Siemens Digital Industries Webinari

FA5: SIMATIC Safety

Današnji predavač

Darko Živković

Responsibility

Sales Engineer

Factory Automation – PLC, HMI, etc.

Focus: OEM, Motion Control

Sitrain training centre manager

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RC-RS DI FA

Belgrade, Serbia

Siemens Digital Industries Webinari, Novembar 2020.

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Datum	Tema	Predavač
03.11.2020.	DI1: Industry Mall & Online software delivery	*Mirko Milovanović*
10.11.2020.	FA5: SIMATIC Safety	*Darko Živković*
17.11.2020.	FA6: SIMATIC IPC	*Tamara Lazić*
24.11.2020.	FA7: SIMATIC IOT	*Zoran Jovanović*

Siemens Digital Industries: Webinari iz prvog ciklusa

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Materijal dostupan na web stranici:
https://new.siemens.com/rs/sr/kompanija/fairs-events/di-webinari.html

FA1: Motion Control	PI1: PI Academy world
FA2: Energy Management System	PI2: PI workshop for specialist
FA3: Redundantni kontroleri serije S7-1500R/H	PI3: #New@PI
FA4: WinCC Unified	AE1: Digitalna rešenja u procesnoj industriji
MC1: DT konfigurator	CP1: Control Panel Online Symposium
MC2: Sizer, large drives	CP2: Clever engineering in the control panel
MC3: Sizer, motion drives	CP3: New series of signaling devices 3SU
CI1: Industrial Networks	CP4: SIRIUS 3RW Soft starters
	DE1: Siemens Digital Enterprise

SIMATIC Safety

Beograd 10.11.2020.

Agenda

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1 **System overview**

2 S7-1500 Controller

3 ET 200

4 Module evaluation and addressing

5 Application samples and tools

How can a user satisfy functional safety requirements? Through the use of an additional system?

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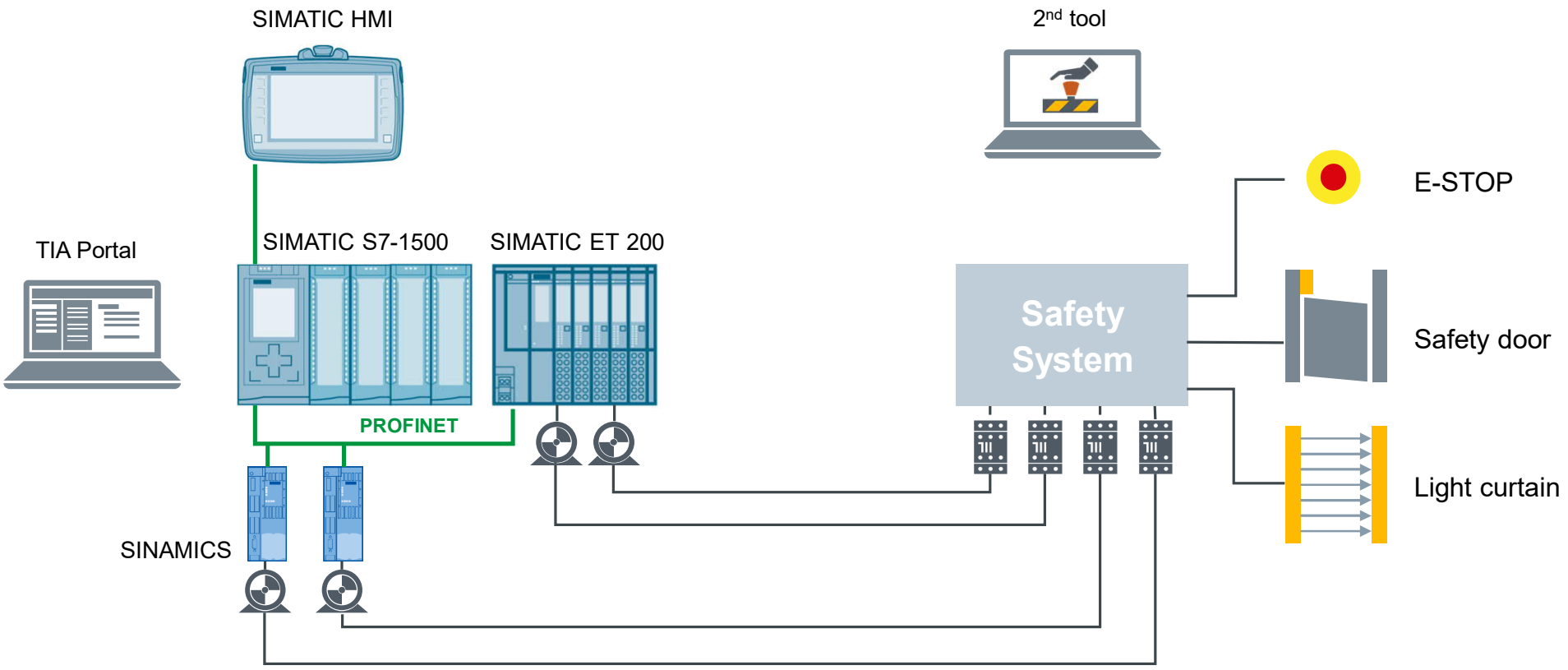

How can a user satisfy functional safety requirements? What are the advantages of SIMATIC Safety Integrated?

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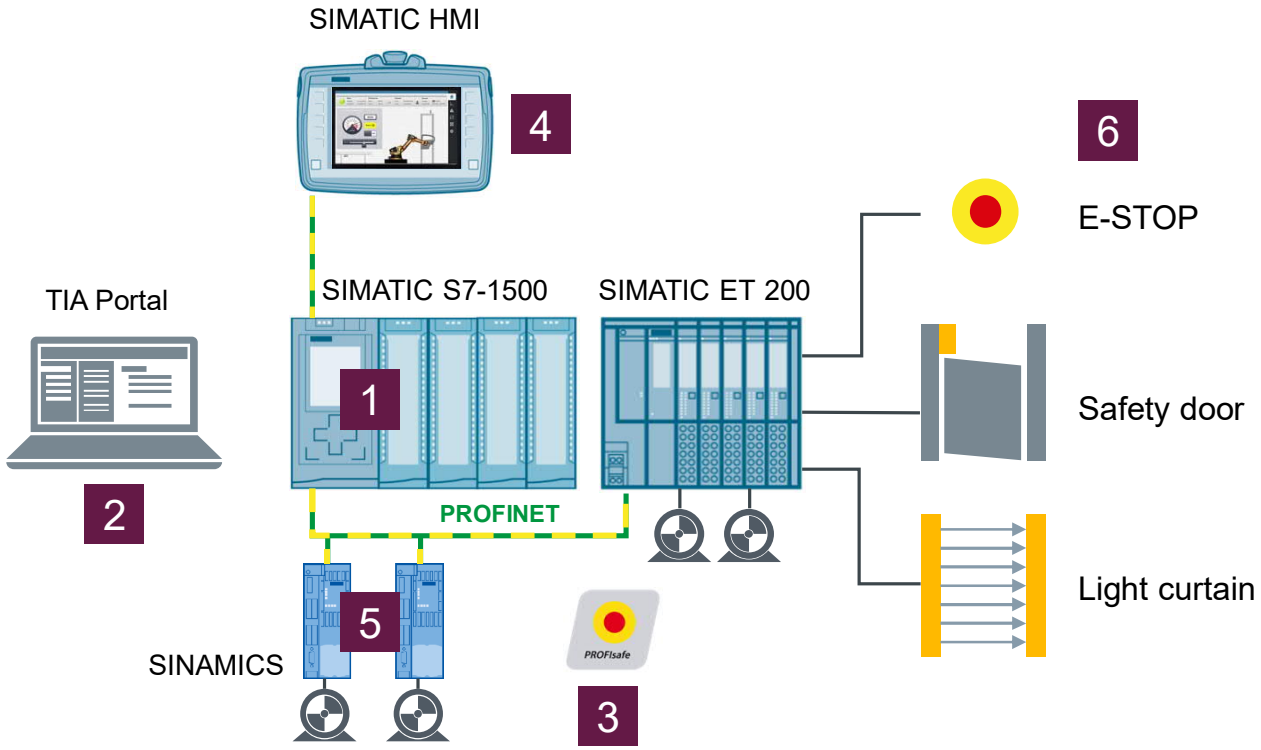

1 One controller

2 One engineering

3 One network

4 Powerful diagnostics

5 SINAMICS Integrated safety functions

6 Flexibility

Second generation of SIMATIC Safety – SIMATIC Safety in the TIA Portal

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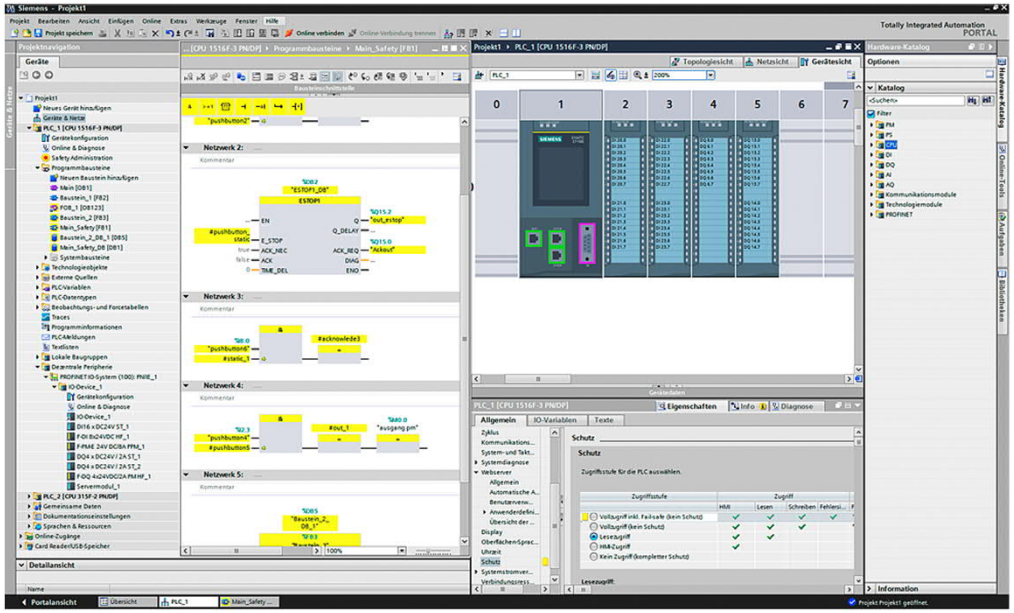
Fail-safe engineering



STEP 7 Safety Basic and Advanced

Fail-safe controller

SIMATIC S7-1500

Fail-safe I/O

SIMATIC ET 200

Agenda

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1 System overview

2 **S7-1500 Controller**

- 2.1 Overview
- 2.2 Access protection
- 2.3 Webserver
- 2.4 Onboard display

3 ET 200

4 Module evaluation and addressing

5 Application samples and tools

Agenda

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1 System overview

2 S7-1500 Controller

- 2.1 **Overview**
- 2.2 Access protection
- 2.3 Webserver
- 2.4 Onboard display

3 ET 200

4 Module evaluation and addressing

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SIMATIC S7-1500 with Safety Integrated – Setup of a safety system

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Safety system

Detection | **Evaluation** | **Response**

Recording an event
(process or human command)

F-DI
- Reads in the switching signal
- Safety-related sensor diagnostics
- Provides the input signal via process image

F-CPU
- Logical linking of safety functions
- Provides the output signal via process image

F-DQ
- Switching the control circuit
- Safety-related diagnostics of the output channel and of the actuator

Switching off the power unit of the drive

Note
Evaluation of the safety system with Siemens **Safety Evaluation Tool (SET)** →

SIMATIC S7-1500 with Safety – Integrated coded processing

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Classical principle of an F-controller: Structural redundancy (HFT)

- Two (or more) identical controllers
- All are executing the same program
- Results are compared

e.g. S5-95F

Principle of Safety Advanced F-controllers: Coded processing

- Generates a coded user F-program via the F-Compiler (diversity)
- Sequential program processing uncoded and coded (time redundancy)
- Results are compared

e.g. S7-1500

Implementation of fail-safety on a CPU (an individual processor with self-tests)

The SIMATIC Controller portfolio always provides the right controller - Plus integrated added value!

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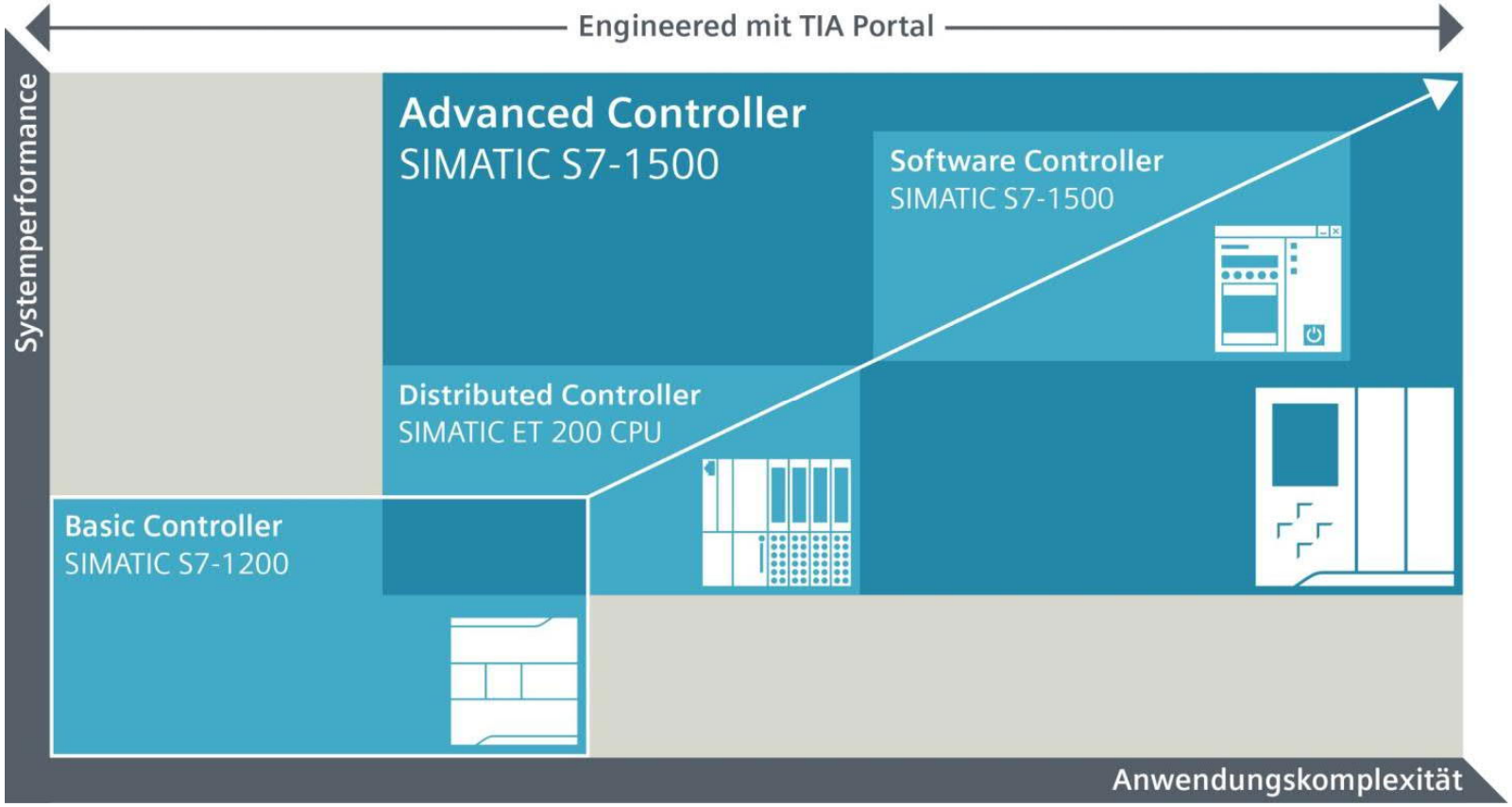

- Efficient engineering
- Innovative design
- Range of diagnostic options
- **Safety Integrated**
- Security Integrated
- Technology Integrated

Advanced Controller –
For expanded control applications

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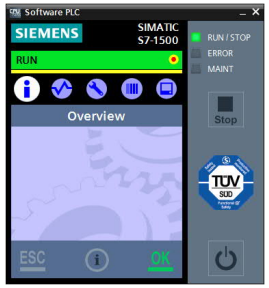
Feature/ function

- One controller for standard- and fail-safe automation
- F-runtime group for autonomous prioritization and timing settings
- All of the controllers with separate status display
- Additional password for the F-configuration and the F-program

Customer benefits

- Simplified CPU selection thanks to optimized portfolio
- Minimization of types and components
- Efficient engineering in the TIA Portal
- Diagnostic message without programming device
- Maximum protection against manipulation

S7-1500 fail-safe CPUs



Software Controller e.g. CPU1507S F

Distributed Controller –
For distributed control applications

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Feature/ function

- One controller for standard- and fail-safe automation
- Same software concept and features as a fail-safe SIMATIC S7-1500F CPU
- Compact design
- Centrally expandable with all of the standard and fail-safe modules of the ET 200SP or ET 200pro
- F-runtime group for autonomous prioritization and timing settings

Customer benefits

- Optimized solution for machines with distributed architecture
- Minimization of types and components
- Implement large projects in a small space
- Up to 1/3 gained space
- High functional density and small size
- Efficient engineering in the TIA Portal

Fail-safe ET 200 F-CPUs

Overview of SIMATIC S7-1500 – The right CPU for every application

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	Compact CPUs		Standard-CPUs						Technology CPUs				MFP
CPU types	**1511C-1 PN**	**1512C-1 PN**	**1511F-1 PN**	**1513F-1 PN**	**1515F-2 PN**	**1516F-3 PN/DP**	**1517F-3 PN/DP**	**1518F-4 PN/DP**	**1511TF-1 PN**	**1515TF-2 PN**	**1516TF-3 PN/DP**	**1517TF-3 PN/DP**	**1518F-4 PN/DP MFP**
Interfaces	1 1	1 1	1 1	1 1	1 2 1	1 2 1	1 2 1	1 2 1 3	1 1	1 2 1	1 2 1	1 2 1	1 2 1 3
Program/ data storage	175 KB 1 MB	250 KB 1 MB	150/ 225 KB 1 MB	300/ 450 KB 1.5 MB	500/ 750 KB 3 MB	1/ 1.5 MB 5 MB	2/3 MB 8 MB	4/6 MB 20 MB	225/ 225 KB 1 MB	750/ 750 KB 3 MB	1.5/ 1.5 MB 5 MB	3/3 MB 8 MB	4/6 MB 20 MB 50 MB[1]
Bit-performance	60 ns	48 ns	60 ns	40 ns	30 ns	10 ns	2 ns	1 ns	60 ns	30 ns	10 ns	2 ns	1 ns
Max. number of connections	96	128	96	128	192	256	320	384	96	192	256	320	384
Positioning axes • **Typical[2]** • **Maximum[2]**	 5 10	 5 10	 5 10	 5 10	 7 30	 7 30	 70 128	 128 128	 5 10	 7 30	 65 80	 70 128	 128 128
Width	85 mm	110 mm	35 mm	35 mm	70 mm	70 mm	175 mm	175 mm	35 mm	70 mm	175 mm	175 mm	175 mm

