Reed Switches Vs Hall Effect & Electromechanical

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Introduction

Purpose

- Explore the different technologies to find the right one for a given sensor application

Objectives

- The sensor technologies we will focus on are – Reed, Hall and Electromechanical Sensors, all of which, provide a potential switching function
- We will define the key functions of these technologies
- Cover the different parameters and compare them to the different technologies

Introduction

With the availability of new technologies more sensing requirements in:

- Telecommunications
- Instrumentation
- Medical
- Automotive
- Household
- Marine
- Consumer products
- General Purpose

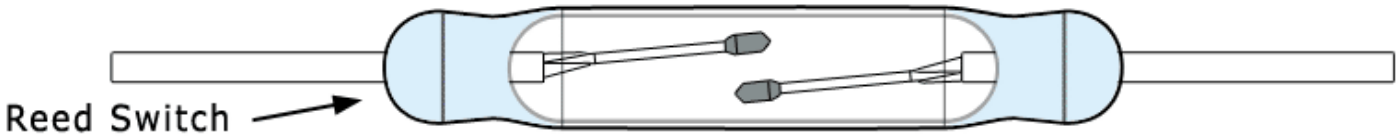
Key Terms

- We need to define the following technologies
  - Reed Sensors
  - Hall Sensors
  - Electromechanical Sensors
- We will use the word load often. A load is that which needs to be powered when the above technologies are switched on.

Key Terms – The Reed Sensor

Reed Switch Sensor

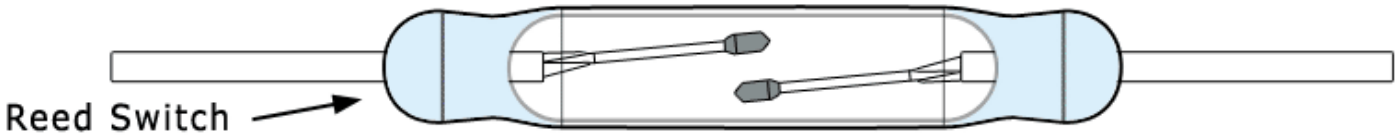
- The reed switch has two leads hermetically sealed in a glass cylinder
- Sensitivity to closure is measured in milli-Tesla (mT) or ampere turns (AT)
- The reed sensor typically uses an external magnet to close the contacts
- When the magnet is brought into the sphere of influence of the reed sensor the contacts will close or Pull-in (PI)
- When the magnet is withdrawn from the proximity of the reed sensor the contacts will open or Drop-out (DO)
- Hysteresis is the ratio of the pull-in divided by the drop-out (PI/DO)



Key Terms – The Reed Sensor

Reed Switch Sensor

- The reed sensor does not need any other circuitry to operate
- The reed sensor has only two leads and are not polarity sensitive
- They can be used in all environmental conditions, over wide temperature ranges and dirty environments



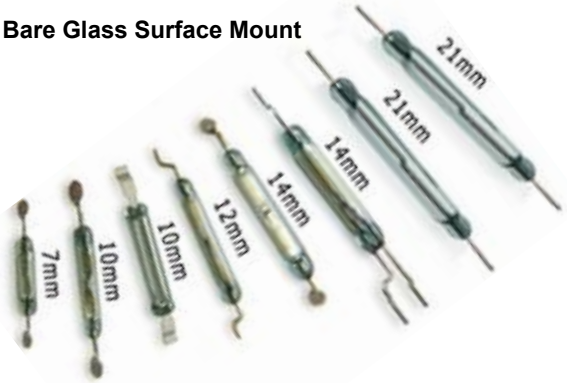
Key Terms – The Reed Sensor

Reed Switch Sensor

› The reed sensor comes in hundreds of different sizes and shapes to meet given applications

