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WHITE PAPER

Exploring Safety Electronics in Modern Elevator Systems

How advanced safety relays, terminal blocks and emergency stop systems improve passenger and technician safety in elevators.

The importance of safety electronics in modern elevator systems can't be overstated. Passenger and technician safety depends not only on mechanical components but also on the electronic systems that monitor, control and respond to potential hazards in real-time.

A successful elevator safety system functions as an integrated chain of protection, where each component must perform reliably and work seamlessly with others. The electronics that form the backbone of safety systems include safety relays, advanced terminal blocks and emergency stop (E-Stop) mechanisms. Rather than operating in isolation, they form multiple layers of protection that work together to ensure safe operation and provide quick responses during emergencies.

For example, when a technician activates an E-Stop during elevator maintenance, the signal must travel through vibration-resistant terminal block connections to reach the safety relay, which responds within milliseconds to safely halt the elevator. This coordinated response depends on every component in the chain performing its role without fail.

The integration of these advanced safety electronics addresses several demands in modern elevators, including the need for fail-safe operation during power failures, durability in high-vibration environments, fast emergency response capabilities and compliance with stringent safety standards.

As elevator systems become more sophisticated, the role of these electronics becomes even more important in protecting people and equipment. This white paper explores how safety relays, terminal blocks and E-Stop mechanisms work together to create comprehensive safety systems that protect people while enabling efficient elevator operation.

The Role of Safety Relays in Elevator Operations

Safety relays, which are essential components in elevator safety, manage electrical circuits and provide fail-safe mechanisms to prevent hazardous situations. These devices are designed for applications like Elevator Standard EN 81-1 (electric) and EN 81-2 (hydraulic), as well as the Escalator Standard EN 115/06.95.

These safety relays operate using Forced-Guided Contacts — also known as captive, locked or positive-guided contacts. This critical feature ensures that Normally Open (NO) and Normally Closed (NC) contacts are mechanically linked, making it impossible for both to be closed at the same time. This mechanical interlocking guarantees a safe state even if a contact welds or a relay part fails.

Beyond core safety, these relays support remote monitoring and predictive maintenance. The ability to reliably diagnose the switching position allows for proactive strategies that identify potential issues before system failures occur, reducing unexpected downtime.

Key Specifications and Advantages of Altech Safety Relays

- Mechanical life: Over 50 million cycles translate to decades of reliable service in 24/7 elevator operations, reducing the frequency of part replacement.
- Contact gap: >0.5 mm minimum separation maintained throughout the life of the relay — even with a malfunction.
- Operate and release times are ≤20 ms and ≤6 ms, respectively, for models like the OA 5612. These responses ensure immediate safe shutdown of the control system when triggered by an E-Stop or sensor.
- Supports switching rates up to 10 operations per second.
- Contact materials are available in multiple options, depending on load.
- High switching reliability, with crown contacts on several models to reliably switch heavy and low current loads.
- Available in RTII (solder line proof) and RTIII (wash proof) versions.

Ensuring Reliable Connections With Advanced Terminal Blocks

Terminal blocks represent critical connection points in elevator electrical systems, and your choice of terminal technology directly impacts system reliability and safety. In elevator shafts, electrical connections are subjected to constant vibration and long, continuous operation. Traditional screw-type terminal blocks, though widely used, have a flaw in these environments. Over time, the constant vibrations can cause screw terminals to loosen, compromising the connections and potentially leading to circuit failures.

Two advanced terminal block technologies that address this issue include Spring Clamp Terminal Blocks — like the Altech CX Series — and Push-in Terminal Blocks — like the Altech CP Series.

