

## SIMATIC

### Automation System S7-300 Fail-Safe Signal Modules

#### Manual



The following supplement is part of this documentation:

No.	Designation	Drawing number	Version
1	Product Information	A5E00137903-03	07/2003

This manual is part of the documentation packages with the order numbers:

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**6ES7988-8FB10-8BA0**

**6ES7988-8FB10-8CA0**

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Preface, Contents	
Use of Fail-Safe Signal Modules	<b>1</b>
Standard Mode	<b>2</b>
Safety Mode	<b>3</b>
Installation	<b>4</b>
Wiring	<b>5</b>
Parameter Assignment	<b>6</b>
Diagnostics	<b>7</b>
General Technical Specifications	<b>8</b>
Digital Modules	<b>9</b>
Analog Module	<b>10</b>
Safety Protector	<b>11</b>
<b>Appendices</b>	
Diagnostic Data of the Signal Modules	<b>A</b>
Dimensioned Drawing of the Signal Modules	<b>B</b>
Accessories and Order Numbers	<b>C</b>
Special Test Certificate and Declaration of Conformity	<b>D</b>
Glossary, Index	

## Safety Guidelines

This manual contains notices intended to ensure personal safety, as well as to protect the products and connected equipment against damage. These notices are highlighted by the symbols shown below and graded according to severity by the following texts:



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### Safety Note

Contains important information on the acceptance and safety-related use of the product.

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### Warning

indicates that death, severe personal injury or substantial property damage can result if proper precautions are not taken.

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### Caution

indicates that minor personal injury can result if proper precautions are not taken.

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### Note

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

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## Qualified Personnel

Only **qualified personnel** should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

## Correct Usage

Note the following:



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### Warning

This device and its components may only be used for the applications described in the catalog or the technical description, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

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### Disclaimer of Liability

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

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A5E00085586



# Preface

## Purpose of the Manual

The information contained in this manual enables you to look up descriptions of operations and functions and the technical specifications of the fail-safe signal modules of the S7-300.

## Contents of the Manual

This reference manual describes the fail-safe S7-300 signal modules. It consists of chapters with instructions and reference chapters (technical specifications and appendices).

The manual covers the following topics:

- Use in standard and safety modes
- Safety functions
- Installation and wiring
- Parameter assignment
- Diagnostic evaluation
- Technical specifications
- Order numbers

## Scope of Validity of the Manual

Module	Order Number	As of Version
Safety Protector	6ES7 195-7KF00-0XA0	01
Bus Module for Safety Protector	6ES7 195-7HG00-0XA0	01
SM 326; DI 24 X 24 V DC; with diagnostic interrupt	6ES7 326-1BK00-0AB0	02
SM 326; DI 8 X NAMUR; with diagnostic interrupt	6ES7 326-1RF00-0AB0	02
SM 326; DO 10 X 24 V DC/2A; with diagnostic interrupt	6ES7 326-2BF00-0AB0	04
SM 336; AI 6 X 13Bit; with diagnostic interrupt	6ES7 336-1HE00-0AB0	01

## Position in the Information Landscape

This manual is part of the documentation package for the S7-400F/FH.

System	Documentation Package	Order Number
S7-400F/FH	<ul style="list-style-type: none"> <li><i>S7-400F and S7-400FH Programmable Controllers, Fail-safe systems</i></li> <li><i>S7-300 Programmable Controller, Fail-Safe Signal Modules</i></li> </ul>	6ES7 988-8FA10-8BA0
S7-300F fail-safe ET 200S modules fail-safe S7-300 signal modules	<ul style="list-style-type: none"> <li><i>S7 Distributed Safety</i></li> </ul>	6ES7 988-8FB10-8BA0

## Additional Important Information on the SM 326; DI 8 × NAMUR

The SM 326; DI 8 × NAMUR; with diagnostic interrupt is part of the SIMATIC S7 range of intrinsically safe digital modules. It can be used in accordance with the installation guidelines of a SIMATIC S7 intrinsically safe digital module.

The installation guidelines for a SIMATIC S7 intrinsically safe digital module are described in detail in the reference manual entitled *S7-300, M7-300, ET 200M Programmable Controllers, I/O Modules with Intrinsically-Safe Signals*.

You can find information on the fundamentals of explosion protection in the manual entitled *S7-300, M7-300 Programmable Controllers, ET 200M, Fundamentals of Explosion Protection*.

## CD-ROM

You can obtain all the SIMATIC S7 documentation as a dedicated SIMATIC S7 collection on CD-ROM.

## Standards, Certificates and Approvals

The S7-300 programmable controller meets the requirements and criteria of IEC 1131, Part 2. The S7-300 meets the requirements for the CE label. Approvals for CSA, UL and FM have been granted for the S7-300.

The fail-safe S7-300 signal modules are also certified for use in safety operation up to the following levels:

- SIL 3 (Safety Integrity Level) in accordance with IEC 61508
- Safety level 6 (AK 6) in accordance with DIN V 19250 (DIN V VDE 0801)
- Category 4 in accordance with EN 954-1

## Recycling and Disposal

The S7-300 can be recycled due to the low level of harmful substances it contains. For further information about environmentally friendly recycling and the procedure for disposing of your old equipment, please contact:

Siemens Aktiengesellschaft  
 System Engineering and Technical Services  
 ATD ERC Essen Recycling/Remarketing  
 Frohnhauser Str. 69  
 D-45127 Essen  
 Germany

Telephone: +49 201/816 1540 (hotline)  
 Fax: +49 201/816 1504

## Aids to Finding Information

To help you find specific information quickly, the manual contains the following aids:

- There is a complete table of contents at the beginning of the manual.
- A heading indicating the contents of each section is provided in the left-hand column on each page of each chapter.
- Following the appendices, you will find a glossary in which important technical terms used in the manual are defined.
- At the end of the manual you will find a detailed index, which makes it easy for you to find the information you are looking for.

## Attributes for Technical Specifications

Some values in the technical specifications are specified with attributes.

These attributes of the values of the technical specifications have the following meanings:

Attribute	Meaning
Minimum/maximum	A minimum/maximum value represents the limit or operating value guaranteed by SIEMENS. This value must not be violated during operation within other operating limits. You must not violate this value as a user.
Typically	The typical value applies under nominal conditions and at an ambient temperature of 25 °C. The typical value can be violated on account of component tolerances.
Approx.	The "approx." value is a value that has been rounded up or down (the weight of a module, for example).
Without attribute	Values without an attribute are rated values, not values subject to tolerance.

## Additional Support

Please contact your local Siemens representative if you have any queries about the use of the products described in this manual.

If you have any questions or suggestions concerning this manual, please fill in the form at the end of the manual and return it to the specified address. We would be grateful if you could also state your personal opinion of the manual on this reply form.

### **SIMATIC Training Center:**

We offer a range of courses to help get you started with the SIMATIC S7 programmable controller. Please contact your local training center or the central training center in Nuremberg, D-90327 Germany (tel. +49 (911) 895-3154)

### **H/F Competence Center:**

The H/F Competence Center in Nuremberg offers a special workshop on the subject of the fault-tolerant SIMATIC S7 automation system. The H/F Competence Center can also provide help with configuration, setup and on-site problems.

Phone: +49 (911) 895-4759

Fax: +49 (911) 895-4519

## Constantly Updated Information

You can obtain constantly updated information on SIMATIC products on the Internet at:

- <http://www.ad.siemens.de/simatic>
- <http://www.siemens.de/safety>

In addition, SIMATIC Customer Support provides you with up-to-date information and downloads that can be useful to you when using SIMATIC products:

- On the Internet at <http://www.ad.siemens.de/simatic-cs>
- Via the SIMATIC Customer Support mailbox on +49 (911) 895-7100

To access the mailbox, use a modem with up to V.34 (28.8 kbps), and set the parameters as follows: 8, N, 1, ANSI. Alternatively, access it using ISDN (x.75, 64 kbps).

You can contact SIMATIC Customer Support on +49 (911) 895-7000 and by fax on +49 (911) 895-7002.

# Contents

<b>1</b>	<b>Use of Fail-Safe Signal Modules .....</b>	<b>1-1</b>
<b>2</b>	<b>Standard Mode.....</b>	<b>2-1</b>
2.1	Configuration Variants of the Fail-Safe I/O Modules in Standard Mode .....	2-1
2.2	Addressing in Standard Mode.....	2-2
2.3	Substitute Value Output by Output Modules.....	2-3
<b>3</b>	<b>Safety Mode.....</b>	<b>3-1</b>
3.1	Configuration Variants of the Fail-Safe I/O Modules in Safety Mode .....	3-2
3.1.1	Single-Channel, One-Sided I/O System .....	3-4
3.1.2	Single-Channel, Switched I/O System .....	3-6
3.1.3	Redundant, Switched I/O System .....	3-8
3.2	Safety Functions in Safety Mode .....	3-10
3.2.1	Safety Functions Required to Reach Safety Levels with Fail-Safe Input Modules.....	3-10
3.2.2	Safety Functions Required to Attain Safety Levels with Fail-Safe Output Modules .....	3-14
3.2.3	Additional Safety Functions in Safety Mode .....	3-15
3.3	Addressing in Safety Mode .....	3-16
3.3.1	Logical Module Address.....	3-16
3.3.2	Channel Number .....	3-17
3.4	Responses to Faults in an F I/O System .....	3-18
3.5	Requirements of Sensors and Actuators .....	3-21
3.6	Replacing Modules in Safety Mode .....	3-23
<b>4</b>	<b>Installation.....</b>	<b>4-1</b>
<b>5</b>	<b>Wiring.....</b>	<b>5-1</b>
<b>6</b>	<b>Parameter Assignment .....</b>	<b>6-1</b>
<b>7</b>	<b>Diagnostics .....</b>	<b>7-1</b>
<b>8</b>	<b>General Technical Specifications .....</b>	<b>8-1</b>
8.1	Standards, Certificates and Approvals.....	8-2
8.2	Safe Functional Extra-Low Voltage for the Fail-Safe Signal Modules .....	8-6
8.3	Electromagnetic Compatibility .....	8-10
8.4	Transport and Storage Conditions .....	8-12
8.5	Mechanical and Climatic Environmental Conditions .....	8-13
8.6	Information on Rated Voltage, Insulation Testing, Safety Class and Protection Level .....	8-15
8.7	Response Times .....	8-16

<b>9</b>	<b>Digital Modules .....</b>	<b>9-1</b>
9.1	SM 326; DI 24 X 24 V DC; with Diagnostic Interrupt.....	9-2
9.1.1	Features, Front View and Terminal Assignment and Block Diagram .....	9-2
9.1.2	Applications of the SM 326; DI 24 X 24 V DC; with Diagnostic Interrupt .....	9-5
9.1.3	Application 1: Standard Mode .....	9-6
9.1.4	Application 2: Standard Mode with High Availability .....	9-7
9.1.5	Application 3: Safety Mode SIL 2 (Safety Level AK 4, Category 3) .....	9-9
9.1.6	Application 4: Safety Mode SIL 2 (Safety Level AK 4, Category 3) with High Availability.....	9-10
9.1.7	Application 5: Safety Mode SIL 3 (Safety Level AK 6, Category 4) .....	9-12
9.1.8	Application 6: Safety Mode SIL 3 (Safety Level AK 6, Category 3) with High Availability.....	9-14
9.1.9	Diagnostic Messages of the SM 326; DI 24 X 24 V DC; with Diagnostic Interrupt.....	9-18
9.1.10	Technical Specifications - SM 326; DI 24 X 24 V DC; with Diagnostic Interrupt.....	9-21
9.2	SM 326; DI 8 X NAMUR; with Diagnostic Interrupt.....	9-23
9.2.1	Features, Front View and Terminal Assignment and Block Diagram .....	9-23
9.2.2	Applications of the SM 326; DI 8 X NAMUR; with Diagnostic Interrupt .....	9-26
9.2.3	Application 1: Standard Mode and Application 3: Safety Mode SIL 2 (Safety Level AK 4, Category 3).....	9-27
9.2.4	Application 2: Standard Mode with High Availability and Application 4: Safety Mode SIL 2 (Safety Level AK 4, Category 3) with High Availability.....	9-28
9.2.5	Application 5: Safety Mode SIL 3 (Safety Level AK 6, Category 4) .....	9-30
9.2.6	Application 6: Safety Mode SIL 3 (Safety Level AK 6, Category 4) with High Availability.....	9-31
9.2.7	Diagnostic Messages of the SM 326; DI 8 X NAMUR; with Diagnostic Interrupt.....	9-33
9.2.8	Technical Specifications - SM 326; DI 8 X NAMUR; with Diagnostic Interrupt.....	9-36
9.3	SM 326; DO 10 X 24 V DC/2A; with Diagnostic Interrupt .....	9-38
9.3.1	Features, Front View and Terminal Assignment and Block Diagram .....	9-38
9.3.2	Applications of the SM 326; DO 10 X 24 V DC/2A; with Diagnostic Interrupt.....	9-41
9.3.3	Application 1: Standard Mode, Application 3: Safety Mode SIL 2 (Safety Level AK 4, Category 3) and Application 5: Safety Mode SIL 3 (Safety Level AK 6, Category 4).....	9-42
9.3.4	Application 2: Standard Mode with High Availability and Application 4: Safety Mode SIL 2 (Safety Level AK 4, Category 3) with High Availability and Application 6: Safety Mode SIL 3 (Safety Level AK 6, Category 4) with High Availability.....	9-43
9.3.5	Diagnostic Messages of SM 326; DO 10 X 24 V DC/2A; with Diagnostic Interrupt.....	9-47
9.3.6	Technical Specifications - SM 326; DO 10 X 24 V DC/2A; with Diagnostic Interrupt.....	9-52



<b>10</b>	<b>Analog Module</b> .....	<b>10-1</b>
10.1	Analog Value Representation .....	10-2
10.1	SM 336; AI 6 X 13Bit; with Diagnostic Interrupt .....	10-4
10.1.1	Features, Front View and Terminal Assignment and Block Diagram .....	10-4
10.1.2	Applications of the SM 336; AI 6 X 13Bit; with Diagnostic Interrupt.....	10-9
10.1.3	Application 1: Standard Mode .....	10-11
10.1.4	Application 2: Standard Mode with High Availability .....	10-14
10.1.5	Application 3: Safety Mode SIL 2 (Safety Level AK 4, Category 3) .....	10-19
10.1.6	Application 4: Safety Mode SIL 2 (Safety Level AK 4, Category 3) with High Availability .....	10-21
10.1.7	Application 5: safety mode SIL 3 (safety level AK 5,6, category 4) .....	10-25
10.1.8	Application 6: Safety Mode SIL 3 (Safety Level AK 5,6, Category 4) with High Availability .....	10-27
10.1.1	Diagnostic Messages of the SM 336; AI 6 X 13Bit; with Diagnostic Interrupt.....	10-31
10.1.1	Technical Specifications - SM 336; AI 6 X 13Bit; with Diagnostic Interrupt.....	10-33
<b>11</b>	<b>Safety Protector</b> .....	<b>11-1</b>
11.1	Features, Front View and Block Diagram .....	11-2
11.2	Configuration Variants.....	11-4
11.3	Technical Specifications.....	11-6
<b>A</b>	<b>Diagnostic Data of the Signal Modules</b> .....	<b>A-1</b>
<b>B</b>	<b>Dimensioned Drawings</b> .....	<b>B-1</b>
<b>C</b>	<b>Accessories and Order Numbers</b> .....	<b>C-1</b>
<b>D</b>	<b>Special Test Certificate and Declaration of Conformity</b> .....	<b>D-1</b>
	<b>Glossary</b> .....	<b>Glossary-1</b>
	<b>Index</b> .....	<b>Index-1</b>



# 1 Use of Fail-Safe Signal Modules

## Possible Uses

The fail-safe signal modules of the S7-300 can only be used in the following systems:

- In the S7-400H fault-tolerant system in standard mode
- In the S7-400F fail-safe system in safety mode
- In the S7-400FH fail-safe, fault-tolerant system in safety mode

The fail-safe signal modules are operated in a distributed configuration in the ET 200M distributed I/O device in both standard and safety mode.

## Use in Standard Mode

The fail-safe signal modules can be used in standard mode with higher diagnostic requirements. In standard mode the fail-safe signal modules behave in the same way as the S7-300 standard I/O modules.

You can set standard mode by means of an address switch on the back of the fail-safe signal modules (see Chapter 4, "Installation").

## Use in Safety Mode

To enable the fail-safe signal modules to be used in safety mode the modules have integrated safety functions. The following safety levels can be achieved by assigning the appropriate parameters to the safety functions in *STEP 7* using the *S7 F Systems* add-on package and by selecting and wiring the sensors/actuators appropriately:

Safety Level in Safety Mode		
To IEC 61508	To DIN V 19250	To EN 954-1
SIL 2	Safety level AK 4	Category 3
SIL 3	Safety level AK 6	Category 4

You can set safety mode by means of an address switch on the back of the fail-safe signal modules (see Chapter 4, "Installation"). The "SAFE" LED indicates that the signal module is in safety mode.

### Higher Availability in Standard and Safety Mode

The fail-safe signal modules can be operated redundantly in both standard mode and safety mode to increase availability.

The redundant signal modules can be connected depending on availability requirements (see the configuration examples in Section 3.1):

- Divided between two ET 200M distributed I/O devices
- Together in the same ET 200M distributed I/O device

### Evaluation of Redundant Process Signals

In standard mode the redundant process signals are evaluated at the user level (in the user program).

The fail-safe signal modules can also be made redundant in safety mode. The redundant process signals are evaluated by means of the fail-safe driver blocks (see the *S7-400F Programmable Controller, Fail-Safe Systems* manual). When you parameterize the fail-safe signal modules in *STEP 7* with the *S7 F systems* add-on package, specify the redundancy channel between the redundant modules.

## 2 Standard Mode

### Contents

You must read this chapter to use the fail-safe signal modules in standard mode.

Section	Contents	Page
2.1	Configuration Variants of the Fail-Safe I/O Modules in Standard Mode	2-1
2.2	Addressing in Standard Mode	2-2
2.3	Substitute Value Output by Output Modules	2-3

### 2.1 Configuration Variants of the Fail-Safe I/O Modules in Standard Mode

#### Distributed Operation in the ET 200M

In standard mode the fail-safe signal modules are operated on a distributed basis in the ET 200M distributed I/O device.

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#### Note

In standard mode, the fail-safe signal modules must **not** be used and configured on central mounting racks as central I/O modules. Only distributed operation in an ET 200M is possible.

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#### Permissible IM 153-x

All the IM 153-x interface modules of the ET 200M distributed I/O device can be used in standard mode.

#### Combination of Fail-Safe I/O Modules with Standard Modules in Standard Mode

In standard mode, the fail-safe signal modules can be operated with together with S7-300 standard modules in an ET 200M without any restrictions.

## Configuration Variants in Standard Mode

In standard mode, the fail-safe signal modules behave in the same way as standard S7-300 I/O modules. You can find a detailed description of the configuration variants of an ET 200M with S7 300 I/O modules in the *ET 200M Distributed I/O Device* manual.

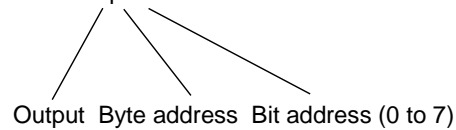
If you want to use the fail-safe signal modules as redundant I/O modules in a fault-tolerant system, consult the *S7-400H Programmable Controller; Fault-Tolerant Systems* manual.

## 2.2 Addressing in Standard Mode

### Signal Module Addresses

In standard mode the fail-safe signal modules are addressed in the same way as the standard S7-300 I/O modules.

For example A 16.2



The byte address is based on the module's start address, which you can set in *STEP 7* using *HWConfig*. The bit address is derived from the position of the channel on the module. Eight consecutive channels are assigned to a byte address.

Permissible address range for the byte address: 8 to 8191 in blocks of eight.

### Addressing Example

Figure 2-1 shows how the individual channels are addressed in standard mode using the example of the SM 326; DO 10 X 24 V DC/2A; with diagnostic interrupt.

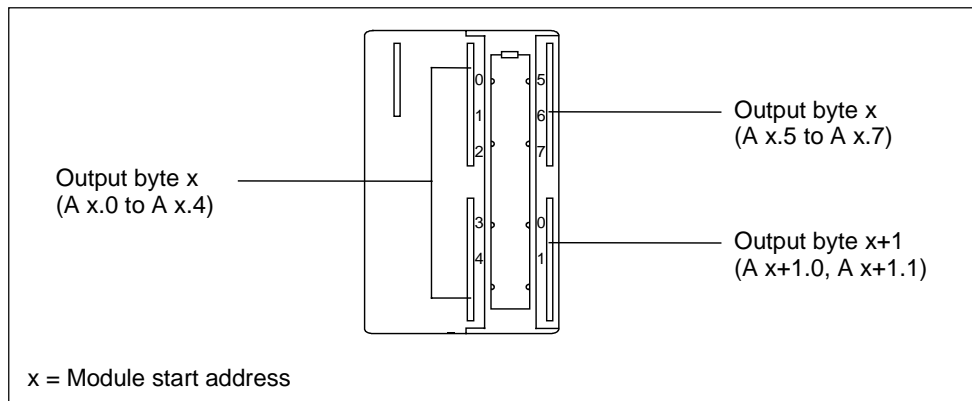


Figure 2-1 Addresses of the Inputs and Outputs in Standard Mode Using the Example of the SM 326; DO 10 X 24 V DC/2A; with Diagnostic Interrupt

## 2.3 Substitute Value Output by Output Modules

### Substitute Value

Substitute values are configurable values submitted by the fail-safe output modules to the process in the following cases, for example:

- STOP of the CPU 417-4 H (or STOP of the CP if a CP is the DP master)
- STOP of the IM 153-x (ET 200M)
- Interruption of the PROFIBUS-DP bus system

### Substitute Value Output

In standard mode the substitute values "0" or "1" can be applied in the case of fail-safe digital output modules. You can parameterize the desired substitute value with the *S7 F Systems* add-on package for *STEP 7*.





# 3 Safety Mode

## Contents



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### Safety Note

This chapter contains important information on the safety-related use of the fail-safe signal modules.

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You must read this chapter to use the fail-safe signal modules in safety mode.

Section	Contents	Page
3.1	Configuration Variants of the Fail-Safe I/O Modules in Safety Mode	3-2
3.2	Safety Functions in Safety Mode	3-10
3.3	Addressing in Safety Mode	3-16
3.4	Responses to Faults in an F I/O System	3-18
3.5	Requirements of Sensors and Actuators	3-21
3.6	Replacing Modules in Safety Mode	3-23

## 3.1 Configuration Variants of the Fail-Safe I/O Modules in Safety Mode

### Distributed Operation in the ET 200M

In safety mode the fail-safe signal modules are operated on a distributed basis in the ET 200M distributed I/O device.

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#### Note

The fail-safe signal modules must **not** be used and configured in safety mode on central mounting racks as central I/O modules. Only distributed operation in an ET 200M is possible.

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### Permissible IM 153-x

Which ET 200M components can be used in safety mode depends on the safety class and the use of a safety protector in the ET 200M configuration:

- If you meet the requirements for the safety class SIL 2, or use a safety protector in safety class SIL 3, you can use all the IM 153-x interface modules of the ET 200M distributed I/O device (like in standard mode). Install the safety protector to the left of the fail-safe signal modules.
- If you don't use a safety protector in ET 200M in SIL 3, you must set up the PROFIBUS-DP lines in the S7-400F and S7-400FH programmable logic controllers with **fiber-optic cables**. Then use the following ET 200M interface module:

ET 200M with IM 153-2 FO (as of order no. 6ES7 153-2AB01-0XB0)

### Combination of Fail-Safe I/O Modules with S7-300 Standard Modules

If you use a safety protector in the ET 200M, you can use fail-safe signal modules with the S7-300 standard signal modules in an ET 200M in safety mode in SIL 3.

The safety protector protects the fail-safe signal modules from possible overvoltage in the event of a fault ("Safe Functional Extra-Low Voltage" see Section 8.2). To do this, the fail-safe signal modules must be inserted in the ET 200M configuration to the right of the safety protector, and all the standard signal modules must be inserted to the left of the safety protector (see Chapter 11).

## Combination of Fail-Safe I/O Modules in Standard and Safety Mode



### Safety Note

In a **single** ET 200M you can operate fail-safe signal modules in different operating modes (i.e. standard mode and safety mode) **together**. It is not necessary to separate the fail-safe signal modules according to standard or safety mode (that is installation in different ET 200M or the use of a safety protector).

## Configuration Variants in Safety Mode

Distributed I/O components can be connected to fail-safe signal modules in the following three ways:

In the System	Configuration Variant	Availability
S7-400F	<ul style="list-style-type: none"> <li>Single-channel, one-sided I/O system</li> </ul>	Standard availability
S7-400FH	<ul style="list-style-type: none"> <li>Single-channel, switched I/O system</li> </ul>	Increased availability
	<ul style="list-style-type: none"> <li>Redundant, switched I/O system</li> </ul>	Maximum availability

The following pages contain some typical configuration examples. The availability of the process signals depends on the configuration variant used.

## Additional Information

You will find detailed information on the safety protector in Chapter 11.

You can find a detailed description of the configuration of an ET 200M in the *ET 200M Distributed I/O Device* manual.

If you want to use the fail-safe signal modules as redundant I/O modules in an FH system, refer to the *S7-400H Programmable Controller; Fault-Tolerant Systems* manual.

### 3.1.1 Single-Channel, One-Sided I/O System

#### What Is a Single-Channel, One-Sided I/O System?

In the case of a single-channel, one-sided configuration, the fail-safe signal modules are not duplicated; there is only one of each. The fail-safe signal modules are addressed by a single CPU.

- Configuration for the S7-400F
  - You will need the following when setting up PROFIBUS-DP **with copper cable**:
    - One F-capable CPU (for example, the CPU 417-4 H)
    - One PROFIBUS-DP line
    - One ET 200M: IM 153-x
    - A safety protector (install on the left of the F I/O)
    - Two bus connectors to connect the CPU module and the IM 153-x to the PROFIBUS-DP
  - You will need the following when setting up the PROFIBUS-DP **with a fiber-optic cable**:
    - One F-capable CPU (the CPU 417-4 H, for example)
    - One PROFIBUS-DP line
    - One ET 200M: IM 153-2 FO
    - A component for connecting the CPUs to the fiber-optic cable (for example, OLM/OBT)
- One of each fail-safe signal module (no redundancy)

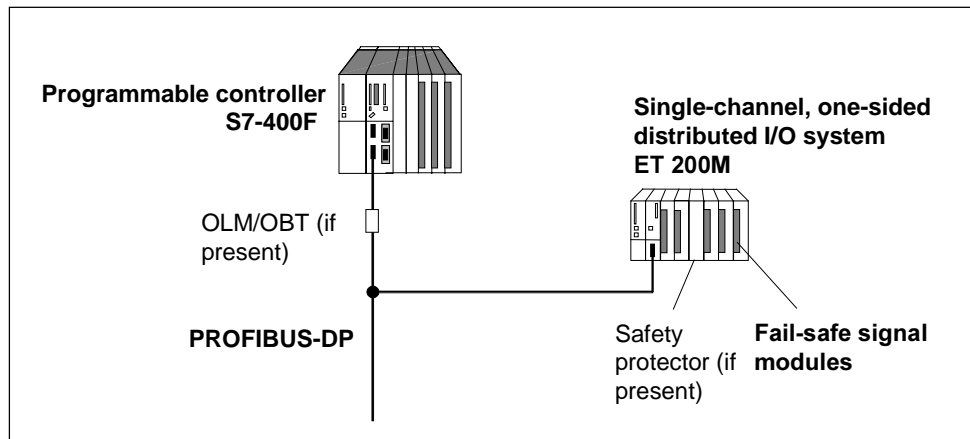


Figure 3-1 Configuration with a Single-Channel, One-Sided I/O System

### Limits of Availability

The I/O components are no longer available to the process in the event of a fault. The fail-safe signal modules are passivated (see Section 3.4).

Possible causes:

- Failure of a fail-safe signal module
- Failure of an IM 153-x/IM 153-2 FO
- Failure of the entire ET 200M
- Failure of the PROFIBUS-DP line
- Failure of the CPU

### 3.1.2 Single-Channel, Switched I/O System

#### What Is a Single-Channel, Switched I/O System?

In the case of a single-channel, switched I/O configuration, the fail-safe signal modules are not duplicated; there is only one of each. The fail-safe signal modules are addressed by two CPUs. The ET 200M has a DP slave interface to each of the two redundant PROFIBUS-DP lines and thus has a physical connection to both CPUs.

- Configuration for the S7-400FH
  - You will need the following when setting up the PROFIBUS-DP **with copper cable**:
    - Two F-capable CPUs (CPU 417-4 H, for example)
    - Two PROFIBUS-DP lines
    - An ET 200M with two IM 153-x interface modules (redundant), each with a PROFIBUS-DP interface
    - A safety protector (install on the left of the F I/O)
    - Two bus connectors to connect both CPU modules and both IM 153-x to the PROFIBUS-DP
  - You will need the following when setting up the PROFIBUS-DP **with a fiber-optic cable**:
    - Two F-capable CPUs (CPU 417-4 H, for example)
    - Two PROFIBUS-DP lines
    - An ET 200M with two IM 153-2 FO interface modules (redundant), each with a PROFIBUS-DP interface
    - Two components for connecting the CPUs to the fiber-optic cables (for example, OLM/OBT)
- One of each fail-safe signal module (no redundancy)

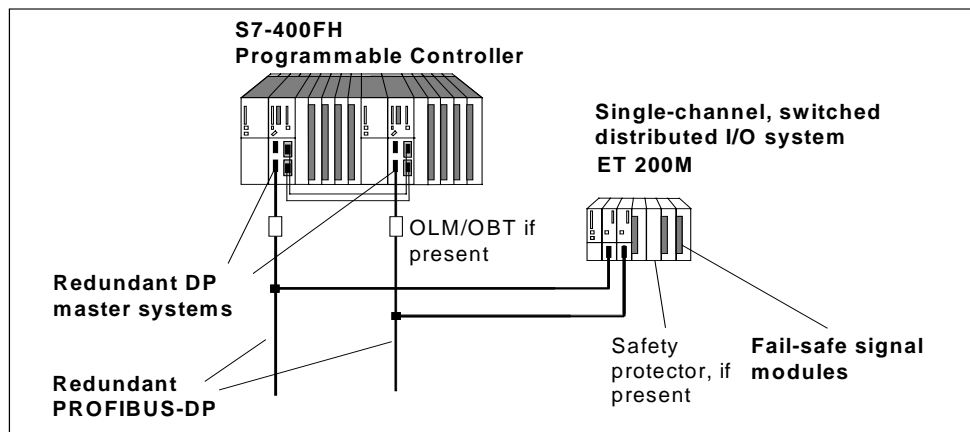


Figure 3-2 Configuration with a Single-Channel, Switched I/O System

### Limits of Availability

In the event of a failure of a fail-safe signal module, the I/O components are no longer available. The relevant fail-safe signal module is passivated (see Section 3.4). The switched I/O system remains available to the process in the event of the following occurring:

- Failure of an IM 153-x/2 FO
- Failure of a PROFIBUS-DP line
- Failure of a CPU

The switched I/O system is no longer available to the process in the event of the following occurring:

- Failure of a fail-safe signal module
- Failure of the entire ET 200M

Availability can be further increased by making the signal modules redundant within an ET 200M. The switched I/O system then remains available to the process even after a fail-safe signal module has failed. Only when the entire ET 200M fails is the switched I/O system no longer available to the process.

### 3.1.3 Redundant, Switched I/O System

#### What is a Redundant, Switched I/O System?

In the case of a redundant, switched I/O system, the fail-safe signal modules are duplicated (redundant). The two fail-safe signal modules are either in separate ET 200M devices or in the same one. In the following example, the two redundant signal modules are in different ET 200M devices.

- Configuration for the S7-400FH
  - You will need the following when setting up the PROFIBUS-DP **with copper cable**:
    - Two F-capable CPUs (CPU 417-4 H, for example)
    - Two PROFIBUS-DP lines
    - Two ET 200M devices: each with two IM 153-x modules
    - Two safety protectors (install on the left of the F I/O)
    - Six bus connectors to connect both CPU modules and the four IM 153-x to the PROFIBUS-DP
  - You will need the following when setting up the PROFIBUS-DP **with a fiber-optic cable**:
    - Two F-capable CPUs (CPU 417-4 H, for example)
    - Two PROFIBUS-DP lines
    - Two ET 200M devices: each with two IM 153-2 FO modules
    - Two components for connecting the CPUs to the fiber-optic cables (for example, OLM/OBT)
- Duplicated (redundant) fail-safe signal modules

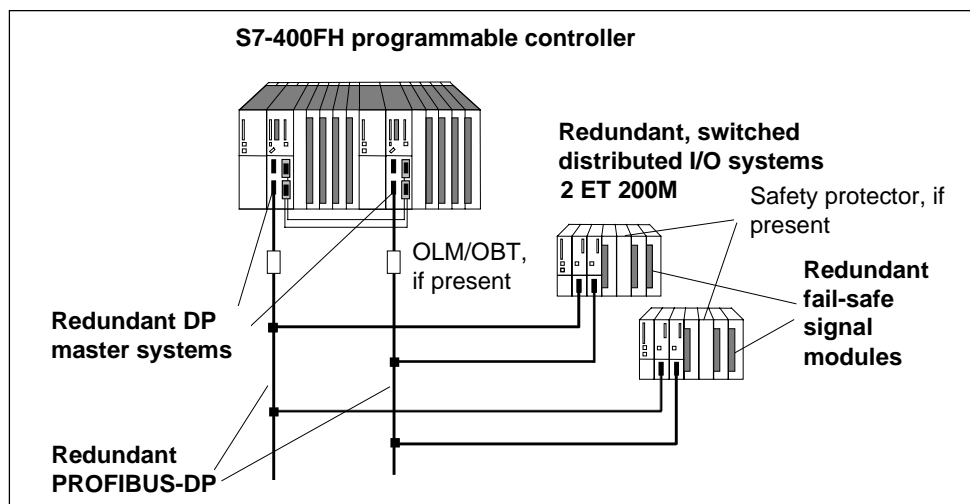


Figure 3-3 Configuration with a Redundant, Switched I/O System



## **Availability**

The I/O system remains available to the process in the event of the following:

- Failure of a fail-safe, redundant signal module
- Failure of an IM 153-x/-2 FO in both ET 200M devices
- Failure of an entire ET 200M
- Failure of a PROFIBUS-DP line
- Failure of a CPU

## 3.2 Safety Functions in Safety Mode



### Safety Note

The information contained in this section will enable you to wire and parameterize the fail-safe signal modules correctly in safety mode in order to achieve a certain safety level.

### 3.2.1 Safety Functions Required to Reach Safety Levels with Fail-Safe Input Modules

#### Sensor Evaluation with Fail-Safe Input Modules

In the case of fail-safe **digital input modules**, the required safety level is attained by using the appropriate type of sensor evaluation.

Safety Level			Type of Sensor Evaluation Required
To IEC 61508	To DIN V 19250	To EN 954-1	
SIL 2	Safety level AK 4	Category 3	1oo1 Evaluation
SIL 3	AK 5, 6	Category 4	1oo2 evaluation

In the case of fail-safe **analog input modules**, 1oo2 sensor evaluation is always carried out in safety mode.

Safety Level			Type of Sensor Evaluation Required
To IEC 61508	To DIN V 19250	To EN 954-1	
SIL 2	Safety level AK 4	Category 3	1oo2 evaluation, single-channel sensors
SIL 3	AK 5, 6	Category 4	1oo2 evaluation, redundant sensors

#### 1oo1 Evaluation

In 1oo1 evaluation, there is one sensor and it is connected to the module via a single channel.

## 1oo2 Evaluation with Digital Modules

In 1oo2 evaluation, the signal statuses of the inputs are compared internally for equivalence or non-equivalence.

For a process signal, sensors can be connected to two opposite inputs of a signal module as follows:

- The signal of a sensor is branched to the two inputs (not in the case of NAMUR).  
A suitable sensor is required to attain SIL 3 (safety level AK 6, category 4) with this interface module.
- The two non-equivalent signals of a non-equivalent sensor are connected to both inputs (not in the case of NAMUR).
- Two identical sensors for the same process parameter (for example, "water level reached") are each connected to one of the two inputs.

Note that in 1oo2 evaluation only half of the inputs of a module are available.

## 1oo2 Evaluation with Analog Input Modules

In the case of the analog input module, once sensor (SIL 2 / AK 4) is connected or two redundant sensors (SIL 3 / AK 5, 6) are connected to two **opposite inputs** of the analog module per process signal in safety mode.

## What Should You Do?

- The sensors on the fail-safe input module must be wired in accordance with the desired sensor evaluation.
- Parameterize the type of sensor evaluation using the *S7 F Systems* add-on package for *STEP 7*.

## Discrepancy Analysis in the Case of Fail-Safe Input Modules

The discrepancy analysis is started if different levels are detected in two associated input signals. After a configurable interval (discrepancy time) has elapsed, a check is carried out to establish whether the discrepancy has disappeared. If not, there is a discrepancy error.

There are two different types of discrepancy analysis with fail-safe input modules:

- Discrepancy analysis in the case of 1oo2 evaluation
- Discrepancy analysis in the case of redundant modules (digital modules only)

## Discrepancy Analysis in the Case of 1oo2 Evaluation

The discrepancy analysis is carried out between the two input signals of the 1oo2 evaluation in the fail-safe input module.

**In the case of digital modules:** If the input signals do not match after the parameterized discrepancy time has elapsed - due to a wire break on a sensor line, for example - the input signal to the CPU is set to "0". This corresponds to ANDing of the input signals. In addition, a diagnostic message indicating the discrepancy error and specifying the relevant channel is generated in the diagnostic buffer of the module.

---

### Note

While the module's discrepancy time elapses, the **old value** of the relevant input channel is sent to the CPU. As a result, the discrepancy time of two-channel sensors for rapid responses must be set for short response times.

It makes no sense, for example, if two-channel sensors with a discrepancy time of 500 ms trigger a time-critical shutdown. In the worst possible case, the sensor-actuator response time increases by around the discrepancy time:

- You should therefore arrange the sensors in the process with as **little discrepancy** as possible.
  - You should then select the **shortest possible** discrepancy time, which, on the other hand, also provides adequate reserves against the erroneous triggering of discrepancy errors.
- 

## Discrepancy Analysis In the Case of Analog Modules

If you have configured safety mode in accordance with SIL 3 / AK 5, 6, you can configure for the analog input module per input a discrepancy time and an absolute tolerance range in % with reference to the measurement range of 4 mA to 20 mA. In addition, you configure the unit value (MIN = the smaller / MAX= the greater) to be taken and forwarded to the CPU.

If the difference between the two measurement values is greater than the configured discrepancy time outside the tolerance range, an error is reported and the unit value is taken.

## Discrepancy Analysis in the Case of Redundant Digital Input Modules

The discrepancy analysis is carried out between the two input signals of the redundant input modules by the fail-safe driver blocks.

If the input signals do not match after the parameterized discrepancy time has elapsed, the output signal of the driver is set to "1". This corresponds to ORing of the signals in the driver.

Since the signals of the two modules can be considered to be safe, you can trust the value "1" of one of the signal modules and pass this signal on to the driver output without a risk to safety. This also ensures the required availability of the system.

When there are discrepancy errors, diagnostic information is output additionally on the fail-safe module driver at the outputs DIAG\_1/2 (see Chapter 8 of the *S7-400F and S7-400FH Programmable Controllers* manual).

### **Parameters for Discrepancy Analysis**

Use the *S7 F Systems* add-on package for *STEP 7* to parameterize the discrepancy time for both discrepancy analyses.

### **Where Should I Look Now?**

Both the wiring and the parameter assignment of the fail-safe input modules is module-specific. The applications of the different modules are described in detail in Chapters 9 and 10.

### 3.2.2 Safety Functions Required to Attain Safety Levels with Fail-Safe Output Modules

#### Test Signal Applications with Fail-Safe Output Modules

In the case of fail-safe output modules, the required safety level can be achieved by applying test signals.

Safety Level			Achieved by Means of Test Signal Application
To IEC 61508	To DIN V 19250	To EN 954-1	
SIL 2	Safety level AK 4	Category 3	<ul style="list-style-type: none"> <li>Dark period (&lt; 1 ms)</li> </ul>
SIL 3	Safety level AK 6	Category 4	<ul style="list-style-type: none"> <li>Light period (&lt; 1 ms) and</li> <li>Dark period (&lt; 1 ms)</li> </ul>

#### Dark Period

Dark periods occur during switch-off tests and during complete bit pattern tests. This involves test-related 0 signals being switched to the output by the fail-safe output module while the output is active. The output is then switched off briefly (dark period). A sufficiently slow actuator does not respond to this and remains switched on.

#### Light Period

Light periods occur during complete bit pattern tests. This involves test-related "1" signals being switched to the output by the fail-safe output module while the output is deactivated (output signal "0"). The output is then switched on briefly (light period). A sufficiently slow actuator will not respond to this and remains switched off.

#### If the Signal Changes Daily or More Often

If the signal changes daily or more often, SIL 3 (safety level AK 6, category 4) can be run without a light period.

#### What Should You Do?

Assign parameters to the following using the *S7 F Systems* add-on package for *STEP 7*:

- The type of test signal application
- Signal Changes Daily or More Often

#### Where Should I Look Now?

The applications and parameter assignment of the fail-safe output modules are described in detail in Chapters 9 and 10.

### 3.2.3 Additional Safety Functions in Safety Mode



#### Safety Note

The information contained in this section will enable you to correctly interpret safety-related diagnostic messages of the fail-safe signal modules. It applies regardless of the safety level that can be achieved.

#### Safety Frame

In safety mode, data is transferred between the CPU and the fail-safe signal module in a safety frame that is up to 16 bytes long. The safety frame consists of:

- Process values (user data)
- A status byte/control byte (coordinating data for safety mode)
- A CRC test value
- A watchdog (or consecutive number)

#### CRC (Cyclic Redundancy Check) Test Value

The validity of the process values in the safety frame, the accuracy of the assigned address references and the safety-related parameters are protected by means of a CRC test value contained in the safety frame.

If a test value error occurs during communication between the CPU and the module due, for example, to temporary high electromagnetic interference, a diagnostic message indicating a test value (CRC) error appears. In the case of fail-safe output modules, the outputs are switched off immediately.

#### Monitoring Time and Consecutive Number

The time-based monitoring of frame updating in the ProfiSafe protocol takes place as a result of the CPU issuing a consecutive number to the fail-safe signal module.

A valid current frame must arrive at the CPU with a valid consecutive number within a configurable monitoring time.

If a valid consecutive number is not detected within the monitoring time, a diagnostic message indicating that the monitoring time for the safety program has been exceeded appears. In the case of fail-safe output modules, the outputs are switched off. In the case of fail-safe digital input modules, the inputs to the CPU are set to "0". In the case of fail-safe analog input modules, the inputs to the CPU are set to the configured substitute value.

You parameterize the monitoring time for each fail-safe signal module in *STEP 7* using the *S7 F Systems* add-on package.

## 3.3 Addressing in Safety Mode

### Addresses

In safety mode of the fail-safe signal modules, a distinction must be drawn between the following:

- Logical module address
- Channel number

### 3.3.1 Logical Module Address

#### Settings

The logical module address of the fail-safe signal modules:

- Is configured as an input parameter of the fail-safe driver blocks
- Is set on the fail-safe signal module using the address switch (DIL switch) (see Chapter 4, "Installation").

#### Permissible Address Range

The fail-safe signal modules occupy up to 16 bytes in the input and output area. Only the following addresses can therefore be used:

Permissible address range: 8 to 8191 in blocks of eight

#### Address Allocation Rules



---

#### Safety Note

- The address set using the address switch of the fail-safe signal modules must correspond to the address specified in *STEP 7 HWConfig*.
  - To ensure that the logical module address is unique on the PROFIBUS-DP bus system, a fail-safe signal module can only be addressed by one CPU. Exception: Switched I/O modules in the S7-400FH (a signal module is always accessed at the same address by one of the two CPUs, the current DP bus master)
  - The logical module addresses of the fail-safe signal modules must be different in the CPUs (they must not overlap) – this applies to all CPUs on the same PROFIBUS-DP line.
  - CPUs in the S7-400FH system must address the same fail-safe signal modules in a switched I/O system.
-



## Protection

The inclusion of the logical module address in the CRC test value of the safety frame protects the address assignment of the fail-safe signal modules.

If the address reference is not valid, for instance if a different address is set on the module to that on the fail-safe driver block, a test value error occurs during communication between the CPU and the module. A diagnostic message indicating an error in the cyclic redundancy check (CRC) appears. -> A transition to a safe state occurs.

## 3.3.2 Channel Number

### Definition

The inputs and outputs are addressed within the safety functions via channel numbers. The channel number is a consecutive number, starting with "0".

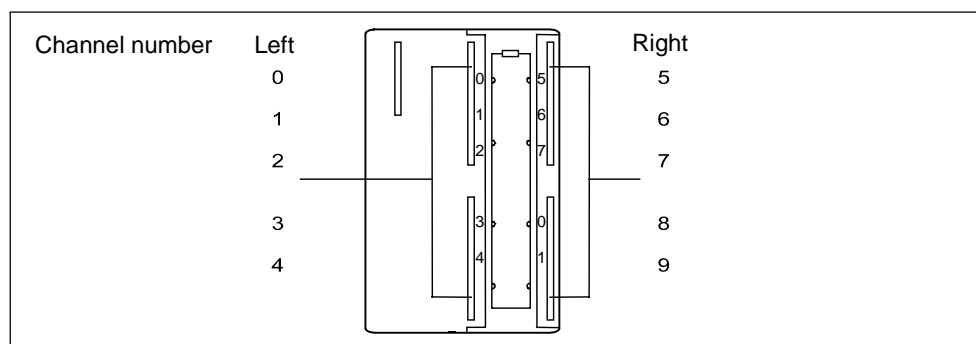
### Application

The channel number of the fail-safe signal modules:

- Is configured as an input or output parameter of the fail-safe driver blocks
- Is referenced in channel-specific diagnostic messages

### Channel Number Example

The following figure shows the assignment of the channel number to the inputs/outputs using the example of the SM 326; DO 10 X 24 V DC/2A; with diagnostic interrupt:



### Halving in the Case of 1oo2 Evaluation with Digital Input Modules

In the case of 1oo2 evaluation on fail-safe digital input modules, the sensors are connected to the opposite terminals of the module via two channels: The number of channels (channel numbers) is halved.

## 3.4 Responses to Faults in an F I/O System

### Safe State (Security Concept)

The basis of the safety concept is that there is a safe, neutral position for all process variables. In the case of digital signal modules, this is always the value "0"; in the case of analog input modules, it is a configurable substitute value.

### Responses to Faults

If a fail-safe signal module reports a fault, it switches the affected channel or all channels to the safe state (i.e. the channels of this module are passivated). The fail-safe signal module reports detected error to the F driver block.

Passivation can be initiated by the fail-safe signal module, the F module driver or F channel driver or by the user in the safety program.

### What is Passivation?

Passivation means that one or more channels of a fail-safe signal module are switched to the safe state in the event of an error.

- **Passivation of output channels** means that the outputs are deenergized. The F channel driver of a passivated digital output channel outputs a substitute value with the quality code (QUALITY) 16#48 and the output QBAD = 1 is set.
- **Passivation of input channels** means that substitute values are forwarded to the safety program, independently of the current process signal. The F channel driver of a passivated digital input channel outputs the substitute value 0 with the quality code (QUALITY) 16#48 and the output QBAD = 1 is set. Depending on the parameterization at the SUBS\_ON input, the F channel driver of an analog input channel outputs a substitute value with the quality code (QUALITY) 16#48 or the last valid value with the quality code (QUALITY) 16#44. In addition, the output QBAD = 1 is set, and, if a substitute value is output, the output QSUBS = 1 is set as well.

### Channel or Module Error?

If a channel error occurs (for example, sensor defective), only the **affected** channel is passivated. In the event of a module fault/error (for example, communication error), all the channels of the fail-safe signal module are passivated.

