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SIMATIC

Programmable Logic Controllers S7-300 Module Data

Reference Manual

The following supplement is part of this documentation:

No.	Designation	Drawing number	Edition
1	Product information	A5E00201782-03	12/2004
2	Product information	A5E00348892-01	08/2004
3	Product information	A5E00352937-02	01/2005
4	Product information	A5E00400156-01	12/2004
5	Product information	A5E00455107-01	05/2005

This manual is part of the documentation package
with the order numbers:
Programmable Controller S7-300:
6ES7398-8FA10-8BA0

ET 200M Distributed I/O Device:
6ES7153-1AA00-8BA0

Edition 02/2004

A5E00105505-03

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:

Danger

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

Warning

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

Caution

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

Caution

indicates that property damage can result if proper precautions are not taken.

Notice

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

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:

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.

Trademarks

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Preface

Purpose of the manual

The information contained in this manual will enable you to look up operator actions, function descriptions and the technical specifications of the signal modules, power supply modules and interface modules of the S7-300.

How to configure, assemble and wire these modules in an S7-300 or ET 200M system is described in the installation manuals for each system.

Required basic knowledge

To understand this manual, it is necessary to have a general knowledge of automation and programmable logic controllers.

Scope of this manual

The present documentation package contains reference manuals for all the modules current at the time the manuals were published.

We reserve the right to enclose a product information leaflet containing up-to-date information on the module with new modules and modules with a new product version.

Changes compared with the previous version

Compared to the previous version, of the "Module Data" reference manual, the following chapters and appendices have been thoroughly revised and new modules added, as necessary:

- Preface
- Chapter 1 "General Technical Specifications"
- Chapter 3 "Digital Modules",
- Chapter 4 "Analog Modules"
- Appendix A "Signal Module Parameter Sets"
- Glossary

Note: The previous version of this "Module Data" reference manual can be recognized by the number in the footer: A5E00105505-02.

The current number is: A5E00105505-03.

Approbations

Refer to Section 1.1 Standards and approvals.

CE Approval

Refer to Section 1.1 Standards and approvals.

Identification for Australia (C-Tick-Mark)

Refer to Section 1.1 Standards and approvals.

Standards

Refer to Section 1.1 Standards and approvals.

How the manual fits in

S7-300

Manual • CPU 31xC and CPU 31x, Technical Data	Description of operation, functions and technical specifications of the CPU.
Reference Manual • CPU Data: CPU 312 IFM – 318-2 DP	Description of operation, functions and technical specifications of the CPU.
Operating Manual • S7-300, CPU 31xC and CPU 31x: Installation	Description of configuration, installation, wiring, networking and commissioning of an S7-300.
Installation manual • Automation system S7-300, installation: CPU 312 IFM – 318-2 DP	Description of configuration, installation, wiring, networking and commissioning of an S7-300.
Manual • CPU 31xC: Technological Functions • Examples	Description of the individual technological functions: Positioning, counting, point–to–point coupling, control. The CD contains examples for the technological functions.
Module data reference manual You are reading this manual → • Reference Manual	Descriptions of functions and technical specifications of signal modules, power supply modules and interface modules.
Instruction List • CPU 312 IFM – 318-2 DP • CPU 31xC and CPU 31x	The instruction set lists of the CPUs and their execution times. A list of executable blocks (OBs/SFCs/SFBs) and their execution times.
Getting Started • CPU 31x: Commissioning • CPU 31xC: Commissioning • CPU 31xC: Positioning with analog output • CPU 314C: Positioning with digital output • CPU 31xC: Counting • CPU 31xC: Rules • CPU 31xC: Point-to-point connection • CPU 317-2 PN/DP: Configuration of the PROFInet interface X2	Getting Started documents use a concrete example to guide you through the individual commissioning steps until you have a functioning application.

ET 200M

Distributed Peripheral manual	
• Manual	Description of configuration, assembly, wiring.
Signal modules for process automation reference manual	
• Reference Manual	Description of use in process automation, parameterization with SIMATIC PDM, digital input modules, digital output modules.
Module data reference manual	
You are reading this manual → • Reference Manual	Descriptions of functions and technical specifications of signal modules, power supply modules and interface modules.

Navigation

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

- At the start of the manual you will find a complete table of contents and a list of the diagrams and tables that appear in the manual.

- An overview of the contents of each section is provided in the left column on each page of each chapter.

- You will find a glossary in the appendix at the end of the manual. The glossary contains definitions of the main technical terms used in the manual.

- At the end of the manual you will find a comprehensive index which gives you fast access to the information you need.

Recycling and disposal

Because of its low-emission equipment, it is possible to recycle the S7-300. For ecologically harmless recycling and disposal of your old device, contact a certificated disposal service for electronic scrap.

Additional support

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

`http://www.ad.siemens.com/automation/partner`

Training center

We offer a range of relevant courses to help you to get started with the SIMATIC S7 programmable controller. Please contact your local training center or the central training center in Nuremberg, D 90327 Germany.
Phone: +49 (911) 895-3200.

Internet: `http://www.sitrain.com`

A&D Technical Support

Worldwide, available 24 hours a day:

Technical Support

Worldwide (Nuernberg) **Technical Support** 24 hours a day, 365 days a year Phone: +49 (180) 5050-222 Fax: +49 (180) 5050-223 E-Mail: adsupport@ siemens.com GMT: +1:00		
Europe / Africa (Nuernberg) **Authorization** Local time: Mon.-Fri. 8:00 AM to 5:00 PM Phone: +49 (180) 5050–222 Fax: +49 (180) 5050-223 E-Mail: adsupport@ siemens.com GMT: +1:00	**United States** (Johnson City) **Technical Support and Authorization** Local time: Mon.-Fri. 8:00 AM to 500 PM Phone: +1 (423) 262 2522 Fax: +1 (423) 262 2289 E-Mail: simatic.hotline@ sea.siemens.com GMT: –5:00	**Asia / Australia** (Beijing) **Technical Support and Authorization** Local time: Mon.-Fri. 8:00 AM to 5:00 PM Phone: +86 10 64 75 75 75 Fax: +86 10 64 74 74 74 E-Mail: adsupport.asia@ siemens.com GMT: +8:00
The languages of the SIMATIC Hotlines and the authorization hotline are generally German and English.		

Service & Support on the Internet

In addition to our documentation, we offer our Know-how online on the internet at:

`http://www.siemens.com/automation/service&support`

where you will find the following:

- The newsletter, which constantly provides you with up–to–date information on your products.

- The right documents via our Search function in Service & Support.

- A forum, where users and experts from all over the world exchange their experiences.

- Your local representative for Automation & Drives.

- Information on field service, repairs, spare parts and more under "Services".

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General Technical Specifications

<div style="text-align: right; font-size: 3em; font-weight: bold;">1</div>

What are general technical specifications?

General technical specifications include the following:

- the standards and test values which the modules of the S7-300 programmable logic controller maintain and satisfy
- the test criteria to which the S7-300 modules were tested.

In this chapter

Section	Contents	Page
1.1	Standards and Approvals	1-2
1.2	Electromagnetic Compatibility	1-6
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1.1   Standards and Approvals

CE approval

The S7-300 programmable logic controller meets the requirements and safety-related requirements of the following EU directives and conforms with the harmonized European standards (EN) for programmable controllers announced in the Official Journals of the European Community:

- 73/23/EEC "Electrical Equipment Designed for Use between Certain Voltage Limits" (Low-Voltage Directive)

- 89/336/EEC "Electromagnetic Compatibility" (EMC Directive)

- 94/9/EU "Devices and protection systems for use as prescribed in potentially explosive areas" (Guidelines for Explosion Protection)

The declarations of conformity are held
at the disposal of the competent authorities at the address below:

Siemens Aktiengesellschaft
Bereich Automatisierungs- und Antriebstechnik
A&D AS RD4
Postfach 1963
D-92209 Amberg

UL approval

Underwriters Laboratories Inc. in accordance with

- UL 508 (Industrial Control Equipment)

CSA approval

Canadian Standards Association in accordance with

- C22.2 No. 142 (Process Control Equipment)

or

Underwriters Laboratories Inc. in accordance with

- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 142 (Process Control Equipment)

or

Underwriters Laboratories Inc. in accordance with

- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 142 (Process Control Equipment)
- UL 1604 (Hazardous Location)
- CSA-213 (Hazardous Location)

APPROVED for use in
Class I, Division 2, Group A, B, C, D Tx;
Class I, Zone 2, Group IIC Tx

Note

The currently applicable approvals can be found on the nameplate of the particular module.

FM approval

Factory Mutual Research (FM) in accordance with
Approval Standard Class Number 3611, 3600, 3810
APPROVED for use in
Class I, Division 2, Group A, B, C, D Tx;
Class I, Zone 2, Group IIC Tx

in accordance with EN 50021 (Electrical apparatus for potentially explosive
atmospheres; Type of protection "n")

II 3 G EEx nA II T4..T5

Identification for Australia

The S7-300 programmable logic controller meets the requirements of standard
AS/NZS 2064 (Class A).

IEC 61131

The S7-300 programmable logic controller meets the requirements and criteria of
standard IEC 61131-2 (Programmable Controllers, Part 2: Equipment
Requirements and Tests).

Shipbuilding approval

Classification Societies:

- ABS (American Bureau of Shipping)
- BV (Bureau Veritas)
- DNV (Det Norske Veritas)
- GL (Germanischer Lloyd)
- LRS (Lloyds Register of Shipping)
- Class NK (Nippon Kaiji Kyokai)

Use in an industrial environment

SIMATIC products have been designed for use in an industrial environment.

Table 1-1   Use in an Industrial Environment

EMC Directive	Requirements in respect of:	
	Emitted interference	**Immunity**
Industry	EN 61000-6-4: 2001	EN 61000-6-2: 2001

Use in residential environments

If you operate an S7-300 in a residential area, you must ensure Limit Value Class B in accordance with EN 55011 to guard against radio interference emissions.

Suitable measures to achieve interference suppression according to Limit Value Class B:

- installation of the S7-300 in grounded cabinets and control boxes
- use of filters in supply lines

Warning

Personal injury or property damage can result.

In areas subject to danger of explosion, personal injury or property damage can result if you withdraw connectors while an S7-300 is in operation.

Always isolate the S7-300 in areas subject to danger of explosion before withdrawing connectors.

1.2   Electromagnetic Compatibility

Introduction

In this section you will find details of the noise immunity of S7-300 modules and details of radio interference suppression.

The S7-300 modules satisfy, among other things, the requirements of the law applicable to EMC on the European domestic market.

Definition of "EMC"

Electromagnetic compatibility (EMC) is the ability of an electrical installation to function satisfactorily in its electromagnetic environment without interfering with that environment.

Pulse-shaped interference

The following table shows the electromagnetic compatibility of modules compared to pulse-shaped disturbance variables. A requirement for this is that the S7-300 system complies with the specifications and directives on electric design.

Table 1-2   Pulse-Shaped Interference

Pulse-Shaped Interference	Tested with	Satisfies degree of severity
Electrostatic discharge according to IEC 61000-4-2	Discharge in air: ± 8 kV Contact discharge: ± 4 kV	3
Bursts (fast transient bursts) to IEC 61000-4-4	2 kV (supply cable) 2 kV (signal cable > 3 m) 1 kV (signal cable < 3 m)	3
Energy-rich single impulse (surge) according to IEC 61000-4-5 External protective circuit required (refer to the manual *S7-300 Programmable Logic Controller, Hardware and Installation*, Chapter "Lightning Protection and Overvoltage Protection")		
• Asymmetrical coupling	2 kV (supply cable) Direct voltage with protective elements 2 kV (signal/ data cable only > 3 m) possibly with protection elements	3
• Symmetrical coupling	1 kV (supply cable) Direct voltage with protection elements 1 kV (signal line only > 3 m) possibly with protection elements	

Additional measures

If you want to connect an S7-300 system to the public network, you must ensure **Limit Value Class B in accordance with EN 55022**.

Sinusoidal interference

The table below shows the EMC behavior of the S7-300 modules with regard to sinusoidal disturbance variables.

Table 1-3   Sinusoidal Interference

Sinusoidal Interference	Test values	Satisfies degree of severity
HF irradiation (electromagnetic fields) according to IEC 61000-4-3 according to IEC 61000-4-3	10 V/m with 80% amplitude modulation of 1 kHz over the range from 80 MHz to 1000 MHz 10 V/m with 50% pulse modulation at 900 MHz	3
HF conductance on cables and cable shields according to IEC 61000-4-6	Test voltage 10 V with 80% amplitude modulation of 1 kHz over the range from 9 MHz to 80 MHz	3

Emission of radio interference

Interference emission of electromagnetic fields in accordance with EN 55011: Limit value class A, Group 1.

From 30 to 230 MHz	< 40 dB (μV/m)Q
From 230 to 1000 MHz	< 47 dB (μV/m)Q
Measured at a distance of 10 m (98.4 ft.)	

Interference emission via the mains AC power supply in accordance with EN 55011: Limit value class A, Group 1.

From 0.15 to 0.5 MHz	< 79 dB (μV)Q
	< 66 dB (μV)M
From 0.5 to 5 MHz	< 73 dB (μV)Q
	< 60 dB (μV)M
From 5 to 30 MHz	< 73 dB (μV)Q
	< 60 dB (μV)M

1.3 Shipping and Storage Conditions for Modules and Backup Batteries

Shipping and storage of modules

S7-300 modules surpass the requirements of IEC 61131-2, in respect of shipping and storage requirements. The following details apply to modules shipped and/or stored in their original packing.

Climatic conditions correspond to IEC 60721-3-3, Class 3K7 for storage and IEC 60721-3-2, Class 2K4 for transportation.

Mechanical conditions correspond to IEC 60721-3-2, Class 2M2.

Table 1-4   Shipping and Storage Conditions for Modules

Condition	Permitted range
Free fall (in shipping packing)	$\leq$ 1m
Temperature	from – 40 °C to + 70°C
Atmospheric pressure	1080 to 660 hPa (corresponding to an altitude of –1000 to 3500 m)
Relative humidity	10 to 95 %, no condensation
Sinusoidal oscillations to IEC 60068-2-6	5 – 9 Hz: 3.5 mm 9 – 150 Hz: 9.8 m/s^2
Shock according to IEC 60068-2-29	250 m/s^2, 6 ms, 1000 shocks

Transporting backup batteries

Wherever possible, transport backup batteries in their original packing. Special approval does not have to be obtained for transporting backup batteries for S7-300 systems. The lithium content of the backup battery is approximately 0.25 g.

Storing backup batteries

Backup batteries must be stored in a cool and dry place. The maximum shelf life is 5 years.

⚠ **Warning**

Improper handling of backup batteries can result in injury and damage to property. If backup batteries are not treated properly, they can explode and cause severe burning.
Observe the following rules when handling backup batteries used in the S7-300 programmable logic controller:

- never charge them
- never heat them
- never throw them in the fire
- never damage them mechanically (drill, squeeze, etc.)

1.4 Mechanical and Climatic Environmental Conditions for Operating S7-300s

Operating conditions

S7-300 systems are intended for stationary use in locations protected against the weather. The operating conditions surpass the requirements of DIN IEC 60721-3-3.

- Class 3M3 (mechanical requirements)
- Class 3K3 (climatic requirements)

Use with additional measures

The S7-300, for example, must **not** be used without taking additional measures:

- in locations exposed to a high degree of ionizing radiation
- in hostile environments caused, for instance, by
  - dust accumulation
  - corrosive vapors or gases
  - strong electric or magnetic fields
- in installations requiring special monitoring, for example
  - elevators
  - electrical installations in particularly hazardous areas

An additional measure might be, for instance, installation of the S7-300 in a cabinet or in a housing.

Ambient mechanical conditions

The ambient mechanical conditions for S7-300 modules are listed in the following table in the form of sinusoidal oscillations.

Table 1-5   Mechanical Conditions

Frequency Range in Hz	Continuous	Occasional
10 ≤ f ≤ 58	0.0375 mm amplitude	0.075 mm amplitude
58 ≤ f ≤ 150	0.5 g constant acceleration	1 g constant acceleration

Reducing vibrations

If your S7-300 modules are exposed to severe shock and/or vibrations, you must take the appropriate measures to reduce the acceleration and/or amplitude, respectively.

We recommend that you install the S7-300 on vibration-damping materials (for example, rubber-metal antivibration mountings).

Ambient mechanical conditions test

The following table contains important information on the type and scope of tests for ambient mechanical conditions.

Table 1-6   Ambient Mechanical Conditions Test

Test ...	Test Standard	Remarks
Vibrations	Vibration test according to IEC 60068 Part 2-6 (sinusoidal)	Type of oscillation: frequency sweeps with a rate of change of 1 octave/minute. 10 Hz ≤ f ≤ 58 Hz, constant amplitude of 0.075 mm 58 Hz ≤ f ≤ 150 Hz, constant acceleration of 1 g Duration of oscillation: 10 frequency sweeps per axis in each of three axes perpendicular to each other
Shock	Shock test to IEC 60068, Part 2-29	Type of shock: half-sine Severity of shock: 15 g peak value, 11 ms duration Direction of shock: 3 shocks each in the +/– direction in each of three axes perpendicular to each other

Climatic conditions

You can use S7-300s under the following climatic conditions:

Table 1-7   Climatic Conditions

Climatic Conditions	Permitted range	Remarks
Temperature: horizontal installation: vertical installation:	from 0 to 60°C from 0 to 40°C	–
Relative humidity	10 to 95 %	Non-condensing, corresponds to relative humidity (RH) Class 2 according to IEC 61131, Part 2
Atmospheric pressure	1080 to 795 hPa	Corresponding to an altitude of –1000 to 2000 m
Concentration of contaminants	SO_2: < 0.5 ppm; RH < 60 %, non-condensing H_2S: < 0.1 ppm; RH < 60 %, non-condensing	Test: 10 ppm; 4 days Test: 1 ppm; 4 days

1.5 Information on Insulation Tests, Protection Class and Degree of Protection

Test voltages

Insulation stability must be demonstrated in the type test with the following test voltages in accordance with IEC 61131-2:

Table 1-8   Test Voltages

Circuits with rated voltage U_e to other circuits or to ground	Test Voltage
< 50 V	500 VDC
< 150 V	2500 VDC
< 250 V	DC 4000 V

Protection class

Protection Class I according to IEC 60536 – in other words, protective conductor connection to rail necessary

Protection against ingress of foreign bodies and water

Degree of protection IP 20 according to IEC 60529, that is, protection against contact with standard probes.

There is no special protection against the ingress of water.

1.6 Rated Voltages of the S7-300

Rated operating voltages

The modules of the S7-300 operate with different rated voltages. The following table contains the rated voltages and the corresponding tolerances.

Table 1-9   Rated Voltages

Rated voltage	Tolerance Range
24 VDC	20.4 to 28.8 VDC
120 VAC	93 to 132 VAC
230 VAC	187 to 264 VAC

1.7 SIPLUS S7-300 modules

Definition

SIPLUS S7-300 modules are modules that can be used under extended environmental conditions. Extended environmental conditions mean:

- operation possible at temperatures from –25°C to +60°C

- occasional, brief condensation permitted

- increased mechanical stress permissible

Comparison with "standard" modules

The functional scope and technical specifications for the SIPLUS S7-300 modules are the same as those of the "standard" modules.

The mechanical and climatic environmental conditions as well as their test method have changed.

The SIPLUS S7-300 modules have their own order numbers (see table 1-10)

Project engineering in *STEP 7*

The SIPLUS S7-300 modules are not included in the hardware catalog. Please design your installation with the corresponding "standard" modules according to the table 1-10.

SIPLUS S7-300 Modules

The following table contains all SIPLUS S7-300 modules.

The order numbers of the corresponding "standard" modules have been included as an aid to configuration. You can refer to the description and technical specifications in the special section on the "standard" module.

Table 1-10 SIPLUS S7-300 Modules

Module	SIPLUS S7-300-SIMATIC module for use under extended environmental conditions	"Standard" modules
	as of order no.	
IM 153-1	6AG1153-1AA03-2XB0	6ES7153-1AA03-0XB0
CPU 312C	6AG1312-5BD00-2AB0	6ES7312-5BD00-0AB0
CPU 313C	6AG1313-5BE00-2AB0	6ES7313-5BE00-0AB0
CPU 314	6AG1314-1AF10-2AB0	6ES7314-1AF10-0AB0
CPU 315-2 DP	6AG1315-2AG10-2AB0	6ES7315-2AG10-0AB0
IM 365	6AG1365-0BA01-2AA0	6ES7365-0BA01-0AA0
SM 321 digital input module;		
SM 321; DI 16 x 24VDC	6AG1321-1BH02-2AA0	6ES7321-1BH02-0AA0
SM 321; DI 32 x 24 VDC	6AG1321-1BL00-2AA0	6ES7321-1BL00-0AA0
SM 321; DI 16 x 24 VDC	6AG1321-7BH01-2AB0	6ES7321-7BH01-0AB0
SM 321; DI 16 x 24 V-125 VDC	6AG1321-1CH20-2AA0	6ES7321-1CH20-0AA0
SM 321; DI 8 x 120/230 VAC	6AG1321-1FF01-2AA0	6ES7321-1FF01-0AA0
SM 322 digital output module;		
SM 322; DO 16 x 24 VDC/0.5 A	6AG1322-1BH01-2AA0	6ES7322-1BH01-0AA0
SM 322; DO 8 x Rel. 230 VAC/5 A	6AG1322-1HF10-2AA0	6ES7322-1HF10-0AA0
SM 322, DO 8 x 48-125 VDC/1.5 A	6AG1322-1CF00-2AA0	6ES7322-1CF00-0AA0
SM 322; DO 8 x 120/230 VAC/2 A	6AG1322-1FF01-2AA0	6ES7322-1FF01-0AA0
SM 322; DO 8 x 24 VDC/0.5 A	6AG1322-8BF00-2AB0	6ES7322-8BF00-0AB0
Digital Input/Output Module SM 323; DI8/DO8 x DC 24V/0.5A	6AG1323-1BH01-2AA0	6ES7323-1BH01-0AA0
Analog input module SM 331 analog input module; AI 2 x 12 bits	6AG1331-7KB02-2AB0	6ES7331-7KB02-0AB0
Analog output module SM 332 analog output module; AO 2 x 12 bits	6AG1332-5HB01-2AB0	6ES7332-5HB01-0AB0
SM 334 analog I/O module; SM 334; AI4/AO 2 x 12 bits	6AG1334-0KE00-2AB0	6ES7334-0KE00-0AB0

1.8   Mechanical and Climatic Ambient Conditions for the Operation of SIPLUS S7-300 Modules

Ambient mechanical conditions

Operating category: according to IEC 721 3-3, Class 3M4.

Ambient mechanical conditions test

The following table contains important information on the type and scope of tests for ambient mechanical conditions of SIPLUS S7-300 modules.

Table 1-11   SIPLUS S7-300 Modules Ambient Mechanical Conditions Test

Test ...	Test Standard	Remarks
Vibrations	Vibration test according to IEC 6008 Part 2-6 (sinusoidal)	Type of oscillation: frequency sweeps with a rate of change of 1 octave/minute. $5 \text{ Hz} \leq f \leq 9 \text{ Hz}$, constant amplitude of 3.5 mm $9 \text{ Hz} \leq f \leq 150 \text{ Hz}$, constant acceleration of 1 g oscillation period: 10 frequency sweeps per axis in each of three axes perpendicular to each other
Shock	Shock test according to IEC 6008 Part 2-27	Type of shock: half-sine severity of shock: 15 g peak value, 11 ms duration Direction of shock: 3 shocks each in the +/– direction in each of three axes perpendicular to each other

Climatic conditions

You can use SIPLUS S7-300 modules under the following climatic conditions:

Operating category: according to IEC 721 3-3, Class 3K5.

Table 1-12   SIPLUS S7-300 Modules Climatic Conditions

Ambient Condition	Permitted range	Remarks
Temperature: horizontal installation vertical installation	–25 °C to 60 °C –25 °C to 40 °C	–
Relative humidity	From 5 to 95 %	**Occasional, brief condensation**, corresponds to relative humidity (RH) Class 2 according to IEC 61131, Part 2
Pollutant concentration (according to IEC 721 3-3; class 3C3)	SO_2: < 0.5 ppm; Relative humidity < 60% H_2S: < 0.1 ppm; Relative humidity < 60%	Test: 10 ppm; 4 days 1 ppm; 4 days

1.9   Use of the ET 200M / S7-300 in a Zone 2 Potentially Explosive Area

The following sections contain important information in the following languages.

In this chapter

Section	Topic
1.9.1	Using the ET 200M / S7-300 in a Zone 2 potentially explosive area
1.9.2	Use of the ET 200M / S7-300 in a Zone 2 Hazardous Area
1.9.3	Utilisation de l'ET 200M / S7-300 dans un environnement à risque d'explosion en zone 2
1.9.4	Aplicación del ET 200M / S7-300 en áreas con peligro de explosión, zona 2
1.9.5	Impiego dell'ET 200M / S7-300 nell'area a pericolo di esplosione zona 2
1.9.6	Gebruik van de ET 200M / S7-300 in het explosieve gebied zone 2
1.9.7	Brug af ET 200M / S7-300 i det eksplosionsfarlige område zone 2
1.9.8	ET 200M / S7-300:n käyttö räjähdysvaarannetuilla alueilla, vyöhyke 2
1.9.9	Användning av ET 200M / S7-300 i explosionsriskområde zon 2
1.9.10	Uso do ET 200M / S7-300 em área exposta ao perigo de explosão, zona 2
1.9.11	Χρηση της συσΚευης ET 200M / S7-300 σε ...

1.9.1 Einsatz der ET 200M / S7-300 im explosionsgefährdeten Bereich Zone 2

Zone 2

Explosionsgefährdete Bereiche werden in Zonen eingeteilt. Die Zonen werden nach der Wahrscheinlichkeit des Vorhandenseins einer explosionsfähigen Atmosphäre unterschieden.

Zone	Explosionsgefahr	Beispiel
2	explosive Gasatmosphäre tritt nur selten und kurzzeitig auf	Bereiche um Flanschverbindungen mit Flachdichtungen bei Rohrleitungen in geschlossenen Räumen
sicherer Bereich	nein	• außerhalb der Zone 2 • Standardanwendungen von dezentraler Peripherie

Nachfolgend finden Sie wichtige Hinweise für die Installation des Dezentralen Peripheriegerätes ET 200M und der SIMATIC S7-300 im explosionsgefährdeten Bereich.

Weitere Informationen

Weitere Informationen zum ET 200M und zu den verschiedenen S7-300-Baugruppen finden Sie im Handbuch.

Fertigungsort

Siemens AG, Bereich A&D
Werner-von-Siemens-Straße 50
92224 Amberg
Germany

Zulassung

⟨Ex⟩   **II 3 G**   **EEx nA II T3 .. T6**   nach EN 50021 : 1999

Prüfnummer: **KEMA 02ATEX1096 X**

Hinweis

Baugruppen mit der Zulassung ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 dürfen nur in Automatisierungssysteme SIMATIC S7-300 / ET 200M der Gerätekategorie 3 eingesetzt werden.

Instandhaltung

Für eine Reparatur muss die betroffene Baugruppe an den Fertigungsort geschickt werden. Nur dort darf die Reparatur durchgeführt werden.

Besondere Bedingungen

1. Das Dezentrale Peripheriegerät ET 200M und die SIMATIC S7-300 müssen in einen Schaltschrank oder ein metallisches Gehäuse eingebaut werden. Diese müssen mindestens die Schutzart IP 54 (nach EN 60529) gewährleisten. Dabei sind die Umgebungsbedingungen zu berücksichtigen, in denen das Gerät installiert wird. Für das Gehäuse muss eine Herstellererklärung für Zone 2 vorliegen (gemäß EN 50021).

2. Wenn am Kabel bzw. an der Kabeleinführung dieses Gehäuses unter Betriebs-bedingungen eine Temperatur > 70 °C erreicht wird oder wenn unter Betriebs-bedingungen die Temperatur an der Aderverzweigung > 80 °C sein kann, müssen die Temperatureigenschaften der Kabel mit den tatsächlich gemessenen Temperaturen übereinstimmen.

3. Die eingesetzten Kabeleinführungen müssen der geforderten IP-Schutzart und dem Abschnitt 7.2 (gemäß EN 50021) entsprechen.

4. Alle Geräte, einschließlich Schalter etc., die an den Ein- und Ausgängen von ET 200M- und S7-300-Systemen angeschlossen werden, müssen für den Explosionsschutz Typ EEx nA oder EEx nC genehmigt sein.

5. Es müssen Maßnahmen getroffen werden, dass die Nennspannung durch Transienten um nicht mehr als 40 % überschritten werden kann.

6. Umgebungstemperaturbereich: 0° C bis 60° C

7. Innerhalb des Gehäuses ist an einem nach dem Öffnen gut sichtbaren Platz ein Schild mit folgender Warnung anzubringen:
Warnung
Das Gehäuse darf nur kurze Zeit geöffnet werden, z. B. für visuelle Diagnose. Betätigen Sie dabei keine Schalter, ziehen oder stecken keine Baugruppen und trennen keine elektrischen Leitungen (Steckverbindungen).
Diese Warnung kann unberücksichtigt bleiben, wenn bekannt ist, dass keine explosionsgefährdete Atmosphäre herrscht.

Liste der zugelassenen Baugruppen

Die Liste mit den zugelassenen Baugruppen finden Sie im Internet:

`http://www4.ad.siemens.de/view/cs/`

unter der Beitrags-ID   13702947

1.9.2 Use of the ET 200M / S7-300 in a Zone 2 Hazardous Area

Zone 2

Hazardous areas are divided up into zones. The zones are distinguished according to the probability of the existence of an explosive atmosphere.

Zone	Explosion Hazard	Example
2	Explosive gas atmosphere occurs only seldom and for a short time	Areas around flange joints with flat gaskets in pipes in enclosed spaces
Safe area	No	• Outside zone 2 • Standard distributed I/O applications

Below you will find important information on the installation of the ET 200M distributed I/O device and the SIMATIC S7-300 in a hazardous area.

Further Information

You will find further information on the ET 200M and the various S7-300 modules in the manual.

Production Location

Siemens AG, Bereich A&D
Werner-von-Siemens-Straße 50
92224 Amberg
Germany

Certification

⟨Ex⟩ **II 3 G   EEx nA II T3 .. T6**   to EN 50021 : 1999

Test number: **KEMA 02ATEX1096 X**

Note

Modules with ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 certification can only be used in SIMATIC S7-300/ET 200M automation systems belonging to equipment category 3.

Maintenance

If repair is necessary, the affected module must be sent to the production location. Repairs can only be carried there.

Special Conditions

1. The ET 200M distributed I/O device and the SIMATIC S7-300 must be installed in a cabinet or metal housing. These must comply with the IP 54 degree of protection as a minimum. The environmental conditions under which the equipment is installed must be taken into account. There must be a manufacturer's declaration for zone 2 available for the housing (in accordance with EN 50021).

2. If a temperature of > 70 °C is reached in the cable or at the cable entry of this housing under operating conditions, or if a temperature of > 80 °C can be reached at the junction of the conductors under operating conditions, the temperature-related properties of the cables must correspond to the temperatures actually measured.

3. The cable entries used must comply with the required IP degree of protection and Section 7.2 (in accordance with EN 50021).

4. All devices (including switches, etc.) that are connected to the inputs and outputs of fail-safe signal modules must be approved for EEx nA or EEx nC explosion protection.

5. Steps must be taken to ensure that the rated voltage through transients cannot be exceeded by more than 40 %.

6. Ambient temperature range: 0° C to 60° C

7. A sign containing the following warning must be put up inside the housing in an easily visible position when the housing is opened:
Warning
The housing can only be opened for a short time (e.g. for visual diagnostics). If you do this, do not operate any switches, remove or install any modules or disconnect any electrical cables (plug-in connections).
You can disregard this warning if you know that the atmosphere is not hazardous (i.e. there is no risk of explosion).

List of Approved Modules

You will find the list of approved modules under the ID 13702947 on the Internet:

http://www4.ad.siemens.de/view/cs/.

1.9.3 Utilisation de l'ET 200M / S7-300 dans un environnement à risque d'explosion en zone 2

Zone 2

Les environnements à risque d'explosion sont répartis en zones. Les zones se distinguent par la probabilité de présence d'une atmosphère explosive.

Zone	Risque d'explosion	Exemple
2	Formation rare et brève d'une atmosphère gazeuse explosive	Environnement de raccords à joints plats dans le cas de conduites dans des locaux fermés
Zone sûre	Non	• A l'extérieur de la zone 2 • Utilisation standard de périphérie décentralisée

Vous trouverez ci-après des remarques importantes pour l'installation de la station de périphérie décentralisée ET 200M et du SIMATIC S7-300 dans un environnement présentant un risque d'explosion.

Informations complémentaires

Des informations complémentaires sur l'ET 200M et les divers modules S7-300 se trouvent dans le manuel.

Lieu de production

Siemens AG, Bereich A&D
Werner-von-Siemens-Straße 50
92224 Amberg
Germany

Homologation

⟨Ex⟩   **II 3 G   EEx nA II T3 .. T6**   selon EN 50021 : 1999

Numéro de contrôle :   **KEMA 02ATEX1096 X**

Nota

Les modules homologués ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 ne peuvent être utilisés que dans des automates SIMATIC S7-300 / ET 200M de catégorie 3.

Entretien

Si une réparation est nécessaire, le module concerné doit être expédié au lieu de production. La réparation ne doit être effectuée qu'en ce lieu.

Conditions particulières

1. La station de périphérie décentralisée ET 200M et le SIMATIC S7-300 doivent être installés dans une armoire ou un boîtier métallique. Ceux-ci doivent assurer au moins l'indice de protection IP 54. Il faut alors tenir compte des conditions d'environnement dans lesquelles l'appareil est installé. Le boîtier doit faire l'objet d'une déclaration de conformité du fabricant pour la zone 2 (selon EN 50021).

2. Si dans les conditions d'exploitation, une température > 70 °C est atteinte au niveau du câble ou de l'entrée du câble dans ce boîtier, ou bien si la température au niveau de la dérivation des conducteurs peut être > 80 °C, les capacités de résistance thermique des câbles doivent corespondre aux températures effectivement mesurées.

3. Les entrées de câbles utilisées doivent avoir le niveau de protection IP exigé et être conformes au paragraphe 7.2 (selon EN 50021).

4. Tous les appareillages (y compris les interrupteurs, etc.) raccordés aux entrées et sorties de modules de signaux à sécurité intrinsèque doivent être homologués pour la protection antidéflagrante type EEx nA ou EEx nC.

5. Il faut prendre des mesures pour que la tension nominale ne puisse pas être dépassée de plus de 40% sous l'influence de transitoires.

6. Plage de température ambiante : 0° C à 60° C

7. A l'intérieur du boîtier, il faut placer, à un endroit bien visible après ouverture, une plaquette comportant l'avertissement suivant :
Avertissement
Ouvrir le boîtier le moins longtemps possible, par exemple pour effectuer un diagnostic visuel. Ce faisant, n'actionnez aucun commutateur, ne déconnectez aucun module et ne débanchez pas de câbles électriques (connexions).
Le respect de cet avertissement n'est pas impératif s'il est certain que l'environnement ne présente pas de risque d'explosion.

Liste des modules homologués

Vous trouverez sur Internet la liste des modules homologués :

http://www4.ad.siemens.de/view/cs/

référence ID 13702947

1.9.4 Aplicación de la ET 200M / S7-300 en áreas con peligro de explosión, zona 2

Zona 2

Las áreas con peligro de explosión se clasifican en zonas. Las zonas se diferencian según la probabilidad de la existencia de una atmósfera capaz de sufrir una explosión.

Zona	Peligro de explosión	Ejemplo
2	La atmósfera explosiva de gas sólo se presenta rara vez y muy brevemente	Áreas alrededor de uniones abridadas con juntas planas en tuberías en locales cerrados
Área segura	No	• fuera de la zona 2 • Aplicaciones estándar de la periferia descentralizada

A continuación encontrará importantes informaciones para la instalación de la unidad periférica descentralizada ET 200M y del SIMATIC S7-300 en áreas con peligro de explosión.

Otras informaciones

Encontrará otras informaciones relativas a la ET 200S y a los distintos módulos S7-300 en el Manual.

Lugar de fabricación

Siemens AG, Bereich A&D
Werner-von-Siemens-Straße 50
92224 Amberg
Germany

Homologación

⟨Ex⟩ **II 3 G   EEx nA II T3 .. T6**   según norma EN 50021 : 1999

Número de comprobación: **KEMA 02ATEX1096 X**

Nota

Los módulos con la homologación ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 pueden utilizarse únicamente en los autómatas programables SIMATIC S7-300 / ET 200M de la categoría de equipo 3.

Mantenimiento

Para una reparación se ha de remitir el módulo afectado al lugar de fabricación. Sólo allí se puede realizar la reparación.

Condiciones especiales

1. La unidad periférica descentralizada ET 200M y el SIMATIC S7-300 se han de montar en un armario eléctrico de distribución o en una carcasa metálica. Éstos deben garantizar como mínimo el grado de protección IP 54. Para ello se han de tener en cuenta las condiciones ambientales, en las cuales se instala el equipo. La caja deberá contar con una declaración del fabricante para la zona 2 (conforme a EN 50021).

2. Si durante la operación se alcanzara una temperatura > 70° C en el cable o la entrada de cables de esta caja o bien una temperatura > 80° C en la bifurcación de hilos, deberán adaptarse las propiedades térmicas de los cables a las temperaturas medidas efectivamente.

3. Las entradas de cable utilizadas deben cumplir el grado de protección IP exigido y lo expuesto en el apartado 7.2 (conforme a EN 50021).

4. Todos los dispositivos –inclusive interruptores, etc.– conectados a las entradas y salidas de módulos de señales de alta disponibilidad deben estar homologados para la protección contra explosiones del tipo EEx nA o EEx nC.

5. Es necesario adoptar las medidas necesarias para evitar que la tensión nominal pueda rebasar en más del 40 % debido a efectos transitorios.

6. Margen de temperatura ambiente: 0° C hasta 60° C

7. Dentro de la caja deberá colocarse en un lugar perfectamente visible tras su apertura un rótulo con la siguiente advertencia:
   Precaución
   Abrir la caja sólo brevemente, p.ej. para el diagnóstico visual. Durante este tiempo Ud. no deberá activar ningún interruptor, desenchufar o enchufar módulos ni separar conductores eléctricos (conexiones enchufables).
   Esta advertencia puede ignorarse si Ud. sabe que en la atmósfera existente no hay peligro de explosión.

Lista de los módulos homologados

En la internet hallará Ud. una lista con los módulos homologados:

http://www4.ad.siemens.de/view/cs/

bajo el ID de asignación 13702947

1.9.5 Impiego dell'ET 200M / S7-300 nell'area a pericolo di esplosione zona 2

Zona 2

Le aree a pericolo di esplosione vengono suddivise in zone. Le zone vengono distinte secondo la probabilità della presenza di un'atmosfera esplosiva.

Zona	Pericolo di esplosione	Esempio
2	L'atmosfera esplosiva si presente solo raramente e brevemente	Aree intorno a collegamenti a flange con guarnizioni piatte nelle condotte in ambienti chiusi
Area sicura	No	• Al di fuori della zona 2 • Applicazioni standard di periferia decentrata

Qui di seguito sono riportate delle avvertenze importanti per l'installazione dell'unità di periferia decentrata ET 200M e del SIMATIC S7-300 nell'area a pericolo di esplosione.

Ulteriori informazioni

Ulteriori informazioni sull'ET 200M e sulle diverse unità S7-300 si trovano nel manuale.

Luogo di produzione

Siemens AG, Bereich A&D
Werner-von-Siemens-Straße 50
92224 Amberg
Germany

Autorizzazione

⟨Ex⟩   **II 3 G   EEx nA II T3 .. T6**   secondo EN 50021 : 1999

Numero di controllo: **KEMA 02ATEX1096 X**

Avvertenza

Le unità con l'autorizzazione ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 possono essere impiegate solo nei sistemi di controllori programmabili SIMATIC S7-300 / ET 200M della categoria di apparecchiature 3.

Manutenzione

Per una riparazione, l'unità interessata deve essere inviata al luogo di produzione. La riparazione può essere effettuata solo lì.

Condizioni particolari

1. L'unità di periferia decentrata ET 200M e il SIMATIC S7-300 devono essere montati in un armadio elettrico o in un contenitore metallico. Questi devono assicurare almeno il tipo di protezione IP 54. In questo caso bisogna tenere conto delle condizioni ambientali nelle quali l'apparecchiatura viene installata. Per il contenitore deve essere presente una dichiarazione del costruttore per la zona 2 (secondo EN 50021).

2. Se nei cavi o nel loro punto di ingresso in questo contenitore viene raggiunta in condizioni di esercizio una temperatura > 70 °C o se in condizioni di esercizio la temperatura nella derivazione dei fili può essere > 80 °C, le caratteristiche di temperatura dei cavi devono essere conformi alla temperatura effettivamente misurata.

3. Gli ingressi dei cavi usati devono essere conformi al tipo di protezione richiesto e alla sezione 7.2 (secondo EN 50021).

4. Tutte le apparecchiature, inclusi interruttori, ecc. che vengono collegati agli ingressi/uscite di unità di segnale ad elevata sicurezza, devono essere stati omologati per la protezione da esplosione tipo EEx nA o EEx nC.

5. Devono essere prese delle misure per evitare che la tensione nominale possa essere superata per più del 40% da parte di transienti.

6. Campo termico ambientale: da 0° C a 60° C

7. All'interno del contenitore va apportata, in un luogo ben visibile dopo l'apertura, una targhetta con il seguente avvertimento:
Attenzione
Il contenitore può rimanere aperto solo per breve tempo, ad esempio per una diagnostica a vista. In tal caso non azionare alcun interruttore, non disinnestare o innestare unità e non staccare connessioni elettriche (connettori).
Non è necessario tenere conto di questo avvertimento se è noto che non c'è un'atmosfera a rischio di esplosione.

Elenco delle unità abilitate

La lista con le unità omologate si trova in Internet al sito:

http://www4.ad.siemens.de/view/cs/

all'ID di voce 13702947

1.9.6 Gebruik van de ET 200M / S7-300 in het explosief gebied zone 2

Zone 2

Explosieve gebieden worden ingedeeld in zones. Bij de zones wordt onderscheiden volgens de waarschijnlijkheid van de aanwezigheid van een explosieve atmosfeer.

Zone	Explosiegevaar	Voorbeeld
2	Een explosieve gasatmosfeer treedt maar zelden op en voor korte duur	Gebieden rond flensverbindingen met pakkingen bij buisleidingen in gesloten vertrekken
Veilig gebied	Neen	• Buiten de zone 2 • Standaardtoepassingen van decentrale periferie

Hierna vindt u belangrijke aanwijzingen voor de installatie van het decentrale periferieapparaat ET 200M en van de SIMATIC S7-300 in het explosief gebied.

Verdere informatie

In het handboek vindt u verdere informatie over de ET 200M en over de verschillende
S7-300-modulen.

Productieplaats

Siemens AG, Bereich A&D
Werner-von-Siemens-Strasse 50
92224 Amberg
Germany

Vergunning

⟨Ex⟩ **II 3 G**   **EEx nA II T3 .. T6**   conform EN 50021 : 1999

Keuringsnummer: **KEMA 02ATEX1096 X**

Opmerking

Modulen met de vergunning ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 mogen slechts worden gebruikt in automatiseringssystemen SIMATIC S7-300 / ET 200M van de apparaatcategorie 3.

Instandhouding

Voor een reparatie moet de betreffende module naar de plaats van vervaardiging worden gestuurd. Alleen daar mag de reparatie worden uitgevoerd.

Speciale voorwaarden

1. Het decentrale periferieapparaat ET 200M en de SIMATIC S7-300 moeten worden ingebouwd in een schakelkast of in een behuizing van metaal. Deze moeten minstens de veiligheidsgraad IP 54 waarborgen. Hierbij dient rekening te worden gehouden met de omgevingsvoorwaarden waarin het apparaat wordt geïnstalleerd. Voor de behuizing dient een verklaring van de fabrikant voor zone 2 te worden ingediend (volgens EN 50021).

2. Als aan de kabel of aan de kabelinvoering van deze behuizing onder bedrijfsomstandigheden een temperatuur wordt bereikt > 70 °C of als onder bedrijfsomstandigheden de temperatuur aan de adervertakking > 80 °C kan zijn, moeten de temperatuureigenschappen van de kabel overeenstemmen met de werkelijk gemeten temperaturen.

3. De aangebrachte kabelinvoeringen moeten de vereiste IP-veiligheidsgraad hebben en in overeenstemming zijn met alinea 7.2 (volgens EN 50021).

4. Alle apparaten, schakelaars enz. inbegrepen, die worden aangesloten op de in- en uitgangen van tegen fouten beveiligde signaalmodulen, moeten zijn goedgekeurd voor de explosiebeveiliging type EEx nA of EEx nC.

5. Er dienen maatregelen te worden getroffen, zodat de nominale spanning door transiënten met niet meer dan 40 % kan worden overschreden.

6. Omgevingstemperatuurbereik: 0° C tot 60° C

7. Binnen de behuizing dient op een na het openen goed zichtbare plaats een bord te worden aangebracht met de volgende waarschuwing:
   Waarschuwing
   De behuizing mag slechts voor korte tijd worden geopend, bijv. voor een visuele diagnose. Bedien hierbij geen schakelaar, trek of steek geen modulen en ontkoppel geen elektrische leidingen (steekverbindingen).
   Deze waarschuwing kan buiten beschouwing blijven, indien bekend is dat er geen explosieve atmosfeer heerst.

Lijst van de toegelaten modulen

De lijst met de toegelaten modulen vindt u in het internet:

http://www4.ad.siemens.de/view/cs/

onder de bijdrage-ID 13702947

1.9.7 Brug af ET 200M / S7-300 i det eksplosionfarlige område zone 2

Zone 2

Eksplosionsfarlige områder inddeles i zoner. Zonerne adskiller sig indbyrdes efter hvor sandsynligt det er, at der er en eksplosiv atmosfære.

Zone	Eksplosionsfare	Eksempel
2	Eksplosiv gasatmosfære optræder kun sjældent og varer kort	Områder rundt om flangeforbindelser med flade pakninger ved rørledninger i lukkede rum
Sikkert område	Nej	• Uden for zone 2 • Standardanvendelser decentral periferi

I det følgende findes vigtige henvisninger vedr. installation af det decentrale periferiudstyr ET 200M og SIMATIC S7-300 i det eksplosionfarlige område.

Yderligere informationer

Yderligere informationer om ET 200M og de forskellige S7-300-komponenter findes i manualen.

Produktionssted

Siemens AG, Bereich A&D
Werner-von-Siemens-Straße 50
92224 Amberg
Germany

Godkendelse

⟨Ex⟩   **II 3 G**   **EEx nA II T3 .. T6**   efter EN 50021 : 1999

Kontrolnummer: **KEMA 02ATEX1096 X**

Bemærk

Komponenter med godkendelsen ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 må kun monteres i automatiseringssystemer SIMATIC S7-300 / ET 200M - udstyrskategori 3.

Vedligeholdelse

Skal den pågældende komponent repareres, bedes De sende den til produktionsstedet. Reparation må kun udføres der.

Særlige betingelser

1. Det decentrale periferiudstyr ET 200M og SIMATIC S7-300 skal monteres i et kontrolskab eller et metalkabinet. Disse skal mindst kunne sikre beskyttelsesklasse IP 54. I denne forbindelse skal der tages højde for de omgivelsestemperaturer, i hvilke udstyret er installeret. Der skal være udarbejdet en erklæring fra fabrikanten for kabinettet for zone 2 (iht. EN 50021).

2. Hvis kablet eller kabelindføringen på dette hus når op på en temperatur på > 70 °C under driftsbetingelser eller hvis temperaturen på åreforegreningen kan være > 80 °C under driftsbetingelser, skal kablernes temperaturegenskaber stemme overens med de temperaturer, der rent faktisk måles.

3. De benyttede kabelindføringer skal være i overensstemmelse med den krævede IP-beskyttelsestype og afsnittet 7.2 (iht. EN 50021).

4. Alle apparater, inkl. kontakter osv., der forbindes med ind- og udgangene til fejlsikre signalkomponenter, skal være godkendt til eksplosionsbeskyttelse af type EEx nA eller EEx nC.

5. Der skal træffes foranstaltninger, der sørger for, at den nominelle spænding via transienter ikke kan overskrides mere end 40 %.

6. Omgivelsestemperaturområde: 0° C til 60° C

7. I kabinettet skal der anbringes et skilt, der skal kunne ses, når kabinettet åbnes. Dette skilt skal have følgende advarsel:
Advarsel
Kabinettet må kun åbnes i kort tid, f.eks. til visuel diagnose. Tryk i denne forbindelse ikke på kontakter, træk eller isæt ikke komponenter og afbryd ikke elektriske ledninger (stikforbindelser).
Denne advarsel skal der ikke tages højde for, hvis man ved, at der ikke er nogen eksplosionsfarlig atmosfære.

Liste over godkendte komponenter

Listen med de godkendte komponenter findes på internettet:

http://www4.ad.siemens.de/view/cs/

under bidrags-ID 13702947

1.9.8 ET 200M / S7-300:n käyttö räjähdysvaarannetuilla alueilla, vyöhyke 2

Vyöhyke 2

Räjähdysvaarannetut alueet jaetaan vyöhykkeisiin. Vyöhykkeet erotellaan räjähdyskelpoisen ilmakehän olemassa olon todennäköisyyden mukaan.

Vyöhyke	Räjähdysvaara	Esimerkki
2	Räjähtävä kaasuilmakehä ilmaantuu vain harvoin ja lyhytaikaisesti	Alueet putkistojen lattatiivisteillä varustuilla laippaliitoksilla suljetuissa tiloissa
turvallinen alue	Ei	• vyöhykkeen 2 ulkopuolella • Hajautetun ulkopiirin vakiosovellukset

Seuraavasta löydätte tärkeitä ohjeita hajautetun ulkopiirilaitteen ET 200M ja SIMATIC S7-300 asennukseen räjähdysvaaranetuilla alueilla.

Lisätietoja

Lisätietoja ET 200M:ään ja erilaisiin S7-300-rakenneryhmiin löydätte ohjekirjasta.

Valmistuspaikka

Siemens AG, Bereich A&D
Werner-von-Siemens-Straße 50
92224 Amberg
Germany

Hyväksyntä

$\langle Ex \rangle$ **II 3 G**   **EEx nA II T3 .. T6**   EN 50021 mukaan: 1999

Tarkastusnumero: **KEMA 02ATEX1096 X**

Ohje

Rakenneryhmät hyväksynnän $\langle Ex \rangle$ II 3 G   EEx nA II T3 .. T6 kanssa saadaan käyttää ainoastaan laitekategorian 3 automatisointijärjestelmissä SIMATIC S7-300 / ET 200M.

Kunnossapito

Korjausta varten täytyy kyseinen rakenneryhmä lähettää valmistuspaikkaan. Korjaus voidaan suorittaa ainoastaan siellä.

Erityiset vaatimukset

1. Hajautettu ulkopiirilaite ET 200M ja SIMATIC S7-300 täytyy asentaa kytkentäkaappiin tai metalliseen koteloon. Näiden täytyy olla vähintään kotelointiluokan IP 54 mukaisia. Tällöin on huomioitava ympäristöolosuhteet, johon laite asennetaan. Kotelolle täytyy olla valmistajaselvitys vyöhykettä 2 varten (EN 50021 mukaan).

2. Kun johdolla tai tämän kotelon johdon sisäänviennillä saavutetaan > 70 °C lämpötila tai kun käyttöolosuhteissa lämpötila voi piuhajaotuksella olla > 80 °C, täytyy johdon lämpötilaominaisuuksien vastata todellisesti mitattuja lämpötiloja.

3. Käytettyjen johtojen sisäänohjauksien täytyy olla vaaditun IP-kotelointiluokan ja kohdan 7.2 (EN 50021 mukaan) mukaisia.

4. Kaikkien laitteiden, kytkimet jne. mukaan lukien, jotka liitetään virheiltä suojattujen signaalirakenneryhmien tuloille ja lähdöille, täytyy olla hyväksyttyjä tyypin EEx nA tai EEx nC räjähdyssuojausta varten.

5. Toimenpiteet täytyy suorittaa, ettei nimellisjännite voi transienttien kautta ylittyä enemmän kuin 40 %.

6. Ympäristölämpötila-alue: 0° C ... 60° C

7. Kotelon sisälle, avauksen jälkeen näkyvälle paikalle, on kiinnitettävä kilpi, jossa on seuraava varoitus:
   Varoitus
   Kotelo saadaan avata ainoastaan lyhyeksi ajaksi, esim. visuaalista diagnoosia varten. Älä tällöin käytä mitään kytkimiä, vedä tai liitä mitään rakenneryhmiä, äläkä erota mitään sähköjohtoja (pistoliittimiä).
   Tätä varoitusta ei tarvitse huomioida, kun on tiedossa, että minkäänlaista räjähdysvaarannettua ilmakehää ei ole olemassa.

Hyväksyttyjen rakenneryhmien lista

Lista hyväksiytyistä rakennesarjoista löytyy internetistä osoitteesta:

http://www4.ad.siemens.de/view/cs/

käyttäjätunnuksella 13702947

1.9.9 Användning av ET 200M / S7-300 i explosionsriskområde zon 2

Zon 2

Explosionsriskområden delas in i zoner. Zonerna delas in enligt sannolikheten att en atmosfär med explosionsfara föreligger.

Zon	Explosionsfara	Exempel
2	Explosiv gasatmosfär uppstår endast sällan eller kortvarigt	Områden kring flänsförbindelser med packningar vid rörledningar i slutna utrymmen
Säkert område	Nej	• Utanför zon 2 • Standardanvändning av decentral periferi

Nedan följer viktiga anvisningar om installationen av den decentrala periferienheten ET 200M och SIMATIC°S7-300 i ett explosionsriskområde.

Ytterligare information

Ytterligare information om ET 200M och de olika S7-300-komponentgrupperna finner du i handboken.

Tillverkningsort

Siemens AG, Bereich A&D
Werner-von-Siemens-Straße 50
92224 Amberg
Germany

Godkännande

⟨Ɛx⟩ **II 3 G** **EEx nA II T3 .. T6** enligt EN 50021 : 1999

Kontrollnummer: **KEMA 02ATEX1096 X**

Anvisning

Komponentgrupper med godkännande ⟨Ɛx⟩ II 3 G EEx nA II T3 .. T6 får endast användas i automatiseringssystemen SIMATIC S7-300 / ET°200M från apparatgrupp 3.

Underhåll

Vid reparation måste den aktuella komponentgruppen insändas till tillverkaren. Reparationer får endast genomföras där.

Särskilda villkor

1. Den decentrala periferienheten ET 200M och SIMATIC°S7-300 måste monteras i ett kopplingsskåp eller metallhus. Dessa måste minst vara av skyddsklass IP 54. Därvid ska omgivningsvillkoren där enheten installeras beaktas. För kåpan måste en tillverkardeklaration för zon 2 föreligga (enligt EN 50021).

2. Om en temperatur på > 70°C uppnås vid husets kabel resp kabelinföring under driftvillkor eller om temperaturen vid trådförgreningen kan vara > 80°C under driftvillkor, måste kabelns temperaturegenskaper överensstämma med den verkligen uppmätta temperaturen.

3. De använda kabelinföringarna måste uppfylla kraven i det krävda IP-skyddsutförandet och i avsnitt 7.2 (enligt EN 50021).

4. Alla apparater, inklusive brytare osv, som ansluts till felsäkrade signalenheters in- och utgångar, måste vara godkända för explosionsskydd av typ EEx nA eller EEx nC.

5. Åtgärder måste vidtas så, att märkspänningen ej kan överskridas med mer än 40°% genom transienter.

6. Omgivningstemperatur: 0° C till 60° C

7. När huset öppnats ska en skylt med följande varning monteras på ett tydligt synligt ställe huset:
   Varning
   Huset får endast öppnas under kort tid, t ex för visuell diagnos. Använd därvid inga brytare, lossa eller anslut inga enheter och frånskilj inga elektriska ledningar (insticksanslutningar).
   Ingen hänsyn måste tas till denna varning om det är säkert att det inte råder någon explosionsfarlig atmosfär.

Lista över godkända komponentgrupper

Lista över godkända enheter återfinns i Internet:

http://www4.ad.siemens.de/view/cs/

under bidrags-ID 13702947

1.9.10 Uso do ET 200M / S7-300 em área exposta ao perigo de explosão 2

Zona 2

As áreas expostas ao perigo de explosão são divididas em zonas. As zonas são diferenciadas de acordo com a probabilidade da existência de uma atmosfera explosiva.

Zona	Perigo de explosão	Exemplo
2	Só raramente e por um breve período de tempo surgem atmosferas explosivas	Áreas em torno de ligações flangeadas com vedações chatas em tubulações em recintos fechados
Área segura	Não	• fora da zona 2 • Aplicações descentralizadas de periferia descentralizada

A seguir, o encontrará avisos importantes para a instalação do aparelho periférico descentralizado ET 200M e da SIMATIC S7-300 em área exposta ao perigo de explosão.

Mais informações

Para obter mais informações sobre o ET 200M e os diversos grupos construtivos S7-300, consulte o manual.

Local de produção

Siemens AG, Bereich A&D
Werner-von-Siemens-Straße 50
92224 Amberg
Germany

Licença

⟨Ɛx⟩   **II 3 G**   **EEx nA II T3 .. T6**   seg. EN 50021 : 1999

Número de ensaio: **KEMA 02ATEX1096 X**

Aviso

Componentes com a licença ⟨Ɛx⟩ II 3 G   EEx nA II T3 .. T6 só podem ser aplicados em sistemas de automação SIMATIC S7-300 / ET 200M da categoria de aparelho 3.

Reparo

Os grupos construtivos em questão devem ser remetidos para o local de produção a fim de que seja realizado o reparo. Apenas lá deve ser efetuado o reparo.

Condições especiais

1. O aparelho periférico ET 200M e a SIMATIC S7-300 devem ser montados em um armário de distribuição ou em uma caixa metálica. Estes devem garantir no mínimo o tipo de proteção IP 54. Durante este trabalho deverão ser levados em consideração as condições locais, nas quais o aparelho será instalado. Para a caixa deverá ser apresentada uma declaração do fabricante para a zona 2 (de acordo com EN 50021).

2. Caso no cabo ou na entrada do cabo desta carcaça sob as condições operacionais seja atingida uma temperatura de > 70 °C, ou caso sob condições operacionais a temperatura na ramificação do fio poderá atingir > 80 °C, as caraterísticas de temperatura deverão corresponder às temperaturas realmente medidas.

3. As entradas de cabo utilizadas devem corresponder ao tipo exigido de proteção IP e à seção 7.2 (de acordo com o EN 50021).

4. Todos os aparelhos, inclusive as chaves, etc., que estejam conectadas em entradas e saídas de módulos de sinais protegidos contra erro, devem possuir a licença para a proteção de explosão do tipo EEx nA ou EEx nC.

5. Precisam ser tomadas medidas para que a tensão nominal através de transitórios não possa ser ultrapassada em mais que 40 %.

6. Área de temperatura ambiente: 0° C até 60° C

7. No âmbito da carcaça deve ser colocada, após a abertura, em um ponto bem visível uma placa com a seguinte advertência:
Advertência
A carcaça deve ser aberta apenas por um breve período de tempo, por ex. para diagnóstico visual. Não acione nenhum interruptor, não retire ou conecte nenhum módulo e não separe nenhum fio elétrico (ligações de tomada).
Esta advertência poderá ser ignorada caso se saiba que não há nenhuma atmosfera sujeita ao perigo de explosão.

Lista dos componentes autorizados

A lista com os módulos autorizados encontram-se na Internet:

http://www4.ad.siemens.de/view/cs/

sob o número de ID 13702947

1.9.11 Χρήση της συσκευής ET 200M / S7-300 σε επικίνδυνη για έκρηξη περιοχή, ζώνη 2

Ζώνη 2

Οι επικίνδυνες για έκρηξη περιοχές χωρίζονται σε ζώνες. Οι ζώνες διαφέρουν σύμφωνα με την πιθανότητα ύπαρξης ενός ικανού για έκρηξη περιβάλλοντος.

Ζώνη	Κίνδυνος έκρηξης	Παράδειγμα
2	Εκρηκτικό περιβάλλον αερίου παρουσιάζεται μόνο σπάνια και για σύντομο χρονικό διάστημα	Περιοχές γύρω από φλαντζωτές συνδέσεις με τσιμούχες σε σωληνώσεις σε κλειστούς χώρους
Ασφαλής περιοχή	Όχι	• Εκτός της ζώνης 2 • Τυπικές εφαρμογές αποκεντρωμένης περιφέρειας

Στη συνέχεια θα βρείτε σημαντικές υποδείξεις για την εγκατάσταση της αποκεντρωμένης περιφερειακής συσκευής ET 200M και του δομικού συγκροτήματος SIMATIC S7-300 σε επικίνδυνη για έκρηξη περιοχή.

Επιπλέον πληροφορίες

Επιπλέον πληροφορίες για τη συσκευή ET 200M και για τα διάφορα δομικά συγκροτήματα (ενότητες) S7-300 θα βρείτε στο εγχειρίδιο.

Τόπος κατασκευής

Siemens AG, Bereich A&D
Werner-von-Siemens-Straße 50
92224 Amberg
Germany

Άδεια

⟨Ex⟩ **II 3 G** **EEx nA II T3 .. T6** σύμφωνα με το πρότυπο EN 50021 : 1999

Αριθμός ελέγχου: **KEMA 02ATEX1096 X**

Υπόδειξη

Τα δομικά συγκροτήματα με την άδεια ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 επιτρέπεται να τοποθετηθούν μόνο σε συστήματα αυτοματισμού SIMATIC S7-300 / ET 200M της κατηγορίας συσκευής 3.

Συντήρηση

Για μια επισκευή πρέπει να σταλθεί το αντίστοιχο δομικό συγκρότημα στον τόπο κατασκευής. Μόνο εκεί επιτρέπεται να γίνει η επισκευή.

Ιδιαίτερες προϋποθέσεις

1. Η αποκεντρωμένη περιφερειακή συσκευή ΕΤ 200Μ και το δομικό συγκρότημα SIMATIC S7-300 πρέπει να ενσωματωθούν σε ένα ερμάριο ζεύξης ή σε ένα μεταλλικό περίβλημα. Αυτά πρέπει να εξασφαλίζουν το λιγότερο το βαθμό προστασίας IP 54. Σε αυτήν την περίπτωση πρέπει να ληφθούν υπόψη οι περιβαλλοντικές συνθήκες, στις οποίες θα εγκατασταθεί η συσκευή. Για το περίβλημα πρέπει να προβλέπεται δήλωση του κατασκευαστή για τη ζώνη 2 (σύμφωνα με το πρότυπο EN 50021).

2. Εάν στο καλώδιο ή στην είσοδο του καλωδίου αυτού του περιβλήματος κάτω από συνθήκες λειτουργίας η θερμοκρασία ξεπεράσει τους 70 °C ή όταν κάτω από συνθήκες λειτουργίας η θερμοκρασία στη διακλάδωση του σύρματος μπορεί να είναι μεγαλύτερη από 80 °C, πρέπει οι θερμοκρασιακές ιδιότητες των καλωδίων να ταυτίζονται με τις πραγματικά μετρημένες θερμοκρασίες.

3. Οι χρησιμοποιούμενες είσοδοι καλωδίων πρέπει να συμμορφώνονται με το βαθμό προστασίας IP 54 στην ενότητα 7.2 (σύμφωνα με το πρότυπο EN 50021).

4. Όλες οι συσκευές, συμπεριλαμβανομένων διακοπτών κ.α., που συνδέονται στις εισόδους και εξόδους δομικών συγκροτημάτων ασφαλών σημάτων, πρέπει να φέρουν εγκριμένη προστασία κατά έκρηξης τύπου EEx nA ή EEx nC.

5. Πρέπει να ληφθούν μέτρα, να μην μπορεί να γίνει υπέρβαση της ονομαστικής τάσης μέσω αιφνίδιας μεταβολής της τάσης πάνω από 40 %.

6. Περιοχή θερμοκρασίας περιβάλλοντος: 0° C έως 60° C

7. Πρέπει να τοποθετηθεί μέσα στο περίβλημα σε ευδιάκριτο σημείο μετά το άνοιγμα μία πινακίδα με την ακόλουθη προειδοποίηση:
Προειδοποίηση
Το περίβλημα επιτρέπεται να ανοίγει μόνο για μικρό χρονικό διάστημα, π.χ. για τη διενέργεια οπτικής διάγνωσης. Μην κάνετε χρήση διακοπτών, μην τραβάτε ή εμβυσματώνετε δομικά συγκροτήματα και μη διαχωρίζετε ηλεκτροφόρους αγωγούς (εμβυσματώσιμες συνδέσεις).
Η προειδοποίηση αυτή δε χρειάζεται να ληφθεί υπ' όψιν, εάν είναι γνωστό ότι δεν υφίσταται ατμόσφαιρα παρουσιάζουσα κίνδυνο έκρηξης.

Κατάλογος των εγκεκριμένων δομικών συγκροτημάτων

Η λίστα με τα εγκριμένα δομικά συγκροτήματα υπάρχει στο διαδίκτυο:

http://www4.ad.siemens.de/view/cs/

με τον κωδικό συνδρομής 13702947

Power Supply Modules

2

Introduction

Various power supply modules are available to supply your S7-300 programmable controller and the sensors/actuators with 24 VDC.

Power supply modules

This chapter describes the technical specifications of the power supply modules of the S7-300 programmable controller.

In addition to the technical specifications, this chapter describes the following:

- The characteristics
- Connection Diagram
- Block Diagram
- Line protection
- Reaction to atypical operating conditions

In this chapter

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2.1 Power Supply Module PS 305; 2 A; (6ES7305-1BA80-0AA0)

Order number "SIMATIC Outdoor module"

6ES7305-1BA80-0AA0

Characteristics

The PS 305 power supply module (2 A) has the following salient features:

- Output current 2 A

- Output voltage 24 VDC; proof against short-circuit and open circuit

- Connection to DC power supply

  (rated input voltage 24/48/72/96/110 VDC)

- Reliable isolation to EN 60 950

- Can be used as load power supply

Terminal assignment of the PS 305; 2 A
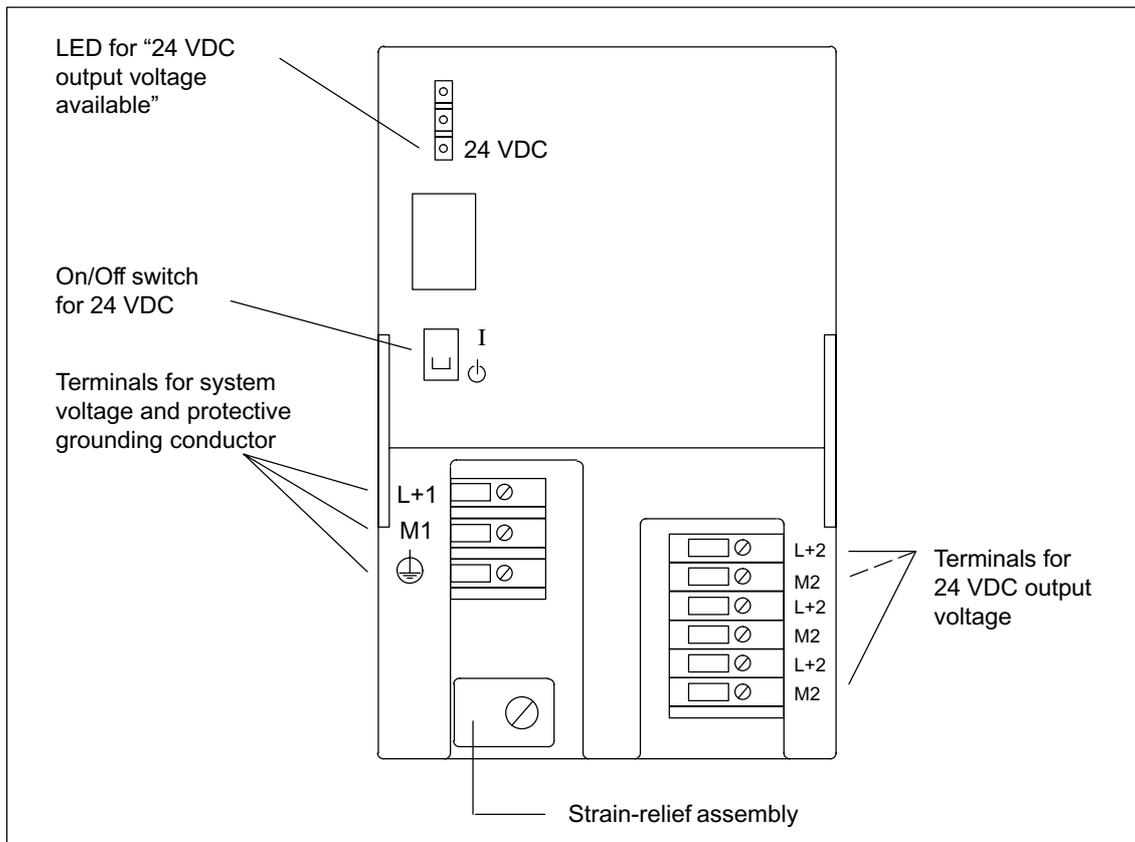
Figure 2-1   Wiring Schematic of the PS 305 Power Supply Module (2 A)

Technical specifications of the PS 305; 2 A (6ES7305-1BA80-0AA0)

Dimensions and Weight	
Dimensions W × H × D (in millimeters)	80 × 125 × 120
Weight	Approx. 740 g
Input Rating	
Input voltage	
• Rated value	24/48/72/96/110 VDC
• Voltage range	16.8 to 138 VDC
Rated input current	
• At 24 V	2.7 A
• At 48 V	1.3 A
• At 72 V	0.9 A
• At 96 V	0.65 A
• At 110 V	0.6 A
Inrush current (at 25 °C)	20 A
I^2t (at inrush current)	5 A^{2}s
Output Rating	
Output voltage	
• Rated value	24 VDC
• Permitted range	24 V ± 3 %, stable at no load
• Ramp-up time	max. 3 s
Output current	
• Rated value	2 A; [1]
	Can be connected in parallel
Short-circuit protection	Electronic, nonlatching, from 1.65 to 1.95 x I_N
Residual ripple	max. 150 mV$_{ss}$

Other Parameters	
Protection class according to IEC 536 (DIN VDE 0106, Part 1)	I, with protective grounding conductor
Insulation	
• Isolation voltage rating (24 V to input)	150 VAC
• Tested with	2800 VDC
Reliable isolation	SELV circuit
Buffering of supply failures (at 24/48/72/96/110 V)	> 10 ms
• Repeat rate	min. 1 s
Efficiency	75%
Power input	64 W
Power loss	16 W
Diagnostics	
LED for output voltage available	Yes, green LED

[1] With limited input voltage range > 24 V (24 to 138 VDC) the PS 305 can be loaded with 3 A.

Basic circuit diagram of the PS 305; 2 A

Figure 2-2   Basic Circuit Diagram of the PS 305 Power Supply Module (2 A)

Line protection

We recommend that you install a miniature circuit-breaker (MCB) (for example Siemens 5SN1 series) with the following rating to protect the incoming supply cable of the PS 305 power supply module (2 A):

- Rated current at 110 VDC: 10 A
- Tripping characteristic (type): C.

Reaction to atypical operating conditions

Table 2-1   Reaction of the PS 305 Power Supply Module (2 A) to Atypical Operating Conditions

If ...	... Then ...	24 VDC LED
... the output circuit is overloaded: • I > 3.9 A (dynamic) • 3 A < I ≤ 3.9 A (static)	Voltage dip, autom. volt. recovery Voltage drop, shortening of service life	Flashes
... the output is short-circuited	Output voltage 0 V; automatic voltage recovery after short circuit has been eliminated	Dark
An overvoltage occurs on the primary side	Possible destruction	-
There is an undervoltage on the primary side	Automatic disconnection; automatic voltage recovery	Dark

2.2 Power Supply Module PS 307; 2 A; (6ES7307-1BA00-0AA0)

Order number

6ES7307-1BA00-0AA0

Characteristics

The PS 307 power supply module (2 A) has the following salient features:

- Output current 2 A

- Output voltage 24 VDC; proof against short-circuit and open circuit

- Connection to single-phase AC system

  (input voltage 120/230 VAC, 50/60 Hz)

- Reliable isolation to EN 60 950

- Can be used as load power supply

Wiring schematic of the PS 307; 2 A
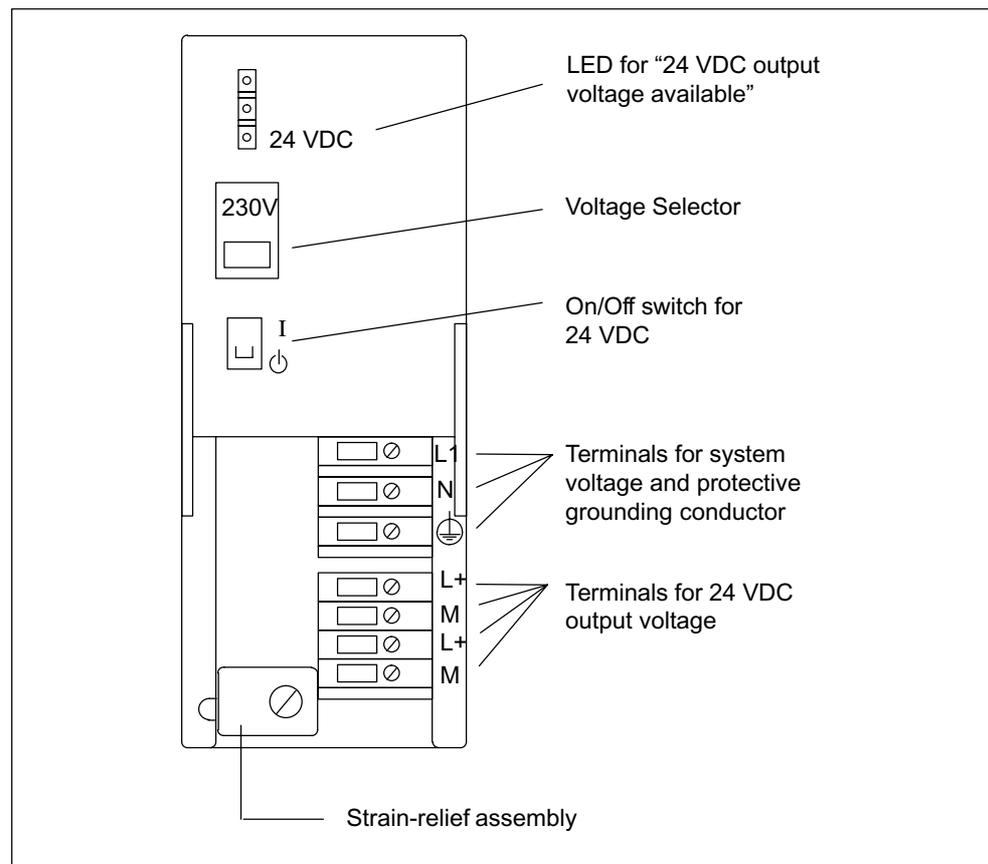
Figure 2-3   Wiring Schematic of the PS 307 Power Supply Module (2 A)

Basic circuit diagram of the PS 307; 2 A
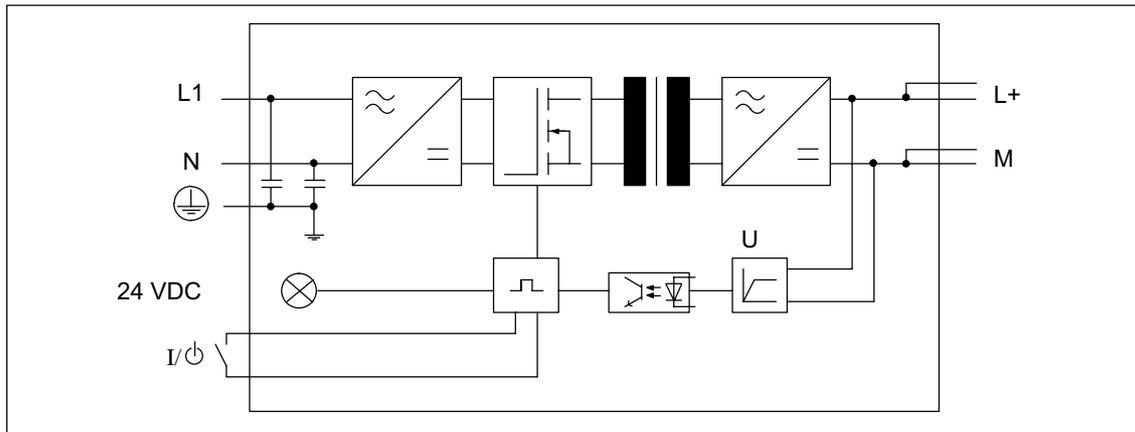
Figure 2-4   Basic Circuit Diagram of the PS 307 Power Supply Module (2 A)

Line protection

We recommend that you install a miniature circuit-breaker (MCB) (for example Siemens 5SN1 series) with the following rating to protect the incoming supply cable of the PS 307 power supply module (2 A):

- Rated current at 230 VAC: 6 A
- Tripping characteristic (type): C.

Reaction to atypical operating conditions

Table 2-2   Reaction of the PS 307 Power Supply Module (2 A) to Atypical Operating Conditions

If ...	... Then ...	24 VDC LED
... the output circuit is overloaded: • I > 2.6 A (dynamic) • 2 A < I ≤ 2.6 A (static)	Voltage dip, autom. volt. recovery Voltage drop, shortening of service life	Flashes
... the output is short-circuited	Output voltage 0 V; automatic voltage recovery after short circuit has been eliminated	Dark
An overvoltage occurs on the primary side	Possible destruction	-
There is an undervoltage on the primary side	Automatic disconnection; automatic voltage recovery	Dark

Technical specifications of the PS 307; 2 A (6ES7307-1BA00-0AA0)

Dimensions and Weight	
Dimensions W × H × D (in millimeters)	50 × 125 × 120
Weight	Approx. 420 g
Input Rating	
Input voltage	
● Rated value	120 / 230 VAC
System frequency	
● Rated value	50 Hz or 60 Hz
● Permitted range	47 Hz to 63 Hz
Rated input current	
● At 230 V	0.5 A
● At 120 V	0.8 A
Inrush current (at 25°C)	20 A
I^2t (at inrush current)	1 A^2s
Output Rating	
Output voltage	
● Rated value	24 VDC
● Permitted range	24 V ± 5 %, stable at no load
● Ramp-up time	max. 2.5 s
Output current	
● Rated value	2 A, Cannot be connected in parallel
Short-circuit protection	Electronic, nonlatching, 1.1 to 1.3 x I_N
Residual ripple	max. 150 mV_{ss}

Other Parameters	
Protection class according to IEC 536 (DIN VDE 0106, Part 1)	I, with protective grounding conductor
Insulation	
● Rated insulation level (24 V to L1)	250 VAC
● Tested with	2800 VDC
Reliable isolation	SELV circuit
Bridging of power failures (at 93 and/or 187 V)	min. 20 ms
● Repeat rate	min 1 s
Efficiency	83 %
Power input	58 W
Power loss	typ. 10 W
Diagnostics	
LED for output voltage available	Yes, green LED

2.3   Power Supply Module PS 307; 5 A; (6ES7307-1EAx0-0AA0)

Order number: "Standard module

6ES7307-1EA00-0AA0

Order number "SIMATIC Outdoor module"

6ES7307-1EA80-0AA0

Characteristics

The PS 307 power supply module (5 A) has the following salient features:

- Output current 5 A

- Output voltage 24 VDC; proof against short-circuit and open circuit

- Connection to single-phase AC system

  (input voltage 120/230 VAC, 50/60 Hz)

- Reliable isolation to EN 60 950

- Can be used as load power supply

Wiring schematic of the PS 307; 5 A
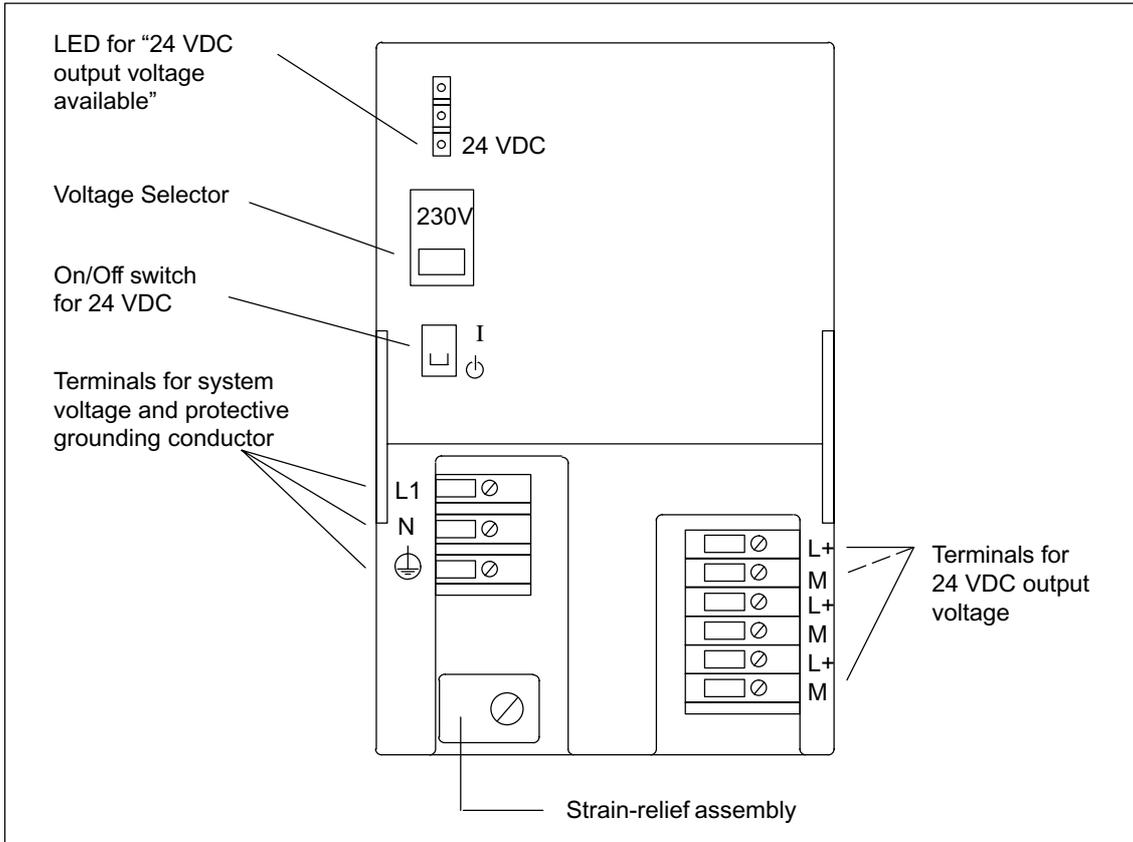
Figure 2-5   Wiring Schematic of the PS 307 Power Supply Module (5 A)

Basic circuit diagram of the PS 307; 5 A
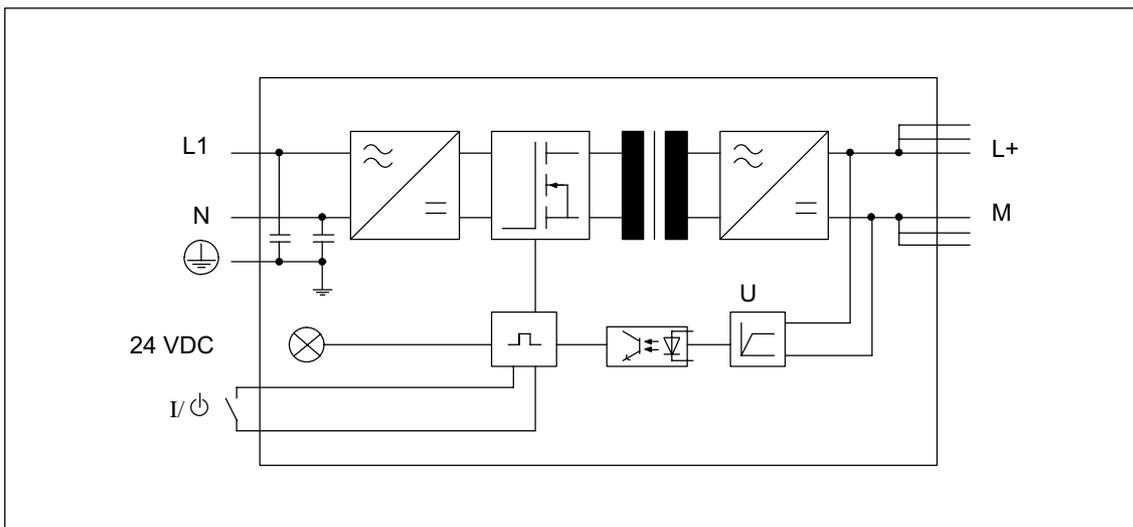
Figure 2-6   Basic Circuit Diagram of the PS 307 Power Supply Module (5 A)

Line protection

We recommend that you install a miniature circuit-breaker (MCB) (for example Siemens 5SN1 series) with the following rating to protect the incoming supply cable of the PS 307 power supply module (5 A):

- Rated current at 230 VAC: 10 A
- Tripping characteristic (type): C.

Reaction to atypical operating conditions

Table 2-3   Reaction of the PS 307 Power Supply Module (5 A) to Atypical Operating Conditions

If ...	... Then ...	24 VDC LED
... the output circuit is overloaded: • I > 6.5 A (dynamic) • 5 A < I ≤ 6.5 A (static)	Voltage dip, autom. volt. recovery Voltage drop, shortening of service life	Flashes
... the output is short-circuited	Output voltage 0 V; automatic voltage recovery after short circuit has been eliminated	Dark
An overvoltage occurs on the primary side	Possible destruction	–
There is an undervoltage on the primary side	Automatic disconnection; automatic voltage recovery	Dark

Technical specifications of the PS 307; 5 A (6ES7307-1EA00-0AA0)

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	80 x 125 x 120
Weight	Approx. 740 g
Input Rating	
Input voltage	
• Rated value	120 / 230 VAC
System frequency	
• Rated value	50 Hz or 60 Hz
• Permitted range	47 Hz to 63 Hz
Rated input current	
• At 120 V	2 A
• At 230 V	1 A
Inrush current (at 25 °C)	45 A
I^2t (at inrush current)	1.2 A^2s
Output Rating	
Output voltage	
• Rated value	24 VDC
• Permitted range	24 V $\pm$ 5 %, stable at no load
• Ramp-up time	max. 2.5 s
Output current	
• Rated value	5 A
	Cannot be connected in parallel
Short-circuit protection	Electronic, nonlatching, from 1.1 to 1.3 x I_N
Residual ripple	max. 150 mV$_{ss}$

Other Parameters	
Protection class according to IEC 536 (DIN VDE 0106, Part 1)	I, with protective grounding conductor
Insulation	
• Rated insulation level (24 V to L1)	250 VAC
• Tested with	2800 VDC
Reliable isolation	SELV circuit
Bridging of power failures (at 93 and/or 187 V)	min. 20 ms
• Repeat rate	min 1 s
Efficiency	87 %
Power input	138 W
Power loss	typ. 18 W
Diagnostics	
LED for output voltage available	Yes, green LED

Technical specifications of the PS 307; 5 A (6ES7307-1EA80-0AA0)

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	80 x 125 x 120
Weight	Approx. 570 g
Input Rating	
Input voltage	
• Rated value	120/230 VDC
System frequency	
• Rated value	50 Hz or 60 Hz
• Permitted range	47 Hz to 63 Hz
Rated input current	
• At 120 V	2.1 A
• At 230 V	1.2 A
Inrush current (at 25 °C)	45 A
I^2t (at inrush current)	1.8 A^2s
Output Rating	
Output voltage	
• Rated value	24 VDC
• Permitted range	24 V $\pm$ 3 %
• Ramp-up time	max. 3 s
Output current	
• Rated value	5 A; cannot be connected in parallel
Short-circuit protection	Electronic, nonlatching, from 1.1 to 1.3 x I_N
Residual ripple	max. 150 mV_{ss}

Other Parameters	
Protection class according to IEC 536 (DIN VDE 0106, Part 1)	I, with protective grounding conductor
Insulation	
• Rated insulation level (24 V to L1)	250 VAC
• Tested with	2800 VDC
Reliable isolation	SELV circuit
Bridging of power failures (at 93 and/or 187 V)	min. 20 ms
• Repeat rate	min. 1 s
Efficiency	84%
Power input	143 W
Power loss	23 W
Diagnostics	
LED for output voltage available	Yes, green LED

2.4 Power Supply Module PS 307; 10 A; (6ES7307-1KA00-0AA0)

Order number

6ES7307-1KA00-0AA0

Characteristics

The PS 307 power supply module (10 A) has the following salient features:

- Output current 10 A
- Output voltage 24 VDC; proof against short-circuit and open circuit
- Connection to single-phase AC system

  (input voltage 120/230 VAC, 50/60 Hz)
- Reliable isolation to EN 60 950
- Can be used as load power supply

Wiring schematic of the PS 307; 10 A
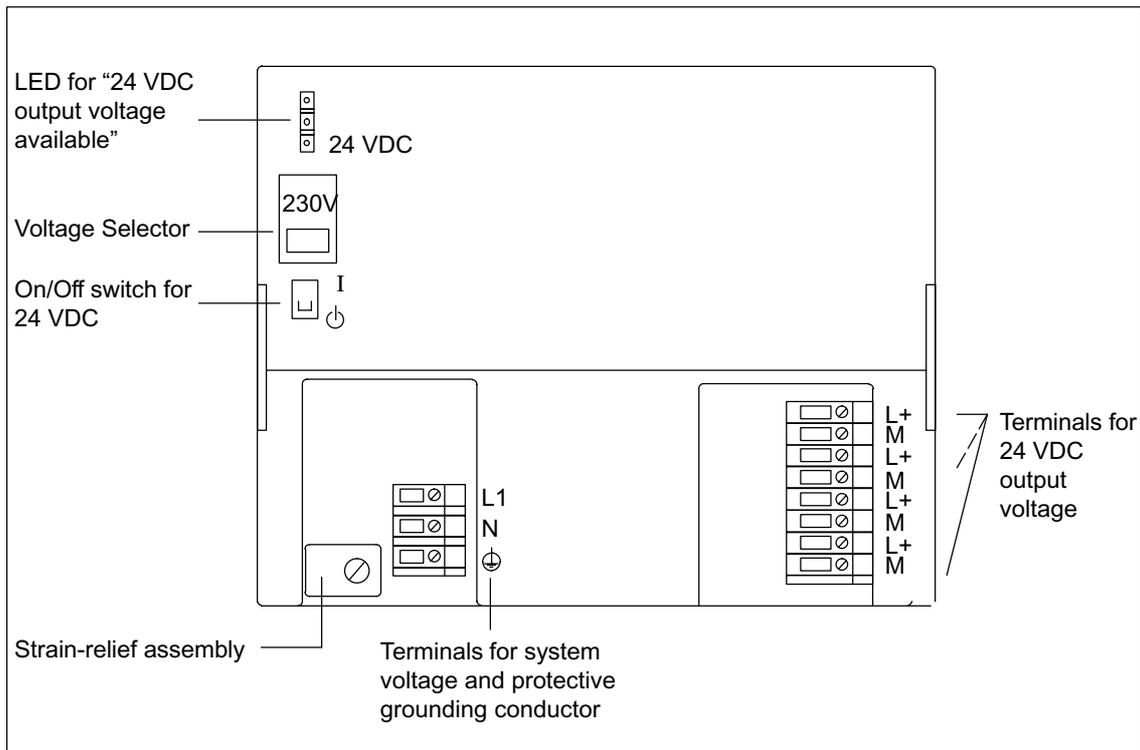
Figure 2-7   Wiring Schematic of the PS 307 Power Supply Module (10 A)

Basic circuit diagram of the PS 307; 10 A
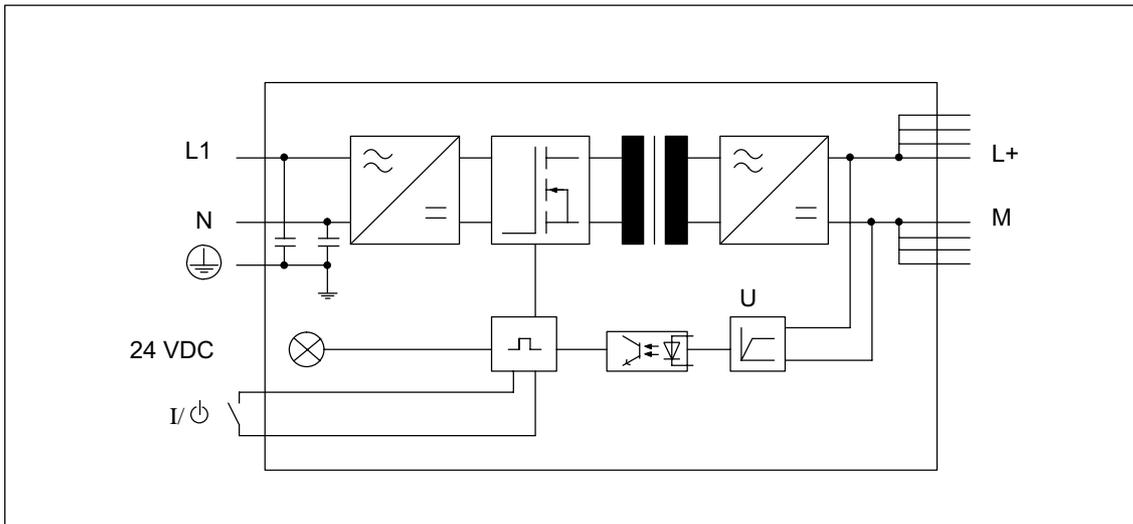
Figure 2-8   Basic Circuit Diagram of the PS 307 Power Supply Module (10 A)

Line protection

We recommend that you install a miniature circuit-breaker (MCB) (for example, Siemens 5SN1 series) with the following rating to protect the incoming supply cable of the PS 307 power supply module (10 A):

- Rated current at 230 VAC: 16 A

- Tripping characteristic (type): C.

Reaction to atypical operating conditions

Table 2-4   Reaction of the PS 307 Power Supply Module (10 A) to Atypical Operating Conditions

If ...	Reaction of the module	24 VDC LED
... the output circuit is overloaded: • I > 13 A (dynamic) • 10 A < I ≤ 13 A (static)	Voltage dip, autom. volt. recovery Voltage drop, shortening of service life	Flashes
... the output is short-circuited	Output voltage 0 V; automatic voltage recovery after short circuit has been eliminated	Dark
An overvoltage occurs on the primary side	Possible destruction	–
There is an undervoltage on the primary side	Automatic disconnection; automatic voltage recovery	Dark

Technical specifications of the PS 307; 10 A (6ES7307-1KA00-0AA0)

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	200 x 125 x 120
Weight	1.2 kg
Input Rating	
Input voltage	
● Rated value	120 / 230 VAC
System frequency	
● Rated value	50 Hz or 60 Hz
● Permitted range	47 Hz to 63 Hz
Rated input current	
● At 230 V	1.7 A
● At 120 V	3.5 A
Inrush current (at 25 °C)	55 A
I^2t (at inrush current)	9 A^2s
Output Rating	
Output voltage	
● Rated value	24 VDC
● Permitted range	24 V ± 5 %, stable at no load
● Ramp-up time	max. 2.5 s
Output current	
● Rated value	10 A, Cannot be connected in parallel
Short-circuit protection	Electronic, nonlatching, from 1.1 to 1.3 x I_N
Residual ripple	max. 150 mV_{ss}

Other Parameters	
Protection class according to IEC 536 (DIN VDE 0106, Part 1)	I, with protective grounding conductor
Insulation	
● Rated insulation level (24 V to L1)	250 VAC
● Tested with	2800 VDC
Reliable isolation	SELV circuit
Bridging of power failures (at 93 and/or 187 V)	min. 20 ms
● Repeat rate	min 1 s
Efficiency	89 %
Power input	270 W
Power loss	typ. 30 W
Diagnostics	
LED for output voltage available	Yes, green LED

Digital Modules

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3

</div>

Structure of the chapter

The present chapter is broken down into the following subjects:

1. Chapter overview of which modules are available and described here

2. Module overview on the most important properties of the modules

3. Sequence of steps from choosing to commissioning the digital module

4. Information that is generally valid – in other words, relating to all digital modules (for example, parameter assignment and diagnostics)

5. Information that refers to specific modules (for example, characteristics, diagram of connections and block diagram, technical specifications and special characteristics of the module):

   a) for digital input modules

   b) for digital output modules

   c) for relay output modules

   d) for digital input/output modules

Additional information

Appendix A describes the structure of the parameter sets (data records 0, 1 and 128) in the system data. You must be familiar with this configuration if you want to modify the parameters of the modules in the *STEP 7* user program.

Appendix B describes the structure of the diagnostic data (data records 0 and 1) in the system data. You must be familiar with this configuration if you want to evaluate the diagnostic data of the modules in the *STEP 7* user program.

In this chapter

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3.25	Digital Input module SM 322; DO 8 x VAC 120/230/2 A; (6ES7322-1FF01-0AA0)	3-84
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3.27	Relay Output Module SM 322; DO 16 x Rel. 120/230 VAC; (6ES7322-1HH01-0AA0)	3-93
3.28	Relay Output Module SM 322; DO 8 x Rel. 230 VAC; (6ES7322-1HF01-0AA0)	3-96
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3.31	Digital Input/Output Module SM 323; DI 16/DO16 x 24 VDC/0.5 A; (6ES7323-1BL00-0AA0)	3-110
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3.1 Module Overview

Introduction

The following tables summarize the most important characteristics of the digital modules. This overview is intended to make it easy to choose the suitable module for your task.

Table 3-1   Digital Input Modules: Characteristics at a Glance

Module Char- acter- istics	SM 321; DI 32 x 24 VDC (-1BL00-)	SM 321; DI 32 x 120 VAC (-1EL00-)	SM 321; DI 16 x 24 VDC (-1BH02-)	SM 321; DI 16 x 24 VDC High Speed (-1BH10-)	SM 321; DI 16 x 24 VDC with hardware and diagnostic interrupts (-7BH01-)	SM 321; DI 16 x 24 VDC; source input (-1BH50-)
Number of inputs	32 DI; isolated in groups of 16	32 DI; isolated in groups of 8	16 DI; isolated in groups of 16	16 DI; isolated in groups of 16	16 DI; isolated in groups of 16	16 DI, source input, isolated in groups of 16
Rated input voltage	24 VDC	120 VAC	24 VDC	24 VDC	24 VDC	24 VDC
Suitable for...	Switches; two, three, and four-wire proximity switches (BEROs)					
Supports clocked operation	No	No	No	Yes	Yes	No
Programmable diagnostics	No	No	No	No	Yes	No
Diagnostic interrupt	No	No	No	No	Yes	No
Hardware interrupt upon edge change	No	No	No	No	Yes	No
Settable input delays	No	No	No	No	Yes	No
Special Features	–	–	–	-	2 short-circuit-pro of sensor supplies for 8 channels each External redundant power supply possible to supply sensors	–

Table 3-2   Digital Input Modules: Characteristics at a glance (continued)

Module Char- acter- istics	SM 321; DI 16 x UC 24/48V (-1CH00-)	SM 321; DI 16 x 48-125 VDC (-1CH20-)	SM 321; DI 16 x 120/230 VAC (-1FH00-)	SM 321; DI 8 x 120/230 VAC (-1FF01-)	SM 321; DI 8 x 120/230 VAC ISOL (-1FF10-)
Number of inputs	16 DI; isolated in groups of 1	16 DI; isolated in groups of 8	16 DI; isolated in groups of 4	8 DI, isolated in groups of 2	8 DI; isolated in groups of 1
Rated input voltage	24 to 48 VDC, 24 to 48 VAC	48 to 125 VDC	120/230 VAC	120/230 VAC	120/230 VAC
Suitable for...	Switches; two, three, and four-wire proximity switches (BEROs)		Switches; two and three-wire AC proximity switches		
Supports clocked operation	No	No	No	No	No
Programmable diagnostics	No	No	No	No	No
Diagnostic interrupt	No	No	No	No	No
Hardware interrupt upon edge change	No	No	No	No	No
Settable input delays	No	No	No	No	No
Special Features		–		–	

Table 3-3   Digital Output Modules: Characteristics at a Glance

Module Char- acter- istics	SM 322; DO 32 x 24 VDC 0.5 A (-1BL00-)	SM 322; DO 32 x VAC 120/230/ 1 A (-1FL00-)	SM 322; DO 16 x 24 VDC/ 0.5 A (-1BH01-)	SM 322; DO 16 x 24 VDC/ 0.5 A High Speed (-1BH10-)	SM 322; DO 16 x 24/48 VUC (-5GH00-)	SM 322; DO 16 x 120/230 VDC/ 1 A (-1FH00-)
Number of outputs	32 DO; isolated in groups of 8	32 DO; isolated in groups of 8	16 DO; isolated in groups of 8	16 DO; isolated in groups of 8	16 DO; isolated in groups of 1	16 DO; isolated in groups of 8
Output current	0.5 A	1.0 A	0.5 A	0.5 A	0.5 A	0.5 A
Rated load voltage	24 VDC	120 VAC	24 VDC	24 VDC	24 to 48 VDC, 24 to 48 VAC	120/230 VAC
Suitable for...	Solenoid valves, DC contactors and indicator lights					
Supports clocked operation	No	No	No	Yes	No	No
Programmable diagnostics	No	No	No	No	Yes	No
Diagnostic interrupt	No	No	No	No	Yes	No
Substitute value output	No	No	No	No	Yes	No
Special Features	–					

Table 3-4   Digital Output Modules: Characteristics at a glance (continued)

Module Char- acter- istics	SM 322; DO 8 x 24VDC/ 2 A (-1BF01-)	SM 322; DO 8 x 24 VDC/0.5 A with diagnostic interrupt (-8BF00-)	SM 322; DO 8 x 48-125 VDC/ 1.5 A (-1CF00-)	SM 322; DO8 x 120/ 230 VAC/2A (-1FF01-)	SM 322; DO8 x 120/ 230 VAC/ 2A ISOL (-5FF00-)
Number of outputs	8 DO; isolated in groups of 4	8 DO; isolated in groups of 8	8 DO; isolated and reverse polarity protection, in groups of 4	8 DO; isolated in groups of 4	8 DO; isolated in groups of 1
Output current	2 A	0.5 A	1.5 A	2 A	2 A
Rated load voltage	24 VDC	24 VDC	48 to 125 VDC	120/230 VAC	120/230 VAC
Suitable for...	Solenoid valves, DC contactors and indicator lights			AC solenoid valves, contactors, motor starters, fractional h.p. motors and indicator lights.	
Supports clocked operation	No	No	No	No	No
Programmable diagnostics	No	Yes	No	No	Yes
Diagnostic interrupt	No	Yes	No	No	Yes
Substitute value output	No	Yes	No	No	Yes
Special Features	–	Redundant driving of a load possible	–	Fuse blown display. Replaceable fuse for each group	-

Table 3-5   Relay Output Modules: Characteristics at a Glance

Module / Characteristics	SM 322; DO 16 x Rel. 120 VAC (-1HH01-)	SM 322; DO 8 x Rel. 230 VAC (-1HF01-)	SM 322; DO 8 x Rel. 230 VAC/ 5 A (-5HF00-)	SM 322; DO 8 x Rel. 230 VAC/ 5 A (-1HF10-)
Number of outputs	16 outputs, isolated in groups of 8	8 outputs, isolated in groups of 2	8 outputs, isolated in groups of 1	8 outputs, isolated in groups of 1
Rated load voltage	24 to 120 VDC, 48 to 230 VAC	24 to 120 VDC, 48 to 230 VAC	24 to 120 VDC, 24 to 230 VAC	24 to 120 VDC, 48 to 230 VAC
Suitable for...	AC/DC solenoid valves, contactors, motor starters, fractional horsepower motors and indicator lights			
Supports clocked operation	No	No	No	No
Programmable diagnostics	No	No	Yes	No
Diagnostic interrupt	No	No	Yes	No
Substitute value output	No	No	Yes	No
Special Features	–			

Table 3-6   Digital Input/Output Modules: Characteristics at a Glance

Module Char- acter- istics	SM 323; DI 16/DO 16x24 VDC/ 0.5 A (-1BL00-)	SM 323; DI 8/DO 8x 24 VDC/0.5 A (-1BH01-)	SM 327; DI 8/DX 8x DC 24 V/0.5 A, parameterizable (-1BH00-)
Number of inputs	16 inputs, isolated in groups of 16	8 inputs, isolated in groups of 8	8 digital inputs and 8 individually parameterizable inputs or outputs, isolated in groups of 16
Number of outputs	16 outputs, isolated in groups of 8	8 outputs, isolated in groups of 8	
Rated input voltage	24 VDC	24 VDC	24 VDC
Output current	0.5 A	0.5 A	0.5 A
Rated load voltage	24 VDC	24 VDC	24 VDC
Inputs suitable for...	Switches and two, three and four-wire proximity switches (BEROs).		
Outputs suitable for...	Solenoid valves, DC contactors and indicator lights		
Supports clocked operation	No	No	No
Programmable diagnostics	No	No	No
Diagnostic interrupt	No	No	No
Hardware interrupt upon edge change	No	No	No
Settable input delay	No	No	No
Substitute value output	No	No	No
Special Features	–		

3.2 Sequence of Steps from Choosing to Commissioning the Digital Module

Introduction

The following table contains the tasks that you have to perform one after the other to commission digital modules successfully.

The sequence of steps is a suggestion, but you can perform individual steps either earlier or later (for example, assign parameters to the module) or install other modules or install, commission etc. other modules in between times.

Sequence of steps

Table 3-7   Sequence of Steps from Choosing to Commissioning the Digital Module

Step	Procedure	Refer To...
1.	Select the module	Section 3.1 and specific module section from Section 3.5
2.	Install the module in the SIMATIC S7 network	"Mounting" section in the Installation Manual for the programmable logic controller being used: • S7-300 Programmable Controllers, Hardware and Installation or S7-400, M7-400 Programmable Controllers, Hardware and Installation or • ET 200M Distributed I/O Device
3.	Assign parameters to module	Section 3.3
4.	Commission configuration	"Commissioning" section in the Installation Manual for the programmable controller being used: • S7-300 Programmable Controllers, Hardware and Installation or S7-400, M7-400 Programmable Controllers, Hardware and Installation or • ET 200M Distributed I/O Device
5.	If commissioning was not successful, diagnose configuration	Section 3.4

3.3 Digital Module Parameter Assignment

Introduction

Digital modules can have different characteristics. You can set the characteristics of dome modules by means of parameter assignment.

The information contained in this section refers only to the programmable digital modules:

- Digital input module SM 321; DI 16 x DC 24 V with process and diagnosis alarm, synchronous; (6ES7321-7BH01-0AB0)

- Digital input module SM 322; DO 8 x VDC 24/0.5 A with diagnostic interrupt (6ES7322-8BF00-0AB0)

- Digital output module SM 322; DO 8 x 120/230 VAC /2A ISOL (6ES7322-5FF00-0AB0)

- Relay output module SM 322; DO 8 x Rel. 230 VAC /5A (6ES7322-5HF00-0AB0)

- Digital Input/Output Module SM 327; DI 8/DX 8 x VDC 24/0.5 A (6ES7327-1BH00-0AB0)

Tools for parameter assignment

You assign parameters to digital modules in *STEP 7*. You must perform parameter assignment in STOP mode of the CPU.

When you have set all the parameters, download the parameters from the programming device to the CPU. On a transition from STOP → to RUN mode, the CPU then transfers the parameters to the individual digital modules.

Static and dynamic parameters

The parameters are divided into static and dynamic parameters.

Set the static parameters in STOP mode of the CPU, as described above.

You can also change the dynamic parameters in the running user program in an S7 logic control using SFC. Note, however, that after a change from RUN → STOP, STOP → RUN of the CPU, the parameters set in *STEP 7* apply again. You will find a description of the parameter assignment of modules in the user program in Appendix A.

Parameter	Settable with	CPU Operating State
Static	PG (STEP 7 HW CONFIG)	STOP
Dynamic	PG (STEP 7 HW CONFIG)	STOP
	SFC 55 in the user program	RUN

Parameters of the digital modules

The settable parameters are listed in the special section on the module.

3.4 Diagnostics of the Digital Modules

Introduction

The information contained in this section refers only to the digital modules with diagnostics capability. For the S7-300, these modules are as follows:

- Digital input module SM 321; DI 16 x DC 24 V with hardware and diagnostic interrupts, clocked; (6ES7321-7BH01-0AB0)

- Digital Output Module SM 322; DO 16 x 24/48 VUC (6ES7322-5GH00-0AB0)

- Digital Output Module SM 322; DO 8 x DC 24 V/0.5 A with diagnostic interrupt (6ES7322-8BF00-0AB0)

- Digital output module SM 322; DO 8 x 120/230 VAC /2A ISOL (6ES7322-5FF00-0AB0)

- Relay output module SM 322; DO 8 x Rel. 230 VAC /5A (6ES7322-5HF00-0AB0)

Programmable and non-programmable diagnostic messages

In diagnostics, we make a distinction between programmable and non-programmable diagnostic messages.

You obtain programmable diagnostic messages only if you have enabled diagnostics by parameter assignment. You perform parameter assignment in the "Diagnostics" parameter field in *STEP 7*.

Non-programmable diagnostic messages are always made available by the digital module irrespective of diagnostics being enabled.

Actions following diagnostic message in *STEP 7*

Each diagnostic message leads to the following actions:

- The diagnostic message is entered in the diagnosis of the digital module and forwarded to the CPU.

- The SF LED on the digital module lights.

- If you have programmed "Enable Diagnostic Interrupt" in STEP 7, a diagnostic interrupt is triggered and OB 82 is called.

Reading out diagnostic messages

You can read out detailed diagnostic messages by means of SFCs in the user program (refer to the Appendix "Diagnostic Data of Signal Modules").

You can view the cause of the error in *STEP 7*, in the module diagnosis (refer to online Help for *STEP 7*).

Diagnostic message by means of SF LED

The digital modules with diagnostics capability indicate errors for you by means of their SF LED (group error LED). The SF LED lights as soon as a diagnostic message is triggered by the digital module. It goes out when all errors have been rectified.

The group fault (SF) LED also lights up in case of external errors (short circuit of sensor supply), independent of the operating status of the CPU (if power is on).

Diagnostic messages interrupt processing by the digital modules

You will find the diagnostic messages with their possible causes and remedial action, together with a description of possible interrupts in the specific section on the module.

3.5 Digital Input Module SM 321; DI 32 x VDC 24; (6ES7321-1BL00-0AA0)

Order number: "Standard module"

6ES7321-1BL00-0AA0

Order number: SIPLUS S7-300 Module

6AG1321-1BL00-2AA0

Characteristics

The digital input module SM 321; DI 32 x 24 VDC has the following salient features:

- 32 inputs, isolated in groups of 16
- 24 VDC rated input voltage
- Suitable for switches and two / three / four-wire BEROs (proximity switches).

Terminal assignment and block diagram of the SM 321; DI 32 x 24 VDC
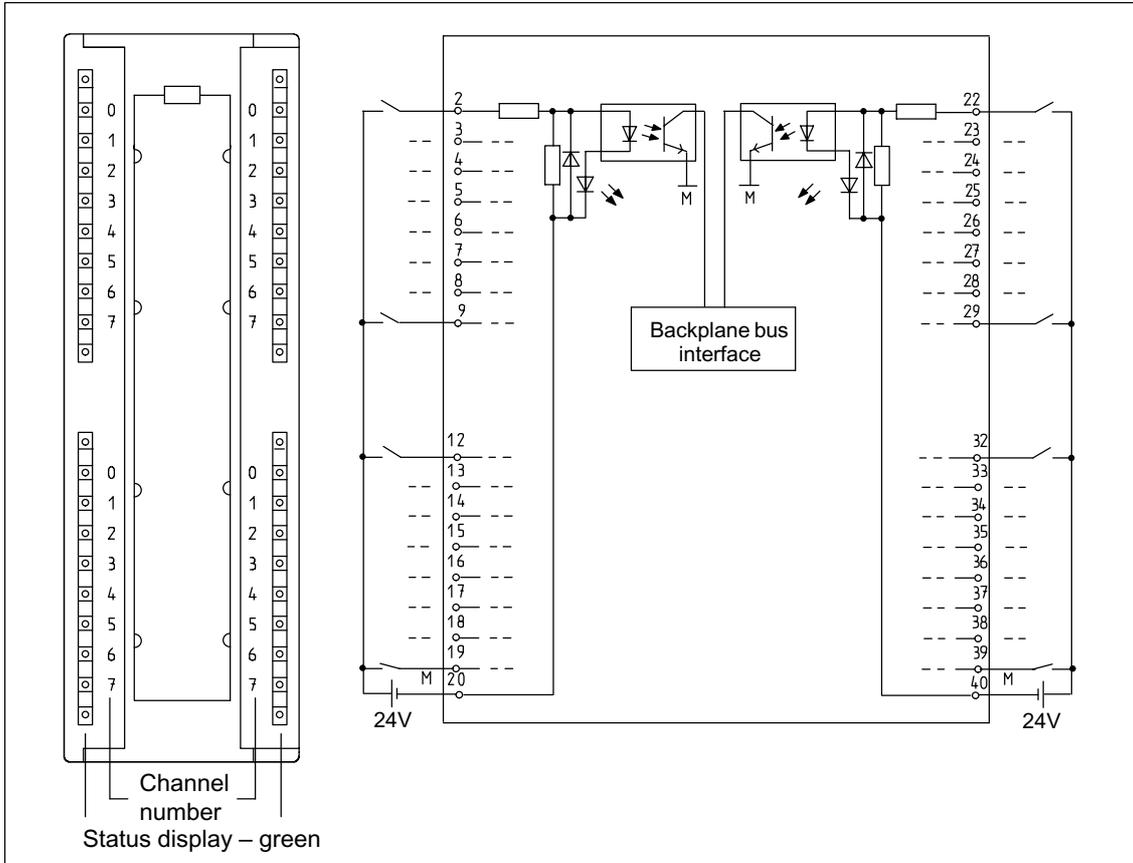
Figure 3-1   Module View and Block Diagram of the Digital Input Module SM 321; DI 32 x 24 VDC

Terminal assignment of the SM 321; DI 32 x 24 VDC

The following figure shows the assignment of the channels to the addresses.
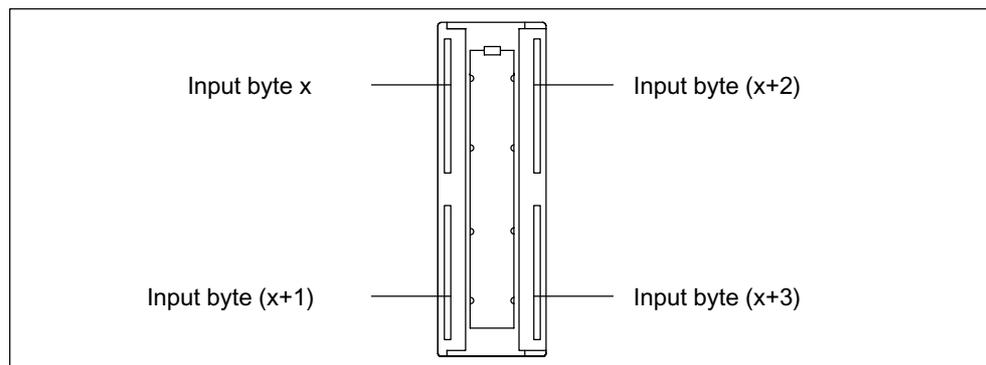
Figure 3-2   Terminal assignment of the SM 321; DI 32 x 24 VDC

Technical specifications of the SM 321; DI 32 x 24 VDC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 120
Weight	Approx. 260 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	32
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Number of inputs that can be triggered simultaneously	
• Horizontal configuration	
Up to 40 °C	32
Up to 60 °C	16
• Vertical configuration	
Up to 40 °C	32
Isolation	
• Between channels and backplane bus	Yes
• Between the channels In groups of	Yes 16
Permitted potential difference	
• Between the different circuits	75 VDC / 60 VAC

Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 15 mA
Power dissipation of the module	typ. 6.5 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None
Data for Selecting a Sensor	
Input voltage	
• Rated value	24 VDC
• For signal "1"	13 to 30 V
• For signal "0"	–30 to + 5 V
Input current	
• At signal "1"	typ. 7 mA
Input delay	
• At "0" to "1"	1.2 to 4.8 ms
• At "1" to "0"	1.2 to 4.8 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
• Permitted bias current	max. 1.5 mA

3.6 Digital Input Module SM 321; DI 32 x 120 VAC; (6ES7321-1EL00-0AA0)

Order number

6ES7321-1EL00-0AA0

Characteristics

The SM 321; DI 32 x 20 VAC features the following characteristics:

- 32 inputs, isolated in groups of 8
- 120 VAC rated input voltage
- Suitable for switches and two / three-wire AC proximity switches

Terminal assignment and block diagram of the SM 321; DI 32 x 120 VAC

Figure 3-3   ModuleView and Block Diagram of Digital Input Module SM 321; DI 32 x 20 VAC

Technical specifications of the SM 321; DI 32 x 120 VAC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 300 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	32
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Number of inputs that can be triggered simultaneously	
• Horizontal configuration	
Up to 40 °C	32
Up to 60 °C	24
• Vertical configuration	
Up to 40 °C	32
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	8
Permitted potential difference	
• Between $M_{internal}$ and the inputs	120 VAC
• Between the inputs of the different groups	250 VAC
Insulation tested with	2500 VDC
Current consumption	
• From the backplane bus	max. 16 mA
Power dissipation of the module	typ. 4 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None
Data for Selecting a Sensor	
Input voltage	
• Rated value	120 VAC
• For "1" signal	74 to 132 V
• For "0" signal	0 to 20 V
• Frequency range	47 to 63 Hz
Input current	
• At "1" signal	typ. 21 mA
Input delay	
• From "0" to "1"	max. 15 ms
• From "1" to "0"	max. 25 ms
Input characteristic curve	According to IEC 61131, type 2
Connection of Two-Wire BEROs	Possible
• Permitted bias current	max. 4 A

3.7 Digital Input Module SM 321; DI 16 x VDC 24; (6ES7321-1BH02-0AA0)

Order number: "Standard module"

6ES7321-1BH02-0AA0

Order number: SIPLUS S7-300 module

6AG1321-1BH02-2AA0

Characteristics

The digital input module SM 321; DI 16 x 24 VDC has the following salient features:

- 16 inputs, isolated in groups of 16
- 24 VDC rated input voltage
- Suitable for switches and two / three / four-wire BEROs (proximity switches).

Terminal assignment and block diagram of the SM 321; DI 16 x 24 VDC

Figure 3-4   Module View and Block Diagram of Digital Input Module SM 321; DI 16 x 24VDC

Technical specifications of the SM 321; DI 16 x 24 VDC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 200 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	16
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Number of inputs that can be triggered simultaneously	
• Horizontal configuration	
Up to 60 °C	16
• Vertical configuration	
Up to 40 °C	16
Isolation	
• Between channels and backplane bus	Yes
Permitted potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 10 mA
Power dissipation of the module	typ. 3.5 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting a Sensor	
Input voltage	
• Rated value	24 VDC
• For signal "1"	13 to 30 V
• For signal "0"	–30 to + 5 V
Input current	
• At signal "1"	typ. 7 mA
Input delay	
• At "0" to "1"	1.2 to 4.8 ms
• At "1" to "0"	1.2 to 4.8 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
• Permitted bias current	max. 1.5 mA

3.8 Digital Input Module SM 321; DI 16 x 24 VDC High Speed; (6ES7321-1BH10-0AA0)

Order number:

6ES7321-1BH10-0AA0

Characteristics

The SM 321; DI 16 x 24 VDC High Speed has the following salient features:

- 16 inputs, isolated in groups of 16
- 24 VDC rated input voltage
- Suitable for switches and two / three / four-wire BEROs (proximity switches).
- Supports clocked operation

Terminal assignment and block diagram of the SM 321; DI 16 x 24 VDC High Speed
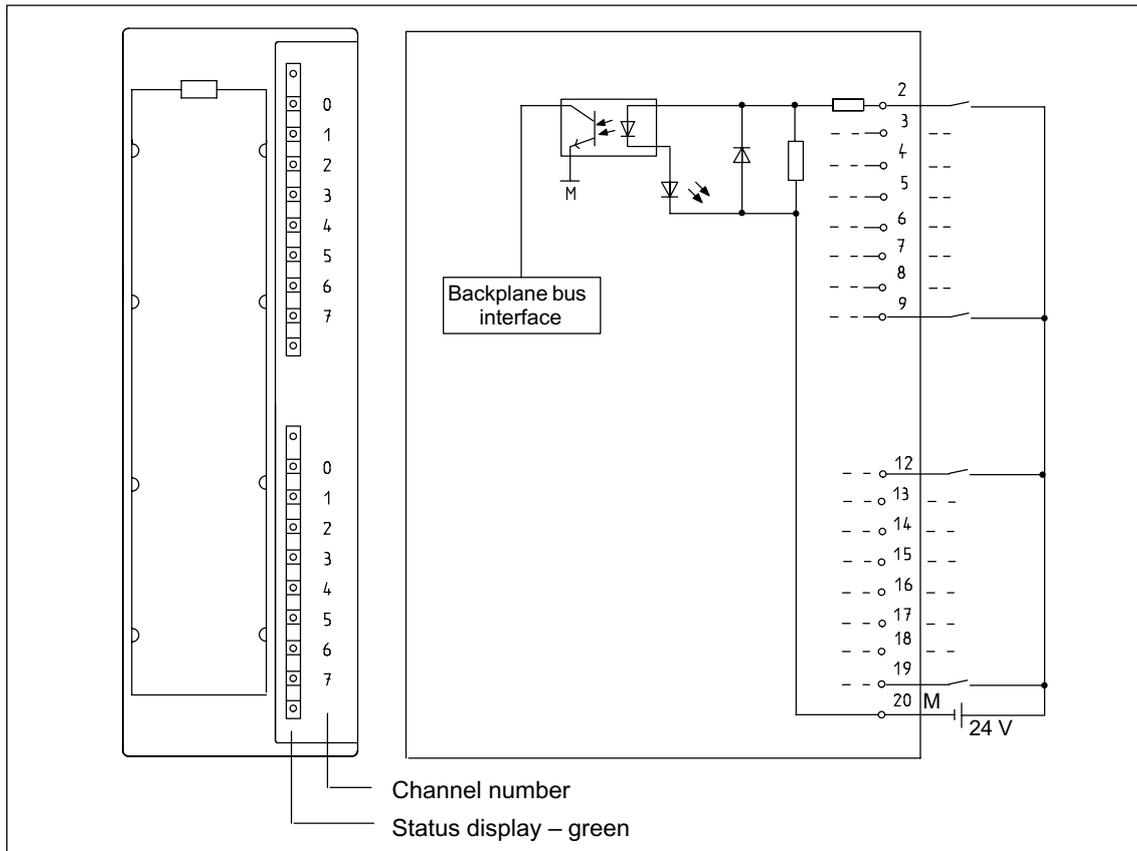
Figure 3-5   Module view and block diagram of the SM 321; DI 16 x 24VDC High Speed

Technical specifications of the SM 321; DI 16 x 24 VDC High Speed

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 200 g

Data for Specific Module	
Supports clocked operation	Yes
Number of inputs	16
Length of cable	
● Unshielded	max. 600 m
● Shielded	max. 1000 m

Voltages, Currents, Potentials	
Number of inputs that can be triggered simultaneously	
● Horizontal configuration	
Up to 60 °C	16
● Vertical configuration	
Up to 40 °C	16
Isolation	
● Between channels and backplane bus	Yes
Permitted potential difference	
● Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
● From the backplane bus	max. 110 mA
Power dissipation of the module	typ. 3.8 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting a Sensor	
Input voltage	
● Rated value	24 VDC
● For signal "1"	13 to 30 V
● For signal "0"	–30 to + 5 V
Input current	
● At signal "1"	typ. 7 mA
Input delay	
● At "0" to "1"	25 to 75 µs
● At "1" to "0"	25 to 75 µs
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
● Permitted bias current	max. 1.5 mA

3.9 Digital input module SM 321; DI 16 x DC 24 V; with Hardware and Diagnostic Interrupts, clocked; (6ES7321-7BH01-0AB0)

Order number: "Standard module"

6ES7321-7BH01-0AB0

Order number: SIPLUS S7-300 module

6AG1321-7BH01-2AB0

Characteristics

The SM 321; DI 16 x 24 VDC; with hardware and diagnostic interrupts features the following characteristics:

- 16 inputs, isolated in groups of 16
- 24 VDC rated input voltage
- Input characteristic curve according to IEC 61131, Type 2
- Suitable for switches and two / three / four-wire BEROs (proximity switches).
- 2 short-circuit-proof sensor supplies for 8 channels each
- External redundant power supply possible to supply sensors
- "Sensor supply (Vs)" status display
- Group error display
- Supports clocked operation
- Supports the "parameter changing during the RUN" function
- Programmable diagnostics
- Programmable diagnostic interrupt
- Programmable hardware interrupt
- Programmable input delays

Terminal assignment and block diagram of the SM 321; DI 16 x 24 VDC
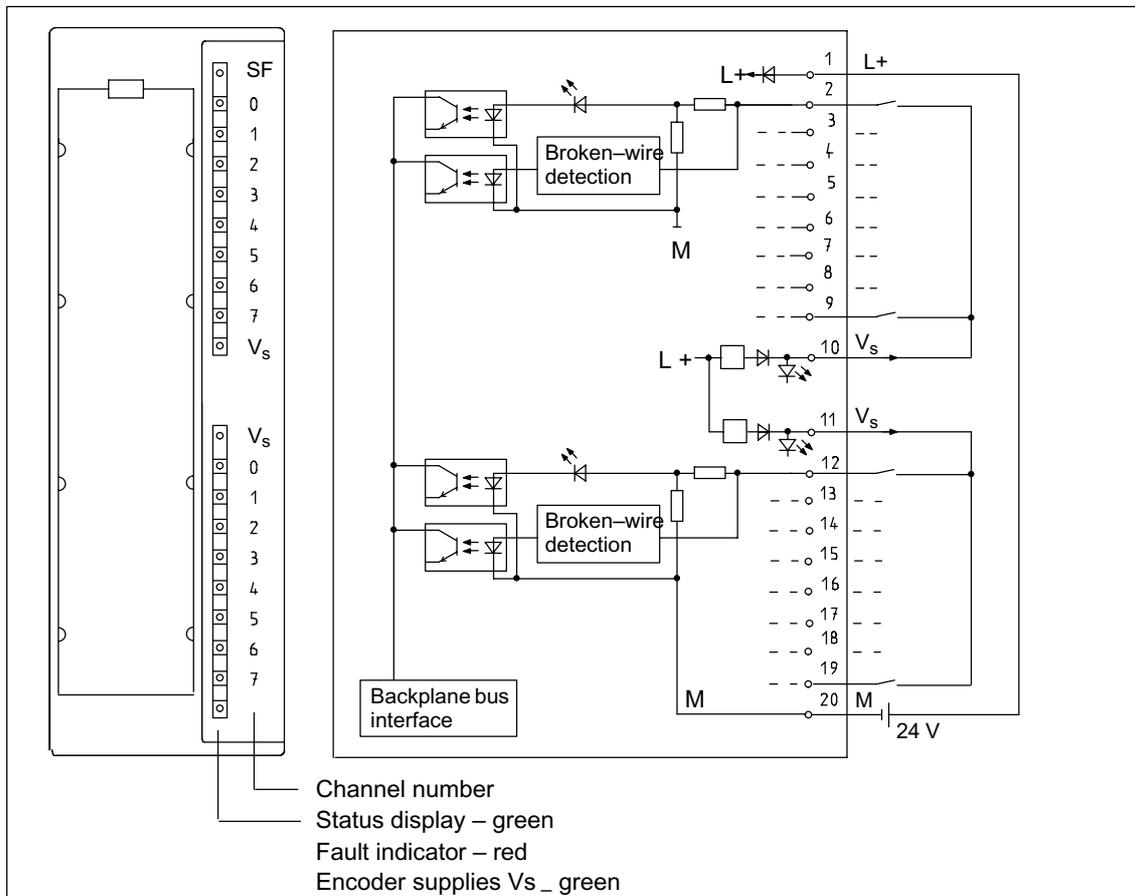
Figure 3-6   Module View and Block Diagram of Digital Input Module SM 321; DI 16 x 24 VDC

Terminal assignment for redundant supply of encoders

The figure below shows how encoder can additionally be supplied by means of Vs with a redundant voltage source – for example, via another module).
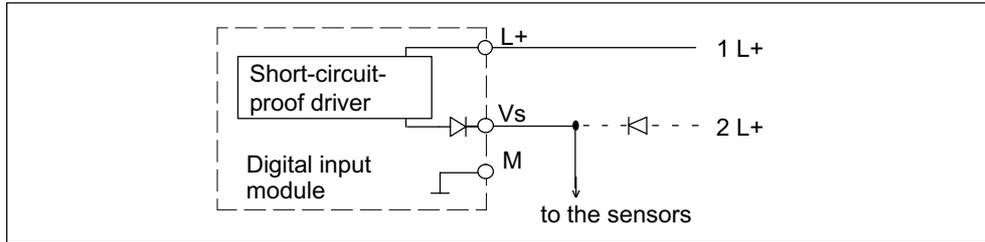
Figure 3-7   Terminal assignment for redundant supply of encoders of SM 321; DI 16 x VDC 24

Terminal assignment for resistive circuit of the encoder

In order to detect a broken wire, it is necessary to wire the encoder contact with a resistor.
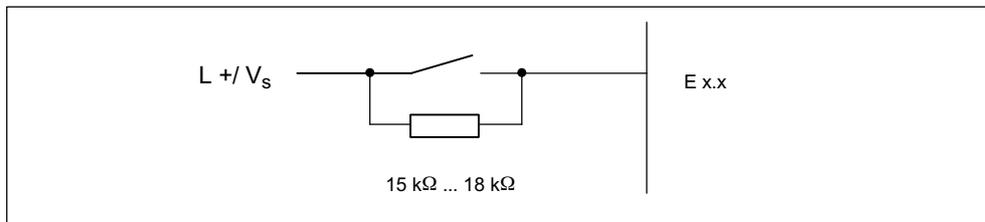
Figure 3-8   Terminal assignment for resistive circuit of the encoder of the SM 321; DI 16 x 24 VDC

Technical specifications of the SM 321; DI 16 x 24 VDC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 200 g
Data for Specific Module	
Supports clocked operation	Yes
Parameter changing during the RUN is possible	Yes
● Behavior of the non para-meterized inputs	gives the last valid output value before the parameterization
Number of inputs	16
Length of cable	
● Unshielded	max. 600 m
● Shielded	max. 1000 m
Voltages, Currents, Potentials	
Power rated voltage of the electronics and encoder L+	24 VDC
● Reverse polarity protection	Yes
Number of inputs that can be triggered simultaneously	
● Horizontal configuration Up to 60 °C	16
● Vertical configuration Up to 40 °C	16
Isolation	
● Between channels and backplane bus	Yes
Permitted potential difference	
● Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
● From the backplane bus	max. 130 mA
● From load voltage L + (without sensor supply VS)	max. 90 mA
Power dissipation of the module	typ. 4 W
Status, Interrupts, Diagnostics	
Status display	
● Inputs	Green LED per channel
● Sensor power supplies (Vs)	Green LED per output

Interrupts	
● Hardware interrupt	Parameters can be assigned
● Diagnostic interrupt	Parameters can be assigned
Diagnostic functions	Parameters can be assigned
● Group error display	Red LED (SF)
● Diagnostics information read-out	Possible
Monitoring of	
● Wire-break	yes, at I < 1 mA
Sensor Power Supply Outputs	
Number of outputs	2
Output voltage	
● With load	min. L+ (–2.5 V)
Output current	
● Rated value	120 mA
● Permitted range	0 to 150 mA
Additional (redundant) supply	Permitted
Short-circuit protection	Yes, electronic
Data for Selecting a Sensor	
Input voltage	
● Rated value	24 VDC
● For signal "1"	13 to 30 V
● For signal "0"	−30 to +5 V
Input current	
● At signal "1"	typ. 7 mA
Input characteristic curve	According to IEC 61131, type 2
Connection of Two-Wire BEROs	Possible
● Permitted bias current	max. 2 mA
Resistive circuit of the sensor for detecting broken wires	10 to 18 kOhm
Time/Frequency	
Internal processing time for status processing (in non synchronous operation)	
● Release of process and diagnosis alarm	max. 40 μs
Input delay	
● Parameters can be assigned	Yes
● Rated value	typ. 0.1/0.5/3/15/20 ms

3.9.1   Synchronicity

Characteristics

Reproducible (i.e. same length) reaction times are achieved for the SIMATIC with an equidistant DP bus cycle and synchronization of the following free running single cycles:

- Free running of the user program. The length of the cycle time can vary due to acyclic program branches.

- Free running, variable DP cycle at the PROFIBUS subnetwork

- Free running cycle at the DP slave back plane bus.

- Free running cycle during signal processing and conversion in the electronic modules of the DP slave.

In the case of equidistance the DP cycle runs in phase and with the same length. The procedure levels of a CPU (OB 61 to OB 64) and the synchronous peripheral are synchronized in this cycle. The E/A data are therefore transferred at defined and consistent time intervals (clock synchronicity).

Requirements

- The DP-Master and DP-Slave must support the synchronicity. They require *STEP 7* from Version 5.2.

Module filtering mode Synchronicity

In synchronous operation, the following conditions apply:

Filter and processing time T_{WE} between reading the current value and loading it into the transfer buffer (the specified value for T_{WE} applies, independent of the activation of the hardware interrupt or diagnosis)	255 to 345 μs
including an input delay time of	100 μs
T_{DPmin}	2.5 ms
Diagnostic interrupt	max. 4 x T_{DP}

Note

In "synchronous" mode the input delay of the inputs is always set to 100 μs independent of the input delay parameterized in *STEP 7*

Further information

Further information on clock synchronicity is given in the Online help of *STEP 7,* in the manual *Local peripheral system ET 200M* and in the manual *Clock synchronicity.*

3.9.2 Assigning Parameters to SM 321; DI 16 x VDC 24

Parameter assignment

You will find a description of the general procedure for assigning parameters to digital modules in the reference manual, section 3.3.

Parameters of the SM 321; DI 16 x 24 VDC

You will find an overview of the parameters that you can set and their default settings for the SM 321; DI 16 x 24 VDC in the table below.

The default settings apply if you have not performed parameter assignment in *STEP 7*.

Table 3-8　Parameters of the SM 321; DI 16 x VDC 24

Parameter	Value Range	Default Settings	Parameter Type	Scope
Enable • Diagnostic interrupt • Hardware interrupt	 Yes/no Yes/no	 No No	Dynamic	Module
Input delay/voltage type	0.1 ms (DC) 0.5 ms (DC) 3 ms (DC) 15 ms (DC) 20 ms (DC/AC)	(DC)	Static	Module
Diagnostics • Sensor supply missing • Wire-break	 Yes/no Yes/no	 No No	Static	Channel group
Trigger for hardware interrupt • Rising edge • Falling edge	 Yes/no Yes/no	 No No	Dynamic	Channel group

Assignment of the encoder supplies to channel groups

The two encoder supplies of the module are used to supply two channel groups: inputs 0 to 7 and inputs 8 to 15. In these two channel groups, you parameterize the diagnostics for the encoder supply, too.

Assigning interrupt parameters to channel groups

The table below shows the channels that can be combined to form a channel group if you would like to parameterize interrupt processing.

You will need the channel group number to set the parameters in the user program with an SFC.

Table 3-9   Assigning Interrupt Parameters to the Inputs of the SM 321; DI 16 x VDC 24

Parameter...	Can Be Set in Following Channel Groups	Channel Group Number
Hardware interrupt (for falling, rising or both types of pulse edges)	0 and 1 2 and 3 4 and 5 6 and 7 8 and 9 10 and 11 12 and 13 14 and 15	0 1 2 3 4 5 6 7
Diagnostic interrupt for missing sensor supply	0 to 7 8 to 15	-
Diagnostic interrupt for wire–break	0 and 1 2 and 3	0 1 :

Tolerances of the programmable input delays

Table 3-10   Tolerances of the Input Delays of SM 321; DI 16 x VDC 24

Programmed Input delay	Tolerance
0.1 ms	60 to 140 μs
0.5 ms	400 to 900 ms
3 ms (preset)	2,6 to 3,3 ms
15 ms	12 to 15 ms
20 ms	17 to 23 ms

3.9.3 Behavior and Diagnostics of the SM 321; DI 16 x 24 VDC

Effect of operating and mode supply voltage on the input values

The input values of the SM 321; DI 16 x 24 DC depend on the operating mode of the CPU and on the supply voltage of the module.

Table 3-11   Dependencies of Input Values on the Operating Mode of the CPU and Supply Voltage L+ of the SM 321; DI 16 x VDC 24

CPU Operating State		Power Supply L+ to Digital Module	Input Value of Digital Module
POWER ON	RUN	L+ exists	Process value
		L+ missing	0 signal
	STOP	L+ exists	Process value
		L+ missing	0 signal
POWER OFF	–	L+ exists	–
		L+ missing	–

Diagnostic Messages of the SM 321; DI 16 x 24 VDC

The table below presents an overview of the diagnostic messages for the SM 321; DI 16 x 24 VDC.

Table 3-12   Diagnostic Messages of the SM 321; DI 16 x VDC 24

Diagnostics Message	LED	Scope of the Diagnostics	Parameters can be assigned
Sensor supply missing	SF	Channel group	Yes
Wire-break	SF	Channel group	
Module not parameterized.	SF	Channel group	
External auxiliary supply missing	SF	Module	No
Internal auxiliary power missing	SF	Module	
Fuse blown	SF	Module	
Incorrect parameter on module	SF	Module	
Watchdog timeout	SF	Module	
EPROM error	SF	Module	
RAM error	SF	Module	
Hardware interrupt lost	SF	Module	

Note

A prerequisite for detecting the errors indicated by programmable diagnostic messages is that you have assigned parameters to the digital module accordingly in *STEP 7*.

Behavior upon failure of the supply voltage

A failure of the supply voltage of the SM 321; DI 16 x 24 DC is always indicated by the SF LED on the module. Furthermore, this information is made available on the module.

The input value is initially held for 20 to 40 ms before the 0 signal is transferred to the CPU. Supply voltage dips < 20 ms do not modify the process value (refer to Table 3-11).

Triggering of the diagnostic interrupt depends on the parameter assignment (see Section 3.9.4).

Failure of the supply voltage with redundant encoder incoming supply

Note

If an external redundant source is applied simultaneously to the sensor supply (Vs), a failure in the internal sensor supply causes a failure of the internal and/or external sensor supply and/or a blown fuse to be indicated instead of a regular sensor supply failure.

Short-circuit of sensor supply Vs

Irrespective of the parameter assignment, the corresponding Vs LED goes out if a short-circuit of the encoder supply Vs occurs.

Causes of error and remedial measures

Table 3-13   Diagnostic Messages of the SM 321; DI 16 x DC 24 V, Causes of Error and
Remedial Action

Diagnostics Message	Possible Error Cause	Remedy
Lack of encoder supply	Overload of sensor supply	Eliminate overload
	Short circuit of sensor supply to M	Eliminate short circuit
External auxiliary voltage missing	Power supply L+ to module missing	Feed supply L+
Internal auxiliary voltage missing	Power supply L+ to module missing	Feed supply L+
	Fuse in module defective	Replace module
Fuse blown	Fuse in module defective	Replace module
Wrong parameters in module	One parameter or the combination of parameters is not plausible	Reassign module parameter
Watchdog tripped	Temporary high electromagnetic interference	Eliminate interference
	Module defective	Replace module
EPROM error	Temporary high electromagnetic interference	Eliminate interference and switch on/off power supply of CPU
	Module defective	Replace module
RAM error	Temporary high electromagnetic interference	Eliminate interference and switch on/off power supply of CPU
	Module defective	Replace module
Hardware interrupt lost	The module cannot send an interrupt, since the previous interrupt was not acknowledged; configuration error possible	Change interrupt processing in CPU and reconfigure module parameters, if required

The error continues until the module is configured with new parameters |
| Module not parameterized | Fault during startup | Reassign module parameters |

3.9.4 Interrupts of the SM 321; DI 16 x 24 VDC

Introduction

This section describes the SM 321; DI 16 x 24 VDC with regard to its interrupt behavior. The following interrupts exist:

- Diagnostic interrupt

- Hardware interrupt

The OBs and SFCs mentioned below can be found in the online Help for *STEP 7*, where they are described in greater detail.

Enabling interrupts

The interrupts are not preset – in other words, they are inhibited without appropriate parameter assignment. Assign parameters to the Interrupt Enable in *STEP 7* (refer to Section 3.9.2).

Diagnostic interrupt

If you have enabled diagnostic interrupts, then active error events (initial occurrence of the error) and departing error events (message after troubleshooting) are reported by means of an interrupt.

The CPU interrupts the execution of the user program and processes the diagnostic interrupt block (OB 82).

In the user program, you can call SFC 51 or SFC 59 in OB 82 to obtain more detailed diagnostic information from the module.

The diagnostic information is consistent until such time as OB 82 is exited. When OB 82 is exited, the diagnostic interrupt is acknowledged on the module.

Hardware interrupt

The SM 321; DI 16 x 24 VDC can trigger a hardware interrupt for every channel group with a rising or falling edge, or both, of a signal status change.

Perform parameter assignment one channel group at a time. It can be modified at any time (in RUN mode using the user program).

Pending hardware interrupts trigger hardware interrupt processing in the CPU (OB 40). The CPU interrupts the execution of the user program or of the priority classes with low priority.

You can set in the user program of the hardware interrupt OB (OB 40) how the programmable logic controller has to react to an edge change. When the hardware interrupt OB is exited, the hardware interrupt is acknowledged on the module.

The module can buffer one interrupt per channel. If no higher priority run-time levels are waiting to be processed, the buffered interrupts (of all modules) are serviced one after the other by the CPU according to the order in which they occurred.

Hardware interrupt lost

In an interrupt has been buffered for a channel and another interrupt occurs on that channel before it has been processed by the CPU, a diagnostic interrupt "hardware interrupt lost" is triggered.

More interrupts on this channel are not acquired until processing of the interrupt buffered on this channel has been executed.

Interrupt-triggering channels

The channel triggered by the hardware interrupt is entered in the start information of the OB 40 in the OB40_POINT_ADDR variable. Figure 3-9 shows the assignment of the bits to the local data double word 8.

Byte	Variable	Data type		Description
6/7	OB40_MDL_ADDR	WORD	B#16#0	Address of the interrupt triggering module
From 8	OB40_POINT_ADDR	DWORD	See Figure 3-9	Display of the interrupt triggering inputs
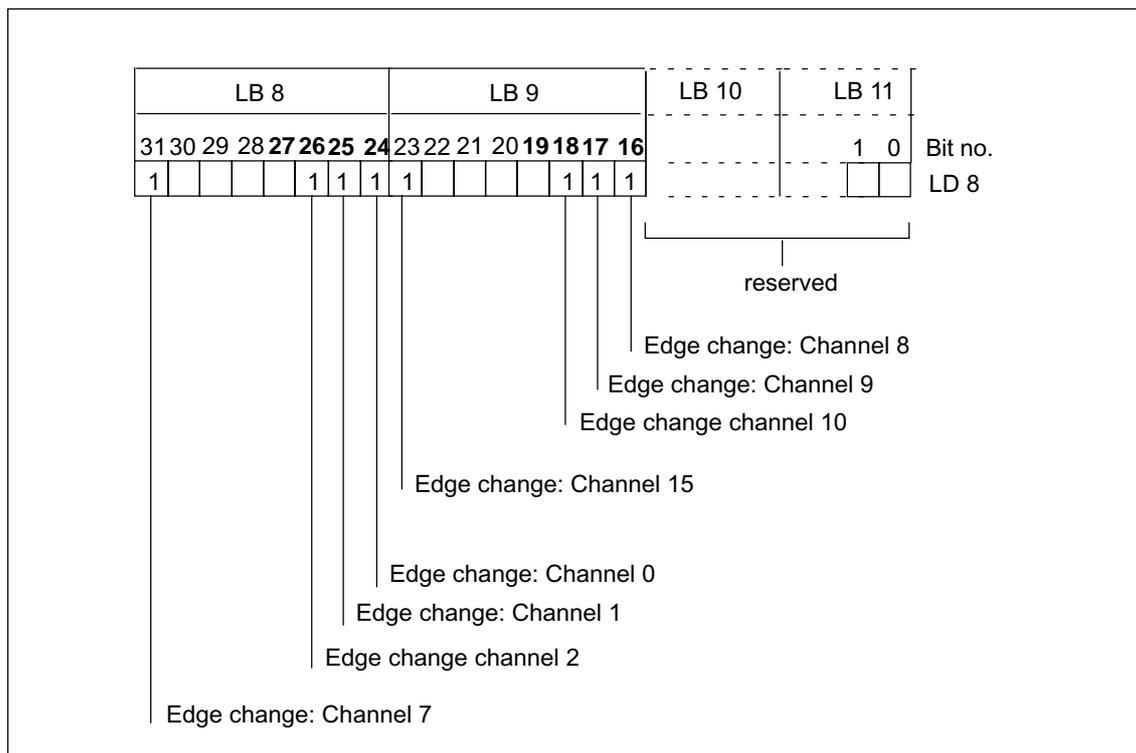
Figure 3-9   Start Information of OB 40: Which Event Has Triggered the Hardware Interrupt at the Limit Value

3.10   Digital Input Module SM 321; DI 16 x DC 24 V; Source Input; (6ES7321-1BH50-0AA0)

Order number

6ES7321-1BH50-0AA0

Characteristics

The SM 321; DI 16 x 24 VDC (source input) has the following salient features:

- 16 inputs, source input, isolated in groups of 16

- 24 VDC rated input voltage

- Suitable for switches and two / three / four-wire BEROs (proximity switches).

