



Best Practices For Reed Relays In High Voltage Applications

Learn how to get the best performance and longest life out of your Reed Relays

Introduction

High voltage applications need to maintain the highest standards for safety, efficiency and reliability to guarantee the best performance and ensure the protection of equipment and people. When it comes to components that can switch high voltages, look no further than High Voltage Reed Relays. They are built from two ferromagnetic contacts sealed in a glass capsule under vacuum, forming a galvanically isolated open contact. The vacuum environment ensures very high insulation resistance, extremely low leakage current, and suppresses arcing across the open gap. This simple but effective construction delivers predictable long-term performance and stable switching behavior in demanding conditions.

“Reed Relays provide a true open environment with minimal current leakage in a compact package.”

When compared with other switching technologies, clear differences emerge. Electromechanical relays offer true galvanic isolation, but they require large contact gaps, which makes them bulky, slower to operate, and subject to wear. Solid-state relays are a more compact solution but, given their semiconductor nature, they exhibit a relatively large leakage current even when in the off state, which limits their use in applications like precision high voltage measurements. Reed Relays can achieve the best of both worlds, providing a true open environment with minimal current leakage in a compact package.

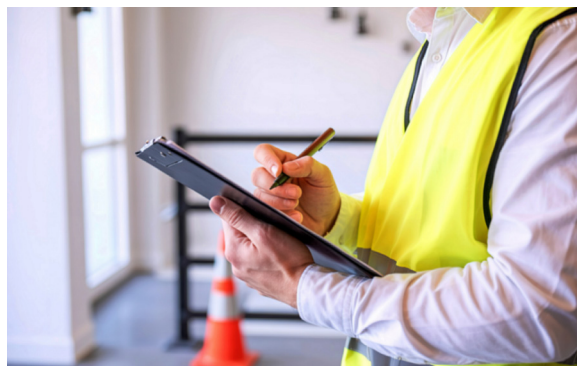
Coto Technology leverages its proven expertise in precision reed relay manufacturing to deliver industry-leading reliability in the Automated Test Equipment (ATE) market. This same commitment to quality extends to our high-voltage product lines, where applications demand the highest

switching reliability and consistent long-term performance. In this document, we will share a list of best practices that will help ensure you get the best performance out of High Voltage Reed Relays in your application.

Best Practices for High Voltage Applications

1. Review Your Industry Standards

High-voltage requirements vary by industry, environment, and application, so it's essential to follow the relevant design standards. For example, IEC 60664-1 provides guidelines for minimum creepage, and clearance distances based on voltage, pollution degree, and material group, helping to ensure compliance and safety. Creepage is the shortest distance along the surface between conductive parts and is related to the main working voltage of the relay. Clearance, on the other hand, is the shortest distance between conductive parts through air and is concerned with overvoltage transients. These parameters determine where breakdown occurs under high voltage, either within the package or through the air. Selecting the right package width and PCB layout is essential to ensure reliable operation. Always check any relevant standards for your application and verify that your design meets the required creepage and clearance distances for the specific voltage levels that are being handled.



2. Prioritize “Cold Switching” whenever possible

Cold Switching ensures the relay contacts are fully closed before the switched load is applied. In contrast, Hot Switching involves applying the load before the relay’s contacts are closed. By applying Cold Switching, the relay’s contact life can be maximized, especially at higher loads. To apply Cold Switching, the reed relay can be paired with another switching solution, such as an Insulated Gate Bipolar Transistor (IGBT) or even a High Voltage Solid-State Relay (such as Coto Technology’s S117x High Voltage CotoMOS® MOSFET relay). In this configuration, the reed relay provides true galvanic isolation when the load is not applied and the solid-state relay or transistor performs the hot switching. This combination of relay technology is excellent for minimizing leakage current and maximizing the life of the reed relay. An example diagram for this configuration is shown below (Figure 1). With Cold Switching, K_1 closes first and then Q_1 applies the High Voltage to the load.

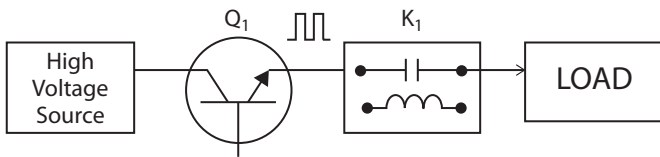


Figure 1: Cold Switching Configuration. K_1 is a Reed Relay, whereas Q_1 can be a solid-state solution, such as a MOSFET Relay or IGBT device.

3. Design with safety margins

Maintaining a healthy safety margin for parameters such as voltage and current is always a good practice. This can mean selecting a reed relay with a higher spec than what is required for the application, to safeguard against potential variations and/or transient phenomena that may exceed the relay’s rated parameter. Crucial parameters to watch out for depend on whether Cold or Hot Switching is employed.

When performing Cold Switching with a high voltage reed relay, it is imperative not to exceed its maximum contact power rating. Other relay parameters – such as switching voltage or current - can go beyond the rated specification as long as the effective power is kept within the relay’s capability. When it comes to Hot Switching, some critical parameters to observe are Breakdown Voltage, which can prevent arcing at the switch contacts, and maximum switching current, as the generation of any inrush currents that exceed this maximum switching current can cause the switch contacts to stick (see more details in Best Practices Tip #4).

For more details on this topic, please view our App Note

on “Reed Relay Power Ratings and Extending Switching Capabilities.”

