ECHOTEL® CONTACT ULTRASOUND

MAGNETROL®

Contact Ultrasonic Level Sensing

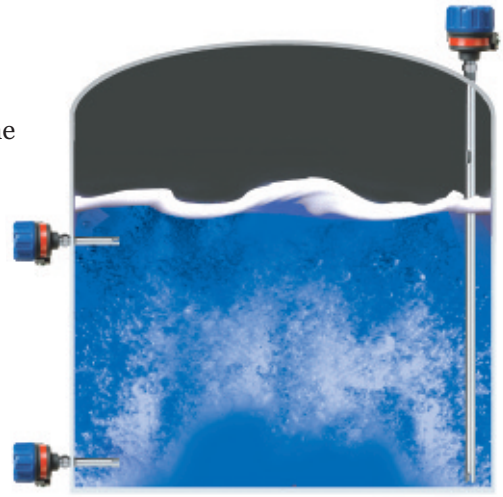
FROM MAGNETROL®

Ultrasound technology was developed during WWII under the acronym **SONAR** (SOund Navigation And Ranging). First applied to process control in the 1960s, ultrasonic level measurement continues to play a significant role in liquid level measurement to this day.

Ultrasonic instruments are made for both contact and non-contact (or through-air) level sensing. This brochure focuses on the Echotel® line of contact ultrasonic products that provide single and dual point liquid level measurement in virtually every process industry.

Continuous-Wave and Pulsed-Signal Sensing

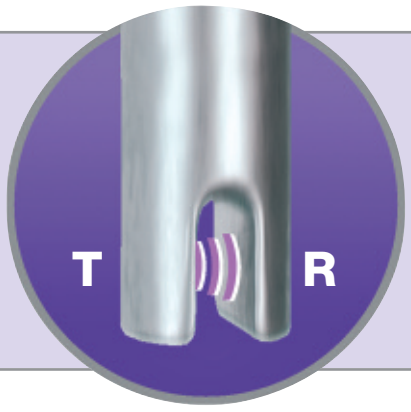
Ultrasonic contact level sensing is achieved by either continuous-wave or pulsed-signal technology. Our **Model 910** continuous-wave switch uses two piezoelectric crystals positioned opposite each other across the transducer gap. The transmit crystal generates an acoustical signal which the receive crystal converts into an electrical signal. When liquid is present in the transducer gap, the amplifier becomes as oscillator causing a relay circuit in the electronics to indicate a wet gap condition. When liquid vacates the gap, the amplifier returns to an idle state.



Challenging process conditions such as suspended solids or aeration are best managed with pulsed-signal technology. Models 961/962 switches further minimize the effects of mild turbulence or splashing with adjustable time delays.

Pulsed-signal **Models 940** and **961/962** feature a digital electronic amplifier which produces a powerful pulse of ultrasonic energy five to ten times stronger than most continuous wave units. This pulsed-signal technology will provide more accurate measurement in conditions of aeration, suspended solids, turbulence, and highly viscous liquids.

The transmit crystal of pulse-signal units generates pulses of high-frequency ultrasonic energy only milliseconds in duration. In between each pulse the receive crystal "listens" for the transmission. If liquid is present in the gap the receive crystal detects the pulse and reports a wet gap condition to the electronics. When the gap is filled with air, the receive crystal cannot detect the pulse, and reports a dry gap condition.



Contact ultrasonic level switches use ceramic discs called piezoelectric crystals to transmit and receive ultrasonic energy. A transmit crystal (T) is positioned on one side of a transducer gap and a receive crystal (R) is positioned on the opposite side. Tip-sensitive style gaps—the only style used on Echotel® switches—can sense level to within ¼" from the end of the transducer.

Application Guidelines

Over 35 years of experience with ultrasonic gap switch technology has made the ECHOTEL brand a world leader in liquid level switches. Today's line offers three distinct product offerings:

910

• For applications where self-test isn't required, our economical **Model 910** with continuous wave technology is a reliable switch with a tip-sensitive transducer.

