



# AUTOMOTIVE LIQUID LEVEL SENSING



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# Introduction

## Purpose

- › There are an increasing multitude of sensing applications in the automotive industry
- › They improve vehicle safety and supply more intelligence



# Introduction

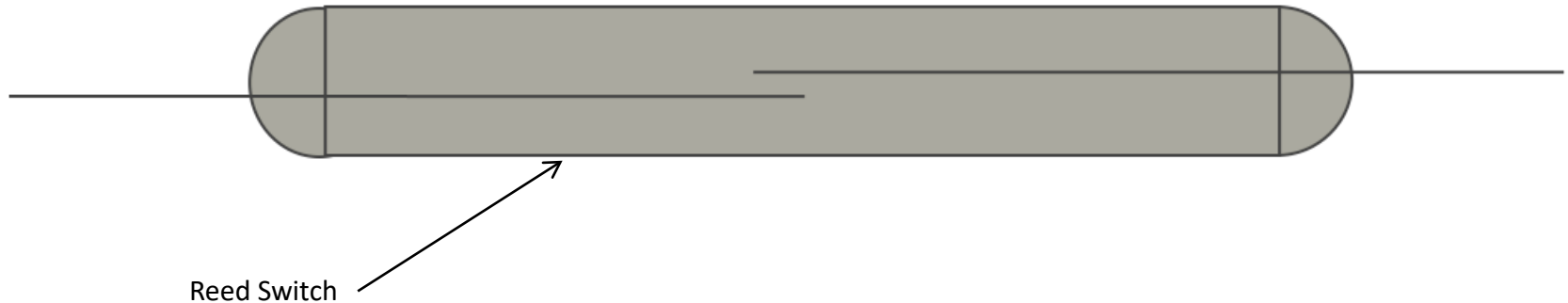
## Objectives

- › Present the hermetically sealed reed sensor technology
- › Define the key functions and key terms
- › Present the automotive sensing needs
- › Present the various package configurations
- › Present the many applications



# Key Terms – The Reed Switch

- › The reed switch has two open contacts that are hermetically sealed in a glass cylinder
- › The contacts are two ferromagnetic leads
- › The two leads are separated internally forming a gap
- › They come in various cylindrical sizes



# Key Terms – The Reed Switch

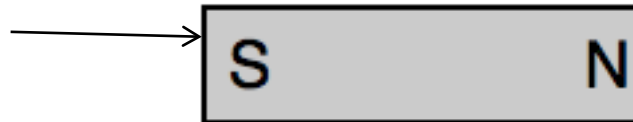
- › Sensitivity to closure is measured in milli-Tesla (mT) or ampere turns (AT)
- › The sensing distance may be adjusted for optimum closing and opening.
- › Hysteresis is the ratio of the closure point divided by the opening point.
- › Hysteresis is critical in some applications.



# Key Terms – The Permanent Magnet

- › Steady magnetic field
- › Has a north and south pole
- › Available in various sizes
- › Available in different strengths
- › Magnetic strength is measured in gauss or milliTesla
- › Magnets come in different materials – rare earth, Alnico, and ferrite
- › Rare earth are the strongest magnets

Permanent Magnet





# Why Reed Sensors for Automotive Applications?

## Key Features

- › Reed sensors ideal in harsh under-the-hood environments.
- › Reed sensors offer remote sensing at distances greater than one inch (25.4 mm)
- › Reed sensors do not require any power when they are in their off or un-energized state.





# Why Reed Sensors for Automotive Applications?

## Where sensing movement is necessary

- › Hood or trunk closure
- › Movement of the brake pedal
- › Door opening or closure
- › Key insertion
- › ABS brakes
- › Speedometers
- › Tachometers
- › Cruise control
- › Tire pressure sensing
- › Door ajar
- › Sunroof position
- › Gear selection
- › Emergency brake
- › Gas cap placement
- › Electric window position
- › Security system controls
- › Air bags
- › Fuel shut off
- › Shock sensor
- › Seat belt sensor
- › Door locks
- › Exhaust fumes emission control
- › Convertible roof end position



# Why Reed Sensors for Automotive Applications?

## Where liquid levels need to be monitored

- › Brake fluid
- › Oil level
- › Fuel level
- › Low fuel level
- › Windshield fluid level
- › Coolant fluid level
- › Transmission fluid



# Automotive Applications

Examine conditions of Automotive Application

Select the sensing technology that is best suited for the application

- › Solid State Sensors
- › Mechanical Sensors
- › Reed Sensors
- › Inductive Sensors
- › Capacitive Sensors



# APPLICATIONS

## BRAKE FLUID SENSOR



## Brake Fluid Sensor

# Requirements

Absolutely vital  
(life/death)  
requirement

Quality and  
reliability  
critical

Under the  
hood dirty  
environment

# Requirements

Operating temperature range  $-55^{\circ}\text{C}$  to  $150^{\circ}\text{C}$

A wide hysteresis is needed.

