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Important note:
The products described here have been developed to realize safety-relevant functions as part of a complete plant or machine. Generally, a complete safety-relevant system includes sensors, evaluation units, signaling devices and concepts for safe shutdown and stopping. The manufacturer of a plant or machine is responsible for ensuring the correct overall function. Siemens AG, its local offices and affiliated companies (in the following "known as Siemens") is not in a position to guarantee all of the properties and features of a complete plant or machine which Siemens did not design.

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## Foreword

### Regulations and Standards
refer to the Safety Integrated System Manual, 5th Edition 1

### Specification and Design of Safety-Relevant Control Systems for Machines

### Connecting Sensors and Actuators

### Fail-Safe Communications using Standard Fieldbuses
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4.1 Fail-safe automation solutions with PROFINET and PROFIsafe
4.2 ASIsafe
Fail-Safe Communications using Standard Fieldbuses
The PROFIsafe profile has been ported to PROFINET. This means that all of the prerequisites have been created for seamless, fail-safe, vertical and horizontal automation solutions based on Industrial Ethernet. The PLC-based solution with PROFINET and PROFIsafe makes plant and machinery construction far more straightforward and, at the same time, more cost effective. It allows new, innovative solutions - but also allows existing bus systems to be integrated. The range of fail-safe controllers and distributed I/O modules is quickly growing.

PROFINET – the new standard for automation

PROFINET has been developed by the PROFIBUS User Organization PNO. This means that it is a non-proprietary, open standard based on Industrial Ethernet. PROFINET consequently uses Fast Ethernet with data transfer rates of 100 Mbit/s and switching technology, utilizes established IT standards such as TCP/IP - and is offering extensive functions for configuration, diagnostics as well as accessing process data via the Internet.

Data transfer using TCP/IP or UDP/IP protocols is completely adequate for control sequences that are not critical from a time perspective. Process data that is critical from a time perspective - e.g. cyclic net data or event-controlled alarms - require, on the other hand, real-time data transfer. PROFINET uses an optimized real-time communications channel that with cycle times in the range of between one and ten milliseconds reaches a performance that is comparable with any of the field buses available in the market. PROFINET Isochronous Real-Time (IRT) with a cycle time under one millisecond with a jitter accuracy of less than one microsecond is available for especially sophisticated tasks such as clock cycle synchronous motion control applications.

Distributed field devices can be integrated just the same as existing field bus systems using proxy technology. The system fulfills all requirements regarding installation technology suitable for industrial environments, simple network administration and diagnostics, protection against unauthorized access and just recently, also fail-safe communications using conventional Industrial Ethernet components (refer to Fig. 4/1).
PROFINET and PROFIsafe

For many years now, safety-relevant technology has been integrated into the standard automation environment based on SIMATIC S7 controllers, PROFIBUS and PROFIsafe. This leading-edge solution has proven itself in many thousands of applications - and that worldwide. The range of Safety Integrated products encompasses all of the required components - from the sensor through the control up to the actuator and is certified for safety levels up to SIL 3 (Safety Integrity Level) of IEC 61508 and Category 4 of EN 954-1.

This portfolio has now been expanded to include PROFINET-capable components. Effective immediately, a complete product range with fail-safe controllers, fail-safe I/O and an appropriate engineering environment is available. This portfolio includes controllers for the medium (S7-300) and upper (S7-400) performance ranges, digital input/output modules belonging to the ET 200S/pro distributed I/O system as well as motor starters and drive inverters with degree of protection IP20 and also IP65/67 for configurations that do not use enclosures and cabinets.

The new fail-safe S7-300 CPUs have PROFIBUS and PROFINET interfaces. The fail-safe ET 200 I/O modules can either be operated on PROFIBUS or PROFINET using the appropriate bus interface modules.

They have their own diagnostic mechanisms and automatically carry-out tests and checks for broken wires, short-circuit and cross-circuit faults.

This means that a complete PLC-based product range is available for safety-relevant applications under PROFIBUS and also PROFINET. The system requirements of the user alone decide which bus is actually used. Many components can be re-used when changing-over from one to the other bus.

PROFIsafe protocol

Communications between fail-safe controllers and fail-safe I/O are established using the "PROFIsafe" protocol profile that has been initially developed for PROFIBUS DP. PROFIsafe was the first communications standard according to IEC 61508 that permits standard and safety-relevant communications along one and the same bus. With SIL 3 and Cat. 4, PROFIsafe fulfills the highest requirements in the production and process industries. PROFIsafe has been checked and certified by the German TÜV (German Technical Inspectorate) and also by the BGIA (BG Institute for Occupational Safety and Health).

Openness of PROFIsafe

While the error identification mechanisms of PROFIsafe V1.30 were sufficient for data transfer via PROFIBUS DP, the more extensive features of Ethernet / PROFINET IO require, for example, a larger address space and expanded switch technology functions in the PROFIsafe protocol. The new PROFIsafe protocol supports 2 modes:

- the V1 mode that is compatible to PROFIsafe V1.30 and
- the V2 mode that supports operation of PROFINET IO and PROFIBUS DP.

The PROFIsafe protocol V2 supports safety-relevant communications for open standard busses - whether it is the proven PROFIBUS DP or all versions of the new, fast PROFINET IO bus system. Using PROFIBUS PA (IEC 61158-2), the seamless, distributed automation extends down into the process world, e.g. for hazardous zones. Not only this, PROFIsafe also supports state-of-the-art radio-based systems via Wireless Industrial Ethernet.

Standard network components, e.g. switches, proxys can also be used for fail-safe communications.
**Integrating existing networks**

PROFINET also allows existing PROFIBUS networks and other fieldbus systems with either standard as well as fail-safe communications to be integrated. This allows composite systems to be configured comprising fieldbus and Ethernet-based sub-systems as well as a gradual transition to PROFINET. Not only this, it helps to protect investments that have buses - allowing them to also be used for fail-safe communications.

The use of the proxy concept simplifies the integration of existing fieldbus systems but at the same time maintaining a high degree of transparency. On Ethernet, a proxy is the representative for one or several fieldbus devices (e.g. connected to PROFIBUS). It ensures transparent communications between the networks and, for instance, transfers cyclic data to the fieldbus devices. As PROFIBUS master, a proxy coordinates data transfer between PROFIBUS nodes and devices.

At the same time, it is the Ethernet node with PROFINET communications (Fig. 4/2).

In addition to proxies that are hard wired, proxies with wireless LAN connectivity can also be used on Industrial Ethernet, which permits completely new automation solutions.

![Communication routes](image)

**Fig. 4/2**

*Fail-safe communications via PROFIsafe for PROFIBUS and PROFINET*
4.2 ASIsafe

New configuration software “asimon V2+”

As already described in the Safety Integrated System Manual (5th Edition), every safety monitor can be simply configured using the PC-based asimon configuration software.

When using the new asimon V2+ software, the range of applications that can be addressed is significantly increased and service is also improved as a result of diagnostic functions that are even more efficient.

Just as before, the safety-relevant logic is parameterized by dragging & dropping. All older monitor versions can be configured using the new asimon V2+ software.

New functions - an overview

- It is simpler to commission the system
  The code sequence of safety AS-i slaves is learnt step-by-step with diagnostic information
  Selectable number of simulated slaves

- Simpler diagnostics via AS-Interface
  A diagnostics index is assigned to the software function block
  The signal and relay outputs are signaled via AS-Interface

Fig. 4/3
Diagnostics index assignment for PLC interrogation
Example of an application: Using the command “AS-i sorting”, the AS-i addresses are assigned a fixed diagnostics index - e.g. AS-i address “1” = “diagnostics index 1”.

• New function blocks
  Monitoring block “zero sequence detection”
  Start blocks “activated via a standard slave” and “activated via the monitor input” (level sensitive)
  Block “operational ON/OFF switching via monitor input”

• Extended function blocks
  Monitoring blocks with selectable functions “local acknowledgment” and “starting test”
  Output blocks “door tumbler mechanisms via delay time” and “door tumbler mechanism via zero speed monitors and delay time” now optionally with STOP1 for enable circuit 1

The door tumbler mechanism is only activated if the zero speed monitor issues an enable signal. If an enable signal is not issued, then the door tumbler mechanism is only re-activated after the selected delay time has expired. This is used to secure the area around machines that have potentially hazardous motion.
5.1 SIRIUS position switches
5.2 SIRIUS Emergency Stop
5.3 SIRIUS command and signaling devices
5.4 SIRIUS safety relays
5.5 ASIsafe
5.6 Safety Motorstarter ET 200 Solutions
5 Safety Industrial Controls

5.1 SIRIUS position switches

Overview

SIRIUS position switches are used to

• Detect the position of moving machine parts and components
• Detect and sense hazardous motion of machine parts and components
• Monitor protective devices with hinged joints such as swiveling doors, hatches, etc.
• Monitor protective devices that can be laterally shifted - such as sliding doors, protective meshes etc.

Features

SIRIUS position switches offer

• A comprehensive range of products with standardized enclosures and actuators
• Simple to mount solutions to detect and monitor hazardous motion and access areas.
• Standard device mounting acc. to Standards EN 50041 and EN 50047
• Maximum protection against tampering and manipulation of the protective devices using, e.g. multiple coded, separate actuators
• Protective devices are monitored up to Category 4 acc. to EN 954-1
• Integrated in the ASIsafe bus system
• High degree of protection, even for standard products

Applications

SIRIUS position switches are used, among other things, for the following tasks:

• In the plant and machinery area to monitor protective barriers and access hatches on printing machines.
• Position switches with locking mechanism are predominantly used to monitor parts of the machine with increased potential hazard - such as robot cells. A protective door is safely interlocked until the machine comes a standstill.
• Safety-relevant shutdown of a machine or system when the end-stop is reached, e.g. for elevators or escalators.
• Protective doors are monitored using magnetically-operated switches that are immune to manipulation when the switch is mounted so that it is covered - this also plays a significant role in areas requiring cleaning and disinfection.
### Standard position switches

As a result of the wide variety of actuators, enclosures and contact systems that are required in the field, SIRIUS 3SE position switches are convincing in almost every application. With positively opening contacts. Versions with dimensions, mounting points and characteristic values are available that are in compliance with Standards EN 50041 to EN 50047.

As a result of their significantly lower switching distance and precise switching points, our short-stroke switches ensure safety-relevant shutdown even for extremely short actuation travel.

### Position switches with separate actuator/locking mechanism

A wide variety of enclosures and actuator versions are available to monitor protective doors. Thanks to the multiple mechanically coded actuators, it is not possible to simply bypass the protective devices. With positively opening contacts.

**Locking mechanism:**
Position switches with separate actuator and locking mechanism keep a protective door interlocked until the operating zone can be entered without incurring any danger. An electrical signal, e.g. from a standstill (zero speed) monitor controls the interlocking solenoids and therefore releases the protective door.

Mechanically locked (closed-circuit principle) and solenoid locked (open-circuit principle) versions with 4 contacts as standard are available.

### Hinge-mounted switches

Versions with a standard enclosure acc. to EN 50047 that are mechanically connected to the hinge axis as well as hinge-mounted switches with already mounted hinge are available. With positively opening contacts.

The NC contacts already open at protective door opening angles of 4 degrees and issue the shutdown command. For versions with snap-action contacts, the signaling command (NO contact) is simultaneously issued with the shutdown command (NC contact).

### Magnetically-operated switches

These contactless magnetically-operated switches offer a high degree of protection against manipulation. They are available in 3 different designs.

The safety-relevant evaluation and monitoring to achieve Category 4 according to EN 954-1 is realized using the 3TK284, 3SE6 safety relays, ASIsafe and F-SIMATIC.
**Design**

- **Standard switches:**
  Modular design with replaceable modules (actuator head, enclosure, contacts).

- **Separate actuator as well as switches with locking mechanism:**
  Fixed contact unit can be combined with various actuators (standard actuators, with lateral mounting and radius actuators).

- **Hinge-mounted switches:**
  Compact contact unit that is directly mounted on the hinged axis or with already pre-assembled hinge.

- **Standard connections for mechanical position switches:**
  Metric glands, preferably M20x1.5. Versions with M12 connector and multi-pole connectors are available.

- **Magnetically-operated switches:**
  Compact, device cast in resin with connecting cables.

