SIEMENS

SIMATIC

ET 200S distributed I/O
IM151-1 COMPACT modules

Manual

Safety Guidelines

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

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

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

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

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

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

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

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

⚠ WARNING
This device 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. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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Disclaimer of Liability

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

Preface

Preface

Purpose of the manual

This manual supplements the *ET 200S Distributed I/O System* Operating Instructions. General functions for the ET 200S are described in the *ET 200S Distributed I/O System* Operating Instructions.

The information in this document along with the operating instructions enables you to commission the ET 200S.

Basic knowledge requirements

To understand these operating instructions you should have general knowledge of automation engineering.

Scope of the manual

This manual applies to this ET 200S module. It describes the components that are valid at the time of publication.

Recycling and disposal

Thanks to the fact that it is low in contaminants, this ET 200S module is recyclable. For environmentally compliant recycling and disposal of your electronic waste, please contact a company certified for the disposal of electronic waste.

Additional support

If you have any questions relating to the products described in these operating instructions, and do not find the answers in this document, please contact your local Siemens representative.

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

The portal to our technical documentation for the various SIMATIC products and systems is available at:

http://www.siemens.com/automation/simatic/portal

The online catalog and ordering system are available at:
http://www.siemens.com/automation/mall

Training center

We offer courses to help you get started with the ET 200S and the SIMATIC S7 automation system. Please contact your regional training center or the central training center in D - 90327, Nuremberg, Germany.
Phone: +49 (911) 895-3200.

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- Fax: + 49 180 5050 223

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- The bulletin board, a worldwide knowledge exchange for users and experts.

- Your local contact for Automation & Drives in our contact database.

- Information about on-site services, repairs, spare parts. Lots more can be found on our "Services" pages.

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What do COMPACT modules offer? 1

COMPACT modules combine the functions of an interface module with the functions of a digital electronic module. In combination with a terminal module TM-C and a terminating module, the IM151-1 COMPACT constitutes a complete slave.

Characteristics of the COMPACT module

- The familiar ET 200S handling also applies to COMPACT modules (mounting, wiring, equipping and configuring).

- Also, an ET 200S configuration with only one COMPACT module must be connected to the right with the terminating module.

- The IM151-1 COMPACT can be expanded with up to 12 peripheral modules, with the exception of fail-safe modules.

  The expansion can be undertaken without additional power modules, if the maximum load in the final voltage groups is not exceeded. The peripheral modules are supplied via the backplane bus from the final voltage group. The total current may not exceed 5 A.

- The terminal module for COMPACT modules can be expanded with additional terminals for connecting additional potentials. This means that connection to 3 and 4 conductor technology is possible.

Configuration options of the COMPACT modules 2

Which COMPACT module matches your application:

Table 2-1   Assignment of COMPACT modules and applications

COMPACT modules	Applications	
IM151-1 COMPACT	• Connecting the PROFIBUS DP via the RS485 interface • Operation as a DPV0 slave • Direct data exchange • Bus length of the ET 200S: not relevant • Integrated peripherals: – 32DI: Digital inputs – 16DI/16DO: Digital inputs/outputs • Number of additional modules: max. 12 • Module types: all except fail-safe modules	Transmission rates: 9.6; 19.2; 45.45; 93.75; 187.5; 500 kBaud, 1.5; 3; 6; 12 Mbit/s

IM151 COMPACT 32DI 24 VDC (6ES7151-1CA00-1BL0)

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3

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Properties

The COMPACT module IM151-1 COMPACT 32DI 24 V DC has the following features:

- It connects the ET 200S with PROFIBUS DP via the RS485 interface.
- The maximum parameter length is 218 bytes.
- The maximum address space is 100 bytes for inputs and 100 bytes for outputs.
- Operation as a DPV0 slave
- A maximum of 12 additional modules can be operated on the IM151-1 COMPACT 32DI 24 V DC.
- The maximum bus length is not relevant.
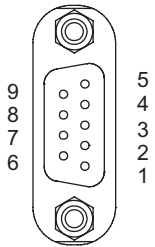
Integrated peripherals:

- 32 digital **inputs**
- Nominal input voltage 24 VDC
- Diagnostics: Short circuit of the encoder supply.
- Diagnostics: No load voltage
- Suitable for switches and proximity switches (BEROs)

Terminal assignment for PROFIBUS DP

The following table shows the terminal assignment of the IM151-1 COMPACT 32DI 24 V DC for PROFIBUS DP:

Table 3-1   Terminal assignment of the IM151-1 COMPACT 32DI 24 V DC for PROFIBUS DP

View		Signal name	Name
	1	-	-
	2	-	-
	3	RxD/TxD-P	Data line B
	4	RTS	Request To Send
	5	M5V2	Data reference potential (station)
	6	P5V2	Supply plus (station)
	7	-	-
	8	RxD/TxD-N	Data line A
	9		

Terminal assignment of TM-C120x for IM151-1 COMPACT 32DI 24 V DC

Terminal	Assignment	Description
Supply voltage		
1L+	L+	24 VDC
2L+	L+	24 VDC (for loop through)
1M	M	Chassis ground
2M	M	Ground (for loop through)
Digital inputs		
1, 2	L+	Load voltage 24 VDC for voltage group 0
3, 4	M	Ground for voltage group 0
5, 6, 9, 10, 13, 14, 17, 18, 25, 26, 29, 30, 33, 34, 37, 38	DI_0, DI_1, DI_2, DI_3, DI_4, DI_5, DI_6, DI_7, DI_8, DI_9, DI_{10}, DI_{11}, DI_{12}, DI_{13}, DI_{14}, DI_{15}	DI_n: Input signal, Channel n
7, 8, 11, 12, 15, 16, 19, 20, 27, 28, 31, 32, 35, 36, 39, 40	L+	Sensor power supply 24 VDC
41, 42	L+	Load voltage 24 VDC for voltage group 2
43, 44	M	Ground for voltage group 2
45, 46, 49, 50, 53, 54, 57, 58, 65, 66, 69, 70, 73, 74, 77, 78	DI_{16}, DI_{17}, DI_{18}, DI_{19}, DI_{20}, DI_{21}, DI_{22}, DI_{23}, DI_{24}, DI_{25}, DI_{26}, DI_{27}, DI_{28}, DI_{29}, DI_{30}, DI_{31}	DI_n: Input signal, Channel n
47, 48, 51, 52, 55, 56, 59, 60, 67, 68, 71, 72, 75, 76, 79, 80	L+	Sensor power supply 24 VDC
21, 22, 23, 24, 61, 62, 63, 64	n. c.	Not connected (max. 30 V DC can be connected)

Usable terminal modules

Usable terminal modules for IM151-1 COMPACT 32DI (6ES7151-1CA00-1BL0)	
TM-C120C (6ES7193-4DL00-0AA0)	◄———————— Spring terminal
TM-C120S (6ES7193-4DL10-0AA0)	◄———————— Screw-type terminal
	Sample connection 2-wire DI L+
	Sample connection 3-wire DI L+ M

