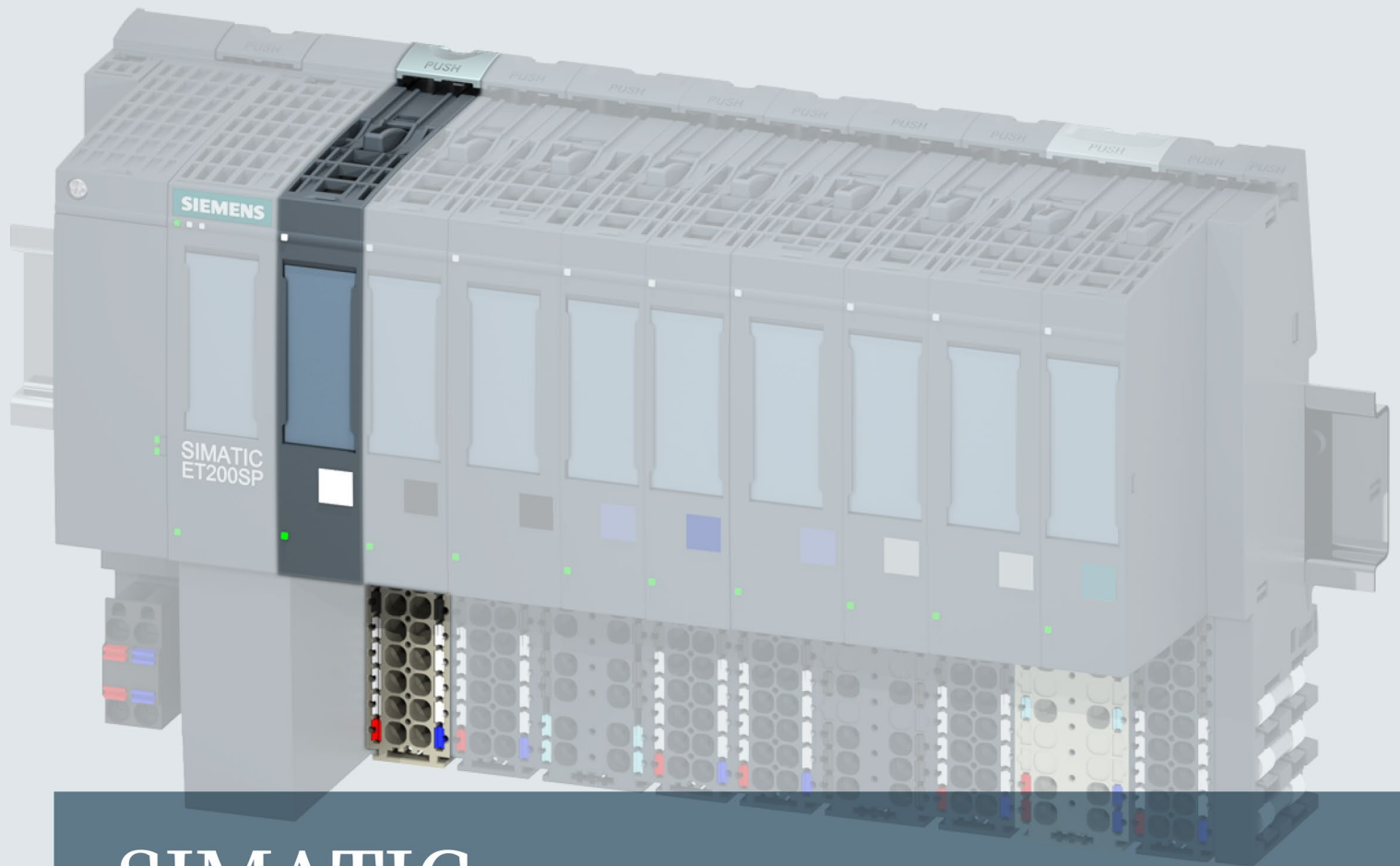


**SIEMENS**



# SIMATIC

ET 200SP

Digital input module DI 16x24VDC ST (6ES7131-6BH00-0BA0)

Manual

Edition

12/2015

Answers for industry.

# SIEMENS

## SIMATIC

ET 200SP  
Digital input module  
DI 16x24VDC ST  
(6ES7131-6BH00-0BA0)

Manual

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## Legal information

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

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

## Purpose of the documentation

This manual supplements the ET 200SP distributed I/O system (<http://support.automation.siemens.com/WW/view/en/58649293>) system manual.

Functions that generally relate to the system are described in this system manual.

The information provided in this manual and in the system/function manuals supports you in commissioning the system.

## Conventions

**CPU:** When the term "CPU" is used in this manual, it applies to the CPUs of the S7-1500 automation system as well as to the CPUs/interface modules of the ET 200SP distributed I/O system.

**STEP 7:** In this documentation, "STEP 7" is used as a synonym for all versions of the configuration and programming software "STEP 7 (TIA Portal)".

