SIEMENS

SIMATIC

ET 200SP
Digital Output Module F-DQ 4x24VDC/2A PM HF (6ES7136-6DB01-0CA0)

Equipment Manual

Original operating instructions

03/2025
A5E03858037-AC

Legal information

Warning notice system

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

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

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

NOTICE

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

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

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

Proper use of Siemens products

Note the following:

⚠ WARNING

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

Trademarks

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Disclaimer of Liability

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

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Introduction

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Purpose of the documentation

This device manual complements the system manual ET 200SP distributed I/O system. You can find functions that generally relate to the ET 200SP system in the system manual ET 200SP distributed I/O system (https://support.industry.siemens.com/cs/ww/en/view/58649293).

The information provided in this device manual and the system manual enables you to commission the ET 200SP distributed I/O system.

Conventions

Note the following identified notes:

NOTE

A note includes important information on the product described in the documentation, on handling the product or on the part of the documentation to which you ought to pay special attention.

Important note for maintaining the operational safety of your plant

NOTE

Plants with safety-related features are subject to special operational safety requirements on the part of the operator. The supplier is also obliged to comply with special product monitoring measures. For this reason, we inform you in personal notifications about product developments and features that are (or could be) relevant to the operation of plants from a safety perspective.

You should subscribe to the corresponding notifications in order to obtain the latest information and to allow you to make any necessary modifications to your system.

Log onto Industry Online Support. Follow the links below and click on "Email on update" on the right-hand side in each case:

- SIMATIC S7-300/S7-300F (https://support.industry.siemens.com/cs/products?pnid=13751&lc=en-WW)
- SIMATIC S7-400/S7-400H/S7-400F/FH (https://support.industry.siemens.com/cs/products?pnid=13828&lc=en-WW)
- SIMATIC S7-1500/SIMATIC S7-1500F (https://support.industry.siemens.com/cs/products?pnid=13716&lc=en-WW)
- SIMATIC S7-1200/SIMATIC S7-1200F (https://support.industry.siemens.com/cs/products?pnid=13683&lc=en-WW)
- Distributed I/O (https://support.industry.siemens.com/cs/products?pnid=14029&lc=en-WW)
- STEP 7 (TIA Portal) (https://support.industry.siemens.com/cs/products?pnid=14340&lc=en-WW)

1.1 ET 200SP Documentation Guide

1.1.1 Information classes ET 200SP

The documentation for the SIMATIC ET 200SP 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/109742709).

Basic information

The System Manual describes in detail the configuration, installation, wiring and commissioning of the SIMATIC ET 200SP distributed I/O system.

The STEP 7 online help supports you in the configuration and programming.

Examples:

- ET 200SP System Manual
- System Manual ET 200SP HA/ET 200SP modules for devices used in a hazardous area
- Online help TIA Portal

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 CPUs
- Equipment Manuals Interface Modules
- Equipment Manuals Digital Modules
- Equipment Manuals Analog Modules
- Equipment Manuals Motor Starter
- BaseUnits Equipment Manuals
- Equipment Manual Server Module
- Equipment Manuals Communications Modules
- Equipment Manuals Technology Modules

General information

The function manuals contain detailed descriptions on general topics relating to the SIMATIC ET 200SP 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
- MultiFieldbus Function Manual

Product Information

Changes and supplements to the manuals are documented in a Product Information. The Product Information takes precedence over the device and system manuals.

You can find the latest Product Information on the ET 200SP distributed I/O system on the Internet. (https://support.industry.siemens.com/cs/de/en/view/73021864)

Manual Collection ET 200SP

The Manual Collection contains the complete documentation on the SIMATIC ET 200SP distributed I/O system gathered together in one file.

You can find the Manual Collection on the Internet.
(https://support.industry.siemens.com/cs/cn/en/view/84133942)

Manual Collection fail-safe modules

The Manual Collection contains the complete documentation on the fail-safe SIMATIC modules, gathered together in one file.

You can find the Manual Collection on the Internet.
(https://support.industry.siemens.com/cs/ww/en/view/109806400)

1.1.2 Basic tools

Tools

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)

SIMATIC Automation Tool

You can use the SIMATIC Automation Tool to perform commissioning and maintenance activities on various SIMATIC S7 stations as bulk operations independent of TIA Portal.

The SIMATIC Automation Tool offers a wide range of functions:

- Scanning of a PROFINET/Ethernet system network and identification of all connected CPUs
- Assignment of addresses (IP, subnet, Gateway) and device name (PROFINET device) to a CPU
- Transfer of the date and the programming device/PC time converted to UTC time to the module
- Program download to CPU
- RUN/STOP mode switchover
- CPU localization through LED flashing
- Reading out of CPU error information
- Reading the CPU diagnostic buffer
- Reset to factory settings
- Firmware update of the CPU and connected modules

You can find the SIMATIC Automation Tool on the Internet.
(https://support.industry.siemens.com/cs/ww/en/view/98161300)

PRONETA

SIEMENS PRONETA (PROFINET network analysis) is a commissioning and diagnostic tool for PROFINET networks. PRONETA Basic has two core functions:

- In the network analysis, you get an overview of the PROFINET topology. Compare a real configuration with a reference installation or make simple parameter changes, e.g. to the names and IP addresses of the devices.
- The "IO test" is a simple and rapid test of the wiring and the module configuration of a plant, including documentation of the test results.

You can find SIEMENS PRONETA Basic on the Internet:
(https://support.industry.siemens.com/cs/ww/en/view/67460624)

SIEMENS PRONETA Professional is a licensed product that offers you additional functions. It offers you simple asset management in PROFINET networks and supports operators of automation systems in automatic data collection/acquisition of the components used through various functions:

- The user interface (API) offers an access point to the automation cell to automate the scan functions using MQTT or a command line.
- With PROFIenergy diagnostics, you can quickly detect the current pause mode or the readiness for operation of devices that support PROFIenergy and change these as needed.
- The data record wizard supports PROFINET developers in reading and writing acyclic PROFINET data records quickly and easily without PLC and engineering.

You can find SIEMENS PRONETA Professional on the Internet.
(https://www.siemens.com/proneta-professional)

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).

1.1.3 S7 Failsafe Configuration Tool (S7-FCT)

SIMATIC S7-FCT

Failsafe Configuration Tool (FCT) enables you to GSD configure the following devices in third-party engineering systems:

- Selected, functionally fail-safe SIMATIC I/O devices
- Functionally fail-safe SIRIUS ACT PROFINET interfaces

The engineering system must meet the following requirements for this:

- Support of the CPD system integration acc. to "PROFIsafe - Profile for Safety Technology on PROFIBUS DP and PROFINET IO"
- TCI implementation to Conformance Class C3

Additional information on S7-FCT can be found on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109762827).

1.1.4 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.

You can find general information and measures relating to industrial cybersecurity in the system manual (https://support.industry.siemens.com/cs/ww/en/view/58649293).

This section provides an overview of security-related information about your SIEMENS device.

NOTE

Security-related changes to software or devices are documented in the "New functions" section.

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.

Product overview

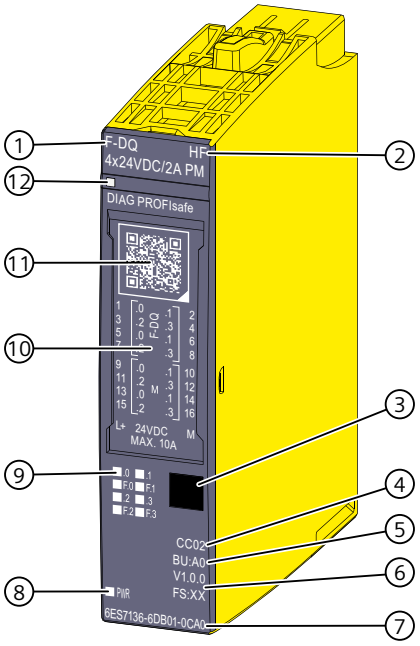
3

3.1 Properties

Article number

6ES7136-6DB01-0CA0

View of the module



①	Module type and name	⑦	Article number
②	Function class	⑧	LED for supply voltage
③	Color coding module type	⑨	LEDs for channel status
④	Color code for selecting the color-coded labels	⑩	Wiring diagram
⑤	BU type	⑪	QR code for identification link
⑥	Firmware and function version	⑫	LED for diagnostics

Figure 3-1 View of the F-DQ 4×24VDC/2A PM HF module

Properties

The module has the following technical properties:

- Fail-safe digital module
- PROFIsafe
- PROFIsafe address type 2
- 4 outputs, PM switching (SIL3/Cat.4/PLe)
- Supply voltage L+
- Output current per output 2 A
- Source output (PM switching)
- Suitable for solenoid valves, DC contactors, and indicator lights
- Diagnostic display (DIAG red/green LED)
- Status display for each output (green LED)
- Fault display for each output (red LED)
- Diagnostics e.g. short-circuit/wire break, channel by channel
- Channel-based or module-based passivation

The module supports the following functions:

- Firmware update
- I&M identification data
- Service data
- "Keep last valid value" parameter

⚠ WARNING

If you have configured the digital output module F-DQ 4×24VDC/2A PM HF (6ES7136-6DB00-0CA0) in a plant, but have inserted the digital output module F-DQ 4×24VDC/2A PM HF (6ES7136-6DB01-0CA0) instead, the information from the equipment manual of the digital output module F-DQ 4×24VDC/2A PM HF (6ES7136-6DB00-0CA0) continues to apply.

⚠ WARNING

The safety parameters in the technical specifications apply for a service life of 20 years and a repair time of 100 hours. If repair is not possible within 100 hours, remove the respective module from the BaseUnit or switch off its supply voltage before the 100 hours have elapsed. The module switches off independently after the 100 hours have expired.

Follow the repair procedure described in section Diagnostic messages (Page 51).

Accessories

The following accessories, which are not included in the product package of the F-module, can be used with the F-module:

- Labeling strips
- Color identification labels
- Reference identification labels
- Shield connection
- Electronic coding element as replacement part (article number 6ES7193-6EF00-1AA0)

You can find more information on accessories in the ET 200SP Distributed I/O System (https://support.industry.siemens.com/cs/ww/en/view/58649293) System Manual.

Passivation of fail-safe outputs over a long period of time

⚠ WARNING

Unintentional activation of F-I/O with fail-safe outputs

If an F-I/O with fail-safe outputs is passivated for a period longer than that specified in the safety parameters (> 100 hours) and the fault remains uncorrected, you need to exclude the possibility that the F-I/O can be activated unintentionally by a second fault, and thus place the F-system in a dangerous state.

Even though it is highly unlikely that such hardware faults occur, you must prevent the unintentional activation of F-I/O with fail-safe outputs by using circuit measures or organizational measures.

One possibility is the shutdown of the power supply of the passivated F-I/O within a time period of 100 hours, for example.

The required measures are standardized for plants with product standards.

For all other plants, the plant operator must create a concept for the required measures and have it approved by the inspector.

Property of the individual shutdown of F-modules with fail-safe outputs:

A channel-specific shutdown occurs when a fault is detected. It is also possible to react to critical process states staggered over time or to perform safety-related shutdown of individual outputs.

