V. Safety Controllers

41 What are “safety controllers” and what are their functions?

Safety controllers (such as SCHMERSAL’s AES and AZR Series) are connected between machine guarding interlock/E-Stop switches and the machine’s stop control elements (such as a motor contactor or control relay).

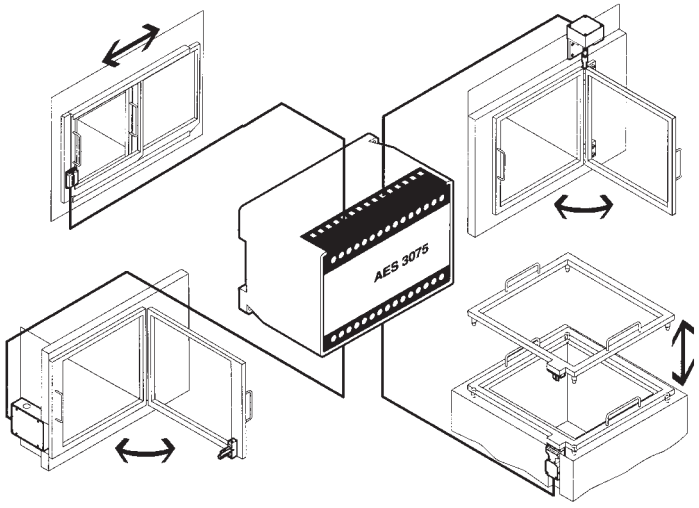
These controllers contain dual, self-checking safety system monitoring circuits and positive-guided output relays. Each is designed to monitor faults in the safety system’s interlock/E-Stop switches, the safety circuit interconnection wiring, and their own internal monitoring circuits and output relays.

Detection of a fault in the machine’s safety circuit or of an open machine guard, disables the module’s output signal(s) facilitating machine stoppage, and/or prevents the restarting of the machine until the fault has been corrected.

In addition to detecting open guards and/or actuated E-Stop switches, safety controllers are capable of detecting the following types of safety system faults:

- Guard monitoring switch/sensor failure
- “Open-circuit” in interconnection wiring
- “Short-circuit” in interconnection wiring
- “Short-to-ground” in interconnection wiring
- Welded contact in controlled output device
- (such as positive-guided motor contactor)
- Failure of safety controller’s positive-guided relay(s)
- Fault in safety system monitoring circuit
- Insufficient operating voltage.

Some microprocessor-based safety controllers, such as SCHMERSAL’S AES Series, also feature integrated system diagnostics with visual LED outputs which indicates fault type and location — thus minimizing machine downtime.



Safety controllers detect and locate system faults. Units are available for use with guard interlock switches, coded-magnet sensors, safety edges, light curtains, E-stops and emergency cable-pull switches to satisfy a broad range of application requirements.

42 Why should safety controllers be used with safety interlocks/E-Stops?

Safety controllers increase the reliability of the machine guarding safety system. Their ability to detect safety circuit faults, and shut down the machine until the fault is corrected, greatly heighten the safety level.

43 What is the difference between a single and dual-channel safety controller, and when should each be used?

A single-channel safety controller is capable of accepting only one (normally-closed) input. When used in safety circuits they are unable to detect a short-circuit failure in the interconnection wiring, or a failure of the monitored input to change state.

A dual-channel safety controller is capable of accepting two inputs; one to each of its two, redundant self-monitoring safety circuits. When used in safety circuits they are typically capable of detecting interconnection wiring faults (such as short-circuits, open circuits, and ground faults) or a failure of one of the monitored input(s) to change state. As such they provide a higher level of safety than single-channel units.

Single-channel safety controllers are suitable for relatively low levels of risk assessment (e.g. EN 954-1 Safety Categories B, 1 and 2). Dual-channel units are appropriate when designing “control reliable” safety systems — that is, systems in which a single component failure will not prevent normal machine stopping action from taking place, but will prevent a successive machine cycle from being initiated.

44 How do I decide which safety controller to use?

Safety controller selection is usually based on:

(1) the type of inputs being monitored (e.g. E-Stops, interlock switches, light curtains, coded-magnet sensors, et al).

(2) the number of inputs being monitored.

(3) the number and type of outputs required from the safety controller (e.g. number of parallel outputs from the module’s positive-guided relays and the number of auxiliary/signaling outputs).

(4) the need/desire to monitor the integrity of the positive-guided contacts in the controlled output device (e.g. motor contactor, control relay, et al).

(5) the level of safety desired (this is usually determined by a structured risk assessment).

These application parameters will normally narrow, and simplify, the choice of safety controller to one or two units.

45 When is it necessary to design a safety system to satisfy the requirements of EN 954-1 Category 4?

Category 4 safety requirements are usually associated with extremely high-risk applications. Consequently the safety system needed to satisfy these conditions can be quite complex and costly.

Since general machine design practice respects classic safety hierarchy, most extremely high-risk hazards — that is:

(a) those which the operator cannot avoid

(b) those in which the operator is exposed frequently or continuously, and

(c) those which could result in serious injury, amputation or death

are designed-out during machine development or are guarded against (if they cannot be designed-out).

Consequently for most applications it is generally not necessary to incur the cost/complexity of Category 4 safety system design. Many low-risk situations can be satisfied by safety systems that meet the requirements of Category B, 1 or 2 as defined by EN 954-1.

In most higher-risk situations, a suitable safety system (and one which meets ANSI's requirement for "control reliability") can be achieved with a system designed to meet the Category 3 requirements of EN 954-1.

When needed, Category 4 requirements can be satisfied by proper selection from SCHMERSAL's wide range of CE-compliant safety interlocks and related safety controllers.