SIMATIC Safety Integrated

for Factory Automation
### SIMATIC Safety Integrated
For all industrial environments

<table>
<thead>
<tr>
<th>Safe und high available</th>
<th>Fail-safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main focus: process automation</td>
<td>Main focus: factory automation</td>
</tr>
</tbody>
</table>

#### Controllers
- CPU 412H
- CPU 414H
- CPU 417H

#### Engineering
- CFC, Safety Matrix
- FUP, KOP

#### PROFIBUS with PROFIsafe-Profile

<table>
<thead>
<tr>
<th>Actors</th>
<th>Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET 200M</td>
<td>ET 200eco</td>
</tr>
<tr>
<td>ET 200S</td>
<td>ET 200pro</td>
</tr>
</tbody>
</table>

#### PROFINET with PROFIsafe-Profile

| ET 200S | ET 200pro |

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1) for Factory Automation
The concept
SIMATIC Safety Integrated
The concept

Introduction
Concept
PROFIsafe
Configurations
Product overview
Periphery connection
S7 Distributed Safety
Further Information

- Standard engineering tool
  - STEP 7

+ Failsafe engineering Tool
  - Distributed Safety

- Standard CPU
  - F-Hardware

+ Failsafe Application Program

- Standard Remote I/O
  - F-Hardware

+ Failsafe I/O Modules

- Standard PROFIBUS DP

+ PROFIsafe
Coexistence of standard program and safety-related program on one CPU

- Changes to the standard program have no effect on the integrity of the safety-related program section
SIMATIC Safety Integrated
The concept

Coded Processing
Time redundancy and diversity replace complete redundancy

Operators → A, B → Operation → C → Output

Coded Processing → AND

Coding → Operators → \( /A, /B \) → Comparison → Divers Output

Comparison → OR

Stop by \( D \neq /C \)

Divers Operators → Divers Operation → \( D = /C \)

Time redundancy
SIMATIC Safety Integrated
The concept

Further Information
S7 Distributed
Safety

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Periphery connection

z = x + y

z = x + y + 1

F-DI

PROFIsafe telegram

Data

CRC

z = x + y

F-CPU

Data

Coded

F-DO

PSF Input Driver

F-CTRL 1

F FBs STEP 7

F-Coded FBs

F-CTRL 2

PSF Output Driver

Wrong CRC
-> PROFIsafe Stop or
-> CPU Stop

PSF Input Driver

F-CTRL 1

F FBs STEP 7

F-Coded FBs

F-CTRL 2

PSF Output Driver

Wrong CRC
-> PROFIsafe Stop or
-> CPU Stop

Industry Sector
PROFIsafe
Introduction

Safety-oriented communication via PROFIsafe-Profile

- First standard of communication in accordance with safety standard IEC 61508
- PROFIsafe-Profile supports the safe communication for the open standard bus PROFIBUS and PROFINET
- The PROFIsafe-Profile meets possible faults like address adulteration, deceleration, data loss with
  - Serial numeration of PROFIsafe-telegram
  - Time monitoring
  - Authenticity monitoring via unique addresses
  - Optimized CRC-checking

PROFIsafe supports standard- and failsafe Communication by one medium
Overview: Possible Errors and detection mechanism

<table>
<thead>
<tr>
<th>Failure type</th>
<th>Remedy:</th>
<th>Consecutive Number</th>
<th>Time Out with Receipt</th>
<th>Codename for Sender and Receiver</th>
<th>Data Consistency Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetition</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deletion</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insertion</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Resequencing</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Corruption</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Delay</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masquerade (standard message mimics failsafe)</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Revolving memory failure within switches</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
PROFIsafe
PROFIsafe Specification V2.0

Which protocol must be supported?

Which protocol must be supported?

