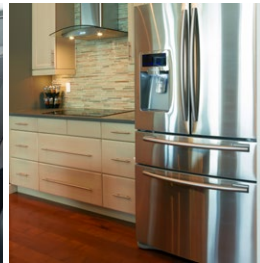
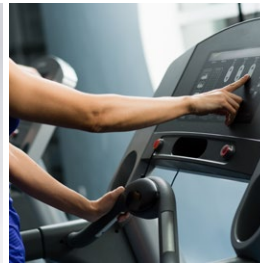




Expertise Applied | Answers Delivered



Reed Switches
Reed Relays
Reed Sensors
Hall Effect Sensors
Custom Sensors
Magnets/Actuators



SENSORS

Application Notes



Sensor Applications

In the following pages you will find practical suggestions and design ideas for implementing different sensor technologies in a variety of applications.

Topic	Pages
Proximity Sensing	1-3
Level Sensing	4-5
Flow Switch Sensing	6
Speed Sensing	7-8



PROXIMITY SENSING USING HALL EFFECT SENSORS

Refrigerator Door

Appliances like refrigerators, freezers and wine coolers are used to keep food/beverages cold and extend their useful life. These appliances contain lights to illuminate the inside compartments when the doors are open. However, the lights only need to turn on when a door is open. To accomplish this, a proximity sensor is needed to detect if the appliance door is open or closed.

A reed sensor can be used to detect the position of the door. In refrigerators, a reed sensor is mounted to the frame of the appliance and a permanent magnet is mounted to each door. Each reed sensor and magnet pair is positioned so that the reed switch contacts close only when the door is completely closed.

The position of the reed sensor's contacts can be monitored by an electronic control unit (ECU) within the refrigerator's electronics assembly to turn the interior lights on and off as needed. Reed sensors are ideal for a variety of position- and proximity-sensing applications where there is a need to detect the presence of a moving part in relation to a sensor in a fixed location.

Features and Benefits:

- No physical contact required to operate the switch
- Zero power required for switch actuation
- Electrical contacts are within a hermetically sealed capsule that is immune to moisture, dust and dirt
- Wide operating temperature range adequate for use in cold temperatures
- Overmolded sensors provide additional protection against mechanical stresses and vibration
- Low-cost alternative to mechanical switch

Suggested Products:

- 55100 (Miniature flange mount Hall effect sensor)
- 55310 (Flat pack digital Hall effect sensor)
- 55140 (Flange mount Hall effect sensor)

Similar Applications:

Refrigerators/freezers, dish washers, washing machines, rice cookers, coffee makers, vacuum cleaners and vending machines