Use in safety mode with the "Keep last valid value" setting

With the "Keep last valid value" setting for the "Behavior at loss of communication" parameter, you can only use the F-DQ 4×24VDC/2A PM HF I/O module in compliance with the EN 54-2 standard.

NOTE

If the "Behavior at loss of communication" parameter is set to "Keep last valid value", it cannot be used in accordance with the standards for machine safety (IEC 61508, ISO 13849-1).

Connecting

4

4.1 Wiring and schematic circuit diagram

This section includes the schematic circuit diagram of the digital output module F-DQ 4×24VDC/2A PM HF with the terminal assignment.

You can find information on wiring the BaseUnit in the ET 200SP Distributed I/O System (https://support.industry.siemens.com/cs/ww/en/view/58649293) System Manual.

General terminal assignment

Table 4-1 Terminal assignment for F-DQ 4×24VDC/2A PM HF

Pin assignment for F-DQ 4×24VDC/2A PM HF (6ES7136-6DB01-0CA0)						
Terminal	**Assign-ment**	**Terminal**	**Assign-ment**	**Description**	**BaseUnit**[1]	**Color identification label (terminals 1 to 16)**
1	DQ-P_0	**2**	DQ-P_1	• DQ-P_n: Output signal, channel n, P-switching • DQ-M_n: Chassis ground for output signal, channel n, M-switching	A0	 CC02 6ES7193-6CP02-2MA0
3	DQ-P_2	**4**	DQ-P_3			
5	DQ-P_0	**6**	DQ-P_1			
7	DQ-P_2	**8**	DQ-P_3			
9	DQ-M_0	**10**	DQ-M_1			
11	DQ-M_2	**12**	DQ-M_3			
13	DQ-M_0	**14**	DQ-M_1			
15	DQ-M_2	**16**	DQ-M_3			
L+	DC24V	**M**	M			

[1] Usable BaseUnit types, can be identified by the last two digits of the article number. See also *ET 200SP Distributed I/O System* system manual

NOTE

The first BaseUnit of a potential group must be a light-colored BaseUnit.

NOTE

The fuse integrated in the BaseUnit type A1 can be triggered for the digital output module, rendering the terminals unusable.

Make sure that you only use digital modules with the BaseUnit type A0 during commissioning.

Switching non-floating loads

If the following two conditions are met, a short-circuit is detected by the F-DQ 4×24VDC/2A PM HF:

- When loads are switched from the F-DQ 4×24VDC/2A PM HF that have a connection between chassis ground and ground. For example to improve the EMC properties.
- When chassis ground and ground are connected on the supplying power supply unit.

From the perspective of the F-module, the M-switch is bridged by the chassis-ground connection.

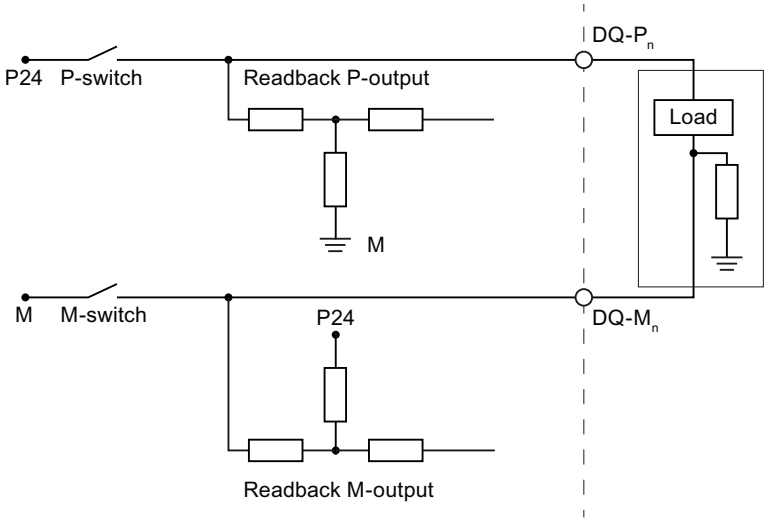


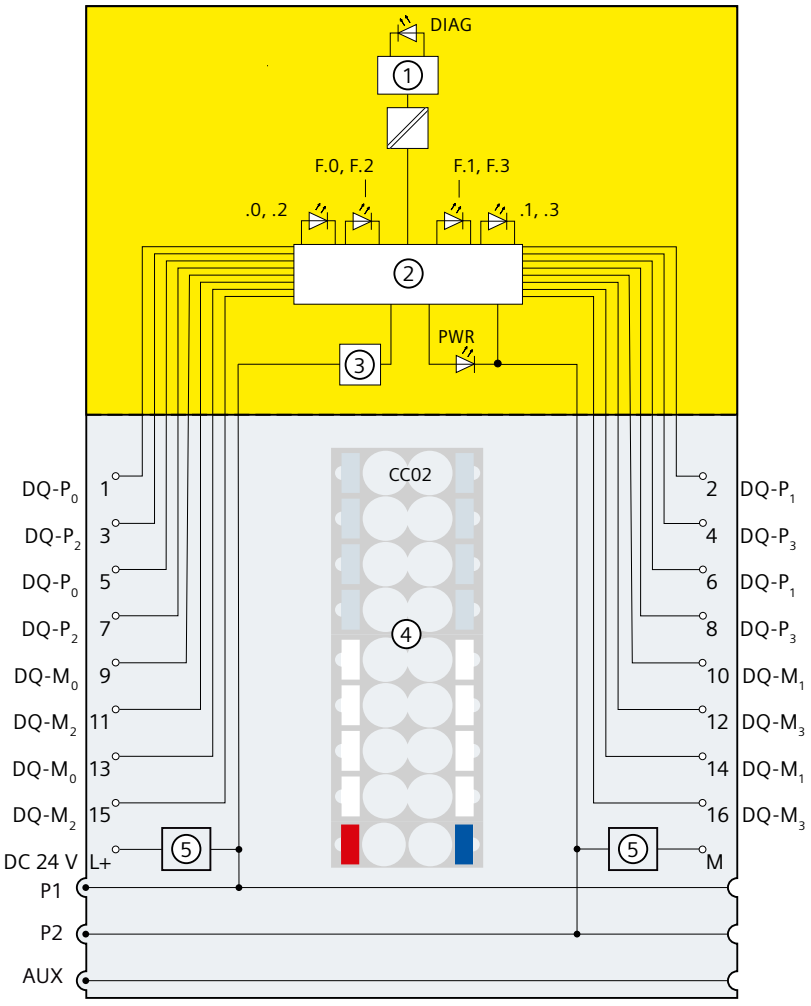
Figure 4-1 Switching of grounded loads (resistance between chassis and ground)

Alternatively, you can use the following modules:

- F-DQ 8x24VDC/0.5A PP HF
- The F-PM-E 24VDC/8A PPM ST power module for which the output is configured as PP switching

Schematic circuit diagram

The following figure shows the pin assignment of the digital output module F-DQ 4×24VDC/2A PM HF on the BaseUnit BU type A0.



①	Backplane bus interface	$DQ\text{-}P_n$	Output signal, channel n, P-switching
②	Input electronics	P1, P2, AUX	Internal self-assembling voltage buses Connection to left (dark-colored BaseUnit) Connection to left interrupted (light-colored BaseUnit)
③	Reverse polarity protection	$DQ\text{-}M_n$	Chassis ground for output signal, channel n, M-switching
④	Color-coded label with color code CC02 (optional)	DIAG	Error or diagnostics LED (green, red)

⑤	Filter connection supply voltage (only when light-colored BaseUnit is present)	0.0 to 0.3	Channel status LED (green)
L+	24 V DC (infeed only with light-colored BaseUnit)	F.0 to F.3	Channel fault LED (red)
M	Chassis ground supply voltage	PWR	Power LED (green)

Figure 4-2 Schematic circuit diagram of the F-DQ 4×24VDC/2A PM HF

Parameters/address space

5

5.1 Parameters

Parameters for F-DQ 4×24VDC/2A PM HF

⚠ WARNING

Diagnostics functions should be activated or deactivated in accordance with the application, see section Applications of the F-I/O module (Page 41).

The following parameters are possible:

Table 5-1 Adjustable parameters

Parameter	Value range	Default	Parameter reassignment in RUN	Scope
F-parameters:				
Manual assignment of F-monitoring time	• Disable • Enable	Disable	No	Module
F-monitoring time	1 to 65535 ms	150 ms	No	Module
F-source address	1 to 65534	Depends on the parameter assignment of the F-CPU	No	Module
F-destination address	1 to 65534	Is proposed by the F-system	No	Module
F-parameter signature (with addresses)	0 to 65535	Is calculated by the F-system	No	Module
F-parameter signature (without address)	0 to 65535	Is calculated by the F-system	No	Module
Behavior after channel fault	• Passivate entire module • Passivate channel	Passivate channel	No	Module
Reintegration after channel fault	• Adjustable • All channels automatically • All channels manually	Adjustable	No	Module
F-I/O DB manual number assignment	• Disable • Enable	Disable	No	Module
F-I/O DB-number	—	Is proposed by the F-system	No	Module
F-I/O DB-name	—	Is proposed by the F-system	No	Module

*) When the "Enable Dynamic Read Back" parameter is enabled.

Parameter	Value range	Default	Parameter reassignment in RUN	Scope
DQ parameters:				
Maximum test period	• 100 s • 1000 s	1000 s	No	Module
Behavior at loss of communication	• Apply substitute value "0" • Keep last valid value	Apply substitute value "0"	No	Module
Disable Dark Test (max. SIL2, CAT3, PLd)	• Disable • Enable	Disable	No	Module
Disable Dark Test for 48 hours	• Disable • Enable	Disable	No	Module
Enable Dynamic Read Back	• Disable • Enable	Disable	No	Module
Channel parameters:				
Channel n				
Activated	• Disable • Enable	Enable	No	Channel
Max. readback time, dark test and switch-off test	• 0.6 to 400.0 ms • 0.6 to 20.0 ms *	1.0 ms	No	Channel
Max. readback time switch-on test	0.6 to 5.0 ms	0.6 ms	No	Channel
Channel failure acknowledge	• Manual • Automatic The value range offered depends on the F-CPU used and the parameter assignment of the F-parameter "Reintegration after channel fault".	Manual	No	Channel
Activated light test	• Disable • Enable	Disable	No	Channel
Diagnosis: Wire break	• Disable • Enable	Disable	No	Channel

*) When the "Enable Dynamic Read Back" parameter is enabled.

5.2 Explanation of parameters

5.2.1 F-parameters

5.2.1.1 PROFIsafe address

You have to assign the PROFIsafe address (F-destination address together with F-source address) to the F-module before you start operation.

- You specify the F-source address with the "Central F-source address" parameter in the F-CPU.
- The F-destination address is assigned automatically for each F-module CPU-wide. You can change the specified F-destination address in the hardware configuration manually.

Information on the F-parameters for the F-monitoring time, the PROFIsafe addressing (F-source address, F-destination address) and the F-I/O DB can be found in the manual SIMATIC Safety – Configuring and Programming (https://support.industry.siemens.com/cs/ww/en/view/54110126).