Please also observe notes marked as follows:

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### Note

A note contains important information on the product described in the documentation, on the handling of the product or on the section of the documentation to which particular attention should be paid.

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To stay informed about product updates as they occur, sign up for a product-specific newsletter. You can find more information on the Internet (<http://support.automation.siemens.com>).

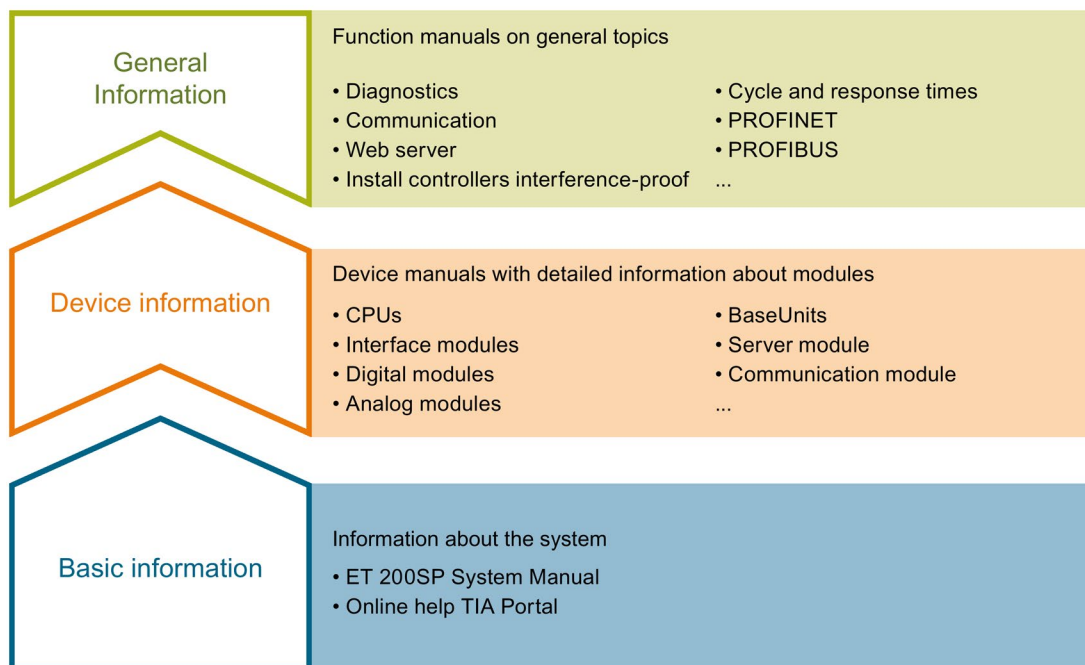
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## Documentation guide

The documentation for the SIMATIC ET 200SP distributed I/O system is arranged into three areas.

This arrangement enables you to access the specific content you require.



### Basic information

The system manual describes in detail the configuration, installation, wiring and commissioning of the SIMATIC ET 200SP. distributed I/O system. The STEP 7 online help supports you in the configuration and programming.

### Device information

Product manuals contain a compact description of the module-specific information, such as properties, terminal diagrams, characteristics and technical specifications.

### General information

The function manuals contain detailed descriptions on general topics regarding the SIMATIC ET 200SP distributed I/O system, e.g. diagnostics, communication, Web server, designing interference-free controllers.

You can download the documentation free of charge from the Internet (<http://w3.siemens.com/mcms/industrial-automation-systems-simatic/en/manual-overview/tech-doc-et200/Pages/Default.aspx>).

Changes and supplements to the manuals are documented in a Product Information.

You can download the product information free of charge from the Internet (<https://support.industry.siemens.com/cs/us/en/view/73021864>).

## Manual Collection ET 200SP

The Manual Collection contains the complete documentation on the SIMATIC ET 200SP distributed I/O system gathered together in one file.

You can find the Manual Collection on the Internet (<http://support.automation.siemens.com/WW/view/en/84133942>).

## "mySupport"

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You configure your own download package with a few clicks.

In doing so you can select:

- Product images, 2D dimension drawings, 3D models, internal circuit diagrams, EPLAN macro files
- Manuals, characteristics, operating manuals, certificates
- Product master data

You can find "mySupport" - CAx Data in the Internet (<http://support.industry.siemens.com/my/ww/en/CAxOnline>).

## Application examples

The application examples support you with various tools and examples for solving your automation tasks. Solutions are shown in interplay with multiple components in the system - separated from the focus in individual products.

You can find the application examples on the Internet (<https://support.industry.siemens.com/sc/ww/en/sc/2054>).

## **TIA Selection Tool**

With the TIA Selection Tool, you can select, configure and order devices for Totally Integrated Automation (TIA).

This tool is the successor of the SIMATIC Selection Tool and combines the known configurators for automation technology into one tool.

