SIEMENS

SIMATIC

ET 200SP HA
Digital Input Module DI 16x24VDC HA (6DL1131-6BH00-0PH1)

Manual

Security information 1

Product overview 2

Wiring 3

Parameters 4

Displays and interrupts 5

Technical specifications 6

Drivers, parameters, diagnostics messages and address space A

11/2017
A5E39265608-AB

Legal information

Warning notice system

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

⚠ 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

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

NOTICE

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

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 product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

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.

Siemens AG
Division Process Industries and Drives
Postfach 48 48
90026 NÜRNBERG
GERMANY

A5E39265608-AB
℗ 01/2018 Subject to change

Copyright © Siemens AG 2017.
All rights reserved

Table of contents

1 Security information....5

2 Product overview....7

2.1 Properties of the I/O module DI 16x24VDC HA....7

3 Wiring....11

3.1 Terminal assignment of the I/O module DI 16x24VDC HA....11

3.2 Schematic circuit diagram....13

4 Parameters....15

4.1 Parameters of the I/O module DI 16x24VDC HA....15

4.2 Module/channel parameters....16

4.3 Explanation of the module/channel parameters....18

5 Displays and interrupts....21

5.1 Status and error displays of the I/O module DI 16x24VDC HA....21

5.2 Interrupts....24

6 Technical specifications....25

A Drivers, parameters, diagnostics messages and address space....31

A.1 Concept of the driver and diagnostics blocks....31

A.2 Parameter assignment....33

A.3 Parameter assignment and structure of the module/channel parameters....35

A.4 Diagnostics messages and maintenance events....38

A.5 Hardware interrupts....40

A.6 Address space....41

A.7 Address space of the time stamping (accuracy 1 ms)....42

Index....43

Security information

1

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines, and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit:
https://www.siemens.com/industrialsecurity

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
https://www.siemens.com/industrialsecurity.

Validity of the documentation

This device manual describes the DI 16×24VDC HA I/O module with the article number 6DL1131-6BH00-0PH1.

It complements the system manual of the ET 200SP HA Distributed I/O System.

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

The information in this device manual and the system/function manuals enables you to put the ET 200SP HA into operation.

Appendices

The appendices provide information that is relevant for using the ET 200SP HA outside the PCS 7 environment.

Conventions

Please also observe notes marked as follows:

Note

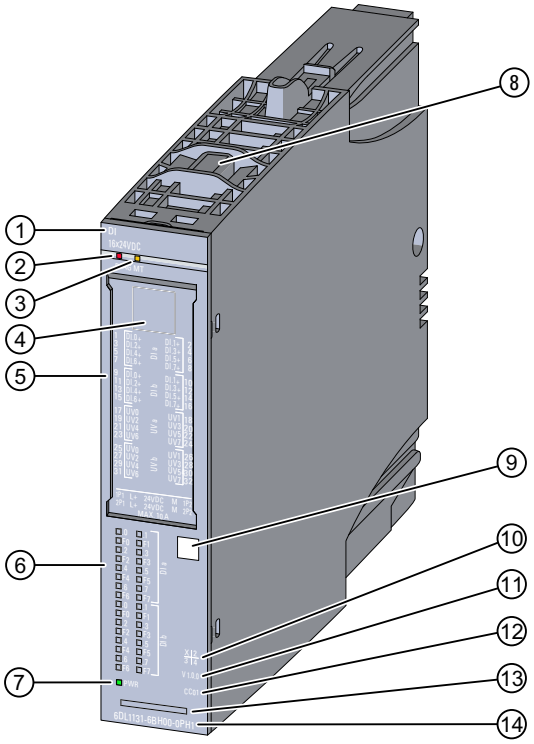
A note contains important information on the product described in the documentation, on the handling of the product or on the section of the documentation to which particular attention should be paid.

Product overview

2

2.1 Properties of the I/O module DI 16x24VDC HA

View of the module



① Module type and designation
② LED for diagnostics
③ LED for maintenance
④ 2D matrix code
⑤ Wiring diagram
⑥ LEDs for channel status/channel fault
⑦ LED for supply voltage
⑧ Output disable switch
⑨ Module type color coding
⑩ Product version
⑪ Function status and firmware version
⑫ Color code for selection of the color-coded labels
⑬ Serial number
⑭ Article number

Figure 2-1 View of the DI 16×24VDC HA

Properties

The I/O module has the following technical properties:

- 16 digital inputs with the following properties that can be individually configured for each channel
  - Pulse stretching
  - Diagnostics
  - Input delay
  - Hardware interrupts for positive and negative edges
- Sink input (PNP, active high)
- Module-specific configurable diagnostics for missing supply voltage L+
- Suitable for connecting switches and 2-wire sensors according to IEC 61131-2, types 1 and 3

The I/O module supports the following functions:

- Firmware update
- I&M identification data
- Parameter reassignment in RUN
- Value status QI
- IO redundancy
- Time stamping with 1 ms accuracy
- Output disable switch

You can configure the I/O module with HW Config and integrate it into your system.

Output disable switch

If you want to pull the I/O module in runtime, you have to press the output disable switch for 3 seconds for the I/O module to be deenergized.

When the output disable switch has been pressed for 3 seconds, the LED DIAG flashes red, the LED MT lights up yellow and the I/O module generates a diagnostics message. See section Status and error displays of the I/O module DI 16x24VDC HA (Page 21).

Note

Pressing the output disable switch interrupts any ongoing firmware update. A firmware update cannot be performed when the device is deenergized.

Accessories

The following accessories must be ordered separately:

- Labeling strips
- Color-coded labels

- Reference identification labels
- Shield connector

Wiring

3

3.1 Terminal assignment of the I/O module DI 16x24VDC HA

Terminal blocks

You can operate the I/O module with the following terminal blocks:

- 6DL1193-6TP00-0DH1, light
- 6DL1193-6TP00-0BH1, dark
- 6DL1193-6TP00-0DM1, light, for redundant configuration
- 6DL1193-6TP00-0BM1, dark, for redundant configuration

The terminal block is not included in the scope of delivery of the I/O module and must be ordered separately.

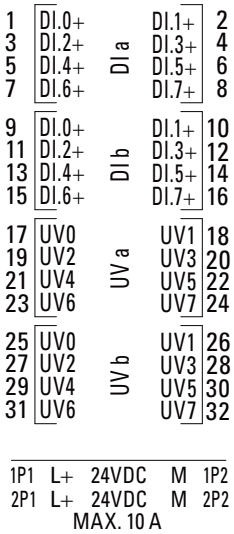
Note

You can find additional information on the configuration in the system manual.

