SIEMENS

SIMATIC

ET 200SP
Digital output module
F-DQ 4x24VDC/2A PM HF
(6ES7136-6DB00-0CA0)

Manual

Translation of original operating instructions

07/2013
A5E03858037-01

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.

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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 device manual complements the system manual ET 200SP distributed I/O system. General functions of the ET 200SP are described in the system manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/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.

Security information

Siemens provides automation and drive products with industrial security functions that support the secure operation of plants or machines. They are an important component in a holistic industrial security concept. With this in mind, our products undergo continuous development. We therefore recommend that you keep yourself informed with respect to our product updates. Please find further information and newsletters on this subject at: (http://support.automation.siemens.com)

To ensure the secure operation of a plant or machine it is also necessary to take suitable preventive action (e.g. cell protection concept) and to integrate the automation and drive components into a state-of-the-art holistic industrial security concept for the entire plant or machine. Any third-party products that may be in use must also be taken into account. Please find further information at: (http://www.siemens.com/industrialsecurity)

Table of contents

Documentation guide

<div style="text-align: right; font-size: 3em;">1</div>

1.1 Documentation guide for F-DQ 4x24VDC/2A PM HF digital output module

Introduction

The documentation of the SIMATIC products has a modular design and includes topics concerning your automation system.

The complete documentation of the ET 200SP system consists of different modules divided into system manuals, function manuals and manuals.

The STEP 7 (online help) information system supports you in configuring and programming your automation system.

Overview of documentation for the fail-safe digital output module F-DQ 4×24VDC/2A PM HF

The table below lists additional documents that complement this description of the fail-safe digital output module DQ 4×24VDC/2A PM HF and are available on the Internet.

Table 1- 1   Documentation for the fail-safe digital output module F-DQ 4×24VDC/2A PM HF

Topic	Documentation	Most important contents
Description of the system	System manual ET 200SP distributed I/O system (http://support.automation.siemens.com/WW/view/en/58649293)	• Application planning • Installation • Connecting • Commissioning • Approvals • TÜV certificate
BaseUnits	Manual ET 200SP BaseUnits (http://support.automation.siemens.com/WW/view/en/58532597/133300)	Technical specifications
Description of the SIMATIC Safety F-system	Programming and operating manual SIMATIC Safety - Configuring and Programming (http://support.automation.siemens.com/WW/view/en/54110126)	• Configuring • Programming • Approvals

SIMATIC manuals

The latest manuals for SIMATIC products are available on the Internet (http://www.siemens.com/automation/service&support) for free download.

Functional Safety Services

Siemens Functional Safety Services support you with a comprehensive package of services from risk assessment to verification all the way to plant commissioning and modernization. We also offer consultation on the use of fail-safe and fault-tolerant SIMATIC S7 automation systems.

You will find more detailed information on the Internet (http://www.siemens.com/safety-services).

Please send your questions to us by e-mail (mailto:safety-services.industry@siemens.com).

Product overview 2

2.1 Properties of the F-DQ 4x24VDC/2A PM HF

Order number

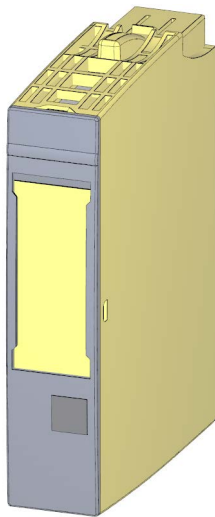6ES7136-6DB00-0CA0

View of the module

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

Properties

- Technical properties
    - Fail-safe digital module
    - 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 signal lamps
    - 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/load voltage missing, channel-specific
    - Channel-specific or passivation throughout the module
    - Direct interconnection to F-DI possible (single channel: SIL1, two-channel: SIL3)
- Supported functions
    - Firmware update
    - I&M identification data
    - PROFIsafe

⚠ **WARNING**

The fail-safe performance characteristics in the technical specifications apply to a proof-test interval of 20 years and a mean time to repair 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 100 hours expires. The module switches off independently after the 100 hours have expired.

Follow the repair procedure described in section Diagnostic messages (Page 38).

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

Additional information on accessories can be found in the ET 200SP Distributed I/O System System Manual (http://support.automation.siemens.com/WW/view/en/58649293).

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.

Connecting

<div style="text-align: right; font-size: 3em;">3</div>

3.1 Terminal assignment

General terminal assignment

Table 3-1   Terminal assignment for F-DQ 4×24VDC/2A PM HF

Terminal assignment for F-DQ 4×24VDC/2A PM HF (6ES7136-6DB00-0CA0)						
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: Ground for output signal, channel n, M-switching	A0	
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			CC02 6ES7193-6CP02-2MA0
L+	DC24V	M	M			

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

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Note

The first BaseUnit must be a light BaseUnit.

Note

The fuse integrated in BaseUnit type A1 can trigger with the digital output module which renders the terminals useless.

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

Switching of grounded loads

The F-DQ 4×24VDC/2A PM HF can switch loads with a connection between chassis and ground of at least 100 kΩ. Otherwise a short circuit is detected.