Terminal assignment and block diagram of the SM 321; DI 16 x 24 VDC
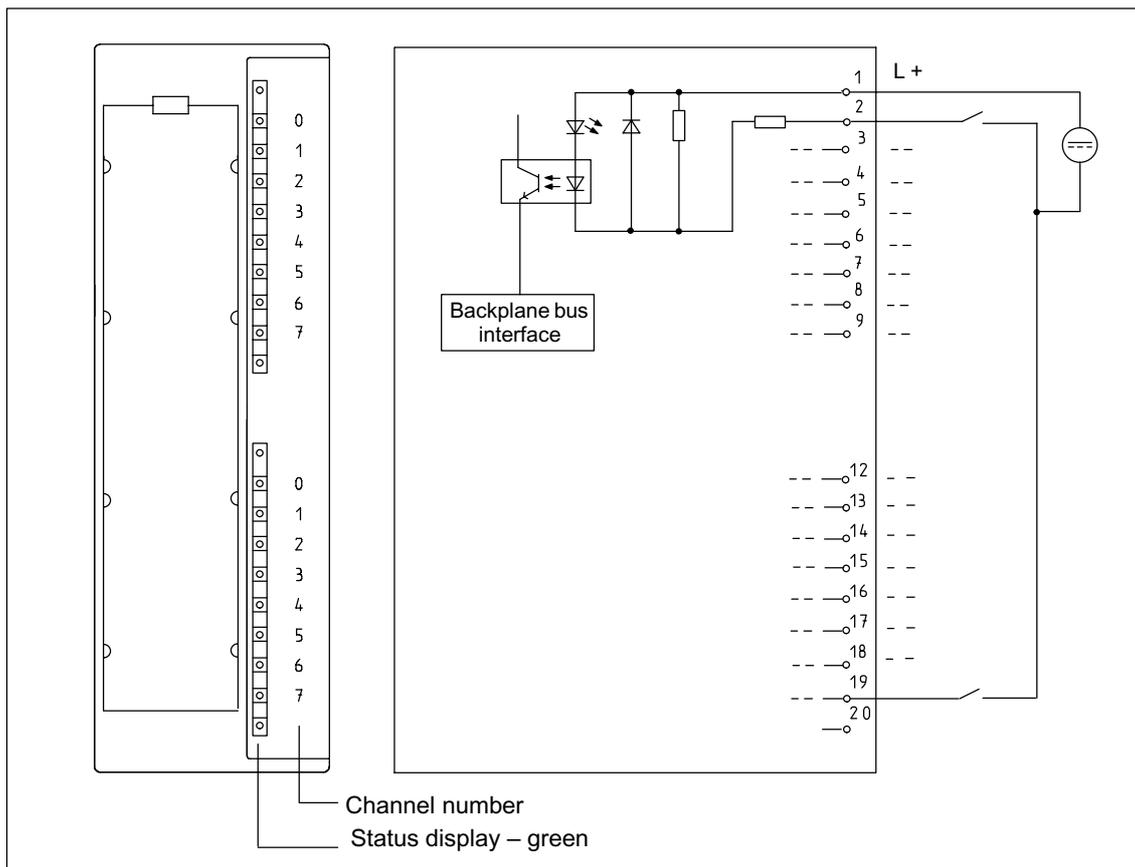
Figure 3-10   Module View and Block Diagram of Digital Input Module SM 321; DI 16 x 24 VDC (Source Input)

Technical specifications of the SM 321; DI 16 x 24 VDC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 200 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	16
Length of cable	
● Unshielded	max. 600 m
● Shielded	max. 1000 m
Voltages, Currents, Potentials	
Number of inputs that can be triggered simultaneously	
● Horizontal configuration	
Up to 60 °C	16
● Vertical configuration	
Up to 40 °C	16
Isolation	
● Between channels and backplane bus	Yes
Permitted potential difference	
● Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
● From the backplane bus	max. 10 mA
Power dissipation of the module	typ. 3.5 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting a Sensor	
Input voltage (reference potential is L+)	
● Rated value	24 VDC
● For signal "1"	–13 V to –30 V
● For signal "0"	+30 V to –5 V
Input current	
● At signal "1"	typ. 7 mA
Input delay	
● At "0" to "1"	1.2 to 4.8 ms
● At "1" to "0"	1.2 to 4.8 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
	max. 1.5 mA
● Permitted bias current	

3.11 Digital Input Module SM 321; DI 16 x UC 24/48 V (6ES7321-1CH00-0AA0)

Order number

6ES7321-1CH00-0AA0

Characteristics

The SM 321; DI 16 x UC24/48 V features the following characteristics:

- 16 inputs, isolated electrically

- Electrical isolation between channels of 120 V

- Rated input voltage from 24 to 48 DC)

- Inputs are fully independent and can be connected in any required configuration

Terminal assignment and block diagram of the SM 321; DI 16 x 24/48 VUC
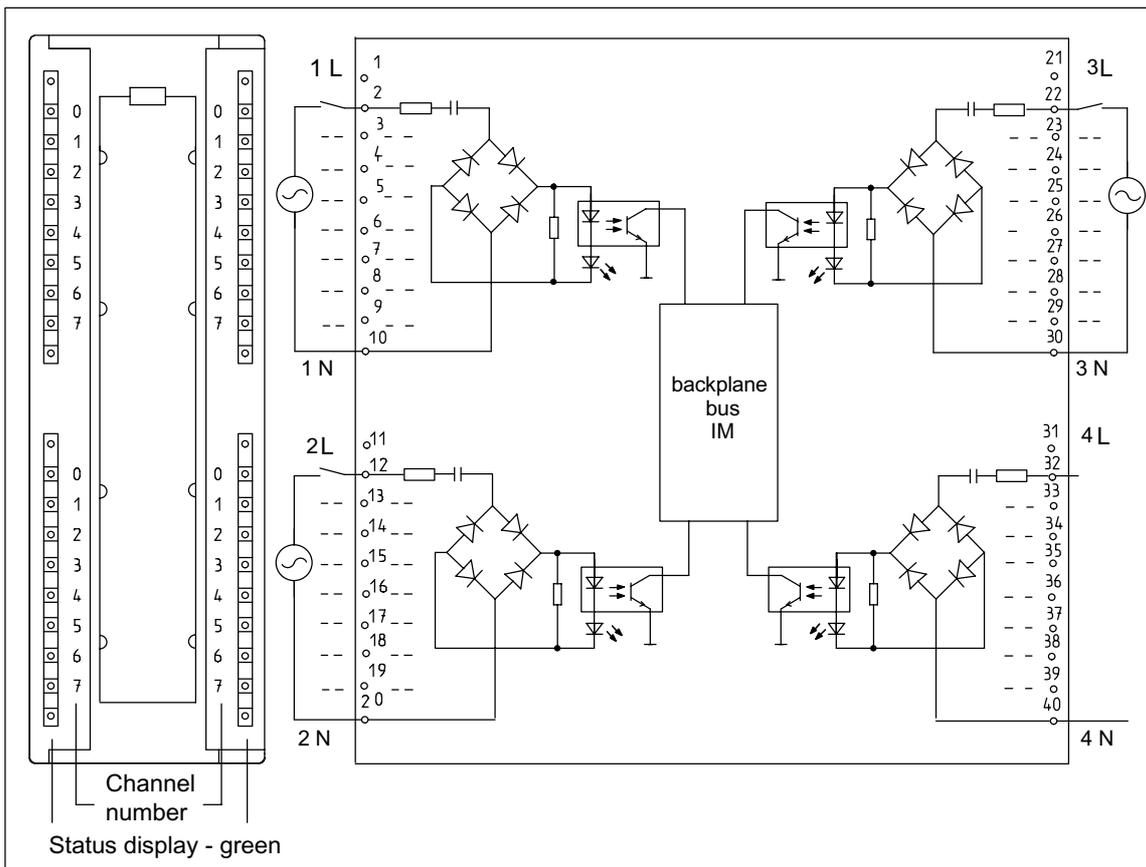

Figure 3-11   Module View and Block Diagram of Digital Input Module SM 321; DI 16 x 24/48VUC

Technical specifications of the SM 321; DI 16 x 24/48 VUC

Dimensions and Weight	
Dimensions W x H x D	40 x 125 x 117
Weight	Approx. 260 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	16
Length of cable	
● Unshielded	max. 600 m
● Shielded	max. 1000 m
Voltages, Currents, Potentials	
Number of inputs that can be triggered simultaneously	
● Horizontal configuration Up to 60°C	16
● All other configuration types Up to 40° C	16
Isolation	
● Between channels and backplane bus	Yes
● Between channels	Yes
In groups of	1
Permitted potential difference	
● Between the channels and the backplane bus	170 VDC, 120 VAC
● Between the inputs of the different groups	170 VDC, 120 VAC
Insulation tested with	
● Between the channels and the backplane bus	1500 VAC
● Between the inputs of the different groups	1500 VAC
Current consumption	
● From the backplane bus	max. 100 mA
Power dissipation of the module	
● Operation with 24 V	typ. 1.5 W
● Operation with 48 V	typ. 2.8 W

Status, Interrupts, Diagnostics	
Status display	Green LEDs per channel
Interrupts	None
Diagnostic functions	None
Data for Selecting a Sensor	
Input voltage	
● Rated value	24 or 48 VDC/ 24 or 48 VAC
● At signal "1"	14 V to 60 V
● At signal "0"	–5 V to 5 V
● Frequency range	0 to 63 Hz
Input current	
● At signal "1"	typ. 2.7 mA
● At signal "0"	–1 to +1 mA
Input delay	
● From " 0" to "1"	max. 16 ms
● At "1" to "0"	max. 16 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
● Permitted bias current	max. 1 mA

3.12 Digital Input Module SM 321; DI 16 x VDC 48-125; (6ES7321-1CH20-0AA0)

Order number: "Standard module"

6ES7321-1CH20-0AA0

Order number: "SIPLUS S7-300-Module"

6AG1321-1CH20-2AA0

Characteristics

The SM 321; DI 16 x 48-125 VDC features the following characteristics:

- 16 inputs, isolated in groups of 8

- Rated input voltage 48 to 125 VDC

- Suitable for switches and two / three / four-wire BEROs (proximity switches).

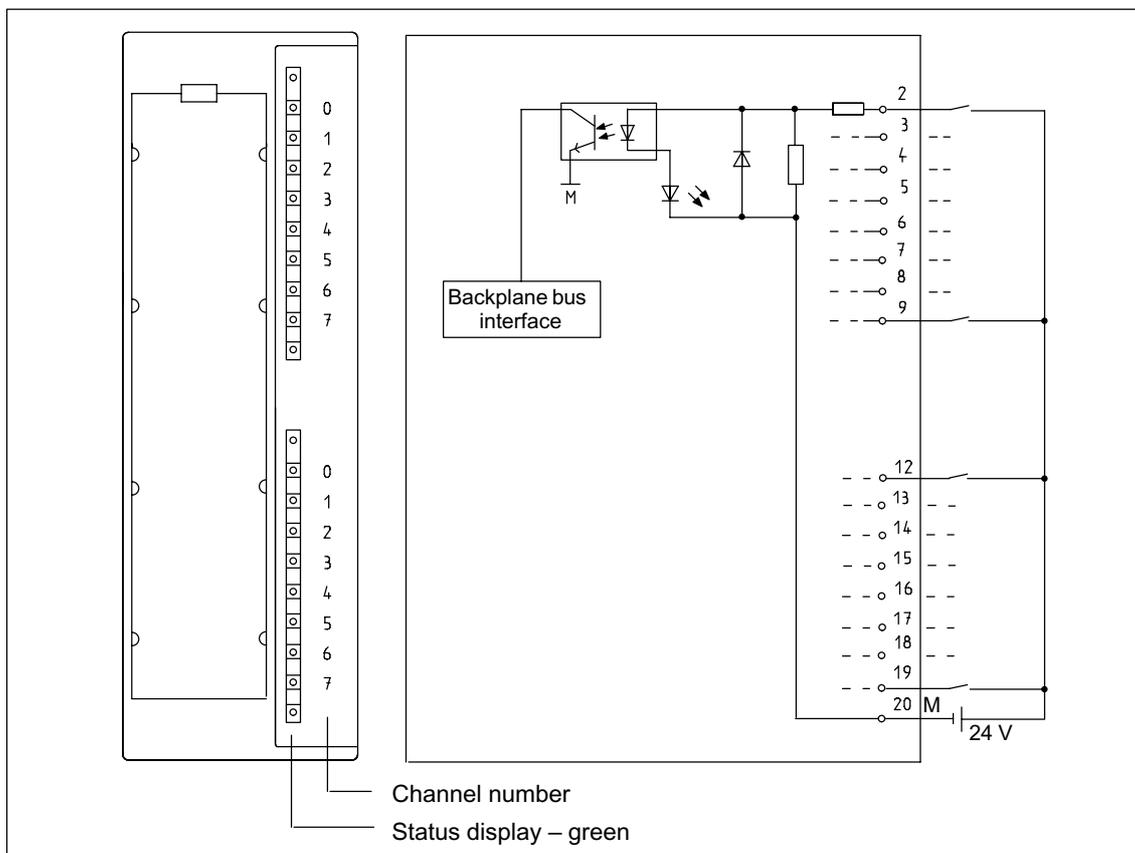### Terminal assignment and block diagram of the SM 321; DI 16 x 48-125 VDC

Figure 3-12   Module View and Block Diagram of SM 321; DI 16 x 48-125 VDC

Technical specifications of the SM 321; DI 16 x 48-125 VDC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 120
Weight	Approx. 200 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	16
Length of cable	
● Unshielded	max. 600 m
● Shielded	max. 1000 m
Voltages, Currents, Potentials	

Number of inputs that can be triggered simultaneously at U_E	Up to 60 V	Up to 146 V
● Horizontal installation		
Up to 50 °C	8	8
Up to 60 °C	8	6
● Vertical configuration		
Up to 40 °C	8	8
Isolation		
● Between channels and backplane bus	Yes	
● Between the channels	Yes	
In groups of	8	
Permiss. potential differences		
● Between the different circuits	146 VDC / 132 VAC	
Insulation tested with	1500 VDC	
Current consumption		
● From the backplane bus	max. 40 mA	
Power dissipation of the module	typ. 4.3 W	

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None
Sensor Selection Data	
Input voltage	
● Rated value	48 VDC to 125 VDC
● For signal "1"	30 V to 146 V
● For signal "0"	−146 V to 15 V
Input current	
● At signal "1"	typ. 3.5 mA
Input delay	
● From " 0" to "1"	0.1 ms to 3.5 ms
● At "1" to "0"	0.7 ms to 3.0 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
	max. 1 mA
● Permitted bias current	

3.13 Digital Input Module SM 321; DI 16 x AC 120/230 V (6ES7321-1FH00-0AA0)

Order number

6ES7321-1FH00-0AA0

Characteristics

The SM 321; DI 16 x 120/230 VAC features the following characteristics:

- 16 inputs, electrically isolated in groups of 4

- 120/230 VAC rated input voltage

- Suitable for switches and two / three-wire proximity switches (alternating voltage)

Terminal assignment and block diagram of the SM 321; DI 16 x 120/230 VAC
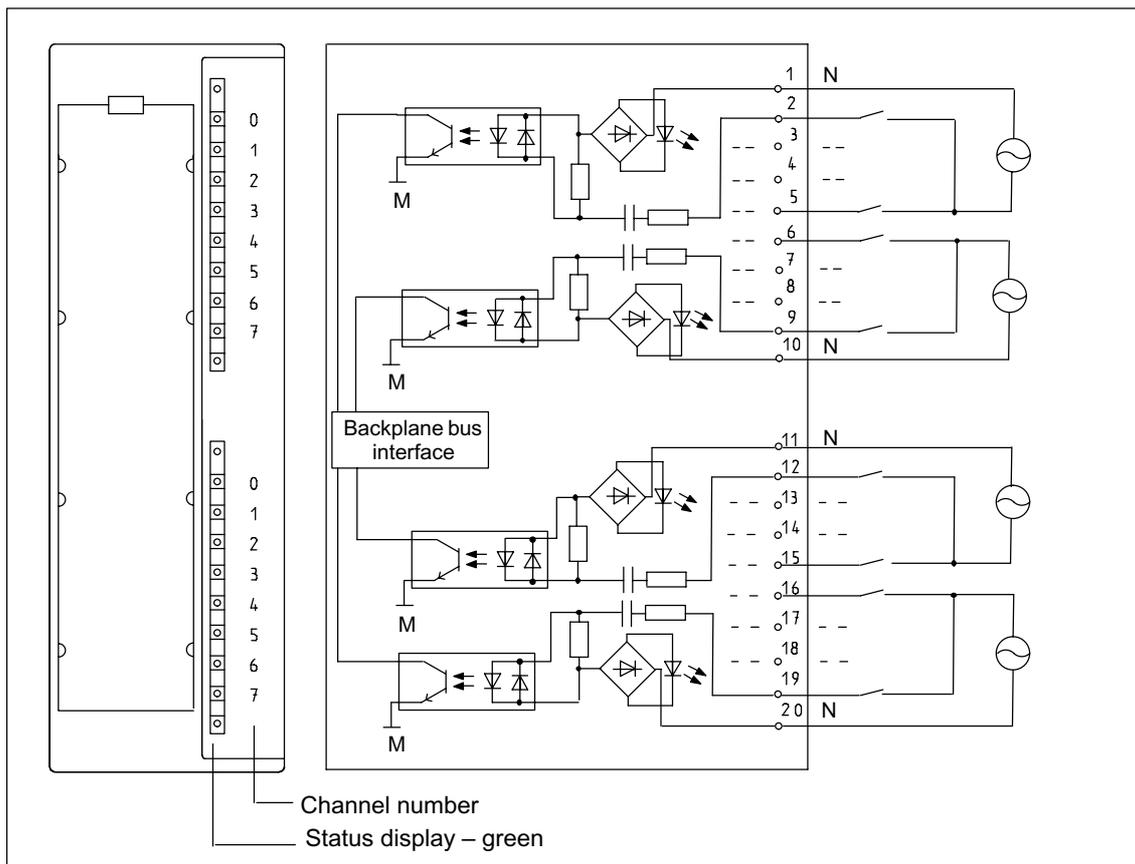
Figure 3-13   Module View and Block Diagram of the SM 321; DI 16 x 120/230VAC

Technical specifications of the SM 321; DI 16 x 120/230 VAC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 240 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	16
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L1	120/230 V
All load voltages must be of the same phase	
Number of inputs that can be triggered simultaneously	
• Horizontal configuration Up to 60 °C	16
• Vertical configuration Up to 40 °C	16
Isolation	
• Between channels and backplane bus	Yes
• Between channels	Yes
In groups of	4
Permitted potential difference	
• Between $M_{internal}$ and the inputs	500 VAC
• Between the inputs of the different groups	230 VAC
Insulation tested with	4000 VDC
Current consumption	
• From the backplane bus	max. 29 mA
Power dissipation of the module	typ. 4.9 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None
SensorSelection Data	
Input voltage	
• Rated value	120/230 VAC
• For signal "1"	79 to 264 V
• For signal "0"	0 to 40 V
• Frequency range	47 to 63 Hz
Input current	
• At signal "1"	
120 V, 60 Hz	typ. 8.0 mA
230 V, 50 Hz	typ. 16.0 mA
Input delay	
• "0" to "1"	max. 25 ms
• "0" to "1"	max. 25 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
	max. 2 mA
• Permitted bias current	

3.14 Digital Input Module SM 321; DI 8 x VAC 120/230; (6ES7321-1FF01-0AA0)

Order number: "Standard module"

6ES7321-1FF01-0AA0

Order number: "SIPLUS S7-300-Module"

6AG1321-1FF01-2AA0

Characteristics

The SM 321; DI 8 x 120/230 VAC features the following characteristics:

- 8 inputs, isolated in groups of 2
- 120/230 VAC rated input voltage
- Suitable for switches and two / three-wire AC proximity switches

Terminal assignment and block diagram of the SM 321; DI 8 x 120/230 VAC
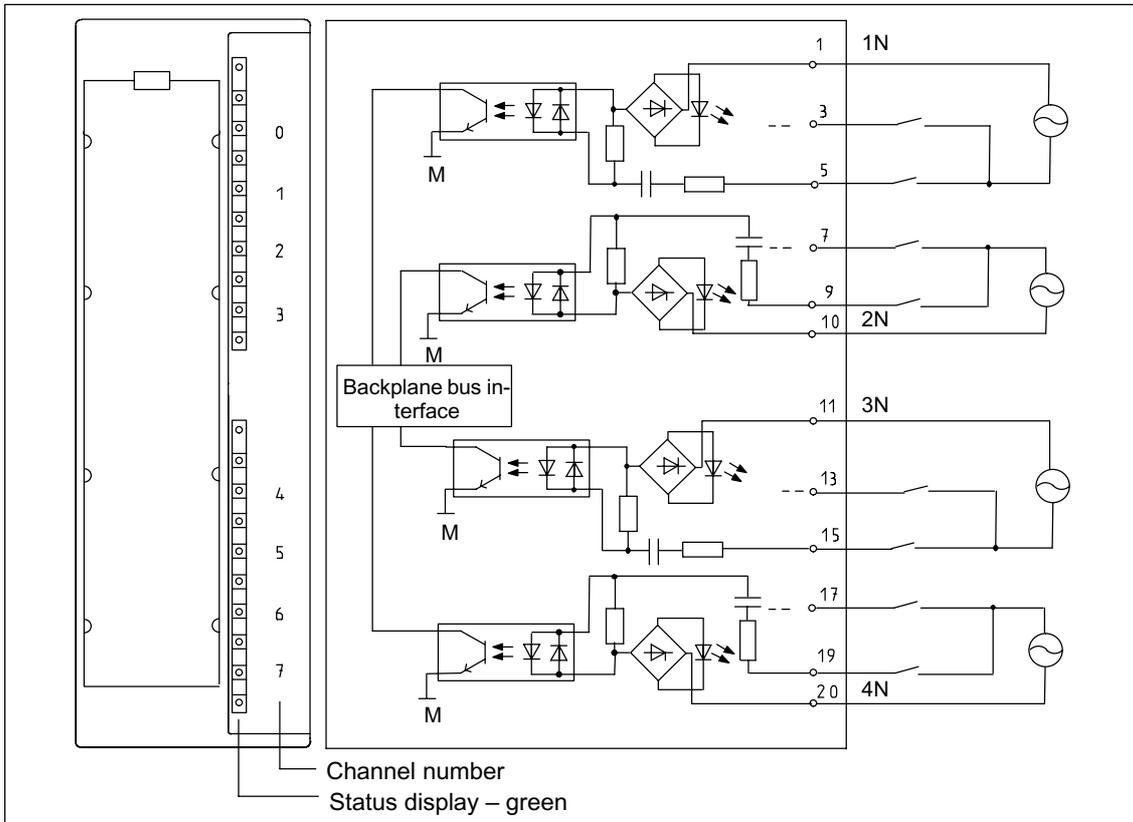
Figure 3-14   Module View and Block Diagram of the SM 321; DI 8 x 120/230 VAC

Technical specifications of the SM 321; DI 8 x 120/230 VAC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 240 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Number of inputs that can be triggered simultaneously	
• Horizontal configuration	
Up to 60 °C	8
• Vertical configuration	
Up to 40 °C	8
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	2
Permitted potential difference	
• Between $M_{internal}$ and the inputs	230 VAC
• Between the inputs of the different groups	500 VAC
Insulation tested with	4000 VDC
Current consumption	
• From the backplane bus	max. 29 mA
Power dissipation of the module	typ. 4.9 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None
Data for Selecting a Sensor	
Input voltage	
• Rated value	120/230 VAC
• For signal "1"	79 to 264 V
• For signal "0"	0 to 40 V
• Frequency range	47 to 63 Hz
Input current	
• At signal "1"	
120 V, 60 Hz	typ. 6.5 mA
230 V, 50 Hz	typ. 11 mA
Input delay	
• At "0" to "1"	max. 25 ms
• At "1" to "0"	max. 25 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
• Permitted bias current	max. 2 mA

3.15 Digital Input Module SM 321;
DI 8 x 120/230 VAC ISOL (6ES7321-1FF10-0AA0)

Order number

6ES7321-1FF10-0AA0

Characteristics

The digital input module SM 321; DI 8 x 120/230 VAC ISOL has the following distinguishing characteristics:

- 8 outputs, isolated in groups of 1

- 120/230 VAC rated input voltage

- Suitable for switches and two / three / four-wire AC proximity switches

Terminal assignment and block diagram of the SM 321; DI 8 x 120/230 VAC ISOL
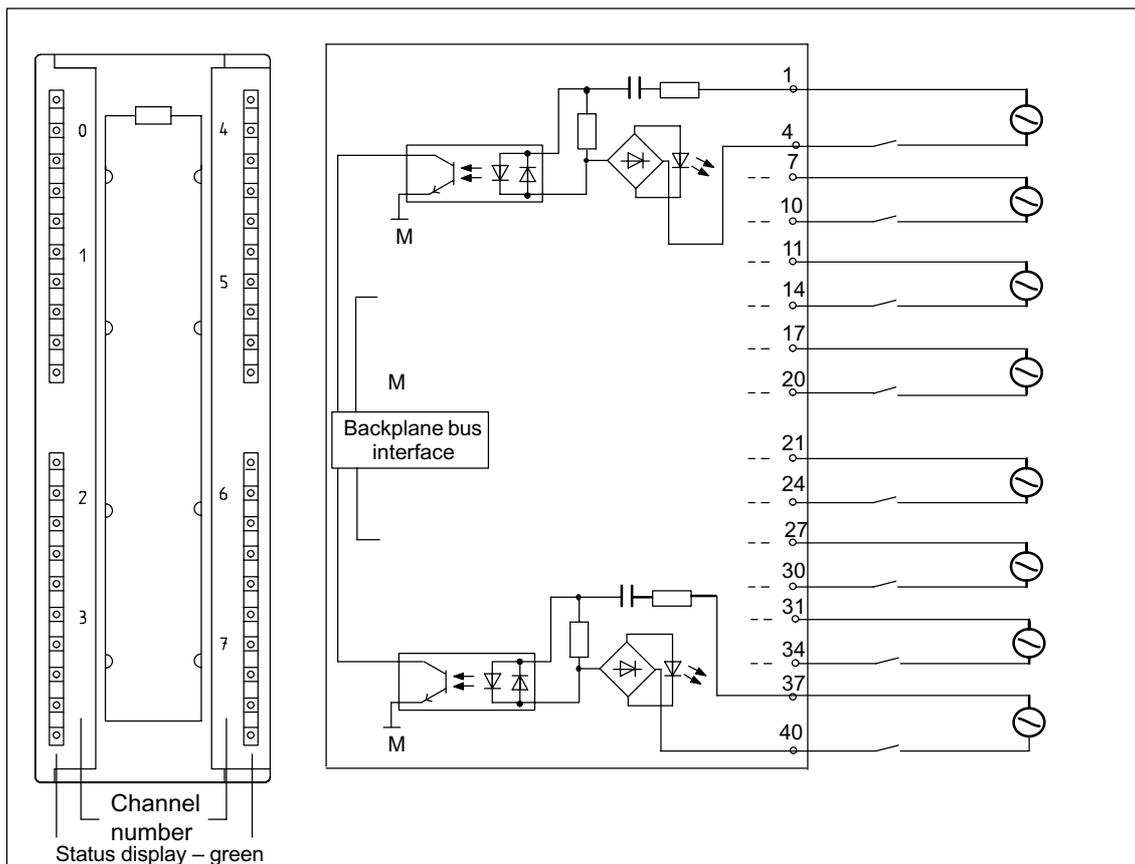
Figure 3-15   Module View and Block Diagram of the SM 321; DI 8 x 120/230 VAC ISOL

Technical specifications of the SM 321; DI 8 x 120/230 VAC ISOL

Dimensions and Weight	
Dimensions W x H x D	40 x 125 x 117
Weight	Approx. 240 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L1	120/230 VAC
All load voltages must be of the same phase	
Number of inputs that can be triggered simultaneously	
• Horizontal configuration Up to 60 °C	8
• Vertical configuration Up to 40 °C	8
Isolation	
• Between channels and backplane bus	Yes
• Between channels	Yes
In groups of	1
Permitted potential difference	
• Between $M_{internal}$ and the inputs	230 VAC
• Between the inputs of the different groups	500 VAC
Insulation tested with	
• Between $M_{internal}$ and the inputs	1500 VAC
• Between the inputs of the different groups	2000 VAC
Current consumption	
• From the backplane bus	max. 100 mA
Power dissipation of the module	typ. 4.9 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None
Data for Selecting a Sensor	
Input voltage	
• Rated value	120/230 VAC
• For signal "1"	79 to 264 V
• For signal "0"	0 to 40 V
• Frequency range	47 to 63 Hz
Input current	
• At signal "1"	
120 V, 60 Hz	typ. 7.5 mA
230 V, 50 Hz	typ. 17.3 W
Input delay	
• "0" to "1"	max. 25 ms
• "0" to "1"	max. 25 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
• Permitted bias current	max. 2 mA

3.16 Digital Output Module SM 322; DO 32 x 24 VDC/ 0.5 A; (6ES7322-1BL00-0AA0)

Order number

6ES7322-1BL00-0AA0

Characteristics

The digital output module SM 322; DO 32 x 24 VDC/0.5 A has the following salient features:

- 32 outputs, isolated in groups of 8
- 0.5 A output current
- 24 VDC rated load voltage
- Suitable for solenoid valves, DC contactors and indicator lights

Using the module with high-speed counters

Please take note of the following information on the use of the module in connection with high-speed counters:

Note

When connecting the 24 V power supply via a mechanical contact, the outputs of the SM 322; DO 32 x DC 24 V/0.5 A carry a "1" signal for approximately 50 μs for reasons associated with the circuitry.

Module View and Block Diagram of the SM 322; DO 32 x 24 VDC/ 0.5 A

Figure 3-16   Module View and Block Diagram of Digital Output Module SM 322; DO 32 x 24 VDC/0.5 A

Terminal assignment

The following figure shows the assignment of the channels to the addresses.
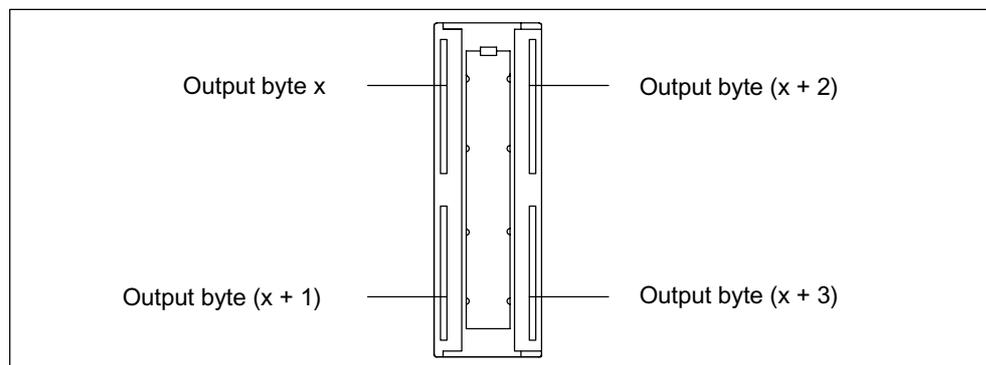
Figure 3-17   Terminal Assignment of the SM 322; DO 32 x 24 VDC

Terminal Assignment of the SM 322; DO 32 x 24 VDC/ 0.5 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 260 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	32
Length of cable	
● Unshielded	max. 600 m
● Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L+	24 VDC
Total current of the outputs (per group)	
● Horizontal configuration	
Up to 40 °C	max. 4 A
Up to 60 °C	max. 3 A
● Vertical configuration	
Up to 40 °C	max. 2 A
Isolation	
● Between channels and backplane bus	Yes
● Between the channels	Yes
In groups of	8
Permitted potential difference	
● Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
● From the backplane bus	max. 110 mA
● From load voltage L + (without load)	max. 160 mA
Power dissipation of the module	typ. 6.6 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting an Actuator	
Output voltage	
● At signal "1"	min. L + (–0.8 V)
Output current	
● At signal "1"	
Rated value	0.5 A
Permitted range	5 mA to 0.6 A
● At signal "0" (leakage current)	max. 0.5 mA
Output delay (for resistive load)	
● From " 0" to "1"	max. 100 μs
● At "1" to "0"	max. 500 μs
Load resistor range	48 Ω to 4 kΩ
Lamp load	max. 5 W
Parallel connection of 2 outputs	
● For redundant triggering of a load	Possible (only outputs of the same group)
● To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
● For resistive load	max. 100 Hz
● Inductive loads according to IEC 947-5-1, DC 13	max. 0.5 Hz
● For lamp load	max. 10 Hz
Limit (internal) of the inductive circuit interruption voltage up	L + (–53 V), typ.
Short-circuit protection of the output	Yes, electronic
● Threshold on	1 A, typ.

3.17 Digital Output Module SM 322; DO 32 x VAC 120/230/1 A; (6ES7322-1FL00-0AA0)

Order number

6ES7322-1FL00-0AA0

Characteristics

The SM 322; DO 32 x VAC 120/230/1 A has the following distinguishing characteristics:

- 32 outputs, fused and isolated in groups of 8

- 1.0 A output current

- 120/230 VAC rated load voltage

- Blown fuse indicator for each group

- Suitable for AC solenoids, contactors, starters, fractional horsepower motors and indicator lights

- Group error display

Terminal assignment and block diagram of the SM 322; DO 32 x VC 120/230/1 A
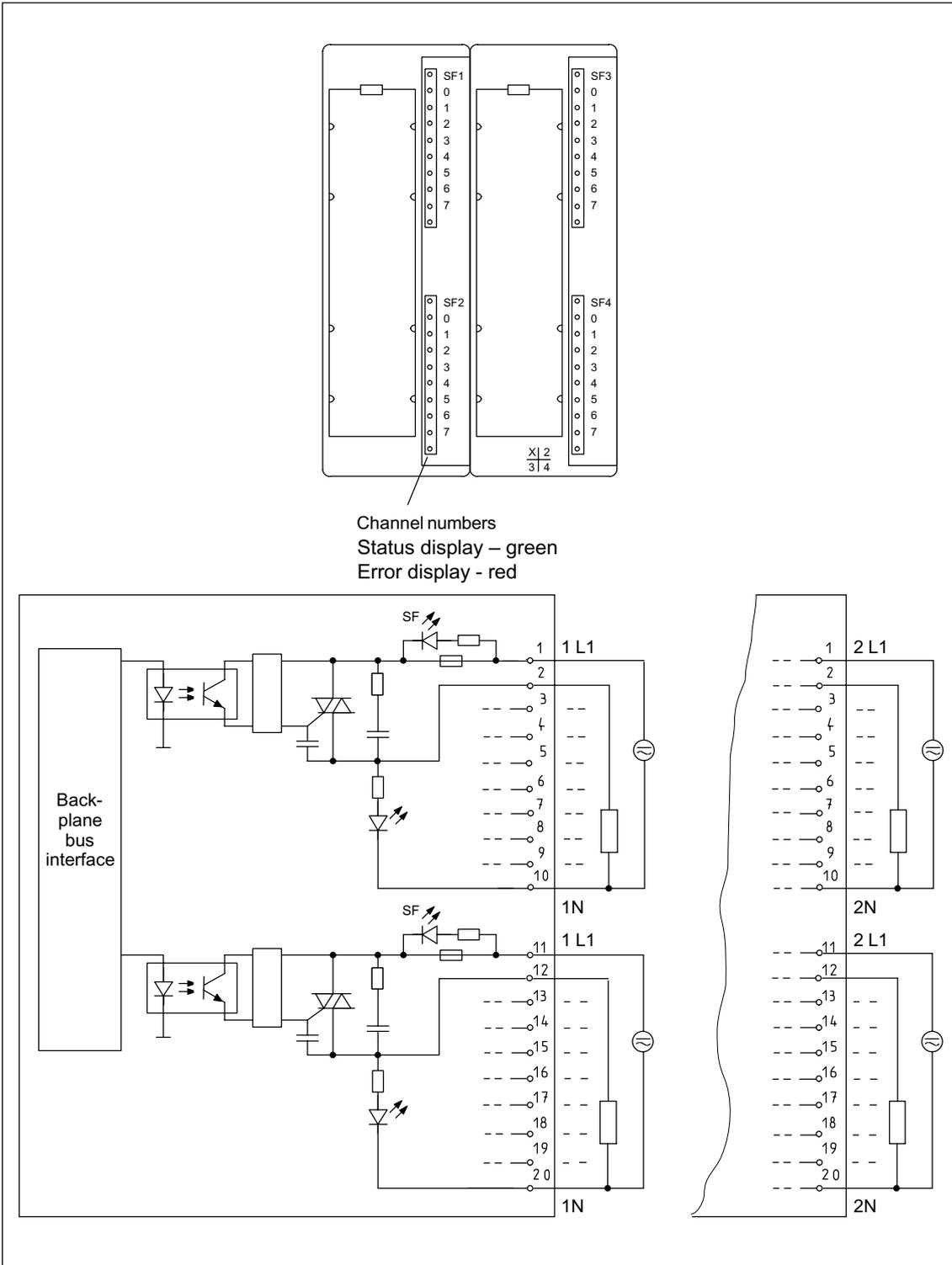
Figure 3-18   Terminal assignment and block diagram of the SM 322; D0 32 x VAC 120/230 /1 A

Terminal assignment

The following figure shows the assignment of the channels to the addresses.
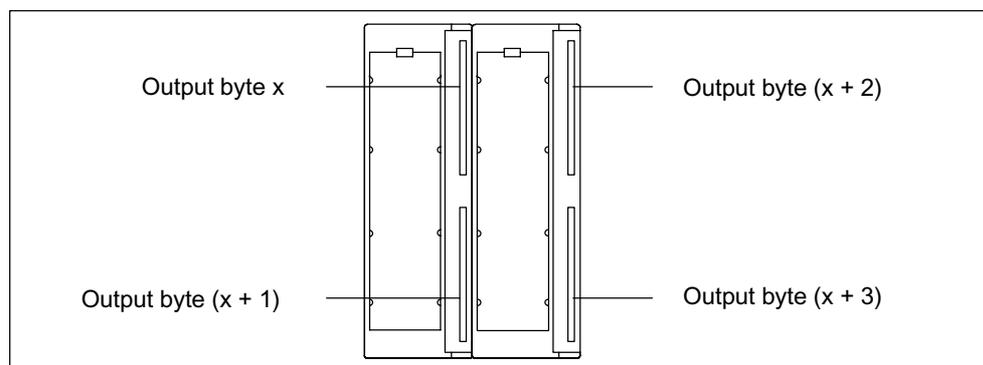
Figure 3-19   Terminal assignment of the SM 322; DO 32 x AC 120/230 V/1 A

Technical specifications of the SM 322; DO 32 x 120 VAC/1.0 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	80 x 125 x 117
Weight	Approx. 500 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	32
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L1	120/230 VAC
• Permitted frequency range	47 Hz to 63 Hz
Total current of the outputs (per group)	
• Horizontal configuration up to 60 °C up to 40 °C	max. 3 A max. 4 A
• Vertical configuration Up to 40°C	max. 4 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	8
Permitted potential difference	
• Between $M_{internal}$ and the outputs	250 VAC
• Between the outputs of the different groups	250 VAC
Insulation tested with	DC 4000 V
Current consumption	
• From the backplane bus	max. 190 mA
• From load voltage L1 (without load)	max. 10 mA
Power dissipation of the module	typ. max. 25 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	No
Diagnostic functions	Yes
• Group error display	Red LED (SF)

Data for Selecting an Actuator	
Output voltage	
• At signal "1"	min. L1 (–0,8 V)
Output current	
• At "1" signal	
Rated value	1 A
Permitted range	10 mA to 1 A
Permitted current surge (per group)	10 A (for 2 AC scan cycles)
• At "0" signal Leakage current	max. 2 mA
Output delay (for resistive load)	
• At "0" to "1"	1 AC scan cycle
• At "1" to "0"	1 AC scan cycle
Blocking voltage Zero transition	max. 60 V
Size of the motor starter	max. size 4 to NEMA
Lamp load	max. 50 W
Parallel connection of 2 outputs	
• For redundant actuation of a load	Possible (only outputs of the same group)
• To increase performance	Not possible
Actuation of digital input	Possible
Switch rate	
• For resistive load	max. 10 Hz
• Inductive loads, according to IEC 947-5-1, AC 15	max. 0.5 Hz 1 Hz
• For lamp load	
Short-circuit protection of the output	No

3.18 Digital Output Module SM 322; DO 16 x DC 24 V/ 0.5 A; (6ES7322-1BH01-0AA0)

Order number: "Standard module"

6ES7322-1BH01-0AA0

Order number: "SIPLUS S7-300-Module"

6AG1322-1BH01-2AA0

Characteristics

The digital output module SM 322; DO 16 x 24 VDC/0.5 A has the following salient features:

- 16 outputs, isolated in groups of 8

- 0.5 A output current

- 24 VDC rated load voltage

- Suitable for solenoid valves, DC contactors and indicator lights

Using the module with high-speed counters

Please take note of the following information on the use of the module in connection with high-speed counters:

Note

When connecting the 24 V power supply via a mechanical contact, the outputs of the SM 322; DO 16 x 24 VDC/0.5 A carry a "1" signal for approximately 50 μs for reasons associated with the circuitry.

Terminal assignment and block diagram of the SM 322; DO 16 x 24 VDC/0.5 A
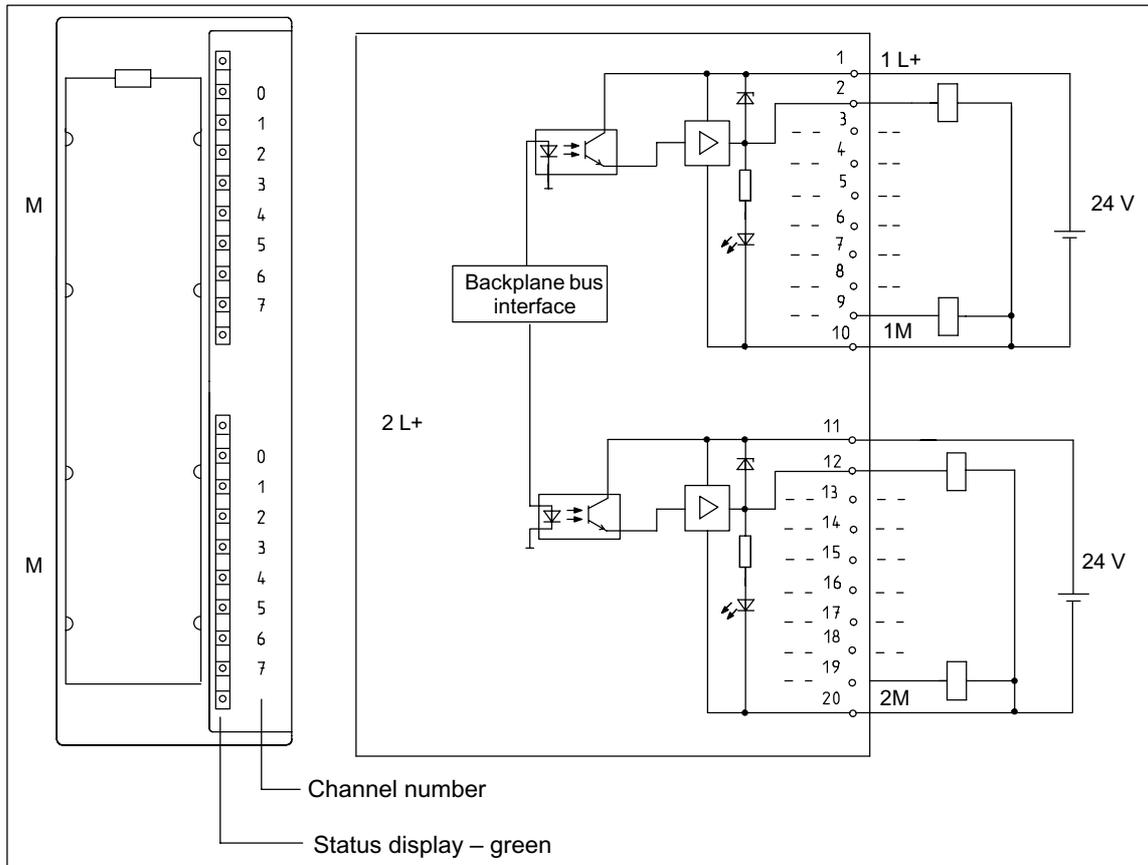
Figure 3-20   Module View and Block Diagram of the SM 322; DO 16 x 24 VDC/0.5 A

Technical specifications of the SM 322; DO 16 x 24 VDC/0.5 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 190 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	16
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L+	24 VDC
Total current of the outputs (per group)	
• Horizontal configuration	
Up to 40 °C	max. 4 A
Up to 60 °C	max. 3 A
• Vertical configuration	
Up to 40 °C	max. 2 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	8
Permitted potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 80 mA
• From load voltage L + (without load)	max. 80 mA
Power dissipation of the module	typ. 4.9 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting an Actuator	
Output voltage	
• At signal "1"	min. L + (–0.8 V)
Output current	
• At signal "1"	
Rated value	0.5 A
Permitted range	5 mA to 0.6 A
• At signal "0" (leakage current)	max. 0.5 mA
Output delay (for resistive load)	
• From " 0" to "1"	max. 100 μs
• At "1" to "0"	max. 500 μs
Load resistor range	48 Ω to 4 kΩ
Lamp load	max. 5 W
Parallel connection of 2 outputs	
• For redundant triggering of a load	Possible (only outputs of the same group)
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 100 Hz
• Inductive loads according to IEC 947-5-1, DC 13	max. 0.5 Hz
• For lamp load	max. 10 Hz
Limit (internal) of the inductive circuit interruption voltage up	L + (–53 V), typ.
Short-circuit protection of the output	Yes, electronic
• Threshold on	1 A, typ.

3.19 Digital Output Module SM 322; DO 16 x 24 VDC/0.5 A High Speed; (6ES7322-1BH10-0AA0)

Order number:

6ES7322-1BH10-0AA0

Characteristics

The SM 322; DO 16 x 24 VDC/0.5 A High Speed has the following salient features:

- 16 outputs, isolated in groups of 8
- 0.5 A output current
- 24 VDC rated load voltage
- Suitable for solenoid valves, DC contactors and indicator lights
- Supports clocked operation

Using the module with high-speed counters

Please take note of the following information on the use of the module in connection with high-speed counters:

Note

When connecting the 24 V power supply via a mechanical contact, the outputs of the SM 322; DO 16 x 24 VDC/0.5 A High Speed carry a "1" signal for approximately 50 μs for reasons associated with the circuitry.

Terminal assignment and block diagram of the SM 322; DO 16 x 24 VDC/0.5 A High Speed
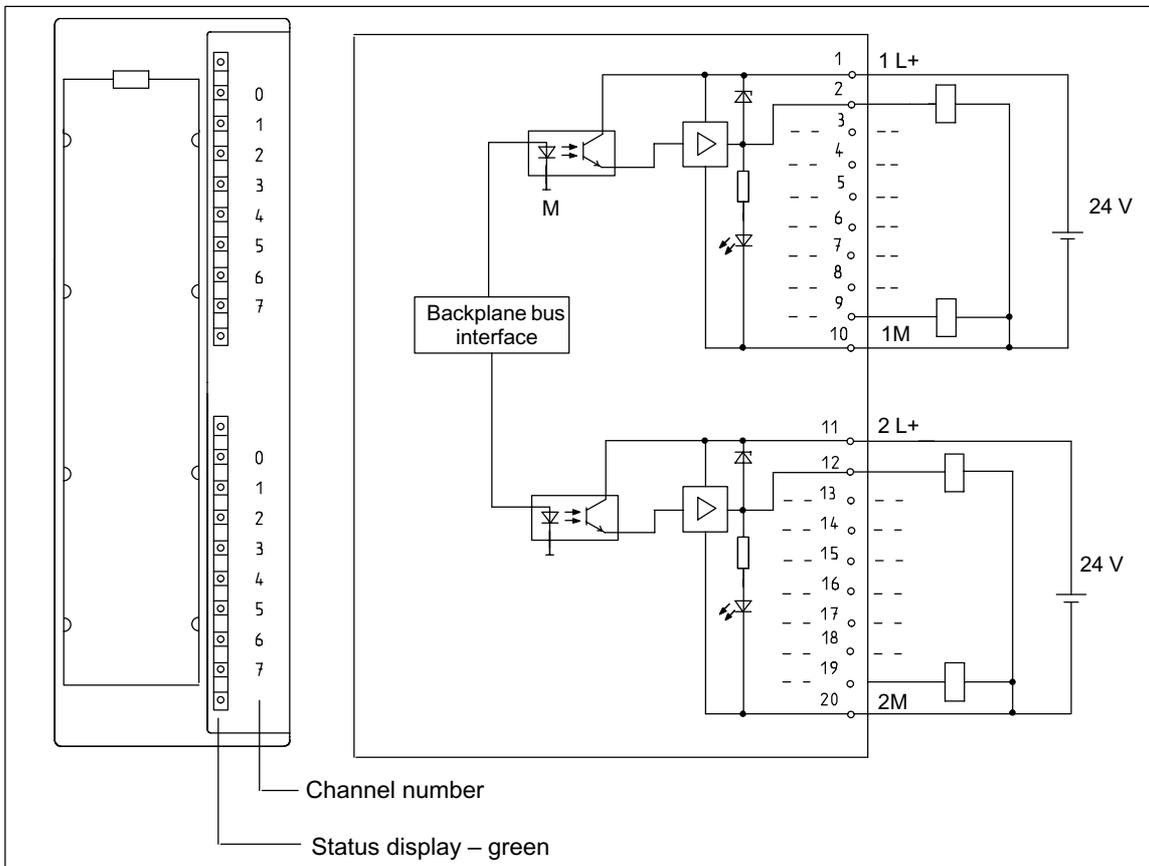
Figure 3-21   Module View and Block Diagram of the SM 322; DO 16 x 24 VDC/0.5 A High Speed

Technical specifications of the SM 322; DO 16 x 24 VDC/0.5 A High Speed

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 200 g
Data for Specific Module	
Supports clocked operation	Yes
Number of outputs	16
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L+	24 VDC
Total current of the outputs (per group)	
• Horizontal configuration	
Up to 40 °C	max. 4 A
Up to 60 °C	max. 3 A
• Vertical configuration	
Up to 40 °C	max. 2 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	8
Permitted potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 70 mA
• From load voltage L + (without load)	max. 110 mA
Power dissipation of the module	typ. 5 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting an Actuator	
Output voltage	
• At signal "1"	min. L + (–0.8 V)
Output current	
• At signal "1"	
Rated value	0.5 A
Permitted range	5 mA to 0.6 A
• At signal "0" (leakage current)	max. 0.5 mA
Output delay (for resistive load)	
• From " 0" to "1"	max. 100 μs
• At "1" to "0"	max. 200 μs
Internal module run time between the backplane bus and the output driver input	
• "0" to "1"	0.1 μs to 20 μs
• At "1" to "0"	0.1 μs to 20 μs
Load resistor range	48 Ω to 4 kΩ
Lamp load	max. 5 W
Parallel connection of 2 outputs	
• For redundant triggering of a load	Possible (only outputs of the same group)
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 1000 Hz
• Inductive loads according to IEC 947-5-1, DC 13	max. 0.5 Hz
• For lamp load	max. 10 Hz
Limit (internal) of the inductive circuit interruption voltage up	L + (–53 V), typ.
Short-circuit protection of the output	Yes, electronic
• Threshold on	1 A, typ.

3.20 Digital Output Module SM 322; DO 16 x 24/48 VUC; (6ES7322-5GH00-0AB0)

Order number

6ES7322-5GH00-0AB0

Characteristics

Digital output module SM 322; DO 16 x UC24/48 V has the following features:

- 16 individually isolated static relay outputs

- Electrical isolation between channels of 120 V

- Switch characteristics: R_{DS} ON is typically 0.25 ohms and R_{DS} OFF is typically greater than 100 G-ohms

- Designed for load voltages up to 48 V AC or DC and there is no minimum load voltage

- Designed for output loads up to 0.5 A and there is no minimum load current

- Outputs are fully independent and can be connected in any required configuration

- Substitute values or "Hold last values" can be programmed for the outputs

- The module has diagnostics for parameterization errors and external loss of voltage

- Suitable for AC solenoids, contact makers, motor starters, fractional horsepower motors and indicator lights

Terminal assignment and block diagram of the SM 322; DO 16 x 24/48 VUC
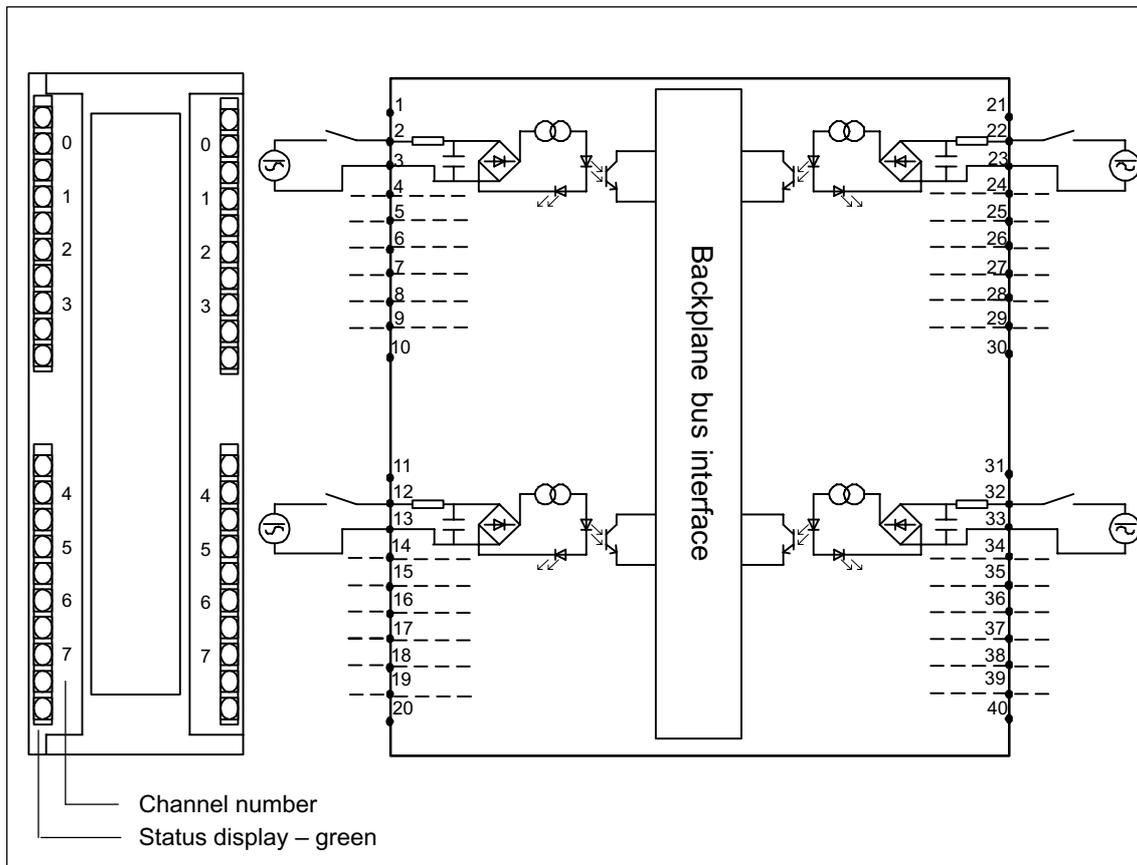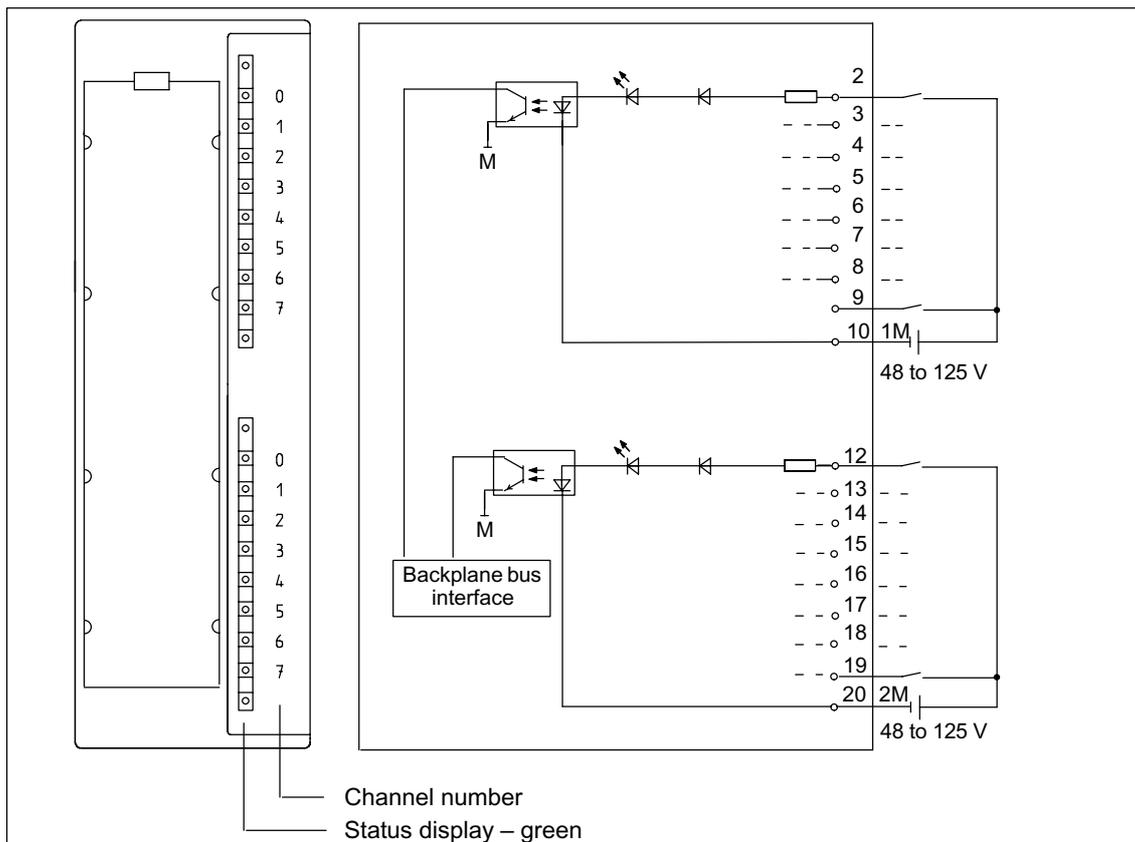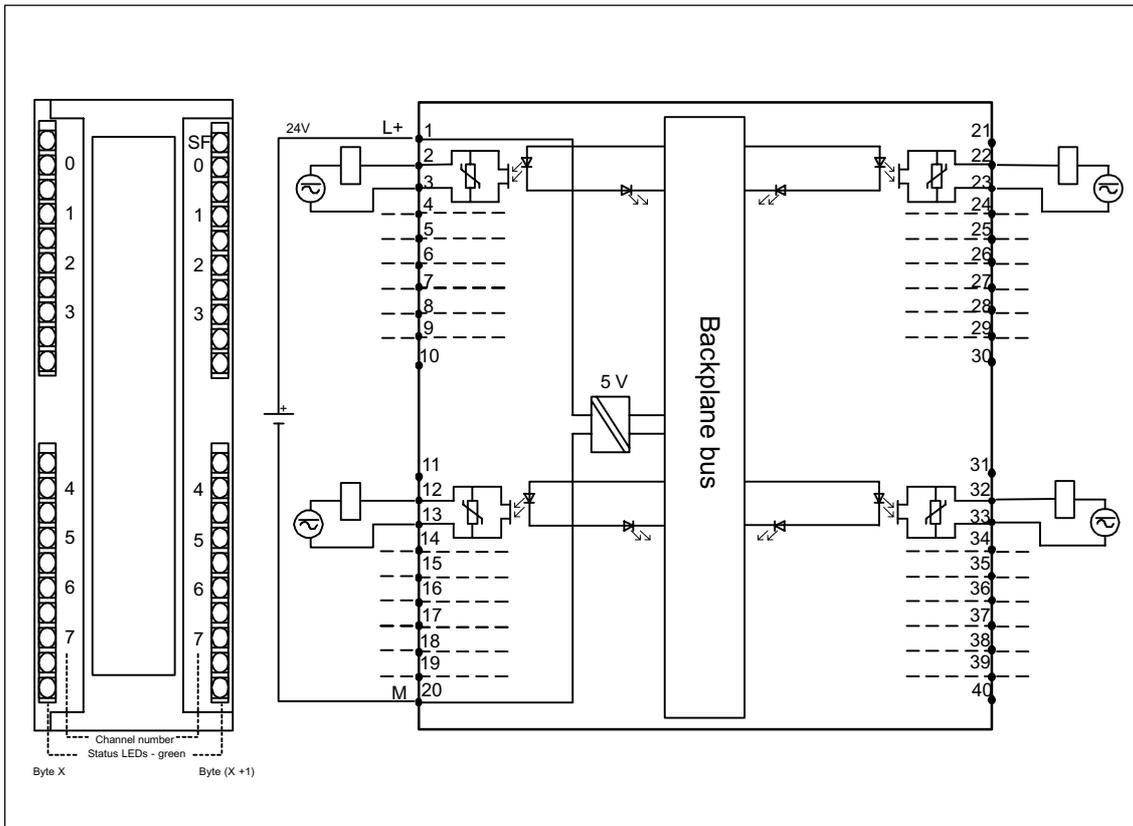

Figure 3-22   Module View and Block Diagram of SM 322; DO 16 x 24/48 VUC

Technical specifications of the SM 322; DO 16 x 24/48 VUC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 260 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	16
Length of cable	
● Unshielded	max. 600 m
● Shielded	max. 1000 m
Voltages, Currents, Potentials	
Power rated voltage of the electronics L+	24 VDC
● Reverse polarity protection	Yes
● Power failure jumpering	min. 5 ms
Total current of the outputs (per group)	
● Horizontal configuration Up to 60° C	max. 0.5 A
● All other mounting positions Up to 40° C	max. 0.5 A
Total current of the outputs (per module)	
● Horizontal configuration Up to 60° C	max. 8 A
● All other mounting positions Up to 40° C	max. 8 A
Isolation	
● Between channels and backplane bus	Yes
● Between channels and power supply of the electronics	Yes
● Between channels	Yes
In groups of	1
Permitted potential difference	
● Between channels and backplane bus	170 VDC, 120 VAC
● Between channels and power supply of the electronics	170 VDC, 120 VAC
● Between the outputs of the different groups	170 VDC, 120 VAC

Insulation tested with	
● Between channels and backplane bus	1500 VAC
● Between channels and power supply of the electronics	1500 VAC
● Between the outputs of the different groups	1500 VAC
Current consumption	
● From the backplane bus	max. 100 mA
● From supply voltage L+	max. 200 mA
Power dissipation of the module	typ. 2.8 W
Status, Interrupts, Diagnostics	
Status display	Green LEDs per channel
Diagnostic functions	
● Group error display	Red LED (SF)
Interrupts	
● Diagnostic interrupt	Parameters can be assigned
● Diagnostics information read-out	Possible
Data for Selecting an Actuator	
Output voltage	
● At signal "1"	min. L+ (–0.25 V)
Output current	
● At signal "1" rated value permissible surge current (per group)	0.5 A max. 1.5 A (max. 50 ms)
● For "0" signal (leakage current)	max. 10 uA
Output delay (for resistive load)	
● From " 0" to "1"	max. 6 ms
● At "1" to "0"	max. 3 ms
External fuse for relay outputs	Fuse, $I^2 t$: 1 A^2 s, quick-acting*
Lamp load	max. 2.5 W
Contact circuit (internal) parallel switching of 2 outputs	Varistor, 85 V
● For redundant triggering of a load	Possible
● To increase performance	Not possible

Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 10 Hz
• Inductive loads according to IEC 947-5-1; DC 12 AC/12	max. 0.5 Hz
• For lamp load	max. 0.5 Hz

* Outputs must be protected by a 250 V quick-acting fuse (recommended fuses: Wickman 194-1100 1.1 A and Littelfuse 0217-800 V 800 mA).
When mounted in a hazardous area in accordance with the National Electric Code (NEC), use only a suitable tool to remove the fuse if the module is not located in a potentially explosive atmosphere.

3.20.1 Parameters of digital output module SM 322 DO 16 x UC24/48 V

Parameter assignment

Table 3-14 and Table 3-15 show the data record numbers for static and dynamic parameters.

Table 3-14 Data record no. 0 (static parameters):

Parameters	Comments
Enable diagnostics	Enabling an interrupt when the module fails because of an operation code error, a hardware fault or a voltage error.

Table 3-15 Data record no. 1 (dynamic parameters):

Parameters	Comments
Behavior on CPU STOP	
Hold last value	
Substitute value output	
Substitute value	
Substitute value	Each bit corresponds to an output.

This module supports failure state/substitute value outputs when the CPU changes from RUN to STOP.

Status display

Each output of this module has a green LED to indicate the status of the relay. There is also a red LED (SF) that indicates the diagnostics status of the module.

Diagnostics, troubleshooting

Diagnostic data is assigned in accordance with the following technical specifications.

In the additional interrupt information, the four system diagnostics data bytes can be read as data record 0 or in the first 4 bytes of data record 1.

Structure of the data record

The structure of data record 1 is as specified in Table 3-16.

Table 3-16   Structure of the data record for SM 322 DO 16 x UC 24/48 V

Data record 1 byte address	Available information	Contents
0..3	System-specific diagnostics data	4 Bytes
4	Channel type	72h
5	Diagnosis length per channel in bytes	0
6	Number of channels	16
7	Channel error vector	0 byte per channel
8..15	Channel-specific diagnostic data	0 byte per channel

Table 3-17 shows the system diagnostics for module SM 322;
DO 16 x UC24/48 V.

Table 3-17   System diagnostics for SM 322 DO 16 x UC 24/48 V

System diagnosis byte 1:		Technical specification
D0:	Module error	Yes
D1:	Internal malfunction	Yes
D2:	External malfunction	Yes
D3:	Channel error	No
D4:	External auxiliary supply missing	Yes
D5:	Front connector missing	No
D6:	Module not parameterized.	Yes
D7:	Wrong parameters	Yes

Table 3-17   System diagnostics for SM 322 DO 16 x UC 24/48 V

System diagnosis byte 2:		
D0..D3	Module Type	1111
D4:	Channel information available	No
D5:	User information available	No
D6:	Diagnostic alarm from substitute	No
D7:	Spare	
System diagnosis byte 3:		
D0:	Memory module incorrect/missing	No
D1:	Communication error	No
D2:	RUN/STOP mode	No
D3:	Time monitoring triggered	Yes
D4:	Internal power failure	No
D5:	Battery 1 empty	No
D6:	Complete backup failure	No
System diagnosis byte 4:		
D7:	Spare	
D0:	Rack failure	No
D1:	Processor failure	Yes
D2:	EPROM error	Yes
D3:	RAM error	Yes
D4:	DAC error	No
D5:	Blown fuse	No
D6:	Hardware interrupt lost	No
D7:	Spare	
Channel-specific diagnosis byte		
D0:	Parameter setup error	No
D1:	Grounding error	No
D2:	Short-circuit to P	No
D3:	Short-circuit to M	No
D4:	Wire-break	No
D5:	Spare	
D6:	Auxiliary supply missing	No
D7:	Overtemperature	No

3.21 Digital Output Module SM 322; DO 16 x VAC 120/230/1 A; (6ES7322-1FH00-0AA0)

Order number

6ES7322-1FH00-0AA0

Characteristics

Digital output module SM 322; DO 16 x 120/230 VAC/1 A has the following distinguishing characteristics:

- 16 outputs, fused and electrically isolated in groups of 8

- 1 A output current

- Rated load voltage 120/230 VAC

- Suitable for AC solenoids, contact makers, motor starters, fractional horsepower motors and indicator lights

Terminal assignment and block diagram of the SM 322 DO 16 x 120/230 VAC/1 A
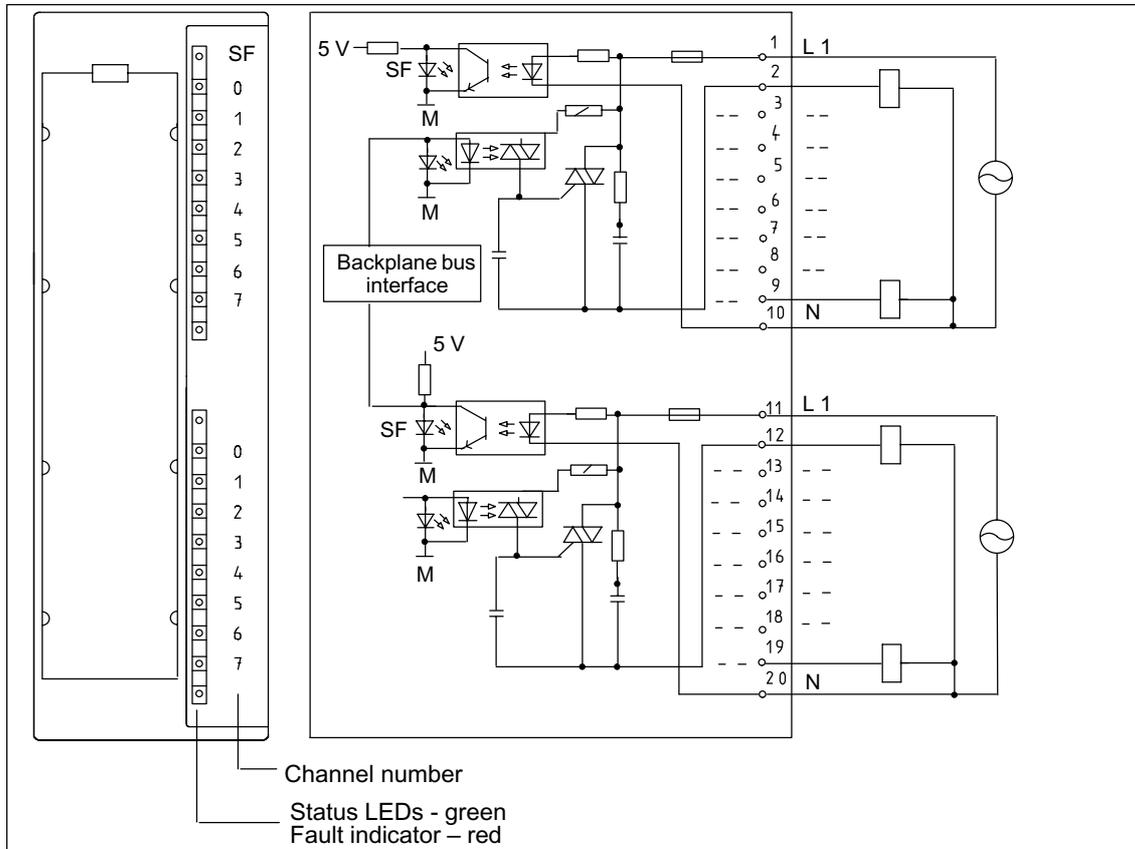
Figure 3-23   Module View and Block Diagram of the SM 322; DO 16 x 120/230 VAC/1 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 275 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	16
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L1 All load voltages must be of the same phase	120/230 VAC
Total current of the outputs (per group)	
• Horizontal configuration	
Up to 40 °C	max. 4 A
Up to 60 °C	max. 2 A
• Vertical configuration	
Up to 40 °C	max. 2 A
Isolation	
• Between channels and backplane bus	Yes
• Between channels	Yes
In groups of	8
Permitted potential difference	
• Between $M_{internal}$ and the outputs	500 VAC
• Between the outputs of the different groups	230 VAC
Insulation tested with	4000 VDC
Current consumption	
• From the backplane bus	max. 200 mA
• From load voltage L+ (without load)	max. 2 mA
Power dissipation of the module	typ. 8.6 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	
• Diagnostic interrupt	No
Diagnostic functions	
• Group error display	Red LED (SF)
	(fuse or no L1/N)

Data for Selecting an Actuator	
Output voltage	
• At signal "1"	min. L + (–0.8 V)
Output current	
• At signal "1"	
Rated value	1 A
Permitted range for 0° C to 40° C	10 mA to 1 A
Permitted range for 0° C to 60° C	10 mA to 0.5 A
Permitted surge current (per group)	max. 20 A (with 2 half-waves)
• At signal "0" (leakage current)	max. 2 mA
Inhibit voltage	max. 60 V
Zero cross inhibit voltage	
Size of the motor starter	max. size 4 to NEMA
Lamp load	max. 50 W
Connecting two outputs in parallel	
• For redundant triggering of a load	Possible (only outputs of the same group)
• To increase performance	No
Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 10 Hz
• Inductive loads, according to IEC 947-5-1, AC 15	max. 0.5 Hz
• For lamp load	max. 1 Hz
Short-circuit protection of output	Fuse 8 A, 250 V; per group
• Min. current required for fuse to blow	min. 40 A
• Max. response time	max. 300 ms
Replacement fuses	8 A fuse, quick-acting
• Wickman	19 194-8 A
• Schurter	SP001.1014
• Littlefuse	217.008
Fuse carrier	
• Wickman	19 653

3.22 Digital Output Module SM 322; DO 8 x 24 VDC/2 A; (6ES7322-1BF01-0AA0)

Order number

6ES7322-1BF01-0AA0

Characteristics

The digital output module SM 322; DO 8 x 24 VDC/2 A has the following salient features.

- 8 outputs, isolated in groups of 4

- 2 A output current

- 24 VDC rated load voltage

- Suitable for solenoid valves, DC contactors and indicator lights

Using the module with high-speed counters

Please take note of the following information on the use of the module in connection with high-speed counters:

Note

When connecting the 24 V power supply via a mechanical contact, the outputs of the SM 322; DO 8 x 24 VDC/2 A carry a "1" signal for approximately 50 μs for reasons associated with the circuitry.

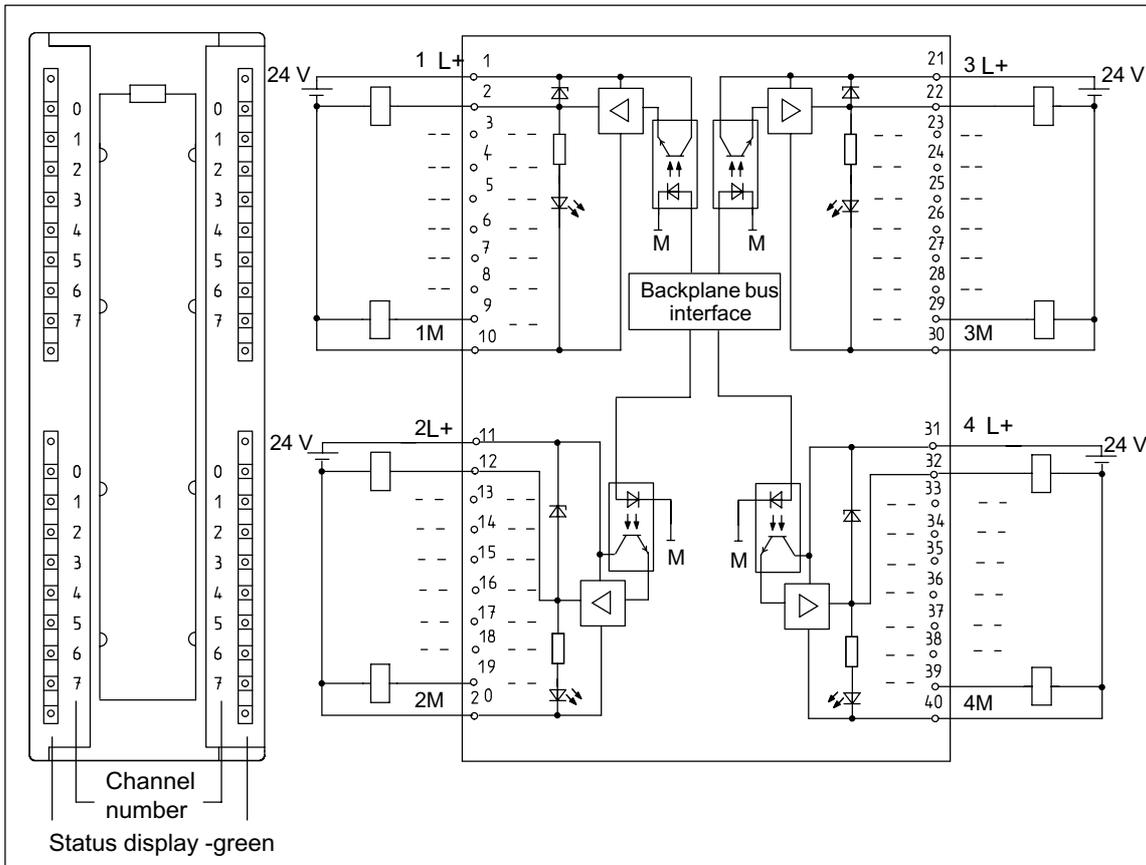## Terminal Assignment and Block Diagram of the SM 322; DO 8 x 24 VDC/2 A
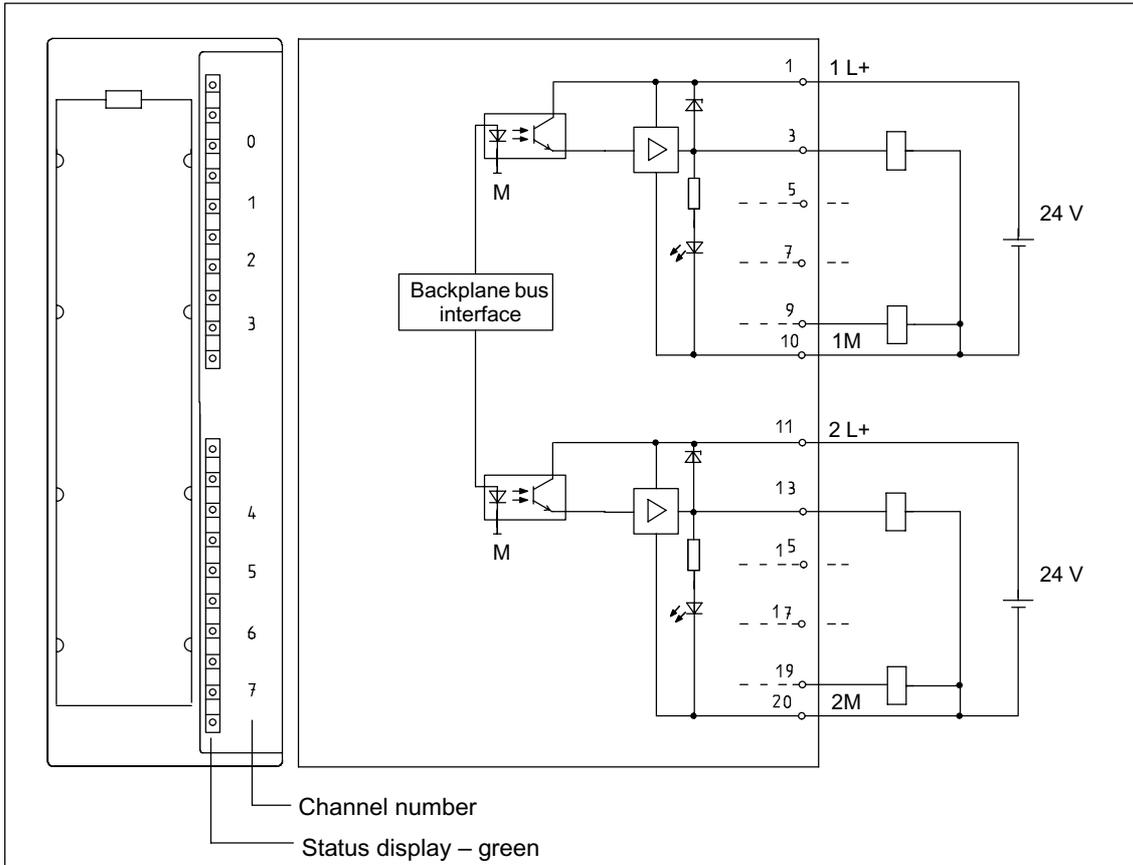
Figure 3-24   Module View and Block Diagram of Digital Output Module SM 322; DO 8 x 24 VDC/2 A

Technical specifications of the SM 322; DO 8 x 24 VDC/2 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 190 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L+	24 VDC
Total current of the outputs (per group)	
• Horizontal configuration	
Up to 60 °C	max. 4 A
• Vertical configuration	
Up to 40 °C	max. 4 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	4
Permitted potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 40 mA
• From load voltage L+ (without load)	max. 60 mA
Power dissipation of the module	typ. 6.8 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting an Actuator	
Output voltage	
• At signal "1"	min. L + –0.8 V
Output current	
• At signal "1"	
Rated value	2 A
Permitted range	5 mA to 2.4 A
• At signal "0" (leakage current)	max. 0.5 mA
Output delay (for resistive load)	
• From " 0" to "1"	max. 100 μs
• At "1" to "0"	max. 500 μs
Load resistor range	12 Ω to 4 kΩ
Lamp load	max. 10 W
Parallel connection of 2 outputs	
• For redundant triggering of a load	Possible (only outputs of the same group)
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 100 Hz
• Inductive loads according to IEC 947-5-1, DC 13	max. 0.5 Hz
• For lamp load	max. 10 Hz
Limit (internal) of the inductive circuit interruption voltage up	typ. L + (–48 V)
Short-circuit protection of the output	Yes, electronic
• Threshold on	typ. 3 A

3.23 Digital Output Module SM 322; DO 8 x DC 24 V/ 0.5 A; with diagnostic interrupt; (6ES7322-8BF00-0AB0)

Order number: "Standard module"

6ES7322-8BF00-0AB0

Order number: "SIPLUS S7-300-Module"

6AG1322-8BF00-2AB0

Characteristics

The digital output module SM 322; DO x 24 VDC/0.5 A has the following salient features:

- 8 outputs, isolated in groups of 8
- 0.5 A output current
- 24 VDC rated load voltage
- Suitable for solenoid valves, DC contactors and indicator lights
- 2 terminals per output
  - Output without series diode
  - Output with series diode (for redundant load control)
- Group error display
- Channel-specific status and error LEDs
- Programmable diagnostics
- Programmable diagnostic interrupt
- Programmable substitute value output

Terminal assignment and block diagram of the SM 322; DO 8 x 24 VDC/0.5 A
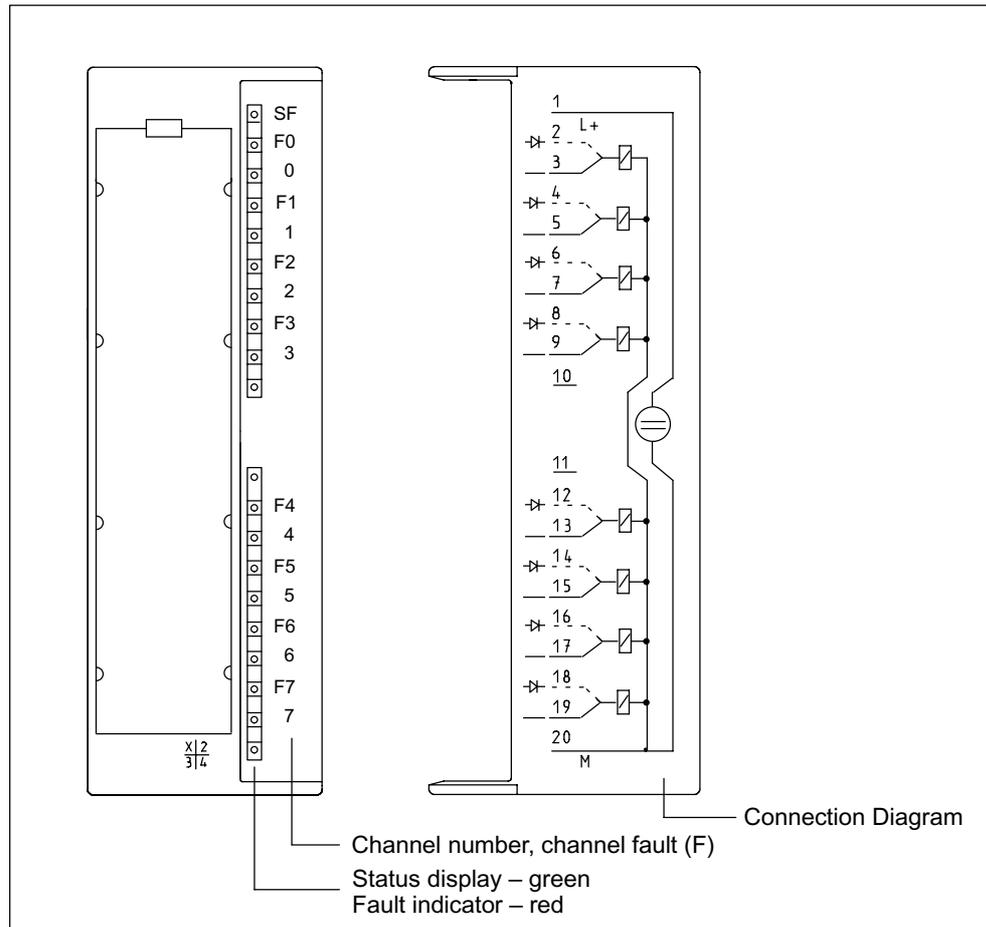
Figure 3-25   Module view of the SM 322; DO 8 × 24 V DC/0.5 A
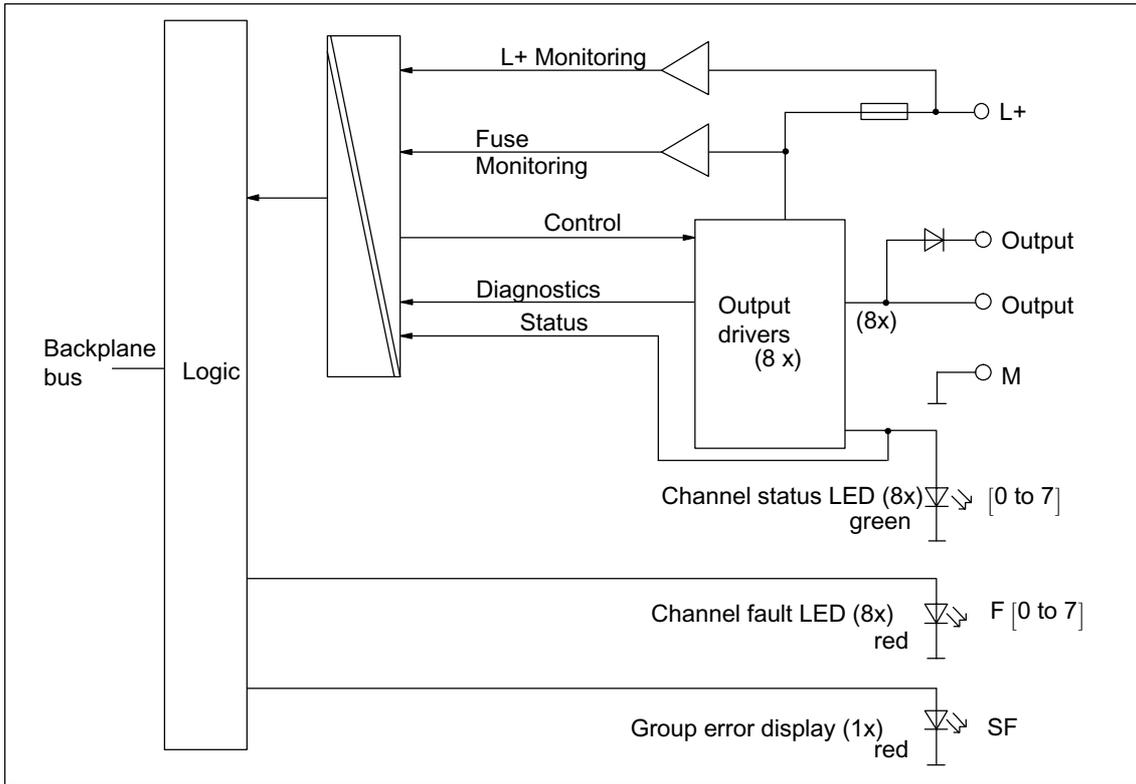
Figure 3-26   Block Diagram of the SM 322; DO 8 $\times$ DC 24 V/0.5 A

Redundant control of a load

The output with series diode can be used for redundant control of a load. Redundant control is possible from two different signal modules without external circuitry. Both modules must have the same reference potential, M.

Note

If the output with series diode is used, external short-circuits to L+ cannot be detected.

Technical specifications of the SM 322; DO 8 x 24 VDC/0.5 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 210 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L+	24 VDC
Total current of the outputs (per group) without series diode	
• Horizontal configuration	
Up to 40 °C	max. 4 A
Up to 60 °C	max. 3 A
• Vertical configuration	
Up to 40 °C	max. 4 A
Total current of the outputs (per group) with series diode	
• Horizontal configuration	
Up to 40 °C	max. 3 A
Up to 60 °C	max. 2 A
• Vertical configuration	
Up to 40 °C	max. 3 A
Isolation	
• Between channels and backplane bus	Yes
Permitted potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 70 mA
• From load voltage L+ (without load)	max. 90 mA
Power dissipation of the module	typ. 5 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	
• Diagnostic interrupt	Parameters can be assigned

Diagnostic functions	Parameters can be assigned
• Group error display	Red LED (SF)
• Channel error display (F)	Red LED (F) per channel
• Diagnostics information readable	Possible
Data for Selecting an Actuator	
Output voltage	
• At signal "1"	
Without series diode	min. L + (–0.8 V)
With series diode	min. L + (–1.6 V)
Output current	
• At signal "1"	
Rated value	0.5 A
Permitted range	10 mA to 0.6 A[1]
• At signal "0" (leakage current)	max. 0.5 mA
Output delay (for resistive load)	
• At "0" to "1"	max. 180 µs
• At "1" to "0"	max. 245 µs
Load resistor range	48 Ω to 3 kΩ
Lamp load	max. 5 W
Parallel connection of 2 outputs	
• For redundant actuation of a load	Output with series diode only, must have the same reference potential
• To increase performance	Not possible
Triggering a digital input	Possible
	1 binary input according to IEC 61131, Type 2; Type 1 with disabled open-circuit monitoring
Switch rate	
• For resistive load	max. 100 Hz
• Inductive load according to IEC 947-5-1, 13 DC	max. 2 Hz
• For lamp load	max. 10 Hz
Limit (internal) of the inductive circuit interruption voltage up	typ. L + (–45 V)
Short-circuit protection of the output	Yes, electronic
• Threshold on	typ. 0.75 A to 1.5 A

[1] 5 mA to 0.6 A with disabled open-circuit monitoring

3.23.1 Assigning Parameters to the SM 322; DO 8 x 24 VDC/0.5 A

Parameter assignment

You will find a description of the general procedure for assigning parameters to digital modules in Section 3.3.

Parameters of the SM 322; DO 8 x 24 VDC/0.5 A

You will find an overview of the parameters that you can set and their default settings for the SM 322; DO 8 x 24 VDC/0.5 A in the table below.

The default settings apply if you have not performed parameter assignment in *STEP 7*.

Table 3-18   Parameters of the SM 322; DO 8 x 24 VDC/0.5 A

Parameter	Value Range	Default Settings	Parameter Type	Scope
Enable				
• Diagnostic interrupt	Yes/no	No	Dynamic	Module
Behavior on CPU STOP	Apply substitute value (EWS)	EWS		
	Hold last value (LWH)			
Diagnostics				
• Wire-break	Yes/no	No		
• No load voltage L+	Yes/no	No	Static	Channel
• Short-circuit to M				
• Short-circuit to L+	Yes/no	No		
	Yes/no	No		
Apply substitute value "1"	Yes/no	No	Dynamic	Channel

3.23.2 Behavior and Diagnostics of the SM 322; DO 8 $\leq$ 24 VDC/0.5 A

Effect of operating and mode supply voltage on the output values

The output values of the SM 322; DO 8 x 24 VDC/0.5 A depend on the operating mode of the CPU and on the supply voltage of the module.

Table 3-19   Dependence of the output values on the operating mode of the CPU and on the supply voltage L+ of the SM 322; DO 8 x 24 VDC/0.5 A.

CPU Operating State		Power Supply L+ to Digital Module	Output Value of Digital Module
POWER ON	RUN	L+ exists	CPU value
		L+ missing	0 signal
	STOP	L+ exists	Substitute value/last value (0 signal preset)
		L+ missing	0 signal
POWER OFF	–	L+ exists	0 signal
		L+ missing	0 signal

Behavior upon failure of the supply voltage

Failure of the supply voltage of the SM 322; DO 8 x 24 VDC/0.5 A is always indicated by the SF LED on the module. Furthermore, this information is made available on the module (entry in diagnosis).

Triggering of the diagnostic interrupt depends on the parameter assignment (see Section 3.23.3).

Diagnostic Messages of the SM 322; DO 8 x 24 VDC/0.5 A

The following table provides an overview of the diagnostic messages of the SM 322; DO 8 x 24 VDC/0.5 A.

Table 3-20   Diagnostic Messages of the SM 322; DO 8 x 24 VDC/0.5 A

Diagnostics Message	LED	Scope of the Diagnostics	Parameters can be assigned
Wire-break	SF	Channel	Yes
Load voltage missing	SF	Channel	Yes
Short-circuit to M	SF	Channel	Yes
Short-circuit to L+	SF	Channel	Yes
External auxiliary supply missing	SF	Module	No
Internal auxiliary power missing	SF	Module	No
Fuse blown	SF	Module	No
Watchdog timeout	SF	Module	No
EPROM error	SF	Module	No
RAM error	SF	Module	No

* Open-circuit detection is performed at a current < 1 mA.
When suitably parameterized, a wire-break results only in the
SF LED and the corresponding channel error LED lighting up.

Note

A prerequisite for detecting the errors indicated by programmable diagnostic messages is that you have assigned parameters to the digital module accordingly in *STEP 7*.

Causes of error and remedial action

Table 3-21   Diagnostic Messages of the SM 322; DO 8 x 24 VDC/0.5 A, Causes of Error and Remedial Action

Diagnostics Message	Error Detection ...	Possible Error Cause	Remedy
Wire-break	Only with output to "1"	Open circuit between module and actuator	Close circuit
		Channel not connected (open)	Disable the "Diagnose Wire-break" parameter for the channel in *STEP 7*
No load voltage	Only with output to "1"	Defective output	Replace module
Short-circuit to M	Only with output to "1"	Overload of output	Eliminate overload
		Short-circuit of output to M	Eliminate short circuit
Short-circuit to L+	Always	Short-circuit at output to L+ of module supply	Eliminate short circuit
No external auxiliary voltage	Always	Power supply L+ to module missing	Feed supply L+
No internal auxiliary voltage	Always	Power supply L+ to module missing	Feed supply L+
		Fuse in module defective	Replace module
Fuse blown	Always	Fuse in module defective	Replace module
Watchdog tripped	Always	Temporary high electromagnetic interference	Eliminate interference
		Module defective	Replace module
EPROM error	Always	Temporary high electromagnetic interference	Eliminate interference and switch on/off power supply of CPU
		Module defective	Replace module
RAM error	Always	Temporary high electromagnetic interference	Eliminate interference and switch on/off power supply of CPU
		Module defective	Replace module

3.23.3 Interrupts of the SM 322; DO 8 x VDC 24/0.5 A

Introduction

The SM 322; DO 8 x 24 VDC/0.5 A can trigger diagnostic interrupts.

The OBs and SFCs mentioned below can be found in the online Help for *STEP 7*, where they are described in greater detail.

Enabling interrupts

The interrupts are not preset – in other words, they are inhibited without appropriate parameter assignment. Assign parameters to the Interrupt Enable in *STEP 7* (refer to Section 3.23.1).

Diagnostic interrupt

If you have enabled diagnostic interrupts, then active error events (initial occurrence of the error) and departing error events (message after troubleshooting) are reported by means of an interrupt.

The CPU interrupts the execution of the user program and processes the diagnostic interrupt block (OB 82).

In the user program, you can call SFC 51 or SFC 59 in OB 82 to obtain more detailed diagnostic information from the module.

The diagnostic information is consistent until such time as OB 82 is exited. When OB 82 is exited, the diagnostic interrupt is acknowledged on the module.

3.24 Digital Output Module SM 322; DO 8 x VDC 48-125/1,5 A; (6ES7322-1CF00-0AA0)

Order number: "Standard module"

6ES7322-1CF00-0AA0

Order number: "SIPLUS S7-300-Module"

6AG1322-1CF00-2AA0

Characteristics

The SM 322; DO 8 x 48-125 VDC/1.5 A features the following characteristics:

- 8 outputs, reverse polarity protection and isolated in groups of 4

- 1.5 A output current

- Rated load voltage 48 to 125 VDC

- Suitable for solenoid valves, DC contactors and indicator lights

- Group error display

Using the module with high-speed counters

Please take note of the following information on the use of the module in connection with high-speed counters:

Note

When connecting the power supply via a mechanical contact, the outputs of the SM 322; DO 8 x 48-125 VDC/1.5 A carry a "1" signal for approximately 50 μs for reasons associated with the circuitry.

Terminal assignment and block diagram of the SM 322; DO 8 x 48-125 VDC/1.5 A
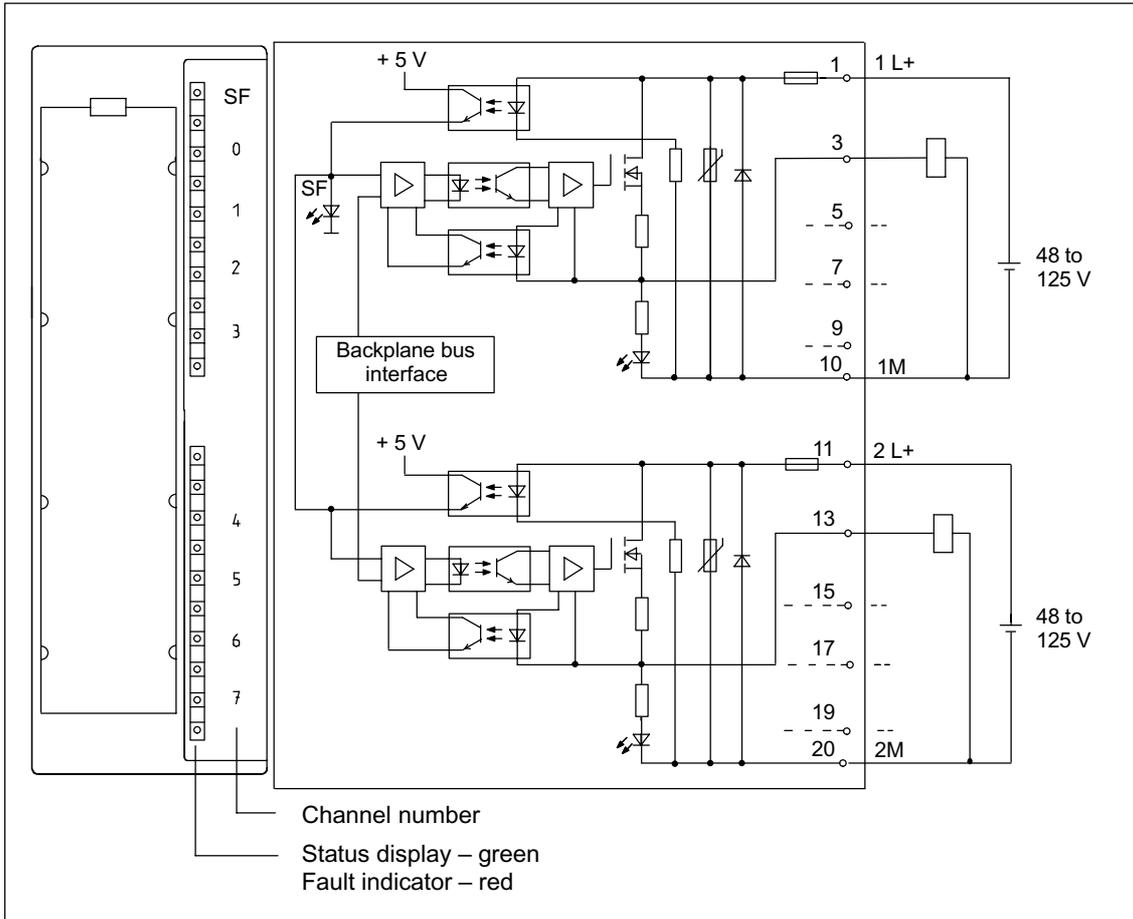
Figure 3-27   Module View and Block Diagram of the SM 322; DO 8 x 48-125 VDC/1.5 A

Technical specifications of the SM 322; DO 8 x 48-125 VDC/1.5 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 250 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L+	48 VDC to 125 VDC
• Reverse polarity protection	Yes, by means of fuse[1]
Total current of the outputs (per group)	
• Horizontal configuration	
Up to 40 °C	max. 6 A
Up to 50 °C	max. 4 A
Up to 60 °C	max. 3 A
• Vertical configuration	
Up to 40 °C	max. 4 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	4
Permitted potential difference	
• Between the different circuits	146 VDC / 132 VAC
Insulation tested with	1500 VAC
Current consumption	
• From the backplane bus	max. 100 mA
• From the load voltage L+ (no load)	max. 2 mA
Power dissipation of the module	typ. 7.2 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	
• Group error display	Red LED (SF)[2]

Data for Selecting an Actuator	
Output voltage	
• At " 1" signal	min. L + (–1.,2 V)
Output current	
• At " 1" signal	
Rated value	1.5 A
Permitted range	10 mA to 1.5 A
• Permitted surge current	max. 3 A for 10 ms
• For "0" signal (leakage current)	max. 0.5 mA
Output delay (for resistive load)	
• From " 0" to "1"	max. 2 ms
• At "1" to "0"	max. 15 ms
Lamp load	max. 15 W at 48 V max. 40 W at 125 V
Parallel connection of 2 outputs	
• For redundant actuation of a load	Possible (only outputs of the same group)
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 25 Hz
• For inductive load	max. 0.5 Hz
• For lamp load	max. 10 Hz
Limit (internal) of the in ductive circuit interruption voltage up	typ. M (–1V)
Short-circuit protection of the output	Yes, electronic[3]
• Threshold on	typ. 4.4 A
Replacement fuses	Fuse 6.,3 A/250 V, quick blow, 5 x 20 mm
• Schurter	SP0001.1012
• Wickman	194-1630-0
Fuse carrier	
• Wickman	653 0000 040

[1] The fuses on this module are merely supplementary fuses. External overcurrent protection (suitable for branch circuits conforming to the local regulations for electrical engineering) is required in the supply cables of the load circuit.

[2] Potential errors are:
- No load voltage
- Fuse defective
- Output overloaded

[3] If an overload condition is detected, the output is inhibited for approximately 2.4 s.

3.25 Digital Output Module SM 322; DO 8 x VAC 120/230/2 A; (6ES7322-1FF01-0AA0)

Order number: "Standard module"

6ES7322-1FF01-0AA0

Order number: "SIPLUS S7-300-Module"

6AG1322-1FF01-2AA0

Characteristics

The SM 322; DO 8 x 120/230 VAC/2 A features the following characteristics:

- 8 outputs, fused and isolated in groups of 4
- 2 A output current
- 120/230 VAC rated load voltage
- Suitable for AC solenoid valves, contactors, motor starters, fractional h.p. motors and indicator lights.
- Group error display

Terminal assignment and block diagram of the SM 322; DO 8 x 120/230 VAC/2 A
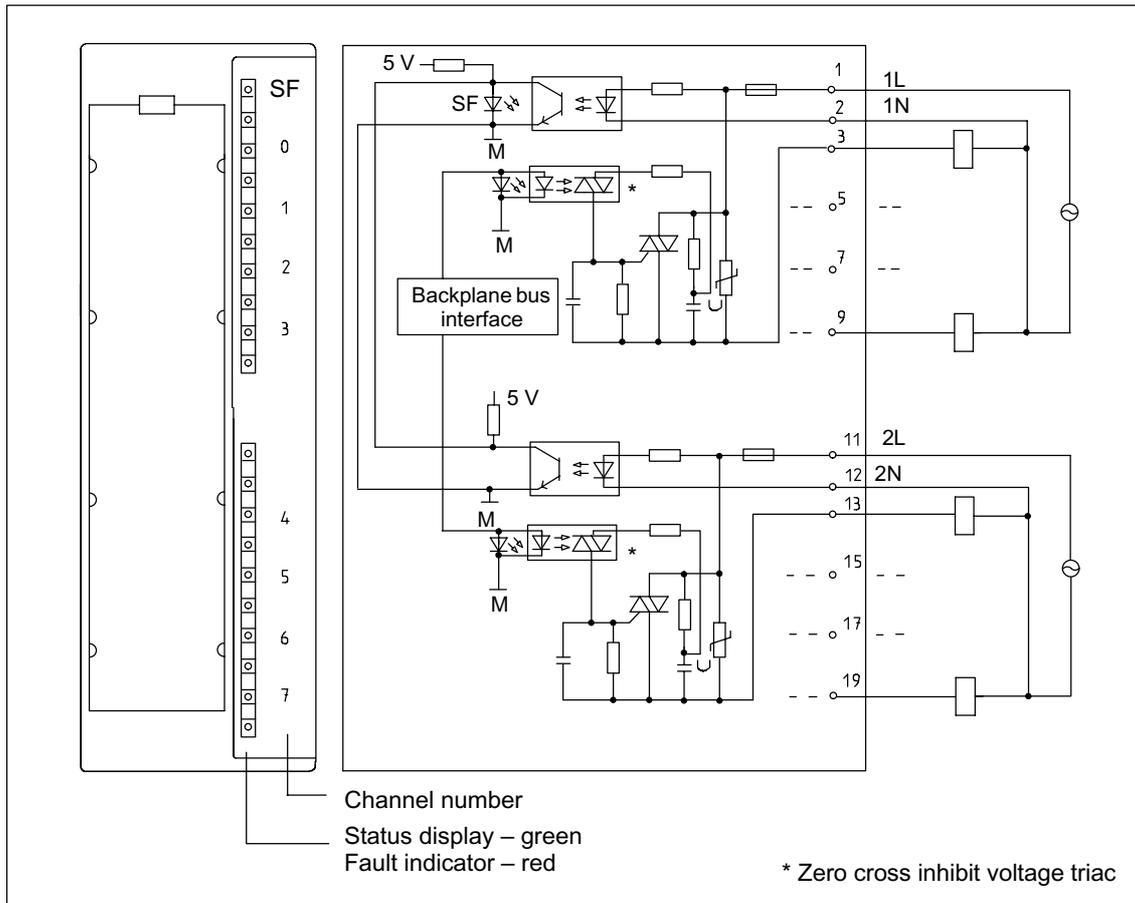
Figure 3-28   Module View and Block Diagram of the SM 322; DO 8 x 120/230 VAC/2 A

Technical specifications of the SM 322; DO 8 x 120/230 VAC/2 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 275 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L1	120/230 VAC
• Permitted frequency range	47 Hz to 63 Hz
Total current of the outputs (per group)	
• Horizontal configuration	
Up to 40 °C	max. 4 A
Up to 60 °C	max. 2 A
• Vertical configuration	
Up to 40 °C	max. 2 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	4
Permitted potential difference	
• Between $M_{internal}$ and the outputs	230 VAC
• Between the outputs of the different groups	500 VAC
Insulation tested with	1500 VAC
Current consumption	
• From the backplane bus	max. 100 mA
• From load voltage L1 (without load)	max. 2 mA
Power dissipation of the module	typ. 8.6 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	Yes
• Group error display	Red LED (SF) [2]

Data for Selecting an Actuator	
Output voltage	
• At signal "1"	
– At maximum current	min. L1 (–1.5 V)
– At minimum current	min. L1 (–8.5 V)
Output current	
• At signal "1"	
Rated value	AC 2 A[1]
Permitted range for 0 °C to 40 °C	10 mA to 2 A
Permitted range for 40 °C to 60 °C	10 mA to 1 A
Permitted current surge (per group)	max. 20 A (not more than 1 AC scan cycle)
• At signal "0" (leakage current)	max. 2 mA
Output delay (for resistive load)	
• From "0" to "1"	Not more than 1 AC scan cycle
• From "1" to "0"	Not more than 1 AC scan cycle
Minimum load current	10 mA
Zero cross inhibit voltage	max. 60 V
Size of the motor starter	max. size 5 to NEMA
Lamp load	max. 50 W
Connecting two outputs in parallel	
• For redundant triggering of a load	Possible (only outputs of the same group)
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 10 Hz
• Inductive loads, according to IEC 947-5-1, AC 15	max. 0.5 Hz
• For lamp load	1 Hz
Short-circuit protection of output	Fuse, 8 A/250 V; per group
• Min. current required for fuse to blow	min. 40 A
• Max. response time	max. 300 ms
Replacement fuses	8 A fuse/quick-acting
• Wickman	194-1800-0
• Schurter	SP001.1013
• Littelfuse	217.008
Fuse carrier	
• Wickman	653 07

[1] The load current must not be half-wave
[2] Potential errors are:
  - No load voltage
  - Fuse defective

3.26 Digital Output Module SM 322; DO 8 x 120/230 VAC/2 A ISOL (6ES7322-5FF00-0AB0)

Order number

6ES7322-5FF00-0AB0

Characteristics

Digital output module SM 322; DO 8 x 120/230 VAC/2 A ISOL has the following distinguishing characteristics:

- 8 outputs, isolated in one group

- Group error display

- Channel-specific status LEDs

- Programmable diagnostics

- Programmable diagnostic interrupt

- Programmable substitute value output

- 2 A output current

- 120/230 VAC rated load voltage

- Suitable for AC solenoid valves, contactors, motor starters, fractional h.p. motors and indicator lights.

Terminal assignment and block diagram of the SM 322; DO 8 x 120/230 VAC/2 A ISOL
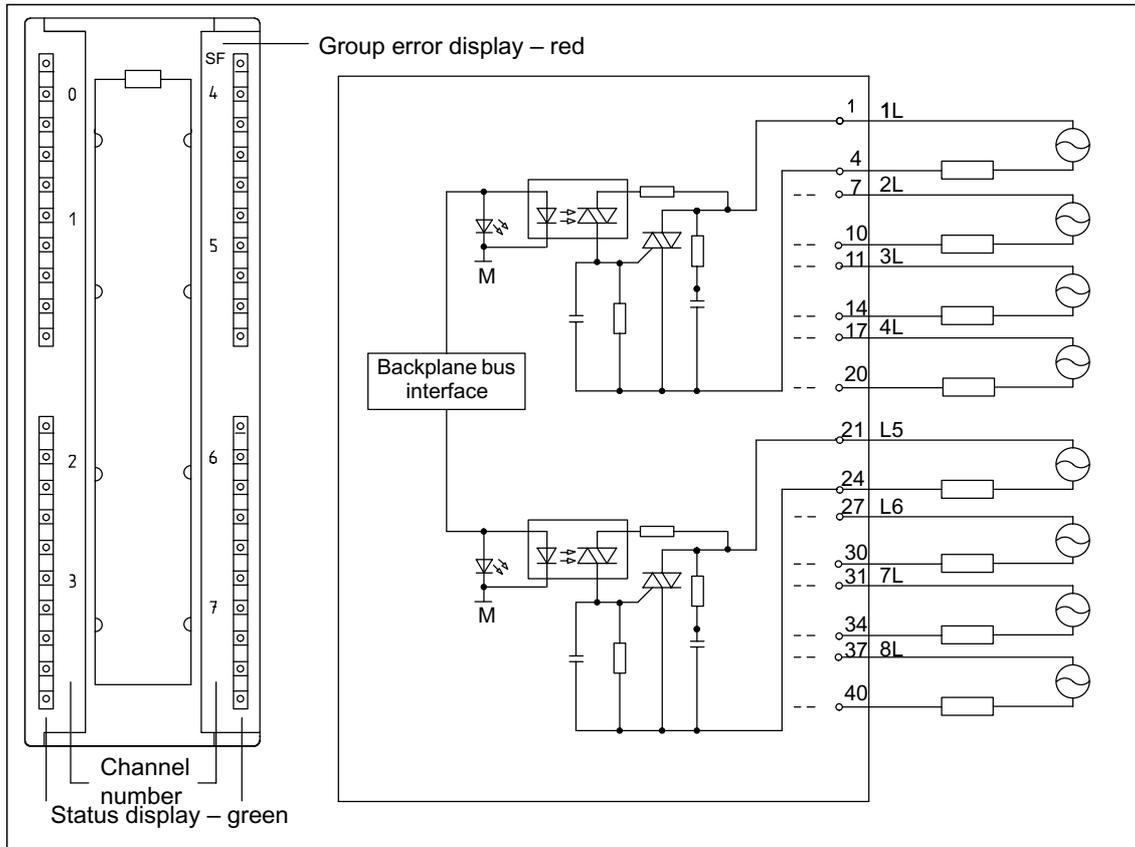
Figure 3-29   Module View and Block Diagram of the SM 322; DO 8 x 120/230 VAC/2 A ISOL

Technical specifications of the SM 322; DO 8 x 120/230 VAC/2 A ISOL

Dimensions and Weight	
Dimensions W x H x D	40 x 125 x 117
Weight	Approx. 275 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L1	120/230 VAC
Total current of the outputs (module)	
• Horizontal configuration	
Up to 40 °C	max. 8 A
Up to 60 °C	max. 4 A
• Vertical configuration	max. 4 A
Up to 40 °C	
Isolation	
• Between channels and backplane bus	Yes
• Between channels	Yes
In groups of	1
Permitted potential difference	
• Between $M_{internal}$ and the outputs	230 VAC
• Between outputs	500 VAC
Insulation tested with	
• Between $M_{internal}$ and the outputs	1500 VAC
• Between the outputs of the different groups	2000 VAC
Current consumption	
• From the backplane bus	max. 100 mA
• From load voltage L1 (without load)	max. 2 mA
Power dissipation of the module	typ. 8.6 W

Data for Selecting an Actuator	
Output voltage	
• At signal "1"	min. L1 (–8.5 V)
Output current	
• At signal "1"	
Rated value	2 A
Permitted range for 0 °C to 40 °C	10 mA to 2 A
Permitted range for 40 °C to 60 °C	10 mA to 1 A
Permitted surge current (per group)	max. 20 A (with 2 half-waves)
• For "0" signal (leakage current)	max. 2 mA
Zero cross inhibit voltage	max. 60 V
Size of the motor starter	max. size 5 to NEMA
Lamp load	max. 50 W
Connecting two outputs in parallel	
• For redundant triggering of a load	Possible
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 10 Hz
• Inductive loads, according to IEC 947-5-1, AC 15	max. 0.5 Hz
• For lamp load	max. 1 Hz
Short-circuit protection of output	Yes, 3.15 A / 250 V fuse, fast-acting

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	
• Diagnostic interrupt	Parameters can be assigned
Diagnostic functions	
• Group error display	Red LED (SF)

Note

The outputs must be protected by a high-speed, fast-acting 3.15 A 250 VAC fuse. When mounted in a hazardous area in accordance with the National Electric Code, a tool must be used to remove the fuse and the area must be designated safe before the fuse is removed/replaced.

Parameterization of the SM 322; DO x 120/230 VAC/2 A ISOL

A description of the general procedure for parameterizing digital modules can be found in section 3.3.

Detailed information on the digital output module parameters can be found in Appendix A.3.

Parameters of the SM 322; DO 8 x 120/230 VAC/2 A ISOL

Table 3-22 shows the settable parameters with the default settings for the SM 322; DO 8 x 120/230 VAC/2 A ISOL.

The default settings apply if you have not performed parameter assignment in STEP 7.

Table 3-22   Parameters of the SM 322; DO 8 x 120/230 VAC/2 A ISOL

Parameter	Value Range	Default settings	Parameter type	Scope
Enable • Diagnostic interrupts	Yes/no	No	Dynamic	Module
Behavior on CPU STOP	Switch substitute value (EWS) Hold last value (LWH)	EWS	Dynamic	Channel
Switch substitute value "1"	Yes/no	No	Dynamic	Channel

Behavior and Diagnostics of the SM 322; DO 8 x 120/230 VAC/2 A ISOL

Table 3-23 gives an overview of the diagnostic messages of the
SM 322; DO 8 x 120/230 VAC/2 A ISOL.

Table 3-23   Diagnostic Messages of the SM 322; DO 8 x 120/230 VAC/2 A ISOL

Diagnostics Message	LED	Scope of the diagnostics	Parameters can be assigned
Time-out	SF	Module	No
EPROM error	SF	Module	No
RAM error	SF	Module	No

Error causes and remedies

Table 3-24 shows the diagnostic messages and error causes as well as the
remedies of the SM 322; DO 8 x 120/230 VAC/2 A ISOL.

Table 3-24   Diagnostic messages of the SM 322; DO 8 x 120/230 VAC/2 A ISOL,
error causes and remedies

Diagnostics message	Error detection	Possible error cause	Remedy
Time-out	Always	Transient high electromagnetic interference	Remove interference and turn the CPU power supply off and on
		Module defective	Replace module
EPROM error	Always	Transient high electromagnetic interference	Remove interference and turn the CPU power supply off and on
		Module defective	Replace module
RAM error	Always	Transient high electromagnetic interference	Remove interference and turn the CPU power supply off and on
		Module defective	Replace module

Interrupts of the SM 322; DO 8 x 120/230 VAC/2 A ISOL

The SM 322; DO 8 x 120/230 VAC/2 A ISOL can trigger diagnostic interrupts.

The OBs and SFCs mentioned below are described in detail in the online Help for STEP 7.

Enabling interrupts

The interrupts are not available – in other words, they are withheld without appropriate parameter assignment. Use STEP 7 to assign parameters for enabling interrupts.

Diagnostic interrupt

If you have enabled diagnostic interrupts, then active error events (initial occurrence of the error) and departing error events (message after troubleshooting) are reported by means of interrupts.

The CPU interrupts execution of the user program and processes the diagnostic interrupt block (OB 82).

In the user program, you can call SFC 51 or SFC 59 in OB 82 to obtain more detailed diagnostic information from the module.

The diagnostic information is consistent until such time as OB 82 is exited. When OB 82 is exited, the diagnostic interrupt is acknowledged at the module.

Load restrictions with a horizontal configuration

With a horizontal configuration, the module loads must be restricted so that two adjacent inputs or outputs do not exceed the maximum rating for an input or an output.

Load restrictions with a vertical configuration

With a vertical configuration, the module loads must be restricted so that four adjacent inputs or outputs do not exceed the maximum rating for an input or an output.

3.27   Relay Output Module SM 322; DO 16 x Rel. 120/230 VAC; (6ES7322-1HH01-0AA0)

Order number

6ES7322-1HH01-0AA0

Characteristics

The SM 322; DO 16 x Rel. 120/230 VAC features the following characteristics:

- 16 outputs, isolated in groups of 8

- Rated load voltage 24 VDC to 120 VDC, 48 VAC to 230 VAC

- Suitable for AC/DC solenoid valves, contactors, motor starters, fractional h.p. motors and indicator lights.

Behavior upon power down of the supply voltage

Note

When the power supply is switched off, the capacitor still stores energy for about 200 ms. The relay can therefore still be driven briefly within this time by the user program.

Terminal assignment and block diagram of the SM 322; DO 16 x Rel. 120/230 VAC
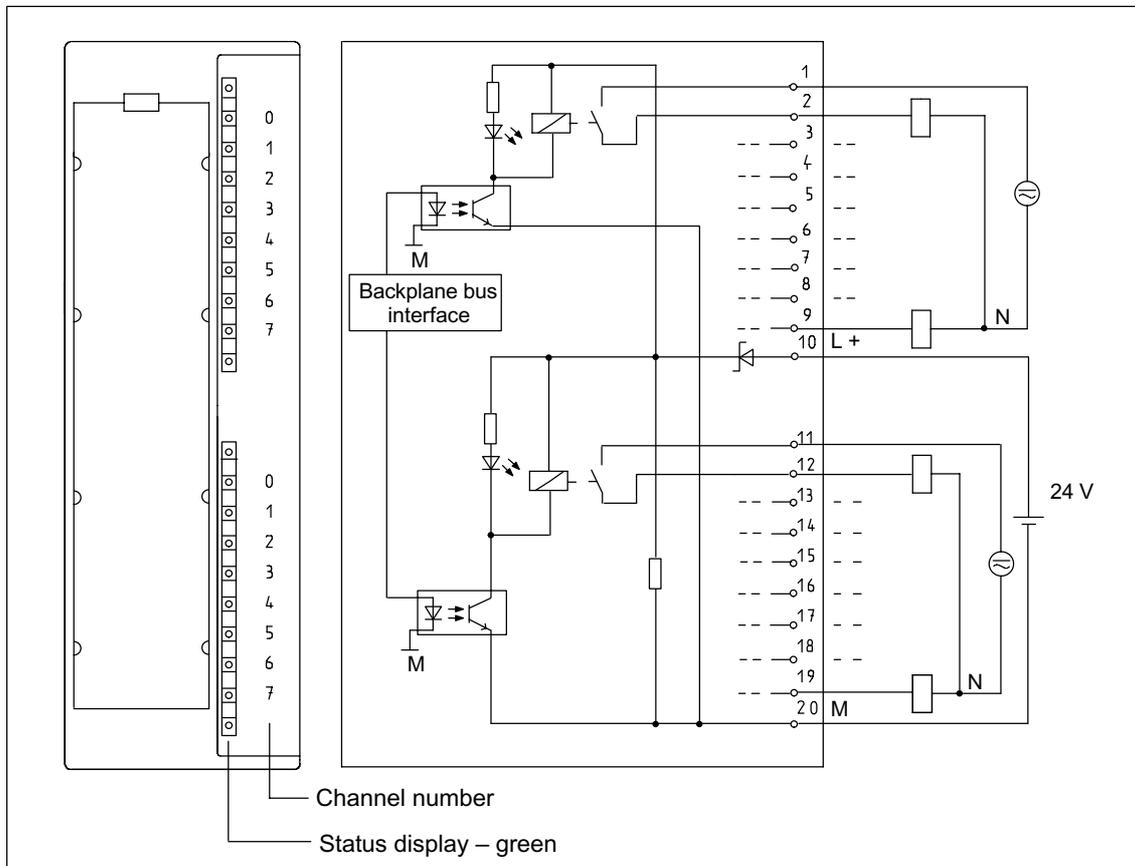
Figure 3-30   Module View and Block Diagram of SM 322; DO 16 x Rel. 120/230 VAC

Technical specifications of the SM 322; DO 16 x Rel. 120/230 VAC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 250 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	16
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated supply voltage of the relay L +	24 VDC
Total current of the outputs (per group)	max. 8 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	8
Permitted potential difference	
• Between $M_{internal}$ and supply voltage of the relays	75 VDC / 60 VAC
• Between $M_{internal}$ and supply voltage of the relays and the outputs	230 VAC
• Between the outputs of the different groups	500 VAC
Insulation tested with	
• Between $M_{internal}$ and supply voltage of the relays	500 VDC
• Between $M_{internal}$ and supply voltage of the relays and the outputs	1500 VAC
• Between the outputs of the different groups	2000 VAC
Current consumption	
• From the backplane bus	max. 100 mA
• From supply voltage L+	max. 250 mA
Power dissipation of the module	typ. 4.5 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None
Data for Selecting an Actuator	
Continuous thermal current	max. 2 A
Minimum load voltage / current	10 V / 10 mA
Short-circuit proof to IEC 947-5-1	200 A, with B10/B16 circuit breaker

Switching capacity and lifetime of the contacts

• For resistive load

Voltage	Current	No. of switching cyc. (typ.)
24 VDC	2.0 A	0.1 million
	1.0 A	0.2 million
	0.5 A	1.0 million
60 VDC	0.5 A	0.2 million
120 VDC	0.2 A	0.6 million
24 VAC	1.5 A	1.5 million
48 VAC	1.5 A	1.5 million
60 VAC	1.5 A	1.5 million
120 VAC	2.0 A	1.0 million
	1.0 A	1.5 million
	0.5 A	2.0 million
230 VAC	2.0 A	1.0 million
	1.0 A	1.5 million
	0.5 A	2.0 million

• Inductive load according to IEC 947-5-1 DC13/AC15

Voltage	Current	No. of switching cyc. (typ.)
24 VDC	2.0 A	0.05 million
	1.0 A	0.1 million
	0.5 A	0.5 million
60 VDC	0.5 A	0.1 million
120 VDC	0.2 A	0.3 million
24 VAC	1.5 A	1 million
48 VAC	1.5 A	1 million
60 VAC	1.5 A	1 million
120 VAC	2.0 A	0.7 million
	1.0 A	1.0 million
	0.5 A	1.5 million
230 VAC	2.0 A	0.7 million
	1.0 A	1.0 million
	0.5 A	1.5 million

An external protection circuit will enhance the service life of the contacts.

Size of the motor starter	max. size 5 to NEMA
Lamp load	50 W / 230 VAC 5 W / 24 VDC
Contact protection (internal)	None
Parallel connection of 2 outputs	
• For redundant triggering of a load	Possible (only outputs of the same group)
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• Mechanical	max. 10 Hz
• For resistive load	1 Hz
• Inductive loads according to IEC 947-5-1, DC 13/AC 15	max. 0.5 Hz
• For lamp load	1 Hz

3.28 Relay Output Module SM 322; DO 8 x Rel. 230 VAC; (6ES7322-1HF01-0AA0)

Order number

6ES7322-1HF01-0AA0

Characteristics

The SM 322; DO 8 x REL. 230 VAC features the following characteristics:

- 8 outputs, isolated in groups of 2

- Rated load voltage 24 VDC to 120 VDC, 48 VAC to 230 VAC

- Suitable for AC/DC solenoid valves, contactors, motor starters, fractional h.p. motors and indicator lights.

Behavior upon power down of the supply voltage

Note

Applicable only for the SM 322; DO 8 x Rel. 230 VAC with product status 1 is:

When the power supply is switched off, the capacitor still stores energy for about 200 ms. The relay can therefore still be driven briefly within this time by the user program.

Terminal assignment and block diagram of the SM 322; DO 8 x Rel. 230 VAC
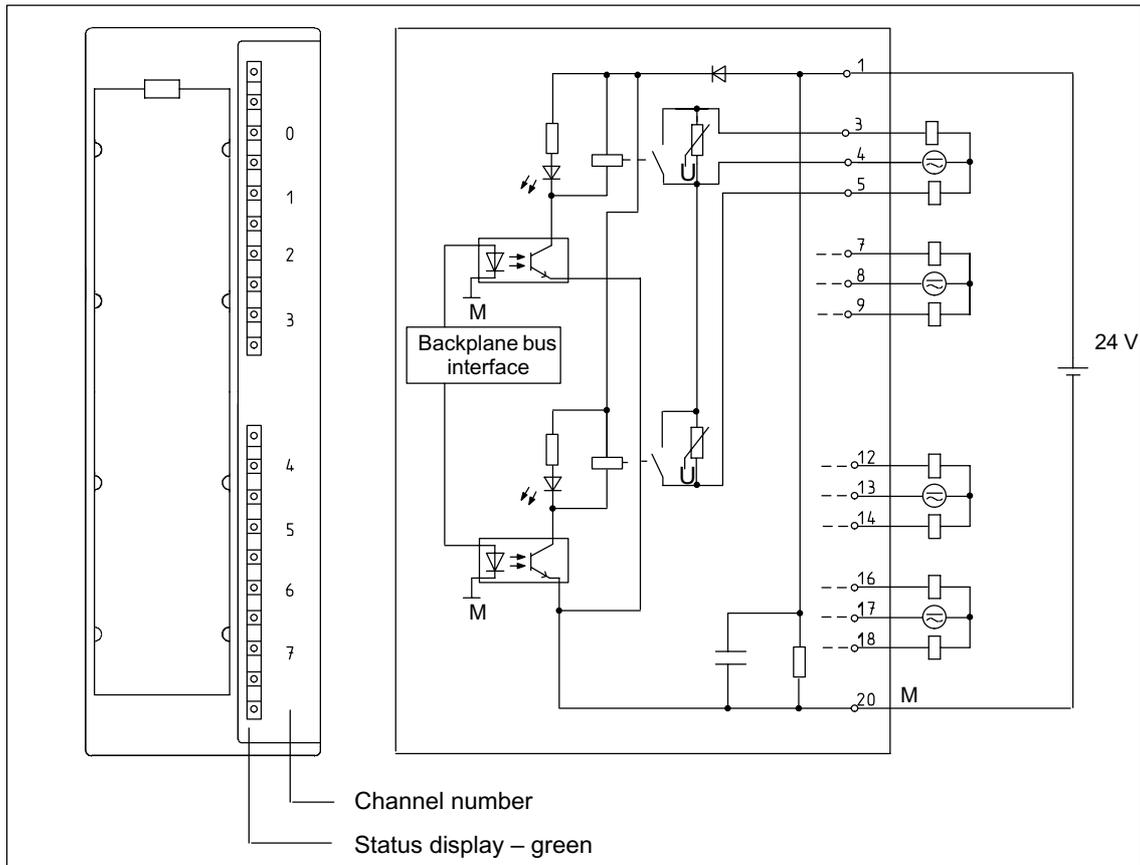
Figure 3-31   Module View and Block Diagram of the SM 322; DO 8 x REL. 230 VAC

Technical specifications of the SM 322; DO 8 x Rel. 230 VAC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 190 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated supply voltage of the relay L +	24 VDC
Total current of the outputs (per group)	max. 4 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	2
Permitted potential difference	
• Between $M_{internal}$ and supply voltage of the relays	75 VDC / 60 VAC
• Between $M_{internal}$ and supply voltage of the relays and the outputs	230 VAC
• Between the outputs of the different groups	400 VAC
Insulation tested with	
• Between $M_{internal}$ and supply voltage of the relays	500 VDC
• Between $M_{internal}$ and supply voltage of the relays and the outputs	1500 VAC
• Between the outputs of the different groups	1500 VAC
Current consumption	
• From the backplane bus	max. 40 mA
• From supply voltage L+	max. 160 mA
Power dissipation of the module	typ. 3.2 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting an Actuator	
Continuous thermal current	max. 3 A
Minimum load voltage / current	10 V /5 mA
Short-circuit proof according to IEC 947-5-1 [2]	With circuit-breaker of characteristic B for:
	cos φ 1.0: 600 A
	cos φ 0.5 to 0.7: 900 A
	With Diazed 8 A fuse: 1000 A

Switching capacity and lifetime of the contacts

• For resistive load

Voltage	Current	No. of switching cyc. (typ.)
24 VDC	2.0 A	0.7 million
	1.0 A	1.6 million
	0.5 A	4 million
60 VDC	0.5 A	1.6 million
120 VDC	0.2 A	1.6 million
48 VAC	2.0 A	1.6 million
60 VAC	2.0 A	1.2 million
120 VAC	2.0 A	0.5 million [2]
	1.0 A	0.7 million [2]
	0.5 A	1.5 million [2]
230 VAC	2.0 A	0.5 million [2]
	1.0 A	0.7 million [2]
	0.5 A	1.5 million

• Inductive load according to IEC 947-5-1 13 DC/15 AC

Voltage	Current	No. of switching cyc. (typ.)
24 VDC	2.0 A	0.3 million
	1.0 A	0.5 million
	0.5 A	1.0 million
60 VDC	0.5 A	0.5 million
120 VDC	0.2 A	0.3 million [2]
48 VAC	1.5 A	1 million
60 VAC	1.5 A	1 million
120 VAC	2.0 A	0.2 million
	1.0 A	0.7 million
	0.7 A	1 million
	0.5 A	2.0 million
230 VAC	2.0 A	0.3 million [2]
	1.0 A	0.7 million [2]
	0.5 A	2 million [2]

Contact protection (internal)	Varistor SIOV-CU4032 K275 G

An external protection circuit will enhance the service life of the contacts.

Data for Selecting an Actuator, continued		
Lamp load [1]	max. 50 W	
	Power	No. of switching cyc. (typ.)
Lamp load (230 VAC) [2]	1000 W 1500 W	25000 10000
Energy-saving lamps/fluorescent lamps with electronic ballast[2]	10×58W	25000
Fluorescent lamps, conventionally compensated [2]	1×58W	25000
Fluorescent lamps, non-compensated [2]	10×58W	25000

Connecting two outputs in parallel	
• For redundant triggering of a load	Possible (only outputs of the same group)
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• Mechanical	max. 10 Hz
• For resistive load	max. 2 Hz
• Inductive loads according to IEC 947-5-1, DC 13/15 AC	max. 0.5 Hz
• For lamp load	max. 2 Hz

[1] Product status 1

[2] Product status 2 or later

3.29 Relay Output Module SM 322;
DO 8 x Rel. 230 VAC/5A; (6ES7322-5HF00-0AB0)

Order number

> 6ES7322-5HF00-0AB0

Characteristics

> Relay output module SM 322; DO 8 x Rel. 230 VAC/5A has the following distinguishing characteristics:
>
> - 8 outputs, isolated in one group
>
> - Load voltage 24 VDC to 120 VDC, 24 VAC to 230 VAC
>
> - Suitable for AC solenoid valves, contactors, motor starters, fractional h.p. motors and indicator lights.
>
> - An RC quenching element can be connected via a jumper (SJ) to protect the contacts.
>
> - Group error display
>
> - Channel-specific status LEDs
>
> - Programmable diagnostic interrupt
>
> - Programmable substitute value output

Protection of contacts against overvoltages

You protect the contacts against overvoltages by inserting jumpers (SJ) on the module between terminals 3 and 4, 7 and 8, 12 and 13 etc. (refer to Figure 3-32).

Terminal assignment and block diagram of the SM 322; DO 8 x Rel. 230 VAC/5A
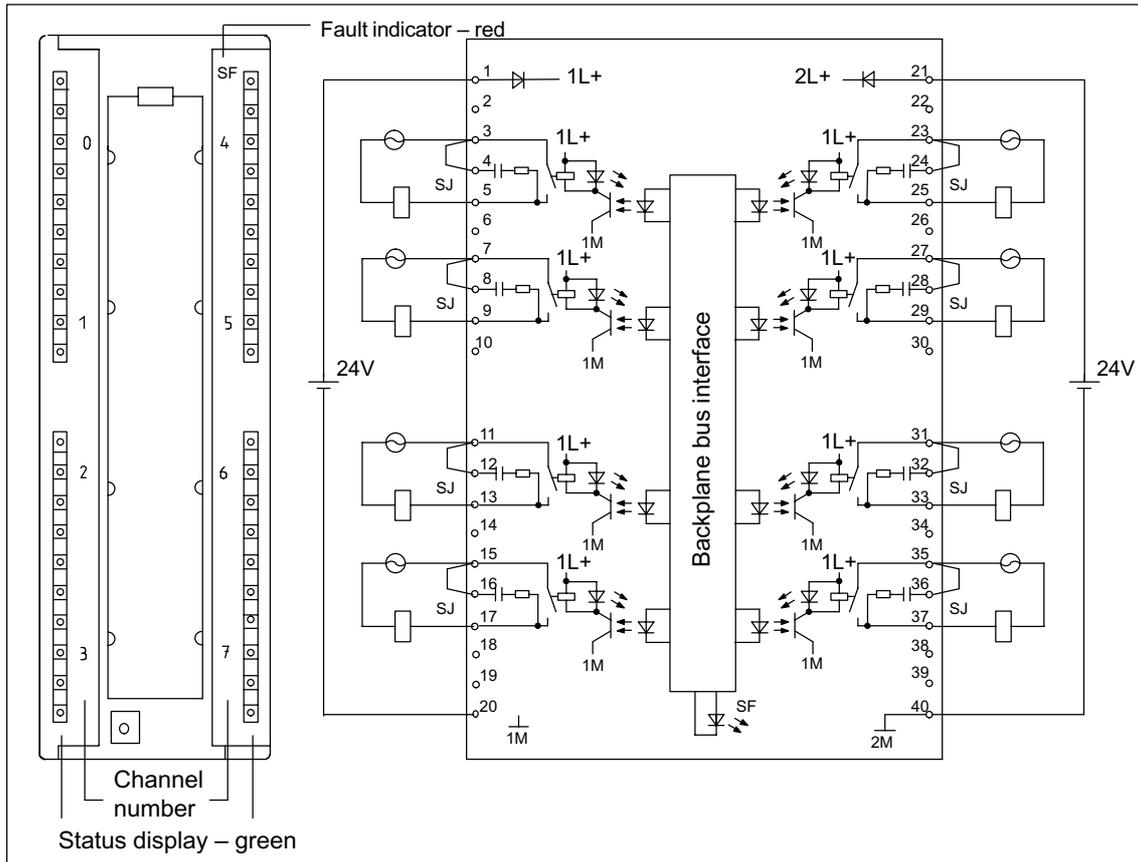
Figure 3-32   Module View and Block Diagram of the SM 322; DO 8 x Rel. 230 VAC/5A

Operation with safe electrical extra-low voltage

When using relay output module 6ES7322-5HF00-0AB0 with safe and electrically isolated extra-low voltage, take the following special characteristic into account:

If a terminal is operated with a safe and electrically isolated extra-low voltage, the horizontally adjacent terminal must be operated at a rated voltage of not more than 120 VUC. With operation at voltages greater than 120 VUC, the creepages and clearances of the 40-pin front connector do not meet the SIMATIC requirements for safe electrical isolation.

If one of the two horizontally adjacent terminals is operated with a safe electrical extra-low voltage, the adjacent terminal must be operated at not more than UC 120 V.
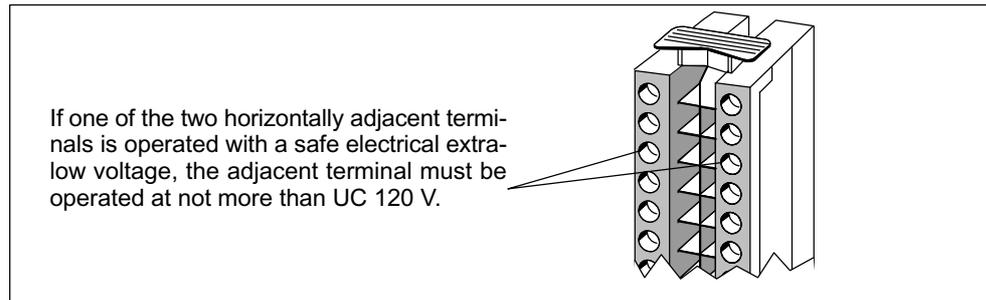
Figure 3-33   Special Characteristic for Operation with a Safe Electrical Extra-Low Voltage

Technical specifications of the SM 322; DO 8 x Rel. 230 VAC/5 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 320 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L +	24 VDC
• Reverse polarity protection	Yes
Total current of the outputs (per group)	
• Horizontal configuration Up to 60° C	max. 5 A
• Vertical configuration Up to 40 ° C	max. 5 A
Isolation	
• Between channels and backplane bus	Yes

• Between the channels and the relay supply voltage	Yes
• Between the channels	Yes
In groups of	1
Permitted potential difference	
• Between $M_{internal}$ and supply voltage of the relays	75 VDC / 60 VAC
• Between $M_{internal}$ and supply voltage of the relays and the outputs	250 VAC
• Between the outputs of the different groups	500 VAC

Insulation tested with	
• Between $M_{internal}$ and supply voltage of the relays	500 VDC
• Between $M_{internal}$ and supply voltage of the relays and the outputs	1500 VAC
• Between the outputs of the different groups	2000 VAC

Current consumption	
• From the backplane bus	max. 100 mA
• From supply voltage L+	max. 160 mA
Power dissipation of the module	typ. 3.5 W

Status, Interrupts, Diagnostics

Status display	Green LED per channel
Interrupts	
• Diagnostic interrupt	Parameters can be assigned
Diagnostic functions	Parameters can be assigned
• Group error display	Red LED (SF)
• Diagnostics information read-out	Possible

Data for Selecting an Actuator

Continuous thermal current	max. 5 A
Minimum load voltage / current	10 V /10 mA[1]
Leakage current	11.5 mA [2]
Short-circuit proof according to IEC 947-5-1	With circuit-breaker of characteristic B for:
	cos φ 1.0: 600 A
	cos φ 0.5 to 0.7: 900 A
	With Diazed 8 A fuse: 1000 A

Switching capacity and lifetime of the contacts

• For resistive load

Voltage	Current	No. of switching cyc. (typ.)
24 VDC	5.0 A	0.2 million
24 VDC	2.5 A	0.4 million
24 VDC	1.0 A	0.9 million
230 VAC	5.0 A	0.2 million
230 VAC	2.5 A	0.4 million
230 VAC	1.0 A	0.9 million

• Inductive load according to IEC 947-5-1 13 DC/15 AC

Voltage	Current	No. of switching cyc. (typ.)
24 VDC	5.0 A	0.1 million
24 VDC	2.5 A	0.25 million
24 VDC	1.0 A	0.5 million
230 VAC	5.0 A	0.1 million
230 VAC	2.5 A	0.25 million
230 VAC	1.0 A	0.5 million

With a connected RC quenching element (jumper "SJ" inserted) or with an external protection circuit, you lengthen the service life of the contacts.

Size of the motor starter	max. size 5 to NEMA

	Power	No. of switching cyc. (typ.)
Lamp load (230 VAC)	1000 W	25000
	1500 W	10000
Energy-saving lamps/fluorescent lamps with electronic ballast	10×58W	25000
Fluorescent lamps, conventionally compensated	1×58W	25000
Fluorescent lamps, non-compensated	10×58W	25000
Contact protection	RC quenching element 330 Ω, 0.1 μF	

Connecting two outputs in parallel

• For redundant triggering of a load	Possible (only outputs with identical load voltage)
• To increase performance	Not possible
Triggering a digital input	Possible

Switch rate

• Mechanical	max. 10 Hz
• For resistive load	max. 2 Hz
• Inductive loads according to IEC 947-5-1, DC 13/15 AC	max. 0.5 Hz
• For lamp load	max. 2 Hz

[1] Without inserted jumper (SJ).

[2] For AC load voltage and inserted jumper (SJ). Without jumper (SJ) inserted there is a leakage current

---

Note

Due to the leakage current of the RC quenching element, wrong signal states might occur when an IEC Type 1 input is connected (remove SJ jumper)

3.29.1 SM 322; DO 8 x Rel. 230 VAC/5A parameterization

Parameter assignment

You will find the general procedure for assigning parameters to digital modules in Section 3.3.

Parameters of the SM 322; DO 8 x Rel. 230 VAC/5A

You will find an overview of the parameters that you can set and their default settings for the SM 322; DO 8 x 230 VDC/0.5 A in the table below.

Table 3-25 Parameters of the SM 322; DO 8 x Rel. 230 VAC/5A

Parameter	Value Range	Default settings	Parameter type	Scope
Enable • Diagnostic interrupts	Yes/no	No	Dynamic	Module
Behavior on CPU STOP	Switch substitute value (EWS) Hold last value (LWH)	EWS	Dynamic	Channel
Switch substitute value "1"	Yes/no	No	Dynamic	Channel

3.29.2 Behavior and Diagnostics of the SM 322; DO 8 x 230 VDC/0.5 A

Diagnostic messages of the SM 322; DO 8 x Rel. 230 VAC/5A

The table below presents an overview of the diagnostic messages for the SM 322; DO 8 x Rel. 230 VAC/5 A.

Table 3-26 Diagnostic Messages of the SM 322; DO 8 x Rel. AC 230 VDC/0.5 A

Diagnostics message	LED	Scope of the diagnostics	Parameters can be assigned
Time-out	SF	Module	No
EPROM error	SF	Module	No
RAM error	SF	Module	No

Error causes and remedies

Table 3-27   Diagnostic messages of the SM 322; DO 8 x Rel. 230 VAC/5A, error causes and remedies

Diagnostics Message	Error Detection	Possible Error Cause	Remedy
Time-out	Always	Temporary high electromagnetic interference	Remove interference and turn the CPU power supply off and on
		Module defective	Replace module
EPROM error	Always	Temporary high electromagnetic interference	Remove interference and turn the CPU power supply off and on
		Module defective	Replace module
RAM error	Always	Temporary high electromagnetic interference	Remove interference and turn the CPU power supply off and on
		Module defective	Replace module

3.29.3   Interrupts of the SM 322; DO 8 x Rel. 230 VAC/5A

Introduction

The SM 322; DO8 x Rel.230VAC/0.5 A can trigger diagnostic interrupts.

The OBs and SFCs mentioned below can be found in the online Help for STEP 7, where they are described in greater detail.

Enabling interrupts

The interrupts are not available – in other words, they are inhibited without appropriate parameter assignment. Use STEP 7 to assign parameters for enabling interrupts.

Diagnostic Interrupt

If you have enabled diagnostic interrupts, then incoming active error events (initial occurrence of the error) and departing error events (message after troubleshooting) are reported by means of interrupts.

The CPU interrupts execution of the user program and processes the diagnostic interrupt block (OB 82).

In the user program, you can call SFC 51 or SFC 59 in OB 82 to obtain more detailed diagnostic information from the module.

The diagnostic information is consistent until such time as OB 82 is exited. When OB 82 is exited, the diagnostic interrupt is acknowledged on the module.

3.30 Relay Output Module SM 322; DO 8 x Rel. VAC 230/5 A; (6ES7322-1HF10-0AA0)

Order number: "Standard module"

6ES7322-1HF10-0AA0

Order number: "SIPLUS S7-300-Module"

6AG1322-1HF10-2AA0

Characteristics

The SM 322; DO 8 x Rel. 230 VAC/5 A features the following characteristics:

- 8 outputs, isolated in groups of 1

- Rated load voltage 24 VDC to 120 VDC, 48 VAC to 230 VAC

- Suitable for AC/DC solenoid valves, contactors, motor starters, fractional h.p. motors and indicator lights.

Measures with switching currents > 3 A

Note

To keep the additional temperature rise of the module near the connectors as low as possible, you must select a cable cross-section of 1.5 mm^2 for connecting cables with switching currents > 3 A.

Terminal assignment and block diagram of the SM 322; DO 8 x Rel. 230 VAC/5 A
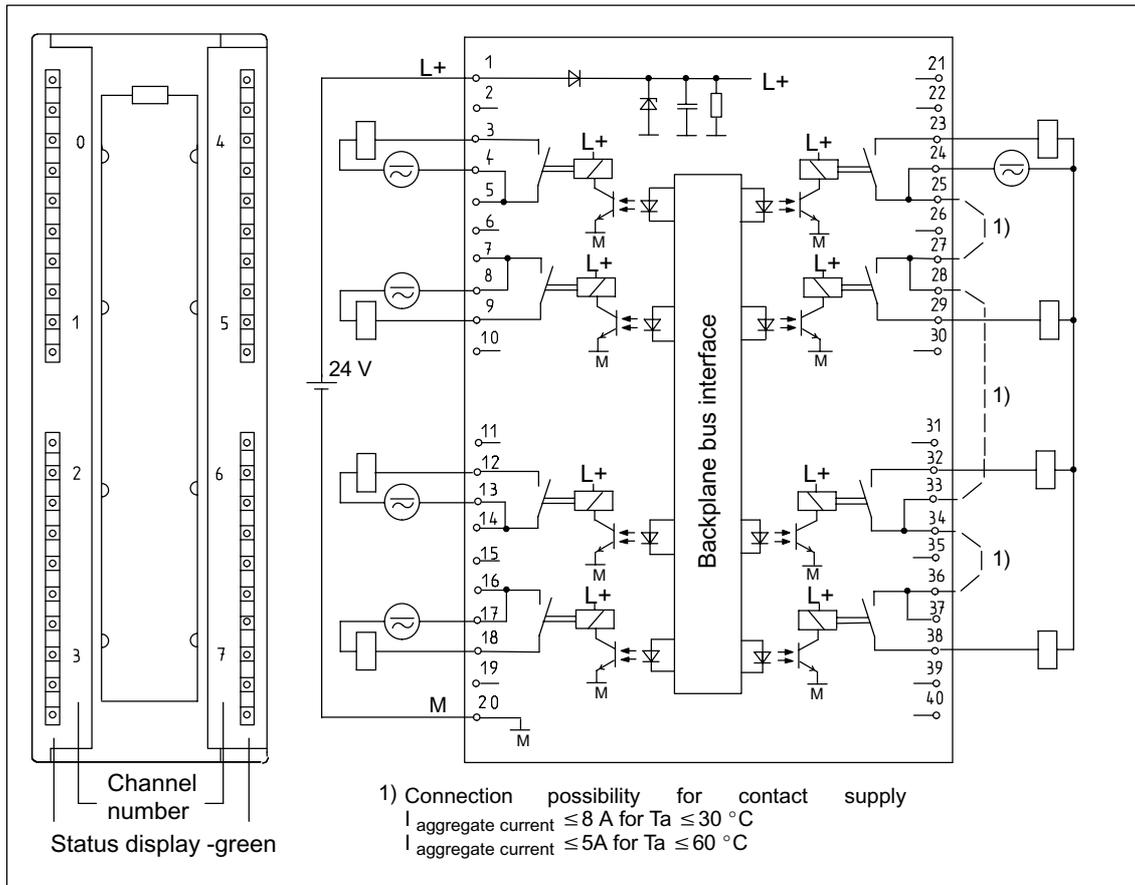
Figure 3-34   Module View and Block Diagram of the SM 322; DO 8 x Rel. 230 VAC/5 A

Operation with safe electrical extra-low voltage

When using relay output module 322-1HF10 with safe and electrically isolated extra-low voltage, take the following special characteristic into account:

If a terminal is operated with a safe and electrically isolated extra-low voltage, the horizontally adjacent terminal must be operated at a rated voltage of not more than 120 VUC. With operation at voltages greater than 120 VUC, the creepages and clearances of the 40-pin front connector do not meet the SIMATIC requirements for safe electrical isolation.

If one of the two horizontally adjacent termi-nals is operated with a safe electrical extra-low voltage, the adjacent terminal must be operated at not more than UC 120 V.
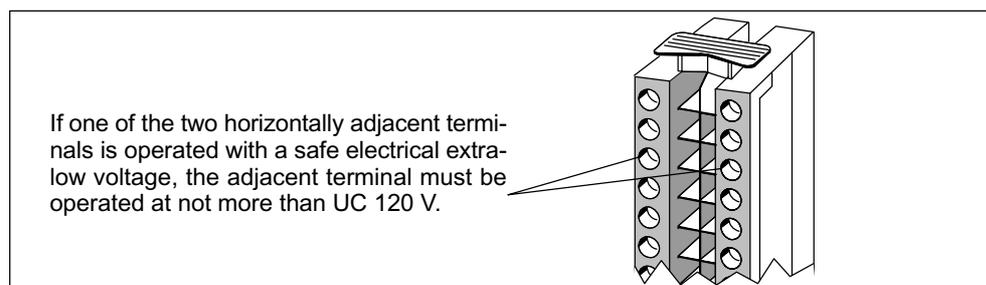
Figure 3-35   Special Characteristic for Operation with a Safe Electrical Extra-Low Voltage

Technical specifications of the SM 322; DO 8 x Rel. 230 VAC/5 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 120
Weight	Approx. 320 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated supply voltage of the relay L +	24 VDC
Total current of the outputs (per group)	
• Horizontal configuration	
Up to 30 °C	max. 8 A
Up to 60 °C	max. 5 A
• Vertical configuration	max. 5 A
Up to 40 °C	
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
In groups of	1

Permitted potential difference	
• Between $M_{internal}$ and supply voltage of the relays	75 VDC / 60 VAC
• Between $M_{internal}$ and supply voltage of the relays and the outputs	250 VAC
• Between the outputs of the different groups	500 VAC
Insulation tested with	
• Between $M_{internal}$ and supply voltage of the relays	500 VDC
• Between $M_{internal}$ and supply voltage of the relays and the outputs	1500 VAC
• Between the outputs of the different groups	2000 VAC
Current consumption	
• From the backplane bus	max. 40 mA
• From supply voltage L+	max. 125 mA
Power dissipation of the module	typ. 4.2 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupt	None
Diagnostic functions	None
Data for Selecting an Actuator	
Continuous thermal current	max. 8 A
Minimum load voltage / current	10 V / 5 mA
Short-circuit proof to IEC 947-5-1	With circuit-breaker of characteristic B for:
	cos φ 1.0: 600 A
	cos φ 0.5 to 0.7: 900 A
	With Diazed 8 A fuse: 1000 A

Switching capacity and lifetime of the contacts

- For resistive load

Voltage	Current	No. of switching cyc. (typ.)
24 VDC	8.0 A	0.1 million
	4.0 A	0.3 million
	2.0 A	0.7
	0.5 A	4.0 million
60 VDC	0.5 A	4 million
120 VDC	0.2 A	1.6 mill.
48 VAC	8.0 A	0.1 million
	2.0 A	1.6 million
60 VAC	8.0 A	0.1 million
	2.0 A	1.2 million
120 VAC	8.0 A	0.1 million
	4.0 A	0.3 million
	2.0 A	0.5 million
	1.0 A	0.7 million
	0.5 A	1.5 million
230 VAC	8.0 A	0.1 million
	4.0 A	0.3 million
	2.0 A	0.5 million
	1.0 A	0.7 million
	0.5 A	1.5 million

Switching capacity and lifetime of the contacts

- Inductive load according to IEC 947-5-1 13 DC/15 AC

Voltage	Current	No. of switching cyc. (typ.)
24 VDC	2.0 A	0.3 million
	1.0 A	0.5 million
	0.5 A	1 million
60 VDC	0.5 A	0.5 million
	0.3 A	1 million
120 VDC	0.2 A	0.5 mill.
48 VAC	3.0 A	0.5 million
	1.5 A	1 million
60 VAC	3.0 A	0.3 million
	1.5 A	1 million
120 VAC	3.0 A	0.2 million
	2.0 A	0.3 million
	1.0 A	0.7 million
	0.5 A	2.0 million
230 VAC	3.0 A	0.1 million
	2.0 A	0.3 million
	1.0 A	0.7 million
	0.5 A	2.0 million

- Aux. contactors Size 0 (3TH28)   30 mill.

An external protection circuit will enhance the service life of the contacts.

	Power	No. of switching cyc. (typ.)
Lamp load (230 VAC)	1000W	25000
	1500W	10000
Energy-saving lamps/fluorescent lamps with electronic ballast	10×58W	25000
Fluorescent lamps, conventionally compensated	1×58W	25000
Fluorescent lamps, non-compensated	10×58W	25000
Contact protection (internal)	None	

Connecting two outputs in parallel

For redundant actuation of a load	Possible
To increase performance	Not possible
Triggering a digital input	Possible

Switch rate

Mechanical	max. 10 Hz
For resistive load	max. 2 Hz
Inductive loads according to IEC 947-5-1, DC 13/15 AC	max. 0.5 Hz
For lamp load	max. 2 Hz

3.31 Digital Input/Output Module SM 323; DI 16/DO 16 x 24 VDC/0.5 A; (6ES7323-1BL00-0AA0)

Order number

6ES7323-1BL00-0AA0

Characteristics

The SM 323; DI 16/DO 16 x 24 VDC/0.5 A features the following characteristics:

- 16 inputs, isolated in groups of 16

- 16 outputs, isolated in groups of 8

- 24 VDC rated input voltage

- 24 VDC rated load voltage

- Inputs suitable for switches and two / three / four-wire BEROs (proximity switches)

- Outputs suitable for solenoid valves, DC contactors and indicator lights

Using the module with high-speed counters

Please take note of the following information on the use of the module in connection with high-speed counters:

Note

When connecting the 24 V power supply via a mechanical contact, the outputs of the SM 323; DI 16/DO 16 x 24 VDC/0.5 A carry a "1" signal for approximately 50 μs for reasons associated with the circuitry.