**Examples**

1. **Standard switches:**
   Sense end positions and endstops on tool slides in special-purpose machinery construction

2. **Switches with separate actuator:**
   Monitor protective doors on automatic production equipment
3. Hinge-mounted switches:

Monitor access hatches for woodworking machines

4. Magnetically-operated switches:

<table>
<thead>
<tr>
<th>Possible combination – monitoring unit – magnetically-operated switch</th>
<th>Monitoring unit</th>
<th>Magnetically-operated switch</th>
<th>Category reached acc. to E 954-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact blocks</td>
<td>Switching signal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. SIRIUS safety combination</td>
<td>3TK284 Electronic</td>
<td>3SE6604-2BA (2 NC, 25x88mm)</td>
<td>3SE6404-2BA</td>
</tr>
<tr>
<td>2. SIRIUS safety combination with auxiliary relays</td>
<td>3TK285 Electronic</td>
<td>3SE6605-1BA (1 NO/1 NC, M80) 3SE6605-2BA (1 NO/1 NC, 25x88)</td>
<td>3SE6704-1BA 3SE6704-2BA</td>
</tr>
<tr>
<td>3. SIRIUS safety load feeders</td>
<td>3RA7. Electronic</td>
<td>3SE6604-2BA</td>
<td>3SE6704-2BA</td>
</tr>
<tr>
<td>4. ASIsafe</td>
<td>3RKL</td>
<td>3SE6604-2BA</td>
<td>3SE6704-2BA</td>
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<tr>
<td>5. SIMATIC ET 200S PROFIsafe</td>
<td>48F-DI DC 24 V</td>
<td>3SE6605-3BA (1 NO/1 NC, 25x88) 3SE6604-2BA (2 NC, 25x88 mm)</td>
<td>3SE6704-3BA 3SE6704-2BA</td>
</tr>
<tr>
<td>6. SIMATIC ET 200M SIMATIC S7-300F</td>
<td>SM826 DI 24 V</td>
<td>3SE6605-3BA (1 NO/1 NC, 25x33)</td>
<td>3SE6704-3BA</td>
</tr>
<tr>
<td></td>
<td>SM826 DI 8 Namur</td>
<td>3SE6604-2BA (2 NC, 25x88 mm)</td>
<td>3SE6704-2BA</td>
</tr>
</tbody>
</table>
### Technical data

#### SIRIUS position switches

<table>
<thead>
<tr>
<th>Category</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard position switches</td>
<td>• Positively opening contacts, acc. to IEC 947-5-1</td>
</tr>
<tr>
<td></td>
<td>• High contact reliability even at 5V DC / 1mA</td>
</tr>
<tr>
<td></td>
<td>• Suitable for ambient temperatures from -35° to +85°C</td>
</tr>
<tr>
<td></td>
<td>• Extremely high mechanical endurance (30 million switching operations)</td>
</tr>
<tr>
<td></td>
<td>• High IP67 degree of protection</td>
</tr>
<tr>
<td></td>
<td>• Various NC/NO contact versions - up to 4 contacts are possible</td>
</tr>
<tr>
<td></td>
<td>• Enclosure in compliance with EN 50041, EN 50047 and special designs</td>
</tr>
<tr>
<td>Position switch with separate actuator/</td>
<td>• Moulded plastic or metal enclosure in IP66 and IP67</td>
</tr>
<tr>
<td>locking mechanism</td>
<td>• Enclosures acc. to EN 50047, EN 50041 and special designs</td>
</tr>
<tr>
<td></td>
<td>• Safety standard for protective door interlocking functions acc. to EN 1088</td>
</tr>
<tr>
<td></td>
<td>• 4 or 5 approach directions</td>
</tr>
<tr>
<td></td>
<td>• High degree of protection IP65 or IP67</td>
</tr>
<tr>
<td></td>
<td>• Mechanical endurance 1x10^6 operating cycles</td>
</tr>
<tr>
<td></td>
<td>• Ambient temperature from -30° to +85°C</td>
</tr>
<tr>
<td></td>
<td>• Various NC/NO contact versions - up to 4 contacts possible, as well as position monitoring of the actuator and the interlocking solenoids with up to 2 contacts.</td>
</tr>
<tr>
<td>Hinge-mounted switches</td>
<td>• Enclosure acc. to EN 50047 for hinge mounting</td>
</tr>
<tr>
<td></td>
<td>• 1NO/1NC snap-action contacts, 5 degree of 15 degree switching point</td>
</tr>
<tr>
<td></td>
<td>• Switch with integrated hinge for 40 mm profile, 4 degree switching point, 1 NO contact/2 NC contacts slow action contacts</td>
</tr>
</tbody>
</table>
5.2 SIRIUS Emergency Stop

Overview

SIRIUS Emergency Stop switches are actuated by operating personnel and are used to manually shut down plants and systems when hazards occur (acc. to ISO 13850 (EN 418)).

Features

SIRIUS Emergency Stop switches distinguish themselves as a result of:

- Extensive product range with various Emergency Stop operator components
  - rotate to release
  - pull to release
  - key-operated release
- Can be simply and quickly mounted
- Plastic and metal versions
- Embedded - among other things in the AS-Interface bus system

The following advantages are obtained:

- Can be used up to Category 4 acc. to EN 954-1 thanks to the positively-opening NC contacts
- High degree of protection up to IP67
- Harmonized range of command and signaling devices
- Directly connected to ASIsafe, directly connected to the yellow profiled cable

Applications

In all types of plants and machines, Emergency Stop command devices allow plants and systems to be manually shut down when hazards arise and are used in the following industry sectors:

- General machinery construction
- Automation technology
- Special machine construction
- Woodworking industry
- Machine tool construction
- Food & Beverage industry

Product family/product groups

The family of SIRIUS command devices includes, in addition to Emergency Stop actuators:

- Pushbuttons
- Indicator lights
- Selector switches
- Key-operated switches
- Emergency Stop command devices

These devices are available either in round or square moulded-plastic versions as well as in round metal versions.

The Emergency Stop command devices can be used up to Category 4 acc. to EN 954-1. They all have positively-opening contacts.

3TK28, ASIsafe and F-SIMATIC are used to safely evaluate and monitor to achieve Category 4 using a safety module.

Technical data

<table>
<thead>
<tr>
<th>SIRIUS Emergency Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of protection</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Mounting hole</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Rated operating voltage</td>
</tr>
<tr>
<td>Rated operating current</td>
</tr>
<tr>
<td>Contact reliability</td>
</tr>
</tbody>
</table>

Design

The command devices have a modular design and comprise actuator elements such as Emergency Stop, pushbutton as well as a holder to retain the device in the front panel and the contact elements and lamp sockets that can be snapped-in.

The actuator element is mounted in a standard 22.5 mm front panel hole and retained from the back with the holder. Contact blocks and lamp sockets are snapped onto the rear of the actuator element.

Contact blocks and lamp sockets are available with screw terminals, Cage Clamp terminals (spring-loaded terminals) as well as with solder pins for soldering into printed circuit boards.

Example

Automated production line with Emergency Stop control devices located at exposed positions. These are used to manually shut down the line or module when a hazard occurs.
Overview

SIRIUS command devices are used to manually shut down plants when hazards occur. They are activated by operating personnel. Classic Emergency Stop command devices (acc. to ISO 13850 (EN 418)) are available for this purpose.

SIRIUS signaling devices are used to visually and acoustically signal machine and plant states. Signaling devices are available for the modular range of “SIRIUS 3SB3 command and signaling devices” as well as 8WD signaling columns with a comprehensive range of accessories.

Features

SIRIUS command devices include:

- 3SE7 cable-operated switches
  - Emergency Stop function acc. to ISO 13850 (EN 418)
  - Versions for cable lengths up to 100 m
  - LED signal display with high intensity
  - Monitoring function for cable breakage and cable tension
  - Integrated ASIsafe

Applications

SIRIUS command and signaling devices allow machines and systems to be manually shut down when a potentially hazardous situation occurs and are mainly used in the following industry sectors.

- General machinery construction
- Automation technology
- Special machine construction
- Woodworking industry
- Machine tool construction
- Food & Beverage industry

Cable-operated switches are used in plants extending over a wide area - for example, transport conveyor belts in open-cast mining or material feeder belts for printing machines.
Product family/product groups

3SE7 cable-operated switches

System comprising cable-operated switch and cable.

Cable-operated switches are, depending on the length of cable required, available in various designs. Cable lengths of up to 100 m are possible. Different contacts are available for each design.

In order that the state of the cable-operated switch is still visible at a distance, the switch can be equipped with an LED signal display.

Extensive range of accessories.

8WD signaling columns

Available elements:

- Steady-light, flash, rotating beacon, repeated light flash and siren elements
- Colors: Red, yellow, green, blue, clear (white)
- Devices are connected using screw and Cage Clamp terminals.
- Up to 5 elements can be mounted in each signaling column.
- Various acoustic modules up to 105 dB are available.

- 8WD signaling columns can be directly connected to the AS-Interface bus system through the ASI module that can be integrated - even using A/B technology.

- Downtimes can be minimized using the new GSM radio element thus increasing productivity. When the individual signal elements are energized, the GSM element sends an appropriate SMS to a cellular telephone. Easy to commission without any programming costs. The GSM frequency of either 900 or 1800 MHz means that it can be used in all of the usual European networks.
Design

SIRIUS 3SB3 command devices have a modular design and comprise actuator elements such as Emergency Stop, pushbuttons as well as holders for mounting in front panel holes and contact blocks and lamp sockets that can be snapped in.

The actuator element is mounted in a standard 22.5 mm front panel hole and retained from the back with the holder. Contact blocks and lamp sockets are snapped onto the rear of the actuator element.

Contact blocks and lamp sockets are available with screw terminals, Cage Clamp terminals (spring-loaded terminals) as well as with solder pins for soldering into printed circuit boards.

Technical data

<table>
<thead>
<tr>
<th>SIRIUS position switches</th>
<th></th>
</tr>
</thead>
</table>
| 3SE7 cable-operated switch | • Metal enclosure in degree of protection IP65  
• Electrical load capability AC 15 – AC 400 V, 6 A  
• Short-circuit protection 6A (slow-acting)  
• High IP65 or IP67 degree of protection  
• Mechanical endurance >1x10^6 operating cycles  
• Ambient temperature from –25°C to +70°C  
• Various NC/NO contact versions - up to 4 contacts are possible |
| 8WD signaling columns | • Connecting element: Rugged thermoplastic enclosure  
• Light elements: Thermoplastic  
• Operating voltages: 24 V AC/DC, 115 V AC and 230 V AC  
• High IP65 degree of protection  
• Ambient temperature from –30°C to +50°C  
• 8WD44 ASI elements:  
  Addressing socket  
  Status LEDs for diagnostics  
  Can be changed-over to an external auxiliary voltage  
  A/B technology  
• 8WD44 GSM radio element:  
  Frequency, 900 or 1800 MHz  
  24 V DC |
5.4 SIRIUS safety relays

3TK2845 “2x monitored start”

Description

For the “2x monitored start” version, sensor block C is equipped with a monitored start instead of an automatic start. Both sensor inputs are acknowledged using a common “ON” button.

The cascading input is implemented as "automatic start".

A device version is also available where output blocks III and IV are switched-out with a delay.

Application

This version can, for example, be used for the following applications.

Sensor block B:
Emergency Stop command device (manual/monitored start)

Sensor block C:
Protective door (manual/monitored start)

Many production cells, e.g. robot cells are secured using protective doors and Emergency Stop command devices. When servicing or loading the robot, the operator opens the protective door and enters the hazardous area. In order to prevent the robot restarting if the protective doors closes behind him or is accidentally closed, the machine restart must be consciously acknowledged using the "ON" button.
The key-operated switch is in the “OFF” position
- Emergency Stop shuts down all outputs
- The protective door shuts down all outputs
- The machine restarts when the Emergency Stop is released, the protective door is closed by pressing “ON”

The key-operated switch is in the “ON” position
- The key-operated switch de-energizes K3 and K4 (they drop out)
- The protective door function is bypassed, K1 and K2 remain energized
- Emergency Stop additionally de-energizes K1 and K2 (they drop out)

3TK2845 “agreement button”

Description
The “agreement button” version is used to connect and evaluate an agreement button. In conjunction with a 3TK2841 it is possible to also incorporate an Emergency Stop. There is also a device version available where output blocks III and IV are switched-out with a delay.
**Application**

This circuit is used in applications where operation must continue although personnel are in the hazardous zone.

In order that the operator is still protected, he carries an agreement button when he enters the hazardous zone.

The machine is shut down if the operator makes a sudden movement as a result of a reflex (e.g. he releases the agreement button or presses the agreement button past its center position).

---

**Circuit example**

The key-operated switch is in the "OFF" position

The agreement button does not have any function here. If the door is actuated, all outputs are shut down. Emergency Stop shuts down the outputs via the cascading input.

The key-operated switch is in the "ON" position

All of the outputs are shut down when the key-operated switch is changed to "ON". The agreement button is now activated. When the operator brings the agreement button into the appropriate position, then the outputs are again enabled (switched-in) even when the door is open. Just as before, Emergency Stop has a higher-level shutdown function.
3TK2845 “mechanical lock”

**Description**

The “mechanical lock” version is provided to connect a position switch locked using spring force. For this version, output blocks III and IV are always switched-in with delay. One of these two outputs must be used to control the solenoid.

**Application**

The mechanical lock is used where machines still run-on after they have been powered-down. In order to prevent anybody entering the hazardous zone during this run-on time, the protective door is interlocked until the hazardous motion has come to a stop.
Circuit example

Emergency Stop:

Output blocks I and II are immediately shut down if Emergency Stop is actuated. Blocks III and IV remain shut down. The equipment is only restarted again after releasing the Emergency Stop and pressing the "ON" button.

Releasing the door:

If the door release is actuated, output blocks I and II immediately shut down. After the selected time has elapsed, output blocks III and IV are switched-in and the door interlocking withdrawn. The equipment is restarted with the "ON" button with the door closed.

Cascading input:

If the cascading input is de-energized, the equipment responds just the same as for an Emergency Stop. The cascading input is implemented as an automatic start.
3TK2845 “solenoid lock”

**Description**

The “solenoid lock” version is used to connect a position switch interlocked using spring force. For this version, output blocks III and IV are always switched-out with a delay. One of these two outputs must be used to control the solenoid.

**Application**

The solenoid lock is used for machines that continue to run-on after they have prevent anybody entering the hazardous zone during this run-on time, the protective door is interlocked until the hazardous motion has come to a stop.

<table>
<thead>
<tr>
<th>A</th>
<th>1</th>
<th>Cascading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y64</td>
<td>Feedback circuit</td>
</tr>
<tr>
<td>B</td>
<td>Y11</td>
<td>Emergency Stop (monitored start)</td>
</tr>
<tr>
<td></td>
<td>Y34</td>
<td>Acknowledgment</td>
</tr>
<tr>
<td></td>
<td>Y35</td>
<td>Cross-circuit fault monitoring active</td>
</tr>
<tr>
<td></td>
<td>Y41</td>
<td>Solenoid lock (monitored start)</td>
</tr>
<tr>
<td></td>
<td>Y51</td>
<td>Cross-circuit fault monitoring active</td>
</tr>
<tr>
<td></td>
<td>Y52</td>
<td>Y65</td>
</tr>
<tr>
<td>C</td>
<td>Y21</td>
<td>Relay output</td>
</tr>
<tr>
<td></td>
<td>Y22</td>
<td>Electronic output</td>
</tr>
<tr>
<td></td>
<td>Y72</td>
<td>Relay output (switch-out delay)</td>
</tr>
<tr>
<td>D</td>
<td>Y72</td>
<td>Electronic output (switch-out delay)</td>
</tr>
<tr>
<td></td>
<td>Y82</td>
<td>Electronic signaling output</td>
</tr>
</tbody>
</table>
Circuit example

Emergency Stop:

Output blocks I and II are immediately shut down if Emergency Stop is actuated. Blocks III and IV remain switched-in. The equipment is only restarted again after releasing the Emergency Stop and pressing the "ON" button.

Releasing the door:

If the door release is actuated, output blocks I and II immediately shut down. After the selected time has elapsed, output blocks III and IV are switched-in and the door interlocking withdrawn. The equipment is restarted with the "ON" button with the door closed.