Chapters 9 and 10 tell you which errors are reported as channel or module errors for each module.



#### Safety Note

When parameterizing the fail-safe signal modules, don't forget to switch on group diagnosis for each channel for the response to channel errors.

---

## Reintegration After Fault/Error Correction

Reintegration means:

- Valid process values are output again on the output channels of the fail-safe output modules.
- The F channel drivers of the fail-safe input modules forward valid process values to the safety program again.

The programming of the F driver blocks as regards passivation and reintegration is explained in detail in the *Fail-Safe Systems* manual.

## Particular Feature of the SM 326; DO 10 x 24 V DC/2A

With the SM 326; DO 10 x 24 V DC/2A the following channel errors

- Short circuit to L+
- Defective output driver

result in the **electronic** fuse failing and the affected module halves of the channels (0...4 and 5...9) being passivated. For example, if a short circuit to L+ occurs on channel 1, channels 0...4 will be passivated.

If short circuits occur repeatedly, the module switches off immediately with program failure.

## Behavior When Group Diagnosis Is Switched Off

The group diagnosis **can** be switched off at unused input or output channels in the interests of availability. This results in the following behavior:

### Fail-Safe Input Modules:

If the group diagnoses of the input channels are switched off, safe "0" values are also sent to the CPU in the event of a fault, but no error messages are sent to the CPU 417-4H.

### Fail-safe output modules:

The following occurs if there are channel faults at outputs with group diagnosis switched off:

- In the case of faults with channel-specific switch-off, the affected channels of the module are **not** switched off.
- In the case of faults at which the affected module half (DO0...DO4 or DO5...DO9) is switched off, the affected module half is **switched off**.
- The CPU does **not** receive a diagnostic message, and the outputs are **not** passivated, depending on the setting on the F channel driver.



### Safety Note

In the case of fail-safe input and output modules in safety mode, group diagnosis must be set for all the connected channels.

Please check that the switching off of the group diagnosis has really only been set for unused input and output channels.

## Passivating Fail-Safe Output Modules Passive Over the Long Term

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### Safety Note

If a fail-safe output module is passivated for an extended period (> 24h) and the fault is not eliminated, it is possible for the module to be activated inadvertently by a second fault, thus putting the system in a dangerous state.

Although the probability of such hardware faults occurring is very slight, such unwanted activation of passivated fail-safe output modules due to switching or organizational measures must be prevented. One possibility is to switch off the power supply to the passivated module for a period of time (for example, 24 hours).

In the case of systems for which there are product standards, the required measures are standardized. In the case of all other systems, the expert accepting it must approve the concept for the required measures put forward by the system operator.

---

### Substitute Value Output

In safety mode it is **not** possible to apply substitute values (0 or 1) in the case of output modules.

### Fault/Error Indication

You can find general information on diagnostic options and diagnostic LEDs in Chapter 7, "Diagnostics".

Module-specific diagnostic messages are listed in Chapters 9 and 10.

## 3.5 Requirements of Sensors and Actuators

### General Requirements to Be Met by Sensors and Actuators



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**Safety Note**

The use of sensors and actuators is outside our field of influence. We have equipped our electronic components in such a way that 85 % of the residual error probability can be allocated to the sensors and actuators (which corresponds to the recommended load sharing between sensors, the actuators and the electronic circuits for input, processing and output in safety-related systems).

You should therefore note that instrumentation with sensors and actuators bears a considerable amount of **responsibility for safety**. Remember that sensors and actuators do not usually last the 10-year preventive maintenance interval specified in IEC 61508 without deteriorating considerably in terms of the safety they offer.

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### Additional Requirement to Be Met by Sensors and NAMUR Sensors



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**Safety Note**

In the case of fail-safe input modules, the value "0" is sent to the CPU (via the fail-safe F driver blocks) when a fault is detected. You must therefore ensure that the sensors are implemented in such a way that the user program responds safely when the state of the sensors is "0".

Example: In its user program, an emergency stop sensor must switch off the relevant actuator when its state is "0" (the emergency stop button is pressed).

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### Additional Requirement to Be Met by Sensors



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**Safety Note**

Ensure that the sensor signals have a minimum duration of 50 ms so that they will be correctly detected.

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### Additional Requirement to Be Met by NAMUR Sensors



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**Safety Note**

Ensure that the NAMUR sensor signals have a minimum duration of 100 ms so that they will be correctly detected.

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## Requirements to Be Met by Analog Sensors

The following generally applies: In order to satisfy the requirements of SIL 2, a single-channel sensor is sufficient; in order to satisfy the requirements of SIL 3, there must be two channels. However, to satisfy the requirements of SIL 2 with a single-channel sensor, this sensor must itself be SIL 2-capable; otherwise, this safety level can only be achieved by using two-channel sensors.

## Additional Requirement to Be Met by Actuators

The fail-safe output modules test the outputs at regular intervals. To do this, the module briefly switches off activated outputs and, if necessary, briefly switches on outputs that were switched off. These test pulses have the following durations:

- Dark period < 1 ms
- Light period < 1 ms

Actuators that respond quickly can be deactivated or activated briefly during the test. If your process cannot tolerate this, use actuators that are sufficiently slow (> 1 ms).



### Safety Note

If the actuators are operated with voltages greater than 24 V DC (for example, with 230 V DC) or if the actuators switch greater voltages, the outputs of a fail-safe output module must be safely isolated from the parts carrying higher voltage. This is usually the case with relays and contactors. Adherence is particularly important in the case of semiconductor switching equipment.

---

## Avoiding Dark Periods During Safety Mode



### Safety Note

If you use actuators that respond too quickly (i.e. < 1 ms) only when the dark period test signal is applied, by connecting two opposite outputs in parallel (with a series diode) you can still use the internal test coordination. The dark periods are suppressed in the case of parallel connection (see page 9-46).

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## Technical Specifications of the Sensors and Actuators

Please also refer to the technical specifications for sensors and actuators in Chapters 9 and 10.

## 3.6 Replacing Modules in Safety Mode

### Insertion/Removal

If the ET 200M is configured with **active bus modules**, the fail-safe signal modules can be inserted and removed during operation.

### S7-400F System

Modules can be replaced during operation of the S7-400F system. The safety functions affected by module replacement can respond.

### S7-400FH System

Redundant modules can be replaced during operation of the S7-400F system. None of the safety functions are triggered by the module replacement.

### Prerequisite for Module Replacement

When replacing a module, make sure that the address switch (DIL switch) on the back of the new module has the same setting as that on the old.

### Additional Information

You can find detailed information on replacing modules in an ET 200M and on the "Replacement of modules during operation" function in the *ET 200M Distributed I/O Device* manual.





## 4 Installation

### Installing Fail-Safe Signal Modules

The fail-safe signal modules are part of the S7-300 range of signal modules and are suitable for distributed use in the ET 200M distributed I/O device.

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#### Note

The fail-safe signal modules must **not** be used and configured on central distributed mounting racks as central I/O modules. Only distributed operation in an ET 200M is possible.

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The fail-safe signal modules are installed in the same way as all other S7 300 signal modules in an ET 200M.

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#### Note

The fail-safe signal modules must be installed in accordance with the installation guidelines of an ET 200M. *ET 200M Distributed I/O Device* manual contains information on how to configure the mechanical design and how to prepare and correctly install the components for use in an ET 200M.

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### Redundant Configuration of the ET 200M

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#### Note

If you use the ET 200M in a redundant configuration, it **must** be in a switch cabinet with sufficient damping to ensure the limit values for radio interference are adhered to (see the chapter entitled "General Technical Specifications").

---

### Address Switch

There is an address switch (DIL switch) on the back of each fail-safe signal module. Make sure **before installation** that the address switch is set correctly. Use the address switch to specify the following:

- Whether the module is to be used in safety or standard mode
- In safety mode: the address of the signal module

The module is delivered with the setting for standard mode (all switches up).

## Setting the Address Switch

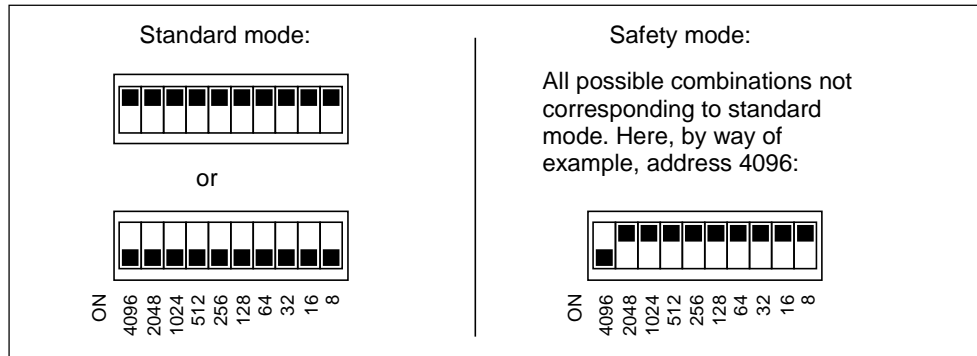


Figure 4-1 Setting the Address Switch (DIL Switch)

# 5 Wiring

## Introduction

In this chapter we indicate what you have to take into account when you wire the fail-safe signal modules. At the very least you must observe these basic rules in order to ensure that your fail-safe signal modules operate faultlessly and satisfactorily.

## Short-Circuit Protection with the SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt



### Safety Note

Short circuits to L+ in the case of the SM 326; DO 10 × 24 V DC/2A; with diagnostic interrupt must be avoided by means of wiring that complies with the standard.

In the case of a short circuit to L+, it can happen that the associated output is not switched off and the actuator remains activated.

## Types of Front Connector

Use the 40-pin front connector to wire the fail-safe signal modules. There are two types of 40-pin front connector: spring terminals and screw-type terminals.

Front Connector	Order Number
Spring terminal, 40-pin	6ES7 392-1AM00-0AA0
Screw-type terminal, 40-pin	6ES7 392-1BM00-0AA0

## Wires

You can use flexible wires with cross-sections as in Table 5-1.

You do not need wire end ferrules. If you use wire end ferrules, only use those listed in Table 5-1.

Table 5-1 Wiring Rules for Module Front Connectors

Wiring Rules for ...		The Front Connectors of the Modules (Spring or Screw-Type Terminals)
Connectable conductor cross-sections for rigid lines		No
Connectable conductor cross-sections for flexible lines	Without wire end ferrule	0.25 to 0.75 mm <sup>2</sup>
	With wire end ferrule	0.25 to 0.75 mm <sup>2</sup> Potential infeed: 1.5 mm <sup>2</sup>
Number of wires per connection		1 or combination of 2 conductors up to 0.75 mm <sup>2</sup> (total) in a common wire end ferrule
Maximum external diameter of the wire's insulation		Ø 2.0 mm Max. 40 wires
		Ø 3.1 mm Max. 20 wires
Stripping length of the wires	Without insulating collar	6 mm
	With insulating collar	6 mm
Wire end ferrules to DIN 46228	Without insulating collar	Version A, 5 to 7 mm long
	With insulating collar	Version E, up to 6 mm long

## Spring Terminals

To wire the front connector using spring terminals, simply insert the screwdriver vertically into the opening with the red opening mechanism, put the wire into the correct terminal, and at the same time remove the screwdriver.

**Tip:** There is a separate opening for test probes up to 2 mm in diameter to the left of the opening for the screwdriver.

## Wiring the Front Connector

To wire the front connector, proceed as follows:

1. Carry out the preparation work for wiring.
2. Wire the front connector.
3. Prepare the signal module for operation.

These steps are explained in detail below.

## Carrying Out the Preparation Work for Wiring.

To carry out the preparation work for wiring, proceed as follows:



### Warning

Accidental contact with live conductors is possible, if the power supply module and any additional load power supplies are switched on.

Make sure the ET 200M is deenergized before doing any wiring!

4. Open the front door (1).
5. Put the front connector in its wiring position (2).

To do this, insert the front connector into the signal module until it snaps into place. The front connector still protrudes from the module in this position.

The advantage of this wiring position is that it makes wiring easier - a wired front connector has no contact to the module in the wiring position.

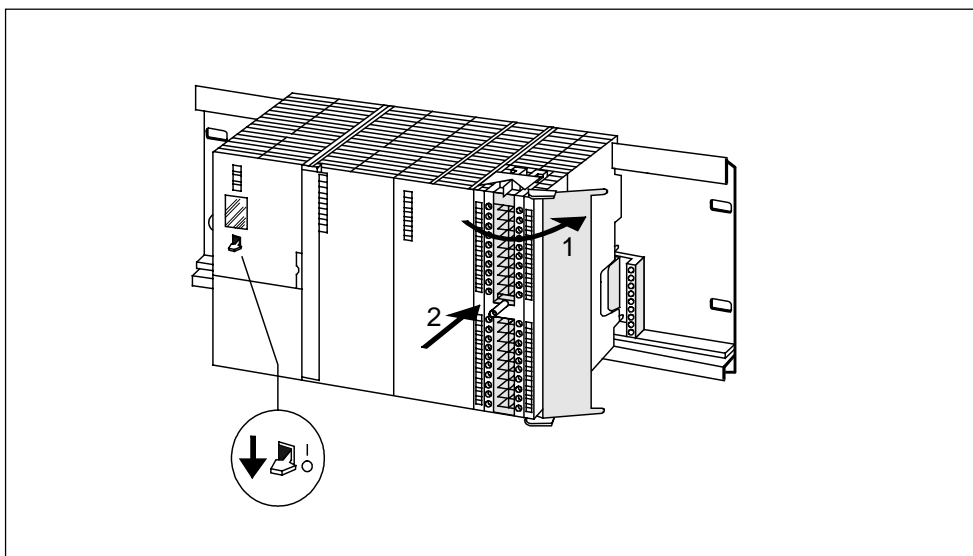


Figure 5-1 Putting the Front Connector in the Wiring Position

6. Strip the wires (see Table 5-1).
7. Do you want to use wire end ferrules?
  - If so, press the end ferrules and the wires together.

## Wiring the Front Connector

The following description is valid for all fail-safe signal modules except the SM 326; DI 8 X NAMUR in a hazardous area (see as of page 5-5).

To wire the 40-pin front connector, proceed as follows:

1. Do you want to bring the wires out at the bottom of the module?

**If so**

Starting at terminal 40 or 20, wire the terminals on each side alternately down to terminals 21 or 1 (1).

**If not**

Starting at terminal 1 or 21, wire the terminals on each side alternately up to terminal 20 or 40.

2. In the case of screw-type terminals: Also tighten the screws of any terminals that are not wired (2).
3. Place the strain-relief grip around the wires and the front connector (3).
4. Pull the cable strain-relief grip tight. Push the lock on the strain-relief grip in to the left to improve utilization of the available space for the wires.

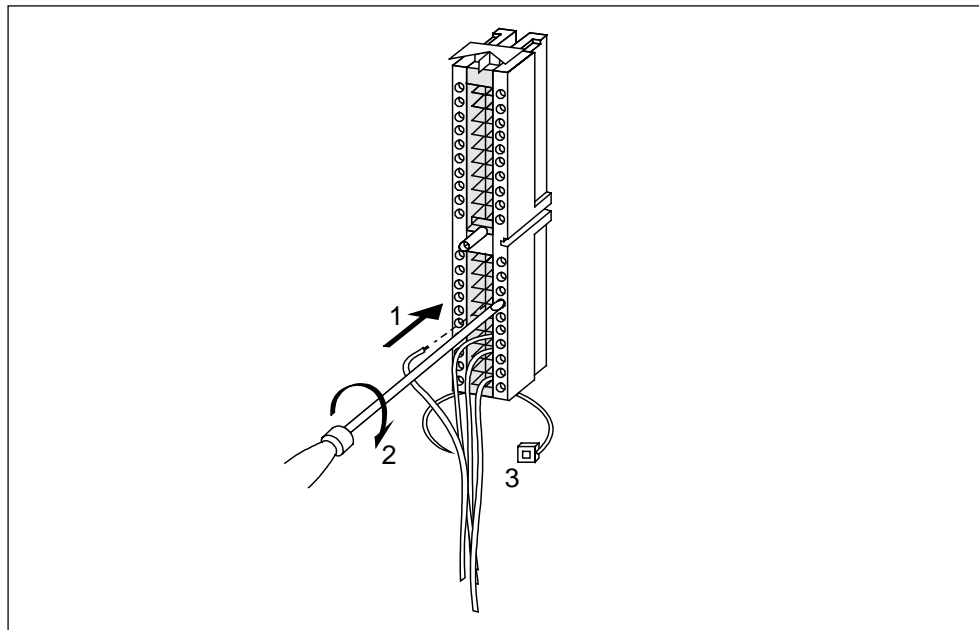


Figure 5-2 Wiring the Front Connector

### Wire Chamber for the SM 326; DI 8 X NAMUR in a Hazardous Area

Follow the following advice when using the SM 326; DI 8 X NAMUR; with diagnostic interrupt in a hazardous area:

#### Note

In the case of the digital input module SM 326; DI 8 X NAMUR; with diagnostic interrupt, the feed wire for L+ / M must go via a wire chamber in order to preserve the clearance in air and leakage path required in a hazardous area.

### Wire Chamber

Order number: 6ES7 393-4AA10-0AA0; quantity 5

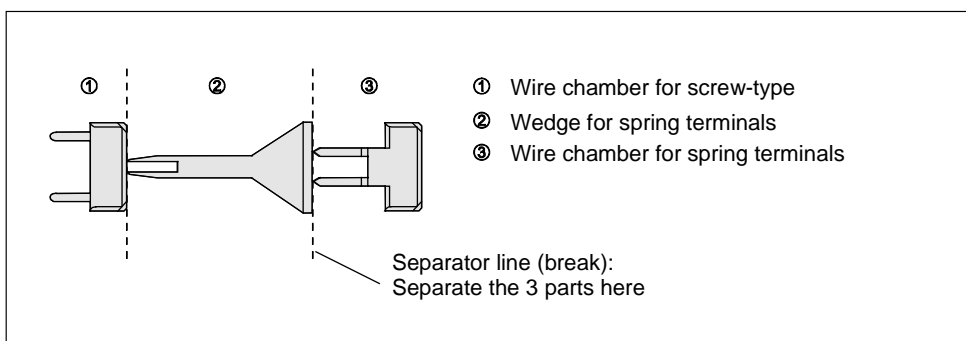


Figure 5-3 Wire Chamber for the SM 326; DI 8 X NAMUR; with Diagnostic Interrupt

### Wiring the Front Connector of the SM 326; DI 8 X NAMUR in a Hazardous Area

1. Attach the power lines to terminals 21 (L+) and 22 (M) and feed them out at the top (1).
2. Insert the wire chamber into terminals 3 and 23 on the front connector (2).

#### Screw-type terminals

Then tighten the screws of terminals 3 and 23.

#### Spring terminals

Use the wedge supplied instead of the screwdriver to install the wire chamber.

3. Wire the process wires and feed them out of the bottom of the module (3).
4. Don't forget to apply the enclosed strain-relief grip around the wires (4).

**Result:** This ensures a safely isolated connection between the wire chamber and the front connector and thus meets the safety requirements to prevent explosions occurring.

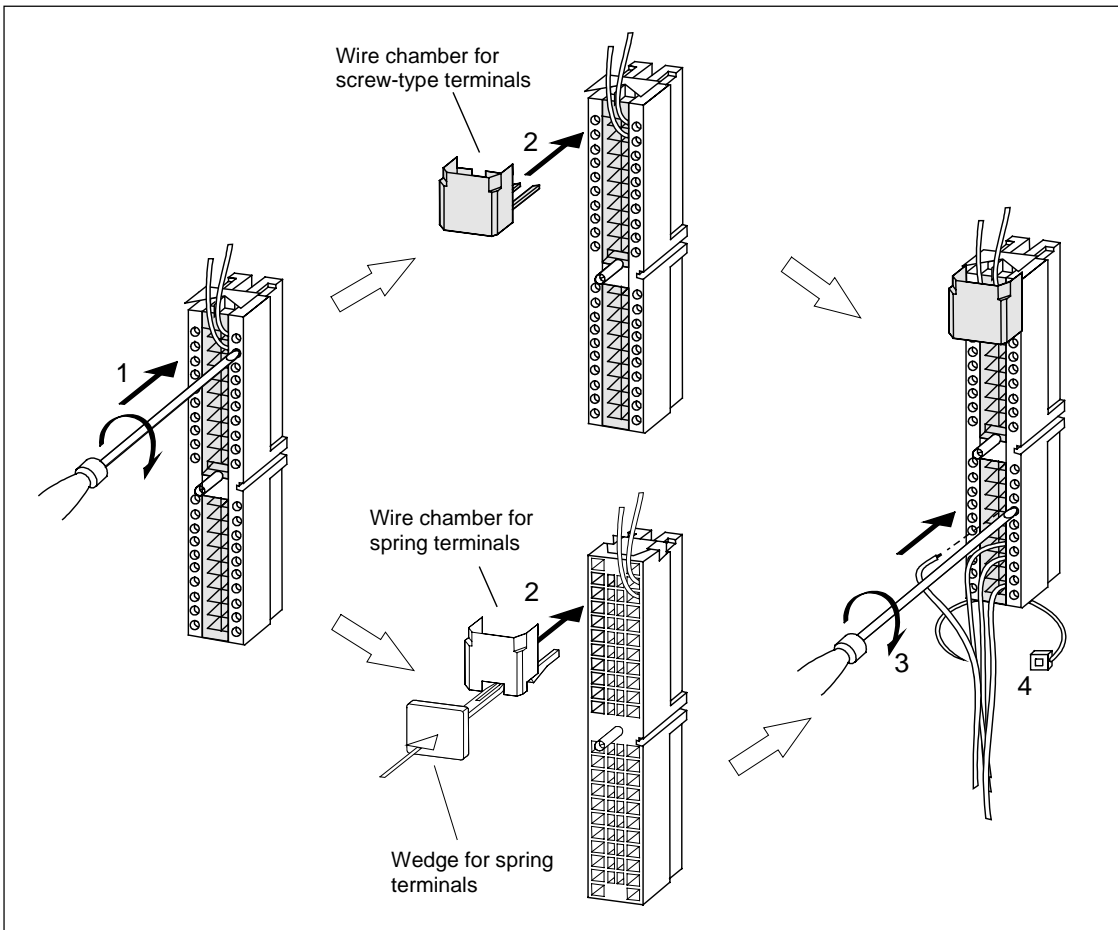


Figure 5-4 Wiring the Front Connector of the SM 326; DI 8 X NAMUR; with Diagnostic Interrupt



## Preparing the Signal Module for Operation

1. Tighten the screw to put the front connector in its operating position (1).

**Note:** When the front connector is in its operating position, a front connector encoding device engages in the front connector. The front connector then only fits this type of module.

2. Close the front door.
3. Enter the channel addresses on the labeling strip.
4. Slide the labeling strip into the front door.

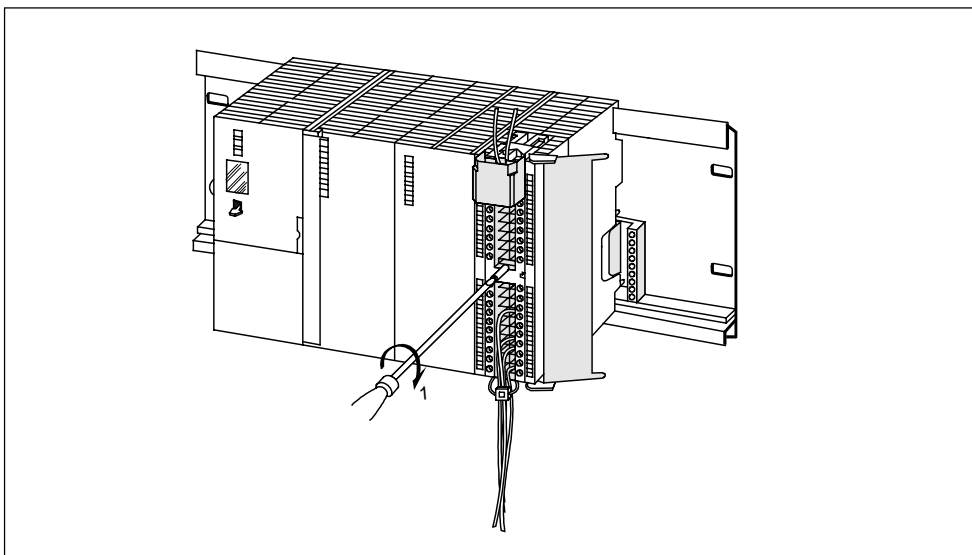


Figure 5-5 Putting the Front Connector in the Operating Position

## Unused Current or Voltage Inputs...

Unused current or voltage inputs of the analog input module SM 336; AI 6 X 13Bit; with diagnostic interrupt do not have to be wired.

---

### Note

Please ensure that inputs that are not configured in HWCONFIG are not wired in order not to unnecessarily increase the response time of the module.

---

### Improvement of Accuracy for Current Measurement on Channels 0 to 3 of the Analog Input Module

If one of the channels 0 to 3 of the SM 336; AI 6 X 13Bit; with diagnostic interrupt is used for current measurements, we recommend that you connect the unwired voltage input with the associated current input, as shown in Figure 5-6 and Figure 5-7. This improves accuracy by approximately 0.2%.

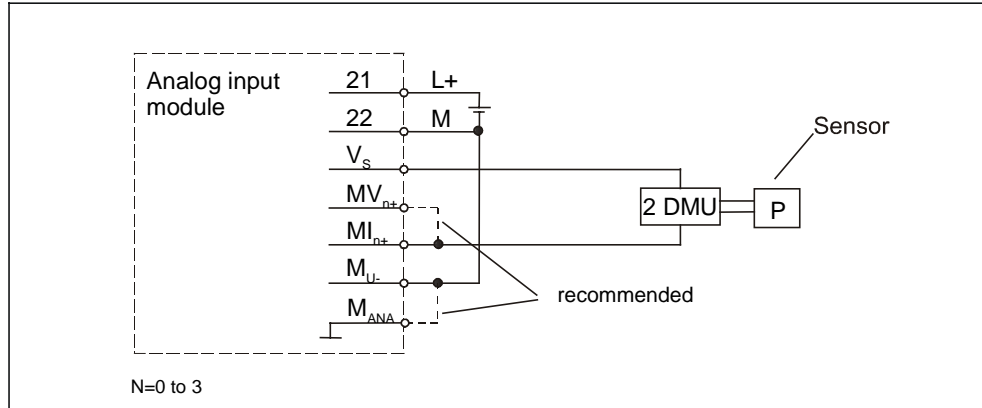


Figure 5-8 Improvement of Accuracy in the Case of Current Measurement on Channels 0 to 3 with 2 WMT

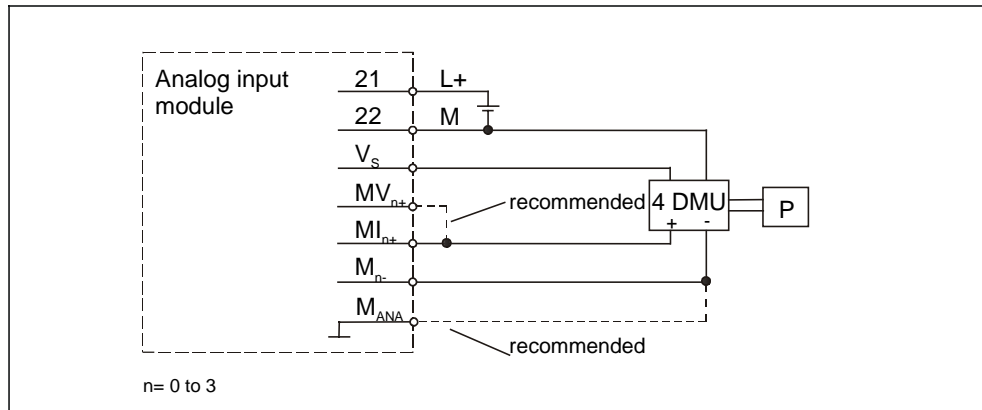


Figure 5-9 Improvement of Accuracy in the Case of Current Measurement on Channels 0 to 3 with 4 WMT

## 6 Parameter Assignment

### Prerequisite

Before you can configure and parameterize the fail-safe signal modules, the *SIMATIC S7 F Systems* add-on package must be installed in *STEP 7*.

### Configuration

Configure the fail-safe signal modules in the usual way using *STEP 7 HWConfig*.



---

#### Safety Note

Make sure that the logical module address in *STEP 7 HWConfig* matches the setting of the address switch on the module (see Chapter 4, "Installation").

---

### Parameter Assignment

To parameterize the fail-safe signal modules, select the module in *STEP 7 HWConfig* and choose the **Edit > Object Properties** menu command.



---

#### Safety Note

You must parameterize the fail-safe signal modules with the CPU in STOP mode.

---

The parameters are transferred from the programming device to the CPU during loading. They are stored there and transferred to the fail-safe signal module by the CPU via the ET 200M.

### Where are the Parameters Described?

You can find the parameters that can be set for the fail-safe signal modules in Chapters 9 and 10.



# 7 Diagnostics

## Definition

By means of diagnostics you can find out whether the signal acquisition of the fail-safe signal modules is working without error. The diagnostic information is assigned either to a channel or the entire module.

## Diagnostic Evaluation

A distinction must be drawn in diagnostic evaluation between configurable and non-configurable diagnostic messages.

---

### Note

In the case of configurable diagnostic messages (for example, wire break, short circuit), a diagnostic message is only issued if you specify during parameter assignment that it should be ("Group Diagnosis" parameter). In the case of non-configurable diagnostic messages, diagnostic messages are issued as a matter of course (i.e. it doesn't depend on parameter assignment).

---

## Diagnostic Messages and Remedies

All the module-specific diagnostic messages, possible causes and remedies for each fail-safe signal module are described in Chapters 9 and 10.

Chapter 9 also tells you which diagnostic messages have to be parameterized and which are displayed channel-specifically.

## Diagnostics Using LEDs

Non-configurable diagnostic messages always make the SF LED come on. The SF LED only comes on for configurable diagnostic messages (for example, wire break, short circuit) if you enable the message during parameter assignment ("Group Diagnosis" parameter).

Table 7-1 Diagnostic LEDs of the Fail-Safe Digital Modules

LED	Safety Mode		Standard mode	
	Channel or Module Error	Defective Module	Channel or Module Error	Defective Module
SF (red)	On	On	On	On
SAFE (green)	On	Off	Off	Off

## **Parameterizing the Diagnosis**

You enable the group diagnosis in *STEP 7* using the *S7 F Systems* add-on package (see Chapters 9 and 10).

## **Reading Out Diagnostic Messages With STEP 7**

You can read out diagnostic data with *STEP 7*:

- From the diagnostic buffer of the CPU or the diagnostic buffer of the module (*STEP 7* function "PLC > Diagnosing hardware").
- In the user program with the SFC 59 (see Appendix A and the *System and Standard Functions* reference manual).

## **Diagnostic Interrupt**

When an error is detected (e. g. short circuit), if diagnostic interrupts have been enabled, the fail-safe signal modules trigger a diagnostic interrupt. The CPU interrupts the processing of the user program and low priority classes, and processes the diagnostic interrupt block (OB 82).

## **Parameterizing the Diagnostic Interrupt**

You enable the diagnostic interrupt in *STEP 7* using the *S7 F Systems* add-on package (see Chapters 9 and 10).

## **Default Setting**

By default, the diagnostic interrupt is disabled.

# 8 General Technical Specifications

## Introduction

This chapter contains the following information on the fail-safe signal modules:

- The most important standards, certificates and approvals
- The general technical specifications

The applies to all the standard products of the SIMATIC S7-300 and S7-400.

## What are General Technical Specifications?

The general technical specifications include the standards and test specifications adhered to and met by the fail-safe signal modules when they are used in an ET 200M, and the criteria on which the fail-safe signal modules are tested.

## Contents

This chapter contains the following information on the general technical specifications:

Section	Contents	Page
8.1	Standards, Certificates and Approvals	8-2
8.2	Safe Functional Extra-Low Voltage for the Fail-Safe Signal Modules	8-6
8.3	Electromagnetic Compatibility	8-10
8.4	Transport and Storage Conditions	8-12
8.5	Mechanical and Climatic Environmental Conditions	8-13
8.6	Information on Rated Voltage, Insulation Testing, Safety Class and Protection Level	8-15
8.7	Response Times	8-16

## 8.1 Standards, Certificates and Approvals

### Introduction

This section describes the following for the fail-safe signal modules:

- The most important standards, certificates and approvals with which the fail-safe signal modules must comply
- In the case of the SM 326; DI 8 X NAMUR, with diagnostic interrupt: the certificate for the connection of signals from a hazardous area.

### IEC 1131

The fail-safe signal modules fulfill the requirements and criteria of IEC 1131, Part 2.

### CE Marking

Our products meet the requirements and protection objectives of the following EC directives and comply with the harmonized European standards (EN) that have been published in the Official Gazettes of the European Community for programmable logic controllers:

- Electromagnetic compatibility (89/336/EEC)
- Low-voltage directive (73/23/EEC )

The EC declarations of conformity are kept available for the relevant authorities at:

Siemens Aktiengesellschaft  
Bereich Automatisierungstechnik  
A&D AS E4  
Postfach 1963  
D-92209 Amberg  
Germany

### Area of Application

SIMATIC products are designed for industrial use.

Area of Application	Requirements for:	
	Emitted Interference	Interference Immunity
Industry	EN 50081-2 : 1993	EN 50082-2 : 1995



## UL Recognition

UL Recognition Mark  
Underwriters Laboratories (UL) to  
UL 508, file no. 116536

## CSA Certification

CSA Certification Mark  
Canadian Standard Association (CSA) to  
C22.2 No. 142, file no. LR 48323

## FM Approval

Factory Mutual Approval Standard Class Number 3611, Class I, Division 2,  
Group A, B, C, D.



### Warning

Personal injury and material damage may be incurred.

In hazardous areas, personal injury or property damage can result if you disconnect any plug-in connections while the system is in operation.

Always deenergize the distributed I/O modules in hazardous areas before removing plug-in connectors.

---

## Marking for Australia



All SIMATIC products with the sign on the left fulfill the requirements of the AS/NZS 2064 standard (Class A).

## Standards, Certificates and Approval for the Connection of Signals from a Hazardous Area to the SM 326; DI 8 X NAMUR; with Diagnostic Interrupt

In addition to fulfilling the requirements described above for the CE marking, the SM 326; DI 8 X NAMUR; with diagnostic interrupt also complies with the following EU directive with the harmonized European standards (EN):

- 94/9/EC "Equipment and protective systems intended for use in potentially explosive atmospheres"

The SM 326; DI 8 X NAMUR; with diagnostic interrupt has II(2)G [Eex ib] IIC certification. The certification is valid for explosive gas compounds in the IIC group (see the manual *S7-300*, *M7-300*, *ET 200M Programmable Controllers, Principles of Intrinsically-Safe Design*). The safety-related limit values can be found in the certificates of conformity (see Appendix D).

**Note**

Modules with II(2)G [EEx ib] IIC certification are considered to be related equipment and must therefore be installed outside the hazardous area. Intrinsically safe electrical equipment for zones 1 and 2 can be connected.

**Summary**

The following table contains an overview of the fail-safe signal modules and details of certificates and approvals and possible applications.

Components	Certification for:			
	Not in Hazardous Areas		Hazardous Areas	
	UL 508	CSA C 22.2 No. 142	FM 3611 Cl. I Div. 2	ATEX 2671 X directive 94/9/EC
SM 326; DI 24 X 24 V DC; with diagnostic interrupt	Yes	Yes	Yes	No
SM 326; DI 8 X NAMUR; with diagnostic interrupt	Yes	Yes	Yes	II(2)G [EEx ib] IIC Yes
SM 326; DO 10 X 24 V DC/2A; with diagnostic interrupt	Yes	Yes	Yes	No
SM 336; AI 6 X 13Bit; with diagnostic interrupt	Yes	Yes	Submitted	No

**TÜV Certification and Standards**

The fail-safe signal modules are certified for the following standards. You can obtain the current status/release of the standard from the report of the TÜV certificate.

Standards for Functional Safety	Standards Safety of Machinery	Additional Standards
DIN V 19250	98/37/EC	DIN VDE 0110-1
DIN V VDE 0801	EN 60204-1	73/23/EEC
DIN V VDE 0801/A1	EN 954-1	93/68/EEC
IEC 61508 - 1 to 7	<b>Standards for Electrical Equipment for Furnaces</b>	EN 55011
prEN 50159-1 and 2	DIN VDE 0116 no. 8.7	EN 50081-2
<b>Standards for Process Engineering</b>	prEN 50156-1	EN 50082-2
DIN V 19251	EN 230 no. 7.3	EN 61131-2
VDI/VDE 2180-1, 2, 3 and 5	EN 298 no. 7.3, 8, 9 and 10	
NE 31	DIN V ENV 1954	
ISA S 84.01		

### **Requesting a TÜV Certificate**

You can request copies of the TÜV certificate and the report of the certificate from the following address:

Siemens Aktiengesellschaft  
Bereich Automatisierungstechnik  
A&D AS E4  
Postfach 1963  
D-92209 Amberg  
Germany

## 8.2 Safe Functional Extra-Low Voltage for the Fail-Safe Signal Modules

### Safe Extra-Low Voltage



---

#### Warning

The fail-safe signal modules must be operated with safe functional extra-low voltage. This means that even in the event of a fault the voltage will be no more than **Um**. The following applies to all fail-safe signal modules:

**Um < 60.0 V**

You can find more information on safe functional extra-low voltage on the data sheets of power supply systems to be used, for example.

---

All the components of the system that can supply electrical energy in any form must comply with this condition.

Each additional circuit used in the system (24 V DC) must have a safe functional extra-low voltage. Refer to the relevant data sheets or contact the manufacturer.

Note also that sensors and actuators with an external supply can be connected to the I/O modules. Make sure here as well that there is safe extra-low voltage. Even in the event of a fault, the process signal of a 24 V digital module may have a fault voltage of no more than  $U_m$ .



---

#### Warning

Every source of voltage (for example, internal 24 V DC load power supplies, external 24 V DC load power supplies, 5 V DC bus voltage) must be electrically connected in such a way that, even when there are differences in potential, the voltage of individual sources of voltage does not increase so as to exceed the maximum fault voltage of  $U_m$ .

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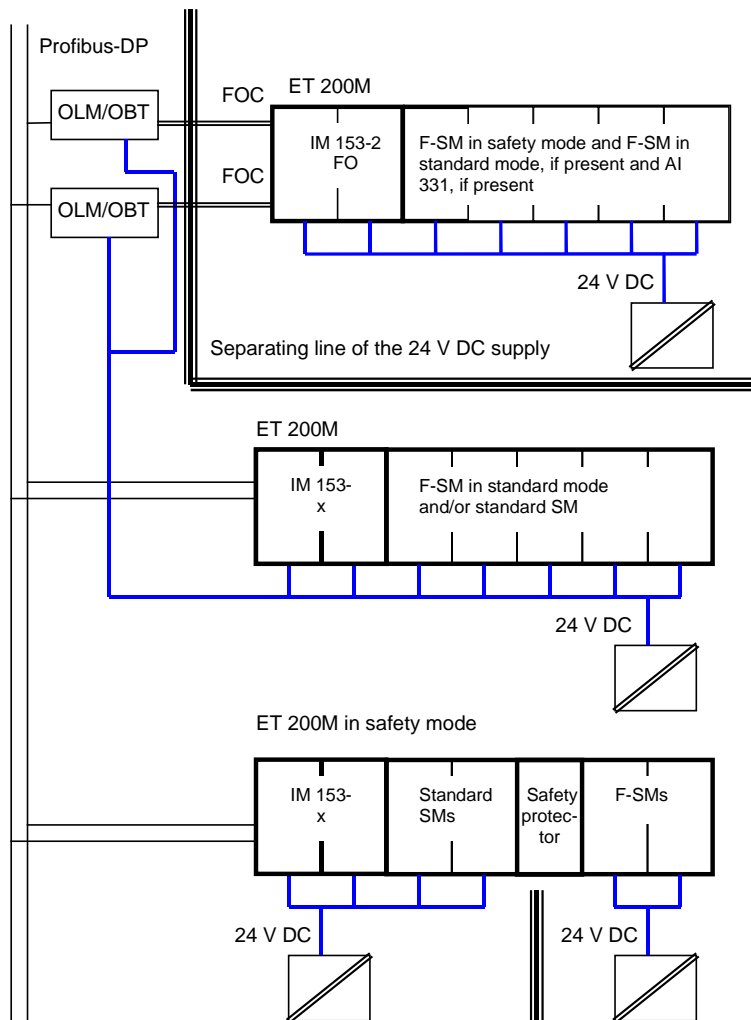
## Rules for Implementing Safe Extra-Low Voltage for Fail-Safe Signal Modules

The components of a fail-safe S7-400F/FH system must be subdivided into two categories as regards the power supply from 24V power supply units:

- Distributed I/O devices with fail-safe signal modules in safety mode
- All other standard components

The following applies to the power supply from 24 V power supply units in fail-safe S7-400F/FH systems: Fail-safe signal modules in safety mode must be supplied **separately** from all other standard components. (In other words, they must not be supplied from the same power supply units.) All 24V power supply units, for both standard and safety components, must have safe electrical isolation.

The diagram below provides an example, showing which components **can** be supplied together from the same 24V power supply units and which components **must** be supplied by different 24V power supply units.



### **Distributed I/O Devices with Fail-Safe Signal Modules in Safety Mode**

In addition to the fail-safe signal modules in safety mode, these can contain:

- Fail-safe signal modules in standard mode
- Analog input modules SM 331 AI2x0/4...20ma, HART, Ex

The above signal modules and the associated IM 153-2 FO interface module(s) can be supplied from one or more common power supply unit(s).

### **Standard Components**

The following are standard components:

- All central SIMATIC components with CPU, power supply module, standard SM, etc.
- Other distributed I/O devices with standard signal modules and/or fail-safe signal modules in safety mode and the associated interface modules (for example, IM 153-x)
- Optical link elements such as OLMs (optical link modules) and OBTs (optical bus terminals)

All these standard components can be supplied from one or more common power supply unit(s).

## **Requirements to Be Met by Power Supply Units**

---

### **Note**

Only use power supply units (230 V AC --> 24 V DC) with a stored energy time for voltage dips of at least 20 ms. The following power supply unit components are available, for example:

S7-400:

- 6ES7 407-0KA01-0AA0 for 10 A
- 6ES7 407-0KR00-0AA0 for 10 A

S7-300:

- 6ES7 307-1BA00-0AA0 for 2 A
- 6ES7 307-1EA00-0AA0 for 5 A
- 6ES7 307-1KA00-0AA0 for 10 A

These requirements do, of course, also apply to power supply units that do not have the S7-300/400 format.

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## Minimum Thread Length for the SM 326; DI 8 X NAMUR for Hazardous Areas



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### Warning

Between the connections with safe functional extra-low voltage and the intrinsically safe connections of the SM 326; DI 8 X NAMUR, a minimum **thread length of 50 mm** must be adhered to.

This can be achieved within the front connector by using a wire chamber (see Chapter 5).

---

It can also happen that the minimum thread length between the different modules is violated (for example, when explosion-proof and standard modules are used together and the minimum thread length between live parts of explosion-proof and standard modules is < 50 mm).

You can comply with the thread length requirements between the modules in the following ways:

- Always insert the SM 326; DI 8 X NAMUR into the ET 200M as the last module (on the far right) on the rail. This will ensure that the thread length to the module on the left is automatically correct because of the module width of the SM 326; DI 8 X NAMUR.
- If that isn't possible, insert the DM 370 dummy module between the affected intrinsically safe and standard modules.
- If you use the bus modules of the active backplane bus, you can also use the intrinsically safe separation bar.



---

### Warning

When carrying out wiring, you must always keep wires that are intrinsically safe separate from wires that are not. Lay them in separate ducts.

---

## Additional Information on Hazardous Areas

You can find more information on the use of the DM 370 and the intrinsically safe separation bar as well as the separation of wires that are intrinsically safe from those that are not in the *S7-300, M7-300, ET 200M Programmable Controllers, I/O Modules with Intrinsically-Safe Signals* reference manual.

## 8.3 Electromagnetic Compatibility

### Definition

Electromagnetic compatibility is the capacity of an electrical device to function satisfactorily in its electromagnetic environment without affecting this environment.

The fail-safe signal modules comply with the requirements of the EMC legislation of the European internal market.

Below you can find information on interference immunity and radio interference suppression.

### Pulse-Shaped Interference

The following table shows the electromagnetic compatibility of the fail-safe signal modules with pulse-shaped interference. The prerequisite for this is that the S7-300/M7-300/ET 200M system complies with the specifications and guidelines on electrical layout.

Pulse-Shaped Interference	Tested With	Corresponds to Severity Level
Electrostatic discharge to IEC 61000-4-2 (DIN VDE 0843 Part 2)	8 kV	3 (Air discharge)
	6 kV	3 (Contact discharge)
Burst pulses (rapid transient interference) to IEC 61000-4-4 (DIN VDE 0843 Part 4)	2 kV (Supply line)	3
	2 kV (Signal line)	4
Surge to IEC 61000-4-5 (DIN VDE 0839 Part 10) An external suppression circuit is not required (see the chapter on lightning and overvoltage protection in the <i>S7-300 Programmable Controller, Hardware and Installation manual</i> )*		
Asymmetrical connection	1 kV (Supply line)	2*
	1 kV (Signal line/ data line)	
Symmetrical connection	0.5 kV (Supply line)	
	0.5 kV (Signal line/ data line)	

\* An external suppression circuit is required for severity level 3. The test values for asymmetrical connection are then 2 kV and for symmetrical connection 1 kV.



## External Suppression Circuit for the ET 200M

When the ET 200M is used with the fail-safe signal modules, an external suppression circuit (surge filter) is required between the load power supply and the load power input of the ET 200M to ensure surge immunity. You can find out the exact type by referring to the chapter on lightning and overvoltage protection in the *S7-300 Programmable Controller, Hardware and Installation* manual.

## Sinusoidal Interference

RF irradiation on the device to IEC 61000-4-3:

- Electromagnetic RF field, amplitude-modulated
  - From 80 to 1000 MHz
  - 10 V/m
  - 80 % AM (1 kHz)
- Electromagnetic RF field, pulse-modulated
  - $900 \pm 5$  MHz
  - 10 V/m
  - 50 % ESD
  - 200 Hz repetition frequency
- RF coupling to signal and data lines etc. to IEC 61000-4-6, high-frequency, asymmetrical, amplitude-modulated
  - From 0.15 to 80 MHz
  - 10 V effective value, unmodulated
  - 80 % AM (1 kHz)
  - $150 \Omega$  source impedance

## Emission of Radio Interference

Emitted interference of electromagnetic fields to EN 55011: limit value class A, group 1.

From 20 to 230 MHz	< 30 dB ( $\mu$ V/m)Q
From 230 to 1000 MHz	< 37 dB ( $\mu$ V/m)Q
Measured at a distance of 30 m	

Emitted interference via system a.c. supply to EN 55011: limit value class A, group 1.

From 0.15 to 0.5 MHz	< 79 dB ( $\mu$ V)Q, < 66 dB ( $\mu$ V)M
From 0.5 to 5 MHz	< 73 dB ( $\mu$ V)Q, < 60 dB ( $\mu$ V)M
From 5 to 30 MHz	< 73 dB ( $\mu$ V)Q, < 60 dB ( $\mu$ V)M

## Redundant Configuration of the ET 200M

---

### Note

If you use the ET 200M in a redundant configuration, it **must** be in a switch cabinet with sufficient damping to ensure the limit values for radio interference are complied with.

---

## Expansion of the Area of Application

If you use the fail-safe signal modules in residential areas, you must ensure adherence to limit value class B to EN 55011 with regard to the emission of radio interference.

The following measures help to achieve adherence to the radio interference level of limit value class B:

- Installation in grounded switch cabinets/boxes
- The use of filters in supply lines

## 8.4 Transport and Storage Conditions

### Fail-Safe Signal Modules

Fail-safe signal modules exceed the requirements of IEC 1131, part 2 as regards transport and storage conditions. The following information applies to fail-safe signal modules transported and stored in the original packaging.

