FLEXIBLE AND FIT FOR THE FUTURE WITH SAFETY

Safety offensive enables efficient development of highly flexible machines: With an object-like, hierarchical-modular structure of the safety function macros, full parameterizability – even during operation – as well as built-in hot-plug capability and extensive functions for robot workspace monitoring, Sigmatek supports developers in machine and plant engineering in achieving the balancing act between maximum flexibility and uncompromising safety, while at the same time reducing development costs. **By Ing. Peter Kemptner, x-technik**

In these fast-moving times, customer needs and product demand change quickly and frequently. This means that the requirements placed on production and packaging machines are also subject to rapid and significant changes. In order to meet these requirements and offer product manufacturers sufficient investment protection, machine and system manufacturers are increasingly designing their products on a modular basis. Only through the combination of standardization and a wide range of variants, machines and systems can be developed with high efficiency and individualization in a short time.

Functional safety as an ongoing issue

It is taken for granted that machines and systems have sufficient functional safety to protect people and machines. Hard-wired using classic relay technology, however, safety circuits are very rigid structures. Their rigid safety concepts require an exact definition of the system topography already at the program creation

stage. This makes the modular design of machines more difficult and dynamic changes to the machine configuration impossible. Already in 2007, Sigmatek was one of the first manufacturers of industrial control and automation systems to launch a programmable safety system on the market. This transports the signals from safety-related sensors to a safety CPU using safe input and output modules via Black Channel over the Ethernet-based system bus. Transmission can also be wireless, for example via WLAN. The wiring of the safety circuit was replaced by the programming of the safety controller. This does not require in-depth programming knowledge, as it is carried out by means of configuration in the graphical user interface of the comfortable LASAL SafetyDesigner development environment.

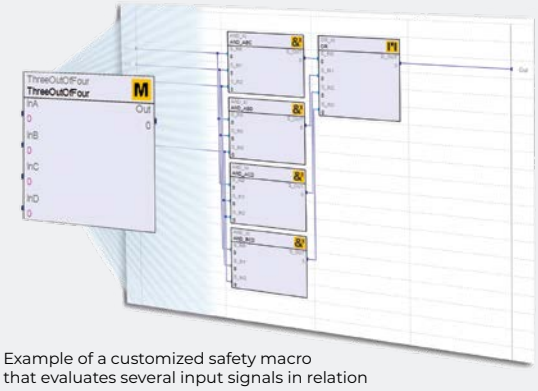
Acceleration through macro technology

Safety development is carried out in the LASAL SafetyDesigner on the basis of certified function blocks (FUB). The FUB library in LASAL contains over 50 of these PLCopen-based blocks. Following the example of object-oriented programming, which has characterized Sigmatek controllers on the application side for 25 years now, Sigmatek created the possibility of customer-specific macro libraries. The special feature of Sigmatek's LASAL safety macros is that they can be structured in a multi-level hierarchy. Each macro is encapsulated in itself and can be tested independently because it has its own CRC check value. This significantly reduces the time and effort required for overall tests to obtain certifications.

„Even if object-oriented programming with inheritance and instantiation is not permitted in safety programming, machine builders can use it to drastically reduce development times," says graduate engineer Andreas Rauhofer, Head of Application Technology at Sigmatek. „Furthermore, with LASAL it has been possible for many years to create a safety application with several safety controllers."

Parameter lists as engineering turbo

The LASAL SafetyDesigner offers developers of safety-related applications the possibility to design them completely parameterizable and thus very flexible. It is therefore sufficient to create just one safety application for a machine or system with numerous options, which applies to all equipment variants.



Example of a customized safety macro that evaluates several input signals in relation to each other and generates a corresponding output signal. **Such macros can then be used as often as required in the safety application.**

The parameterization, i.e. the adaptation to the – often customer-specific – concrete machine, is carried out via a parameter list. Like the application itself, the parameter list is also protected. To ensure the safety of your application, password-protected mechanisms are used when transferring the lists for setting different equipment variants.

The use of parameter lists alone for the creation of large safety applications reduces the development effort for machines with many variants to an significant extent. In addition, the unhindered exchange of data with the „gray" control system enables the automation of test sequences. The time savings are enormous, especially with large, modular machines whose safety programs can have several 10,000 FUBs.

