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The image shows a clean, modern industrial factory floor. In the center, a yellow safety cage with a metal mesh door surrounds a robotic arm. The floor is marked with black and yellow diagonal stripes. In the background, there are various industrial structures, including a large metal pillar with a 'C 10' label. The ceiling is a complex network of white metal beams and pipes.

The Fast and Easy Way to Safe Machines

Safety Integrated – Exploiting the advantages of integrated safety technology

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



“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 increasing requirements. On the one hand, this is owed to strict 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 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: These advantages include 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 receive 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**

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 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.

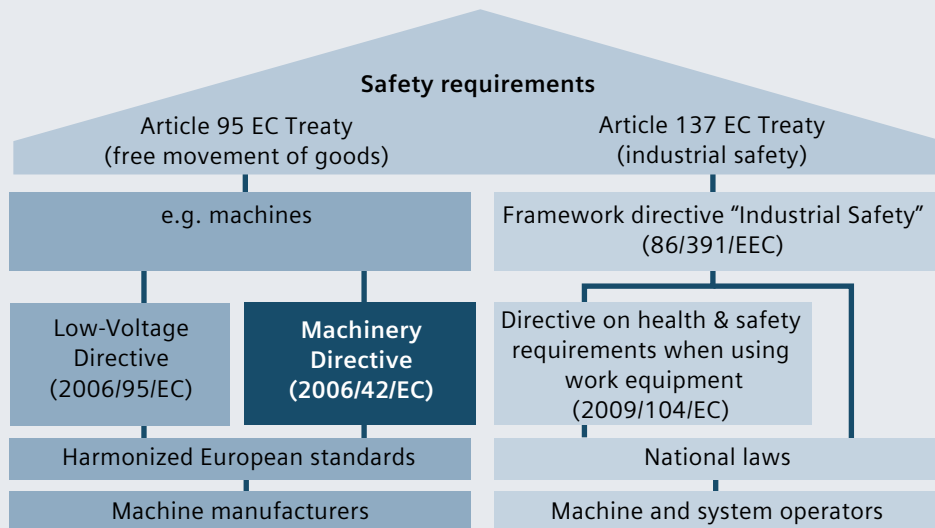
The basic requirements for machine manufacturers or system operators who significantly modernize and modify their machines themselves are laid down in corresponding European directives – for example in the machinery directives, EMC directives, etc.





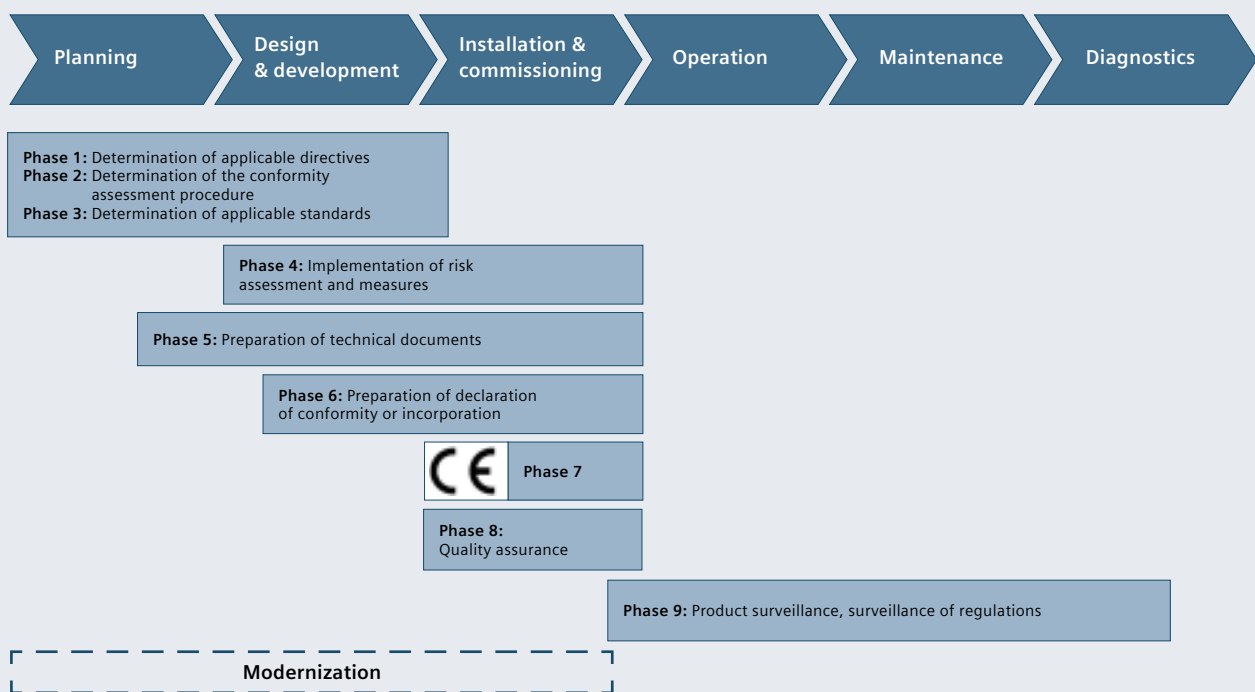
European directives for machines

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: 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.

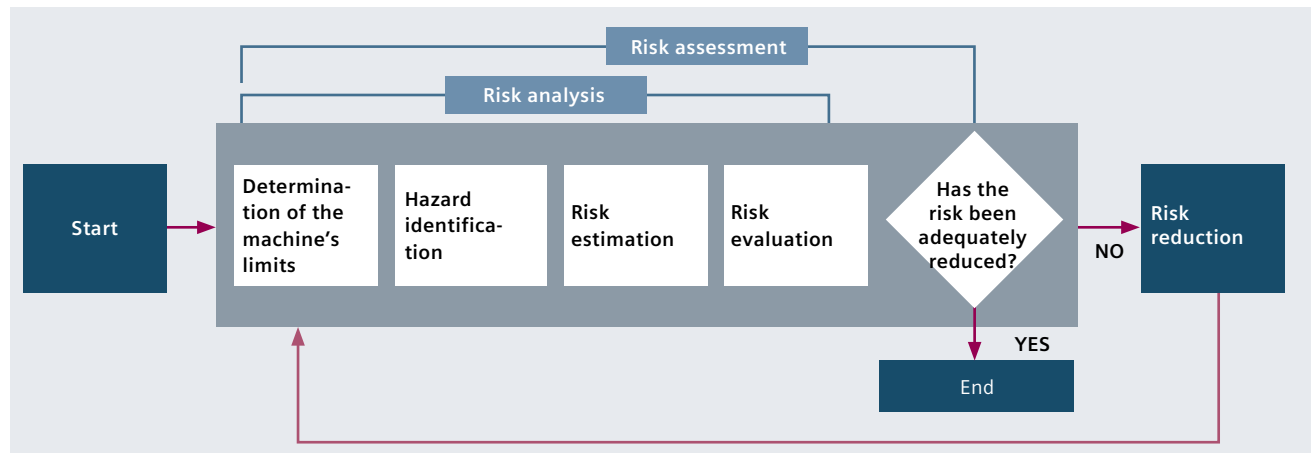
Risk assessment implementation is to be considered a design-accompanying process which is to be carried out by experts of various disciplines. In this context, the EN ISO 12100 standard offers support by description of an iterative procedure for risk assessment. Also as an example: in the US, this is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



Free "Machine safety" online training 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



2. Three levels of risk reduction

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:

