SIEMENS

SIMATIC

ET 200AL

Digital input module DI 16x24VDC 8xM12 (6ES7141-5AH00-0BA0)

Manual

Edition 02/2016

Answers for industry.

SIEMENS

SIMATIC

ET 200AL
Digital input module
DI 16x24VDC 8xM12
6ES7141-5AH00-0BA0)

Manual

02/2016

A5E36681813-AA

Legal information

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⚠ 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.

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Preface

Preface

Purpose of the documentation

This manual supplements the ET 200AL distributed I/O system (https://support.industry.siemens.com/cs/us/en/view/89254965) system manual. Functions that are generally applicable to the ET 200AL distributed I/O system are described there.

The information provided in the present manual, the system manual and the function manuals enables you to commission the ET 200AL distributed I/O system.

Conventions

Please also observe notes marked as follows:

Note

Indicates important product information to which particular attention should be paid.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

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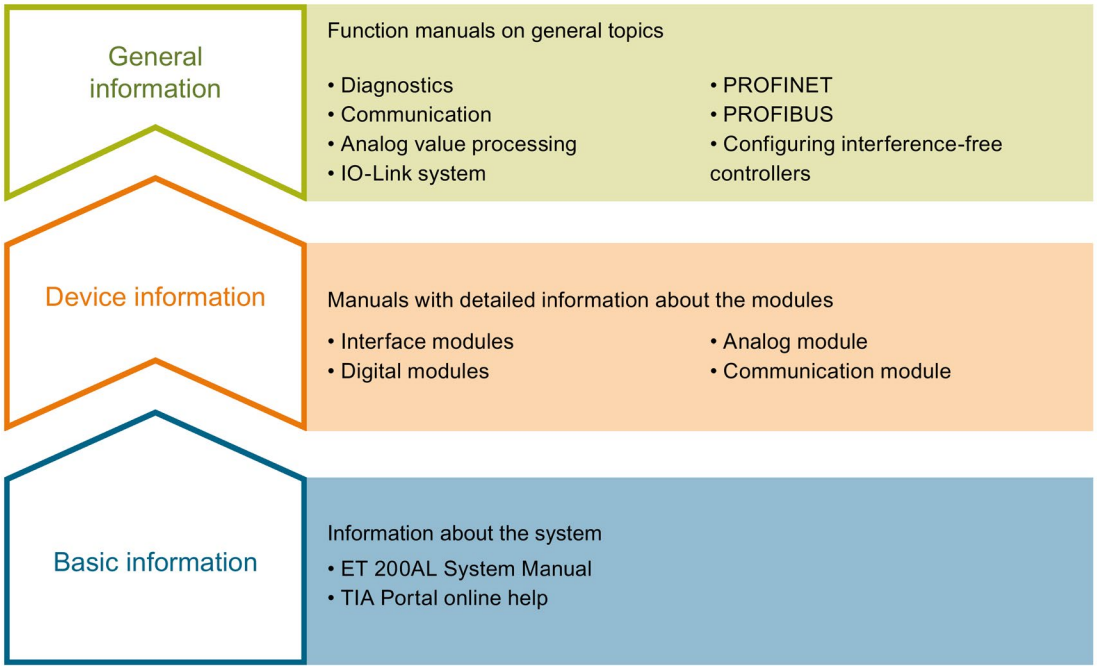
To stay informed about product updates as they occur, sign up for a product-specific newsletter. You can find more information on the Internet (http://support.automation.siemens.com).

Table of contents

Documentation guide

1

The documentation for the SIMATIC ET 200AL 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 and Getting Started describe in detail the configuration, installation, wiring and commissioning of the SIMATIC ET 200AL 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 200AL distributed I/O system, e.g. diagnostics, communication, Motion Control, Web server.

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).

Manual Collection ET 200AL

The Manual Collection contains the complete documentation on the SIMATIC ET 200AL 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/95242965).

"mySupport"

With "mySupport", your personal workspace, you make the best out of your Industry Online Support.

In "mySupport", you can save filters, favorites and tags, request CAx data and compile your personal library in the Documentation area. In addition, your data is already filled out in support requests and you can get an overview of your current requests at any time.

