

Ultrasonic Measurement *prosonic*

Universal transmitter with rugged sensors
for level or open channel flow measurement



FMU Prosonic
Transmitter

Benefits

- flexibility
 - universal transmitters cover a wide range of measurement and control applications
 - sensors provide liquid and solids level measurement spans from two inches (50 mm) to over 230 feet (70 m)
 - up to five programmable relays
 - field, panel, and rack mount versions
- enhanced reliability
 - no electronics in sensor to fail
 - rugged sensors have high material buildup immunity and corrosion resistance
- low installed cost
 - common shielded twisted-pair wiring between sensor and transmitter
 - offers combination open channel flow and wet well level measurement in one transmitter
 - standard temperature measurement in sensor for speed of sound compensation
 - one or two standard isolated 4 to 20 mA DC outputs
- enhanced safety
 - low (under 50 V) voltage transmission to sensor
 - overflow/underfill level switch option provides added protection
- simple installation and maintenance
 - uses standardized matrix operator interface
 - invisible fuzzy logic implementation manager guides operation

Applications

- water and wastewater management
 - open channel flow
 - differential level/screen control
 - wet well level/pump sequencing
- solids handling
 - hopper level
 - silo level
- liquids management
 - storage tank level
 - process vessel level

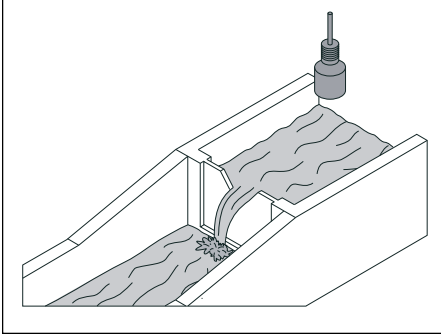
Endress + Hauser

The Power of Know-how



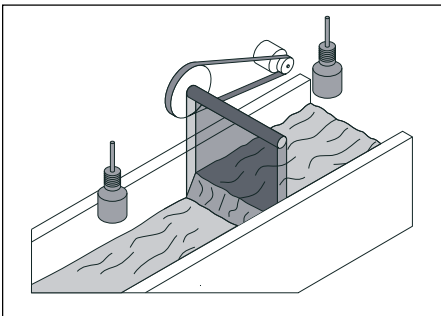
General Information

Prosonic is designed specifically for customers who need to make reliable ultrasonic level or open channel flow measurement. Prosonic is based on the ultrasonic theory, which states that sound travels through space at known rates depending on the density and temperature of the medium. Ultrasonic level technology measures the time it takes for a burst of sound to travel from a sensor to a reflective surface and back. It then converts that information into a level measurement. This noncontact approach is ideal for many industrial applications where corrosive conditions, changing product characteristics, and other factors make contacting level measurement devices less reliable.



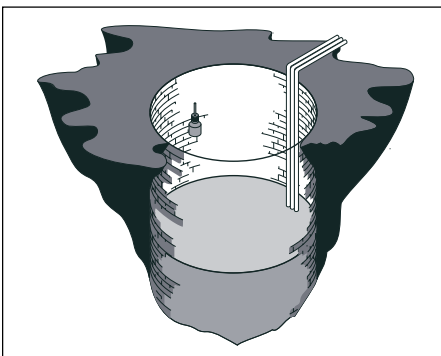
Provides 150 programmed flow curves

Predicting all the conditions that affect an ultrasonic level measurement system often can be a difficult task. Applications that appear to be simple may become very challenging due to filling noise, nuisance reflections, or variable material profiles. Even more challenging are applications where these and other interfering conditions are changing constantly.



Differential level measurement and screen control

Prosonic brings many reliable level measurement and operating capabilities closer to the user. A new generation of ultrasonic sensors provides high sensitivity, rugged construction, and resistance to corrosive coatings. A fuzzy logic implementation manager in the transmitter smoothly combines many sophisticated signal processing techniques through the Endress+Hauser operator interface. The user can set up a Prosonic application by entering a few parameters describing individual measurement needs. As conditions change, Prosonic adapts to provide reliable level information. Prosonic also provides HART® or Rackbus communication allowing an operator to remotely interface with the measurement system anywhere on its 4 to 20 mA loop with a handheld communicator or laptop computer.