F-DI  Fail-safe digital input
F-DO  Fail-safe digital output
IO-C  PROFINET IO-Controller

Zur sicheren Kommunikation muss auch der PROFIBUS Teilnehmer die möglichen Fehler des Switches beherrschen.
## PROFIsafe Specification V2.0

### Which protocol version applies when?

- **Goal:** 100% compatibility

- A PROFIsafe slave which supports the v2 mode must be able to replace an older version of this PROFIsafe slave which only supports the v1 mode without the need of any adaption.

<table>
<thead>
<tr>
<th>PROFIsafe V2 Slave used in</th>
<th>Protocol with 8Bit-Counter (= PROFIsafe V1 mode)</th>
<th>Protocol with 24Bit-Counter (= PROFIsafe V2 mode)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROFIBUS network only</td>
<td>mandatory</td>
<td>mandatory</td>
</tr>
<tr>
<td>PROFINET network only</td>
<td>-</td>
<td>mandatory</td>
</tr>
<tr>
<td>PROFIBUS / PROFINET network</td>
<td>mandatory</td>
<td>mandatory</td>
</tr>
</tbody>
</table>
PROFIsafe Specification V2.0

Which protocol version applies when?

PROFINET – PROFIsafe V2

PROFIBUS – PROFIsafe V1 or V2

I/O-Device V2

Proxy

Only DP Slave V2

DP Master

DP Slave V1

V1 = PROFIsafe Profil V1
V2 = PROFIsafe Profil V2

DP Slave V2
Configurations
Configurations
Non-Safety and Safety in one System

- Introduction
- Concept
- PROFlsafe

Configurations
- Product overview
- Periphery connection
- S7 Distributed Safety
- Further Information

HMI System
S7 300F / S7 400F

ET 200M
ET 200eco
ET 200S
SIGUARD Laserscanner Light Curtain

e.g. PROFIBUS DP

PROFIsafe Concept
Non-Safety and Safety in one System
Configurations
Non-Safety und Safety in separated PLCs

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ET 200M
ET 200S

Non-Safety PLC

HMI System

S7 300F / S7 400F

E.g. PROFIBUS DP

SIGUARD
Laserscanner
Light Curtain

ET 200S
ET 200M
Configurations
Non-Safety und Safety in separated Systems

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Further Information

HMI System

Non-Safety PLC

ET 200M
ET 200S

S7 300F / S7 400F
SIGUARD Laserscanner
Light Curtain

ET 200S
ET 200M

e.g. PROFIBUS DP

Industry Sector
Configurations
Decentralized approach

Safety and Non-Safety as separated function production cells with own safety circuits

Non-Safety DP Master

IM 151-7 F-CPU

I-DP Slave

IM 151-7 F-CPU

I-DP Slave

S7 300 F-CPU

I-DP Slave

e.g. PROFIBUS DP

One Visualisation for Non-Safety and Safety

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Product overview
SIMATIC Safety Integrated Controller for Factory Automation

Introduction
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PROFIsafe
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SIMATIC Safety Integrated controllers for Factory automation

Use of centralized and distributed ET 200S, ET 200M, ET 200pro and ET 200eco I/O with PROFIsafe

Programming with standard-STEP 7 in FBD and LAD
- Block library with examples certified by German Technical Inspectorate (TÜV) (S7 Distributed Safety)

Compliance with all essential safety standards
TÜV Certificate No.: Z2 02 03 20411 009
- EN 954 (to Category 4)
- IEC 61508 (to SIL 3)
- IEC 62061 (to SIL 3)
- UL 1998, UL 508 and UL 991
- NFPA 79-2002 (US) and NFPA 85 (US)
### SIMATIC Safety Integrated Controller

