

ECHOTEL® NON-CONTACT ULTRASOUND



Magnetrol®

Worldwide Level and Flow Solutions℠

Non-Contact Ultrasonic Level Measurement

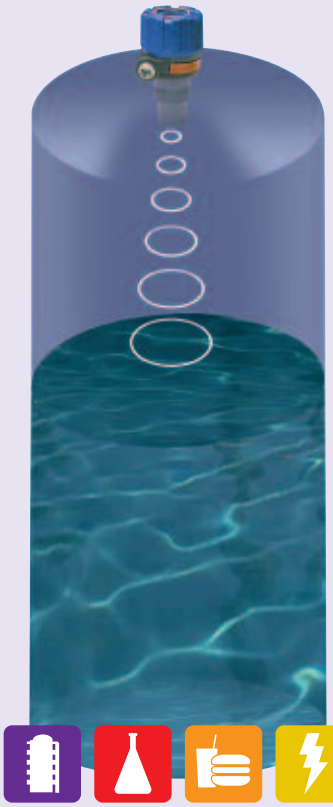


Non-contact ultrasonic level technology is a proven method for accurate liquid level measurement. Process control instruments utilizing this technology sense and measure liquid level, volume, or open channel flow without making physical contact with the liquid itself. This offers distinct advantages over many contact technologies in applications where corrosive media, suspended solids, changing media characteristics, or coating media are present.

Measuring with Ultrasound

Two components make up a typical non-contact ultrasonic measurement device: the transmitter, or electronics; and the transducer, or sensor. A piezoelectric crystal within the transducer converts electrical signals generated by the transmitter into a series of ultrasonic pulses. Under ideal conditions, these pulses are transmitted through free air at the speed of sound until they come into contact with the liquid surface where they are reflected back to the transducer. The transmitter's electronics then measures the pulse's round-trip time and digitally processes the information to indicate liquid level. A transmitter programmed with a vessel's geometry can calculate the liquid volume of a vessel. A transmitter programmed to convert the level reading into units of volume per time can measure the liquid flow rate in an open channel.

Ultrasound 101:
The Basics



The **Transmitter** houses the electronics for signal processing and control outputs. Depending on the model, transmitters can be mounted either integrally or remotely.

The **Transducer** is located inside the vessel. It transmits and receives the ultrasonic signals.

Assuring Signal Integrity

In the real world of process management, an ultrasonic signal launched into free air is vulnerable to distortion from many sources. Unless safeguards are taken by mechanical means or advanced signal processing, non-contact measurement can be greatly compromised.

The most obvious form of interference are the physical structures inside of a vessel—pipes, ladders, struts, agitator blades, or irregular tank geometry. All of these can fall within the path of the ultrasonic beam to compromise the signal.

The greater the distance from the transducer, the wider the beam spreads, thereby increasing the likelihood that a "false target" will enter the beam's path. At 2 feet from the transducer, a typical ultrasonic beam may be less than 6 inches in diameter; but at 35 feet from the transducer the conical shaped beam will expand to a diameter of 7 feet.

Magnetrol's 335, 355, 344 and 345 transmitters have a False Target Rejection feature which filters out obstructions that may lie within the path of the beam. By entering the locations of the obstructions into the transmitter's false target memory, the user can program out the erroneous targets.

As an additional measure to assure instrument integrity, Magnetrol transmitters feature a self-diagnostics capability which continuously checks all relays, outputs and the overall function of the transducer and electronics.

Ambient temperature can also have a significant effect on the accuracy of a non-contact ultrasonic transmitter. As temperature decreases, air becomes

more dense, resulting in slower sound velocity. Since measurement is directly dependent on sound speed, it is necessary to compensate for temperature changes. All Magnetrol's transducers include a temperature compensation circuit which continuously monitors the temperature at the sensor and compensates for variations over the full temperature range of the transducer.

Ultrasonic non-contact devices are typically rated for a maximum range in ideal conditions. But process conditions can impact the maximum range of measurement. These conditions include surface agitation, vapors and steam, foam and air movement. A derating multiplier can be computed to yield a new maximum range for optimum performance. A lower frequency transducer, such as the 38 kHz model, provides increased power with a longer wavelength to increase measurement range and improve performance where steam, vapors or turbulence may be present.