With the TIA Selection Tool, you can generate a complete order list from your product selection or product configuration.

You can find the TIA Selection Tool on the Internet

(<http://w3.siemens.com/mcms/topics/en/simatic/tia-selection-tool>).



## Product overview

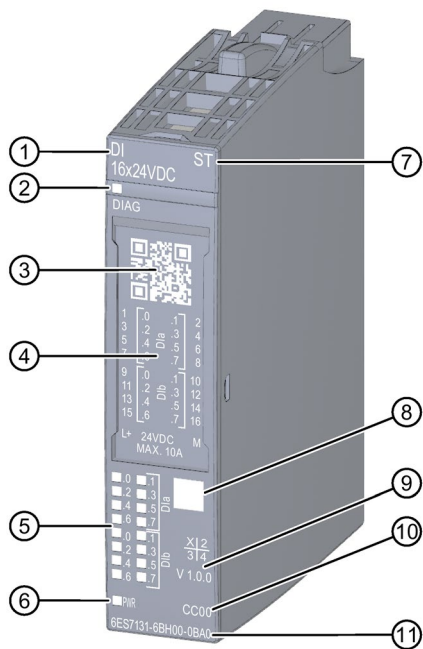
### 2.1 Properties

#### Article number

6ES7131-6BH00-0BA0 (packaging unit: 1 unit)

6ES7131-6BH00-2BA0 (packaging unit: 10 units)

#### View of the module



- |                           |  |
|---------------------------|--|
| ① Module type and name    | ⑦ Function class   |
| ② LED for diagnostics     | ⑧ Color coding module type                                 |
| ③ 2D matrix code          | ⑨ Function and firmware version                            |
| ④ Wiring diagram          | ⑩ Color code for selecting the color identification labels |
| ⑤ LEDs for channel status | ⑪ Article number   |
| ⑥ LED for supply voltage  |  |

Image 2-1 View of the module DI 16×24VDC ST

### Properties

The module has the following technical properties:

- Digital input module with 16 inputs
- Sink input, (PNP, P-reading)
- Supply voltage L+
- Configurable input delay 0.05 to 20 ms (per channel)
- Configurable diagnostics (per module)
- Suitable for connection of switches and 2-wire sensors in accordance with IEC 61131, type 3

The module supports the following functions:

- Firmware update
- I&M identification data
- Configuration in RUN

Table 2- 1 Version dependencies of other module functions

Function	Product version of the module as of	Firmware version of the module as of
Value status	1	V1.1.0

You can configure the module with STEP 7 (TIA Portal) and with a GSD file.

### Accessories

The following accessories must be ordered separately:

- Labeling strips
- Color identification labels
- Reference identification label
- Shield connector

### See also

You can find additional information on the accessories in the system manual ET 200SP distributed I/O system (<https://support.industry.siemens.com/cs/ww/en/view/91696622>).

# Connecting

## 3.1 Wiring and block diagram

This section includes the block diagram of the DI 16x24VDC ST module with the terminal assignments for a 1-wire connection.

Information on wiring the BaseUnit can be found in the system manual ET 200SP distributed I/O system (<http://support.automation.siemens.com/WW/view/en/58649293>).

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**Note**

The load group of the module must begin with a light-colored BaseUnit. Keep this in mind also during the configuration.

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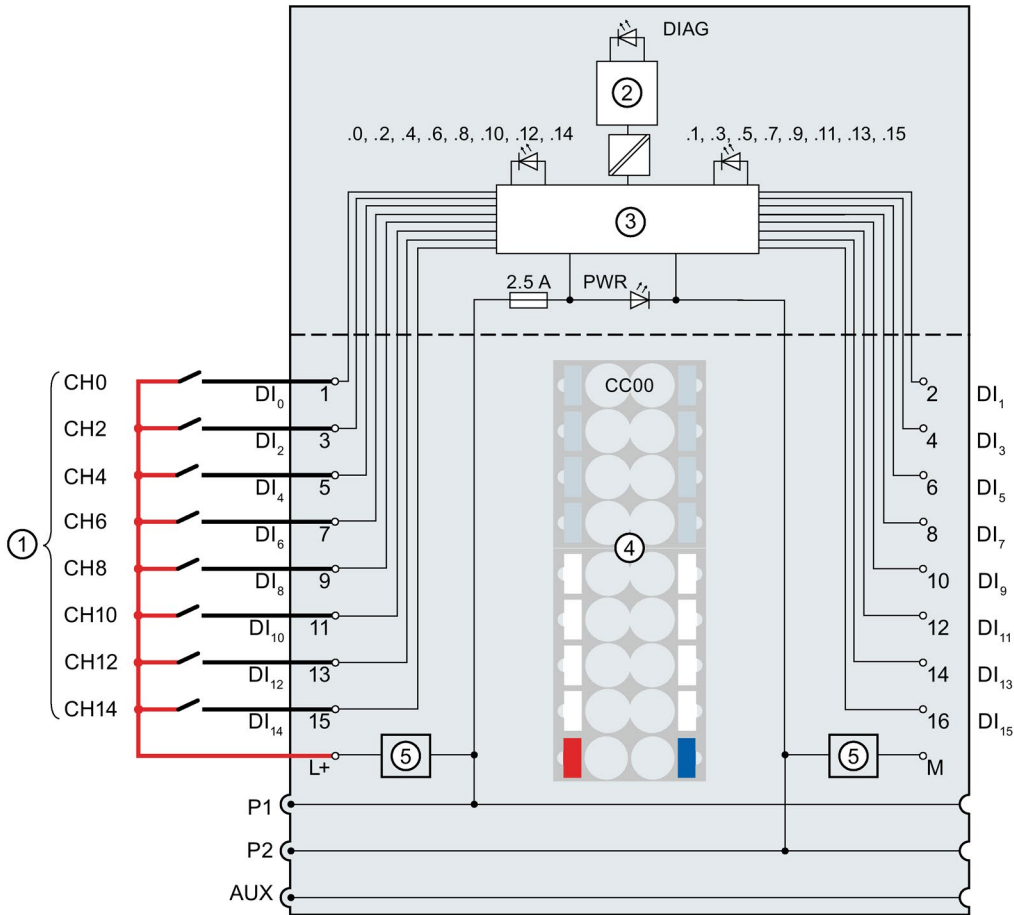
**Note**