Terminal assignment and block diagram of the SM 323; DI 16/DO 16 x 24 VDC/0.5 A

Figure 3-36   Module View and Block Diagram of the SM 323; DI 16/DO 16 x 24 VDC/0.5 A

Terminal assignment

The figure below shows the assignment of the channels to the input and output addresses.
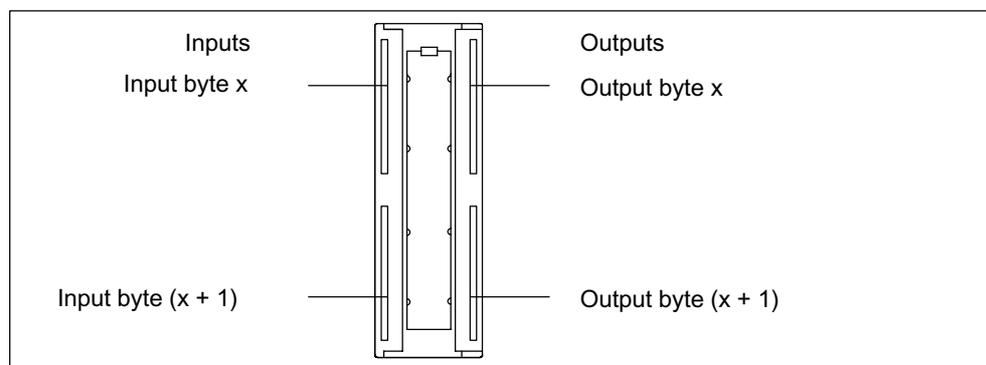
Figure 3-37   Terminal assignment of the SM 323; DI 16/DO 16 x 24 VDC/0.5 A

Technical specifications of the SM 323; DI 16/DO 16 x 24 VDC/0.5 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 260 g

Data for Specific Module	
Clocked	No
Number of inputs	16
Number of outputs	16
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m

Voltages, Currents, Potentials	
Rated load voltage L+	24 VDC
Number of inputs that can be triggered simultaneously	
• Horizontal configuration	
Up to 40 °C	16
Up to 60 °C	8
• Vertical configuration	
Up to 40 °C	16
Total current of the outputs (per group)	
• Horizontal configuration	
Up to 40 °C	max. 4 A
Up to 60 °C	max. 3 A
• Vertical configuration	
Up to 40 °C	max. 2 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
Inputs in groups of	16
Outputs in groups of	8
Permitted potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation tested with	VDC 500
Current consumption	
• From the backplane bus	max. 80 mA
• From load voltage L+ (without load)	max. 80 mA
Power dissipation of the module	typ. 6.5 W

Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting a Sensor	
Input voltage	
• Rated value	24 VDC
• For signal "1"	13 to 30 V
• For signal "0"	–30 to + 5 V
Input current	
• At signal "1"	typ. 7 mA
Input delay	
• At "0" to "1"	1.2 to 4.8 ms
• At "1" to "0"	1.2 to 4.8 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
• Permitted bias current	max. 1.5 mA

Data for Selecting an Actuator	
Output voltage	
• At signal "1"	min. L + (–0.8 V)
Output current	
• At signal "1"	
Rated value	0.5 A
Permitted range	5 mA to 0.6 A
• At signal "0" (leakage current)	max. 0.5 mA
Output delay (for resistive load)	
• At "0" to "1"	max. 100 µs
• At "1" to "0"	max. 500 µs
Load resistor range	48 Ω to 4 kΩ
Lamp load	max. 5 W
Parallel connection of 2 outputs	
• For redundant triggering of a load	Possible (only outputs of the same group)
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 100 Hz
• Inductive load according to IEC 947-5-1, 13 DC	max. 0.5 Hz
• For lamp load	max. 10 Hz
Limit (internal) of the inductive circuit interruption voltage up	L + (–53 V), typ.
Short-circuit protection of the output	Yes, electronic
• Threshold on	1 A, typ.

3.32 Digital Input/Output Module SM 323; DI 8/DO 8 x VDC 24/0.5 A; (6ES7323-1BH01-0AA0)

Order number: "Standard module"

6ES7323-1BH01-0AA0

Order number: "SIPLUS S7-300-Module"

6AG1323-1BH01-2AA0

Characteristics

The SM 323; DI 8/DO 8 x 24 VDC/0.5 A features the following characteristics:

- 8 inputs, isolated in groups of 8
- 8 outputs, isolated in groups of 8
- 24 VDC rated input voltage
- 24 VDC rated load voltage
- Inputs suitable for switches and two / three / four-wire BEROs (proximity switches)
- Outputs suitable for solenoid valves, DC contactors and indicator lights

Using the module with high-speed counters

Please take note of the following information on the use of the module in connection with high-speed counters:

Note

When connecting the 24 V power supply via a mechanical contact, the outputs of the SM 323; DI 8/DO 8 x 24 VDC/0.5 A carry a "1" signal for approximately 50 μs for reasons associated with the circuitry.

Terminal assignment and block diagram of the SM 323; DI 8/DO 8 x 24 VDC/0.5 A
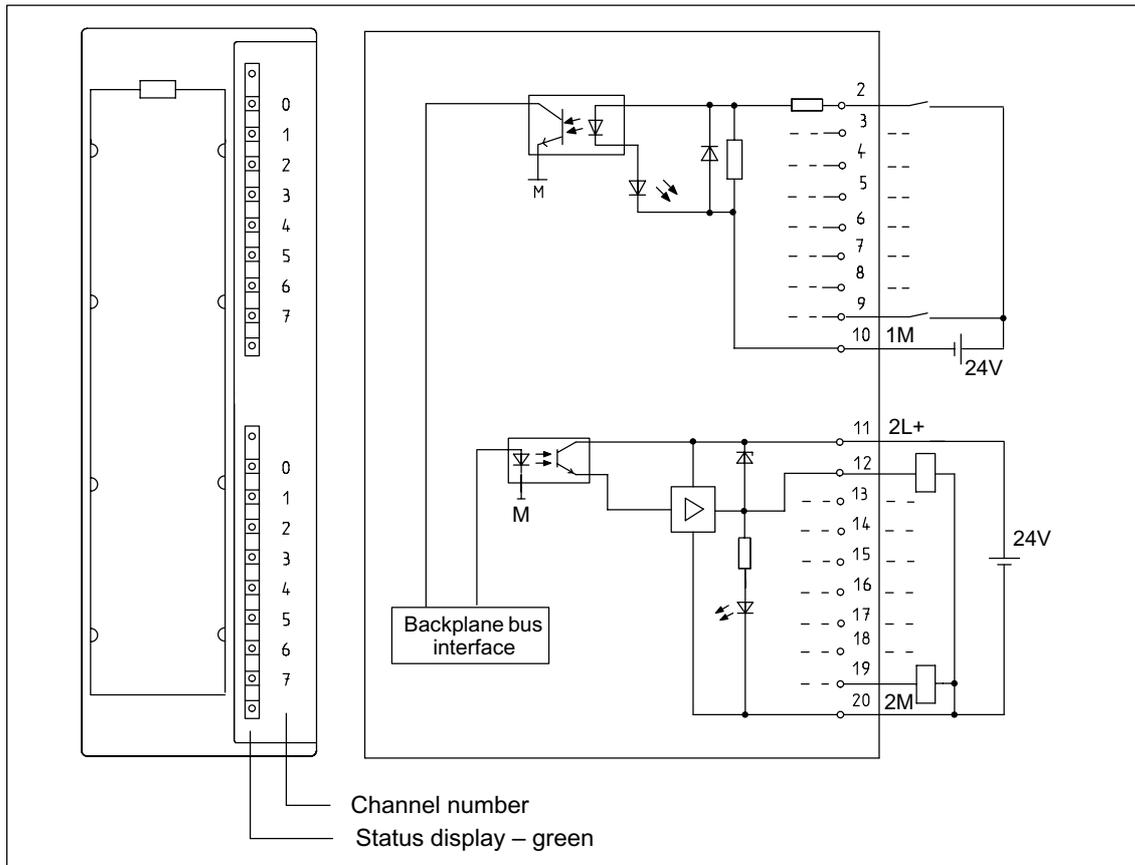
Figure 3-38   Module View and Block Diagram of Digital Input/Output Module SM 323;
                DI 8/DO 8 x 24 VDC/0.5 A

Technical specifications of the SM 323; DI 8/DO 8 x 24 VDC/0.5 A

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 200 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8
Number of outputs	8
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L+	24 VDC
Number of inputs that can be triggered simultaneously	
• Horizontal configuration	
Up to 60 °C	8
• Vertical configuration	
Up to 40 °C	8
Total current of the outputs (per group)	
• Horizontal configuration	
Up to 60 °C	max. 4 A
• Vertical configuration	
Up to 40 °C	max. 4 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	Yes
Inputs in groups of	8
Outputs in groups of	8
Permitted potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 40 mA
• From load voltage L+ (without load)	max. 40 mA
Power dissipation of the module	typ. 3.5 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting a Sensor	
Input voltage	
• Rated value	24 VDC
• For signal "1"	13 to 30 V
• For signal "0"	–30 to 5 V
Input current	
• At signal "1"	typ. 7 mA
Input delay	
• At "0" to "1"	1.2 to 4.8 ms
• At "1" to "0"	1.2 to 4.8 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
• Permitted bias current	max. 1.5 mA
Data for Selecting an Actuator	
Output voltage	
• At signal "1"	min. L + (–0.8 V)
Output current	
• At signal "1"	
Rated value	0.5 A
Permitted range	5 mA to 0.6 A
• At signal "0" (leakage current)	max. 0.5 mA
Output delay (for resistive load)	
• At "0" to "1"	max. 100 μs
• At "1" to "0"	max. 500 μs
Load resistor range	48 Ω to 4 kΩ
Lamp load	max. 5 W
Parallel connection of 2 outputs	
• For redundant triggering of a load	Possible (only outputs of the same group)
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 100 Hz
• Inductive load according to IEC 947-5-1, 13 DC	max. 0.5 Hz
• For lamp load	max. 10 Hz
Limit (internal) of the inductive circuit interruption voltage up	L + (–53 V), typ.
Short-circuit protection of the output	Yes, electronic
• Threshold on	1 A, typ.

3.33 Digital Input/Output Module SM 327; DI 8/DX 8 x DC 24 V/0.5 A; parameterizable (6ES7327-1BH00-0AB0)

Order number

6ES7327-1BH00-0AB0

Characteristics

The SM 327; DI 8/DX 8 $\times$ VDC 24/0.5 A features the following characteristics:

- 8 digital inputs and 8 individual parameterizable inputs or outputs, isolated in groups of 16
- 24 VDC rated input voltage
- Inputs suitable for switches and two / three / four-wire BEROs (proximity switches)
- 0.5 A output current
- 24 VDC rated load voltage
- Outputs suitable for solenoid valves, DC contactors and indicator lights
- The parameters of the module can be dynamically changed-channel during the RUN (CiR-capable)
- Re-readability of the outputs.

Using the module with high-speed counters

Please take note of the following information on the use of the module in connection with high-speed counters:

Note

When connecting the 24 V power supply via a mechanical contact, the outputs of the SM 327; DI 8/DX 8 x DC 24 V/0.5 A carry a "1" signal for approximately 50 μs for reasons associated with the circuitry.

**Terminal assignment and block diagram of the SM 327;
DI 8/DX 8 x DC 24 V/0.5 A, parameterizable**
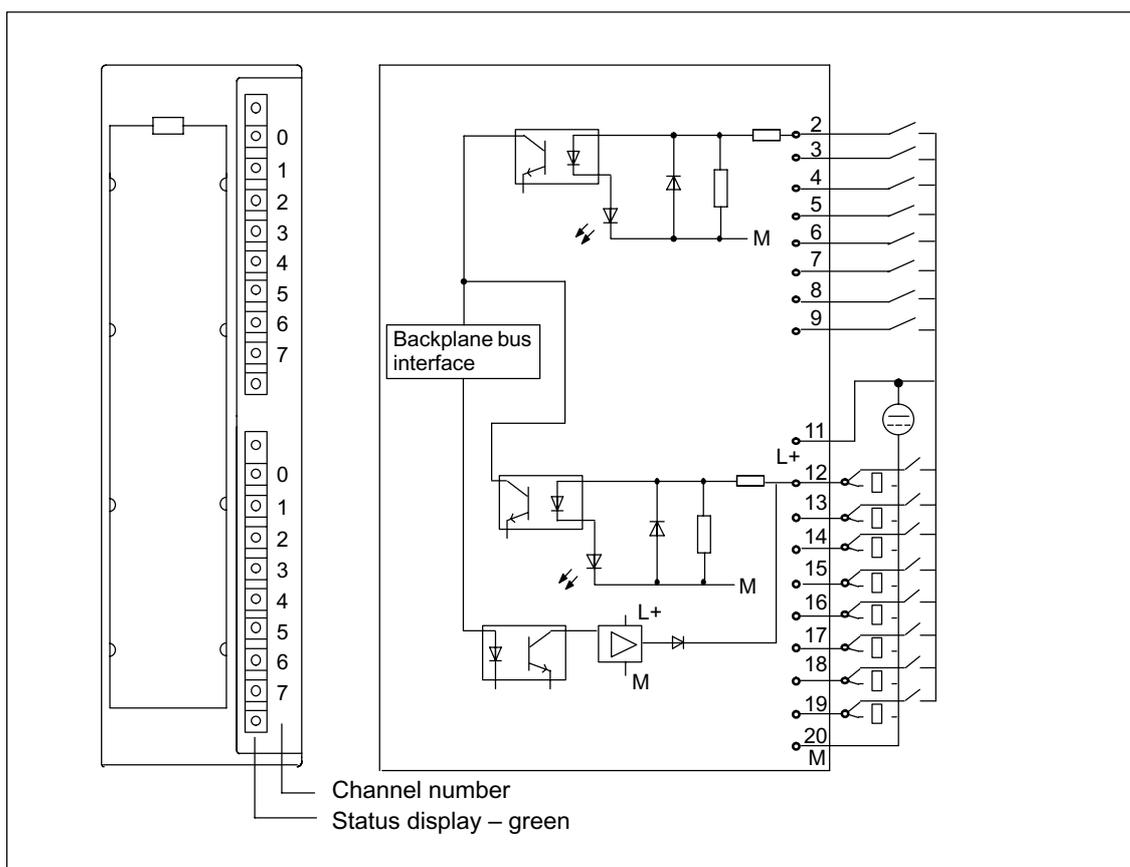
Figure 3-39   Terminal assignment and block diagram of the SM 327; DI 8/DX 8 x DC 24 V/0.5 A, parameterizable

Technical data of the SM 327; DI 8/DX 8 x DC 24 V/0.5 A, parameterizable

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 120
Weight	Approx. 200 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8 digital
Number of inputs/outputs	8 single, parameterizable
Length of cable	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Voltages, Currents, Potentials	
Rated load voltage L+	24 VDC
Number of inputs that can be triggered simultaneously	
• Horizontal configuration Up to 60 °C	16
• Vertical configuration Up to 40 °C	16
Total current of the outputs (per group)	
• Horizontal configuration Up to 40 °C	max. 4 A
Up to 60 °C	max. 3 A
• Vertical configuration Up to 40 °C	max. 2 A
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	No
Permitted potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 60 mA
• From load voltage L+ (without load)	max. 20 mA
Power dissipation of the module	typ. 3 W
Status, Interrupts, Diagnostics	
Status display	Green LED per channel
Interrupts	None
Diagnostic functions	None

Data for Selecting a Sensor	
Input voltage	
• Rated value	24 VDC
• For signal "1"	15 to 30 V
• For signal "0"	–30 to 5 V
Input current	
• At signal "1"	typ. 6 mA
Input delay	
• At "0" to "1"	1.2 to 4.8 ms
• At "1" to "0"	1.2 to 4.8 ms
Input characteristic curve	According to IEC 61131, type 1
Connection of Two-Wire BEROs	Possible
• Permitted bias current	max. 1.5 mA
Data for Selecting an Actuator	
Output voltage	
• At signal "1"	min. L + (– 1,5 V)
Output current	
• At signal "1"	
Rated value	0.5 A
Permitted range	5 mA to 0.6 A
• At signal "0" (leakage current)	max. 0.5 mA
Output delay (for resistive load)	
• At "0" to "1"	max. 350 μs
• At "1" to "0"	max. 500 μs
Load resistor range	48 Ω to 4 kΩ
Lamp load	max. 5 W
Parallel connection of 2 outputs	
• For redundant triggering of a load	Possible
• To increase performance	Not possible
Triggering a digital input	Possible
Switch rate	
• For resistive load	max. 100 Hz
• Inductive load according to IEC 947-5-1, 13 DC	max. 0.5 Hz
• For lamp load	max. 10 Hz
Limit (internal) of the inductive circuit interruption voltage up	typ. L + (–54 V)
Short-circuit protection of the output	Yes, electronic
• Threshold on	1 A, typ.

3.33.1 Assigning Parameters to the SM 327; DI 8/DX 8 x VDC 24/0.5 A

Parameter assignment

You will find a description of the general procedure for assigning parameters to digital modules in Section 3.3.

Parameters of the SM 327; DI 8/DX 8 x DC 24 V/0.5 A, parameterizable

You will find an overview of the parameters that you can set and their default settings for the SM 327; DI 8/DX 8 x VDC 24/0.5 A in the table below.

The default settings apply if you have not performed parameter assignment in *STEP 7*.

You will see which parameters you can modify from the list:

- In *STEP 7*
- With SFC 55 "WR_PARM"
- with SFB 53 "WRREC" (e. g. for GSD).

The parameters set with *STEP 7* can also be transferred with SFCs 56 and 57 and the SFB 53 to the module (refer to the *STEP 7* manuals).

Table 3-28 Parameters of the SM 327; DI 8/DX 8 $\times$ VDC 24/0.5 A

Parameter	Value Range	Default Settings	Parameter Type	Scope	Data Record No.	Parameters can be assigned with ...	
						SFC 55, SFB 53	Programming device
Digital output	Yes/no	No	Dynamic	Channel	1	Yes	Yes

Structure of data record 1

The following figure shows the structure of data record 1 of the dynamic parameters of the SM 327; DI 8/DX 8 x DC 24 V/0.5 A.
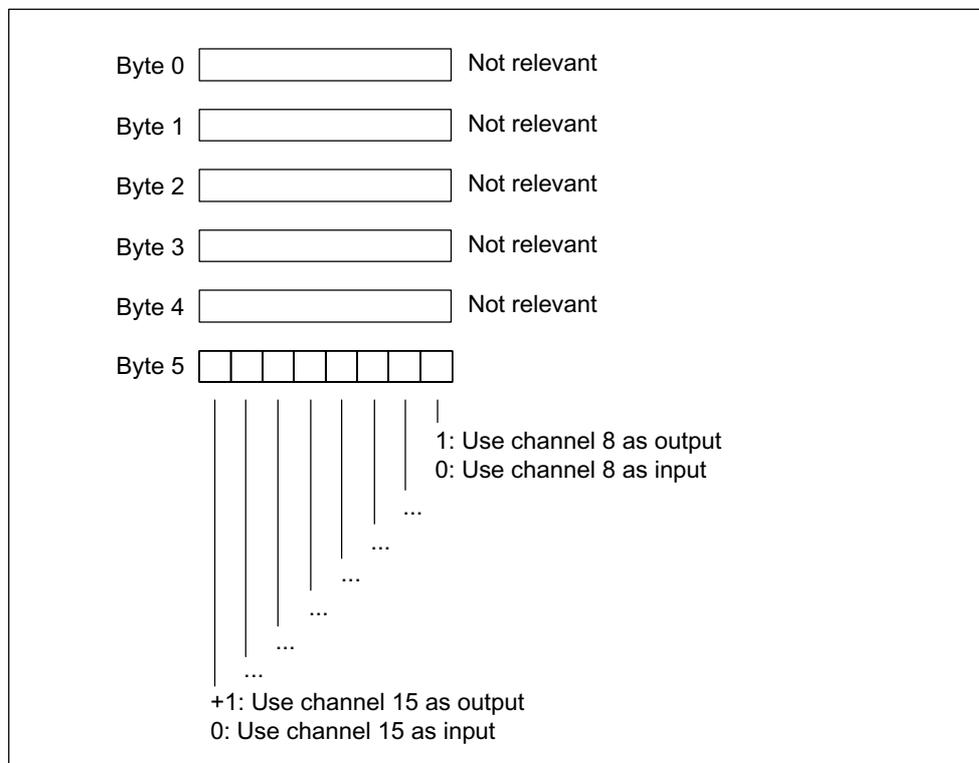
Figure 3-40   Data record 1 of the SM 327; DI 8/DX 8 x VDC 24/0.5 A

Re-readability of the outputs

The digital outputs can be read back into the user data area: If, e. g. A11.3 is parameterized as an output, it can be read back via E11.3. see Figure3-41
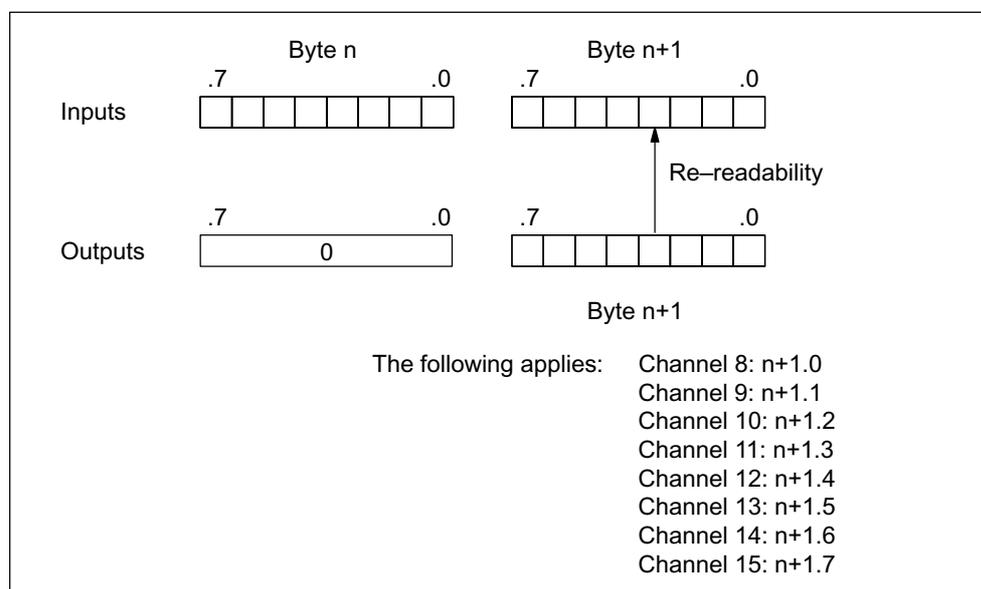
Figure 3-41   Re-readability of the outputs of the SM 327; DI 8/DX 8 x DC 24 V/0.5 A

Analog Modules

4

Structure of the chapter

The present chapter is broken down into the following subjects:

1. Chapter overview of which modules are available and described here

2. Module overview of the most important properties of the modules

3. Sequence of Steps from Choosing to Commissioning the Analog Module

4. Information that is generally available – in other words, affects all analog modules (such as parameter assignment and diagnostics)

5. Information that refers to specific modules (for example, characteristics, diagram of connections and block diagram, technical specifications and special characteristics of the module):

   a) for analog input modules

   b) for analog output modules

   c) for analog input/output modules

STEP 7 blocks for analog functions

You can use the blocks FC 105 "SCALE" (Scale Values) and FC 106 "UNSCALE" (Unscale Values) for reading and outputting analog values in *STEP 7*. You will find the FCs in the standard library of *STEP 7* in the subdirectory called "TI-S7-Converting Blocks" (for a description, refer to the *STEP 7* Online Help for the FCs).

Additional information

Appendix A describes the structure of the parameter sets (data records 0, 1 and 128) in the system data. You must be familiar with this configuration if you want to modify the parameters of the modules in the *STEP 7* user program.

Appendix B describes the structure of the diagnostic data (data records 0 and 1) in the system data. You must be familiar with this configuration if you want to evaluate the diagnostic data of the modules in the *STEP 7* user program.

In this chapter

4.1 Module Overview

Introduction

The following tables summarize the most important characteristics of the analog modules. This overview is intended to make it easy to choose the suitable module for your task.

Table 4-1   Analog Input Modules: Characteristics at a Glance

Module Char- acter- istics	SM 331; AI 8 x 16 bits (-7NF00-)	SM 331; AI 8 x 16 bits (-7NF10-)	SM 331; AI 8 x 14 bits High Speed (-7HF0x-)	SM 331; AI 8 x 13 bits (-1KF01-)
Number of inputs	8 inputs in 4 channel groups	8 inputs in 4 channel groups	8 inputs in 4 channel groups	8 inputs in 8 channel groups
Resolution	Adjustable for each channel group: ● 15 bits + sign	Adjustable for each channel group: ● 15 bits + sign	Adjustable for each channel group: ● 13 bits + sign	Adjustable for each channel group: ● 12 bits+sign
Measuring Method	Adjustable for each channel group: ● Voltage ● Current	Adjustable for each channel group: ● Voltage ● Current	Adjustable for each channel group: ● Voltage ● Current	Adjustable for each channel: ● Voltage ● Current ● Resistors ● Temperature
Selection of measuring range	Arbitrary, per channel group	Arbitrary, per channel group	Arbitrary, per channel group	Arbitrary, per channel
Supports clocked operation	No	No	Yes	No
Programmable diagnostics	Yes	Yes	Yes	No
Diagnostic interrupt	Adjustable	Adjustable	Adjustable	No
Limit value monitoring	Adjustable for 2 channels	Adjustable for 8 channels	Adjustable for 2 channels	No
Hardware interrupt upon limit violation	Adjustable	Adjustable	Adjustable	No
Hardware interrupt at end of cycle	No	Yes	No	No
Potential relationships	Galvanic isolation to: ● CPU	Galvanic isolation to: ● CPU	Galvanic isolation to: ● CPU ● Load voltage (**not** for 2-DMU)	Galvanic isolation to: ● CPU
Permitted potential difference between the inputs (ECM)	50 VDC	60 VDC	11 VDC	2.0 VDC
Special Features	–	-	–	–

Sign   Sign
2-DMU   2-wire transmitter

Table 4-2   Analog Input Modules: Characteristics at a glance (continued)

Module / Characteristics	SM 331; AI 8 x 12 bits (-7KF02-)	SM 331; AI 8 x RTD (-7PF00-)	SM 331; AI 8 x TC (-7PF10-)	SM 331; AI 2 x 12 bits (-7KB02-)
Number of inputs	8 inputs in 4 channel groups	8 inputs in 4 channel groups	8 inputs in 4 channel groups	2 inputs in 1 channel group
Resolution	Adjustable for each channel group: • 9 bits+sign • 12 bits+sign • 14 bits+sign	Adjustable for each channel group: • 15 bits + sign	Adjustable for each channel group: • 15 bits + sign	Adjustable for each channel group: • 9 bits+sign • 12 bits+sign • 14 bits+sign
Measuring Method	Adjustable for each channel group: • Voltage • Current • Resistors • Temperature	Adjustable for each channel group: • Resistors • Temperature	Adjustable for each channel group: • Temperature	Adjustable for each channel group: • Voltage • Current • Resistors • Temperature
Selection of measuring range	Arbitrary, per channel group	Arbitrary, per channel group	Arbitrary, per channel group	Arbitrary, per channel group
Programmable diagnostics	No	Yes	Yes	Yes
Supports clocked operation	Yes	No	No	No
Diagnostic interrupt	Adjustable	Adjustable	Adjustable	Adjustable
Limit value monitoring	Adjustable for 2 channels	Adjustable for 8 channels	Adjustable for 8 channels	Adjustable for 1 channel
Hardware interrupt upon limit violation	Adjustable	Adjustable	Adjustable	Adjustable
Hardware interrupt at end of cycle	No	Adjustable	Adjustable	No
Potential relationships	Galvanic isolation to: • CPU • Load voltage (**not** for 2-DMU)	Galvanic isolation to: • CPU	Galvanic isolation to: • CPU	Galvanic isolation to: • CPU • Load voltage (**not** for 2-DMU)
Permitted potential difference between the inputs (ECM)	2.5 VDC	75 VDC / 60 VAC	75 VDC / 60 VAC	2.5 VDC
Special Features	–	–	–	–

Sign   Sign
2-DMU   2-wire transmitter

Table 4-3   Analog Output Modules: Characteristics at a Glance

Module / Characteristics	SM 332; AO 8 x 12 bits (-5HF00-)	SM 332; AO 4 x 16 bits (-7ND01-)	SM 332; AO 4 x 12 bits (-5HD01-)	SM 332; AO 2 x 12 bits (-5HB01-)
Number of outputs	8 Output channels	4 outputs in 4 channel groups	4 Output channels	2 Output channels
Resolution	12 bits	16 bits	12 bits	12 bits
Output type	Channel by channel: • Voltage • Current	Channel by channel: • Voltage • Current	Channel by channel: • Voltage • Current	Channel by channel: • Voltage • Current
Supports clocked operation	No	Yes	No	No
Programmable diagnostics	Yes	Yes	Yes	Yes
Diagnostic interrupt	Adjustable	Adjustable	Adjustable	Adjustable
Substitute value output	No	Adjustable	Adjustable	Adjustable
Potential relationships	Galvanic isolation between: • CPU • Of the load voltage	Galvanic isolation between: • CPU and channel • The channels • Output and L+, M • CPU and L+, M	Galvanic isolation to: • CPU • Of the load voltage	Galvanic isolation to: • CPU • Of the load voltage
Special Features	–	–	–	–

Table 4-4   Analog Input/Output Modules: Characteristics at a Glance

Module Characteristics	SM 334; AI 4/AO 2 x 8/8 bits (-0CE01-)	SM 334; AI 4/AO 2 x 12 bits (-0KE00-)
Number of inputs	4 inputs in 1 channel group	4 inputs in 2 channel groups
Number of outputs	2 outputs in 1 channel group	2 outputs in 1 channel group
Resolution	8 bits	12 bits + sign
Measuring Method	Adjustable for each channel group: • Voltage • Current	Adjustable for each channel group: • Voltage • Resistors • Temperature
Output type	Channel by channel: • Voltage • Current	Channel by channel: • Voltage
Supports clocked operation	No	No
Programmable diagnostics	No	No
Diagnostic interrupt	No	No
Limit value monitoring	No	No
Hardware interrupt upon limit violation	No	No
Hardware interrupt at end of cycle	No	No
Substitute value output	No	No
Potential relationships	• Non-isolated to CPU • Galvanic isolation to load voltage	Galvanic isolation to: • CPU • Of the load voltage
Special Features	Not parameterizable, setting of measurement and output type by means of wiring	–

4.2 Sequence of Steps from Choosing to Commissioning the Module

Introduction

The following table contains the tasks that you have to perform one after the other to commission analog modules successfully.

The sequence of steps is a suggestion, but you can perform individual steps either earlier or later (for example, assign parameters to the module) or install other modules or install, commission etc. other modules in between times.

Sequence of steps

Table 4-5   Sequence of Steps from Choosing to Commissioning the Analog Module

Step	Procedure	Refer To...
1.	Select the module	Section 4.1 and specific module section from Section 4.22
2.	With some analog input modules: set the measuring method and measuring range by means of the measuring range module	Section 4.4
3.	Install the module in the SIMATIC S7 network	”Mounting” section in the Installation Manual for the programmable logic controller being used: • S7-300 Programmable Controllers, Hardware and Installation or S7-400, M7-400 Programmable Controllers, Hardware and Installation or
4.	Assign parameters to module	Section 4.7
5.	Connect measuring sensor or loads to module	Sections 4.8 to 4.15
6.	Commission configuration	”Commissioning” section in the Installation Manual for the programmable controller being used: • S7-300 Programmable Controllers, Hardware and Installation or S7-400, M7-400 Programmable Controllers, Hardware and Installation or • ET 200M Distributed I/O Device
7.	If commissioning was not successful, diagnose configuration	Section 4.16

4.3   Analog Value Representation

Introduction

This section describes the analog values for all the measuring ranges and output ranges which you can use with the analog modules.

Converting Analog Values

The CPU processes the analog values in binary form only.

Analog input modules convert the analog process signal into digital form.

Analog output modules convert the digital output value into an analog signal.

Analog value representation with 16-bit resolution

The digitized analog value is the same for both input and output values having the same nominal range. The analog values are represented as a fixed-point number in two's complement. The resulting assignment is as follows:

Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value of bits	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Sign

The sign of the analog value is always contained in bit number 15:

- "0" → +
- "1" → −

Resolution less than 16 bits

If the resolution of an analog module has fewer than 16 bits, the analog value is stored left-justified on the module. The lower-order bit positions not used are padded with zeros ("0").

Example

In the following example you can see how the positions not padded with "0" are written for low resolution.

Table 4-6   Example: Bit pattern of a 16-bit and a 13-bit analog value

Resolution	Analog value															
Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16-bit analog value	0	1	0	0	0	1	1	0	0	1	1	1	0	0	1	1
13-bit analog value	0	1	0	0	0	1	1	0	0	1	1	1	0	**0**	**0**	**0**

4.3.1   Analog Value Representation for Analog Input Channels

Introduction

The tables in this chapter contain the measured value representations for the various measuring ranges of the analog input modules. The values in the tables apply to all modules with the corresponding measuring ranges.

Notes for readers of the tables

Tables 4-8 to 4-9 contain the binary representation of the measured values.

Since the binary representation of the measured values is always the same, starting at 4-10 these tables only contain the measured values and the units.

Measured-value resolution

The resolution of the analog values may differ, depending on the analog module and its parameterization. With resolutions < 15 bits, the bits indicated by "x" are set to "0".

Note: This resolution does not apply to temperature values. The converted temperature values are the result of a conversion in the analog module (see Tables 4-16 to 4-31).

Table 4-7   Possible analog value resolutions

Resolution in bits (+ sign)	Units		Analog value	
	decimal	hexadecimal	High-Order Byte	Low-Order Byte
8	128	80_H	Sign 0 0 0 0 0 0 0	1 x x x x x x x
9	64	40_H	Sign 0 0 0 0 0 0 0	0 1 x x x x x x
10	32	20_H	Sign 0 0 0 0 0 0 0	0 0 1 x x x x x
11	16	10_H	Sign 0 0 0 0 0 0 0	0 0 0 1 x x x x
12	8	8_H	Sign 0 0 0 0 0 0 0	0 0 0 0 1 x x x
13	4	4_H	Sign 0 0 0 0 0 0 0	0 0 0 0 0 1 x x
14	2	2_H	Sign 0 0 0 0 0 0 0	0 0 0 0 0 0 1 x
15	1	1_H	Sign 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1

Binary representation of the input ranges

The input ranges shown in Tables 4-8 to 4-9 are defined in two's complement representation:

Table 4-8   Bipolar Input Ranges

Units	Measured Value in %	Data Word																Range
		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
32767	>118.515	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Overflow
32511	117.589	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	Over range
27649	$\times > 100.004$	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
27648	100.000	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	Rated range
1	0.003617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
−1	−0.003617	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
−27648	−100.000	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	
−27649	≤ -100.004	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	Under range
−32512	−117.593	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
−32768	≤ -117.596	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Underflow

Table 4-9   Unipolar Input Ranges

Units	Measured Value in %	Data Word																Range
		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
32767	≥ 118.515	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Overflow
32511	117.589	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	Over-range range
27649	≥ 100.004	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
27648	100.000	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	Rated range
1	0.003617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
−1	−0.003617	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Under-range range
−4864	−17.593	1	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	
−32768	≤ -17.596	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Underflow

Analog Value Representation in Voltage Measuring Ranges

Table 4-10   Analog Value Representation in Voltage Measuring Ranges ± 10 V to ± 1 V

System		Voltage Measuring Range				
Dec.	Hex.	±10 V	±5 V	±2.5 V	±1 V	
32767	7FFF	11.851 V	5.926 V	2.963 V	1.185 V	Overflow
32512	7F00					
32511	7EFF	11.759 V	5.879 V	2.940 V	1.176 V	Overrange
27649	6C01					
27648	6C00	10 V	5 V	2.5 V	1 V	Rated range
20736	5100	7.5 V	3.75 V	1.875 V	0.75 V	
1	1	361.7 μV	180.8 μV	90.4 μV	36.17 μV	
0	0	0 V	0 V	0 V	0 V	
−1	FFFF					
−20736	AF00	−7.5 V	−3.75 V	−1.875 V	−0.75 V	
−27648	9400	−10 V	−5 V	−2.5 V	−1 V	
−27649	93FF					Underrange
−32512	8100	−11.759 V	−5.879 V	−2.940 V	−1.176 V	
−32513	80FF					Underflow
−32768	8000	−11.851 V	−5.926 V	−2.963 V	−1.185 V	

Table 4-11   Analog Value Representation in Voltage Measuring Ranges ± 500 mV to ± 80 mV

System		Voltage Measuring Range			
Dec.	Hex.	±500 mV	±250 mV	±80 mV	
32767	7FFF	592.6 mV	296.3 mV	94.8 mV	Overflow
32512	7F00				
32511	7EFF	587.9 mV	294.0 mV	94.1 mV	Overrange
27649	6C01				
27648	6C00	500 mV	250 mV	80 mV	Rated range
20736	5100	375 mV	187.5 mV	60 mV	
1	1	18.08 μV	9.04 μV	2.89 μV	
0	0	0 mV	0 mV	0 mV	
−1	FFFF				
−20736	AF00	−375 mV	−187.5 mV	−60 mV	
−27648	9400	−500 mV	−250 mV	−80 mV	
−27649	93FF				Underrange
−32512	8100	−587.9 mV	−294.0 mV	−94.1 mV	
−32513	80FF				Underflow
−32768	8000	−592.6 mV	−296.3 mV	−94.8 mV	

Table 4-12   Analog Value Representation in Voltage Measuring Ranges 1 to 5 V and
0 to 10 V

System		Voltage Measuring Range		
Dec.	Hex.	1 to 5 V	0 to 10 V	
32767	7FFF	5.741 V	11.852 V	Overflow
32512	7F00			
32511	7EFF	5.704 V	11.759 V	Overrange
27649	6C01			
27648	6C00	5 V	10 V	Rated range
20736	5100	4 V	7.5 V	
1	1	1 V + 144.7 μV	0 V + 361.7 μV	
0	0	1 V	0 V	
−1	FFFF			Underrange
−4864	ED00	0.296 V	Negative values not possible	
−4865	ECFF			Underflow
−32768	8000			

Analog Value Representation in Current Measuring Ranges

Table 4-13   Analog Value Representation in Current Measuring Ranges ± 20 mA to ± 3.2 mA

System		Current Measuring Range			
Dec.	Hex.	±20 mA	±10 mA	±3.2 mA	
32767	7FFF	23.70 mA	11.85 mA	3.79 mA	Overflow
32512	7F00				
32511	7EFF	23.52 mA	11.76 mA	3.76 mA	Overrange
27649	6C01				
27648	6C00	20 mA	10 mA	3.2 mA	Rated range
20736	5100	15 mA	7.5 mA	2.4 mA	
1	1	723.4 nA	361.7 nA	115.7 nA	
0	0	0 mA	0 mA	0 mA	
−1	FFFF				
−20736	AF00	−15 mA	−7.5 mA	−2.4 mA	
−27648	9400	−20 mA	−10 mA	−3.2 mA	
−27649	93FF				Underrange
−32512	8100	−23.52 mA	−11.76 mA	−3.76 mA	
−32513	80FF				Underflow
−32768	8000	−23.70 mA	−11.85 mA	−3.79 mA	

Table 4-14   Analog Value Representation in Current Measuring Ranges 0 to 20 mA and 4 to 20 mA

System		Current Measuring Range		
Dec.	Hex.	0 to 20 mA	4 to 20 mA	
32767	7FFF	23.70 mA	22.96 mA	Overflow
32512	7F00			
32511	7EFF	23.52 mA	22.81 mA	Overrange
27649	6C01			
27648	6C00	20 mA	20 mA	Rated range
20736	5100	15 mA	16 mA	
1	1	723.4 nA	4 mA + 578.7 nA	
0	0	0 mA	4 mA	
–1	FFFF			Underrange
–4864	ED00	–3.52 mA	1.185 mA	
–4865	ECFF			Underflow
–32768	8000			

Analog Value Representation for Resistance-Type Transmitters

Table 4-15   Analog Value Representation for Resistance Type Transmitters from 10 kΩ and from 150 Ω to 600 Ω

System		Resistance-Type Transmitter Range				
Dec.	Hex.	10 kΩ	150 Ω	300 Ω	600 Ω	
32767	7FFF	11.852 kΩ	177.77Ω	355.54 Ω	711.09 Ω	Overflow
32512	7F00		150.01 Ω	300.01 Ω	600.02 Ω	
32511	7EFF	11.759 kΩ	176.38 Ω	352.77 Ω	705.53 Ω	Overrange
27649	6C01					
27648	6C00	10 kΩ	150 Ω	300 Ω	600 Ω	Rated range
20736	5100	7.5 kΩ	112.5 Ω	225 Ω	450 Ω	
1	1	361.7mΩ	5.43 mΩ	10.85 mΩ	21.70 mΩ	
0	0	0 Ω	0 Ω	0 Ω	0 Ω	
		(negative values physically not possible)				Underrange

Analog value representation for RTD Resistance Temperature Detectors Pt x00 standard

Table 4-16   Analog value representation for RTD Resistance Temperature Detectors PT 100, 200, 500, 1000

Pt x00 standard in °C (1 digit =0.1°C)	Units		Pt x00 standard in °F (1 digit =0.1 °F)	Units		Pt x00 standard in K (1 digit = 0.1 K)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal		decimal	hexa-decimal	
> 1000.0	32767	7FFF$_H$	> 1832.0	32767	7FFF$_H$	> 1273.2	32767	7FFF$_H$	Overflow
1000.0 : 850.1	10000 : 8501	2710$_H$: 2135$_H$	1832.0 : 1562.1	18320 : 15621	4790$_H$: 3D05$_H$	1273.2 : 1123.3	12732 : 11233	31BC$_H$: 2BE1$_H$	Overrange
850.0 : −200.0	8500 : −2000	2134$_H$: F830$_H$	1562.0 : −328.0	15620 : −3280	3D04$_H$: F330$_H$	1123.2 : 73.2	11232 : 732	2BE0$_H$: 2DC$_H$	Rated range
−200.1 : −243.0	−2001 : −2430	F82F$_H$: F682$_H$	−328.1 : −405.4	−3281 : −4054	F32F$_H$: F02A$_H$	73.1 : 30.2	731 : 302	2DB$_H$: 12E$_H$	Underrange
< −243.0	−32768	8000$_H$	< −405.4	−32768	8000$_H$	< 30.2	32768	8000$_H$	Underflow

Analog value representation for RTD Resistance Temperature Detectors Pt x00 climate

Table 4-17   Analog value representation for RTD Resistance Temperature Detectors Pt 100, 200, 500, 1000

Pt x00 climate in °C (1 digit = 0.01°C)	Units		Pt x00 climate in °F (1 digit = 0.01 °F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
>155.00	32767	7FFF$_H$	>311.00	32767	7FFF$_H$	Overflow
155.00 : 130.01	15500 : 13001	3C8C$_H$: 32C9$_H$	311.00 : 266.01	31100 : 26601	797C$_H$: 67E9$_H$	Overrange
130.00 : −120.00	13000 : −12000	32C8$_H$: D120$_H$	266.00 : −184.00	26600 : −18400	67E8$_H$: B820$_H$	Rated range
−120.01 : −145.00	−12001 : −14500	D11F$_H$: C75C$_H$	−184.01 : −229.00	−18401 : −22900	B81F$_H$: A68C$_H$	Underrange
< −145.00	−32768	8000$_H$	< −229.00	−32768	8000$_H$	Underflow

Analog value representation for RTD Resistance Temperature Detectors Ni x00 standard

Table 4-18   Analog value representation for RTD Resistance Temperature Detectors Ni100, 120, 200, 500, 1000, LG-Ni 1000

Ni x00 standard in °C (1 digit = 0.1°C)	Units		Ni x00 standard in °F (1 digit = 0.1 °F)	Units		Ni x00 standard in K (1 digit = 0.1 K)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal		decimal	hexa-decimal	
>295.0	32767	7FFF$_H$	>563.0	32767	7FFF$_H$	>568.2	32767	7FFF$_H$	Overflow
295.0 : 250.1	2950 : 2501	B86$_H$: 9C5$_H$	563.0 : 482.1	5630 : 4821	15FE$_H$: 12D5$_H$	568.2 : 523.3	5682 : 5233	1632$_H$: 1471$_H$	Overrange
250.0 : −60.0	2500 : −600	9C4$_H$: FDA8$_H$	482.0 : −76.0	4820 : −760	12D4$_H$: FD08$_H$	523.2 : 213.2	5232 : 2132	1470$_H$: 854$_H$	Rated range
−60.1 : −105.0	−601 : −1050	FDA7$_H$: FBE6$_H$	−76.1 : −157.0	−761 : −1570	FD07$_H$: F9DE$_H$	213.1 : 168.2	2131 : 1682	853$_H$: 692$_H$	Underrange
< −105.0	−32768	8000$_H$	< −157.0	−32768	8000$_H$	<168.2	32768	8000$_H$	Underflow

Analog value representation for RTD Resistance Temperature Detectors Ni x00 climate

Table 4-19   Analog value representation for RTD Resistance Temperature Detectors Ni 100, 120, 200, 500, 1000, LG-Ni 1000

Ni x00 climate in °C (1 digit = 0.01°C)	Units		Ni x00 climate in °F (1 digit = 0.01 °F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 295.00	32767	7FFF$_H$	>325.11	32767	7FFF$_H$	Overflow
295.00 : 250.01	29500 : 25001	733C$_H$: 61A9$_H$	327.66 : 280.01	32766 : 28001	7FFE$_H$: 6D61$_H$	Overrange
250.00 : −60.00	25000 : −6000	61A8$_H$: E890$_H$	280.00 : −76.00	28000 : −7600	6D60$_H$: E250$_H$	Rated range
−60.01 : −105.00	−6001 : −10500	E88F$_H$: D6FC$_H$	−76.01 : −157.00	−7601 : −15700	E24F$_H$: C2AC$_H$	Underrange
< −105.00	−32768	8000$_H$	< −157.00	−32768	8000$_H$	Underflow

Analog value representation for RTD Resistance Temperature Detectors Cu 10 standard

Table 4-20   Analog Value Representation for RTD Resistance Temperature Detectors Cu 10

Cu 10 standard in °C (1 digit = 0.01°C)	Units		Cu 10 standard in °F (1 digit = 0.01 °F)	Units		Cu 10 standard in K (1 digit = 0.01 K)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal		decimal	hexa-decimal	
> 312.0	32767	7FFF$_H$	>593.6	32767	7FFF$_H$	>585.2	32767	7FFF$_H$	Overflow
312.0 : 260.1	3120 : 2601	C30$_H$: A29$_H$	593.6 : 500.1	5936 : 5001	1730$_H$: 12D5$_H$	585.2 : 533.3	5852 : 5333	16DC$_H$: 14D5$_H$	Overrange
260.0 : −200.0	2600 : −2000	A28$_H$: F830$_H$	500.0 : −328.0	5000 : −3280	1389$_H$: F330$_H$	533.2 : 73.2	5332 : 732	14D4$_H$: 2DC$_H$	Rated range
−200.1 : −240.0	−2001 : −2400	F82F$_H$: F6A0$_H$	−328.1 : −400.0	−3281 : −4000	F32F$_H$: F060$_H$	73.1 : 33.2	731 : 332	2DB$_H$: 14C$_H$	Underrange
< −240.0	−32768	8000$_H$	< −400.0	−32768	8000$_H$	<33.2	32768	8000$_H$	Underflow

Analog value representation for RTD Resistance Temperature Detectors Cu 10 climate

Table 4-21   Analog Value Representation for RTD Resistance Temperature Detectors Cu 10

Cu 10 climate in °C (1 digit = 0.01°C)	Units		Cu 10 climate in °F (1 digit = 0.01 °F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 180.00	32767	7FFF$_H$	>325.11	32767	7FFF$_H$	Overflow
180.00 : 150.01	18000 : 15001	4650$_H$: 3A99$_H$	327.66 : 280.01	32766 : 28001	7FFE$_H$: 6D61A$_H$	Overrange
150.00 : −50.00	15000 : −5000	3A98$_H$: EC78$_H$	280.00 : −58.00	28000 : −5800	6D60$_H$: E958$_H$	Rated range
−50.01 : −60.00	−5001 : −6000	EC77$_H$: E890H	−58.01 : −76.00	−5801 : −7600	E957$_H$: E250H	Underrange
< −60.00	−32768	8000$_H$	< −76.00	−32768	8000$_H$	Underflow

Analog value representation for thermocouples type B

Table 4-22   Analog value representation for thermocouples type B

Type B in °C	Units		Type B in °F	Units		Type B in K	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal		decimal	hexa-decimal	
>2070.0	32767	7FFF$_H$	>3276.6	32767	7FFF$_H$	>2343.2	32767	7FFF$_H$	Overflow
2070.0 : 1821.0	20700 : 18210	50DC$_H$: 4722$_H$	3276.6 : 2786.6	32766 : 27866	7FFE$_H$: 6CDA$_H$	2343.2 : 2094.2	23432 : 20942	5B88$_H$: 51CE$_H$	Overrange
1820.0 : 0.0	18200 : 0	4718$_H$: 0000$_H$	2786.5 : 32.0	27865 : 320	6CD9$_H$: 0140$_H$	2093.2 : 273.2	20932 : 2732	51C4$_H$: 0AAC$_H$	Rated range
: −120.0	: −1200	: FB50$_H$	: −184.0	: −1840	: F8D0$_H$	: 153.2	: 1532	: 05FC$_H$	Underrange
< −120.0	−32768	8000$_H$	< −184.0	−32768	8000$_H$	<153.2	32768	8000$_H$	Underflow

Analog Value Representation for Thermocouples type C

Table 4-23   Analog value representation for thermocouples type C

Type C in °C	Units		Type C in °F	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
>2500.0	32767	7FFFH	>3276.6	32767	7FFFH	Overflow
2500.0 : 2315.1	25000 : 23151	61A8$_H$: 5A6F$_H$	3276.6 : 2786.6	32766 : 27866	7FFE$_H$: 6CDA$_H$	Overrange
2315.0 : 0.0	23150 : 0	5A6E$_H$: 0000$_H$	2786.5 : 32.0	27865 : 320	6CD9$_H$: 0140$_H$	Rated range
0.1 : −120.0	−1 : −1200	FFFF$_H$: FB50$_H$	31.9 : −184.0	319 : −1840	013F$_H$: F8D0$_H$	Underrange
< −120.0	−32768	8000$_H$	< −184.0	−32768	8000$_H$	Underflow

Analog Value Representation for Thermocouples type E

Table 4-24   Analog value representation for thermocouples type E

Type E in °C	Units		Type E in °F	Units		Type E in K	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal		decimal	hexa-decimal	
> 1200.0	32767	7FFF$_H$	> 2192,0	32767	7FFF$_H$	> 1473.2	32767	7FFF$_H$	Overflow
1200.0 : 1000.1	12000 : 10001	2EE0$_H$: 2711$_H$	2192.0 : 1833.8	21920 : 18338	55A0$_H$: 47A2$_H$	1473.2 : 1274.2	14732 : 12742	398C$_H$: 31C6$_H$	Overrange
1000.0 : −270.0	10000 : −2700	2710$_H$: F574$_H$	1832.0 : −454.0	18320 : −4540	4790$_H$: EE44$_H$	1273.2 : 0	12732 : 0	31BC$_H$: 0000$_H$	Rated range
< −270.0	< −2700	H	< −454.0	< −4540	<EE44$_H$	<0	<0	<0000$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...									
... of F0C4$_H$ and outputs 8000$_H$.			... of FB70$_H$ and outputs 8000$_H$.			... of E5D4$_H$ and outputs 8000$_H$.			

Analog Value Representation for Thermocouples type J

Table 4-25   Analog value representation for thermocouples type J

Type J in °C	Units		Type J in °F	Units		Type J in K	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal		decimal	hexa-decimal	
> 1450.0	32767	7FFF$_H$	> 2642,0	32767	7FFF$_H$	> 1723.2	32767	7FFF$_H$	Overflow
1450.0 : 1201.0	14500 : 12010	38A4$_H$: 2EEA$_H$	2642.0 : 2193.8	26420 : 21938	6734$_H$: 55B2$_H$	1723.2 : 1474.2	17232 : 14742	4350$_H$: 3996$_H$	Overrange
1200.0 : −210.0	12000 : −2100	2EE0$_H$: F7CC$_H$	2192.0 : −346.0	21920 : −3460	55A0$_H$: F27C$_H$	1473.2 : 63.2	14732 : 632	398C$_H$: 0278$_H$	Rated range
< −210.0	< −2100	H	< −346.0	< −3460	H	<63.2	< 632	< 0278$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...									
... of F31C$_H$ and outputs 8000$_H$.			... of EA0C$_H$ and outputs 8000$_H$.			... of FDC8$_H$ and outputs 8000$_H$.			

Analog value representation for thermocouples type K

Table 4-26   Analog value representation for thermocouples type K

Type K in °C	Units decimal	Units hexa-decimal	Type K in °F	Units decimal	Units hexa-decimal	Type K in K	Units decimal	Units hexa-decimal	Range
> 1622.0	32767	7FFF$_H$	>2951.6	32767	7FFF$_H$	> 1895.2	32767	7FFF$_H$	Overflow
1622.0 : 1373.0	16220 : 13730	3F5C$_H$: 35A2$_H$	2951.6 : 2503.4	29516 : 25034	734C$_H$: 61CA$_H$	1895.2 : 1646.2	18952 : 16462	4A08$_H$: 404E$_H$	Overrange
1372.0 : −270.0	13720 : −2700	3598$_H$: F574$_H$	2501.6 : −454.0	25061 : −4540	61B8$_H$: EE44$_H$	1645.2 : 0	16452 : 0	4044$_H$: 0000$_H$	Rated range
< −270.0	< −2700	< F574$_H$	< −454.0	< −4540	<EE44$_H$	0 %	0 %	< 0000$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...									
... of F0C4$_H$ and outputs 8000$_H$.			... of E5D4$_H$ and outputs 8000$_H$.			... of FB70$_H$ and outputs 8000$_H$.			

Analog value representation for thermocouples type L

Table 4-27   Analog value representation for thermocouples type L

Type L in °C	Units decimal	Units hexa-decimal	Type L in °F	Units decimal	Units hexa-decimal	Type L in K	Units decimal	Units hexa-decimal	Range
>1150.0	32767	7FFF$_H$	>2102.0	32767	7FFF$_H$	>1423.2	32767	7FFF$_H$	Overflow
1150.0 : 901.0	11500 : 9010	2CEC$_H$: 2332$_H$	2102.0 : 1653.8	21020 : 16538	521C$_H$: 409A$_H$	1423.2 : 1174.2	14232 : 11742	3798$_H$: 2DDE$_H$	Overrange
900.0 : −200.0	9000 : −2000	2328$_H$: F830$_H$	1652.0 : −328.0	16520 : −3280	4088$_H$: F330$_H$	1173.2 : 73.2	11732 : 732	2DD4$_H$: 02DC$_H$	Rated range
< −200.0	< −2000	< F830$_H$	< −328.0	< −3280	H	<73.2	< 732	<02DC$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...									
... of F380$_H$ and outputs 8000$_H$.			... of EAC0$_H$ and outputs 8000$_H$.			... of FE2C$_H$ and outputs 8000$_H$.			

Analog Value Representation for Thermocouples type N

Table 4-28   Analog value representation for thermocouples type N

Type N in °C	Units		Type N in °F	Units		Type N in K	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal		decimal	hexa-decimal	
> 1550.0	32767	7FFF$_H$	>2822.0	32767	7FFF$_H$	> 1823.2	32767	7FFF$_H$	Overflow
1550.0 : 1300.1	15500 : 13001	3C8C$_H$: 32C9$_H$	2822.0 : 2373.8	28220 : 23738	6E3C$_H$: 5CBA$_H$	1823.2 : 1574.2	18232 : 15742	4738$_H$: 3D7E$_H$	Overrange
1300.0 : −270.0	13000 : −2700	32C8$_H$: F574$_H$	2372.0 : −454.0	23720 : −4540	5CA8$_H$: EE44$_H$	1573.2 : 0	15732 : 0	3D74$_H$: 0000$_H$	Rated range
< −270.0	< −2700	< F574$_H$	< −454.0	< −4540	<EE44$_H$	0 %	0 %	< 0000$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...									
... of F0C4$_H$ and outputs 8000$_H$.			... of E5D4$_H$ and outputs 8000$_H$.			... of FB70$_H$ and outputs 8000$_H$.			

Analog Value Representation for Thermocouples type R, S

Table 4-29   Analog value representation for thermocouples type R, S

Types R, S in °C	Units		Types R, S in °F	Units		Types R, S in K	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal		decimal	hexa-decimal	
>2019.0	32767	7FFF$_H$	>3276.6	32767	7FFF$_H$	>2292.2	32767	7FFF$_H$	Overflow
2019.0 : 1770.0	20190 : 17770	4EDE$_H$: 4524$_H$	3276.6 : 3218.0	32766 : 32180	7FFE$_H$: 7DB4$_H$	2292.2 : 2043.2	22922 : 20432	598A$_H$: 4FD0$_H$	Overrange
1769.0 : −50.0	17690 : −500	451A$_H$: FE0C$_H$	3216.2 : −58.0	32162 : −580	7DA2$_H$: FDBC$_H$	2042.2 : 223.2	20422 : 2232	4FC6$_H$: 08B8$_H$	Rated range
−51.0 : −170.0	−510 : −1700	FE02$_H$: F95C$_H$	−59.8 : −274.0	−598 : −2740	FDAA$_H$: F54C$_H$	222.2 : 103.2	2222 : 1032	08AE$_H$: 0408$_H$	Underrange
< −170.0	−32768	8000$_H$	< −274.0	−32768	8000$_H$	< 103-2	< 1032	8000$_H$	Underflow

Analog Value Representation for Thermocouples type T

Table 4-30   Analog value representation for thermocouples type T

Type T in °C	Units decimal	Units hexa-decimal	Type T in °F	Units decimal	Units hexa-decimal	Type T in K	Units decimal	Units hexa-decimal	Range
>540.0	32767	7FFF$_H$	>1004.0	32767	7FFF$_H$	>813.2	32767	7FFF$_H$	Overflow
540.0 : 401.0	5400 : 4010	1518$_H$: 0FAA$_H$	1004.0	10040	2738$_H$	813.2	8132	1FC4$_H$	Overrange
400.0 : −270.0	4000 : −2700	0FA0$_H$: F574$_H$	752.0 : −454.0	7520 : −4540	1D60$_H$: EE44$_H$	673.2 : 3.2	6732 : 32	1AAC$_H$: 0020$_H$	Rated range
< −270.0	< −2700	H	< −454.0	< −4540	<EE44$_H$	<3.2	< 32	< 0020$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...									
... of F0C4$_H$ and outputs 8000$_H$.			... of E5D4$_H$ and outputs 8000$_H$.			... of FB70$_H$ and outputs 8000$_H$.			

Analog Value Representation for Thermocouples type U

Table 4-31   Analog value representation for thermocouples type U

Type U in °C	Units decimal	Units hexa-decimal	Type U in °F	Units decimal	Units hexa-decimal	Type U in K	Units decimal	Units hexa-decimal	Range
>850.0	32767	7FFF$_H$	>1562.0	32767	7FFF$_H$	>1123.2	32767	7FFF$_H$	Overflow
850.0 : 601.0	8500 : 6010	2134$_H$: 177A$_H$	1562.0 : 1113.8	15620 : 11138	2738.0$_H$: 2B82$_H$	1123.2 : 874.2	11232 : 8742	2BE0$_H$: 2226$_H$	Overrange
600.0 : −200.0	6000 : −2000	1770$_H$: F830$_H$	1112.0 : −328.0	11120 : −3280	2B70$_H$: F330$_H$	873.2 : 73.2	8732 : 732	221C$_H$: 02DC$_H$	Rated range
< −200.0	< −2000	H	< −328.0	< −3280	H	<73.2	< 732	<02DC$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...									
... of F380$_H$ and outputs 8000$_H$.			... of EAC0$_H$ and outputs 8000$_H$.			... of FE2C$_H$ and outputs 8000$_H$.			

4.3.2   Analog Value Representation for Analog Output Channels

Introduction

The tables in this chapter contain the analog value representation for output channels of the analog output modules. The values in the tables apply to all modules with the corresponding output ranges.

Notes for readers of the tables

Tables 4-32 to 4-33 contain the binary representation of the output values.

Since the binary representation of the output values is always the same, starting at 4-34 these tables only contain the output ranges and the units.

Output ranges for the SM 334; AI 4/AO 2 $\times$ 8/8 bits

The analog input/output module SM 334; AI 4/AO 2 x 8/8 bits has output ranges from 0 to 10 V and from 0 to 20 mA. Unlike the other analog modules, the SM 334 has a lower resolution, however. Please not that the SM 334; AI 4/AO 2 x 8/8 bits with product status 1 does not have overranges.

Binary representation of the output ranges

The output ranges shown in Tables 4-32 to 4-33 are defined in two's complement representation:

Table 4-32 Bipolar Output Ranges

Units	Output Value in %	Data Word																Range
		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
≥ 32512	0 %	0	1	1	1	1	1	1	1	x	x	x	x	x	x	x	x	Overflow
32511	117.589	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	Over range
27649	≥ 100.004	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
27648	100.000	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	
1	0.003617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Rated range
−1	−0.003617	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
−27648	−100.000	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	
−27649	≤ 100.004	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	Under range
−32512	−117.593	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
≤ 32513	0 %	1	0	0	0	0	0	0	0	x	x	x	x	x	x	x	x	Underflow

Table 4-33 Unipolar Output Ranges

Units	Output Value in %	Data Word																Range
		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
≥ 32512	0 %	0	1	1	1	1	1	1	1	x	x	x	x	x	x	x	x	Over-flow
32511	117.589	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	Over-range
27649	≥ 100.004	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	
27648	100.000	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	
1	0.003617	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	Rated range
0	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
−1	0.000	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Limited to rated range lower limit 0 V and 0 mA
−32512		1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
≤ 32513	0 %	1	0	0	0	0	0	0	0	x	x	x	x	x	x	x	x	Under-flow

Analog Value Representation in Voltage Output Ranges

Table 4-34   Analog Value Representation in Output Range ±10 V

System			Voltage Output Range	
	Dec.	**hex**.	**±10 V**	
118.5149%	32767	7FFF	0.00 V	Overflow, off circuit and de-energized
	32512	7F00		
117.589%	32511	7EFF	11.76 V	Overrange
	27649	6C01		
100 %	27648	6C00	10 V	
75%	20736	5100	7.5 V	
0.003617%	1	1	361.7 µV	Rated range
0 %	0	0	0 V	
	−1	FFFF	−361.7 µV	
−75 %	−20736	AF00	−7.5 V	
−100 %	−27648	9400	−10 V	
	−27649	93FF		Underrange
−117.593%	−32512	8100	−11.76 V	
	−32513	80FF		Underflow, off circuit and de-energized
−118.519%	−32768	8000	0.00 V	

Table 4-35   Analog Value Representation in Output Ranges 0 to 10 V and 1 to 5 V

System			Voltage Output Range		
	Dec.	**hex**.	**0 to 10 V**	**1 to 5 V**	
118.5149%	32767	7FFF	0.00 V	0.00 V	Overflow, off circuit and de-energized
	32512	7F00			
117.589%	32511	7EFF	11.76 V	5.70 V	Overrange
	27649	6C01			
100 %	27648	6C00	10 V	5 V	
75%	20736	5100	7.5 V	3.75 V	
0.003617%	1	1	361.7µV	1V+144.7µV	Rated range
0 %	0	0	0 V	1 V	
	−1	FFFF			Underrange
−25 %	−6912	E500		0 V	
	−6913	E4FF			Not possible. The output value is limited to 0 V.
−117.593%	−32512	8100			
	−32513	80FF			Underflow, off circuit and de-energized
−118.519%	−32768	8000	0.00 V	0.00 V	

Analog Value Representation in Current Output Ranges

Table 4-36   Analog Value Representation in Output Range ±20 mA

System			Current Output Range	
	Dec.	hex.	±20 mA	
118.5149%	32767	7FFF	0.00 mA	Overflow, off circuit and de-energized
	32512	7F00		
117.589%	32511	7EFF	23.52 mA	Overrange
	27649	6C01		
100 %	27648	6C00	20 mA	
75%	20736	5100	15 mA	
0.003617%	1	1	723.4 nA	
0 %	0	0	0 mA	Rated range
	−1	FFFF	−723.4 nA	
−75 %	−20736	AF00	−15 mA	
−100 %	−27648	9400	−20 mA	
	−27649	93FF		Underrange
−117.593%	−32512	8100	−23.52 mA	
	−32513	80FF		Underflow, off circuit and de-energized
−118.519%	−32768	8000	0.00 mA	

Table 4-37   Analog Value Representation in Output Ranges 0 and 20 mA and 4 to 20 mA

System			Current Output Range		
	Dec.	hex.	0 to 20 mA	4 to 20 mA	
118.5149%	32767	7FFF	0.00 mA	0.00 mA	Overflow, off circuit and de-energized
	32512	7F00			
117.589%	32511	7EFF	23.52 mA	22.81 mA	Overrange
	27649	6C01			
100 %	27648	6C00	20 mA	20 mA	
75%	20736	5100	15 mA	15 mA	Rated range
0.003617%	1	1	723.4 nA	4mA+578.7 nA	
0 %	0	0	0 mA	4 mA	
	−1	FFFF			Underrange
−25 %	−6912	E500		0 mA	
	−6913	E4FF			Not possible. The output value is limited to 0 mA.
−117.593%	−32512	8100			
	−32513	80FF			Underflow, off circuit and de-energized
−118.519%	−32768	8000	0.00 mA	0.00 mA	

4.4 Setting the Measuring Method and Measuring Ranges of Analog Input Channels

Two procedures

There are two procedures for setting the measuring method and the measuring ranges of the analog input channels of the analog modules:

- With measuring range module and *STEP 7*

- By means of wiring the analog input channel and *STEP 7*

Which of these two methods is used for the individual analog modules depends on the module and is described in detail in the specific module sections.

The procedure for setting the measuring method and measuring range of the module in *STEP 7* is described in Section 4.7.

The following section describes how you set the measuring method and the measuring range by means of measuring range modules.

Setting the Measuring Method and the Measuring Ranges with Measuring Range Modules

If the analog modules haves measuring range modules, they are supplied with the measuring range modules plugged in.

If necessary, the measuring range modules must be replugged to change the measuring method and the measuring range.

Note

Make sure that the measuring range modules are on the side of the analog input module.

Before installing the analog input module, therefore, check whether the measuring range modules have to be set to another measuring method and another measuring range.

Possible settings for the measuring range modules

The measuring range modules can be set to the following positions: "A", "B", "C" and "D".

Which measuring range module positions you must select for the individual measuring methods and measuring ranges is described in detail in the specific module section.

The settings for the various types of measurement and measuring ranges are also printed on the analog module.

Replugging measuring range modules

If you want to replug a measuring range module, perform the following steps:

1. Use a screwdriver to ease the measuring range module out of the analog input module.
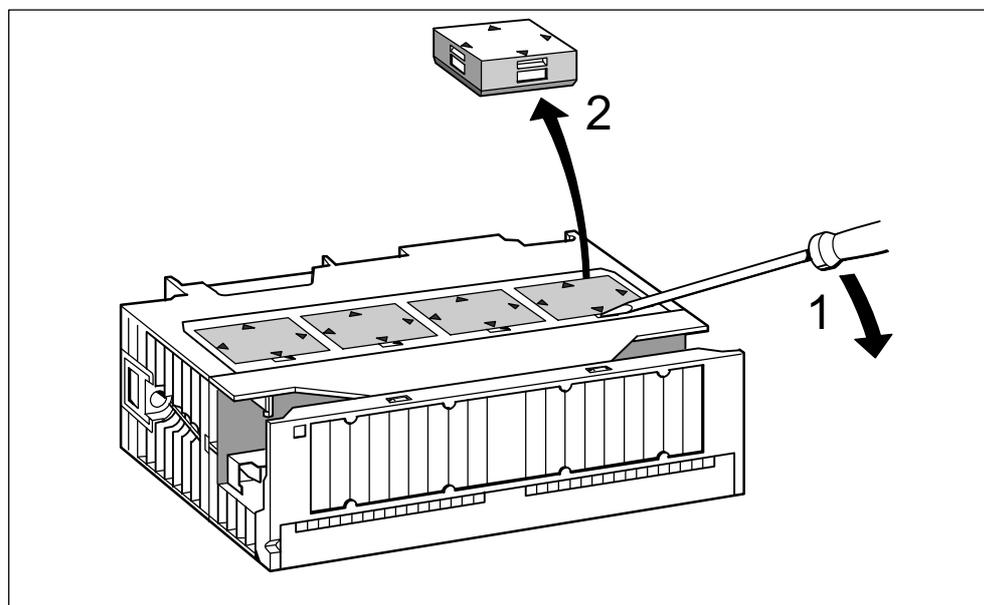
Figure 4-1   Easing Measuring Range Modules from the Analog Input Module

2. Insert the measuring range module (correctly positioned (1)) into the analog input module.

   The measuring range selected is the one that points to marker point on module (2).
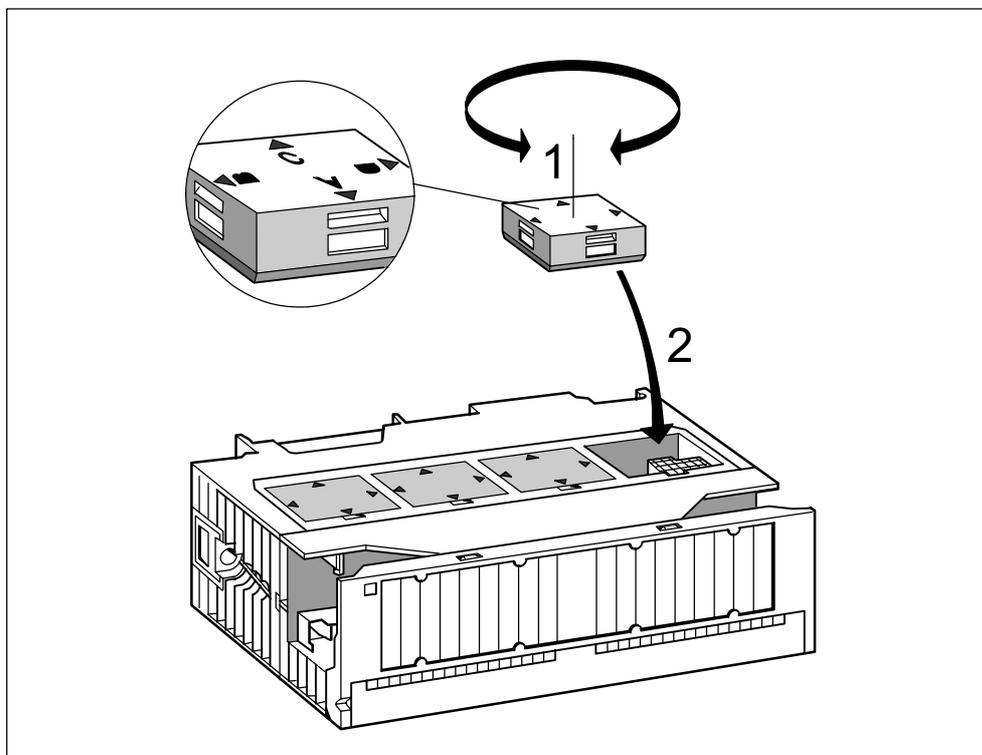
Figure 4-2   Inserting Measuring Range Modules into the Analog Input Module

Perform the same steps for all other measuring range modules.

The next step is to install the module.

> **⚠ Caution**
>
> If you have not set the measuring range modules correctly, the module may be destroyed.
>
> Make sure that the measuring range module is in the correct position before connecting a sensor to the module.

4.5 Behavior of the Analog Modules

Introduction

In this section, you will find information on:

- How the analog input and output values depend on the operating states of the CPU and the supply voltage of the analog module

- The behavior of the analog modules depending on where the analog values lie within the value range

- The effect of the operational limit of the analog module on the analog input and output value, as illustrated by an example

4.5.1 Effect of Supply Voltage and Operating Mode

Effect of supply voltage and operating mode on the modules

The input and output values of the analog modules depend on the operating state of the CPU and on the supply voltage of the module.

Table 4-38 Dependencies of the Analog Input/Output Values on the Operating State of the CPU and the Supply Voltage L+

CPU Operating State		Supply Voltage L+ at Analog Module	Input Value of the Analog Input Module	Output Value of the Analog Output Module
POWER ON	RUN	L+ present	Measured value	CPU values
			$7FFF_H$ until first conversion following power-up or after parameter assignment of the module has been completed	Until the first conversion... • **after power-up** has been completed, a signal of 0 mA or 0 V is output. • **after parameter assignment** has been completed, the previous value is output.
		L+ missing	Overflow value	0 mA/0 V
POWER ON	STOP	L+ present	Measured value	Substitute value/last value (default values: 0 mA/0 V)
			$7FFF_H$ until first conversion following power-up or after parameter assignment of the module has been completed	
		L+ missing	Overflow value	0 mA/0 V
POWER OFF	–	L+ present	–	0 mA/0 V
		L+ missing	–	0 mA/0 V

Behavior on failure of the supply voltage

Failure of the supply voltage of the analog modules is always indicated by the SF LED on the module. Furthermore, this information is made available on the module (entry in diagnostic buffer).

Triggering of the diagnostic interrupt depends on the parameter assignment (see Section 4.7).

4.5.2 Effect of Range of Values of the Analog Values

Effect of errors on analog modules with diagnostics capability

Any errors that occur can lead to a diagnostics entry and a diagnostic interrupt with analog modules with diagnostics capability and corresponding parameter assignment. You will find the errors that might be involved in Section 4.16.

Effect of range of values on the analog input module

The behavior of the analog modules depends on where the input values lie within the range of values.

Table 4-39 Behavior of the Analog Input Modules as a Function of the Position of the Analog Value within the Range of Values

Measured Value In	Input Value	SF LED	Diagnostics	Interrupt
Rated range	Measured value	–	–	–
Overrange/underrange	Measured value	–	–	–
Overflow	$7FFF_H$	Flashes[1]	Entered[1]	Diagnostic interrupt[1]
Underflow	8000_H	Flashes[1]	Entered[1]	Diagnostic interrupt[1]
Beyond the programmed limit	Measured value	–	–	Hardware interrupt[1]

[1] Only for modules with diagnostics capability and depending on parameter assignment

Effect of range of values on the analog output module

The behavior of the analog modules depends on where the output values lie within the value range.

Table 4-40   Behavior of the Analog Output Modules as a Function of the Position of the
Analog Value within the Range of Values

Process Value Lies Within	Output Value	SF LED	Diagnostics	Interrupt
Rated range	CPU value	–	–	–
Overrange/underrange	CPU value	–	–	–
Overflow	0 signal	–	–	–
Underflow	0 signal	–	–	–

4.5.3 Effect of Operational Limit and Basic Error Limit

Operational limit

The operational limit is the measuring error or output error of the analog module over the entire temperature range authorized for the module, referred to the rated range of the module.

Basic error limit

The basic error limit is the operational limit at 25 °C, referred to the rated range of the module.

Note

The percentage details of operational and basic error limits in the technical specifications of the module always refer to the **highest possible** input and output value in the rated range of the module.

Example of determination of the output error of a module

An analog output module SM 332; AO 4 x 12 bits is being used for voltage output. The output range from "0 to 10 V" is being used. The module is operating at an ambient temperature of 30 °C. Thus the operational limit applies. The technical specifications of the module state:

- Operational limit for voltage output: ± 0.5 %

An output error, therefore, of ± 0.05 V (± 0.5% of 10 V) over the whole rated range of the module must be expected.

This means that with an actual voltage of, say, 1 V, a value in the range from 0.95 V to 1.05 V is output by the module. The relative error is ± 5 % in this case.

The figure below shows for the example how the relative error becomes increasingly less the more the output value approximates to the end of the rated range of 10 V.
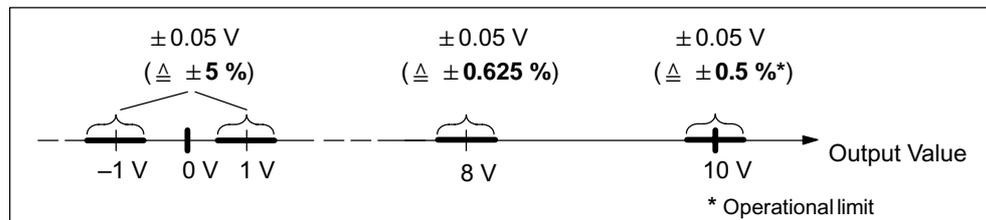
Figure 4-3   Example of the Relative Error of an Analog Output Module

4.6 Conversion, Cycle, Setting and Response Time of Analog Modules

Conversion time of analog input channels

The conversion time consists of a basic conversion time and additional processing times of the module for:

- Resistance test
- Wire-break monitoring

The basic conversion time depends directly on the conversion method of the analog input channel (integrating method, instantaneous value conversion).

In the case of integrating conversion methods, the integration time has a direct influence on the conversion time. The integration time depends on the interference frequency suppression that you set in *STEP 7* (refer to Section 4.7.1).

For the basic conversion times and additional processing times of the different analog modules refer to the technical specifications of the module concerned, starting at Section 4.18.

Scan time of analog input channels

Analog-to-digital conversion and the transfer of the digitized measured values to the memory and/or to the bus backplane are performed sequentially – in other words, the analog input channels are converted one after the other. The scan time – in other words, the time elapsing until an analog input value is again converted, is the sum of the conversion times of all activated analog input channels of the analog input module.

The following figure illustrates the components of the scan time for an n-channel analog module.
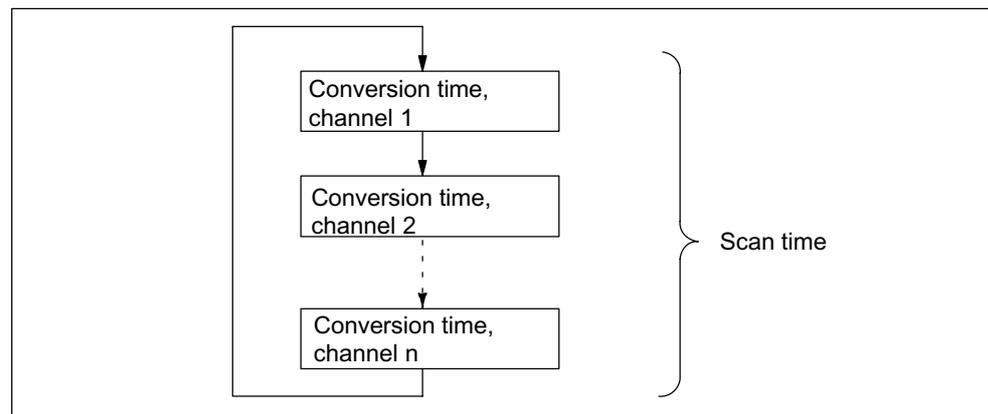
Figure 4-4   Scan time of an analog input or output module

Conversion and scan times for analog input channels in channel groups

When the analog input channels are grouped in channel groups, you must take into account the conversion time channel group by channel group.

Example

Two analog input channels of the analog input module SM 331; AI 2 × 12 bits are combined to form a channel group. You must therefore grade the scan time in steps of 2.

Setting smoothing of analog values

You can set the smoothing of the analog values in *STEP 7* for some analog input modules.

Using smoothing

Smoothing of analog values ensures a stable analog signal for further processing.

It makes sense to smooth the analog values with slow variations of measured values – for example, with temperature measurements.

Smoothing principle

The measured values are smoothed by digital filtering. Smoothing is accomplished by the module calculating average values from a defined number of converted (digitized) analog values.

The user assigns parameters to smoothing at not more than four levels (none, low, average, high). The level determines the number of analog signals used for averaging.

The higher the smoothing level chosen, the more stable is the smoothed analog value and the longer it takes until the smoothed analog signal is applied after a step response (refer to the following example).

Example

The following figure shows the number of module cycles for a step response after which the smoothed analog value is approximately 100% applied, as a function of the smoothing that has been set. The figure applies to every change of signal at the analog input.
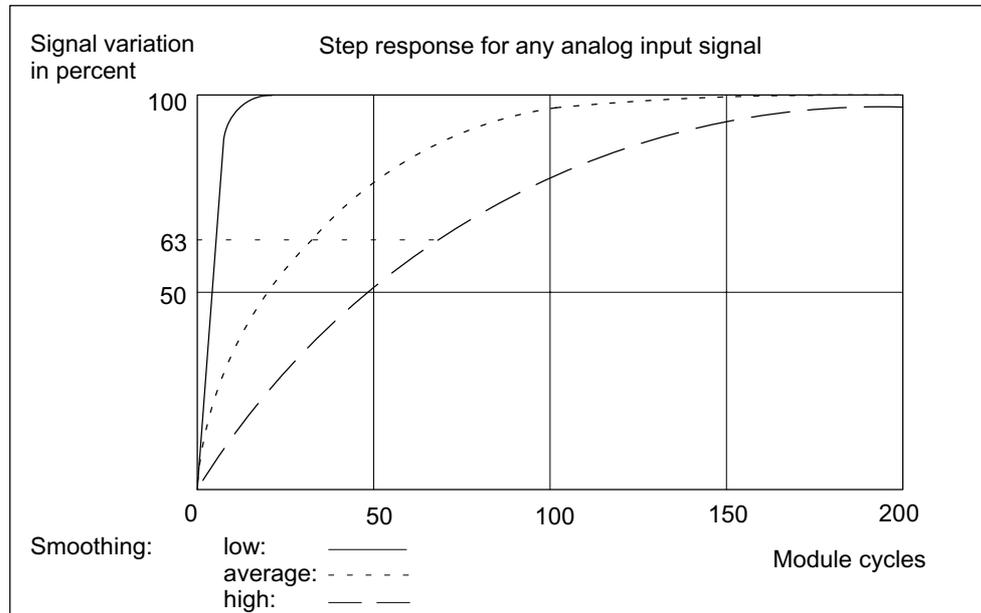
Figure 4-5   Example of the Influence of Smoothing on the Step Response

Additional information on smoothing

Refer to the specific section on the analog input module (from Section 4.22) to determine whether smoothing can be set for the specific module and for any special features that have to be taken into account.

Conversion time of the analog output channels

The conversion time of the analog output channels comprises the transfer of the digitized output values from the internal memory and the digital-to-analog conversion.

Scan time of analog output channels

The analog output channels are converted sequentially – in other words, the analog output channels are converted one after the other.

The scan time – in other words, the time elapsing until an analog output value is again converted, is the sum of the conversion times of all activated analog output channels (refer to 4-4).

Tip

> You should disable any analog channels that are not being used to reduce the scan time in *STEP 7*.

Overview of the settling time and response time of the analog output modules

t_A = Response time

t_Z = Scan time corresponds to n $\times$ conversion time (n = activated channels)

t_E = Settling time

t_1 = New digitized output value is present

t_2 = Output value transferred and converted

t_3 = Specified output value reached
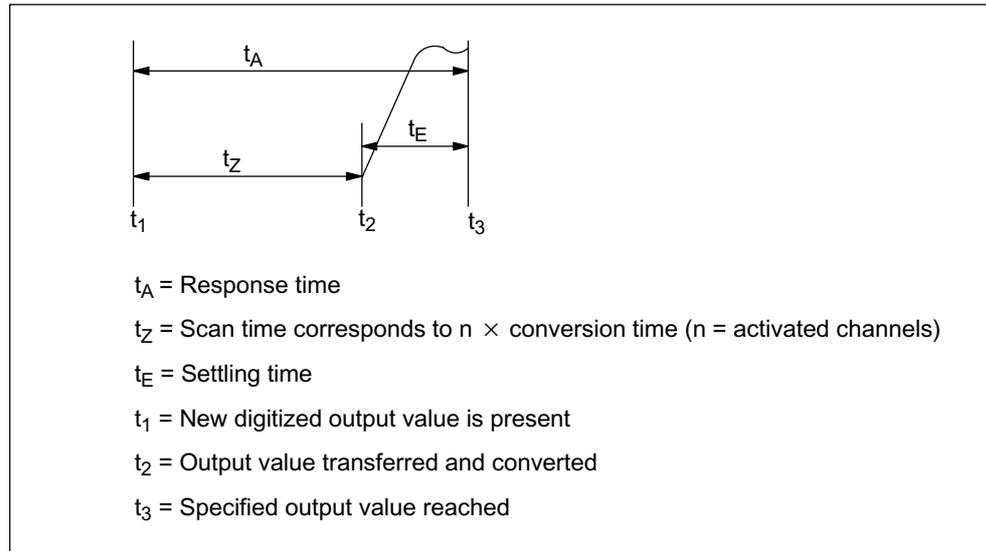
Figure 4-6   Settling and Response times of the Analog Output Channels

Settling time

> The settling time (t_2 to t_3) – in other words, the time elapsing from application the converted value until the specified value is reached at the analog output – is load-dependent. A distinction is made between resistive, capacitive and inductive loads.

> For the settling times of the different analog output modules as a function of load refer to the technical specifications of the module concerned, starting at Section 4.28.

Response time

> The response time (t_1 to t_3) – in other words, the time elapsing from application of the digital output values in the internal memory until the specified value is reached at the analog output – in a worst case scenario is the sum of the scan time and the settling time.

> You have a worst case situation, if, shortly prior to the transfer of a new output value, the analog channel has been converted and is not converted again until all other channels are converted (scan time).

4.7   Analog module parameter assignment

Introduction

Analog modules can have different characteristics. You can set the characteristics of the modules by means of parameter assignment.

Tools for parameter assignment

You assign parameters to analog modules with *STEP 7*. You must perform parameter assignment in STOP mode of the CPU.

When you have set all the parameters, download the parameters from the programming device to the CPU. On a transition from STOP to → RUN mode, the CPU then transfers the parameters to the individual analog modules.

In addition, if necessary you must place the measuring range modules of the module in the necessary position (refer to Section 4.4).

Static and dynamic parameters

The parameters are divided into static and dynamic parameters.

Set the static parameters in STOP mode of the CPU, as described above.

You can similarly modify the dynamic parameters in the current user program by means of SFCs. Note, however, that after a change from RUN → STOP, STOP → RUN of the CPU, the parameters set in *STEP 7* apply again. You will find a description of the parameter assignment of modules in the user program in Appendix A.

Parameter	Settable with	CPU Operating State
Static	PG (STEP 7 HW CONFIG)	STOP
Dynamic	PG (STEP 7 HW CONFIG)	STOP
	SFC 55 in the user program	RUN

4.7.1   Parameters of the Analog Input Modules

The analog input modules use a subset of the parameters and ranges of values listed in the table below, depending on the functionality. Refer to the section on the module concerned, starting from Section 4.22, for the subset "mastered" by the specific analog modules.

The default settings apply if you have not performed parameter assignment in *STEP 7*.

Table 4-41   Parameters of the Analog Input Modules

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Enable • Diagnostic interrupt • Hardware interrupt upon limit violation • Hardware interrupt at end of cycle	Yes/no Yes/no Yes/no	No No No	Dynamic	Module
Trigger for hardware interrupt • Upper limit value • Lower limit value	Constraint possible due to measuring range 32511 to –32512 –32512 to 32511	–	Dynamic	Channel or Channel group
Diagnostics • Group diagnostics • With wire-break check	Yes/no Yes/no	No No	Static	Channel or Channel group

Table 4-41 Parameters of the Analog Input Modules, continued

Parameter	Value Range		Default Settings	Para- meter Type	Scope
Measurement • Measuring method	Deactivated		U		
	U	Voltage			
	4DMU	Current (4-wire transmitter)			
	2DMU	Current (2-wire transmitter)			
	R-4L	Resistance (four-conductor connection)			
	R-3L	Resistance (three-conductor connection)			
	RTD-4L	Bulb resistor (linear, four-conductor connection)			
	RTD-3L	Bulb resistor (linear, three-conductor connection)			Channel or Channel group
	TC-I[1]	Thermocouple (internal comparison)		Dynamic	
	TC-E[1]	Thermocouple (external comparison)			
	TC-IL[2]	Thermocouple (linear, internal comparison)			
	TC-EL[2]	Thermocouple (linear, external comparison)			
	TC-L00C[2]	Thermocouple (linear, reference temp. 0 °C)			
	TC-L50C[2]	Thermocouple (linear, reference temp. 50°C)			
• Measuring range	For the settable measuring ranges of the input channels, please refer to the individual module description.		± 10 V		
• Reaction with open thermocouple	Overflow; underflow		Overflow		
• Temperature unit[3]	Degrees Celsius; degrees Fahrenheit; degrees Kelvin		Degrees Celsius	Dynamic	Module
• Module filtering mode	8 channels hardware filter 8 channels software filter 4 channels hardware filter		8 channels, hardware filter	Dynamic	Module

Table 4-41   Parameters of the Analog Input Modules, continued

Parameter	Value Range	Default Settings	Para-meter Type	Scope
• Temperature coefficient for temperature measurement with bulb resistor (RTD)	Platinum (Pt) 0.00385 Ω/Ω/ °C 0.003916 Ω/Ω/ °C 0.003902 Ω/Ω/ °C 0.003920 Ω/Ω/ °C 0.003851 Ω/Ω/ °C Nickel (Ni) 0.00618 Ω/Ω/ °C 0.00672 Ω/Ω/ °C Copper (Cu) 0.00427 Ω/Ω/ °C	0.00385	Dynamic	Channel or Channel group
• Interference frequency suppression	400/60/50 Hz; 400 Hz; 60 Hz; 50 Hz; 10 Hz	50 Hz	Dynamic	Channel or Channel group
• Smoothing	None Low Average High	None	Dynamic	Channel or Channel group

[1]   The module supplies a decimal value of the measured thermal voltage to the CPU – for example, 27648 at 80 mV (refer to Table 4-11)

[2]   The module supplies a temperature value to the CPU – for example, 120°C (refer to Table 4-17)

[3]   1 digit =0.1 °C; 1 digit =0.1 °F

4.7.2 Parameters of the Analog Output Modules

The analog output modules use a subset of the parameters and ranges of values listed in the table below, depending on the functionality. Refer to the section on the module concerned, starting from Section 4.28, for the subset "mastered" by the specific analog modules.

The default settings apply if you have not performed parameter assignment in *STEP 7.*

Table 4-42   Parameters of the Analog Output Modules

Parameter	Value Range	Default Settings	Para- meter Type	Scope
Enable • Diagnostic interrupt	Yes/no	No	Dynamic	Module
Diagnostics • Group diagnostics	Yes/no	No	Static	Channel
Output • Output type • Output range	Deactivated Voltage Current For the settable measuring ranges of the output channels, please refer to the individual module description.	U ± 10 V	Dynamic	Channel
Response with CPU-STOP	ASS Outputs de-energized LWH Hold last value EWS Apply substitute value	ASS	Dynamic	Channel

4.7.3 Parameters of the analog input/output modules

The analog input/output modules make available the parameters in the following table. The default settings apply if you have not performed parameter assignment in *STEP 7*.

Table 4-43 Parameters of the Analog Input/Output Modules

Parameter	Value Range	Default Settings	Para-meter Type	Scope

Input
Measurement
• Measuring method
	Deactivated
	U Voltage
	R-4L Resistance
	    (four-conductor connection)
	RTD-4L Bulb resistor (linear,
	    four-conductor connection)
		RTD-4L		

• Measuring Range	0 to 10 V 10000 Ω Pt 100 climate	Pt 100 climate	Dynamic	Channel
• Integration time	20 ms; 16.6 ms	20 ms		
Output • Output type	Deactivated Voltage	U	Dynamic	Channel
• Output range	0 to 10 V	0 to 10 V		

4.8 Connecting Sensors to Analog Inputs

Introduction

You can connect different sensors to the analog input modules depending on the measuring method; voltage and current sensors, and resistors.

This section contains general information that is generally applicable to all the connection options for sensors described in the sections that follow.

Cables for analog signals

To reduce electrical interference, you should use twisted-pair shielded cables for the analog signals. The shield of the analog signal cables should be grounded at both cable ends.

If there are potential differences between the cable ends, an equipotential bonding current can flow over the shield, which leads to an interference of the analog signals. In such a case, you should ground the shield at one end of the cable only.

Isolated analog input modules

In the case of isolated analog input modules, there is no electrical connection between the reference point of the measuring circuit M_{ANA} and the M terminal of the CPU.

You must use isolated analog input modules if a potential difference U_{ISO} can occur between the reference point of the measuring circuit M_{ANA} and the M terminal of the CPU. An equipotential bonding conductor between the M_{ANA} terminal and the M terminal of the CPU ensures that U_{ISO} does not exceed the permitted value.

Non-isolated analog input modules

In the case of the non-isolated analog input modules, you must establish a connection between the reference point of the measuring circuit M_{ANA} and the M terminal of the CPU or IM 153. To do so, connect the M_{ANA} terminal with the M terminal of the CPU or IM 153. A potential difference between M_{ANA} and the M terminal of the CPU or IM 153 can result in corruption of the analog signal.

Limited potential difference UCM

Only a limited potential difference U_{CM} (common mode voltage) may occur between the measuring lines M– of the input channels and the reference point of the measuring circuit M_{ANA}. In order to prevent the permissible value from being exceeded, you must take different actions, described below, depending on the potential connection of the sensors.

Abbreviations and mnemonics used in the figures below

The abbreviations and mnemonics used in the figures below have the following meanings:

M +:	Measuring lead (positive)
M–:	Measuring lead (negative)
M_{ANA}:	Reference potential of the analog measuring circuit
M:	Ground terminal
L +:	Terminal for 24 VDC supply voltage
U_{CM}:	Potential difference between inputs and reference potential of the M_{ANA} measuring circuit
U_{ISO}:	Potential difference between M_{ANA} and M terminal of CPU
I +:	Measuring lead for current input
U +:	Measuring lead for voltage input

Connecting isolated measuring sensors

Isolated sensors are not connected with the local ground potential (local ground). They can be operated free of potential.

With isolated sensors, potential differences might arise between the different sensors. These potential differences can arise as a result of interference or the local distribution of the sensors.

To prevent the permissible value for U_{CM} being exceeded when used in environments with a high level of EMC interference, we advise you to connect M– with M_{ANA}.

You can operate the CPU in Grounded mode (refer to the figure below) or Ungrounded mode.
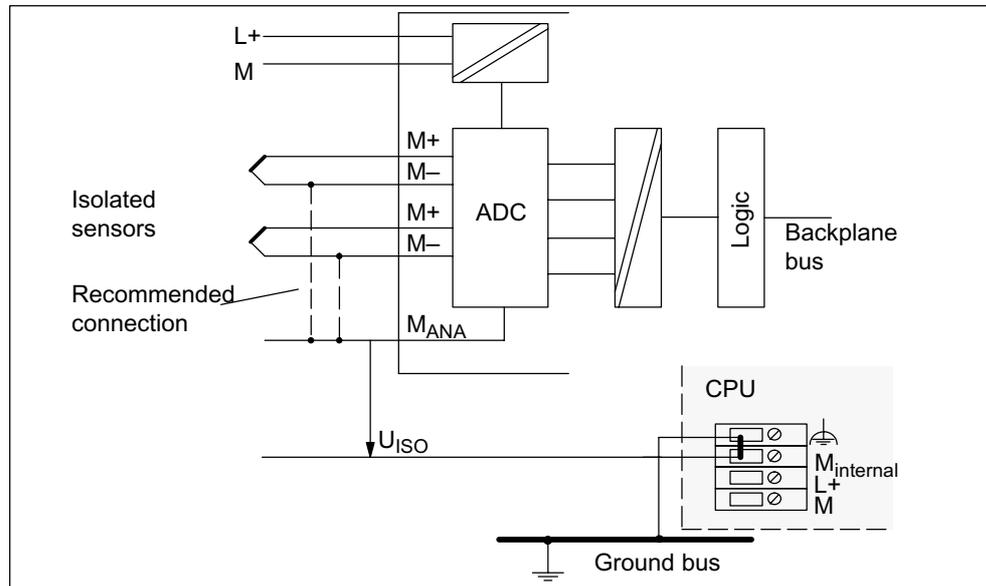
Figure 4-7   Connecting Isolated Sensors to an Isolated AI
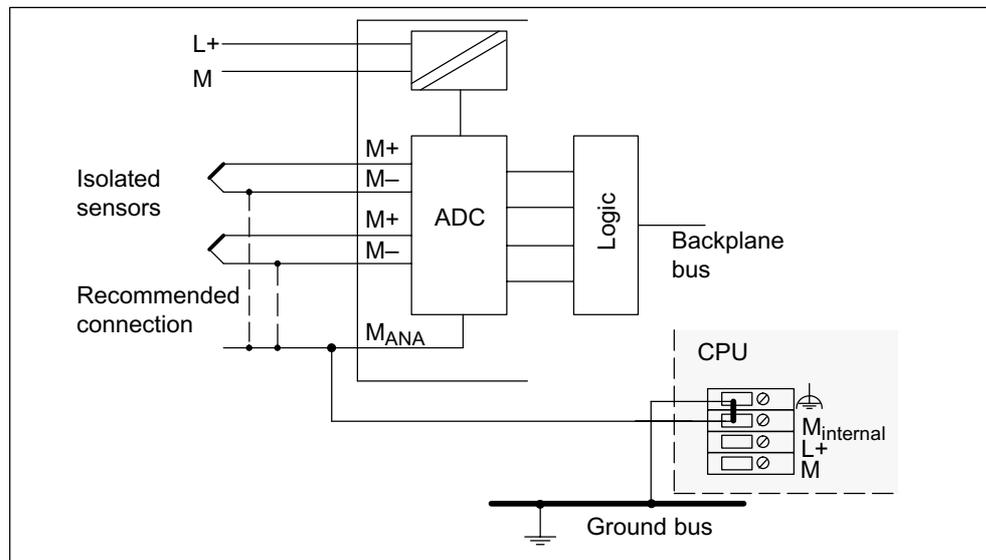
Figure 4-8   Connecting Isolated Sensors to a Non-Isolated AI

Note

Do not connect M– to M_{ANA} when connecting 2-wire transmitters for current measurement and resistance-type sensors. This also applies to inputs which are not used.

Non-isolated sensors

The non-isolated sensors are connected with the local ground potential (local ground). When using non-isolated sensors, you must connect M_{ANA} to the local ground.

Connecting non-isolated sensors

Caused by local conditions or interferences, potential differences U_{CM} (static or dynamic) can occur between the locally distributed individual measuring points. If the potential difference U_{CM} exceeds the permissible value, you must provide equipotential bonding conductors between the measuring points.

When connecting non-isolated sensors to optically isolated modules, you can operate the CPU in Grounded mode (refer to the figure below) or Ungrounded mode.
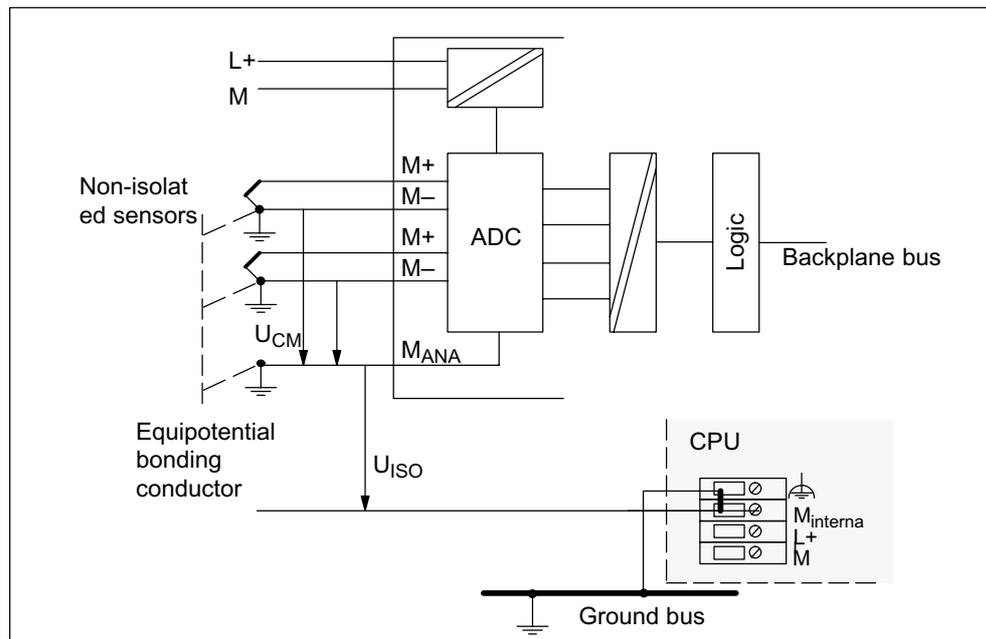
Figure 4-9   Connecting Non-Isolated Sensors to an Isolated AI

When connecting non-isolated sensors to non-isolated modules, you can operate the CPU only in Grounded mode.
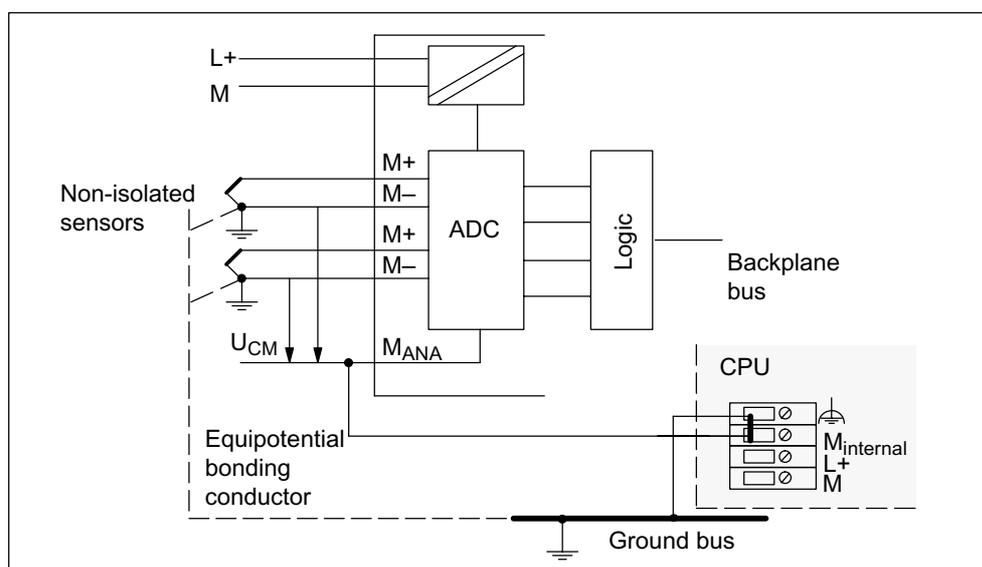
Figure 4-10   Connecting non-isolated sensors to a non-isolated AI

Note

You must not use non-isolated two-wire transmitters and non-isolated resistance-type sensors with a non-isolated AI!

4.9   Connecting Voltage Sensors

Note

The necessary connecting cables, which result from the potential connection of the analog input module and the sensors, are not drawn in the figures shown below.

In other words, you must continue to take note of and implement Section 4.8 with its generally valid information for connecting sensors.

Abbreviations and mnemonics used in the figure below

The abbreviations and mnemonics used in the figure below have the following meanings:

M +:	Measuring lead (positive)
M–:	Measuring lead (negative)
M_{ANA}:	Reference potential of the analog measuring circuit
M :	Ground terminal
L +:	Terminal for 24 VDC supply voltage
U +:	Measuring lead for voltage input

Connection of voltage sensors
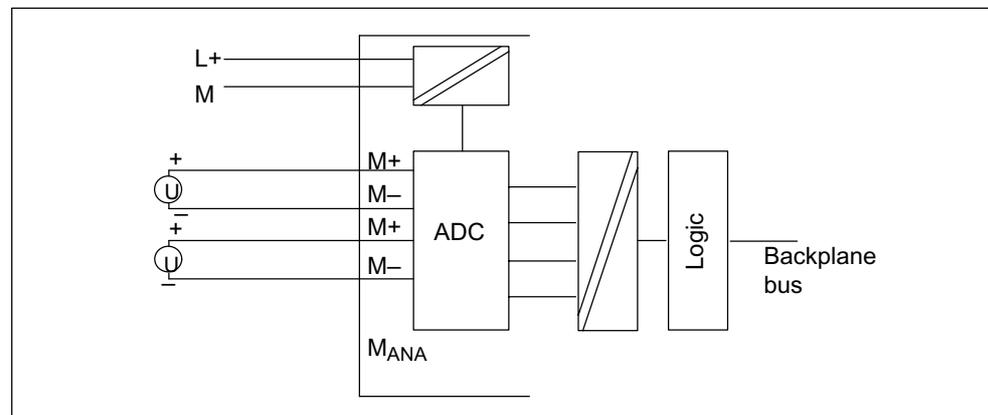
Figure 4-11   Connecting Voltage Sensors to an Isolated AI

4.10   Connecting Current Sensors

Note

The necessary connecting cables, which result from the potential connection of the analog input module and the sensors, are not drawn in the figures shown below.

In other words, you must continue to take note of and implement Section 4.8 with its generally valid information for connecting sensors.

Abbreviations and mnemonics used in the figures below

The abbreviations and mnemonics used in the figures below have the following meanings:

M +:	Measuring lead (positive)
M–:	Measuring lead (negative)
M_{ANA}:	Reference potential of the analog measuring circuit
M :	Ground terminal
L +:	Terminal for 24 VDC supply voltage
I +:	Measuring lead for current input

Supply voltage of the sensors

The 2-wire transmitter receives its short-circuit-proof power supply via the terminals of the analog input module.

This transmitter then converts the measured variable into a current. Two-wire transmitters must be isolated sensors.

Four-wire transmitters have separate power supplies.

Connecting 2-wire transmitters
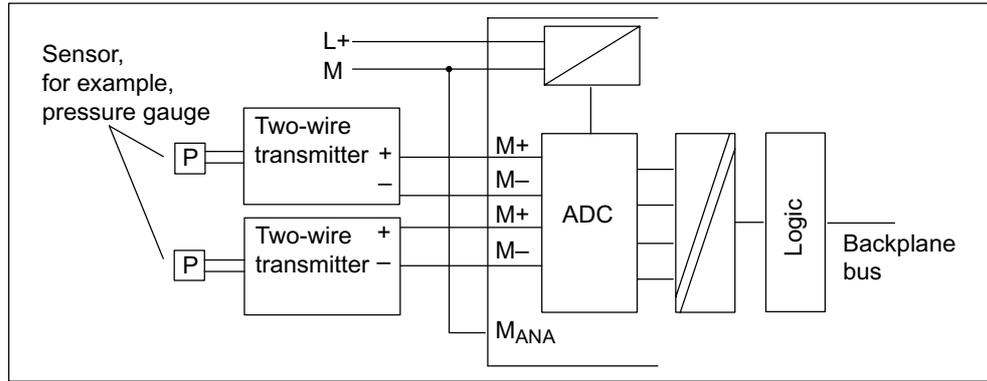
Figure 4-12   Connecting two-wire transmitters to an isolated AI

When the supply voltage L+ is fed from the module, you must assign parameters to the two-wire transmitter as a four-wire transmitter in *STEP 7*.
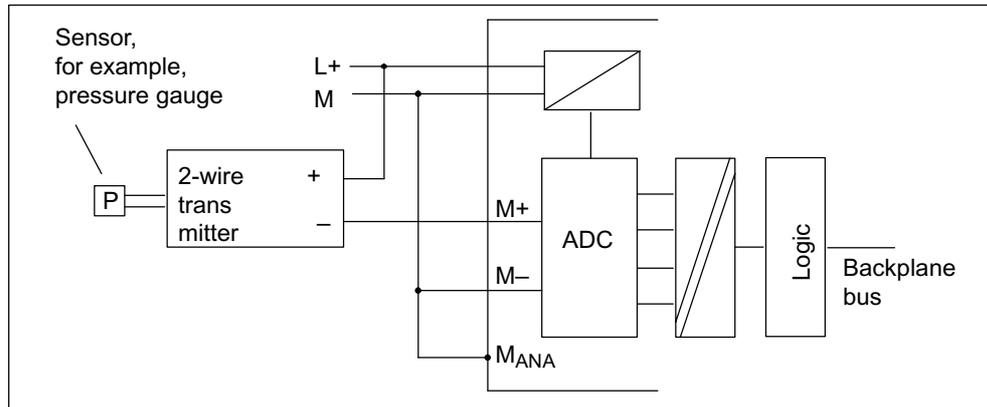
Figure 4-13   Connecting two-wire transmitters supplied from L+ to an isolated AI

Connecting four-wire transmitters
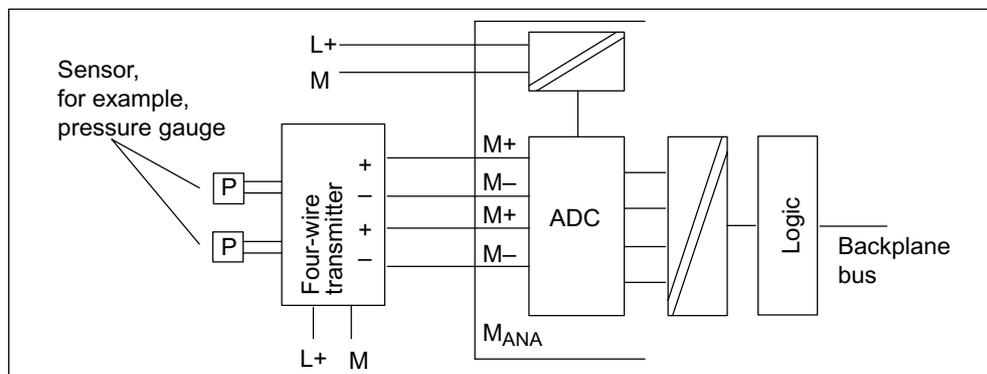
Figure 4-14   Connecting four-wire transmitters to an isolated AI

4.11   Connecting Resistance Thermometers and Resistors

Note

The necessary connecting cables, which result from the potential connection of the analog input module and the sensors, are not drawn in the figures shown below.

In other words, you must continue to take note of and implement Section 4.8 with its generally valid information for connecting sensors.

Abbreviations and mnemonics used in the figures below

The abbreviations and mnemonics used in the figures below have the following meanings:

I_{C+}:   Constant-current lead (positive)

I_{C-}:   Constant-current lead (negative)

M_+:   Measuring lead (positive)

M_-:   Measuring lead (negative)

M_{ANA}:   Reference potential of the analog measuring circuit

M: Ground terminal

L_+:   Terminal for 24 VDC supply voltage

S–:   Detector lead (negative)

Connecting Resistance Thermometers and Resistors

The resistance thermometers/resistors are wired in a four-conductor, three-conductor or two-conductor connection.

With four-conductor and three-conductor connections, the module supplies a constant current via terminals I_{C+} and I_{C-} so that the potential drop occurring on the measuring cables is compensated. It is important that the connected constant current cables are directly connected to the resistance thermometer/resistor.

Measurements with four-conductor or three-conductor connections supply a more precise measuring result due to compensation than measurements with a two-conductor connection.

Four-conductor connection of a resistance thermometer

The voltage generated at the resistance thermometer is measured via the M_+ and M_- terminals. When you connect, watch out for the polarity of the connected cable (connect I_{C+} and M_+ as well as I_{C-} and M– to the resistance thermometer).

When connecting, make sure that the connected cables **I_C+ and M+** and the cables **I_C– and M–** are connected directly to the resistance thermometer.
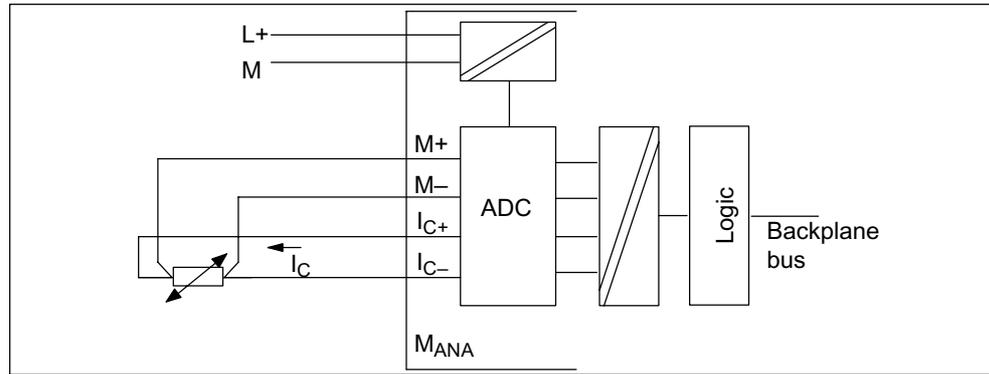
Figure 4-15   Four-conductor connection of resistance thermometers to an isolated AI

Three-conductor connection of a resistance thermometer

With a three-conductor connection on modules with four terminals, you must normally insert a **jumper between M_- and I_{C-}** (refer to Figure 4-16). Take note of the exception for the SM 331; AI 8 × RTD (refer to Figure 4-18).

When connecting, make sure that the connected cables **I_C+ and M+** are connected directly to the resistance thermometer.
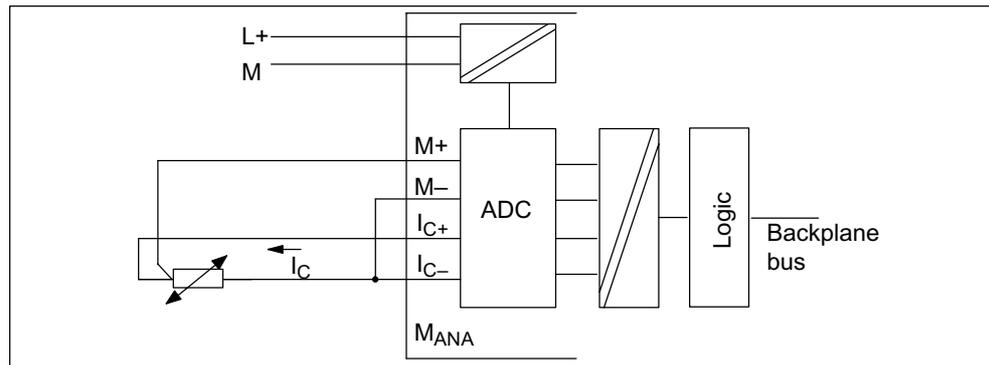
Figure 4-16   Three-Conductor Connection of Resistance Thermometers to an Isolated AI

Two-conductor connection of a resistance thermometer

With a two-conductor connection, you must insert jumpers on the module between M_+ and I_{C+} and between M_- and I_{C-}.
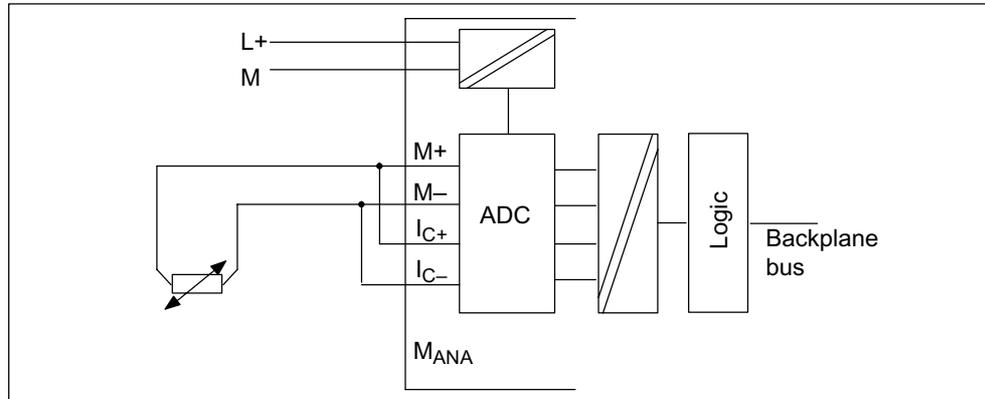
Figure 4-17   Two-Conductor Connection of Resistance Thermometers to an Isolated AI

Three-conductor connection to the SM 331; AI 8 × RTD

With a three-conductor connection to the SM 331; AI 8 × RTD you must insert a **jumper between M_+ and I_{C+}** (refer to figure4-18).

When connecting, make sure that the connected cables **I_C- and $M-$** are connected directly to the resistance thermometer.
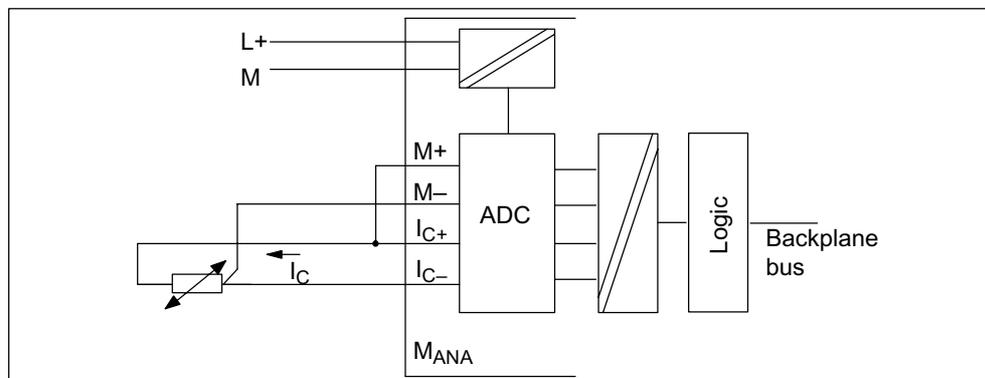
Figure 4-18   Three-Conductor Connection of Resistance Thermometers to the SM 331;
AI 8 x RTD

⚠ **Caution**

Due to incorrect wiring of the three-conductor connection, unforeseen operation of the module and dangerous conditions can result in the system.

4.11.1 Connecting resistance thermometers to the SM 331; AI 8 x 13 bits

Two-conductor connection

With a two-conductor connection, you must insert jumpers on the module between M– and S–.
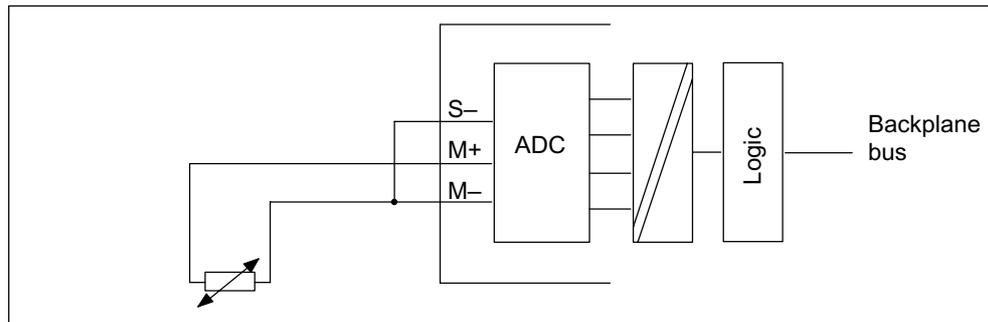
Figure 4-19   Two-conductor connection of resistance thermometers to the SM 331; AI 8x 13 bits

Three-conductor connection
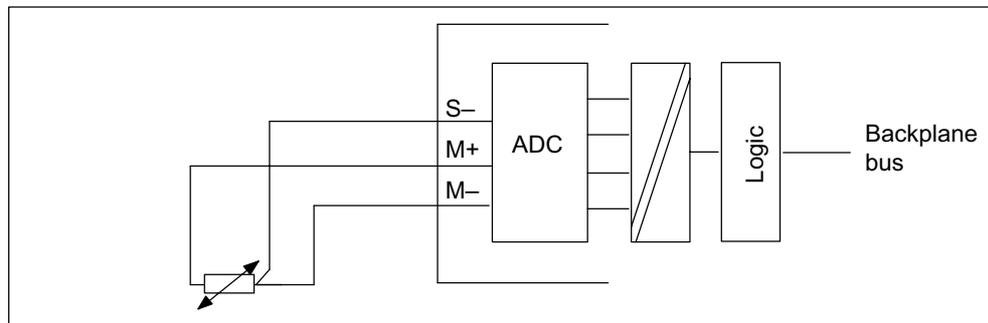
Figure 4-20   Three-conductor connection of resistance thermometers to the SM 331; AI 8 x 13 bits

Four-conductor connection

With a four-conductor connection, you must not connect the fourth conductor (the conductor is not used at all, see Figure 4-21).
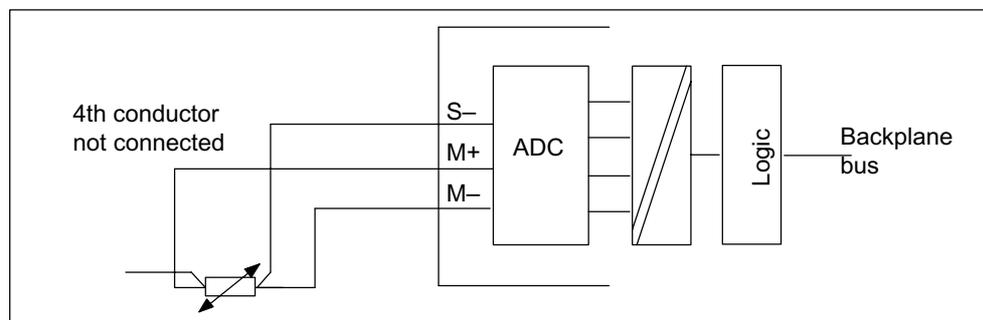
Figure 4-21   Four-Conductor Connection of Resistance Thermometers to the SM 331;
AI 8 x 13 bits

4.12   Connecting Thermocouples

Design of thermocouples

A thermocouple consists of a pair of sensors and the necessary installation and connecting parts. The thermocouple consists of two wires of dissimilar metals or metal alloys soldered or welded together at the ends.

There are different types of thermocouple, depending on the composition of the material used – for example, K, J, N thermocouples. The measuring principle of all thermocouples is the same, irrespective of their type.
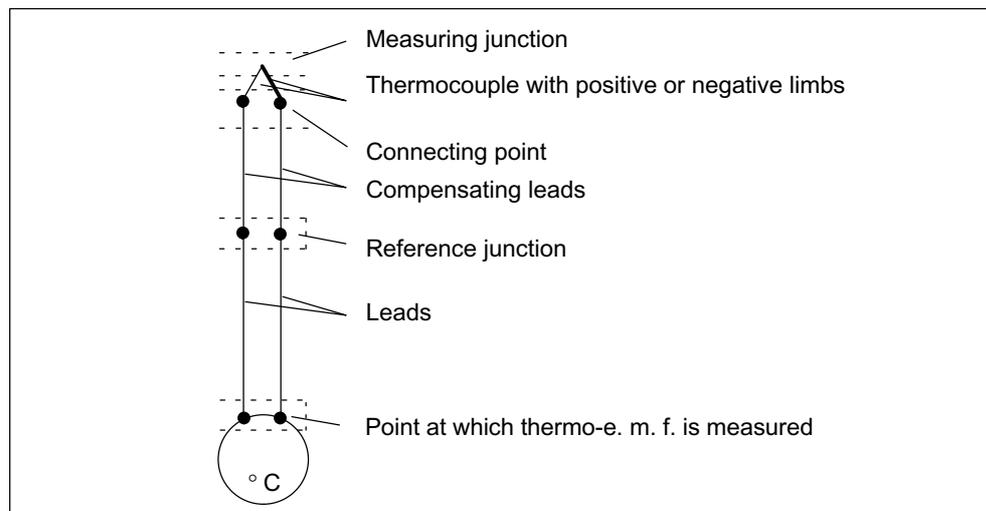
Figure 4-22   Design of Thermocouples

Principle of Operation of Thermocouples

If the measuring point is subjected to a temperature different from that of the free ends of the thermocouple (point of connection), a voltage, the thermo emf, occurs at the free ends. The magnitude of the thermo-e.m.f. generated depends on the difference between the temperature at the measuring junction and the temperature at the free ends, as well as on the material combination used for the thermocouple.

Since a thermocouple always measures a temperature difference, the free ends must be kept at a known temperature at a reference junction in order to determine the temperature of the measuring junction.

The thermocouples can be extended from their point of connection to the reference junction by means of compensating wires. These compensating wires consist of the same material as the thermocouple wires. The supply leads are copper wire. **Note:** Make sure these wires are connected with the correct polarity, otherwise there will be considerable measuring errors.

Compensation of the reference junction temperature

You can compensate for the effects of temperature fluctuations at the reference junction by means of compensating leads.

There are several options for you to choose from for acquiring the reference junction temperature in order to obtain an absolute temperature value from the difference in temperature between the reference junction and measuring point.

You can use internal or external compensation, depending on where you want the reference junction to be.

Table 4-44   Options for Compensation of the Reference Junction Temperature

Option	Explanation
No compensation	If you want to acquire only the difference in temperature between the measuring point and the reference junction.
Internal compensation (refer to Figure 4-23 for connection)	If you employ internal compensation, the internal temperature (thermocouple internal comparison) of the module is used for comparison purposes.
External compensation with compensating box in the leads of an individual thermocouple (refer to Figures 4-24 and 4-25 for its connection)	You have already acquired and compensated the reference junction temperature (thermocouple external comparison) using a compensating box, which you have looped into an individual thermocouple. No further processing is necessary owing to the module.
Only for SM 331; AI 8 x TC: External compensation with resistance thermometer for acquisition of the reference junction temperature (refer to Figure 4-26 and 4-27for connection)	You can acquire the reference temperature by means of a resistance thermometer (platinum or nickel) and have it calculated by the module for any thermocouple.

Theory of operation of internal compensation

With internal compensation, you can establish the reference point across the terminals of the analog input modules. In this case, you must run the compensating lines right up to the analog module. The internal temperature sensor acquires the temperature of the module and supplies a compensation voltage.

Note that internal compensation is not as accurate as external compensation.

Theory of operation of external compensation with compensating box

If you employ external compensation, the temperature of the reference junction of the thermocouples is taken into account via a compensating box, for example.

The compensating box contains a bridge circuit calibrated for a definite reference junction temperature. The reference junction is formed by the connections for the ends of the thermocouple's compensating leads.

If the actual temperature deviates from the compensating temperature, the temperature-sensitive bridge resistance changes. This results in a positive or negative compensating voltage, which is added to the thermo-e.m.f.

Abbreviations and mnemonics used in the figures below

The abbreviations and mnemonics used in the figures below have the following meanings:

M +:	Measuring lead (positive)
M–:	Measuring lead (negative)
I_C+:	Positive connection of constant current output
I_C-:	Negative connection of constant current output
COMP$_+$:	Compensating terminal (positive)
COMP $_-$:	Compensating terminal (negative)
M_{ANA}:	Reference potential of the analog measuring circuit
M :	Ground terminal
L +:	Terminal for 24 VDC supply voltage
P5V:	Module logic power supply
KV +/KV –:	Connections to the shunt comparison

Note

The necessary connecting cables, which result from the potential connection of the analog input module and the sensors, are not drawn in the figures shown below.

In other words, you must continue to take note of and implement Section 4.8 with its generally valid information for connecting sensors.

Connection of thermocouples with internal compensation

Connect the thermocouples to the inputs of the module, either directly or by means of compensating lines. Each channel group can use a thermocouple type supported by the analog module independently of the other channel groups.
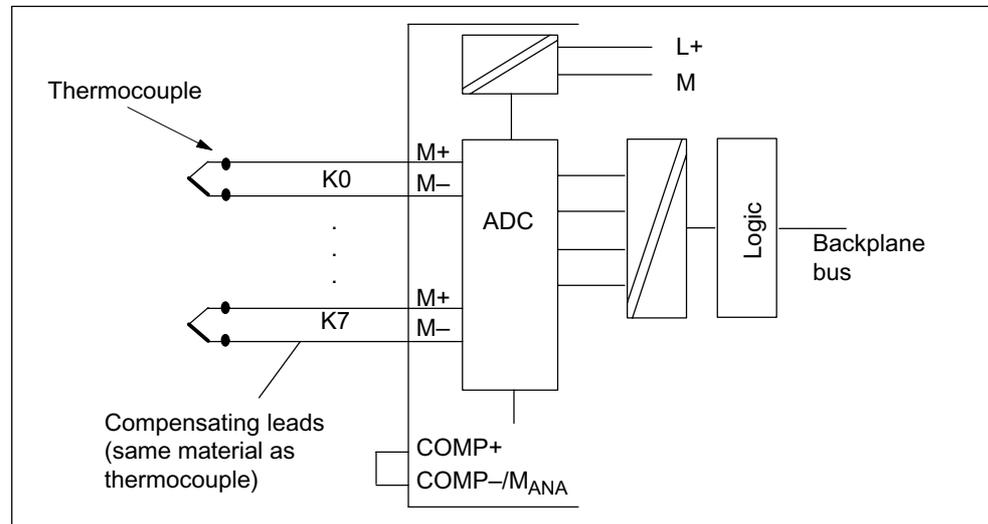
Figure 4-23   Connection of Thermocouples with Internal Compensation to an Isolated AI

Connecting the compensating box

Connect the compensating box to the COMP terminals of the module, locating the compensating box at the reference junction of the thermocouples. The compensating box must have an isolated supply. The power supply must have adequate filtering, for example by means of a grounded shielding winding.

The terminals for connecting the thermocouple to the compensating box are not required and must therefore be shorted (refer to Figure 4-25 for an example).

The following constraints apply:

- The parameters of a channel group are general valid for all channels of that group (for example, input voltage, integrating time etc.)

- External compensation with connection of the compensating box to the COMP terminals of the module can be performed only for one thermocouple type. In other words, all channels operating with external compensation must use the same type.

Connecting thermocouples with compensating box

If all thermocouples connected to the inputs of the module have the same comparison point, you compensate as follows:
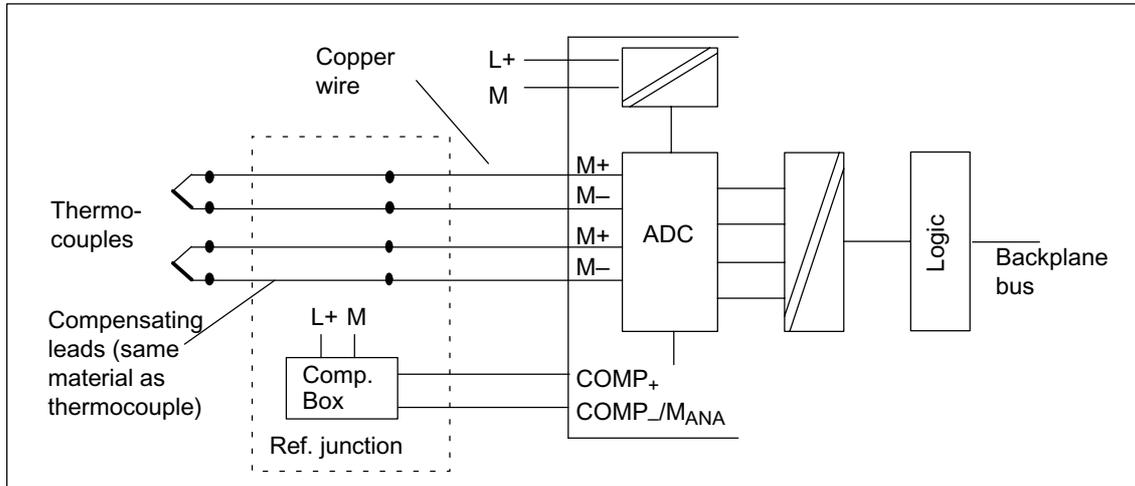
Figure 4-24   Connection of Thermocouples with Compensation Box to an Isolated AI

Note

Use compensating boxes with a **reference junction temperature of 0°C** for analog input modules.

Recommended compensating box

We recommend you to use a comparison point (with integrated power supply unit) from Siemens as a compensating box. You will find the necessary ordering data in the table below.

Table 4-45   Ordering Data of the Comparison Point

Recommended Compensating Box			Order number
Reference junction with integrated power supply unit, for rail mounting			M72166-□□□□□
Auxiliary power	220 VAC		B1
	110 VAC		B2
	24 VAC		B3
	24 VDC		B4
Connection to thermocouple	Fe-CuNi	Type L	1
	Fe/Cu Ni	Type J	2
	Ni Cr/Ni	Type K	3
	Pt 10% Rh/Pt	Type S	4
	Pt 13% Rh/Pt	Type R	5
	Cu/Cu Ni	Type U	6
	Cu/Cu Ni	Type T	7
Reference temperature	0 °C		00

Connecting to the comparison point (Order No. M72166-xxx00)

If all thermocouples connected to the inputs of the module have the same comparison point, you compensate as follows:
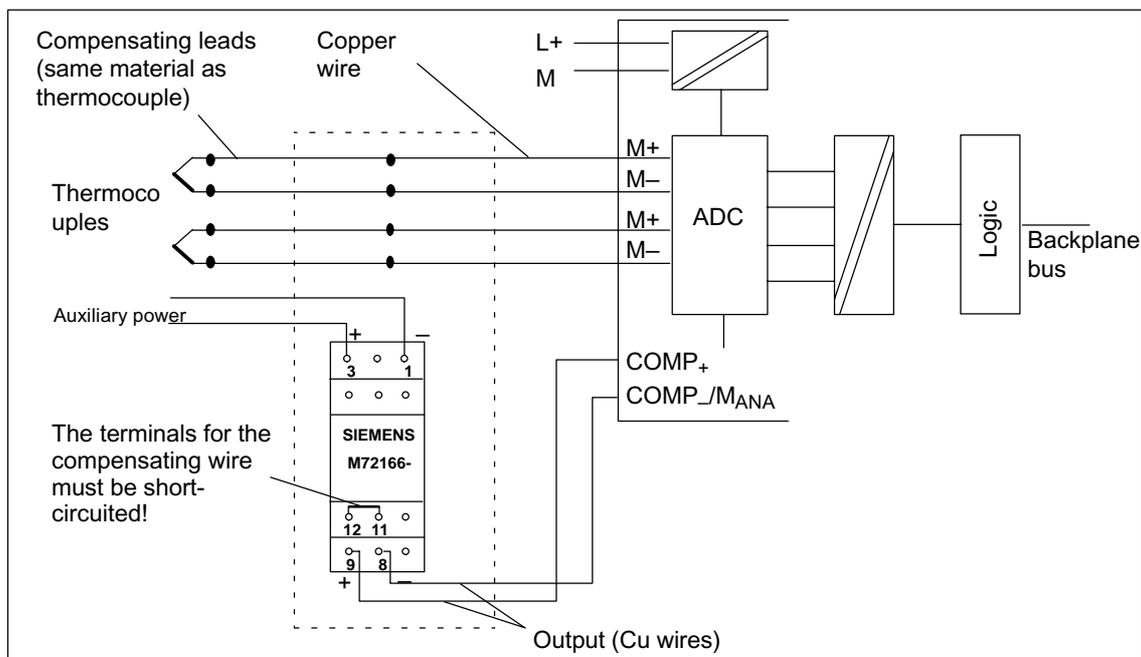
Figure 4-25   Connection of Thermocouples with Comparison Point (Order No. M72166-xxx00) to an Isolated AI

Connecting thermocouples with temperature compensation to the SM 331; AI 8 x TC

All 8 inputs are available as measurement channels when the thermocouples are connected via reference junctions that are controlled at 0 °C or 50 °C.
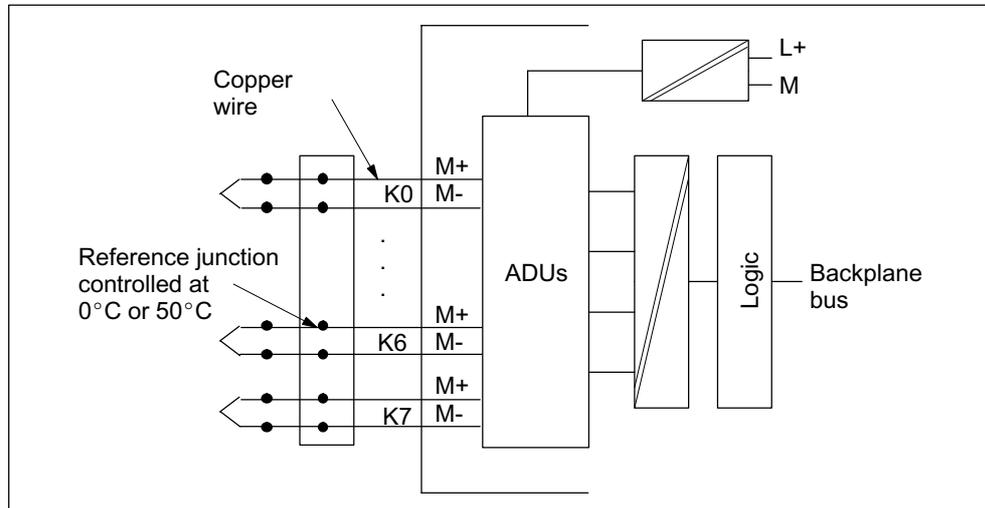
Figure 4-26   Connecting thermocouples via a reference junction to the

SM 331; AI 8 x TC

Connecting thermocouples with resistance thermometer to the SM 331; AI 8 x TC

With this type of compensation, the reference junction terminal temperature is determined by a bulb resistor sensor with a temperature range of -25 °C to 85 °C.
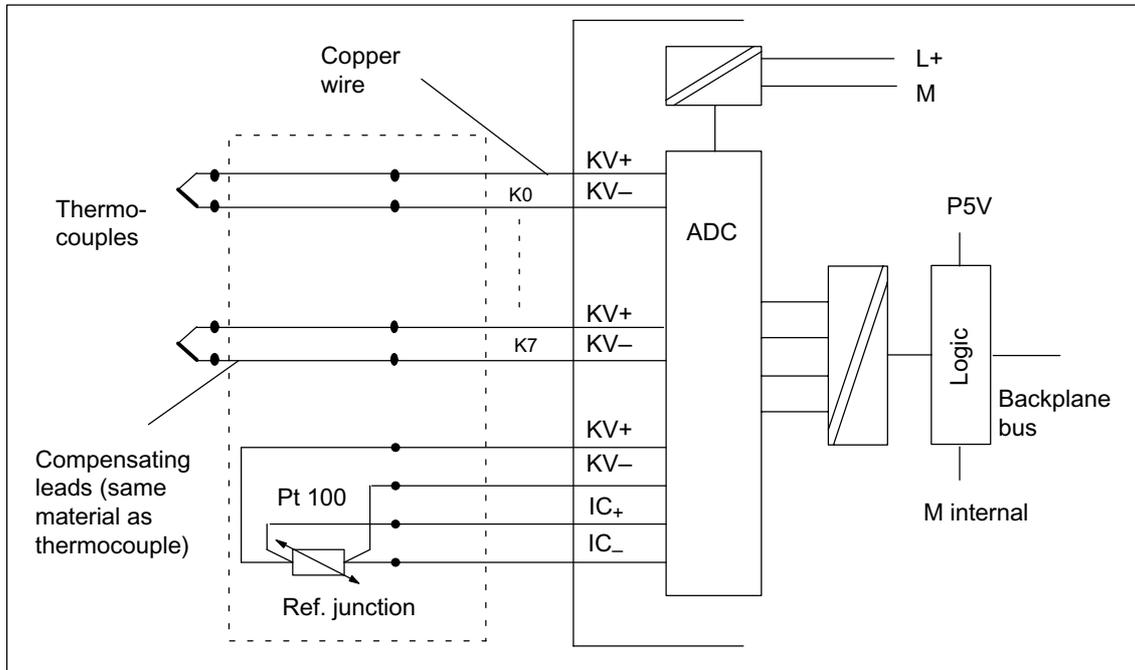
Figure 4-27   Connecting thermocouples with external compensation via resistance thermometers to the SM 331; AI 8 x TC

4.13   Connecting Loads/Actuators to analogo output

Introduction

You can use the analog output modules to supply loads and actuators with current and voltage.

This section contains general information that is generally applicable to all the connection options for loads and actuators described in the sections that follow.

Cables for analog signals

For the analog signals, you should use shielded and twisted pair cables. The cables Q_V and S+ and M and S–, respectively, are to be twisted together. This reduces the interference. Ground the screen of the analog cables at both ends of the cables.

If there are potential differences between the cable ends, an equipotential bonding current, which can flow over the shield, can cause interference of the analog signals. In such a case, you should ground the shield at one end of the cable only.

Isolated Analog Output Modules

With the isolated analog output modules there is no electrical connection between the reference point of the measuring circuit M_{ANA} and the M terminal of the CPU.

You must use isolated analog output modules if a potential difference U_{ISO} can occur between the reference point of the measuring circuit M_{ANA} and the M terminal of the CPU. By means of a equipotential bonding conductor between the M_{ANA} terminal and the M terminal of the CPU, make sure that U_{ISO} does not exceed the permitted value.

Non-Isolated Analog Output Modules

With the non-isolated analog output modules, you must establish a connection between the reference point of the measuring circuit M_{ANA} and the M terminal of the CPU. Therefore, connect the M_{ANA} terminal with the M terminal of the CPU. A potential difference between M_{ANA} and the M terminal of the CPU can lead to a corruption of the analog signal.

4.14   Connecting Loads/Actuators to Voltage Outputs

Connecting Loads to a Voltage Output

Connecting loads to a voltage output is possible both in a four-conductor and a two-conductor connection. However, not all analog output modules allow both types of connection.

Note

The necessary connecting cables, which result from the potential connection of the analog output module, are not drawn in the figures shown below.

In other words, you must continue to take note of and implement Section 4.13 with its generally valid information for connecting loads and actuators.

Abbreviations and mnemonics used in the figures below

The abbreviations and mnemonics used in the figures below have the following meanings:

Q_V: Analog output voltage

S +:   Detector lead (positive)

S–:   Detector lead (negative)

M_{ANA}:   Reference potential of analog circuit

R_L: Load impedance

L +:   Terminal for 24 VDC supply voltage

M :   Ground terminal

U_{ISO}:   Potential difference between M_{ANA} and M terminal of CPU.

Connecting Loads to a Voltage Output of an Isolated Module over a Four-Conductor Connection

A high accuracy at the load can be achieved through the four-conductor connection. You must therefore connect the sensor leads (S– and S+) directly to the load. The voltage is thus measured and corrected directly at the load.

Interferences or a voltage drop can result in a potential difference between the sensor lead S– and the reference circuit of the analog circuit M_{ANA}. This potential difference must not exceed the permissible value. If the permissible potential difference is exceeded, the accuracy of the analog signal is impaired.
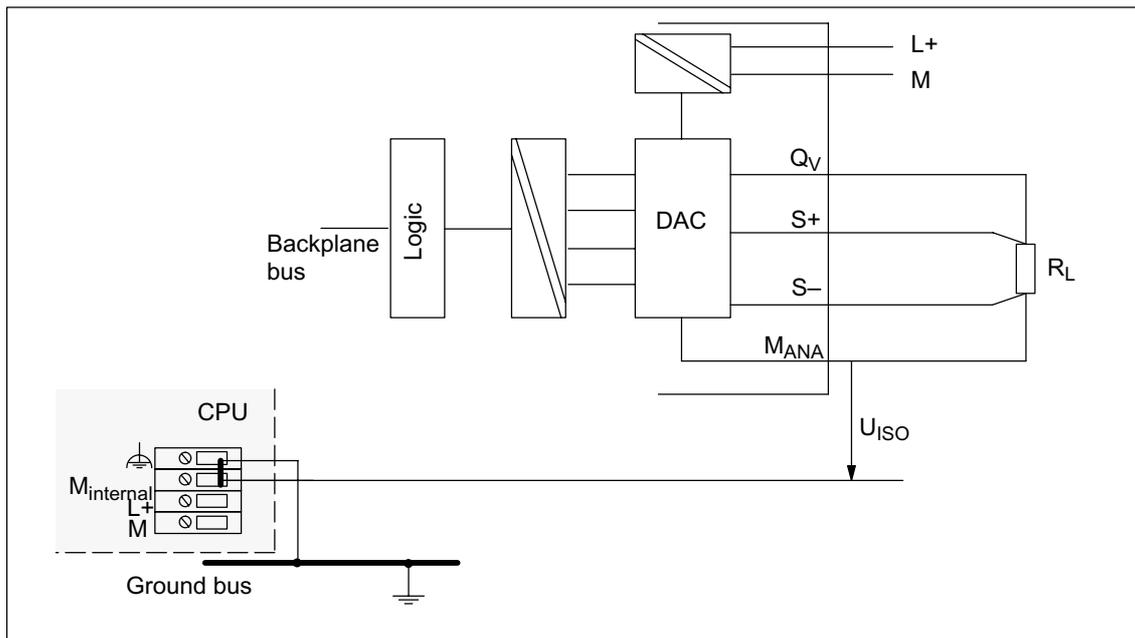
Figure 4-28   Connecting Loads to a Voltage Output of an Isolated AO over a Four-Conductor Connection

Connecting loads to a voltage output of a non-isolated module via a two-conductor connection

With a two-conductor connection, the S+ and S– terminals can be left open. However, you will not achieve the accuracy of a four-conductor connection.

Connect the load to terminals Q_V and the reference point of the measuring circuit, M_{ANA}.
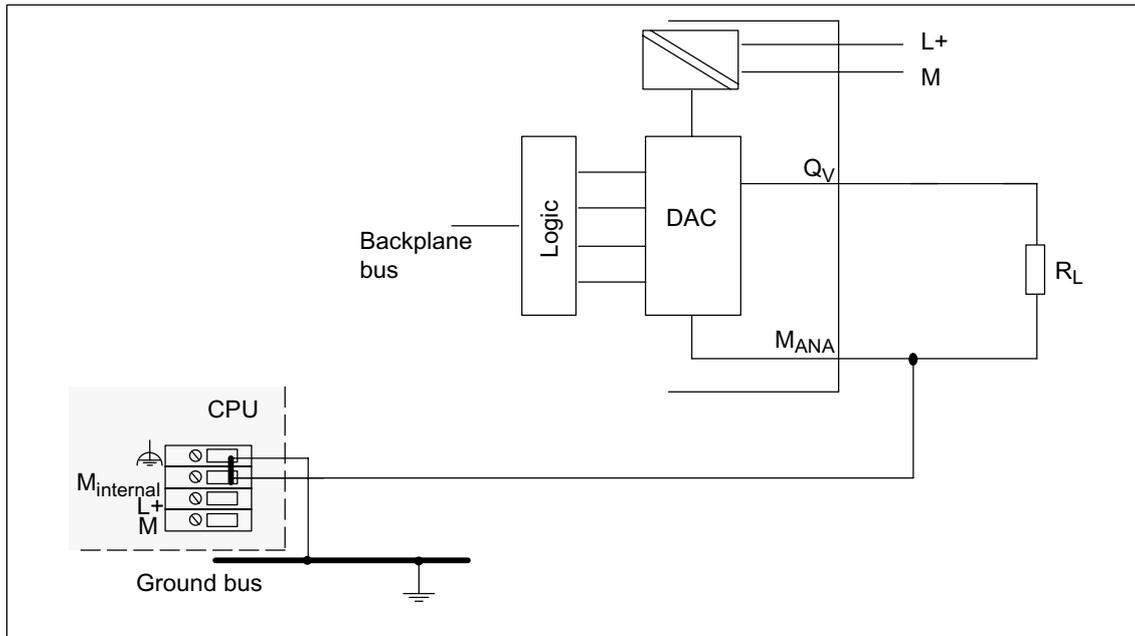
Figure 4-29   Connecting Loads to a Voltage Output of a Non-Isolated AO over a Two-Conductor Connection

4.15 Connecting Loads/Actuators to Current Outputs

Note

The necessary connecting cables, which result from the potential connection of the analog output module, are not drawn in the figures shown below.

In other words, you must continue to take note of and implement Section 4.13 with its generally valid information for connecting loads and actuators.

Abbreviations and mnemonics used in the figures below

The abbreviations and mnemonics used in the figures below have the following meanings:

Q_I: Analog output current

M_{ANA}:   Reference potential of analog circuit

R_L: Load impedance

L +:   Terminal for 24 VDC supply voltage

M :   Ground terminal

U_{ISO}:   Potential difference between M_{ANA} and M terminal of CPU.

Connecting Loads to a Current Output

You must connect loads to Q_I and the reference point of the analog circuit M_{ANA} of a current output.
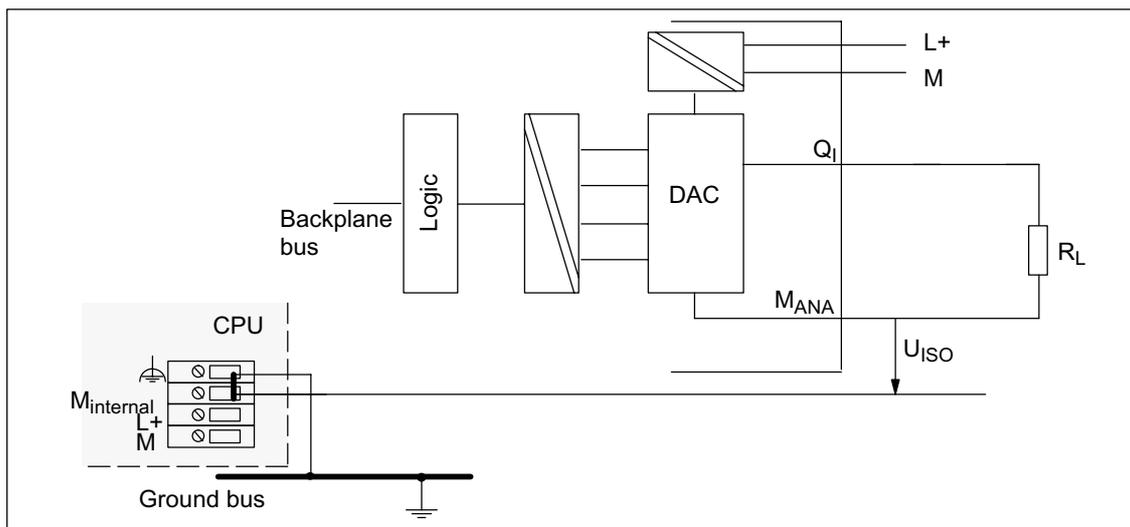
Figure 4-30   Connecting Loads to a Current Output of an Isolated AO

Figure 4-31   Connecting Loads to a Current Output of a Non-Isolated AO

4.16   Diagnostics of the Analog Modules

Programmable and Non-Programmable Diagnostic Messages

In diagnostics, we make a distinction between programmable and non-programmable diagnostic messages.