Usable terminal modules for IM151-1 COMPACT 32DI (6ES7151-1CA00-1BL0)
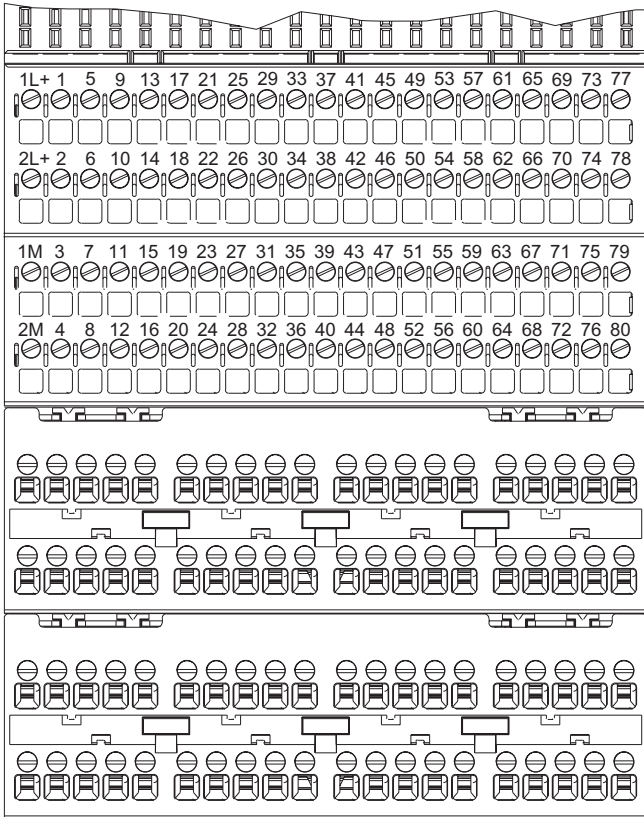
Sample connection

4-wire

DI

L+

M

PE (AUX1)
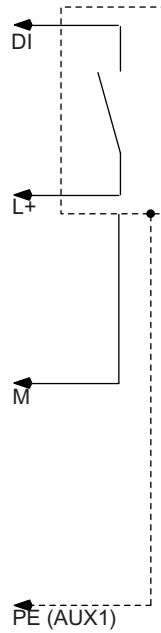
Block diagram

Figure 3-1   Block diagram for IM151-1 COMPACT 32DI 24 V DC

Technical data for IM151-1 COMPACT 32DI DC24V (6ES7151-1CA00-1BL0)

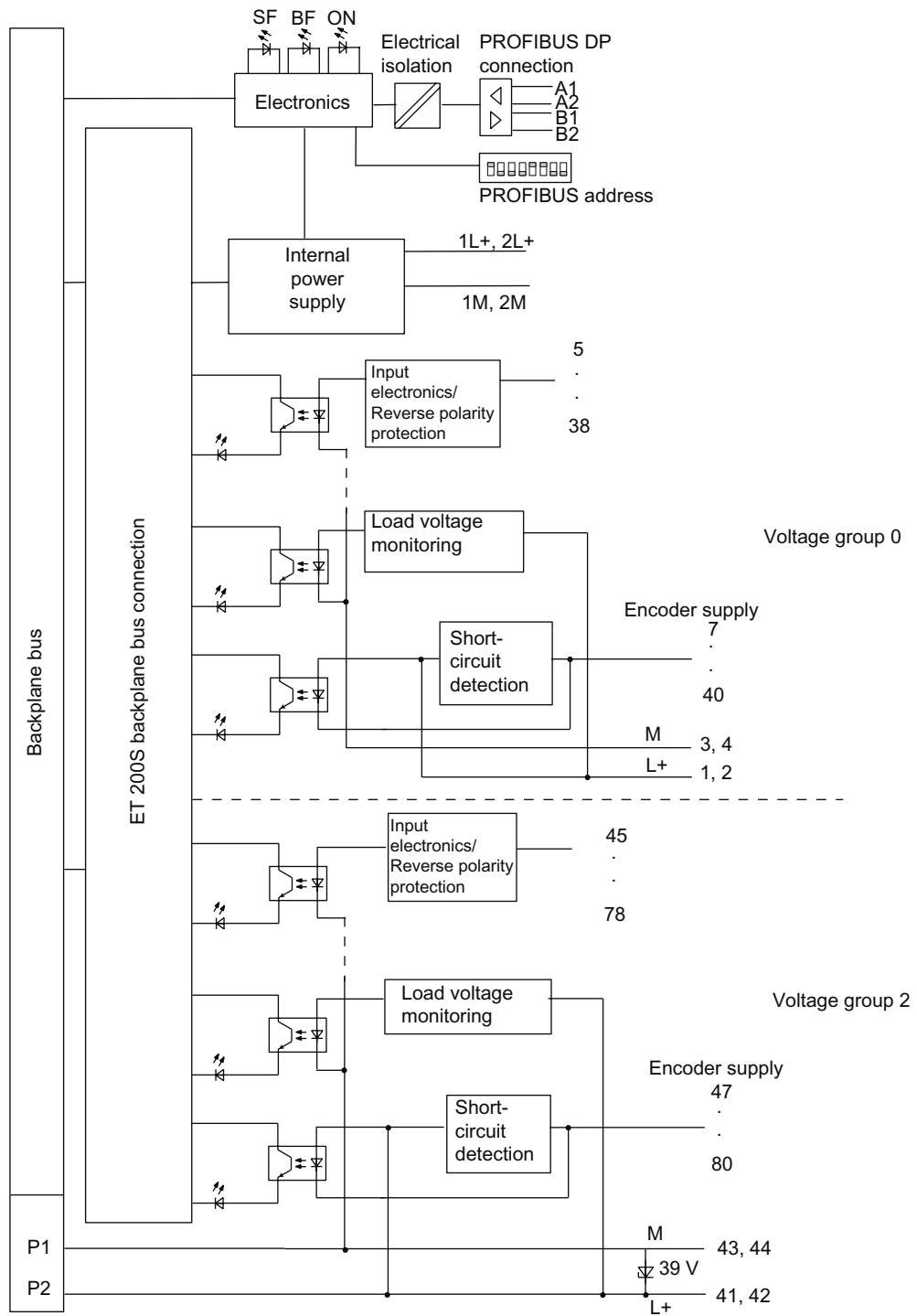| Dimensions and weight	
Dimension B (mm)	120
Weight	Approx. 230 g
Module-specific data	
Data transmission rate	9.6; 19.2; 45.45; 93.75; 187.5; 500 kBaud, 1.5; 3; 6; 12 Mbit/s
Bus protocol	PROFIBUS DP
Interface	RS 485
SYNC capability	yes
FREEZE capability	Yes
Manufacturer ID	8201_H
Direct data exchange	yes
Cycle synchronization	No
Parameter length	23 bytes
Address space	
• Interface module	100-byte inputs / 100-byte outputs
• I/Os	4-byte inputs
Option handling	No
I&M data	No
Firmware update	No
Max. output current of the PROFIBUS DP interface (5, 6)	80 mA
Power dissipation of the module	Typically 3 W
Voltages, currents, potentials	
Rated supply voltage of the electronic components (1L+)	24 VDC
• Incorrect polarity protection	Yes
• Power failure bypass	No
Max. current carrying capacity	5 A, for I/O modules connected after the IM151-1 COMPACT
Galvanic isolation	
• Between the backplane bus and electronic components	No
• Between the PROFIBUS DP and electronic components	yes
• Between the supply voltage and electronic components	No
Permitted potential difference (to the rail)	75 VDC / 60 VAC
Insulation test voltage	500 VDC
Current consumption from rated supply voltage (1L+)	Approx. 100 mA

Status, interrupts, diagnostics	
Interrupts	None
Diagnostics functions (for PROFIBUS DP)	yes
Diagnostics functions (for internal periphery)	module granular (A peripheral fault will not cause the station to fail.)
• Group error • PROFIBUS DP bus monitoring	Red "SF" LED red "BF" LED
• Monitoring of the power supply voltage of the electronics	Green "ON" LED
Integral I/O	
Number of inputs	32DI
Cable lengths	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Integrated periphery (voltages, currents, potentials)	
Rated load voltage	24 VDC
• Incorrect polarity protection	yes
Galvanic isolation	
• Between the channels	No
• Between the channels and backplane bus	yes
Permissible potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation test voltage	500 VDC
Current consumption	
• from load voltage	dependent on the sensor
Integrated peripherals (status, interrupts, diagnostics)	
Status display	green LED per channel
Diagnostics functions	yes • Short-circuit at sensor supply • No load voltage
Sensor supply outputs	
Output voltage	
• With load	min. L+ (-0.5 V)
Output current	
• Rated value	500 mA
• Permitted range	0 to 500 mA
Short-circuit protection	yes, electronic [1]