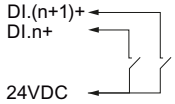
General pin assignment

Table 3-1 Pin assignment of the DI 16×24VDC HA

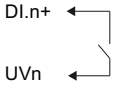
Terminal	Assignment	Terminal	Assignment	Explanations
1	DI a /DI.0+	2	DI a /DI.1+	DI a /DI.n+: Input signal, channel n (0…7) DI b /DI.n+: Input signal, channel n+8 (8…15) UV a /UV.n: Sensor supply, channel n (0...7) UV b /UV.n: Sensor supply, channel n+8 (8…15) 1P1: Supply voltage L+ of the voltage bus 1P 2P1: Supply voltage L+ of the voltage bus 2P 1P2: Ground reference of the voltage bus 1P 2P2: Ground reference of the voltage bus 2P
3	DI a /DI.2+	4	DI a /DI.3+	
5	DI a /DI.4+	6	DI a /DI.5+	
7	DI a /DI.6+	8	DI a /DI.7+	
9	DI b /DI.0+	10	DI b /DI.1+	
11	DI b /DI.2+	12	DI b /DI.3+	
13	DI b /DI.4+	14	DI b /DI.5+	
15	DI b /DI.6+	16	DI b /DI.7+	
17	UV a/UV0	18	UV a/UV1	
19	UV a/UV2	20	UV a/UV3	
21	UV a/UV4	22	UV a/UV5	
23	UV a/UV6	24	UV a/UV7	
25	UV b/UV0	26	UV b/UV1	
27	UV b/UV2	28	UV b/UV3	
29	UV b/UV4	30	UV b/UV5	
31	UV b/UV6	32	UV b/UV7	
1P1	L+	1P2	M	
2P1[1]	L+	2P2	M	



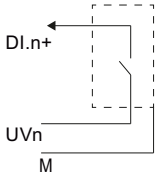
1-wire



2-wire



3-wire



[1] If the module is plugged into a TB45R-P32 terminal block suitable for IO redundancy, the potential at this terminal is 1P3.

3.2 Schematic circuit diagram

The following figure shows the block diagram of the DI 16×24VDC HA.

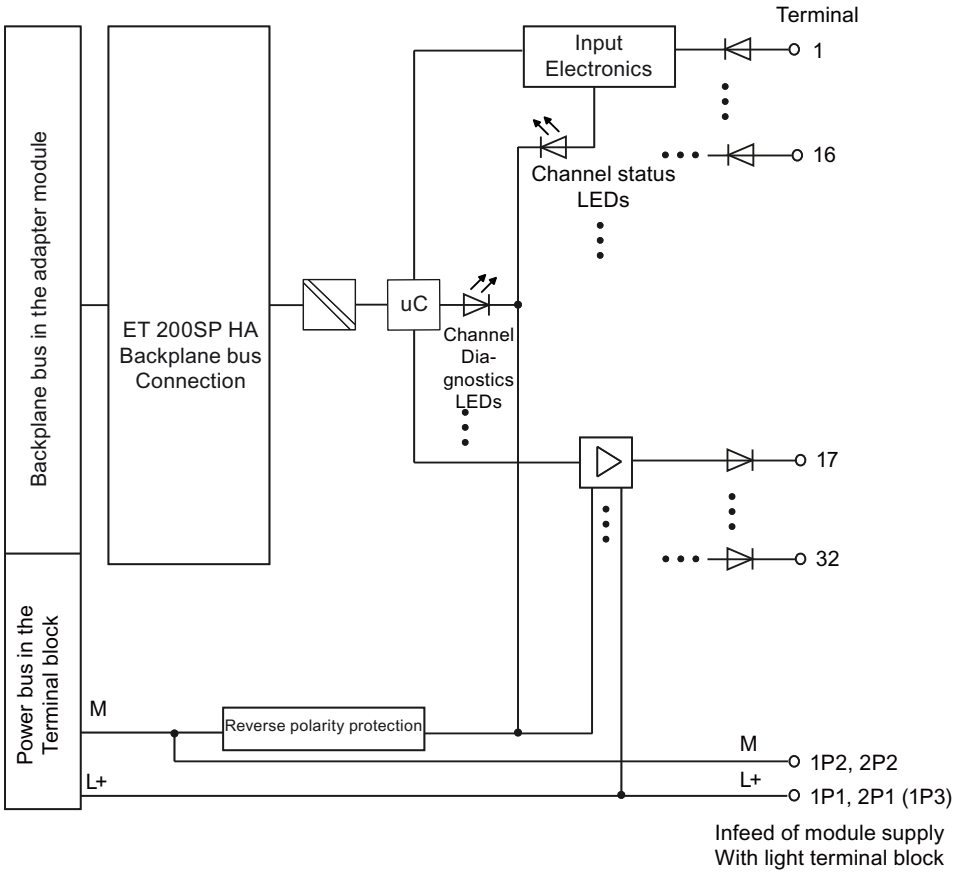


Figure 3-1 Block diagram DI 16X24VDC HA

Parameters

4

4.1 Parameters of the I/O module DI 16x24VDC HA

Configuration

You configure the I/O module with PCS 7 V9.0 or higher.

Parameters

You define the functioning of the I/O module via parameters.

See also

Parameter assignment and structure of the module/channel parameters (Page 35)

4.2 Module/channel parameters

Parameters of the DI 16X24VDC HA

You have the following setting options:

Table 4-1 Parameters and their defaults

Parameter	Value range	Default	Parameter re-assignment in RUN	Efficiency range
Diagnostics, Missing supply voltage L+	• Enabled • Disabled	Enabled	Yes	Module
IO redundancy	• None • 2 modules	None	No	Module
Diagnostics Short-circuit to ground	• Enabled • Disabled	Enabled	Yes	Channel
Diagnostics, Wire break [1]	• Enabled • Disabled	Enabled	Yes	Channel
Check for wire break	• Enabled • Disabled	Enabled	Yes	Channel
Channel activated	• Enabled • Disabled	Enabled	Yes	Channel
Input delay [2]	• None • 0.05 ms • 0.1 ms • 0.4 ms • 0.8 ms • 1.6 ms • 3.2 ms • 12.8 ms • 20 ms	3.2 ms	Yes	Channel
Pulse stretching [2]	• None • 0.05 s • 0.1 s • 0.2 s • 0.5 s • 1 s • 2 s	None	Yes	Channel
Hardware interrupts rising edge [2]	• Enabled • Disabled	Disabled	Yes	Channel

Parameter	Value range	Default	Parameter re-assignment in RUN	Efficiency range
Hardware interrupts falling edge [2]	• Enabled • Disabled	Disabled	Yes	Channel
Potential group	• Use potential group of the left module • Allow new potential group	Use potential group of the left module	No	Module

[1] The wire break diagnostics can only be enabled when the "Check for wire break" parameter is enabled. If you use a simple encoder contact, you need to connect a parallel resistor to enable wire break diagnostics in the open state (sensor resistance for wire break diagnostics: 15 kΩ to 18 kΩ).