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

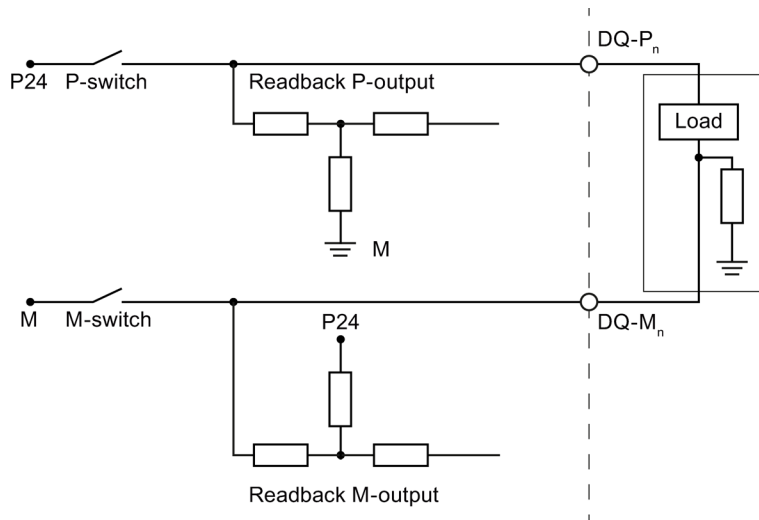Figure 3-1   Switching of grounded loads (resistance between chassis and ground)

Alternatively, you can use F-PM-E 24VDC/8A PPM ST power module in which the output is configured as a PP-switching output.

See also

ET 200SP distributed I/O system
(http://support.automation.siemens.com/WW/view/en/58649293)

3.2 Block diagram

Block diagram

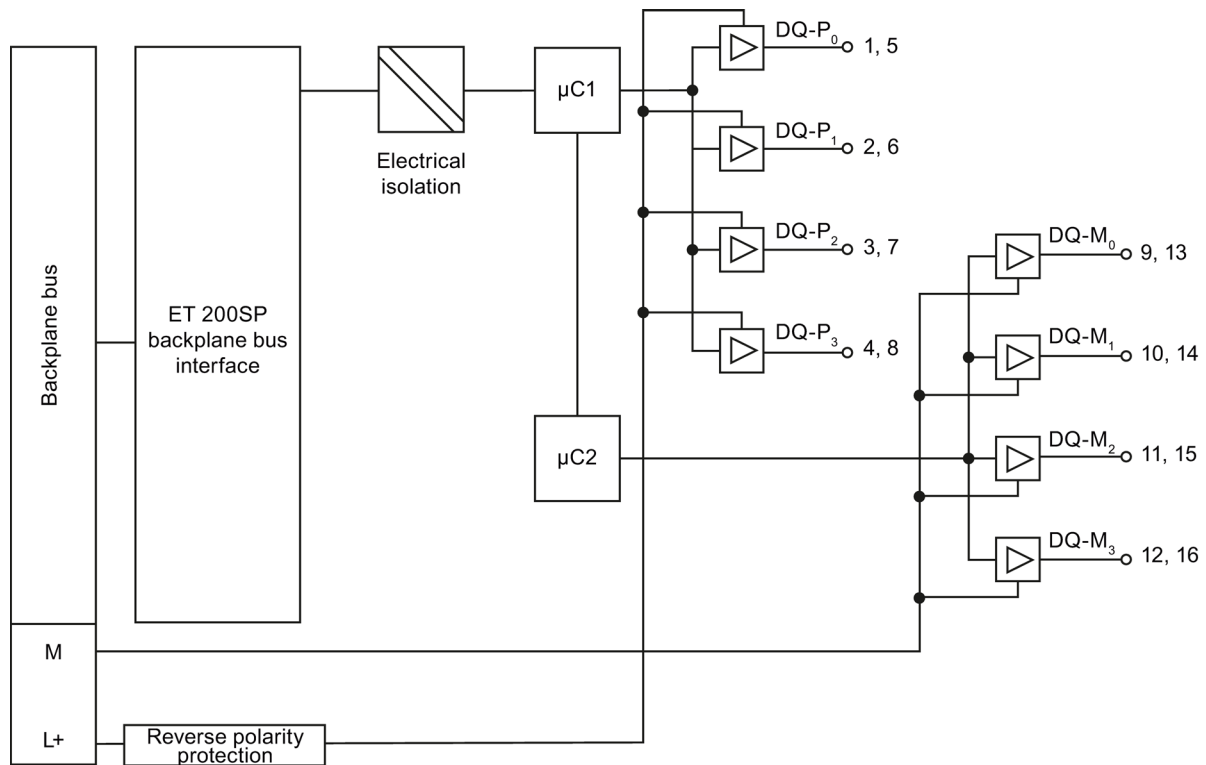Figure 3-2   Block diagram F-DQ 4×24VDC/2A PM HF

Parameters/address space

<div style="text-align: right; font-size: 2em;">4</div>

4.1 Parameters

Parameters

⚠ WARNING
Diagnostic functions should be activated or deactivated in accordance with the application.