Level measurement and pump sequencing of up to five pumps

The Prosonic family is designed to fulfill many measurement and control needs. Prosonic addresses water/wastewater management, solids handling, and process industry liquid level measurement requirements.

In the water/wastewater management industry, Prosonic measures open channel flow, differential level across screens, and wet well level. It provides sampler, differential screen and pump sequencing control. Prosonic offers accurate measurements of hopper level and bulk storage inventory. In the field of liquids management, Prosonic provides level measurement in a wide variety of process and storage vessels. The dual-channel Prosonic can measure level in any two applications simultaneously - for example, open channel flow and long range liquid level, or short range liquid and long range solids level.

Endress+Hauser offers eight different sensors with characteristics suited for various ranges and measurement conditions. Prosonic can measure material spans from two inches to 147 feet with a resolution of 1/32" (1 mm) or 0.1% of span (whichever is greater). Users can mount the sensor up to 1,000 feet (300 m) from its transmitter using industry standard shielded twisted-pair wire. HART® technology enables users to interact with the measuring system at any point in the 4 to 20 mA loop.

The dual-channel Prosonic, FMU 862, provides point and continuous, long and short range, and differential level measurement. The FMU 862 also can support a single open channel flow measurement. The FMU 862 is designed for use with single channel level in solids or liquids environments. The FMU 861 is designed to make open channel flow measurements. All systems have three or five relay outputs for limit signals, totalizers, and printers.

Certified quality

Development, production, and documentation are all critical factors when evaluating the quality of Prosonic. Endress+Hauser is an approved company which fulfills all the quality standards set by ISO 9001.

Features and Benefits

Several factors can distort an ultrasonic measurement. By eliminating multiple reflections, unwanted echoes, effects of sensor coatings, and unwanted noise, Prosonic provides very accurate and dependable measurements.

The sensor, connecting cable, and transmitter all contribute to reliable ultrasonic level measurement, economical installation costs, ease of operation, and safe plant operation.

Sensors

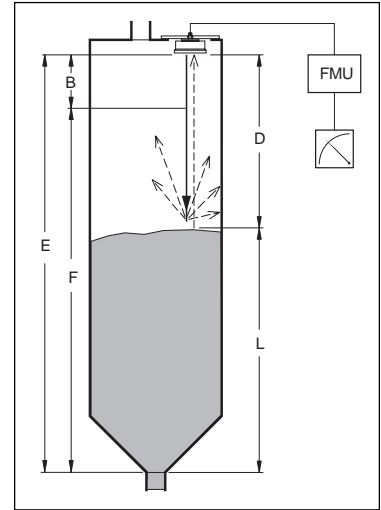
Prosonic draws from a family of sensors providing the highest efficiency and resistance to material buildup available. The greater efficiency of the FDU 8X sensor family provides reliable measurement of level even with substantial material buildup or dripping liquids. The sensor can even be submerged in liquids without damage. Other ultrasonic level suppliers may provide thin membrane ultrasonic sensors that, due to weak acoustic power and lack of protection, are easily compromised by buildup and corrosion.

The FDU 8X sensor design reduces side lobes, which are responsible for many of the unwanted reflections found in sensors offered by other manufacturers. This sensor design enhances the reliability of the system by reducing the number of unwanted reflections the transmitter must filter out. The integral temperature sensor is a standard Prosonic offering; it gives the user speed-of-sound compensation without requiring an optional temperature sensor. Because Prosonic has no electronics in the sensor, less of the system is exposed to hostile conditions in the field.

