FLOWLINE™

LEVEL BEST

Technology Guide for Crushers, Transfer Stations, Stockpile, Silo and Bin Applications

EchoPro® Pulse Solids Radar

EchoPro® 26 GHz Pulse Radar Transmitter

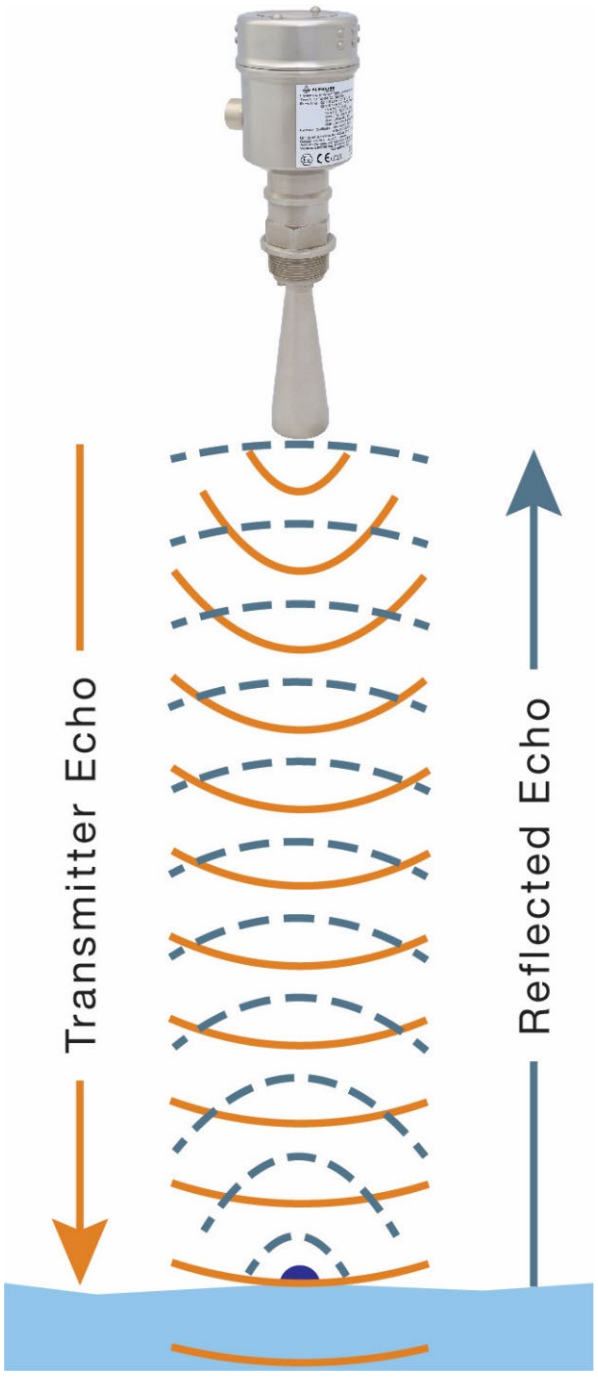
Flowline's next generation non-contact level measurement, EchoPro®, focuses on microwave RF 26 GHz pulse radar sensors. The technology enables highly accurate & repeatable level measurement in extreme, corrosive liquid-media environments. EchoPro® is ideal for inventory management and control targeting crushers, transfer stations, stockpiles, silos and bin applications.

History of Pulse Radar

It was in 1886 where German Physicist Heinrich Hertz showed that radio waves could be reflected from solid objects. However, it was not until the early 20th century that systems able to use these principles became available. Christian Hulsmeyer, a German inventor, first used them to build a simple ship detection device intended to help avoid collisions in fog. Numerous similar systems, which provided directional information to objects over short ranges were developed over the next two decades

How does Radar work?

Radar (**RA**dio **D**etection **A**nd **R**anging) is an object-detection system that uses radio waves to determine the range, angle or velocity of objects. It can be used to detect aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, terrain and level. A Radar device transmits radio waves or microwaves at the speed of light that reflect from any object in their path. The receiver, which is typically the same system that transmits the microwave, receives and processes these microwaves to determine the properties of the object(s). With Pulse Radar transmitters, these microwaves are not constant, but rather short impulses that are typically a millisecond or nanosecond in duration. These impulses are transmitted, travel through air or free space, towards the liquid. When the impulse hits the surface of the solids media, part of the impulse



Echo Time Delay = Distance

Distance = (Speed of light x time delay) / 2

energy is reflected back up to the transmitter to the circuitry which then calculates the level from the time difference between the impulse transmission and the receipt. This is also known as "time of flight."

