

Liquid Level Control Applications For The Coal Fire Power Generation Industry



The global power generation industry is rapidly changing. Increase in power consumption, economic growth, the introduction of non-conventional, renewable generation and environmental pressures all play a role in the type of new builds and how they are operated as part of the overall energy mix. This presents significant opportunities for safe and reliable plant operation while at the same time enhancing performance metrics through the use of our level technologies.

Magnetrol® International and its subsidiary Orion Instruments® are worldwide leaders in the manufacturing of level instrumentation to monitor and control the most critical plant processes for peak efficiency.

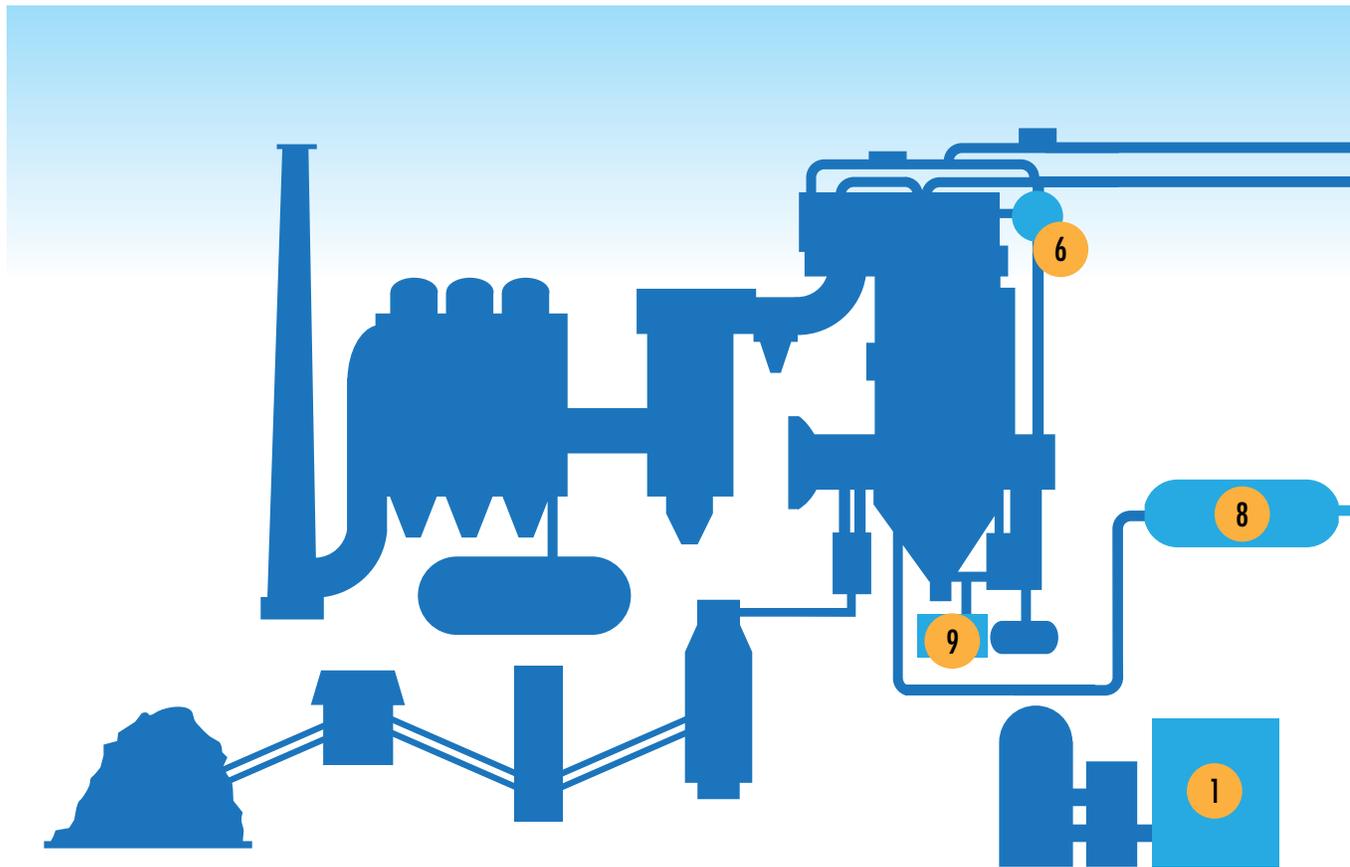


Level Controls for Power Generation Since 1932

MAGNETROL International has a reputation for providing reliable and quality instrumentation capable of withstanding the harshest conditions routinely found in coal-fired power plants. We are the first name in mechanical buoyancy and displacer technologies and globally recognized as the premier system for TWIP (Turbine Water Induction Protection) and other critical applications where operation under extreme pressures and temperatures is mandatory to mitigate damage to expensive hardware.

