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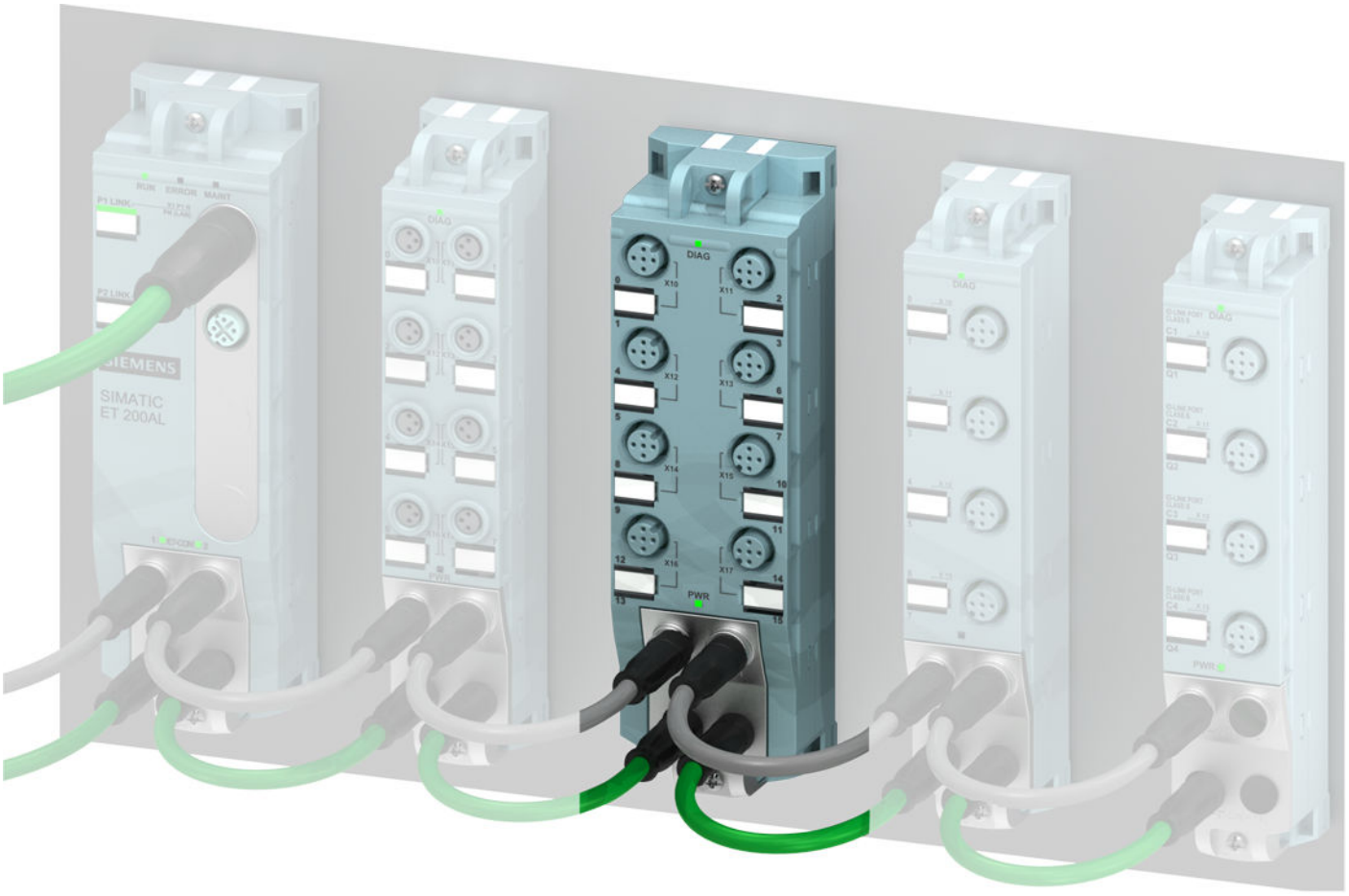
SIMATIC ET 200AL

6ES7143-5AH00-0BA0

DIGITAL I/O MODULE

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Edition 10/2024

SYSTEM MANUAL

SIMATIC

ET200AL

Digital input/output module DIQ 16x24VDC/0.5A 8xM12
6ES7143-5AH00-0BA0

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SIMATIC

ET 200AL
Digital input/Digital output module
DIQ 16x24VDC/0.5A 8xM12
(6ES7143-5AH00-0BA0)

Equipment Manual

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Counting 5

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Parameter data record B

10/2024
A5E38688112-AE

Legal information

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

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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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⚠ WARNING

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GERMANY

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Introduction

1

Purpose of the documentation

This Equipment 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 Equipment 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, on the handling of the product or on the section of the documentation to which particular attention should be paid.

Recycling and disposal

For ecologically sustainable recycling and disposal of your old device, contact a certified disposal service for electronic scrap and dispose of the device in accordance with the regulations in your country.

1.1 ET 200AL Documentation Guide

1.1.1 ET 200AL 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.

You can download the documentation free of charge from the Internet. (https://support.industry.siemens.com/cs/ww/en/view/109742667)

Basic information



The System Manual describes 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.

Examples:

- ET 200AL System Manual
- STEP 7 Professional
- Product information

Device information



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

Examples:

- Equipment Manuals Interface Modules
- Equipment Manuals Digital Modules
- Equipment Manuals Analog Modules
- Equipment Manuals Communications Modules

General information



The function manuals contain detailed descriptions on general topics relating to the SIMATIC ET 200AL distributed I/O system.

Examples:

- Function Manual ET 200AL/ET 200SP Mixed Configuration
- Function Manual Diagnostics
- Function Manual Communication
- PROFINET Function Manual
- PROFIBUS Function Manual
- Function Manual Designing Interference-free Controllers
- Function Manual IO-Link system

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.
(https://support.industry.siemens.com/cs/ww/en/view/95242965)

1.1.2 Tool support

The tools described below support you in all steps: from planning, over commissioning, all the way to analysis of your system.

TIA Selection Tool

The TIA Selection Tool tool supports you in the selection, configuration, and ordering of devices for Totally Integrated Automation (TIA).

As successor of the SIMATIC Selection Tools , the TIA Selection Tool assembles the already known configurators for automation technology into a single 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.
(https://support.industry.siemens.com/cs/ww/en/view/109767888)

SINETPLAN

SINETPLAN, the Siemens Network Planner, supports you in planning automation systems and networks based on PROFINET. The tool facilitates professional and predictive dimensioning of your PROFINET installation as early as in the planning stage. In addition, SINETPLAN supports you during network optimization and helps you to exploit network resources optimally and to plan reserves. This helps to prevent problems in commissioning or failures during productive operation even in advance of a planned operation. This increases the availability of the production plant and helps improve operational safety.

The advantages at a glance

- Network optimization thanks to port-specific calculation of the network load
- Increased production availability thanks to online scan and verification of existing systems
- Transparency before commissioning through importing and simulation of existing STEP 7 projects
- Efficiency through securing existing investments in the long term and the optimal use of resources

You can find SINETPLAN on the Internet (https://new.siemens.com/global/en/products/automation/industrial-communication/profinet/sinetplan.html).

See also

PRONETA Professional (https://support.industry.siemens.com/cs/ww/en/view/109781283)

1.2 SIMATIC Technical Documentation

Additional SIMATIC documents will complete your information. You can find these documents and their use at the following links and QR codes.

The Industry Online Support gives you the option to get information on all topics. Application examples support you in solving your automation tasks.

Overview of the SIMATIC Technical Documentation

Here you will find an overview of the SIMATIC documentation available in Siemens Industry Online Support:

Industry Online Support International (https://support.industry.siemens.com/cs/ww/en/view/109742705)

Watch this short video to find out where you can find the overview directly in Siemens Industry Online Support and how to use Siemens Industry Online Support on your mobile device:

Quick introduction to the technical documentation of automation products per video (https://support.industry.siemens.com/cs/us/en/view/109780491)

YouTube video: Siemens Automation Products - Technical Documentation at a Glance (https://youtu.be/TwLSxxRQQsA)

Retention of the documentation

Retain the documentation for later use.

For documentation provided in digital form:

1. Download the associated documentation after receiving your product and before initial installation/commissioning. Use the following download options:
   - Industry Online Support International: (https://support.industry.siemens.com)

     The article number is used to assign the documentation to the product. The article number is specified on the product and on the packaging label. Products with new, non-compatible functions are provided with a new article number and documentation.
   - ID link:

     Your product may have an ID link. The ID link is a QR code with a frame and a black frame corner at the bottom right. The ID link takes you to the digital nameplate of your product. Scan the QR code on the product or on the packaging label with a smartphone camera, barcode scanner, or reader app. Call up the ID link.
2. Retain this version of the documentation.

Updating the documentation

The documentation of the product is updated in digital form. In particular in the case of function extensions, the new performance features are provided in an updated version.

1. Download the current version as described above via the Industry Online Support or the ID link.
2. Also retain this version of the documentation.

mySupport

With "mySupport" you can get the most out of your Industry Online Support.

Registration	You must register once to use the full functionality of "mySupport". After registration, you can create filters, favorites and tabs in your personal workspace.
Support requests	Your data is already filled out in support requests, and you can get an overview of your current requests at any time.
Documentation	In the Documentation area you can build your personal library.
Favorites	You can use the "Add to mySupport favorites" to flag especially interesting or frequently needed content. Under "Favorites", you will find a list of your flagged entries.
Recently viewed articles	The most recently viewed pages in mySupport are available under "Recently viewed articles".
CAx data	The CAx data area gives you access to the latest product data for your CAx or CAe system. You configure your own download package with a few clicks: • 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" on the Internet. (https://support.industry.siemens.com/My/ww/en)

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 can find the application examples on the Internet.
(https://support.industry.siemens.com/cs/ww/en/ps/ae)

Industrial cybersecurity 2

2.1 Introduction to industrial cybersecurity

Due to the digitalization and increasing networking of machines and industrial plants, the risk of cyber attacks is also growing. Appropriate protective measures are therefore mandatory, particularly in the case of critical infrastructure facilities.

Refer to the System Manual for general information and measures regarding industrial cybersecurity.

This section provides an overview of security-related information pertaining to your SIMATIC device.

2.2 Cybersecurity information

Siemens provides products and solutions with industrial cybersecurity 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 cybersecurity 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 cybersecurity measures that may be implemented, please visit
https://www.siemens.com/cybersecurity-industry.

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 Cybersecurity RSS Feed under
https://new.siemens.com/cert.

2.3 Cybersecurity-relevant information

Observe all relevant cybersecurity information.

Security features of the product	Reference
Data integrity	The topic of data integrity is described in the Industrial cybersecurity section of the System Manual (http://support.automation.siemens.com/WW/view/en/89254965).
Signed firmware update	The topic of signed firmware updates is described in the Industrial cybersecurity section of the System Manual (http://support.automation.siemens.com/WW/view/en/89254965).

Product overview

3

3.1 Properties

Article number

6ES7143-5AH00-0BA0

View of the module

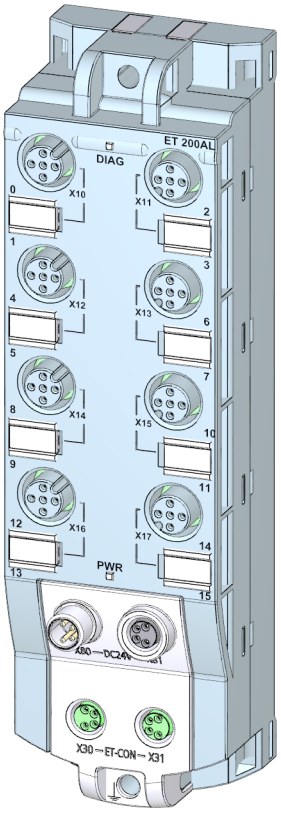


Figure 3-1 View of the digital input/digital output module DIQ 16x24VDC/0.5A 8xM12

Properties

The module has the following technical properties:

- 16 digital inputs or digital outputs, depending on configuration and parameter assignment
  - 8 DIQ signals connected to 1L+ (non-switched)
  - 8 DQ signals connected to 2L+ (switched)
- M12 sockets for connection of sensors and actuators
- Digital inputs:
  - 24 V DC supply voltage
  - Suitable for switches and proximity switches
  - Input delay configurable
  - Configurable diagnostics can be set for each module
- Digital outputs:
  - Rated load voltage 24 V DC
  - Suitable for solenoid valves, DC contactors, and indicator lights
  - Output current per output 0.5 A
  - Configurable diagnostics can be set for each module
- Counters:
  - Configuration method 2xCount or 4xCount with 2 or 4 counters
  - Counting frequency 2 kHz
  - Counting width 32 bits
  - Counting direction parameterizable or controllable via direction input
  - GATE function controllable via the control interface or via control input
  - Configurable diagnostics and hardware interrupts can be set for each module
  - Input delay configurable
- 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:

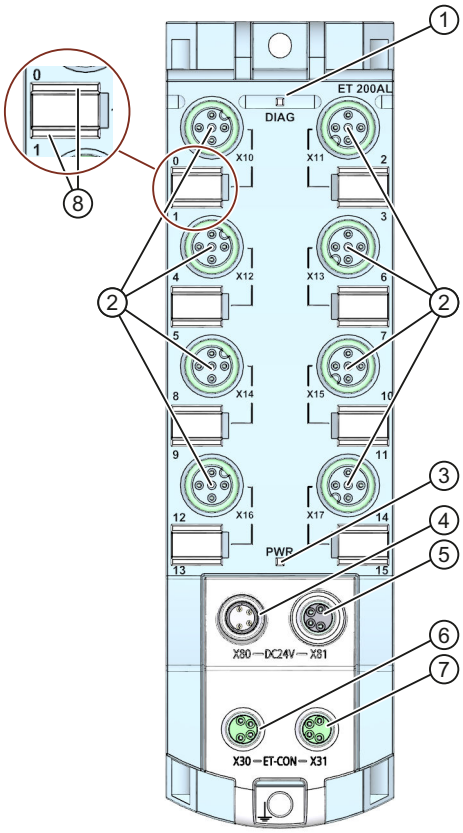
- Connectors
- Cables
- Stripping Tool for ET-Connection
- M8 sealing cap
- M12 sealing cap

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.

3.2 Operator controls and display elements

The following figure shows the operator controls and display elements of the digital input/digital output module DIQ 16x24VDC/0.5A 8xM12.



① DIAG: LED display for the diagnostic status
② X10 to X17: Sockets for the input/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 15 for the channel status

Figure 3-2 Operator controls and display elements

Configuration modes for digital inputs/outputs

4

4.1 Overview

Introduction

With the configuration modes for digital inputs and outputs, you can configure each channel of the module as an input or output consistent with your application.

You use the available configuration modes to specify how the channels will be used:

- DIQ:
  You can use each channel as an input or output through a corresponding parameter assignment.
- DIQ with value status:
  You can use each channel as an input or output through a corresponding parameter assignment. Additionally, the value status gives you information about the validity of the digital values and the channel status.
- DQ16:
  All channels (0..15) are configured as outputs.
- DI8/DQ8:
  Channels 0..7 are configured as inputs, and channels 8..15 are configured as outputs.
- DIQ MIX:
  The channels 0, 2, 4, 6, 8, 10, 12, 14 and 16 have a fixed configuration as outputs, the channels 1, 3, 5, 7, 9, 11, 13 and 15 have a fixed configuration as inputs.

NOTE

Project engineering configuration mode DIQ MIX

Note that you can only use the configuration mode DIQ MIX when configuring via GSD file and in connection with the interface modules IM 157-1 PN and IM 157-1 DP.

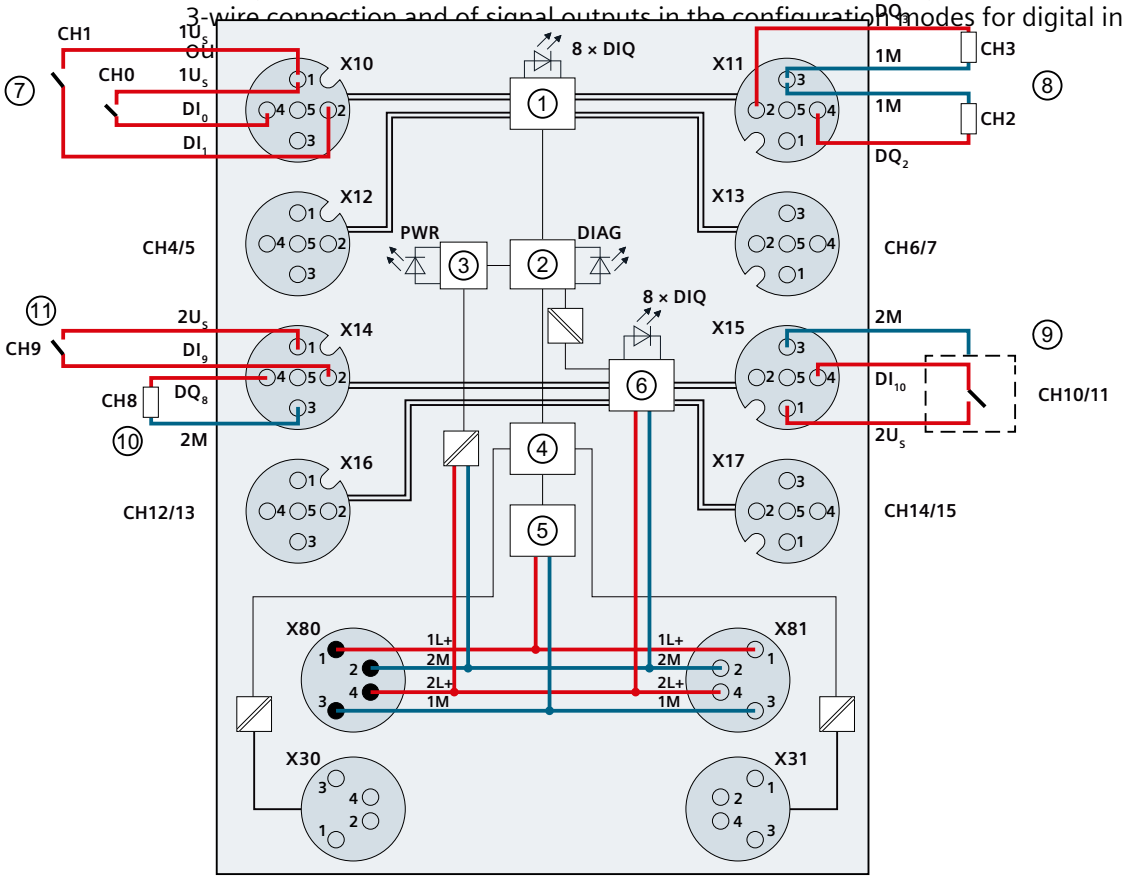
Benefits

The address space occupied by the module is significantly reduced in the DQ16, DI8/DQ8 and DIQ MIX configuration modes compared with the DIQ configuration modes.
This reduction offers you advantages if you have already assigned the available address space of your plant for other processes.

