pickering

Application Guide

How Data Acquisition Benefits from Reed Relays

In this application guide:

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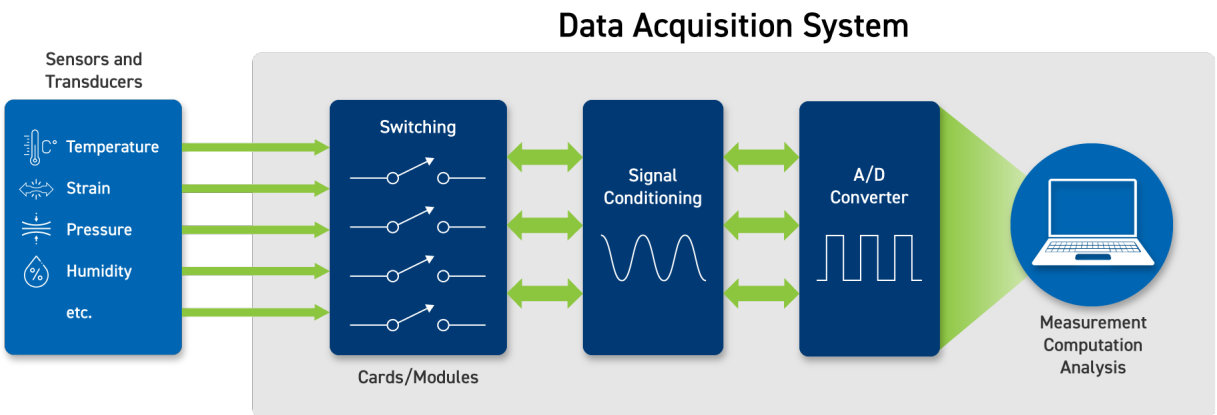
Pickering 55 Years 1968 - 2023

Data Acquisition

Introduction to Data Acquisition

In data acquisition (DAQ) applications, measurements need to be taken from a wide range of transducer and sensor types. Many produce a voltage in response to a condition; for example, a photovoltaic (PV) cell reacting to light or a Hall effect sensor reacting to the presence of a magnetic field. In other cases, a fundamental property/ characteristic of the sensor is relative to its environment, as is the case with a resistance temperature detector (RTD) or a dielectric sensor used to measure moisture content.

The outputs/properties of the transducers are then conditioned into signals for feeding into data logging instrumentation (data loggers) or to act as inputs into closed loop control circuitry.
In many cases, multiple sensors or transducers are employed; for example, several RTDs might be used to measure temperature in different locations. However, it is impractical to have a signal conditioning circuit for each sensor. Instead, it is more efficient to poll the sensors. Moreover, common signal conditioning circuitry can be used with different sensor types (see Figure 1). The circuitry's gain and perhaps filtering are controlled to make best use of the sensors' range.



The Role of Reed Relays in DAQ Systems

Reed relays are ideal for connecting the signal conditioning circuitry to the sensors for a variety of reasons. Where accuracy is concerned:

- Having a low thermal EMF can be important because some transducers, such as thermocouples, produce very small voltages. The presence of too much thermal EMF between the transducer and the signal conditioning circuitry will skew the readings.
- Figure 2 shows the response of one of Pickering's low thermal EMF devices (from its 100 series – in which device dimensions are just 24.1 x 10.2 x 15.2 mm (L x W x H).
- Reed relays have very low leakage currents and capacitance (well below 1 nA and 1 pF), giving them an advantage over semiconductor switches. For example, a typical MOSFET might have a leakage current ranging from 10 nA to 1 µA, and capacitance values from tens of pF to several hundred pF, depending on the device specifications.
- Using instrumentation grade reed switches with sputtered ruthenium plated contacts ensures excellent low-level performance and because the reed relay's switch contacts are hermetically sealed (either in a vacuum or an inert gas) the contact resistance will be stable over billions of operations. This is not the case with electromechanical relays (EMRs) as their switch contacts are exposed to the atmosphere and prone to surface oxidization.

