AUX1 sent	Auxiliary control signal AUX1 was transferred with value "1." If the error acknowledgment bit in the output process image has the value "0", the message is reset.
1.5	Auxiliary signal AUX2 sent	Auxiliary control signal AUX2 was transmitted with value "1." If the error acknowledgment bit in the output process image has the value "0", the message is reset.
1.6 ... 1.7	Reserved	-
2.0 ... 2.7	Reserved	-
3.0 ... 3.7	Reserved	-

### 6.4.3 DS 204 Status code sequences

#### Description

The DS 204 contains the statuses of all AS-i slaves that are known to the F-CM AS-i Safety ST module.

Table 6- 12 DS 204: Status code sequences

Byte	Description
0 ... 13	Reserved
14 ... 17	Status code sequence for AS-i address 1
18 ... 21	Status code sequence for AS-i address 2
22 ... 25	Status code sequence for AS-i address 3
26 ... 29	Status code sequence for AS-i address 4
30 ... 33	Status code sequence for AS-i address 5
34 ... 37	Status code sequence for AS-i address 6
38 ... 41	Status code sequence for AS-i address 7
42 ... 45	Status code sequence for AS-i address 8
46 ... 49	Status code sequence for AS-i address 9
50 ... 53	Status code sequence for AS-i address 10
54 ... 57	Status code sequence for AS-i address 11
58 ... 61	Status code sequence for AS-i address 12
62 ... 65	Status code sequence for AS-i address 13
66 ... 69	Status code sequence for AS-i address 14
70 ... 73	Status code sequence for AS-i address 15
74 ... 77	Status code sequence for AS-i address 16
78 ... 81	Status code sequence for AS-i address 17
82 ... 85	Status code sequence for AS-i address 18
86 ... 90	Status code sequence for AS-i address 19
90 ... 91	Status code sequence for AS-i address 20
94 ... 97	Status code sequence for AS-i address 21
98 ... 101	Status code sequence for AS-i address 22
102 ... 105	Status code sequence for AS-i address 23
106 ... 109	Status code sequence for AS-i address 24
110 ... 113	Status code sequence for AS-i address 25
114 ... 117	Status code sequence for AS-i address 26
118 ... 121	Status code sequence for AS-i address 27
122 ... 125	Status code sequence for AS-i address 28
126 ... 129	Status code sequence for AS-i address 29
130 ... 133	Status code sequence for AS-i address 30
134 ... 137	Status code sequence for AS-i address 31
138 ... 199	Reserved

Table 6- 13 DS 204: Read ASIsafe slave status: Data structure of a slave

Byte	Description	
x + 0	Status code sequence for AS-i address n	Byte 0
x + 1	Status code sequence for AS-i address n	Byte 1
x + 2	Status code sequence for AS-i address n	Byte 2
x + 3	Status code sequence for AS-i address n	Byte 3

Table 6- 14 Assignment of the bits of an AS-i address in the "Status code sequence" data structure

Byte	Bit	Description	Setting	Meaning of the setting
0	0 ... 2	Status of the slave	= 0	No slave present
			= 1	Standard slave (not safety-related)
			= 2	Safe slave, but the code sequence type safe input/safe output is not yet decoded.
			= 3	Code sequence type safe output
			= 4	Code sequence type safe input
			= 5 ... 7	Reserved
	3	-	Reserved	-
	4 ... 6	Status of parameter assignment	= 0	No safe AS-i output slave or AS-i input slave is configured.
			= 1	Reserved
			= 2	Safe AS-i slave is configured The detected slave corresponds to the activation.
= 3			Safe AS-i slave is configured The detected slave does not correspond to the activation.	
= 4 ... 7	Reserved			
7	-	Reserved	-	
1	0 ... 2	Status of the code sequence	= 0	Code sequence irrelevant: No activation or no slave is present.
			= 1	Code sequence missing: No code sequence is taught or transferred.
			= 2	Code sequence duplicated: At least one other slave has the same code sequence.
			= 3	Code sequence new: The taught code sequence does not correspond to the transferred code sequence.
			= 4	Code sequence known: The taught code sequence does not correspond to the transferred code sequence.
			= 5 ... 7	Reserved
	3	-	Reserved	-
	4 ... 5	Status of the safe input 1	= 0	The input is not present (or the code sequence type is not yet decoded).
			= 1	Error, e.g., code sequence error
			= 2	Input signal = 0: The contact is open.
			= 3	Input signal = 1: The contact is closed.

6.4 Data records for diagnostics

Byte	Bit	Description	Setting	Meaning of the setting	
1	6 ... 7	Status of the safe input 2	= 0	The input is not present (or the code sequence type is not yet decoded).	
			= 1	Error, e.g., code sequence error	
			= 2	Input signal = 0: The contact is open.	
			= 3	Input signal = 1: The contact is closed.	
2	0 ... 1	Status of the "F-OUT 1" control signal for safe output	= 0	The output is not present (or the code sequence type is not yet decoded).	
			= 1	Error, e.g., code sequence error	
			= 2	Control signal for output = 0	
			= 3	Control signal for output = 1	
	2 ... 3	Status of the "F-OUT 2" control signal for safe output	= 0	The output is not present (or the code sequence type is not yet decoded).	
			= 1	Error, e.g., code sequence error	
			= 2	Control signal for output = 0	
			= 3	Control signal for output = 1	
	4 ... 5	Status of the "F-OUT 3" control signal for safe output	= 0	The output is not present (or the code sequence type is not yet decoded).	
			= 1	Error, e.g., code sequence error	
			= 2	Control signal for output = 0	
			= 3	Control signal for output = 1	
6 ... 7	Status of the "F-OUT 4" control signal for safe output	= 0	The output is not present (or the code sequence type is not yet decoded).		
		= 1	Error, e.g., code sequence error		
		= 2	Control signal for output = 0		
		= 3	Control signal for output = 1		
3	0 ... 1	Status of the auxiliary signal 1	= 0	The signal is not present (or the code sequence type is not yet decoded).	
			= 1	Error, e.g., code sequence error	
			= 2	Auxiliary signal = 0	
			= 3	Auxiliary signal = 1	
	2 ... 3	Status of the auxiliary signal 2	= 0	The signal is not present (or the code sequence type is not yet decoded).	
			= 1	Error, e.g., code sequence error	
			= 2	Auxiliary signal = 0	
			= 3	Auxiliary signal = 1	
	4 ... 7	-	-	Reserved = 0	-

## Code sequences

The principle of the ASIsafe code sequences is briefly explained in Section Safety-related communication with AS-Interface (Page 35).