You obtain programmable diagnostic messages only if you have enabled diagnostics by parameter assignment. You perform parameter assignment in the "Diagnostics" parameter field in *STEP 7* (refer to Section 4.7).

Non-programmable diagnostic messages are always made available by the analog module irrespective of diagnostics being enabled.

Actions following diagnostic message in *STEP 7*

Each diagnostic message leads to the following actions:

- The diagnostic message is entered in the diagnosis of the analog module and forwarded to the CPU.

- The error LED on the analog module lights.

- If you have programmed "Enable Diagnostic Interrupt" with STEP 7, a diagnostic interrupt is triggered and OB 82 is called (refer to Section 4.17).

Reading out diagnostic messages

You can read out detailed diagnostic messages by means of SFCs in the user program (refer to the Appendix "Diagnostic Data of Signal Modules").

You can view the cause of the error in *STEP 7*, in the module diagnosis (refer to online Help for *STEP 7*).

Diagnostic message in the measured value of analog input modules

Every analog input module supplies the measured value $7FFF_H$ irrespective of the parameter assignment when an error is detected. This measured value means either Overflow, Malfunction or a channel is disabled.

Diagnostic message by means of SF LED

Every analog module indicates errors for you by means of your SF LED (group error LED). The SF LED lights as soon as a diagnostic message is triggered by the analog module. It goes out when all errors have been rectified.

Diagnostic messages of the analog input modules

The table below gives an overview of the diagnostic messages for the analog input modules.

Table 4-46   Diagnostic Messages of the Analog Input Modules

Diagnostics Message	LED	Diagnostics Effective for	Parameters can be assigned
External auxiliary supply missing	SF	Module	No
Configuring/parameter assignment error	SF	Channel	Yes
Common-mode error	SF	Channel	Yes
Wire-break	SF	Channel	Yes
Underflow	SF	Channel	Yes
Overflow	SF	Channel	Yes

Diagnostic messages of the analog output modules

The table below gives an overview of the diagnostic messages for the analog output modules.

Table 4-47   Diagnostics Messages of the Analog Output Modules

Diagnostics Message	LED	Diagnostics Effective for	Parameters can be assigned
External auxiliary supply missing	SF	Module	No
Configuring/parameter assignment error	SF	Channel	Yes
Short-circuit to M	SF	Channel	Yes
Wire-break	SF	Channel	Yes

Note

A prerequisite for detecting the errors indicated by programmable diagnostic messages is that you have assigned parameters to the analog module accordingly in *STEP 7.*

Causes of errors and remedial measures for analog input modules

Table 4-48   Diagnostics Messages of the Analog Input Modules, Causes of Errors and
Remedial Measures

Diagnostics Message	Possible Error Cause	Remedy
External load voltage missing	Load voltage L+ of module missing	Feed supply L+
Configuring/parameter assignment error	Illegal parameters transferred to module	Check measuring range module
		Reassign module parameter
Common-mode error	Potential difference U_{CM} between the inputs (M–) and reference potential of measuring circuit (M_{ANA}) too high	Connect M– with M_{ANA}
Wire-break	Resistance too high in the sensor connection	Use different type of sensor or connection, e.g. use conductors with a larger cross-sectional core area
	Open circuit between module and sensor	Close circuit
	Channel not connected (open)	Disable channel group ("measuring procedure" parameter
		Connect channel

Table 4-48   Diagnostics Messages of the Analog Input Modules, Causes of Errors and
Remedial Measures

Diagnostics Message	Possible Error Cause	Remedy
Underflow	Input value underflows underrange, error may be caused: Wrong measuring range selected	Configure other measuring range
	With the measuring ranges 4 to 20 mA and 1 to 5 V, if necessary by polarity reversal of sensor connection	Check terminals
Overflow	Input value overflows overrange	Configure other measuring range

Causes of errors and remedial measures for analog output modules

Table 4-49   Diagnostics Messages of the Analog Output Modules, Causes of Errors and
Remedial Measures

Diagnostics Message	Possible Error Cause	Remedy
External load voltage missing	Load voltage L+ of module missing	Feed supply L+
Configuring/parameter assignment error	Illegal parameters transferred to module	Reassign module parameter
Short-circuit after M	Overload of output	Eliminate overload
	Short-circuit of output Q_V after M_{ANA}	Eliminate short circuit
Wire-break	Actuator resistance too high	Use different type of actuator or connection, e.g. use conductors with a larger cross-sectional core area
	Open circuit between module and actuator	Close circuit
	Channel not used (open)	Disable channel group ("output type" parameter)

4.17 Interrupts of the Analog Modules

Introduction

In this Section, the interrupt behavior of the analog modules is described. The following interrupts exist:

- Diagnostic interrupt

- Hardware interrupt

Note that not all analog modules have interrupt capability or they are only capable of a subset of the interrupts described here Refer to the technical specifications of the modules, starting at Section 4.18, to determine which analog modules have interrupt capability.

The OBs and SFCs mentioned below can be found in the online Help for *STEP 7*, where they are described in greater detail.

Enabling interrupts

The interrupts are not preset – in other words, they are inhibited without appropriate parameter assignment. Assign parameters to the Interrupt Enable in *STEP 7* (refer to Section 4.7).

Diagnostic interrupt

If you have enabled diagnostic interrupts, then active error events (initial occurrence of the error) and departing error events (message after troubleshooting) are reported by means of an interrupt.

The CPU interrupts the execution of the user program and processes the diagnostic interrupt block (OB 82).

In the user program, you can call SFC 51 or SFC 59 in OB 82 to obtain more detailed diagnostic information from the module.

The diagnostic information is consistent until such time as OB 82 is exited. When OB 82 is exited, the diagnostic interrupt is acknowledged on the module.

Hardware interrupt with trigger "Upper or lower limit exceeded"

Define a working range by setting parameters for an upper and lower limit value. If the process signal (for example, the temperature) leaves this working range, the module triggers a hardware interrupt, provided the interrupt is enabled.

The CPU interrupts execution of the user program and processes the hardware interrupt block (OB 40).

In the user program of OB 40, you can set how the programmable logic controller is required to react to a limit value being surpassed or not being reached.

When OB 40 is exited, the hardware interrupt is acknowledged on the module.

Note

Note that a hardware interrupt is not triggered if you have set the upper limit above the overrange or the lower limit below the underrange.

Structure of the start information tag OB40_POINT_ADDR of OB 40

The limit values exceeded by the different channels are entered in the start information of OB 40 in the tag OB40_POINT_ADDR. The following figure shows the assignment to the bits of local data double word 8.
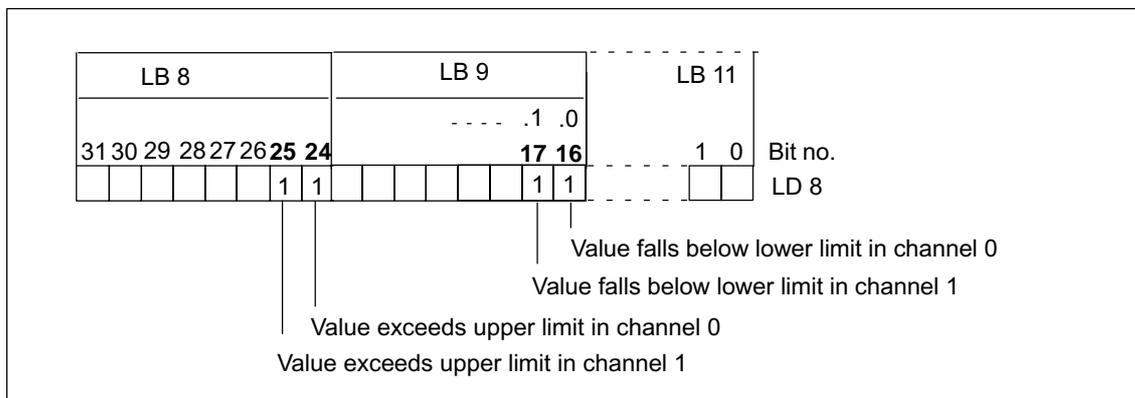
Figure 4-32   Start Information of OB 40: Which Event Has Triggered the Hardware Interrupt at the Limit Value

Hardware interrupt upon trigger "Reached end of scan cycle"

By parameterizing the hardware interrupt a the end of the scan cycle, you have the option of synchronizing a process with the scan cycle of the analog input module.

A scan cycle includes the conversion of the measured values of all enabled channels of the analog input module. The module processes the channels one after the other. After all the measured values have been converted, the module of the CPU reports by means of an interrupt that there are new measured values on all channels.

You can use the interrupt to load the currently converted analog values.

4.18   Analog Input Module SM 331; AI 8 x 16 bits; (6ES7331-7NF00-0AB0)

Order number

6ES7331-7NF00-0AB0

Characteristics

The analog input module SM 331; AI 8 x 16 bits has the following characteristic features:

- 8 inputs in 4 channel groups

- Measured-value resolution 15 bits + sign (independent of integration time)

- Measurement mode selectable per channel group:

    – Voltage

    – Current

- Arbitrary measuring range and filter/update rate selection per channel group

- Programmable diagnostics

- Programmable diagnostic interrupt

- Two channels with limit monitoring

- Programmable hardware interrupt when limit has been exceeded

- Isolated against the backplane bus interface

- Permissible common mode voltage between channels of 50 VDC maximum

Terminal connection diagram and block diagram of the SM 331; AI 8 x 16 bits
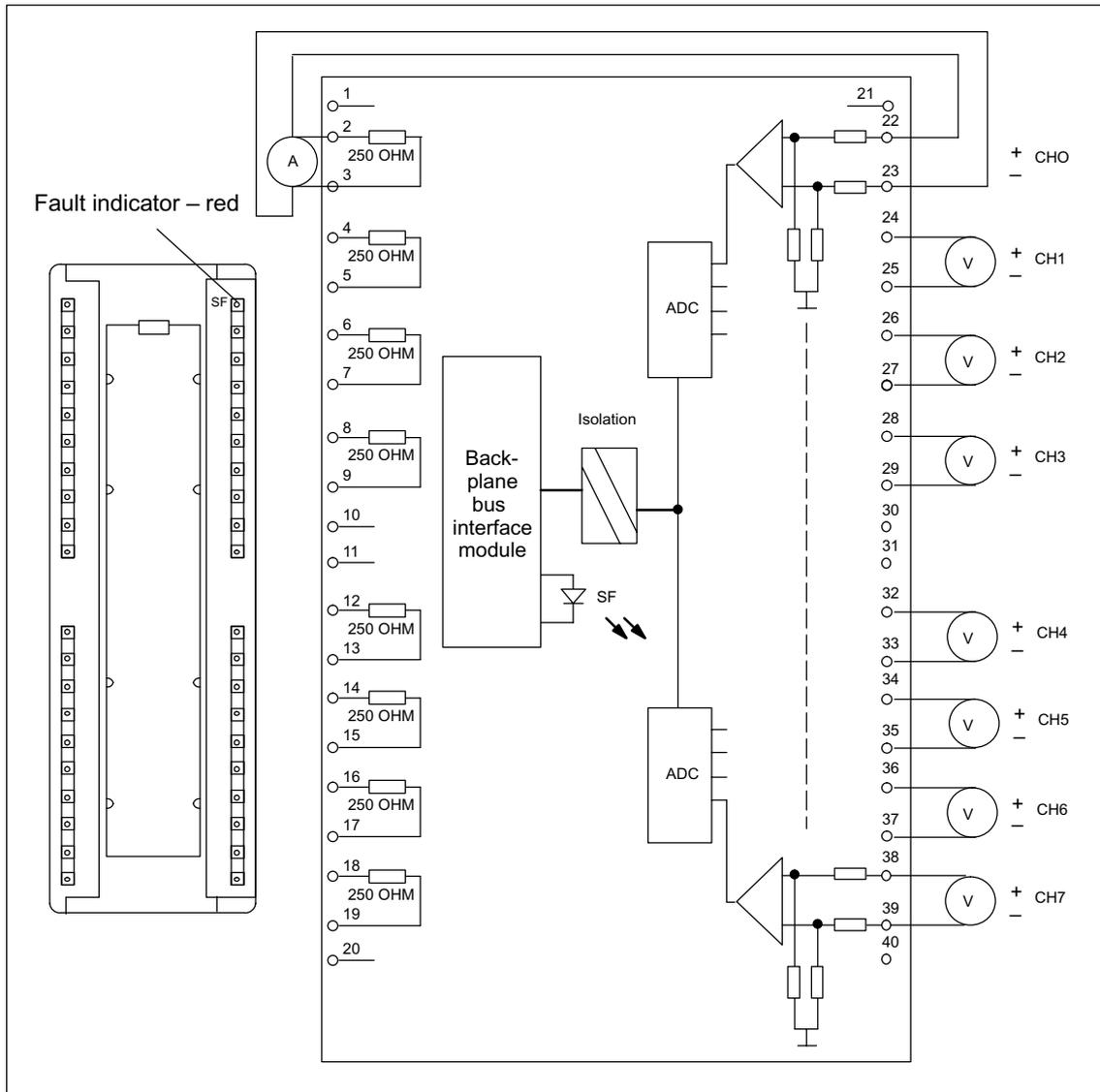
Figure 4-33   Module view and block diagram of the analog input module SM 331; AI 8 x 16 bits

Please note that in Figure 4-33, channel 0 is configured for current measurement and channel 7 for voltage measurement.

Wiring of the module for measuring current

Current measurements are made by paralleling a channel's voltage input terminals with its respective current sense resistor. This is accomplished by jumpering the channels input terminals to the adjacent terminals on the field connector.

Example: To configure channel 0 for current mode, you must jumper terminal 22 to 2 and terminal 23 to 3.

The channel being configured for current measurements must be paired with the sense resistor connected to the channel's adjacent terminals in order to achieve the specified accuracy.

Technical specifications of the SM 331; AI 8 x 16 bits

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 272 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8
Length of cable	
• Shielded	max. 200 m
Voltages, Currents, Potentials	
Isolation	
• Between channels and backplane bus	Yes
Permitted potential difference	
• Between the inputs (ECM)	50 VDC, 35 VAC
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 130 mA
Power dissipation of the module	typically 0.6 W

Analog value generation				
Measuring principle	Integrating			
Integration time/conversion time/ resolution (per channel)				
• Parameters can be assigned	Yes			
• Integration time in milliseconds	10	16.7	20	100
• Basic conversion time per channel group when more than one channel group is active	35	55	65	305
• Channel conversion time per channel group if only channel group 0 or 1 is enabled	10	16.7	20	100
Channel integration time (1/f1) in ms	10	16.7	20	100
• Resolution including sign	15 bits + sign			
• Suppression of interference voltage for interference frequency f1 in Hertz	100	60	50	10
Basic execution time of the module, in ms (all channels enabled)	140	220	260	1220

Suppression of interference, Limits of Error	
Noise suppression for f = n × (f1 ± 1%), (f1 = interference frequency); n= 1, 2, ...	
• Common-mode noise (U_{cm} < 50 V)	> 100 dB
• Series-mode interference (peak value of interference < rated value of input range)	> 90 dB
Crosstalk between the inputs	> 100 dB
Operational limit (over entire temperature range, referred to input range)	U_{CM} = 0 / U_{CM} = ±50 V
• Voltage input	±0.1% / ± 0.7%
• Current input	±0.3% / ± 0.9%
Basic error (operational limit at 25° C referred to input range)	
• Voltage input	±0.05%
• Current input	±0.05%
Temperature error (with reference to the input range)	±0.005%/K
Linearity error (with reference to the input range)	±0.03%
Repeat accuracy (in the steady state at 25°C, referred to the input range)	±0.025%

Status, Interrupts, Diagnostics		
Interrupts		
• Hardware interrupt when limit has been exceeded	Programmable channels 0 and 2	
• Diagnostic interrupt	Programmable	
Diagnostic functions	Programmable	
• Group error display	Red LED (SF)	
• Diagnostics information read-out	Possible	
Data for Selecting a Sensor		
Input range (rated values)/Input resistance		
• Voltage	± 5 V	/ 2MΩ
	1 to 5 V	/ 2MΩ
	± 10 V	/ 2MΩ
• Current	0 to 20 mA;	/ 250 Ω
	± 20 mA	/ 250 Ω
	4 to 20 mA:	/ 250 Ω
Maximum input voltage for voltage input (destruction limit)	max. 50 V continuous	
Maximum input current for current input (destruction limit)	max. 32 mA	
Connection of the sensor		
• For measuring voltage	Possible	
• For measuring current		
As two-wire transmitter	Possible with separate supply for the transmitter	
As four-wire transmitter	Possible	
• Load of the two-wire transmitter	max. 820 Ω	

4.18.1 Commissioning the SM 331; AI 8 x 16 bits

You set the mode of operation of the SM 331; AI 8 x 16 bits *STEP 7*.

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in Section 4.7.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 4-50   Parameters of the SM 331; AI 8 x 16 bits

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Enable • Diagnostic interrupt • Hardware interrupt upon limit violation	Yes/no Yes/no	No No	Dynamic	Module
Trigger for hardware interrupt • Upper limit value • Lower limit value	Constraint possible due to measuring range. 32511 to –32512 –32512 to 32511	–	Dynamic	Channel
Diagnostics • Group diagnostics • With wire-break check	Yes/no Yes/no	No No	Static	Channel group
Measurement • Measuring Method • Measuring Range • Interference Suppression	Deactivated U Voltage 4DMU Current (4-wire transmitter) Refer to Section 4.18.2 for the measuring ranges of the input channels that you can set. 400 Hz; 60 Hz; 50 Hz; 10 Hz	U ± 10 V 50 Hz	Dynamic	Channel group

Channel groups

The channels of the SM 331; AI 8 x 16 bits are arranged in four groups of two. You can only ever assign parameters to one channel group.

The table below shows which channels are parameterized as a channel group in each case. You will need the channel group number to set the parameters in the user program with an SFC.

Table 4-51   Assignment of Channels of the SM 331; AI 8 x 16 bits to Channel Groups

Channels ...	... form one Channel Group each
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

High Speed Update Mode

In the high speed update mode, updates for the two channels in the group occur three times faster than with multiple channel groups enabled.

Example: If channels 0 and 1 are enabled with 2.5 ms filtering, data updates for both channels will be available to the PLC every 10 msec. (For other filter settings, the filter setting equals the update rate.)

The high speed update mode is only available when both channels are enabled on channel group 0 or 1, in other words, the "measuring method" parameter is set. However, only channel group 0 or only channel 1 (in other words, not both together) must be enabled.

Special characteristic of channel groups for hardware interrupts

You can set hardware interrupts in *STEP 7* for the channel groups 0 and 1. Note, however, that a hardware interrupt is set only for the first channel in the channel group in each case – in other words, for channel 0 or channel 2

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4-46, on page 4-72.

4.18.2 Measuring Methods and Measuring Ranges of the SM 331; AI 8 x 16 bits

Measuring Methods

You can set the following measuring methods for the input channels:

- Voltage measurement
- Current measurement

You perform the setting with the "measuring method" parameter in *STEP 7*.

Unused Channels

Set the "measuring method" parameter for unused channels to "disabled". In this way you shorten the scan time of the module.

Since configured inputs can remain unused because of the channel group generation, you must take note of the following special characteristics of these inputs to enable the diagnostic functions on the used channels.

- **Measuring range 1 to 5 V:** Connect the unused input in parallel with a used input of the same channel group.
- **Current measurement 4 to 20 mA:** Connect the unused input in series with an input of the same channel group. Ensure that a current sense resistor is connected for each active and unused channel.
- **Other ranges:** Short the positive to the negative input of the channel.

Measuring ranges

The measuring ranges are set with the "measuring range" parameter in *STEP 7*.

Table 4-52   Measuring Ranges of the SM 331; AI 8 x 16 bits

Method Selected	Measuring Range	Description
U: Voltage	$\pm$5 V 1 to 5 V $\pm$10 V	You will find the digitized analog values in Section 4.3.1 in the voltage measuring range
4DMU: Current (4-wire transmitter)	from 0 to 20 mA $\pm$20 mA from 4 to 20 mA	You will find the digitized analog values in Section 4.3.1 in the current measuring range

Default Settings

The default settings of the module are "voltage" for the measuring method " and ± 10 V" for the measuring range. You can use this combination of measuring method and measuring range without parameterizing the SM 331; AI 8 x 16 bits in *STEP 7*.

Measuring errors with common-mode voltages

The SM 331; AI 8 x 16 bits can make measurements in the presence of AC or DC common mode voltage.

For **AC common mode voltages** at multiples of the filter frequency setting, the suppression of interference is accomplished by the integration period of the A/D converter and by the common mode suppression of the input amplifiers. For AC common mode voltages < 35 V_{RMS}, the suppression ratio of > 100 dB results in negligible measurement error.

For **DC common mode voltages**, only the interference suppression of the input amplifier stage is available to minimize the effect of the common mode voltage. Therefore, some accuracy degradation occurs in proportion to the common mode voltage. The worst case error occurs with 50 VDC between one channel and the other seven channels. The calculated worst case error is 0.7 % at 0 to 60 °C, and measured error is typically ≤ 0.1% at 25 °C.

Special characteristic of parameter assignment to upper and lower limit values

The parameterizable limit values (triggers for hardware interrupt) differ for the SM 331; AI 8 x 16 bits from the range of values contained in Table 4-50.

The reason for this is that numerical methods in the module software for evaluating the process variables prevent values up to 32511 from being reported in some cases. The process input value at which a hardware interrupt for an underflow or overflow occurs depends on the calibration factors for an individual channel and can vary between the lower limits shown in the table below and the value 32511 ($7EFF_H$).

Limit values should not be set at values higher than the minimum potential limit values shown in the table below.

Table 4-53   Minimum Possible Upper and Lower Limit Values of SM 331; AI 8 x 16 bits

Measuring Range	Minimum Possible Upper Limit Value	Minimum Possible Lower Limit Value
±10 V	11.368 V 31430 7AC6$_H$	−11.369 V −31433 8537$_H$
±5 V	5.684 V 31430 7AC6$_H$	−5.684 V −31430 853A$_H$
1 to 5 V	5.684 V 32376 7E78$_H$	0.296 V −4864 ED00$_H$
0 to 20 mA	22.737 mA 31432 7AC8$_H$	−3.519 mA −4864 ED00$_H$
4 to 20 mA	22.737 mA 32378 7E7A$_H$	1.185 mA −4864 ED00$_H$
±20 mA	22.737 mA 31432 7AC8$_H$	−22.737 mA −31432 8538$_H$

Wire-Break Check

The wire-break check is available for the 1 to 5 V voltage range and the 4 to 20 mA current range.

The following applies to both measuring ranges:

Enabled wire-break check, the analog input module enters a wire-break in the diagnosis if a current falls below 3.6 mA (0.9 V).

If you have enabled diagnostic interrupts during configuration, the module additionally triggers a diagnostic interrupt.

If no diagnostic interrupt has been enabled, the illuminated SF LED is the only indication of the wire-break and you must evaluate the diagnostic bytes in the user program.

With a **disabled** wire-break check and enabled diagnostic interrupt, the module triggers a diagnostic interrupt when the underflow is reached.

4.19 Analog Input Module SM 331; AI 8 x 16 bits (6ES7331-7NF10-0AB0)

Order number

6ES7331-7NF10-0AB0

Characteristics

The isolated analog input module SM 331; AI 8 x 16 bits has the following characteristic features:

- 8 isolated inputs in 4 channel groups
- Measured-value resolution 15 bits + sign
- Rapid measured value updating for up to 4 channels
- Measuring method selectable per channel group
- Programmable diagnostics
- Programmable diagnostic interrupt
- 8 channels with limit monitoring
- Programmable hardware interrupt when limit has been exceeded
- Programmable end-of-scan-cycle interrupt
- Electrical isolation to the backplane bus interface

Special feature

When you use the SM 331; AI 8 x 16 bits in the distributed peripheral ET 200M, you must have one of the following IM 153-x:

- IM 153-1   6ES7153-1AA03-0XB0, E 01
- IM 153-2   6ES7153-2AA02-0XB0, E 05
- IM 153-2   6ES7153-2AB01-0XB0, E 04

Terminal connection diagram and block diagram of the SM 331; AI 8 x 16 bits
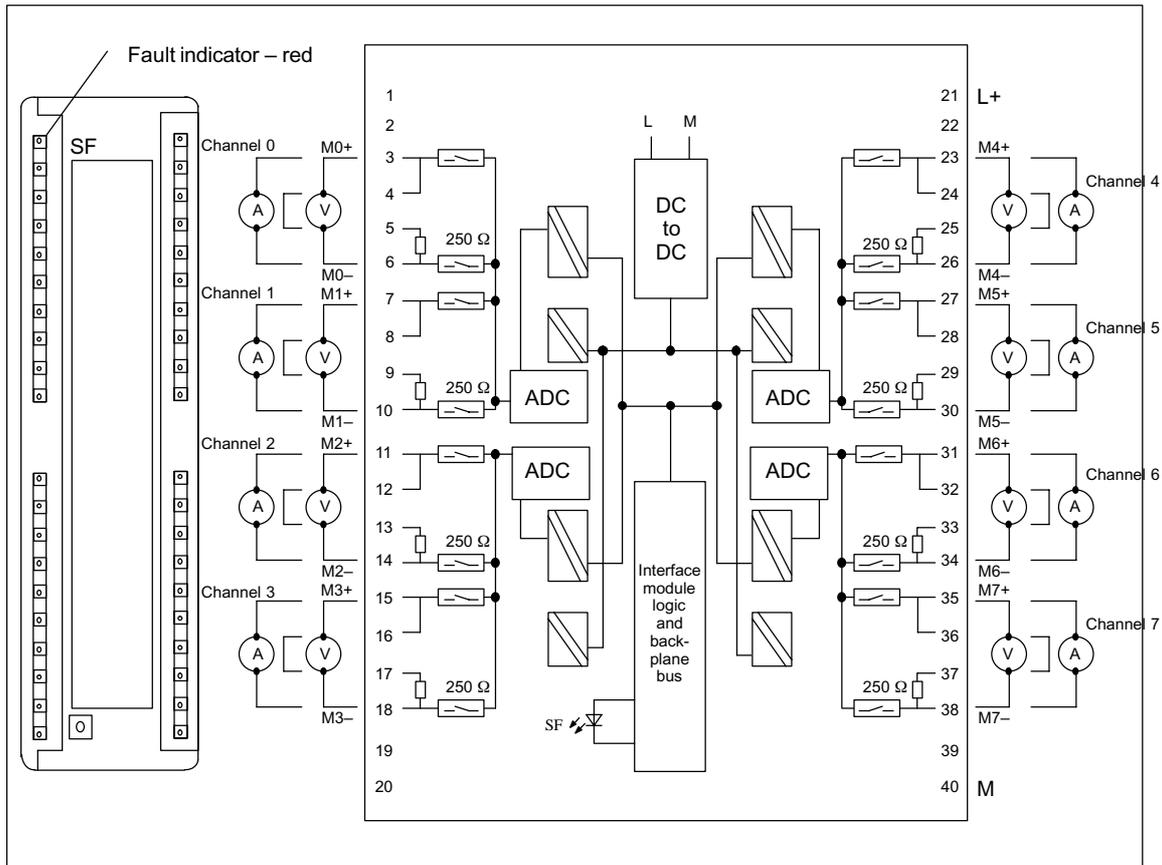
Figure 4-34   Module View and Block Diagram of the SM 331; AI 8 x 16 bits

Technical specifications of the SM 331; AI 8 x 16 bits

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 272 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8
Length of cable	
● Shielded	max. 200 m
Voltages, Currents, Potentials	
Power rated voltage of the electronics L+	24 VDC
● Reverse polarity protection	Yes
Isolation	
● Between channels and backplane bus	Yes
● Between channels and power supply of the electronics	Yes
● Between the channels	Yes
In groups of	2
Permitted potential difference	
● Between the inputs (ECM)	75 VDC / 60 VAC
● Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VAC
Current consumption	
● From the backplane bus	max. 100 mA
● From the power supply L+	max. 200 mA
Power dissipation of the module	typ. 3.0 W
Analog value generation	
Measuring principle	Integrating
Integration time/conversion time/ resolution (per channel)	
● Parameters can be assigned	Yes
● Basic conversion time in ms (8-channel mode)	95/83/72/23
● Basic conversion time in ms (4-channel mode)	10[1]
● Resolution including sign	16 bits
● Noise suppression for frequency f1 in Hz	All[2]/50/60/400

Smoothing of the measured values	None / low/ average/ high
Basic execution time of the module, in ms (8-channel-mode)	190/166/144//46
Basic execution time of the module, in ms (4-channel-mode)	10[1]
Suppression of interference, Limits of Error	
Interference suppression for $F = n \times (f1 \pm 1\%)$ (f1 = interference frequency, n = 1, 2, ...)	
● Common-mode interference (U_{cm} < AC 60 V)	> 100 dB
● Series-mode interference (peak value of interference < rated value of input range)	>90 dB [3]
Crosstalk between the inputs	> 100 dB
Operational limit (in the entire temperature range, with reference to the input range)	
● Input voltage	± 0.1%
● Input current	± 0.1%
Basic error (operational limit at 25 °C, referred to input range)	
● Voltage input	± 0.05%
● Current input	± 0.05%
Temperature error (with reference to the input range)	± 0.005%/K
Linearity error (with reference to the input range)	± 0.01%
Repeatability (in steady state at 25 °C, referred to the input range)	± 0.01%
Status, interrupts, diagnostics	
Interrupts	
● Hardware interrupt if the limit value is exceeded	Programmable channels 0 – 7
● Hardware interrupt at end of cycle	Parameters can be assigned
● Diagnostic interrupt	Parameters can be assigned
Diagnostic functions	Parameters can be assigned
● Group error display	Red LED (SF)
● Diagnostics information read-out	Possible

Data for selecting a sensor	
Input range (rated values) / input resistance	
• Voltage	$\pm$ 5 V / 2 MΩ 1 to 5 V / 2 MΩ $\pm$ 10 V / 2 MΩ
• Current	0 to 20 mA / 250 Ω 4 to 20 mA / 250 Ω $\pm$ 20 mA / 250 Ω
Maximum input voltage for voltage input (destruction limit)	35 VDC continuous; 75 VDC for max. 1 s (duty factor 1:20)
Maximum input current for current input (destruction limit)	40 mA
Connection of the sensor	

•	For measuring voltage	Possible
•	For measuring current	
	As two-wire transmitter	Possible with separate supply for the transmitter
	As four-wire transmitter	Possible

1) Interference frequency for 4-channel mode is "All"
2) Interference frequencies 50/60/400 Hz are designated as "All"
3) Series-mode rejection for 8-channel mode is reduced as follows:

50 Hz	> 70 dB
60 Hz	> 70 dB
400 Hz	> 80 dB
50/60/400 Hz	> 90 dB

4.19.1 Commissioning the SM 331; AI 8 x 16 bits

The mode of operation of the SM 331; AI 8 x 16 bits is set with *STEP 7*.

Parameter

You will find a description of the general procedure for parameterizing the SM 331; AI 8 x 16 bits, in section 4.7.

Parameterization restrictions when using the analog input module SM 331; AI 8 x 16 bits with PROFIBUS masters that only support DPV0.

When you use the isolated analog input module SM 331; AI 8 $\times$ 16 bits in an ET200M PROFIBUS slave system with a PROFIBUS master which is not an S7 master, certain parameters are not permitted. Masters that are not S7 masters do not support hardware interrupts. So all the parameters associated with these functions are deactivated. The deactivated parameters are hardware interrupt enable, hardware restrictions and end-of-scan-cycle interrupt enable. All the other parameters are permitted.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 4-54   Parameters of the SM 331; AI 8 x 16 bits

Parameter	Value Range	Default settings	Para- meter Type	Scope
Enable • Hardware interrupt if the limit value is exceeded	Yes/no	No	Dynamic	
• Hardware interrupt at end of cycle	Yes/no	No	Dynamic	Module
• Diagnostic interrupt	Yes/no	No	Dynamic	
Hardware interrupt trigger • Upper limit	32511 to –32512	–	Dynamic	Channel
• Lower limit	–32512 to 32511	–	Dynamic	Channel
Diagnostics • Group diagnostics	Yes/no	No	Static	Channel
• Wire-Break Check	Yes/no	No		Channel
Measurement • Module mode	• 8 channels • 4 channels	Yes No	Dynamic	Module
• Interference Suppression	50 Hz 60 Hz 400 Hz 50/60/400 Hz	50/60/400 Hz		Channel group
• Smoothing	• None • Low • Average • High	None	Dynamic	Channel group
• Measuring Method	• Measuring Range:		Dynamic	Channel group
Deactivated				
Voltage	• ± 5 V • 1 to 5 V • ± 10 V	± 10 V		
Current (4-wire transmitter)	• 0 to 20 mA • 4 to 20 mA • ± 20 mA	4 to 20 mA		

Channel groups

The channels of the SM 331; AI 8 x16 bits are arranged in groups of two inputs each. You must assign the same parameters to both the inputs in a group. The interrupt limits are the exception here.

Table 4-55 shows which channels of the isolated analog input module SM 331; AI 8 x 16 bits are configured as a channel group. To set the parameters by means of SFC in the user program, you need the numbers of the channel groups. Detailed information on this can be found in Appendix A.

Table 4-55   Assignment of the channels of the isolated analog input module SM 331; AI 8 x 16 bits to channel groups

Channels ...	... form one channel group each
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

Operating states

The following modes are available for the isolated analog input module SM 331; AI 8 x 16 bits:

- 8 channels
- 4 channels

4.19.2   8-channel mode

Description of the module cycle

In 8-channel mode, the isolated analog input module SM 331; AI 8 x 16 bits switches between the two channels in each group. As the module contains four analog/digital converters (ADC), all four of the ADCs simultaneously convert for channels 0, 2, 4 and 6. Once the even-numbered channels have been converted, all the ADCs simultaneously convert for the odd-numbered channels 1, 3, 5 and 7 (see Figure 4-35).
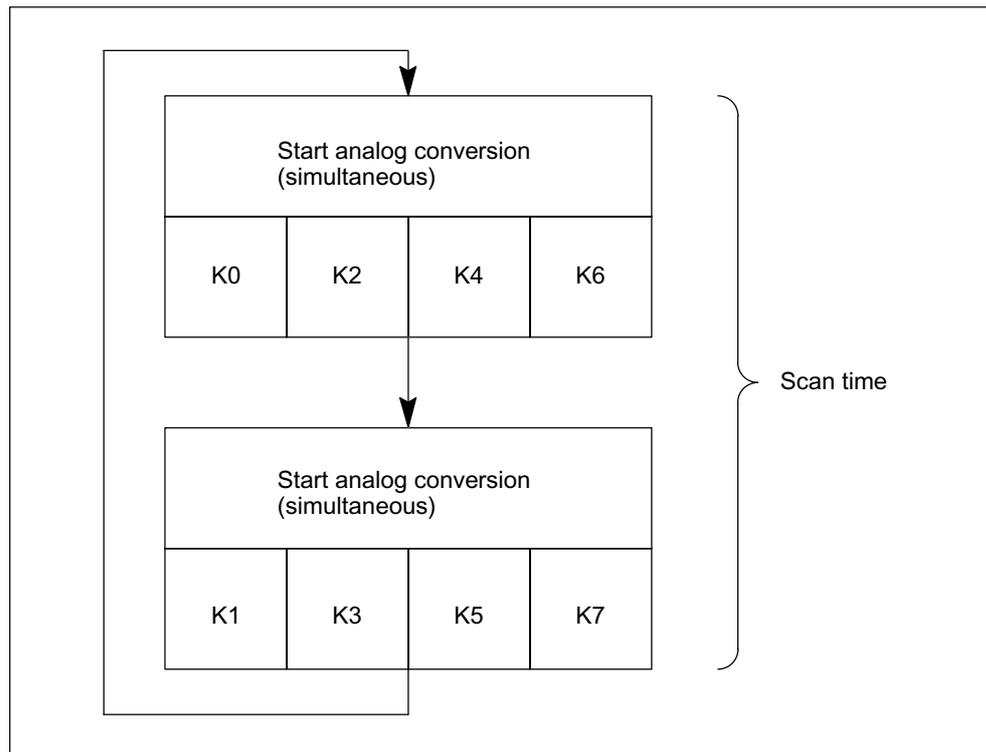
Figure 4-35   8-channel mode cycle

Scan time of the module

In the 8-channel mode of the SM 331; AI 8 x 16 bits, the channel conversion time depends on the selected interference frequency. When you set an interference frequency of 50 Hz, the channel conversion time including communication time is 76 ms. When you set an interference frequency of 60 Hz, the channel conversion time is 65 ms. When you set an interference frequency of 400 Hz, the channel conversion time is reduced to 16 ms. When you set an interference frequency of 50, 60 and 400 Hz, the channel conversion time is 88 ms. The module must then be switched over to the other channel of the group by means of opto-MOS relays. Opto-MOS relays need 7 ms to switch and settle. Table 4-56 shows the scan times of the module at certain interference frequencies.

Table 4-56   Scan times in 8-channel mode

Interference frequency (Hz)	Channel scan time (ms)	Module scan time (All channels)
50	83	166
60	72	144
400	23	46
400/60/50	95	190

4.19.3   4-channel mode

Description of the module cycle

In 4-channel mode, the SM 331; AI 8 x 16 bits does not switch over between the channels of the individual groups. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6.
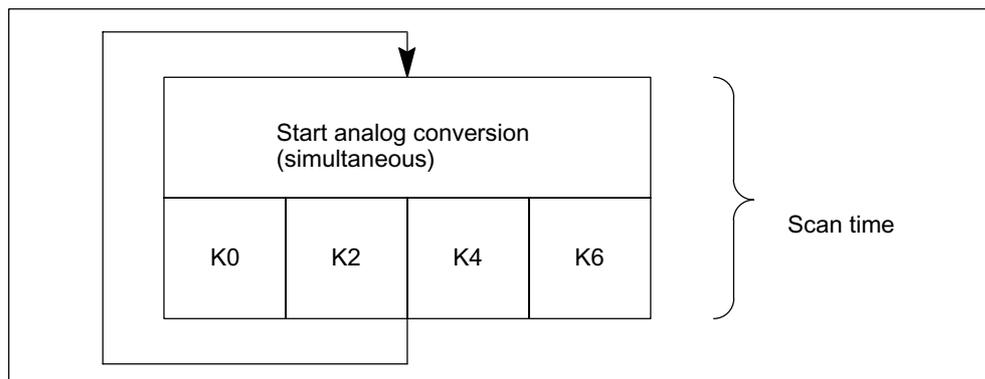
Figure 4-36   4-channel mode cycle

Scan time of the module

In 4-channel mode, the channel conversion time including communication time of the SM 331; AI 8 x 16 bits is 10 ms. As the module does not switch over between the channels in a group, the channel scan time and the module scan time are the same: 10 ms.

4.19.4 Measuring Methods and Measuring Ranges of the SM 331; AI 8 x16 bits

Measuring Methods

You can set the following measuring methods for the input channels:

*   Voltage measurement

*   Current measurement (4-wire transmitter)

You perform the setting with the "measuring method" parameter in *STEP 7*.

Unused Channels

Set the "measuring method" parameter for unused channels to "disabled". In this way you shorten the scan time of the module.

Since configured inputs can remain unused because of the channel group generation, you must take note of the following special characteristics of these inputs to enable the diagnostic functions on the used channels.

*   **Measuring range 1 to 5 V:** Connect the unused input in parallel with a used input of the same channel group.

*   **Current measurement, 4 to 20 mA:** Connect the unused input in series with an input of the same channel group. Ensure that a current sense resistor is connected for each active and unused channel.

*   **Other ranges:** Short the positive to the negative input of the channel.

Wire–break check

The wire-break check is a module software function that is available for all the voltage ranges and the current range of 4 to 20 mA.

- With the ± 5 V, 1 to 5 V or ± 10 V measuring ranges and an **enabled** wire-break check, the isolated analog input module enters a wire-break in the diagnosis when the process value achieves a positive full-scale deflection (32768). If you enabled the diagnostic interrupt during configuration, the analog input module also triggers a diagnostic interrupt.

  If the diagnostic interrupt has not been enabled, the illuminated SF display is the only indication that there is a wire-break. You must then analyze the diagnosis bytes in the user program.

- With a measuring range of 4 to 20 mA and an **enabled** wire-break check, the isolated analog input module enters wire-break in the diagnosis when the process value falls below 3.6 mA. If you enabled the diagnostic interrupt during configuration, the analog input module also triggers a diagnostic interrupt.

  If the diagnostic interrupt has not been enabled, the illuminated SF display is the only indication that there is a wire-break. You must then assess the diagnosis bytes in the user program.

- If the wire-break check is not enabled, the isolated analog input module triggers a diagnostic interrupt if the limit value for underflow is not reached.

Measuring ranges

You perform setting of the measuring ranges with the "measuring range" parameter in *STEP 7*.

Table 4-57   Measuring ranges of the SM 331; AI 8 x 16 bits

Method Selected	Output Range	Description
Voltage	± 5 V From 1 to 5 V ± 10 V	You will find the digital analog values from Section 4.3.1 in the voltage and current output ranges
Current (4-wire transmitter)	From 0 to 20 mA From 4 to 20 mA ± 20 mA	

Short circuit to M or L

If you short an input channel to M or L, the module does not suffer any damage. The channel continues to issue valid data; neither is a diagnosis reported.

Overflow, underflow and hardware interrupt limits

The diagnosis operating limits for overflow and underflow for some of the measuring ranges differ from those given in section 4.3.1 of the manual. In some cases, numerical methods in the module software for evaluating the process variables prevent values up to 32511 being signaled.

Hardware interrupt limits must not be set to values greater than the smallest possible limit value of the overflow or underflow operating limits for the end-of-scan-cycle interrupt in section 4.3.1.

End-of-scan-cycle interrupt

By enabling the end-of-scan-cycle interrupt, you can synchronize a process with the conversion cycle of the module. The interrupt occurs when the conversion of all the enabled channels is complete.

Table 4-58   Content of the 4 bytes with additional information from OB40 during a hardware interrupt or an end-of-scan-cycle interrupt

Content of the 4 bytes with additional information		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Byte
Special analog markers	**2 bits per channel to identify the range**									
	Upper limit exceeded in channel	7	6	5	4	3	2	1	0	0
	Lower limit exceeded in channel	7	6	5	4	3	2	1	0	1
	End-of-scan-cycle event						X			2
	Unassigned bit									3

4.20 Analog input module
SM 331; AI 8 x 14 bits High Speed; synchronous;
(6ES7331-7HF0x-0AB0)

Order number

6ES7331-7HF00-0AB0 resp.

6ES7331-7HF01-0AB0

Characteristics

The SM 331; AI 8 x 14 bits High Speed has the following features:

- 8 inputs in 4 channel groups

- Measured-value resolution: 13 bits + sign

- Measuring method selectable per channel group:

  – Voltage

  – Current

- Arbitrary measuring range selection per channel group

- Programmable hardware interrupt

- Programmable diagnostics

- Programmable diagnostic interrupt

- Two channels with limit monitoring

- Programmable hardware interrupt when limit has been exceeded

- Supports clocked operation

- Isolated against the backplane bus interface

- Isolated against the load voltage (**not for** 2-wire transducers)

Terminal assignment and block diagram of the SM 331; AI 8 x 14 bit High Speed
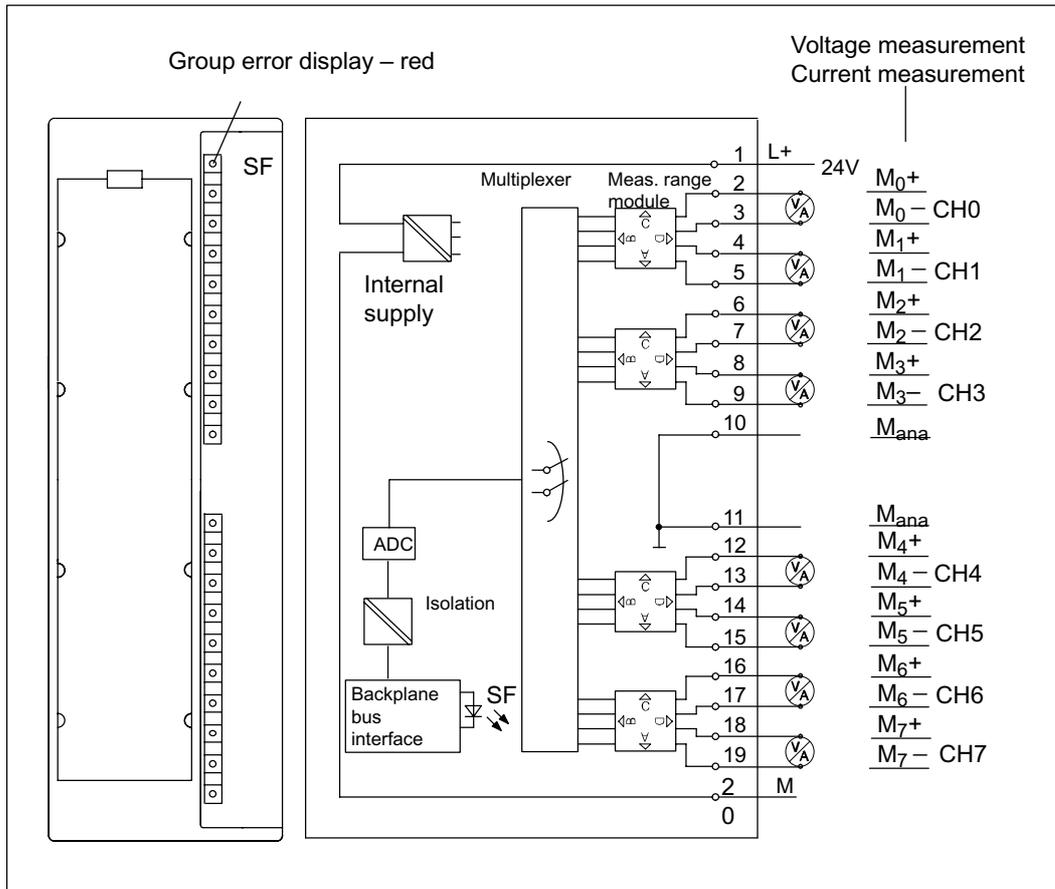
Figure 4-37   Terminal assignment and block diagram of the SM 331; AI 8 x 14 bits High Speed

Technical specifications of the SM 331; AI 8 x 14 bit High Speed

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 230 g
Data for Specific Module	
Supports clocked operation	Yes
Number of inputs	8
Length of cable	
• Shielded	max. 200 m
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L +	24 VDC
• Reverse polarity protection	Yes
Power supply of the transmitters	
• Supply current	max. 30 mA (per channel)
• Short-circuit-proof	Yes
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	No
• Between channels and power supply of the electronics	Yes
Permitted potential difference	VDC 11/VAC 8 V
• Between inputs and M_{ANA} (UCM)	
– At signal = 0 V	
– Not for 2-wire transmitter	
• Between the inputs (E_{CM})	VDC 11/VAC 8 V
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	
• Channels against back plane bus and load voltage L +	500 VDC
Current consumption	
• From the backplane bus	max. 100 mA
• From load voltage L + (without 2–wire transducer)	max. 50 mA
Power dissipation of the module	typ. 1.5 W

Analog value generation				
Measuring principle	Instantaneous value conversion			
Integration time/conversion time/ resolution (per channel)				
• Parameters can be assigned	Yes			
• Basic conversion time per channel	52 µs			
• Resolution (incl. overrange)	14 bits			
• Noise suppression for frequency f1 in Hz	None	400	60	50
• Basic execution time of the module (independent of the number of released channels)	0.42 ms			
Suppression of interference, Limits of Error				
Noise suppression for f = n × (f1 ± 1 %), (f1 = interference frequency) n=1.2...				
• Common-mode interference (U_{CM} < 11 V_{SS})	> 80 dB			
• Series-mode interference(peak value of interference < rated value of input range)	> 40 dB			
Crosstalk between the inputs	> 65 dB			
Operational limit (in the entire temperature range, with reference to the input range)				
• Voltage input	± 1 V	± 0.3 %		
	± ×5 V	± 0.4 %		
	± 10 V	± 0.3 %		
	1 to 5 V;	± 0.4 %		
• Current input	± 20 mA	± 0.3 %		
	0 to 20 mA;	± 0.3 %		
	4 to 20 mA:	± 0.3 %		

Basic error (operational limit at 25 °C, referred to input range)		
• Voltage input	± 1 V	± 0.2 %
	± 5 V	± 0.25 %
	± 10 V	± 0.2 %
	1 to 5 V;	± 0.25 %
• Current input	± 20 mA	± 0.2 %
	0 to 20 mA;	± 0.2 %
	4 to 20 mA:	± 0.2 %
Temperature error (with reference to the input range)	± 0.004 %/K	
Linearity error (with reference to the input range)	± 0.03%	
Repeat accuracy (in the steady state at 25 °C, referred to the input range)	± 0.1 %	
Status, interrupts, diagnostics		
Interrupts		
• Hardware interrupt	Parameters can be assigned	
• Diagnostic interrupt	Parameters can be assigned	
Diagnostic functions		
• Group error display	Red LED (SF)	
• Diagnostics information read-out	Possible	

Data for Selecting a Sensor		
Input range (rated values)/Input resistance		
• Voltage	± 1 V	/10 MΩ
	± 5 V	/100 kΩ
	± 10 V	/100 kΩ
	1 to 5 V;	/100 kΩ
• Current	± 20 mA	/50 Ω
	0 to 20 mA;	/50 Ω
	4 to 20 mA:	/50 Ω
Maximum input voltage for voltage input (destruction limit)	max. 20 V continuous; 75 V for max. 1 s (duty factor 1:20)	
Maximum input current for current input (destruction limit)	40 mA	
Connection of the sensor		
• For measuring voltage	Possible	
• For measuring current		
As two-wire transmitter	Possible	
As four-wire transmitter	Possible	
• Load of the 2–wire measurement transducer (at L+ = DC 24 V)	max. 820 Ω	
Characteristic linearization	None	

4.20.1 Synchronicity

Characteristics

Reproducible (i.e. same length) reaction times are achieved with the SIMATIC with an equidistant DP bus cycle and the synchronization of the following free running single cycles:

- Free running of the user program. The length of the cycle time can vary due to acyclic program branching.

- Free running, variable DP cycle at the PROFIBUS subnetwork

- Free running cycle at the DP slave backplane bus.

- Free running cycle during the signal processing and conversion in the electronic modules of the DP slave.

In the case of equidistance the DP cycle runs in phase and with the same length. In this cycle the processing levels of a CPU (OB 61 to OB 64) and the synchronous peripheral are synchronized. The I/O data are therefore transferred at defined and consistent time intervals (clock synchronicity).

Requirements

- The DP-Master and DP-Slave must support the synchronicity. They require *STEP 7* from Version 5.2.

Module filtering mode: Synchronicity

In synchronous operation the following conditions apply:

Standard Mode	
Filter and processing time T_{WE} between reading the current value and loading it into the transfer buffer (the specified value for T_{WE} applies, independent of the activation of the diagnosis)	max. 625 μs
including an input delay time of	10 μs
T_{DPmin}	3.5 ms
Diagnostic interrupt	max. 4 x T_{DP}
Fast Mode (only possible with 6ES7331-7HF01-0AB0)	
Filter and processing time T_{WE} between reading in the current value and allocation in the transfer buffer (diagnosis not selectable)	max. 625 μs
including an input delay time of	10 μs
T_{DPmin}	1 ms

Note

By using "Fast Mode" the cycle of the DP system can be accelerated. However, this is at the expense of the diagnosis: The diagnosis is switched off in this operating mode.

Together with the calculation and transfer times required on the IM 153, the specified value for T_{WE} results in the minimum settable value of *HW Config* of 875 μs for T_i.

The specified value for T_{DPmin} is dependent on the extent of extension of the DP slave/IM 153: If there are a number of different plugged in modules, the slowest module determines the time T_{DPmin}.

Note

In "Synchronous" mode, independent of the parameterization made in *STEP 7*, the module always sets itself to "Integration time: no /parasitic frequency". The "hardware interrupt" functionality is not possible in "Synchronous" mode.

Calculation of the filter and processing time

Independent of the number parameterized channels, the same time conditions are always valid. The time related to the clock signal for the reading of a specific channel is calculated according to the formula:

T_{WE_CH} = (Channel number +1) x 52 μs + tv; tv = 119 to 209 μs

T_{WE}								
A/D conversion								internal processing (tv)
CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0	
52μs	52μs	52μs	52μs	52μs	52μs	52μs	52μs	209μs
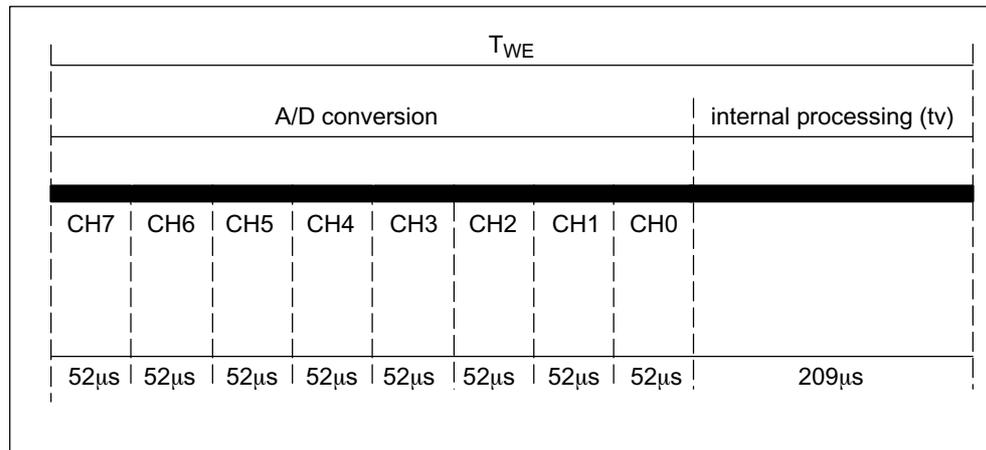
Figure 4-38   Calculation of the filter and processing time

Explanation of the mode of operation in synchronous operation

The module begins with the A/D conversion of channel 7 and saves this result internally. Then channels 6...0 are converted sequentially at intervals of 52 μs in the same way. After a further internal processing time the result becomes available to all converted channels at the backplane bus for collection by the CPU.

Further information

Further information on synchronicity can be found in the Online help of *STEP 7,* in the manual *Local peripheral system ET 200M* and in the manual *Synchronicity.*

4.20.2 Commissioning the SM 331; AI 8 × 14 bits High Speed

You set the mode of operation of the SM 331; AI 8 x 14 bits High Speed by means of measuring range modules on the module and in *STEP 7*.

Meas. range module

If necessary, the measuring range modules must be replugged to change the measuring method and the measuring range. You must then switch the 24 V supply off and on at the front connector. The steps you have to perform to do this are described in detail in the reference manual, Section 4.4.

The corresponding table in the reference manual, Section 4.20.3, tells you which assignment you have to select for which measuring method and measuring range. In addition, the necessary settings are embossed on the module.

Default settings for measuring range module

The measuring range modules are preset to "B" (voltage; ± 10 V) when the module is supplied.

To use the following preset measuring methods and measuring ranges, you only have to change the measuring range module to the corresponding setting. Parameter assignment in *STEP 7* is not necessary.

Table 4-59   Default Settings of the SM 331; AI 8 x 14 bits High Speed using Measuring Range Modules

Measuring Range Module Setting	Measuring Method	Measuring Range
A	Voltage	± 1 V*
B	Voltage	± 10 V
C	Current, Four-wire transmitter	4 to 20 mA
D	Current, Two-wire transmitter	4 to 20 mA

*   You must short-circuit unused channels and connect them to M_{ANA}.

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in the reference manual, section 4.7.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 4-60   Parameters of the SM 331; AI 8 x 14 bits High Speed

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Enable • Diagnostic interrupt • Hardware interrupt upon limit violation	Yes/no Yes/no	No No	Dynamic	Module
Fast Mode (only settable if the 331-7HF01 was registered in synchronous operation in the properties of the DP slave)	Yes/no	No	Static	Module
Trigger for hardware interrupt • Upper limit value • Lower limit value	Constraint possible due to measuring range. 32511 to –32512 –32512 to 32511	–	Dynamic	Channel
Diagnostics • Group diagnostics	Yes/no	No	Static	Channel group
Measurement • Measuring Method	Deactivated U Voltage 4DMU Current (4-wire transmitter) 2DMU Current (2-wire transmitter)	U	Dynamic	Channel or Channel group
• Measuring Range	Refer to the reference manual, section 4.20.3, for the measuring ranges of the input channels that you can set.	± 10 V		
• Interference Suppression	none; 400 Hz; 60 Hz; 50 Hz	50 Hz		

Channel groups

The channels of the SM 331; AI 8 x 14 bits High Speed are arranged in four groups of two. You can only ever assign parameters to one channel group.

Die SM 331; AI 8 x 14 bits High Speed has a measuring range module for each channel group.

The table below shows which channels are parameterized as a channel group in each case. You will need the channel group number to set the parameters in the user program with an SFC.

Table 4-61 Assignment of the channels of the SM 331; AI 8 x 14 bits High Speed to channel groups

Channels ...	... form one Channel Group each
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

Special characteristic of channel groups for hardware interrupts

You can set hardware interrupts in *STEP 7* for the channel groups 0 and 1. Note, however, that a hardware interrupt is set only for the first channel in the channel group in each case – in other words, for channel 0 or channel 2

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4-47 in the reference manual.

4.20.3   Measuring Methods and Measuring Ranges of the SM 331; AI 8 x 14 bits High Speed

Measuring Methods

You can set the following measuring methods for the input channels:

- Voltage measurement

- Current measurement

You perform the setting by means of the measuring range modules on the module and with the "measuring method" parameter in *STEP 7*.

Unused Channels

You must short-circuit unused channels and connect them to MANA. In this way, you obtain an optimum interference immunity for the analog input module. Set the "measuring method" parameter for unused channels to "disabled".

Special characteristics of unused channels for some measuring ranges

Since configured inputs can remain unused because of the channel group generation, you must take note of the following special characteristics of these inputs to enable the diagnostic functions on the used channels.

- **Measuring range 1 to 5 V:** Connect the unused input in parallel with a used input of the same channel group.

- **Current measurement, 2-wire transmitter:**
   There are two ways to use the channels:

   a) Leave the unused input open and do not enable diagnostics for this channel group. Otherwise, if diagnostics are enabled, the analog module triggers a single diagnostic interrupt and the SF LED of the analog module comes on.

   b) Connect the unused input with a resistance of 1.5 to 3.3 kW. You may then enable diagnostics for this channel group.

- **Current measurement 4 to 20 mA, 4-wire transmitter:** Connect the unused input in series with an input of the same channel group.

Measuring ranges

You perform the setting of the measuring ranges by means of the measuring range modules on the module and with the "measuring method" parameter in *STEP 7*.

Table 4-62 Measuring Ranges of the SM 331; AI 8 x 14 bits High Speed

Method Selected	Measuring Range (Type of Sensor)	Measuring Range Module Setting	Description
U: Voltage	$\pm$ 1 V	A	You will find the digitized analog values in the reference manual, section 4.3.1, in the voltage measuring range
	$\pm$ 5 V 1 to 5 V $\pm$ 10 V	B	
4DMU: Current (4-wire transmitter)	0 to 20 mA 4 to 20 mA $\pm$ 20 mA	C	You will find the digitized analog values in the reference manual, section 4.3.1, in the current measuring range
2DMU: Current (2-wire transmitter)	4 to 20 mA	D	

Default Settings

The default settings of the module in *STEP 7* are the "voltage" measuring method and the $\pm$ "10 V" measuring range. You can use this combination of measuring method and measuring range without parameterizing the SM 331; AI 8 x 14 bits High Speed with *STEP 7.*

Special characteristics of the wire-break check for the 4 to 20 mA measuring range

With a parameterized measuring range of 4 to 20 mA and **enabled wire-break check**, the analog input module enters wire-break in the diagnosis when a current falls below 3.6 mA.

If you have enabled diagnostics interrupt during configuration, the module additionally triggers a diagnostic interrupt.

If no diagnostic interrupt has been enabled, the illuminated SF LED is the only indication of the wire-break and you must evaluate the diagnostic bytes in the user program.

With a parameterized measuring range of 4 to 20 mA and **disabled wire-break check** and enabled diagnostic interrupt, the module triggers a diagnostic interrupt when the underflow is reached.

4.21   Analog Input Module SM 331; AI 8 x 13 bits; (6ES7331-1KF01-0AB0)

Order number

6ES7331-1KF01-0AB0

Characteristics

The analog input module SM 331; AI 8 x 13 bits has the following characteristic features:

- 8 inputs
- Measured-value resolution 12 bits + sign
- Measuring method selectable:
    - Voltage
    - Current
    - Resistors
    - Bulb resistor
- Isolated against the backplane bus interface

Terminal Connection Diagram and Block Diagram of the SM 331; AI 8 x 13 bits

The following figure shows some examples of connections for the different types of measurements on channels 4 to 7. Basically, these connection examples apply to all channels (channel 0 to 7).
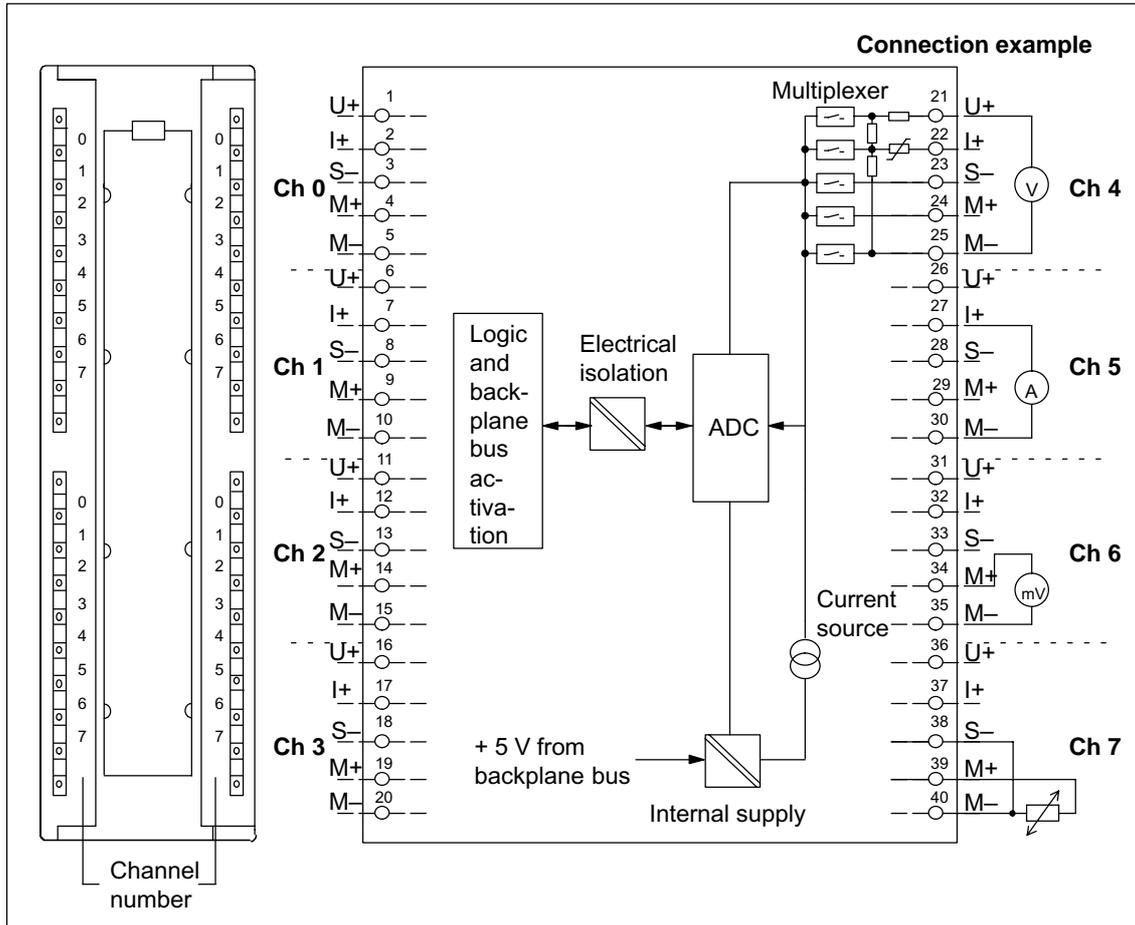
Figure 4-39 Module View and Block Diagram of the Analog Input Module SM 331; AI 8 x 13 bits

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Note

When connecting the voltage and current sensors, make sure that you do not exceed the maximum permitted common-mode voltage U_{CM} of 2 V between the inputs. So to prevent measuring errors, interconnect the individual M– terminals.

It is not necessary to interconnect the M– terminals when measuring resistors and resistance temperature detectors.

Technical specifications of the SM 331; AI 8 x 13 bits

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 250 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8
• For resistance-type sensor	8
Length of cable	
• Shielded	max. 200 m
	max. 50 m at 50 mV
Voltages, Currents, Potentials	
Constant current for resistance-type sensor	
• Resistance thermometer and resistance measurement 0 ... 600 Ω	0.83 mA
• Resistance measurement 0 ... 6 kΩ	0.25 mA
Isolation	
• Between channels and backplane bus	Yes
• Between the channels	No
Permitted potential difference	
• Between the inputs (E_{CM})	2.0 VDC
• Between the inputs and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 90 mA
Power dissipation of the module	typ. 0.4 W

Analog value generation		
Measuring principle	Integrating	
Integration time/resolution (per channel)		
• Programmable	Yes	
• Noise suppression for frequency f1 in Hz	50	60
• Integration time in milliseconds	60	50
• Basic conversion time including Integration time in milliseconds	66	55
Additional conversion time for measuring resistance, in ms	66	55
• Resolution in bits (incl. Overrange	13 bits	13 bits
Suppression of interference, Limits of Error		
Noise suppression for f = n × (f1 ± 1 %), (f1 = interference frequency) n = 1.2		
• Common-mode interference (U_{CM} < 2 V)	> 86 dB	
• Series-mode noise (peak value of noise < nominal value of input range)	> 40 dB	
Crosstalk between the inputs	> 50 dB	

Operational limit (in the entire temperature range, with reference to the input range)		
• Voltage input	± × 5 V × ± × 10 V 1 to 5 V 0 to 10 V	± 0.6 %
	± 50 mV ± 500 mV ± 1 V	± 0.5 %
• Current input	± × 20 mA 0 to 20 mA 4 to 20 mA	± 0.5 %
• Resistors	0 to 6 kΩ 0 to 600 Ω	± 0.5 % ± 0.5 %
• Resistance thermometer	Pt 100 Ni 100 Standard	± 1.2 K
	Pt 100 Ni 100 Climate	± 1 K
	Ni 1000, LG-Ni 1000 Standard	± 1 K
	Ni 1000 LG-Ni 1000 Climate	± 1 K

Basic error (operational limit at 25 °C, referred to input range)		
• Voltage input	± × 5 V × ± × 10 V 1 to 5 V 0 to 10 V	± 0.4 %
	± 50 mV ± 500 mV ± 1 V	± 0.3 %
• Current input	± × 20 mA 0 to 20 mA 4 to 20 mA	± 0.3 %
• Resistors	0 to 6 kΩ 0 to 600 Ω	± 0.3 % × ± 0.3 %
• Resistance thermometer	Pt 100 Ni 100 Standard	± 1 K
	Pt 100 Ni 100 Climate	± 0.8 K
	Ni 1000 LG-Ni 1000 Standard	± 0.8 K
	Ni 1000 LG-Ni 1000 Climate	± 0.8 K

Temperature error (with reference to the input range)	± 0.006 %/K / 0.006 K/K
Linearity error (with reference to the input range)	± 0.1 % / 0.1 K
Repeat accuracy (in the steady state at 25 °C, referred to the input range)	± 0.1 % / ± 0.1 K

Status, interrupts, diagnostics	
Interrupts	None
Diagnostic functions	None

Data for Selecting a Sensor		
Input range (rated values)/Input resistance		
• Voltage	± 50 mV ± 500 mV ± 1 V ± 5 V ± 10 V 1 to 5 V; 0 to 10 V	100 kΩ
• Current	± 20 mA 0 to 20 mA; 4 to 20 mA:	50 Ω
• Resistors	0 to 6 kΩ 0 to 600 Ω	100 MΩ
• Resistance thermometer	Pt 100 Ni 100 Ni 1000 LG-Ni 1000 Standard / Climate	100 MΩ
Maximum input voltage for voltage input U+ (destruction limit)	max. 30 V continuous	
Maximum input voltage for voltage inputs M+, M-, S– (destruction limit)	max. 12 V continuous; 30 V for max. 1 s	
Maximum input current for current input I+ (destruction limit)	40 mA	

Connection of the sensor		Characteristic linearization	Programmable
• For measuring voltage	Possible	• For RTD	Pt 100 Standard / Climate Ni 100 Standard / Climate Ni 1000 Standard / Climate LG-Ni 1000 Standard / Climate
• For measuring current		• Technical unit for temperature measurement	Degrees Celsius, degrees Fahrenheit, Kelvin
As two-wire transmitter	Possible, with external supply		
As four-wire transmitter	Possible		
• For measuring resistance			
with two-conductor connection	Possible		
with three-conductor connection	Possible		
with four-conductor connection	Possible		

4.21.1   Parameters of the SM 331; AI 8 x 13 bits

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in the reference manual, section 4.7.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 4-63   Parameters of the SM 331; AI 8 x 13 bits

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Measurement • Measuring Method	Deactivated U Voltage I Current R Resistors RTD Bulb resistor	U	Dynamic	Channel
• Measuring Range	Voltage $\pm$ 50 mV; $\pm$ 500 mV; $\pm$ 1 V; 1 to 5 V; $\pm$ 5 V; 0 to 10 V; $\pm$ 10 V	$\pm$ 10 V		
	Current 0 to 20 mA; 4 to 20 mA; $\pm$ 20 mA	$\pm$ 20 mA		
	Resistors 0 to 600 Ω; 0 to 6 kΩ	600 Ω		
	Bulb resistor (linear) Pt 100 Climate / Standard Ni 100 Climate / Standard Ni 1000 Climate / Standard LG-Ni 1000 Climate / Standard	Pt 100 standard		
• Temperature coefficient	Pt 100 0.003850 Ω/Ω/ °C (IST-90) Ni 100 / Ni 1000 0.006180 Ω/Ω/ °C LG-Ni 1000 0.005000 Ω/Ω/ °C	0.003850		
• Interference Frequency Suppression	50 Hz; 60 Hz	50 Hz		Module
• Temperature unit	Degrees Celsius, degrees Fahrenheit, Kelvin*	Degrees Celsius		

*   only Pt 100 Standard, Ni 100 Standard, Ni 1000 Standard, LG-Ni 1000 Standard

4.21.2 Measuring Methods of the SM 331; AI 8 x 13 bits

Measuring Methods

You can set the following measuring methods for the input channels:

- Voltage measurement

- Current measurement

- Resistance test

You perform the setting with the "measuring method" parameter in *STEP 7.*

Unused Channels

Set the "measuring method" parameter for unused channels to "disabled". In this way you shorten the scan time of the module.

4.22 Analog Input Module SM 331; AI 8 x 12 bits; (6ES7331-7KF02-0AB0)

Order number

6ES7331-7KF02-0AB0

Characteristics

The analog input module SM 331; AI 8 x 12 bits has the following characteristic features:

- 8 inputs in 4 channel groups

- Measured-value resolution; settable per group (depending on the integration time set)

    – 9 bits + sign

    – 12 bits + sign

    – 14 bits + sign

- Measuring method selectable per channel group:

    – Voltage

    – Current

    – Resistors

    – Temperature

- Arbitrary measuring range selection per channel group

- Programmable diagnostics

- Programmable diagnostic interrupt

- Two channels with limit monitoring

- Programmable hardware interrupt when limit has been exceeded

- Isolated against the backplane bus interface

- Isolated against load voltage (except when at least one coding key is inserted in position D)

Resolution

The resolution of the measured value is a direct function of the integration time selected. In other words the longer the integration time for an analog input channel, the more accurate the resolution of the measured value will be (see Technical Specifications of the module and Table 4-6 on page 4-10).

Terminal Connection Diagram and Block Diagram of the SM 331; AI 8 x 12 bits

Figure 4-40   Module View and Block Diagram of the Analog Input Module SM 331; AI 8 x 12 bits

The input resistances depend on the measuring range selected (see Technical Specifications).

Technical specifications of the SM 331; AI 8 x 12 bits

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 250 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8
• For resistance-type sensor	4
Length of cable	max. 200 m
• Shielded	max. 50 m at 80 mV and thermocouples
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L +	24 VDC
• Reverse polarity protection	Yes
Power supply of the transmitters	
• Supply current	max. 60 mA (per channel)
• Short-circuit-proof	Yes
Constant current for resistance-type sensor	typ. 1.67 mA
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
– Not for 2-wire transmitter	
Permitted potential difference	
• Between inputs and M_{ANA} (U_{CM})	2.5 VDC
– At signal = 0 V	
• Between the inputs (ECM)	2.5 VDC
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 50 mA
• From the backplane bus L +	max. 30 mA (without two-wire transmitter)
Power dissipation of the module	typ. 1 W

Analog value generation				
Measuring principle	Integrating			
Integration time/conversion time/ resolution (per channel)				
• Programmable	Yes			
• Integration time in milliseconds	2.5	$16^2/_3$	20	100
• Basic conversion time including Integration time in milliseconds	3	17	22	102
Additional conversion time for measuring resistance, in ms or	1	1	1	1
Additional conversion time for open-circuit monitoring, in ms or	10	10	10	10
Additional conversion time for measuring resistance **and** open-circuit monitoring, in ms	16	16	16	16
• Resolution in bits (incl. overrange)	9 bits	12 bits	12 bits	14 bits
• Noise suppression for frequency f1 in Hz	400	60	50	10
• Basic execution time of the module, in ms (all channels enabled)	24	136	176	816
Smoothing of the measured values	None			

Suppression of interference, Limits of Error		
Noise suppression for F = n × (f1 ± 1 %), (f1 = interference frequency)		
● Common-mode interference (U_{CM} < 2.5 V)	> 70 dB	
● Series-mode noise (peak value of noise < nominal value of input range)	> 40 dB	
Crosstalk between the inputs	> 50 dB	
Operational limit (in the entire temperature range, with reference to the input range)		
● Voltage input	80 mV	± 1 %
	250 to 1000 mV	± 0.6 %
	2.5 to 10 V	± 0.8 %
● Current input	3.2 to 20 mA	± 0.7 %
● Resistors	150Ω; 300Ω; 600 Ω	± 0.7 %
● Thermocouple	Type E, N, J, K, L	± 1.1 %
● Resistance thermometer	Pt 100/ Ni 100	± 0.7 %
	Pt 100 climate	± 0.8 %
Basic error (operational limit at 25 °C referred to input range)		
● Voltage input	80 mV	± 0.7 %
	250 to 1000 mV	± 0.4 %
	2.5 to 10 V	± 0.6 %
● Current input	3.2 to 20 mA	± 0.5 %
● Resistors	150Ω; 300Ω; 600 Ω	± 0.5 %
● Thermocouple	Type E, N, J, K, L	± 0.7 %
● Resistance thermometer	Pt 100/ Ni 100	± 0.5 %
	Pt 100 climate	± 0.6 %
Temperature error (with reference to the input range)	± 0.005 %/K	
Linearity error (with reference to the input range)	± 0.05 %	
Repeatability (in steady state at 25 °C referred to input range)	± 0.05 %	
Temperature error of internal compensation	± 1 %	

Status, Interrupts, Diagnostics		
Interrupts		
● Hardware interrupt when limit has been exceeded	Programmable channels 0 and 2	
● Diagnostic interrupt	Programmable	
Diagnostic functions	Programmable	
● Group error display	Red LED (SF)	
● Diagnostics information read-out	Possible	

Data for Selecting a Sensor		
Input range (rated values)/Input resistance		
● Voltage	± 80 mV	/10 MΩ
	± 250 mV	/10 MΩ
	± 500 mV	/10 MΩ
	±1000 mV	/10 MΩ
	± 2.5 V	/100kΩ
	± 5 V	/100kΩ
	1 to 5 V;	/100kΩ
	± 10 V	/100kΩ
● Current	± 3.2 mA	/25 Ω
	± 10 mA	/25 Ω
	± 20 mA	/25 Ω
	0 to 20 mA;	/25 Ω
	4 to 20 mA:	/25 Ω
● Resistors	150 Ω	/10 MΩ
	300 Ω	/10 MΩ
	600 Ω	/10 MΩ
● Thermocouples	Type E, N, J, K, L	/10 MΩ
● Resistance thermometer	Pt 100, Ni 100	/10 MΩ
Maximum input voltage for voltage input (destruction limit)	max. 20 V continuous; 75 V for max. 1 s (duty factor 1:20)	
Maximum input current for current input (destruction limit)	40 mA	

Connection of the sensor		Characteristic linearization	Programmable
• For measuring voltage	Possible	• for thermocouples	Type E, N, J, K, L
• For measuring current		• For RTD	Pt 100 (standard, climate range) Ni 100 (standard, climate range)
As two-wire transmitter	Possible		
As four-wire transmitter	Possible		
• For measuring resistance		Temperature compensation	Programmable
With two-conductor connection	Possible	• Internal temperature compensation	Possible
With three-conductor connection	Possible	• External temperature compensation with compensating box	Possible
With four-conductor connection	Possible		
• Load of the two-wire transmitter	max. 820 Ω	• Compensation for 0 °C comparison point temperature	Possible
		• Technical unit for temperature measurement	Degrees Celsius

4.22.1 Commissioning the SM 331; AI 8 x 12 bits

You set the mode of operation of the SM 331; AI 8 x 12 bits by means of measuring range modules on the module and in *STEP 7*.

Meas. range module

If necessary, the measuring range modules must be replugged to change the measuring method and the measuring range. The steps you have to perform to do this are described in detail in Section 4.4.

The corresponding table in Section 4.22.2 tells you which assignment you have to select for which measuring method and measuring range. In addition, the necessary settings are embossed on the module.

Default settings for measuring range module

The measuring range modules are preset to "B" (voltage; $\pm$ 10 V) when the module is supplied.

To use the following preset measuring methods and measuring ranges, you only have to change the measuring range module to the corresponding setting. Parameter assignment in *STEP 7* is not necessary.

Table 4-64   Default Settings of the SM 331; AI 8 x 12 bits Using Measuring Range Modules

Measuring Range Module Setting	Measuring Method	Measuring Range
A	Voltage	$\pm$ 1000 mV
B	Voltage	$\pm$ 10 V
C	Current, Four-wire transmitter	4 to 20 mA
D	Current, Two-wire transmitter	4 to 20 mA

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in Section 4.7.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 4-65   Parameters of the SM 331; AI 8 x 12 bits

Parameter	Value Range	Default Settings	Para- meter Type	Scope
Enable • Diagnostic interrupt • Hardware interrupt upon limit violation	Yes/no Yes/no	No No	Dynamic	Module
Trigger for hardware interrupt • Upper limit value • Lower limit value	Constraint possible due to measuring range. From 32511 to –32512 –32512 to 32511	–	Dynamic	Channel
Diagnostics • Group diagnostics • With wire-break check	Yes/no Yes/no	No No	Static	Channel group

Table 4-65   Parameters of the SM 331; AI 8 x 12 bits, continued

Parameter	Value Range	Default Settings	Para-meter Type	Scope

Measurement
● Measuring Method
	Deactivated
	U Voltage
	4DMU Current (4-wire transmitter)
	2DMU Current (2-wire transmitter)
	R-4L Resistance
	          (four-conductor connection)
	RTD-4L Bulb resistor
	          (linear, four-conductor
	          connection)
	TC-I Thermocouple
	          (internal comparison)
	TC-E Thermocouple
	          (external comparison)
	TC-IL Thermocouple
	          (linear, internal comparison)
	TC-EL Thermocouple
	          (linear, external comparison)
		U	Dynamic	Channel or Channel group

● Measuring Range	Refer to Section 4.22.2 for the measuring ranges of the input channels that you can set.	$\pm$ 10 V		
● Interference Suppression	400 Hz; 60 Hz; 50 Hz; 10 Hz	50 Hz		

Channel groups

The channels of the SM 331; AI 8 x 12 bits are arranged in four groups of two. You can only ever assign parameters to one channel group.

The analog input module SM 331; AI 8 x 12 bits has a measuring range module for each channel group.

The table below shows which channels are parameterized as a channel group in each case. You will need the channel group number to set the parameters in the user program with an SFC.

Table 4-66   Assignment of Channels of the SM 331; AI 8 x 12 bits to Channel Groups

Channels ...	... form one Channel Group each
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

Special characteristic of channel groups with resistance measurement

If you use the resistance measurement method, there is only one channel per channel group. The "2nd" channel of each group is used for current injection (I_C).

The measured value is obtained by accessing the "1st" channel of the group. The "2nd" channel of the group has the default carry value "7FFF$_H$".

Special characteristic of channel groups for hardware interrupts

You can set hardware interrupts in *STEP 7* for the channel groups 0 and 1. Note, however, that a hardware interrupt is set only for the first channel in the channel group in each case – in other words, for channel 0 or channel 2

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4-46, on page 4-72.

4.22.2 Measuring Methods and Measuring Ranges of the SM 331; AI 8 x 12 bits

Measuring Methods

You can set the following measuring methods for the input channels:

- Voltage measurement
- Current measurement
- Resistance test
- Temperature measurement

You perform the setting by means of the measuring range modules on the module and with the "measuring method" parameter in *STEP 7.*

Unused Channels

You must short-circuit unused channels and connect them to M$_{ANA}$. In this way, you obtain an optimum interference immunity for the analog input module. Set the "measuring method" parameter for unused channels to "disabled". In this way you shorten the scan time of the module.

If you do not use the COMP input, you must short-circuit it also.

Special characteristics of unused channels for some measuring ranges

Since configured inputs can remain unused because of the channel group generation, you must take note of the following special characteristics of these inputs to enable the diagnostic functions on the used channels.

- **Measuring range 1 to 5 V:** Connect the unused input in parallel with a used input of the same channel group.

- **Current measurement, 2-wire transmitter:**
  There are two ways to use the channels:

  a) Leave the unused input open and do not enable diagnostics for this channel group. Otherwise, if diagnostics are enabled, the analog module triggers a single diagnostic interrupt and the SF LED of the analog module comes on.

  b) Connect the unused input with a resistance of 1.5 to 3.3 kΩ. You may then enable diagnostics for this channel group.

- **Current measurement 4 to 20 mA, 4-wire transmitter:** Connect the unused input in series with an input of the same channel group.

Special characteristic when all channels are disabled

If you disable **all** input channels of the module and enable diagnostics when parameterizing the analog input module SM 331; AI 8 × 12 bits, the module does **not** indicate that the "external auxiliary voltage" is missing.

Measuring ranges

You perform the setting of the measuring ranges by means of the measuring range modules on the module and with the "measuring method" parameter in *STEP 7*.

Table 4-67   Measuring Ranges of the SM 331; AI 8 x 12 bits

Method Selected	Measuring Range (Type of Sensor)	Measuring Range Module Setting	Description
U: Voltage	± 80 mV ± 250 mV ± 500 mV ± 1000 mV	A	You will find the digitized analog values in Section 4.3.1 in the voltage measuring range
	± 2.5 V ± 5 V 1 to 5 V ± 10 V	B	
TC-I:thermocouple (internal compensation) (thermovoltage measurement) TC-E: Thermocouple (external compensation) (thermovoltage measurement)	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi] Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	A	You will find the digitized analog values in Section 4.3.1 in ± 80 mV the voltage measuring range

Table 4-67   Measuring Ranges of the SM 331; AI 8 x 12 bits, continued

Method Selected	Measuring Range (Type of Sensor)	Measuring Range Module Setting	Description
2DMU: Current (2-wire transmitter)	4 to 20 mA	D	You will find the digitized analog values in Section 4.3.1 in the current measuring range
4DMU: Current (4-wire transmitter)	$\pm$ 3.2 mA $\pm$ 10 mA 0 to 20 mA 4 to 20 mA $\pm$ 20 mA	C	
R-4L: Resistors (four-conductor connection)	150 Ω 300 Ω 600 Ω	A	You will find the digitized analog values in Section 4.3.1 in the resistance measuring range
TC-IL: Thermocouple (linear, internal compensation) (temperature measurement)	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi] Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	A	You will find the digitized analog values in Section 4.3.1 in the temperature range The characteristics are linearized: • Pt 100 to DIN IEC 751 • Ni 100 according to IEC DIN 43760 • Thermocouple to DIN 584, type L to DIN 43710.
TC-EL: Thermocouple (linear, external compensation) (temperature measurement)			
RTD-4L: Bulb resistor (linear, four-conductor connection) (temperature measurement)	Pt 100 climate Ni 100 climate Pt 100 standard Ni 100 standard	A	

Default Settings

The default settings of the module in *STEP 7* are the "voltage" measuring method and the "$\pm$ 10 V" measuring range. You can use this combination of measuring method and measuring range without parameterizing the SM 331; AI 8 x 12 bits with *STEP 7*.

Wire-Break Check

The wire-break check is intended primarily for temperature measurements (thermocouples and bulb resistors.

Special characteristics of the wire-break check for the 4 to 20 mA measuring range

With a parameterized measuring range of 4 to 20 mA and **enabled wire-break check**, the analog input module enters wire-break in the diagnosis when a current falls below 3.6 mA.

If you have enabled diagnostics interrupt during configuration, the module additionally triggers a diagnostic interrupt.

If no diagnostic interrupt has been enabled, the illuminated SF LED is the only indication of the wire-break and you must evaluate the diagnostic bytes in the user program.

With a parameterized measuring range of 4 to 20 mA and **disabled wire-break check** and enabled diagnostic interrupt, the module triggers a diagnostic interrupt when the underflow is reached.

4.23 Analog Input Module SM 331; AI 8 x RTD (6ES7331-7PF00-0AB0)

Order number

6ES7331-7PF00-0AB0

Characteristics

The analog input module SM 331; AI 8 x RTD has the following characteristic features:

- 8 differential inputs for RTD resistance temperature detector in 4 channel groups
- Optional setting of the resistance thermometer type per channel group
- Rapid measured value updating for up to 4 channels
- Measured-value resolution 15 bits + sign (independent of integration time)
- Programmable diagnostics
- Programmable diagnostic interrupt
- 8 channels with limit monitoring
- Programmable hardware interrupt when limit has been exceeded
- Programmable end-of-scan-cycle interrupt
- Isolated against the backplane bus interface

Use of the module in the distributed peripheral ET 200M

When you use the SM 331; AI 8 x RTD in the distributed peripheral ET 200M, you must have one of the following IM 153 x:

- IM 153-1; ab 6ES7153-1AA03-0XB0, E 01
- IM 153-2; ab 6ES7153-2AA02-0XB0, E 05
- IM 153-2; ab 6ES7153-2AB01-0XB0, E 04

Terminal connection diagram and block diagram of the SM 331; AI 8 x RTD

Figure 4-41   Module View and Block Diagram of the SM 331; AI 8 x RTD

Technical specifications of the SM 331; AI 8 x RTD

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 272 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8
Length of cable	
• Shielded	max. 200 m
Voltages, Currents, Potentials	
Power rated voltage of the electronics L+	24 VDC
• Reverse polarity protection	Yes
Constant measured current for resistance-type sensor	max. 5 mA
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
• Between the channels	Yes
In groups of	2
Permitted potential difference	
• Between the inputs (U_{CM})	75 VDC / 60 VAC
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 100 mA
• From the power supply L+	max. 240 mA
Power dissipation of the module	typ. 4.6 W

Analog value generation	
Measuring principle	Integrating
Module filtering mode	**8 channels, hardware**
Integration/conversion time/ resolution (per channel)	
• Programmable	Yes
• Basic conversion time in ms	80
• Additional conversion time for measuring resistance, in ms	185*
• Additional conversion time for open-circuit monitoring, in ms	100
• Resolution including sign	16 bits
• Noise suppression for interference frequency f1 in Hz	400 / 60 / 50
Smoothing of the measured values	None / low/ average/ high
Conversion time (per channel)	100 ms
Basic response time of module (all channels enabled)	200 ms
Module filtering mode	**8 channels, software**
Integration/conversion time/ resolution (per channel)	
• Programmable	Yes
• Basic conversion time in ms	8 / 25 / 30
• Additional conversion time for measuring resistance, in ms	45 / 79 / 89*
• Additional conversion time for open-circuit monitoring, in ms	20 / 37 / 42
• Resolution including sign	16 bits
• Noise suppres sion for interference frequency f1 in Hz	400 / 60 / 50
Smoothing of the measured values	None / low/ average/ high
Conversion time (per channel)	20 / 37 / 42 ms
Basic response time of module (all channels enabled)	40 / 79 / 84 ms

Module filtering mode	**4 channels, hardware**
Integration/conversion time/ resolution (per channel)	
• Programmable	Yes
• Basic conversion time in ms	3.3
• Additional conversion time for measuring resistance, in ms	185*
• Additional conversion time for open-circuit monitoring, in ms	85**
• Resolution including sign	16 bits
• Noise suppres sion for interference frequency f1 in Hz	400 / 60 / 50
Smoothing of the measured values	None / low/ average/ high
Basic response time of module (all channels enabled)	10 ms

Suppression of interference, Limits of Error	
Noise suppression for f = n × (f1 1%), "(f1 = interference frequency) n = 1.2, etc.	
• Common-mode interference (U$_{CM}$ < 60 VAC)	> 100 dB
• Series-mode interference (peak value of interference < rated value of input range)	> 90 dB
Crosstalk between the inputs	> 100 dB
Operational limit (over entire temperature range, referred to 0 to 60 °C input range)	
• Resistance thermometer	± 1.0 °C
• Resistors	± 0.1 %
Basic error (operational limit at 25°C, referred to input range)	
• Resistance thermometer	± 0.5 °C
• Resistors	± 0.05 %
Temperature error (with reference to the input range)	± 0.005 %/K

Linearity error (with reference to the input range)	± 0.02 %
Repeat accuracy (in the steady state at 25 °C, referred to the input range)	± 0.01 %

Status, Interrupts, Diagnostics	
Interrupts	
• Hardware interrupt	Programmable (channels 0 – 7)
• Diagnostic interrupt	Programmable
Diagnostic functions	Programmable
• Group error display	Red LED (SF)
• Diagnostic information can be displayed	Possible

Data for Selecting a Sensor	
Input range (rated values) input resistance	
• Resistance thermometer	Pt 100, Pt 200, Pt 500, Pt 1000, Ni 100, Ni 120, Ni 200, Ni 500, Ni 1000, Cu 10
• Resistors	150, 300, 600 Ω
Maximum input voltage for voltage input (destruction limit)	35 VDC continuous; 75 VDC for max. 1 s (duty factor 1:20)
Connection of the sensor	
• For measuring resistance	
With two-conductor connection	Possible (without resistance correction)
With three-conductor connection	Possible
With four-conductor connection	Possible
Characteristic linearization	
• Resistance thermometer	Pt 100, Pt 200, Pt 500, Pt 1000, Ni 100, Ni 120, Ni 200, Ni 500, Ni 1000, Cu 10 (standard and climatic range)
• Technical unit for temperature measurement	Degrees Celsius; degrees Fahrenheit

*   The resistance measurement for a three-conductor connection is performed every 5 minutes.
**   Open-circuit monitoring in module filtering mode 4 Channels, Hardware is performed every 3 seconds.

4.23.1 Commissioning the SM 331; AI 8 x RTD

You set the mode of operation of the SM 331; AI 8 x RTD in *STEP 7.*

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in Section 4.7.

Parameterization restrictions when using the SM 331; AI 8 x RTD with PROFIBUS masters that only support DPV0.

When you use the analog input module SM 331; AI 8 x RTD in an ET 200M PROFIBUS slave system with a PROFIBUS master which is not an S7 master, certain parameters are not permitted. Masters that are not S7 masters do not support hardware interrupts. So all the parameters associated with these functions are deactivated. The deactivated parameters are hardware interrupt enable, hardware restrictions and end-of-scan-cycle interrupt enable. All the other parameters are permitted.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 4-68 Parameters of the SM 331; AI 8 x RTD

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Enable • Diagnostic interrupt • Hardware interrupt upon limit violation • Hardware interrupt at end of cycle	Yes/no Yes/no Yes/no	No No No	Dynamic	Module
Trigger for hardware interrupt • Upper limit value • Lower limit value	32511 to –32512 –32512 to 32511	32767 -32768	Dynamic	Channel
Diagnostics • Group diagnostics • With wire-break check	Yes/no Yes/no	No No	Static	Channel group

Table 4-68   Parameters of the SM 331; AI 8 x RTD, continued

Parameter	Value Range	Default Settings	Para-meter Type	Scope

Measurement
• Measuring Method
	Deactivated
	R-4L Resistance
	       (four-conductor connection)
	R-3L Resistance,
	       three-conductor connection
	RTD-4L Bulb resistor
	       (linear, four-conductor
	       connection)
	RTD-3L Bulb resistor
	       (linear, three-conductor
	       connection)
		RTD-4L	Dynamic	Channel group

• Measuring Range	Refer to Section 4.23.2 for the measuring ranges of the input channels that you can set.	Pt 100 climate 0.003850 (IPTS-68)		
• Temperature unit	Degrees Celsius; degrees Fahrenheit	Degrees Celsius	Dynamic	Module
• Module filtering mode	8 channels hardware filter 8 channels software filter 4 channels hardware filter	8 channels, hardware filter	Dynamic	Module
• Temperature coefficient for temperature measurement with bulb resistor (RTD)	Platinum (Pt) $0{,}003850\ \Omega/\Omega/\ °C$ $0.003916\ \Omega/\Omega/\ °C$ $0.003902\ \Omega/\Omega/\ °C$ $0.003920\ \Omega/\Omega/\ °C$ $0{,}003850\ \Omega/\Omega/\ °C$ (ITS-90) Nickel (Ni) $0.006180\ \Omega/\Omega/\ °C$ $0.006720\ \Omega/\Omega/\ °C$ Copper (Cu) $0.00427\ \Omega/\Omega/\ °C$	0.003850	Dynamic	Channel group
• Interference suppression*	50/60/400 Hz; 400 Hz; 60 Hz; 50 Hz	50/60/400 Hz	Dynamic	Channel group
• Smoothing	None Low Average High	None	Dynamic	Channel group

*   50/60/400 Hz programmable only for modes 8 or 4-Channel Hardware Filter Modes;
    50 Hz, 60 Hz or 400 Hz programmable only for mode 8-Channel Hardware Filter Mode

Channel groups

The channels of the SM 331; AI 8 x RTD are arranged in four groups of two. You can only ever assign parameters to one channel group.

The table below shows which channels are parameterized as a channel group in each case. You will need the channel group number to set the parameters in the user program with an SFC.

Table 4-69   Assignment of Channels of the SM 331; AI 8 x RTD to Channel Groups

Channels ...	... form one Channel Group each
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

Special characteristic of channel groups for hardware interrupts upon limit violation

You can set the upper and lower limits for each channel with hardware interrupts in *STEP 7.*

Module filtering mode

The SM 331; AI $8 \times$ RTD operates in one of the following modes:

- "Hardware filter, 8 channels"

- "Software filter, 8 channels"

- "Hardware filter, 4 channels"

The operating mode affects the scan time of the module.

"Hardware filter 8 channels" mode

In "Hardware filter 8 channels" mode, the analog input module SM331; AI 8 x RTD switches over between the two channels in each group. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6. Once the even-numbered channels have been converted all the ADCs simultaneously convert for the odd-numbered channels 1, 3, 5 and 7 (see Figure 4-42).

Figure 4-42   Hardware filter 8 channels scan time

Scan time of the module

In 8-channel hardware filter mode, the channel conversion time including the communication time of the analog input module SM 331; AI 8 x RTD is 85 ms. The module must then be switched over to the other channel in the group by means of opto-MOS relays. Opto-MOS relays need 12 ms to switch and settle. Each channel needs a time of 97 ms, so that the scan time is exactly 194 ms.

Scan time = $(t_K + t_U)$ x 2

Scan time = (85 ms + 12 ms) x 2

Scan time = <u>194 ms</u>

t_K: channel conversion time for one channel

t_U: time for switching to the other channel in the channel group

"Software filter 8 channels" mode

In "Software filter 8 channels" mode, the analog/digital conversion occurs in exactly the same way as in "hardware filter 8 channels" mode. That is to say, as the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6. Once the even-numbered channels are converted, all the ADCs convert simultaneously for the odd-numbered channels 1, 3, 5 and 7 (see Figure 4-43).
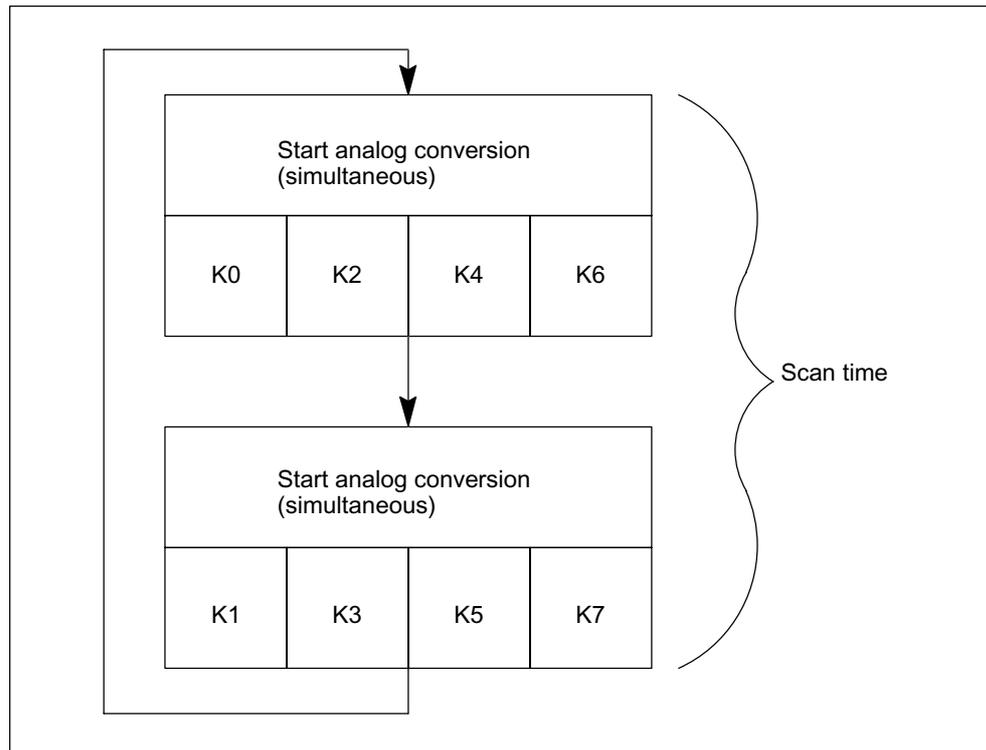
Figure 4-43   Software filter 8 channels scan time

Scan time of the module

The channel conversion time depends, however, on the programmed interference frequency suppression. When you set an interference frequency of 50 Hz, the channel conversion time including communication time is 30 ms. When you set an interference frequency of 60 Hz, the channel conversion time is 25 ms. When you set an interference frequency of 400 Hz, the channel conversion time is reduced to 8 ms. As with 8-channel hardware filter mode, the module must be switched over by means of opto MOS relays with a time of 12 ms for switching to the other channel of the group. This relationship is shown in the table that follows.

Table 4-70   Scan Times in "Software Filter, 8 Channels" Mode

Programmed Interference Frequency Suppression	Channel Scan Time*	Module Scan Time (All Channels)
50 Hz	42 ms	**84 ms**
60 Hz	37 ms	**74 ms**
400 Hz	20 ms	**40 ms**

* Channel scan time = channel conversion time + 12 ms switching time to the other channel in the channel group

Scan time in "Hardware Filter, 4 Channels" mode

In this mode, the module does not switch between the channels of the different groups. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6.
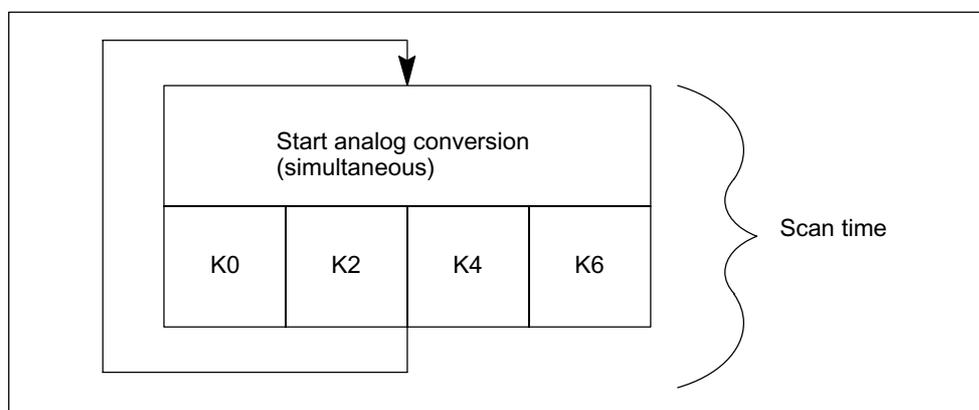
Figure 4-44   Hardware filter 4 channels scan time

Scan time of the module

In 4-channel hardware filter mode, the channel conversion time including the communication time of the analog input module SM 331; AI 8 x RTD is 10 ms. As the module does not switch over between the channels in a group, the channel scan time and the module scan time are the same: 10 ms.

Channel conversion time = channel scan time = module scan time = **<u>10 ms</u>**

Prolongation of the scan time with a wire-break check

The wire-break check is a software function of the module that is available in all operating modes.

In the 8-channel hardware and software filter operating modes, the scan time of the module is doubled, irrespective of the number of channels for which wire-break has been enabled.

In the 4-channel hardware filter operating mode, the module interrupts processing of the input data 170 ms and performs a wire-break check. In other words, each wire-break check prolongs the scan time of the module by 170 ms.

Smoothing of the measured values

You fill find information that is generally applicable to the smoothing of analog values in Section 4.6.

Special characteristic with short-circuit to M or L

If you short an input channel to M or L, the module does not suffer any damage. The channel continues to issue valid data; neither is a diagnosis reported.

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4-46, on page 4-72.

4.23.2 Measuring Methods and Measuring Ranges of the SM 331; AI 8 x RTD

Measuring Methods

You can set the following measuring methods for the input channels:

- RTD 4-conductor measurement

- RTD 3-conductor measurement

- Resistor 4-conductor measurement

- Resistor 3-conductor measurement

You perform the setting with the "measuring method" parameter in *STEP 7*.

Unused Channels

Set the "measuring method" parameter for unused channels to "disabled". In this way you shorten the scan time of the module.

You must terminate an unused channel of an enabled channel group with a nominal resistance in order to avoid diagnostic errors for the unused channel (refer to the block diagram, Figure 4-41, for the connection).

In the "4-Channel Hardware Filter" operating mode, termination is not necessary provided that you have disabled the unused channel groups. Channels 1, 3, 5 and 7 are not monitored in this mode.

Measuring ranges

You perform setting of the measuring ranges with the "measuring range" parameter in *STEP 7*.

Table 4-71   Measuring ranges of the SM331; AI 8 x RTD

Method Selected	Measuring Range	Description
Resistors: (Three-conductor/four-conductor terminal)	150 Ω 300 Ω 600 Ω	You will find the digital analog values in Section 4.3.1
Resistance RTD (Three-conductor/four-conductor terminal)	Pt 100 climate Pt 200 climate Pt 500 climate Pt 1000 climate Ni 100 climate Ni 120 climate Ni 200 climate Ni 500 climate Ni 1000 climate Cu 10 climate Pt 100 standard Pt 200 standard Pt 500 standard Pt 1000 standard Ni 100 standard Ni 120 standard Ni 200 standard Ni 500 standard Ni 1000 standard Cu 10 standard	

Special characteristic of parameter assignment to upper and lower limit values

The programmable limit values (triggers for hardware interrupt) differ for the AI 8 × RTD from the range of values shown in Table 4-68.

The reason for this is that numerical methods in the module software for evaluating the process variables prevent values up to 32511 from being reported in some cases. The process input value at which a hardware interrupt for an underflow or overflow occurs depends on the calibration factors for an individual channel and can vary between the lower limits shown in the table below and 32511 ($7EFF_H$).

Limit values should not be set at values higher than the minimum potential limit values shown in the table below.

End-of-scan-cycle interrupt

By enabling the end-of-scan-cycle interrupt, you can synchronize a process with the conversion cycle of the module. The interrupt occurs when the conversion of all the enabled channels is complete.

Table 4-72   Content of the 4 bytes with additional information from OB40 during a hardware interrupt or an end-of-scan-cycle interrupt

Content of the 4 bytes with additional information		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Byte
Special analog markers	**2 bits per channel to identify the range**									
	Upper limit exceeded in channel	7	6	5	4	3	2	1	0	0
	Lower limit exceeded in channel	7	6	5	4	3	2	1	0	1
	End-of-scan-cycle event						X			2
	Unassigned bit									3

4.24 Analog Input Module SM 331; AI 8 x TC (6ES7331-7PF10-0AB0)

Order number

6ES7331-7PF10-0AB0

Characteristics

The analog input module SM 331; AI 8 x TC has the following features:

- 8 differential inputs for thermocouples (TC) in 4 channel groups
- Optional setting of the thermocouple type per channel group
- Rapid measured value updating for up to 4 channels
- Measured-value resolution 15 bits + sign (independent of integration time)
- Programmable diagnostics
- Programmable diagnostic interrupt
- 8 channels with limit monitoring
- Programmable hardware interrupt when limit has been exceeded
- Programmable end-of-scan-cycle interrupt
- Programmable reaction to open thermocouple
- Isolated against the backplane bus interface

Use of the module in the distributed peripheral ET 200M

When you use the SM 331; AI 8 x TC in the distributed peripheral ET 200M, you must have one of the following IM 153-x:

- IM 153-1; as of 6ES7153-1AA03-0XB0, E 01
- IM 153-2; as of 6ES7153-2AA02-0XB0, E 05
- IM 153-2; as of 6ES7153-2AB01-0XB0, E 04

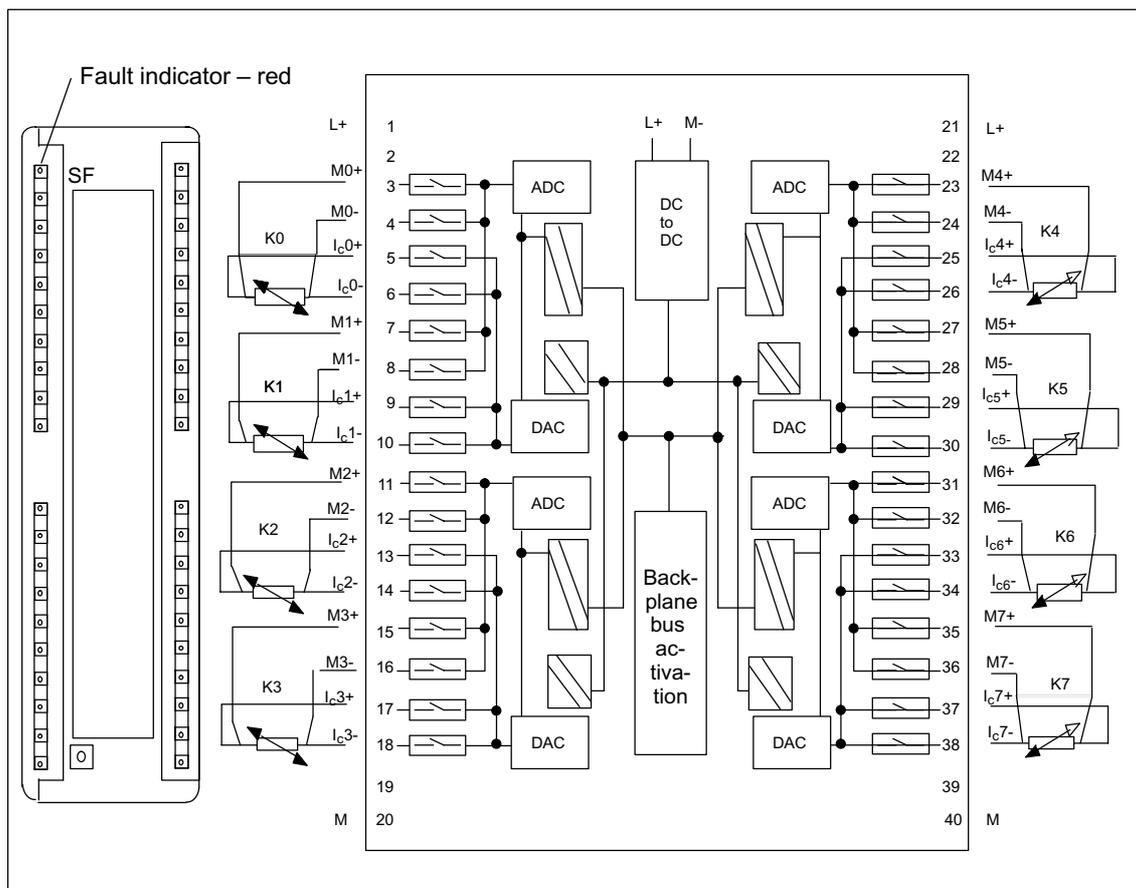## Terminal connection diagram and block diagram of the SM 331; AI 8 x TC

Figure 4-45   Module View and Block Diagram of the SM 331; AI 8 x TC

Technical specifications of the SM 331; AI 8 x TC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 272 g
Data for Specific Module	
Supports clocked operation	No
Length of cable	
● Shielded	max. 100 m
Voltages, Currents, Potentials	
Power rated voltage of the electronics L+	24 VDC
● Reverse polarity protection	Yes
Constant measured current for resistance-type sensor	typ. 0.7 mA
Isolation	
● Between channels and backplane bus	Yes
● Between channels and power supply of the electronics	Yes
● Between the channels	Yes
In groups of	2
Permitted potential difference	
● Between the inputs (U_{CM})	75 VDC / 60 VAC
● Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC 60 VAC
Insulation tested with	500 VDC
Current consumption	
● From the backplane bus	max. 100 mA
● From supply voltage L+	max. 240 mA
Power dissipation of the module	typ. 3.0 W

Analog value generation	
Measuring principle	Integrating
Module filtering mode	**8 channels, hardware**
Integration time/conversion time/ resolution (per channel)	
● Programmable	Yes
● Basic conversion time in ms	95
● Additional conversion time for open-circuit monitoring, in ms	4
● Resolution including sign	16 bits
● Noise suppression for interference frequency f1 in Hz	400/60/50
Smoothing of the measured values	None / low/ average/ high
Basic response time of module (all channels enabled)	190 ms
Module filtering mode	**8 channels, software**
Integration time/conversion time/ resolution (per channel)	
● Programmable	Yes
● Basic conversion time in ms	23/72/83
● Additional conversion time for open-circuit monitoring, in ms	4
● Resolution including sign	16 bits
● Noise suppression for interference frequency f1 in Hz	400/60/50
Smoothing of the measured values	None / low/ average/ high
Basic response time of module (all channels enabled)	46/144/166 ms

Analog Value Generation (Cont'd)	
Measuring principle	Integrating
Module filtering mode	**4 channels, hardware**
Integration time/conversion time/ resolution (per channel)	
● Programmable	Yes
● Basic conversion time in ms	1.0
● Additional conversion time for open-circuit monitoring, in ms	93 [1])
● Resolution including sign	16 bits
● Noise suppression for frequency f1 in Hz	400/60/50
Smoothing of the measured values	None / low/ average/ high
Basic response time of module (all channels enabled)	10 ms

Suppression of interference, Limits of Error			
Noise suppression for f = n × (f1 ± 1%), (f1 = interference frequency) n = 1.2, etc.			
● Common-mode interference (U_{cm} < 60 VAC)	> 100 dB		
● Series-mode interference (peak value of interference < rated value of input range)	> 90 dB [2])		
Crosstalk between the inputs	> 100 dB		
Operational limit (over entire temperature range, referred to 0 to 60 °C input range) Note: This limit does not cover the error cold connection point[3])			
● Thermocouple			
Type T	-200 °C to	+400 °C	±0.7 °C
	-230 °C to	-200 °C	±1.0 °C
Type U	-150 °C to	+400 °C	±0.9 °C
	-200 °C to	-150 °C	±1.2 °C
Type E	-200 °C to	+1000 °C	±1.2 °C
	-230 °C to	-200 °C	±1.5 °C
Type J	-150 °C to	+1200 °C	±1.4 °C
	-210 °C to	-150 °C	±1.7 °C
Type L	-150 °C to	+900 °C	±1.5 °C
	-200 °C to	-150 °C	±1.8 °C
Type K	-200 °C to	+1372 °C	±2.1 °C
	-230 °C to	-200 °C	±2.9 °C
Type N	-200 °C to	+1300 °C	±2.2 °C
	-230 °C to	-200 °C	±3.0 °C
Type R	+100 °C to	+1769 °C	±1.5 °C
	-50 °C to	+100 °C	±1.8 °C
Type S	+100 °C to	+1769 °C	±1.7 °C
	-50 °C to	+100 °C	±2.0 °C
Type B [4])	+200 °C to	+1820 °C	±2.3 °C
	+45 °C	+200 °C	±2.5 °C
Type C	+100 °C to	+2315 °C	±2.3 °C
	0 °C	+100 °C	±2.5 °C
Basic error (operational limit at 25°C, referred to input range)			
● Thermocouple			
Type T	-200 °C to	+400 °C	±0.2 °C
	-230 °C to	-200 °C	±0.5 °C
Type U	-150 °C to	+400 °C	±0.2 °C
	-200 °C to	-150 °C	±0.5 °C
Type E	-200 °C to	+1000 °C	±0.2 °C
	-230 °C to	-200 °C	±0.5 °C
Type J	-150 °C to	+1200 °C	±0.2 °C
	-210 °C to	-150 °C	±0.5 °C
Type L	-150 °C to	+900 °C	±0.2 °C
	-200 °C to	-150 °C	±0.5 °C
Type K	-200 °C to	+1372 °C	±0.2 °C
	-230 °C to	-200 °C	±1.0 °C
Type N	-200 °C to	+1300 °C	±0.2 °C
	-230 °C to	-200 °C	±1.0 °C
Type R	+100 °C to	+1769 °C	±0.2 °C
	-50 °C to	+100 °C	±0.5 °C
Type S	+100 °C to	+1769 °C	±0.2 °C
	-50 °C to	+100 °C	±0.5 °C
Type B [4])	+200 °C to	+1820 °C	±0.3 °C
	+45 °C to	+200 °C	±0.5 °C
Type C	+100 °C to	+2315 °C	±0.3 °C
	0 °C	+100 °C	±0.5 °C

Temperature error (with reference to the input range)	±0.005%/K
Linearity error (with reference to the input range)	± 0.02%
Repeat accuracy (in the steady state at 25 °C, referred to the output range 3)	±0.01%
Status, interrupts, diagnostics	
Interrupts	
• Hardware interrupt	Programmable (channels 0 to 7)
• Diagnostic interrupt	Programmable
Diagnostic functions	Programmable
• Group error display	Red LED (SF)
• Diagnostics information read-out	Possible

Data for Selecting a Sensor	
Input ranges (rated values)/ input resistance	
• Thermocouples	Type B, C, N, E, R, S, J, L, T, K, U
Maximum input voltage for voltage input (destruction limit)	20 VDC continuous; 75 VDC for max. 1 s (duty factor 1:20)
Characteristic linearization	Programmable
Temperature compensation	Programmable
• Internal temperature compensation	Possible
• External temperature compensation with Pt 100	Possible
• Compensation for 0°C comparison point temperature	Possible
• Compensation for 50°C comparison point temperature	Possible
• Technical unit for temperature measurement	Degrees Celsius/ degrees Fahrenheit

1) Open-circuit monitoring in 4 channels, Hardware operating mode is performed every 3 seconds.

2) Series-mode rejection in 8 channels, software mode is reduced as follows:

50 Hz > 70 dB

60 Hz > 70 dB

400 Hz > 80 dB

3) The operational limit comprises only the basic error of the analog input at Ta = 25 °C and the total temperature error. The total error must cover the error for the compensation of the cold connection point. Internal compensation of the cold connection point = max. 1.5 °C
External compensation of the cold connection point = accuracy of the used external RTD is +0.1 °C
External compensation of the cold connection point, where the connection point is held at 0 °C or 50 °C = accuracy of the connection point temperature control.

4) Because of the slight rise over the range of approx. 0 °C to 85 °C, the lack of compensation of the comparison point temperature only has a negligible effect on a type B thermocouple. If there is no compensation and the measuring method "Compensation to 0 °C" is set, the deviation in the type B thermocouple duringtemperature measurement is: 200 °C to 1802 °C <0.5 °C

4.24.1   Commissioning the SM 331; AI 8 x TC

You set the mode of operation of the SM 331; AI 8 x TC bits in *STEP 7.*

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in Section 4.7.

Parameterization restrictions when using the analog input module SM 331; AI 8 x TC with PROFIBUS masters that only support DPV0.

When you use the analog input module SM 331; AI 8 x TC in an ET 200M PROFIBUS slave system with a PROFIBUS master which is not an S7 master, certain parameters are not permitted. Masters that are not S7 masters do not support hardware interrupts. So all the parameters associated with these functions are deactivated. The deactivated parameters are hardware interrupt enable, hardware restrictions and end-of-scan-cycle interrupt enable. All the other parameters are permitted.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 4-73   Parameters of the SM 331; AI 8 x TC

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Enable • Diagnostic interrupt • Hardware interrupt upon limit violation • Hardware interrupt at end of cycle	Yes/no Yes/no Yes/no	No No No	Dynamic	Module
Trigger for hardware interrupt • Upper limit value • Lower limit value	32511 to –32512 –32512 to 32511	32767 -32768	Dynamic	Channel
Diagnostics • Group diagnostics • With wire-break check	Yes/no Yes/no	No No	Static	Channel group

Table 4-73   Parameters of the SM 331; AI 8 x TC, continued

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Measurement • Measuring Method	Deactivated TC-IL Thermocouple (linear, internal comparison) TC-EL Thermocouple (linear, external comparison) TC-L00C Thermocouple (linear, ref. temperature 0°C) TC-L50C Thermocouple (linear, ref. temperature 50°C)	TC-IL	Dynamic	Channel group
• Measuring Range	For the settable measuring ranges of the input channels, please refer to the individual module description.	Type K		
• Reaction to open thermocouple	Overflow; underflow	Overflow		
• Temperature unit	Degrees Celsius; degrees Fahrenheit	Degrees Celsius	Dynamic	Module
• Module filtering mode	8 channels hardware filter 8 channels software filter 4 channels hardware filter	8 channels, hardware filter	Dynamic	Module
• Interference suppression*	50/60/400 Hz; 400 Hz; 60 Hz; 50 Hz;	50/60/400 Hz	Dynamic	Channel group
• Smoothing	None Low Average High	None	Dynamic	Channel group

*   50/60/400 Hz programmable only for modes 8 or 4-Channel Hardware Filter Modes;
    50 Hz, 60 Hz or 400 Hz programmable only for mode 8-Channel Hardware Filter Mode

Channel groups

The channels of the SM 331; AI 8 x TC are arranged in four groups of two. You can only ever assign parameters to one channel group.

The table below shows which channels are parameterized as a channel group in each case. You will need the channel group number to set the parameters in the user program with an SFC.

Table 4-74   Assignment of Channels of the SM 331; AI 8 x TC to Channel Groups

Channels ...	... form one Channel Group each
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

Special characteristic of channel groups for hardware interrupts upon limit violation

You can set the upper and lower limits for each channel with hardware interrupts in *STEP 7*.

Module filtering mode

The SM 331; AI 8 x TC operates in one of the following modes:

- "Hardware filter, 8 channels"
- "Software filter, 8 channels"
- "Hardware filter, 4 channels"

The operating mode affects the scan time of the module.

"Hardware filter 8 channels" mode

In 8-channel hardware filter mode, the analog input module SM331; AI 8 x TC switches over between the two channels in each group. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6. Once the even-numbered channels have been converted all the ADCs simultaneously convert for the odd-numbered channels 1, 3, 5 and 7 (see Figure 4-35).

Figure 4-46   Hardware filter 8 channels scan time

Scan time in the mode

In 8-channel hardware filter mode, the channel conversion time including the communication time of analog input module SM331; AI 8 x TC is 91 ms. The module must then be switched over to the other channel in the group by means of opto-MOS relays. Opto-MOS relays need 7 ms to switch and settle. Each channel needs a time of 98 ms, so that the scan time is exactly 196 ms.

Scan time = $(t_K + t_U)$ x 2

Scan time = (91 ms + 7 ms) x 2

Scan time = <u>196 ms</u>

t_K: channel conversion time for one channel
t_U: time for switching to the other channel in the channel group

"Software filter 8 channels" mode

In 8-channel software filter mode, the analog input module SM331; AI 8 x TC switches over between the two channels in each group. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6. Once the even-numbered channels have been converted all the ADCs simultaneously convert for the odd-numbered channels 1, 3, 5 and 7 (see Figure 4-47).

```
┌─────────────────────────────────────────────────────────┐
│   ┌─────────────────────────────────────┐                │
│   │                                  ↓  │                │
│   │   ┌─────────────────────────────┐   ╮               │
│   │   │ Start analog conversion     │   │               │
│   │   │ (simultaneous)              │   │               │
│   │   ├──────┬──────┬──────┬──────┤   │               │
│   │   │  K0  │  K2  │  K4  │  K6  │   │               │
│   │   └──────┴──────┴──────┴──────┘   ├─ Scan time     │
│   │              ↓                      │               │
│   │   ┌─────────────────────────────┐   │               │
│   │   │ Start analog conversion     │   │               │
│   │   │ (simultaneous)              │   │               │
│   │   ├──────┬──────┬──────┬──────┤   │               │
│   │   │  K1  │  K3  │  K5  │  K7  │   ╯               │
│   └───┴──────┴──────┴──────┴──────┘                    │
└─────────────────────────────────────────────────────────┘
```

Figure 4-47   Software filter 8 channels scan time

Scan time of the module

In the 8-channel software filter mode of analog input module SM331; AI 8 x TC, the channel conversion time is guided by the interference frequency set. When you set an interference frequency of 50 Hz, the channel conversion time including communication time is 76 ms. When you set an interference frequency of 60 Hz, the channel conversion time is 65 ms. When you set an interference frequency of 400 Hz, the channel conversion time is reduced to 16 ms. As with 8-channel hardware filter mode, the module must be switched over by means of opto MOS relays with a switchover time of 7 ms to the other channel of the group. Table 4-75 shows the scan time of the module at a certain interference frequency.

Table 4-75   Scan Times in "Software Filter, 8 Channels" Mode

Programmed Interference Frequency Suppression	Channel Scan Time*	Module Scan Time (All Channels)
50 Hz	83 ms	**166 ms**
60 Hz	72 ms	**144 ms**
400 Hz	23 ms	**46 ms**

*   Channel scan time = channel conversion time + 7 ms switching time to the other channel in the channel group

"Hardware filter 4 channels" mode

In 4-channel hardware filter mode, the analog input module SM331; AI 8 x TC does not switch over between the channels of the individual groups. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6.

Figure 4-48   Hardware filter 4 channels scan time

Scan time of the module

In 4-channel hardware filter mode, the channel conversion time including the communication time of analog input module SM331; AI 8 x TC is 10 ms. As the module does not switch over between the channels in a group, the channel scan time and the module scan time are the same: 10 ms.

Channel conversion time = channel scan time = module scan time = **<u>10 ms</u>**

Prolongation of the scan time with a wire-break check

The wire-break check is a software function of the module that is available in all operating modes.

In the 8-Channel Hardware and Software Filter operating mode prolongs the scan time of the module by 4 ms, irrespective of the number of channels for which wire-break has been enabled.

In the 4-Channel Hardware Filter operating mode, the module interrupts processing of the input data 170 ms and performs a wire-break check. In other words, each wire-break check prolongs the scan time of the module by 93 ms.

Smoothing of the measured values

You fill find information that is generally applicable to the smoothing of analog values in Section 4.6.

Special characteristic with short-circuit to M or L

If you short an input channel to M or L, the module does not suffer any damage. The channel continues to issue valid data; neither is a diagnosis reported.

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4-46, on page 4-72.

4.24.2 Measuring Methods and Measuring Ranges of the SM 331; AI 8 x TC

Measuring Methods

You can set the following measuring methods for the input channels:

- Thermocouple, linearization with reference temperature 0 °C
- Thermocouple, linearization with reference temperature 50 °C
- Thermocouples, linearization with internal comparison
- Thermocouple, linearization with external comparison

You perform the setting with the "measuring method" parameter in *STEP 7*.

Unused Channels

Set the "measuring method" parameter for unused channels to "disabled". In this way you shorten the scan time of the module.

You must terminate an unused channel in an enabled channel group to avoid diagnostic errors for the unused channel. To do this, short the Plus input and Minus input of the channel.

In the "4-Channel Hardware Filter" operating mode, termination is not necessary provided that you have disabled the unused channel groups. Channels 1, 3, 5 and 7 are not monitored in this mode.

Measuring ranges

You perform setting of the measuring ranges with the "measuring range" parameter in *STEP 7*.

Table 4-76   Measuring Ranges of the SM331; AI 8 x TC

Method Selected	Measuring Range	Description
TC-L00C: (thermocouple, linear, reference temperature 0 °C) TC-L50C: (thermocouple, linear, reference temperature 50 °C) TC-IL: (thermocouple, linear, internal compensation) TC-EL: (thermocouple, linear, external compensation)	Type B Type C Type E Type J Type K Type L Type N Type R Type S Type T Type U	You will find the digitized analog values in Section 4.3.1 in the temperature range

Special characteristic of parameter assignment to upper and lower limit values

The programmable limit values (triggers for hardware interrupt) differ for the AI 8 x TC from the range of values shown in Table 4-73.

The reason for this is that numerical methods in the module software for evaluating the process variables prevent values up to 32511 from being reported in some cases. The process input value at which a hardware interrupt for an underflow or overflow occurs depends on the calibration factors for an individual channel and can vary between the lower limits shown in the Table below and 32511 ($7EFF_H$).

Limit values should not be set at values higher than the minimum potential limit values shown in the tables below.

Table 4-77   Minimum Possible Upper and Lower Limit Values of SM 331; AI 8 x TC in °C

Thermo-couple	Minimum Possible Upper Limit Value			Minimum Possible Lower Limit Value		
	in °C	Dec.	Hex.	in °C	Dec.	Hex.
Type B	1820.1	18201	$471A_H$	0	0	0
Type C	---	---	---	---	---	---
Type E	---	---	---	---	---	---
Type J	1200.1	12001	$2EE1_H$	<-210.0	<-2100	
Type K	1372.1	13721	3599_H	<-270.0	<-2700	
Type L	900.1	9001	2329_H	<-200.0	<-2000	< F830H
Type N	---	---	---	---	---	---
Type R, S	1769.1	1769.1	$451B_H$	-50.1	-501	$FE0B_H$
Type T	400.1	4001	$0FA1_H$	<-270.0	<-2700	
Type U	600.1	6001	1771_H	<-200.0	<-2000	< F830H

Table 4-78 Minimum Possible Upper and Lower Limit Values of SM 331; AI 8 x TC in °F

Thermo-couple	Minimum Possible Upper Limit Value			Minimum Possible Lower Limit Value		
	in °F	Dec.	Hex.	in °F	Dec.	Hex.
Type B	2786.6	27866	6CDA$_H$	0	0	0
Type C	---	---	---	---	---	---
Type E	---	---	--	---	---	--
Type J	2192.2	21922	55A2$_H$	<-346.0	<-3460	
Type K	2501.8	25018	61BA$_H$	<454.0	<-4540	<EE44H
Type L	1652.2	16522	408A$_H$	<-328.0	<-3280	F330H
Type N	---	---	---	---	---	---
Type R, S	3216.4	3216.4	7DA4$_H$	-58.2	-582	FDBA$_H$
Type T	752.2	7522	1062$_H$	<454.0	<-4540	<EE44H
Type U	1112.2	11122	2B72$_H$	<-328.0	<-3280	

End-of-scan-cycle interrupt

By enabling the end-of-scan-cycle interrupt, you can synchronize a process with the conversion cycle of the module. The interrupt occurs when the conversion of all the enabled channels is complete.

Table 4-79 Content of the 4 bytes with additional information from OB40 during a hardware interrupt or an end-of-scan-cycle interrupt

Content of the 4 bytes with additional information		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Byte
Analog special markers	2 bits per channel to identify the range									
	Upper limit exceeded in channel	7	6	5	4	3	2	1	0	0
	Lower limit exceeded in channel	7	6	5	4	3	2	1	0	1
	End-of-scan-cycle event						X			2
	Unassigned byte									3

4.25 Analog Input Module SM 331; AI 2 x 12 bits; (6ES7331-7KB02-0AB0)

Order number: "Standard module"

6ES7331-7KB02-0AB0

Order number: "SIPLUS S7-300-Module"

6AG1 331-7KB02-2AB0

Characteristics

The analog input module SM 331; AI 2 x 12 bits has the following characteristic features:

- Two inputs in one channel group
- Measured-value resolution (depending on the integration time set)
    - 9 bits + sign
    - 12 bits + sign
    - 14 bits + sign
- Measuring method selectable per channel group:
    - Voltage
    - Current
    - Resistors
    - Temperature
- Arbitrary measuring range selection per channel group
- Programmable diagnostics
- Programmable diagnostic interrupt
- One channel with limit monitoring
- Programmable hardware interrupt when limit has been exceeded
- Isolated against the backplane bus interface
- Isolated against load voltage (except when at least one coding key is inserted in position D)

Resolution

The resolution of the measured value is a direct function of the integration time selected. In other words the longer the integration time for an analog input channel, the more accurate the resolution of the measured value will be (see Technical Specifications of the module and Table 4-6 on page 4-10).

Terminal Connection Diagram and Block Diagram of the SM 331; AI 2 x 12 bits
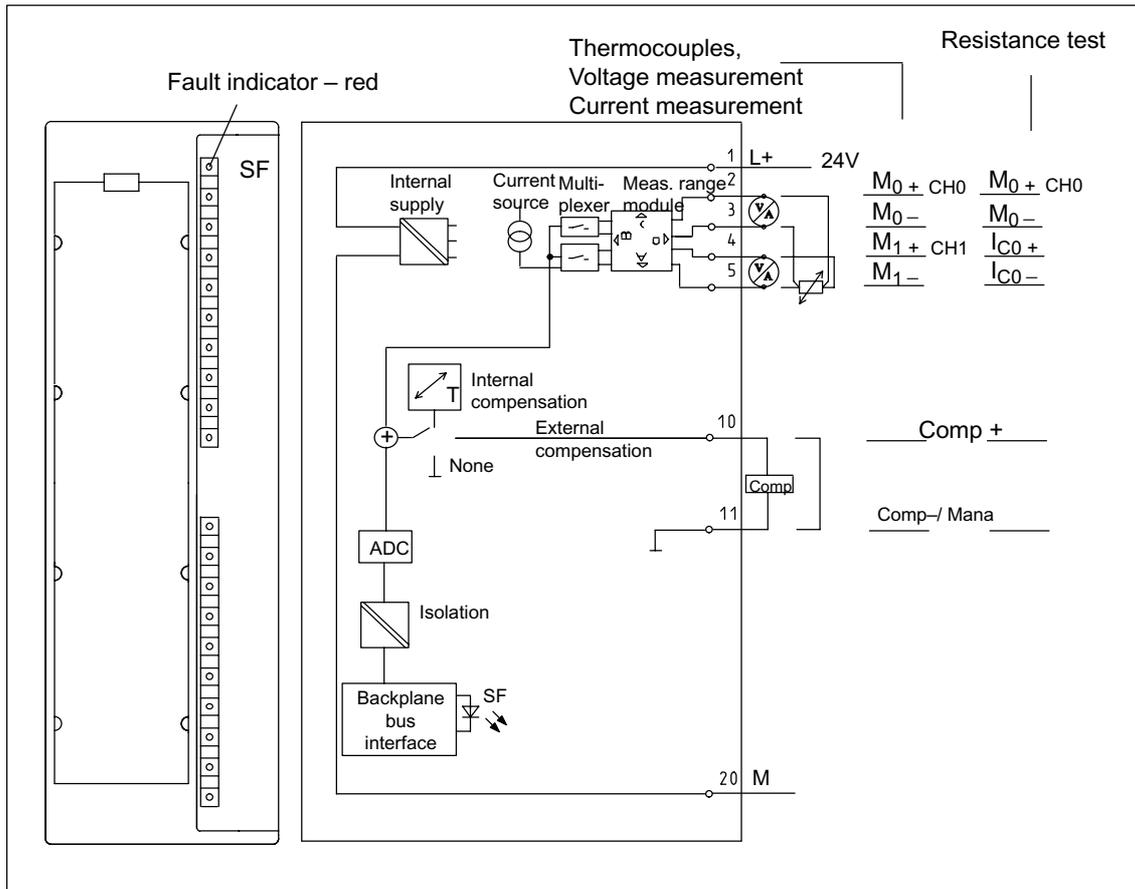
Figure 4-49   Module View and Block Diagram of the Analog Input Module SM 331; AI 2 x 12 bits

The input resistances depend on the measuring range selected (refer to the technical specifications for the module).

Technical specifications of the SM 331; AI 2 x 12 bits

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 250 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	2
• For resistance-type sensor	1
Length of cable	max. 200 m
• Shielded	max. 50 m at 80 mV and thermocouples
Voltages, Currents, Potentials	
Rated supply voltage of the electronics L +	24 VDC
• Reverse polarity protection	Yes
Power supply of the transmitters	
• Supply current	max. 60 mA (per channel)
• Short-circuit-proof	Yes
Constant current for resistance-type sensor	typ. 1.67 mA
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
– Not for 2-wire transmitter	
Permitted potential difference	2.5 VDC
• Between inputs and M_{ANA} (U_{CM})	
– At signal = 0 V	
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 50 mA
• From the backplane bus L +	max. 30 mA (without two-wire transmitter)
Power dissipation of the module	typ. 1.3 W

Analog value generation				
Measuring principle	Integrating			
Integration time/conversion time/ resolution (per channel)				
• Parameters can be assigned	Yes			
• Integration time in milliseconds	2.5	$16^2/_3$	20	100
• Basic conversion time including Integration time in milliseconds	6	34	44	204
Additional conversion time for measuring resistance, in ms or	1	1	1	1
Additional conversion time for open-circuit monitoring, in ms or	10	10	10	10
Additional conversion time for measuring resistance **and** open-circuit monitoring, in ms	16	16	16	16
• Resolution in bits (incl. overrange)	9 bits	12 bits	12 bits	14 bits
• Noise suppression for frequency f1 in Hz	400	60	50	10
• Basic response time of module, in ms (all channels enabled)	6	34	44	204
Smoothing of the measured values	None			

Suppression of interference, Limits of Error		
Noise suppression for f = n $\times$ (f1 $\pm$ 1 %), (f1 = interference frequency) n=1.2...		
• Common-mode interference (U_{CM} < 2.5 V)	> 70 dB	
• Series-mode noise (peak value of noise < nominal value of input range)	> 40 dB	
Crosstalk between the inputs	> 50 dB	
Operational limit (in the entire temperature range, with reference to the input range)		
• Voltage input	80 mV	$\pm$ 1 %
	250 to 1000 mV	$\pm$ 0.6 %
	2.5 to 10 V	$\pm$ 0.8 %
• Current input	3.2 to 20 mA	$\pm$ 0.7 %
• Resistors	150Ω; 300Ω; 600 Ω	$\pm$ 0, 7 %
• Thermocouple	Type E, N, J, K, L	$\pm$ 1, 1 %
• Resistance thermometer	Pt 100/ Ni 100	$\pm$ 0, 7 %
	Pt 100 climate	$\pm$ 0, 8 %
Basic error (operational limit at 25 °C referred to input range)		
• Voltage input	80 mV	$\pm$ 0.6 %
	250 to 1000 mV	$\pm$ 0.4 %
	2.5 to 10 V	$\pm$ 0.6 %
• Current input	3.2 to 20 mA	$\pm$ 0.5 %
• Resistors	150Ω; 300Ω; 600 Ω	$\pm$ 0.5 %
• Thermocouple	Type E, N, J, K, L	$\pm$ 0.7 %
• Resistance thermometer	Pt 100/ Ni 100	$\pm$ 0.5 %
	Pt 100 climate	$\pm$ 0.6 %
Temperature error (with reference to the input range)	$\pm$ 0.005 %/K	
Linearity error (with reference to the input range)	$\pm$ 0.05 %	
Repeatability (in steady state at 25 °C referred to input range)	$\pm$ 0.05 %	
Temperature error of internal compensation	$\pm$ 1 %	

Status, Interrupts, Diagnostics		
Interrupts		
• Hardware interrupt when limit has been exceeded	Programmable channel 0	
• Diagnostic interrupt	Programmable	
Diagnostic functions	Programmable	
• Group error display	Red LED (SF)	
• Diagnostics information read-out	Possible	

Data for Selecting a Sensor		
Input range (rated values)/Input resistance		
• Voltage	$\pm$ 80 mV	/10 MΩ
	$\pm$ 250 mV	/10 MΩ
	$\pm$ 500 mV	/10 MΩ
	$\pm$ 1000 mV	/10 MΩ
	$\pm$ 2.5 V	/100kΩ
	$\pm$ 5 V	/100kΩ
	1 to 5 V;	/100kΩ
	$\pm$ 10 V	/100kΩ
• Current	$\pm$ 3.2 mA	/25 Ω
	$\pm$ 10 mA	/25 Ω
	$\pm$ 20 mA	/25 Ω
	0 to 20 mA;	/25 Ω
	4 to 20 mA:	/25 Ω
• Resistors	150 Ω	/10 MΩ
	300 Ω	/10 MΩ
	600 Ω	/10 MΩ
• Thermocouples	Type E, N, J, K, L	/10 MΩ
• Resistance thermometer	Pt 100, Ni 100	/10 MΩ
Maximum input voltage for voltage input (destruction limit)	max. 20 V continuous; 75 V for max. 1 s (duty factor 1:20)	
Maximum input current for current input (destruction limit)	40 mA	

Connection of the sensor		Characteristic linearization	Parameters can be assigned
• For measuring voltage	Possible	• for thermocouples	
• For measuring current			Type E, N, J, K, L
As two-wire transmitter	Possible	• For RTD	Pt 100 (standard, climate range) Ni 100 (standard, climate range)
As four-wire transmitter	Possible	Temperature compensation	Parameters can be assigned
• For measuring resistance	Possible	• Internal temperature compensation	Possible
With two-conductor connection	Possible	• External temperature compensation with compensating box	Possible
With three-conductor connection	Possible	• Compensation for 0 °C comparison point temperature	Possible
With four-conductor connection		• Technical unit for temperature measurement	Degrees Celsius
• Load of the two-wire transmitter	max. 820 Ω		

4.25.1   Commissioning the SM 331; AI 2 x 12 bits

You set the mode of operation of the SM 331; AI 2 x 12 bits by means of a measuring range module on the module and in *STEP 7*.

Measuring range module

If necessary, the measuring range module must be replugged to change the measuring method and the measuring range. The steps you have to perform to do this are described in detail in Section 4.4.

The corresponding table in Section 4.25.2 tells you which assignment you have to select for which measuring method and measuring range. In addition, the necessary settings are embossed on the module.

Default settings for measuring range module

The measuring range module is preset to "B" (voltage; ± 10 V) when the module is supplied.

To use the following preset measuring methods and measuring ranges, you only have to change the measuring range module to the corresponding setting. Parameter assignment in *STEP 7* is not necessary.

Table 4-80   Default Settings of the SM 331; AI 2 x 12 bits Using Measuring Range Module

Measuring Range Module Setting	Measuring Method	Measuring Range
A	Voltage	± 1000 mV
B	Voltage	± 10 V
C	Current, Four-wire transmitter	4 to 20 mA
D	Current, Two-wire transmitter	4 to 20 mA

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in Section 4.7.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 4-81   Parameters of the SM 331; AI 2 x 12 bits

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Enable • Diagnostic interrupt • Hardware interrupt upon limit violation	Yes/no Yes/no	No No	Dynamic	Module
Trigger for hardware interrupt • Upper limit value • Lower limit value	32511 to –32512 –32512 to 32511	–	Dynamic	Channel
Diagnostics • Group diagnostics • With wire-break check	Yes/no Yes/no	No No	Static	Channel group

Table 4-81   Parameters of the SM 331; AI 2 x 12 bits, continued

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Measurement • Measuring Method	Deactivated U Voltage 4DMU Current (4-wire transmitter) 2DMU Current (2-wire transmitter) R-4L Resistance (four-conductor connection) RTD-4L Bulb resistor (linear, four-conductor connection) TC-I Thermocouple (internal comparison) TC-E Thermocouple (external comparison) TC-IL Thermocouple (linear, internal comparison) TC-EL Thermocouple (linear, external comparison)	U	Dynamic	Channel or Channel group
• Measuring Range	Refer to Section 4.25.2 for the measuring ranges of the input channels that you can set.	± 10 V		
• Interference Suppression	400 Hz; 60 Hz; 50 Hz; 10 Hz	50 Hz		

Channel groups

The two channels of the analog input module SM 331; AI 2 x 12 bits are combined to a channel group. You can only ever assign parameters to the channel group.

The SM 331; AI 2 x 12 bits has a measuring range module for the channel group 0.

Special characteristic of channel groups with resistance measurement

If you use the resistance measurement method, the analog input module has only one channel. The "2nd" channel is used for current injection (I_C).

The measured value is obtained by accessing the "1st" channel. The "2nd" channel has the default carry value "$7FFF_H$".

Special characteristic of channel groups for hardware interrupts

You can set a hardware interrupt in *STEP 7* for the channel group. Note, however, that a hardware interrupt is set only for the first channel in the channel group in each case – in other words, for channel 0.

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4-46, on page 4-72.

4.25.2 Measuring Methods and Measuring Ranges of the SM 331; AI 2 x 12 bits

Measuring Methods

You can set the following measuring methods for the input channels:

- Voltage measurement
- Current measurement
- Resistance test
- Temperature measurement

You perform the setting by means of the measuring range module on the module and with the "measuring method" parameter in *STEP 7*.

Unused Channels

You must short-circuit unused channels and connect them to M_{ANA}. In this way, you obtain an optimum interference immunity for the analog input module. Set the "measuring method" parameter for unused channels to "disabled". In this way you shorten the scan time of the module.

If you do not use the COMP input, you must short-circuit it also.

Special characteristics of unused channels for some measuring ranges

Since configured inputs can remain unused because of the channel group generation, you must take note of the following special characteristics of these inputs to enable the diagnostic functions on the used channels.

- **Measuring range 1 to 5 V:** Connect the unused input in parallel with a used input of the same channel group.

- **Current measurement, 2-wire transmitter:**
  There are two ways to use the channels:

  a) Leave the unused input open and do not enable diagnostics for this channel group. Otherwise, if diagnostics are enabled, the analog module triggers a single diagnostic interrupt and the SF LED of the analog module comes on.

  b) Connect the unused input with a resistance of 1.5 to 3.3 kΩ You may then enable diagnostics for this channel group.

- **Current measurement 4 to 20 mA, 4-wire transmitter:** Connect the unused input in series with an input of the same channel group.

Measuring ranges

You perform the setting of the measuring ranges by means of the measuring range module on the module and with the "measuring method" parameter in *STEP 7*.

Table 4-82 Measuring Ranges of the SM 331; AI 2 x 12 bits

Method Selected	Measuring Range (Type of Sensor)	Measuring Range Module Setting	Description
U: Voltage	± 80 mV ± 250 mV ± 500 mV ± 1000 mV	A	You will find the digitized analog values in Section 4.3.1 in the voltage measuring range
	± 2.5 V ± 5 V 1 to 5 V ± 10 V	B	
TC-I: Thermocouple (internal compensation) (thermovoltage measurement)	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi] Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	A	You will find the digitized analog values in Section 4.3.1 in ± 80 mV the voltage measuring range
TC-E: Thermocouples (external compensation) (thermovoltage measurement)			
2DMU: Current (2-wire transmitter)	4 to 20 mA	D	You will find the digitized analog values in Section 4.3.1 in the current measuring range
4DMU: Current (4-wire transmitter)	± 3.2 mA ± 10 mA 0 to 20 mA 4 to 20 mA ± 20 mA	C	
R-4L: Resistors (four-conductor connection)	150 Ω 300 Ω 600 Ω	A	You will find the digitized analog values in Section 4.3.1 in the resistance measuring range
TC-IL: thermocouples (linear, internal compensation) (temperature measurement)	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi] Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	A	You will find the digitized analog values in Section 4.3.1 in the temperature range The characteristics are linearized: • Pt 100 to DIN IEC 751 • Ni 100 according to IEC DIN 43760 • Thermocouple to DIN 584, type L to DIN 43710.
TC-EL: Thermocouples (linear, external compensation) (temperature measurement)	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi] Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	A	
RTD-4L: Bulb resistor (linear, four-conductor connection) (temperature measurement)	Pt 100 climate Ni 100 climate Pt 100 standard Ni 100 standard	A	

Default Settings

The default settings of the module in *STEP 7* are the "voltage" measuring method and the "± 10 V" measuring range. You can use this combination of measuring method and measuring range without parameterizing the SM 331; AI 8 × 12 bits with *STEP 7*.

Wire-Break Check

The wire-break check is intended primarily for temperature measurements (thermocouples and bulb resistors.

Special characteristics of the wire-break check for the 4 to 20 mA measuring range

With a parameterized measuring range of 4 to 20 mA and **enabled wire-break check**, the analog input module enters wire-break in the diagnosis when a current falls below 3.6 mA.

If you have enabled diagnostics interrupt during configuration, the module additionally triggers a diagnostic interrupt.

If no diagnostic interrupt has been enabled, the illuminated SF LED is the only indication of the wire-break and you must evaluate the diagnostic bytes in the user program.

With a parameterized measuring range of 4 to 20 mA and **disabled wire-break check** and enabled diagnostic interrupt, the module triggers a diagnostic interrupt when the underflow is reached.

4.26 Analog Output Module SM 332; AO 8 x 12 bits; (6ES7332-5HF00-0AB0)

Order number

6ES7332-5HF00-0AB0

Characteristics

The analog input module SM 332; AO 8 x 12 bits has the following characteristic features

- 8 Output channels
- The individual output channels can be programmed as
  - Voltage outputs
  - Current outputs
- Resolution 12 bits
- Programmable diagnostics
- Programmable diagnostic interrupt
- Isolated against backplane bus interface and load voltage

Terminal connection and block diagram of analog output module SM 332; AO 8 x 12 bits
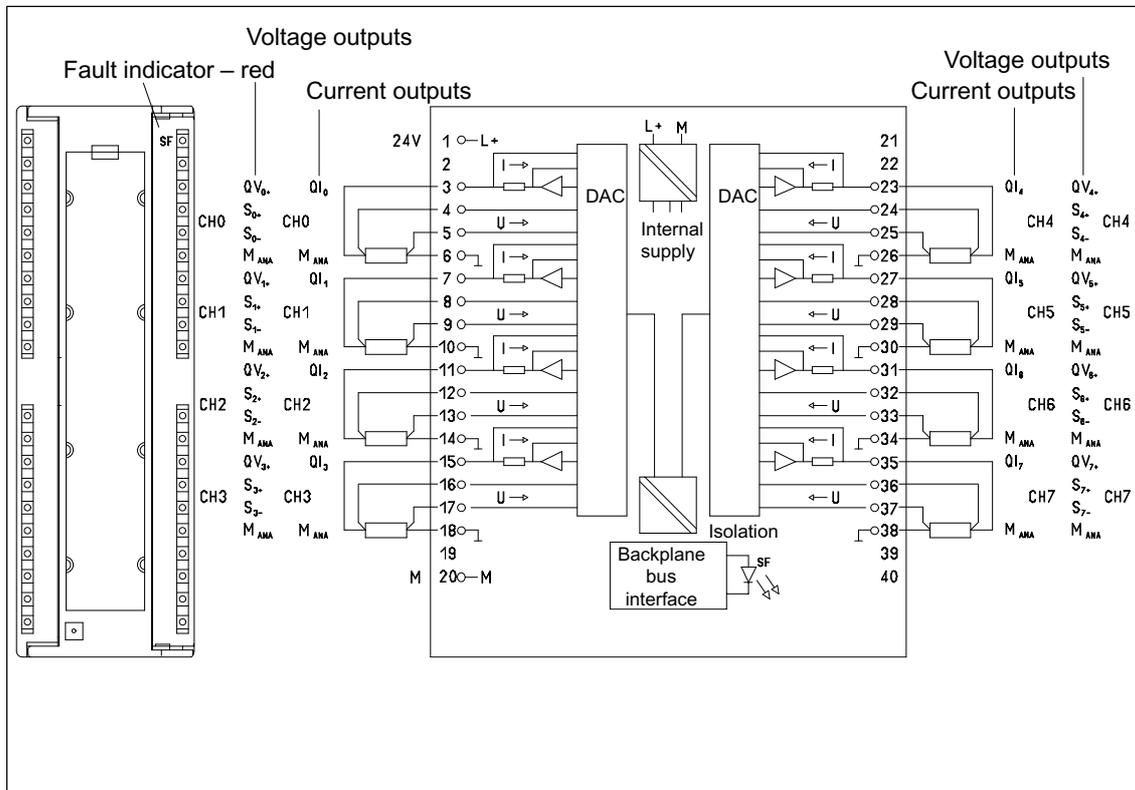
Figure 4-50   Module View and Block Diagram of the Analog Output Module SM 332; AO 8 × 12 bits

Technical specifications of the SM 332; AO 8 x 12 bits

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 272 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8
Length of cable	
• Shielded	max. 200 m
Voltages, Currents, Potentials	
Rated load voltage L+	24 VDC
• Reverse polarity protection	Yes
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
• Between the channels	No
• Between channels and load voltage L+	Yes
Permitted potential difference	
• Between S– and M_{ANA} (U_{CM})	3 VDC
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 100 mA
• From supply voltage L+ (no load)	max. 340 mA
Power dissipation of the module	typically 6.0 W

Analog value generation	
• Resolution including sign	
• ± 10 V; ± 20 mA; 4 to 20 mA; 1 to 5 V	11 bits + sign
• 0 to 10 V; 0 to 20 mA;	12 bits
• Conversion time (per channel)	max. 0.8 ms
Settling time	
• For resistive load	0.2 ms
• For capacitive load	3.3 ms
• For inductive load	0.5 ms (1 mH)
	3.3 ms (10 mH)
Suppression of interference, Limits of Error	
• Crosstalk between the outputs	> 40 dB
Operational limit (in the entire temperature range, with reference to the output range)	
• Voltage outputs	±0.5 %
• Current outputs	±0.6 %
Basic error (operational limit at 25 °C referred to the output range)	
• Output voltage	± 0.4 %
• Output current	± 0.5 %
• Temperature error (with reference to the output range)	±0.002 % /K
• Linearity error (with reference to the output range)	+ 0.05 %
• Repeat accuracy (in the steady state at 25°C, referred to the output range)	±0.05 %
• Output ripple; band width 0 to 50 kHz (with reference to the output range)	± 0.05 %

Status, interrupts, diagnostics	
Interrupts	
● Diagnostic Interrupt	Programmable
Diagnostic functions	Parameters can be assigned
● Group error display	
● Diagnostics information read-out	Red LED (SF) Possible
Data for Selecting an Actuator	
Output ranges (rated values)	
● Voltage	± 10 V 0 to 10 V 1 to 5 V
● Current	± 20 mA 0 to 20 mA 4 to 20 mA
Impedance (in the nominal output range)	
● For voltage outputs	min. 1 kΩ
– capacitive load	max. 1 μF
● For current outputs	max. 500 Ω
– At U_{CM} < 1 V	max. 600 Ω
– For inductive load	max. 10 mH

Voltage outputs	
● Short-circuit protection	Yes
● Short-circuit current	max. 25 mA
Current outputs	
● No-load voltage	max. 18 V
Destruction limit for voltages/currents connected from outside	
● Voltage at outputs to M_{ANA}	max. 18 V continuous; 75 V for max. 1 s (mark-to-space ratio 1:20)
● Current	max. 50 mA DC
Connection of actuators	
● For voltage output Four-conductor connection	Possible
● For current output Two-conductor connection	Possible

4.26.1   Commissioning the SM 332; AO 8 x 12 bits

Note

If the load voltage (L+) is switched off and on, this may result in incorrect output values at the output for approx. 10 ms.

