Integrated safety technology
Integrated safety technology - why?

Today, safety on machines is limited to Emergency-stops that are wired directly to safety relays in the switching cabinet. The only possible safety reaction is switching off the machine. The future looks different: Fixed wiring will be replaced by safe data transfer via the existing machine bus system. Flexibly configured or programmed safety behavior adapts optimally to various Emergency-stop situations. Complete diagnostics of safety components via the machine bus system provides detailed data about the status of the machine.

State-of-the-art technology
The insufficiency of manipulation immunity and the inadequacy of current safety solutions encourage dangerous behavior when operating machines. 25% of all accidents in the workplace result from this situation. New safety technology possibilities provide considerable potential for improvement here. While working to improve the safety of machines, safety technology guidelines are continually updated according to the current technological situation. In this way, improvements become mandatory.

Smart safe reactions
Emergency-stop equals machine stop. Is that necessary? When opening a protective cover, it is often sufficient to reduce the speed. Smart safe reactions to various situations provide safety without stopping the production process. Emptying the machine and setting it up again are not required, the assumed required manipulation is not necessary. These are real advantages for the user that can be implemented with programmable safety behavior.

Flexibility reduces costs
Distributed I/O increases flexibility. That’s valid for standard I/O as well as for safe I/O. Integrated safety technology modules will be simply supplemented as standard I/O modules; everything else remains the same. Modular machine manufacturing is supported optimally in this way. This flexibility is also possible in the safety controller. Different machine models can be handled by programming the application as needed. Expensive adaptations are not needed, and costs are reduced.
Integrated safety technology

Open
B&R attaches great importance to POWERLINK Safety. Like all POWERLINK technologies, this is a completely open standard. Various manufacturers from different fields of automation technology have specified the concepts and requirements. The result is POWERLINK Safety, the first real-time Ethernet-based safety bus. The function blocks specified in PLCopen are the basis for safety programming. This manufacturer-independent standard continues B&R’s open concept.

Fast
A cycle time of 200 µs for SIL 3 is a new dimension for safety communication. Reaction times shrink by a factor of 10, and the advantages of hard-wired solutions are combined with the possibilities of modern, integrated and intelligent safety bus technology. POWERLINK and POWERLINK Safety accomplish this all while using standard Ethernet mechanisms. This allows these protocols to be combined with all conventional and, more importantly, newer Ethernet profiles. Currently, POWERLINK with POWERLINK Safety is being implemented on automation networks with a data range of 1 GBit/s. The wireless, safety-oriented data transfer of POWERLINK Safety using wireless LAN technologies is also possible. This makes POWERLINK Safety the fastest and most flexible real-time safety bus on the market.

Innovative
Reducing to one cable means transferring safe data using the existing infrastructure. Additional cabling of a safe line is not necessary. Transparent and non-reactive access of safe data is an integral part of non-safe machine control. Complicated communication mechanisms between safe and non-safe areas are things of the past. A smart safe reaction instead of a hard machine stop provides advantages for processes, avoids manipulations and increases the value of machines.

Uncomplicated
Simple exchange of devices, simple but safe update mechanisms or remote diagnostics for all errors - uncomplicated handling during service is the basic requirement for practical use. For this, all procedures must be protected from accidental errors and intentional manipulation. Protective measures include separate pulse outputs for each safety input, protection against mixing up safety circuits, as well as software protection using a SafeKEY.

Programming safe applications is reduced to virtually wiring certified function blocks. Implementation, testing, and commissioning - themselves complex safety procedures - are extremely simplified through this.

Integrated safety highlights
- Open standard
- Fastest real-time safety bus system on the market
- SIL 3 at bus cycle times of 200 µs
- Smart safe reactions
- No additional wiring
- Decentralized safety technology
- Fully integrated in existing topologies
- Scaleable solution for simple and complex machines
**Integrated safety technology**

Emphasis is placed on the products when it comes to integrated safety technology. That’s why X20 SafeIO modules, the integral SafeMC (safe motion control) capabilities of ACOPOS and ACOPOSmulti platforms, SafeLOGIC and the SafeDESIGNER toolset in Automation Studio catch the eye. But integrated safety technology means much more than that: It is a synonym for the way in which the safety-related components work with one another and expands the capabilities of the standard automation technology.