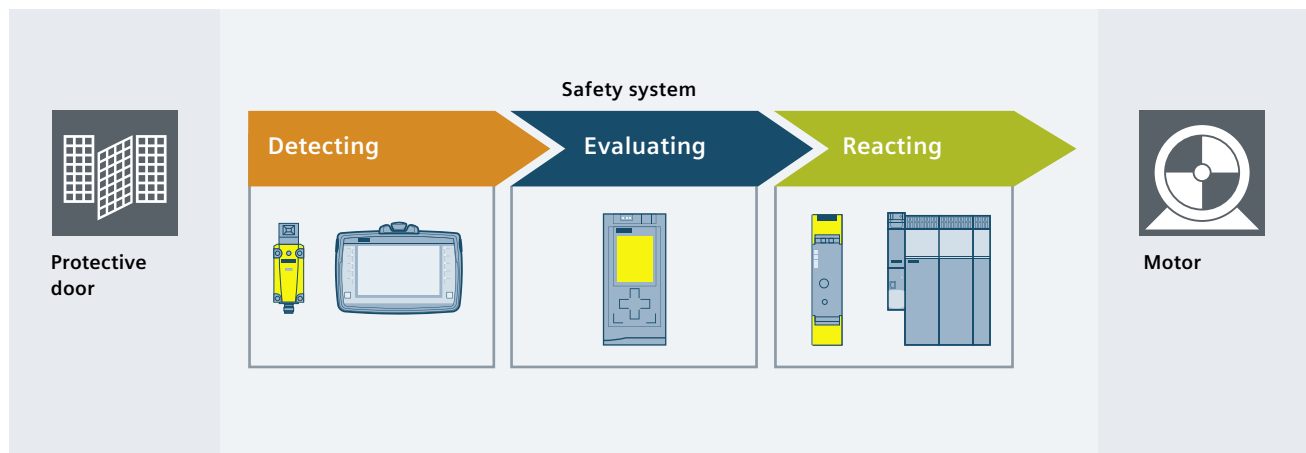
- Detecting (position switch, E-STOP, light curtain, etc.)
- Evaluating (fail-safe controller, safety relay, etc.)
- Reacting (contactor, frequency converter, etc.)

Level 3: User information on residual risks

As a matter of fact, users have to be 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

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](https://www.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](https://www.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.

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.

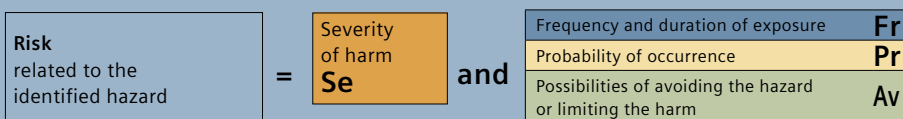
This determination is based on:

- 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.



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

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

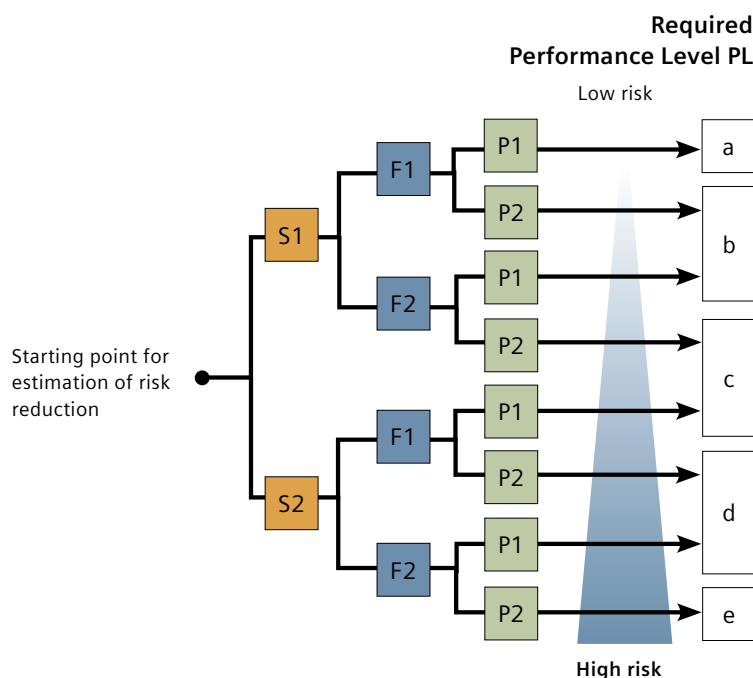
Effects	Severity of harm Se	Class $C = Fr + Pr + Av$				
		3-4	5-7	8-10	11-13	14-15
Death, loss of an eye or arm	4	SIL 2	SIL 2	SIL 2	SIL 3	SIL 3
Permanent, loss of fingers	3	Other measures			SIL 2	SIL 3
Reversible, medical treatment	2	Other measures			SIL 1	SIL 2
Reversible, first aid	1	Other measures				SIL 1

Exemplary calculation: $5 + 4 + 3 = 12$ (Class 11-13)

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

Risk estimation is based on the same risk parameters:

Risk parameters
S = 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
a, b, c, d, e = Targets of the safety-related Performance Level



Steps to be carried out by the machine manufacturer



3. Validation

Validation is important in the development of safety-related components for control systems. A validation plan should include all documents of the validation procedure, the relevant operating and environmental conditions, and the analysis and test methods applied. For this purpose, a test plan first has to be drawn up with the relevant test specification, including a detailed description of the tests, the test setup, the test environment, and the test programs and error simulations. The test plan must also include the expected results of the individual tests. The validation can start in any phase of the machine life, but must be completed before delivery or handover.

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 procedure is to ensure that the implemented safety functions make the required contribution to risk reduction to ensure that the machine is safe and remains so.

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.





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



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. The Siemens characteristic values in XML format are also available and can be downloaded from the web page of the Safety Evaluation Tool.

Further information is available at:
siemens.com/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



Calculation of SIL or PL for subsystems and the overall system



Exemplary machine with flexible, autonomous safety solution



Result report for machine documentation

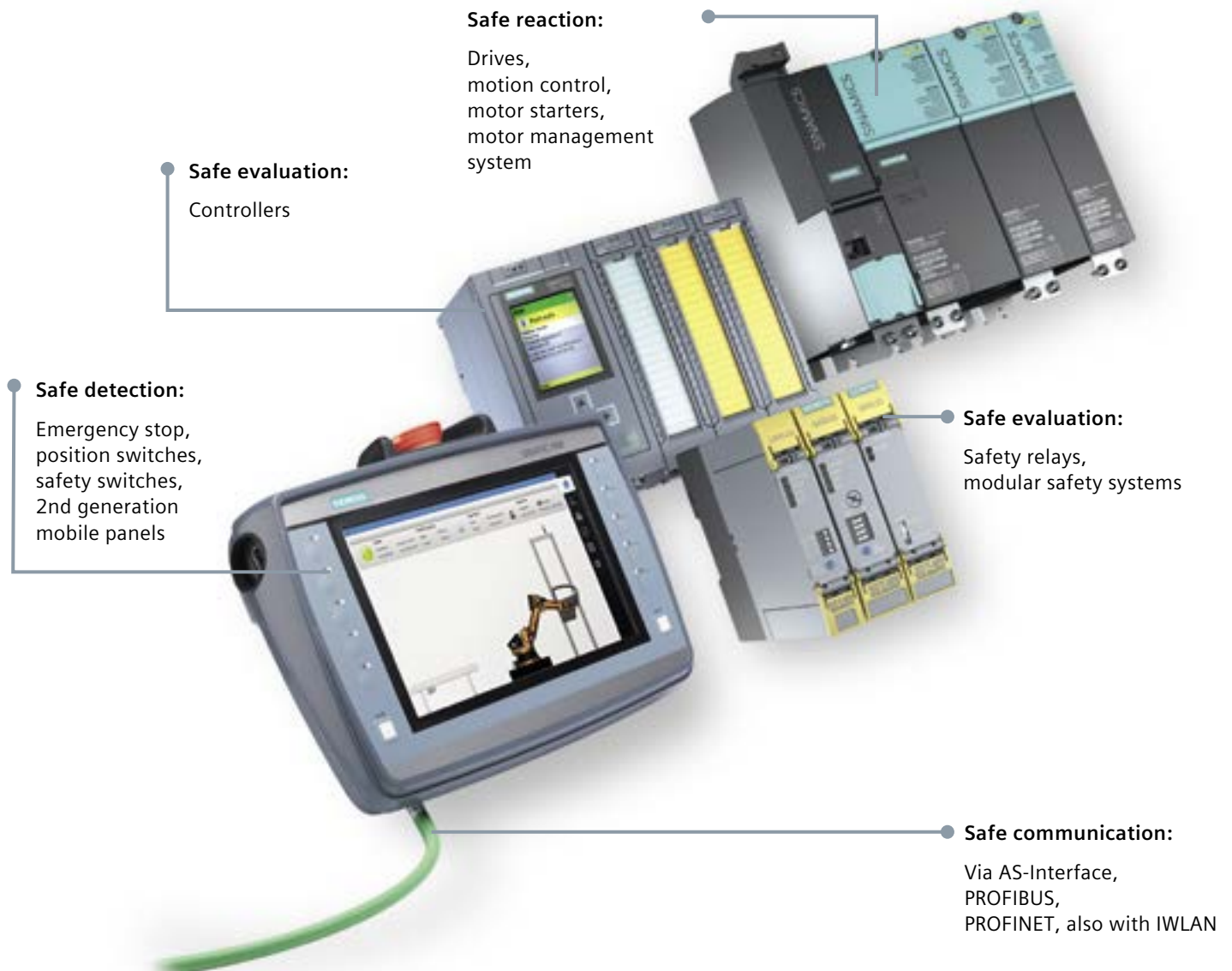
Safety Integrated: Consistent integration of safety technology in standard automation