Technology Advantages and Limitations

The advantages of non-contact sensing are:

- No contact with corrosive, contaminating liquids.
- Accurate to within 0.25% of measured span.
- Continuous and multiple-point sensing available.
- No moving parts for reduced maintenance.
- Not affected by changes in liquid properties such as specific gravity, dielectric shifts, pH, etc.
- Intrinsically safe, non-incendive and explosion proof instruments are available.

Conditions limiting ultrasound's effectiveness include:

- Surface foam that absorbs the ultrasonic signal.
- Vapors that significantly alter the speed of sound.
- Operating pressures exceeding 50 psig (3.45 bar).
- Temperatures exceeding +200° F (+93° C). ■

ECHOTEL Real World Applications

Echotel non-contact ultrasonic transmitters have been engineered to meet the process requirements of major industries including: Oil & Gas, Chemicals, Food & Beverage, Power Generation, Pulp and Paper, Water & Wastewater, Pharmaceutical, and Petrochemical.

Chemical Feed Tanks



Clarifier Level



Influent/Effluent Flow



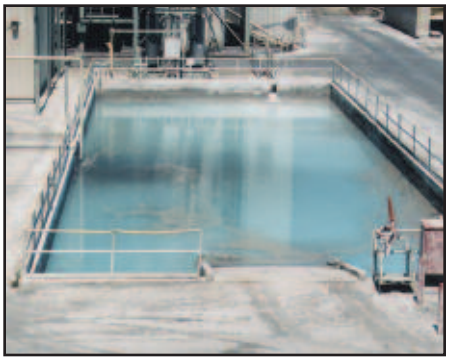
Fuel Oil Storage



Condensate Storage



Open Atmosphere Sumps



ECHOTEL
NON-CONTACT ULTRASOUND

300/301

For Liquid Level, Volume or Open Channel Flow

Available as an integral or remote mounted unit, this versatile and powerful ultrasonic transmitter is easy to install and quick to calibrate.



Model 300/301
A 16-button keypad and two-line, 16-character LCD display is inside the explosion-proof housing



◀ Advanced Electronics

Isolated 4–20 mA output with an active/passive mode for loop power or device power. RS-485 with Modbus protocol allows bi-directional communication with DCS or PLC. Two or four 10 amp SPDT gold flash relays for a wide variety of alarm and control schemes.

Explosion-Proof Transmitter and Transducer ▶

The Model 300/301 has Explosion-Proof FM and CSA agency approvals for both the transducer and the transmitter: Class I, Division 1, Groups B, C, and D.





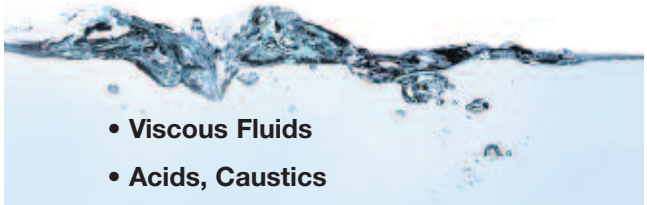
◀ Fast, Password-Protected Calibration

Unique QuickCal™ calibration feature allows complete system calibration in 90 seconds. A password protection feature also prevents unwanted tampering with the configuration data.

Model 300/301 Transmitter Specifications	
Power Supply	120 VAC ±10%, 50-60 Hz
	240 VAC ±10%, 50-60 Hz
	24 VDC ±20%
Power Consumption	12 watts maximum
Analog Output Signal	
Active Mode	4–20 mA (isolated); maximum of
	1,000 Ω loop resistance
Passive Mode	4–20 mA (isolated); loop resist-
	ance dependent on power supply
	(32 volt max) 1,000 Ω @ 24 volts
Digital Output	RS-485 with Modbus
Relays	10 amp SPDT resistive (0, 2 or 4)
Fail-safe	User selectable for analog and
	relay outputs
Ambient Temperature	
Electronics	-40° to +160° F (-40° to +71° C)
Display	Two-line, 32 character LCD
Keypad	16-button (inside housing)
Response Time	2 seconds, typical
Accuracy	±0.25% of calibrated span