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

Parameter	Value range	Parameter reassignment in RUN	Scope
F-parameters:			
Manual assignment of the F-monitoring time	• disable • enable	no	Module
F-monitoring time	1 to 65535 ms	no	Module
F-source address	1 to 65534	no	Module
F-destination address	1 to 65534	no	Module
F-parameter signature (without address)	0 to 65535	no	Module
Behavior after channel faults	• Passivate entire module • Passivate channel	no	Module
F-I/O DB manual number assignment	• disable • enable	no	Module
F-I/O DB number	—	no	Module
F-I/O DB name	—	no	Module
DQ parameters:			
Maximum test period	• 100 s • 1000 s	no	Module

Parameter	Value range	Parameter reassignment in RUN	Scope
Channel parameters:			
Channel n			
Activated	• disable • enable	no	Channel
Max. readback time dark test	0.6 to 400.0 ms	no	Channel
Disable dark test for 48 hours	• disable • enable	no	Channel
Max. readback time switch on test	0.6 to 5.0 ms	no	Channel
Activated light test	• disable • enable	no	Channel
Diagnosis: Wire break	• disable • enable	no	Channel

4.2 Explanation of parameters

4.2.1 F-parameters

F-parameters

Information on F-parameters is available in the SIMATIC Safety – Configuring and Programming (http://support.automation.siemens.com/WW/view/en/54110126) manual.

4.2.2 Parameters of the channels

4.2.2.1 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.

4.2.2.2 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.

4.2.2.3 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 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.
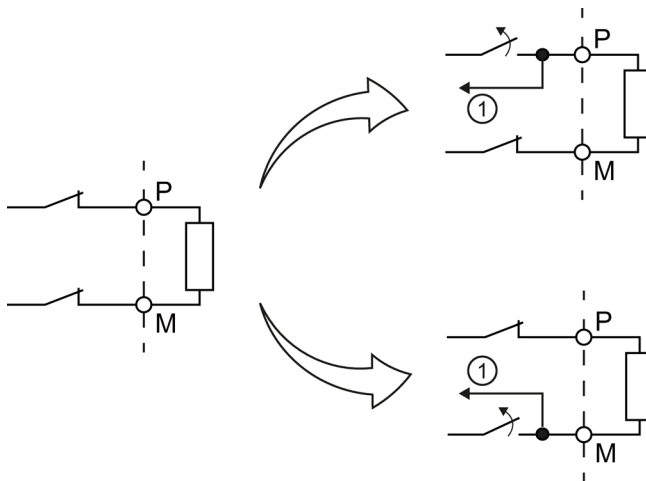
① Readback

Figure 4-1   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 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 response time of the F-module.

⚠ **WARNING**

Through the configured readback time dark test, short circuits (cross-circuits) to a signal with a frequency greater than 1/(2 x configured readback time dark test) 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 set the readback time dark 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.

If the capacity of the actuator is not known, it may be necessary for you to determine the value for the readback time light 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 dark test so 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 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 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

Configured max. test time
max. 100 or 1000 seconds

Module cycle

100 ms

0.6 ... 400 ms
Configurable max. readback time dark test or test with output signal "1"
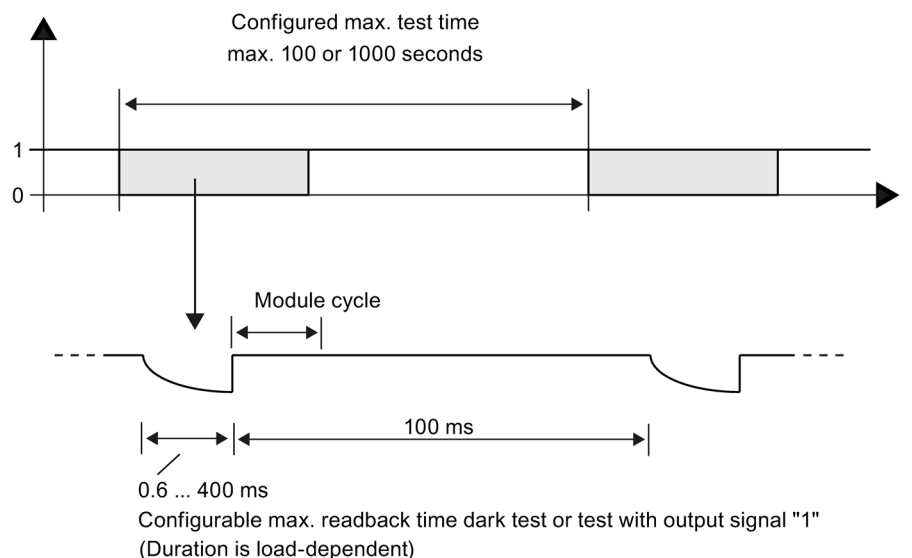(Duration is load-dependent)

Figure 4-2   Test pulses of the dark test

The interval between two test pulses is 100 ms.

4.2.2.4 Disable dark test for 48 hours

This option allows you to suppress the dark test.

If the channel is permanently active (1) for 48 hours, a single dark test pulse is directed to this channel once the time has expired.

You must provide the signal change from 1 to 0 at the channel yourself within 48 hours to prevent the dark test pulse. This also applies to the operating time if the operating time is < 48 hours. The dark test is suspended for another 48 hours after the signal change from 0 to 1.

The dark test is permanently suppressed if the following condition is met:

● A signal change from 1 to 0 takes place before the 48 hours have expired.

> ⚠ **WARNING**
>
> 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 module is passivated. This is necessary because a complete bit pattern test is not performed within 48 hours, which means an undetected error burst may not be ruled out.
>
> Consult the respective requirements of your product standards regarding error detection time.

