INTRODUCTION TO THE OPTICAL LEVEL SENSOR

A SOLID STATE LIQUID LEVEL SENSOR THAT IS INDEPENDENT OF PRESSURE, TEMPERATURE AND DIELECTRIC CONSTANT.

CONTENTS

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Introduction

The patented solid state sensor uses the established principle of Total Internal Reflection in a novel way to allow a linear probe to be used. Inside the probe, which is fully encapsulated, is a ladder of Infra Red LEDs and Opto-sensors which are electronically scanned by the control electronics to give a direct liquid level.

This is independent of dielectric constant, conductivity, temperature, pressure etc. The design is modular allowing different lengths of probe to be manufactured. Where required it can also be certified Intrinsically Safe. A Video demonstration is available. See link below.

The Optical Level Sensor (OLS) was selected by a large UK supermarket chain after trials that compared it to Ultrasonic and Capacitance models. The application is for monitoring the level of liquid refrigerant. It is installed in all their major stores refrigeration plant. Other applications for the OLS are in the chemical, heating and ventilating, food and drink, oil, process and water industries.

Product Innovation is currently looking for distributers, installers/specifiers in the retail refrigeration market both within and outside the UK to promote and distribute the product.

Product Innovation Ltd can make prototypes for specific applications on request. For more information contact the Chairman, Peter Frank at Peter.Frank@productinnovation.com

Video Demonstration

YouTube

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Level Sensor Comparison Chart

The large majority of level sensor applications are covered by 4 different technologies.

Each technology has its own strengths and weaknesses as summarised in the table below.

Feature	*Optical*	*Float*	*Capacitance*	*Ultrasonic*
Direct Sensing of Liquid Level	✓	X	X	X
No Moving Parts Totally Solid State	✓	X Float can get stuck or sink	✓	✓
Unaffected by Temperature	✓	✓	X (The dielectric constant can change with temperature)	X The speed of sound in a gas such as air changes with temperature. It also changes with different gases.
Unaffected by the Liquid Medium	✓	✓	X	X (If the gas above the liquid is not air)
No Calibration Needed	✓	✓	X	X
Impervious to Pressure	✓	X Float can leak and then sink	Some Models	Some Models
Resolution	**Good** Does not alter with pressure, temperature or dielectric constant	**Medium** Limited to how close the sensors can be to each other	**Good** But can drift if there is a change in dielectric constant	**Good** But based on the speed of sound in the gas/air above the liquid. This will change with temperature.
Price	**Medium**	**Low to Medium**	**Medium to High**	**Medium to High**

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The Technologies Explained

The Optical Sensor

This consists of a clear rod (made from epoxy) within which is a PCB containing a ladder of Infra Red LEDs and Photo sensors. The electronic control powers up pairs of LED/Photo Sensors in turn in order to find the first point at which a sensor pair is below the liquid.

It uses the physics principle of Total Internal Reflection to sense the liquid. It then translates this position into a voltage (or other) output. The liquid level is thus directly sensed by the optics. It is the only sensor that can do this.

The Float Sensor

This consists of a central rod within which is a row of reed switches or Hall Effect switches. A float with an embedded magnet in it and with a hole through its centre is placed over the rod.

As it moves up and down along the length of the rod the magnet activates individual switches. The output to voltage (or other) is dependent on which switch has been activated. Although very simple this technology can be prone to the float sticking or sinking. The float itself can be quite bulky and the resolution is limited to how close the reed switches can be placed next to each other.

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Capacitance

The technology measures the capacitance between two vertical conductors placed near each other. Typically this will be a metal rod within a metal tube. As the liquid moves up and down the capacitance between the two conductors is measured and this is then translated into the output signal. However the capacitance depends on the dielectric constant of the liquid being measured. This means either that the sensor has to be calibrated for the particular liquid, or it has to have a self calibration mechanism.

Such a mechanism is usually two horizontal plates near each other and at the base of the sensor where it is presumed there will be liquid filling the gap. These plates then determine the dielectric of the liquid. And this is then used to interpret the level as the liquid moves up the rod. Complicated, and clearly can be affected by any sludge or debris at the base of the tank. Also dielectric constant varies with temperature so this calibration depends on the liquid all being at one temperature.

Ultrasonic

The technology is based on sending out a sound pulse from a sensor above the liquid. The electronics then measures the time taken for the sound pulse to bounce back to the sensor. This time measurement is used to measure the distance of the sensor to the liquid. This approach has some problems to overcome: Reflections of the sound pulse can come from internal structures within the tank of liquid, and the time measured depends heavily on the gas or air above the liquid and also the temperature of that gas/air. These are compensated for in some of these sensors, but naturally the compensation method can add some variation in the reading. The speed of sound in a gas/air depends both on the gas and its temperature. Where there is pressurised gas above the liquid (as in the case of refrigerant) the sensor must be calibrated to suit that particular gas.