940

• Though OEM priced, our compact **Model 940** offer both advanced tip-sensitive transducers and pulsed signal technology.

• Single Point **Model 961** and dual-point **Model 962** offer tip-sensitive transducers, pulsed signal technology, advanced self-test and a time delay feature.

961

Models 961/962 represent the pinnacle of ultrasonic switch development at Magnetrol®. Their continuous self-testing of electronics, transducer, piezoelectric crystals, and testing for electromagnetic noise, alarms the user of a malfunction or the presence of EMI/RFI noise. An adjustable time delay of 0.5 to 45 seconds helps curtail nuisance alarms and relay chattering.

With extensive FM, CSA, and ATEX approvals the Models 961/962 are suitable for virtually any hazardous location. Their SFF* value of over 90% makes them suitable for use in Safety Integrity Level (SIL) 2 loops. Having either relay output or mA current shift capability, Models 961/962 can be used for more process applications, making them the most universal liquid level switches available today.

Advantages and Limitations

The advantages of contact level sensing using ultrasonic technologies are:

- Low cost single and dual point sensing.
- Accurate and reliable in a wide variety of liquids.
- Unlike tuning forks, no density adjustments required.
- Easy installation and simple configuration.
- A broad range of available sensor materials.
- Transmits a stable signal despite liquid property changes in specific gravity, conductivity, pH, and dielectric or temperature shifts.
- Switches are 100% electronic and contain no moving parts which can degrade or require high maintenance.

Certain process conditions may interfere with the ultrasonic signal. These conditions include:

- Slurries with a very high percentage of solids.
- Extreme aeration of the liquid.
- Liquids which generate crystallized coatings.
- Very aggressive turbulence and splashing.

At a Glance: ECHOTEL® CONTACT ULTRASOUND *Contact Ultrasonic Switches*

Model	Ultrasonic Technology	Set Points	Output	Mounting	SIL Loop	3-A	Self-Test	Time Delay
910	Continuous Wave	Single	Relay	Integral	N.A.			
940	Pulsed Signal	Single	Relay	Integral	2			
961	Pulsed Signal	Single	Relay or CS	Integral or Remote	2	■	■	■
962	Pulsed Signal	Dual	Relay or CS	Integral or Remote	2		■	■

*In the language of Safety Instrumented Systems (SIS), Safe Failure Fraction (SFF) indicates all safe and dangerous detected failures. The Models 940 and 961/962 SFF values are over 90%, which allows them to be used in SIL 2 loops.

ECHOTEL® CONTACT ULTRASOUND

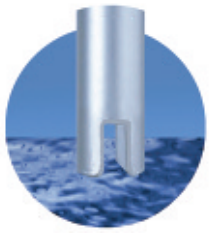
910 Level Switch

Model 910

A reliable switch featuring a 10-amp DPDT gold flash relay field-selectable for high or low level fail-safe. Worldwide safety approvals, 2-year warranty.

Proximity Sensing

The **Model 910** features a tip-sensitive transducer which measures liquid level to within 0.25" (6 mm) from the end of its transducer. When used as a low level switch, it can measure level further down into a tank or vessel.



Omni-Directional Mounting

Model 910 may be mounted horizontally or vertically. Mounting options include NPT and BSP threaded, flanges and sanitary connections.

Worldwide Safety Approvals

With FM, CSA and ATEX approvals on one agency nameplate, this is the perfect switch for OEM applications with global customer destinations.

Model 910 Electrical Specifications	
Power Supply:	120 VAC (+10%/-15%), 50/60 Hz
	240 VAC (+10%/-15%), 50/60 Hz
	24 VDC (±10%)
Power Consumption:	2.5 VA nominal
Relay Output:	
Gold Flash:	DPDT, 10 amps @ 120 VAC,
	240 VAC, or 24 VDC
Hermetically-Sealed:	DPDT, 5 amps @ 120 VAC,
	240 VAC, 24 VDC
Repeatability:	0.078" (2 mm)
Fail-Safe:	Field selectable high or low
Ambient Temperature:	
Electronics:	-40 to +160 °F (-40 to +71 °C)
Process Temperature:	
Transducer:	-40 to +250 °F (-40 to +121 °C)
Operating Pressure:	800 psig (55 bar) maximum