You must register once to use the full functionality of "mySupport".

You can find "mySupport" on the Internet (https://support.industry.siemens.com/My/ww/en).

"mySupport" - Documentation

In the Documentation area in "mySupport" you can combine entire manuals or only parts of these to your own manual.
You can export the manual as PDF file or in a format that can be edited later.

You can find "mySupport" - Documentation on the Internet (http://support.industry.siemens.com/My/ww/en/documentation).

"mySupport" - CAx data

In the CAx data area in "mySupport", you can access the current product data for your CAx or CAe system.

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 on 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 on individual products.

You will 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

2.1 Properties

Article number

6ES7141-5AH00-0BA0

View of the module

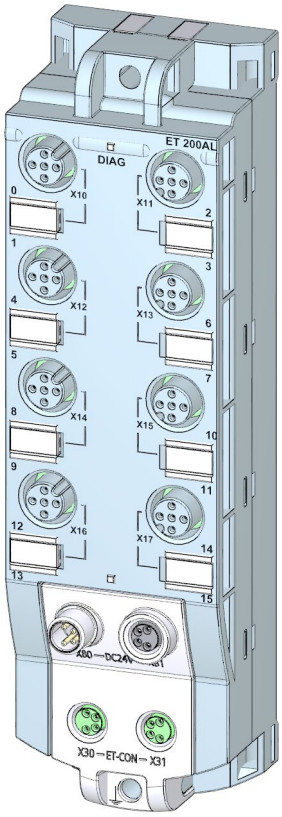


Image 2-1 View of the DI 16x24VDC 8xM12 digital input module

Properties

The module has the following technical properties:

- 16 digital inputs
- M12 sockets for connection of sensors
- 24 V DC supply voltage
- Configurable diagnostics can be set for each module
- Typical input delay of 3 ms
- Suitable for switches and proximity switches
- Dimensions 45 x 159 mm

The module supports the following functions:

- Firmware update
- Identification and maintenance data I&M0 to I&M3
- Value status (Quality Information)
- PROFIenergy

Accessories

The following components are included in the module package:

- Identification labels

Other components

The following component can be ordered as spare part:

- Identification labels

The following components can be ordered as accessories:

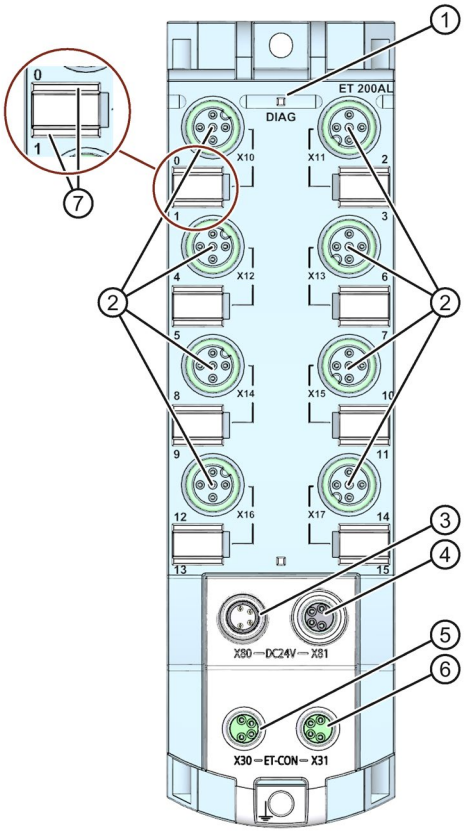
- Connectors
- Cables
- Stripping Tool for ET-Connection
- M8 sealing cap
- M12 sealing cap

See also

You can find more information on accessories in the Accessories/spare parts section of the ET 200AL distributed I/O system (https://support.industry.siemens.com/cs/us/en/view/89254965) system manual.

2.2 Operator controls and display elements

The figure below shows the operator controls and display elements of the DI 16x24VDC 8xM12 digital input module.