Cascading input:

If the cascading input is de-energized, the equipment responds just the same as for an Emergency Stop. The cascading input is implemented as an automatic start.

<table>
<thead>
<tr>
<th>Version</th>
<th>Order No. [MLFB]</th>
<th>Terminal</th>
<th>x=0</th>
<th>x=1</th>
<th>x=2</th>
<th>x=4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x monitored start</td>
<td>3TK2845-1DB4x</td>
<td>Screw terminal</td>
<td>Instantaneous</td>
<td>0.05 – 3 s</td>
<td>0.05 – 30 s</td>
<td>5 – 300 s</td>
</tr>
<tr>
<td>Agreement button</td>
<td>3TK2845-1EB4x</td>
<td>Screw terminal</td>
<td>Instantaneous</td>
<td>0.05 – 3 s</td>
<td>0.05 – 30 s</td>
<td>5 – 300 s</td>
</tr>
<tr>
<td>mechanical lock</td>
<td>3TK2845-1FB4x</td>
<td>Screw terminal</td>
<td>--</td>
<td>0.05 – 3 s</td>
<td>0.05 – 30 s</td>
<td>5 – 300 s</td>
</tr>
<tr>
<td>solenoid lock</td>
<td>3TK2845-1GB4x</td>
<td>Screw terminal</td>
<td>--</td>
<td>0.05 – 3 s</td>
<td>0.05 – 30 s</td>
<td>5 – 300 s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Version</th>
<th>Order No. [MLFB]</th>
<th>Terminal</th>
<th>x=0</th>
<th>x=1</th>
<th>x=2</th>
<th>x=4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x monitored start</td>
<td>3TK2845-2DB4x</td>
<td>Spring-loaded terminal</td>
<td>Instantaneous</td>
<td>0.05 – 3 s</td>
<td>0.05 – 30 s</td>
<td>5 – 300 s</td>
</tr>
<tr>
<td>Agreement button</td>
<td>3TK2845-2EB4x</td>
<td>Spring-loaded terminal</td>
<td>Instantaneous</td>
<td>0.05 – 3 s</td>
<td>0.05 – 30 s</td>
<td>5 – 300 s</td>
</tr>
<tr>
<td>mechanical lock</td>
<td>3TK2845-2FB4x</td>
<td>Spring-loaded terminal</td>
<td>--</td>
<td>0.05 – 3 s</td>
<td>0.05 – 30 s</td>
<td>5 – 300 s</td>
</tr>
<tr>
<td>solenoid lock</td>
<td>3TK2845-2GB4x</td>
<td>Spring-loaded terminal</td>
<td>--</td>
<td>0.05 – 3 s</td>
<td>0.05 – 30 s</td>
<td>5 – 300 s</td>
</tr>
</tbody>
</table>
**5.5 ASIsafe**

**Reference - follow-on**

Overview, features/customer benefits as well as function/design and application areas were discussed in Chapter 4.2 (Safe communications via standard fieldbuses; Section ASIsafe in the Safety System Manual, 5th Edition).

Following-on from this, the product range will now be individually described.

### Safety monitors

The safety monitor is the core element of ASIsafe. The safety monitor (basic) monitors data transferred via AS-Interface (master calls - response from safety slaves). Additional functions are possible using the new enhanced safety monitor. A larger working memory (RAM) allows complex applications to be configured. Brief shutdown operations are saved in a buffer memory for diagnostic purposes. The logical functions can be linked with one another and cascaded. Additional timers have been integrated for switch-in and switch-on delay and also pulse functions. Removable terminals are new - they ensure simple installation and fast replacement.

### SIRIUS Emergency Stop

Emergency Stop devices can be directly connected using the Standard ASI Interface with safety-relevant communications. This applies to Emergency Stop devices from the range of SIRIUS 3SB3 command devices that are mounted in front panels and for mounting in an enclosure. An Emergency Stop device mounted in a front panel can be directly connected to the AS-Interface via a safety module.

### Emergency Stop in enclosures

Various AS-Interface capable enclosures equipped with 3SB3 command devices can be implemented with safety-relevant connection for an Emergency Stop. Command and signaling devices can be arranged in enclosures according to customer specifications. These can be configured using a configurator that can be found under the following link:

http://www.siemens.de/sirius-befehlen
SIRIUS position switches can be directly connected using the standard AS-Interface with safety-relevant communications. There is a direct connection available for this purpose, that is mounted onto the position switch thread. This means that the components for the safety functions no longer have to be conventionally wired.

The light curtains and light grids, Category 4 according to EN 954-1 offer active optical protection for persons at machines. They can be optionally directly connected to AS-Interface in a safety-relevant fashion.

The laser scanner is an optical electro-sensitive protective device to secure hazardous areas. It has a radius of up to 4 m. The AS-Interface version permits a direct safety-relevant connection to be established.

The compact K45F safety module is equipped with 2 safety-relevant inputs for electro-mechanical transmitters and sensors. In operation up to Category 2 according to EN 954-1, both inputs can be separately used. However, the module has a 2-channel input if Category 4 is required.
The compact K60F safety module is equipped with 2 safety-relevant inputs for electro-mechanical transmitters and sensors. Both inputs can be separately used in operation up to Category 2 according to EN 954-1. However, the module has a 2-channel input if Category 4 is required. The module also has two non-safety-relevant outputs. K60F is available in two versions:
- Power supply for the outputs via the yellow cable
- Auxiliary power supply for the outputs via the black cable (V_{aux.})

The safety SlimLine Module S22.5F has 2 “safety” inputs for electro-mechanical sensors and allows safety-relevant signals to be connected to ASIsafe in local electrical cabinets and boxes. Both inputs can be separately used for operation up to Category 2. The module has a 2-channel input if Category 4 is required.

Two S22.5F module versions have been recently included in the range, which in addition to the two safety-relevant inputs, also have two standard outputs. They are either supplied from the yellow AS-Interface cable or via the auxiliary voltage from the black 24 V DC cable. The safety SlimLine modules S22.5F are suitable for use in control cabinets and local electrical enclosures. They have removable terminals for simple installation/replacement.

The new AS-Interface Analyser is the ideal supplement for local diagnostics of the AS-Interface Networks. The quality and function of an AS-Interface installation can be completely checked using the analyser - this significantly speeds-up commissioning. Monitoring, evaluating and preventive investigation of the AS-Interface network are simpler and more detailed.

An LED display directly at the unit allows the network to be monitored without having to use a note-book. Further, the analog I/O signals and the state of the safety slaves are now displayed. Preventive diagnostics is simplified as a result of the newly introduced "common error signal". Thanks to the further optimized operator navigation, users with somewhat less experience can start to use the “Expert Mode”.

The basic and comprehensive AS-i diagnostics is now supported by the HMIpro operator software TRANSLINE 2000 package. It is now possible to simply engineer the system in a standard way as pre-configured screens are being integrated - and now also taken into account ASIsafe Slaves. Users are provided with a fast overview from where they can call-up detailed information about all of the plant and system components.

All of the diagnostic functions of the AS-i bus can be displayed at any time on the HMI screen via the control (PLC) and graphically displayed next to the master diagnostics (when slaves fail, etc.).
5.6 Safety Motorstarter
ET 200 Solutions

**Overview**
As part of the SIMATIC ET 200 distributed I/O system, all motor starters are integrated into the existing automation system via PROFIBUS or PROFINET. The finely modular system architecture guarantees optimum integration of all applications with reference to individual machines or complete plants. This is true for the production as well as for the process industry. The direct or reversing motor starter for ET 200S and for ET 200pro can be combined with safety systems. They are used wherever it is decisive to reduce engineering costs, wiring and equipment - but also where availability and flexibility counts.

<table>
<thead>
<tr>
<th>Motorstarter Standard</th>
<th>Motorstarter High Feature</th>
<th>Motorstarter Failsafe</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Direct and reversing starters</td>
<td>• Direct and reversing starters</td>
<td>In addition to all of the features of Motorstarter High Feature, ET 200S Motorstarter Failsafe also offer:</td>
</tr>
<tr>
<td>• Power range up to 12 A / 5.5 kW</td>
<td>• Low number of versions as a result of the wide range overload protection</td>
<td>• Intrinsically safe, based on a self-monitoring function certified by the German Technical Inspectorate (TÜV) and internal redundant shutdown in compliance with Category 4 acc. to EN 954-1 and SIL 3 acc. to IEC 61508</td>
</tr>
<tr>
<td>• Self-establishing power bus ET 200S up to 40 A ET 200pro up to 25 A</td>
<td>• Selective motor protection concept that can be parameterized via the bus</td>
<td>• Assigned to one of 6 safety-relevant shutdown groups</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ET 200pro Station with motor starters Standard and High Feature</th>
<th>ET 200pro Station with motor starters Standard and High Feature</th>
<th>ET 200pro Station with motor starters Failsafe</th>
</tr>
</thead>
</table>
The Safety Motorstarter ET 200 Solutions allow motors to be shutdown in a safety-relevant fashion and are predestined for all applications up to Category 4 according to EN 954-1 or SIL 3 according to IEC 61508. They comprise:

- Safety modules
- Motorstarter Standard
- Motorstarter High Feature
- Motorstarter Failsafe (ET 200S)

The topmost objective is to offer an optimum and highly effective safety concept that takes into account trends in automation technology and the appropriate standards - and is also accepted in the field. This is the reason that two different multifunctional safety concepts are available:

- For systems with a locally restricted safety concept
  - Sensor assignment is wiring-oriented
  - Logic is with local evaluation

- For systems that use an F control
  - It doesn’t matter at which station sensors and actuators are located (assignment can be freely programmed)
  - Safety-relevant communications

*Hot swapping*: A device is replaced in operation without any consequences for the operational CPU and motor starter.
<table>
<thead>
<tr>
<th>Safety Motorstarter Solution</th>
<th>Motor starter</th>
<th>Safety module</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local</strong></td>
<td>PM-D F1 (monitored start)</td>
<td>Motorstarter Standard or Motorstarter High Feature</td>
</tr>
<tr>
<td></td>
<td>PM-D F2 (automatic start)</td>
<td>(delayed shutdown, 0.5–30 s)</td>
</tr>
<tr>
<td></td>
<td>PM-D F3</td>
<td>PM-D F4 (station expansion for line-type configuration)</td>
</tr>
<tr>
<td></td>
<td>PM-D F5</td>
<td>PM-D F5 (contact multiplier)</td>
</tr>
<tr>
<td><strong>PROFIsafe</strong></td>
<td>PM-D F PROFIsafe F-CM (contact multiplier)</td>
<td>Motorstarter Standard or Motorstarter High Feature</td>
</tr>
<tr>
<td></td>
<td>PM-D F2</td>
<td>(automatic start)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Motorstarter Solution</th>
<th>Motor starter</th>
<th>Safety module</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>with ET 200S</strong></td>
<td>PM-D FX1 (with 6 shutdown groups)</td>
<td>Motorstarter FailSafe</td>
</tr>
<tr>
<td></td>
<td>Motorstarter FailSafe</td>
<td>PM-D F PROFIsafe (with 6 shutdown groups)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Motorstarter Solution</th>
<th>Motor starter</th>
<th>Safety module</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>with ET 200pro</strong></td>
<td>F-RSM (Safety Local Isolator Switch Module: Emergency Stop or protective door; monitored or automatic start) ASM 400 V (Disconnecting Module up to 400 M)</td>
<td>Motorstarter Standard or Motorstarter High Feature</td>
</tr>
</tbody>
</table>
Safety Motorstarter Solution Local

From the perspective of safety systems, this solution is frequently used for safety-relevant applications that are limited in terms of their geographical extent. They operate autonomously and do not require a safety-relevant control. It is not necessary to specifically program the safety system.

For Safety Motorstarter ET 200 Solution Local, the motor starter versions Standard, High Feature and Failsafe (for ET 200S) can be seamlessly used. The safety-relevant sensors are directly connected to the safety modules. Depending on the selected function, these switch downstream motor starters in a safety-relevant fashion. Further, all of the signals from the modules are automatically transferred as diagnostic signals - for example when cross-circuit faults occur in Emergency Stop circuits.

When combined with external safety relays or ASIsafe, then Safety Module PM-DFX1 is specifically used for ET 200S. This allows up to 6 shutdown groups to be fed. This means that individual Motorstarter Failsafe can be shutdown in a safety-relevant fashion - either selectively or cascaded.

Fig. 5/2
Integrating command and detecting devices

Fig. 5/3
Integrating external safety circuits
Safety Motorstarter ET 200pro Solution Local

The new standard for applications without electrical cabinets

Any three-phase loads can be protected and controlled using the ET 200pro motor starters. These are an integral part of the ET 200pro distributed I/O system and are implemented in a high IP65 degree of protection. This means that they are optimally suited for use in modular, distributed I/O without electrical cabinets or enclosures. The low variance (2 devices up to 5.5 kW) optimizes engineering and stock inventory costs.

They are directly connected to PROFIBUS or PROFINET, which ensures transparent automation structures. This also applies to the extensive diagnostic functions regarding transferring the current value or tripping frequency.

The motor starter option that can be ordered with 400 V AC brake output offers the possibility of controlling motors equipped with a 400 V AC brake. Autonomous special functions can be implemented with the 4 locally effective inputs on the Motorstarter High Feature. These inputs operate independently of the bus and higher-level control, e.g. as fast stop for valve control systems or end stop shutdown functions.

All 400 V components have power connectors with interlocking clips in compliance with ISO 23570 connection systems.

Safety Motorstarter Solution Local are used for safety-relevant applications. These comprise:

- the Safety Local Isolator and
- the 400 V Disconnecting Module

A safety level corresponding to Category 4 can be achieved with the appropriate circuit.

Safety Local Isolator Module

The Safety Local Isolator Module with the load disconnector function and integrated group fusing function is an isolator that can be parameterized using a DIP switch with integrated safety evaluation functionality.

It is used to

- Connect a 1 or 2-channel Emergency Stop circuit (protective door or Emergency Stop button).
- When an Emergency Stop is issued, it is used to shut down the 400 V disconnecting module up to Category 4 acc. to EN 954-1 / SIL 3 acc. to IEC 61508. This safely disconnects the 400 V.
- Selectable starting behavior (auto start / monitored start) using a shift switch.
- Safety output, e.g. to control the locking mechanism (locking solenoid) of a protective door monitoring switch.

