

Edition

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EQUIPMENT MANUAL

SIMATIC

ET 200SP

Digital output module F-DQ 8x24VDC/0.5A PP HF
6ES7136-6DC00-0CA0

SIEMENS

SIMATIC

ET 200SP Digital output module F-DQ 8x24VDC/0.5A PP HF

Equipment Manual

Original operating instructions

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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.

Preface

Purpose of the documentation

This manual supplements the system manual Distributed I/O System ET 200SP (<https://support.industry.siemens.com/cs/ww/en/view/58649293>).

Functions that affect the system in general are described in this system manual.

The information in this manual and the system/function manuals provide support when you commission the system.

A description of the F-system SIMATIC Safety can be found in the programming and operating manual SIMATIC Safety – Configuring and Programming (<https://support.industry.siemens.com/cs/ww/en/view/54110126>).

Conventions

CPU: When the term "CPU" is used below, it refers to the central processing units of the S7-1200/1500 automation system and the S7-300/S7-400 automation systems of the previous generation and to CPUs of the ET 200SP distributed I/O system.

STEP 7: In this documentation, "STEP 7" is used as a synonym for all versions of the configuration and programming software " (STEP 7 TIA Portal)".

PII: Process image input.

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.

Standards

You can find a dated reference to the respective standards in the certificate (<https://support.industry.siemens.com/cs/ww/en/view/57141281>) or in the EC Declaration of Conformity (<https://support.industry.siemens.com/cs/ww/en/view/71764057>) for the F-module.

Certified versions

You can find the certified product and firmware versions in Annex 1 of the report to the TÜV certificate (<https://support.industry.siemens.com/cs/ww/en/view/57141289>).

Recycling and disposal

For environmentally friendly recycling and disposal of your old equipment, contact a certified electronic waste disposal company and dispose of the equipment according to the applicable regulations in your country.

Important note for maintaining the operational safety of your system

WARNING

The operators of systems with safety-related characteristics must adhere to specific operational safety requirements. The supplier is also obliged to comply with special product monitoring measures. Siemens informs system operators in the form of personal notifications about product developments and properties which may be or become important issues in terms of operational safety.

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 on to 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/ww/en/ps/13751>)
- SIMATIC S7-400/S7-400H/S7-400F/FH (<https://support.industry.siemens.com/cs/ww/en/ps/13828>)
- S7-1500 Software Controller (<https://support.industry.siemens.com/cs/us/en/ps/13912>)
- SIMATIC S7-1500/SIMATIC S7-1500F (<https://support.industry.siemens.com/cs/ww/en/ps/13716>)
- SIMATIC S7-1200/SIMATIC S7-1200F (<https://support.industry.siemens.com/cs/ww/en/ps/13683>)
- Distributed I/O (<https://support.industry.siemens.com/cs/ww/en/ps/14029>)
- STEP 7 (TIA Portal) (<https://support.industry.siemens.com/cs/ww/en/ps/24471>)

Siemens provides products and solutions with industrial security 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 security 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 security measures that may be implemented, please visit (<https://www.siemens.com/industrialsecurity>).

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 customers' exposure to cyber threats.

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

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ET 200SP documentation guide

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>)

1.2 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 PROFlenergy diagnostics, you can quickly detect the current pause mode or the readiness for operation of devices that support PROFlenergy 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>).

1.3 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>).

1.4 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>)

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: <ul style="list-style-type: none">• 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>)

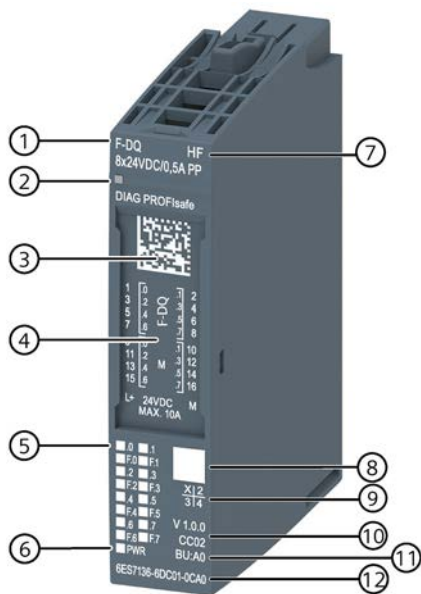
Product overview

2.1 Properties

Article number

6ES7136-6DC00-0CA0

View of the module



- ① Module type and name
- ② LED for diagnostics
- ③ 2D matrix code
- ④ Connection diagram
- ⑤ LEDs for channel status
- ⑥ LED for supply voltage
- ⑦ Function class
- ⑧ Color identification module type
- ⑨ Function and firmware version
- ⑩ Color code to select the color identification labels
- ⑪ Article number

Figure 2-1 View of the module F-DQ 8x24VDC/0.5A PP HF

Properties

The module has the following technical characteristics:

- Fail-safe digital module
- PROFIsafe
- Supports the "RIOforFA-Safety" profile on F-CPU S7-1200/1500.
- PROFIsafe address type 2
- 8 outputs, PP-switching (SIL3/Cat.4/PLe)
- Supply voltage L+
- Output current 0.5 A per output
- Sourcing output (PP-switching)
- Suitable for solenoid valves, DC contactors and signal lamps
- Direct interconnection to inputs of an F-DI possible
- Diagnostics display (DIAG red/green LED)
- Status display for each output (green LED)
- Fault display for each output (red LED)
- Diagnostics
 - e.g., short-circuit, channel-specific
 - e.g. supply voltage missing, module-specific
- Channel-specific or module-wide passivation

The module supports the following functions:

- Firmware update
- I&M identification data
- Service data (V1.0.1 and higher)

WARNING

The fail-safe performance characteristics in the technical specifications apply for a mission time of 20 years and a repair time of 100 hours. If a repair within 100 hours is not possible, remove the respective module from the BaseUnit or switch off its supply voltage before the 100 hours elapse. The module switches off independently after the 100 hours have expired. Follow the repair procedure described in section Diagnostics alarms (Page 49).

Note

Cyclic reading of I&M data

Cyclic reading of I&M data can affect the timing of the F-modules. You should therefore avoid short read cycles of less than 500 ms.


Accessories

The following accessory must be ordered separately:

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

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

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

 WARNING
Unintentional activation of F-I/O with fail-safe outputs
<p>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 put the F-system in a dangerous state.</p> <p>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.</p> <p>One possibility is the shutdown of the power supply of the passivated F-I/O within a time period of 100 hours, for example.</p> <p>The required measures are standardized for plants with product standards.</p> <p>For all other plants, the plant operator must create a concept for the required measures and have it approved by the inspector.</p>

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.

Connecting

3.1 Wiring and block diagram

This section provides the block diagram of the F-DQ 8x24VDC/0.5A PP HF F-module with the terminal assignment.

You can find information about the various connection options and their configuration in the section Applications of the F-I/O module (Page 32) or Parameters/address space (Page 19).

You can find more information about wiring the BaseUnit in the ET 200SP Distributed I/O System (<https://support.industry.siemens.com/cs/ww/en/view/58649293>) system manual.

Note

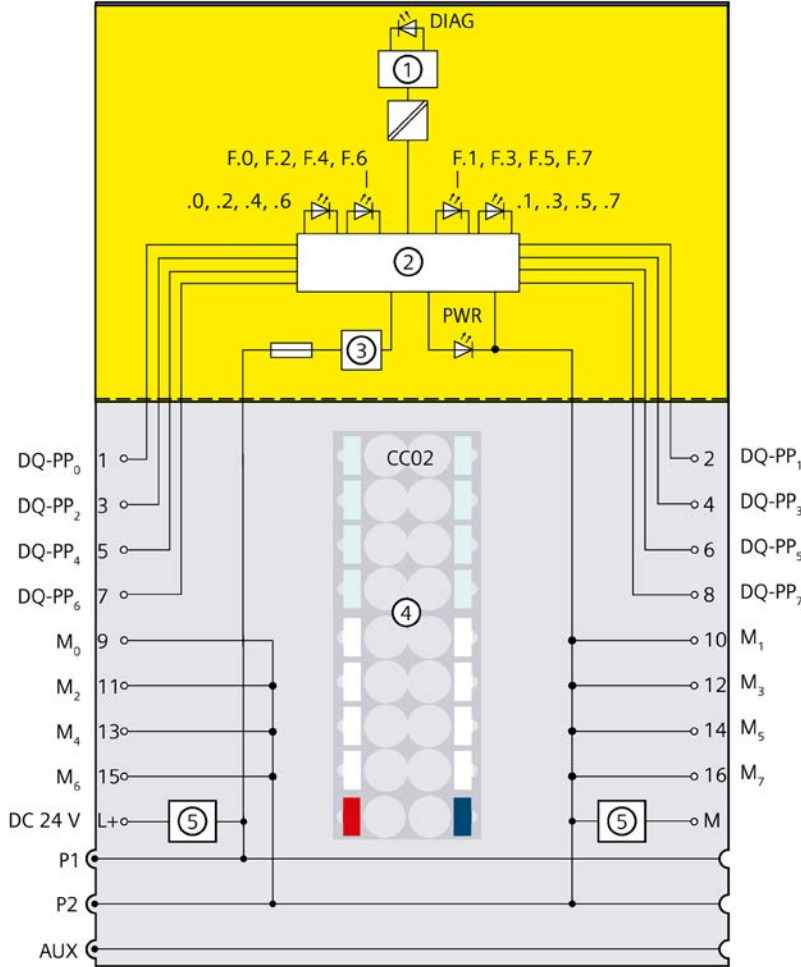
The load group of the F-module must begin with a light-colored BaseUnit. Keep this in mind as well during configuration.

Note

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

Block diagram

The following figure shows the terminal assignment of the F-DQ 8x24VDC/0.5A PP HF digital output module on BaseUnit BU type A0.