Cable Connections

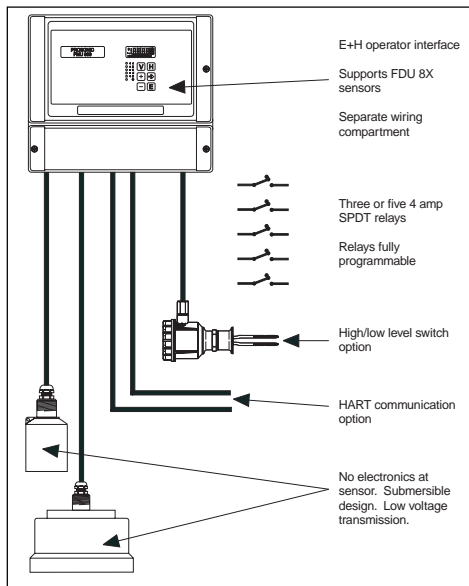
Prosonic sensors can be mounted up to 1,000 feet (300 m) away from the transmitter using common shielded twisted-pair wiring. It may be possible to install Prosonic using existing wiring.

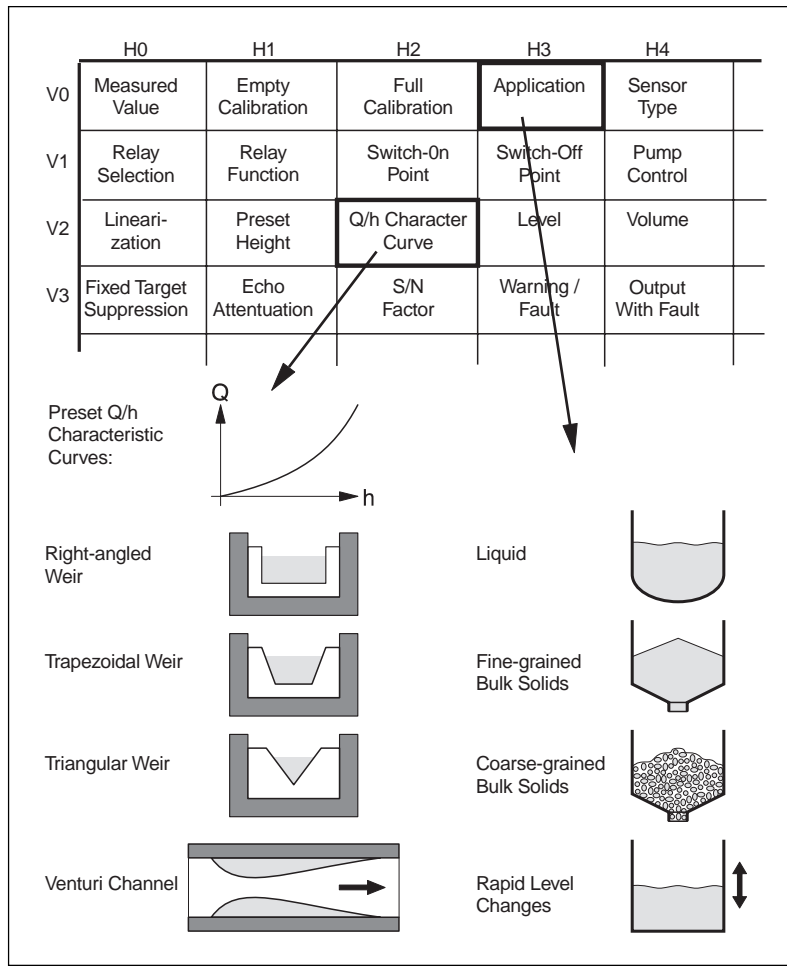
Model	Features
FMU 860	Single channel level
FMU 861	Single channel open channel flow
FMU 862	Dual channel for differential, averaging, and dual level measurements. Single channel for open channel flow.
Options	LCD backlighting, Rackbus or HART® protocol, 3 or 5 output relays, overfill / underfill protection.



B = Blocking distance
 NOTE: Blocking distance is the area directly below the sensor in which level cannot be sensed. Each time the sensor pulses, it must stop ringing before it can listen for a returned signal. This waiting period translates into a specific distance which is inherent to the sensor model specified.
 D = Distance from sensor to surface of fill material
 L = Level in vessel
 F = Maximum fill height (100% full)
 E = Zero point of measurement (0%, empty)

Blocking Distance (B)	
FDU 80 / 80 F	12" (0.3 m)
FDU 81 / 81 F	20" (0.5 m)
FDU 82	29" (0.8 m)
FDU 83	36" (1.0 m)
FDU 84	29" (0.8 m)
FDU 85	29" (0.8 m)
FDU 86	62" (1.6 m)





The unique design of the FMU 8X sensors requires less than 50 volts to operate. Most other industrial ultrasonic sensors available today require up to 1000 volts, requiring coaxial cable to safely convey this high voltage in the field. Prosonic offers lower installed costs because shielded twisted-pair wiring is less expensive than coaxial cable.