Fig. 5/4
Safety Local isolator module and 400 V disconnecting module
400 V Disconnecting Module

The 400 V Disconnecting Module can be used in conjunction with the Safety Local Isolator Module for local safety-relevant applications up to Category 4 according to EN 954-1 / SIL 3 according to IEC 61508. It contains two contactors connected in series to disconnect the main circuit in a safety-relevant fashion. A safety rail in the backplane bus module is used to provide the auxiliary power supply of the device. It is used to

- Disconnect the main circuit supply,
- Signal the status of the module function via bus,
- Feed in power, loop-through the power at the front using power connectors with clip interlocking according to ISO 23570 connection systems.

Command and detecting devices as well as signals from external safety circuits can be integrated in a safety-relevant application with ET 200pro motor starters using the Safety Motorstarter ET 200pro Solution Local. The advantages include the low wiring costs and the high IP65 degree of protection. This means that a safety-relevant application can be directly and optimally implemented in a plant or system.
# Technical data

<table>
<thead>
<tr>
<th>General data</th>
<th>Safety Local Isolator Module</th>
<th>400V Disconnecting Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting dimensions (W x H x D) in mm</td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td>Direct and reversing starters</td>
<td>110 x 230 x 170</td>
<td>mm</td>
</tr>
<tr>
<td>Permissible ambient temperature</td>
<td>°C</td>
<td>°C</td>
</tr>
<tr>
<td>in operation</td>
<td>-25 ... +55</td>
<td>-40 ... +70</td>
</tr>
<tr>
<td>during storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permissible position in use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration strength acc. to IEC 60068, Part 2-6</td>
<td>g</td>
<td>2</td>
</tr>
<tr>
<td>Shock strength acc. to IEC 60068, Part 2-27</td>
<td>Semi-sinusoidal 15 g/11 ms</td>
<td></td>
</tr>
<tr>
<td>Current drain</td>
<td>mA</td>
<td>mA</td>
</tr>
<tr>
<td>from the auxiliary circuit L+M (U1)</td>
<td>Approx. 20</td>
<td></td>
</tr>
<tr>
<td>from the auxiliary circuit A1/A2 (U2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated operating current for power bus I₀</td>
<td>A</td>
<td>25</td>
</tr>
<tr>
<td>Rated operating voltage V₀</td>
<td>V</td>
<td>400</td>
</tr>
<tr>
<td>Approval DIN VDE 0106, Part 101</td>
<td>V</td>
<td>to 500</td>
</tr>
<tr>
<td>CSA and UL-listed</td>
<td>V</td>
<td>to 600</td>
</tr>
<tr>
<td>Connection cross-sections</td>
<td>mm²</td>
<td>max. 6 x 4</td>
</tr>
<tr>
<td>Power infeed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP</td>
<td>65</td>
</tr>
<tr>
<td>Shock hazard protection</td>
<td>Safe to finger touch</td>
<td></td>
</tr>
<tr>
<td>Degree of pollution</td>
<td>3, IEC 60664 (IEC 61131)</td>
<td></td>
</tr>
<tr>
<td>Rated withstand voltage strength Vpulse</td>
<td>kV</td>
<td>6</td>
</tr>
<tr>
<td>Rated insulating voltage V₁</td>
<td>V</td>
<td>400</td>
</tr>
<tr>
<td>Rated operating current for starter I₀</td>
<td>A</td>
<td>25</td>
</tr>
<tr>
<td>AC-1/2/3 at 40 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>at 400 V</td>
<td>A</td>
<td>25</td>
</tr>
<tr>
<td>at 500 V</td>
<td>A</td>
<td>25</td>
</tr>
<tr>
<td>Rated short-circuit interrupting capacity</td>
<td>kA</td>
<td>50 at 400 V</td>
</tr>
<tr>
<td>Coordination type acc. to IEC 60947-4-1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Protective separation between main and auxiliary circuits</td>
<td>V</td>
<td>400, acc. to DIN VDE 0106. Part 101</td>
</tr>
<tr>
<td>Switching times at 0.85 ... 1.1 x V₀</td>
<td>ms</td>
<td>ms</td>
</tr>
<tr>
<td>Closing delay</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Opening delay</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Device functions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group diagnostics</td>
<td>Yes, can be parameterized</td>
<td></td>
</tr>
<tr>
<td>Device displays</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group fault</td>
<td>SF-LED (red)</td>
<td></td>
</tr>
</tbody>
</table>
Safety Motorstarter Solution PROFIsafe

This solution is the optimum one if the safety system at the control level (safety-relevant control) is required for especially sophisticated safety-relevant applications that are networked with one another. Standard and safety-relevant communications are realized through a single bus system - PROFIBUS or PROFINET with the PROFIsafe profile.

As a result of the PROFIsafe profile, safety functions are available throughout the complete network. This means that the Safety Motorstarter Solution PROFIsafe (specifically for ET 200S) permit selective and safety-relevant shutdown of individual Motorstarter Fail-safe, safety-relevant shutdown of individual Motorstarter Fail-safe or a safety-relevant shutdown of a group of Standard or High Feature motor starters depending on the plant or system requirements. It is not important to know which I/O station the safety-relevant command devices were connected. Within the scope of the Distributed Safety concept, all sensors and actuators can be freely programmed in Step7. This means that this solution offers a previously unknown degree of flexibility and reduced wiring for applications in plants or systems extending over a wide area or where it is necessary to sporadically modify the assignment of the safety segments.

The Safety Module PM-DF PROFIsafe receives the shutdown signal from the ET 200S interface module and safely shuts down between 1 and 6 shutdown groups. Whereby, each individual Motorstarter Fail-safe can be freely assigned. For PROFIsafe applications, this safety module can be used, when required, to selectively shut down motor starters or fail-safe frequency inverters in a safety-relevant fashion.

The interface between PROFIsafe and systems utilizing conventional safety technology is established through the Failsafe Contact Multiplier (F-CM) with 4 floating contacts. This F-CM can be freely used in the station.
Safety Motorstarter Solution PROFIsafe for PROFINET

PROFINET - the open and innovative Industrial-Ethernet standard fulfills all of the requirements in the automation environment. The acceptance of PROFINET in the market is continually increasing as a result of a wide range of advantages (e.g. real-time capability, deterministic mechanism, simple network administration, safety-relevant communication, ...).

With PROFINET, cyclic communications are realized between an IO controller and its IO devices just the same as for PROFIBUS. Together with its IO devices or systems, a controller forms a PROFINET IO system.

These IO devices - as distributed I/O - allow, just the same as for PROFIBUS, the use of motor starters ET 200S (IP20) or ET 200pro (IP65) for safety-relevant applications. The existing German Technical Inspectorate certificates (TÜV) apply specifically to the ET 200 S I/O system for safety modules (with existing PROFIsafe driver adaptation) and for fail-safe motor starters independent of the bus system for safety levels up to SIL 3 of IEC 61508 and Category 5 of EN 954-1.

ET 200 Configurator software

The ET 200 Configurator software is listed in Catalog CA01 and can also be downloaded from the Internet at no charge: [http://www.siemens.de/sirius-starten](http://www.siemens.de/sirius-starten) or [http://www.siemens.de/ET200S](http://www.siemens.de/ET200S)
6.1 Switching strips SIMATIC FS100
6.2 Light barriers SIMATIC FS200
6.3 Laser scanners SIMATIC FS600
6.4 Light curtains and light grids SIMATIC FS400
6.5 Technical data
Crushing edges at many machines and other pieces of equipment represent a risk of hazard. In situations such as these, the best form of security is rubber switching strips, that stop the potentially hazardous motion in a fail-safe fashion. They can also prevent injury by acting as a buffer.

The rubber profile (signal transmitter) is optically monitored using a fail-safe send/receive sensor, that is inserted in the profile from the outside. It can be cut to size on-site so that it can be used for applications of any length.

Electro-sensitive light barriers are especially suitable if there is little space when securing access to hazardous zones, dangerous locations or access points. These light barriers have an IP65 degree of protection and in Category 2 have a range of up to 150 m. The light barriers, Category 4 with a range of 60 m are equipped with infrared light whose frequency is modulated and have an integrated dust monitoring function. In conjunction with additional evaluation units, start/restart inhibit, contactor monitoring or muting functions are possible.

The LS4 laser scanner is an optical distance sensor to flexibly secure hazardous zones. It emits safe laser pulses and by evaluating reflections, the scanner detects persons and objects and responds corresponding to the programmed protective fields.
6.4 Light curtains and light grids SIMATIC FS400

THE ELECTRO-SENSITIVE AND ACTIVE OPTOELECTRONIC LIGHT CURTAINS AND LIGHT GRIDS FOR CATEGORY 2 AND 4 ACC. TO EN 954-1 PROTECT OPERATING PERSONNEL AT OR CLOSE TO OPERATIONAL MACHINES AND EQUIPMENT. THEY ARE ESPECIALLY IMMUNE TO NOISE AND DISTURBANCES AND HAVE A HIGH AVAILABILITY AS A RESULT OF THE SPECIALLY DEVELOPED INTEGRATED CIRCUITS (ASICs) AND A PATENTED, INTELLIGENT EVALUATION TECHNIQUE. A WIDE RANGE OF FUNCTIONS, SUCH AS START/RESTART INHIBIT, CONTACTOR MONITORING, MUTING, CYCLIC CONTROL AND BLANKING PERMIT AN EXTREMELY WIDE RANGE OF APPLICATION TO BE ADDRESSED. WHETHER FOR PROTECTING FINGERS AND HANDS, TO HORIZONTALLY SECURE HAZARDOUS ZONES OR TO SECURE ACCESS POINTS. VERSIONS ARE AVAILABLE THAT CAN BE CONNECTED TO ASIsafe. A LIGHT CURTAIN OR LIGHT GRID COMPRIS A TRANSMITTER AND A RECEIVER THAT ARE MOUNTED OPPOSITE TO ONE ANOTHER. DEPENDING ON THE RESOLUTION AND LENGTH, A SPECIFIC NUMBER OF TRANSMITTING AND RECEIVING DIODES ARE LOCATED ONE ABOVE THE OTHER. THE INFRARED LEDs OF THE TRANSMITTER SEND SHORT LIGHT PULSES THAT ARE RECEIVED BY THE ASSOCIATED RECEIVER DIODES.

Light curtains SIMATIC FS400

**Benefits**

**Integrated functions**
- Start/restart inhibit
- Contactor monitoring
- "Blanking" function package with fixed blanking
  floating blanking
  reduced resolution
- "Muting" function package
- Multi-scan function
- Cycle control

**Configuration**
- Using an opto-magnetic teach-in key
- Configuration data is transferred using a plug-in configuration card
- 2 data transfer channels
- Host and guest devices can be cascaded
- Extended display (2 x 7 segments)
- Outputs/connections:
  - Local interface
  - Cable gland
  - Hirschmann connector
  - Brad-Harrison connector
  - Transistor outputs
  - Relay outputs
  - Connection to ASIsafe

Design

A light curtain or light grid comprises a transmitter and a receiver that are mounted opposite to one another. Depending on the resolution and length, a specific number of transmitting and receiving diodes are located one above the other. The infrared LEDs of the transmitter send short light pulses that are received by the associated receiver diodes.

Light curtains and grids 3RG78 42 and 3SF78 42 for Category 4 acc. to EN 954-1

- Resolutions 14, 30, 50 and 90 mm,
- Protective field heights from 150 to 3000 mm,
- 2, 3 or 4-beam light grids.
- Host and guest devices can be cascaded for higher protective field heights or lengths - or for angled arrangements

Light curtains and grids 3RG78 44 and 3SF78 44 with integrated evaluation for Category 4 acc. to EN 954-1

- Resolutions 14, 30, 50 and 90 mm,
- Protective field heights from 150 to 3000 mm,
- 2, 3 or 4-beam light grids,
- Transceiver, 2-beam with deflecting mirror
- Host and guest devices can be cascaded for higher protective field heights or lengths - or for angled arrangements
Light curtains 3RG78 41 for Category 2 acc. to EN 954-1

- Resolution 30, 55 and 80 mm,
- Protective field heights from 150 mm to 1800 mm,
- Host and guest devices can be cascaded for higher protective field heights or lengths - or for angled arrangements

Light curtains 3RG78 43 with integrated evaluation for Category 2 acc. to EN 954-1, developed acc. to EN 61508 (SIL 2), suitable for risk assessment acc. to prEN ISO 13489

- Resolutions 20, 30, 40 and 90 mm
- Protective field heights from 150 to 1800 mm

### 6.5 Technical data

<table>
<thead>
<tr>
<th>Connection</th>
<th>Light curtains 3RG7844/3SF7844, Category 4</th>
<th>Light curtains 3RG7844/3SF7844, Category 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Integrated standard</td>
<td>Integrated blanking</td>
</tr>
<tr>
<td>Transistor output with Brad-Harrison-connector (MIN series)</td>
<td>Resolutions 14 mm, 30 mm, 50 mm</td>
<td>Resolutions 14 mm, 30 mm, 50 mm</td>
</tr>
<tr>
<td>Transistor outputs with cable gland</td>
<td>Resolutions 14 mm, 30 mm, 50 mm</td>
<td>Resolutions 14 mm, 30 mm, 50 mm</td>
</tr>
<tr>
<td>Relay output with Hirschmann connector</td>
<td>Resolutions 14 mm, 30 mm</td>
<td>Resolutions 14 mm, 30 mm</td>
</tr>
<tr>
<td>ASIsafe</td>
<td>Resolutions 14 mm, 30 mm</td>
<td>Resolutions 30 mm and 30 mm with integr. LED</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>connector</th>
<th>Light curtains 3RG7843, Category 2</th>
<th>Light curtains 3RG7841 Category 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Integrated standard</td>
<td>Integrated blanking</td>
</tr>
<tr>
<td>M12 connection</td>
<td>Resolutions 20 mm, 30 mm, 40 mm, 90 mm</td>
<td></td>
</tr>
</tbody>
</table>
### Connection