The F-CM AS-i Safety ST module manages the code sequences of the safe AS-i slaves in two steps. First, the F-CM AS-i Safety ST module reads all code sequences on the AS-i bus and checks whether the respective code sequence is plausible. This operation is referred to as "teaching the code sequences". The code sequences taught in this way are in volatile memory. The taught code sequences are transferred to the non-volatile memory after a request by the user.

### Initial commissioning

During initial commissioning, the F-CM AS-i Safety ST module must teach the code sequences of all safe AS-i input slaves present on the AS-i bus and transfer them to non-volatile memory. In so doing, the module detects both the slaves for which input monitoring is activated as well as the other safe input slaves.

### Replacement of a safe AS-i input slave

After replacement of a safe AS-i input slave, the new code sequence must be taught and saved.

If the code sequence is not saved for a safe AS-i input slave, or if the code sequence does not correspond to the saved code sequence, the input channel will be passivated and assigned the substitute value "0".

As soon as the F-CM AS-i Safety ST module detects a new code sequence, the code sequences are automatically taught. Confirm the transfer of the code sequences into the memory to prevent unauthorized changes to the AS-i component.

For the transfer of the code sequences to the non-volatile memory, you can open the "Teach ASIsafe" dialog by pressing the "Teach ..." button.

Alternatively, the transfer is also possible by pressing the optional "TEACH" button (at least 3 s).

### Replacement of the F-CM AS-i Safety ST module

The non-volatile memory is located in the BaseUnit. The transferred code sequences are retained in this memory after replacement of the F-CM AS-i Safety ST module.

Below is a description of the options offered by the F-CM AS-i Safety ST module for transferring code sequences.

### See also

Connection (Page 27)

## 7.1 Transferring code sequences via STEP 7 online access

When code sequence are managed via *STEP 7* online access, you have the option of monitoring the status of the existing code sequences in a graphic overview. In particular, the graphic overview offers advantages for initial commissioning. In addition, you can use the graphic overview for transferring the code sequences of replaced slaves during operation. You can open the graphic overview for diagnostic purposes without changing the saved code sequences. The transfer of taught code sequences is possible but not mandatory.

In order to open this dialog, there must be an online connection to the controller or to the F-CM AS-i Safety ST module. Load the hardware configuration into the modules of the controller before teaching the code sequences so that the online configuration of the F-CM AS-i Safety ST module matches the offline configuration.

### 7.1.1 "Teach ASIsafe code sequences" dialog

The "Teach ASIsafe code sequences" dialog contains an overview of the code sequences of the existing safety-related AS-i slaves. In this dialog, you start the transfer of the code sequences read in on the AS-i bus into the memory of the F-CM AS-i Safety ST module.

The "Teach ASIsafe code sequences" dialog does not make any changes to the module configuration. You can open the dialog for information purposes during operation. The information displayed in the dialog are obtained online from the F-CM AS-i Safety ST module. There is no comparison with the offline configuration in this case.

Within the "AS-i addresses 0...15" and "AS-i addresses 16...31", you see the following information for each AS-i address:

- Slave status
- Code sequence
- F-IN 1 ... 2
- F-OUT 1 ... 4

For the AS-i address 0, only information about the slave status can be displayed because a slave with the address 0 does not exchange cyclic input/output data.

Below this information you see:

- The "Transfer taught code sequences" button
- The "Progress of teaching operation" display

By double-clicking the "Close" button, you can exit the dialog at any time. If the button is actuated, the data will not be changed. If the code sequences have not been transferred or have only been partially transferred, a corresponding notice appears.

**"Slave Status" column**

The "Slave status" column shows the following information about the AS-i address via a color code:

<b>Gray</b>	The address does not exist on the AS-i bus. It is not needed in the configuration of the F-CM AS-i Safety ST module (input monitoring control / output monitoring control deactivated)
<b>Green (without check mark)</b>	The address belongs to a slave that exists on the AS-i bus. However, the slave is not needed in the configuration of the F-CM AS-i Safety ST module (input monitoring control / output monitoring control deactivated). The slave on the AS-i bus is a safe slave or a standard slave. It is available for use by the AS-i master or another module.
<b>Green (with check mark)</b>	The address is present on the AS-i bus and corresponds to the configuration of the F-CM AS-i Safety ST module (input monitoring or output monitoring is activated).
<b>Yellow</b>	An error has been detected: The address is present on the AS-i bus but does not correspond to the configuration of the F-CM AS-i Safety ST module (input monitoring control or output monitoring control is activated). Check the slave. Replace the slave with the required slave or change the configuration.
<b>Red</b>	An error has been detected: The address is not present on the AS-i bus but is needed in the configuration of the F-CM AS-i Safety ST module (input monitoring or output monitoring is activated). <ul style="list-style-type: none"><li>• Check whether the slave exists on the AS-i bus and has been included in the communication by the AS-i master.</li><li>• Check whether the slave is contained in the configuration of the AS-i master. Correct the configuration of the AS-i bus, if required.</li></ul>

