

# LIQUID LEVEL SENSING USING REED SWITCH TECHNOLOGY

When measuring discrete levels of liquids such as automobile brake fluid, reed switch technology is simple, inexpensive and reliable. The principle involves a magnet mounted on a float that closes an adjacent magnetic reed switch as the magnet approaches the switch. Typically, the reed switch is mounted and sealed in a plastic or non-magnetic metal tube, and a ring magnet mounted on a float rides up and down the tube depending on the liquid level. Since the tube is non-ferrous, it does not impede the magnetic field, so the switch operates when the field intensity reaches a threshold level. Thus the reed switch is protected from the fluid being monitored. The tube should be designed so that the point of entry of the sensor leads is above the highest liquid level. Typically, a magnet made with inexpensive plastic bonded ferrite with an energy product of about 16-KJ/m<sup>3</sup> can be used. Such magnets only cost a few cents. The principle is shown here.

Using a ring magnet is a good solution since as the magnet sweeps by the reed switch, only one closure occurs as the plane of the magnet lines up with the contact gap of the switch. Other types of magnets and polar angles can cause two or even three closures, causing potential problems in the software used to monitor the level sensor.

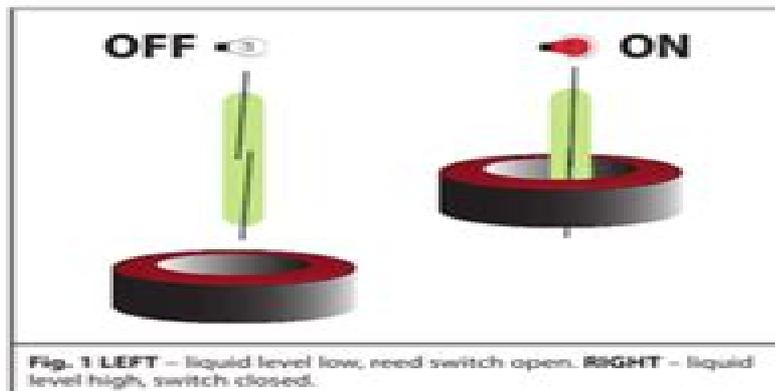


Fig. 1 LEFT – liquid level low, reed switch open. RIGHT – liquid level high, switch closed.

The system shown in Figure 1 is typical configuration used for brake fluid level monitoring in automobiles, to test that the reservoir is FULL. Note that if the wires to the sensor are severed, the reed switch appears to be open and the sensor registers low. It is therefore fail-safe in this application. Other applications such as monitoring that a tank, sump or overflow vessel is EMPTY require that the reed switch is mounted lower, so it is closed when the magnet is low. If the vessel fills, the float magnet rises and the reed switch opens. Severed sensor wires then register as a vessel overflow condition – a false positive signal, but one which ensures that vessel overflow cannot be missed.

Simulation tools developed by Coto and used for customer support allow magnet-switch system designs to be rapidly prototyped.

The method described so far frequently implemented in automobiles for monitoring brake fluid levels. It can be modified to register multiple levels by incorporating a chain of reed switches and a resistor ladder that provides a varying resistance or voltage depending on the liquid level. For example, using three reed switches instead of one, the reed switch level sensor can register a **RED** alert - "stop and check brake fluid immediately," **ORANGE** - "check brake fluid level soon," and **GREEN** - "brake fluid level OK."

Discrete voltage levels corresponding to each switch closure can be developed using a resistor ladder. A typical configuration for a 4-switch system is shown in Figure 2. The resistor network can be extended to any number of levels within the resolution range of the A/D converter that is being used. Thus deep tanks can be monitored with many discrete levels. Variable switch spacing schemes can also be devised to suit tanks with spherical or other varying cross sections.

In the case of a three-level sensor, the vehicle's computer can monitor  $V_{OUT}$  and unambiguously determine the three different liquid alert levels. With this scheme, the sensor designer should space the reed switches so that only one is closed at

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