①	Backplane bus interface	M _n	Ground for connection of actuator of channel n.
②	Output 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-PP _n	Output bit n, channel n, PP-switching (sourcing output)
④	Color-coded label with color code CC02 (optional)	DIAG	LED error of diagnostics (green, red)
⑤	Filter circuit supply voltage (available in light-colored BaseUnit only)	.0 to .7	LED channel status (green)
24 VDC	Supply voltage L+ (feed for light-colored BaseUnit only)	F.0 to F.7	LED channel error (red)
M	Supply voltage ground	PWR	LED Power (green)

Figure 3-1 Block diagram

Parameters/address space

4.1 Parameters

Parameters for F-DQ 8x24VDC/0.5A PP HF

! WARNING

Diagnostics functions should be activated or deactivated in accordance with the application, see section Applications of the F-I/O module (Page 32).

The following parameters are possible:

Table 4- 1 Configurable parameters

Parameters	Value range	Default	Parameter reassignment in RUN	Scope
F-parameters:				
Manual assignment of F-monitoring time	<ul style="list-style-type: none"> Disable Enable 	Disable	No	Module
F-monitoring time	1 to 65535 ms	150 ms	No	Module
F-source address	1 to 65534	Dependent on parameter assignment of the F-CPU	No	Module
F-destination address	1 to 65534	Suggested by F-system	No	Module
F-parameter signature (without addresses)	0 to 65535	Calculated by F-system	No	Module
Behavior after channel faults	<ul style="list-style-type: none"> Passivate the entire module Passivate channel 	Passivate channel	No	Module
Reintegration after channel fault	<ul style="list-style-type: none"> Adjustable All channels automatically All channels manually 	(S7-300/400) Adjustable (S7-1200/1500) All channels manually	No	Module
F-I/O DB manual number assignment	<ul style="list-style-type: none"> Disable Enable 	Disable	No	Module
F-I/O DB number	—	Suggested by F-system	No	Module
F-I/O DB name	—	Suggested by F-system	No	Module
DQ parameters:				

4.1 Parameters

Parameters	Value range	Default	Parameter reassignment in RUN	Scope
Maximum test period	<ul style="list-style-type: none"> 100 s 1000 s 	1000 s	No	Module
Disable dark test for 48 hours	<ul style="list-style-type: none"> Disable Enable 	Disable	No	Module
Channel parameters:				
Channel n				
Activated	<ul style="list-style-type: none"> Enable 	Enable	No	Channel
Max. readback time light test / dark test	<ul style="list-style-type: none"> 0.8 / 1.0 ms 3.0 / 5.0 ms 	0.8 / 1.0 ms	No	Channel
Activated light test	<ul style="list-style-type: none"> Enable 	Enable	No	Channel
Channel failure acknowledge	<ul style="list-style-type: none"> Manual Automatic <p>The value range offered depends on the F-CPU in use and on the configuration of the F-parameter "Reintegration after channel fault".</p>	(S7-300/400) Parameter is not supported (S7-1200/1500) Manual	No	Channel

4.2 Explanation of parameters

4.2.1 F-parameters

4.2.1.1 F-parameters

You must assign the PROFIsafe address (F-destination address together with F-source address) to the F-module before you put it into operation.

- You define the F-source address with the "Central F-source address" parameter in the F-CPU.
- An F-destination address unique throughout the CPU is automatically assigned for each F-module. You can manually change the F-destination addresses assigned in the hardware configuration.

You can find information on F-parameters for the F-monitoring time, the PROFIsafe address assignment (F-source address, F-destination address) and the F I/O DB 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>)

4.2.1.2 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"

4.2 Explanation of parameters

4.2.1.3 Reintegration after channel fault

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

Use in 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 in S7-1500 F-CPUs

When using the fail-safe module in S7-1500 F-CPUs, you set this parameter in the STEP 7 dialog of the fail-safe 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.

4.2.2 Parameters of the channels

4.2.2.1 Maximum test period

With this parameter, you specify the time within which the light, dark 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 period is reduced to 60 seconds.


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

4.2.2.2 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. 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.

 WARNING
When you use the function "Disable dark test for 48 hours", 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.

When you activate the parameter "Disable dark test for 48 hours", all channels use the values set for channel 0 for the parameter "Max. readback time light test / dark test".

4.2.2.3 Activated

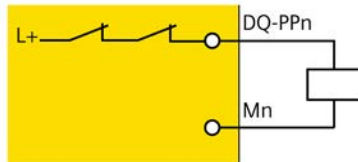
The channel is always activated for this F-module.

4.2.2.4 Max. readback time dark test

Function

Dark tests are shutdown tests with bit pattern test.

For a dark test, a test signal is switched to the output channel while the output channel has the 1-signal. 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 4-1 Functional principle of the dark test (PP switching)

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

If the expected signals could not be read back correctly after expiration of the readback time dark 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 maximum readback time for the dark test increases the reaction time of the F-module.

! WARNING

Through the configured dark test time, short-circuits (cross-circuits) to a signal with a frequency greater than $1/(2 \times \text{configured dark test time})$ Hz cannot be recognized (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 readback time dark test

Because the fault reaction time is extended by the length of the readback time dark test, we recommend that you only use the large readback time dark test if the output channel would be passivated with the small readback time.

In case of the "Connecting a load per digital output" (Page 33) application, see the warnings and notes in the section describing the application.

To determine the readback time required for your actuator, refer to the diagram in the section Switching capacitive loads (Page 60).

Setting readback time dark test with unknown actuator capacity

If the capacity of the actuator is not known, it may be necessary for you to set the larger readback time. This may also be necessary due to component variation in the actuator or external influences.

Proceed as follows:

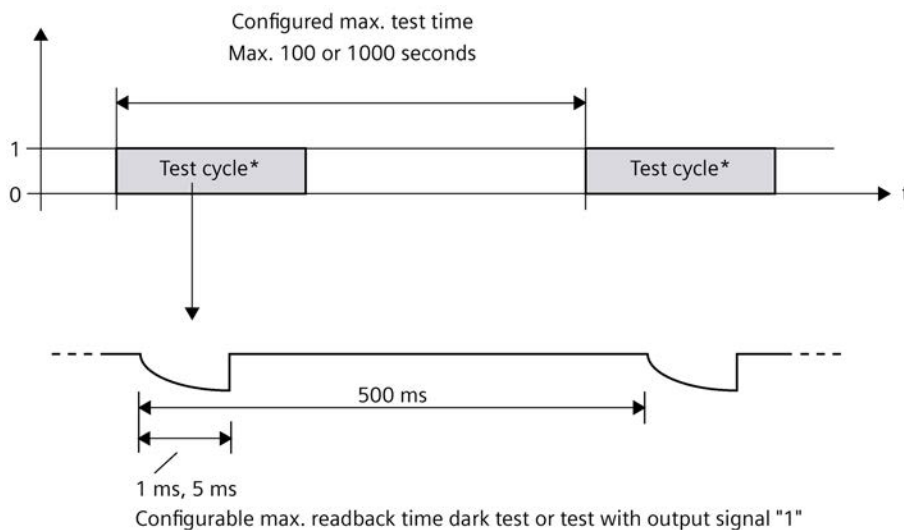
- Set the readback time dark test so that the output channel can be read back correctly but your actuator does not respond yet.
- For verification use a 1-signal with a minimum duration that corresponds to the "Maximum test period".
- If the output channel is passivated sporadically, set a higher value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

If you have set the readback time dark test 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.

Test pulses of the dark test

The interval between two test pulses is 500 ms.



* Output of test pulses only during test cycle.

Figure 4-2 Test pulses of the dark test

Note

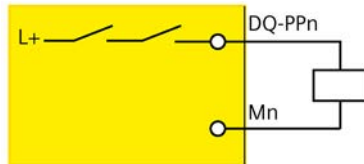
If the dark test detects an error, the affected channel is switched off with the error message "Short circuit to L+", all the other channels with the error message "Safety-related shutoff".

4.2.2.5 Max. readback time light test

Function

Short-circuit is detected with a 0-signal at the output.

For a light test, a test signal is switched to the output channel while the output channel has the 0-signal. 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.



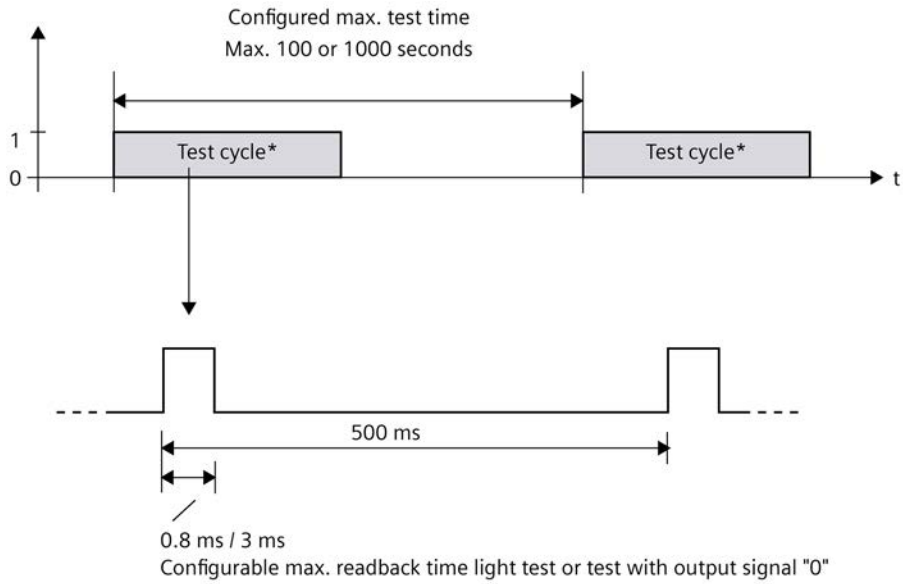
① Readback

Figure 4-3 Functional principle of the light test

If the signal was not read back correctly once the maximum readback time light test has expired, 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 light test for the light test increases the reaction time of the F-module.