All products in the B&R integrated safety technology program are optimally adjusted to each other and, more importantly, to existing automation products. Compatible applications can therefore be created very easily. Elegant application solutions with integral smart safe reactions and maximum cost reductions result.

**Integrated and innovative**

- Safe and standard data transfer via the same cable
- Programming safety and standard applications with Automation Studio
- Servo drive with integrated safety functions
- Transparent data exchange
Integrated safety technology

Fast and safe
- Safe reactions as fast as hard-wired reactions
- IEC 61508, SIL 3
- EN954, CAT 4
- IEC 62061, SIL 3
- EN ISO 13849, PLe

Smart safe reactions
- Safely limited speeds, safe direction of rotation, safe operation halt, Safe Stop 1, Safe Stop 2
- Adapted responses instead of hard machine stops
- No loss of machine synchronicity
- Minimum standstill times

Open
- POWERLINK Safety for open connections
- Embedded in POWERLINK reference data
- PLCopen safety function blocks

Simple
- Decentralized, reduced wiring
- Simple installation and maintenance
- “Virtual wiring” of PLCopen safety function blocks
Safe X20 modules
SafeI/O modules from the family of modular X20 I/O systems are multi-functional. To connect safe digital sensors and actuators, one module type is available for each. Adapting to specific application requirements like multi-channel analysis, filter parameters, or specific functions for disabling OSSD output characteristics are handled using parameters in the module. This reduces the amount of required replacement parts.

Of course, SafeI/O modules are completely integrated in the X20 system family and can be used in any combination or position in the topology.

Safe input modules

<table>
<thead>
<tr>
<th>Technical data</th>
<th>X20SI4100</th>
<th>X20SI2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input channels according to IEC61131-2, Type 1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Pulse outputs</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Equivalent function for N.C. / N.C. sensor types</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Antivalent function for N.C. / N.O. sensor types</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Minimum X2X cycle time</td>
<td>200 μs</td>
<td>200 μs</td>
</tr>
<tr>
<td>Input filter</td>
<td>0 ms - 100 ms</td>
<td>0 ms - 100 ms</td>
</tr>
<tr>
<td>Spacing</td>
<td>25 mm</td>
<td>25 mm</td>
</tr>
<tr>
<td>Protection type</td>
<td>IP20</td>
<td>IP20</td>
</tr>
</tbody>
</table>

Applications
- Light curtain, laser scanner
- Emergency-stop switch
- Contactless sensors
- Operating mode selector
- Two-hand control devices
- Feedback contacts of safety relays
- Safety shutoff mats
- ACOPOS/ACOPOSmulti enable
- Safety relays
- Safety valves
- Motor holding brakes
- Safety door locking
- Compact motors
# Integrated safety technology

## Safe output modules

<table>
<thead>
<tr>
<th>Technical data</th>
<th>X20SO4120</th>
<th>X20SO2120</th>
<th>X20SO4110</th>
<th>X20SO2110</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output channels</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Rated output current per channel</td>
<td>2 A</td>
<td>2 A</td>
<td>0.5 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>Total current</td>
<td>5 A</td>
<td>4 A</td>
<td>2 A</td>
<td>1 A</td>
</tr>
<tr>
<td>Maximum OSSD low phase</td>
<td>500 µs</td>
<td>500 µs</td>
<td>500 µs</td>
<td>500 µs</td>
</tr>
<tr>
<td>Minimum X2X cycle time</td>
<td>200 µs</td>
<td>200 µs</td>
<td>200 µs</td>
<td>200 µs</td>
</tr>
<tr>
<td>Short circuit fuse</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Spacing</td>
<td>25 mm</td>
<td>25 mm</td>
<td>25 mm</td>
<td>25 mm</td>
</tr>
<tr>
<td>Protection type</td>
<td>IP20</td>
<td>IP20</td>
<td>IP20</td>
<td>IP20</td>
</tr>
</tbody>
</table>
Safety as an integral system component
Nowadays, safety technology is a rigid technology separate from flexible machine control. Next to the sleek automation of production machines designed with well-established fieldbus systems, the implementation of safety technology seems archaic by comparison. In many cases, the lack of flexibility makes it necessary to work restrictively with safety fences and enclosures. This in turn hinders the productivity of a system due to time-consuming and complicated procedures.