Custom Packaging

Bare Glass Surface Mount



Float Type Level Sensors

Threaded Screw & Cylindrical Panel Mount

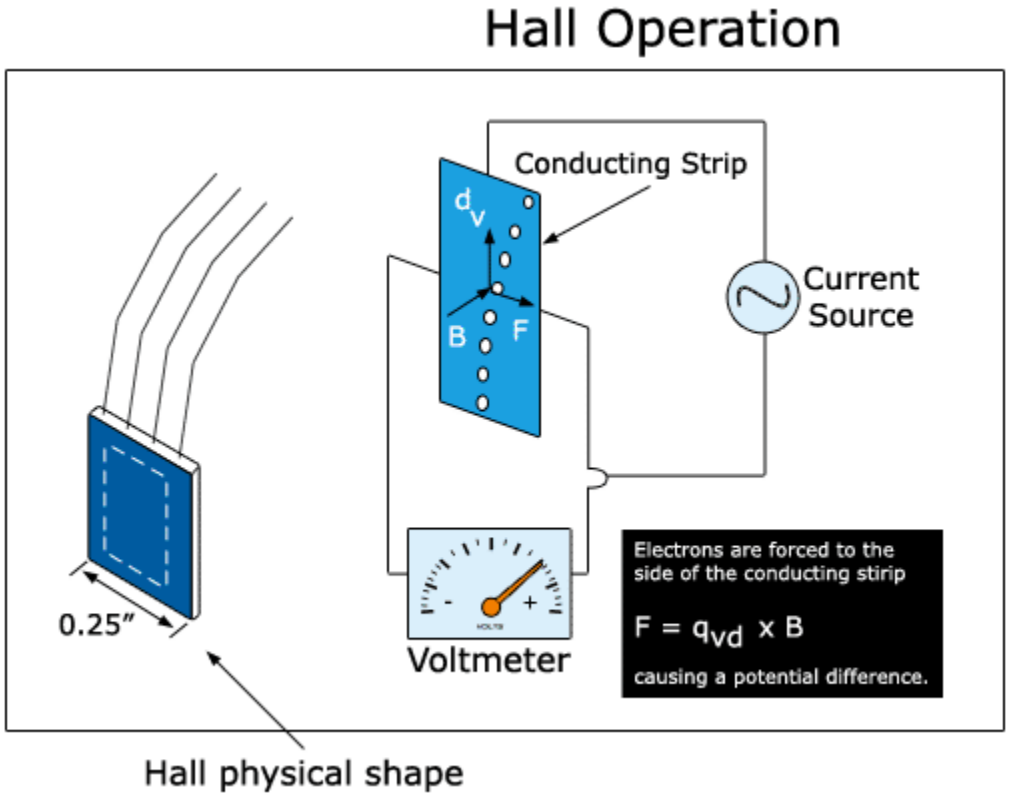
Rectangular Screw Mount

Molded Surface Mount

Key Terms – The Hall Sensor

Hall Sensor

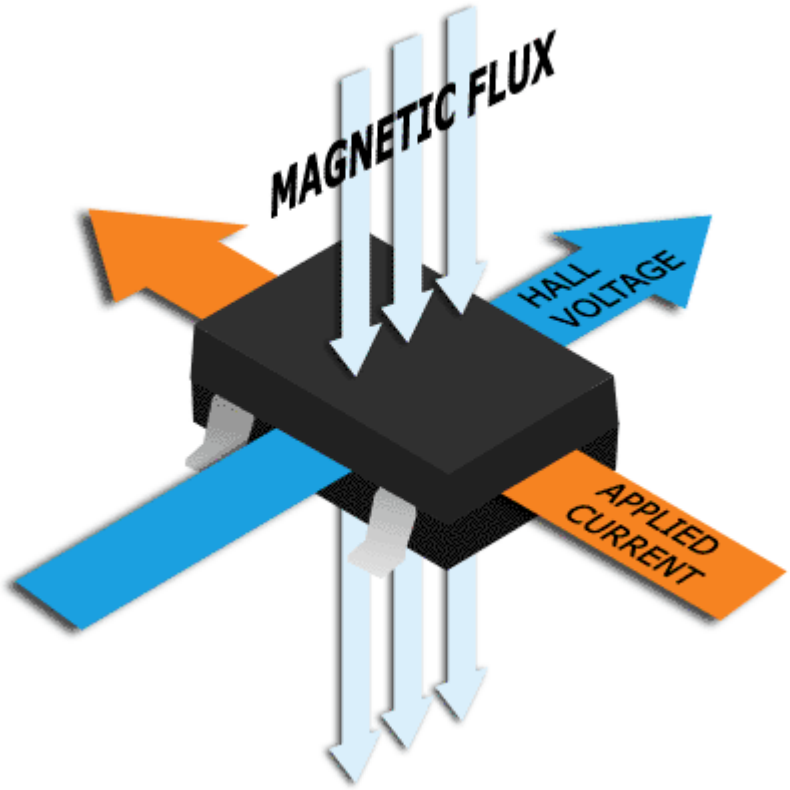
- The hall sensor is a semiconductor device
- An electric current must always be flowing in the hall sensor
- The hall sensor produces a voltage when a magnet or magnetic field is brought close enough to the device.
- The voltage is measured in milli-volts