Complementing our mechanical products is a wide range of level technologies designed not only to make a reliable measurement, but offer a tangible return on investment as related to “heat rate” in coal-fired operations by eliminating difficulties associated with feedwater heater level control during base load and load following operations. The Eclipse® Model 706 Guided Wave Radar transmitter is the preferred continuous level control offering operators highly accurate data to better manage controllable losses while simplifying periodic maintenance requirements.

Most Common Power Generation Applications

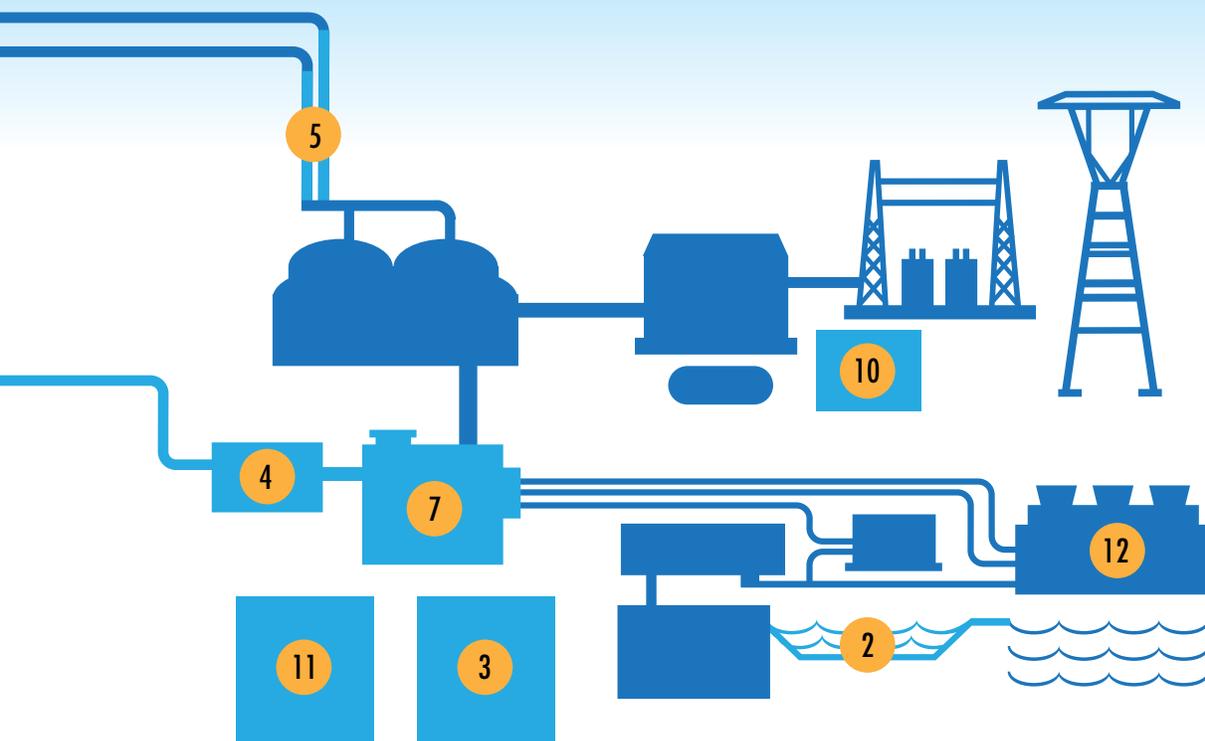


1. Fuel Oil Storage	5. Condensate Drip Legs & Drains	9. Boiler Blowdown Tank
2. Open Atmosphere Sumps	6. Steam Drums*	10. Lubrication Oil Tanks
3. Condensate Storage	7. Condenser Hotwell	11. Ammonia/Caustic/Acid Storage
4. Deaerator*	8. Feedwater Heaters*	12. Cooling Tower Basin