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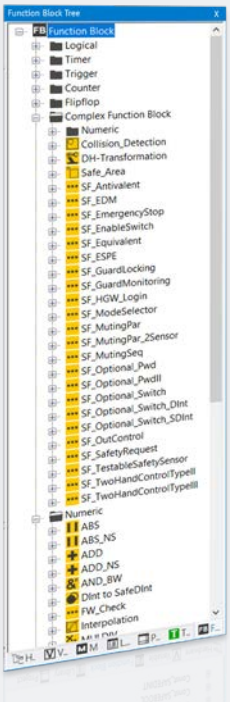
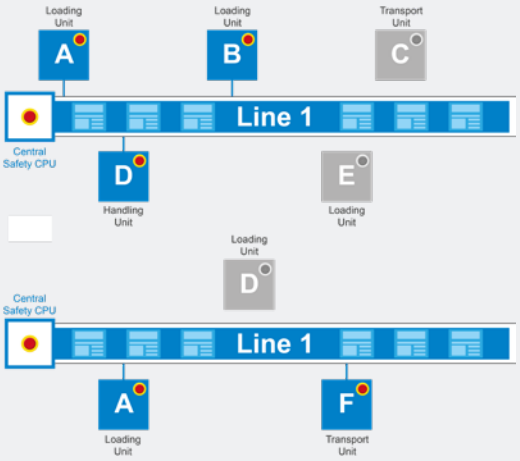


The LASAL SafetyDesigner library contains a wide range of certified function blocks that **simplify the creation of safety-relevant applications:** in addition to Logical, Timer, Trigger and Numeric, there are also very complex functions such as Collision Detection, Safe Area, Ramp Monitor or Optional Password.



Sigmatek's Safety Hot Swap feature allows machine modules with an emergency stop function to be flexibly integrated into the system **and disconnected and reconnected elsewhere in the machine network.**

Safety for dynamic system concepts

However, the most interesting/special feature of the parameter list configurable safety is that it is not only suitable for the quick and easy production of various variants before delivery. This method makes it possible to change the parameterization of the safety controller during the operating time by replacing the parameter list. This means that machines and systems can be operated much more flexibly than before. „The exchange of parameter lists during operation enables scenarios where previous, rigid safety concepts failed," confirms Andreas Rauhofer. „This means that the monitoring of protective mechanisms around machine modules that are not currently required could be dropped in order to improve the accessibility of the rest of the machine."

The SCP 211 safety CPU convinces with its **fast processing speed and extensive memory.**

And this is how the whole thing works: Thanks to a Dynamic Link Library (DLL) created by Sigmatek, a non-safe application in the machine controller or an edge device can transfer a new parameter list via a safe connection. To ensure the necessary safety, manual acknowledgement by the machine personnel is required for data exchange.

More flexibility for sure

The possibility to dynamically change the configuration of a safety application completes the hot-swap capability that has been available for some time. This offers the possibility of logging individual machine modules on or off to the safety application during operation. It allows machine parts with their own safety CPU to be flexibly added, removed or regrouped. In this case too, the user must take active action to register and remove machine parts in order to ensure orderly, safe operation. If a unit is disconnected from the central safety controller without first logging off, this triggers an emergency stop for all connected machine modules after the configurable watchdog time has elapsed.

New functions for S-DIAS safety

The number of sensors to be monitored is growing rapidly in automation, especially in the safety-relevant area. This is why Sigmatek developed the SCP 211, an even more powerful safety CPU. The device beats the processing speed of its little sister SCP 111 by a factor of four. With 1 MB Flash and 500 kB SRAM, the 25 mm wide DIN rail module also offers more memory.

On the software side, the safety CPU has numerous new functions that simplify the creation and handling of safety applications. In addition to reloading parameter lists, this also includes the creation of flag variables and constants in list form as well as arrays. These can be used, for example, to store characteristic curves or for dynamic input mapping via the parameter list. Together with new safety function blocks for converting data types, interpolation and array processing, these make it easier to implement a wide range of variants with just one safety application. In addition, the safety program can be loaded onto several machines using micro SD cards. A validation button integrated into the safety CPU ensures the necessary safety.

The compact drives of the DIAS Drive 2000 series from Sigmatek offer high power density and flexibility as well as the **ability to react quickly to safety-related violations.** They are also equipped with a growing variety of TÜV-certified integrated safety functions.

Functional explosion in the drive

The servo drives of the DIAS 2000 series from Sigmatek offer high power density and flexibility for controlling servomotors in a very compact housing. In addition to one to three axes, they integrate a circuit supply, power filter, brake resistor and DC link in just 75x240x219 mm in size 1 and 150x240x219 mm in size 2. Very short controller cycle times of 62.5 µs give the DIAS Drives excellent servo performance and the ability to react quickly to safety-related protection violations.