<table>
<thead>
<tr>
<th>Integrated standard</th>
<th>Integrated blanking</th>
<th>Integrated muting</th>
<th>Integrated cycle control</th>
<th>External evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transistor output with Brad-Harrison connector (MIN series)</td>
<td></td>
<td>Range 18 m</td>
<td></td>
<td>Ranges 18 m, 60 m</td>
</tr>
<tr>
<td>Transistor outputs with cable gland</td>
<td>Ranges 18 m, 70 m</td>
<td>Ranges 18 m, 70 m</td>
<td></td>
<td>Ranges 18 m, 60 m</td>
</tr>
<tr>
<td>Relay output with Hirschmann connector</td>
<td>Range 18 m</td>
<td>Ranges 18 m, 70 m and 18 m with integr. LED and transceiver (range 6.5 m)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASIsafe</td>
<td></td>
<td>Ranges 18 m, 70 m and 18 m with integr. LED and transceiver (range 6.5 m)</td>
<td></td>
<td>Ranges 18 m, 60 m</td>
</tr>
</tbody>
</table>

### Light curtains, Category 4

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Protective field heights</th>
<th>Beam number</th>
<th>Beam clearance</th>
<th>Resolution</th>
<th>Protective field heights</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 mm</td>
<td>150 to 1800 mm</td>
<td>Light grid, 2-beam</td>
<td>500 mm</td>
<td>20 mm</td>
<td>150 to 1800 mm</td>
</tr>
<tr>
<td>30 mm</td>
<td>150 to 1800 mm</td>
<td>Light grid, 3-beam</td>
<td>400 mm</td>
<td>30 mm</td>
<td>150 to 1800 mm</td>
</tr>
<tr>
<td>50 mm</td>
<td>450 to 1800 mm</td>
<td>Light grid, 4-beam</td>
<td>300 mm</td>
<td>40 mm</td>
<td>150 to 1800 mm</td>
</tr>
<tr>
<td>90 mm</td>
<td>750 to 3000 mm</td>
<td>Transceiver, 2-beam</td>
<td>500 mm</td>
<td>50 mm</td>
<td>300 to 1800 mm</td>
</tr>
<tr>
<td>90 mm</td>
<td>750 to 3000 mm</td>
<td>Transceiver, 2-beam</td>
<td>500 mm</td>
<td>50 mm</td>
<td>300 to 1800 mm</td>
</tr>
</tbody>
</table>

### Light grid, Category 4

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Protective field heights</th>
<th>Beam number</th>
<th>Beam clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 mm</td>
<td>450 to 1800 mm</td>
<td>Light grid, 3-beam</td>
<td>400 mm</td>
</tr>
<tr>
<td>90 mm</td>
<td>150 to 1800 mm</td>
<td>Light grid, 4-beam</td>
<td>400 mm</td>
</tr>
</tbody>
</table>

### Light curtains, Category 2

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Protective field heights</th>
<th>Beam number</th>
<th>Beam clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 mm</td>
<td>450 to 1800 mm</td>
<td>Light grid, 3-beam</td>
<td>400 mm</td>
</tr>
<tr>
<td>90 mm</td>
<td>150 to 1800 mm</td>
<td>Light grid, 4-beam</td>
<td>400 mm</td>
</tr>
</tbody>
</table>
7.1 Standards
7.2 PROFINET-CPUs
Fail-Safe Controls
7 Fail-Safe Controls
SIMATIC Safety Integrated

7.1 Standards

Fail-safe SIMATIC controls fulfill all important Standards and regulations and are certified by the German Technical Inspectorate (TÜV).

Production automation

• IEC 61508 (up to SIL 3)
• IEC 62061
• EN 954 (up to Category 4)
• NFPA 79-2002 and NFPA 85
• UL 1998, UL 508 and UL 991

Certificate under: [http://www.siemens.de/f-cpu](http://www.siemens.de/f-cpu)

Factory automation

• IEC 61508 (up to SIL 3)
• EN 954 (up to Category 4)
• NFPA 72
• ANSI/ISA S84, API 14C, BLRBAC

Certificate under: [http://www4.ad.siemens.de/WW/view/de/17968956](http://www4.ad.siemens.de/WW/view/de/17968956)

PROFIBUS and PROFINET with PROFIsafe are also part of SIMATIC Safety Integrated and are certified acc. to IEC 61508 (up to SIL 3), EN 954 (up to Category 4), NFPA 79-2002 therefore fulfilling the highest requirements for the production and process industries. Not only this, PROFIBUS DP expanded by the data transmission version PA (IEC 1158-2), means that distributed automation can be seamlessly implemented in an integrated fashion down to the field level. The I/O modules comply with SIL 3 (acc. to IEC 61508) and Category 4 (acc.to EN 954). They are UL listed as well as certified by the German Technical Inspectorate (TÜV).

7.2 PROFINET-CPUs

The previous range of fail-safe CPUs has been expanded by two new S7-300 CPUs with integrated PROFINET interface.

The fail-safe PROFINET-CPUs 317F-2 PN/DP and 315F-2 PN/DP offer a combined PROFIBUS DP/MPI and a PROFINET interface for 100 Mbit/s, based on the Ethernet communications standard. This means that they can also be used as network transition between Ethernet and PROFIBUS.

Further, they allow distributed field devices to be controlled that are directly connected to Industrial Ethernet (PROFINET IO).

Communications are established through Ethernet-TCP/IP using PROFINET and the S7 protocol.

The CPUs can be programmed with STEP 7 or also via the PROFINET interface.

Fig. 7/1
CPU 317F-2 PN/DP

I/O

The table is used as a selection tool and indicates which ET 200 distributed I/O system supports
• which functions
• which bus systems with which interface modules.
<table>
<thead>
<tr>
<th>I/O</th>
<th>ET 200S</th>
<th>ET 200M</th>
<th>ET 200pro</th>
<th>ET 200eco</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Features</strong></td>
<td>Finely modular I/O with up to 8 fail-safe channels per module</td>
<td>Modular I/O for applications with a high number of channels with up to 24 fail-safe channels per module</td>
<td>Modular, multifunctional I/O in high degr. of prot. IP65/67</td>
<td>Favorably-priced block I/O in high degr. of prot. IP65/67</td>
</tr>
<tr>
<td>No. of modules</td>
<td>63</td>
<td>8</td>
<td>16</td>
<td>1 basic module</td>
</tr>
<tr>
<td>DI</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DO</td>
<td>✓ (up to 2 A)</td>
<td>✓ (up to 2 A)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DI/DO</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>AI</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Motor starters</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Drive inverters</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Used in hazardous zones</td>
<td>Zone 2,22</td>
<td>Zone 2,22</td>
<td>Zone 2,22</td>
<td></td>
</tr>
<tr>
<td><strong>PROFIBUS</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Interface module</td>
<td>IM 151-1 HF</td>
<td>IM 153-2 HF</td>
<td>IM 154-2 DP HF with connection modules for direction connection, ECOFAST and M12 or 7/8&quot;</td>
<td>IM 154-4 PN HF with connection module for M12 or 7/8&quot;</td>
</tr>
<tr>
<td>Main Order No.</td>
<td>6ES7 151-1BA. 153-2BA. 153-2BB.</td>
<td>154-2AA.</td>
<td>194-3AA.</td>
<td></td>
</tr>
<tr>
<td><strong>PROFINET</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Interface module</td>
<td>IM 151-3 PN HF</td>
<td>IM 154-4 PN HF with connection module for M12 or 7/8&quot;</td>
<td>IM 154-3PN HF with connection module for M12 or 7/8&quot;</td>
<td></td>
</tr>
<tr>
<td>Main Order No.</td>
<td>151-3BA.</td>
<td>154-4AB.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table:
*Comparison of the various families of I/O*

Data transfer rate, PB 12 Mbit/s

Data transfer rate PN 100 Mbit/s
SIMATIC ET 200pro

SIMATIC ET 200pro is an especially small, extremely rugged and powerful distributed I/O system with an IP65/67 degree of protection. It does not require a control cabinet and can be mounted directly on or at the machine. Thanks to its modular time-saving configuration, it allows flexible distributed automation solutions to be implemented in-line with specific customer specifications.

ET 200pro can be connected to well-proven fieldbuses such as PROFINET or PROFIBUS, the open Industrial Ethernet Standard for company-wide automation. ET 200pro offers extensive diagnostics to reduce downtimes in your plant.

Fail-safe electronic modules and High-Feature interface modules are available for automation tasks with the highest demands placed on safety.

The electronic modules (EM 8/16 F-DI and EM 4/8 F-DI/4 F-DO) can be used alone in one station or combined with standard modules.

Fig. 7/2
SIMATIC ET 200pro
Technical data

<table>
<thead>
<tr>
<th>CPU</th>
<th>IM 151-7 F-CPU</th>
<th>CPU 315F-2 DP</th>
<th>CPU 315F-2 PN/DP</th>
<th>CPU 317F-2 DP</th>
<th>CPU 317F-2 PN/DP</th>
<th>CPU 416F-2</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Bus system</th>
<th>PROFIBUS (DP)</th>
<th>PROFINET (PN)</th>
<th>PROFINET (PN)</th>
<th>PROFINET (PN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging technology</td>
<td>ET 200S</td>
<td>S7-300 with central and/or distributed fail-safe I/O</td>
<td>S7-400 with distributed fail-safe I/O</td>
<td></td>
</tr>
<tr>
<td>Range of applications</td>
<td>Distributed applications in the lower performance range</td>
<td>Med. performance range</td>
<td>Med. to upper performance range</td>
<td>Top performance range</td>
</tr>
<tr>
<td>RAM</td>
<td>64 KB</td>
<td>192 KB</td>
<td>256 KB</td>
<td>512 KB</td>
</tr>
<tr>
<td>Load memory (plug-in)</td>
<td>64 KB - 8 MB</td>
<td>256 KB integr. 64 KB - 8 MB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flag bits</td>
<td>2 KBit</td>
<td>16 KBit</td>
<td>64 KBit</td>
<td>128 KBit</td>
</tr>
<tr>
<td>FB/FC/DB</td>
<td>512/512/511</td>
<td>2048/2048/1023</td>
<td>2048/2048/2047</td>
<td>2048/2048/4095</td>
</tr>
<tr>
<td>Fail-safe I/O</td>
<td>Up to 28</td>
<td>Up to 320</td>
<td>&gt; 500</td>
<td>&gt; 1000</td>
</tr>
<tr>
<td>I/O address range I/O</td>
<td>244 Byte / 244 Byte</td>
<td>2 KB / 2 KB</td>
<td>8 KB / 8 KB</td>
<td>16 KB / 16 KB</td>
</tr>
<tr>
<td>Process image</td>
<td>128 Byte / 128 Byte</td>
<td>384 Byte / 384 Byte</td>
<td>1 KB / 1 KB</td>
<td>16 KB / 16 KB</td>
</tr>
<tr>
<td>Interfaces</td>
<td>MPI / DP</td>
<td>MPI and MPI / DP</td>
<td>MPI and MPI / PN</td>
<td>MPI and MPI / DP</td>
</tr>
<tr>
<td>No. of bus devices</td>
<td>32</td>
<td>125</td>
<td>124 and 128</td>
<td>125</td>
</tr>
<tr>
<td>Dimensions</td>
<td>60 x 120 x 75</td>
<td>40 x 125 x 130</td>
<td>80 x 125 x 130</td>
<td>25 x 290 x 219</td>
</tr>
</tbody>
</table>

1) with CP 443-1 Advanced
## Shared I/O

<table>
<thead>
<tr>
<th>Fail-safe ET 200S modules</th>
<th>Digital input 4/8 F-DI 24 V DC</th>
<th>Digital output 4 F-DO 24 V DC</th>
<th>Power module PM-PM-D F 24 V DC</th>
<th>Power module PM-PM-E F pp 24 V DC</th>
<th>Power module PM-PM-E F pm 24 V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of inputs/outputs</td>
<td>4 (2-channel for SIL 3 sensors)</td>
<td>4 for 24 V/2 A</td>
<td>6 shutdown groups each 3 A (total current 5 A)</td>
<td>2 relays (total current 10 A)</td>
<td>Up to 2 SIL 3 outputs for 24 V/2 A, 2 relays (total current 10 A)</td>
</tr>
<tr>
<td>Input or output voltage</td>
<td>24 V DC</td>
<td>24 V DC</td>
<td>24 V DC</td>
<td>24 V DC</td>
<td>24 V DC</td>
</tr>
<tr>
<td>Main Order No.</td>
<td>6ES7 138-4FA-......</td>
<td>6ES7 138-4FB-......</td>
<td>3RK1903-3BA-......</td>
<td>6ES7 138-4CF4-......</td>
<td>6ES7 138-4CF-......</td>
</tr>
</tbody>
</table>

## Fail-safe Motor Starter

- **Power at 500 V**: 7.5 kW
- **Rated operating current IE**: 16 A
- **Short-circuit-breaking capacity**: 50 kA at 400 V
- **Coding**: Can be assigned to 1 of 6 Shutdown groups
- **Main Order No., motor starters**: 3RK1301-0.813-.AA2
- **Main Order No., terminal module**: 3RK1903-3A...

## Failsafe Contact Multiplier F-CM

- **Contacts**: 4 NO
- **Diagnostics**: Power failure, device error
- **Switching capacity**: 1.5 A / 24 V
- **Main Order No.**: 3RK1 903-3CA...

## Failsafe Power Module PM-D F X1 (input terminal module)

- **Operation**: Standalone with external safety system
- **Double terminals for shutdown groups**: 6
- **Diagnostics**: Power failure
- **Main Order No.**: 3RK1 903-3DA...

