Reed Switch Operation

HSI SENSING™
HERMETIC SWITCH INC.

Reed Switch Application Notes

APPLICATION NOTES: Reed Switch Operation

With a Magnet

A reed switch is activated by a magnetic field. It's important to realize that there are numerous possibilities for a switch's orientation within a given magnetic field. In the diagrams on page 7 you can see several basic examples of reed switch operation with the use of a moving and stationary magnet.

The length of the magnet and the length of the reed switch both affect the magnetic field coupling. Removal of the switch lead material reduces the "magnetic antennae." The magnetic coupling is reduced, the sensitivity is decreased, and the magnet must get closer to the reed switch to activate it. This is a general rule for a parallel mode of operation

Magnetic Sensitivity

Reed switches are tested in standard test coils. Being long and slender with contact leads at each end, a coil of magnetic wire spread over the glass length provides excellent magnetic coupling. The switch leads protrude from each end of the coil for connection during the test. The magnetic sensitivity is stated in Ampere-Turns, which is related to that specific test coil. The sensitivity rating reflects the amount of current (Ampere) that is flowing through the coil having a specific number of TURNS, when the switch contacts operate.

Definitions

Pull-In (Operate)
Magnetic field strength at which the reed switch is activated.

Drop-Out (Release)
Magnetic field strength at which the reed switch is de-activated.

Differential
The difference between the Pull-In and Drop-Out of a reed switch expressed in Ampere-Turn, usually identified by the symbol Δ. Differential is commonly specified when the contacts must Drop-Out when the magnetic field strength is reduced a specific amount.

Dwell
In a Form C switch, the difference in field strength (expressed in ampere-turns) between the value when the common reed breaks the Normally Closed contact and the value when the common reed makes the Normally Open contact. Dwell can be an undesirable phenomenon. If mentioned at all, it is stated to limit the size of any Dwell in the acceptable product.

Custom Sensitivity
By design HSI Sensing's equipment is capable of manufacturing reed switches to precise and custom pull-in, drop-out and differential specifications. HSI Sensing has years of experience in customizing the sensitivity of reed switches to specific application requirements.

Static Contact Resistance
The resistance of the reed switch when the contacts are closed (measured in Ohms). Initial Contact Resistance refers to the maximum resistance of new contacts. All switches are measured for contact resistance at a specified magnetic overdrive after contacts are stabilized. HSI Sensing employs the four-point connection testing method (Kelvin Method).

Magnetic Overdrive

Magnetic overdrive is the additional voltage or current applied to the coil beyond the Pull-In value. Overdrive is typically defined in additional Ampere-Turns or Voltage.

When testing contact resistance, it is 2 to 5 Ampere-Turns, or, 10% - 25% Ampere-Turns more than Pull-In. In the application it is recommended that 25% - 50% more magnetic overdrive be applied to ensure long life.

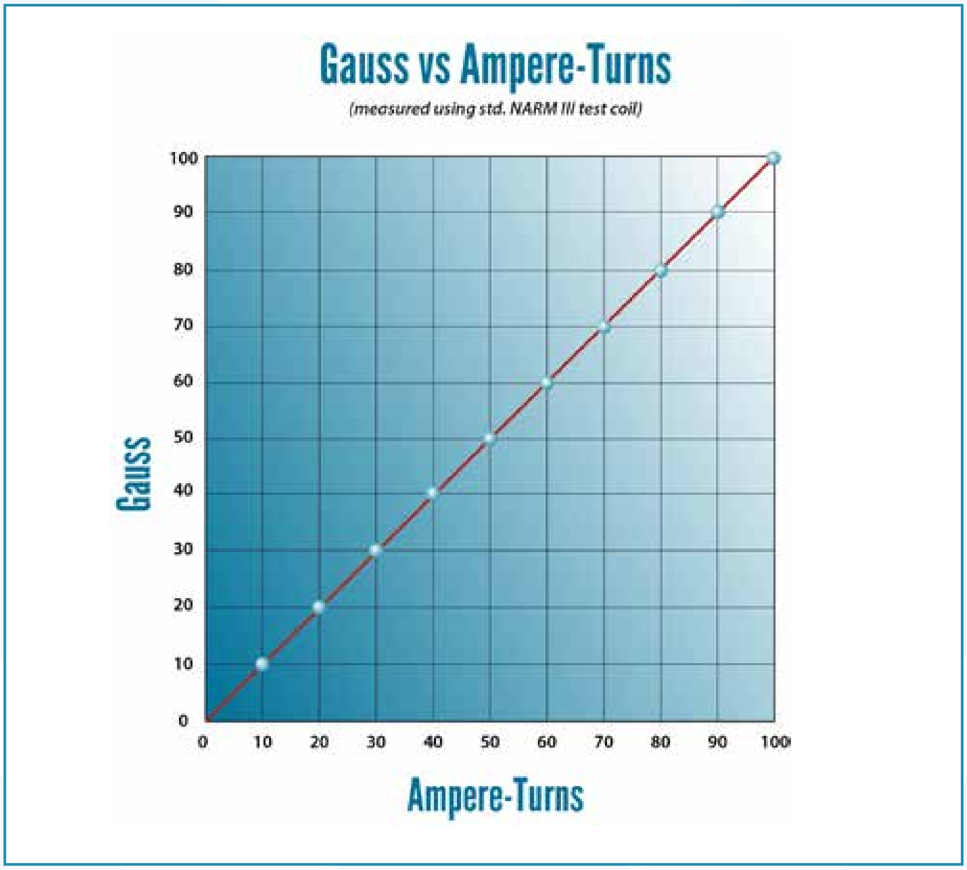
Magnetic overdrive in a magnet application is achieved by additional magnet travel beyond the point the switch achieves pull-in, moving the magnet closer to the reed switch.