Liquid Level Control Applications For The Power Generation Industry

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*Certain level applications readily lend themselves to performance improvements that can dramatically enhance a plant's overall efficiency and profitability. Technologies offering more precise level indication and are not affected by process variables provide operators with a "true" indication allowing them to better manage

the process. For example, feedwater heaters in coal-fired plants historically suffer from inefficiencies due to poor level controls which increase "heat rate"; thus reducing efficiency. MAGNETROL International and ORION INSTRUMENTS offer cost containment opportunities by eliminating these level related inefficiencies.

Liquid Level Applications

Fuel Oil Storage

Crude oils with lower flash points represent a greater fire hazard and require safety-certified liquid level switches and transmitters.

- Eclipse® Model 706 Guided Wave Radar Transmitter
- Pulsar® Model R86 Pulse Burst Radar Transmitter



Open Atmosphere Sumps

Level control in collection and processing basins must often tolerate corrosive media, punishing weather conditions and liquids with high solids content.

- ECLIPSE Model 706 Guided Wave Radar Transmitter
- Pulsar Model R86 Pulse Burst Radar Transmitter
- Displacer Type Liquid Level Switch



Condensate Storage/Overflow

Accurate, reliable liquid level monitoring in the condensate storage tank ensures the proper supply of make-up water.

- ECLIPSE Model 706 Guided Wave Radar Transmitter
- PULSAR Model R96 Pulse Burst Radar Transmitter
- Displacer Type Liquid Level Switch



Deaerator

Pressure fluctuations are extensive in the deaerator and result in flashing, thereby requiring level controls that can withstand varying temperatures and pressures.

- Model B75 Liquid Level Switch
- ECLIPSE Model 706 Guided Wave Radar Transmitter
- Model B40 Float-Actuated High Pressure, High-Temperature Switch
- Aurora® Magnetic Level Indicator



Condensate Drip Legs & Drains

Level instrumentation must contend with high temperatures and pressures associated with drip legs, to ensure proper functioning of the condensate collection system and prevent damage to the turbine.

- Model B40 Float-Actuated High Pressure, High-Temperature Switch
- Model B75 Liquid Level Switch



Steam Drums

Precise level in the steam drum is important to optimize steam/water separation and steam quality.

- Model B40 Float-Actuated High Pressure, High-Temperature Switch
- ECLIPSE Model 706 Guided Wave Radar Transmitter
- AURORA Magnetic Level Indicator
- ATLAS MLI with Jupiter® Magnetostrictive Level Transmitter



Condenser Hotwell

Level control in the hotwell can prevent make-up water loss in the turbine cycle due to leakage, steam venting or other usage.



- Model B40 Float-Actuated High Pressure, High-Temperature Switch
- ECLIPSE Model 706 Guided Wave Radar Transmitter
- E3 Modulelevel® Liquid Level Displacer Transmitter
- AURORA Magnetic Level Indicator
- ATLAS MLI with Jupiter Magnetostrictive Level Transmitter



Feedwater Heaters

Feedwater heater level is controlled to prevent damage to expensive hardware while at the same time optimizing level control to improve efficiency (heat rate) during base load as well as load following operations.



- Model B40 Float-Actuated High Pressure, High-Temperature Switch
- ECLIPSE Model 706 Guided Wave Radar Transmitter
- E3 MODULELEVEL Liquid Level Displacer Transmitter
- AURORA Magnetic Level Indicator
- ATLAS MLI with Jupiter Magnetostrictive Level Transmitter



Boiler Blowdown Tanks

Good boiler blowdown practices reduce water treatment needs and operation costs, as well as the chance of catastrophic explosion.



- ECLIPSE Model 706 Guided Wave Radar Transmitter
- E3 MODULELEVEL Liquid Level Displacer Transmitter
- Model B75 Liquid Level Switch
- AURORA Magnetic Level Indicator
- ATLAS MLI with Jupiter Magnetostrictive Level Transmitter



Lubrication Oil Tanks

Reliable level monitoring of lube oil reservoirs ensures proper functioning of turbines, electrical generators and other equipment with integral lubrication systems.



