TROUBLESHOOTING PROFISAFE MODULES

PROFIsafe modules generation 4 – FDI and FDO

SUMMARY

1. Power supply – Power supply concept
2. Safety inputs
3. Safety outputs – 4FDI/4FDO
4. Safety outputs – 4FDI/2FDO
5. Contactors with reduction of “closing power” and “holding power”
6. Control SEW drives

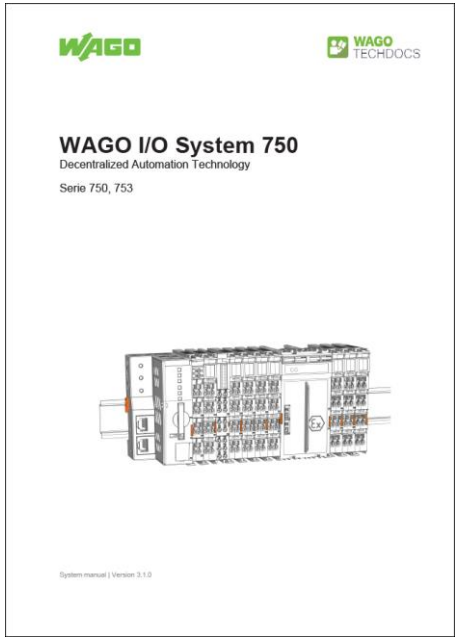
SUMMARY

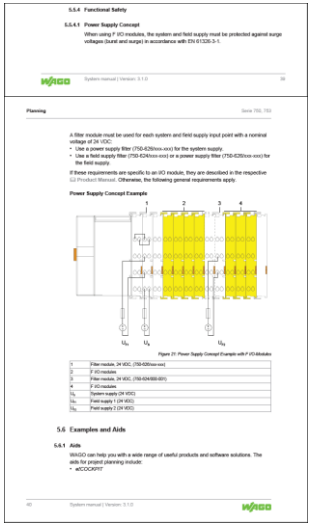
1. Power Supply – Power supply concept
2. Safety inputs
3. Safety outputs – 4FDI/4FDO
4. Safety outputs – 4FDI/2FDO
5. Contactors with reduction of “closing power” and “holding power”
6. Control SEW drives

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Power supply – Power supply concept – WAGO IO-System 750

- Fundamentals “System manual WAGO I/O System 750”
  - ➢ Version 3.1.0 – Chapter 5.5.4 Functional safety
    - General and essential requirements
    - References to specific requirements
    - Refer to product manuals



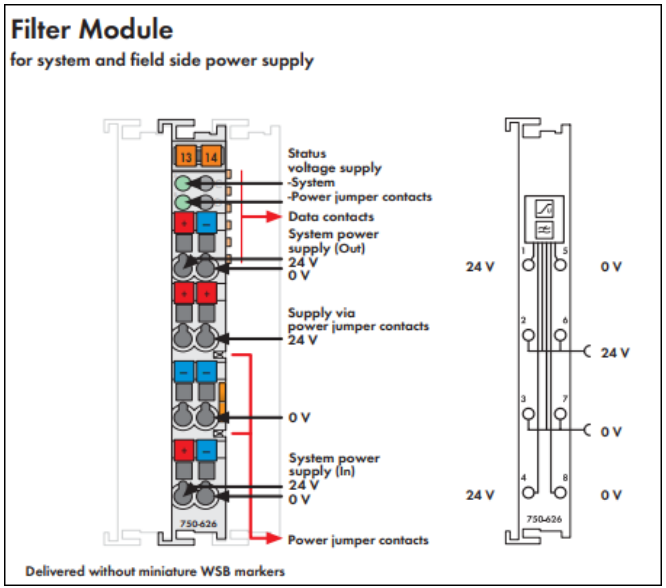


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Power supply – Power supply concept – Filter modules (1)

- Filter module bus coupler and field power supply 750-626
  - Used directly after bus coupler
  - Filter system supply bus coupler
  - Filter field power supply with power contacts
- Option for new potential group field supply
  - Used at decentralized IO-System
  - Use filter power supply with power contacts
  - Advantage of same filter module for all requirements



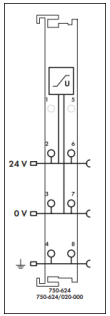
750-626
- Required for shipbuilding certified operation with both 758 Series IPCs and 750-625 Ex-i supply module.
- Required for the use of 750 Series PROFIsafe modules.

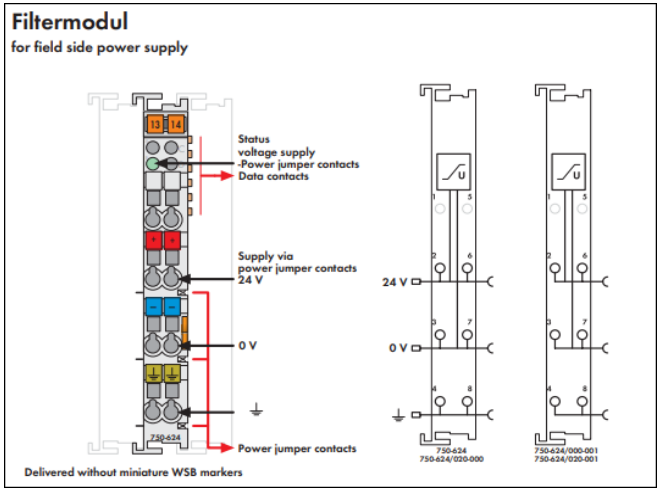
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

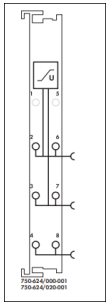
Power supply – Power supply concept – Filter modules (2)

- Filter module field power supply 750-624
  - Filter field power supply with power contacts
  - Supply module 750-602 required





- Supply and filter module field power supply 750-624/000-001
  - Filter field power supply with power contacts
  - Variant direct supply and filter module
  - Without field power connection to the left



750-624, 750-624/000-001

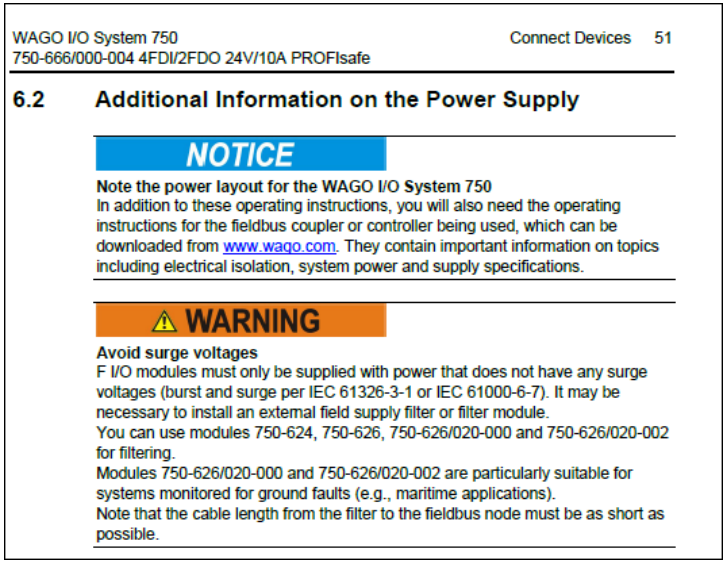
- Required for shipbuilding certified operation with 750-625 Ex i supply module.
- Required for the use of 750 Series PROFIsafe modules.
- 750-624/000-001 may also be used as a supply module.

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Power supply – Power supply concept – References technical manual

- Enhanced requirements using PROFIsafe
  - ➢ Technical manual PROFIsafe module
  - ➢ Considerations power supply
    - Output voltage on error
    - Overload behavior
- System limits
  - ➢ Current limitation power contacts
  - ➢ Total current internal power supply



WAGO I/O System 750 Connect Devices 51
750-666/000-004 4FDI/2FDO 24V/10A PROFIsafe

6.2 Additional Information on the Power Supply

NOTICE

Note the power layout for the WAGO I/O System 750
In addition to these operating instructions, you will also need the operating instructions for the fieldbus coupler or controller being used, which can be downloaded from www.wago.com. They contain important information on topics including electrical isolation, system power and supply specifications.

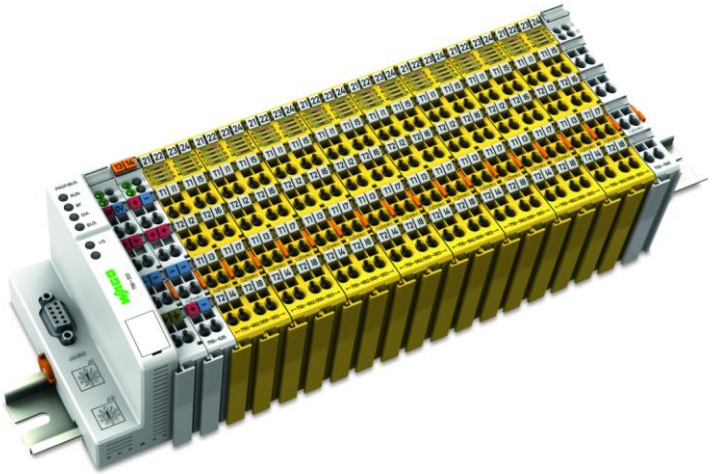
⚠ WARNING

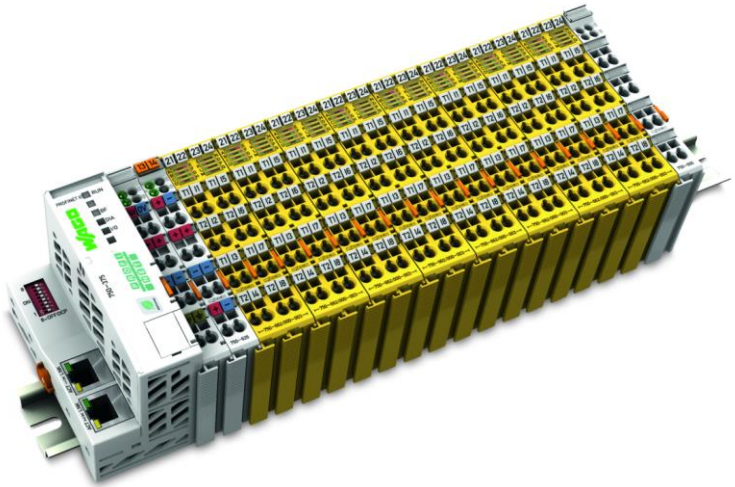
Avoid surge voltages
F I/O modules must only be supplied with power that does not have any surge voltages (burst and surge per IEC 61326-3-1 or IEC 61000-6-7). It may be necessary to install an external field supply filter or filter module.
You can use modules 750-624, 750-626, 750-626/020-000 and 750-626/020-002 for filtering.
Modules 750-626/020-000 and 750-626/020-002 are particularly suitable for systems monitored for ground faults (e.g., maritime applications).
Note that the cable length from the filter to the fieldbus node must be as short as possible.

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Power supply – Power supply concept – Abstract





- Electronic power supply of the IO modules provided by the bus coupler
- Don’t exceed maximum current of power supply bus coupler
- Additional system supply module with electronic power supply available (750-613)

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

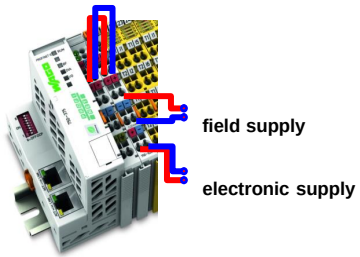
Power supply – Power supply concept – PROFIsafe modules

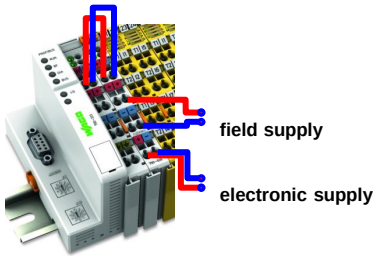
bus interface	item number	total current electronic power supply
PROFIBUS-DP	750-333	1800 mA
PROFINET IO advanced	750-375	1700 mA
PROFINET IO advanced eco	750-377	700 mA

bus interface	item number	total current electronic power supply
Supply module DC24V with electronic power supply	750-613	2000 mA

PROFIsafe modules	item number	max. current of module
4FDI 24V DC	75x-661/000-004	120 mA
8FDI 24 DC	75x-662/000-004	120 mA
4FDI / 4FDO 24V DC	75x-667/000-004	120 mA
4FDI / 2FDO 24V DC	75x-666/000-004	120 mA
4FAI 0(4)…20 mA	75x-668/000-004	120 mA

- Don’t exceed total current of electronic power supply bus coupler
- Pay attention to ups and downs of power supply 24V DC
- Voltage of power supplies monitored with diagnosis messages

