AVW Technical Guide

Safety PLCs and Safety Relays in Stage Automation

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1. Introduction

Modern stage automation systems rely on safety-related control systems to protect performers, technicians, and equipment from hazardous machinery movement.

Two common technologies used to implement these safety systems are **safety relays** and **safety programmable logic controllers (Safety PLCs)**.

Both devices are designed to monitor safety inputs such as emergency stop buttons, limit switches, and safety sensors, and to ensure machinery moves into a safe state if a hazardous condition occurs.

Understanding the differences between safety relays and safety PLCs helps engineers select appropriate safety solutions for stage automation systems.

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2. What is a Safety Relay?

A safety relay is a specialised control device designed to monitor safety circuits and ensure that machinery stops safely when required.

Safety relays typically monitor devices such as:

- emergency stop buttons
- safety gate switches
- light curtains
- limit switches
- two-hand control devices

Unlike standard relays, safety relays include **internal redundancy and fault monitoring** to detect failures in the safety circuit.

If a fault is detected, the relay will prevent the system from restarting until the problem is corrected.

Safety relays are commonly used in smaller systems where safety logic requirements are relatively simple.

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3. What is a Safety PLC?

A safety PLC is a programmable controller designed to perform safety-related control functions.

Like standard PLCs, safety PLCs allow engineers to implement complex control logic using software. However, safety PLCs include additional features to ensure that safety functions meet strict reliability requirements.

Safety PLCs typically support:

- multiple safety inputs and outputs
- configurable safety logic
- networked safety communication
- diagnostics and fault monitoring

Safety PLCs are commonly used in **large or complex automation systems** where multiple safety functions must be coordinated.

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4. Standards and Certification

Safety relays and safety PLCs must comply with recognised safety standards.

Common standards include:

- EN ISO 13849 – defines Performance Levels (PL)
- IEC 61508 – defines Safety Integrity Levels (SIL)
- BS EN 17206 – stage machinery safety

Manufacturers typically specify the **SIL or PL rating** that their safety devices can support.

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5. Key Differences

Feature	**Safety Relay**	**Safety PLC**
Configuration	Fixed wiring logic	Programmable
System size	Small systems	Large or complex systems
Flexibility	Limited	High
Diagnostics	Basic	Advanced
Cost	Lower	Higher

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6. Typical Stage Automation Applications

Safety relays may be used for:

- emergency stop circuits
- simple stage lift protection
- small automation systems
- standalone machinery

Safety PLCs are often used for:

- complex stage automation systems
- multiple coordinated motion systems
- large theatre installations
- integrated safety monitoring

Large venues with extensive automation systems often rely on safety PLCs to manage multiple safety functions across the stage.

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7. Advantages and Limitations

Safety Relays

Advantages:

- simple design
- easy to implement
- lower cost
- reliable for basic safety functions

Limitations:

- limited flexibility
- difficult to expand
- complex wiring for large systems

Safety PLCs

Advantages:

- flexible safety logic
- easier expansion
- integrated diagnostics
- support for complex systems

Limitations:

- higher cost
- requires specialised programming
- more complex system validation

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8. Practical Considerations for Stage Automation

When selecting a safety control system, engineers should consider:

- system complexity
- number of safety devices
- future system expansion
- required safety performance level
- maintenance and diagnostics

In many modern theatre installations, safety PLCs are preferred due to their flexibility and ability to manage complex automation systems.

However, safety relays remain an effective solution for simpler applications.

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9. Practical Takeaways

- Safety relays and safety PLCs both implement **safety-related control systems**.
- Safety relays are ideal for **simple safety circuits**.
- Safety PLCs provide **greater flexibility for complex automation systems**.
- Both technologies must meet recognised safety standards.
- System design should always begin with **risk assessment**.

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10. Further Reading

- IEC 61508 – Functional Safety
- EN ISO 13849 – Safety of Machinery Control Systems
- BS EN 17206 – Machinery for Stages and Production Areas

- **About the Author**
- Anton Woodward works in theatre engineering and stage automation systems.
- More technical resources and safety guides are available at:
- www.avw.co.uk