POWERLINK Safety sets technical standards
There are a number of new approaches to safe fieldbus systems that are heavily influenced by proprietary standards and long response times. The ACOPOSmulti drive system is different. This system is based on POWERLINK Safety.

Enabling functions such as safely limited speed is done directly over the network. Wiring these safety-related signals to the drive is now a thing of the past. The information is collected from its source via safe digital inputs and outputs. The information is then distributed to respective sensors and actuators, the drive in this case, via a safe central unit, the SafeLOGIC controller.

Connecting over POWERLINK results in the best possible SafeLOGIC communication connection to the standard controller for non-safe program creation without any additional work.

Safe drive functions
Safety in the ACOPOSmulti drive system comprises the following functions taken from Cat. 4, EN 954-1:
- Uncontrolled or controlled stops
- Safe stop and operation halt
- Safe Stop 1, Safe Stop 2
- Safely limited speed
- Safe direction of rotation

The functions described above are offered as options with the understanding that they are not a part of all the drives in a production machine.

Basic functions like uncontrolled stops and safely stopping (both according to Cat. 4, EN 954-1) are part of the standard delivery. Therefore, the safety-related functions can be implemented in simple applications via conventional wiring.

Safe configuration and programming
All safe connections lead to the SafeLOGIC controller. This is where the logical relationships between the individual safe devices are defined. Programming based on PLCopen function blocks is also an option in addition to pure configuration. Routing can be set up to the SafeLOGIC controller via the normal CPU and POWERLINK for programming.
Integrated safety technology

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe torque off</td>
<td>No energy is provided to the drive. There is no torque present.</td>
</tr>
<tr>
<td>Safe operating stop</td>
<td>The drive is stabilized in a resting position. The controller remains active. The position is not lost.</td>
</tr>
<tr>
<td>Safe stop 1</td>
<td>Stop with safe torque off. Switches to safe operating stop after delay time elapses.</td>
</tr>
<tr>
<td>Safe stop 2</td>
<td>Stop with safe torque off. Ramp monitoring. Switches to safe operating stop after delay time elapses.</td>
</tr>
<tr>
<td>Safely limited speed</td>
<td>Speed monitoring. Specified limit value not exceeded.</td>
</tr>
<tr>
<td>Safe direction</td>
<td>Direction monitoring. Locks from an incorrect direction.</td>
</tr>
</tbody>
</table>
SafeLOGIC - The safe PLC

SafeLOGIC
The SafeLOGIC controller handles all central tasks within a safety-oriented application. Three different functional areas exist here. The configuration management monitors the entire safety-oriented configuration of the application. When replacements are needed, the parameter management makes sure that newly installed modules are assigned correct parameters that apply to the application. Lastly, the SafeLOGIC controller handles the actual safety-oriented execution of the application program.

Configuration management
- Ensures a consistent, safety-oriented machine configuration.
- Mechanisms are specified in POWERLINK Safety and therefore span across different system providers.
- Checks the module type as well as hardware and firmware versions against application specifications.
- Checks the configuration at startup and periodically during operation.

Parameter management
- Ensures consistent parameters in the devices.
- Mechanisms are specified in POWERLINK Safety and therefore span across different system providers.
- Checks the parameters against application specifications.
- Performs complete and autonomous parameter downloads.