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"	Typically 3 mA (at 24 V)
Input delay	
• At "0" to "1"	Typically 3 ms (1.2 to 4.8 ms)
• At "1" to "0"	Typically 3 ms (1.2 to 4.8 ms)
Input characteristic curve	According to IEC 61131, type 1
Connection of two-wire BEROs	Supported
• Permitted bias current	max. 1.5 mA
[1] per voltage group	

16DI/16DO 24 V DC/0.5 A IM151-1 COMPACT (6ES7151-1CA00-3BL0)

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Properties

The COMPACT-module M151-1 COMPACT 16DI/16DO 24 VDC/0.5 A has the following features:

- It connects the ET 200S with PROFIBUS DP via the RS485 interface.
- The maximum parameter length is 244 bytes.
- The maximum address space is 100 bytes for inputs and 100 bytes for outputs.
- Operation as a DPV0 slave
- A maximum of 12 additional modules can be operated on the M151-1 COMPACT 16DI/16DO 24 VDC/0.5 A.
- The maximum bus length is not relevant.
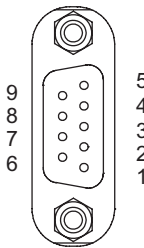
Integrated peripherals:

- 16 digital **inputs**
    - Nominal input voltage 24 VDC
    - Diagnostics: Short circuit on the encoder supply
    - Diagnostics: No load voltage
    - Suitable for switches and proximity switches (BEROs)
- 16 digital **outputs**
    - Output current 0.5 A per output
    - Rated load voltage 24 VDC
    - Diagnostics: No load voltage
    - Suitable for solenoid valves, DC contactors, and indicator lights
    - Substitute value behavior configurable

Terminal assignment for PROFIBUS DP

The following table shows the terminal assignment of the IM151-1 COMPACT 16DI/16DO 24 VDC/0.5 A for PROFIBUS DP:

Table 4-1   Terminal assignment of the IM151-1 COMPACT 16DI/16DO 24 VDC/0.5 A for PROFIBUS DP

View		Signal name	Name
	1	-	-
	2	-	-
	3	RxD/TxD-P	Data line B
	4	RTS	Request To Send
	5	M5V2	Data reference potential (station)
	6	P5V2	Supply plus (station)
	7	-	-
	8	RxD/TxD-N	Data line A
	9		

Terminal assignment of TM-C120x for IM151-1 COMPACT 16DI/16DO 24 VDC/0.5 A

Terminal	Assignment	Description
Supply voltage		
1L+	L+	24 VDC
2L+	L+	24 VDC (for loop through)
1M	M	Chassis ground
2M	M	Ground (for loop through)
Digital inputs		
1, 2	L+	Load voltage 24 VDC for voltage group 0
3, 4	M	Ground for voltage group 0
5, 6, 9, 10, 13, 14, 17, 18, 25, 26, 29, 30, 33, 34, 37, 38	DI_0, DI_1, DI_2, DI_3, DI_4, DI_5, DI_6, DI_7, DI_8, DI_9, DI_{10}, DI_{11}, DI_{12}, DI_{13}, DI_{14}, DI_{15}	DI_n: Input signal, Channel n
7, 8, 11, 12, 15, 16, 19, 20, 27, 28, 31, 32, 35, 36, 39, 40	L+	Sensor power supply 24 V DC
21, 22, 23, 24	n. c.	Not connected (max. 30 V DC can be connected)

Terminal	Assignment	Description
Digital outputs		
41, 42	L+	Load voltage 24 VDC for voltage group 2
61, 62	L+	Load voltage 24 VDC for voltage group 3
43, 44	M	Ground for voltage group 2
63, 64	M	Ground for voltage group 3
45, 46, 49, 50, 53, 54, 57, 58, 65, 66, 69, 70, 73, 74, 77, 78	DO_0, DO_1, DO_2, DO_3, DO_4, DO_5, DO_6, DO_7, DO_8, DO_9, DO_{10}, DO_{11}, DO_{12}, DO_{13}, DO_{14}, DO_{15}	DO_n: Output signal, Channel n
47, 48, 51, 52, 55, 56, 59, 60, 67, 68, 71, 72, 75, 76, 79, 80	M	Chassis ground

Usable terminal modules

Usable terminal modules for IM151-1 COMPACT 16DI/16DO (6ES7151-1CA00-3BL0)	
TM-C120C (6ES7193-4DL00-0AA0)	◀——————— Spring terminal
TM-C120S (6ES193-4DL10-0AA0)	◀——————— Screw-type terminal

Usable terminal modules for IM151-1 COMPACT 16DI/16DO (6ES7151-1CA00-3BL0)

DI   DO

1L+ 1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77
2L+ 2 6 10 14 18 22 26 30 34 38 42 46 50 54 58 62 66 70 74 78
1M 3 7 11 15 19 23 27 31 35 39 43 47 51 55 59 63 67 71 75 79
2M 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80

Wiring examples
3-wire

DI   DO
L+   M
M   L+

DI   DO

1L+ 1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77
2L+ 2 6 10 14 18 22 26 30 34 38 42 46 50 54 58 62 66 70 74 78
1M 3 7 11 15 19 23 27 31 35 39 43 47 51 55 59 63 67 71 75 79
2M 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80

Wiring examples
4-wire

DI   DO
L+   M
M   L+
PE (AUX1)   PE (AUX1)
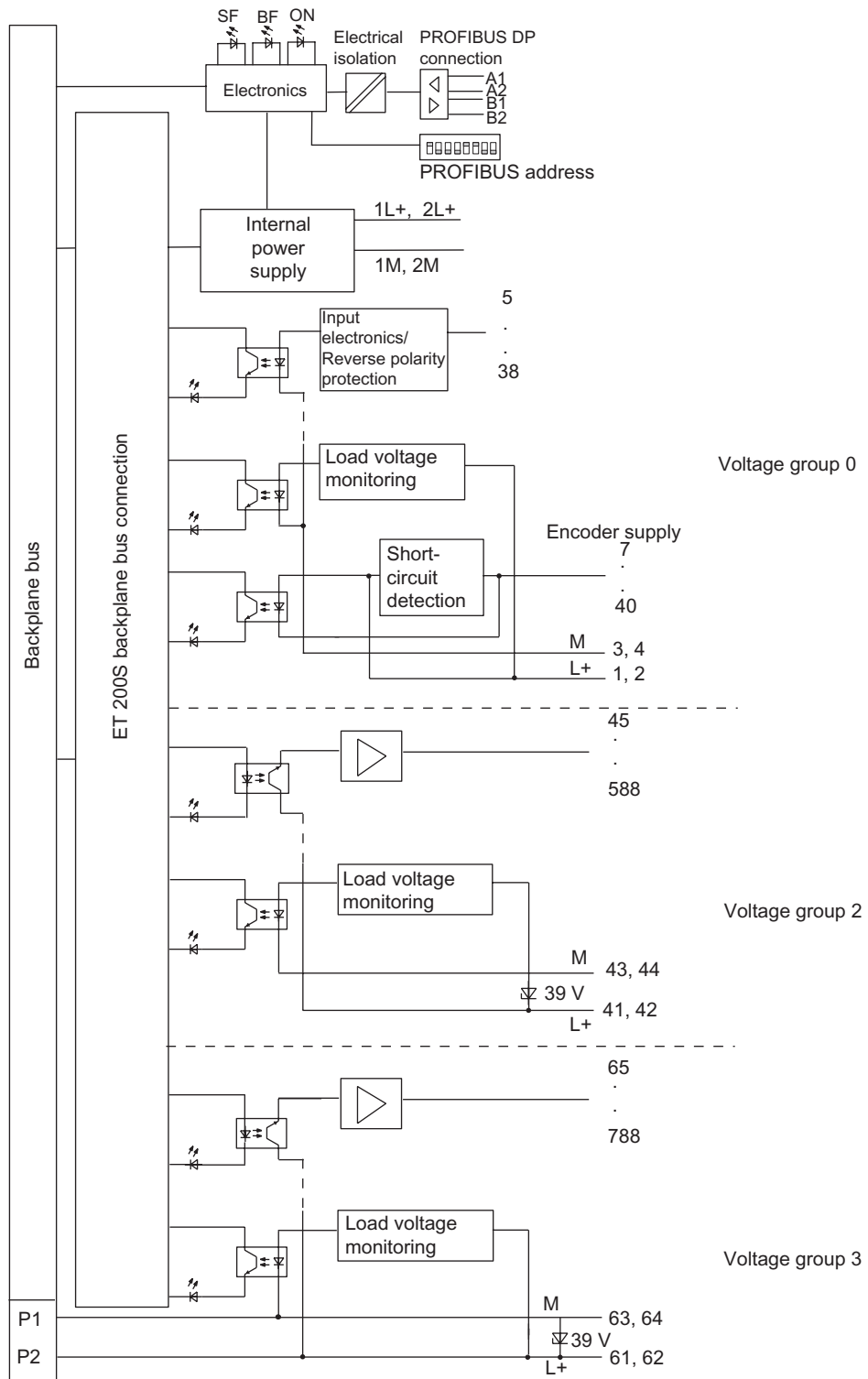
Block diagram