Test pulses of the light test



* Output of test pulses only during test cycle.

Figure 4-4 Test pulses of the light test

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

If a light pulse returns a fault, the same light pulse (which means the same bit pattern) is repeated once after 500 ms. If the fault is still present, the maximum test period is automatically reduced to 60 seconds and a diagnostics alarm is generated. If the fault is no longer present, the output channel is reintegrated after the next fault-free test cycle.

4.2.2.6 Activated light test

The light test is always enabled for this F-module.

4.2.2.7 Channel failure acknowledge

Use on S7-1200/1500 F-CPU

This parameter is only relevant if the fail-safe module is operated on an S7-1500 F-CPU, and 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 should react to a channel fault:

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

Use in S7-300/400 F-CPU

The value of this parameter is not relevant in the case of operation on S7-300/400 F-CPU. There 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.

4.3 Address space

Address assignment of the digital output module F-DQ 8x24VDC/0.5A PP HF

The digital output module F-DQ 8x24VDC/0.5A PP HF occupies the following address areas in the F-CPU:

Table 4-2 Address assignment in the F-CPU

Occupied bytes in the F-CPU:		
F-CPU	In input range	In output range
S7-300/400 F-CPU's	IB x + 0 to x + 4	QB x + 0 to x + 4
S7-1200/1500 F-CPU's	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 8x24VDC/0.5A PP 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 8x24VDC/0.5A PP HF:

Table 4-3 Address assignment of user data in the input range

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 ₇	Value status DQ ₆	Value status DQ ₅	Value status DQ ₄	Value status DQ ₃	Value status DQ ₂	Value status DQ ₁	Value status DQ ₀

x = Module start address

Table 4-4 Address assignment of user data in the output range

Byte in the F-CPU	Assigned bits in F-CPU per F-module:							
	7	6	5	4	3	2	1	0
QB x + 0	DQ ₇	DQ ₆	DQ ₅	DQ ₄	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

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

See also

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

Applications of the F-I/O module

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

You carry out the wiring on the appropriate BaseUnit. For more on this, see Connecting section in the system manual Distributed I/O System ET 200SP (<https://support.industry.siemens.com/cs/ww/en/view/58649293>).

5.1 Installation of the ground line between the power supply and the BaseUnit

Interconnection	Achievable fail-safe performance characteristics	
	Single ground line	Redundant ground line
Connection of the load to the M _n terminal of the BaseUnit	SIL3/Cat.4/PLe	Not required
Connection of the load to the ground of the BaseUnit	SIL3/Cat.3/PLd	SIL3/Cat.4/PLe

In case of redundant installation of the ground line between the power supply and the BaseUnits, the ground connection to the BaseUnits must be installed as follows:

- When the fail-safe digital output module F-DQ 8x24VDC/0.5A PP HF is installed on a dark-colored BaseUnit, terminal M of this dark-colored BaseUnit must be additionally connected to the ground of the power supply.
- When the fail-safe digital output module F-DQ 8x24VDC/0.5A PP HF is installed on a light-colored BaseUnit, terminal M of the dark-colored BaseUnit installed to the right of the light-colored BaseUnit must be additionally connected to the ground of the power supply.

WARNING

When connecting the load to the ground of the power supply, you must run two ground lines between the power supply and the BaseUnits for safety reasons to achieve SIL3/Cat.4/PLe. Otherwise, the maximum residual current at signal "0" (specified in the technical specifications) cannot be maintained if a single ground line is interrupted.

See also

Connecting (Page 17)

5.2 Application: Wiring a load to each digital output

Each of the 8 fail-safe digital outputs consists of two P-switches, which form a PP-switch DQ-PP_n. You connect the load between the sourcing output DQ-PP_n and ground. The ground may be the internal ground M_n or an external ground. The two P-switches are always activated so that voltage is applied to the load. This circuit achieves SIL3/Cat.4/PLe.

To achieve SIL3/Cat.4/PLe see section Installation of the ground line between the power supply and the BaseUnit (Page 32).

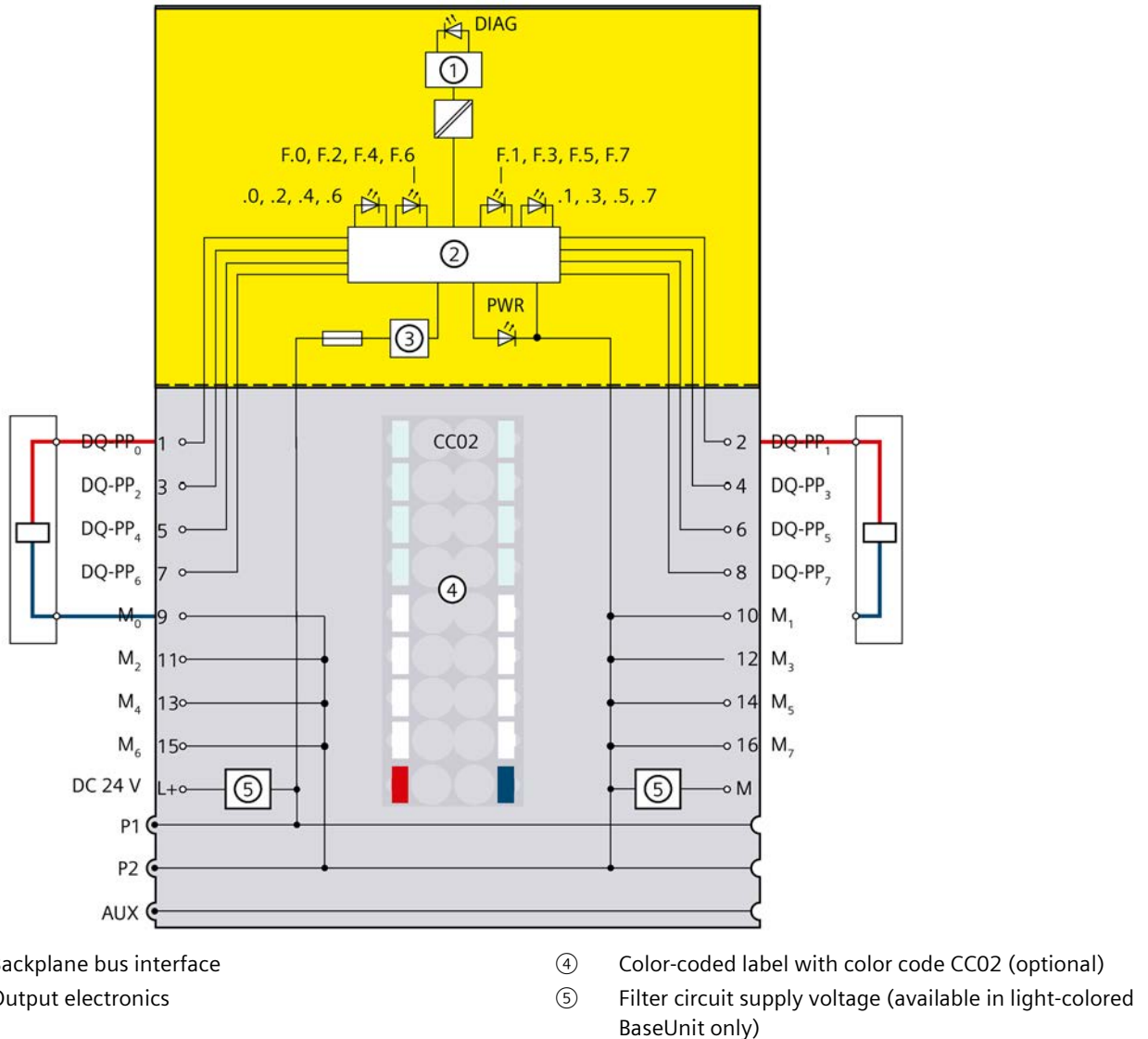


Figure 5-1 Wiring diagram for one relay each to a F-DQ of the digital output module F-DQ 8x24VDC/0.5A PP HF

 **WARNING**

In order to achieve SIL3/Cat.4/PLe with this wiring, a suitably-qualified actuator, e.g. in accordance with IEC 60947, is required.

 **WARNING**

The actuator can no longer be shut down if a cross circuit has developed between positive potential (e.g. L+) and DQ-PP_n. To prevent cross-circuits between positive potential (e.g. L+) and DQ-PP_n, you must route the lines used to connect the actuators in a cross-circuit-proof manner (for example, as separate, sheathed cables or in separate cable ducts).

 **WARNING**

If there is a cross-circuit to another output at a non-passivated, switched off output, a brief 1-signal can occur with a duration of $2 \times \text{max. cycle time } (T_{\text{cycle}}) + \text{Max. readback time dark test } (T_{\text{rb}})$.