[1] Additional 50 MB memory for ODK applications; [2] For 4ms Servo/IPO cycle

Overview of SIMATIC S7-1500 – The right CPU for every application

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	Distributed Controller			Software Controller		
CPU types	**1510SP F-1 PN**	**1512PN F-1 PN**	**1516pro F-2 PN**	**1505SP PC 2(F)**	**1507S (F)**	**1508S (F)**
Interfaces						
Program/ data storage	100/ 150 KB 750 KB	200/ 300 KB 1 MB	1 MB/ 1,5 MB 5 MB	1/ 1,5 MB 5 MB	5/ 7,5 MB 20 MB	10/ 12,5 MB 100 MB
Bit-performance	72 ns	48 ns	10 ns	10 ns	1 ns[2]	1 ns[2]
Max. number of connections	96	128	96	88	128	192
Positioning axes • **Typical**[1] • **Maximum**[1]	 5 10	 5 10	 5 10	 30	 30[2]	 30[2]
Width	100 mm	100 mm	135 mm	160 mm		

[1] For 4ms Servo/IPO cycle; [2]auf IPC427E

Agenda

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1 System overview

2 S7-1500 Controller

- 2.1 Overview
- **2.2 Access protection**
- 2.3 Webserver
- 2.4 Onboard display

3 ET 200

4 Module evaluation and addressing

5 Application samples and tools

SIMATIC S7-1500 with Safety Integrated
CPU/program protection

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Any user can read and change the hardware configuration and the blocks

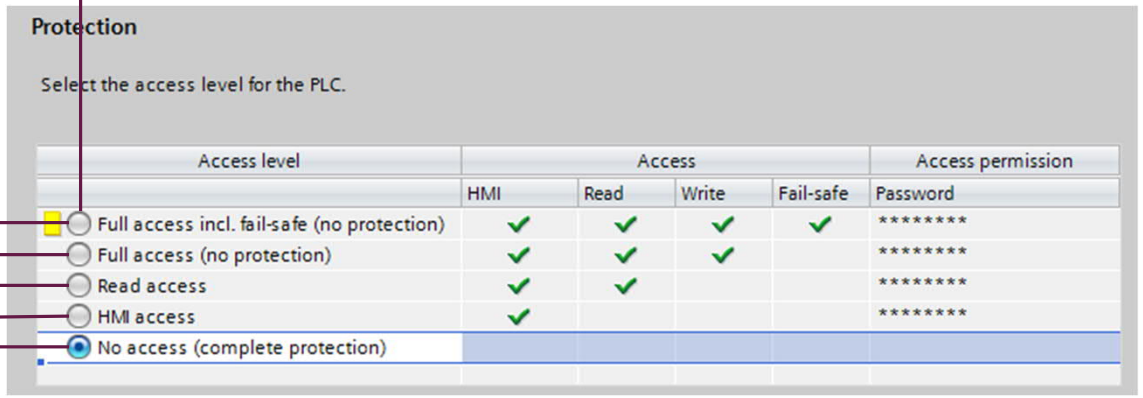
The standard protection level is "No protection"

Password only for fail-safe part

Read-only

HMI communication is possible

Complete protection



SIMATIC S7-1500 with Safety Integrated
CPU/program protection

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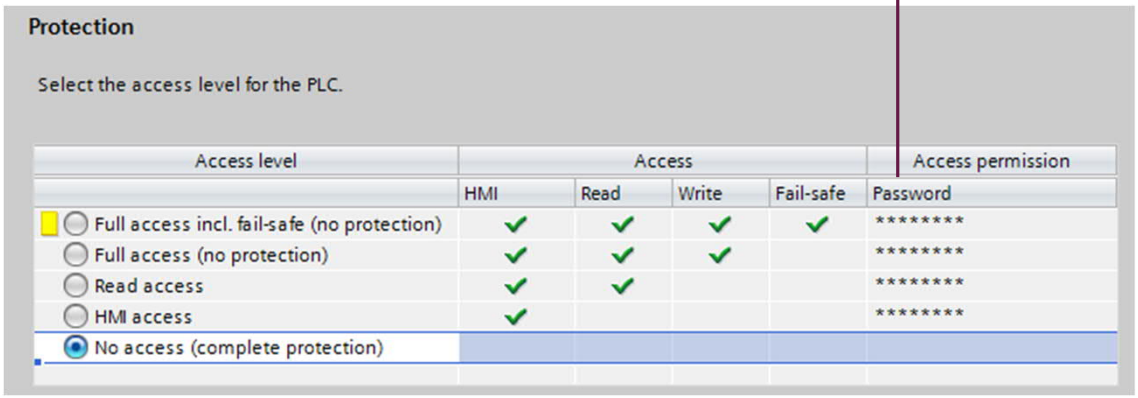
Separate password protection for every access level (e.g. for different user groups)



Agenda

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1 System overview

2 S7-1500 Controller

- 2.1 Overview
- 2.2 Access protection
- **2.3 Webserver**
- 2.4 Onboard display

3 ET 200

4 Module evaluation and addressing

5 Application samples and tools

SIMATIC S7-1500 with Safety Integrated
Web server – representation of the safety data

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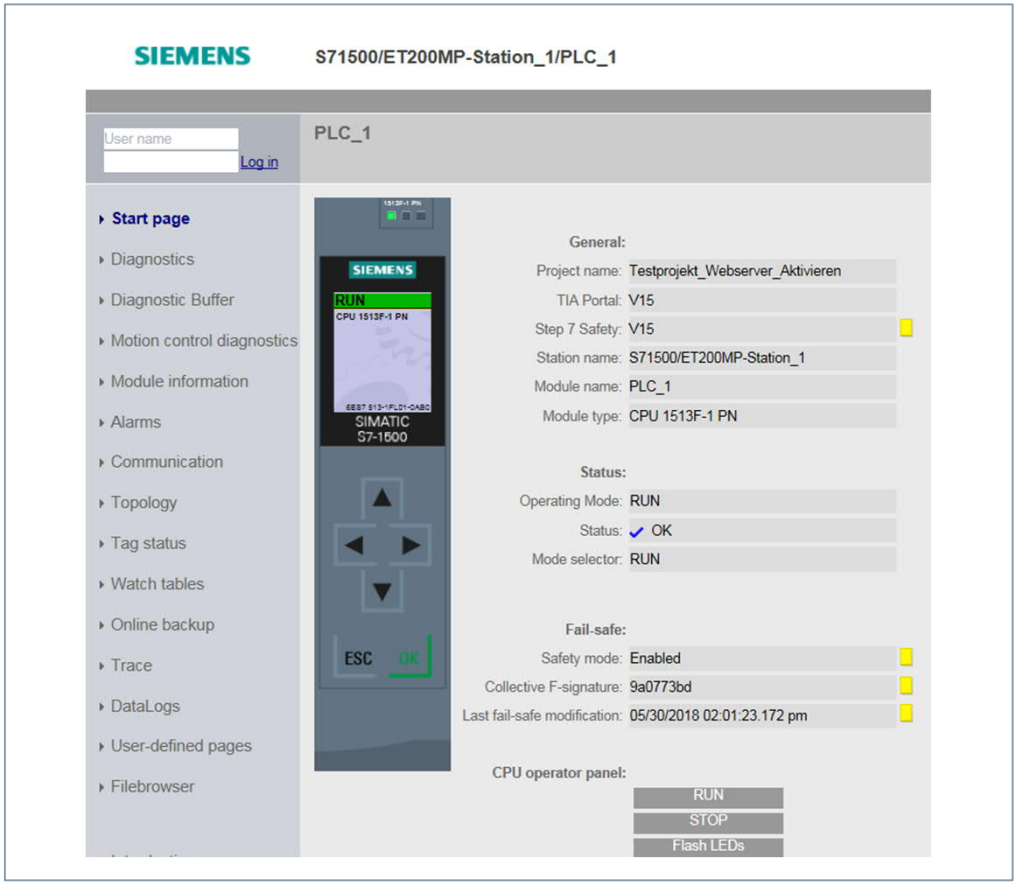
With the activation of the web server, the following information is available on the start page

- TIA Portal and STEP 7 Safety versions
- Safety mode enabled/disabled
- Collective signature of the safety program
- CPU time stamp of the last change to the safety program



SIMATIC S7-1500 with Safety Integrated
Web server – representation of the safety data

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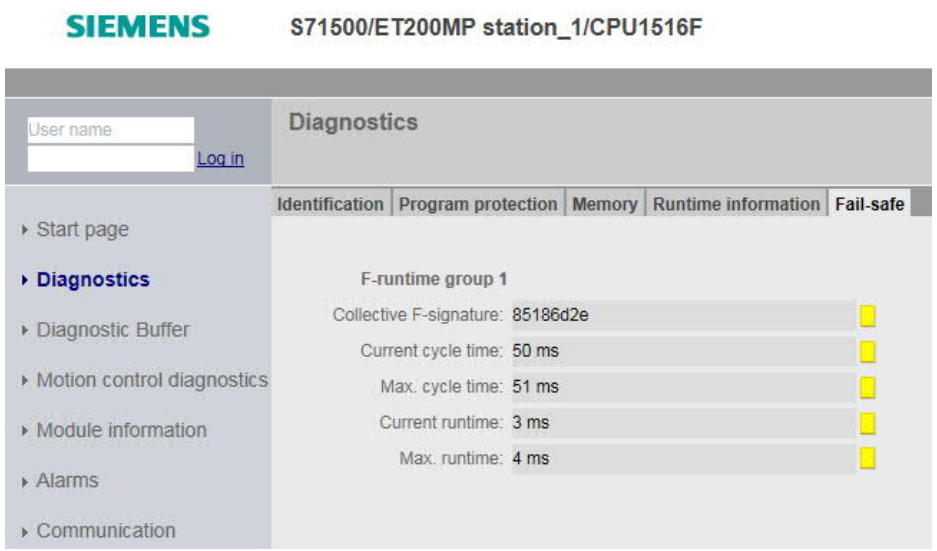
Information on the F-runtime group

- Name of the F-runtime group
- Collective F-signature
- Current cycle time
- Max. cycle time
- Current runtime
- Max. runtime



SIMATIC S7-1500 with Safety Integrated
Web server – representation of the safety data

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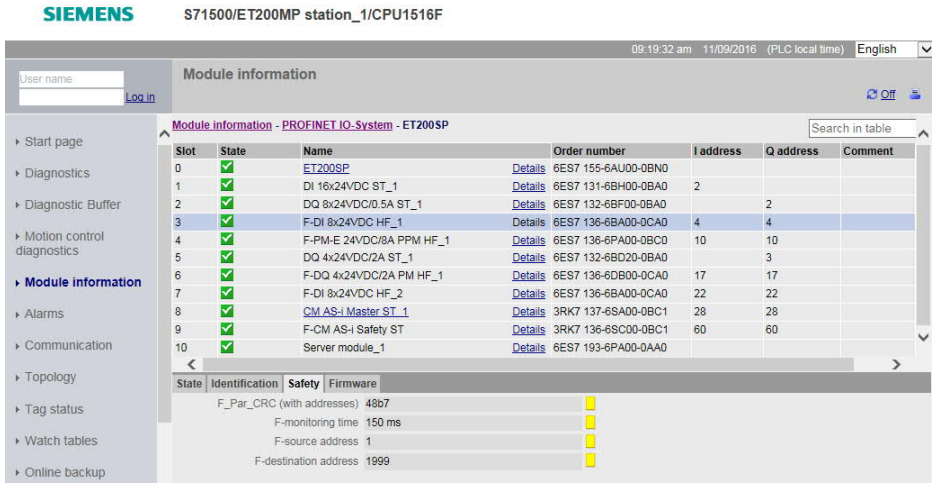
"Safety" tab of the module information of the F-I/O

- F-parameter signature (with PROFIsafe address)
- F-monitoring time
- F-source address
- F-destination address



SIMATIC S7-1500 with Safety Integrated
Web server – user administration

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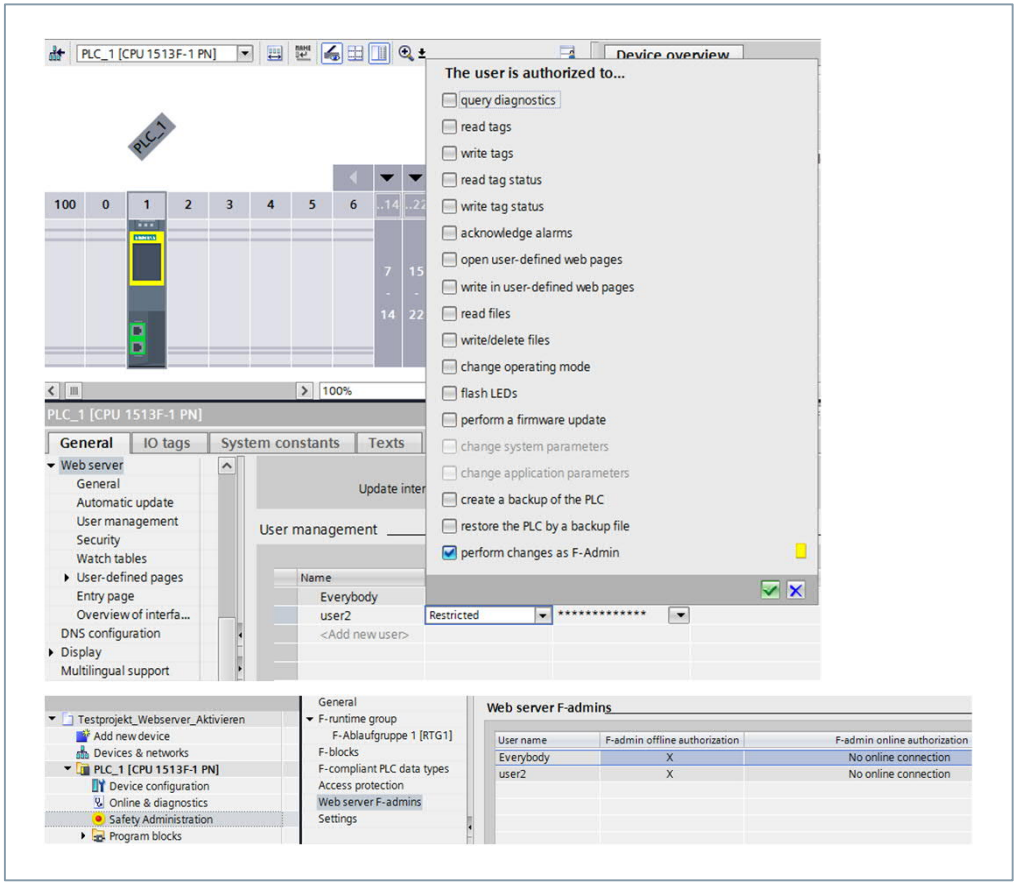
With the user administration of the Web server, there is the authorization "F-Admin"

- The F-Admin attribute does not provide any authorizations on its own
- The programmer can define which authorizations an F-Admin has
- All of the F-Admins are listed in the Safety Administration



Agenda

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1 System overview

2 S7-1500 Controller

- 2.1 Overview
- 2.2 Access protection
- 2.3 Webserver
- **2.4 Onboard display**

3 ET 200

4 Module evaluation and addressing

5 Application samples and tools

SIMATIC S7-1500 with Safety Integrated
Display – representation of the safety data

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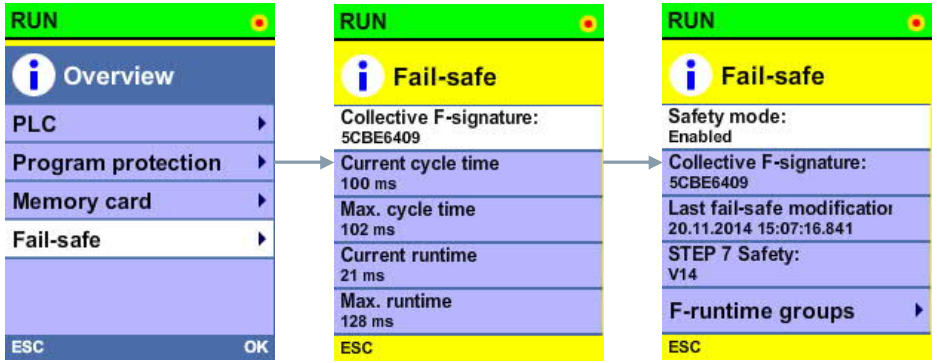
S7-1500 F-CPUs with a display show the following in the "Overview" menu under "Fail-safe"

- Safety mode enabled/disabled
- Collective F-signature
- Last fail-safe change
- The version of STEP 7 Safety that was used to compile the safety program
- Information on the F-runtime groups
  - Name of the F-runtime group
  - Collective F-signature
  - Current cycle time
  - Max. cycle time
  - Current runtime
  - Max. runtime



SIMATIC S7-1500 with Safety Integrated
Display – representation of the safety data

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For each F-I/O, the following is displayed under "Fail-safe parameters"

- F-parameter signature (with address)
- Safety mode
- F-monitoring time
- F-source address
- F-destination address

The following, additional menu item is displayed in the "Settings" menu under "Protection"

- Enable/disable F-password
  → This makes it possible to prevent access to the CPU in RUN, even if the F-password is known

Agenda

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1 System overview

2 S7-1500 Controller

3 **ET 200**

- 3.1 IP 20 - ET 200SP
- 3.2 IP 20 - S7-1500/ ET 200MP
- 3.3 IP 65 - ET 200eco PN

4 Module evaluation and addressing

5 Application samples and tools

Agenda

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1 System overview

2 S7-1500 Controller

3 ET 200

- 3.1 **IP 20 - ET 200SP**
- 3.2 IP 20 - S7-1500/ ET 200MP
- 3.3 IP 65 - ET 200eco PN

4 Module evaluation and addressing

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ET 200SP –
Optimal use of the space in the control cabinet

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Investment protection	Easily add fail-safe modules to the standard I/O
Easy commissioning	PROFIsafe address is configured via the software and saved in the coding element
Easy device replacement	PROFIsafe address is automatically imported from the intelligent coding element
High availability	• Onboard signal test: short circuit, wire break • Easy and quick fault localization by means of fine-granular error messages in plain text
Optimal utilization of the control cabinet volume	• Reduction of the module width by 50% or more • Load group formation without power module

Control cabinet

ET 200SP – interface modules

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ET 200SP	IM DP HF	IM PN ST	IM PN HF
Number of modules	32	32	64
Fail-safe I/O modules	✓	✓	✓
Isochronous mode (synchronization with program cycle)	✓	✓	✓
Hot swapping	Multiple	Simple	Multiple
Media redundancy (MRP)	✗	✓	✓
Prioritized startup	✗	✓	✓
RUN with gaps	✓	✓	✓