Transducer Specifications	
Frequency	38 kHz
Beam Angle	Conical 12°
Max Range/Span	30 feet (9.1 m) / 28.5 feet (8.7 m)
Dead Zone	18 inches (460 mm) minimum
Process Temp	-40° to +163° F (-40° to +73° C)
Process Pressure	Atmospheric to 50 psig (3.45 bar)
Cable Length	500 feet maximum

Applications



- **Viscous Fluids**
- **Acids, Caustics**
- **Water & Wastewater**
- **Chemicals**
- **Pulp & Paper**
- **Power Generation**

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335

For Liquid Level, Volume or Open Channel Flow



With flexible software, advanced signal processing and a powerful transducer, the Model 335 offers outstanding measurement performance and value.



◀ Hinged, Dual Compartments

The LCD module compartment houses the user interface and the lower compartment houses the wiring terminals. A screw release allows the LCD compartment to swing completely clear of the wiring module.



Plug-In Display Module ▶

The module offers easy set-up and configuration of all process parameters via four push buttons. The custom graphics LCD displays six-characters and a bar graph of signal strength or tank level. The module can be removed to configure other 335 units.



▲ View of LCD module through housing cover window

◀ Enlarged view of LCD module in working unit

▼ LCD module removed





◀ 335 Electronics

Advanced digital signal processing provides optimum performance in a variety of process conditions.

Echotel 335 Transmitter Specifications	
Power Supply	85 to 255 VAC
Output Signal	4–20 mA (isolated); 600 Ω load
Fault Detection	Configurable 3 amp SPDT relay,
	LED, and 3.6 or 22 mA
Relay	One, 3-amp SPDT
Fail-safe	Software selectable
Ambient Temperature	-22° to +140° F (-30° to +60° C)
Display	Removable six-digit LCD module
	with dual function bar graph
Keypad	4-button menu-driven data entry
LED Status Indication	Echo strength, power, relay LED's
Compensation	Auto temperature compensation
	over transducer operating range
Accuracy	±0.2% of measured distance,
	plus 0.05% of the range
Enclosure	Dual compartment cast aluminum
Protection	NEMA 6 (IP 67)

Transducer Specifications	
Frequency	50 kHz
Beam Angle	Conical 7°
Max Range	26 feet (8 m)
Dead Zone	14 inches (350 mm)
Process Temp	-22° to +195° F (-30° to +90° C)
Process Pressure	Atmospheric to 44 psig (3 bar)
Material	Polypropylene
Protection	NEMA 6P (IP68)

Applications



- **Sump, Well, & Tank Level**
- **Open Channel Flow**
- **Water & Wastewater Treatment**
- **Chemical Storage Tanks**
- **Food & Beverage Containers**
- **Pulp & Paper Vessels**

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344/345

For Liquid Level, Volume or Open Channel Flow

A remote mounted, full-featured ultrasonic transmitter with extensive agency approvals. Many transducer configurations and transmitter options are available for greater versatility.



Convenient Front Panel Interface

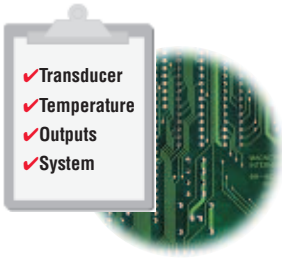


Front panel keypad makes programming convenient; once wired, there's no need to open the enclosure. A large, 16-character alphanumeric display shows all parameters and a password code prevents unauthorized tampering with configuration data.

Choice of Transducers

The Model 344 employs the powerful 38 kHz Kynar transducer used primarily for level and volume applications. The Model 345 uses the 50 kHz transducer, available either in Kynar or 316 stainless steel. Transducers feature temperature compensation.

Full-Featured Electronics



Automatic, continuous self-test checks transducer signal, temperature sensor, all outputs and system functionality for proper operation. False target buffering feature eliminates signal interference for up to nine fixed tank obstructions.

