

AN ESSENTIAL DESIGN DECISION

The Benefits of Reed Switches and Sensors





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Introduction

Switches and sensors are used in a wide variety of applications, such as activating a car burglar alarm, starting a home appliance, or controlling factory machinery. While there are many types of switches and sensors, reed switches offer important advantages over other options. Some key benefits include hermetically sealed contacts, immunity to radiation, galvanic isolation, no power operation, long service life, high mechanical stability, high operational speed, ease of customization and low cost. Hermetically sealed switches can work efficiently and effectively in harsh and hazardous environments, and over a wide temperature range. Plus, they experience very low mechanical wear, resulting in a very long operational lifespan. Reed switches are rated for tens of millions or billions of actuations. In a circuit, they are not vulnerable to RF interference and their low-profile makes them easy to use in space-constrained environments. Furthermore, testing is simple in any circuit, and custom solutions are quick and easy for any unique requirements. All of these features come at a price that is affordable for all kinds of markets.

The reed switch is an electromechanical device operated by an applied magnetic field. In its simplest form, it consists of a pair of ferromagnetic flexible metal contacts in a hermetically sealed glass envelope. Generally composed of iron and nickel, the blades overlap internally in the glass capsule with a gap of a few microns between them. In the presence of a suitable magnetic field, the metal blades contact each other as shown in Figure 1.

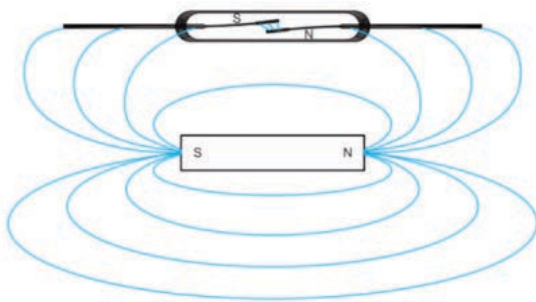


Figure 1 The basic operation of a reed switch under the influence of the magnetic field of a permanent magnet

When a magnet approaches these blades, the two blades pull toward one another. Once touching, the blades close the normally open (NO) contacts, allowing electricity or current to flow. Reed switches that contain a non-ferromagnetic contact offer a normally closed (NC) form. An approaching magnet will disconnect the contact and pull away from the switching contact.

Contacts can be constructed from a variety of metals, including tungsten and rhodium, and filled with inert gas—commonly nitrogen—in a closed glass tube to seal the contacts. The internal pressure is under one atmosphere. Hermetically sealing isolates the contacts, which prevents corrosion and any sparks that might result from contact movement. The external magnetic field is generated either by a permanent magnet or an electromagnetic coil.

Basic Electrical Parameters

Some key electrical parameters of the reed switch include pull-in (PI), drop-out (DO), hysteresis, contact resistance, and dynamic contact resistance. While PI is defined as that point where the contacts close, DO is described as that point where the contacts open and has similar characteristics as the PI. It is also described as release or reset voltage/current or ampere-turns (AT).

When using a magnet, PI is usually measured as a distance from the reed switch to the magnet in mm (or inches) or in field strength AT, mTesla, or Gauss. Similarly, using a coil, the PI is measured in volts across the coil, mA flowing in the coil, or AT. Generally, this parameter is specified as a maximum.

No matter how well the reed blades are annealed, they will still have a slight amount of retentivity—a slight amount of magnetism left in the blades after the magnetic field is removed or eliminated from the reed switch. To obtain consistent PI and DO results, saturating the reed switch with a strong magnetic field first, before taking the PI measurement, will produce more consistent results.

When measured using a coil, the PI is subject to changes at different temperatures, and is usually specified at 20 °C (Figure 2).

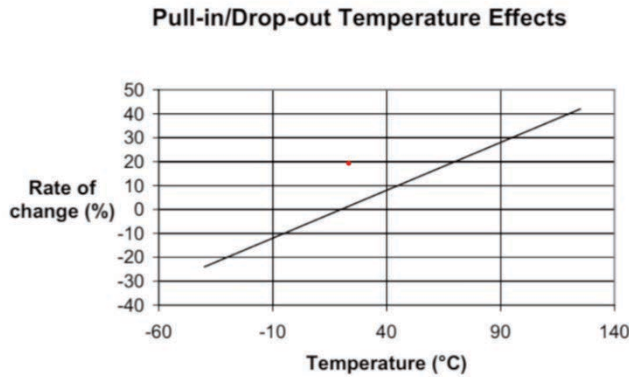


Figure 2 The Pull-In and Drop-Out points change with temperature at the rate of 0.4% /°C
Source: Standex Electronics Detect

Because there is hysteresis between the PI and DO points, it is normally defined as the ratio of DO/PI and expressed in %. This hysteresis characteristic can vary depending upon the reed switch design, such as variations in plating or sputtering thickness, blade stiffness, blade overlap, blade length, gap size, seal length, etc. Figure 3 depicts hysteresis when using a magnet to operate a reed switch.