[2] The input delay is switched off on all channels when high precision time stamping is activated. When high precision time stamping is activated, pulse stretching and the rising/falling edge hardware interrupt are deactivated on all channels (not adjustable).

Parameter reassignment

Each configuration change resets the corresponding reaction. Changing the configuration of a function does not affect other functions.

4.3 Explanation of the module/channel parameters

Diagnostics, Missing supply voltage L+

Enabling of the diagnostics for missing or insufficient supply voltage L+.

IO redundancy

You can configure two identical modules redundantly. To do so, plug both modules into a redundant terminal block side by side. You can find additional information on mounting modules in an IO redundancy configuration in the ET 200SP HA System Manual, section "Installing", "Installing terminal block".

In IO redundancy mode, the left-hand module is the master and the right-hand module is the slave.

Both redundant modules measure simultaneously and independently in the process. Both redundant modules generate diagnostics, alarms and process values.

Diagnostics, Short-circuit to ground

Enabling of the diagnostics if a short-circuit of the actuator supply to ground occurs.

Diagnostics, Wire break

When wire-break check is activated, you can enable wire-break diagnostics via the Diagnostics, Wire break parameter for insufficient current flow on the input.

Check for wire break

Enable for wire break check. The module can only detect a wire break when the wire-break check is activated.

Channel activated

Specifies whether a channel is activated or deactivated.

Input delay

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

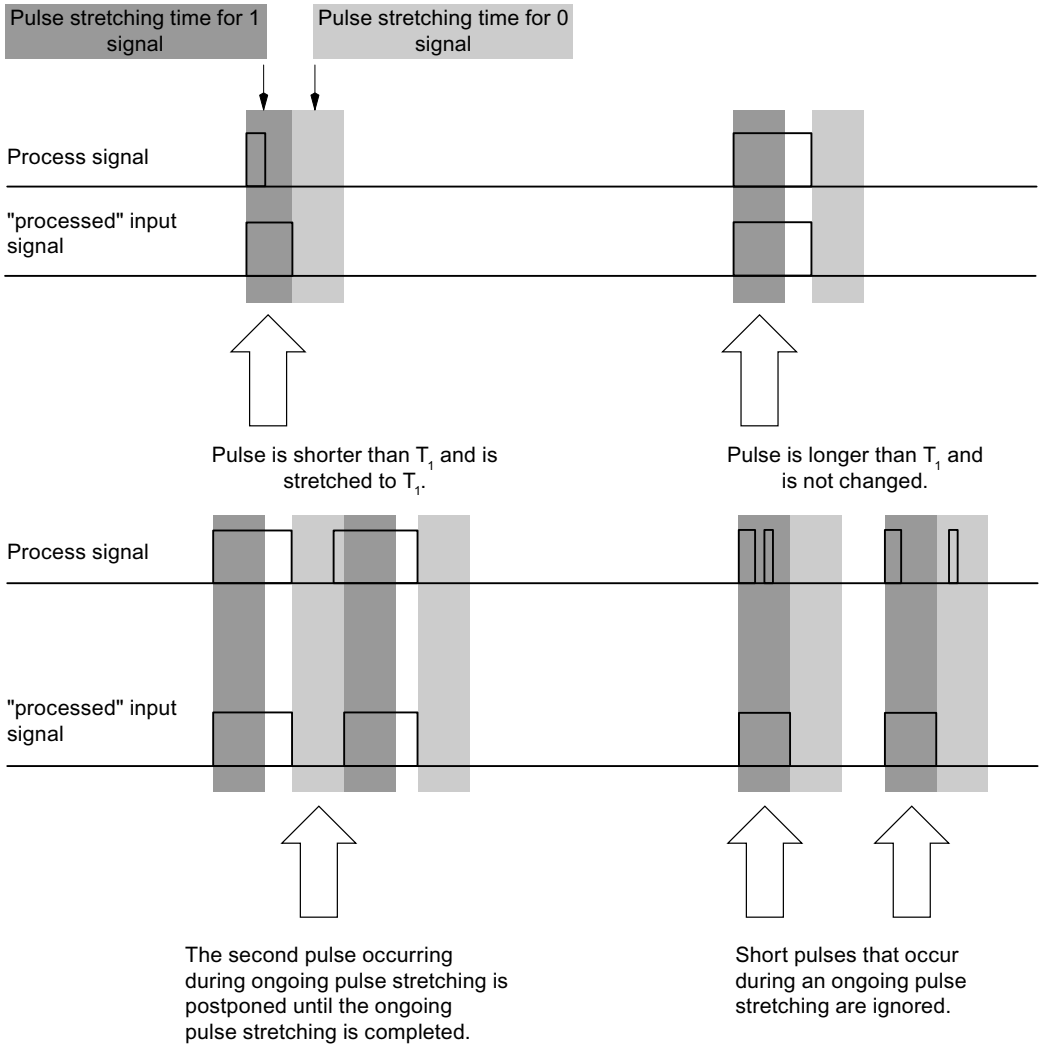
For input channels with longer input delays, the read-in time is moved accordingly. This means individual channels can be assigned input delays, if necessary, without having a negative impact on the possible cycle time.

Pulse stretching

Pulse stretching is a function for changing a digital input signal. A pulse on a digital input is stretched to at least the configured length. If the input pulse is already longer than the configured length, the pulse is not changed.

Principle of pulse stretching

The figure below uses examples to show whether and how input pulses are changed.



T_1 Pulse stretching parameter

Figure 4-1 Principle of pulse stretching

Hardware interrupts positive edge

Specifies if a hardware interrupt should be generated for a rising edge.

Hardware interrupts negative edge

Specifies if a hardware interrupt should be generated for a falling edge.

Potential group

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

A potential group begins with a light terminal block, via which the required supply voltage is fed to all I/O modules of the potential group. The light-colored terminal block interrupts the self-assembling voltage buses to the left neighbor

All other I/O modules of this potential group are plugged into dark terminal blocks. I/O modules on dark terminal blocks take the potentials of self-assembling voltage rails from the left neighbor.

A potential group ends with the dark terminal block, which follows a light terminal block or a server module in the station configuration.

You can find additional information on the configuration of the potential group in the system manual *SIMATIC; Distributed I/O System; ET 200SP HA*.