Figure 4-1   Block diagram for IM151-1 COMPACT 16DI/16DO 24 VDC/0.5 A

Technical data for IM151-1 COMPACT 16DI/16DO DC24V/0.5 A (6ES7151-1CA00-3BL0)

Dimensions and weight	
Dimension B (mm)	120
Weight	Approx. 230 g
Module-specific data	
Data transmission rate	9.6; 19.2; 45.45; 93.75; 187.5; 500 kBaud, 1.5; 3; 6; 12 Mbit/s
Bus protocol	PROFIBUS DP
Interface	RS 485
SYNC capability	Yes
FREEZE capability	Yes
Manufacturer ID	8200_H
Direct data exchange	yes
Cycle synchronization	No
Parameter length	26 bytes
Address space	
• Interface module	100-byte inputs / 100-byte outputs
• I/Os	2-byte inputs/2-byte outputs
Option handling	No
I&M data	No
Firmware update	No
Max. output current of the PROFIBUS DP interface (5, 6)	80 mA
Power dissipation of the module	Typically 3 W
Voltages, currents, potentials	
Rated supply voltage of the electronic components (1L+)	24 V DC
• Reverse polarity protection	Yes
• Power failure bypass	No
Max. current carrying capacity	5 A, for I/O modules connected after the IM151-1 COMPACT
Galvanic isolation	
• Between the backplane bus and electronic components	No
• Between the PROFIBUS DP and electronic components	yes
• Between the supply voltage and electronic components	No
Permitted potential difference (to the rail)	75 VDC / 60 VAC
Insulation test voltage	500 VDC
Current consumption from rated supply voltage (1L+)	Approx. 100 mA

Status, interrupts, diagnostics	
Interrupts	None
Diagnostics functions (for PROFIBUS DP)	yes
Diagnostics functions (for internal periphery)	module granular (A peripheral fault will not cause the station to fail.)
• Group error • PROFIBUS DP bus monitoring	Red "SF" LED red "BF" LED
• Monitoring of the power supply voltage of the electronics	Green "ON" LED
Integral I/O	
Number of inputs / outputs	16 / 16
Cable lengths	
• Unshielded	max. 600 m
• Shielded	max. 1000 m
Integrated peripherals - inputs (voltages, currents, potentials)	
Rated load voltage	24 V DC
• Reverse polarity protection	Yes
Electrical isolation	
• Between the channels	No
• Between the channels and backplane bus	yes
Permissible potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation test voltage	500 V DC
Current consumption	
• from load voltage	Dependent on the sensor
Integrated peripherals - inputs (status, interrupts, diagnostics)	
Status display	green LED per channel
Diagnostics functions	yes • Short-circuit at sensor supply • No load voltage
Sensor supply outputs	
Output voltage	
• With load	min. L+ (-0.5 V)
Output current	
• Rated value	500 mA
• Permitted range	0 to 500 mA
Short-circuit protection	yes, electronic [1]

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"	Typically 3 mA (at 24 V)
Input delay	
• At "0" to "1"	Typically 3 ms (1.2 to 4.8 ms)
• At "1" to "0"	Typically 3 ms (1.2 to 4.8 ms)
Input characteristic curve	According to IEC 61131, type 1
Connection of 2-wire BEROs	Supported
• Permitted bias current	max. 1.5 mA
Integrated peripherals - outputs (voltages, currents, potentials)	
Rated load voltage L+	24 V DC
• Reverse polarity protection	yes
Total current for outputs (per voltage group)	
• Horizontal assembly	
– up to 30 °C	max. 4 A
– Up to 40 °C	max. 3 A
– up to 60 °C	max. 2 A
• Vertical assembly	
– up to 55 °C	Max. 2 A
Galvanic isolation	
• Between the channels	Yes, each in groups of up to 8
• Between the channels and backplane bus	yes
Permissible potential difference	
• Between the different circuits	75 VDC / 60 VAC
Insulation tested	500 V DC
Current consumption	
• From load voltage L+ (no load)	max. 5 mA per voltage group
Integrated peripherals - outputs (status, interrupts, diagnostics)	
Status display	green LED per channel
Diagnostics functions	yes
	• No load voltage

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	7 mA to 0.6 A
• With signal "0" (residual current)	max. 0.5 mA
Output delay (for resistive load)	
• At "0" to "1"	max. 500 µs
• At "1" to "0"	max. 1.3 ms
Load resistor range	48 Ω to 4 kΩ
Lamp load	max. 5 W
Connecting two outputs in parallel	
• For redundant triggering of a load	yes (per voltage group)
• To increase performance	No
Control of a digital input	yes
Switch rate	
• For resistive load	100 Hz
• on inductive load	2 Hz
• For lamp load	10 Hz
Limitation (internal) of the voltage induced on circuit interruption	Typically L+ (-55 V to -60 V)
Reverse-voltage proof	yes, when using the same load voltage as on the voltage group infeed
Short-circuit protection of the output	Yes[2]
• Threshold on	0.7 to 1.9 A

[1] per voltage group

[2] per channel

Parameters

5

5.1 Parameters for IM151-1 COMPACT

Table 5-1   Parameters for IM151-1 COMPACT

IM151-1 COMPACT	Value range	Default setting	Applicability
Operation at set <> actual configuration	disable/enable	Disable	Slave station
Identifier-related diagnostics	disable/enable	enable	Slave station
Module status	disable/enable	enable	Slave station
Channel-specific diagnostics	disable/enable	enable	Slave station
Analog-value format [1]	SIMATIC S7/ SIMATIC S5	S7	Slave station
Interference frequency suppression	50 Hz / 60 Hz	50 Hz	Slave station
Reference junction slot	None /2 to 13	None	Slave station
Reference junction input	RTD on channel 0/ RTD on channel 1	0	Slave station
Integrated periphery 32DI			
Diagnostics: Short circuit at voltage groups encoder supply	disable/enable	Disable	Voltage group
Diagnostics: No load voltage for voltage groups	disable/enable	Disable	Voltage group
Integrated periphery 16DI/16DO			
Diagnostics: Short-circuit sensor supply voltage group 0	disable/enable	Disable	Voltage group
Diagnostics: No load voltage for voltage groups	disable/enable	Disable	Voltage group
Response to CPU/master STOP	Switch substitution value / hold last value	Substitute a value	Module
Substitute value [2]	"0"/ "1"	"0"	Channel

[1] The parameter only exists when configuring via the GSD file.