## Fail-safe frequency converter

- **Power rating**: Up to 4.0 kW
- **Main Order No.**: 6SL3 244-0S-......
<table>
<thead>
<tr>
<th>Fail-safe S7-300 signal-modules</th>
<th>Digital input SM 326 F DI 24 x 24 V DC</th>
<th>Digital input SM 326 F 8 x (NAMUR)</th>
<th>Digital output SM 326 F DO 10 x 24 V DC/2A</th>
<th>Digital output SM 326 F DO 8 x 24 V DC/2A</th>
<th>Analog input-module SM 336 F</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of inputs and outputs</td>
<td>Up to 24 (1-channel for SIL 2 sensors) up to 12 (2-channel for SIL 3 sensors)</td>
<td>8 (1-channel) 4 (2-channel)</td>
<td>10</td>
<td>8</td>
<td>6 (2-channel for SIL 3 sensors) 13 bit</td>
</tr>
<tr>
<td>Input or output voltage</td>
<td>24 V DC</td>
<td>NAMUR</td>
<td>24 V DC</td>
<td>24 V DC P-M switching</td>
<td>--</td>
</tr>
<tr>
<td>Alarms</td>
<td>Diagnostic alarm</td>
<td>Diagnostic alarm</td>
<td>Diagnostic alarm</td>
<td>Diagnostic alarm</td>
<td>--</td>
</tr>
<tr>
<td>Input current/output current</td>
<td>--</td>
<td>--</td>
<td>2 A per channel for signal &quot;1&quot;</td>
<td>2 A per channel for signal &quot;1&quot;</td>
<td>4-20 mA</td>
</tr>
<tr>
<td>Main Order No.</td>
<td>6ES7 326-1BK-.....</td>
<td>6ES7 326-1RF-.....</td>
<td>6ES7 326-2BF-.....</td>
<td>6ES7 326-2BF4-.....</td>
<td>6ES7 336-1HE-.....</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fail-safe ET 200pro modules</th>
<th>Digital input EM 8/16 F-DI</th>
<th>Digital input/output EM 4/8 F-DI/4 F-DO</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of inputs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-channel for SIL 3 sensors</td>
<td>8</td>
<td>4</td>
</tr>
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8.1 SINUMERIK 840D sl / SINAMICS S120
8 Fail-Safe Motion Control Systems

8.1 SINUMERIK 840D sl / SINAMICS S120

Overview

The new SINUMERIK 840D sl offers a high degree of modularity, openness, flexibility, a standard and unified structure for operator control, programming and visualization. No only this, it also provides a system platform with leading-edge functions for almost all technologies.

SINUMERIK 840D sl is integrated in the SINAMICS S120 drive converter system and is supplemented by the SIMATIC S7-300 automation system. It is a new, digital complete system admirably suited for the medium and upper performance ranges.

SINUMERIK 840D sl distinguishes itself as a result of its flexibility, highest dynamic performance, precision and the fact that it can be optimally integrated into networks.
CNC control SINUMERIK 840D sl

On a SINUMERIK NCU (NCU 710.1 / NCU 720.1 / NCU 730.1) SINUMERIK 840D sl combines CNC, HMI, PLC, closed-loop control and communication tasks.

Equipped with an NCU 710.1, SINUMERIK 840D sl can control up to 6 axes. Equipped with the NCU 720.1 and the NCU 730.1, the number of axes and/or the performance of the closed-loop drive control can be increased up to 31 axes.

Servo control drive systems
SINAMICS S120

SINAMICS S120 is a truly modular system and addresses sophisticated drive tasks for an extremely wide range of applications. Users select from a whole range of components and functions that are harmonized with one another to precisely obtain the combination that best addresses their particular requirements.

All of the SINUMERIK 840D sl / SINAMICS S120 components - including the motors and encoders - are connected with one another via the common serial DRIVE–CLiQ interface.

Motors

SINAMICS S120 is supplemented by a wide range of synchronous and induction motors.

Additional information on the SINUMERIK 840D sl / SINAMICS S120 system and the associated motors, is provided in Catalogs NC 61 and D21.2.

Safety-relevant functions

The safety-relevant functions of the SINUMERIK 840D sl / SINAMICS S120 system are integrated in the four subsystems, NC, PLC, drive controller and Motor Modules. The safety-relevant functions are implemented using 2 channels; crosswise data comparison is made between the two channels.

Safe standstill (SH)

Safe standstill (SH) is used to safely disconnect the torque-generating energy feed to the motor when a fault occurs or in conjunction with a specific function. This is realized for each axis and the power is disconnected contactless. However, there is no electrical isolation in the Motor Module and in the Line Module. The safety-relevant pulse cancellation, integrated in the Motor Modules, forms the basis of this function.

The “safe standstill” function is just integrated in the drive and can therefore be activated on an axis-for-axis basis via terminals without requiring a higher-level control and without the “safety integrated” option. In conjunction with SINUMERIK 840D sl and the “Safety Integrated” option, “safe standstill” is activated on an axis-for-axis basis via PROFIsafe.

Safe operating stop (SBH)

Using the safe operating stop (SBH) function, drives are monitored to ensure that they are stationary (zero speed). However, the drives are at the same time fully functional in the closed-loop control mode.

Safely reduced speed (SG)

Using the safely reduced speed (SG) function, configurable speed limit values are monitored in a safety-relevant fashion. This function is used, for instance, when setting-up without using an agreement button.

Safe software limit switches (SE)

Using the safe software limit switches (SE), a working area/protective area demarcation can be made or traversing ranges limited.

Safe software cams (SN)

Using safe software cams (SN) a safety-relevant range detection can be implemented on an axis-for-axis basis.

Safety-relevant input/output signals (SGE/SGA)

The safety-relevant input/output signals (SGE/SGA) form the interface to the process. Digital signals can be entered into the system through 2 channels or also be output from the system.

Safe programmable logic (SPL)

Safe programmable logic (SPL) allows safety-relevant sensors and actuators to be directly connected and internally logically combined.
Safety-relevant communications via a standard bus

The distributed I/O for the safety-relevant input and output signals are always connected via PROFIBUS with the PROFIsafe profile. Safety modules from the ET 200S, ET 200pro and ET 200eco range of products can be used as I/O modules.

Safe brake management

The safe brake management comprises the safe brake test and the safe brake control.

The safe brake control is implemented in the drive and is initiated together with the "safe standstill" function. The command to open or close the brake is transferred to the Motor Modules via DRIVE-CLiQ. The brake is controlled in a safety-relevant fashion when the pulses are canceled using a special, safety-relevant, P/M switching output on the Motor Modules.

Integrated acceptance test

The partially automated acceptance test offers, in addition to the time saving, a prompted test sequence and automatic configuration of trace functions. The automatically generated acceptance protocol is a clear proof of quality for the functional safety of the machine - both for the machinery construction OEMs as well as for company actually operating the machines.
9.1 G120 drive inverter
9 Fail-Safe Drives

9.1 G120 drive inverter

Overview

The SINAMICS G120 drive inverter is a modular system for standard drives.

Every SINAMICS G120 comprises a Power Module (PM), a Control Unit (CU) and a Basic Operator Panel (BOP).

By suitably combining the various Control Units with the wide range of Power Modules, a drive solution is obtained that is optimized both for the application and in terms of cost. The PM240 Power Module (with integrated braking chopper, prepared for resistor braking) as well as the PM250 Power Module (suitable for regenerating into the line supply) are suitable for use in safety-relevant applications.

In conjunction with a Safety Control Unit (this is identified by the “-F” type supplement), a drive is transformed into a Safety Integrated Drive.

This has a fail-safe closed-loop control function for induction motors in various control modes (V/f, FCC, vector control with and without encoders).

The fail-safe drive inverter has four safety-relevant functions certified according to EN 954-1, Cat. 3 and IEC 61508, SIL 2.

• Safe Torque Off (STO); the drive torque is safely disabled to prevent the drive actively moving.

• Safely-Limited Speed (SLS); to protect against potentially hazardous motion when a limit frequency is exceeded. 1)

• Safe Stop 1 (SS1); Safe Stop 1 to continuously monitor a safe braking ramp.

• Safe Brake Control (SBC); safe brake control to safely control an external brake.

2) Only in non-regenerative operation (loads that drive the motor are not permissible).

Fig. 9/1
SINAMICS G120 drive inverter, frame size B
These safety functions can either be controlled using safety-relevant digital inputs (FDIs) or directly using PROFIsafe. The CUs of the G120 product family offer two safety-relevant digital inputs as well as also a PROFIBUS interface that can be parameterized corresponding to the actual configuration.

The G120 drive inverter is parameterized and commissioned using “Starter” - a screen form oriented engineering tool that users can order at no charge.

**Benefits**

In conjunction with the fail-safe Control Unit and Power Module, SINAMICS G120 offers a transparent and efficient safety solution:

When compared to conventional solutions, the safety acceptance procedure in the machine is significantly simplified:

- The integration of the safety system allows safety-relevant concepts in-line with those required in practice but at the same time simplifies the installation.
- As a result of the integrated functionality, less space is required in the electrical cabinet when compared to “classic” safety systems utilizing conventional components.

- The “Safe Stop 1” and “Safely-Limited Speed” functions are implemented in the drive inverter so that an encoder is not required (sensorless solution). This means that they can be realized with minimum costs.

- **Flexibility:**
  The modularity of SINAMICS G120 allows both fail-safe as well as standard components to be simultaneously used.

- **Cost reduction:**
  In may cases, external switching devices and relays can be eliminated by using “Safe Torque Off”.

- **Reliability:**
  The “Safe Torque Off” function is a pure electronic function and therefore has no contacts. This results in the shortest and reliable response times (e.g. light curtains used for personnel protection).

- **Simple engineering**
  These functions are engineered with the “Starter” engineering tool that is used for the other drive units.

- **High availability:**
  Parameters can be easily copied to other drive inverters (e.g. when drives are to be replaced) as an external memory medium (MMC - Micro Memory Card) is used.

*Fig. 9/2*

SINAMICS G120 drive inverter, frame size A-F, with or without CU or Basic Operator Panel (BOP)
Applications

The G120 drive inverter can be used for numerous variable-speed drive applications. It can be used for a wide range of applications as a result of its flexibility.

The wide range of applications includes cranes and lifting devices, applications in conveyor technology, in pumps, fans and compressors, punches and presses, high-bay racking systems, machines for the food & beverage industry, packaging machines, regenerative power conversion etc. This means applications that require a higher degree of functionality and dynamic performance from drive inverters than is generally the case. The drive inverter is distinguished as a result of its especially high performance and by the fact that it is especially easy to use.

Design

Fig. 9/3
Modular concept: SINAMICS G120 comprises the Control Unit, Power Module and Basic Operator Panel

Fig. 9/4
By combining it with an F-CU, a Power Module becomes a safety-relevant drive
1. Safe Torque Off (STO) - the torque is safely disabled to prevent the drive actively moving

The safety function “Safe Torque Off” interrupts the power supply (shutdown path A) that transfers the pulses in the power unit and additionally cancels the pulses (shutdown path B). As a result of the appropriate feedback signals (feedback signal A, feedback signal B), the drive is in a safety-relevant no-torque condition and is prevented from restarting.

Safe Torque Off can be selected both via PROFIBUS/PROFINET (PROFIsafe) as well as via fail-safe digital inputs. For PROFIsafe, the appropriate data integrity is achieved using a checksum (CRC). For the safety-relevant digital input, this is achieved as a result of redundancy (Channel A, Channel B).

The safety-relevant shutdown is also realized through two channels using two processors (processor 1 and processor 2). They verify their expected signal responses using a crosswise data comparison.

A brake is automatically applied with “Safe Torque Off”. The brake is also applied through two channels whereby the expected signal response is verified using a feedback signal. Safety-relevant brake control is therefore obtained.

In addition, for shutdown via the individual shutdown paths, a forced checking procedure is applied by checking the expected signal responses via the feedback signals from the particular switching actions.
2. Safe Stop 1 (SS1); Safe Stop 1 to continually monitor a safe braking ramp

The “Safe Stop 1” safety function (safe braking ramp) monitors the drive while it brakes to ensure that it finally comes to a stop.

The drive is braked along a braking ramp that can be parameterized. During braking, the frequency setpoint is continually compared with the feedback signal of the actual frequency detection.

If the frequency for the zero speed monitoring is fallen below, a safe stop is initiated in the drive.

If the braking function fails, then a safe stop is immediately initiated and the drive goes into an error state.
3. Safely-Limited Speed (SLS) to protect against potentially hazardous motion when a limit frequency is exceeded.

The safety function "Safely-Limited Speed" monitors the actual frequency to ensure that an upper limit frequency that can be parameterized is not exceeded.

The response in the drive inverter when the upper limit frequency is exceeded also depends on the SLS mode that can be parameterized:

- **SLS mode 0:**
  An error is immediately output if, when initiating the safely-limited speed, the actual frequency is higher than the upper limit value. As a result, the drive inverter is stopped using the safety function "Safe Stop 1".

  If the actual frequency lies below the upper limit frequency, the monitoring function becomes active and the actual speed is frozen.

- **SLS mode 1:**
  If, when initiating the safely-limited speed, the actual frequency is higher than the upper limit value, then initially the frequency is reduced using the "Safe Stop 1" function. A value that can be parameterized below the upper limit frequency is set as the target speed and not zero speed.

- **SLS mode 2:**
  If, when initiating the safely-limited speed, the actual frequency is higher than the upper limit value, an error is immediately output and the drive inverter is stopped using safety function "Safe Stop 1".

  If the actual frequency lies below the upper limit frequency, the monitoring becomes active. The actual speed can still be changed. When the SLS safety function is activated, and the actual frequency is exceeded, then an error condition is immediately signaled and the drive inverter is brought into a safe condition.
Integration

These drive inverters can be easily integrated into a SIMATIC environment. The drive inverter and its safety functions can be controlled either using fail-safe digital inputs as well as also via PROFIsafe.

G120 drive inverters therefore offer three basic possibilities when it comes to configuring fail-safe systems and in turn for controlling integrated safety functions.

A central fail-safe CPU is used to evaluate the safety-relevant signals and control the integrated safety functions of the G120 drive inverter via PROFIBUS DP using PROFIsafe.

When appropriately parameterized and configured, the integrated safety functions of the G120 drive inverter can be controlled via fail-safe digital inputs. However, the drive inverter can still be integrated into a PROFIBUS environment without PROFIsafe.

Fig. 9/9
Controlling the safety functions via PROFIsafe

Fig. 9/10
Controlling the safety functions via fail-safe digital inputs with connection to the bus
A conventional, local solution to control the integrated safety functions of the G120 drive inverter is also possible. In this case, it is only necessary to parameterize the fail-safe digital inputs of the drive inverter.

