Safety first

Servo drives with integrated safety functions guarantee user-friendly safety in mechanical engineering

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Virtually any machine movements in an industrial environment result in hazards for the operating and maintenance staff. Servo drives with appropriate approved and certified amplifiers simplify compliance with the applicable safety requirements. Safety functions integrated in the drive technology ensure optimal protection for employees in critical situations and reduce the workload of the controller.

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At its headquarters in Solingen, Germany, and at roughly 30 production facilities worldwide, Esab GmbH manufactures welding equipment and consumables, as well as cutting equipment for virtually any welding or cutting process. The head office of the cutting machinery division is located in Karben near Frankfurt am Main. The portal machines with movable bridge (Fig. 1) are available for laser, oxy and plasma cutting. Depending on the design, they are suitable for a wide range of sheet metals, in particular structural steel, stainless steel and aluminium. The blow-torch machines are customised precisely for the respective requirements: In general, Esab uses sample material provided by the user to determine all cutting parameters, i.e. the best cutting process and the processing speed, nozzle type, process gases, etc.
Employee and property protection

When manufacturing its machines, the company has always focused on the protection of employees and property and considers itself a pioneer of integrated safety technology in the industry. The servo drives used in the blow-torch machines contribute to this as well (Fig. 2). The company from Karben has collaborated successfully with Yaskawa for over ten years in this field. With its integrated safety functions, the latest generation of drives offers maximum safety without restricting user friendliness.

The changes in conditions as a result of the new machinery directives have also changed the safety requirements. However this cannot be permitted to complicate handling. At the same time, the controller is relieved of all drive-specific safety tasks, because Yaskawa Sigma-5 drives have all of the properties required by the applicable safety standards and are certified accordingly by TÜV Süd.

Since the EN ISO 13489-1:2008 “Safety of machinery – Safety-related parts of control systems” standard has come into effect, the control components used to build safe machines are either evaluated according to their Performance Level (PL a to e) or their Safety Integrity Level (SIL 1 to 4). IEC 61800-5-2 defines the safety functions for adjustable speed drives.

Safe workflows during practical operation

ESAB uses two of these advanced safety functions (Fig. 3) for their blow-torch machines: SLS (Safely Limited Speed) and SS1 (Safe Stop 1). STO (Safe Torque Off, i.e. safe disconnection from the power) is standard in all Sigma-5 series servo amplifiers. The safety functions SS1 and SLS can be integrated using an option card. The same applies to SS2 (Safe Stop 2, safe stop with position monitoring), which is essential for stamping machines and punches, for example. In the worst-case scenario, the tool must not only be stopped safely, it must also be held in position safely to rule out injury to persons or damage to property.

The following example (Fig. 4) shows how blow-torch machines benefit specifically from integrated safety technology: If a safety door is opened for configuration or maintenance work, the motion controller integrated in the servo amplifier restricts the speed of the motion to a safe speed. The Sigma-5 safety module monitors compliance with the preset speed. If the safely limited speed is exceeded, the drive is switched off directly via STO.

The reaction is similar if the machine is shut down due to a light barrier signal or because an emergency stop switch is activated, for example. The safety function SS1 monitors the controlled shutting down. STO safely disconnects the drives from the power supply and the maintenance or configuration staff can work on the machine without danger. All of these safety-relevant functions are performed by the Sigma-5 servo controller; the higher-order machine controller is not affected.

Overall, depending on the size of the respective blow-torch machine, at least three servo drives are used – two to drive the moving bridge on the X axis and another to move the cutting tool on the Y axis.

The motors used must each provide 400 W of power in the application described for small blow-torch machines. However, in order to cope with higher mass moments of inertia, they are designed for a maximum power of 800 W. Other power ranges are also no problem in principle for the Sigma-5 servo drives; the complete series covers motor outputs from 50 W to 15 kW, which means that the outputs required even for large blow-torch machines can be covered easily. All conventional bus systems can be used to connect the units to higher-level control networks simply and easily. This includes Ethernet/IP, EtherCat, Powerlink and CANopen, for example. Profinet will be available soon. The drive technology can therefore be incorporated into the user’s automation environment seamlessly. This opens up interesting possibilities for mechanical engineering.
2: Servo drives with integrated safety functions. They ensure maximum safety without limiting user-friendliness.

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<tr>
<th>Safe Torque Off (STO)</th>
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<td>![Diagram of Safe Torque Off (STO)]</td>
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<th>Safe Stop 2 (SS2)</th>
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<td>![Diagram of Braking ramp monitoring]</td>
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<td>![Diagram of Position monitoring]</td>
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3: Overview of safety functions: Safe Torque Off (STO), Safe Stop 1 (SS1), Safe Stop 2 (SS2) and Safety Limited Speed (SLS)
4: Practical example: Safety door monitoring

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