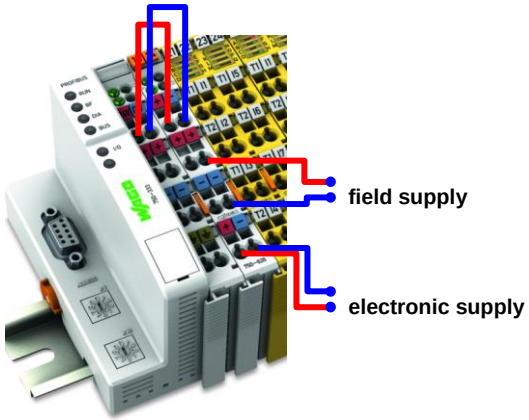




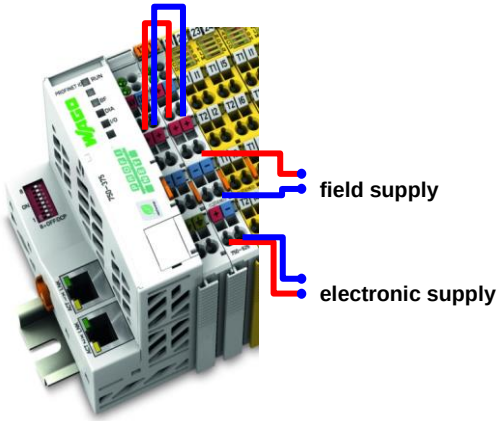
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Power supply – Power supply concept – Electronic and field supply



- PROFIBUS-DP Slave (750-333)
- Filter module (750-626) immediately afterwards bus coupler

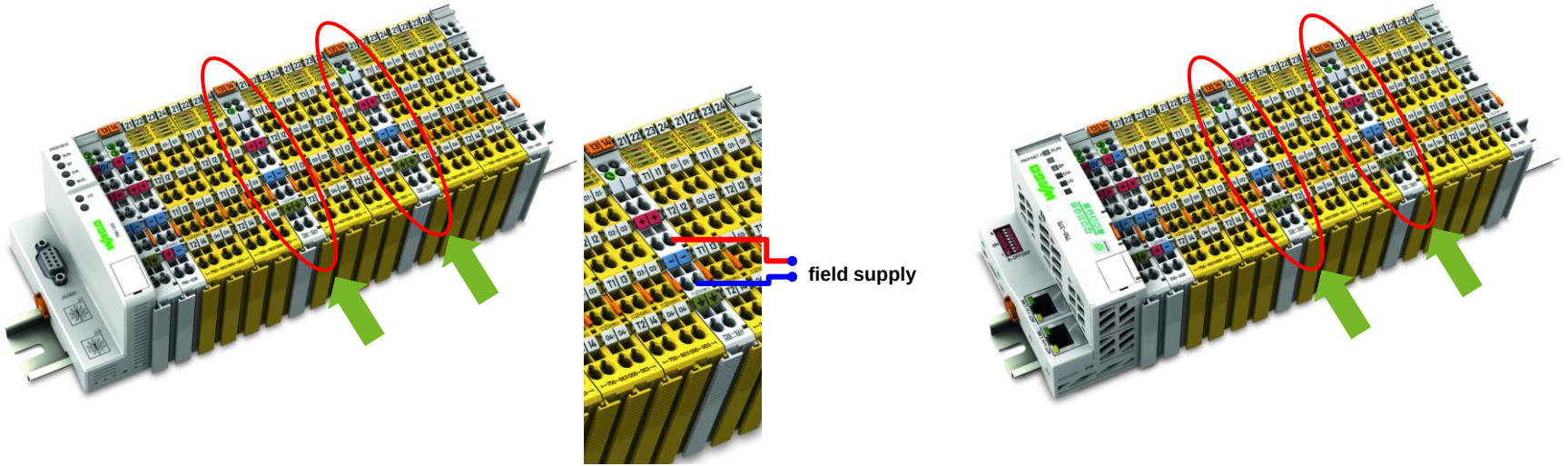


- PROFINET IO-Device advanced (750-375)
- Filter module (750-626) immediately afterwards bus coupler

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Power supply – Power supply concept – Power supply group safety outputs

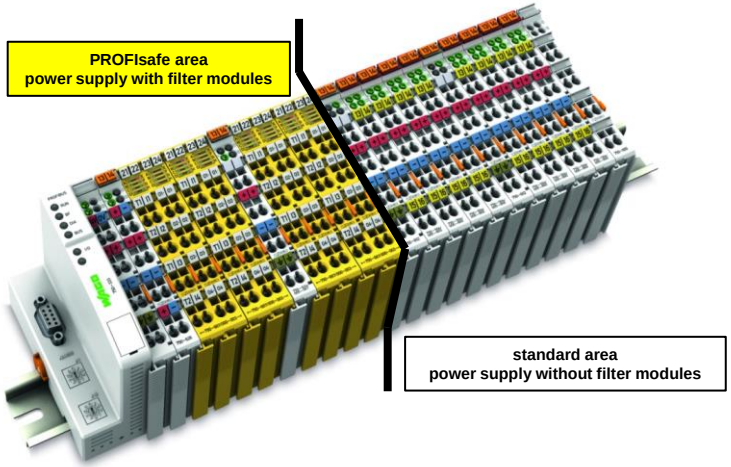


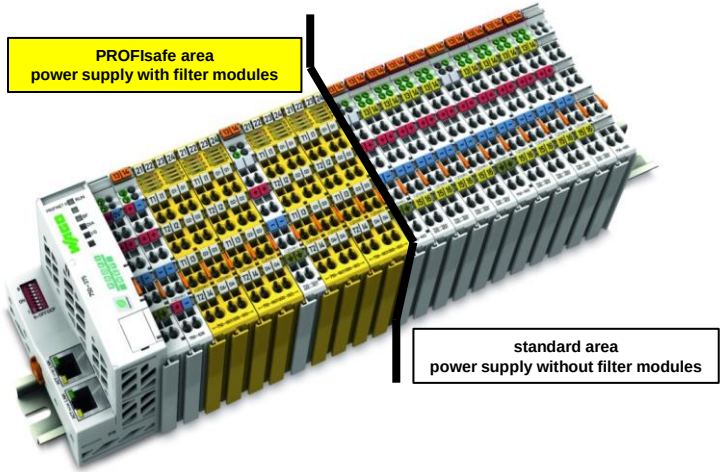
- Using field power supply groups – maximum current of power contacts reached
- Additional field power supply with supply and filter module (750-624/000-001)
- Pay attention to maximum current of power contacts field area

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Power supply – Power supply concept – Power supply behind PROFIsafe modules





- Using filter modules at “PROFIsafe area” – recommended realization
- Power supply after “PROFIsafe area” without filter modules
- Advice configuration – PROFIsafe modules – standard modules – Ex i modules

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Power supply – Power supply concept – References PROFINET IO-Device

- Using PROFINET IO-Device advanced eco 750-377
  - ➢ Total current electronic power supply only 700 mA
  - ➢ PROFIsafe module ***generation 4*** with inputs and outputs requires up to 120 mA
    - ✓ ***5 PROFIsafe modules generation 4 with inputs and outputs possible***
    - ✓ Additional I/O modules requires additional system supply

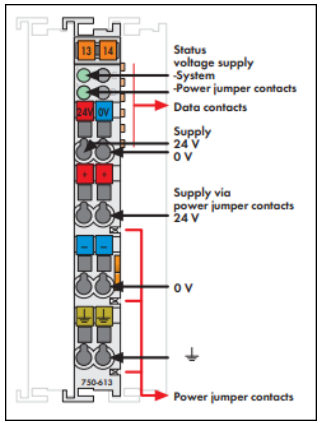
- Using PROFINET IO-Device advanced 750-375 recommended
  - ➢ Total current electronic power supply only 1700 mA
  - ➢ PROFIsafe module ***generation 4*** with inputs and outputs requires up to 120 mA
    - ✓ ***13 PROFIsafe modules generation 4 with inputs and outputs possible***
    - ✓ Additional I/O modules requires additional system supply

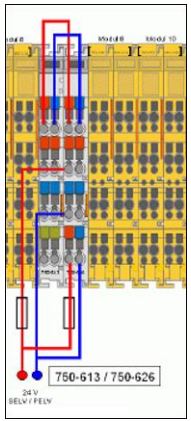
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Power supply – Power supply concept – References supply module with system supply

- Using supply module DC 24V with system supply 750-613
  - Enhance system supply with additional 2A
  - Connection power supply like “coupler”
- Combination with PROFIsafe modules
  - Usage at area PROFIsafe modules – filter modules required
  - Combination 750-613 and 750-626 necessary



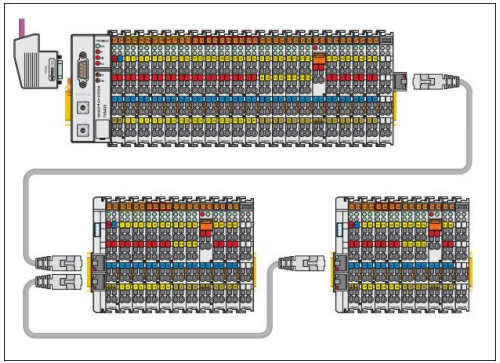


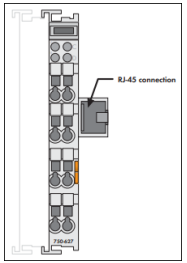
Attention should be paid to the technical manuals !

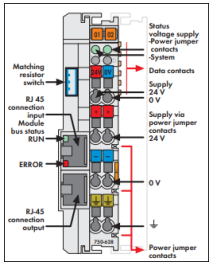
TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Power supply – Power supply concept – References data bus extension

- Activation necessary
  - Modify device settings at TIA project
- Effect to safety reaction times
- PROFIsafe modules in front of extension
  - Power supply with filter modules in combination with PROFIsafe modules
  - Behind PROFIsafe modules “standard” power supply
- PROFIsafe modules behind extension – at coupler module
  - Power supply with filter modules up to coupler module at all segments
  - Power supply coupler module 750-628 in combination with filter module 750-626
  - System supply with coupler module only 400 mA







- **Practical experience**
  - **PROFIsafe modules in combination with data bus extension not recommended**
  - **Avoid PROFIsafe modules behind coupler module**

Attention should be paid to the technical manuals !

SUMMARY

1. Power Supply – Power supply concept
2. Safety inputs
3. Safety outputs – 4FDI/4FDO
4. Safety outputs – 4FDI/2FDO
5. Contactors with reduction of “closing power” and “holding power”
6. Control SEW drives

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety inputs – Fundamentals

- Power supply safety inputs
  - Sensor supply T1 and T2 realized as “clocked” power supplies
  - Test cycle between T1 and T2 shifted
  - Clock interpretation can be switched off at safety input
    - Using external power supply 24 V for sensor
    - Using OSSD outputs with safety inputs

- Practical experience
  - Only one pair of T1 and T2 used in one cable
    - Short circuit and cross circuit detection
  - Parameter settings based on used sensor

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety inputs – Abstract

- Clock outputs T1 & T2
  - Clocked voltage – realized short-circuit-protected
  - Extract technical manual 75x-667/000-004

⚠ WARNING

Ensure protected installation when the short circuit test is activated!
With the two clock outputs T1 and T2, you can install the signal lines of at most two contiguous input channels in one common cable. Otherwise, the F I/O module cannot detect short circuits between signal lines of the inputs that are tested with the same clock output. Make sure that the signal lines that belong to the same clock output T1 or T2 are installed with protection against each other according to IEC 60204-1 or ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts).

⚠ WARNING

Ensure protected installation of signal lines when Short circuit test is set to "deactivated"!
If you have set the **Short circuit test** parameter of an input to "deactivated," the signal lines must be installed with protection between the lines themselves and between the sensors and inputs according to IEC 60204-1 or ISO 13849-2 (e.g., as separate sheathed lines or in separate cable ducts), since external short circuits cannot be detected.