### "Code sequence" column

The "Code sequence" column shows the following information about the AS-i address via a color code:

<b>Gray</b>	No code sequence is needed for the address.
<b>Green (without check mark)</b>	A code sequence was taught but not transferred to the memory. Start the transfer of the code sequence by double-clicking the "Transfer taught code sequences" button.
<b>Green (with check mark)</b>	The code sequence was transferred to the non-volatile memory. Note: This status is also displayed when the output control is activated for this address. The code sequences for safe outputs are automatically predefined in the F-CM AS-i Safety ST module. They are not transferred to the non-volatile memory of the code sequences.
<b>Yellow</b>	An error has been detected: A code sequence was taught that is already being used by another slave. The code sequence cannot be used. Replace the slave with a different slave.
<b>Red</b>	Warning or error: The address is sending an incomplete or invalid code sequence. Check whether both inputs of the safe input slave are assigned with the "ON" signal. If required, actuate the associated safety contacts. The contacts must be closed. <ul style="list-style-type: none"><li>• Check whether a cross-circuit exists at the inputs. If necessary, correct the wiring of the inputs.</li></ul>



**"F-IN 1 ... 2" column**

The "F-IN 1 ... 2" column shows the following information about the AS-i address via a color code:

The numbers 1 to 2 designate the number of the input channel.

**Gray** The input channel is not present. A safe input slave was not detected at the address.

**Green** The input channel shows the value 1 ("ON" status).

**White** The input channel shows the value 0 ("OFF" status).

**Yellow** The input channel shows the value 0 ("OFF" state) or is not present.

Note:

The status indication is unambiguous once the code sequence has been taught for a safe input slave (both inputs assigned with "ON" signal), or when an "ON" signal has been read in for an externally controlled safe output slave.

**Red** An error was detected, e.g., a code sequence error:  
The status of the input channel cannot be read in. Substitute value 0 is used.

**"F-OUT 1 ... 4" column**

The "F-OUT 1 ... 4" column shows the following information about the AS-i address via a color code:

The numbers 1 to 4 designate the number of the output channel.

**Gray** The output channel is not present. A safe output channel was not detected at the address.

**Green** The output channel shows the value 1 ("ON" status).

**White** The output channel shows the value 0 ("OFF" status).

**Yellow** The output channel shows the value 0 ("OFF" state) or is not present.

Note:

The status indication is unambiguous once the code sequence has been taught for a safe input slave (both inputs assigned with "ON" signal), or when an "ON" signal has been read in for an externally controlled safe output slave.

**Red** An error was detected, e.g., a code sequence error:  
The status of the output channel cannot be read in.

If the output control is activated for the address, the F-CM AS-i Safety ST module can control the status for F-OUT 1. The F-CM AS-i Safety ST module cannot control F-OUT 2 ... 4. The value 0 is output here.

If an external control unit uses the output address, the dialog shows the statuses for F-OUT 1 ... 4 read in on the AS-i bus.


### 7.1.2 Transferring taught code sequences

In order for the input data of a safe AS-i input slave to be evaluated and made available to the safety program, the taught code sequences must be transferred to the non-volatile memory.

To do so, click the "Transfer taught code sequences..." button.

A dialog opens prompting you whether the code sequences are to be transferred. With "Yes" you confirm that you are addressing the correct module. For checking purposes, the "ADDR" LED flashes green on the front of the F-CM AS-i Safety ST module. The code sequences are transferred to the non-volatile memory. The input data of the safe AS-i input slaves are then evaluated. Reintegration in the safety program is enabled.

With "No" you cancel the prompt without transferring the code sequence.

 <b>WARNING</b>
<b>The switching on of plant components may result in death, severe injury, and serious property damage.</b>
Depending on the safety program, the transfer of code sequences may cause plant components to be switched on. Before transferring the code sequences, ensure that no personal injury or property damage can occur. After transferring the code sequences, check the safety equipment for proper functioning.

The "Transfer taught code sequences" button is deactivated when all taught code sequences have already been transferred to the non-volatile memory.

### 7.1.3 "Progress of teaching operation" display

You can track the progress of the teaching operation.

#### Progress bar "Teaching in progress":

If at least one safe slave is detected on the AS-i bus whose code sequence has not yet been taught an active progress bar and the text "Teaching in progress" is displayed. Check the displays in the "Code sequences" column and ensure that the safe slaves send their code sequences.

For further information, refer to the "'Code sequence' column".

#### Taught slaves:

The "Taught slaves" output field shows the number of already transferred code sequences in relation to the number of code sequences that must still be transferred. You will additionally see the numerical ratio as a percentage. When 100% is indicated, all code sequences have been transferred to the non-volatile memory.

For further information, refer to "Transfer taught code sequences".

## 7.2 Transferring code sequences with the "TEACH" button.

The use of the "TEACH" button provides an easy way of transferring taught code sequences.

The "TEACH" button can be used, for example, to transfer code sequences of replaced modules during operation. However, it is also suitable for initial commissioning.

To learn how to connect the button to the BaseUnit, refer to Section "Connecting". You can track the progress of the code sequence transfer via the LEDs.

Press the "TEACH" button for at least 3 s. This action causes all currently taught code sequences that are unique and consistent to be transferred to the non-volatile memory. The input data of the safe AS-i input slaves are then evaluated. Reintegration in the safety program is enabled.

### WARNING

**The switching on of plant components may result in death, severe injury, and serious property damage.**

Depending on the safety program, the transfer of code sequences may cause plant components to be switched on. Before transferring the code sequences, ensure that no personal injury or property damage can occur. After transferring the code sequences, check the safety equipment for proper functioning.