See also

S7 Distributed Safety - Configuring and Programming (https://support.industry.siemens.com/cs/ww/en/view/22099875)

5.2.1.2 Behavior after channel fault

This parameter is used to specify whether the entire F-module is passivated or just the faulty channel(s) in the event of channel faults:

- "Passivate the entire module"
- "Passivate channel"

5.2.1.3 Reintegration after channel fault

Use this parameter to select how the channels of the fail-safe module are reintegrated after a fault.

Use on S7-300/400 F-CPUs

This parameter is always set to "Adjustable" when you use the fail-safe module in S7-300/400 F-CPUs.

You make the required setting in the F-I/O DB of the fail-safe module.

Use on S7-1200/1500 F-CPUs

When using the F-module on F-CPUs S7-1200/1500, set this parameter in the STEP 7 dialog of the F-module:

- "Adjustable"
- "All channels automatically"
- "All channels manually"

If you have set the "Behavior after channel fault" parameter to "Passivate channel", you enable individual setting of the reintegration type per channel with the parameter assignment

"Adjustable". The reintegration type of the respective channel is specified with the "Channel failure acknowledge" channel parameter.

If you have set the "Behavior after channel fault" parameter to "Passivate the entire module", you can only select the same reintegration type for all channels.

5.2.2 DQ parameters

5.2.2.1 Maximal test period

With this parameter, you specify the time within which the light, dark and switch on tests (complete bit pattern test) should be performed throughout the module. When this time expires, the tests are repeated. In case of a fault, the test time is reduced to 60 seconds.

- Use "1000 s", for example, to conserve your actuators.
- Use "100 s" to detect faults more quickly.

5.2.2.2 Behavior at loss of communication

Defines the reaction of the digital output in the event of CPU STOP or communication failure between the F-module and CPU.

- Apply substitute value "0"
- Keep last valid value

Behavior of the I/O module depending on the "Behavior at loss of communication" parameter.

With the "Keep last valid value" setting of the "Behavior at loss of communication" parameter, the I/O module is only compliant with EN 54-2.

Options:

- Safety mode (SIL3)
- Safety mode (EN 54)

You can find more information on the behavior of the I/O module depending on the "Behavior at loss of communication" parameter in the section "Reaction of the output module with the "Keep last valid value" setting (Page 27)".

5.2.2.3 Reaction of the output module with the "Keep last valid value" setting

Behavior of I/O module

Depending on the "Behavior at loss of communication" parameter, the digital output module complies with the following standards:

Table 5-2 Conformity to standards

Setting of the "Behavior at loss of communication" parameter	
"Apply substitute value "0""	**"Keep last valid value"**
In conformance with all standards mentioned in the certificates. You will find the certificates on the Internet at: • Certificate for S7 F/FH Systems (https://support.industry.siemens.com/cs/ww/en/ps/14362/cert)	Only compliant with EN 54-2

NOTE

To provide the substitute value, it is necessary to supply the interface module with voltage.

Applications

Typical applications for safety mode with the "Keep last valid value" setting are:

- Ventilation systems
- Smoke flaps

Reactions to faults

NOTE

Observe the appropriate standards for the installation.

NOTE

With the "Keep last valid value" setting of the "Behavior at loss of communication" parameter, only the EN 54-2 standards are met.

The last valid value is supplied when the following communication failures/interruptions occur:

- STOP of the F-CPU (interruption of the PROFIsafe communication)
- Breakdown of PROFIsafe communication
  - Following CRC errors
  - Disconnection of the PROFINET connection
  - Monitoring time of data frames exceeded
- Error in the safety program of the F-CPU
- Error in the PROFIsafe protocol

After resumption of the PROFIsafe communication, the current process value is output again.

The safe state "0" is assumed at the output of the digital output module when the following faults occur:

- Channel fault
- Module fault

If a channel fault occurs in connection with S7 F/FH systems, the last valid value of all error-free channels is held after a STOP-RUN transition of the F-CPU until the channels are re-integrated in the safety program. If the parameter "Behavior after channel fault" is set to "Passivate entire module", you need to eliminate the channel fault before you can reintegrate the channels in the safety program.

5.2.2.4 Disable Dark Test (max. SIL2, CAT3, PLd)

To prevent an unwanted reaction of the actuator to a dark test, you can deactivate the dark test at the F-module output. An unwanted reaction can be for example, the brief de-energizing of a magnetic drive or a process value change of a digital input with very short input delay.

A capacitive load that does not correspond to the load curves (see section Switching capacitive loads (Page 62)) can lead to passivation of the output during a process value change, switch-on test or light test despite the dark test being disabled.

The "Enable Dynamic Read Back" and "Disable Dark Test for 48 hours" parameters must be disabled in conjunction with the "Disable Dark Test (max. SIL2, CAT3, PLd)" parameter.

They achieve max. SIL2/Cat.3/PLd with disabled dark test.

For disabled dark test:

⚠ WARNING

SIL2/Cat.3/PLd requires that there is a signal change from "1" to "0" at the corresponding output at least once a year. The "0" signal must have a duration of at least 2 seconds. It is not enough to simply turn off the supply voltage of the F-module and turn it on again.

⚠ WARNING

When you use the function "Disable Dark Test", cross-circuits between channels with "1" signal are not detected. If an error caused by short-circuits (cross-circuits) is detected when you request the safety function (shutdown of the output), not only is this output passivated, but all outputs are shut down and the F-module is passivated. Also take into consideration the respective requirements of your product standards regarding error detection time.

5.2.2.5 Disable Dark Test for 48 hours

This option allows you to suppress the dark test.

To suppress dark test pulses, you must ensure that all channels together carry the 0-signal once within the 48 hours. This suspends the dark test for a further 48 hours.

If this condition is not fulfilled, all dark test pulses will be applied anyway on all channels after expiration of this time. With 0-signal channels, the test pulses of light test continue to occur.

The "Enable Dynamic Read Back" and "Disable Dark Test for 48 hours" parameters must be disabled in conjunction with the "Disable Dark Test (max. SIL2, CAT3, PLd)" parameter.

If the following condition is met, the dark test is permanently suppressed:

- Before the 48 hours have elapsed, all channels together have a 0 signal.

⚠ WARNING

If a fault caused by short-circuits (cross-circuits) is detected when the safety function is requested (switching off of the output), not only is this output passivated but all outputs are switched off and the module is passivated. This is necessary because no complete bit pattern test is performed within 48 hours and therefore an undetected accumulation of errors cannot be ruled out.

Observe the respective requirements of your product standards with regard to the error discovery time.

If you enable the "Disable Dark Test for 48 hours" parameter, all channels use the values set for channel 0 for the "Max. readback time switch-on test/dark test" parameter.

5.2.2.6 Enable Dynamic Read Back

To avoid an undesired reaction of the actuator to a dark test, you have the option of dynamizing the dark test of the output of the F-module.

The dynamic readback function ends the dark test as soon as the readback signal of the dark test has been validly detected.

- The "Disable Dark Test (max. SIL2, CAT3, PLd)" and "Disable Dark Test for 48 hours" parameters must be disabled in conjunction with the "Enable Dynamic Read Back" parameter.
- The value range of the "Max. readback time, dark test and switch-off test" parameter is limited to a range between 0.6 and 20 ms.

⚠ WARNING

If the "Enable Dynamic Read Back" function is used, cross-circuits between 1-signal channels are not detected.

If an error caused by short-circuits (cross-circuits) is detected when you request the safety function (shutdown of the output), not only is this output passivated, but all outputs are shut down and the F-module is passivated.

Also take into consideration the respective requirements of your product standards regarding error detection time.

5.2.3 Parameters of the channels

5.2.3.1 Activated

If you select this check box, the corresponding channel is enabled for signal processing in the safety program.

You can deactivate an unused channel with this parameter.

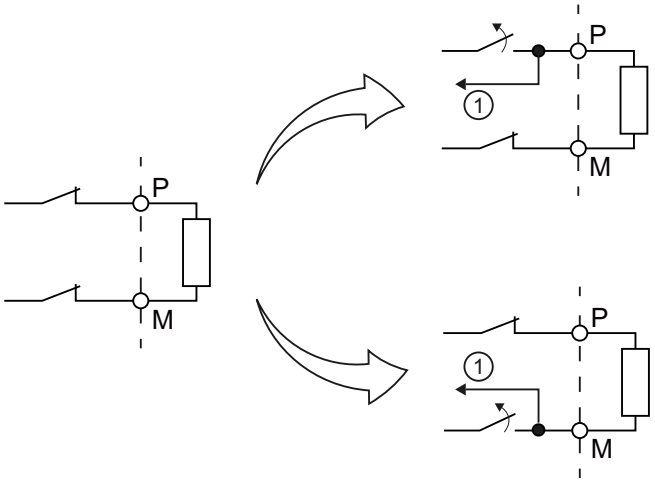
5.2.3.2 Max. readback time, dark test and switch-off test

Function

Dark tests are switch-off tests with bit pattern test.

For "Disable dark test" mode, the parameter "Max. readback time, dark test and switch-off test" is only relevant for the process value change.

For a dark test, a test signal is switched to the output channel while the output channel is active (output signal "1"). This output channel is then briefly disabled (= "dark period") and read back. A sufficiently slow actuator does not respond to this and remains switched on.



① Readback

Figure 5-1 Functional principle of the dark test (PM switching)

This parameter allows you to set the time for the readback.

If the expected signals (P-readback and M-readback) could not be read back correctly after expiration of the max. readback time, dark test and switch-off test, the output channel is passivated.

No new process values are switched to the output channels while a bit pattern is still active (switch test is carried out). This means that a higher max. readback time, dark test and switch-off test increases the response time of the F-module.

⚠ WARNING

Through the configured "Max. readback time, dark test and switch-off test", short circuits (cross-circuits) to a signal with a frequency greater than 1/(2 x configured max. readback time, dark test and switch-off test) Hz cannot be detected (50:50 sampling ratio).

Short circuits (cross-circuits) to an output of the same module are recognized.

The parameter also has an effect on the short circuit detection (cross-circuit) with "1" signal when the output signal is changed from "1" to "0" with the safety program.

Setting the parameter "Max. readback time, dark test and switch-off test"

Because the fault response time is extended by the max. readback time, dark test and switch-off test, we recommend that you set the max. readback time, dark test and switch-off test by trial and error as low as possible, but high enough that the output channel is not passivated.

You determine the readback time required for your actuator with the diagram in the chapter Switching capacitive loads (Page 62).

If the capacity of the actuator is not known, it may be necessary for you to determine the value for the max. readback time, dark test and switch-off test by trial and error. This may also be necessary due to the part variances in the actuator or external influences.

Proceed as follows:

- Set the "Max. readback time, dark test and switch-off test" so that the output channel can be read back correctly but your actuator does not respond yet.
- For verification, use the process value "1" with a minimum duration that corresponds to the "Maximum test time" parameter.
- If the output channel is passivated sporadically, set a higher value for the max. readback time, dark test and switch-off test.
- If the output channel is passivated, the max. readback time, dark test and switch-off test is too small for a connected capacitive load. The discharge cannot take place within the configured max. readback time, dark test and switch-off test. Increase the max. readback time, dark test and switch-off test.

If you have set the max. readback time, dark test and switch-off test to the maximum value of 400 ms and there is still a passivation of the output channel, there is either an external fault or the connected capacity is outside the permitted range.