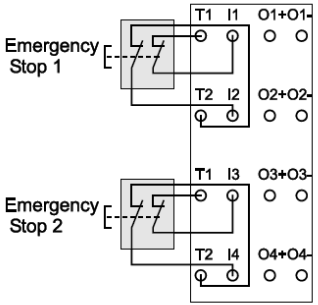


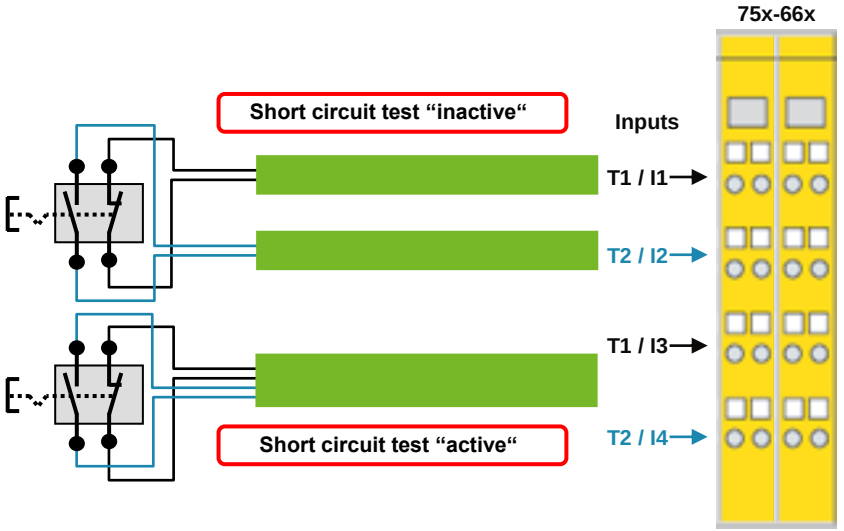
Figure 22: Connection of Two Emergency Stop Switches, Dual-Channel, Equivalent Pre-Evaluation

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety inputs – References short circuit test

- Cable system based on parameter “short circuit test safety inputs”
  - ➢ Parameter settings based on realized cable system
  - ➢ Parameter “short circuit test safety inputs – inactive”
    - Single line cabling
  - ➢ Parameter “short circuit test safety inputs – active”
    - Common cabling possible
    - Clock T1 & T2 and related signals



Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety inputs – Signal preprocessing (1)

- Antivalent evaluation
  - Technical manual

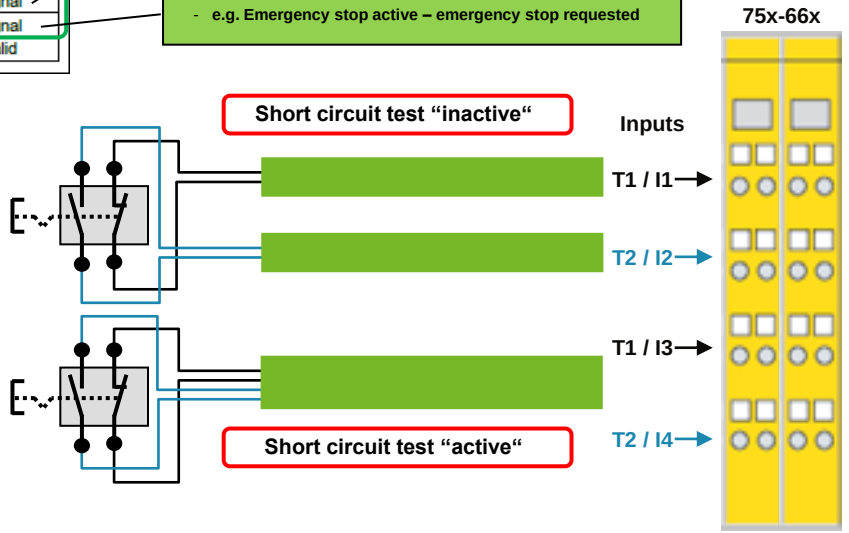
Table 36: Antivalent Pre-Evaluation

Inputs		Process Image		Signal Status
Ix+1	Ix	Ix+1	Ix	
0	0	0	0	Invalid
0	1	1	1	1-signal
1	0	0	0	0-signal
1	1	0	0	Invalid

- e.g. Emergency stop not active – “normal position“

- e.g. Emergency stop active – emergency stop requested

  - Wiring
    - “Opener“ with I1 / I3 / I5 / I7
    - “Closer“ with I2 / I4 / I6 / I8
  - Module parameter
    - Dual channel evaluation “yes“
    - Valence evaluation “antivalent“
    - Discrepancy time based on requirements
    - Short circuit test “active”



Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety inputs – Signal preprocessing (2)

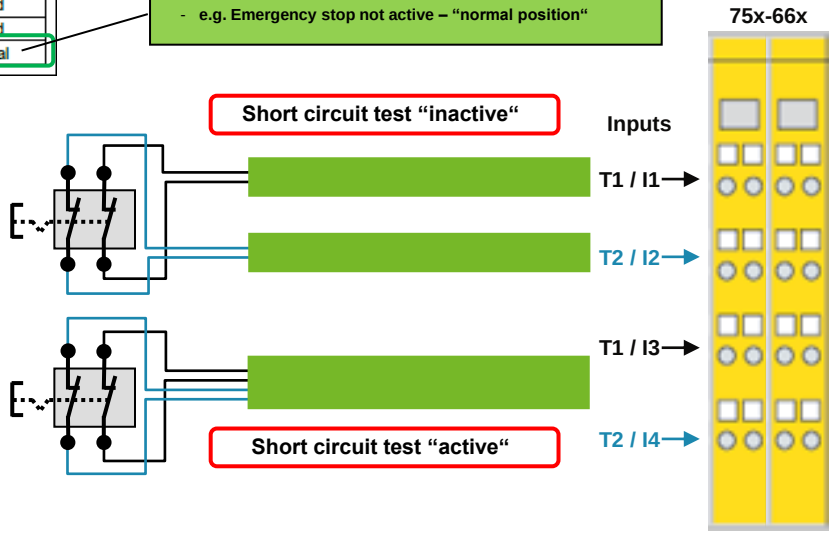
- Equivalent evaluation
  - Technical manual

Table 35: Equivalent Pre-Evaluation

Inputs		Process Image		Signal Status
Ix+1	Ix	Ix+1	Ix	
0	0	0	0	0-signal
0	1	0	0	Invalid
1	0	0	0	Invalid
1	1	1	1	1-signal

- e.g. Emergency stop active – emergency stop requested

- e.g. Emergency stop not active – “normal position“



  - Wiring
    - “Opener 1“ with I1 / I3 / I5 / I7
    - „Opener 2“ with I2 / I4 / I6 / I8
  - Module parameter
    - Dual channel evaluation “yes“
    - Valence evaluation “equivalent“
    - Discrepancy time based on requirements
    - Short circuit test “active”

Attention should be paid to the technical manuals !

WAGO PROFISAFE MODULES – INTEGRATION TIA

Safety inputs – Sensors with OSSD outputs (1)

- Fundamentals
  - OSSD – **O**utput **S**ignal **S**witching **D**evice
  - Safety related output switching element

- Usage
  - Safety related outputs at sensors
  - Functionality different per device

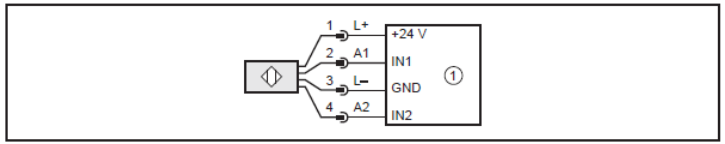
- Connection OSSD outputs to safety inputs
  - Fundamentals at manual of safety related device with OSSD outputs
  - In some cases signal preprocessing necessary – equivalent / exclusive-OR
  - Pay attention to manual of the safety relates device with OSSD outputs

Attention should be paid to the technical manuals !

WAGO PROFISAFE MODULES – INTEGRATION TIA

Safety inputs – Sensors with OSSD outputs (2)

- Example inductive safety related sensor GF711S Co. IFM
  - Information manual GF711S Co. IFM



1: safety-related logic unit *

* When there is no current flow on the output stage, back feeding > 3.5 V will lead to malfunction.

8.3 LED display

LED	Operating status	Outputs	A1 (OSSD)	A2 (OSSD)
○ Signal ○ Power	No voltage supply	Both outputs switched off	0	0
○ Signal ✸ Power	Undervoltage		1 0	0 0
○ Signal ✸ Power	Overvoltage	Both outputs switched off	0	0
	Sensor fault (→ 10 Troubleshooting)	One output or both outputs switched off	0 1 0	1 0 0
● Signal ● Power	Damping element in the enable zone	Both outputs enabled	1	1
	Damping element in the close zone	Output A2 is switched off	1	0

UK

  - Advice usage in combination with WAGO PROFIsafe modules
    - Output A1 directly connected to FDI n
    - Output A2 directly connected to FDI n+1
    - Interpretation of sensor signals at safety application – check details output state of A1 and A2
    - Adjust input filter FDI based on application requirements

Attention should be paid to the technical manuals !

WAGO PROFISAFE MODULES – INTEGRATION TIA

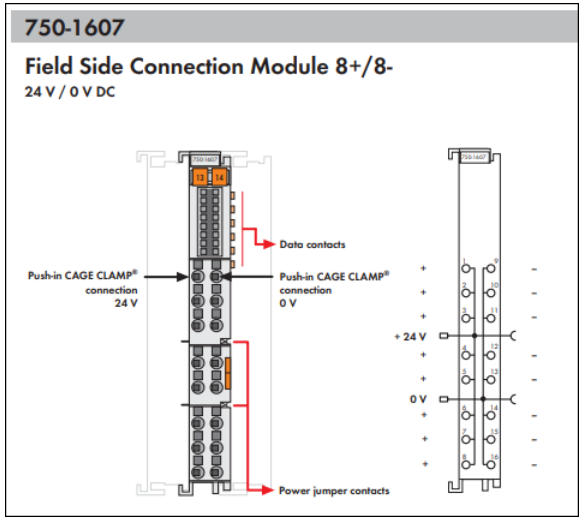
Safety inputs – Sensors with OSSD outputs (3)

- Notes Power supply OSSD sensors
  - ➢ Notes Parameters “short circuit test" and “test pulse duration"

> The digital inputs are tested cyclically by the F I/O module. If the **Short circuit test** parameter is set to the value “deactivated,” then the F I/O module only tests the input circuit for internal errors. You can set the **Short circuit test** parameter to “deactivated” if, for example, you connect the OSSD semiconductor output of a sensor (such as light arrays, light barriers, etc.) to the digital input of the F I/O module.

> The test pulse duration applies equally to the test pulses at clock outputs T1 and T2. However, if the short circuit test of all input channels assigned to a clock output is deactivated, then the clock output in question is switched off (see sections “Commissioning” > ... > “Short Circuit Test Ix Parameter” and “Emergency Stop Connection, Single-Channel”). In this case, the **Test Pulse Duration** parameter has no effect on the clock output in question, and the parameterized value is irrelevant.

  - ➢ Use of field side connection module
    - Plugged in front of the PROFIsafe module
    - Power supply OSSD senso



Attention should be paid to the technical manuals !

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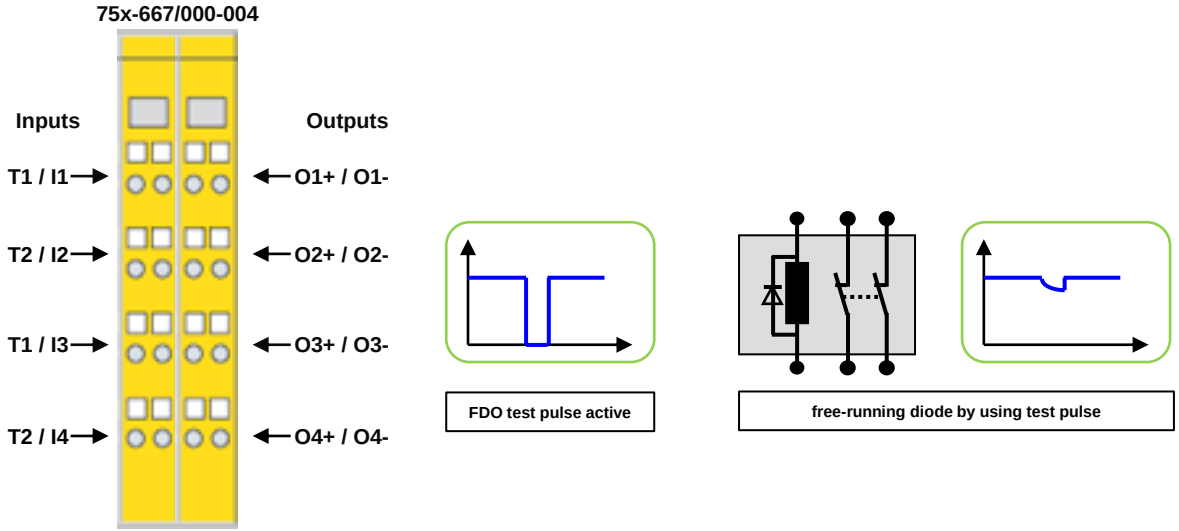
TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Abstract

- Output module with 4 safety outputs
  - ➢ Test functions per output parametrizable
  - ➢ External diode (free-running diode) for inductive load – pay attention to technical manual

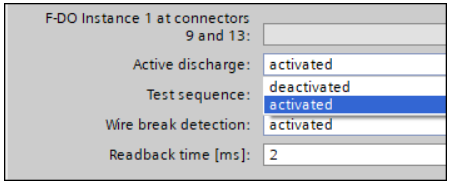


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Module parameter (1)

- Active discharge
  - ➢ “Discharge” of capacitive load at connection “O+”
  - ➢ Parameter
    - Activated – Function activated
    - Deactivated – Function deactivated – Behavior like generation 3
    - ***Default settings “Activated”***



  - ➢ Reference technical manual

7.3.6.2 Active Discharge

If the **Active discharge** parameter is set to the value “activated,” then higher discharge current flows briefly upon switch-off to support larger capacitive loads.

NOTICE

Maximum switching frequency when discharge activated

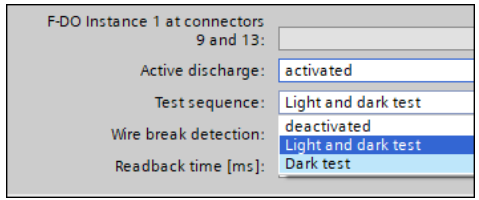
If the **Active discharge** parameter is set to the value “activated,” the maximum switching frequency allowed for the digital output is 0.1 Hz. Otherwise, the F I/O module may overheat.