Transmitter

The FMU 86X transmitters offer signal processing capabilities and ease of operation unmatched by suppliers of other ultrasonic measurement systems.

Endress+Hauser Operator Interface

Prosonic offers an operator interface that is becoming the standard for the industry. The Endress+Hauser operator interface is a matrix array offering access to information and parameters common to hundreds of thousands of measurement systems installed worldwide. Users responsible for installing or interacting with these instruments do not have to learn another new operator interface in order to work with the Prosonic.

Prosonic has five level measurement operating modes to make initial setup easier for the end user: standard, liquids, liquids with rapid level changes, fine-grained bulk solids, coarse bulk solids, and solids with rapid level changes. In addition to the five operating modes, Prosonic includes 150 preset open channel calibration curves designed to mate with your particular weir or channel.

Fuzzy Logic

Through the Endress+Hauser operator interface and invisible to the user is a management system that processes a collection of patented or proprietary signal processing algorithms. The user can enter one or two values through the operator interface defining the type of level or open channel flow application installed. The fuzzy logic implementation manager selects and blends the signal processing algorithms best suited to the application. Users can set up most applications without the need for factory or other trained personnel. Selected signal processing algorithms are described in the following sections.

Time Dependent Threshold

The time dependent threshold (TDT) detects echoes above a set level by gauging a collection of echoes (and noise) returned from various distances. This collection of echoes often is referred to as an envelope curve. Typically, the TDT is set higher for echoes closer to the sensor and lower for echoes farther away so that much of the unwanted noise is not detected. Because the TDT is fixed at the beginning and end of the envelope curve, it is not always able to respond to changes within the envelope curve from filling operations, material buildup, and dust formation. For many applications, it is implemented successfully.

Floating Average Curve

The floating average curve (FAC), a dynamic adaptation of the TDT, can respond to level changes that the TDT cannot detect. Like the TDT, the FAC filters out noise and unwanted echoes. However, the FAC is generated from a running average of envelope curves, enabling Prosonic to detect true level echoes even when acoustic conditions vary greatly. This method enables Prosonic to respond to changes within the envelope curve that the TDT is unable to manage.

Tank Mapping

Tank mapping is a patented technique that digitizes and eliminates unwanted echoes from fixed reflective surfaces inside a silo or vessel (see illustration left). Via the Endress+Hauser operator interface, users can set the TDT or FAC to ignore unwanted echoes when the silo or vessel is empty. When the material level moves up and down past the source of unwanted echoes, the echo representing the level is tracked, rather than the unwanted echoes.

First Echo Factor

Sometimes the echoes detected by the TDT or FAC do not represent the true level. Echoes from the walls of a silo or hopper may be as significant as the direct echoes from the material surface. The relative sizes of these echoes may vary, so an algorithm is used to decide which echo is correct. This algorithm calculates an effective first echo factor that adjusts to the amplitude of the largest echo and changes with variations in the strength of the echoes. A large echo amplitude results in a large first echo factor and a small echo amplitude results in a small factor.

The algorithm is set up with the appropriate first echo factors and first echo switch-off points with each operating mode. The effective first echo factor is formed from these values and the echo attenuation. If a smaller, earlier echo exceeds an effective first echo factor, it is considered to be the one representing true level.