Type of Condition	Permissible Range
Free fall	≤ 1m
Temperature	From - 40 °C to + 70°C
Air pressure	From 1080 to 660 hPa (corresponds to an altitude of -1000 to 3500 m)
Relative humidity	From 5 to 95 %, without condensation

## 8.5 Mechanical and Climatic Environmental Conditions

### Conditions of Use

The fail-safe signal modules are intended for permanent installation in a sheltered location. The conditions of use exceed the requirements of IEC 1131-2.

The fail-safe signal modules fulfill the conditions of use of class 3C3 to DIN EN 60721 3-3 (installation sites with high traffic density and in the direct vicinity of industrial plant with chemical emissions).

### Restrictions

A fail-safe signal module must **not** be used without additional measures in the following locations:

- In locations with a high level of ionizing radiation
- In locations with difficult operating conditions such as the following, for example:
  - Dust
  - Corrosive fumes or gases
- In plants that require special monitoring such as:
  - Electrical plants in particularly hazardous areas

An additional measure for use can be, for example, to install the ET 200M with fail-safe signal modules in cabinets.

### Mechanical Environmental Conditions

The mechanical environmental conditions for fail-safe signal modules are listed in the following table in the form of sinusoidal oscillations.

Frequency Range (Hz)	Continuous	Occasional
$10 \leq f \leq 58$	0.0375 mm amplitude	0.075 mm amplitude
$58 \leq f \leq 150$	0.5 g constant acceleration	1 g constant acceleration

### Reduction of Oscillations

If the fail-safe signal modules are subjected to large surges or oscillations, you must reduce the acceleration or amplitude using suitable measures.

We recommend installation on damping material (for example, rubber metal vibration damper).

### Testing for Mechanical Environmental Conditions

The following table provides information on the type and scope of the tests for mechanical environmental conditions.

Testing for:	Test Standard	Remarks
Oscillations	Oscillations tested in accordance with IEC 68, parts 2-6 (sine)	Type of oscillation: Frequency sweeps with a rate of change of 1 octave per minute. 10 Hz ≤ f ≤ 58 Hz, const. amplitude 0.075 mm 58 Hz ≤ f ≤ 150 Hz, const. acceleration 1 g Duration of oscillation: 10 frequency sweeps per axis on each of the 3 axes arranged vertically in relation to each other
Surge	Surges tested in accordance with IEC 68, Parts 2-27	Surge type: Half-sine Surge strength: 15 g peak value, 11 ms duration Surge direction: 3 surges in both +/- directions on each of the 3 axes arranged vertically in relation to each other

### Climatic Environmental Conditions

The fail-safe signal modules can only be used in the following climatic environmental conditions:

Environmental Conditions	Operating Ranges	Remarks
Temperature: Horizontal installation Vertical installation	From 0 to 60°C From 0 to 40°C	-
Relative humidity	From 5 to 95 %	Without condensation - corresponds to a relative humidity stress level of 2 to IEC 1131-2
Air pressure	From 1080 to 795 hPa	Corresponds to an altitude of -1000 to 2000 m
Contaminant concentration	SO <sub>2</sub> : < 0.5 ppm; Relative humidity < 60 %, no condensation H <sub>2</sub> S: < 0.1 ppm; Relative humidity < 60 %, no condensation	Test: 10 ppm; 4 days  1 ppm; 4 days

## 8.6 Information on Rated Voltage, Insulation Testing, Safety Class and Protection Level

### Rated Voltages for Operation

The fail-safe signal modules work with a rated voltage of 24 V DC. The tolerance range is 20.4 to 28.8 V DC.

We recommend the power supply modules from the "SITOP power" Siemens range for the supply voltages.

### Test Voltages

The insulation resistance can be verified during routine testing using the following test voltages in accordance with IEC 1131 part 2:

Circuits with a Rated Voltage of $U_e$ Against Other Circuits or Ground	Test Voltage
$0 \text{ V} < U_e \leq 50 \text{ V}$	500 V DC

### Safety Class

Safety class I to IEC 60536 (VDE 0106, part 1), i.e. a ground terminal connection to the rail is required!

### Foreign Body and Water Protection

IP 20 degree of protection to EN 60529, i.e. protection against contact with standard test fingers.

In addition: protection against foreign bodies with a diameter of more than 12.5 mm.

No special protection against water.

## 8.7 Response Times

You can obtain the different parts of the following formula from the technical specifications of the relevant modules in Chapters 9 and 10.

### Response Times of the Fail-Safe Digital Modules

The response times of the fail-safe digital modules are calculated as for standard modules by means of the following formula:

#### Fail-safe digital input modules:

Response time = internal preprocessing time + input delay

Example of the SM 326; DI 24 X 24 V DC; with diagnostic interrupt in SIL 2 safety mode:

Response time = 29 ms + 3 ms = 32 ms

#### Fail-safe digital output modules:

Response time = internal preprocessing time + output delay

The output delay can always be disregarded.

Example of the SM 326; DO 10 X 24 V DC/2A; with diagnostic interrupt in safety mode:

Response time = 24 ms + 0 ms = 24 ms

### Response Time of the Fail-Safe Analog Input Modules

The response time (conversion time) of the fail-safe analog input modules is calculated by means of the following formula:

Response time = response time per channel X N + basic response time

N = the number of channels activated

Example of the SM 336; AI 6 X 13Bit; with diagnostic interrupt, all channels wired (N = 6), interference frequency 50 Hz:

Response time = 6 X 50 ms + 50 ms = 350 ms

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#### Note

You calculate the maximum response time by inserting the maximum values from the technical specifications of the fail-safe signal modules in the above formulas.

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# 9 Digital Modules

## Introduction

Three fail-safe, redundancy-capable digital modules of the S7-300 module range are available for the connection of digital sensors/encoders and/or loads/actuators for the fail-safe and fault-tolerant S7-400F and S7-400FH automation systems.

## Digital Modules

This chapter contains the following information on each fail-safe digital module:

- Features
- Module view and block diagram
- Applications with terminal assignment diagrams and parameter assignment
- Diagnostic messages with remedies
- Technical specifications



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### Safety Note

The safety parameters in the technical specifications are valid for a proof test period of 10 years.

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## Contents

The following digital modules are described in this chapter:

Section	Contents	Page
9.1	SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt	9-2
9.2	SM 326; DI 8 × NAMUR; with Diagnostic Interrupt	9-23
9.3	SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt	9-38

## 9.1 SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt

### 9.1.1 Features, Front View and Terminal Assignment and Block Diagram

#### Order Number

6ES7 326-1BK00-0AB0

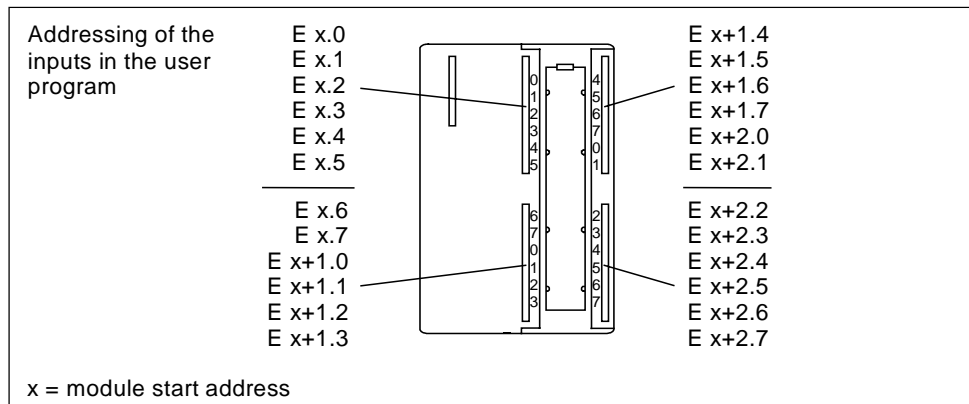
#### Features

The SM 326; DI 24 × 24 V DC ; with diagnostic interrupt has the following features:

- 24 inputs, isolated in groups of 12
- Rated input voltage of 24 V DC
- Suitable for switches and 2-/3-/4-wire proximity switches (BEROs)
- 4 short circuit-proof sensor supplies for 6 channels in each case, isolated in groups of 2
- External sensor supply possible
- Common error indicator (SF)
- Safety mode indicator (SAFE)
- Status indicator for each channel (green LED)
- Configurable diagnosis
- Configurable diagnostic interrupt
- Usable in standard and safety modes

#### Address Assignment in Standard Mode

The following figure shows the allocation of channels to addresses in standard mode.





### Front View

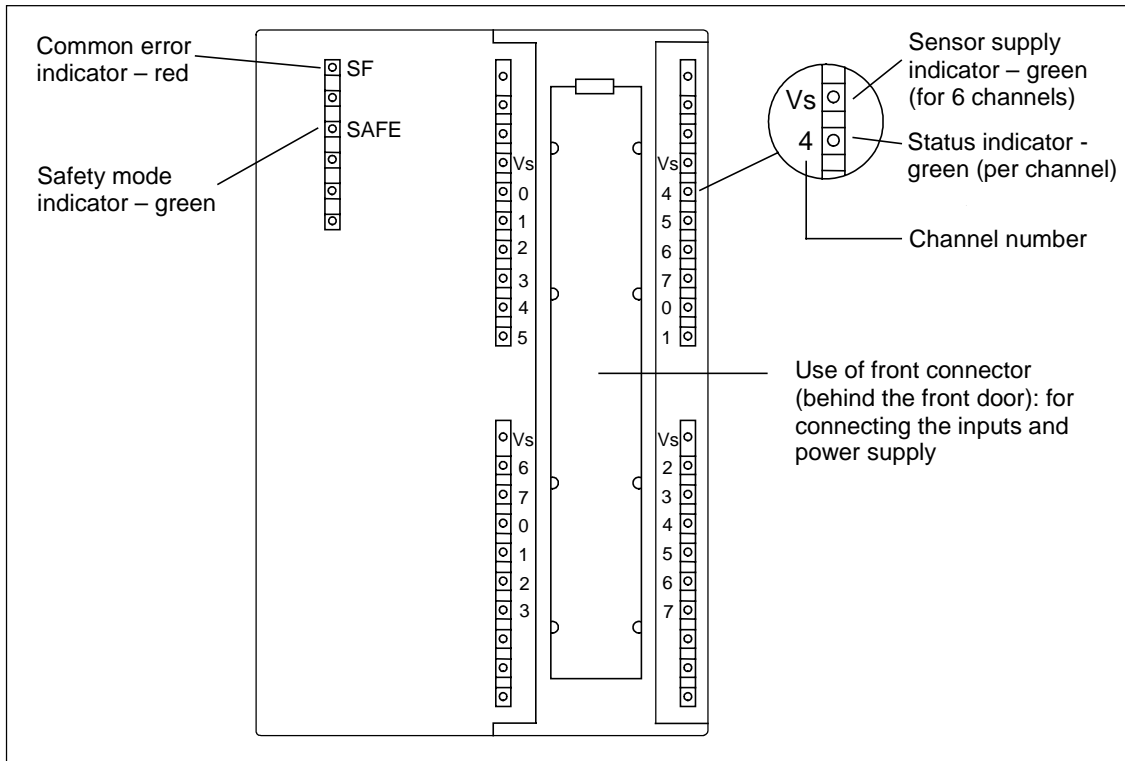
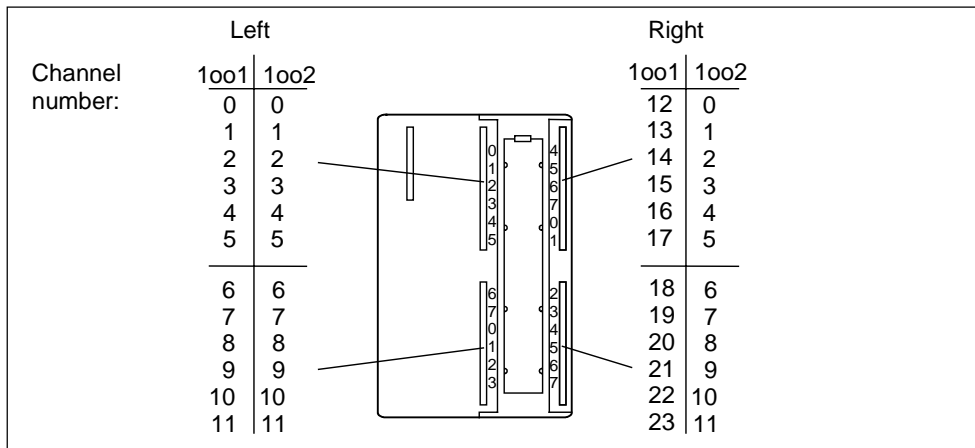


Figure 9-1 Front View of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt

### Channel Numbers in Safety Mode

In the safety functions, the inputs of the SM 326; DI 24 × 24 V DC; with diagnostic interrupt are addressed by means of channel numbers. The inputs are identified uniquely on the fail-safe driver block by means of the channel number and assigned the channel-specific diagnostic messages.

In the 1oo2 evaluation of the sensors the number of channels is halved.



### Terminal Assignment and Block Diagram

Figure 9-2 shows the terminal assignment and block diagram of the SM 326; DI 24 × 24 V DC; with diagnostic interrupt.

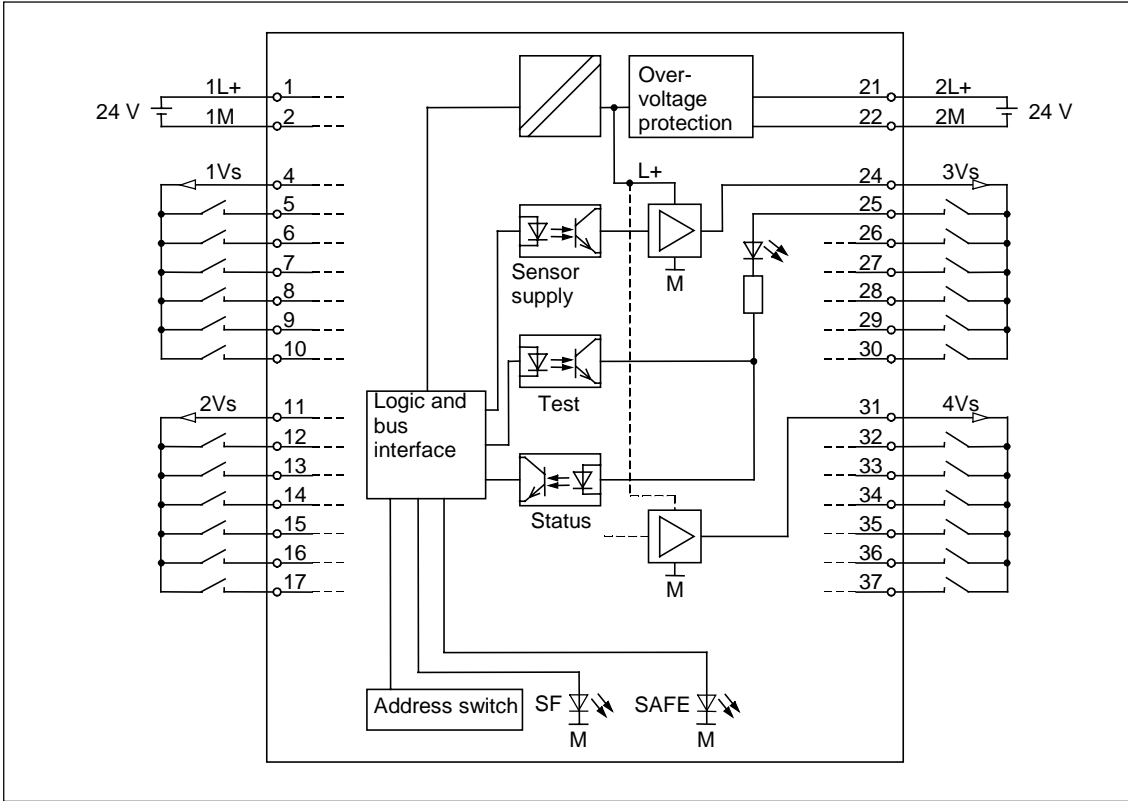


Figure 9-2 Terminal Assignment and Block Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt and Internal Sensor Supply

### External Sensor Supply

The following figure shows how the sensors can be supplied via an external sensor supply (for example, via another module: L+).

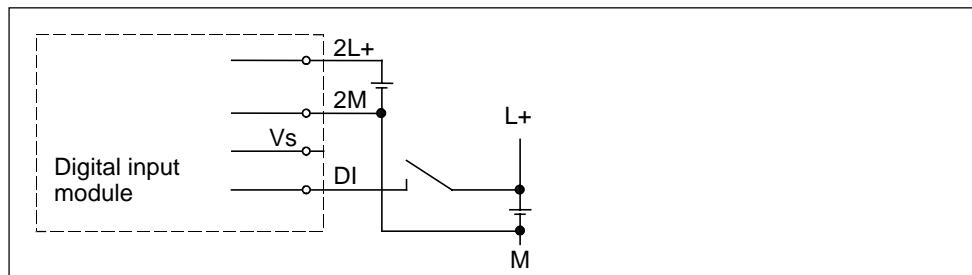


Figure 9-3 External Sensor Supply for the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt

## 9.1.2 Applications of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt

### Selecting the Application

Figure 9-4 will help you select the application that corresponds to your fail-safety and availability requirements. On the following pages you can find out how to wire the module for each application and which parameters you must set in *STEP 7* using the *S7 F Systems* add-on package.

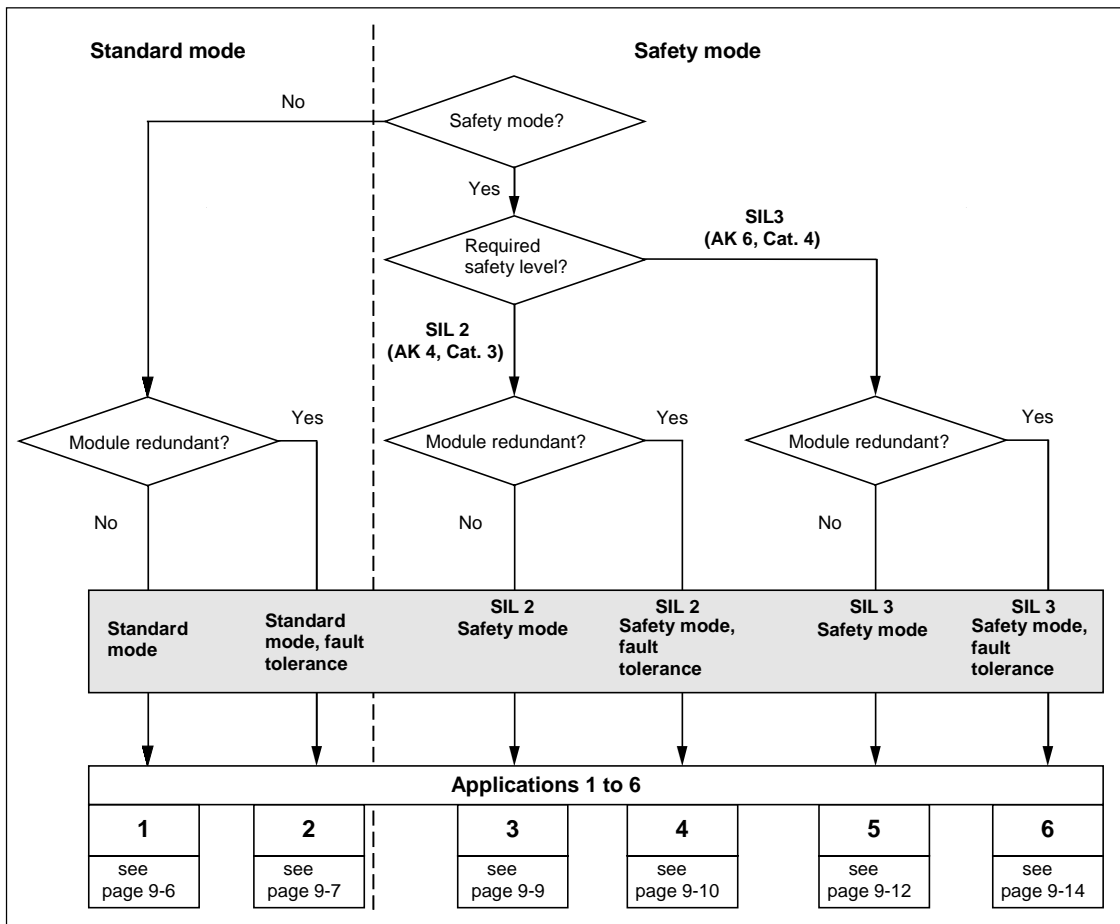


Figure 9-4 Selecting the Application - SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt



#### Safety Note

The safety level attained depends on the sensor quality and on the length of the proof period in accordance with IEC 61500 (period for preventative maintenance). If the sensor quality is worse than stipulated by the required safety level, the sensor must be used redundantly and be connected via two channels.

### 9.1.3 Application 1: Standard Mode

Below you can find the wiring diagram and the parameter assignment of the SM 326; DI 24 × 24 V DC; with diagnostic interrupt for:

- Application 1: standard mode

Diagnostic messages, possible fault causes and their remedies can be found in Tables 9-7 and 9-8.

#### Wiring Diagram for Application 1 – Single-Channel Sensor

24 process signals can be connected to a digital module. A sensor is connected via a single channel for each process signal. The digital module provides the sensor supply  $V_s$  for 6 channels. The sensors can also be supplied via an external sensor supply.

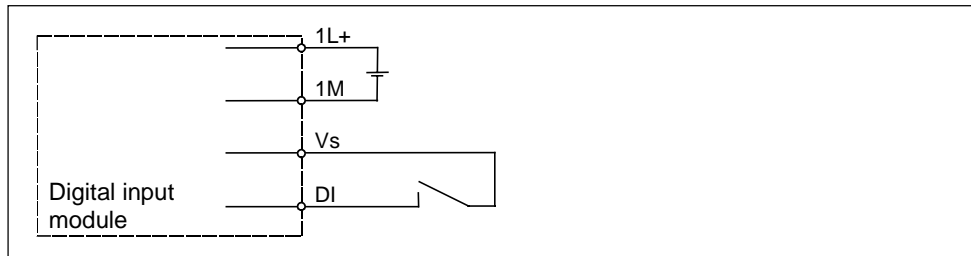


Figure 9-5 Wiring Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 1 – Single-Channel Sensor

#### Parameters for Application 1

Table 9-1 Parameters of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 1

Parameters	Range of Values in Standard Mode	Type	Effective in
<b>"Inputs" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Safety Mode	No	Static	Module
Sensor Supply via Module	Yes/no	Static	Module
With Short-Circuit Test	Yes/no (only when "Sensor Supply via Module" = yes)	Static	Module
Group Diagnosis	Yes/no	Static	channel

### 9.1.4 Application 2: Standard Mode with High Availability

Below you can find the wiring diagrams and the parameter assignment of the SM 326; DI 24 × 24 V DC; with diagnostic interrupt for:

- Application 2: standard mode with high availability

Diagnostic messages, possible fault causes and their remedies can be found in Tables 9-7 and 9-8.

#### Wiring Diagram for Application 2 – Single-Channel Sensor

24 process signals can be connected to two redundant digital modules. One sensor is connected via a single channel to the two digital modules for each process signal. The L+ sensor supply must be connected to the sensor externally.

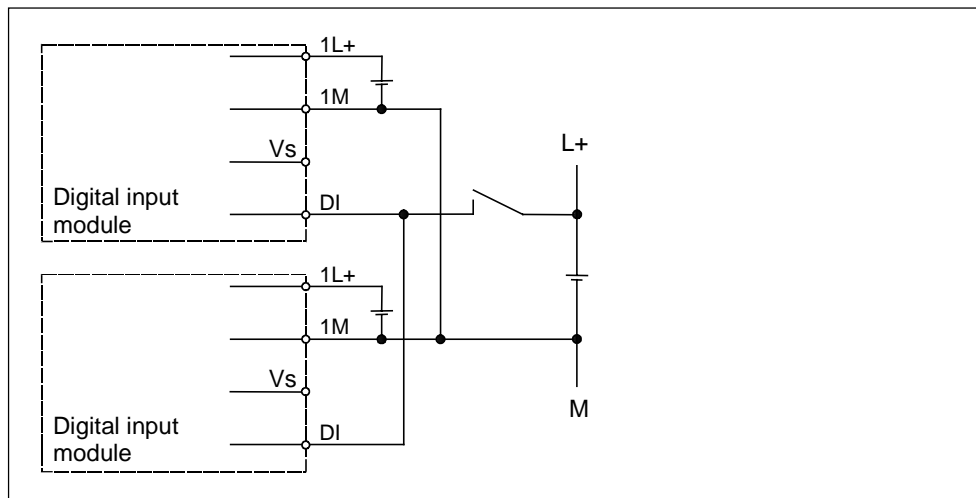


Figure 9-6 Wiring Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 2 – Single-Channel Sensor

### Wiring Diagram for Application 2 – Redundant Sensor

24 process signals can be connected to two redundant digital modules. Two redundant sensors are connected via one channel to the two digital modules for each process signal. The digital module provides the sensor supply  $V_s$  for 6 channels. The sensors can also be supplied via an external sensor supply.

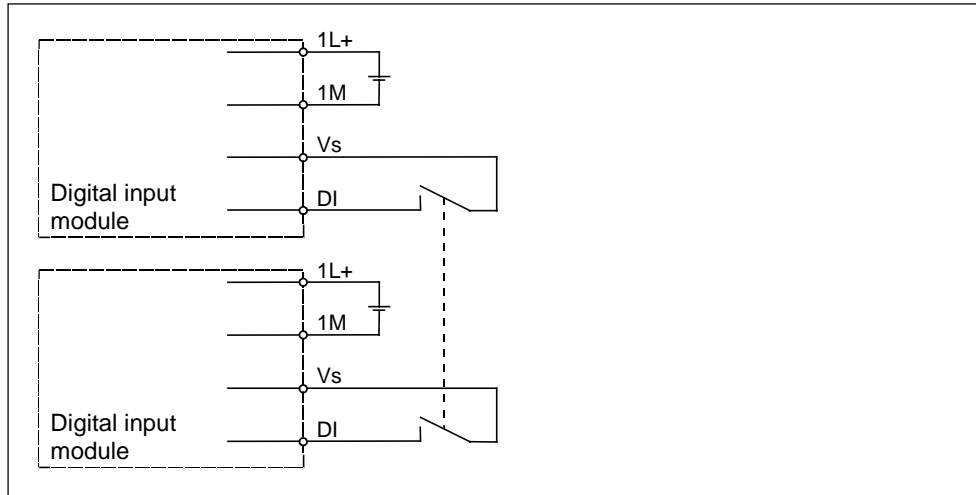


Figure 9-7 Wiring Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 2 – Redundant Sensor

### Parameters for Application 2

Table 9-2 Parameters of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 2

Parameters	Range of Values in Standard Mode	Type	Effective in
<b>"Inputs" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Safety Mode	No	Static	Module
Sensor Supply via Module	<ul style="list-style-type: none"> <li>• No (with single-channel sensor)</li> <li>• Yes/no (with redundant sensor)</li> </ul>	Static	Module
With Short-Circuit Test	Yes/no (only when "Sensor Supply via Module" = yes)	Static	Module
Group Diagnosis	Yes/no	Static	channel

### 9.1.5 Application 3: Safety Mode SIL 2 (Safety Level AK 4, Category 3)

Below you can find the wiring diagram and the parameter assignment of the SM 326; DI 24 × 24 V DC; digital module for:

- Application 3: safety mode SIL 2 (safety level AK 4, category 3)

Diagnostic messages, possible fault causes and their remedies can be found in Tables 9-7 and 9-8.

#### Wiring Diagram for Application 3 – Single-Channel Sensor

24 process signals can be connected to a digital module. One sensor is connected via a single channel (1oo1 evaluation) for each process signal. The digital module provides the sensor supply  $V_s$  for 6 channels. The L+ sensor supply can also be connected to the digital module externally.

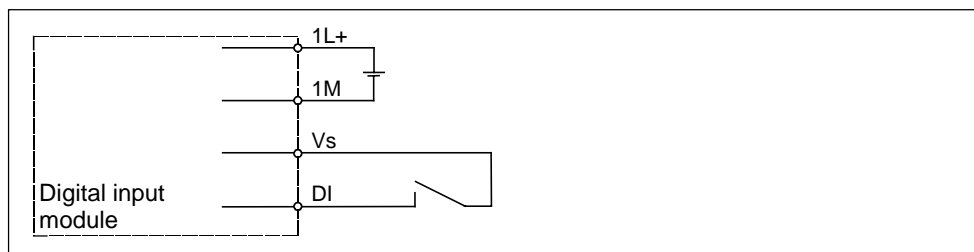


Figure 9-8 Wiring Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 3 – Single-Channel Sensor

#### Parameters for Application 3

Table 9-3 Parameters of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 3

Parameters	Range of Values in Safety Mode	Type	Effective in
<b>"Inputs" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Safety Mode	Yes	Static	Module
Monitoring Time	10 to 10000 ms	Static	Module
Sensor Evaluation	1oo1 Evaluation	Static	Module
Sensor Supply via Module	Yes/no	Static	Module
With Short-Circuit Test	Yes/no (only when "Sensor Supply via Module" = yes)	Static	Module
Group Diagnosis	Yes/no	Static	Channel
<b>"Redundancy" Tab</b>			
Redundancy	None	Static	Module

### 9.1.6 Application 4: Safety Mode SIL 2 (Safety Level AK 4, Category 3) with High Availability

Below you can find the wiring diagrams and the parameter assignment of the SM 326; DI 24 × 24 V DC; digital module for:

- Application 4: safety mode SIL 2 (safety level AK 4, category 3) with high availability

Diagnostic messages, possible fault causes and their remedies can be found in Tables 9-7 and 9-8.

#### Wiring Diagram for Application 4 – Single-Channel Sensor

24 process signals can be connected to two redundant digital modules. One sensor (1oo1 evaluation) is connected via a single channel to the two digital modules for each process signal. The L+ sensor supply must be connected to the sensor externally.

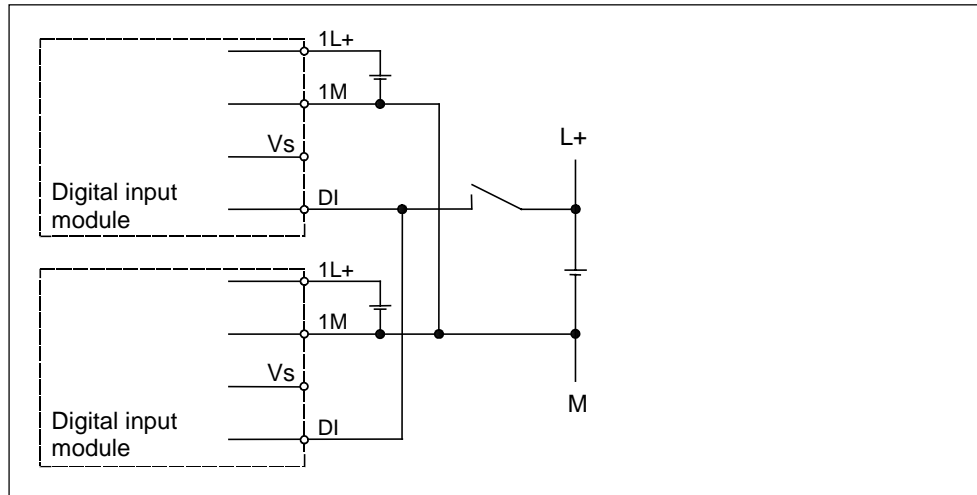


Figure 9-9 Wiring Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 4 – Single-Channel Sensor

#### Wiring Diagram for Application 4 – Redundant Sensor

24 process signals can be connected to two redundant digital modules. Two redundant sensors are connected via one channel (1oo1 evaluation) to the two digital modules for each process signal. The digital module provides the sensor supply  $V_s$  for 6 channels. The sensors can also be supplied via an external sensor supply.



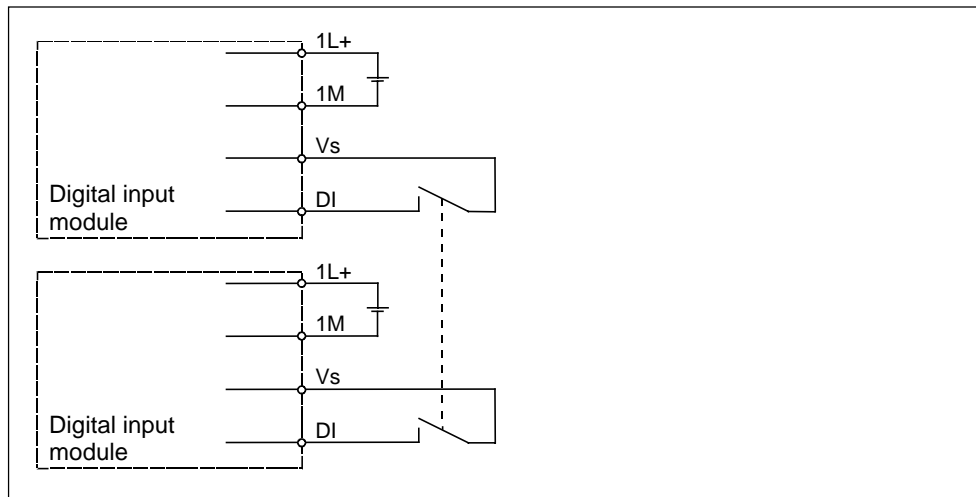


Figure 9-10 Wiring Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 4 – Redundant Sensor

### Parameters for Application 4

Table 9-4 Parameters of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 4

Parameters	Range of Values in Safety Mode	Type	Effective in
<b>"Inputs" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Safety Mode	Yes	Static	Module
Monitoring Time	10 to 10000 ms	Static	Module
Sensor Evaluation	1oo1 Evaluation	Static	Module
Sensor Supply via Module	Yes/no	Static	Module
With Short-Circuit Test	Yes/no (only when "Sensor Supply via Module" = yes)	Static	Module
Group Diagnosis	Yes/no	Static	Channel
<b>"Redundancy" Tab</b>			
Redundancy	Two Modules	Static	Module
Redundant Module	(Selection of an existing additional module of the same type)	Static	Driver block
Discrepancy Time	10 to 30000 ms	Static	Driver block

### 9.1.7 Application 5: Safety Mode SIL 3 (Safety Level AK 6, Category 4)

Below you can find the wiring diagrams and the parameter assignment of the SM 326; DI 24 × 24 V DC; digital module for:

- Application 5: safety mode SIL 3 (safety level AK 6, category 4)

Diagnostic messages, possible fault causes and their remedies can be found in Tables 9-7 and 9-8.

#### Wiring Diagram for Application 5 – Reading in Sensor Signal Twice

12 process signals can be connected to a digital module. One sensor is connected via a single channel to two **opposite inputs** in the digital module (1oo2 evaluation) for each process signal. The digital module provides the sensor supply  $V_s$  for 6 channels. The sensors can also be supplied via an external sensor supply.

A suitable sensor is required to attain SIL 3 (safety level AK 6, category 4) with this interface module.

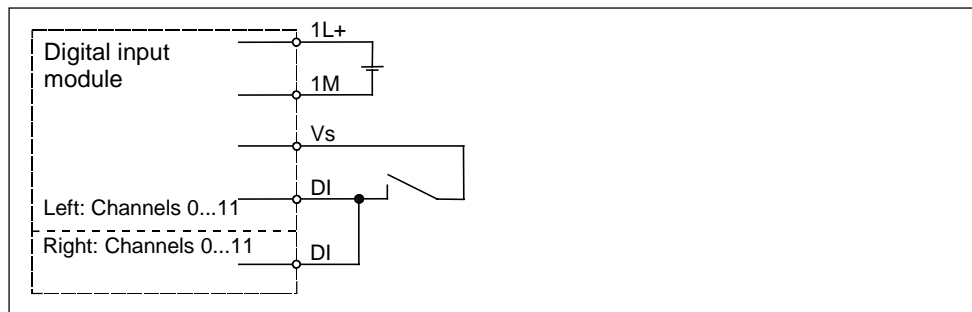


Figure 9-11 Wiring Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 5 – Redundant Sensor, Reading in Sensor Signal Twice

#### Wiring Diagram for Application 5 – Non-Equivalent Sensor

12 process signals can be connected to a digital module. One non-equivalent sensor is connected to two **opposite inputs** in the digital module (1oo2 evaluation) for each process signal. The digital module provides the sensor supply  $V_s$  for 6 channels. The sensors can also be supplied via an external sensor supply.

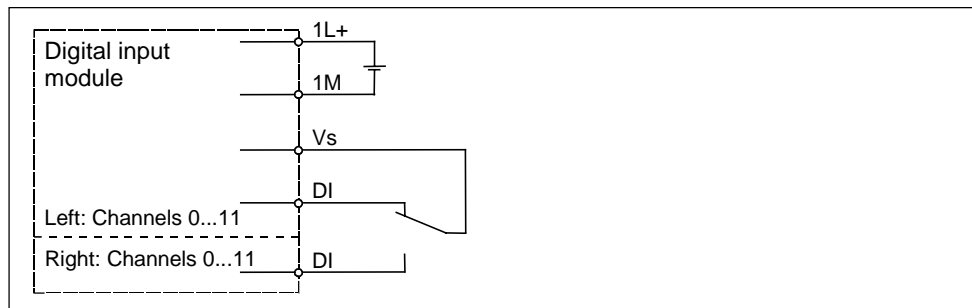


Figure 9-12 Wiring Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 5 – Non-Equivalent Sensor Signal

### Wiring Diagram for Application 5 – 2-Channel Sensor

12 process signals can be connected to a digital module. One sensor is connected via 2 channels to two **opposite inputs** in the digital module (1oo2 evaluation) for each process signal. The digital module provides the sensor supply  $V_s$  for 6 channels. The sensors can also be supplied via an external sensor supply.

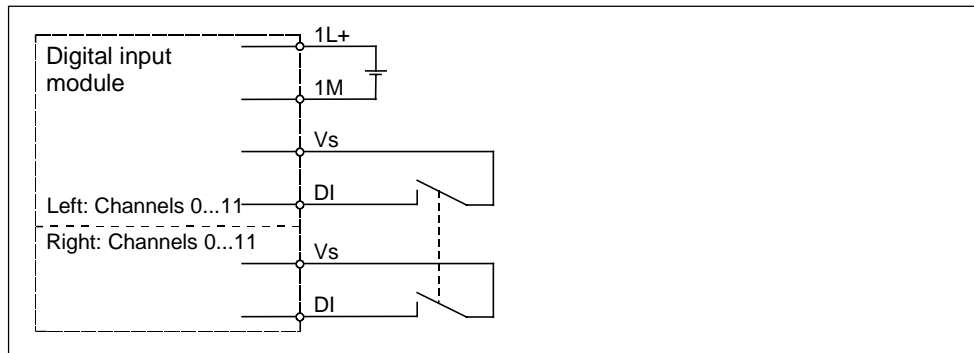


Figure 9-13 Wiring Diagram of the SM 326; DI 24 X 24 V DC; with Diagnostic Interrupt for Application 2 – 2-Channel Sensor

### Parameters for Application 5

Table 9-5 Parameters of the SM 326; DI 24 X 24 V DC; with Diagnostic Interrupt for Application 5

Parameters	Range of Values in Safety Mode	Type	Effective in
<b>"Inputs" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Safety Mode	Yes	Static	Module
Monitoring Time	10 to 10000 ms	Static	Module
Sensor Evaluation	1oo2 evaluation	Static	Module
Sensor Supply via Module	Yes/no	Static	Module
With Short-Circuit Test	Yes/no (only when "Sensor Supply via Module" = yes)	Static	Module
Group Diagnosis	Yes/no	Static	Channel
Type of Sensor Circuit	<ul style="list-style-type: none"> <li>• 2-Chann. (for Figure 9-13)</li> <li>• 2-Chann. Non-Equiv. (for Figure 9-12)</li> <li>• 1-Chann. (for Figure 9-11)</li> </ul>	Static	Channel
Discrepancy Time	10 to 30000 ms (2-Chann. only)	Static	Channel
<b>"Redundancy" Tab</b>			
Redundancy	None	Static	Module

### 9.1.8 Application 6: Safety Mode SIL 3 (Safety Level AK 6, Category 3) with High Availability

Below you can find the wiring diagrams and the parameter assignment of the SM 326; DI 24 × 24 V DC; digital module for:

- Application 6: safety mode SIL 3 (safety level AK 6, category 3) with high availability

Diagnostic messages, possible fault causes and their remedies can be found in Tables 9-7 and 9-8.

#### Wiring Diagram for Application 6 – Reading in Sensor Signal Twice

12 process signals can be connected to two redundant digital modules. Two redundant sensors are required for each process signal. One sensor is connected via a single channel to two **opposite inputs** in the digital module (1oo2 evaluation) for each module. The digital module provides the sensor supply  $V_s$  for 6 channels. The sensors can also be supplied via an external sensor supply.

A suitable sensor is required to achieve SIL 3/safety level AK 6/category 4 with this interface module.

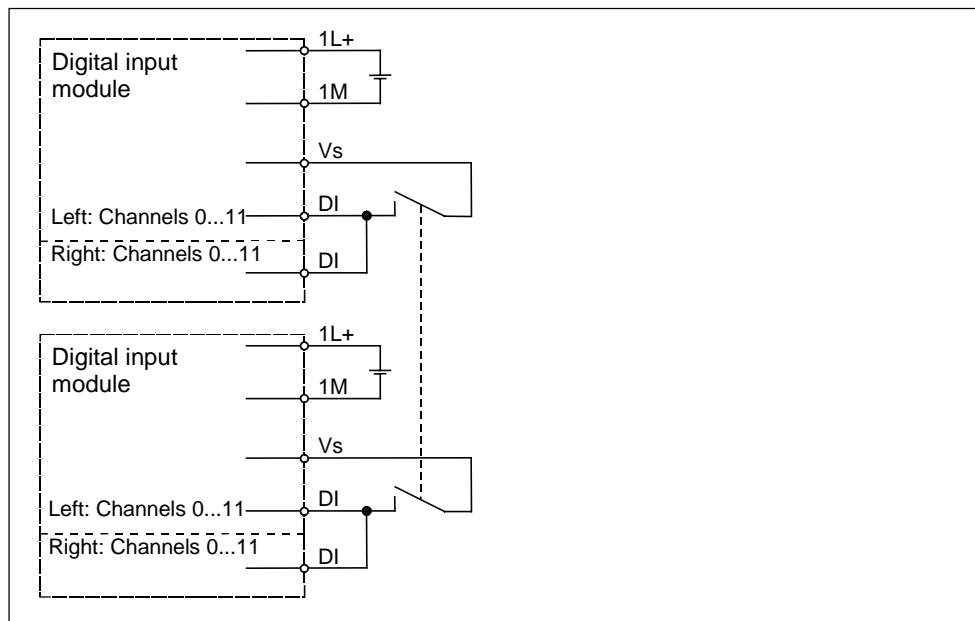


Figure 9-14 Wiring Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 6 – Redundant Sensor, Reading in Sensor Signal Twice

### Wiring Diagram for Application 6 – Redundant and Non-Equivalent Sensor

12 process signals can be connected to two redundant digital modules. Two redundant sensors are required for each process signal. One non-equivalent sensor is connected to two **opposite inputs** in the digital module (1oo2 evaluation) for each module. The digital module provides the sensor supply  $V_s$  for 6 channels. The sensors can also be supplied via an external sensor supply.

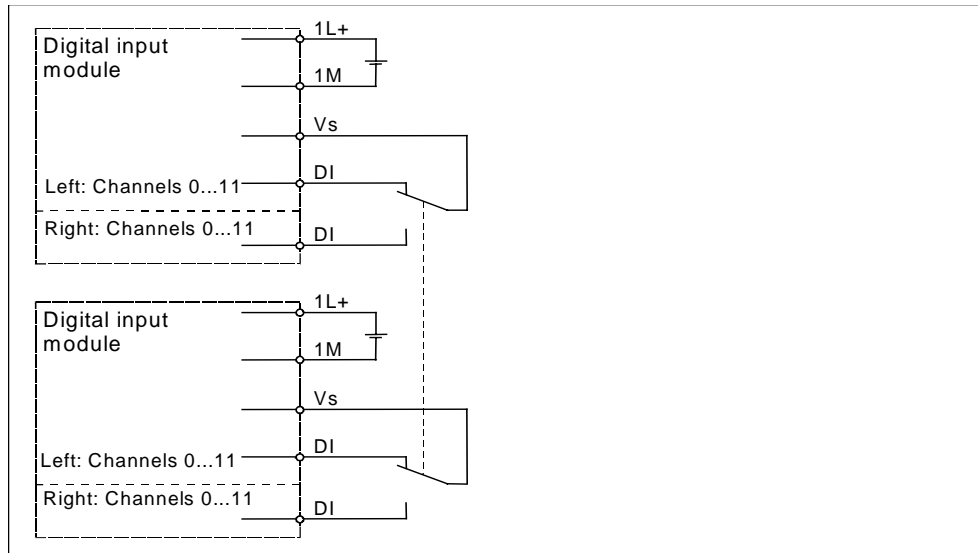


Figure 9-15 Wiring Diagram of the SM 326; DI 24 X 24 V DC; with Diagnostic Interrupt for Application 6 – Redundant and Non-Equivalent Sensor

### Wiring Diagram for Application 6 – 2-Channel Sensor

12 process signals can be connected to two redundant digital modules. One sensor is connected via 2 channels to the two digital modules (1oo2 evaluation) for each process signal. The sensor supply must be connected externally to the sensor.

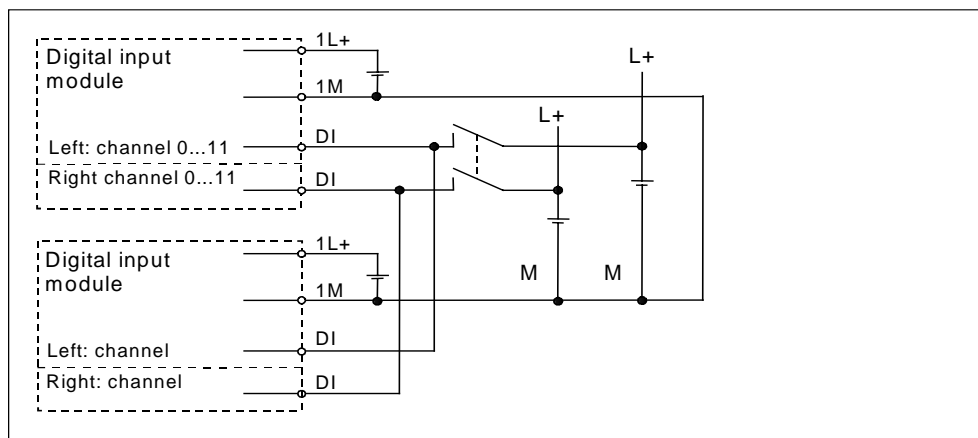


Figure 9-16 Wiring Diagram of the SM 326; DI 24 X 24 V DC; with Diagnostic Interrupt for Application 6 – 2-Channel Sensor

### Wiring Diagram for Application 6 – Redundant and 2-Channel Sensor

12 process signals can be connected to two redundant digital modules. Two redundant sensors are required for each process signal. One sensor is connected via 2 channels to two **opposite inputs** in the digital module (1oo2 evaluation) for each module. The digital module provides the sensor supply  $V_s$  for 6 channels. The sensors can also be supplied via an external sensor supply.