**Technical data**

**Fail-safe G120 drive inverter**

| Safety classes that can be achieved | Category 3 acc. to EN 954-1  
| Safety classes that can be achieved | Up to SIL 2 acc. to IEC 61508  
| Safety functions | Specifying: PFH (probability of failures per hour, SFF (safe failure fraction))  
| Safety functions | Safe Torque Off (STO)  
| Safety functions | Safe Stop 1 (SS1)  
| Safety functions | Safely-Limited Speed (SLS)  
| Safety functions | Safe Brake Control (SBC)  
| Degree of protection | IP20  
| Additional features | Fail-safe coupling through safety-relevant digital inputs and PROFIsafe  
| Additional features | Modular design  
| Additional features | Energy recovery with regenerative feedback into the line supply - without chopper resistor (PM250)  
| Additional features | Standard and fail-safe frequency inverter  
| Additional features | V/f open-loop control  
| Additional features | Closed-loop vector control with and without an encoder  
| Additional features | Closed-loop torque control  

Fig. 9/11

*Control via fail-safe digital inputs*
11.1 Terminology and abbreviations
11.2 References
11.3 Contact – Internet, Hotlines
11.4 Seminars available for safety technology, Standards and Directives
11.5 Index
11 Appendix

11.1 Terminology and abbreviations

Terminology

Requirement Class (AK)
Measure of the safety-related performance of control equipment. Defined in DIN V 19250 and DIN V VDE 0801.

Actuator
An actuator converts electrical signals into mechanical or other non-electrical quantities.

Failure/fault

Failure
When a piece of equipment or a device is no longer capable of executing a specific function.

Fault
Unintentional status of a piece of equipment or device which is characterized by the fact that it is not capable of executing a specified function.

Note: "Failure" is an event and "Fault" is a condition.

Blanking
Using blanking, a specified section or area is suppressed from a protective field, e.g. a light curtain or light grid, i.e. it is disabled. There are two types of blanking: Fixed and floating blanking.

Fixed blanking
For fixed blanking, the selected area or range is fixed. This function is used, for example, if fixed objects protrude into the protective field.

Floating blanking
Floating blanking permits that normally one or two light beams in a protective field are interrupted without a stop signal being output from a light curtain. This function is required if the "permissible" interruption of the light beams does not refer to a fixed position in the protective field, e.g. if a moving cable enters the protective field.

Fault tolerance
Fault tolerance N means that a piece of equipment or device can still execute the specified task even when N faults are present. For N+1 faults, the piece of equipment or device fails when executing the specified function.

Danger
Potential source of damage.
(from EN 292-1 and ISO 12100-1)

for example, hazard as a result of electric shock, hazard due to crushing, ...

Jitter
Deviation between consecutive clock cycle signals that should have a constant distance between them (isochronous or equidistant). Jitter is used to evaluate the time synchronism for clock-cycle synchronous data transfer.

With response times of less than 1 ms and a jitter below 1 μs, almost all multi-axis applications can be controlled using Ethernet.

Channel
Element or group of elements that executes a function independently.

2-channel structure
Structure that is used to achieve fault tolerance.
For example, a 2-channel contactor control can be achieved if at least two enable circuits are available and the main current can be redundantly switched-off or a sensor (e.g. Emergency Stop switch) is interrogated using two contacts that are then separately connected to evaluation unit.

**Category**

In EN 954-1 (prEN ISO 13849-1) this is used to “classify the safety-related parts of a control with reference to their immunity to faults and their behavior under fault conditions which is achieved as a result of the structural arrangement of the parts and/or their reliability.”

**Load group**

A group of motor starters that is supplied through a power bus. A load group can be located within a potential group or can include parts of two potential groups.

**Motor starter (MS)**

Motor starters include direct and reversing starters. Starting and direction of rotation are determined using a motor starter.

**Direct starter**

A direct starter is a motor starter for one direction of rotation, which directly powers up or powers down a motor. It comprises a circuit-breaker and a contactor.

**Reversing starter**

A reversing starter is a motor starter for two directions of rotation. It comprises a circuit-breaker and two contactors.

**Muting**

Muting disables one or several safety functions for a limited time in line with specifications

**EMERGENCY SWITCHING-OFF**

Emergency Switching-off equipment

Arrangement of components that are used to implement Emergency Switching-Off function (EN 418 and ISO 13850). (Note: Today, a differentiation is made between "Stopping in an emergency" and "Power off in an emergency".

**Stopping in an emergency**

A function which either avoids or minimizes impending or existing danger for persons, damage to the machine or when carrying out work;

– initiated by a single action of a person. (EN 291-1 and ISO 12100-1)

**Power off in an emergency**

Power off in an emergency is achieved by disconnecting the machine from the power supply as a consequence of a Category 0 Stop (EN 60204 1997). Power off in an emergency should be provided, in compliance with EN 60204-1 1997, where there is the possibility of danger due to electricity (electric shock).

**Emergency Stop**

An operation in an emergency that is designed to stop a process or movement that is potentially dangerous (from EN 60204-1 Annex D).

**Potential group**

A group of motor starter and/or electronic modules which is supplied from a power module.

**Proxy**

A proxy or proxy server is a service program for computer networks that communicates through data transfer. It makes data transfer more efficient (lower network load when high data quantities are being transferred) and faster - it can also increase the level of safety.

Communication is established between computers or programs in so-called computer networks. From the perspective of the server, a proxy behaves like a client - as far as the client is concerned like a server.

**Redundancy**

Availability of resources or equipment to execute a specific function.
Risk
Combination of the probability of the occurrence of damage and the extent of the damage.

Feedback circuit
Circuit to monitor controlled contactors.
The function of contactors can be monitored by reading back the positively driven auxiliary contacts using an evaluation unit. If the contactor contacts are welded, the evaluation unit prevents a restart.

Safety Integrity Level (SIL)
In IEC 61508, this is defined as the measure for the safety performance of electrical or electronic control equipment (-> Chapter 1 of the Safety Integrated System Manual, 5th Edition).

Safety
Freedom from unacceptable risk.

Functional safety
Part of the safety of a piece of equipment or device (e.g. machine, plant, which depends on the correct function.

Safety function
Function (e.g. of a machine or a control) whose failure (or breakdown) can increase the risk(s).

Safety functions of EN 954 controls
"A function, initiated by an input signal and processed by safety-related parts of controls that allows the machine to achieve a safe condition (as system)."

Safety-related control function
Control function that is executed by a safety-related control system in order that a system goes into a safe condition (e.g. machine) or to avoid hazardous conditions occurring.

Safety-related control function (IEC 62061)
Slightly differing definitions are provided in the various Standards.

Stop
This is a function that is intended to avoid or minimize hazards to personnel, damage to the machine or the execution of operational processes. It has priority over every other operating mode.

Stop Category
A term which is used in EN 60204-1 to designate three different stopping functions.

Partial potential group
A partial potential group exists, if within a potential group, the auxiliary voltage can be partially switched out.

Enabling device
Additional manually actuated control device that permits a specific function of a machine if it is continually actuated.

Two-hand circuit
Control device, which requires that it is simultaneously actuated by both hands in order to activate hazardous machine functions and also maintain them.
### Abbreviations

<table>
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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>BIA</td>
<td>German BG Institute for Safety and Health</td>
</tr>
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<td>BWS</td>
<td>Electrosensitive devices</td>
</tr>
<tr>
<td>CNC</td>
<td>Computerized Numerical Control</td>
</tr>
<tr>
<td>CPU</td>
<td>Central Processing Unit</td>
</tr>
<tr>
<td>DMS</td>
<td>Direct Measuring System</td>
</tr>
<tr>
<td>FTS</td>
<td>Driverless transportation system</td>
</tr>
<tr>
<td>HMI</td>
<td>Human Machine Interface</td>
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<td>IBS</td>
<td>Commissioning</td>
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<td>IMS</td>
<td>Indirect Measuring System</td>
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<td>KDV</td>
<td>Cross-checking</td>
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<td>MRPD</td>
<td>Machine Readable Product Designation: Order No. of Siemens components</td>
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<td>NC</td>
<td>Numerical Control</td>
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<tr>
<td>NCK</td>
<td>Numerical Control Kernel</td>
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<tr>
<td>NCU</td>
<td>Numerical Control Unit</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Association</td>
</tr>
<tr>
<td>OP</td>
<td>Operator Panel</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
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<tr>
<td>PLC</td>
<td>Programmable Logic Controller</td>
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<td>PM</td>
<td>Positive-ground switching</td>
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<td>PP</td>
<td>Positive-Positive switching</td>
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### Previously used function designation

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<td>Stop C</td>
<td>---</td>
</tr>
<tr>
<td>Stop D</td>
<td>---</td>
</tr>
<tr>
<td>Stop E</td>
<td>---</td>
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<td>Sichere Bremsrampe</td>
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<td>Sicherer Betriebshalt</td>
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<td>Sicher reduzierte Geschwindigkeit</td>
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<td>Sichere Bremsenansteuerung</td>
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<td>Sicherheitsgerichtete Ein-/Auszangssignale</td>
<td>SGE / SGA</td>
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### Function designation according to IEC 61800-5-2 (draft)

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<td>Sicherer Stillstand 1</td>
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<tr>
<td>Sicherer Stillstand 2</td>
<td>SS2</td>
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<tr>
<td>Sicherer Betriebshalt</td>
<td>SO</td>
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<tr>
<td>Sicher begrenzte Geschwindigkeit</td>
<td>SLG</td>
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<td>Sicher begrenzte Lage</td>
<td>SLG</td>
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<td>Sichere Bremsenansteuerung</td>
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<td>Sichere Drehzahlüberwachung</td>
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<td>Sichere Nocken</td>
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<td>Sicheres Software Relais</td>
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11.2 References


[6] Safety-related data transfer; Requirements as well as deterministic and probabilistic techniques; 1998, Uwe Jesgarzewski, Rainer Faller – TÜV Product Service

11.3 Contact – Internet, Hotlines

**Internet address:**

General information

http://www.siemens.de/safety

http://www.siemens.de/automation/mall

AS-Interface

http://www.siemens.de/as-interface

SIRIUS

http://www.siemens.de/sirius

SIMATIC

http://www.siemens.de/simatic-controller

http://www.siemens.de/simatic-dp

SIMATIC Sensors

http://www.siemens.de/simatic-sensors/fs

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Because training is decisive for your success

SITRAIN® - the Siemens Training for Automation and Industrial Solutions - is there to support you in mastering all of your tasks.

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Our trainers have in-depth experience in the field and also extensive didactic experience. Personnel that develop these training courses have a direct link to our product development groups and they directly pass on their knowledge to the trainers.

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Because our trainers are very much in touch with what is required in practice, means that they can really communicate theoretical knowledge. But as everyone knows, theory can be somewhat dull, and this is why we place the highest significance on practical training - that represents up to halve of the course time. This means that you can immediately implement what you have learned in your day-to-day business. The training courses use training equipment that has been specifically developed for this purpose so that you feel absolutely confident in our training courses.

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We have a total of approximately 300 courses and provide training for the complete range of A&D products and to a large extent, plant solutions from I&S. Off-site training courses, self-learning software and moderated seminars in the web complement our classic range of courses.

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Blended Learning means a combination of various learning/training media and sequence of courses. For instance, a course in a training-center can be optimally supplemented by self-learning programs to prepare for a course or after a course. As a supplement, SITRAIN utilizes moderated online training in order to provide courses at agreed time live in the Internet.

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All of the training possibilities at a glance! You can comfortably scan our global portfolio of courses, you can call-up all of the course dates online, and courses where there is still space available are listed, updated on a daily basis, so that you can directly register for the course you wish to participate in.

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This course provides you with the current situation - as far as standards are concerned - in production technology. You will also get to know how to correctly apply it in practice using selected examples. The objective of this course is to merge theory and practice. You will secure a high production quality and achieve competitive advantages by competently implementing this knowledge in your own operation.

Contents

- **EC Machinery Directive**
  - Basics, definitions, requirements, implementation, application on new machines and new machine equipment
  - Applying when making modifications and upgrading

- **EC Directive**
  - Basic, definitions, requirements, implementation

- **Overview of the Standards**
  - EN ISO 12 100 (EN 292), EN 1050 (ISO 14121)
  - EN 60204-1
  - EN 954-1, (prEN ISO 13849-1), EN ISO 13849-2, (EN 954-2)
  - EN 62061, IEC 61508

- **Example from the field - automobile industry** (painting shop, subsequent handling with transport using a rail-based system)
  - Standards and use
  - Applications
  - Configuration/design and implementation of the risk analysis using conventional wiring and bus-based solutions.

Target groups

- Decision makers, sales personnel, project managers, project team members, programmers, commissioning engineers, users

Duration

- 2 days

Course fee

- € 680
- We reserve the right to revise prices

Course locations

- Nuremberg, Mannheim

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Participants learn how to handle, engineer, program, commission, diagnose and troubleshoot distributed safety systems. This includes the fail-safe CPUs 315F-2DP, CPU 317F-2DP, CPU 416F DP and the IM151-F CPU. The fail-safe programming is realized in the programming languages F-FBD or F-LAD.

Contents

- **Overview, Standards and Directives**
  - AS S7-300F (principle, system design and I/O)
  - Engineering fail-safe I/O with distributed safety
  - Programming a safety-related user program

- **Fail-safe communications PROFsaf e** (CPU-CPU communications, Master-slave communications)

- **Diagnostic capability** (CPU diagnostics, I/O diagnostics, other diagnostic tools)

- **Exercises on configuring the I/O, communications, troubleshooting**

- **Examples for programming** (Emergency Stop, protective door, safety-related shutdown, passivation, special programming issues)

Target groups

- Programmers, commissioning engineers, application engineers

Duration

- 3 days

Course fee

- € 1260
- We reserve the right to revise prices

Course locations

- Essen, Hanover, Mannheim, Nuremberg, Stuttgart
### Engineering and programming F systems in the STEP7 / PCS7 environment (ST-PPFS)

Participants learn how to handle, configure engineer, program, commission and troubleshoot F-systems. These include fail-safe CPUs 414-4 H and CPU 417-4 H that are optionally available as high availability versions. The CFC programming language is used to program in a fail-safe fashion the safety-related applications that these CPUs control.