① DIAG: LED display for the diagnostic status
② X10 to X17: Sockets for the input signal
③ X80: Connector for infeed of the supply voltage (POWER input)
④ X81: Socket for loop-through of the supply voltage (POWER output)
⑤ X30: Socket for ET-Connection IN
⑥ X31: Socket for ET-Connection OUT
⑦ LED displays 0 to 15 for the channel status

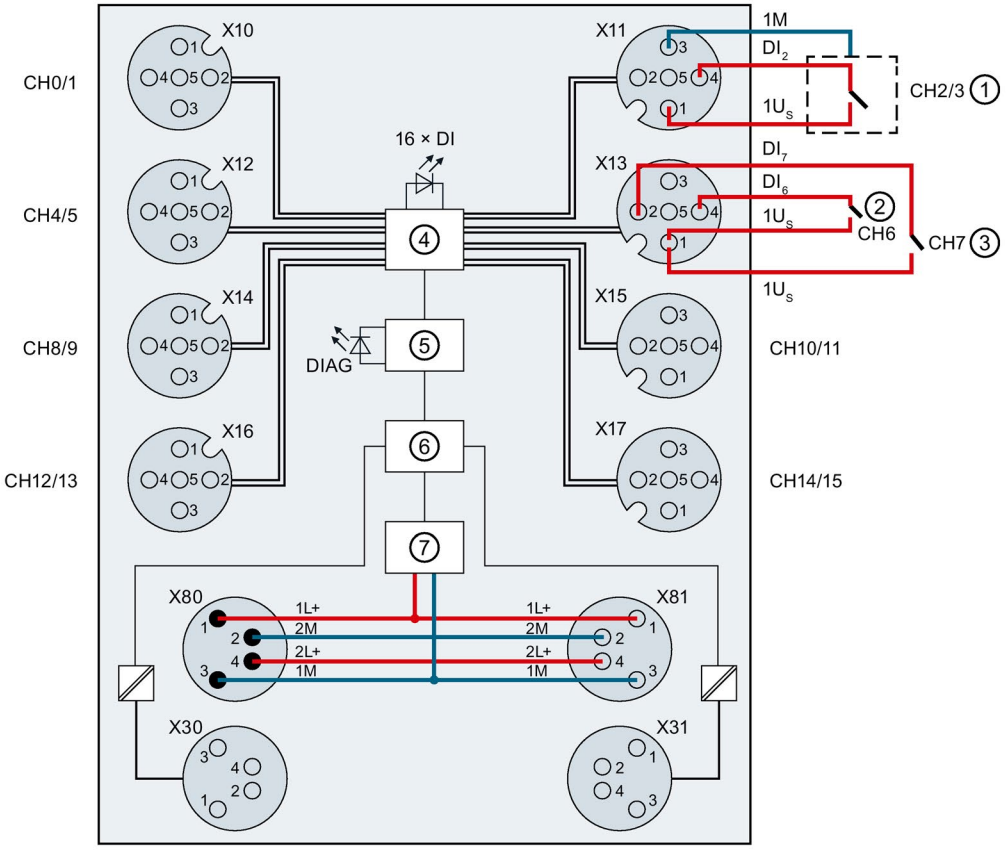
Image 2-2 Operator controls and display elements

Wiring

3

3.1 Terminal and block diagram

The figure below shows an example of the pin assignment of signal inputs with 2-wire and 3-wire connection.



①	3-wire connection	X30	Infeed of the ET-Connection
②	2-wire connection	X31	Loop-through of the ET-Connection
③	2-wire connection	1L+	Supply voltage 1L+ (non-switched)
④	DI circuit	1M	Ground 1M (non-switched)
⑤	Microcontroller	2L+	Load voltage 2L+ (switched)
⑥	ET-Connection interface	2M	Ground 2M (switched)
⑦	Internal supply voltage	$1U_S$	24 V encoder supply
X10 to X17	Channels 0 to 7	DI_n	Input signal
X80	Infeed of supply voltages	DI	Channel status LEDs (0 to 15) (green)
X81	Loop-through of supply voltages	DIAG	LED diagnostic status (red/green)

Image 3-1 Terminal and block diagram

3.2 Pin assignment

Note

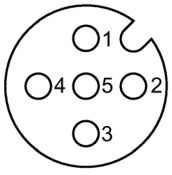
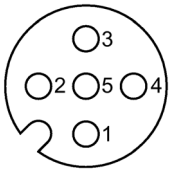
Color coding

The sockets for ET-Connection and the power supply of the modules are color-coded. These colors correspond to the colors of the offered cables.