- Tuffy® II Float-Actuated Switch
- ECLIPSE Model 706 Guided Wave Radar Transmitter
- AURORA Magnetic Level Indicator
- ATLAS MLI with Jupiter Magnetostrictive Level Transmitter



Cooling Tower Basin

Proper level control in the cooling tower basin eliminates low level damage to pumps while preventing costly overflow conditions. Vulnerability to foam from chemical injection and modest buildup is fundamental to selecting the correct technology.



- ECLIPSE Model 706 Guided Wave Radar Transmitter
- Displacer Type Liquid Level Switch



Ammonia/Caustic/Acid Storage

Managing hazardous and non-hazardous chemical storage inventory and replenishment safely and reliably is critical to ensure availability during normal operation.



- ECLIPSE Model 706 Guided Wave Radar Transmitter
- ATLAS MLI with Jupiter Magnetostrictive Level Transmitter
- AURORA Magnetic Level Indicator
- Displacer Type Liquid Level Switch
- Model R82 Pulse Burst Radar Transmitter



Mechanical Buoyancy Liquid Level Control Solutions

Series 75 Sealed External Caged Liquid Level Switch



Series 75 external cage type level switches are completely self-contained units designed for side mounting to a tank or vessel with threaded, socket weld or flanged pipe connections. These float-actuated controls have proven their reliability in process control for decades.

Series B40 High Pressure, High-Temperature Liquid Level Switch



The B40 external cage type level switch is a float-actuated control specifically designed and constructed for high pressure, high temperature service conditions such as boilers. It is available in rugged industrial or ASME B31.1 construction.

TUFFY II Side-Mounted Float Switch



The TUFFY II buoyancy level switch is a float-actuated device designed for horizontal mounting in a tank or vessel through threaded or flanged pipe connections. The compact size allows for installation in small vessels, while its many features provide a variety of application uses. The single switch mechanism is available in SPDT or DPDT forms on units designed for fixed or adjustable, narrow or wide differential and interface service levels.

Displacer Type Liquid Level Switch



MAGNETROL displacement type level switches offer the industrial user a wide choice of alarm and control configurations. Every unit utilizes a simple buoyancy principle and is well suited for simple or complex applications, such as foaming or surging liquids or agitated fluids, and usually costs less than other types of level switches.

Performance

Description	Specification
Max. Pressure	Max. 2625 psig (181 bar) – float Max. 5000 psig (345 bar) – displacer
Max. Temperature	Max. +1000 °F (+540 °C) – float Max. +500 °F (+260 °C) – displacer
Min. Density	0.4
Configuration	Side-side, side-bottom, top mounted and side-mounted
Main Features	No power required Up to 3 switch levels Flanged and sealed caged designs Proven reliability ASME B31.1/B31.3 construction

*Consult factory for other temp/pressure ratings and switch options.

Displacer Liquid Level Control Solutions



Digital E3 MODULELEVEL Liquid Level Displacer Transmitter

The Digital E3 MODULELEVEL displacer transmitter is an advanced, intrinsically safe two-wire instrument utilizing simple buoyancy principle to detect and convert liquid level changes into a stable output signal. The linkage between the level sensing element and output electronics provides a simple mechanical design and construction. The vertical in-line design of the transmitter results in low instrument weight and simplified installation. The instrument comes in a variety of configurations and pressure ratings for varied applications.

The Digital E3 MODULELEVEL has microprocessor-based electronics with 4–20 mA/HART or FOUNDATION™ fieldbus output. E3 supports the FDT/DTM standard, and a PACTware™ PC software package allows for additional configuration and trending capabilities.

Performance: Level

Reference Conditions	Water @ +70 °F (+20 °C) with 14" displacer, wet calibration
Linearity	±0.50% of full span
Repeatability	±0.30% of full span
Ambient temperature effect	Maximum zero shift is 0.017%/°F over ambient temperature range
Process Temp. Range	Steam: -20 to +500 °F (-30 to +260 °C) Non-Steam: -20° to +600° F (-30° to +315° C)
Process Pressure Range	5150 psig @ 100 °F (355 bar @ 40 °C)
Hysteresis	±0.20% of full span
Response Time	< 1 second
Warm-up Time	< 5 seconds
SIL	Suitable for use in SIL 2 environments with SFF of 92.3%

Performance: Interface Level and Density¹

Linearity	±0.70% of full span
Repeatability	±0.40% of full span
Ambient temperature effect	Maximum zero shift is 0.017%/°F over ambient temperature range

¹ The displacer must always be completely immersed in process liquid when the E3 is used in interface or density service. Top mounted models require liquid level to exceed the top of the displacer by 2" at all times to ensure optimal performance.