4.2.2.5 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.
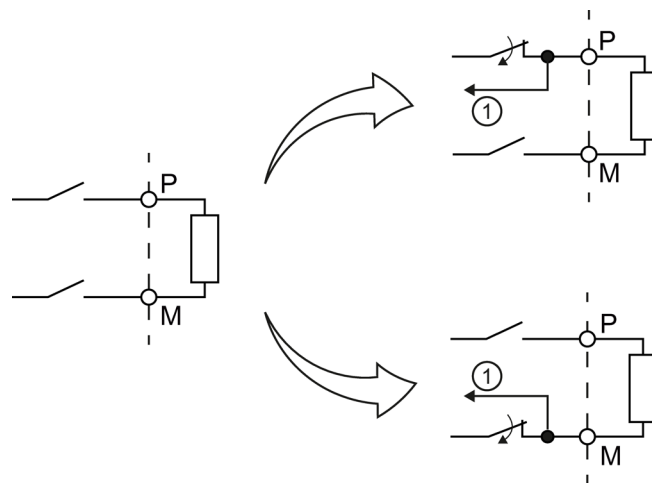
① Readback

Figure 4-3   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.

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.

4.2.2.6   Activated light test

Function

Overload and wire break are 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 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.
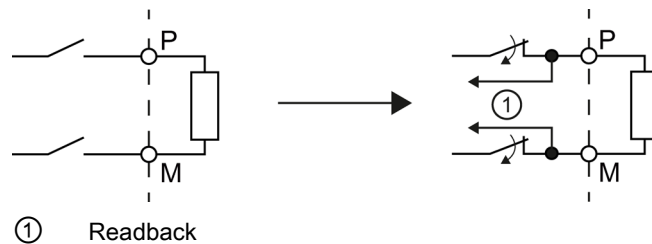
①   Readback

Figure 4-4   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.

If the readback signals are incorrect, the signal is present for the configured readback time at the output channel before the fault causes passivation of the output channel.

If the signal was not read back correctly once the maximum readback time switch on 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 switch on test for the light test increases the response time of the F-module.
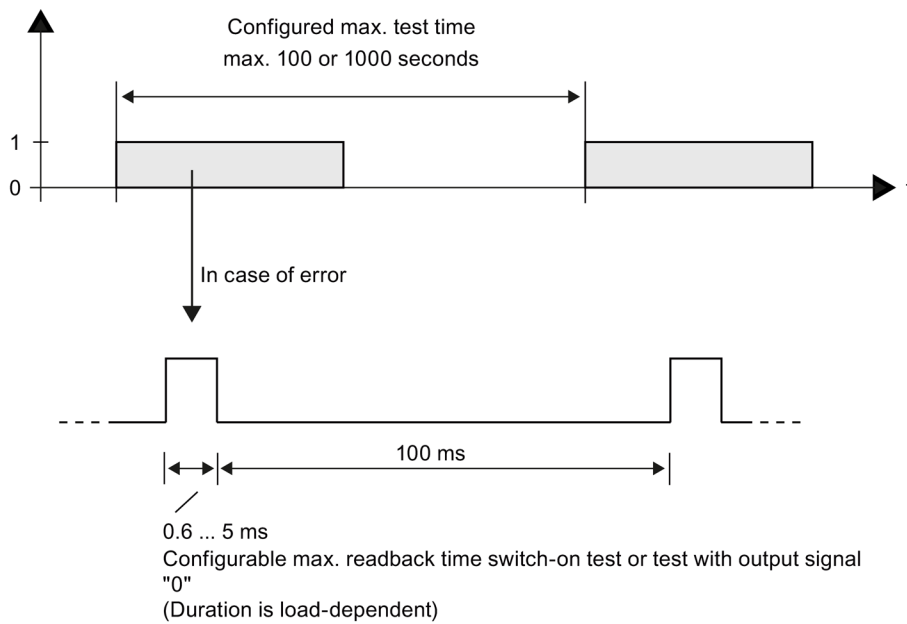
Test pulses of the light test

Figure 4-5   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.

4.2.2.7   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.

You also have to activate the light test to detect a wire break with an output signal "0".

4.3   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 4- 2   Address assignment in the F-CPU

Occupied bytes in the F-CPU:	
In input range	In output range
x + 0 to x + 4	x + 0 to x + 4

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 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
x + 0	—	—	—	—	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
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

For detailed information about F-I/O access, refer to the SIMATIC Safety – Configuring and Programming (http://support.automation.siemens.com/WW/view/en/54110126) manual.

See also

Value status (Page 42)

Applications of the F-I/O module

<div align="right">5</div>

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

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

The wiring is carried out on the matching BaseUnit (Page 13).

5.2 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.
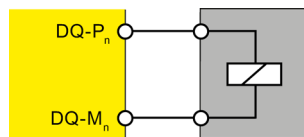

Figure 5-1   Wiring diagram for 1 relay each at 1 F-DQ of the digital output module F-DQ 4×24VDC/2A PM HF

⚠ **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.

5.3   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.

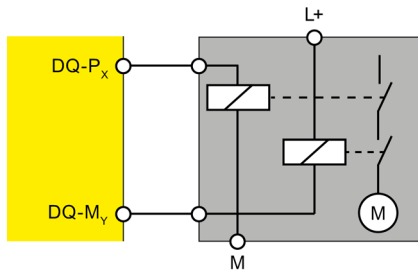This configuration achieves SIL3/Cat.4/PLe (process status readback required).

