SIEMENS

SIMATIC

ET 200AL

Digital output module DQ 8x24VDC/2A 8xM12 (6ES7142-5AF00-0AB0)

Manual

Edition 02/2016

Answers for industry.

SIEMENS

SIMATIC

ET 200AL
Digital output module
DQ 8x24VDC/2A 8xM12
(6ES7142-5AF00-0BA0)

Manual

02/2016

A5E36683723-AA

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 Digital Factory
Postfach 48 48
90026 NÜRNBERG
GERMANY

A5E36683723-AA
℗ 02/2016 Subject to change

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.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. You can find more information about industrial security on the Internet (http://www.siemens.com/industrialsecurity).

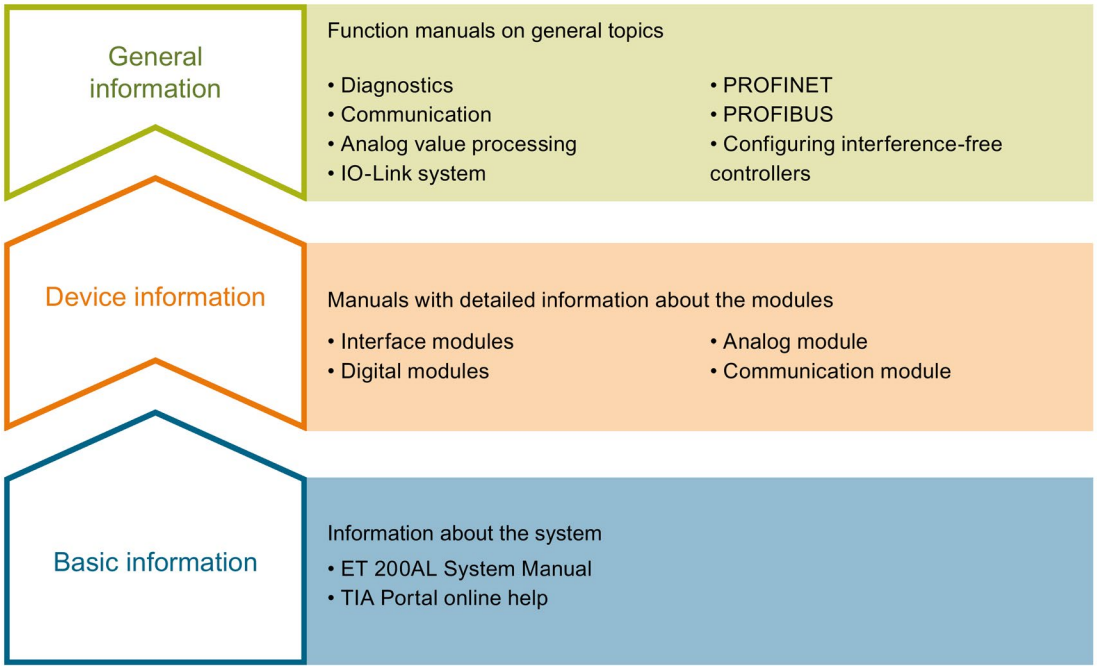
To stay informed about product updates as they occur, sign up for a product-specific newsletter. You can find more information on the Internet (http://support.automation.siemens.com).

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

6ES7142-5AF00-0BA0

View of the module

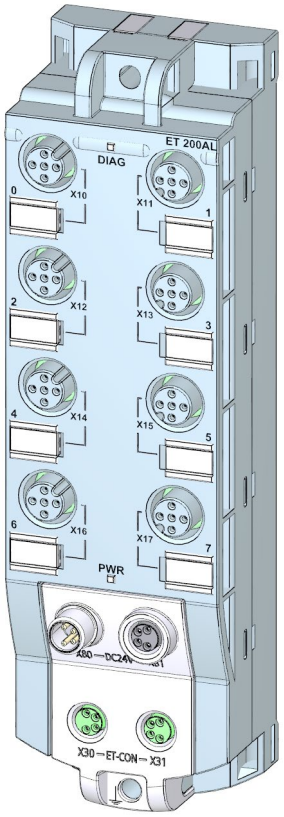


Image 2-1 View of the DQ 8x24VDC/2A 8xM12 digital output module

Properties

The module has the following technical properties:

- 8 digital outputs
  - Channels 0 to 3 connected to 1L+ (non-switched)
  - Channels 4 to 7 connected to 2L+ (switched)
- M12 sockets for connection of actuators
- Rated load voltage 24 V DC
- Suitable for solenoid valves, DC contactors, and indicator lights
- Output current per output 2 A
- Configurable diagnostics can be set for each module
- 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:

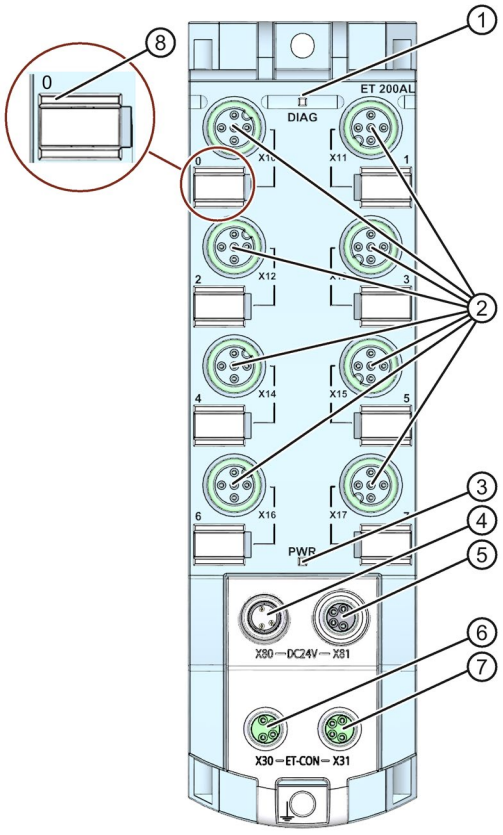
- Connectors
- Cables
- Stripping Tool for ET-Connection
- M8 sealing cap
- M12 sealing cap

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 DQ 8x24VDC/2A 8xM12 digital output module.



① DIAG: LED display for the diagnostic status
② X10 to X17: Sockets for the output signal
③ PWR: LED display for load voltage 2L+
④ X80: Connector for infeed of the supply voltage (POWER input)
⑤ X81: Socket for loop-through of the supply voltage (POWER output)
⑥ X30: Socket for ET-Connection IN
⑦ X31: Socket for ET-Connection OUT
⑧ LED displays 0 to 7 for the channel status

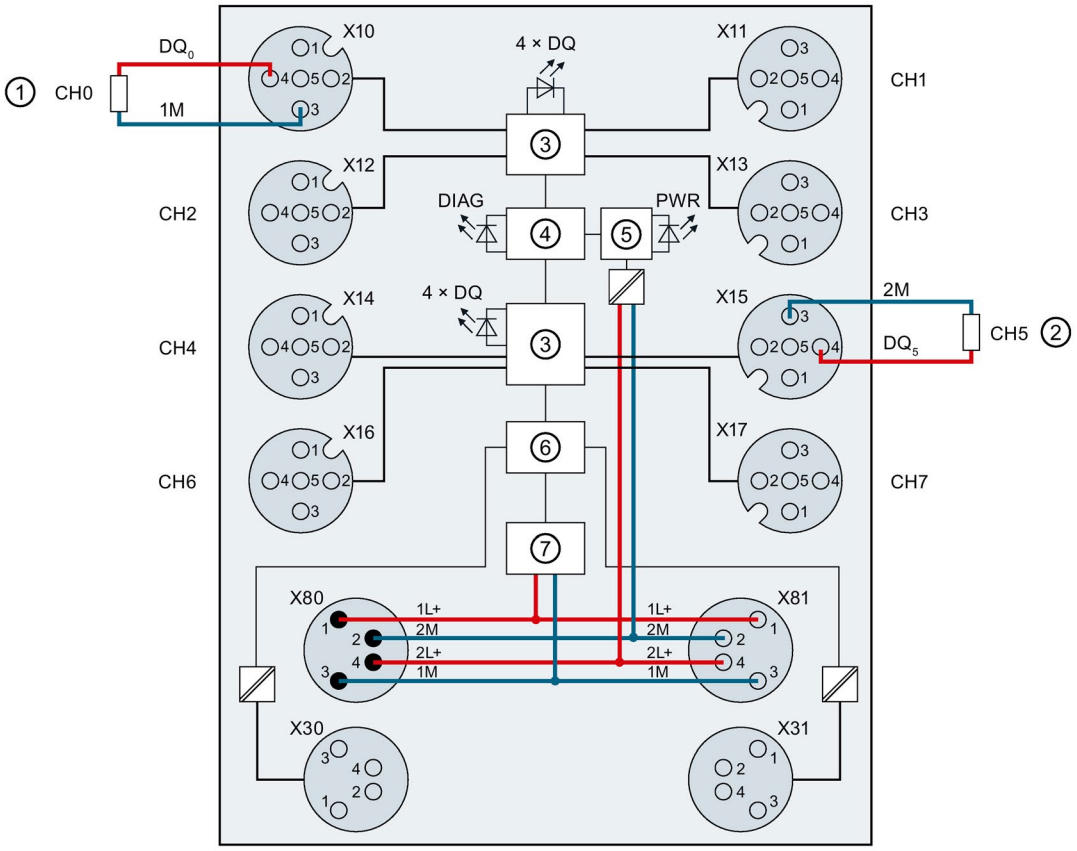
Image 2-2 Operator controls and display elements