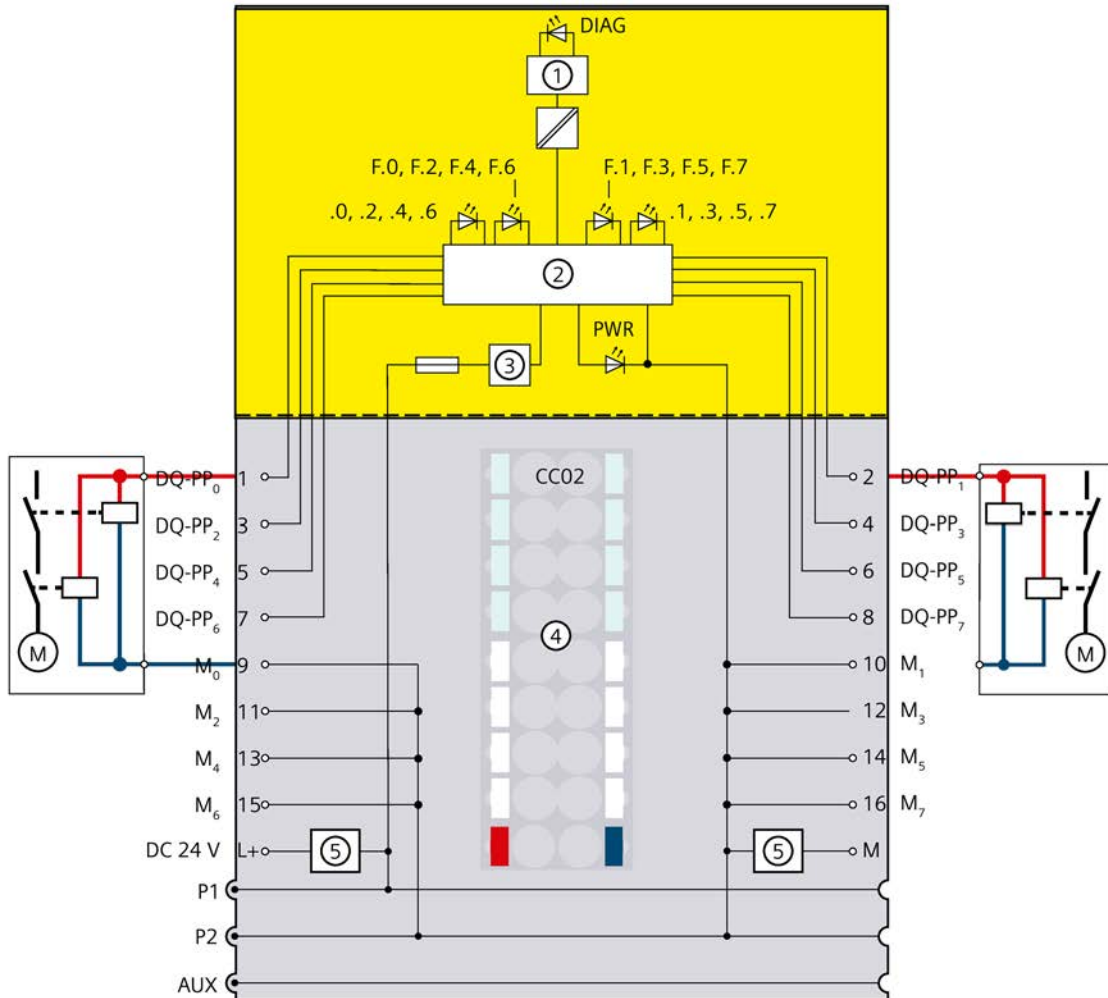
If there is a cross-circuit between two outputs, the test pulses of light tests of the respective other output are also visible. With a different setting of the "Max. readback time light test" parameter, this can cause cyclically occurring 1-signals that last as long as the longest configured "Max. readback time light test".

If the above mentioned 1-signals dangerously affect the plant when a cross-circuit occurs between outputs, you need to guard against the cross-circuits between the outputs with a cross-circuit-proof installation, for example, with separate sheathed cables or separate cable ducts.

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

The ground may be the internal ground M_n or an external ground. This circuit achieves SIL3/Cat.4/PLe.

To achieve SIL3/Cat.4/PLe see section Installation of the ground line between the power supply and the BaseUnit (Page 32).



- ① Backplane bus interface
- ② Output electronics
- ③ Reverse polarity protection
- ④ Color-coded label with color code CC02 (optional)
- ⑤ Filter circuit supply voltage (available in light-colored BaseUnit only)

Figure 5-2 Wiring diagram for two relays in parallel to a F-DQ of the digital output module F-DQ 8x24VDC/0.5A PP HF

 **WARNING**

The actuator can no longer be shut down if a cross circuit has developed between positive potential (e.g. L+) and DQ-PP_n. To prevent cross-circuits between positive potential (e.g. L+) and DQ-PP_n, you must route the lines used to connect the actuators in a cross-circuit-proof manner (for example, as separate, sheathed cables or in separate cable ducts).

 **WARNING**

If there is a cross-circuit to another output at a non-passivated, switched off output, a brief 1-signal can occur with a duration of $2 \times \text{max. cycle time } (T_{\text{cycle}}) + \text{Max. readback time dark test } (T_{\text{rb}})$.

If there is a cross-circuit between two outputs, the test pulses of light tests of the respective other output are also visible. With a different setting of the "Max. readback time light test" parameter, this can cause cyclically occurring 1-signals that last as long as the longest configured "Max. readback time light test".

If the above mentioned 1-signals dangerously affect the plant when a cross-circuit occurs between outputs, you need to guard against the cross-circuits between the outputs with a cross-circuit-proof installation, for example, with separate sheathed cables or separate cable ducts.

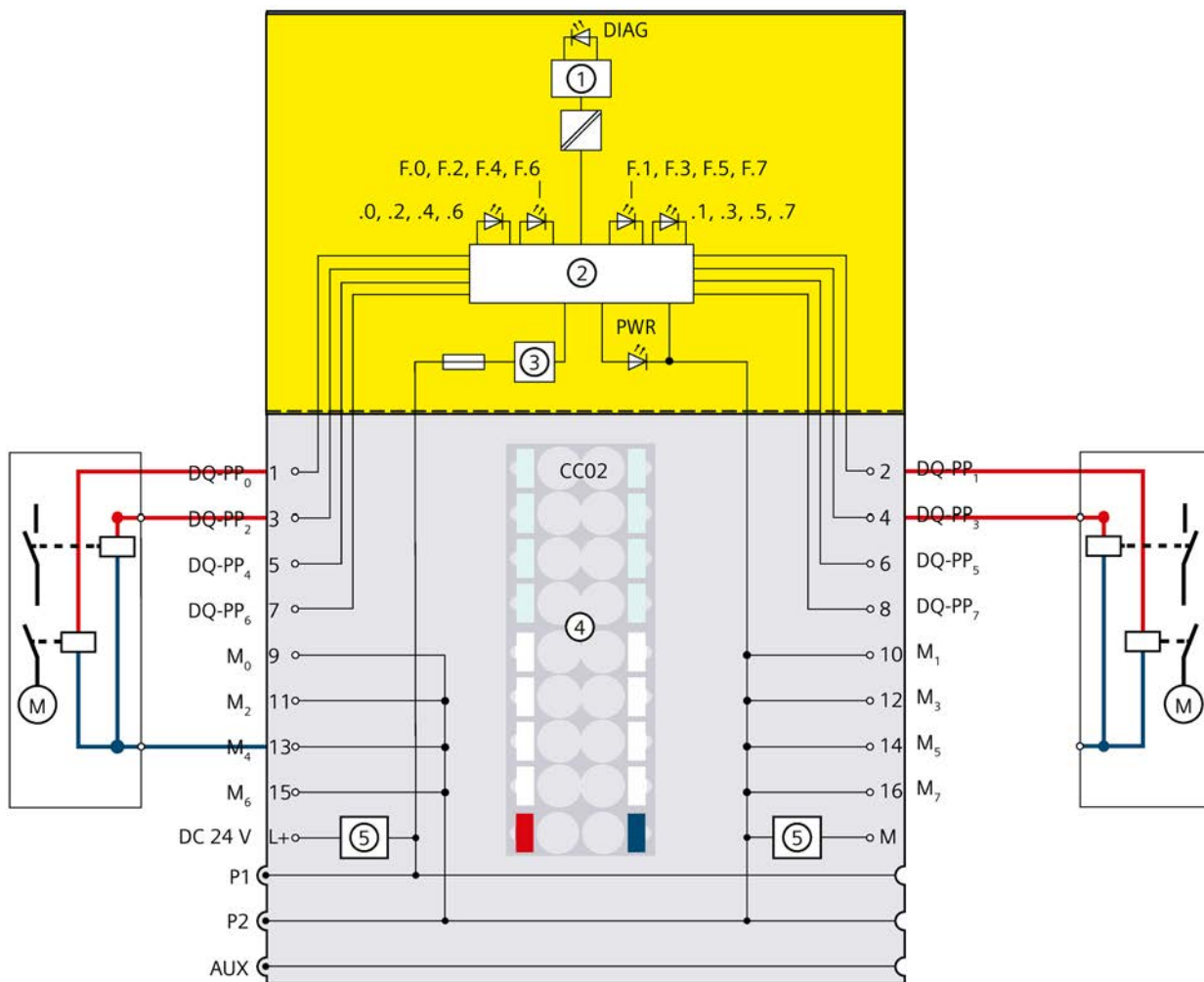
5.4 Application: Two-channel actuator connection via 2 digital outputs

Electronic outputs

Safety-related electronic outputs are always implemented internally using two channels. As a result, each of these outputs can be used for applications up to SIL3 according to EN 62061 or Cat.4/PLe according to EN ISO 13849-1. The two outputs must have an identical configuration and be controlled simultaneously. Passivation must take place module-wide.

The ground may be the internal ground M_n or an external ground. This circuit achieves SIL3/Cat.4/PLe. To achieve SIL3/Cat.4/PLe, see section Installation of the ground line between the power supply and the BaseUnit (Page 32).

5.4 Application: Two-channel actuator connection via 2 digital outputs



- ① Backplane bus interface
- ② Output electronics
- ③ Reverse polarity protection
- ④ Color-coded label with color code CC02 (optional)
- ⑤ Filter circuit supply voltage (available in light-colored BaseUnit only)

Figure 5-3 Wiring diagram for two relays in parallel to two F-DQs of the digital output module F-DQ 8x24VDC/0.5A PP HF

⚠ WARNING

In order to achieve SIL3/Cat.4/PLe with this wiring, a suitably-qualified actuator, e.g. in accordance with IEC 60947, is required.

5.5 Application: Connection of a fail-safe digital input to each digital output

Each of the 8 fail-safe digital outputs can be connected to a fail-safe digital input of the type 1, 2 or 3 in accordance with IEC61131-2.

In this application, the input delay of the fail-safe digital input must be set so that the light test and the dark test of the fail-safe digital output do not impair the fail-safe digital input.

You can achieve SIL3/Cat.4/PLe with this circuit.