Figure 5-2   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 the P-switch and M-switch of a fail-safe digital output, you should always install the cables for the connection of the relays to the P-switch and M-switch separately to prevent any 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.

5.4 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.
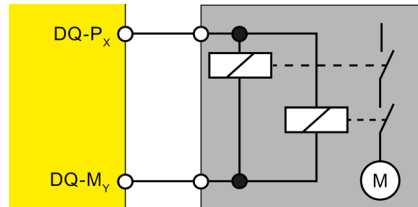

Figure 5-3   Wiring diagram for 2 relays each parallel at 1 F-DQ of the digital output module F-DQ 4×24VDC/2A PM HF

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

6.1 Status and error display

LED display

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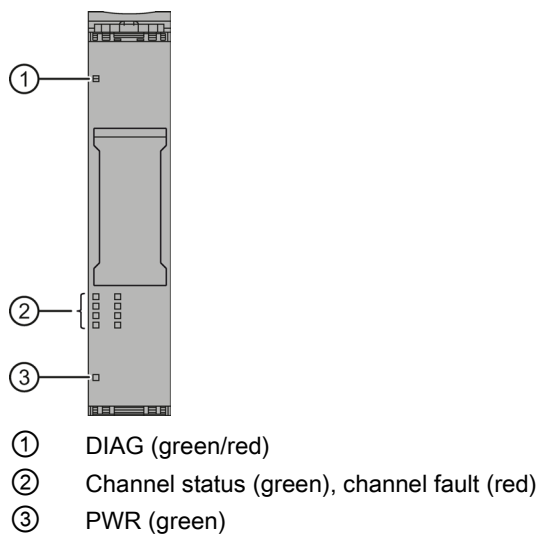② Channel status (green), channel fault (red)
③ PWR (green)

Figure 6-1 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 38).

> ⚠ **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 6- 1   Meaning of the PWR LED

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

DIAG LED

Table 6- 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

Channel status/channel fault LED

Table 6- 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 6- 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

6.2 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 38).

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. Follow the fault remedying procedure described in section Diagnostic messages (Page 38).

Table 6- 5   Diagnostic interrupts of the F-DQ 4x24VDC/2A PM HF

Diagnostic interrupt	Fault code	Scope of diagnostic interrupt	Configurable
Overtemperature	5_D	F-module	No
Parameter assignment error	16_D		
Load voltage missing	17_D		
Access to retentive storage of F-address not possible	30_D		
Different destination address (F_Dest_Add)	64_D		
Invalid destination address (F_Dest_Add)	65_D		
Invalid source address (F_Source_Add)	66_D		
Watchdog time is 0 ms (F_WD_Time or F_WD_Time2)	67_D		
"F_SIL" parameter exceeds the application-specific SIL	68_D		
"F_CRC_Length" parameter does not match the generated CRC	69_D		
Incorrect F-parameter version or F_Block_ID	70_D		
CRC1 error	71_D		
Inconsistent iParameters (iParCRC error)	75_D		
F_Block_ID not supported	76_D		

Diagnostic interrupt	Fault code	Scope of diagnostic interrupt	Configurable
Internal error	256$_D$		
Time monitoring activated	259$_D$		
Internal supply voltage of the module failed	260$_D$		
Output short-circuited to L+	261$_D$	Channel	Yes
Output short-circuited to ground	262$_D$		
Wire break	265$_D$		
Incorrect/inconsistent firmware present. Firmware update required	283$_D$	F-module	No
Switching frequency too high	785$_D$	Channel	
Undertemperature	786$_D$	F-module	
PROFIsafe communication error (timeout)	792$_D$	F-module	
PROFIsafe communication error (CRC)	793$_D$	F-module	
PROFIsafe address assignment error	794$_D$	F-module	
		Channel	No
Output defective	797$_D$		
Readback error	798$_D$	Channel	
Overload	800$_D$	Channel	
Supply voltage too high	802$_D$	F-module	
Supply voltage too low	803$_D$	F-module	

6.3 Diagnostic messages

Diagnostic messages

Module faults are indicated as diagnostics (module status).

Note

You can connect two actuators per output.

The diagnostics of the two actuators influenced each other in the case of duplicate 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 (http://support.automation.siemens.com/WW/view/en/54110126) manual.

Table 6- 6   Diagnostic messages of the F-DQ 4×24VDC/2A PM HF

Diagnostic message	Fault code	Meaning	Remedy
Overtemperature	5$_D$	An excessively high temperature was measured in the F-module.	Operate the F-module within the specified temperature range. (see Technical specifications (Page 43)) Once the fault has been eliminated, the F-module must be removed and inserted or the power switched OFF and ON
Wire break	6$_D$	Possible causes: • There is an interrupted cable between the module and actuator. • The channel is not connected (open). • There is a short circuit between channels with different signals.	• Establish a cable connection. • Disable the wire break detection for the channel in the parameter assignment. • Eliminate the short circuit.
Parameter assignment error	16$_D$	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.
Load voltage missing	17$_D$	Missing or insufficient supply voltage L+	• Check supply voltage L+ at BaseUnit • Check BaseUnit type