[2] If the supply voltage to the COMPACT module fails, the digital outputs will not supply a substitute value. Output value = 0

5.2 Parameter description

5.2.1 Enable startup for set <> actual configuration

When this parameter is enabled, and

- modules next to IM151-1 COMPACT are removed and plugged during operation, then a station failure of ET 200S will not occur.

- The actual configuration differs from the expected configuration, the ET 200S remains engaged in data transfer with the DP master.

When this parameter is disabled, and

- modules next to IM151-1 COMPACT are removed and plugged during operation, then a station failure of ET 200S will occur.

- The actual configuration differs from the expected configuration, there is no data transfer between the DP master and the ET 200S.

5.2.2 Analog-value format

Here you set the number format for all analog electronic modules positioned next to the IM151-1 COMPACT.

5.2.3 Interference frequency suppression

The frequency of your AC power system can interfere with the measured value, particularly when measuring in low voltage ranges and using thermocouple elements. You can enter the mains frequency for your system here (50 Hz or 60 Hz).

The interference frequency suppression parameter applies to all analog electronic modules. With this parameter, you also specify the integration and conversion time of the various modules. See the technical data for the analog electronic modules.

5.2.4 Reference junction slot

This parameter allows you to assign a slot (none, 2 to 13) where the channel for measuring the reference temperature is located (calculation of the compensation value).

Reference

For information on connecting thermocouples, refer to the *manuals* for the *analog electronic modules*.

5.2.5 Reference junction input

This parameter can be used to set the channel (0/1) for measuring the reference temperature (calculation of the compensation value) for the assigned slot

Reference

For information on connecting thermocouples, refer to the manuals for the analog electronic modules.
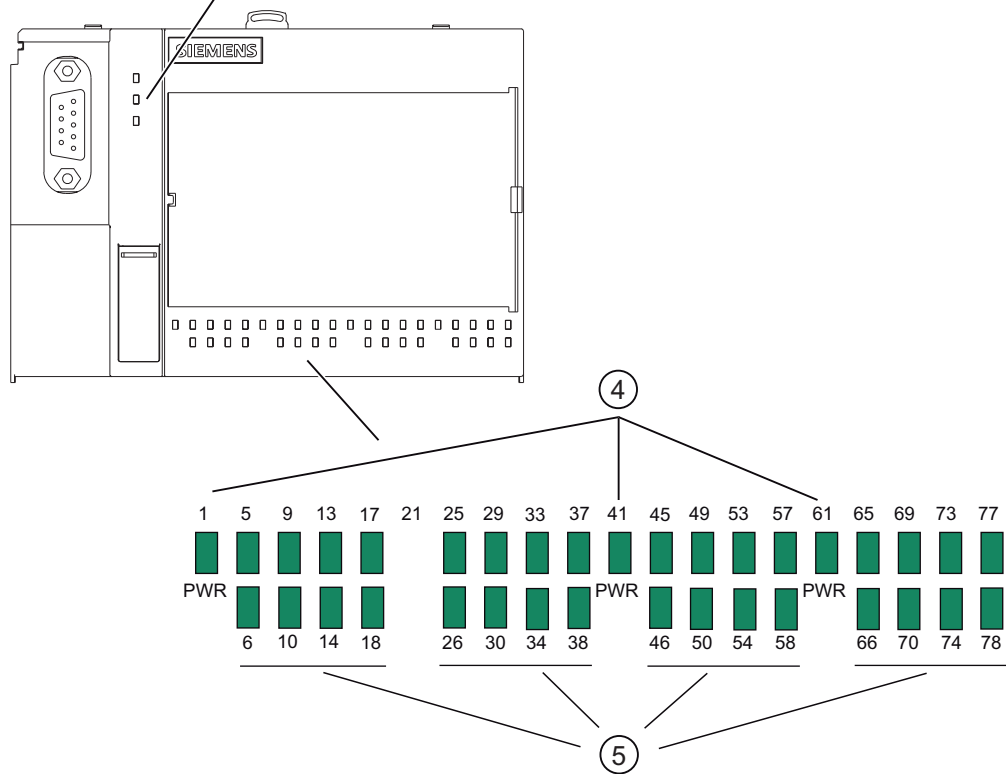
Error and system messages

<div style="text-align: right; font-size: 3em;">6</div>

6.1 Diagnostics using LED display

COMPACT modules

LED displays on COMPACT modules:

①   Batch error (red)
②   Bus fault (red)
③   Power supply (green)
④   Load voltage voltage group n present (green)
⑤   Status display for input/output status (green)

Status and error displays by means of LEDs on COMPACT modules

The table below shows the status and error displays on the IM151-1 COMPACT module.

Table 6-1   Status and error displays on the IM151-1 COMPACT (interface part)

Event (LEDs)			Cause	Remedy
SF	BF	ON		
off	off	off	No supply voltage available on COMPACT module. Hardware defect on COMPACT module.	Switch on the power supply voltage 24 VDC on the COMPACT module.
*	*	values	Supply voltage available on COMPACT module.	---
*	Flashing	values	The COMPACT module is not configured or is configured incorrectly. No data exchange is taking place between the DP master and the COMPACT module. Causes: • The PROFIBUS address is incorrect. • Configuration error • Configuration error	• Check the COMPACT module. • Check the configuration and parameter assignment. • Check the PROFIBUS address.
*	values	values	Transmission rate detection, illegal PROFIBUS address, or bottom DIP switch (PROFIBUS address) not in the OFF position. Causes: • The response monitoring interval has elapsed. • Bus communication to the COMPACT module via PROFIBUS DP is interrupted.	Set a valid PROFIBUS address (1 to 125) on the COMPACT module or check the bus configuration. • Check that the bus connector is correctly inserted. • Check whether the bus cable to the DP master has been disconnected. • Switch the 24 VDC supply voltage off and on again at the COMPACT module.
values	*	values	The IM151-1 COMPACT (ET 200S) configuration structure doe not coincide with the actual structure of the station.	Check the structure of the ET 200S for missing or defective modules or whether an unconfigured module is inserted. Check the configuration (using COM PROFIBUS or STEP 7, for example) and correct the parameter assignment error.
			There is an error in an I/O module, or the COMPACT module is defective.	Replace the COMPACT module, or contact your Siemens representative.
values	off	values	• Parameter assignment incorrect • Hardware defect in the COMPACT module's integrated I/O. • A short circuit is present in the digital input sensor power supply or in the digital output load voltage.	• Check the parameter assignment. • Exchange the COMPACT module. • Check the power supply lines.
off	off	values	Data exchange is taking place between the DP master and IM151-1 COMPACT. The preset configuration and actual configuration of IM151-1 COMPACT (ET 200S) coincide.	----
* not relevant				

Table 6-2   Status and error displays on the IM151-1 COMPACT (integrated periphery)

Event (LEDs)														Cause
SF	1	41	61	5	6	9	:::	38	45	46	49	:::	78	
values														No configuration or incorrect module plugged in. There is a diagnostic message. ⇒ Check the parameter assignments. Evaluate the diagnostics.
	values													Load voltage voltage group 0 available.
		values												Load voltage voltage group 2 available.
			values											Load voltage voltage group 3 available.
				values										Input on channel 0 activated.
					values									Input on channel 1 activated.
						values								Input on channel 2 activated.
							:::							:::
								values						Input on channel 15 activated.
									values					Input/output on channel 16 activated.
										values				Input/output on channel 17 activated.
											values			Input/output on channel 18 activated.
												:::		:::
													values	Input/output on channel 31 activated.