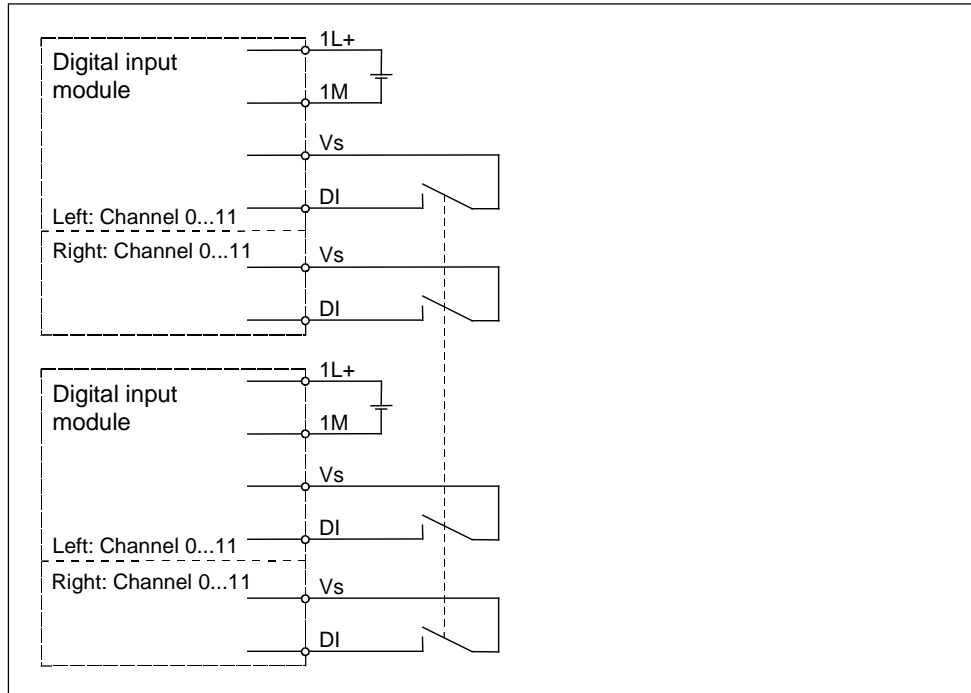


Figure 9-17 Wiring Diagram of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt for Application 2 – Redundant and 2-Channel Sensor

## Parameters for Application 6

Table 9-6 Parameters of the SM 326; DI 24 X 24 V DC; with Diagnostic Interrupt for Application 6

Parameters	Range of Values in Safety Mode	Type	Effective in
<b>"Inputs" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Safety Mode	Yes	Static	Module
Monitoring Time	10 to 10000 ms	Static	Module
Sensor Evaluation	1oo2 evaluation	Static	Module
Sensor Supply via Module	Yes/no	Static	Module
With Short-Circuit Test	Yes/no (only when "Sensor Supply via Module" = yes)	Static	Module
Group Diagnosis	Yes/no	Static	Channel
Type of Sensor Circuit	<ul style="list-style-type: none"> <li>• 2-Chan. (for Figures 9-16, 17)</li> <li>• 2-Chann. Non-Equiv. (for Figure 9-15)</li> <li>• 1-Chan. (for Figure 9-14)</li> </ul>	Static	Channel
Discrepancy Time	10 to 30000 ms (2-Chann. only)	Static	Channel
<b>"Redundancy" Tab</b>			
Redundancy	Two Modules	Static	Module
Redundant Module	(Selection of an existing additional module of the same type)	Static	Driver block
Discrepancy Time	10 to 30000 ms	Static	Driver block

### 9.1.9 Diagnostic Messages of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt

#### Possible Diagnostic Messages

Table 9-7 gives you an overview of the diagnostic messages of the SM 326; DI 24 × 24 V DC; with diagnostic interrupt.

The diagnostic messages are assigned either to a channel or the entire module. Some diagnostic messages only occur in certain applications.

Table 9-7 Diagnostic Messages of the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt

Diagnostic Message	Reported in Application	Diagnosis Effective in	Configurable
Short circuit or sensor supply defective	1, 2, 3, 4, 5, 6	Channel	Yes
Short circuit to L+ on the unswitched sensor line (contact open)			
Short circuit to ground or sensor supply defective			
Short circuit to sensor supply line on unswitched sensor line (contact open)			
Discrepancy error 1oo2 evaluation	5, 6	Channel	
External auxiliary voltage missing	1, 2, 3, 4, 5, 6	Module	No
Module not assigned parameters			
Wrong parameters on module			
Loss of communication			
Module-internal supply voltage failed			
Time monitoring responded (watchdog)			
EPROM fault			
RAM fault			
Processor failure			
Parameter assignment error (with consecutive) number)			
Internal error in the read circuit/test circuit	1, 2, 3, 4, 5, 6	Channel	
Error in the cyclic redundancy check (CRC)	3, 4, 5, 6	Module	
Monitoring time for data message frame exceeded			
Message frame error during non fail-safe communication	1,2	Module	



## Short Circuit to M and L+

The internal short-circuit tests are carried out as follows:

Short circuit to chassis ground is always tested, regardless of the configuration.

Short circuit to L+ is only tested when sensor supply via module and short-circuit test are configured in HWCONFIG.

## Fault Causes and Remedies

You can find the possible causes for faults and the corresponding remedies for the individual diagnostic messages of the SM 326; DI 24 × 24 V DC; with diagnostic interrupt in Table 9-8.

Table 9-8 Diagnostic Messages and Their Remedies for the SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt

Diagnostic Message	Possible Fault Causes	Remedies
Internal short circuit or sensor supply defective	Internal fault of the sensor supply	Replace the module
Short circuit to L+ on the unswitched sensor line (contact open)	Short circuit to L+ of the unconnected sensor line	Eliminate short circuit
Short circuit to ground or sensor supply defective	Short circuit of the input to M	Eliminate short circuit
	Internal fault of the sensor supply	Replace the module
Short circuit on the unconnected sensor line (contact open) to the sensor supply line	Short circuit between the unconnected sensor line and the sensor supply line	Eliminate short circuit
Discrepancy error 1oo2 evaluation	Failed process signal Defective sensor	Check the process signal; replace the sensor, if necessary
	Short circuit between the unconnected sensor line and the sensor supply line	Eliminate short circuit
	Wire break on the connected sensor line or the sensor supply line	Eliminate wire break
	Discrepancy time parameterized too short	Check the parameterization of the discrepancy time
External auxiliary voltage missing	The L+ supply voltage of the module is missing	Feed the L+ supply
Module not assigned parameters	No parameters transferred to the module	Reparameterize the module
Wrong parameters on module	Incorrect parameters transferred to the module	Reparameterize the module
	The setting of the logical module address in STEP 7 does not correspond to the setting of the address switch on the module.	Correct the address setting and reparameterize the module

Diagnostic Message	Possible Fault Causes	Remedies
Loss of communication	Communication problem between the CPU and the module due, for example to a defective PROFIBUS connection or to impermissibly high electromagnetic interference	Check the PROFIBUS connection Eliminate the problems
	Monitoring time for safety frame exceeded	Check the parameterization of the monitoring time
	Test value error (CRC) due, for example, to impermissibly high electromagnetic interference	Eliminate the problems
	CPU has gone into STOP	Read out diagnostic buffer
Module-internal supply voltage failed	Internal fault of the L+ supply voltage	Replace the module
Time monitoring responded (watchdog)	Overload due to diagnostic request (SFCs)	Reduce the number of diagnostic requests
	Impermissibly high electromagnetic interference	Eliminate the problems
	Defective Module	Replace the module
EPROM fault RAM fault	Impermissibly high electromagnetic interference	Eliminate the interference and switch the supply voltage off/on
	Defective Module	Replace the module
Processor failure	Impermissibly high electromagnetic interference	Eliminate the problems
	Defective Module	Replace the module
Parameter assignment error (with consecutive number)	Error in dynamic parameter assignment	Check the parameter assignment in the user program If necessary, contact SIMATIC Customer Support
Internal error in the read circuit/test circuit	Defective Module	Replace the module
Error in the cyclic redundancy check (CRC)	Test value error during communication between the CPU and the module due, for example, to impermissibly high electromagnetic interference or due to watchdog monitoring errors	Eliminate the problems
Monitoring time for data message frame exceeded	Parameterized monitoring time for a watchdog of the module exceeded	Check the parameterization of the monitoring time
	Power-up of fail-safe signal module	-
Message frame error during non fail-safe communication	Enter the watchdog and/or the test value in the data frame	Check the data frame for the "0" entry for the watchdog and test value

### 9.1.10 Technical Specifications - SM 326; DI 24 × 24 V DC; with Diagnostic Interrupt

Dimensions and Weight	
Dimensions W × H × D (mm)	80 × 125 × 120
Weight	Approx. 442 g
Module-Specific Data	
Number of inputs	24
Occupied address area	
• In the PII	10 bytes
• In the PIQ	4 bytes
Line length	
• Unshielded	Max. 100 m
• Shielded	Max. 200 m
Maximum safety level that can be achieved in safety mode	
• To IEC 61508	SIL 3
• To DIN V 19250	Safety level AK 6
• To EN 954-1	Cat. 4
Safety parameters	SIL 2      SIL 3
• Low demand mode (average probability of failure on demand)	1.55E-06    4.99E-08
• High demand/continuous mode (probability of a dangerous failure per hour)	1.77E-11    5.70E-13
Voltages, Currents, Potentials	
Rated supply voltage of the electronic components and sensors 1L+, 2L+	24 V DC
• Reverse polarity protection	Yes
• Voltage failure buffering (does not apply to sensor supply outputs)	5 ms
Number of inputs that can be addressed simultaneously	
• Horizontal installation	
Up to 40 °C	24
Up to 60 °C	24 (at 24 V) 18 (at 28.8 V)
• Vertical installation	
Up to 40 °C	24
Electrical isolation	
• Between the channels and backplane bus	Yes
• Between the channels	
In groups of	Yes
Permissible potential difference between the different circuits	75 V DC 60 V AC

Insulation tested with	75 V DC
Power input	
• From the backplane bus	Typically 90 mA
• From load voltage 1L+, 2L+ (without load)	Typically 350 mA
Power loss of the module	Typically 9.0 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	
• Diagnostic interrupt	Configurable
Diagnostic functions	Configurable
• Common error display	Red LED (SF)
• Fail-safe mode display	Green LED (SAFE)
• Diagnostic information can be read out	Possible
Sensor Supply Outputs	
Number of outputs	4
Electrical isolation of the outputs	Yes
• In groups of	2
Output voltage	
• Loaded	Min. L+ (-1.5 V)
Output current	
• Rated value	400 mA
• Permissible Range	0 to 400 mA
Additional (redundant) supply	Permissible
Short-circuit protection	Yes, electronically
Data for Selecting a Sensor	
Input voltage	
• Rated value	24 V DC
• At signal "1"	11 to 30 V
• At signal "0"	- 30 to 5 V
Input current	
• At signal "1"	Typically 10 mA
Input characteristic	To IEC 1131, type 2
Connection of 2-wire BERO	Possible if "With Short-Circuit Test" parameter is set to "no"
• Permissible closed-circuit current	Max. 2 mA

<b>Time, Frequency</b>	
Internal preprocessing time (without input delay) for	Max.
• Standard mode	25 ms
• Safety mode SIL 2 (safety level AK 4, category 3)	29 ms
• Safety mode SIL 3 (safety level AK 6, category 4)	34 ms
Input delay	
• From "0" to "1"	2.1 to 3.4 ms
• From "1" to "0"	2.1 to 3.4 ms
Acknowledgment time	
• In standard mode	Max. 23 ms
• In safety mode with 1oo1 sensor evaluation	Max. 24 ms
• In safety mode with 1oo2 sensor evaluation	Max. 27 ms
Minimum sensor signal duration	Min. 32 ms

## 9.2 SM 326; DI 8 × NAMUR; with Diagnostic Interrupt

### 9.2.1 Features, Front View and Terminal Assignment and Block Diagram

#### Order Number

6ES7 326-1RF00-0AB0

#### Features

The SM 326; DI 8 × NAMUR; with diagnostic interrupt has the following features:

- SIMATIC S7 intrinsically safe digital module, suitable for connecting signals from a hazardous area
- 8 single-channel inputs and 4 two-channel inputs isolated from one another
- Rated input voltage of 24 V DC
- Suitable for the following sensors
  - To DIN 19234 and NAMUR (with diagnostic evaluation)
  - Switched mechanical contacts (with diagnostic evaluation)
- 8 short circuit-proof sensor supplies for 1 channel, isolated from one another
- Common error indicator (SF)
- Safety mode indicator (SAFE)
- Status indicator for each channel (green LED)
- Configurable diagnosis
- Configurable diagnostic interrupt
- Usable in standard and safety modes

#### Adhering to Clearance in Air and Leakage Paths in Hazardous Areas

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##### Note

In the case of the digital input module SM 326; DI 8 × NAMUR; with diagnostic interrupt, the L+/M infeed must be via the wire chamber to adhere to the creepages and clearances in hazardous areas (order no. 6ES7393-4AA10-0AA0) (see Chapter 5).

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**Front View**

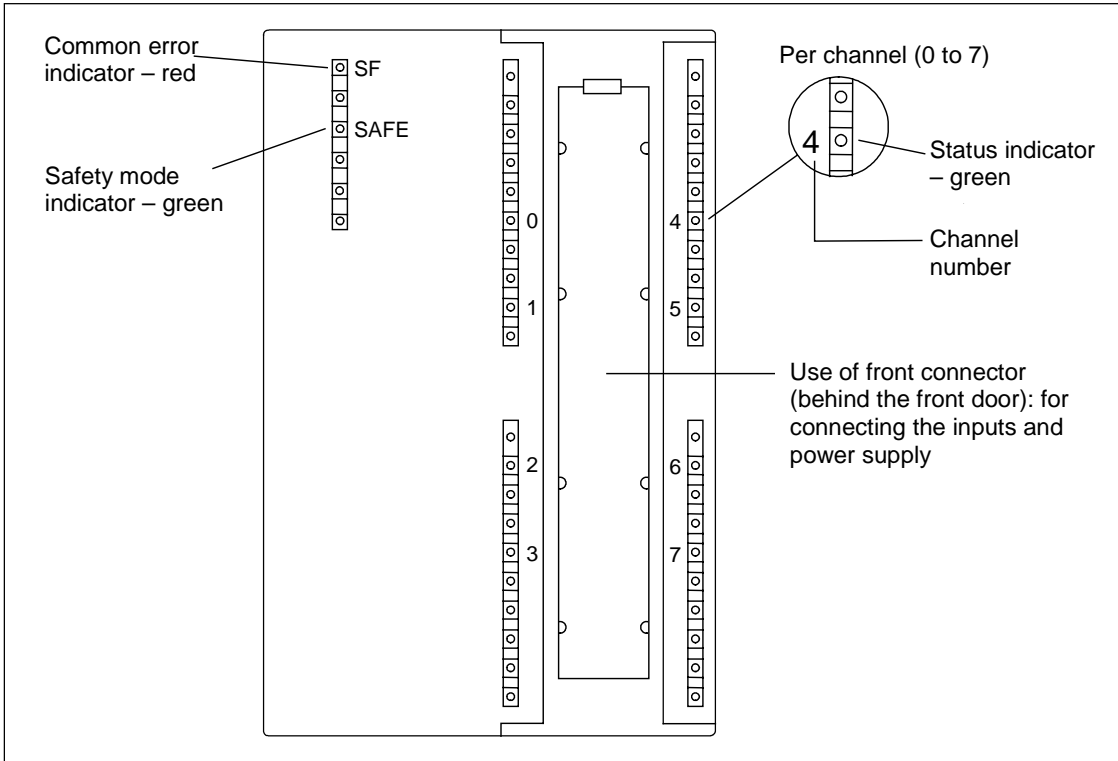


Figure 9-18 Front View of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt

**Connectable Sensors**

Figure 9-19 shows the possible sensors and their connection to the SM 326; DI 8 × NAMUR; with diagnostic interrupt.

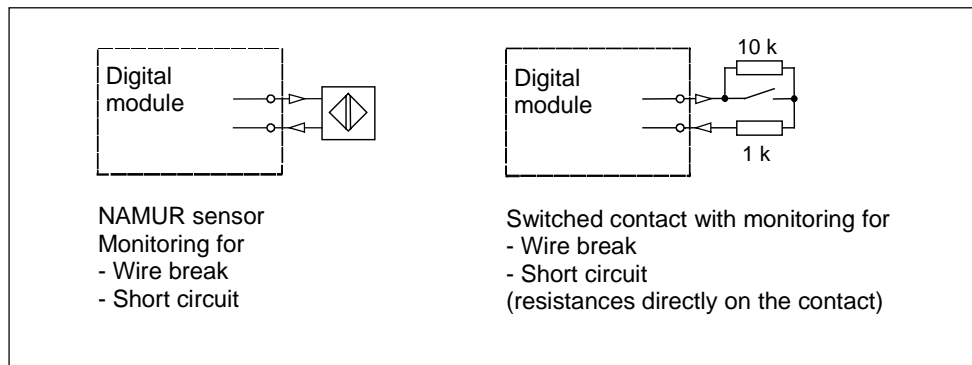


Figure 9-19 Connectable Sensors of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt

### Terminal Assignment and Block Diagram

Figure 9-20 shows the terminal assignment and block diagram of the SM 326; DI 8 × NAMUR; with diagnostic interrupt.

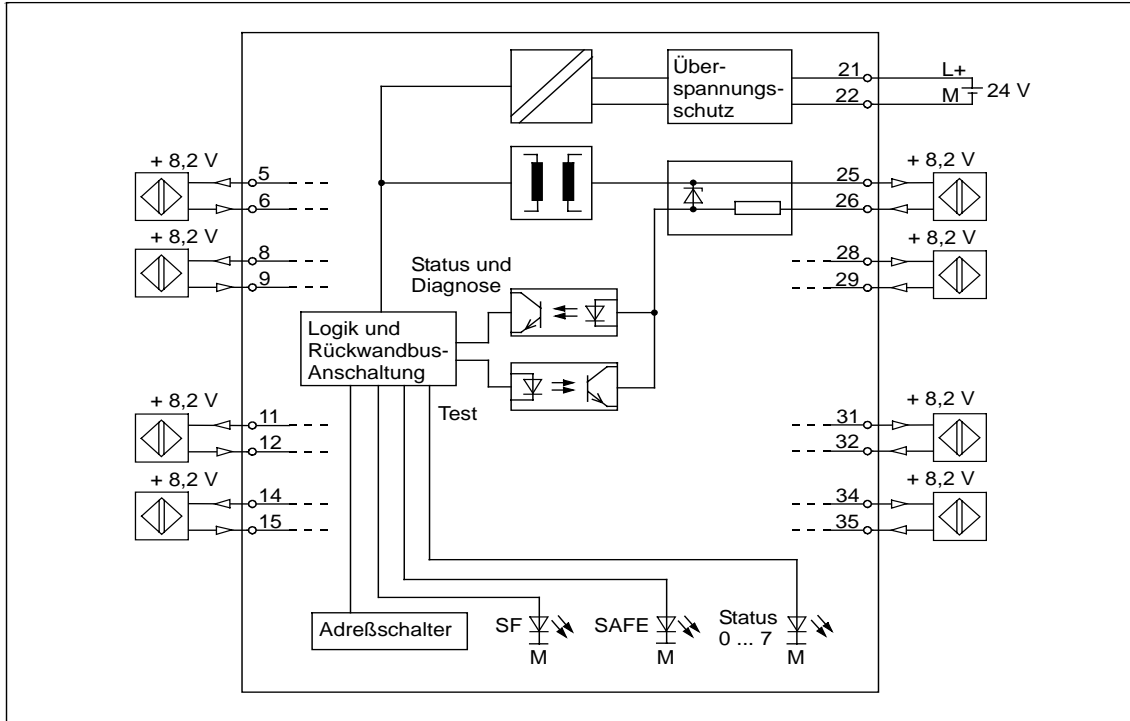
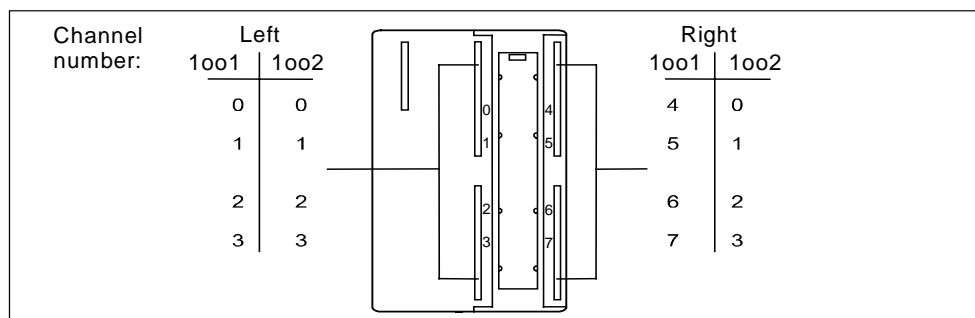


Figure 9-20 Terminal Assignment and Block Diagram of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt

### Channel Numbers in Safety Mode

In the safety functions, the inputs of the SM 326; DI 8 × NAMUR; with diagnostic interrupt are addressed by means of channel numbers. The inputs are identified uniquely on the fail-safe driver block by means of the channel number and assigned the channel-specific diagnostic messages.

In the 1oo2 evaluation of the sensors the number of channels is halved.



## 9.2.2 Applications of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt

### Selecting the Application

Figure 9-21 will help you to select the application that corresponds to your fail-safety and availability requirements. On the following pages you can find out how to wire the module for each application and which parameters you must set in *STEP 7* using the *S7 F Systems* add-on package.

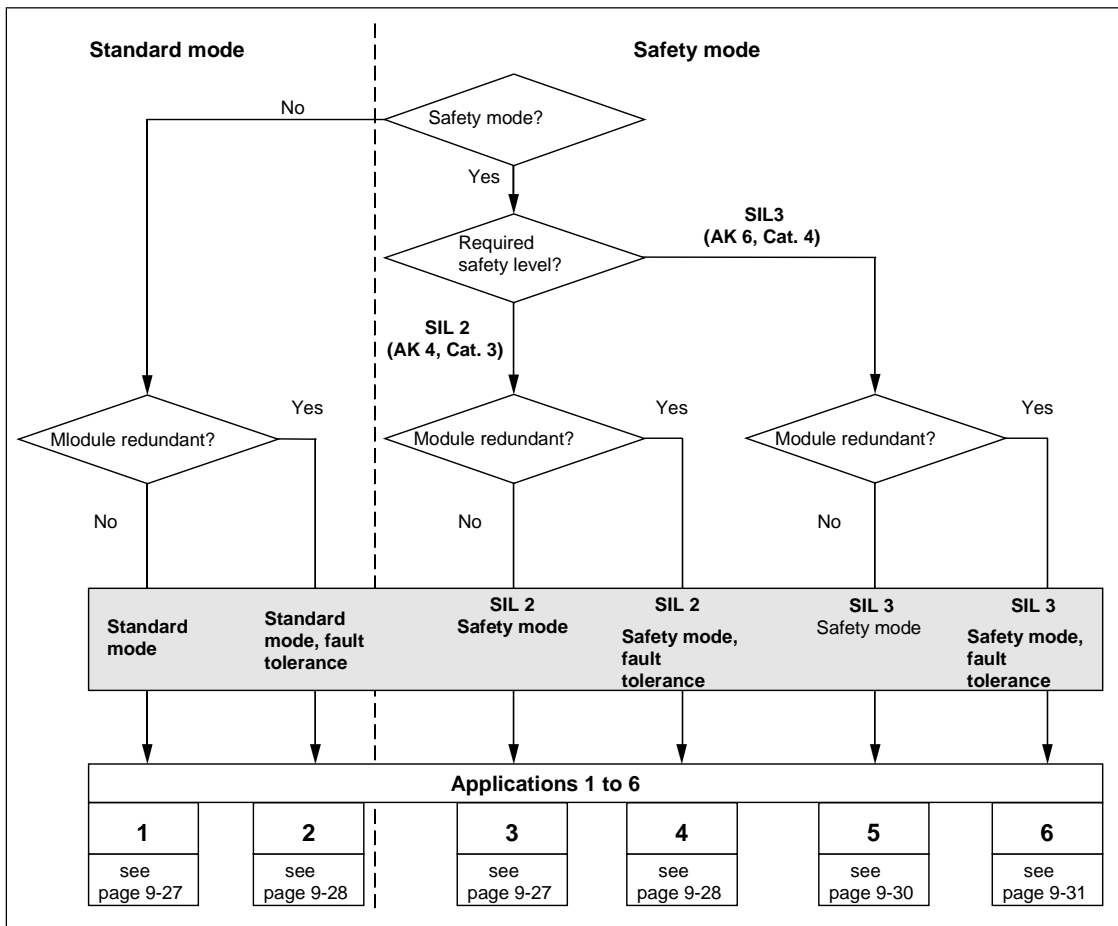


Figure 9-21 Selecting the Application - SM 326; DI 8 × NAMUR; with Diagnostic Interrupt



#### Safety Note

The safety level attained depends on the sensor quality and on the length of the proof-test period in accordance with IEC 61500 (period for preventative maintenance). If the sensor quality is worse than stipulated by the required safety level, the sensor must be used redundantly and be connected via two channels.



### 9.2.3 Application 1: Standard Mode and Application 3: Safety Mode SIL 2 (Safety Level AK 4, Category 3)

Below you can find the wiring diagram and the parameter assignment of the SM 326; DI 8 × NAMUR; with diagnostic interrupt for:

- Application 1: standard mode
- Application 3: safety mode SIL 2 (safety level AK 4, category 3)

Diagnostic messages, possible fault causes and remedies can be found in Tables 9-13 and 9-14.

#### Wiring Diagram for Applications 1 and 3

8 process signals can be connected to a digital module. A single-channel sensor (1oo1 evaluation) is connected to the digital module for each process signal. The digital module provides the sensor supply  $V_s$ .

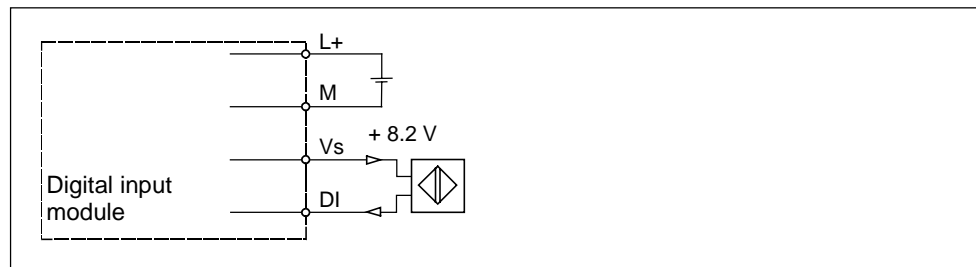


Figure 9-22 Wiring Diagram of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt for Applications 1 and 3

#### Parameters for Applications 1 and 3

Table 9-9 Parameters of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt for Applications 1 and 3

Parameters	Range of Values in		Type	Diagnosis Effective in
	Safety Mode	Standard mode		
<b>"Inputs" Tab</b>				
Enable Diagnostic Interrupt	Yes/no	Yes/no	Static	Module
Safety Mode	Yes	No	Static	Module
Monitoring Time	10 to 10000 ms	-	Static	Module
Sensor Evaluation	1oo1 Evaluation	-	Static	Module
Group Diagnosis	Yes/no	Yes/no	Static	Channel
<b>"Redundancy" Tab</b>				
Redundancy	None	-	Static	Module

### 9.2.4 Application 2: Standard Mode with High Availability and Application 4: Safety Mode SIL 2 (Safety Level AK 4, Category 3) with High Availability

Below you can find the wiring diagram and the parameter assignment of the SM 326; DI 8 × NAMUR; with diagnostic interrupt for:

- Application 2: standard mode with high availability
- Application 4: safety mode SIL 2 (safety level AK 4, category 3) with high availability

Diagnostic messages, possible fault causes and remedies can be found in Tables 9-13 and 9-14.

#### Wiring Diagram for Applications 2 and 4

8 process signals can be connected to two redundant digital modules. Two redundant sensors are connected via one channel (1oo1 evaluation) to the two digital modules for each process signal. The relevant digital module provides the sensor supply  $V_s$ .

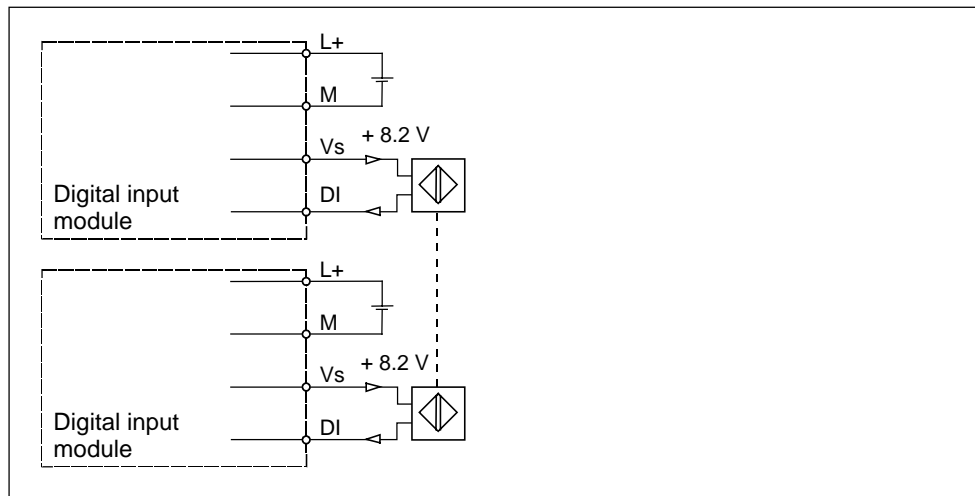


Figure 9-23 Wiring Diagram of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt for Applications 2 and 4

## Parameters for Applications 2 and 4

Table 9-10 Parameters of the SM 326; DI 8 X NAMUR; with Diagnostic Interrupt for Applications 2 and 4

Parameters	Range of Values in		Type	Diagnosis Effective in
	Safety Mode	Standard mode		
<b>"Inputs" Tab</b>				
Enable Diagnostic Interrupt	Yes/no	Yes/no	Static	Module
Safety Mode	Yes	No	Static	Module
Monitoring Time	10 to 10000 ms	-	Static	Module
Sensor Evaluation	1oo1 Evaluation	-	Static	Module
Group Diagnosis	Yes/no	Yes/no	Static	Channel
<b>"Redundancy" Tab</b>				
Redundancy	Two Modules	-*	Static	Module
Redundant Module	(Selection of an existing additional module of the same type)	-	Static	Driver block
Discrepancy Time	10 to 30000 ms	-	Static	Driver block

\* The redundancy of two modules in standard mode must be configured in the user program in the same way as for S7-300 standard modules.

### 9.2.5 Application 5: Safety Mode SIL 3 (Safety Level AK 6, Category 4)

Below you can find the wiring diagram and the parameter assignment of the SM 326; DI 8 × NAMUR; with diagnostic interrupt for:

- Application 5: safety mode SIL 3 (safety level AK 6, category 4)

Diagnostic messages, possible fault causes and remedies can be found in Tables 9-13 and 9-14.

#### Wiring Diagram for Application 5

4 process signals can be connected to a digital module. One sensor is connected via 2 channels (1oo2 evaluation) to two **opposite inputs** in the digital module for each process signal. The digital module provides the sensor supply  $V_s$ .

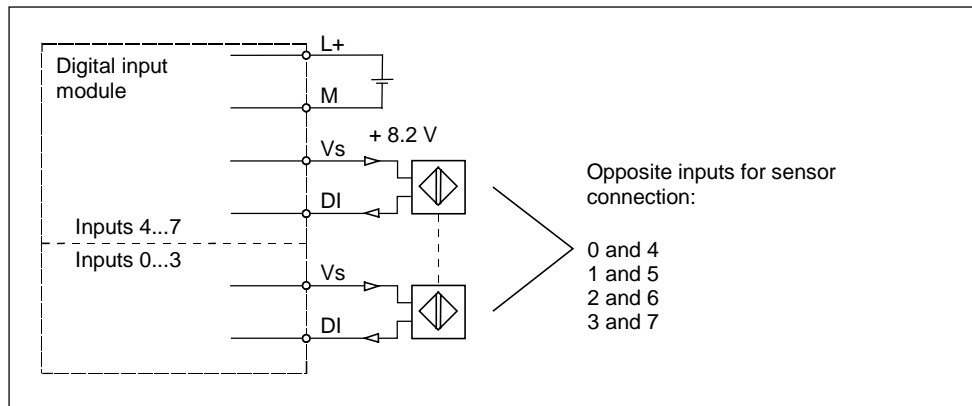


Figure 9-24 Wiring Diagram of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt for Application 5

#### Parameters for Application 5

Table 9-11 Parameters of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt for Application 5

Parameters	Range of Values in Safety Mode	Type	Effective in
<b>"Inputs" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Safety Mode	Yes	Static	Module
Monitoring Time	10 to 10000 ms	Static	Module
Sensor Evaluation	1oo2 evaluation	Static	Module
Group Diagnosis	Yes/no	Static	Channel
Discrepancy Time	10 to 30000 ms	Static	Channel
<b>"Redundancy" Tab</b>			
Redundancy	None	Static	Module

## 9.2.6 Application 6: Safety Mode SIL 3 (Safety Level AK 6, Category 4) with High Availability

Below you can find the wiring diagram and the parameter assignment of the SM 326; DI 8 × NAMUR; with diagnostic interrupt for:

- Application 6: safety mode SIL 3 (safety level AK 6, category 4) with high availability

Diagnostic messages, possible fault causes and remedies can be found in Tables 9-13 and 9-14.

### Wiring Diagram for Application 6

4 process signals can be connected to two redundant digital modules. Two redundant sensors are connected via two channels (1oo2 evaluation) to the two digital modules for each process signal. The sensor contacts of the sensor each lead to **opposite inputs** of the same digital module. The relevant digital module provides the sensor supply  $V_s$ .

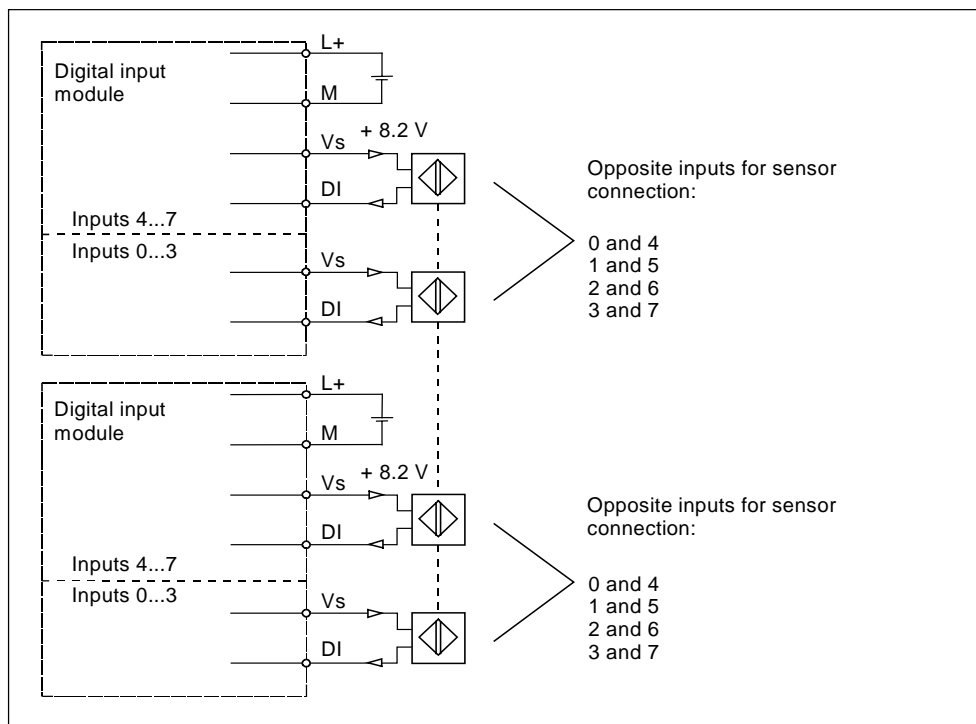


Figure 9-25 Wiring Diagram of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt for Application 6

## Parameters for Application 6

Table 9-12 Parameters of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt for Application 6

Parameters	Range of Values in Safety Mode	Type	Effective in
<b>"Inputs" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Safety Mode	Yes	Static	Module
Monitoring Time	10 to 10000 ms	Static	Module
Sensor Evaluation	1oo2 evaluation	Static	Module
Group Diagnosis	Yes/no	Static	Channel
Discrepancy Time	10 to 30000 ms	Static	Channel
<b>"Redundancy" Tab</b>			
Redundancy	Two modules	Static	Module
Redundant Module	(Selection of an existing additional module of the same type)	Static	Driver block
Discrepancy Time	10 to 30000 ms	Static	Driver block

## 9.2.7 Diagnostic Messages of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt

### Possible Diagnostic Messages

Table 9-13 gives you an overview of the diagnostic messages of the SM 326; DI 8 × NAMUR; with diagnostic interrupt.

The diagnostic messages are assigned either to a channel or the entire module. Some diagnostic messages only occur in certain applications.

Table 9-13 Diagnostic Messages of the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt

Diagnostic Message	Reported in Application	Diagnosis Effective in	Configurable
Wire break or internal error in sensor supply	1, 2, 3, 4, 5, 6	Channel	Yes
Short circuit or sensor supply defective			
Short circuit between sensor line and sensor supply line			
Short circuit or wire break on unswitched sensor line (contact open)			
Discrepancy error (1oo2 evaluation)	5, 6	Channel	
External auxiliary voltage missing	1, 2, 3, 4, 5, 6	Module	No
Module not assigned parameters			
Wrong parameters on module			
Loss of communication			
Module-internal supply voltage failed			
Time monitoring responded (watchdog)			
EPROM fault			
RAM fault			
Internal error in read circuit/test circuit or defective sensor supply			
Processor failure			
Parameter assignment error (with consecutive) number)	3, 4, 5, 6	Module	
Error in the cyclic redundancy check (CRC)			
Monitoring time for data message frame exceeded	1, 2	Module	
Message frame error during non fail-safe communication			

## Fault Causes and Remedies

You can find the possible causes for errors and the corresponding remedies for the individual diagnostic messages of the SM 326, DI 8 × NAMUR; with diagnostic interrupt in Table 9-14.

Table 9-14 Diagnostic Messages and Their Remedies for the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt

Diagnostic Message	Possible Fault Causes	Remedies
Wire break or internal fault of the sensor supply	Interruption of the wire between the module and the NAMUR sensor	Reestablish the connection
	With contacts as sensors: 10 kΩ series resistor directly above the contact is missing or interrupted	Insert 10 kΩ series resistor directly above the contact
	Channel is not connected (open)	Disable the "Group Diagnosis" parameter for the channel
	Internal fault of the sensor supply	Replace the module
Short circuit or sensor supply defective	Short circuit to L + of the sensor supply line	Eliminate short circuit
	With contacts as sensors: Short circuit to L+ of the connected sensor line (contact closed)	Eliminate short circuit
	With contacts as sensors: 1 kΩ series resistor in the wire to the contact is missing	Insert 1 kΩ series resistor in the wire directly on the contact
	Internal fault of the sensor supply	Replace the module
Short circuit between the sensor line and the sensor supply line	Short circuit between the two sensor lines	Eliminate short circuit
Short circuit or wire break on unswitched sensor line (contact open)	Short circuit to M of the unconnected sensor line	Eliminate short circuit
	Interruption in the wire between the module and the sensor	Reestablish the connection
Discrepancy error (1oo2 evaluation)	Failed process signal Defective NAMUR sensor	Check the process signal; replace the NAMUR sensor, if necessary
	Short circuit between the unconnected sensor line and the sensor supply line	Eliminate short circuit
	Wire break on the connected sensor line or the sensor supply line	Eliminate wire break
	Discrepancy time parameterized too short	Check the parameterization of the discrepancy time
External auxiliary voltage missing	The L+ supply voltage of the module is missing	Feed the L+ supply
Module not assigned parameters	No parameters transferred to the module	Reparameterize the module



Diagnostic Message	Possible Fault Causes	Remedies
Wrong parameters on module	Incorrect parameters transferred to the module	Reparameterize the module
	The setting of the logical module address in STEP 7 does not correspond to the setting of the address switch on the module.	Correct the address setting and reparameterize the module
Loss of communication	Communication problem between the CPU and the module due, for example to a defective PROFIBUS connection or to impermissibly high electromagnetic interference	Check the PROFIBUS connection Eliminate the problems
	Monitoring time for data frame exceeded	Check the parameterization of the monitoring time
	Test value error (CRC) due, for example, to impermissibly high electromagnetic interference	Eliminate the problems
	CPU has gone into STOP	Read out diagnostic buffer
Module-internal supply voltage failed	Internal fault of the L+ supply voltage	Replace the module
Time monitoring responded (watchdog)	Overload due to diagnostic request (SFCs)	Reduce the number of diagnostic requests
	Impermissibly high electromagnetic interference	Eliminate the problems
	Defective Module	Replace the module
EPROM fault RAM fault	Impermissibly high electromagnetic interference	Eliminate the interference and switch the supply voltage off/on
	Defective Module	Replace the module
Internal error in read circuit/test circuit or defective sensor supply	Defective Module	Replace the module
Processor failure	Impermissibly high electromagnetic interference	Eliminate the problems
	Defective Module	Replace the module
Parameter assignment error (with consecutive) number)	Error in dynamic parameter assignment	Check the parameter assignment in the user program If necessary, contact SIMATIC Customer Support
Error in the cyclic redundancy check (CRC)	Test value error during communication between the CPU and the module due, for example, to impermissibly high electromagnetic interference or due to watchdog monitoring errors	Eliminate the problems
Monitoring time for safety frame exceeded	Parameterized monitoring time for a watchdog of the module exceeded	Check the parameterization of the monitoring time
	Power-up of fail-safe signal module	-
Message frame error during non fail-safe communication	Enter the watchdog and/or the test value in the data frame	Check the data frame for the "0" entry for the watchdog and test value

## 9.2.8 Technical Specifications - SM 326; DI 8 × NAMUR; with Diagnostic Interrupt

Dimensions and Weight	
Dimensions W × H × D (mm)	80 × 125 × 120
Weight	Approx. 482 g
Module-Specific Data	
Number of inputs	
• Single-channel	8
• Two-channel	4
Occupied address area	
• In the PII	6 bytes
• In the PIQ	4 bytes
Line length	
• Shielded	Max. 200 m
• Unshielded	Max. 100 m
Ignition protection type	II(2)G [EEx ib] IIC to EN 50020
Test number KEMA	99 ATEX 2671 X
Maximum safety level that can be achieved in safety mode	
• To IEC 61508	Single-ch. Two-ch.
• To DIN V 19250	SIL 2 SIL 3
• To EN 954-1	AK 4 AK 5, 6
	Cat. 3 Cat. 4
Safety parameters	
	SIL 2 SIL 3
• Low demand mode (average probability of failure on demand)	2.74E-06 4.83E-08
• High demand / cont. mode (probability of a dangerous failure per hour)	3.13E-11 5.51E-13
Voltages, Currents, Potentials	
Rated supply voltage of the electr. comp. and sensor L+	24 V DC
• Reverse polarity protection	Yes
• Voltage failure bridging	5 ms
Number of inputs that can be addressed simultaneously	
• Horizontal installation Up to 60 °C	8
• Vertical installation Up to 40 °C	8
Electrical isolation	
• Between the channels and backplane bus	Yes
• Between the channels and power supply to the electronic components	Yes
• Between the channels	Yes

Permissible potential difference	
• Between different circuits [EEx]	60 V DC 30 V AC
• Between different circuits [not EEx]	75 V DC 60 V AC
Insulation tested with	
• Channels against the backplane bus and load voltage L+	1500 V AC
• Load voltage L+ against the backplane bus	500 V DC and 350 V AC
• Chan. between each other	1500 V AC
Power input	
• From the backplane bus	Max. 90 mA
• From load voltage L+ (without load)	Max. 160 mA
Power loss of the module	Typically 4.5 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	
• Diagnostic interrupt	Configurable
Diagnostic functions	
• Common error display	Red LED (SF)
• Fail-safe mode display	Green LED (SAFE)
• Diagnostic information can be read out	Possible
Sensor Supply Outputs	
Number of outputs	8
Output voltage	8.2 V DC
Short-circuit protection	Yes, electronically
Safety Guidelines (See Conformity Description in the Appendix)	
Highest values of the input circuits (per channel)	
• U <sub>o</sub> (Output open-circuit voltage)	Max. 10 V
• I <sub>o</sub> (Short-circuit current)	Max. 13.9 mA
• P <sub>o</sub> (Load power)	Max. 33.1 mW
• L <sub>o</sub> (Permissible external induction)	Max. 80 mH
• C <sub>o</sub> (Permissible external capacity)	Max. 3 µF
• U <sub>m</sub> (Fault voltage)	Max. 60 V DC Max. 30 V AC
• T <sub>a</sub> (Permissible ambient temperature)	Max. 60 °C

Data for Selecting a Sensor	
Sensor	To DIN 19234 and NAMUR
Input current	
• At signal "0"	0.35 to 1.2 mA
• At signal "1"	2.1 to 7 mA

Time, Frequency		
Internal preprocessing time (without input delay) for	Typ.	Max.
• Standard mode	55 ms	60 ms
• Safety Mode	55 ms	60 ms
Input delay		
• From "0" to "1"	1.2 to 3 ms	
• From "1" to "0"	1.2 to 3 ms	
Acknowledgment time		
• In standard mode	Max. 68 ms	
• In safety mode	Max. 68 ms	
Minimum sensor signal duration	Min. 38 ms	

## 9.3 SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt

### 9.3.1 Features, Front View and Terminal Assignment and Block Diagram

#### Order Number

6ES7 326-2BF00-0AB0

#### Features

The SM 326; DO 10 × 24 V DC/2A; with diagnostic interrupt has the following features:

- 10 inputs, isolated in groups of 5
- Output current 2 A
- Rated load voltage 24 V DC
- Suitable for solenoid valves, DC contactors and indicator lights
- 2 connections per output
  - One connection for single-channel actuator control (without series diode)
  - One connection for redundant actuator control (with series diode)
- Common error display (SF)
- Safety mode indicator (SAFE)
- Status indicator for each channel (green LED)
- Configurable diagnosis
- Configurable diagnostic interrupt
- Configurable substitute value output in standard mode
- Usable in standard and safety modes

#### Redundant Output Signals



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#### Safety Note

The output with a series diode can be used for redundant control of an actuator. Redundant control can take place from 2 different modules without an external circuit. The two signal modules must have the same reference potential (M).

