Application note AN/LEVEL/002–EN

Laser and ultrasonic level transmitters
Water and wastewater applications

Continuous level measurement is an important customer requirement since level output gives a better indication of how full is a vessel and enables predictive control.

Measurement made easy

Introduction

To meet its customer's needs, ABB offers a range of complementary non-contact level products using laser and ultrasonic technology, enabling optimal performance in a wide range of conditions.

Ultrasonic level transmitter

Ultrasonic level transmitters are commonly found throughout water and wastewater processes. Over the last few years, ultrasonic level has become the industry standard for most liquid level requirements. There is simply no other technology that can offer the same level of performance for the price of a typical ultrasonic level transmitter. Ultrasonic level instruments have evolved to come preconfigured with the functionality needed in the water and wastewater industry; for example, pump control, cycling and monitoring and open channel flow calculation with totalizer.

ABB offers two variations of the technology. The compact, integrated KMicro series and the LST400 – a remote transmitter with control functionality.

Laser level measurement

There are, however, some applications where ultrasonic technology are not well suited. For these applications, ABB offers a unique solution using laser level measurement technology. Laser level is particularly useful for measuring level in constrained spaces such as pumping stations with exposed pipes and deep wells. Another area where laser is used is in the presence of turbulent water where ultrasonic level instruments may not work reliably. ABB offers the LM80 with a measuring range of up to 30 m (100 ft.) and the LM200 with a measuring range of up to 45 m (147ft.). Both laser level products are available with a heated lens option that enables measurement in the presence of condensation.

Intake sources

Water can be taken from a number of sources including lakes, dams, rivers and wells.

River level measurement – laser

— LM80 and LM200 are equipped with high humidity settings to improve laser intensity and fog penetration.
— The non-condensing optics eliminate condensation build-up on detector and laser beam windows.
— River water is always moving and often has foam on the surface. The laser signal is not affected by foam.

Well – laser

— The LM80 laser transmitter can measure in wells up to 30 m (100 ft.) deep and the LM200 can measure in wells up to 45 m (147 ft.) deep.
— The laser level transmitter is installed at the top of the well for easy access and maintenance.
— Laser technology is unaffected by gas.
— The laser level transmitter is equipped with a visible laser pointer that enables easy aiming in deep and / or narrow spaces.

Fig. 1: Laser measuring sewage levels

Open channel flow

Weirs and flumes – ultrasonic

— LST400 can be configured easily to measure the flow through influent flumes and effluent flumes.
— The LST400's narrow beam angle makes installation easy, even in small channels.
— Temperature compensation is standard on all instruments, resulting in reliable and accurate measurement in changing ambient conditions.
— Common channels are preconfigured for easy setup.
— Built in totalization function makes it easy to keep track of total volumes over a long period of time.

Fig. 2: Water flowing in an irrigation canal

Pump control

Pumping stations and lift stations – ultrasonic

LST400 is preconfigured to perform pump control, cycling and monitoring.

- Most pumping stations and lift stations work well with LST400's narrow beam angle of 7 degrees (full angle). It enables LST400 to be installed where many other ultrasonic instruments have trouble measuring.
- The powerful sensor ensures that suspended solids, slight foaming and movement in the water have no effect on measurement reliability.
- LST400's relays and its pump control, cycling and monitoring functions allow LST400 to control pumps and monitor their running time and cycles. Using these functions enables LST400 to not only monitor level, but also control level at remote sites where full control systems are not available.

Fig. 3: LST400 in sewerage plant

Fig. 4: Water pumping station

Pumping stations and lift stations – laser

The water level is an important parameter in controlling the pumps in a pumping station. The LM80 laser level transmitter is well suited for this application because:

— When the pumps are running the water is often turbulent. The signal averaging features of the LM80 can be used to compensate for this effect.
— The LM80's very narrow laser beam enables easy installation in sumps and lift stations with internal structure.
— Laser is a reliable technology for measuring liquid in the presence of foam.
— The LM80's fast response ensures rapid tracking of water surface level changes.
— The LM80 can be installed on a stand pipe, away from water surges, to protect from submerging.
— The two relays on the LM80 can be used to directly turn pumps on and off.