ET 200SP –
Select right base unit for F-DI and F-DQ

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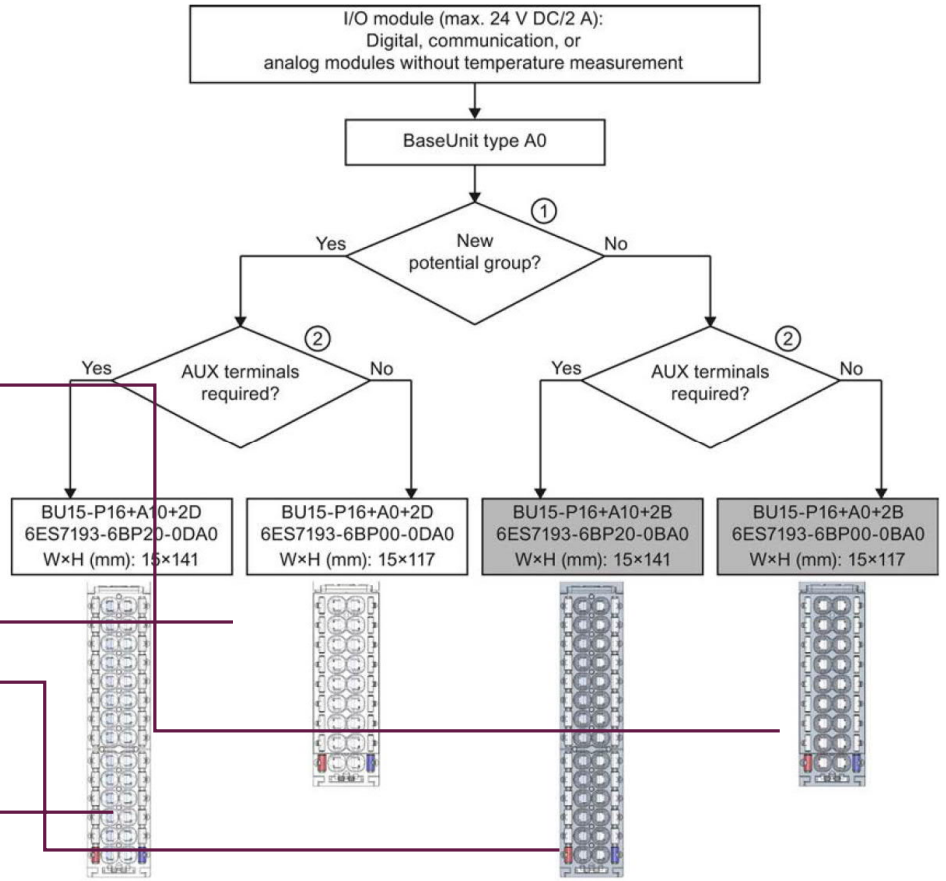
New potential group needed? → White base unit

Would you like to use the existing potential group? → Dark base unit

Base units with additional AUX terminals



ET 200SP –
Select right base unit for F-PM and F-RQ

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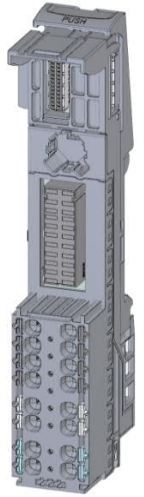
Establishes new potential group for collective shutdown

- Base unit: BU20-P6+A2+4D
- MLFB: 6ES7193-6BP20-0DC0

Power module F-PM-E PPM 24VDC/8A

Special base unit for F-RQ

- Base unit: BU20-P8+A4+0B
- MLFB: 6ES7193-6BP20-0BF0



Relay modules F-RQ 1x24VDC/24..230VAC/5A

ET 200SP –
Select right base unit

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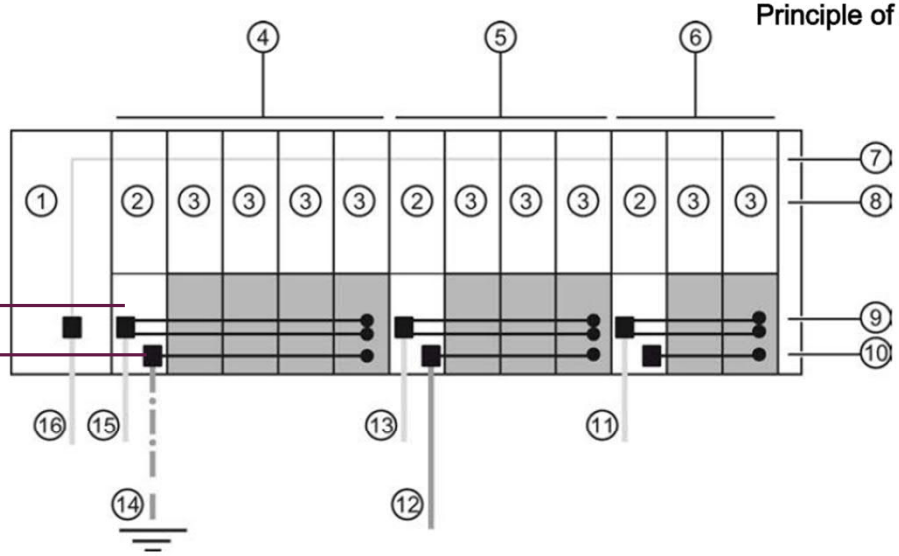
New potential group

AUX terminals connected

Principle of operation



①	Interface module	⑨	P1/P2 power buses
②	BaseUnit BU...D	⑩	AUX bus
③	BaseUnit BU...B	⑪	Supply voltage L+ (3)
④	Potential group 1	⑫	Additionally required voltage
⑤	Potential group 2	⑬	Supply voltage L+ (2)
⑥	Potential group 3	⑭	Protective conductor
⑦	Backplane bus	⑮	Supply voltage L+ (1)
⑧	Server module	⑯	Supply voltage 1L+

ET 200SP –
Select right base unit

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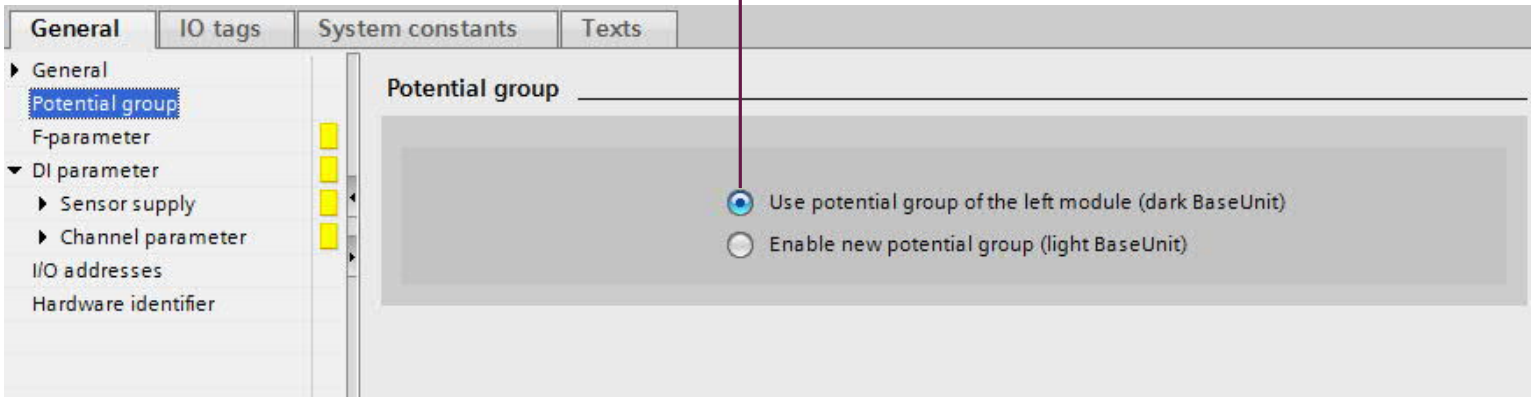
Select the right base unit in the hardware configuration

Select the right potential group



ET 200SP – Fail-safe digital input module F-DI 8x24VDC HF

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Properties

- Central/distributed application
- 8 inputs up to SIL 2 or 4 inputs up to SIL 3
- 8 outputs for encoder power supply
- Integrated diagnostics of the input circuit by means of short circuit and discrepancy evaluation
- External sensor supply possible
- Channel and module-wide passivation in the event of an error
- Chatter monitoring of the input signals
- Width: 15 mm

F-DI 8x24VDC HF

ET 200SP – F-DI 8x24VDC HF – interconnection possibilities

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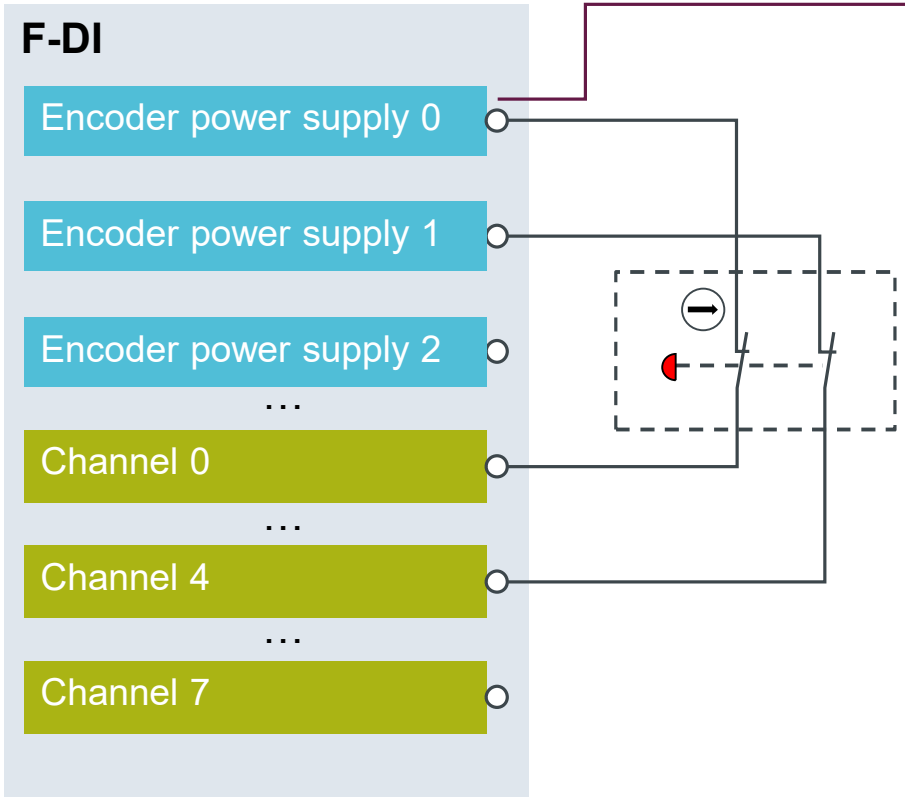
Emergency stop command device

Module diagnostics

- Two-channel evaluation (2v2), channels 0+4 form a channel group
  → 1 signal in the process image
- Internal encoder supply
- Short circuit monitoring
- Discrepancy monitoring

→ High diagnostics (up to SIL 3/PL e)



The encoder power supply can be assigned in any way per input

ET 200SP – F-DI 8x24VDC HF – interconnection possibilities

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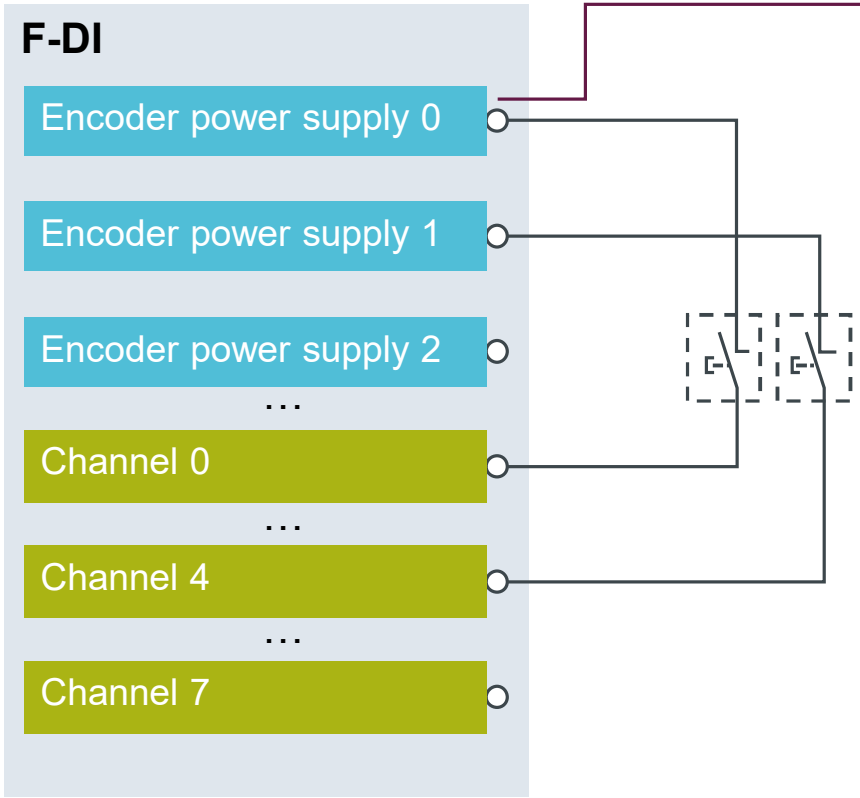
Two-hand operator control device

Module diagnostics

- Single-channel evaluation (1v1)
- Internal encoder supply
- Short circuit monitoring
- No discrepancy monitoring

→ High diagnostics (up to SIL 3/PL e)[1]



The encoder power supply can be assigned in any way per input

[1] When using the library's safety function "TWO_H_EN", observe EN574 Synchronization time: 500 ms

ET 200SP – F-DI 8x24VDC HF – interconnection possibilities

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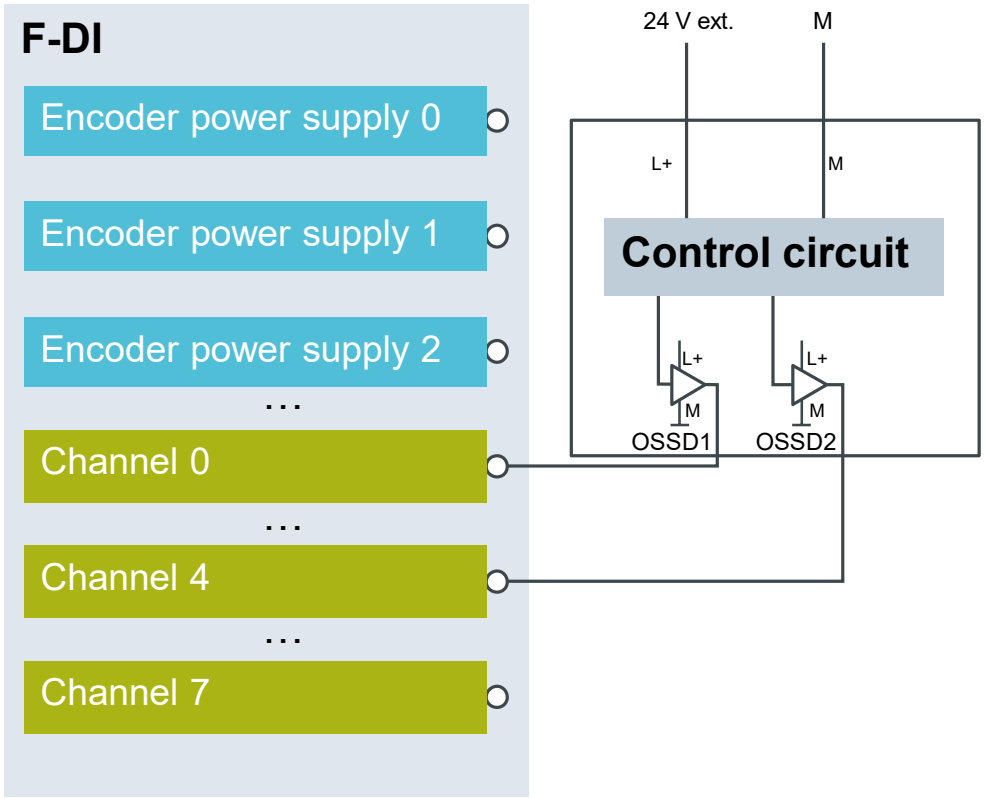
OSSD output (safety door switch or light curtain)

Module diagnostics

- Two-channel evaluation (2v2), channels 0+4 form a channel group
  → 1 signal in the process image
- External encoder power supply
- No short circuit monitoring of the module (integrated in sensor)
- Discrepancy monitoring

→ High diagnostics (up to SIL 3/PL e)



ET 200SP – Overview
Fail-safe digital output modules

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	F-DQ 4x24VDC/ 2A PM HF	F-DQ 8x24VDC/ 0.5A PP HF	F-RQ 1x24VDC/ 24..230VAC/5A	F-PM-E 24 V DC/ 8 A PPM
				
Number of F-outputs	4	8	1	1
Switching capacity	24 V DC/2 A	24 V DC/0.5 A	24 V DC/24.. 230 V AC/5 A	24 V DC/8 A
Output type	Electronic plus-minus	Electronic plus-minus	Relay	Electronic plus-minus or plus-plus
Usable up to	SIL 3/PL e	SIL 3/PL e	SIL e/PL e (if controlled via F-DQ 4)	SIL 3/PL e SIL 2/PL d[1]

[1] For collective shutdown via standard modules

ET 200SP – F-DQ 4x24VDC/2A PM HF

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Properties

- Central/distributed application
- 4 fail-safe digital outputs 2A (P/M-switching) up to SIL 3
- Open circuit/overload monitoring
- Cross circuit monitoring
- Module passivation in fault scenario
- Width: 15 mm