4.2 Wiring

4.2.1 Terminal and block diagram

The figure below shows an example of the pin assignment of signal inputs with 2-wire and 3-wire connection and of signal outputs in the configuration modes for digital inputs and



①	DI/DQ circuit (1L+ non-switched)	X81	Loop-through of supply voltages
②	Microcontroller	X30	Infeed of the ET-Connection
③	Monitoring	X31	Loop-through of the ET-Connection
④	ET-Connection interface	1L+	Supply voltage 1L+ (non-switched)
⑤	Internal supply voltage	1M	Ground 1M (non-switched)
⑥	DI/DQ circuit (2L+ switched)	2L+	Load voltage 2L+ (switched)
⑦	Parameterized as inputs: 2-wire connection	2M	Ground 2M (switched)
⑧	Parameterized as outputs	$1U_S$	24 V encoder supply
⑨	Configured as input: 3-wire connection	$2U_S$	24 V encoder supply
⑩	Configured as output	DIQ_n	Input/output signal
⑪	Configured as input: 2-wire connection	DIQ	LEDs channel status (0..15) (green)
X10 to X17	Channels 0 to 15	DIAG	Diagnostic status LED (red/green)
X80	Infeed of supply voltages	PWR	LED supply voltage 2L+ (green)

Figure 4-1 Wiring and block diagram of configuration modes for digital inputs and outputs

4.2.2 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.

NOTICE

24 V encoder supply $1U_S$ / $2U_S$

Use only the 24 V encoder supplies $1U_S$ and $2U_S$ provided by the digital input/digital output module to supply power to the encoder.

Pin assignment of the sockets for digital inputs/digital outputs in the configuration modes DIQ and DIQ with value status

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

Table 4-1 Pin assignment for digital inputs/digital outputs

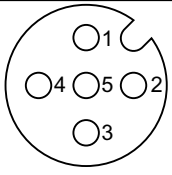
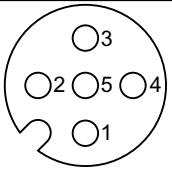
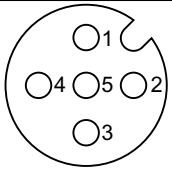
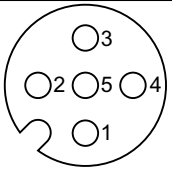
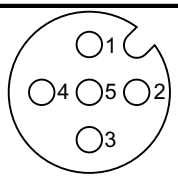
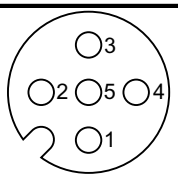
Pin	Assignment	Front view of the sockets	
	X10 to X13 sockets for digital inputs / outputs	**X10, X12**	**X11, X13**
1	24 V encoder supply $1U_S$ (derived from 1L+ non-switched)		
2	Input/output signal DIQ_1: Connector X10 Input/output signal DIQ_3: Connector X11 Input/output signal DIQ_5: Connector X12 Input/output signal DIQ_7: Connector X13		
3	Ground 1M		
4	Input/output signal DIQ_0: Connector X10 Input/output signal DIQ_2: Connector X11 Input/output signal DIQ_4: Connector X12 Input/output signal DIQ_6: Connector X13		
5	Functional earth FE		

Table 4-2 Pin assignment for digital inputs/digital outputs

Pin	Assignment	Front view of the sockets	
	X14 to X17 sockets for digital inputs / outputs	**X14, X16**	**X15, X17**
1	24 V encoder supply $2U_S$ (derived from 2L+ switched)		
2	Input/output signal DIQ_9: Connector X14 Input/output signal DIQ_{11}: Connector X15 Input/output signal DIQ_{13}: Connector X16 Input/output signal DIQ_{15}: Connector X17		

Pin	Assignment	Front view of the sockets	
	X14 to X17 sockets for digital inputs / outputs	**X14, X16**	**X15, X17**
3	Ground 2M		
4	Input/output signal DIQ_8: Connector X14 Input/output signal DIQ_{10}: Connector X15 Input/output signal DIQ_{12}: Connector X16 Input/output signal DIQ_{14}: Connector X17		
5	Functional earth FE		

Pin assignment of the sockets for digital inputs/digital outputs in the configuration mode DQ16

The tables below show the pin assignments of the 8 sockets for connection of the digital inputs/digital outputs in the configuration mode DQ16.
In this configuration mode, socket pins 2 and 4 are always permanently assigned to output signals.

Table 4-3 Pin assignment for digital inputs/digital outputs

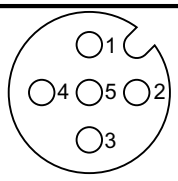
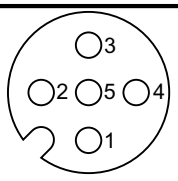
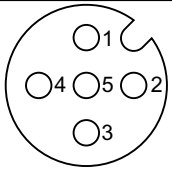
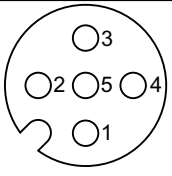
Pin	Assignment	Front view of the sockets	
	X10 to X13 sockets for digital inputs / outputs	**X10, X12**	**X11, X13**
1	24 V encoder supply $1U_S$ (derived from 1L+ non-switched)		
2	Output signal DQ_1: Connector X10 Output signal DQ_3: Connector X11 Output signal DQ_5: Connector X12 Output signal DQ_7: Connector X13		
3	Ground 1M		
4	Output signal DQ_0: Connector X10 Output signal DQ_2: Connector X11 Output signal DQ_4: Connector X12 Output signal DQ_6: Connector X13		
5	Functional earth FE		

Table 4-4 Pin assignment for digital inputs/digital outputs

Pin	Assignment	Front view of the sockets	
	X14 to X17 sockets for digital inputs / outputs	**X14, X16**	**X15, X17**
1	24 V encoder supply $2U_S$ (derived from 2L+ switched)		
2	Output signal DQ_9: Connector X14 Output signal DQ_{11}: Connector X15 Output signal DQ_{13}: Connector X16 Output signal DQ_{15}: Connector X17		
3	Ground 2M		
4	Output signal DQ_8: Connector X14 Output signal DQ_{10}: Connector X15 Output signal DQ_{12}: Connector X16 Output signal DQ_{14}: Connector X17		
5	Functional earth FE		

Pin assignment of the sockets for digital inputs/digital outputs in the configuration mode DI8/DQ8

The tables below show the pin assignments of the 8 sockets for connection of the digital inputs/digital outputs in the configuration mode DI8/DQ8.
In this configuration mode, pins 2 and 4 for the sockets X10 to X13 are always permanently assigned to the input signals, pins 2 and 4 for the sockets X14 to X17 are always permanently assigned to the output signals.

Table 4-5 Pin assignment for digital inputs/digital outputs

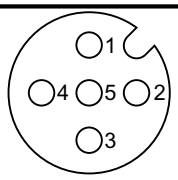
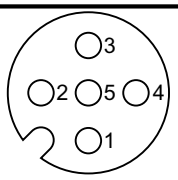
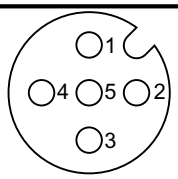
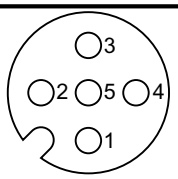
Pin	Assignment	Front view of the sockets	
	X10 to X13 sockets for digital inputs / outputs	**X10, X12**	**X11, X13**
1	24 V encoder supply $1U_S$ (derived from 1L+ non-switched)		
2	Input signal DI_1: Connector X10 Input signal DI_3: Connector X11 Input signal DI_5: Connector X12 Input signal DI_7: Connector X13		
3	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		
5	Functional earth FE		

Table 4-6 Pin assignment for digital inputs/digital outputs

Pin	Assignment	Front view of the sockets	
	X14 to X17 sockets for digital inputs / outputs	**X14, X16**	**X15, X17**
1	24 V encoder supply $2U_S$ (derived from 2L+ switched)		
2	Output signal DQ_9: Connector X14 Output signal DQ_{11}: Connector X15 Output signal DQ_{13}: Connector X16 Output signal DQ_{15}: Connector X17		
3	Ground 2M		
4	Output signal DQ_8: Connector X14 Output signal DQ_{10}: Connector X15 Output signal DQ_{12}: Connector X16 Output signal DQ_{14}: Connector X17		
5	Functional earth FE		

Pin assignment of the sockets for digital inputs/digital outputs in the configuration mode DIQ MIX

The tables below show the pin assignments of the 8 sockets for connection of the digital inputs/digital outputs in the configuration mode DIQ MIX.
In this configuration mode, socket pin 2 is always permanently assigned to input signals, pin 4 is always permanently assigned to output signals.

Table 4-7 Pin assignment for digital inputs/digital outputs

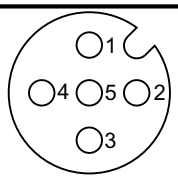
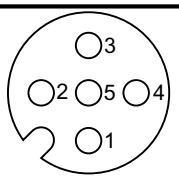
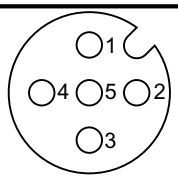
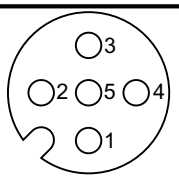
Pin	Assignment	Front view of the sockets	
	X10 to X13 sockets for digital inputs / outputs	**X10, X12**	**X11, X13**
1	24 V encoder supply $1U_S$ (derived from 1L+ non-switched)		
2	Input signal DI_1: Connector X10 Input signal DI_3: Connector X11 Input signal DI_5: Connector X12 Input signal DI_7: Connector X13		
3	Ground 1M		
4	Output signal DQ_0: Connector X10 Output signal DQ_2: Connector X11 Output signal DQ_4: Connector X12 Output signal DQ_6: Connector X13		
5	Functional earth FE		

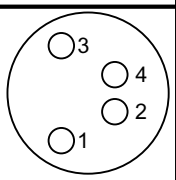
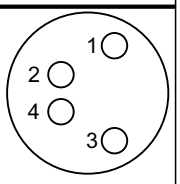
Table 4-8 Pin assignment for digital inputs/digital outputs

Pin	Assignment	Front view of the sockets	
	X14 to X17 sockets for digital inputs / outputs	**X14, X16**	**X15, X17**
1	24 V encoder supply $2U_S$ (derived from 2L+ switched)		
2	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	Ground 2M		
4	Output signal DQ_8: Connector X14 Output signal DQ_{10}: Connector X15 Output signal DQ_{12}: Connector X16 Output signal DQ_{14}: Connector X17		
5	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.

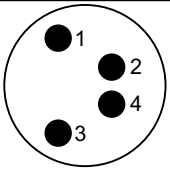
Table 4-9 Pin assignment for ET-Connection

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.

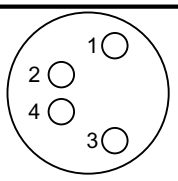
Table 4-10 Pin assignment of the supply voltage connector

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 4-11 Pin assignment of the supply voltage socket

Pin	Assignment X81 socket (POWER output)	Assignment of the core color of the power cable	Front view of the socket
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.

4.3 Parameters/address space

4.3.1 Parameters

The following table shows the parameters for the DIQ 16x24VDC/0.5A 8xM12 digital input / digital output module in the configuration modes for digital inputs and outputs.

Table 4-12 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 encoder supply or of the output to ground)
Reaction to CPU/master STOP	• Shut down • Keep last value • Output substitute value	Shut down	Module (digital outputs)

* = Can only be set in DIQ or DIQ with value status configuration mode.
** = Not available in DQ16 mode. Only values starting from 1.6 ms can be configured for the input delay for channels 8..15.

Parameters	Value range	Default	Scope
Freely configurable channel*	• DI • DQ	DI	Channel
Substitute value channel	• 0 • 1	0	Channel (digital outputs)
Input delay**	• 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	Channel (Digital inputs)

* = Can only be set in DIQ or DIQ with value status configuration mode.
** = Not available in DQ16 mode. Only values starting from 1.6 ms can be configured for the input delay for channels 8..15.

4.3.2 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, at short-circuit of an encoder supply or of an output to ground.

Freely assignable channel

With this parameter, you set whether the channel is to be operated as an input or output. You can only set this parameter in the DIQ and DIQ with value status configuration modes.

Reaction to CPU/master STOP

With this parameter, you set the reaction of the channels configured as output of the digital input/output module after a CPU/master STOP:

- Deactivate: 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

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

Input delay

This parameter can be used to avoid signal faults. Changes to the signal are only detected if they are present and stable for longer than the set input delay time.
You cannot set this parameter in DQ16 mode.

4.3.3 Address space

The DIQ 16x24VDC/0.5A 8xM12 digital input/output module occupies a different number of bytes in the process image input (PII) or process image output (PIQ), depending on which configuration mode you selected.
The following figures show you the various assignments of the address spaces.

NOTE

Parameter assignment of the channels

In the configuration modes for digital inputs and outputs, either all channels are user configurable or all channels have a fixed configuration, depending on the configuration.

For the channels that are configured as an input, the corresponding values in the output data do not trigger any reaction.

For the channels that are configured as an output, the input value in the process image is 0.

Configuration mode DIQ without value status

The tables below show the assignment of the address space for the DIQ 16x24VDC/0.5A 8xM12 digital input/digital output module in the DIQ without value status configuration mode (Quality Information, QI).

Table 4-13 Address space in the configuration mode DIQ without value status

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
Assignment in the process image input (PII)									
IB x									Input values on channels 0 ... 7
IB x +1									Input values on channels 8 ... 15
Assignment in the process image output (PIQ)									
QB x									Output values on channels 0 ... 7
QB x +1									Output values on channels 8 ... 15

Configuration mode DIQ with value status

The tables below show the assignment of the address space for the digital input/digital output module DIQ 16x24VDC/0.5A 8xM12 with value status (Quality Information, QI) in the configuration mode DIQ. If you are using PROFINET and the value status was enabled, the addresses for the value status are available. The value status is not available for PROFIBUS.

Table 4-14 Address space in the configuration mode DIQ with value status

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
Assignment in the process image input (PII)									
IB x									Input values on channels 0 ... 7
IB x +1									Value status (QI) for inputs on channels 0 ... 7*
IB x +2									Value status (QI) for inputs on channels 0 ... 7*
IB x +3									Value status (QI) for inputs on channels 8 ... 15*
IB x +4									Value status (QI) for outputs on channels 0 ... 7*
IB x +5									Value status (QI) for outputs on channels 8 ... 15*
Assignment in the process image output (PIQ)									
QB x									Output values on channels 8 ... 15
QB x +1									Output values on channels 8 ... 15

* 0 = Value read in at channel is incorrect

Configuration mode DQ16

In DQ16 configuration mode, the address space is reduced by the fixed parameter assignment.

Table 4-15 Address space in the configuration mode DQ16

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
Assignment in the process image output (PIQ)									
QB x									Output values on channels 0 ... 7
QB x +1									Output values on channels 8 ... 15

Configuration mode DI8/DQ8

In DI8/DQ8 configuration mode, the address space is reduced by the fixed parameter assignment of the channels.

Table 4-16 Address space in the configuration mode DI8/DQ8

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
Assignment in the process image input (PII)									
IB x									Input values on channels 0 ... 7
Assignment in the process image output (PIQ)									
QB x									Output values on channels 8 ... 15

Configuration mode DIQ MIX

In DIQ MIX configuration mode, the address space is reduced by the fixed parameter assignment of the channels.