Pin assignment of the sockets for digital inputs

The table below shows the pin assignment of the 8 sockets for the connection of digital inputs.

Table 3- 1 Pin assignment for digital inputs

Pin	Assignment	Front view of the sockets	
	X10 to X17 sockets for digital inputs	**X10, X12, X14, X16**	**X11, X13, X15, X17**
1	24 V encoder supply $1U_S$ (derived from 1L+ non-switched)		
2	Input signal DI_1: Connector X10 Input signal DI_3: Connector X11 Input signal DI_5: Connector X12 Input signal DI_7: Connector X13 Input signal DI_9: Connector X14 Input signal DI_{11}: Connector X15 Input signal DI_{13}: Connector X16 Input signal DI_{15}: Connector X17		
3	Encoder supply ground 1M		
4	Input signal DI_0: Connector X10 Input signal DI_2: Connector X11 Input signal DI_4: Connector X12 Input signal DI_6: Connector X13 Input signal DI_8: Connector X14 Input signal DI_{10}: Connector X15 Input signal DI_{12}: Connector X16 Input signal DI_{14}: Connector X17		
5	Functional earth FE		

NOTICE

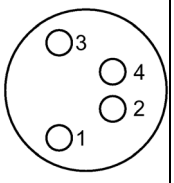
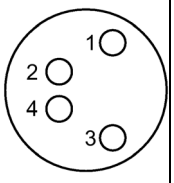
24 V encoder supply $1U_S$

Use only the 24 V encoder supply $1U_S$ provided by the digital input module to supply power to the encoder.

Pin assignment of the sockets for ET-Connection

The table below shows the pin assignments of the 2 sockets for the connection of ET-Connection.

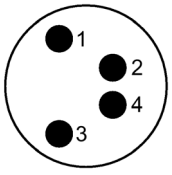
Table 3- 2 Pin assignment for ET-Connection

Pin	Assignment		Assignment of the wire color of the bus line cable for ET-Connection	Front view of the sockets	
	X30 socket (ET-Connection IN)	X31 socket (ET-Connection OUT)		X30	X31
1	TXP	RXP	Yellow		
2	RXP	TXP	White		
3	RXN	TXN	Blue		
4	TXN	RXN	Orange		
Shield-ing	Functional earth FE		-		

Pin assignment of the connector for infeed of the supply voltage

The table below shows the pin assignment of the connector for infeed of the supply voltage.

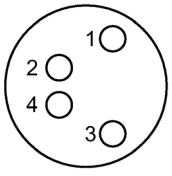
Table 3- 3 Pin assignment of the supply voltage connector

Pin	Assignment	Assignment of the wire color of the power line cable	Front view of the connector
	X80 connector (POWER input)		
1	Supply voltage 1L+ (non-switched)	Brown	
2	Ground 2M (switched)	White	
3	Ground 1M (non-switched)	Blue	
4	Load voltage 2L+ (switched)	Black	

Pin assignment of the socket for loop-through of the supply voltage

The table below shows the pin assignment of the socket for loop-through of the supply voltage.

Table 3- 4 Pin assignment of the supply voltage socket

Pin	Assignment	Assignment of the wire color of the power line cable	Front view of the socket
	X81 socket (POWER output)		
1	Supply voltage 1L+ (non-switched)	Brown	
2	Ground 2M (switched)	White	
3	Ground 1M (non-switched)	Blue	
4	Load voltage 2L+ (switched)	Black	

NOTICE
ET-Connection/supply voltage Observe the correct wiring of the M8 sockets for ET-Connection and the supply voltage. Mixing up the ET-Connection connectors and the connectors for the supply voltage can destroy the module.

Parameters/address space

4

4.1 Parameters

The table below shows the parameters for the DI 16x24VDC 8xM12 digital input module.

Table 4- 1 Parameters

Parameters	Value range	Default	Scope
Diagnostics: Short-circuit to ground	• Disable • Enable	Disable	Module

4.2 Explanation of the parameters

Diagnostics: Short-circuit to ground

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

4.3 Address space

The figure below shows the assignment of the address space for the digital input module DI 16x24VDC 8xM12 with value status (Quality Information, QI).