F-DQ 4x24VDC/2A PM HF

ET 200SP – F-DQ 4x24VDC/2A PM HF – interconnection possibilities

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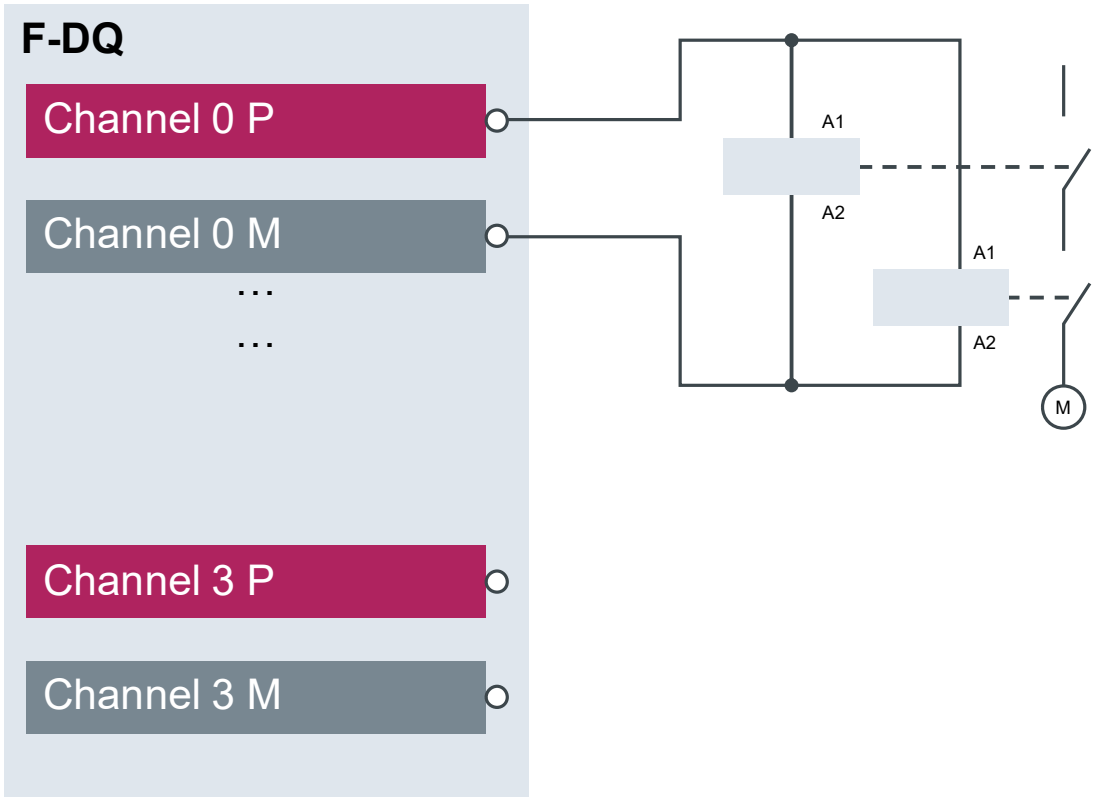
Two-channel contactor control

Module diagnostics

- Short circuit P to L+
- Short circuit M to ground
- Cross circuit monitoring
  P-… to P-…
  or M-… to M-…
- Open circuit/overload monitoring
  P-switch

→ High diagnostics
(up to SIL 3/PL e)[1]



[1] When implementing feedback circuit monitoring (FDBACK block) in the F-user program

ET 200SP – F-DQ 4x24VDC/2A PM HF – dark test

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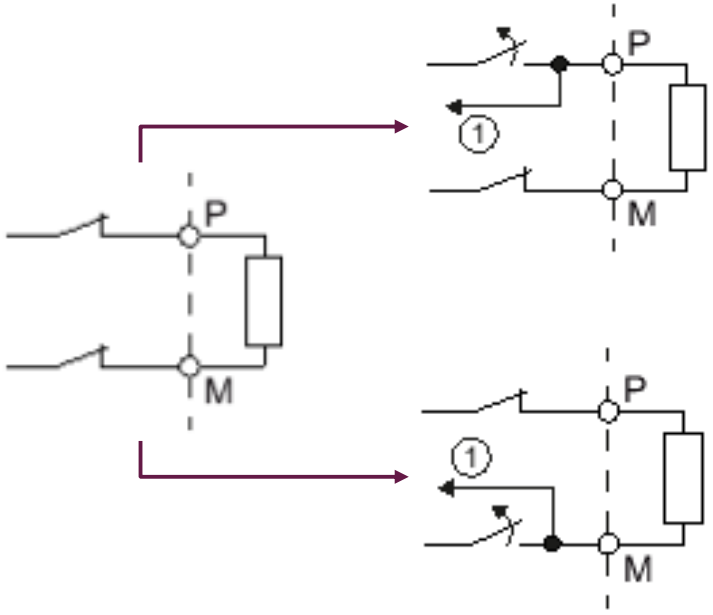
Dark test

- Test required, permanently activated
- Test signal while channel is active ("1")
- Alternating brief deactivation of P or M and read back of the output channel
- Sufficiently slow actuators do not respond to test signal

The dark test detects the following errors

- Internal errors of the P and M switches
- Short circuit, e.g. P0 to L+ or M0 to ground
- Cross circuit, e.g. P0 to P1 or M0 to M1



1 Read-back

ET 200SP – F-DQ 4x24VDC/2A PM HF – switch-on test

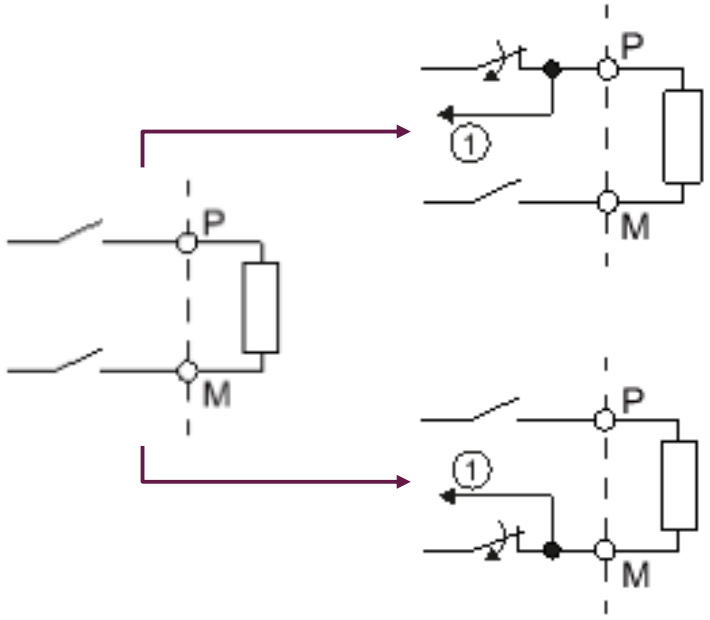
SIEMENS
Ingenuity for life

Switch-on test

- Test required, permanently activated
- Test signal while channel is inactive ("0")
- Alternating brief activation of P or M and read back of the output channel
- Actuator is not activated by the test signal

The switch-on test detects the following errors

- Internal errors of the P and M switches
- Short circuit, e.g. P0 to L+ or M0 to ground
- Cross circuit, e.g. P0 to P1 or M0 to M1



1 Read-back

ET 200SP – F-DQ 4x24VDC/2A PM HF – light test

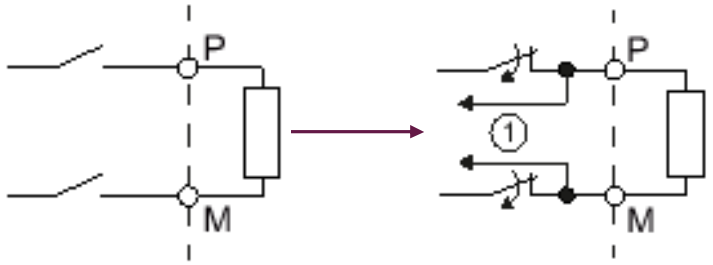
SIEMENS
Ingenuity for life

Light test

- Test optional, to be parameterized by user
- Test signal while channel is inactive ("0")
- Simultaneous brief activation of P or M and read back of the output channel
- Sufficiently slow actuator does not respond to test signal

The light test detects the following errors

- Overload with signal "0" at output
- Open circuit with signal "0" at output



1 Read-back

ET 200SP – F-DQ 8x24VDC/0.5A PP HF

SIEMENS
Ingenuity for life

Properties

- Central/distributed application
- 8 fail-safe digital outputs 0.5 A (P/P-switching) up to SIL 3
- Overload monitoring
- Cross circuit monitoring
- Module passivation in fault scenario
- Dark test can be deactivated for 48 hours
- "RIOforFA-Safety" profile is supported
- Width: 15 mm

F-DQ 4x24VDC/2A PM HF

In the event of a cross circuit between a positive potential (e.g. L+) and DQ-PPn, the activated actuator can no longer be shut down.

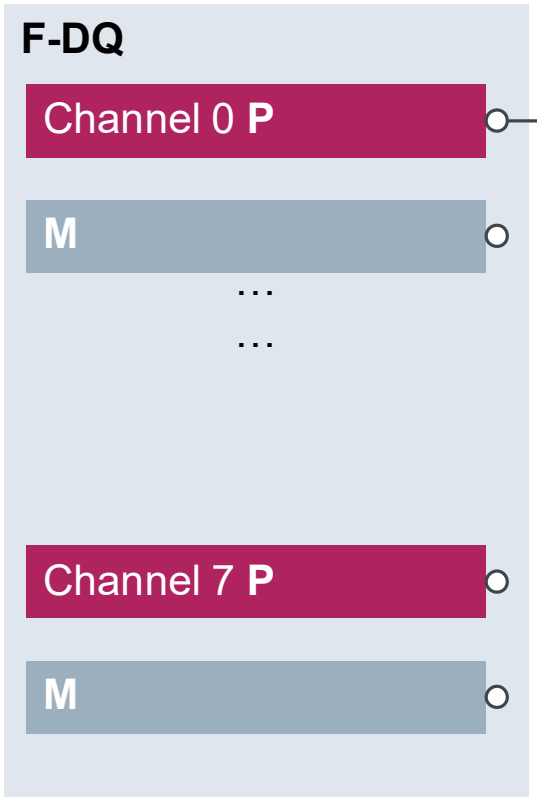
ET 200SP – F-DQ 8x24VDC/0.5A PP HF – interconnection possibilities

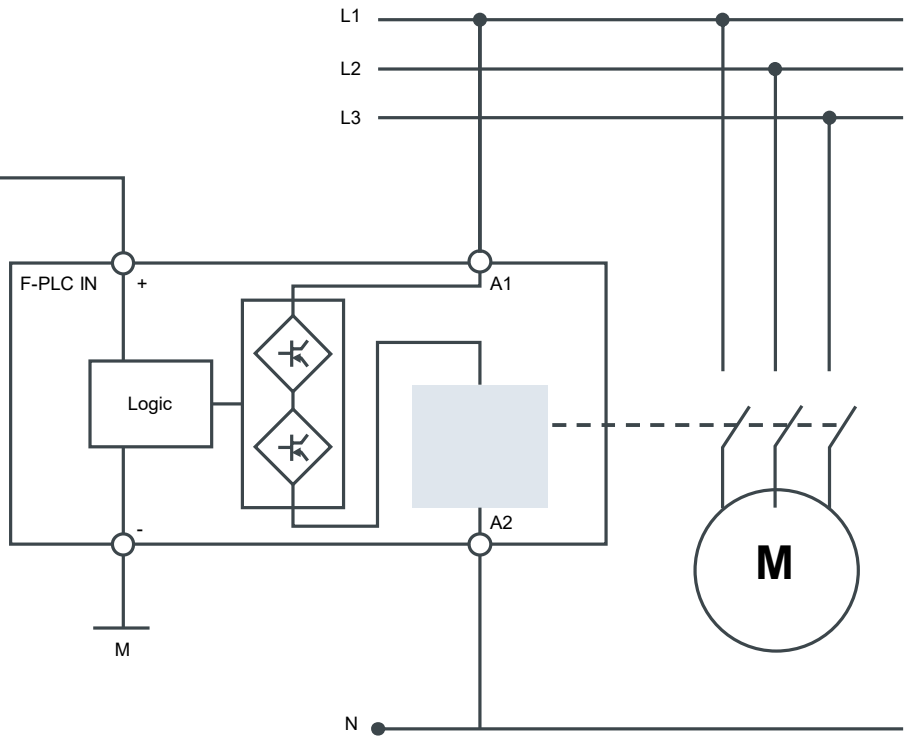
SIEMENS
Ingenuity for life

Contactor with fail-safe control input

Module diagnostics

- Short circuit P to L+
- Cross circuit monitoring P-… to P-
- Diagnostics up to SIL 2





ET 200SP – F-DQ 8x24VDC/0.5A PP HF – interconnection possibilities

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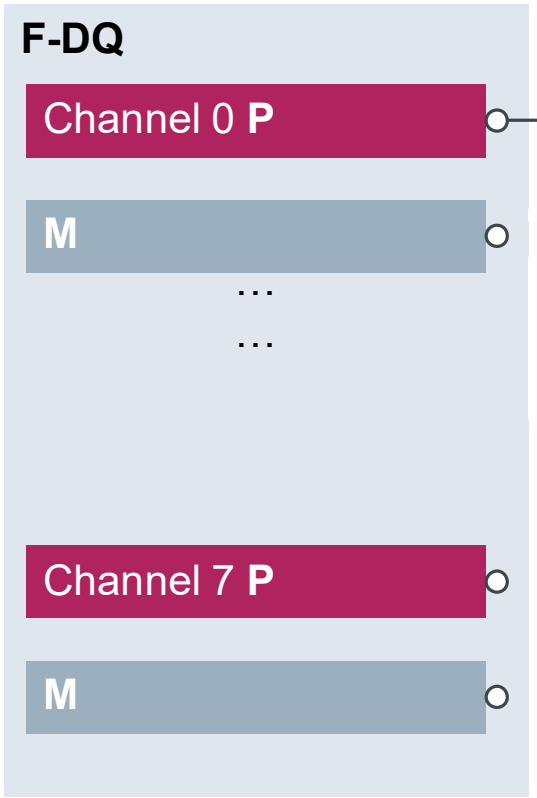
Ingenuity for life

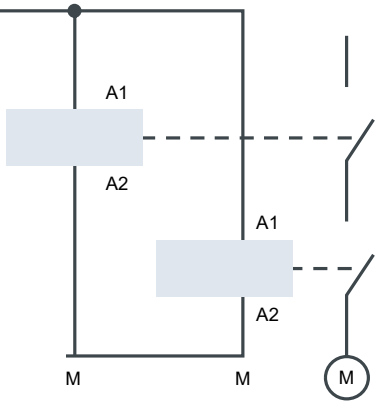
Two-channel contactor control

Module diagnostics

- Short circuit P to L+
- Cross circuit monitoring P-… to P-
- Missing supply

→ High diagnostics (up to SIL 3/PL e)[1]





[1] When implementing feedback circuit monitoring (FDBACK block) in the F-user program

ET 200SP – F-DQ 8x24VDC/0.5A PP HF – interconnection possibilities

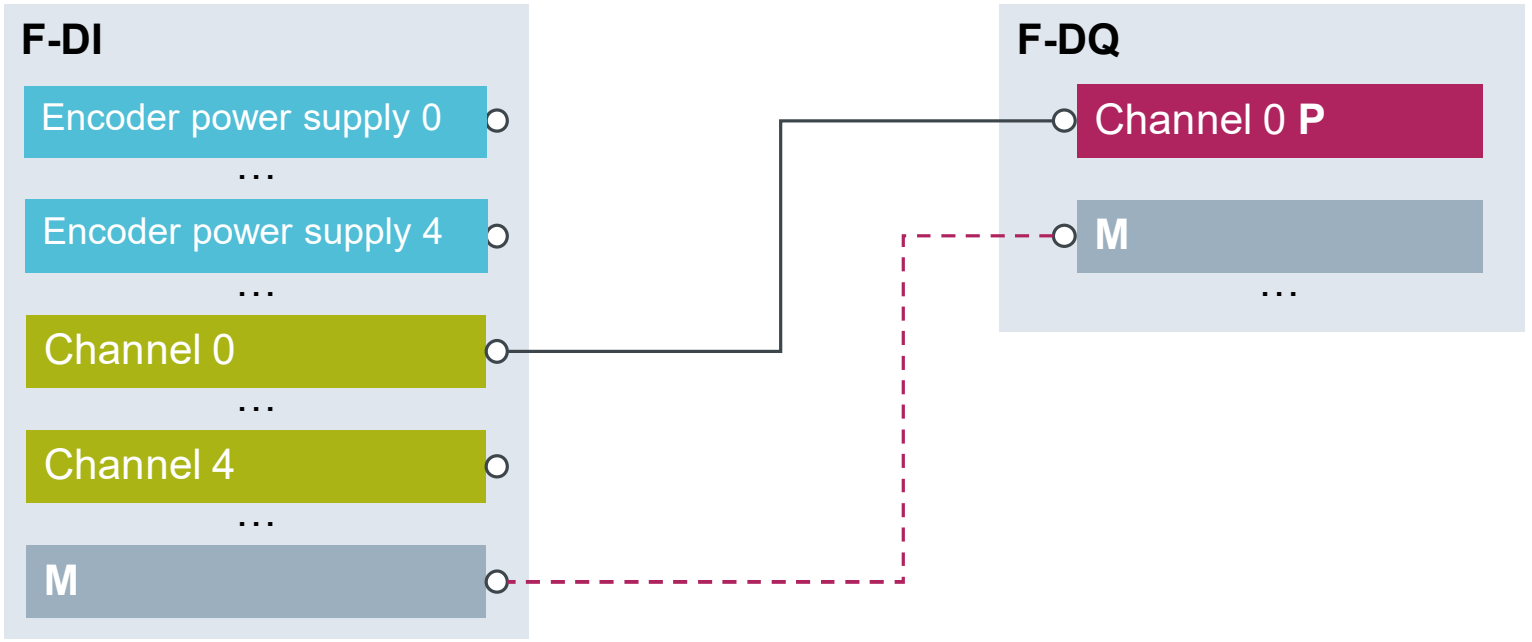
SIEMENS
Ingenuity for life

Direct wiring to F-DI

Module diagnostics

- Short circuit P to L+
- Cross circuit monitoring P-… to P-

→ High diagnostics (up to SIL 3/PL e)



When supplying both modules from different power supply units, a ground equalization must take place.