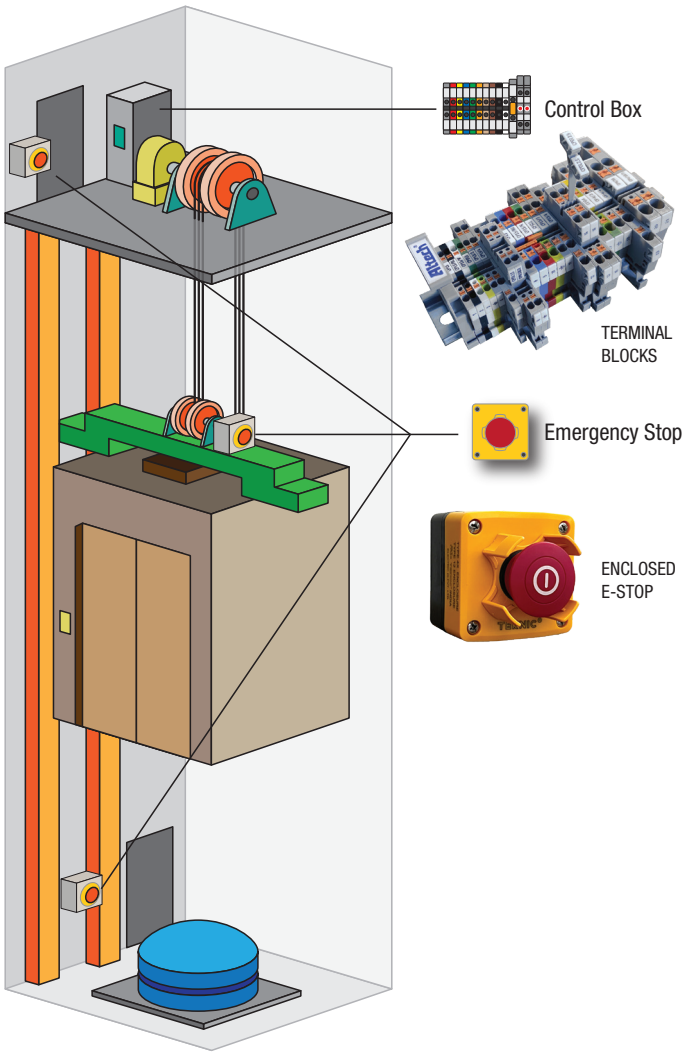
Spring Clamp Terminal Blocks:

These terminal blocks overcome the vibration issue through an innovative clamping mechanism. The spring mechanism maintains constant pressure on conductors, pressing them firmly against current bars despite vibration levels. This consistent contact pressure maintains reliable electrical connections throughout the elevator's operational life, while the elimination of vibration-induced connection failures enhances system reliability and reduces maintenance requirements.

Altech's CX Series terminal blocks continuously maintain a 150N clamping force and achieve vibration resistance up to 10g, 10–2,000 Hz, ensuring connections remain secure and maintenance-free even in demanding elevator shaft environments. These features also significantly reduce troubleshooting time and improve safety.

Technical Specifications: The Altech CX Series

- Vibration resistance: tested to 10g, 10–2,000 Hz per IEC 60068-2-64
- 150N minimum clamping force maintained continuously
- Wire capacity: 0.08-2.5mm² (AWG 28-12) for flexible wire
- Contact resistance: <5mΩ initial, <10mΩ after life testing
- Temperature cycling: -40°C to +100°C, 1,000 cycles per IEC 60068-2-14
- High-impact, self-extinguishing Polyamide PA66 construction



Push-in Terminal Blocks:

The second type of terminal block uses a push-in connection, which represents the latest advancement in spring technology and offers time savings, a compact design and secure wiring. This technology maintains long-term contact reliability and is specifically engineered for the harshest environments, including steady vibrations and high temperature variations.
Another major advantage is installation efficiency. Push-in terminal blocks eliminate the need for tools for solid wires or flexible wires with ferrules, supporting direct connections and reducing wiring time by over 50% compared to traditional screw-type alternatives. The consistency of the connection quality is independent of operator skill, ensuring uniform performance across all termination points.

This no-tool-required direct connection feature accelerates the installation and commissioning process, making complex elevator wiring jobs faster and reducing labor costs without sacrificing the reliable, gas-tight connection achieved by the stainless-steel push-in spring.

Both spring clamp and push-in terminal block series are available in a variety of configurations for design flexibility, including versions for different connection types, and utilize high-impact, self-extinguishing materials (such as Polyamide PA66) for durability and enhanced fire safety.