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### Front View

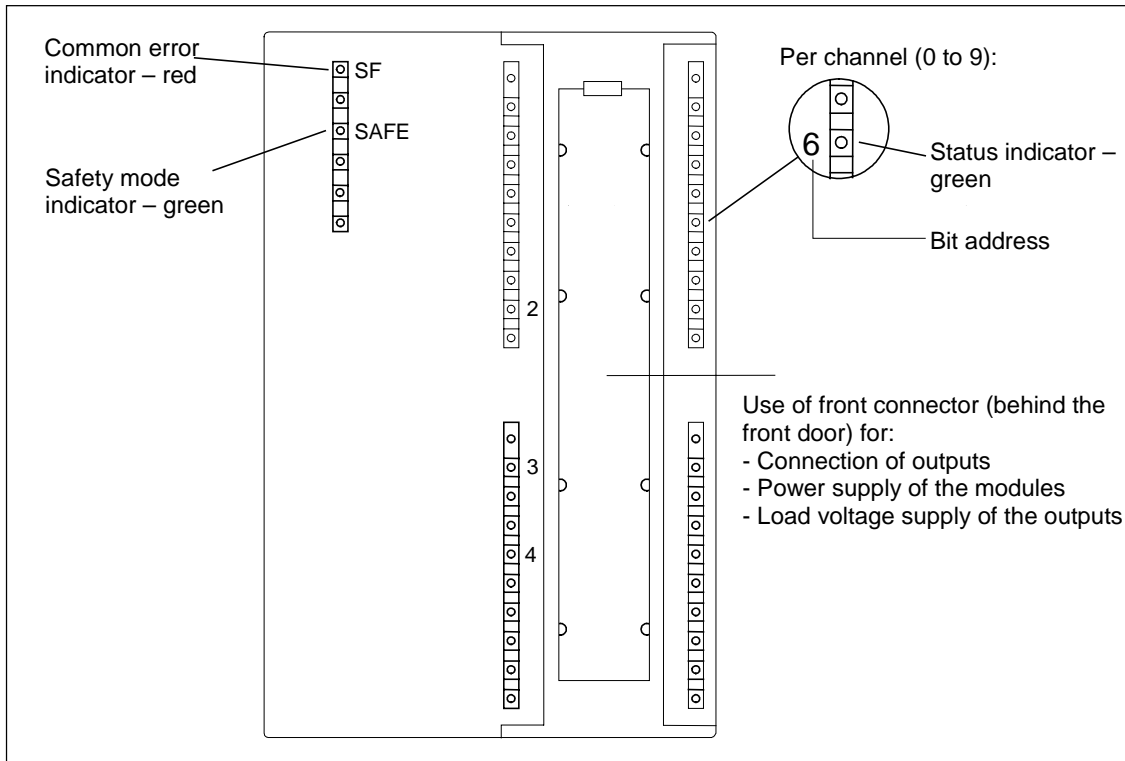
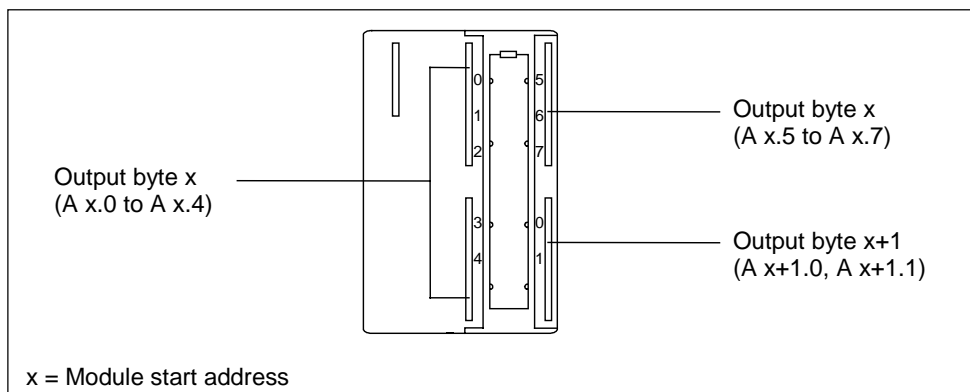


Figure 9-26 Front View of the SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt

### Address Assignment

The following figure shows the allocation of the channels to the addresses in standard mode.



### Terminal Assignment and Block Diagram

Figure 9-27 shows the terminal assignment and the block diagram of the SM 326; DO 10 × DC 24V/2A; with diagnostic interrupt.

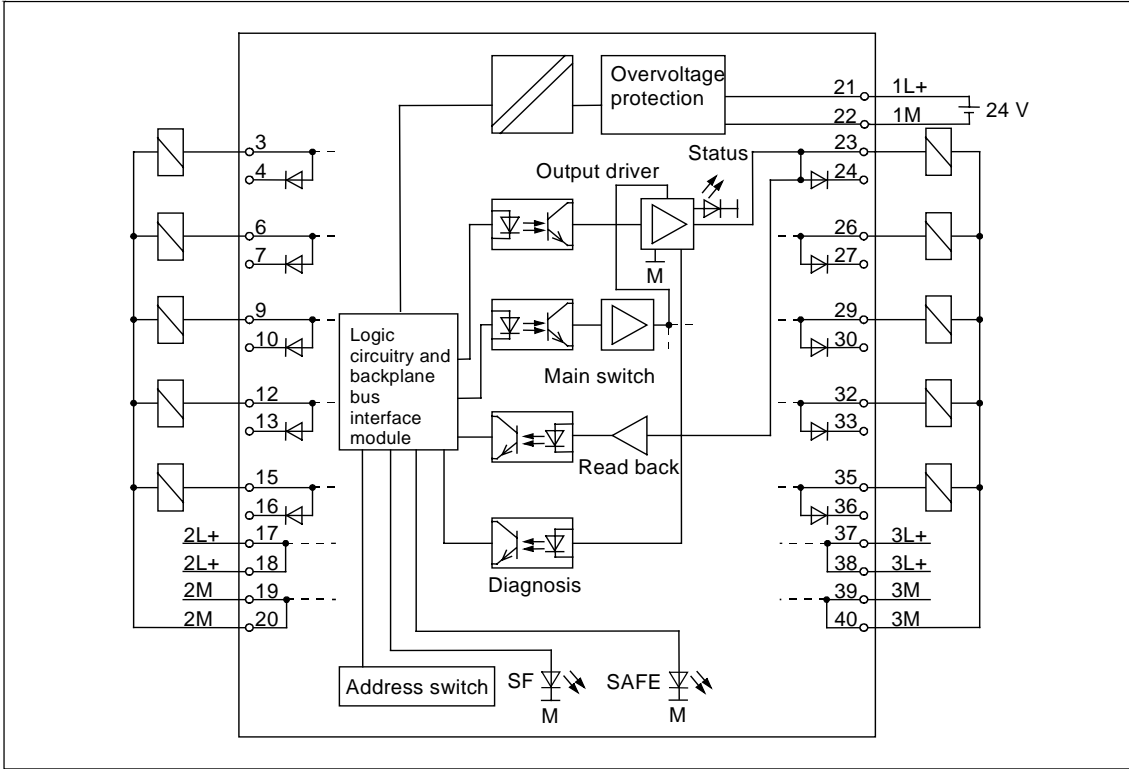
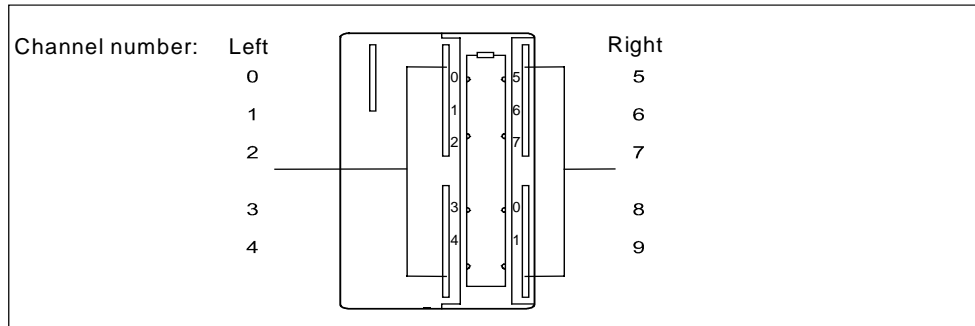


Figure 9-27 Terminal Assignment and Block Diagram of the SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt

### Channel Numbers in Safety Mode

In the safety functions the outputs of the SM 326; DO 10 × 24 V DC/2A; with diagnostic interrupt are addressed by means of channel numbers. The outputs are identified uniquely on the fail-safe driver blocks by means of the channel numbers and the channel-specific diagnostic messages are assigned.



### 9.3.2 Applications of the SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt

#### Selecting the Application

Figure 9-28 helps you to select the application in accordance with the requirements in terms of fail safety and fault tolerance (availability). On the following pages you can find out how to wire the module for each application and which parameters you must set in *STEP 7* using the *S7 F Systems* add-on package.

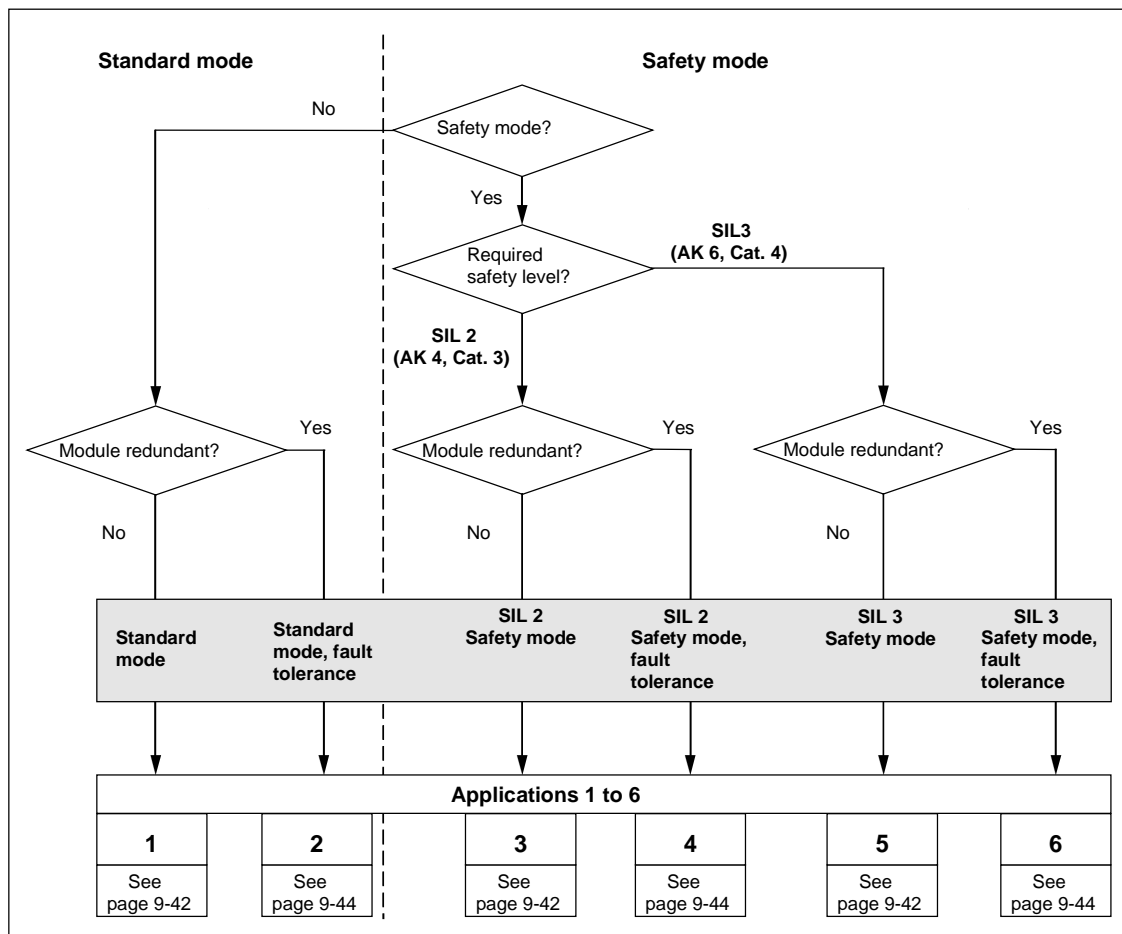


Figure 9-28 Selecting the Application - SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt

## Avoiding Dark Periods During Safety Mode



### Safety Note

If you use actuators that only respond too quickly when the dark period test signal is applied (i. e.  $< 1$  ms), you can still use the internal test coordination by connecting two opposite outputs in parallel (with a series diode). The dark periods are suppressed in the case of parallel connection (see page 9-46).

### 9.3.3 Application 1: Standard Mode, Application 3: Safety Mode SIL 2 (Safety Level AK 4, Category 3) and Application 5: Safety Mode SIL 3 (Safety Level AK 6, Category 4)

Below you can find the wiring diagram and the parameter assignment of the SM 326; DO 10  $\times$  24 V DC/2A; with diagnostic interrupt for:

- Application 1: standard mode
- Application 3: safety mode SIL 2 (safety level AK 4, category 3)
- Application 5: safety mode SIL 3 (safety level AK 6, category 4)

Diagnostic messages, possible fault causes and remedies can be found in Tables 9-17 and 9-18.

### Wiring Diagram for Applications 1, 3 and 5

10 process signals can be output by one digital module. One actuator is connected via a single pin for each process signal. The load power supply is connected to the digital module on terminals 2L+/2M, 3L+/3M.

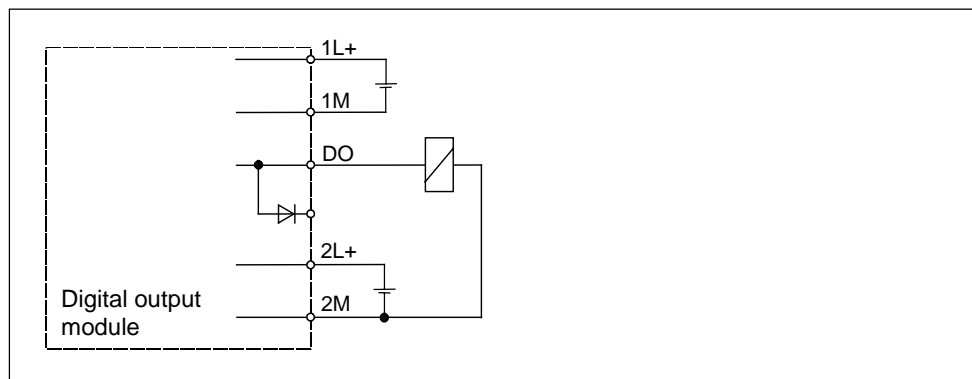


Figure 9-29 Wiring Diagram of the SM 326; DO 10  $\times$  24 V DC/2A; with Diagnostic Interrupt for Application 1, 3 and 5



## Parameters for Applications 1, 3 and 5

Table 9-15 Parameters of the SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt for Applications 1, 3 and 5

Parameters	Range of Values		Type	Diagnosis Effective in
	Safety Mode	Standard mode		
<b>"Inputs" Tab</b>				
Enable Diagnostic Interrupt	Yes/no	Yes/no	Static	Module
Mode	<ul style="list-style-type: none"> <li>Safety mode in accordance with SIL2/safety level AK4</li> <li>Safety Mode in Accordance with SIL3/Safety Level AK5, 6</li> </ul>	<ul style="list-style-type: none"> <li>Standard mode</li> </ul>	Static	Module
Monitoring Time	10 to 10000 ms	-	Static	Module
Signal Changes Daily or More Often	Yes/no (Only with SIL 3/safety level AK5, 6)	-	Static	Module
Behavior at CPU-STOP	-	<ul style="list-style-type: none"> <li>Apply Substitute Value</li> <li>Keep Last Valid Value</li> </ul>	Static	Module
Group Diagnosis	Yes/no	Yes/no	Static	Channel
Apply Substitute Value "1"	-	Yes/no	Static	Channel
<b>"Redundancy" Tab</b>				
Redundancy	None	-	Static	Module

### 9.3.4 Application 2: Standard Mode with High Availability and Application 4: Safety Mode SIL 2 (Safety Level AK 4, Category 3) with High Availability and Application 6: Safety Mode SIL 3 (Safety Level AK 6, Category 4) with High Availability

Below you can find the wiring diagram and the parameter assignment of the SM 326; DO 10 × 24 V DC/2A; with diagnostic interrupt for:

- Application 2: standard mode with high availability
- Application 4: safety mode SIL 2 (safety level AK 4, category 3) with high availability
- Application 6: safety mode SIL 3 (safety level AK 6, category 4) with high availability

Diagnostic messages, possible fault causes and remedies can be found in Tables 9-17 and 9-18.

### Wiring Diagram for Applications 2, 4 and 6

10 process signals can be output from two redundant digital modules. One actuator controlled redundantly by the two digital modules is required for each process signal. The load power supply is connected to the relevant digital module at terminals 2L+/2M, 3L+/3M.

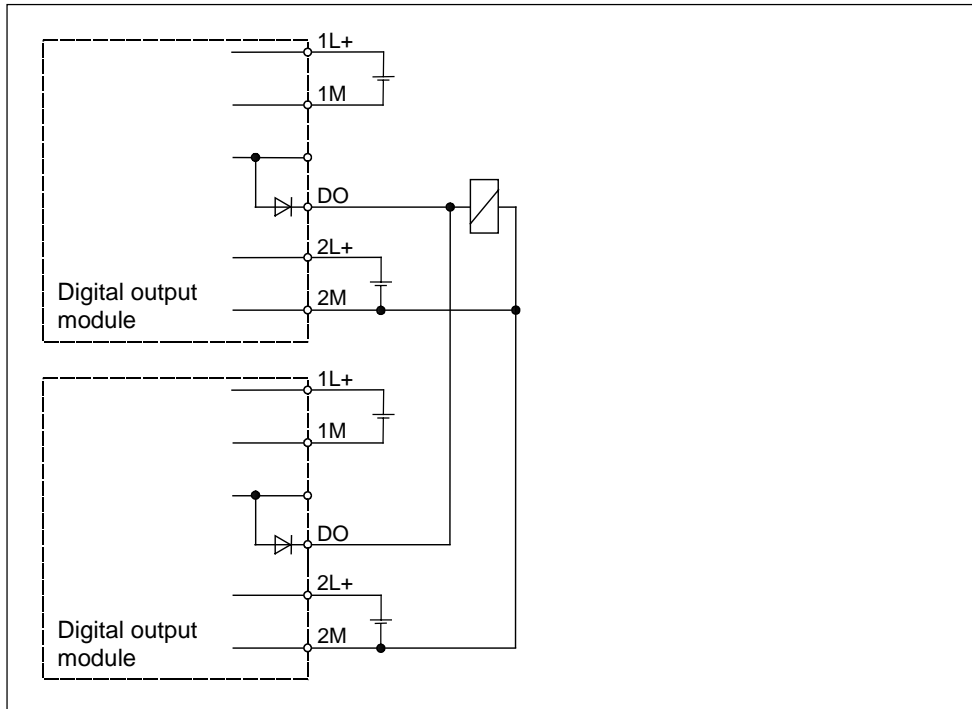


Figure 9-30 Wiring Diagram of the SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt for Applications 2, 4 and 6

## Parameters for Applications 2, 4 and 6

Table 9-16 Parameters of the SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt for Applications 2, 4 and 6

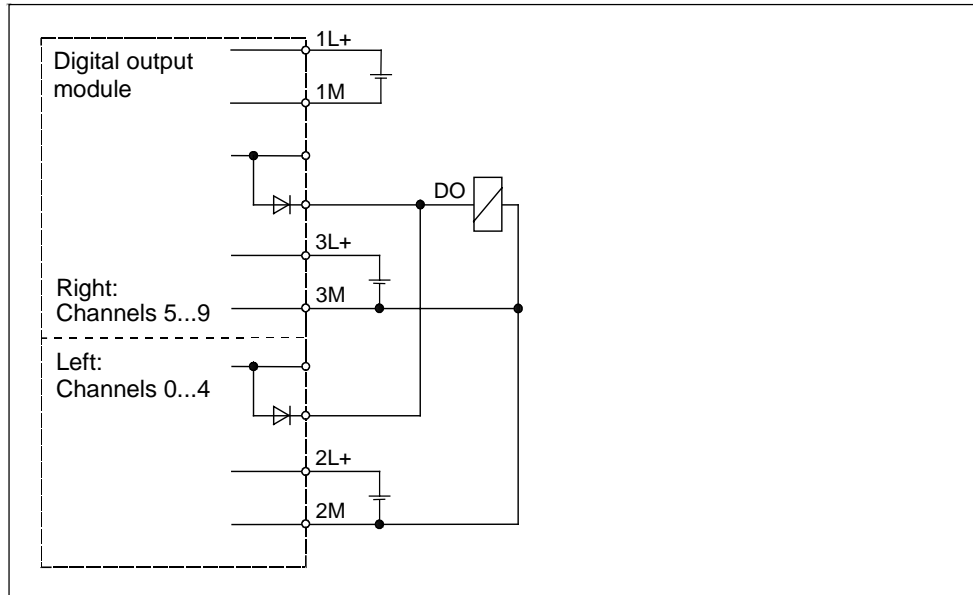
Parameters	Range of Values		Type	Diagnosis Effective in
	Safety Mode	Standard mode		
<b>"Inputs" Tab</b>				
Enable Diagnostic Interrupt	Yes/no	Yes/no	Static	Module
Mode	<ul style="list-style-type: none"> <li>Safety mode in accordance with SIL2/safety level AK4</li> <li>Safety Mode in Accordance with SIL3/Safety Level AK5, 6</li> </ul>	<ul style="list-style-type: none"> <li>Standard mode</li> </ul>	Static	Module
Monitoring Time	10 to 10000 ms	-	Static	Module
Signal Changes Daily or More Often	Yes/no (Only with SIL 3/safety level AK5, 6)	-	Static	Module
Behavior at CPU-STOP	-	<ul style="list-style-type: none"> <li>Apply Substitute Value</li> <li>Keep Last Valid Value</li> </ul>	Static	Module
Group Diagnosis	Yes/no	Yes/no	Static	Channel
Apply Substitute Value "1"	-	Yes/no	Static	Channel
<b>"Redundancy" Tab</b>				
Redundancy	Two Modules	-*	Static	Module
Redundant Module	(Selection of an existing additional module of the same type)	-	Static	Driver block

\* The redundancy of two modules in standard mode must be configured in the user program in the same way as for S7-300 standard modules.

### Parallel Connection of Two Outputs for Dark Period Suppression

Connecting two outputs in parallel to suppress a dark period is possible in all applications in safety mode (3, 4, 5 and 6).

Connect two **opposite outputs** with a series diode to an output. By interconnecting them in this way and using an internal test coordination between outputs 0...4 and 5... 9, you suppress the "0" test pulse (dark period).



Assign parameters to the fail-safe signal modules as described for the various applications on the previous pages. An additional parameter is not required for the interconnection.

Make sure that the two interconnected outputs are always controlled identically rather than one output on its own. A total of 4 outputs with a series diode are required for a process signal in a redundant I/O system.

### 9.3.5 Diagnostic Messages of SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt

#### Possible Diagnostic Messages

Table 9-17 gives you an overview of the diagnostic messages of the SM 326; DO 10 × 24 V DC/2A; with diagnostic interrupt.

The diagnostic messages are assigned either to a channel or the entire module. Some diagnostic messages only occur in certain applications.

Table 9-17 Diagnostic Messages of the SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt

Diagnostic Message	Reported in Application	Diagnosis Effective in	Configurable
Wire break	1, 2, 3, 4, 5, 6	Channel	Yes
Short circuit to ground at the output or output driver defective			
Short circuit to L+ at the output or output driver defective			
External auxiliary voltage missing	1, 2, 3, 4, 5, 6	Module	No
Module not assigned parameters			
Wrong parameters on module			
Loss of communication			
Module-internal supply voltage failed			
Time monitoring responded (watchdog)			
EPROM fault			
RAM fault			
Internal error in read circuit/test circuit or defective sensor supply			
Processor failure			
Parameter assignment error (with consecutive) number			
External load voltage missing			
Defective main switch			
Defective output driver			
Excess temperature at output driver			
Load voltage not connected	3, 4, 5, 6	Module	
Defective load voltage or not connected			
Error in the cyclic redundancy check (CRC)	1, 2	Module	
Monitoring time for data message frame exceeded			
Message frame error during non fail-safe communication			

## Fault Causes and Remedies

You can find the possible causes for errors and the corresponding remedies for the individual diagnostic messages of the SM 326, DO 10 × 24 V DC/2A, with diagnostic interrupt in Table 9-18.

Table 9-18 Diagnostic Messages and Their Remedies for the SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt

Diagnostic Message	Fault Detection	Possible Fault Causes	Remedies
Wire break	Only in the event of "1" at the output or during light test*	Interruption in the wire between the module and the actuator	Reestablish the connection
		Channel is not connected (open)	Disable "Group diagnosis" for the channel
		In the case of outputs with a series diode: Short circuit of the output to 1L+ of the module supply	Eliminate short circuit
		In the case of outputs with a series diode: Short circuit between channels with different signals	Eliminate short circuit
Short circuit to ground at the output or output driver defective	Only in the event of "1" at the output or during light test*	Output overload	Eliminate overload
		Short circuit of the output to M	Eliminate short circuit
		Undervoltage of the load voltage supply	Check the load voltage supply
		Defective output driver	Replace the module
Short circuit to L+ at the output or output driver defective	Only in the event of "1" at the output without a series diode or in the case of an output with a series diode and an internal L+ short circuit	Short circuit of the output to 1L+ of the module supply	Eliminate short circuit Module reset necessary (supply voltage off/on)
		Short circuit between channels with different signals	Eliminate short circuit Module reset necessary (supply voltage off/on)
		Defective output driver	Replace the module
External auxiliary voltage missing	General	The 1L+ supply voltage of the module is missing	Feed the 1L+ supply
Module not assigned parameters	General	No parameters transferred to the module	Reparameterize the module
Wrong parameters on module	General	Incorrect parameters transferred to the module	Reparameterize the module
		The setting of the logical module address in STEP 7 does not correspond to the setting of the address switch on the module.	Correct the address setting and reparameterize the module

\* Light period occurs in SIL 3 when the "Signal Changes Daily or More Often" parameter is deselected

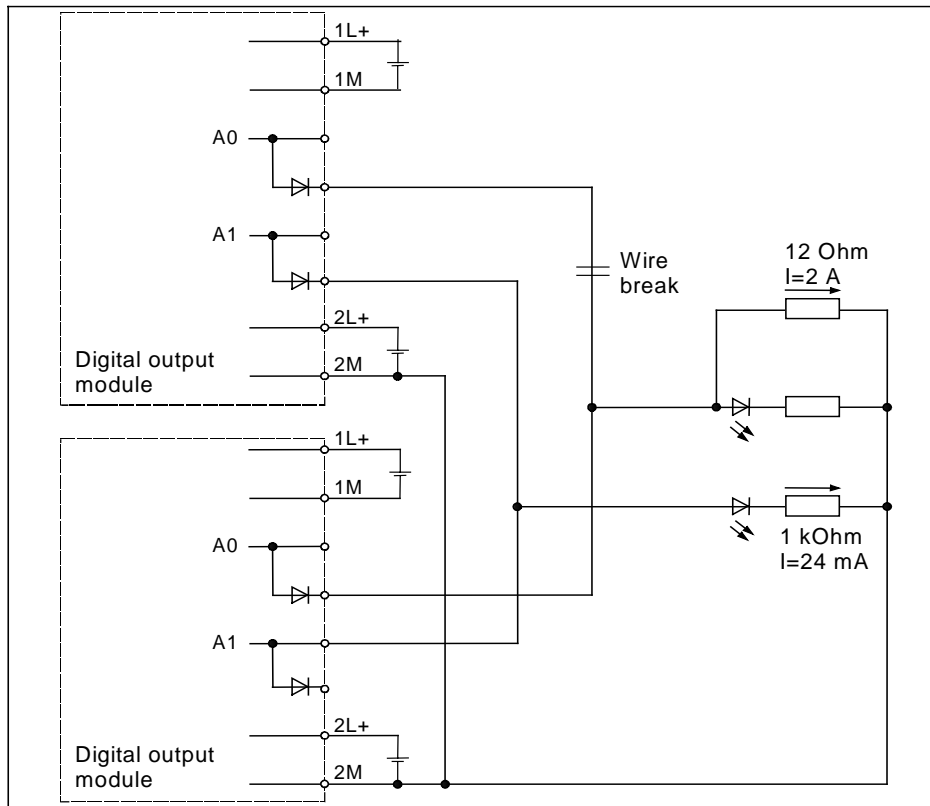
Diagnostic Message	Fault Detection	Possible Fault Causes	Remedies
Module-internal supply voltage failed	General	Internal fault of the 1L+ supply voltage	Replace the module
Time monitoring responded (watchdog)	General	Overload due to diagnostic request (SFCs)	Reduce the number of diagnostic requests
		Impermissibly high electromagnetic interference	Eliminate the problems
		Defective Module	Replace the module
Loss of communication	General	Communication problem between the CPU and the module due, for example to a defective PROFIBUS connection or to impermissibly high electromagnetic interference	Check the PROFIBUS connection Eliminate the problems
		Monitoring time for data frame exceeded	Check the parameterization of the monitoring time
		Test value error (CRC) due, for example, to impermissibly high electromagnetic interference	Eliminate the problems
		CPU has gone into STOP	Read out diagnostic buffer
EPROM fault RAM fault	General	Impermissibly high electromagnetic interference	Eliminate the interference and switch the supply voltage off/on
		Defective Module	Replace the module
Internal error in the read circuit/test circuit	General	Defective Module	Replace the module
Processor failure	General	Impermissibly high electromagnetic interference	Eliminate the problems
		Defective Module	Replace the module
Parameter assignment error (with consecutive number)	General	Error in dynamic parameter assignment	Check the parameterization in the user program If necessary, contact SIMATIC Customer Support
External load voltage missing	General	The load voltage 2L+, 3L+ of the module is missing	Feed supply 2L+, 3L+
Defective main switch	General	Defective Module	Replace the module
Defective output driver	General	Defective Module	Replace the module
Excess temperature at output driver	General	Output overload	Eliminate overload
		Internal error of the output driver	Replace the module
Load voltage not connected	General	The load voltage 2L+, 3L+ of the module is missing	Feed supply 2L+, 3L+

<b>Diagnostic Message</b>	<b>Fault Detection</b>	<b>Possible Fault Causes</b>	<b>Remedies</b>
Defective load voltage or not connected	General	Load voltage 2L+, 3L not connected	Feed supply 2L+, 3L+
		External fault of the load voltage 2L+, 3L+	Replace the module
Error in the cyclic redundancy check (CRC)	General	Test value error occurred in the communication between the CPU and the module due, for example, to impermissibly high electromagnetic interference or due to watchdog monitoring errors	Eliminate the problems
Monitoring time for data message frame exceeded	General	Parameterized monitoring time for a watchdog of the module exceeded	Check the parameterization of the monitoring time
		Power-up of fail-safe signal module	-
Message frame error during non fail-safe communication	General	Enter the watchdog and/or the test value in the data frame	Check the data frame for the "0" entry for the watchdog and test value



## Faulty Diagnosis After a Wire Break on Redundant Digital Output Modules

During the redundant use of fail-safe output modules SM 326; DO 10 × 24 V DC/2A; with diagnostic interrupt, the following response may occur in the event of a fault: When a wire break occurs on a channel, the faulty channel and another channel or several other channels are reported as faulty when the **connected loads are very different**.



### Example:

In this example, channels A0 and A1 are reported faulty when a wire break occurs at A0. The cause is the very extreme variation in load on the two channels: 2 A and 24 mA.

### What to do:

To obtain a correct error diagnosis from the modules, the output channels of a module must have approximately the same load. This means that the ratio of the lowest load to the highest load must be at least 1:5.

## Faulty Diagnosis Given a Short Circuit

During a short circuit of a channel of the fail-safe digital output module SM 326; DO 10 × 24 V DC/2A; with diagnostic interrupt after L+ or a short circuit between channels with different signals, in addition to the affected channel, all the other channels of the half containing the faulty channel are also reported as faulty and passivated. A short circuit that lasts a long time will result in the complete failure of the module.

### 9.3.6 Technical Specifications - SM 326; DO 10 × 24 V DC/2A; with Diagnostic Interrupt

Dimensions and Weight	
Dimensions W × H × D (mm)	80 × 125 × 120
Weight	Approx. 465 g
Module-Specific Data	
Number of outputs	10
Occupied address area	
• In the PII	6 bytes
• In the PIQ	8 bytes
Line length	
• Unshielded	Max. 600 m
• Shielded	Max. 1000 m
• At SIL 3, safety level AK 5 and 6, Cat. 4	Max. 200 m
Maximum safety level that can be achieved in safety mode	
• To IEC 61508	SIL 3
• To DIN V 19250	AK 5 and 6
• To EN 954-1	Cat. 4
Safety parameters	SIL 2    SIL 3
• Low demand mode (average probability of failure on demand)	6.97E-06    6.97E-06
• High demand/continuous mode (probability of a dangerous failure per hour)	7.96E-11    7.96E-11
Voltages, Currents, Potentials	
Rated supply voltage of the electronic components 1L+	24 V DC
• Reverse polarity protection	Yes
Rated load voltage 2L+/3L+	24 V DC
• Reverse polarity protection	No
Total current of the outputs without series diode (per group)	
• Horizontal installation	
Up to 40 °C	Max. 7.5 A
Up to 60 °C	Max. 5 A
• Vertical installation	
Up to 40 °C	Max. 5 A
Total current of the outputs with series diode (per group)	
• Horizontal installation	
Up to 40 °C	Max. 5 A
Up to 60 °C	Max. 4 A
• Vertical installation	
Up to 40 °C	Max. 4 A

Electrical isolation	
• Between the channels and backplane bus	Yes
• Between the channels and power supply to the electronic components	Yes
• Between the channels	Yes
In groups of	5
Insulation tested with	75 V DC
Power input	
• From the backplane bus	Max. 100 mA
• From the supply volt. 1L+	Max. 70 mA
• From the load voltage 2L+/3L+ (without load)	Max. 100 mA
Power loss of the module	Typically 12 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	
• Diagnostic interrupt	Configurable
Diagnostic functions	Configurable
• Common error display	Red LED (SF)
• Fail-safe mode display	Green LED (SAFE)
• Diagnostic information can be read out	Possible
Substitute values can be applied	Yes, only in standard mode
Data for Selecting an Actuator	
Output voltage	
• At signal "1"	
Without series diode	Min. L + (- 1.0 V)
With series diode	Min. L + (- 1.8 V)
Output current	
• At signal "1"	
Rated value	2 A
Permissible range up to 40°C	7 mA to 2 A
Horizontal installation	
Permissible range up to 40°C horizontal installation	7 mA to 1 A
Permissible range up to 60°C	7 mA to 1 A
Horizontal installation	
• At signal "0" (residual current)	Max. 0.5 mA
Load impedance range	
• Up to 40 °C	12 Ω up to 3.4 kΩ
• Up to 60 °C	24 Ω up to 3.4 kΩ

Data for Selecting an Actuator (Continued)	
Lamp load	Max. 5 W
Parallel connection of 2 outputs	
<ul style="list-style-type: none"> <li>For redundant control of a load</li> </ul>	Only outputs with series diode; outputs must have the same reference potential
<ul style="list-style-type: none"> <li>For an increase in power</li> </ul>	Not possible
Control of a digital input	Possible
Switching rate	
<ul style="list-style-type: none"> <li>In the case of a resistive load</li> </ul>	Max. 30 Hz
<ul style="list-style-type: none"> <li>In the case of an inductive load</li> </ul>	Max. 2 Hz
	To IEC 947-5-1, 13 DC
<ul style="list-style-type: none"> <li>In the case of a lamp load</li> </ul>	Max. 10 Hz
Inductive breaking voltage limited (internally) to	
<ul style="list-style-type: none"> <li>With series diode</li> </ul>	Typically L + (- 33 V)
<ul style="list-style-type: none"> <li>Without series diode</li> </ul>	Typically L + (- 53 V)
Short-circuit protection of the output	Yes, electronically
<ul style="list-style-type: none"> <li>Response threshold</li> </ul>	2.6 to 4 A

Time, Frequency	
Internal processing time for	Max.
<ul style="list-style-type: none"> <li>Standard mode</li> </ul>	22 ms
<ul style="list-style-type: none"> <li>Safety Mode</li> </ul>	24 ms
Acknowledgment time	
<ul style="list-style-type: none"> <li>In standard mode</li> </ul>	Max. 19 ms
<ul style="list-style-type: none"> <li>In safety mode</li> </ul>	Max. 20 ms



# 10 Analog Module

## Introduction

To connect analog sensors/encoders, you can choose a fail-safe, redundancy-capable analog input module of the S7-300 module range, the SM 336; AI 6 × 13 bit; with diagnostic interrupt for the fail-safe and fault-tolerant S7-400F and S7-400FH programmable logic controller.

In this chapter you will find the following for the fail-safe analog module:

- Features
- Module view and block diagram
- Applications with terminal assignment diagrams and parameter assignment
- Diagnostic messages with remedies
- Technical specifications



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### Safety Note

The safety parameters in the technical specifications are valid for a proof test period of 10 years.

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## Contents

Section	Contents	Page
10.1	Analog Value Representation	10-2
10.2	SM 336; AI 6 × 13Bit; with Diagnostic Interrupt	10-4

## 10.1 Analog Value Representation

### Measured Value Ranges

Measurement Range	Measurement Range	Measurement Range		Unit		Range
0 to 20 mA	4 to 20 mA	0 to 10 V	In % of Nominal Range	Decimal	Hexa-decimal	
Standard mode	Safety mode	Standard mode				Operating mode
> 23.515 mA	> 22.814 mA	> 11.7593 V	> 117.589	32767	7FFF <sub>H</sub>	Overflow
23.515 mA	22.814 mA	11.7589 V	117,589	32511	7EFF <sub>H</sub>	Overrange
·	·	·	·	·	·	
·	·	·	·	·	·	Nominal range
20.007 mA	20.007 mA	> 10.0004 V	100,004	27649	6C01 <sub>H</sub>	
20 mA	20 mA	10 V	100	27648	6C00 <sub>H</sub>	Nominal range
·	·	·	·	·	·	
2.89 iA	4mA + 2,315iA	1.45 mV	0,014	4	4 <sub>H</sub>	Underrange
0 mA	4.00 mA	0 V	0	0	0 <sub>H</sub>	
-0.0007 mA	3.9995 mA	-0.36 mV	-0.0036	-1	FFFF <sub>H</sub>	Underrange
·	·	·	·	·	·	
-3.518 mA	1.185512 mA	-1.759 V	-17.593	-4864	ED00 <sub>H</sub>	Underflow
< -3.518 mA	< 1.185 mA (see below)	< - 1.759 V	< -17.593	-32768	8000 <sub>H</sub>	

The decimal and hexadecimal units can only take on values that are multiples of 4.

### Wire Break Check and Underflow Check in the Range 4 to 20 mA

In the range 4 to 20 mA a distinction is drawn as to whether or not a wire break check is configured:

- If a wire break check is configured, an underflow check is not carried out. A wire break is reported at < 3.6 mA with 7FFF<sub>H</sub>.
- If a wire break check is not configured, underflow is reported at < 1.18 mA with 8000<sub>H</sub>.

## Measured Value Resolution

The SM 336; AI 6 × 13Bit; with diagnostic interrupt has 13-bit resolution. This means that the last two bits are set to 0. Thus, only values that are multiples of 4 can be accepted. 1 digit (13-bit measurement range) corresponds to 4 digits in Simatic.

### Bit Pattern

Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Significance of the bits	Sign	$2^{15}$	$2^{14}$	$2^{13}$	$2^{12}$	$2^{10}$	$2^9$	$2^8$	$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$
Example	0	1	0	0	1	1	0	0	1	1	1	1	1	1	<b>0</b>	<b>0</b>

### Resolution

Measurement Range	% of Nominal Range	Resolution
0 to 20 mA	0,014	2.89 iA
4 to 20 mA	0,014	2.32 iA
0 to 10 V	0,014	1.45 mV



### Safety Note

Only the measurement range 4 to 20 mA is permissible in safety mode.

## 10.2 SM 336; AI 6 × 13Bit; with Diagnostic Interrupt

### 10.2.1 Features, Front View and Terminal Assignment and Block Diagram

#### Order Number

6ES7 336-1HE00-0AB0

#### Features

The SM 336; AI 6 × 13Bit; with diagnostic interrupt has the following features:

- 6 analog inputs with isolation between the channels and backplane bus
- Input ranges:
  - 0 to 20 mA or 4 to 20 mA, 0 to 10 V in standard mode
  - 4 to 20 mA in safety mode
- Short circuit-proof power supply of 2- or 4-wire measuring transducers via the module
- External sensor supply possible
- Common error indicator (SF)
- Safety mode indicator (SAFE)
- Sensor supply indicator (Vs)
- Configurable diagnosis
- Configurable diagnostic interrupt
- Usable in standard and safety modes

#### Usage of the Inputs

You can use the inputs as follows:

In standard mode:

- All 6 channels for current measurement of 0 to 20 mA or 4 to 20 mA or
- Up to 4 channels for voltage measurement of 0 to 10 V and the other two for current measurement
- Other combinations of current measurement and voltage measurement taking into account the above constraint for voltage measurement

In safety mode

- All 6 channels for current measurement of 4 to 20 mA



### Front View

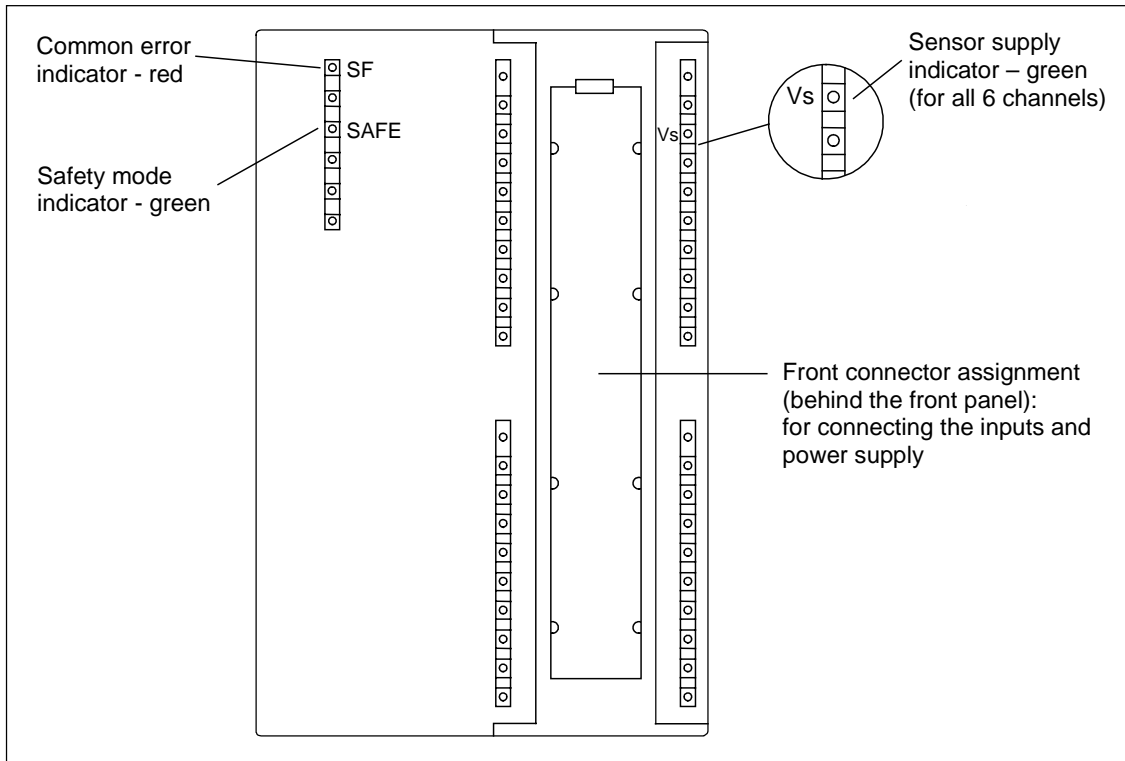


Figure 10-1 Front View of the SM 336; AI 6 × 13Bit; with Diagnostic Interrupt

### Terminal Assignment and Block Diagram

Figure 10-2 shows the terminal assignment and block diagram of the SM 336; AI 6 × 13Bit; with diagnostic interrupt. The internal wiring of the connections on the left-hand side of the diagram corresponds to the wiring of the connections on the right. The interconnections between the analog sensors for the different applications are indicated in the following sections.

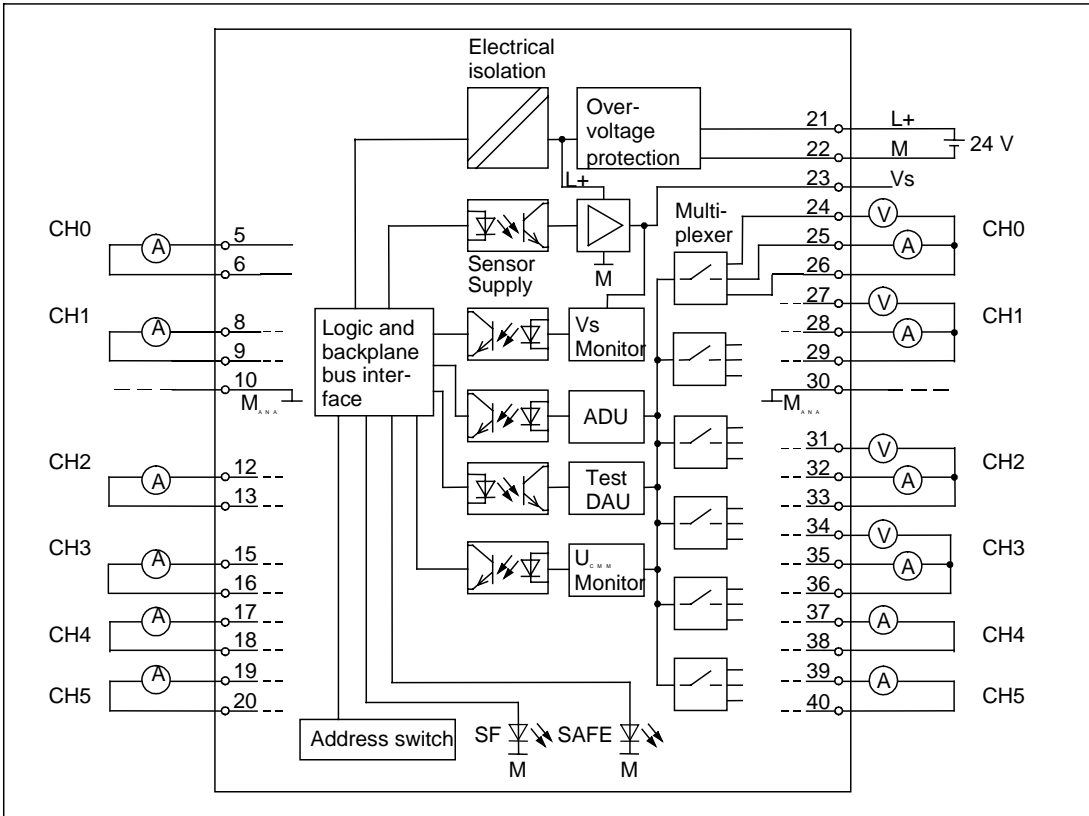


Figure 10-2 Terminal Assignment and Block Diagram of the SM 336; AI 6 × 13Bit; with Diagnostic Interrupt and Internal Sensor Supply

Key:

A - current measurement

V - voltage measurement

## External Sensor Supply

The following diagrams show how the sensors can be supplied by means of an external sensor supply (for example via another module: 1L+).

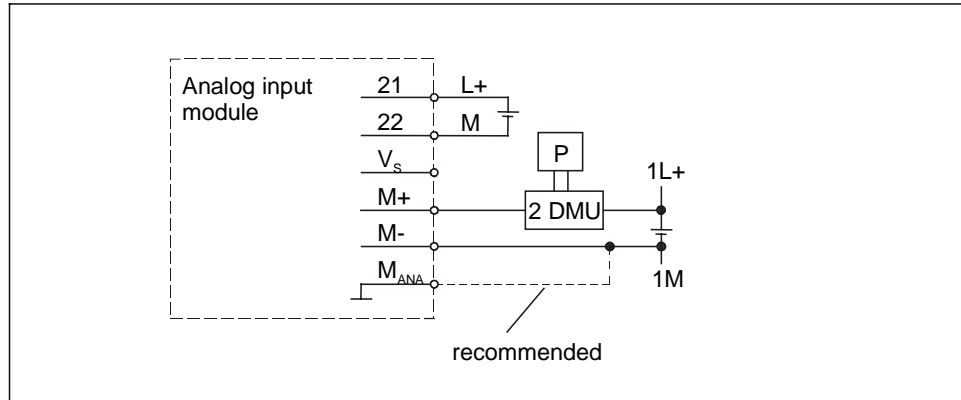


Figure 10-3 External Sensor Supply, 2-Wire Measuring Transducer for the SM 336; AI 6 × 13Bit; with Diagnostic Interrupt

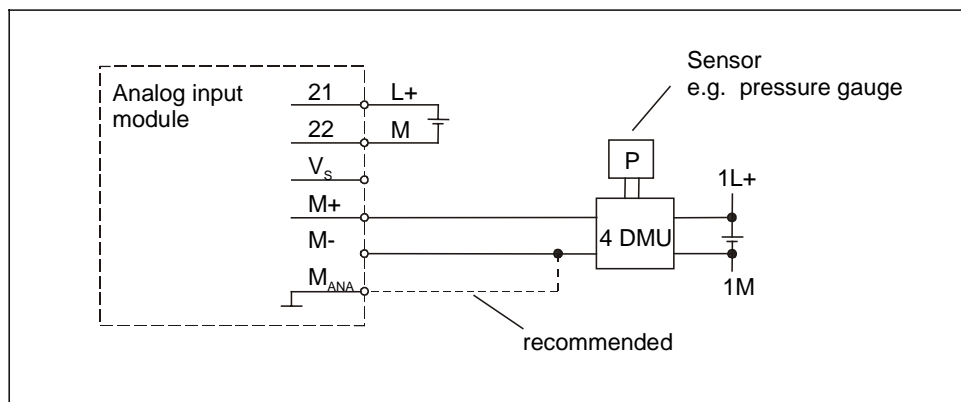


Figure 104 External Sensor Supply, 4-Wire Measuring Transducer for the SM 336; AI 6 × 13Bit; with Diagnostic Interrupt



### Safety Note

The **stability** of the external sensor supply must correspond to the desired safety level (AK 4, 5, 6 or SIL 2, 3). If this is not the case, we recommend one of the following options:

- **Redundant** external sensor supply
- **Monitoring** of the external sensor supply for undervoltage/overvoltage including shutdown of the sensor supply in the event of a problem (single-channel for SIL 2 and dual-channel for SIL 3).

