

**SIEMENS**



# The Fast and Easy Way to Safe Machines – at Highest Productivity

Exploiting the advantages of integrated safety technology

[siemens.com/safety-integrated](http://siemens.com/safety-integrated)

Best Practice  
Award by  
Frost & Sullivan

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GLOBAL SMART MACHINE SAFETY NETWORKS  
COMPANY OF THE YEAR AWARD

Answers for industry.



**“Safety Integrated facilitates the easy implementation of powerful safety concepts on the basis of Totally Integrated Automation.”**

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**“The prevention of accidents must not be understood as a regulation required by law, but as a precept of human responsibility and economic reason.”**

Werner von Siemens, 1880

# Functional safety: From necessity to competitive advantage

The functional safety of machines and systems is subject to constantly increasing requirements. On the one hand, this is owed to ever stricter legal regulations for the protection of persons to be met by machine manufacturers and operators. On the other hand, any potential risks posed by a machine should be largely eliminated from the start also for economic reasons.

## **Safety Integrated:** **Fast and easy implementation of functional safety**

With Safety Integrated, we offer the world's most unique and comprehensive portfolio of control, drive and switching technology which covers all requirements placed upon the functional safety of machines and systems.

Safety Integrated facilitates the seamless integration of safety technology in standard automation concepts. This entails decisive advantages, both for machine manufacturers and system operators: Considerably reduced engineering expenditures, increased availability and system consistency. All in all, this means that Safety Integrated significantly eases and accelerates the realization of safe and productive machines.

With Safety Integrated, you opt for the reliable protection of persons, machines and the environment – and benefit from maximum and sustainable efficiency and flexibility!

Helpful tools, videos and further information are available at: [siemens.com/safety-integrated](http://siemens.com/safety-integrated)

## **Functional safety: Success factor for machine manufacturers and system operators**

- Enhanced productivity through increased machine availability: Reduction of unplanned downtimes and smoother production workflows
- Prolonged service life of the systems
- Avoidance of direct consequential costs of personal injuries (for medical care, wages and compensations)
- Avoidance of indirect consequential costs of injuries (e.g. fines due to non-compliance with regulations or repair costs)
- Enhanced global competitiveness through improved export capability of machines



The term functional safety refers to the part of the safety of a system which depends on the correct functioning of the safety-related (sub-) systems as well as external risk reduction devices.

Once again, Safety Integrated was honored with an award – the Frost & Sullivan Award. In a current best practice report, the renowned analysis company confirms the feasibility of highly innovative and cost-efficient solutions on the basis of Safety Integrated.



## Guaranteed compliance: Standards and regulations

### Siemens supports you!

As partner for all safety issues, we not only offer high-quality products and systems, but also competently help you to comply with international standards and regulations – with safety trainings, functional examples and certified products.

### Mandatory in Europe, employed worldwide: Safe machines

European machine manufacturers (product safety) and machine operators (industrial safety) are required by law to ensure the protection of persons and the environment. The safety awareness is constantly increasing in many other countries where such legal regulations are not yet in place. Machines “provided” in Europe have to be safe – whether they are new or old. In this context, the term “provision” implies that the machine is manufactured or significantly modified in Europe – or is imported to and operated in Europe.

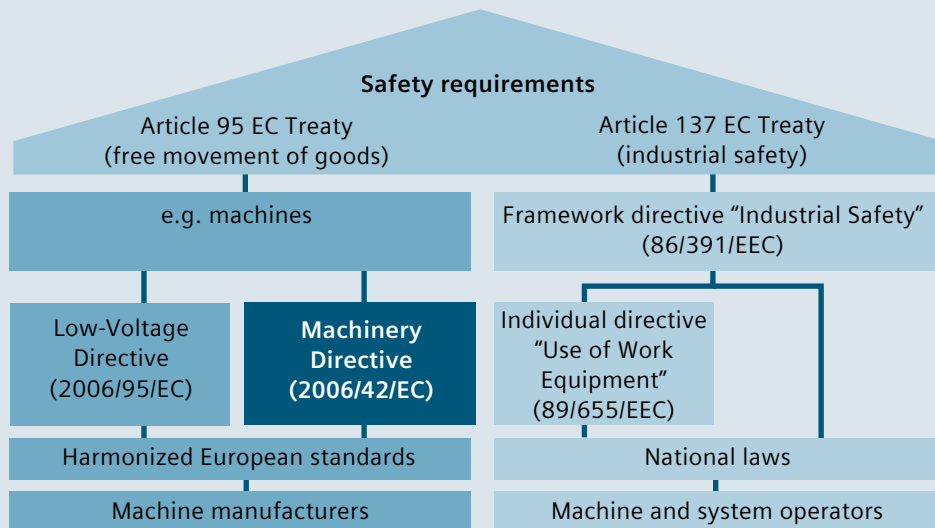
The basic requirements for machine manufacturers or system operators who significantly modernize and modify their machines themselves are laid down in corresponding European directives – for example in the machinery directives, EMC directives, etc.





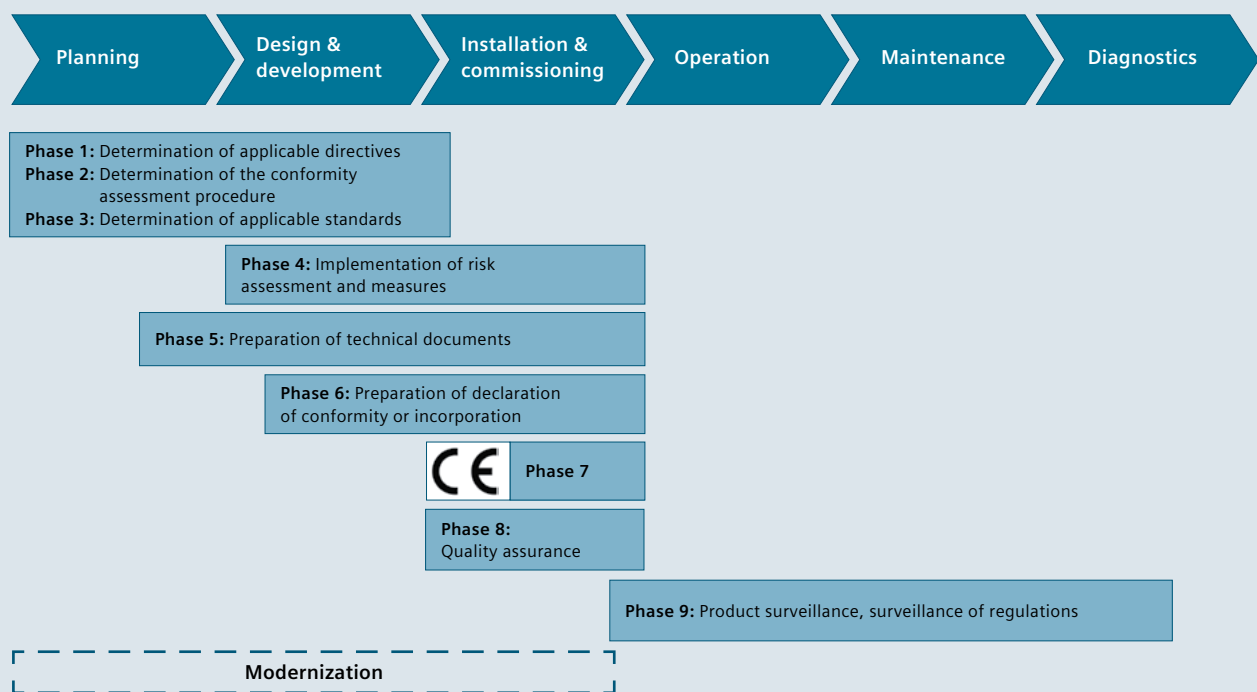
## European directives for machines

A machine is considered safe when it complies with the requirements of the machinery directive.



**Presumption of conformity:** Compliance with the respective directive is assumed with specific application of the harmonized standards.

**Declaration of conformity:** The machine manufacturer confirms compliance with the directive and attaches the CE mark to the machine.



CE conformity process for machines and systems

# Step-by-step approach for safe machine concepts

Steps to be carried out by the machine manufacturer

1. Risk assessment

2. Risk reduction

3. Validation

## 1. Risk assessment: Most important during the planning phase

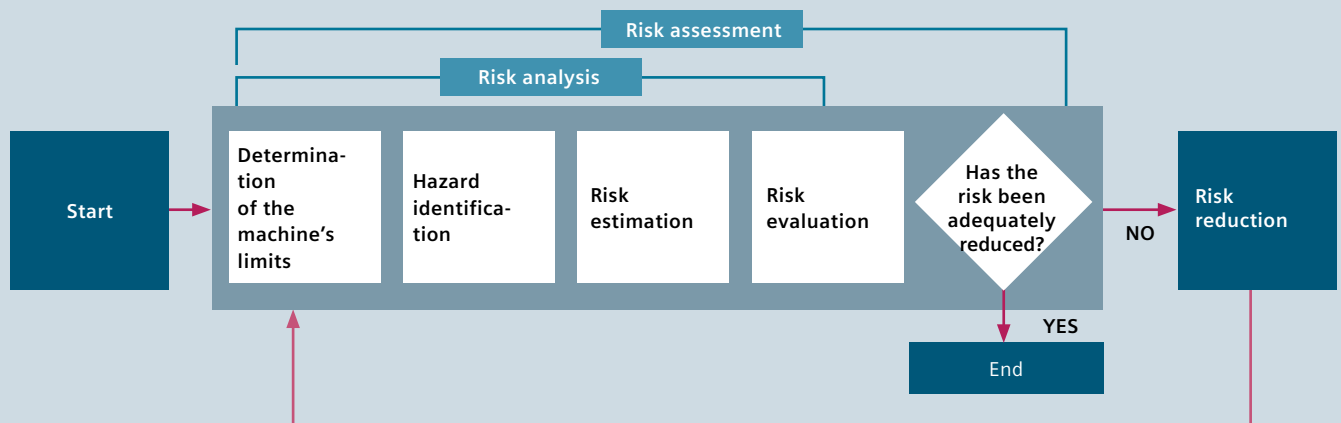
The machine manufacturer is obliged to implement risk assessment in order to identify all hazards associated with his system, to assess and evaluate the respective risks and to design and construct the system in consideration of such hazards.

Risk assessment implementation is to be considered a design-accompanying process which is to be carried out by experts of various disciplines. In this context, the EN ISO 12100 standard offers support by description of an iterative procedure for risk assessment. Also as an example: in the US, this is covered by the ANSI B11.0 standard.



Free online training "machine safety" available at:  
[siemens.com/safety-standards](https://www.siemens.com/safety-standards)

Interactive animation: Make a filling plant safe  
step by step – at:  
[siemens.com/safety-integrated](https://www.siemens.com/safety-integrated)



Iterative procedure for risk assessment in accordance with EN ISO 12100



4. Provision of the machine

5. Market product surveillance

## 2. Risk reduction in three levels

Following risk assessment, a decision as to whether risk reduction measures have to be initiated must be made. Such risk reduction comprises design measures, technical protective equipment as well as training measures for users – and can be divided into three levels.

### Level 1: Safe design

Safe design can for example be ensured through the integration of safety in the machine (covers, fences, etc.). These measures take top priority within the scope of risk reduction. They are to ensure the following:

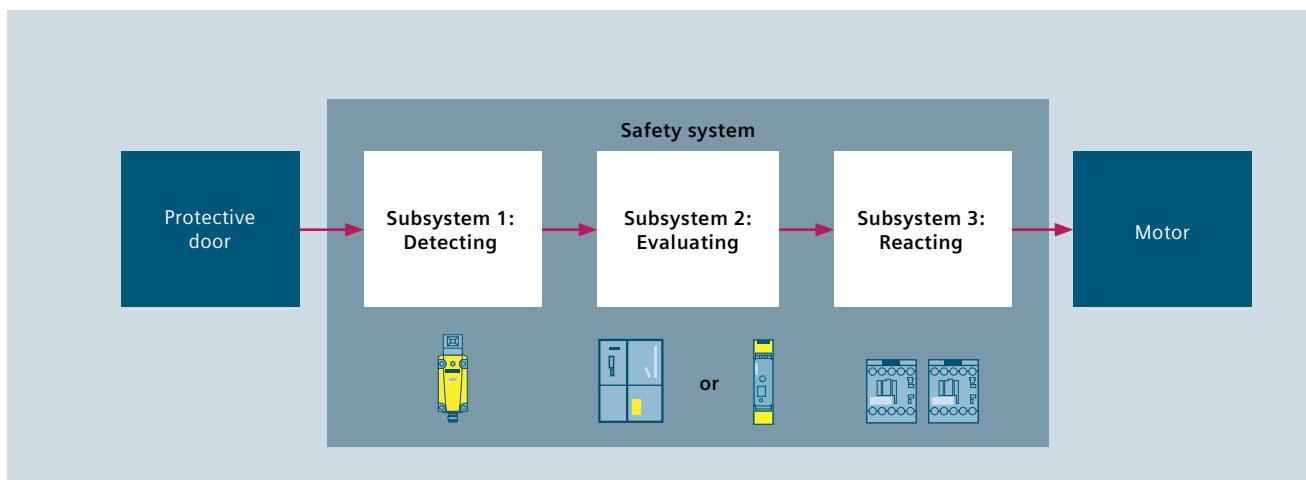
- Avoidance of crushing points
- Avoidance of electric shock
- Concepts for machine shutdown in case of emergency
- Concepts for operation and maintenance

### Level 2: Technical protective measures

A safety function has to be defined for each hazard which cannot be eliminated by means of design measures. As shown in the following example, such safety function can be executed by a safety system: “When the protective door is opened during normal operation, the motor has to be switched off.”