For factory automation

<table>
<thead>
<tr>
<th></th>
<th>IM151-7 F-CPU</th>
<th>CPU 315F-2DP</th>
<th>CPU 317F-2DP</th>
<th>CPU 319-3PN/DP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work memory</strong></td>
<td>128 kB</td>
<td>192 kB (2DP)</td>
<td>1 MB</td>
<td>1.4 MB</td>
</tr>
<tr>
<td><strong>Load memory</strong></td>
<td></td>
<td>256 kB (2PN/DP)</td>
<td>64kB – 8 MB</td>
<td>64kB – 8 MB</td>
</tr>
<tr>
<td>(plug in)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Process image</strong></td>
<td>128 Byte</td>
<td>384 Byte</td>
<td>2048 Byte</td>
<td>2048 Byte</td>
</tr>
<tr>
<td>PII/PIO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FB/FC/DB</strong></td>
<td>1024/1024/511</td>
<td>2048/2048/1023</td>
<td>2048/2048/2047</td>
<td>2048/2048/4095</td>
</tr>
<tr>
<td><strong>Bit memories</strong></td>
<td>2048 Bit</td>
<td>16 kBit</td>
<td>32 kBit</td>
<td>64 kBit</td>
</tr>
</tbody>
</table>

* integrated
## SIMATIC Safety Integrated Controller
### For Factory Automation

<table>
<thead>
<tr>
<th>Product Overview</th>
<th>CPU 416F-2</th>
<th>CPU 416F-3PN/DP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work memory</strong></td>
<td>5.6 MB</td>
<td>11.2 MB</td>
</tr>
<tr>
<td><strong>Load memory</strong></td>
<td>1 MB–64 MB</td>
<td>1 MB–64 MB</td>
</tr>
<tr>
<td><strong>Process image</strong></td>
<td>16 kB</td>
<td>16 kB</td>
</tr>
<tr>
<td><strong>FB/FC/DB</strong></td>
<td>5000/5000/10000</td>
<td>5000/5000/10000</td>
</tr>
<tr>
<td><strong>Bit memories</strong></td>
<td>128 kBit</td>
<td>128 kBit</td>
</tr>
</tbody>
</table>
Fail-safe ET 200S I/O
The range at a glance

SIMATIC PROFIsafe-Modules
- Observing the discrepancy, short circuit/cross circuit and wire break observing on board
- Parameterization with STEP 7

<table>
<thead>
<tr>
<th>Fail-safe periphery</th>
<th>DI</th>
<th>DO</th>
<th>DI / DO</th>
<th>AI</th>
<th>Relay/Switch</th>
<th>Motor starter</th>
<th>Frequency-converter</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET 200M</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>The modular I/O for multi-channel applications with up to 24 channels per module</td>
</tr>
<tr>
<td>ET 200S</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>--</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>The bit-modular I/O with up to eight channels per module</td>
</tr>
<tr>
<td>ET 200pro</td>
<td>x</td>
<td>--</td>
<td>x</td>
<td>--</td>
<td>x (x)</td>
<td>--</td>
<td>--</td>
<td>The modular, multifunctional I/O in high degree of protection IP 65/67</td>
</tr>
<tr>
<td>ET 200eco</td>
<td>x</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>The low-cost block peripheral device in high degree of protection IP 65/67</td>
</tr>
</tbody>
</table>

X¹ in preparation
(x) in conjunction with F-Switch PROFIsafe and Disconnecting Module ASM-400V
Fail-safe ET 200S I/O
The range at a glance

- For centralized expansion of the ET 200S F-CPU
- For distributed expansion of ET 200S F-CPU, S7-300F, S7-400F, S7-400FH

→ Supported safety related busses
  - PROFIBUS via IM151-1 HF
  - PROFINET via
    - IM151-3 PN HF with integrated 2-port switch
    - IM 151-3 PN FO (Plastic optical fiber)