The address space for the value status is allocated by the module, if the value status is configured using the PROFINET interface module.

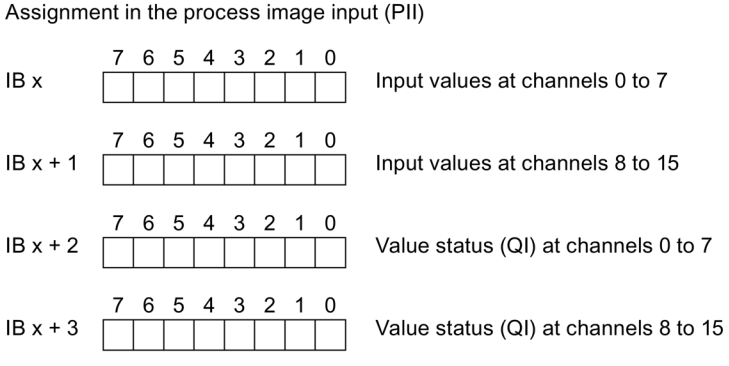


Image 4-1 Address space

Configuration options of the DI 16x24VDC 8xM12 digital input module

You have the following configuration options:

- Configuration 1: without value status
- Configuration 2: with value status

Evaluating the value status

An additional two bytes are occupied in the input address space if you enable the value status for the digital input module. Bits 0 to 7 in these bytes are assigned to a channel and return information about the validity of the digital input value.

Bit = 1: No error on channel.

Bit = 0: Error on channel.

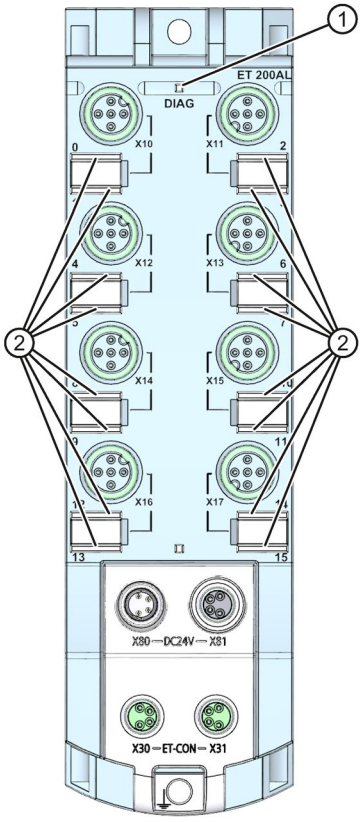
Interrupts/diagnostic alarms

5

5.1 Status and error displays

LED displays

The figure below shows the LED displays (status and error displays) of the DI 16x24VDC 8xM12 digital input module.



① Diagnostic status (DIAG) (red/green)
② Channel status (0 to 15) (green)

Image 5-1 LED displays

Meaning of the LEDs

The following tables set out the meaning of the status and error displays. Remedial measures for diagnostic alarms can be found in section Diagnostics alarms (Page 20).

DIAG LED

Table 5- 1 Error display of the DIAG LED

DIAG LED	Meaning
Off	No supply voltage 1L+
Flashes	• Module parameters not assigned • Loading firmware (while the firmware update is being performed, all LEDs retain their current status)
On	Module parameters assigned and no module diagnostics
Flashes	Module parameters assigned and module diagnostics

LED channel status

Table 5- 2 LED channel status display

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

5.2 Interrupts

The DI 16x24VDC 8xM12 digital input module supports diagnostic interrupts.