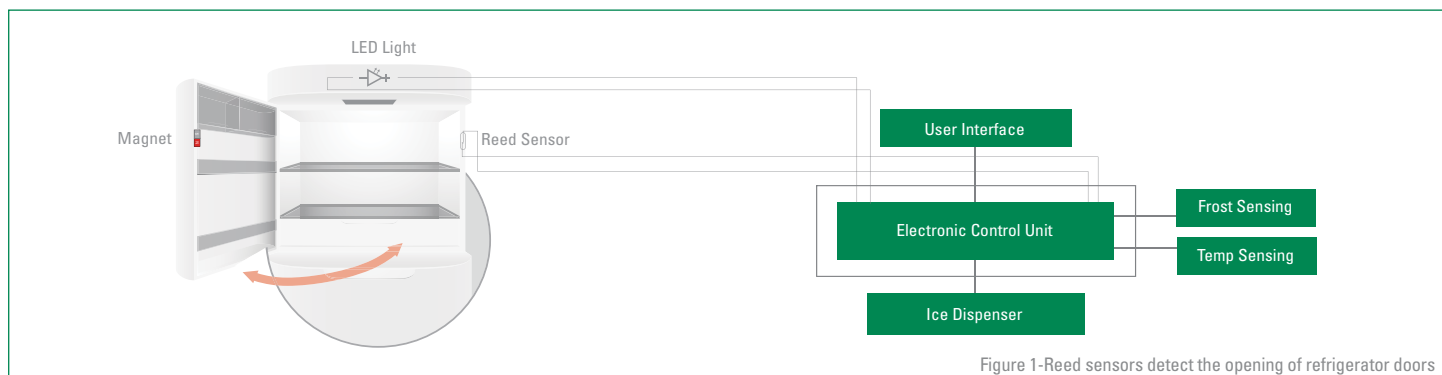


Figure 1-Reed sensors detect the opening of refrigerator doors



PROXIMITY SENSING USING HALL EFFECT SENSORS

Garage Door

Hall effect sensors can be used to detect the movement of a garage door to stop the motor once the door has reached its open or closed position. Typically, a system of two Hall effect sensors, each associated with its own permanent magnet, is used to determine whether the door is completely open, completely closed or somewhere in between.

One of the magnets is mounted on the chain drive of the garage door opener so that it is positioned directly next to the Hall effect sensor used to detect a closed door. The other magnet is positioned so that it moves with the chain and is located directly next to the other Hall effect sensor when the door is completely open.

Similar to reed sensors, Hall effect sensors are ideal for position or proximity sensing where there is a need to detect the presence of a moving part in relation to one or more sensors in fixed locations. They offer extended life and reliability over reed sensors since there are no electrical contacts that are opened and closed. Common examples include door- and lid-position sensing in the similar applications listed.

Features and Benefits:

- No physical contact required to operate the switch
- Wide operating temperature range adequate for use in hot and cold temperatures
- Hall effect sensor is an integrated circuit with no mechanical moving components
- Encapsulated sensors provide additional protection against environmental/mechanical stresses and vibration
- Reliable operation for millions of cycles
- Low-cost alternative to mechanical switches or infrared/optical sensors

Suggested Products:

- 55100 (Miniature flange mount Hall effect sensor)
- 55310 (Flat pack digital Hall effect sensor)
- 55140 (Flange mount Hall effect sensor)

Similar Applications:

Dishwashers, washing machines, vacuum cleaners, security locks on doors and vending machines

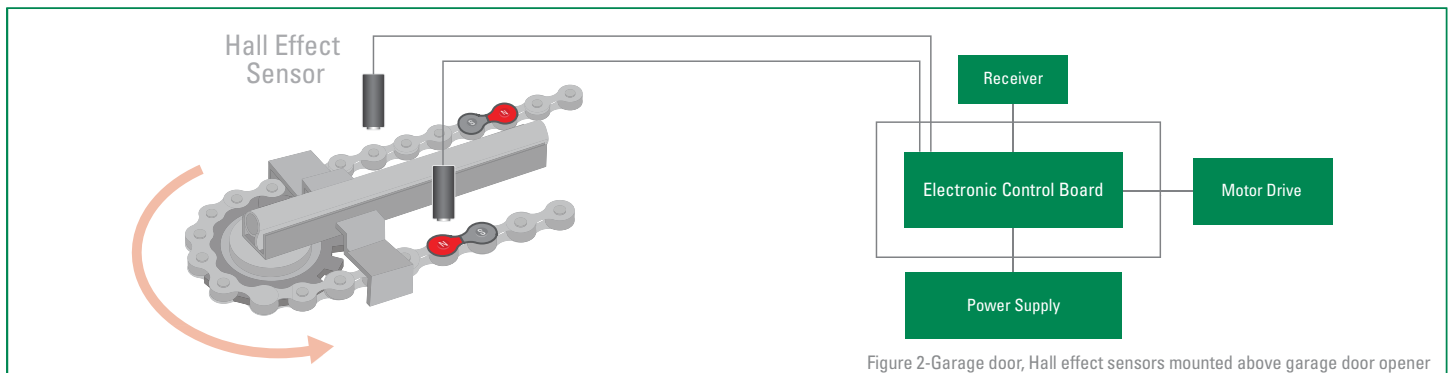


Figure 2-Garage door, Hall effect sensors mounted above garage door opener



SECURITY AND ALARM SYSTEMS

Door and Window Alarms

Many types of security alarm systems use a reed switch/sensor attached to the frame of the door or window. The actuating magnet is attached to the moving door or window so that when it is opened, the reed sensor detects the moving magnet and opens/closes its electrical contacts—sending a signal to the alarm system.