A safety system executes safety functions and is comprised of subsystems:

- Detecting (position switch, E-STOP, light curtain, etc.)
- Evaluating (fail-safe controller, safety relay, etc.)
- Reacting (contactor, frequency converter, etc.)



Safety system for the safety function: “When the protective door is opened, the motor has to be switched off.”

# Risk reduction through technical protective measures

## Relevant standards for the selection and realization of safety-related parts for machine control

Machine manufacturers can ensure compliance with the new machinery directive and resulting export capability and liability by the application of the EN ISO 13849-1 and IEC 62061 standards. Besides qualitative considerations, also quantitative aspects are introduced by these standards. Protective measures for risk reduction which are

described by means of safety functions can be derived from the process of risk assessment. The solution of the safety function is then verified and evaluated with the help of hardware and, if required, software components until the safety integrity as required in the risk assessment is achieved.



### IEC 62061 standard: Functional safety of safety-related, electrical, electronic and programmable control systems

The IEC 62061 standard specifies requirements and provides recommendations for the design, integration and validation of safety-related, electrical, electronic and programmable electronic control systems (SRECS). A system designed in accordance with IEC 62061 complies with all relevant requirements of IEC 61508.

The IEC 62061 standard does not define any requirements for the capacity of non-electrical (e.g. hydraulic, pneumatic, electromechanical) safety-related control elements for machines.

#### Application of IEC 62061

The IEC 62061 (EN 62061) standard can be applied for the evaluation of all electrical and electronic systems, independently of their category. The requirements can also be applied to non-electrical controls, given they comply with ISO 13849. Subsystems (SRP/CS) assessed in accordance with EN ISO 13849-1 can be used comparably. A comparison table with SIL and PL values, based on PFHD values, is available for this purpose.

#### Implementation made easy

Siemens offers comprehensive support with the safety standards' application:

- Courses on the application of standards and regulations
- Certified products
- Functional examples with standards calculation

Further information is available at:

[siemens.com/safety-integrated](http://siemens.com/safety-integrated)

#### Verification of the safety concept on the basis of requirements

The TÜV-tested Safety Evaluation Tool offers support with the assessment of safety functions.

Further information is available on page 11, as well as at: [siemens.com/safety-evaluation-tool](http://siemens.com/safety-evaluation-tool)



### ISO 13849-1 standard: Safety-related parts of control systems – Part 1, general principles for design

The ISO 13849-1 standard may be applied to safety-related parts of control systems (SRP/CS) and all types of machines – regardless of the technology and energy used (electrical, hydraulic, pneumatic, mechanical, etc.). It also specifies special requirements for SRP/CS with programmable electronic systems. As EN ISO 13849-1 it replaces the EN 954-1:1996 standard.

Most important changes:

- Performance Level (beyond the exclusive consideration of categories)
- Incorporation of development and application of so-called programmable electronic systems with safety function (PES) in safety-related parts of control systems
- Extended consideration of the control and avoidance of systematic failures and faults

#### Application of ISO 13849-1

Application of the ISO 13849-1 standard is recommendable when the safety function is mainly realized on the basis of fluid power (hydraulic, pneumatic).

#### Both standards

The risk of each hazard is estimated on the basis of the risk elements' determination.

This determination is based on:

- Severity of the harm
- Frequency and duration of a person's exposure to the hazard
- Probability of occurrence of a hazardous event
- Possibilities of avoiding or limiting the harm

The required Safety Integrity Level (SIL in accordance with IEC 62061) or Performance Level (PL in accordance with ISO 13849-1) is determined on the basis of these criteria.

# Risk estimation based on determination and evaluation of risk elements

The risk elements (S, F, PR and P) serve as input parameters for both standards, but their usability within the standard differs. While a Safety Integrity Level (SIL) is determined according to IEC 62061, a Performance Level (PL) is determined according to ISO 13849-1.

Risk related to the identified hazard

Severity of harm  
**Se**

and

|   |           |
|---|-----------|
| Frequency and duration of exposure                        | <b>Fr</b> |
| Probability of occurrence                                 | <b>Pr</b> |
| Possibilities of avoiding the hazard or limiting the harm | <b>Av</b> |



## IEC 62061 Determination of the required SIL (by means of SIL assignment)

| Frequency and/or duration of exposure<br><b>Fr</b> |          | Probability of occurrence of the hazardous event<br><b>Pr</b> |          | Possibility of avoidance<br><b>Av</b> |          |
|--|----------|---|----------|---------------------------------------|----------|
| ≤ 1 hour   | 5        | Frequent  | 5        |                                       |          |
| > 1 hour to ≤ 1 day                                | <b>5</b> | Probable  | <b>4</b> |                                       |          |
| > 1 day to ≤ 2 weeks                               | 4        | Possible  | 3        | Impossible                            | 5        |
| > 2 weeks to ≤ 1 year                              | 3        | Seldom  | 2        | Possible                              | <b>3</b> |
| > 1 year   | 2        | Negligible  | 1        | Probable                              | 1        |

| Severity of harm<br><b>Se</b> | Severity of harm<br><b>Se</b> | Class<br>$K = F + W + P$ |       |       |              |       |
|-------------------------------|-------------------------------|--------------------------|-------|-------|--------------|-------|
|                               |                               | 3-4                      | 5-7   | 8-10  | <b>11-13</b> | 14-15 |
| Death, loss of an eye or arm  | 4                             | SIL 2                    | SIL 2 | SIL 2 | SIL 3        | SIL 3 |
| Permanent, loss of fingers    | 3                             | Other measures           |       |       | SIL 2        | SIL 3 |
| Reversible, medical treatment | 2                             |                          |       |       | SIL 1        | SIL 2 |
| Reversible, first aid         | 1                             |                          |       |       |              | SIL 1 |

Exemplary calculation

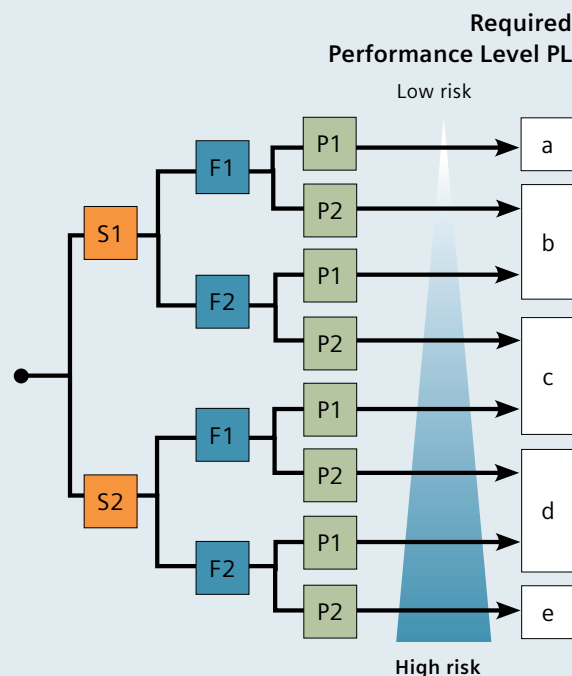


## ISO 13849-1: Determination of the required PL (by means of risk graph)

Risk estimation is based on the same risk parameters:

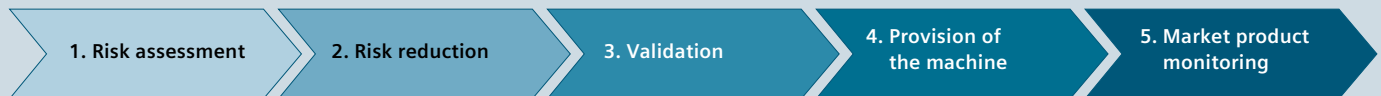
| Risk parameters  |  |
|--|--|
| Severity of the injury   |  |
| S1 = Minor (generally reversible) injury                               |  |
| S2 = Severe (generally irreversible) injury, including death           |  |
| F = Frequency and/or duration of exposure to the hazard                |  |
| F1 = Seldom to more often and/or short duration of exposure            |  |
| F2 = Frequent to constant and/or long duration of exposure             |  |
| P = Possibilities of avoiding the hazard or limiting the harm          |  |
| P1 = Possible under certain conditions                                 |  |
| P2 = Hardly possible   |  |
| <b>a, b, c, d, e = Targets of the safety-related Performance Level</b> |  |

starting point for estimation of risk reduction





Steps to be carried out by the machine manufacturer



## 2. Risk reduction: Level 3

### Level 3: User information on residual risks

As a matter of fact, users have to be comprehensively informed of any possible residual risks. However, such information does not replace the request for safe design and technical protective measures, but is merely intended to supplement such measures. User information for example comprises of:

- Warnings in the operating instructions
- Special work instructions
- Pictograms
- Note on the use of personal protective equipment

## 3. Validation

The term validation refers to the assurance of the specified requirements' holistic implementation. Furthermore, validation is to prove the seamless recording, implementation and documentation both of legal requirements – specified by standards or directives – as well as requirements specified by the end user.

The customer specification documents, in which the requirements placed upon the manufacturer are described, serve as the starting point for validation. Validation starts with the validation plan's preparation. The validation plan has to specify and describe the requirements placed upon the validation process, the specified safety functions, their category, Performance Level or Safety Integrity Level. Furthermore, the validation plan also has to specify means for the validation's implementation, e.g. test equipment. Even though validation may start in any phase of the machine's service life, its completion is to be ensured prior to the machine's delivery or transfer.

## Validation target

Assurance of compliance with requirements

- specified in European directives
- resulting from the customers specification documents, the machine's application and any further country-specific requirements applicable to the machine
- The purpose of the validation process lies in assuring that the machine's construction complies with the requirements for its intended use.

## 4. Making the machine available on the market

All machine-relevant information must be disposable when the machine is made available on the market. This comprises: customers specification documents, technical documentation (also see machinery directive, annex VII), certificate of conformity, acceptance report if applicable, transport documents, etc.

## 5. Product monitoring

Every manufacturer is obliged to monitor his product by means of a survey for any hidden defects after it has been placed on the market. For example, information as to whether the product is actually used as originally intended as well as information regarding its behavior over the course of its lifecycle is to be collected.

In particular, dangerous defects as well as misuse or incorrect product handling are to be rectified by means of corresponding measures. The user has to be informed of any discovered hidden defects.

**Neutral data interface:**

Safety-relevant characteristic values of third-party products can now be imported into the Safety Evaluation Tool in XML format according to VDMA 66413 specification. Alternatively, the characteristic values of Siemens safety products can be exported for other calculation tools.

Further information is available at:  
[siemens.com/safety-evaluation-tool](http://siemens.com/safety-evaluation-tool)

## More efficient implementation of legal functional safety requirements: Safety Evaluation Tool

### Fast and easy assessment of safety functions with the Safety Evaluation Tool

The Safety Evaluation Tool for the IEC 62061 and ISO 13849-1 standards facilitates the realization of safe machine concepts without any detours. This TÜV-tested online tool quickly and safely guides you through the safety functions' calculation steps and supports the successive determination of the attained safety integrity (SIL/PL) – from specification of the system structure down to component selection. The result: A standard-compliant report which can be integrated in your documentation as safety proof.

### Your advantages:

- Faster assessment of safety functions
- Calculation in accordance with current standards
- Ease of archiving:  
Projects can be saved and called up as required
- Quick and easy handling:  
Comprehensive, predefined example libraries
- Fast access to product data
- Free use of the online tool\*

\* Only the usual costs for Internet access accrue.

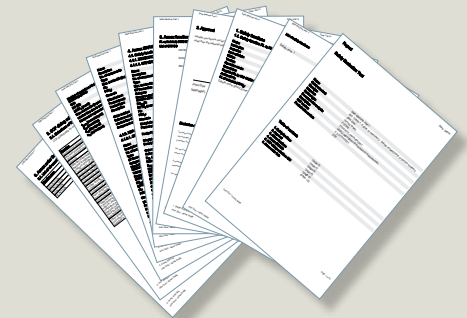
[siemens.com/safety-evaluation-tool](http://siemens.com/safety-evaluation-tool)



Calculation of SIL or PL for subsystems and the overall system



Exemplary machine with flexible, autonomous safety solution



Result report for machine documentation

# Safety Integrated: Consistent integration of safety technology in standard automation

As trendsetter and innovation driver in the automation industry, Siemens offers Safety Integrated for the consistent implementation of safety technology in accordance with Totally Integrated Automation. On the one hand, this is realized through the direct integration of safety-technical functions in our standard products and, on the other hand, through the consistent and ease of integration of safety technology in standard automation. The resulting advantages for machine manufacturers and system operators are enormous – particularly from an economic point of view.

## Added value for machine manufacturers and system operators

The integration of safety technology in standard automation concepts entails considerable and sustainable user benefits for enhanced competitiveness.

Machine manufacturers benefit from reduced hardware and significantly simplified engineering. The result: Considerably faster realization of machines and systems as well as easier adjustability to new requirements.

The advantages for system operators: They are provided with safe and more productive machines and systems. A single integrated system of safety technology and standard automation reduces downtimes due to improved diagnostics and this also increases the system availability. Retrofits and modernizations are simplified: Due to flexible, modularly expandable concepts, machines and systems can be upgraded to state-of-the-art technology way more efficiently.