<table>
<thead>
<tr>
<th>Digital inputs/outputs</th>
<th>For connecting digital sensors/encoders and/or loads/actuators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power modules</td>
<td>For monitoring and short-circuit protection of the load and sensor supply voltages</td>
</tr>
<tr>
<td>Fail-safe motor starters</td>
<td>In the event of E-STOP the motor starters assigned switch off selective and supervised</td>
</tr>
<tr>
<td>Fail-safe frequency converters</td>
<td>For “Safe Standstill“, ”Safe Brake Ramp“and “ Safely Reduced Speed“</td>
</tr>
</tbody>
</table>
## Fail-safe ET 200S I/O
### Input/output modules and power modules

- F-DI and F-DO for connecting digital sensors/actuators and/or loads/actuators

<table>
<thead>
<tr>
<th>Module</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/8 F-DI DC 24V</td>
<td>- 4 x 2-channel inputs, SIL 3/Cat. 4/PL e or 8 x 1-channel inputs, SIL 2/ PL d</td>
</tr>
<tr>
<td>4 F-DO DC 24V/2A</td>
<td>- 4 channels source/sink output, SIL 3/Cat. 4/ PL e</td>
</tr>
<tr>
<td></td>
<td>- Access of muting-monitors</td>
</tr>
<tr>
<td>1 F-RO DC 24V/5A AC24..230V/5A</td>
<td>- Fail-safe relay module</td>
</tr>
<tr>
<td></td>
<td>- 1 x relay output 5 A/ 230V for SIL 3/Cat.4/ PL e (requires FDO for controlling)</td>
</tr>
<tr>
<td>EM 4 F-DI / 3 F-DO DC24V/2A</td>
<td>- I/O-modul for SIL 2/Cat.3/PL d</td>
</tr>
<tr>
<td></td>
<td>- 3 channel output; max. 4A; P-M-switching</td>
</tr>
<tr>
<td></td>
<td>- 4 channel input; L+: 24 V</td>
</tr>
<tr>
<td></td>
<td>- Flexible use up to SIL 2/Kat.3/PL d</td>
</tr>
</tbody>
</table>
Fail-safe ET 200S I/O
Input/output modules and power modules

- Power modules for monitoring and securing the load and encoder supply voltages

<table>
<thead>
<tr>
<th>Module</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM-E F DC24 V (P-M-switching)</td>
<td>- 2 channels source/sink output, SIL 3/Cat. 4/ PL e</td>
</tr>
<tr>
<td></td>
<td>- Safety relay 10A, SIL 3/Cat. 4/PL e</td>
</tr>
<tr>
<td></td>
<td>- Safety-related shutdown of standard DO, Cat. 3/PL d</td>
</tr>
<tr>
<td>PM-E F DC24 V (P-P-switching)</td>
<td>- Safety relay 10A , SIL 3/Cat. 4/ PL d</td>
</tr>
<tr>
<td></td>
<td>- Safety-related shutdown of standard DO up to Cat. 3/PL d</td>
</tr>
</tbody>
</table>
Fail-safe ET 200S I/O
Motor starters

- No external feeder contactor required
- Diagnostics (short-circuit, temperature)
- Parameterization functions for simple commissioning

<table>
<thead>
<tr>
<th>Modules</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM-DF PROFIsafe</td>
<td>- 6 fail-safe shutdown groups SIL 3/Cat. 4/ PL e</td>
</tr>
<tr>
<td></td>
<td>- Status display per fail-safe shutdown group</td>
</tr>
<tr>
<td></td>
<td>- Diagnostics (short-circuit, temperature)</td>
</tr>
<tr>
<td>F CM</td>
<td>- 4 x 2 safe contact multiplier, SIL 3/Cat. 4/PL e</td>
</tr>
<tr>
<td></td>
<td>- Must be combined with PM-D F / PM-D FX1</td>
</tr>
<tr>
<td>F direct starter</td>
<td>- Switching capacity to 7.5 kW (16A)</td>
</tr>
<tr>
<td></td>
<td>- Intrinsically safe to Cat. 4/ PL e</td>
</tr>
<tr>
<td></td>
<td>- 1 direction of rotation</td>
</tr>
<tr>
<td>F reversing starter</td>
<td>- Switching capacity to 7.5 kW (16A)</td>
</tr>
<tr>
<td></td>
<td>- Intrinsically safe to Cat. 4/PL e</td>
</tr>
<tr>
<td></td>
<td>- 2 directions of rotation</td>
</tr>
</tbody>
</table>
Fail-safe ET 200S I/O
Frequency converter