6.2   Diagnostic messages of the electronic modules

Actions following a diagnostic message in DPV0 mode

The error is entered in the diagnostics frame in the channel-specific diagnostics:

- The SF LED on the interface module lights up.
- Several diagnostic messages can be output simultaneously.

6.3 Diagnostics with STEP 7

6.3.1 Diagnostics readout

Introduction

The slave diagnostics comply with IEC 61784-1:2002 Ed1 CP 3/1. Depending on the DP master, slave diagnostics can be read out with *STEP 7* for all DP slaves that comply with the standard.

Length of the diagnostics frame

- For the ET 200S with the COMPACT module, the maximum frame length is 44 bytes.
- The minimum frame length is
  - 6 bytes (identifier-related diagnostics, module status, and channel-specific diagnostics disabled via parameter assignment).

Options for reading out the diagnostics

The table below shows the options for reading out the diagnostics with *STEP 7* on PROFIBUS DP.

Table 6-3   Reading out the diagnostics with STEP 7 on PROFIBUS DP

Automation system with DP master	Block or tab in *STEP 7*	Application	Reference
SIMATIC S7/M7	"DP Slave Diagnostics" tab	Slave diagnostics in plain text on the STEP 7 user interface	"Diagnosing hardware" in *STEP 7* Online Help
	SFC 13 "DP NRM_DG"	Reading out slave diagnostics (store in the data area of the user program)	SFC see *STEP 7 Online Help*

Example of reading out S7 diagnostics using SFC 13 "DP NRM_DG"

Here, you will find an example of how to use SFC 13 to read out the slave diagnostics for a DP slave in the STEP 7 user program.

For the purpose of this STEP 7 user program, the following is assumed:

- The diagnostic address of the ET 200S is 1022 (3FE$_H$).

- The slave diagnostics are to be stored in DB 82: Starting from address 0.0, length = 43 bytes.

- The slave diagnostics can be up to 43 bytes long.

STEP 7 user program

STL		Description
CALL SFC 13		
REQ	:=TRUE	Read request
LADDR	:=W#16#3FE	Diagnostic address of the ET 200S
RET_VAL	:=MW0	RET_VAL of SFC 13
RECORD	:=P#DB82.DBX 0.0 BYTE 43	Data record for the diagnostics in DB 82
BUSY	:=M2.0	The read process runs through several OB 1 cycles

6.3.2 Structure of the slave diagnostics

Structure of the slave diagnostics

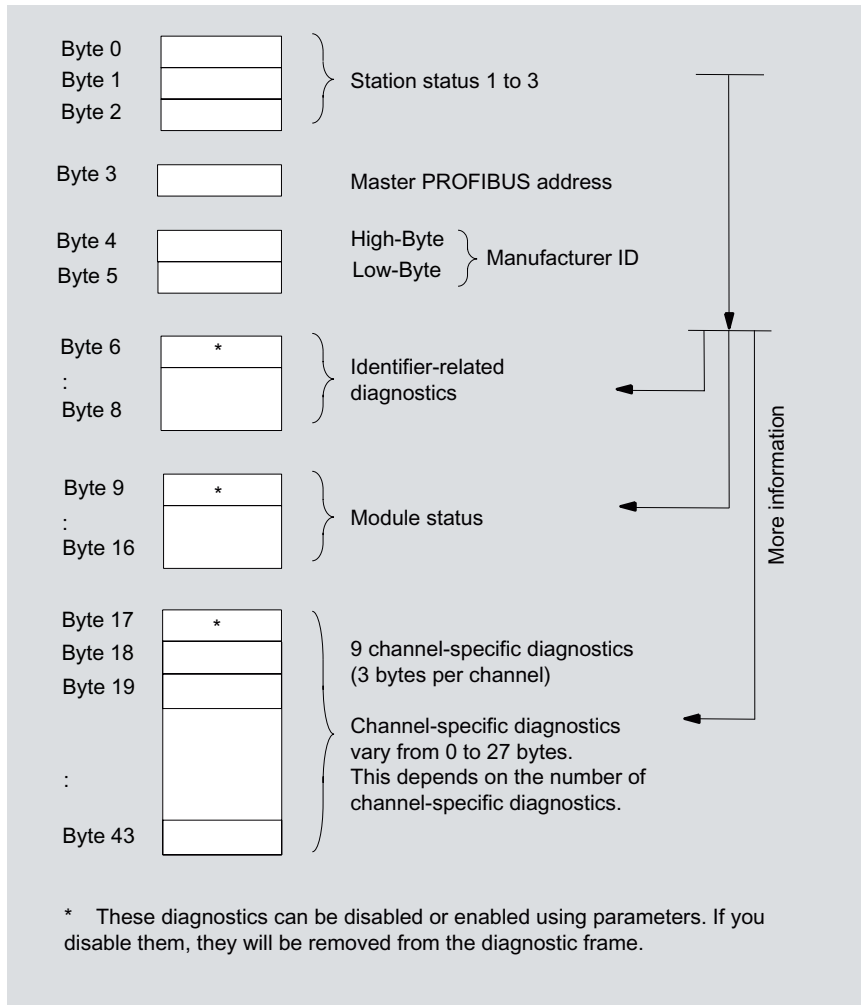The figure below shows the structure of the slave diagnostics.

Figure 6-1   Structure of the slave diagnostics

Note

In the case of the COMPACT modules, the length of the diagnostics frame is 44 bytes.

You can identify the length of the last received diagnostics frame in *STEP 7* by referring to the RET_VAL parameter of the SFC 13.

6.3.3 Station statuses 1 to 3

Definition

Station statuses 1 to 3 provide an overview of the status of a DP slave.

Structure of station status 1 (byte 0)

Table 6-4   Structure of station status 1 (byte 0)

Bit	Meaning	Cause/Remedy
0	1: The DP slave cannot be accessed by the DP master.	• Is the correct PROFIBUS address set on the DP slave? • Is the bus connector plugged in? • Is the DP slave connected to the voltage supply? • Is the RS-485 repeater set correctly? • Has the DP slave been reset?
1	1: The DP slave is not yet ready to exchange data.	• Wait, the DP slave is currently starting up.
2	1: The configuration data transferred from the DP master to the DP slave does not match the slave configuration.	• Has the correct station type or the correct DP slave configuration been entered in the configuration software?
3	1: External diagnostics information is pending. (Group diagnostics display)	• Evaluate the ID-specific diagnostics information, the module status, and/or the channel-specific diagnostics information. As soon as all errors have been eliminated, bit 3 will be reset. The bit will be set again when there is a new diagnostics message in the bytes of the aforementioned diagnostics.
4	1: The required function is not supported by the DP slave (for example, changing the PROFIBUS address by means of software).	• Check the configuration.
5	1: The DP master cannot interpret the response of the DP slave.	• Check the bus configuration.
6	1: The DP slave type does not match the software configuration.	• Has the correct station type been entered in the configuration software?
7	1: Parameters have been assigned to the DP slave by a different DP master (not the one that currently has access to the DP slave).	• The bit is always 1, for example, if you access the DP slave with the programming device or another DP master. • The PROFIBUS address of the DP master that assigned parameters to the DP slave is located in the "Master PROFIBUS address" diagnostics byte.

