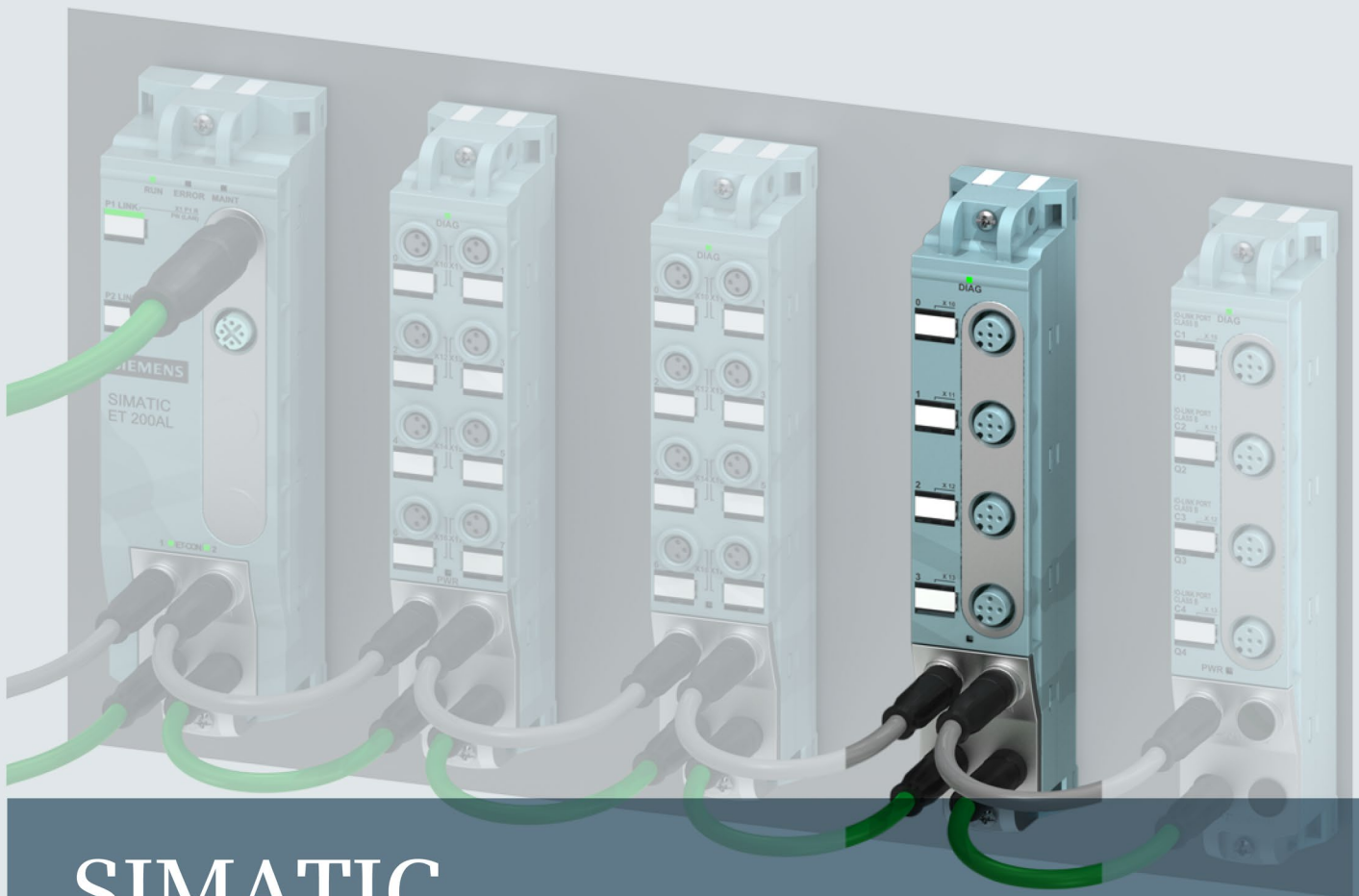




SIMATIC

ET 200AL

Analog output module AQ 4xU/I 4xM12 (6ES7145-5ND00-0BA0)

Manual

Edition

12/2016

SIMATIC

ET 200AL Analog output module AQ 4xU/I 4xM12 (6ES7145-5ND00-0BA0)

Manual

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

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.

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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.