### Increased efficiency

- Minimized type differentiations
- Minimized costs due to a single bus as well as engineering system
- Easily reproducible machines due to intelligent software solutions

### Increased productivity

- Faster commissioning, prewired and certified components – expertise in product liability
- Minimized downtimes due to quick fault localization and comprehensive diagnostics functions
- Quicker restarts after system modifications
- Production without standstills due to additionally available safe, fault-tolerant systems
- Space-, time- and cost-saving assembly



#### Increased standardization

- Simplified operation due to uniform user interfaces
- Improved reusability due to the application of libraries
- Reduced variety of control cabinets on machines
- Easier installation due to bus systems

#### Increased flexibility

- Tailored solutions due to modular system
- Easy expandability and integration in the Totally Integrated Automation architecture
- Improved global market opportunities due to availability of required approvals and compliance with EU directives
- Easier maintenance and system expandability due to long-term product and system availability

## Safe and productive application: Safety Integrated in practical use



### Modular safety technology eases the safety concept for a new special machine of Ideal Maschinenbau GmbH

The Bavarian-based Ideal Maschinenbau GmbH machine construction company was in search for a suitable safety technology concept for the complex requirements of its new airbag folding machine. The company opted for the software-based SIRIUS 3RK3 modular safety system (MSS), which amongst others facilitates reduced space requirements and improved flexibility as well as minimized installation and commissioning expenditures.

### SIPA Berchi relies on integrated PC-based safety solution

With SINCRO TRIBLOC, the Italian company SIPA Berchi realized a very compact filling machine for PET bottles, which for the first time attaches the labels prior to the filling of the bottles. The sorting out of mislabeled bottles prior to filling, results in considerable cost savings for beverage producers.

The PC-based safety solution consists of a fail-safe SIMATIC WinAC RTX F software controller and the modular SIMATIC S7-mEC embedded controller and offers genuine added value in terms of performance and cost savings.



The SIPA Berchi video is accessible via:  
[siemens.de/referenzvideo-sipa-berchi](http://siemens.de/referenzvideo-sipa-berchi)



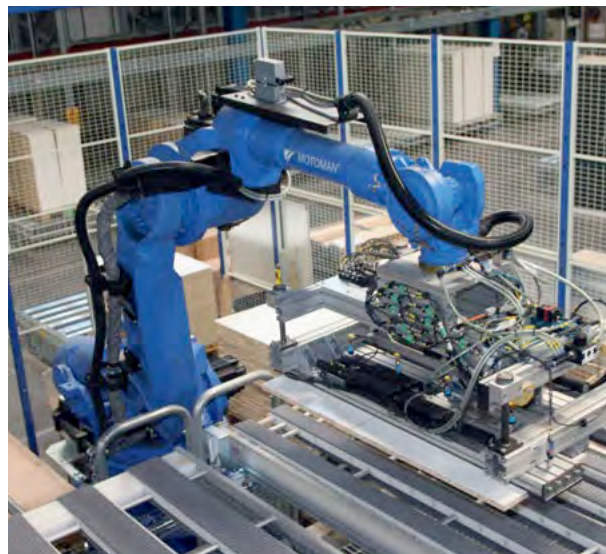
### Silesian Theater opts for modern automation technology in historic ambience

For its stage technology's modernization, the Silesian Theater opted for an integrated automation solution with a comprehensive safety concept. The application of state-of-the-art components such as SIMATIC S7-319F controller, SINAMICS S120 drives with integrated safety functions and safe communication via PROFIsafe allowed for the realization of a modern theater technology control concept which sets new standards – both in terms of performance and functional safety.

Further references on Safety Integrated are available at [siemens.com/safety-integrated](http://siemens.com/safety-integrated)

### Integrated safety for minimized downtimes in the packing line of an IKEA supplier

The company Gyllensvaans Möbler planned the construction of a new, fully automatic packing line in order to optimize the production of the world-famous Billy bookcases in terms of quality and speed. With the SIMATIC S7-416F and S7-317F control systems as well as engineering with STEP 7 and the Distributed Safety option package, downtimes could be reduced to a minimum and service and maintenance could be significantly reduced – through the utilization of comprehensive diagnostics.



### Barilla Wasa benefits from efficient engineering with TIA Portal

The world-famous crispbread producer wanted to ensure intuitive and efficient engineering for future modernization and expansion projects. The first plant part was successfully converted to the innovative TIA Portal engineering framework during a production break. Barilla Wasa relies on fail-safe controllers such as SIMATIC CPU S7-315F-2 PN/DP as basis for the integration of safety functions. The configuration and programming of safety functions in the Portal requires the STEP 7 Safety Advanced option package. The new safety engineering solution offers a uniform operating concept both for standard and safety-related programs.

### Drive system with integrated safety functions for textile printing machines of J. Zimmer Maschinenbau GmbH

J. Zimmer Maschinenbau GmbH is a globally leading company in the field of textile printing and coating machines. Its portfolio amongst others comprises systems for the imprinting of fleece fabrics using the rotary printing method. The corresponding special requirements are implemented by means of SIMATIC S7-317F controllers and SINAMICS S120 drives: In case of EMERGENCY-STOP, the fabric webs can be safely braked from 50 m/min to standstill within 2 seconds and quickly restarted after fault rectification.



### Wilbert relies on IPC-controlled safety for its heavy construction cranes – for high productivity and reliability

In the field of building construction, rotating tower cranes for the building material's quick and reliable transportation to their usage sites play a major role. The company Wilbert located in Waldlaubersheim has specialized in the design, construction and leasing of such cranes. For its heavy lifter WT2405L e.tronic (120 m tower height, up to 128 t nominal lifting force, max. load torque of 2400 mt), the company relies on powerful drive technology and comprehensive safety equipment.

The crane operator is provided with all required data via a SIMATIC MP277 touch panel. Safe crane control is ensured by the SIMATIC S7 controller with the IPC-based WinAC RTX-F safety controller, which detects and processes all safety-relevant signals together with an ET 200 IM151-8F distributed safety controller. The combination of safety and control functions in one PLC reduces hardware and engineering costs. As both safety-related and standard communication are realized via PROFINET, wiring expenditures are minimized, wiring faults are avoided and commissioning is accelerated. The overall safety concept is based on Safety Integrated products.



Scan the QR code and watch the video!



The crane is controlled via a fail-safe WinAC RTX-F soft PLC (left) and the drives via SINAMICS S120. The hoisting gear's drive is monitored for deviations regarding speed and direction of rotation and is safely disconnected in case of fault to prevent load crashes.



Further information on door management systems:  
[siemens.com/sidoor](http://siemens.com/sidoor)

### Smart door management

Protective machine doors can be precisely moved with the SIDOOR ATD400W automatic door control. The intelligent and autonomous system solution automatically calculates the door's optimum driving performance and ensures its continuous maintenance. The door drive complies with Performance Level d in accordance with EN 13849-1.



As a special highlight, the complete commissioning process is extremely easy and yet absolutely safe. It is based on one-time activation of the "teach-in drive" function. Using the integrated RS485 interface, the data of the door control device can be recorded and

visualized via the service tool for maintenance and diagnostics purposes. The particularly compact SIDOOR door control is reliable, rugged and consistently accurate. This minimizes maintenance and repair expenditures.

# Functional safety of machines and systems: Scalable solution examples

No matter which safety task you need to solve: Safety Integrated offers the easier and faster way to safe and productive machine concepts. This is proven by the following examples of four typical machine concepts – from compact to highly flexible.

Simple solutions for  
few safety functions

1

Compact machine with locally restricted safety technology and intelligent motor starter connection



2

Machine with flexible, autonomous safety solution



3

Machine and systems with distributed safe sensors and actuators with ASIsafe



4

Machine with variable quantity structure and flexible requirements regarding safety functions



Integrated solutions  
for a large number  
of safety functions

## 1

## Compact machine with locally restricted safety technology and intelligent motor starter connection



Simple, flexible, efficient:  
SIRIUS 3SK1 safety relay,  
Advanced basic unit

In many systems, simple solutions for safety applications (e.g. for evaluation of EMERGENCY-STOP, protective door, light barrier, etc.) are absolutely sufficient. This is where the new SIRIUS safety relays come in. They facilitate the effortless implementation of only few safety functions. Their modular design ensures ease of planning, commissioning and expansion – without the need of any programming knowledge.

The result: Fast and easy realization of safe and productive safety solutions.

### Requirements

- Realization of compact machines with local use of safety technology
- Easy wiring without programming or PC knowledge
- Implementation of simple safety solutions on the basis of example applications
- Few safety functions and minimum space requirements in the control cabinet

### Solution

SIRIUS 3SK1 safety relays for safety applications up to SIL 3 or PL e

- Easy parameterization with the help of DIP switches
- Elimination of wiring between the switching devices and optional integration of fail-safe SIRIUS 3RM1 motor starters due to device connector

### Advantages

Fast and easy realization of safe and productive systems

- Cost savings due to compact product portfolio, minimum wiring expenditures and narrow width
- Simplicity and efficiency throughout the system's entire lifecycle
- Easy realization of application adjustments and expansions due to the system's modularity

Further information is available at:  
[siemens.com/safety-relays](http://siemens.com/safety-relays)

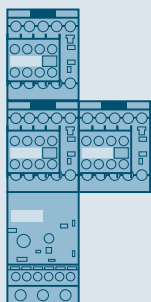
**GIT**  
**SICHERHEIT**  
**AWARD**  
**2014**  
**WINNER**

The SIRIUS 3SK1 system facilitates the easy realization of safety applications and the quick and effortless implementation of numerous applications. If the basic unit's inputs and outputs are not sufficient, the modular system can be easily expanded. The rear device connector ensures minimized wiring expenditures and supplies all devices with power. This eliminates wiring faults between the devices and supports considerable time savings in terms of mounting and commissioning. Actuators and sensors can be easily connected.



Safety functions in this example:  
 1) Monitoring of protective cover  
 2) Emergency stop

Before: Discrete solution with contactors and OLRs



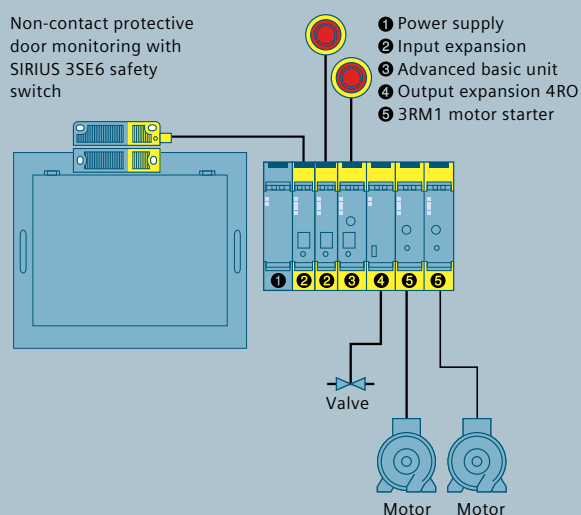
New: SIRIUS 3RM1 compact motor starter



Advantages: Width of only 22.5 mm, economization of up to 3 devices, no wiring, integration in the system of 3SK1 safety relays.

Compact machine with locally restricted safety technology

Non-contact protective door monitoring with SIRIUS 3SE6 safety switch



The SIRIUS 3RM1 motor starter represents the ideal solution for space-saving motor starter applications in the control cabinet. Based on hybrid technology, it replaces up to four devices and features integrated safety technology.

## 2

## Machine with flexible, autonomous safety solution



SIRIUS  
3RK3 modular safety system

With the SIRIUS 3RK3 modular safety system (MSS), users can rely on an integrated modular system which facilitates machine and system operation with maximum flexibility and efficiency – both with new machine applications and retrofits. Safety functions can be quickly and easily parameterized via the MSS ES software. The SIRIUS 3RK3 MSS can be employed for all safety functions up to SIL 3 in accordance with IEC 62061 and PL e in accordance with ISO 13849-1.

#### Requirements

- Safe machine concepts which support flexible adjustment to specific requirements and easy configuration
- Easy, quick and cost-efficient realization of modular machine concepts
- Faster parameterization – with optional integration of diagnostics and process data in an automation system

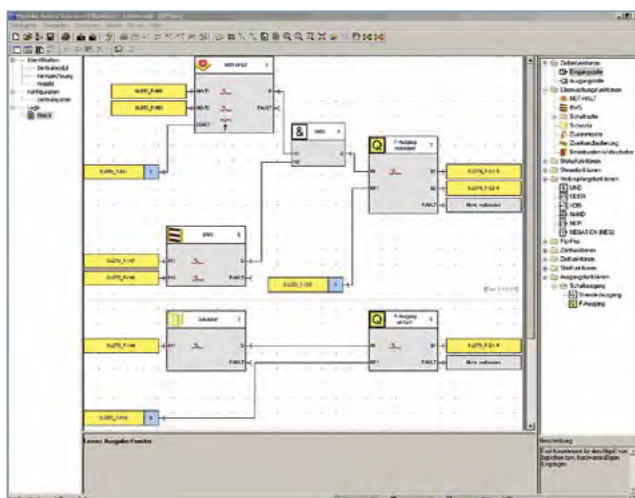
#### Solution

- 3RK3 modular safety system with modular hardware structure
- Interconnection of logic and safety functions without programming knowledge via prefabricated blocks; easy use of blocks via drag & drop and subsequent parameterization
- Integration in the automation system's process image
- Utilization of standardized diagnostics mechanisms
- Easy parameterization with the help of DIP switches

#### Advantages

- Time savings due to intuitive, easy parameterization and comprehensive online test options
- Efficiency due to modular expandability
- Cost savings as a result of reduced type differentiations due to software-based functionality

Animations on the modular safety system's functionality are available on the Internet at:  
[siemens.com/sirius-mss](http://siemens.com/sirius-mss)



#### More efficient diagnostics options

For more complex systems which also include controls, the MSS can be connected to the control via an interface module. This allows for the exchange and visualization of process and diagnostics data. The 3RK3 Advanced central module facilitates cyclic data exchange of up to 64 bit, while up to 32 bit are supported by the 3RK3 Basic central module. In addition, the 3RK3 Advanced module supports the direct transfer of cyclic and acyclic diagnostics data to the control via AS-Interface.