4. Mitigate capacitive inrush currents and avoid reactive loads

A capacitive element along the portion of the circuit interrupted by the reed relay will generate a large inrush current spike once the reed switch closes. This large spike can damage the contacts of the reed switch by creating micro-welds, where the plating on a small spot on the contacts melts and then solidifies after the inrush current goes down. This can lead to a failure mode where the relay contacts stick together at those spots when they should be opened (this is known as “sticking”). To mitigate this, a current limiting resistor can be placed along the path of the switch to ensure the current never exceeds the maximum current limit of the reed switch inside the relay.

5. Validate with real load conditions

Perhaps the most important way to confirm proper operation of a given design is to test the relay with the actual load conditions it will encounter in the application. This can highlight any potential issues that may have been overlooked during the design process. Coto Technology can provide customers with technical guidance and can even perform some testing to address questions regarding reed relay performance. For more information on Coto’s testing capabilities and how we can help you, please contact us via our website (<https://cototechnology.com>).

6. Review the supplier’s catalog and customization capabilities

Reed relay manufacturers like Coto Technology offer a wide selection of reed relays for different high voltage applications. In addition to our comprehensive high voltage reed relay selection, we offer various customization options for high voltage reed relays. These custom options include higher switching and breakdown capabilities, alternate pin layouts, cables instead of pins, etc. For more information about our High Voltage Reed Relay customization options, please see the following App Note: “**Ensuring Reliability through Customization and Rigorous Testing**”. For any specific requirements not covered either by our customization options or our standard catalog, please contact Coto Technology.

7. If using multiple relays in proximity, design to avoid magnetic interference

Reed relays are electromagnetic components, given that they use an electric current to produce a magnetic field that closes the switch (Form A / Normally Open relay), opens it

(Form B/Normally Closed relay) or a combination of both (Form C / Changeover relay). This generated magnetic field will leak outside of the relay package; the amount of leakage depends on the design of the coil, the relay package and whether there is any ferromagnetic shielding on the relay. This leaked magnetic field may adversely affect nearby relays in one of the following ways:

- **Soft interference:** the leakage field from one relay alters the pull-in and drop-out voltages of a nearby relay.
- **Hard interference:** the leakage field from one relay interferes with the operation of a nearby relay, preventing it from opening or closing.

The level of magnetic interference can be exacerbated if the relay has a magnet inside – as is the case with Form B (and some Form C / Changeover) relays. There are several measures that can mitigate the effect of any leakage magnetic fields:

- Select a relay with an external **ferromagnetic shield**, such as our 9104-Series Reed Relay.
- For relays without external mag shields, increase the **on-center distance** between adjacent relays. This is especially crucial for reed relays containing an internal bias magnet.
- When using reed relays in a matrix (as shown in Figure 2) **alternating the polarity of relays** in pairs helps to minimize the effects of magnetic interaction - especially for the relays around the center of the matrix.
- Whenever possible, **avoid simultaneous operation** of adjacent relays.

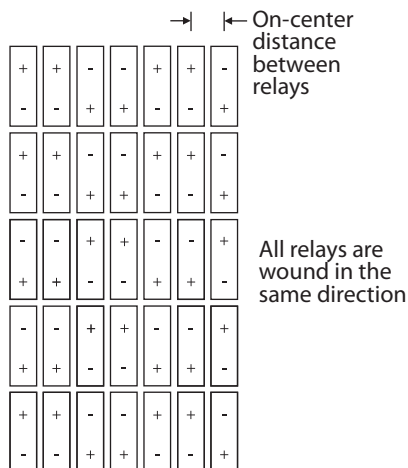


Figure 2: It is helpful to orient adjacent reed relays in the proper direction in order to cancel out any external magnetic influence and ensure all reed relays will operate appropriately.

For more information about proper spacing between relays and/or to obtain proper spacing guidance on your reed relay configuration, please reach out to Coto Technology via our website <https://cototechnology.com> and one of our Application Engineers will be available to assist you.

Conclusion

Best practices for high voltage relays include things like ensuring compliance with relevant specs, maintaining proper pin spacing to ensure good creepage/clearance, mitigation of transient phenomena like inrush current, and spacing relays to minimize any magnetic interference. With these best practices in mind, you can ensure the best performance and longest life for reed relays in your application. If you have any questions about any of these or any other topics related to High Voltage Reed Relays and their operation, please reach out to us via our website, at <https://cototechnology.com>.

Glossary of Terms/More information:

Breakdown voltage/dielectric strength: The breakdown voltage is the maximum voltage that can be applied across the open switch contacts before electrical breakdown occurs. It is primarily dependent on the gap between the reed switch contacts and the type of gas used inside the glass capsule that houses the reed switch. Higher AT switches within a given switch family have larger gaps and higher breakdown voltage. This parameter is also affected by the shape of the contacts, since pitting or “whiskering” of the contact surfaces can develop regions of high electric field gradient that promote electron emission and avalanche breakdown. Since such pitting can be asymmetric, breakdown voltage tests should be performed with forward and reverse polarity. When testing bare switches, ambient light can affect the point of avalanche and should be controlled or eliminated for consistent testing. Breakdown voltage measurements can be used to detect reed switch capsule damage.

Insulation resistance: The DC resistance between two specified test points. At higher operating temperatures, insulation resistance may be lower than stated values.

Switching voltage: The maximum voltage that can be hot switched by a relay at a specified current without exceeding its rating. Generally lower than breakdown voltage, since it has to allow for any possible arcing at the time of contact breaking.

Cold switching: A circuit design that ensures the relay contacts are fully closed before the switched load is applied. Operating and release time and bouncing must be considered when programming the opening/closure of the reed relay switch. If technically feasible, cold switching is the best method for maximizing contact life at higher loads.

Hot switching: Involves applying the voltage/current before the switch is closed.