Table 4-17 Address space in the configuration mode DIQ MIX

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
Assignment in the process image input (PII)									
IB x									Input values on channels 1, 3, 5, 7, 9, 11, 13 and 15
Assignment in the process image output (PIQ)									
QB x									Output values on channels 0, 2, 4, 6, 8, 10, 12 and 14

Evaluating the value status

An additional 4 bytes are occupied in the input address space if you enable the value status for the digital input/digital output module. The value status of the inputs is assigned to the input bytes x + 2 and x + 3. The value status of the outputs is assigned to the input byte x + 4 and x + 5. 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.
If the channel is configured as input, this means:

- Short-circuit of an encoder supply to ground, or
- Parameter error or
- For channels 8 ... 15: Missing load voltage 2L+

If the channel is configured as output, this means:

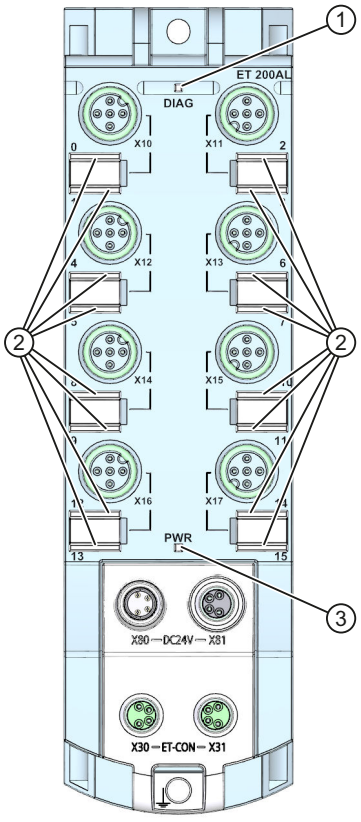
- Short-circuit of output to ground or
- Parameter error or
- For channels 8 ... 15: Missing load voltage 2L+

4.4 Interrupts/diagnostic alarms

4.4.1 Status and error displays

LED displays

The figure below shows the LED displays (status and error displays) of the digital input module / digital output module DIQ 16x24VDC/0.5A 8xM12.



①	Diagnostic status (DIAG)	(red/green)
②	Channel status (0 to 15)	(green)
③	Load voltage 2L+ (PWR)	(green)

Figure 4-2 LED displays

Meaning of the LEDs

The following tables set out the meaning of the status and error displays. Remedial measures for diagnostic reports can be found in chapter Diagnostics alarms (Page 33).

DIAG LED

Table 4-18 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 module diagnostics
☼ Flashes	Module parameters assigned and module diagnostics

LED channel status

Table 4-19 LED channel status display

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

PWR LED

Table 4-20 Status display of the PWR LED

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

4.4.2 Interrupts

The digital input / digital output module DIQ 16x24VDC/0.5A 8xM12 in the configuration method DIQ supports diagnostic interrupts.

Diagnostic interrupt

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

- Short-circuit of an encoder supply to ground, or
- Short-circuit of an output to ground
- Load voltage 2L+ missing or too low
- Parameter assignment error

4.4.3 Diagnostics alarms

For each diagnostic event, a diagnostics alarm is issued and the LED DIAG flashes red on the digital input/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 4-21 Diagnostics alarms, their meanings and corrective measures

Diagnostics alarm	Error code	Meaning	Solution
Short circuit[1]	1_H	Short-circuit encoder supply to ground	Eliminate the short-circuit
		Short-circuit of outputs to ground	
Parameter assignment error	10_H	• The module cannot evaluate parameters for the channel • Incorrect parameter assignment	Correct the parameter assignment.

1 If a short-circuit of the encoder supply to ground is detected, the diagnostics alarm "Short-circuit" is always output. This alarm is output even if all channels are configured as outputs.

2 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

3 A diagnostics alarm is output for a signed firmware update.

Diagnostics alarm	Error code	Meaning	Solution
Load voltage 2L+ missing[2]	11_H	Load voltage 2L+ missing or too low	• Check the supply voltage • Check the module
Security event: Firmware has been successfully downloaded and activated for installation.[3]	191_H	Firmware has been successfully downloaded and activated for installation.	-
Security event: The firmware integrity checks failed.[3]	192_H	Security event: The firmware integrity checks failed.	• Verify if the firmware update file you are using comes from a secure source. • Download the firmware again from the Siemens Support Web page. • Repeat the firmware update.

1 If a short-circuit of the encoder supply to ground is detected, the diagnostics alarm "Short-circuit" is always output. This alarm is output even if all channels are configured as outputs.

2 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

3 A diagnostics alarm is output for a signed firmware update.

NOTE

Channel type

The digital input/digital output module is always signaled as a mixed module (channel type "Input/Output") in the case of diagnostic events, even if you have configured the digital input/digital output module exclusively as an output or input module.

Counting

5

Counting function

Counting refers to the detection and summation of events. The respective counters of the module detect encoder signals and pulses and evaluate them accordingly, for example:

- For counting general piece goods up to a maximum limit
- For applications with recurring counting processes

You can control the counting processes with the digital inputs of the digital input / digital output module belonging to the counter. You can control the digital output belonging to the counter exactly to defined counter values via comparative results independently of the user program.

You can parameterize the behavior of the respective counter by means of the functions described below.

Counter limits

The counter values define the range of values of the counter value than can be used. The counter limits are configurable and can be modified during runtime using the user program. The maximum adjustable count limit amounts to 2147483647 (2^{31}-1). The maximum adjustable count limit amounts to -2147483648 (-2^{31}).
You can continue or stop counting (automatic gate stop) on violation of a counting limit At an overflow or underflow of the count value one event bit is respectively set in the feedback interface. The count value jumps to the respective other counting limit.

Start value

You can configure a start value within the counter limits. The start value can be modified during runtime with the user program.

Load value

In addition to the parameterization you can influence the counting behavior additionally via the control interface by means of the load value. Depending on the bit sequence of the load request (LD_SLOT) contained in the control byte you can load the load value (SLOT) as a current count value, start value, comparative value or count limit.

If you re-parameterize the module, loaded values are overwritten automatically. Therefore, if necessary, carry out the adjustment of the values via the control interface again after a re-parameterization.

Comparison value

You specify a comparison value that controls the associated count output independently of the user program.
The comparison value can be parameterized and can be changed with the user program during runtime.

Gate control

Together with the hardware gate the software gate forms the internal gate. The module only counts when the internal gate is open.
You control the HW gate externally via the digital inputs DI_4 and DI_6. You control the SW gate via the user program. You can activate and use the hardware gate in the 2xCount configuration method by using parameterization.

Counting direction

The counting direction is specified either by the direction of the respective counter or via the parameter assignment of the counter.
You control the counting direction via the digital inputs DI_5 and DI_7. You can activate and use the direction inputs in the 2xCount configuration method by using parameterization.

Overview of configuration methods

The following table shows a list of the channel properties for the configuration methods 2xCount and 4xCount.
You can count with DI_0 and DI_2 (configuration method 2xCount) or respectively with DI_0, DI_2, DI_4 and DI_6 (configuration method 4xCount).

Table 5-1 Configuration methods of the DIQ 16x24VDC/0.5A 8xM12

Property	Configuration method	
	2xCount (Page 38)	**4xCount** (Page 58)
Number of counters	2	4
Counter width, max. counting frequency	32 bits, 2 kHz	32 bits, 2 kHz
Counter inputs	Channels 0, 2	Channel 0, 2, 4, 6
Count outputs	Channel 1, 3	Channel 1, 3, 5, 7
Input for gate stop / start[1]	Channel 4, 6	-
Input for counting direction[1]	Channel 5, 7	-
Number of freely parameterizable channels	8	8

[1] = Can also be used as default digital inputs via the parameter assignment as "Digital input without function".

[2] = Only values as of 1.6 ms can be parameterized as the input delay for Channels 8..15.

Property		Configuration method	
		2xCount (Page 38)	**4xCount** (Page 58)
Parameterizable input delay[2]		0.05 ms .. 20 ms	0.05 ms .. 20 ms
Process data length	Inputs	14 bytes	26 bytes
	Outputs	14 bytes	26 bytes

1 = Can also be used as default digital inputs via the parameter assignment as "Digital input without function".

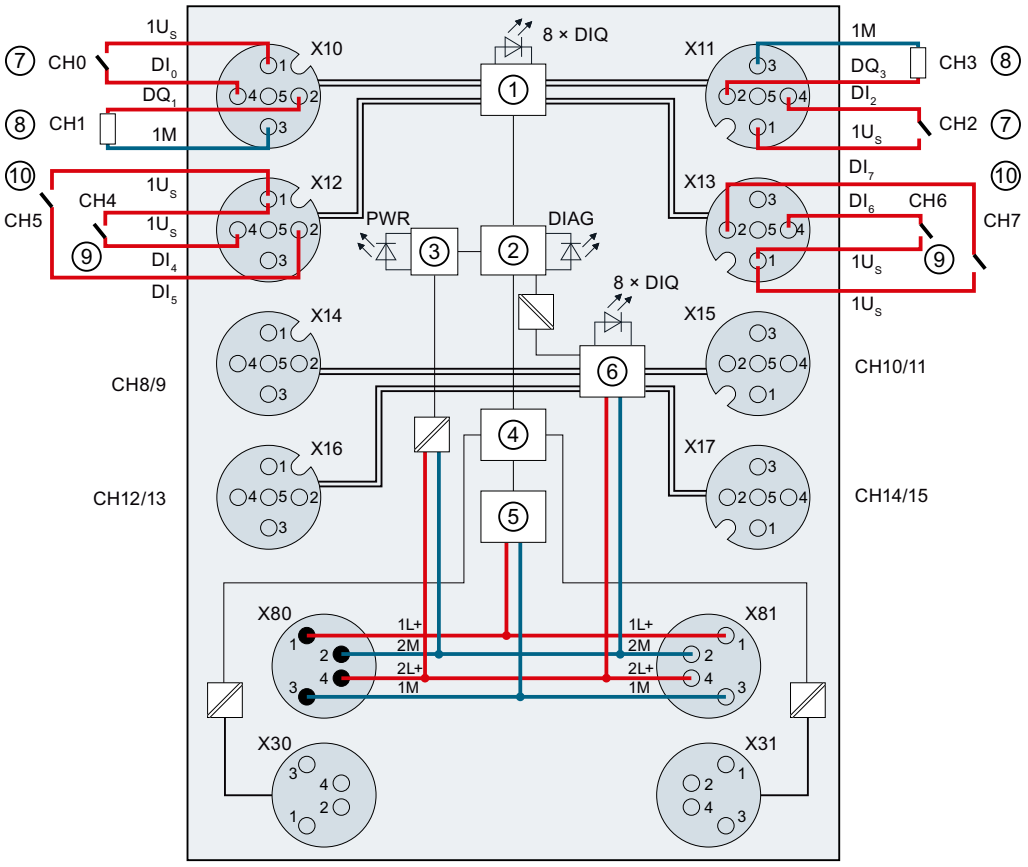
2 = Only values as of 1.6 ms can be parameterized as the input delay for Channels 8..15.

5.1 Configuration method 2xCount

5.1.1 Wiring

5.1.1.1 Terminal and block diagram

The following figure shows as an example the pin assignment of the counters in the configuration method Count (2xCount). Connection examples for allocating the freely parameterizable channels 8..15 are available in the section Configuration method DIQ, subsection Terminal and block diagram (Page 20).



①	DI/DQ circuit (1L+ non-switched)	X81	Loop-through of supply voltages
②	Microcontroller	X30	Infeed of the ET-Connection
③	Monitoring	X31	Loop-through of the ET-Connection
④	ET-Connection interface	1L+	Supply voltage 1L+ (non-switched)
⑤	Internal supply voltage	1M	Ground 1M (non-switched)
⑥	DI/DQ circuit (2L+ switched)	2L+	Load voltage 2L+ (switched)
⑦	Counting input counter	2M	Ground 2M (switched)
⑧	DQ for counters	$1U_S$	24 V encoder supply
⑨	Gate start/stop (level-controlled) or digital input without function	DIQ_n	Input/output signal

⑩	Counting direction or digital input without function	DIQ	Channel status LEDs (0 to 15) (green)
X10 to X17	Channels 0 to 15	DIAG	Diagnostic status LED (red/green)
X80	Infeed of supply voltages	PWR	LED supply voltage 2L+ (green)

Figure 5-1 Wiring and block diagram configuration method 2xCount

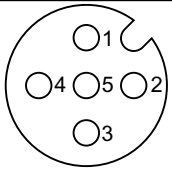
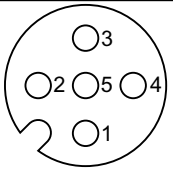
5.1.1.2 Pin assignment

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 counting channels and digital inputs / outputs

The table below shows the pin assignments of the 4 sockets for the connection of the counting channels.

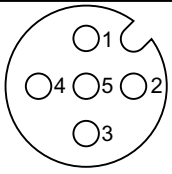
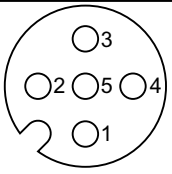
Table 5-2 Pin assignment for counting channels

Pin	Assignment	Front view of the sockets	
	X10 to X13 - sockets for counting channels	**X10, X12**	**X11, X13**
1	24 V encoder supply $1U_S$ (derived from 1L+ non-switched)		
2	Count output for Counter 0: Connector X10 Counting output for Counter 1: Connector X11 Counting direction of Counter 0 or Input signal DI_5: Connector X12 Counting direction of Counter 1 or Input signal DI_7: Connector X13		
3	Ground 1M		
4	Count input for Counter 0: Connector X10 Count input for Counter 1: Connector X11 Counting direction of Counter 0 or Input signal DI_4: Connector X12 Counting direction of Counter 1 or Input signal DI_6: Connector X13		
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/digital output module to supply power to the encoder.

The table below shows the pin assignments of the 4 sockets for the connection of the digital inputs / digital outputs.

Table 5-3 Pin assignment for digital inputs/digital outputs

Pin	Assignment	Front view of the sockets	
	X14 to X17 - sockets for digital inputs / outputs	**X14, X16**	**X15, X17**
1	24 V encoder supply $2U_S$ (derived from 2L+ switched)		
2	Input/output signal DIQ_9: Connector X14 Input/output signal DIQ_{11}: Connector X15 Input/output signal DIQ_{13}: Connector X16 Input/output signal DIQ_{15}: Connector X17		
3	Ground 2M		
4	Input/output signal DIQ_8: Connector X14 Input/output signal DIQ_{10}: Connector X15 Input/output signal DIQ_{12}: Connector X16 Input/output signal DIQ_{14}: Connector X17		
5	Functional earth FE		

NOTICE

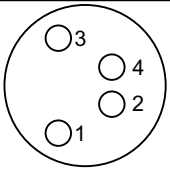
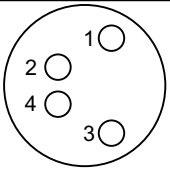
24 V encoder supply $2U_S$

Use only the 24 V encoder supply $2U_S$ provided by the digital input/digital output 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.

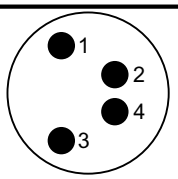
Table 5-4 Pin assignment for ET-Connection

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.

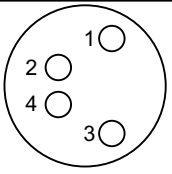
Table 5-5 Pin assignment of the supply voltage connector

Pin	Assignment X80 connector (POWER input)	Assignment of the core color of the power cable	Front view of the connector
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 5-6 Pin assignment of the supply voltage socket

Pin	Assignment X81 socket (POWER output)	Assignment of the core color of the power cable	Front view of the socket
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.

5.1.2 Parameters/address space

5.1.2.1 Parameters

In the configuration method 2xCount of the digital input / digital output module DIQ 16x24VDC/0.5A 8xM12 the Channels 0 to 7 are used by the counting function. The Channels 8 to 15 can be parameterized freely.

The following table shows the general parameter of the module.

Table 5-7 General 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 encoder supply or of the output to ground)
Behavior at CPU/master STOP (8...15)	• Shut down • Keep last value • Output substitute value	Shut down	Module (digital outputs)

The following table shows the parameters of Counter 0 and Counter 1.

Table 5-8 Parameters of Counter 0 and Counter 1

Parameter	Value range	Default	Scope
Counting behavior Counter 0 (DI0), Counter 1 (DI2)			
Input delay DI	• 0.05 ms • 0.1 ms • 0.4 ms • 0.8 ms • 1.6 ms • 3.2 ms • 12.8 ms • 20 ms	0.05 ms	Counter
Counting direction[1]	• Forward • Backward	Forward	Counter
Edge selection	• On a rising edge • On a falling edge	On a rising edge	Counter
Behavior when a counting limit is exceeded	• Stop counting • Continue counting	Stop counting	Counter
Comparison value	-2147483648...21474836-47	10	Counter

1 = Is ignored if DI5/DI7 is parameterized as the direction input.

2 = Cannot be parameterized with GSD file

Parameter	Value range	Default	Scope
Start value[2]	-2147483648...21474836-47	0	Counter
High count limit	-2147483648...21474836-47	2147483647	Counter
Counter low limit[2]	-2147483648...21474836-47	0	Counter
Behavior Counter 0 (DQ1), Counter 1 (DQ3)			
Behavior DQ	• Count value between a comparison value and the high counting limit • Count value between a comparison value and the low counting limit	Count value between a comparison value and the high counting limit	Counter
Hardware interrupt DQ	• Inactive • Comparison event for DQ has occurred	Inactive	Counter
Behavior at CPU/master STOP for DQ	• Continue • Output substitute value	Continue	Counter
Substitute value DQ	• 0 • 1	0	Counter
Behavior Counter 0 (DI4), Counter 1 (DI6)			
Behavior DI	• Digital input without function • Gate start/stop (level-controlled)	Digital input without function	Counter
Behavior Counter 0 (DI5), Counter 1 (DI7)			
Behavior DI	• Digital input without function • Counting direction	Digital input without function	Counter
Input delay DI	• 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	Counter

[1] = Is ignored if DI5/DI7 is parameterized as the direction input.