ET 200SP – F-RQ 1x24VDC/24..230VAC/5A

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Properties

- Central/distributed application
- Module with a relay output (two isolated NO contacts)
- Control voltage 24 V DC
- Total current for both NO contacts, max. 5 A
- Isolated from the control voltage
- Readback channel in PII
- up to SIL 3/PL e for activation with F-DQ (P/M)
- Width: 20 mm

ET 200SP – F-RQ 1x24VDC/24..230VAC/5A – interconnection possibilities

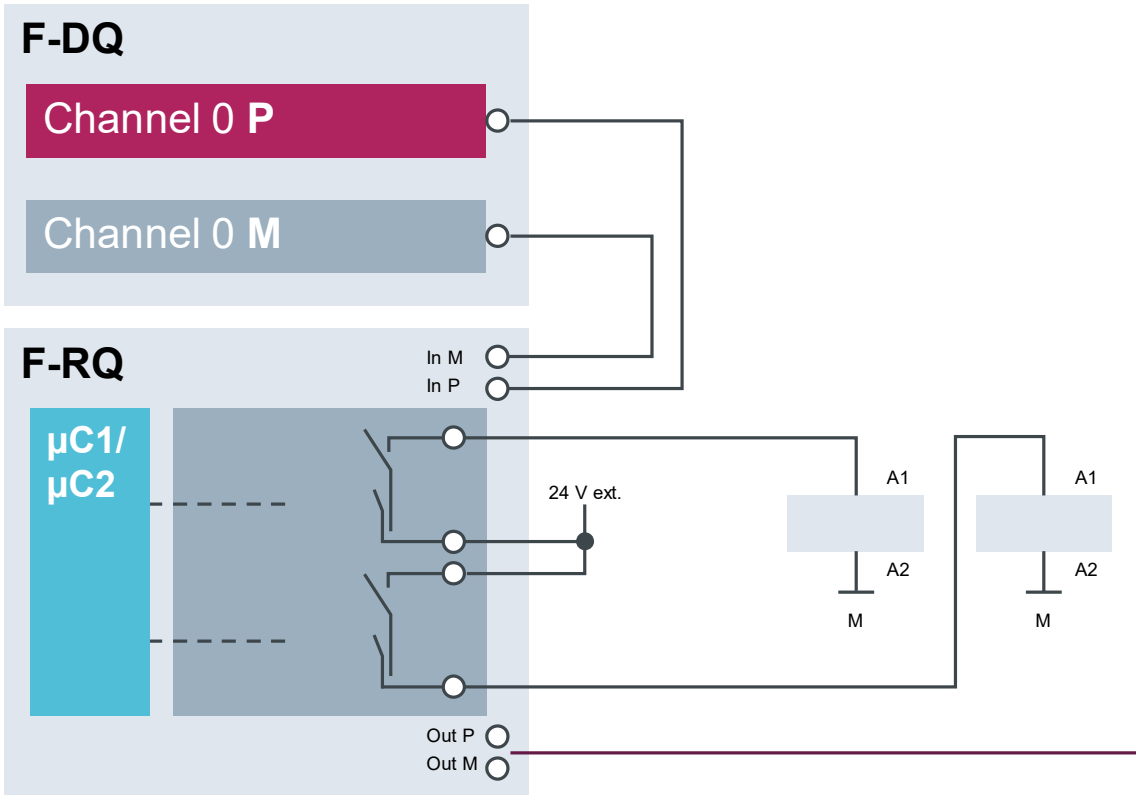
SIEMENS
Ingenuity for life

Two-channel contactor control

Module diagnostics

- Relay contacts with module-internal feedback circuit signal in the PII
- Galvanically isolated switching contacts

→ High diagnostics (up to SIL 3/PL e)[1]



Cascading signal for controlling additional F-RQ modules

[1] Activated by F-DQ (P/M-switching)

ET 200SP – F-PM-E 24VDC/8A PPM

SIEMENS
Ingenuity for life

Properties

- Central/distributed application
- Two fail-safe digital inputs up to SIL 2/PL d or a fail-safe digital input up to SIL 3/PL e
- Two outputs for encoder power supply
- A fail-safe digital output, PM or PP-switching, up to SIL 3/PL e (direct) or SIL 2/PL d for collective shutdown via std. DQ
- Output current up to 8 A
- Short circuit/cross circuit/open circuit monitoring
- Dark test can be deactivated (from FW V2.0)
  → No change for the collective shutdown of standard modules
  → F-DQ only reaches SIL 2
- Module passivation in fault scenario
- Width: 20 mm

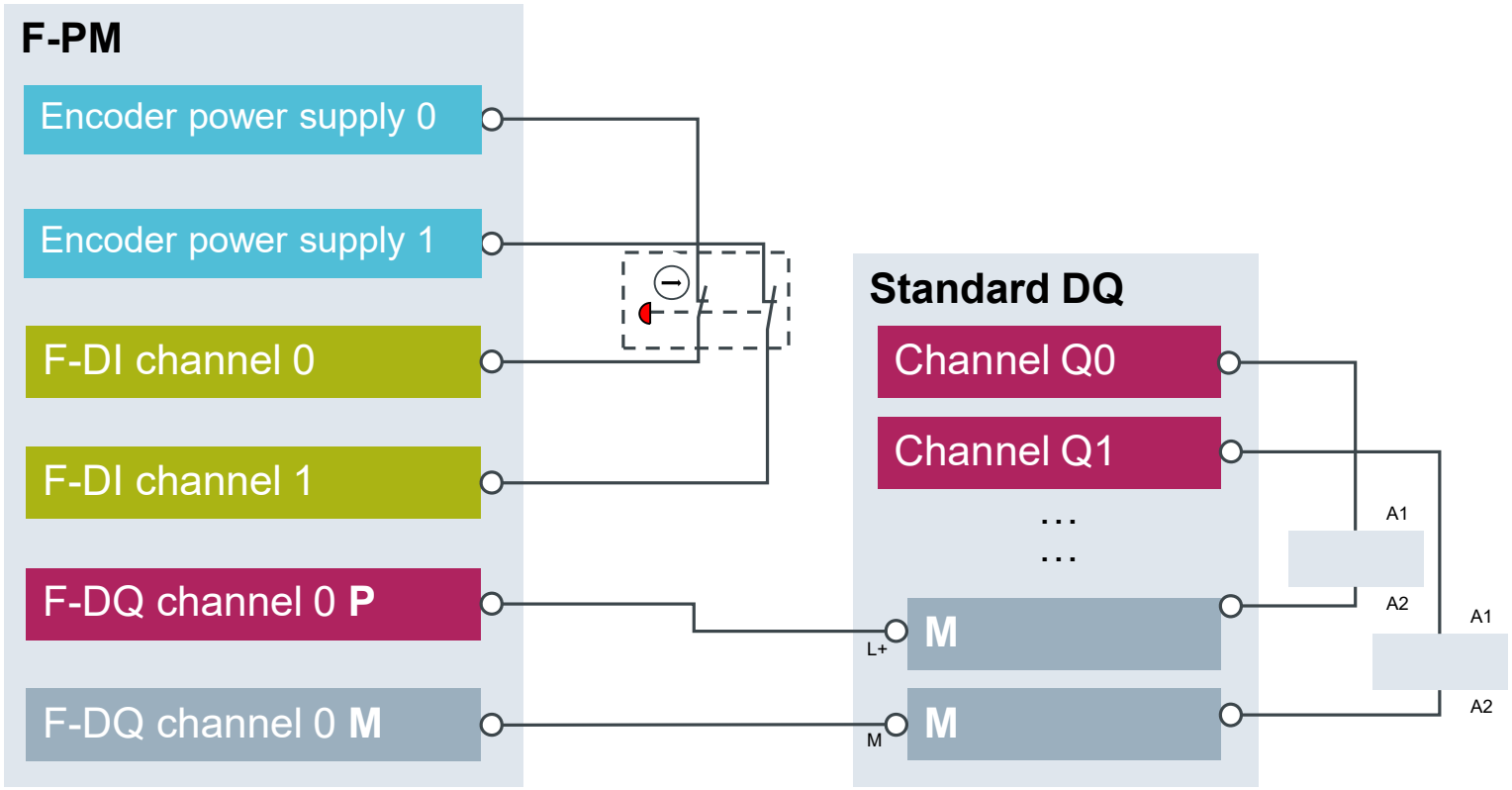
F-PM-E 24 V DC/8 A PPM

ET 200SP – F-PM-E 24VDC/8A PPM – interconnection possibilities

SIEMENS
Ingenuity for life

Safety-oriented shutdown of standard DQ modules

- High diagnostics as with F-DI/F-DQ modules (cross circuit/short circuit monitoring, discrepancy evaluation)
- Evaluation of the safety function directly via F-PM-E module (one/two-channel evaluation) or in F-CPU
- Quick collective shutdown of standard DQ modules up to SIL 2

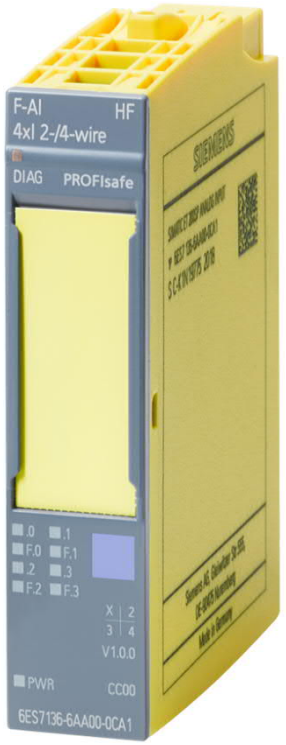


ET 200SP – Fail-safe analogue input module F-AI 4xI 0(4)…20 mA 2-/4-wire HF

SIEMENS
Ingenuity for life

Properties

- Central/distributed application
- 4 inputs up to SIL 2 or 2 inputs up to SIL 3
- 4 outputs for encoder power supply
- Measuring ranges: 0..20 mA and 4..20 mA
- Resolution 16-bit incl. sign
- External encoder supply possible
- Open circuit detection
- Channel and module-wide passivation in the event of an error
- "RIOforFA-Safety" profile is supported
- Width: 15 mm



F-AI 4xI 0(4) … 20 mA 2/4-wire HF

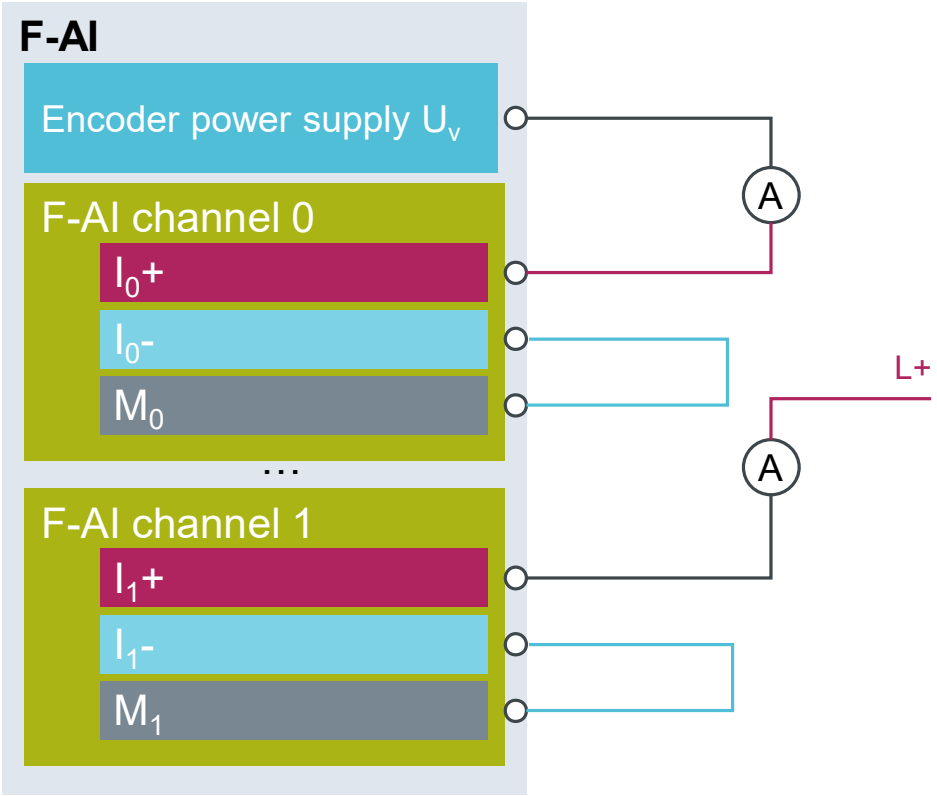
ET 200SP – F-AI 4xI 0(4)…20 mA 2-/4-wire HF – interconnection possibilities

SIEMENS
Ingenuity for life

Single-channel evaluation with 2-wire transducer

Module diagnostics

- SIL 3/Cat. 3/PL d
- Internal and external encoder supply
- Open circuit monitoring
- Short circuit monitoring



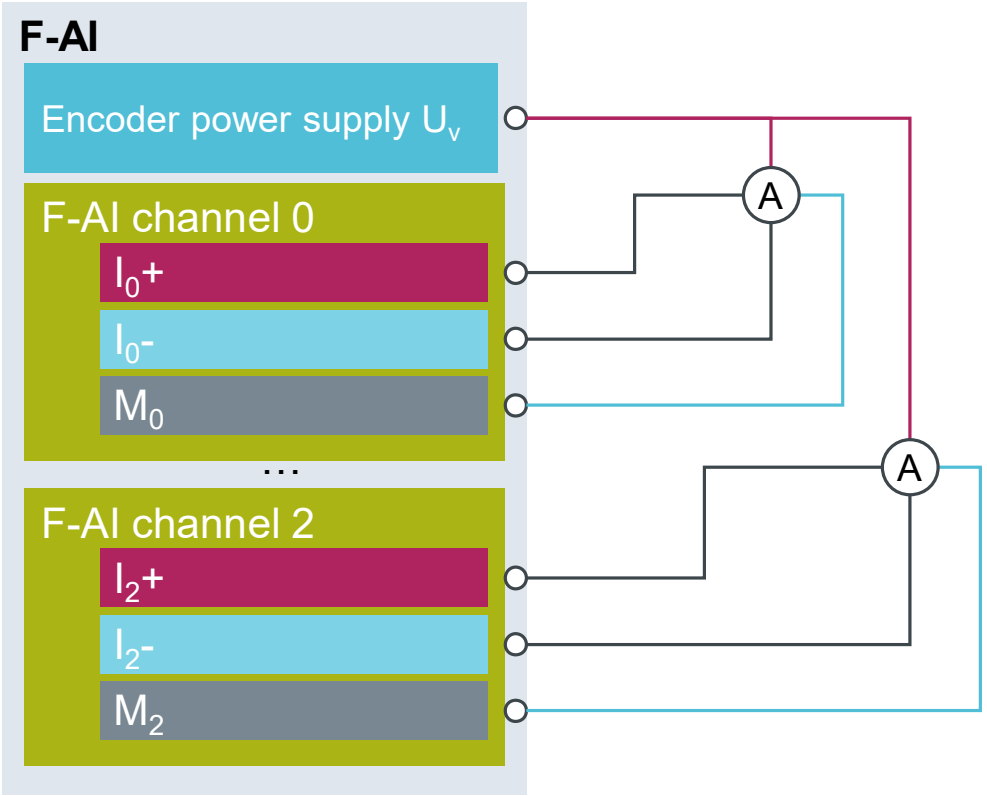
ET 200SP – F-AI 4xI 0(4)…20 mA 2-/4-wire HF – interconnection possibilities

SIEMENS
Ingenuity for life

Two-channel evaluation with 4-wire transducer

Module diagnostics

- SIL 3/Cat. 4/PL e
- Internal encoder supply (external also possible)
- Open circuit monitoring
- Short circuit monitoring



ET 200SP – F-motor starter

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Ingenuity for life

Properties

- Switching and protective module for three-phase induction motors, single-phase AC motors and three-phase induction motors
- Integrated short circuit and overload protection
- Direct or reversing start function
- Diagnostic functions
- Energy management functions
- Shutdown up to SIL 3 (according to IEC 61508), PL e
  and Cat.4 (according to EN ISO 13849-1) possible

ET 200SP – F-motor starter – Base unit explanation

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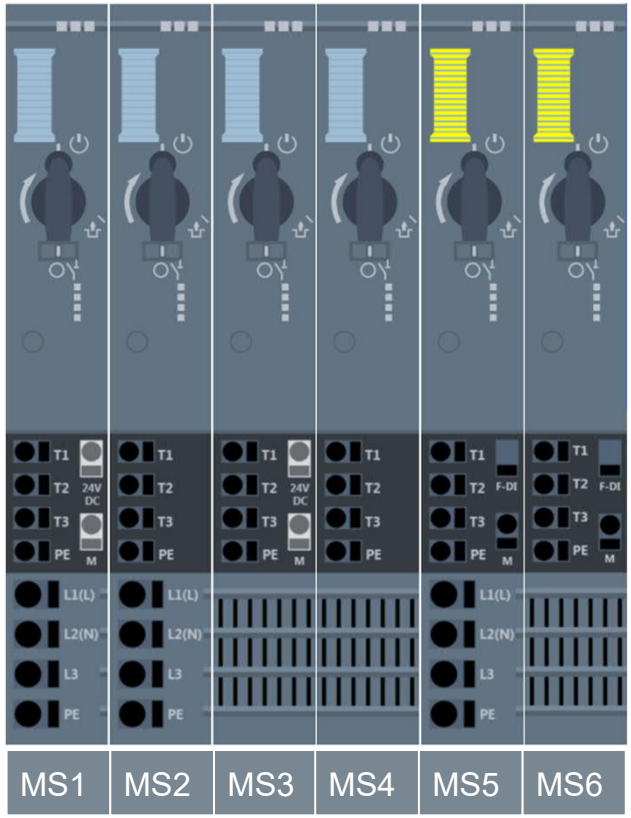
Ingenuity for life

- **MS1**: BU with infeed of **24 V** and **400 V**
- **MS2**: BU with infeed of **400 V**
  (24 V bridged from the previous BU)
- **MS3**: BU with infeed of **24 V**
  (400 V bridged from the previous BU)
- **MS4**: BU without an infeed
  (24 V and 400 V bridged from the previous BU)
- **MS5**: BU with **F-DI** input and **400 V** infeed
- **MS6**: BU with **F-DI** input (400 V
  bridged from the previous BU)

The fail-safe motor starter can be used with any BU (MS1 – MS6) up to **SIL 3**:
The 24 V supply is an infeed by means of an **F-DQ** or **F-PM-E** module (also via BUs).
Advantages when using BU30-**MS5** and BU30-**MS6**

- Communication with the motor starter is retained in the event of a shutdown
- Quick restart after a fail-safe shutdown



ET 200SP – F-motor starter – interconnection options

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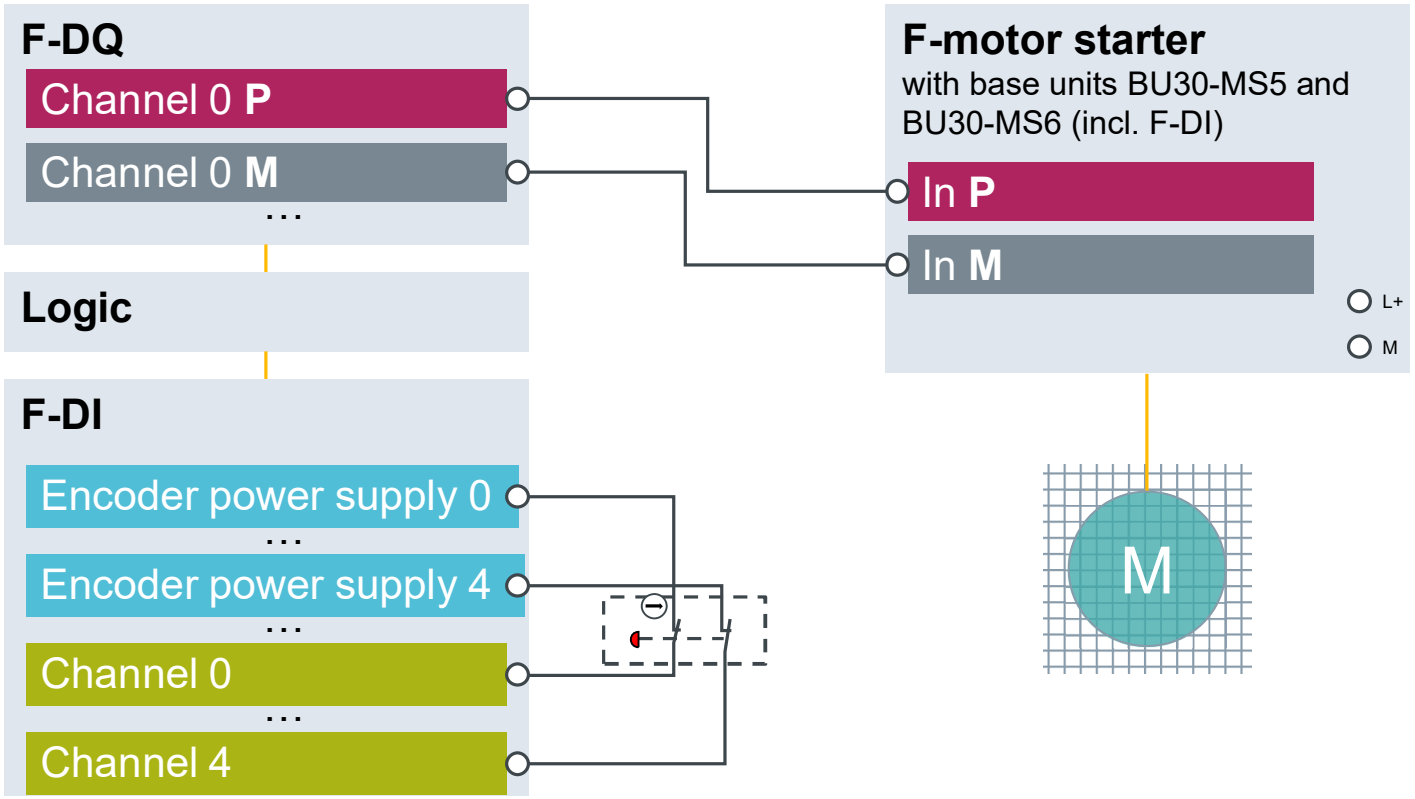
Shutdown of the MS via F-DQ