⚠ WARNING
To achieve SIL3/Cat.4/PLe using this wiring, you must use a suitably qualified fail-safe digital input, e.g. ET 200SP F-DI 8x24VDC HF.

Input without ground return

To achieve SIL3/Cat.4/PLe see section Installation of the ground line between the power supply and the BaseUnit (Page 32).

If the fail-safe digital output module F-DQ 8x24VDC/0.5A PP HF and the fail-safe digital input module are supplied by different power supply units, the grounds of the two power supply units must be connected to each other.

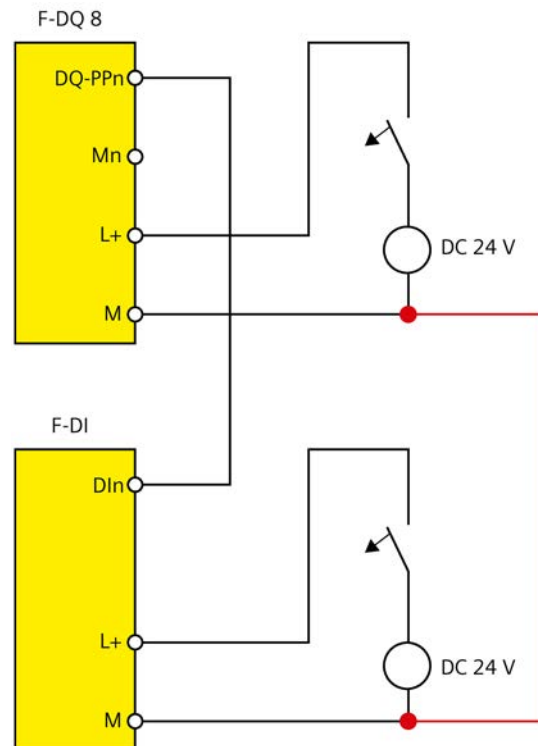


Figure 5-4 Wiring diagram of an output of the digital output module F-DQ 8x24VDC/0.5A PP HF with an input of a fail-safe digital input module (without ground return).

 **WARNING**

To avoid an impermissible process value at the fail-safe digital input, the wiring must be installed so that an interruption of the connection between the ground of the fail-safe digital output module and the ground of the fail-safe digital input module can be excluded (e.g. redundant lines).

 **WARNING**

In case of a cross-circuit between a positive potential (e.g. L+) and DQ-PP_n, a 1-signal is permanently present at the fail-safe digital input. To prevent cross-circuits between positive potential (e.g. L+) and DQ-PP_n, you must route the lines used to connect the fail-safe digital inputs in a cross-circuit-proof manner, for example, as separate, sheathed cables or in separate cable ducts.

 **WARNING**

If there is a cross-circuit to another output at a non-passivated, switched off output, a brief 1-signal can occur with a duration of $2 \times \text{max. cycle time } (T_{\text{cycle}}) + \text{Max. readback time dark test } (T_{\text{rb}})$.

If there is a cross-circuit between two outputs, the test pulses of light tests of the respective other output are also visible. With a different setting of the "Max. readback time light test" parameter, this can cause cyclically occurring 1-signals that last as long as the longest configured "Max. readback time light test".

If the above mentioned 1-signals dangerously affect the plant when a cross-circuit occurs between outputs, you need to guard against the cross-circuits between the outputs with a cross-circuit-proof installation, for example, with separate sheathed cables or separate cable ducts.

Input with ground return

To achieve SIL3/Cat.4/PLe see section Installation of the ground line between the power supply and the BaseUnit (Page 32).

In this application for potential-free, fail-safe digital inputs, the connection DI_{n-} of the fail-safe digital input is returned to the internal ground M_n of the fail-safe digital output module.

5.5 Application: Connection of a fail-safe digital input to each digital output

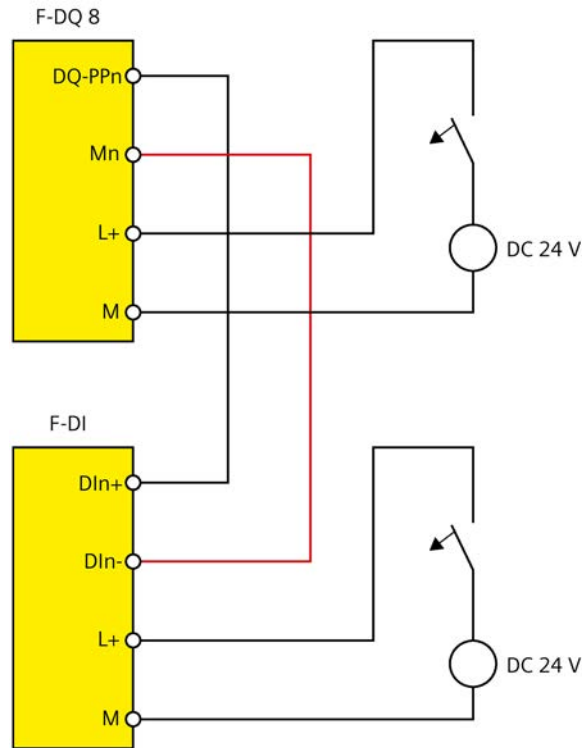


Figure 5-5 Wiring diagram of an output of the digital output module F-DQ 8x24VDC/0.5A PP HF with an input of a fail-safe digital input module (with ground return).

! WARNING

In case of a cross-circuit between a positive potential (e.g. L+) and DQ-PP_n, a 1-signal is permanently present at the fail-safe digital input. To prevent cross-circuits between positive potential (e.g. L+) and DQ-PP_n, you must route the lines used to connect the fail-safe digital inputs in a cross-circuit-proof manner, for example, as separate, sheathed cables or in separate cable ducts.

! WARNING

If there is a cross-circuit to another output at a non-passivated, switched off output, a brief 1-signal can occur with a duration of $2 \times \text{max. cycle time } (T_{\text{cycle}}) + \text{Max. readback time dark test } (T_{\text{rb}})$.

If there is a cross-circuit between two outputs, the test pulses of light tests of the respective other output are also visible. With a different setting of the "Max. readback time light test" parameter, this can cause cyclically occurring 1-signals that last as long as the longest configured "Max. readback time light test".

If the above mentioned 1-signals dangerously affect the plant when a cross-circuit occurs between outputs, you need to guard against the cross-circuits between the outputs with a cross-circuit-proof installation, for example, with separate sheathed cables or separate cable ducts.

5.6 Application: Connection of the ET 200SP digital output module F-RQ 1x24VDC/24..230VAC/5A (6ES7136-6RA00-0BF0)

You can use any of the 8 fail-safe digital outputs to actuate one or more digital output modules F-RQ 1x24VDC/24..230VAC/5A.

Pay attention to the permitted current for the corresponding output channel and the total current over all outputs at the corresponding ambient temperature.

To achieve SIL3/Cat.4/PLe see section Installation of the ground line between the power supply and the BaseUnit (Page 32).

For operation of the digital output module F-RQ 1x24VDC/24..230VAC/5A as of FS 04, use of the following readback times is required: Channel parameter Max. readback time light test/dark test with the default value "0.8 / 1.0 ms".

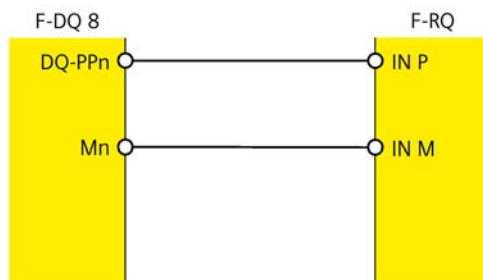


Figure 5-6 Wiring diagram

Note

The output signals "OUT P, OUT M" of the digital output module F-RQ 1x24VDC/24..230VAC/5A are looped through from "IN P, IN M" and should therefore be considered like the output signals of the F-DQ 8x24VDC/0.5A PP HF "DQ-PP_n, M_n". For this reason, please observe the wiring rules for the F-DQ 8x24VDC/0.5A PP HF.

WARNING

The digital output module F-RQ 1x24VDC/24..230VAC/5A can no longer be shut down if a cross circuit has developed between positive potential (e.g. L+) and DQ-PP_n. To prevent cross-circuits between positive potential (e.g. L+) and DQ-PP_n, you must route the lines used to connect the digital output modules F-RQ 1x24VDC/24..230VAC/5A in a cross-circuit-proof manner, e.g. as separate, sheathed cables or in separate cable ducts.

! WARNING

If there is a cross-circuit to another output at a non-passivated, switched off output, a brief 1-signal can occur with a duration of $2 \times \text{max. cycle time } (T_{\text{cycle}}) + \text{Max. readback time dark test } (T_{\text{rb}})$.

If there is a cross-circuit between two outputs, the test pulses of light tests of the respective other output are also visible. With a different setting of the "Max. readback time light test" parameter, this can cause cyclically occurring 1-signals that last as long as the longest configured "Max. readback time light test".

If the above mentioned 1-signals dangerously affect the plant when a cross-circuit occurs between outputs, you need to guard against the cross-circuits between the outputs with a cross-circuit-proof installation, for example, with separate sheathed cables or separate cable ducts.

Interrupts/diagnostic messages

6.1 Status and error display

LED display

The following figure shows the LED display of the F-DQ 8x24VDC/0.5A PP HF.

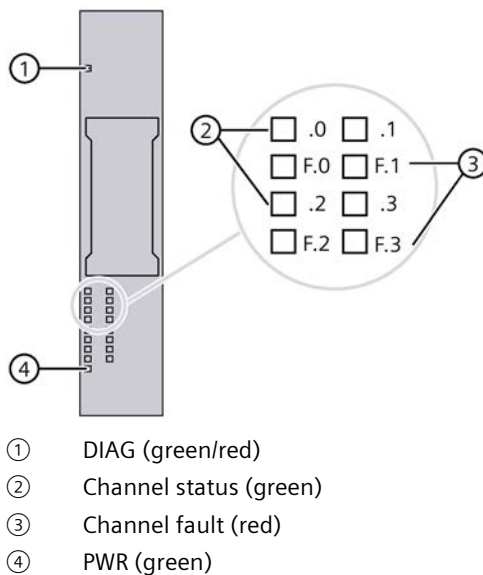



Figure 6-1 LED display






Meaning of the LED displays

The following tables show the meaning of the status and error displays. You can find solutions for diagnostics alarms in section Diagnostics alarms (Page 49).