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

Preface

Preface

Purpose of the documentation

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

A note contains important information on the product described in the documentation and on the handling of the product 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, systems, machines and networks.

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To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under (<http://www.siemens.com/industrialsecurity>).

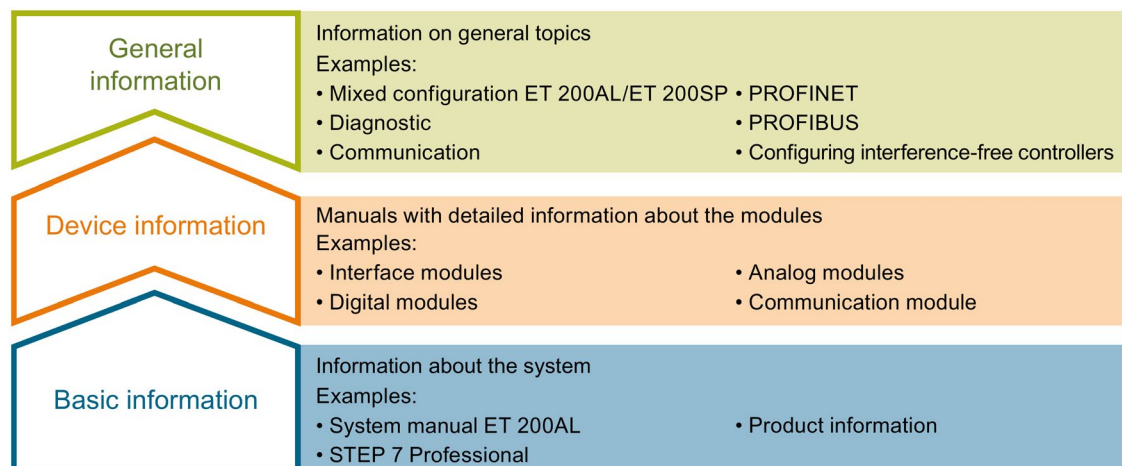
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Documentation guide

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 (<https://support.industry.siemens.com/cs/ww/en/view/109742667>).

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

2.1 Properties

Article number

6ES7145-5ND00-0BA0

View of the module

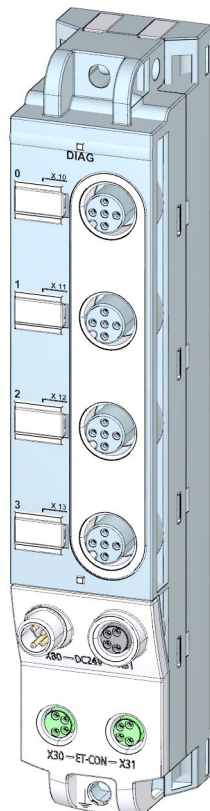


Figure 2-1 View of the analog output module AQ 4xU/I 4xM12

Properties

The module has the following technical properties:

- 4 analog outputs
- M12 sockets for connection of actuators
- Voltage output can be set for each channel
- Current output can be set for each channel
- Resolution: 16-bit
- Dimensions 30 x 159 mm
- Configurable diagnostics can be set for each channel

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
- Spacers

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

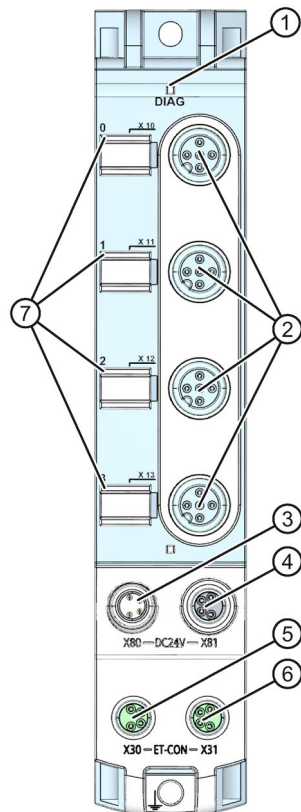
See also

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 AQ 4xU/I 4xM12 analog output module.