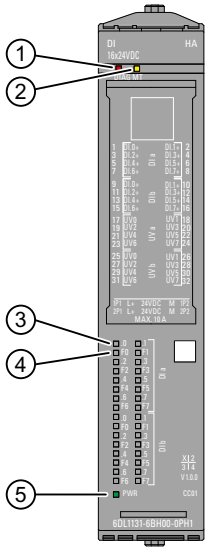
Displays and interrupts

5

5.1 Status and error displays of the I/O module DI 16x24VDC HA

LED displays

The following figure shows the LED displays of the I/O module:



① DIAG LED (green/red)
② MT LED (yellow)
③ Channel status LED (green)
④ Channel fault LED (red)
⑤ PWR LED (green)

Figure 5-1 LED displays

Meaning of the LED displays

The tables below explain the meaning of the status and error displays. Remedial measures for diagnostics alarms can be found in section Diagnostics messages and maintenance events (Page 38).

DIAG LED

Table 5-1 Diagnostics display of the DIAG LED

DIAG LED	Meaning
Off	The power supply of the ET 200SP HA is disrupted or switched off.
Flashes	Module is not configured.
On	Module is configured, a diagnostics message is not pending.
Flashes	Module is configured, at least one diagnostic message is pending.

MT LED

Table 5-2 Status display of the LED MT

MT LED	Meaning
Off	No maintenance required.
On	Maintenance is required, i.e. at least one maintenance event has occurred.

Channel status/channel error LED

Regardless of the parameter assignment, the green LED channel status shows the signal level at the input terminal. It lights up starting at approximately 10 V of terminal current.

The red channel fault LED lights up when a channel diagnostics is active for an enabled channel.

Table 5-3 Status and error display of the LEDs channel status and channel error

LED channel status	LED channel error	Meaning
Off	Off	Process signal = 0 and • Channel disabled or module switched off • Channel enabled and no channel diagnostics pending • Module diagnostics pending
On	Off	Process signal = 1 and • Channel disabled or module switched off • Channel enabled and no channel diagnostics pending • Module diagnostics pending

LED channel status	LED channel error	Meaning
□ Off	■ On	Process signal = 0 and • Channel enabled and channel diagnostics pending
■ On	■ On	Process signal = 1 and • Channel enabled and channel diagnostics pending

PWR LED

Table 5-4 Status display of the PWR LED

PWR LED	Meaning
□ Off	Supply voltage L+ missing.
■ On	Supply voltage L+ present.

5.2 Interrupts

The I/O module supports diagnostics interrupts, maintenance messages and hardware interrupts. You can find additional information on hardware interrupts in the appendix Hardware interrupts (Page 40)

Diagnostics interrupts

The I/O module generates a diagnostics interrupt at the following events:

- Supply voltage missing
- Short-circuit to ground
- Wire break
- Parameter assignment error
- Hardware interrupt lost
- Channel/component temporarily unavailable
- Retentive memory in carrier module defective
- Retentive memory in the terminal block defective
- Shutdown on button activation
- IO redundancy parameter assignment inconsistent

Maintenance messages

The I/O module generates a maintenance message for the following events:

- Redundancy partner has different hardware/firmware
- IO redundancy warning
- Retentive memory in carrier module defective
- Retentive memory in the terminal block defective

Technical specifications

6

Technical specifications of the DI 16X24VDC HA

Article number	6DL1131-6BH00-0PH1
General information	
Product type designation	DI 16x24VDC HA
HW functional status	FS01
Firmware version	V1.0
• FW update possible	Yes
Usable terminal block	TB type H1 and M1
Color code for module-specific color identification plate	CC01
Product function	
• I&M data	Yes; I&M0 to I&M3
Engineering with	
• PCS 7 configurable/integrated as of version	V9.0
Operating mode	
• DI	Yes
• Counter	No
• Oversampling	No
• MSI	No
Redundancy	
• Redundancy capability	Yes; With TB type M1
Supply voltage	
Rated value (DC)	24 V
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Input current	
Current consumption (rated value)	60 mA; without sensor supply
Current consumption, max.	120 mA; without sensor supply
Encoder supply	
Number of outputs	16
Output voltage encoder supply, min.	18.2 V; L+ (-1 V)
Short-circuit protection	Yes; Electronic (response threshold 0.7 A to 1.3 A; for IO redundancy up to 2.6 A) Ensure sufficient low-resistance cable routing to the sensor/actuator in order to attain the response threshold. Depending on the cable cross-section used, there may be constraints regarding the usable length of cable.
Output current	

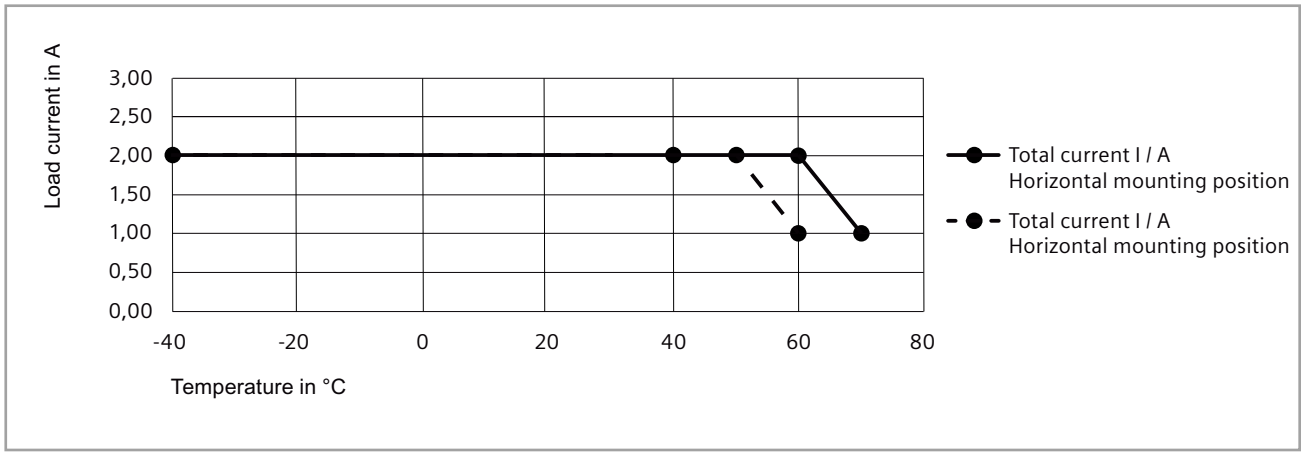
Article number	6DL1131-6BH00-0PH1
• up to 60 °C, max.	2 A; 1 A when mounted vertically; see derating information in Equipment Manual
• up to 70 °C, max.	1 A; See derating information in Equipment Manual
24 V encoder supply	
• 24 V	Yes
• Short-circuit protection	Yes; Electronic (response threshold 0.7 A to 1.3 A; for IO redundancy up to 2.6 A) Ensure sufficient low-resistance cable routing to the sensor/actuator in order to attain the response threshold. Depending on the cable cross-section used, there may be constraints regarding the usable length of cable.
Power	
Power available from the backplane bus	80 mW
Power loss	
Power loss, typ.	3.6 W; Maximum value (taking the max. encoder current and the max. operating voltage into account)
Address area	
Address space per module	
• Address space per module, max.	2 byte; + 2 bytes for QI information (additional 18 bytes when using high-precision time stamping)
Hardware configuration	
Automatic encoding	
• Mechanical coding element	Yes
Digital inputs	
Number of digital inputs	16
Digital inputs, parameterizable	Yes
Source/sink input	Yes; P-reading
Input characteristic curve in accordance with IEC 61131, type 1	Yes
Input characteristic curve in accordance with IEC 61131, type 2	No
Input characteristic curve in accordance with IEC 61131, type 3	Yes
Pulse extension	Yes
• Length	Off, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s
Time stamping	Yes; Resolution 10 ms
Time stamp (with precision of 1 ms)	Yes; Resolution 1ms
Edge evaluation	Yes; rising edge, falling edge, edge change
Input voltage	
• Type of input voltage	DC
• Rated value (DC)	24 V
• for signal "0"	-30 to +5V
• for signal "1"	+11 to +30V
Input current	
• for signal "1", typ.	2.5 mA