Make sure that you only use digital modules with BaseUnit type A0 during commissioning.

---

**Wiring: 1-wire connection**

The following figure shows the block diagram and an example of the terminal assignment of the digital input module DI 16x24VDC ST on the BaseUnit BU type A0 without AUX terminals (1-wire connection).



①	1-wire connection	DI <sub>n</sub>	Input signal, channel n
②	Backplane bus interface	L+	24 V DC (infeed only with light-colored BaseUnit)
③	Input electronics	M	Ground
④	Color-coded label with color code CC00 (optional)	DIAG	Error or diagnostics LED (green, red)
⑤	Filter connection supply voltage (only when light-colored BaseUnit is present)	.0 to .15	Channel status LED (green)
P1, P2, AUX	Internal self-assembling voltage buses Connection to left (dark-colored BaseUnit) Connection to left interrupted (light-colored BaseUnit)	PWR	Power LED (green)

Image 3-1 Wiring and block diagram for 1-wire connection of encoders

# Parameters/address space

## 4.1 Parameters

### Parameters for DI 16x24VDC ST

The effective range of the configurable parameters depends on the type of configuration. The following configurations are possible:

- Central operation with an ET 200SP CPU
- Distributed operation on PROFINET IO in an ET 200SP system
- Distributed operation on PROFIBUS DP in an ET 200SP system

When assigning parameters in the user program, use the "WRREC" instruction to transfer the parameters to the module using the data records; refer to section Parameter assignment and structure of parameter data record (Page 24).

The following parameter settings are possible:

Table 4- 1 Configurable parameters and their defaults (GSD file)

Parameters	Range of values	Default	Parameter reassignment in RUN	Effective range with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP <sup>2</sup>
Diagnostics: No supply voltage L+	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Disable	Yes	Module	Module
Diagnostics wire break <sup>1</sup>	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Disable	Yes	Module	Module
Channel activated	<ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>	Enable	Yes	Channel	Channel

4.1 Parameters

Parameters	Range of values	Default	Parameter reassignment in RUN	Effective range with configuration software, e.g. STEP 7 (TIA Portal)	
				GSD file PROFINET IO	GSD file PROFIBUS DP <sup>2</sup>
Input delay	<ul style="list-style-type: none"> <li>• None</li> <li>• 0.05 ms</li> <li>• 0.1 ms</li> <li>• 0.4 ms</li> <li>• 0.8 ms</li> <li>• 1.6 ms</li> <li>• 3.2 ms</li> <li>• 12.8 ms</li> <li>• 20 ms</li> </ul>	3.2 ms	Yes	Channel	Module
Potential group	<ul style="list-style-type: none"> <li>• Use potential group of the left module (module plugged into a dark-colored BaseUnit)</li> <li>• Enable new potential group (module plugged into light-colored BaseUnit)</li> </ul>	Use potential group of the left module	No	Module	Module

<sup>1</sup> If you use a floating switch, you need to connect a resistor in parallel so that the wire break diagnostics is enabled in the open state (sensor resistance for the wire break diagnostics: 25 kΩ to 45 kΩ).

<sup>2</sup> Due to the limited number of parameters with a maximum of 244 bytes per ET 200SP station for a PROFIBUS GSD configuration, the configuration options are restricted. If required, you can assign these parameters using data record 128 as described in the "GSD file PROFINET IO" column (see table above). The parameter length of the I/O module is 4 bytes.