Similarly, reed switches can easily be mounted to circuit boards used in smoke or gas alarm systems. In portable systems, such as gas detectors, the reed switch is used to activate the system when the handheld detector or reader is placed in the docking station. In systems with smoke/gas detectors in fixed positions, the reed switch can be activated with a handheld magnetic wand to put the detector in test mode.

Reed switches and reed sensors are effective solutions for many types of security and alarm sensor applications. Examples include detecting the door and window position, measuring the sump pump water level or activating the test mode of a smoke detector. Reed relays can be used to activate the alarm loop in active sensors like motion sensors and smoke detectors.

Features and Benefits:

- No physical contact is required to operate the switch
- Zero power required for switch actuation
- Wide operating temperature range adequate for use in hot and cold temperatures
- Electrical contacts are within a hermetically sealed capsule that is immune to moisture, dust and dirt
- Overmolded sensors provide additional protection against mechanical stresses
- Low-cost alternative to mechanical

Suggested Products:

- MDSM-10 (10 mm reed switch)
- 59020 (Miniature firecracker)
- 59140 (Miniature flange mount)
- 59170 (11 mm overmolded reed switch)
- HE3621A0510 (Miniature SIL reed relay)

Similar Applications:

Burglar systems, smoke alarms and gas detection systems

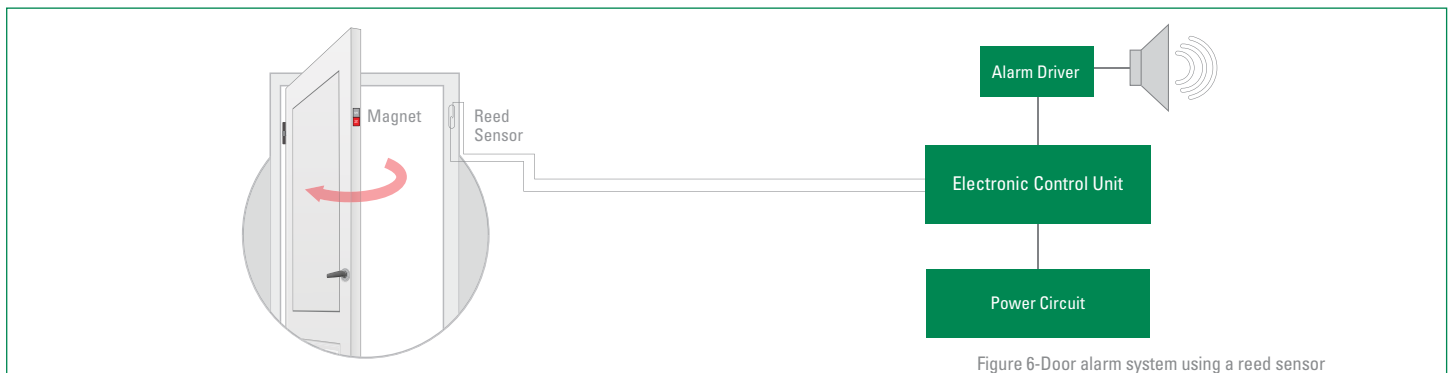


Figure 6-Door alarm system using a reed sensor



CONTINUOUS LEVEL SENSING Industrial Tank Water Level

Resistive reed ladder networks are used to measure the liquid level in a tank, which allows for a continuous output signal rather than discrete signals from single-point level sensors. This continuous level sensor produces a variable resistance or continuous current/voltage that is related to the position of the float/magnet assembly. As the liquid level changes, the relative float position follows, activating the reeds sequentially and producing the associated output voltage or resistance value. The typical spacing between reed switches is usually provided in 6.35 mm or 12.7 mm steps.