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.





Functional safety of machines and systems: Scalable solutions

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 safety technology and intelligent motor starter connection



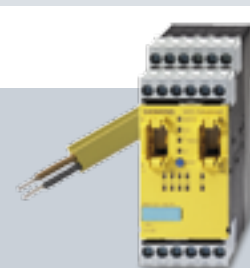
2

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

GIT
SECURITY
AWARD
2014
WINNER



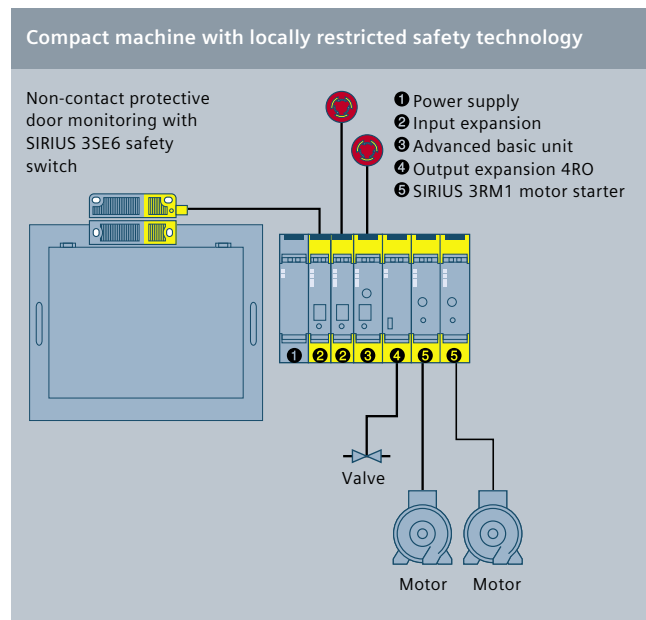
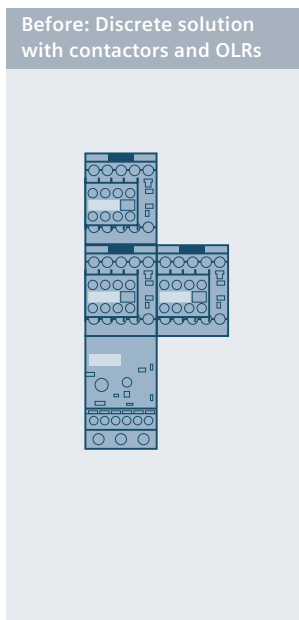
The SIRIUS 3SK1 system facilitates the easy realization of safety applications and the quick and effortless implementation of numerous applications. If the basic unit's inputs and outputs are not sufficient, the modular system can be easily expanded. The rear device connector ensures minimized wiring 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.



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

Safety functions in this example:

- ① Monitoring of protective cover
- ② Emergency stop



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.

1

3SK2 – New dimension in evaluation units opens up new possibilities



SIRIUS 3SK2 safety relays for more demanding safety applications



Simple and convenient: SIRIUS Safety ES

- Simple parameterization by drag and drop
- Engineering, commissioning, and documentation processes are fully supported by functions such as consistency check, online diagnostics, forcing, and engineering documentation

Do you want to implement more demanding safety functions with the simplicity that is typical of SIRIUS? And you need a number of safety functions that selectively shut down plant sections for your plant concept? The new 3SK2 basic units could be exactly what you are looking for. With the new software-parameterizable 3SK2 safety relays, fail-safe outputs can be switched off independently of each other. The 3SK2 devices are simple to parameterize via software. As the fail-safe outputs can be freely assigned, it is possible to parameterize which sensors act on which outputs.

Requirements

- Implementation of demanding safety applications, such as protective door with lock or muting
- Implementation of selective shutdowns using separate shutdown paths
- Simple parameterization of more demanding safety applications without the need for programming skills

Solution

- SIRIUS 3SK2 safety relays can be simply parameterized by drag and drop with certified blocks
- Device connectors save wiring between the relays and permit seamless integration of fail-safe SIRIUS 3RM1 motor starters

Advantages

- Achieve safe and productive plants quickly and easily, even for more demanding safety functions, without the need for programming skills
- Simplicity and efficiency over the entire lifecycle of a plant
- Simple and flexible expansion of applications thanks to system modularity
- Engineering, commissioning, and documentation processes are fully supported by functions such as consistency check, online diagnostics, forcing, and engineering documentation

SIRIUS Safety ES Trial Version available free of charge from:
<https://support.industry.siemens.com/cs/ww/de/ps/21192>

Further information is available from:
[siemens.com/safety-relays](https://www.siemens.com/safety-relays)



Highlights of the 3SK2 include the new protective door monitoring safety functions with lock or muting. The 3SK2 devices are parameterized with the intuitive SIRIUS Safety Software – by drag&drop. This opens up new possibilities without complicated wiring or programming. Moreover, extensive diagnostic functions reduce plant standstills.



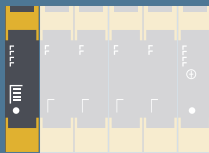
SIRIUS 3SK1

The SIRIUS 3SK portfolio provides the ideal solution for all safety applications. Simple, modular, flexible

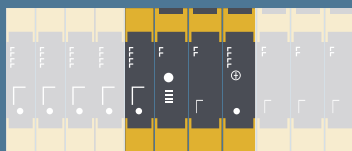
SIRIUS 3SK is a highly streamlined product portfolio. The 3SK1 range has been developed to allow fast, simple implementation of the most common safety functions.

More complex safety systems can be created using devices from the new 3SK2 series.

SIRIUS 3SK1 Standard



SIRIUS 3SK1 Advanced



Two-hand operation



Emergency stop



Light grid



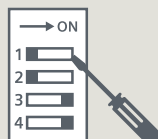
LASER
Laser scanner



Protective door

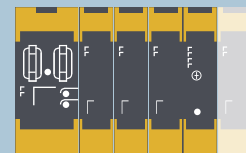


Mat



SIRIUS 3SK2

SIRIUS 3SK2



Protective door with tumbler



Muting



Independent output functions



Time-delayed disconnection



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

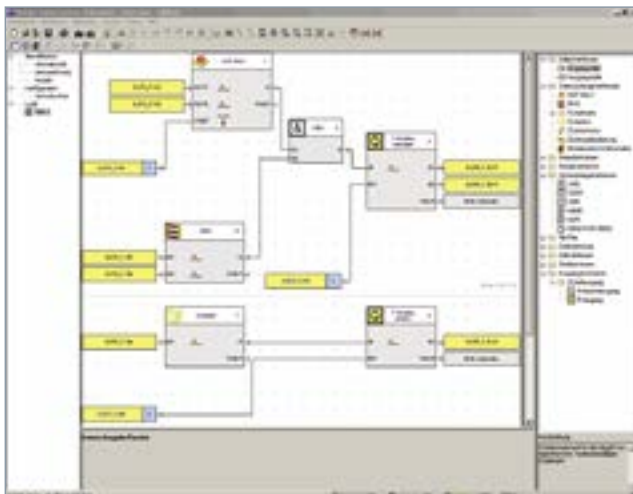
- Safe machine concepts which support flexible adjustment to specific requirements and easy configuration
- Easy, quick and cost-efficient realization of modular machine concepts
- Faster parameterization – with optional integration of diagnostics and process data in an automation system

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

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

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.