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in Section 4.7.

You will find an overview of the programmable parameters and their default values in Table 4-42, on page 4-43.

Assigning parameters to channels

You can configure each output channel of the SM 332; AO 8 x 12 bits individually. You can thus assign separate parameters for each output channel.

When you set the parameters with SFCs in the user program, the parameters are assigned to channel groups. Every output channel of the SM 332; AO 8 x 12 bits is assigned to a channel group in this instance – in other words, for example output channel 0 = channel group 0.

Note

If you modify output ranges when the analog output module SM 332; AO 8 x 12 bits is in operation, incorrect intermediate values may arise across the output.

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4-47, on page 4-73.

4.26.2   Output Ranges of the Analog Output Module SM 332; AO 8 x 12 bits

Connecting the analog outputs

You can connect the outputs as voltage or current outputs, or disable them. You perform connection of the outputs with the "output type" parameter in *STEP 7*.

Unused Channels

So that unused output channels of the SM 332; AO 8 x 12 bits remain de-energized, you must set the "output type" parameter to "disabled" and leave the terminal open.

Output ranges

You program the output ranges for voltage and current outputs in *STEP 7*.

Table 4-83   Output Ranges of the Analog Output Module SM 332; AO 8 x 12 bits

Selected Type of Output	Output Range	Description
Voltage	1 to 5 V 0 to 10 V ± 10 V	You will find the digital analog values in Section 4.3.2 in the voltage and current output ranges
Current	From 0 to 20 mA From 4 to 20 mA ± 20 mA	

Default Settings

The default settings of the module are "Voltage" for the output type and "± 10 V" for the output range. You can use this combination of output type and output range without parameterizing the SM 332; AO 8 x 12 bits in *STEP 7*.

Wire-Break Check

The analog output module SM 332; AO 8 x 12 bits carries out a wire-break check only for current outputs.

Short-circuit test

The analog output module SM 332; AO 8 x 12 bits carries out a short-circuit test only for voltage outputs.

4.27 Analog output module SM 332; AO 4 x 16 bit; synchronous; (6ES7332-7ND01-0AB0)

Order number

6ES7332-7ND01-0AB0

Characteristics

The analog output module SM 332; AO 4 x 6 bits has the following characteristic features:

- 4 outputs in 4 channel groups

- The individual output channels can be programmed as

  - Voltage outputs

  - Current outputs

- Resolution of 16 bits

- Supports clocked operation

- Supports the "parameter changing during the RUN" function

- Programmable diagnostics

- Programmable diagnostic interrupt

- Programmable substitute value output

- Galvanic isolation between:

  - Backplane bus interface and analog output channel

  - The different analog output channels

  - Analog output and L+, M

  - Backplane bus interface and L+, M

Terminal connection and block diagram of analog output module SM 332; AO 4 x 16 bit
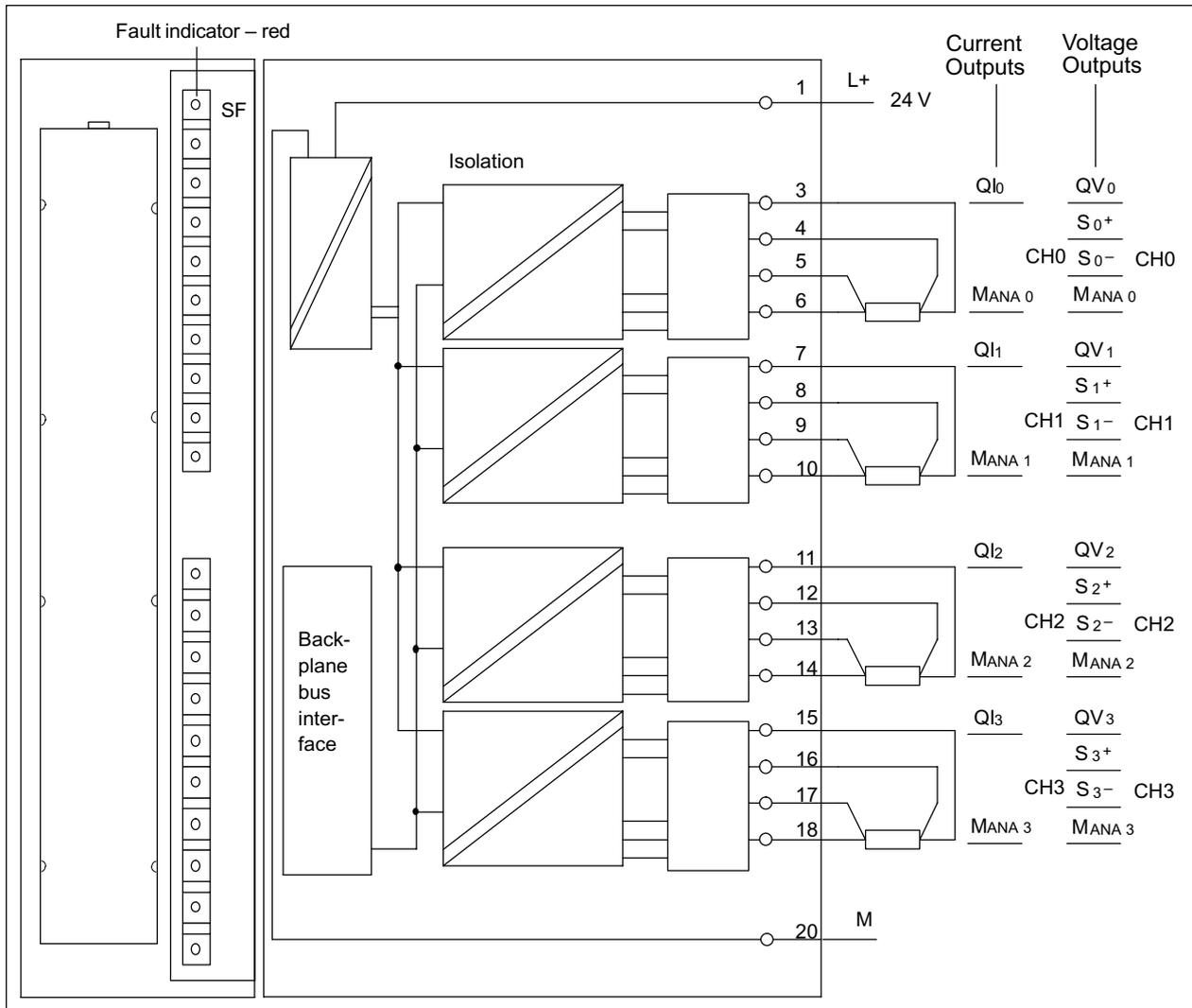
Figure 4-51   Module View and Block Diagram of the SM 332; AO 4 x 16 bits

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Note

Switching the rated load voltage (L+) off and on for approx. 10 ms can lead to incorrect intermediate values at the output.

Technical specifications of the SM 332; AO 4 x 16 bit

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 220 g

Data for Specific Module	
Supports clocked operation	Yes
Changing parameters during the RUN possible	Yes
• Behavior of the non parameterized outputs	outputs the last valid output value before the parameterization
Number of outputs	4
Length of cable	
• Shielded	max. 200 m

Voltages, Currents, and Potentials	
Rated load voltage L+	24 VDC
• Reverse polarity protection	Yes
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
• Between the channels	Yes
Permitted potential difference	
• Between the outputs (ECM)	200 VDC / 120 VAC
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	200 VDC / 120 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 100 mA
• From the load voltage L+ (no load)	max. 240 mA
Power dissipation of the module	typ. 3 W

Analog value generation	
Resolution (incl. sign)	
• ± 10 V	16 bits
• 0 to 10 V	15 bits
• 1 to 5 V	14 bits
• ± × 20 mA	15 bits

• 0 to 20 mAV	14 bits
• 4 to 20 mA	14 bits
Conversion time (per channel)	
• in standard operation	max. 0.8 ms
• in clocked operation	1.6 ms
Basic response time of module (independent of number of released channels)	
• in standard operation	3.2 ms
• in clocked operation	2.4 ms
Settling time	
• For resistive load	0.2 ms
• For capacitive load	3.3 ms
• For inductive load	0.5 ms (1 mH)
	3.3 ms (10 mH)

Suppression of interference, Limits of Error	
Crosstalk between outputs	> 100 dB
Operational limit (in the entire temperature range, with reference to the output range)	
• Voltage outputs	± 0.12%
• Current outputs	± 0.18%
Basic error (operational limit at 25° C, referred to output range)	
• Voltage outputs	
± × 10 V	± 0.02%
0 to 10 V	± 0.02%
1 to 5 V	± 0.04%
• Current outputs	
± × 20 mA	± 0.02%
0 to 20 mA;	± 0.02%
4 to 20 mA	± 0.04%
Temperature error (with reference to the output range)	
• Voltage outputs	± 0.0025% / K
• Current outputs	± 0.004% / K
Linearity error (with reference to the output range)	± 0.004%
Repeat accuracy (in the steady state at 25° C, referred to the output range)	± 0.002 %
Output ripple; band width 0 to 50 kHz (with reference to the output range)	± 0.05%

Status, interrupts, diagnostics	
Interrupts	
• Diagnostic interrupt	Programmable
Diagnostic functions	Programmable
• Group error display	Red LED (SF)
• Diagnostic information readable	Possible
Substitute value can be applied	Yes, programmable
Data for Selecting an Actuator	
Output ranges (rated values)	
• Voltage	±10 V 0 to 10 V 1 to 5 V
• Current	±20 mA 0 to 20 mA 4 to 20 mA
Load resistance (in the nominal range of the output)	
• For voltage outputs	min. 1 kΩ
– capacitive load	max. 1 µF
• For current outputs	max. 500 Ω
– Inductive load	max. 1 mH

Voltage outputs	
• Short-circuit protection	Yes
• Short-circuit current	max. 40 mA
Current outputs	
• No-load voltage	max. 18 V
Destruction limit against voltages/currents applied from outside	
• Voltage at outputs to M_{ANA}	max. 15 V continuous 75 VDC for no more than 0.1 s (pulse duty factor 1 : 20)
• Current	max. 50 mA DC
Connection of actuators	
• For voltage output	
– Four-conductor connection (measuring circuit)	Possible
• For current output	
– Two-conductor connection	Possible

4.27.1 Synchronicity

Characteristics

Reproducible (i.e. same length) reaction times are achieved with the SIMATIC with an equidistant DP bus cycle and the synchronization of the following free running single cycles:

- Free running of the user program. The length of the cycle time can vary due to acyclic program branching.

- Free running, variable DP cycle at the PROFIBUS subnetwork

- Free running cycle at the DP-Slave back plane bus.

- Free running cycle during the signal conditioning and conversion in the electronic modules of the DP-Slave.

In the case of equidistance the DP cycle runs in phase and with the same length. In this cycle the processing levels of a CPU (OB 61 to OB 64) and the synchronous peripheral are synchronized. The I/O data are therefore transferred at defined and consistent time intervals (clock synchronicity).

Requirements

- The DP-Master and DP-Slave must support the synchronicity. They require *STEP 7* from Version 5.2.

Module filtering mode: Synchronicity

In synchronous operation the following conditions apply:

Processing and activation time T_{WA} between reading the output value into the output buffer and loading it into the D/A converter for the output	1.6 ms
T_{DPmin}	2.4 ms
Diagnostic interrupt	max. 4 x T_{DP}

Calculation of the filter and processing time

Independent of the number parameterized channels the same time conditions are always valid.
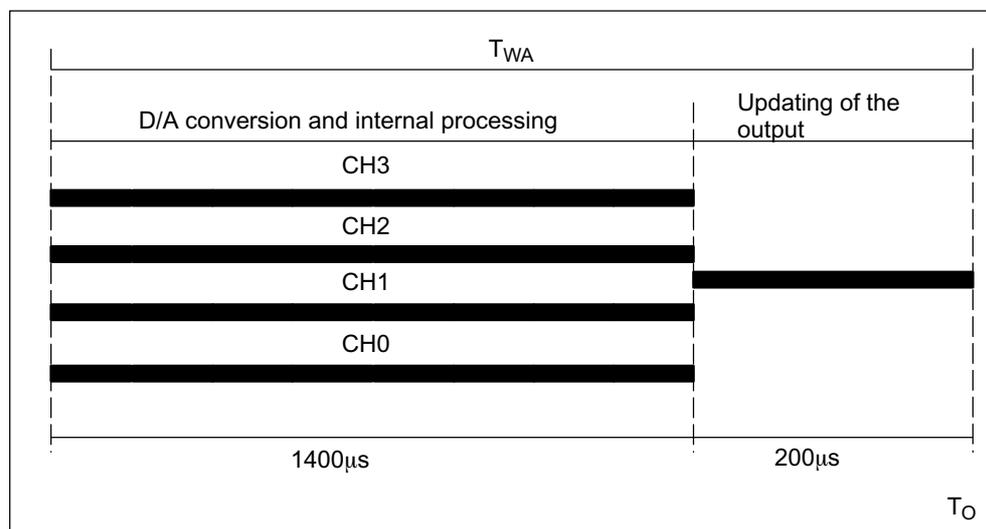
Figure 4-52   Calculation of the processing time and the time for updating the output

Explanation of the mode of operation in synchronous operation

During the time T_O - T_{WA}, the module reads the output data and saves the data internally. After the internal processing time of each channel the results are written in the individual D/A converters.

Further information

Further information on clock synchronicity can be found in the Online help of *STEP 7,* in the manual *Local Peripheral System ET 200M* and in the manual *Clock Synchronicity.*

4.27.2 Commissioning the SM 332; AO 4 x 16 bit

Note

When switching on and off the rated load voltage (L+), wrong intermediate values can occur across the output for approximately 10 ms.

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in the reference manual, section 4.7.

You will find an overview of the programmable parameters and their default values in Table 4-42 in the reference manual.

Assigning parameters to channels

You can configure each output channel of the SM 332; AO 4 x 16 bits individually. You can thus assign separate parameters for each output channel.

When you set the parameters with SFCs in the user program, the parameters are assigned to channel groups. Every output channel of the SM 332; AO 4 x 16 bits is assigned to a channel group in this instance – in other words, for example output channel 0 = channel group 0.

Note

If you modify output ranges when the analog output module SM 332; AO 4 x 16 bits is in operation, incorrect intermediate values may arise across the output.

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4-47 in the reference manual.

4.27.3 Output Ranges of the Analog Output Module SM 332; AO 4 x 16 bits

Connecting the analog outputs

You can connect the outputs as voltage or current outputs, or disable them. You perform connection of the outputs with the "output type" parameter in *STEP 7*.

Unused Channels

So that unused output channels of the SM 332; AO 4 x 16 bits remain de-energized, you must set the "output type" parameter to "disabled" and leave the terminal open.

Output ranges

You program the output ranges for voltage and current outputs in *STEP 7*.

Table 4-84   Output Ranges of the Analog Output Module SM 332;
AO 4 x 16 bits

Selected Type of Output	Output Range	Description
Voltage	1 to 5 V 0 to 10 V ± 10 V	You will find the digital analog values in section 4.3.2 in the reference manual in the voltage and current output ranges
Current	From 0 to 20 mA From 4 to 20 mA ± 20 mA	

Default Settings

The default settings of the module are "Voltage" for the output type and "± 10 V" for the output range. You can use this combination of output type and output range without parameterizing the SM 332; AO 4 x 16 bits in *STEP 7*.

Substitute values

You can configure the SM 332; AO 4 x 16 bits for the CPU operating mode STOP as follows: Outputs De-energized, Hold Last Value or Inject Substitute Values. If you inject substitute values, they must be within the output range.

4.28   Analog Output Module SM 332; AO 4 x 12 bits; (6ES7332-5HD01-0AB0)

Order number

6ES7332-5HD01-0AB0

Characteristics

The analog output module SM 332; AO 4 x 12 bits has the following characteristic features:

- 4 Output channels
- The individual output channels can be programmed as
  - Voltage outputs
  - Current outputs
- Resolution 12 bits
- Programmable diagnostics
- Programmable diagnostic interrupt
- Programmable substitute value output
- Isolated against backplane bus interface and load voltage

Terminal connection and block diagram of analog output module SM 332; AO 4 x 12 bits
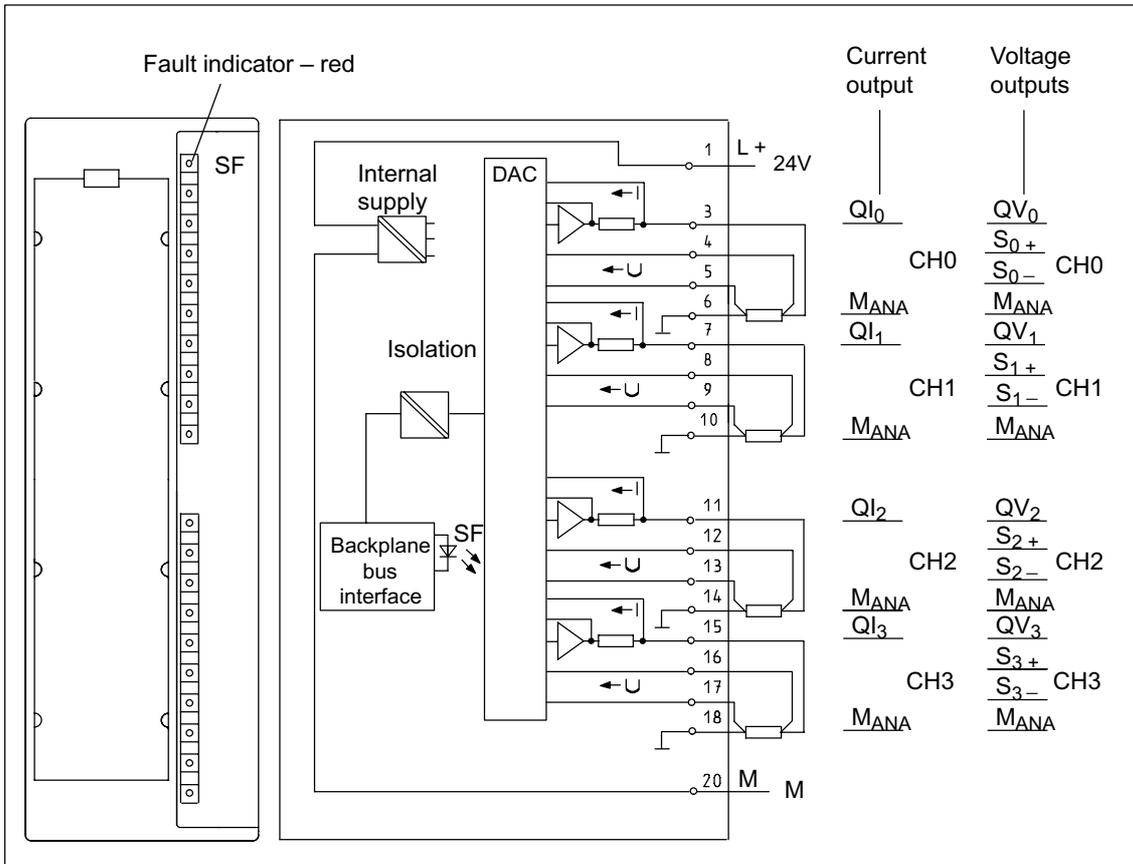
Figure 4-53   Module View and Block Diagram of the Analog Output Module SM 332; AO 4 x 12 bits

Technical specifications of the SM 332; AO 4 x 12 bits

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 220 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	4
Length of cable	
• Shielded	max. 200 m
Voltages, Currents, Potentials	
Rated load voltage L +	24 VDC
• Reverse polarity protection	Yes
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
• Between the channels	No
• Between channels and load voltage L+	Yes
Permitted potential difference	
• Between S– and M_{ANA} (U_{CM})	3 VDC
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 60 mA
• From the load voltage L+ (no load)	max. 240 mA
Power dissipation of the module	typ. 3 W

Analog value generation	
Resolution including sign	
• ± 10 V; ± 20 mA; 4 to 20 mA; 1 to 5 V	11 bits + sign
• 0 to 10 V; 0 to 20 mA	12 bits
Conversion time (per channel)	max. 0.8 ms
Settling time	
• For resistive load	0.2 ms
• For capacitive load	3.3 ms
• For inductive load	0.5 ms (1 mH)
	3.3 ms (10 mH)
Suppression of interference, Limits of Error	
Crosstalk between the outputs	> 40 dB
Operational limit (in the entire temperature range, with reference to the output range)	
• Voltage outputs	± 0.5 %
• Current outputs	± 0.6 %
Basic error (operational limit at 25° C, referred to output range)	
• Voltage outputs	± 0.4 %
• Current outputs	± 0.5 %
Temperature error (with reference to the output range)	± 0.002 %/K
Linearity error (with reference to the output range)	± 0.05 %
Repeatability (in steady state at 25 °C, referred to output range)	± 0.05 %
Output ripple; range 0 to 50 kHz (referred to output range)	± 0.05 %
Status, interrupts, diagnostics	
Interrupts	
• Diagnostic interrupt	Parameters can be assigned
Diagnostic functions	Programmable
• Group error display	Red LED (SF)
• Diagnostic information readable	Possible
Substitute value can be applied	Yes, programmable

Data for Selecting an Actuator	
Output ranges (rated values)	
• Voltage	±10 V 0 to 10 V 1 to 5 V
• Current	±20 mA 0 to 20 mA 4 to 20 mA
Load resistance (in the nominal range of the output)	
• For voltage outputs	min. 1 kΩ
– capacitive load	max. 1 µF
• For current outputs	max. 500 Ω
– At U_{CM}< 1V	max. 600 Ω
– Inductive load	max. 10 mH
Voltage outputs	
• Short-circuit protection	Yes
• Short-circuit current	max. 25 mA
Current outputs	
• No-load voltage	max. 18 V

Destruction limit against voltages/currents applied from outside	
• Voltage at outputs to M_{ANA}	max. 18 V continuous; 75 V for max. 1 s (duty factor 1:20)
• Current	max. 50 mA DC
Connection of actuators	
• For voltage output	
– Four-conductor connection (measuring circuit)	Possible
• For current output	
– Two-conductor connection	Possible

4.28.1   Commissioning the SM 332; AO 4 x 12 bits

Note

When switching on and off the rated load voltage (L+), wrong intermediate values can occur across the output for approximately 10 ms.

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in Section 4.7.

You will find an overview of the programmable parameters and their default values in Table 4-42, on page 4-43.

Assigning parameters to channels

You can configure each output channel of the SM 332; AO 4 x 12 bits individually. You can thus assign separate parameters for each output channel.

When you set the parameters with SFCs in the user program, the parameters are assigned to channel groups. Every output channel of the SM 332; AO 4 x 12 bits is assigned to a channel group in this instance – in other words, for example output channel 0 = channel group 0.

Note

If you modify output ranges when the analog output module SM 332; AO 4 x 12 bits is in operation, incorrect intermediate values may arise across the output.

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4-47, on page 4-73.

4.28.2 Output Ranges of the Analog Output Module SM 332; AO 4 x 12 bits

Connecting the analog outputs

You can connect the outputs as voltage or current outputs, or disable them. You perform connection of the outputs with the "output type" parameter in *STEP 7*.

Unused Channels

So that unused output channels of the SM 332; AO 4 x 12 bits remain de-energized, you must set the "output type" parameter to "disabled" and leave the terminal open.

Output ranges

You program the output ranges for voltage and current outputs in *STEP 7*.

Table 4-85   Output Ranges of the Analog Output Module SM 332; AO 4 x 12 bits

Selected Type of Output	Output Range	Description
Voltage	1 to 5 V 0 to 10 V ± 10 V	You will find the digital analog values in Section 4.3.2 in the voltage and current output ranges
Current	From 0 to 20 mA From 4 to 20 mA ± 20 mA	

Default Settings

The default settings of the module are "Voltage" for the output type and "± 10 V" for the output range. You can use this combination of output type and output range without parameterizing the SM 332; AO 4 x 12 bits in *STEP 7*.

Wire-Break Check

The analog output module SM 332; AO 4 x 12 bits carries out a wire-break check only for current outputs.

Short-circuit test

The analog output module SM 332; AO 4 x 12 bits carries out a short-circuit test only for voltage outputs.

Substitute values

You can configure the SM 332; AO 4 x 12 bits for the CPU operating mode STOP as follows: Outputs De-energized, Hold Last Value or Inject Substitute Values. If you inject substitute values, they must be within the output range.

Special characteristic of substitute values for output ranges 1 to 5 V and 4 to 20 mA

The following special characteristic applies to output ranges 1 to 5 V and 4 to 20 mA:

You have to set the substitute value $E500_H$ for the output to become de-energized (refer to Tables 4-35 and 4-37 on pages 4-26 and 4-27).

4.29 Analog Output Module SM 332; AO 2 x 12 bits; (6ES7332-5HB01-0AB0)

Order number: "Standard module"

6ES7332-5HB01-0AB0

Order number: "SIPLUS S7-300-Module"

6AG1 332-5HB01-2AB0

Characteristics

The analog output module SM 332; AO 2 x 12 bits has the following characteristic features:

- 2 Output channels
- The individual output channels can be programmed as
  - Voltage outputs
  - Current outputs
- Resolution 12 bits
- Programmable diagnostics
- Programmable diagnostic interrupt
- Programmable substitute value output
- Isolated against backplane bus interface and load voltage

Terminal connection diagram and block diagram of the SM 332; AO 2 x 12 bits
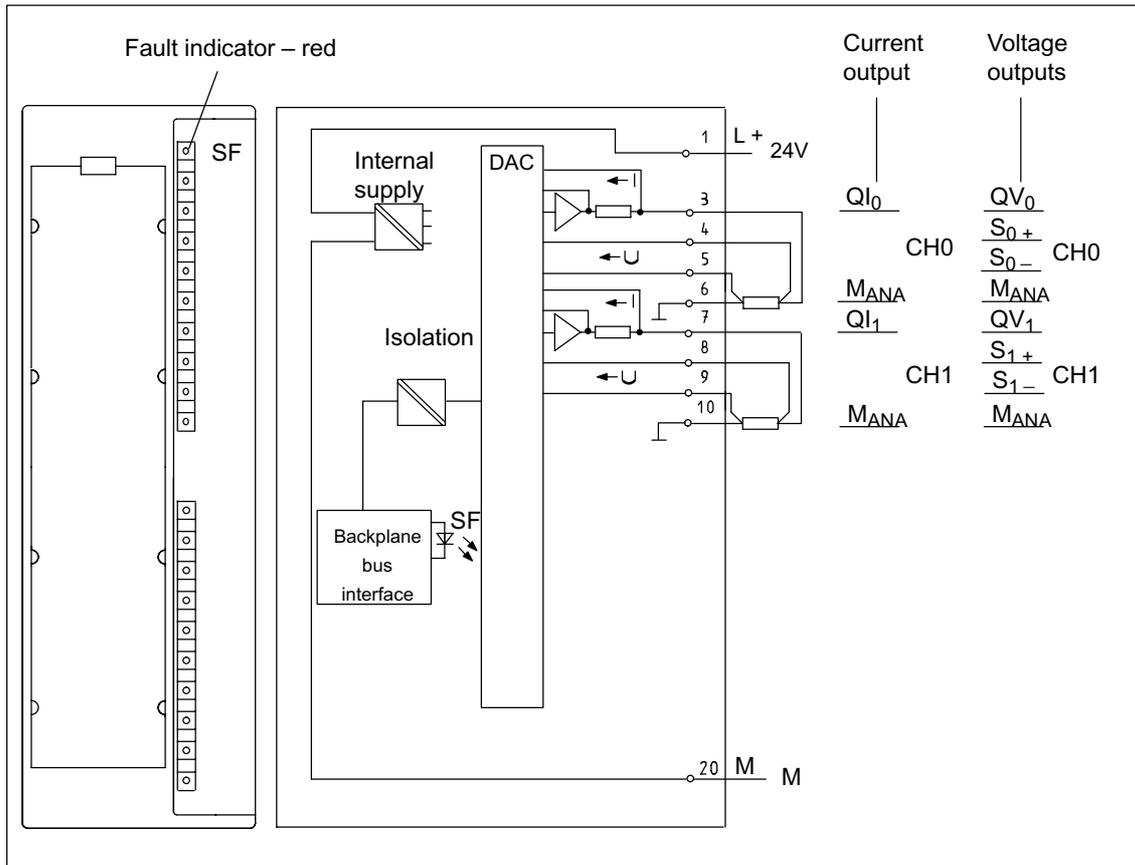
Figure 4-54   Module View and Block Diagram of the Analog Output Module SM 332; AO 2×12 bits

Technical specifications of the SM 332; AO 2 x 12 bits

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 220 g
Data for Specific Module	
Supports clocked operation	No
Number of outputs	2
Length of cable	
• Shielded	max. 200 m
Voltages, Currents, Potentials	
Rated load voltage L +	24 VDC
• Reverse polarity protection	Yes
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
• Between the channels	No
• Between channels and load voltage L+	Yes
Permitted potential difference	
• Between S– and M_{ANA} (U_{CM})	3 VDC
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 60 mA
• From the load voltage L+ (no load)	max. 135 mA
Power dissipation of the module	typ. 3 W

Analog value generation	
Resolution including sign	
• $\pm$ 10 V; $\pm$ 20 mA; 4 to 20 mA; 1 to 5 V	11 bits + sign
• 0 to 10 V; 0 to 20 mA	12 bits
Conversion time (per channel)	max. 0.8 ms
Settling time	
• For resistive load	0.2 ms
• For capacitive load	3.3 ms
• For inductive load	0.5 ms (1 mH)
	3.3 ms (10 mH)
Suppression of interference, Limits of Error	
Crosstalk between the outputs	> 40 dB
Operational limit (in the entire temperature range, with reference to the output range)	
• Voltage outputs	$\pm$ 0.5 %
• Current outputs	$\pm$ 0.6 %
Basic error (operational limit at 25° C, referred to output range)	
• Voltage outputs	$\pm$ 0.4 %
• Current outputs	$\pm$ 0.5 %
Temperature error (with reference to the output range)	$\pm$ 0.002 %/K
Linearity error (with reference to the output range)	$\pm$ 0.05 %
Repeatability (in steady state at 25 °C, referred to output range)	$\pm$ 0.05 %
Output ripple; range 0 to 50 kHz (referred to output range)	$\pm$ 0.05 %
Status, interrupts, diagnostics	
Interrupts	
• Diagnostic interrupt	Parameters can be assigned
Diagnostic functions	Programmable
• Group error display	Red LED (SF)
• Diagnostic information readable	Possible
Substitute value can be applied	Yes, programmable

Data for Selecting an Actuator	
Output ranges (rated values)	
• Voltage	±10 V 0 to 10 V 1 to 5 V
• Current	±20 mA 0 to 20 mA 4 to 20 mA
Load resistance (in the nominal range of the output)	
• For voltage outputs	min. 1 kΩ
– capacitive load	max. 1 μF
• For current outputs	max. 500 Ω
– At U_{CM}< 1V	max. 600 Ω
– Inductive load	max. 10 mH
Voltage outputs	
• Short-circuit protection	Yes
• Short-circuit current	max. 25 mA
Current outputs	
• No-load voltage	max. 18 V

Destruction limit against voltages/currents applied from outside	
• Voltage at outputs to M_{ANA}	max. 18 V continuous; 75 V for max. 1 s (duty factor 1:20)
• Current	max. 50 mA DC
Connection of actuators	
• For voltage output	
– Two-conductor connection	Possible
– Four-conductor connection (measuring circuit)	Possible
• For current output	
– Two-conductor connection	Possible

4.29.1   Commissioning the SM 332; AO 2 x 12 bits

Note

When switching on and off the rated load voltage (L+), wrong intermediate values can occur across the output for approximately 10 ms.

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in Section 4.7.

You will find an overview of the programmable parameters and their default values in Table 4-42, on page 4-43.

Assigning parameters to channels

You can configure each output channel of the SM 332; AO 2 x 12 bits individually. You can thus assign separate parameters for each output channel.

When you set the parameters with SFCs in the user program, the parameters are assigned to channel groups. Every output channel of the SM 332; AO 2 x 12 bits is assigned to a channel group in this instance – in other words, for example output channel 0 = channel group 0.

Note

If you modify output ranges when the analog output module SM 332; AO 2 $\times$ 12 bits is in operation, incorrect intermediate values can arise across the output.

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4-47, on page 4-73.

4.29.2 Output Ranges of the Analog Output Module SM 332; AO 2 x 12 bits

Connecting the analog outputs

You can connect the outputs as voltage or current outputs, or disable them. You perform connection of the outputs with the "output type" parameter in *STEP 7*.

Unused Channels

So that unused output channels of the SM 332; AO 2 x 12 bits remain de-energized, you must set the "output type" parameter to "disabled" and leave the terminal open.

Output ranges

You program the output ranges for voltage and current outputs in *STEP 7*.

Table 4-86   Output Ranges of the Analog Output Module SM 332; AO 2 x 12 bits

Selected Type of Output	Output Range	Description
Voltage	1 to 5 V 0 to 10 V $\pm$ 10 V	You will find the digital analog values in Section 4.3.2 in the voltage and current output ranges
Current	From 0 to 20 mA From 4 to 20 mA $\pm$ 20 mA	

Default Settings

The default settings of the module are "Voltage" for the output type and "$\pm$ 10 V" for the output range. You can use this combination of output type and output range without parameterizing the SM 332; AO 2 x 12 bits in *STEP 7*.

Wire-Break Check

The analog output module SM 332; AO 2 x 12 bits carries out a wire-break check only for current outputs.

Short-circuit test

The analog output module SM 332; AO 2 x 12 bits carries out a short-circuit check only for voltage outputs.

Substitute values

You can configure the SM 332; AO 2 x 12 bits for the CPU operating mode STOP as follows: Outputs De-energized, Hold Last Value or Inject Substitute Values. If you inject substitute values, they must be within the output range.

Special characteristic of substitute values for output ranges 1 to 5 V and 4 to 20 mA

The following special characteristic applies to output ranges 1 to 5 V and 4 to 20 mA:

You have to set the substitute value E500$_H$ for the output to remain de-energized (refer to Tables 4-35 and 4-37 on pages 4-26 and 4-27).

4.30 Analog Input/Output Module SM334; AI 4/AO 2 x 8/8 bits; (6ES7334-0CE01-0AA0)

Order number

6ES7334-0CE01-0AA0

Characteristics

The analog input/output module SM 334: AI 4/AO 2 x 8/8 bits has the following characteristic features:

- Four inputs, two outputs
- Resolution 8 bits
- Not parameterizable, setting of measurement and output type by means of wiring
- Measuring range of 0 to 10 V or 0 to 20 mA
- Output range of 0 to 10 V or 0 to 20 mA
- Both voltage and current output options
- Non-isolated against the backplane bus interface
- Isolated from load voltage

Module View and Block Diagram of the SM 334; AI 4/AO 2 x 8/8 bits

Select the measuring method of the input channels and the output type of the output channels via the wiring.
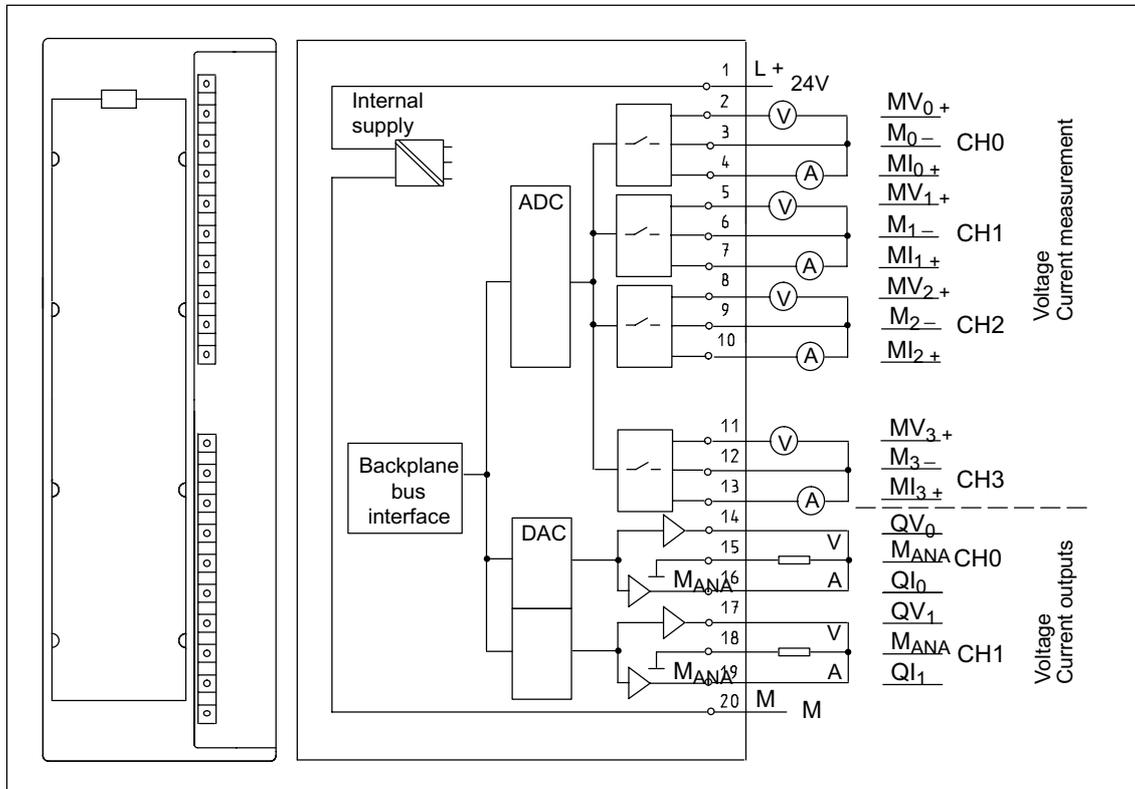
Figure 4-55   Module View and Block Diagram of the Analog Input/Output Module SM 334; AI 4/AO 2 x 8/8 bits

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Note

Note when connecting the SM 334 that:

- the **analog chassis ground M_{ANA} (terminal 15 or 18) is connected to the chassis ground M of the CPU and/or the interface module (IM)**. Use a wire with a minimum cross-section of 1 mm^2 for this.

  If there is no ground connection between M_{ANA} and M, the module switches off. Inputs are read with $7FFF_H$; outputs return a value of 0. If the module is run without a ground connection for some time, it may be destroyed.

- The **supply voltage for the CPU and/or the interface module (IM) must not be connected with reversed polarity**. Reverse polarity causes the destruction of the module because M_{ANA} is subjected to an unauthorized high potential (+24 V).

Technical specifications of the SM 334; AI 4/AO 2 x 8/8 bits

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 285 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	4
Number of outputs	2
Length of cable	
• Shielded	max. 200 m
Voltages, Currents, Potentials	
Rated load voltage L +	24 VDC
Power rated voltage of the rated electronics voltage and rated load voltage L+	24 VDC
Isolation	
• Between channels and backplane bus	No
• Between channels and power supply of the electronics	Yes
Between the channels	No
Permitted potential difference	
• Between inputs and M_{ANA} (U_{CM})	1 VDC
• Between the inputs (ECM)	1 VDC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 55 mA
• From power supply and load voltage L+ (no load)	max. 110 mA
Power dissipation of the module	typ. 3 W
Analog Value Generation for the Inputs	
Measuring principle	Instantaneous value conversion
Integration/conversion time (per channel)	
• Parameters can be assigned	No
• Integration time in milliseconds	500
• Basic conversion time including Integration time in milliseconds	100
• Resolution including sign	8 bits

Time constant of the input filter	max. 0.8 ms
Basic execution time of the module (all channels enabled)	max. 5 ms
Analog Value Generation for the Outputs	
Resolution including sign	8 bits
Conversion time (per channel)	max. 500 μs
Settling time	
• For resistive load	0.3 ms
• For capacitive load	3.0 ms
• For inductive load	0.3 ms
Suppression of interference, Limits of Error for the Inputs	
Noise suppression for f = n $\times$ (f1 $\pm$ 1 %) (f1 = interference frequency)	
• Common-mode interference (U_{pp} < 1 V)	> 60 dB
Crosstalk between the outputs	> 50 dB
Operational limit (in the entire temperature range, with reference to the input range)	
• Voltage input	$\pm$ 0.9 %
• Current input	$\pm$ 0.8 %
Basic error (operational limit at 25° C, referred to input range)	
• Voltage input	$\pm$ 0.7 %
• Current input	$\pm$ 0.6 %
Temperature error (with reference to the input range)	$\pm$ 0.005 %/K
Linearity error (with reference to the input range)	$\pm$ 0.05 %
Repeatability (in steady state at 25 °C referred to input range)	$\pm$ 0.05 %
Output ripple; range 0 to 50 kHz (referred to output range)	$\pm$ 0.05 %

Suppression of interference, Limits of Error	
Crosstalk between the outputs	> 40 dB
Operational limit (in the entire temperature range, with reference to the output range)	
● Voltage outputs	$\pm$ 0.6 %
● Current outputs	$\pm$ 1.0 %
Basic error (operational limit at 25 °C referred to the output range)	
● Voltage outputs	$\pm$ 0.5 %
● Current outputs	$\pm$ 0.5 %
Temperature error (with reference to the output range)	$\pm$ 0.02 %/K
Linearity error (with reference to the output range)	$\pm$ 0.05 %
Repeat accuracy (in the steady state at 25 °C referred to the output range)	$\pm$ 0.05 %
Output ripple (bandwidth referred to the output range)	$\pm$ 0.05 %
Status, interrupts, diagnostics	
Interrupts	None
Diagnostic functions	None
Data for Selecting a Sensor	
Input range (rated values)/Input resistance	
● Voltage	0 to 10 V/100 k Ω
● Current	0 to 20 mA/50 Ω
Maximum input voltage for voltage input (destruction limit)	max. 20 V continuous; 75 V for max. 1 s (duty factor 1:20)
Maximum input current for current input (destruction limit)	40 mA
Connection of the sensor	
● For measuring voltage	Possible
● For measuring current	
As two-wire transmitter	Not possible
As four-wire transmitter	Possible

Data for Selecting an Actuator	
Output ranges (rated values)	
● Voltage	0 to 10 V
● Current	0 to 20 mA
Impedance (in the nominal output range)	
● For voltage outputs	min. 5 kΩ
– capacitive load	max. 1 μF
● For current outputs	max. 300 Ω
– Inductive load	max. 1 mH
Voltage outputs	
● Short-circuit protection	Yes
● Short-circuit current	max. 11 mA
Current outputs	
● No-load voltage	max. 15 V
Destruction limit against voltages/currents applied from outside	
● Voltage at outputs to M_{ANA}	max. 15 V continuous;
● Current	max. 50 mA DC
Connection of actuators	
● For voltage output	
Two-conductor connection	Possible
Four-conductor connection (measuring circuit)	Not possible
Connection of the sensor	
● For measuring current	
Two-conductor connection	Possible

4.30.1 Commissioning the SM 334; AI 4/AO 2 x 8/8 bits

The analog/output module SM 334; AI 4/AO 2 x 8/8 bits is a non-isolated module. You cannot program the SM 334; AI 4/AO 2 x 8/8 bits.

Important information on connecting the module

Note

Note when connecting the SM 334 that:

- the **analog chassis ground M_{ANA} (terminal 15 or 18) is connected to the chassis ground M of the CPU and/or the interface module (IM)**. Use a wire with a minimum cross-section of 1 mm^2 for this.

  If there is no ground connection between M_{ANA} and M, the module switches off. Inputs are read with 7FFF$_H$; outputs return a value of 0. If the module is run without a ground connection for some time, it may be destroyed.

- the **supply voltage for the CPU and/or the interface module (IM) must not be connected with reversed polarity**. Reverse polarity causes the destruction of the module because M_{ANA} is subjected to an unauthorized high potential (+24 V).

Addressing

The inputs and outputs of the module are addressed as of the initial module address.

The address of a channel is obtained from the module start address and an address offset.

Input Addresses

The following addresses apply to the inputs:

Chan-nel	Address
0	Initial module address
1	Module start address + 2 bytes address offset
2	Module start address + 4 bytes address offset
3	Module start address + 6 bytes address offset

Output Addresses

The following channel addresses apply to the module outputs:

Chan-nel	Address
0	Initial module address
1	Module start address + 2 bytes address offset

4.30.2 Measuring/output method and measuring/output range of the SM 334; AI 4/AO 2 x 8/8 bits

You cannot program the SM 334; AI 4/AO 2 x 8/8 bits.

Selecting the Measurement Method and the Type of Output

Select the measuring method of an input channel (voltage, current) by wiring the input channel appropriately.

Select the type of output of an output channel (voltage, current) by wiring the output channel appropriately.

Unused Channels

You must short-circuit unused input channels and you should connect them to M_{ANA}. In this way, you obtain an optimum noise immunity for the analog module.

Unused output channels must be left open.

Measuring ranges

The SM 334; AI 4/AO 2 x 8/8 bits has the measuring ranges 0 to 10 V and 0 to 20 mA.

Unlike the other analog modules, the SM 334 has a lower resolution and no negative measuring ranges. Take this into account when you read measured value tables 4-10 and 4-14 on pages 4-13 and 4-15.

Output ranges

The SM 334; AI 4/AO 2 x 8/8 bits has the output ranges 0 to 10 V and 0 to 20 mA.

Unlike the other analog modules, the SM 334 has a lower resolution the analog outputs do not have underranges. Take this into account when you read tables 4-35 and 4-37 on pages 4-26 and 4-27.

4.31   Analog Input/Output Module SM 334; AI 4/AO 2 x 12 bits; (6ES7334-0KE00-0AB0)

Order number: "Standard module"

6ES7334-0KE00-0AB0

Order number: "SIPLUS S7-300-Module"

6AG1 334-0KE00-2AB0

Characteristics

The SM 334 has the following characteristic features:

- Four inputs in two groups

- 2 outputs (voltage outputs)

- Resolution of 12 bits + sign

- Measuring method selectable

  – Voltage

  – Resistors

  – Temperature

- Isolated against the backplane bus interface

- Isolated from load voltage

Terminal connection and block diagram of the SM334; AI 4/AO 2 $\times$ 12 bits
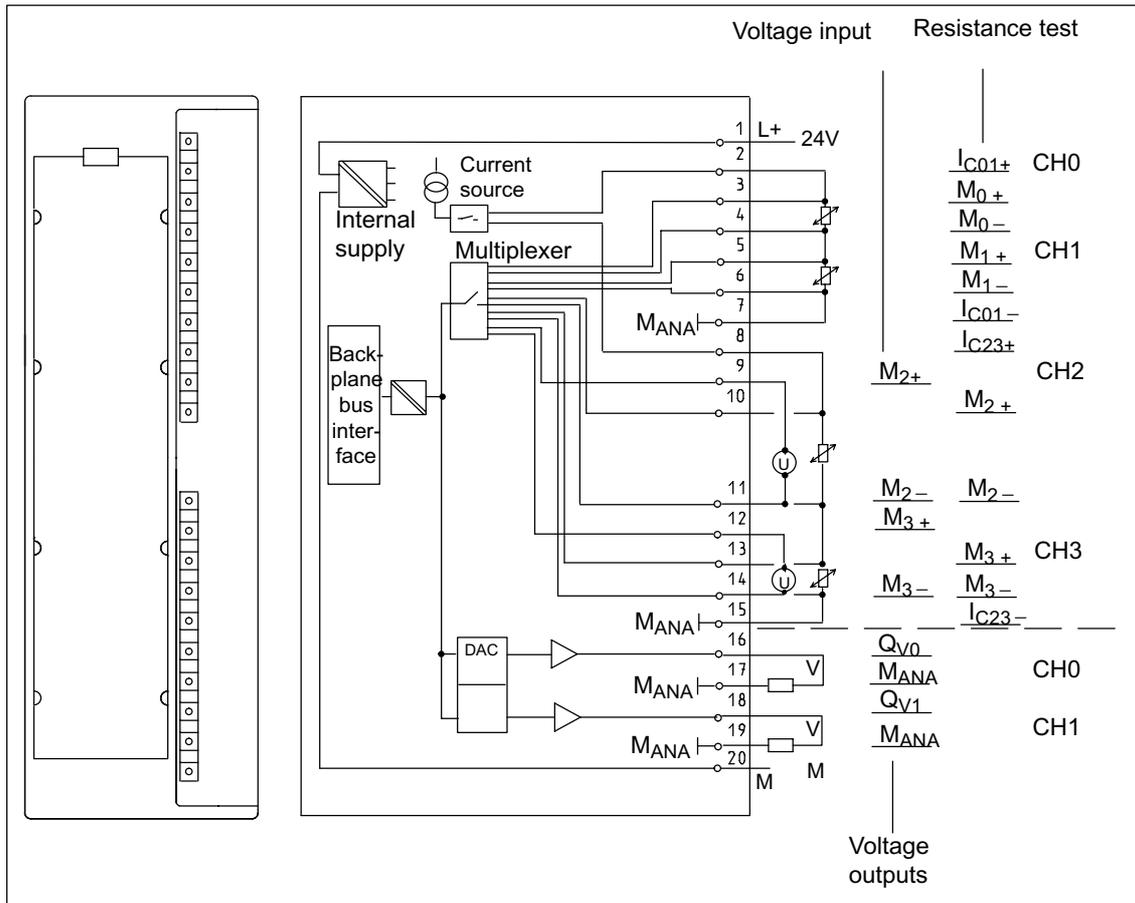
Figure 4-56   Module View and Block Diagram of the SM 334; AI 4/AO 2 x 12 bits

Technical specifications of the SM334; AI 4/AO 2 x 12 bits

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 200 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	4
• For resistance-type sensor	4
Number of outputs	2
Shielded line length	max. 100 m
Voltages, Currents, Potentials	
Rated load voltage L +	24 VDC
• Reverse polarity protection	Yes
Supply voltage of the rated electronics voltage and rated load voltage L+	24 VDC
Power supply of the transmitters	
• Short-circuit-proof	Yes
Constant measured current for resistance-type sensor	
• For PT 100	typ. 490 μA
• At 10 kΩ	at 105 μA
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
Between the channels	No
Permitted potential difference	
• Between inputs and M_{ANA} (U_{CM})	1 V
• Between the inputs (ECM)	1 V
• Between M_{ANA} and $M_{internal}$-(U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 60 mA
• From power supply and load voltage L+ (no load)	max. 80 mA
Power dissipation of the module	typ. 2 W

Analog Value Generation for the Inputs		
Measuring principle	Integrating	
Integration/conversion time (per channel)		
• Parameters can be assigned	Yes	
• Integration time in milliseconds	$16^2/_3$	20
• Basic conversion time including Integration time in milliseconds	72	85
• Additional conversion time for measuring resistance, in ms	72	85
• Resolution in bits (incl.) overrange)	12 bits	12 bits
• Suppression of interference voltage for interference frequency f1 in Hertz	60	50
Smoothing of the measured values	Programmable, in 2 stages	
Time constant of the input filter	0.9 ms	
Basic response time of module (all channels enabled)	350 ms	
Analog Value Generation for the Outputs		
Resolution (incl. Overrange	12 bits	
Conversion time (per channel)	500 μs	
Settling time		
• For resistive load	max. 0.8 ms	
• For capacitive load	max. 0.8 ms	

Suppression of interference, Limits of Error for the Inputs		
Noise suppression for f = n × (f1 ± 1 %) (f1 = interference frequency)		
● Common-mode interference (U_{pp} < 1 V)	> 38 dB	
● Series-mode interference (peak value of interference < rated value of input range)	> 36 dB	
Crosstalk between the inputs	> 88 dB	
Operational limit (in the entire temperature range, with reference to the input range)		
● Voltage input	0 to 10 V	± 0.7 %
● Resistor input	10 k Ω	± 3.5 %
● Temperature input	Pt 100	± 1 %
Basic error (operational limit at 25 °C, referred to input range)		
● Voltage input	0 to 10 V	± 0.5 %
● Resistor input	10 k Ω	± 2.8 %
● Temperature input	Pt 100	± 0.8 %
Temperature error (with reference to the input range)	± 0.01 %/K	
Linearity error (with reference to the input range)	± 0.05 %	
Repeat accuracy (in the steady state at 25 °C, referred to the input range)	± 0.05 %	

Suppression of interference, Limits of Error		
Crosstalk between the outputs	> 88 dB	
Operational limit (in the entire temperature range, with reference to the output range)		
● Voltage outputs	± 1.0 %	
Basic error (operational limit at 25 °C, referred to output range)		
● Voltage outputs	± 0.85 %	
Temperature error (with reference to the output range)	± 0.01 %/K	
Linearity error (with reference to the output range)	± 0.01 %	
Repeat accuracy (in the steady state at 25°C, referred to the output range)	± 0.01 %	
Output ripple; band width 0 to 50 kHz (with reference to the output range)	± 0.1 %	

Status, interrupts, diagnostics		
Interrupts	None	
Diagnostic functions	None	

Data for Selecting a Sensor		
Input range (rated values)/Input resistance		
● Voltage	0 to 10 V	100 k Ω
● Resistors	10 kΩ	10 mΩ
● Temperature	PT 100	10 mΩ
Maximum input voltage for voltage input (destruction limit)	max. 20 V continuous; 75 V for max. 1 s (duty factor 1:20)	
Connection of the sensor		
● For measuring voltage	Possible	
● For measuring resistance		
With two-conductor connection	Possible	
With three-conductor connection	Possible	
With four-conductor connection	Possible	
Characteristic linearization	Parameters can be assigned	
● For RTD	PT 100 (climate range)	
User data in engineering format	Degrees Celsius	

Data for Selecting an Actuator		
Output range (rated value)		
● Voltage	0 to 10 V	
Impedance (in the nominal output range)		
● For voltage outputs	min. 2.5 kΩ	
– capacitive load	max. 1.0 μF	
Voltage outputs		
● Short-circuit protection	Yes	
● Short-circuit current	max. 10 mA	
Destruction limit for voltages/ currents connected from outside		
● Voltage at outputs to M_{ANA}	max. 15 V continuous;	
Connection of actuators		
● For voltage output		
Two-conductor connection	Possible	
Four-conductor connection (measuring circuit)	Not possible	

4.31.1 Commissioning the SM 334; AI 4/AO 2 x 12 bits

Note

Below the rated load voltage range, incorrect intermediate values occur at the output when the rated load voltage supply (L+) is switched on/off.

STEP 7 **V 4.0 tool for parameter assignment**

The SM 334; AI 4/AO 2 x 12 bits is contained in the module catalog in *STEP 7* V 4.0 or higher.

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in Section 4.7.

You will find an overview of the programmable parameters and their default values in Table 4-43, on page 4-44.

4.31.2 Measuring/output method and measuring/output range of the SM 334; AI 4/AO 2 x 12 bits

Connecting the inputs and outputs

You can connect the inputs as voltage, resistance or temperature measurement inputs, or deactivate them.

You can connect the outputs as voltage, or disable them.

Perform connection of the inputs and outputs with the parameters "measuring method" and "output method" in *STEP 7*.

Connection options for the input channels

You can connect the SM 334; AI 4/AO 2 x 12 bits in the following combinations:

Channel	Wiring Versions
Channels 0 and 1	• 2 x temperature or • 2 x resistance
Channels 2 and 3	• 2 x voltage, • 2 x resistance, • 2 x temperature, • 1 x temperature and 1 x voltage, or • 1 x resistance and 1 x voltage

---

Note

Simultaneous connection of a temperature sensor and a resistor to channels 0 and 1 and 2 and 3 is not allowed.

The reason common current source for both channels.

Unused Channels

Set the "measuring method" parameter for unused input channels to "disabled". In this way you shorten the scan time of the module.

You must short-circuit unused input channels and you should connect them to M_{ANA}. In this way, you obtain an optimum interference immunity for the analog input module.

So that unused output channels of the SM 334; AI 4/AO 2 x 12 bits remain de-energized, you must set the "output type" parameter to "disabled" and leave the terminal open.

Measuring ranges

Use *STEP 7* for programming the measuring ranges.

Table 4-87   Measuring ranges of the SM 334;AI 4/AO 2 x 12 bits

Method Selected	Measuring Range	Description
U: Voltage	0 to 10 V	You will find the digital analog values in Section 4.3.1
R-4L: Resistance (four-conductor connection)	10 kΩ	
RTD-4L: Bulb resistor (linear, four-conductor connection) (temperature measurement)	Pt 100 climate	

Default settings of inputs

The default settings of the module are the "Bulb resistor (linear, four-conductor connection)" measuring method and the "Pt 100 climate" measuring range. You can use this combination of measuring method and measuring range without parameterizing the SM 334; AI 4/AO 2 x 12 bits in *STEP 7*.

Output ranges

Use *STEP 7* for programming the output ranges.

Table 4-88   Output ranges of the SM 334;AI 4/AO 2 x 12 bits

Selected Type of Output	Output Range	Description
Voltage	0 to 10 V	You will find the digital analog values in Section 4.3.2 in the voltage output range

Default settings of outputs

The default settings of the module are "Voltage" for the output type and "0 to 10 V" for the output range. You can use this combination of measuring method and measuring range without parameterizing the SM 334; AI4/AO 2 x 2 bits in *STEP 7*.

Special Signal modules

5

In this Appendix

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5.1 Module Overview

Introduction

The following table summarizes the most important features of the signal modules described in this chapter. This overview is intended to make it easy to choose the suitable module for your task.

Table 5-1   Special signal modules: Characteristics at a Glance

Module Characteristics	Simulator module SM 374; IN/OUT 16	Dummy module DM 370	Position decoder module SM 338; POS-INPUT
Number of inputs/outputs	• max. 16 inputs or outputs	1 slot reserved for 1 non-parameterized module	• 3 inputs for connection of absolute value encoders (SSI) • 2 digital inputs for freezing the encoder values
Suitable for...	Simulation of: • 16 inputs or • 16 outputs or • 8 in– and outputs	Placeholder for: • Interface Modules • Non-parameterized signal modules • Modules which occupy 2 slots	Position decoding with up to 3 absolute value encoders (SSI) Encoder types: Absolute value encoder (SSI) with 13-bit, 21-bit or 25-bit message lengths Data format: Gray code or binary code
Supports clocked operation	No	No	Yes
Programmable diagnostics	No	No	No
Diagnostic interrupt	No	No	Adjustable
Special Features	Function adjustable with screwdriver	When replacing the DM 370 with another module, the mechanical assembly and address assignment/address location of the entire assembly remain unchanged	Absolute value encoders with a monoflop time greater than 64 μs cannot be used on the SM 338

5.2   Simulator Module SM 374; IN/OUT 16; (6ES7374-2XH01-0AA0)

Order number

>   6ES7374-2XH01-0AA0

Characteristics

>   The simulator module SM 374; IN/OUT 16 is distinguished by the following features:
>
>   - Simulation of:
>   - 16 inputs or
>   - 16 outputs or
>   - 8 inputs and 8 outputs (each with the same start addresses!)
>   - Status displays for simulation of inputs and outputs
>   - Function adjustable with screwdriver

Note

Do not activate the switch for setting the function in RUN!

Configuration with *STEP 7*

>   The simulator module SM 374; IN/OUT 16 is not included in the module catalog of *STEP 7* i.e., the order number of the SM 374 is not recognized by *STEP 7*. You must therefore "simulate" the function of the simulator module required for the configuration as follows:
>
>   - If you want to use SM 374 **with 16 inputs**, enter the order number of a digital input module with 16 inputs in *STEP 7*;
>
>   e.g.: 6ES7321-1BH02-0AA0
>
>   - If you want to use SM 374 **with 16 outputs**, enter the order number of a digital output module with 16 outputs in *STEP 7*;
>
>   e.g.: 6ES7322-1BH01-0AA0
>
>   - If you want to use SM 374 **with 8 inputs and 8 outputs**, enter the order number of a digital input/output module with 8 inputs and 8 outputs in *STEP 7*;
>
>   e.g.: 6ES7323-1BH02-0AA0

Module view (without front door)
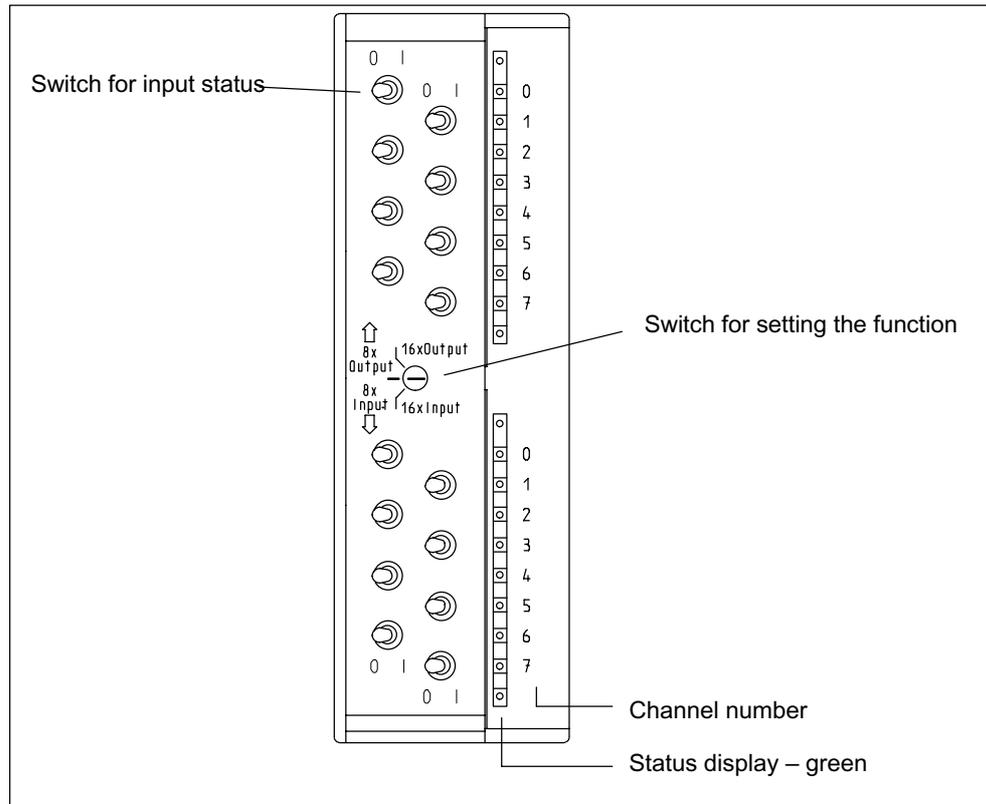
Figure 5-1   Module view of the simulator module SM 374; IN/OUT 16

Technical specifications of the SM 374; IN/OUT 16

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 × 125 × 110
Weight	Approx. 190 g
Data for Specific Module	
Optional simulation of	16 inputs 16 outputs 8 in– and outputs

Voltages, Currents, Potentials	
Current consumption from the backplane bus	max. 80 mA
Power dissipation of the module	type. 0.35 W
Status, Interrupts, Diagnostics	
Status display	yes, green LED per channel
Interrupts	No
Diagnostic functions	No

5.3 Dummy Module DM 370; (6ES7370-0AA01-0AA0)

Order number

6ES7370-0AA01-0AA0

Characteristics

The dummy module DM 370 reserves a slot for a non-parameterized module. They can be used as placeholders for:

- Interface modules (without reservation of address space)

- Non-parameterized signal modules (with reservation of address space)

- Modules which occupy 2 slots (with reservation of address space)

When replacing the dummy module with another module from S7-300, the mechanical assembly and the address assignment/address allocation of the entire assembly remain unchanged.

Configuration with *STEP 7*

You must only configure the dummy module DM 370 with *STEP 7* if the module of the slot is to be reserved for a parameterized signal module. If the module is reserving the slot for an interface module, the configuration cannot be carried out with *STEP 7*.

Modules which occupy 2 slots

For modules which occupy 2 slots, you must plug in 2 dummy modules. Only the dummy module in slot "x" reserves the address space (not the dummy module in slot "x + 1"; for details of the procedure, see table 5-2).

A maximum of 8 modules may be plugged into a module carrier (SM/FM/CP). If you, for example, reserve a slot for an 80 mm wide module with 2 dummy modules, you may still plug in 7 other modules (SM/FM/CP) because the dummy module only occupies the address space for 1 module.

Module view
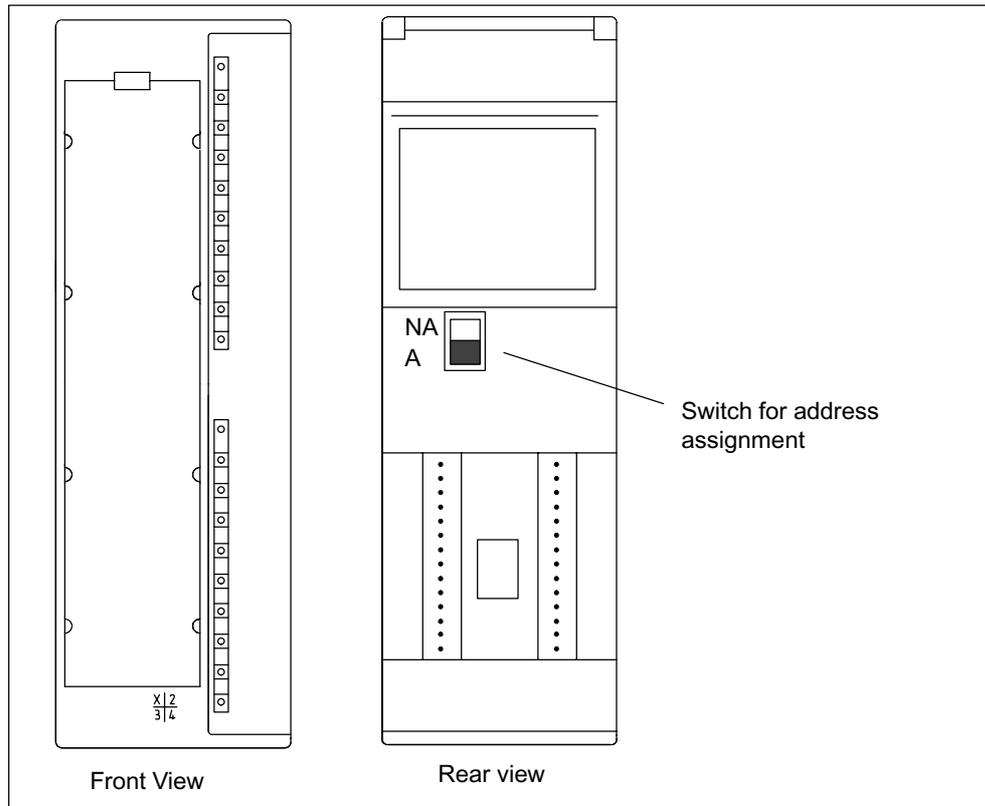
Figure 5-2   Module view of the dummy module DM 370

Switch settings for address assignment

The following table shows how to set the switch on the rear side of the module according to the module type.

Table 5-2   Meaning of the switch settings of the dummy module DM 370

Switch setting	Meaning	Use
NA / A (top black)	The dummy module reserves one slot. The module is not configured and does not occupy any address space.	• Without active backplane bus: In configurations for which a purely physical single slot should be reserved, with electrical connection to the S7 300 bus. • With active backplane bus: No
NA / A (bottom black)	The dummy module reserves one slot. The module must be configured and occupies 1 byte input address space (with system default outside the process image).	In configurations for which a slot with an address should be reserved.
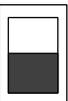
Technical specifications of the DM 370

Dimensions and Weight		Voltages, Currents, Potentials	
Dimensions W x H x D (in millimeters)	40 x 125 x 120	Current consumption from the backplane bus	ca. 5 mA
Weight	Approx. 180 g	Power loss	typ. 0.03 W

5.4 Position Decoder Module SM 338; POS-INPUT; (6ES7338-4BC01-0AB0)

Order number

6ES7338-4BC01-0AB0

Characteristics

The position decoder module SM 338; POS-INPUT is distinguished by the following features:

- 3 inputs for the connection of maximum three absolute value encoders (SSI) and 2 digital inputs to freeze the encoder values

- Direct reaction possible to encoder values in moving systems

- Processing of acquired encoder values of the SM 338 in user program

- Supports clocked operation

- Type of encoder value acquisition (see chapter 5.4.4) can be selected:
    - Free running
    - Clocked

- 24 VDC rated input voltage

- Non-isolated against the CPU

Supported encoder types

The following encoder types are supported by the SM 338; POS-INPUT:

- Absolute value encoder (SSI) with 13-bit message length

- Absolute value encoder (SSI) with 21-bit message length

- Absolute value encoder (SSI) with 25-bit message length

Supported data formats

The SM 338; POS-INPUT supports the gray code and binary code data formats.

5.4.1   Synchronous Operation

Note

The basics of synchronous operation are described in a separate manual.

Hardware requirements

For the synchronous operation of the SM 338, you require:

- CPU which supports clocked operation
- DP master which supports the equidistant bus cycle
- Slave interface (IM 153-x) which supports synchronous operation

Characteristics

Depending on the system parameterization, the SM 338 works in either non-synchronous or synchronous mode.

In synchronous operation, the data exchange between DP master and SM 338 is synchronous to the PROFIBUS DP cycle.

In synchronous operation all 16 bytes of the checkback interface are consistent.

If synchronicity is lost due to faults or failure or delay of Global Control (GC), the SM 338 goes back into synchronous operation in the next cycle without error response.

If synchronicity is lost, the checkback interface is not updated.

5.4.2　Terminal Connection Diagram and Block Diagram
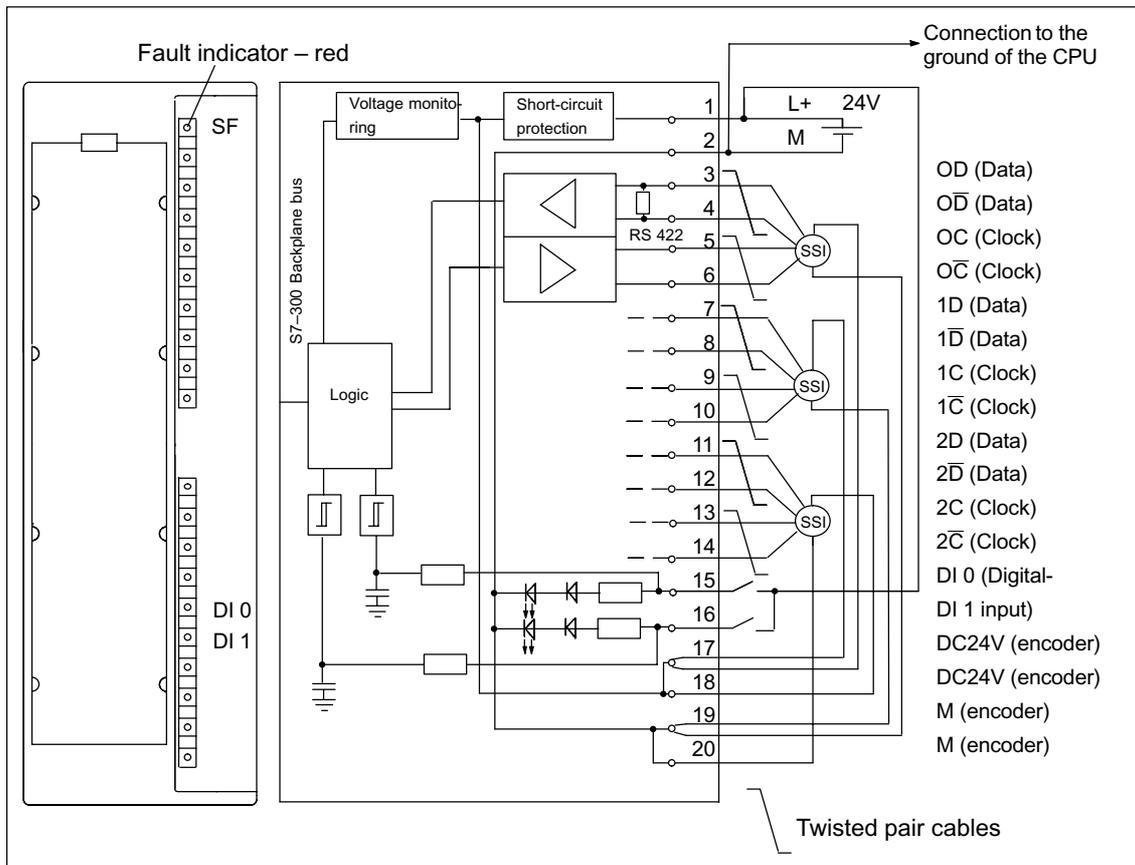
Figure 5-3　Module View and Block Diagram of the SM 338; POS-INPUT

Wiring rules

Please observe the following important rules of the wiring of the module:

- The ground of the encoder supply is connected non-isolated to the ground of the CPU. Thus, connect pin 2 of the SM 338 (M) with low impedance with the ground of the CPU.

- The encoder lines (pins 3 to 14) must be twisted pairs and shielded. Apply the shield to both sides.
  For the shield connection to the SM 338, use the shield connection element (order number 6ES7390-5AA00-0AA0).

- If the output current (900 mA) of the encoder supply is exceeded, then you must connect an external power supply.

5.4.3 Functions of the SM 338; POS INPUT

5.4.4 Encoder value acquisition

The absolute value encoder transfers its encoder values in messages to the SM 338. The transfer of the message is initiated by the SM 338.

- In non-synchronous operation, the encoder values are acquired while it is free running.

- In synchronous operation the encoder values are acquired synchronized to the PROFIBUS DP cycle at each T_i.

Free running encoder value acquisition

The SM 338 always initiates the transfer of a message after the end of the parameterized monoflop time.

Asynchronous to these free running messages, the SM 338 processes the acquired encoder values during the cycle of its updating rate (see Technical Data).

Thus, in the case of free running encoder value acquisition, encoder values of different ages result. The difference between the maximum and minimum age is the jitter (see Technical Data).

Synchronous encoder values acquisition

Synchronous encoder values acquisition is automatically set if, in the DP master system, the equidistant bus cycle is activated and the DP Slave is synchronized to the DP cycle.

The SM 338 initiates the transfer of a message in each PROFIBUS DP cycle at the time T_i.

Synchronous to the PROFIBUS DP cycle, the SM 338 processes the transferred encoder values.

5.4.5 Gray/Dual Converter

In the Gray setting, the encoder values provided by the absolute value encoder in gray code is converted into Dual code. In the Dual setting, encoder values provided by the absolute value encoder remain unchanged.

Note

If you have selected the Gray setting, the SM 338 always converts the entire encoder value (13, 21, 25 bits). As a result, preceding special bits affect the encoder values and following bits could be falsified under certain circumstances.

5.4.6 Transferred Encoder Value and Normalization

The transferred encoder value contains the encoder position of the absolute value encoder. Depending on the encoder used, additional bits which are located before and after the encoder position are also transferred in addition to the encoder position.

So that the SM 338 can detect the encoder position, make the following settings:

- Normalization, places (0..12), or
- Normalization, units / revolution

Normalization, places

The normalization determines the position of the encoder values in the checkback interface.

- If "Places" = 1, 2....12, this indicates that the following non relevant bits in the encoder values are removed and the encoder value is right justified in the address range (see following example).

- If "Places" = 0, this indicates that the following bits are retained and available for evaluation.
  This can be useful if you use an absolute value encoder which transfers information in the following bits (see manufacturer information) and you want to evaluate these (see also chapter 5.4.5).

Parameter units / revolution

A maximum of 13 bits are available for the units/revolution. According to the "Places" data, the resulting number of units/revolution is automatically displayed.

Example of normalization of an encoder value

You are using a single-turn encoder with 2^9 units= 512 units/ revolution (resolution/360°).

In *STEP 7* you have set the following parameters:

- Absolute encoder: 13 bits

- Normalization: 4 places

- Units / revolution: 512

Before the normalization: cyclically acquired encoder values 100

```
31                          Double data word
0|0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 1 0 0|X X X X
                                        |___Relevant bits___|     0
                                        |_____Transferred bits_____|
```
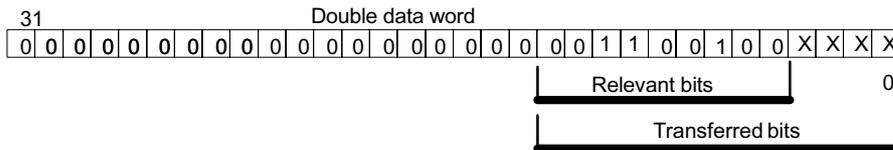
After the normalization: encoder values 100

```
31                          Double data word                          0
0|0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 1 0 0
                                              |___Relevant bits___|
```
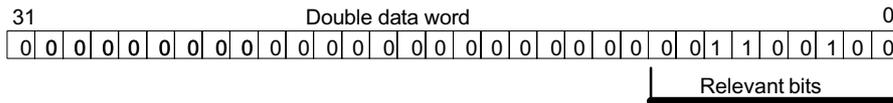
Result: Bits 0 to 3 (4 places, marked with "x") are omitted.

5.4.7   Freeze Function

The freeze function "freezes" the current encoder values of the SM 338. The freeze function is coupled to the digital inputs DI 0 and DI 1 of the SM 338.

The freeze is triggered by an edge change (rising edge) on DI 0 or DI 1. A frozen encoder value is identified by the bit 31 (output address) being set. With a digital input you can freeze one, two or three encoder values.

You must switch on the freeze function, i.e. set the corresponding parameters in *STEP 7* .

The encoder values are retained until the freeze function is ended and can thus be evaluated dependent on the event.

Ending the freeze function

The freeze function must be ended at every encoder input. You acknowledge the function in the user program by setting the bit 0, 1 or 2 depending on the channel with the *STEP 7*-Operation T PAB "xyz" (for a program example, see chapter 5.4.9).

After exiting, bit 31 of the corresponding encoder value is again deleted and the encoder values are again updated. A renewed freezing of the encoder values is again possible as soon as you have deleted the acknowledgment bit in the output address of the module.

In synchronous operation the acknowledgment is processed at time T_o. From this point in time a renewed freezing of the encoder values can take place via the digital inputs.

Note

The freeze function is automatically acknowledged if you newly parameterize the corresponding channel with different parameters (see 5.4.8 chapter).
If the parameters remain identical, the freeze function remains unaffected.

5.4.8   SM 338; POS-INPUT Parameterization

You parameterize the SM 338; POS-INPUT with *STEP 7*. You must perform parameter assignment in STOP mode of the CPU.

As soon as you have set all the parameters, download the parameters from the programming device to the CPU. On a transition from STOP to → RUN mode, the CPU then transfers the parameters to the SM 338.

The parameters cannot be changed by the user program.

Parameters of the SM 338; POS-INPUT

You will find an overview of the parameters that you can set and their default settings for the SM 338 in the table below.

The default settings apply if you have not performed parameter assignment in *STEP 7* (default setting bold).

Table 5-3   Parameters of the SM 338; POS-INPUT

Parameter	values Range	Note
Enable • Diagnosis interrupt	 Yes/no	Release parameter. Affects all 3 channels.
Absolute value encoder (SSI) [1]	none; **13 bits**; 21 bits; 25 bits	none: The encoder input is switched off.
Code type [1]	**Gray**; Binary	Code provided by encoder.
Baud rate [1],[3]	**125 kHz**; 250 kHz; 500 kHz; 1 MHz	Data transfer rate of the SSI position decoder. Observe the relationship between the cable length and baud rate (see Technical Data)
Monoflop time [1],[2],[3]	16 μs; 32 μs; 48 μs; **64 μs**	The monoflop time is the minimum time interval between 2 SSI message frames. The parameterized monoflop time must always be greater than the monoflop time of the absolute value encoder.
Normalization • Places • Units / revolution [4]	 **0** to 12 2 to **8192**	Normalizing right justifies the encoder values of the encoder absolute; non-relevant places are discarded.
Switching on freeze	**off**; 0; 1	Designation of the digital input whose rising edge causes a freezing of the encoder value.

[1]   See technical data of the absolute value encoder
[2]   The monoflop time is the time interval between 2 SSI message frames. The parameterized monoflop time must be greater than the monoflop time of the absolute value encoder (see technical data of the manufacturer). The time $2 \times \times (1 / \text{baud rate})$ is added to the value parameterized in HW config. At a baud rate of 125 kHz with a parameterized monoflop time of 16 μs, an effective monoflop time of 32 μs is actually achieved.
[3]   The following restriction applies to the monoflop time of the absolute value encoder:
       $(1 / \text{baud rate}) < \text{Monoflop time of the absolute value encoder} < 64\ \mu s + 2 \times \times (1 / \text{baud rate})$
[4]   to the power of two

Note

Please note that in non synchronous operation the baud rate and the monoflop time affect the accuracy and actuality of the encoder values.
In synchronous operation the baud rate and the monoflop time affect the accuracy of the freeze function.

5.4.9   SM 338; POS-INPUT Addressing

Data range for the encoder values

The inputs and outputs of the SM 338 are addressed as of the initial module address. The input and output address is determined at the configuration of the SM 338 in *STEP 7*.

Input Addresses

Table 5-4   SM 338; POS-INPUT: Input Addresses

Encoder input	Input address (from the configuration) + address offset
0	"Initial module address"
1	"Module start address" + 4 bytes address offset
2	"Module start address" + 8 bytes address offset

Structure of the double data word

For each encoder input the double data word is made up as follows:

Freeze   Encoder value in gray or binary code
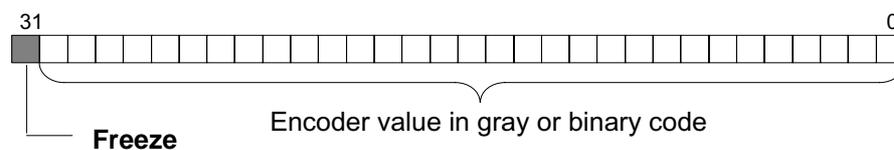
0 = encoder value is not frozen. The value is constantly updated.

1 = encoder value is frozen. The value remains constant until acknowledgment.

Output Address

Initial module address

Acknowledging the freeze function:

Bit 0 = encoder input 0

Bit 1 = encoder input 1

Bit 2 = encoder input 2
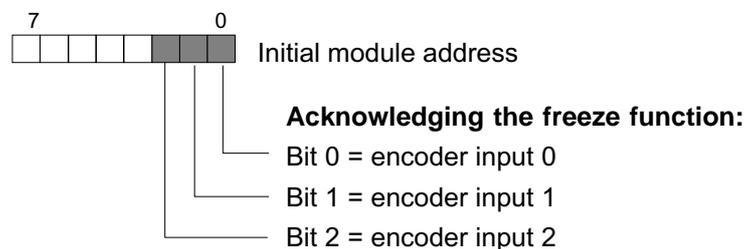
Reading out data areas

You can read out the data areas in your user program with the *STEP 7*-Operation L PED "xyz".

Example of access to encoder values and use of the freeze function

You want to read out and evaluate the value of the encoder at the encoder inputs.
The module start address is 256.

```
AWL                            Explanation
L      PED    256    //        Read encoder value in the address range for
                               encoder input 0
T      MD     100    //        Store encoder value in marker double word
U      M      100.7  //        Acquire and store freeze status for later
=      M      99.0   //        acknowledgment

L      PED    260    //        Read encoder value in the address range for
                               encoder input 1
T      MD     104    //        Store encoder value in marker double word
U      M      104.7  //        Acquire and store freeze status for later
=      M      99.1   //        acknowledgment

L      PED    264    //        Read encoder value in the address range for
                               encoder input 2
T      MD     108    //        Store encoder value in marker double word
U      M      108.7  //        Acquire and store freeze status for later
=      M      99.2   //        acknowledgment

L      MB     99     //        Load and acknowledge freeze condition
T      PAB    256    //        (SM 338: output address 256)
```

Afterwards you can further process the encoder values from the marker range MD
100, MD 104 and MD 108. The encoder value is contained in bits 0 to 30 of the
marker double word.

5.4.10   Diagnosis of the SM 338; POS-INPUT

The SM 338 makes diagnostic messages available, i.e., all diagnostic messages are always provided by the SM 338 without your assistance.

Actions following diagnostic message in *STEP 7*

Each diagnostic message leads to the following actions:

- The diagnostic message is entered in the diagnosis of the module and forwarded to the CPU.

- The SF LED on the module lights.

- If you have programmed "Enable Diagnostic Interrupt" in STEP *7* , a diagnostic interrupt is triggered and OB 82 is called.

Reading out diagnostic messages

You can read out detailed diagnostic messages by means of SFCs in the user program (refer to the Appendix "Diagnostic Data of Signal Modules").

You can view the cause of the error in *STEP 7*, in the module diagnosis (refer to online Help for *STEP 7*).

Diagnostic message via SF LED

The SM 338 indicate errors for you by means of their SF LED (group error LED). The SF LED lights as soon as a diagnostic message is triggered by the SM 338. It goes out when all errors have been rectified.

The group fault (SF) LED also lights up in case of external errors (short circuit of encoder supply), independent of the operating status of the CPU (if power is on).

The SF LED lights up temporarily at startup during the self test of the SM 338.

Diagnostic messages of the SM 338; POS INPUT

The table below gives an overview of the diagnostic messages for the SM 338.

Table 5-5   Diagnostic messages of the SM 338; POS INPUT

Diagnostics Message	LED	Scope of the Diagno-stics
Module problem	SF	Module
Internal malfunction	SF	Module
External malfunction	SF	Module
Channel error present	SF	Module
External auxiliary supply missing	SF	Module
Module not parameterized.	SF	Module
Wrong parameters	SF	Module
Channel information available	SF	Module
Time monitoring triggered	SF	Module
Channel error present	SF	Channel (encoder input)
Configuring/parameter assignment error	SF	Channel (encoder input)
External channel error (encoder fault)	SF	Channel (encoder input)

Causes of errors and remedial measures

Table 5-6   Diagnostics Messages of the SM 338, Causes of Errors and Remedial Measures

Diagnostics Message	Possible Error Cause	Remedy
Module fault	An error detected by the module has occurred.	
Internal error	Module has detected an error within the automation system.	
External error	Module has detected an error outside of the automation system.	
Channel error present	Indicates that only specific channels are faulty.	
External auxiliary supply missing	The power supply L+ to the module is missing	Feed supply L+
Module not parameterized	Module requires information whether it should work with parameters preset by the system or with your parameters.	Message present after network active until transfer of the parameters by the CPU complete; parameterize module if necessary.
Wrong parameters	One parameter or the combination of parameters is not plausible	Reassign module parameter
Channel information present	Channel error present; module can provide additional channel information.	
Watchdog tripped	Temporary high electromagnetic interference	Eliminate interference
Channel error present	An error detected by the module has occurred at the encoder input.	
Configuration / parameterization error	Illegal parameter had been transferred to module	Reassign module parameter
External channel error (encoder error)	Broken wire in encoder cable, encoder cable not connected or encoder defective.	Check connected encoder

5.4.11   Interrupts of the SM 338; POS INPUT

Introduction

In this Section, the interrupt behavior of the SM 338; POS-INPUT is described. The SM 338 can trigger diagnostic interrupts.

The OBs and SFCs mentioned below can be found in the online Help for *STEP 7*, where they are described in greater detail.

Enabling interrupts

The interrupts are not preset – in other words, they are inhibited without appropriate parameter assignment. Assign parameters to the Interrupt Enable in *STEP 7* (refer to Section 5.4.8).

Diagnostic interrupt

If you have enabled diagnostic interrupts, then incoming active error events (initial occurrence of the error) and departing error events (message after troubleshooting) are reported by means of interrupts.

The CPU interrupts execution of the user program and processes the diagnostic interrupt block (OB 82).

In the user program, you can call SFC 51 or SFC 59 in OB 82 to obtain more detailed diagnostic information from the module.

The diagnostic information is consistent until such time as OB 82 is exited. When OB 82 is exited, the diagnostic interrupt is acknowledged on the module.

5.4.12 Technical Specifications of the 338; POS-INPUT

Dimensions and Weight	
Dimensions B x H x T (mm)	40 x 125 x 120
Weight	Approx. 235 g
Voltages, Currents, Potentials	
Rated load voltage L+	24 VDC
• Range	20.4 ... 28.8 V
• Reverse polarity protection	No
Isolation	no, only against shield
Permitted potential difference	1 VDC
• between input (M connection) and central grounding point of the CPU	
Encoder supply	
• Output voltage	L+ –0.8 V
• Output current	max. 900 mA, short circuit–proof
Current dissipation	
• From the backplane bus	max. 160 mA
• From the load voltage L+ (no load)	max. 10 mA
Power dissipation of the module	typ. 3 W
Encoder inputs POS INPUT 0 to 2	
Position decoding	absolute
Difference signals for SSI data and SSI clock	according to RS422
Data transfer rate and cable length of absolute value encoders (twisted pair and shielded)	• 125 kHz max. 320 m • 250 kHz max. 160 m • 500 kHz max. 60 m • 1 MHz max. 20 m

Message duration of the SSI transmission	13 bits	21 bits	25 bits
• 125 kHz	112 µs	176 µs	208 µs
• 250 kHz	56 µs	88 µs	104 µs
• 500 kHz	28 µs	44 µs	52 µs
• 1 MHz	14 µs	22 µs	26 µs
Monoflop time[2]	16 µs, 32 µs, 48 µs, 64 µs		

Digital inputs DI 0, DI 1	
Isolation	no, only against shield
Input voltage	0-Signal: –3 V ... 5 V
	1-Signal: 11 V ... 30.2 V
Input current	0-Signal: ≤ 2 mA (quiescent current)
	1-Signal: 9 mA (typ.)
Input delay	0 > 1: max. 300 µs
	1 > 0: max. 300 µs

Maximum repeat frequency	1 kHz
Connection of a two–wire BEROS, type 2	Possible
Shielded line length	600 m
Unshielded line length	32 m
Status, Interrupts, Diagnostics	
Interrupts	
• Diagnostic interrupt	Parameters can be assigned
Status display of digital inputs	LED (green)
Group error/fault	LED (red)
Inaccuracy of the encoder value	
Free running encoder value acquisition	
• maximum age [1]	($2 \times$ Message duration) + monoflop time + 580 µs
• minimum age [1]	Message duration + 130 µs
• Jitter	Message duration + monoflop time + 450 µs
Update rate	Evaluation of the message every 450 µs
Synchronous encoder value acquisition	
• Age	Encoder value at time T_i of the current PROFIBUS DP cycle
Inaccuracy of the frozen encoder value (freeze)	
Free running encoder value acquisition	
• maximum age [1]	($2 \times$ Message duration) + monoflop time + 580 µs
• minimum age [1]	Message duration + 130 µs
• Jitter	Message duration + monoflop time + 450 µs
Synchronous encoder value acquisition	
• Jitter	Max (message duration$_n$ + param. Monoflop time $_n$) n = 0, 1, 2, (Channel)

[1] Age of the encoder values determined by the transfer process and the processing

[2] The following restriction applies to the monoflop time of the absolute value encoder:
(1 / baud rate) < Monoflop time of the absolute value encoder < 64 µs + 2 x (1 / baud rate)

Interface Modules

6

Interface modules

In this chapter you will find the technical specifications and characteristic features of the interface modules for the S7-300.

Contents

The following interface modules are described in this chapter:

6.1 Module Overview

Introduction

The following table summarizes the most important characteristics of the interface modules described in this chapter. This overview is intended to make it easy to choose the suitable module for your task.

Table 6-1   Interface Modules: Characteristics at a Glance

Module Char- acter- istics	Interface Module IM 360	Interface Module IM 361	Interface Module IM 365
Suitable for plugging into S7-300 mounting racks	• 0	• 1 to 3	• 0 and 1
Data transmission	• From IM 360 to IM 361 over the connecting cable 386	• From the IM 360 to the IM 361 or from the IM 361 to the IM 361 via connecting cable 386	• From IM 365 to IM 365 via connecting cable 386
Distance between...	• Max. 10 m	• Max. 10 m	• 1 m, permanently connected
Special Features	---	---	• Preassembled module pair • Install only signal modules in rack 1 • IM 365 does not route the communication bus to subrack 1

6.2 Interface Module IM 360; (6ES7360-3AA01-0AA0)

Order number

6ES7360-3AA01-0AA0

Characteristics

The interface module IM 360 has the following characteristic features:

- Interface for rack 0 of the S7-300

- Data transfer from IM 360 to IM 361 over the connecting cable 368

- Maximum distance between IM 360 and IM 361 is 10 m (32.8 ft.)

Status and fault LEDs

The interface module IM 360 has the following status and fault LEDs.

LED	Meaning	Explanation
SF	Group error/fault	The LED lights up if • the connecting cable is missing. • IM 361 is switched off.

Front View

Figure 6-1 shows the front view of the interface module IM 360.
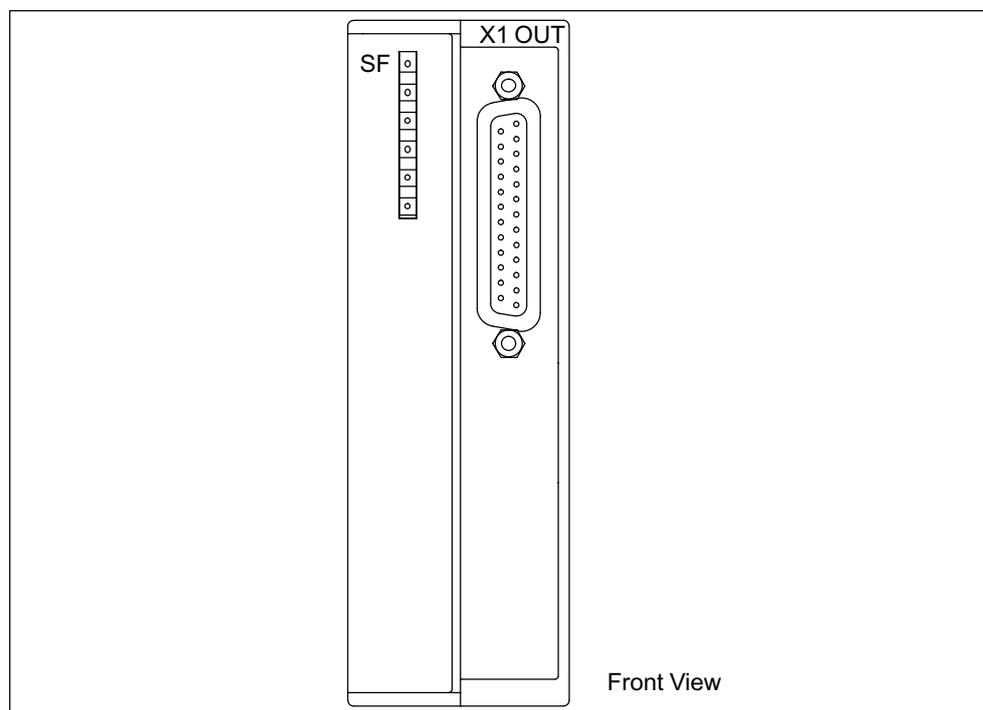
Figure 6-1   Front View of the Interface Module IM 360

Technical specification

The following overview lists the technical specifications for the interface module IM 360.

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 120
Weight	Approx. 250 g
Data for Specific Module	
Length of cable	
• Maximum length to next IM	10 m
Current consumption	
• From the backplane bus	350 mA
Power loss	typ. 2 W
Status and fault LEDs	Yes

6.3   Interface Module IM 361; (6ES7361-3CA01-0AA0)

Order number

6ES7361-3CA01-0AA0

Characteristics

The interface module IM 361 has the following characteristic features:

- 24 VDC power supply

- Interface for racks 1 to 3 of the S7-300

- Current output via the S7-300 backplane bus max. 0.8 A

- Data transfer from the IM 360 to the IM 361 or from the IM 361 to the IM 361 via connecting cable 368

- Maximum distance between IM 360 and IM 361 is 10 m (32.8 ft.)

- Maximum distance between IM 361 and IM 361 is 10 m

Status and fault LEDs

The interface module IM 361 has the following status and fault LEDs.

LED	Meaning	Explanation
SF	Group error/fault	The LED lights up if • the connecting cable is missing • the series-connected IM 361 is switched off • the CPU is in the POWER OFF state
5 VDC	5 VDC supply for the S7-300 backplane bus	–

Front View

Figure 6-2 shows the front view of the interface module IM 361.
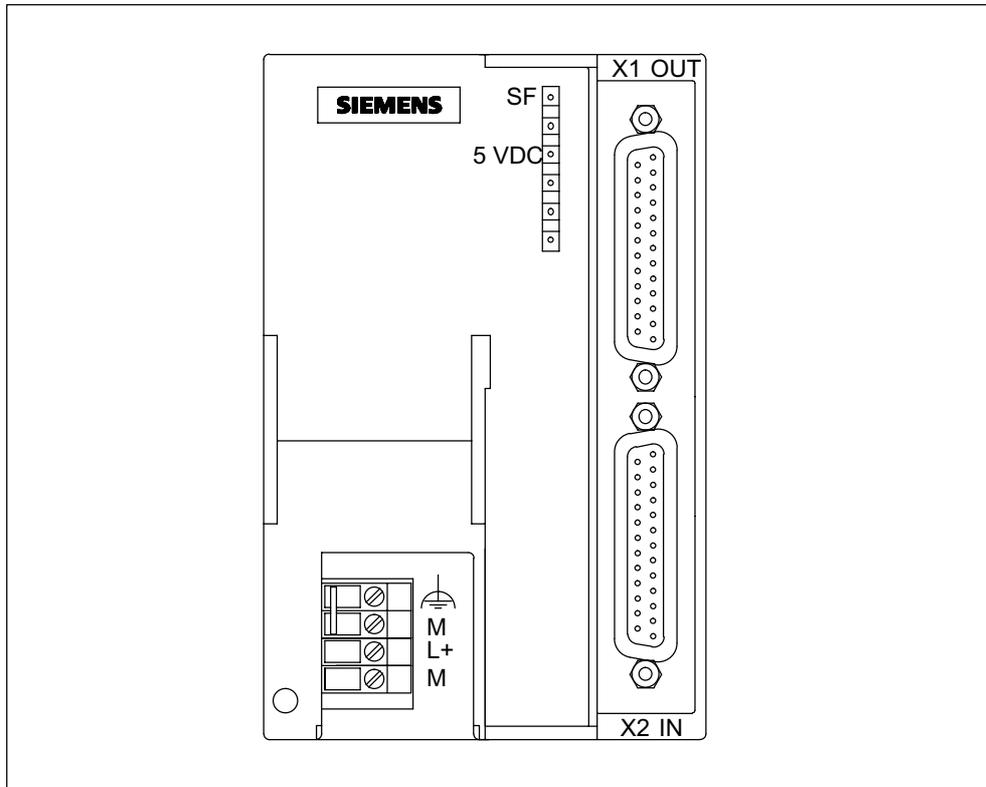
Figure 6-2   Front View of the Interface Module IM 361

Technical specification

The following overview lists the technical specifications for the interface module IM 361.

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	80 x 125 x 120
Weight	505 g
Data for Specific Module	
Length of cable Maximum length to next IM	10 m
Current consumption From 24 VDC	0.5 A
Power loss	typ. 5 W
Current output To backplane bus	0.8 A
Status and fault LEDs	Yes

6.4 Interface Module IM 365; (6ES7365-0BA01-0AA0)

Order number: "Standard module"

6ES7365-0BA01-0AA0

Order number: "SIPLUS S7-300-Module"

6AG1365-0BA01-2AA0

Characteristics

The interface module IM 365 has the following characteristic features:

- Pre-assembled pair of modules for rack 0 and rack 1

- Total power supply of 1.2 A, of which up to 0.8 A can be used per rack.

- Connecting cable with a length of 1 m already permanently connected

- Install only signal modules in rack 1

- IM 365 does **not** forward the C bus to rack 1, i.e. you cannot plug FMs with a C bus function in rack 1.

Front View

Figure 6-3 shows the front view of the interface module IM 365.
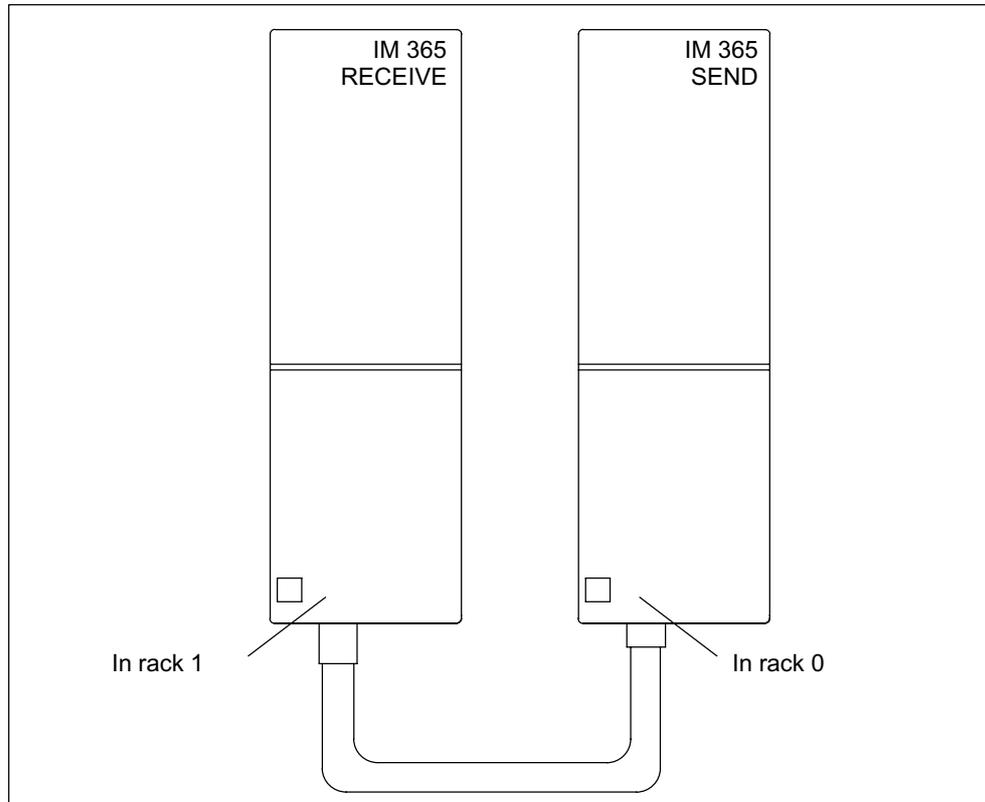
Figure 6-3   Front View of the Interface Module IM 365

Technical specification

The following overview lists the technical specifications for the interface module IM 365.

Dimensions and Weight	
Dimensions W x H x D per rack (in millimeters)	40 x 125 x 120
Total weight	580 g

Data for Specific Module	
Length of cable	
Maximum length to next IM	1 m
Current consumption	
From the backplane bus	100 mA
Power loss	typ. 0.5 W
Current output	max. 1.2 A
Per rack	0.8 A
Status and fault LEDs	No

RS 485 Repeater

7

In this chapter

In this chapter, you will find a detailed description of the RS 485-Repeater.

Included in the description are:

- The purpose of the RS 485 repeater
- The maximum cable lengths possible between two RS 485 repeaters
- The functions of the individual operating elements and terminals
- Information about grounded and non-grounded operation
- Technical specifications and the block diagram

Further information

You will find further information on the RS 485 repeater in the manuals *Hardware and Installation* in the Chapter "Configuring of an MPI or PROFIBUS-DP network".

Diagnostic repeater

Compared to the RS 485 repeater, the diagnostic repeater has new characteristics: Diagnostic function and modeling as the DP slave. For additional information, refer to the *Diagnostic Repeater for PROFIBUS-DP* manual, order no. 6ES7972-0AB00-8xA0.

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7.1 Application and Characteristics; (6ES7972-0AA01-0XA0)

Order number

6ES7972-0AA01-0XA0

What is an RS 485 repeater?

The RS 485 repeater amplifies data signals on bus lines and interconnects bus segments.

Application of the RS 485 repeater

You need an RS 485 repeater if:

- More than 32 nodes are connected to the bus

- Bus segments are to be operated non-grounded on the bus, or

- The maximum cable length of a segment is exceeded. (See table 7-1).

Table 7-1   Maximum Cable Length of a Segment

Baud Rate	Max. Cable Length of a Segment (in m)
9.6 to 187.5 kbd	1000
500 kbaud	400
1.5 Mbaud	200
3 to 12 Mbaud	100

Rules

If you configure the bus with RS 485 repeaters:

- Up to 9 RS 485 repeaters can be connected in series.

- The maximum cable length between two nodes must not exceed the values in Table 7-2.

Table 7-2   Maximum Cable Length between Two RS 485 Repeaters

Baud Rate	Maximum Length of Cable between 2 Nodes (in m) with RS 485 Repeater (6ES7972-0AA01-0XA0)
9.6 to 187.5 kbaud	10000
500 kbaud	4000
1.5 Mbaud	2000
3 to 12 Mbaud	1000

7.2 Appearance of the RS 485 Repeater; (6ES7972-0AA01-0XA0)

The table below shows the appearance of the RS 485 repeater and lists its functions.

Table 7-3 Description and Functions of the RS 485 Repeater

Repeater Design	No.	Function
	①	Connection for the RS 485 repeater power supply (pin "M5.2" is the ground reference, if you want to measure the voltage difference between terminals "A2" and "B2").
	②	Shield clamp for the strain relief and grounding of the bus cable of bus segment 1 or bus segment 2
	③	Terminals for the bus cable of bus segment 1
	④	Terminating resistance for bus segment 1
	⑤	Switch for OFF operating mode (= isolate bus segments from each other – for example, for startup
	⑥	Terminating resistance for bus segment 2
	⑦	Terminals for the bus cable of bus segment 2
	⑧	Slide for mounting and removing the RS 485 repeater on the standard rail
	⑨	Interface for programming device/OP in bus segment 1
	⑩	LED 24 V supply voltage
	⑪	LED for bus segment 1
	⑫	LED for bus segment 2

7.3 RS 485 Repeater in Ungrounded and Grounded Operation

Grounded or ungrounded

The RS 485 repeater is ...

- Grounded, if all other nodes in the segment are also operated with a grounded potential

- Ungrounded, if all other nodes in the segment are operated with an ungrounded potential

Note

The bus segment 1 is grounded if you connect a programming device to the PG/OP socket of the RS 485 repeater. Ground connection is effected since the MPI in the programming device is grounded and the PG/OP socket is connected internally with bus segment 1 in the RS 485 repeater.

Grounded operation of the RS 485 repeater

For grounded operation of the RS 485 repeater, you must jump terminals "M" and "PE" on the top of the RS 485 repeater.

Ungrounded operation of the RS 485 repeater

For ungrounded operation of the RS 485 repeater, "M" and "PE" on the top of the RS 485 repeater must not be interconnected. In addition, the supply voltage of the RS 485 repeater must be ungrounded.

Terminal connection diagram

In the case of a repeater configuration with ungrounded reference potential (ungrounded operation), any interference currents and static charges are discharged by means of an RC network integrated in the repeater (refer to Figure 7-1) to the protective conductor.
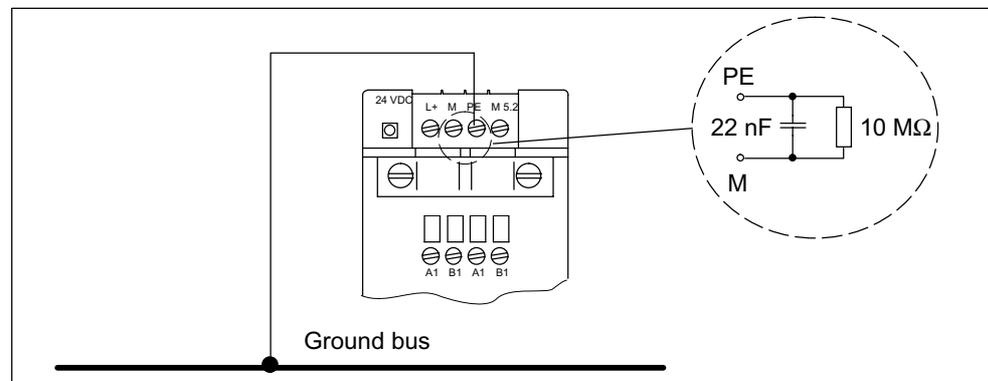
Figure 7-1   RC Network with 10 MΩ for Configuration with Ungrounded Reference Potential

Isolation between bus segments

Bus segment 1 and bus segment 2 are galvanically isolated from each other. The PG/OP interface is connected internally to the port for bus segment 1. Figure 7-2 shows the front panel of the RS 485 repeater.
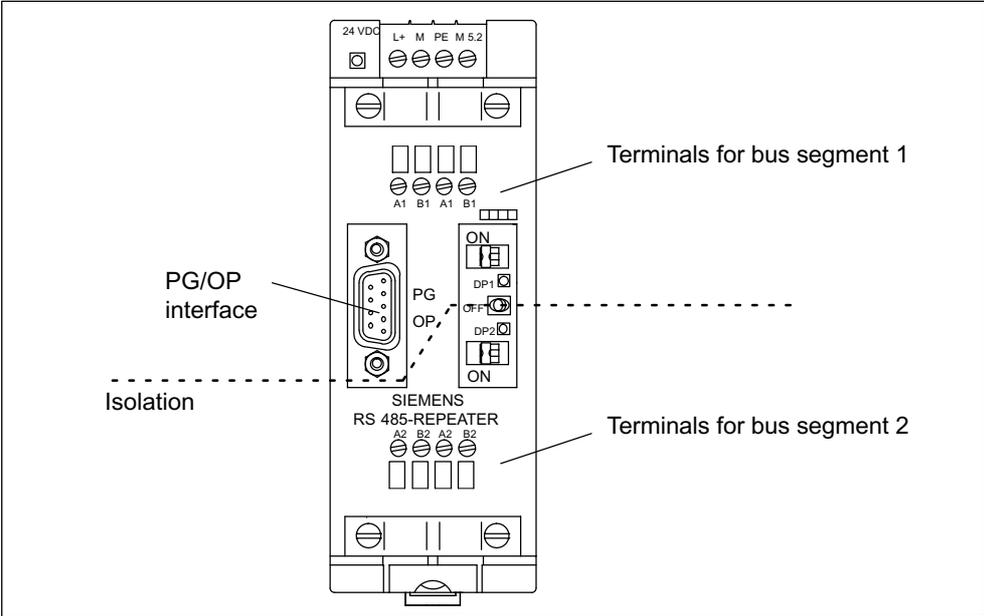
Figure 7-2   Isolation between the Bus Segments

Amplification of the bus signals

The amplification of the bus signals takes place between the port for bus segment 1 or the PG/OP interface and the port for bus segment 2.

7.4 Technical Specifications

Technical specifications of the RS 485 repeater

Technical Specification	
Power supply • Rated voltage • Ripple	 24 VDC 20.4 to 28.8 VDC
Current consumption at rated voltage • Without node at PG/OP socket • Node at PG/OP socket (5 V/90 mA) • Node at PG/OP socket (24 V/100 mA)	 100 mA 130 mA 200 mA
Isolation	Yes, 500 VAC
Connection of fiber optic cables	Yes, via repeater adapters
Redundancy operation	No
Transmission rate (automatically detected by the repeater)	9.6 kbaud, 19.2 kbaud, 45.45 kbaud, 93.75 kbaud, 187.5 kbaud, 500 kbaud. 1.5 Mbaud. 3 Mbaud, 6 Mbaud, 12 Mbaud
Degree of protection	IP 20
Dimensions W x H x D	45 x 128 x 67
Weight (incl. packaging)	350 g

Pin assignment of the sub-D connector (PG/OP socket)

View	Pin No.	Signal Name	Designation
	1	–	–
	2	M24V	Ground 24 V
	3	RxD/TxD-P	Data line B
	4	RTS	Request To Send
	5	M5V2	Data reference potential (from station)
	6	P5V2	Supply plus (from station)
	7	P24V	24 V
	8	RxD/TxD-N	Data line A
	9	–	–
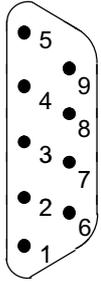
Block diagram of the RS 485 repeater

- Bus segment 1 and bus segment 2 are galvanically isolated from each other.

- Bus segment 2 and the PG/OP socket are galvanically isolated from each other.

- Signals are amplified

    – between bus segment 1 and bus segment 2

    – between PG/OP socket and bus segment 2
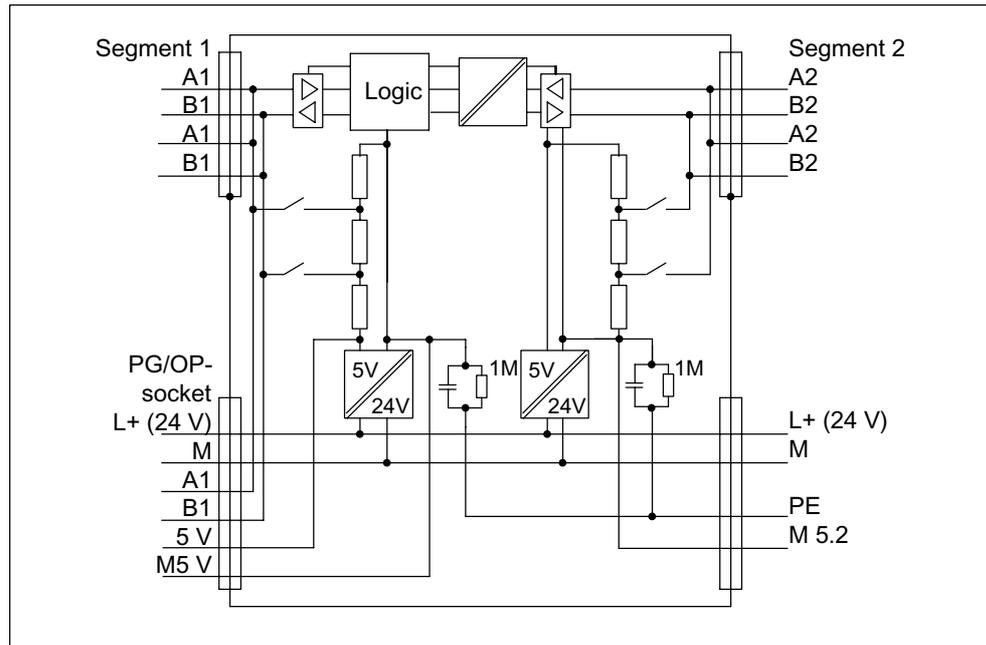
Figure 7-3   Block diagram of the RS 485 repeater

SIMATIC TOP Connect and SIMATIC TOP Connect TPA

8

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8.2	Wiring Components	8-4
8.3	Wiring SIMATIC TOP Connect with Digital Modules	8-12
8.4	Wiring SIMATIC TOP Connect TPA with Analog Modules	8-20

Structure of the chapter

Sections 8.1 and 8.2 apply to SIMATIC TOP connect and SIMATIC TOP connect TPA.

Section 8.3 contains specific information on SIMATIC TOP connect and thus supplements the preceding sections.

Section 8.4 contains specific information on SIMATIC TOP connect TPA and thus supplements Sections 8.1 and 8.2.

8.1 Module Overview

Introduction

"SIMATIC TOP connect" denotes components for wiring digital modules.

"SIMATIC TOP connect TPA" denotes components for wiring analog modules.

Wiring

Wiring with SIMATIC TOP connect/... TPA is a fast and cost-effective alternative to conventional wiring of the actuators and sensors directly at the front connector of the module. When using these components, you wire actuators and sensors "in situ" on one more terminal blocks. You establish the connection to the module by means of a connecting cable (round-sheath ribbon cable).

Configuration of SIMATIC TOP connect with a S7-300

A SIMATIC TOP connect and a SIMATIC TOP connect TPA always consist of:

- A front connector module with flat ribbon connection ①,

- One or more terminal blocks ③ and

- One or more connecting cables with plug-and-socket connectors at ends ②
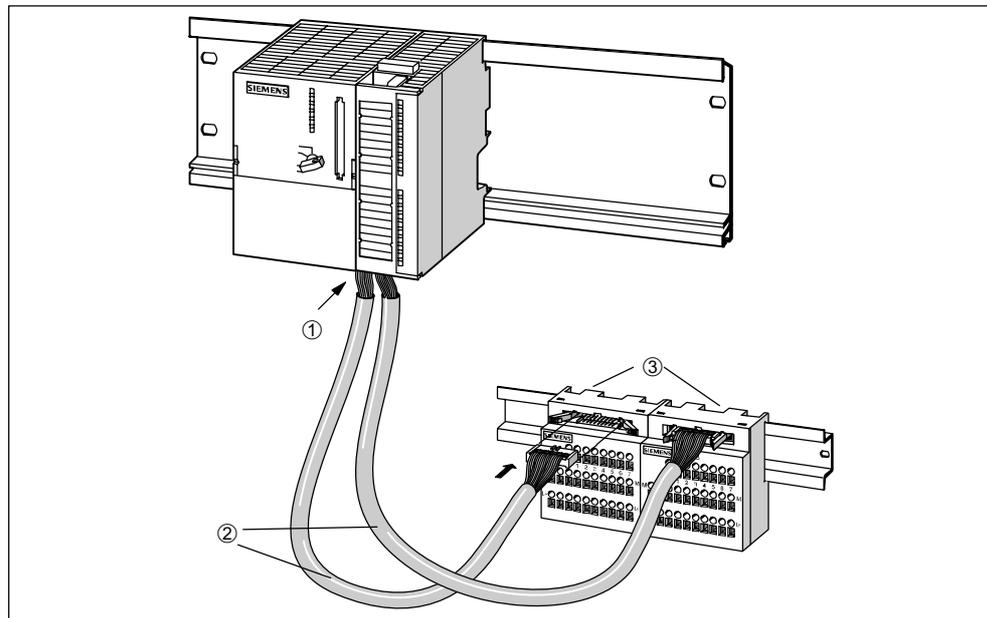
Figure 8-1   SIMATIC TOP connect on a S7-300

Advantages

Use of SIMATIC TOP connect/... TPA features the following advantages:

- Fast, low-cost wiring (the use of central terminal blocks is no longer necessary)
- Simple mounting of the components (front connector module, connecting cable, terminal block)
- Each component can be replaced separately
- Connecting cable configurable without waste
- Wiring errors are drastically reduced
- Neat and tidy cabinet wiring
- The supply voltage for the module can be connected to components of SIMATIC TOP connect/... TPA
- Simplification of the terminals for M- and L+ connection

Range of modules

The table below lists all the modules which you can wire with SIMATIC TOP connect and SIMATIC TOP connect TPA.

You will find a detailed list of the components of SIMATIC TOP connect/... TPA with their order numbers in Table 8-5 on page 8-12 and Table 8-13 on page 8-20.

Table 8-1   SIMATIC TOP connect/... TPA: Connectable Modules

Component	Front view of terminal block	Wiring possible with module...
SIMATIC TOP connect		SM 321; DI 32 x DC 24 V SM 321; DI 16 x DC 24 V SM 321; DI 16 x 24 VDC; source input
		SM 322; DO 32 x DC 24 V/0.5 A SM 322; DO 16 x DC 24 V/0.5 A SM 322; DO 8 x 24 VDC/0.5 A with diagnostic interrupt SM 322; DO 8 x DC 24 V/2 A
		SM 323; DI 16/DO 16 x DC 24 V/0.5 A SM 323; DI 8/DO 8 x DC 24 V/0.5 A
SIMATIC TOP connect TPA		SM 331 analog input module; AI 2 x 12 bits SM 331; AI 8 x 12 bits SM 332; AO 4 x 12 bits SM 332 analog output module; AO 2 x 12 bits SM 332; AO 4 x 16 bits SM 334; AI 4/AO 2 x 8/8 bits SM 334; AI 4/AO 2 x 12 bits SM 335; AI 4/AO 4 x 14 bits;
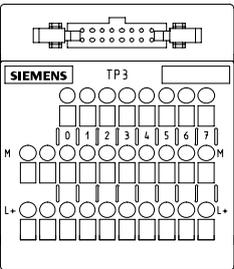
8.2 Wiring Components

Introduction

The following table contains the tasks that you have to perform one after the other to commission SIMATIC TOP connect/... TPA successfully.

The sequence of steps is a suggestion but you can perform individual steps sooner or later.

Sequence of steps for wiring

Table 8-2   Sequence of Steps for Wiring SIMATIC TOP connect/... TPA

Step	Procedure	Refer to Section...
1.	Cut connecting cable to length and terminate	8.2.1
2.	Wire the front connector module	8.2.2 and 8.3 or 8.4
3.	Connect the connecting cable to the terminal block	8.2.3 and 8.3 or 8.4
4.	Wire actuators/sensors to the terminal block	8.2.4

8.2.1   Cut the Connecting Cable to Length and Terminate

Maximum length of cable

The length of the connecting cable (round-sheath ribbon cable) between the SIMATIC S7 and the terminal blocks must not be more than 30 m.

Using the connectors

You must attach connectors to either end of the round-sheath ribbon cable, for connection to the front connector module and the terminal block.

Connect the round-sheath ribbon cable to connector

1. Cut the round-sheath ribbon cable to the length required and remove part of the cable sheath at both ends.

   You will find the length of the cable sheath that has to be removed in the following table:

Cable end to ...		Cable sheath to be removed		external ribbon cable	internal ribbon cable	external ribbon cable	internal ribbon cable
		20-pin front connector	40-pin front connector	20-pin front connector		40-pin front connector	
... top connector of front connector module	1 x 16 core shielded/unshielded	110 mm	115 mm				
... bottom connector of front connector module		70 mm	75 mm				
... top connector of front connector module	2 x 16 core unshielded	95 mm	115 mm	95 mm		115 mm	
... bottom connector of front connector module		95 mm	115 mm		40 mm		75 mm
... socket of terminal block		40 mm		100 mm			

2. Thread the cable into the 16-pin connector.

   It is important that you note the position of the details marked in the following figure.
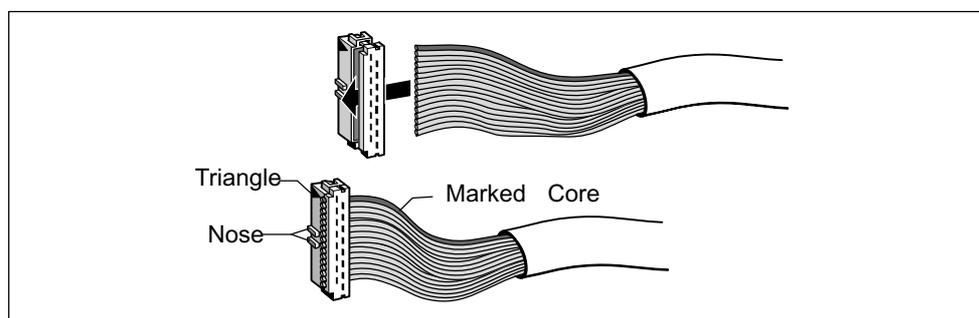
Figure 8-2   Threading the Round-Sheath Ribbon Cable into the Connector

3. Clamp the end of the cable into the connector with the crimping tool.

4. Attach the strain relief device to the connector of the terminal block as follows:

   – Fold back the cable over the connector

   – Push the enclosed strain relief device over the cable

   – Snap the strain relief device into place on the connector

8.2.2 Wiring the Front Connector Module

Introduction

This chapter describes the principle of wiring the front connector modules. Note also the special sections for SIMATIC TOP connect and SIMATIC TOP connect TPA (Section 8.3 and 8.4, respectively). In those sections, you will find, among other things, selection criteria for the front connector modules and specific connection examples.

Using the front connector module

You require the front connector module to connect the connecting cable to the module. In addition, you can connect the supply voltage of the module to the front connector module.

Wiring rules for connecting the supply voltage

The following table shows you what you have to consider when connecting the module supply voltage to the terminal block or front connector module.

The terminals for the supply voltage are screws or spring-loaded terminals (refer to Section 8.2.4 for handling spring-loaded terminals).

Table 8-3   Wiring Rules for Connecting the Supply Voltage

Rules for ...	Terminal block		Front connector	
	Spring-loaded connection	Screw-type connection	Up to 4 Terminals	Up to 8 Terminals
Conductor cross-sections suitable for connection:				
Solid conductors	No		No	No
Stranded conductors				
• Without end ferrules	0.25 to 1.5 mm^2		0.25 to 1.5 mm^2	0.25 to 0.75 mm^2
• With end ferrules	0.25 to 1.5 mm^2		0.25 to 1.5 mm^2	0.25 to 0.75 mm^2
No of conductors per terminal	1 or combination of 2 conductors up to 1.5 mm^2 (sum) in a common end ferrule			
Max. diameter of conductor insulation	$\varnothing$ 3.1 mm		$\varnothing$ 3.1 mm	$\varnothing$ 2.0 mm
Length of conductor insulation to be stripped				
• Without insulation collar	11 mm		6 mm	
• With insulation collar	11 mm		–	
End ferrules to DIN 46228				
• Without insulation collar	Model A; up to 12 mm long	Model A; up to 12 mm long	Model A; 5 to 7 mm long	
• With insulation collar			–	
– 0.25 to 1.0 mm^2	Model E; up to 12 mm long	Model E; up to 12 mm long		
– 1.5 mm^2	Model E; 12 mm long	Model E; 18 mm long		

Connect the connecting cable and the supply voltage to the front connector module

1. Open the front door of the module.

2. Bring the front connector into the wiring position.

3. If necessary, connect the cables for the incoming supply of the module supply voltage.

4. Insert the connecting cable into the front connector module as shown in the following figure:
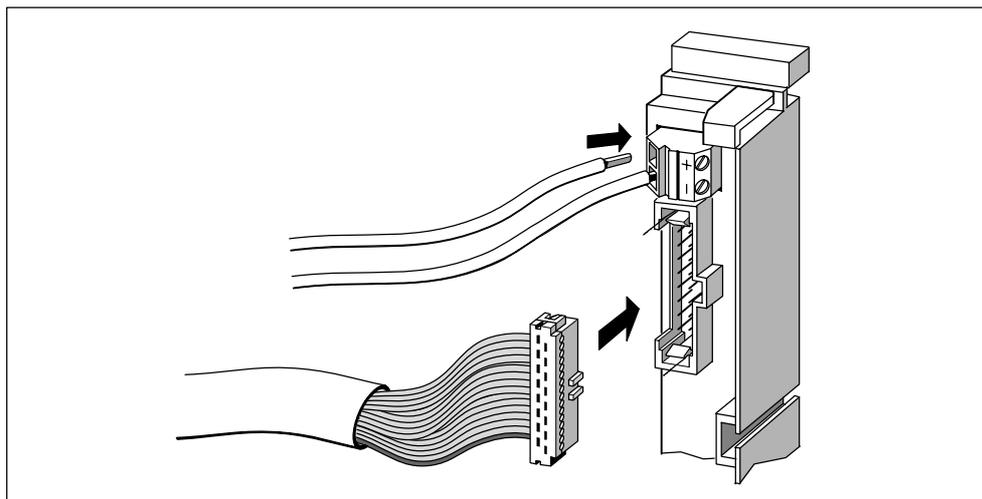
Figure 8-3   Inserting the Connecting Cable into the Front Connector Module

5. Twist every connecting cable 90° downwards and turn through one whole turn to the extent possible.

Additional steps for wiring for 32-channel digital modules

Note

When using 32-channel digital modules, you must observe the assignment of the supply connections to the connecting cable terminals and the assignment of the connecting cable terminals to the address bytes of the module (refer to Figure 8-4 and Table 8-4).

6. Thread a strain relief assembly into the middle of the front connector. This strain relief assembly is used to fix the connecting cables in the narrow cable stowage area of the module.

7. Thread the strain relief assembly into the front connector.

Front connector module for 32-channel digital modules

The following figure shows the front view of the front connector module for 32-channel digital modules.
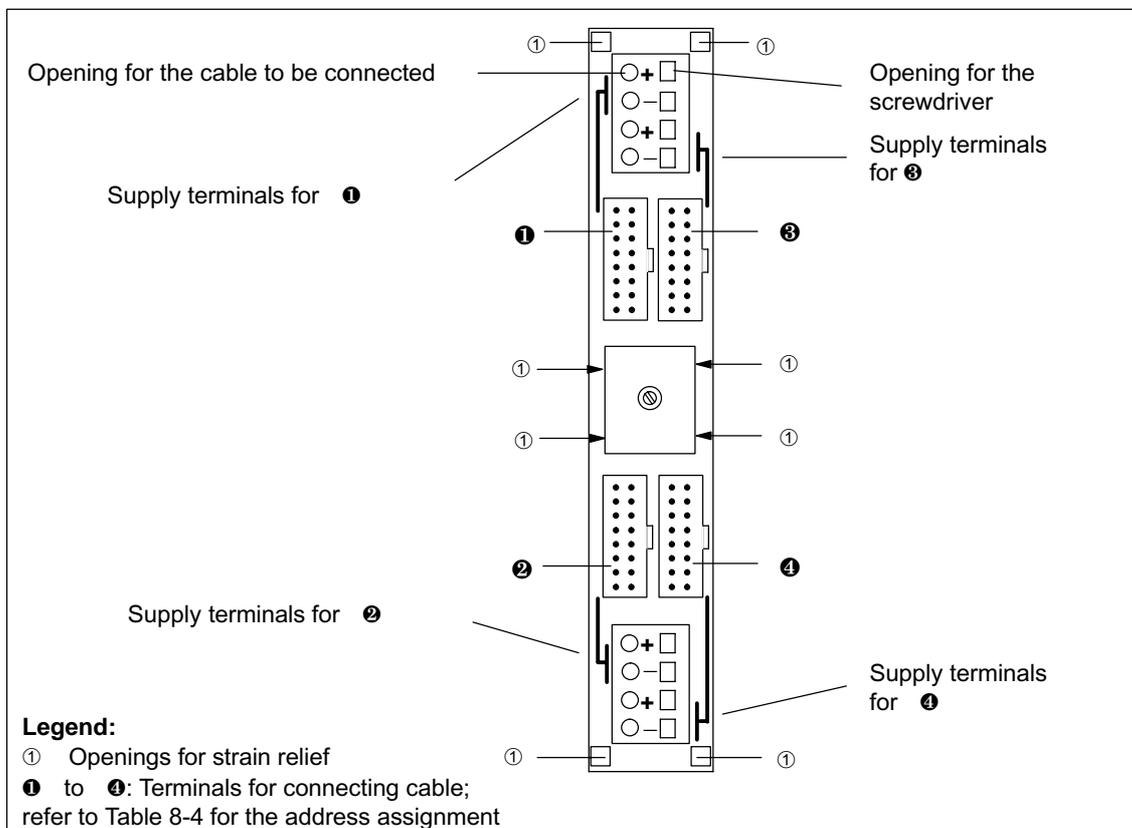
Figure 8-4   Front connector module for 32-channel digital modules

Assignment of connecting cable terminals to address bytes of 32-channel digital modules

Table 8-4   Assignment of Connecting Cable Terminals to Address Bytes of 32-Channel Digital Modules

Refer to Figure 8-4: Connecting Cable Terminal	Address Assignment for		
	Digital Input Module	Digital Output Module	Digital Input/Output Module
❶	IB x	QB x	IB x
❷	IB (x+1)	QB (x+1)	IB (x+1)
❸	IB (x+2)	QB (x+2)	QB x
❹	IB (x+3)	QB (x+3)	QB (x+1)

8.2.3 Connecting the Connecting Cable to the Terminal Block

Introduction

A description of how to mount the terminal blocks is presented in the following. Note also the special sections for SIMATIC TOP connect and SIMATIC TOP connect TPA (Section 8.3 and 8.4, respectively). In those sections, you will find, among other things, selection criteria for the different terminal blocks and specific connection examples.

Mounting the terminal block and connecting cable

1. Attach the terminal block to a 35 mm standard rail in accordance with EN 50 022.

2. Insert the connecting cable into the terminal block as shown in the following figure:
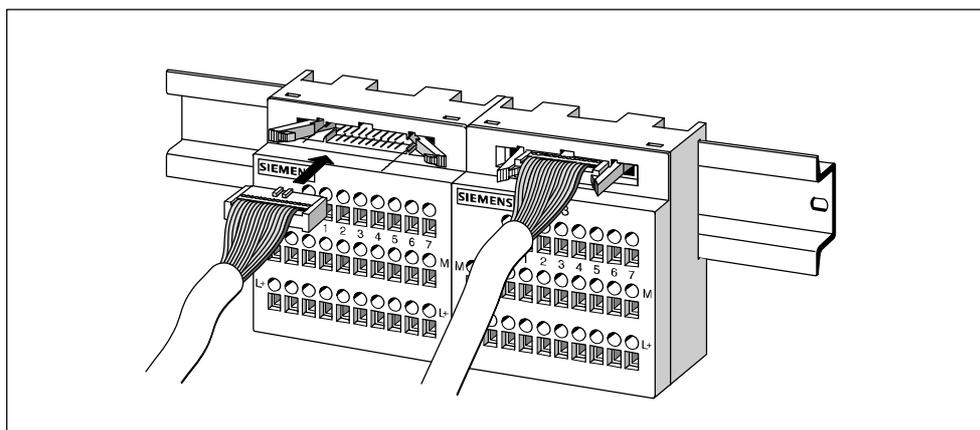
Figure 8-5   Insert the connecting cable into the terminal block

8.2.4 Wiring Actuators/Sensors to the Terminal Block

Screw-type or spring-loaded terminals

To mount the signal leads of the actuators/sensors to the terminal block and the supply lines to the terminal block and front connector module, you can choose between screw-type and spring-loaded components.

The principle of spring-loaded components is dealt with in greater detail in the following, since it allows fast and simple connection of the signal lines and supply cables.

Spring-loaded terminal block

Opening for the cable to be connected

Opening for the screwdriver for pressing the spring-loaded contact
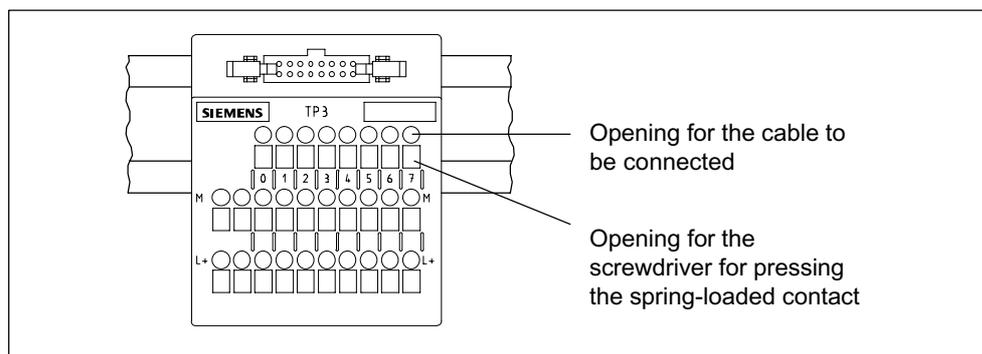
Figure 8-6   Spring-loaded terminal block

> ⚠ **Caution**
>
> The spring-loaded contact will be damaged, if you insert the screwdriver into the opening for the cable.
>
> Make sure that you insert the screwdriver only into the rectangular opening of the terminal block.

Attaching the cable to the spring-loaded contact

Attach the cables to the spring-loaded contacts as follows:

1. Use a screwdriver ① to press down the spring-loaded terminal in the rectangular opening and to hold it down.

2. Insert the cable ② into the round opening of the corresponding spring-loaded terminal as far as it will go.

3. Remove the screwdriver ③ from the spring-loaded terminal. The cable is held by the spring-loaded contact.
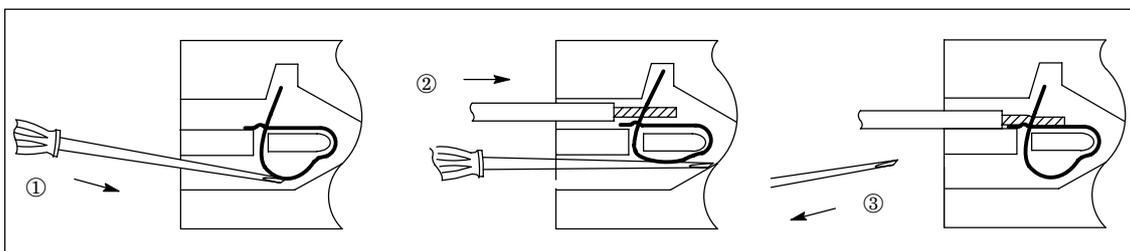
Figure 8-7   Principle of Spring-Loaded Connections

8.3   Wiring SIMATIC TOP Connect with Digital Modules

Introduction

For wiring the module with actuators/sensors using SIMATIC TOP connect, you must first select the components as a function of the module and method of connection (screw type or spring-loaded terminal, one-conductor, three-conductor or 2A connection; relay).

8.3.1   SIMATIC TOP Connect Components and Selection Aid

Components

The following table contains all the component of SIMATIC TOP connect.

Table 8-5   Components of SIMATIC TOP connect

Components of SIMATIC TOP connect			Order number
Terminal block	... for one-conductor connection	Spring-loaded screw-type	6ES7924-0AA00-0AB0 6ES7924-0AA00-0AA0
	... for one-conductor connection (10 items)	Spring-loaded screw-type	6ES7924-0AA00-1AB0 6ES7924-0AA00-1AA0
	... for three-conductor connection	Spring-loaded screw-type	6ES7924-0CA00-0AB0 6ES7924-0CA00-0AA0
	... for three-conductor connection (10 items)	Spring-loaded screw-type	6ES7924-0CA00-1AB0 6ES7924-0CA00-1AA0
	... for 2A modules	Spring-loaded screw-type	6ES7924-0BB00-0AB0 6ES7924-0BB00-0AA0
	... for 2A modules (10 items)	Spring-loaded screw-type	6ES7924-0BB00-1AB0 6ES7924-0BB00-1AA0
	... for relays	Spring-loaded screw-type	6ES7924-0CD00-0AB0 6ES7924-0CD00-0AA0
Front connector	for 32-channel modules (refer to Figure 8-4)	Voltage supply via: Spring-loaded terminals	6ES7921 3AA20-0AA0
	for 16-channel modules	Voltage supply via: spring-loaded screw-type	6ES7921-3AA00-0AA0 6ES7921-3AB00-0AA0
	for 16-channel 2A modules	Voltage supply via: spring-loaded screw-type	6ES7921-3AC00-0AA0 6ES7921-3AD00-0AA0
Connectors (plug-in connectors), set of 8 (insulation displacement connectors)			6ES7921-3BE10-0AA0
Round-sheath ribbon cable 1 x 16	Unshielded	30 m 60 m	6ES7923-0CD00-0AA0 6ES7923-0CG00-0AA0
	Shielded	30 m 60 m	6ES7923-0CD00-0BA0 6ES7923-0CG00-0BA0

Table 8-5   Components of SIMATIC TOP connect, continued

Components of SIMATIC TOP connect			Order number
Round-sheath ribbon cable 2 x 16	Unshielded	30 m 60 m	6ES7923-2CD00-0AA0 6ES7923-2CG00-0AA0
Crimping tool for 16-pin connector			6ES7928-0AA00-0AA0

Selection aid

In the following table you will find the components of SIMATIC TOP connect with which you can wire the digital modules.

Table 8-6   Selection Table for SIMATIC TOP connect Components

Digital Modules	Terminal block for...				Front connector module for...	
	One-con-ductor connection	Three-con-ductor connection	2A modules	Relays	SM; 16 or 32 channels	2A modules
SM 321; DI 32 x 24 VDC	✕	✕	–	–	✕	–
SM 321; DI 16 x 24 VDC	✕	✕	–	–	✕	–
SM 321; DI 16 x 24 VDC; source input	✕	✕	–	–	✕	–
SM 322; DO 32 x 24 VDC/0.5 V	✕	✕	–	✕	✕	–
SM 322; DO 16 x 24 VDC/0.5 V	✕	✕	–	✕	✕	–
SM 322; DO 8 x 24VDC/0.5 V; with diagnostic interrupt	✕	✕	–	–	✕	–
SM 322; DO 8 x 24 VDC/2 A	–	–	✕	–	–	✕
SM 323; DI 16/DO 16 x 24VDC/ 0.5 A	✕	✕	–	–	✕	–
SM323; DI 8/DO 8 x 24 VDC/0.5 A	✕	✕	–	–	✕	–

One-conductor or three-conductor connection

With the three-conductor connection, you can optionally apply the supply voltage for the module to the front connector module or to the terminal block. With the one-conductor connection, this can only be done to the front connector module.

2A module connection

You require the following information on wiring 2A modules only when you want to use the SM 322; 8 x DO 24 VDC/2 A with SIMATIC TOP connect.

8.3.2 Wiring the Module with Terminal Block for One-Conductor Connection

Connection Notes

Table 8-7   Connection Notes for SIMATIC TOP connect with One-Conductor Connection

Digital Modules	Connection Notes				
	Supply Voltage Feed-In			Additional jumper required at power supply	Description on terminal block not in line with description on SM
	At front connector only	Add. ground conn. at terminal block	At front connector or terminal block		
SM 321; DI 32 x DC 24 V	✕	–	–	–	–
SM 321; DI 16 x DC 24 V	✕	–	–	–	–
SM 321; DI 16 x 24 VDC; source input	✕	–	–	–	–
SM 322; DO 32 x DC 24 V/0.5 A	✕	–	–	–	–
SM 322; DO 16 x DC 24 V/0.5 A	✕	–	–	–	–
SM 322; DO 8 x 24 VDC/0.5 A with diagnostic interrupt	✕	–	–	–	✕
SM 323; DI 16/DO 16 x DC 24 V/0.5 A	✕	–	–	–	–
SM 323; DI 8/DO 8 x 24 VDC/0.5 A	✕	–	–	–	–

Assignments of the terminal block for one-conductor connection

Table 8-8   Terminal Assignments of the Terminal Block for One-Conductor Connection

Front view of terminal block	Assignments of the Terminals
	Top row: Terminals 0 to 7: inputs/outputs x.0 to x.7

Connecting the power supply

Always connect the supply voltage to the front connector module Observe the wiring rules in Table 8-3 on page 8-7.

In the following example, you must connect L+ to Plus of the **upper** terminal and M to Minus of the **lower** terminal.

Connecting the terminal block for one-conductor connection
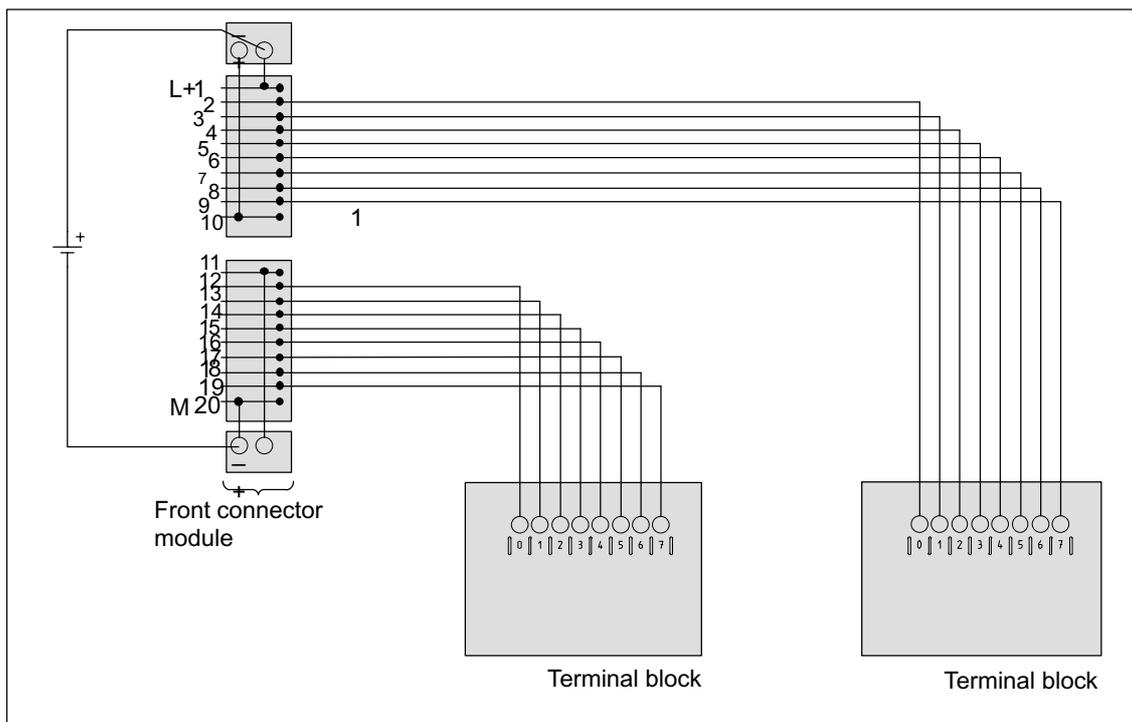
Figure 8-8   Wiring a Digital Module with Terminal Block for a One-Conductor Connection

8.3.3 Wiring the Module with Terminal Block for Three-Conductor Connection

Connection Notes

Table 8-9   Connection Notes for SIMATIC TOP connect with Three-Conductor Connection

Digital Modules	Connection Notes				
	Supply Voltage Feed-In			Additional jumper required at power supply	Description on terminal block not in line with description on SM
	At front connector only	Add. ground conn. at terminal block	At front connector or terminal block		
SM 321; DI 32 x DC 24 V	–	–	✕	✕	–
SM 321; DI 16 x DC 24 V	–	–	✕	✕	–
SM 321; DI 16 x 4 VDC; source input	–	–	✕	✕	–
SM 322; DO 32 x DC 24 V/0.5 A	–	–	✕	–	–
SM 322; DO 16 x DC 24 V/0.5 A	–	–	✕	–	–
SM 322; DO 8 x 24 VDC/0.5 A with diagnostic interrupt	–	–	✕	✕	✕
SM 323; DI 16/DO 16 x 24 VDC/0.5 A	–	–	✕	–	–
SM 323; DI 8/DO 8 x 24 VDC/0.5 A	–	–	✕	–	–

Assignment of the terminal block for three-conductor connection

Table 8-10   Terminal Assignments of the Terminal Block for Three-Conductor Connection

Front view of terminal block	Assignments of the Terminals
	Top row: Terminals 0 to 7: inputs/outputs x.0 to x.7
	Center row: All terminals: M potential
	Bottom row: All terminals: L + potential

Connecting the power supply

Observe the wiring rules in Table 8-3 on page 8-7.

With some digital modules, two jumpers are generally required for connecting the supply voltage (refer to Table 8-9 on page 8-16).

You can wire the jumpers either in the front connector or in the terminal block. Irrespective of this, you must interconnect the two Plus terminals and the two Minus terminals.

Connecting the terminal block for three-conductor connection
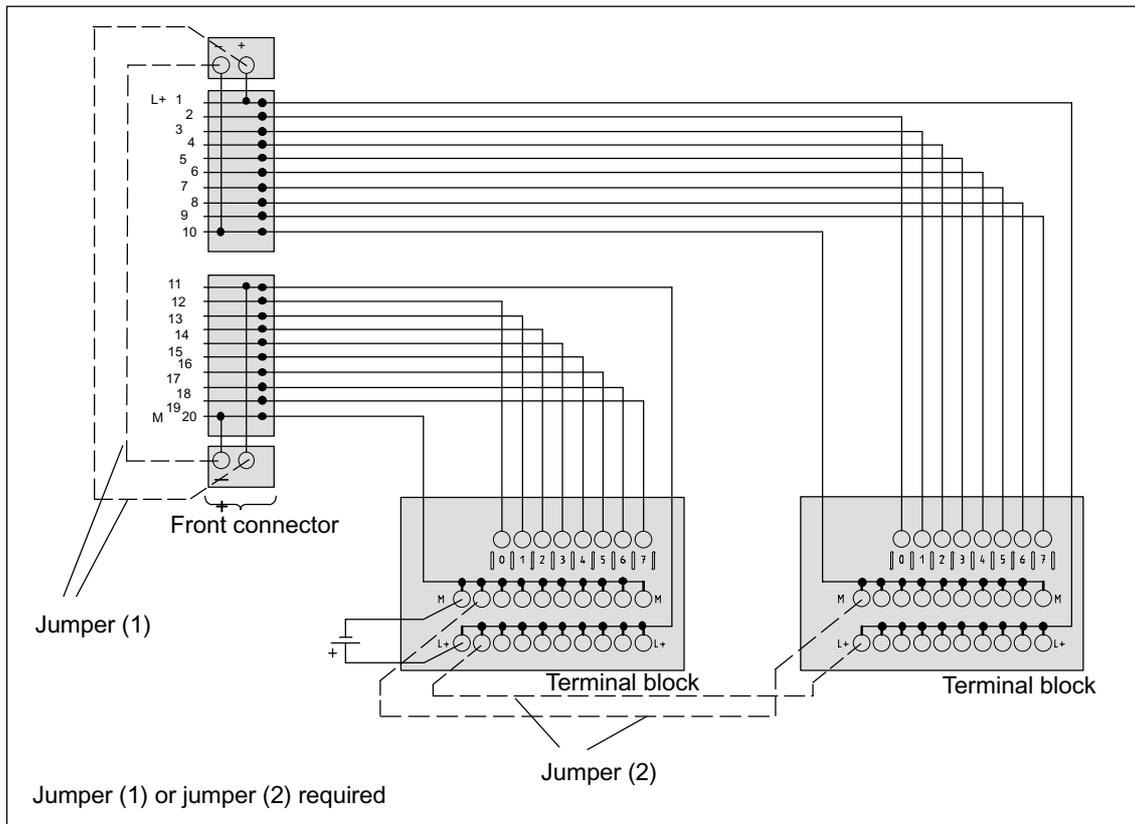
Figure 8-9   Wiring a Digital Module with Terminal Block for a Three-Conductor Connection

8.3.4   Wiring the Module with Terminal Block for 2A Modules

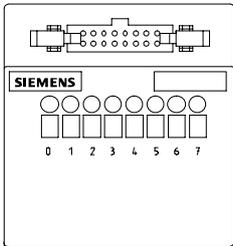You can use the terminal block for 2A modules to wire the SM 322;
8 x DO 24 VDC/2A.