Zone Evaluation

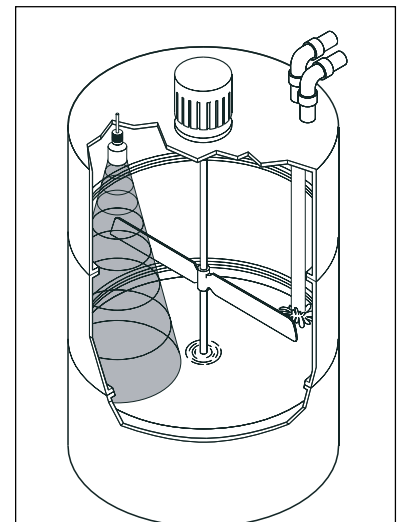
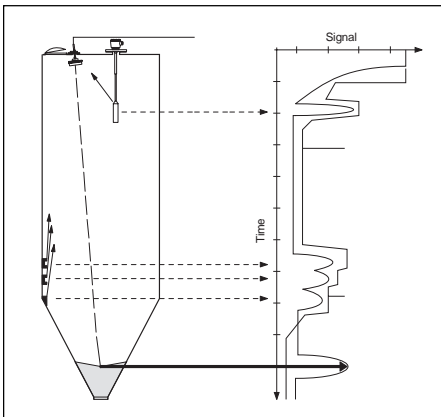
Bulk materials in silos or hoppers often form multiple reflective surfaces. These diffused echoes representing several levels may cause a constantly changing display as the echo pattern changes. Zone evaluation is a mathematical smoothing of the envelope curve melding the diffused echoes into one echo that more clearly represents the level measurement value.

Fuzz Filter

The fuzz filter operates like a register that can have 0, 2, 4, 8, or 16 storage locations. With every ultrasonic pulse, the fuzz filter stores a new measured value. The displayed value is calculated from the average of all the values. When all storage locations are full, the oldest value is removed and replaced by the next value, and so on. This process rapidly produces a stable displayed value. Jitter during constant level conditions is eliminated, and runoff after filling or emptying the vessel is prevented.

Agitator Filter

The movement of agitator blades in the path of the ultrasonic beam can cause significant undesired reflections. The agitator filter algorithm determines the reflective pattern of the agitator blade and eliminates it from further signal processing.



Sensor Selection

The most crucial aspect of the measuring process is sensor selection and installation. Preliminary selection of the sensor can be made by comparing your needs to the sensor specifications. When making a final decision, use the table (right) to choose the correct sensor.

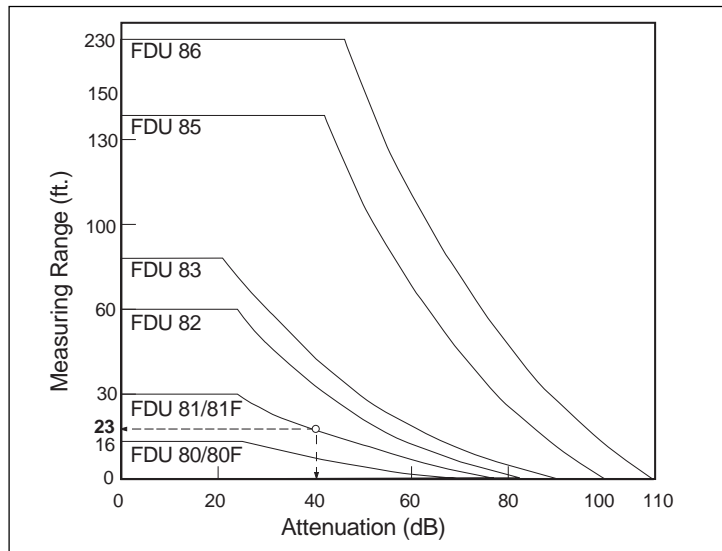
The diagram below defines the effect echo attenuation has on the sensor's measurement range. The ideal echo attenuation curves are shown for each sensor. Also shown is the echo attenuation detection limit (120dB), the lowest echo attenuation detectable by the Prosonic transmitter. To account for extraneous tank noise, a 20 dB noise buffer is added, which sets a practical echo attenuation detection limit (100 dB).

A number of echo attenuation sources that affect proper sensor selection are shown in the table at the right. Add the echo attenuation sources that are present in your application. Use your estimated attenuation total and the Range diagram below to determine each sensor's practical measurement range.