Model 344/345 Transmitter Specifications	
Power Supply	120 VAC ±10%, 50-60 Hz
	240 VAC ±10%, 50-60 Hz
	24 VDC ±20%
Power Consumption	12 watts (without heater)
Output Signal	4–20 mA isolated (1,000 Ω load),
	RS-232 (data logger downloading)
Relays	Four, 10-amp resistive, SPDT
Fail-safe	User selectable for analog and
	relay outputs
Display	16-character alphanumeric
Keypad	16-button integral to front panel
Response Time	2 seconds, typical
Accuracy	±0.25% of configured span
Ambient Temperature	
with Heater & Thermostat	-40° to +160° F (-40° to +70° C)
w/o Heater & Thermostat	-4° to +160° F (-20° to +70° C)
Agency Approvals	Class I, Division 2, Non-incendive
	and NEMA 4X from FM and CSA

Transducer Specifications		
Frequency	38 kHz	50 kHz
Max Range	35 feet (10.7 m)	25 feet (7.6 m)
Max Span	33.5 feet (10.2 m)	24 feet (7.3 m)
Process Temp	-40° to +163° F	-40° to +200° F
	(-40° to +73° C)	(-40° to +93° C)
Process Pressure	Atmospheric to 50 psig (3.45 bar)	
Beam Angle	Conical 12°	
Cable Length	500 feet maximum	

Applications



- **Sump & Wastewater**
- **Slurries, Viscous Fluids**
- **Pulp & Paper**
- **Power Generation**
- **Petrochem**

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355

For Liquid Level, Volume or Open Channel Flow

Outstanding measurement performance and value in a two-wire, integral transmitter featuring flexible software and advanced signal processing.



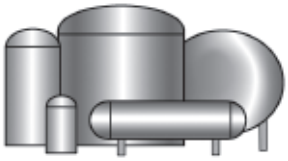
Temperature Compensated Echo Rejection

The Model 355 has a patent-pending echo rejection technique that constantly adjusts the rejected echo profile based on the current sound propagation velocity. This technique keeps the transmitter tracking the actual liquid level as opposed to false targets even when temperature changes alter the shape of the echo rejection profile.



Dual Flow Totalizers

Two 7-digit flow totalizers are provided for recording flow. One totalizer is resettable and the other is non-resettable. Several multipliers are selectable to allow for proper scaling. Totalizer time is also recorded to show how long each totalizer has been recording flow.



Stored Tank Shapes for Volume

Volume configuration with the 355 is as easy as selecting the tank shape and inputting 1–3 dimensions. While a 20-point custom table is also available, selecting the actual tank shape provides for a fast and accurate configuration for a variety of common tank shapes.

Model 355 Transmitter Specifications	
Power Supply	16 to 36 VDC
Power Consumption	Less than 1 Watt
Output Signal	4–20 mA with optional HART®
Fault Detection	Selectable from 3.6, 22 mA, or hold
Damping	Adjustable from 1–60
Ambient Temperature	-40° to +175° F (-40° to 80° C)
Display	2-line × 16-character LCD
Keypad	4-push-button menu-driven
Compensation	Auto temperature compensation
	over transducer operating range
Accuracy	Greater of ±0.2% of range or
	0.24 inch (6 mm)
Repeatability	±0.125 inch (3 mm)
Resolution	0.1 inch (2.5 mm)
Linearity	±0.4 inch (10 mm)
Response Time	Less than 1 second (typical)
Warm-up Time	30 seconds
Enclosure	Cast aluminum or Lexan®
Protection	NEMA 6 (IP 67)

Transducer Specifications	
Frequency	60 kHz
Beam Angle	Conical 10°
Max Range	20 feet (6 meters)
Blocking Distance	10 inches (250 mm)
Process Temp	-40° to +175° F (-40° to +80° C)
Process Pressure	0 to 43.5 psig (0 to 3 bar)
Material	Kynar® Flex (PVDF) or polypropylene
Protection	NEMA 6P (IP 68)

Applications



- **Sump, Well, Tank Level**
- **Highly Viscous Media**
- **Paint, Ink & Solvents**
- **Food & Beverage Vessels**
- **Batch & Day Tanks**



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