For all general and low level DAQ applications, Pickering reed relays offer a very wide range of suitable products with a variety of contact configurations, form A, form B and form C. From industry standard 0.2" and 0.15" wide packages to the 4 mm^2 range with the smallest board area currently available from any manufacturer.

Additionally, many applications require the measurement of high voltages. For example, the individual dies on power semiconductor wafers are typically probed to confirm functionality (and to monitor fabrication yield) before they are cut, diced, and packaged. There is also the need for high voltage DAQ during the development and production of electric vehicles, and monitoring on solar farms. In this respect, reed relays that use reed switches sealed in a vacuum have much higher switching and standoff voltages. For example, the Series 104 can handle up to 1.5 kV switching and 5 kV standoff, and within a small SIL package size.

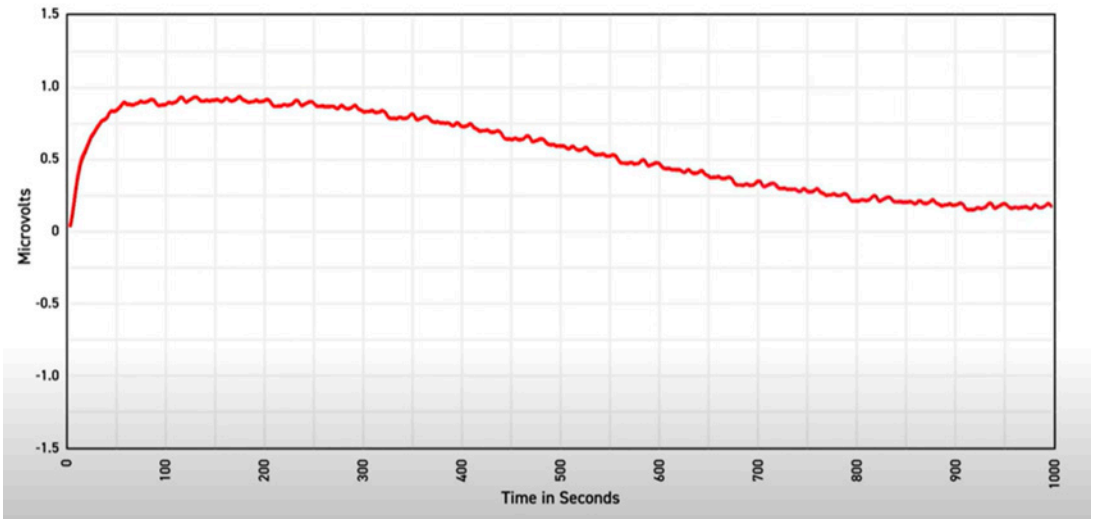


Figure 2 The thermal EMF response of a 100-2-A-5/2D.

There is often a requirement to measure a relatively high current, for which high power reed relays such as those in Pickering's recently announced 144 series are ideal. Devices can switch up to 2 A, while still being suitable for low-level switching.

On a general note, for high power applications it is important to keep high- and low-voltage circuitry apart. A reed relay is ideal for this task because there is no physical connection between its coil (driven by low voltage control electronics) and the reed switch (potentially connecting to high voltage or passing a high current). Semiconductor switches on the other hand have been known to fail in such a way that the high voltage or current makes its way into the control circuitry.

Above, we have focused mainly on the capabilities of the reed switch, which is indeed the most important component within the device. However, for battery powered DAQ applications, a high coil resistance is strongly recommended. This is because energizing the coil draws less power than would otherwise be the case, thereby extending battery life and reducing thermal EMF.

Reed Relay Technologies

Comparing Relay Technologies

There are essentially three ways to electronically switch in DAQ systems

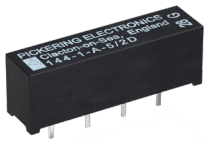
Electromechanical Relays (EMRs)

Used in many general purpose switching applications. However, with contacts exposed to the atmosphere, surface oxidization can significantly impact their low level switching performance along with relatively slow operating speeds.