Diagnostic message	Fault code	Meaning	Remedy
Access to retentive storage of F-address not possible	30$_D$	The F-destination address stored in the coding element cannot be accessed.	Verify that the coding element is present or replace the coding element.
Different destination address (F_Dest_Add)	64$_D$	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.
Invalid destination address (F_Dest_Add)	65$_D$	The PROFIsafe driver has detected an invalid F-destination address.	Check the parameter assignment of the PROFIsafe driver.
Invalid source address (F_Source_Add)	66$_D$	The PROFIsafe driver has detected an invalid F-source address.	
Watchdog time is 0 ms (F_WD_Time or F_WD_Time2)	67$_D$	The PROFIsafe driver has detected an invalid watchdog time.	
"F_SIL" parameter exceeds the application-specific SIL	68$_D$	The PROFIsafe driver has detected a discrepancy between the SIL setting of the communication and the application.	
"F_CRC_Length" parameter does not match the generated CRC	69$_D$	The PROFIsafe driver has detected a discrepancy in the CRC length.	
Incorrect F-parameter version or F_Block_ID	70$_D$	The PROFIsafe driver has detected an incorrect version of the F-parameters or an invalid F_Block_ID.	
CRC1 error	71$_D$	The PROFIsafe driver has detected inconsistent F-parameters.	
Inconsistent iParameters (iParCRC error)	75$_D$	The PROFIsafe driver has detected inconsistent iParameters.	Check the parameter assignment.
F_Block_ID not supported	76$_D$	The PROFIsafe driver has detected an incorrect Block ID.	Check the parameter assignment of the PROFIsafe driver.
Internal error	256$_D$	Possible causes: • Impermissibly high electromagnetic interference is present. • The F-module is defective.	• Eliminate the interference. The module must then be pulled and plugged, or the power switched OFF and ON • Replace the F-module.
Internal supply voltage of the module failed	260$_D$	Possible causes: • Impermissibly high electromagnetic interference is present. • The F-module is defective.	• Eliminate the electromagnetic interference. The module must then be pulled and plugged, or the power switched OFF and ON • Replace the F-module.
Output short-circuited to L+	261$_D$	Short circuit to L+ can mean: • The output cable is short-circuited to L+. • The capacitive load is too high.	• Correct the process wiring. • Increase the test times (dark, light, switch-on tests).

Diagnostic message	Fault code	Meaning	Remedy
Output short-circuited to ground	262$_D$	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).
Incorrect/inconsistent firmware present. Firmware update required	283$_D$	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.
Switching frequency too high	785$_D$	The maximum switching frequency of the F-module has been exceeded.	Reduce the switching frequency. (see Technical specifications (Page 43))
Undertemperature	786$_D$	The minimum permissible temperature limit has been violated.	Operate the F-module within the specified temperature range. (see Technical specifications (Page 43))
PROFIsafe communication error (timeout)	792$_D$	The PROFIsafe driver has detected a timeout. Possible causes: • The F-monitoring time is set incorrectly. • Bus faults are present.	• Check the parameter assignment. • Ensure that communication is functioning correctly.
PROFIsafe communication error (CRC)	793$_D$	The PROFIsafe driver has detected a CRC error. Possible causes: • 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.	• Check the communication connection between the F-module and F-CPU. • Eliminate the electromagnetic interference.
PROFIsafe address assignment error	794$_D$	An error occurred during the automatic PROFIsafe address assignment.	Check the configuration.
Output defective	797$_D$	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.

Diagnostic message	Fault code	Meaning	Remedy
Readback error	798$_D$	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	800$_D$	The maximum permissible output current has been exceeded. The output stage has been switched off. Possible causes: • A short circuit exists.	Check the process wiring.
Supply voltage too high	802$_D$	The supply voltage is too high.	Check the supply voltage.
Supply voltage too low	803$_D$	The supply voltage is too low.	Check the supply voltage.

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 43) 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 (http://support.automation.siemens.com/WW/view/en/54110126) manual.

6.4 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 27).

Reference

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

Technical specifications

7

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

	6ES7136-6DB00-0CA0
Product type designation	F-DQ 4x24VDC HF
General information	
Hardware product version	01
Firmware version	V1.0.0
Product function	
I&M data	Yes; IM0 to IM3
Engineering with	
STEP 7 TIA Portal configurable/integrated as of version	V12.0
STEP 7 configurable/integrated as of version	as of V5.5 SP3 / -
PROFINET as of GSD version/GSD revision	V2.31
Supply voltage	
Type of supply voltage	24 V DC
Rated value (DC)	24 V
Low limit of permissible range (DC)	20.4 V
High limit of permissible range (DC)	28.8 V
Reverse polarity protection	Yes
Input current	
Current consumption (rated value)	75 mA; without load
Current consumption, max.	21 mA; from backplane bus
Output voltage	
Rated value (DC)	24 V
Power	
Power consumption from the backplane bus	70 mW
Power loss	
Power loss, typ.	4 W
Address space	
Address space per module	
Input	5 bytes
Output	5 bytes