Attention should be paid to the technical manuals !

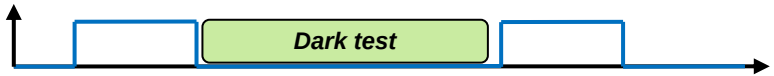
TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

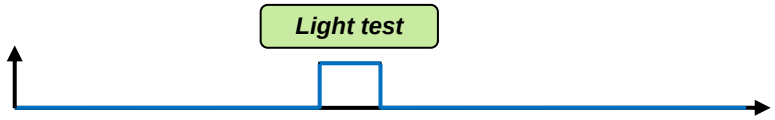
Safety outputs 4FDI/4FDO – Module parameter (2)

- Test sequence
  - ➢ Assign test sequence per output
  - ➢ Parameter
    - ○ Deactivated

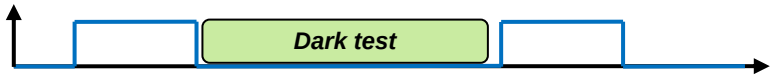


    - ○ Light and dark test





    - ○ Dark test



    - ○ ***Default settings “Dark test”***

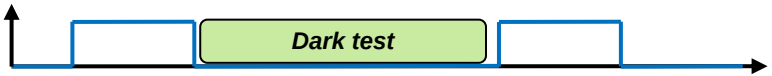
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

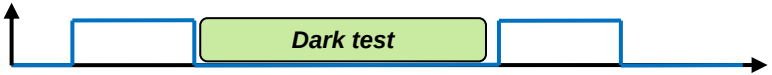
Safety outputs 4FDI/4FDO – Module parameter (3)

- References Test sequence
  - ➢ Deactivated
    - Without active test sequences

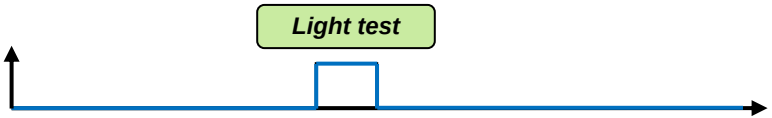
  - ➢ Dark test
    - Test pulse at active output
    - Test pulse length results from parameter "read-back time



  - ➢ Dark and light test
    - Test pulse at active output
    - Test pulse length results from parameter "read-back time



    - Test pulse at inactive output
    - Test pulse length maximum 1ms



Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Module parameter (4)

- References Test sequence – Technical manual

⚠ WARNING

Note voltage pulse

With single-channel use of an output (Ox+ to GND, Ox– to 24 V) and the light test sequence activated, a short voltage pulse with a maximum duration of 1 ms is present. Either the connected actuator must react to short voltage pulses with sufficient time lag, or the safety function must be able to tolerate the short voltage pulses. If neither holds, the light test must be deactivated. If the actuator connection is dual-channel, no voltage pulse occurs at the actuator.

⚠ WARNING

Switch off digital outputs cyclically if test sequence deactivated

If the test sequence is deactivated, the output in question (e.g., O1) must be switched off at least once every 24 hours for at least the amount of time corresponding to the read-back setting. If the test sequence is deactivated for multiple outputs (e.g., O1 together with O2), then the outputs must be switched off at different times in dual-channel applications in order for short circuits and cross circuits between the outputs (e.g., O1 and O2) to be detected. The outputs must be switched off automatically by the controller. It suffices if the switch-off is executed by the process itself, not controlled by a timer.

Each output can be monitored with cyclic diagnostic tests in addition to static monitoring. The cyclic diagnostic tests are performed at a diagnostic interval of 1 minute (in the event of an error, the diagnostic interval is reduced to 10 seconds).

In the process, the dark test sequence tests whether a switched-on output can still be switched off and whether cross circuits to other outputs are present. The switch-off duration for a dark test of a safe output channel is at most the value of the **Readback time** parameter setting, but the F I/O module reduces it to the duration required for detecting the switch-off.

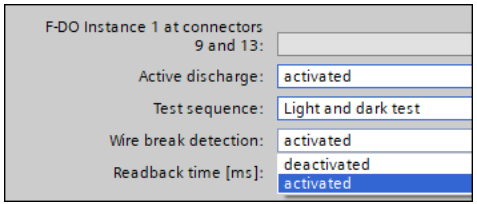
The light test sequence tests whether cross circuits to other outputs are present at an output that is switched off. The maximum duty cycle for a light test of a safe output channel Ox+ or Ox– is 1 ms.

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Module parameter (5)

- Wire break detection
  - ➢ Check connection between module and load
  - ➢ Parameter
    - Activated – Function activated
    - Deactivated – Function deactivated
    - ***Default settings “Deactivated”***
  - ➢ References technical manual
    - Wire break detection only possible at output “O-”
    - Load connected at active wire break detection between “O+” and “O-”
    - Test functions deactivated at output – Deactivate wire break detection

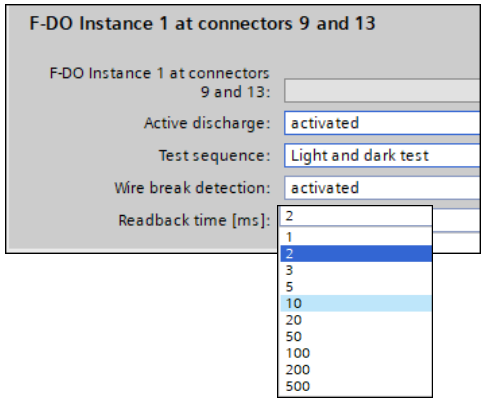


Attention should be paid to the technical manuals !

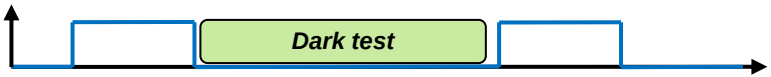
TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Module parameter (6)

- Readback time
  - ➢ Watchdog “readback function safety output”
  - ➢ Parameter
    - Modification in steps from 1ms
    - ***Default settings “1ms”***



  - ➢ References adjust readback time
    - Readback time = maximum length test pulse / switch off time safety output



    - Automatic adjustment to required duration = test pulse length for "shutdown detection"
    - Verification of setting by measuring test pulse length and voltage curve at the output

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Module parameter (6)

- References adjust readback time
  - ➢ Practical experiences
    - “Normal relay“ with freewheeling diode – test pulse length 2ms up to 5ms
    - Safety relay with internal power supply – test pulse length 5ms up to 20ms
  - ➢ Technical manual

7.6.2.8 Switching Capacitive and Electronic Loads

You can use the F I/O module to switch electronic loads (e.g., electronically controlled door locking devices).

In addition, capacitive loads can be switched according to the technical data. When switching capacitive loads, the diagnostic message “Short circuit to V_{CC}” or “Short circuit to GND” may occur. This can be fixed by increasing the read-back time and/or using active discharge; see section “Commissioning” > ... > “Adjustable Parameters for Digital Outputs” > “Active Discharge.”

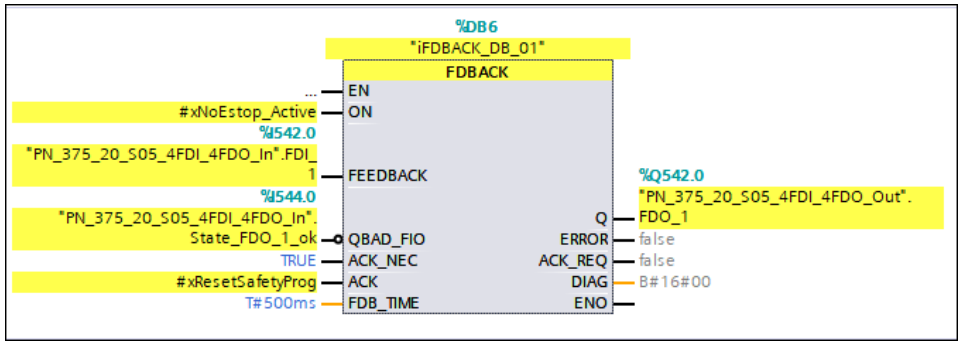
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Safety programming – FDBACK

- “FD_BACK” – Feedback monitoring
  - ON – Local activation / enable output – Without structure values
  - FEEDBACK – Feedback “NC” contact – Relay not active
  - QBAD_FIO – QBAD information F-IO data block of PROFIsafe modules
  - ACK_NEC / ACK – Acknowledgement in case of error

- Screenshot TIA

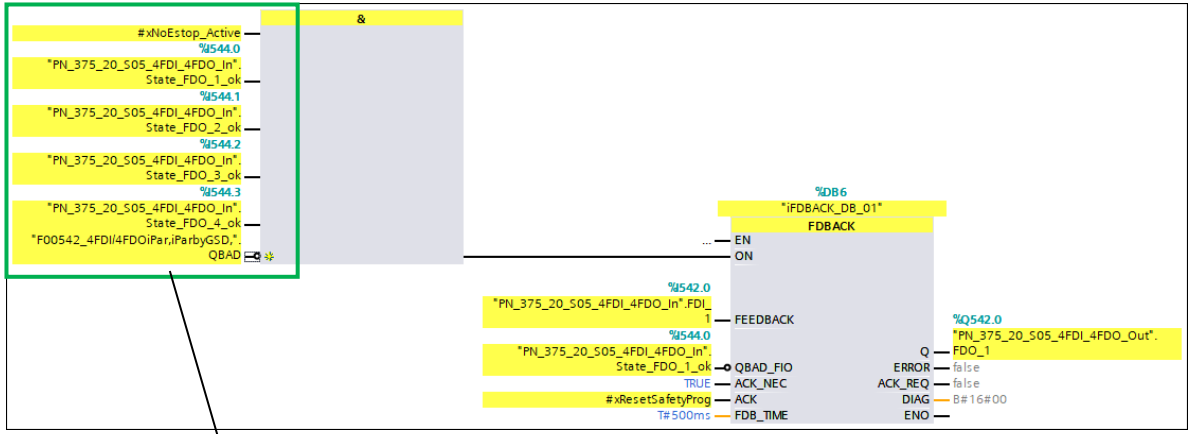


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Safety programming – Shutoff module error (1)

- “FD_BACK” – Feedback monitoring – References
  - Activate all outputs of module if **no** channel / module error active
  - Deactivate all outputs of module if **a** channel / module error active
- Screenshot TIA



Channel status required directly via cyclic process data "%Ix.x" and QBAD information of the F-I/O data module

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Safety programming – Shutoff module error (2)

- Release control with module status
  - Data block with “module status – Safety programming”
  - Generate “module status – Safety programming”
  - Safety application – Using “module status – Safety programming”

- Data block information “module status – Safety programming”
  - Per PROFIsafe module information “FDI ok”, FDO ok” and “Module ok” required

S05_4FDI_4FDO_F_PRG_FDI_ok	Bool	FALSE
S05_4FDI_4FDO_F_PRG_FDO_ok	Bool	FALSE
S05_4FDI_4FDO_F_PRG_Module_ok	Bool	FALSE

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Safety programming – Shutoff module error (3)

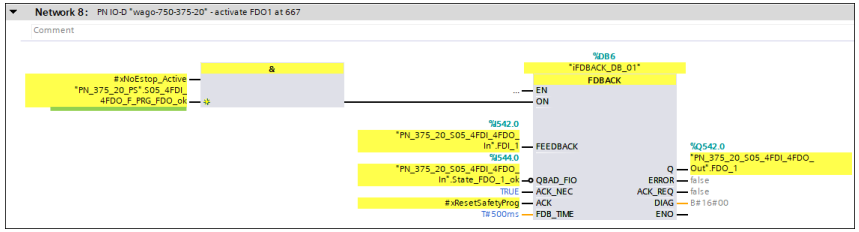
- Generate “module status – Safety programming”
  - ➢ Call function at start of safety application – Generate “module status – Safety programming”

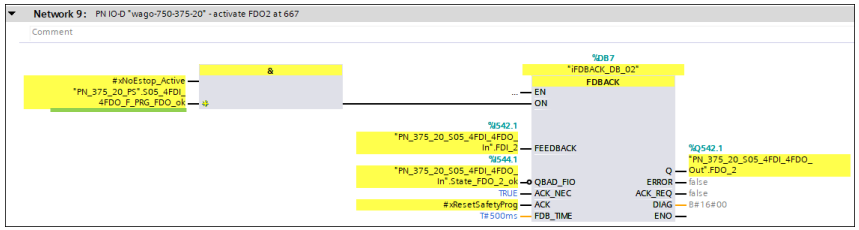
Attention should be paid to the technical manuals !