Chemical storage tanks

Whether removing suspended particles from water in the coagulation and flocculation processes, or chlorination and dechlorination in the effluent line, chemicals are used throughout the water treatment process. Measuring chemical levels using contact-based level technologies introduces possibilities of corrosion, therefore non-contact methods are preferred.

Processes where chemical tanks are found include:

— Chlorination and dechlorination
— Flocculent
— Coagulant
— Liquid polymer

The following sections describe the use of contactless technologies to measure these levels.

Chemical storage – ultrasonic

— KMicro and LST400 have options for PVDF sensors that are resistant to corrosion to ensure many years of use in these chemically aggressive environments.
— Non-contact, corrosion resistant measurements are the only way to ensure maintenance-free operation for this application.

Chemical storage – laser

— In storage vessels where there are liquid chemicals, the laser works perfectly and is unaffected by off-gassing and fumes from the liquid.

Water storage tanks

Water storage tanks are found everywhere in the water industry. Some examples include:

— Raw water reservoirs store raw water for later processing.
— Clean water reservoirs store water that is ready for distribution.
— Filtrate tanks store water after sludge dewatering to return to the treatment process.

Water storage – ultrasonic

— LST400 is used for larger reservoirs and KMicro for smaller tanks.
— LST400 adjusts automatically to difficult conditions where other ultrasonic instruments won't be able to measure, by adjusting signal power, number of pulses and receiver gain dynamically. This enables LST400 to work in conditions with fog, foam on the surface and some ripples in the water without interruption.
— Easy installation with all settings required for a standard level measurement on the first easy setup menu. 99 % of installations require no further configuration.
— LST400 is the only instrument in its category to include graphic echo display directly on the instrument. Using this functionality during installation means no additional cables or accessories are needed to install and validate the installation.
— Great performance for the cost ensures ultrasonic is the only choice for these simple water level measurements.

Water storage – laser

— The LM80 and LM200 laser level transmitters are not affected by the turbulence that is often present in wastewater treatment plants.
— Splash and fog issues can be addressed by using drilled extension tube.
— Easy installation because LM80 can be installed above the tank. No need to get into difficult areas to find the ideal installation position.
— LM80 and LM200 can be equipped with high humidity settings to improve laser intensity and fog penetration.
— Non-condensing optics eliminate condensation build-up on detector and laser beam windows.
— A laser is ideal for applications where an ultrasonic echo would be adversely affected by the presence of, for example, spider webs and foam.

Process tanks

Mechanical screen – ultrasonic and laser

Differential level is measured at the mechanical screen. The inlet level raises as debris gathers. This alarm alerts operators to remove this material.

— LM80 or KMicro can be used for this measurement. Both provide a 4 to 20 mA output and can be integrated into a controller or control system.
— LM80 has two relays and KMicro has a single relay that can be set to act like a single point switch. This means that a single instrument can offer continuous, non-contact level measurement as well as non-contact set point switches.

Aeration tanks – ultrasonic

Aeration tanks can be difficult to measure with an uneven surface due to aeration.

— LST400 was designed with enough power and special GAP automatic gain and power adjustments to enable it to receive an echo easily, even in heavily aerated tanks.