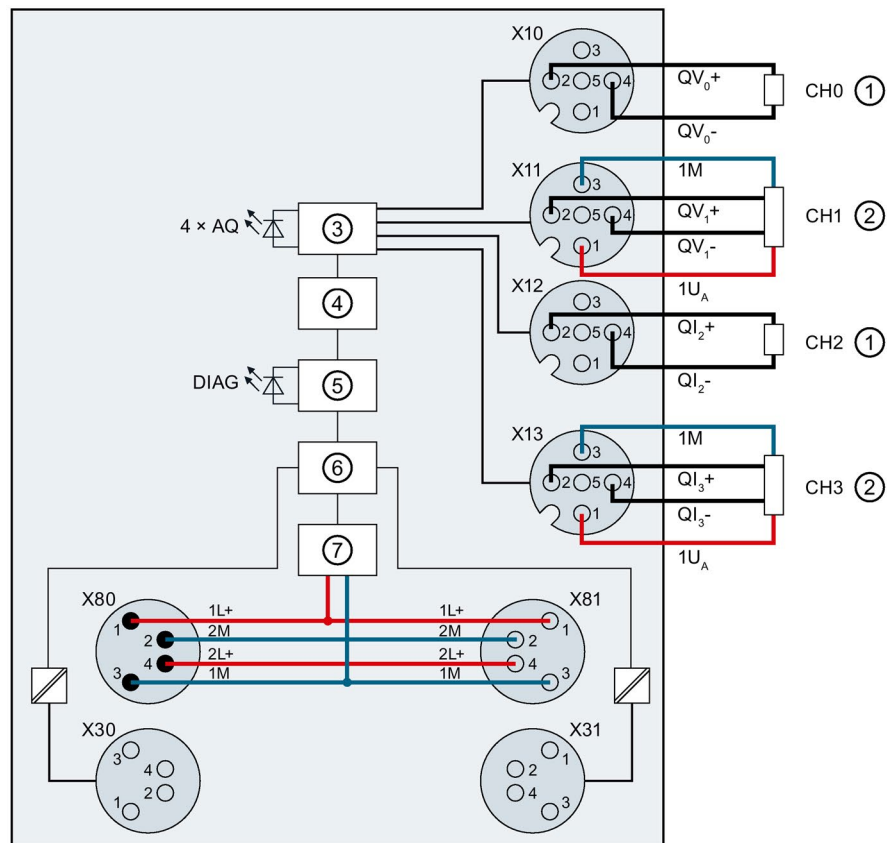
- ① DIAG: LED display for the diagnostic status
- ② X10 to X13: Sockets for the output signal
- ③ X80: Connector for infeed of the supply voltage (POWER input)
- ④ X81: Socket for loop-through of the supply voltage (POWER output)
- ⑤ X30: Socket for ET-Connection IN
- ⑥ X31: Socket for ET-Connection OUT
- ⑦ LED displays 0 to 3 for the channel status

Figure 2-2 Operator controls and display elements

Wiring

3.1 Terminal and block diagram

The example in the following figure shows the pin assignment for voltage and current output of the analog output module AQ 4xU/I 4xM12.



①	Voltage/current output as 2-wire connection	X31	Loop-through of the ET-Connection
②	Voltage/current output as 4-wire connection	1L+	Supply voltage 1L+ (non-switched)
③	Output driver	1M	Ground 1M (non-switched)
④	Digital-to-analog converter (DAC)	2L+	Load voltage 2L+ (switched)
⑤	Microcontroller	2M	Ground 2M (switched)
⑥	ET-Connection interface	1UA	24 V actuator supply
⑦	Internal supply voltage	QV _n /QI _n +	Voltage/current output positive, channel n
X10 to X13	Channels 0 to 3	QV _n /QI _n -	Voltage/current output negative, channel n
X80	Infeed of supply voltages	AQ	Channel status LEDs (0, 1, 2 and 3) (green)
X81	Loop-through of supply voltages	DIAG	Diagnostic status LED (red/green)
X30	Infeed of the ET-Connection		

Figure 3-1 Terminal and block diagram for voltage and current output

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 analog outputs

The tables below show the pin assignments of the 4 sockets for connection of the analog outputs.