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Why is Radar used?

Non-contact Pulse Radar provides direct measurement from the transmitter to the solids surface. It has been utilized in extremely challenging applications for level measurement in crushers, transfer stations, stockpiles, silos and bins. Since Pulse Radar is non-contact and has no moving parts, little to no maintenance is required and no calculations or compensation is necessary against the following properties:

- Solid Density
- Dielectric or Conductivity changes

Pulse Radar also provides you with the following application advantages:

- Continuous, non-contact level measurement for solids applications
- Process temperature range: -40ºF (-40ºC) to 752°F (400°C)
- Process pressure range: Atmospheric
- Accuracy is not affected by environmental conditions including the following
  - Temperature
  - Pressure
  - Vapor
  - Vacuum
  - Condensation
  - Dust
  - Uneven surfaces

Where is Pulse Radar used?

The level measurement and control industry today offers many different measurement technologies. Each technology has its strengths and weaknesses. It is important to select the right technology for your application. Pulse Radar transmitters are intended for storage and process applications with extreme environments like dust, gases, condensation, vacuum, high temperature or uneven surfaces. Pulse Radar is widely used in the following applications:

- Crushers
  - Aggregates
- Transfer Stations
  - Aggregates
  - Building Materials
- Stockpile
  - Grains
  - Powders
  - Aggregates
  - Building Materials

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EchoPro® Pulse Solids Radar

- Silo
  - Grain
  - Pellets
  - Powders
  - Building Materials
- Bins
  - Grain
  - Pellets
  - Powder
  - Aggregates
  - Building Materials

Including the following materials:

- Coal
- Animal Feed
- Cement
- Sand
- Wood Chips
- Fly Ash
- Plastic Pellets
- Silica
- Carbon Black
- Lime
- Rubber
- Flour
- Paper Pulp

EchoPro Configuration

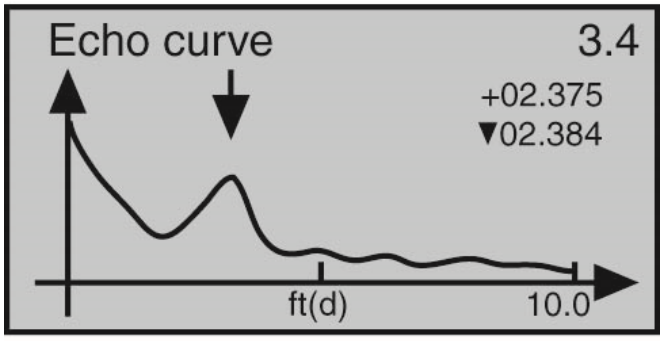
(Flowline Design Features)

The EchoPro® 26 GHz Pulse radar transmitter is configured via a push button display on the sensor face. Program the scale of your application with engineering units as well as advanced solids measurement adjustments like:

- Fast Level Changes
- Low Dielectric
- Powder/Dust
- Large Angle of Repose
- Weak return signals

What is an EchoCurve?

The EchoCurve displays the primary echo return(s) that the sensor is currently seeing graphically, the location and amplitude of the return(s), and the numeric air gap from the sensor's measurement location to the liquid below. Pressing the ESCAPE button will display the EchoCurve.



Above the echo return peak is a floating arrow to represent the measured liquid level.

Creating a New False EchoCurve

(Flowline Design Features)

Obstruction in the tank (mixer blades, side wall weld joints or material build-up, aeration systems, level switches, grain spreaders, fans and heating equipment, etc.) or tall tank risers or installation fittings can create false echo returns that impair the sensor's measurement. The EchoCurve maps all echo returns within the tank, differentiating between good and false echoes, and stores those identified as false into the False Echo Curve, so they will not be considered in the level measurement.

What is the new FCC regulation?