Fig. 5: Aerated activated sludge tank at a wastewater treatment plant

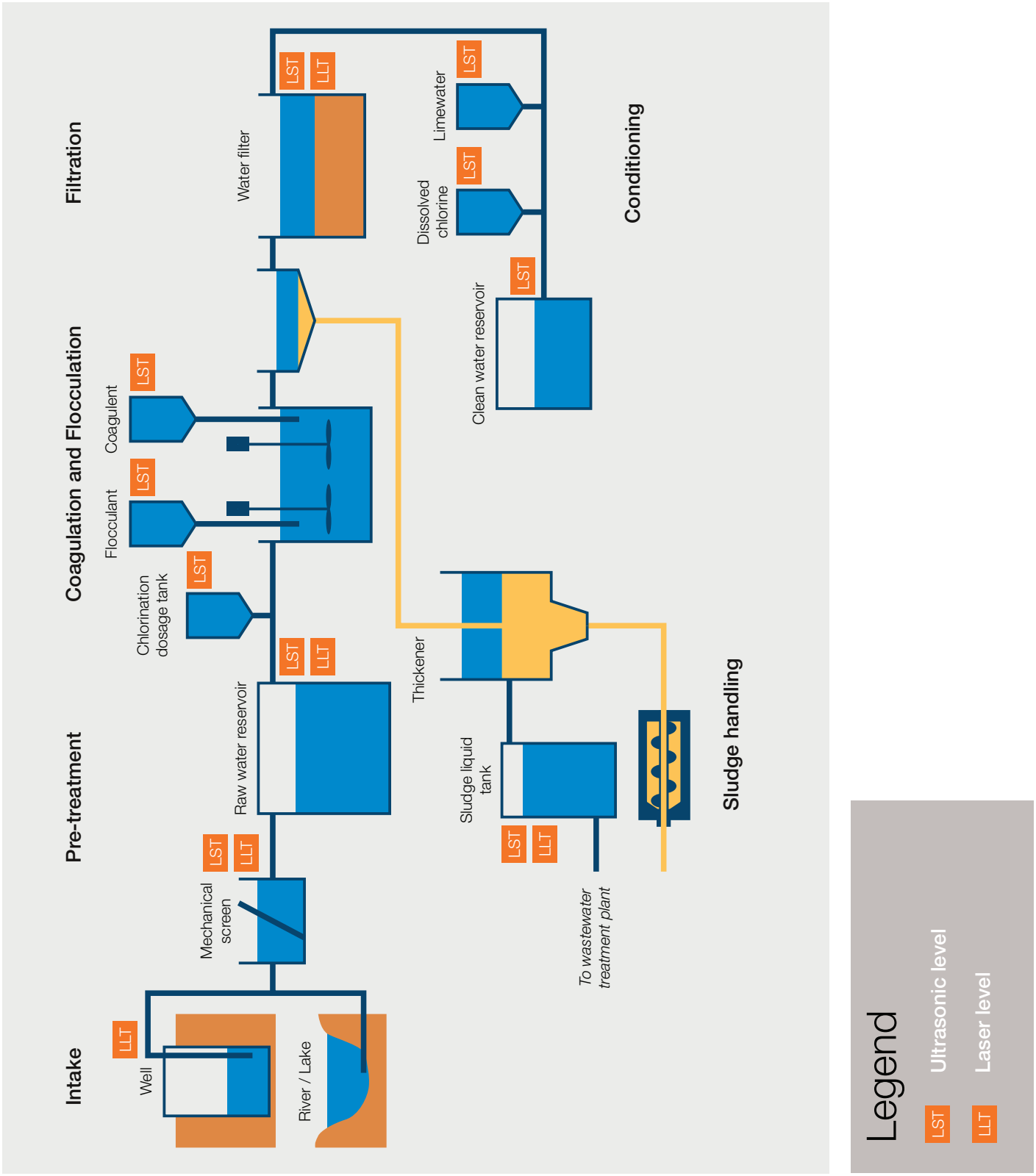

Fig. 6: Potable water

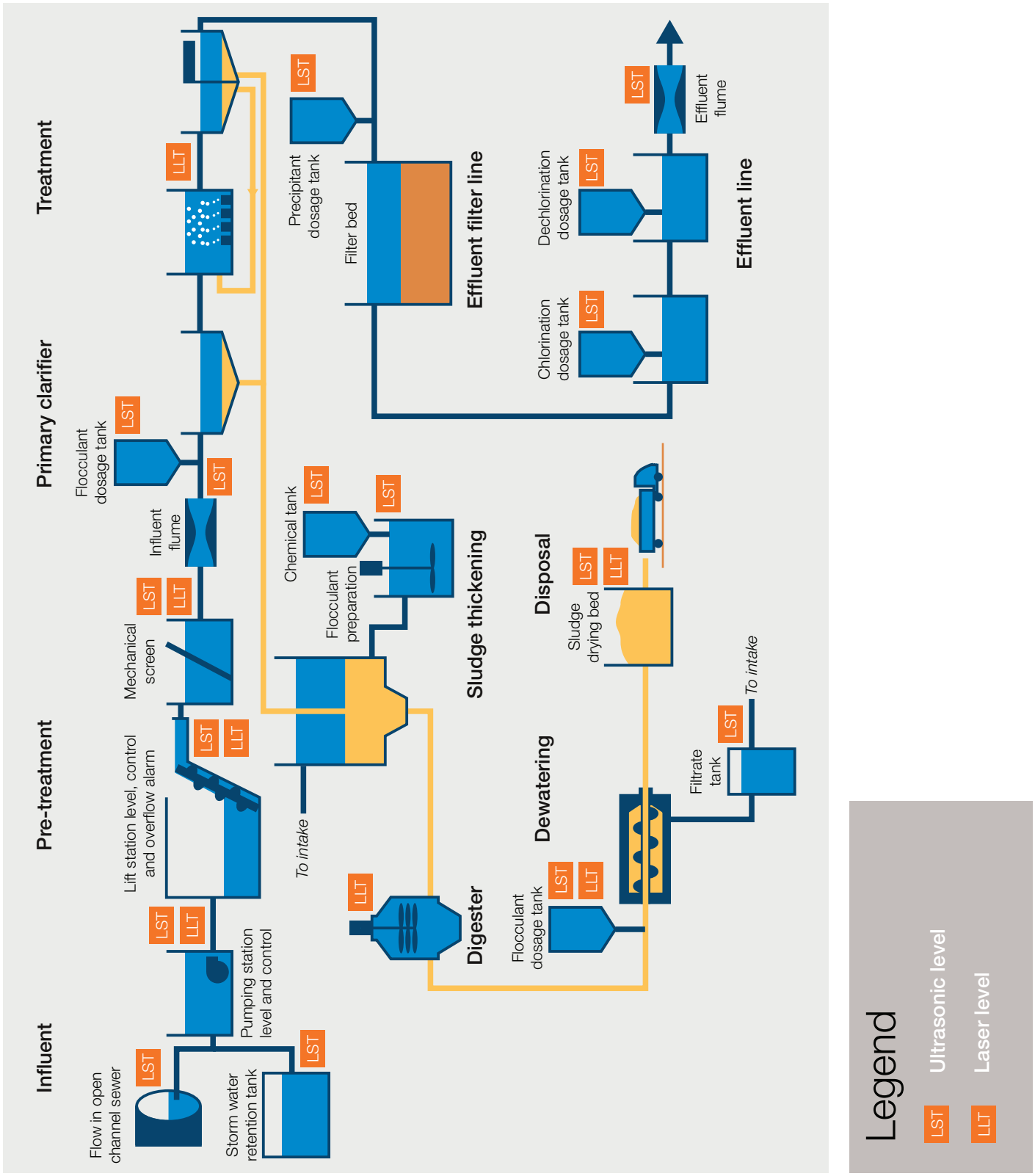

Fig. 7: Waste water

Filtration – ultrasonic

During the filtration stage, chemicals and other micro particles are removed from water.

— A simple level measurement made by KMicro helps to trigger the backwash process to clear the filter.