Integrated but separated
Integrated because of
- Transparent data exchange between the standard CPU and the SafeLOGIC controller
- Transparent data exchange between SafeIO modules and the standard CPU
- Transparent data exchange between standard I/O and the SafeLOGIC controller
- SafeDESIGNER integrated in Automation Studio

Separated because of
- Free choice of standard CPU platform (SoftPLC, X20, ACOPos, Power Panel) without restrictions by SafeLOGIC
- Scalability of the standard CPU without affecting the SafeLOGIC
- Separate management of access rights in Automation Studio

SafeKEY: removable storage medium
**SafeKEY**
- Storage medium for the application, configuration, and device parameters.
- Removable so that data can be handled very easily on an initialized SafeLOGIC controller during maintenance.

**Scalability**

**SafeLOGIC standard edition**
- For simple applications
- For applications with up to 20 safe devices

**SafeLOGIC extended edition**
- For complex applications
- For applications with up to 100 safe devices
SafeDESIGNER - Simply safe

SafeDESIGNER
The functions of the SafeDESIGNER package expand Automation Studio to include necessary engineering tools for configuring safety-oriented applications. This continues the “integrated but separated” concept. The safety-oriented functions are completely encapsulated and subject to an independent access rights management. However, the central thread is the uniform look and feel as well as functions that are adjusted to each other uniformly throughout both configuration views.

Graphical program editor
The graphical program editor is the core of the SafeDESIGNER toolset and sets new standards with regard to ergonomics and user-friendliness for safety-oriented editors. A modern interface and the ability to use features from the PC world such as drag and drop, cut and paste, etc. considerably simplify the application creation process. Intuitive operation of the system reduces development time and, more importantly, errors. In other words, it implicitly ensures simple and safe programming.

In the background, the system monitors the safety and plausibility of the application being developed. A consistent and logical separation of safety-oriented data types from standard data types makes it easier for the user to differentiate and separate signals.

SafeNAVIGATOR
The SafeNAVIGATOR is the link between the standard and the safety-oriented views. The modules assembled in the physical view of the hardware tree are checked for relevance in the safety application and displayed in the SafeNAVIGATOR. This allows only relevant modules to be presented to the safety-oriented application engineer.

The SafeNAVIGATOR provides different views and sorting patterns to simplify navigation. This allows the user to choose whether the objects are displayed according to their safety-oriented addressing or fieldbus topology or sorted according to safety-oriented variable names or the variable names from the standard view.

Graphical program editor highlights
- Ladder Diagram and function block programming (LD, FBK)
- Strict separation of data types for “safe” and “standard” signals
- Diverse compiler for highest safety

SafeNAVIGATOR highlights
- Reduced display of safety-oriented components
- Clearly arranged tree display
- Simple navigation
- Separates the safety-oriented application from changes to the standard configuration
Parameter editor
The parameter editor is responsible for managing safety-oriented parameters for the modules and the application. Response times that need to be adhered to for safety or the existence of machine options can be configured here, for example.

The access concept protects parameters from unauthorized or unintended changes. The safety-oriented application engineer has write access to all parameters. In contrast, the commissioning engineer has write access to commissioning parameters only, which must then be adjusted when commissioning the application (e.g. machine options).

Commissioning license
SafeDESIGNER is not mandatory to commission a safety-oriented application, but it considerably reduces the effort involved. The following functions support the commissioning technician:
- Variable watch integrated in the graphical program editor for easily testing sensor wiring
- Output forcing for easily checking actuator wiring
- Commissioning parameters for adapting the machine to current circumstances, e.g. enabling/disabling machine options.

Verification and validation
In accordance with safety standards, extremely careful verification and validation procedures must be carried out for a safety-related application. The functions integrated in SafeDESIGNER support the user in these configuration phases.

The online functions allow the safety application to be safely downloaded to or uploaded from the SafeLOGIC controller. Safety-oriented measures such as checking the serial number, CRC checks, and informational dialog boxes are implemented for this. The user can therefore always be certain that the right project is on the right controller. The variable watch and force functions integrated in the graphical program editor enormously simplify the check of program functions as well as the wiring.