## 4.2 Declaration of parameters

### **Diagnostics: No supply voltage L+**

Enabling of the diagnostics for no or insufficient supply voltage L+.

### **Diagnostics: Wire break**

Enabling diagnostics if the line to the encoder is interrupted.

### **Channel activated**

Determines whether a channel is activated or deactivated.

### **Input delay**

This parameter can be used to suppress signal interference. Changes to the signal are only detected if they are constantly pending longer than the set input delay time.

### **Potential group**

A potential group consists of a group of directly adjacent I/O modules within an ET 200SP station, which are supplied via a common supply voltage.

A potential group begins with a light-colored BaseUnit through which the required voltage is supplied for all modules of the potential group. The light-colored BaseUnit interrupts the three self-assembling voltage buses P1, P2 and AUX to the left neighbor.

All additional I/O modules of this potential group are plugged into dark-colored BaseUnits. You take the potential of the self-assembling voltage buses P1, P2 and AUX from the left neighbor.

A potential group ends with the dark-colored BaseUnit, which follows a light-colored BaseUnit or server module in the station configuration.

### **See also**

You can find additional information in the system manual ET 200SP distributed I/O system (<https://support.industry.siemens.com/cs/ww/en/view/91696622>).

## 4.3 Address space

The module can be configured differently in STEP 7; see following table. Depending on the configuration, additional/different addresses are assigned in the process image input.

### Configuration options of DI 16x24VDC ST

You can configure the module with STEP 7 (TIA Portal) or with a GSD file. If you configure the module by means of a GSD file, the configurations are available under various short designations/module names; see the table below. The following configurations are possible:

Table 4- 2 Configuration options with GSD file

Configuration	Short designation/module name in the GSD file	Configuration software, e.g. with STEP 7 (TIA Portal)		
		Integrated in the hardware catalog STEP 7, as of V13, SP1	GSD file PROFINET IO	GSD file PROFIBUS DP
1 x 16-channel without value status	DI 16x24VDC ST V1.0	X	X	X
1 x 16-channel without value status	DI 16x24VDC ST V1.1	---	X	X
1 x 16-channel with value status	DI 16x24VDC ST V1.1, QI	---	X	---

### Evaluating the value status

An additional two bytes are allocated in the input address space if you enable the value status for the digital module. Bits 0 to 15 in these bytes are assigned to a channel. They provide information about the validity of the digital value.

Bit = 1: No fault is present on the channel.

Bit = 0: Channel is deactivated or there is a fault on the module.

If a fault occurs on a channel with this module, the value status for all channels is 0.



## Address space

The following figure shows the assignment of the address space for the DI 16×24VDC ST with value status (Quality Information (QI)). The addresses for the value status are only available if the value status is enabled.

Assignment in the process image input (PII)

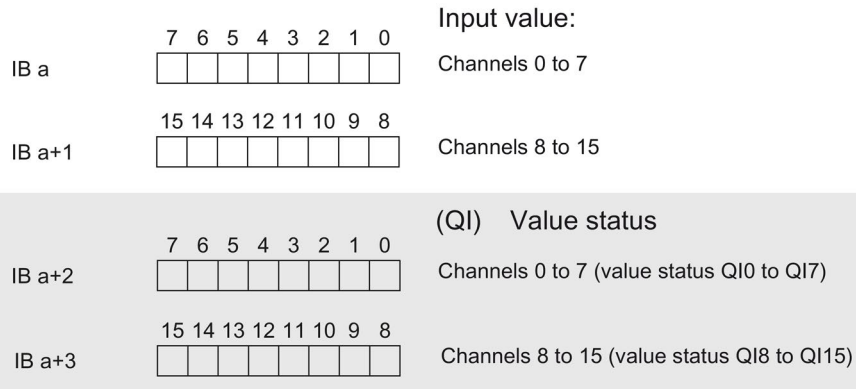


Image 4-1 Address space of the DI 16×24VDC ST with value status

## Interrupts/diagnostic alarms

### 5.1 Status and error display

#### LED display

The following figure shows you the LED display of the DI 16x24VDC ST.

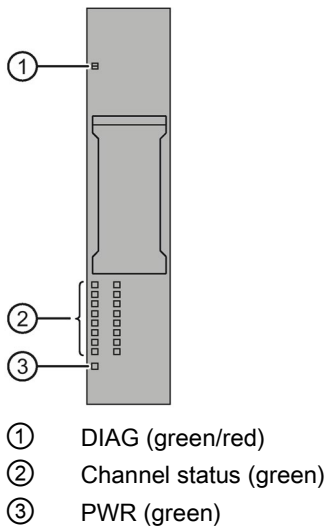






Image 5-1 LED display

## Meaning of the LEDs

The following tables show the meaning of the status and error displays. Corrective measures for diagnostics alarms can be found in section Diagnostic messages (Page 20).