Key Terms – The Hall Sensor

Hall Sensor

- Hall sensors are not affected in any way with shock and vibration
- They can be used in most environmental conditions
- Can be used in dirty environments



Key Terms – The Hall Sensor

Hall Sensor

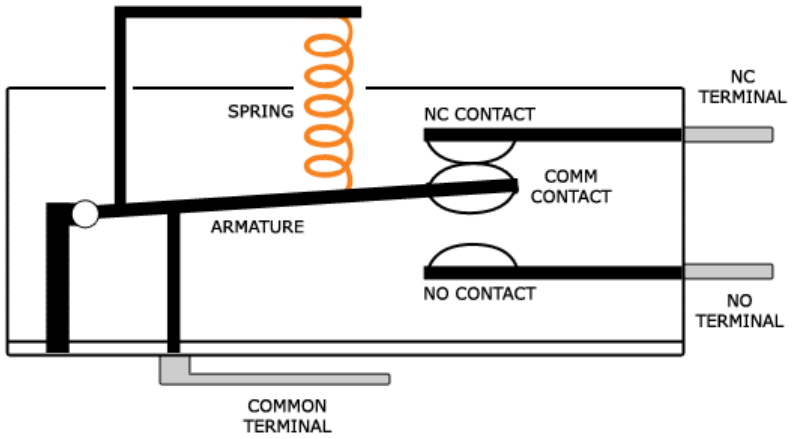
- Because of the semiconductor integration process, the hall chip can be very small
- Hall sensors come in several packages with a minimum of 3 electrical leads
- Hall sensors need added electronic circuitry to function

Key Terms – The Electromechanical Sensor

Electromechanical Sensor

- The electromechanical Sensor requires a mechanical movement that presses against a mechanical lever on the sensor
- The mechanical movement will close a set of contacts usually internal to the sensor
- They can have two or more leads
- They can have spst and/or spdt (single pole with single throw and double throw contacts)

Electromechanical Sensor

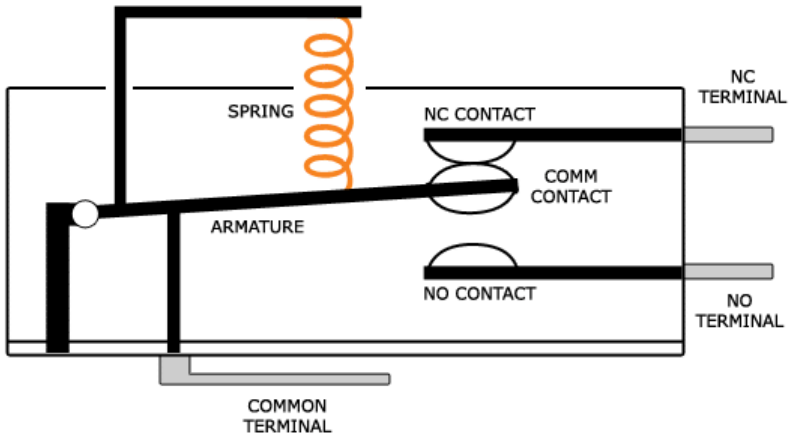


Key Terms – The Electromechanical Sensor

Electromechanical Sensor

- Electromechanical Sensor
- The electromechanical sensors require no external circuitry for proper operation
- They come in many different package styles
- These sensor are not suitable in all environments

Electromechanical Sensor



Parameter Analysis

- In the following slides we will look at the various critical specifications that help define our applications
- We will look at these parameters and how they compare for each of the technologies

Parameter Analysis

Sensor Technology	Additional Circuitry Required?
Reed Sensor	NO
Hall Sensor	YES
Electromechanical Sensor	NO

Parameter Analysis

Sensor Technology	Current Draw Required in OFF State?
Reed Sensor	NO
Hall Sensor	YES
Electromechanical Sensor	NO