- Safe standstill
- Safe brake ramp
- Safely reduced speed

Certified by German Institute for Occupational Safety (BIA) and fulfill the requirements of Category 3 acc. to EN 954-1 and SIL 2 of IEC61508

<table>
<thead>
<tr>
<th>Modules</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM-D F X1, PM-DF PROFIsafe</td>
<td>6 fail-safe shutdown groups SIL 3/Cat. 4/PL e</td>
</tr>
<tr>
<td></td>
<td>Status display for each fail-safe shutdown group</td>
</tr>
<tr>
<td></td>
<td>Diagnostics: Short-circuit, over temperature, parameterization error</td>
</tr>
<tr>
<td>ICU24F</td>
<td>Control unit of the ET 200S FC frequency converter with integrated safety functions</td>
</tr>
<tr>
<td></td>
<td>Closed-loop vector control</td>
</tr>
<tr>
<td></td>
<td>Evaluable speed encoder &amp; temperature sensors</td>
</tr>
<tr>
<td></td>
<td>Slot for an optional Micro Memory Card (MMC)</td>
</tr>
<tr>
<td>IPM25</td>
<td>Available power ratings: 0.75 kW, 2.2 kW, 4.0 kW</td>
</tr>
<tr>
<td></td>
<td>Line-commutated regenerative feedback</td>
</tr>
</tbody>
</table>
## Fail-safe ET 200M I/O
### The range at a glance

- For centralized expansion of the S7-300F
- For distributed expansion of S7-300F, S7-400F, S7-400FH
- Supported safety related busses
  - **PROFIBUS** via IM153-2 HF resp. IM153 FO HF

### Module Properties

<table>
<thead>
<tr>
<th>Module</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM 326 DI 24 24V DC</td>
<td>12 x 2-channel inputs, SIL 3/Cat./PL e 4 or 24 x 1-channel inputs, SIL 2/PL d</td>
</tr>
<tr>
<td>SM 326 DO 10 24V DC/2A</td>
<td>10 x channel outputs, SIL 3/Cat. 4/PL e, P-P switching</td>
</tr>
<tr>
<td>SM 326 D0 8 PM</td>
<td>8 x channel outputs, SIL 3/Cat. 4/PL e, P-M switching</td>
</tr>
<tr>
<td>SM 336 AI 6 13 bits</td>
<td>6 x 2-channel inputs, SIL 3/Cat. 4/PL e, 0-20mA</td>
</tr>
<tr>
<td>SM 326 DI 8NAMUR</td>
<td>4 x 2-channel inputs, SIL 3/Cat. 4/PL e or 8 x 1-channel inputs, SIL 2/PL d</td>
</tr>
<tr>
<td>Isolating module</td>
<td>Galvanic isolation between F and standard modules for SIL 3/Cat. 4/PL e</td>
</tr>
</tbody>
</table>

- Isolating module
  - Galvanic isolation between F and standard modules for SIL 3/Cat. 4/PL e

---

**Product overview**

- **Periphery connection**
  - For centralized expansion of the S7-300F
  - For distributed expansion of S7-300F, S7-400F, S7-400FH

- **Supported safety related busses**
  - **PROFIBUS** via IM153-2 HF resp. IM153 FO HF
## Fail-safe ET 200pro I/O
### The range at a glance

- For distributed expansion of ET 200S F-CPU, S7-300F und S7-400F
- Supported safety related busses
  - PROFIBUS via IM 154-2 DP HF
  - PROFINET via IM 154-4 PN HF
- Cabinet-free application due to high degree of protection IP65/67