When the transfer of the code sequences has been ended successfully, the "TEACH" LED goes out and you can release the "TEACH" button.

If you press the "TEACH" button before all code sequences are taught, the code sequences received up to then will be transferred.

## 7.3 Final steps

### 7.3.1 Reintegrating passivated input channels

The input channels of the F-CM AS-i Safety ST module for which no valid code sequences are saved supply the substitute value "0" and are passivated.

After the transfer of the code sequences, the passivated channels must be reintegrated so that the application can work with the real process values.

The procedure for this can be found in the following Programming and Operating Manuals:

- SIMATIC Safety - Configuring and Programming  
(<http://support.automation.siemens.com/WW/view/en/54110126/0/en>)
- S7 Distributed Safety  
(<http://support.automation.siemens.com/WW/view/en/22099875/0/en>)

After transferring the code sequences, check the safety equipment for proper functioning.

# Alarm, fault, and system events

## 8.1 Overview

### Diagnostics options

The following diagnostics options are available for the F-CM AS-i Safety ST module:

- LEDs on the module
- Diagnostics in *STEP 7*:
  - Diagnostic buffer
- Alarm messages in user program

### See also

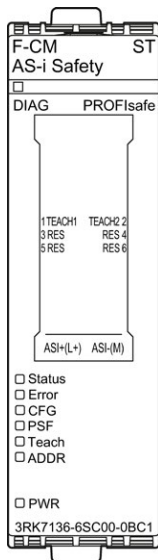
Meaning of the LEDs (Page 79)

## 8.2 LED statuses

### 8.2.1 Arrangement of the LEDs on the F-CM AS-i Safety ST

#### Introduction

LEDs on the front plate of the respective module display module-internal and module-external faults. The LEDs and their evaluation are described in the manuals for the relevant modules of the SIMATIC devices.



DIAG	Diagnosis
STATUS	Operating state of the module
Error	Operating state of the module
CFG	Fault on the AS-i bus
PSF	Process signal error, e.g., channel fault on AS-i-F input slave
Teach	Teaching: Teaching of code sequences
ADDR	Addressing of the F-CM AS-i Safety ST module. F-addressing and teaching. The LED indicates whether the module is conducting safety-relevant communication with the software tool.
PWR	Supply voltage

Figure 8-1 LEDs of F-CM AS-i Safety ST





## 8.2.2 Meaning of the LEDs

The "F-CM AS-i Safety ST" module has 8 LEDs on the front:

### LED "DIAG"

The "DIAG" LED displays the general status of the ET 200SP module



Table 8- 1 Meaning of the "DIAG" LED

"DIAG"	Meaning
<input type="checkbox"/> Off	The voltage is not OK.
 Green flashes	The F-CM AS-i Safety ST module is not ready for operation. The module parameters are not assigned.
 Green ON	The F-CM AS-i Safety ST module is parameterized and error-free. No diagnostic alarms of the F-CM AS-i Safety ST are active.
 Red flashes	The F-CM AS-i Safety ST module is parameterized and indicates a diagnostic fault, or a firmware update is in progress.
 The two-color LED alternately flashes red/green	The position (ping) is displayed for 3 seconds.

### LED "Status"

The "Status" and "Error" LEDs indicate the operating state of the device.




Table 8- 2 Meaning of the "Status" LED

"Status"	Meaning
 Green ON	<ul style="list-style-type: none"><li>• The F-CM AS-i Safety ST module is OK.</li><li>• Cyclic I/O data exchange active</li></ul>
 Green flashes	<ul style="list-style-type: none"><li>• The system is powering up.</li><li>• No cyclic I/O data exchange</li></ul>

### LED "Error"

The "Status" and "Error" LEDs indicate the operating state of the device.

Table 8- 3 Meaning of the "Error" LED




"Error"	Meaning
 Red ON	<b>Serious device fault, e.g.,</b> <ul style="list-style-type: none"><li>• Fault in the electronics</li><li>• Excessive temperature rise</li></ul>
 Red flashes	<b>Device fault, e.g.,</b> <ul style="list-style-type: none"><li>• Intermittent data processing error (EMC problem)</li><li>• Contact problem with the backplane bus</li><li>• Missing coding element in the BaseUnit</li><li>• Missing firmware update</li></ul>
 Off	No error



## LED "CFG"

The "CFG" LED indicates errors on the AS-i bus.




Table 8- 4 Meaning of the "CFG" LED

"CFG"	Meaning
 Red ON	The AS-i bus is O. K., but a code sequence error exists.
 Red flashes	Fault on the AS-i bus: <ul style="list-style-type: none"> <li>• A code sequence does not exist or it is incomplete.</li> </ul>
 "Off"	All code sequences are completely transferred.

## LED "PSF"

The "PSF" LED indicates process signal errors at one or more channels of the module.




Table 8- 5 Meaning of the "PSF" LED

LED "PSF"	Meaning
 Red ON	PROFIsafe channel fault for the complete F-CM AS-i Safety ST module, e.g. fault on F-CM AS-i input slave
 Red "flashes"	<ul style="list-style-type: none"> <li>• Discrepancy error at the inputs of a safe AS-i input slave</li> <li>• Sequence error at the inputs of a safe AS-i input slave</li> <li>• Code sequence error at a safe AS-i input slave, e.g., due to cross-circuit at inputs or an EMC problem</li> <li>• Failure of a safe AS-i input slave</li> </ul> The channel involved is passivated. The "PSF" LED goes out only after all channels have been reintegrated.
 "Off"	No process signal error

## LED "TEACH"

This LED indicates teaching of safe AS-i slaves. The "TEACH" LED indicates the progress of the teaching operation.



Table 8- 6 Meaning of the "TEACH" LED

LED "TEACH"	Meaning
 Yellow ON	Teaching of code sequences successfully completed. The taught code sequences are being transferred.
 Yellow flashes	Teaching of code sequences in progress.
 "Off"	The code sequences are completely transferred.