Table 3- 1 Pin assignment of the sockets for analog outputs (voltage output)

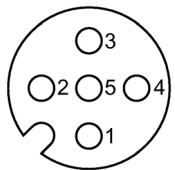
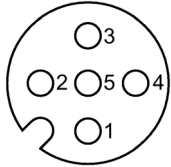
Pin	Assignment	Front view of the sockets
	X10 to X13 - sockets for analog outputs (voltage output)	
1	24 V actuator supply 1U _A (derived from 1L+ Non-Switched)	
2	Voltage output positive QV ₀ +: Connector X10 Voltage output positive QV ₁ +: Connector X11 Voltage output positive QV ₂ +: Connector X12 Voltage output positive QV ₃ +: Connector X13	
3	Ground for actuator supply 1M	
4	Voltage output negative QV ₀ -: Connector X 10 Voltage output negative QV ₁ -: Connector X11 Voltage output negative QV ₂ -: Connector X12 Voltage output negative QV ₃ -: Connector X13	
5	Functional earth FE	
Shield	Functional earth FE	

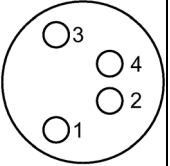
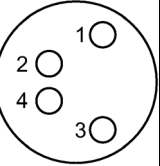
Table 3- 2 Pin assignment of the sockets for analog outputs (current output)

Pin	Assignment	Front view of the sockets
	X10 to X13 - sockets for analog outputs (current output)	
1	24 V actuator supply 1U _A (derived from 1L+ Non-Switched)	
2	Current output positive QI ₀ +: Connector X10 Current output positive QI ₁ +: Connector X11 Current output positive QI ₂ +: Connector X12 Current output positive QI ₃ +: Connector X13	
3	Ground for actuator supply 1M	
4	Current output negative QI ₀ -: Connector X10 Current output negative QI ₁ -: Connector X11 Current output negative QI ₂ -: Connector X12 Current output negative QI ₃ -: Connector X13	
5	Functional earth FE	
Shield	Functional earth FE	

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.

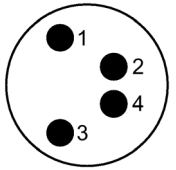
Table 3- 3 Pin assignment for ET-Connection

Pin	Assignment		Assignment of the core color of the bus 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	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.

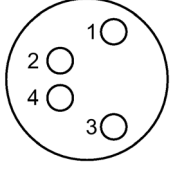
Table 3- 4 Pin assignment of the supply voltage connector

Pin	Assignment	Assignment of the core color of the power 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- 5 Pin assignment of the supply voltage socket

Pin	Assignment	Assignment of the core color of the power 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 connector for ET-Connection and the connector for the supply voltage can destroy the module.

Parameters/address space

4.1 Output ranges

The table below indicates which output types and ranges are configurable.

Output type and output ranges

Table 4- 1 Output type and output ranges

Output type	Output range
Disabled	-
Voltage	+/- 10 V 0 V to 10 V 1 V to 5 V
Current	+/- 20 mA 0 mA to 20 mA 4 mA to 20 mA

The tables of the output ranges, overflow, overrange, etc. are provided in the appendix Representation of analog values (Page 30).

4.2 Parameters

Parameters of the AQ 4xU/I 4xM12 analog output module

The table below lists the parameters that can be set. The effective range of the parameters that can be set depends on the type of configuration. The following configurations are possible:

- Distributed operation on PROFINET IO
- Distributed operation with PROFIBUS DP

The following parameter settings are possible:

Table 4- 2 Configurable parameters and their defaults

Parameters	Value range	Default	GSD file PROFINET IO	GSD file PROFIBUS DP
Output type/range	• Disabled • Voltage ± 10 V • Voltage 0 V to 10 V • Voltage 1 V to 5 V • Current ± 20 mA • Current 0 mA to 20 mA • Current 4 mA to 20 mA	Current 4 mA to 20 mA	Channel	Channel
Diagnostics: Actuator supply short circuit to ground	• Disable • Enable	Disable	Module	Module*
Diagnostics: Short circuit to ground (output type voltage)	• Disable • Enable	Disable	Channel	
Diagnostics: Wire break (output type current)	• Disable • Enable	Disable	Channel	Module
Diagnostics: Under-flow	• Disable • Enable	Disable	Channel	Module
Diagnostics: Over-flow	• Disable • Enable	Disable	Channel	Module
Reaction to CPU/master STOP	• Shut down • Keep last value • Output substitute value	Shut down	Channel	Module
Substitute value	See section Explanation of the parameters (Page 18)	0	Channel	Channel

* = With configuration via PROFIBUS GSD file, the two short-circuit diagnostics ("Diagnostics: Actuator supply short circuit to ground" and "Diagnostics: Short circuit to ground" for voltage outputs) are activated or deactivated using a module-wide parameter "Diagnostics: Short circuit to ground". They cannot be adjusted independently of one another.