The CRC protection carried out throughout the entire SafeDESIGNER project gives the safety application a unique fingerprint. This CRC is stored in the project info together with additional project and application data, specifications for the responsible persons, testing and commissioning checklists, and version information.

Parameter editor highlights
- Simple configuration
- Selection lists
- Advanced access protection
- Separation of application parameters from commissioning parameters
Virtual wiring with PLCopen safety FBKs

PLCopen safety function blocks
The function blocks for safety-oriented applications standardized in the PLCopen revolutionize the development of safety applications. The function blocks are certified and therefore reduce time and cost in all phases of the safety application's life cycle. From the specification and implementation to testing and checking functions, the procedure used is more similar to virtual wiring than it is to programming.

Unlike "real wiring", downloading the program to the SafeLOGIC guarantees that an identical copy will be stored. This completely eliminates wiring errors during series production. Naturally, all options for a safe programmable controller are available to handle even more complex problems that can’t be solved with "real wiring".

<table>
<thead>
<tr>
<th>Sensor connection</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function block</strong></td>
<td><strong>Function</strong></td>
</tr>
<tr>
<td>EQUIVALENT</td>
<td>1 of 2 evaluation of two equivalent contacts (N.C. / N.C. or N.O. / N.O.) with discrepancy time monitoring.</td>
</tr>
<tr>
<td>ANTIVALENT</td>
<td>1 of 2 evaluation of two different contacts (N.C. / N.O.) with discrepancy time monitoring.</td>
</tr>
<tr>
<td>MODE SELECTOR</td>
<td>Operating mode switch (1 of max. 8 evaluation) with discrepancy time monitoring.</td>
</tr>
<tr>
<td>EMERGENCY STOP</td>
<td>E-stop evaluation with restart inhibit.</td>
</tr>
<tr>
<td>ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT (ESPE)</td>
<td>Evaluation of an ESPE signal with restart inhibit.</td>
</tr>
<tr>
<td>TWO-HAND CONTROL TYPE II</td>
<td>Evaluation for a two-handed operator console without monitoring of the simultaneous operation.</td>
</tr>
<tr>
<td>TWO-HAND CONTROL TYPE III</td>
<td>Evaluation for a two-handed operator console with monitoring of the simultaneous operation.</td>
</tr>
<tr>
<td>SAFETY GUARD MONITORING</td>
<td>Safety door monitoring with discrepancy time monitoring and restart inhibit.</td>
</tr>
<tr>
<td>TESTABLE SAFETY SENSORS</td>
<td>Testing of an ESPE device with restart inhibit.</td>
</tr>
<tr>
<td>ENABLE SWITCH</td>
<td>Evaluation of a enable switch with restart inhibit.</td>
</tr>
</tbody>
</table>
### Integrated safety technology

#### Actuator connection

<table>
<thead>
<tr>
<th>Function block</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTCONTROL</td>
<td>Control of an actuator with restart inhibit.</td>
</tr>
<tr>
<td>EXTERNAL DEVICE MONITORING</td>
<td>Control of an actuator with evaluation of the feedback signals and restart inhibit.</td>
</tr>
<tr>
<td>SAFETY REQUEST</td>
<td>General safety request with status monitoring.</td>
</tr>
<tr>
<td>SAFETY GUARD INTERLOCKING WITH LOCKING</td>
<td>Control of a safety door with bolt.</td>
</tr>
</tbody>
</table>

#### Muting

<table>
<thead>
<tr>
<th>Function block</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEQUENTIAL MUTING</td>
<td>Muting with standard sensors in a sequential arrangement.</td>
</tr>
<tr>
<td>PARALLEL MUTING</td>
<td>Muting with standard sensors in a parallel arrangement.</td>
</tr>
<tr>
<td>PARALLEL MUTING WITH 2 SENSORS</td>
<td>Muting with safety sensors in a parallel arrangement.</td>
</tr>
</tbody>
</table>