Littelfuse supplies full assemblies that include stainless steel or plastic housings. Bare reed switches are also available.

Level sensors incorporating reed switch and resistance technology are commonly used for measuring continuous liquid levels in the automotive, marine and industrial markets. The float, which contains a magnet, moves up or down over the sealed stem containing the reed switches/resistors.

Features and Benefits:

- Continuous level output signal, not like a single-point level sensor
- Electrical contacts are within a hermetically sealed capsule that is immune to moisture, dust and dirt
- Sensor housing provides protection against mechanical stresses and vibration
- Reliable switching for millions of open/close operations
- Wide operating temperature range adequate for use in hot and cold temperatures

Suggested Products:

- MDSM-10 (10 mm reed switch)
- MDSM-4 (15 mm reed switch)
- Custom-designed level sensor assembly

Similar Applications:

Fluid-level sensing for: urea in diesel trucks, fuel tanks, HVAC refrigerator tanks and condensate water tanks

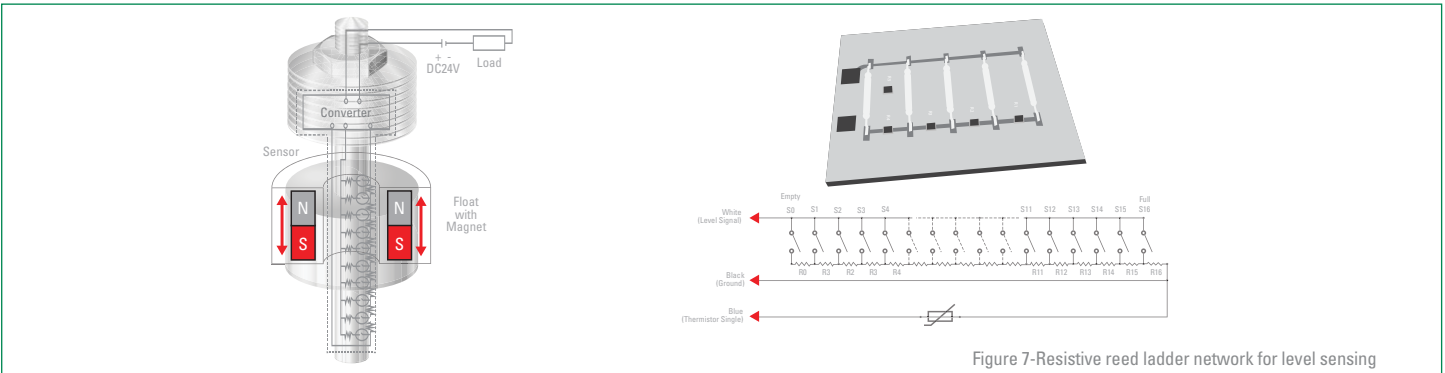


Figure 7-Resistive reed ladder network for level sensing



LEVEL SENSING

Dishwasher Water Level

When provided with a float magnet, reed sensors can function as fluid-level sensors. For example, in a dishwasher, a float-type level sensor is used to detect if the water level inside of the water collection pan has reached the fill limit.

The float sensor consists of a reed switch mounted within a shaft and a permanent magnet provided within a float housing. The shaft is vertically mounted within the water collection pan so that the reed switch is positioned at the water fill limit of the pan. As the water level rises, the magnet within the float travels up the shaft to the point where it comes into the proximity of the reed switch. The reed switch senses the presence of the magnet and signals the dishwasher's ECU that the water level has reached its fill limit.

Level sensors incorporating reed switch technology are low-cost solutions for any application where there is a need to detect the amount of liquid in a tank or pan. They are commonly used in white goods and appliances.