Diagnostic interrupt

The digital input module generates a diagnostic interrupt at the following events:

- Short-circuit of encoder supply to ground

5.3 Diagnostics alarms

For each diagnostic event, a diagnostics alarm is issued and the DIAG LED flashes red on the digital input module. 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- 3 Diagnostics alarms, their meanings and corrective measures

Diagnostics alarm	Error code	Meaning	Remedy
Short-circuit	1_H	Short-circuit encoder supply to ground	Eliminate the short-circuit

Technical specifications

6

6.1 Technical specifications

Technical specifications of the DI 16x24VDC 8xM12 digital input module

	6ES7141-5AH00-0BA0
General information	
Product type designation	DI 16X24VDC, 8XM12
Hardware functional status	E01
Firmware version	V1.0.x
Product function	
I&M data	Yes; I&M0 to I&M3
Engineering with	
STEP 7 TIA Portal can be configured/integrated as of version	As of STEP 7 V13 SP1
STEP 7 can be configured/integrated as of version	V5.5 SP4 Hotfix 7 or higher
PROFIBUS as of GSD version/GSD revision	GSD as of revision 5
PROFINET as of GSD version/GSD revision	GSDML V2.3.1
Supply voltage	
Load voltage 1L+	
Rated value (DC)	24 V
Low limit of permitted range (DC)	20.4 V
High limit of permitted range (DC)	28.8 V
Reverse polarity protection	Yes; against destruction; encoder supply outputs are connected with reverse polarity
Input current	
Current consumption (rated value)	30 mA; no load
From load voltage 1L+ (unswitched voltage)	4 A; maximum value
From load voltage 2L+, max.	4 A; maximum value
Encoder supply	
Number of outputs	8
24 V encoder supply	
Short-circuit protection	Yes; per module, electronic
Output current, max.	1.4 A; total current of all encoders
Power loss	
Power loss, typ.	2.7 W
Digital inputs	
Number of inputs	16
Input characteristic curve acc. to IEC 61131, type 3	Yes

	6ES7141-5AH00-0BA0
Number of inputs that can be controlled simultaneously	
All mounting positions	
• up to 55 °C, max.	16
Input voltage	
Type of input voltage	DC
Rated value (DC)	24 V
For signal "0"	-30 ... +5 V
For signal "1"	+11 ... +30 V
Input current	
For signal "1", typ.	3.2 mA
Input delay (for rated value of input voltage)	
For standard inputs	
• at "0" to "1", min.	1.2 ms
• at "0" to "1", max.	4.8 ms
• at "1" to "0", min.	1.2 ms
• at "1" to "0", max.	4.8 ms
Cable length	
Unshielded, max.	30 m
Encoders	
Connectable encoders	
2-wire sensor	Yes
• Permissible quiescent current (2-wire sensor), max.	1.5 mA
Interrupts/diagnostics/status information	
Interrupts	
Diagnostic interrupt	Yes; configurable
Diagnostics alarms	
Short-circuit	Yes; encoder supply to ground; module-based
Diagnostics indicator LED	
Channel status display	Yes; green LED
For module diagnostics	Yes; green/red LED
Electrical isolation	
Between load voltages	Yes
Electrical isolation of channels	
Between channels	No
Between the channels and backplane bus	Yes
Between the channels and power supply of the electronics	No
Insulation	
Insulation tested with	707 V DC (type test)

	6ES7141-5AH00-0BA0
Degree of protection and protection class	
Degree of protection according to EN 60529	
• IP65	Yes
• IP67	Yes
Ambient conditions	
Ambient temperature in operation	
Min.	-25 °C
Max.	55 °C
Connection technology	
Inputs/outputs	M12, 5-pin
Power supply	M8, 4-pin
ET-Connection	
ET-Connection	M8, 4-pin, shielded
Dimensions	
Width	45 mm
Height	159 mm
Depth	40 mm
Weights	
Weight, approx.	184 g

PROFIenergy 7

7.1 Pause function

Introduction

PROFIenergy is a PROFINET-based data interface for switching off consumers centrally and in a coordinated manner during pause times regardless of the manufacturer or device type. This has the aim that the process is only provided with the energy that is absolutely required. In so doing, the majority of the energy savings come from the process itself; the PROFINET device contributes only a few watts to the possible savings. In PROFIenergy, this operating state is referred to as a "pause".

Start and end of a pause

You enable and disable the pause function of the system at the beginning and end of pauses, respectively; the IO controller then sends the PROFIenergy command "Start_Pause" or "End_Pause" to the modules.

Use the "Start_Pause" command to start a pause.

Use the "End_Pause" command to end a pause.