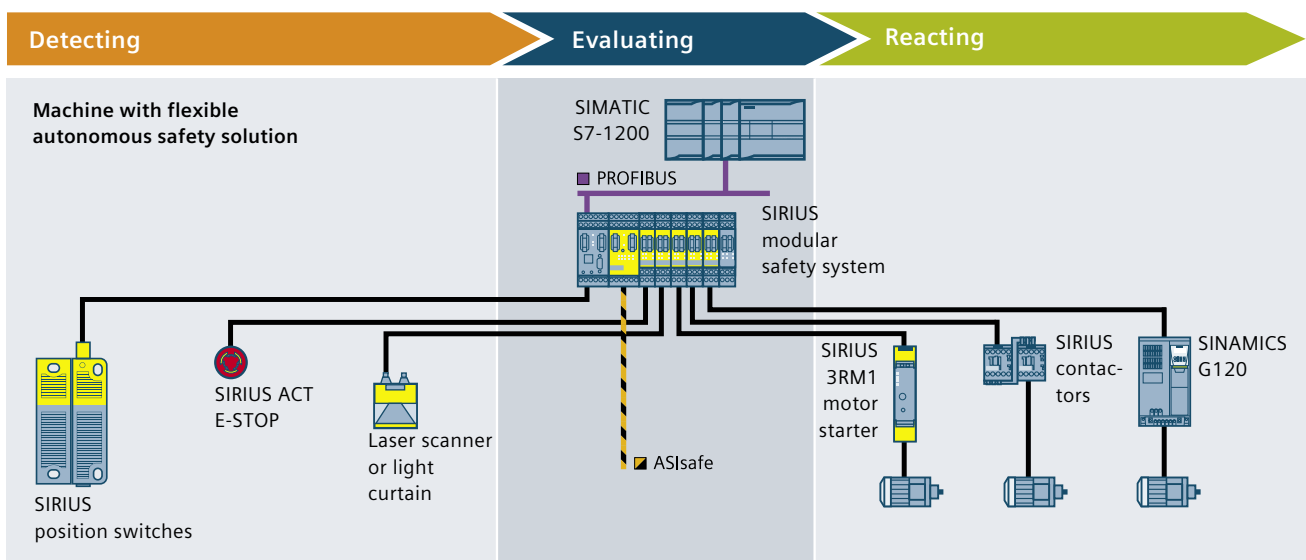


Interactive animation: Make this package unit of a filling plant safe step by step – at [siemens.com/safety-integrated](https://www.siemens.com/safety-integrated)

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 SIRIUS Safety 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 SIRIUS Safety ES software on the basis of pre-defined, 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
siemens.com/sirius-mss



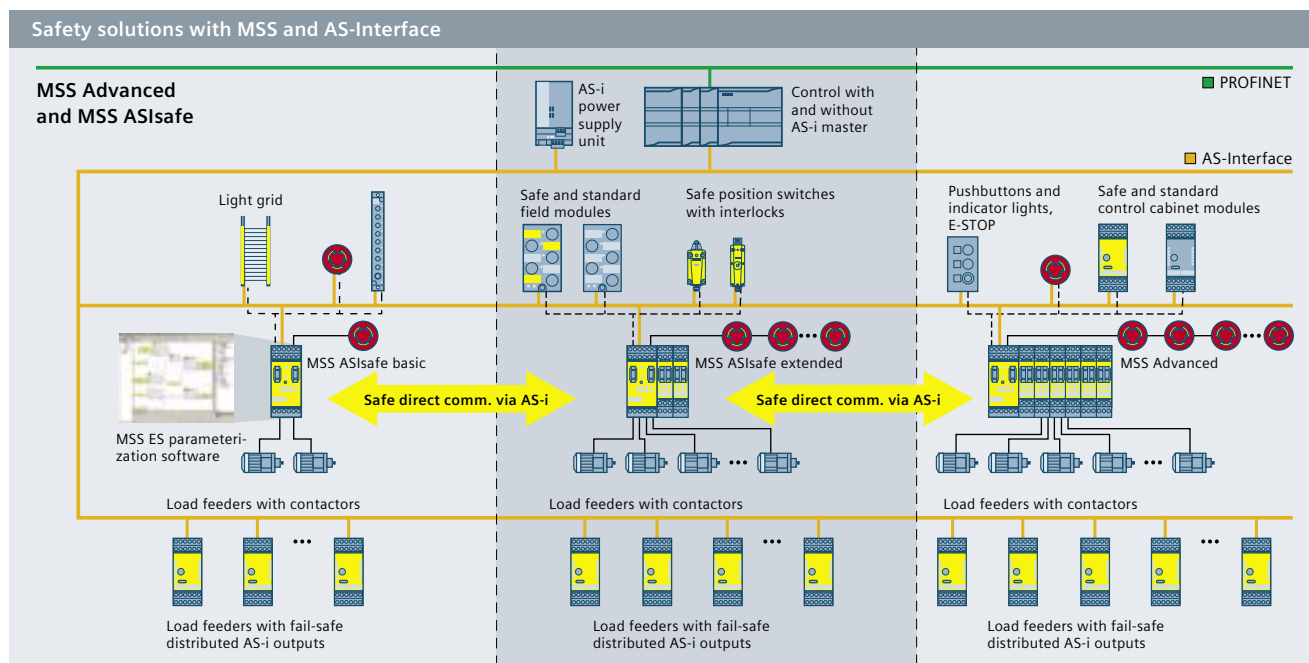
Interactive animation: Make this palletizing unit of a filling plant safe step by step – at [siemens.com/safety-integrated](https://www.siemens.com/safety-integrated)

Safety functions in this example:

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

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.



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

SIMATIC controllers with Safety Integrated offer the greatest possible integration: one controller, one communication system, and one engineering concept for standard and fail-safe automation. Ensuring efficient and reliable protection of people, machines, and the environment.

Thanks to the standardized engineering in the TIA Portal, safety-related programs can be simply ported from one SIMATIC controller to another SIMATIC controller. This saves time and reduces costs.

All SIMATIC controllers with Safety Integrated are designed for safety-related use up to SIL 3 according to EN 62061 and PL e according to ISO 13849.

Requirements

- Integration of the safety function into the automation concept
- Flexibility in the type and number of safety functions and the devices that can be connected
- Standardized engineering for standard and fail-safe automation
- Effortless but detailed diagnostics
- Remote access for diagnostic purposes (including safety)
- Protection against tampering