<table>
<thead>
<tr>
<th>Digital inputs/outputs</th>
<th>For connecting digital sensors/encoders and/or loads/actuators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power modules</td>
<td>For monitoring and short-circuit protection of the load and sensor supply voltages</td>
</tr>
<tr>
<td>Motor starters</td>
<td>Motor starters up to 5,5 kW switching capacity in conjunction with F-Switch PROFIsafe and Disconnecting Module ASM-400V</td>
</tr>
<tr>
<td>Fail-safe frequency converters</td>
<td>For “Safe Standstill“, ”Safe Brake Ramp“and “Safely Reduced Speed“ (in preparation)</td>
</tr>
</tbody>
</table>
Fail-safe ET 200pro I/O
Input/output modules

- F-DI and F-DO for the connection of digital sensors/encoders

<table>
<thead>
<tr>
<th>Module</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>EM 16/8 F-DI</td>
<td>- 8x2-channel inputs, SIL 3/Cat.4/PL e or 16x1-channel inputs, SIL 2/Cat.3/PL d</td>
</tr>
<tr>
<td></td>
<td>- Rated input voltage 24V DC</td>
</tr>
<tr>
<td></td>
<td>- 2 short circuit proof supply</td>
</tr>
<tr>
<td>EM 8/4 F-DI/F-DO</td>
<td>- 4x2-channel inputs, SIL 3/Cat.4/PL e or 8x1-channel inputs, SIL 2/Cat.3/PL d</td>
</tr>
<tr>
<td></td>
<td>- 4xP-M-switching outputs, SIL 3/Cat.4/PL e</td>
</tr>
<tr>
<td></td>
<td>- Output current 2A</td>
</tr>
<tr>
<td></td>
<td>- Voltage 24V DC</td>
</tr>
</tbody>
</table>
Fail-safe ET 200pro I/O
Motor starter and F-Switch 1(2)

- No external feeder contactor required
- Diagnostics (short-circuit, temperature)
- Parameterization functions for simple commissioning

<table>
<thead>
<tr>
<th>Module</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor starter</td>
<td>Motor starters up to 5,5 kW switching capacity</td>
</tr>
<tr>
<td></td>
<td>- All settings can be parameterized by bus</td>
</tr>
<tr>
<td></td>
<td>- Comprehensive diagnostics signals</td>
</tr>
<tr>
<td></td>
<td>- Overload can be acknowledged by remote reset</td>
</tr>
<tr>
<td></td>
<td>- Current unbalance monitoring</td>
</tr>
<tr>
<td></td>
<td>- Stall protection</td>
</tr>
<tr>
<td></td>
<td>- Emergency start function in the event of overload</td>
</tr>
<tr>
<td></td>
<td>- Current value transmission by bus</td>
</tr>
<tr>
<td></td>
<td>- Current limit monitoring</td>
</tr>
<tr>
<td></td>
<td>- Direct-on-line or reversing starters</td>
</tr>
<tr>
<td></td>
<td>- 25 A per segment</td>
</tr>
<tr>
<td></td>
<td>- Supplied with 400 V AC brake contact as an option</td>
</tr>
</tbody>
</table>

- No external feeder contactor required
- Diagnostics (short-circuit, temperature)
- Parameterization functions for simple commissioning
### Further Information

#### S7 Distributed Safety Periphery connection

#### Product overview

<table>
<thead>
<tr>
<th>Module</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-Switch PROFIsafe</td>
<td>- 3 x P-P-switching source/sink output, SIL 3/Cat. 4/ PL e&lt;br&gt;- Permits safe disconnection of standard I/O modules, SIL 2/Cat.3/PL d&lt;br&gt;- Safe controlling of ET200pro motor starters in conjunction with the ASM 400V module, SIL 3/Cat.4/PL e&lt;br&gt;- Activation of parameterized safety functions of ET200pro frequency converters (in preparation)&lt;br&gt;- 2 x digital inputs, SIL 3/Cat.4/PL e</td>
</tr>
<tr>
<td>400 V disconnecting module</td>
<td>- Double disconnection of the main circuit supply, SIL 3/Cat.4/PL e&lt;br&gt;- Feedback of the module's functional state over bus</td>
</tr>
</tbody>
</table>
Fail-safe ET 200eco I/O
The range at a glance