4.3 Explanation of the parameters

Short-circuit detection

The diagnostics for short circuit to ground can be configured for the voltage output type. Short-circuit detection cannot be guaranteed for small output values (between 0.1 V and +0.1 V).

Wire break detection

The diagnostics for wire break can be configured for the current output type. Wire break detection cannot be guaranteed for small output values (between -0.2 mA and +0.2 mA).

4.3 Explanation of the parameters

Output type/range channel n

With this parameter, you set the output type or output range for the channel to control the actuator.

Note

Unused channels

"Deactivate" unused channels in the parameter assignment to improve the power consumption of the module.

A deactivated channel always returns the value "no voltage or current".

Diagnostics: Actuator supply short circuit to ground

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

Diagnostics: Short circuit to ground

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

Diagnostics: Wire break

Enabling of the diagnostics if the line to the actuator is broken.

Diagnostics: Underflow

Enabling of the diagnostics when the output value violates the underrange, falls below the minimum output value or reaches the underflow.

Diagnostics: Overflow

Enabling of the diagnostics when the output value exceeds the overrange.

Reaction to CPU/master STOP

Adjusts the reaction of the module after a CPU/master STOP.

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

Substitute value

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

The table below shows the permitted value ranges for the substitute values:

Table 4- 3 Permissible substitute values for the output ranges

Output type	Output range	Valid substitute value
Current	±10 V	-32512 to 32511
	0 V to 10 V	0..32511
	1 V to 5 V	-6912 to 32511
Voltage	±20 mA	-29031..29030
	0 mA to 20 mA	0..29030
	4 mA to 20 mA	-692 to 29376

4.4 Address space

The following figure shows the assignment of the address space for the AQ 4xU/I 4xM12 analog output module with value status (Quality Information (QI)).

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

Assignment in the process image output (PIQ)

	7	6	5	4	3	2	1	0		Con- nectors	Pin assignment		Channel
											U	I	
QB x										X10	Pin 2, 4	Pin 2, 4	0
QB x+1													
QB x+2										X11	Pin 2, 4	Pin 2, 4	1
QB x+3													
QB x+4										X12	Pin 2, 4	Pin 2, 4	2
QB x+5													
QB x+6										X13	Pin 2, 4	Pin 2, 4	3
QB x+7													

Assignment in the process image input (PII)

	7	6	5	4	3	2	1	0	
QB x	0	0	0	0					Value status (QI) at channels 0 to 3

Figure 4-1 Address space

Configuration options of the AQ 4xU/I 4xM12 analog output module

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 analog output module. Bits 0 to 3 in this byte are assigned to a channel and return information about the validity of the analog values or the channel status.

Bit = 1: No error on channel.

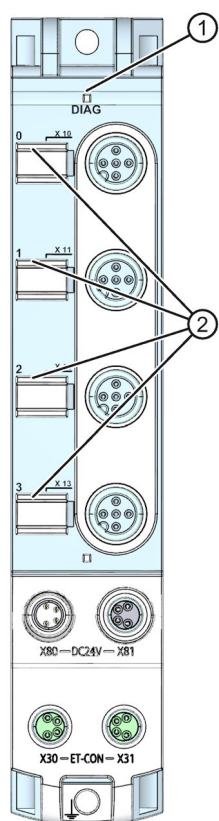
Bit = 0: Error on channel.

Interrupts/diagnostics alarms

5.1 Status and error displays

LED displays

The figure below shows the LED display (status and error displays) of the AQ 4xU/I 4xM12 analog output module.



- ① Diagnostic status (DIAG) (red/green)
- ② Channel status (0, 1, 2 and 3) (green)

Figure 5-1 LED displays

Meaning of the LEDs

The following tables set out the meaning of the status and error displays. Corrective measures for diagnostics alarms can be found in the section Diagnostics alarms (Page 23).

DIAG LED

Table 5- 1 Error display of the DIAG LED

DIAG LED	Meaning
 Off	No supply voltage 1L+
 Flashes	- Module parameters not assigned (after switching on the supply voltage 1L+) - Loading firmware (while the firmware update is being performed, all LEDs retain their current status) - No connection to the ET-Connection and/or the fieldbus
 On	Module parameters assigned and no diagnostics
 Flashes	Module parameters assigned and diagnostics

LED for the channel status

Table 5- 2 Status display of the LEDs 0, 1, 2 and 3

LED 0, 1, 2 and 3	Meaning
 Off	- Channel deactivated - Channel activated and incorrect parameter assignment - Parameter error possible with GSD
 On	Channel activated and correct parameter assignment

5.2 Interrupts

The AQ 4xU/I 4xM12 analog output module supports diagnostics interrupts.