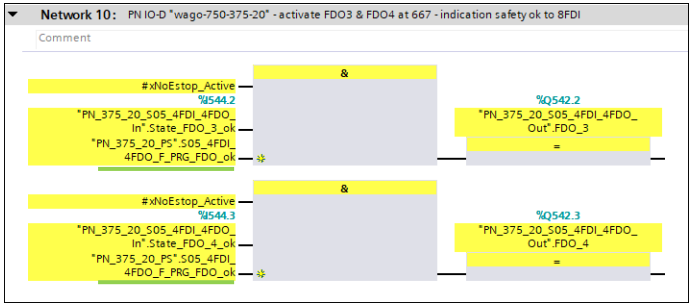
TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Safety programming – Shutoff module error (4)

- Safety application – Using “module status – Safety programming”
  - ➢ Enable output control with “module status – Safety programming”







Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Safety programming – Error Error-ID 16#75D6 (1)

- Practical experience direct activation of safety outputs
  - ➢ Programming
    - Local safety tags & channel status based on input of periphery area “%Ix.x”
    - Direct activation or function block “FDBACK” used
  - ➢ Functional test safety programming
    - Response application at error-free operation and module / channel error active at safety output
  - ➢ References F-CPU changes to STOP at functional test – Siemens FAQ ID 19183712

SIEMENS

support.industry.siemens.com | Product Support | Friday, 5. April 2024

Entry type: **FAQ**, Entry ID: **19183712**, Entry date: **07/06/2017**

What should you do if the F-CPU goes into STOP mode and the message "Data corruption in the safety program ..." appears in the diagnostics buffer?

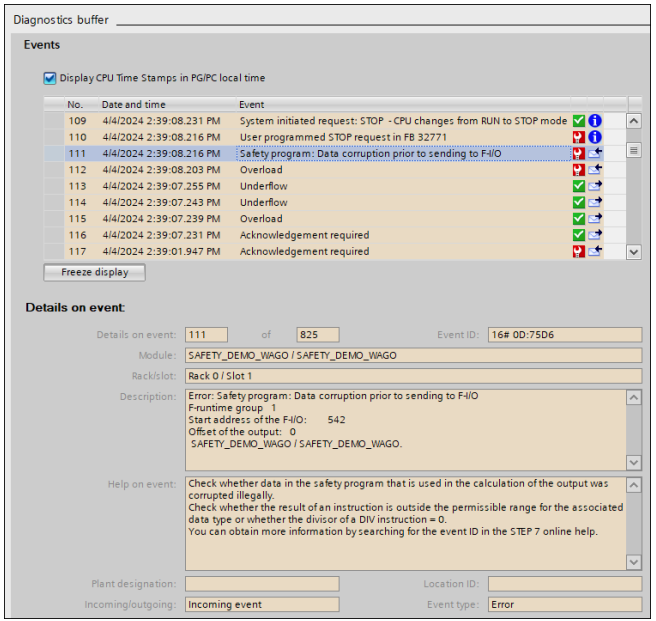
If data corruption occurs, then one of the following error messages is displayed in the diagnostics buffer: "Data corruption before output to F IO (75D6)" or "Data corruption in the safety program before output to partner F-CPU (75D7)"

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/4FDO – Safety programming – Error Error-ID 16#75D6 (2)

- References F-CPU changes to STOP at functional test and using “FD_BACK”
  - ➢ Fault “wiring” / “integration” of FDBACK at application
  - ➢ References “wiring” inputs of “FDBACK”
    - ALL – Without structure values
    - ON – Local safety tag
    - FEEDBACK – Digital input feedback “%Ix.x”
    - QBAD_FIO – Channel status “%Ix.x”
  - ➢ References programming enable with “ON”
    - Without structure values
    - Only local safety tags
  - ➢ Additional references available at “troubleshooting programming”



Attention should be paid to the technical manuals !

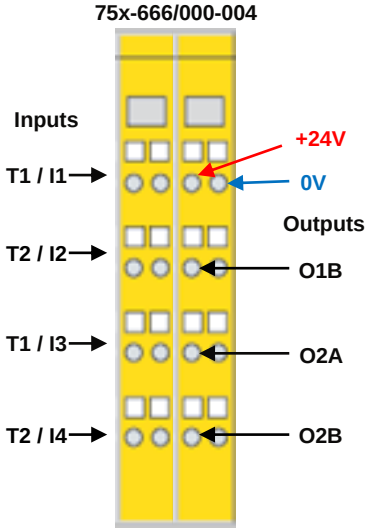
SUMMARY

1. Power Supply – Power supply concept
2. Safety inputs
3. Safety outputs – 4FDI/4FDO
4. Safety outputs – 4FDI/2FDO
5. Contactors with reduction of “closing power” and “holding power”
6. Control SEW drives

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Abstract

- Output module with 2 safety semiconductor outputs
  - Own power supply 24V for outputs
  - Independent usage of outputs



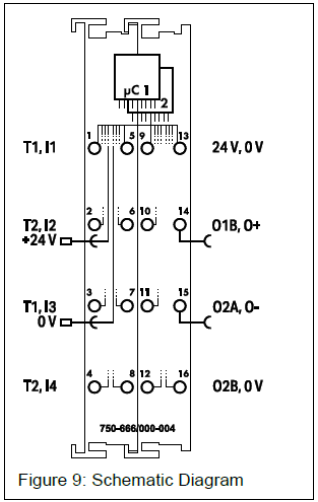


Figure 9: Schematic Diagram

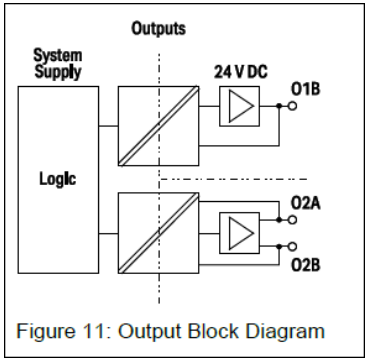


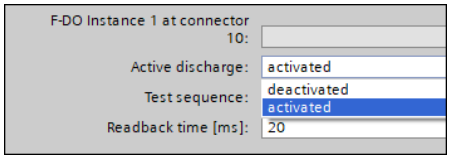
Figure 11: Output Block Diagram

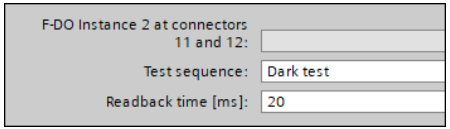
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Module parameter (1)

- Active discharge at F-DO 1
  - ➢ “Discharge” of capacitive load at connection “O+”
  - ➢ Parameter
    - Activated – Function activated
    - Deactivated – Function deactivated – Behavior like generation 3
    - ***Default settings “Activated”***
  - ➢ Reference technical manual





7.3.6.2 Active Discharge

If the **Active discharge** parameter is set to the value “activated,” then higher discharge current briefly flows upon switch-off to support larger capacitive loads. This function is supported exclusively for connection O1.

NOTICE

Maximum switching frequency when discharge activated

If the **Active discharge** parameter is set to the value “activated,” the maximum switching frequency allowed for the digital output is 0.1 Hz. Otherwise, the F I/O module may overheat.

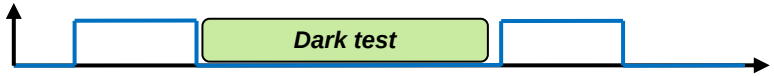
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

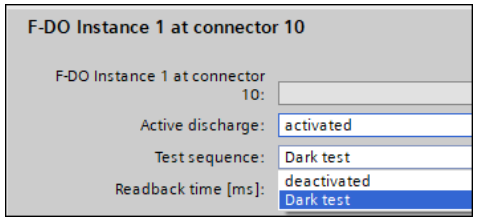
Safety outputs 4FDI/2FDO – Module parameter (2)

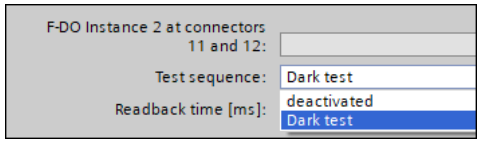
- Test sequence
  - ➢ Assign test sequence per output
  - ➢ Parameter
    - ○ Deactivated

    - ○ Dark test



    - ○ ***Default settings "Dark test"***





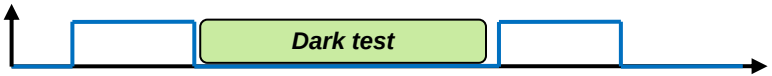
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Module parameter (3)

- References Test sequence
  - ➢ Deactivated
    - Without active test sequences

  - ➢ Dark test
    - Test pulse at active output
    - Test pulse length results from parameter "read-back time



Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Module parameter (4)

- References Test sequence – Technical manual

7.3.6.3 Dark Test Sequence

⚠ WARNING

Switch off digital outputs cyclically if test sequence deactivated
If the test sequence is deactivated, the output in question (e.g., O1) must be switched off at least once every 24 hours for at least the amount of time corresponding to the read-back setting. The output switch-off must be performed by the controller. It is sufficient if the switch-off is executed by the process itself, not controlled by a timer.

Each output can be monitored with cyclic diagnostic tests in addition to static monitoring. The cyclic diagnostic tests are performed at a diagnostic interval of 1 minute (in the event of an error, the diagnostic interval is reduced to 10 seconds).

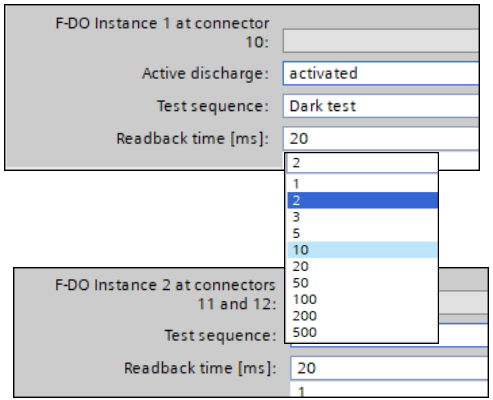
In the process, the dark test sequence tests whether an output that is switched on can still be switched off. The switch-off duration for a dark test of a safe output channel is at most the value of the **Readback time** parameter setting, but the F I/O module reduces it to the duration required for detecting the switch-off.

Attention should be paid to the technical manuals !

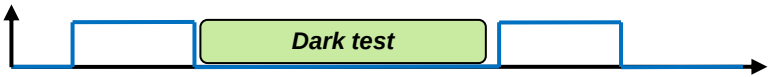
TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Module parameter (5)

- Readback time
  - ➢ Watchdog “readback function safety output”
  - ➢ Parameter
    - Modification in steps from 1ms
    - ***Default settings “1ms”***



  - ➢ References adjust readback time
    - Readback time = maximum length test pulse / switch off time safety output



    - Automatic adjustment to required duration = test pulse length for "shutdown detection"
    - Verification of setting by measuring test pulse length and voltage curve at the output

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Module parameter (6)

- References adjust readback time
  - ➢ Practical experiences
    - “Normal relay“ with freewheeling diode – test pulse length 2ms up to 5ms
    - Safety relay with internal power supply – test pulse length 5ms up to 20ms
  - ➢ Technical manual

7.6.2.10 Switching Capacitive and Electronic Loads

You can use the F I/O module to switch electronic loads (e.g., electronically controlled door locking devices).

In addition, capacitive loads can be switched according to the technical data. When switching capacitive loads, the diagnostic message “Short circuit to V_{cc}” or “Short circuit to GND” may occur. This can be fixed by increasing the read-back time and/or using active discharge; see section “Commissioning” > ... > “Adjustable Parameters for Digital Outputs” > “Active Discharge.”