Structure of station status 2 (byte 1)

Table 6-5   Structure of station status 2 (byte 1)

Bit		Meaning
0	1:	The DP slave parameters need to be reassigned.
1	1:	A diagnostics message is pending. The DP slave will not operate until the problem is eliminated (static diagnostics message).
2	1:	The bit on the DP slave is always "1".
3	1:	The watchdog is activated for this DP slave.
4	1:	The DP slave has received the "FREEZE" control command [1].
5	1:	The DP slave has received the "SYNC" control command [1].
6	0:	Bit is always "0".
7	1:	The DP slave is disabled, that is, it has been removed from the processing in progress.
[1] The bit is updated only if another diagnostics message changes also.		

Structure of station status 3 (byte 2)

Table 6-6   Structure of station status 3 (byte 2)

Bit		Meaning
0 to 6	0:	Bits are always set to "0".
7	1:	• There are more diagnostics messages pending than the DP slave is able to store. • The DP master cannot enter all the diagnostics messages sent by the DP slave in its diagnostics buffer (channel-specific diagnostics).

6.3.4   Master PROFIBUS address

Definition

The Master PROFIBUS address diagnostics byte contains the PROFIBUS address of the DP master:

- That assigned parameters to the DP slave
- That has read and write access to the DP slave

The master PROFIBUS address is located in byte 3 of the slave diagnostics.

6.3.5   Identifier-related diagnostics

Definition

The identifier-related diagnostics indicate whether or not modules of the ET 200S have errors/faults. In the case of the IM151-1 COMPACT modules, identifier-related diagnostics start at byte 6 and are 3 bytes long.

Structure of the identifier-related diagnostics

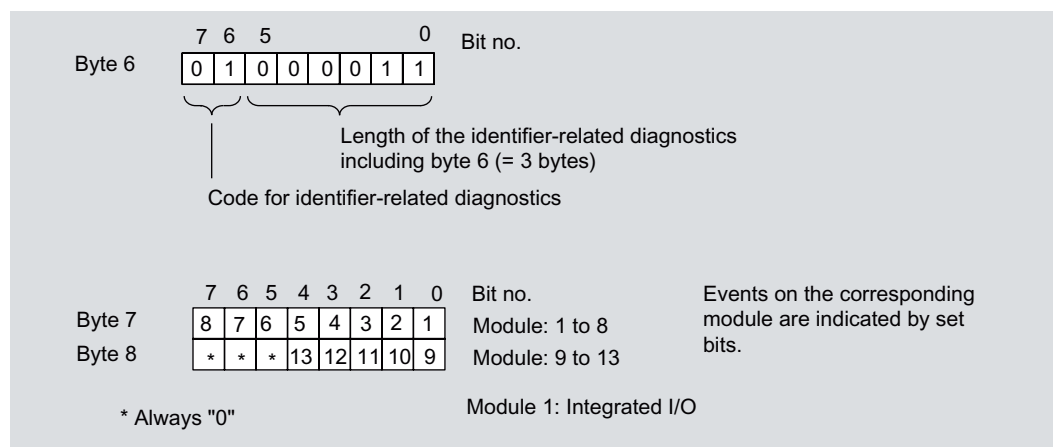The identifier-related diagnostics for ET 200S are structured as follows for the IM151-1 COMPACT modules:

Figure 6-2   Structure of the identifier-related diagnostics for IM151-1 COMPACT modules

6.3.6 Module status

Definition

The module status indicates the status of the configured modules and provides more information on the identifier-related diagnostics with respect to the configuration. With the COMPACT module, the module status starts after the identifier-related diagnostics and consists of 8 bytes.

Structure of the module status

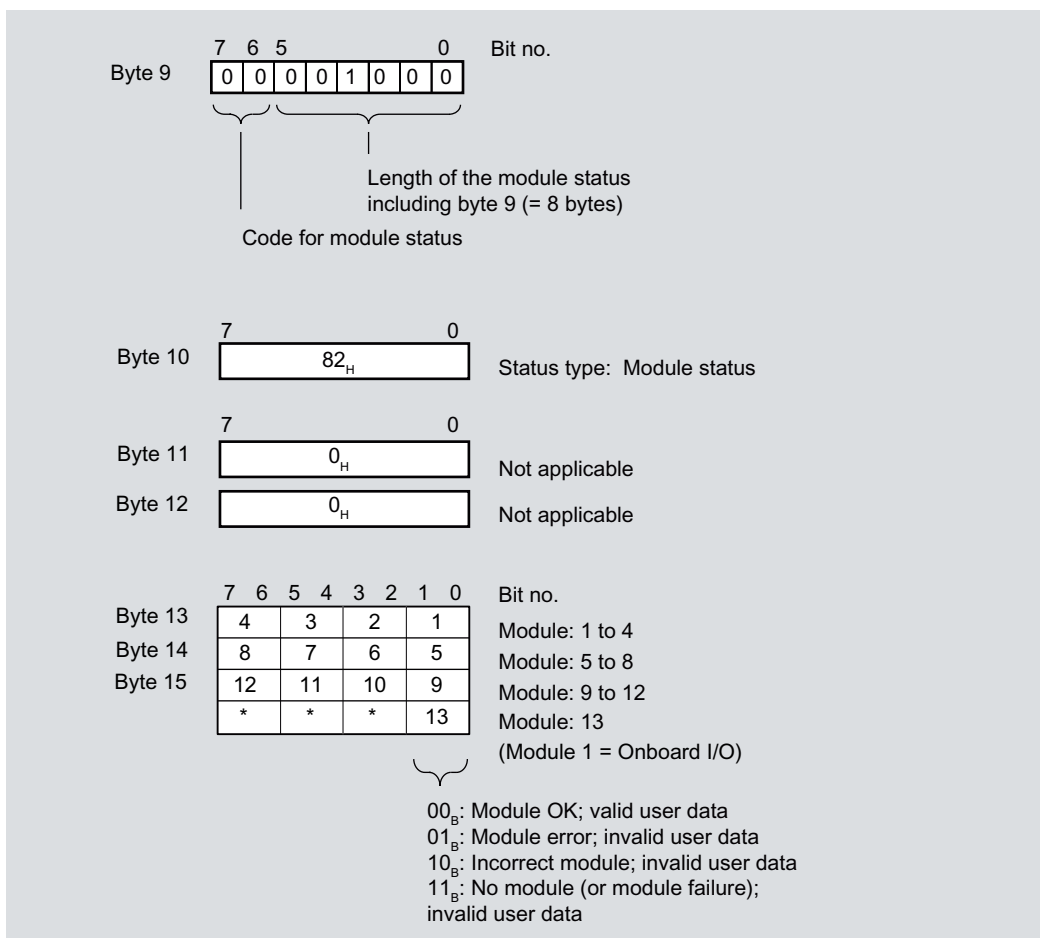The module status for the ET 200S with COMPACT modules is structured as follows:

Figure 6-3   Structure of the module status for the ET 200S with COMPACT module

6.3.7 Channel-specific diagnostics

Definition

Channel-specific diagnostics provide information about channel errors in modules and details of the identifier-related diagnostics. The channel-specific diagnostics start after the module status (if parameters are preset accordingly). The maximum length is limited by the maximum total length of slave diagnostics, i.e., 44 bytes in DPV0 mode. Channel-specific diagnostics do not affect the module status.

Up to 9 channel-specific diagnostic messages are possible.

Structure of channel-specific diagnostics

The channel-specific diagnostics for the ET 200S with COMPACT modules are structured as follows:

Byte 17

7 6 5 4 3 2 1 0   Bit no.

1 0

000000_B to 001100_B:
Slot for the module that is providing the channel-specific diagnostics.

Code for channel-specific diagnostics

Byte 18

7 6 5 4 3 2 1 0   Bit no.