Magnetic Overdrive is a critical parameter because it provides low and stable contact resistance as well as outstanding performance in applications over the life of the reed switch.

Ampere Turns versus milli-Tesla and/or Gauss

The measure of the magnetic field strength required to operate a reed switch is expressed in ampere turns. The relationship between magnet strength (measured in gauss or Tesla) and reed switch sensitivity (measured in ampere-turns) to the corresponding activation distance depends on the magnet size, shape, and material, as well as the size and modification (if any) of the reed switch. The orientation of the magnet relative to the reed switch is also very important. Is the switch being operated by one pole of the magnet or both north and south poles?

Magnets are manufactured to feature-specific gauss strength. Magnet shape and size dictates how strong the magnetic field is at a specific distance from the magnet. In many motion and/or proximity sensor (reed switch in a housing) applications it is known how much gauss is available to activate the switch. Hence the need to understand the correlation of gauss to ampere turns. The Gauss vs Ampere Turns graph illustrates the measurement of gauss versus ampere turns in one standard test coil. In this example the magnetic field is uniform in shape and alignment. Since magnets do not deliver the type of uniformity in field shape as compared to the inside of a test coil, this graph should be used only as a guide.



As a guide, approximately 0.1 milli-Tesla (mT) is equivalent to 1 Gauss is equivalent to 1 ampere turn. Many applications specify a specific magnetic field strength in Tesla, or more specifically mT.

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Switch, Sensor and Magnet Engineering

Several factors affect the magnetic coupling between the reed switch and the magnet. These factors include but are not limited to switch modification, neighboring ferrous components, magnet-to-switch orientation, and magnet motion. To solve a specific problem with a magnet motion and reed switch activation, experimentation using switches with a range of sensitivity and a set of magnets of different sizes, strengths, shapes, and possibly materials is required. Magnet materials to consider are neodymium, alnico and others.

For end-on operation with an offset-gap reed switch, placing the gap end toward the magnet approach and removing the lead will allow magnetism to reach the gap more efficiently and can increase the sensitivity. However, this alignment, which employs only one pole of the magnet, typically requires a magnet double the strength of a magnet with a parallel mode operation, or the activate distance may be about half. Experimentation and research is key in determining the switch and magnet specifications.

HSI Sensing offers engineering assistance to match the proper reed switch with magnet motion. We offer many stock magnets to aid in application development. In many cases our production equipment utilizes the customer end-use product in our test fixtures. Sampling and/or 100% testing ensures every switch or sensor meets the functional operational requirements. For more information on reed switch and magnet designs to work with your specific application contact HSI Sensing.

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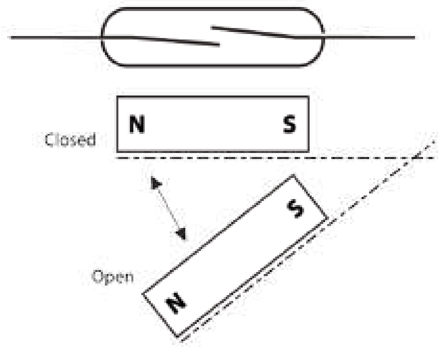
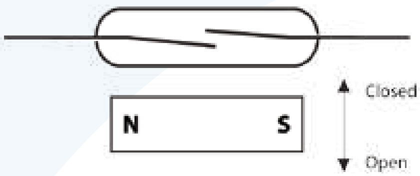
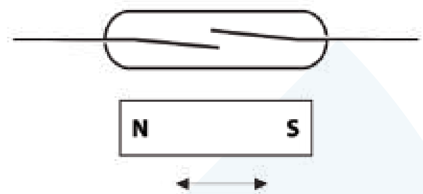
As explained on the previous pages, reed switches are activated by magnetic fields. It's important to realize that there are numerous possibilities for a switch's orientation within a given magnetic field. On this page, you can see several basic examples.