Solid State Relays (SSRs)

There are no physical contacts but there can be relatively high ON resistances. SSRs may have high leakage current and capacitance which can also impact low level signals.

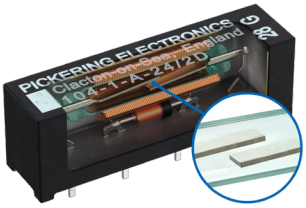
Reed Relays



With instrumentation grade reed switches sealed in an inert gas or a vacuum, reed relays can switch varied signals with little degradation over billions of operations. Much faster than EMRs and providing better isolation and signal path than SSRs, they are often the best solution for a wide range of data acquisition applications.

When choosing a reed relay for a data acquisition application, the following are the most crucial factors to consider:

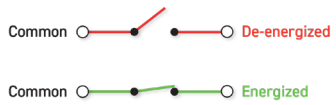
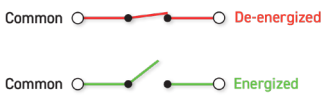
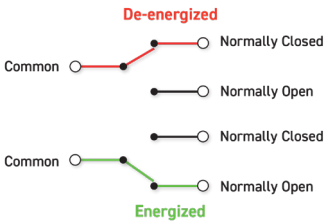
- **Maximum Switching Voltage.** The highest DC or AC (peak) voltage that can be switched.
- **Minimum Standoff Voltage.** The minimum DC or AC (peak) voltage that can be applied across the open contacts before breakdown occurs. For high-voltage applications, the higher the minimum standoff voltage the better, as it improves safety and reliability.
- **Maximum Switching Current.** The maximum current the contacts can switch within the constraints of the contact power rating. Note: be mindful of switching (on) to highly capacitive loads and when removing power from highly inductive loads.
- **Maximum Carry Current.** The highest continuous current the device can pass through its closed contacts.
- **Coil Voltage.** The nominal DC operating voltage of the relay coil.
- **Coil Resistance.** The nominal resistance of the operating coil, usually specified at 25 °C.
- **Insulation Resistance.** This is the resistance between any of the device pins. This needs to be very high (ideally greater than 1TΩ (Tera Ohms, so 1 x 10^{12} Ohms) if you are to keep current leakage to a minimum.
- **Contact Resistance.** The maximum initial contact resistance for the closed switch.



For high-voltage reed relays, the contact is sealed in a vacuum, greatly increasing the minimum standoff and maximum switching voltages. Insulation resistance is high thanks to pin spacing and the relay's base material. As for external shield clearance, this is not an issue when the EM shielding is on the inside of the device.

By considering these key factors, you can make a well-informed decision when selecting the appropriate reed relay for your application. Other information you will need to consider when designing your data acquisition equipment includes contact configuration and service life.

Contact Configuration (Forms)

Form A	Form B	Form C
		
With the coil de-energized the switch is normally open (NO). If just one switch is present, the form is 1A, meaning single pole single throw normally open (SPST-NO). If two switches are present, the form is 2A, meaning double pole single throw normally open (DPST-NO). With three switches it is 3A (3PST-NO).	With the coil de-energized the switch is normally closed (NC). If just one switch is present, the form is 1B, meaning single pole single throw normally closed (SPST-NC). If two switches are present, the form is 2B, meaning double pole single throw normally closed (DPST-NC). With three switches it is 3B (3PST-NC).	These are changeover devices that break their NC contact (and close the NO one) when the coil is energized. If just one switch is present, the form is 1C, meaning single pole, double throw (SPDT). If two switches are present, the form is 2C DPDT. With three switches it is 3C.

What's the Service Life?

This is the one figure on any datasheet, from any manufacturer, that is open to interpretation. We state 1 x 10^9 operations for most applications, but the fact of the matter is the figure could be higher or lower depending on the exact application. Considerations are: How close to voltage and current limits are you operating? What is the switching duty cycle? Are you likely to see inrush currents?