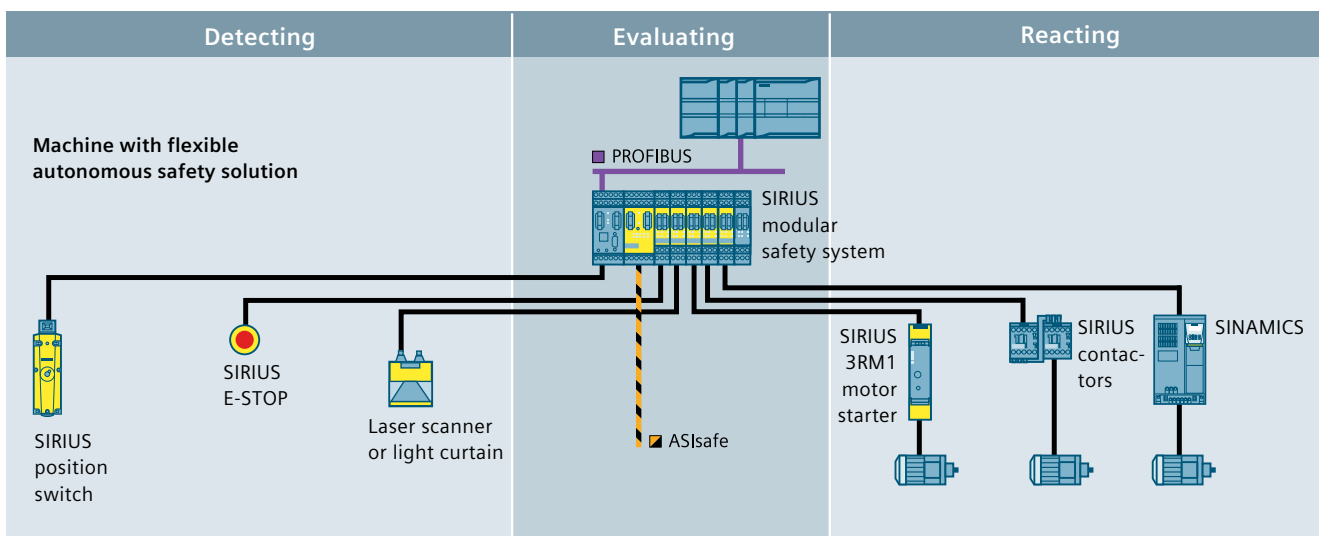


**Interactive animation:** Make this package unit of a filling plant safe step by step – at [siemens.com/safety-integrated](http://siemens.com/safety-integrated)

The MSS Advanced module facilitates the realization of complex applications with multiple safety functions – e.g. muting functions with light curtains for access protection, protective door monitoring with and without interlocks as well as EMERGENCY-STOP applications. The MSS ES graphical parameterization software provides prefabricated blocks for this purpose.

Safety functions in this example:

- 1) Protective door monitoring
- 2) Zone monitoring
- 3) Emergency stop



The complete MSS system offers outstanding functionality and diagnostics options. Also the direct connection of safe sensors and actuators as well as direct data exchange with adjacent safety cells is supported via AS-Interface.

# 3

## Machine and systems with distributed safe sensors and actuators

AS-Interface facilitates the safe and efficient realization of applications with numerous sensors and actuators – also ease of expansion with systems comprising multiple safety areas.



The new central modules of the SIRIUS 3RK3 modular safety system support the easy realization of safe AS-Interface applications.

The ASIsafe basic and ASIsafe extended central modules ensure the distributed detection and switching of sensors and actuators via AS-Interface. The result: Modular machine structure with easy expandability and high flexibility.

### Requirements

- Safe expansive machine concepts which comprise of widely distributed safe sensors and actuators in the field
- One bus system for standard and fail-safe communication – without restrictions
- Multiple enabling circuits which can be easily parameterized via a graphical editor – using drag & drop

### Solution

- Modular and scalable SIRIUS 3RK3 safety system with 2 to 50 independent enabling circuits (two-channel)
- Fail-safe and standard communication on a single bus line
- On a distributed network, detection of safe sensors and safe switching of actuators via AS-Interface

### Advantages

- Easy routing of the AS-i bus in accordance with the system's mechanical design due to topology-free structure
- Intuitive graphical parameterization of the safety function via the MSS ES software on the basis of predefined, certified function blocks
- Easy mounting concept (IP67) and expandability
- Increased availability: Safety cell monitoring by the modular safety system as an autonomous component; this means that safe system operation can be continued even in case of failure of the main standard controller
- Direct data exchange with other safety cells: ASIsafe also supports fail-safe direct data exchange between the respective 3RK3 modular safety systems in various safety areas
- Speed: Faster reaction in case of faults due to the elimination of additional bus runtimes via PROFIsafe; this allows for minimized dimensioning of safety areas

Further information is available at:  
[siemens.com/as-interface](http://siemens.com/as-interface)  
[siemens.com/sirius-mss](http://siemens.com/sirius-mss)



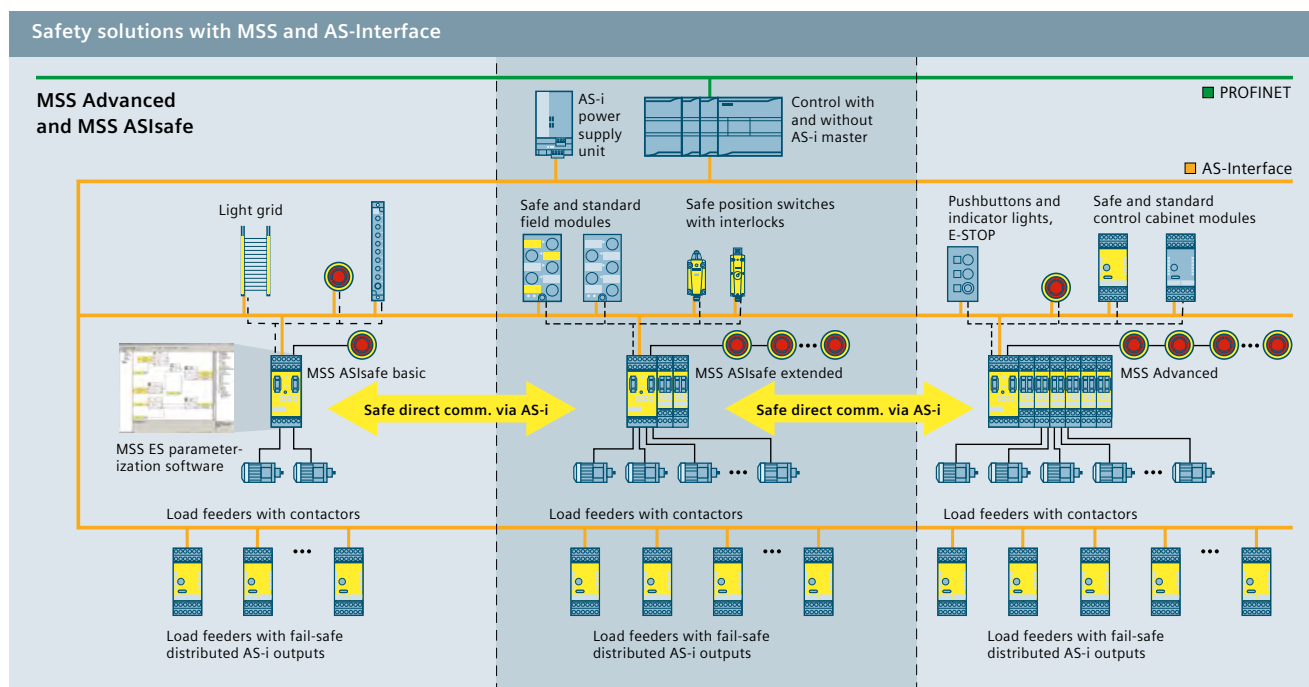
**Interactive animation:** Make this palletizing unit of a filling plant safe step by step – at [siemens.com/safety-integrated](http://siemens.com/safety-integrated)

**ASIsafe Solution Local:** The ASIsafe Solution Local requires only few components for a safety cell – an MSS central module and safe slaves. Neither fail-safe PLC nor special masters are required. The MSS monitors safe sensors (e.g. EMERGENCY-STOP), evaluates them in accordance with its parameterized safe logic and ensures their safe distributed disconnection via ASIsafe and safe AS-i outputs.

Safety cells with fail-safe direct data exchange can be interconnected via ASIsafe. For example, operation of an EMERGENCY-STOP button in one safety cell also effects safe disconnection in the next safety cell.

Safety functions in this example:

- 1) Access monitoring
- 2) Protective door monitoring
- 3) Emergency stop



MSS ASIsafe basic  
2 to 10 enabling circuits

MSS ASIsafe extended  
2 to 20 enabling circuits

MSS Advanced  
2 to 50 enabling circuits

## 4

## Machine with variable quantity structure and flexible requirements regarding safety functions

Particularly with large, highly flexible systems, the integration of safety technology in standard automation offers considerable cost-savings and increase in productivity. SIMATIC facilitates the easy integration of safety functions up to SIL 3 in accordance with IEC 62061 and PL e in accordance with EN ISO 13849-1 in a standard automation structure – in a scalable manner and meeting the requirements of the respective applications. The integrated solution with fail-safe SIMATIC controllers provides an integrated, safe and innovative system both for standard and safety programs – offering maximum flexibility, easy expandability and cost savings.

SIMATIC Safety Integrated comprises of a scalable range of safety-related controllers in various designs for the entire field of production automation, based on diverse hardware and software architectures: From modular controllers, to embedded automation products, down to PC-based controllers.

### Requirements

- Utilization in existing systems and architectures
- Uniform engineering for standard and safety automation
- No performance restrictions resulting from the employed safety solution
- Faster diagnostics, evaluation and rectification of faults
- Mixed or separate assembly of standard and safety-related hardware
- Central software installation, also beyond network limits
- Easy documentation of modifications
- Support with the safety program's acceptance and no need for renewed acceptance of the safety program after modifications in the standard program

### Solution

- One controller, uniform intuitive engineering and a single bus system for standard and safety automation
- Standard and fail-safe communication via international PROFIBUS and PROFINET standards, also wireless via IWLAN
- Fail-safe controllers with integrated device and system diagnostics as well as graphical information and mobile devices for fault rectification
- Routing beyond network limits
- Program comparisons and generation of standard-compliant documentation
- Certified block library for safety functions

### Advantages

- Reduced costs and enhanced efficiency
- Future-proof concept with faster return on investment due to innovations such as safety for Windows, fail-safe communication via IWLAN or processing of standard and fail-safe programs with a single CPU
- Getting started quickly with fail-safe programming due to intuitive engineering
- Increased productivity due to minimized downtimes as a result of efficient fault diagnostics as well as intelligent, fail-safe products





## Fail-safe controllers and I/O modules

With SIMATIC Safety Integrated systems, the evaluation unit consists of fail-safe controllers and fail-safe I/O modules. Fail-safe communication is realized via the safety-related PROFIsafe profile. The fail-safe SIMATIC controllers feature the following functions:

- Checking of the fail-safe controller's state by means of comprehensive self-tests and self-diagnostics
- Simultaneous processing of standard and safety program on a single controller



Fail-safe controllers

### SIMATIC modular controllers

- **S7-1500F:** Fail-safe CPUs for demanding standard and fail-safe applications with very high requirements
- **S7-400F:** Fail-safe CPUs for the top performance range, also as highly available functionality
- **S7-300F:** Fail-safe CPUs for the medium to top performance range, optionally with integrated motion control functionality
- **ET 200 F-CPU:** Fail-safe, intelligent interface modules for the lower performance range

### SIMATIC PC-based controllers

- **WinAC RTX F:** Fail-safe S7 software controllers for the PC with Windows XP and Windows 7

### SIMATIC embedded bundles

- **S7-mEC-RTX F:** Fail-safe embedded controllers in S7-300 design, pre-installed with Windows XP Embedded Standard and S7 software controller WinAC RTX F
- **IPC227D/IPC427C bundle with WinAC RTX F:** Fail-safe embedded DIN rail PC, pre-installed with Windows Embedded Standard 2009 or Standard 7 and S7 software controller WinAC RTX F
- **HMI IPC277D/IPC477C bundle with WinAC RTX F:** Embedded panel PC, pre-installed with Windows Embedded Standard 2009 or Standard 7 and fail-safe S7 software controller WinAC RTX F



Fail-safe I/O

Fail-safe I/Os from the ET 200 range are available as versions for the control cabinet as well as for application without control cabinet – both in modular and block design.

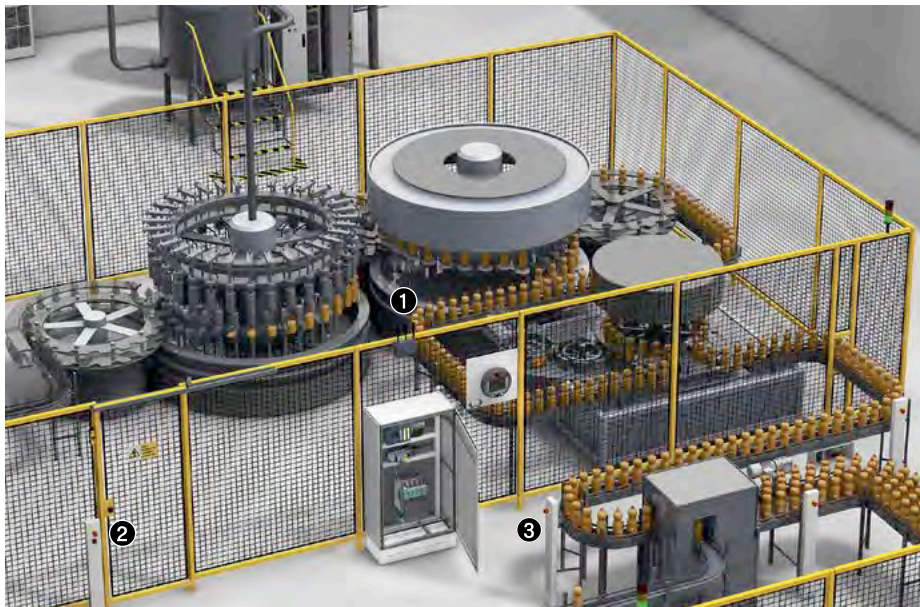
Both standard as well as fail-safe modules can be operated within an ET 200 station.