The following conditions will also cause a pause to be ended:

- Reconfiguration in RUN
- Controller failure
- Firmware update
- Station stop
- Restart of the interface module through:
  - POWER OFF/POWER ON of an interface module
  - POWER OFF/POWER ON of an I/O module
  - Termination of ET-Connection1 or ET-Connection2

The specific behavior of the digital input module is explained in the following section.

Additional information

You can find additional information on working with PROFIenergy in the "PROFIenergy" section of the manual IM 157-1 PN interface module (https://support.industry.siemens.com/cs/ww/en/view/89254863) and the "Saving energy with PROFIenergy" section of function manual PROFINET with STEP 7 V13 (https://support.industry.siemens.com/cs/ww/en/view/49948856).

Application examples (https://support.industry.siemens.com/cs/ww/en/view/41986454) are also available on the Internet.

7.2 Behavior of the digital input module

Display

The channel status LEDs are directly influenced by the signal level at the socket.
If the encoder supply is switched off, this causes the channel status LEDs to also switch off.

Response to error detection

All channels that are in pause mode on "PE_MODE_PROCEED" report their diagnostic status as in productive mode.

The following applies for all channels which switch to a different pause mode:

- Encoder supply switch-off upon the start of "pause" does not result in the "Short-circuit" alarms.
- During the "pause", error detection of "Short circuit" is not possible:
  - Alarms for errors already pending before the "pause" are retained.
  - After the "pause" is over, the error status is updated and incoming/outgoing errors are reported correspondingly.

Mode parameter

The following table shows the "Mode" parameter.

Table 7- 1 Mode parameter

Element	Code	Explanation
Mode	0_D: PE_MODE_PROCEED	Proceed at "pause" • Value status "GOOD"
	1_D: PE_MODE_SHUTDOWN	Switch off at "pause" • Encoder supply U_S switched off [1] • Pause substitute value: 0_B • Value status "BAD"
	3_D: PE_MODE_LAST_VALUE	Last value at "pause" • Encoder supply U_S switched off [1] • Pause substitute value: Last input value • Value status "BAD"
	4_D: PE_MODE_SUBST_VALUE	Substitute value at "pause" • Encoder supply U_S switched off [1] • Pause substitute value: Configured pause substitute value • Value status "BAD"

[1] As there is only one encoder supply U_S for all channels, the supply can only be switched off at "pause" if no channel is configured in PE_MODE_PROCEED.

Dimension drawing

A

The figure below shows the dimension drawing of the DI 16x24VDC 8xM12 digital input module in front and side view.

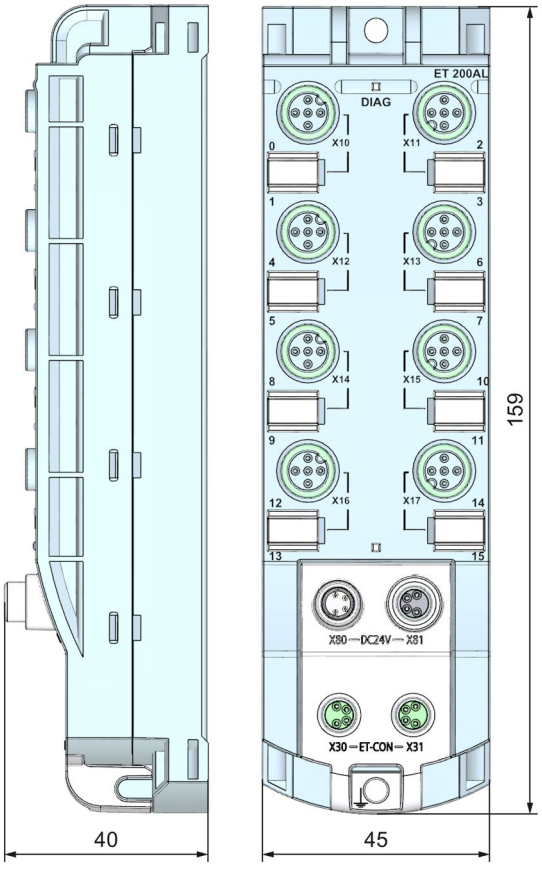


Image A-1 Dimension drawing