Liquid Level Applications

PROCESS MEDIA:

- **Clean liquids**
- **Low viscosity liquids**
- **Liquids with low % solids**
- **Corrosive liquids**

OF SPECIAL INTEREST TO:

- **Water and Wastewater Treatment**
- **Foods, Beverages, Pharmaceuticals**
- **Oil and Gas Industries**
- **OEM and Skid Manufacturers**

ECHOTEL® CONTACT ULTRASOUND

940 Level Switch

¾" NPT Fitting

ANSI Fitting

Economical, very compact switches with pulsed signal technology and tip-sensitive transducers. High cost-benefit ratio for OEM switch users.

High-Performance Ultrasound

Pulsed signal technology excels in difficult conditions that may cause other ultrasonic switches to falter. This technology also provides excellent immunity from electrical noise that is common in many industrial applications.

Electronics

Model 940 Relay Version offers a 1-amp SPDT relay output.

Suitable for SIL Loops

Safety Integrity Level (SIL) data is available for the 940 switch in the form of a Failure Modes, Effects and Diagnostic Analysis (FMEDA) report. The Model 940 is suitable for use in SIL 2 loops.

Model 940 Specifications	
Power Supply:	12 to 35 VDC
Power Consumption:	Less than 1 Watt
Signal Output:	SPDT relay, 1 amp @ 30 VDC, 0.5 amp @ 125 VDC, 0.5 amp @ 150 VAC
Cabling:	12" (305 mm) flying leads of 18 AWG wires
Repeatability:	0.078" (2 mm)
Response Time:	0.5 second typical
Ambient Temperature:	-40 to +185 °F (-40 to +85 °C)
Process Temperature:	-40 to +185 °F (-40 to +85 °C)
Maximum Pressure:	2000 psig (138 bar); 1500 psig (103 bar) for transducers over 2" (5 cm)
Ingress Protection:	NEMA 4X (IP66)
Shock:	ANSI/ISA-S71.03 Class SA1
Vibration:	ANSI/ISA-S71.03 Class VC2

Liquid Level Applications

CONTROL FUNCTIONS:

- **Pump protection**
- **Fill line monitoring**
- **Interstitial space leak detection**
- **High or low level alarm**

OF SPECIAL INTEREST TO:

- **OEM Applications**
- **Pharmaceutical Plants**
- **Food Processors**

ECHOTEL® CONTACT ULTRASOUND

961/962 Level Switches

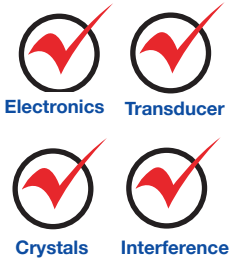
When you add-up the features, these all new single and dual point switches are superior to any ultrasonic or tuning fork level switch on the market.

Innovative Transducer Design

The tip-sensitive transducers have a pressure rating (up to 2000 psig, 138 bar) higher than any other ultrasonic gap or tuning fork level switch. The dual gap transducer has a unique flow-through upper gap that allows over 100" (254 cm) between upper and lower gaps. Combine these features with powerful pulsed signal technology for superior performance in difficult process conditions and you have the most capable ultrasonic level switch available today.

Advanced Self-Test Technology

New self-test technology not only tests the electronics, transducer, and piezoelectric crystals, but also checks for the presence of electromagnetic noise interference. Should the diagnostic data indicate a problem with the unit, an alarm signal alerts the user to the malfunction.



Adjustable Time Delay

Turbulence and splashing can cause many switches with fixed time response to produce false level alarms. Model 961/962 switches overcome this nuisance with an adjustable time delay. A potentiometer sets a ½ to 45 second delay to disregard waves or splashes so the unit reliably detects true liquid level.