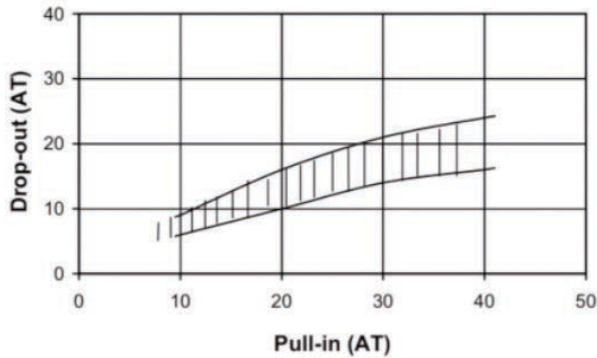


Figure 3 Variation in hysteresis with ampere turns (AT)
Source: Standex Electronics Detect

Likewise, contact resistance is the DC resistance generated by the reed blades (bulk resistance) and the resistance across the contact gap. Typically, contact resistance for a reed switch is approximately 70 mΩ, 10 to 25 mΩ of which is the actual resistance across the contacts (Figure 4).

However, dynamic contact resistance (DCR) is a true measure of the disposition of the contacts. As shown in Figure 4, the contact resistance is mostly made up of bulk resistance or lead resistance. Measuring the resistance

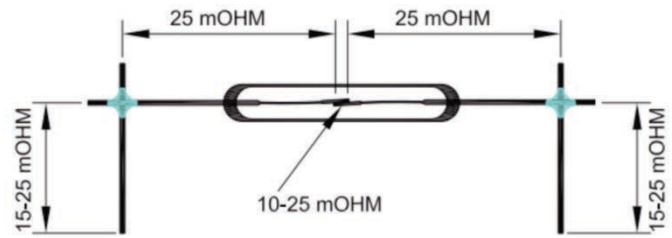


Figure 4 Contact resistance is generated by the reed blades (bulk resistance) and the resistance across the contact gap
Source: Standex Electronics Detect

across the reed switch under dynamic conditions gives a better indication of the contacts' functionality.

Benefits of Reed Switches

Because reed switches are hermetically sealed, they can operate in harsh and hazardous environments, such as moist and/or dusty conditions, active liquid and gas media, and across a wide range of temperatures varying from -60°C to +155°C. Plus, they are immune to radiation, and offer total galvanic isolation of the load and control circuits.

Other salient features include low control power (50-200 mW), low resistance (0.05-0.15 Ohm), high insulation resistance (10¹⁰-10¹² Ohm), fast operating speed (0.5-1.5 ms), long life expectancy at high reliability (10⁶-10⁸ switching cycles), high mechanical stability (shocks up to 500 g), and vibration in the frequency range up to 3000 Hz at 15-20 g). Additionally, reed switches can work with a variety of voltages, loads and frequencies, as the switch functions simply as a connected or disconnected wire. Consequently, loads as low as a few μW to as high as 120 W can be switched.

Compared to Hall-effect sensors, reed sensors offer several advantages. Key benefits include cost effective, high isolation, hermetically sealed, low contact resistance, switching power, high magnetic sensitivity, high voltage, high carry current, high shock resistance, long life expectancy, wide temperature range, and no external power. Inherent switch hysteresis is another attractive feature useful in certain metering applications. Because without hysteresis, a very small change in the magnetic field could result in an unintended change in the output and a measurement error.

By comparison, the magnetic sensitivity switch points of reed switches are more precise with a high degree of accuracy. Typically, a reed switch may be specified for a sensitivity from 18 to 22 AT, offering a 20% sensitivity range. Unlike reed, a Hall-effect sensor has a sensitivity range of 75%. In addition, reed switches are widely available in custom sensitivity ranges that can be tailored to meet unique requirements of a specific application.

Reed switches also offer a high degree of design flexibility, as they can be used either alone or as part of a more specialized circuit. For example, a reed relay combines a reed switch with an electromagnetic coil for activation (Figure 5). They are generally gated using transistors, TTL directly, or CMOS drivers. In comparison to other technologies, reed relays require relatively little power to operate and are more durable, readily switching billions of operations. In an application like automatic test equipment, which may be called upon to switch tens of millions of operations per year, the reed relay rises to the challenge.

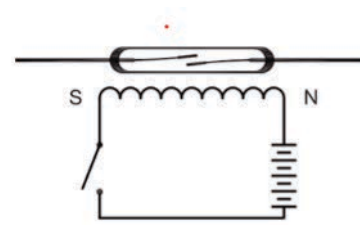


Figure 5 A reed relay combines a reed switch with a wire wound electromagnetic coil for activation
Source: Standex Electronics Detect

