

## Introduction

Reed switches and sensors are highly effective solutions for flow sensing applications that can be used for detecting the presence of fluid flow in a system or even measure the rate of fluid flow.

Tankless water heaters are becoming a widely popular solution for water heating needs. The availability of hot water on demand and the perceived limitless supply of hot water make these types of water heaters much more attractive than traditional tank water heaters. These water heaters also provide long-term energy savings since energy is used only when there is a demand for hot water. In order to effectively heat the water when there is a demand, a sensor is needed to detect the flow of water.

## Solution

### Flow Switches

A **flow switch** is used to detect the presence of water flow and turns on the system to heat the water. Whenever there is a hot water demand, a reed sensor within the tankless water heater identifies the demand and initiates the heating process. This sensor monitors the presence of water flow while two other sensors measure the incoming and outgoing water temperature. This information is transmitted continually to a microprocessor controller which determines the precise amount of power to send to the heating elements to heat the water to the desired temperature.

### Flow Sensors

A **flow sensor** performs the same function but provides the added benefit of measuring the rate of water flow. Flow sensors are also used in tankless water heaters. In Europe and other regions, pressure pump showers with flow sensor-based utility metering technology are widely used. The pressure pump creates pressure for the shower when water flow is sensed, which helps conserve water.

Many multi-unit apartment buildings are equipped with water submetering systems that employ flow sensors to measure water usage in individual apartments. Even in some individual homes, submetering systems with flow sensors are being installed to monitor water usage at various locations throughout the home. The lowering costs of wireless communication technology helps to make these systems more economically feasible.

Littelfuse® recommends the following products as flow switches and sensors:

**Table 1: Suggested Products**

Suggested Products
59165 Overmolded Reed Switch
HA-15 Reed Switch
MDCG-4 Reed Switch
MDSM-4 Reed Switch
59140 Mini Flange Mount Reed Sensor
55140 Flange Mount Hall Effect Sensor
Custom Designed Flow Sensor

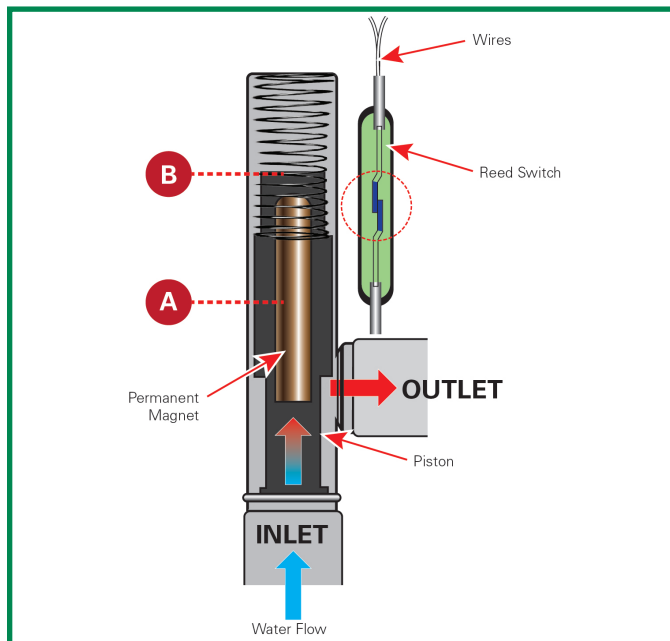
Reed sensors are commonly used for water or gas flow detection in the following applications:

- **Washing Machines**
- **Gas Meters**
- **Pool Pumps**
- **Medical/dental Surgical Room**
- **Water Submetering System**
- **Dish Washers**
- **Hot tubs and spas**
- **Pool Chlorinators**

## How It Works

Littelfuse offers reed switches and reed sensors for use in a variety of flow sensing applications. Reed switches have two or three ferromagnetic blades that have the contact area coated with special precious metal materials. These blades are then hermetically sealed within a glass tube filled with nitrogen gas. Reed switches are operated with a magnetic field usually produced by a permanent magnet. This magnetic sensing technology is employed in both flow switches and flow sensors.

In a **flow switch** assembly, a magnet is placed within a piston that is loaded against a spring which compresses when water flow starts. When the piston/magnet is properly positioned near the reed switch the contacts, will close, indicating that the water is flowing.