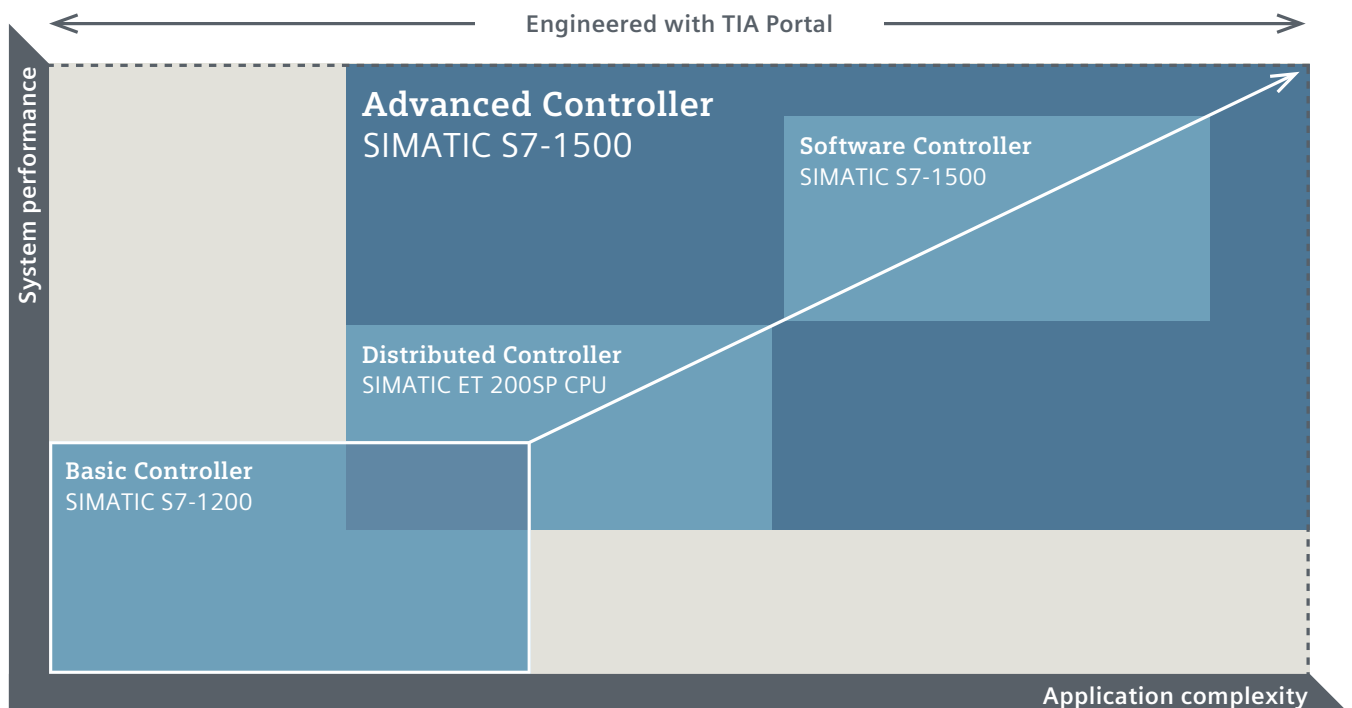
Solution

- One SIMATIC controller with Safety Integrated
 - Integrated system diagnostics
 - Web server
 - Integrated access protection
- Standard and fail-safe communication via PROFIBUS and PROFINET, as well as wirelessly via IWLAN
- Efficient engineering with the TIA Portal

Advantages

- Cost reduction and economic efficiency achieved with just a few safety functions
- Integrated solution for small to complex applications
- Better integration of the safety functions into the overall sequence of production processes
- Productivity thanks to minimized downtimes achieved by efficient fault diagnostics
- Future-proof with investment protection

Further information is available at:
siemens.com/simatic-safety





The Totally Integrated Automation Portal (TIA Portal) offers the latest software technology that reveals its true potential by means of an intuitive user interface. Thanks to the user-friendly layout and the simple navigation, the important programming and editing functions are quick and easy to understand – leaving users to concentrate fully on their engineering task.

STEP 7 Safety Advanced /STEP 7 Safety Basic

With the STEP 7 Safety Advanced or Basic option packages, users benefit from an extremely high level of convenience and integration when developing safety-related programs: All the necessary configuration and programming tools are integrated into the STEP 7 operator interface and utilize a common project structure.

With STEP 7 Safety Advanced or Basic, all the advantages of the TIA Portal can also be used for fail-safe automation:

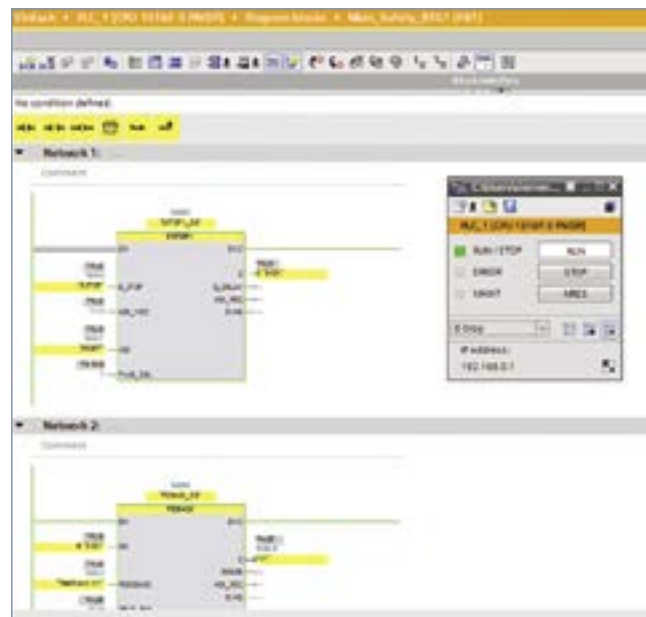
- Intuitive user interface; operating concept is identical to that used for creating standard programs for getting started
- Smart library concept simplifies validation of safety-related applications
- No separate programming of system diagnostics
- Checking and testing of the entire project, incl. safety before commissioning, by means of PLCSIM
- Trace functionality for safety-related signals, too

Further highlights:

- Certified function block library
- Change log
- Standard-compliant documentation

Testing the TIA Portal

Curious? Just try the TIA Portal.
For more information go to:
siemens.com/tia-portal



In the TIA Portal you can simulate entire programs (incl. Safety).

4

Machine with variable quantity structure and flexible requirements regarding safety functions



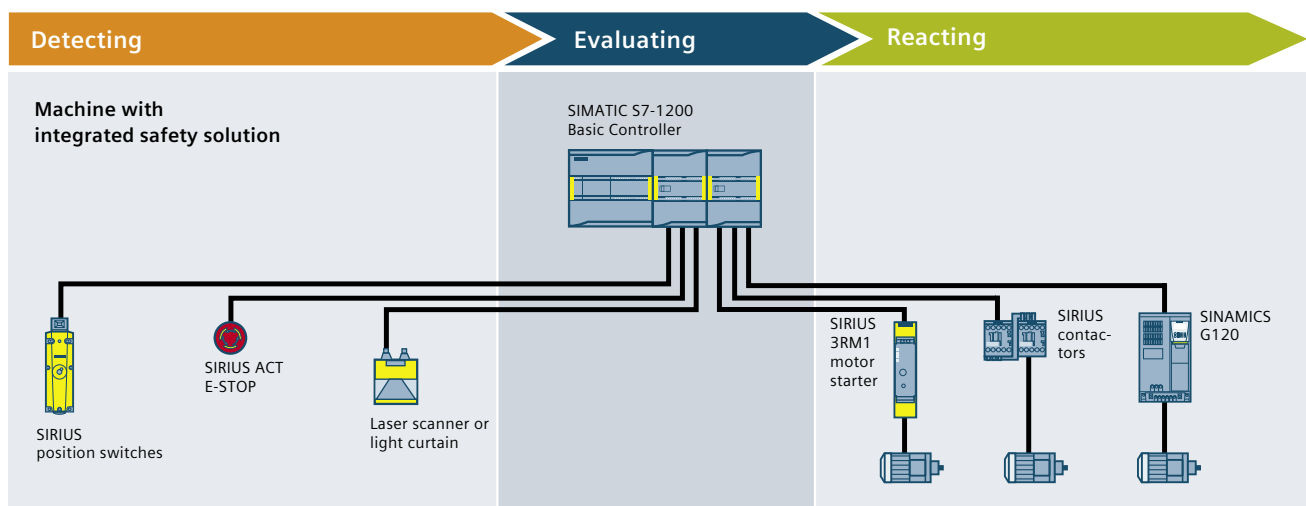
Basic Controller with Safety Integrated: SIMATIC S7-1200

SIMATIC S7-1200 Basic Controllers features an impressive array of technological functions and integrated I/Os, as well as a compact, space-saving design.

These controllers are the intelligent choice for everyday automation tasks in small projects.

The fail-safe S7-1200 CPUs with Safety Integrated can also perform monitoring of safety functions, such as protective door with lock. The fail-safe sensors and actuators are connected via fail-safe signal modules.