- **ET 200SP F:** Compact and scalable I/O system
- **ET 200S F:** Finely modular and with comprehensive functional scope
- **ET 200M F:** High-channel and modular design
- **ET 200pro F:** Modular and multifunctional
- **ET 200eco F:** Digital block I/O
- **ET 200iSP F:** Intrinsically safe, for explosive areas

Further information is available at:  
[siemens.com/simatic-safety](http://siemens.com/simatic-safety)

## 4

## Machine with variable quantity structure and flexible requirements regarding safety functions



**Interactive animation:** Make a filling plant safe step by step – at [siemens.com/safety-integrated](http://siemens.com/safety-integrated)

When employing machines with variable quantity structure and flexible requirements of safety functions, you benefit from uniform engineering and a single bus system. Standard and safety tasks can be realized via one control. The option of mixed standard and safety-related hardware assembly is advantageous with highly flexible systems.

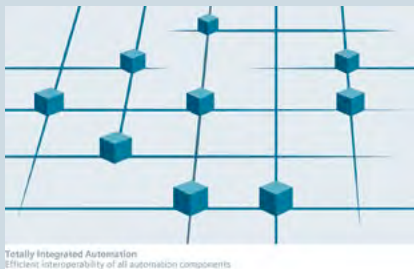
Safety functions in this example:

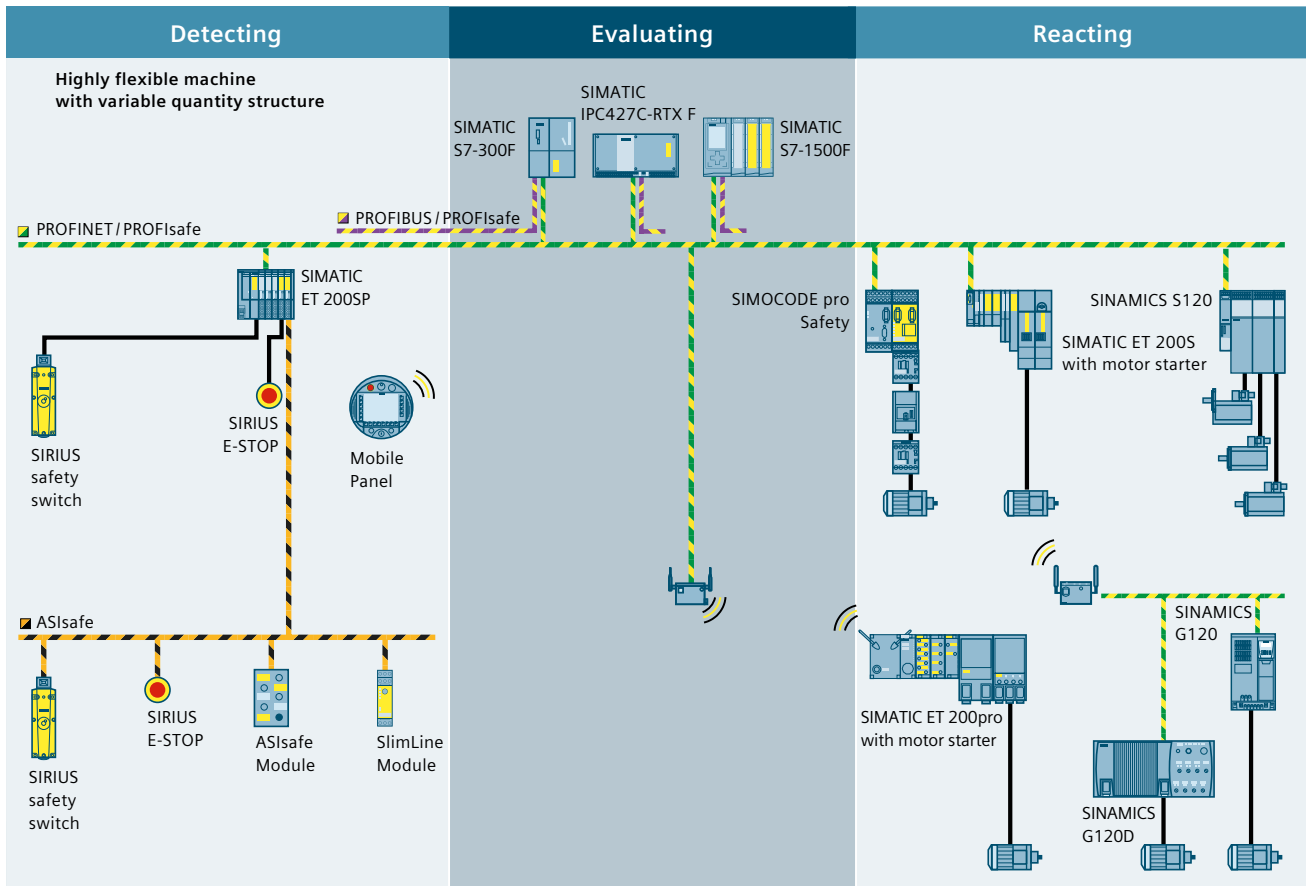
- 1) Speed monitoring/working safely in hazard zones
- 2) Protective door monitoring
- 3) Emergency stop

### Totally Integrated Automation: Efficient automation starts with efficient engineering

Safety Integrated is an integral part of Totally Integrated Automation. The open system architecture covers the entire production process and offers maximum interoperability across all automation components. This is made possible by consistent data management, global standards, and uniform interfaces for hardware and software.

These shared characteristics minimize engineering time. The result: lower costs, reduced time to market, and greater flexibility.





For fail-safe communication, Safety Integrated both uses the proven-and-tested field bus systems AS-Interface and PROFIBUS as well as the innovative Industrial Ethernet standard PROFINET, which facilitates innovative solutions for safe and efficient machines and systems – such as wireless fail-safe communication via IWLAN.

## Fail-safe communication

### First choice for maximum efficiency: PROFINET, PROFIBUS and AS-Interface

The safety-relevant data are transferred via the already existing standard bus. This facilitates significant savings in terms of installation and engineering. Safe I/O modules can be combined with standard modules and safe data can be reused for diagnostics purposes on the standard level. Furthermore, safe components by third-party suppliers can be effortlessly connected.

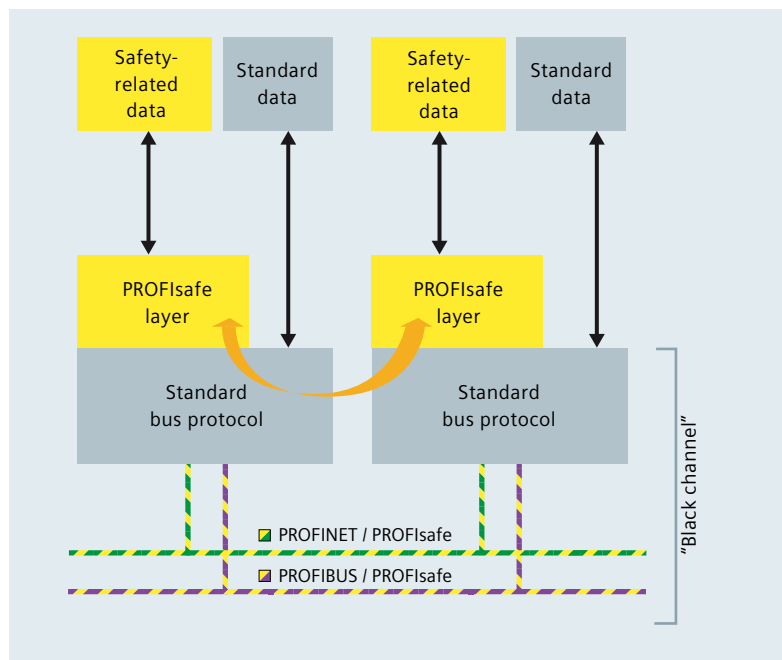
### Reliable compliance with high requirements: PROFIsafe

PROFIsafe® was the first communication standard defined in accordance with IEC 61508 to allow for standard and safety-related communication on a single bus cable. PROFIsafe can be easily retrofitted as the existing wiring can be used. PROFIsafe uses the PROFINET and PROFIBUS services. This ensures compliance with maximum requirements up to PL e in accordance with ISO 13849 and SIL 3 in accordance with IEC 61508.

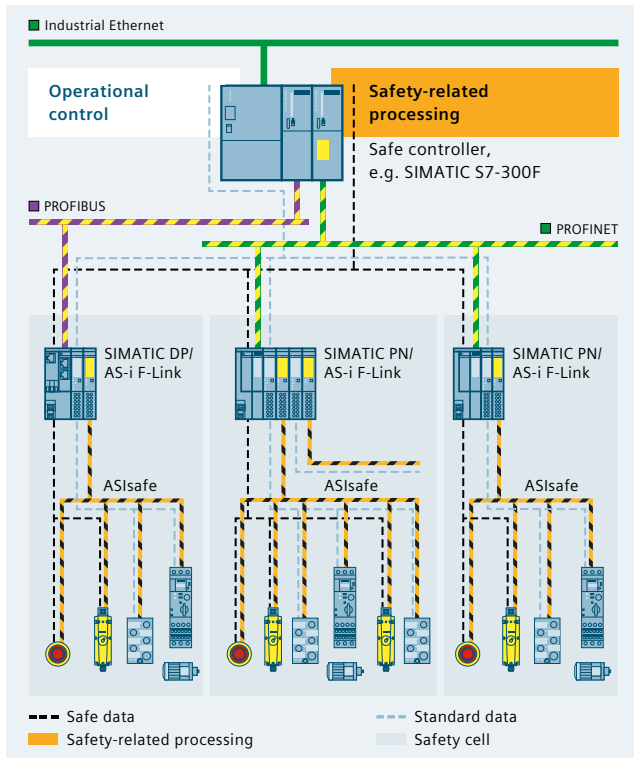
#### Security note:

The assurance of safe system or machine operation necessitates the implementation of additional suitable protective measures and the integration of all automation and drive components in a holistic state-of-the-art industrial security concept.

Further information is available at:  
<http://siemens.com/industrialsecurity>



Safety-related and standard data are transferred via the same bus with PROFIsafe. The term black channel implies that safety-related communication is independent of the bus system and the subordinate network components.



The advantages of AS-i can also be utilized in complex safety applications. The DP/AS-i F-Link facilitates the application of AS-i under fail-safe SIMATIC or SINUMERIK controllers. Acting as a link in bus-based safety technology, it supports the transfer of ASIsafe telegrams to the PROFI-safe protocol. As usual, the detection of safe signals is realized by means of rugged ASIsafe slaves.

Evaluation is carried out by the available F-PLC. Actuator response is realized on the PROFI-safe level, optionally via F-DO/F-RO modules in the central rack or with the help of the fail-safe distributed I/O.

ASIsafe Solution PROFI-safe



## Maximum engineering efficiency: TIA Portal

The Totally Integrated Automation Portal (TIA Portal) offers state-of-the-art software technology, whose full potential is controlled via an intuitive user interface. The intuitive layout and easy navigation support rapid and easy familiarization with important programming and editing functions – enabling users to fully focus on their engineering tasks.

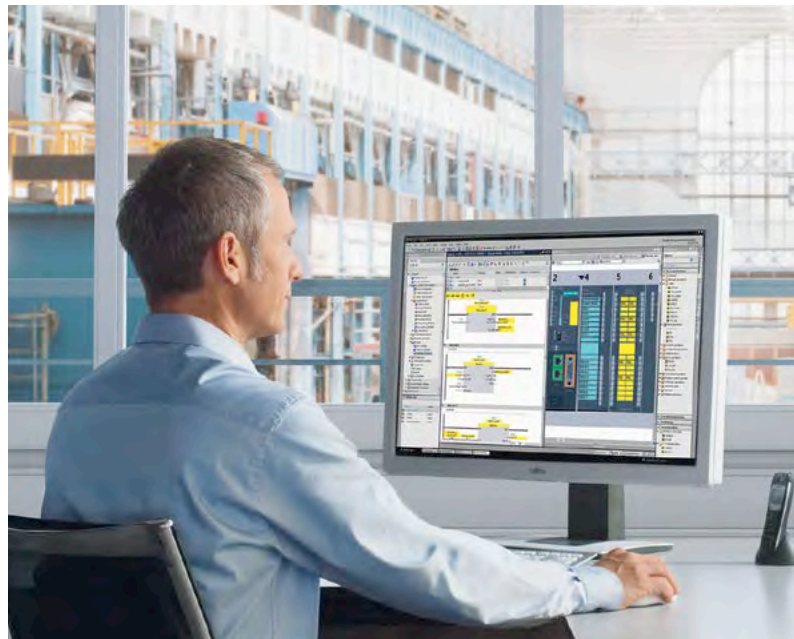
### Two views for selection

Two views are available for selection upon project start:

- Task-oriented portal view with simplified user guidance
- Project view with quick access to the relevant tools

The portal view intuitively guides the user through each engineering step. The modules are clearly and thematically arranged in the hardware catalog on the right. They can be selected by article number and directly “plugged” into the photorealistic rack via drag & drop. The structured tree provides all parameters directly in the program editor. All device-specific settings, e.g. operating mode, can be immediately made in the device properties.