Engineered Smart

Designed for wiring and configuration ease, the ergonomic housing contains electronics, relays, time delay potentiometer, push-buttons for level and for malfunction alarm testing, high/low level DIP switch, and independent/joint DIP switch *(line-powered Model 961 shown).*

Liquid Level Applications

CONTROL FUNCTIONS:

- High or Low level alarm
- Pump and Overfill protection
- Single-point 3-A sanitary
- Seal Pot level

OF SPECIAL INTEREST TO:

- Chemical, Petrochemical
- Water and Wastewater
- Food and Pharmaceutical
- Pulp and Paper
- Power Generation

961/962 Electronics Specifications

With Current Shift Output		
Supply Voltage:		11 to 35 VDC
Output:	Normal:	8 mA
	Alarm Condition:	16 mA
	Malfunction:	3.6 mA or 22 mA selectable
Loop Resistance:		104 ohms with 11 VDC input, 1100 ohms with 35 VDC input
Fail-Safe:		Field selectable, high or low level
Power Consumption:		Less than 1 watt
Ambient Temperature:		-40° to +160° F (-40° to +71° C)

With Relay Output		
Supply Voltage:		102 to 265 VAC, or 18 to 32 VDC
Relay Outputs:	961:	One DPDT level relay and one SPDT malfunction relay
	962:	Two DPDT level relays and one SPDT malfunction relay
Relay Ratings:	DPDT:	5 amps @ 120 VAC, 250 VAC, and 30 VDC, 0.15 amp @ 125 VDC
	SPDT:	5 amps @ 120 VAC, 250 VAC, and 30 VDC, 0.15 amp @ 125 VDC
Fail-Safe:		Field selectable, high or low level
Power Consumption:		Less than 3 watts
Ambient Temperature:		-40 to +160 °F (-40 to +71 °C)

Suitable for SIL 2 Loops

Worldwide Safety Approvals

3-A Authorized (Model 961)

961/962 Performance Specifications

Repeatability:	± 0.078" (2 mm)
Response Time:	0.5 second typical
Time Delay:	Variable 0.5 to 45 seconds on rising and falling levels
Self-Test:	
Automatic:	Continuously verifies operation of electronics, transducer, piezoelectric crystals, and electrical noise
Manual:	Push button verifies operation of electronics, transducer, and piezoelectric crystals
Shock Class:	ANSI/ISA-S71.03 Class SA1
Vibration Class:	ANSI/ISA-S71.03 Class VC2
Humidity:	0 – 99%, non-condensing
Compatibility:	Meets CE Electromagnetic requirements EN 61326

961 Single Point Transducer Specifications

Transducer Material	Operating Temperature Range	Maximum Pressure	Actuation Length
316 Stainless Steel:	-40 to +325 °F (-40 to +163 °C)	2000 psig (138 bar)	1" and 2" (3 and 5 cm)
316 Stainless Steel:	-40 to +325 °F (-40 to +163 °C)	1500 psig (103 bar)	3" to 130" (6 to 330 cm)
Hastelloy® C-276®:	-40 to +325 °F (-40 to +163 °C)	2000 psig (138 bar)	1" and 2" (3 and 5 cm)
Hastelloy C-276:	-40 to +325 °F (-40 to +163 °C)	1500 psig (103 bar)	3" to 130" (6 to 330 cm)
Monel®:	-40 to +325 °F (-40 to +163 °C)	1200 psig (83 bar)	1" to 130" (3 to 330 cm)
Kynar® (NPT rating):	-40 to +250 °F (-40 to +121 °C)	200 psig (14 bar)	2" to 120" (5 to 305 cm)
CPVC (NPT rating):	-40 to +180 °F (-40 to +82 °C)	200 psig (14 bar)	2" to 120" (5 to 305 cm)

962 Dual Point Transducer Specifications

Transducer Material	Operating Temperature Range	Maximum Pressure	Actuation Length
316 Stainless Steel:	-40 to +325 °F (-40 to +163 °C)	1500 psig (103 bar)	5" to 130" (13 to 330 cm)
CPVC (NPT rating):	-40 to +180 °F (-40 to +82 °C)	200 psig (14 bar)	5" to 130" (13 to 330 cm)

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