

## Questions to Consider When Selecting Relays

### Overview

When purchasing relay products, there are different types of relays that are available. At times, it can be confusing as to which relay types to select.

Below, we will review two primary relay types and the questions that can be asked to determine which relays are best for your application.

The two primary types we use are Form C relays and Solid State relays (SSR).

Form C relays are electromechanical relays. They have a normally open (NO) contact and a normally closed (NC) contact, with a common (C) terminal. They operate in a "break before make" fashion.

SSRs are MOSFET based devices that act as relays. They come in two primary versions, high-side and low-side.

### High Side SSRs:

High side SSRs are typically used in new installation applications so the load will only be connected to ground when it is not energized. This is the most common SSR type, and is the kind used on our PCI-IDIO-XX, PCI-IDO-XX, 104-IDIO-XX and USB-IDIO-XX series products.

### Low Side SSRs:

Low side SSRs are used mainly in legacy applications where the architecture is already established and switching to ground is required to energize a load. This is similar to open collector switching. The positive voltage of the system is connected the load at all times (The load is always hot). This is inherently less safe than a high-side switched system. This is why new designs tend to use high-side switches.

### Advantages of SSRs over Form C relays:

- SSRs are faster than electromechanical relays, on the order of microseconds vs. milliseconds
- Increased lifetime, particularly if activated many times, as there are no moving parts to wear
- More reliable, typically are fully protected and won't fail
- Output resistance remains constant regardless of amount of use
- Clean, bounceless operation
- Decreased electrical noise when switching
- No sparking, allowing use in environments where it is critical that no spark is generated during switching
- Totally silent operation
- Inherently smaller than a mechanical relay of similar specification (if desired may have the same "casing" form factor for interchangeability)
- Much less sensitive to storage and operating environment factors such as mechanical shock, vibration, humidity, and external magnetic fields
- Higher extended temperature range (-40C to +85C)

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### Disadvantages of SSRs vs Form C relays:

- Voltage/current characteristic of semiconductor rather than mechanical contacts:
  - When closed, SSRs have higher resistance (generating heat), and increased electrical noise
  - When open, SSRs have lower resistance, and reverse leakage current (typically  $\mu\text{A}$  range)
  - SSR characteristics are not linear (not purely resistive), distorting switched waveforms to some extent. An electromechanical relay has the low ohmic (linear) resistance of the associated mechanical switch when activated, and the exceedingly high resistance of the air gap and insulating materials when open.
  - Some types of SSRs have polarity-sensitive output circuits, meaning they can't switch AC voltage. Electromechanical relays are not affected by polarity.
- SSRs have the possibility of spurious switching due to voltage transients (due to much faster switching than mechanical relay)
- SSRs require an isolated bias supply for the gate charge circuit
- Higher transient reverse recovery time ( $T_{rr}$ ) due to the presence of Body diode
- SSRs have a tendency to fail "shorted" on their outputs, while electromechanical relay contacts tend to fail "open".

### So, with this information, here are questions we ask:

How will the relays be used in the application?

What are they connected to?

How often will they be actuated?

If in the 100k to millions operations, the SSRs are preferred.

Will the system be battery powered?

If so, Form C might be preferred as the leakage current of the SSRs might be an issue.

What temperature range do the relays need to operate in?

Form C relays are limited to  $-40^{\circ}\text{C}$  through  $+70^{\circ}\text{C}$ .

What voltage needs to be switched?

How much current does the relay need to carry??

Some of our relays handle 1 amp, some handle 2 amps.

If using SSRs, will the load be connected to Vcc (Low-side) or to Ground (High-Side)?

Do they need debounced operation? (SSR preferred)