000000_B to 000011_B: Number of the channel/voltage group that provides the diagnostics

Channel type: 01_B: Input channel
10_B: Output channel
11_B: Input/output channel

Byte 19

7 6 5 4 3 2 1 0

Error type (see manual for the relevant module)

Channel resolution: 001_B: Bit
010_B: 2 bits
011_B: 4 bits
100_B: Byte
101_B: Word
110_B: 2 words

Byte 20   Next channel-specific diagnostic message
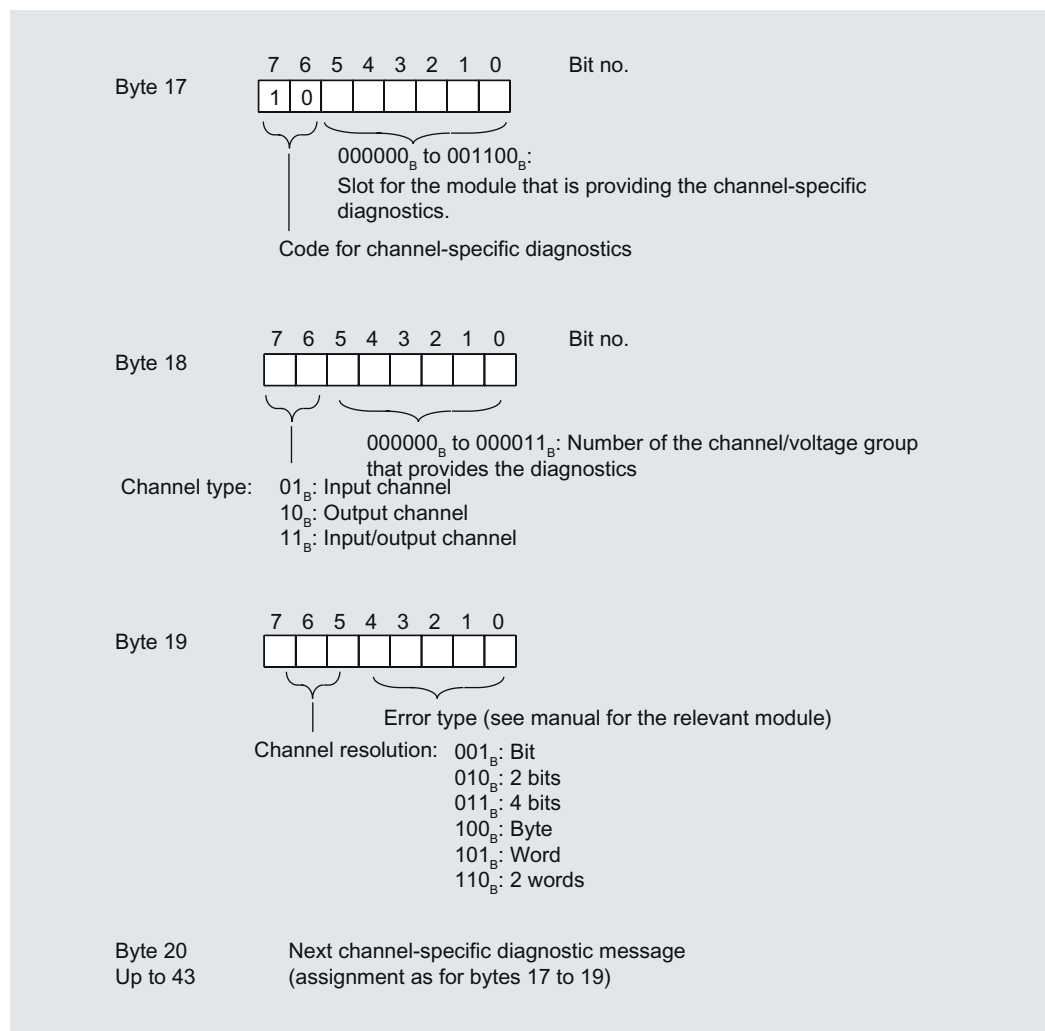Up to 43   (assignment as for bytes 17 to 19)

Figure 6-4   Structure of the channel-specific diagnostics for the ET 200S with COMPACT module

Note

The module slot coding is contained in byte 17, bits 0 to 5. The following applies: Displayed number +1 ≙ Slot of the module (0 ≙ Slot 1; 1 ≙ Slot 2; 3 ≙ Slot 4, etc.)

In bits 6/7 of byte 18, 00_B is output if a power module reports channel-specific diagnostics.

6.3.8 Incorrect module configurations of ET 200S on the PROFIBUS DP

Invalid module configuration states

The following invalid ET 200S module configuration states lead to an ET 200S station failure or prevent entry into data exchange. These responses occur regardless of whether the IM parameters "Operation at set <> actual configuration", "Replace modules during operation", and "Startup at set <> actual configuration" have been enabled.

● Two missing modules

● Terminating module missing

● Number of modules exceeds maximum configuration

● Backplane bus fault (for example, defective terminal module)

Note

The station will not start up if **one** module is missing (gap) and the ET 200S is switched on.

Diagnostics

You can identify any invalid module configuration states on the basis of the following diagnostics:

Identifier-related diagnostics	Module status
All 13 bits set	● 01_B: "Module error; invalid user data" for all modules (slots) until the cause of the error is found ● 11_B: "No module; invalid user data" once the cause of the error is found

Response times for the ET 200S $\qquad$ 7

Calculating the response times for the 32DI IM151-1 COMPACT and 16 DI/16 DO IM151-1 COMPACT

The following equation enables you to make an approximate calculation of the ET 200S response time:

32DI IM 151-1 COMPACT:
Response time [µs] = 156 m + 33 do + 486 ai + 374 ao + 1,633 t + 1,576

16 DI/16 DO IM 151-1 COMPACT:
Response time [µs] = 156 m + 33 do + 486 ai + 374 ao + 1,633 t + 1664

Explanation of the parameters:
- **m**: Total number of all modules (power modules, digital electronic modules, analog electronic modules, 4 IQ-SENSE electronic modules, 4POTDIS potential distribution module, RESERVE module, technological modules, and motor starters)
- **do**: Sum total of all digital output modules
- **ai**: Sum total of all analog input modules and 1SSI fast electronic modules
- **ao**: Sum total of all analog output modules
- **t**: Total number of technological modules (except 1SSI fast)

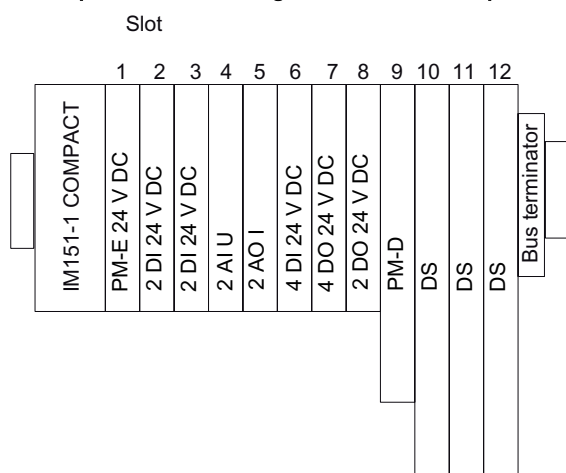**Example for calculating the ET 200S response time for 32DI COMPACT**

Figure 7-1   Example setup for calculating the response time of the 32DI IM151-1 COMPACT

Calculation method:
m = 12; do = 2; ai = 1; ao = 1; t = 0
Response time = 156 m + 33·do + 486 ai + 374 ao + 1,633 t + 1,576
Response time = 156 12 + 33·2 + 486 1 + 374 1 + 1,633 0 + 1,576
Response time = **4374 µs**

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