### **Recommendation: Internal Sensor Supply**

We recommend that you always use the short circuit-proof internal sensor supply of the module. The internal sensor supply is monitored and the status indicated by the  $V_s$  LED (see Figure 10-1).

### **Isolated Measuring Sensor**

The isolated measuring sensors are not connected to the local ground potential. They can thus be operated isolated. As a result of local conditions or disruptions, (static or dynamic) potential differences (UCM) can occur between the measuring lines (M–) of the input channels and the reference point of the measuring circuit (MANA).

To prevent the permissible value for UCM from being exceeded in environments with serious EMC problems, we recommend that you connect M– with MANA.

### **Non-Isolated Measuring Sensors**

The non-isolated measuring sensors are connected to the local ground potential. You must connect MANA to the ground potential. As a result of local conditions or disruptions, (static or dynamic) potential differences (UCM) can occur between the locally distributed measurement points.

If the permissible value for UCM is exceeded, you must provide equipotential bonding conductors between the measurement points.

## 10.2.2 Applications of the SM 336; AI 6 × 13Bit; with Diagnostic Interrupt

### Selecting the Application

The figure below will help you to select the application that corresponds to your fail-safety and availability requirements. In the pages that follow you will learn how to wire the module and which parameters you have to set in *STEP 7* with the *S7 F Systems* add-on package for each application.

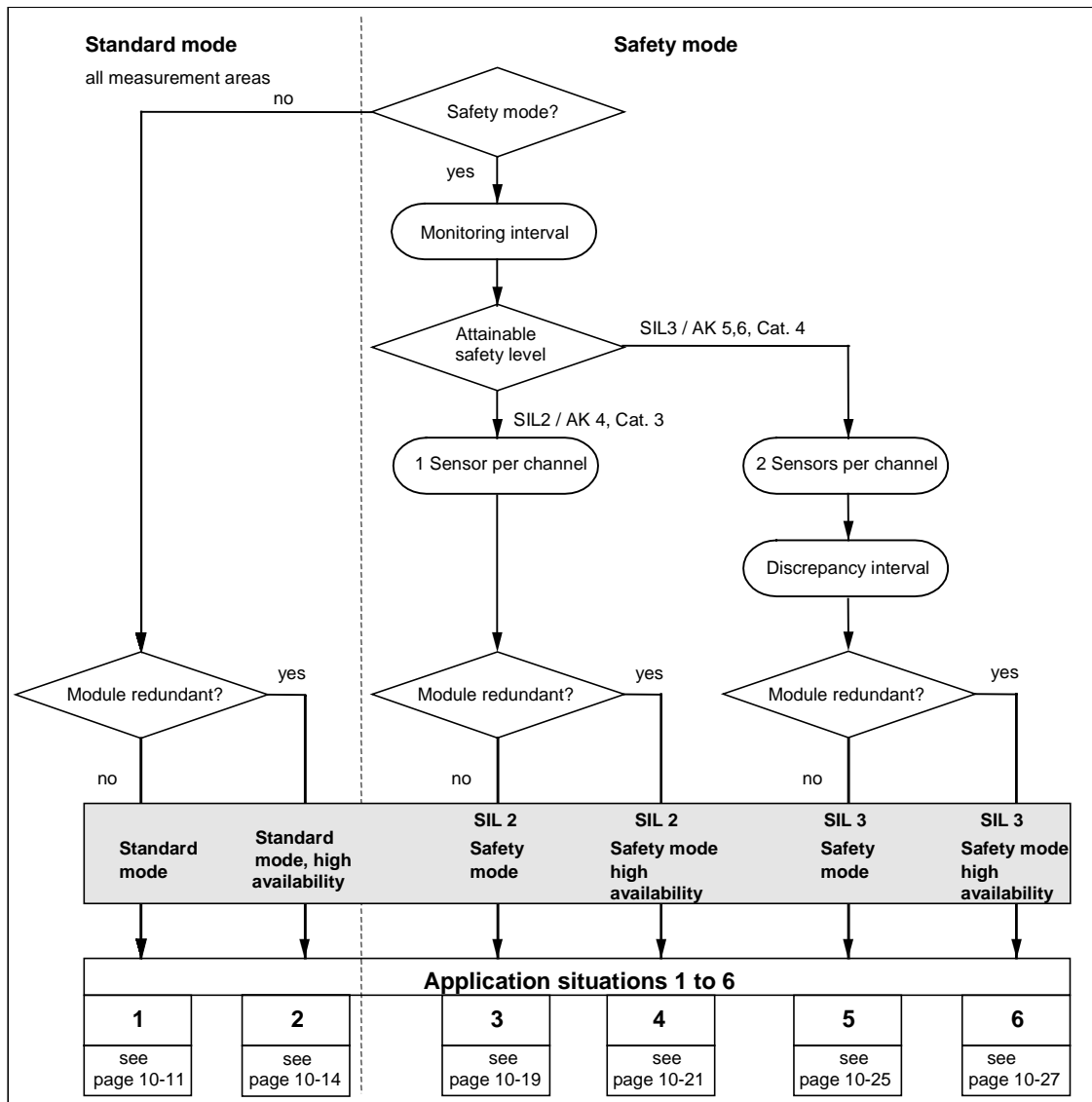


Figure 10-5 Application Selection - SM 336; AI 6 × 13Bit; with Diagnostic Interrupt

**Safety Note**

The safety level attained depends on the sensor quality and on the length of the proof period in accordance with IEC 61500 (period for preventative maintenance). If the sensor quality is worse than stipulated by the required safety level, the sensor must be used redundantly and be connected via two channels.

---

**Wiring Schemes**

There are 3 wiring schemes for each application depending on the measurement type.

Wiring Scheme	Measurement Type	Range	Channels	Abbreviation in HWCONFIG
A	Current measurement 2-wire measuring transducer	4 to 20 mA	0 to 5	2WMT
B	Current measurement 4-wire measuring transducer	4 to 20 mA 0 to 20 mA*	0 to 5	4WMT
C	Voltage measurement*	0 to 10 V	0 to 3	

\* 0 to 20 mA current measurement and voltage measurement is only possible in standard mode.

**Note**

In the diagrams of the following wiring schemes, the connections to the reference point of the measurement circuit (MANA) are indicated by a broken line. This means that the connections can be regarded as recommendations (see "Improvement of Accuracy for Current Measurement on Channels 0 to 3 of the Analog Input Module" in Chapter 5, on page 5-8).

A broken line between two or four sensors means that the sensors detect the same thing.

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### 10.2.3 Application 1: Standard Mode

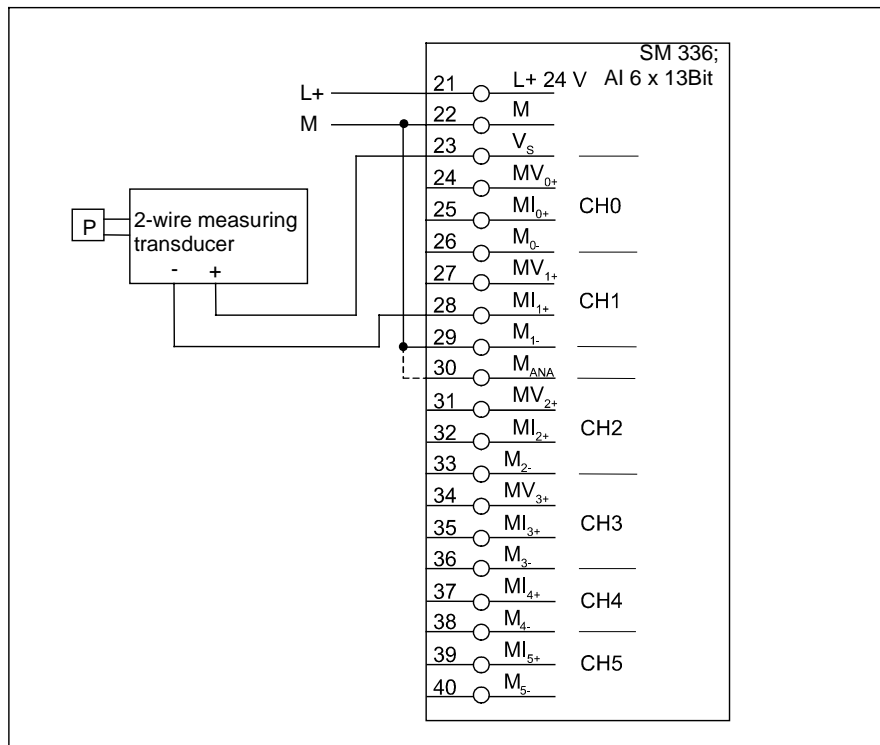
Below you can find the wiring schemes and the parameter assignment of the SM 336; AI 6 × 13Bit; with diagnostic interrupt for:

- Application 1: standard mode

For diagnostic messages, possible causes of errors and their remedies, please refer to Table 10-1 and Table 10-2 on page 10-31, 10-32.

#### Wiring Scheme A, 4 to 20 mA Current Measurement, 2-Wire Measuring Transducer, for Application 1

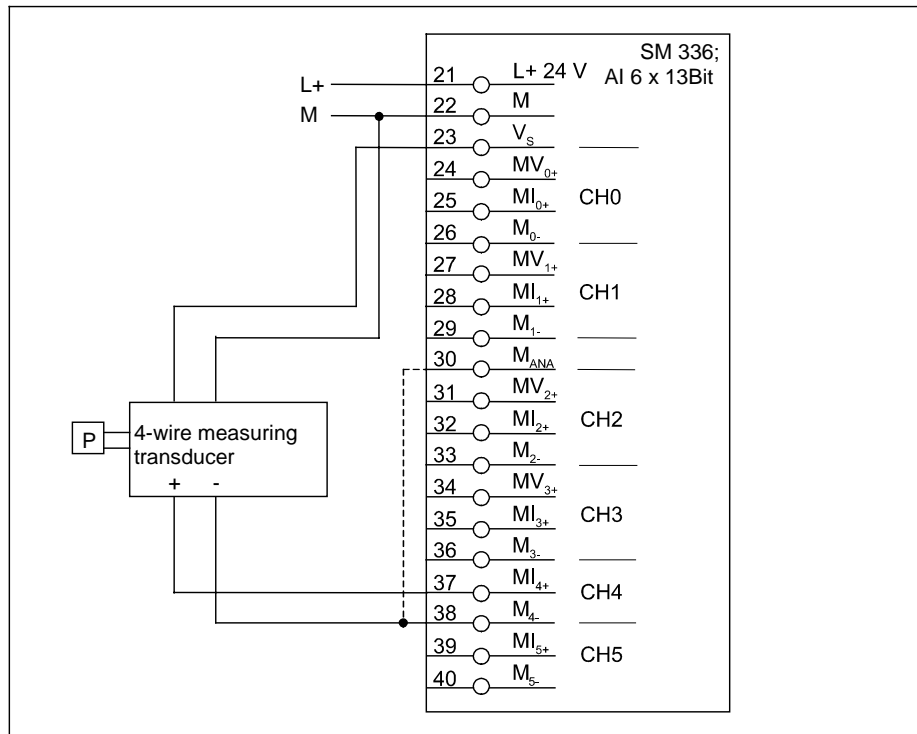
6 process signals can be connected to an analog module. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-3).



### Wiring Scheme B, 4 to 20 mA Current Measurement, 4-Wire Measuring Transducer, for Application 1

6 process signals can be connected to an analog module. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-4 on page 10-7).

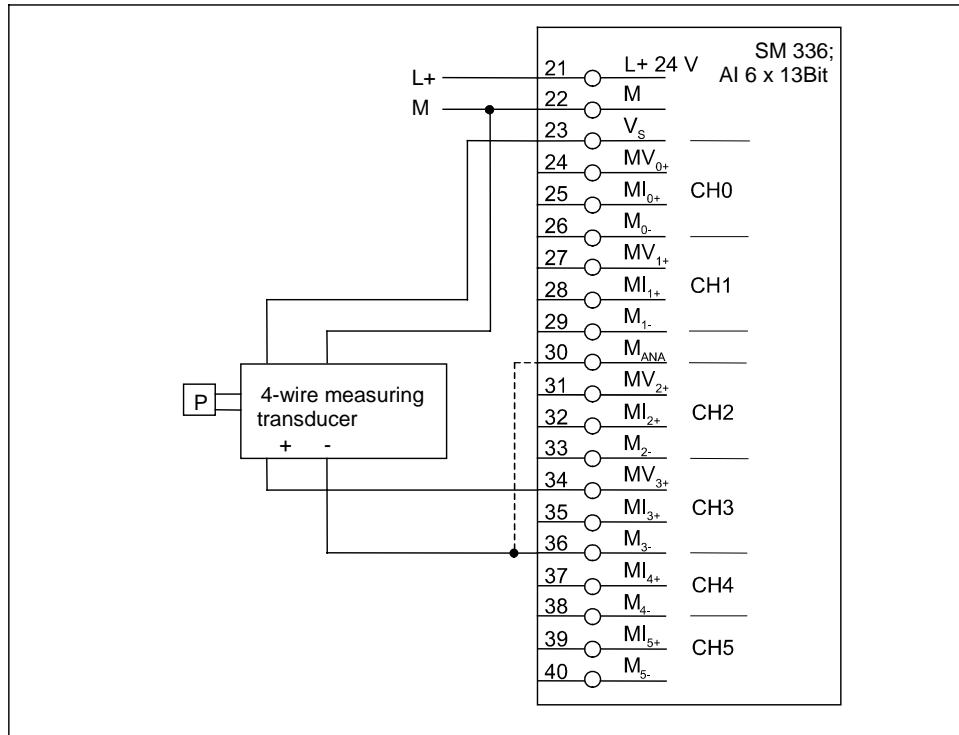
In the case of wire break monitoring, the measurement range is reduced to 4 to 20 mA.





### Wiring Scheme C, 0 to 10 V Voltage Measurement, for Application 1

4 process signals can be connected to an analog module. The analog module provides the sensor supply  $V_S$  for 4 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-4).



## Parameters for Application 1

Parameters	Range of Values in Standard Mode	Type	Effective in
<b>"Inputs 1" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Interference Frequency	50 Hz/60 Hz	Static	Module
Group Diagnosis	Yes/no	Static	Channel
Wire-Break Check (only at 4 to 20 mA)	Yes/no	Static	Channel
Measurement Type	Disabled 4WMT 2WMT U	Static	Channel
Measurement Range	4 to 20 mA 0 to 20 mA 0 to 10 V	Static	Channel
<b>"Inputs 2" Tab</b>			
Safety Mode	No (standard mode)	Static	Module
Monitoring Time	-	Static	Module
<b>"Redundancy" Tab</b>			
Redundancy	None	Static	Module

### 10.2.4 Application 2: Standard Mode with High Availability

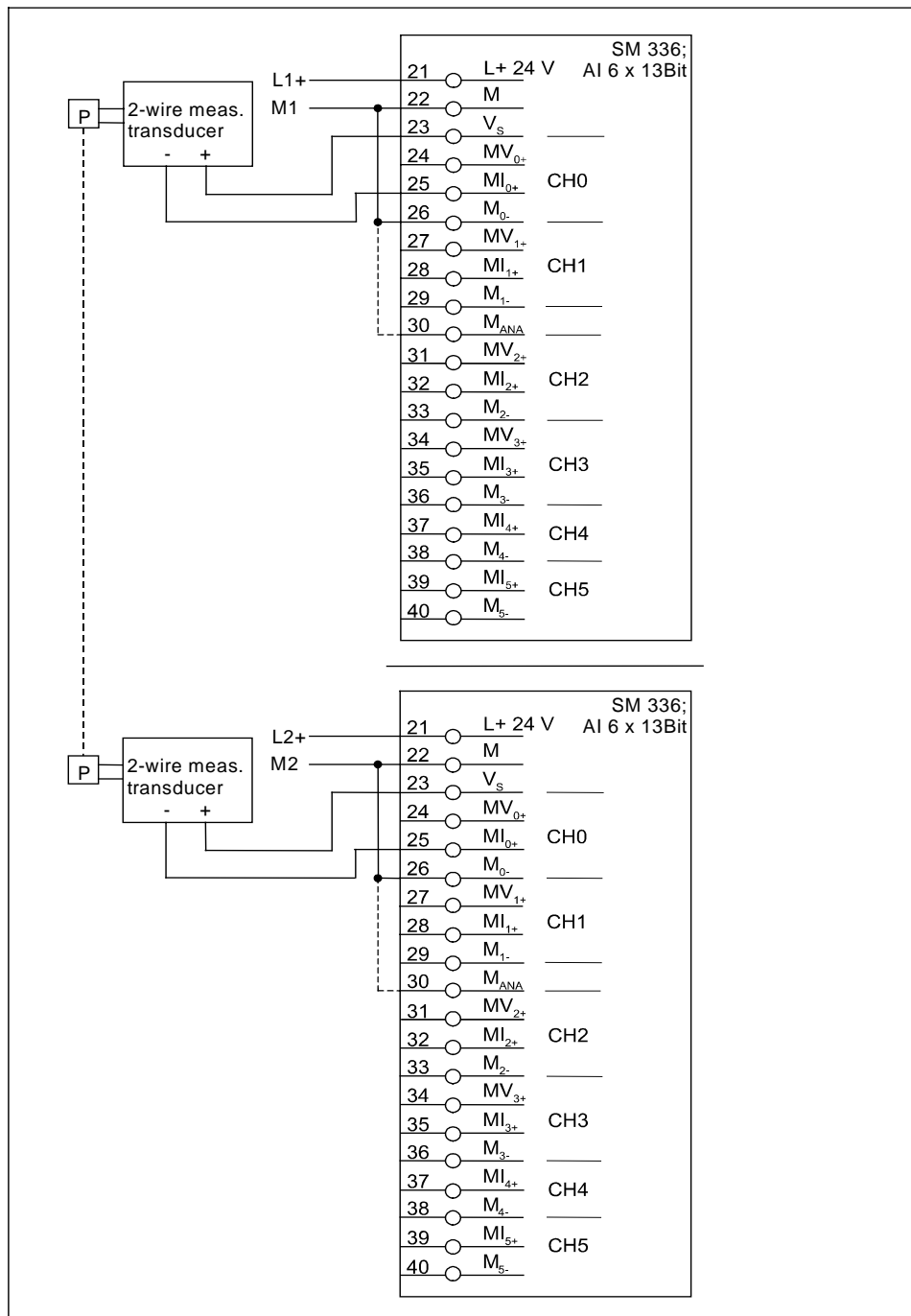
Below you can find the wiring schemes and the parameter assignment of the SM 336; AI 6 × 13Bit; with diagnostic interrupt for:

- Application 2: standard mode with high availability

Diagnostic messages, possible fault causes and remedies can be found in Tables 10-1 and 10-2.

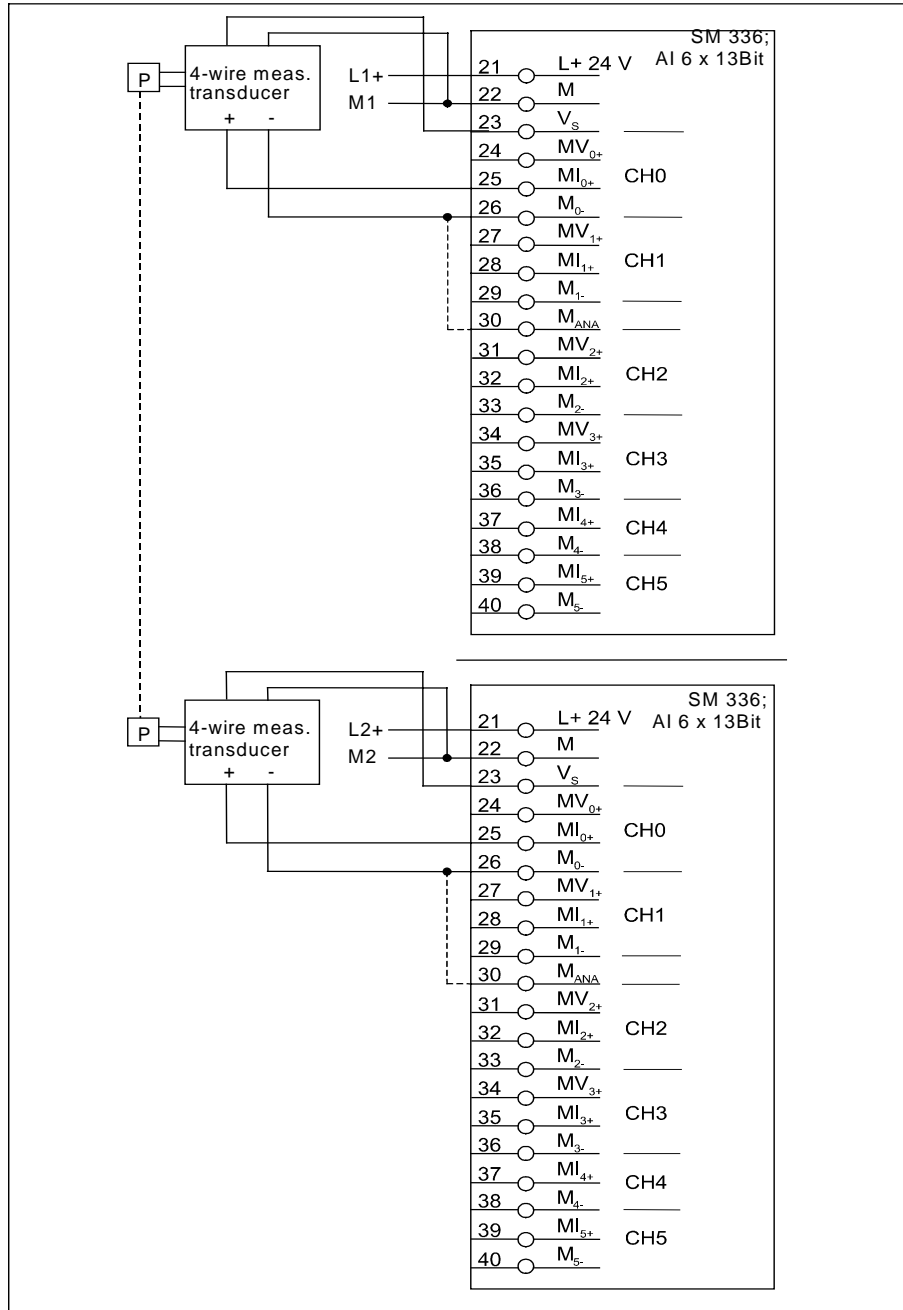
### Wiring Scheme A, 4 to 20 mA Current Measurement, 2-Wire Measuring Transducer, for Application 2

6 process signals can be connected to two redundant analog modules. Two sensors are connected via one channel to the two analog modules for each process signal. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-3).



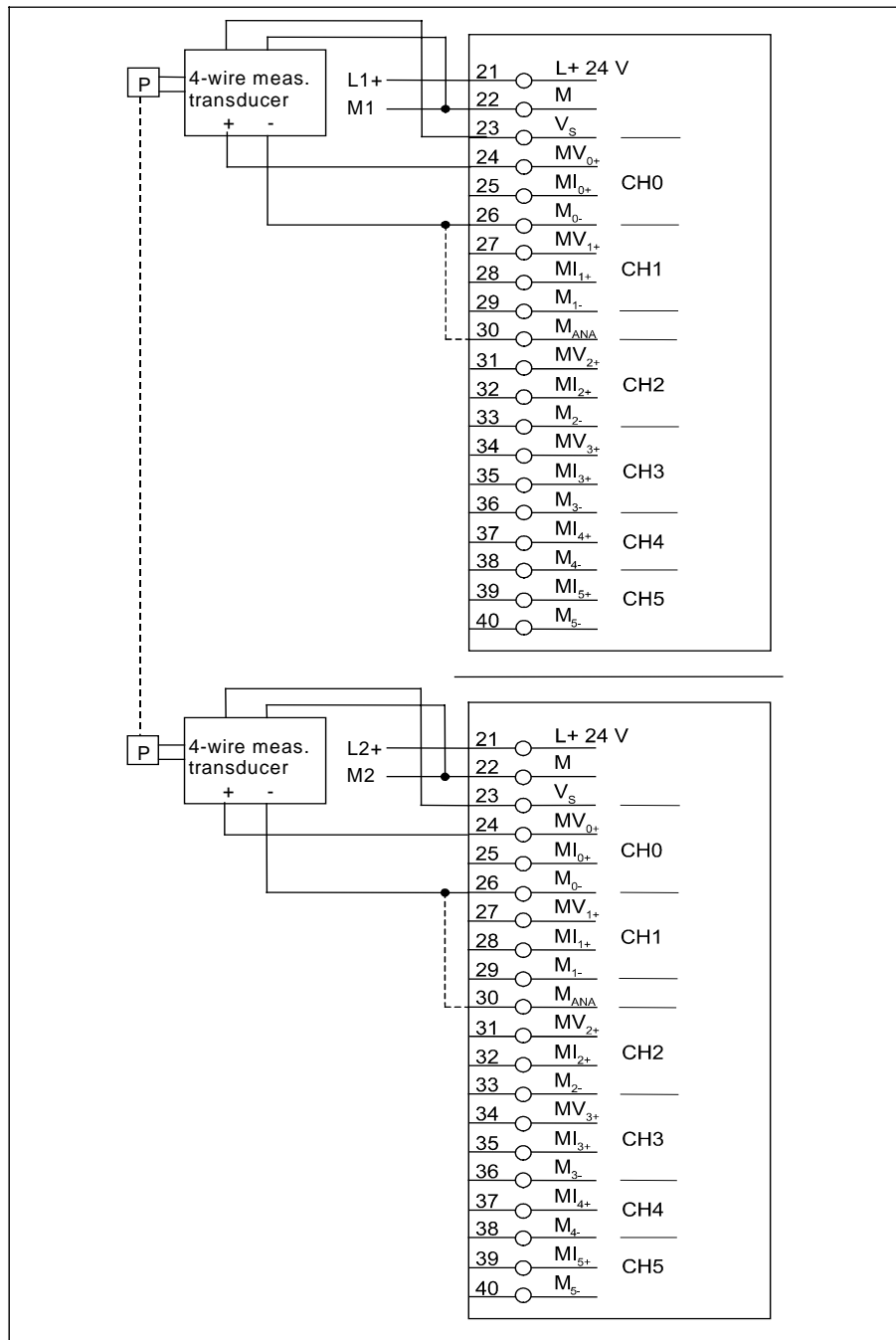
### Wiring Scheme B, 4 to 20 mA Current Measurement, 4-Wire Measuring Transducer, for Application 2

6 process signals can be connected to two redundant analog modules. Two sensors are connected via one channel to the two analog modules for each process signal. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-4). In the case of wire break monitoring, the measurement range is reduced to 4 to 20 mA.



### Wiring Scheme C, 0 to 10 V Voltage Measurement, 4-Wire Measuring Transducer, for Application 2

4 process signals can be connected to two redundant analog modules. Two sensors are connected via one channel to the two analog modules for each process signal. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-4).



## Parameters for Application 2

Parameters	Range of Values in Standard Mode	Type	Effective in
<b>"Inputs 1" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Interference Frequency	50 Hz/60 Hz	Static	Module
Group Diagnosis	Yes/no	Static	Channel
Wire-Break Check (only at 4 to 20 mA)	Yes/no	Static	Channel
Measurement Type	Disabled 4WMT 2WMT U	Static	Channel
Measurement Range	4 to 20 mA 0 to 20 mA 0 to 10 V	Static	Channel
<b>"Inputs 2" Tab</b>			
Safety Mode	No (standard mode)	Static	Module
Monitoring Time	-	Static	Module
<b>"Redundancy" Tab</b>			
Redundancy	Two Modules	Static	Module
Redundant Module	Selection of an existing additional module of the same type	Static	Driver block

By default, the redundancy of two modules must be configured in the user program as for S7-300 standard modules.

### 10.2.5 Application 3: Safety Mode SIL 2 (Safety Level AK 4, Category 3)

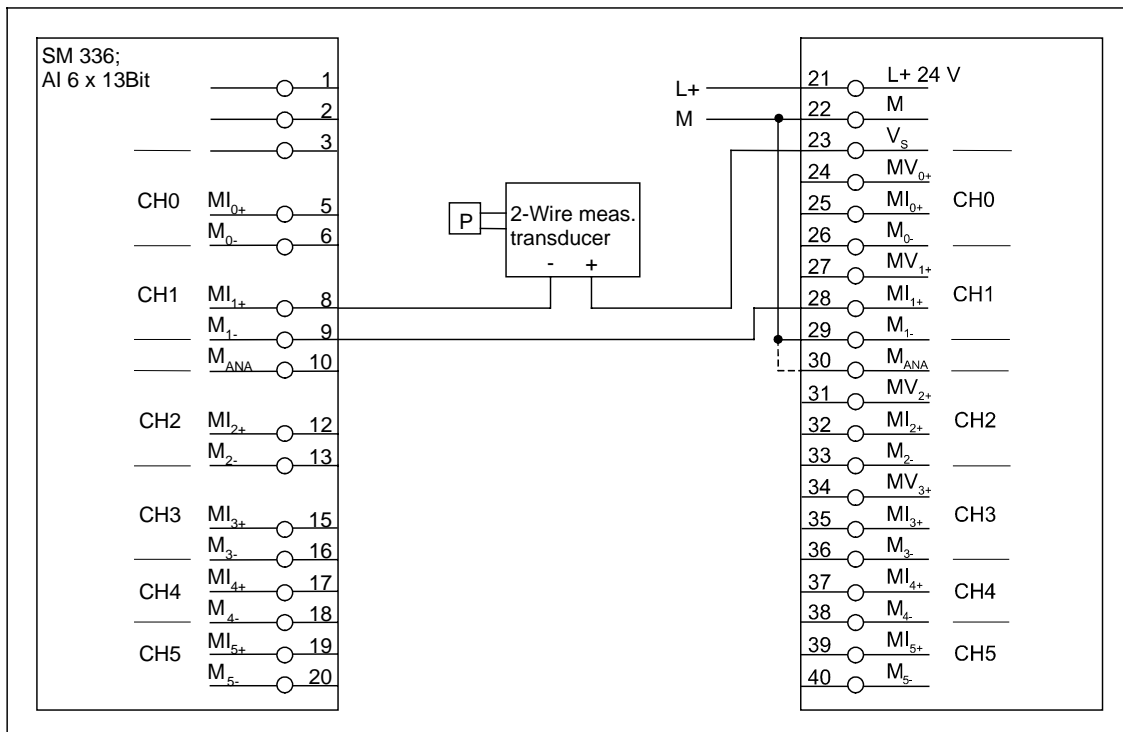
Below you can find the wiring schemes and the parameter assignment of the SM 336; AI 6 × 13Bit; with diagnostic interrupt for:

- Application 3: safety mode SIL 2 (safety level AK 4, category 3)

Diagnostic messages, possible fault causes and remedies can be found in Tables 10-1 and 10-2.

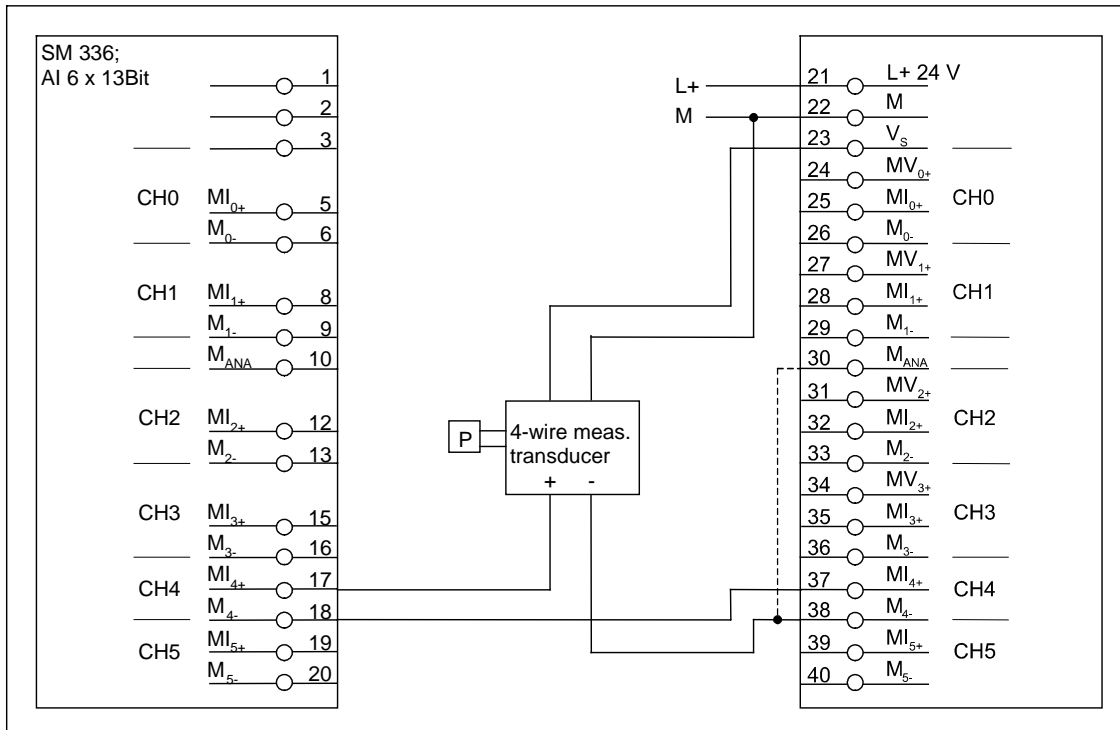
#### Wiring Scheme A, 4 to 20 mA Current Measurement, 2-Wire Measuring Transducer, for Application 3

6 process signals can be connected to an analog module. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-3).



### Wiring Scheme B, 4 to 20 mA Current Measurement, 4-Wire Measuring Transducer, for Application 3

6 process signals can be connected to an analog module. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-4).





### Parameters for Application 3

Parameters	Range of Values in Safety Mode	Type	Effective in
<b>"Inputs 1" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Interference Frequency	50 Hz/60 Hz	Static	Module
Group Diagnosis	Yes/no	Static	Channel
Wire-Break Check (only at 4 to 20 mA)	Yes/no	Static	Channel
Measurement Type	Disabled 4WMT 2WMT	Static	Channel
Measurement Range	4 to 20 mA	Static	Channel
<b>"Inputs 2" Tab</b>			
Safety Mode	To SIL 2 / AK 4 1 Sensor	Static	Module
Monitoring Time	10 to 10000 ms	Static	Module
<b>"Redundancy" Tab</b>			
Redundancy	None	Static	Module

#### 10.2.6 Application 4: Safety Mode SIL 2 (Safety Level AK 4, Category 3) with High Availability

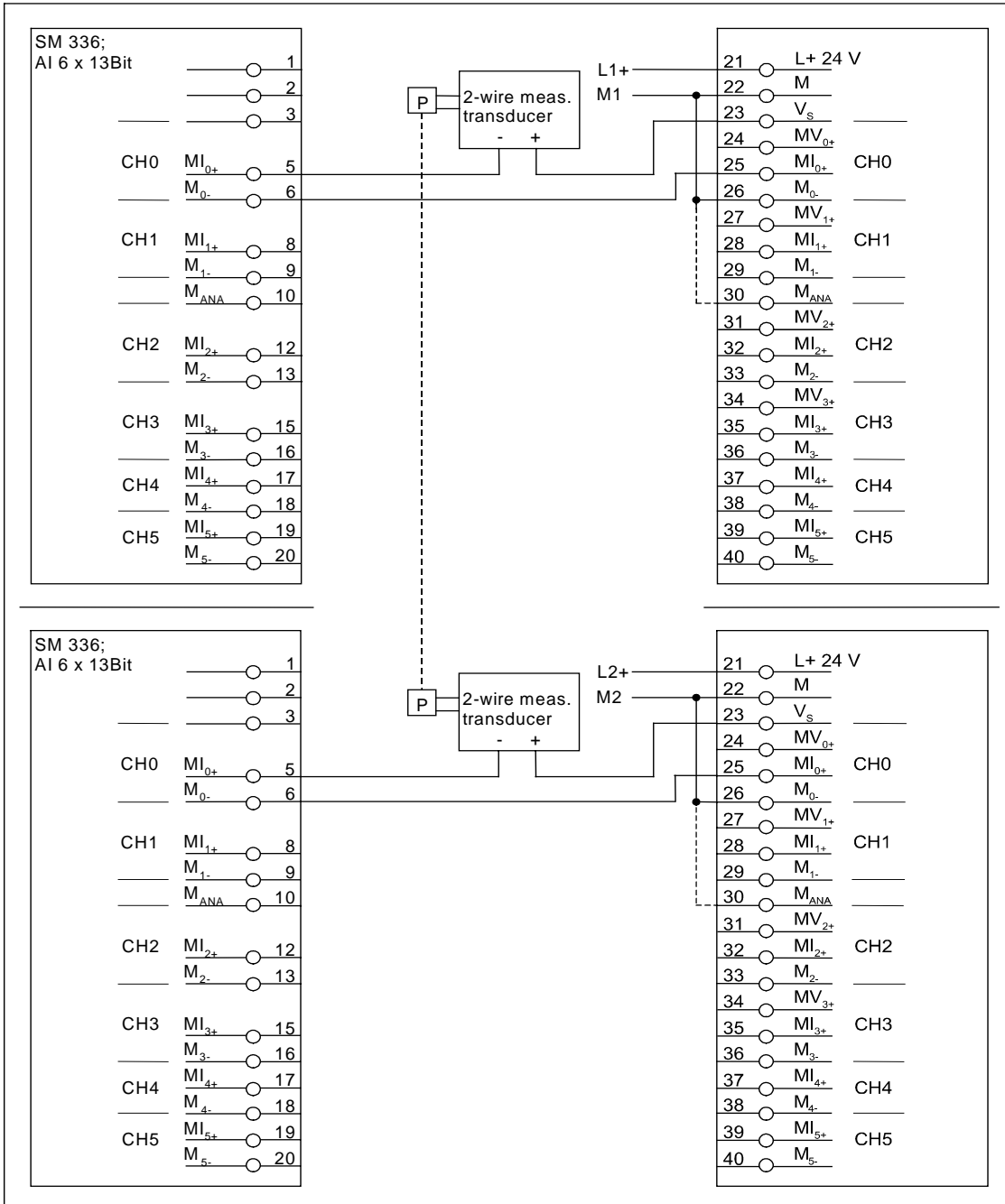
Below you can find the wiring schemes and the parameter assignment of the SM 336; AI 6 × 13Bit; with diagnostic interrupt for:

- Application 4: safety mode SIL 2 (safety level AK 4, category 3) with high availability

Diagnostic messages, possible fault causes and remedies can be found in Tables 10-1 and 10-2.

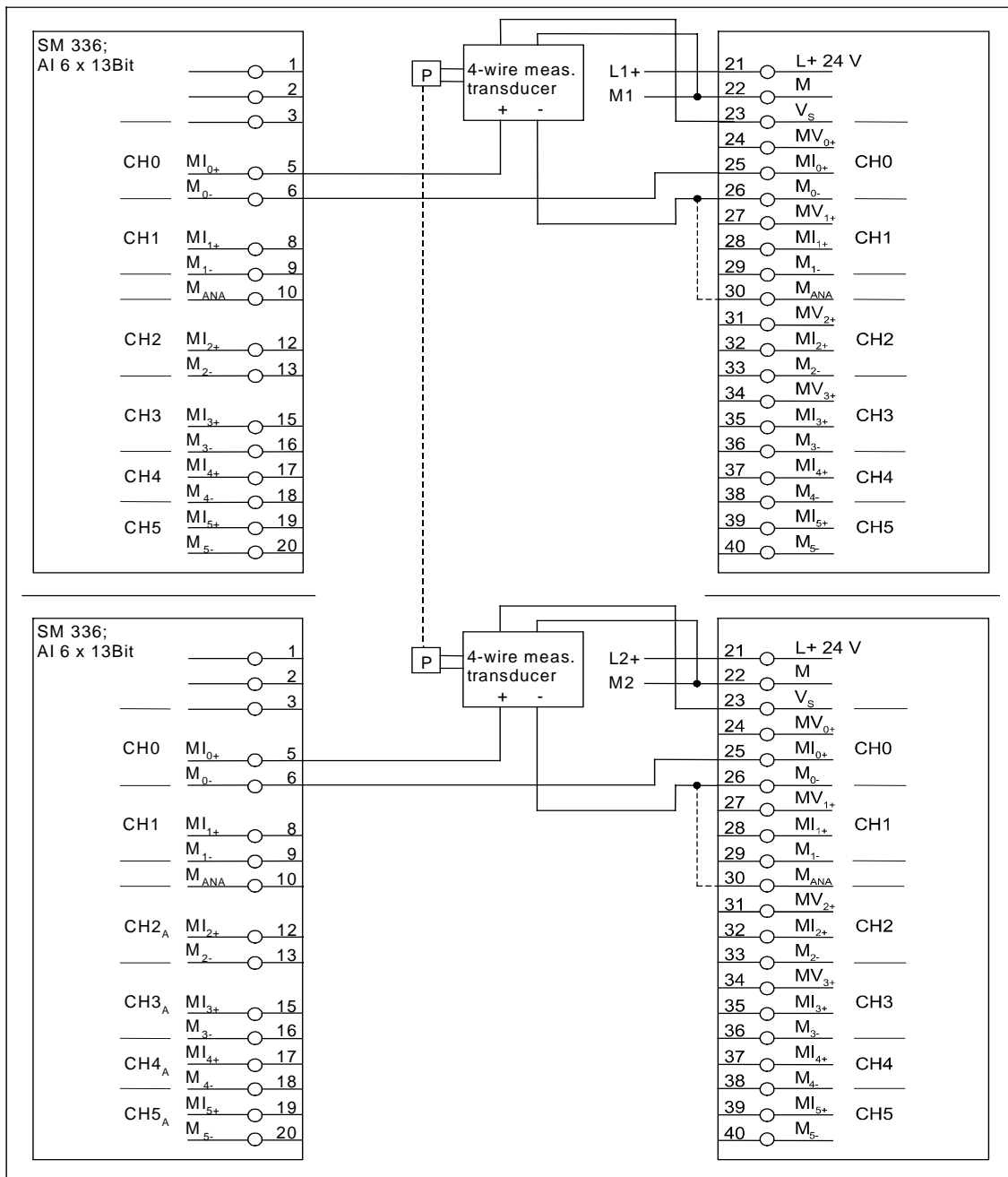
### Wiring Scheme A, 4 to 20 mA Current Measurement, 2-Wire Measuring Transducer, for Application 4

6 process signals can be connected to two redundant analog modules. Two sensors are connected via one channel to the two analog modules for each process signal. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 4-3).



### Wiring Scheme B, 4 to 20 mA Current Measurement, 4-Wire Measuring Transducer, for Application 4

6 process signals can be connected to two redundant analog modules. Two sensors are connected via one channel to the two analog modules for each process signal. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-4).



### Parameters for Application 4

Parameters	Range of Values in Safety Mode	Type	Effective in
<b>"Inputs 1" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Interference Frequency	50 Hz/60 Hz	Static	Module
Group Diagnosis	Yes/no	Static	Channel
Wire-Break Check (only at 4 to 20 mA)	Yes/no	Static	Channel
Measurement Type	Disabled 4WMT 2WMT	Static	Channel
Measurement Range	4 to 20 mA	Static	Channel
<b>"Inputs 2" Tab</b>			
Safety Mode	To SIL 2 / AK 4 1 Sensor	Static	Module
Monitoring Time	10 to 10000 ms	Static	Module
<b>"Redundancy" Tab</b>			
Redundancy	Two modules	Static	Module
Redundant Module	Selection of an existing additional module of the same type	Static	Driver block

### 10.2.7 Application 5: Safety Mode SIL 3 (Safety Level AK 5,6, Category 4)

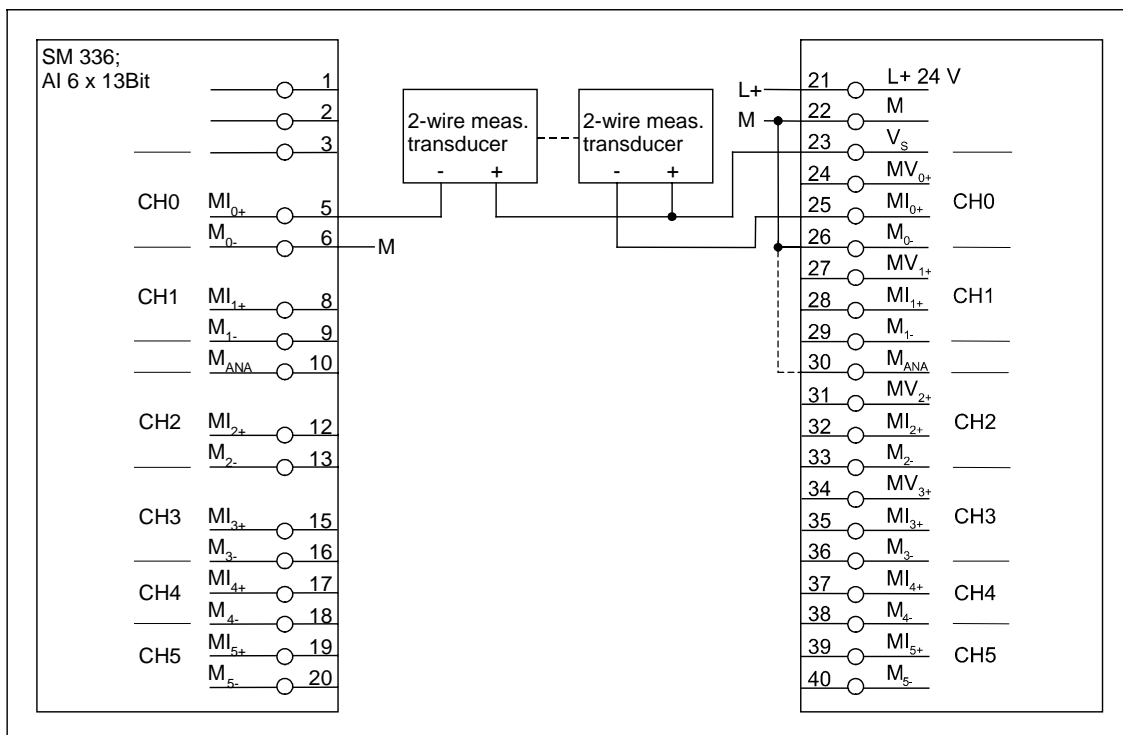
Below you can find the wiring schemes and the parameter assignment of the SM 336; AI 6 × 13Bit; with diagnostic interrupt for:

- Application 5: safety mode SIL 3 (safety level AK 5,6, category 4)

Diagnostic messages, possible fault causes and remedies can be found in Tables 10-1 and 10-2.