[2] = Cannot be parameterized with GSD file

The table below shows the parameters of the freely assignable Channels 8...15.

Table 5-9 Parameter freely assignable Channels 8..15

Parameter	Value range	Default	Scope
Freely assignable channel	• DI • DQ	DI	Channel
Substitute value channel	• 0 • 1	0	Channel (digital outputs)
Input delay	• 1.6 ms • 3.2 ms • 12.8 ms • 20 ms	3.2 ms	Channel (digital inputs)

See also

Pin assignment (Page 40)

5.1.2.2 Explanation of the parameters

General 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, at short-circuit of an encoder supply or of an output to ground.

Behavior at CPU/master STOP (8...15)
With this parameter you set the reaction of the digital outputs of after a CPU/master STOP.
Behavior DQ at freely assignable Channels 8...15:

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

Parameter counting function

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

NOTE
Influences the counting frequency
When setting the input delay take into account that the counting frequency possible is automatically reduced at higher values.
In order to achieve the maximum counting frequency of 2 kHz select an input delay smaller than 0.4 ms.

Counting direction
Use this parameter to select the direction in which counting is carried out:

- Forward
- Backward.

NOTE

If you have parameterized DI_5 or DI_7 as the direction input in the respective counter, this parameter is ineffective.

Edge selection
Use this parameter to select the edge that is counted:

- At rising edge:
  The respective counter counts all the rising edges at the counter input.
- At falling edge:
  The respective counter counts all the falling edges at the counter input.

NOTE

If you have parameterized DI_5 or DI_7 as the direction input in the respective counter and the counting direction changes in the process, the count edge is adapted automatically (contrary edges).

Behavior when a counting limit is exceeded
With this parameter you select the behavior when the high counting limit is violated in the upward direction or the low counting limit is violated in the downward direction:

- Stop counting:
  After a counting limit is violated, the internal gate is closed. This stops the counting process. The counter value is set to the opposite counting limit. To start the counting process again, you must close and reopen the SW gate.
- Continue counting:
  After a counting limit is violated, the counter value is set to the opposite counting limit and counting continues.

Comparison value
With this parameter you specify the comparison value.
The following applies:

- Low counting limit ≤ Comparison value ≤ High counting limit

Start value
With this parameter you specify the start value.
The following applies:

- Low counting limit ≤ Start value ≤ High counting limit

High counting limit
With this parameter you specify the high counting limit.
The following applies:

- Low counting limit < High counting limit ≤ 2147483647 (2^{31} - 1)

Low counting limit
With this parameter you specify the low counting limit.
The following applies:

- High counting limit > Low counting limit ≥ -2147483648 (-2^{31})

Behavior DQ
With the "Behavior DQ" you select the counter values at which the count output is set.
When the current count value fulfils the parameterized condition, the associated count output is set.
This means the signal state "1" is set at the count output when:

- Count value between a comparison value and the high counting limit:
  Comparison value ≤ Count value ≤ High counting limit

or

- Count value between a comparison value and the low counting limit:
  Low counting limit ≤ Count value ≤ Comparison value.

Hardware interrupt DQ
With this parameter you specify whether or not a hardware interrupt is generated by the event "Comparison event occurred for DQ".

Behavior at CPU/master STOP for DQ
With this parameter you set the reaction of the count output of a counter after a CPU/master STOP.
Behavior DQ:

- Continue: Signal state of the count output continues to be controlled by comparison conditions.
- Output substitute value: The count output outputs a configured substitute value.

NOTE

Count value at CPU/Master STOP

Independently of the selected reaction of the count output, the count value continues to change during a CPU/Master STOP depending on the input edge, counting continues.

Substitute value DQ
With this parameter you set the substitute value of the digital output of a counter if the setting "Output substitute value" has been selected at the parameter "Behavior at CPU/master STOP for DQ".

Behavior DI (gate control)
With this parameter you select whether a counting function is assigned to the digital input or whether this functions like a standard digital input:

- Gate start/stop:
  The digital input influences the internal gate of Counter 0 or Counter 1. Signal "1" at the digital input opens the HW gate for the counter. Signal "0" at the digital input closes the HW gate for the counter.
- Digital input without function:
  No counting function is assigned to the digital input. It functions like a standard digital input.

Behavior DI (direction input)
With this parameter you select whether a counting function is assigned to the digital input or whether this functions like a standard digital input:

- Counting direction:
  The digital input reverses the counting direction at Counter 0 or Counter 1, in order to adjust it to the process. With signal "0" at the digital input, the counter forwards. With signal "1" at the digital input, the counter counts backwards.
- Digital input without function:
  No counting function is assigned to the digital input. It functions like a standard digital input.

Parameter freely assignable Channels 8..15

Freely assignable channel
With this parameter, you set whether the channel is to be operated as an input or output.

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

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

See also

Assignment of the feedback interface (Page 51)

5.1.2.3 Assignment of the control interface

The user program uses the control interface to influence the behavior of the counters and the channels 8...15 of the module parameterized as an output.
The figure below shows the address assignment of the module in the process image output in the configuration method 2xCount.
At Counter 0 x stands for the output byte QB 2 in this case, at Counter 1 you add 6 bytes to this output byte.
When you assign a different start address to the digital input/digital output module, the byte sequence changes correspondingly.

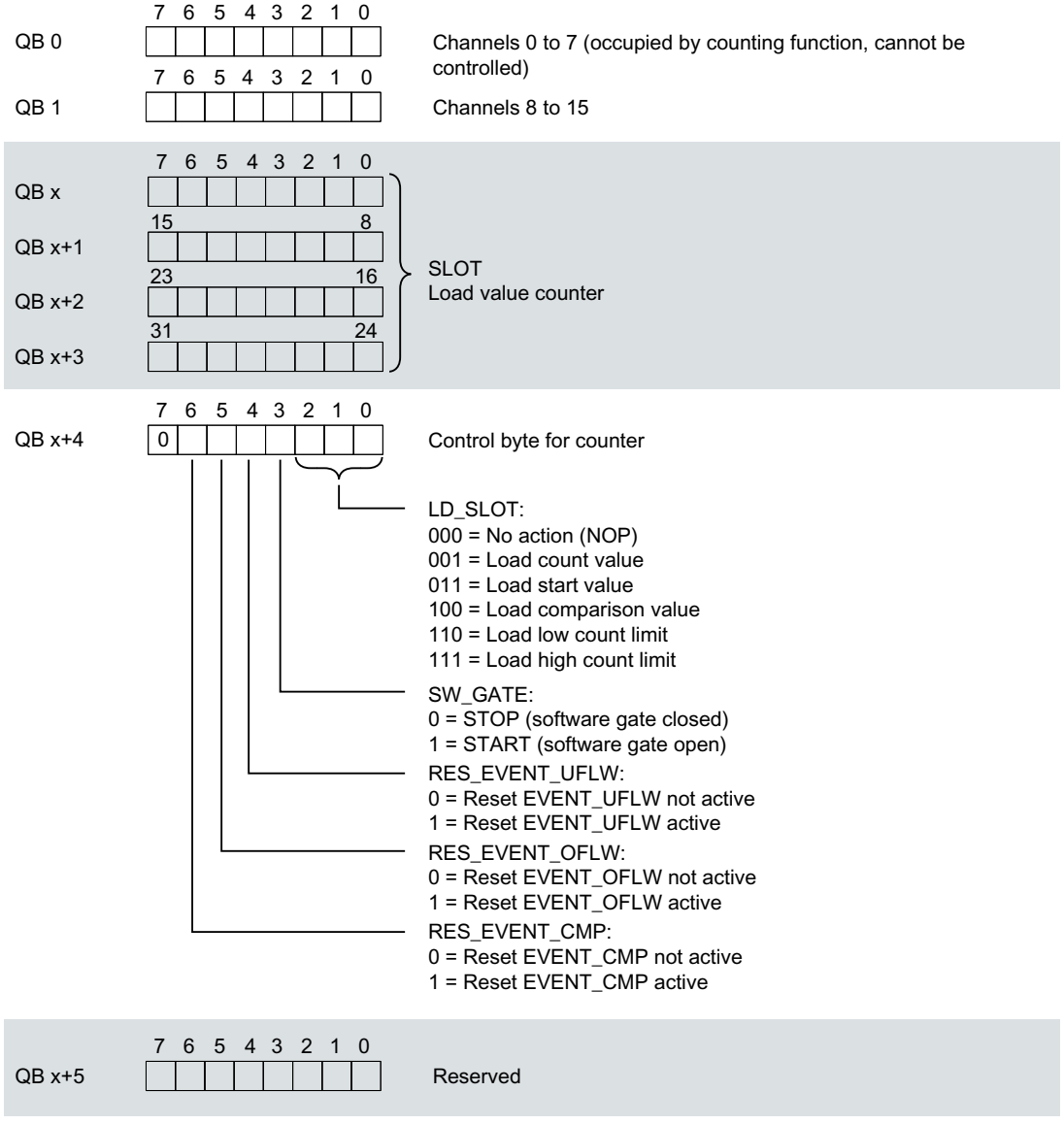


Figure 5-2 Address space control interface configuration method 2xCount

NOTE

Parameter assignment of the channels

The corresponding values in the output data do not trigger any reaction for all the channels that are used as an input.

You cannot control the count outputs via the user program.

5.1.2.4 Explanations on the control interface

Table 5-10 Explanations on the control bits

Control bit	Explanations
SLOT	You specify the load value for the respective counter in these bytes. Through the load request LD_SLOT you load the predefined value into the counter.
LD_SLOT	With this load request you control for which value of the counter the value specified in SLOT is to be loaded. The counter carries out the respective action as soon as LD_SLOT changes. If you have entered the load request LD_SLOT = 011_B open the SW gate, every counting process begins with the value defined in the SLOT as the start value. If you have entered a different load request and open the SW gate, counting is continued with the current count value at every start of the counting process. Both cases also apply at a parameterized HW gate as long as and until the SW gate is closed.
SW_GATE	With this bit you open and close the SW gate of the respective counter. Together with the hardware gate the software gate forms the internal gate. The module only counts when the internal gate is open. 0 means: Software gate closed 1 means: Software gate open
RES_EVENT_UFLW	With this bit you trigger the resetting of the stored event in the feedback bit EVENT_UFLW for the respective counter.
RES_EVENT_OFLW	With this bit you trigger the resetting of the stored event in the feedback bit EVENT_OFLW for the respective counter.
RES_EVENT_CMP	With this bit you trigger the resetting of the stored event in the feedback bit EVENT_CMP for the respective counter.

5.1.2.5 Assignment of the feedback interface

Feedback interface

The user program receives current values and status information from the module via the feedback interface.
The figure below shows the address assignment of the module in the process image input in the configuration method 2xCount.
At Counter 0 x stands for the input byte IB 2 in this case, at Counter 1 you add 6 bytes to this output byte.
When you assign a different start address to the digital input/digital output module, the byte sequence changes correspondingly.

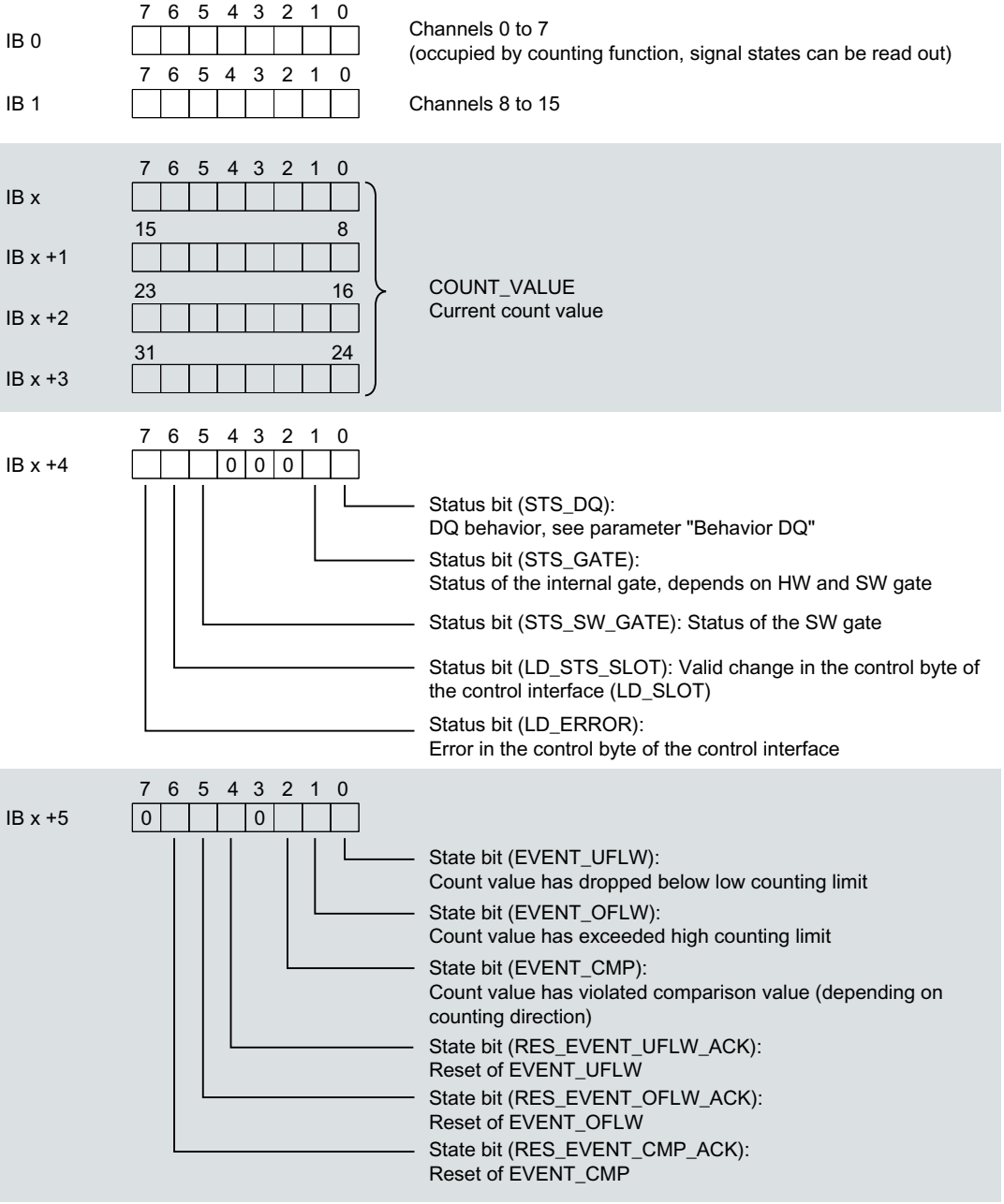


Figure 5-3 Address space feedback interface configuration method 2xCount

5.1.2.6 Explanations for the feedback interface

Table 5-11 Explanations for the feedback bits

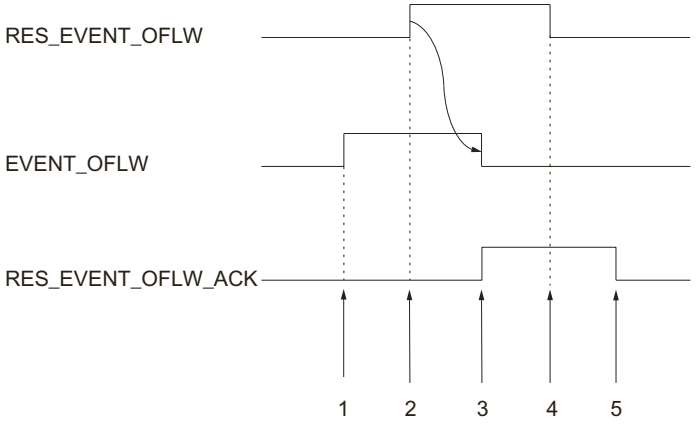
Feedback bit	Explanations
COUNT_VALUE	This value supplies the current count value for the respective counter.
STS_DQ	This bit returns the current signal state of the count output.
STS_GATE	Together with the hardware gate the software gate forms the internal gate. This bit shows the state of the internal gate for the respective counter. The module only counts when the internal gate is open. 0 means: Internal gate closed / counter does not count 1 means: internal Tor open / counter counts **Note:** After a POWER OFF / ON or a change in the parameterization, all the values of the changed counter are transferred again to the module. In the process the internal gate of the respective counter is closed and the count value is set to the start value. Close and open the respective SW gate to restart the counting process. **Note:** When the PROFIBUS interface model is used, the CPU/Master automatically generates the "rising edge" signal after disconnection/reconnection of the communications. This continues the counting process.
STS_SW_GATE	This bit shows the status of the software gate. 0 means: Software gate closed 1 means: Software gate open
LD_STS_SLOT	This bit indicates through a status change (toggling) for the respective counter that loading of the control interface has been carried out successfully.
LD_ERROR	This bit indicates for the respective counter that an error has occurred during loading of the control interface. The load value was not accepted. One of the following conditions is fulfilled: • Low counting limit > Count value • Low counting limit > Start value • Low counting limit > Comparison value • Count value > High counting limit • Start value > High counting limit • Comparison value > High counting limit • Low counting limit ≥ High counting limit • No valid load request in LD_SLOT
EVENT_UFLW	This bit shows for the respective counter whether an underflow (value dropped below the low count limit) has occurred. You reset the state by acknowledging with RES_EVENT_UFLW.
EVENT_OFLW	This bit shows for the respective counter whether an overflow (value exceeded the high count limit) has occurred. You reset the state by acknowledging with RES_EVENT_OFLW.
EVENT_CMP	This bit shows for the respective counter whether a comparison event with the comparison value has occurred. You reset the state by acknowledging with RES_EVENT_CMP. The EVENT_CMP bit is not set if the count value is set to the start value.