Test pulses of the dark test

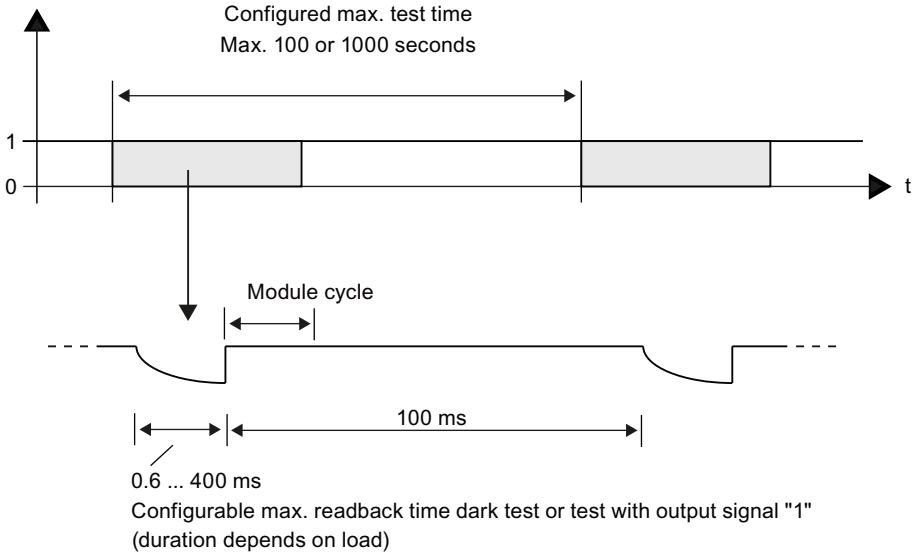


Figure 5-2 Test pulses of the dark test

The interval between two test pulses amounts to at least 100 ms.

NOTE

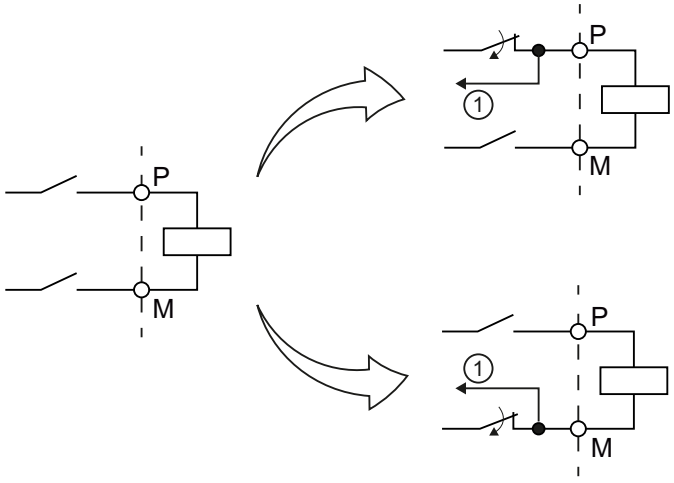
Note that the test pulses can be T_{diff} longer than the set test time.
T_{diff} = max (150 µs, min (10% of the set test time, 300 µs))

5.2.3.3 Max. readback time switch on test

Function

The switch on test is part of the bit pattern test.

During the switch on test, the P-switch and M-switch of the output channel are alternately closed and read back when the output channel is inactive (output signal "0"). Contrary to the light test, no power flows through the connected load during the switch on test.



① Readback

Figure 5-3 Functional principle of the switch on test (PM switching)

This parameter allows you to set the time for the readback. If the signal was not read back correctly once the time has expired, the output channel is passivated.

The switch on test detects the following faults:

- Short circuit to L+ with output signal "0"
- Short circuit to ground with output signal "0"

⚠ WARNING

Through the configured readback time, short circuits (cross-circuits) to an interfering signal with a frequency > 1 / (2 x configured readback time) Hz can be suppressed (50:50 sampling ratio).

Short circuits (cross-circuits) to an output of the same module are recognized.

Setting readback time

Because the fault reaction time is extended by the length of the set readback time, we recommend that you set the readback time by trial and error as low as possible but high enough that the output channel is not passivated.

To determine the readback time required for your actuator, refer to the diagram in the section Switching capacitive loads (Page 62).

If the capacitance of the actuator is not known, you may have to determine the required value for the readback time switch-on test by trial and error. This may also be necessary due to the part variances in the actuator or external influences.

Proceed as follows:

- Set the readback time switch on test in such a way that the output channel can be read back correctly but your actuator does not respond yet.
- If the output channel is passivated sporadically, set a higher value for the maximum readback time switch on test.
- If the output channel is passivated, the readback time is too small for a connected capacitive load. The charge of the capacitive load cannot take place during the configured readback time. Increase the readback time.

If you have set the readback time to the maximum value of 5 ms and there is still a passivation of the output channel, there is either an external fault or the connected capacity is outside the permitted range.

To increase availability, we recommend that you maintain an interval to the determined limit for the times.

5.2.3.4 Channel failure acknowledge

Use on S7-1200/1500 F-CPUs

The parameter is only relevant if the F-module is operated on an S7-1200/1500 F-CPU.

The parameter can only be set if the F-parameter "Behavior after channel fault" is set to "Passivate channel" and the F-parameter "Reintegration after channel fault" is set to "Adjustable".

The value of this parameter specifies how the channel reacts after a channel fault:

- Manual: A channel failure is reintegrated after manual acknowledgment.
- Automatic: The channel is reintegrated automatically after a channel fault. Manual acknowledgment is not necessary.

Use on S7-300/400 F-CPUs

The value of this parameter is not relevant in the case of operation on S7-300/400 F-CPUs. For S7-300/400 F-CPUs you set the corresponding property at the F-I/O DB by means of the ACK_NEC tag.

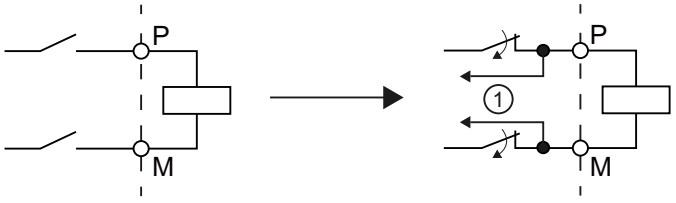
For detailed information about the F-I/O DB, refer to the SIMATIC Safety – Configuring and Programming (https://support.industry.siemens.com/cs/ww/en/view/54110126) manual.

5.2.3.5 Activated light test

Function

Overload and wire break are detected with a 0 signal at the output. Wire break is only detected with a 0 signal at the output if the "Diagnosis: Wire break" parameter is activated in addition to the "Activated light test" parameter.

For a light test, a test signal is switched to the output channel while the output channel is inactive (output signal "0"). The output channel is switched on briefly during the light test (= "light period") and read back. A sufficiently slow actuator does not respond to this and remains switched off.



① Readback

Figure 5-4 Functional principle of the light test (PM switching)

In contrast to the switch on test, the P-switch and the M-switch switch at the same time during the light test and power flows through the connected load.

With bad readback signals, the signal is always present at the output channel for the configured readback time.

If a wire break or overload is detected after the maximum readback time has elapsed, the output channel is passivated.

No new process values are switched to the output channels while a bit pattern is still active (switch test is carried out). This means that a higher maximum readback time switch on test for the light test increases the response time of the F-module.

Test pulses of the light test

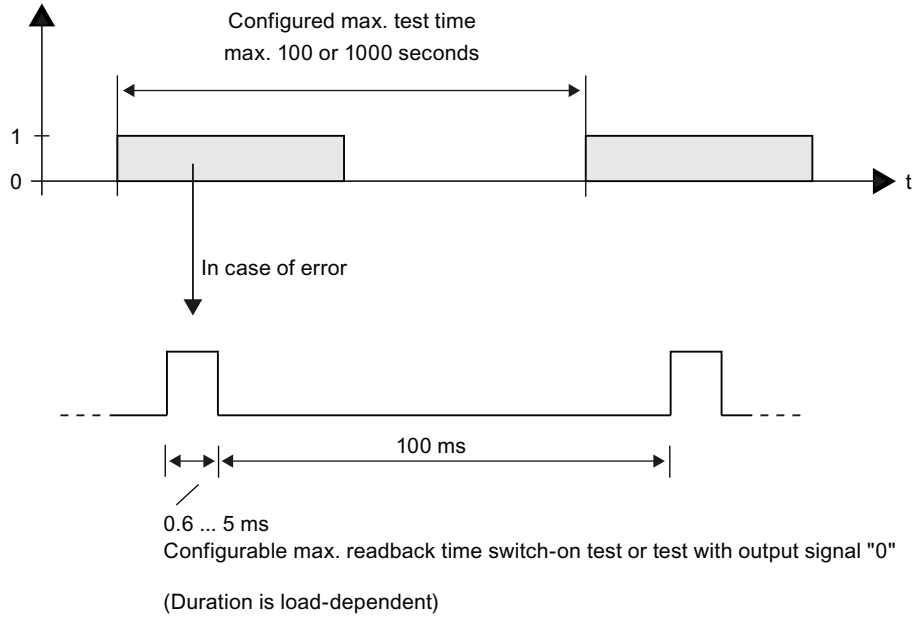


Figure 5-5 Test pulses of the light test

A light pulse with the configured duration takes place within the configured maximum test time per output channel.

If a light pulse returns a fault, the same light pulse (which means the same bit pattern) is repeated once after 100 ms. If the fault is still present, the maximum test time is automatically reduced to 60 seconds and a diagnostic message is generated. If the fault is no longer present, the output channel is reintegrated after the next fault-free test cycle.

5.2.3.6 Diagnosis: Wire break

You can use a wire break test to monitor the connection from the output channel to the actuator.

Selecting this check box enables the wire break monitoring for the relevant channel.

To detect a wire break with a "0" output signal, you must also enable the light test.

5.3 Address space

Address assignment of the digital output module F-DQ 4×24VDC/2A PM HF

The digital output module F-DQ 4×24VDC/2A PM HF occupies the following address areas in the F-CPU:

Table 5-3 Address assignment in the F-CPU

	Occupied bytes in the F-CPU:	
F-CPU	**In input range**	**In output range**
F-CPUs S7-300/400	IB x + 0 to x + 4	QB x + 0 to x + 4
F-CPUs S7-1200/1500	IB x + 0 to x + 5	QB x + 0 to x + 5

x = Module start address

Address assignment of the user data and the value status of digital output module F-DQ 4×24VDC/2A PM HF

The user data occupy the following addresses in the F-CPU out of all the assigned addresses of the digital output module F-DQ 4×24VDC/2A PM HF:

Table 5-4 Address assignment through user data

Byte in the F-CPU	Assigned bits in F-CPU per F-module:							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
IB x + 0	—	—	—	—	Value status DQ_3	Value status DQ_2	Value status DQ_1	Value status DQ_0
QB x + 0	—	—	—	—	DQ_3	DQ_2	DQ_1	DQ_0

x = Module start address

NOTE

You may only access the addresses occupied by user data and value status.

The other address areas occupied by the F-modules are assigned for functions including safety-related communication between the F-modules and F-CPU in accordance with PROFIsafe.