Guided Wave Radar Liquid Level Control Solutions



ECLIPSE Model 706 Guided Wave Radar Transmitter

The ECLIPSE Model 706 high performance transmitter is a loop-powered, 24 VDC level transmitter that is based upon the proven technology of guided wave radar. Encompassing a number of significant engineering accomplishments, this leading-edge level transmitter is designed to provide measurement performance well beyond that of more traditional technologies.

Utilizing "diode switching" technology, along with the most comprehensive probe offering on the market, this single transmitter can be used in a wide variety of applications ranging from very light hydrocarbons to water-based media.

The innovative dual-compartment enclosure is angled to maximize ease of wiring, configuration and viewing of the versatile graphic LCD display. The universal transmitter can be used and interchanged with all probe types and is suitable for use in critical SIL 2 hardware safety loops.

Performance

Reference Conditions	Reflection from liquid, with dielectric constant in center of selected range, with a 72" (1.8 m) coaxial probe at +70° F (20 °C), in Auto threshold Mode
Linearity	Coaxial/Caged Probes: < 0.1% of probe length or 0.1 inch (2.5 mm), whichever is greater Single Rod in Tanks/Twin Cable: < 0.3% of probe length or 0.3 inch (8 mm) whichever is greater
Accuracy	Coaxial/Caged Probes: ±0.1% of probe length or ±0.1 inch (2.5 mm), whichever is greater Single Rod in Tanks/Twin Cable: ±0.5% of probe length or ±0.5 inch (13 mm), whichever is greater Interface Operation: ±1 inch (25 mm)
Resolution	±0.1 inch (2.5 mm)
Repeatability	< 0.1 inch (2.5 mm)
Hysteresis	< 0.1 inch (2.5 mm)
Response Time	< 1 second
Initialization Time	< 10 seconds
Ambient Temperature Effect	Approximately ±0.02% of probe length per degree C (for probes greater than 8 feet [2.5 meters])
Process Dielectric Effect	< 0.3 inch (7.5 mm) within selected range
Measuring Range	6–240 inches (15-610 cm)
Process Temperature	-320 to +850 °F (-196 to +450 °C)
Process Press Full Vacuum	6250 psig (431 bar)

Pulse Burst Radar Level Control Solutions



PULSAR Model R86 Pulse Burst Radar Level Transmitter

The PULSAR R86 Radar transmitter is the latest generation of MAGNETROL 24 VDC, loop-powered, non-contact radar transmitters. Enhanced performance and innovative diagnostics bring simplicity to an often complicated technology. This latest entry into the radar level measurement field is designed to provide unparalleled performance and ease of use. PULSAR non-contact radar is the perfect compliment to the MAGNETROL ECLIPSE Model 706 Guided Wave Radar transmitter. Together, these transmitters offer the ultimate solution to the vast majority of process level applications.

Performance

Reference Conditions	Reflection from ideal reflector at +70 °F (+20 °C)
Linearity	±0.1 inch (3 mm) or 0.1% of tank height (whichever is greater)
Measured Error	±0.1 inch (3 mm) or 0.1% of tank height (whichever is greater)
Resolution	0.1 inch (2.5 mm)
Repeatability	±0.2 inch (5 mm) or 0.05% of tank height (whichever is greater)
Response Time	< 2 seconds
Initialization Time	< 30 seconds
Ambient Temperature Range	-40 to +175 °F (-40 to +80 °C) / ATEX EEx d -40 to +160 °F (-40 to + 70 °C)
Measuring Range	Up to 130 feet (40 meters)
Process Temperature Range	-40 to +750 °F (-40 to +400 °C)
Process Pressure Range	-14.7 to 2320 psig (-1.0 to 160 bar)



Model R82 Pulse Burst Radar Level Transmitter

The MAGNETROL Model R82 is an economical, loop-powered radar transmitter bringing radar to everyday applications. Daily applications that have been considered for ultrasonic can now utilize the superior performance of radar technology. The electronics are housed in a compact, single compartment cast aluminum or Lexan® housing. The R82 measures effectively even when atmospheres above the liquid are saturated with vapor. Pulse Burst technology and advanced signal processing manage common disturbances such as false echoes caused by obstructions, multi-path reflections from tank sidewalls or turbulence caused by agitators, aggressive chemicals or aerators.