Feedback bit	Explanations
RES_EVENT_UFLW_ACK	This bit shows for the respective counter whether the resetting of the event bit EVENT_UFLW is active.
RES_EVENT_OFLW_ACK	This bit shows for the respective counter whether the resetting of the event bit EVENT_OFLW is active.
RES_EVENT_CMP_ACK	This bit shows for the respective counter whether the resetting of the event bit EVENT_CMP is active.

Complete acknowledgment principle

Storing bits are acknowledged in accordance with the complete acknowledgment principle.

The figure below shows an example for the course of the complete acknowledgment principle at an overflow:



① The feedback bit EVENT_OFLW is set as a storing event at an overflow bit.

② The set the control bit RES_EVENT_OFLW in order to initiate resetting of EVENT_OFLW.

③ The feedback bit RES_EVENT_OFLW_ACK is set when the resetting of EVENT_OFLW has been recognized.

④ You reset the control bit RES_EVENT_OFLW .

⑤ The feedback bit RES_EVENT_OFLW_ACK is reset.

Figure 5-4 Acknowledgment principle

NOTE

When you have initiated the resetting of an event bit, you have to wait for the respective feedback bit. You can initiate a further reset subsequently.

NOTE

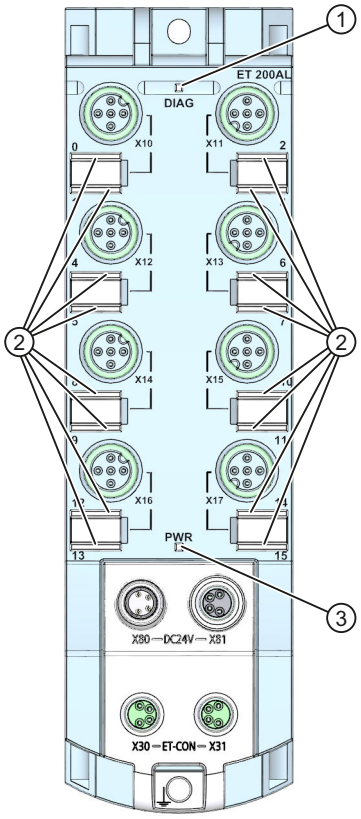
An opening of the SW gate or HW gate (0-1 transition) resets all event bits.

5.1.3 Interrupts/diagnostic alarms

5.1.3.1 Status and error displays

LED displays

The figure below shows the LED displays (status and error displays) of the digital input module / digital output module DIQ 16x24VDC/0.5A 8xM12.



① Diagnostic status (DIAG) (red/green)
② Channel status (0 to 15) (green)
③ Load voltage 2L+ (PWR) (green)

Figure 5-5 LED displays

Meaning of the LEDs

The following tables set out the meaning of the status and error displays. Remedial measures for diagnostic reports can be found in chapter Diagnostics alarms (Page 57).

DIAG LED

Table 5-12 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 module diagnostics
☼ Flashes	Module parameters assigned and module diagnostics

LED channel status

Table 5-13 LED channel status display

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

PWR LED

Table 5-14 Status display of the PWR LED

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

5.1.3.2 Interrupts

The digital input / digital output module DIQ 16x24VDC/0.5A 8xM12 in the configuration method 2xCount supports diagnostic and hardware interrupts.

Diagnostic interrupt

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

- Short-circuit of an encoder supply to ground, or
- Short-circuit of an output to ground
- Load voltage 2L+ missing or too low
- Parameter assignment error

Hardware interrupt

The module generates a hardware interrupt at the following event:

- Comparison event occurred for DQ

For detailed information on the error event, refer to the hardware interrupt organization block with the "RALRM" instruction (read additional interrupt info) and to the STEP 7 online help.

The module channel that triggered the hardware interrupt is entered in the start information of the organization block. The figure below shows the assignment to the bits of the local data double word 8.

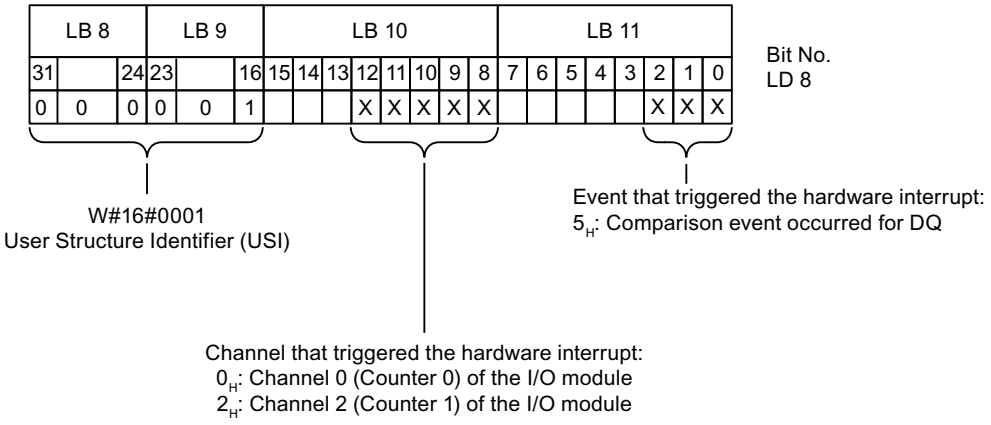


Figure 5-6 Start information of the organization block in the configuration method 2xCount

5.1.3.3 Diagnostics alarms

For each diagnostic event, a diagnostics alarm is issued and the LED DIAG flashes red on the digital input/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 5-15 Diagnostics alarms, their meanings and corrective measures

Diagnostics alarm	Error code	Meaning	Solution
Short circuit[1]	1_H	Short-circuit of an encoder supply to ground	• Eliminate the short-circuit
		Short-circuit of an output to ground	
Parameter assignment error	10_H	Module parameter assignment is faulty	Correction of the parameter assignment
Load voltage 2L+ missing[2]	11_H	Load voltage 2L+ missing or too low	• Check the supply voltage • Check the module
Hardware interrupt lost	16_H	At least one hardware interrupt could not be signaled because too many hardware interrupts are pending.	Correct the program or the process

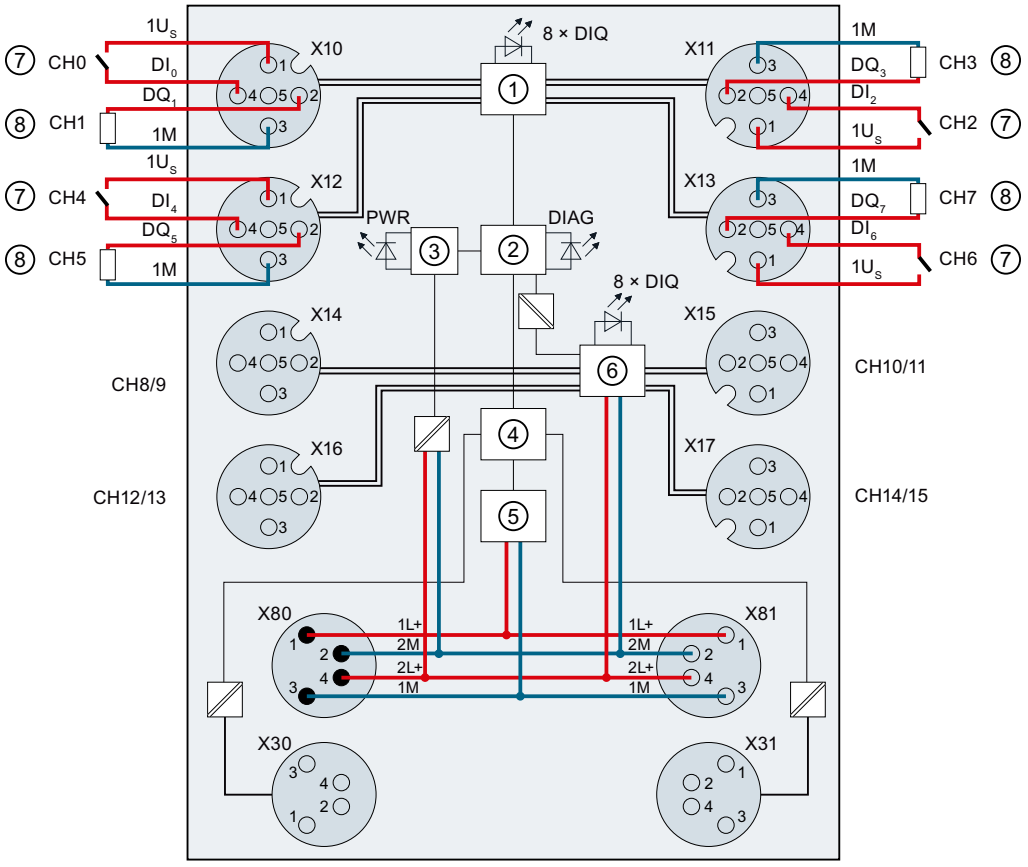
[1] If a short-circuit of the encoder supply to ground is detected, the diagnostic alarm "Short-circuit" is always output. This alarm is output even if all channels are configured as outputs.
[2] If you are using ET 200AL modules in connection with the ET 200SP distributed I/O system, the diagnostic alarm "Load voltage missing" is displayed.

5.2 Configuration method 4xCount

5.2.1 Wiring

5.2.1.1 Terminal and block diagram

The following figure shows as an example the pin assignment of the counters in the configuration method Count (4xCount). Connection examples for allocating the freely parameterizable channels 8..15 are available in the section Configuration method DIQ, subsection Terminal and block diagram (Page 20).



①	DI/DQ circuit (1L+ non-switched)	X30	Infeed of the ET-Connection
②	Microcontroller	X31	Loop-through of the ET-Connection
③	Monitoring	1L+	Supply voltage 1L+ (non-switched)
④	ET-Connection interface	1M	Ground 1M (non-switched)
⑤	Internal supply voltage	2L+	Load voltage 2L+ (switched)
⑥	DI/DQ circuit (2L+ switched)	2M	Ground 2M (switched)
⑦	Counting input counter	1U$_S$	24 V encoder supply
⑧	DQ for counters	DIQ$_n$	Input/output signal
X10 to X17	Channels 0 to 15	DIQ	Channel status LEDs (0 to 15) (green)
X80	Infeed of supply voltages	DIAG	Diagnostic status LED (red/green)
X81	Loop-through of supply voltages	PWR	LED supply voltage 2L+ (green)

Figure 5-7 Wiring and block diagram configuration method 4xCount

5.2.1.2 Pin assignment

NOTE

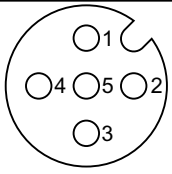
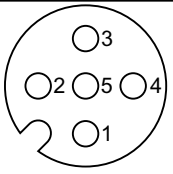
Color coding

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 counting channels and digital inputs / outputs

The table below shows the pin assignments of the 4 sockets for the connection of the counting channels.

Table 5-16 Pin assignment for counting channels

Pin	Assignment	Front view of the sockets	
	X10 to X13 - sockets for counting channels	**X10, X12**	**X11, X13**
1	24 V encoder supply $1U_S$ (derived from 1L+ non-switched)		
2	Count output for Counter 0: Connector X10 Counting output for Counter 1: Connector X11 Counting output for Counter 2: Connector X12 Counting output for Counter 3: Connector X13		
3	Ground 1M		
4	Count input for Counter 0: Connector X10 Count input for Counter 1: Connector X11 Count input for Counter 2: Connector X12 Count input for Counter 3: Connector X13		
5	Functional earth FE		

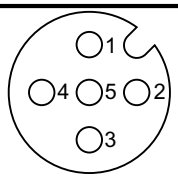
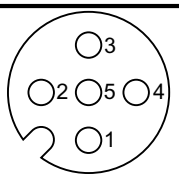
NOTICE

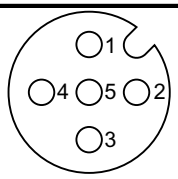
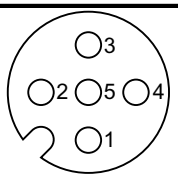
24 V encoder supply $1U_S$

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

The table below shows the pin assignments of the 4 sockets for the connection of the digital inputs / digital outputs.

Table 5-17 Pin assignment for digital inputs/digital outputs

Pin	Assignment	Front view of the sockets	
	X14 to X17 - sockets for digital inputs / outputs	**X14, X16**	**X15, X17**
1	24 V encoder supply $2U_S$ (derived from 2L+ switched)		
2	Input/output signal DIQ_9: Connector X14 Input/output signal DIQ_{11}: Connector X15 Input/output signal DIQ_{13}: Connector X16 Input/output signal DIQ_{15}: Connector X17		

Pin	Assignment	Front view of the sockets	
	X14 to X17 - sockets for digital inputs / outputs	X14, X16	X15, X17
3	Ground 2M		
4	Input/output signal DIQ_8: Connector X14 Input/output signal DIQ_{10}: Connector X15 Input/output signal DIQ_{12}: Connector X16 Input/output signal DIQ_{14}: Connector X17		
5	Functional earth FE		

NOTICE

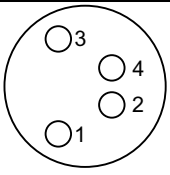
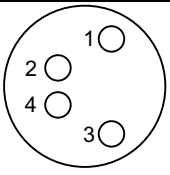
24 V encoder supply $2U_S$

Use only the 24 V encoder supplies $2U_S$ provided by the digital input/digital output 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.

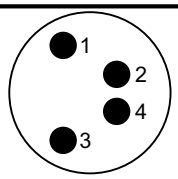
Table 5-18 Pin assignment for ET-Connection

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.

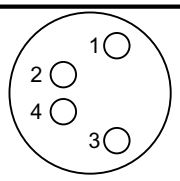
Table 5-19 Pin assignment of the supply voltage connector

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 5-20 Pin assignment of the supply voltage socket

Pin	Assignment X81 socket (POWER output)	Assignment of the core color of the power cable	Front view of the socket
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.

5.2.2 Parameters/address space

5.2.2.1 Parameters

In the configuration method 4xCount of the digital input / digital output module DIQ 16x24VDC/0.5A 8xM12 the Channels 0 to 7 are used by the counting function. The Channels 8 to 15 can be parameterized freely.

The following table shows the general parameter of the module.

Table 5-21 General 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 encoder supply or of the output to ground)
Behavior at CPU/master STOP (8...15)	• Shut down • Keep last value • Output substitute value	Shut down	Module (digital outputs)

The table below shows the parameters of Counter 0 to Counter 3.

Table 5-22 Parameters of Counter 0 to Counter 3

Parameter	Value range	Default	Scope
Counting behavior Counter 0 (DI0), Counter 1 (DI2), Counter 2 (DI4) and Counter 3 (DI6)			
Input delay DI	• 0.05 ms • 0.1 ms • 0.4 ms • 0.8 ms • 1.6 ms • 3.2 ms • 12.8 ms • 20 ms	0.05 ms	Counter
Counting direction	• Forward • Backward	Forward	Counter
Edge selection	• On a rising edge • On a falling edge	On a rising edge	Counter
Behavior when a counting limit is exceeded	• Stop counting • Continue counting	Stop counting	Counter
Comparison value	-2147483648...2147483-647	10	Counter
Start value[1]	-2147483648...2147483-647	0	Counter
High count limit	-2147483648...2147483-647	2147483647	Counter
Low counting limit[1]	-2147483648...2147483-647	0	Counter
Behavior Counter 0 (DQ1), Counter 1 (DQ3), Counter 2 (DQ5), Counter 3 (DQ7)			
Behavior DQ	• Count value between a comparison value and the high counting limit • Count value between a comparison value and the low counting limit	Count value between a comparison value and the high counting limit	Counter
Hardware interrupt DQ	• Inactive • Comparison event for DQ has occurred	Inactive	Counter
Behavior at CPU/master STOP for DQ	• Continue • Output substitute value	Continue	Counter
Substitute value DQ	• 0 • 1	0	Counter

[1] = Cannot be parameterized with GSD file

The table below shows the parameters of the freely assignable Channels 8...15.

Table 5-23 Parameter freely assignable Channels 8..15

Parameter	Value range	Default	Scope
Freely assignable channel	• DI • DQ	DI	Channel
Substitute value channel	• 0 • 1	0	Channel (digital outputs)
Input delay	• 1.6 ms • 3.2 ms • 12.8 ms • 20 ms	3.2 ms	Channel (digital inputs)

See also

Pin assignment (Page 60)

5.2.2.2 Explanation of the parameters

General 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, at short-circuit of an encoder supply or of an output to ground.

Behavior at CPU/master STOP (8...15)
With this parameter you set the reaction of the digital outputs of after a CPU/master STOP.
Behavior DQ at freely assignable Channels 8...15:

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

Parameter counting function

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

NOTE
Influences the counting frequency
When setting the input delay take into account that the counting frequency possible is automatically reduced at higher values.
In order to achieve the maximum counting frequency of 2 kHz select an input delay smaller than 0.4 ms.

Counting direction
Use this parameter to select the direction in which counting is carried out:

- Forward
- Backward.

Edge selection
Use this parameter to select the edge that is counted:

- At rising edge:
  The respective counter counts all the rising edges at the counter input.
- At falling edge:
  The respective counter counts all the falling edges at the counter input.