	6ES7136-6DB00-0CA0
Digital outputs	
Number of outputs	4
Digital outputs, configurable	Yes
Short circuit protection	Yes
• Response threshold, typ.	> 3.3 A
Wire break detection	Yes
• Response threshold, typ.	8 mA
Overload protection	Yes
• Response threshold, typ.	2.9 A
Voltage induced on current interruption limited to	typ. 2*47V
Switching capacity of outputs	
With resistive load, max.	2 A
With lamp load, max.	10 W
Load resistance range	
Low limit	12 Ω
High limit	2000 Ω
Output voltage	
Type of output voltage	DC
For "1" signal, min.	24 V; L+ (-0.5 V)
Output current	
For "1" signal, rated value	2 A
For "0" signal, residual current, max.	0.5 mA
Switching frequency	
With resistive load, max.	30 Hz; symmetrical
With inductive load, max.	0.1 Hz; acc. to IEC 947-5-1, DC13, symmetrical
With lamp load, max.	10 Hz; symmetrical
Total current of outputs	
Max. current per channel	2 A; (note derating data in the manual)
Max. current per module	6 A; (note derating data in the manual)
Length of cable	
Cable length, shielded, max.	1000 m
Cable length unshielded, max.	500 m
Interrupts/diagnostics/status information	
Fail-safe values can be switched to	No
Interrupts	
Diagnostic interrupt	Yes
Diagnostic messages	
Diagnostics	Yes, see section "Interrupts/diagnostic messages" in the manual

	6ES7136-6DB00-0CA0
Diagnostics display LED	
RUN LED	Yes; green LED
ERROR LED	Yes; red LED
Monitoring of supply voltage	Yes; green PWR LED
Channel status display	Yes; green LED
For channel diagnostics	Yes; red LED
For module diagnostics	Yes; green/red DIAG LED
Electrical isolation	
Electrical isolation channels	
Between channels	No
Between the channels and the backplane bus	Yes
Between the channels and the supply voltage of the electronics	No
Permitted potential difference	
Between different circuits	75 V DC / 60 V AC
Isolation	
Isolation test voltage	707 V DC (type test)
Standards, approvals, certificates	
SIL acc. to IEC 61508	SIL 3
Suitable for safety functions	Yes
Maximum achievable safety class in safety mode	
Performance level according to EN ISO 13849-1	PLe
Low demand (PFD) acc. to SIL3	< 2.00E-05 1/h
High demand (PFH) acc. to SIL3	< 1.00E-09 1/h
Environmental conditions	
Operating temperature	
Min.	0 °C
Max.	60 °C
Horizontal installation, min.	0 °C
Horizontal installation, max.	60 °C
Vertical installation, min.	0 °C
Vertical installation, max.	50 °C
Storage/transport temperature	
Min.	-40 °C
Max.	70 °C

	6ES7136-6DB00-0CA0
Dimensions	
Width	15 mm
Weights	
Weight, approx.	57 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

Because of the small size of the modules, pay attention to the development of heat between adjacent modules when output modules are exposed to elevated loads. 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
(http://support.automation.siemens.com/WW/view/en/58532597/133300) manual

Response times

A

Introduction

The next section shows the response times of the digital output moduleF-DQ 4×24VDC HF. The response times of digital output module F-DQ 4×24VDC HF are included in the calculation of the F-system response time.

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} = 15.5 ms

You assign the dark test time and switch-on time in STEP 7.

Maximum response time in the error-free case

The maximum response time for fail-safe digital outputs in the error-free case is equal to:

Maximum response time = $2 \times T_{cycle}$ + Maximum(dark test time, switch-on time)

Maximum response time with error and change of user data

Maximum response time = $3 \times T_{cycle}$ + Maximum(dark test time, switch-on time)

Maximum response time with detection by bit pattern test

Maximum response time = T_{cycle} + Maximum(dark test time, switch-on time) + configured test time