Article number	6DL1131-6BH00-0PH1
Input delay (for rated value of input voltage)	
for standard inputs	
– parameterizable	Yes; none / 0.05 / 0.1 / 0.4 / 0.8 / 1.6 / 3.2 / 12.8 / 20 ms
Cable length	
• shielded, max.	1 000 m
• unshielded, max.	600 m
Encoder	
Connectable encoders	
• 2-wire sensor	Yes
– permissible quiescent current (2-wire sensor), max.	1.5 mA
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Alarms	
• Diagnostic alarm	Yes; channel by channel
• Hardware interrupt	Yes; channel by channel
Diagnostic messages	
• Diagnostic information readable	Yes
• Monitoring the supply voltage	Yes; Module-wise
– parameterizable	Yes
• Monitoring of encoder power supply	Yes
• Wire-break	Yes; Channel-by-channel, optional protective circuit for preventing wire-break diagnostics in the case of simple encoder contacts: 15 kOhm to 18 kOhm
• Short-circuit to M	Yes; Encoder supply to M, channel by channel
Diagnostics indication LED	
• MAINT LED	Yes; yellow LED
• Monitoring of the supply voltage (PWR-LED)	Yes; green PWR LED
• Channel status display	Yes; Green LED
• for channel diagnostics	Yes; Red LED
• for module diagnostics	Yes; Green/red LED
Potential separation	
Potential separation channels	
• between the channels	No
• between the channels and backplane bus	Yes
• between the channels and the power supply of the electronics	No
Isolation	
Isolation tested with	1 500 V DC/1 min, type test
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	-40 °C

Article number	6DL1131-6BH00-0PH1
• horizontal installation, max.	70 °C
• vertical installation, min.	-40 °C
• vertical installation, max.	60 °C
Dimensions	
Width	22.5 mm
Height	115 mm
Depth	138 mm
Weights	
Weight, approx.	135 g

Derating curve

The following figure shows the load current derating with horizontal and vertical mounting positions.



Cycle time

The cycle time describes the time slice in which signals from the inputs are acquired and processed. The cycle time of the I/O module is 1 ms (250 µs for time stamping).

Minimum pulse length

In order for a pulse or an edge transition to be reliably detected by the I/O module, the signal status must be active for at least the duration of the minimum pulse length.

In non-redundant mode, the minimum pulse length is greater than the input delay and greater than the cycle time.

In IO redundancy mode, the minimum pulse length is greater than the input delay and greater than the cycle time + 50 ms.

Redundancy failover time

At an I/O redundancy failover, the update time of the process values or the detection of an edge transition is delayed once by no longer than this time.
The maximum redundancy failover time of the I/O module is 55 ms.

Drivers, parameters, diagnostics messages and address space

A

A.1 Concept of the driver and diagnostics blocks

Use outside the PCS 7 environment

The following information of the appendix is relevant for use of the ET 200SP HA outside the PCS 7 environment. If you do not plan to operate outside the PCS 7 environment, you do not need the information in the appendix.

Tasks of the driver and diagnostics blocks (driver blocks)

In process control systems, certain demands are placed on the diagnostics/signal processing. This includes the monitoring of modules, DP/PA slaves and DP master systems for malfunctions and failures.

To enable this, blocks are available in the PCS 7 library that implement the interface to the hardware including test functions.

These blocks perform two basic tasks:

- They provide signals from the process to the AS for further processing.
- They monitor modules, DP/PA slaves, and DP master systems for failure.

When the process signals are read in, these blocks access the process image input (or process image partition) (PII) and when the process signals are output, they access the process image output (or process image partition) (PIQ).

Concept

The concept of the driver and diagnostics blocks for PCS 7 can be characterized as follows:

- The separation between user data processing (CHANNEL blocks) and diagnostics data processing (MODULE blocks)
- The symbolic addressing of the I/O signals
- The automatic generation of the MODULE blocks by CFC

This block concept supports all modules from the list of approved modules.
When new Siemens or non-Siemens module types are integrated, the meta-knowledge for the driver generator can be extended by additional XML files (object and action lists).

Note

Note the following:

- The library with the driver blocks has to installed using the Setup program on the PC. This is the only method of ensuring that the meta-knowledge required for the driver generator is available. You must not copy the library from another computer.
- You can also use driver blocks from another library (for example, your own blocks from your own library). You can specify this additional library in the "Generate module drivers" dialog box. The driver generator then searches for the block to be imported in the library specified here. If the block is not found here, it is searched for in the library specified in the control file (XML file).
- If the S7 program contains a signal-processing block but not from one of the PCS 7 libraries, you have to specify the version of the driver library from which the driver blocks are to be imported in the "Generate module drivers" dialog box.

Time-optimized processing

To enable time-optimized processing during runtime, the organization blocks for error handling (for example, OB85, OB86) are automatically divided into runtime groups and the driver blocks are integrated in the corresponding runtime groups.

