Better Machine Safety Means Better Productivity

Learn the Value of Embedded Safety Drives and Networked Safety

Life Is On

Schneider Electric
“Safety has evolved from being a cost burden and ‘necessary evil’ to a strategy for improving productivity and reducing downtime.”

- ARC Advisory Group

Traditionally, the functions of automated machine safety and control have been kept separate. But advanced safety technology embedded within automation components is not just a means to ensure operator safety — it’s also a way to improve performance.

This e-book explores how embedded safety drives and Ethernet-networked drives lower hardware costs, increase operator safety, and reduce the amount of “full shutdown” downtime, which adds up to more productivity.
Given today’s high-throughput production lines, even a simple safety stop for a relatively short period of downtime can be costly. However, technological advances now enable safety functionality to be embedded within automation components such as variable speed drives and servo drives. A single drive component capable of standard control functions as well as safety monitoring offers several advantages to OEMs and their end-user customers:

- Lower installation costs
- Enhanced operator safety
- Increased machine productivity
- Improved production line performance

Embedded safety drives ensure a safer working environment for machine operators by simplifying the safety system. Drives that integrate both control and safety functionality reduce the complexity of engineering two separate control and safety systems. Fewer devices and less cabling mean fewer potential points of failure.

Additional information
For an industry analyst’s discussion on embedded safety and how modern safety systems improve productivity, download the IHS white paper Machine Safety in Factory Automation.
It may seem that the two concepts of “enhanced safety” and “improved productivity” are mutually exclusive within the context of industrial machinery: safety demands downtime, whereas productivity demands uptime. But today’s advanced safety technology — in particular, variable speed drives and servo drives embedded with safety functionality — are able to better safeguard operators while minimizing production line shutdown time.

Instead of compromising the health of machinery, utilizing a single drive component can actually improve machine performance and extend its useful lifetime. Advanced safety functions enable safe stop ramps without completely shutting down power to the machines. This reduces the chances of breakdown and avoids full-stop-and-restart cycles. Production may continue at a reduced rate while operators safely intervene to resolve machine stops.

Embedded safety drives integrate safety functions that control the drive output to the electrical motor in response to safety-related events. These functions can either stop the drive without shutting off power to the motor entirely, or control its speed — a drive does not have to “wait” for an overspeed or blockage to signal an abnormal condition. Three of the most common functions are STO (Safe Torque Off), SLS (Safe Limited Speed), and SS1 (Safe Stop 1).

SEE DEFINITIONS ON NEXT PAGE »
Embedded safety improves productivity

STO (Safe Torque Off)

STO ensures that there will be no torque on the motor, so the machine is not able to move and harm operators or damage components. The electronic switching time is much faster than with electromechanical components in a conventional solution.

SLS (Safe Limited Speed)

SLS slows down and then holds the motor at a predefined speed. If this speed is exceeded, STO automatically kicks in. This function protects machinery by ensuring that damage is not caused by machines’ running too fast, and also enables operators to reduce the speed of a machine to a level where they can safely intervene.

Safe Stop 1 (SS1)

SS1 stops a motor by controlled braking, according to a predefined speed ramp. It checks that the motor has actually stopped (or reached a predefined minimum speed), then activates STO. This function brakes high-speed motors more quickly and safely than conventional electromechanical solutions. The automatic switchover to STO enhances operator safety.
Embedded safety drives reduce costs

Using an embedded safety drive means investing in one component rather than two. Specifically, the initial cost outlay of two devices — one for control and one for safety — is reduced by using a single device that has both safety and control functionality.

Although variable speed drives or servo drives with embedded safety are likely to cost more than drives solely used for control or for safety, the overall hardware cost savings can be as high as 30%. Complementary savings are realized from reduced cabling needs, fewer circuit breakers, and simplified installation. Plus, the savings from reduced cabling can account for 15% of the installation costs. A single embedded safety drive eliminates the cabling cost associated with connecting numerous devices, which can be a significant amount.

Most important, a safety system with fewer devices is likely to be more robust. Fewer devices and less cabling reduce the potential for failure. Generally, a simpler system is a safer system. With every additional device that is needed to construct the safety system, the overall performance and reliability are lessened — no matter how highly rated the individual components are.

Replacing hardware with embedded software, which is certified for specific conditions, increases the overall reliability index of the system. When a system segregates safety and control functions, one must ensure that both control and safety are well coordinated. Whereas with embedded safety, the function and the behavior of the control are certified to be linked to this safety function — precluding a source of failure.

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Opening up new ways to respond to potentially unsafe conditions in a controlled manner, technological advancements now enable safety devices to be networked as a cohesive system. Networking simplifies the integration of automation and safety control, offering all the operational and cost-saving advantages of a less-complex system, as well as additional benefits:

• Lower installation costs due to fewer hardware components and reduced cabling — and therefore fewer potential points of failure
• Faster commissioning time
• Quicker and easier certification
• Simplified (and less expensive) maintenance

A number of safety protocols are already used widely for networking discrete machine safety components. Analysts forecast an increasingly higher adoption rate in the foreseeable future. The compatibility of both the safety- and control-based protocols have enabled quick and straightforward integration to a single low-cost, high-speed Ethernet network.
Embedded safety over Ethernet

SAFETY NETWORKING PROTOCOL ANALYSIS (2013 VS. 2018)

The World Market for Machine safety by Networking Technology

2013-2018 (Thousands of Nodes Connected)

Integration allows safety and control systems to “talk” with each other and share data such as diagnostics, system status, alarms, events, and other critical information. Safety over Ethernet simplifies safety system communications, reducing the need for multiple hardware components and their associated expense. A standard networking backbone for the safety system means that automatic slowdown can be implemented for the production line, enabling better management and coordination of production.

Embedded safety over Ethernet also benefits OEMs and their end-user customers during the certification process. As devices are networked using a standard but robust Ethernet cable using a certified channel, the system performance is guaranteed.

Safety over Ethernet simplifies safety system communications, reducing the need for multiple hardware components and their associated expense.

Today's wireless solutions adhere to stringent safety standards and have overcome challenges that have hindered adoption in the past. The Schneider Electric white paper Wireless Technology – Changing the Face of Safety Applications explores how modern wireless implementations can benefit user safety and boost productivity.
Conclusion

Advanced safety technology — in particular, variable speed drives and servo drives that integrate safety and control functionality — increases operator protection while simultaneously minimising the amount of time the production line is shut down. No longer are productivity and safety mutually exclusive objectives.

Embedded safety drives represent a new, forward-looking alternative to the conventional approach of using multiple hardware components to create separate, independent systems for machine control and safety. Embedding safety functionality into the control drives reduces the complexity of the safety system, and generally a less complicated system is a safer system.

Not only do embedded safety drives reduce hardware costs by as much as 30%, they also extend the useful lifetime of machinery. Safety functions enable safe stop ramps without completely shutting down power to the machines, improving overall production line performance.

Networking safety systems over Ethernet cable enables quicker certification and easier integration of safety and control. System complexity and wiring is also significantly reduced, which helps improve overall safety due to fewer components with the potential to fail.

As with embedded safety drives, networking a control and safety system using an integrated, single backbone improves operator safety whilst enabling cost and installation time savings. Adopting embedded safety hardware and communications can realize a significant cost advantage over the traditional hardwired and stand-alone approach.

This ebook is an abridged version of the Schneider Electric white paper, How Embedded Safety Drives and Networked Safety Cut Costs and Boost Productivity. Please download the complete white paper for more detail.
References