## LED "ADDR"

The "ADDR" LED indicates that the device is conducting safety-relevant communication with a software tool.



Table 8- 7 Meaning of the "ADDR" LED

LED "ADDR"	Meaning
 Green flashes	Feedback that the module is addressed: <ul style="list-style-type: none"> <li>• For assignment of the F-address</li> <li>• For transfer of the code sequences</li> <li>• Firmware update in progress</li> </ul>
 Off	Not relevant

**LED "PWR"**

The "PWR" LED indicates the status of the voltage supply.

Table 8- 8 Meaning of the "PWR" LED

LED "PWR"	Meaning
 Green ON	AS-i voltage is applied.
 "Off"	Insufficient AS-i voltage is applied.

## **8.3 Diagnostic messages**

### **General**

The F-CM AS-i Safety ST module generates one or more alarms when various events occur.

Which events lead to which alarm messages is indicated in the description of data record DS 92 "Device-specific diagnostics".

The alarms use the diagnostic fault codes F0 to F31 according to the PROFIBUS Standard.

### **See also**

DS 92 Device-specific diagnostics (Page 57)

## **8.4 Replacement of defective devices**

### **8.4.1 Replacing a safe AS-i input slave**

Replace a failed safe AS-i input slave with a new device of the same type and assign the correct AS-i address to the slave. This address assignment can be performed automatically by the AS-i master (see manual of the AS-i master) or manually, e.g., with the AS-i addressing device (1904-2AB02).

Close the contacts on the inputs of the safe AS-i input slave so that the slave sends the code sequences.

The F-CM AS-i Safety ST module detects a new code sequence automatically and teaches it. For reintegration, the taught code sequence must be transferred.

The transfer can be started from the STEP 7 online dialog or by pressing the optional "TEACH" button (at least 3 s). For more information, see Section Code sequences (Page 69).

Observe the "CFG" and "TEACH" LEDs, see Section Meaning of the LEDs (Page 79).

To exclude impermissible duplicate code sequences for two safe input slaves, code sequences from all safe input slaves present on the AS-i bus must be transferred, regardless of whether the monitoring is activated or deactivated.

### **8.4.2 Replacing the safe AS-i output module (evaluation unit)**

After replacement of a safe AS-i output module (evaluation unit), no setting is necessary on the F-CM AS-i Safety ST module.

Observe the operating instructions of the AS-i output module, and set the correct F-address for the AS-i output module and the AS-i address of any integrated standard slave.

An error acknowledgment for the affected output switching group must be performed, if necessary. See Section 6.3 Address space.

Non-safety related AS-i slaves (standard slaves) are not evaluated by the F-CM AS-I Safety ST module. Observe the replacement instructions in the operating instructions of the AS-i master or the slave.

### **8.4.3 Replacing the F-CM AS-i Safety ST module**

When the F-CM AS-i Safety ST module is replaced, the new device automatically receives all necessary settings from the head module (IM) of the ET 200SP and the coding element in the BaseUnit.

For more information, see Manual

ET 200SP Distributed I/O System

(<http://support.automation.siemens.com/WW/view/en/58649293/0/en>)

## Technical specifications

### 9.1 Technical specifications

#### Technical specifications of the F-CM AS-i Safety ST

		3RK7 136-6SC00-0BC1
<b>product designation</b>		F-CM AS-i Safety ST
<b>Product-type designation</b>		ASIsafe communication module
<b>Protection class IP</b>		IP20
<b>Type of voltage supply</b>		via AS-i
<b>Consumed current</b>		
<ul style="list-style-type: none"> <li>• from profile conductors of the AS-interface               <ul style="list-style-type: none"> <li>– at 24 V with AS-i Power24V maximum      A      0.07</li> <li>– at 30 V maximum      A      0.07</li> </ul> </li> <li>• from backplane bus      A      0.03</li> </ul>		
<b>Resistive loss</b>		W      2.1
<b>Insulation voltage rated value</b>		V      500
<b>Product function adapted for AS-i Power24V</b>		Yes
<b>Type of projection of the AS-interface</b>		STEP7 Safety
<b>Version of the AS-interface specification</b>		V 3.0
<b>Type of data transmission</b>		ET 200SP backplane bus
<b>Number of interfaces as AS-interface</b>		1
<b>Number of interfaces others</b>		1
<b>Protocol is supported PROFI-safe protocol</b>		Yes
<b>Access to digital I/O data</b>		Via the process image and data set transfer
<b>Width</b>	mm	20
<b>Height</b>	mm	73
<b>Depth</b>	mm	58
<b>Type of mounting</b>		Can be plugged into terminal module

9.1 Technical specifications

		3RK7 136-6SC00-0BC1
<b>Ambient temperature</b>		
<ul style="list-style-type: none"> <li>• if installed on horizontal mounting rail                             <ul style="list-style-type: none"> <li>– during operation</li> </ul> </li> <li>• if installed on vertical mounting rail                             <ul style="list-style-type: none"> <li>– during operation</li> </ul> </li> <li>• during storage</li> <li>• during transport</li> </ul>	<p>°C</p> <p>°C</p> <p>°C</p> <p>°C</p>	<p>0 ... 60</p> <p>0 ... 50</p> <p>-40 ... +70</p> <p>-40 ... +70</p>
<b>Relative humidity at 25 °C during operating maximum</b>	%	95
<b>Installation altitude at a height over sea level maximum</b>	m	2 000
<b>Module format</b>		ET 200SP design
<b>Type of display as status display by LED</b>		DIAG STATUS ERROR CFG SF TEACH ADDR PWR
<b>Acceptability for application safety-related function</b>		Yes
<b>Explosion protection labeling for intrinsic safety of related operating resources</b>		
<ul style="list-style-type: none"> <li>• EEX ia</li> <li>• EEX ib</li> </ul>		<p>No</p> <p>No</p>
<b>Explosion protection category for gas</b>		none
<b>Explosion protection category for dust</b>		none