Further information is available at:
siemens.com/s7-1200



In addition to the “normal” control tasks, the fail-safe CPUs of the S7-1200 also perform monitoring of the safety functions (e.g. protective door). For this purpose, the sensors and actuators are read in and controlled via fail-safe I/O modules. (Connection via PROFINET/PROFIsafe is available soon.)

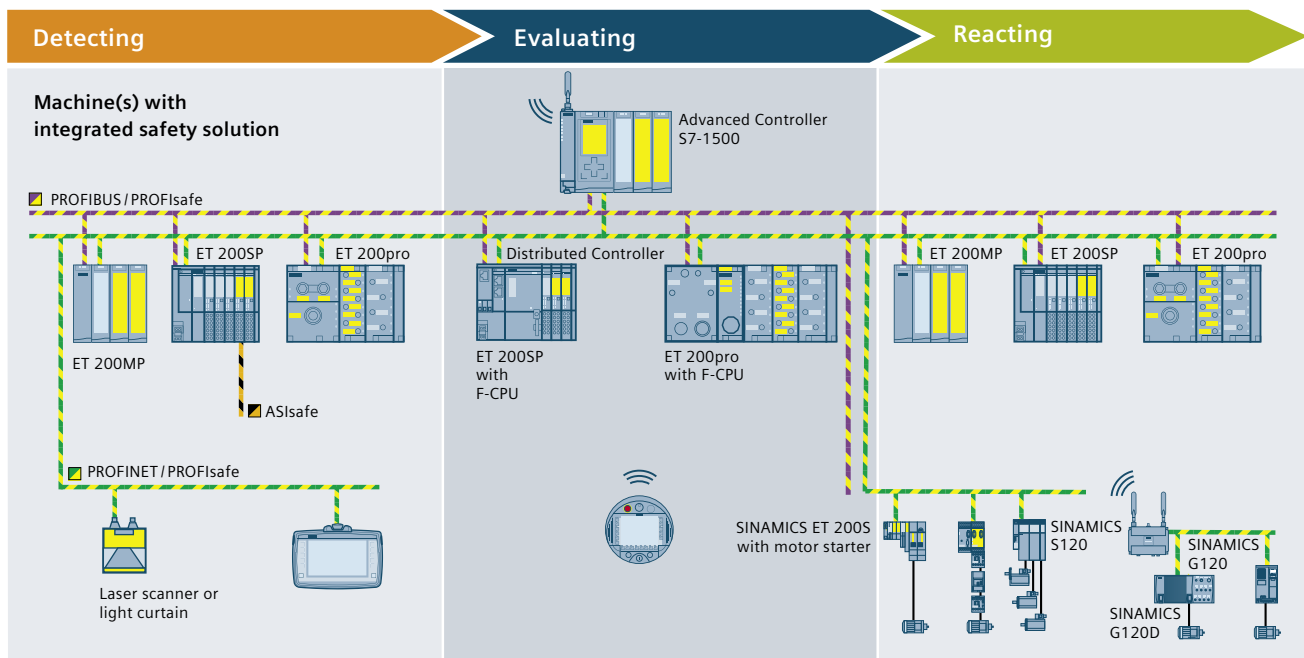


Advanced Controller with Safety Integrated: SIMATIC S7-1500

The flagship of the Advanced Controllers is the SIMATIC S7-1500. It is the current standard for the entire factory automation complex, including sophisticated safety-oriented applications. Thanks to its unrestricted scalability, SIMATIC S7-1500 is the perfect controller solution for automating everything from an individual machine to an entire plant. The fail-safe sensors and actuators can be connected as a centralized or distributed configuration via SIMATIC ET200 fail-safe signal modules. It is also possible to connect them directly via PROFINET or PROFIBUS.

- This makes flexible implementation of the safety-related functions of the SINAMICS converters (G120 and S120) possible without additional hardware costs, for example
- This also applies to other types of devices, such as laser scanners, HMI panels with emergency stop functionality, etc.
- It is possible to use Industrial Wireless LAN (PROFINET) for driverless systems (charging trucks), for example

Further information is available at:
siemens.com/s7-1500



SIMATIC Safety Integrated always provides the possibility of optimally integrating the safety functions independently of the general requirements of the automation solution. The sensors and actuators required for this can be connected via signal modules or very versatilely via PROFINET and PROFIBUS. The fail-safe communication via IWLAN permits new approaches for safe and economically efficient machines and plants.

Distributed Controller with Safety Integrated: SIMATIC ET 200SP

The SIMATIC ET 200 CPU distributed controllers combine compact design with versatility. The perfect solution in the mid-performance range for machines with distributed intelligence or series machines where little space is available. The fail-safe CPUs with Safety Integrated can also perform monitoring of safety functions, such as protective door with lock.

The fail-safe sensors and actuators are connected via fail-safe signal modules either in a centralized or in a distributed manner. The Distributed Controllers make it possible to integrate devices both via PROFINET/PROFIBUS and AS-Interface.

Further information is available at:
siemens.com/et200sp

4

Machine with variable quantity structure and flexible requirements regarding safety functions

In the control cabinet (IP20)			Without control cabinet (IP65/67)	
Scalable	Multi-channel		Multifunctional	Block
				
ET 200SP	ET 200MP		ET 200pro	ET 200eco
Multifunctional	Modular	Intrinsically-safe		
				
ET 200S	ET 200M	ET 200iSP		

Further information is available at:
siemens.com/et200

I/O systems with Safety Integrated: SIMATIC ET 200
The fail-safe I/Os from the SIMATIC ET 200 spectrum are available for cabinet mounting and for cabinet-free use – in both modular and block design.

The I/O is connected by means of PROFIsafe via PROFIBUS and/or PROFINET. Within an ET 200 station, both standard and fail-safe modules can be operated. All Safety modules are designed for safety-related use up to SIL 3 according to EN 62061 and PL e according to ISO 13849.



SIMATIC HMI Mobile Panels 2nd Generation – Power and Safety in your hands
The second generation of SIMATIC HMI Mobile Panels now offers more power, flexibility, convenience, and quality. This makes mobile operator control and monitoring even more efficient and safer.

Further information is available at:
siemens.com/hmi



Safety Integrated as an essential component of Totally Integrated Automation

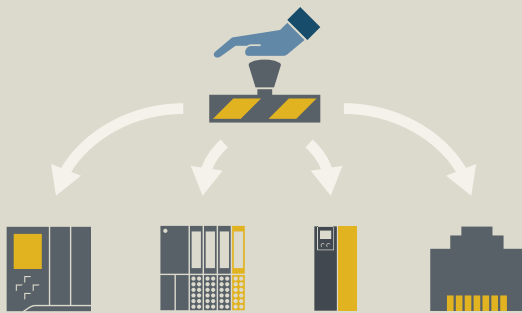
Machines have to be **safe**.
But can safety be **economical**?



Safety Integrated with Totally Integrated Automation combines **safety** with **productivity**.

Safe, fault-tolerant applications compliant with **current international** guidelines ensure **maximum process safety**.

The **safety functions** are integrated into the automation components.



Safety-related communication is achieved using standard buses



and even via WLAN.



And the **seamless integration** into the TIA Portal ensures **efficient engineering**.



Perfect protection of personnel, machinery, and the environment



Further information is available at:
siemens.com/tia-si

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.

The advantages of AS-i can also be utilized in complex safety applications. The DP/AS-i F-Link facilitates the application of AS-Interface 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 PROFIsafe protocol. As usual, the detection of safe signals is realized by means of rugged ASIsafe slaves.