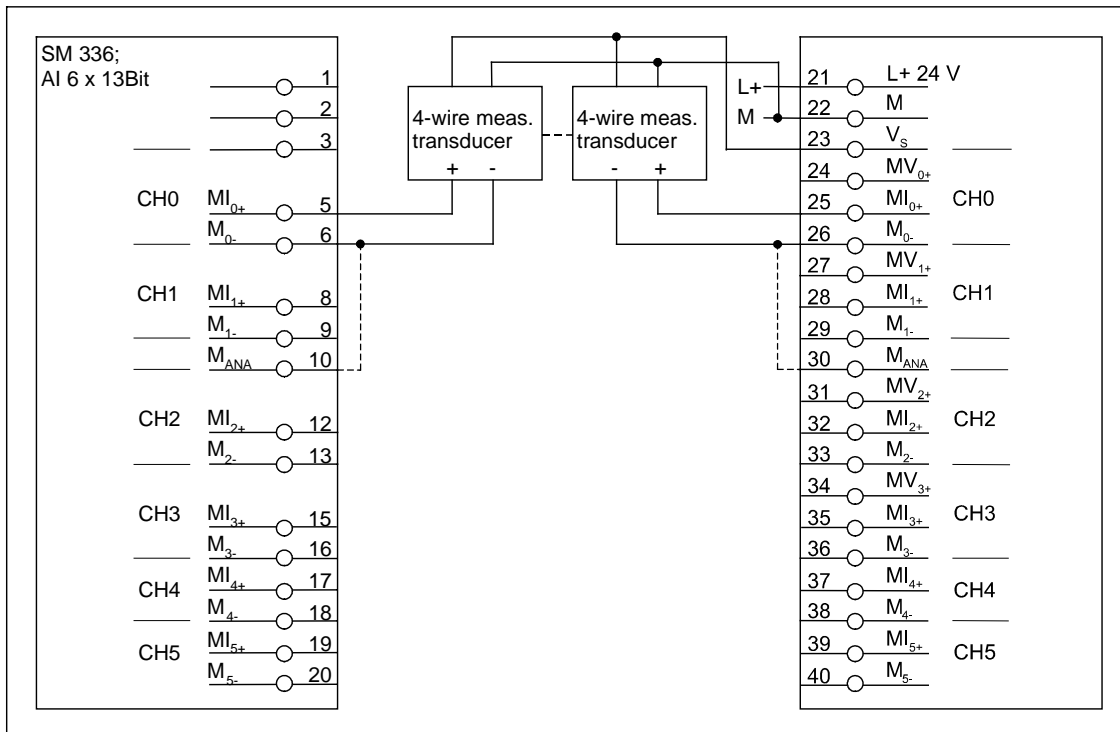
#### Wiring Scheme A, 4 to 20 mA Current Measurement, 2-Wire Measuring Transducer, for Application 5

6 process signals can be connected to an analog module. Two redundant sensors are connected to two **opposite inputs** of the analog module (1oo2 evaluation) for each process signal. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-3).



### Wiring Scheme B, 4 to 20 mA Current Measurement, 4-Wire Measuring Transducer, for Application 5

6 process signals can be connected to an analog module. Two redundant sensors are connected to two **opposite inputs** of the analog module (1oo2 evaluation) for each process signal. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-4).



## Parameters for Application 5

Parameters	Range of Values in Safety Mode	Type	Effective in
<b>"Inputs 1" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Interference Frequency	50 Hz/60 Hz	Static	Module
Group Diagnosis	Yes/no	Static	Channel
Wire-Break Check	Yes/no	Static	Channel
Measurement Type	Disabled 4WMT 2WMT	Static	Channel
Measurement Range	4 to 20 mA	Static	Channel
<b>"Inputs 2" Tab</b>			
Safety Mode	To SIL 3 / AK 5, 6 2 Sensors	Static	Module
Monitoring Time	10 to 10000 ms	Static	Module
Discrepancy Time	10 to 10.000 ms	Static	Module
Tolerance Range for the Measurement Range	0 to 20 % in 1 % increments	Static	Module
Unit Value	MIN/MAX	Static	Module
<b>"Redundancy" Tab</b>			
Redundancy	None	Static	Module

### 10.2.8 Application 6: Safety Mode SIL 3 (Safety Level AK 5,6, Category 4) with High Availability

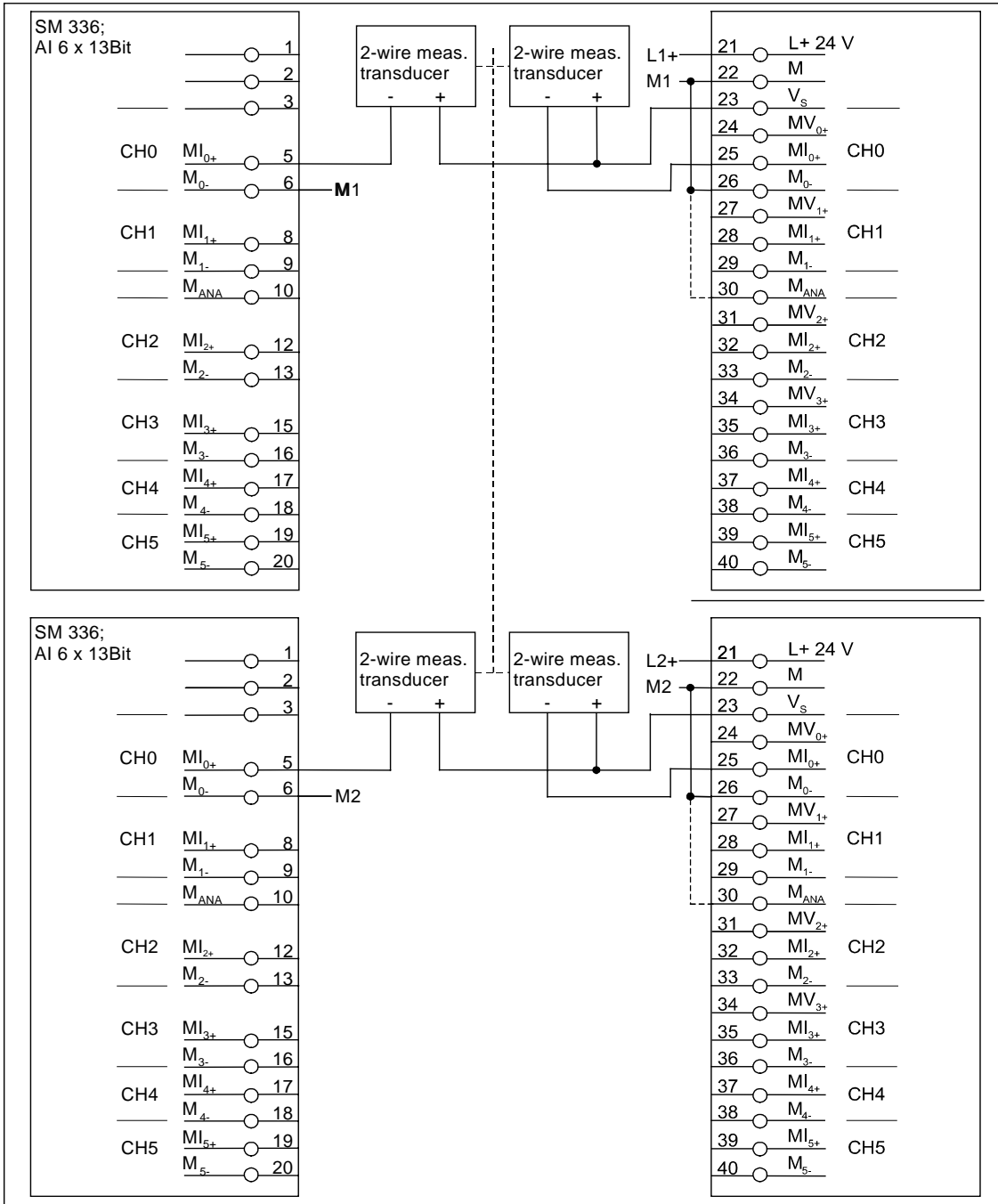
Below you can find the wiring schemes and the parameter assignment of the SM 336; AI 6 × 13Bit; with diagnostic interrupt for:

- Application 6: safety mode SIL 3 (safety level AK 5,6, category 4) with high availability

Diagnostic messages, possible fault causes and remedies can be found in Tables 10-1 and 10-2.

### Wiring Scheme A, 4 to 20 mA Current Measurement, 2-Wire Measuring Transducer, for Application 6

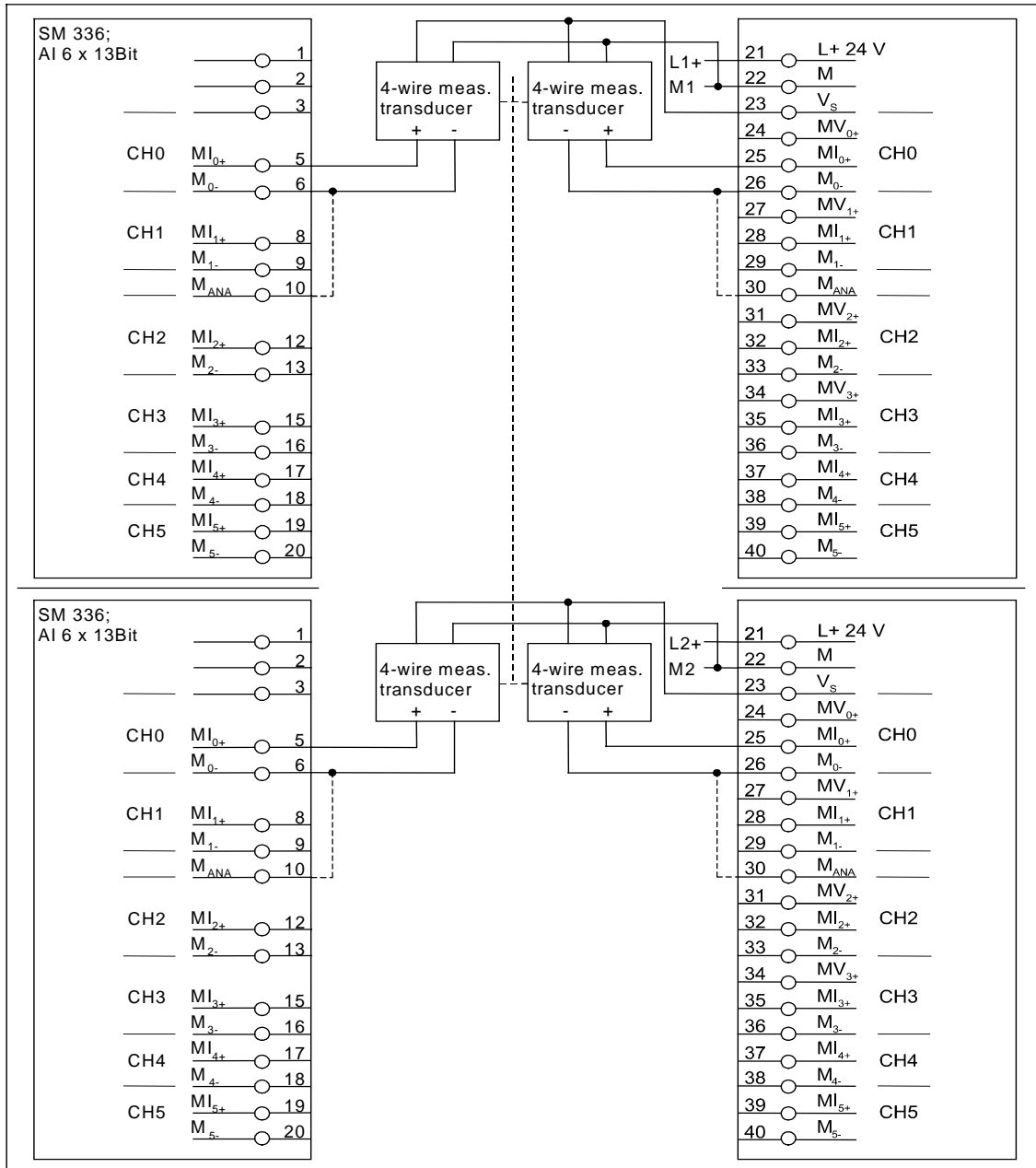
6 process signals can be connected to two redundant analog modules. Four redundant sensors are required for each process signal. Two sensors are connected via two channels to two **opposite inputs** of the analog module (1002 evaluation) for each module. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-3).





### Wiring Scheme B, 4 to 20 mA Current Measurement, 4-Wire Measuring Transducer, for Application 6

6 process signals can be connected to two redundant analog modules. Four redundant sensors are required for each process signal. Two sensors are connected via two channels to two **opposite inputs** of the analog module (1oo2 evaluation) for each module. The analog module provides the sensor supply  $V_S$  for 6 channels. The sensors can also be supplied via an external sensor supply (see Figure 10-4).



### Parameters for Application 6

Parameters	Range of Values in Safety Mode	Type	Effective in
<b>"Inputs 1" Tab</b>			
Enable Diagnostic Interrupt	Yes/no	Static	Module
Interference Frequency	50 Hz/60 Hz	Static	Module
Group Diagnosis	Yes/no	Static	Channel
Wire-Break Check (only at 4 to 20 mA)	Yes/no	Static	Channel
Measurement Type	Disabled 4WMT 2WMT	Static	Channel
Measurement Range	4 to 20 mA	Static	Channel
<b>"Inputs 2" Tab</b>			
Safety Mode	To SIL 3 / AK 5, 6 2 Sensors	Static	Module
Monitoring Time	10 to 10000 ms	Static	Module
Discrepancy Time	0 to 30.000 ms	Static	Module
Tolerance Range for the Measurement Range	1 to 20 % in 1 % increments	Static	Module
Unit Value	MIN/MAX	Static	Module
<b>"Redundancy" Tab</b>			
Redundancy	Two Modules	Static	Module
Redundant Module	Selection of an existing additional module of the same type	Static	Driver block

## 10.2.9 Diagnostic Messages of the SM 336; AI 6 × 13Bit; with Diagnostic Interrupt

### Possible Diagnostic Messages

Table 10-1 gives you an overview of the diagnostic messages of the SM 336; AI 6 × 13Bit; with diagnostic interrupt.

The diagnostic messages are assigned either to a channel or the entire module. Some diagnostic messages only occur in certain applications.

Table 10-1 Diagnostic Messages of the SM 336; AI 6 × 13Bit; with Diagnostic Interrupt

Diagnostic Message	Reported in Application		Diagnosis Effective in	Configurable
Wire break	1, 2, 3, 4, 5, 6	A, B	Channel	Yes
Violation of the tolerance range between 2 sensors (in safety mode only)	4, 6			
Common-mode error	1, 2, 3, 4, 5, 6	A, B, C	Channel	No
Lower limit violation (see the section on wire-break and underflow checks on page 10-2)	1, 2, 3, 4, 5, 6	A, B, C		
Upper limit violation	1, 2, 3, 4, 5, 6	A, B, C		
Configuration error or parameter assignment error	1, 2, 3, 4, 5, 6	A, B, C	Module	
ADC/DAC fault				
External auxiliary voltage missing				
Internal auxiliary voltage failed				
Time monitoring responded (watchdog)				
EPROM error, RAM error				

## Fault Causes and Remedies

You can find the possible causes for errors and the corresponding remedies for individual diagnostic messages of the SM 336; AI 6 × 13Bit; with diagnostic interrupt in Table 10-2.

Table 10-2 Diagnostic Messages and Their Remedies for the SM 336; AI 6 × 13Bit; with Diagnostic Interrupt

Diagnostic Message	Possible Fault Causes	Remedies
Wire break (only in measurement range 4 to 20 mA)	Interruption in the measuring wire between the module and the sensor	Reestablish the connection
	Incorrect measurement range set	Set the measurement range to 4 to 20 mA
Violation of the tolerance range between 2 sensors (in safety mode only)	Parameterized tolerance range violated after expiration of the discrepancy time	Set a greater tolerance range and/or discrepancy time, as required
	Wire break	Correct the wire break, if necessary. Check the process signal.
ADC/DAC fault	Internal error at analog value test	Replace the module
	Discrepancy between the two inputs too great in safety mode to SIL 2	Wiring fault Wire analog signal to both inputs or
	Error reported by internal voltage measuring device	Replace the module
Common-mode error	Potential difference ( $U_{CM}$ ) between the inputs (M-) and the reference potential of the measuring circuit ( $M_{ANA}$ ) is too great	Connect M- to $M_{ANA}$
Configuration error or parameter assignment error	Incorrect parameters in the module	Reparameterize the module
Lower limit violation (see the section on wire-break and underflow checks on page 10-2)		Install a suitable sensor, check the wiring (reverse polarization of the sensor)
Upper limit violation		Install a suitable sensor, reverse polarization of the sensor
External auxiliary voltage missing	The L+ supply voltage of the module is missing	Feed the L+ supply
Internal auxiliary voltage failed or incorrect	Supply voltage L+ of the module missing or module defective	Feed supply L+ or Replace the module
Time monitoring responded (watchdog)	Electromagnetic interference temporarily too high	Eliminate the problems
	Defective Module	Replace the module
EPROM fault RAM fault	Electromagnetic interference temporarily high	Eliminate the interference and switch the supply voltage of the CPU off/on
	Defective Module	Replace the module

## 10.2.10 Technical Specifications - SM 336; AI 6 × 13Bit; with Diagnostic Interrupt

Dimensions and Weight	
Dimensions W × H × D (mm)	80 × 125 × 120
Weight	Approx. 480 g
Module-Specific Data	
Number of inputs	6
Occupied address area	
• In the PII	16 bytes
• In the PIQ	4 bytes
Line length	
• Shielded	Max. 200 m
Maximum safety level that can be achieved in safety mode	
• To IEC 61508	Max. SIL 3
• To DIN V 19250	Max. AK 6
• To EN 954-1	Max. cat. 4
Safety parameters	
• Low demand mode (average probability of failure on demand) SIL 3	4.96E-08
• high demand / continuous mode (probability of a dangerous failure per hour) SIL 3	5.66E-13
Protection of the supply voltages L+ and L <sub>ref</sub> from surge stress to IEC 1000-4-5 (internal)	±0.5 kV, 1.2/50 µs
Protection of the analog inputs and sensor supply output from surge stress to IEC 1000-4-5 (internal)	±2 kV, 1.2/50 µs
Voltages, Currents, Potentials	
Rated supply voltage of the electronic components L+	24 V DC
• Reverse polarity protection	Yes
• Voltage failure bridging	5 ms
Electrical isolation	
• Between the channels and backplane bus	Yes
• Between the channels and power supply to the electronic components	Yes, only with ext. sensor supply
• Between the channels	No
• Between the power supply and sensor supply	No

Permissible potential difference	
• Between inputs and MANA (UCM)	6.0 V DC
• Between MANA and Minternal (UIso)	75 V DC, 60 V AC
Insulation tested with	600 V DC
Nominal insulation voltage	75 V DC/60 V AC
Power input	
• From the backplane bus	Max. 90 mA
• From supply voltage L+	Typically 160 mA
Common-mode voltage	
• Permissible common-mode voltage between inputs (UCM)	Max. ±6 V
• Monitoring of common-mode voltage	Yes, response range > 6 V or < -6 V
Power loss of the module	Typically 4.25 W
Analog Value Formation	
Measuring principle	Integrating
Integrations/conversion time	
• Configurable	Yes
• Integration Time	
At 50 Hz	20.00 ms
At 60 Hz	16.66 ms
• Resolution incl. overrange	13 bit + sign
Response time per activated channel	
At 50 Hz	Max. 50 ms
At 60 Hz	Max. 44 ms
Basic response time	
At 50 Hz	Max. 50 ms
At 60 Hz	Max. 44 ms
Acknowledgment time corresponds to the:	
Max. response time = max. response time per channel × N + max. basic response time	
(N = the number of activated channels)	

Interference Suppression, Error Limits	
Interference voltage suppression for $f=n \times (50/60 \text{ Hz} \pm 1 \%)$ , $n=1, 2, \dots$	Min. 38 dB
Common-mode interference ( $U_{cm} \leq 6 \text{ Veff}$ )	Min. 75 dB
Crosstalk between inputs	Min. 75 dB
Basic error limit (operational limit at 25 °C, with reference to the input range)	
• Input current	$\pm 0.40 \%$
• Input voltage	$\pm 0.40 \%$
Temperature error (with reference to input range)	$\pm 0.002 \%/K$
Linearity error (with reference to input range)	$\pm 0.05 \%$
Repeat accuracy (in a steady state at 25°C, with reference to input range)	$\pm 0.05 \%$
Operational limit (in the entire temperature range, with reference to the input range)	
• Current	$\pm 0.48 \%$
• Voltage	$\pm 0.48 \%$
Status, Interrupts, Diagnostics	
Interrupts	
• Process interrupt	No
• Diagnostic interrupt	Yes, configurable
Diagnostic functions	
• Indication of safety-related operation	Green LED (SAFE)
• Monitoring of sensor supply	Green LED (Vs)
• Common error display	Red LED (SF)
• Diagnostic information readable	Yes
Substitute values can be applied	Programmable in safety program

Sensor Supply Output	
Number of outputs	1
Output voltage	
• Loaded	Min. L+ (-1.5 V)
Output current	
• Rated value	1.0 A
• Permissible Range	0 to 1.3 A
Short-circuit protection	Yes, electronically
Isolation to DIN VDE 0160	
• Between output Vs and backplane bus	Yes
• Between output and L+	No
• Test Voltage	600 V DC
• Nominal insulation voltage	75 V DC/60 V AC
Data for Selecting a Sensor	
Input range (rated values)/input resistance in standard mode	
• Voltage	0 to 10 V / 59 k $\Omega$
• Current	0 to 20 mA , 4 to 20 mA/107 $\Omega$
Input range (rated values)/input resistance in safety mode	
• Current	4 to 20 mA/107 $\Omega$
Permissible input voltage for input voltage (destruction limit)	Max. 30 V continuously; max. 38 V for max. 1s (pulse duty factor 1:20)
Permissible input current for input current (destruction limit)	Max. 40 mA
Connection of the signal sensors	
• For voltage measurement	Possible
• For current measurement	Possible
• As 4-wire measuring transducer	Possible
• As 2-wire measuring transducer	Possible
• Burden of the 2-wire measuring transducer	Max. 600 $\Omega$

# 11 Safety Protector

## Introduction

The safety protector is available for you to be able to use fail-safe signal modules and S7-300 standard modules together **in safety mode in an ET 200M**.



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### Safety Note

The safety parameters in the technical specifications are valid for a proof test period of 10 years.

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## Contents

Section	Contents	Page
11.1	Features, Front View and Block Diagram	11-2
11.2	Configuration Variants	11-4
11.3	Technical Specifications	11-6

## 11.1 Features, Front View and Block Diagram

### Order Number

6ES7 195-7KF00-0XA0

### Features

The safety protector protects the fail-safe signal modules from possible overvoltage in the event of a fault. This makes it possible to use fail-safe signal modules and S7-300 standard modules in an ET 200M station even in safety mode.

The safety protector is not assigned any addresses, does not issue diagnostic messages and is not parameterized using *STEP 7*.

### Advantages

Using the safety protector in the ET 200M has the following advantages:

- PROFIBUS-DP lines can be connected with copper bus cables; it is not necessary to use fiber-optic cable technology.
- You can use any IM 153-x.
- It is possible to have a mixed configuration of fail-safe signal modules in safety mode and S7-300 standard modules in an ET 200M.

### Safety Class SIL 3 with the Safety Protector

Please note that when using applications in SIL 3, you can only get the above advantages if you use the safety protector.

### Safety Class SIL 2 without the Safety Protector

If you maintain safe functional extra-low voltage (see Section 8.2) in all the components connected on the PROFIBUS-DP, the following then applies to applications in SIL 2:

The safety protector is **not** required. This means you can achieve the above advantages even if you don't use the safety protector.



**Front View**

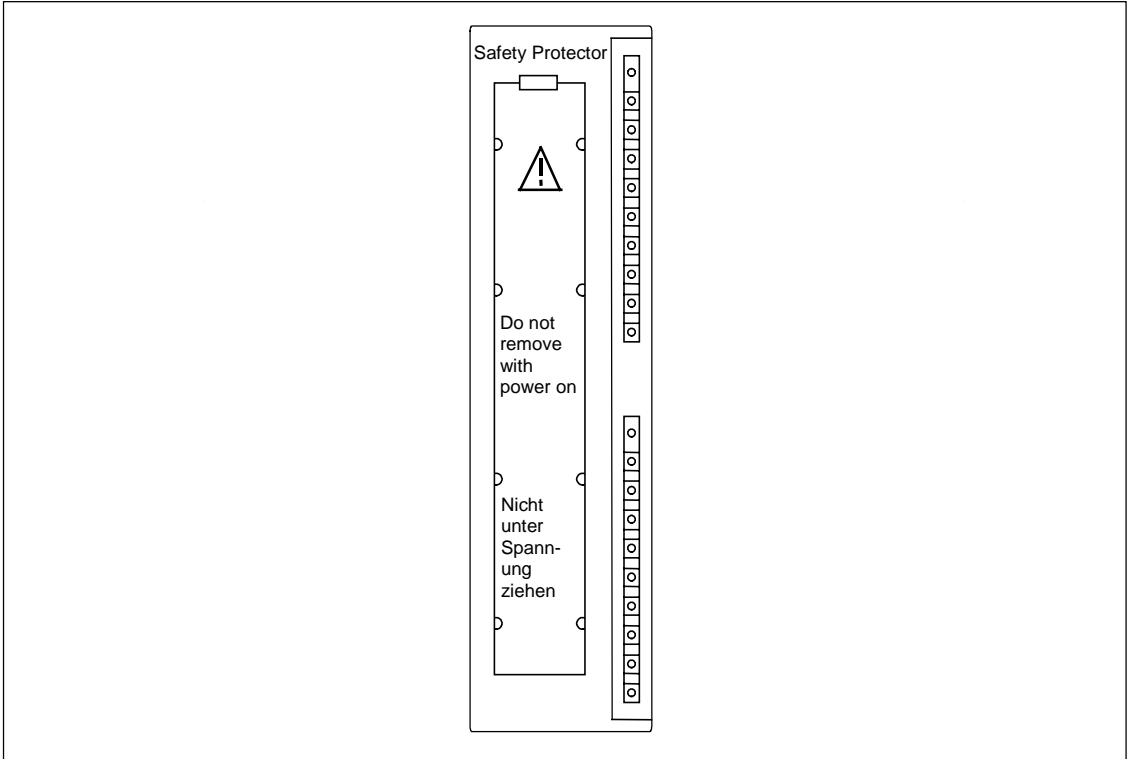


Figure 11-1 Front View of the Safety Protector

**Block Diagram**

The following figure illustrates the block diagram of the safety protector.

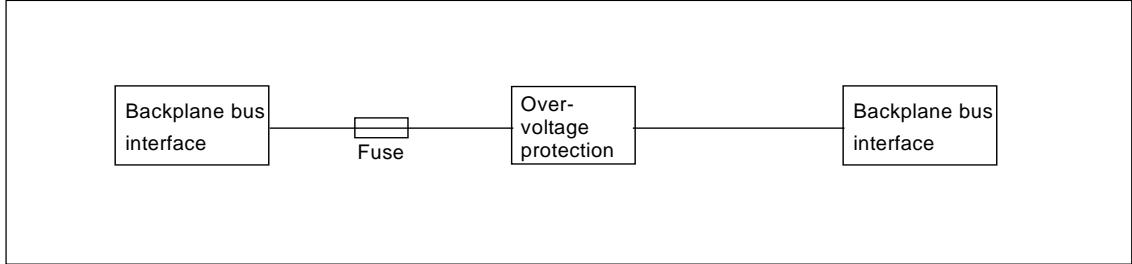


Figure 11-2 Block Diagram of the Safety Protector

## 11.2 Configuration Variants

### Introduction

There are two possible ways of setting up an ET 200M with a safety protector, depending on whether or not it is necessary to replace modules during operation.

### Setting up an ET 200M with a Safety Protector (no Module Replacement During Operation)

The ET 200M is 40 mm wider due to the safety protector. However, you can still insert a maximum of 8 signal modules.

The following figure gives you a sample configuration with 7 signal modules.

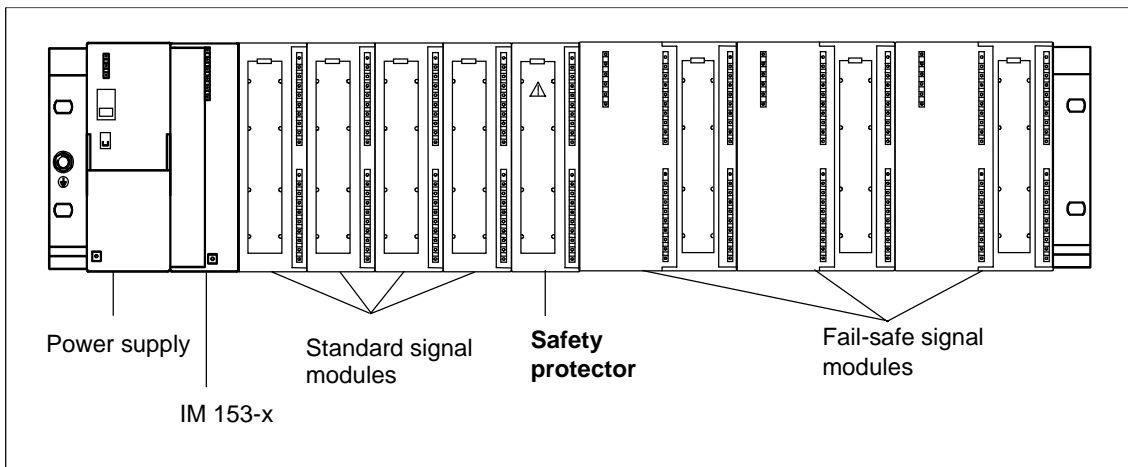


Figure 11-3 Setting Up an ET 200M with a Safety Protector (Module Replacement During Operation Is Not Possible)

### Note

To ensure that overvoltage protection is maintained in safety mode, you do the following:

- Always insert the standard signal modules to the left of the safety protector and the fail-safe signal modules to the right of the safety protector
- Ground the rail
- Connect the safety protector to functional ground. To do this, connect pins 19 and 20 of the safety protector to the rail with one cable each (conductor cross section = 1.5 mm<sup>2</sup>) as short as possible.

## Replacing Modules in Safety Mode

If you set up the safety protector and all the other modules in an ET 200M configuration with active bus modules, you can then insert and remove all the modules - **except the safety protector** - during operation.



### Warning

The bus module for the safety protector (order no. 6ES7 195-7HG00-0XA0) can only be used in an ET 200M if a safety protector is inserted. It is only for connecting the safety protector to the active backplane bus.

The safety protector itself must not be inserted or removed during operation! (This would result in ET 200M station failure.)

## Setting Up an ET 200M with a Safety Protector on the Active Backplane Bus

The ET 200M is 80 mm wider due to the bus module for the safety protector. You can still insert a maximum of 8 signal modules. Remember that you need to install the rail for the replacement of modules during operation (order no. 6ES7 195-1GX00). The following figure shows you a sample configuration with 7 signal modules.

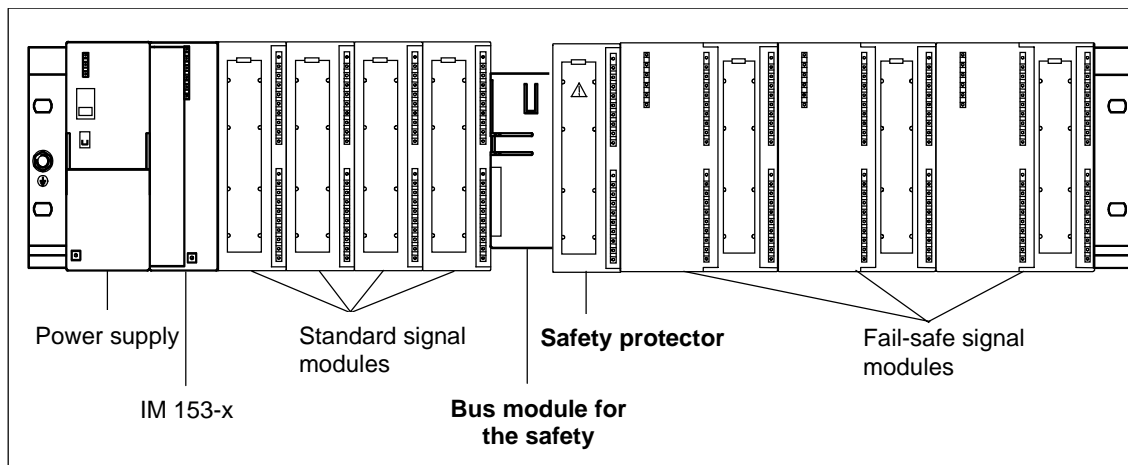


Figure 11-4 Setting Up an ET 200M with a Safety Protector on the Active Backplane Bus

### Note

To ensure that overvoltage protection is maintained in safety mode, you do the following:

- Always insert the standard signal modules to the left of the safety protector and the fail-safe signal modules to the right of the safety protector
- Ground the rail
- Connect the safety protector to functional ground. To do this, connect pins 19 and 20 of the safety protector to the rail with one cable each (conductor cross section = 1.5 mm<sup>2</sup>) as short as possible.

## Power Supply of the Modules

Fail-safe signal modules in safety mode must be supplied **separately** to all the other standard components with 24 VDC. This means that they must not receive power from the same power supplies (see also Section 8.2).

In our examples (see Figures 11-3 and 11-4), this means that:

- The IM 153-x and the standard signal modules have their own power supply
- The fail-safe signal modules have their own power supply
- The safety protector doesn't need its own power supply

## Additional Information

You can find detailed information on the installation of modules and bus modules, replacing modules within an ET 200M and the "Replacement of modules during operation" function in the *ET 200M Distributed I/O Device* manual.

You will also find information on the preparation and installation of rails in this manual.

## 11.3 Technical Specifications

<b>Dimensions and Weight</b>	
Dimensions W × H × D (mm)	40 × 125 × 120
Weight	Approx. 230 g
<b>Voltages, Currents, Potentials</b>	
Power loss of the module	None

# A Diagnostic Data of the Signal Modules

## Introduction

The structure of the diagnostic data in the system data is described in this appendix. You must know this structure if you want to evaluate the diagnostic data of the fail-safe signal modules in the STEP 7 user program.

## Further Reading

You can find a detailed description of the principle behind evaluating the diagnostic data of signal modules in the user program as well as a description of the SFCs you require for this in the *System and Standard Functions* reference manual.

## Reading out the SFCs for Diagnosis

The following SFCs are available for reading out the diagnostic data of the fail-safe signal modules in the user program:

SFC No.	Identifier	Application
59	RD_REC	Reading out data records of the S7 diagnosis (stored in the data area of the user program)
13	DPNRM_DG	Reading out slave diagnosis (stored in data area of the user program)

## Position in the Diagnostic Frame of the Slave Diagnosis

If the fail-safe signal modules are being used in a distributed configuration in the ET 200M and a diagnostic interrupt occurs, records 0 and 1 are entered in the slave diagnosis of the ET 200M (= interrupt section).

The position of the interrupt section in the slave diagnosis depends on the structure of the diagnostic frame and on the length of the channel-specific diagnosis.

You can find an exact description of the structure of the diagnostic frame and the position of the interrupt section in accordance with the PROFIBUS standard in the chapter on commissioning and diagnostics in the *ET 200M Distributed I/O Device* manual.

## Records 0 and 1 of the System Data

The diagnostic data of a module can be up to 16 bytes long. It is located in records 0 and 1 of the system data area:

- Data record 0 contains 4 bytes of diagnostic data describing the state of a signal module.
- Data record 1 contains:
  - 4 bytes of diagnostic data of the signal module, which are also in record 0
  - Up to 12 bytes of channel-specific diagnostic data

## Structure and Contents of the Diagnostic Data

The structure and contents of the individual bytes of the diagnostic data are described below.

The following generally applies: If an error occurs, the corresponding bit is set to "1".

## Bytes 0 and 1

Figure A-1 shows you the contents of bytes 0 and 1 of the diagnostic data.

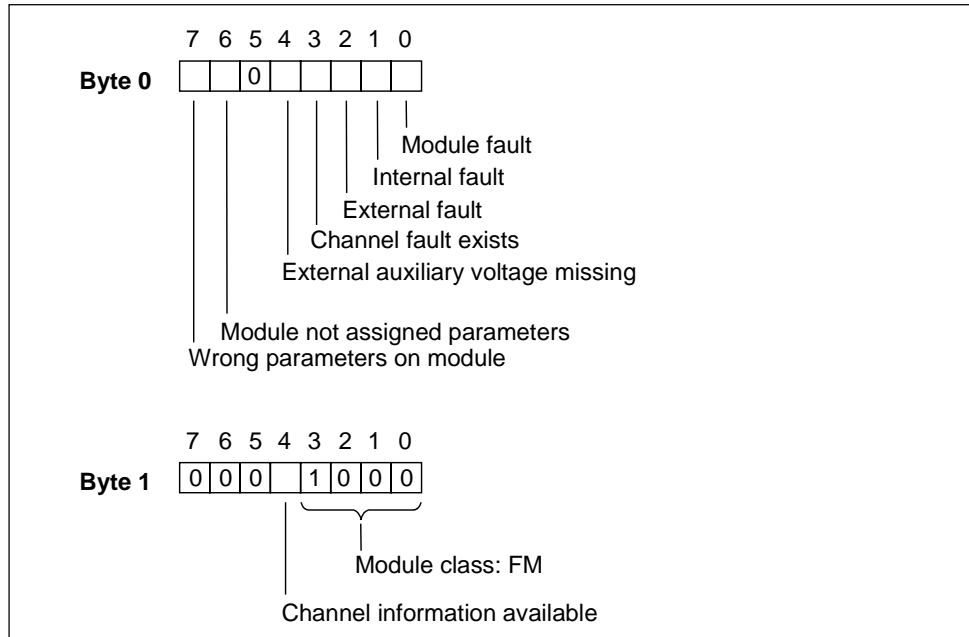


Figure A-1 Bytes 0 and 1 of the Diagnostic Data

### Bytes 2 and 3

Figure A-2 shows you the contents of bytes 2 and 3 of the diagnostic data.

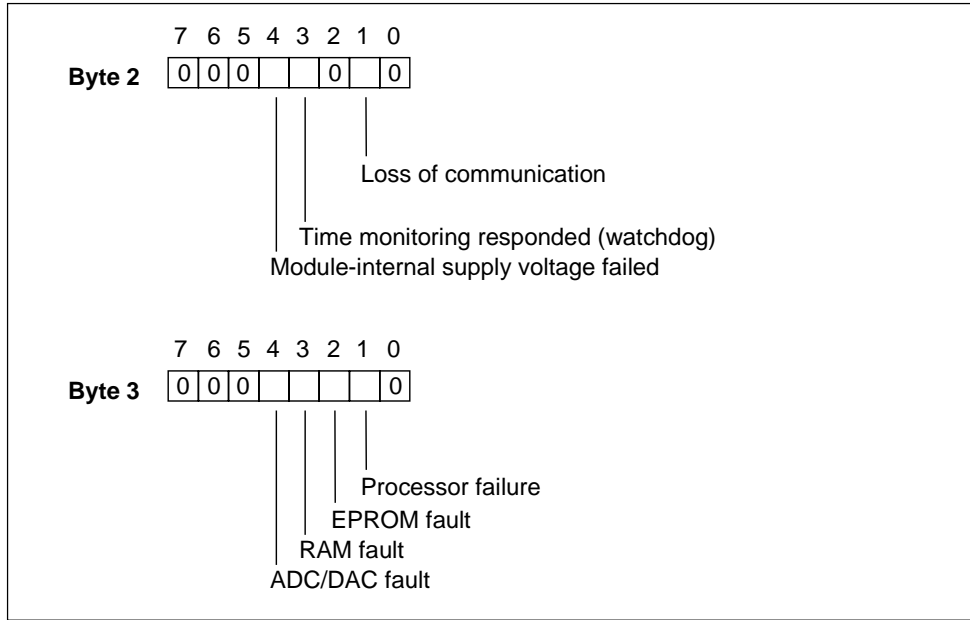


Figure A-2 Bytes 2 and 3 of the Diagnostic Data

### Bytes 4 to 6

Figure A-3 shows you the contents of bytes 4 and 6 of the diagnostic data.

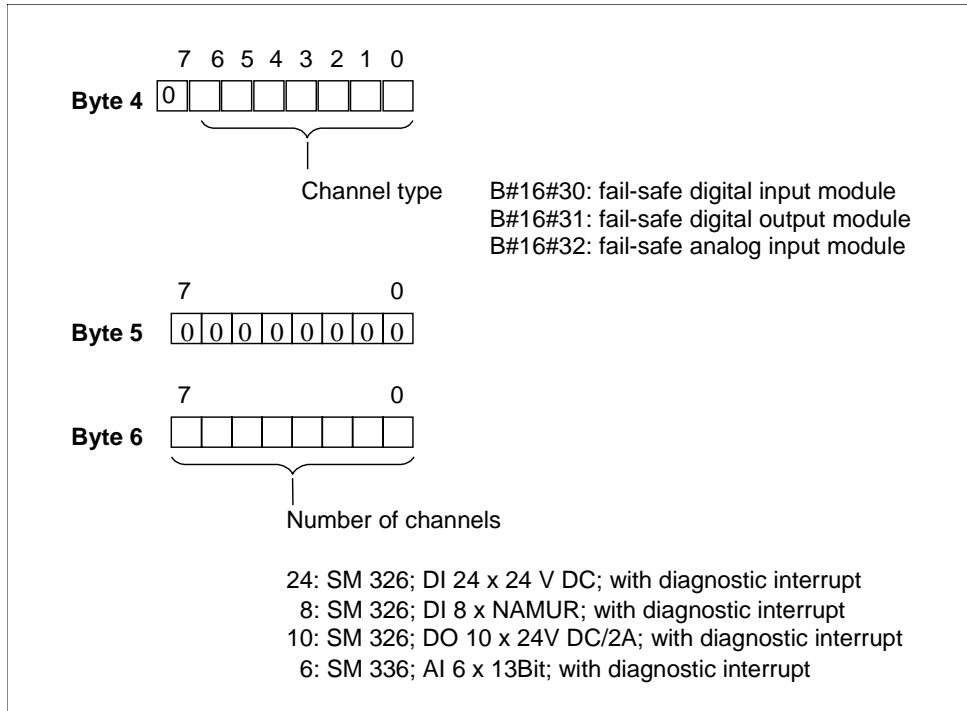


Figure A-3 Bytes 4 and 6 of the Diagnostic Data



**Bytes 7 to 9 for the SM 326; DI 24 × 24V DC; with Diagnostic Interrupt**

Figure A-4 shows you the contents of bytes 7 to 9 of the diagnostic data for the SM 326; DI 24 × 24V DC; with diagnostic interrupt.

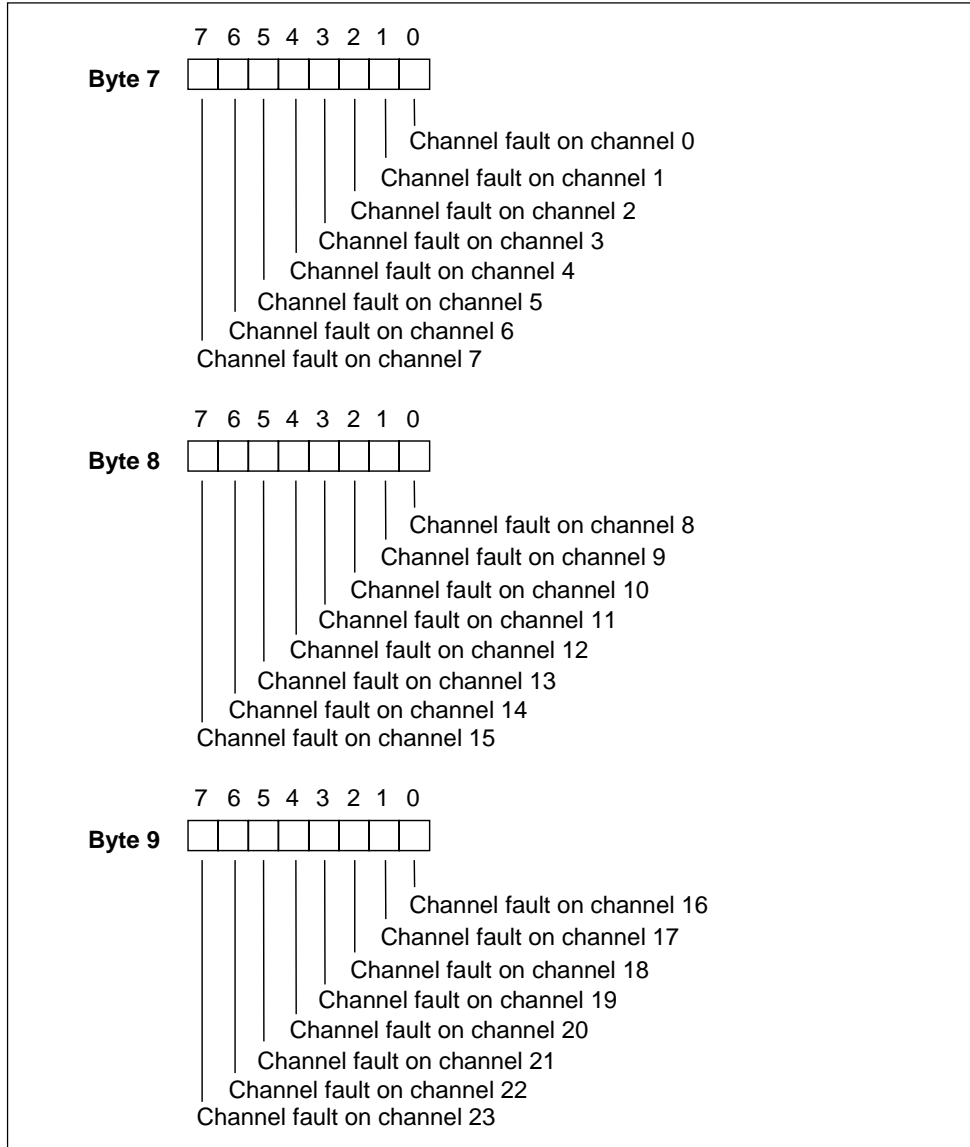


Figure A-4 Bytes 7 to 9 of the Diagnostic Data for the SM 326; DI 24 × 24V DC; with Diagnostic Interrupt

**Byte 7 for the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt**

Figure A-5 shows you the contents of byte 7 of the diagnostic data for the SM 326; DI 8 × NAMUR; with diagnostic interrupt.

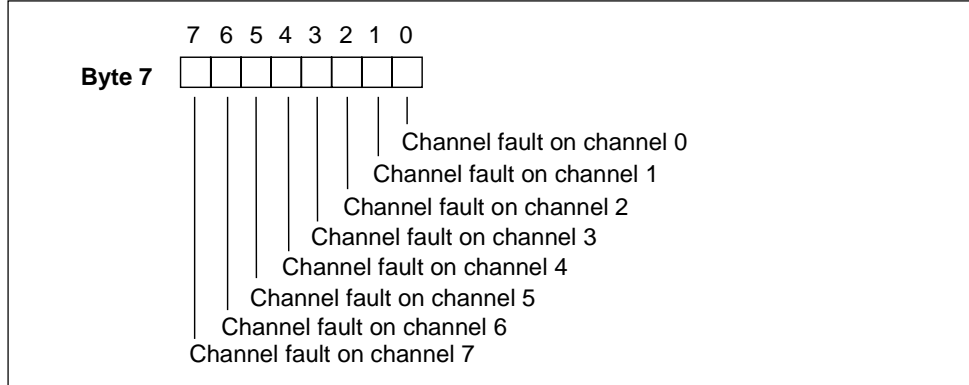


Figure A-5 Byte 7 of the Diagnostic Data for the SM 326 DI 8 × NAMUR; with Diagnostic Interrupt

**Bytes 7 and 8 for the SM 326; DO 10 × 24V DC/2A; with Diagnostic Interrupt**

Figure A-6 shows you the contents of bytes 7 and 8 of the diagnostic data for the SM 326; DO 10 × 24V DC/2A; with diagnostic interrupt.