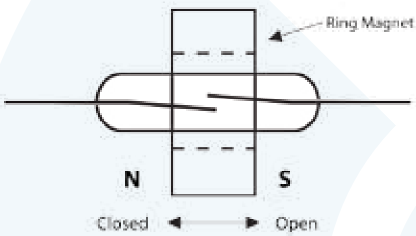
A pivoting/swinging magnet will operate the reed switch.



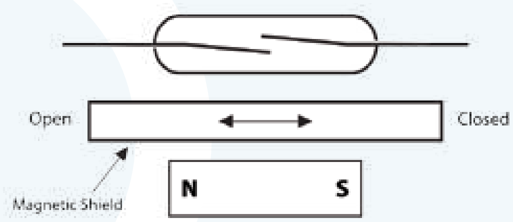
A magnet moved in a front to back motion (perpendicular towards and away) will operate the reed switch



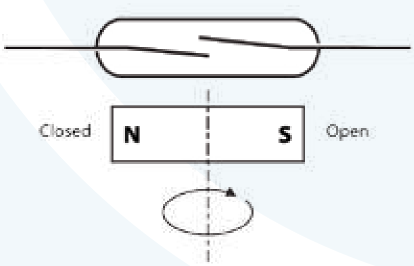
A reed switch can operate with a magnet moving parallel to the reed switch.



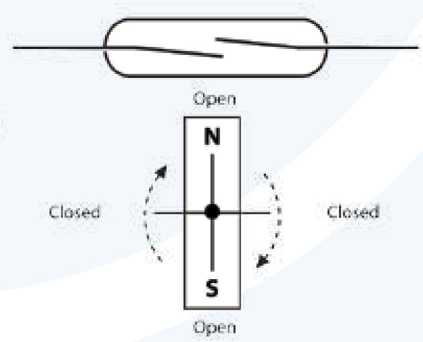
A reed switch moving through a circular/ring magnet will operate up to 3 times.



Shielding (Indirect Actuation):
If the reed switch and magnet are stationary, the movement of a shield (made of ferro-magnetic material) between the switch and the magnet will open and close the switch's contacts. The shield is used to divert the magnetic field away from the switch.



Rotation:
Magnets can be rotated several different ways to operate the reed switch. For more information on the effects of rotary magnetic motions, contact HSI Sensing.



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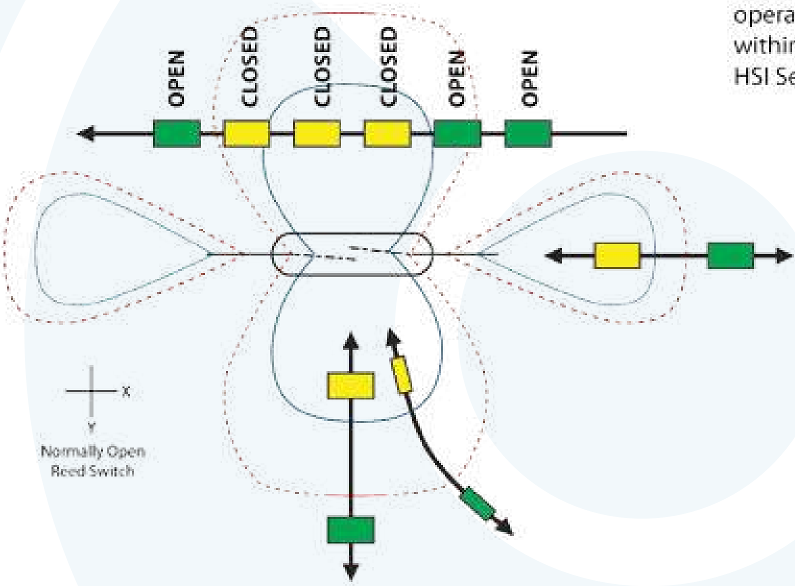
Common Paths of Reed Switch Activation...

A magnet can actuate a reed switch several different ways. The drawing below demonstrates several common paths a magnet travels to operate the switch's contacts. The blue line represents the point at which the switch is activated by the magnet (also called the Release or Drop-Out). As shown in the drawing, a magnet must pass the Operate point (blue line) for the switch to be activated. To de-activate the switch the magnet must travel outside the Release point (red dotted line).

- A magnet's path
- The magnet is activating the switch
- The magnet is not activating the switch
- The point of activation, also known as Operate or Pull-In
- The Point of de-activation, also known as Release or Drop-Out

If you have specific questions about the operation of a reed switch, especially within a certain application, please contact HSI Sensing.



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