Additional information

You can find detailed information on F-I/O access in the SIMATIC Safety – Configuration and Programming (https://support.industry.siemens.com/cs/ww/en/view/54110126) manual or S7 Distributed Safety - Configuring and Programming (https://support.industry.siemens.com/cs/ww/en/view/22099875).

See also

Value status (Page 55)

Applications of the F-I/O module

6

6.1 Applications of the F-DQ 4x24VDC/2A PM HF

You achieve SIL3/Cat.4/PLe with the following applications.

The wiring is performed on a suitable BaseUnit (Page 19).

6.2 Application: Wiring a load to each digital output

Each of the four fail-safe digital output consists of a P-switch DQ-P_n and an M-switch DQ-M_n. You connect the load between the P-switch and the M-switch. The two switches are always activated so that voltage is applied to the load. This circuit achieves SIL3/Cat.4/PLe.

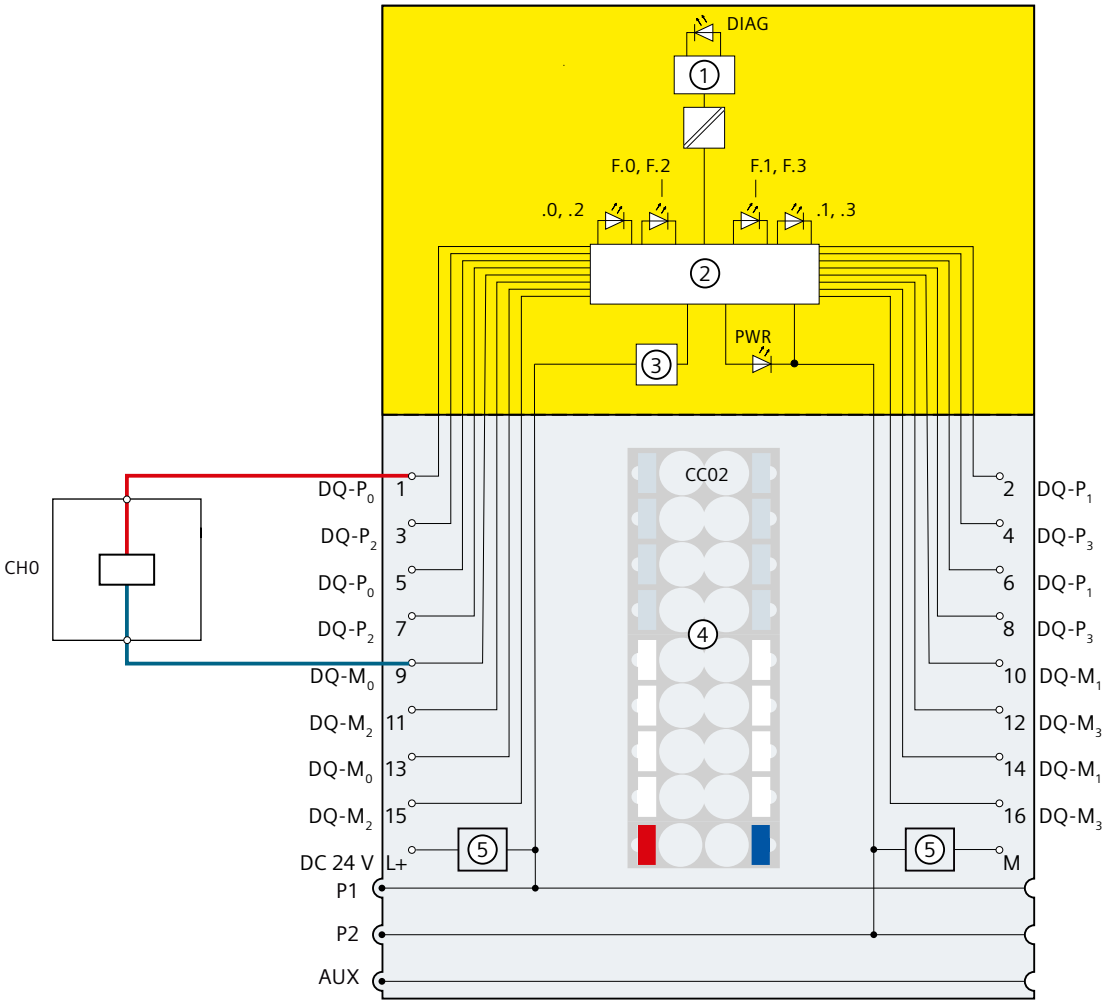


Figure 6-1 Wiring diagram for 1 relay each at 1 F-DQ of the digital output module F-DQ 4×24VDC/2A PM HF

WARNING

In order to achieve SIL3/Cat.4/PLe with this wiring, you must install a qualified actuator, for example, in accordance with IEC 60947.

6.3 Application: Connection of loads to L+ and M at each digital output

You can connect two relays using one fail-safe digital output. The following conditions should be kept in mind:

- Same reference potential
- The normally open contacts of the two relays must be connected in series.

This configuration achieves SIL3/Cat.4/PLe (process status readback required).

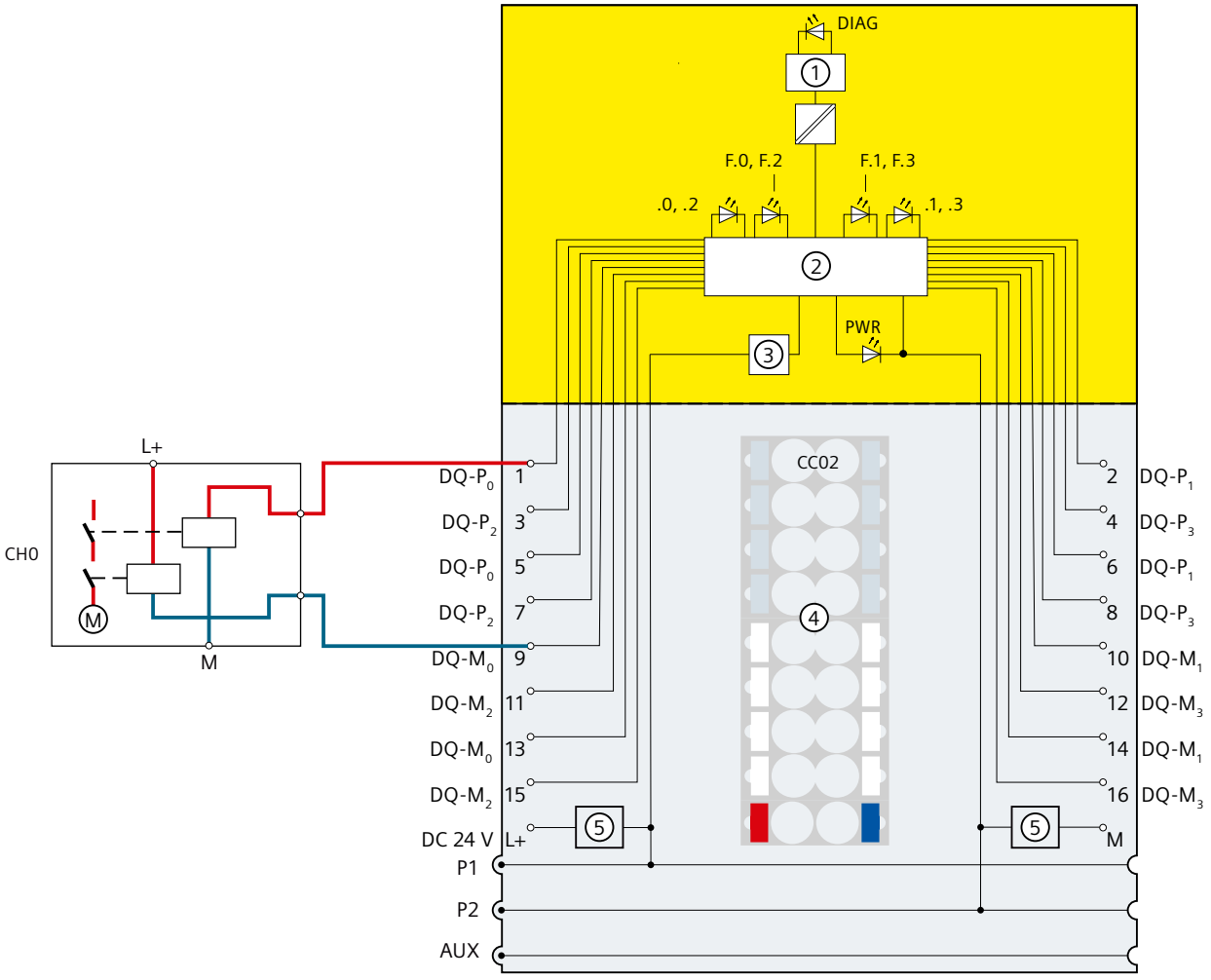


Figure 6-2 Wiring diagram for connecting 2 relays each to 1 F-DQ of the digital output module F-DQ 4×24VDC/2A PM HF

WARNING

When two relays are connected to one digital output, as shown in the figure above, the "wire break" and "overload" faults are detected only at the P-switch of the output (not at the M-switch).

⚠ WARNING

With a cross circuit between P-switch and M-switch of the output, the module detects the fault and switches off the output. But the actuator is still supplied with power due to the external fault.

To avoid cross-circuits between P- and M-switches of a fail-safe digital output, you need to lay the cables for connecting the relays to the P- and M-switch in such a way that they are protected against cross-circuits, for example as separately sheathed cables or in separate cable ducts.

NOTE

The digital output module F-DQ 4×24VDC/2A PM HF performs a bit pattern test depending on the parameter assignment. For this, the module outputs up to 5 ms pulses depending on the parameter assignment. This test (switch-on test) is run with a time offset between the P-switch and M-switch to prevent the actuator from being activated. This pulse may cause the corresponding relay to operated, which may reduce its service life.

We therefore recommend adhering to the wiring scheme described below.

6.4 Application: Wiring two loads in parallel to each digital output

To protect against cross-circuits between P-switch and M-switch in fail-safe digital outputs, we recommend the following wiring scheme. This circuit achieves SIL3/Cat.4/PLe.