## 9.2 Safe technical specifications

### Safety characteristics

Table 9- 1 Maximum achievable safety class in safety mode

Standard	Designation	Value
SIL according to IEC 61508	SIL	3
EN ISO 13849-1 <sup>1)</sup>	PL	e
	Category	4

1) Performance Level

Table 9- 2 Safety characteristics

Characteristic	Designation	Value
High Demand according to SIL 3 <sup>1)</sup>	PFH <sub>D</sub>	1.00 x 10 <sup>-9</sup> x 1 / h
Total value for AS-i system with the F-CM AS-i Safety ST module <sup>2)</sup>		1.89 x 10 <sup>-9</sup> x 1 / h
Individual value for F-CM AS-i Safety ST	PFH <sub>D</sub>	0.89 x 10 <sup>-9</sup> x 1 / h
Individual value for AS-Interface transfer procedure	PFH <sub>D</sub>	1.00 x 10 <sup>-9</sup> x 1 / h
Individual value for AS-Interface slave <sup>2)</sup>	PFH <sub>D</sub>	0
Proof test interval	T1	20 years
Low Demand according to SIL 3 <sup>3)</sup>	PFD	2.00 x 10 <sup>-5</sup>
Total value for AS-i system with the F-CM AS-i Safety ST module <sup>2)</sup>		1.55 x 10 <sup>-5</sup>
Individual value for F-CM AS-i Safety ST	PFD	0.55 x 10 <sup>-5</sup>
Individual value for AS-Interface transfer procedure	PFD	1.00 x 10 <sup>-5</sup>
Individual value for AS-Interface slave <sup>2)</sup>	PFD	0
Mean Time To dangerous Failure	MTTF <sub>d</sub>	≥100 years (37 000 years) High (according to EN ISO 13849-1)
Diagnostic Coverage level	DC	>99 %
Common Cause Failure	CCF	75 points (requirements met according to EN ISO 13849-1)

1) Probability of a dangerous failure in the case of an operating mode with high or continuous demand rate

2) Value "0" as an approximation for the individual value for AS-Interface slave applies only under the assumption that the PFH<sub>D</sub> or PFD value of the AS-i slave is comparatively low and, thus, the PFH<sub>D</sub> or PFD value of the AS-i slave does not contribute significantly to the PFH<sub>D</sub> or PFD value of the total system. For this, observe the technical specifications of the safe AS-i slaves and use the specific values of the manufacturer.

3) Probability of a dangerous failure in the case of an operating mode with lower demand rate

## 9.3 Response times

The response times specified below represent worst case specifications. The response times relate to the switch-off operation (status change "1" → "0").

The response times for the switch-on operation (status change "0" → "1") can be longer but are not relevant for the given safety-related examination.

### Maximum response time in the input direction

The maximum response time in the input direction results from the calculation of the response time from the safe AS-i input slave up to the head module (IM) of the ET 200SP:

- max. 5 ms AS-i bus cycle with maximum configuration
- max. 5 ms Disturbance in AS-i bus cycle with maximum configuration
- max. 20 ms Module-internal processing
- max. 2 ms Transfer ET 200SP backplane bus

-----  
max. 32 ms Total response time in input direction (with 0 ms input delay)



#### WARNING

##### Increased response time

If an input delay time > 0 is assigned for a safe input, this input delay time must be added to the total response time.

In the total response time indicated above, external influencing variables are **not** included:

- Response time of the sensor
- Additional response time in the safe AS-i input slave (see operating instructions)
- Bus response time between the head module (IM) of the ET 200SP and the controller
- Response time of the controller
- Timeout time (F-monitoring time) of the controller in case of PROFIsafe failure

These influencing variables must be taken into consideration when calculating the system response time of the total system.

In the above-indicated total response time, it is taken into consideration that a maximum of 4 AS-i bus cycle times elapse between a safe input slave failure and detection of an error.


### Maximum response time in the output direction

The maximum response time in the output direction results from the calculation of the response time from the head module (IM) of the ET 200SP to the safe AS-i input slave (evaluation unit).

- max. 2 ms Transfer ET 200SP backplane bus
- max. 20 ms Module-internal processing
- max. 5 ms AS-i bus cycle with maximum configuration
- max. 5 ms Disturbance in AS-i bus cycle with maximum configuration

-----

max. 32 ms Total response time in output direction (for disturbance-free PROFIsafe transmission)

 <b>WARNING</b>
<p><b>Increased response time</b></p> <p>In case of PROFIsafe failure, the total response time in the output direction increases by the set timeout time of the F-CM AS-i Safety ST module (see F-parameters, F-monitoring time).</p> <p>In the total response time indicated above, external influencing variables are <b>not</b> included:</p> <ul style="list-style-type: none"> <li>• Response time of the controller</li> <li>• Bus response time between the controller and the head module (IM) of the ET 200SP</li> <li>• Response time in the safe AS-i output module (evaluation unit), see operating instructions</li> <li>• For response time of the safe AS-i output module (evaluation unit) in case of AS-i failure, see operating instructions</li> <li>• Response time of the actuator (e.g., contactor)</li> </ul> <p>These influencing variables must be taken into consideration when calculating the system response time of the total system.</p>

### Additional information

Further information is provided in

System Manual SIMATIC Industrial Software Safety Engineering in SIMATIC S7  
<http://support.automation.siemens.com/WW/view/en/12490443/0/en>

For calculation of response times, the following aid is available on the Internet:

- For S7 Distributed Safety, the Excel file S7fcotia.xls  
<http://support.automation.siemens.com/WW/view/en/25412441>

## 9.4 Calculation of monitoring times and response times

The Excel file S7fcotia.xls for S7 Distributed Safety is available on the Internet to aid the approximate calculation of the runtime of the F-runtime group, the minimum F-monitoring time, and the maximum response time of the safety program:

S7fcotia (<http://support.automation.siemens.com/WW/view/en/25412441>)

Additional information is available in Manual "Safety Engineering in SIMATIC S7".