Wiring

3

3.1 Terminal and block diagram

The example in the figure below shows the pin assignment of signal outputs.



①	Output to 1L+	X30	Infeed of the ET-Connection
②	Output to 2L+	X31	Loop-through of the ET-Connection
③	DQ circuit	1L+	Supply voltage 1L+ (non-switched)
④	Microcontroller	1M	Ground 1M (non-switched)
⑤	Monitoring	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	DQ_n	Output signal
X80	Infeed of supply voltages	DQ	Channel status LEDs (0 to 7) (green)
X81	Loop-through of supply voltages		

Image 3-1 Terminal and block diagram

3.2 Pin assignment

Note

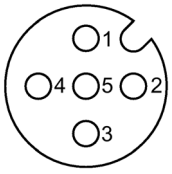
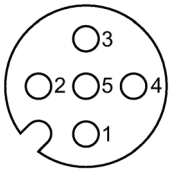
Color coding

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 outputs

The tables below show the pin assignments of the 8 sockets for connection of the digital outputs.

Table 3- 1 Pin assignment for digital outputs

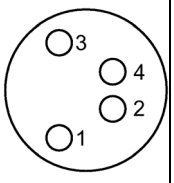
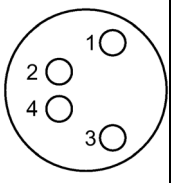
Pin	Assignment	Front view of the sockets	
	X10 to X17 sockets for digital outputs	X10, X12, X14, X16	X11, X13, X15, X17
1	Unassigned		
2	Unassigned		
3	X10 - X13: Ground 1M X14 - X17: Ground 2M		
4 *	Output signal DQ_0: Connector X10 Output signal DQ_1: Connector X11 Output signal DQ_2: Connector X12 Output signal DQ_3: Connector X13 Output signal DQ_4: Connector X14 Output signal DQ_5: Connector X15 Output signal DQ_6: Connector X16 Output signal DQ_7: Connector X17		
5	Functional earth FE		

* The outputs DQ_0 to DQ_3 are connected to 1L+; the outputs DQ_4 to DQ_7 are connected to 2L+.

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.

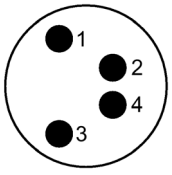
Table 3- 2 Pin assignment for ET-Connection

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		
Shiel-ding	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.

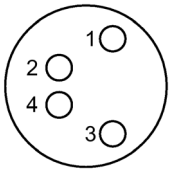
Table 3- 3 Pin assignment of the supply voltage connector

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 DQ 8x24VDC/2A 8xM12 digital output module.

Table 4- 1 Parameters

Parameters	Value range	Default	Scope
Diagnostics: Missing load voltage 2L+	• Disable • Enable	Disable	Module
Diagnostics: Short-circuit to ground	• Disable • Enable	Disable	Module (Short-circuit of the output to ground)
Reaction to CPU/master STOP	• Shut down • Keep last value • Output substitute value	Shut down	Module
Substitute value channel 0 … 7	• 0 • 1	0	Channel

4.2 Explanation of the parameters

Diagnostics: Missing load voltage 2L+

Enabling of the diagnostics for missing or insufficient load voltage 2L+.

Diagnostics: Short-circuit to ground

Enabling of the diagnostics for short-circuit of the output to ground.

Reaction to CPU/master STOP

With this parameter, you set the reaction of the digital outputs of the module after a CPU/master STOP:

- Shut down: The digital output is de-energized.
- Keep last value: The last value of the digital output remains activated.
- Output substitute value: The module outputs a configured substitute value.