Ability to have the on-board computer know that the sensor is in the circuit



# Brake Fluid Sensor Technology Selection

## Reed Sensor Selected

- › In this case, a float with an imbedded magnet is placed within the brake fluid
- › The reed switch is housed in a plastic sealed package locked in place externally and under the brake fluid tank



# Brake Fluid Sensor Technology Selection

## Reed Sensor Selected

- › When the brake fluid float is low enough the reed switch will activate
- › An indicator light on the dashboard is turned on
- › Turns off the ABS system





# Why the Reed Sensor Was Selected for Brake Fluid Sensor

The reed sensor is hermetically sealed and further contained in a sealed plastic package

Not affected by the 'under the hood' environment

It offers the best quality and reliability where it can operate for billions of operations

Dynamic contact resistance testing (DCR)



# Why the Reed Sensor Was Selected for Brake Fluid Sensor

Accurate open and closure points for reliable operation



Ability to adjust the hysteresis which allows for a wide differential between closure and opening

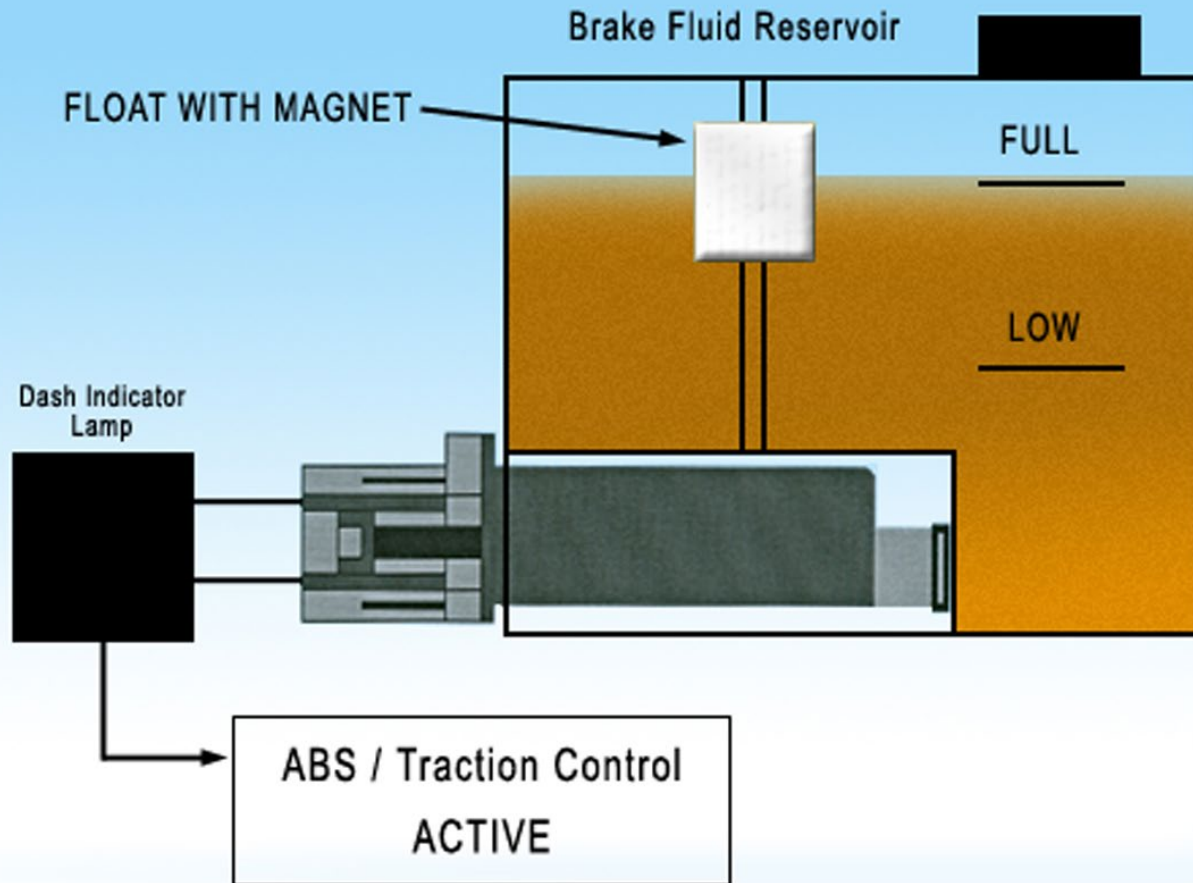


Use of a PCB allows for a more reliable electrical connection approach

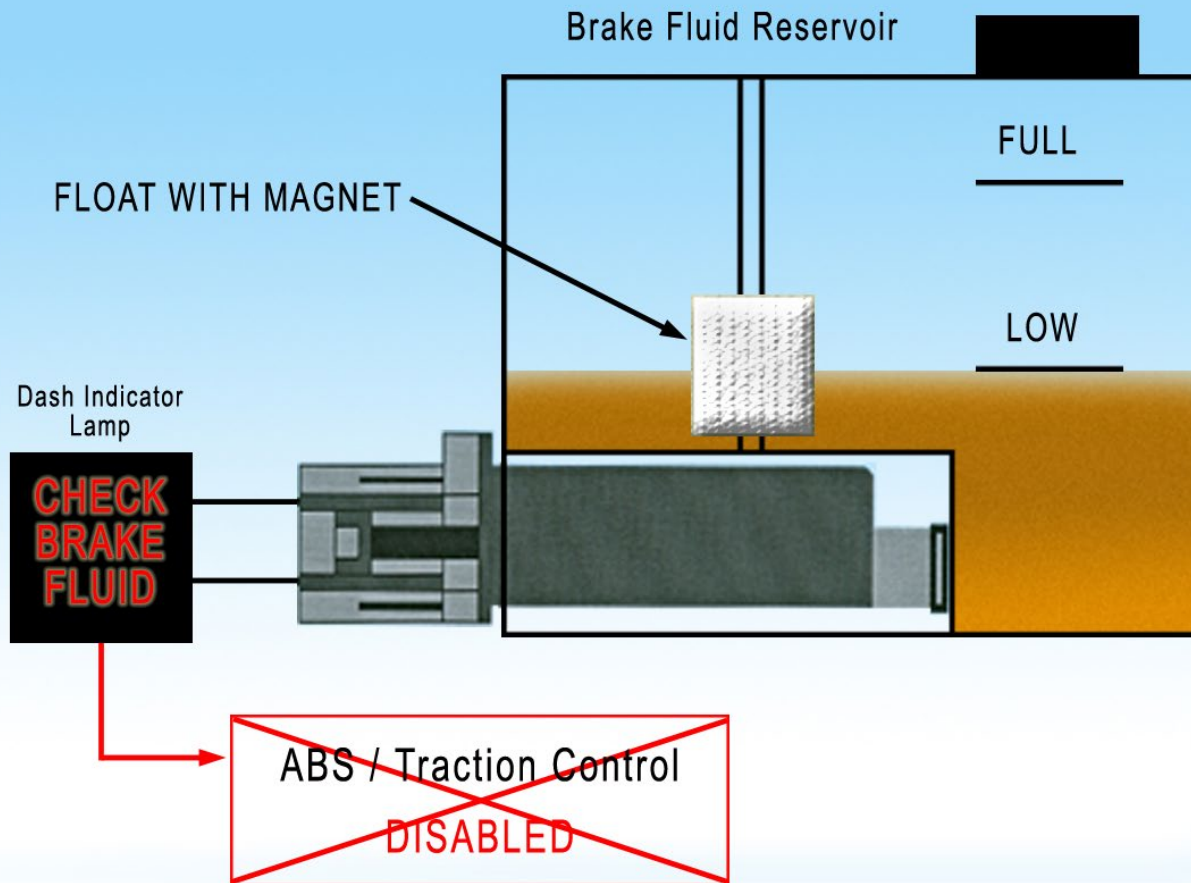


High resistance resistor within the sensor used for monitoring

# Why the Reed Sensor Was Selected for Brake Fluid Sensor



# Why the Reed Sensor Was Selected for Brake Fluid Sensor





# APPLICATIONS

## BRAKE PEDAL SENSOR



# Brake Pedal Sensor

## Requirements

Another vital  
requirement

Quality and  
reliability  
critical

100s of  
thousands of  
operations  
expected



## Brake Pedal Sensor

# Requirements

Dirty  
sometimes wet  
environment

Must have a  
rugged well  
sealed sensor

Must have a  
long sensing  
distance



## Brake Pedal Sensor

# Requirements

Operating temperature range  $-40^{\circ}\text{C}$  to  $60^{\circ}\text{C}$

Must have a rugged well sealed sensor

Braking activation and brake lights







# Why the Reed Sensor Was Selected for Brake Pedal Sensor

- › Ability to operate in temperatures from  $-55^{\circ}\text{C}$  to  $150^{\circ}\text{C}$  with no negative effects
- › Ability to operate for 100's of thousands of operations reliably