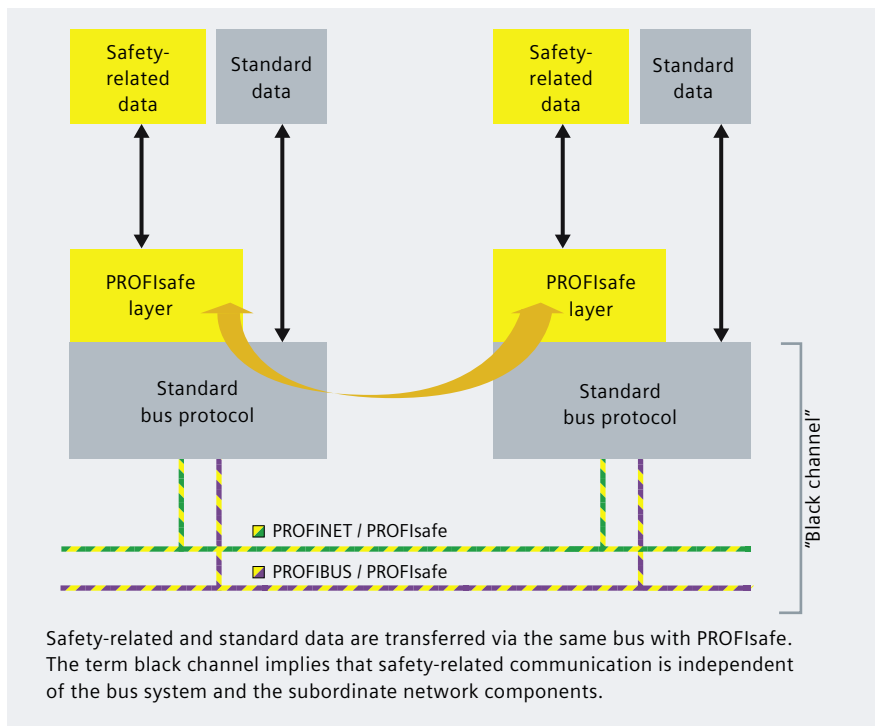
Evaluation is carried out by the available F-PLC. Actuator response is realized on the PROFIsafe level, optionally via F-DO/F-RO modules in the central rack or with the help of the fail-safe distributed I/O.



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:
www.siemens.com/industrialsecurity

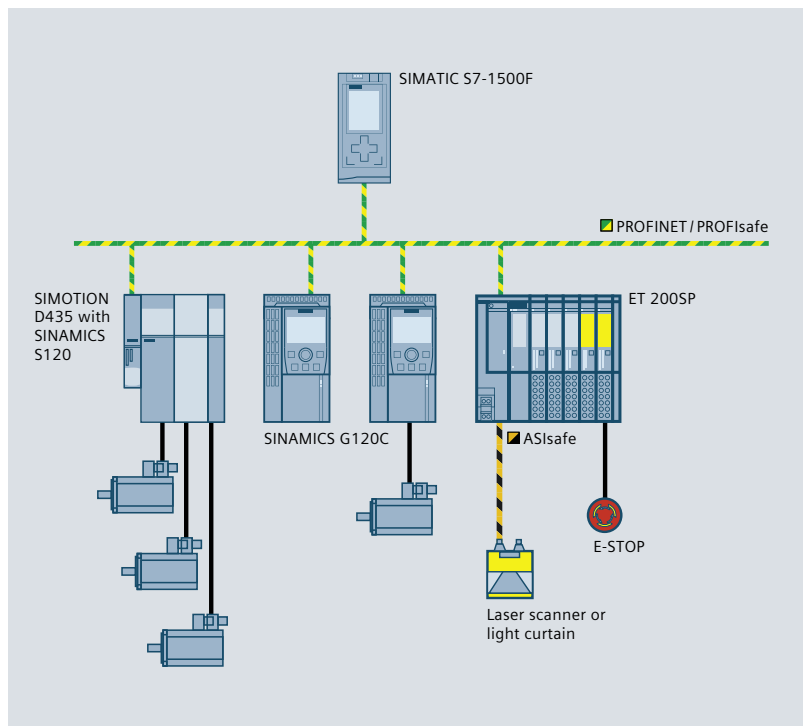
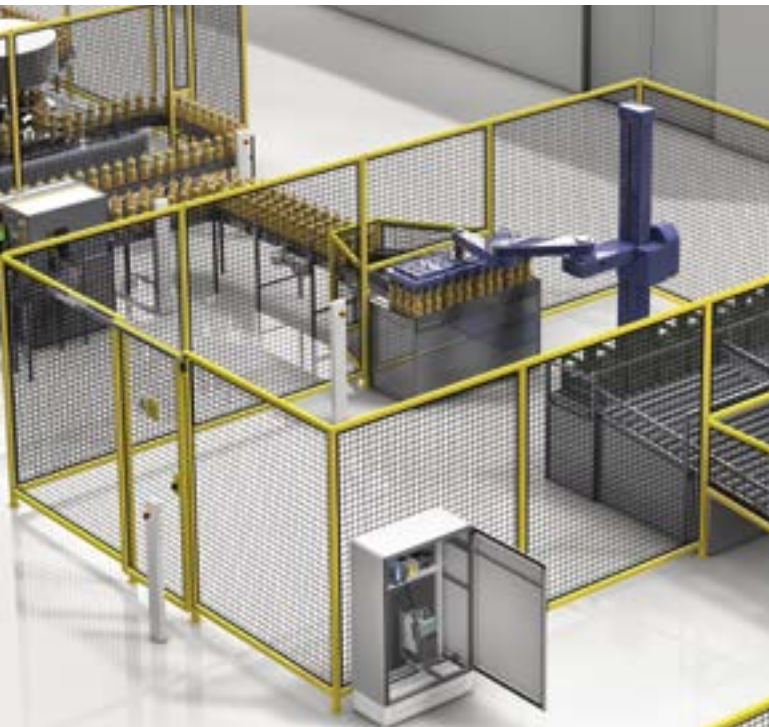




At a glance

AS-i master for SIMATIC ET 200SP (CM/F-CM AS-i Safety ST for SIMATIC ET 200SP)

- AS-i as the feeder for higher-level bus systems
- Simple integration
 - of AS-Interface devices into the SIMATIC and SINUMERIK
 - of fail-safe AS-Interface networks via PROFIsafe into SIMATIC F controllers (PROFINET/PROFIBUS)
 - into the TIA Portal/STEP 7: just one engineering framework for configuration of the controller, AS-i Master, and Safety
- Fast diagnostics: on the slave, centrally via Web server, HMI, or 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.


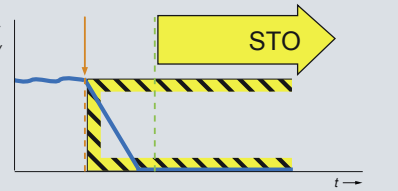
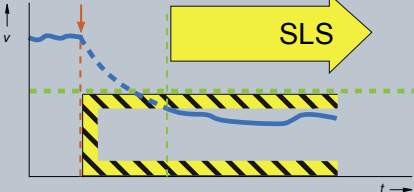
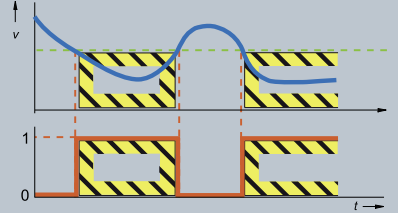
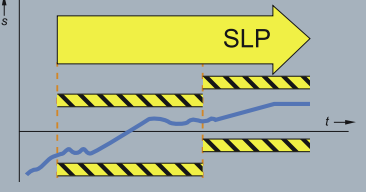

Siemens offers a comprehensive product portfolio for the efficient realization of powerful safety concepts for all application profiles.

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"> • SINAMICS G110D, G110M, • SINAMICS G120, • SINAMICS G120C, D, • SINAMICS G130/G150 	<ul style="list-style-type: none"> • SINAMICS S110, • SINAMICS S120, S120M, • SINAMICS S150, • SINAMICS SM150 	<ul style="list-style-type: none"> • SINUMERIK 828D, • SINUMERIK 840D sl

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 style="text-align: center;">STO</h3> <p>Safe torque off (STO): This function prevents any further release of a torque on the motor shaft.</p> 	<h3 style="text-align: center;">SS1</h3> <p>Safe stop 1 (SS1): 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 style="text-align: center;">SLS</h3> <p>Safely limited speed (SLS): This function monitors the drive for exceedance of one or several specified maximum speeds.</p> 	<h3 style="text-align: center;">SSM</h3> <p>Safe speed monitor (SSM): 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 style="text-align: center;">SLP</h3> <p>Safely limited position (SLP): 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 style="text-align: center;">SP</h3> <p>Safe position (SP): 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> 

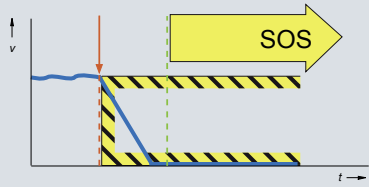


SS2

Safe stop 2 (SS2):

Like the SS1 function, this function actively brakes a drive. However, the SS2 function is activated upon standstill instead of the STO function.