Diagnostic interrupt

The module generates a diagnostic interrupt at the following events:

- Short-circuit of the actuator supply
- Short-circuit (voltage)
- Wire break (current)
- High limit violated
- Low limit violated
- Parameter assignment error

5.3 Diagnostics alarms

For each diagnostic event, a diagnostics alarm is issued and the DIAG LED flashes red on the analog output 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.

The following tables show the diagnostics alarms for all measuring ranges.

Table 5- 3 Diagnostics alarms

Diagnostics alarm	Error code	Meaning	Solution
Short circuit to ground	1 _H	• Short-circuit of actuator supply to ground • Short-circuit of output to ground	Correct the process wiring
Wire break	6 _H	Actuator circuit impedance too high	Use a different actuator type or modify the wiring, e.g. use cables with larger cross-section
		Wire break between the module and sensor	Connect the cable
		Channel not connected (open)	• Deactivate diagnostics • Connect the channel • Deactivate channel
High limit violated	7 _H	The output value set by the user program violates the valid rated range/overrange.	Correct the output value
Low limit violated	8 _H	The output value set by the user program violates the valid rated range/underrange.	Correct the output value
Parameter assignment error	10 _H	Module parameter assignment is faulty	Correct the parameter assignment

Technical specifications

Technical specifications of the AQ 4xU/I 4xM12 analog output module

	6ES7145-5ND00-0BA0
General information	
Product type designation	AQ 4XU/I, 4XM12
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	STEP 7 V14 or higher
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; actuator supply outputs are connected with reverse polarity
Input current	
Current consumption (rated value)	110 mA; no load
From load voltage 1L+ (unswitched voltage)	4 A; maximum value
From load voltage 2L+, max.	4 A; maximum value
Actuator supply	
Number of outputs	4
Short-circuit protection	Yes; per module, electronic
Output current	
Rated value	Total current 1 A to 45 °C, 0.5 A to 55 °C
Power loss	
Power loss, typ.	2.6 W
Analog outputs	
Number of analog outputs	4
Voltage output, short-circuit protection	Yes
Voltage output, short-circuit current, max.	24 mA
Current output, no-load voltage, max.	15 V
Cycle time (all channels), max.	1 ms

	6ES7145-5ND00-0BA0
Output ranges, voltage	
0 V to 10 V	Yes; 15 bit
1 V to 5 V	Yes; 14 bit
-10 V to +10 V	Yes; 16 bit incl. sign
Output ranges, current	
0 mA to 20 mA	Yes; 15 bit
-20 mA to +20 mA	Yes; 16 bit incl. sign
4 mA to 20 mA	Yes; 14 bit
Wiring the actuators	
for voltage output two-wire connection	Yes
for voltage output four-wire connection	Yes
for current output two-wire connection	Yes
for current output four-wire connection	Yes
Load resistance (in the rated range of the output)	
for voltage outputs, min.	1 kΩ
for voltage outputs, capacitive load, max.	1 μF
for current outputs, max.	500 Ω
for current outputs, inductive load, max.	1 mH
Destruction limit for externally applied voltages and currents	
Voltages at the outputs to MANA	16 V
Cable length	
Shielded, max.	30 m
Analog value generation for the outputs	
Settling time	
for resistive load	1 ms
for capacitive load	1 ms
for inductive load	1 ms
Errors/accuracies	
Output ripple (in relation to output range, bandwidth 0 kHz to 50 kHz), (+/-)	0.02%
Linearity error (in relation to output range), (+/-)	0.1%
Temperature error (in relation to output range), (+/-)	0.005%/K
Crosstalk between outputs, max.	-70 dB
Repeat accuracy in settled state at 25 °C (in relation to output range), (+/-)	0.03%
Operational limit in the entire temperature range	
Voltage in relation to output range, (+/-)	0.25%
Current in relation to output range, (+/-)	0.25%
Basic error limit (operational limit at 25 °C)	
Voltage in relation to output range, (+/-)	0.15%
Current in relation to output range, (+/-)	0.15%

	6ES7145-5ND00-0BA0
Interrupts/diagnostics/status information	
Substitute values can be applied	Yes; channel-based, configurable
Interrupts	
Diagnostic interrupt	Yes; configurable
Diagnostics alarms	
Wire break	Yes; channel-based, only for output type current
Short-circuit	Yes; actuator supply module-based, for output type voltage channel-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)
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	30 mm
Height	159 mm
Depth	40 mm
Weights	
Weight, approx.	175 g

PROFenergy

7.1 Pause function

Introduction

PROFenergy 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 PROFenergy, 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 PROFenergy 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 response of the analog output module is explained in the section below.