Switching of loads

<div align="right">

B

</div>

B.1 Connecting capacitive loads

If an F-DQ 4×24VDC HF digital output module is interconnected with loads that require little current and have capacitance, this can lead to detection of a short circuit or overload. 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.
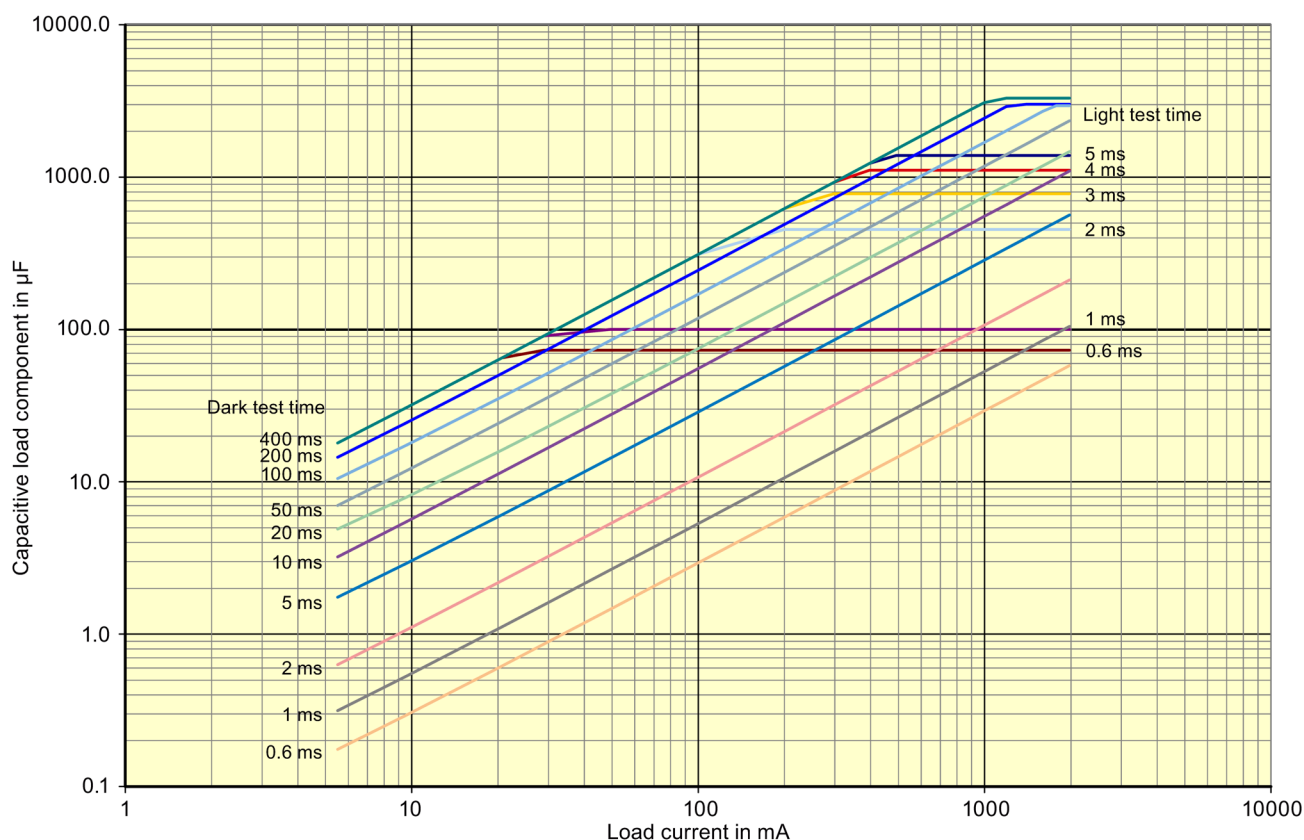

Figure B-1   Switching of capacitive loads for the F-DQ 4×24VDC HF digital output module depending on the configured dark and light test times

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.
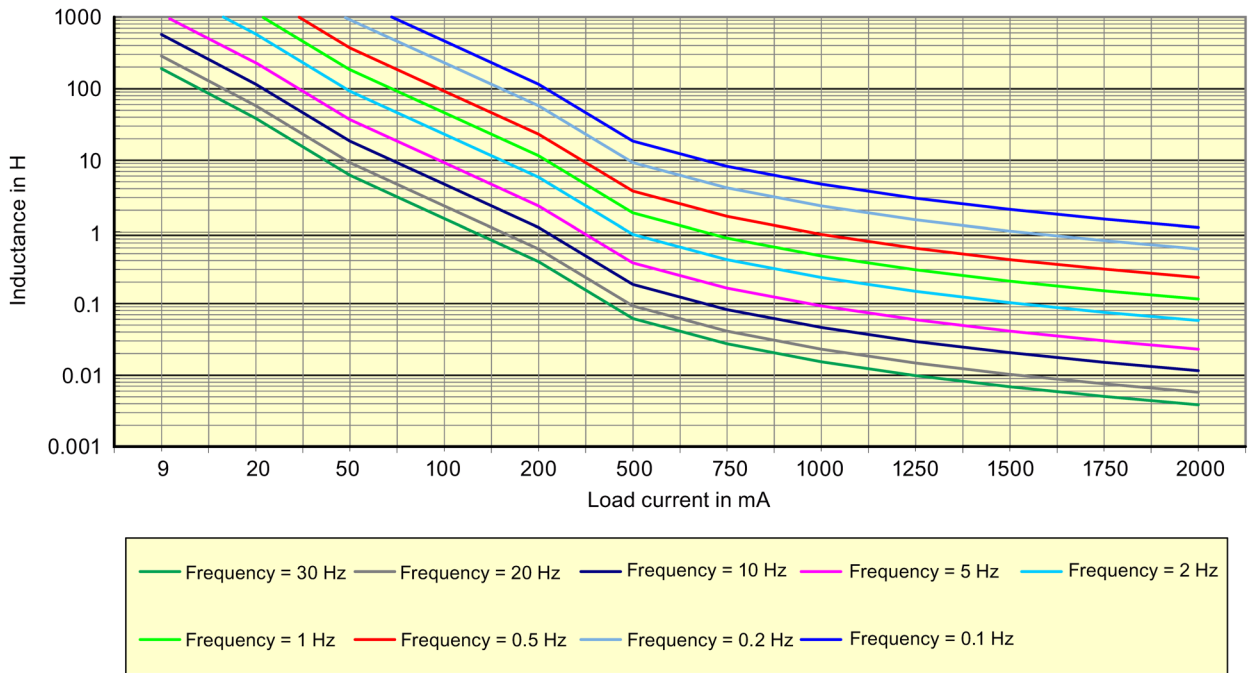

Figure B-2 Switching of inductive loads for the F-DQ 4x24VDC/2A PM HF digital output module depending on the load current and switching frequency