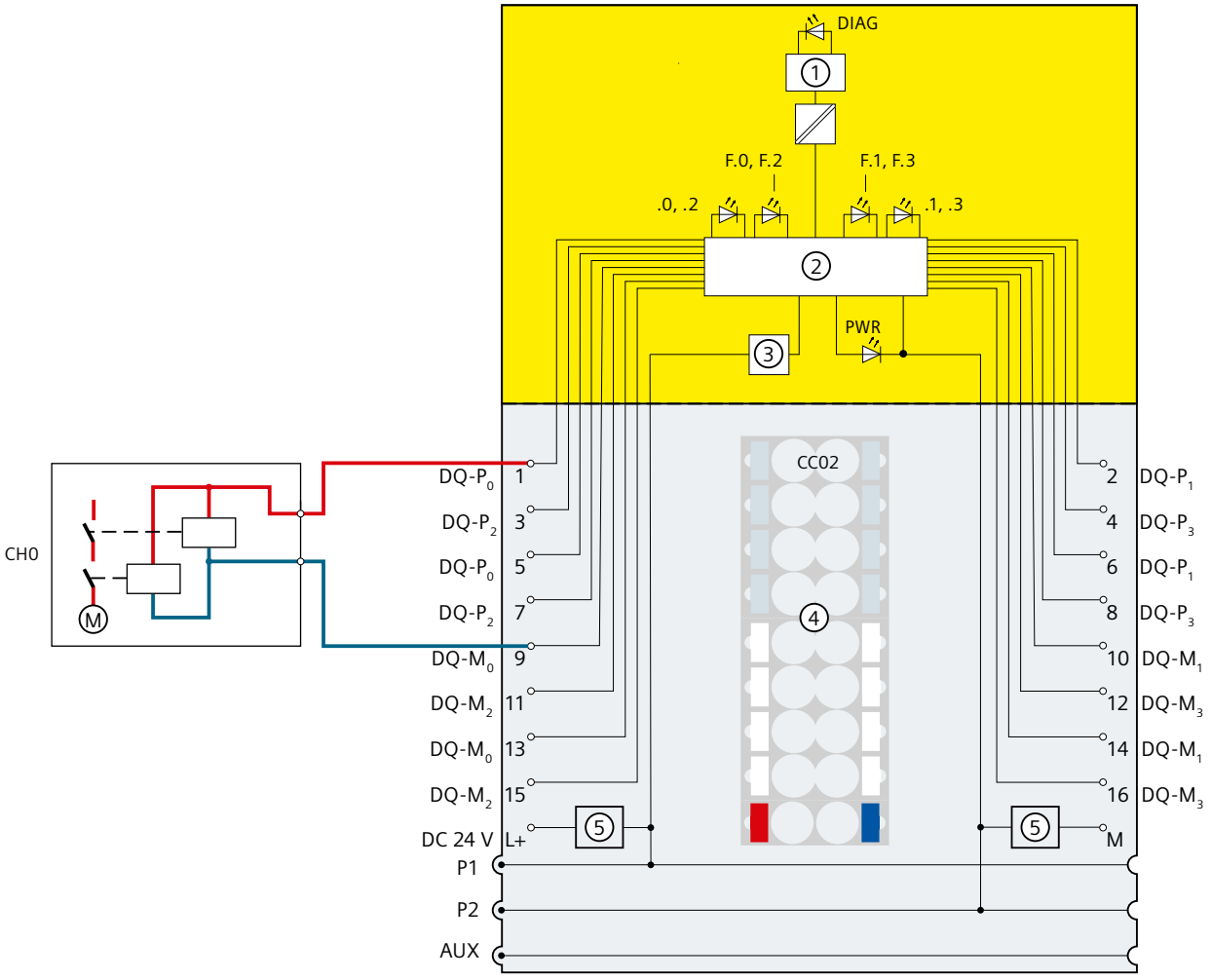


Figure 6-3 Wiring diagram for 2 relays each parallel at 1 F-DQ of the digital output module F-DQ 4×24VDC/2A PM HF

NOTE

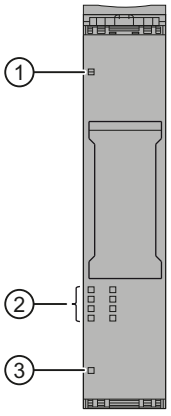
With a parallel connection of two relays on one digital output (as shown above) the "wire break" fault is only detected if the wire break disconnects both relays from P or M. This diagnostics is not safety-related.

Interrupts/diagnostic messages

7

7.1 Status and error display

LED display



① DIAG (green/red)
② Channel status (green), channel fault (red)
③ PWR (green)

Figure 7-1 LED display

Meaning of the LED displays

The following tables explain the meaning of the status and error displays. Remedies for diagnostic messages can be found in section Diagnostic messages (Page 51).

WARNING

The DIAG LED and the channel status and channel fault LEDs of the outputs are not designed as safety-related LEDs and therefore may not be evaluated for safety-related activities.

PWR LED

Table 7-1 Meaning of the PWR LED

PWR	Meaning
□ Off	Supply voltage L+ missing
■ On	Supply voltage L+ available

DIAG LED

Table 7-2 Meaning of the DIAG LED

DIAG	Meaning
Off	Backplane bus supply of the ET 200SP not okay
Flashing	Module parameters not configured
On	Module parameters configured and no module diagnostics
Flashing	Module parameters configured and module diagnostics
Flashing	Module waits for user acknowledgment

Channel status/channel fault LED

Table 7-3 Meaning of the channel status/channel fault LED

Channel status	Channel fault	Meaning
Off	Off	Process signal = 0 and no channel diagnostics
On	Off	Process signal = 1 and no channel diagnostics
Off	On	Process signal = 0 and channel diagnostics
Alternately flashing		Channel waiting for user acknowledgment

Channel status/DIAG/channel fault LED

Table 7-4 Meaning of the channel status/DIAG/channel fault LED

Channel status	DIAG	Channel fault	Meaning
Off	Flashing	All On	The PROFIsafe address does not match the configured PROFIsafe address
Flashing	Flashing	Off	Identification of the F-module when assigning the PROFIsafe address

7.2 Interrupts

Introduction

The F-DQ 4x24VDC/2A PM HF fail-safe digital output module supports diagnostic interrupts.

Diagnostic interrupt

The F-module generates a diagnostic interrupt for each diagnostic message described in section Diagnostic messages (Page 51).

The table below provides an overview of the diagnostic interrupts of the F-module . The diagnostic interrupts are assigned either to one channel or the entire F-module.

⚠ WARNING

Before acknowledging the short circuit diagnostic message, remedy the respective fault and validate your safety function. Proceed as described in section Diagnostic messages (Page 51) to eliminate the error.

Module-wide diagnostic interrupts:

- Overtemperature
- Parameter error
- Supply voltage missing
- Mismatch of safety destination address (F_Dest_Add)
- Safety destination address not valid (F_Dest_Add)
- Safety source address not valid (F_Source_Add)
- Safety watchdog time value is 0 ms (F_WD_Time)
- Parameter F_SIL exceeds SIL from specific device application
- Parameter F_CRC_Length does not match the generated values
- Version of F parameter set incorrect
- CRC1 fault
- Device-specific diagnostics information, see manual
- Inconsistent iParameters (iParCRC error)
- F_Block_ID not supported
- Transmission error: Inconsistent data (CRC error)
- Transmission error: Timeout (watchdog time 1 or 2 expired)
- Channel failure acknowledgment
- Watchdog tripped
- Invalid/inconsistent firmware present
- Diagnostic queue overflow

- F-address memory not accessible
- No valid F-address available
- Undertemperature
- Auxiliary voltage too high
- Auxiliary voltage too low
- F-module error (0x032F)

Channel-wide diagnostic interrupts

- Wire break
- Safety-related shutdown
- Short-circuit to L+
- Short-circuit to ground
- Frequency too high
- Output defective
- Readback failure
- Overload

7.3 Diagnostic messages

Diagnostic messages

Module faults are indicated as diagnostics (module status).

NOTE

You can connect multiple actuators per output

The diagnostics of the actuators influence each other in the case of multiple wiring.

This means:

- A wire break is only signaled if both actuators are affected.
- A single short-circuit affects both actuators.

Once the fault is eliminated, the F-module must be reintegrated in the safety program. For additional information on passivation and reintegration of F-I/O, refer to the SIMATIC Safety – Configuring and Programming (https://support.industry.siemens.com/cs/ww/en/view/54110126) manual or S7 Distributed Safety - Configuring and Programming (https://support.industry.siemens.com/cs/ww/en/view/22099875).

Table 7-5 Diagnostic messages of the F-DQ 4×24VDC/2A PM HF

Diagnostic message	Fault code	Meaning	Remedy
Overtemperature	5_H	An excessively high temperature was measured in the F-module.	Operate the F-module within the specified temperature range. (See Technical specifications (Page 56)) Once the fault has been eliminated, the F-module must be removed and inserted or the power switched OFF and ON
Wire break	6_H	Possible causes: • There is an interrupted cable between the module and actuator. • The channel is not connected (open).	• Establish a cable connection. • Disable the wire break detection for the channel in the parameter assignment. • Eliminate the short circuit.
Parameter error	10_H	Parameter assignment errors include: • The F-module cannot use the parameters (unknown, invalid combination, etc.). • The F-module parameters have not been configured.	Correct the parameter assignment.
Supply voltage missing	11_H	Missing or insufficient supply voltage L+	• Operate the F-module within the specified supply voltage range. • Check BaseUnit type
Safety-related shutdown	19_H	The channel was switched off for safety reasons due to an error on another channel. Possible causes: • There is a short-circuit. • The capacitive load is too high.	• Correct the process wiring. • Increase the test times (dark and light test).

Diagnostic message	Fault code	Meaning	Remedy
Mismatch of safety destination address (F_Dest_Add)	40_H	The PROFIsafe driver has detected a different F-destination address.	Check the parameter assignment of the PROFIsafe driver and the address setting of the F-module.
Safety destination address not valid (F_Dest_Add)	41_H	The PROFIsafe driver has detected an invalid F-destination address.	Check the parameter assignment of the PROFIsafe driver.
Safety source address not valid (F_Source_Add)	42_H	The PROFIsafe driver has detected an invalid F-source address.	
Safety watchdog time value is 0 ms (F_WD_Time)	43_H	The PROFIsafe driver has detected an invalid watchdog time.	
Parameter F_SIL exceeds SIL from specific device application	44_H	The PROFIsafe driver has detected a discrepancy between the SIL setting of the communication and the application.	
Parameter F_CRC_Length does not match the generated values	45_H	The PROFIsafe driver has detected a discrepancy in the CRC length.	
Version of F parameter set incorrect	46_H	The PROFIsafe driver has detected an incorrect version of the F-parameters or an invalid F_Block_ID.	
CRC1 fault	47_H	The PROFIsafe driver has detected inconsistent F-parameters.	
Device-specific diagnostics information, see manual	48_H	The PROFIsafe driver has received inconsistent fail-safe parameters.	
Inconsistent iParameters (iParCRC error)	$4B_H$	The PROFIsafe driver has detected inconsistent iParameters.	Check the parameter assignment.
F_Block_ID not supported	$4C_H$	The PROFIsafe driver has detected an incorrect Block ID.	Check the parameter assignment of the PROFIsafe driver.
Transmission error: Inconsistent data (CRC error)	$4D_H$	The firmware of the F-module has detected a CRC error. Possible causes: • The communication between F-CPU and F-module is interrupted. • Impermissibly high electromagnetic interference is present. • An error has occurred during the sign-of-life monitoring.	• Check the communication connection between the F-module and the F-CPU. • Eliminate the cause of the electromagnetic interference. • POWER OFF - ON of the station • Reassign the configuration and parameter assignments to the F-module (the station).
Transmission error: Timeout (watchdog time 1 or 2 expired)	$4E_H$	The firmware of the F-module has detected a timeout. Possible causes: • The F-monitoring time is set incorrectly. • A bus fault is present.	Check the parameter assignment. Make sure that your communication is operating correctly.
Channel failure acknowledgment	$4F_H$	A channel fault was detected. A confirmation is required to enable the channel.	Confirm the channel fault.