Echo Attenuation Sources	dB
Temperature difference Up to 68°F (20°C) Up to 104°F (40°C) Up to 140°F (60°C)	0 5 to 10 10 to 20
Fill Stream Out of detection range Small quantities in detection range Large quantities in detection range	0 5 to 10 10 to 20
Dust No dust development Little dust development Heavy dust development	0 5 5 to 10
Solid Material Surface Hard, rough Soft (e.g., peat, dust covered clinker)	20 20 to 40
Liquid Surface Calm Wavy Very turbulent (e.g. agitator)	0 5 to 10 10 to 20
Foam	CF
Pressure 14 to 30 psi Partial vacuum	0 CF
Steam	CF
Liquids / Solids Extended Temperature Range (-40°F) signal reduction (add to attenuation dB for temperatures from -4° to -40°F)	
FDU 80 / FDU 81	4
FDU 82 / FDU 83	15
FDU 84	15
FDU 85	20

Echo attenuation as a function of range for various sensors (ideal reflection and atmospheric conditions)
Sensors mounted in nozzles generate a background noise of 20 dB which decreases with measuring range - at 13 feet (4 m) it falls to 0 dB.

Check the factors affecting your measurement from the table above. Add up their attenuation values. Take this sum and find the point where it intersects with the range limit of the sensor you are using. This gives the maximum measuring range of that sensor.



Example For Calculating the Range (Liquid Tank)

FACTORS	ATTENUATION
Temperature difference in tank, maximum 104°F (40°C)	10 dB
Small fill stream quantities in detection range	10 dB
Liquid surface is strongly turbulent	20 dB
Sum of Attenuation Values	40 dB

Under the above conditions, the range is approximately 23 feet (7 m) with the FDU 81 sensor.

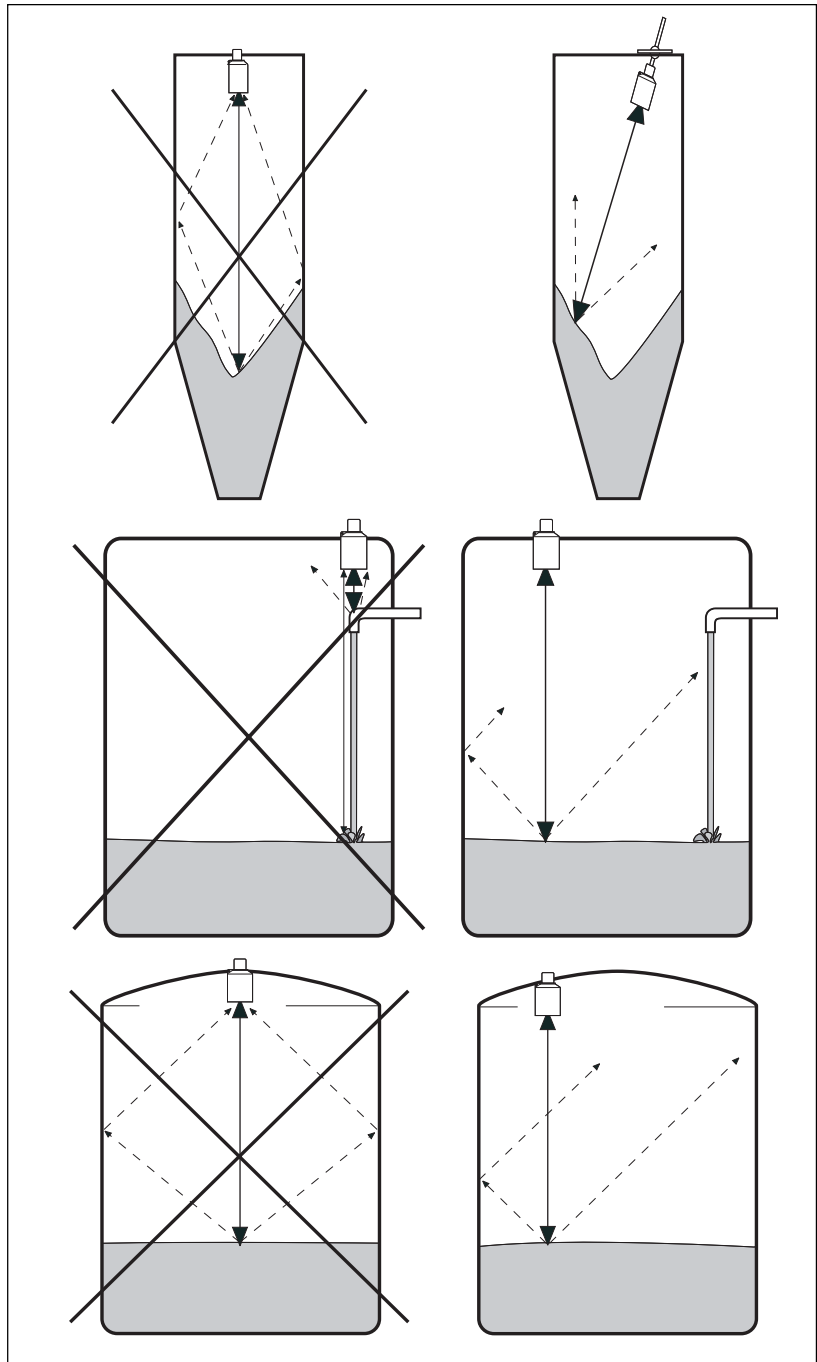
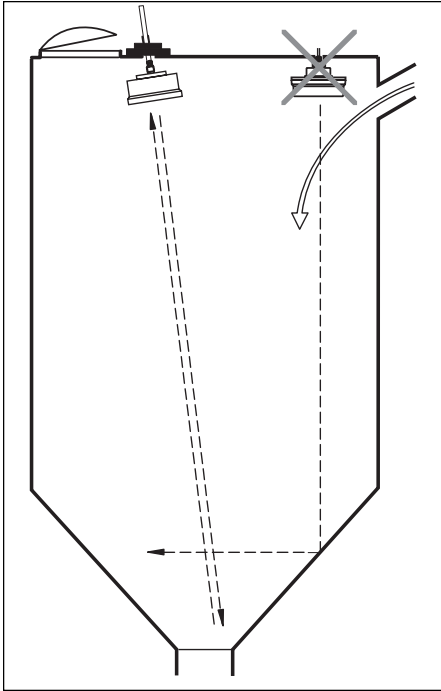
Sensor Location