Substitute value channel 0 … 7

With this parameter, you set substitute values for the digital outputs.

4.3 Address space

The figure below shows the assignment of the address space for the digital output module DQ 8x24VDC/2A 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.

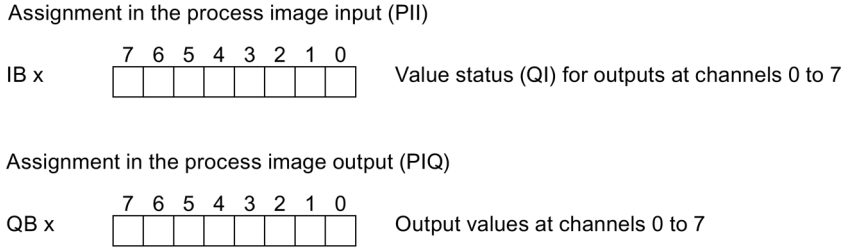


Image 4-1 Address space

Configuration options of the digital output module DQ 8x24VDC/2A 8xM12

You have the following configuration options:

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

Evaluating the value status

An additional byte is occupied in the input address space if you enable the value status for the digital output module. The value status of the outputs is assigned to bits 0 to 7 in input byte x. This additional information provides information regarding the validity of the digital values or channel status.

Bit = 1: No error on channel.

Bit = 0: Error on channel.
This means:

- Short-circuit of output to ground or
- Parameter error or
- For channels 4 ... 7: Missing load voltage 2L+

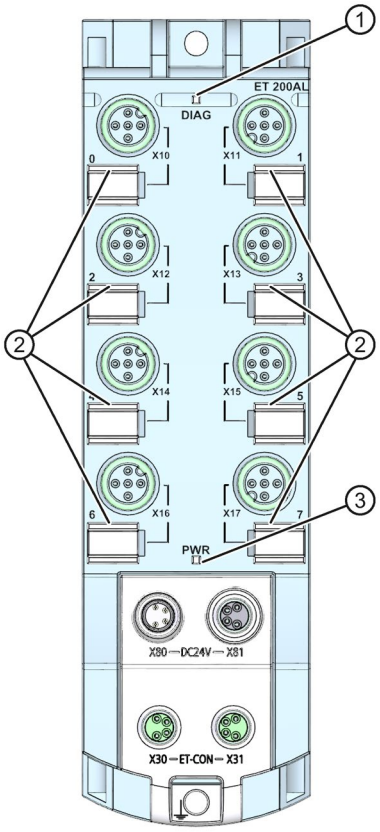
Interrupts/diagnostic alarms

5

5.1 Status and error displays

LED displays

The figure below shows the LED displays (status and error displays) of the digital output module DQ 8x24VDC/2A 8xM12.



①	Diagnostic status (DIAG)	(red/green)
②	Channel status (0 to 7)	(green)
③	Load voltage 2L+ (PWR)	(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 the 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

PWR LED

Table 5- 3 Status display of the PWR LED

PWR LED	Meaning
▫ Off	Load voltage 2L+ is missing or too low
■ On	Load voltage 2L+ present

5.2 Interrupts

The digital output module DQ 8x24VDC/2A 8xM12 supports diagnostics interrupts.

Diagnostic interrupt

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

- Short-circuit of outputs to ground
- Load voltage 2L+ missing or too low

5.3 Diagnostics alarms

For each diagnostic event, a diagnostics alarm is issued and the DIAG LED flashes red on the digital output module. You can read out the diagnostics alarms, for example, from the diagnostics buffer of the CPU. You can evaluate the error codes with the user program.

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

Diagnostics alarm	Error code	Meaning	Remedy
Short-circuit	1_H	Short-circuit of outputs to ground	• Eliminate the short-circuit
Load voltage 2L+ missing*	11_H	Load voltage 2L+ missing or too low	• Check the supply voltage • Check the module
* If you are using ET 200AL modules in connection with the ET 200SP distributed I/O system, the diagnostics alarm "Load voltage missing" is displayed.			