Technical specifications: The Altech CP Series

- Wire range: 0.14-4.0 mm² (AWG 26-12) for solid conductors; 0.14-2.5 mm² (AWG 26-14) for flexible wire with ferrules
- Actuation force: <30N for direct insertion (tool-free)
- Contact resistance: <5mΩ per IEC 60947-7-1
- Vibration resistance: 10g, 10–2,000 Hz per IEC 60068-2-64
- Temperature range: -50°C to +120°C operating
- Installation time: 50% faster than screw terminals
- Stainless steel push-in spring for corrosion resistance
- Self-extinguishing Polyamide PA66 housing material

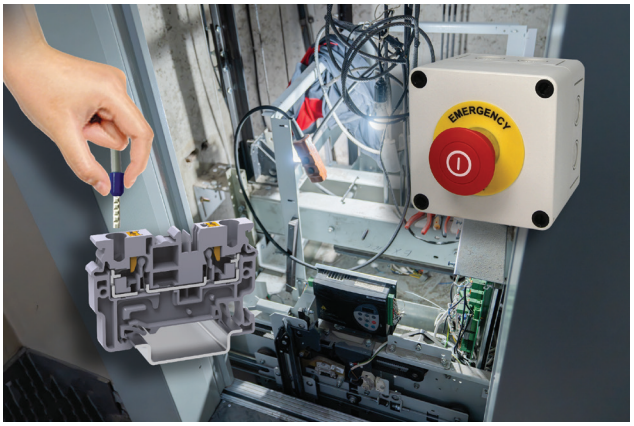
Emergency Stop Mechanisms: The Last Line of Defense

Emergency Stop (E-Stop) mechanisms are a mandatory safety feature that provides personnel with an immediate way to halt elevator and escalator operations during an emergency. In elevators, E-Stops serve as critical safety devices for maintenance and inspection personnel — as required by codes like ASME A17.1 / CSA B44 (Safety Code for Elevators and Escalators).

E-Stops are explicitly required in the elevator pit and on the top of the elevator car as part of the car top inspection station, which is designed for use by qualified technicians.

- **Elevator Car Top Inspection Station:**
  The E-Stop button immediately stops the elevator in case of emergency during maintenance.

- **Elevator Pit:**
  An E-Stop switch must be provided in the pit, adjacent to the access, enabling technicians to immediately remove power from the motor and brake.
- **Escalators:**
  E-Stops are also found in public-facing locations on escalators for passenger or operator use. In these areas, E-Stops often include protective shrouds to prevent accidental actuation while still ensuring the E-Stop can be pressed quickly when needed.



E-Stop devices are distinguished from standard "stop switches" by requiring a human action for resetting — often a twist, pull or key release — before the machine can be restarted, providing a foolproof shutdown. Their actuators must also be colored red with a yellow background to ensure high visibility and recognition in an emergency.

Altech's E-Stops incorporate sophisticated design features that further enhance safety and usability. Protective shrouds, typically made from durable polycarbonate, ensure long-term durability while preventing accidental actuation, while the standardized 22.5-mm mounting configurations offer flexibility to accommodate various actuator types.

Additional features and benefits include:

- **Material Innovations:**
  Advanced materials like ABS/Nylon and polycarbonate offer mechanical strength and self-extinguishing properties to reduce fire risk during electrical faults, ensuring E-Stop functionality even under adverse conditions.
- **Seamless Integration:**
  E-Stop mechanisms are designed to integrate seamlessly with other safety components. When one is engaged, the coordinated response with safety relays and terminal blocks minimizes accident risk.

Compliance and Standards Adherence
All safety electronics in elevator systems must comply with stringent safety standards to ensure their effectiveness and reliability. These include:

- **DIN EN 61810-3:**
  Specifies requirements for relays with forcibly guided (mechanically linked) contacts.
- **IEC 60947-5-1 and EN 60947-5-5:**
  International standards specifying requirements for E-Stop functions and electromechanical control circuit devices.
- **UL, NEC, CSA, IEC, VDE:**
  General standards for push buttons and control components.
- **NEMA Type 4X, 12:**
  Common enclosure protection rating for harsh environments.
- **ASME A17.1 / CSA B44:**
  The primary safety code for elevators and escalators.

Compliance with these standards is critical for protecting passengers, personnel and equipment from potential hazards. The standards address not only functional requirements, but also the environmental conditions and performance criteria that the electronics must meet throughout their operational lives.

Learn More
The safety of elevator systems depends on the integration of advanced safety electronics that work together to create multiple layers of protection. Safety relays ensure fail-safe electrical control, advanced push-in and spring clamp terminal blocks guarantee reliable connections in high-vibration environments and E-Stops serve as the final line of defense for maintenance personnel. Integrating these components creates comprehensive safety systems that protect people while enabling more efficient elevator operation.

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