- For distributed expansion of ET 200S F-CPU, S7-300F und S7-400F for a cabinet-free distribution
  - Supported safety related busses
    - PROFIBUS
- F-DI for the connection of digital sensors/encoders

<table>
<thead>
<tr>
<th>Module</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/8 F-DI DC 24V</td>
<td>- 8 inputs, SIL2/Cat.3/PL d or 4 inputs, SIL3/Cat.4/PL e</td>
</tr>
<tr>
<td></td>
<td>- Internal encoder supply</td>
</tr>
<tr>
<td></td>
<td>- Dimensions like standard modules</td>
</tr>
<tr>
<td></td>
<td>- Degree of protection IP 65/67</td>
</tr>
</tbody>
</table>
Failsafe periphery
Hardware requirements for SIL3 / Cat.4

S7 300:
- Safety protector (rel. 03) required between standard modules (PLC, IM, SM, CP, FM, …) and failsafe modules.

ET 200M:
- Safety protector required between standard modules (like IM, SM, CP, FM, …) and failsafe modules
  - beside IM153-2 FO without standard modules

ET 200S:
- PM-E DC 24V AC120V/DC230V or PM-E DC24..48V
- Only failsafe I/O modules within one power group
## Failsafe periphery
Required address area

Maximum amount of failsafe I/O modules for the F-CPU is depending on the process image:

- e.g. CPU 315-2DP  max. 384 byte PII/PIO

<table>
<thead>
<tr>
<th>Configuration</th>
<th>PII / PIO</th>
<th>PII / PIO</th>
<th>PII / PIO</th>
<th>PII / PIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET200M</td>
<td>10/4 Byte</td>
<td>5/5 Byte</td>
<td>6/8 Byte</td>
<td>6/4 Byte</td>
</tr>
<tr>
<td>ET200S</td>
<td>6/4 Byte</td>
<td>5/5 Byte</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ET200pro</td>
<td>8/4 Byte</td>
<td>7/5 Byte</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ET200eco</td>
<td>6/4 Byte</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* only addresses divisible by 8
PROFIsecure communication via PROFINET and PROFIBUS

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*Not available with WLAN
PROFIsafe communication via PROFIBUS

- DP Master
- DP Slave
- DP/DP Coupler
- DP Master – DP Master
- DP Master - I-Slave
- Master - Slave
- I-Slave - I-Slave*
- I-Slave - Slave*
- I-DP Slave
- DP Slave

* also available with standard DP Master
Sensor/ actuator connection
Sensor / actuator connection to failsafe modules

Achievable safety category
- The achievable safety category is depending on the quality of the sensor (proof test interval, Mtbf time, probability of failures etc.) and the way of connecting to failsafe I/O modules.

Selection of sensor:
- When connecting electronic sensors to the failsafe input modules, the testing of the short-circuit detection can interfere the sensor because of the pulsing of the internal sensor supply. Therefore the short circuit test has to be deactivated.