Technical specifications

6

6.1 Technical specifications

Technical specifications of the DQ 8x24VDC/2A 8xM12 digital output module

	6ES7142-5AF00-0BA0
General information	
Product type designation	DQ 8X24VDC/2A, 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; loads will be activated
Load voltage 2L+	
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; loads will be activated
Input current	
Current consumption (rated value)	40 mA; no load
From load voltage 1L+ (unswitched voltage)	4 A; maximum value
From load voltage 2L+, max.	4 A; maximum value
Power loss	
Power loss, typ.	4 W
Digital outputs	
Number of outputs	8
• In groups of	4; 2 load groups for 4 outputs each
Short-circuit protection	Yes; per channel, electronic
• Response threshold, typ.	2.8 A
Limitation of inductive shutdown voltage to	2L+ (-47 V)

	6ES7142-5AF00-0BA0
Switching capacity of outputs	
With lamp load, max.	10 W
Load resistance range	
Low limit	12 Ω
High limit	4 kΩ
Output voltage	
For signal "1", min.	L+ (-0.8 V)
Output current	
For signal "1" rated value	2 A
For signal "1" permissible range, max.	2 A, with inductive load according to IEC 60947-5-1, DC13 / AC-15
For signal "0" residual current, max.	0.5 mA
Switching frequency	
With resistive load, max.	100 Hz
With inductive load, max.	0.1 Hz; 0.25 Hz at 25 °C
With lamp load, max.	1 Hz
Total current of outputs	
Current per group, max.	4 A; with inductive load, max. 2 channels per group
Cable length	
Unshielded, max.	30 m
Interrupts/diagnostics/status information	
Substitute values can be applied	Yes; channel-based, configurable
Interrupts	
Diagnostic interrupt	Yes; configurable
Diagnostics alarms	
Short-circuit	Yes; outputs to ground; module-based
Diagnostics indicator LED	
Channel status display	Yes; green LED
For module diagnostics	Yes; green/red LED
For load voltage monitoring	Yes; green LED
Electrical isolation	
Between load voltages	Yes
Electrical isolation of channels	
Between the channels, in groups of	4
Between the channels and backplane bus	Yes
Between the channels and power supply of the electronics	No; 4 channels are non-isolated and 4 channels are isolated from supply voltage 1L+
Insulation	
Insulation tested with	707 V DC (type test)

	6ES7142-5AF00-0BA0
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.	192 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 output module is explained in the following sections.

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 output module

Display

The channel status LEDs are directly affected by the signal level at the socket.

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:

- 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" • Pause substitute value: 0_B • Value status "BAD"
	3_D: PE_MODE_LAST_VALUE	Last value at "pause" • Pause substitute value: Last output value is maintained • Value status "BAD"
	4_D: PE_MODE_SUBST_VALUE	Substitute value at "pause" • Pause substitute value: Configured pause substitute value is output • Value status "BAD"

Dimension drawing

A

The figure below shows the dimension drawing of the DQ 8x24VDC/2A 8xM12 digital output module in front and side views.

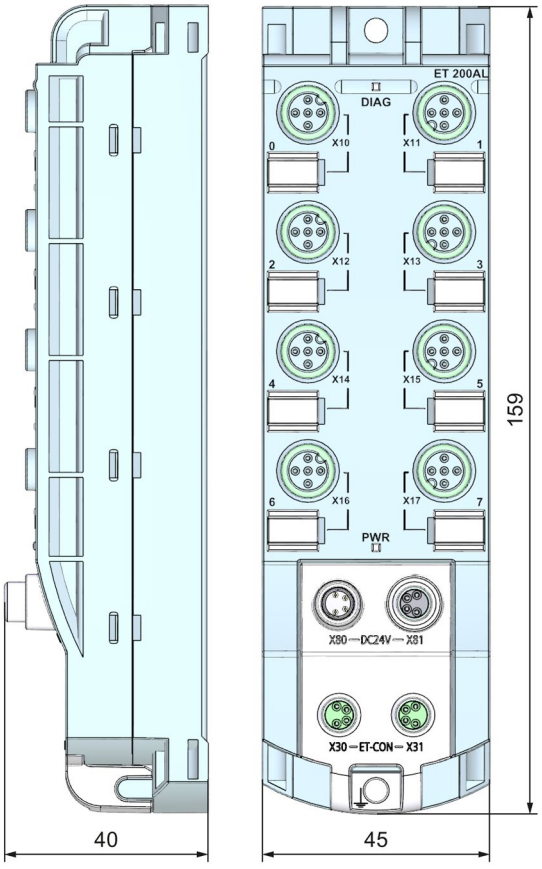


Image A-1 Dimension drawing