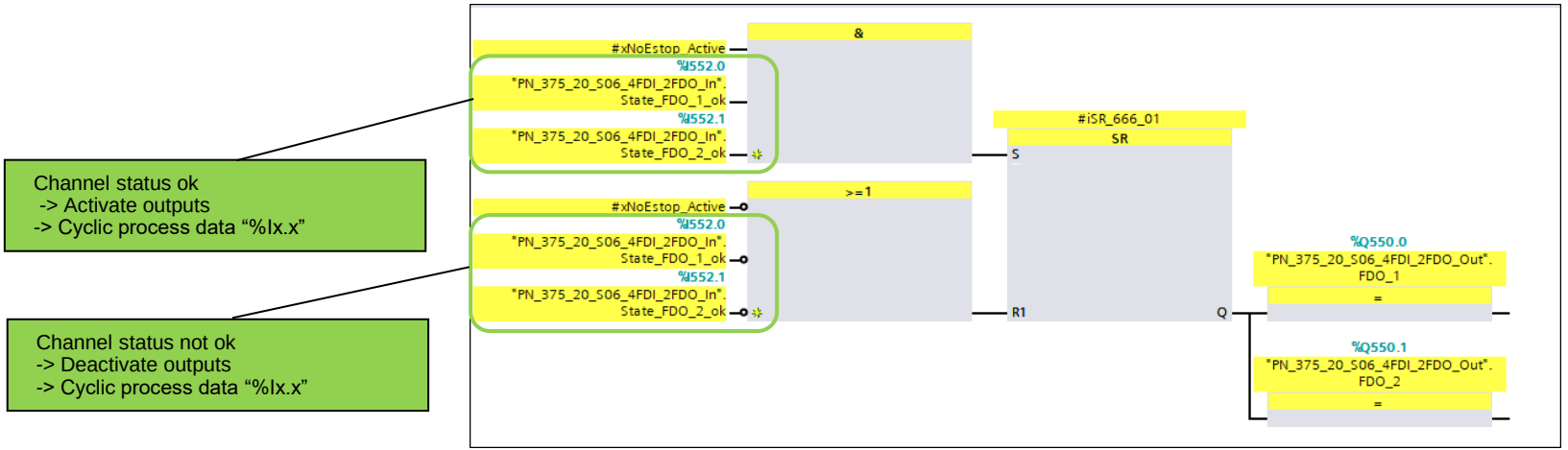
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Safety programming – Shutoff module error (1)

- Direct control of outputs without function block
  - ➢ Activation based on application requirements and channel state outputs

- Screenshot TIA project



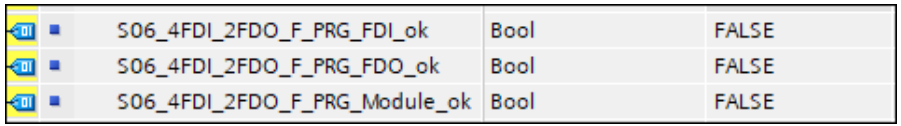
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Safety programming – Shutoff module error (2)

- Release control with module status
  - Data block with “module status – Safety programming”
  - Generate “module status – Safety programming”
  - Safety application – Using “module status – Safety programming”

- Data block information “module status – Safety programming”
  - Per PROFIsafe module information “FDI ok”, FDO ok” and “Module ok” required



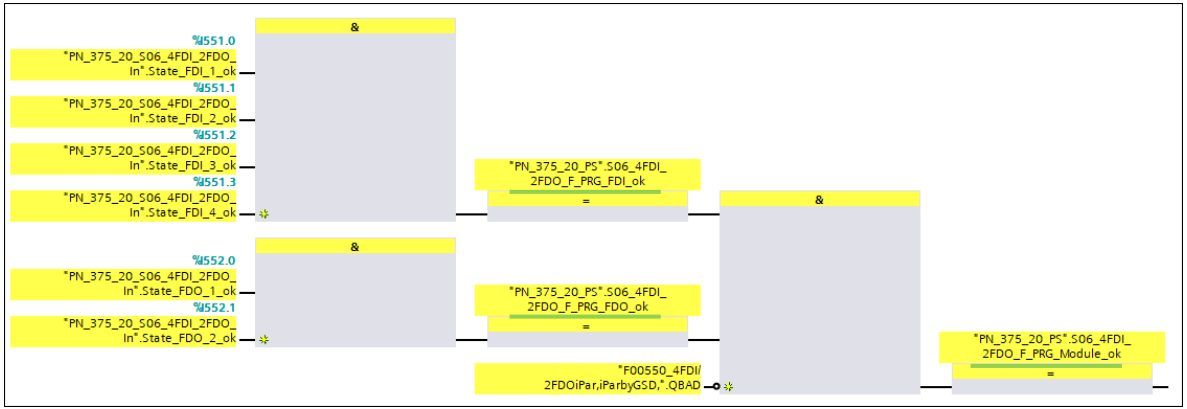
S06_4FDI_2FDO_F_PRG_FDI_ok	Bool	FALSE
S06_4FDI_2FDO_F_PRG_FDO_ok	Bool	FALSE
S06_4FDI_2FDO_F_PRG_Module_ok	Bool	FALSE

Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Safety programming – Shutoff module error (3)

- Generate “module status – Safety programming”
  - ➢ Call function at start of safety application – Generate “module status – Safety programming”

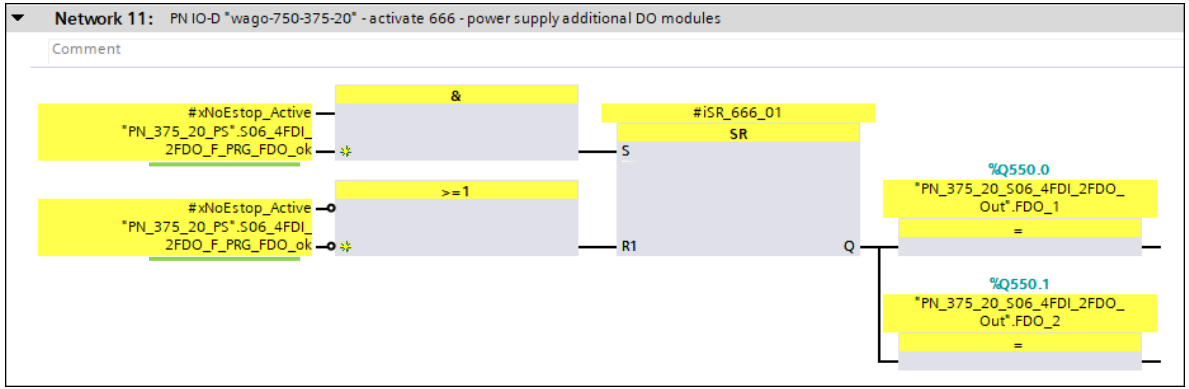


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Safety programming – Shutoff module error (4)

- Safety application – Using “module status – Safety programming”
  - ➢ Enable output control with “module status – Safety programming”

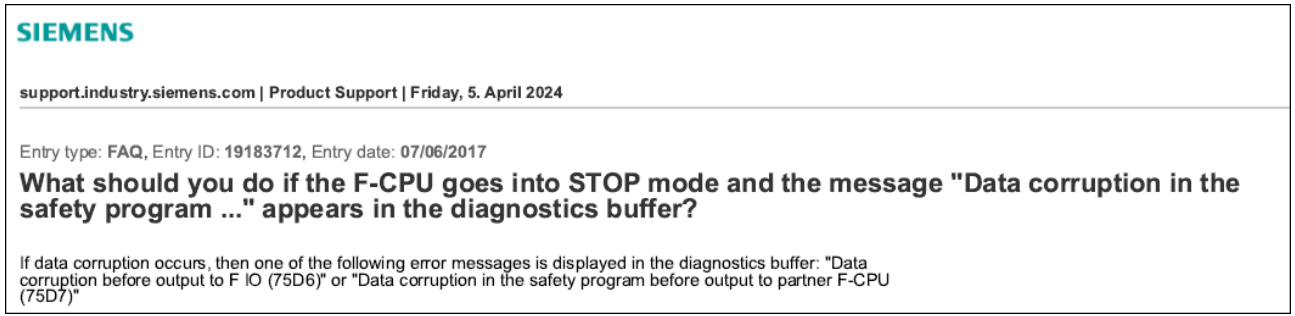


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Safety outputs 4FDI/2FDO – Safety programming – Error Error-ID 16#75D6

- Practical experience direct activation of safety outputs
  - ➢ Programming
    - Local safety tags & channel status based on input of periphery area “%Ix.x”
  - ➢ Functional test safety programming
    - Response application at error-free operation and module / channel error active at safety output
  - ➢ References F-CPU changes to STOP at functional test – Siemens FAQ ID 19183712



SIEMENS

support.industry.siemens.com | Product Support | Friday, 5. April 2024

Entry type: **FAQ**, Entry ID: **19183712**, Entry date: **07/06/2017**

What should you do if the F-CPU goes into STOP mode and the message "Data corruption in the safety program ..." appears in the diagnostics buffer?

If data corruption occurs, then one of the following error messages is displayed in the diagnostics buffer: "Data corruption before output to F IO (75D6)" or "Data corruption in the safety program before output to partner F-CPU (75D7)"

Attention should be paid to the technical manuals !

SUMMARY

1. Power Supply – Power supply concept
2. Safety inputs
3. Safety outputs – 4FDI/4FDO
4. Safety outputs – 4FDI/2FDO
5. Contactors with reduction of “closing power” and “holding power”
6. Control SEW drives

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Contactors with reduction of “closing and holding power” – General

- Fundamentals
  - New realization of topic “energy efficiency”
  - Substitution of “classic coil” with electronic components
  - Reduction of closing power and holding power at control

- Consequences
  - Changing behavior in combination with plc control

- References
  - Use contactor for “plc control” or “fail safe control”
  - Pay attention to references at the product manual
  - Pay attention to references “detection of open circuits” at safety outputs

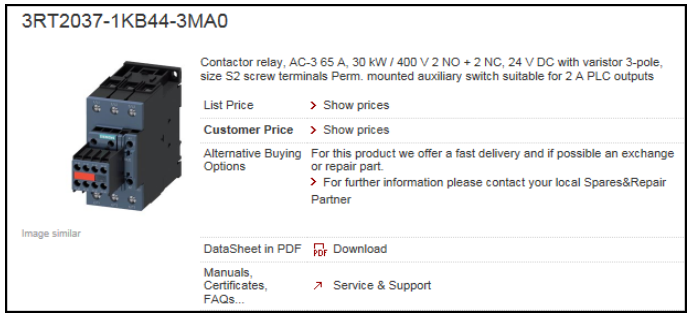
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Contactors with reduction of “closing and holding power” – Example Siemens 3RT (1)

- General
  - Customer request – use Siemens 3RT contactor
  - Reduction of closing power and holding power
  - Controlled with safety output

- Information
  - Technical manual contactor assemblies SIRIUS 3RT from 09/2017
  - Siemens Mall information 3RT2037

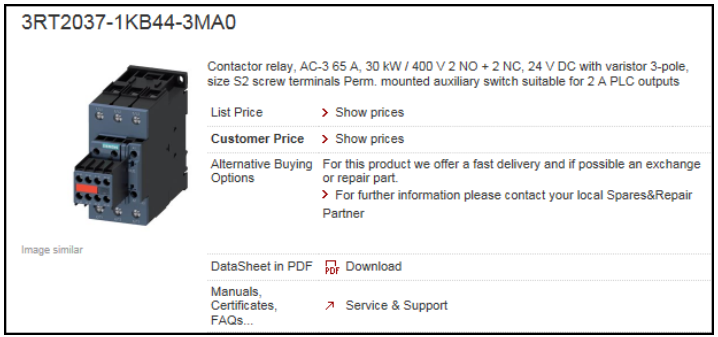


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Contactors with reduction of “closing and holding power” – Example Siemens 3RT (2)

- Available information
  - ➢ Siemens Mall 3RT2037
    - Suitable for 2A PLC outputs



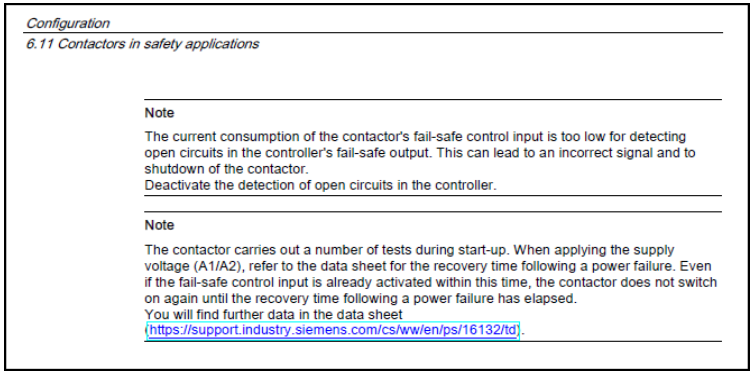
3RT2037-1KB44-3MA0

Image similar

Contactor relay, AC-3 65 A, 30 kW / 400 V 2 NO + 2 NC, 24 V DC with varistor 3-pole, size S2 screw terminals Perm. mounted auxiliary switch suitable for 2 A PLC outputs

List Price	› Show prices
Customer Price	› Show prices
Alternative Buying Options	For this product we offer a fast delivery and if possible an exchange or repair part. › For further information please contact your local Spares&Repair Partner
DataSheet in PDF	Download
Manuals, Certificates, FAQs...	Service & Support

  - ➢ References technical manual SIRIUS 3RT
    - Deactivation detection of open circuits
    - Pay attention to recovery time



Configuration

6.11 Contactors in safety applications

Note

The current consumption of the contactor's fail-safe control input is too low for detecting open circuits in the controller's fail-safe output. This can lead to an incorrect signal and to shutdown of the contactor.
Deactivate the detection of open circuits in the controller.

Note

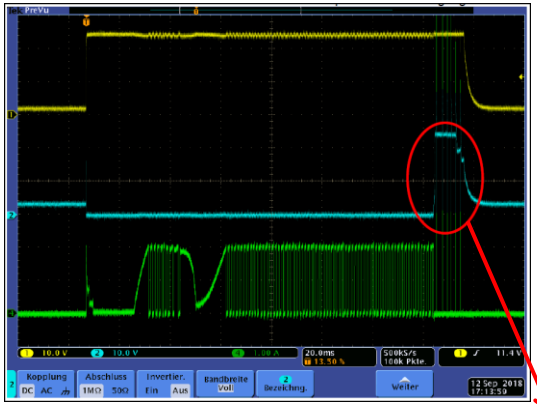
The contactor carries out a number of tests during start-up. When applying the supply voltage (A1/A2), refer to the data sheet for the recovery time following a power failure. Even if the fail-safe control input is already activated within this time, the contactor does not switch on again until the recovery time following a power failure has elapsed.
You will find further data in the data sheet {https://support.industry.siemens.com/cs/ww/en/ps/16132/td}.