Behavior when a counting limit is exceeded
With this parameter you select the behavior when the high counting limit is violated in the upward direction or the low counting limit is violated in the downward direction:

- Stop counting:
  After a counting limit is violated, the internal gate is closed. This stops the counting process. The counter value is set to the opposite counting limit. To start the counting process again, you must close and reopen the SW gate.
- Continue counting:
  After a counting limit is violated, the counter value is set to the opposite counting limit and counting continues.

Comparison value
With this parameter you specify the comparison value.
The following applies:

- Low counting limit ≤ Comparison value ≤ High counting limit

Start value
With this parameter you specify the start value.
The following applies:

- Low counting limit ≤ Start value ≤ High counting limit

High counting limit
With this parameter you specify the high counting limit.
The following applies:

- Low counting limit < High counting limit ≤ 2147483647 (2^{31} - 1)

Low counting limit
With this parameter you specify the low counting limit.
The following applies:

- High counting limit > Low counting limit ≥ -2147483648 (-2^{31})

Behavior DQ
With the "Behavior DQ" you select the counter values at which the count output is set.
When the current count value fulfils the parameterized condition, the associated count output is set.
This means the signal state "1" is set at the count output when:

- Count value between a comparison value and the high counting limit:
  Comparison value ≤ Count value ≤ High counting limit

or

- Count value between a comparison value and the low counting limit:
  Low counting limit ≤ Count value ≤ Comparison value.

Hardware interrupt DQ
With this parameter you specify whether or not a hardware interrupt is generated by the event "Comparison event occurred for DQ".

Behavior at CPU/master STOP for DQ
With this parameter you set the reaction of the count output of a counter after a CPU/master STOP.
Behavior DQ:

- Continue: Signal state of the count output continues to be controlled by comparison conditions.
- Output substitute value: The count output outputs a configured substitute value.

NOTE

Count value at CPU/Master STOP

Independently of the selected reaction of the count output, the count value continues to change during a CPU/Master STOP depending on the input edge, counting continues.

Substitute value DQ
With this parameter you set the substitute value of the digital output of a counter if the setting "Output substitute value" has been selected at the parameter "Behavior at CPU/master STOP for DQ".

Parameter freely assignable Channels 8..15

Freely assignable channel
With this parameter, you set whether the channel is to be operated as an input or output.

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

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

5.2.2.3 Assignment of the control interface

The user program uses the control interface to influence the behavior of the counters and the channels 8...15 of the module parameterized as an output.
The figure below shows the address assignment of the module in the process image output in the configuration method 4xCount.
At Counter 0 x stands for the output byte QB 2 in this case, at Counters 1 to 3 you add 6 bytes, 12 bytes and 18 bytes respectively to this output byte.
When you assign a different start address to the digital input/digital output module, the byte sequence changes correspondingly.

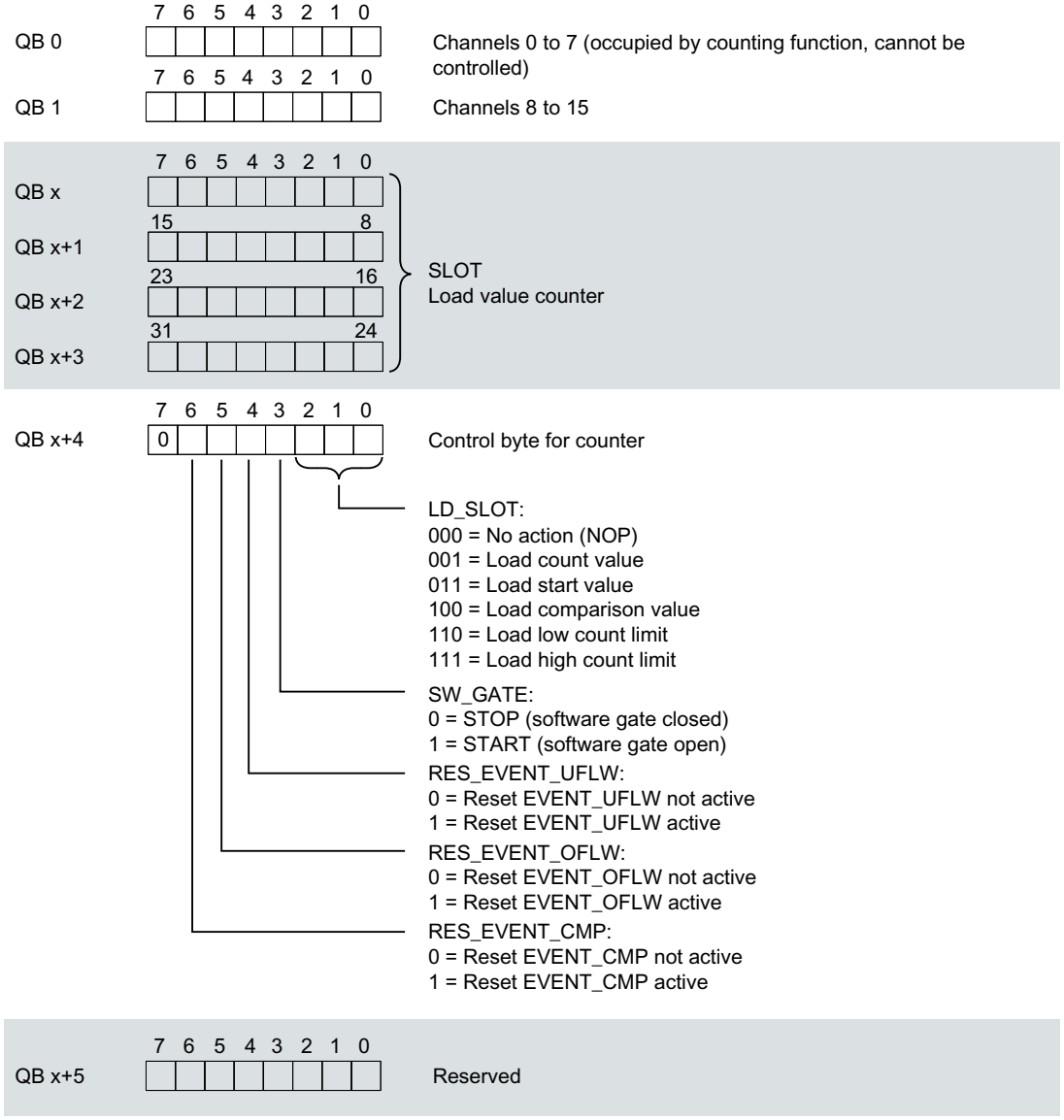


Figure 5-8 Address space control interface configuration method 4xCount

NOTE

Parameter assignment of the channels

The corresponding values in the output data do not trigger any reaction for all the channels that are used as an input.

You cannot control the count outputs via the user program.

5.2.2.4 Explanations on the control interface

Table 5-24 Explanations on the control bits

Control bit	Explanations
SLOT	You specify the load value for the respective counter in these bytes. Through the load request LD_SLOT you load the predefined value into the counter.
LD_SLOT	With this load request you control for which value of the counter the value specified in SLOT is to be loaded. The counter carries out the respective action as soon as LD_SLOT changes. If you have entered the load request LD_SLOT = 011_B open the SW gate, every counting process begins with the value defined in the SLOT as the start value. If you have entered a different load request and open the SW gate, counting is continued with the current count value at every start of the counting process. Both cases apply as long as and until the SW gate is closed.
SW_GATE	With this bit you open and close the SW gate of the respective counter. The module only counts when the software gate is open. 0 means: Software gate closed 1 means: Software gate open
RES_EVENT_UFLW	With this bit you trigger the resetting of the stored event in the feedback bit EVENT_UFLW for the respective counter.
RES_EVENT_OFLW	With this bit you trigger the resetting of the stored event in the feedback bit EVENT_OFLW for the respective counter.
RES_EVENT_CMP	With this bit you trigger the resetting of the stored event in the feedback bit EVENT_CMP for the respective counter.

5.2.2.5 Assignment of the feedback interface

Feedback interface

The user program receives current values and status information from the module via the feedback interface.
The figure below shows the address assignment of the module in the process image input in the configuration method 4xCount.
At Counter 0 x stands for the input byte IB 2 in this case, at Counters 1 to 3 you add 6 bytes, 12 bytes and 18 bytes respectively to this input byte.
When you assign a different start address to the digital input/digital output module, the byte sequence changes correspondingly.

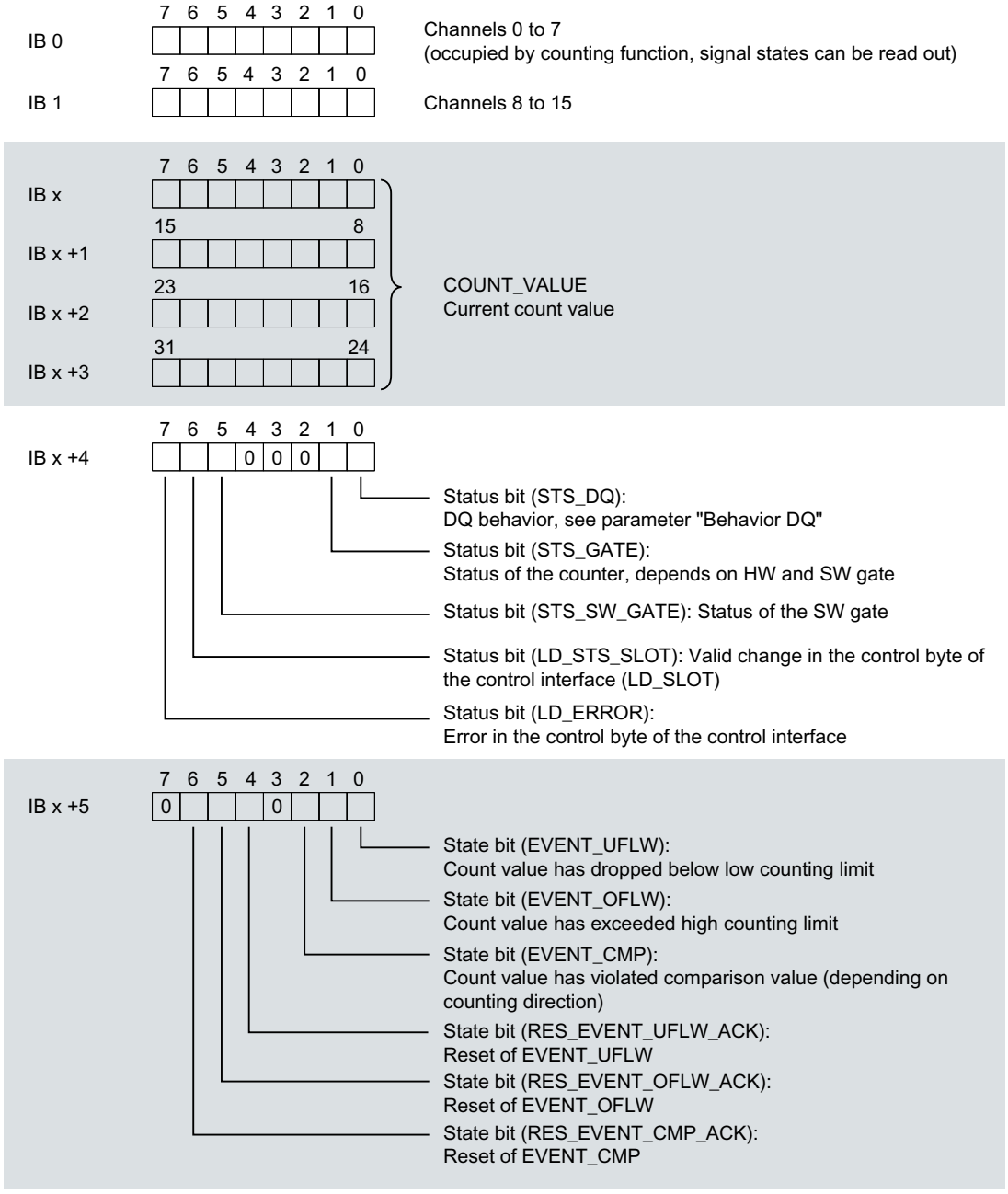


Figure 5-9 Address space feedback interface configuration method 4xCount

5.2.2.6 Explanations for the feedback interface

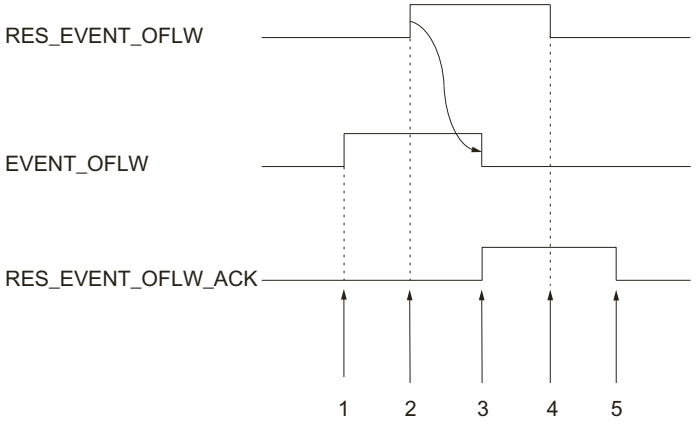
Table 5-25 Explanations for the feedback bits

Feedback bit	Explanations
COUNT_VALUE	This value supplies the current count value for the respective counter.
STS_DQ	This bit returns the current signal state of the count output.
STS_GATE	This bit shows the state of the internal gate for the respective counter. The module only counts when the internal gate is open. 0 means: Internal gate closed / counter does not count 1 means: internal Tor open / counter counts **Note:** After a POWER OFF / ON or a change in the parameterization, all the values of the changed counter are transferred again to the module. In the process the internal gate of the respective counter is closed and the count value is set to the start value. Close and open the respective SW gate to restart the counting process. **Note:** When the PROFIBUS interface model is used, the CPU/Master automatically generates the "rising edge" signal after disconnection/reconnection of the communications. This continues the counting process.
STS_SW_GATE	This bit shows the status of the software gate. 0 means: Software gate closed 1 means: Software gate open
LD_STS_SLOT	This bit indicates through a status change (toggling) for the respective counter that loading of the control interface has been carried out successfully.
LD_ERROR	This bit indicates for the respective counter that an error has occurred during loading of the control interface. The load value was not accepted. One of the following conditions is fulfilled: • Low counting limit > Count value • Low counting limit > Start value • Low counting limit > Comparison value • Count value > High counting limit • Start value > High counting limit • Comparison value > High counting limit • Low counting limit ≥ High counting limit • No valid load request in LD_SLOT
EVENT_UFLW	This bit shows for the respective counter whether an underflow (value dropped below the low count limit) has occurred. You reset the state by acknowledging with RES_EVENT_UFLW.
EVENT_OFLW	This bit shows for the respective counter whether an overflow (value exceeded the high count limit) has occurred. You reset the state by acknowledging with RES_EVENT_OFLW.
EVENT_CMP	This bit shows for the respective counter whether a comparison event with the comparison value has occurred. You reset the state by acknowledging with RES_EVENT_CMP. The EVENT_CMP bit is not set if the count value is set to the start value.
RES_EVENT_UFLW_ACK	This bit shows for the respective counter whether the resetting of the event bit EVENT_UFLW is active.
RES_EVENT_OFLW_ACK	This bit shows for the respective counter whether the resetting of the event bit EVENT_OFLW is active.
RES_EVENT_CMP_ACK	This bit shows for the respective counter whether the resetting of the event bit EVENT_CMP is active.

Complete acknowledgment principle

Storing bits are acknowledged in accordance with the complete acknowledgment principle.

The figure below shows an example for the course of the complete acknowledgment principle at an overflow:



① The feedback bit EVENT_OFLW is set as a storing event at an overflow bit.

② The set the control bit RES_EVENT_OFLW in order to initiate resetting of EVENT_OFLW.

③ The feedback bit RES_EVENT_OFLW_ACK is set when the resetting of EVENT_OFLW has been recognized.

④ You reset the control bit RES_EVENT_OFLW .

⑤ The feedback bit RES_EVENT_OFLW_ACK is reset.

Figure 5-10 Acknowledgment principle

NOTE

When you have initiated the resetting of an event bit, you have to wait for the respective feedback bit. You can initiate a further reset subsequently.

NOTE

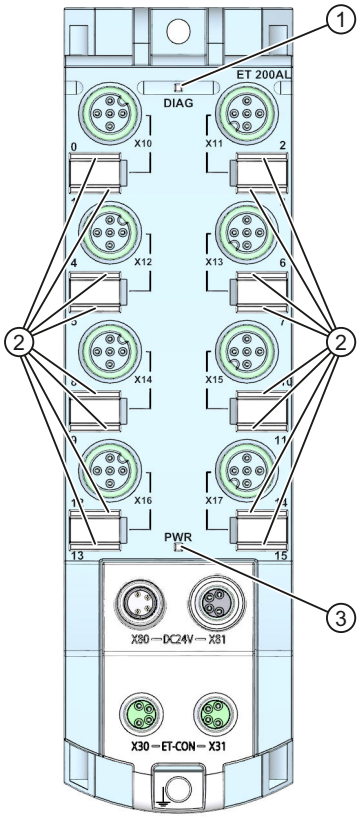
An opening of the SW gate or HW gate (0-1 transition) resets all event bits.

5.2.3 Interrupts/diagnostic alarms

5.2.3.1 Status and error displays

LED displays

The figure below shows the LED displays (status and error displays) of the digital input module / digital output module DIQ 16x24VDC/0.5A 8xM12.