 WARNING
<p>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.</p>


DIAG LED

Table 6- 1 Error display of the LED DIAG

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	<ul style="list-style-type: none"> Module parameters configured and module diagnostics Operation in S7-1200/1500 F-CPU: At least one channel is waiting for user acknowledgment.
 Flashing	<ul style="list-style-type: none"> Operation in S7-1200/1500 F-CPU: The F-module expects user acknowledgment after a module error. Operation in S7-300/400 F-CPU: The F-module is waiting for user acknowledgment.

Channel status/channel fault LED

Table 6- 2 Status display of the LEDs channel status / channel error

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		<ul style="list-style-type: none"> • Operation in S7-1200/1500 F-CPUs: At least one channel is waiting for user acknowledgment. • Operation in S7-300/400 F-CPUs: At least one channel is waiting for user acknowledgment.

Channel status/DIAG/channel fault LED

Table 6- 3 Status display of the LEDs channel status / DIAG / channel error

Channel status	DIAG	Channel fault	Meaning
□ Off	■ Flash- ing	■ All On	The PROFIsafe address does not match the configured PROFIsafe address or there is a module fault. See section Interrupts (Page 47).
■ Flashing	■ Flash- ing	□ Off	Identification of the F-module when assigning the PROFIsafe address

PWR LED

Table 6- 4 Status display of LED PWR

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

6.2 Interrupts

Introduction

The fail-safe digital output module F-DQ 8x24VDC/0.5A PP HF supports diagnostic interrupts.

Diagnostic interrupts

The F-module generates a diagnostic interrupt for each diagnostics alarm described in section Diagnostics alarms (Page 49).

The list 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 diagnostics message, correct the respective fault and validate your safety function. In this case, follow the steps described in section Diagnostics alarms (Page 49).

Module-wide diagnostic interrupts

- Overtemperature
- Error
- Parameter error
- Supply voltage missing
- Safety-related shutoff
- Channel/component temporarily unavailable
- 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 incorrectly
- CRC1 fault
- Save iParameter watchdog time exceeded
- Restore iParameter watchdog time exceeded
- Inconsistent iParameters (iParCRC error)
- F_Block_ID not supported
- Transmission error: Inconsistent data (CRC error)

6.2 Interrupts

- Transmission error: Timeout (watchdog time 1 or 2 expired)
- Module is defective
- Watchdog tripped
- Invalid/inconsistent firmware present
- F-address memory not accessible
- Undertemperature
- Supply voltage too high
- Supply voltage too low

Channel-wide diagnostic interrupts

- Short-circuit to L+
- Short-circuit to ground
- Channel failure acknowledgment
- Frequency too high

6.3 Diagnostics alarms

Diagnostics alarms

A diagnostics alarm is generated for each diagnostics event and the F-module flashes the DIAG LED. You can read out the diagnostics alarm, for example, from the diagnostics buffer of the F-CPU. You can evaluate the error codes using the user program.

Note

You can connect several actuators per output.

If several actuators are connected to an output, the diagnostics of each actuator affects the other ones.

In other words, a single short-circuit affects multiple 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.

Table 6- 5 Diagnostics alarms, their meaning and possible remedies

Diagnostics alarm	Fault code	Meaning	Solution
Overtemperature	5H	An excessively high temperature was measured in the F-module.	Operate the F-module within the specified temperature range (see Technical specifications (Page 54)) Once the temperature has been reduced and returns to the specified range, the F-module must be removed and inserted or the power switched OFF and ON.
Parameter error	10H	Parameter assignment errors include: <ul style="list-style-type: none"> 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	11H	Missing or insufficient supply voltage L+	<ul style="list-style-type: none"> Operate the F-module within the specified supply voltage range. Check BaseUnit type
Safety-related shutoff	19H	For safety purposes, channel was switched off due to an error on another channel. Possible causes: <ul style="list-style-type: none"> A short-circuit exists. The capacitive load is too high. 	<ul style="list-style-type: none"> Correct the process wiring. Increase the test times (dark, light).

6.3 Diagnostics alarms

Diagnostics alarm	Fault code	Meaning	Solution
Channel/component temporarily unavailable	1FH	The firmware version of the F-module is inconsistent.	Repeat the firmware update.
Mismatch of safety destination address (F_Dest_Add)	40H	The firmware of the F-module has detected a different F-destination address.	<ul style="list-style-type: none"> Check the parameter assignment of the PROFIsafe driver and the PROFIsafe address assigned to the F-module. Assign the PROFIsafe address to the F-module (again).
Safety destination address not valid (F_Dest_Add)	41H	The firmware of the F-module has detected an illegal different F-destination address.	Check the configuration/parameter assignment of the iPar server.
Safety source address not valid (F_Source_Add)	42H	The firmware of the F-module has detected a different F-source address.	
Safety watchdog time value is 0 ms (F_WD_Time)	43H	The firmware of the F-module has detected an invalid watchdog time.	
Parameter F_SIL exceeds SIL from specific device application	44H	The firmware of the F-module has detected a discrepancy between the SIL setting of the communication and the application.	
Parameter F_CRC_Length does not match the generated values	45H	The firmware of the F-module has detected a discrepancy in the CRC length.	
Version of F-parameter set incorrectly	46H	The firmware of the F-module has detected an incorrect F_Par_Version or an invalid F_Block_ID.	
CRC1 fault	47H	The firmware of the F-module has detected inconsistent F-parameters.	
Save iParameter watchdog time exceeded	49H	iPar server does not respond to "save iPar" within 4.4 minutes.	
Restore iParameter watchdog time exceeded	4AH	iPar server does not respond to "restore iPar" within 4.4 minutes.	Check the configuration/parameter assignment of the iPar server.
Inconsistent iParameters (iParCRC error)	4BH	The firmware of the F-module has detected inconsistent iParameters.	Check the parameter assignment.
F_Block_ID not supported	4CH	The firmware of the F-module has detected an incorrect block ID.	Check the parameter assignment of the PROFIsafe driver.
Transmission error: Inconsistent data (CRC error)	4DH	<p>The firmware of the F-module has detected a CRC error.</p> <p>Possible causes:</p> <ul style="list-style-type: none"> The communication between the F-CPU and F-module is disturbed. Impermissibly high electromagnetic interference is present. An error occurred in the sign-of-life monitoring. 	<ul style="list-style-type: none"> Check the communication connection between the F-module and F-CPU. Eliminate the electromagnetic interference. Power switched OFF and ON for station Assign the configuration and parameter assignment to the F-module (of the station).

Diagnostics alarm	Fault code	Meaning	Solution
Transmission error: Timeout (watchdog time 1 or 2 expired)	4EH	The firmware of the F-module has detected a timeout. Possible causes: <ul style="list-style-type: none"> The F-monitoring time is set incorrectly. A bus fault is present. 	<ul style="list-style-type: none"> Check the parameter assignment. Ensure that communication is functioning correctly.
Module is defective	100H	Possible causes: <ul style="list-style-type: none"> Impermissibly high electromagnetic interference is present. The F-module has detected an internal error and has reacted in a safety-related manner. Wrong BaseUnit 	<ul style="list-style-type: none"> Eliminate the interference. The module must then be pulled and plugged, or the power switched OFF and ON If the F-module cannot be put back into operation, consider replacing it. Use a BaseUnit of the type A0.
Watchdog tripped	103H	Possible causes: <ul style="list-style-type: none"> Impermissibly high electromagnetic interference is present. The F-module has detected an internal error and has reacted in a safety-related manner. 	<ul style="list-style-type: none"> Eliminate the interference. The module must then be pulled and plugged, or the power switched OFF and ON If the F-module cannot be put back into operation, consider replacing it.
Short-circuit to L+	105H	Short circuit to L+ can mean: <ul style="list-style-type: none"> The output cable is short-circuited to L+. The capacitive load between the channels is too high (for example, due to cable length or load current being too low). There is a short circuit between two output channels. You must eliminate the error within 100 hours; otherwise, the F-module is permanently passivated and an acknowledgment is no longer possible.	<ul style="list-style-type: none"> Correct the process wiring. Increase the test times (dark, light). Pay attention to the warnings in Applications of the F-I/O module (Page 32).
Short-circuit to ground	106H	Short-circuit to ground can mean: <ul style="list-style-type: none"> The output cable is short-circuited to ground. The output signal is short-circuited to ground. The capacitive load is too high. You must eliminate the error within 100 hours; otherwise, the F-module is permanently passivated and an acknowledgment is no longer possible.	<ul style="list-style-type: none"> Correct the process wiring. Increase the test times (dark, light). Check the actuator.

6.3 Diagnostics alarms

Diagnostics alarm	Fault code	Meaning	Solution
Invalid/inconsistent firmware present	11BH	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.	<ul style="list-style-type: none"> 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.
Channel failure acknowledgment	30BH	A channel fault was detected. Confirmation is required to enable the channel.	Confirm the channel fault.
F-address memory not accessible	30DH	The F-source address and F-destination address stored in the coding element cannot be accessed.	Verify that the coding element is present or replace the coding element.
Frequency too high	311H	The maximum switching frequency of the F-module has been exceeded.	Reduce the switching frequency (see Technical specifications (Page 54))
Undertemperature	312H	The minimum permissible temperature limit has been violated.	<p>Operate the F-module within the specified temperature range (see Technical specifications (Page 54))</p> <p>Once the temperature has increased and returns to the specified range, the F-module must be removed and inserted or the power switched OFF and ON.</p>
Supply voltage too high	321H	The supply voltage is too high.	Check the supply voltage and then test the safety application.
Supply voltage too low	322H	<ul style="list-style-type: none"> The supply voltage is too low. EMC, wrong BaseUnit 	Check the supply voltage and then test the safety application.