The TIA Portal helps both new and experienced users to optimize their workflow productivity.



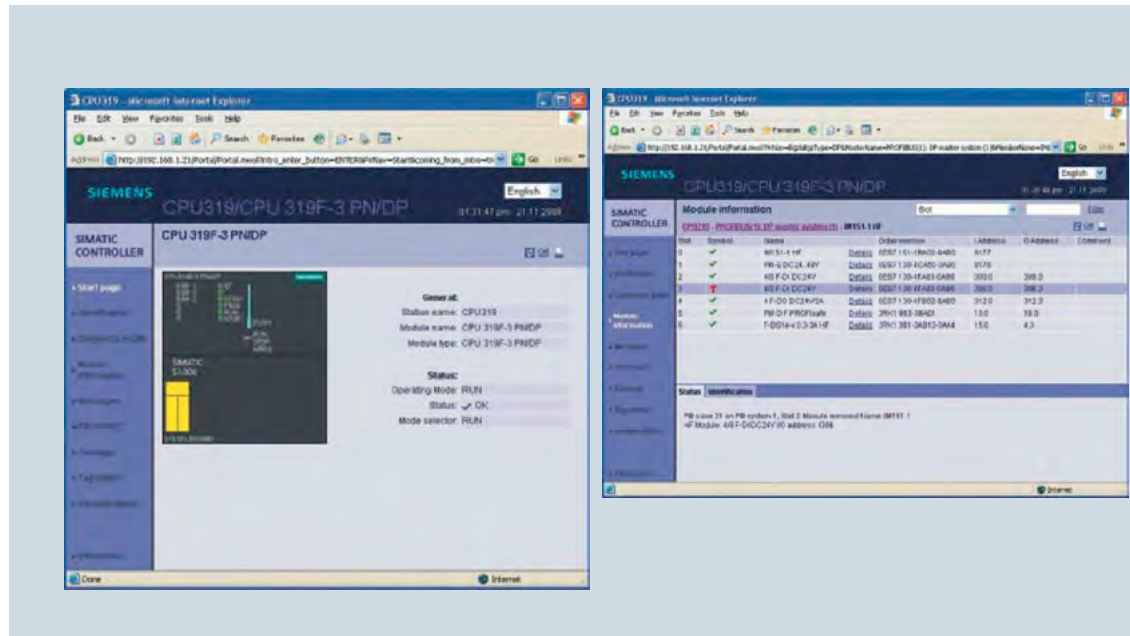
### Integration of safety in the TIA Portal

STEP 7 Safety Advanced facilitates the seamless integration of safety technology in the TIA Portal. Yet, safety-related programs can also be created using STEP 7 and Distributed Safety as before. Correspondingly created programs can be integrated in the TIA Portal anytime.

Both engineering tools offer commands, operations and blocks for safety-related programs in the LAD and FBD languages. For this purpose, a library with preconfigured and TÜV-approved blocks for safety-related functions is available. No special engineering know-how is required as programming is carried out in the familiar STEP 7 environment. Fault detection functions and safety checks during safety program generation as well as safety program comparisons are supported.

### Drive technology in the TIA Portal

With SINAMICS Startdrive as part of the TIA Portal, the safety functions integrated in the converters can be intuitively parameterized via graphical interfaces.



Integrated web server functionality – without additional software tools

## Engineering with STEP 7 Safety Advanced

With STEP 7 Safety Advanced, users benefit from maximum comfort and consistency with the creation of safety-related programs. All required configuration and programming tools are integrated in the STEP 7 user interface on the basis of a joint project structure.

With STEP 7 Safety, all advantages of the TIA Portal can also be utilized for fail-safe automation applications:

- Intuitive operation and identical operating concept as for the creation of standard programs for quick familiarization with the creation of fail-safe programs
- Identical configuration of the F-system as for the standard system
- Ready-to-start: The F-runtime group is automatically created upon insertion of the F-CPU
- The library concept simplifies the safety-related application's validation
- The Safety Administration Editor provides central support with the management, display and modification of safety-relevant parameters
- Uniform and integrated identification of all safety-relevant objects
- Support of 32-bit integer data types

## Engineering with STEP 7 V5.5 and S7 Distributed Safety

The Distributed Safety engineering tool facilitates the realization of safety-related automation applications with STEP 7 version 5.5 in LAD or FBD. The safety program is called up from the standard user program via the so-called F-call.

### Web server functionality

SIMATIC controllers, panels and switches feature an integrated web server functionality for online access to setting options and device information – from any Internet-capable PC. The data are directly displayed in the web browser. No additional software tools are required.

### Testing the TIA Portal

- Did we arouse your interest? Simply test the TIA Portal and see for yourself. More information is available at <http://siemens.com/tia-portal>

## Drives with integrated safety functions

Electrically driven power units and machine components frequently bear enormous risk potentials. Rotating units such as saws, rollers and spindles may lead to severe or even fatal injuries. The same applies to linearly moved machine units such as handling axes and machine slides.

### Easier and faster realization of standard-compliant, powerful safety concepts

Drives with integrated safety functions facilitate the easy realization of safety concepts. Previously required electro-mechanical components and corresponding wiring are done away with. The transfer of safety-relevant signals can be realized via standard field buses, which additionally minimizes wiring complexity and expenditures.

Furthermore, drives with integrated safety functions support the implementation of way more powerful safety concepts – both in terms of functionality and response times. In many cases, this even results in increased productivity.





Depending on the required motion profile, the most varying components are employed for moving the motors in practice.

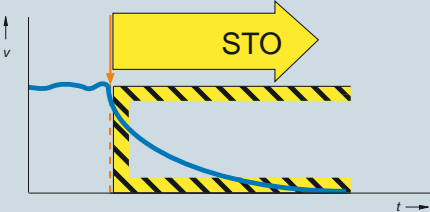
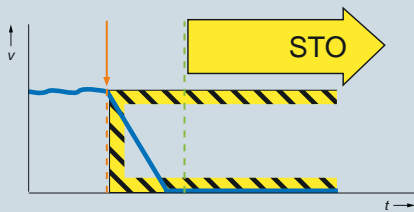
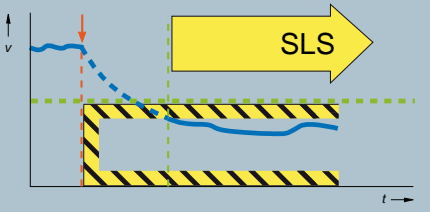
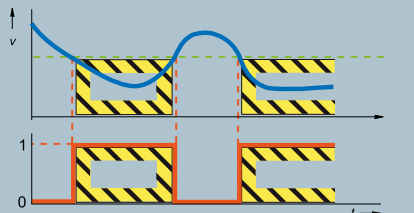


Siemens offers a comprehensive product portfolio for the efficient realization of powerful safety concepts for all application profiles.

The table below provides an overview of the recommended products for the respective application cases.



| Application class | Fixed-speed applications                                    | Variable-speed applications  | High-performance and motion control applications  | Numeric control in processing machines   |
|-------------------|---|--|---|--|
| Application areas | Conveyor technology, pumps, power units                     | Conveyor technology, handling, pumps, extruders, agitators, mills, power units   | Production machines, handling devices, converting applications (winding, ...), mounting equipment   | Machine tools, processing machines (wood, plastic, ...)                                      |
| Operating mode    | ON/OFF operation or continuous operation with fixed speed   | ON/OFF operation with acceleration/brake ramp, continuous operation with variable speed  | Continuous operation with high speed accuracy or fixed-cycle operation with frequent acceleration/delay: Positioning, motion control, interpolating operation of drive axes | Interpolating operation of multiple feed axes, speed control of spindles                     |
| Product groups    | SIRIUS motor starters, SIMOCODE pro motor management system | SINAMICS G General Performance drives  | SINAMICS S High Performance drives  | SINUMERIK CNC systems  |
|                   |   | <ul style="list-style-type: none"> <li>SINAMICS G110D, G110M,</li> <li>SINAMICS G120,</li> <li>SINAMICS G120C, D,</li> <li>SINAMICS G130/G150</li> </ul> | <ul style="list-style-type: none"> <li>SINAMICS S110,</li> <li>SINAMICS S120, S120M,</li> <li>SINAMICS S150,</li> <li>SINAMICS SM150</li> </ul>                             | <ul style="list-style-type: none"> <li>SINUMERIK 828D,</li> <li>SINUMERIK 840D sl</li> </ul> |

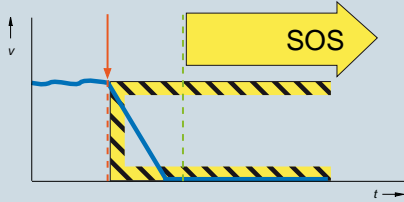
Drive-integrated safety functions can be roughly divided into three classes:

|   |   |  |
|---|---|--|
| <p>Functions for safe drive shutdown without the necessity of disconnecting the power connection to the mains</p> | <h3>STO</h3> <p><b>Safe torque off (STO):</b><br/>This function prevents any further release of a torque on the motor shaft.</p>    | <h3>SS1</h3> <p><b>Safe stop 1 (SS1):</b><br/>This function actively brakes the drive before activation of the STO function. Drives with high kinetic energy can be rapidly brought to standstill with this function in case of danger.</p>   |
| <p>Functions for reliable drive motion monitoring</p>   | <h3>SLS</h3> <p><b>Safely limited speed (SLS):</b><br/>This function monitors the drive for exceedance of one or several specified maximum speeds.</p>    | <h3>SSM</h3> <p><b>Safe speed monitor (SSM):</b><br/>This function signals the shortfall of a specified speed. No drive-autonomous response is effected.</p>    |
| <p>Functions for reliable drive position monitoring</p>   | <h3>SLP</h3> <p><b>Safely limited position (SLP):</b><br/>This function prevents overshooting of a specified position range. It facilitates the axis-specific realization of working area / protection zone delimitation or traversing range limitation.</p>  | <h3>SP</h3> <p><b>Safe position (SP):</b><br/>This function transfers the drive's safe position values to the superior control (F-PLC), where the safe cam (SCA) function can for example be realized. SCA outputs a safe signal when the drive is positioned within a specified position range.</p>  |

## SS2

### Safe stop (SS2):

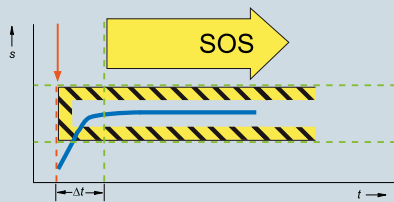
Like the SS1 function, this function actively brakes a drive. However, the SOS function is activated upon standstill instead of the STO function. As with SS1, drives with high kinetic energy are quickly brought to standstill in case of danger.



## SOS

### Safe operating stop (SOS):

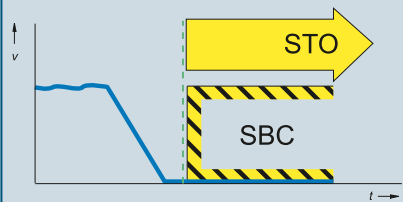
This function can be used alternatively to STO. As opposed to STO, the motor is not switched to a torque-free state, but the drive remains in position control, retains its position and is monitored for standstill.



## SBC/STO

### Safe brake management:

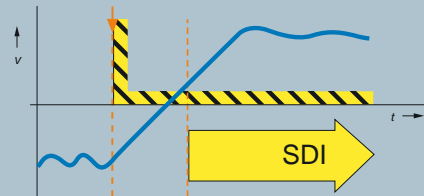
This function consists of safe brake control (SBC) and a safe brake test (SBT). The safely controlled and tested brake in connection with the safely monitored drive results in a safe holding system for anti-fall guards on vertical axes.



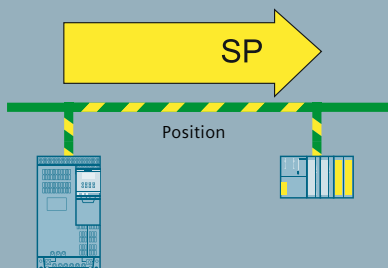
## SDI

### Safe direction (SDI):

This function monitors compliance with the selected direction of motion/rotation.



This function can be used to implement a reliable range recognition for specific axes. Using SP, also multi-axis safety concepts can be realized in the F-control.



**Further safety functions are available particularly for safety solutions in machine tools in connection with the SINUMERIK CNC control:**

### Safe programmable logics

With the help of safe programmable logics, safety-related sensors and actuators can be directly connected to the control's I/O and evaluated by means of software without external evaluation units.

Further information is available at:  
[siemens.com/safety-drives](http://siemens.com/safety-drives)

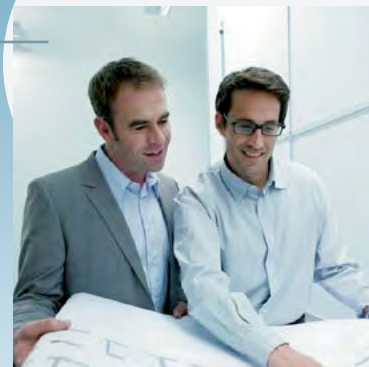
# Competent support throughout the entire lifecycle

With our innovative and comprehensive safety technology product portfolio as well as competent support services, we offer substantial advantages – throughout all phases of the product lifecycle.

