

Safety-conscious drives meet safety standards

In the last decade, updated safety standards have made it possible for electronic safety functions to be built directly into drives which control motor and machinery movements in industrial processes. *Mikko Ristolainen* explains how this approach simplifies things for designers and machine builders, while also providing higher overall safety and protection levels.

Machine safety strategies aimed at protecting people, property and ecosystems can benefit from innovations in drive technology with safety functions being built directly into the drive. This can offer significant benefits to machine builders, designers, engineers and end-users, who want to meet all relevant safety requirements with less hassle while saving time and money.

Integrated safety

Integrated safety has revolutionised the way we achieve machine protection. New electronic safety solutions integrated into the drive are capable of replacing safety systems based on external electro-mechanical add-on

devices. In ABB's drives, for example, integrated safety consists of the safe torque off (STO) function. Additional safety functions can also be integrated into the all-compatible ACS880 industrial drives, using the optional safety functions module.

Implementing a machine safety system from start to finish can be seen as a daunting and complicated undertaking. But it is now made much easier thanks to drive-based functional safety technology, and standardisation that unifies requirements and terminology used across the market. So, we can move away from the separate electro-mechanical machine safety measures that involve hard-wired logic add-ons like relays and contactors. Instead, electronic safety functions are built

directly into the drive's safety logic.

Some of the most important benefits that can be obtained with integrated safety in drives include reduced design time and effort as well as easy commissioning of one or several built-in pre-programmed safety functions in one common safety module. Other advantages include reduced number of devices, cabling, and costs, as well as no wearing parts, when compared to the use of electro-mechanical safety devices.

Design tools

The safety designer's job starts with a risk analysis aimed at defining if and where risk reducing safety functionality is needed on the machine and then deciding which safety levels and functions are required. To make this



process easier, ABB's functional safety design tool helps machine builders, OEMs and system integrators to calculate, verify and document the required, designed and achieved safety levels like SIL and PL using a very logical stepwise procedure, according to machinery standards EN IEC 62061 and EN ISO 13849-1.

Such a functional safety design tool can help cut the designer's workload by simplifying and speeding up the design process, while simultaneously ensuring the safety design calculations are carried out according to the relevant standards. Additionally, ABB's design tool is compatible with numerous safety libraries including the company's own, as well as other manufacturer's, safety devices, making calculations and device selection faster and easier.

Once the machine design is approved, drive-based functional safety is ready for implementation. Safe torque off (STO), which is the safety function that brings drives safely to a no-torque state (emergency stop) and/or prevents an unexpected start-up, is the compulsory foundation for drive-based functional safety. STO is, therefore, built into the drive as an electronic safety function to be used as an alternative to traditional electro-mechanical methods such as contactors. ABB's all-compatible drives have STO built-in as a standard feature.

With STO as the foundation of drive-based functional safety, ABB has developed a range of solutions including modules with TÜV Nord-certified safety functions (FSO-12 and FSO-21). The safety module works seamlessly with the all-compatible ACS880 drives. It complies with SIL3 / PL_e and offers several optional safety functions in a compact 'safety-yellow' coloured module. The functions are: Safe stop 1 (SS1), Safe stop emergency (SSE), Safe brake control (SBC), Safely-limited speed (SLS) and Safe maximum speed (SMS). The FSO-21 safety functions module offers the additional safety functions: Safe speed monitoring (SSM) and Safe direction (SDI).

The ability to build in pre-

Expanded safety at work range

With a new generation of programmable safety controls and an expanded line of safety relays, Leuze electronic believes it is able to offer safe solutions for all applications in machine and system construction.

Its new safety relays allow many smaller safety tasks to be solved – from the monitoring of simple components, such as E-STOP or safety switches, to the integration of optoelectronic sensors or standstill monitoring of motors with its 22.5 mm housings

– the relays have a compact design taking up little room in the switch cabinet.

The safe controls of the MSI 400 product family offers both 24 inputs/ outputs as well as an Ethernet interface and integrated industrial Ethernet protocol such as Profibus and Ethernet IP in a compact design.

The safety controls are said to be suitable for the safe monitoring of simple safety functions as well as for performing more complex safety tasks.

programmed functions like SS1 and SLS in a drive is a benefit. When comparing modern integrated safety to the way it has traditionally been done – by connecting discrete devices together in a certain wiring and logic sequence – this benefit becomes obvious.

Functionality at the drive

Using the safety module provides straightforward functionality right in the drive. There is no need to figure out how to hook up and wire the logic with relays, resets and contactors. Instead users can work in harmony with the drive's functionality. All that is needed is to commission the required built-in functions based on the safety design, and this eliminates the electro-mechanical logic design task.

The safety functions module provides pre-programmed safety logic functions that can easily be implemented in the drive according to the 'connect-configure-reconfigure' principle. The main benefit is the integrated safety functions that work seamlessly together alongside the drive control system. In addition, diagnostic features aid troubleshooting to keep the system continuously safe, with critical safety-related status and event-system messages part of the standard drive operation, accessible through the drives control panel.

Direct benefits for the machine builder, designer or machine user include

less cabling, which saves costs and makes the safety design work within a smaller footprint. Faster response time also provides improved protection in an emergency situation.

Additionally, the design of the safety module means less maintenance and less chance of breakdown as there are no wearing parts. A further benefit is encoderless capability for speed-related safety functions to be used in certain suitable applications. This results in lower costs and higher reliability.

A system-wide safety approach

The safety functions module is easy to connect to a safety PLC making it possible to build larger safety systems. The PLC controls several drives, and the safety module provides the local safety functionality and feedback to and from each drive. ABB achieves connection between the drive and PLC via a PROFI-safe-based fieldbus.

The integration of electronic safety functions into drives is now possible due to updated safety standards. When combined with a deep knowledge of both drive technologies and safety design, new approaches to drive-based functional safety offer real value for machine builders, designers and safety engineers.

Mikko Ristolainen is ABB Drives functional safety manager, and is an expert on drive-based functional safety at ABB's drives factory in Helsinki.