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.

A supply voltage that is too low is detected for voltages less than 17 V. A supply voltage that is too high is detected for voltages greater than 32 V.

When the voltage is then recovered (level must remain within the specified value range for at least 1 minute (see Technical specifications (Page 54): Voltages, Currents, Potentials)), the DIAG LED stops flashing. The module remains passivated.

Generally applicable information on diagnostics

Information on diagnostics that pertains to all fail-safe modules (for example, readout of diagnostics functions or passivation of channels) is available in the SIMATIC Safety – Configuring and Programming (<https://support.industry.siemens.com/cs/ww/en/view/54110126>) manual.

6.4 Value status

Properties

In addition to the diagnostics alarm and the status and error display, the F-module provides 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 affected by a short-circuit and the plausibility check.

- 1B: A valid process value is output for the channel.
- 0B: 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 30).

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

Technical specifications of F-DQ 8x24VDC/0.5A PP HF

The table below shows the technical specifications as of 12/2022. A data sheet with technical specifications updated on a daily basis can be found on the Internet (<https://support.industry.siemens.com/cs/ww/en/pv/6ES7136-6DC00-0CA0/td?dl=en>).

Article number	6ES7136-6DC00-0CA0
General information	
Product type designation	F-DQ 8x24 V DC/0.5 A PP HF
Firmware version	
<ul style="list-style-type: none"> FW update possible 	Yes
usable BaseUnits	BU type A0
Color code for module-specific color identification plate	CC02
Product function	
<ul style="list-style-type: none"> I&M data 	Yes; I&M0 to I&M3
Engineering with	
<ul style="list-style-type: none"> STEP 7 TIA Portal configurable/integrated from version 	V14 SP1 with HSP 202
<ul style="list-style-type: none"> STEP 7 configurable/integrated from version 	V5.5 SP4 HF5
<ul style="list-style-type: none"> PROFINET from GSD version/GSD revision 	V2.31
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)	75 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
Address area	
Address space per module	
<ul style="list-style-type: none"> Inputs 	6 byte; 5 bytes non-RIOforFA; 6 bytes RIOforFA
<ul style="list-style-type: none"> Outputs 	6 byte; 5 bytes non-RIOforFA; 6 bytes RIOforFA

Article number	6ES7136-6DC00-0CA0
Hardware configuration	
Automatic encoding	Yes
<ul style="list-style-type: none"> Electronic coding element type F 	Yes
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	8
Digital outputs, parameterizable	Yes
Short-circuit protection	Yes
<ul style="list-style-type: none"> Response threshold, typ. 	Min. 0.7 A
Open-circuit detection	No
Limitation of inductive shutdown voltage to	Typ. -39 V
Controlling a digital input	Yes
Switching capacity of the outputs	
<ul style="list-style-type: none"> with resistive load, max. 	0.5 A
<ul style="list-style-type: none"> on lamp load, max. 	2 W
Load resistance range	
<ul style="list-style-type: none"> lower limit 	48 Ω
<ul style="list-style-type: none"> upper limit 	12 000 Ω
Output voltage	
<ul style="list-style-type: none"> for signal "1", min. 	24 V; L+ (-0.5 V)
Output current	
<ul style="list-style-type: none"> for signal "1" rated value 	0.5 A
<ul style="list-style-type: none"> for signal "0" residual current, max. 	0.5 mA
Switching frequency	
<ul style="list-style-type: none"> with resistive load, max. 	30 Hz; Symmetrical
<ul style="list-style-type: none"> with inductive load, max. 	0.1 Hz; according to IEC 60947-5-1, DC-13, symmetrical
<ul style="list-style-type: none"> with capacitive load, max. 	2 Hz; Symmetrical
<ul style="list-style-type: none"> on lamp load, max. 	10 Hz; Symmetrical
Total current of the outputs	
<ul style="list-style-type: none"> Current per channel, max. 	0.5 A; note derating data in the manual
<ul style="list-style-type: none"> Current per module, max. 	3 A; note derating data in the manual
Total current of the outputs (per module)	
horizontal installation	
<ul style="list-style-type: none"> up to 40 °C, max. 	3 A
<ul style="list-style-type: none"> up to 50 °C, max. 	2.5 A
<ul style="list-style-type: none"> up to 60 °C, max. 	2 A
vertical installation	
<ul style="list-style-type: none"> up to 50 °C, max. 	2 A

Article number	6ES7136-6DC00-0CA0
Cable length	
• shielded, max.	100 m
• unshielded, max.	100 m
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Substitute values connectable	No
Alarms	
• Diagnostic alarm	Yes
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
Probability of failure (for service life of 20 years and repair time of 100 hours)	
– Low demand mode: PFDavg in accordance with SIL3	< 6.00E-05
– High demand/continuous mode: PFH in accordance with SIL3	< 2.00E-09 1/h
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	0 °C
• horizontal installation, max.	60 °C
• vertical installation, min.	0 °C

Article number	6ES7136-6DC00-0CA0
• vertical installation, max.	50 °C
Altitude during operation relating to sea level	
• Installation altitude above sea level, max.	4 000 m; with derating
Dimensions	
Width	15 mm
Height	73 mm
Depth	58 mm
Weights	
Weight, approx.	48 g

Dimension drawing

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

Response times

Introduction

You can find the reaction times of the F-DQ 8x24 V DC/0.5 A PP HF digital output module below. The reaction times of the F-DQ 8x24 V DC/0.5 A PP HF digital output module are included in the calculation of the F-system reaction time.

Use the SIMATIC STEP7 Reaction Time Table (<https://support.industry.siemens.com/cs/ww/en/view/93839056>) for this.

Definition of reaction time for fail-safe digital outputs

The reaction 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

- Max. cycle time: $T_{\text{cycle}} = 8 \text{ ms}$
- Max. acknowledgment time (Device Acknowledgment Time): $T_{\text{DAT}} = 16 \text{ ms}$

The maximum reaction time in the case of fault (One Fault Delay Time, OFDT) is equivalent to the maximum reaction time with no faults (Worst Case Delay Time, WCDT).

You assign the parameters for maximum readback time dark test (T_{rb}) and maximum readback time light test ($T_{\text{rb_lt}}$) in STEP 7 or the TIA Portal.

Operating mode: Disable dark test for 48 hours – disabled

Maximum reaction time with no faults (Worst Case Delay Time, WCDT)

$$t \leq 4 * T_{\text{cycle}}$$

Maximum reaction time with detection of a channel fault by readback

$$t \leq 6 * T_{\text{cycle}} + T_{\text{rb}}$$

Maximum reaction time with detection of a channel fault by bit pattern test

$$t \leq 2 * T_{\text{cycle}} + \text{maximum test period}$$

Operating mode: Disable dark test for 48 hours – enabled

Maximum reaction time with no faults (Worst Case Delay Time, WCDDT)

$$t \leq 5 * T_{\text{cycle}} + T_{\text{rb}} + T_{\text{rb_lt}}$$

Maximum reaction time with detection of a channel fault

A channel fault may not be detected until a 0-1 process value change takes place on the corresponding channel. Please note the restrictions detailed in section Disable dark test for 48 hours (Page 23)

Switching of loads

B.1 Connecting capacitive loads

If an F-DQ 8x24VDC/0.5A PP HF digital output module is interconnected with loads that have an excessive capacitance, this can lead to detection of a short-circuit. 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 current and maximum switchable load capacitance at a supply voltage of 24 V DC.