If an error occurs, the SUBNET block, for example, activates the relevant runtime group, the RACK block or MODULE block contained in the runtime group detects the error, evaluates it and outputs a process control message to the OS.

The diagnostics information of the module block (OMODE_xx output) is also transferred to the corresponding CHANNEL block (MODE input). If necessary, this information can be displayed by means of a PCS 7 block that can be operated and monitored on the OS or by means of a user block in a process picture (color change of the measured value or flashing display, etc.).

A.2 Parameter assignment

Parameter assignment in the user program

You can reconfigure individual channels of the module in RUN without this having an effect on the other channels.

Changing parameters in RUN

The parameters are transferred to the module with the "WRREC" instruction via data record 128.

The parameters set in STEP 7 are not changed in the CPU, which means the parameters set in STEP 7 will be valid again after a restart.

If you reconfigure a module and diagnostics are pending prior to the reconfiguration, these diagnostics are not signaled as "outgoing".

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 the corresponding error code.

The STATUS output parameter is 4 bytes long and is configured as followed:

- Byte1: Function_Num, general error code
- Byte2: Error_Decode, location of the error code
- Byte3: Error_Code_1, error code
- Byte4: Error_Code_2, manufacturer-specific extension of the error code

Module-specific errors are displayed via Error_Decode = 0x80 and Error_Code_1 / Error_Code_2.

Error_ Code_ 1	Error_ Code_ 2	Cause	Remedy
0xB0	0x00	Number of the data record unknown	Enter valid number for data record.
0xB1	0x01	Length of the data record is incorrect	Enter valid value for data record length.
0xB2	varia- ble	Module cannot be reached	• Check station - is the module plugged in correctly? • Check the parameters of the WRREC instruction.
0xE0	0x01	Wrong version in the header	Correct the version number of the parameter block.
0xE0	0x02	Header error (number or length of parameter block)	Correct the length and number of the parameter blocks.

Error_ Code_ 1	Error_ Code_ 2	Cause	Remedy
0xE1	0x01	Reserved bit set	Check and correct the parameters
0xE1	0x02	Invalid diagnostics enable bit set for operating mode	
0xE1	0x03	Invalid hardware interrupt enable bit set for operating mode	
0xE1	0x07	Invalid coding for input delay	
0xE1	0x0B	Invalid coding for pulse stretching	
0xE1	0x0E	Invalid redundancy parameter assignment	

A.3 Parameter assignment and structure of the module/channel parameters

Structure of data record 128

Data record 128 has a length of 76 bytes.

It contains module parameters as well as channel or technology parameters of the 16 channels; 4 bytes each.

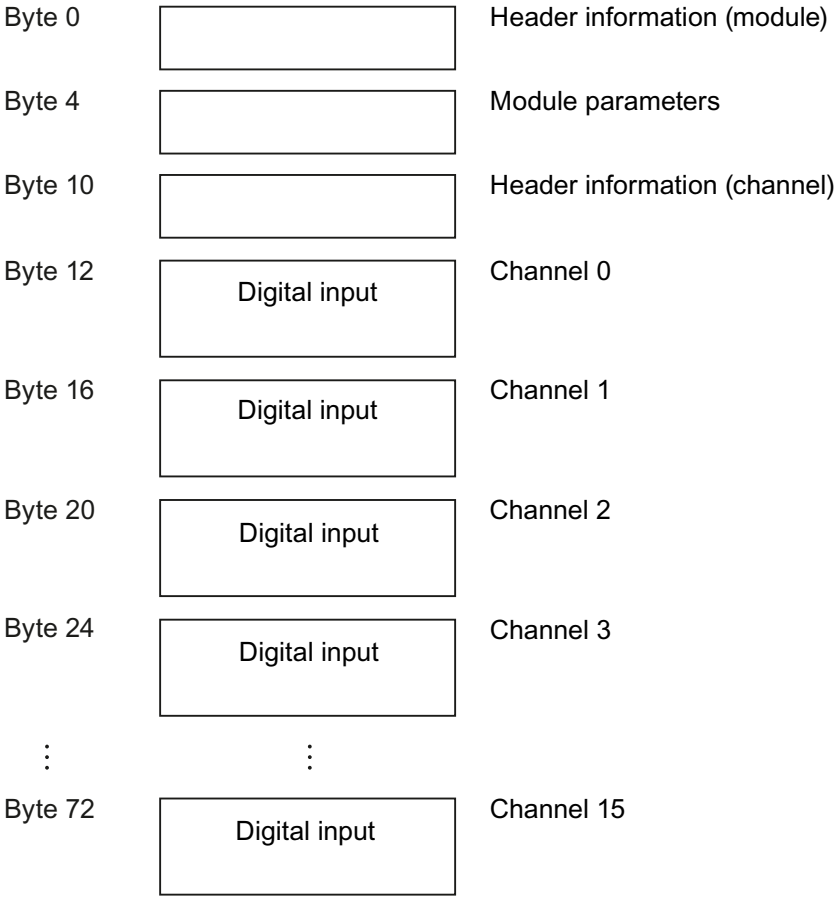


Figure A-1 Structure of data record 128

Header information and module parameters

The following figure shows the configuration of the header information and module parameters.

Byte 0	7 6 5 4 3 2 1 0 0 1 0 0 0 0 0 0	Minor version Major version Reserved
Byte 1	7 6 5 4 3 2 1 0 0 0 0 0 0 0 1 0	Number of subsequent parameter structures
Byte 2	7 6 5 4 3 2 1 0 0 0 0 0 0 0 0 1	Number of subsequent module parameter blocks
Byte 3	7 6 5 4 3 2 1 0 0 0 0 0 0 1 1 0	Length of the module parameter block
Byte 4	7 6 5 4 3 2 1 0 0 0 _ _ 0 0 0 _	Diagnostics for missing supply voltage L+ Redundancy role: 0="Off" 2="Master" 3="Slave"
Byte 5	7 6 5 4 3 2 1 0 0 0 0 0 0 0 0 0	Reserved
Byte 6	7 6 5 4 3 2 1 0 _ _ _ _ _ _ _ _	Standalone mode: Irrelevant Redundancy mode: Logical base address, high byte
Byte 7	7 6 5 4 3 2 1 0 _ _ _ _ _ _ _ _	Standalone mode: Irrelevant Redundancy mode: Logical base address, low byte
Byte 8	7 6 5 4 3 2 1 0 _ _ _ _ _ _ _ _	Standalone mode: Irrelevant Redundancy mode: Logical base address of the partner module, high byte
Byte 9	7 6 5 4 3 2 1 0 _ _ _ _ _ _ _ _	Standalone mode: Irrelevant Redundancy mode: Logical base address of the partner module, low byte
Byte 10	7 6 5 4 3 2 1 0 0 0 0 1 0 0 0 0	Number of subsequent channel parameter blocks = 16
Byte 11	7 6 5 4 3 2 1 0 0 0 0 0 0 1 0 0	Length of a channel parameter block = 4 bytes

Figure A-2 Header information and module parameters of data record 128

Channel parameters

Each channel parameter block contains the cable parameters for the digital input (4 bytes).