### DIAG LED

Table 5- 1 Error display of the DIAG LED

DIAG LED	Meaning
 Off	Backplane bus supply of the ET 200SP not OK
 Flashes	Module parameters not assigned
 On	Module parameters assigned and no module diagnostics
 Flashes	Module parameters assigned and module diagnostics



### Channel status LED

Table 5- 2 Status display of the channel status LED

Channel status LED	Meaning
 Off	Process signal = 0
 On	Process signal = 1

### PWR LED

Table 5- 3 Status display of the PWR LED

PWR LED	Meaning
 Off	Missing supply voltage L+
 On	Supply voltage L+ present

## 5.2 Interrupts

The DI 16x24VDC ST digital input module supports diagnostic interrupts.

### Diagnostics interrupts

The module generates a diagnostic interrupt at the following events:

- Wire break
- Parameter assignment error
- Supply voltage missing
- Channel temporarily unavailable

## 5.3 Diagnostic messages

A diagnostics alarm is generated and the DIAG-LED flashes on the module for each diagnostics event. You can read out the diagnostics alarms, for example, in the diagnostics buffer of the CPU. You can evaluate the error codes with the user program.

Table 5- 4 Diagnostics alarms, their meaning and corrective measures

Diagnosics alarm	Error code	Meaning	Solution
Wire break	6H	Impedance of encoder circuit too high.	Use a different encoder type or modify the wiring, for example, use cables with larger cross-section
		Wire break between the module and sensor	Connect the cable
		Channel not connected (open)	<ul style="list-style-type: none"> <li>• Disable diagnostics</li> <li>• Connect a resistor of between 25 and 45 kOhms to the encoder contacts</li> </ul>
Parameter assign-ment error	10H	<ul style="list-style-type: none"> <li>• The module cannot evaluate parame-ters for the channel.</li> <li>• Incorrect parameter assignment.</li> </ul>	Correct the parameter assignment
Supply voltage miss-ing	11H	Missing or insufficient supply voltage L+	<ul style="list-style-type: none"> <li>• Check supply voltage L+ on the BaseUnit</li> <li>• Check BaseUnit type</li> </ul>
Channel temporarily unavailable	1FH	Firmware update is currently in progress or has been canceled. The module does not read in process values in this state.	<ul style="list-style-type: none"> <li>• Wait for firmware update.</li> <li>• Restart the firmware update.</li> </ul>

## Technical specifications

### 6.1 Technical specifications

#### Technical specifications of the DI 16x24VDC ST

<b>6ES7131-6BH00-0BA0</b>	
<b>General information</b>	
Product type designation	ET 200SP, DI 16x24VDC ST, PU 1
Firmware version	V1.1
<ul style="list-style-type: none"> <li>FW update possible</li> </ul>	Yes
Usable BaseUnits	BU type A0
Color code for module-specific color identification label	CC00
<b>Product function</b>	
I&M data	Yes; I&M0 to I&M3
<b>Engineering with</b>	
STEP 7 TIA Portal can be configured/integrated as of version	V13 SP1
STEP 7 can be configured/integrated as of version	V5.5 / -
PCS 7 can be configured/integrated as of version	V8.1 SP1
PROFIBUS as of GSD version/GSD revision	GSD revision 5
PROFINET as of GSD version/GSD revision	GSDML V2.3
<b>Operating mode</b>	
DI	Yes
Counter	No
Oversampling	No
MSI	No
<b>Supply voltage</b>	
Rated value (DC)	24 V
Valid range, low limit (DC)	19.2 V
Valid range, high limit (DC)	28.8 V
Polarity reversal protection	Yes
<b>Input current</b>	
Current consumption, max.	90 mA

<b>6ES7131-6BH00-0BA0</b>	
<b>Encoder supply</b>	
Short-circuit protection	No
<b>24 V encoder supply</b>	
24 V	No
Short-circuit protection	No
<b>Power loss</b>	
Power loss, typ.	1.7 W
<b>Address area</b>	
<b>Address space per module</b>	
Address space per module, max.	2 bytes; + 2 bytes for QI information
<b>Digital inputs</b>	
Number of inputs	16
Sinking/sourcing input	Yes; reading p
Input characteristic curve acc. to IEC 61131, type 1	Yes
Input characteristic curve acc. to IEC 61131, type 2	No
Input characteristic curve acc. to IEC 61131, type 3	Yes
Pulse stretching	No
<b>Input voltage</b>	
Type of input voltage	DC
Rated value (DC)	24 V
For signal "0"	-30 ... +5 V
For signal "1"	+11 ... +30 V
<b>Input current</b>	
For signal "1", typ.	2.5 mA
<b>Input delay (for rated value of input voltage)</b>	
For standard inputs	
<ul style="list-style-type: none"> <li>• Configurable</li> </ul>	Yes; 0.05 / 0.1 / 0.4 / 0.8 / 1.6 / 3.2 / 12.8 / 20 ms (in each case + delay of 30 to 500 µs, depending on cable length)
<ul style="list-style-type: none"> <li>• With "0" to "1", min.</li> </ul>	0.05 ms
<ul style="list-style-type: none"> <li>• With "0" to "1", max.</li> </ul>	20 ms
<ul style="list-style-type: none"> <li>• With "1" to "0", min.</li> </ul>	0.05 ms
<ul style="list-style-type: none"> <li>• With "1" to "0", max.</li> </ul>	20 ms
For interrupt inputs	
<ul style="list-style-type: none"> <li>• Configurable</li> </ul>	No
for counters/technological functions	
<ul style="list-style-type: none"> <li>• Configurable</li> </ul>	No
<b>Cable length</b>	
Shielded, max.	1000 m
Unshielded, max.	600 m