For best performance and maximum range, the selected sensor should be positioned vertically at the top of the vessel. It should be in a location that maximizes its returned echo signal and minimizes vessel obstructions in its line of sight. Although an individual sensor has a constant, definable output beam, the more important consideration is the line-of-sight reflected echo.

resulting reflected echoes. On vessels that have coned bottoms, or dished (round) tops, positioning the sensor away from the vessel center is recommended to eliminate echo travel paths not related to the level.

Maximizing the returned level echo is generally accomplished by avoiding sensor mounts that either sight into the fill stream or position the sensor so that a large part of its output beam is lost into the vessel wall (see illustration at left).

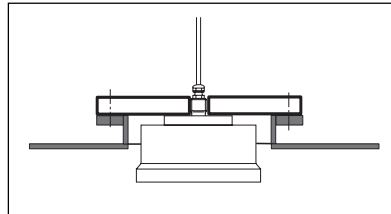
Minimizing vessel obstructions in the line of sight is accomplished by considering the geometry of both the vessel and the



Sensor Installation

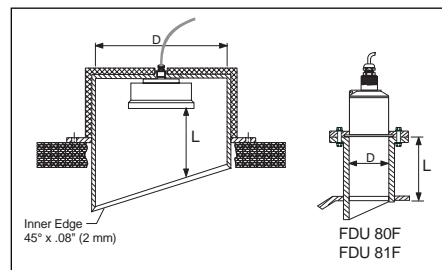
Prosonic sensors are provided with 1" NPT fittings for mounting flexibility. The FDU 80/81F sensors may also be installed with a slip-on flange.

For optimum performance, the sensor should be installed so that its lower edge is below the top of the tank or silo. This can be done if the maximum level does not enter into the blocking distance (blind space) of the sensor. See illustration below.