Connection Notes

Table 8-11   Connection Notes for SIMATIC TOP connect with 2A Module Connection

Digital Modules	Connection Notes				
	Supply Voltage Feed-In			Add. jumper required for power supply	Descr. on terminal block not in line with descr. on SM
	At front connector only	Add. ground conn. at terminal block	At front connector or terminal block		
SM 322; DO 16 × 24 VDC/2 A	×	×	–	–	–

Assignment of the Terminal Block for Connection of 2A Modules

Table 8-12   Terminal Assignments of the Terminal Block for 2A Modules

Front view of terminal block	Assignments of the Terminals (left)	Assignments of the Terminals (right)
	Top row: Terminals 0 to 3: outputs x.0 to x.3	Top row, on right: Terminals 0 to 3: outputs x.4 to x.7
	Center row: Terminals 0 to 3: potential M1 for x.0 to x.3	Center row, on right: Terminals 0 to 3: potential M2 for x.4 to x.7
	Bottom row: two-terminal connection for M1	Bottom row: two-terminal connection for M2

Connecting the power supply

Please observe the following when connecting the power supply:

- Apply the wiring rules in Table 8-3 on page 8-7.

- Connect the supply voltage at the front connector module to the potential terminals using separate cables.

- You must equip each terminal block with a cable for M1 or M2, in addition to the connecting cable.

- Connect M1 or M2 via a separate line with the front connector and the terminal block. You may jumper the potential of M1 and M2.

Connection to terminal block for 2A modules
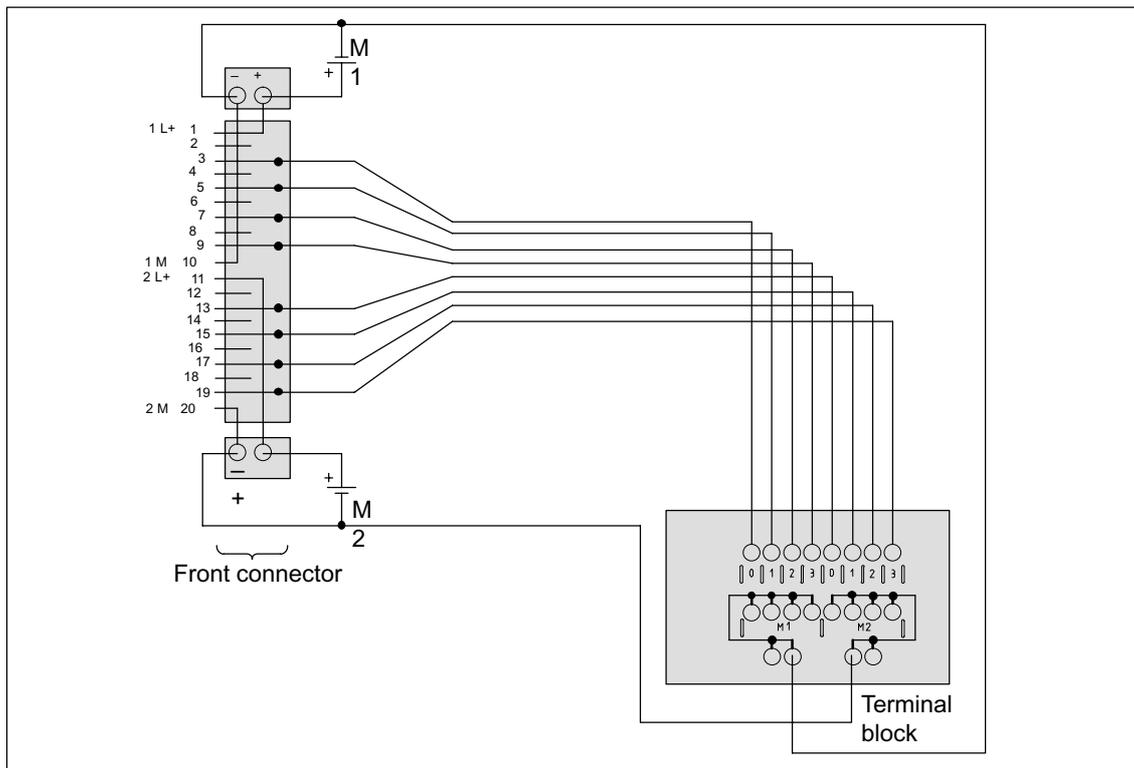
Figure 8-10   Wiring with Terminal Block for 2A Module

8.4 Wiring SIMATIC TOP Connect TPA with Analog Modules

Introduction

For wiring the module with actuators/sensors using SIMATIC TOP connect TPA, you must first select the components as a function of the method of connection (screw-type or spring-loaded terminal).

8.4.1 SIMATIC TOP connect TPA Components and Selection Aid

Components

The following table contains all the component of SIMATIC TOP connect TPA.

Table 8-13 Components for SIMATIC TOP connect TPA

Components of SIMATIC TOP connect TPA			Order number
Terminal block	Quantity: 1	Spring-loaded terminals	6ES7924-0CC00-0AB0
		Screw-type terminals	6ES7924-0CC00-0AA0
	Quantity: 10	Spring-loaded terminals	6ES7924-0CC00-1AB0
		Screw-type terminals	6ES7924-0CC00-1AA0
Front connector		Voltage supply via:	
		Spring-loaded terminals	
		Screw-type terminals	6ES7921-3AF00-0AA0
			6ES7921-3AG00-0AA0
Connectors (plug-in connectors), set of 8 (insulation displacement connectors)			6ES7921-3BE10-0AA0
Shielding plate for terminal block, set of 4			6ES7928-1BA00-0AA0
Terminal element for:			
2 cables, each with a shield diameter of 2 to 6 mm			6ES7390-5AB00-0AA0
1 cable with a shield diameter of 3 to 8 mm			6ES7390-5BA00-0AA0
1 cable with a shield diameter of 4 to 13 mm			6ES7390-5CA00-0AA0
Round-sheath ribbon cable, shielded $\varnothing$ 8 mm	30 m		6ES7923-0CD00-0BA0
	60 m		6ES7923-0CG00-0BA0
Crimping tool for 16-pin connector			6ES7928-0AA00-0AA0

8.4.2 SIMATIC TOP Connect TPA Terminal Assignment and Terminal Allocation

Terminal marking

On the TPA terminal block, the terminals are identified by letters. This simplifies the allocation of the terminals on the analog module to the terminals on the terminal block.

Terminal block assignment

Table 8-14   Terminal Assignment of the Terminal Block of SIMATIC TOP connect TPA

Front view of terminal block	Assignments of the Terminals
	Terminals (Z) and (Y) can be used for multiplying arbitrary potentials and signals.
	The terminals having identical letters are electrically interconnected, **with the exception** of terminals (Z) and Z, and also (Y) and Y.

Multiplier terminal

The lower tier of terminals on the terminal block is designed as 2 x 5 multiplier terminals.

Terminal allocation of an analog module to SIMATIC TOP connect TPA

Terminal number on module	Terminal number on module	Terminal assignment on terminal block TPA	
		Terminal block 1	Terminal block 2
1	1	Y	Y
2	2	B	
3	3	C	
4	4	D	
5	5	E	
6	6	F	
7	7	G	
8	8	H	
9	9	I	
10	10	K	K
11	11	A	A
12	12		B
13	13		C
14	14		D
15	15		E
16	16		F
17	17		G
18	18		H
19	19		I
20	20	Z	Z
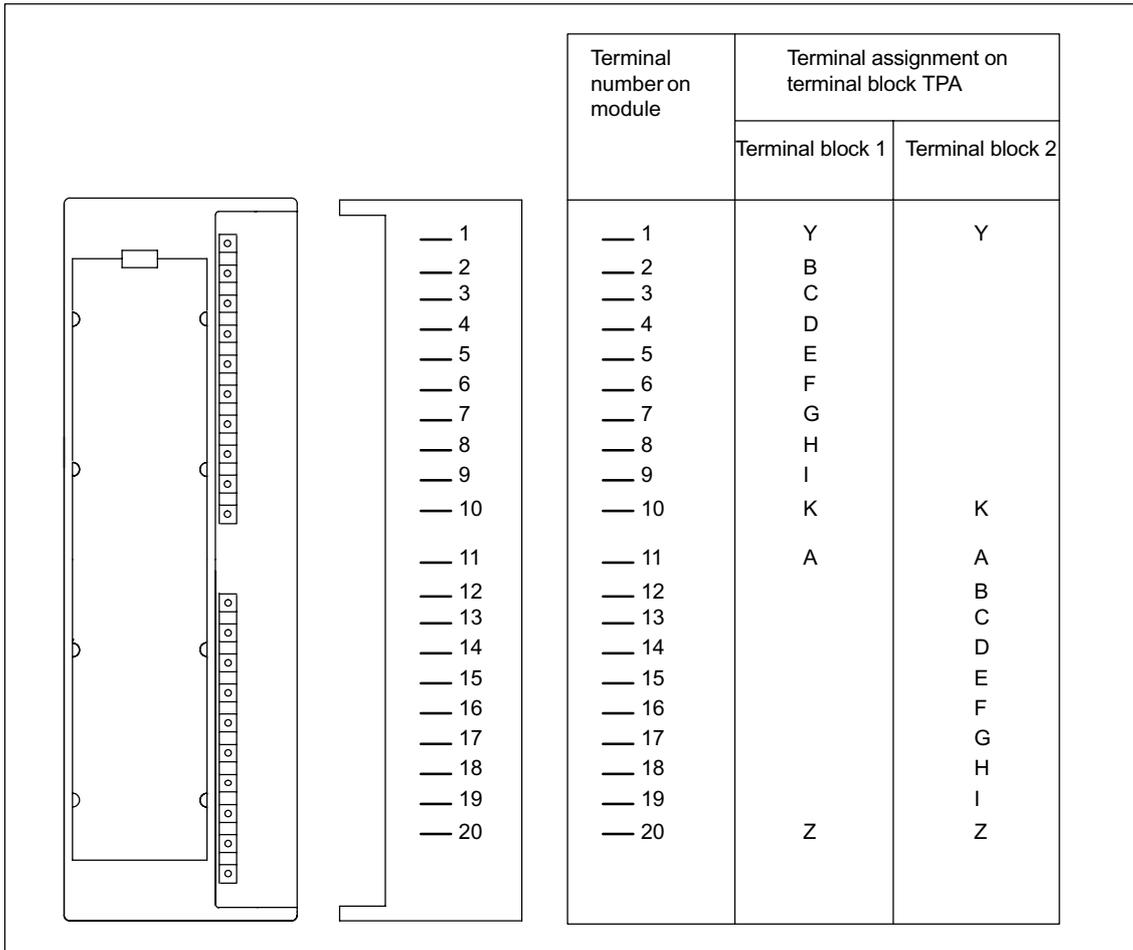
Figure 8-11   Terminal Assignment of Analog Module to SIMATIC TOP connect TPA

8.4.3   Connecting the Signal-Line Shield

Two options for connecting the shield

You can connect the signal line shield to ground as follows:

- On the analog module by means of a shield-support element

  (refer to the manual *Hardware and Installation for the S7-300* or the manual *Distributed I/O device ET 200M* in the section on wiring)

- Directly to the terminal block by means of a shielding plate

Connecting the shield to the terminal block using a shielding plate

1. Before mounting, attach a shielding plate to the terminal block.

2. Mount the terminal block on the DIN rail.

   (In the figure below, you can see that the shielding plate is applied to the rear of the terminal block and thus there is a connection to the grounded rail.)

3. Place the signal-line shield with the shield terminals on the shielding plate.
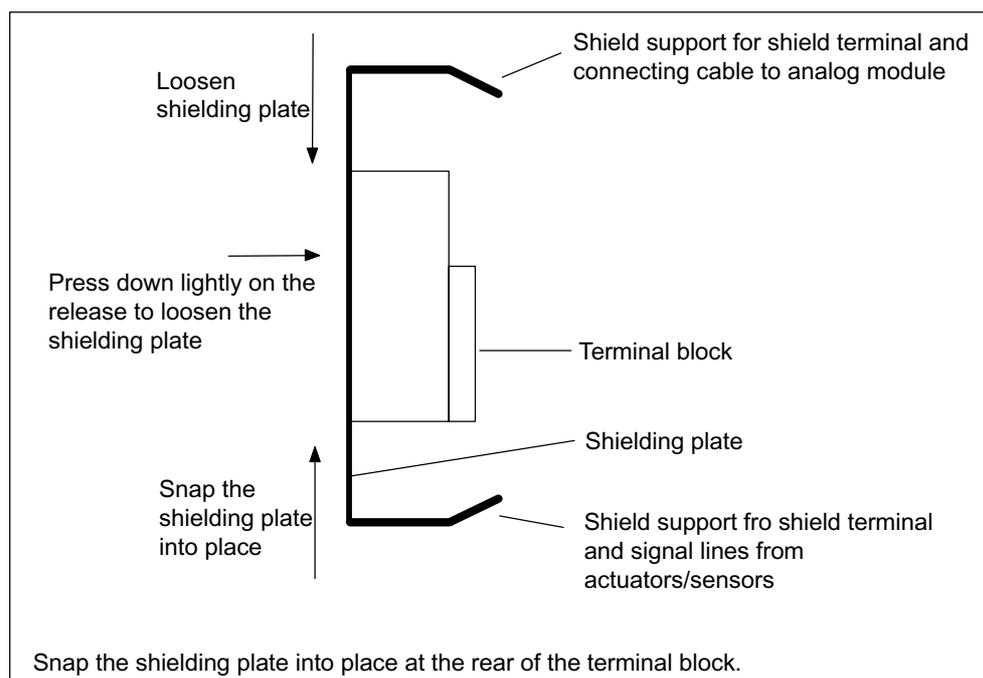
Figure 8-12   SIMATIC TOP connect TPA Terminal Block with Shielding Plate

8.4.4 Connection Example

Connecting the load voltage supply

You can connect the load voltage supply of the analog module to the front connector module. There are separate terminals on the front connector module for the load voltage L+ and M. Observe the wiring rules in Table 8-3 on page 8-7.

Allocation of front connector to terminal block

The **upper socket** of the front connector module is the connection for **terminal block 1** and the **lower socket** of the front connector module is the connection for **terminal block 2**.

Connection example

The illustration below shows an example of connecting the analog input module SM 321; AI 8 x 12 bits in "Resistance Test" mode.

Resistance test	Terminal number on module	Terminal assignment on terminal block TPA	
		Terminal block 1	Terminal block 2
L +	1	Y	Y
M_{0+} CH0	2	B	
M_{0-}	3	C	
I_{C0+}	4	D	
I_{C0-}	5	E	
M_{1+} CH2	6	F	
M_{1-}	7	G	
I_{C1+}	8	H	
I_{C1-}	9	I	
Comp +	10	K	K
Comp–/ Mana	11	A	A
M_{2+} CH4	12		B
M_{2-}	13		C
I_{C2+}	14		D
I_{C2-}	15		E
M_{3+} CH6	16		F
M_{3-}	17		G
I_{C3+}	18		H
I_{C3-}	19		I
M	20	Z	Z
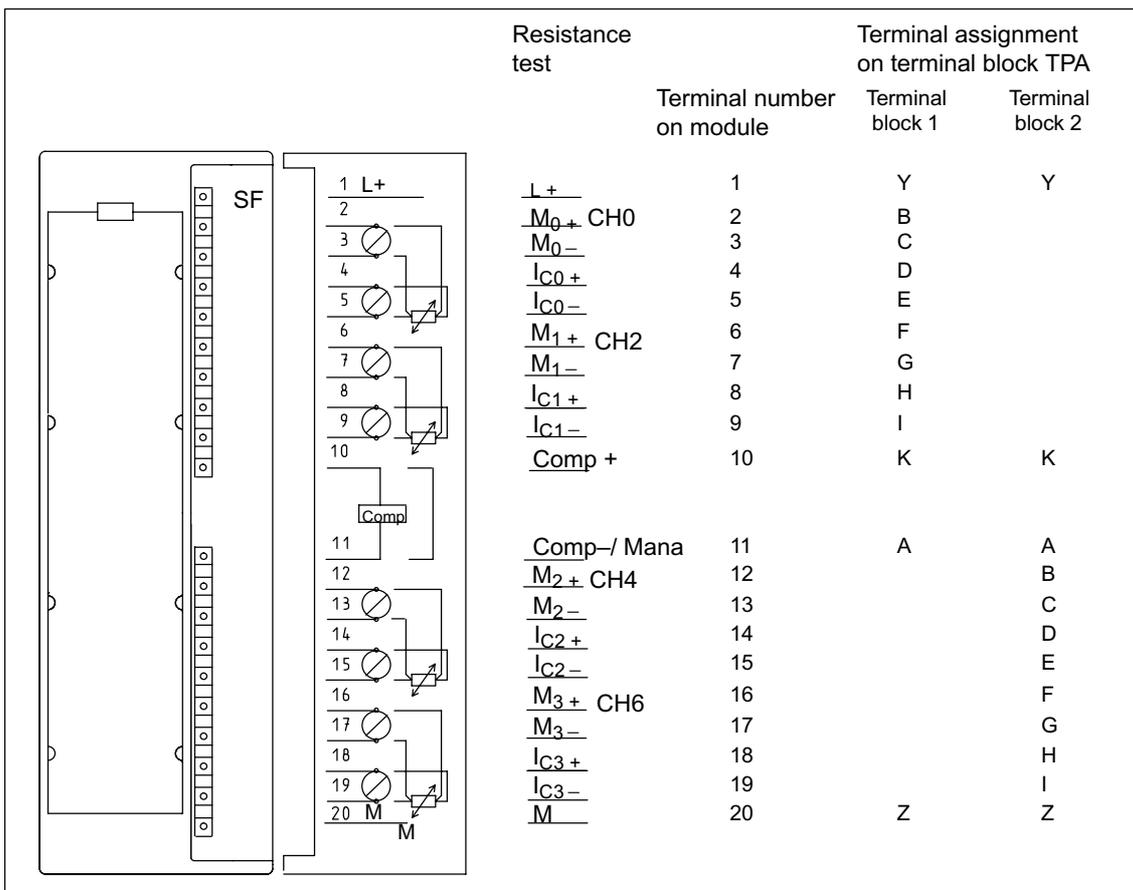
Figure 8-13   Example of Connecting SIMATIC TOP connect TPA to SM 321; AI 8 x 12 bits

Parameter Sets for Signal Modules

A

In this chapter

A.1 How to Assign the Parameters for Signal Modules in the User Program

Parameter assignment in the user program

You have already assigned parameters to the modules in *STEP 7*.

In the user program, you can use a SFC:

- To reassign parameters to the module and
- To transfer the parameters from the CPU to the addressed signal module

Parameters stored in data records

The parameters of the signal modules are located in data records 0 and 1; for some other analog input modules, in data record 128 as well.

Modifiable parameters

You can change the parameters of record 1 and pass them to the signal module using SFC 55. The parameters set on the CPU are not changed when you do this!

You cannot modify the parameters of data record 0 in the user program.

SFCs for parameter assignment

The following SFCs are available for assigning parameters to the signal modules in the user program:

Table A-1   SFCs for assigning Parameters to Signal Modules

SFC No.	Identifier	Application
55	WR_PARM	Transfer modifiable parameters (data record 1 and 28) to the addressed signal module.
56	WR_DPARM	Transfer parameters (data record 0, 1 **or** 128) from the CPU to the addressed signal module.
57	PARM_MOD	Transfer all parameters (data record 0, 1 **and** 128) from the CPU to the addressed signal module.

Description of the parameters

The following sections contain **all** the modifiable parameters for the various module classes. The parameters of the signal modules are described:

- In the on-line help of *STEP 7*

- In this reference manual

  You will find the parameters that can be adjusted for the signal module concerned in the specific sections for the different signal modules.

Further references

An in-depth description of the principle of assigning parameters to signal modules in the user program and a description of the SFCs that can be used for that purpose will be found in the *STEP 7* manuals.

A.2　Parameters of the Digital Input Modules

Parameters

The table below contains all the parameters you can set for digital input modules.

Note

For details of the parameters of parameterized digital input/output modules, see the respective chapter of the module concerned.

You will see which parameters you can modify from the list:

- In *STEP 7*
- With SFC 55 "WR_PARM"
- With SFB 53 "WRREC" (e. g. for GSD).

The parameters set with *STEP 7* can also be transferred with SFCs 56 and 57 and the SFB 53 to the module (refer to the STEP *7* manuals).

Table A-2　Parameters of the Digital Input Modules

Parameter	Data Record No.	Parameters can be assigned with ...	
		... SFC 55, SFB 53	... Programming Device
Input delay	0	No	Yes
Diagnosis of missing sensor supply		No	Yes
Diagnosis of broken wire		No	Yes
Hardware interrupt enable	1	**Yes**	Yes
Diagnostics interrupt enable		**Yes**	Yes
Hardware interrupt with rising edge		**Yes**	Yes
Hardware interrupt with falling edge		**Yes**	Yes

Note

If you want to enable the diagnostic interrupt in the user program in data record 1, you must enable the diagnosis in data record 0 beforehand using *STEP 7*.

Data record 1 structure

The figure below shows the structure of data record 1 for the parameters of the digital input modules.

You activate a parameter by setting the corresponding bit to "1".
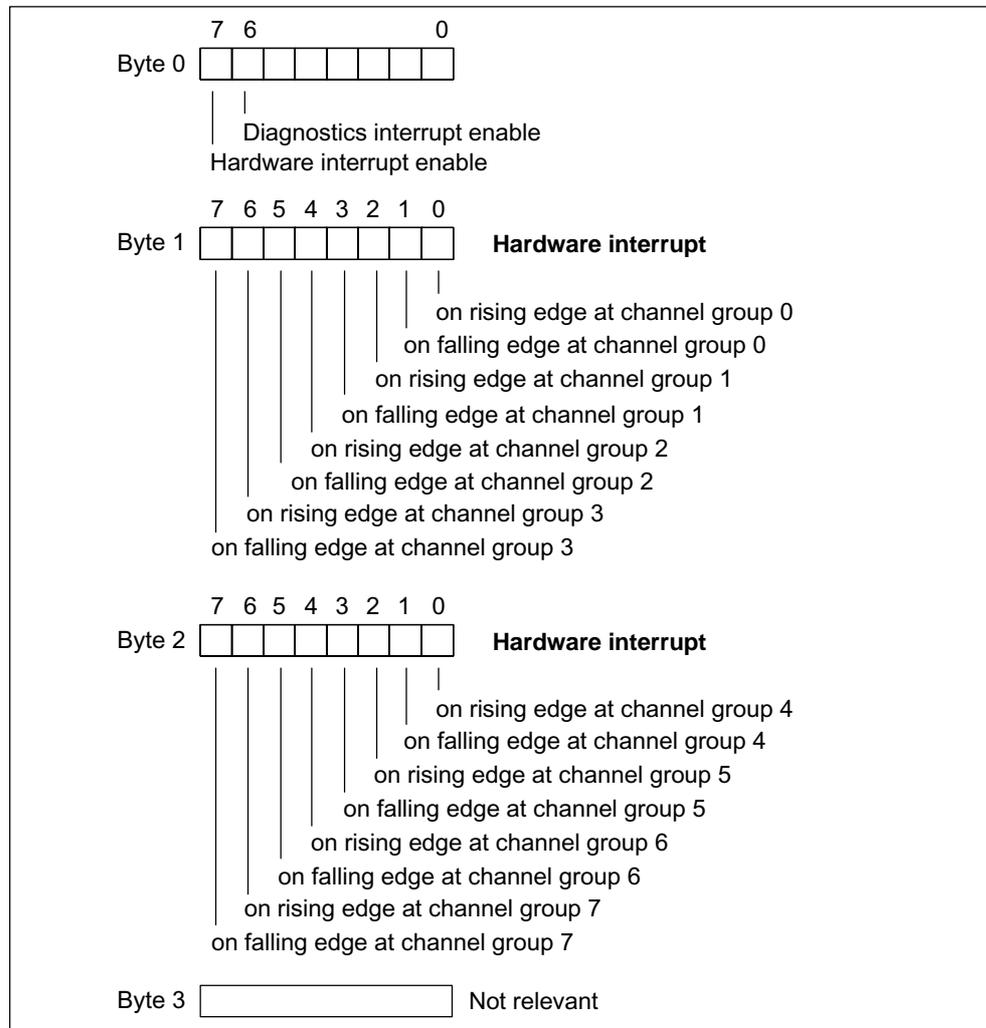
Figure A-1   Data Record 1 for Parameters of the Digital Input Modules

A.3 Parameters of the Digital Output Modules

Parameters

The table below contains all the parameters you can set for digital output modules.

Note

For details of the parameters of parameterized digital input/output modules, see the respective chapter of the module concerned.

You will see which parameters you can modify from the list:

- In *STEP 7*

- With SFC 55 "WR_PARM"

- With SFB 53 "WRREC" (e. g. for GSD).

The parameters set with *STEP 7* can also be transferred with SFCs 56 and 57 and the SFB 53 to the module (refer to the STEP *7* manuals).

Table A-3   Parameters of the Digital Output Modules

Parameter	Data Record No.	Parameters can be assigned with ...	
		... SFC 55, SFB 53	... Programming Device
Diagnosis of missing load voltage L+	0	No	Yes
Diagnosis of broken wire		No	Yes
Diagnosis of short–circuit to M		No	Yes
Diagnosis of short–circuit to L+		No	Yes
Diagnostics interrupt enable	1	**Yes**	Yes
Behavior on CPU STOP		**Yes**	Yes
Enable substitute value "1"		**Yes**	Yes

Note

If you want to enable the diagnostic interrupt in the user program in data record 1, you must enable the diagnosis in data record 0 beforehand using *STEP 7*.

Data record 1 structure

The figure below shows the structure of data record 1 for the parameters of the digital output modules.

You activate a parameter by setting the corresponding bit in byte 0 to "1".

Figure A-2   Data Record 1 for Parameters of the Digital Output Modules

---

Note

You should only enable the parameters in byte 0, "Hold last valid value" and "Enable substitute value" as an alternative.

A.4   Parameters of the Analog Input Modules

Parameters

The table below contains all the parameters you can set for analog input modules.

You will see which parameters you can modify from the list:

- In *STEP 7*

- With SFC 55 "WR_PARM"

The parameters set with *STEP 7* can also be transferred with SFCs 56 and 57 to the module (refer to the *STEP 7* manuals).

Table A-4   Parameters of the Analog Input Modules

Parameter	Data Record No.	Parameters can be assigned with ...	
		... SFC 55	**... Programming Device**
Diagnostics: Group diagnostics	0	No	Yes
Diagnostics: With wire-break check		No	Yes
Temperature unit		No	Yes
Temperature coefficient		No	Yes
Smoothing		No	Yes
Diagnostics interrupt enable	1	**Yes**	Yes
Limit value interrupt enable		**Yes**	Yes
Cycle end interrupt enable		**Yes**	Yes
Interference Suppression		**Yes**	Yes
Measuring Method		**Yes**	Yes
Measuring Range		**Yes**	Yes
Upper limit value		**Yes**	Yes
Lower limit value		**Yes**	Yes

Note

If you want to enable the diagnostic interrupt in the user program in data record 1, you must enable the diagnosis in data record 0 beforehand using *STEP 7*.

Data record 1 structure

The figure below shows the structure of data record 1 for the parameters of the analog input modules.

You activate a parameter by setting the corresponding bit in byte 0 and 1 to "1".

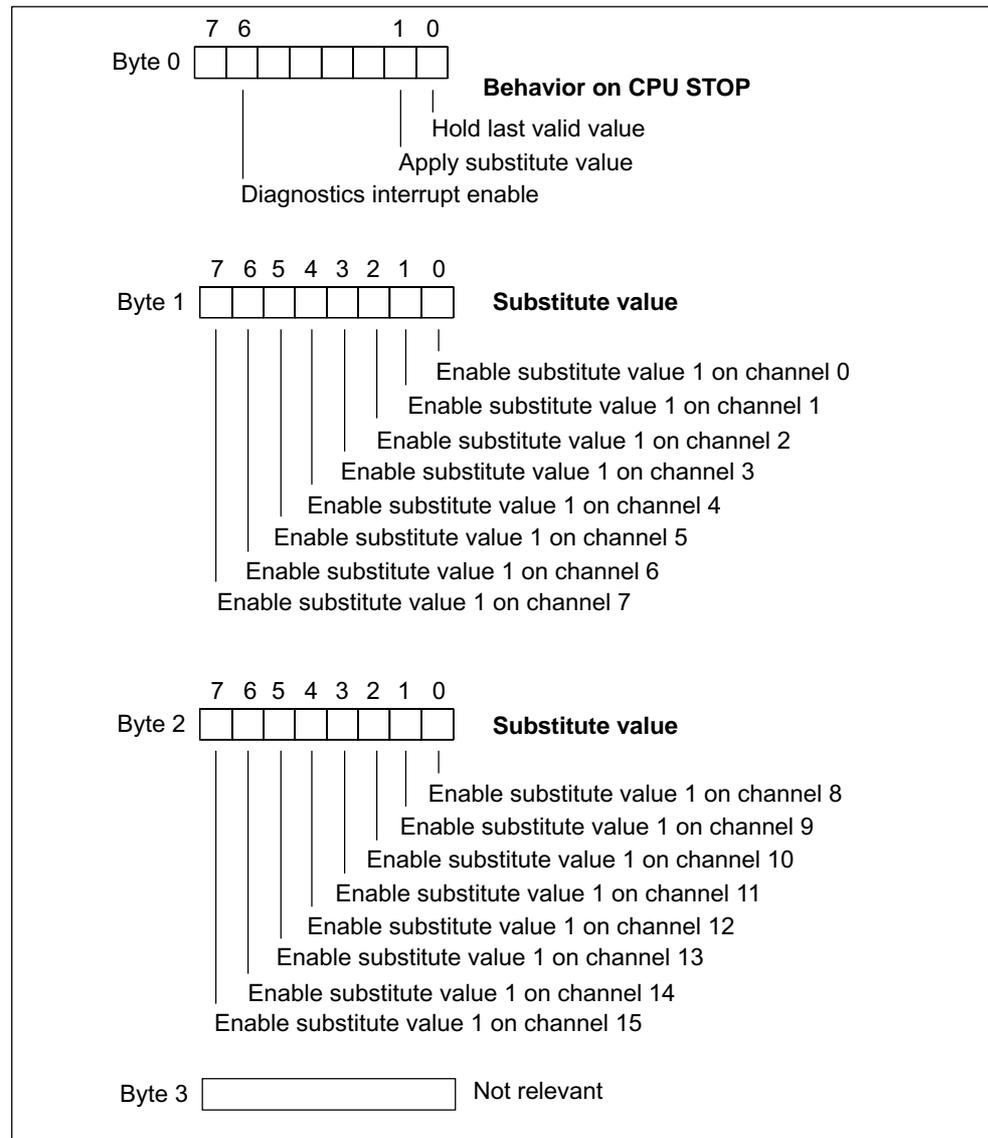

Figure A-3   Data Record 1 for Parameters of the Analog Input Modules

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Note

The representation of the limit values matches the analog value representation (see Chapter 4). Please observe the range limits when setting the limit values.

Interference frequency suppression

The table below contains the codes for the different frequencies, which you enter in byte 1 of data record 1 (refer to Figure A-3). You must count the resulting integration time separately for each channel!

Table A-5   Codes for Interference Suppression of the Analog Input Modules

Interference Suppression	Integration Time	Code
400 Hz	2.5 ms	2#00
60 Hz	16.7 ms	2#01
50 Hz	20 ms	2#10
10 Hz	100 ms	2#11

Measuring methods and measuring ranges

The table below contains all the measuring methods and measuring ranges of the analog input modules and their codes. You must enter these codes in bytes 2 to 5 of data record 1 (refer to Figure A-3).

Note

Please note that a measuring range module may need to be reconnected, depending on the measuring range (see Chapter 4)!

Table A-6   Codes for the Measuring Ranges of the Analog Input Modules

Measuring Method	Code	Measuring Range	Code
Deactivated	2#0000	Deactivated	2#0000
Voltage	2#0001	± 80 mV ± 250 mV ± 500 mV ± 1 V ± 2.5 V ± 5 V 1 to 5 V 0 to 10 V ± 10 V ± 25 mV ± 50 mV	2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001 2#1010 2#1011

Table A-6   Codes for the Measuring Ranges of the Analog Input Modules

Measuring Method	Code	Measuring Range	Code
Four-wire transmitter	2#0010	± 3.2 mA ± 10 mA 0 to 20 mA 4 to 20 mA ± 20 mA ± 5 mA	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101
Two-wire transmitter	2#0011	4 to 20 mA	2#0011
Resistance, four-conductor connection	2#0100	150 Ω 300 Ω 600 Ω 10 kΩ	2#0010 2#0100 2#0110 2#1001
Resistor four-conductor connection; 100 Ω compensation	2#0110	52 to 148 Ω 250 Ω 400 Ω 700 Ω	2#0001 2#0011 2#0101 2#0111
Thermal resistance + linearization four-conductor connection	2#1000	Pt 100 climate Ni 100 climate Pt 100 standard range Pt 200 standard range Pt 500 standard range Pt 1000 standard range Ni 1000 standard range Pt 200 climate Pt 500 climate Pt 1000 climate Ni 1000 climate Ni 100 standard range	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001 2#1001 2#1011
Thermocouples internal comparison	2#1010	Type B [PtRh – PtRh] Type N [NiCrSi – NiSi] Type E [NiCr – CuNi] Type R [PtRh –Pt] Type S [PtRh –Pt] Type J [Fe – CuNi IEC] **Type L [Fe – CuNi]** Type T [Cu – CuNi] Type K [NiCr – Ni] Type U [Cu –Cu Ni]	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001
Thermocouples external comparison	2#1011		
Thermocouples + linearization internal comparison	2#1101		
Thermocouples + linearization external comparison	2#1110		

A.5 Parameters of the SM 331; AI 8 x RTD

Parameters

The table below contains all the parameters which you can set for analog input module SM 331; AI 8 x RTD.

You will see which parameters you can modify from the list:

- In *STEP 7*
- With SFC 55 "WR_PARM"

The parameters set with *STEP 7* can also be transferred with SFCs 56 and 57 to the module (refer to the *STEP 7* manuals).

Table A-7   Parameters of the SM 331; AI 8 x RTD

Parameter	Data Record No.	Parameters can be assigned with ...	
		... SFC 55	... Programming Device
Diagnostics: Group diagnostics	0	No	Yes
Diagnostics: With wire-break check		No	Yes
Diagnostics interrupt enable	1	**Yes**	Yes
Limit value interrupt enable		**Yes**	Yes
Cycle end interrupt enable		**Yes**	Yes
Temperature unit		**Yes**	Yes
Measuring Method	128	**Yes**	Yes
Measuring Range		**Yes**	Yes
Module filtering mode		**Yes**	Yes
Temperature coefficient		**Yes**	Yes
Interference Suppression		**Yes**	Yes
Smoothing		**Yes**	Yes
Upper limit value		**Yes**	Yes
Lower limit value		**Yes**	Yes

Note

If you want to enable the diagnostic interrupt in the user program in data record 1, you must enable the diagnosis in data record 0 beforehand using *STEP 7*.

Structure of data record 1

The figure below shows the structure of data record 1 for SM 331;
AI 8 xRTD. You activate a parameter by setting the corresponding bit to "1".
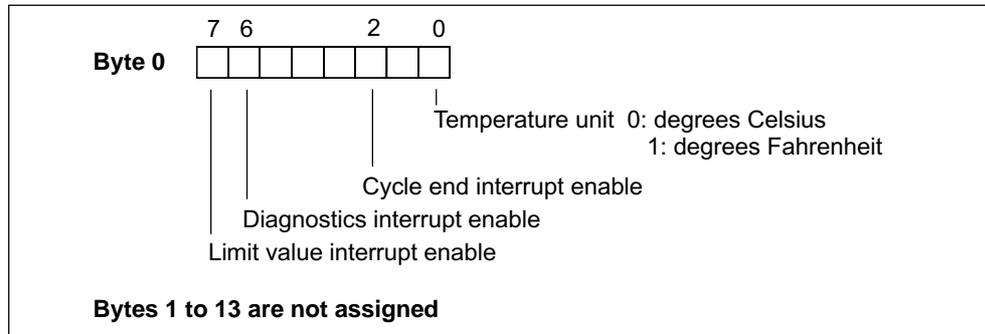
Figure A-4   Data Record 1 of the Parameters for SM 331; AI 8 x RTD

Structure of data record 128

The figure below shows the structure of data record 128 for SM 331; AI 8 x RTD.
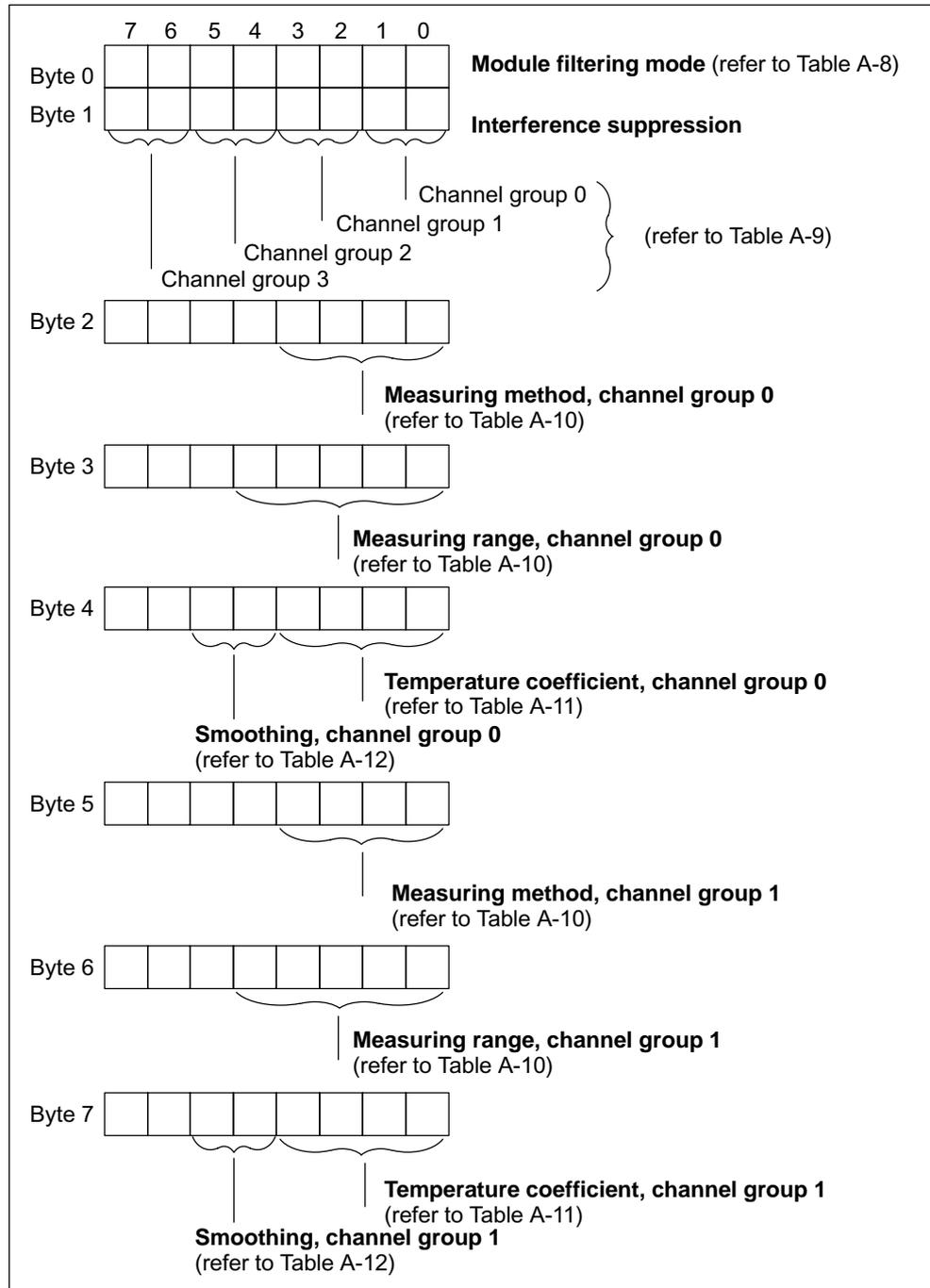
Figure A-5   Data Record 128 of the Parameters for SM 331; AI 8 $\times$ RTD

Byte 8 — Measuring method, channel group 2 (refer to Table A-10)

Byte 9 — Measuring range, channel group 2 (refer to Table A-10)

Byte 10 — Temperature coefficient, channel group 2 (refer to Table A-11); Smoothing, channel group 2 (refer to Table A-12)

Byte 11 — Measuring method, channel group 3 (refer to Table A-10)

Byte 12 — Measuring range, channel group 3 (refer to Table A-10)

Byte 13 — Temperature coefficient, channel group 3 (refer to Table A-11); Smoothing, channel group 3 (refer to Table A-12)

Byte 14 High Byte / Byte 15 Low Byte — Upper limit value channel group 0; channel 0

Byte 16 High Byte / Byte 17 Low Byte — Lower limit value channel group 0; channel 0

Byte 18 High Byte / Byte 19 Low Byte — Upper limit value channel group 0; channel 1

Byte 20 High Byte / Byte 21 Low Byte — Lower limit value channel group 0; channel 1

Figure A-6   Data Record 128 of the SM 331; AI 8 x RTD (Continued)

Byte 22		High Byte	Upper limit value channel group 1; channel 2
Byte 23		Low Byte	
Byte 24		High Byte	Lower limit value channel group 1; channel 2
Byte 25		Low Byte	
Byte 26		High Byte	Upper limit value channel group 1; channel 3
Byte 27		Low Byte	
Byte 28		High Byte	Lower limit value channel group 1; channel 3
Byte 29		Low Byte	
Byte 30		High Byte	Upper limit value channel group 2; channel 4
Byte 31		Low Byte	
Byte 32		High Byte	Lower limit value channel group 2; channel 4
Byte 33		Low Byte	
Byte 34		High Byte	Upper limit value channel group 2 channel 5
Byte 35		Low Byte	
Byte 36		High Byte	Lower limit value channel group 2; channel 5
Byte 37		Low Byte	
Byte 38		High Byte	Upper limit value channel group 3; channel 6
Byte 39		Low Byte	
Byte 40		High Byte	Lower limit value channel group 3; channel 6
Byte 41		Low Byte	
Byte 42		High Byte	Upper limit value channel group 3; channel 7
Byte 43		Low Byte	
Byte 44		High Byte	Lower limit value channel group 3; channel 7
Byte 45		Low Byte	

Figure A-7   Data Record 128 of the SM 331; AI 8 x RTD (Continued)

Note

The representation of the limit values matches the analog value representation (see Chapter 4). Please observe the range limits when setting the limit values.

Operating modes of the SM 331; AI 8 × RTD

The table below contains the codes for the different operating modes, which you enter in byte 0 of data record 128 (refer to Figure A-5).

Table A-8   Codes of Operating Modes of the SM 331; AI 8 x RTD

Module filtering mode	Code
8 channels hardware filter	2#00000000
8 channels software filter	2#00000001
4 channels hardware filter	2#00000010

Interference frequency suppression of the SM 331; AI 8 x RTD

The table below contains the codes for the different frequencies, which you enter in byte 1 of data record 128 (refer to Figure A-5). Note that the settings 50 Hz, 60 Hz and 400 Hz only apply to 8-channel software filter mode. The setting 50, 60 and 400 Hz only applies to 8-channel and 4-channel hardware filter mode.

Table A-9   Interference Frequency Suppression Codes for SM 331; AI 8 x RTD

Interference Suppression	Code
400 Hz	2#00
60 Hz	2#01
50 Hz	2#10
50/60/400 Hz	2#11

Measuring methods and measuring ranges of the SM 331; AI 8 x RTD

The table below contains all the measuring methods and measuring ranges of the module and its codes. You must enter these codes in the corresponding bytes of data record 128 (refer to Figure A-3).

Table A-10 Codes for the Measuring Ranges of the SM 331; AI 8 x RTD

Measuring Method	Code	Measuring Range	Code
Deactivated	2#0000	Deactivated	2#0000
Resistance, four-conductor connection	2#0100	150 Ω 300 Ω 600 Ω	2#0010 2#0100 2#0110
Resistance, three-conductor connection	2#0101	150 Ω 300 Ω 600 Ω	2#0010 2#0100 2#0110

Table A-10 Codes for the Measuring Ranges of the SM 331; AI 8 x RTD, continued

Measuring Method	Code	Measuring Range	Code
Thermal resistance + linearization four-conductor connection	2#1000	Pt 100 climate	2#00000000
		Ni 100 climate	2#00000001
		Pt 100 standard	2#00000010
		Ni 100 standard	2#00000011
		Pt 500 standard	2#00000100
		Pt 1000 standard	2#00000101
		Ni 1000 standard	2#00000110
		Pt 200 climate	2#00000111
		Pt 500 climate	2#00001000
		Pt 1000 climate	2#00001001
		Ni 1000 climate	2#00001010
		Pt 200 standard	2#00001011
		Ni 120 standard	2#00001100
		Ni 120 climate	2#00001101
		Cu 10 climate	2#00001110
		Cu 10 standard	2#00001111
		Ni 200 standard	2#00010000
		Ni 200 climate	2#00010001
		Ni 500 standard	2#00010010
		Ni 500 climate	2#00010011
Thermal resistance + linearization three-conductor connection	2#1001	Pt 100 climate	2#00000000
		Ni 100 climate	2#00000001
		Pt 100 standard	2#00000010
		Ni 100 standard	2#00000011
		Pt 500 standard	2#00000100
		Pt 1000 standard	2#00000101
		Ni 1000 standard	2#00000110
		Pt 200 climate	2#00000111
		Pt 500 climate	2#00001000
		Pt 1000 climate	2#00001001
		Ni 1000 climate	2#00001010
		Pt 200 standard	2#00001011
		Ni 120 standard	2#00001100
		Ni 120 climate	2#00001101
		Cu 10 climate	2#00001110
		Cu 10 standard	2#00001111
		Ni 200 standard	2#00010000
		Ni 200 climate	2#00010001
		Ni 500 standard	2#00010010
		Ni 500 climate	2#00010011

Temperature coefficient of the SM 331; AI 8 x RTD

The table below contains the codes for the temperature coefficient which you enter in the corresponding byte of data record 128 (refer to Figure A-5).

Table A-11   Codes of Temperature Coefficients of the SM 331; AI 8 x RTD

Temperature coefficient	Code
Pt0.003850 $\Omega/\Omega/°C$ (IPTS-68)	2#0000
Pt0.003916 $\Omega/\Omega/°C$	2#0001
Pt0.003902 $\Omega/\Omega/°C$	2#0010
Pt0.003920 $\Omega/\Omega/°C$	2#0011
Pt0.003850 $\Omega/\Omega/°C$ (ITS-90)	2#0100
Ni 0.006180 $\Omega/\Omega/°C$	2#1000
Ni 0.006720 $\Omega/\Omega/°C$	2#1001
Cu0.00427 $\Omega/\Omega/°C$	2#1100

Smoothing of the SM 331; AI 8 x RTD

The table below contains the codes for all smoothing modes, which you enter in the corresponding byte of data record 128 (refer to Figure A-5).

Table A-12   Codes Smoothing of the SM 331; AI 8 x RTD

Smoothing	Code
None	2#00
Low	2#01
Average	2#10
High	2#11

A.6　　　Parameters of the SM 331; AI 8 x TC

Parameters

The table below contains all the parameters which you can set for analog input module SM 331; AI 8 x TC.

You will see which parameters you can modify from the list:

- In *STEP 7*

- With SFC 55 "WR_PARM"

The parameters set with *STEP 7* can also be transferred with SFCs 56 and 57 to the module (refer to the *STEP 7* manuals).

Table A-13 Parameters of the SM 331; AI 8 x TC

Parameter	Data Record No.	Parameters can be assigned with ...	
		... SFC 55	... Programming Device
Diagnostics: Group diagnostics	0	No	Yes
Diagnostics: With wire-break check		No	Yes
Diagnostics interrupt enable	1	**Yes**	Yes
Limit value interrupt enable		**Yes**	Yes
Cycle end interrupt enable		**Yes**	Yes
Temperature unit		**Yes**	Yes
Measuring Method	128	**Yes**	Yes
Measuring Range		**Yes**	Yes
Module filtering mode	128	**Yes**	Yes
Reaction to open thermocouple		**Yes**	Yes
Interference Suppression		**Yes**	Yes
Smoothing		**Yes**	Yes
Upper limit value		**Yes**	Yes
Lower limit value		**Yes**	Yes

Note

If you want to enable the diagnostic interrupt in the user program in data record 1, you must enable the diagnosis in data record 0 beforehand using *STEP 7*.

Structure of data record 1

The figure below shows the structure of data record 1 of the SM 331; AI 8 x TC.
You activate a parameter by setting the corresponding bit to "1".
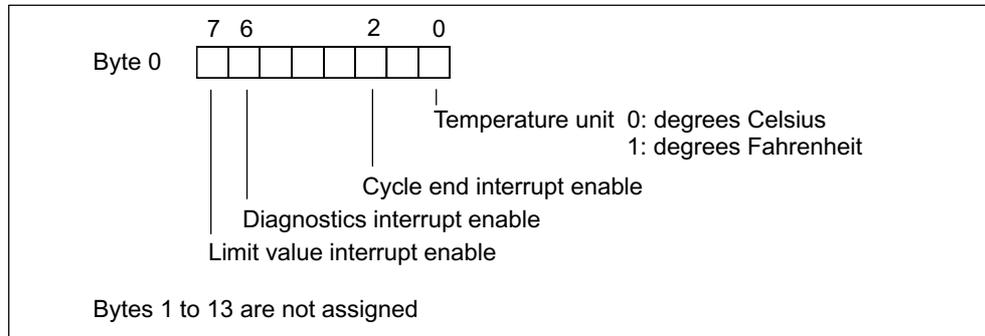

Figure A-8   Data Record 1 of the Parameters for SM 331; AI 8 x TC

Structure of data record 128

The figure below shows the structure of data record 128 for SM 331;
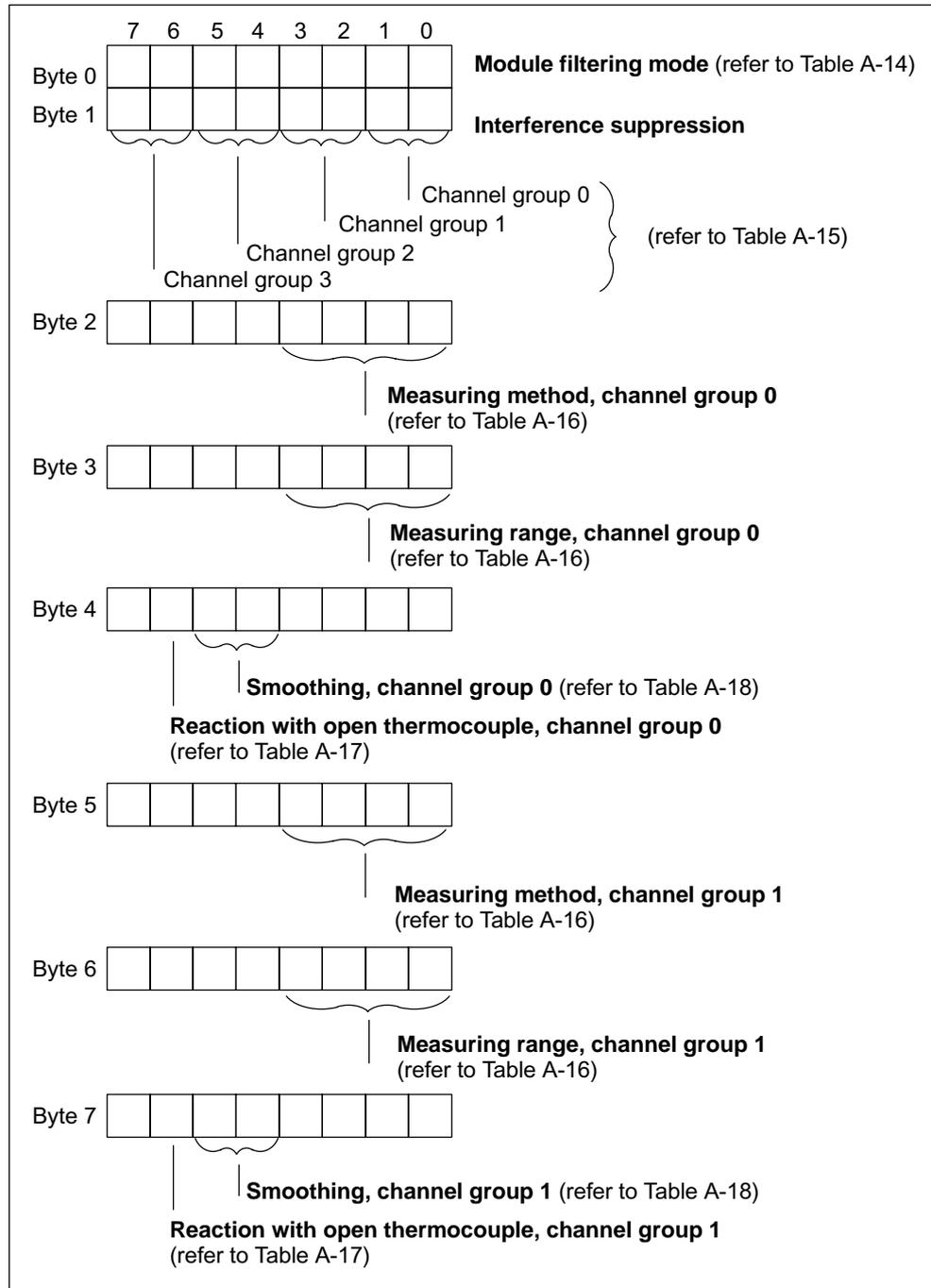AI 8 x TC.

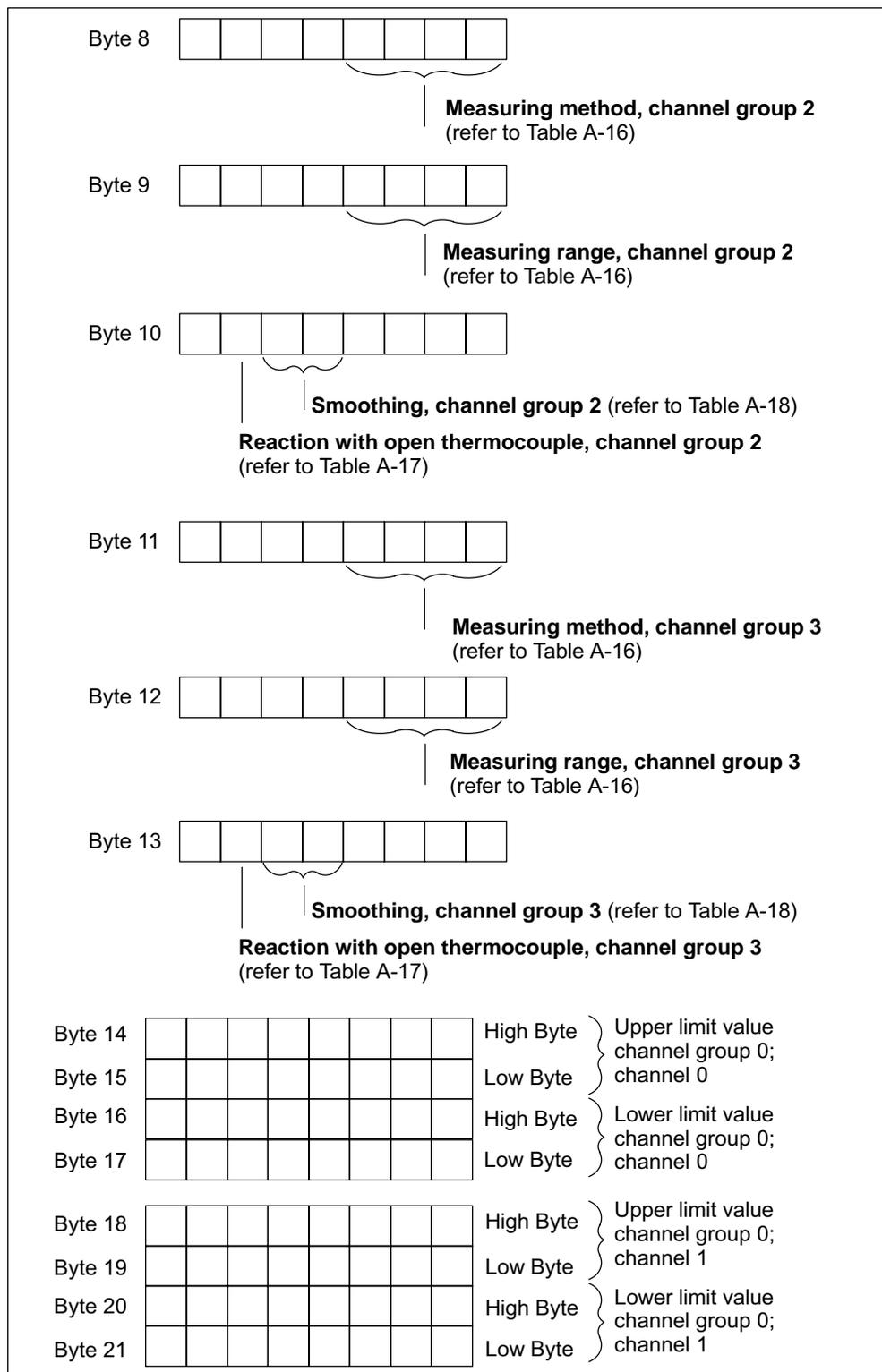Figure A-9   Data Record 128 of the SM 331; AI 8 x TC

Byte 8 — **Measuring method, channel group 2** (refer to Table A-16)

Byte 9 — **Measuring range, channel group 2** (refer to Table A-16)

Byte 10 — **Smoothing, channel group 2** (refer to Table A-18)
Reaction with open thermocouple, channel group 2 (refer to Table A-17)

Byte 11 — **Measuring method, channel group 3** (refer to Table A-16)

Byte 12 — **Measuring range, channel group 3** (refer to Table A-16)

Byte 13 — **Smoothing, channel group 3** (refer to Table A-18)
Reaction with open thermocouple, channel group 3 (refer to Table A-17)

Byte 14 — High Byte — Upper limit value channel group 0; channel 0
Byte 15 — Low Byte
Byte 16 — High Byte — Lower limit value channel group 0; channel 0
Byte 17 — Low Byte

Byte 18 — High Byte — Upper limit value channel group 0; channel 1
Byte 19 — Low Byte
Byte 20 — High Byte — Lower limit value channel group 0; channel 1
Byte 21 — Low Byte

Figure A-10   Data Record 128 of the SM 331; AI 8 x TC (Continued)

Byte 22									High Byte	⎞ Upper limit value
Byte 23									Low Byte	⎬ channel group 1; channel 2
Byte 24									High Byte	⎞ Lower limit value
Byte 25									Low Byte	⎬ channel group 1; channel 2
Byte 26									High Byte	⎞ Upper limit value
Byte 27									Low Byte	⎬ channel group 1; channel 3
Byte 28									High Byte	⎞ Lower limit value
Byte 29									Low Byte	⎬ channel group 1; channel 3
Byte 30									High Byte	⎞ Upper limit value
Byte 31									Low Byte	⎬ channel group 2; channel 4
Byte 32									High Byte	⎞ Lower limit value
Byte 33									Low Byte	⎬ channel group 2; channel 4
Byte 34									High Byte	⎞ Upper limit value
Byte 35									Low Byte	⎬ channel group 2 channel 5
Byte 36									High Byte	⎞ Lower limit value
Byte 37									Low Byte	⎬ channel group 2; channel 5
Byte 38									High Byte	⎞ Upper limit value
Byte 39									Low Byte	⎬ channel group 3; channel 6
Byte 40									High Byte	⎞ Lower limit value
Byte 41									Low Byte	⎬ channel group 3; channel 6
Byte 42									High Byte	⎞ Upper limit value
Byte 43									Low Byte	⎬ channel group 3; channel 7
Byte 44									High Byte	⎞ Lower limit value
Byte 45									Low Byte	⎬ channel group 3; channel 7

Figure A-11   Data Record 128 of the SM 331; AI 8 x TC (Continued)

Note

The representation of the limit values matches the analog value representation (see Chapter 4). Please observe the range limits when setting the limit values.

Operating modes of the SM 331; AI 8 x TC

The table below contains the codes for the different operating modes, which you enter in byte 0 of data record 128 (refer to Figure A-9).

Table A-14 Codes of Operating Modes of the SM 331; AI 8 x TC

Module filtering mode	Code
8 channels hardware filter	2#00000000
8 channels software filter	2#00000001
4 channels hardware filter	2#00000010

Interference frequency suppression of the SM 331; AI 8 x TC

The table below contains the codes for the different frequencies, which you enter in byte 1 of data record 128 (refer to Figure A-9). Note that the settings 400 Hz, 60 Hz and 50 Hz only apply to 8-channel software filter mode. The setting 50, 60 and 400 Hz only applies to 8-channel and 4-channel hardware filter mode.

Table A-15 Interference Frequency Suppression Codes for SM 331; AI 8 x TC

Interference Suppression	Code
400 Hz	2#00
60 Hz	2#01
50 Hz	2#10
50/60/400 Hz	2#11

Measuring methods and measuring ranges of the SM 331; AI 8 x TC

The table below contains all the measuring methods and measuring ranges of the module and its codes. You must enter these codes in the corresponding bytes of data record 128 (refer to Figure A-3).

Table A-16   Codes for the Measuring Ranges of the SM 331; AI 8 x TC

Measuring Method	Code	Measuring Range	Code
Deactivated	2#0000	Deactivated	2#0000
Thermocouple, linear, reference temperature 0 °C	2#1010	B N E R S J L T K U C	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001 2#1010
Thermocouple, linear, reference temperature 50 °C	2#1011	B N E R S J L T K U C	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001 2#1010
Thermocouple, linear, internal comparison	2#1101	B N E R S J L T K U C	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001 2#1010
Thermocouple, linear, external comparison	2#1110	B N E R S J L T K U C	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001 2#1010

Reaction to open thermocouple of the SM 331; AI 8 x TC

The table below contains the codes for the reactions to an open thermocouple, which you enter in the corresponding byte of data record 128 (refer to Figure A-9).

Table A-17 Codes of Reaction to Open Thermocouple of the SM 331; AI 8 x TC

Reaction to open thermocouple	Code
Overflow	2#0
Underflow	2#1

Smoothing of the SM 331; AI 8 x TC

The table below contains the codes for all smoothing modes, which you enter in the corresponding byte of data record 128 (refer to Figure A-9).

Table A-18 Codes Smoothing of the SM 331; AI 8 x TC

Smoothing	Code
None	2#00
Low	2#01
Average	2#10
High	2#11

A.7   Parameters of the SM 331; AI 8 x 13 bits

Structure of data record 1

The figure below shows the structure of data record 1 for the parameters of the analog input module.

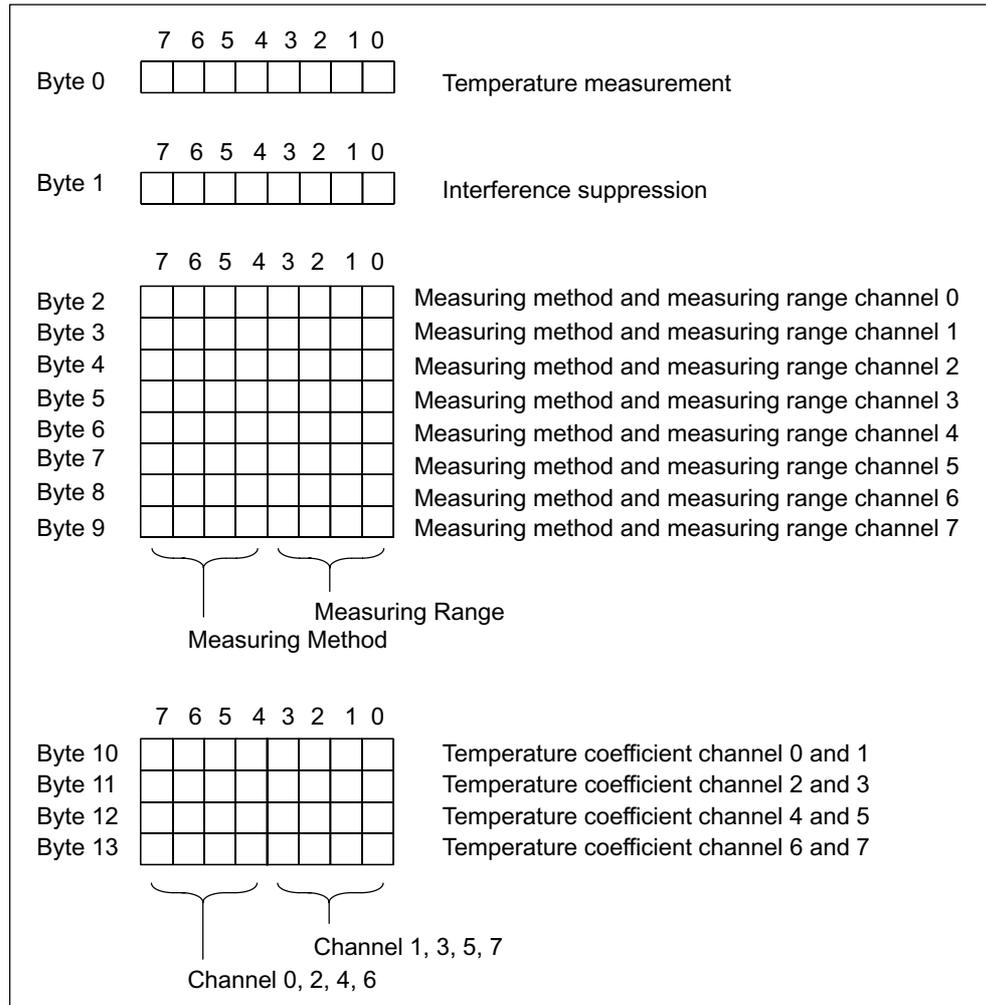You activate a parameter by setting the corresponding bit in byte to "1".

Figure A-12   Data Record 1 for Parameters of the Analog Input Modules

Temperature measurement

The table below contains the codes for the different temperature measurements, which you enter in byte 0 of data record 1 (refer to Figure A-12).

Table A-19 Codes for temperature measurement of the analog input module

Temperature unit for linearization	Code
Degrees Celsius	2#0000 0000
Degrees Fahrenheit	2#0000 1000
Kelvin	2#0001 0000

Interference frequency suppression

The table below contains the codes for the different frequencies, which you enter in byte 1 of data record 1 (refer to Figure A-12). You must work out the resulting integration time separately for each module!

Table A-20 Codes for Interference Suppression of the Analog Input Module

Interference Suppression	Integration Time	Code
60 Hz	50 ms	2#01
50 Hz	60 ms	2#10

Measuring methods and measuring ranges

The table below contains all the measuring methods and measuring ranges of the analog input module and their codes. You must enter these codes in bytes 2 to 13 of data record 1 (refer to Figure A-12).

Note

Please note that the analog input module must be wired in accordance with the measuring range and at the front connector correspondingly!

Table A-21 Codes for the Measuring Ranges of the Analog Input Module

Measuring Method	Code	Measuring Range	Code
Deactivated	2#0000	Deactivated	2#0000
Voltage	2#0001	± 50 mV ± 500 mV ± 1 V ± 5 V 1 to 5 V 0 to 10 V ± 10 V	2#1011 2#0011 2#0100 2# 0110 2#0111 2#1000 2#1001

Table A-21 Codes for the Measuring Ranges of the Analog Input Module

Measuring Method	Code	Measuring Range	Code
Current	2#0010	0 to 20 mA 4 to 20 mA ± 20 mA	2#0010 2#0011 2#0100
Resistors	2#0101	600 Ω 6 kΩ	2#0110 2#1000
Bulb resistor (linear)	2#1001	Pt 100 Climate Pt 100 Standard Ni 100 Climate Ni 100 Standard Ni 1000 / LG-Ni 1000 Climate Ni 1000 / LG-Ni 1000 Standard	2#0000 2#0010 2#0001 2#0011 2#1010 2#0110

Temperature coefficient

The table below contains the codes for the temperature coefficient which you enter in the corresponding byte of data record (refer to Figure A-12).

Table A-22 Codes for temperature measurement of the analog input module

Temperature coefficient	Measuring Range	Code
Pt0.003850 Ω/Ω/°C (ITS-90)	Pt 100	2#0100
Ni 0.006180 Ω/Ω/°C	Ni 100 / Ni 1000	2#1000
Ni 0.005000 Ω/Ω/°C	LG-Ni 1000	2#1010

A.8 Parameters of the SM 331; AI 8 x 16 bits

Parameters

Table A-23contains all the parameters which you can set for the isolated analog input module SM 331; AI 8 x bits. This comparison indicates which methods you can use for the configuration of the individual parameters:

- SFC 55 "WR_PARM"
- STEP 7 programming device

The parameters that you have set with STEP 7 can also be transferred to the module by means of SFC 56 or SFC 57.

Table A-23 Parameters for the isolated analog input module SM 331; AI 8 x 16 bits

Parameter	Data Record No.	Configurable with...	
		... SFC 55	...programming device
Diagnostics: Group diagnostics	0	No	Yes
Diagnostics: With wire-break check		No	Yes
Limit value interrupt enable	1	Yes	Yes
Diagnostics interrupt enable		Yes	Yes
Cycle end interrupt enable		Yes	Yes
Module mode	128	Yes	Yes
Interference Suppression		Yes	Yes
Measuring Method		Yes	Yes
Measuring Range		Yes	Yes
Smoothing		Yes	Yes
Upper limit value		Yes	Yes
Lower limit value		Yes	Yes

Note

If you want to enable the diagnostic interrupt in the user program in data record 1, you must enable the diagnosis in data record 0 beforehand using *STEP 7*.

Structure of data record 1

Figure A-13 shows the structure of data record 1 for the parameters of the isolated analog input module SM 331; AI 8 x 16 bits.

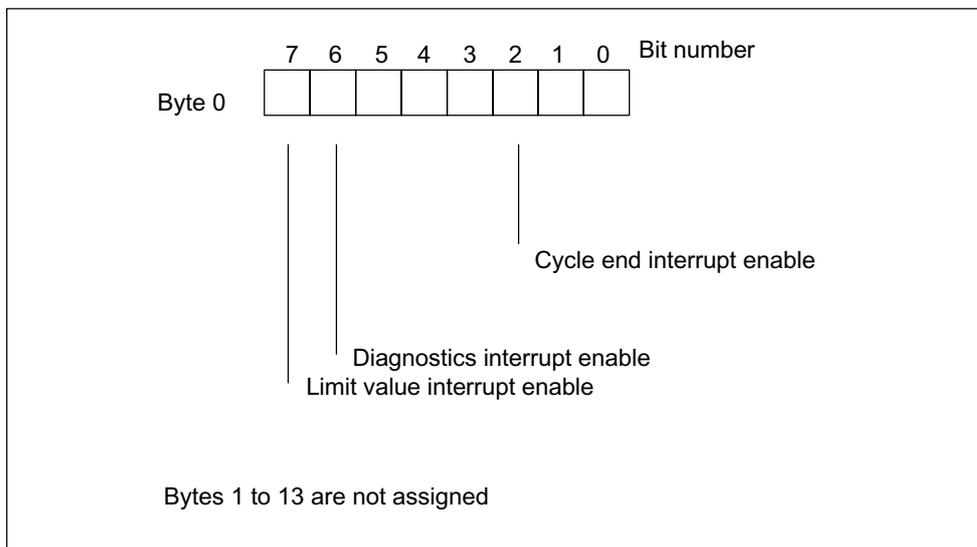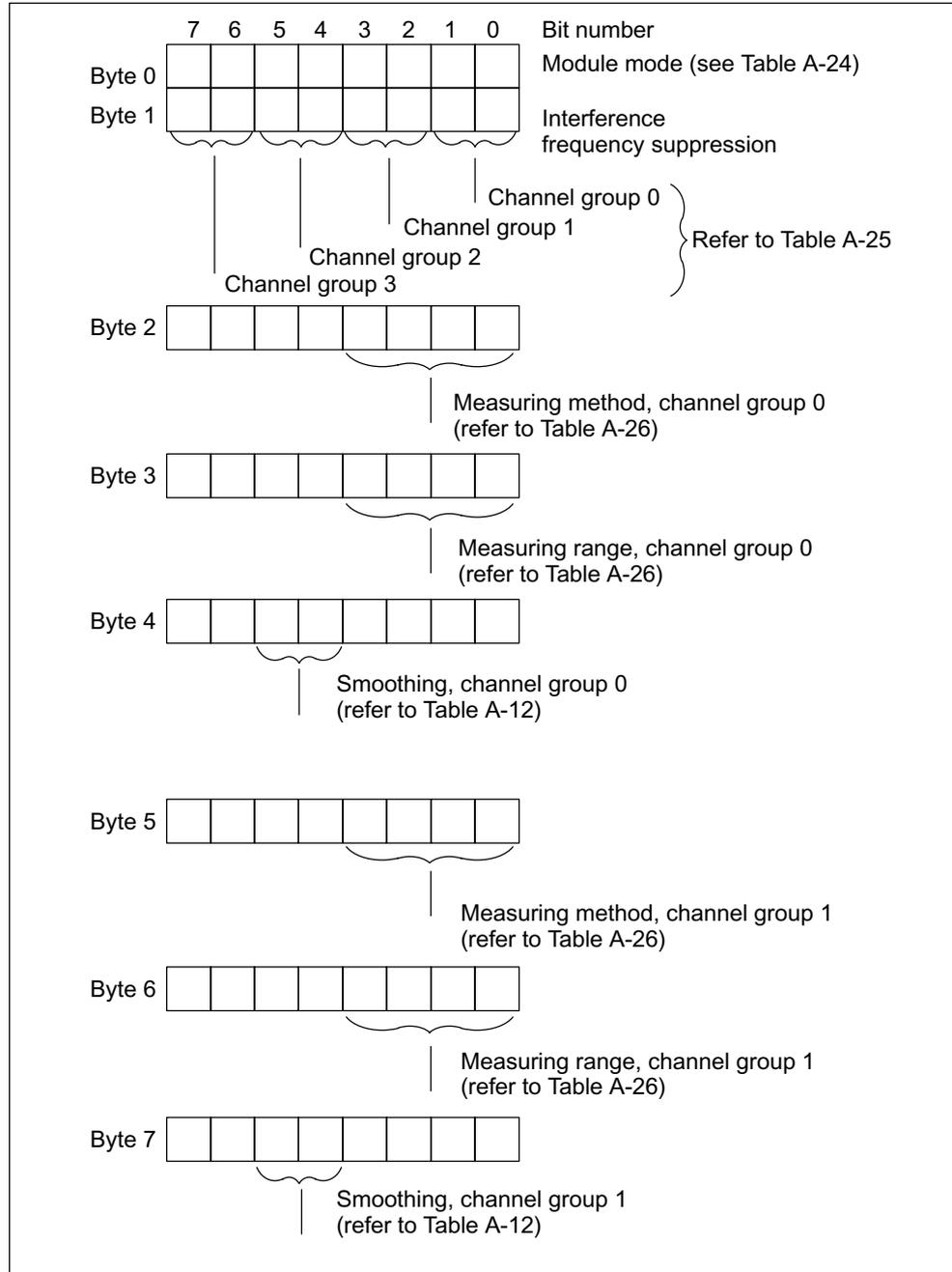You can activate a parameter by setting the corresponding bit in byte 0 to "1".

Figure A-13   Data Record 1 of the Parameters for SM 331; AI 8 x 16 bits

Structure of data record 128

Figure shows the structure of data record 128 for the parameters of the isolated analog input module SM 331; AI 8 x 16 bits.

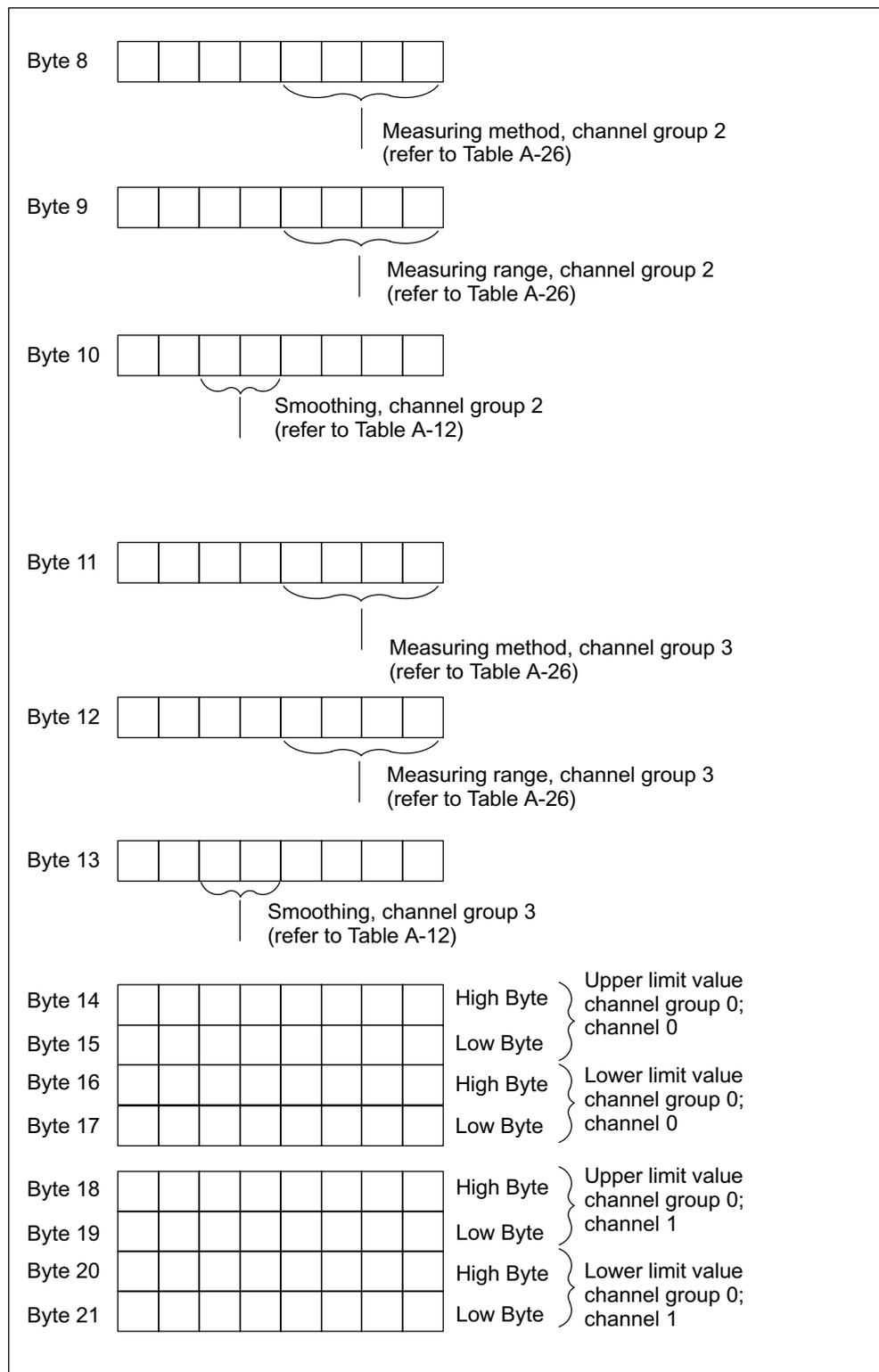Figure A-14   Data record 128 for parameters of the SM 331; AI 8 x 16 bits

Figure A-15   Data record 128 for SM 331; AI 8 x 16 bits (continued)

Byte 22	High Byte	Upper limit value channel group 1; channel 2	
Byte 23	Low Byte		
Byte 24	High Byte	Lower limit value channel group 1; channel 2	
Byte 25	Low Byte		
Byte 26	High Byte	Upper limit value channel group 1; channel 3	
Byte 27	Low Byte		
Byte 28	High Byte	Lower limit value channel group 1; channel 3	
Byte 29	Low Byte		
Byte 30	High Byte	Upper limit value channel group 2; channel 4	
Byte 31	Low Byte		
Byte 32	High Byte	Lower limit value channel group 2; channel 4	
Byte 33	Low Byte		
Byte 34	High Byte	Upper limit value channel group 2 channel 5	
Byte 35	Low Byte		
Byte 36	High Byte	Lower limit value channel group 2; channel 5	
Byte 37	Low Byte		
Byte 38	High Byte	Upper limit value channel group 3; channel 6	
Byte 39	Low Byte		
Byte 40	High Byte	Lower limit value channel group 3; channel 6	
Byte 41	Low Byte		
Byte 42	High Byte	Upper limit value channel group 3; channel 7	
Byte 43	Low Byte		
Byte 44	High Byte	Lower limit value channel group 3; channel 7	
Byte 45	Low Byte		

Figure A-16   Data record 128 for parameters of the SM 331; AI 8 x 16 bits (continued)

Note

The representation of the limit values matches the analog value representation (see Chapter 4). Please observe the range limits when setting the limit values.

Module modes

Table A-24 contains the codes for the module modes, which you enter in byte 0 of data record 128 (see Figure A-14).

Table A-24 Codes for the modes of SM 331; AI 8 x 16 bits

Module mode	Code
8 channels	2#00000000
4 channels	2#00000001

Interference suppression

Table A-25 contains the codes for the different frequencies, which you enter in byte 1 of data record 128 (see Figure A-14). Note that 4-channel mode only functions if interference frequency suppression of 50, 60 and 400 Hz is set.

Table A-25 Codes for interference frequency suppression of the SM 331; AI 8 x 16 bits

Interference Suppression	Code
400 Hz	2#00
60 Hz	2#01
50 Hz	2#10
50, 60 and 400 Hz	2#11

Measuring methods and measuring ranges

Table A-26 contains all the measuring ranges for the isolated analog input module SM 331; AI 8 x 16 bits. Table A-26 also shows the codes for measuring methods and measuring ranges. You must enter these codes in accordance with the required measuring range in the relevant byte of data record 128 (see Figure A-14).

Table A-26 Codes for the measuring ranges of the SM 331; AI 8 x16 bits

Measuring Method	Code	Measuring Range	Code
Deactivated	2#0000	Deactivated	2#0000
Voltage	2#0001	± 5 V 1 to 5 V ± 10 V	2#0110 2#0111 2#1001
Current (4-wire transmitter)	2#0002	0 to 20 mA 4 to 20 mA ± 20 mA	2#0010 2#0011 2#0100

Settings for input smoothing

Table A-27 contains all the smoothing settings for the isolated analog input module SM 331; AI 8 x 16 bits. According to the smoothing required, you must enter these codes in the corresponding byte of data set 128 (see imag eA-14.

Table A-27   Codes for the smoothing mode settings of the SM 331;
            AI 8 x 16 bits

Smoothing mode setting	Code
None	2#00
Low	2#01
Average	2#10
High	2#11

A.9   Parameters of the Analog Output Modules

Parameters

Table A-28 contains all the parameters you can set for analog output modules..
The comparison shows:

- Which parameters you can change with *STEP 7* and

- Which parameters you can change with SFC 55 "WR_PARM".

The parameters which you set with *STEP 7* can also be transferred to the module
with SFCs 56 and 57.

Table A-28   Parameters of the Analog Output Modules

Parameter	Data Record No.	Parameters can be assigned with ...	
		... SFC 55	**... Programming Device**
Diagnostics: Group diagnostics	0	No	Yes
Diagnostics interrupt enable	1	**Yes**	Yes
Behavior on CPU STOP		**Yes**	Yes
Output type		**Yes**	Yes
Output Range		**Yes**	Yes
Substitute value		**Yes**	Yes

Note

If you want to enable the diagnostic interrupt in the user program in data record 1,
you must enable the diagnosis in data record 0 beforehand using *STEP 7*.

Data record 1 structure

The figure below shows the structure of data record 1 for the parameters of the analog output modules.

You activate the diagnostics interrupt enable by setting the corresponding bit in byte 0 to "1".
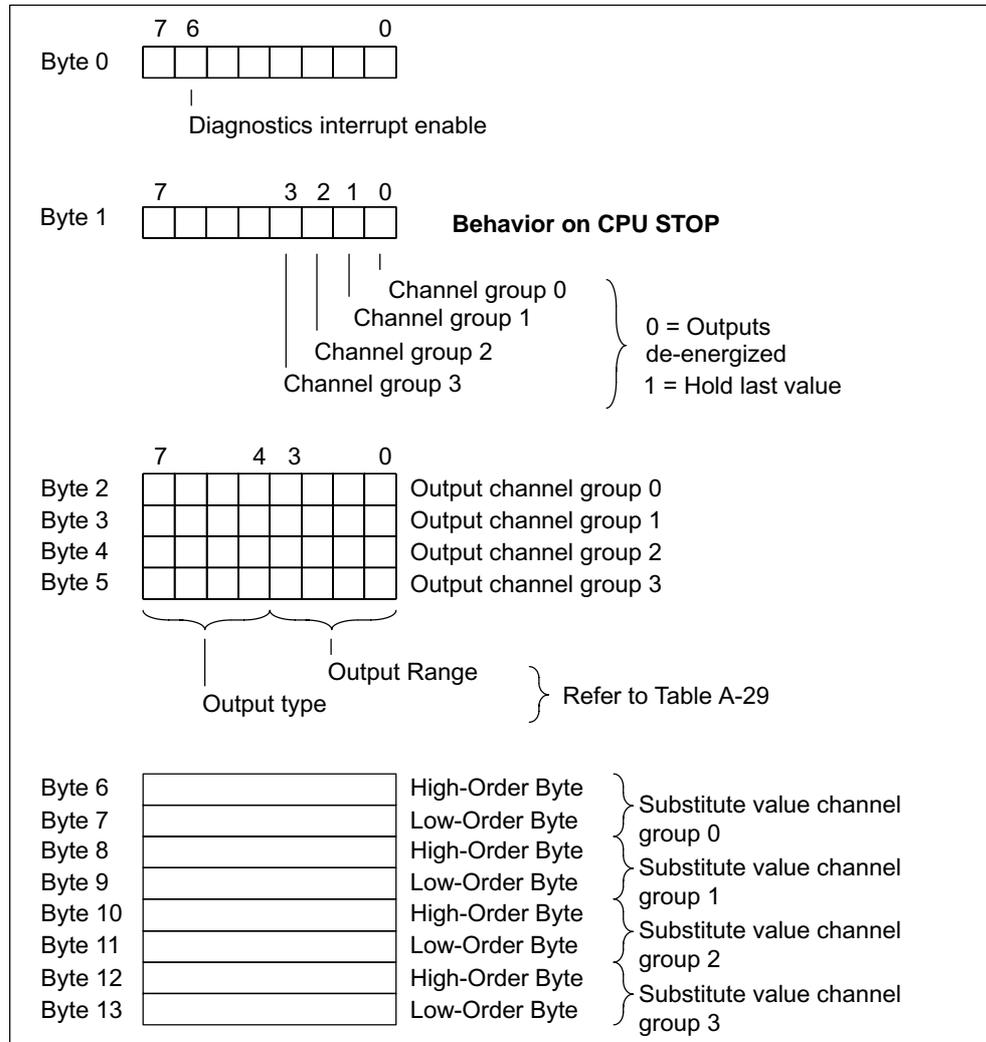

Figure A-17   Data Record 1 for Parameters of the Analog Output Modules

Setting substitute values

Note

For output ranges 4 to 20 mA and 1 to 5 V you must set the substitute value
E500$_H$ so that the output remains de-energized (refer to Tables 4-35 and 4-37 on
pages 4-26 and 4-27).

The representation of the substitute values corresponds to the analog value
representation. You should observe the relevant range limits when setting the
substitute values.

Output methods and output ranges

The table below contains all the output methods and output ranges of the analog
output modules and their codes. You must enter these codes in bytes 2 to 5 of
data record 1 (refer to FigureA-17).

Table A-29 Codes for the Output Ranges of the Analog Output Modules

Output type	Code	Output Range	Code
Deactivated	2#0000	Deactivated	2#0000
Voltage	2#0001	1 to 5 V 0 to 10 V ± 10 V	2#0111 2#1000 2#1001
Current	2#0010	0 to 20 mA 4 to 20 mA ± 20 mA	2#0010 2#0011 2#0100

A.10 Parameters of the SM 332; AO 8 x 12 bits

Parameters

Table A-28 contains all the parameters that you can set for the analog output module SM 332; AO 8 x 12 bits. The comparison shows:

- Which parameters you can change with *STEP 7* and

- Which parameters you can change with SFC 55 "WR_PARM".

The parameters which you set with *STEP 7* can also be transferred to the module with SFCs 56 and 57.

Table A-30 Parameters of the SM 332; AO 8 x 12 bits.

Parameter	Data Record No.	Parameters can be assigned with ...	
		... SFC 55	... Programming Device
Diagnostics: Group diagnostics	0	No	Yes
Diagnostics interrupt enable	1	**Yes**	Yes
Behavior on CPU STOP		**Yes**	Yes
Output type		**Yes**	Yes
Output Range		**Yes**	Yes

Note

If you want to enable the diagnostic interrupt in the user program in data record 1, you must enable the diagnosis in data record 0 beforehand using *STEP 7*.

Structure of data record 1

The diagram below shows the structure of data record 1 of the parameters of the SM 332; AO 8 x 12 bits.

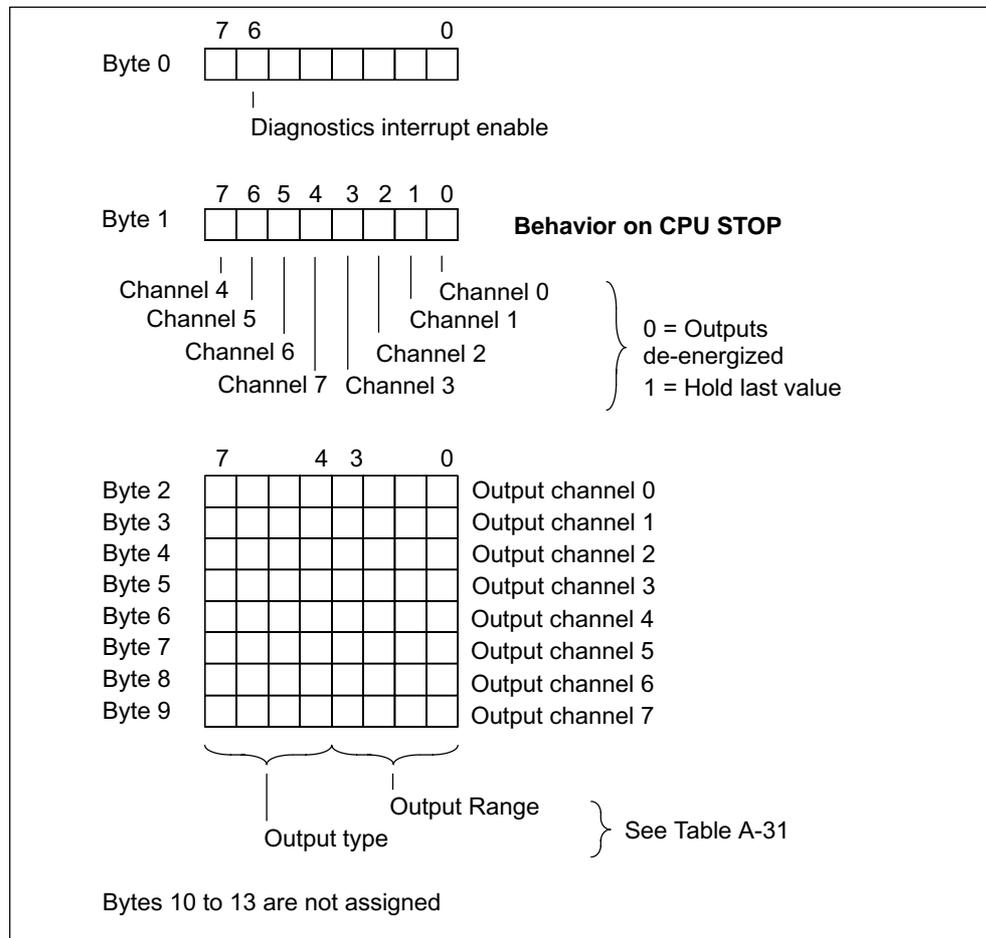You activate the diagnostics interrupt enable by setting the corresponding bit in byte 0 to "1".

Figure A-18   Data Record 1 for Parameters of the Analog Output Modules

Output method and output range

The following table contains all the output methods and output ranges of the SM 332; AO 8 x 12 bits , with their coding. You must enter these codes in bytes 2 to 9 of data record 1 (refer to FigureA-18).

Table A-31 Codes for the output ranges of the analog output module SM332; AO 8 x 12 bits

Output type	Code	Output range	Code
Deactivated	2#0000	Deactivated	2#0000
Voltage	2#0001	1 to 5 V 0 to 10 V ± 10 V	2#0111 2#1000 2#1001
Current	2#0010	0 to 20 mA 4 to 20 mA ± 20 mA	2#0010 2#0011 2#0100

A.11 Parameters of the Analog Input/Output Modules

Parameters

The table below contains all the parameters you can set for analog input/output modules.

You will see which parameters you can modify from the list:

- In *STEP 7*
- With SFC 55 "WR_PARM"

The parameters set with *STEP 7* can also be transferred with SFCs 56 and 57 to the module (refer to the *STEP 7* manuals).

Table A-32 Parameters of the Analog Input/Output Modules

Parameter	Data Record No.	Parameters can be assigned with ...	
		... SFC 55	... Programming Device
Measuring Method		**Yes**	Yes
Measuring Range		**Yes**	Yes
Integration Time	1	**Yes**	Yes
Output type		**Yes**	Yes
Output Range		**Yes**	Yes

Structure of data record 1

The figure below shows the structure of data record 1 for the parameters of the analog input/output modules.

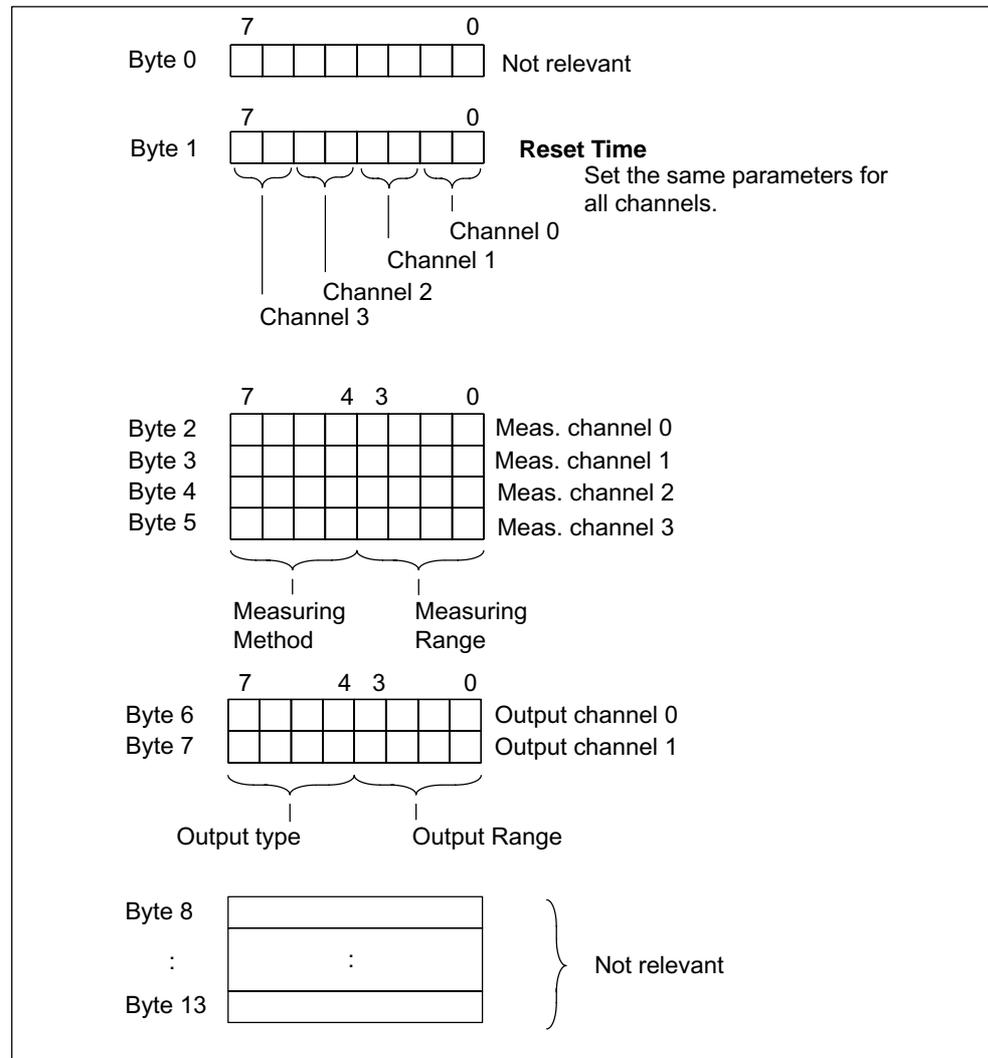You activate a parameter by setting the corresponding bit in byte 0 and 1 to "1".

Figure A-19   Data Record 1 for Parameters of the Analog Input/Output Modules

Measuring methods and measuring ranges

The table below contains all the measuring methods and measuring ranges of the analog input/output modules and their codes. You must enter these codes in bytes 2 to 5 of data record 1 (refer to Figure A-19).

Table A-33 Codes for the Measuring Ranges of the Analog Input/Output Modules

Measuring Method	Code	Measuring Range	Code
Deactivated	2#0000	Deactivated	2#0000
Voltage	2#0001	0 to 10 V	2#1000
Resistance, four-conductor connection	2#0100	10 kΩ	2#1001
Thermal resistance + linearization four-conductor connection	2#1000	Pt 100 climate	2#0000

Output methods and output ranges

The table below contains all the output methods and output ranges of the analog input/output modules and their codes. You must enter these codes in bytes 6 and 7 of data record 1 (refer to Figure A-19).

Table A-34 Codes for the Output Ranges of the Analog Input/Output Modules

Output type	Code	Output Range	Code
Deactivated	2#0000	Deactivated	2#0000
Voltage	2#0001	0 to 10 V	2#1000

Diagnostics Data of Signal Modules

In this Appendix

Section	Contents	Page
B.1	Evaluating Diagnostic Data of the Signal Modules in the User Program	B-1
B.2	Structure and Content of Diagnostic Data Bytes 0 to 7	B-2
B.3	Channel-Specific Diagnostic Data from Byte 7	B-5
B.4	Diagnostic data of the SM 338; POS-INPUT	B-7

B.1 Evaluating Diagnostic Data of the Signal Modules in the User Program

In this Appendix

This Appendix describes the structure of the diagnostic data in the system data. You must be familiar with this configuration if you want to evaluate the diagnostics data of the signal module in the *STEP 7* user program.

Diagnostic data are contained in data records

The diagnostic data of a module can be up to 16 bytes long and are contained in data records 0 and 1:

* Data record 0 contains 4 bytes of diagnostic data that describe the current status of a programmable logic controller.

* Data record 1 contains the four bytes of diagnostic data that are also contained in data record 0 **and** as many as 12 bytes of module specific diagnostic data.

Further references

An in-depth description of the principle of evaluating the diagnostic data of signal modules in the user program and a description of the SFCs that can be used for that purpose will be found in the *STEP 7* manuals.

B.2 Structure and Content of Diagnostic Data Bytes 0 to 7

The structure and contents of the different bytes of the diagnostic data are described below. The following general rule applies: When an error occurs, the bit concerned is set to "1".
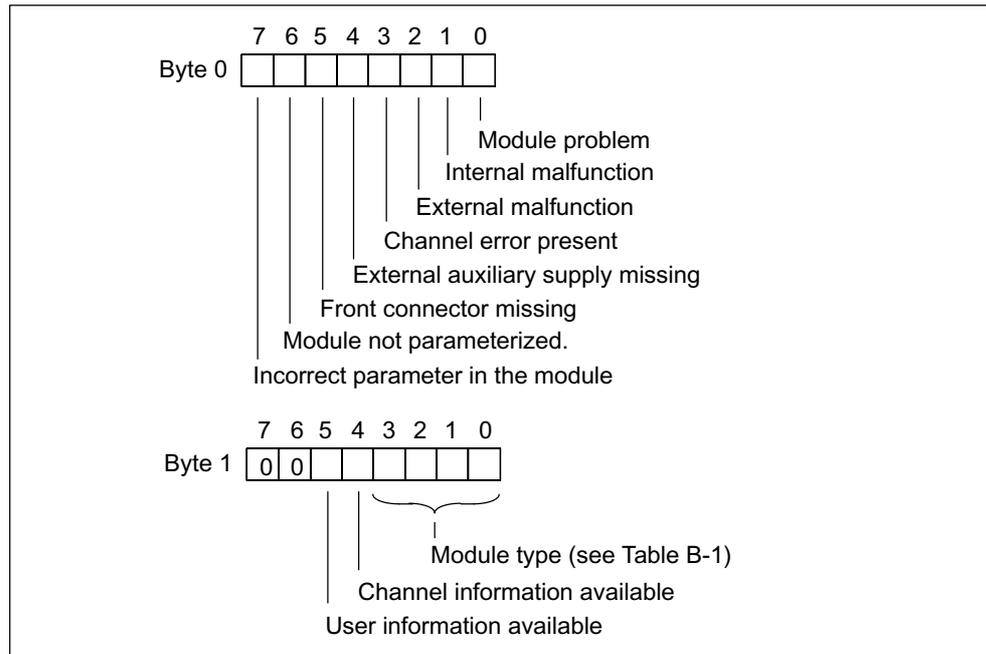
Bytes 0 and 1

Figure B-1   Bytes 0 and 1 of the Diagnostic Data

Module types

The following table contains the IDs of the module classes (bits 0 to 3 in byte 1).

Table B-1   Codes of the Module Types

Code	Module Type
0101	Analog module
0110	CPU
1000	Function module
1100	CP
1111	Digital module

Bytes 2 and 3
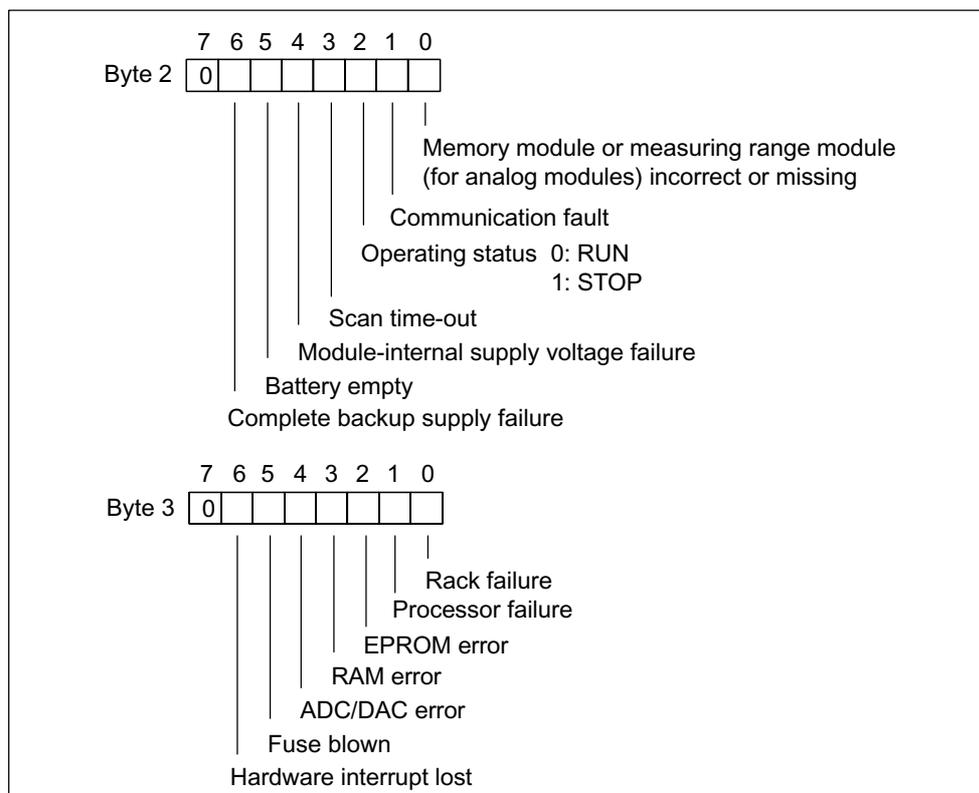
Figure B-2   Bytes 2 and 3 of the Diagnostics Data

Bytes 4 to 7
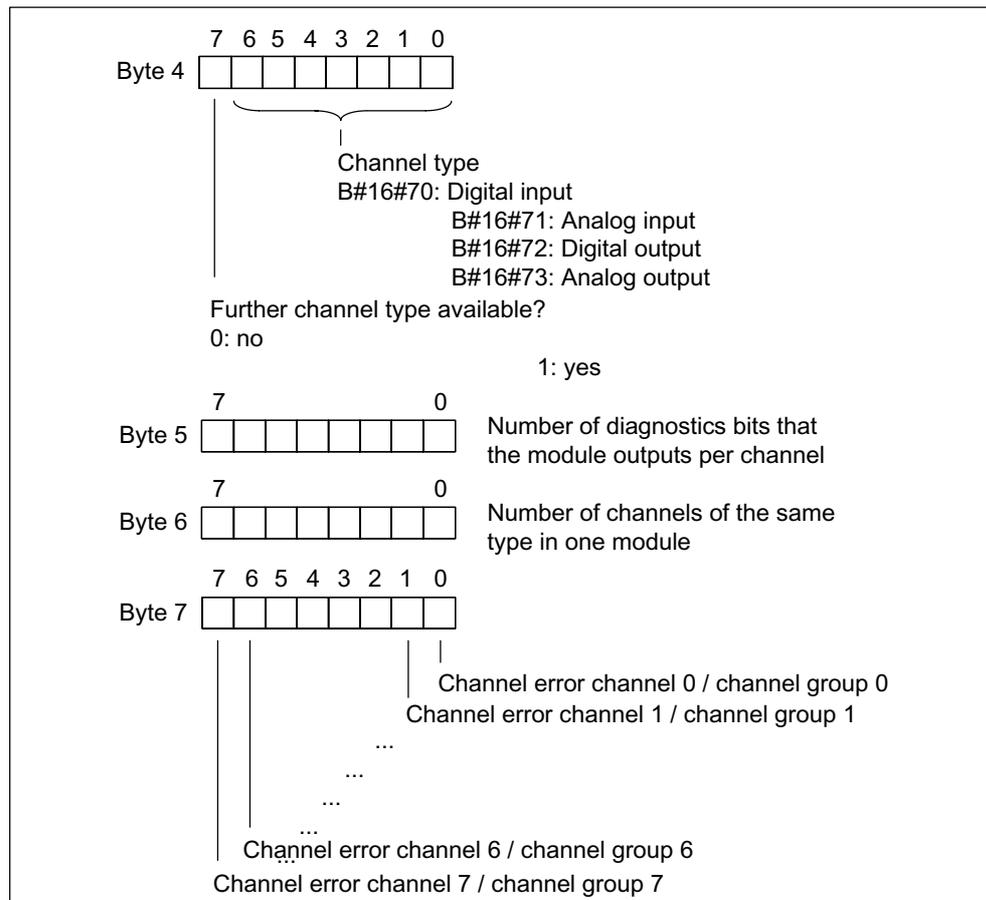
Figure B-3   Bytes 4 to 7 of the Diagnostics Data

B.3 Channel-Specific Diagnostic Data from Byte 8

From byte 8 up to byte 15, data record 1 contains the channel-specific diagnostic data. The figures below show the assignment of the diagnostic byte for a channel or a channel group of the specific module. The following general rule applies: When an error occurs, the bit concerned is set to "1".

You will find a description of possible error causes and appropriate remedies in the section called "Diagnostics of the Modules".

Digital input channel of the SM 321; DI 16 $\times$ 24 VDC; with hardware and diagnostic interrupts

```
        7 6 5 4 3 2 1 0
       ┌─┬─┬─┬─┬─┬─┬─┬─┐
       │0│0│ │ │ │ │ │ │
       └─┴─┴─┴─┴─┴─┴─┴─┘
                      └─── Configuring/parameter assignment error
                    └───── Ground fault
                  └─────── Short-circuit to L+
                └───────── Short-circuit to M
              └─────────── Wire-break
            └───────────── Sensor supply missing
```
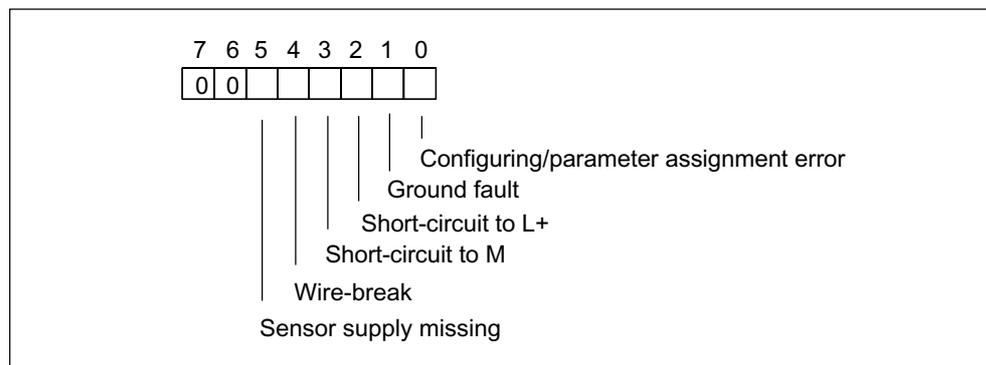
Figure B-4   Diagnostic Byte for a Digital Input Channel of the SM 321; DI 16 x 24 VDC

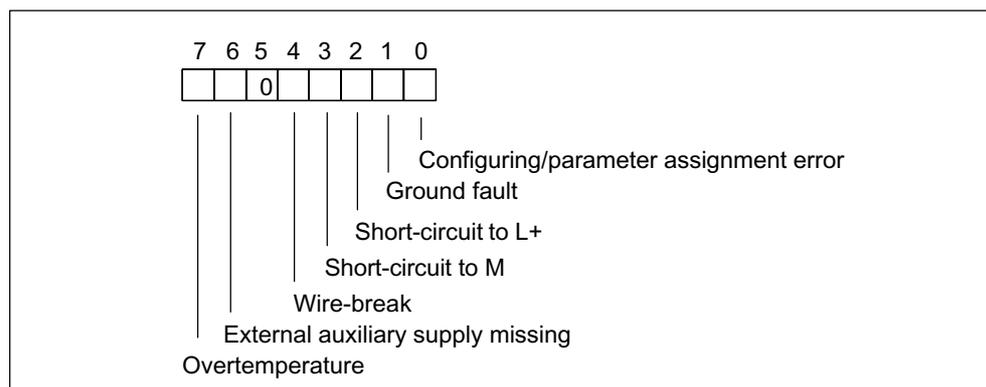**Digital output channel of the SM 322; DO 8 x 24 VDC/0.5 A; with diagnostic interrupt**

```
        7 6 5 4 3 2 1 0
       ┌─┬─┬─┬─┬─┬─┬─┬─┐
       │ │ │0│ │ │ │ │ │
       └─┴─┴─┴─┴─┴─┴─┴─┘
                      └─── Configuring/parameter assignment error
                    └───── Ground fault
                  └─────── Short-circuit to L+
                └───────── Short-circuit to M
              └─────────── Wire-break
            └───────────── External auxiliary supply missing
          └─────────────── Overtemperature
```

Figure B-5   Diagnostic Byte for a Digital Output Channel of the SM 322;
DO 8 x 24 VDC/0.5 A

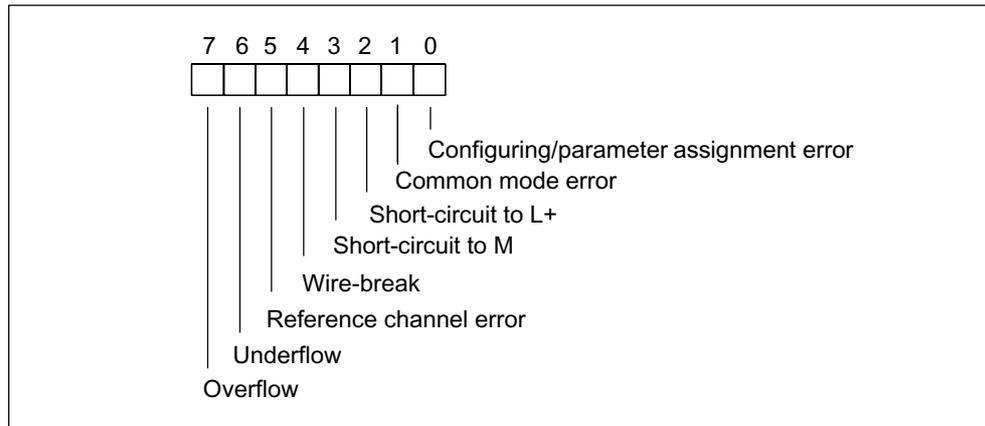## Analog input channel of the SM 331 modules with diagnostics capability

```
        7 6 5 4 3 2 1 0
       ┌─┬─┬─┬─┬─┬─┬─┬─┐
       │ │ │ │ │ │ │ │ │
       └─┴─┴─┴─┴─┴─┴─┴─┘
        │ │ │ │ │ │ │ │
        │ │ │ │ │ │ │ └── Configuring/parameter assignment error
        │ │ │ │ │ │ └──── Common mode error
        │ │ │ │ │ └────── Short-circuit to L+
        │ │ │ │ └──────── Short-circuit to M
        │ │ │ └────────── Wire-break
        │ │ └──────────── Reference channel error
        │ └────────────── Underflow
        └──────────────── Overflow
```

Figure B-6   Diagnostic Byte for an Analog Input Channel of a SM 331 with Diagnostics Capability

Analog output channel of the SM 332 modules with diagnostics capability

```
        7 6 5 4 3 2 1 0
       ┌─┬─┬─┬─┬─┬─┬─┬─┐
       │0│ │0│ │ │ │ │ │
       └─┴─┴─┴─┴─┴─┴─┴─┘
          │   │ │ │ │ │
          │   │ │ │ │ └── Configuring/parameter assignment error
          │   │ │ │ └──── Common mode error
          │   │ │ └────── Short-circuit to L+
          │   │ └──────── Short-circuit to M
          │   └────────── Wire-break
          └────────────── External auxiliary supply missing
```
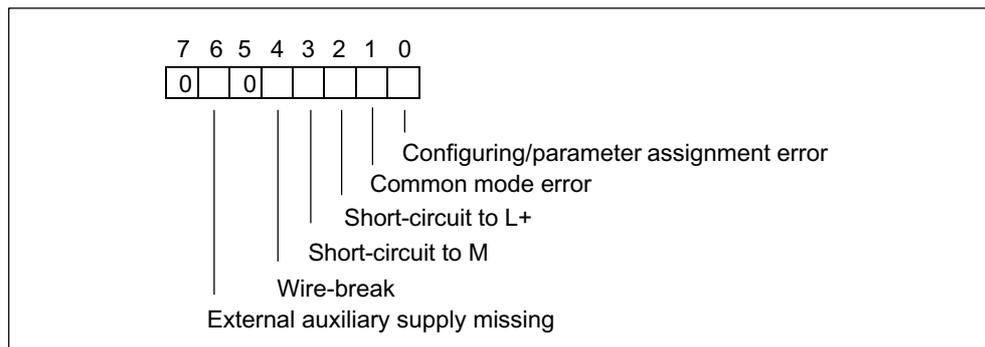
Figure B-7   Diagnostic Byte for an Analog Output Channel of a SM 332 with Diagnostics Capability

B.4 Diagnostic Data of the SM 338; POS-INPUT

The structure and contents of the different bytes of the diagnostic data for position detection module SM 338; POS-INPUT are described below. The following general rule applies: When an error occurs, the bit concerned is set to "1".

Section 5.4 includes a description of possible error causes and appropriate remedies.

Bytes 0 and 1
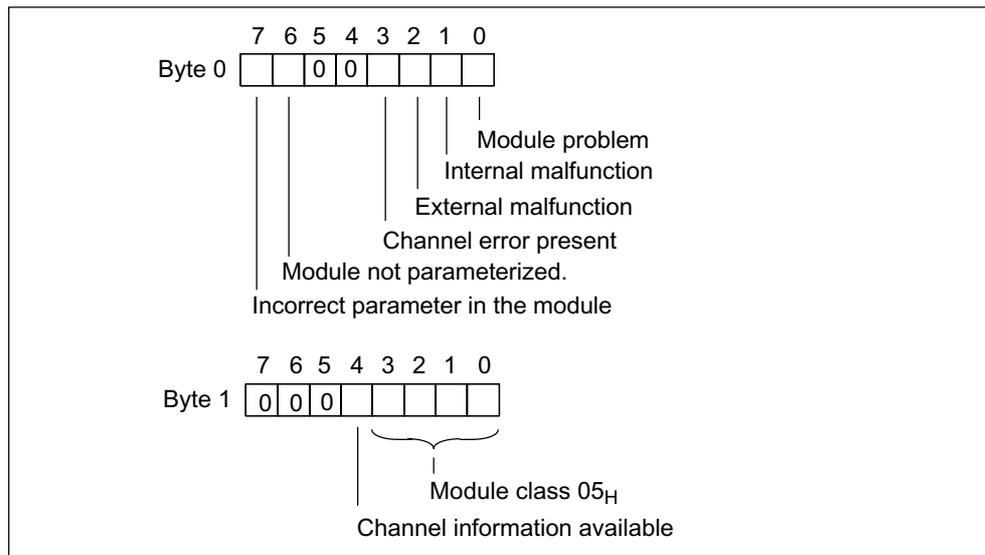
Figure B-8   Bytes 0 and 1 of the Diagnostic Data for the SM 338; POS-INPUT

Bytes 2 to 7
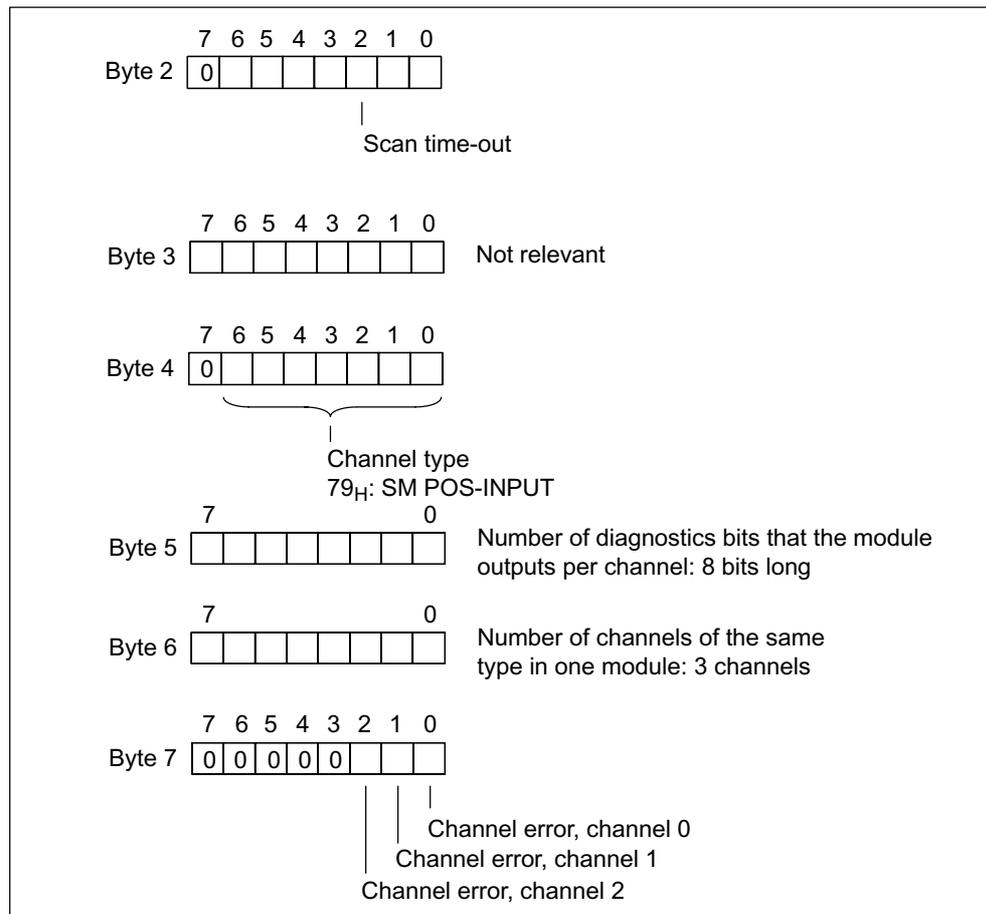
Figure B-9   Bytes 2 and 7 of the Diagnostic Data for the SM 338; POS-INPUT

Bytes 8 to 10

From byte 8 up to byte 10, data record 1 contains the channel-specific diagnostic data. The figure below shows the assignment of the diagnostic byte for a channel of the SM 338; POS-INPUT.
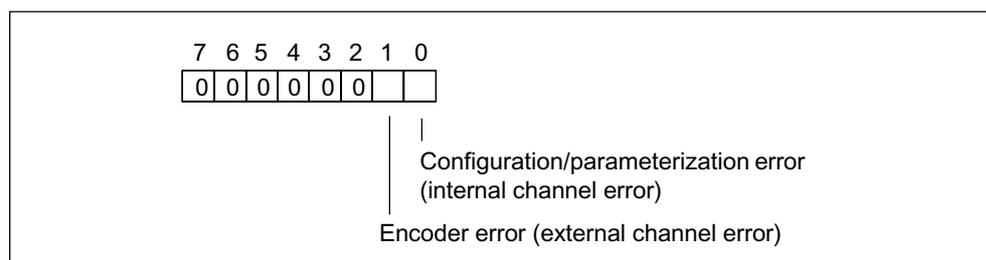
Figure B-10   Diagnostic Byte for a Channel of the SM 338; POS-INPUT

Dimension Drawings

C

Introduction

In this appendix you will find the dimension drawings for the most important components of an S7-300. The specifications in these dimension drawings are required for dimensioning the S7-300 configuration. The dimensions of an S7-300 configuration must be taken into account when installing an S7-300 in cabinets, switchgear rooms, etc. This appendix does not contain any dimension drawings of the CPUs of the S7-300 or M7-300 or of the IM 153-1. These dimension drawings are contained in the relevant manuals.

Contents

In this appendix, you will find the dimension drawings of the following S7-300 components.

C.1 Dimension Drawings of the Rails

483 mm standard rail

Figure C-1 shows the dimension drawing of the 483 mm standard rail.
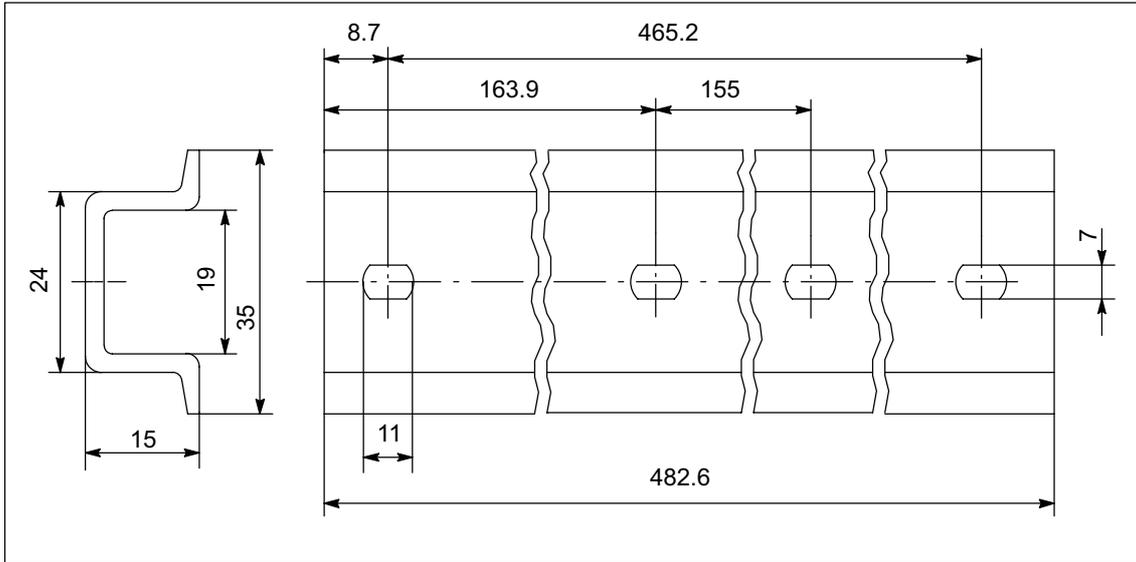
Figure C-1   Dimension Drawing of the 483 mm Standard Rail

530 mm standard rail

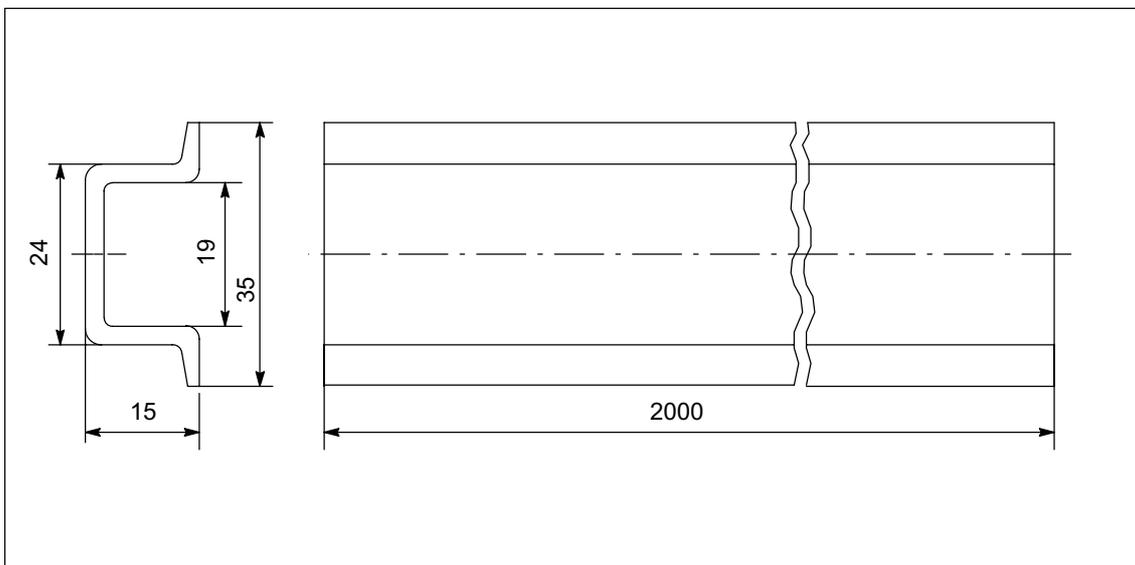Figure C-2 shows the dimension drawing of the 530 mm standard rail.
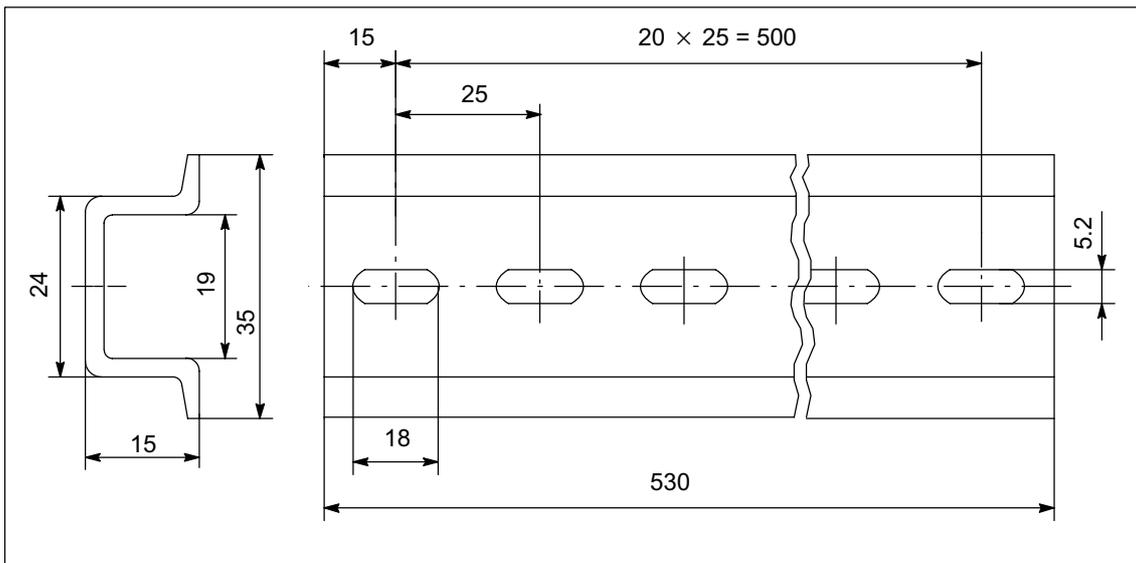
Figure C-2   Dimension Drawing of the 530 mm Standard Rail

830 mm standard rail
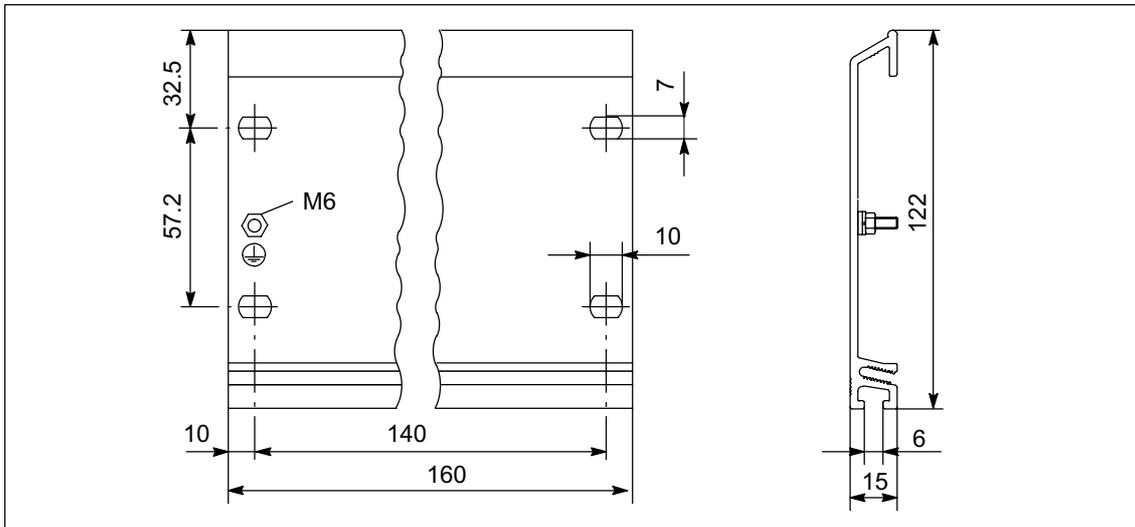
Figure C-3 shows the dimension drawing of the 830 mm standard rail.
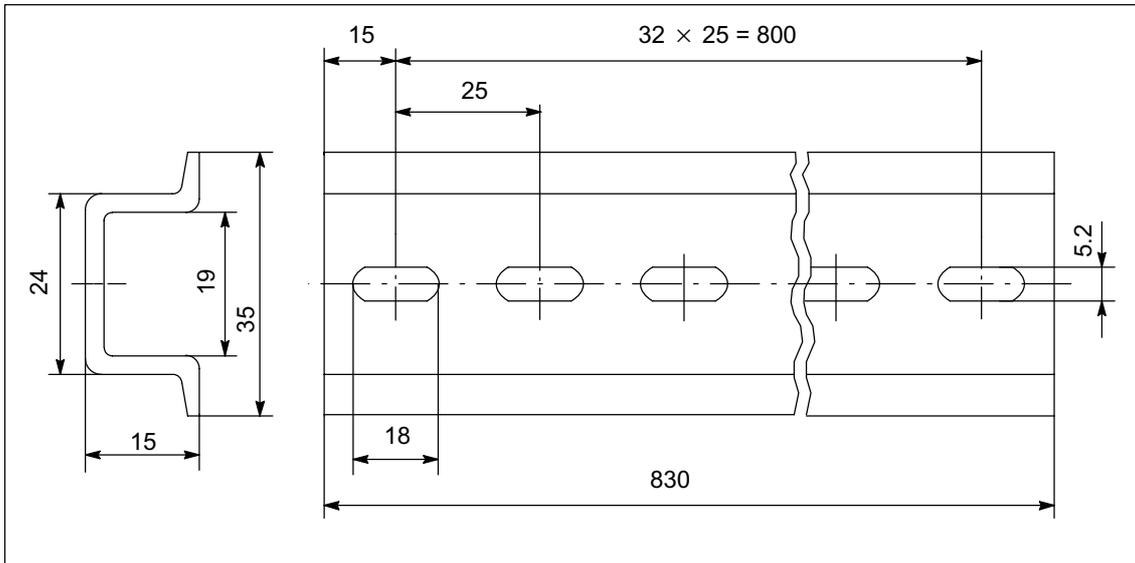
Figure C-3   Dimension Drawing of the 830 mm Standard Rail

2000 mm standard rail

Figure C-4 shows the dimension drawing of the 2000 mm standard rail.

Figure C-4   Dimension Drawing of the 2000 mm Standard Rail

160 mm rail

Figure C-5 shows the dimension drawing of the 160 mm rail.

Figure C-5   Dimension Drawing of the Rail with 160 mm Standard Width

482.6 mm rail

Figure C-6 shows the dimension drawing of the 482.6 mm rail.
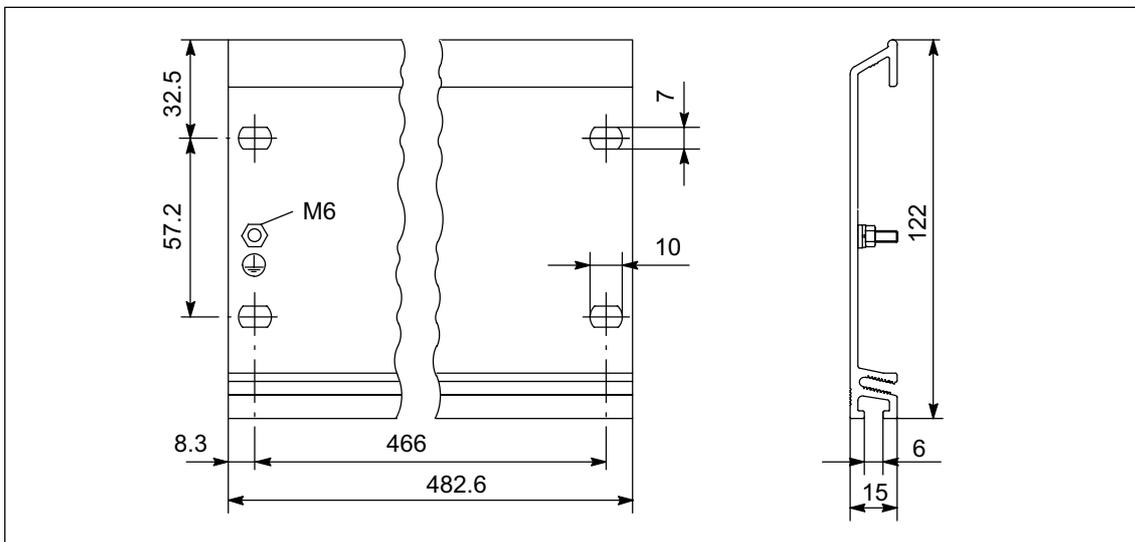
Figure C-6   Dimension Drawing of the Rail with 482.6 mm Standard Width

530 mm rail

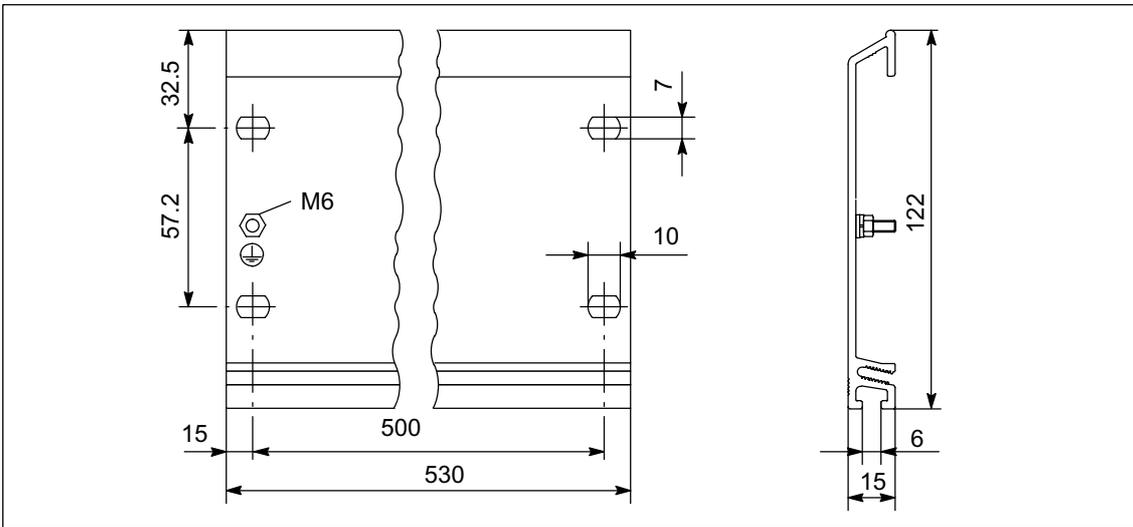Figure C-7 shows the dimension drawing of the 530 mm rail.

Figure C-7   Dimension Drawing of the Rail with 530 mm Standard Width

830 mm rail

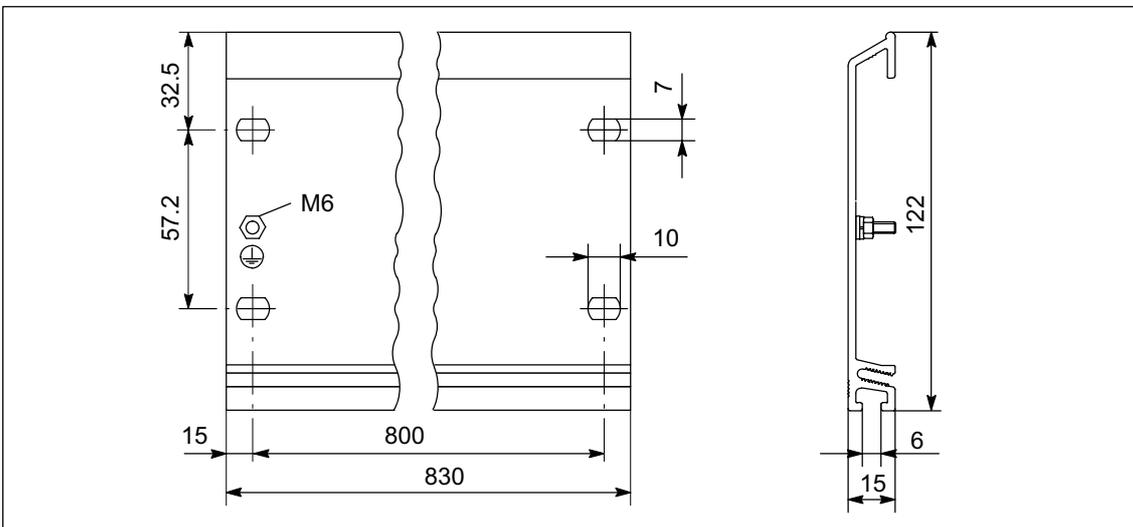Figure C-8 shows the dimension drawing of the 830 mm rail.

Figure C-8   Dimension Drawing of the Rail with 830 mm Standard Width

2000 mm rail

Figure C-9 shows the dimension drawing of the 2000 mm rail.
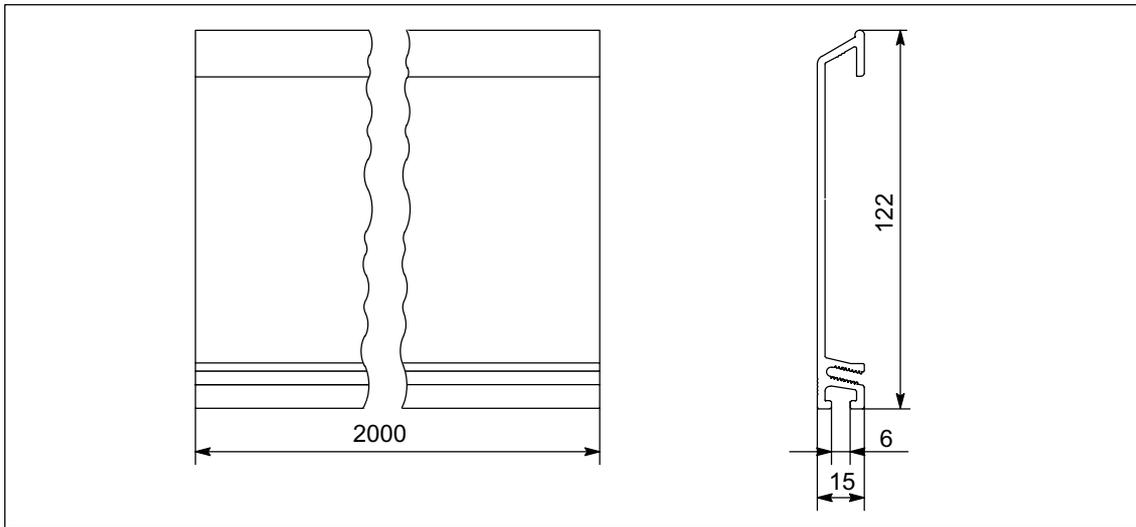

Figure C-9   Dimension Drawing of the 2000 mm Rail

Rail for "Insert and Remove" function

Figure C-10 shows the dimension drawing of the rail for the "Insert and Remove" function with active bus module, S7-300 module and explosion-proof partition. The rail is 482.6 mm or 530 mm long.
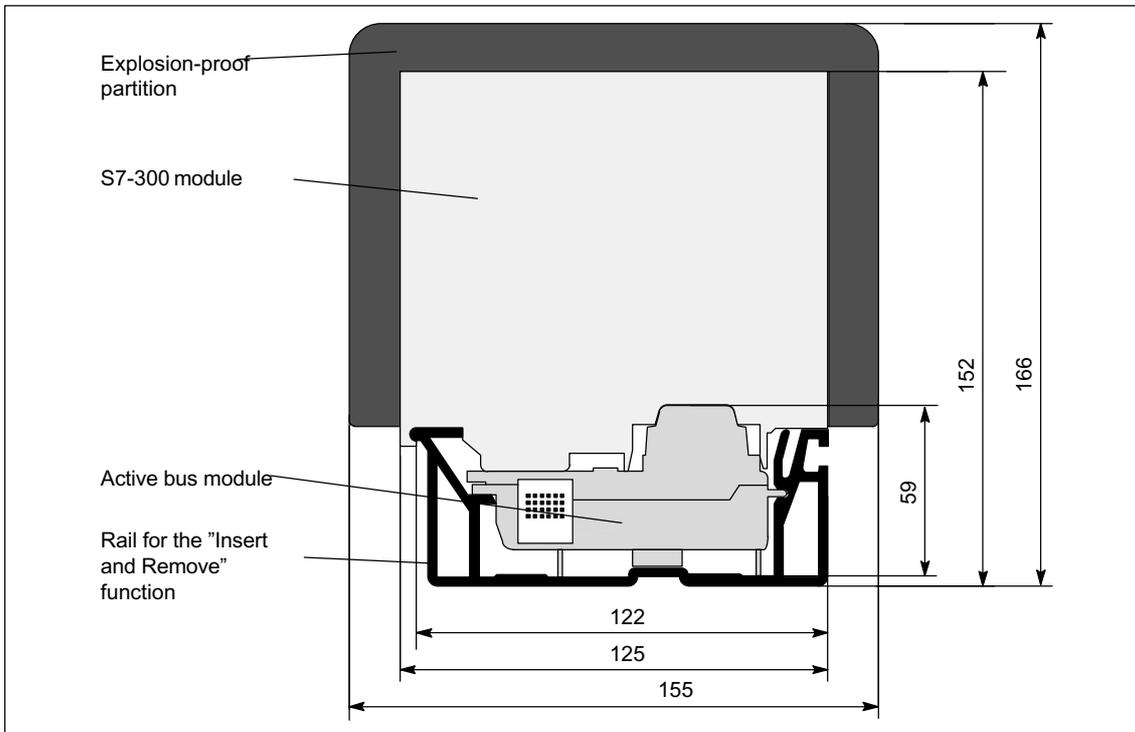

Figure C-10   Complete Dimension Drawing of a Rail for "Insert and Remove" Function with Active Bus Module, S7-300 Module and Explosion-proof Partition

Bus modules (Expansion buses)

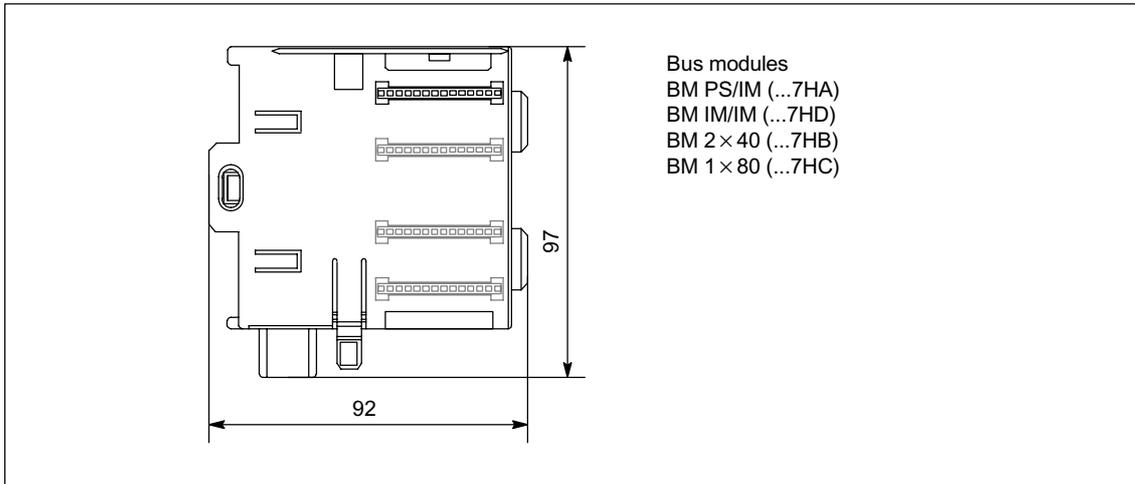Figure C-11 shows the dimension drawing of the active bus module for the "Insert and Remove" function.