#### Motion

<table>
<thead>
<tr>
<th>Function block</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAFESTOP1</td>
<td>Request and status monitoring of a safe stop 1 safety function.</td>
</tr>
<tr>
<td>SAFESTOP2</td>
<td>Request and status monitoring of a safe stop 2 safety function.</td>
</tr>
<tr>
<td>SAFELY LIMITED SPEED</td>
<td>Request and status monitoring of a safe limited speed safety function.</td>
</tr>
</tbody>
</table>
**Safety life cycle**
For the first time, a safety standard is concerned with the entire life cycle of a safety-oriented product. IEC 61508 requires the highest degree of safety-oriented sensibility during all phases of a product's life cycle. Since products of integrated safety technology conform to this standard during planning, specification, development and testing stages - availability, maintenance, and diagnostics were already taken into consideration in the earlier project phases.

**Error detection**
Integrated safety technology products are equipped with extensive internal diagnostic routines to detect internal module errors as well as external wiring problems. All diagnosed errors are indicated using a status LED directly on the module as well as sending the diagnostic data via POWERLINK or via the remote backplane. Errors can therefore be evaluated with a simple look at the module or in the application with the integrated system support.

**Replacing modules**
A defective module is signaled by a red “SE” LED and/or channel LED on the module. In addition, SafeLOGIC shows the number of faulty modules in its configuration range.

Defective modules must be removed and replaced by functioning modules. At this point, the user does not need to pay attention to specifying module parameters correctly since this is handled independently by the SafeLOGIC controller. This prevents any faulty configurations from being made.

After replacing the last defective module, the user needs to confirm the module exchange with the SafeLOGIC controller. The controller then begins running its own check of the replaced modules for module type and compatibility; if necessary, it performs any firmware updates or parameter downloads. Any discrepancies that arise are indicated as defective modules in the same way as before. This procedure repeats itself until all replaced modules match the specifications of the safety application with regard to module type and compatibility.

A function test must be performed once this state has been reached. The function test can usually be restricted to the safety functions respective to the modules. SafeLOGIC signals this phase via a blinking LED. Once the function test is successful, it is confirmed once again with the SafeLOGIC controller. The controller then reverts back to normal operation. The maintenance case can be considered closed once the measures taken have been logged in the respective maintenance documentation for the safety application. Module replacement is usually limited to just a single module. Since there can't really be any mix-ups when inserting modules or terminals in this case, the function test can be left out.
Replacing a SafeLOGIC controller
If a SafeLOGIC controller is defective, the procedure is just like the one for a normal module. The only other thing to keep in mind is that the number of defective modules cannot be signaled to the defective SafeLOGIC controller. In this case, the SafeLOGIC module should be replaced first so that the number of additional faulty modules can be signaled correctly once more.

When exchanging the SafeLOGIC module, applying the SafeKEY from the defective device restores the safety application and all application-specific data.

Commissioning
Commissioning a safety-oriented application is identical to replacing a module. Since all safety-oriented components are new in this situation and considered replaced, the subsequent function test needs to include all of the usual and complete safety-oriented functions used in safety engineering.

Machine options that might be necessary during commissioning can be enabled or disabled using the SafeDESIGNER commissioning license.
Standards and guidelines

Guidelines based on harmonized standards are the foundation for international trade. For machine manufacturers, machine guidelines are extremely important.

Following the guidelines, and therefore the standards listed in the guidelines, provides support for machine manufacturers when submitting the conformity declaration for the CE mark. When doing this, the conformity evaluation procedure requires a danger analysis to be carried out followed by a risk evaluation. The safety level required for the safety function can be determined using the risk graphs shown in various standards.

Safety standards and levels
Based on POWERLINK Safety, X20 safety modules achieve safety integrity level 3 according to IEC 61508 and meet the requirements for performance level PL e according to EN 13849. This makes it possible to create applications up to category 4 according to EN 954-1, and this can be done for the first time with cycle times of 200 μs. The certification was submitted to TÜV Rhineland.

EN 954-1
Harmonized, i.e. listed in the machine guidelines as the comprehensive standard for “safety-related controller components”. Regards all relevant technology as well as electrical, pneumatic, and hydraulic components in the area of machine manufacturing. Shows deficits for complex electronic systems, programmable systems in particular.