Features and Benefits:

- No physical contact required to operate the switch
- Zero power required for switch actuation
- Electrical contacts are within a hermetically sealed capsule that is immune to moisture, dust and dirt
- Wide operating temperature range adequate for use in hot and cold temperatures
- Sensor housing provides protection against mechanical stresses and vibration
- Reliable switching for millions of open/close operations

Suggested Products:

- 59630 (Float sensor)
- FLEX-14 (14 mm reed switch)
- MDSR-10 (10 mm reed switch)
- MACD-14 (14 mm reed switch)
- 59300 (reed level sensor)

Similar Applications:

Dish washers, washing machines, air conditioners, dehumidifiers and coffee brewers

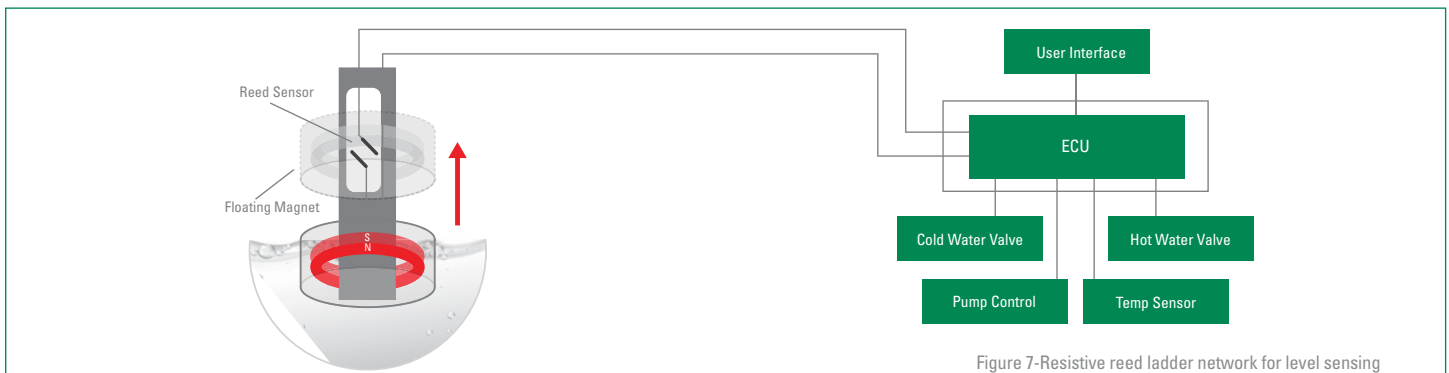
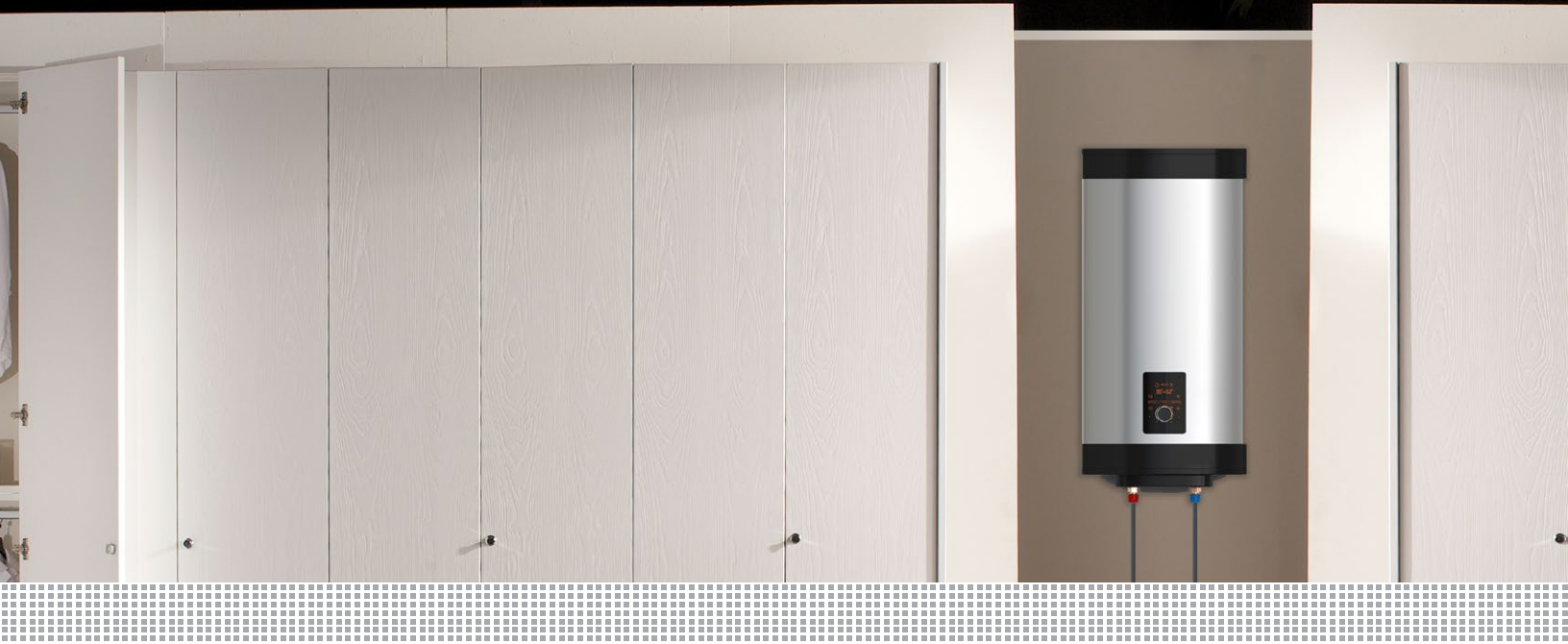