You can download this free of charge on the Internet at:

Safety Engineering in SIMATIC S7

(<http://support.automation.siemens.com/WW/view/en/12490443/0/en>)

### Notes on completing the Excel file S7fcotia.xls (when used without IE/PB Link)

#### Tab "max. runtime F-run-time group"

Enter the number of modules (in the relevant F-runtime group) in the "F-CM AS-i Safety ST" row under "ET 200SP fail-safe modules".

#### Tab "min. F-Monitoring times"

In the "Configuring the PROFIsafe monitoring time" section, select one of the following variants depending on which head module (IM) of the ET 200SP is being used.

- Variant 3 (distributed F-I/O via PROFINET IO)

Use the values from the following table.

Table 9- 3 Values for calculating the minimum F-monitoring times

Description	Designation	Value
Max. acknowledgment time of the F-CM AS-i Safety ST	T_DAT	20 ms
F-I/O with inputs and outputs	-	Yes

#### Tab "max. response times"

In the "Input" section, select one of the following variants for the relevant signal flow of the safety function depending on which head module (IM) of the ET 200SP is being used:

- Variant 3 (distributed F-I/O via PROFINET IO)

Use the values from the following table.

Table 9- 4 Values for calculating the max. response times

Description	Designation	Value
Max. discrepancy time (Note: The safe value 0 is supplied while the discrepancy time is running)	T_DIS	0
Maximum response time in error-free operation	T_WCDT	20 ms
Maximum response time when an error is present	T_OFDT	20 ms
Max. acknowledgment time of the F-I/O	T_DAT	20 ms
Configured PROFIsafe monitoring time	T_PSTO, conf.	F_WD_TIME (see the setting on the PROFISAFE tab of the properties dialog)
Max. response time of sensor Note: For T_Sensor_DLY, the part of the system starting from the F-CM AS-i Safety ST module up to the sensor, including the AS-i bus, is considered.	T_Sensor_DLY	10 ms (signal flow of AS-i Bus) + Assigned input delay + Response time of the sensor + Additional response time in the safe AS-i input slave



# List of abbreviations

## A.1 List of abbreviations

### Meaning of abbreviations

Abbreviation	Meaning
ADDR	Addressing
AS-i	AS-Interface
ATEX	Atmosphere Explosive
AUX	Auxiliary
BF	AS-i bus error
BU	BaseUnit
CFG	Configuration
CM	Communication Module
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
DI	Digital Input
DIAG	Diagnosis
DP	Distributed peripherals
DS	Data record/data set
I/O	Input/Output
EMC	Electromagnetic compatibility
EN	Europäische Norm (European standard)
F-	Fail-safe
GSD	Generic Station Description
GSDML	Generic Station Description Markup Language
HF	High Feature
HSP	Hardware support package
HW	Hardware
HW ID	Hardware identifier
I&M	Identification and Maintenance
ID	Identifier
IEC	International Electrotechnical Commission
IM	Interface module
IO	Input Output
IP	Ingress Protection (enclosure class)
ISO	International Organization for Standardization
LED	Light Emitting Diode

List of abbreviations

A.1 List of abbreviations

Abbreviation	Meaning
LPS	List of configured AS-i slaves (list of "projected" slaves)
NEC	National Electrical Code
NFPA	National Fire Protection Association
PIQ	Process Image Output
PII	Process image input
PELV	Protective extra low voltage
PF	Peripheral fault
PFD	Probability of dangerous failure on demand (from IEC 61508)
PFH <sub>b</sub>	Probability of dangerous failure per hour (from IEC 61508)
PL	Performance Level
PSF	Process signal error
PWR	Power
SELV	Safety Extra Low Voltage
SIL	Safety Integrity Level
GF, CF	System fault
PLC	Programmable logic controller



## References

### B.1 References

#### Additional documentation

Further information is available in the following documents:

Document type	Internet link
System Manual	ET 200SP System Manual ( <a href="http://support.automation.siemens.com/WW/view/en/58649293/0/en">http://support.automation.siemens.com/WW/view/en/58649293/0/en</a> )
Manual	ET 200SP BaseUnits ( <a href="http://support.automation.siemens.com/WW/view/en/59753521/0/en">http://support.automation.siemens.com/WW/view/en/59753521/0/en</a> )
System Manual	ET 200SP distributed I/O system ( <a href="http://support.automation.siemens.com/WW/view/en/58649293/0/en">http://support.automation.siemens.com/WW/view/en/58649293/0/en</a> )
Product Information	Product Information ET 200SP Distributed I/O System ( <a href="http://support.automation.siemens.com/WW/view/en/78361093/0/en">http://support.automation.siemens.com/WW/view/en/78361093/0/en</a> )
Programming and Operating Manual	SIMATIC Safety - Programming and configuring ( <a href="http://support.automation.siemens.com/WW/view/en/54110126/0/en">http://support.automation.siemens.com/WW/view/en/54110126/0/en</a> )
Programming and Operating Manual	S7 Distributed Safety ( <a href="http://support.automation.siemens.com/WW/view/en/22099875/0/en">http://support.automation.siemens.com/WW/view/en/22099875/0/en</a> )
Manual	CM AS-i Master ST for SIMATIC ET 200SP ( <a href="http://support.automation.siemens.com/WW/view/en/71756485">http://support.automation.siemens.com/WW/view/en/71756485</a> )
System Manual	AS-Interface System Manual ( <a href="http://support.automation.siemens.com/WW/view/en/26250840/0/en">http://support.automation.siemens.com/WW/view/en/26250840/0/en</a> )
FAQ	FAQ "Compatibility for AS-i Power24V" ( <a href="http://support.automation.siemens.com/WW/view/en/20025980/133000">http://support.automation.siemens.com/WW/view/en/20025980/133000</a> )
IEC 61508 standard	-
System Manual	SIMATIC Industrial Software Safety Engineering in SIMATIC S7 ( <a href="http://support.automation.siemens.com/WW/view/en/12490443/0/en">http://support.automation.siemens.com/WW/view/en/12490443/0/en</a> )