<b>6ES7131-6BH00-0BA0</b>	
<b>Encoders</b>	
<b>Supported encoders</b>	
2-wire sensor	Yes
<ul style="list-style-type: none"> <li>Permissible quiescent current (2-wire sensor), max.</li> </ul>	1.5 mA
<b>Isochronous mode</b>	
Isochronous mode (application synchronized up to terminal)	No
<b>Interrupts/diagnostics/status information</b>	
<b>Interrupts</b>	
Diagnostics interrupt	Yes
<b>Diagnostics alarms</b>	
Diagnostic information can be read	Yes
Diagnostics	Yes
Monitoring of the supply voltage	Yes
<ul style="list-style-type: none"> <li>Configurable</li> </ul>	Yes
Monitoring of the encoder supply	No
Wire break	Yes; module by module
Short-circuit	No
Group error	Yes
<b>Diagnostics indicator LED</b>	
Monitoring of the supply voltage (PWR LED)	Yes; green PWR LED
Channel status display	Yes; green LED
For channel diagnostics	No
For module diagnostics	Yes; green/red DIAG LED
<b>Electrical isolation</b>	
<b>Electrical isolation of channels</b>	
Between the channels	No
Between the channels and backplane bus	Yes
Between the channels and voltage supply of the electronics	No
<b>Permitted potential difference</b>	
Between different circuits	75 V DC / 60 V AC (basic insulation)
<b>Insulation</b>	
Insulation tested with	707 V DC (type test)
<b>Dimensions</b>	
Width	15 mm
<b>Weights</b>	
Weight, approx.	28 g

## Dimension drawing

See manual ET 200SP BaseUnits  
(<http://support.automation.siemens.com/WW/view/en/59753521>)

## Parameter data record

### A.1 Parameter assignment and structure of parameter data record

The data record of the module has an identical structure, regardless of whether you configure the module with PROFIBUS DP or PROFINET IO. With data record 128, you can reconfigure the module in your user program regardless of your programming. This means that you can use all the functions of the module even if you configured it via PROFIBUS-GSD.

#### Parameter assignment in the user program

You can change the parameters of the module in RUN.

#### Changing parameters in RUN

The "WRREC" instruction is used to transfer the parameters to the module using data record 128. The parameters set in STEP 7 are not changed in the CPU, which means that the parameters set in STEP 7 will be valid again after a restart.

#### Output parameter STATUS

If errors occur when transferring parameters with the "WRREC" instruction, the module continues operation with the previous parameter assignment. The STATUS output parameter contains a corresponding error code.

You will find a description of the "WRREC" instruction and the error codes in the STEP 7 online help.



Structure of data record 128

**Note**

Channel 0 includes the diagnostics enable for the entire module.

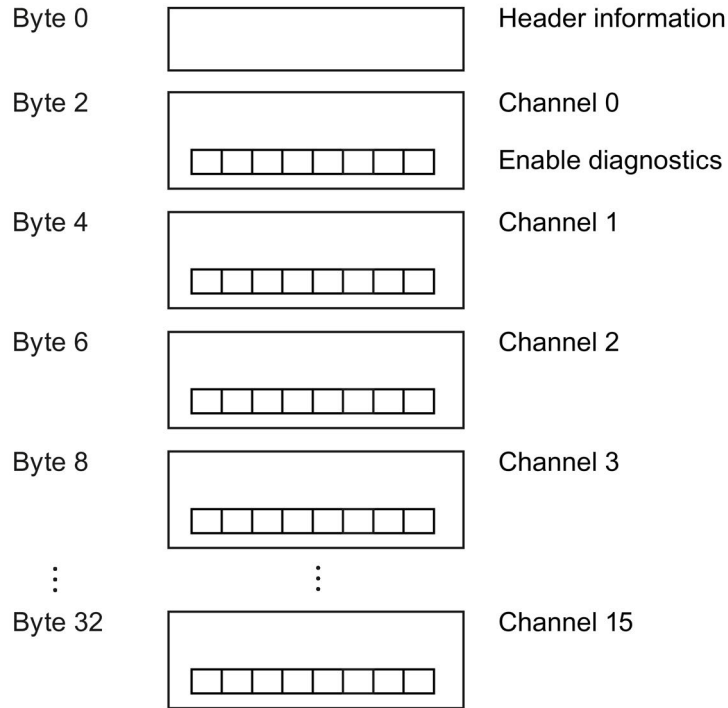


Image A-1 Structure of data record 128

**Header information**

The figure below shows the structure of the header information.