These reactions must be carried out reliably and quickly, preferably directly in the drives. The MDD 2000 Drives were previously equipped with integrated safety functions certified to SIL 3, PL e, Cat. 4 by TÜV, such as Safe Torque Off (STO), Safe Stop 1 (SS1), Safe Operating Stop (SOS), Safe Brake Control (SBC) or Safely Limited Speed (SLS). Following the current expansion, they now contain eleven additional safety functions as standard. These include Safe Speed Monitor (SSM), Safe Maximum Speed (SMS), the acceleration functions Safe Maximum Acceleration (SMA) and Safely Limited Acceleration (SLA), the position functions Safely Limited Position (SLP), Safe Position (SP), Safely Limited Increment (SLI) and Safe CAM (SCA) as well as Safe Direction (SDI).

The taming of the robot

Robots are taking on more and more tasks in production and working increasingly closely with humans. To ensure a safe working environment for them, the robots' workspaces must be safely monitored. To this end, Sigmatek has created three new function blocks: „Denavit-Hartenberg (DH) Transformation", „Collision Detection" and „Safe Area". These are available in the LASAL SafetyDesigner and can be easily used in projects by setting the appropriate parameters.

Used once for each robot axis, the DH Transformation module defines the tool center point (TCP) of a robot so that it can be reliably monitored despite the multi-axis movement. Thanks to Safe Area and Collision Detection, a collision between the TCP of a robot and other objects in a defined workspace is detected at an early stage and thus prevented. The module detects collisions by comparing the enveloping sphere across the current TCP position with the defined workspace limits.

Complex workspaces can be created by linking different workspaces and the robot joints can be independently monitored using individual enveloping spheres. This also ensures driving over obstacles safely but close to them. All of this works with all robot kinematics, with six-axis articulated robots as well as with SCARA and even with delta robots. However, the use of the SCP 211 safety CPU presented above is mandatory for its implementation.

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The safe function blocks DH Transformation, Collision Detection and **Safe Area enable safe workspace monitoring for any robot kinematics.**

With Sigmatek's extended safety possibilities, machine manufacturers can drastically reduce development times and create highly flexible, future-proof machines and systems whose realization had failed due to the existing standard safety concepts.

DI (FH) Andreas Rauhofer, Head of Application Technology at Sigmatek GmbH & Co KG

EFFICIENT SAFETY DEVELOPMENT OF FUTURE-PROOF MACHINES

Sigmatek supports machine and system manufacturers with sophisticated and flexible safety concepts to achieve the balancing act between maximum flexibility and uncompromising safety, while at the same time reducing the time and costs required for development. Andreas Rauhofer, Head of Application Technology at Sigmatek GmbH & Co KG, knows what is behind the current safety offensive. **The Interview was led by Ing. Peter Kemptner, x-technik**

Mr. Rauhofer, what prompted Sigmatek to launch this safety offensive?

Production systems are increasingly being designed on a modular basis and with a wide range of variants, and they should also be able to adapt dynamically to changing production requirements. At the same time, they must offer uncompromising functional safety. The pressure on development times and costs is also increasing. Furthermore lack of qualified personnel in the development departments adds to the problem. With previous methods and standard safety concepts, these are contradictions that can hardly be overcome. As a pioneer of object-oriented programming for industrial automation, Sigmatek enables its customers to develop complex, flexible and therefore future-proof applications for machines and systems in a highly efficient manner. For us, it makes sense to extend this philosophy and its possibilities to the area of safety.

Is object-oriented programming suitable for safety applications?

Inheritance and instantiation as characteristics of genuine object-oriented programming are not permitted in safety programming. This is carried out in the LASAL SafetyDesigner on the basis of certified function blocks based on PLCopen. Following the example of object-oriented programming, the FUBs can be combined into macros in a multi-level hierarchy and stored in a macro library for later use through parameterization. This not only reduces the time and effort required to create the program, but also significantly reduces the overall testing required to obtain certification.

What are the benefits of parameterizing entire safety applications using a parameter list?

Thanks to the complete parameterization capability, it is sufficient to create just a single safety application for all configuration variants of a machine or system with numerous options. By automating the test sequences via test programs that run in the „gray" sequence control system, this reduces the development effort for machines with many variants. Together with the hot-plug capability, the parameterization of the safety controller during operation enables extremely flexible operation of modular machines and systems.

Which of the new products presented do you consider to be the most important?

None, because they all play indispensable roles in solving the overall task – just like the hot-swap capability already presented in 2020. When it comes to efficiently developing modular, flexible and safe machines and systems, the powerful SCP 211 safety CPU is just as important as the fast-reacting drives and the expanded safe function blocks, as well as customized macro libraries and the parameter list.

Thank you very much for the interview.

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