Selection of actuators:
- Because of the internal testing (dark test/ bright test) of the output channels the actuators must be able to tolerate test pulses of 1ms
Sensor connection with failsafe inputs
Examples: Cat.3

For shut down signals the first connector has to be NC
Sensor connection with failsafe inputs
Examples: Cat.4

- Internal power supply need not to be used
- For shut down signals the first connector has to be NC

**Configurations**
- One channel sensors
- Two channel sensor (according Cat.4)
- Exclusive OR sensor according Cat.4)
Further Information

S7 Distributed Safety

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Power circuit 24V - P/M-switched up to 2A and 10A

- Control by F-DO (Electronic output)
  - Power circuit max. 2A
  - Controlled in F-program

- Control by PM-E F (Relais output)
  - Power circuit max. 10A
  - Position control e.g. with additional sensors: Pressure sensor endcontrol ... per Valve
Power circuit >24V - P/M-switched
Example: normal synchron drive - Cat.4

- Motor starter failsafe
- Replaces discreet circuits
- Failsafe shut of with PM-D F with 6 power groups in ET 200S PROFIsafe
- Position control of power indirectly with forced contacts
- Feedback
- PROFIBUS mit PROFIsafe
- DI
- Electronic-output – P
- Electronic-output - M

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© Siemens AG 2008 - Subject to modifications
Power circuit >24V - P/M-switched  
Example: normal synchron drive - Cat.4

- PROFIBUS with PROFlsafe
- F-DO
- Motor starter failsafe
- Replaces discret circuits
- Failsafe shut of with PM-D F with 6 power groups in ET 200S PROFlsafe

- Electronic-output – P
  Cross circuit between P-M must be excluded
  Power circuit 400V

- Feedback
- Position control of power indirectly with forced contacts
- Electronic-output - M
Power circuit – switched by 1F-RO
Example: DC24V/AC24-230V up to 5A - Cat.4

Controlled by F-DO

1F-RO

PROFIBUS with PROFIsafe

4F-DO 1F-RO

to control classical safety loops

to control loads directly
DC 24V/5A
AC 24-230V/5A

wiring to other 1F-RO modules
to switch a group of signals
Power circuits 24V with group shut down
Example: valve block Cat.3

- PROFIBUS mit PROFIsafe
- PM-E F
- Position control e.g. with additional sensors: Pressure sensor endcontrol ... per Valve
- M-Potential
- Safety related shut down with PM-E F
- Selective control with standard DO
- Power circuit 24V/max.10A

DO

Valve group

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In general

Distributed Safety

- for configuring the hardware and programming the safety-related application with FBD and LAD in the familiar STEP 7 environment (STEP 7 option package)

The integral F library of commands

- with off-the-shelf TÜV-certified programming examples and function blocks – individually modifiable
  - EMERGENCY-OFF
  - Two-hand control
  - Muting
  - Gate monitoring
  - ....
S7 Software Distributed Configuration of the PLC

Configuration of F-PLC within STEP7 HW Config.

- Online password protection for PLC
- Enable PLC for safety mode
- Adjust reserved address areas for compiler blocks
S7 Distributed Safety
Configuration of the F-periphery

Configuration of F-modules within STEP7 HW Config.

- Short- and cross circuit test on signal line
- Discrepancy control when for 2oo2 evaluation
- PROFIsafe parameters automatically adjusted
Software Distributed Safety
Handling of the F-program

Central handling and status of the failsafe application from SIMATIC Manager with the Safety program menu

- Status, protection, generating, loading, documentation ...
New functions

- Channel granulate passivating for channel faults
  - With entry in the diagnostic buffer of the PLC
    - E.g. F-DI discrepancy fault
    - E.g. F-DO wire break

- Usability
  - Extension and improvement of the password handling
  - Delta-Download of F-program
  - More Powerful Compilerchecks
    - Detection of Writing Accesses on F-Resources out of the Standard User-Programm
    - Detection, if there is a depassivation sequence in the F-programm for every used F-I/O
  - OV-Bit check
  - Logbook

- Support of PROFINET with PROFIsafe Profil
- Failsafe S7-communication between S7-31x-2PN/DP CPU's on Industrial Ethernet
- Profibus data exchange broadcast
  - Direct data exchange between I-DP Slaves und DP-Slaves
Further Information

www.siemens.com/f-cpu

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www.siemens.de/automation/csi_de_WW/appl&tools
Thank you