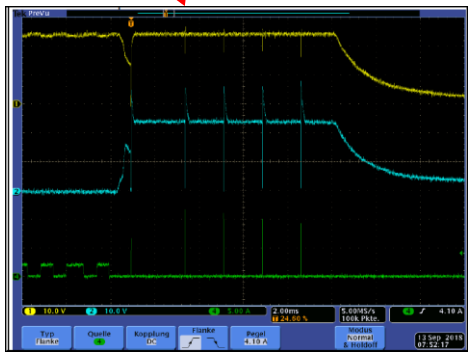
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Contactors with reduction of “closing and holding power” – Example Siemens 3RT (3)

- Behavior 3RT2037-1KB44 3MA0 – power on & test pulse
  - ➢ Contactor connect to O+ and O- at FDO
    - „1“ – Voltage FDO connection O+ / O-
    - „4“ – Current at current clamp
  - ➢ Recognitions
    - Current pulses of contactor changed at test pulse
    - Measurement current with peaks up to 13 A



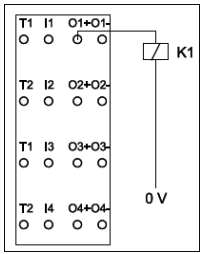


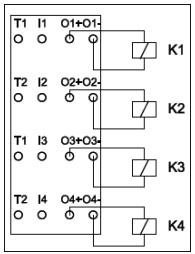
Attention should be paid to the technical manuals !

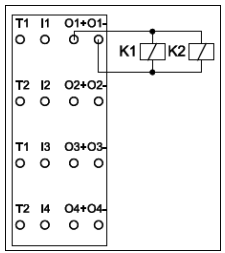
TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Contactors with reduction of “closing and holding power” – Example Siemens 3RT (5)

- Summary behavior 3RT2037-1KB44 3MA0
  - ➢ Contactor generates current peaks at power on and active test pulse in combination with safety outputs
  - ➢ Peculiarities not shown at the technical manual
  - ➢ Use in combination with WAGO PROFIsafe module **4FDI/4FDO 75x-667/000-004**
    - Safety outputs generation 4 overloadable
    - Connection examples







    - Pay attention to technical manual

SUMMARY

1. Power Supply – Power supply concept
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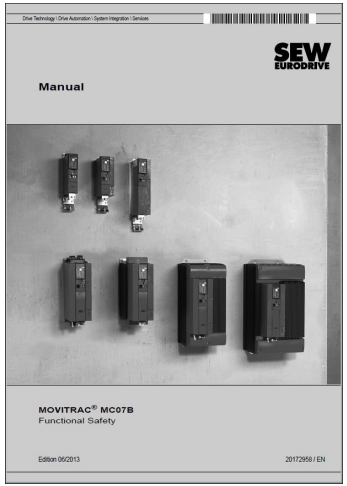
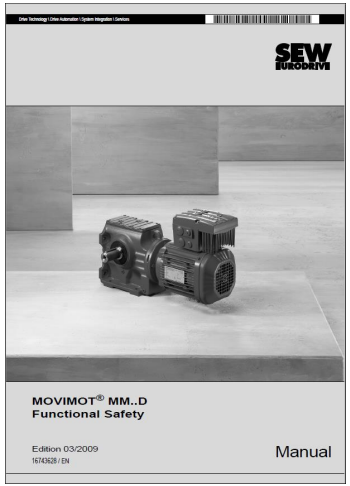
3. Safety outputs – 4FDI/4FDO
4. Safety outputs – 4FDI/2FDO
5. Contactors with reduction of “closing power” and “holding power”
6. Control SEW drives

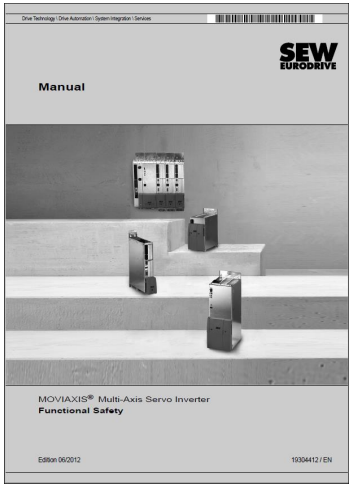
TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Control SEW drives – Fundamentals

- Requirements and opportunities
  - ➢ Fundamentals at technical manual of Co. SEW
  - ➢ Pay attention to suggestions and boundary conditions
  - ➢ Variant solution only in coordination with Co. SEW
- Extract available documents





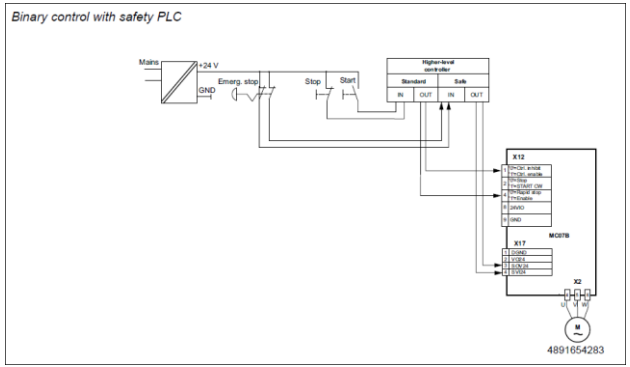


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

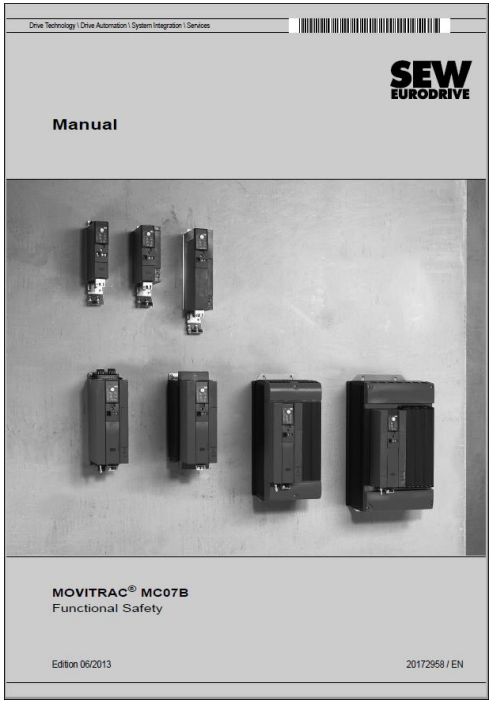
Control SEW drives – MOVITRAC (1)

- Extract technical manual MOVITRAC MC07B
  - ➢ Control with safety PLC – Screenshot page 22



  - ➢ Input capacitance X17:4 – Screenshot page 30

Input capacitance X17:4	Size 0: 27 µF Sizes 1 to 5: 270 µF

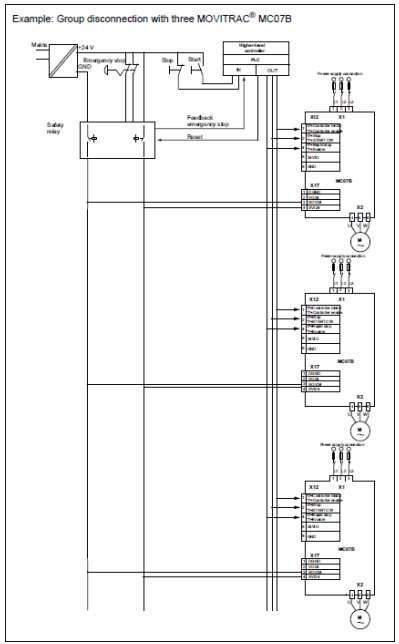


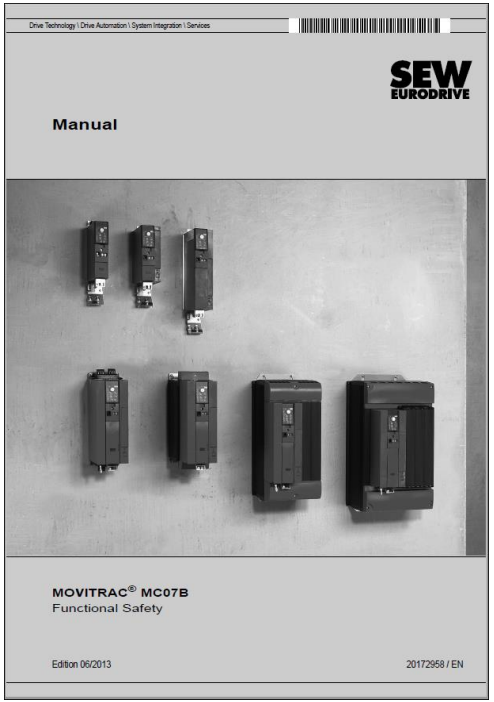
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Control SEW drives – MOVITRAC (1)

- Extract technical manual MOVITRAC MC07B
  - ➢ Group disconnection – Screenshot page 29



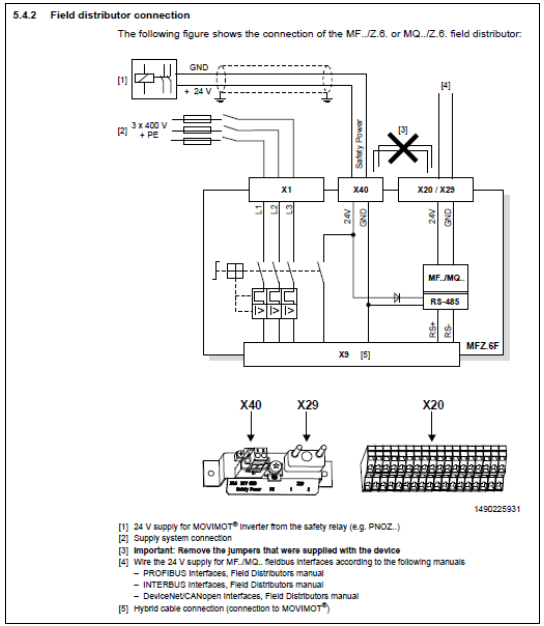


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Control SEW drives – MOVIMOT (1)

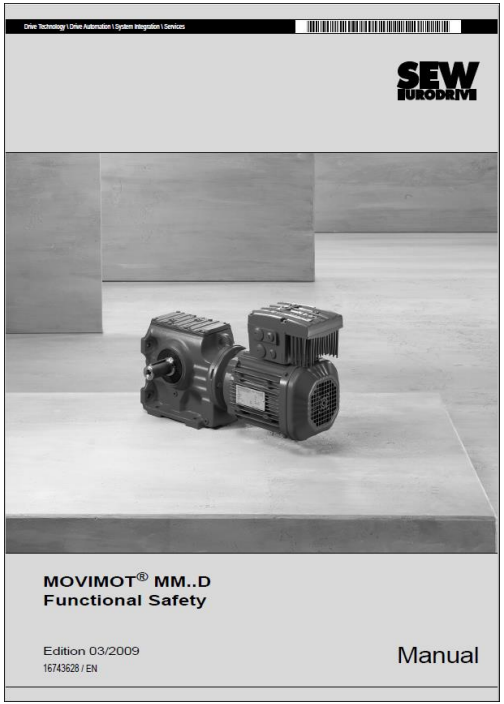
- Extract technical manual MOVIMOT MM..DD
  - ➢ Field distributer connection – Screenshot page 31



5.4.2 Field distributor connection

The following figure shows the connection of the MF../Z.6. or MQ../Z.6. field distributor:

[1] 24 V supply for MOVIMOT® inverter from the safety relay (e.g. PNOZ..)
[2] Supply system connection
[3] **Important: Remove the jumpers that were supplied with the device**
[4] Wire the 24 V supply for MF../MQ.. fieldbus interfaces according to the following manuals
– PROFIBUS Interfaces, Field Distributors manual
– INTERBUS Interfaces, Field Distributors manual
– DeviceNet/CANopen Interfaces, Field Distributors manual
[5] Hybrid cable connection (connection to MOVIMOT®)

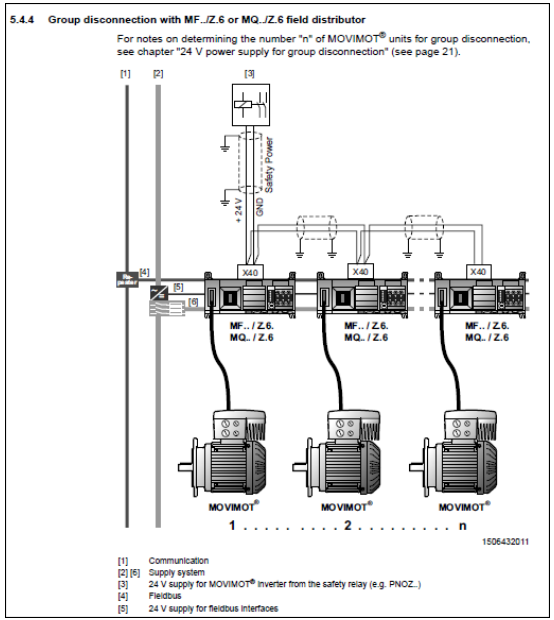


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Control SEW drives – MOVIMOT (2)

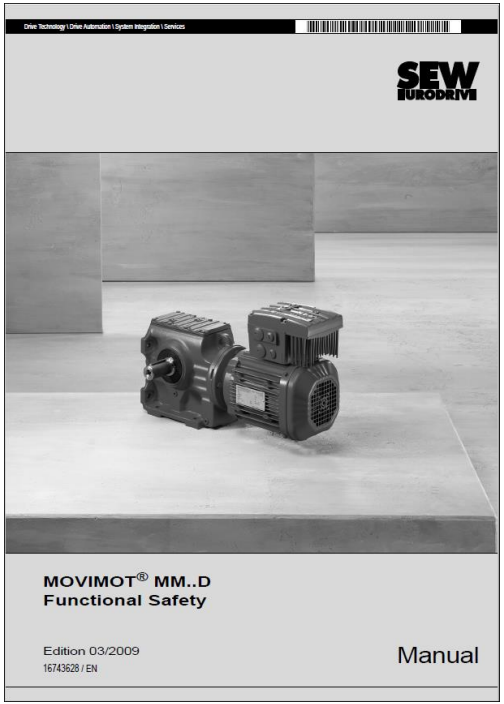
- Extract technical manual MOVIMOT MM..DD
  - ➢ Group disconnection – Screenshot page 33



5.4.4 Group disconnection with MF../Z.6 or MQ../Z.6 field distributor

For notes on determining the number "n" of MOVIMOT® units for group disconnection, see chapter "24 V power supply for group disconnection" (see page 21).