**Figure 1: Flow Switch Detects Presence of Water Flow**

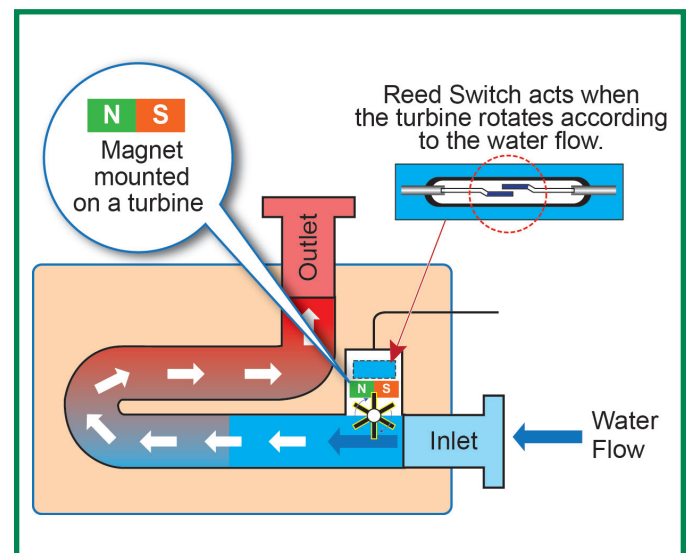
### FEATURES AND BENEFITS

- No physical contact is required to operate the switch or sensor
- Wide operating temperature range adequate for use in cold and hot temperatures
- Electrical contacts are within a hermetically sealed capsule and are thus immune to moisture, dust, and dirt
- Over-molded sensors provide additional protection against mechanical stresses
- Reliable switching for millions of open/close operations
- Low cost alternative to mechanical switches

The flow switch housing should consist of a non ferrous material such as brass, copper or plastic. The magnet should be within a non-ferrous piston material that is connected to a non-ferrous spring. When there is no flow of water, the magnet will be in position **A** as shown in **Figure 1**. When user opens a tap, water will start to flow, pushing the magnet to position **B**.

**Flow sensors** utilize a reed switch to detect the motion of a paddle wheel (turbine) fixed with a permanent magnet, which operates as an integrated unit as shown in **Figure 2**. The reed switch is situated above the turbine such that the switch closes when a magnet on the wheel passes by. The number of close/open cycles of the switch in a given timeframe can be related to the flow rate of water. A microprocessor in the tankless water heater's control unit monitors the flow rate and adjusts heating of the water accordingly.

For many flow sensing applications, the design of the sensor is heavily dependent on the design of the overall flow system. Space constraints and the location of inlets and outlets in the system can limit the size and form factor of the flow sensors, as well as limit where the flow sensors can be installed. Furthermore, due to unique factors such as pipe size, fluid volume, and pressure in each system, custom sensor designs are often required to ensure proper fit and functionality. Magnetic field strength, sensitivity of the reed switch, the gap between the magnet and reed switch, and other factors play a large role in the functionality of the flow sensor. Customizations such as specific reed switch sensitivities and mechanical packages are available to meet unique design needs. Custom designed flow sensors using Hall Effect technology are also an option.