Properties

- SIL 3 /Cat. 4/PL e
- Each motor starter is controlled with one channel of an F-DQ
- The diagnostics of each MS is retained during a fail-safe shutdown
- Quick re-activation possible
- Collective shutdown conditionally possible



ET 200SP – F-motor starter – interconnection options

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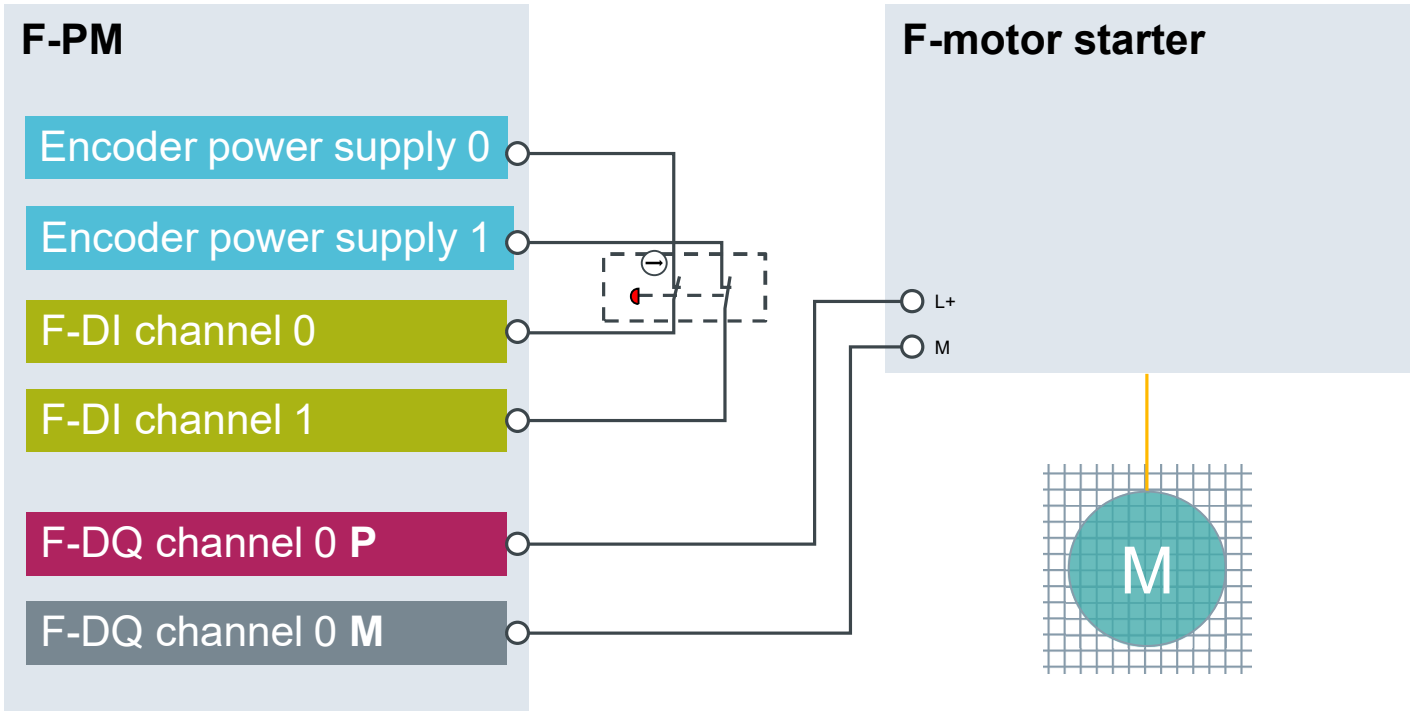
Ingenuity for life

Shutdown of the MS via F-PM

Properties

- SIL 3/Cat. 4/PL e
- 24 V of the motor starter is safely switched with the shutdown signal (backplane bus) of the F-PM-E
- No corresponding diagnostics of the MS are available during a safe shutdown
- After the 24 V has been re-activated, the MS must be restarted
- Collective shutdown possible



ET 200SP –
F-CM AS-i Safety ST

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Ingenuity for life

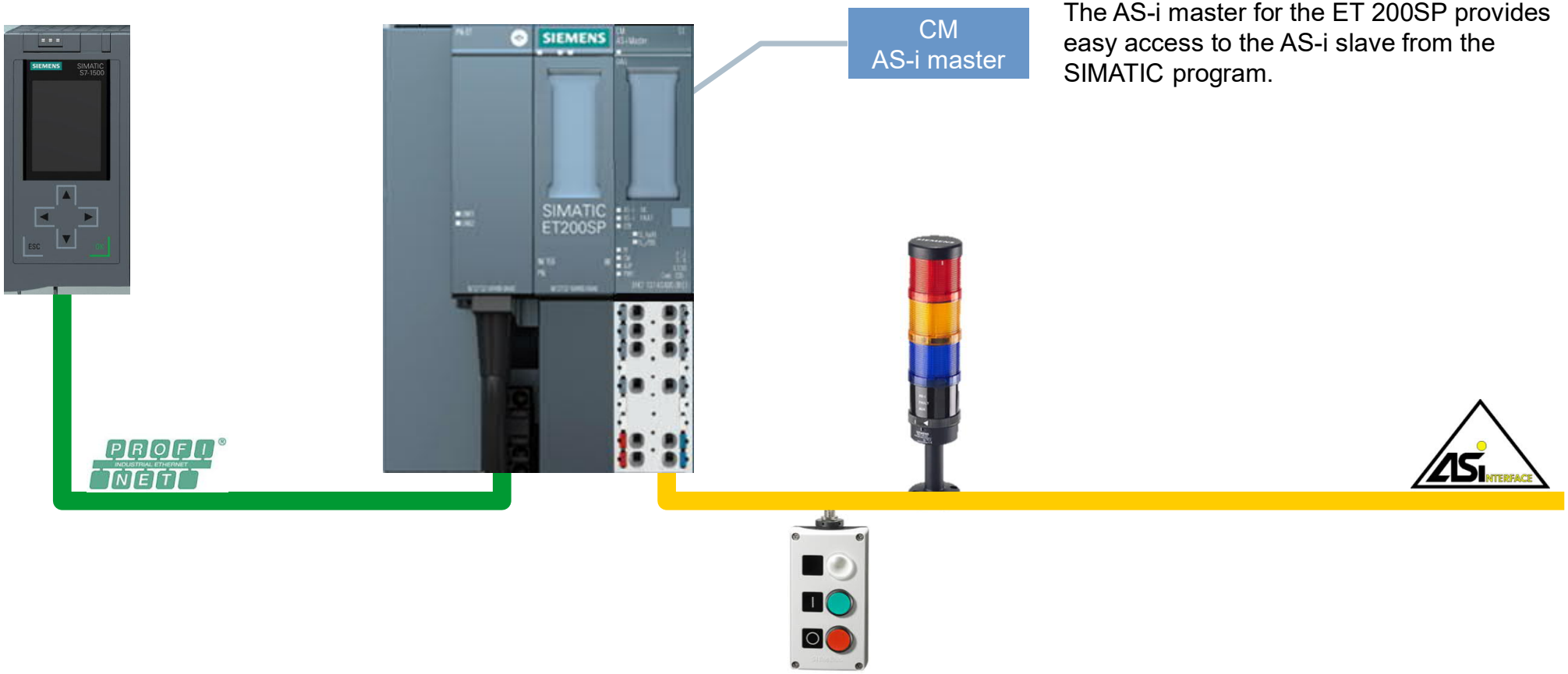
Properties

- Central/distributed application
- Converts the ASIsafe protocol to PROFIsafe
- Secure communication in both directions possible (SIL 3)
- Up to 31 secure AS-i slaves can be evaluated per network
- Up to 16 secure AS-i actuators can be controlled per network
- Integration as 31 F-DI/16 F-DO modules
- One F-address per AS-i network
- Module width: 20 mm

F-CM AS-i Safety ST

ET 200SP –
CM AS-i master and F-CM AS-i safety

SIEMENS
Ingenuity for life



The AS-i master for the ET 200SP provides easy access to the AS-i slave from the SIMATIC program.

ET 200SP –
CM AS-i master and F-CM AS-i safety

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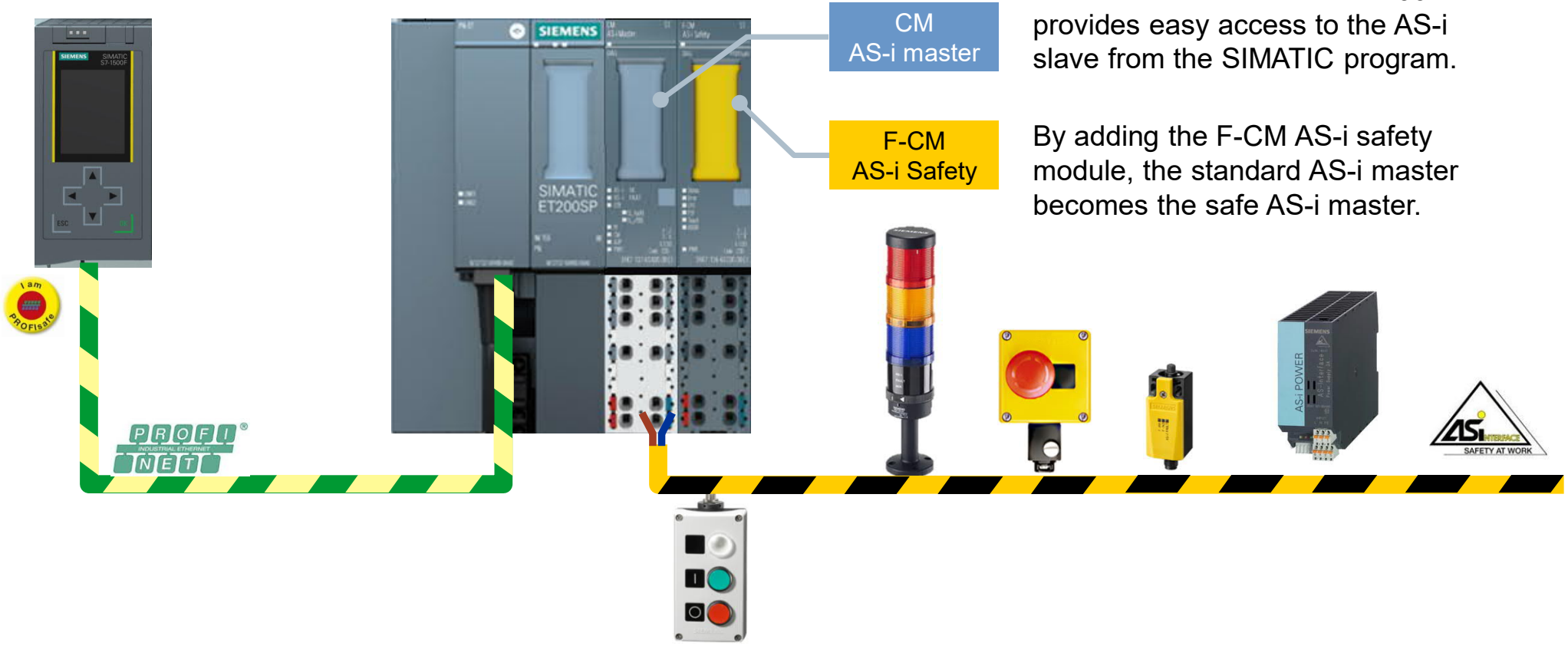
Ingenuity for life



The AS-i master for the ET 200SP provides easy access to the AS-i slave from the SIMATIC program.

By adding the F-CM AS-i safety module, the standard AS-i master becomes the safe AS-i master.

Agenda

SIEMENS
Ingenuity for life

1 System overview

2 S7-1500 Controller

3 ET 200

- 3.1 IP 20 - ET 200SP
- **3.2 IP 20 - S7-1500/ ET 200MP**
- 3.3 IP 65 - ET 200eco PN

4 Module evaluation and addressing

5 Application samples and tools

SIMATIC ET 200MP –
The modular I/O system for the central control cabinet

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Investment protection	Easily add fail-safe modules to the standard I/O
Easy commissioning	PROFIsafe address is configured via the software and saved in the coding element
Easy device replacement	PROFIsafe address is automatically imported from the intelligent coding element
High availability	• Onboard signal test: short circuit, wire break • Easy and quick fault localization by means of fine-granular error messages in plain text
Optimal utilization of the control cabinet volume	• Implementation of a multi-tier system without changing the system • High-channel modules

ET 200MP – interface modules

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ET 200MP	IM 155-5 DP ST	IM 155-5 PN ST	IM 155-5 PN HF
Number of modules	12	30	30
Fail-safe I/O modules	✓	✓	✓
Isochronous mode (synchronization with program cycle)	✓	✓	✓
Media redundancy (MRP)	✗	✓	✓
Prioritized startup	✗	✓	✓
Shared device	✗	✓	✓

ET 200MP – Fail-safe digital input module F-DI 16x24VDC

SIEMENS
Ingenuity for life

Properties

- Central/distributed application
- 16 inputs up to SIL 2 or 8 inputs up to SIL 3
- 4 outputs for encoder power supply
- Integrated diagnostics of the input circuit by means of short circuit and discrepancy evaluation
- External sensor supply possible
- Module passivation in fault scenario
- Pulse stretching and chatter monitoring of the input signals
- "RIOforFA-Safety" profile is supported
- Width: 35 mm

F-DI 16x24VDC

ET 200MP – F-DI 16x24VDC – interconnection possibilities

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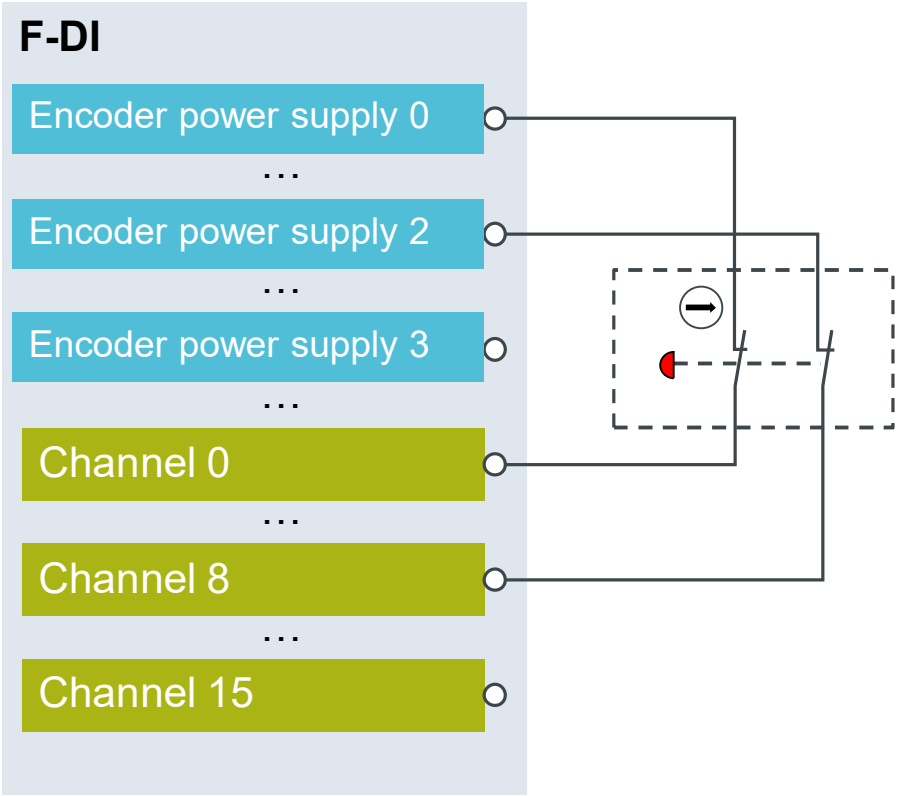
Ingenuity for life

Emergency stop command device

Module diagnostics

- Two-channel evaluation (2v2), channels 0+8 form a channel group
  → 1 signal in the process image
- Internal encoder supply
- Short circuit monitoring
- Discrepancy monitoring

→ High diagnostics (up to SIL 3/PL e)



ET 200MP – F-DI 16x24VDC – interconnection possibilities

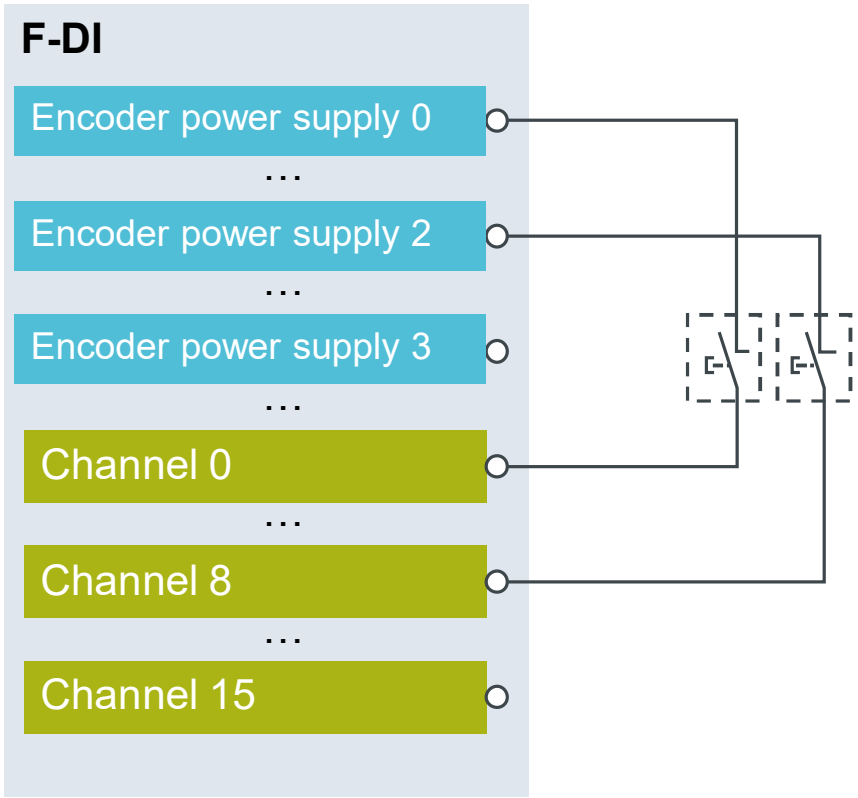
SIEMENS
Ingenuity for life

Two-hand operator control device

Module diagnostics

- Single-channel evaluation (1v1)
- Internal encoder supply
- Short circuit monitoring
- **No** discrepancy monitoring