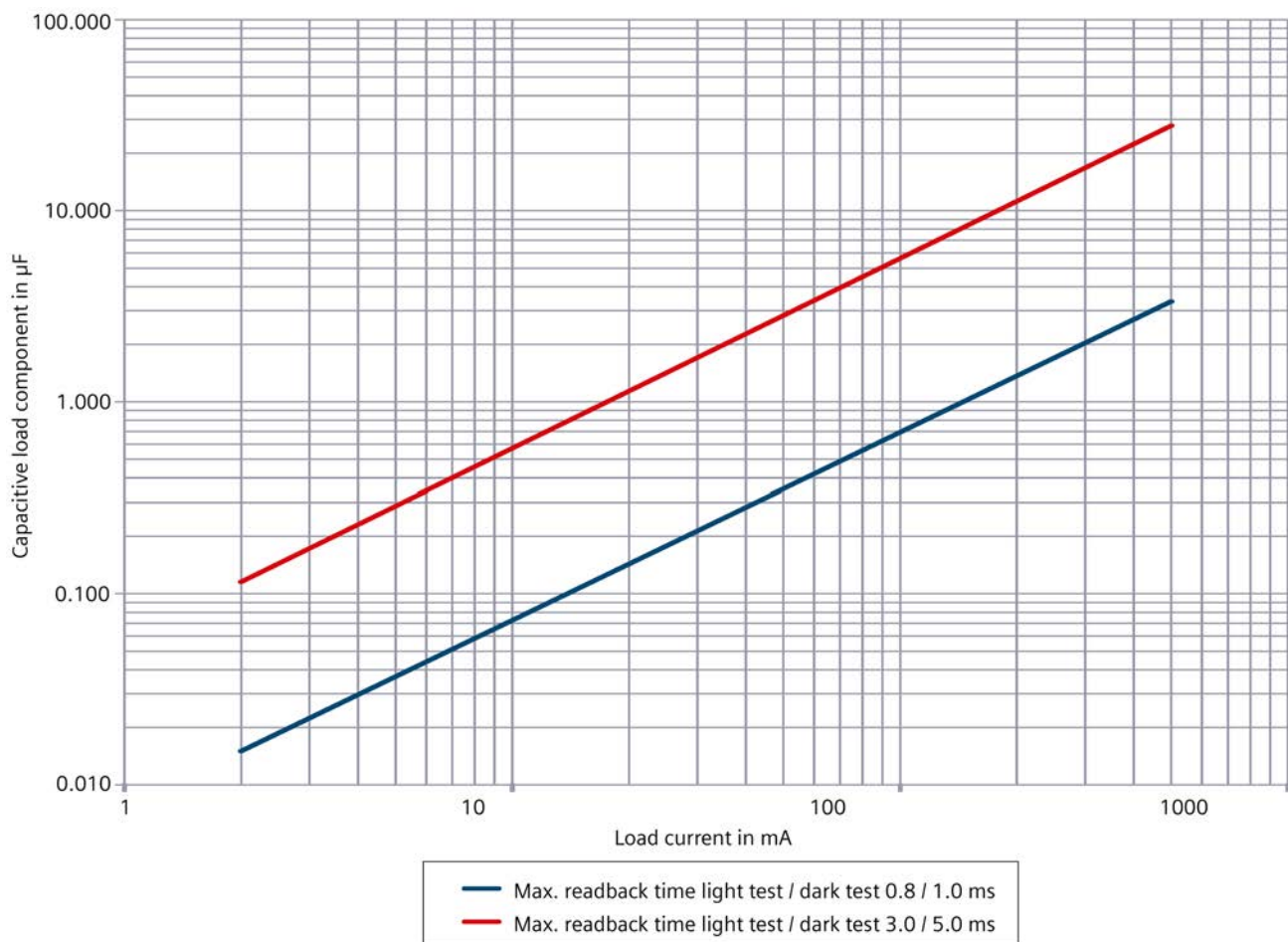


Figure B-1 Switching of capacitive loads for the F-DQ 8x24VDC/0.5A PP HF digital output module depending on the configured max. readback time light test / dark test.

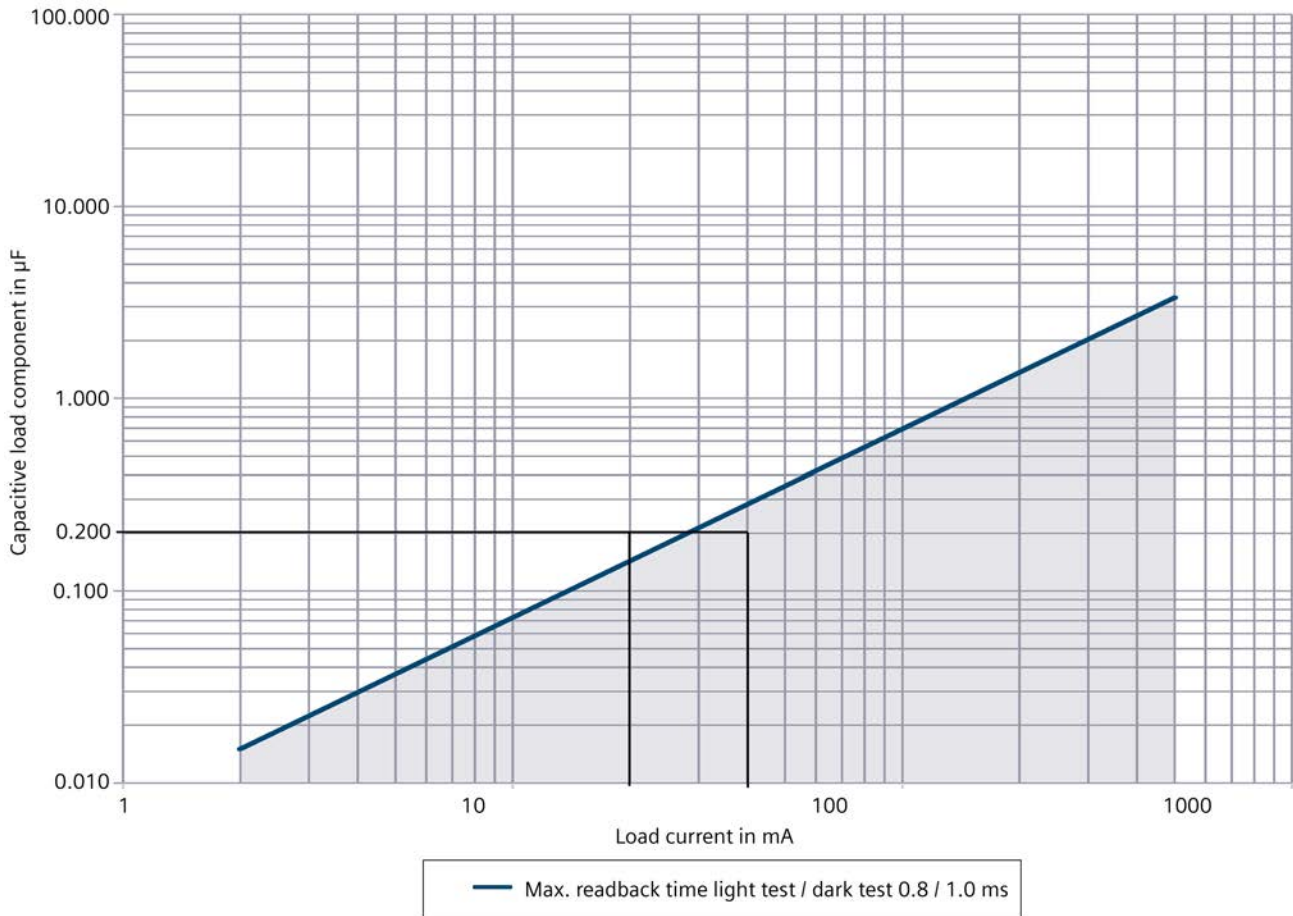
Remedy for detecting a short circuit

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 trend, select an actuator with higher current consumption so that the new operating point is below the curve.

Example

You have configured a maximum readback time light test/dark test of "0.8 / 1.0 ms". You have set the load current to 20 mA and the capacity to 0.2 μF . The operating point is thus outside the range defined by the trend (gray background).

Solution: Select an actuator with higher current consumption. In this example, 40 mA. Alternatively, you can configure the parameter "Max. readback time light test / dark test" with "3.0 / 5.0 ms".



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.

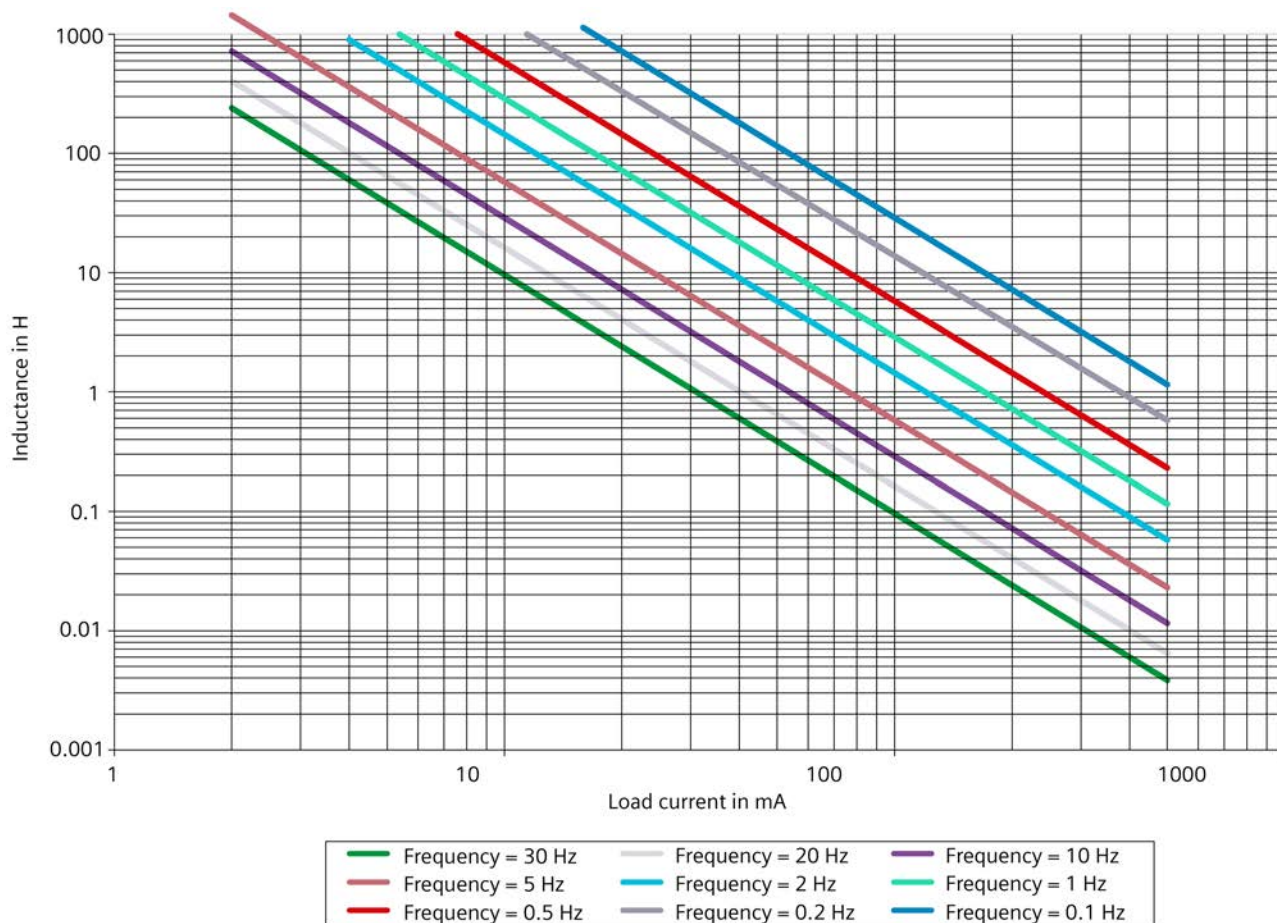


Figure B-2 Switching of inductive loads for the F-DQ 8x24VDC/0.5A PP HF digital output module depending on the load current and switching frequency