(Flowline Design Advantage)

Since Pulse radar has impulses dispersed into open air, the Federal Communications Commission (FCC) has to regulate these microwaves. The FCC ensures that these impulses do not interfere with other frequencies traveling in open air, i.e. radio or TV, military communications, cellular signals, etc. The FCC 15.209 regulation stated that all pulse radar transmitters are to be installed in metal or cement tanks to contain the energy.

In 2014, the FCC changed this regulation and approved FCC 15.256 directive. This new regulation states that pulse radar transmitters can be installed in plastic, fiberglass or and tank material, including open air as long as the sensors are pointed to the ground and the beam angle of the pulse is less than 12 degrees. This new directive opens up many applications where pulse radar was not previously utilized. The Flowline EchoPro® product family is one of the first radar transmitters to meet the new FCC directive.

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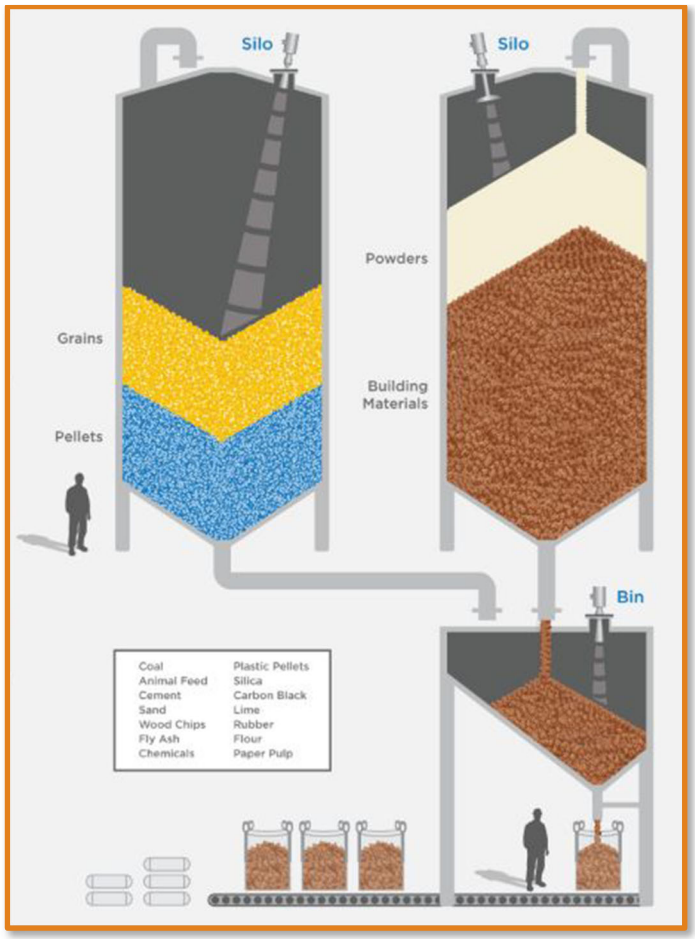
EchoPro® Pulse Radar Transmitter – Intrinsically Safe Applications

Flowline EchoPro's with three (3) different product configurations maximizes application bandwidth delivering high performance to value transmitters for repeatable, accurate and reliable level measurement solutions.

The **EchoPro® LR36** is an intrinsically safe 26 GHz radar level transmitter that provides continuous level measurement up to 32.8' (10m) with a 4-20mA signal output. Its PFA coated horn targets easy application conditions with corrosive media, light agitation, condensation, or vapor and installation in a low-profile tank adapter or flange fitting.

The **EchoPro® LR41** is an intrinsically safe 26 GHz radar level transmitter that provides continuous level measurement up to 98.4' (30m) with a 4-20mA signal output. It has 3 available horn sizes for challenging application conditions with low or non-corrosive media, light surface foam or agitation, higher temperature or pressure, adapter, flange fitting or metal stand pipe.

The **EchoPro® LR46** is an intrinsically safe 26 GHz radar level transmitter that provides continuous level measurement up to 65.6' (20m) with a 4-20mA signal output. It has a PTFE coated flanged horn for challenging applications conditions with corrosive media, light surface foam, or agitation, higher temperature or pressure, condensation or vapor and installation in a flange fitting.



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