EN 13849
Successor to EN 954-1 and also harmonized when released, i.e. listed in the machine guidelines. As in EN 954-1, regards all technology relevant to machine manufacturing. Refers to IEC 61508 for complex electronic and programmable systems.

IEC 62061
Harmonized, i.e. listed in the machine guidelines as the standard for “safety-related controller components”. Regards exclusively electrical components; therefore often insufficient by itself with regard to comprehensive safety in machine manufacturing.

IEC 61508
Valid for manufacturers of safety-related systems. Not directed to any specific machine manufacturers.

Risk graphs to determine the safety level

<table>
<thead>
<tr>
<th>Safety category</th>
<th>Performance level (PL)</th>
<th>Safety integrity level (SIL)</th>
<th>Undetected errors per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAT 1</td>
<td>PL a</td>
<td>SIL 1</td>
<td>10^{-5}</td>
</tr>
<tr>
<td>CAT 2/3</td>
<td>PL b</td>
<td>SIL 1</td>
<td>3 * 10^{-6}</td>
</tr>
<tr>
<td>CAT 3</td>
<td>PL c</td>
<td>SIL 2</td>
<td>10^{-8}</td>
</tr>
<tr>
<td>CAT 4</td>
<td>PL d</td>
<td>SIL 3</td>
<td>10^{-10}</td>
</tr>
</tbody>
</table>

Highlights
- EN 954-1 CAT 4
- EN 13849 PL e
- IEC 62061 SIL 3
- IEC 61508 SIL 3
- Cycle times as low as 200 μs
- TÜV Rhineland certification
Integrated safety technology products need a suitable backbone that allows safe communication between products when exchanging data. This is where POWERLINK Safety is ideally suited.

With POWERLINK Safety, devices can exchange safety-oriented data over any network or fieldbus medium. This safety-oriented data can then be read by the standard components. These devices can also send and receive standard messages from standard components. This makes it possible to directly exchange data between a standard controller and the safety components. Despite this, the safety technology is not affected by alterations or expansions in the standard automation or network topology. This is decisive for not having to recheck the safety-oriented application during expansions or involving the certification authorities if the machines require certification.

**Simple and robust maintenance and configuration**

POWERLINK was developed for rigorous industrial use. The same principles were also applied to POWERLINK Safety. That's why POWERLINK Safety implemented simple and proven measures for solving safety-oriented requirements. When combined, these simple measures form the innovative properties that currently make POWERLINK Safety the most modern bus system in the area of safety engineering. The application profiles have the same structure as CANopen device profiles. Centralized services handle the automatic parameter assignment when replacing a device. During maintenance, time-consuming as well as simple settings that are often forgotten are no longer necessary. This increases safety and considerably reduces costs.

**High-performance, reliable, fast**

An important feature of POWERLINK Safety is the data protection with less than 10⁻¹⁹ possible unrecognized distortions per data packet. This extremely high level of data protection allows safety-oriented data to be transported with an extremely short cycle time in the network. Even with a cycle time of 100 μs and 36 million data packets per hour, POWERLINK Safety still adheres to the limit value required by the safety standard. This feature makes it possible to send safety-related data at a very high repeat rate. It's even possible to transfer data at a rate of 1 GBit/s, a speed used by the newest POWERLINK products. The failure of one or more data packets can be tolerated without triggering the safety function or causing the safety-oriented response time to suffer. The safety bus thus becomes a highly powerful, robust communication medium.

**Manufacturer-independent concept**

Proprietary solutions limit machine manufacturers to selecting only certain components. The POWERLINK Standardization Group includes 400 systems manufacturers, service providers, and end users who are united in the development and application of the POWERLINK and POWERLINK Safety designs. A broad foundation of more than 210,000 Ethernet POWERLINK nodes in more than 28,000 field applications demonstrates the maturity, customer acceptance, and manufacturer-independence of POWERLINK.