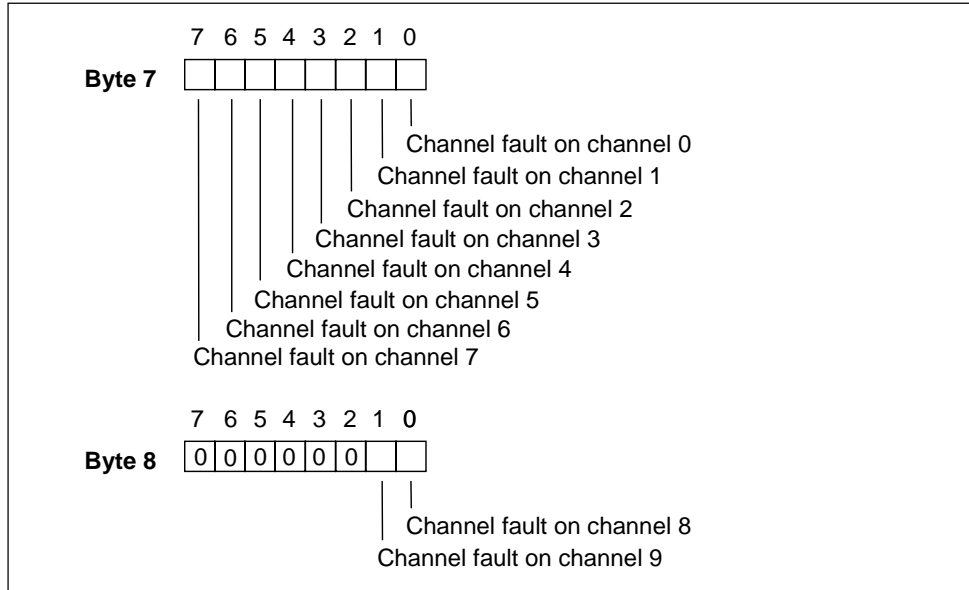


Figure A 6 Bytes 7 and 8 of the Diagnostic Data for the SM 326; DO 10 × 24V DC/2A; with Diagnostic Interrupt

**Byte 7 for the SM 336; AI 6 × 13Bit; with Diagnostic Interrupt**

Figure A-7 shows you the contents of byte 7 of the diagnostic data for the SM 336; AI 6 × 13Bit; with diagnostic interrupt.

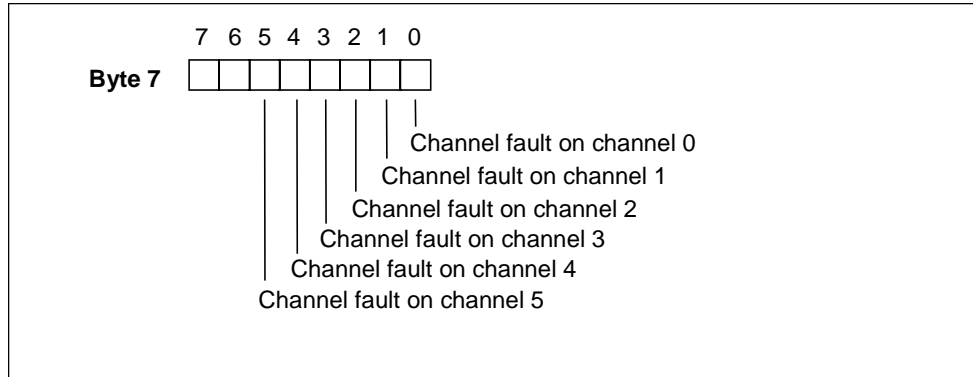


Figure A-7 Byte 7 of the Diagnostic Data for the SM 336; AI 6 × 13Bit; with Diagnostic Data



## B Dimensioned Drawings

### Signal Module

The following figure shows a dimensioned drawing of the signal modules (without removal or insertion during operation). The different signal modules can vary in appearance. The specified dimensions are, however, always the same.

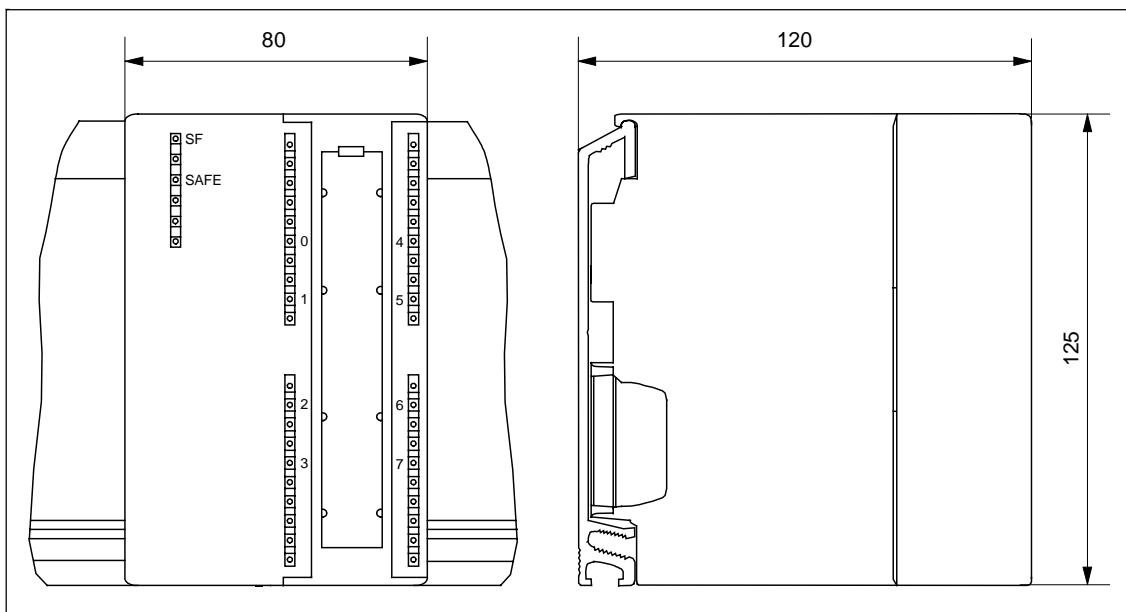


Figure B-1 Dimensioned Drawing of a Signal Module

### Signal Module with Active Bus Module

The following figure shows the dimensioned drawing (side view) of a signal module for the function "Insertion and Removal" with active bus module, S7-300 module and intrinsically safe partition. The dimensions indicated are the same for all signal modules on the active backplane bus.

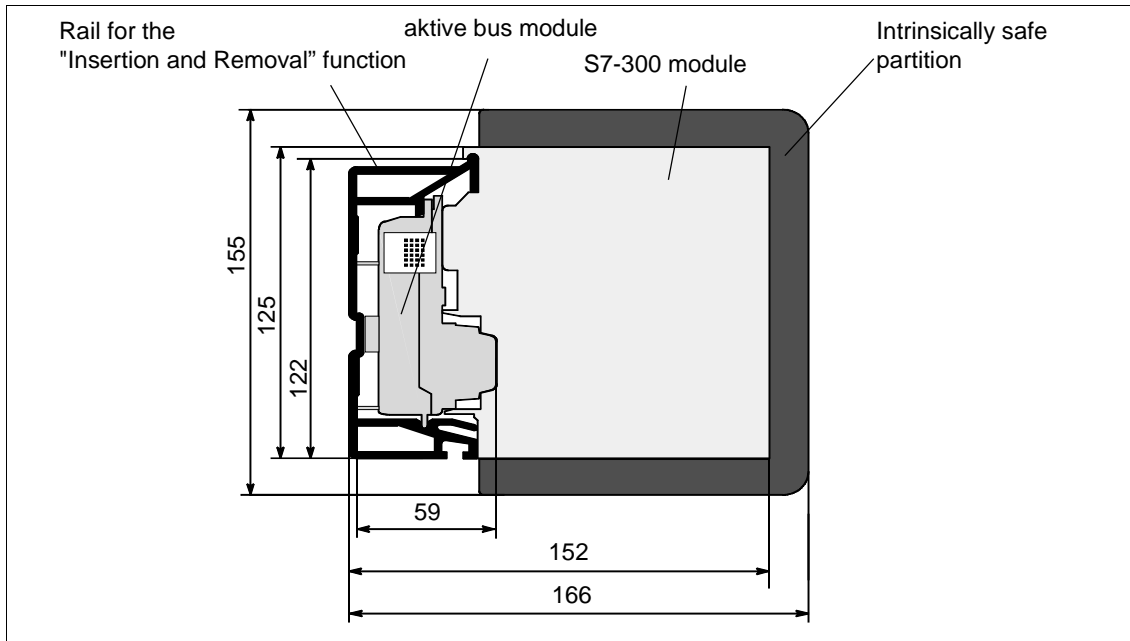


Figure B-2 Dimensioned Drawing of a Signal Module with Active Bus Module, S7-300 Module and Intrinsically Safe Partition

### Safety Protector

The following figure shows the dimensioned drawing of the safety protector

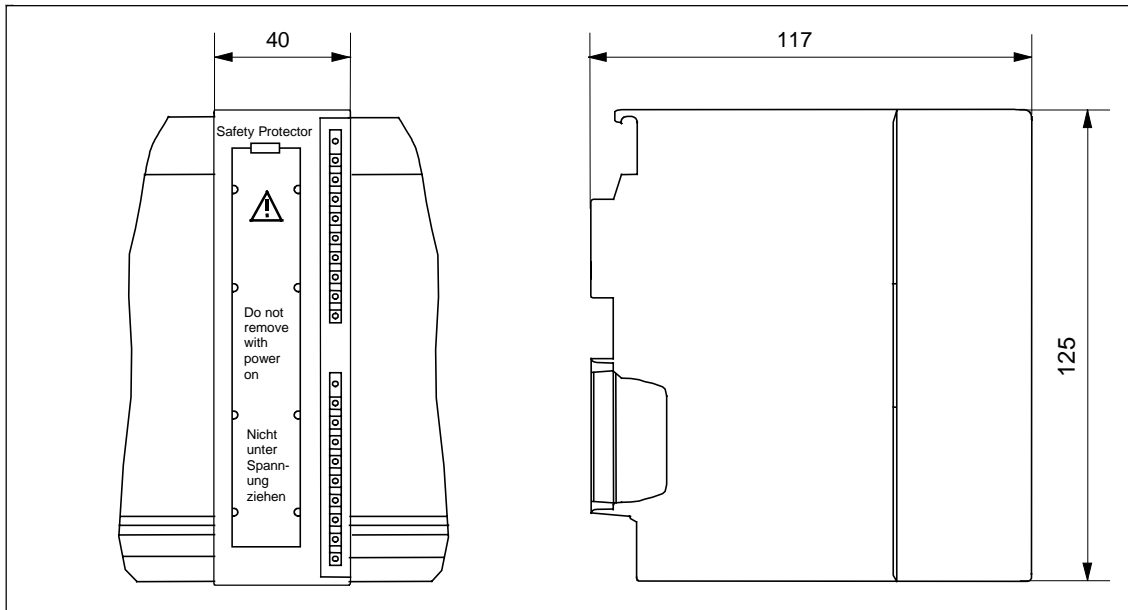


Figure B-3 Dimensioned Drawing of the Safety Protector

### Bus Module for the Safety Protector

The following figure shows the dimensioned drawing of the bus module of the safety protector.

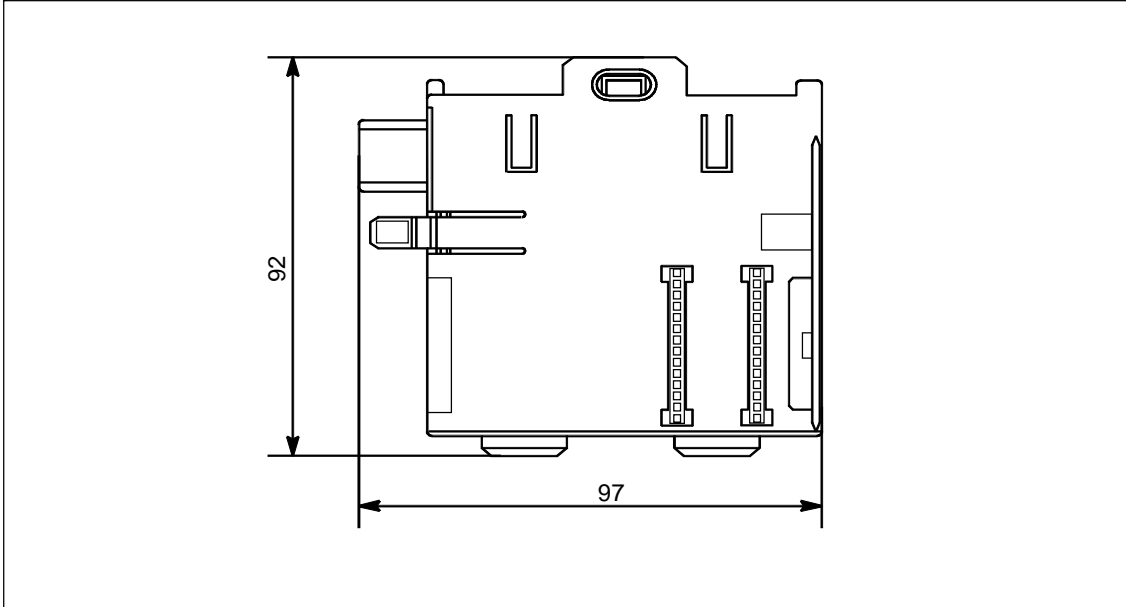


Figure B-4 Dimensioned Drawing of the Bus Module of the Safety Protector



## C Accessories and Order Numbers

### Accessories and Order Numbers

The table below lists the order numbers of the fail-safe signal modules, the safety protector and the accessories you can order for the fail-safe signal modules.

Component	Order Number
Fail-safe signal modules	
• SM 326; DI 24 × 24V DC; with diagnostic interrupt	6ES7 326-1BK00-0AB0
• SM 326; DI 8 × NAMUR; with diagnostic interrupt	6ES7 326-1RF00-0AB0
• SM 326; DO 10 × 24V DC/2A; with diagnostic interrupt	6ES7 326-2BF00-0AB0
• SM 336; AI 6 × 13Bit; with diagnostic interrupt	6ES7 336-1HE00-0AB0
Safety protector	6ES7 195-7KF00-0XA0
Bus module for safety protector	6ES7 195-7HG00-0XA0
Wire chamber for the SM 326; DI 8 × NAMUR; with diagnostic interrupt (quantity 5)	6ES7 393-4AA10-0AA0
Labeling strips	
• Yellow labeling strips (quantity 10)	6ES7 392-2XX20-0AA0
• Yellow label covers, transparent yellow (quantity 10)	6ES7 392-2XY20-0AA0
40-pin front connector	
• Screw-type	6ES7 392-1AM00-0AA0
• Spring-type	6ES7 392-1BM00-0AA0
Bus connector	6ES7 390-0AA00-0AA0



## **D Special Test Certificate and Declaration of Conformity**

### **SM 326; DI 8 × NAMUR; with Diagnostic Interrupt**

This appendix contains the EU special test certificate and the declaration of conformity of the SM 326; DI 8 × NAMUR; with diagnostic interrupt for the connection of signals from hazardous areas.

## EU Special Test Certificate for the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt




### (1) EG-BAUMUSTERPRÜFBESCHEINIGUNG

- (2) Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen - Richtlinie 94/9/EG
- (3) EG-Baumusterprüfbescheinigung Nummer: KEMA 99ATEX2671 X
- (4) Gerät oder Schutzsystem: Digitaleingabebaugruppe SM326, F-DI 8 x NAMUR, Typ 6ES7 326-1RF00-0AB0
- (5) Hersteller: Siemens AG
- (6) Anschrift: Werner von Siemens Strasse 50, 92209 Amberg, Deutschland
- (7) Die Bauart dieses Gerätes sowie die verschiedenen zulässigen Ausführungen sind in der Anlage zu dieser Baumusterprüfbescheinigung festgelegt.
- (8) KEMA bescheinigt als benannte Stelle Nr. 0344 nach Artikel 9 der Richtlinie 94/9/EG des Rates der Europäischen Gemeinschaften vom 23. März 1994 die Erfüllung der grundlegenden Sicherheits- und Gesundheitsanforderungen für die Konzeption und den Bau von Geräten und Schutzsystemen zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen gemäß Anhang II der Richtlinie.  
  
Die Ergebnisse der Prüfung sind in dem vertraulichen Prüfbericht Nr. 92671 festgelegt.
- (9) Die grundlegenden Sicherheits- und Gesundheitsanforderungen werden erfüllt durch Übereinstimmung mit:  
  
EN 50014 : 1992 + prA1      EN 50020 : 1994
- (10) Falls, das Zeichen "X" hinter der Bescheinigungsnummer steht, wird auf besondere Bedingungen für die sichere Anwendung des Gerätes in der Anlage zu dieser Bescheinigung hingewiesen.
- (11) Diese EG-Baumusterprüfbescheinigung bezieht sich nur auf die Konzeption und den Bau des festgelegten Gerätes oder Schutzsystemes. Falls erforderlich, sind weitere Anforderungen dieser Richtlinie für die Herstellung und das Inverkehrbringen dieser Geräte oder Schutzsysteme zu erfüllen.
- (12) Die Kennzeichnung des Gerätes oder Schutzsystemes muß die folgenden Angaben enthalten:

 II (2) G      [EEx ib] IIC

Arnhem, 27. Mai 1999  
im Auftrag der Direktion der N.V. KEMA

  
C.M. Boschloo  
Certification Manager

• Diese Bescheinigung darf nur ungekürzt und unverändert weiterverbreitet werden

N.V. KEMA  
Utrechtseweg 310, 6812 AR Arnhem  
Postfach 9035, 6800 ET Arnhem, die Niederlande  
Telefon +31 26 3 56 27 46, Telefax +31 26 3 51 01 78

AKKREDITIERT DURCH  
DEN NIEDERLÄNDISCHEN  
AKKREDITIERUNGSRAT



cocdui  
97-11-07

**EU Special Test Certificate for the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt (Continued)**



(13)

**A N L A G E**

(14)

zur EG-Baumusterprüfbescheinigung KEMA 99ATEX2671 X

(15) **Beschreibung**

Die Digitaleingabebaugruppe SM326, F-DI 8 x NAMUR, Typ 6ES7 326-1RF00-0AB0 ist eine steckbare Pheripheriebaugruppe aus dem Automatisierungssystem SIMATIC S7-300 und enthält acht Eingangs- und Meßumformerversorgungsstromkreise zum Anschluß von bescheinigter eigensicherer Meßumformer.

Umgebungstemperaturbereich 0 °C ... +60 °C.

**Elektrische Daten**

Versorgungs- und Busstromkreise..... nicht eigensicherer Stromkreis, geeignet zum Anschluß an elektrischen Betriebsmittel mit einer Betriebsspannung bis zu 60 V.  
(Klemmen 21 und 22)

Ein- und Ausgangsstromkreis ..... in Zündschutzart Eigensicherheit EEx ib IIC mit folgenden Höchstwerten:  
(Klemmen 5 bis 15 und 25 bis 35)

$$\begin{aligned}U_o &= 10 \text{ V} \\I_o &= 13,9 \text{ mA} \\P_o &= 33,1 \text{ mW}\end{aligned}$$

Höchstzulässige äußere Kapazität  $C_o = 3 \mu\text{F}$   
Höchstzulässige äußere Induktivität  $L_o = 80 \text{ mH}$

Die eigensicheren Ein- und Ausgangsstromkreise sind von den nichteigensicheren Versorgungs- und Busstromkreisen bis zu einer Summe der Scheitelwerte der Nennspannungen von 60 V sicher galvanisch getrennt.

**Stückprüfung**

Der Transformator soll, vor dem Einbau in dem Betriebsmittel, einer Prüfspannung von 2500 V während einer Minute zwischen der primären und sekundären Wicklung widerstehen.

(16) **Prüfbericht**

KEMA Nr. 92671

(17) **Besondere Bedingungen**

Die Digitaleingabebaugruppe ist außerhalb des explosionsgefährdeten Bereiches in ein geeignetes Gehäuse einzubauen das mindestens die Schutzart IP20 nach EN 60529 gewährleistet.

Die Digitaleingabebaugruppe ist innerhalb des explosionsgefährdeten Bereiches in ein geeignetes Gehäuse einzubauen. Diese Zusammenstellung muß gesondert geprüft werden.

Blatt 2/3

## EU Special Test Certificate for the SM 326; DI 8 NAMUR; with Diagnostic Interrupt (Continued)



(13) **A N L A G E**

(14) **zur EG-Baumusterprüfbescheinigung KEMA 99ATEX2671 X**

(17) **Besondere Bedingungen (Fortsetzung)**

Nach Einbau der Digitaleingabebaugruppe sollen alle zutreffende Trennungen und Verbindungsleitungen und Anschlüsse die Bedingungen von Abschnitt 6.4 nach EN 50 020 - 1994 entsprechen.

Bei der Installation ist die Leitungskammer einzusetzen oder zwischen den eigensicheren und den nichteigensicheren Stromkreisen ist durch Einfügen einer Trennwand ein Mindestabstand von 50 mm (Fadenmaß) zu realisieren bzw. die Anschlussteile sind zusätzlich zu isolieren.

(18) **Grundlegende Sicherheits- und Gesundheitsanforderungen**

Grundlegende Sicherheits- und Gesundheitsanforderungen welche nicht abgedeckt sind von den unter (9) erwähnten Normen	
Abschnitt	Thema
1.0.5	Kennzeichnung
1.0.6 b)	Betriebsanleitung

Diese Grundlegende Sicherheits- und Gesundheitsanforderungen sind geprüft worden und die Prüfergebnisse sind festgelegt worden in dem unter (16) erwähnten Prüfbericht.

(19) **Prüfungsunterlagen**

unterschrieben

1. Product compliance report ANNEX II, Rev. A	29.03.1999
2. Beschreibung (12 Seiten)	09.04.1999
3. Zeichnung Nr. 3NEA-720 3034-01 (17 Blatt)	09.03.1999
NEP 720 3010 01 (11 Blatt)	17.12.1998
NEP 720 3013 01 (12 Blatt)	24.03.1999
NEP 720 3024 01 (11 Blatt)	15.03.1999
NEP 720 3027 01 (11 Blatt)	15.03.1999
720 3021 01 000 (2 Blatt)	22.02.1999
720 3008 02 000 (4 Blatt)	22.03.1999
720 3011 02 000 (5 Blatt)	19.03.1999
720 3022 01 000 (8 Blatt)	30.03.1999
720 3025 01 000 (7 Blatt)	26.03.1999
EXBL_1.DS4	04.03.1999
EXBL_2.DS4	04.03.1999
4. Muster	

Blatt 3/3

**Special Test Certificate for the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt  
(Supplement)**



**1. NACHTRAG**

zur EG-Baumusterprüfbescheinigung KEMA 99ATEX2671 X

Hersteller: Siemens AG

Anschrift: Werner von Siemens Strasse 50, 92209 Amberg, Deutschland

**Beschreibung**

Die Digitaleingabebaugruppe SM326, F-DI 8 x NAMUR, Typ 6ES7 326-1RF00-0AB0 darf künftig auch entsprechend den unten aufgeführten Unterlagen gefertigt werden.

Die Änderungen betreffen die Elektronik.

Alle übrigen Daten bleiben unverändert.

**Prüfungsunterlagen**

	<u>unterschieden am</u>
1. Beschreibung (2 Seiten)	21.07.1999
2. Zeichnung Nr. NEP 720 3027 01 (11 Blatt)	) 20.07.1999
NEP 720 3024 01 (11 Blatt)	)
720 3025 01 000 (7 Blatt)	) 21.07.1999
720 3022 01 000 (8 Blatt)	)

Arnhem, den 11. November 1999  
im Auftrag der Direktion der N.V. KEMA

C.M. Boschloo  
Certification Manager

Kennzeichen: II (2) G [EEx ib] IIC

[99.1840]

° Dieser Nachtrag darf nur ungekürzt und unverändert weiterverbreitet werden

Blatt 1/1

**Declaration of Conformity for the SM 326; DI 8 × NAMUR; with Diagnostic Interrupt**

**SIEMENS**

**Declaration of EC-Conformity**  
No: Ex03:1999

We

**Siemens AG,**  
A&D AS  
**Werner-von-Siemens-Straße 50,**  
92224 Amberg

declare under our sole responsibility that the product:

**Digital input module SM 326, F-DI 8 x NAMUR, Typ 6ES7 326-1RF00-0AB0**  
(name, type or model)

to which this declaration relates is in conformity with the following standards or normative documents:

**EN 50014: 1992 + prA1, EN 50020: 1994**  
**EN 50081-2: 1993, EN 50082-2: 1995**  
(title and / or number and date of issue of the standards or other normative documents)

The indicated product is in conformance with the regulation of the following European Directives:

**94/9 EC** As set out in Article 9 of the European Community guideline 94/9/EC of 23 March 1994, the fundamental safety and health requirements for the conception and construction of devices and protection systems for agreed use in hazardous areas are confirmed in accordance with Appendix II of the guideline.

Name of notified body - EC type evaluation certificate No.:

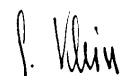
**KEMA 99ATEX2671 X**  
**N.V. KEMA**  
**Utrechtseweg 310**  
**6812 AR Arnhem**  
**Postfach 9035, 6800 ET Arnhem, Niederlande**

Identification No. of notified body "Production control"

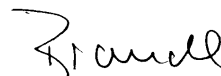
**0344**

**89/336/EEC** Council Directive on the harmonization of the laws of the member states relating to electromagnetic compatibility (EMC Directive).

Amberg, 1999-07-02  
(place and date of issue)



Klein/A&D AS E 4  
(name and signature or equivalent marking of authorized person)



Brandl/A&D AS EWA QSD  
(name and signature or equivalent marking of authorized person)



# Glossary

**1oo1 Evaluation** Type of Sensor Evaluation: In 1oo1 evaluation, there is one sensor and it is connected to the module via a single channel.

**1oo2 Evaluation** Type of Sensor Evaluation: In 1oo2 evaluation, the signal statuses of the inputs are compared internally (equivalence or non-equivalence).

## A

**Actuator** Actuators are, for example, power relays or contactors for switching on consumers or consumers themselves (for example, directly controlled solenoid valves).

**Availability** This is the probability that a system is functional at any particular time. It can be increased by redundancy (for example, by using redundant signal modules and/or by using multiple sensors at the same measuring point).

## C

**Category** Category to EN 954-01  
The fail-safe signal modules can be used in safety mode up to Category 4.

**Channel Error** Channel-related fault (for example, wire break or short circuit). In channel-specific passivation, the affected channel is automatically depassivated after the error has been eliminated.

**Channel Number** In the safety functions, the inputs and outputs are addressed via channel numbers. The channel number is a consecutive number, starting with "0".

**Channel-Specific Passivation** When a channel error occurs, only the affected channel is passivated in this type of passivation. In the event of a module error, all the channels of the fail-safe signal module are passivated.

Channel-specific passivation is possible if automatic reintegration is permissible for the affected process (i.e. if automatic reintegration is possible from a safety point of view and thus no user acknowledgment is required).

**CRC** Cyclic redundancy check -> CRC test value

**CRC Test Value** The validity of the process values in the safety frame, the accuracy of the assigned address references and the safety-related parameters are secured by means of a CRC test value contained in the safety frame.

## D

**Dark Period** Dark periods occur during switch-off tests and during complete bit pattern tests. This involves test-related 0 signals being switched to the output by the fail-safe output module while the output is active. The output is then switched off briefly (dark period). A sufficiently slow actuator does not respond to this and remains switched on.

**Discrepancy Analysis** Discrepancy analysis is used to detect errors on the basis of the times of two signals with the same functionality. The discrepancy analysis is started if different levels are detected in two associated input signals. After a configurable interval (discrepancy time) has elapsed, a check is carried out to establish whether the discrepancy has disappeared. If not, there is a discrepancy error.

There are two different types of discrepancy analysis with fail-safe input modules:

- In the case of 1oo2 evaluation:  
The discrepancy analysis is carried out between the two input signals of the 1oo2 evaluation in the fail-safe input module.
- In the case of redundant I/O modules:  
The discrepancy analysis is carried out between the two input signals of the redundant input modules by means of the fail-safe driver blocks.

**Discrepancy Time** Configurable time for the discrepancy analysis

**F**

**Fail-Safe Signal Modules** Signal modules of the S7-300 that can be used for safety-related operation (safety mode) in the fail-safe S7-400F/FH systems. These modules are equipped with integrated safety functions.

**Fail-Safe Systems** Fail-safe systems are characterized by the fact that they remain in or revert to a safe state immediately after certain failures occur.

**L**

**Light Period** Light periods occur during complete bit pattern tests. This involves test-related 1 signals being switched to the output by the fail-safe output module while the output is inactive (output signal "0"). The output is then switched on briefly (light period). A sufficiently slow actuator will not respond to this and remains switched off.

**M**

**Module Error** Module-wide error: Module errors can be external errors (e. g. load voltage missing) or internal errors (for example, processor failure). An internal error always requires module replacement.

**Module Redundancy** An additional, identical module is operated redundantly to increase availability.

**Monitoring Time** Frame updating is monitored on the basis of time by mean of the CPU specifying a watchdog to the fail-safe signal module.  
A valid current frame must arrive at the CPU with a new watchdog within a configurable monitoring time.  
If a valid watchdog is not detected within the monitoring time, the outputs of the fail-safe output modules are switched off. In the case of fail-safe input modules, the inputs to the CPU are passivated.

## O

**OBT**                      **Optical Bus Terminal (OBT):** Resources for the connection of an individual PROFIBUS-DP device without an integrated optical interface or an RS 485 segment on the optical PROFIBUS-DP.

**OLM**                      **Optical Link Module (OLM):** Resources for the fiber-optic cable interconnection to implement electrical signals in optical ones and vice versa.

## P

**Passivation**              Passivation of digital output channels means that the outputs are deenergized.  
Passivation of input channels occurs when the inputs transfer a substitute value or - in the case of analog input - also the last valid value to the CPU (via the fail-safe driver blocks), irrespective of the current process signal.

## R

**Redundancy, Availability-Enhancing**              Multiple availability of components with the aim of ensuring the components continue to function even in the event of hardware faults.

**Redundancy, Safety-Enhancing**              Multiple availability of components with the aim of compensating for revealing hardware faults through comparison (for example, 1oo2 evaluation in the S7-400F/FH).

## S

**Safe State**                      The basis of the safety concept for the S7-400F/FH is that there is a safe, neutral position for all process variables. In the case of binary signal modules, this is always the value "0".

**Safety Frame**                      In safety mode, data is transferred between the CPU and the fail-safe signal module in a safety frame that is up to 16 bytes long.

---

<b>Safety Function</b>	<p>A mechanism integrated in the fail-safe signal module that enables it to be used in the fail-safe S7-400F/FH systems.</p> <p>IEC 61508: Function implemented by a safety system to ensure that the system is kept in a safe state or brought into a safe state in the event of a particular problem.</p>
<b>Safety Integrity Level</b>	<p>SIL (Safety Integrity Level) in accordance with IEC 61508</p> <p>The fail-safe signal modules can be used in safety mode up to SIL 3.</p>
<b>Safety Level</b>	<p>Safety level (AK) in accordance with DIN V 19250 (DIN V VDE 0801)</p> <p>Categories or levels describing safety requirements in order to avoid and deal with faults. The fail-safe signal modules can be used in safety mode up to requirement class AK6.</p>
<b>Safety Mode</b>	<p>Operating mode of the fail-safe signal modules - The fail-safe signal modules are equipped with integrated safety functions for use in the fail-safe S7-400F/FH systems.</p> <p>In safety mode, the fail-safe signal modules are operated in a distributed configuration in the ET 200M distributed I/O device.</p>
<b>Safety Note</b>	<p>Important information relating to the acceptance and safety-related use of the product.</p>
<b>Sensor</b>	<p>Sensors permit the exact measurement of paths, positions, speeds, operating speeds, weights, etc.</p>
<b>Sensor Evaluation</b>	<p>There are two types of sensor evaluation:</p> <ul style="list-style-type: none"><li>• 1oo1 evaluation: The sensor signal is read once</li><li>• 1oo2 evaluation: To increase availability, the sensor signal is read in twice from the same module twice and compared internally.</li></ul>
<b>Standard Mode</b>	<p>Operating mode of the fail-safe signal modules - In standard mode, the fail-safe signal modules behave in the same way as standard S7-300 I/O modules.</p>



# Index

1oo1 evaluation ..... 3-10  
1oo2 evaluation ..... 3-11

## A

Address switch ..... 4-1  
Addressing  
  in standard mode ..... 2-2  
Addressing in safety mode ..... 3-16  
AK 4, AK 5,6  
  for SM 336, AI 6 × 13Bit ..... 10-9  
AK 4, AK 6  
  in SM 326, DO 10 × 24 V DC/2A ..... 9-41  
Analog modules ..... 5-7, 10-1

## C

Categories 3, 4  
  in SM 326, DI 24 × 24 V DC ..... 9-5  
  in SM 326, DI 8 × NAMUR ..... 9-26  
  in SM 326, DO 10 × 24 V DC/2A ..... 9-41  
Category 3, 4 ..... 1-1  
  for SM 336, AI 6 × 13Bit ..... 10-9  
CE marking ..... 8-2  
Certificates ..... 8-2  
Certificates and approvals  
  FM, UL, CSA, KEMA ..... 8-3  
Channel number ..... 3-17  
Conditions of use ..... 8-13  
Configuration  
  redundant, switched I/O system ..... 3-8  
  safety mode ..... 3-2  
  single-channel, one-sided I/O system ..... 3-4  
  single-channel, switched I/O system ..... 3-6  
  standard mode ..... 2-1  
Consecutive number ..... 3-15  
CRC test value ..... 3-15  
CSA certification ..... 8-3  
Cyclic redundancy check ..... 3-15

## D

Dark period ..... 3-14  
Degree of protection ..... 8-15  
Degree of protection, IP 20 ..... 8-15  
Diagnostic data ..... A-1  
Diagnostic evaluation ..... 7-1  
Diagnostic interrupt ..... 7-2  
  parameterizing ..... 7-2  
Diagnostic messages  
  SM 326, DI 24 × 24 V DC ..... 9-18  
  SM 326, DI 8 × NAMUR ..... 9-33

SM 326, DO 10 × 24 V DC/2A ..... 9-47  
SM 336, AI 6 × 13Bit ..... 10-31  
Diagnostic messages and remedies ..... 7-1  
Diagnostics using LEDs ..... 7-1  
Digital modules ..... 9-1  
DIL switch ..... 4-1  
Dimensioned drawing ..... B-1  
Dimensioned drawing bus module for the  
  safety protector ..... B-4  
DIN V 19250 ..... 1-1  
Discrepancy analysis ..... 3-11

## E

EMC directive ..... 8-12  
EN 954-1 ..... 1-1  
Environmental conditions ..... 8-13  
  mechanical ..... 8-13  
Error causes  
  for SM 336, AI 6 × 13Bit ..... 10-32  
ET 200M  
  setup with a safety protector ..... 11-4

## F

Fault causes  
  in SM 326, DI 24 × 24 V DC ..... 9-19  
  in SM 326, DI 8 × NAMUR ..... 9-34  
  in the SM 326, DO 10 × 24 V DC/2A ..... 9-48  
Fault responses ..... 3-18  
Fault/error indication ..... 3-20  
FM approval ..... 8-3  
Front connector ..... 5-1  
  wiring position ..... 5-3

## G

General technical specifications ..... 8-1

## H

Higher availability ..... 1-2

## I

I/O system  
  redundant, switched ..... 3-8  
  single-channel, one-sided ..... 3-4  
  single-channel, switched ..... 3-6  
IEC 1131 ..... 8-2  
IEC 61508 ..... 1-1

- IM 153-x
  - permissible in safety mode ..... 3-2
  - permissible in standard mode ..... 2-1
- Insertion/removal ..... 3-23
- Installation ..... 4-1
- Insulation testing ..... 8-15
- Interference
  - pulse-shaped ..... 8-10, 8-11
  - sinusoidal ..... 8-11
- IP 20 ..... 8-15
  
- L**
- LED display ..... 7-1
- Light period ..... 3-14
  
- M**
- Measuring sensor
  - analog input module ..... 10-8
- Module address ..... 3-16
- Monitoring time ..... 3-15
  
- O**
- Oscillations ..... 8-13
  
- P**
- Parameterizing the diagnosis ..... 7-2
- Parameters ..... 6-1
- Passivation ..... 3-18
- Power supply
  - of the modules in safety mode ..... 11-6
- Power supply units ..... 8-8
- Pulse-shaped interference ..... 8-10, 8-11
  
- R**
- Radio interference
  - emission of ..... 8-11
- Rated voltages ..... 8-15
- Reading out diagnostic messages with
  - STEP 7 ..... 7-2
- Records 0 and 1
  - diagnostic data ..... A-1
- Redundant I/O modules ..... 1-2
- Replacing a module ..... 3-23
- Response time
  - fail-safe analog input modules ..... 8-16
- Response times ..... 8-16
  - fail-safe digital modules ..... 8-16
  
- S**
- Safe extra-low voltage ..... 8-6
- Safe state ..... 3-18
- Safety class ..... 8-15
- Safety frame ..... 3-15
  
- Safety functions ..... 2-1, 3-2, 3-12, 4-1
- Safety level AK 4, AK 6 ..... 1-1
  - in SM 326, DI 24 × 24 V DC ..... 9-5
  - in SM 326, DI 8 × NAMUR ..... 9-26
- Safety levels ..... 1-1
- Safety mode ..... 1-1, 2-1, 3-1, 3-2, 3-12
  - addressing ..... 3-16
  - configuration variants of the I/O modules ..... 3-2
  - power supply of the modules ..... 11-6
  - replacing a module ..... 3-23
  - replacing the module ..... 11-5
- Safety operation ..... 4-1
- Safety protector ..... 3-2, 11-1
  - block diagram ..... 11-3
  - front view ..... 11-3
  - order number ..... 11-2
  - setup in the ET 200M ..... 11-4
  - technical specifications ..... 11-6
- DIN V VDE 0801 ..... 1-1
- Sensor evaluation
  - 1oo1 evaluation ..... 3-10
  - 1oo2 evaluation ..... 3-10
- Short-circuit protection ..... 5-1
- SIL 2, SIL 3
  - for SM 336, AI 6 × 13Bit ..... 10-9
  - in SM 326, DI 24 × 24 V DC ..... 9-5
  - in SM 326, DI 8 × NAMUR ..... 9-26
  - in SM 326, DO 10 × 24 V DC/2A ..... 9-41
  - safety levels ..... 1-1
- Sinusoidal interference ..... 8-11
- SM 326, DI 24 × 24 V DC , with diagnostic
  - interrupt
    - order number ..... 9-2
- SM 326, DI 24 × 24 V DC, with diagnostic
  - interrupt
    - 1oo1 evaluation ..... 9-9, 9-10
    - 1oo2 evaluation ..... 9-12, 9-14
    - applications ..... 9-5
    - categories 3, 4 ..... 9-5
    - diagnostic messages ..... 9-18
    - external sensor supply ..... 9-4
    - fault causes and remedies ..... 9-19
    - features ..... 9-2
    - front view ..... 9-3
    - parameters ..... 9-6, 9-8, 9-9, 9-11, 9-13, 9-17
    - safe extra-low voltage ..... 8-6
    - safety level AK 4, AK 6 ..... 9-5
    - short circuit to M and L+ ..... 9-19
    - SIL 2, SIL 3 ..... 9-5
    - technical specifications ..... 9-21
    - terminal assignment and block diagram ..... 9-4
- SM 326, DI 8 × NAMUR, with diagnostic
  - interrupt
    - 1oo1 evaluation ..... 9-27, 9-28
    - 1oo2 evaluation ..... 9-30, 9-31
    - applications ..... 9-26
    - categories 3, 4 ..... 9-26
    - connectable sensors ..... 9-24
    - diagnostic messages ..... 9-33
    - fault causes and remedies ..... 9-34
    - features ..... 9-23







# SIEMENS

## Produktinformation / Product information

**S7-300 Fehlersichere Signalbaugruppen, A5E00048969-04, Ausg. 07/2003**  
**S7-300 Fail-Safe Signal Modules (F-SM), A5E00085586-04, Edition 07/2003**

### Deutsch

Diese Produktinformation enthält wichtige Informationen für das Handbuch Automatisierungssystem S7-300 Fehlersichere Signalbaugruppen, ab Ausgabe 03/2002 mit der Nummer A5E00048969-04. Sie ist als separater Bestandteil aufzufassen und in Zweifelsfällen in der Verbindlichkeit anderen Aussagen in Handbüchern und Katalogen übergeordnet.

### Einsetzbare fehlersichere Signalbaugruppen in S7-Distributed Safety, V 5.2

Bitte beachten Sie, dass für den Aufbau von S7-Distributed Safety alle fehlersicheren Signalbaugruppen S7-300 ab dem entsprechenden Erzeugnis- und Firmware-Stand einsetzbar sind:

S7-300 Fehlersichere Signalbaugruppen (FS-M)	Zentraler Aufbau		Dezentraler Aufbau (in ET 200M)	
	Sicherheits- betrieb der F-SM	Standard- betrieb der F-SM	Sicherheits- betrieb der F-SM	Standard- betrieb der F-SM
SM 326; DI 24 × DC 24V, mit Diagnosealarm (6ES7 326-1BK00-0AB0, ab Erzeugnisstand 2, FW-Stand 2.0.0)	ja	ja	ja	ja
SM 326; DI 8 × NAMUR, mit Diagnosealarm (6ES7 326-1RF00-0AB0, ab Erzeugnisstand 5, FW-Stand 1.0.5)	ja	ja	ja	ja
SM 326; DO 10 × DC 24V/2A, mit Diagnosealarm (6ES7 326-2BF00-0AB0, ab Erzeugnisstand 4, FW-Stand 2.0.0)	ja	ja	ja	ja
SM 326; DO 10 × DC 24V/2A, mit Diagnosealarm (6ES7 326-2BF01-0AB0, ab Erzeugnisstand 1, FW-Stand 2.0.4)	ja	ja	ja	ja
SM 336; AI 6 × 13Bit, mit Diagnosealarm (6ES7 336-1HE00-0AB0 ab Erzeugnisstand 4, FW-Stand 1.0.3)	ja	ja	ja	ja

## Änderung zum Handbuch S7-300, *Fehlersichere Signalbaugruppen*

Entgegen den Angaben im Handbuch, im Kapitel 8.2, dürfen fehlersichere Signalbaugruppen im Sicherheitsbetrieb mit allen anderen Standardkomponenten aus einem Netzteil versorgt werden.

## Redundanter Aufbau von SM 326; DO 10 × DC 24V/2A; mit Diagnosealarm im F-System S7 FH Systems

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### Hinweis

Wenn Sie die SM 326; DO 10 × DC 24V/2A; mit Diagnosealarm redundant einsetzen, dann müssen Sie diese F-SMs mit der gleichen Lastspannung versorgen. Ist dies aus Verfügbarkeitsgründen nicht mit einem Netzgerät möglich, so setzen Sie zwei Netzgeräte redundant ein. Beachten Sie bitte, dass die Netzgeräte über Dioden gekoppelt sein müssen.

---

## SM 326; DO 10 × DC 24V/2A; mit Diagnosealarm (ab Bestell-Nr. 6ES7 326-2BF01-0AB0)

### Parameter "Signal wechselt täglich oder öfter":

Entgegen den Angaben im Handbuch, im Kapitel 9.3.3 und 9.3.4, ist der Parameter "Signal wechselt täglich oder öfter" auch einstellbar für AK4/SIL2/Kat.3-Anwendungen oder für Standardbetrieb der SM 326; DO 10 × DC 24V/2A; mit Diagnosealarm, wenn folgende Hard- und Software eingesetzt wird:

- SM 326; DO 10 × DC 24V/2A; mit Diagnosealarm, ab Bestell-Nr. 6ES7 326-2BF01-0AB0,
- *STEP 7*, ab V 5.2 und
- *S7 Distributed Safety*, ab V 5.2 + Servicepack 1

### Diagnosemeldung "Kurzschluss des Ausgangs nach L+ oder Ausgangstreiber defekt":

Entgegen den Angaben im Handbuch, im Kapitel 9.3.5, wird für die SM 326; DO 10 × DC 24V/2A; mit Diagnosealarm, ab Bestell-Nr. 6ES7 326-2BF01-0AB0 "Kurzschluss des Ausgangs nach L+ oder Ausgangstreiber defekt" als Baugruppenfehler gemeldet und nicht kanalgranular.

## Technische Daten der SM 326; DO 10 × DC 24V/2A; mit Diagnosealarm

Entgegen den Angaben im Handbuch, im Kapitel 9.3.6, beträgt die Schaltfrequenz bei ohmscher Last maximal 10 Hz.

---

## English

This product information contains important information on the S7-300 Fail-Safe Signal Modules manual, as of version 03/2002 with the number A5E00085586-04. It is to be considered a separate component and more up-to-date compared to other documents and catalogs if uncertainties arise.

### Fail-Safe Signal Modules Employable in S7-Distributed Safety, V 5.2

Please ensure that all fail-safe S7-300 signal modules are operable with the appropriate manufacturing and firmware version when installing S7-Distributed Safety:

S7-300 Fail-safe Signal Modules (FS-M)	Central Configuration		Distributed Configuration (in ET 200M)	
	F-SM saftey operation	F-SM standard operation	F-SM safety operation	F-SM standard operation
SM 326; DI 24 × DC 24V, with diagnostic interrupt (6ES7 326-1BK00-0AB0, as of version 2, FW version 2.0.0)	yes	yes	yes	yes
SM 326; DI 8 × NAMUR, with diagnostic interrupt (6ES7 326-1RF00-0AB0, as of version 5, FW version 1.0.5)	yes	yes	yes	yes
SM 326; DO 10 × DC 24V/2A, with diagnostic interrupt (6ES7 326-2BF00-0AB0, as of version 4, FW version 2.0.0)	yes	yes	yes	yes
SM 326; DO 10 × DC 24V/2A, with diagnostic interrupt (6ES7 326-2BF01-0AB0, as of version 1, FW version 2.0.4)	yes	yes	yes	yes
SM 336; AI 6 × 13Bit, with diagnostic interrupt (6ES7 336-1HE00-0AB0, as of version 4, FW version 1.0.3)	yes	yes	yes	yes

## Modifications to S7-300, Fail-Safe Signal Modules Manual

Contrary to the information in chapter 8.2 of the manual, fail-safe signal modules may be supplied with all other standard components from **one** power supply in safety mode.

## Redundant Configuration of SM 326; DO 10 × DC 24V/2A; with the F-System Diagnostic Interrupt S7 FH Systems

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### Note

If you use SM 326; DO 10 × DC 24V/2A with a redundant diagnostic interrupt, the F-SMs must be supplied with the same load voltage. If this is not possible with one power supply unit due to availability, then use two redundant power supply units. Please note that the power supply devices must be connected via diodes.

---

## SM 326; DO 10 × DC 24V/2A; with diagnostic alarm (as of Order No. 6ES7 326-2BF01-0AB0)

### Signal changes daily or more often" parameter:

Contrary to the information in the manual, as stated in sections 9.3.3 and 9.3.4, "Signal changes daily or more often" parameter can also be set for AK4/SIL2/Kat.3 applications or for standard operation of the SM 326; DO 10 DC 24V/2A; with diagnostic alarm when the following hardware and software is used:

- SM 326; DO 10 × DC 24V/2A; with diagnostic alarm, as of Order No. 6ES7 326-2BF01-0AB0,
- *STEP 7*, as of V 5.2 and
- *S7 Distributed Safety*, as of V 5.2 + Servicepack 1

### Diagnostic alarm "Short-circuited output after L+ or output driver defective":

Contrary to the information in the manual, as stated in section 9.3.5, "Short-circuited output after L+ or output driver defective" is reported as a module error and not on the channel level for the SM 326; DO 10 DC 24V/2A; with diagnostic alarm, as or Order No. 6ES7 326-2BF01-0AB0.

## Specifications for SM 326; DO 10 × DC 24V/2A; with diagnostic alarm

Contrary to the information in the manual, as stated in section 9.3.6, the operating frequency is maximum 10 Hz for resistive load.

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