Diagnostic message	Fault code	Meaning	Remedy
Watchdog tripped	103_H	Possible causes: • Impermissibly high electromagnetic interference is present. • The F-module has detected an internal error and reacted to it in a safety-oriented manner.	• Correct the fault. The module must then be pulled and plugged, or the power switched OFF and ON • If the F-module cannot be put into operation anymore, consider a replacement.
Short-circuit to L+	105_H	Short circuit to L+ can mean: • The output cable is short-circuited to L+. • There is a short circuit between two output channels. • The capacitive load is too high.	• Correct the process wiring. • Increase the test times (dark, light, switch-on tests).
Short-circuit to ground	106_H	Short circuit to ground can mean: • The output cable is short-circuited to ground. • The output signal is short-circuited to ground. • There is a short circuit between two output channels. • The capacitive load is too high.	• Correct the process wiring. • Increase the test times (dark, light, switch-on tests).
Invalid/inconsistent firmware present	$11B_H$	The firmware is incomplete and/or firmware added to the F-module is incompatible. This leads to errors or functional limitations when operating the F-module.	• Perform a firmware update for all parts of the F-module and note any error messages. • Use only firmware versions released for this F-module.
Diagnostic queue overflow	$13E_H$	Overflow of the diagnostics memory. Not all pending diagnostics could be sent. This error can result in deactivation of the module up to switching on/off of the supply voltage.	Eliminate the previously reported error.
F-address memory not accessible	$30D_H$	F-source address placed in the coding element and F-destination address cannot be accessed.	Check whether the coding element is available or replace it.
No valid F-address available	$30E_H$	No valid PROFIsafe address is stored in the retentive memory. Possible causes: • Initial commissioning • Deliberate parameter change of the PROFIsafe address • Deviation between setpoint and actual configuration of the plant.	• Perform the assignment of the PROFIsafe address during initial commissioning or deliberate parameter changes. • Check the consistency between the setpoint and actual configuration.
Frequency too high	311_H	The maximum switching frequency of the F-module has been exceeded.	Reduce the switching frequency (see Technical specifications (Page 56)).
Undertemperature	312_H	The minimum permissible temperature limit has been violated.	Operate the F-module within the specified temperature range. (See Technical specifications (Page 56))

Diagnostic message	Fault code	Meaning	Remedy
Output defective	$31D_H$	The F-module has detected an internal error. Possible causes: • The capacitive load is too high. • Short circuit to L+ or M • The F-module is defective	• Increase the test times (dark, light, switch-on tests). • Check the wiring. • Replace the F-module.
Readback failure	$31E_H$	The F-module has detected an internal error. Possible causes: • Impermissibly high electromagnetic interference is present. • The capacitive load is too high. • The F-module is defective.	• Increase the test times (dark, light, switch-on tests). • If the error persists, replace the F-module.
Overload	320_H	The maximum permissible output current has been exceeded. The output stage has been switched off. Possible causes: • A short circuit exists. • The capacitive load is too high.	Check the process wiring.
Auxiliary voltage too high	321_H	The supply voltage is too high.	Check the supply voltage.
Auxiliary voltage too low	322_H	The supply voltage is too low.	Check the supply voltage.
F-module error (0x032F)	$32F_H$	Possible causes: • Impermissibly high electromagnetic interference is present. • The F-module is defective.	• The internal diagnostics has detected an error. Pulling and plugging the module or POWER OFF – POWER ON is necessary. • If the F-module cannot be put into operation anymore, consider a replacement.

Supply voltage outside the nominal range

If the supply voltage L+ is outside the specified value range, the DIAG LED flashes and the module is passivated.

When the voltage is then recovered (level must remain within the specified value for at least 1 minute (see Technical specifications (Page 56) Voltages, Currents, Potentials)), the DIAG LED stops flashing. The module remains passivated.

Generally applicable information on diagnostics

For information on diagnostics which apply to all fail-safe modules (e.g. for reading out the diagnostic functions, passivation of channels), refer to the SIMATIC Safety - Configuring and Programming (https://support.industry.siemens.com/cs/ww/en/view/54110126) manual or S7 Distributed Safety - Configuring and Programming (https://support.industry.siemens.com/cs/ww/en/view/22099875).

7.4 Value status

Properties

In addition to the diagnostic messages and the status and error display, the F-module makes available information about the validity of each input and output signal – the value status. The value status is entered in the process image along with the input signal.

Value status for digital input and output modules

The value status is additional binary information of a digital input or output signal. It is entered in the process image of the inputs (PII) at the same time as the process signal. It provides information about the validity of the input or output signal.

The value status is influenced by the wire break check, short-circuit, chatter monitoring, pulse extension, and plausibility check.

- 1_B: A valid process value is output for the channel.
- 0_B: A fail-safe value is output for the channel, or the channel is deactivated.

Assignment of the inputs and value status in the PII

Each channel of the F-module is assigned a value status in the process image of the inputs. You can find the assignment in section Address space (Page 39).

Reference

A detailed description of the evaluation and processing of the respective input signals can be found in the SIMATIC Safety – Configuring and Programming (https://support.industry.siemens.com/cs/ww/en/view/54110126) manual.

Technical specifications

8

Technical specifications of F-DQ 4×24VDC/2A PM HF

The following table lists the technical specifications on 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/6ES7136-6DB01-0CA0/td?dl=en).

Article number	6ES7136-6DB01-0CA0
General information	
Product type designation	F-DQ 4x24VDC/2A PM HF
Firmware version	
• FW update possible	Yes
usable BaseUnits	BU type A0
Color code for module-specific color identification plate	CC02
Product function	
• I&M data	Yes; I&M0 to I&M3
Engineering with	
• STEP 7 TIA Portal configurable/integrated from version	V20 with HSP / V21
• PROFINET from GSD version/GSD revision	GSDML V2.45
Supply voltage	
Rated value (DC)	24 V
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
power supply according to NEC Class 2 required	No
Input current	
Current consumption (rated value)	30 mA; without load
Current consumption, max.	21 mA; From the backplane bus
output voltage / header	
Rated value (DC)	24 V
Power	
Power available from the backplane bus	70 mW
Power loss	
Power loss, typ.	3 W

Article number	6ES7136-6DB01-0CA0
Address area	
Address space per module	
• Inputs	6 byte; S7-300/400F CPU, 5 byte
• Outputs	6 byte; S7-300/400F CPU, 5 byte
Hardware configuration	
Automatic encoding	Yes
• Electronic coding element type F	Yes
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	4
Digital outputs, parameterizable	Yes
Short-circuit protection	Yes
• Response threshold, typ.	> 3.3 A
Open-circuit detection	Yes
• Response threshold, typ.	8 mA
Overload protection	Yes
• Response threshold, typ.	3 A
Limitation of inductive shutdown voltage to	sourcing output: -39 V DC in relation to 2M, sinking output: +47 V DC in relation to 2M
Controlling a digital input	Yes; digital output, according to IEC 61131-2, type 2
Switching capacity of the outputs	
• with resistive load, max.	2 A
• on lamp load, max.	10 W
Load resistance range	
• lower limit	12 Ω
• upper limit	2 000 Ω
Output voltage	
• for signal "1", min.	24 V; L+ (-0.5 V)
Output current	
• for signal "1" rated value	2 A
• for signal "0" residual current, max.	0.5 mA
Switching frequency	
• with resistive load, max.	30 Hz; Symmetrical
• with inductive load, max.	0.1 Hz; according to IEC 60947-5-1, DC-13, symmetrical
• with capacitive load, max.	30 Hz; observe chapter "Switching of capacitive loads" in the manual
• on lamp load, max.	10 Hz; Symmetrical

Article number	6ES7136-6DB01-0CA0
Total current of the outputs	
• Current per channel, max.	2 A; note derating data in the manual
• Current per module, max.	6 A; note derating data in the manual
Cable length	
• shielded, max.	1 000 m
• unshielded, max.	500 m
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Substitute values connectable	No
Alarms	
• Diagnostic alarm	Yes
• Hardware interrupt	No
Diagnostics indication LED	
• RUN LED	Yes; green LED
• ERROR LED	Yes; red LED
• Monitoring of the supply voltage (PWR-LED)	Yes; green PWR LED
• Channel status display	Yes; green LED
• for channel diagnostics	Yes; red LED
• for module diagnostics	Yes; green/red DIAG LED
Potential separation	
Potential separation channels	
• between the channels	No
• between the channels and backplane bus	Yes
• between the channels and the power supply of the electronics	No
Isolation	
Isolation tested with	707 V DC (type test)
Standards, approvals, certificates	
Suitable for safety functions	Yes
Highest safety class achievable in safety mode	
• Performance level according to ISO 13849-1	PLe
• Category according to ISO 13849-1	Cat. 4
• SIL acc. to IEC 61508	SIL 3

Article number	6ES7136-6DB01-0CA0
Probability of failure (for service life of 20 years and repair time of 100 hours)	
– Low demand mode: PFDavg in accordance with SIL2	< 2.00E-04
– Low demand mode: PFDavg in accordance with SIL3	< 2.00E-05
– High demand/continuous mode: PFH in accordance with SIL2	< 1.00E-08 1/h
– High demand/continuous mode: PFH in accordance with SIL3	< 1.00E-09 1/h
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	0 °C
• horizontal installation, max.	60 °C
• vertical installation, min.	0 °C
• vertical installation, max.	50 °C
Altitude during operation relating to sea level	
• Installation altitude above sea level, max.	4 000 m; Restrictions for installation altitudes > 2 000 m, see manual
Dimensions	
Width	15 mm
Height	73 mm
Depth	58 mm
Weights	
Weight, approx.	30 g

Temperature characteristic values

Mounting position	Maximum temperature	Total current across all channels
Horizontal	40 °C	6 A
	50 °C	5 A
	60 °C	4 A
Vertical	50 °C	4 A

NOTE

Due to the small size of output modules with higher loads, pay attention to the heat development between adjacent modules. If overtemperature occurs in an output module exposed to an elevated load, shutdown may result and reduce the plant availability. If you fully load an output module, the average total current of the modules directly adjacent to it should not exceed 75% of the values listed in the technical specifications. If you load directly adjacent modules with their maximum total current, reduce the maximum total current of the output module by 1 A (e.g., for horizontal installation up to 60 °C → total current of 3 A across all channels).

Dimension drawing

See ET 200SP BaseUnits (https://support.industry.siemens.com/cs/ww/en/view/59753521) manual

Response times

A

Introduction

The reaction time of the digital output module F-DQ 4×24VDC/2A PM HF is specified below. The reaction times of the digital output module F-DQ 4×24VDC/2A PM HF are included in the calculation of the reaction time of the F-system.

Definition of response time for fail-safe digital outputs

The response time represents the interval between an incoming safety message frame from the backplane bus and the signal change at the digital output.

Times required for the calculation

- Maximum cycle time: T_{cycle} = 5 ms
- Max. acknowledgment time (device acknowledgment time): T_{DAT} = 31 ms

You configure the dark test time (Readback time, T_{rb}) and switch-on time (Readback time switch-on test, T_{rb_swon}) in STEP 7.

