SELECTING THE OPTIMAL CONTROLLER

Some form of a safety controller is required to meet higher risk categories and to meet the requirements for Control Reliability. This guide is intended to help you properly select and apply Schmersal Safety Controllers.

It is common to want to look at safety issues as “Here is Application Number 116 and I can find the solution in my Safety Handbook under Solution Number 116”. Unfortunately, this is seldom possible. In most cases you are forced to re-examine previous solutions for similar safety issues as it is generally application specific. For any given situation, there may be a number of correct solutions depending on the overall system design.

A safe machine is generally achieved through the combination of safety measures incorporated by design and taken by the machine operator. Ideally such measures should be addressed during the design phase. In addition proper training of machine operators and maintenance personnel is critical for safe operation.

While individual component suppliers can provide general guidance and technical information related to their products, it is the responsibility of the machine designer or retrofitter to ensure the safety system is designed to meet the appropriate standards.

To minimize the possibility of worker injury and address industry safety standards/guidelines, it is recommended that the machine designer follow these general steps:

1. Become familiarized with the pertinent safety Standards
2. Specify the limits of the machine
3. Identify the hazards and assess the risks
4. Remove the hazards or limit the risk by design
5. For remaining hazards, install necessary protective devices
6. Inform and warn the operator of any remaining risks/hazards

In designing a machine guarding safety system, the following objectives should be considered:

- Design to suit the working environment
- Achieve the desired degree of protection
- Do not interfere with machine operation
- Do not encourage manipulation/bypassing
- Make it difficult to override
- Do not cause any additional dangers/hazards

It is impossible to correctly select and apply a Safety Controller without performing some type of quantitative risk assessment. “Guesstimating” a control category for a Performance Level may lead to excessive expense and/or to an inadequate or unsafe system. There are a number of approaches to risk assessment, most of which use some form of decision tree to determine the appropriate safety control category. One such approach is discussed in the next section.

Certain factors may be considered when trying to select the optimal controller for an application:

- Supply Voltage Requirements
  24VAC, 24VDC, 110VAC, 230VAC, etc.
- Input Monitoring Requirements
  1NC, 1NO/1NC, 2NC, PNP, etc.
- Feedback & Reset Requirements
  Automatic, manual, monitored manual, etc.
- Output Requirements
  Time delayed, semiconductors, dry contacts, etc.
- Type of Performance Level required

SAFETY CONTROLLER SELECTION CRITERIA

It helps the selection process to view a safety controller as having four basic characteristics, each determined by the application requirements. This approach can be applied to any safety controller.

FOUR BASIC SAFETY CONTROLLER CHARACTERISTICS

Supply Voltage Requirements

Select your supply voltage. While many voltages are possible (24VDC, 24VAC, 24VAC/DC, 115VAC and 230VAC), 24 VDC gives the most flexibility since virtually all controllers are available in this voltage. Also, since a transformer and rectifier are not required, this unit generally is less expensive and smaller than a 115VAC model.

Regardless of supply voltage, it is always converted by the controller electronics to 24VDC for internal operation and for powering monitored input devices. Hence monitored devices only need to be rated for 24VDC.

Input Monitoring Requirements

The first step is to determine whether you need single channel (up to control category 2 designs used for safety functions up to PLd) or dual channel (control category 3 & 4 designs used for safety functions of PL_d and PL_e) operation.

Single-channel systems must monitor one NC positivebreak contact. Dual-channel systems can monitor 1NO/1NC or 2NC contacts. Generally, these need to be isolated dry contacts since most controllers will view C-form contacts as a short circuit. Remember that 24VDC is supplied by the safety controller for monitoring these contacts.

Safety controllers are available for monitoring nonpotential free contacts (such as PNP outputs from light curtains). Models are also available that allow users to field select the monitored contact configuration.

Another consideration is crossed wire detection (a short between channels). This requires special circuitry in the safety controllers and is required for category 4 designs.

Feedback & Reset Circuit Requirements

Safety controllers with feedback capability can also monitor control relays and motor contactors with positive-guide contacts. Such feedback is required for safety control category 3 & 4 designs. A NC auxiliary contact is wired into the feedback loop (with or without a reset (start) button) to detect welded contacts in these external control devices. The safety controller detects the existence of a weld when the relay shuts down due to a power loss or open machine guard and prevents a restart.

In order to reset the controller, the feedback loop must be closed (at least temporarily). If the NC auxiliary contact stays open due to a contact weld, the controller cannot be reset.

Reset can be automatic or be manual. With automatic reset the controller will automatically reset (outputs close) when the machine guard is closed. A reset or start button can be added to the feedback loop if desired. The controller only needs to momentarily see a 24VDC signal at the feedback terminals to reset.

With a manual monitored/trailing edge reset, some type of manual pushbutton is required. The feedback loop circuitry is designed so that it needs to see a 24V to 0V transition (trailing edge) in order to reset. This method of reset is generally required when a person can actually get inside a machine guard (where they would be at risk if the equipment should automatically restart when the guard closes).

Output Requirements

Determine the number and type of safety controller outputs required for machine control elements and signaling.

Following are the types of safety controller outputs:

A. NO safety enable circuits — instant or timed.
B. NO or NC auxiliary relay contacts — not to be used for safety functions, but only for annunciation
C. Semiconductor outputs for annunciation.