[1] Communication
[2] [6] Supply system
[3] 24 V supply for MOVIMOT® inverter from the safety relay (e.g. PNOZ..)
[4] Fieldbus
[5] 24 V supply for fieldbus interfaces

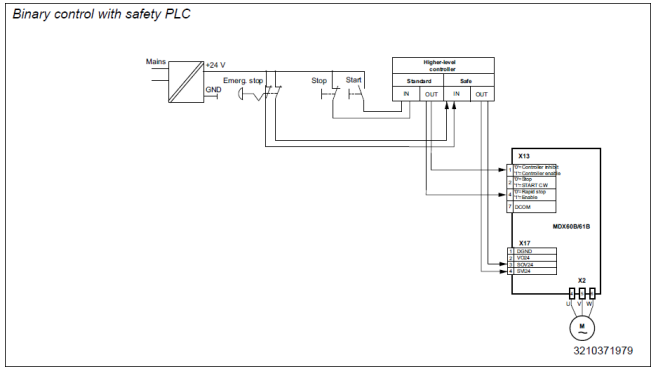


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

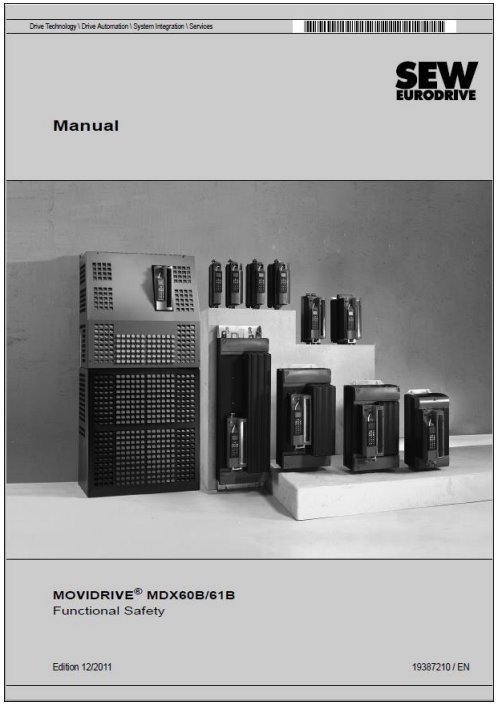
Control SEW drives – MOVIDRIVE (1)

- Extract technical manual MOVIDRIVE MDX60B/61B
  - ➢ Control with safety PLC – Screenshot page 22



  - ➢ Input capacitance X17:4 – Screenshot page 30

Input capacitance X17:4	Size 0: 27 µF Sizes 1 to 5: 270 µF

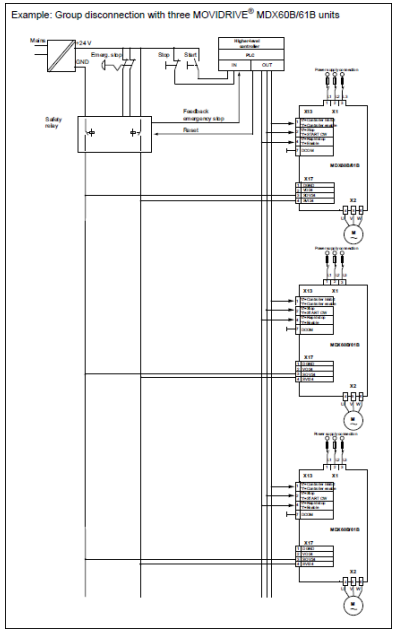


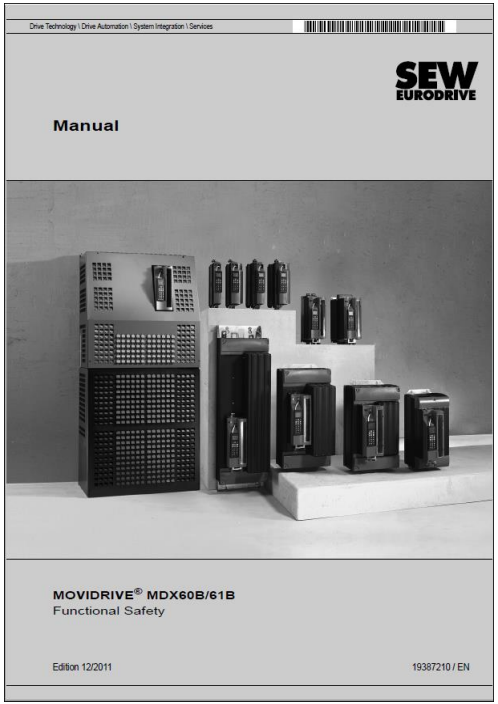
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Control SEW drives – MOVIDRIVE (2)

- Extract technical manual MOVIDRIVE MDX60B/61B
  - ➢ Group disconnection – Screenshot page 29



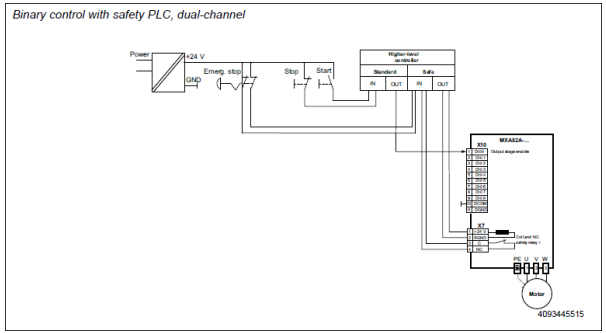


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

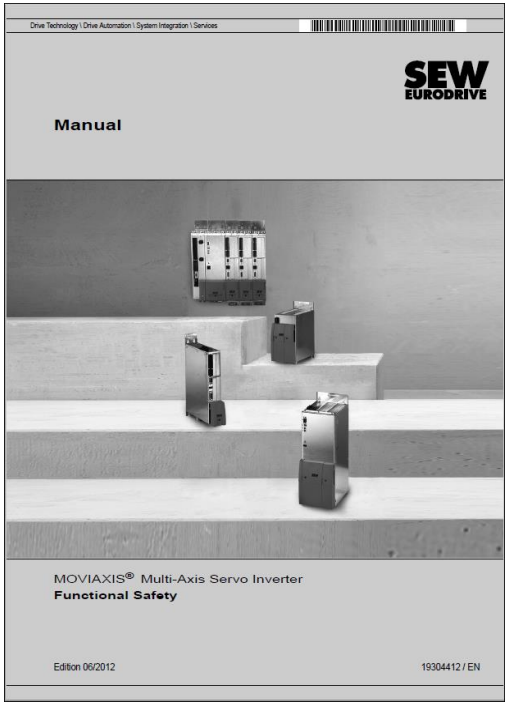
Control SEW drives – MOVIAXIS (1)

- Extract technical manual MOVIAXIS
  - ➢ Control with safety PLC – Screenshot page 25



  - ➢ Technical data – Screenshot page 40

Control voltage V_{24V} at the relay coil **Terminal X7; 1, 2** **Terminal X8; 1, 2**	DC +19.2 V to +30 V (> 15 mA) => relay coil energized DC -2 V to +2 V (> 2 mA) => relay coil dropped out safely Only use voltage sources with safe disconnection (SELV/PELV) in accordance with VDE 0100 for the control input at terminals 1 and 2.

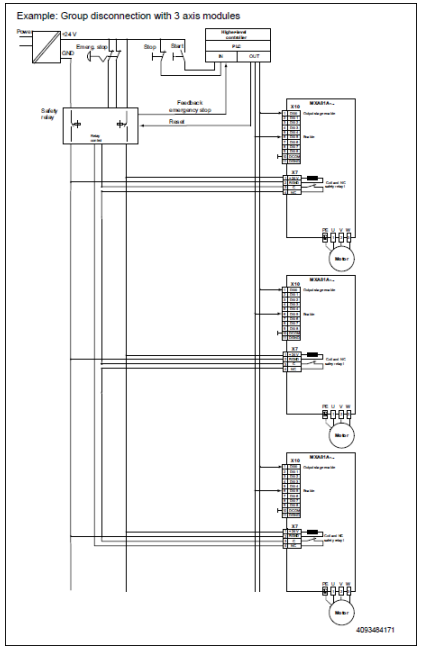


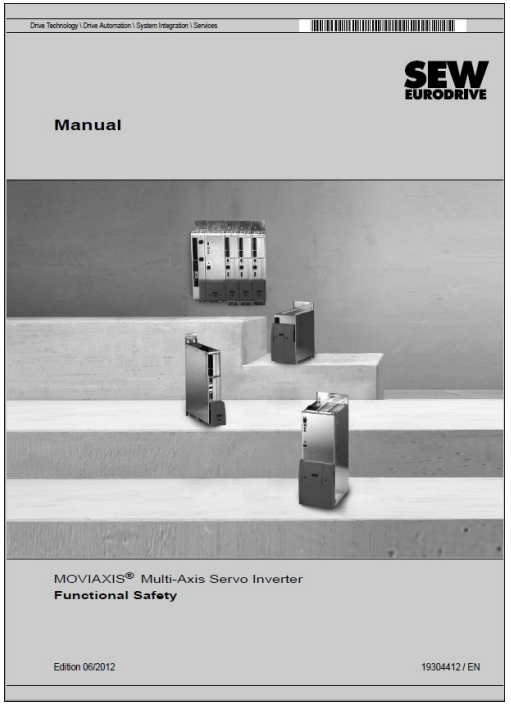
Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Control SEW drives – MOVIAXIS (2)

- Extract technical manual MOVIAXIS
  - ➢ Group disconnection – Screenshot page 37



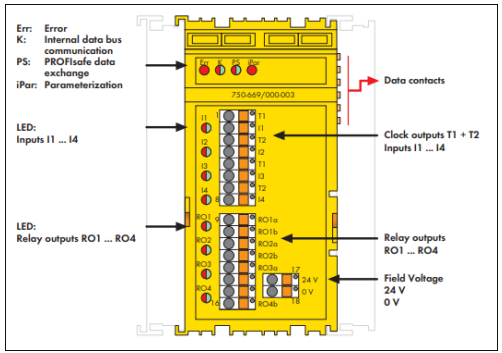


Attention should be paid to the technical manuals !

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Control SEW drives – Summary

- Requirements SEW drives
  - ➢ High input capacity of safety inputs present
  - ➢ Examples with safety relays per variant available
- Recommendation based on technical documentation of Co. SEW
  - ➢ Use WAGO PROFIsafe Module 4FDI / 4FRO – 750-669/000-003
    - o 4 safety relay outputs
    - o 4 safety inputs for additional feedback information



Technical Data	
Inputs:	
Sensor inputs	I1 ... I4; clock sensitive to T1 ... T2
	Type 1 acc. to IEC 61131
Input current (typ.)	2.2 mA
Input frequency (max.)	50 Hz
Outputs	
Outputs	Relay outputs: RO1 ... RO4;
	Isolation voltage: 48 VAC, 60 VDC
Load switching voltage range	5 V ... 60 V DC (SELV/PELV);
	5 V ... 48 V AC
Output current (per channel)	O1 ... O4: 6 A;
	Switching current range: 3 mA ... 6 A
	(compatible with the WAGO 75x-66x/
	000-003 PROFIsafe Modules)
Total output current	24 A
Switching delay	< 50 ms

Attention should be paid to the technical manuals !


WAGO

TROUBLESHOOTING PROFISAFE MODULES G4 – FDI AND FDO

Version information

Date	Version	
17.03.23	3.0	• New format of information
09.05.23	3.1	• Separate information 4FDI/4FDO and 4FDI/2FDO
10.04.24	3.2	• Update information activate FDO