# Glossary

## **1oo1 evaluation**

Type of sensor evaluation. With 1oo1 evaluation, the sensor exists once. The sensor is connected to the F-module over a single channel.

## **1oo2 evaluation, equivalent**

Type of sensor evaluation. With 1oo2 evaluation, two input channels are occupied by one two-channel sensor or by two single-channel sensors. The input signals are compared internally for equivalence.

## **AS-i (AS-Interface)**

Actuator-sensor interface. A networking system for the lowest field level of the automation level. The networking system is suitable for networking sensors and actuators with control devices (previous designation: SINEC S1).

## **AS-i A/B slave**

AS-i A/B slaves use the extended address range. You can assign two A/B slaves as a pair to an address on AS-Interface. Because of the address organization, you can therefore connect up to 62 AS-i A/B slaves to AS-Interface.

## **AS-i analog slave**

AS-i analog slaves are AS-i slaves that exchange analog values with the AS-i master.

## **AS-i master**

The AS-i master monitors and controls binary or analog sensors and actuators via AS-i modules or AS-i slaves.

## **AS-i slave**

All devices that can be addressed by an AS-i master are referred to as AS-i slaves. AS-i slaves are differentiated based on their design (AS-i modules as well as sensors or actuators with integrated AS-i connection) and their addressing range (AS-i standard slave and AS-i A/B slave with extended addressing range).

## **AS-i standard slave**

The AS-i standard slave occupies one address on AS-Interface; because of to the address organization, up to 31 AS-i standard slaves can therefore be connected to AS-Interface.

## ASIsafe®

The AS-Interface Safety at Work concept allows the integration of safety-related components in an AS-Interface network, e.g.:

- EMERGENCY STOP switch
- Protective door switch
- Safety light grid

These safety-related components are fully compatible, according to EN 50 295, with the well-known AS-Interface components, e.g., master, slaves, power supply unit, etc. They can be operated together on the yellow AS-Interface cable. Siemens supplies all components for configuring a safe AS-Interface network.

## CM

Communication Module

Module for communication tasks that is used in an automation system as an interface expansion for the CPU.

## CPU

Central Processing Unit

## CRC

Cyclic Redundancy Check is a test procedure for checking the integrity of data. A generator polynomial is used to calculate a checksum over the data to be monitored. This checksum is, in the signature sense, characteristic of the data concerned. The generator polynomial can be calculated according to various algorithms.

## DIAG

Diagnosis

## Distributed Safety

Siemens-specific addition to PROFIsafe. The Distributed Safety fail-safe system with F-Configuration Pack supports implementation of safety concepts for machine and personal protection.

With Distributed Safety, passivation of selective channels has possible since PROFIsafe V2.0. The quality bits transferred in the process image are used to enter a substitute value in the process image for the channel concerned. The quality bits for the inputs and outputs are subsequently transferred in the process image to the actual process data. The same mechanism that PROFIsafe uses for reintegration of the module is used for reintegration of passivated channels.

**F-address**

Each fail-safe module has an F-address. For the F-CM AS-i Safety ST module, the F-address must initially be assigned online using *Step 7*. You specify the F-address in the configuration.

**Fail-safe systems**

Fail-safe systems are characterized in that, when certain failures occur, the system remains in a safe state or changes over directly to another safe state.

**F-parameters**

The fail-safe parameters are safety-relevant parameters. They are needed for communication via PROFIsafe.

**I-parameters**

Individual parameters for revising the AS-i functionality. The I-parameters are safety-relevant.

**LED**

A light-emitting diode that is used to display the signal status.

**Nibble**

A nibble is a unit of information that comprises four bits.

**Passivation**

When a fail-safe I/O device detects an error, it switches the affected channel, or all channels, to the safe state. That is, the channels of these fail-safe I/O devices are passivated. The fail-safe I/O device signals the detected fault to the F-CPU.

In the case of passivation of a fail-safe I/O device with inputs, the fail-safe system provides the safety program with substitute value "0" instead of the process values that are present at the fail-safe inputs.

In the case of passivation of a fail-safe I/O device with outputs, the fail-safe system transfers substitute value "0" to the fail-safe outputs instead of the output values supplied by the safety program.

**PROFIsafe**

Safety-related bus profile of PROFINET IO for communication between the safety program and the fail-safe I/Os in a fail-safe system.

**Proof test interval**

Time interval after which a component must be put into error-free state. The component is replaced or proof is furnished that it is entirely free of errors.

**Safe state**

The basis of the safety concept in fail-safe systems is that a safe state exists for all process variables.

**Safety class**

Safety integrity level SIL in accordance with IEC 61508. The higher the safety integrity level, the stronger the measures for avoiding systematic failures as well as for overcoming intermittent failures and hardware failures.

Fail-safe modules used in safety mode can achieve up to safety class SIL 3.

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Tel.: +49 (911) 895-5900  
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Siemens AG  
Industry Sector  
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