Also, at what point do you consider the device to be failing? When contact resistance increases by 10%? 20%? More?

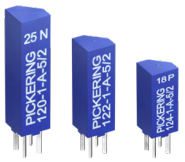
Rest Assured, We're Here to Help

Tell us about your application and we'll not only recommend the most suitable device, but we'll also give you an indication of the device's realistic service life.

RECOMMENDED PRODUCTS

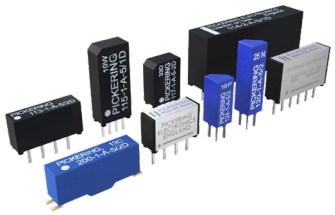
Pickering Electronics has an extensive range of high-performance reed relays that are ideally suited to DAQ applications in which the parameter being measured is very low (the output from a thermocouple, for example) as well as high voltage devices. What follows are just a few recommendations based on the issues discussed above, i.e., we highlight key features and device properties that are of particular importance in most DAQ applications.

Ultra-High Density Reed Relays



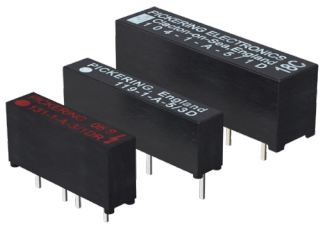
These relays have a maximum switch current of **1 A** (up to **20 W**), and the maximum carry current is **1.2 A**. Fast operate and release times (as low as **80 µs** or less) make these relays suitable for high-speed test systems.
Body dimensions from (W x H x D): 3.9 x 9.5 x 3.9 mm.
Available forms: **1 Form A** contact configuration.

High Density Relays



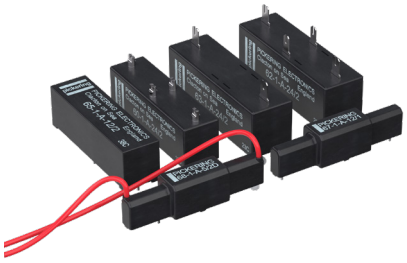
These relays have a maximum switch current of **1 A** (up to **20 W**), and the maximum carry current is **1.2 A**. Switches feature sputtered ruthenium contacts for long life and high reliability.
Body dimensions from (W x H x D): 6.6 x 9.5 x 3.7 mm.
Available forms: **1 Form A**, **1 Form A Coax**, **2 Form A**, **1 Form B**, and **1 Form C** contact configurations.

Miniature High-Voltage Reed Relays



These relays have switching voltages up to **1.5 kV** and standoff voltages up to **5 kV**.
The maximum switch current is **1 A** (up to **25 W**) and the maximum carry current is **1.5 A**. High coil resistance options (up to **6.8 kΩ**). Thermal EMF devices are between **3 and 10 µV**. Relays can endure temperatures as high as **150 °C** if requested.
Body dimensions from (W x H x D): 12.5 x 6.6 x 3.7 mm.
Available forms: **1 Form A**, **2 Form A**, and **1 Form B** contact configurations.

High-Voltage Reed Relays



These relays have switching voltages up to **12.5 kV** and minimum standoff voltages up to **20kV**. The maximum switch current is **3 A** (up to **200 W**) and the maximum carry current is up to **5 A**. Option of PCB pins, chassis, PCB mounting, and flying leads.
Body dimensions from (W x H x D): 58.4 x 19.0 x 12.6 mm.
Available forms: **1 Form A**, **1 Form B**, and **1 Form C** contact configurations.

Free relay samples are available. Go to: pickering**relay**.com/samples

RECOMMENDED PRODUCTS

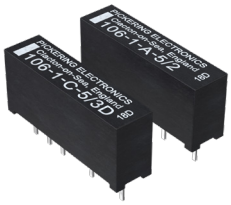
High Coil Resistance Reed Relays

These relays have a maximum switch current of **1 A** (up to **20 W**), and the maximum carry current is **1.2 A**. Featuring high coil resistances (up to **6 kΩ**), devices are ideal for portable instruments.
Body dimensions from (W x H x D): 8.13 x 15.24 x 4.8 mm.
Available forms: **1 Form A**, **2 Form A**, **1 Form B**, and **1 Form C** contact configurations.