# Why the Reed Sensor Was Selected for Brake Pedal Sensor

- › Accurate open and closure points for reliable operation
- › Dynamic Contact resistance testing (DCR)



# APPLICATIONS

## WINDOW WASHER FLUID LEVEL SENSOR

# Window Washer Fluid Level Sensor

## Requirements

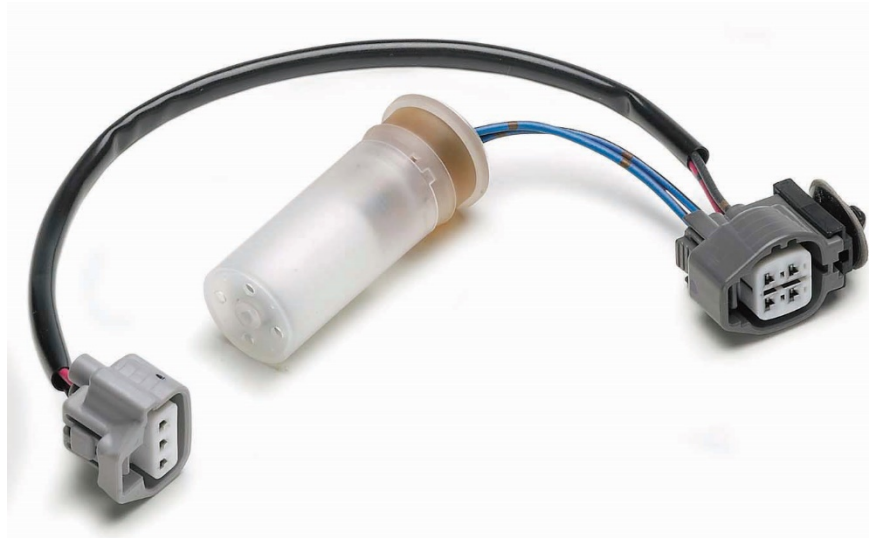
- › The window washing operation is considered a critical safety requirement
- › Sensing fluid level therefore is critical
- › Sensor quality and reliability a strong requirement



# Window Washer Fluid Level Sensor

## Requirements

- › Dirty wet 'under the hood' environment
- › Must operate -55°C to 150°C
- › Must have a rugged well sealed sensor





# Window Washer Fluid Level Sensor

## Requirements

- › Careful position of sensor away from the magnetic field of washer pump motor
- › Sensor may be top, side or bottom, mounted depending upon the design of the fluid container
- › Side mounting may require anti-rotation device
- › Integrated automotive connector
- › Sensor may need to incorporate the float mechanism as well as the sensing mechanism



# Window Washer Fluid Level Sensor

## Requirements

- › Must have a wide differential or wide hysteresis to prevent rapid turn on and turn-off when the fluid is sloshing.
- › Must be able to operate properly with different specific gravities







# Window Washer Fluid Level Sensor

## Requirements

- › Ability to directly switch incandescent and led indicators and/or send the signals to a on board computer
- › Capable of supplying an electrical signal to the on board computer that the sensor is properly electrically connected

# Window Washer Fluid Level Technology Selection

## Reed Sensor Selected

- › Hermetically sealed reed switch technology
- › A turnkey component
- › Ability to switch higher power and low-level digital signals



# Why the Reed Sensor Was Selected for Window Washer Fluid Level

- › A hermetically sealed reed sensor was selected to better deal with the wet, dirty ‘under the hood’ operating environment
- › In addition, the reed switch is housed in a plastic sealed package
- › The sensor and float can be locked in place on the fluid container



# Why the Reed Sensor Was Selected for Window Washer Fluid Level

- › Ability to operate in temperatures from  $-55^{\circ}\text{C}$  to  $150^{\circ}\text{C}$
- › Ability to operate for 100's of millions of operations
- › Dynamic Contact resistance testing (DCR)



# Why the Reed Sensor Was Selected for Window Washer Fluid Level

- › Accurate open and closure points for reliable operation
- › Provide wide hysteresis
- › Ability to meet different or changing specific gravities





# Summary

- › Each technology has its own best operating characteristics
- › Reed sensors are the design-in choice when encountering wet, dirty, and wide operating temperatures ranges
- › Reed sensors continues to be selected for liquid level detection
- › The applications listed earlier all use reed sensors for the same reasons as presented in the detailed applications

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