Bus modules
BM PS/IM (...7HA)
BM IM/IM (...7HD)
BM 2 × 40 (...7HB)
BM 1 × 80 (...7HC)

Figure C-11   Dimension Drawing of the Active Bus Modules

C.2   Dimension Drawings of the Power Supply Modules

PS 307; 2 A

Figure C-12 shows the dimension drawing of the PS 307; 2 A power supply module.
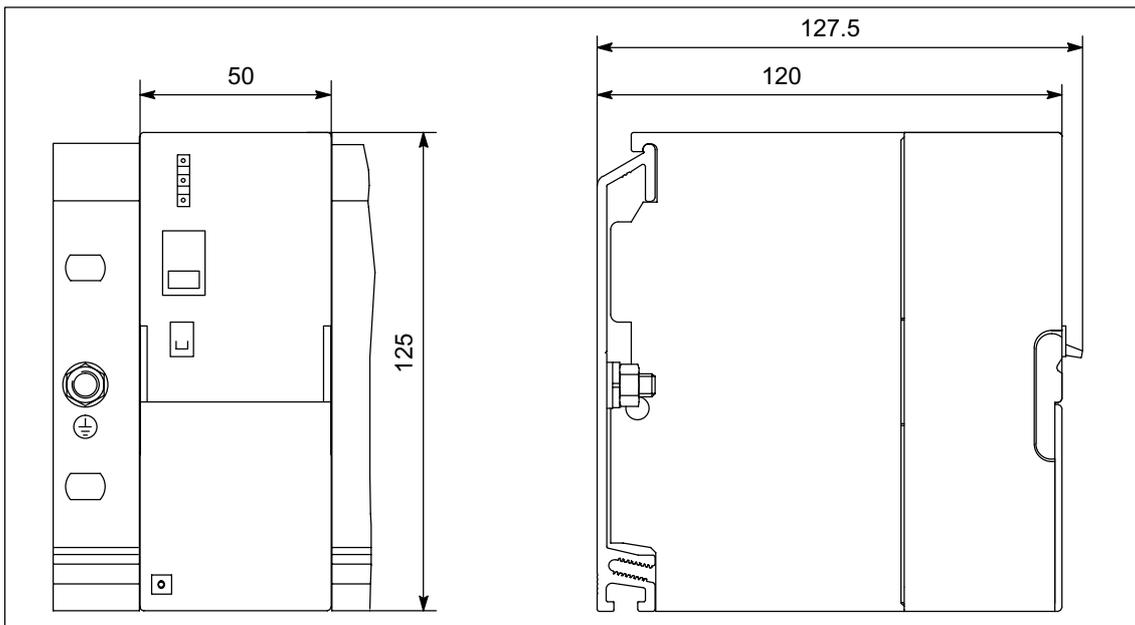

Figure C-12   Power Supply Module PS 307; 2 A

PS 307; 5A

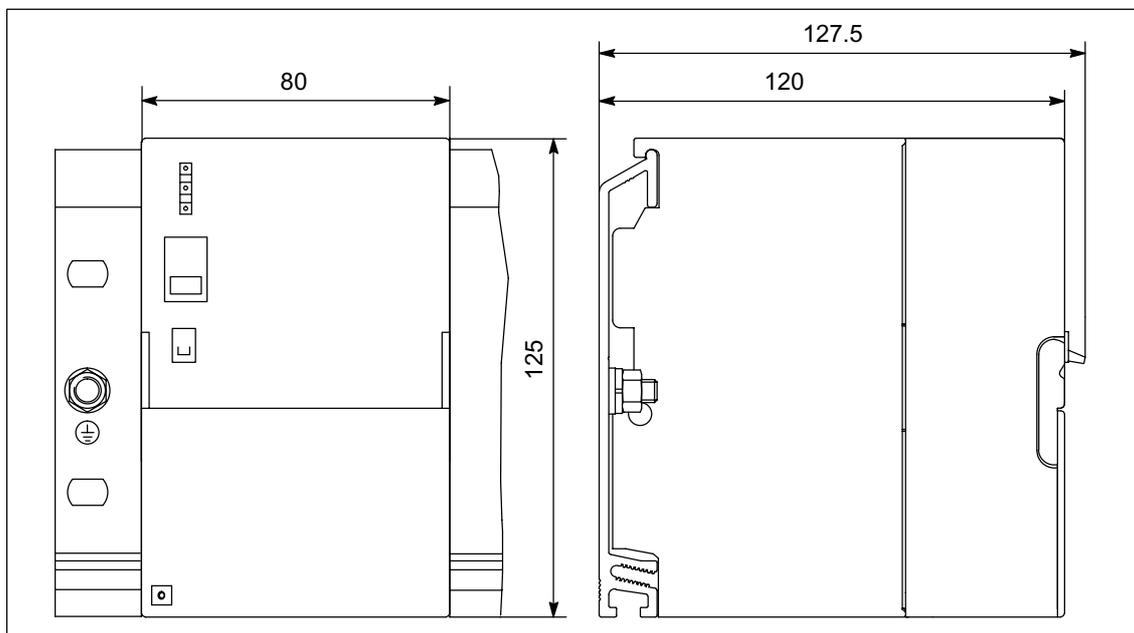Figure C-13 shows the dimension drawing of the PS 307; 5 A power supply module.

Figure C-13   Power Supply Module PS 307; 5 A

PS 307; 10 A

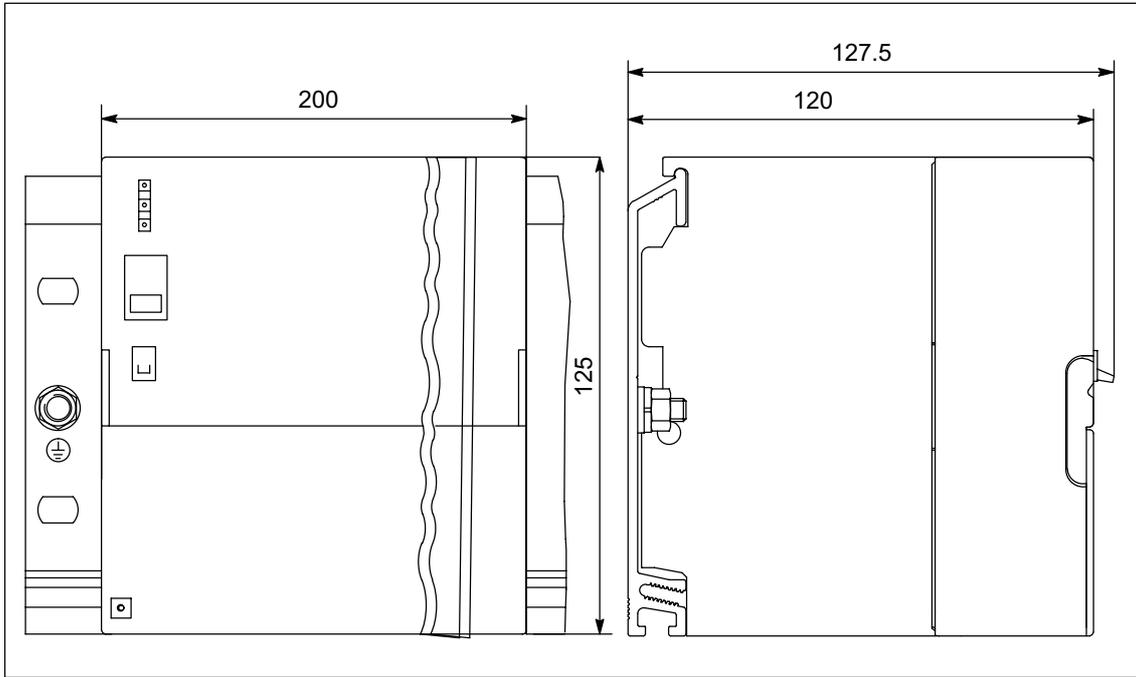Figure C-14 shows the dimension drawing of the PS 307; 10 A power supply module.

Figure C-14   Power Supply Module PS 307; 10 A

PS 307; 5 A with CPUs 313/314/315/315-2 DP

Figures C-15 and C-16 show the dimension drawings of the configuration of a power supply module PS 307; 5 A with the CPUs 313/314/315/315-2 DP. Observe the dimensions that result from the use of the power connector for wiring the PS 307; 5 A with the CPU.
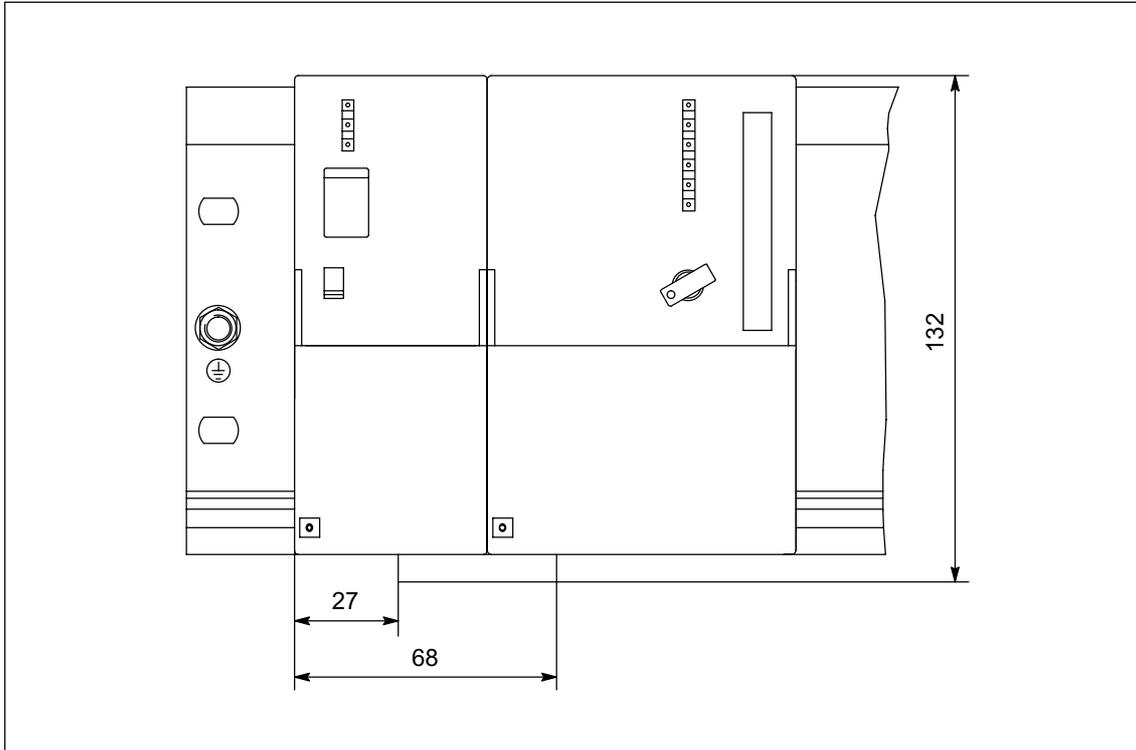

Figure C-15   Dimension Drawing of the Power Supply Module PS 307; 5 A with CPUs 313/314/315/315-2 DP. Front View

PS 307; 5 A with CPUs 313/314/315/315-2 DP

Figure C-16 shows the dimension drawing of the power supply module PS 307; 5 A with the CPUs 313/314/315/315-2 DP in the side view.

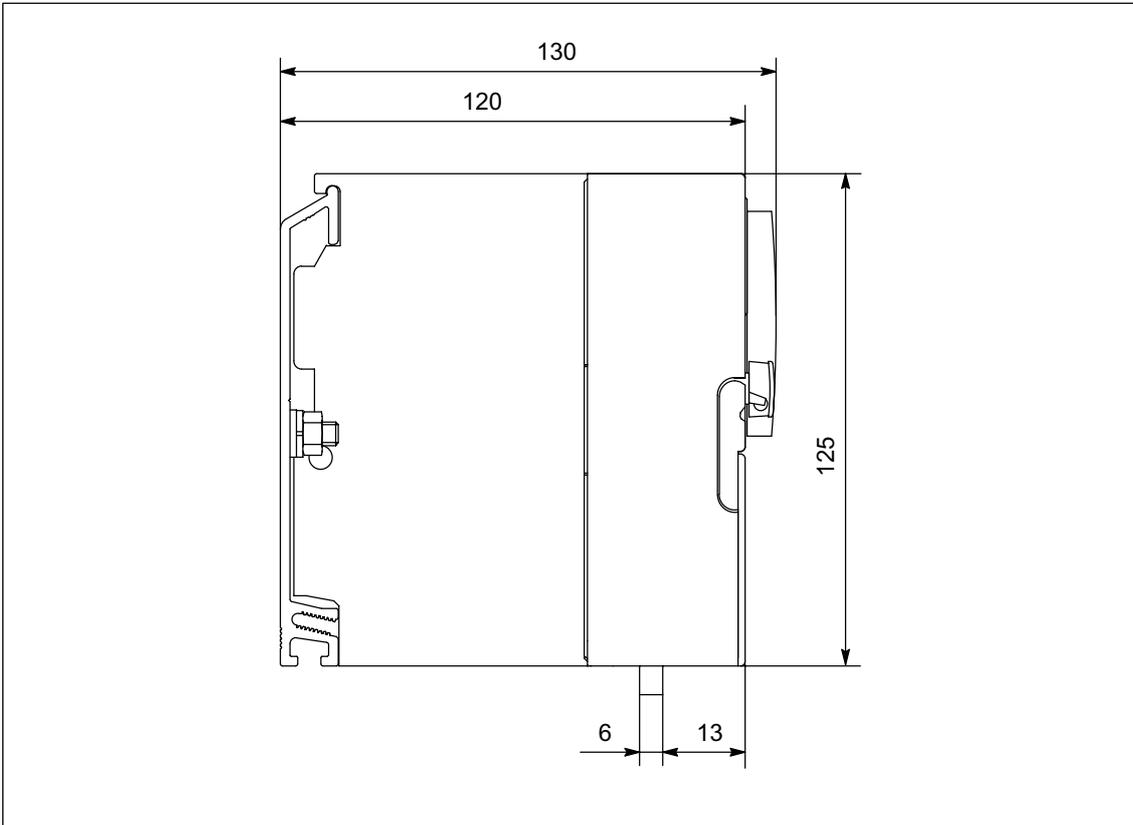Figure C-16   Dimension Drawing of the Power Supply Module PS 307; 5 A with CPUs 313/314/315/315-2 DP. Side View

C.3 Dimension Drawings of the Interface Modules

IM 360

Figure C-17 shows the dimension drawing of the interface module IM 360.
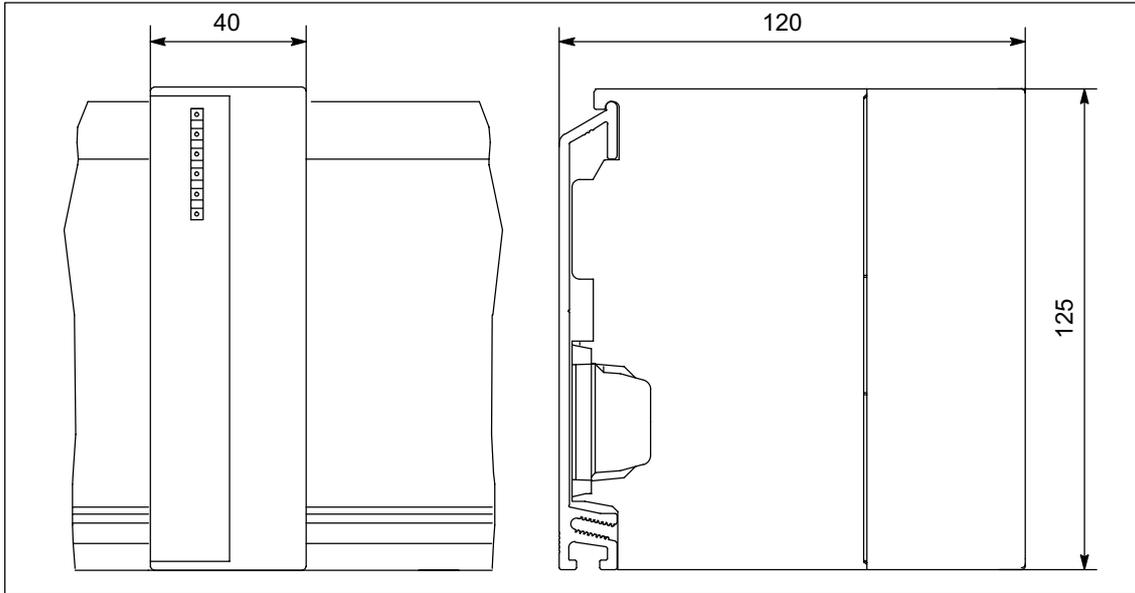

Figure C-17   Interface Module IM 360

IM 361

Figure C-18 shows the dimension drawing of the interface module IM 361.

Figure C-18   Interface Module IM 361

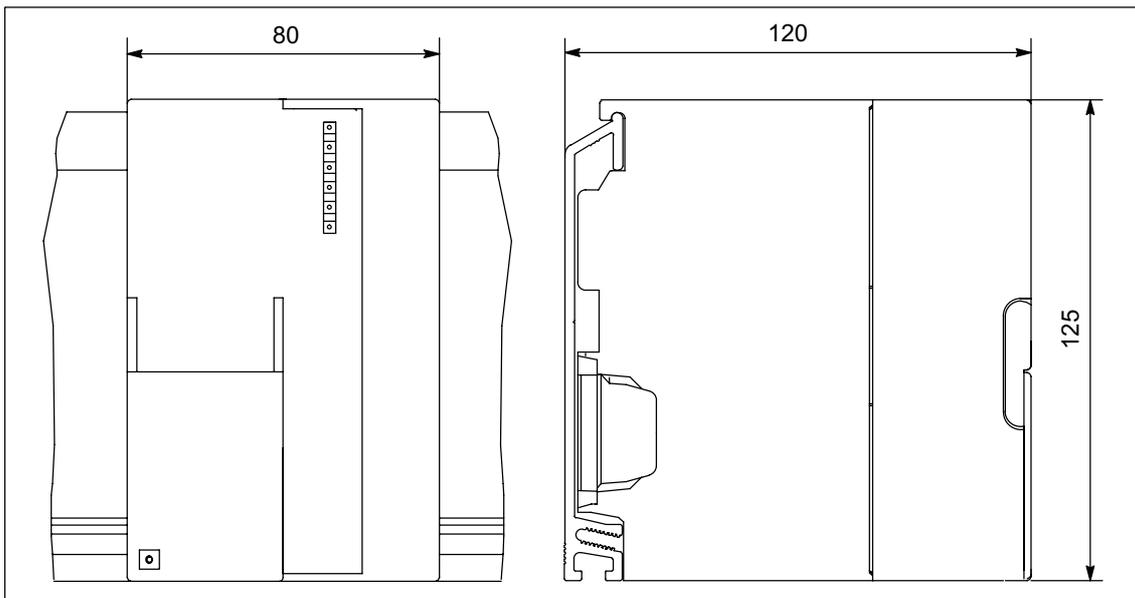## IM 365

Figure C-19 shows the dimension drawing of interface module IM 365.
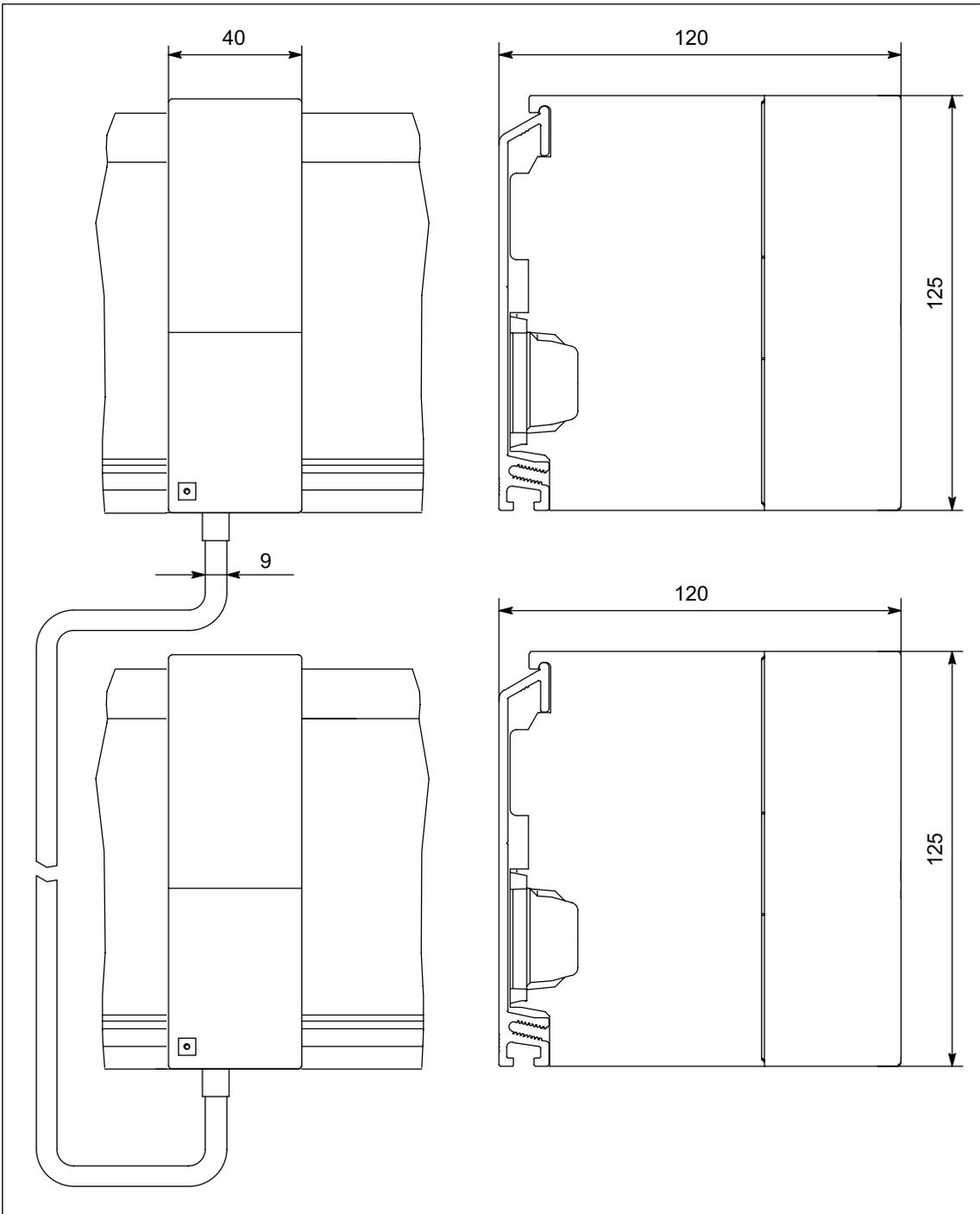
Figure C-19   Interface Module IM 365

C.4 Dimension Drawings of the Signal Modules

Signal Module

Figure C-20 shows the dimension drawing of the signal module.
A signal module might look slightly different than the example below. The
dimensions however are always the same.
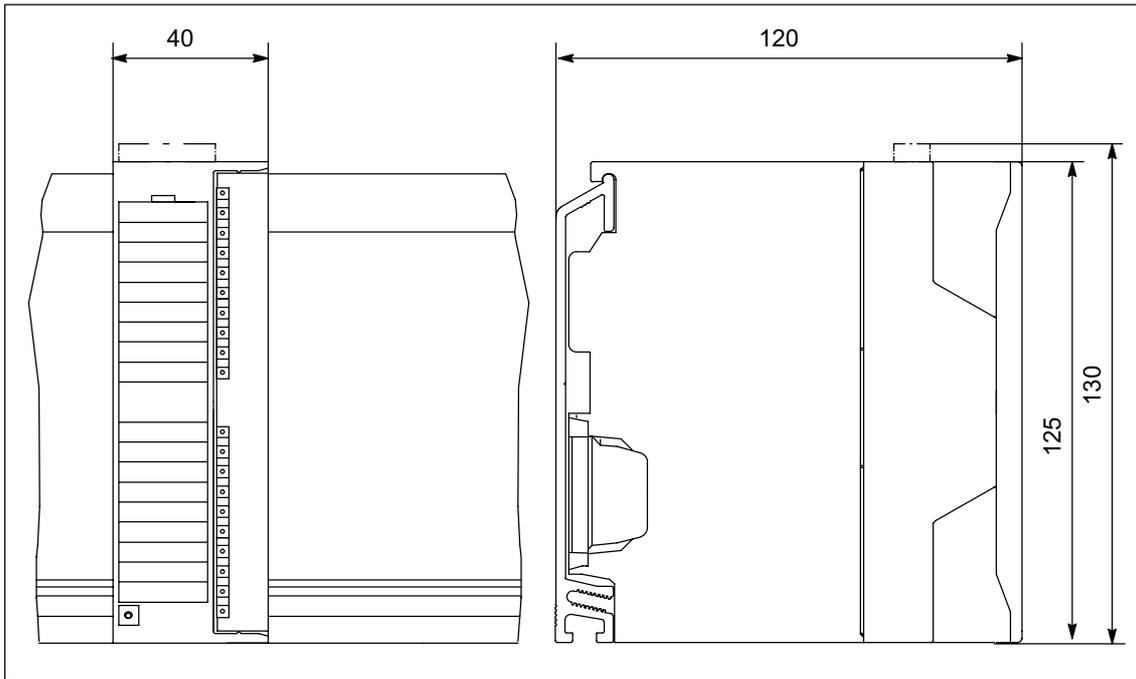
Figure C-20   Signal Module

C.5 Dimension Drawings for Accessories

Shield connecting element

Figure C-21 shows the dimension drawing of the shield connecting element in connection with two signal modules.
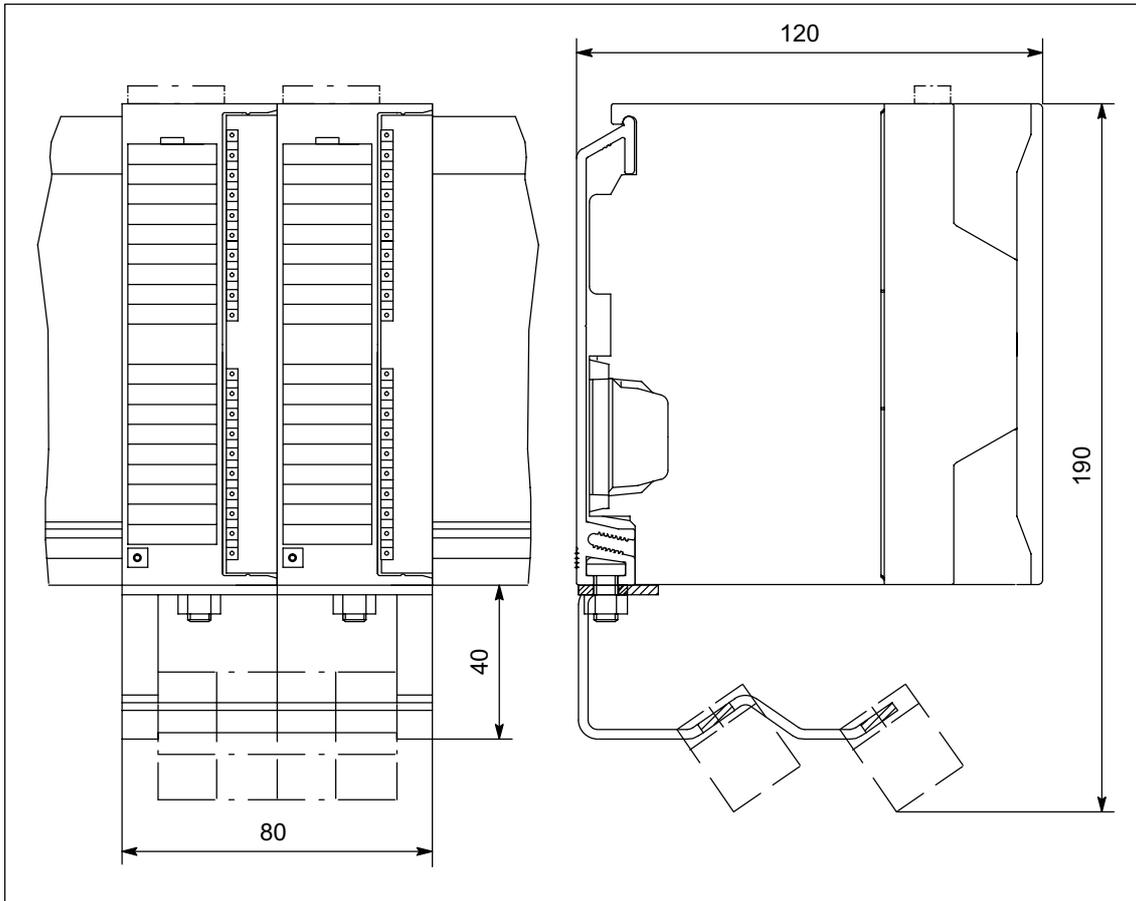
Figure C-21   2 Signal Modules with Shield Connecting Element

SIMATIC TOP connect, 3-tier

Figure C-22 shows the dimension drawing of the 3-tier SIMATIC TOP connect.
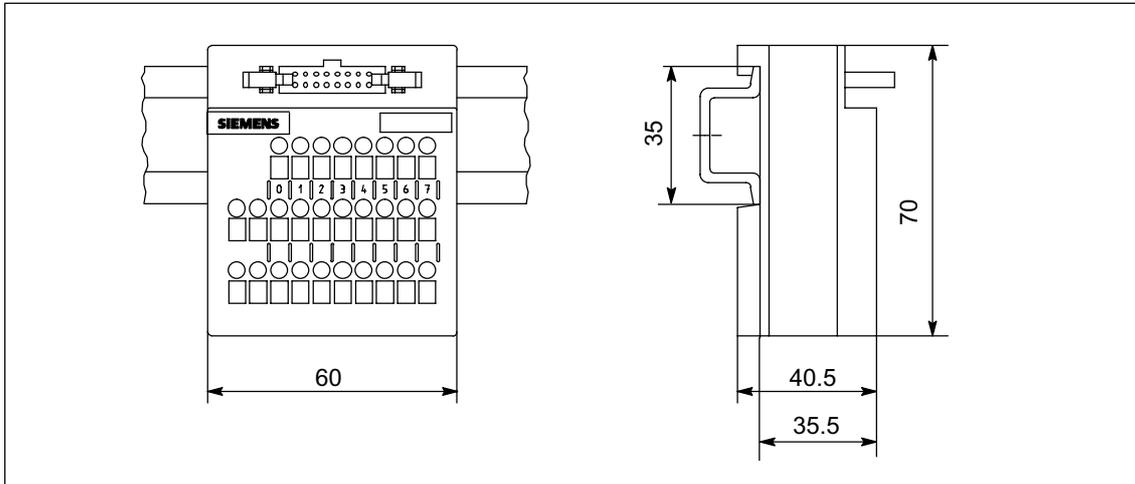
Figure C-22 SIMATIC TOP connect, 3-tier

SIMATIC TOP connect, 2-tier

Figure C-23 shows the dimension drawing of the 2-tier SIMATIC TOP connect.
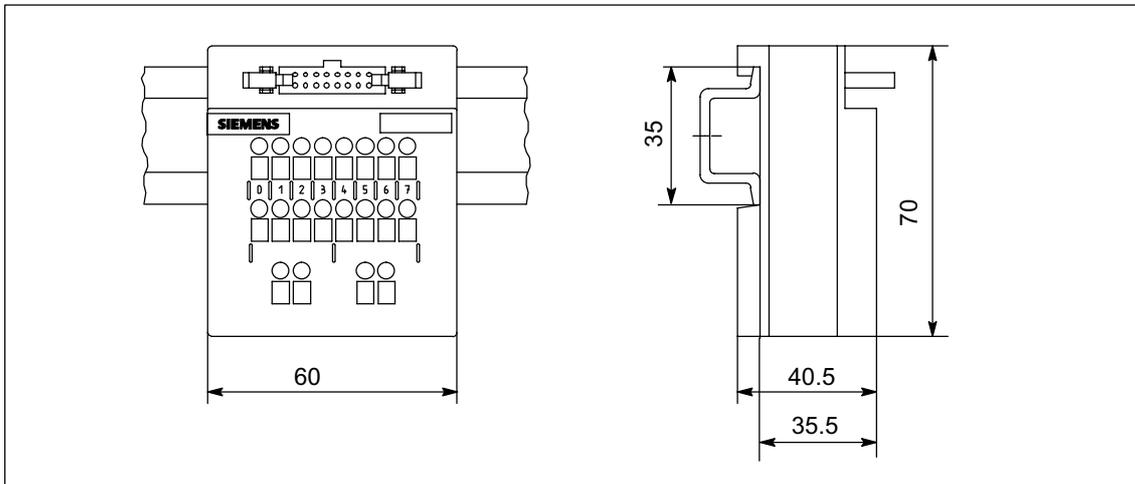
Figure C-23 SIMATIC TOP connect, 2-tier

SIMATIC TOP connect, 1-tier

Figure C-24 shows the dimension drawing of the 1-tier SIMATIC TOP connect.
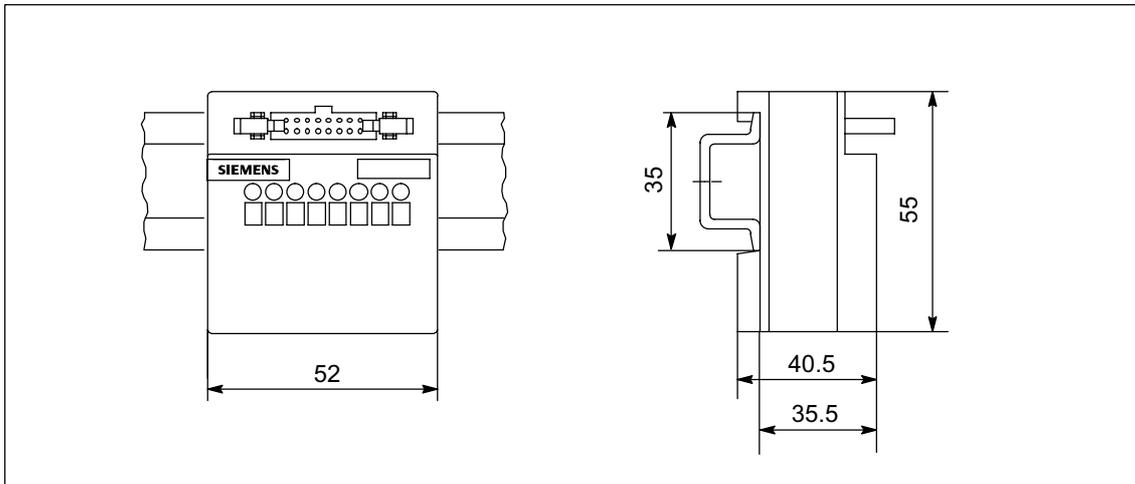
Figure C-24   SIMATIC TOP connect, 1-tier

RS 485 repeater on standard rail

Figure C-25 shows the dimension drawing of the RS 485 repeater on the standard rail.

Figure C-25   RS 485 Repeater on Standard Rail

RS 485 repeater on S7-300 rail

Figure C-26 shows the dimension drawing of the RS 485 repeater on the S7-300 rail.
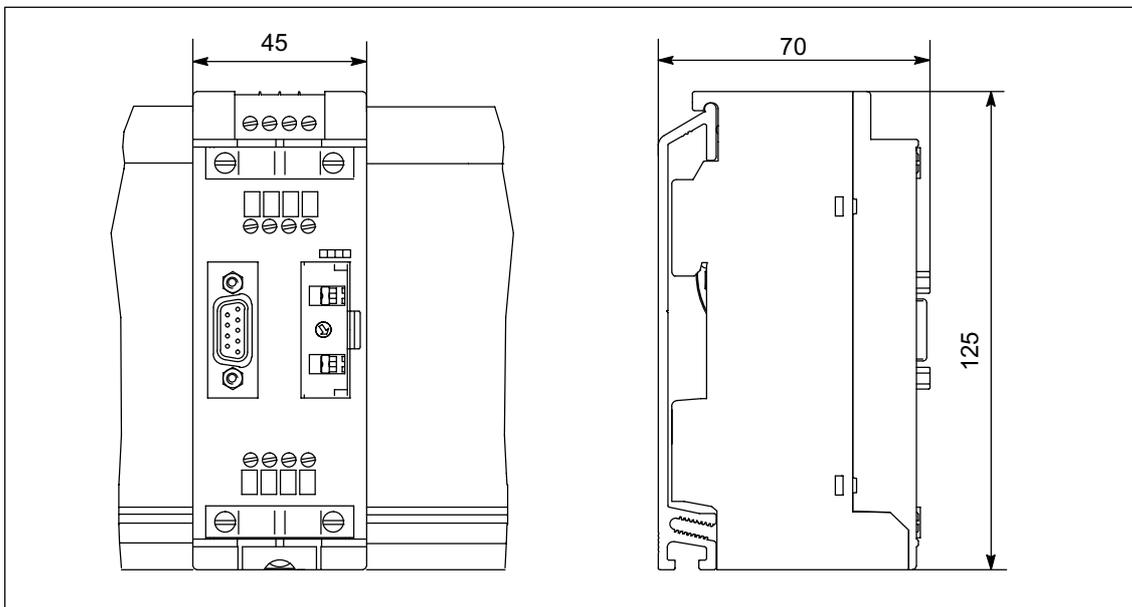
Figure C-26   RS 485 repeater on S7-300 rail

Spare Parts and Accessories for S7-300 Modules

D

Spare parts

Table D-1 lists all the parts you can order separately or later for S7-300 programmable controllers.

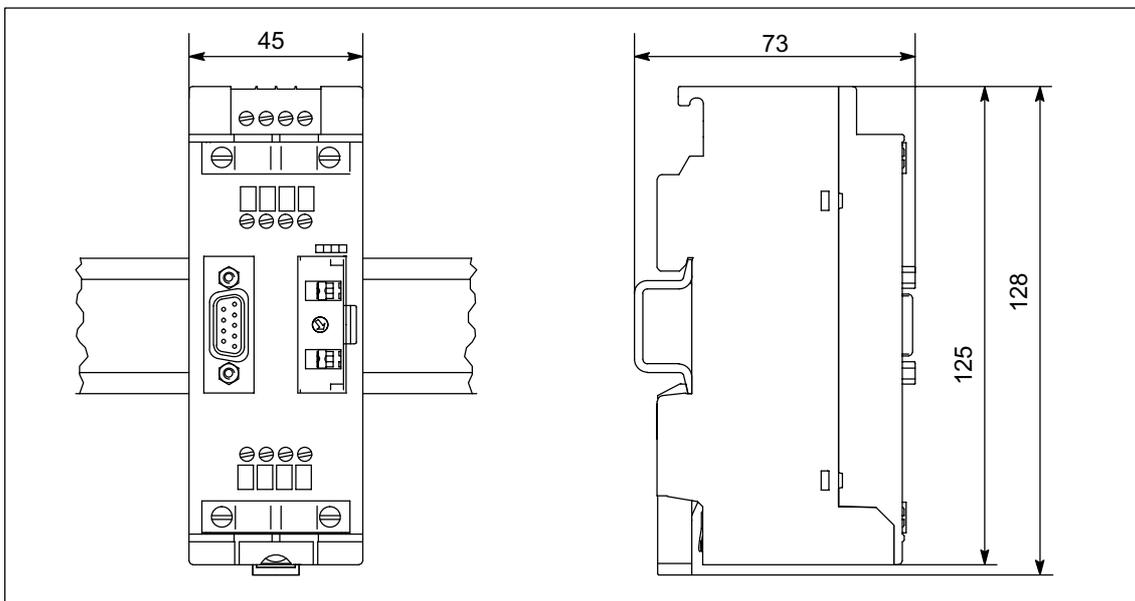Table D-1   Accessories and Spare Parts

S7-300 Parts	Order number
Bus connector	6ES7390-0AA00-0AA0
Power connector between power supply unit and CPU	6ES7390-7BA00-0AA0
Labeling strip (Qty 10)	
• For 8/16-channel modules	6ES7392-2XX00-0AA0
• For 32-channel modules	6ES7392-2XX10-0AA0
Labeling strips to be printed	
• For 16-channel modules (petrol)	6ES7392-2AX00-0AA0
(light beige)	6ES7392-2BX00-0AA0
(yellow)	6ES7392-2CX00-0AA0
(red)	6ES7392-2DX00-0AA0
• For 32-channel modules (petrol)	6ES7392-2AX10-0AA0
(light beige)	6ES7392-2BX10-0AA0
(yellow)	6ES7392-2CX10-0AA0
(red)	6ES7392-2DX10-0AA0
• Instructions for printing labeling strips with artwork	www.siemens.de/automation/csi/product Contribution ID No.: 11978022
Slot numbering label	6ES7912-0AA00-0AA0
Front connector 20-pin	
• Screw-type Connection	6ES7392-1AJ00-0AA0
• Spring-loaded Connection	6ES7392-1BJ00-0AA0
Front connector 40-pin	
• Screw-type Connection	6ES7392-1AM00-0AA0
Front connector for 2 flat ribbon terminals	
• Screw-type Connection	6ES7921-3AB00-0AA0
• Spring-loaded Connection	6ES7921-3AA00-0AA0

Table D-1   Accessories and Spare Parts, continued

S7-300 Parts	Order number
Front connector for 4 flat ribbon terminals ● Spring-loaded Connection	 6ES7921-3AA20-0AA0
SIMATIC TOP connect, 1-tier, with ● Screw-type Connection ● Spring-loaded Connection	 6ES7924-0AA00-0AA0 6ES7924-0AA00-0AB0
SIMATIC TOP connect, 2-tier, with ● Screw-type Connection ● Spring-loaded Connection	 6ES7924-0BB00-0AA0 6ES7924-0BB00-0AB0
SIMATIC TOP connect, 3-tier, with ● Screw-type Connection ● Spring-loaded Connection	 6ES7924-0CA00-0AA0 6ES7924-0CA00-0AB0
Round-sheath ribbon cable (16-pin) ● Unshielded 30 m ● Unshielded 60 m ● Shielded 30 m ● Shielded 60 m	 6ES7923-0CD00-0AA0 6ES7923-0CG00-0AA0 6ES7923-0CD00-0BA0 6ES7923-0CG00-0BA0
Plug-in connectors, 16-pin, set of 8 (insulation displacement connectors)	6ES7921-3BE10-0AA0
Shield connecting element	6ES7390-5AA00-0AA0
Shield connection terminals for ● 2 cables, each with a shield diameter of 2 to 6 mm ● 1 cable with a shield diameter of 3 to 8 mm ● 1 cable with a shield diameter of 4 to 13 mm	 6ES7390-5AB00-0AA0 6ES7390-5BA00-0AA0 6ES7390-5CA00-0AA0
Measuring range module for analog modules	6ES7974-0AA00-0AA0
Fuse set for 120/230 VAC digital output modules (contains 10 fuses and 2 fuse carriers)	6ES7973-1HD00-0AA0
Interconnecting cable between IM 360 and IM 361 or IM 361 and IM 361 ● 1 m ● 2.5 m ● 5 m ● 10 m	 6ES7368-3BB01-0AA0 6ES7368-3BC51-0AA0 6ES7368-3BF01-0AA0 6ES7368-3CB01-0AA0

Guidelines for Handling Electrostatic Sensitive Devices (ESD)

E

Introduction

In this appendix, we explain

- what is meant by "electrostatic sensitive devices"

- the precautions you must observe when handling and working with electrostatic sensitive devices.

Contents

This chapter contains the following sections on electrostatic sensitive devices:

Section	Contents	Page
E.1	What is ESD?	E-2
E.2	Electrostatic Charging of Persons	E-3
E.3	General Protective Measures Against Electrostatic Discharge Damage	E-4

E.1   What is ESD?

Definition

All electronic modules are equipped with large-scale integrated ICs or components. Due to their design, these electronic elements are very sensitive to overvoltages and thus to any electrostatic discharge.

The abbreviation **ESD** has been introduced for these **E**lectrostatic **S**ensitive **D**evices/**M**odules. The designation **ESD** is used internationally for **e**lectrostatic **s**ensitive **d**evice.

Electrostatic sensitive devices are labeled with the following symbol:
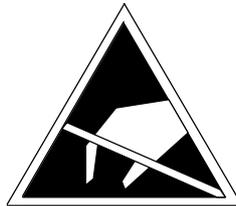
⚠️ **Caution**

Electrostatic sensitive devices are subject to voltages that are far below the voltage values that can still be perceived by human beings. These voltages are present if you touch a component or the electrical connections of a module without previously being electrostatically discharged. In most cases, the damage caused by an overvoltage is not immediately noticeable and results in total damage only after a prolonged period of operation.

E.2   Electrostatic Charging of Persons

Charging

Every person with a non-conductive connection to the electrical potential of its surroundings can be charged electrostatically.

Figure E-1 shows you the maximum values for electrostatic voltages which can build up on a person coming into contact with the materials indicated in the figure. These values are in conformity with the specifications of IEC 801-2.
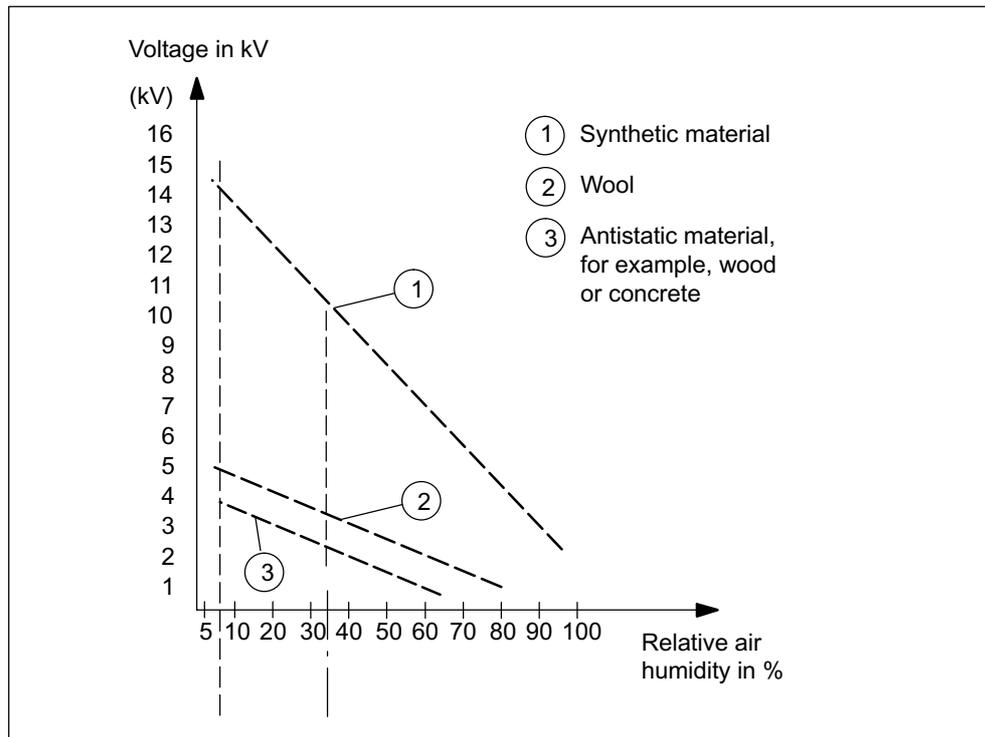
Figure E-1   Electrostatic Voltages which Can Build up on a Person

E.3 General Protective Measures Against Electrostatic Discharge Damage

Ensure sufficient grounding

Make sure that the personnel, working surfaces and packaging are sufficiently grounded when handling electrostatic sensitive devices. You thus avoid electrostatic charging.

Avoid direct contact

You should touch electrostatic sensitive devices only if it is unavoidable (for example, during maintenance work). Hold modules without touching the pins of components or printed conductors. In this way, the discharged energy cannot affect the sensitive devices.

If you have to carry out measurements on a module, you must discharge your body before you start the measurement by touching grounded metallic parts. Use grounded measuring devices only.

List of Abbreviations

F

Abbreviation	Explanation
AC	Alternating current
ADC	Analog-to digital converter
AI	Analog input
AO	Analog output
PLC	Programmable logic controller
COMP	Compensating terminal
CP	Communications processor
CPU	Central processing unit of a PLC
DAC	Digital-to-analog converter
DB	Data block
DC	Direct current
DI	Digital input
DO	Digital output
ESD	Electrostatic sensitive devices
EMC	Electromagnetic compatibility
EPROM	Erasable programmable read-only memory
EWS	Apply substitute value
FB	Function block
FC	Function
FEPROM	Flash erasable programmable read only memory
ES	Encoder supply
I+	Measuring lead for current input
I_C	Constant-current lead
KV	Shunt comparison
L+	Terminal for 24 VDC supply voltage
LWH	Hold last valid value
FOC	Fiber-optic cable
M	Ground terminal
M+	Measuring lead (positive)
M–	Measuring lead (negative)
M_{ANA}	Reference potential of the analog measuring circuit
MPI	Multipoint interface

OB	Organization block
OP	Operator panel
OS	Operator system
PIQ	Process-image output table
PII	Process-image input table
Programming device	Programming device
PS	Power supply
Q_I	Analog output current
Q_V	Analog output voltage
RAM	Random access memory
R_L	Load impedance
S +	Detector lead (positive)
S–	Detector lead (negative)
SF	"Group error" error LED
SFB	System function block
SFC	System function
SM	Signal module
PLC	Programmable logic control
SSI	Synchronous serial interface
TD	Text display
U+	Measuring lead for voltage input
U_{CM}	Common mode voltage
U_{iso}	Potential difference between M_{ANA} and local ground
Sign	Sign

Glossary

Address

An address denotes a specific operand or address area; examples of this are: input I 12.1; memory word MW 25; data block DB 3.

Aggregate current→

Sum of the currents of all output channels on a digital output module.

Backplane bus →

→ The backplane bus is a serial data bus that is used by the modules to communicate with each other and to supply them with the voltage they require. The interconnection of the modules is established by the bus connector.

Basic conversion time

Time for the actual encoding of a channel (integration time) plus the required times for the internal control; i. e. after this time a channel is completely processed.

Basic error limit

The basic error limit is the operational limit at 25 °C, referred to the rated range of the analog module.

Basic response time

Time which an analog input/output module requires for a cycle if all channels are released; it corresponds to the "number of all channels x basic conversion time".

Bus

A bus is a transmission medium that interconnects several nodes. Data transmission can be serial or parallel, and be performed over electric conductors or fiber-optic cables.

Bus segment

A bus segment is a self-contained section of a serial bus system. Bus segments are interconnected by means of → repeaters.

CiR

Equipment changes in running operations (Configuration in RUN)

Common mode voltage

A voltage that is common to all inputs/outputs of a group and is measured between this group and any reference point (usually to ground).

Communication processor

Programmable module for communication tasks, such as networking, point-to-point connection.

Comparison point

When using thermocouples on analog input modules: point of known temperature (for example, → compensating box).

Compensating box

Compensating boxes can be used for measuring temperatures with thermocouples on analog input modules. The compensating box is a compensation circuit for compensating temperature fluctuations at the → Comparison point.

Complete restart

When a CPU starts up (say, when the mode selector switch is moved from STOP to RUN or when the mains supply is turned on), OB 100 (Restart) is processed before cyclic programming processing (OB 1).

With a complete restart, the → Process input image is read in and the *STEP 7* user program is processed, starting with the first instruction in OB1.

Configure

Select and put together different components on a programmable logic controller and install the requisite software and adapt to the specific use (for example, by assigning parameters to the modules).

CP

→ Communications processor

CPU

The CPU (central processing unit) is a CPU module of the → programmable logic controller that stores and runs the user program. It contains the operating system, memory, processing unit and communication interface.

Default setting

> The default setting is a sensible basic setting that is used whenever no other value is used.

Destruction limit

> Limit of permitted input voltage / input current.
>
> If this limit is exceeded, the measuring accuracy may deteriorate. If the destruction limit is exceeded by a vast amount, this may destroy the internal measuring circuit.

Diagnostic buffer

> The diagnostic buffer is a buffered memory area in the CPU which stores the diagnostics events in the order in which they occurred.
>
> For troubleshooting, the user can read out the exact error cause in *STEP 7* (PLC –> Module State) from the diagnostic buffer.

Diagnostic data

> All the diagnostics events that occurred are collected in the CPU and entered in the → Diagnostic buffer. If there is an error OB, it is started.

Diagnostic Interrupt

> Modules with diagnostics capability report system errors by means of diagnostic interrupts to the → CPU. The operating system of the CPU calls OB 82 in the course of a diagnostic interrupt.

Diagnostics

> Generic term for → System diagnostics, process error diagnosis and user-defined diagnostics.

Direct access

> A direct access is the direct accessing of the CPU by means of the → Backplane bus to modules while avoiding the → Process image.

Encoder absolute

> An encoder absolute determines the path traveled during position detection by reading a numerical value. In the case of encoders absolute with a serial interface (SSI), path information is transferred synchronously and serially according to the SSI protocol (synchronous serial interface).

Equipotential bonding

Electrical connection (equipotential bonding conductor), which brings the bodies of electrical resources and foreign conductive bodies to an identical or approximately identical potential in order to avoid interfering or hazardous voltages between these bodies.

FREEZE

Parameter in *STEP 7* for position detection module SM 338; POS-INPUT. The FREEZE function is a control command for freezing current encoder values of the SM 338 to the instantaneous value.

Ground

The conductive ground whose electric potential can be set equal to zero at every point.

In the proximity of grounding electrodes, the ground can have a potential differing from zero. The term "reference ground" is frequently used to describe such circumstances.

Ground, to

To ground means connect an electrically conductive part by means of a grounding system to the grounding electrode (one or more conductive parts having a very good contact to ground).

Hardware interrupt

A hardware interrupt is triggered by interrupt-triggering modules as a result of a certain event in the process (overshooting or undershooting of a limit value; a module has completed the cyclic conversion of its channels).

The hardware interrupt is reported to the CPU. In accordance with the priority of this interrupt, the → Organization block assigned to it is scanned.

Hold last value (LWH)

The module retains the last value read out before STOP mode.

Input delay

Parameter in *STEP 7* for digital input modules. The input delay is used to suppress injected interference. Interfering pulses from 0 ms to the set input delay are suppressed.

The set input delay is subject to a tolerance, which can be taken from the technical specifications of the module. A high input delay suppresses long interfering pulses, whereas a low input delay suppresses short ones.

The permissible input delay depends on the length of the cable between the encoder and the module. For example, a high input delay has to be set for long unshielded supply conductors to the encoder (longer than 100m).

Integration time

> Parameter in *STEP 7* for analog input modules. The integration time is the inverse value of the → Interference frequency suppression in ms.

Interface, multipoint

> → MPI

Interference frequency suppression

> Parameter in *STEP 7* for analog input modules. The frequency of the AC network can interfere with the measured value, especially with measurements in low voltage ranges and with thermocouples. This parameter is used by the user to specify the prevailing line frequency on his system.

Interrupt

> The SIMATIC S7 is familiar with 28 different run-time level, which govern running of the user program. These run-time levels include interrupts such as hardware interrupts, among other things. When an interrupt occurs, the operating system automatically calls an assigned organization block in which the user can program the reaction he wants (for example, in an FB).

Interrupt, diagnostic

> → Diagnostic Interrupt

Interrupt, end-of-scan-cycle interrupt

> → Hardware interrupt

Interrupt, hardware

> → Hardware interrupt

Linearity error

> The linearity error identifies the maximum deviation of the measured/output value from the ideal linear relationship between the measuring/output signal and the digital value. The data is a percentage and relates to the rated range of the analog module.

Logic block

> In a SIMATIC S7 context, a logic block is a block that contains a part of the *STEP 7* user program. By contrast, a data block only contains data. There are the following logic blocks: organization blocks (OBs), function blocks (FBs), functions (FCs), system function block (SFBs), system functions (SFCs).

Measuring range module

Measuring range modules are plugged into the analog input modules for adaptation to different measuring ranges.

Module filtering mode

By operating mode we mean:

1. The selection of an operating mode of the CPU using the mode switch or the PG

2. The type of program execution in the CPU

3. A parameter in *STEP 7* for analog input modules

Monoflop time

Parameter in *STEP 7* for position detection module SM 338; POS-INPUT. The monoflop time is the time interval between 2 SSI message frames ($\rightarrow$ Encoder absolute).

MPI

The multipoint interface (MPI) is the programmer port of the SIMATIC S7. It is used to access programmable modules ((CPUs, CPs), text displays and operator panel from a central point. The nodes on the MPI can communicate with each other.

Non-isolated

In the case of non-isolated input/output modules, the reference potentials of the control and load circuit are electrically connected.

Normalizing

Parameter in *STEP 7* for position detection module SM 338; POS-INPUT. Normalizing right justifies the encoder value of the $\rightarrow$ encoder absolute; non-relevant places are discarded.

OB

$\rightarrow$ Organization block

Operational limit

The operational limit is the measuring or output error of the analog module over the entire temperature range, referred to the rated range of the analog module.

Optically isolated

With optically isolated input/output modules, the reference potentials of the control and load circuit are galvanically isolated; for example, by an optocoupler, contact assembly or repeater. Input/output circuits can be connected to common potential.

Organization block

Organization blocks (OBs) form the interface between the operating system of the CPU and the user program. The order in which the user program is processed is defined in the organization blocks.

Parameters

1. Tag of a $\rightarrow$ Logic block

2. Tag for setting the characteristics of a module (one or more per module). When delivered to the customer, each module has a practical basic setting for its parameters, which the user can modify in **STEP 7**.

Process image

The signal states of the digital input and output modules are stored in the CPU in process image.

A distinction is made between the process-image of inputs and of outputs. The process input image (PII) is read by the input modules before the operating system scans the user program. The process output image (PIQ) is transferred to the output modules at the end of program scanning.

Product status

Products having an identical order number are distinguished by their product status. The product status is incremented for upwards compatible extensions, modifications due to production reasons (use of new component parts and components) and troubleshooting.

Programming device

$\rightarrow$ Programming device

Programming device

A programming device (PG) is a personal computer in a specific industry-standard and compact design. A PG is completely equipped for programming SIMATIC programmable logic controllers.

Reaction to open thermocouple

Parameter in *STEP 7* for analog input modules when using Thermocouples. This parameter defines whether "Overflow" ($7FFF_H0$) or "Underflow" (8000_H0) is output by the module in the event of an open thermocouple.

Reference potential

Potential from the point of view of which the voltages of the involved circuits are analyzed and measured.

Repeat accuracy

The repeat accuracy identifies the maximum deviation among the measured/output values that then occurs, when the same input signal is again applied or the same input value specified. The repeat accuracy relates to the rated range of the module and applies to the settled temperature state.

Repeater

Equipment for the amplification of bus signals and connection of $\rightarrow$ bus segments over long distances.

Resolution

With analog modules, the number of bits which represent the digitized analog value in binary. Resolution depends on the module and with analog input modules on the $\rightarrow$ integration time. The precision of the resolution of a measured value increases with the length of the integration time. The resolution can be as many as 16 bits, including sign.

Retentivity

Data areas in data blocks, and also timers, counters and memory markers are retentive when their contents are not lost upon a complete restart or POWER DOWN.

Scan time

The scan time is the time required by the $\rightarrow$ CPU to scan the $\rightarrow$ user program once.

Segment

$\rightarrow$ Bus segment

SFC

$\rightarrow$ System function

Signal module

Signal modules (SM) form the interface between the process and the programmable logic controller. There are input modules, output modules, input/output modules (both digital and analog).

Smoothing

Parameter in *STEP 7* for analog input modules. The measured values are smoothed by digital filtering. For specific modules it is possible to choose between no, low, medium and high smoothing. The higher the smoothing, the greater is the time constant of the digital filter.

STARTUP

The STARTUP mode is transvered during the transition from STOP mode to RUN mode. STARTUP can be triggered by the → Mode switch or following power-on or by means of an operator input on the programming device. With the S7-300 and M7-300, a → Complete restart is performed.

Status mode

The SIMATIC S7 programmable logic controllers are familiar with the following of status modes: STOP, → STARTUP, RUN and STOP.

Substitute value

Substitute values are values that can be output to the process when signal output modules have failed or be used in the user program instead of a process value when signal input modules have failed.

The substitute values can be assigned parameters by the user in *STEP 7* (old value retained, substitute value 0 or 1). They are values which the output(s) have to output in the event of a CPU STOP.

System diagnostics

System diagnostics is the detection, analysis and reporting of errors that occur within the programmable logic controller. Examples of such errors are: program errors or failures on modules. System errors can be indicated with LED displays or in **STEP 7**.

System function

A system function (SFC) is a function that is integrated in the operating system of the CPU a function that can be triggered in the *STEP 7* user program, if necessary.

Temperature coefficient

Parameter in *STEP 7* for analog input modules when measuring temperatures with a resistance thermometer (RTD). The temperature coefficient you select depends on the resistance thermometer being used (to DIN standard).

Temperature error

The temperature error identifies the drift of the measured/output value caused by the change in the ambient temperature of the analog module. It is specified as a percentage per Kelvin and relates to the rated range of the analog module.

Temperature errors of internal compensation

The temperature error of internal compensation only occurs during thermocouple measurement. It identifies the additional error which is to be taken into account and added to the actual temperature error when "internal comparison" mode is selected. The data is either given as a percentage relative to the physical rated range of the analog module or as an absolute value in °C.

Two-conductor/three-conductor/four-conductor connection

Method of connection to the module – for example, of resistance thermometers/ resistors to the front connector of the analog input module or of loads at the voltage output of an analog output module.

Two-wire transmitter/four-wire transmitter

Kind of transmitter (two-wire transmitter: supply (via terminals of the analog input module; 4-wire transmitter: supply via separate terminals of the transmitter)

Ungrounded

Without galvanic connection to ground

User program

The user program contains all the statements, tags and data for signal processing used to control a system or a process. It is assigned to a programmable module (CPU, FM, for example) and can be structured in smaller units (blocks).

Wire-break

Parameter in *STEP 7*. A wire-break test is used for monitoring the connection from the input to the encoder and from the output to the actuator. With wirebreak, the module detects a flow of current at the appropriately parameterized input/output.

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Product Information on the Manual

Edition 12.2004

S7-300 Programmable Controller; Module Specifications, as of Edition 02/2004 (A5E00105505)

ET 200M Distributed I/O Device Signal Modules for Process Automation, as of Edition 10/2004 (A5E00085262)

S7-300, ET 200M Programmable Controller, Modules with Intrinsically-Safe Signals, as of Edition 08/2003 (A5E00172008)

Introduction

Parameterizable signal modules of the S7-300 product family mentioned in this product information document can be reparameterized online using STEP7 *HWCONFIG* in RUN mode of the CPU.

In other words, the module parameters can be changed without switching the CPU to STOP mode or affecting other modules.

The following prerequisites must be met in order to use this function:

- STEP7 as of Version 5.2

- Distributed use of the S7-300 modules described in the S7-400 programmable controller (CPUs as of V3.1 or CP 443-5 extended as of V5.0).

- Use of the ET 200M with the IM 153-2 as of 6ES7153-2BA00-0XB0 or 6ES7153-2BB00-0XB0

- Use of the IM 157 as of 6ES7157-0AA82-0XA00

You will find a detailed description of the prerequisites and principles of operation in the manual *Modifying the System during Operation via CiR* (visit `http://www.siemens.com/automation/service&support` and enter the entry ID: 14044916).

Reparameterization steps in RUN mode

Observe the reparameterization steps described in the above manual.

Note the peculiarities of certain modules described in the table.

Example 1:

To change a measuring range for modules, proceed as follows:

1. Change the user program so that the channel to be reparameterized is no longer evaluated, and download it to the CPU.

2. Change the measuring range for the module in HWCONFIG, and download the changed configuration to the CPU.

3. Adapt the user program to the changed channel, and download it to the CPU.

Example 2:

When reparameterizing certain modules (see the table), you should ensure that there is no pending diagnostic event (e.g. a wire break message) before carrying out reparameterization, since otherwise it may happen in some cases that outgoing diagnostic events are no longer reported. As a result, the SF LEDs on the CPU, IM, or module will continue to shine, for example, although the reparameterized module is working correctly. If such a situation does arise, however, the module must be removed and then plugged in again.

Notes on the table

There is a separate table for each manual that describes the technical specifications of the signal modules of the S7-300 product family.

The "Behavior of the Inputs/Outputs" column indicates the behavior of the inputs/outputs when reparameterization is carried out in RUN mode, provided they are not affected by reparameterization.

Module	Behavior of the inputs/outputs	Peculiarities when reparameterizing
S7-300 module specifications		
6ES7 321-7BH00-0AB0 **6ES7 321-7BH80-0AB0** SM 321; DI 16 × DC 24 V; with hardware interrupt and diagnostic interrupt	Supply the last valid process value before parameterization	---
6ES7 321-7BH01-0AB0 SM 321; DI 16 × DC 24 V; with hardware interrupt and diagnostic interrupt, clocked		
6ES7 322-8BF00-0AB0 **6ES7 322-8BF80-0AB0** SM 322; DO 8 × DC 24 V/ 0.5 A; with diagnostic interrupt	Output the last valid output value before parameterization	---
6ES7 322-5FF00-0AB0 SM 322;DO 8 × AC 120/230V/ 2A ISOL		
6ES7 322-5GH00-0AB0 SM 322; DO 16 × UC 24/48V		
6ES7 322-5HF00-0AB0 SM 322; DO 8 × Rel. AC 230V/5A		
6ES7 331-7NF00-0AB0 SM 331; AI 8 × 16 Bit	Supply the last valid process value before parameterization	SF LED shines: If there was a pending diagnosis before reparameterization, the SF LEDs (on the CPU, IM, or module) may still be shining although there is no longer a pending diagnosis and the module is working correctly. Remedy: • Only reparameterize when there is no pending diagnosis on the module, or • Remove the module, and then plug it in again
6ES7 331-7NF10-0AB0 SM 331; AI 8 × 16 Bit		
6ES7 331-7PF00-0AB0 SM 331; AI 8 × RTD		
6ES7 331-7PF10-0AB0 SM 331; AI 8 × TC		

Module	Behavior of the inputs/outputs	Peculiarities when reparameterizing
6ES7 332-5HD01-0AB0 SM 332; AO 4 × 12 Bit	Output the last valid output value before parameterization	SF LED shines: If there was a pending diagnosis before reparameterization, the SF LEDs (on the CPU, IM, or module) may still be shining although there is no longer a pending diagnosis and the module is working correctly. Remedy: • Only reparameterize when there is no pending diagnosis on the module, or • Remove the module, and then plug it in again
6ES7 332-5HB01-0AB0 **6ES7 332-5HB81-0AB0** SM 332; AO 2 × 12 Bit		
6ES7 332-5HF00-0AB0 SM 332; AO 8 × 12 Bit		---
6ES7 332-7ND00-0AB0 **6ES7 332-7ND01-0AB0** SM 332; AO 4 × 16 Bit		---

Module	Behavior of the inputs/outputs	Peculiarities when reparameterizing
ET 200M signal modules for process automation (PCS7)		
6ES7 321-7TH00-0AB0 SM 321; DI 16 × NAMUR	Supply the last valid process value (including the value status) before parameterization	SF LED shines: If there was a pending diagnosis before reparameterization, the SF LEDs (on the CPU, IM, or module) may still be shining although there is no longer a pending diagnosis and the module is working correctly. Remedy: • Only reparameterize when there is no pending diagnosis on the module, or • Remove the module, and then plug it in again
6ES7 322-8BH00-0AB0 SM 322; DO 16 × DC 24 V/0,5A	Output the last valid output value before parameterization	

Module	Behavior of the inputs/outputs	Peculiarities when reparameterizing
S7-300, ET 200, I/O modules with intrinsically-safe signals		
6ES7 321-7RD00-0AB0 SM 321; DI 4 × NAMUR	Supply the last valid process value before parameterization	SF LED shines: If there was a pending diagnosis before reparameterization, the SF LEDs (on the CPU, IM, or module) may still be shining although there is no longer a pending diagnosis and the module is working correctly. Remedy: • Only reparameterize when there is no pending diagnosis on the module, or • Remove the module, and then plug it in again
6ES7 322 5RD00-0AB0 SM 322; DO 4 × 15V/20mA	Output the last valid output value before parameterization	---
6ES7 322-5SD00-0AB0 SM 322; DO 4 × 24V/10mA		
6ES7 331-7RD00-0AB0 SM 331; AI 4 × 0/4...20mA	Supply the last valid process value before parameterization	---
6ES7 331-7SF00-0AB0 SM 331; AI 8 × TC/4 × RTD		---
6ES7 331-7TB00-0AB0 SM 331; AI 2 × 0/4...20mA HART		---
6ES7 332-5RD00-0AB0 SM 332; AO 4 × 0/4...20mA	Output the last valid output value before parameterization	SF LED shines: If there was a pending diagnosis before reparameterization, the SF LEDs (on the CPU, IM, or module) may still be shining although there is no longer a pending diagnosis and the module is working correctly. Remedy: • Only reparameterize when there is no pending diagnosis on the module, or • Remove the module, and then plug it in again
6ES7 332-5TB00-0AB0 SM 332; AO 2 × 0/4...20mA HART		---

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Product Information

SIMATIC S7-300

Analog Output Module SM 332; AO 4 × 16 Bit **as of Version** $\frac{X \mid 2}{3 \mid 4}$

New Analog Output Module Available

The S7-300 Analog Output Module SM 332; AO 4 × 16 Bit has been added to the S7-300 family. The order number for this module is 6ES7 332-7ND02-0AB0.

This product information includes details about the characteristics and technical specifications of the Analog Output module SM 332; AO 4 × 16 Bit. Refer to the *S7-300 Installation and Hardware Manual* for more information about the S7-300 product family.

You will also learn:

- How to start up the analog output module
- The output ranges available for the analog output module
- How to configure the analog output module

Additional Assistance

For assistance in answering technical questions, for training on this product, or for ordering, contact your Siemens distributor or sales office.

Analog Output Module SM 332; AO 4 × 16 Bit; (6ES7 332-7ND02-0AB0)

Order No.

6ES7 332-7ND02-0AB0

Characteristic Features

The Analog Output Module SM 332; AO 4 × 16 Bit has the following characteristic features:

- 4 outputs in 4 channel groups
- Individual output channels can be programmed as
    - voltage outputs
    - current outputs
- Resolution of 16 bits
- Supports clocked operation
- Programmable diagnostics
- Programmable diagnostic interrupt
- Programmable substitute value output
- Galvanic Isolation between:
    - backplane bus interface and analog output channels
    - the different analog output channels
    - analog output and L+, M
    - backplane bus interface and L+, M

Terminal Connection Diagram

Figure 1 shows the analog terminal connection diagram and the wiring diagram for the Output Analog Module SM 332 AO 4 × 16 Bit.

The detailed technical specifications for this analog output module are on the following page.
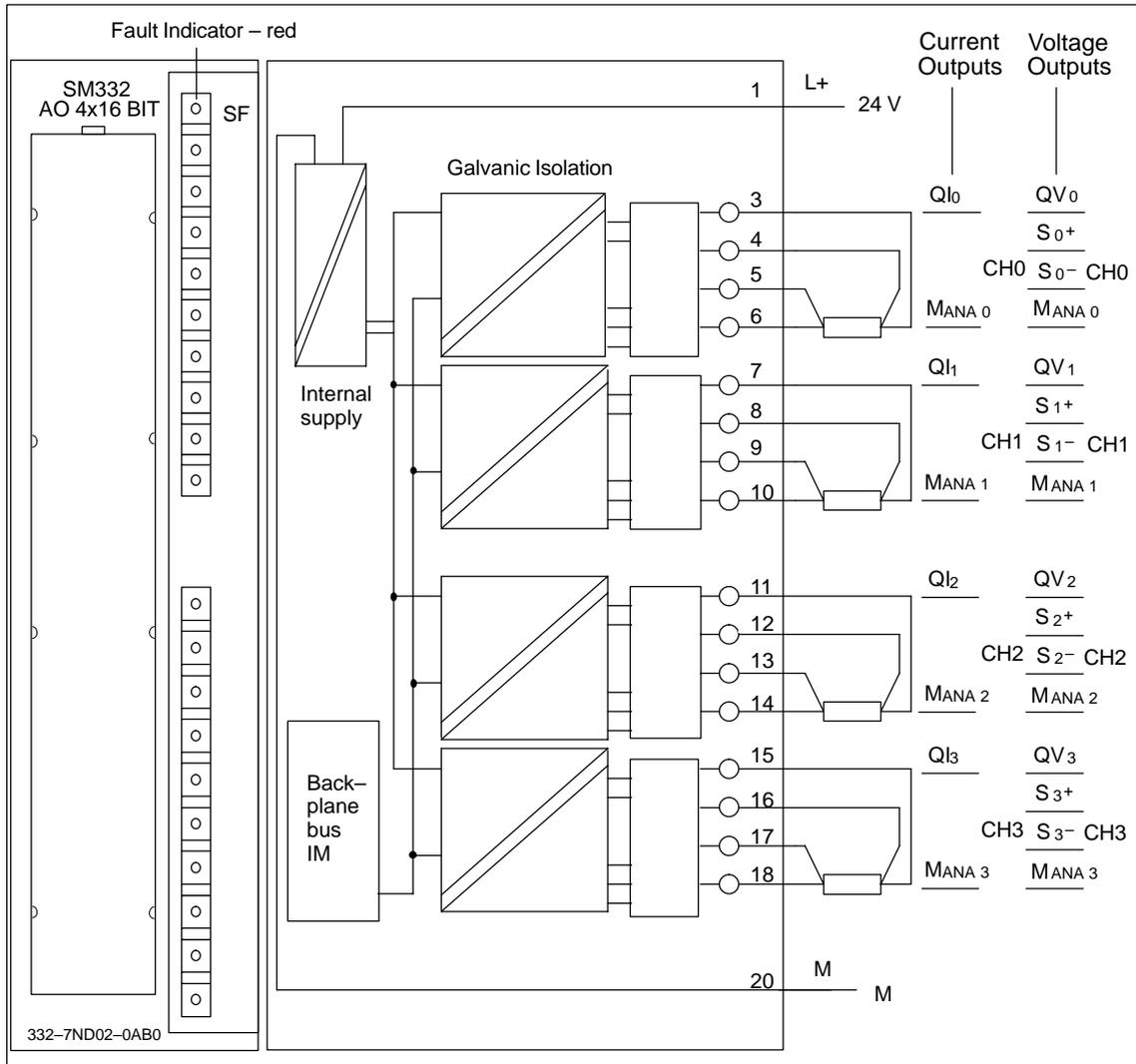
Figure 1   Connection Diagram of Analog Output Module SM 332; AO 4 x 16 Bit

---

Note

Switching the rated load voltage (L+) on and off, can cause wrong intermediate values at the output for approximately 10 ms.

Hazardous Location Information

"Power, input and output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods [Article 501-4 (b) of the National Electric Code, NFPA 70] and in accordance with the authority having jurisdiction."

Peripheral equipment must be suitable for the location it is used in.

The equipment must be suitable for use in Class I, Div. 2, Groups A, B, C, and D Hazardous Locations and nonhazardous locations only.

⚠️ **Warning**
Explosion Hazard

Substitution of components may impair suitability for Class I, Div. 2 Hazardous Locations. Different or lesser quality components may cause an explosion or other hazardous situation, which could result in death or serious injury, and/or damage to equipment.

To avoid potentially hazardous situations, always use the appropriate components.

⚠️ **Warning**
Explosion Hazard

Never disconnect equipment before powering off or before ascertaining that the area is nonhazardous. Disconnecting equipment before powering off or in a hazardous area may cause an explosion, which could result in death or serious injury, and/or damage to equipment.

To avoid potentially hazardous situations, always power off equipment and assure that the area is nonhazardous before disconnecting.

Dimensions and Weight	
Dimensions W × H × D (in millimeters)	40 × 125 × 117
Weight	Approx. 220 g

Data for Specific Module	
Supports clocked operation	Yes
Number of outputs	4
Length of cable	
• Shielded	max. 200 m

Voltages, Currents, Potentials	
Power rated voltage of the electronics L+	24 VDC
• Reverse polarity protection	Yes
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
• Between the channels	Yes
Permitted potential difference	
• Between the outputs (E_{CM})	DC 200 V/AC 120 V
• Between M_{ANA} and $M_{internal}$ (E_{ISO})	DC 200 V/AC 120 V
Insulation tested with	DC 1500 V
Current consumption	
• From the backplane bus	max. 120 mA
• From the power supply L+	max. 290 mA
Power dissipation of the module	typ. 3 W

Analog Value Generation	
Resolution including sign	
• ± 10 V	16 bits
• 0 to 10 V	15 bits
• 1 to 5 V	14 bits
• ± 20 mA	16 bits
• 0 to 20 mA	15 bits
• 4 to 20 mA	15 bits
Conversion time (per channel)	
• In standard mode	< 200 µs
• In clocked mode	640 µs
Basic response time of module (all channels enabled)	
• In standard mode	< 800 µs
• In clocked mode	750 µs
Settling time	
• For resistive load	0.2 ms
• For capacitive load	3.3 ms
• For inductive load (1 mH)	0.5 ms
• For inductive load (10 mH)	3.3 ms

Suppression of interference, Limits of Error	
Crosstalk between the outputs	> 100 dB
Operational limit (in the entire temperature range, with reference to the output range)	
• Voltage output	±0.12%
• Current output	±0.18%
Basic error (operational limit at 25° C, with reference to the output range)	
• Voltage output	
± 10 V	± 0.02%
0 to 10 V	± 0.02%
1 to 5 V	± 0.04%
• Current output	
± 20 mA	± 0.02%
0 to 20 mA	± 0.02%
4 to 20 mA	± 0.04%
Temperature error (with reference to the output range)	
• Voltage output	± 0.0025% / K
• Current output	± 0.004% / K
Linearity error (with reference to the output range)	± 0.004%
Repeatability (in steady state at 25° C, with reference to the output range)	±0.002%
Output ripple; bandwidth 0 to 50Khz (with reference to the output range)	±0.05%

Status, Interrupts, Diagnostics	
Interrupts	
• Diagnostics interrupt	Parameters can be assigned
Diagnostics functions	Parameters can be assigned
• Group error display	Red LED (SF)
• Diagnostics information can be displayed	Possible
Substitute value can be applied	Yes. Parameters can be assigned

Data for Selecting an Actuator	
Output ranges (rated values)	
• Voltage	± 10 V 0 to 10 V 1 to 5 V
• Current	± 20 mA 0 to 20 mA 4 to 20 mA
Load resistance (in the nominal range of the output)	
• For voltage outputs	min. 1 kΩ
Capacitive load	max. 1 µF
• For current outputs	max. 500 Ω
Inductive load	max. 1 mH
Voltage output	
• Short-circuit protection	Yes
• Short-circuit current	max. 40 mA
Current output	
• No-load voltage	max. 18 V

Destruction limit against voltages/currents applied from outside	
• Voltage to the outputs against M_{ANA}	max. 15 V continuous; 75 V for max. 1 $_s$ (pulse duty factor 1:20)
• Current	max. DC 50 mA
Connection of actuators	
• For voltage output Four–conductor connection (measuring circuit)	Possible
• For current output Two–conductor connection	Possible

Synchronous Operation

Characteristics

Reproducible response times (i.e., of equal length) are achieved in SIMATIC with an equidistant DP bus cycle and synchronization of the following individual asynchronous cycles:

- Asynchronous cycle of the user program. Cycle length can vary, due to acyclical program branches.

- Asynchronous, variable DP cycle on the PROFIBUS subnet

- Asynchronous cycle on the DP slave backplane bus

- Asynchronous cycle during signal conditioning and conversion in the electronic modules of the DP slaves

With equidistance, the DP cycle operates in the same clock cycle, with the same length. The execution levels of a CPU (OB61 to OB64) and the synchronous I/O are synchronized with this clock cycle. Thus, I/O data are transferred in defined, constant time intervals (synchronous operation). The maximum "jitter" is ± 50 µs.

Requirements

- The DP master and DP slave must support synchronous operation. You must have Step 7 Version 5.2 or higher.

Operating Mode: Synchronous Operation

The following conditions are applicable for synchronous operation:

Table 1   Conditions for Synchronous Operation

Processing and activation time T_{WA} between read in of output value in the transfer buffer and loading in the output DAC	750μs
T_{DPmin}	1100μs
Diagnostic interrupt	4 x T_{DP}, max

Processing and Output Update Time

The same time conditions are always applicable, irrespective of the number of channels programmed.
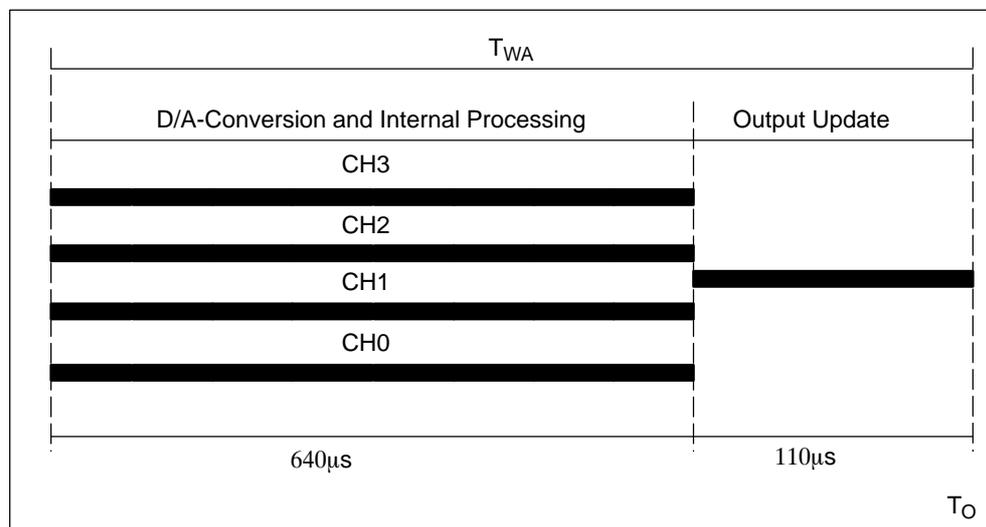
Figure 2   Calculation of the Processing Time and Output Update Time

Description of the Method of Functioning in Synchronous Operation

At time $T_0 - T_{WA}$, the module reads in the output data and saves the data internally. Following internal processing time for each channel, the results are written to each D/A converter.

Additional Information

You will find additional information about synchronous operation in the STEP 7 online Help, the *ET 200M Distributed I/O System manual* and the *Synchronous Operation Manual*.

Starting Up the Analog Output Module SM 332; AO 4 × 16 Bit

Parameter Assignment

The Analog Output Module SM 332; AO 4 × 16 Bit is set using one of the following methods.

- With STEP 7 (see the *STEP 7 User Manual*)

- In the user program by means of SFCs (see the *STEP 7 System and Standard Functions Reference Manual)*

Note

If you modify output ranges when the Analog Output Module SM 332; AO 4 x 16 Bit is in operation, intermediate values can appear at the output.

Default Setting

The Analog Output Module SM 332; AO 4 × 16 Bit has default settings for the type of output, diagnostics, interrupts, etc. (see Table 1).

These default settings apply if you do not re-initialize the module with STEP 7.

Table 1   Parameters and Default Settings for the Analog Output Module
            SM 332 AO 4 x 16 Bit.

Parameter	SM 332; AO 4 × 16 Bit		Parameter Type	Scope
	Value Range	Default Settings		
Enable • Diagnostics interrupt	Yes/No	No	Dynamic	Module
Diagnostics • Channel Diagnostics	Yes/No	No	Static	Channel
Response with CPU-STOP	LWH Hold last value ASS Output de-energized	ASS	Dynamic	Channel
Output • Output Type	Deactivated Voltage Current	U	Dynamic	Channel
• Output Range	0 to 20 mA 4 to 20 mA ± 20 mA 1 to 5 V 0 to 10 V ± 10 V	± 10 V	Dynamic	Channel

Parameter Assignment in the User Program

You can configure each output channel of the SM 332; AO 4 × 16 Bit individually.
This allows you to assign individual parameters for each output channel. When you
set the parameters in the user program, the parameters are assigned to channel
groups. Each output channel of the Analog Output Module SM 332; AO 4 × 16 Bit
is then assigned to one channel group, i.e. output channel 0 = channel group 0.

Unused Output Channels

To ensure the unused output channels of the Analog Output Module SM 332;
AO 4 × 16 Bit are not active. You must deactivate them and leave them open.
Deactivate the output channel using the "Output" parameter block when you
program with STEP 7.

Substitute Values

You can configure the SM 332; AO 4 × 16 Bit for the CPU operating mode STOP
as follows: Outputs De-energized, Hold Last Value or Inject Substitute Values. If
you inject substitute values, they must be within the output range.

Output Ranges for the Analog Output Module SM 332; AO 4 x 16 Bit

Analog Outputs

You can use the outputs of the Analog Output Module SM 332; AO 4 × 16 Bit as:

- Voltage outputs
- Current outputs

Set the outputs group-wise, using STEP 7 for programming the output type.

Output Ranges

Set the output ranges for the voltage and/or current outputs with STEP 7.

Table 2 lists all the possible output ranges for the Analog Output Module SM 332; AO 4 × 16 Bit.

Table 2   Output Ranges for Analog Output Module

Selected Type of Output	Description	Output Range
Voltage	Table 3 and Table 4 show the digital analog values in the analog output range.	1 to 5V 0 to 10 V ± 10 V
Current	Table 3 and Table 4 show the digital analog values in the analog output measuring range.	0 to 20 mA 4 to 20 mA ± 20 mA

Default Settings

The default settings of the module are "Voltage" for the output type and "± 10 V" for the output range. You can use this combination of output type and output range without parameterizing the SM 332; AO 4 × 16 Bit in STEP 7.

Analog Value Representation of the Output Ranges for the Analog Output Module SM 332; AO 4 × 16 Bit

Introduction

The tables in this section contain the digitized analog values for the various output ranges of the analog output module.

How to Read the Output-Value Tables

Tables 3 and 4 contain the digital analog values for the various ouput ranges.

Since the binary representation for the analog values is always the same, these tables only contain the output values and the units.

Voltage and Current Output Ranges

Table 3 shows the representation of the digitized output value:

- For the voltage output ranges ±10 V and

- For the current output range ± 20 mA.

Table 3   Representation of the Digital Output Value of the Analog Output Module (Voltage and Current Output Ranges)

Range	System Word Units		Output Range ± 10 V	Output Range ± 20 mA
	Decimal	Hexadecimal		
Overflow	32767	$7FFF_H$	0.0000	0.0000
Overrange	32511 : 27649	$7EFF_H$: $6C01_H$	11.7589 : 10.0004	23.515 : 20.0007
Nominal Range	27648 20736 : −20736 −27648	$6C00_H$ 5100_H : $AF00_H$ 9400_H	10.00 7.5 : −7.5 −10.00	20.000 14.998 : −14.998 −20.000
Underrange	−27649 : −32512	$93FF_H$: 8100_H	−10.0004 : −11.7589	−20.0007 : −23.515
Underflow	−32768	8000_H	0.0000	0.0000

Table 4 shows the representation of the digitized output value:

- For the voltage output ranges 1 to 5 V, 0 to10 V and

- For the current output ranges 0 to 20 mA, 4 to 20 mA

Table 4   Representation of the Digital Output Value of the Analog Output Module (Voltage and Current Output Ranges)

Range	System Word Units		Output Range 1 to 5 V	Output Range 0 to 10 V	Output Range 0 to 20 mA	Output Range 4 to 20 mA
	Decimal	Hexadecimal				
Overflow	32767	$7FFF_H$	0.0000	0.0000	0.0000	0.0000
Overrange	32511 : 27649	$7EFF_H$: $6C01_H$	5.8794 : 5.0002	11.7589 : 10.0004	23.515 : 20.0007	22.810 : 20.0005
Nominal Range	27648 20736 : 0	$6C00_H$ 5100_H : 0_H	5.000 4.000 : 1.000	10.00 7.50 : 0.000	20.000 14.998 : 0.000	20.000 16.000 : 4.000
Under-range	−1 : −6912	$FFFF_H$: $E500_H$	0.9999 : 0.0000	0.0000 : 0.0000	0.0000 : 0.0000	3.9995 : 0.0000
Underflow	−32768	8000_H	0.0000	0.0000	0.0000	0.0000

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Product Information

Use of subassemblies/modules in a Zone 2 Hazardous Area

Einsatz der Baugruppen/Module im explosions-gefährdeten Bereich Zone 2

Zone 2

Explosionsgefährdete Bereiche werden in Zonen eingeteilt. Die Zonen werden nach der Wahrscheinlichkeit des Vorhandenseins einer explosionsfähigen Atmosphäre unterschieden.

Zone	Explosionsgefahr	Beispiel
2	explosive Gasatmosphäre tritt nur selten und kurzzeitig auf	Bereiche um Flanschverbindungen mit Flachdichtungen bei Rohrleitungen in geschlossenen Räumen
sicherer Bereich	nein	• außerhalb der Zone 2 • Standardanwendungen von dezentraler Peripherie

Nachfolgend finden Sie wichtige Hinweise für die Installation der Baugruppen/Module im explosionsgefährdeten Bereich.

Weitere Informationen

Weitere Informationen zu den Baugruppen/Modulen finden Sie im dazugehörigen Handbuch.

Fertigungsort / Zulassung

⟨Ex⟩ **II 3 G   EEx nA II T3 .. T6**   nach EN 50021 : 1999

Prüfnummer: *siehe Tabelle*

Fertigungsort	Baugruppen/Module	Prüfnummer
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S Fehlersichere Module	KEMA 01 ATEX 1238X
	S7-300 ET 200M Buskopplung DP/PA Diagnoserepeater S7-300 Fehlersichere Baugruppen	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Hinweis

Baugruppen/Module mit der Zulassung ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 dürfen nur in SIMATIC-Systemen der Gerätekategorie 3 eingesetzt werden.

Instandhaltung

Für eine Reparatur müssen die betroffene Baugruppen/Module an den Fertigungsort geschickt werden. Nur dort darf die Reparatur durchgeführt werden.

Besondere Bedingungen

1. Baugruppen/Module müssen in einen Schaltschrank oder ein metallisches Gehäuse eingebaut werden. Diese müssen mindestens die Schutzart IP 54 (nach EN 60529) gewährleisten. Dabei sind die Umgebungsbedingungen zu berücksichtigen, in denen das Gerät installiert wird. Für das Gehäuse muss eine Herstellererklärung für Zone 2 vorliegen (gemäß EN 50021).

2. Wenn am Kabel bzw. an der Kabeleinführung dieses Gehäuses unter Betriebs-bedingungen eine Temperatur > 70 °C erreicht wird oder wenn unter Betriebs-bedingungen die Temperatur an der Aderverzweigung > 80 °C sein kann, müssen die Temperatureigenschaften der Kabel mit den tatsächlich gemessenen Temperaturen übereinstimmen.

3. Die eingesetzten Kabeleinführungen müssen der geforderten IP-Schutzart und dem Abschnitt 7.2 (gemäß EN 50021) entsprechen.

4. Alle Geräte, einschließlich Schalter etc., die an den Ein- und Ausgängen von SIMATIC-Systemen angeschlossen werden, müssen für den Explosionsschutz Typ EEx nA oder EEx nC genehmigt sein.

5. Es müssen Maßnahmen getroffen werden, dass die Nennspannung durch Transienten um nicht mehr als 40 % überschritten werden kann.

6. Umgebungstemperaturbereich: 0° C bis 60° C

7. Innerhalb des Gehäuses ist an einem nach dem Öffnen gut sichtbaren Platz ein Schild mit folgender Warnung anzubringen:

/!\ **Warnung**
Das Gehäuse darf nur kurze Zeit geöffnet werden, z. B. für visuelle Diagnose. Betätigen Sie dabei keine Schalter, ziehen oder stecken keine Baugruppen und trennen keine elektrischen Leitungen (Steckverbindungen).
Diese Warnung kann unberücksichtigt bleiben, wenn bekannt ist, dass keine explosionsgefährdete Atmosphäre herrscht.

Liste der zugelassenen Baugruppen/Module

Die Liste mit den zugelassenen Baugruppen/Module finden Sie im Internet:

http://www4.ad.siemens.de/view/cs/

unter der Beitrags-ID 13702947.

Use of subassemblies/modules in a Zone 2 Hazardous Area

Zone 2

Hazardous areas are divided up into zones. The zones are distinguished according to the probability of the existence of an explosive atmosphere.

Zone	Explosion Hazard	Example
2	Explosive gas atmosphere occurs only seldom and for a short time	Areas around flange joints with flat gaskets in pipes in enclosed spaces
Safe area	No	• Outside zone 2 • Standard distributed I/O applications

Below you will find important information on the installation of the subassemblies/modules in a hazardous area.

Further Information

You will find further information on the subassemblies/modules in the corresponding manual.

Production Location / Certification

$\langle \text{Ex} \rangle$ **II 3 G**   **EEx nA II T3 .. T6**   to EN 50021 : 1999

Test number: *see table below*

Production Location	Subassemblies/Modules	Test Number
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET-200S ET 200S fault-tolerant modules	KEMA 01 ATEX 1238X
	S7-300 ET-200M DP/PA bus interface Diagnostics repeater S7-300 fault-tolerant modules	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Note

Subassemblies/modules with $\langle \text{Ex} \rangle$ II 3 G   EEx nA II T3 .. T6 certification can only be used in SIMATIC systems rated as category 3 equipment.

Maintenance

If repair is necessary, the affected subassemblies/modules must be sent to the production location. Repairs can only be carried out there.

Special Conditions

1. Subassemblies/modules must be installed in a cabinet or metal housing. These must comply with the IP 54 degree of protection as a minimum. The environmental conditions under which the equipment is installed must be taken into account. There must be a manufacturer's declaration for zone 2 available for the housing (in accordance with EN 50021).

2. If a temperature of > 70 °C is reached in the cable or at the cable entry of this housing under operating conditions, or if a temperature of > 80 °C can be reached at the junction of the conductors under operating conditions, the temperature-related properties of the cables must correspond to the temperatures actually measured.

3. The cable entries used must comply with the required IP degree of protection and Section 7.2 (in accordance with EN 50021).

4. All devices (including switches, etc.) that are connected to the inputs and outputs of SIMATIC systems must be approved for EEx nA or EEx nC explosion protection.

5. Steps must be taken to ensure that the rated voltage through transients cannot be exceeded by more than 40 %.

6. Ambient temperature range: 0° C to 60° C

7. A sign containing the following warning must be put up inside the housing in an easily visible position when the housing is opened:

⚠	**Warning**
	The housing can only be opened for a short time (e.g. for visual diagnostics). If you do this, do not operate any switches, remove or install any modules or disconnect any electrical cables (plug-in connections).
	You can disregard this warning if you know that the atmosphere is not hazardous (i.e. there is no risk of explosion).

List of Approved Subassemblies/Modules

You will find the list of approved subassemblies/modules under the ID 13702947 on the Internet:

http://www4.ad.siemens.de/view/cs/.

Utilisation des modules / coupleurs dans la zone à risque d'explosion 2

Zone 2

Les environnements à risque d'explosion sont répartis en zones. Les zones se distinguent par la probabilité de présence d'une atmosphère explosive.

Zone	Risque d'explosion	Exemple
2	Formation rare et brève d'une atmosphère gazeuse explosive	Environnement de raccords à joints plats dans le cas de conduites dans des locaux fermés
Zone sûre	Non	- A l'extérieur de la zone 2 - Utilisation standard de périphérie décentralisée

Vous trouverez ci-après des remarques importantes pour l'installation de la station de périphérie décentralisée des modules / coupleurs dans la zone à risque d'explosion.

Informations complémentaires

Des informations complémentaires sur les modules / cartouches se trouvent dans le manuel correspondant.

Lieu de fabrication / Homologation

⟨Ex⟩　**II 3 G**　　**EEx nA II T3 .. T6**　　　selon EN 50021 : 1999

Numéro de contrôle :　　*voir tableau*

Lieu de fabrication	Modules / coupleurs	Numéro de contrôle
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S Modules à sécurité intrinsèque ET 200S	KEMA 01 ATEX 1238X
	S7-300 ET 200M Couplage de bus DP/PA Répéteur de diagnostic Modules à sécurité intrinsèque S7-300	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Nota

Les modules / coupleurs homologués ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 ne peuvent être utilisés que dans des systèmes SIMATIC de catégorie 3.

Entretien

Si une réparation est nécessaire, le module / coupleur concerné doit être expédié au lieu de production. La réparation ne doit être effectuée qu'en ce lieu.

Conditions particulières

1. Les modules / coupleurs doivent être installés dans une armoire ou un boîtier métallique. Ceux-ci doivent assurer au moins l'indice de protection IP 54. Il faut alors tenir compte des conditions d'environnement dans lesquelles l'appareil est installé. Le boîtier doit faire l'objet d'une déclaration de conformité du fabricant pour la zone 2 (selon EN 50021).

2. Si dans les conditions d'exploitation, une température > 70 °C est atteinte au niveau du câble ou de l'entrée du câble dans ce boîtier, ou bien si la température au niveau de la dérivation des conducteurs peut être > 80 °C, les capacités de résistance thermique des câbles doivent corespondre aux températures effectivement mesurées.

3. Les entrées de câbles utilisées doivent avoir le niveau de protection IP exigé et être conformes au paragraphe 7.2 (selon EN 50021).

4. Tous les appareillages (y compris les interrupteurs, etc.) raccordés aux entrées et sorties de systèmes SIMATIC doivent être homologués pour la protection antidéflagrante type EEx nA ou EEx nC.

5. Il faut prendre des mesures pour que la tension nominale ne puisse pas être dépassée de plus de 40% sous l'influence de transitoires.

6. Plage de température ambiante : 0° C à 60° C

7. A l'intérieur du boîtier, il faut placer, à un endroit bien visible après ouverture, une plaquette comportant l'avertissement suivant :

Avertissement
Ouvir le boîtier le moins longtemps possible, par exemple pour effectuer un diagnostic visuel. Ce faisant, n'actionnez aucun commutateur, ne déconnectez aucun module et ne débanchez pas de câbles électriques (connexions).
Le respect de cet avertissement n'est pas impératif s'il est certain que l'environnement ne présente pas de risque d'explosion.

Liste des modules / coupleurs homologués

Vous trouverez sur Internet la liste des modules / coupleurs homologués :

http://www4.ad.siemens.de/view/cs/

référence ID 13702947.

Aplicación de los módulos / tarjetas en áreas con peligro de explosión, zona 2

Zona 2

Las áreas con peligro de explosión se clasifican en zonas. Las zonas se diferencian según la probabilidad de la existencia de una atmósfera capaz de sufrir una explosión.

Zona	Peligro de explosión	Ejemplo
2	La atmósfera explosiva de gas sólo se presenta rara vez y muy brevemente	Áreas alrededor de uniones abridadas con juntas planas en tuberías en locales cerrados
Área segura	no	• fuera de la zona 2 • Aplicaciones estándar de la periferia descentralizada

A continuación encontrará importantes informaciones para la instalación de los módulos / tarjetas en áreas con peligro de explosión.

Otras informaciones

Encontrará otras informaciones relativas a los módulos / tarjetas en el Manual correspondiente.

Lugar de fabricación / Homologación

⟨Ex⟩　　**II 3 G**　　**EEx nA II T3 .. T6**　　　　según norma EN 50021 : 1999

Número de comprobación:　　　*véase tabla*

Lugar de fabricación	Módulos / tarjetas	Número de comprobación
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S Grupos ET 200S a prueba de fallos	KEMA 01 ATEX 1238 X
	S7-300 ET 200M Acoplamiento de bus DP/PA Repetidor de diagnóstico Grupos S7-300 a prueba de fallos	KEMA 02 ATEX 1096 X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125 X
	S7-300 CP TS Adapter	KEMA 03 ATEX 1228 X
	SIMATIC NET	KEMA 03 ATEX 1226 X

Nota

Los módulos / tarjetas con la homologación $\langle Ex \rangle$ II 3 G   EEx nA II T3 .. T6 pueden utilizarse únicamente en los sistemas SIMATIC de la categoría de equipo 3.

Mantenimiento

Para una reparación se ha de remitir el módulo / tarjeta afectado al lugar de fabricación. Sólo allí se puede realizar la reparación.

Condiciones especiales

1. Los módulos / tarjetas se han de montar en un armario eléctrico de distribución o en una carcasa metálica. Éstos deben garantizar como mínimo el grado de protección IP 54 (conforme a EN 60529). Para ello se han de tener en cuenta las condiciones ambientales, en las cuales se instala el equipo. La caja deberá contar con una declaración del fabricante para la zona 2 (conforme a EN 50021).

2. Si durante la operación se alcanzara una temperatura > 70° C en el cable o la entrada de cables de esta caja o bien una temperatura > 80° C en la bifurcación de hilos, deberán adaptarse las propiedades térmicas de los cables a las temperaturas medidas efectivamente.

3. Las entradas de cable utilizadas deben cumplir el grado de protección IP exigido y lo expuesto en el apartado 7.2 (conforme a EN 50021).

4. Todos los dispositivos –inclusive interruptores, etc.– conectados a las entradas y salidas de sistemas SIMATIC deben estar homologados para la protección contra explosiones del tipo EEx nA o EEx nC.

5. Es necesario adoptar las medidas necesarias para evitar que la tensión nominal pueda rebasar en más del 40 % debido a efectos transitorios.

6. Margen de temperatura ambiente: 0° C hasta 60° C

7. Dentro de la caja deberá colocarse en un lugar perfectamente visible tras su apertura un rótulo con la siguiente advertencia:

⚠ **Precaución**
Abrir la caja sólo brevemente, p.ej. para el diagnóstico visual. Durante este tiempo Ud. no deberá activar ningún interruptor, desenchufar o enchufar módulos ni separar conductores eléctricos (conexiones enchufables).
Esta advertencia puede ignorarse si Ud. sabe que en la atmósfera existente no hay peligro de explosión.

Lista de los módulos / tarjetas homologados

En la internet hallará Ud. una lista con los módulos / tarjetas homologados:

http://www4.ad.siemens.de/view/cs/

bajo el ID de asignación 13702947.

Impiego delle unità/moduli nell'area a pericolo di esplosione zona 2

Zona 2

Le aree a pericolo di esplosione vengono suddivise in zone. Le zone vengono distinte secondo la probabilità della presenza di un'atmosfera esplosiva.

Zona	Pericolo di esplosione	Esempio
2	L'atmosfera esplosiva si presente solo raramente e brevemente	Aree intorno a collegamenti a flange con guarnizioni piatte nelle condotte in ambienti chiusi
Area sicura	No	• Al di fuori della zona 2 • Applicazioni standard di periferia decentrata

Qui di seguito sono riportate delle avvertenze importanti per l'installazione delle unità/moduli nell'area a pericolo di esplosione.

Ulteriori informazioni

Ulteriori informazioni sulle unità/moduli si trovano nel corrispondente manuale.

Luogo di produzione / Omologazione

⟨Ex⟩   **II 3 G   EEx nA II T3 .. T6**   secondo EN 50021 : 1999

Numero di controllo: *vedi tabella*

Luogo di produzione	Unità/moduli	Numero di controllo
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S Unità ad elevata sicurezza ET 200S	KEMA 01 ATEX 1238X
	S7-300 ET 200M Accoppiamento di bus DP/PA Repeater di diagnostica Unità ad elevata sicurezza S7-300	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Avvertenza

Le unità/moduli con l'omologazione ⟨Ex⟩ II 3 G EEx nA II T3 .. T6 possono essere impiegati solo nei sistemi SIMATIC della categoria di apparecchiature 3.

Manutenzione

Per una riparazione, le unità/i moduli interessati devono essere inviati al luogo di produzione. La riparazione può essere effettuata solo lì.

Condizioni particolari

1. Le unità/i moduli devono essere montati in un armadio elettrico o in un contenitore metallico. Questi devono assicurare almeno il tipo di protezione IP 54. In questo caso bisogna tenere conto delle condizioni ambientali nelle quali l'apparecchiatura viene installata. Per il contenitore deve essere presente una dichiarazione del costruttore per la zona 2 (secondo EN 50021).

2. Se nei cavi o nel loro punto di ingresso in questo contenitore viene raggiunta in condizioni di esercizio una temperatura > 70 °C o se in condizioni di esercizio la temperatura nella derivazione dei fili può essere > 80 °C, le caratteristiche di temperatura dei cavi devono essere conformi alla temperatura effettivamente misurata.

3. Gli ingressi dei cavi usati devono essere conformi al tipo di protezione richiesto e alla sezione 7.2 (secondo EN 50021).

4. Tutte le apparecchiature, inclusi interruttori, ecc. che vengono collegati agli ingressi/uscite di sistemi SIMATIC, devono essere stati omologati per la protezione da esplosione tipo EEx nA o EEx nC.

5. Devono essere prese delle misure per evitare che la tensione nominale possa essere superata per più del 40% da parte di transienti.

6. Campo termico ambientale: da 0° C a 60° C

7. All'interno del contenitore va apportata, in un luogo ben visibile dopo l'apertura, una targhetta con il seguente avvertimento:

⚠ **Attenzione**

Il contenitore può rimanere aperto solo per breve tempo, ad esempio per una diagnostica a vista. In tal caso non azionare alcun interruttore, non disinnestare o innestare unità e non staccare connessioni elettriche (connettori).
Non è necessario tenere conto di questo avvertimento se è noto che non c'è un'atmosfera a rischio di esplosione

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Elenco delle unità/moduli omologati

L'elenco con le unità/moduli omologati si trova in Internet al sito:

http://www4.ad.siemens.de/view/cs/

all'ID di voce 13702947.

Gebruik van de componenten/modulen in het explosief gebied zone 2

Zone 2

Explosieve gebieden worden ingedeeld in zones. Bij de zones wordt onderscheiden volgens de waarschijnlijkheid van de aanwezigheid van een explosieve atmosfeer.

Zone	Explosiegevaar	Voorbeeld
2	Een explosieve gasatmosfeer treedt maar zelden op en voor korte duur	Gebieden rond flensverbindingen met pakkingen bij buisleidingen in gesloten vertrekken
Veilig gebied	neen	• Buiten de zone 2 • Standaardtoepassingen van decentrale periferie

Hierna vindt u belangrijke aanwijzingen voor de installatie van de componenten/modulen in het explosief gebied.

Verdere informatie

In het bijhorende handboek vindt u verdere informatie over de componenten/modulen

Productieplaats / Vergunning

⟨Ex⟩   **II 3 G**   **EEx nA II T3 .. T6**   conform EN 50021 : 1999

Keuringsnummer: *zie tabel*

Productieplaats	Componenten/modulen	Keuringsnummer
Siemens AG, Bereich A&D Werner-von-Siemens-Strasse 50 92224 Amberg Germany	ET 200S ET 200S tegen fouten beveiligde componenten	KEMA 01 ATEX 1238X
	S7-300 ET 200 M Buskoppeling DP/PA Diagnoserepeater S7-300 tegen fouten beveiligde componenten	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Opmerking

Componenten/modulen met de vergunning ⟨Ex⟩ II 3 G EEx nA II T3 .. T6 mogen slechts worden gebruikt in SIMATIC-systemen van de apparaatcategorie 3.

Instandhouding

Voor een reparatie moeten de betreffende componenten/modulen naar de plaats van vervaardiging worden gestuurd. Alleen daar mag de reparatie worden uitgevoerd.

Speciale voorwaarden

1. Componenten/modulen moeten worden ingebouwd in een schakelkast of in een behuizing van metaal. Deze moeten minstens de veiligheidsgraad IP 54 waarborgen. Hierbij dient rekening te worden gehouden met de omgevingsvoorwaarden waarin het apparaat wordt geïnstalleerd. Voor de behuizing dient een verklaring van de fabrikant voor zone 2 te worden ingediend (volgens EN 50021).

2. Als aan de kabel of aan de kabelinvoering van deze behuizing onder bedrijfsomstandigheden een temperatuur wordt bereikt > 70 °C of als onder bedrijfsomstandigheden de temperatuur aan de adervertakking > 80 °C kan zijn, moeten de temperatuureigenschappen van de kabel overeenstemmen met de werkelijk gemeten temperaturen.

3. De aangebrachte kabelinvoeringen moeten de vereiste IP-veiligheidsgraad hebben en in overeenstemming zijn met alinea 7.2 (volgens EN 50021).

4. Alle apparaten, schakelaars enz. inbegrepen, die worden aangesloten op de in- en uitgangen van SIMATIC-systemen, moeten zijn goedgekeurd voor de explosiebeveiliging type EEx nA of EEx nC.

5. Er dienen maatregelen te worden getroffen, zodat de nominale spanning door transiënten met niet meer dan 40 % kan worden overschreden.

6. Omgevingstemperatuurbereik: 0° C tot 60° C

7. Binnen de behuizing dient op een na het openen goed zichtbare plaats een bord te worden aangebracht met de volgende waarschuwing:

Waarschuwing
De behuizing mag slechts voor korte tijd worden geopend, bijv. voor een visuele diagnose. Bedien hierbij geen schakelaar, trek of steek geen modulen en ontkoppel geen elektrische leidingen (steekverbindingen).
Deze waarschuwing kan buiten beschouwing blijven, indien bekend is dat er geen explosieve atmosfeer heerst.

Lijst van de toegelaten componenten/modulen

De lijst met de toegelaten componenten/modulen vindt u in het internet:

http://www4.ad.siemens.de/view/cs/

onder de bijdrage-ID 13702947.

Brug af komponenter/moduler i det eksplosionsfarlige område zone 2

Zone 2

Eksplosionsfarlige områder inddeles i zoner. Zonerne adskiller sig indbyrdes efter hvor sandsynligt det er, at der er en eksplosiv atmosfære.

Zone	Eksplosionsfare	Eksempel
2	Eksplosiv gasatmosfære optræder kun sjældent og varer kort	Områder rundt om flangeforbindelser med flade pakninger ved rørledninger i lukkede rum
Sikkert område	Nej	• Uden for zone 2 • Standardanvendelser decentral periferi

I det følgende findes vigtige henvisninger vedr. installation af komponenter/moduler i det eksplosionsfarlige område.

Yderligere informationer

Yderligere informationer om komponenterne/modulerne findes i den pågældende manual.

Produktionssted / Godkendelse

⟨Ex⟩   **II 3 G   EEx nA II T3 .. T6**   efter EN 50021 : 1999

Kontrolnummer: *se tabel*

Produktionssted	Komponenter/moduler	Kontrolnummer
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S fejlsikre komponenter	KEMA 01 ATEX 1238X
	S7-300 ET 200M Buskobling DP/PA Diagnoserepeater S7-300 fejlsikre komponenter	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Bemærk

Komponenter/moduler med godkendelsen ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 må kun monteres i SIMATIC-systemer for udstyrskategori 3.

Vedligeholdelse

Hvis de pågældende komponenter/moduler skal repareres, bedes De sende dem til produktionsstedet. Reparation må kun udføres der.

Særlige betingelser

1. Komponenterne/modulerne skal monteres i et kontrolskab eller et metalkabinet. Disse skal mindst kunne sikre beskyttelsesklasse IP 54. I denne forbindelse skal der tages højde for de omgivelsestemperaturer, i hvilke udstyret er installeret. Der skal være udarbejdet en erklæring fra fabrikanten for kabinettet for zone 2 (iht. EN 50021).

2. Hvis kablet eller kabelindføringen på dette hus når op på en temperatur på > 70 °C under driftsbetingelser eller hvis temperaturen på åreforegreningen kan være > 80 °C under driftsbetingelser, skal kablernes temperaturegenskaber stemme overens med de temperaturer, der rent faktisk måles.

3. De benyttede kabelindføringer skal være i overensstemmelse med den krævede IP-beskyttelsestype og afsnittet 7.2 (iht. EN 50021).

4. Alle apparater, inkl. kontakter osv., der forbindes med ind- og udgangene til SIMATIC-systemerne, skal være godkendt til eksplosionsbeskyttelse af type EEx nA eller EEx nC.

5. Der skal træffes foranstaltninger, der sørger for, at den nominelle spænding via transienter ikke kan overskrides mere end 40 %.

6. Omgivelsestemperaturområde: 0° C til 60° C

7. I kabinettet skal der anbringes et skilt, der skal kunne ses, når kabinettet åbnes. Dette skilt skal have følgende advarsel:

⚠ **Advarsel**
Kabinettet må kun åbnes i kort tid, f.eks. til visuel diagnose. Tryk i denne forbindelse ikke på kontakter, træk eller isæt ikke komponenter og afbryd ikke elektriske ledninger (stikforbindelser).
Der skal ikke tages højde for denne advarsel, hvis man ved, at der ikke er nogen eksplosionsfarlig atmosfære.

Liste over godkendte komponenter/moduler

Listen med de godkendte komponenter/moduler findes på internettet:

http://www4.ad.siemens.de/view/cs/

under bidrags-ID 13702947.

Rakenneryhmien/moduulien käyttö räjähdysvaarannetuilla alueilla, vyöhyke 2

Vyöhyke 2

Räjähdysvaarannetut alueet jaetaan vyöhykkeisiin. Vyöhykkeet erotellaan räjähdyskelpoisen ilmakehän olemassa olon todennäköisyyden mukaan.

Vyöhyke	Räjähdysvaara	Esimerkki
2	Räjähtävä kaasuilmakehä ilmaantuu vain harvoin ja lyhytaikaisesti	Alueet putkistojen lattatiivisteillä varustuilla laippaliitoksilla suljetuissa tiloissa
turvallinen alue	ei	• vyöhykkeen 2 ulkopuolella • Hajautetun ulkopiirin vakiosovellukset

Seuraavasta löydätte tärkeitä ohjeita rakenneryhmien/moduulien asennukseen räjähdysvaarannetuilla alueilla.

Lisätietoja

Lisätietoja rakenneryhmiin/moduuleihin löydätte niihin kuuluvista ohjekirjasta.

Valmistuspaikka / Hyväksyntä

⟨Ex⟩　　**II 3 G**　　　**EEx nA II T3 .. T6**　　　EN 50021 mukaan: 1999

Tarkastusnumero: *katso taulukko*

Valmistuspaikka	Rakenneryhmät/moduulit	Tarkastusnumero
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S läpi-iskuvarmat rakenneryhmät	KEMA 01 ATEX 1238X
	S7-300 ET 200M Väyläkytkin DP/PA Dignoositoistin S7-300 läpi-iskuvarmat rakenneryhmät	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Ohje

Rakenneryhmät/moduulit hyväksynnän ⟨Ex⟩ II 3 G　EEx nA II T3 .. T6　kanssa saadaan käyttää ainoastaan laitekategorian 3 SIMATIC-järjestelmissä.

Kunnossapito

Korjausta varten täytyy kyseinen rakenneryhmä/moduuli lähettää valmistuspaikkaan. Korjaus voidaan suorittaa ainoastaan siellä.

Erityiset vaatimukset

1. Rakenneryhmät/moduulit täytyy asentaa kytkentäkaappiin tai metalliseen koteloon. Näiden täytyy olla vähintään kotelointiluokan IP 54 mukaisia. Tällöin on huomioitava ympäristöolosuhteet, johon laite asennetaan. Kotelolle täytyy olla valmistajaselvitys vyöhykettä 2 varten (EN 50021 mukaan).

2. Kun johdolla tai tämän kotelon johdon sisäänviennillä saavutetaan > 70 °C lämpötila tai kun käyttöolosuhteissa lämpötila voi piuhajaotuksella olla > 80 °C, täytyy johdon lämpötilaominaisuuksien vastata todellisesti mitattuja lämpötiloja.

3. Käytettyjen johtojen sisäänohjauksien täytyy olla vaaditun IP-kotelointiluokan ja kohdan 7.2 (EN 50021 mukaan) mukaisia.

4. Kaikkien laitteiden, kytkimet jne. mukaan lukien, jotka liitetään SIMATIC-järjestelmien tuloille ja lähdöille, täytyy olla hyväksyttyjä tyypin EEx nA tai EEx nC räjähdyssuojausta varten.

5. Toimenpiteet täytyy suorittaa, ettei nimellisjännite voi transienttien kautta ylittyä enemmän kuin 40 %.

6. Ympäristölämpötila-alue: 0° C ... 60° C

7. Kotelon sisälle, avauksen jälkeen näkyvälle paikalle, on kiinnitettävä kilpi, jossa on seuraava varoitus:

⚠️ **Varoitus**
Kotelo saadaan avata ainoastaan lyhyeksi ajaksi, esim. visuaalista diagnoosia varten. Älä tällöin käytä mitään kytkimiä, vedä tai liitä mitään rakenneryhmiä, äläkä erota mitään sähköjohtoja (pistoliittimiä).
Tätä varoitusta ei tarvitse huomioida, kun on tiedossa, että minkäänlaista räjähdysvaarannettua ilmakehää ei ole olemassa.

Hyväksyttyjen rakenneryhmien/moduulien lista

Lista hyväksytyistä rakennesarjoista/moduuleista löytyy internetistä osoitteesta:

http://www4.ad.siemens.de/view/cs/

käyttäjätunnuksella 13702947.

Användning av komponentgrupperna/modulerna i explosionsriskområde zon 2

Zon 2

Explosionsriskområden delas in i zoner. Zonerna delas in enligt sannolikheten att en atmosfär med explosionsfara föreligger.

Zon	Explosionsfara	Exempel
2	Explosiv gasatmosfär uppstår endast sällan eller kortvarigt	Områden kring flänsförbindelser med packningar vid rörledningar i slutna utrymmen
Säkert område	Nej	• Utanför zon 2 • Standardanvändning av decentral periferi

Nedan följer viktiga anvisningar om installationen av komponentgrupperna/modulerna i ett explosionsriskområde.

Ytterligare information

Ytterligare information om komponentgrupperna/modulerna finner du i tillhörande handbok.

Tillverkningsort / Godkännande

⟨Ex⟩　**II 3 G**　　**EEx nA II T3 .. T6**　　　enligt EN 50021 : 1999

Kontrollnummer: *se tabell*

Tillverkningsort	Komponentgrupper/ moduler	Kontrollnummer
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S Felsäkra komponentgrupper	KEMA 01 ATEX 1238X
	S7-300 ET 200M Busskoppling DP/PA Diagnosrepeater S7-300 Felsäkra komponentgrupper	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Anvisning

Komponentgrupper/moduler med godkännande ⬡ II 3 G   EEx nA II T3 .. T6 får endast användas i SIMATIC-system i apparatgrupp 3.

Underhåll

Vid reparation måste den aktuella komponentgrupperna/modulerna insändas till tillverkaren. Reparationer får endast genomföras där.

Särskilda villkor

1. Komponentgrupperna/modulerna måste monteras i ett kopplingsskåp eller metallhus. Dessa måste minst vara av skyddsklass IP 54. Därvid ska omgivningsvillkoren där enheten installeras beaktas. För kåpan måste en tillverkardeklaration för zon 2 föreligga (enligt EN 50021).

2. Om en temperatur på > 70°C uppnås vid husets kabel resp kabelinföring under driftvillkor eller om temperaturen vid trådförgreningen kan vara > 80°C under driftvillkor, måste kabelns temperaturegenskaper överensstämma med den verkligen uppmätta temperaturen.

3. De använda kabelinföringarna måste uppfylla kraven i det krävda IP-skyddsutförandet och i avsnitt 7.2 (enligt EN 50021).

4. Alla apparater, inklusive brytare osv, som ansluts till in- och utgångarna på SIMATIC-system, måste vara godkända för explosionsskydd av typ EEx nA eller EEx nC.

5. Åtgärder måste vidtas så, att märkspänningen ej kan överskridas med mer än 40 % genom transienter.

6. Omgivningstemperatur: 0° C till 60° C

7. När huset öppnats ska en skylt med följande varning monteras på ett tydligt synligt ställe huset:

⚠ **Varning**
Huset får endast öppnas under kort tid, t ex för visuell diagnos. Använd därvid inga brytare, lossa eller anslut inga enheter och frånskilj inga elektriska ledningar (insticksanslutningar).
Ingen hänsyn måste tas till denna varning om det är säkert att det inte råder någon explosionsfarlig atmosfär.

Lista över godkända komponentgrupper/moduler

Lista över godkända komponentgrupper/moduler finns på Internetadressen:

http://www4.ad.siemens.de/view/cs/

under bidrags-ID 13702947.

Uso de grupos construtivos/módulos em área exposta ao perigo de explosão 2

Zona 2

As áreas expostas ao perigo de explosão são divididas em zonas. As zonas são diferenciadas de acordo com a probabilidade da existência de uma atmosfera explosiva.

Zona	Perigo de explosão	Exemplo
2	Só raramente e por um breve período de tempo surgem atmosferas explosivas	Áreas em torno de ligações flangeadas com vedações chatas em tubulações em recintos fechados
Área segura	não	• fora da zona 2 • Aplicações descentralizadas de periferia descentralizada

A seguir, o encontrará avisos importantes para a instalação de grupos construtivos/ módulos em área exposta ao perigo de explosão.

Mais informações

Para obter mais informações sobre grupos construtivos/módulos, consulte o respectivo manual.

Local de produção / Licença

⟨Ex⟩   **II 3 G**   **EEx nA II T3 .. T6**   seg. EN 50021 : 1999

Número de ensaio: *veja a tabela*

Local de produção	Grupos construtivos/módulos	N° de ensaio
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Alemanha	ET 200S ET 200S Grupos construtivos protegidos contra erro	KEMA 01 ATEX 1238X
	S7-300 ET 200M Acoplador bus DP/PA Repetidor de diagnóstico S7-300 Grupos construtivos protegidos contra erro	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Alemanha	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Aviso

Os grupos construtivos/módulos com a licença ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 só podem ser aplicados em sistemas SIMATIC da categoria de aparelho 3.

Reparo

Os grupos construtivos/módulos em questão devem ser remetidos para o local de produção a fim de que seja realizado o reparo. Apenas lá deve ser efetuado o reparo.

Condições especiais

1. Os grupos construtivos/módulos devem ser montados em um armário de distribuição ou em uma caixa metálica. Estes devem garantir no mínimo o tipo de protecção IP 54. Durante este trabalho deverão ser levados em consideração as condições locais, nas quais o aparelho será instalado. Para a caixa deverá ser apresentada uma declaração do fabricante para a zona 2 (de acordo com EN 50021).

2. Caso no cabo ou na entrada do cabo desta carcaça sob as condições operacionais seja atingida uma temperatura de > 70 °C, ou caso sob condições operacionais a temperatura na ramificação do fio poderá atingir > 80 °C, as caraterísticas de temperatura deverão corresponder às temperaturas realmente medidas.

3. As entradas de cabo utilizadas devem corresponder ao tipo exigido de protecção IP e à seção 7.2 (de acordo com o EN 50021).

4. Todos os aparelhos, inclusive as chaves, etc., que estejam conectadas em entradas e saídas dos sistemas SIMATIC devem possuir a licença para a protecção de explosão do tipo EEx nA ou EEx nC.

5. Precisam ser tomadas medidas para que a tensão nominal através de transitórios não possa ser ultrapassada em mais que 40 %.

6. Área de temperatura ambiente: 0° C até 60° C

7. No âmbito da carcaça deve ser colocada, após a abertura, em um ponto bem visível uma placa com a seguinte advertência:

⚠ **Advertência**
A carcaça deve ser aberta apenas por um breve período de tempo, por ex. para diagnóstico visual. Não acione nenhum interruptor, não retire ou conecte nenhum módulo e não separe nenhum fio elétrico (ligações de tomada).
Esta advertência poderá ser ignorada caso se saiba que não há nenhuma atmosfera sujeita ao perigo de explosão.

Lista dos grupos construtivos/módulos autorizados

A lista com os grupos construtivos/módulos autorizados encontram-se na Internet:

http://www4.ad.siemens.de/view/cs/

sob o número de ID 13702947.

Χρήση των δομικών συγκροτημάτων/μονάδων σε επικίνδυνη για έκρηξη περιοχή, ζώνη 2

Ζώνη 2

Οι επικίνδυνες για έκρηξη περιοχές χωρίζονται σε ζώνες. Οι ζώνες διαφέρουν σύμφωνα με την πιθανότητα ύπαρξης ενός ικανού για έκρηξη περιβάλλοντος.

Ζώνη	Κίνδυνος έκρηξης	Παράδειγμα
2	Εκρηκτικό περιβάλλον αερίου παρουσιάζεται μόνο σπάνια και για σύντομο χρονικό διάστημα	Περιοχές γύρω από φλαντζωτές συνδέσεις με τσιμούχες σε σωληνώσεις σε κλειστούς χώρους
Ασφαλής περιοχή	όχι	• Εκτός της ζώνης 2 • Τυπικές εφαρμογές αποκεντρωμένης περιφέρειας

Στη συνέχεια θα βρείτε σημαντικές υποδείξεις για την εγκατάσταση των δομικών συγκροτημάτων/μονάδων σε επικίνδυνη για έκρηξη περιοχή.

Επιπλέον πληροφορίες

Επιπλέον πληροφορίες για τα δομικά συγκροτήματα/μονάδες θα βρείτε στο αντίστοιχο εγχειρίδιο.

Τόπος κατασκευής / Άδεια

$\langle\!\langle Ex \rangle\!\rangle$ **II 3 G** **EEx nA II T3 .. T6** σύμφωνα με το πρότυπο EN 50021 : 1999

Αριθμός ελέγχου: *βλέπε πίνακα*

Τόπος κατασκευής	Δομικά συγκροτήματα/μονάδες	Αιθμ. ελέγχου
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S Ασφαλή σε περίπτωση βλάβης δομικά συγκροτήματα	KEMA 01 ATEX 1238X
	S7-300 ET 200M Σύζευξη διαύλου DP/PA Επαναλήπτης διάγνωσης S7-300 Ασφαλή σε περίπτωση βλάβης δομικά συγκροτήματα	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Υπόδειξη

Τα δομικά συγκροτήματα/οι μονάδες με την άδεια ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 επιτρέπεται να τοποθετηθούν μόνο σε συστήματα αυτοματισμού SIMATIC της κατηγορίας συσκευής 3.

Συντήρηση

Για μια επισκευή πρέπει να σταλθούν τα αντίστοιχα δομικά συγκροτήματα/μονάδες στον τόπο κατασκευής. Μόνο εκεί επιτρέπεται να γίνει η επισκευή.

Ιδιαίτερες προϋποθέσεις

1. Τα δομικά συγκροτήματα/μονάδες πρέπει να ενσωματωθούν σε ένα ερμάριο ζεύξης ή σε ένα μεταλλικό περίβλημα. Αυτά πρέπει να εξασφαλίζουν το λιγότερο το βαθμό προστασίας IP 54 (κατά EN 60529). Σε αυτήν την περίπτωση πρέπει να ληφθούν υπόψη οι περιβαλλοντικές συνθήκες, στις οποίες θα εγκατασταθεί η συσκευή. Για το περίβλημα πρέπει να προβλέπεται δήλωση του κατασκευαστή για τη ζώνη 2 (σύμφωνα με το πρότυπο EN 50021).

2. Εάν στο καλώδιο ή στην είσοδο του καλωδίου αυτού του περιβλήματος κάτω από συνθήκες λειτουργίας η θερμοκρασία ξεπεράσει τους 70 °C ή όταν κάτω από συνθήκες λειτουργίας η θερμοκρασία στη διακλάδωση του σύρματος μπορεί να είναι μεγαλύτερη από 80 °C, πρέπει οι θερμοκρασιακές ιδιότητες των καλωδίων να ταυτίζονται με τις πραγματικά μετρημένες θερμοκρασίες.

3. Οι χρησιμοποιούμενες είσοδοι καλωδίων πρέπει να συμμορφώνονται με το βαθμό προστασίας IP 54 στην ενότητα 7.2 (σύμφωνα με το πρότυπο EN 50021).

4. Όλες οι συσκευές, συμπεριλαμβανομένων διακοπτών κ.α., που συνδέονται στις εισόδους και εξόδους των συστημάτων SIMATIC, πρέπει να φέρουν εγκριμένη προστασία κατά έκρηξης τύπου EEx nA ή EEx nC.

5. Πρέπει να ληφθούν μέτρα, να μην μπορεί να γίνει υπέρβαση της ονομαστικής τάσης μέσω αιφνίδιας μεταβολής της τάσης πάνω από 40 %.

6. Περιοχή θερμοκρασίας περιβάλλοντος: 0° C έως 60° C

7. Πρέπει να τοποθετηθεί μέσα στο περίβλημα σε ευδιάκριτο σημείο μετά το άνοιγμα μία πινακίδα με την ακόλουθη προειδοποίηση:

Προειδοποίηση
Το περίβλημα επιτρέπεται να ανοίγει μόνο για μικρό χρονικό διάστημα, π.χ. για τη διενέργεια οπτικής διάγνωσης. Μην κάνετε χρήση διακοπτών, μην τραβάτε ή εμβυσματώνετε δομικά συγκροτήματα και μη διαχωρίζετε ηλεκτροφόρους αγωγούς (εμβυσματώσιμες συνδέσεις).
Η προειδοποίηση αυτή δε χρειάζεται να ληφθεί υπ' όψιν, εάν είναι γνωστό ότι δεν υφίσταται ατμόσφαιρα παρουσιάζουσα κίνδυνο έκρηξης**.**

Κατάλογος των εγκεκριμένων δομικών συγκροτημάτων/μονάδων

Η λίστα με τα εγκριμένα δομικά συγκροτήματα/μονάδες υπάρχει στο διαδίκτυο:

http://www4.ad.siemens.de/view/cs/

με τον κωδικό συνδρομής 13702947.

Použití konstrukčních skupin / modulů v prostředí s nebezpečím výbuchu Zóna 2

Zóna 2

Oblasti s nebezpečím výbuchu jsou rozděleny do zón. Zóny jsou rozlišeny podle pravděpodobnosti výskytu explosivní atmosféry.

Zóna	Nebezpečí exploze	Příklad
2	Explosivní plynová atmosféra se vyskytuje pouze zřídka a krátkodobě	Oblasti kolem přírubových spojů s plochým těsněním u potrubí v uzavřených prostorech
Bezpečná oblast	není	• Mimo zónu 2 • Standardní aplikace necentrálních periferií

Dále naleznete důležité pokyny pro instalaci konstrukčních skupin/modulů v oblastech s nebezpečím výbuchu.

Další informace

Další informace ke konstrukčním skupinám/modulům naleznete v příslušné příručce.

Místo výroby / Registrace

⟨Ex⟩   **II 3 G**   **EEx nA II T3 .. T6**   dle EN 50021 : 1999

Zkušební číslo: *viz tabulka*

Místo výroby	Konstrukční skupiny/Moduly	Kontrolní číslo
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S Konstrukční skupiny odolné proti chybám	KEMA 01 ATEX 1238X
	S7-300 ET 200M Spojka sběrnice DP/PA Diagnostické translační relé S7-300 Konstrukční skupiny odolné proti chybám	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Upozornění

Konstrukční skupiny/Moduly s osvědčením ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 smějí být použity pouze v systémech SIMATIC, přístrojové kategorie 3.

Údržba

K opravě musí být příslušné konstrukční skupiny/moduly zaslány do výrobního místa. Oprava smí být provedena pouze zde.

Zvláštní podmínky

1. Konstrukční skupiny/moduly musí být zabudovány v rozvaděči nebo kovovém krytu. Ty musí minimálně zajišťovat druh ochrany IP 54 (dle EN 60529). Přitom je nutno respektovat okolní podmínky, v nichž je přístroj instalován. Pro kryt musí být k dispozici prohlášení výrobce pro zónu 2 (dle EN 50021).

2. Pokud je na kabelu popř. kabelovém vedení tohoto krytu dosaženo za provozních podmínek teploty > 70 °C, nebo když za provozních podmínek může být na kabelových větvích teplota > 80 °C, musí teplotní vlastnosti kabelu souhlasit se skutečně naměřenými teplotami.

3. Použité kabelové přívody musí odpovídat požadovanému druhu ochrany IP a odstavci 7.2 (dle EN 50021).

4. Všechny přístroje, včetně spínačů atd. napojených na vstupy a výstupy systémů SIMATIC, musí mít osvědčení vůči výbuchu typu EEx nA nebo EEx nC.

5. Musí být provedena opatření k zamezení přechodného překročení jmenovitého napětí, nepřesahující více než 40 %.

6. Rozsah teploty okolí: 0° C do 60° C

7. Uvnitř krytu je nutno na dobře viditelném místě po otevření připevnit štítek s následujícím varováním:

⚠ **Varování**
Kryt smí být otevřen pouze krátce, např. pro vizuální diagnostiku. Nepoužívejte přitom žádný spínač, nevytahujte ani nezasunujte žádné konstrukční skupiny a neoddělujte žádná elektrická vedení (konektorové spoje).
Toto varování nemusíte respektovat, pokud je známo, že se na místě nevyskytuje explozivní atmosféra.

Seznam konstrukčních skupin/modulů s osvědčením

Seznam konstrukčních skupin/modulů s osvědčením naleznete na Internetu:

http://www4.ad.siemens.de/view/cs/

pod identifikací příspěvku ID 13702947.

Sõlmede/moodulite kasutamine plahvatusohtliku piirkonna tsoonis 2

Tsoon 2

Plahvatusohtlikud piirkonnad jagatakse tsoonideks. Tsoone eristatakse vastavalt plahvatusohtliku keskkonna esinemise tõenäosusele.

Tsoon	Plahvatusoht	Näide
2	üldine plahvatav keskkond esineb ainult harva ja lühiajaliselt	Piirkonnad lamedate rõngastihenditega torustike äärikliidete ümbruses suletud ruumides
ohutu piirkond	ei	• väljaspool tsooni 2 • Mittstsentraalse välisseadme standardsed rakendused

Järgnevalt leiate Te olulisi juhiseid sõlmede/moodulite paigaldamiseks plahvatusohtlikus piirkonnas.

Täiendav info

Üksikasjalik info sõlmede/moodulite kohta on toodud seadme juurde kuuluvas käsiraamatus.

Valmistamiskoht / Kasutusluba

$\langle Ex \rangle$ **II 3 G**   **EEx nA II T3 .. T6**   vastavalt standardile EN 50021 : 1999

Katsetusnumber: *vaadake tabelit*

Valmistamiskoht	Sõlmed/moodulid	Katsetusnumber
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S Rikkekindlad sõlmed	KEMA 01 ATEX 1238X
	S7-300 ET 200M Siinühendus DP/PA Diagnostikarepiiter S7-300 Rikkekindlad sõlmed	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Juhis

Sõlmi/mooduleid kasutusloaga $\langle Ex \rangle$ II 3 G   EEx nA II T3 .. T6   tohib kasutada ainult SIMATIC-süsteemides, mille seadmeklass on 3.

Korrashoid

Parandamiseks tuleb sõlmed/moodulid saata valmistamiskohta. Parandustöid tohib teha ainult seal.

Eritingimused

1. Sõlmed/moodulid tuleb monteerida jaotuskarpi või metallkorpusesse. Need peavad tagama kaitseastme vähemalt IP 54 (vastavalt standardile EN 60529). Seejuures peab arvesse võtma seadme paigaldamise keskkonna tingimusi. Korpuse jaoks peab tsooni 2 jaoks olema tootja juhis (vastavalt standardile EN 50021).

2. Kui selle korpuse kaabli juures või kaabelvaheliku (kaabelsisestuse) juures töötingimustes saavutatakse temperatuur > 70 °C või, kui töötingimustes temperatuur soone hargnemiskoha juures võib olla > 80 °C, peavad kaabli termilised omadusd olema vastavuses tegelikult mõõdetud temperatuuridega.

3. Kasutatavad kaabelvahelikud (kaabelsisestused) peavad vastama nõutud IP-kaitseastmele ja osas 7.2 toodud nõuetele (vastavalt standardile EN 50021).

4. Kõik seadmed, kaasa arvatud lülitid, jt., mis SIMATIC-süsteemide sisendite ja väljundite külge ühendatakse, peavad võimaldama plahvatuskaitse tüüpi EEx nA või EEx nC.

5. Peab rakendama abinõusid, et nimipinget üleminekute tõttu ei saaks ületatada üle 40 %.

6. Ümbritseva keskkona temperatuurivahemik: 0° C kuni 60° C

7. Korpuse sisse tuleb sellisesse kohta, mis pärast avamist on hästi nähtav, panna silt järgmise hoiatusega:

⚠️ **Ettevaatust**

Korpust tohib avada ainult lühikeseks ajals, näiteks visuaalse diagnostika jaoks. Seejuures ärge kasutage ühtegi lülitit ega võtke välja ega pange sisse ühtegi sõlme ega lahutage ühtegi elektrijuhet (pistikühendused).
Seda hoiatust võib mitte arvesse võtta, kui on teada, et ei esine mingit plahvatusohtlikku keskkonda.

Lubatud sõlmede/moodulite loetelu

Lubatud sõlmede/modulite loetelu leiate Te internetist:

http://www4.ad.siemens.de/view/cs/

lisas-ID 13702947.

Ierīču/moduļu pielietojums sprādzienbīstamas teritorijas zonā 2

Zona 2

Sprādzienbīstamās teritorijas ir sadalītas zonās. Šīs zonas atšķir pēc sprādzienbīstamas atmosfēras pastāvēšanas iespējamības.

Zona	Sprādzienbīstamība	Piemērs
2	eksplozīva gāzes atmosfēra izveidojas reti un uz īsu laiku	Teritorijas ap atloku savienojumiem ar plakaniem blīvējumiem uz cauruļvadiem slēgtās telpās
droša teritorija	nē	• Ārpus zonas 2 • Decentralizētas perifērijas ierīces standartlietojumi

Turpmāk atrodamas svarīgas norādes par ierīču/moduļu uzstādīšanu sprādzienbīstamajā zonā.

Turpmāka informācija

Turpmāka informācija par ierīcēm/moduļiem ir atrodama attiecīgajā rokasgrāmatā.

Izgatavošanas vieta / Atļauja

⟨Ɛx⟩   **II 3 G**   **EEx nA II T3 .. T6**   saskaņā ar EN 50021 : 1999

Pārbaudes numurs: *skatīt tabulu*

Izgatavošanas vieta	Ierīces/moduļi	Pārbaudes numurs
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S	KEMA 01 ATEX 1238X
	S7-300 ET 200M Kopnes savienotājs DP/PA Diagnostikas atkārtotājs S7-300 Pret kļūdām aizsargātas ierīces	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Norāde

Ierīces/moduļi ar atļauju ⟨Ex⟩ II 3 G EEx nA II T3 .. T6 var tikt pielietotas tikai 3.kategorijas SIMATIC sistēmās.

Tehniskā apkope

Attiecīgu ierīču/moduļu remontam tie ir jānosūta ražotājam. Remontu drīkst veikt tikai tur.

Īpaši apstākļi

1. Ierīces/moduļi jāiebūvē sadales skapī vai metāla korpusā. Tiem jānodrošina aizsardzības līmenis ne mazāks kā IP 54 (saskaņā ar EN 60529). Turklāt, ierīces uzstādīšanā jāievēro apkārtējas vides apstākļi. Korpusam ir nepieciešams izgatavotāja apliecinājums zonai 2 (saskaņā ar EN 50021).

2. Ja uz kabeļa vai šī korpusa kabeļu ievades ekspluatācijas apstākļos tiek sasniegta temperatūra > 70 °C vai ja ekspluatācijas apstākļos uz kabeļa atzariem var būt temperatūra > 80 °C, kabeļu temperatūras īpašībām jāatbilst faktiski nomērītām temperatūrām.

3. Pielietojamām kabeļu ievadēm jāatbilst nepieciešamajam aizsardzības veidam IP un sadaļai 7.2 (saskaņā ar EN 50021).

4. Visām ierīcēm, ieskaitot pārslēgus utt., kas tiek pieslēgti pie SIMATIC sistēmu ievadēm un izvadēm, jābūt atļaujām EEx nA vai EEx nC tipa sprādzienaizsardzībai.

5. Nepieciešams veikt pasākumus, lai pārejas spriegums nepārsniegtu nominālo spriegumu vairāk kā par 40 %.

6. Apkārtējas temperatūras diapazons: 0° C līdz 60° C

7. Korpusa iekšpusē, vietā, kas ir labi redzama, atverot to, ir jāizvieto plāksne ar sekojošo brīdinājumu:

⚠ **Brīdinājums**
Korpusu var atvērt tikai īslaicīgi, piemēram, vizuālai diagnostikai. Pie tam nenospiediet nekādus slēdžus, neievietojiet un neizņemiet nekādas ierīces un nepārtrauciet elektriskās līnijas (spraudsavienojumus).
Šis brīdinājums var tikt neņemts vērā, ja ir zināms, ka nepastāv sprādzienbīstama atmosfēra.

Pieļaujamo ierīču/moduļu saraksts

Pieļaujamo ierīču/moduļu saraksts ir atrodams Internetā:

http://www4.ad.siemens.de/view/cs/

zem datu ID 13702947.

Konstrukcinių grupių/modulių panaudojimas sprogioje 2 zonos aplinkoje

Zona 2

Sprogi aplinka yra apibūdinama keliomis zonomis. Zonos skirstomos pagal galimos sprogios terpės atsiradimo tikimybę.

Zona	Sprogimo pavojus	Pavyzdys
2	sprogi atmosfera būna retai ir trumpai	Uždarų patalpų vamzdynuose - flanšo su tarpikliais sujungimų vietose
saugioji sritis	nėra	• ne zonoje 2 • Standartinė periferinė sistema

Toliau pateikiamas informacija apie konstrukcinių grupių ir modulių montavimą sprogioje aplinkoje.

Papildoma informacija

Papildomos informacijos apie konstrukcines grupes/modulius rasite eksploatacijos vadove.

Pagaminimo vieta / Saugos reikalavimai

⟨Ex⟩　**II 3 G**　　**EEx nA II T3 .. T6**　　　pagal EN 50021 : 1999

Patikros numeris: žiūr. *lentelėje*

Pagaminimo vieta	Konstrukcinės grupės/moduliai	Patikros numeris
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Ambergas Vokietija	ET 200S ET 200S nuo trukdžių apsaugotos konstrukcinės grupės	KEMA 01 ATEX 1238X
	S7-300 ET 200M Magistralinė jungtis DP/PA Diagnozės retransliatorius S7-300 nuo trukdžių apsaugotos konstrukcinės grupės	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Vokietija	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Nuoroda

Konstrukcines grupes/modulius, kurių leidimas eksploatuoti yra ⟨Ex⟩ II 3 G
EEx nA II T3 .. T6 galima naudoti tik 3 kategorijos sistemose "SIMATIC".

Priežiūra

Esant gedimams, konstrukcinę grupę/modulį išsiųskite gamintojui. Tik jis gali kvalifikuotai suremontuoti įtaisą.

Specialiosios sąlygos

1. Konstrukcines grupes/modulius montuokite jungimo spintoje arba metaliniame korpuse. Korpuso ar jungimo spintos saugos klasė turi būti mažiausiai "IP 54" (pagal EN 60529). Būtina atsižvelgti į kitas aplinkos sąlygas. Norint korpusą eksploatuoti zonoje 2, būtinas gamintojo pažymėjimas (pagal EN 50021).

2. Jei korpuso kabelio arba kabelio prijungimo temperatūra pakyla daugiau nei 70 °C arba laidų atšakoje temperatūra padidėja daugiau nei 80 °C, reikia naudoti kabelius, kurių terminės savybės atitinka išmatuotas temperatūros vertes.

3. Kabelių sujungimai turi būti saugos klasės IP ir atitikti 7.2 skyriaus (pagal EN 50021) reikalavimus.

4. Visi prietaisai, įskaitant ir jungiklius, jungiami sistemų "SIMATIC" įeigose ir išeigose, turi būti tipo "EEx nA" arba "EEx nC" - apsaugoti nuo sprogimo.

5. Būtina imtis priemonių, kad pereinamųjų grandžių vardinė įtampa neviršytų 40 %.

6. Leistina aplinkos temperatūra: 0° C iki 60° C

7. Atidarę korpusą, jo viduje gerai matomoje vietoje, įtaisykite lentelę su įspėjimu:

⚠ **Įspėjimas**
Korpusą` atidaryti tik trumpam laikui, pvz., patikrai. Neliesti jungiklių, konstrukcinių grupių neištraukti ir nekišti, neatjungti elektrinių sujungimų (kištukinių sujungimų).
Šio įspėjimo galima nepaisyti, kai yra žinoma, jog darbinė aplinka yra nesprogi.

Leistinų konstrukcinių grupių/modulių sąrašas

Leistinų konstrukcinių grupių/modulių sąrašą rasite interneto puslapyje:

http://www4.ad.siemens.de/view/cs/

įvedę kodą 13702947.

A főegységek/modulok alkalmazása a 2. zóna robbanásveszélyes környezetben

2. zóna

A robbanásveszélyes környezeteket zónákba sorolják be. A robbanásveszélyes légkör előfordulásának valószínűsége alapján különböztetik meg a zónákat.

Zóna	Robbanásveszély	Példa
2	robbanásveszélyes gázat tartalmazó légkör csak ritkán és rövid ideig lép fel	zárt helységekben elhelyezett csővezetékeknél a lapos tömítéssel rendelkező karimás kötések környezetében
biztonságos környezet	nem	• a 2. zónán kívül • a decentrális periféria készülékek standard alkalmazásai

A következőkben fontos utasításokat talál a főegységek/modulok telepítéséhez a robbanásveszélyes környezetbe.

További információk

A további információkat a főegységekhez/modulokhoz megtalálja a hozzátartozó kézikönyvben.

Gyártási hely / Engedélyezés

⟨Ex⟩ **II 3 G   EEx nA II T3 .. T6**   az EN 50021 : 1999 szerint

Ellenőrző szám: *lásd a táblázatot*

Gyártási hely	Főegységek/modulok	Ellenőrző szám
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S hibabiztos főegységek	KEMA 01 ATEX 1238X
	S7-300 ET 200M DP/PA buszcsatoló Diagnózisrepeater S7-300 hibabiztos főegységek	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Utasítás

⟨Ex⟩Az II 3 G EEx nA II T3 .. T6 engedélyezéssel rendelkező főegységeket/modulokat alkalmazhatja csak a 3. felszerelés-kategóriába tartozó SIMATIC rendszerekbe.

Karbantartás

Javítás esetén küldje az érintett főegységeket/modulokat a gyártási helyre. Csak itt hajthatják végre a javítást.

Különleges feltételek

1. A főegységeket/modulokat egy kapcsolószekrénybe vagy egy fém házba kell beszerelni. Ezeknek kell biztosítaniuk legalább az IP 54 védettségi fokozatot (EN 60529 szerint). Itt figyelembe kell venni azokat a környezeti feltételeket, amelyek fellépnek a készülék telepítésekor. A házhoz meg kell legyen a gyártói nyilatkozat a 2. zónához (az EN 50021 szerint).

2. Ha a jelen ház kábelén ill. kábelvezetésen üzemi feltételek mellett a hőmérséklet > 70 °C, vagy ha az üzemi feltételek mellett a hőmérséklet > 80 °C az érelágazásokon, akkor meg kell egyezzenek a kábel hőmérsékleti tulajdonságai a ténylegesen mért hőmérsékletekkel.

3. Az alkalmazott kábelvezetések meg kell feleljenek a követelt IP védettségi fokozatnak és a 7.2. bekezdésnek (EN 50021 szerint).

4. Minden készülék, kapcsolót stb. beleértve, amelyeket a SIMATIC rendszerek be- és kimeneteire csatlakoztattak, engedélyezve kell legyen az EEx nA vagy EEx nC típusú robbanásvédelemhez.

5. Intézkedéseket kell hozni, hogy a tranziensek ne lépjék túl a névleges feszültséget több mint 40 %-al.

6. Környezeti hőmérséklet tartomány: 0° C ... 60° C

7. A házon belül -a nyitáskor jól látható helyen- helyezzen el egy táblát a következő figyelmeztetéssel:

⚠ **Figyelmeztetés**
A házat csak rövid ideig szabad nyitani, pl. optikai diagnózishoz. Eközben ne működtessen egy kapcsolót sem, ne húzzon ki vagy dugjon be egy főegységet sem és ne válasszon le villamos vezetékeket (dugós csatlakozók).
Ez a figyelmeztetés mellőzhető, ha tudott, hogy nem áll fenn robbanásveszélyes légkör.

A megengedett főegységek/modulok listája

A megengedett főegységek/modulok listáját megtalálja az interneten:

http://www4.ad.siemens.de/view/cs/

a 13702947 cikk azonosító szám alatt.

Tqegħid tal-Komponenti / *Modules* fiż-Żona 2, fejn hemm Riskju ta' Splużjoni

Żona 2

Sezzjonijiet fejn hemm riskju ta' splużjoni jitqassmu f'żoni. Tagħmel distinzjoni bejn żona u oħra skond il-probabbiltà li jkun hemm ambjent li jista' jwassal għal splużjoni.

Żona	Periklu ta' Splużjoni	Eżempju
2	ambjent gassuż li jista' jisplodi jfeġġ rarament u għal żmien qasir	Żoni madwar flanġ ġojnts b'gaskits ċatti f'kanni ġewwa spazji magħluqin
żona ż-żgura	le	• barra miż-żona 2 • użu normali ta' *devices* periferali deċentralizzati

Issib hawn taħt indikazzjonijiet importanti għall-installazzjoni ta' komponenti / *modules* fiż-żona fejn hemm riskju ta' splużjoni.

Aktar Tagħrif

Aktar tagħrif fuq il-komponenti / *modules* jinstab fil-manwal ikkonċernat.

Post ta' Manifattura / Approvazzjoni

⟨Ex⟩ **II 3 G   EEx nA II T3 .. T6**   skond EN 50021 : 1999

Numru taċ-Ċertifikat: ara t-tabella

Post ta' Manifattura	Komponenti / Modules	Numru taċ-Ċertifikat
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S *modules* ma jistgħux ifallu	KEMA 01 ATEX 1238X
	S7-300 ET 200M *bus coupling* DP/PA Ripetitur ta' dijanjosi S7-300 *modules* ma jistgħux ifallu	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Nota

Komponenti / *modules* bl-approvazzjoni ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 jistgħu jintużaw biss ġewwa sistemi SIMATIC tal-kategorija 3.

Manutenzjoni

Fil-każ li jkun hemm bżonn ta' tiswija, il-komponenti / *modules* ikkonċernati għandhom jintbagħtu fil-post ta' manifattura. It-tiswijiet jistgħu jsiru biss f'dan il-post.

Kundizzjonijiet Speċjali

1. Komponenti / *modules* għandhom jiġu mmontati ġewwa swiċċ kabinett jew kaxxa tal-metall. Dawn iridu jiggarantixxu protezzjoni mill-inqas tat-tip IP 54 (skond EN 60529). Inti u tagħmel hekk, trid taħseb għall-kundizzjonijiet ambjentali ta' waqt l-installazzjoni tad-*device*. Irid ikun hemm dikjarazzjoni tal-manifatturier għall-kaxxa għaż-żona 2 (skond EN 50021).

2. Jekk fil-kejbil, jew fil-kaxxa mad-daħla għall-kejbil, tintlaħaq temperatura ta' aktar minn 70 °C taħt kundizzjonijiet ta' ħidma, jew jekk fil-post fejn jinfirdu l-wajers jista' jkun li hemm temperatura ta' aktar minn 80 °C, il-kejbil irid ikollu proprjetajiet ta' temperatura xierqa għat-temperaturi tabilħaqq imkejlin.

3. Id-daħliet għall-kejbil li jintużaw iridu jikkonformaw mat-tip ta' protezzjoni IP mitlub u t-taqsima 7.2 (skond EN 50021).

4. Id-*devices* kollha, swiċċijiet etc. inklużi, li jitqabbdu ma' l-*inputs* u l-*outputs* ta' sistemi SIMATIC, iridu jkunu approvati għal protezzjoni kontra splużjoni tat-tip EEx nA jew EEx nC.

5. Iridu jittieħdu miżuri biex il-vultaġġ nominali ma jitqabbiżx b'aktar minn 40% minħabba transitorji.

6. Varjazzjoni tat-temperatura ambjentali: 0° C sa 60° C

7. Għandha titqiegħed tabella bit-twissija li ġejja ġewwa l-kaxxa, f'post li jidher sew wara li tinfetaħ il-kaxxa:

⚠️ **Twissija**
Il-kaxxa tista' tinfetaħ biss għal żmien qasir, per eżempju għal dijanjosi viżwali. Inti u tagħmel hekk, ma tista' tmiss l-ebda swiċċ, ddaħħal jew tneħħi l-ebda *module* u tneħħi l-ebda kejbil elettriku (konnessjonijiet li tipplaggjahom).
Tista' ma tagħtix każ ta' din it-twissija meta taf li m'hemmx riskju ta' splużjoni fl-ambjent.

Lista ta' Komponenti / *Modules* Approvati

Issib il-lista ta' komponenti / *modules* approvati fl-internet:

http://www4.ad.siemens.de/view/cs/

bin-numru ta' identifikazzjoni 13702947.