Performance

Reference Conditions	Reflection from ideal reflector at +70 °F (+20 °C)
Linearity	±0.2 inch (5 mm) or 0.05% of tank height (whichever is greater)
Measured Error	±0.2" (5 mm) or 0.05% of tank height (whichever is greater) Within 60" (1.5 m) of antenna threads, performance will begin degrading, reaching ±0.8" (2 cm) within 15" (38cm)
Resolution	0.1 inch (2.5 mm)
Repeatability	< 0.1 inch (2.5 mm) or 0.025% of tank height
Response Time	< 1 second
Warm-up Time	30 seconds
Ambient Temp. Effect	0.05% per 10 °C
Process Dielectric Effect	< 0.3" within selected range
Measuring Range	Up to 40 feet (12.2 meters)
Maximum Rate of Change	180 inches (450 cm)/minute
Maximum Dielectric:	1.7

Magnetic Level Indicator Level Control Solutions



ATLAS and AURORA Magnetic Level Indicators

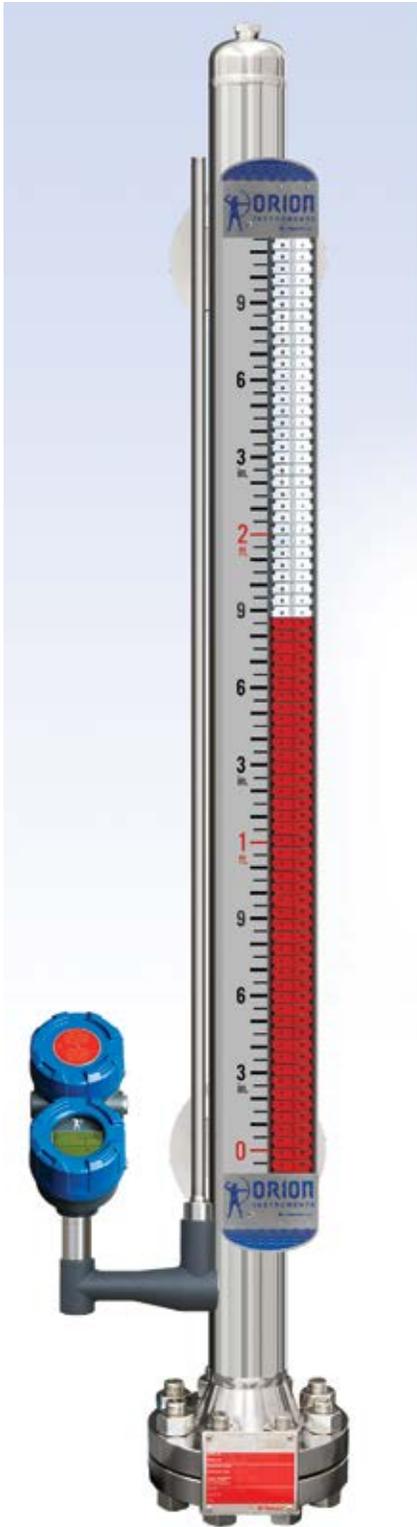
ATLAS is a basic, high-performance magnetic level indicator suitable for a wide range of process conditions. Atlas is the perfect choice if you're looking for a reliable visual indication solution without necessarily requiring an accompanying continuous level transmitter. It can, however, be coupled with several transmitter and switch options to expand its overall capability.

AURORA is the most innovative MLI on the market. AURORA revolutionized magnetic level indication by integrating high-performance Guided Wave Radar technology into a robust MLI. The result: a diverse instrumentation system relying on two completely different principles of technology: Buoyancy + Radar.