Additional information

You can find additional information on working with PROFenergy in the "PROFenergy" 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 PROFenergy" section of function manual PROFINET with STEP 7 V14 (<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 Response of analog output module

Display

The channel status LEDs are not affected by PROFenergy.

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 conditions apply to all channels which switch to the pause mode "PE_MODE_SHUTDOWN":

- "Wire break" and "Short circuit" error detection is **not** possible during the pause:
 - Alarms for errors already pending before the "pause" are retained.
 - Incoming and outgoing errors are reported once the "pause" has ended.

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

- "Wire break" and "Short circuit" error recognition is possible during the pause. These errors are reported.
- The selection of an incorrect pause substitute value which does not correspond to the output range may result in the message "High limit violated" or "Low limit violated". The pause substitute output value effective at the channel is limited to the high or low control limit for the output range.

Mode parameter

The following table shows the "Mode" parameter.

Table 7- 1 Mode parameter

Element	Code	Explanation
Mode	0D: PE_MODE_PROCEED	Proceed at "pause" • Value status "GOOD"
	1D: PE_MODE_SHUTDOWN	Switch off at "pause" • Actuator supply U_A switched off • Outputs de-energized • Value status "BAD"
	3D: PE_MODE_LAST_VALUE	Last value at "pause" • Pause substitute value: Last output value: • Value status "BAD"
	4D: PE_MODE_SUBST_VALUE	Substitute value at "pause" • Pause substitute value: Configured pause substitute value • Value status "BAD"

¹ As there is only one actuator supply U_A for all channels, the supply can only be switched off during a "pause" if all channel parameters have been set to switch off.

Dimension drawing

The figure below shows the dimension drawing of the AQ 4xU/I 4xM12 analog output module in front and side view.

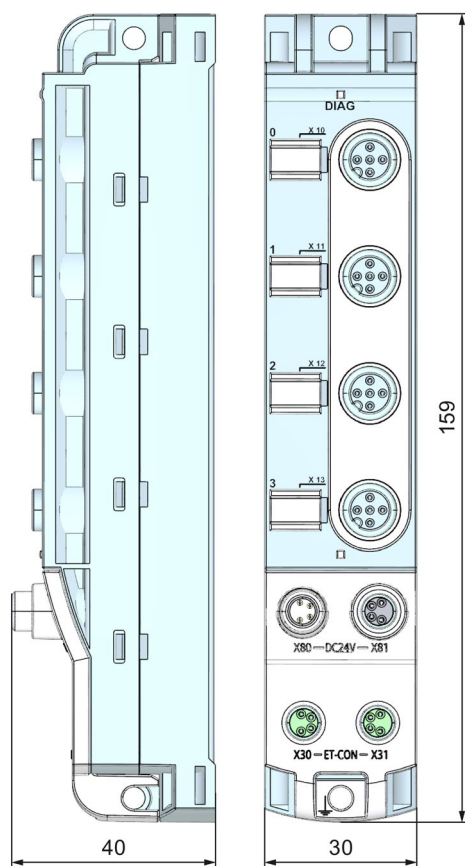


Figure A-1 Dimension drawing

Representation of analog values

This appendix shows the analog values for all output ranges supported by the AQ 4xU/I 4xM12 analog output module.

Measured value resolution

The digitized analog value is the same for all output values at the same nominal range. Analog values are output as fixed point numbers in two's complement.

Table B- 1 Resolution of the analog values

Resolution in bits including sign	Values		Analog value	
	Decimal	Hexadecimal	High byte	Low byte
16	1	1 _H	Sign 0 0 0 0 0 0	0 0 0 0 0 0 1

B.1 Representation of analog values in the voltage output ranges

The tables below list the decimal and hexadecimal values (codes) of the possible voltage output ranges.