## Our services\*

- Support throughout the entire lifecycle:
  - Planning and conceptual design (e.g. with functional examples)
  - Preparation, right down to machine acceptance and transfer
  - Installation and commissioning
- Comprehensive training offer
- Consulting on the application / interpretation of safety-relevant directives and standards
- Safety Evaluation Tool for support with safety integrity determination and standard-compliant report generation
- Quick on-site service due to global presence
- Fast spare parts delivery for low capital commitment
- TÜV-compliant user manuals
- Regular renewal of safety-relevant components
- Modernization concepts and implementation in accordance with your requirements and state-of-the-art technology

\* These services can be rendered directly by Siemens or by certified Siemens Solution Partners.



## Design and engineering

### Requirements

Prior to designing a machine, the machine manufacturer is required to perform a risk analysis in consideration of all relevant standards. This shows the hazards posed by the machine and the respectively required protection measures.

### Siemens system advantages

Modular solutions, tailored to various machines and systems

- Innovative technologies
- Globally applicable products and systems with the required approvals and compliance with the EU directives



## Modernization and optimization

### Requirements

For upgrading existing systems to state-of-the-art safety technology, expansion or modernization measures are required. We help you to optimally comply with all current safety requirements by means of tests, documentation, consulting and the definition of rectification measures.

### Siemens system advantages

- Easy expandability through integration in the Totally Integrated Automation architecture
- Long-term product availability



## Maintenance

### Requirements

Maintenance measures must be carried out quickly to keep downtimes at a minimum. Fault rectification must be accomplished as fast as possible as production must not be interrupted – or only interrupted for minimum periods – for reasons of competitiveness.

### Siemens system advantages

- Quick fault diagnostics and rectification due to the Safety Integrated concept
- Long-term availability of components

## Operation and servicing

### Requirements

The operator must observe the framework directive on industrial safety as well as the documentation on compliance with the machinery directive to be prepared by the machine manufacturer.

### Siemens system advantages

- Faster fault diagnostics and rectification for increased productivity
- Easier handling due to uniform operating concept
- Minimized downtimes and accelerated workflows due to integrated safety functions

## Mounting and commissioning

### Requirements

The risk analysis shows which components are required for the protection of hazardous areas. A proof of safety is required for the machine's CE marking.

### Siemens system advantages

- Space-, time- and cost-saving assembly due to the integration of safety technology in standard automation
- Faster commissioning due to comprehensive diagnostics as well as prewired and certified components

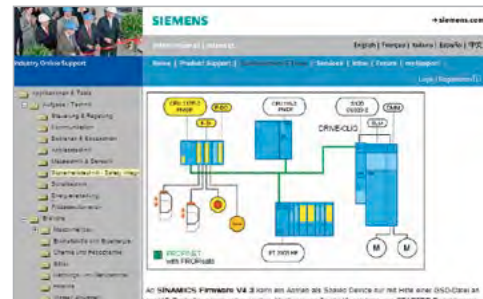
# Service & support



## Easy download of catalogs and information material

All current catalogs, customer magazines, brochures, demo software and special offers as well as our "Safety Integrated" catalog are available for download from our Information and Download Center.

[siemens.com/safety-infomaterial](http://siemens.com/safety-infomaterial)



## Functional examples

Application-oriented functional examples covering typical requirements in the field of industrial safety technology are available on the Internet. They comprise safety functions with product examples, including wiring plan, programming code and assessment in accordance with IEC 62061 and ISO 13849.

[siemens.com/safety-functional-examples](http://siemens.com/safety-functional-examples)

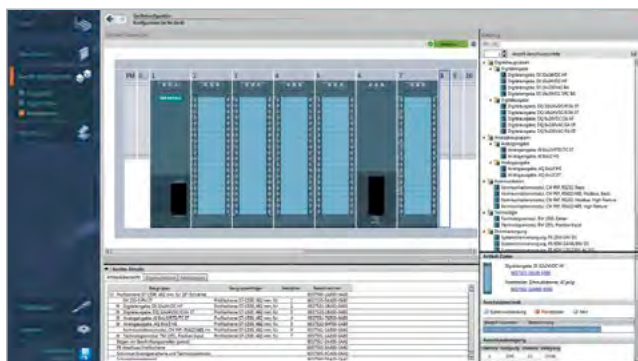
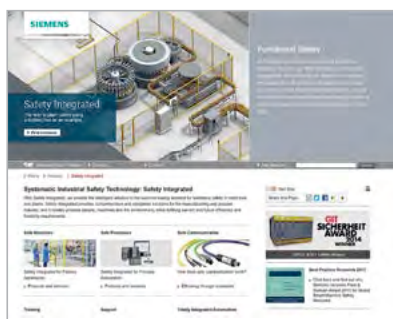
Examples of some common applications:  
[www.siemens.com/safety-applications](http://www.siemens.com/safety-applications)

## Newsletter

Always up-to-date: Our regular newsletter provides you with information on safety technology.

Simply register at:  
[siemens.com/safety-integrated](http://siemens.com/safety-integrated)

→ Newsletter



## Configurators for ease of handling

Easy compilation of products and systems: Our various configurators, including the TIA Selection Tool, can be called up via:  
[www.siemens.com/tia-selection-tool](http://www.siemens.com/tia-selection-tool)


For a complete overview of our configurators, visit:  
[www.siemens.com/industrymall](http://www.siemens.com/industrymall)



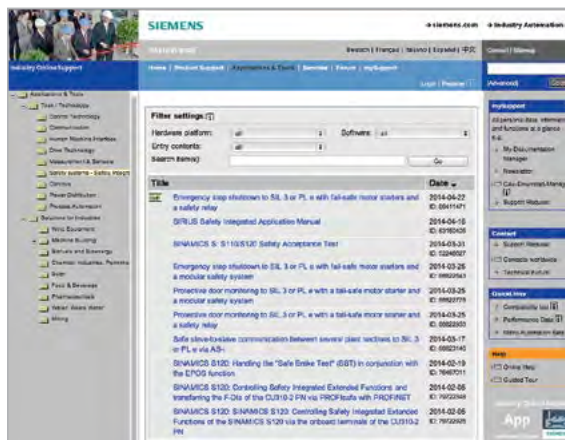
## Online ordering

24/7 access to a comprehensive information and ordering platform for products and systems from our safety technology portfolio? Comprehensive information on our complete portfolio? Product selection, delivery status tracking and comprehensive service, support and training information? All this can be conveniently found in our Mall at:

[www.siemens.com/industrymall](http://www.siemens.com/industrymall)



To product overview



## Online support

Documentation, applications, functional examples, FAQs and software updates, Online Support Request and Technical Forum – all available via:

<http://support.automation.siemens.com>

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Competent support with technical questions and information on spare parts, repairs and service contracts is available via:

Tel.: +49 180 50 50 222\*

Fax: +49 180 50 50 223

The experts of our Technical Assistance will be particularly pleased to help you with any questions pertaining to industrial controls:

**Personally from Monday to Friday, 8.00 am to 5.00 pm (CET)**

Tel.: +49 911 895 5900\*

E-mail:

[technical-assistance@siemens.com](mailto:technical-assistance@siemens.com)

Fax:

+49 911 895 5907

## Functional safety services

We support you with the implementation of risk assessments, with SIL / PL verification or with the programming and testing of safety functions.  
Contact: [safety-services.industry@siemens.com](mailto:safety-services.industry@siemens.com)

## Professional on-site support: Solution Partners

To master the increasing requirements in the field of safety technology, Siemens also relies on selected "Siemens Solution Partners Automation". These highly qualified partner companies provide professional consulting services and effective support for all relevant safety aspects of your automation projects.

[www.siemens.com/automation/solutionpartner](http://www.siemens.com/automation/solutionpartner)



## Training

Risk assessment, standards, CE marking, product training: More information on our comprehensive SITRAIN training program is available on the Internet at:

[www.siemens.com/sitRAIN-safetyintegrated](http://www.siemens.com/sitRAIN-safetyintegrated)

Or contact us personally via:

**Information hotline:**



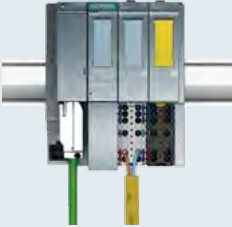


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Fax:



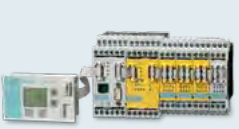



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\* 0.14 €/min. from German landline network, deviating mobile communications prices possible






## Detecting

|  | Detecting  |  |   |  |   |
|--|--|--|---|--|---|
|  |   |   |                                       |   |    |
| <b>Products</b>                        | SIRIUS position switches with separate actuator, without and with interlocks, hinge switches, non-contact safety switches (RFID) and magnetically-operated switches  | SIRIUS commanding and signaling devices, EMERGENCY-STOP, cable-operated switches, two-hand operation consoles, signaling columns and integrated signal lamps | SIMATIC AS-i F-Link safety-related AS-i Link for PROFINET and PROFIBUS  | SIMATIC mobile panel 277F IWLAN, SIMATIC key panel   | SIRIUS safety relays<br>1) 3SK1 safety relays<br>2) 3TK28 standstill monitor<br>3) 3TK28 speed monitor  |
| <b>Approval (max.)</b>                 |  |  |   |  |   |
| IEC 62061 (IEC 61508)                  | Up to SIL 3  | Up to SIL 3  | Up to SIL 3   | Up to SIL 3  | Up to SIL 3   |
| ISO 13849-1                            | Up to PL e   | Up to PL e   | Up to PL e  | Up to PL e   | Up to PL e  |
| Others                                 |  |  | NFPA 79, NRT-listed   |  | NFPA 79, NRTL-listed  |
| <b>Application / safety functions</b>  | <p><b>Position switches:</b><br/>For mechanical monitoring on protective equipment, protective doors or protective flaps; for accurate position scanning</p> <p><b>Non-contact safety switches:</b><br/>For position monitoring of movable protective equipment; position monitoring of rotatable, laterally movable or removable protective equipment with encoded actuator</p> | E-STOP applications in the production and process industry; state signaling on machines and systems  | Safe gateway for transfer of ASIsafe signals to the PROFIsafe telegram for safety applications in production automation | <p><b>Mobile panels:</b><br/>Machine-level operation and monitoring of production systems with safety-critical applications, realization of safety-relevant tasks, e.g. fault rectification in running systems.</p> <p><b>Safety functions:</b></p> <ul style="list-style-type: none"> <li>• E-STOP button</li> <li>• 2 acknowledgement buttons</li> <li>• Transponder identification and distance measuring for safe registration and operation</li> </ul> <p><b>Key Panels:</b></p> <ul style="list-style-type: none"> <li>• Freely configurable digital I/Os</li> <li>• Fail-safe version for the connection of E-STOP buttons, acknowledgement buttons or for the detection of other fail-safe signals</li> <li>• Connection and communication via PROFINET</li> </ul> <p><b>Engineering:</b></p> <ul style="list-style-type: none"> <li>• Safety Advanced for STEP 7 V12 SP1 or higher in the TIA Portal</li> <li>• Distributed Safety for STEP 7 V5.5</li> </ul> | <p>1) Monitoring of protective equipment, e.g. E-STOP commanding devices, position switches and non-contact sensors:</p> <ul style="list-style-type: none"> <li>• Modularly expandable system for additional sensor and actuator inputs</li> <li>• Easy connection of SIRIUS 3RM1 motor starters to 3SK1 via device connectors</li> </ul> <p>2) Safe standstill monitoring: Motor standstill monitoring without sensors</p> <p>3) Safe speed monitoring:</p> <ul style="list-style-type: none"> <li>• 3 parameterizable limit values for standstill, setup speed and automatic speed</li> <li>• Optional connection of various sensors and encoders</li> <li>• Integrated protective door monitoring</li> </ul> |
| <b>Fail-safe communication options</b> | AS-Interface (ASIsafe)   | AS-Interface (ASIsafe)   | AS-Interface (ASIsafe) and PROFIBUS or PROFINET with PROFIsafe  | PROFINET with PROFIsafe profile, IWLAN with PROFIsafe  |   |