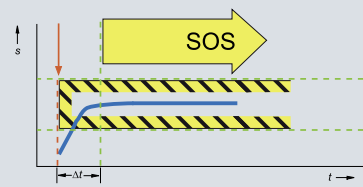
As with SS1, drives with high kinetic energy are quickly brought to standstill in case of danger.



SOS

Safe operating stop (SOS):

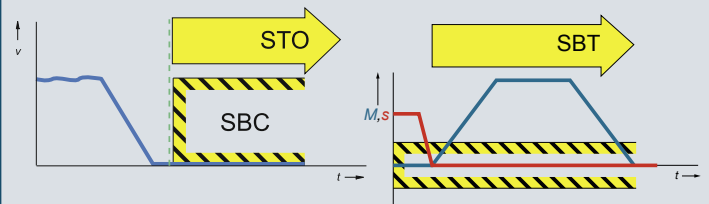
This function can be used alternatively to STO. As opposed to STO, the motor is not switched to a torque-free state, but the drive remains in position control, retains its position and is monitored for standstill.



SBC/SBT

Safe brake management:

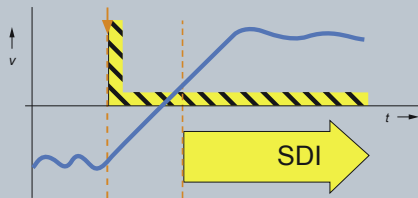
This function consists of safe brake control (SBC) and a safe brake test (SBT). The safely controlled and tested brake in connection with the safely monitored drive results in a safe holding system for anti-fall guards on vertical axes.



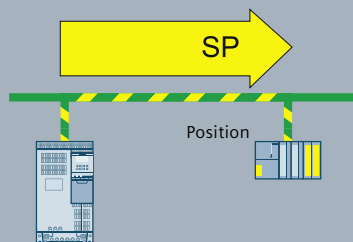
SDI

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

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
- 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

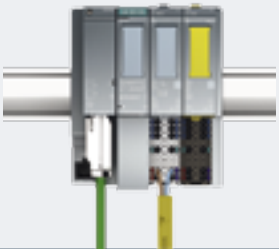
The risk analysis shows which components are required for the protection of hazardous areas. A proof of safety is required for the machine's CE marking.

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

Products for safe machines and plants

Detecting

			
Products	SIRIUS position switches with separate actuator, without and with interlocks, hinge switches, non-contact safety switches (RFID) and magnetically-operated switches	SIRIUS ACT emergency stop	SIMATIC AS-i F-Link safety-related AS-i Link for PROFINET and PROFIBUS
	www.siemens.com/sirius-detecting	www.siemens.com/sirius-act	www.siemens.com/simatic-safety-integrated
Approval (max.)			
IEC 62061 (IEC 61508)	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
Others			NFPA 79, NRTL-listed
Fail-safe communication options	AS-Interface (ASIsafe)	AS-Interface (ASIsafe)	AS-Interface (ASIsafe) and PROFIBUS or PROFINET with PROFIsafe

Evaluating

			
Products	SIRIUS 3SK safety relays	SIMOCODE pro 3UF7 motor management system with fail-safe DM-F local or PROFIsafe expansion modules	Safe ASIsafe I/O modules <ul style="list-style-type: none"> • Safe input modules • MSS ASIsafe • Safe AS-i outputs
	www.siemens.com/safety-relays	www.siemens.com/simocode	www.siemens.com/sirius
Approval (max.)			
IEC 62061 (IEC 61508)	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
Others	NFPA 79, NRTL-listed	NFPA 79, NRTL-listed, IEC 61511	NFPA 79, NRTL-listed
Fail-safe communication options		PROFIBUS and PROFINET with PROFIsafe profile	AS-Interface (ASIsafe)



- SIMATIC HMI mobile panel 277F IWLAN
- SIMATIC HMI key panel

www.siemens.com/mobile-panels

Up to SIL 3

Up to PL e

PROFINET with PROFIsafe profile, IWLAN with PROFIsafe



Interactive animation: Make a filling plant safe step by step – at siemens.com/safety-integrated



SIRIUS 3RK3 modular safety system



SIMATIC fail-safe controllers with Safety Integrated



Highly available controllers with Safety Integrated



SIMATIC I/O systems with Safety Integrated

www.siemens.com/simatic-controller

www.siemens.com/et200

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

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

Diagnostics via PROFIBUS, AS-Interface (ASIsafe)

PROFINET with PROFIsafe, IWLAN with PROFIsafe

PROFINET with PROFIsafe

PROFIBUS with PROFIsafe profile: All systems
PROFINET with PROFIsafe profile: ET 200S, ET 200M, ET 200SP, ET 200pro (IWLAN interface module available)

				
Products	SIRIUS 3RM1 motor starters	Motor starters for: ET 200S (IP20) ET 200pro (IP65)	Frequency converters • SINAMICS G120C • SINAMICS G120 • SINAMICS G120D • SINAMICS G110M	Frequency converters • SINAMICS G130 • SINAMICS G150
	www.siemens.com/motorstarter/3rm1	www.siemens.com/motorstarter	www.siemens.com/safety-drives	
Approval (max.)				
IEC 62061 (IEC 61508)	Up to SIL 3	Up to SIL 3	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
Others		NFPA 79, NRTL-listed		
Fail-safe communication options		Solution PROFIsafe: PROFIBUS/PROFINET with PROFIsafe profile Solution Local: On-site safety application	PROFIBUS/PROFINET with PROFIsafe profile	PROFIBUS/PROFINET with PROFIsafe profile

¹⁾ Integrated safety functions can be realized without sensors

²⁾ Integrated safety functions can be realized with or without sensors

SERVICE & SUPPORT








Functional examples

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

www.siemens.com/safety-functional-examples

Examples of some common applications:
www.siemens.com/safety-applications

				
SINAMICS S110 positioning drive	<ul style="list-style-type: none"> • SINAMICS S120 drive system • SINAMICS S120M distributed servo drive • SINAMICS S150 cabinet unit 	SIMOTION D motion control system	Machine tool control <ul style="list-style-type: none"> • SINUMERIK 840D sl • SINUMERIK 828D 	SIDOOR ATD401W door management
				www.siemens.com/sidoor
Up to SIL 2	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; Cat. 3	Up to PL d
	NFPA 79, NRTL-listed ³⁾			
PROFIBUS / PROFINET with PROFI-safe profile	PROFIBUS / PROFINET with PROFI-safe profile	PROFIBUS / PROFINET with PROFI-safe profile	SINUMERIK 840D sl: PROFIBUS / PROFINET with PROFI-safe profile	

³⁾ Only valid for SINAMICS S120 booksize

Online ordering

Our A&D mall has got it all covered:
www.siemens.com/industrymall

Configurators for ease of handling

Our various configurators, including the TIA Selection Tool, can be called up via:
www.siemens.com/tia-selection-tool

References

Safety Integrated in the application:
www.siemens.com/automation/references

Training

More information on our comprehensive SITRAIN training program is available on the Internet at:

www.siemens.com/sitrain-safetyintegrated

Functional safety services

Further information is available at:
www.siemens.com/safety-integrated

Solution Partners

Our highly qualified partner companies offer professional consulting and active support with all the relevant safety aspects of your automation projects:

www.siemens.com/automation/solutionpartner

Find out more:

siemens.com/safety-integrated

Systematic industrial safety technology:

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

Safety Integrated – at a glance!



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