→ High diagnostics (up to SIL 3/PL e)[1]



[1] When using the library's safety function "TWO_H_EN", observe EN574 Synchronization time: 500 ms

ET 200MP – F-DI 16x24VDC – interconnection possibilities

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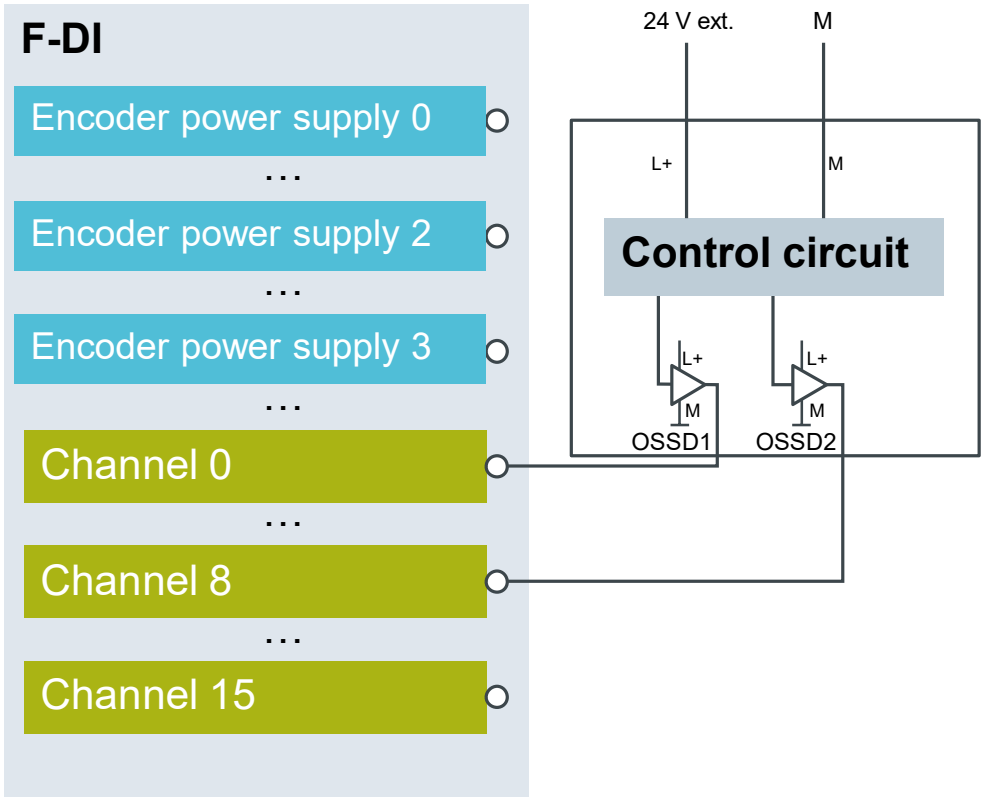
Ingenuity for life

OSSD output (safety door switch or light curtain)

Module diagnostics

- Two-channel evaluation (2v2), channels 0+8 form a channel group
  → 1 signal in the process image
- External encoder power supply
- Short circuit monitoring
- Discrepancy monitoring

→ High diagnostics
(up to SIL 3/PL e)



ET 200MP – Fail-safe digital output module F-DQ 8x24VDC/2A PPM

SIEMENS
Ingenuity for life

Properties

- Central/distributed application
- 8 fail-safe digital outputs 2A (PM-or PP-switching) up to SIL 3/PL e
- Open circuit/overload monitoring
- Cross circuit monitoring
- Module passivation in fault scenario
- "RIOforFA-Safety" profile is supported
- Width: 35 mm

ET 200MP – F-DQ 8x24VDC/2A PPM – interconnection possibilities

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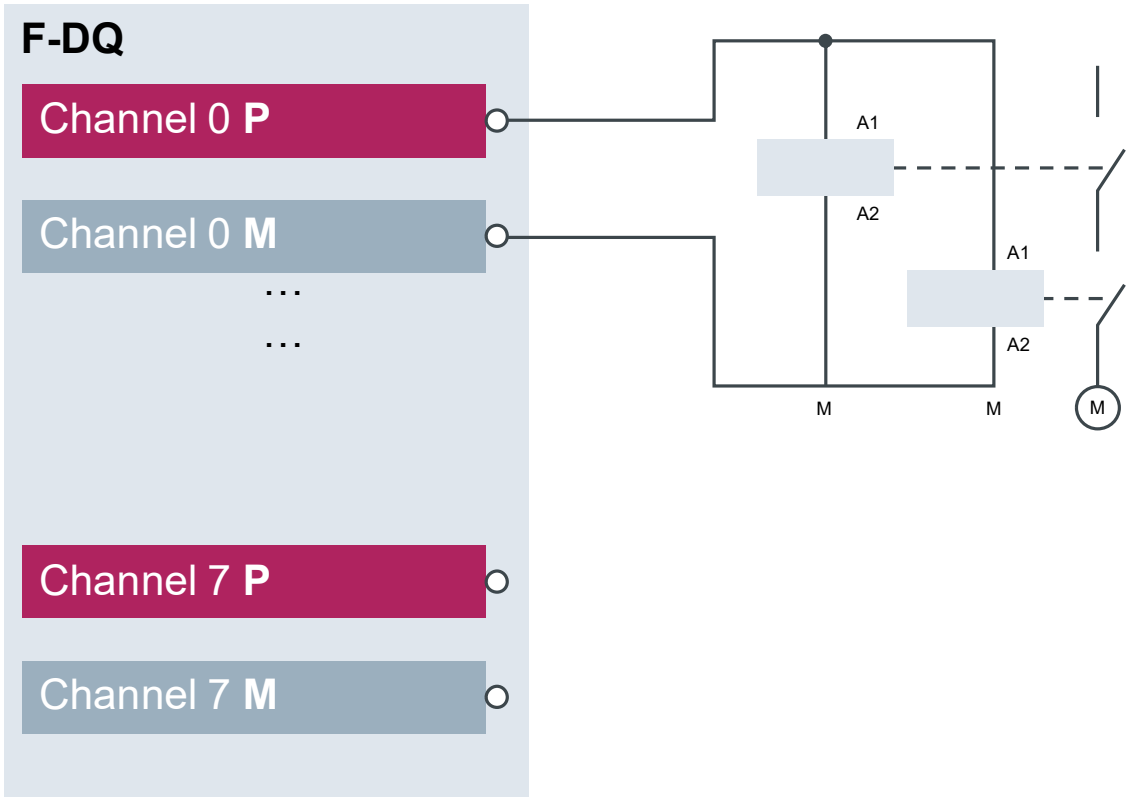
Ingenuity for life

Two-channel contactor control PM-switching

Module diagnostics

- Short circuit P to L+
- Cross circuit monitoring P-… to P
- Missing supply

→ High diagnostics (up to SIL 3/PL e)[1]



[1] When implementing feedback circuit monitoring (FDBACK block) in the F-user program

ET 200MP – F-DQ 8x24VDC/2A PPM – interconnection possibilities

SIEMENS
Ingenuity for life

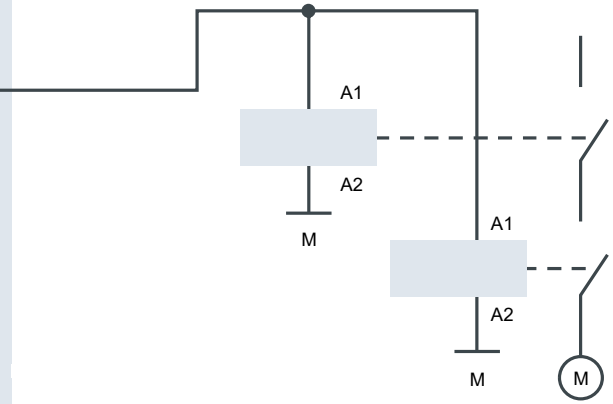
Two-channel contactor control PP-switching

Module diagnostics

- Short circuit P to L+
- Cross circuit monitoring P-… to P-…
- Open circuit/overload monitoring P-switch

→ High diagnostics (up to SIL 3/PL e)[1]

[1] When implementing feedback circuit monitoring (FDBACK block) in the F-user program



In the event of a cross circuit between a positive potential (e.g. L+) and DQ-PPn, the activated actuator can no longer be shut down

ET 200MP – F-DQ 8x24VDC/2A PPM – dark test

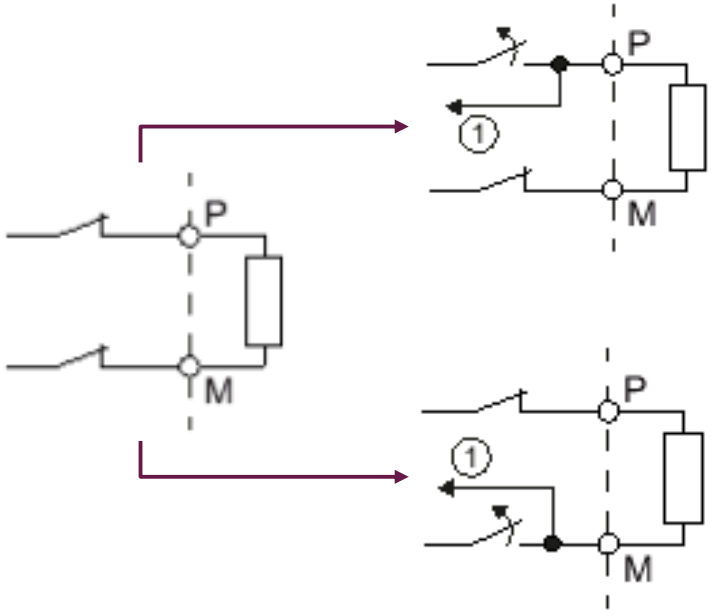
SIEMENS
Ingenuity for life

Dark test

- Test required, permanently activated
- Test signal while channel is active ("1")
- Alternating brief deactivation of P or M and read back of the output channel
- Sufficiently slow actuators do not respond to test signal

The dark test detects the following errors

- Internal errors of the P and M switches
- Short circuit, e.g. P0 to L+ or M0 to ground
- Cross circuit, e.g. P0 to P1 or M0 to M1



1 Read-back

ET 200MP – F-DQ 8x24VDC/2A PPM – switch-on test

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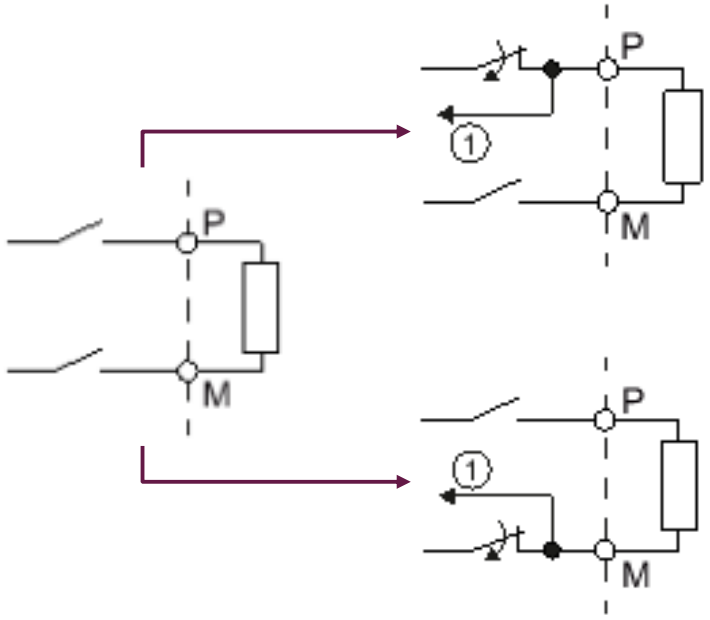
Ingenuity for life

Switch-on test

- Test required, permanently activated
- Test signal while channel is inactive ("0")
- Alternating brief activation of P or M and read back of the output channel
- Actuator is not activated by the test signal

The switch-on test detects the following errors

- Internal errors of the P and M switches
- Short circuit, e.g. P0 to L+ or M0 to ground
- Cross circuit, e.g. P0 to P1 or M0 to M1



1 Read-back

ET 200MP – F-DQ 8x24VDC/2A PPM – light test

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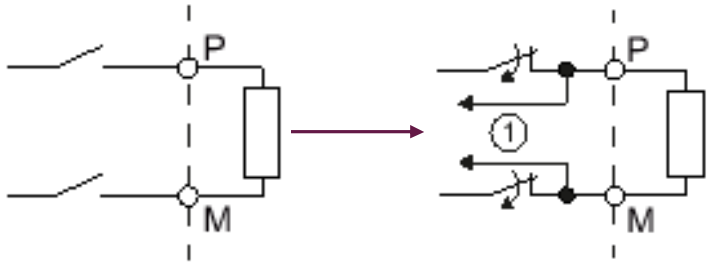
Ingenuity for life

Light test

- Test optional, to be parameterized by user
- Test signal while channel is inactive ("0")
- Simultaneous brief activation of P or M and read back of the output channel
- Sufficiently slow actuator does not respond to test signal

The light test detects the following errors

- Overload with signal "0" at output
- Open circuit with signal "0" at output



1 Read-back

Agenda

SIEMENS
Ingenuity for life

1 System overview

2 S7-1500 Controller

3 ET 200

- 3.1 IP 20 - ET 200SP
- 3.2 IP 20 - S7-1500/ ET 200MP
- **3.3 IP 65 - ET 200eco PN**

4 Module evaluation and addressing

5 Application samples and tools

ET 200eco PN –
Block I/O in IP67 with PROFINET connection

SIEMENS
Ingenuity for life

Robust design

- Due to excellent, rugged design and degree of protection up to IP67 for harsh industrial environments, regardless of installation location
- Resistant to vibrations, dust, oil or humidity
- Possible use in space-sensitive areas directly at the machine

Easy commissioning and expansion

- Easy handling ensures fast commissioning and maintenance
- Flexible expansion of the system via PROFINET possible

New: Fail-safe digital input/ output module

For processing fail-safe digital signals

ET200eco PN – Fail-safe digital input/output module F-DI 8 x 24VDC, 4xM12/F-DQ 3 x 24 VDC/2 A PM, 3xM12

SIEMENS
Ingenuity for life

Properties

- Direct connection to higher-level controller via PROFINET/Profisafe
- 8 fail-safe digital inputs up to SIL 2/PL d or 4 fail-safe digital inputs up to SIL 3/PL e
- 2 outputs for encoder power supply
- External encoder supply possible
- Integrated diagnostics of the input circuit by means of short circuit and discrepancy evaluation
- 3 fail-safe digital outputs P/M-switching up to SIL 3/PL e
- Open circuit/overload/cross circuit monitoring
- Channel or module passivation in event of an error
- "RIOforFA-Safety" profile is supported
- Dimensions: 60 mm x 175 mm x 49 mm (W/H/D)

Connection of sensors and actuators to ET 200eco PN

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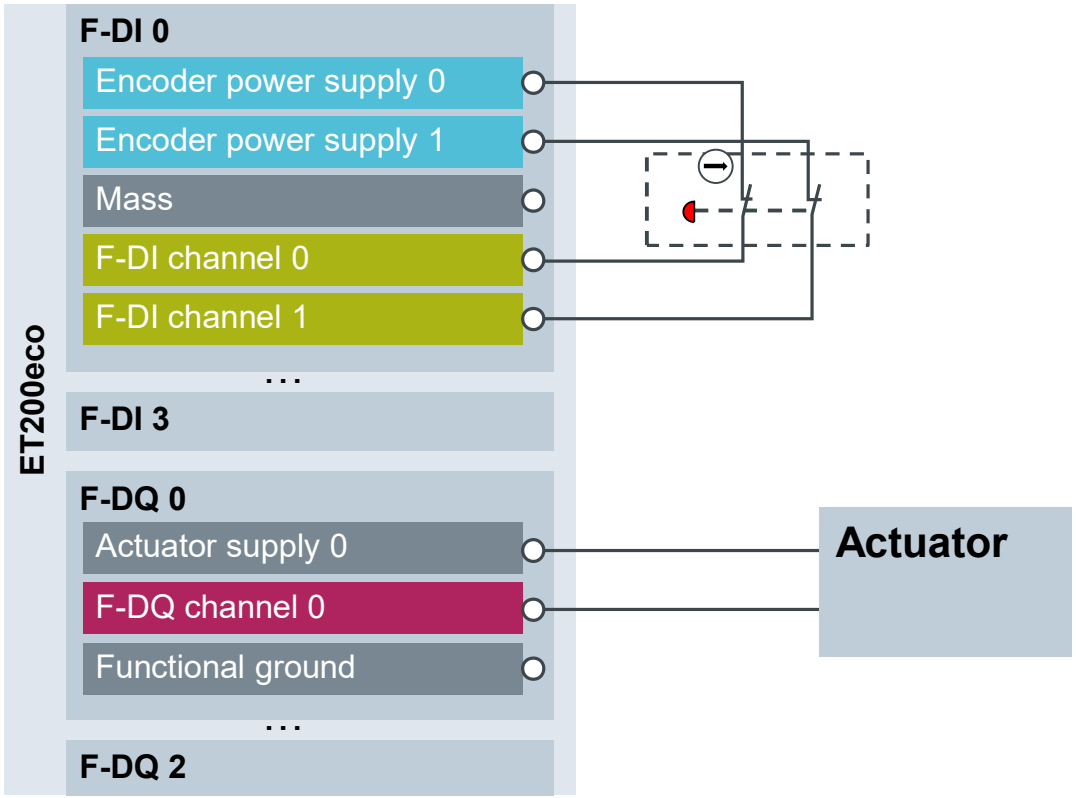
Module diagnostics

- Open circuit monitoring
- Short circuit monitoring
- F-DI 8x 1v1 up to SIL 2/Cat. 3/PL d
- F-DI 4x 2v2 up to SIL 3/Cat. 4/PL e
- F-DQ up to SIL 3/Cat. 4/PL e