Figure 7-Resistive reed ladder network for level sensing



FLOW SWITCH Tankless Water Heater

A flow switch utilizes a reed switch to detect the motion of a valve, paddle wheel or piston that is fitted with a permanent magnet. For example, in some tankless water heater units, the flow sensor contains a permanent magnet that is fixed to a piston that moves when there is water pressure present in the system. As the water pressure increases, the piston movement brings the magnet into the proximity of the reed switch. This causes the reed switch to close and signals the presence of water flow.

A flow sensor utilizes a turbine with an attached magnet that rotates by a fixed reed switch or Hall effect sensor. The speed at which the turbine rotates is proportional to the flow rate of the fluid.

Reed sensors are highly effective solutions for flow-sensing applications where there is a need to detect the presence of liquid or gas flow in a system. Common uses include water or gas flow in the similar applications listed.

Features and Benefits:

- No physical contact is required to operate the switch
- Zero power required for switch actuation
- Wide operating temperature range adequate for use in hot and cold temperatures
- Reliable switching for millions of open/close operations
- Electrical contacts are within a hermetically sealed capsule that is immune to moisture, dust and dirt
- Overmolded sensors provide additional protection against mechanical stresses

Suggested Products:

- MDSM-4 (15 mm reed switch)
- MLSM-4 (15 mm reed switch)
- MDCG-4 (15 mm reed switch)
- MDSR-10 (10 mm reed switch)
- 59165 (16 mm overmolded reed switch)
- 59170 (11 mm overmolded reed switch)

Similar Applications:

Dish washers, washing machines, hot tubs and utility gas meters

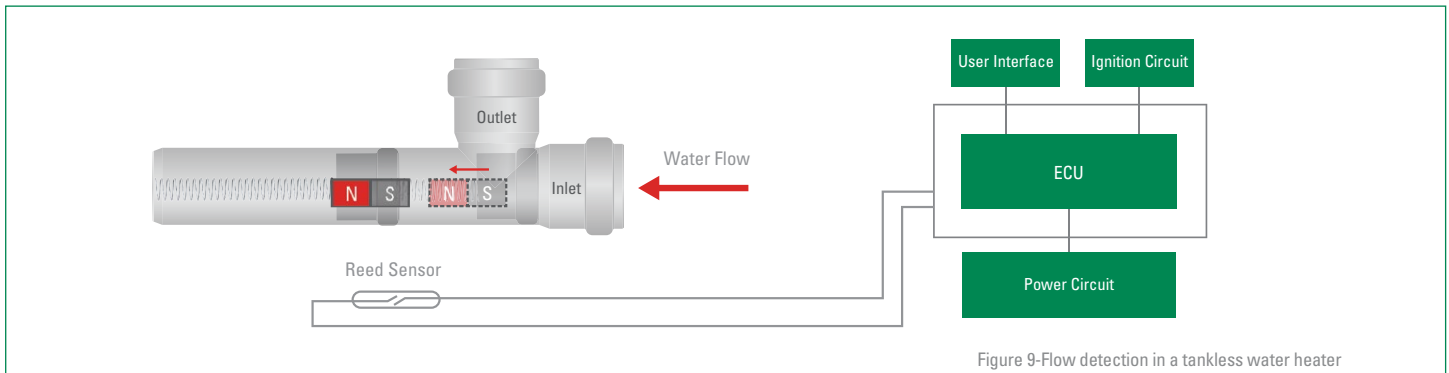
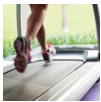


Figure 9-Flow detection in a tankless water heater



SPEED SENSING USING REED SENSORS

Treadmill Pulley

Reed switch-based sensors are used as highly effective speed sensors in low-cycle-rate applications with rates up to a few thousand revolutions per minute (RPM).

For example, in treadmills, a reed sensor is used to detect the speed of the moving belt. Two permanent magnets are placed on diametrically opposite ends of the belt pulley, and a reed sensor is mounted to the treadmill frame perpendicular to one end of the pulley.

As the treadmill pulley rotates, the reed sensor detects when each of the magnets is close to the sensor. The time interval between the detection of each magnet is used to compute the speed at which the pulley is rotating.

Reed sensors are highly accurate in speed-sensing applications where there is a rotating part. They are commonly used in fitness equipment where there is a rotating part with a variable speed.

Features and Benefits:

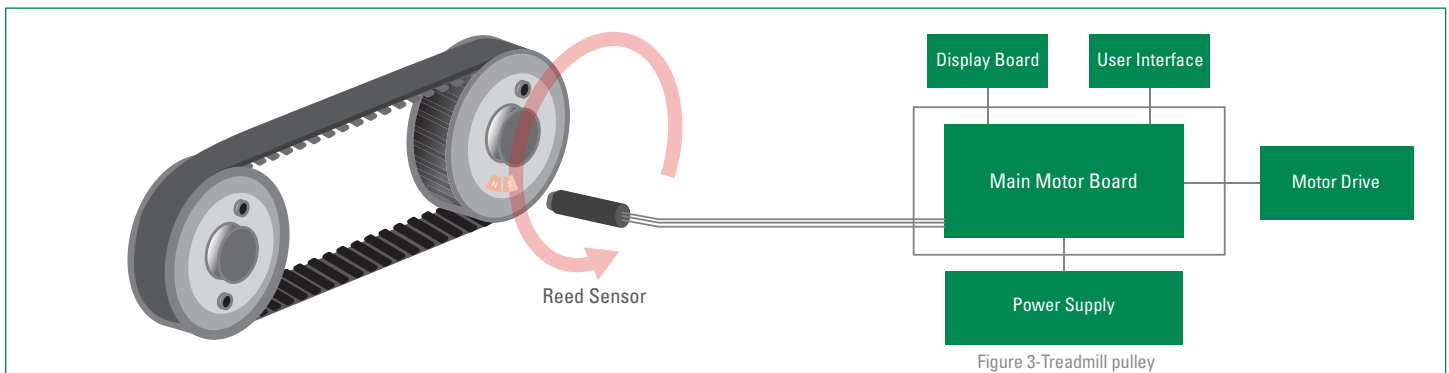
- Effective, noncontact solution used to switch the sensor
- Digital output signal is used to compute speed with high accuracy
- Long lifetime and reliable sensing for millions of operations
- Low-cost alternative to infrared/optical sensors
- Overmolded sensors provide additional protection against mechanical stresses and vibration