**Contents**

- Overview, redundant systems (H/F differences, availability, redundant systems, regulations)
- AS S7-400F (principle, system design and I/O)
- Engineering fail-safe I/O with F-Systems
- Programming a safety-relevant user program using CFC
- Fail-safe communications Profisafe
- Exercises to configure I/O, communications, fault-finding
- Programming example, special programming issues

**Target groups**

Programmers, commissioning engineers, application engineers

**Duration**

3 days

**Course fee**

€ 1410

We reserve the right to revise prices

**Course locations**

Essen, Mannheim, Nuremberg

### SIMATIC S7, S7-400 H system course (ST-7H400H)

Participants learn how to handle, engineer, commission and troubleshoot the fault-tolerant SIMATIC S7-400H automation systems.

**Contents**

- Overview, redundant systems (H/F difference, availability, redundant systems)
- AS S7-400H (principle, system configuration and I/O, synchronization, coupling and updating the reserve, self-test, principle mode of operation, fault/error processing)
- Configuring with STEP7/HSys (system parameterization, system handling, fault diagnostics, documentation)
- Exercises to configure the I/O, troubleshooting, programming examples

**Target groups**

Programmers, commissioning engineers, application engineers

**Duration**

3 days

**Course fee**

€ 1260

We reserve the right to revise prices

**Course locations**

Essen, Nuremberg
This course provides participants with the knowledge and skill sets that are required to service and maintain a machine equipped with SINUMERIK 840D and Safety Integrated. After participating in the course, course participants can troubleshoot and resolve faults. After repair/software upgrades, course participants can check the safety-related functions and accept them.

Contents
- General information on safety-related systems
- System prerequisites
- Description of the basic relevant function
- Safe programmable logic
- Connecting sensors/actuators
- Test stop
- Description of the machine data and interface signals
- Procedure when commissioning and troubleshooting
- Evaluating diagnostic and alarm displays
- Circuit examples for Safety Integrated
- Acceptance report
- Practical fault finding exercises and service at training models equipped with digital feed and main spindle drives

Target groups
Service personnel, maintenance personnel

Duration
3 days

Course fee
€ 1410

We reserve the right to revise prices

Course locations
Chemnitz, Düsseldorf, Nuremberg-Moorenbrunn

This course shows participants how to engineer and commission the Safety Integrated functionality with a SINUMERIK 840D. After the course, participants can engineer, test and commission the Safety Integrated function and a SINUMERIK 840D special system configuration with safety-relevant functions.

Contents
- General information on safety-relevant systems
- System prerequisites
- Description of the basic relevant function
- Safe programmable logic
- Connecting sensors/actuators
- Test stop
- Safety-related communications with PROFIsafe
- Safe brake management
- Description of the machine data and interface signals
- Procedure when commissioning and troubleshooting
- Evaluation of diagnostic and alarm displays
- Circuit examples for Safety Integrated
- Acceptance report
- Practical exercises to engineer, commission and service equipment on training models equipped with digital feed and main spindle drives

Target groups
Commissioning engineers, application engineers, service personnel

Duration
5 days

Course fee
€ 2350

We reserve the right to revise prices

Course location
Nuremberg-Moorenbrunn
This course addresses all employees in development, mechanical design, production and service that require practical know-how and skill sets regarding EMC for their day-to-day work. The individual subjects will be highlighted using video films. The effects of EMC phenomena with effects that are manifested in practice with the appropriate measures to prevent them and counter-measures will also be demonstrated. The objective of this training course is to learn how to avoid or resolve EMC faults.

**Contents**

- What you have to especially observe when planning plants and systems
- How an EMC-correct electrical cabinet looks like, especially with variable-speed drives, background information on the individual cabinet design rules
- How is a differentiation made between software, hardware and EMC disturbances
- Which measuring equipment makes sense for fault finding and how is it used
- Tips and tricks when fault-finding, how you can subsequently increase the noise immunity
- Causes and effects of static discharge and the appropriate counter-measures
- The advantages and disadvantages of different grounding techniques, what causes potential differences, how is potential bonding implemented
- Causes, effects and avoiding harmonics, resonance effects in the line supply, filter circuits, blocking circuits etc.
- When and how can filters be effectively used
- Everything about cable shield connections
- Motor bearing currents, cause, effects, counter-measures
- Aspects related to lightning protection, identifying hazards up to the use of protective elements
- Introduction into Standards, CE caution, new EMC directive!

**Target groups**

Programmers, commissioning engineers, application engineers, service personnel, maintenance personnel

**Duration**

3 days

**Course fee**

€ 1140

We reserve the right to revise prices

**Course locations**

Erlangen, Mannheim, Munich, Chemnitz, Stuttgart, Frankfurt, Hanover
This course provides manufacturers and users of electrical equipment - that is operated in hazardous zones - basic theoretical and practical information on electrical explosion protection. This includes the underlying physics, basic legal issues, possible protective measures for electrical equipment and information on their use. Presentations and excerpts from video films will show how explosions occur and the associated hazards.

**Contents**

- Explosion, conditions for explosion
- Sources of ignition
- Primary and secondary explosion protection
- Safety-related parameters
- Temperature classes, explosion groups, zone classification
- Basic legal issues regarding explosion protection
- Classes of protection for electrical equipment
- Construction regulations for equipment according to EN 50 014-50 028
- Coding of electrical equipment
- The special explosion protective measures implemented for this equipment will be discussed using a specific piece of equipment as an example

**Target group**

Decision-makers, sales personnel, commissioning engineers, project engineers, service personnel, maintenance personnel

**Duration**

1 day

**Course fee**

€ 335

We reserve the right to revise the prices

**Course location**

Mannheim

This course provides participants that develop, construct and support explosion-protected electrical equipment and intrinsically safe systems a more in-depth analysis of the class of protection, intrinsic safety and the design of equipment with intrinsically safe circuits. The use of intrinsically safe equipment is explained using application examples. Further, when combining intrinsically safe with the associated equipment, the necessary proof of intrinsic safety is explained using the appropriate examples.

**Contents**

- Construction regulations for equipment according to DIN EN 50 014 and 50 020
- Basic information about the class of protection, intrinsic safety
- Minimum ignition curves
- Intrinsically safe and the associated electrical equipment
- Properties of special, intrinsically safe equipment, coding
- Requirements when erecting equipment in the individual zones acc. to DIN 0165
- Connecting-up equipment to create intrinsically safe plants/systems (DIN EN 50 039)
- Erection of intrinsically safe plants/systems according to VDE 0165
- Operation, repair, and testing of equipment

**Target group**

Decision-makers, sales personnel, commissioning engineers, project engineers, service personnel, maintenance technicians

**Duration**

1 day

**Course fee**

€ 335

We reserve the right to revise the prices

**Course location**

Mannheim
### New Standards for safety technology in the production industry (ST-NSST)

As machinery and plant constructor - as well as company operating such plants/systems - you are legally obliged to guarantee the safety of man and the environment. At first glance, new standards and regulations represent a barrier - but also open-up many possibilities. This seminar will provide you with an overview regarding practically applying standards and regulations and you will be able to ensure that the safety technology of your machine or plant will be in compliance with the appropriate legislation.

**Contents**
- Overview regarding the requirements and Standards for functional safety.
- Current developments and new issues (e.g. ISO 12100, ISO 14121, IEC 62061, ISO 13849 (rev), ...).
- Procedure when engineering, accepting and operating plants and machines – previous approach – future approach.
- Requirements placed on the system and components, system design (qualitative and quantitative analysis).
  - Acceptance
  - Export

**Target group**
- Decision-makers, sales personnel, project managers, project personnel

**Duration**
- 1 day

**Course fee**
- € 240
- We reserve the right to revise the prices

**Course location**
- On request

### Testing, using and handling electro-sensitive protective equipment - (SE-FSZERT)

In this workshop you will learn how to check/test, use and handle electro-sensitive protective equipment and devices (light curtains, light grids and laser scanners) from the SIMATIC sensor series. You will receive a certificate that entitles you to carry-out the annual device check according to Paragraph 2 Section 7 BetrSichV.

**Inhalte**
- European Directives.
- Safety-relevant parts of controls according to EN 945-1
- Safety light curtains
- Safety laser scanners
- Calculating safety clearances according to EN 999
- Evaluation units

**Contents**
- Checking/ testing electro-sensitive devices
- Diagnostics
- Obtaining the capability certificate for SIMATIC sensor devices

**Note**

Course participants must bring their own notebook (laptop PC). It should have the following basic features: CPU Intel Pentium with min. 500 MHz or comparable, min. 16 Mbyte RAM, minimum free space on the hard disk of 10 Mbyte, Windows 98, 2000, NT, XP. When the course starts, the parameterizing software will be installed on the notebook (laptop PC) of the course participant at no charge. This is the reason that you must have administrator rights to install programs under Windows.

**Target group**
- Operating personnel, users, decision-makers, sales personnel, commissioning engineers, project engineers, programmers, service personnel

**Duration**
- 2 days

**Course fee**
- € 620
- We reserve the right to revise the prices

**Course location**
- On request
The course provides system know-how about the standard AS-Interface networking system. After you have participated in this course you will understand the functions of the system components and the standard and expanded operation of SIMATIC S7 master modules. You will be able to design, configure and commission AS interface for your automation system. The course will also include information on the DP/AS-Interface Link 20E network transition and will provide basic knowledge about PROFINET DP. The AS-Interface components for Safety at Work (safety monitor, Emergency Stop switch, position switch etc.) are connected to an AS-Interface network.

Contents
- Basic information about the Actuator-Sensor Interface (AS-Interface)
- Design and engineering
- Introduction into the system components
- AS-Interface, master
- AS-Interface, slaves, A/B technology
- AS-Interface, power supplies, cables and accessories
- Commissioning, testing and diagnostic capabilities
- Addressing device
- Network transitions, PROFINET DP / AS-Interface (DP/AS-i Link 20E)
- Safety at Work
- Practical exercises

Target group
Decision-makers, sales personnel, project managers, project personnel, programmers, commissioning engineers, design engineers, service personnel, service technicians

Duration
3 days

Course fee
€ 1020

We reserve the right to revise the prices

Course location
Mannheim

This course will provide information about the new functions of Safety Integrated that are available with software version 6 of SINUMERIK 840D. After the course, participants will be able to engineer, test and commission the new functions of Safety Integrated for special machine configurations with safety-relevant functions.

Prerequisites
Participation in course NC-84DSIW up to December 2002 or NC-84DSIS

Contents
- Overview of the new safety functions of SW release 6.X
- Acceptance report with SinuCom NC
- Pulse cancellation in the NC
- Safety-relevant communications with PROFIsafe
- Safe brake management
- Extended diagnostic functions
- Extended configuring of alarm texts
- Practical exercises on engineering, commissioning and service carried-out on training models with digital feed and main spindle drives

Target group
Commissioning engineers, project engineers, service personnel

Duration
3 days

Course fee
€ 1410

We reserve the right to revise the prices

Course location
Nuremberg

For additional dates, course locations and prices, please go to the following Internet address:
www.siemens.de/sitrain
This seminar is intended to provide course participants with information on currently active developments in national and international technical regulations and provide them with methods and tools so that these regulations can be complied with in practice. These subjects will be then discussed in more depth using examples from the field.

Contents

- Plant safety for process plants
- Technical regulations and rules, explanation of the associated terminology, hierarchy of the regulations, legislation, ordinances, ensuring plant safety using process control technology, explanation and in-depth discussion of such issues as BImSchG, GPSG, fault regulations, UVV, BGR,BGV, EU legislation, EU Directives
- Machine and plant safety
- Possibility and limits of process control technology for tasks relating to plant safety, design, mode of operation and fault behavior of PLT protective devices
- NE 97 fieldbus for safety technology
- Company-specific safety management according to IEC 61511-1
- Experience of a specialist safety evaluator when carrying-out checks
- CE marking for machines and plants
- Integration of safety technology – pros and cons
- Example for implementing international rules regarding machines / process-related plants
- Implementation of safety-relevant applications in the process industry with Siemens products/systems using a practical example involving SIMATIC S7-400FH / SIMATIC PCS7

Target group

EMR specialist engineers, EMR technicians, EMR supervisors, employees involved in EMR planning, system development personnel, operations managers, operations assistants, operations engineers, technicians

Duration

2 days

Course fee

€ 680

We reserve the right to revise the prices

Course locations

Frankfurt, Mannheim
EMC from the very start, focus on plants and machines (MP-EMVLP)

The objective of this course is to provide basic know-how and more in-depth information about Electromagnetic Compatibility (EMC). It starts with the basics up to the application and includes practical exercises on measuring techniques and EMC measures to upgrade equipment and plants. At the beginning of the course, participants will learn about the physical basics and interrelationships of EMC. Based on this, some of the usual customer requirements will be discussed as well as legal and standards-related issues. Measures and methods will be provided to realize an EMC-correct design and configuration of plants and machines. The material learnt will be discussed in more detail using exercises at a certified testing laboratory (Siemens EMC Center, Erlangen). More than 10 specialists with many years of experience in EMC-correct development and engineering as well as the EMC testing of industrial plants and devices will provide a comprehensive overview about basics, requirements and measures to be applied.

**Contents**

- EMC basics
- Filter technology
- Plant and system planning
- Simulation of systems
- Cables and signal interfaces
- Cabinet design and wiring
- Legislation and Standards
- Measurements in plants and on machines
- EMC-correct configuration of plants and machines using drive converters as an example
- Magnetic fields
- Practical tests carried-out in a test laboratory

**Target group**

Project managers, project personnel, commissioning engineers, engineers, service personnel

**Duration**

3 days

**Course fee**

€ 1140

We reserve the right to revise the prices

**Course location**

Erlangen

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Commissioning and engineering SINAMICS G120 (DR-G120-EXP)

This course provides the basis for fast and successful commissioning - even for sophisticated applications. In addition to the basic information about the motor and drive converter, special attention is paid to subjects such as closed-loop control structures, free signal interconnection (BICO technology) and integrated safety functions (Safety Integrated).

**Target group**

Commissioning engineers, engineers, programmers

**Course fee**

€ 840

We reserve the right to revise the prices

**Duration**

2 days

**Course location**

Nuremberg
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Impressum:

Safety Integrated System Manual
The Safety Portfolio for Global Industries
5th Edition Supplement

Published by:
Siemens AG
Automation and Drives Group
Postfach 4848, D-90327 Erlangen

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Design:
NEW ORANGE DESIGN, Obernzenn

Printing:
Farbendruck Hofmann, Langenzenn

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Fee, € 2