ET200eco PN – module overview including size and pin assignment

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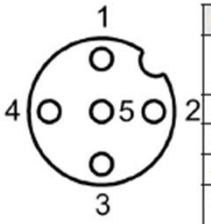
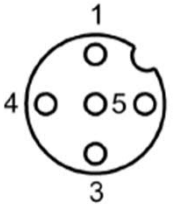
Fail-safe inputs ports 0, 1, 2 and 3

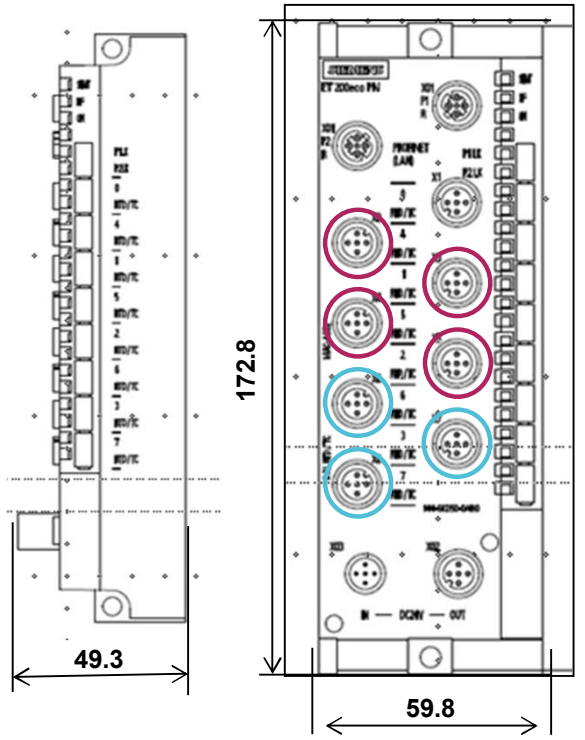


Pin	Funktion
1	U1 (TPO1): +24 V, max. 500 mA (kurzschlussslcher), parametrlerbar
2	F-DI 2 (SIn2)
3	0 V (GND)
4	F-DI 1 (SIn1)
5	U2 (TPO2): +24 V, max. 200 mA (kurzschlussslcher), parametrlerbar

Fail-safe outputs ports 4 and 5



Pin	Funktion
1	n.c.
2	n.c.
3	0 V Aktorversorgung
4	F-DO 1: +24 V, max. 2 A (kurzschlussslcher)
5	Funktlonserde (FE)



Safe input port

Safe output port

F-DI 8 x 24 V DC, 4xM12/F-DQ 3 x 24 V DC/2 A PM, 3xM12

Agenda

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1 System overview

2 S7-1500 Controller

3 ET 200

4 **Module evaluation and addressing**

5 Application samples and tools

Module evaluation
Passivation/reintegration

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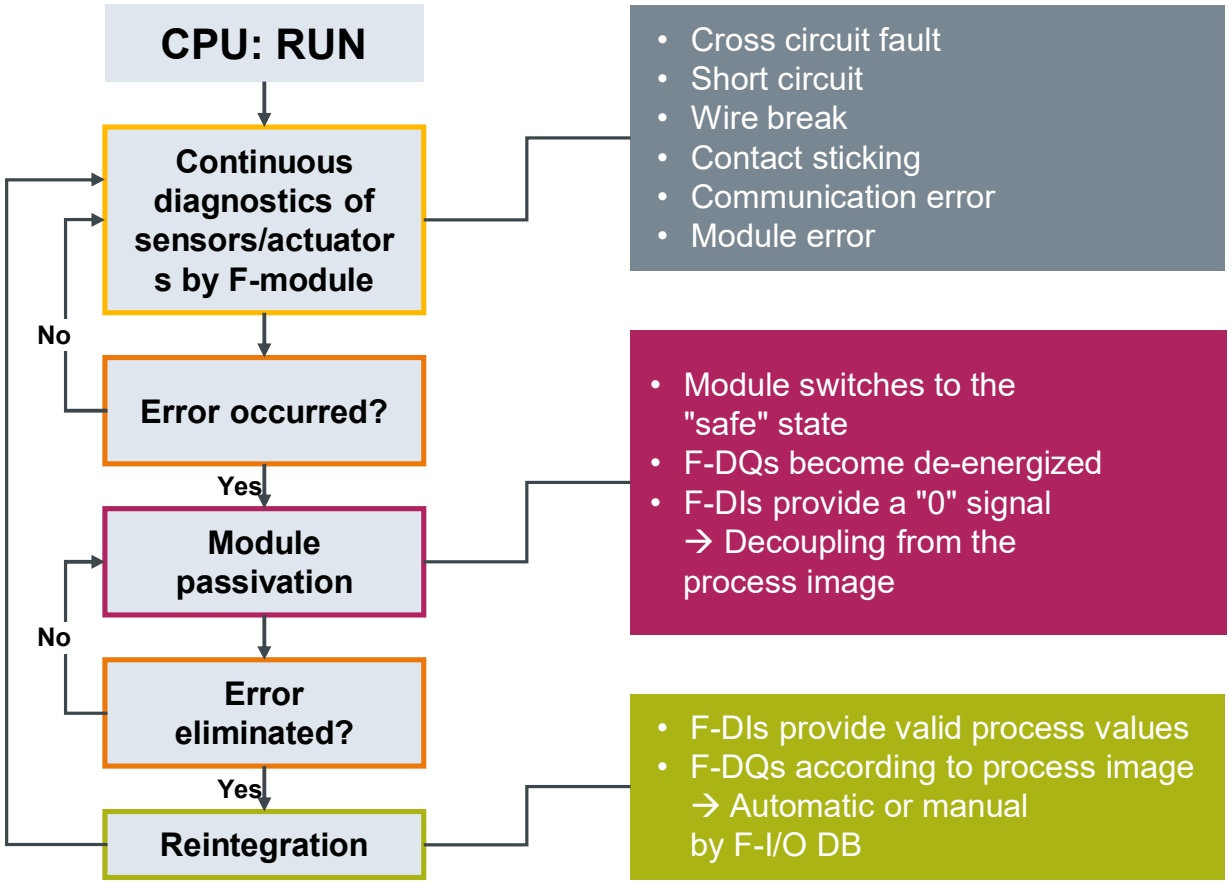
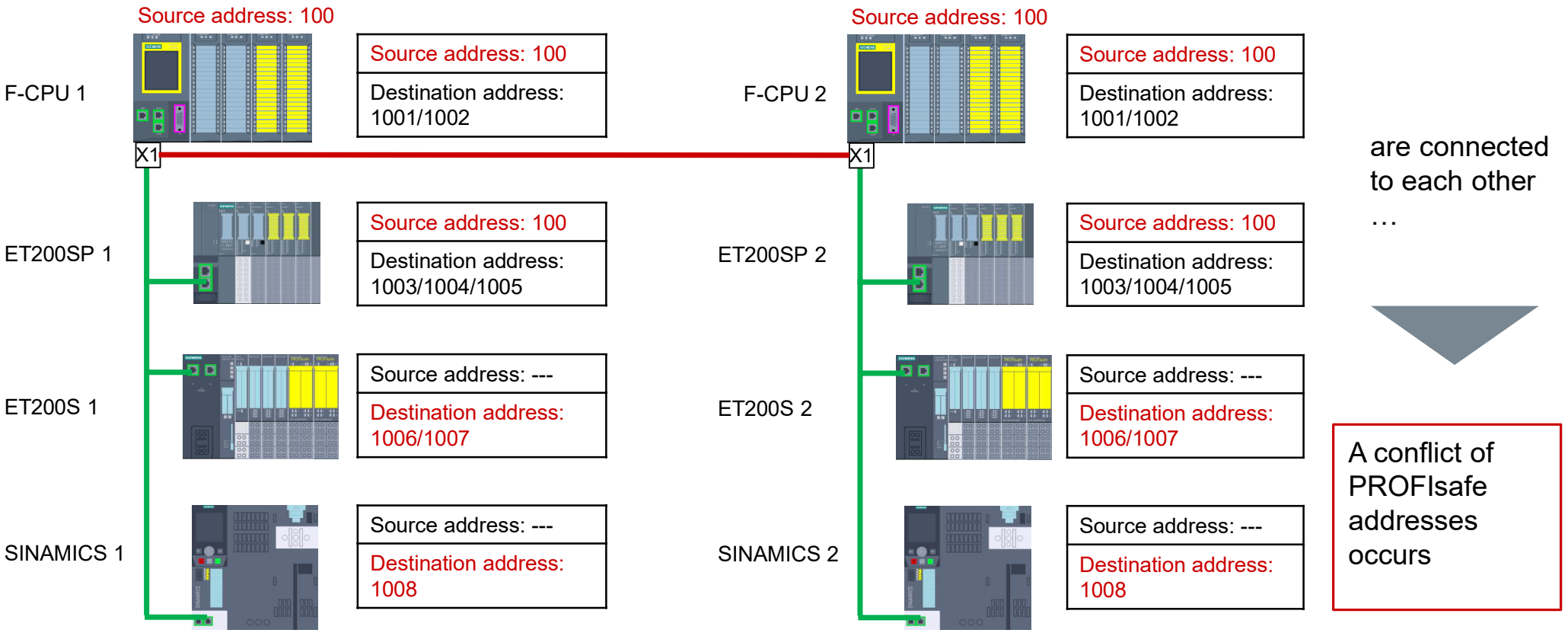


Unambiguousness of PROFIsafe addresses – PROFIsafe addressing



Unambiguousness of PROFIsafe addresses – PROFIsafe addressing

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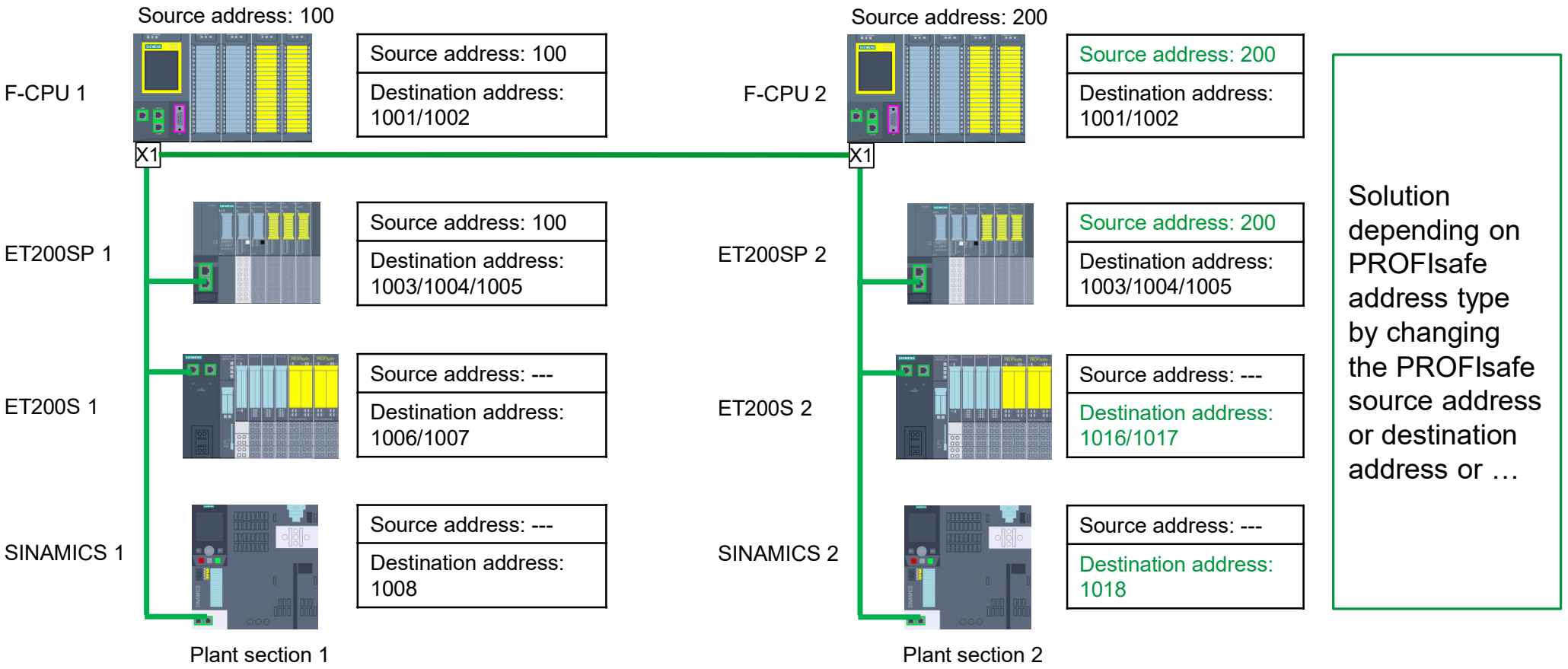

Unambiguousness of PROFIsafe addresses – PROFIsafe addressing

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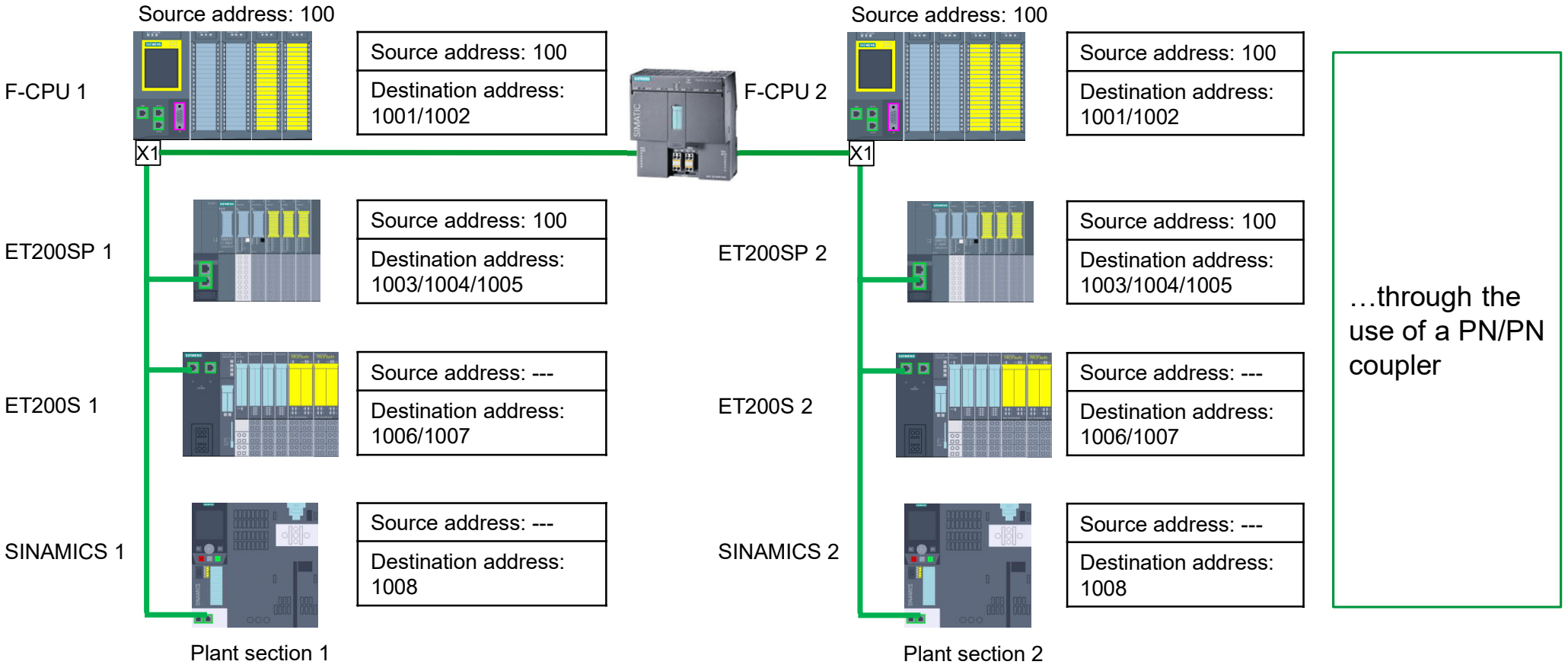

Unambiguousness of PROFIsafe addresses – Network separation

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Network-separating components can be

- PN/PN coupler
- CM for S7-1500
- 2nd interface of the S7-1500
- CP for S7-300 and S7-400

Generally, routers are also network-separating. The user must check, however, whether the forwarding of PROFINET telegrams from the routers can be ruled out

For further information see FAQ

Agenda

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1 System overview

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5 **Application samples and tools**

Siemens Evaluation Tool (SET) – the straight path to a safer machine

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Tool for evaluating safety functions of a machine

- Certification of a safe machine with automatic calculation and documentation according to the current standards (IEC 62061 and ISO 13849-1)
- TÜV-tested tool
- Complete the necessary entries in just a few steps
- Quick access to current product data via comprehensive, pre-defined example libraries
- User-friendly archiving: Projects can be saved and called up again as required

Free use of online tool

SIMATIC Automation Tool (SAT) – Commissioning, maintenance and servicing of SIMATIC devices

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Tool for adapting/servicing the devices in a network without TIA Portal (for S7-1200/1500(F), ET200(F), SCALANCE switches, identification systems RFID)

- Illustration of the accessible devices and address assignments (IP, subnet, gateway) and station name change (PROFINET device)
- Program download to CPU (F-programs V3.1 or higher) and HMI
- Backup and restore of projects for CPU (F-projects from V3.1) and HMI
- Firmware update of the CPU and connected modules
- Read-out of the CPU diagnostics buffer
- Reset to factory settings (also F-CPU)

Further information on SIMATIC Automation Tool →

DF FA S SUP application examples in the SIOS – Safety

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Mode selection

Entry ID: 89260861

- These FAQ describe the requirements for a mode selection with standard modules
- They describe the standard-related backgrounds as well as those specified by the machinery directive

Safety with the S7-1200 FC CPU

Entry ID: 109478932

- For a total of 30 scenarios of protective door and emergency stop applications, you have an F-block at your disposal for the direct use of an S7-1200 FC CPU
- In addition to the use of the S7-1200 FC CPU there is also an explanation of what must be considered for reaching a specific PL/SIL

SLS specification via HMI

Entry ID: 67634251

- This application example supports you when creating a safety-oriented input function for setpoint values for a drive via an HMI system
- It provides you with a safety concept, which you can use to solve the task described above up to SIL 2 according to IEC 62061 or PL d according to ISO 13849-1

Safety Integrated programming guideline

Entry ID: 109750255

- Supplement to the program guidelines for S7-1200/1500 controllers, with safety-specific information
- You will gain many advantages if your adhere to the recommendations cited here
  - Reusability of program components
  - Easier acceptance (code review, error detection and correction)
  - Reduction of programming errors

PROFIsafe address assignment

Entry ID: 109740240

In various system configurations, there are different requirements for the network-wide and CPU-wide unambiguity of PROFIsafe addresses. This document explains the requirements based on example configurations

Configuration control with safety

Entry ID: 109481852

- This application example describes how F-modules behave when configuration control is used
- It explains which procedure is needed for using this functionality

Thank you!

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Questions and Answers

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Hvala na pažnji!

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