Parameter Analysis

Sensor Technology	Input Polarity Sensitive?	Comment
Reed Sensor	NO	None required
Hall Sensor	YES	Input polarities must be observed for proper operation
Electromechanical Sensor	NO	None required

Parameter Analysis

Sensor Technology	Output Polarity Sensitive?	Comment
Reed Sensor	NO	No output sensitivity
Hall Sensor	YES	Output polarities must be observed for proper operation
Electromechanical Sensor	NO	None required

Parameter Analysis

Sensor Technology	Sensing Distance	Comment
Reed Sensor	>1” or 2.54cm	No physical contact required
Hall Sensor	>1” or 2.54cm	No physical contact required
Electromechanical Sensor	Sensing can only works by mechanically touching and depressing the sensor lever	

Parameter Analysis

Sensor Technology	Minimum Sensing Distance	Comment
Reed Sensor	0.04” or 1.0mm	No physical contact required
Hall Sensor	0.04” or 1.0mm	No physical contact required
Electromechanical Sensor	Has no sensing distance	Physical contact is required

Parameter Analysis

Sensor Technology	Hysteresis
Reed Sensor	40% - 95%
Hall Sensor	No hysteresis
Electromechanical Sensor	Hysteresis is fixed and can be controlled

Parameter Analysis

Sensor Technology	ON Resistance	Comment
Reed Sensor	Typically 50 – 100 mΩ	
Hall Sensor	Typically > 1000Ω	
Electromechanical Sensor	Typically 50 – 100 mΩ	Can widely vary depending on voltage/ current flowing in load

Parameter Analysis

Sensor Technology	Switching Loads Directly?
Reed Sensor	Can switch loads directly. Requires no other circuitry
Hall Sensor	Cannot switch loads directly. Requires other circuitry
Electromechanical Sensor	Can switch loads directly. Requires no other circuitry

Parameter Analysis

Sensor Technology	Voltage Switching Range
Reed Sensor	0 – 1000 Volts
Hall Sensor	Puts out milli-volts. Requires other circuitry for higher voltages.
Electromechanical Sensor	> 5 Volts – 240 Volts

Parameter Analysis

Sensor Technology	Current Switching Range
Reed Sensor	Up to 1 Amp directly and carry up to 3 Amps
Hall Sensor	Requires other circuitry
Electromechanical Sensor	Up to 1 Amp directly and carry up to 3 Amps

Parameter Analysis

Sensor Technology	Operate Time	Release Time
Reed Sensor	< 100 µsec	< 25 µsec
Hall Sensor	< 10 µsec	< 10 µsec
Electromechanical Sensor	< 100 msec	< 100 msec

Parameter Analysis

Sensor Technology	Output Capacitance
Reed Sensor	Typically 0.2 pico-farads
Hall Sensor	Typically 100 nano-farads
Electromechanical Sensor	Typically 50 pico-farads

Parameter Analysis

Sensor Technology	Output Isolation
Reed Sensor	Typically > 1×10^{12} Ω
Hall Sensor	Typically > 1×10^{7} Ω
Electromechanical Sensor	Typically > 1×10^{8} Ω

Parameter Analysis

Sensor Technology	Life Expectancy
Reed Sensor	Up to 1 Billion operations
Hall Sensor	Unlimited
Electromechanical Sensor	Up to 1 Million operations

Parameter Analysis

Sensor Technology	EDI / RFI Susceptibility
Reed Sensor	None
Hall Sensor	Very
Electromechanical Sensor	None

Parameter Analysis

Sensor Technology	Shock
Reed Sensor	Can be susceptible to shock. Newer MEM micro-reed sensors are not susceptible to shock.
Hall Sensor	No susceptibility to shock
Electromechanical Sensor	Relatively low susceptibility to shock

Parameter Analysis

Sensor Technology	Operating Temperature	Storage Temperature
Reed Sensor	-55°C to 200°C	-55°C to 100°C
Hall Sensor	-0°C to 70°C	-55°C to 100°C
Electromechanical Sensor	-20°C to 100°C	-55°C to 100°C

Summary

- Each technology has its own best operating characteristics
- Each technology needs to be selected based on the requirements
- Choosing the wrong technology for a given application can result in a lot of time and money lost along with the loss of several potential customers
- Care must be taken when pairing a technology to a given application

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