Zastosowanie grup konstrukcyjnych / modułów w 2 strefie zagrożenia wybuchem

Strefa 2

Otoczenie zagrożone wybuchem dzielone jest na strefy. Strefy dzielą się ze względu na stopień prawdopodobieństwa powstania atmosfery stwarzającej możliwość powstania wybuchu.

Strefa	Niebezpieczeństwo eksplozji	Przykład
2	atmosfera gazowa z zagrożeniem wybuchem występuje rzadko i na krótki okres czasu	miejsca wokół łącz w kanałach technicznych z opaskami przy przewodach instalacyjnych w pomieszczeniach zamkniętych
obszar bezpieczny	nie	• poza 2 strefą • standardowe zastosowanie decentralnych urządzeń peryferyjnych

Dalej znajdą Państwo informacje dotyczące instalacji grup konstrukcyjnych / modułów w otoczeniu zagrożonym wybuchem.

Pozostałe informacje

Dalsze informacje dotyczące grup konstrukcyjnych / modułów znajdą państwo w odpowiedniej instrukcji.

Miejsce produkcji / Rejestracja

⟨Ex⟩　　**II 3 G**　　**EEx nA II T3 .. T6**　　　stosownie do EN 50021 : 1999

Nr testu: *zobacz tabela*

Miejsce produkcji	Grupy konstrukcyjne / moduły	Nr testu
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Niemcy	ET 200S ET 200S grupy konstrukcyjne odporne na uszkodzenia	KEMA 01 ATEX 1238X
	S7-300 ET 200M Zbierające łącze sprzężające DP/PA powtarzacz diagnozy S7-300 grupy konstrukcyjne odporne na uszkodzenia	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Niemcy	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Uwaga

Grupy konstrukcyjne / moduły zarejestrowane jako ⟨Ɛx⟩ II 3 G   EEx nA II T3 .. T6 wolno stosować jedynie w systemach SIMATIC o 3 kategorii urządzenia.

Konserwacja

W celu naprawy należy odpowiednie grupy konstrukcyjne / moduły przesłać do miejsca produkcji. Jedynie serwis producenta jest upoważniony do dokonywania napraw.

Warunki szczególne

1. Grupy konstrukcyjne / moduły muszą zostać zamontowane do skrzynki ochronnej lub metalowej puszki ochronnej. Muszą one spełniać wymagania co najmniej stopnia IP 54 (stosownie do EN 60529). Należy brać pod uwagę warunki otoczenia, w którym urządzenie będzie instalowane. Należy posiadać oświadczenie producenta dopuszczające puszkę do użytku w strefie 2 (stosownie do EN 50021).

2. W przypadku, gdyby na przewodzie tej puszki podczas pracy temperatura mogła przekroczyć > 70 °C, lub żyła przewodu mogłaby osiągnąć temperaturę > 80 °C, właściwości cieplne przewodu muszą zostać dobrane do takich wartości.

3. Wszystkie stosowane przewody muszą odpowiadać właściwemu stopniowi ochrony IP oraz warunkom określonym w punkcie 7.2 (stosownie do EN 50021).

4. Wszystkie urządzenia włączając w to przełączniki itp., które podłączane są do wejść lub wyjść systemów SIMATIC muszą być dopuszczone do ochrony przeciw wybuchom typu EEx nA lub EEx nC.

5. Muszą zostać spełnione takie warunki, aby napięcie miana w przejściach nie mogło przekroczyć więcej niż 40 %.

6. Temperatura otoczenia: od 0° C do 60° C

7. W puszce w dobrze widocznym po otwarciu miejscu należy umieścić ostrzeżenie następującej treści:

⚠ **Uwaga**
Puszkę wolno otworzyć jedynie na krótki okres czasu na przykład w celu kontroli optycznej. Nie wolno przy tym naciskać na żaden z przełączników, nie wolno wyciągać ani montować żadnej grupy konstrukcyjnej ani też odłączać żadnych przewodów elektrycznych (łącza wsuwkowe).
Powyższego ostrzeżenia nie trzeba przestrzegać jeśli wiadomo jest, iż na miejscu nie ma zagrożenia wybuchem.

Lista dopuszczonych grup konstrukcyjnych / modułów

Wykaz dopuszczonych grup konstrukcyjnych / modułów znajduje się na stronie internetowej:

http://www4.ad.siemens.de/view/cs/

w części ID 13702947.

Použitie konštrukčných skupín / modulov v prostredí s nebezpečenstvom výbuchu zóny 2

Zóna 2

Prostredia s nebezpečenstvom výbuchu sa rozdeľujú do zón. Zóny sa rozlišujú podľa pravdepodobnosti prítomnosti atmosféry so schopnosťou výbuchu.

Zóna	Nebezpečenstvo explózie	Príklad
2	plynová atmosféra s nebezpečenstvom výbuchu sa vyskytuje len zriedka a krátkodobo	priestory okolo prírubových spojov s plochými tesneniami pri potrubných vedeniach v uzavretých priestoroch
bezpečná oblasť	nie	• mino zóny 2 • štandardné použitia decentrálnej periférie

Ďalej nájdete dôležité pokyny pre inštaláciu konštrukčných skupín / modulov v prostredí s nebezpečenstvom výbuchu.

Ďalšie informácie

Ďalšie informácie ku konštrukčným skupinám / modulom nájdete v príslušnej príručke.

Miesto vyhotovenia / Osvedčenie

⟨Ex⟩   **II 3 G**   **EEx nA II T3 .. T6**   podľa EN 50021 : 1999

Číslo skúšky : *pozri tabuľka*

Miesto vyhotovenia	Konštrukčné skupiny / moduly	Číslo skúšky
Siemens AG, divízia A&D Werner-von-Siemens-Straße 50 92224 Amberg Nemecko	ET 200S ET 200S konštrukčné skupiny odolné voči poruchám	KEMA 01 ATEX 1238X
	S7-300 ET 200M Zbernicový väzbový člen DP/PA opakovač diagnózy S7-300 konštrukčné skupiny odolné voči poruchám	KEMA 02 ATEX 1096X
Siemens AG, divízia A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Nemecko	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Upozornenie

Konštrukčné skupiny / moduly s osvedčením ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 sa smú používať len v systémoch SIMATIC kategórie zariadenia 3.

Údržba

Za účelom opravy sa musia príslušné konštrukčné skupiny / moduly zaslať na miesto vyhotovenia. Oprava sa smie vykonávať len na tomto mieste !

Špeciálne podmienky

1. Konštrukčné skupiny / moduly sa musia vmontovať do spínacej skrine alebo do kovového puzdra schránky. Tie musia zabezpečovať druh ochrany minimálne IP 54 (podľa EN 60529). Pritom je potrebné zohľadniť podmienky prostredia, do ktorého sa bude zariadenie inštalovať. V prípade puzdra musí existovať vyhlásenie výrobcu pre zónu 2 (podľa EN 50021).

2. V prípade, že na kábli, prípadne na káblovom prívode tohto puzdra presiahne teplota pri prevádzkových podmienkach hodnotu > 70 °C, alebo ak na vetve žily môže byť pri prevádzkových podmienkach teplota > 80 °C, musia tepelné vlastnosti kábla vyhovovať skutočne nameraným hodnotám.

3. Všetky použité káblové prívody musia zodpovedať požadovanému druhu ochrany IP a odseku 7.2 (podľa EN 50021).

4. Všetky zariadenia, vrátane prepínača, atď., ktoré sa pripoja na vstupy a výstupy systémov SIMATIC, musia byť schválené pre ochranu voči výbuchu typu EEx nA alebo EEx nC.

5. Musia sa splniť také opatrenia, aby sa menovité napätie cez prechody nemohlo prekročiť o viac ako 40 %.

6. Rozsah okolitých teplôt: 0° C až 60° C

7. V puzdre je na dobre viditeľné miesto po otvorení potrebné umiestniť štítok s nasledovnou výstrahou:

⚠️ **Výstraha**
Puzdro sa môže otvoriť len počas krátkej doby, napríklad pre vizuálnu diagnózu. Nestlačte pritom žiadny prepínač, nevytiahnite alebo nezasuňte žiadnu konštrukčnú skupinu a neoddeľte žiadne elektrické vedenia (zástrčkové spojenia).
Túto výstrahu si nemusíte všímať v takom prípade, ak je známe, že sa na mieste nevyskytuje atmosféra s nebezpečenstvom výbuchu.

Zoznam dovolených konštrukčných skupín / modulov

Zoznam dovolených konštrukčných skupín / modulov sa nachádza na internete :

http://www4.ad.siemens.de/view/cs/

v článku ID 13702947.

Uporaba sklopov/modulov v eksplozivno ogroženem območju cone 2

Cona 2

Eksplozivno ogrožena območja se delijo na cone. Cone se ločijo po verjetnosti prisotnosti eksplozivne atmosfere.

Cona	Nevarnost eksplozije	Primer
2	eksplozivna zmes plinov v atmosferi je redka in traja le kratko.	Območja okoli prirobnih spojev z ploskimi tesnili pri cevnih napeljavah v zaprtih prostorih.
sigurno območje	ne	• izven cone 2 • Standardna uporaba decentralne periferije.

Sledijo pomembni napotki o inštalaciji sklopov/modulov v eksplozivno ogroženem območju.

Nadaljnje informacije

Nadaljnje informacije o sklopih/modulih najdete v priloženem priročniku.

Mesto izdelave / Dovoljenje - Atest

⟨Ex⟩ **II 3 G   EEx nA II T3 .. T6**   po EN 50021 : 1999

kontrolna številka: *glej tabelo*

Mesto izdelave	Sklopi/moduli	kontrolna številka:
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S Sklopi varovani proti okvari	KEMA 01 ATEX 1238X
	S7-300 ET 200M bus vezava DP/PA Diagnozni repeater S7-300 Sklopi varovani proti okvari	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Opozorilo

Sklopi/moduli z dovoljenjem ⟨Ex⟩ II 3 G   EEx nA II T3 .. T6 se lahko uporabijo samo v SIMATIC-Sistemih kategorije 3 .

Vzdrževanje

V primeru popravila pošljete sklope/module na kraj izdelave. Popravila lahko izvajajo samo na tem naslovu!

Posebni pogoji

1. Sklopi/moduli se morajo vgraditi v elektro omaro ali metalno ohišje. Omara/ohišje mora zadostiti varovanju IP 54 (po EN 60529). Pri tem je potrebno upoštevati tudi pogoje okolice, v kateri se naprava nahaja. Ohišje mora imeti izjavo (atest) proizvajalca za uporabo v coni 2 (po EN 50021).

2. Če na kablu oz. uvodnici tega ohišja v režimu obratovanja temperatura doseže vrednost > 70 °C ali če doseže na razcepih vodnikov v obratovanju temperatura vrednost > 80 °C, se morajo temperaturne lastnosti kablov skladati z dejansko namerjenimi.

3. Uporabljene uvodnice morajo ustrezati predpisani IP zaščiti in poglavju 7.2 (po EN 50021).

4. Vse naprave, vključno s stikali itd., ki so priklopljene na vhodih oz. izhodih sistemov SIMATIC, morajo biti odobrene za zaščito proti eksplozijam tipa EEx nA ali EEx nC.

5. Zagotoviti se mora, da nazivna napetost ne prekorači več kot 40% pri tranzienci (preklopih, vklopih,...).

6. Temperaturno območje okolice: 0° C do 60° C

7. V notranjosti ohišja, na odprtem dobro vidljivem mestu, se pritrdi napis z naslednjim opozorilom:

⚠️ **Opozorilo**
Ohišje se lahko odpre samo za kratek čas, npr. za vizualno diagnozo. Pri tem ne vklapljajte/izklaplajte stikal, sklopov ali električnih vodnikov (vtičnih spojev). Opozorilo ne velja, kadar je znano, da ni eksplozivne atmosfere.

Seznam dovoljenih sklopov/modulov

Seznam dovoljenih sklopov/modulov najdete na internetu na spletni strani:

http://www4.ad.siemens.de/view/cs/

pod ID prispevka 13702947.

Patlama tehlikesi olan Alan 2 bölgesinde ünite gruplarının/modüllerin kullanılması

Alan 2

Patlama tehlikesi olan bölgeler alanlara ayrılır. Alanlar, patlayabilecek atmosfere sahip ortam ihtimaline göre farklı derecelere ayrılır.

Alan	Patlama tehlikesi	Örnek
2	Patlayıcı gaz atmosferi sadece nadir ve kısa bir süre için söz konusu	Kapalı alanlardaki boru bağlantılarında yassı contalı flanş bağlantıları civarındaki bölgeler
Güvenli bölge	hayır	• Alan 2 haricinde • Merkezi olmayan periferi standart uygulamaları

Aşağıda, ünite gruplarının/modüllerin patlama tehlikesi olan bölgelerde kurulması için önemli bilgiler bulacaksınız.

Daha başka bilgiler

Ünite grupları/modüller hakkında daha fazla bilgi için ilgili kılavuza bakınız.

İmalat yeri / Lisans

⟨Ex⟩   **II 3 G   EEx nA II T3 .. T6**   EN 50021 standartına göre: 1999

Test numarası: *bkz. Tablo*

İmalat yeri	Ünite grupları/Modüller	Kontrol numarası
Siemens AG, Bereich A&D Werner-von-Siemens-Straße 50 92224 Amberg Germany	ET 200S ET 200S Hataya karşı emniyetli ünite grupları	KEMA 01 ATEX 1238X
	S7-300 ET 200M Bus kuplajı DP/PA Diyagnoz repeater ünitesi S7-300 Hataya karşı emniyetli ünite grupları	KEMA 02 ATEX 1096X
Siemens AG, Bereich A&D Östliche Rheinbrückenstr. 50 76187 Karlsruhe Germany	S7-400	KEMA 03 ATEX 1125X
	S7-300 CP TS Adapter II	KEMA 03 ATEX 1228X
	SIMATIC NET	KEMA 03 ATEX 1226X

Bilgi

⟨Ex⟩ II 3 G EEx nA II T3 .. T6 lisanslı ünite grupları/modüller sadece 3 numaralı cihaz kategorisine ait SIMATIC sistemlerine kullanılabilir.

Bakım ve koruma

Bir onarım gerekli olması halinde, ilgili ünite grupları/modüller imalat yerine gönderilmelidir. Onarım sadece orada yapılabilir ve yapılmalıdır.

Özel koşullar

1. Ünite grupları/modüller bir şalter dolabı içine veya metal kasa içine monte edilmelidir. Bu kasalar en az IP 54 (EN 60529 standartına göre) koruma türüne ait olmalıdır. Burada, cihazın kurulduğu çevre koşulları dikkate alınmalıdır. Kullanılacak kasa için, alan 2 için geçerli bir üretici beyanı mevcut olmalıdır (EN 50021 standartına istinaden).

2. Kabloda ya da bu kasanın kablo girişindeki işletme koşullarında sıcaklık > 70 °C oluyorsa veya işletme koşullarında kablo telleri (damarları) ayrılma noktasında sıcaklık > 80 °C olma ihtimali varsa, kablonun sıcaklık ile ilgili özellikleri, gerçekten ölçülmüş sıcaklıklara uygun olmalıdır.

3. Kullanılmış olan kablo girişleri, talep edilen IP koruma türüne ve bölüm 7.2 (EN 50021 standartına göre) dahilindeki taleplere uygun olmalıdır.

4. SIMATIC sistemlerinin giriş ve çıkışlarına bağlanan tüm cihazlar (şalterler vs. dahil) için, EEx nA veya EEx nC patlamaya karşı koruma tipine istinaden izin alınmış olmalıdır.

5. Nominal gerilimin transiyentlerden (hatlardaki dalgalanmalardan dolayı ani gerilim ve akım değişiklikleri) dolayı azami %40 aşılması için gerekli önlemler alınmalıdır.

6. Çevre sıcaklığı aralığı: 0° C ile 60° C arasında

7. Kasa dahilinde, açıldıktan sonra iyi görülebilen bir yere aşağıdaki uyarı takılmalıdır:

⚠ **İkaz**
Kasa sadece kısa bir süre açılmalıdır, örn. görsel diyagnoz için. Herhangi bir şaltere basmayınız, herhangi bir ünite grubunu çekip çıkarmayınız veya takmayınız, elektrik hatlarını (soket bağlantıları) ayırmayınız.
Eğer patlama tehlikesi söz konusu olan bir atmosfer olmadığı biliniyorsa, işbu ikaz göz ardı edilebilir.

İzin verilmiş olan ünite gruplarının/modüllerin listesi

İzin verilmiş olan ünite gruplarının/modüllerin listesi için internete bakınız:

http://www4.ad.siemens.de/view/cs/

Doküman ID 13702947.

SIEMENS

Product Information

SIMATIC S7-300

Analog Input Module SM 331; AI 8 × RTD   **Release** $\dfrac{\text{X}\,|\,2}{3\,|\,4}$

New analog input module available

The S7-300 Analog Input Module SM 331; AI 8 × RTD has been added to the S7-300 family. The order number for this module is 6ES7 331-7PF01-0AB0.

This product information includes details about the characteristics and technical specifications of analog input module SM 331; AI 8 × RTD. Refer to the *S7-300 Installation and Hardware Manual* for more information about the S7-300 product family.

You will also learn:

- How to start up analog input module SM 331; AI 8 × RTD

- The measuring ranges available for analog input module SM 331; AI 8 × RTD

- How to configure analog input module SM 331; AI 8 × RTD

Additional assistance

For assistance in answering technical questions, for training on this product, or for ordering, contact your Siemens distributor or sales office.

Analog Input Module SM 331; AI 8 × RTD (6ES7 331-7PF01-0AB0)

Order no.

6ES7 331-7PF01-0AB0

Characteristic features

The analog input module SM 331; AI 8 × RTD has the following characteristic features:

- 8 differential inputs for RTD resistance temperature detector in 4 channel groups

- Optional setting of the resistance thermometer type per channel group

- Rapid measured value updating for up to 4 channels

- Measured-value resolution 15 bits + sign (independent of integration time)

- Programmable diagnostics

- Programmable diagnostic interrupt

- 8 channels with limit monitoring

- Programmable hardware interrupt when limit has been exceeded

- Programmable end-of-scan-cycle interrupt

- Isolated against the backplane bus interface

- Fully compatible with predecessor module SM 331-7PF00

- Includes Russian GOST RTD characteristics

Special feature

When operated in an ET200M distributed I/O configuration, the analog input module SM 331; AI 8 × RTD can only be used in the ET200M distributed I/O configuration with the following versions of the IM153 (or later)

- IM153-1   6ES7 153-1AA03-0XB0 V.1

- IM153-2   6ES7 153-2AA02-0XB0 V.5
             6ES7 153-2AB01-0XB0 V.4

Terminal connection diagram

Figure 1 shows the terminal connection diagram and the 4-wire wiring diagram for the SM331; AI 8 × RTD Module.

The detailed technical specifications for this analog input module are on the following page.
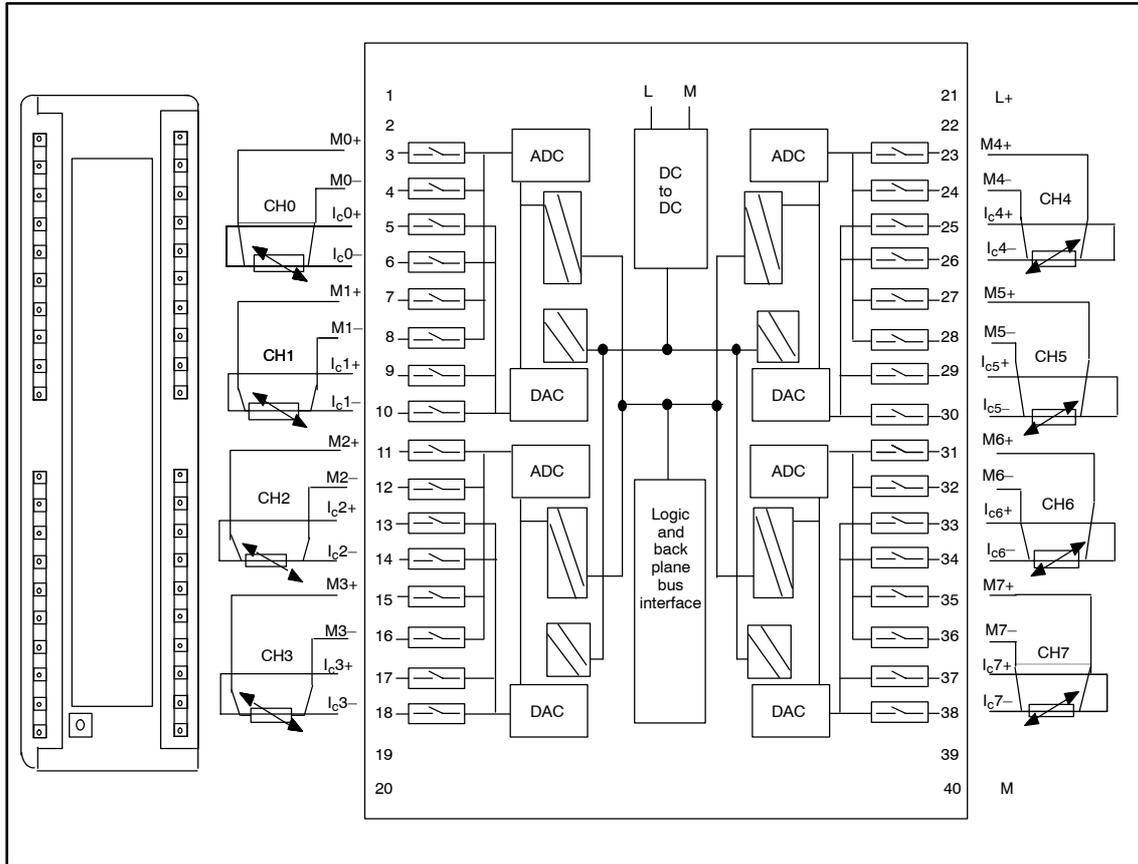
Figure 1   Connection Diagram of Analog Input Module SM 331; AI 8 × RTD

Technical specifications of the SM 331; AI 8 x RTD

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 272 g
Data for Specific Module	
Supports clocked operation	No
Number of inputs	8
Length of cable	
• Shielded	max. 200 m
Voltages, Currents, Potentials	
Power rated voltage of the electronics L+	24 VDC
• Reverse polarity protection	Yes
Constant measured current for resistance-type sensor	max. 5 mA
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
• Between the channels	Yes
In groups of	2
Permitted potential difference	
• Between the inputs (U_{CM})	75 VDC / 60 VAC
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 100 mA
• From the power supply L+	max. 240 mA
Power dissipation of the module	typ. 4.6 W

Analog value generation	
Measuring principle	Integrating
Module filtering mode	**8 channels, hardware**
Integration/conversion time/ resolution (per channel)	
• Programmable	Yes
• Basic conversion time in ms	80
• Additional conversion time for measuring 3L resistance, in ms	100*
• Additional conversion time for open-circuit monitoring, in ms	0
• Resolution including sign	16 bits
• Noise suppression for interference frequency f1 in Hz	400 / 60 / 50
Smoothing of the measured values	None / low/ average/ high
Conversion time (per channel)	100 ms
Basic response time of module (all channels enabled)	200 ms
Module filtering mode	**8 channels, software**
Integration/conversion time/ resolution (per channel)	
• Programmable	Yes
• Basic conversion time in ms	8 / 25 / 30
• Additional conversion time for measuring 3L resistance, in ms	25 / 43 / 48*
• Additional conversion time for open-circuit monitoring, in ms	0
• Resolution including sign	16 bits
• Noise suppression for interference frequency f1 in Hz	400 / 60 / 50
Smoothing of the measured values	None / low/ average/ high
Conversion time (per channel)	25 / 43 / 48 ms
Basic response time of module (all channels enabled)	50 / 86 / 96 ms

Module filtering mode	**4 channels, hardware**
Integration/conversion time/ resolution (per channel)	
• Programmable	Yes
• Basic conversion time in ms	3.3
• Additional conversion time for measuring 3L resistance, in ms	100*
• Additional conversion time for open-circuit monitoring, in ms	100**
• Resolution including sign	16 bits
• Noise suppres sion for interference frequency f1 in Hz	400 / 60 / 50
Smoothing of the measured values	None / low/ average/ high
Basic response time of module (all channels enabled)	10 ms

Suppression of interference, Limits of Error	
Noise suppression for f = n × (f1 1%), "(f1 = interference frequency) n = 1.2, etc.	
• Common-mode interference (U$_{CM}$ < 60 VAC)	> 100 dB
• Series-mode interference (peak value of interference < rated value of input range)	> 90 dB
Crosstalk between the inputs	> 100 dB
Operational limit (over entire temperature range, referred to 0 to 60 °C input range)	
• Resistance thermometer	
Pt 50, Pt 100, Pt 200, Pt 500, Pt 1000, Ni 100, Ni 120, Ni 200, Ni 500, Ni 1000, Cu 50, Cu 100,	±1.0 °C
Pt 10, Cu 10	±2.0 °C
• Resistors	±0.1 %

Basic error (operational limit at 25°C, referred to input range)	
• Resistance thermometer	
Pt 50, Pt 100, Pt 200, Pt 500, Pt 1000, Ni 100, Ni 120, Ni 200, Ni 500, Ni 1000, Cu 50, Cu 100,	±0.5 °C
Pt 10, Cu 10	±1.0 °C
• Resistors	±0.05 %
Temperature error (with reference to the input range)	
• Resistance thermometer	±0.015 °C/K
• Resistors	±0.005 %/K
Linearity error (with reference to the input range)	
• Resistance thermometer	±0.2 °C
• Resistors	±0.02 %
Repeat accuracy (in the steady state at 25 °C, referred to the input range)	
• Resistance thermometer	±0.2 °C
• Resistors	±0.01 %

Status, Interrupts, Diagnostics	
Interrupts	
• Hardware interrupt	Programmable (channels 0 − 7)
• Diagnostic interrupt	Programmable
Diagnostic functions	Programmable
• Group error display	Red LED (SF)
• Diagnostic information can be displayed	Possible

Data for Selecting a Sensor	
Input range (rated values) input resistance	
• Resistance thermometer	Pt 10, Pt 50, Pt 100, Pt 200, Pt 500, Pt 1000, Ni 100, Ni 120, Ni 200, Ni 500, Ni 1000, Cu 10, Cu 50, Cu 100,
• Resistors	150, 300, 600 Ω
Maximum input voltage for voltage input (destruction limit)	35 VDC continuous; 75 VDC for max. 1 s (duty factor 1:20)
Connection of the sensor	
• For measuring resistance	
With two-conductor connection	Possible
With three-conductor connection	Possible[***]
With four-conductor connection	Possible
Characteristic linearization	
• Resistance thermometer	Pt 10, Pt 50, Pt 100, Pt 200, Pt 500, Pt 1000, Ni 100, Ni 120, Ni 200, Ni 500, Ni 1000, Cu 10, Cu 50, Cu 100 (standard and climatic range)
• Technical unit for temperature measurement	Degrees Celsius; degrees Fahrenheit

* The resistance measurement for a three-conductor connection is performed every 5 minutes.

** Open-circuit monitoring in module filtering mode 4 Channels, Hardware is performed every 3 seconds.

*** Maximum lead resistance for 3-wire sensor measurements for PT 10 and Cu 10 RTD elements is 10 Ω. For all other RTD elements. The maximum lead resistance for 3-wire sensor measurements is 20 Ω.

Commissioning the SM 331; AI 8 x RTD

You set the mode of operation of the SM 331; AI 8 x RTD:

- With STEP 7 (see the *STEP 7 User Manual*) or

- In the user program by means of SFCs (see the *STEP 7 System and Standard Functions Reference Manual*)

Parameterization restrictions when using the SM 331; AI 8 x RTD with PROFIBUS masters that only support DPV0.

When you use the analog input module SM 331; AI 8 x RTD in an ET 200M PROFIBUS slave system with a PROFIBUS master which is not an S7 master, certain parameters are not permitted. Masters that are not S7 masters do not support hardware interrupts. So all the parameters associated with these functions are deactivated. The deactivated parameters are hardware interrupt enable, hardware restrictions and end-of-scan-cycle interrupt enable. All the other parameters are permitted.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 1   Parameters of the SM 331; AI 8 x RTD

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Enable • Diagnostic interrupt • Hardware interrupt upon limit violation • Hardware interrupt at end of cycle	Yes/no Yes/no Yes/no	No No No	Dynamic	Module
Trigger for hardware interrupt • Upper limit value • Lower limit value	 32511 to −32512 −32512 to 32511	 32767 -32768	Dynamic	Channel
Diagnostics • Group diagnostics • With wire-break check	 Yes/no Yes/no	 No No	Static	Channel group

Table 1   Parameters of the SM 331; AI 8 x RTD, continued

Parameter	Value Range	Default Settings	Para-meter Type	Scope

Measurement
• Measuring Method
	Deactivated
	R-4L Resistance
	            (four-conductor connection)
	R-3L Resistance,
	            (three-conductor connection)
	RTD-4L Temperature resistor
	            (linear, four-conductor
	            connection)
	RTD-3L Temperature resistor
	            (linear, three-conductor
	            connection)
		RTD-4L	Dynamic	Channel group

• Measuring Range	Refer to the section on measuring ranges of the input channels that you can set.	Pt 100 climatic 0.003850 (IPTS-68)		
• Temperature unit	Degrees Celsius; degrees Fahrenheit	Degrees Celsius	Dynamic	Module
• Module filtering mode	8 channels hardware filter 8 channels software filter 4 channels hardware filter	8 channels, hardware filter	Dynamic	Module
• Temperature coefficient for temperature measurement with bulb resistor (RTD)	Platinum (Pt) 0.003850 $\Omega/\Omega/$ °C (IPTS-68) 0.003916 $\Omega/\Omega/$ °C 0.003902 $\Omega/\Omega/$ °C 0.003920 $\Omega/\Omega/$ °C 0.003850 $\Omega/\Omega/$ °C (ITS-90) 0.003910 $\Omega/\Omega/$ °C Nickel (Ni) 0.006170 $\Omega/\Omega/$ °C 0.006180 $\Omega/\Omega/$ °C 0.006720 $\Omega/\Omega/$ °C 0.005000 $\Omega/\Omega/$ °C (LG Ni 1000) Copper (Cu) 0.004260 $\Omega/\Omega/$ °C 0.004270 $\Omega/\Omega/$ °C 0.004280 $\Omega/\Omega/$ °C	0.003850	Dynamic	Channel group
• Interference suppression*	50/60/400 Hz; 400 Hz; 60 Hz; 50 Hz	50/60/400 Hz	Dynamic	Channel group
• Smoothing	None Low Average High	None	Dynamic	Channel group

*   50/60/400 Hz programmable only for modes 8 or 4-Channel Hardware Filter Modes;
    50 Hz, 60 Hz or 400 Hz programmable only for mode 8-Channel Hardware Filter Mode

Channel groups

The channels of the SM 331; AI 8 x RTD are arranged in four groups of two. You can only ever assign parameters to one channel group.

The table below shows which channels are parameterized as a channel group in each case. You will need the channel group number to set the parameters in the user program with an SFC.

Table 2   Assignment of Channels of the SM 331; AI 8 x RTD to Channel Groups

Channels ...	... form one Channel Group each
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

Special characteristic of channel groups for hardware interrupts upon limit violation

You can set the upper and lower limits for each channel with hardware interrupts in *STEP 7*.

Module filtering mode

The SM 331; AI 8 × RTD operates in one of the following modes:

- "Hardware filter, 8 channels"
- "Software filter, 8 channels"
- "Hardware filter, 4 channels"

The operating mode affects the scan time of the module.

"Hardware filter 8 channels" mode

In "Hardware filter 8 channels" mode, the analog input module SM331; AI 8 x RTD switches over between the two channels in each group. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6. Once the even-numbered channels have been converted all the ADCs simultaneously convert for the odd-numbered channels 1, 3, 5 and 7 (see Figure 2).

Figure 2   Hardware filter 8 channels scan time

Scan time of the module

In 8-channel hardware filter mode, the channel conversion time including the communication time of the analog input module SM 331; AI 8 x RTD is 84 ms. The module must then be switched over to the other channel in the group by means of opto-MOS relays. Opto-MOS relays need 16 ms to switch and settle. Each channel needs a time of 100 ms, so that the scan time is exactly 200 ms.

Scan time = $(t_K + t_U)$ x 2

Scan time = (84 ms + 16 ms) x 2

Scan time = <u>200 ms</u>

t_K: channel conversion time for one channel

t_U: time for switching to the other channel in the channel group

"Software filter 8 channels" mode

In "Software filter 8 channels" mode, the analog/digital conversion occurs in exactly the same way as in "hardware filter 8 channels" mode. That is to say, as the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6. Once the even-numbered channels are converted, all the ADCs convert simultaneously for the odd-numbered channels 1, 3, 5 and 7 (see Figure 3).
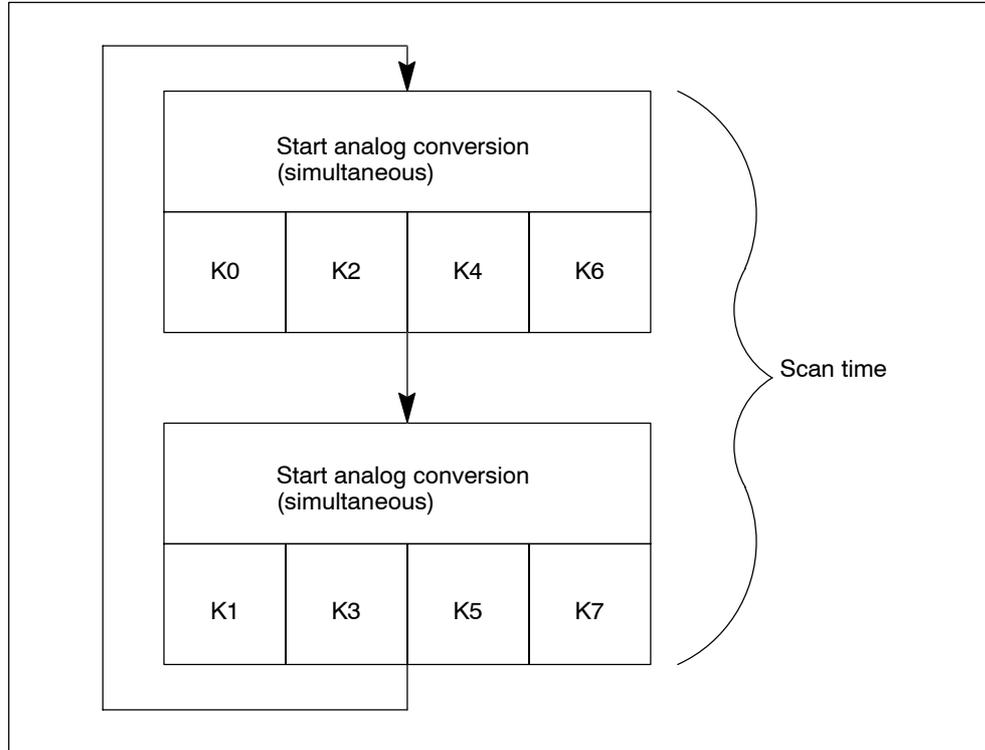
Figure 3   Software filter 8 channels scan time

Scan time of the module

The channel conversion time depends, however, on the programmed interference frequency suppression. When you set an interference frequency of 50 Hz, the channel conversion time including communication time is 32 ms. When you set an interference frequency of 60 Hz, the channel conversion time is 27 ms. When you set an interference frequency of 400 Hz, the channel conversion time is reduced to 9 ms. As with 8-channel hardware filter mode, the module must be switched over by means of opto MOS relays with a time of 16 ms for switching to the other channel of the group. This relationship is shown in the table that follows.

Table 3   Scan Times in "Software Filter, 8 Channels" Mode

Programmed Interference Frequency Suppression	Channel Scan Time*	Module Scan Time (All Channels)
50 Hz	48 ms	**96 ms**
60 Hz	43 ms	**86 ms**
400 Hz	25 ms	**50 ms**

* Channel scan time = channel conversion time + 16 ms switching time to the other channel in the channel group

Scan time in "Hardware Filter, 4 Channels" mode

In this mode, the module does not switch between the channels of the different groups. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6.
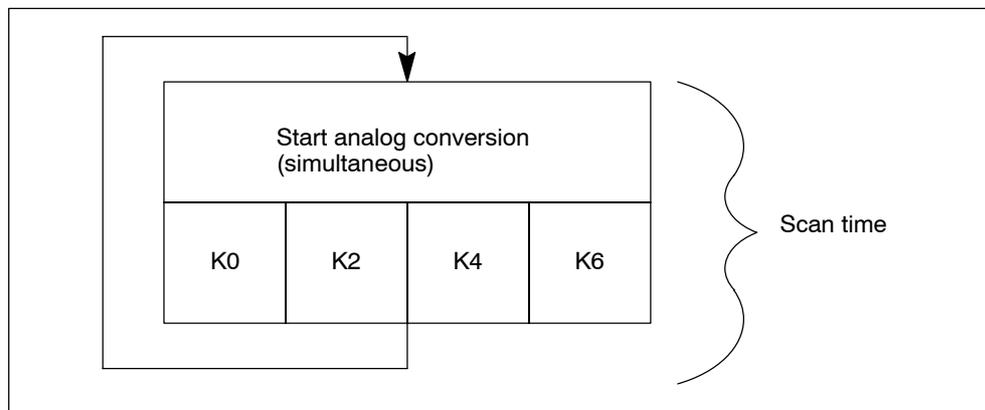
Figure 4   Hardware filter 4 channels scan time

Scan time of the module

In 4-channel hardware filter mode, the channel conversion time including the communication time of the analog input module SM 331; AI 8 x RTD is 10 ms. As the module does not switch over between the channels in a group, the channel scan time and the module scan time are the same: 10 ms.

Channel conversion time = channel scan time = module scan time = **10 ms**

Prolongation of the scan time with a wire-break check

The wire-break check is a hardware function of the module that is available in all operating modes.

In the 8-channel hardware and software filter operating modes, the scan time of the module is unchanged, irrespective of the number of channels for which wire-break has been enabled.

In the 4-channel hardware filter operating mode, the module interrupts processing of the input data 100 ms and performs a wire-break check. In other words, each wire-break check prolongs the scan time of the module by 100 ms.

Smoothing of the measured values

You fill find information that is generally applicable to the smoothing of analog values in Section 4.6 of the *SIMATIC Programmable Logic Controller S7-300 Module Data Reference Manual* .

Special characteristic with short-circuit to M or L

If you short an input channel to M or L, the module does not suffer any damage. The channel continues to issue valid data; neither is a diagnosis reported.

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Section 4.16 of the *SIMATIC Programmable Logic Controller S7-300 Module Data Reference Manual* .

Measuring Methods and Measuring Ranges of the SM 331; AI 8 x RTD

Measuring Methods

You can set the following measuring methods for the input channels:

- RTD 4-conductor measurement
- RTD 3-conductor measurement
- Resistor 4-conductor measurement
- Resistor 3-conductor measurement

You perform the setting with the "measuring method" parameter in *STEP 7*.

Unused Channels

Set the "measuring method" parameter for unused channels to "disabled". In this way you shorten the scan time of the module.

You must terminate an unused channel of an enabled channel group with a nominal resistance in order to avoid diagnostic errors for the unused channel (refer to the block diagram, Figure 1, for the connection).

In the "4-Channel Hardware Filter" operating mode, termination is not necessary provided that you have disabled the unused channel groups. Channels 1, 3, 5 and 7 are not monitored in this mode.

Measuring ranges

You perform setting of the measuring ranges with the "measuring range" parameter in *STEP 7*.

Table 4   Measuring ranges of the SM331; AI 8 x RTD

Method Selected	Measuring Range
Deactivated	Deactivated
Resistance, four-conductor connection	150 Ω 300 Ω 600 Ω
Resistance, three-conductor connection	150 Ω 300 Ω 600 Ω

Table 4   Measuring ranges of the SM331; AI 8 x RTD

Method Selected	Measuring Range
Thermal resistance +linearization four-conductor connection	Pt 100 Climatic
	Ni 100 Climatic
	Pt 100 Standard
	Ni 100 Standard
	Pt 500 Standard
	Pt 1000 Standard
	Ni 1000 Standard
	Pt 200 Climatic
	Pt 500 Climatic
	Pt 1000 Climatic
	Ni 1000 Climatic
	Pt 200 Standard
	Ni 120 Standard
	Ni 120 Climatic
	Cu 10 Climatic
	Cu 10 Standard
	Ni 200 Standard
	Ni 200 Climatic
	Ni 500 Standard
	Ni 500 Climatic
	Pt 10 GOST Climatic
	Pt 10 GOST Standard
	Pt 50 GOST Climatic
	Pt 50 GOST Standard
	Pt 100 GOST Climatic
	Pt 100 GOST Standard
	Pt 500 GOST Climatic
	Pt 500 GOST Standard
	Cu 10 GOST Climatic
	Cu 10 GOST Standard
	Cu 50 GOST Climatic
	Cu 50 GOST Standard
	Cu 100 GOST Climatic
	Cu 100 GOST Standard
	Ni 100 GOST Climatic
	Ni 100 GOST Standard

Method Selected	Measuring Range
Thermal resistance +linearization three-conductor connection	Pt 100 Climatic
	Ni 100 Climatic
	Pt 100 Standard
	Ni 100 Standard
	Pt 500 Standard
	Pt 1000 Standard
	Ni 1000 Standard
	Pt 200 Climatic
	Pt 500 Climatic
	Pt 1000 Climatic
	Ni 1000 Climatic
	Pt 200 Standard
	Ni 120 Standard
	Ni 120 Climatic
	Cu 10 Climatic
	Cu 10 Standard
	Ni 200 Standard
	Ni 200 Climatic
	Ni 500 Standard
	Ni 500 Climatic
	Pt 10 GOST Climatic
	Pt 10 GOST Standard
	Pt 50 GOST Climatic
	Pt 50 GOST Standard
	Pt 100 GOST Climatic
	Pt 100 GOST Standard
	Pt 500 GOST Climatic
	Pt 500 GOST Standard
	Cu 10 GOST Climatic
	Cu 10 GOST Standard
	Cu 50 GOST Climatic
	Cu 50 GOST Standard
	Cu 100 GOST Climatic
	Cu 100 GOST Standard
	Ni 100 GOST Climatic
	Ni 100 GOST Standard

End-of-scan-cycle interrupt

By enabling the end-of-scan-cycle interrupt, you can synchronize a process with the conversion cycle of the module. The interrupt occurs when the conversion of all the enabled channels is complete.

Table 5   Content of the 4 bytes with additional information from OB40 during a hardware interrupt or an end-of-scan-cycle interrupt

Content of the 4 bytes with additional information		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Byte
Special analog markers	**2 bits per channel to identify the range**									
	Upper limit exceeded in channel	7	6	5	4	3	2	1	0	0
	Lower limit exceeded in channel	7	6	5	4	3	2	1	0	1
	End-of-scan-cycle event						X			2
	Unassigned bit									3

Wiring Diagrams

Figure 5 shows the wiring diagrams for 4-wire and 3-wire sensor elements. When you use a 3-wire sensor, ensure you insert the jumper between M+ and I_c+. Incorrect wiring results in unpredictable module behavior.
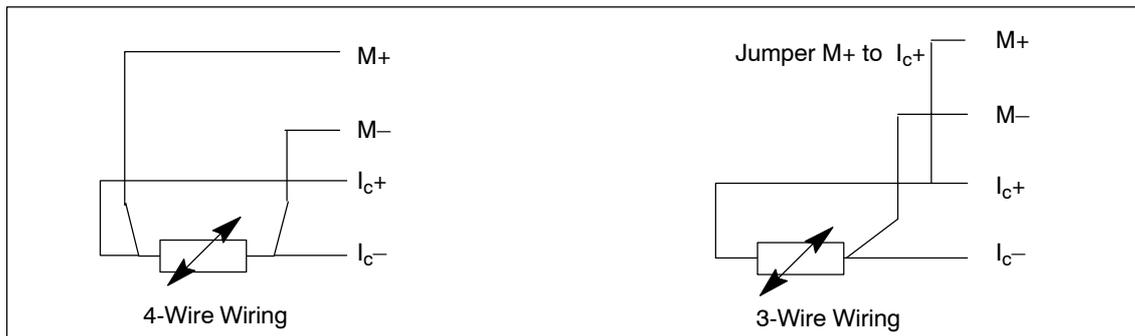
Figure 5   4-Wire and 3-Wire Wiring Diagram

Unused Input Channels

In order to reduce unnecessary wiring, use STEP 7 to deactivate unused channel groups of the SM331; AI $8 \times$ RTD module (see Table 1).

You must terminate an unused channel within an activated group to eliminate diagnostic errors for the unused input. Figure 5 shows how to attach a nominal resistor for the selected input range to terminate the unused input.

When you operate in the 4 Channel Hardware Module Mode, no channel termination is required if you deactivate the unused input channel groups. Channels 1, 3, 5 and 7 are not monitored during this module mode of operation.

Analog Value Representation of the Measuring Ranges of the Analog Input Module SM 331: AI 8 × RTD

Introduction

The tables in this section contain the digitized analog values for the various measuring ranges of the analog input module. See table 6 through table 17.

How to Read the Measured-Value Tables

Since the binary representation for the analog values is always the same, these tables only contain the measured values and the units.

Resistance-Type Sensors Measuring Ranges

Table 6 shows the representation of the digitized measured value for resistance-type sensors with the measuring ranges 150 Ω, 300 Ω, and 600 Ω.

Table 6   Analog Value Representation for Resistance Type Transmitters from 150 Ω to 600 Ω

System		Resistance-Type Transmitter Range			
Dec.	**Hex.**	**150 Ω**	**300 Ω**	**600 Ω**	
32767	7FFF	177.77 Ω	355.54 Ω	711.09 Ω	Overflow
32512	7F00	150.01 Ω	300.01 Ω	600.02 Ω	
32511	7EFF	176.38 Ω	352.77 Ω	705.53 Ω	Overrange
27649	6C01				
27648	6C00	150 Ω	300 Ω	600 Ω	
20736	5100	112.5 Ω	225 Ω	450 Ω	
1	1	5.43 mΩ	10.85 mΩ	21.70 mΩ	Rated range
0	0	0 Ω	0 Ω	0 Ω	
		(negative values physically not possible)			Underrange

Pt Standard Temperature Ranges

Table 7 shows the representation of the digitized measured value for the standard temperature range of the Pt 100, Pt 200, Pt 500 and Pt 1000 sensors. In addition, GOST Pt 0.003850 (ITS-90) 10, 50, 100, and 500 temperature ranges are represented.

Table 7   Analog value representation for RTD Resistance Temperature Detectors Pt 10, 50, 100, 200, 500, 1000

Pt x00 standard in °C (1 digit =0.1°C)	Units		Pt x00 standard in °F (1 digit =0.1 °F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 1000.0	32767	$7FFF_H$	> 1832.0	32767	$7FFF_H$	Overflow
1000.0 : 850.1	10000 : 8501	2710_H : 2135_H	1832.0 : 1562.1	18320 : 15621	4790_H : $3D05_H$	Overrange
850.0 : −200.0	8500 : −2000	2134_H : $F830_H$	1562.0 : −328.0	15620 : −3280	$3D04_H$: $F330_H$	Rated range
−200.1 : −243.0	−2001 : −2430	$F82F_H$: $F682_H$	−328.1 : −405.4	−3281 : −4054	$F32F_H$: $F02A_H$	Underrange
< −243.0	−32768	8000_H	< −405.4	−32768	8000_H	Underflow

Pt Climatic Temperature Ranges

Table 8 shows the representation of the digitized measured value for the climatic temperature range of the Pt 100, Pt 200, Pt 500 and Pt 1000 sensors. In addition, GOST Pt 10, 50, 100, and 500 temperature ranges are represented.

Table 8   Analog value representation for RTD Resistance Temperature Detectors Pt 10, 50, 100, 200, 500, 1000

Pt x00 climatic in °C (1 digit = 0.01°C)	Units		Pt x00 climatic in °F (1 digit = 0.01°F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
>155.00	32767	7FFF$_H$	>311.00	32767	7FFF$_H$	Overflow
155.00 : 130.01	15500 : 13001	3C8C$_H$: 32C9$_H$	311.00 : 266.01	31100 : 26601	797C$_H$: 67E9$_H$	Overrange
130.00 : −120.00	13000 : −12000	32C8$_H$: D120$_H$	266.00 : −184.00	26600 : −18400	67E8$_H$: B820$_H$	Rated range
−120.01 : −145.00	−12001 : −14500	D11F$_H$: C75C$_H$	−184.01 : −229.00	−18401 : −22900	B81F$_H$: A68C$_H$	Underrange
< −145.00	−32768	8000$_H$	< −229.00	−32768	8000$_H$	Underflow

Ni Standard Temperature Ranges

Table 9 shows the representation of the digitized measured value for the standard temperature range of the Ni 100, Ni 120, Ni 200, Ni 500 and Ni 1000 sensors.

Table 9   Analog value representation for RTD Resistance Temperature Detectors Ni100, 120, 200, 500, 1000, LG-Ni 1000

Ni x00 standard in °C (1 digit = 0.1°C)	Units		Ni x00 standard in °F (1 digit = 0.1°F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
>295.0	32767	7FFF$_H$	>563.0	32767	7FFF$_H$	Overflow
295.0 : 250.1	2950 : 2501	B86$_H$: 9C5$_H$	563.0 : 482.1	5630 : 4821	15FE$_H$: 12D5$_H$	Overrange
250.0 : −60.0	2500 : −600	9C4$_H$: FDA8$_H$	482.0 : −76.0	4820 : −760	12D4$_H$: FD08$_H$	Rated range
−60.1 : −105.0	−601 : −1050	FDA7$_H$: FBE6$_H$	−76.1 : −157.0	−761 : −1570	FD07$_H$: F9DE$_H$	Underrange
< −105.0	−32768	8000$_H$	< −157.0	−32768	8000$_H$	Underflow

Ni Climatic Temperature Ranges

Table 10 shows the representation of the digitized measured value for the standard temperature range of the Ni 100, Ni 120, Ni 200, Ni 500 and Ni 1000 sensors.

Table 10   Analog value representation for RTD Resistance Temperature Detectors Ni 100, 120, 200, 500, 1000, LG-Ni 1000

Ni x00 climatic in °C (1 digit = 0.01°C)	Units		Ni x00 climatic in °F (1 digit = 0.01°F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 295.00	32767	7FFF$_H$	>325.11	32767	7FFF$_H$	Overflow
295.00 : 250.01	29500 : 25001	733C$_H$: 61A9$_H$	327.66 : 280.01	32766 : 28001	7FFE$_H$: 6D61$_H$	Overrange
250.00 : −60.00	25000 : −6000	61A8$_H$: E890$_H$	280.00 : −76.00	28000 : −7600	6D60$_H$: E250$_H$	Rated range
−60.01 : −105.00	−6001 : −10500	E88F$_H$: D6FC$_H$	−76.01 : −157.00	−7601 : −15700	E24F$_H$: C2AC$_H$	Underrange
< −105.00	−32768	8000$_H$	< −157.00	−32768	8000$_H$	Underflow

Cu Standard Temperature Ranges

Table 11 shows the representation of the digitized measured value for the standard temperature range of the Cu 10 sensor.

Table 11   Analog Value Representation for RTD Resistance Temperature Detectors Cu 10

Cu 10 standard in °C (1 digit = 0.01°C)	Units		Cu 10 standard in °F (1 digit = 0.01°F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 312.0	32767	7FFF$_H$	>593.6	32767	7FFF$_H$	Overflow
312.0 : 260.1	3120 : 2601	C30$_H$: A29$_H$	593.6 : 500.1	5936 : 5001	1730$_H$: 12D5$_H$	Overrange
260.0 : −200.0	2600 : −2000	A28$_H$: F830$_H$	500.0 : −328.0	5000 : −3280	1389$_H$: F330$_H$	Rated range
−200.1 : −240.0	−2001 : −2400	F82F$_H$: F6A0$_H$	−328.1 : −400.0	−3281 : −4000	F32F$_H$: F060$_H$	Underrange
< −240.0	−32768	8000$_H$	< −400.0	−32768	8000$_H$	Underflow

Cu Climatic Temperature Ranges

Table 12 shows the representation of the digitized measured value for the climatic temperature range of the Cu 10 sensor. In addition, GOST Cu 10, 50, and 100 temperature ranges are represented.

Table 12   Analog Value Representation for RTD Resistance Temperature Detectors Cu 10, 50, 100

Cu 10 climatic in °C (1 digit = 0.01°C)	Units		Cu 10 climatic in °F (1 digit = 0.01°F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 180.00	32767	7FFF$_H$	>327.66	32767	7FFF$_H$	Overflow
180.00 : 150.01	18000 : 15001	4650$_H$: 3A99$_H$	327.66 : 280.01	32766 : 28001	7FFE$_H$: 6D61A$_H$	Overrange
150.00 : −50.00	15000 : −5000	3A98$_H$: EC78$_H$	280.00 : −58.00	28000 : −5800	6D60$_H$: E958$_H$	Rated range
−50.01 : −60.00	−5001 : −6000	EC77$_H$: E890H	−58.01 : −76.00	−5801 : −7600	E957$_H$: E250H	Underrange
< −60.00	−32768	8000$_H$	< −76.00	−32768	8000$_H$	Underflow

Pt 0.003910 GOST Standard Temperature Ranges

Table 13 shows the representation of the digitized measured value for the GOST standard temperature range of the Pt 10, 50, 100, 500 sensors.

Table 13   Analog value representation for GOST RTD Resistance Temperature Detectors Pt 10, 50, 100, 500

Pt x00 standard in °C (1 digit =0.1°C)	Units		Pt x00 standard in °F (1 digit =0.1°F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 1295.0	32767	7FFF$_H$	> 2363.0	32767	7FFF$_H$	Overflow
1295.0 : 1100.1	12950 : 11001	3296$_H$: 2AF9$_H$	2363.0 : 2012.1	23630 : 20121	5CE4$_H$: 4E99$_H$	Overrange
1100.0 : −260.0	11000 : −2600	2AF8$_H$: F5D8$_H$	2012.0 : −436.0	20120 : −4360	4E98$_H$: EEF8$_H$	Rated range
−260.1 : −273.2	−2601 : −2732	F5D7$_H$: F554$_H$	−436.1 : −459.7	−4361 : −4597	EEF7$_H$: EE0B$_H$	Underrange
< −273.2	−32768	8000$_H$	< −459.7	−32768	8000$_H$	Underflow

Ni GOST Standard Temperature Ranges

Table 14 shows the representation of the digitized measured value for the GOST standard temperature range of the Ni 100 sensor.

Table 14   Analog value representation for GOST RTD Resistance Temperature Detector Ni100

Ni 100 standard in °C (1 digit = 0.1°C)	Units		Ni 100 standard in °F (1 digit = 0.1°F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
>212.4	32767	$7FFF_H$	>414.3	32767	$7FFF_H$	Overflow
212.4 : 180.1	2124 : 1801	$084C_H$: 0709_H	414.3 : 356.1	4143 : 3561	$102F_H$: $0DE9_H$	Overrange
180.0 : −60.0	1800 : −600	0708_H : $FDA8_H$	356.0 : −76.0	3560 : −760	$0DE8_H$: $FD08_H$	Rated range
−60.1 : −105.0	−601 : −1050	$FDA7_H$: $FBE6_H$	−76.1 : −157.0	−761 : −1570	$FD07_H$: $F9DE_H$	Underrange
< −105.0	−32768	8000_H	< −157.0	−32768	8000_H	Underflow

Ni GOST Climatic Temperature Ranges

Table 15 shows the representation of the digitized measured value for the GOST climatic temperature range of the Ni 100 sensor.

Table 15   Analog value representation for GOST RTD Resistance Temperature Detector Ni 100

Ni 100 climatic in °C (1 digit = 0.1°C)	Units		Ni 100 climatic in °F (1 digit = 0.1°F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 212.40	32767	$7FFF_H$	>327.66	32767	$7FFF_H$	Overflow
212.40 : 180.01	21240 : 18001	$52F8_H$: 4651_H	327.66 : 280.01	32766 : 28001	$7FFE_H$: $6D61_H$	Overrange
180.00 : −60.00	18000 : −6000	4650_H : $E890_H$	280.00 : −76.00	28000 : −7600	$6D60_H$: $E250_H$	Rated range
−60.01 : −105.00	−6001 : −10500	$E88F_H$: $D6FC_H$	−76.01 : −157.00	−7601 : −15700	$E24F_H$: $C2AC_H$	Underrange
< −105.00	−32768	8000_H	< −157.00	−32768	8000_H	Underflow

Cu 0.00426 GOST Standard Temperature Ranges

Table 16 shows the representation of the digitized measured value for the GOST standard temperature range of the Cu 10, 50, 100, 500 sensors.

Table 16   Analog Value Representation for GOST RTD Resistance Temperature Detectors Cu 10, 50, 100, 500

Cu xx0 standard in °C (1 digit = 0.1°C)	Units		Cu xx0 standard in °F (1 digit = 0.01°F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 240.0	32767	7FFF$_H$	>464.0	32767	7FFF$_H$	Overflow
240.0 : 200.1	2400 : 2001	0960$_H$: 07D1$_H$	464.0 : 392.1	4640 : 3921	1220$_H$: 0F51$_H$	Overrange
200.0 : −50.0	2000 : −500	07D0$_H$: FE0C$_H$	392.0 : −58.0	3920 : −580	0F50$_H$: FDBC$_H$	Rated range
−50.1 : −60.0	−501 : −600	FE0B$_H$: FDA8$_H$	−58.1 : −76.0	−581 : −760	FDBB$_H$: FD08$_H$	Underrange
< −60.0	−32768	8000$_H$	< −76.0	−32768	8000$_H$	Underflow

Cu 0.00428 GOST Standard Temperature Ranges

Table 17 shows the representation of the digitized measured value for the GOST standard temperature range of the Cu 10, 50, 100, 500 sensors.

Table 17   Analog Value Representation for RTD Resistance Temperature Detectors Cu 10, 50, 100, 500

Cu xx0 standard in °C (1 digit = 0.1°C)	Units		Cu xx0 standard in °F (1 digit = 0.01°F)	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 240.0	32767	7FFF$_H$	>464.0	32767	7FFF$_H$	Overflow
240.0 : 200.1	2400 : 2001	0960$_H$: 07D1$_H$	464.0 : 392.1	4640 : 3921	1220$_H$: 0F51$_H$	Overrange
200.0 : −200.0	2000 : −2000	07D0$_H$: F830$_H$	392.0 : −328.0	3920 : −3280	0F50$_H$: F330$_H$	Rated range
−200.1 : −240.0	−2001 : −2400	F82F$_H$: F6A0$_H$	−328.1 : −405.4	−3281 : −4054	F32F$_H$: F02A$_H$	Underrange
< −240.0	−32768	8000$_H$	< −405.4	−32768	8000$_H$	Underflow

Parameter Sets for Analog Input Module SM 331; AI 8 × RTD

Parameter assignment in the user program

You have already assigned parameters to the modules in *STEP 7*.

In the user program, you can use a SFC:

- To reassign parameters to the module and

- To transfer the parameters from the CPU to the addressed modules

Parameters stored in data records

The parameters of the AI 8 x RTD module are located in data records 0 and 1; for some other analog input modules, in data record 128 as well.

Modifiable parameters

You can change the parameters of record 1 and pass them to the module using SFC 55. The parameters set on the CPU are not changed when you do this!

You cannot modify the parameters of data record 0 in the user program.

SFCs for parameter assignment

The following SFCs are available for assigning parameters to the AI 8 x RTD module in the user program:

Table 18   SFCs for assigning Parameters to Signal Modules

SFC No.	Identifier	Application
55	WR_PARM	Transfer modifiable parameters (data record 1 and 28) to the addressed signal module.
56	WR_DPARM	Transfer parameters (data record 0, 1 **or** 128) from the CPU to the addressed signal module.
57	PARM_MOD	Transfer all parameters (data record 0, 1 **and** 128) from the CPU to the addressed signal module.

Description of the parameters

The following sections contain **all** the modifiable parameters for the AI 8 x RTD module. The parameters of the AI 8 x RTD modules are described:

- In the on-line help of *STEP 7*

- In this Product Information document.

  You will find the parameters that can be adjusted for the signal module concerned in the specific sections for the different signal modules.

Parameters of Analog Input Module SM 331; AI 8 × RTD

Parameters

The table below contains all the parameters which you can set for analog input module SM 331; AI 8 x RTD.

You will see which parameters you can modify from the list:

- In *STEP 7*

- With SFC 55 "WR_PARM"

The parameters set with *STEP 7* can also be transferred with SFCs 56 and 57 to the module (refer to the *STEP 7* manuals).

Table 19   Parameters of the SM 331; AI 8 x RTD

Parameter	Data Record No.	Parameters can be assigned with ...	
		... SFC 55	... Programming Device
Diagnostics: Group diagnostics	0	No	Yes
Diagnostics: With wire-break check		No	Yes
Diagnostics interrupt enable	1	**Yes**	Yes
Limit value interrupt enable		**Yes**	Yes
Cycle end interrupt enable		**Yes**	Yes
Temperature unit		**Yes**	Yes
Measuring Method	128	**Yes**	Yes
Measuring Range		**Yes**	Yes
Module filtering mode		**Yes**	Yes
Temperature coefficient		**Yes**	Yes
Interference Suppression		**Yes**	Yes
Smoothing		**Yes**	Yes
Upper limit value		**Yes**	Yes
Lower limit value		**Yes**	Yes

Note

If you want to enable the diagnostic interrupt in the user program in data record 1, you must enable the diagnosis in data record 0 beforehand using *STEP 7*.

Structure of Data Record 1

Figure 6 shows the structure of data record 1 for the parameters of the Analog Input Module SM 331; AI 8 × RTD.

You can activate a parameter by setting the corresponding bit in byte 0 to "1".
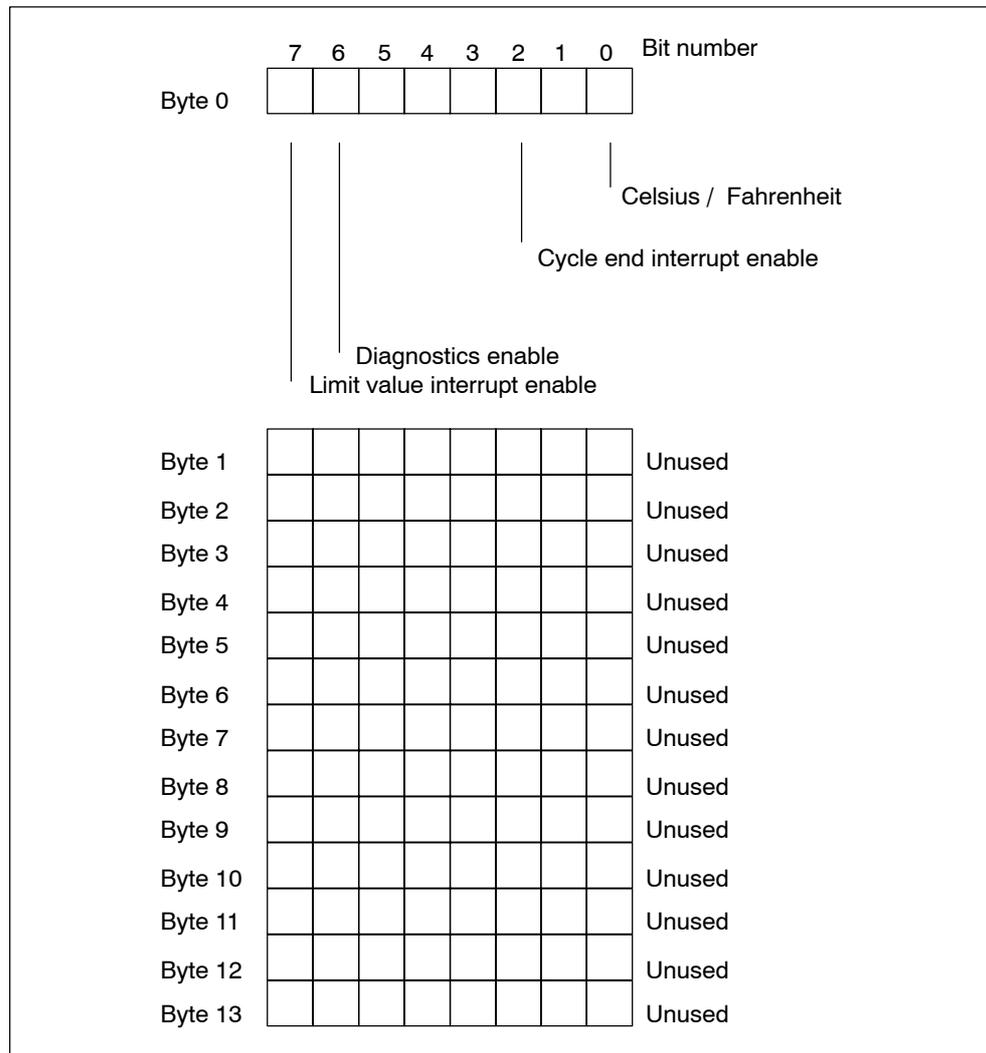
Figure 6   Data Record 1 for Parameters of the Analog Input Module SM 331; AI 8 × RTD

Structure of Data Record 128

Figure 7 shows the structure of data record 128 for the parameters of the Analog Input Module SM 331; AI 8 × RTD.
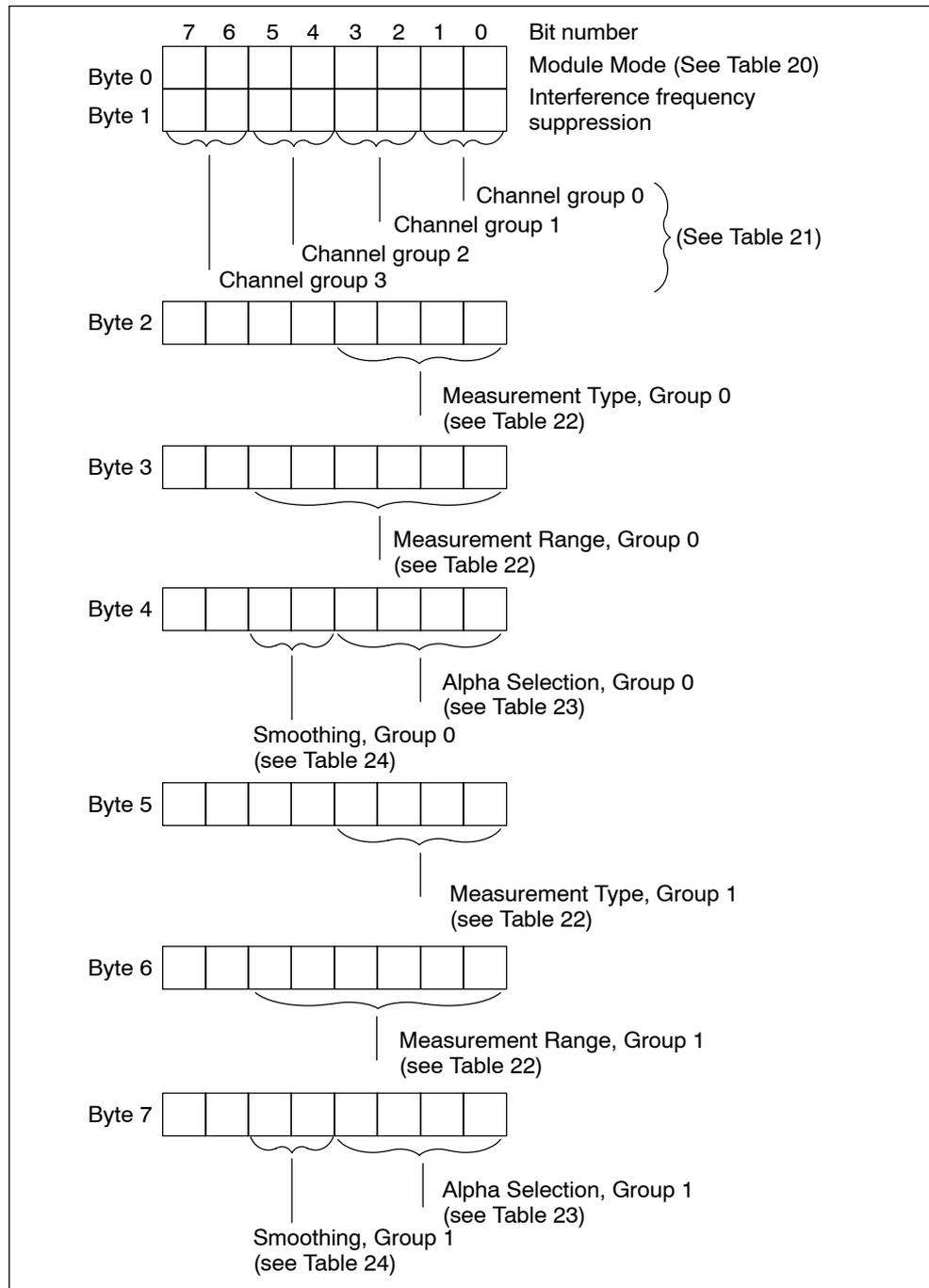
Figure 7   Data Record 128 for Parameters of the Analog Input Module
SM 331; AI 8 × RTD
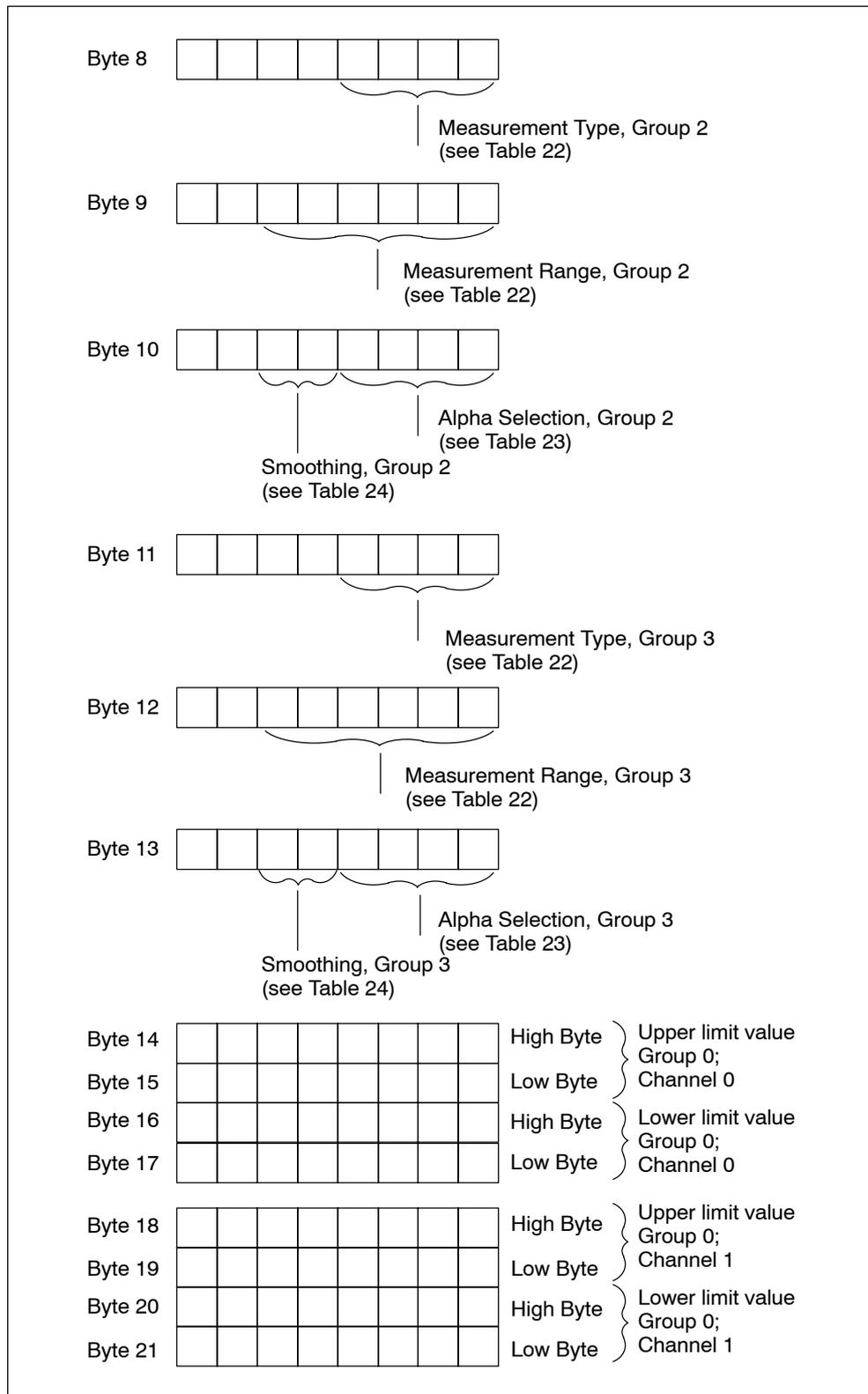
Figure 7   Data Record 128 for Parameters of the Analog Input Module SM 331; AI 8 × RTD
(continued)
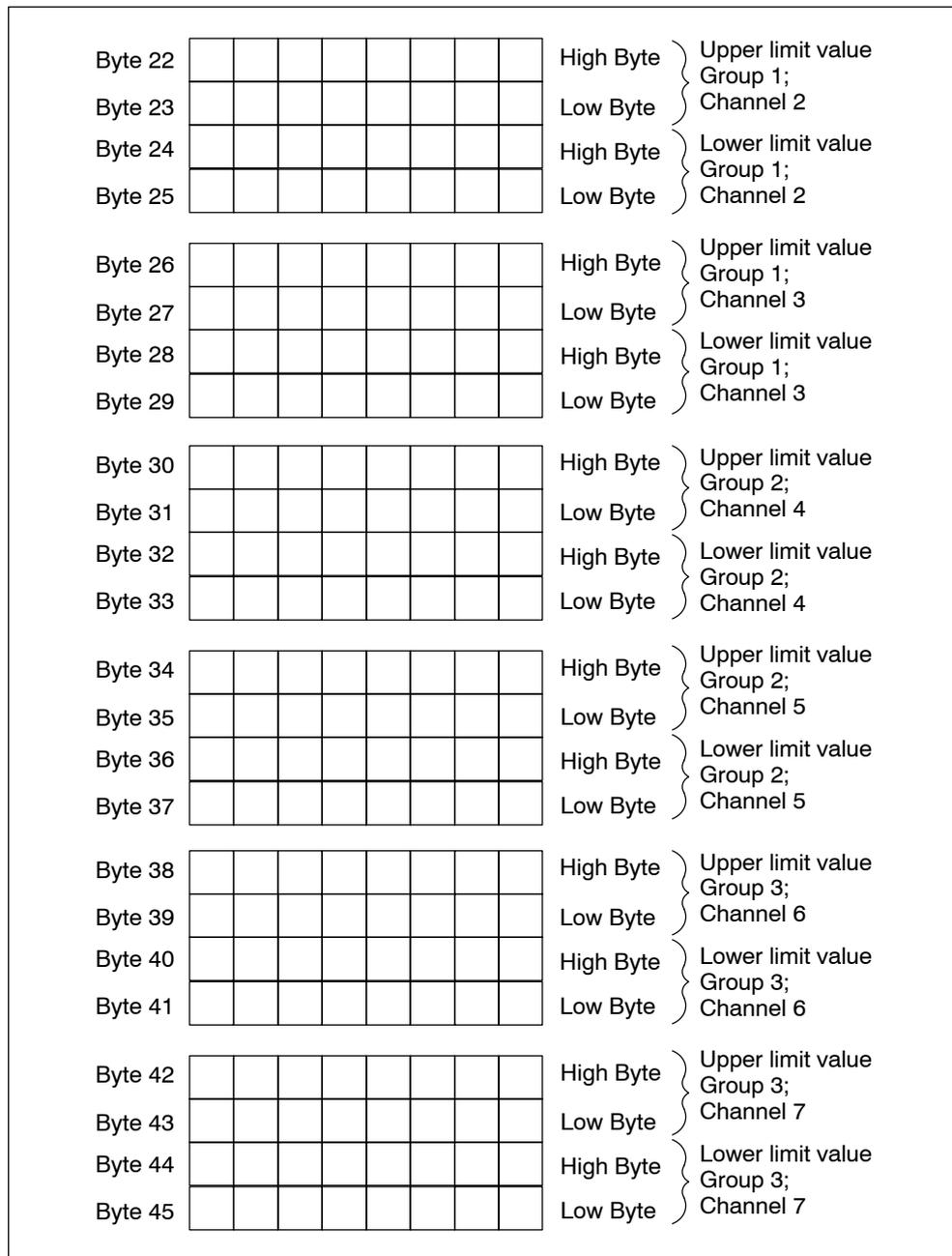
Figure 7   Data Record 128 for Parameters of the Analog Input Module SM 331; AI 8 × RTD
(continued)

The representation of the limit values matches the analog value representation.
Observe the range limits when setting the limit values.

Module Mode

Table 20 contains the codes for the various module operating modes that you enter in byte 0 of data record 128 (see Figure 7).

Table 20   Codes for the module modes of the Analog Input Module SM 331; AI 8 × RTD

Module Mode	Code
8 Channel Hardware Filtering	2#00000000
8 Channel Software Filtering	2#00000001
4 Channel Hardware Filtering	2#00000010

Interference Frequency Suppression

Table 21 contains the codes for the various frequencies that you enter in record 128 (see Figure 7). Note that the 50 Hz, 60 Hz, and 400 Hz selections are for the 8 Channel Software Filtering module mode only. The 50, 60, and 400 Hz selection is for the 8 Channel and 4 Channel Hardware Filtering module modes only.

Table 21   Codes for the Interference Frequency Suppression of Analog Input Module SM 331; AI 8 × RTD

Interference Frequency Suppression	Code
400 Hz	2#00
60 Hz	2#01
50 Hz	2#10
50, 60, and 400 Hz	2#11

Measurement Type and Measurement Range

Table 22 contains all the measuring ranges for the Analog Input Module SM 331; AI 8 × RTD. Table 22 also shows the codes for the measurement types and the measuring range. You must enter these codes, according to the measuring range desired, in the appropriate bytes of data record 128 (see Figure 7).

Table 22   Measuring ranges of the SM331; AI 8 x RTD

Method Selected	Code (Hex)	Measuring Range	Code (Hex)
Deactivated	0x0	Deactivated	0x00
Resistance, four-conductor connection	0x4	150 Ω 300 Ω 600 Ω	0x02 0x04 0x06
Resistance, three-conductor connection	0x5	150 Ω 300 Ω 600 Ω	0x02 0x04 0x06

Table 22   Measuring ranges of the SM331; AI 8 x RTD

Method Selected	Code (Hex)	Measuring Range	Code (Hex)
Thermal resistance +linearization four-conductor connection	0x8	Pt 100 Climatic	0x00
		Ni 100 Climatic	0x01
		Pt 100 Standard	0x02
		Ni 100 Standard	0x03
		Pt 500 Standard	0x04
		Pt 1000 Standard	0x05
		Ni 1000 Standard	0x06
		Pt 200 Climatic	0x07
		Pt 500 Climatic	0x08
		Pt 1000 Climatic	0x09
		Ni 1000 Climatic	0x0A
		Pt 200 Standard	0x0B
		Ni 120 Standard	0x0C
		Ni 120 Climatic	0x0D
		Cu 10 Climatic	0x0E
		Cu 10 Standard	0x0F
		Ni 200 Standard	0x10
		Ni 200 Climatic	0x11
		Ni 500 Standard	0x12
		Ni 500 Climatic	0x13
		Pt 10 GOST Climatic	0x14
		Pt 10 GOST Standard	0x15
		Pt 50 GOST Climatic	0x16
		Pt 50 GOST Standard	0x17
		Pt 100 GOST Climatic	0x18
		Pt 100 GOST Standard	0x19
		Pt 500 GOST Climatic	0x1A
		Pt 500 GOST Standard	0x1B
		Cu 10 GOST Climatic	0x1C
		Cu 10 GOST Standard	0x1D
		Cu 50 GOST Climatic	0x1E
		Cu 50 GOST Standard	0x1F
		Cu 100 GOST Climatic	0x20
		Cu 100 GOST Standard	0x21
		Ni 100 GOST Climatic	0x22
		Ni 100 GOST Standard	0x23

Method Selected	Code (Hex)	Measuring Range	Code (Hex)
Thermal resistance +linearization three-conductor connection	0x9	Pt 100 Climatic	0x00
		Ni 100 Climatic	0x01
		Pt 100 Standard	0x02
		Ni 100 Standard	0x03
		Pt 500 Standard	0x04
		Pt 1000 Standard	0x05
		Ni 1000 Standard	0x06
		Pt 200 Climatic	0x07
		Pt 500 Climatic	0x08
		Pt 1000 Climatic	0x09
		Ni 1000 Climatic	0x0A
		Pt 200 Standard	0x0B
		Ni 120 Standard	0x0C
		Ni 120 Climatic	0x0D
		Cu 10 Climatic	0x0E
		Cu 10 Standard	0x0F
		Ni 200 Standard	0x10
		Ni 200 Climatic	0x11
		Ni 500 Standard	0x12
		Ni 500 Climatic	0x13
		Pt 10 GOST Climatic	0x14
		Pt 10 GOST Standard	0x15
		Pt 50 GOST Climatic	0x16
		Pt 50 GOST Standard	0x17
		Pt 100 GOST Climatic	0x18
		Pt 100 GOST Standard	0x19
		Pt 500 GOST Climatic	0x1A
		Pt 500 GOST Standard	0x1B
		Cu 10 GOST Climatic	0x1C
		Cu 10 GOST Standard	0x1D
		Cu 50 GOST Climatic	0x1E
		Cu 50 GOST Standard	0x1F
		Cu 100 GOST Climatic	0x20
		Cu 100 GOST Standard	0x21
		Ni 100 GOST Climatic	0x22
		Ni 100 GOST Standard	0x23

Resistance-type Thermometer Alpha Selection

Table 23 contains all the alpha selections for the resistance-type thermometer measuring range of the Analog Input Module SM 331; AI 8 × RTD. You must enter these codes, according to the measuring range desired, in the appropriate bytes of data record 128 (see Figure 7).

Table 23   Codes for the Alpha Selection of the Analog Input Module SM 331; AI × 8 RTD

Alpha Selection	Code
Pt 0.003850 Ω/Ω/°C (IPTS-68)	2#0000
Pt 0.003916 Ω/Ω/°C	2#0001
Pt 0.003902 Ω/Ω/°C	2#0010
Pt 0.003920 Ω/Ω/°C	2#0011
Pt 0.003850 Ω/Ω/°C (ITS-90)	2#0100
Pt 0.003910 Ω/Ω/°C	2#0101
Ni 0.006170 Ω/Ω/°C	2#0111
Ni 0.006180 Ω/Ω/°C	2#1000
Ni 0.006720 Ω/Ω/°C	2#1001
Ni 0.005000 Ω/Ω/°C (LG Ni 1000)	2#1010
Cu 0.004260 Ω/Ω/°C	2#1011
Cu 0.004270 Ω/Ω/°C	2#1100
Cu 0.004280 Ω/Ω/°C	2#1101

Input Smoothing Selection

Table 24 contains all the smoothing selections for the Analog Input Module SM 331; AI 8 × RTD. You must enter these codes, according to the measuring range desired, in the appropriate bytes of data record 128 (see Figure 7).

Table 24   Codes for the Smoothing Selection of the Analog Input Module SM 331; AI 8 RTD

Smoothing Selection	Code
None	2#00
Weak	2#01
Medium	2#10
Strong	2#11

SIEMENS

Product Information

SIMATIC S7-300

Analog Input Module SM 331; AI 8 × TC as of Version $\frac{X|2}{3|4}$

New Analog Input Module Available

The S7-300 Analog Input Module SM 331; AI 8 × TC has been added to the S7-300 family. The order number for this module is 6ES7 331-7PF11-0AB0.

This product information includes details about the characteristics and technical specifications of analog input module SM 331; AI 8 × TC. Refer to the *S7-300 Installation and Hardware Manual* for more information about the S7-300 product family.

You will also learn:

- How to start up the analog input module
- The measuring ranges available for the analog input module
- How to configure the analog input module

Additional Assistance

For assistance in answering technical questions, for training on this product, or for ordering, contact your Siemens distributor or sales office.

Characteristic Features and Technical Specifications of the Analog Input Module SM 331; AI 8 × TC

Order No.

   6ES7 331-7PF11-0AB0

Characteristics

The analog input module SM 331; AI 8 x TC has the following features:

- 8 differential inputs for thermocouples (TC) in 4 channel groups
- Optional setting of the thermocouple type per channel group
- Rapid measured value updating for up to 4 channels
- Measured-value resolution 15 bits + sign (independent of integration time)
- Programmable diagnostics
- Programmable diagnostic interrupt
- 8 channels with limit monitoring
- Programmable hardware interrupt when limit has been exceeded
- Programmable end-of-scan-cycle interrupt
- Programmable reaction to open thermocouple
- Isolated against the backplane bus interface
- Fully compatible with predecessor module 6ES7 331-7PF10-0AB0
- Added support for Russian GOST thermocouple characteristics, TXK/XK(L)

Use of the module in the distributed peripheral ET 200M

When you use the SM 331; AI 8 x TC in the distributed peripheral ET 200M, you must have one of the following IM 153-x:

- IM 153-1; as of 6ES7153-1AA03-0XB0, E 01
- IM 153-2; as of 6ES7153-2AA02-0XB0, E 05
- IM 153-2; as of 6ES7153-2AB01-0XB0, E 04

Terminal connection diagram and block diagram of the SM 331; AI 8 x TC
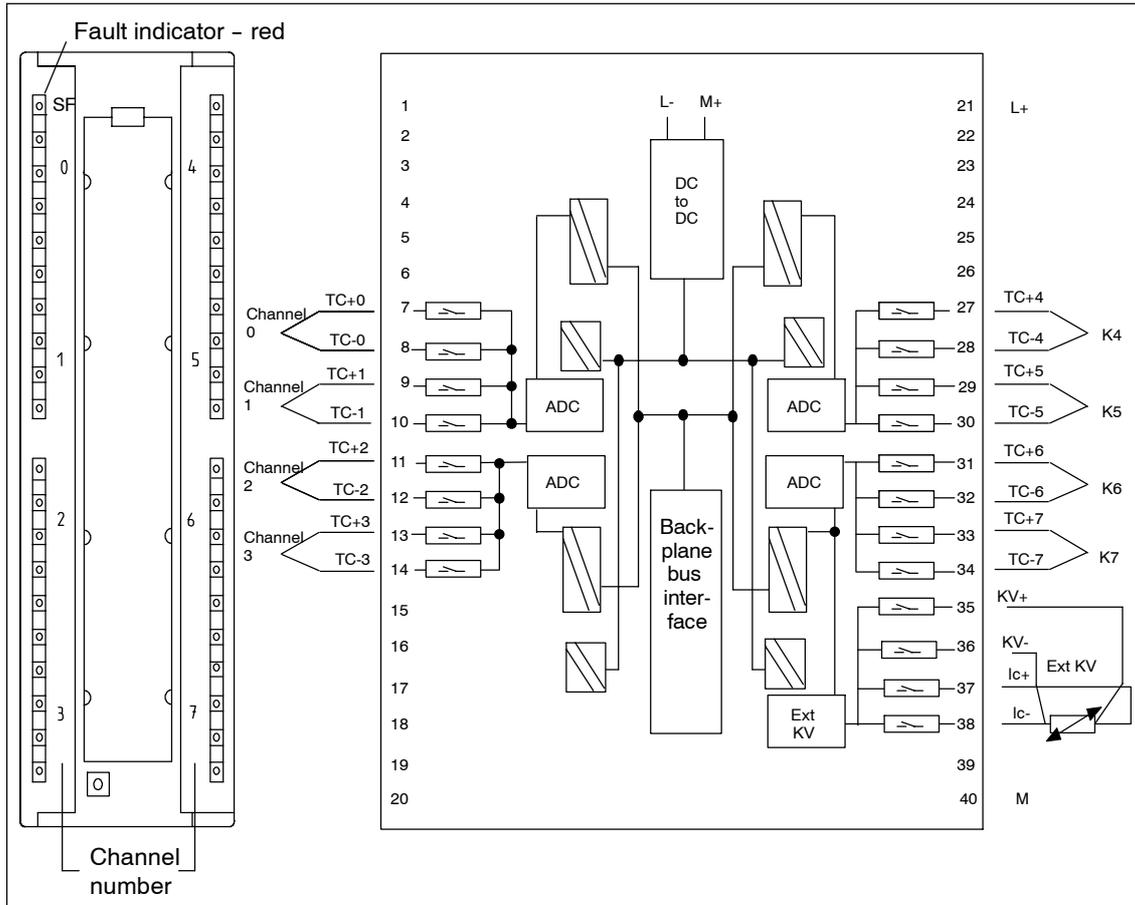
Figure 1   Module View and Block Diagram of the SM 331; AI 8 x TC

Technical specifications of the SM 331; AI 8 x TC

Dimensions and Weight	
Dimensions W x H x D (in millimeters)	40 x 125 x 117
Weight	Approx. 272 g
Data for Specific Module	
Supports clocked operation	No
Length of cable	
• Shielded	max. 100 m
Voltages, Currents, Potentials	
Power rated voltage of the electronics L+	24 VDC
• Reverse polarity protection	Yes
Constant measured current for resistance-type sensor	typ. 0.7 mA
Isolation	
• Between channels and backplane bus	Yes
• Between channels and power supply of the electronics	Yes
• Between the channels	Yes
In groups of	2
Permitted potential difference	
• Between the inputs (U_{CM})	75 VDC / 60 VAC
• Between M_{ANA} and $M_{internal}$ (U_{ISO})	75 VDC / 60 VAC
Insulation tested with	500 VDC
Current consumption	
• From the backplane bus	max. 100 mA
• From supply voltage L+	max. 240 mA
Power dissipation of the module	typ. 3.0 W

Analog value generation	
Measuring principle	Integrating
Module filtering mode	**8 channels, hardware**
Integration time/conversion time/ resolution (per channel)	
• Programmable	Yes
• Basic conversion time in ms	95
• Additional conversion time for open-circuit monitoring, in ms	4
• Resolution including sign	16 bits
• Noise suppression for interference frequency f1 in Hz	400/60/50
Smoothing of the measured values	None / low/ average/ high
Basic response time of module (all channels enabled)	190 ms
Module filtering mode	**8 channels, software**
Integration time/conversion time/ resolution (per channel)	
• Programmable	Yes
• Basic conversion time in ms	23/72/83
• Additional conversion time for open-circuit monitoring, in ms	4
• Resolution including sign	16 bits
• Noise suppression for interference frequency f1 in Hz	400/60/50
Smoothing of the measured values	None / low/ average/ high
Basic response time of module (all channels enabled)	46/144/166 ms

<table>
<tr><td colspan="2" align="center">Analog Value Generation (Cont'd)</td></tr>
</table>

Measuring principle	Integrating
Module filtering mode	**4 channels, hardware**

Integration time/conversion time/ resolution (per channel)

• Programmable	Yes
• Basic conversion time in ms	1.0
• Additional conversion time for open-circuit monitoring, in ms	93 [1]
• Resolution including sign	16 bits
• Noise suppression for frequency f1 in Hz	400/60/50
Smoothing of the measured values	None / low/ average/ high
Basic response time of module (all channels enabled)	10 ms

<table>
<tr><td colspan="2" align="center">Suppression of interference, Limits of Error</td></tr>
</table>

Noise suppression for $f = n \times$ (f1 ± 1%), (f1 = interference frequency) n = 1.2, etc.

• Common-mode interference (U_{cm} < 60 VAC)	> 100 dB
• Series-mode interference (peak value of interference < rated value of input range)	> 90 dB [2]
Crosstalk between the inputs	> 100 dB

Operational limit (over entire temperature range, referred to 0 to 60 °C input range) Note: This limit does not cover the error cold connection point[3]

• Thermocouple

Type T	-200 °C to	+400 °C	±0.7 °C
	-230 °C to	-200 °C	±1.5 °C
Type U	-150 °C to	+600 °C	±0.9 °C
	-200 °C to	-150 °C	±1.2 °C
Type E	-200 °C to	+1000 °C	±1.2 °C
	-230 °C to	-200 °C	±1.5 °C
Type J	-150 °C to	+1200 °C	±1.4 °C
	-210 °C to	-150 °C	±1.7 °C
Type L	-150 °C to	+900 °C	±1.5 °C
	-200 °C to	-150 °C	±1.8 °C
Type K	-150 °C to	+1372 °C	±2.1 °C
	-220 °C to	-150 °C	±2.9 °C
Type N	-150 °C to	+1300 °C	±2.2 °C
	-200 °C to	-150 °C	±3.0 °C
Type R	+100 °C to	+1769 °C	±1.5 °C
	-50 °C to	+100 °C	±1.8 °C
Type S	+100 °C to	+1769 °C	±1.7 °C
	-50 °C to	+100 °C	±2.0 °C
Type B [4]	+800 °C to	+1820 °C	±2.3 °C
	+200 °C	+800 °C	±3.8 °C
Type C	+100 °C to	+2315 °C	±2.3 °C
	0 °C	+100 °C	±2.5 °C
Type	-150 °C to	+800 °C	±1.0 °C
Txk/xk(L)	-200 °C	-150 °C	±1.5 °C

Basic error (operational limit at 25°C, referred to input range)

• Thermocouple

Type T	-200 °C to	+400 °C	±0.5 °C
	-230 °C to	-200 °C	±1.0 °C
Type U	-150 °C to	+600 °C	±0.5 °C
	-200 °C to	-150 °C	±1.0 °C
Type E	-200 °C to	+1000 °C	±0.5 °C
	-230 °C to	-200 °C	±1.0 °C
Type J	-150 °C to	+1200 °C	±0.5 °C
	-210 °C to	-150 °C	±1.0 °C
Type L	-150 °C to	+900 °C	±0.5 °C
	-200 °C to	-150 °C	±1.0 °C
Type K	-150 °C to	+1372 °C	±0.5 °C
	-220 °C to	-150 °C	±1.0 °C
Type N	-150 °C to	+1300 °C	±0.5 °C
	-200 °C to	-150 °C	±1.0 °C
Type R	+100 °C to	+1769 °C	±0.5 °C
	-50 °C to	+100 °C	±1.0 °C
Type S	+100 °C to	+1769 °C	±0.5 °C
	-50 °C to	+100 °C	±1.0 °C
Type B [4]	+800 °C to	+1820 °C	±1.0 °C
	+200 °C to	+800 °C	±2.0 °C
Type C	+100 °C to	+2315 °C	±0.5 °C
	0 °C	+100 °C	±1.0 °C
Type	-150 °C to	+800 °C	±0.5 °C
Txk/xk(L)	-200 °C	-150 °C	±1.0 °C

			Data for Selecting a Sensor		
Temperature error (with reference to the input range)	±0.005%/K		Input ranges (rated values)/ input resistance		
Linearity error (with reference to the input range)	± 0.02%		• Thermocouples	Type B, C, N, E, R, S, J, L, T, K, U, Txk/xk(L)	
Repeat accuracy (in the steady state at 25 °C, referred to the output range 3)	±0.01%		Maximum input voltage for voltage input (destruction limit)	20 VDC continuous; 75 VDC for max. 1 s (duty factor 1:20)	
Status, interrupts, diagnostics			Characteristic linearization	Programmable	
Interrupts			Temperature compensation	Programmable	
• Hardware interrupt	Programmable (channels 0 to 7)		• Internal temperature compensation	Possible	
• Diagnostic interrupt	Programmable		• External temperature compensation with Pt 100 (0.003850)	Possible	
Diagnostic functions	Programmable		• Compensation for 0°C comparison point temperature	Possible	
• Group error display	Red LED (SF)		• Compensation for 50°C comparison point temperature	Possible	
• Diagnostics information read-out	Possible		• Technical unit for temperature measurement	Degrees Celsius/ degrees Fahrenheit	

[1] Open-circuit monitoring in 4 channels, Hardware operating mode is performed every 3 seconds.

[2] Series-mode rejection in 8 channels, software mode is reduced as follows:

50 Hz > 70 dB

60 Hz > 70 dB

400 Hz > 80 dB

[3] The operational limit comprises only the basic error of the analog input at Ta = 25 °C and the total temperature error. The total error must cover the error for the compensation of the cold connection point. Internal compensation of the cold connection point = max. 1.5 °C
External compensation of the cold connection point = accuracy +0.1 °C of the used external RTD. External compensation of the cold connection point, where the connection point is held at 0 °C or 50 °C = accuracy of the connection point temperature control.

[4] Because of the slight rise over the range of approx. 0 °C to 85 °C, the lack of compensation of the comparison point temperature only has a negligible effect on a type B thermocouple. If there is no compensation and the measuring method "Compensation to 0 °C" is set, the deviation in the type B thermocouple duringtemperature measurement is: 200 °C to 1802 °C <0.5 °C

Commissioning the SM 331; AI 8 × TC

You set the mode of operation of the SM 331; AI 8 x TC bits in *STEP 7*.

Parameter

You will find a description of the general procedure for assigning parameters to analog modules in Section 4.7 of the *SIMATIC Programmable Logic Controllers S7–300 Module Data Manual*.

Parameterization restrictions when using the analog input module SM 331; AI 8 x TC with PROFIBUS masters that only support DPV0.

When you use the analog input module SM 331; AI 8 x TC in an ET 200M PROFIBUS slave system with a PROFIBUS master which is not an S7 master, certain parameters are not permitted. Masters that are not S7 masters do not support hardware interrupts. So all the parameters associated with these functions are deactivated. The deactivated parameters are hardware interrupt enable, hardware restrictions and end-of-scan-cycle interrupt enable. All the other parameters are permitted.

An overview of the parameters that you can set and their default settings are shown in the table below.

Table 1   Parameters of the SM 331; AI 8 x TC

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Enable • Diagnostic interrupt • Hardware interrupt upon limit violation • Hardware interrupt at end of cycle	Yes/no Yes/no Yes/no	No No No	Dynamic	Module
Trigger for hardware interrupt • Upper limit value • Lower limit value	 32511 to –32512* –32512 to 32511*	 32767 -32768	Dynamic	Channel
Diagnostics • Group diagnostics • With wire-break check	 Yes/no Yes/no	 No No	Static	Channel group

* These values are within overrange and underrange limits. See Tables 7 through 17.

Table 1   Parameters of the SM 331; AI 8 x TC, continued

Parameter	Value Range	Default Settings	Para-meter Type	Scope
Measurement • Measuring Method	Deactivated TC-IL Thermocouple (linear, internal comparison) TC-EL Thermocouple (linear, external comparison) TC-L00C Thermocouple (linear, ref. temperature 0°C) TC-L50C Thermocouple (linear, ref. temperature 50°C)	TC-IL	Dynamic	Channel group
• Measuring Range	For the settable measuring ranges of the input channels, please refer to the individual module description.	Type K		
• Reaction to open thermocouple	Overflow; underflow	Overflow		
• Temperature unit	Degrees Celsius; degrees Fahrenheit	Degrees Celsius	Dynamic	Module
• Module filtering mode	8 channels hardware filter 8 channels software filter 4 channels hardware filter	8 channels, hardware filter	Dynamic	Module
• Interference suppression*	50/60/400 Hz; 400 Hz; 60 Hz; 50 Hz;	50/60/400 Hz	Dynamic	Channel group
• Smoothing	None Low Average High	None	Dynamic	Channel group

*   50/60/400 Hz programmable only for modes 8 or 4-Channel Hardware Filter Modes;
    50 Hz, 60 Hz or 400 Hz programmable only for mode 8-Channel Hardware Filter Mode

Channel groups

The channels of the SM 331; AI 8 x TC are arranged in four groups of two. You can only ever assign parameters to one channel group.

The table below shows which channels are parameterized as a channel group in each case. You will need the channel group number to set the parameters in the user program with an SFC.

Table 2   Assignment of Channels of the SM 331; AI 8 x TC to Channel Groups

Channels ...	... form one Channel Group each
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

Special characteristic of channel groups for hardware interrupts upon limit violation

You can set the upper and lower limits for each channel with hardware interrupts in *STEP 7*.

Module filtering mode

The SM 331; AI 8 x TC operates in one of the following modes:

- "Hardware filter, 8 channels"
- "Software filter, 8 channels"
- "Hardware filter, 4 channels"

The operating mode affects the scan time of the module.

"Hardware filter 8 channels" mode

In 8-channel hardware filter mode, the analog input module SM331; AI 8 x TC switches over between the two channels in each group. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6. Once the even-numbered channels have been converted all the ADCs simultaneously convert for the odd-numbered channels 1, 3, 5 and 7 (see Figure 2).

Figure 3   Hardware filter 8 channels scan time

Scan time in the mode

In 8-channel hardware filter mode, the channel conversion time including the communication time of analog input module SM331; AI 8 x TC is 91 ms. The module must then be switched over to the other channel in the group by means of opto-MOS relays. Opto-MOS relays need 7 ms to switch and settle. Each channel needs a time of 98 ms, so that the scan time is exactly 196 ms.

Scan time = $(t_K + t_U)$ x 2

Scan time = (91 ms + 7 ms) x 2

Scan time = <u>196 ms</u>

t_K: channel conversion time for one channel
t_U: time for switching to the other channel in the channel group

"Software filter 8 channels" mode

In 8-channel software filter mode, the analog input module SM331; AI 8 x TC switches over between the two channels in each group. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6. Once the even-numbered channels have been converted all the ADCs simultaneously convert for the odd-numbered channels 1, 3, 5 and 7 (see Figure 4).
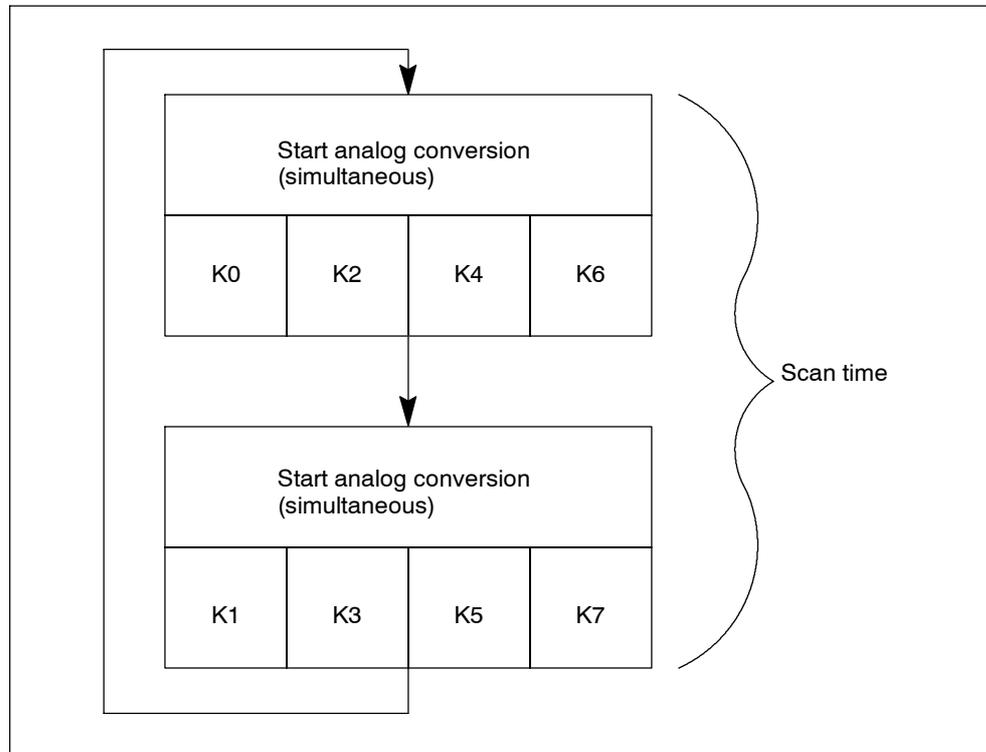

Figure 4   Software filter 8 channels scan time

Scan time of the module

In the 8-channel software filter mode of analog input module SM331; AI 8 x TC, the channel conversion time is guided by the interference frequency set. When you set an interference frequency of 50 Hz, the channel conversion time including communication time is 76 ms. When you set an interference frequency of 60 Hz, the channel conversion time is 65 ms. When you set an interference frequency of 400 Hz, the channel conversion time is reduced to 16 ms. As with 8-channel hardware filter mode, the module must be switched over by means of opto MOS relays with a switchover time of 7 ms to the other channel of the group. Table 3 shows the scan time of the module at a certain interference frequency.

Table 3　　Scan Times in "Software Filter, 8 Channels" Mode

Programmed Interference Frequency Suppression	Channel Scan Time*	Module Scan Time (All Channels)
50 Hz	83 ms	**166 ms**
60 Hz	72 ms	**144 ms**
400 Hz	23 ms	**46 ms**

* Channel scan time = channel conversion time + 7 ms switching time to the other channel in the channel group

"Hardware filter 4 channels" mode

In 4-channel hardware filter mode, the analog input module SM331; AI 8 x TC does not switch over between the channels of the individual groups. As the module contains four analog/digital converters (ADC), all four of the ADCs convert simultaneously for channels 0, 2, 4 and 6.

Figure 5　　Hardware filter 4 channels scan time

Scan time of the module

In 4-channel hardware filter mode, the channel conversion time including the communication time of analog input module SM331; AI 8 x TC is 10 ms. As the module does not switch over between the channels in a group, the channel scan time and the module scan time are the same: 10 ms.

Channel conversion time = channel scan time = module scan time = **10 ms**

Prolongation of the scan time with a wire-break check

The wire-break check is a software function of the module that is available in all operating modes.

In the 8-Channel Hardware and Software Filter operating mode prolongs the scan time of the module by 4 ms, irrespective of the number of channels for which wire-break has been enabled.

In the 4-Channel Hardware Filter operating mode, the module interrupts processing of the input data 170 ms and performs a wire-break check. In other words, each wire-break check prolongs the scan time of the module by 93 ms.

Smoothing of the measured values

You fill find information that is generally applicable to the smoothing of analog values in Section 4.6 of the *SIMATIC Programmable Logic Controllers S7–300 Module Data Manual*.

Special characteristic with short-circuit to M or L

If you short an input channel to M or L, the module does not suffer any damage. The channel continues to issue valid data; neither is a diagnosis reported.

Diagnostics

You will find the diagnostic messages that are grouped under the "group diagnosis" parameter in Table 4–46, on page 4–72 of the *SIMATIC Programmable Logic Controllers S7–300 Module Data Manual*.

Connecting Thermocouples

Design of thermocouples

A thermocouple consists of a pair of sensors and the necessary installation and connecting parts. The thermocouple consists of two wires of dissimilar metals or metal alloys soldered or welded together at the ends.

There are different types of thermocouple, depending on the composition of the material used – for example, K, J, N thermocouples. The measuring principle of all thermocouples is the same, irrespective of their type.
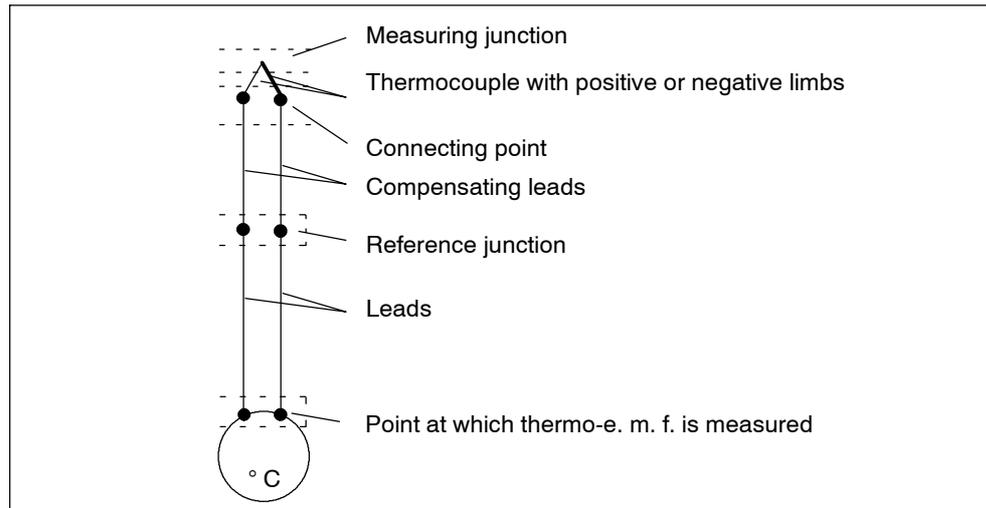
Figure 6   Design of Thermocouples

Principle of Operation of Thermocouples

If the measuring point is subjected to a temperature different from that of the free ends of the thermocouple (point of connection), a voltage, the thermo emf, occurs at the free ends. The magnitude of the thermo-e.m.f. generated depends on the difference between the temperature at the measuring junction and the temperature at the free ends, as well as on the material combination used for the thermocouple.

Since a thermocouple always measures a temperature difference, the free ends must be kept at a known temperature at a reference junction in order to determine the temperature of the measuring junction.

The thermocouples can be extended from their point of connection to the reference junction by means of compensating wires. These compensating wires consist of the same material as the thermocouple wires. The supply leads are copper wire. **Note:** Make sure these wires are connected with the correct polarity, otherwise there will be considerable measuring errors.

Compensation of the reference junction temperature

You can compensate for the effects of temperature fluctuations at the reference junction by means of compensating leads.

There are several options for you to choose from for acquiring the reference junction temperature in order to obtain an absolute temperature value from the difference in temperature between the reference junction and measuring point.

You can use internal or external compensation, depending on where you want the reference junction to be.

Table 4   Options for Compensation of the Reference Junction Temperature

Option	Explanation
No compensation	If you want to acquire only the difference in temperature between the measuring point and the reference junction.
Internal compensation (refer to Figure 7 for connection)	If you employ internal compensation, the internal temperature (thermocouple internal comparison) of the module is used for comparison purposes.
External compensation with resistance thermometer for acquisition of the reference junction temperature (refer to Figure 8 and LEERER MERKERfor connection)	You can acquire the reference temperature by means of a resistance thermometer and have it calculated by the module for any thermocouple.

Theory of operation of internal compensation

With internal compensation, you can establish the reference point across the terminals of the analog input modules. In this case, you must run the compensating lines right up to the analog module. The internal temperature sensor acquires the temperature of the module and supplies a compensation voltage.

Note that internal compensation is not as accurate as external compensation.

Abbreviations and mnemonics used in the figures below

The abbreviations and mnemonics used in the figures below have the following meanings:

M +:	Measuring lead (positive)
M−:	Measuring lead (negative)
I_C+:	Positive connection of constant current output
I_C-:	Negative connection of constant current output
$COMP_+$:	Compensating terminal (positive)
$COMP_-$:	Compensating terminal (negative)
M_{ANA}:	Reference potential of the analog measuring circuit
M :	Ground terminal
L +:	Terminal for 24 VDC supply voltage
P5V:	Module logic power supply
KV +/KV −:	Connections to the shunt comparison

Note

The necessary connecting cables, which result from the potential connection of the analog input module and the sensors, are not drawn in the figures shown below.

Connection of thermocouples with internal compensation

Connect the thermocouples to the inputs of the module, either directly or by means of compensating lines. Each channel group can use a thermocouple type supported by the analog module independently of the other channel groups.
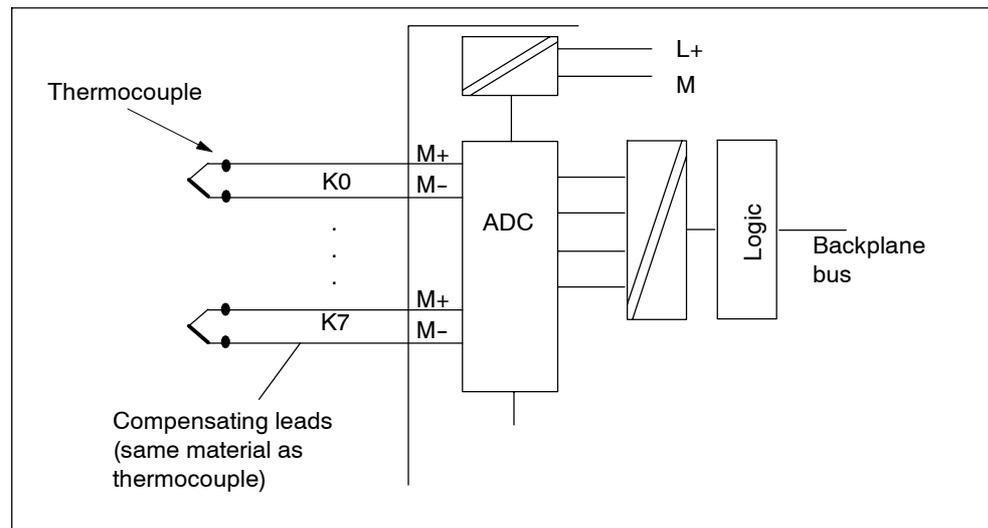
Figure 7   Connection of Thermocouples with Internal Compensation to an Isolated AI

Connecting thermocouples with temperature compensation to the SM 331; AI 8 x TC

All 8 inputs are available as measurement channels when the thermocouples are connected via reference junctions that are controlled at 0 °C or 50 °C.
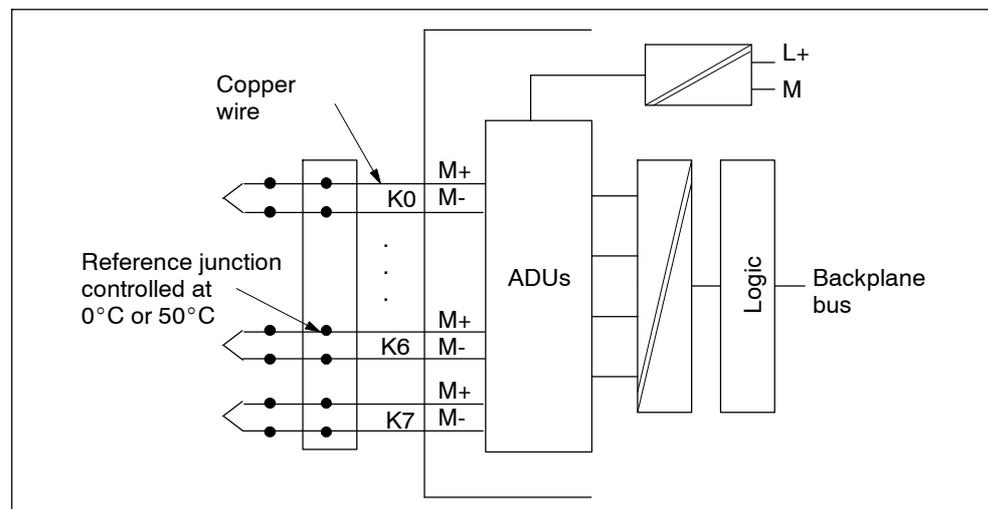
Figure 8   Connecting thermocouples via a reference junction to the SM 331; AI 8 x TC

Connecting thermocouples with resistance thermometer to the SM 331; AI 8 x TC

With this type of compensation, the reference junction terminal temperature is determined by a bulb resistor sensor with a temperature range of -25 °C to 85 °C.
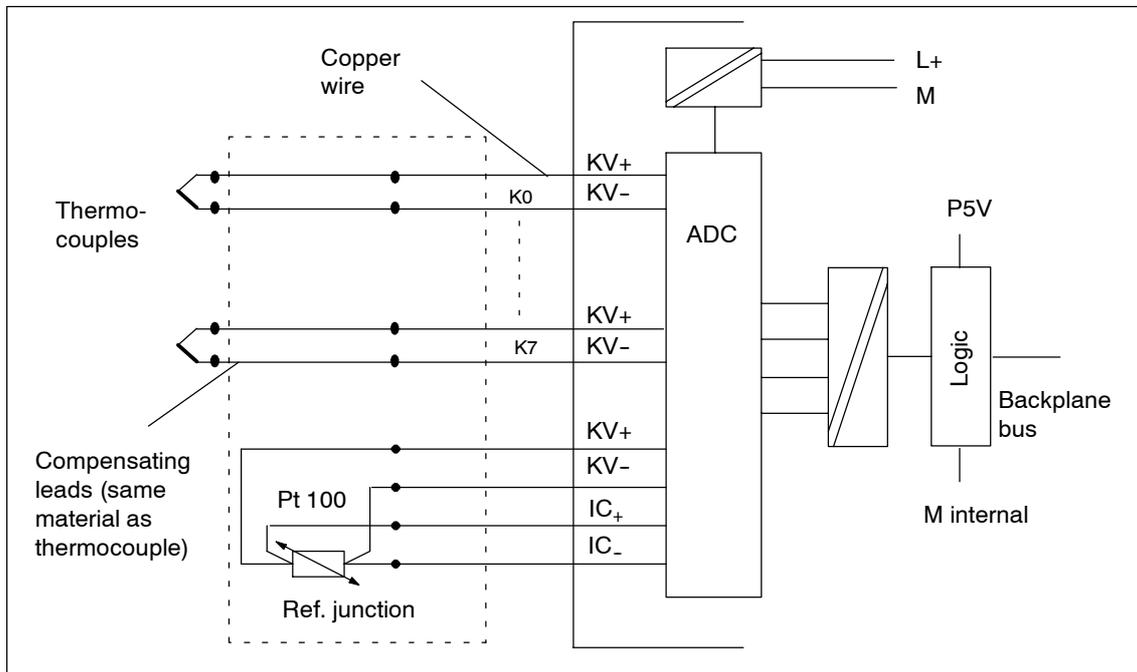

Figure 9   Connecting thermocouples with external compensation via resistance thermometers to the SM 331; AI 8 x TC

Measuring Methods and Measuring Ranges of the Analog Input Module SM 331; AI 8 × TC

Measuring Methods

You can set the following measuring methods for the input channels:

- Thermocouple, linearization with reference temperature 0 °C
- Thermocouple, linearization with reference temperature 50 °C
- Thermocouples, linearization with internal comparison
- Thermocouple, linearization with external comparison

You perform the setting with the "measuring method" parameter in *STEP 7*.

Unused Channels

Set the "measuring method" parameter for unused channels to "disabled". In this way you shorten the scan time of the module.

You must terminate an unused channel in an enabled channel group to avoid diagnostic errors for the unused channel. To do this, short the Plus input and Minus input of the channel.

In the "4-Channel Hardware Filter" operating mode, termination is not necessary provided that you have disabled the unused channel groups. Channels 1, 3, 5 and 7 are not monitored in this mode.

Measuring ranges

You perform setting of the measuring ranges with the "measuring range" parameter in *STEP 7*.

Table 5   Measuring Ranges of the SM331; AI 8 x TC

Method Selected	Measuring Range	Description
TC-L00C: (thermocouple, linear, reference temperature 0 °C) TC-L50C: (thermocouple, linear, reference temperature 50 °C) TC-IL: (thermocouple, linear, internal compensation) TC-EL: (thermocouple, linear, external compensation)	Type B Type C Type E Type J Type K Type L Type N Type R Type S Type T Type U Type Txk/xk(l)	You will find the digitized analog values in Section 4.3.1 in the temperature range of the *SIMATIC Programmable Logic Controllers S7–300 Module Data Manual*

End-of-scan-cycle interrupt

By enabling the end-of-scan-cycle interrupt, you can synchronize a process with the conversion cycle of the module. The interrupt occurs when the conversion of all the enabled channels is complete.

Table 6   Content of the 4 bytes with additional information from OB40 during a hardware interrupt or an end-of-scan-cycle interrupt

Content of the 4 bytes with additional information		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Byte
Analog special markers	2 bits per channel to identify the range									
	Upper limit exceeded in channel	7	6	5	4	3	2	1	0	0
	Lower limit exceeded in channel	7	6	5	4	3	2	1	0	1
	End-of-scan-cycle event						X			2
	Unassigned byte									3

Analog Value Representation of the Measuring Ranges of the Analog Input Module SM 331: AI 8 × TC

Introduction

The tables in this section contain the digitized analog values for the various measuring ranges of the analog input module. See Table 7 through Table LEERER MERKER.

How to Read the Measured-Value Tables

Since the binary representation for the analog values is always the same, these tables only contain the measured values and the units.

Analog value representation for thermocouples type B

Table 7   Analog value representation for thermocouples type B

| Type B in °C | Units | | Type B in °F | Units | | Range |
	decimal	hexa-decimal		decimal	hexa-decimal	
>2070.0	32767	7FFF$_H$	>3276.6	32767	7FFF$_H$	Overflow
2070.0 : 1821.0	20700 : 18210	50DC$_H$: 4722$_H$	3276.6 : 2786.6	32766 : 27866	7FFE$_H$: 6CDA$_H$	Overrange
1820.0 : 0.0	18200 : 0	4718$_H$: 0000$_H$	2786.5 : 32.0	27865 : 320	6CD9$_H$: 0140$_H$	Rated range
: -120.0	: -1200	: FB50$_H$	: -184.0	: -1840	: F8D0$_H$	Underrange
< -120.0	-32768	8000$_H$	< -184.0	-32768	8000$_H$	Underflow

Analog Value Representation for Thermocouples type C

Table 8   Analog value representation for thermocouples type C

Type C in °C	Units		Type C in °F	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
>2500.0	32767	7FFFH	>3276.6	32767	7FFFH	Overflow
2500.0 : 2315.1	25000 : 23151	61A8$_H$: 5A6F$_H$	3276.6 : 2786.6	32766 : 27866	7FFE$_H$: 6CDA$_H$	Overrange
2315.0 : 0.0	23150 : 0	5A6E$_H$: 0000$_H$	2786.5 : 32.0	27865 : 320	6CD9$_H$: 0140$_H$	Rated range
0.1 : −120.0	−1 : −1200	FFFF$_H$: FB50$_H$	31.9 : −184.0	319 : −1840	013F$_H$: F8D0$_H$	Underrange
< −120.0	−32768	8000$_H$	< −184.0	−32768	8000$_H$	Underflow

Analog Value Representation for Thermocouples type E

Table 9   Analog value representation for thermocouples type E

Type E in °C	Units		Type E in °F	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 1200.0	32767	7FFF$_H$	> 2192,0	32767	7FFF$_H$	Overflow
1200.0 : 1000.1	12000 : 10001	2EE0$_H$: 2711$_H$	2192.0 : 1833.8	21920 : 18338	55A0$_H$: 47A2$_H$	Overrange
1000.0 : −270.0	10000 : −2700	2710$_H$: F574$_H$	1832.0 : −454.0	18320 : −4540	4790$_H$: EE44$_H$	Rated range
< −270.0	< −2700	<F574$_H$	< −454.0	< −4540	<EE44$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...						
... of F0C4$_H$ and outputs 8000$_H$.			... of FB70$_H$ and outputs 8000$_H$.			

Analog Value Representation for Thermocouples type J

Table 10   Analog value representation for thermocouples type J

Type J in °C	Units decimal	Units hexa-decimal	Type J in °F	Units decimal	Units hexa-decimal	Range
> 1450.0	32767	7FFF$_H$	> 2642,0	32767	7FFF$_H$	Overflow
1450.0 : 1201.0	14500 : 12010	38A4$_H$: 2EEA$_H$	2642.0 : 2193.8	26420 : 21938	6734$_H$: 55B2$_H$	Overrange
1200.0 : −210.0	12000 : −2100	2EE0$_H$: F7CC$_H$	2192.0 : −346.0	21920 : −3460	55A0$_H$: F27C$_H$	Rated range
< −210.0	< −2100	<F7CC$_H$	< −346.0	< −3460	<F27C$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...						
... of F31C$_H$ and outputs 8000$_H$.			... of EA0C$_H$ and outputs 8000$_H$.			

Analog value representation for thermocouples type K

Table 11   Analog value representation for thermocouples type K

Type K in °C	Units decimal	Units hexa-decimal	Type K in °F	Units decimal	Units hexa-decimal	Range
> 1622.0	32767	7FFF$_H$	>2951.6	32767	7FFF$_H$	Overflow
1622.0 : 1373.0	16220 : 13730	3F5C$_H$: 35A2$_H$	2951.6 : 2503.4	29516 : 25034	734C$_H$: 61CA$_H$	Overrange
1372.0 : −270.0	13720 : −2700	3598$_H$: F574$_H$	2501.6 : −454.0	25061 : −4540	61B8$_H$: EE44$_H$	Rated range
< −270.0	< −2700	< F574$_H$	< −454.0	< −4540	<EE44$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...						
... of F0C4$_H$ and outputs 8000$_H$.			... of E5D4$_H$ and outputs 8000$_H$.			

Analog value representation for thermocouples type L

Table 12   Analog value representation for thermocouples type L

Type L in °C	Units		Type L in °F	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
>1150.0	32767	7FFF$_H$	>2102.0	32767	7FFF$_H$	Overflow
1150.0 : 901.0	11500 : 9010	2CEC$_H$: 2332$_H$	2102.0 : 1653.8	21020 : 16538	521C$_H$: 409A$_H$	Overrange
900.0 : −200.0	9000 : −2000	2328$_H$: F830$_H$	1652.0 : −328.0	16520 : −3280	4088$_H$: F330$_H$	Rated range
< −200.0	< −2000	< F830$_H$	< −328.0	< −3280	<F330$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...						
... of F380$_H$ and outputs 8000$_H$.			... of EAC0$_H$ and outputs 8000$_H$.			

Analog Value Representation for Thermocouples type N

Table 13   Analog value representation for thermocouples type N

Type N in °C	Units		Type N in °F	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
> 1550.0	32767	7FFF$_H$	>2822.0	32767	7FFF$_H$	Overflow
1550.0 : 1300.1	15500 : 13001	3C8C$_H$: 32C9$_H$	2822.0 : 2373.8	28220 : 23738	6E3C$_H$: 5CBA$_H$	Overrange
1300.0 : −270.0	13000 : −2700	32C8$_H$: F574$_H$	2372.0 : −454.0	23720 : −4540	5CA8$_H$: EE44$_H$	Rated range
< −270.0	< −2700	< F574$_H$	< −454.0	< −4540	<EE44$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...						
... of F0C4$_H$ and outputs 8000$_H$.			... of E5D4$_H$ and outputs 8000$_H$.			

Analog Value Representation for Thermocouples type R, S

Table 14   Analog value representation for thermocouples type R, S

Types R, S in °C	Units		Types R, S in °F	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
>2019.0	32767	7FFF$_H$	>3276.6	32767	7FFF$_H$	Overflow
2019.0 : 1770.0	20190 : 17770	4EDE$_H$: 4524$_H$	3276.6 : 3218.0	32766 : 32180	7FFE$_H$: 7DB4$_H$	Overrange
1769.0 : −50.0	17690 : −500	451A$_H$: FE0C$_H$	3216.2 : −58.0	32162 : −580	7DA2$_H$: FDBC$_H$	Rated range
−51.0 : −170.0	−510 : −1700	FE02$_H$: F95C$_H$	−59.8 : −274.0	−598 : −2740	FDAA$_H$: F54C$_H$	Underrange
< −170.0	−32768	8000$_H$	< −274.0	−32768	8000$_H$	Underflow

Analog Value Representation for Thermocouples type T

Table 15   Analog value representation for thermocouples type T

Type T in °C	Units		Type T in °F	Units		Range
	decimal	hexa-decimal		decimal	hexa-decimal	
>540.0	32767	7FFF$_H$	>1004.0	32767	7FFF$_H$	Overflow
540.0 : 401.0	5400 : 4010	1518$_H$: 0FAA$_H$	1004.0	10040	2738$_H$	Overrange
400.0 : −270.0	4000 : −2700	0FA0$_H$: F574$_H$	752.0 : −454.0	7520 : −4540	1D60$_H$: EE44$_H$	Rated range
< −270.0	< −2700	<F574$_H$	< −454.0	< −4540	<EE44$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...						
... of F0C4$_H$ and outputs 8000$_H$.			... of E5D4$_H$ and outputs 8000$_H$.			

Analog Value Representation for Thermocouples type U

Table 16   Analog value representation for thermocouples type U

Type U in °C	Units decimal	Units hexa-decimal	Type U in °F	Units decimal	Units hexa-decimal	Range
>850.0	32767	7FFF$_H$	>1562.0	32767	7FFF$_H$	Overflow
850.0 : 601.0	8500 : 6010	2134$_H$: 177A$_H$	1562.0 : 1113.8	15620 : 11138	2738.0$_H$: 2B82$_H$	Overrange
600.0 : –200.0	6000 : –2000	1770$_H$: F830$_H$	1112.0 : –328.0	11120 : –3280	2B70$_H$: F330$_H$	Rated range
< –200.0	< –2000	<F830$_H$	< –328.0	< –3280	<F330$_H$	Underflow
In the case of incorrect wiring (e. g. polarity reversal or open inputs) or of a sensor error in the negative range (e. g. incorrect thermocouple type), the analog input module signals underflow ...						
... of F380$_H$ and outputs 8000$_H$.			... of EAC0$_H$ and outputs 8000$_H$.			

Analog Value Representation for Thermocouples type TXK/XKL GOST

Table 17   Analog value representation for thermocouples type TXK/XKL GOST

Type TXK/XKL in °C	Units decimal	Units hexa-decimal	Type TXK/XKL in °F	Units decimal	Units hexa-decimal	Range
>1050.0	32767	7FFFH	>1922.0	32767	7FFFH	Overflow
1050.0 : 800.1	10500 : 8001	2904$_H$: 1F41$_H$	1922.0 : 1472.1	19220 : 14721	4B14$_H$: 3981$_H$	Overrange
800.0 : 0.0 : –200.0	8000 : 0 : –2000	1F40$_H$: 0000$_H$: F830$_H$	1472.0 : 32.0 : –328.0	14720 : 320 : –3280	3980$_H$: 0140$_H$: F330$_H$	Rated range
< –200.0	–32768	8000$_H$	< –328.0	–32768	8000$_H$	Underflow

Parameter Sets for Analog Input Module SM 331; AI 8×TC

Parameter Assignment in the User Program

You have already set the parameters for the S7-300 module using STEP 7. You can use an SFC in the user program to change the AI 8×TC module dynamic parameters. You can also use an SFC in the user program to transfer the parameters from the CPU to the addressed module.

Parameters Stored in Data Records

The parameters for the AI 8×TC module are stored in three data records: records 0, 1 and 128.

Modifiable Parameters

You can change the parameters of record 1 and/or record 128 and pass them to the AI 8×TC module using SFC 55. This does not change the parameters set on the CPU. You cannot change the S7-300 parameters of record 0 in the user program.

The following section shows an overview of the parameters that are stored in records 0, 1, and 128 for the AI 8×TC module.

SFCs for Parameter Assignment

The following SFCs are available for assigning the parameters for the AI 8×TC module in the user program.

Table 18   SFCs for Assigning Module Parameters

SFC No.	Identifier	Application
55	WR_PARM	Transfer modifiable parameters (record 1 and 128) to the addressed signal module.
56	WR_DPARM	Transfer parameters (records 0, 1 or 128) from the CPU to the addressed signal module.
57	PARM_MOD	Transfer all parameters (records 0, 1, and 128) from the CPU to the addressed signal module.

Description of the Parameters

The following section contains all the modifiable parameters for the AI 8×TC module.

The parameters for the AI 8×TC module are described in this Product Information document and in the online help of STEP 7.

Parameters of Analog Input Module SM 331; AI 8 × TC

Parameters

Table 19 contains all the parameters that you can set for the Analog Input Module SM 331; AI 8 × TC. The comparison shows:

- Parameters you can change using STEP 7.
- Parameters you can change using SFC 55 "WR_PARM".

The parameters you set using STEP 7 can also be transferred to the module using SFCs 56 and 57.

Table 19   Parameters for the Analog Input Module SM 331; AI 8 × TC

Parameter	Data Record No.	Configurable with...	
		...SFC 55	...Programming Device
Diagnostics: Group	0	No	Yes
Diagnostics: with wire-break	0	No	Yes
Limit value interrupt enable	1	Yes	Yes
Diagnostic interrupt enable	1	Yes	Yes
End of cycle interrupt enable	1	Yes	Yes
Measurement units	1	Yes	Yes
Module Mode	128	Yes	Yes
Interference frequency suppression	128	Yes	Yes
Measurement type	128	Yes	Yes
Measurement range	128	Yes	Yes
Measurement smoothing	128	Yes	Yes
Measurement TC burnout	128	Yes	Yes
Upper limit value	128	Yes	Yes
Lower limit value	128	Yes	Yes
Note: Before you can enable the diagnostic interrupt in record 1 in the user program, you must first enable the diagnostics in record 0 with STEP 7.			

Structure of Data Record 1

Figure 10 shows the structure of data record 1 for the parameters of the Analog Input Module SM 331; AI 8 × TC.

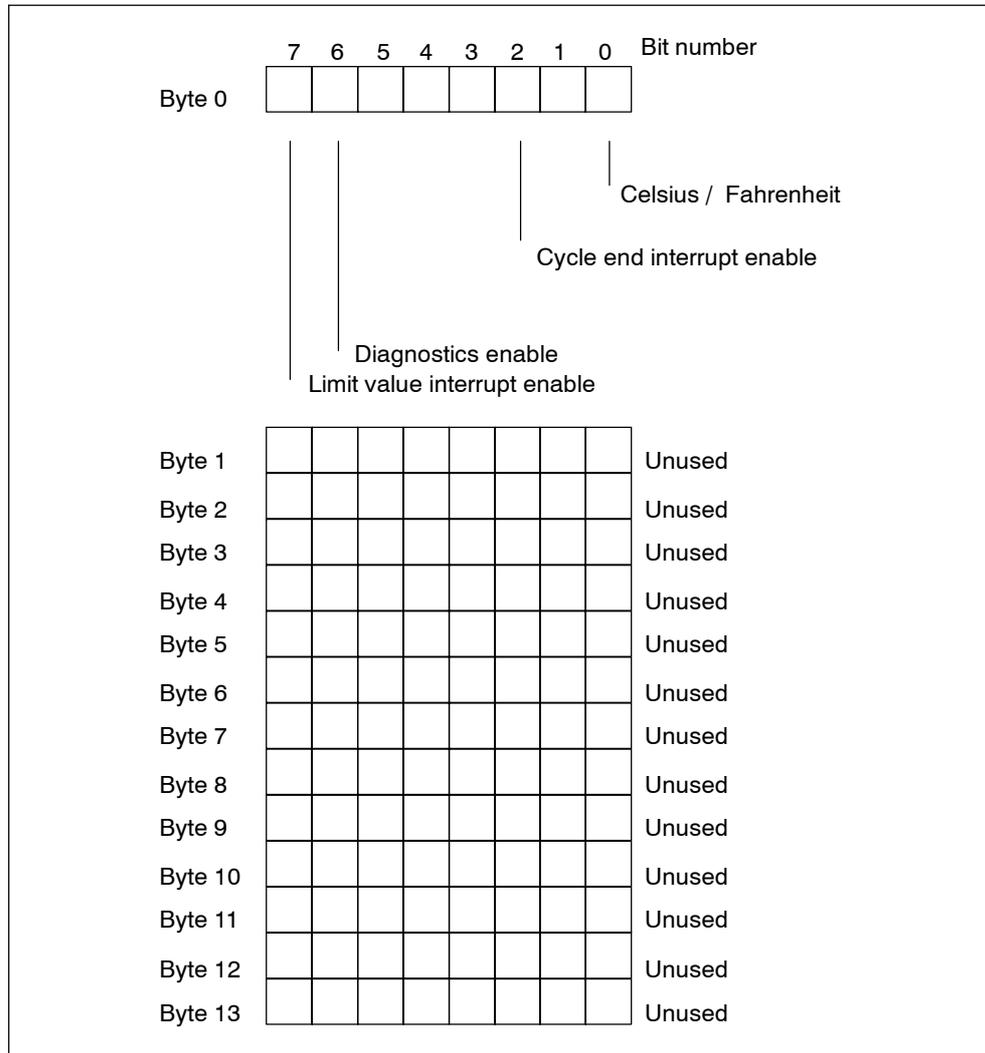You can activate a parameter by setting the corresponding bit in byte 0 to "1".

Figure 10   Data Record 1 for Parameters of the Analog Input Module SM 331; AI 8 × TC

Structure of Data Record 128

Figure 11 shows the structure of data record 128 for the parameters of the Analog Input Module SM 331; AI 8 × TC.
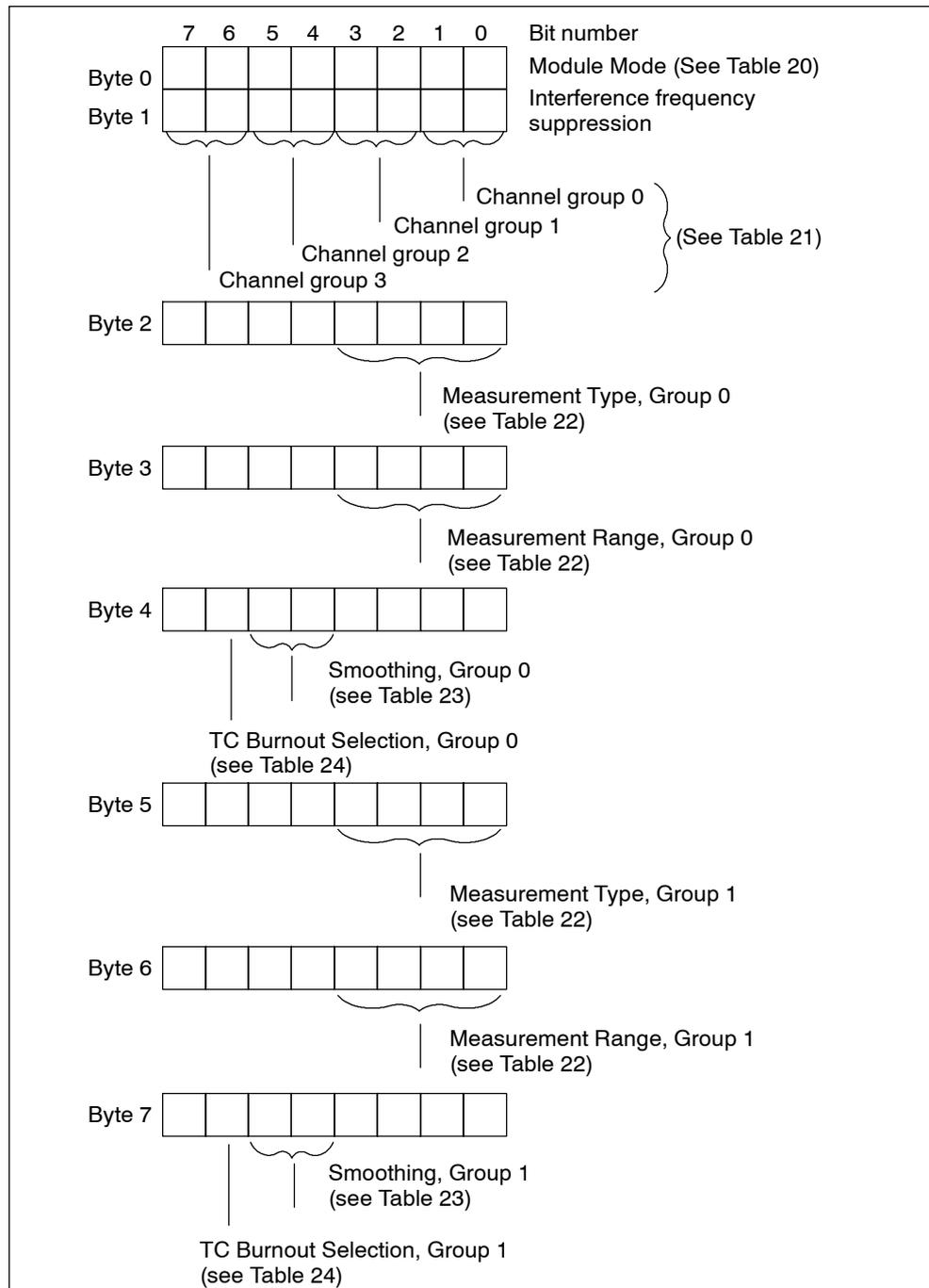

Figure 11   Data Record 128 for Parameters of the Analog Input Module SM 331; AI 8 × TC
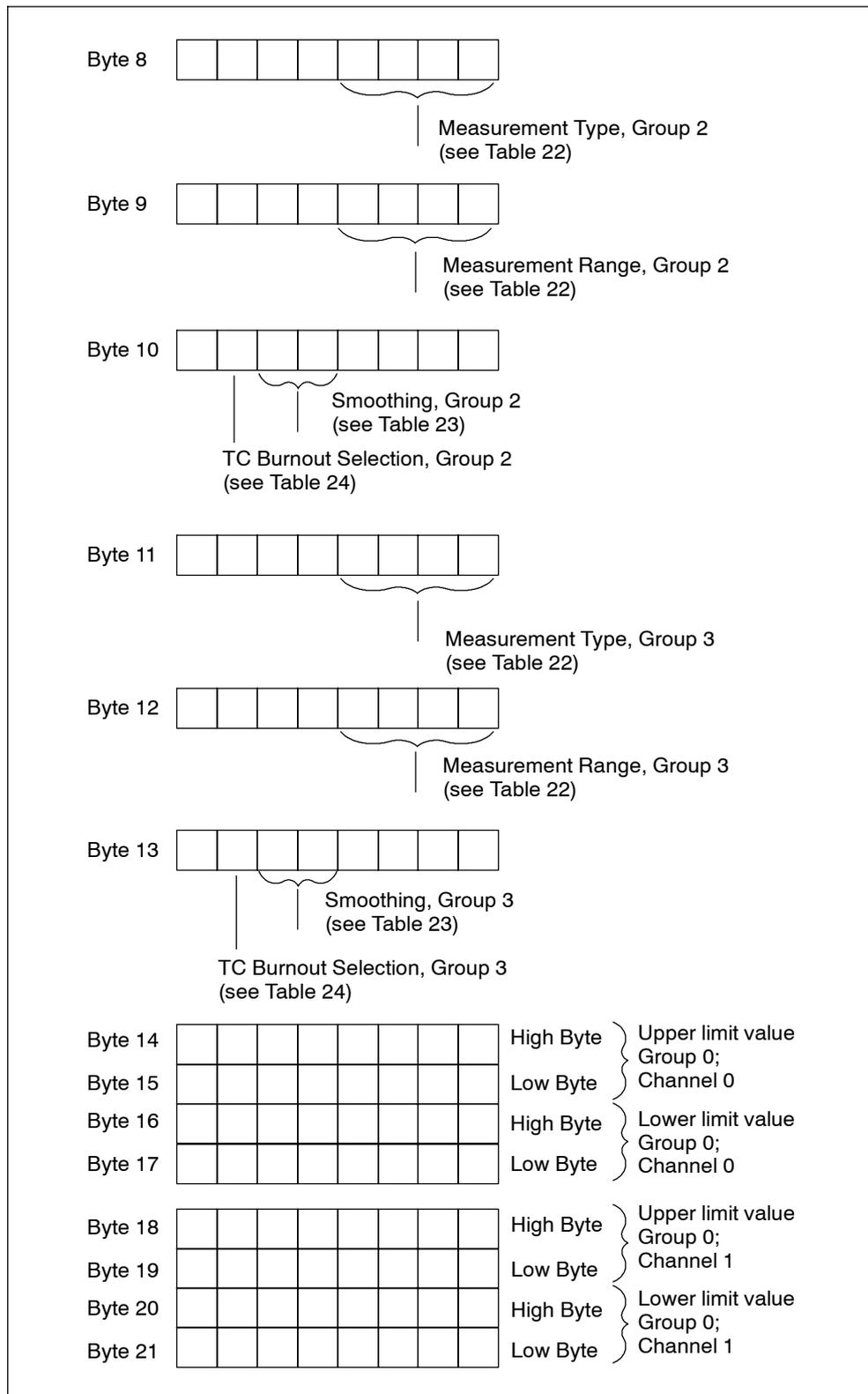
Figure 11   Data Record 128 for Parameters of the Analog Input Module SM 331; AI 8 × TC (continued)
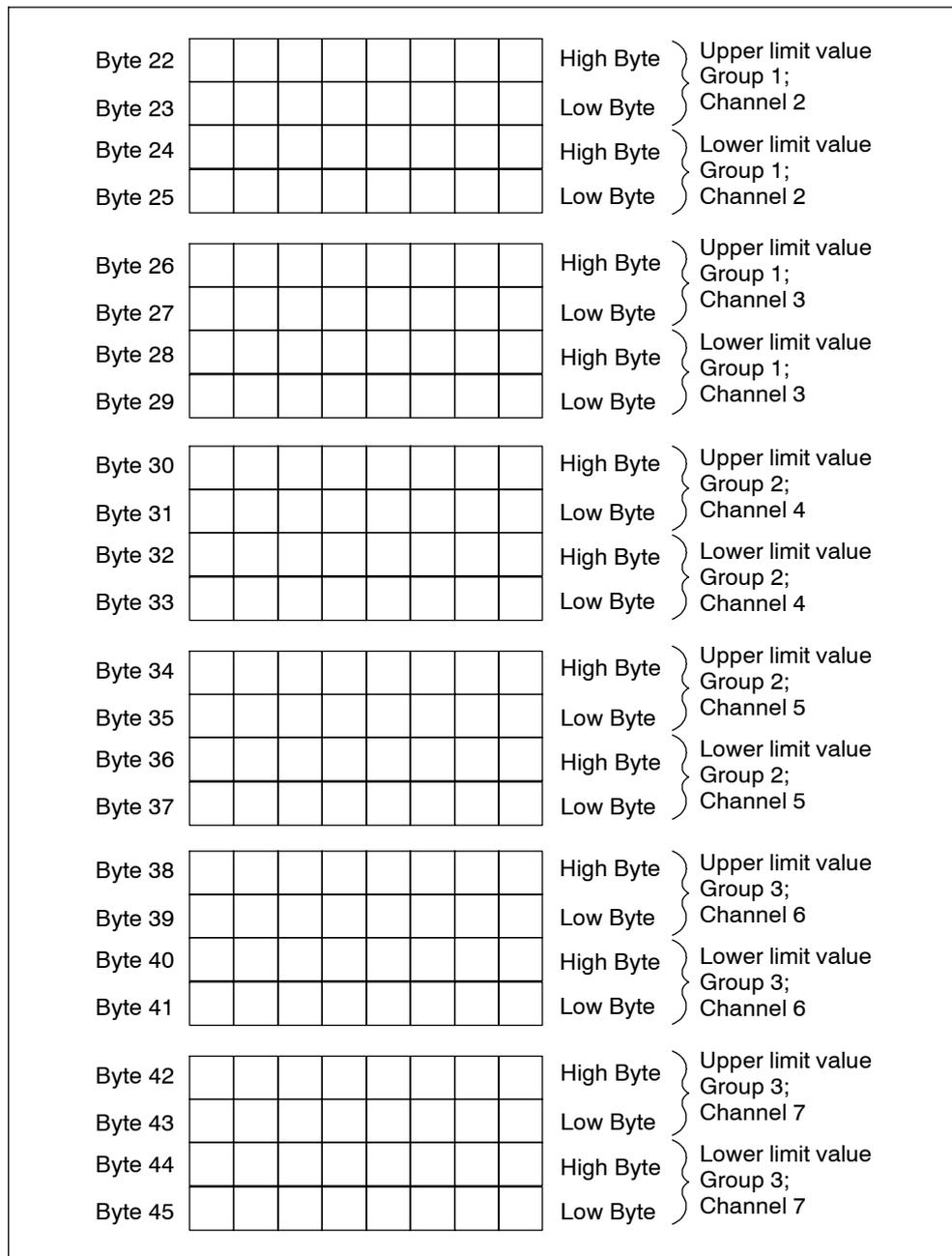
Figure 11   Data Record 128 for Parameters of the Analog Input Module SM 331; AI 8 × TC (continued)

The representation of the limit values matches the analog value representation. Observe the range limits when setting the limit values.

Module Mode

Table 20 contains the codes for the various module operating modes that you enter in byte 0 of data record 128 (see Figure 11).

Table 20   Codes for the module modes of the Analog Input Module SM 331; AI 8 × TC

Module Mode	Code
8 Channel Hardware Filtering	2#00000000
8 Channel Software Filtering	2#00000001
4 Channel Hardware Filtering	2#00000010

Interference Frequency Suppression

Table 21 contains the codes for the various frequencies that you enter in byte 1 of data record 128 (see Figure 11). Note that the 50 Hz, 60 Hz, and 400 Hz selections are for the 8 Channel Software Filtering module mode only. The 50, 60, and 400 Hz selection is for the 8 Channel and 4 Channel Hardware Filtering module modes only.

Table 21   Codes for the Interference Frequency Suppression of Analog Input Module SM 331; AI 8 × TC

Interference Frequency Suppression	Code
400 Hz	2#00
60 Hz	2#01
50 Hz	2#10
50, 60, and 400 Hz	2#11

Measuring Methods and Measuring Ranges of the SM 331; AI 8 x TC

Table 22 contains all the measuring methods and measuring ranges of the module and its codes. You must enter these codes in the corresponding bytes of data record 128 (see Figure 11).

Table 22   Codes for the Measuring Ranges of the SM 331; AI 8 × TC

Measurement Type	Code	Measurement Range	Code
Deactivated	2#0000	Deactivated	2#0000
Thermocouple, linearization, reference temperature 0° C	2#1010	B N E R S J L T K U C TXK/XK(L)	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001 2#1010 2#1011
Thermocouple, linearization, reference temperature 50° C	2#1011	B N E R S J L T K U C TXK/XK(L)	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001 2#1010 2#1011
Thermocouple, linearization, internal comparison	2#1101	B N E R S J L T K U C TXK/XK(L)	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001 2#1010 2#1011
Thermocouple, linearization, external comparison	2#1110	B N E R S J L T K U C TXK/XK(L)	2#0000 2#0001 2#0010 2#0011 2#0100 2#0101 2#0110 2#0111 2#1000 2#1001 2#1010 2#1011

Input Smoothing Selection

Table 23 contains all the smoothing selections for the Analog Input Module SM 331; AI 8×TC. You must enter these codes, according to the smoothing option desired, in the appropriate bytes of data record 128 (see Figure 11).

Table 23　　Codes for the Smoothing Selection of the Analog Input Module SM 331; AI 8×TC

Smoothing Selection	Code
None	2#00
Weak	2#01
Medium	2#10
Strong	2#11

TC Burnout Selection

Table 24 contains all the TC burnout selections for the Analog Input Module SM 331; AI 8×TC. You must enter these codes, according to the TC burnout selection desired, in the appropriate bytes of data record 128 (see Figure 11).

Table 24　　Codes for the TC Burnout Selection of the Analog Input Module SM 331; AI 8×TC

Smoothing Selection	Code
Upscale	2#0
Downscale	2#1