## Evaluating

|   |  |  |   |  |   |
|---|--|--|---|--|---|
|   |   |   |   |   |    |
| SIMOCODE pro 3UF7 motor management system with fail-safe DM-F local or PROFIsafe expansion modules  | ASIsafe<br>1) Safe input modules<br>2) MSS ASIsafe<br>3) Safe AS-i outputs   | SIRIUS 3RK3 modular safety system  | SIMATIC fail-safe controllers   | SIMATIC fail-safe and highly available controllers   | SIMATIC I/O   |
| Up to SIL 3   | Up to SIL 3  | Up to SIL 3  | Up to SIL 3   | Up to SIL 3  | Up to SIL 3   |
| Up to PL e  | Up to PL e   | Up to PL e   | Up to PL e  | Up to PL e   | Up to PL e  |
| NFPA 79, NRTL-listed, IEC 61511   | NFPA 79, NRTL-listed   | NFPA 79, NRTL-listed   | NFPA 79, NFPA 85, NRTL-listed, IEC 61511  | NFPA 79, NFPA 85, NRTL-listed, IEC 61511   | NFPA 79, NFPA 85, NRTL-listed, IEC 61511  |
| <p>Motor management with integrated safety functions for process automation:</p> <ul style="list-style-type: none"> <li>• Safe motor disconnection</li> <li>• Fail-safe digital module DM-F Local: For safe disconnection via hardware signal; 2 relay enabling circuits, joint switching; 2 relay outputs, fail-safe disconnected common potential; inputs for sensor circuit, start signal, cascading and feedback circuit</li> <li>• Fail-safe digital module DM-F PROFIsafe: For safe disconnection via PROFIBUS/PROFINET; 2 relay enabling circuits, joint switching; 2 relay outputs, fail-safe disconnected common potential; 1 input for feedback circuit; 3 binary standard inputs</li> <li>• Setting of safety functions directly on the DM-F Local or in STEP 7 (DM-F PROFIsafe)</li> </ul> <p><b>Engineering:</b></p> <ul style="list-style-type: none"> <li>• via TIA Portal</li> <li>• via SIMOCODE ES</li> </ul> | <p>1) Interlinking of safety switches and safety sensors via safe AS-i bus</p> <p>2) All safety applications in the field of production automation:</p> <ul style="list-style-type: none"> <li>• Monitoring and evaluation of safe signals via AS-i, incl. disconnection on 2–50 independent enabling circuits</li> <li>• Optional control of safe AS-i outputs for the safe disconnection of motors or load feeders</li> <li>• Safe direct data exchange and coupling of ASIsafe networks independently of PROFIsafe</li> </ul> <p>3) Safe distributed disconnection of motors and drives via AS-i</p> <p><b>Engineering:</b></p> <ul style="list-style-type: none"> <li>• Integration in the TIA Portal</li> </ul> | <p>Modular, parameterizable safety system for all safety applications in the field of production automation:</p> <ul style="list-style-type: none"> <li>• Safe evaluation of mechanical and electro-sensitive protective equipment</li> <li>• Integrated diagnostics function</li> <li>• Integrated signal test and discrepancy time monitoring</li> <li>• Easy realization of safety functions on the basis of prefabricated function blocks</li> <li>• Connection of safety sensors and safe actuators also via AS-i</li> <li>• Optional safe direct data exchange via AS-i</li> </ul> <p><b>Engineering:</b></p> <ul style="list-style-type: none"> <li>• Parameterization via MSS ES</li> <li>• Integration in the TIA Portal</li> </ul> | <p>Scalable, fail-safe controllers:</p> <ul style="list-style-type: none"> <li>• Modular controllers: CPU 1516F/1518F CPU 315F/317F/319F CPU 414F/416F ET 200F-CPU for ET 200S and ET 200pro</li> <li>• Technology controllers with motion control: CPU 317TF-3PN/DP</li> <li>• PC-based automation: Software controllers, embedded controllers, IPCs</li> </ul> <p><b>Safety functions:</b></p> <ul style="list-style-type: none"> <li>• Integrated diagnostics</li> <li>• Co-existence of standard and fail-safe programs in one CPU</li> </ul> <p><b>Engineering:</b></p> <ul style="list-style-type: none"> <li>• Safety Advanced for STEP 7 in TIA Portal</li> <li>• Distributed Safety for STEP 7 V5.5 with F-FBD and F-LAD as well as integrated library with TÜV-certified safety blocks</li> <li>• Optional: Library with function blocks for presses</li> </ul> | <p>Modular power controllers for the medium to top performance range:</p> <ul style="list-style-type: none"> <li>• CPU S7 400 H</li> <li>• Loadable function blocks, function application groups (isochronous)</li> </ul> <p><b>Safety functions:</b></p> <ul style="list-style-type: none"> <li>• Integrated signal test and discrepancy time monitoring</li> <li>• One distributed I/O system with standard and fail-safe input and output modules</li> <li>• Configuration of signal test and discrepancy time visualization with STEP 7</li> </ul> <p><b>Engineering:</b></p> <ul style="list-style-type: none"> <li>• Safety Advanced for STEP 7 in TIA Portal</li> <li>• Distributed Safety for STEP 7 V5.5</li> </ul> | <p>Scalable and redundant I/O systems:</p> <ul style="list-style-type: none"> <li>• ET 200SP</li> <li>• ET 200S</li> <li>• ET 200M</li> <li>• ET 200pro</li> <li>• ET 200eco</li> <li>• ET 200iSP</li> </ul>          |
| PROFIBUS and PROFINET with PROFIsafe profile  | AS-Interface (ASIsafe)   | Diagnostics via PROFIBUS, AS-Interface (ASIsafe)   | • PROFINET with PROFIsafe, IWLAN with PROFIsafe   | PROFINET with PROFIsafe  | <ul style="list-style-type: none"> <li>• PROFIBUS with PROFIsafe profile: All systems</li> <li>• PROFINET with PROFIsafe Profile: ET 200S, ET 200M, ET 200SP, ET 200pro (IWLAN interface module available)</li> </ul> |

## Reacting

|  |   |   |   |   |   |
|--|---|---|---|---|---|
|  |    |    |   |    |    |
| <b>Products</b>                        | SIRIUS 3RM1 motor starters  | Motor starters for: <ul style="list-style-type: none"> <li>ET 200S (IP20)</li> <li>ET 200pro (IP65)</li> </ul>  | Frequency converters <ol style="list-style-type: none"> <li>1) SINAMICS G120C</li> <li>2) SINAMICS G120</li> <li>3) SINAMICS G120D</li> <li>4) SINAMICS G110M</li> </ol>  | Frequency converters SINAMICS G130<br>SINAMICS G150   | SINAMICS S110 positioning drive   |
| <b>Approval (max.)</b>                 |   |   |   |   |   |
| IEC 62061 (IEC 61508)                  | Up to SIL 3   | Up to SIL 3   | Up to SIL 2   | Up to SIL 2   | Up to SIL 2   |
| ISO 13849-1                            | Up to PL e  | Up to PL e  | Up to PL d; Cat. 3  | Up to PL d; Cat. 3  | Up to PL d; Cat. 3  |
| Others                                 |   | NFPA 79, NRTL-listed  |   |   |   |
| <b>Application / safety functions</b>  | <p>All safety applications in the field of production automation and drive tasks for motors up to approx. 3 kW, e.g. conveyor technology, lifting drives, machine tools and production machines:</p> <ul style="list-style-type: none"> <li>Starting and reversing as well as safe disconnection with durable and energy-efficient hybrid switching technology</li> <li>Integrated ATEX-certified overload protection with flexible wide setting range</li> <li>Optional short-circuit protection up to 55 kA with SIRIUS circuit breakers</li> <li>Direct-on-line and reversing starter versions with screw-type and spring-loaded connection system</li> <li>Narrow design with 22.5 mm width</li> <li>Eased connection to SIRIUS 3SK1 safety relays via device connectors</li> <li>Easy realization of group assemblies by means of special infeed system</li> </ul> | <p>All safety applications in the field of production automation and distributed drive tasks, e.g. conveyor technology and lifting drives:</p> <ul style="list-style-type: none"> <li>Starting and safe disconnection with conventional and electronic switching technology</li> <li>Integrated motor protection</li> <li>Safe selective disconnection (ET 200S)</li> <li>All system advantages of SIMATIC ET 200S and SIMATIC ET 200pro</li> </ul> <p><b>Engineering:</b></p> <ul style="list-style-type: none"> <li>Safety Advanced for STEP 7 in TIA Portal</li> <li>Distributed Safety for STEP 7 V5.5</li> </ul> | <ol style="list-style-type: none"> <li>1) Compact frequency converters for applications from 0.37 – 18.5 kW</li> <li>2) Modular frequency converters for applications from 0.37 – 250 kW</li> <li>3) Distributed frequency converters in high degree of protection (IP65) for applications from 0.75 – 7.5 kW</li> <li>4) Distributed motor-mounted converters (IP66) for applications from 0.37 to 4 kW</li> </ol> <p>The SINAMICS G120 devices are employed for the speed-variable operation of asynchronous motors in conveyor technology, pumps, fans and compressors as well as other power units, e.g. extruders.</p> <p><b>Integrated safety functions:<sup>1)</sup></b></p> <ul style="list-style-type: none"> <li>Safe torque off</li> <li>Safe stop 1</li> <li>Safely limited speed</li> <li>Safe direction of motion</li> <li>Safe speed monitoring</li> <li>Safe brake control</li> </ul> | <p>Frequency converters for speed-variable single drives from 75 to 2700 kW, e.g. pumps, fans, compressors, conveyor belts, extruders, agitators, mills.</p> <p><b>Integrated safety functions:</b></p> <ul style="list-style-type: none"> <li>Safe torque off</li> <li>Safe stop 1</li> <li>Safe brake control</li> <li>Safely limited speed<sup>2)</sup></li> <li>Safe direction of motion<sup>2)</sup></li> <li>Safe speed monitoring</li> </ul> | <p>Single-axis servo drive for simple positioning applications with synchronous/asynchronous motors with power ratings from 0.12 to 90 kW.</p> <p><b>Integrated safety functions:</b></p> <ul style="list-style-type: none"> <li>Safe torque off</li> <li>Safe stop 1 and 2</li> <li>Safe operating stop</li> <li>Safely limited speed<sup>2)</sup></li> <li>Safe direction of motion<sup>2)</sup></li> <li>Safe speed monitoring<sup>2)</sup></li> <li>Safe brake control</li> </ul> |
| <b>Fail-safe communication options</b> |   | <ul style="list-style-type: none"> <li>Solution PROFIsafe: PROFIBUS/PROFINET with PROFIsafe profile</li> <li>Solution Local: On-site safety application</li> </ul>  | PROFIBUS/PROFINET with PROFIsafe profile  | PROFIBUS/PROFINET with PROFIsafe profile  | PROFIBUS/PROFINET with PROFIsafe profile  |

<sup>1)</sup> Integrated safety functions can be realized without sensors<sup>2)</sup> Integrated safety functions can be realized with or without sensors

## Reacting

|  |  |  |   |
|--|--|--|---|
|   |   |    |    |
| 1) SINAMICS S120 drive system<br>2) S120M distributed servo drive<br>3) SINAMICS S150 cabinet unit   | SINUMERIK 840D sl machine tool control   | SINUMERIK 828D machine tool control  | SIDOOR ATD400W door management  |
| Up to SIL 2  | Up to SIL 2  | Up to SIL 2  |   |
| Up to PL d; Cat. 3   | Up to PL d; Cat. 3   | Up to PL d; Cat. 3   | Up to PL d  |
| NFPA 79, NRTL-listed <sup>3)</sup>   |  |  |   |
| 1) Modular drive system for demanding applications with continuous motion control and motion control tasks with powers from 0.12 to 6500 kW for production machines (e.g. packaging, textiles, printing, ...), presses, handling equipment, paper machines, ...<br>2) Distributed servo drive for modular machine concepts with high degree of protection IP67, e.g. for packaging, printing, glass, and textiles industry<br>3) Demanding, variable-speed single drives with high power ratings (75 to 1200 kW), such as test bays, centrifuges, cross cutters, cable winches, or conveyor belts.<br><br><b>Integrated safety functions:</b> <ul style="list-style-type: none"> <li>• Safe torque off</li> <li>• Safe stop 1 and 2</li> <li>• Safe operating stop</li> <li>• Safely limited speed<sup>2)</sup></li> <li>• Safe direction of motion<sup>2)</sup></li> <li>• Safe speed monitoring<sup>2)</sup></li> <li>• Safe brake control</li> <li>• Safe brake test</li> <li>• Safely limited position</li> <li>• Safe position</li> </ul> | Control and drive system for machine tool and production machines on the basis of the SINAMICS S120 drive system<br>Application examples: Machine tools (turning, milling, grinding, nibbling, ...)<br><br><b>Integrated safety functions:</b> <ul style="list-style-type: none"> <li>• Safe torque off</li> <li>• Safe stop 1 and 2</li> <li>• Safe acceleration monitoring</li> <li>• Safe operating stop</li> <li>• Safely limited speed</li> <li>• Safely limited position</li> <li>• Safe brake management</li> <li>• Safe brake control</li> <li>• Safe brake test</li> <li>• Safe software cams</li> <li>• Safety-related inputs/outputs</li> <li>• Safe programmable logics</li> <li>• Integrated acceptance test</li> </ul> | Control and drive system for machine tool and production machines based on SINAMICS S120 drive system<br>Application examples: Machine tools (turning, milling)<br><br><b>Integrated safety functions in connection with SINAMICS S120:</b> <ul style="list-style-type: none"> <li>• Safe torque off</li> <li>• Safe stop 1 and 2</li> <li>• Safe operating stop</li> <li>• Safely limited speed</li> <li>• Safe direction of motion</li> <li>• Safe speed monitoring</li> <li>• Safe brake control</li> </ul> | In machine tools and production machines <ul style="list-style-type: none"> <li>• Moving of doors with a door weight of up to 400 kg</li> <li>• Safe limitation of the force in direction open/close</li> </ul> |
| PROFIBUS/PROFINET with PROFI-safe profile  | PROFIBUS/PROFINET with PROFI-safe profile  |  |   |

<sup>3)</sup> Only valid for SINAMICS S120 booksize

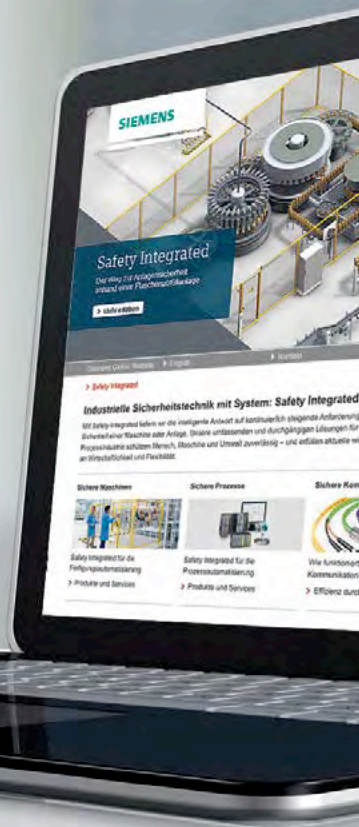
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- › Find the right safety solution in a breeze
- › Learn everything about machine safety
- › Experience safety in production and process automation

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