The following figure shows the configuration of the channel parameters for channels 0 to 15.

x = 12 + (channel number * 4); with channel number 0…15

All unused bits and the bits or bytes marked as "reserved" must be set to zero.
You activate a channel parameter by setting the corresponding bit to "1" or the corresponding value.

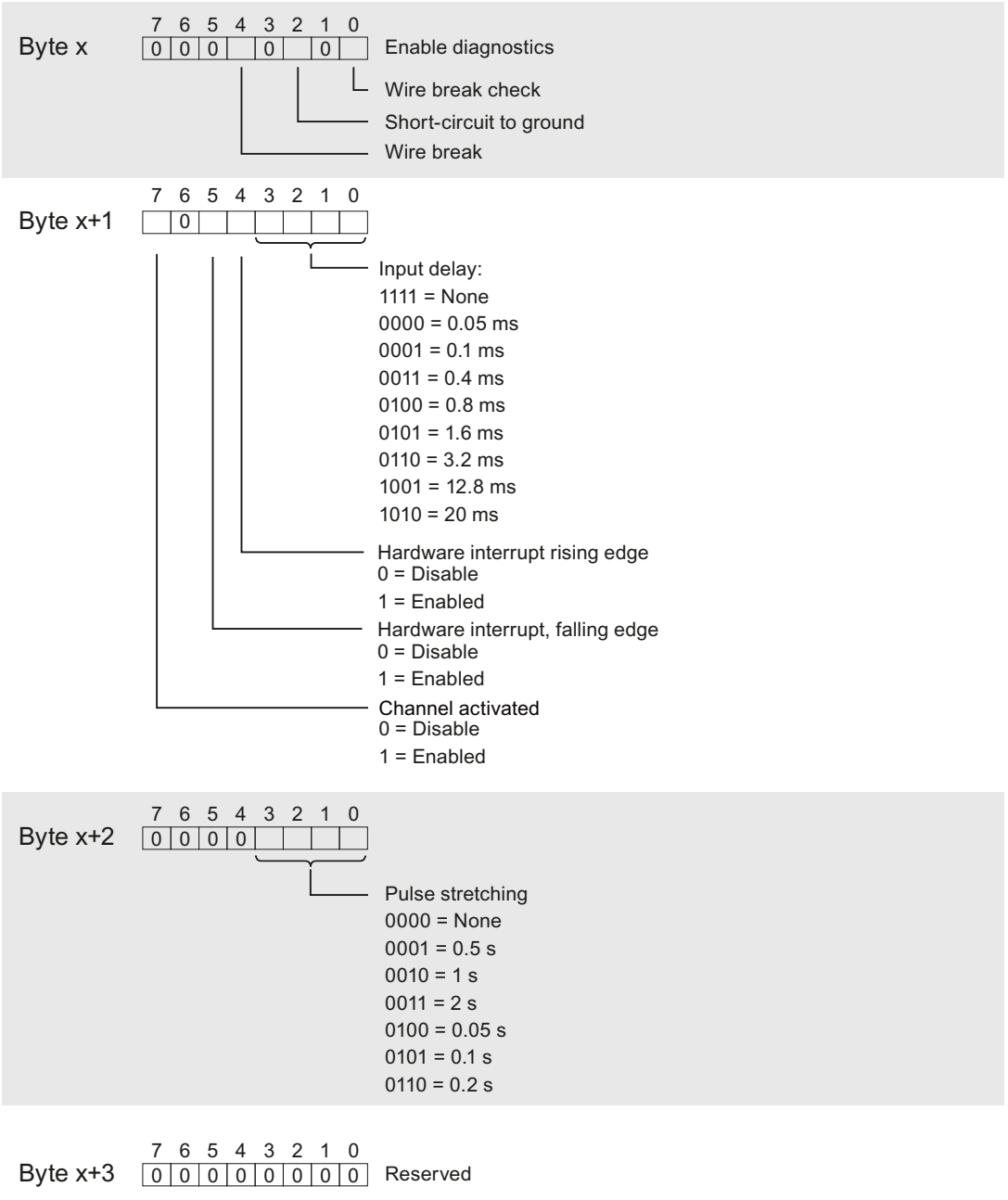


Figure A-3 Configuration byte x to x+3 for the channels 0 to 15

A.4 Diagnostics messages and maintenance events

Diagnostics messages

A diagnostics message is generated for each diagnostics event and the DIAG LED on the DI 16×24VDC HA flashes red or the MT LED lights up yellow.

In addition, channel-specific channel diagnostics are displayed through the corresponding channel error/status LEDs.

The diagnostics messages can be read in the diagnostics buffer of the CPU, for example.

Diagnostic messages are assigned either channel-specific to an input or assigned as module messages to all inputs. All channels are switched off for diagnostics messages that affect the entire module. Only the corresponding digital input is affected by diagnostics messages, which refer to individual channels.

Table A-1 Diagnostic messages, their meanings and remedy options

Diagnostics message	Error code	Assignment	Meaning	Remedy
Wire break	6_H	Channel	Impedance of encoder circuitry is too high	Use another type of encoder or wiring, for example, use conductors with a larger cross-section
			Wire break between the module and sensor	Connect the cable
			Channel not connected (open)	• Disable diagnostics • Connect encoder contact with a 15 kΩ to 18 kΩ resistor. • Switch off wire break check
Parameter assignment error	10_H	Module	• Parameter assignment does not match the terminal block used • Incorrect parameter assignment	• Correct the parameter assignment • Check terminal block[1]
Supply voltage missing	11_H	Module	Missing or insufficient supply voltage L+	• Check the supply voltage L + on the terminal block • Check terminal block
Hardware interrupt lost	16_H	Module	Error is reported because the events occur faster than they can be processed in the system.	
Channel/component temporarily unavailable	$1F_H$	Module	Firmware update is in progress or has been canceled during the update. The module does not read any process values in this state.	• Restart the firmware update • Wait for firmware update
Short-circuit/overload at external encoder supply	$10E_H$	Channel	Short-circuit of the encoder supply to ground	Correction of the process wiring
Shutdown on button activation	122_H	Module	The output disable switch was activated	Pull module

Diagnostics message	Error code	Assignment	Meaning	Remedy
Inconsistent parameter assignment	123_H	Module	Errors in the redundancy parameters sent to the module	Check the parameter assignment
Retentive memory in carrier module defective	154_H	Module	An error of the memory block on the adapter module was detected during startup	Replace carrier module
Retentive memory in the terminal block defective	155_H	Module	An error of the memory block on the terminal block was detected during startup	Replace terminal block

[1] Only the terminal blocks (TB 45 ...) are suitable for use with I/O modules in IO redundancy.