Specifications: MLI

Design	Atlas, Aurora – single chamber
Materials of construction (MLI)	Metal alloys 316/316L or 304/304L stainless steel, 321 stainless steel, 347 stainless steel, Titanium, Monel, Hastelloy B, Hastelloy C-276, Inconel 625, Inconel 825, Alloy 20, Electropolished 316 stainless steel, 904L stainless steel and other non-magnetic alloys
	Plastics/Composites Fiberglass, PVC, CPVC, Kynar, polypropylene
Materials of construction (Float)	Varies per application – 316 stainless steel and titanium are standard (exotic alloys available)
Construction Options	Conformance to Industrial Grade, ASME B31.1, S-Stamp, U-Stamp, UM Stamp available
Certified material test reports (CMTR)	Available upon request
Pressure class ratings	ANSI 150#, 300#, 600#, 900#, 1500#, 2500# DIN PN16, PN25, PN40, PN63, PN100, PN160, PN250, PN320
Process connection sizes	½" to 8" DN 20 to DN 150
Process connection types	MNPT, FNPT, Weldolet®, Sockolet®, threaded nipple, buttweld nipple, plain-end nipple, slip-on flanges, weldneck flanges, lap joint flanges, TriClamp® fitting, Van Stone flanges
Measuring range	12 to 600 inches (30 to 1524 cm)
Temperature range	-320 to +1000 °F (-196 to +538 °C)
Pressure range	Full vacuum to 4500 psig (310 bar)
Specific gravity range	As low as 0.25 S.G. (consult factory for lower specific gravities)
Visual Indicators	Magnetically actuated flag assembly in contrasting orange/black, yellow/black, red/white colors, or high visibility shuttle follower (customer colors available)
REVEAL™ Flag assembly seal	Inert gas filled and sealed with double o-ring & InstaSeal™ valve IP66 & IP68 Rated
REVEAL™ visual indicator	Visible from 200 feet (51 meters)
Aluminum visual indicator	Visible from 100 feet (30.5 meters)
Scale options	Etched stainless steel with either height, volume, or percentage units (custom markings and colors available)
Transmitter options	ECLIPSE Guided Wave Radar JUPITER Magnetostrictive

Magnetostrictive Level Control Solutions



JUPITER Magnetostrictive Transmitter

With a JUPITER Magnetostrictive Transmitter, an ORION INSTRUMENTS MLI offers high accuracy and high linearity at a reasonable price. Equip any ORION INSTRUMENTS magnetic level indicator with a high-accuracy JUPITER Magnetostrictive Transmitter for expanded control capability.

JUPITER is a precision, loop-powered magnetostrictive level transmitter that simply mounts externally to any MLI. The magnetic field generated by the float interacts with the magnetostrictive wire to create a torsional twist in the wire. A sensitive piezoelectric sensor then detects the return acoustic signal and determines the precise elapsed time from pulse generation to detection of the return signal. A sampling update of ten times per second ensures high-accuracy measurement.

- Graphic display with Echo Curve capability
- Smart Probe greatly simplifies initial setup
- Removable and Rotatable Head with remote-mount option

Performance

Measuring Range	6 to 400 inches (15 to 999 cm)
Resolution	0.003 mA analog 1 mm (display)
Repeatability	$\pm 0.014"$ or $\pm 0.005\%$ of full span (whichever is greater)
Non-Linearity	$\pm 0.05"$ or $\pm 0.01\%$ of full scale (whichever is greater)
Lower Dead Zone	Less than 1 inch (.039 cm) when top mounted electronics
Damping	0–25 seconds; adjustable
Safety Integrity Level	Single Float: SIL 2 as 1oo1, SFF 93.1% Dual-Float: SIL2 as 1oo1, SFF 91.9%
Process Temperature	External Mount: -320 to +850 °F (-195 to +455 °C) *with insulation Direct Insertion: -320 to +800 °F (-195 to +427 °C)
Process Pressure	Direct Insertion: Full vacuum to 3000 psig (207 bar) @ 100 °F

The Power Industries Preferred Partners in Level Control Solutions



MAGNETROL International and ORION INSTRUMENTS offer much more than world-class instrumentation. Our extensive line of level and flow technologies provide single-source convenience while our industry expertise, engineering experience and industry leading service network help you solve the most challenging process control issues to keep your plant operating safely and at peak efficiency.



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