Fig. 8: Purification in tank by biological organisms

Hoppers with sludge cake – laser

— Wastewater treatment plant is problematic for other technologies due to splashing on the sensors.

— Sometimes customers require a redundant level on a vessel but this can cause signals to overlap and interfere. The LM80's very narrow laser beam enables it to be fitted in such a position as to eliminate the potential for interference.

Digester – laser

— The LM80 laser level transmitter is not affected by suspended solids.

— In digesters fitted with blades, the LM80 can be configured to blank the blades. Alternatively, the LM80's focused beam (less than 0.3 °) enable it to be positioned between the blades and digester wall.

— The laser is a unique product that can solve level measurement problems in digesters without false echoes.

— The laser provides reliable level measurement through foam and is unaffected by density changes, gas concentration and pressure fluctuations.

Sewage overflow – laser

— The LM200 laser is able to read level in 147 ft sewage overflow.

— Laser is the only non-contact level technology that provides long range measurement at reasonable cost.

Fig. 9: Water recycling on sewage treatment station

Product summary

LST400 and KMicro

Ultrasonic level technology provides the best performance for standard water applications. Advances in ultrasonic technology over the last decade has made many measurements possible and even easy, which were previously not possible using the technology. ABB's ultrasonic level transmitters lead the way in the water industry in many ways.

— Easy to install
— Works in many environments where other ultrasonic instruments fail. Including narrow areas, turbulent surfaces and surfaces with some foam
— Industry specific functionality make ultrasonic the perfect level instrument for the water industry

Features
Range up to 15 m (50 ft.)
Isolated 4 to 20 mA output with HART 7
Graphic LCD display with echo display
5 configurable relays (8 amp)
GAP dynamic gain, amplitude and power technology

Benefits
Narrow Beam angle enables measurement where other ultrasonic instruments would pick up false echoes
LST400 is the most robust instrument, surviving all weather conditions encountered
Graphic echo display allows for easy installation
The powerful sensor easily penetrates foam, steam, turbulence and even works with condensation on the sensor face
Industry specific integrated pump control and open channel flow functions make ABB's ultrasonic technology perfect for water applications
Corrosion resistant options ensure ensures the device will last many years

LM80 and LM200

Laser level measurement technology is the best solution for wastewater level measurement in wells, sumps, lift stations and digesters. Applied in water applications with suspended solids and opaque appearance, the LM80 and LM200 often take the stage when hydrostatic, ultrasonic and radar transmitters meet their limitations. With beam divergence of less than 0.3 °, the laser can perform level measurement in confined spaces, through protective cover grids, inside narrow deep wells and near flat walls.

— Narrow beam, easy to install in confined spaces
— Insensitive to air temperature, pressure and measured material dielectric
— No calibration required
— Very accurate, instantaneous measurement

Features
Robust construction
Non-condensing optics (heated lens)
Narrow beam
Low beam divergence
Non-contact pulsed laser technique
No moving parts
Fast electronics
4 – 20 mA current loop and relays
Configuration device

Benefits
Maintenance free
High precision to get around infrastructures
Range: LM80 – up to 30 m (100 ft) LM200 – up to 45 m (147 ft)
Easy to install and use
Insensitive to: vessel size and shape, gas, vibration, high humidity, condensation, moving and falling material, material's dielectric constant
Rapid response
Corrosion resistant options available

Notes

Contact us

ABB Inc.
Process Automation
3400, Rue Pierre-Ardouin
Quebec, (Quebec) G1P 0B2
Canada
Tel: +1 418 877-2944
Fax: +1 418 877-2834
1 800 858-3847(North America)
E-Mail: ftir@ca.abb.com

ABB Engineering (Shanghai) Ltd.
Process Automation
No.4528, Kangxin Highway,
Pudong New District
Shanghai, 201319
P.R. China
Tel: +86 (0) 21 6105 6666
Fax: +86 (0) 21 6105 6677

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AN/LEVEL/001-EN 11.2015

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