Maintenance events

A maintenance event is generated for each maintenance required identified. The MT LED lights up on the module.

Maintenance messages do not have a direct influence on the functions of the module or digital inputs.

Table A-2 Maintenance messages, their meaning and possible remedies

Maintenance message	Error code	Assignment	Meaning / Cause	Remedy
Redundancy partner has different hardware/firmware version	120_H	Module	The redundantly configured and interconnected I/O modules are not compatible	Check the operating status and firmware version of the modules and replace modules or perform a firmware update.
IO redundancy warning	121_H	Module	Unable to correctly communicate with the partner module	• Check/replace right-hand module • Check/replace left-hand module • Check/replace terminal block See also the "*ET 200SP HA Distributed I/O system*" system manual, Chapter "Replacing an I/O module at IO redundancy".
Retentive memory in carrier module defective	154_H	Module	Fault detected in the data block on the carrier module during operation	Replace carrier module
Retentive memory in the terminal block defective	155_H	Module	An error of the memory block on the terminal block was detected during operation	Replace terminal block

A.5 Hardware interrupts

Hardware interrupts

The DI 16×24VDC HA generates a hardware interrupt for the following events:

- At a rising edge (signal change from 0 to 1)
- At a falling edge (signal change from 1 to 0)

Interrupt OBs are called automatically if an interrupt occurs.

You can find detailed information on the event in the hardware interrupt organization block with the "RALRM" instruction (read additional interrupt information).

The module channel that triggered the hardware interrupt is recorded in the start information of the OB40 in the OB40_POINT_ADDR tag. The figure below shows the assignment to the bits of local data double word 8.

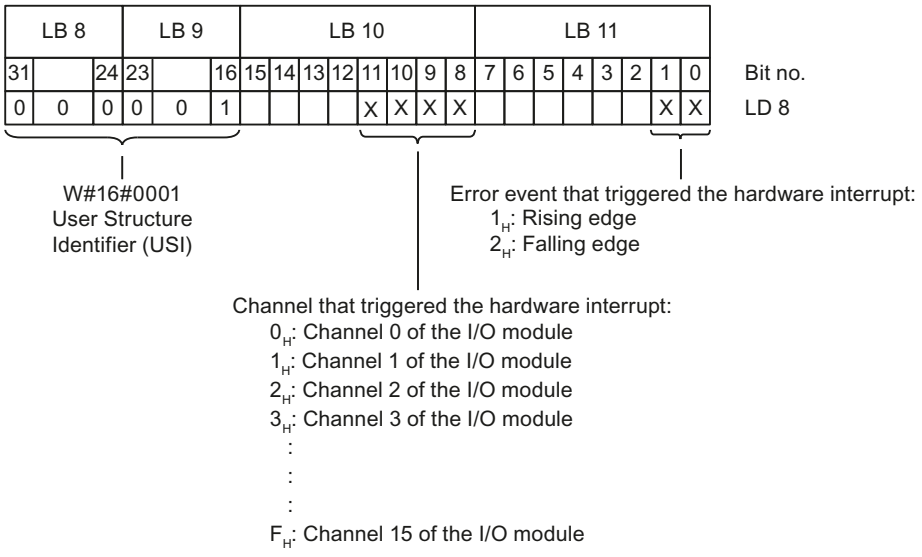


Figure A-4 Start information of the organization block

A.6 Address space

Abbreviations

- "IB" stands for input byte, that is, the module start address in the input area
- "DI" stands for digital input
- "QDIn" stands for the value status (QI) of digital input n

Address space

The following figure shows the mapping of the address space of the DI 16x24VDC HA.

Table A-3 Address space of the DI 16x24VDC HA

IB x +	7	6	5	4	3	2	1	0
0	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
1	DI15	DI14	DI13	DI12	DI11	DI10	DI9	DI8
2	QDI7	QDI6	QDI5	QDI4	QDI3	QDI2	QDI1	QDI0
3	QDI15	QDI14	QDI13	QDI12	QDI11	QDI10	QDI9	QDI8

Evaluate value status

There is a bit value status for each digital input in the input address space.

Irrespective of the diagnostics enables, each value status (each QI bit) provides information on the validity of the corresponding process value.

- Value status = 1: Process value okay, "good"
- Value status = 0: Process value not okay, "bad"

Basically, the value status is set to "good" if the digital value can be detected without error. The value status is set to "bad" in the following cases:

- The digital value cannot be output due to an error.
- The digital channel is deactivated.

Note

The value status is not set to "bad" when there is a wire break on the channel and the wire break test is disabled.

A.7 Address space of the time stamping (accuracy 1 ms)

Address space

The following table shows the mapping of the address space of the DI 16x24VDC HA with time stamping (accuracy 1 ms).

Table A-4 Address space of the DI 16x24VDC HA with time stamping (accuracy 1 ms)

IB x +	7	6	5	4	3	2	1	0
0	I7	I6	I5	I4	I3	I2	I1	I0
1	I15	I14	I13	I12	I11	I10	I9	I8
2	QI7	QI6	QI5	QI4	QI3	QI2	QI1	QI0
3	QI15	QI14	QI13	QI12	QI11	QI10	QI9	QI8
4 to 21	Time information for time stamping (accuracy 1 ms)							

Index

C

Channel fault LED, 21
Channel parameters, 16, 35
Channel status LED, 21
Conventions, 6

D

Data record 128, 35
  Header information, 36
DI 16x24VDC HA
  Accessories, 8
  Channel parameters, 16
  Functions, 8
  Module parameters, 16
  Parameter, 15
  Parameters, 16
  Pin assignment, 12
  Properties, 8
  Schematic circuit diagram, 13
  Technical specifications, 25
DIAG LED, 22
Diagnostics interrupt, 24
Documentation
  Range of validity, 5

L

LED displays, 21

M

Module parameters, 16
MT LED, 22

O

Output disable switch, 8

P

Parameters, 15, 16
Pin assignment, 12
PWR LED, 23

S

Schematic circuit diagram, 13

T

Technology parameters, 35
Terminal block, 11

V

Value status
  Evaluating, 41