Suggested Products:

- 59025 (Firecracker)
- 59065 (Threaded barrel)
- 59140 (Miniature flange mount)
- 59150 (Flange mount)

Similar Applications:

Fitness equipment, including treadmill, stationary bicycle and elliptical cross-trainer





SPEED SENSING USING HALL EFFECT SENSORS

Washing Machine Drum Speed

Hall effect sensors make very effective rotary speed sensors. The strengths of these sensors are their reliability, repeatability, accuracy and high speed. For example, in a clothes washing machine, a digital or latching Hall effect sensor can be used to detect a rotating ring magnet to determine the rotating speed of the drum. Multipole magnets (e.g., 8–40 poles) are typically used as the ring magnets in these designs. The frequency and resolution of speed are affected by the number of magnet poles.

Direction, as well as speed, can be measured. The direction signal can be provided by either quadrature signaling or with the direction encoded in the pulse width. Quadrature signaling involves two square wave speed signals where the direction of rotation is determined by the lead vs. lag phase relationship between the two signals.

Another popular method of detecting speed is to use Hall effect speed sensors to detect rotating ferrous gear teeth such as in an automotive transmission speed sensor application. The Hall effect sensor has a back-bias magnet and detects the variation in magnetic flux density between the gear tooth and the Hall effect sensor.

Features and Benefits:

- Digital output signal is used to compute speed with high accuracy
- Long lifetime and reliable sensing for millions of operations
- Effective for high-speed applications
- Available with a selection of cable length and connector options

Suggested Products:

- 55140 (Flange mount)
- 55310 (Flat pack digital)
- 55505 (Gearthooth sensor)
- 55075 (Gearthooth sensor)
- Custom-designed sensor

Similar Applications:

DC motors, vacuum cleaners and wheel speed

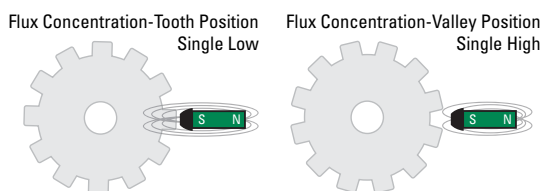


Figure 5-Gearthooth sensing

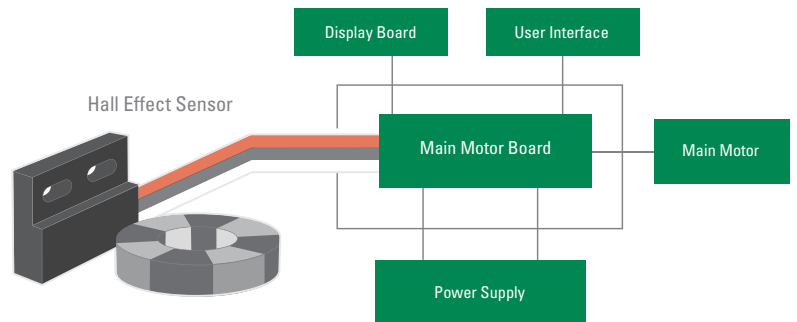


Figure 4-Washing machine drum speed sensor with ring magnet



About Us

Littelfuse products are vital components in virtually every market that uses electrical energy, from consumer electronics to automobiles, commercial vehicles and industrial equipment. Littelfuse is the preferred brand for leading manufacturers around the world, with more than 30 sales, manufacturing and engineering facilities and a global network of distribution channels.

Littelfuse Products

Our products are well-proven designs manufactured to our high standards. Our experts are committed to delivering the best products and solutions for your specific needs.

Our global organization provides:

- Custom sensor designs per customer specifications
- Vertically integrated manufacturing
- In-house magnetic simulation support
- Quick turnaround for custom sensor prototypes

Littelfuse has sales offices around the world in over 40 locations. For more information, please visit www.littelfuse.com/contactus.