①	Diagnostic status (DIAG)	(red/green)
②	Channel status (0 to 15)	(green)
③	Load voltage 2L+ (PWR)	(green)

Figure 5-11 LED displays

Meaning of the LEDs

The following tables set out the meaning of the status and error displays. Remedial measures for diagnostic reports can be found in chapter Diagnostics alarms (Page 76).

DIAG LED

Table 5-26 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 module diagnostics
☼ Flashes	Module parameters assigned and module diagnostics

LED channel status

Table 5-27 LED channel status display

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

PWR LED

Table 5-28 Status display of the PWR LED

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

5.2.3.2 Interrupts

The digital input / digital output module DIQ 16x24VDC/0.5A 8xM12 in the configuration method 4xCount supports diagnostic and hardware interrupts.

Diagnostic interrupt

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

- Short-circuit of an encoder supply to ground, or
- Short-circuit of an output to ground
- Load voltage 2L+ missing or too low
- Parameter assignment error

Hardware interrupt

The module generates a hardware interrupt at the following event:

- Comparison event occurred for DQ

For detailed information on the error event, refer to the hardware interrupt organization block with the "RALRM" instruction (read additional interrupt info) and to the STEP 7 online help.

The module channel that triggered the hardware interrupt is entered in the start information of the organization block. The figure below shows the assignment to the bits of the local data double word 8.

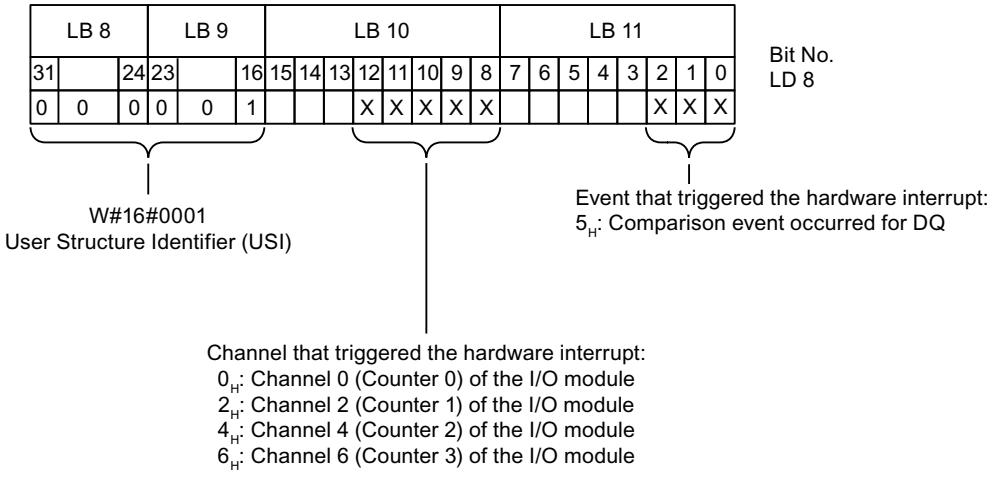


Figure 5-12 Start information of the organization block in the configuration method 4xCount

5.2.3.3 Diagnostics alarms

For each diagnostic event, a diagnostics alarm is issued and the LED DIAG flashes red on the digital input/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 5-29 Diagnostics alarms, their meanings and corrective measures

Diagnostics alarm	Error code	Meaning	Solution
Short circuit[1]	1_H	Short-circuit of an encoder supply to ground	• Eliminate the short-circuit
		Short-circuit of an output to ground	
Parameter assignment error	10_H	Module parameter assignment is faulty	Correction of the parameter assignment
Load voltage 2L+ missing[2]	11_H	Load voltage 2L+ missing or too low	• Check the supply voltage • Check the module
Hardware interrupt lost	16_H	At least one hardware interrupt could not be signaled because too many hardware interrupts are pending.	Correct the program or the process

[1] If a short-circuit of the encoder supply to ground is detected, the diagnostic alarm "Short-circuit" is always output. This alarm is output even if all channels are configured as outputs.
[2] If you are using ET 200AL modules in connection with the ET 200SP distributed I/O system, the diagnostic alarm "Load voltage missing" is displayed.

5.3 Examples of counting

In this section, you will find examples of the behavior of the counter and how you can specify this behavior. You specify the properties of the counter in the parameter assignment.

The boundary conditions apply for the following examples:

- You set the bit SW_GATE to "1", the counting process starts.
- If you reset the bit SW_GATE before a count limit is reached, the counting process stops. Set the bit SW_GATE to restart the counting process.
  The value with which the counting process starts again depends on the content of the control interface.

These conditions only apply if you do not use a HW gate (configuration method 2xCount).

Behavior DQ - Count value between a comparison value and the high counting limit (counting direction forward)

The following section shows the behavior of the count output with the parameter assignment "Set output DQ: Count value between a comparison value and the high counting limit".

The count output is set to "1" if the current values lies between the comparison value and the high count limit.
You can optionally enable a hardware interrupt through the parameterization. This is generated with the rising edge of the count output.

The following figure shows an example of the signal state of the count output depending on the parameterization mentioned above.

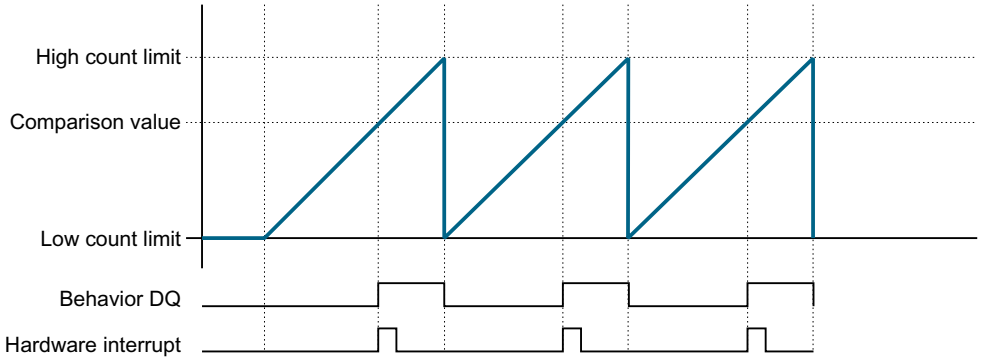


Figure 5-13 Behavior DQ and hardware interrupt

Behavior DQ - count value between a comparison value and the low counting limit (counting direction backward)

The following section shows the behavior of the count output with the parameter assignment "Set output DQ: Between a comparison value and the low counting limit".

The count output is set to "1" if the current values lies between the comparison value and the low count limit.
You can optionally enable a hardware interrupt through the parameterization. This is generated with the rising edge of the count output.

The following figure shows an example of the signal state of the count output depending on the parameterization mentioned above.

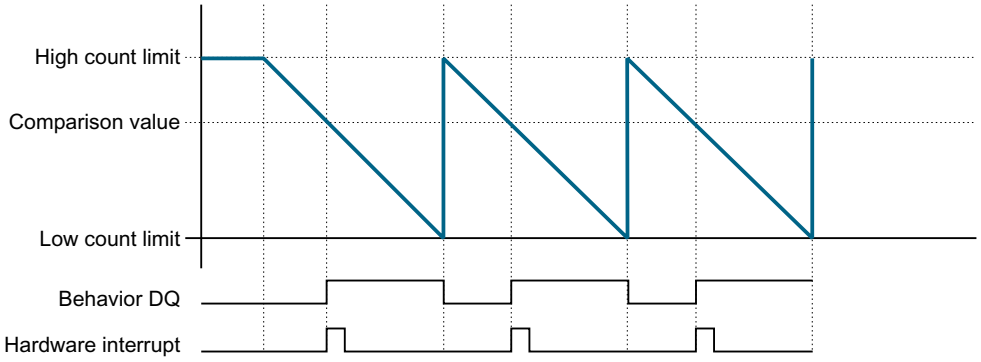


Figure 5-14 Behavior DQ and hardware interrupt

Start and stop the counting process via the gate control (counting direction forward, configuration method 2xCount)

The following section shows the behavior of the counter depending on the control input at the parameterization "Behavior DI: Gate control in combination with "Behavior when a counting limit is exceeded: Stop counting".

If you set the HW gate to "1" via the control input, the counting process is started. If you set the HW gate to "0", the counting process stops.
Note that the counting process also stops if you close the SW gate while the HW gate is opened.
HW gate ans SW gate together form the internal gate. The module only counts when the internal gate is open.

The following figure shows an example of the behavior of the counter at gate control with the principle of stopping counting when a counting limit is exceeded.

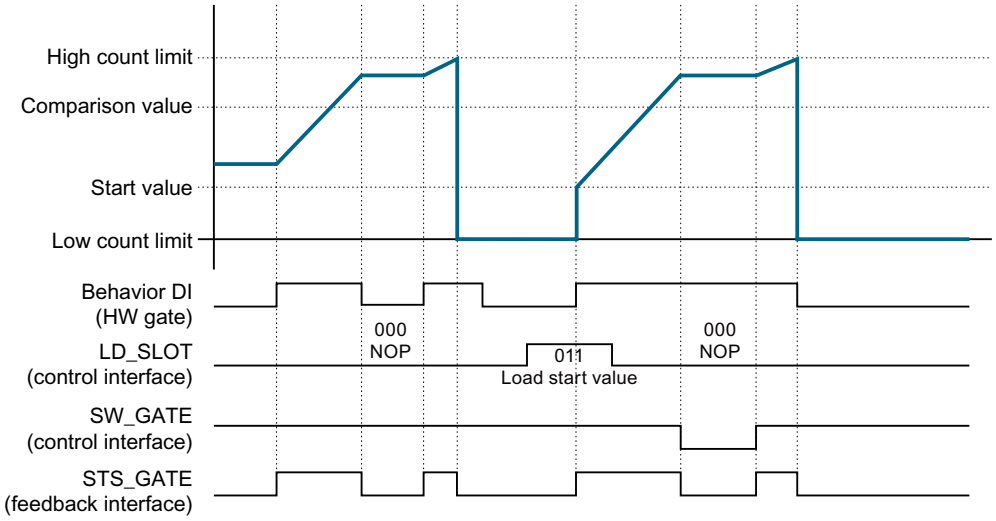


Figure 5-15 Gate control and principle: Stop counting

Change counting direction via count input and stop counting (configuration method 2xCount)

The following section shows the behavior of the counter depending on the direction input at the parameterization "Behavior DI: Counting direction" in combination with "Behavior when a counting limit is exceeded: Stop counting".
If you have parameterized the digital input of a counter as a direction input, you can change the counting direction via corresponding signals at this input.

Irrespective of the parameterization the counter always forward id the signal state "0" is set at direction input or, respectively backward if the signal state is "1".
If you change the counting direction via a signal change at the direction input, the edge detection (rising / falling edge) is also switched over.

The following figure shows an example of the behavior of the counter at a change in the counting direction with the principle of stopping counting when a counting limit is exceeded.

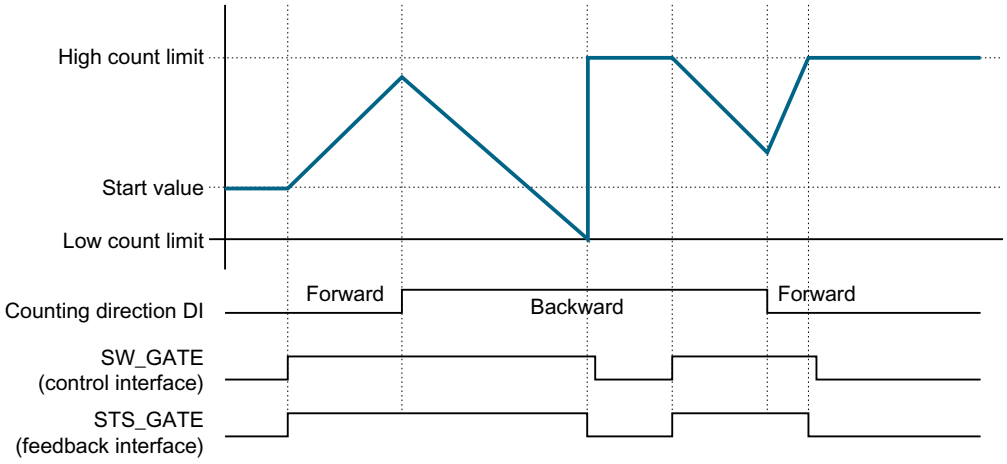


Figure 5-16 Changing the counting direction and principle: Stop counting

Behavior when a counting limit is exceeded - Stop counting (counting direction forward)

The following section describes the effects of the parameter "Behavior when a counting limit is exceeded: Stop counting" in the counting direction forward. To control the counter, the bits of the control byte of the control interface are used, see the configuration method 2xCount, section Assignment of the control interface (Page 49) and configuration method 4xCount, section Assignment of the control interface (Page 67).

You have entered the bit string 011 in the control byte of the control interface. This bit string loads the value defined in the load value (SLOT) as the start value of the counter via the load request (LD_SLOT).

After the high counting limit is violated, counting is aborted (counting stops) and the counted value jumps to the low counting limit.
The bit STS_GATE is reset in the feedback interface, the bit EVENT_OFLW is set.

The following figure shows an example of the principle of stopping counting when the high count limit is exceeded, counting direction forward.
The behavior "Behavior DQ" is set to "Count value between a comparison value and the high counting limit".

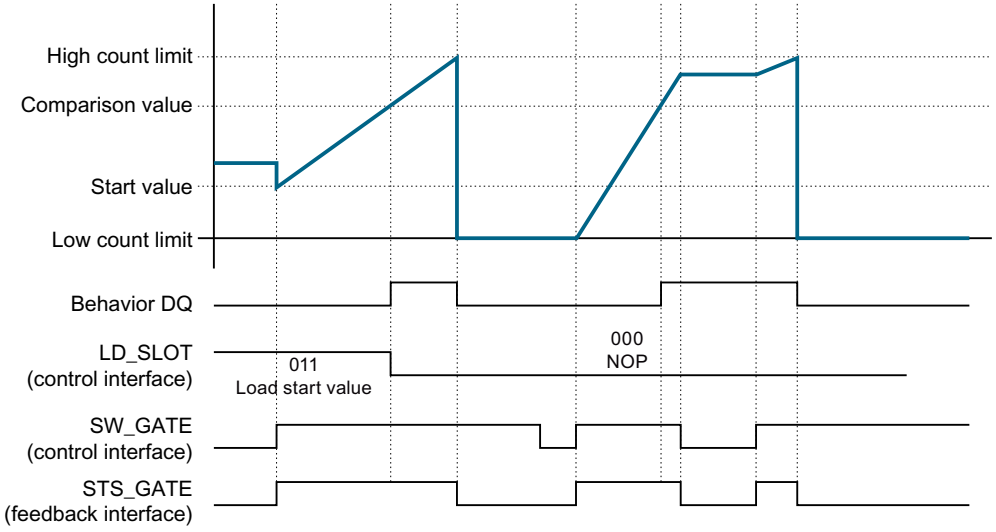


Figure 5-17 Principle: Stop counting (counting direction forward)

You can find additional information on the behavior of the counter at an overflow in the section Explanations for the feedback interface (Page 52).

Behavior when a counting limit is exceeded - Continue counting (counting direction backward)

The following section describes the effects of the parameter "Behavior when a counting limit is exceeded: Continue counting". To control the counter, the bits of the control byte of the control interface are used, see the configuration method 2xCount, section Assignment of the control interface (Page 49) and configuration method 4xCount, section Assignment of the control interface (Page 67).

After the low counting limit is underpassed, the counted value jumps to the high counting limit and counting is continued.
The bit STS_GATE is **not** reset when a count limit is exceeded.

The following figure shows an example of the principle of stopping counting when the low count limit is exceeded, counting direction backward.
The behavior "Behavior DQ" is set to "Count value between a comparison value and the high counting limit".

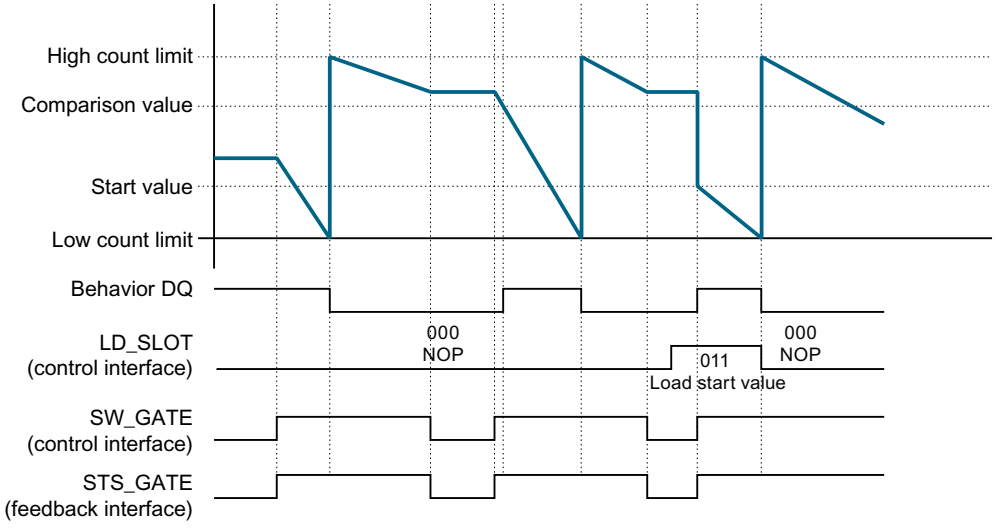


Figure 5-18 Principle: Continue counting (counting direction backward)

Reference

You will find general information on the counting function in the section Counting (Page 35).