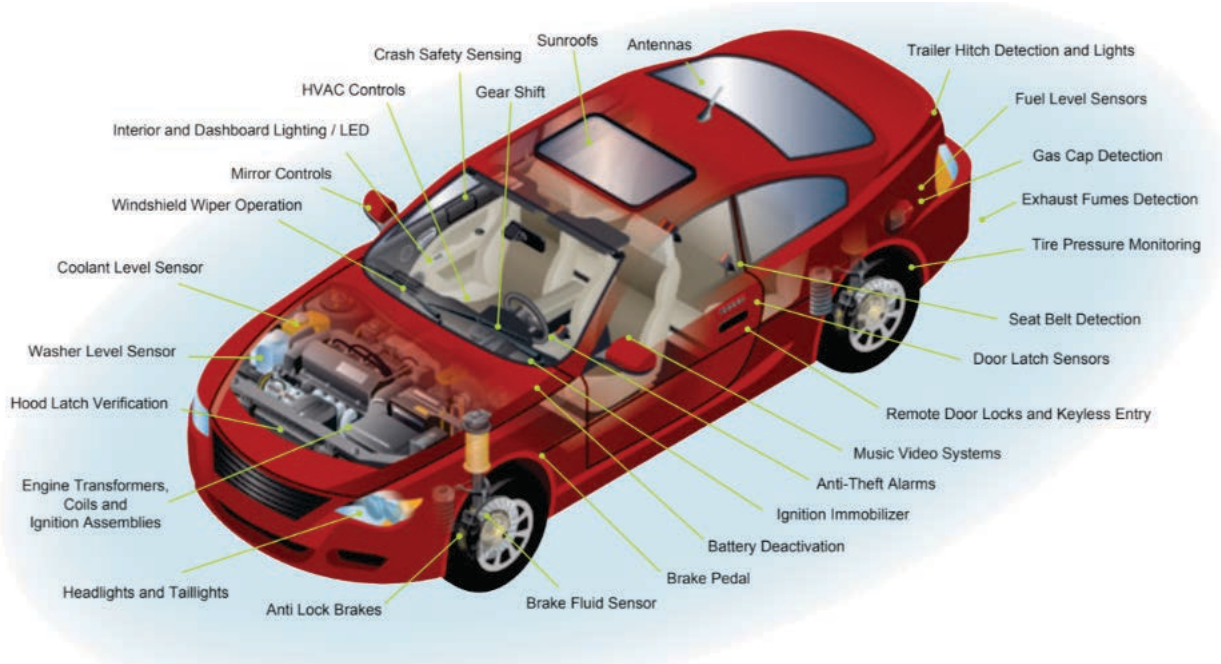


Figure 6 Reed Switches and Sensors are vital for automotive applications
Source: Standex Electronics Detect

Applications and Markets

Essentially, reed switches and sensors are adopted in a broad range of applications and markets, including appliance, automotive, HVAC, agriculture, test & measurement, medical, telecommunications, industrial, household, security and marine. In short, a reed switch/sensor can play an important role within any application that needs a high-performance on/off, open/close, power transfer, lighting, starting, measuring, or detecting switch. For example, from read-outs on the dashboard to measurement of coolant, brake, windshield, tire pressure, and emissions, reed switches and sensors enable vital processes within automobiles, heavy-duty trucks, recreational vehicles, airplanes, trains, motorcycles, electric cars, e-bikes, boats, and more (Figure 6).

On the home front, reed switches and sensors are making their way into household appliances and electronics that are now also being designed in conjunction with smart metering devices. Detecting door position and monitoring fluid levels are just a couple examples of reed switch and sensor applications. Plus, they are being designed into many types of consumer electronics products and a wide variety of toys and medical devices.

Many other applications are benefitting from reed switches and sensors. They include test and measurement equipment, rain gauge sensors, wind speed and direction sensing, barometric sensing, inside/outside temperature sensing, position sensor for exact window sunshade control, solar panels, agriculture, forestry and construction machinery, and many more.

Reliable Source

Serving this wide array of applications spread across multiple industries requires a reliable source with a capacity and a reputation, which includes knowledge and experience. There is no one-size-fits-all solution when it comes to selecting reed switches and sensors. Such a wide range of products and applications needs a wide range of switches and sensors. In other words, selecting the right reed switch or sensor for the applications is not a trivial task. Only an experienced engineer with knowledge of the products can select and guide you through this maze of products.

While there are several suppliers serving this market, there is only one that stands out as a leader. With over 50 years of experience, Standex Electronics Detect is the world's largest manufacturer of reed switches (>700M/year) with >50% market share, and offering the most comprehensive listing of reed switches that cover the majority of low power switching requirements. In fact, it offers a broad portfolio that includes magnetic reed switches, reed relays, and reed sensors. For applications that need a custom solution, Standex Electronics Detect has the capability and experience to deliver a custom solution that is optimized for a customer's specific and unique application.

The continued growth of Standex Electronics Detect is creating new solutions for the present and the future. By offering new reed switch technologies, wider product ranges, and in-house production capabilities in the areas of EV and alternative energy, we're preparing the world for a better future.

Summary

With a broad portfolio of reed switches, sensors, and relays, and the experience in designing and producing these products, Standex Electronics Detect is a one-stop shop for any company, small or big, that is looking for the best, most reliable, and cost-effective solution to their problems. Standex Detect is the preferred worldwide source for reed switch technology. Think of Standex Detect as your partner in solving your problem.





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