Definition of maximum reaction time in an error-free scenario (worst case delay time, WCDT)

The maximum reaction time (T_{WCDT}) for fail-safe digital outputs in the error-free case is as follows:

Max. reaction time (T_{WCDT}) = 2 × T_{cycle} + Maximum T_{rb} (dark test time), T_{rb_swon} (switch-on time)

Definition of maximum reaction time if there is a fault/error (one fault delay time, OFDT)

Max. reaction time (T_{OFDT}) = 2 × T_{cycle} + Maximum T_{rb} (dark test time), T_{rb_swon} (switch-on time)

Maximum reaction time when a channel fault is detected by bit pattern test

Max. reaction time (T_{WCDT}) = 2 ×T_{cycle} + Maximum T_{rb} (dark test time), T_{rb_swon} (switch-on time) + configured test time

Mode of operation: Disable Dark Test for 48 hours - enabled

It can take up to a process value change 0-1 on the corresponding channel before a channel fault is detected. Note the restrictions in the section Disable Dark Test for 48 hours (Page 30).

Switching of loads

B

B.1 Connecting capacitive loads

If a digital output module F-DQ 4×24VDC/2A PM HF is connected to loads that require little current and have a capacitance, a short-circuit or overload may be detected. Reason: The capacitance cannot be sufficiently discharged or charged during the configured readback time of the bit pattern test.

The typical trend shown in the diagram below represents the correlation between load impedance and maximum switched load capacitance at a supply voltage of 24 V DC.

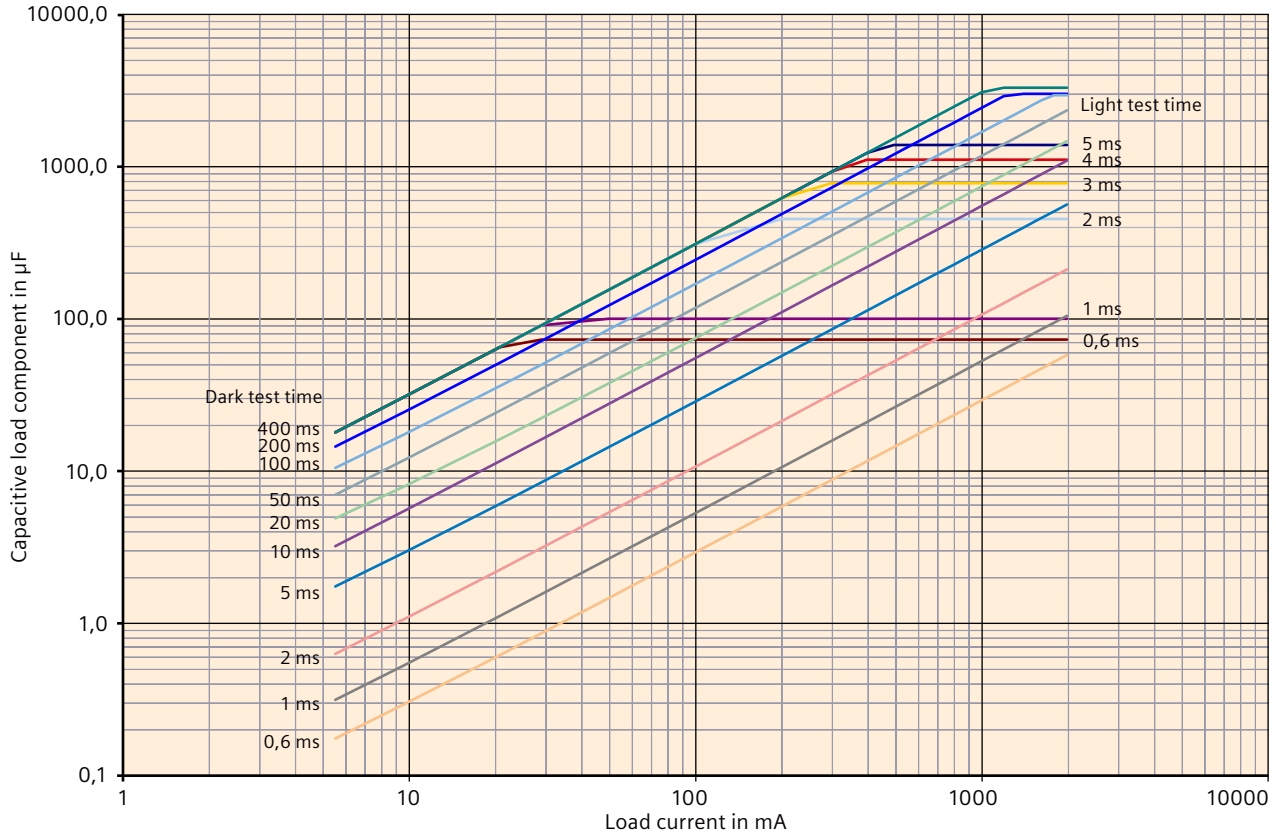


Figure B-1 Switching of capacitive loads for digital output module F-DQ 4×24VDC/2A PM HF depending on the configured dark and light test time

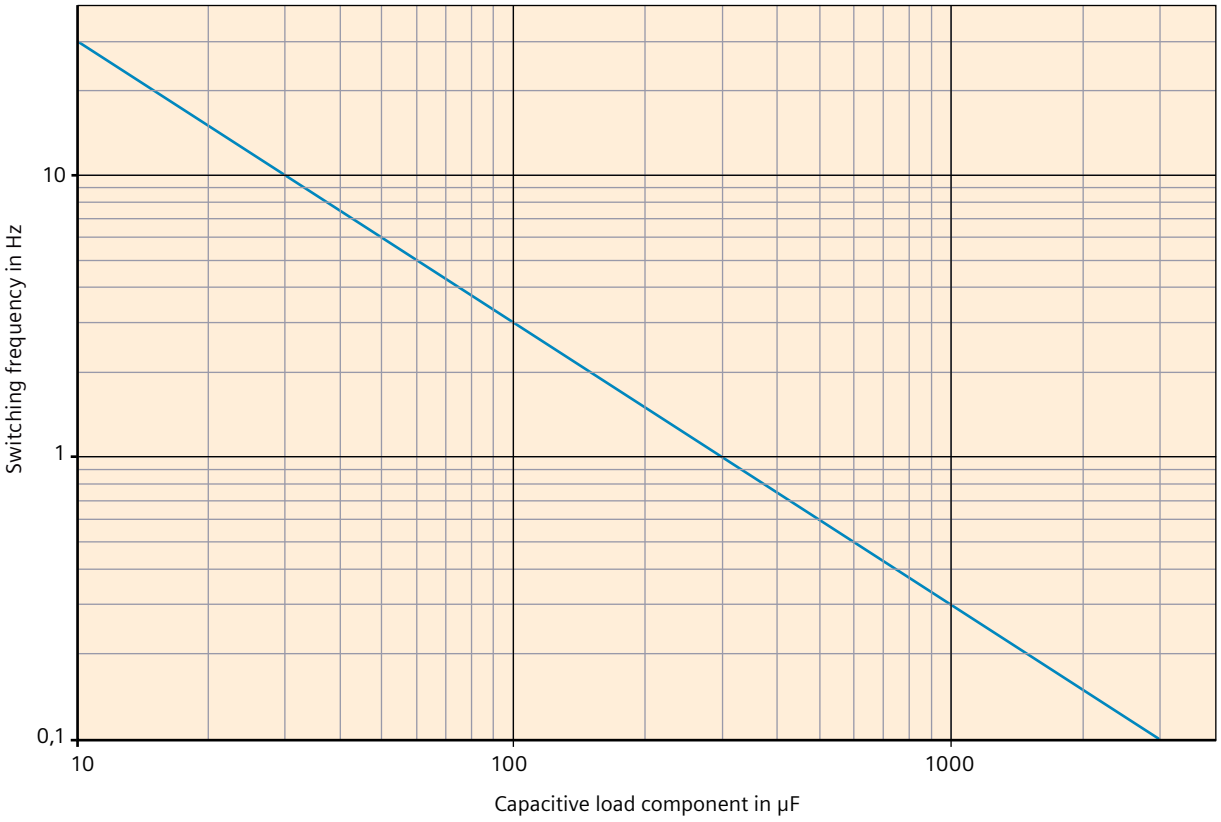


Figure B-2 Maximum switching frequency depending on the capacity of the load

Remedy for detecting a short circuit

1. Determine the load current and capacitance of the load.
2. Locate the operating point in the diagram above.
3. If the operating point is above the curve, you must increase the load current until the new operating point is below the curve by connecting a resistor in parallel.

B.2 Switching of inductive loads

Switching of inductive loads

The diagram below shows the maximum permitted inductive loads as a function of the load current and switching frequency.

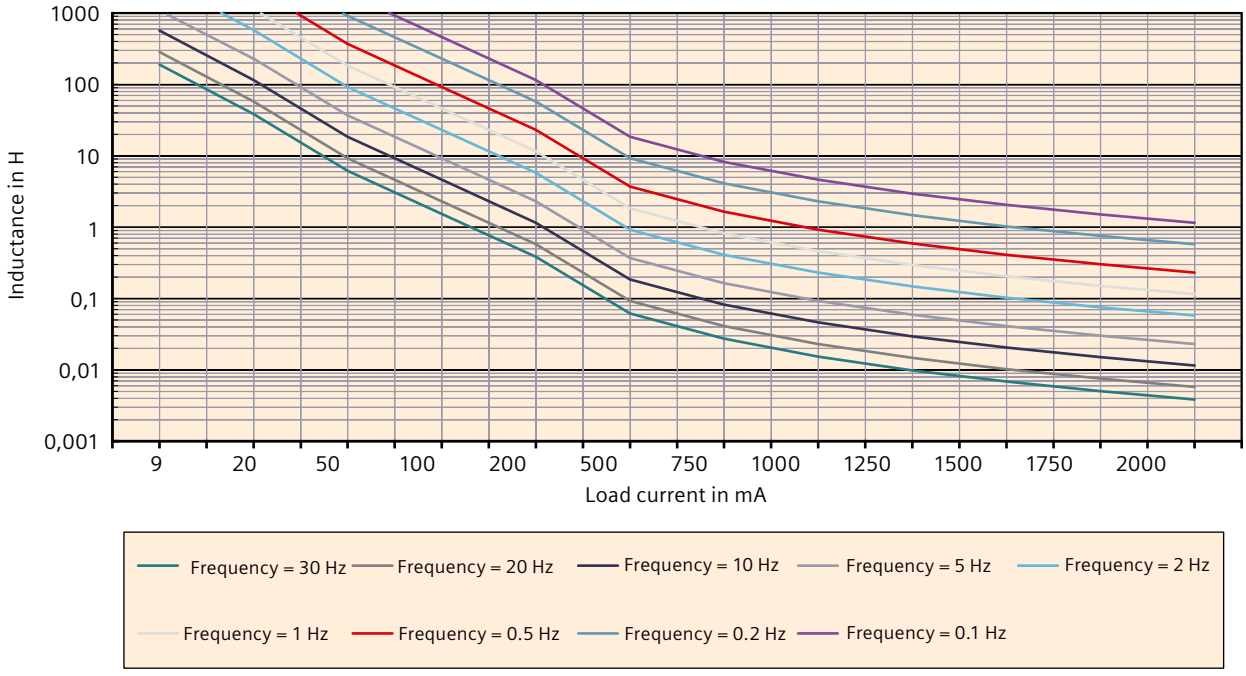


Figure B-3 Switching of inductive loads for the digital output module F-DQ 4x24VDC/2A PM HF depending on load current and switching frequency