Further information about the pin assignment, parameters, control and feedback interface, etc. is available in the sections Configuration method 2xCount (Page 38) and Configuration method 4xCount (Page 58).

Technical specifications

6

Technical specifications of the DIQ 16x24VDC/0.5A 8xM12 digital input/digital output module

The following table shows the technical specifications as of the issue date. You can find a data sheet including daily updated technical specifications on the Internet (https://support.industry.siemens.com/cs/ww/en/pv/6ES7143-5AH00-0BA0/td?dl=en).

Article number	6ES7143-5AH00-0BA0
General information	
Product type designation	DIQ 16x24VDC/0.5A
HW functional status	FS06
Firmware version	V2.0.x
Product function	
• I&M data	Yes; I&M0 to I&M3
Engineering with	
• STEP 7 TIA Portal configurable/integrated from version	STEP 7 V14 or higher
• STEP 7 configurable/integrated from version	V5.5 SP4 Hotfix 7 or higher
• PROFIBUS from GSD version/GSD revision	GSD as of Revision 5
• PROFINET from GSD version/GSD revision	GSDML V2.3.1
Operating mode	
• DI	Yes
• Counter	Yes
• DQ	Yes
Supply voltage	
power supply according to NEC Class 2 required	No
Load voltage 1L+	
• Rated value (DC)	24 V
• permissible range, lower limit (DC)	20.4 V
• permissible range, upper limit (DC)	28.8 V
• Reverse polarity protection	Yes; Against destruction; encoder power supply outputs applied with reversed polarity, loads pick up

Article number	6ES7143-5AH00-0BA0
Load voltage 2L+	
• Rated value (DC)	24 V
• permissible range, lower limit (DC)	20.4 V
• permissible range, upper limit (DC)	28.8 V
• Reverse polarity protection	Yes; Against destruction; encoder power supply outputs applied with reversed polarity, loads pick up
Input current	
Current consumption (rated value)	60 mA
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 load voltage, electronic
• Output current, max.	1.4 A; Total current of all encoders, max. 0.7 A per load voltage
Power loss	
Power loss, typ.	4 W
Digital inputs	
Number of digital inputs	16; Parameterizable as DIQ
Input characteristic curve in accordance with IEC 61131, type 3	Yes
Number of simultaneously controllable inputs	
all mounting positions	
– up to 55 °C, max.	16
Digital input functions, parameterizable	
• Freely usable digital input	Yes
• Counter	Yes
– Number, max.	4
– Counting frequency, max.	2 kHz
– Counting width	32 bit; Incl. sign
– Counting direction up/down	Yes
Input voltage	
• Rated value (DC)	24 V
• for signal "0"	-3 to +5V
• for signal "1"	+11 to +30V
Input current	
• for signal "1", typ.	3 mA

Article number	6ES7143-5AH00-0BA0
Input delay (for rated value of input voltage)	
for standard inputs	
– parameterizable	Yes
– at "0" to "1", min.	0.05 ms; 1.6 ms for channels 8 through 15
– at "0" to "1", max.	20 ms
– at "1" to "0", min.	0.05 ms; 1.6 ms for channels 8 through 15
– at "1" to "0", max.	20 ms
for technological functions	
– parameterizable	Yes
Cable length	
• unshielded, max.	30 m
Digital outputs	
Number of digital outputs	16; Parameterizable as DIQ
• in groups of	8; 2 load groups for 8 outputs each
Short-circuit protection	Yes; per channel, electronic
• Response threshold, typ.	0.7 A
Limitation of inductive shutdown voltage to	L+ (-53 V)
Digital output functions, parameterizable	
• Switching tripped by comparison values	Yes
• Freely usable digital output	Yes
Switching capacity of the outputs	
• on lamp load, max.	5 W
Load resistance range	
• lower limit	48 Ω
• upper limit	4 kΩ
Output voltage	
• for signal "1", min.	L+ (-0.8 V)
Output current	
• for signal "1" rated value	0.5 A
• for signal "0" residual current, max.	0.5 mA
Switching frequency	
• with resistive load, max.	100 Hz
• with inductive load, max.	0.5 Hz
• on lamp load, max.	1 Hz
Total current of the outputs	
• Current per group, max.	4 A
Cable length	
• unshielded, max.	30 m

Article number	6ES7143-5AH00-0BA0
Encoder	
Connectable encoders	
• 2-wire sensor	Yes
– permissible quiescent current (2-wire sensor), max.	1.5 mA
Interrupts/diagnostics/status information	
Substitute values connectable	Yes; channel by channel, parameterizable
Alarms	
• Diagnostic alarm	Yes; Parameterizable
Diagnoses	
• Short-circuit	Yes; Outputs to M; encoder supply to M; module by module
Diagnostics indication LED	
• Channel status display	Yes; green LED
• for module diagnostics	Yes; green/red LED
• For load voltage monitoring	Yes; green LED
Potential separation	
between the load voltages	Yes
Potential separation channels	
• between the channels, in groups of	8
• between the channels and backplane bus	Yes
• between the channels and the power supply of the electronics	No; 8 channels are non-isolated and 8 channels are isolated from supply voltage 1L+
Isolation	
Isolation tested with	707 V DC (type test)
Degree and class of protection	
IP degree of protection	IP65/67
Standards, approvals, certificates	
Suitable for safety-related tripping of standard modules	No
product functions / security / header	
signed firmware update	Yes
data integrity	Yes
Ambient conditions	
Ambient temperature during operation	
• min.	-30 °C
• max.	55 °C
Altitude during operation relating to sea level	
• Ambient air temperature-barometric pressure-altitude	Up to max. 5 000 m, at installation height > 2 000 m additional restrictions

Article number	6ES7143-5AH00-0BA0
connection method	
Design of electrical connection for the inputs and outputs	M12, 5-pole
Design of electrical connection for supply voltage	M8, 4-pole
ET-Connection	
• ET-Connection	M8, 4-pin, shielded
Dimensions	
Width	45 mm
Height	159 mm
Depth	40 mm
Weights	
Weight, approx.	195 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/digital output module with counting function is explained in the following sections.

Additional information

You can find more information on working with PROFIenergy in the "PROFIenergy" section of the Equipment 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 (https://support.industry.siemens.com/cs/ww/en/view/49948856).

Application examples and manual information are also available on the Internet FAQs (https://support.industry.siemens.com/cs/ww/en/view/109807766).

7.2 Behavior of the digital inputs

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] There are two encoder supplies, $1U_S$ for Channels 0 to 7 and $2U_S$ for Channels 8 to 15. At a "Pause" the supplies can only be switched off if no channel is configured in PE_MODE_PROCEED.

7.3 Behavior of the digital outputs

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 7-2 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"

7.4 Behavior of the digital inputs of the counters

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.

NOTE

Channels of a counter

All the channels that belong to a counter must have the same PROFIenergy behavior.
If substitute value behavior is parameterized, this also has to be the same for all channels of a counter.
If the PROFIenergy behavior is not the same for all the channels of a counter, the module rejects the PROFIenergy parameterization.

Further information on the assignment of the counting channels for the configuration method 2xCount is available in the section Pin assignment (Page 40), for the configuration method 4xCount in the section Pin assignment (Page 60).

Mode parameter

The following table shows the "Mode" parameter.

Table 7-3 Mode parameter

Element	Code	Explanation
Mode	0_D: PE_MODE_PROCEED	The counter functions as in the normal count mode. The count output depends on the count value.
	1_D: PE_MODE_SHUTDOWN	The count value is no loner updated. The count output is set to 0.
	3_D: PE_MODE_LAST_VALUE	The count value is no longer updated (the input does not supply any edges). The count output contains the last value, since the count is no longer updated.
	4_D: PE_MODE_SUBST_VALUE	The count value is no longer updated (the input does not supply any edges). The count output is set to the parameterized substitute value, irrespective of the count value.

Dimension drawing

A

The figure below shows the dimension drawing of the DIQ 16x24VDC/0.5A 8xM12 digital input/digital output module in front and side views.

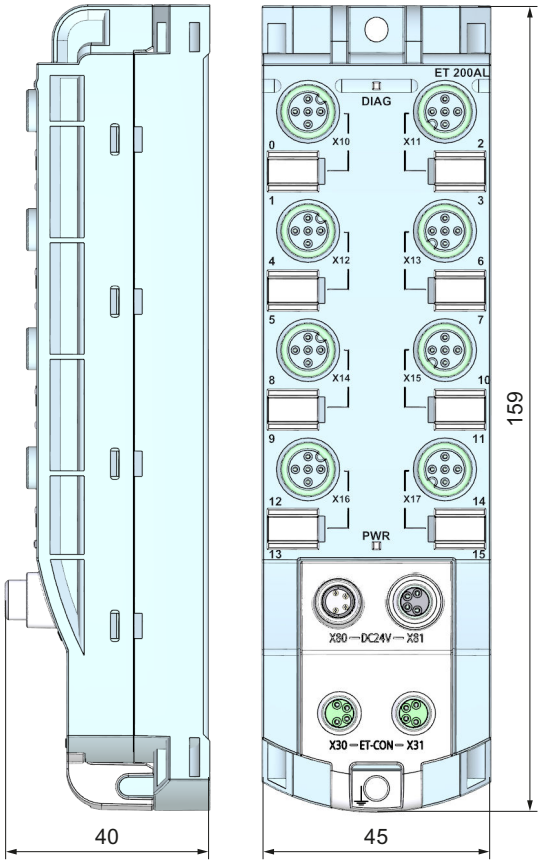


Figure A-1 Dimension drawing

Parameter data record

B

B.1 Structure of data record 128 for the module parameter assignment

With data record 128, you can reassign the module parameters in your user program, regardless of your programming. This means that you can use all the functions of the module even if you configured the module with a GSD file.

Parameter assignment in the user program

You can reassign the parameters of the module in RUN. For example, you can change the settings of individual channels in RUN without this having an effect on the other channels.

Changing parameters in RUN

The "WRREC" instruction is used to transfer the parameters to the module using data record 128. The parameters set with STEP 7 are not changed in the CPU by this action. After a restart, the parameters set in STEP 7 are still valid.

Output parameter STATUS

If an error occurs during the transfer of the parameters with the "WRREC" instruction, the module continues operation with the previously valid parameter assignment. The STATUS output parameter contains a corresponding error code.

The instruction "WRREC" and the error codes are described in the online help of STEP 7.

Structure of data record 128

The following table shows the structure of data record 128 and the parameters.

You activate a parameter by setting the corresponding bit to "1".

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0...1	**Header information**							
0	Reserved[1]		Major Version = 10_B		Minor Version = 0000_B			
1	Module parameter length = 14_D ($0000\ 1110_B$)							
2...5	**Parameter**							
2	Reserved[1]				Response at CPU/master STOP[2]	Diagnostics: Short-circuit to ground	Diagnostics: Missing load voltage 2L+	Reserved[1]
					00_B: Shut down 10_B: Keep last value 11_B: Output substitute value	0_B: Disable 1_B: Enable	0_B: Disable 1_B: Enable	
3	Configuration method channel 7	Configuration method channel 6	Configuration method channel 5	Configuration method channel 4	Configuration mode channel 3	Configuration mode channel 2	Configuration mode channel 1	Configuration mode channel 0
	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ
4	Configuration mode channel 15	Configuration mode channel 14	Configuration mode channel 13	Configuration mode channel 12	Configuration mode channel 11	Configuration mode channel 10	Configuration mode channel 9	Configuration mode channel 8
	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ	0_B: DI 1_B: DQ
5	Substitute value channel 7[2]	Substitute value channel 6[2]	Substitute value channel 5[2]	Substitute value channel 4[2]	Substitute value channel 3[2]	Substitute value channel 2[2]	Substitute value channel 1[2]	Substitute value channel 0[2]
	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1
6	Substitute value channel 15[2]	Substitute value channel 14[2]	Substitute value channel 13[2]	Substitute value channel 12[2]	Substitute value channel 11[2]	Substitute value channel 10[2]	Substitute value channel 9[2]	Substitute value channel 8[2]
	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1	0_B: 0 1_B: 1
7	Input delay channel 1[3]				Input delay channel 0[3]			

1 Reserved bits must be set to 0

2 The following applies only to the configuration of the channel as a DQ

3 The following applies only to the configuration of the channel as a DI. For the channels 0 ... 7, you can parameterize one of the 8 different input delay values.

4 The following applies only to the configuration of the channel as a DI. For channels 8 ... 15, you can parameterize a value starting at 1.6 ms from the 4 different input delay values.

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
7	0000_B: 0.05 ms 0001_B: 0.1 ms 0011_B: 0.4 ms 0100_B: 0.8 ms 0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms				0000_B: 0.05 ms 0001_B: 0.1 ms 0011_B: 0.4 ms 0100_B: 0.8 ms 0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms			
8	Input delay channel 3[3]				Input delay channel 2[3]			
	0000_B: 0.05 ms 0001_B: 0.1 ms 0011_B: 0.4 ms 0100_B: 0.8 ms 0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms				0000_B: 0.05 ms 0001_B: 0.1 ms 0011_B: 0.4 ms 0100_B: 0.8 ms 0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms			
9	Input delay channel 5[3]				Input delay channel 4[3]			
	0000_B: 0.05 ms 0001_B: 0.1 ms 0011_B: 0.4 ms 0100_B: 0.8 ms 0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms				0000_B: 0.05 ms 0001_B: 0.1 ms 0011_B: 0.4 ms 0100_B: 0.8 ms 0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms			
10	Input delay channel 7[3]				Input delay channel 6[3]			
	0000_B: 0.05 ms 0001_B: 0.1 ms 0011_B: 0.4 ms 0100_B: 0.8 ms 0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms				0000_B: 0.05 ms 0001_B: 0.1 ms 0011_B: 0.4 ms 0100_B: 0.8 ms 0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms			
11	Input delay channel 9[4]				Input delay channel 8[4]			
	0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms				0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms			
12	Input delay channel 11[4]				Input delay channel 10[4]			

1 Reserved bits must be set to 0

2 The following applies only to the configuration of the channel as a DQ

3 The following applies only to the configuration of the channel as a DI. For the channels 0 ... 7, you can parameterize one of the 8 different input delay values.

4 The following applies only to the configuration of the channel as a DI. For channels 8 ... 15, you can parameterize a value starting at 1.6 ms from the 4 different input delay values.

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
12	0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms				0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms			
13	Input delay channel 13[4]				Input delay channel 12[4]			
	0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms				0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms			
14	Input delay channel 15[4]				Input delay channel 14[4]			
	0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms				0101_B: 1.6 ms 0110_B: 3.2 ms 1001_B: 12.8 ms 1010_B: 20 ms			
15	Reserved[1]							

1 Reserved bits must be set to 0

2 The following applies only to the configuration of the channel as a DQ

3 The following applies only to the configuration of the channel as a DI. For the channels 0 ... 7, you can parameterize one of the 8 different input delay values.

4 The following applies only to the configuration of the channel as a DI. For channels 8 ... 15, you can parameterize a value starting at 1.6 ms from the 4 different input delay values.

B.2 Error transferring the data record

If you carry out the parameter settings in STEP 7 (TIA Portal) or in STEP 7 , the parameters are verified before they are transferred to the I/O device. This avoids errors in the parameter assignment.

In other applications, for example with a GSD file, the I/O device verifies the transferred parameter data record. If the I/O device determines impermissible or inconsistent parameter values, an error code (see below) as well as the Diagnostic interrupt "Parameter assignment error" (Page 33) are issued. In this case the new parameter data set is rejected and the current parameter values continue to be used until a valid parameter data set is transferred.

WRREC

You can change the parameter data record in the RUN operating state of the CPU by using the instruction WRREC (Write Record). The WRREC instruction returns corresponding error codes when errors occur in the STATUS parameter.

Example:

Let us assume that the execution of WRREC results in an impermissible value for the operating mode, for example 9, being written to the module. As a result the module rejects the complete parameter data record. You recognize this by evaluating the STATUS output parameter of the WRREC instruction. The STATUS output parameter is output as an ARRAY[1..4] from BYTE data with the value 16#DF80E111:

Example WRREC STATUS data	Address	Meaning
DF_H	STATUS[1]	Error while writing a data record via PROFINET IO (IEC 61158-6)
80_H	STATUS[2]	Error while reading or writing a data record via PROFINET IO (IEC 61158-6)
$E1_H$	STATUS[3]	Module-specific error
11_H	STATUS[4]	Error code from the following table: The parameter "Operating mode" has an invalid value.

Error codes

The Error codes table shows the following:

- The specific error codes of the module
- The meaning of the error code
- A suggestion for correcting the error
- The data record at which the error may occur

Table B-1 Error codes

Error code in the STATUS parameter (hexadecimal)				Meaning	Solution	DS128
Byte 0	**Byte 1**	**Byte 2**	**Byte 3**			
DF	80	B0	xx	Number of the data record unknown.	Enter a valid number for the data record.	✓
DF	80	B1	xx	Length of the data record incorrect.	Enter a valid value for the data record length.	✓
DF	80	B2	xx	Module slot invalid or cannot be reached.	Check the assigned values for the parameters of the "WRREC" instruction.	✓
DF	80	E0	xx	Wrong version or error in the header information.	Correct the version, length and number of parameter blocks.	✓
DF	80	E1	01	Reserved bit set.	Check the parameters of the I/O device.	✓