Table B- 2 Voltage output range +/-10 V

Values			Voltage output range	Range
	Dec.	Hex.	±10 V	
118.5149%	32767	7FFF	11.76 V	Maximum output value
	32512	7F00		
117.589%	32511	7EFF	11.76 V	Overrange
	27649	6C01		
100%	27648	6C00	10 V	Nominal range
75%	20736	5100	7.5 V	
0.003617%	1	1	361.7 µV	
0%	0	0	0 V	
	-1	FFFF	-361.7 µV	
-75%	-20736	AF00	-7.5 V	
-100%	-27648	9400	-10 V	
	-27649	93FF		Underrange
-117.593%	-32512	8100	-11.76 V	
	-32513	80FF	-11.76	Minimum output value
-118.519%	-32768	8000		

Table B- 3 Voltage output range 0 V to 10 V

Values			Voltage output range	Range
	Dec.	Hex.	0 V to 10 V	
118.519%	32767	7FFF	11.76 V	Maximum output value
	32512	7F00		
117.589%	32511	7EFF	11.76 V	Overrange
	27649	6C01		
100%	27648	6C00	10 V	Nominal range
75%	20736	5100	7.5 V	
0.003617%	1	1	361.7 μ V	
0%	0	0	0 V	
	-1	FFFF	0 V	Minimum output value
-118.519%	-32768	8000		

Table B- 4 Voltage output range 1 to 5 V

Values			Voltage output range	Range
	Dec.	Hex.	1 V to 5 V	
118.519%	32767	7FFF	5.70 V	Maximum output value
	32512	7F00		
117.589%	32511	7EFF	5.70 V	Overrange
	27649	6C01		
100%	27648	6C00	5 V	Nominal range
75%	20736	5100	4 V	
0.003617%	1	1	1 V + 144.7 μ V	
0%	0	0	1 V	
	-1	FFFF	1 V - 144.7 μ V	Underrange
-25%	-6912	E500	0 V	
	-6913	E4FF	0 V	Minimum output value
-118.519%	-32768	8000		

B.2 Representation of analog values in the current output ranges

The tables below list the decimal and hexadecimal values (codes) of the possible current output ranges.

Table B- 5 Current output range +/-20 mA

Values			Current output range	Range
	Dec.	Hex.	± 20 mA	
118.5149%	32767	7FFF	21 mA	Maximum output value
	29031	7167		
105%	29030	7166	21 mA	Overrange
	27649	6C01	20 mA + 723.4 nA	
100%	27648	6C00	20 mA	Nominal range
75%	20736	5100	15 mA	
0.003617%	1	1	723.4 nA	
0%	0	0	0 mA	
	-1	FFFF	-723.4 nA	
-75%	-20736	AF00	-15 mA	
-100%	-27648	9400	-20 mA	
	-27649	93FF	-20 mA + 723.4 nA	Underrange
-105%	-29031	8E99	-21 mA	
	-29032	8E98	-21 mA	Minimum output value
-118.519%	-32768	8000		

Table B- 6 Current output range 0 mA to 20 mA

Values			Current output range	Range
	Dec.	Hex.	0 mA to 20 mA	
118.5149%	32767	7FFF	21 mA	Maximum output value
	29031	7167		
105%	29030	7166	21 mA	Overrange
	27649	6C01	20 mA + 723.4 nA	
100%	27648	6C00	20 mA	Nominal range
75%	20736	5100	15 mA	
0.003617%	1	1	723.4 nA	
0%	0	0	0 mA	
	-1	FFFF	0 mA	
-118.519%	-32768	8000		Minimum output value

Table B- 7 Current output range 4 mA to 20 mA

Values			Current output range	Range
	Dec.	Hex.	4 mA to 20 mA	
118.5149%	32767	7FFF	21 mA	Maximum output value
	29377	72C1		
106.25%	29376	72C0	21 mA	Overrange
	27649	6C01	20 mA + 578.7 nA	
100%	27648	6C00	20 mA	Nominal range
75%	19008	4A40	16 mA	
0.003617%	1	1	4 mA + 578.7 nA	
0%	0	0	4 mA	
	-1	FFFF	3.9995 mA	Underrange
-2.5%	-692	FD4C	3.6 mA	
	-693	FD4B	3.6 mA	Minimum output value
-118.519%	-32768	8000		