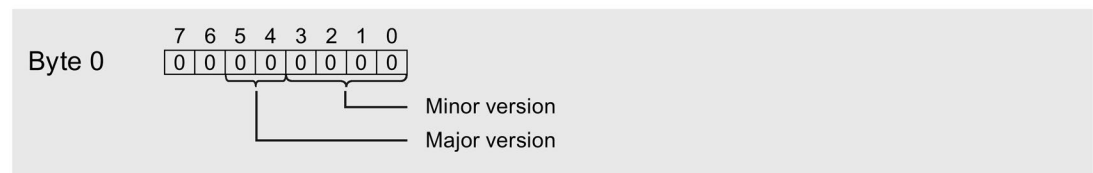
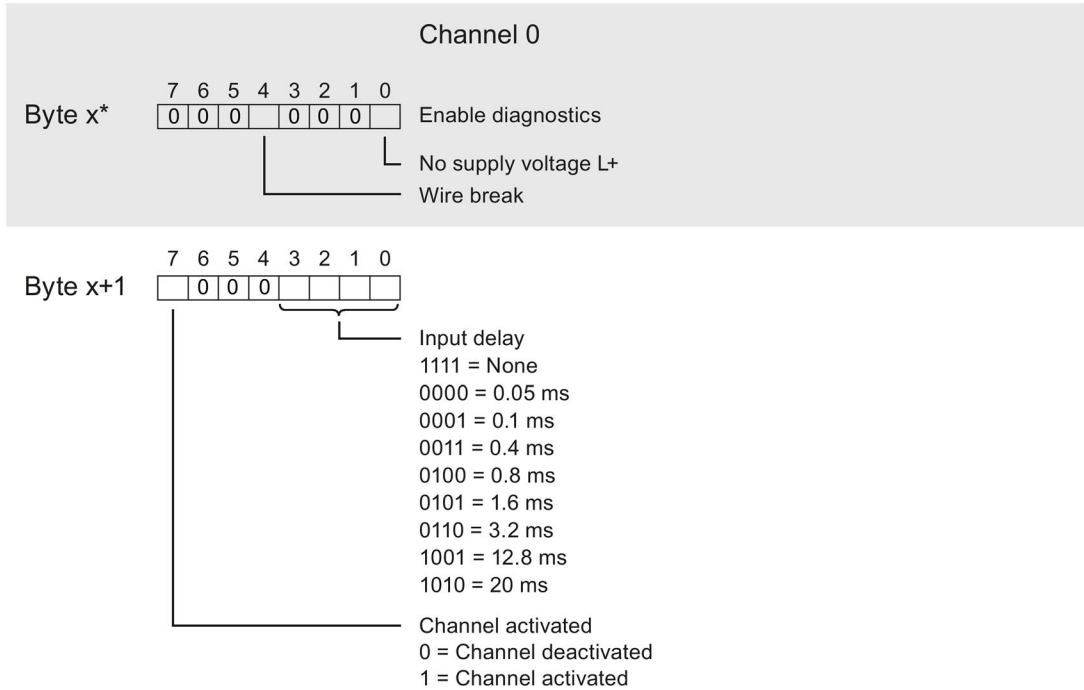


Image A-2 Header information

**Parameters**

The figure below shows the structure of the parameters for channels 0 to 15. You enable a parameter by setting the corresponding bit to "1".



\* x = 2 + (channel number × 2); channel number = 0 to 15

Image A-3 Structure byte x to x+1 for the channels 0 to 15

## Error transmitting the data record

The module always checks all values of the data record to be sent. The module applies the values from the data record only when all values have been transmitted without errors.

The WRREC instruction for writing data records returns the appropriate error code if there are errors in the STATUS parameter.

The following table shows the module-specific error codes and their meaning for parameter data record 128.

Error code in the STATUS parameter (hexadecimal)				Meaning	Solution
Byte 0	Byte 1	Byte 2	Byte 3		
DF	80	B0	xx	Number of the data record unknown	Enter valid number for data record.
DF	80	B1	xx	Length of the data record incorrect	Enter valid value for data record length.
DF	80	B2	xx	Slot invalid or unavailable	<ul style="list-style-type: none"> <li>• Check the station to determine whether the module is plugged in or pulled.</li> <li>• Check assigned values for the parameters of the WREC instruction.</li> </ul>
DF	80	E0	xx	Wrong version or error in the header information	Correct the version, length and number of parameter blocks.
DF	80	E1	xx	Parameter error	Check the parameters of the module