**Figure 2: Flow Sensor Measures Water Flow Rate**

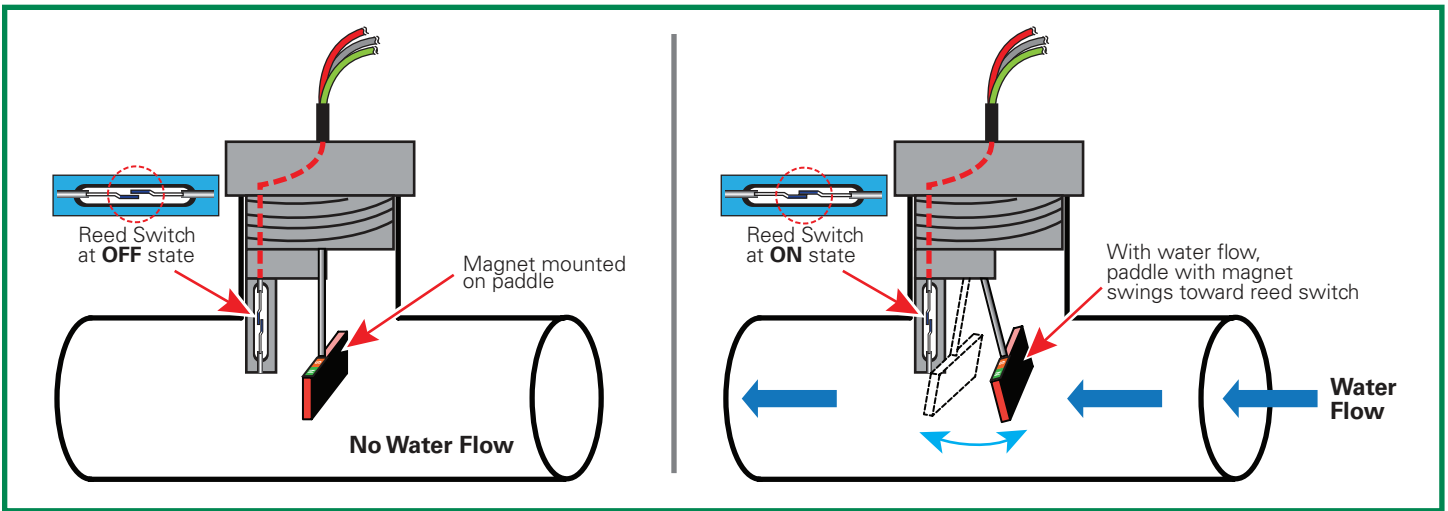


Figure 3: Flow Switch activates when the paddle moves

## Beyond Sensing, Littelfuse® Offers Circuit Protection Solutions

In addition to sensor products, Littelfuse offers the world's broadest and deepest portfolio of circuit protection and power control solutions.

Littelfuse recommends the following products for use in these applications:

Table 2: Circuit Protection and Power Control Solutions

Application Example	Product Series
<b>Power Control</b>	
Heater AC Power Control	Q60xxxH6 Thyristors
<b>Circuit Protection</b>	
AC Mains	TMOV, LA, UltraMOV Varistors
	3AG, 5x20mm Fuses
	Holders, Blocks, Clips
Touch Screen/Display Panel	SP1001, SP1003 Diode Arrays
	Multilayer Varistors

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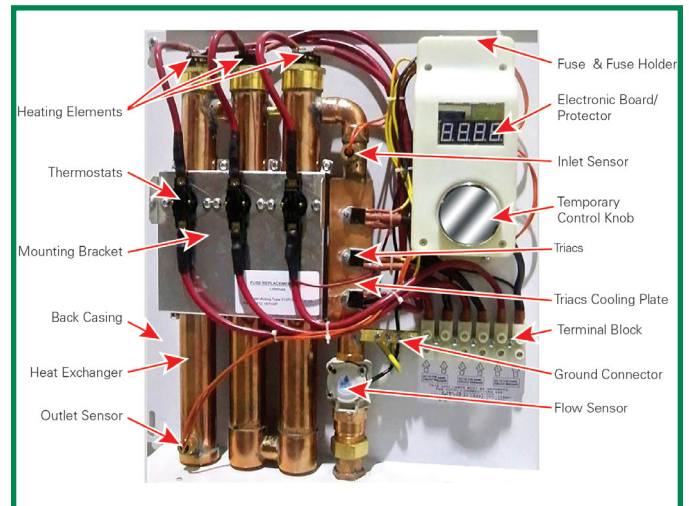


Figure 4: Construction of a Tankless Water Heater

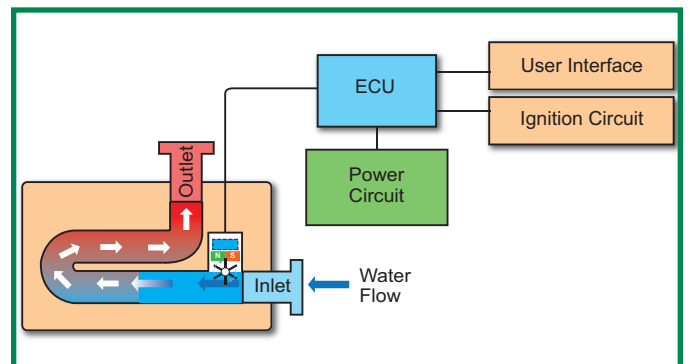


Figure 5: Block Diagram Showing Flow Sensing in Tankless Water Heater