Low Thermal EMF Reed Relays

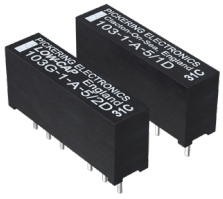
These relays have a maximum switch current of **1 A** (up to **20 W**), and the maximum carry current is **1.2 A**. Devices feature low thermal EMF (around **1 µV** or less) and low power consumption.
Body dimensions from (W x H x D): 20.1 x 9.4 x 7.4 mm.
Available forms: **1 Form A**, **2 Form A**, **1 Form B**, and **1 Form C** contact configurations.

Industry Standard Size Reed Relays



These relays have a maximum switch current of **1 A** (up to **20 W**), and the maximum carry current is **1.2 A**. Featuring superb contact resistance stability and ultra-high insulation resistance.
Body dimensions from (W x H x D): 19.1 x 7.6 x 4.8 mm.
Available forms: **1 Form A**, **2 Form A**, **1 Form B**, **1 Form C**, and **2 Form C** contact configurations.

Low Capacitance Reed Relays



These relays have a maximum switch current of **1 A** (up to **20 W**), and the maximum carry current is **1.2 A**. Ultra-low capacitance levels of typically **0.1 pf**, compared to typically 2.5 pF for a standard device.
Body dimensions from (W x H x D): 19.1 x 8.1 x 4.8 mm.
Available forms: **1 Form A** contact configuration.

Coaxial Reed Relays

These relays have a maximum switch current of **1 A** (up to **20 W**), and the maximum carry current is **1.2 A**. Devices with **50 and 75 Ω** coils are suitable for up to **5 GHz**, making them ideal for RF Signal Switching, RF switched tunable filters, and High-Speed Digital Switching. Available in **thru-hole** and **SMT**.
Body dimensions from (W x H x D): 12.5 x 6.6 x 3.7 mm.
Available forms: **1 Form A** and **1 Form B**

Free relay samples are available. Go to: pickering**relay**.com/samples

SCAN ME TO REQUEST FREE SAMPLES

Customization

While we have recommended a variety of our relays, each with performance characteristics and properties that make them ideal for data acquisition equipment applications, we have over a thousand catalogue parts; so, there are plenty to choose from. However, if you cannot find a product that meets your exact requirements, we offer a **full customization service**.

We have a well-proven development lifecycle of: agree requirements, design, manufacture, test, approve, and deliver. And if your custom design is based on one of our existing products (which is likely to be the case) you can expect to receive samples in as few as two weeks.

For further information, contact our technical sales team at **techsales@pickeringrelay.com**
or vist pickeringrelay.com/custom-reed-relays

About Pickering Electronics

Pickering Electronics was established over 50 years ago to design and manufacture high quality reed relays, intended principally for use in instrumentation and test equipment. Today, Pickering's Single-in-Line (SIL/SIP) range is by far the most developed in the relay industry, with devices 25% the size of our competitors' electrically equivalent devices. These small SIL/SIP reed relays are sold in high volumes to large ATE and semiconductor companies throughout the world.

The privately-owned Pickering Group comprises three electronics manufacturers: reed relay company Pickering Electronics; Pickering Interfaces, designers and manufacturers of modular signal switching and simulation products, and Pickering Connect, which designs and manufactures cables and connectors. The group employs over 500 people primarily in the UK and Czech Republic with additional employees in sales offices in the US, China, Germany, Sweden, and France.

Technical Help

Please go to: **pickeringrelay.com/help**.
If your questions are not answered here, please e-mail: **techsales@pickeringrelay.com**.
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