Flange mounting

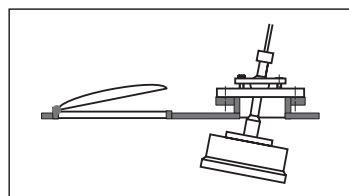
Pipe well mounting is used when the material high level is high enough that the sensor must be moved to allow for the blocking distance.



Pipe well mounting

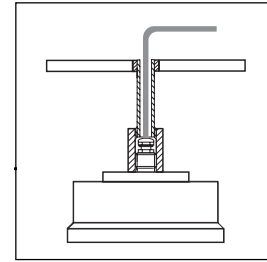
Sensor	D	L
FDU 80 / 80 F	3.9" (100 mm)	<13.7" (<350 mm)
FDU 81 / 81 F	5.9" (150 mm)	<13.7" (<350 mm)
FDU 82	5.9" (150 mm)	<11.8" (<300 mm)
FDU 83	7.8" (200 mm)	<15.7" (<400 mm)
FDU 84 / 85	9.8" (250 mm)	<19.7" (<500 mm)
FDU 86	12" (300 mm)	<24" (<600 mm)

Sensor positioner mounting, below, depicts how the sensor can be installed in the best position with respect to the measured material. A sensor positioner can be used to install a sensor in a tank that has an opening smaller than the sensor's diameter.



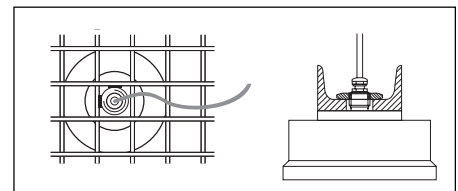
Sensor positioner mounting

Pipe or conduit mounting can be used where the strength of the mounting matches the sensor weight.



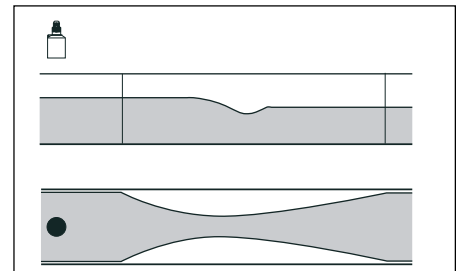
Pipe or conduit mounting

Support bracket mounting and grid mounting illustrate two other common installation approaches.



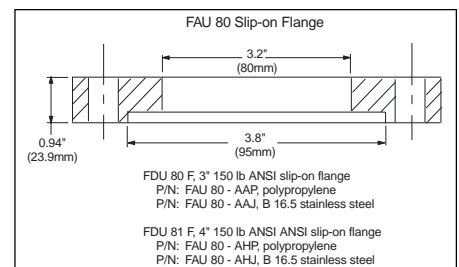
Grid and support bracket mounting

Open channel flow applications require that the sensor be mounted over the center line of the weir or flume and at a height exceeding the sum of the highest flow level and the sensor's blocking distance.



Open channel flow mounting

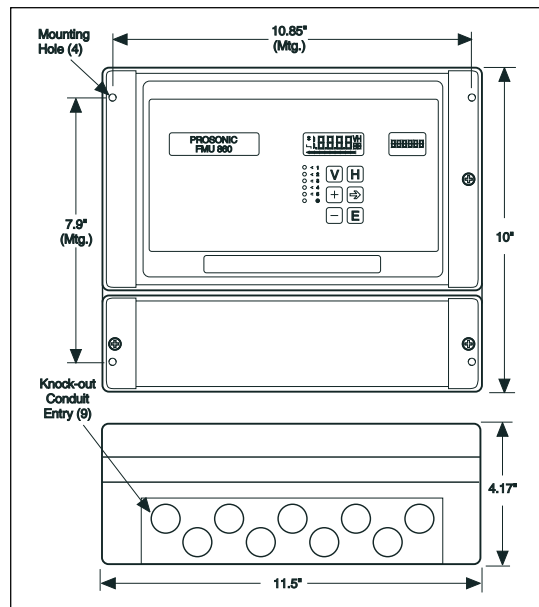
The FDU 80 F and FDU 81 F sensors can be flush mounted using the FAU 80 slip-on flange.



Technical Data

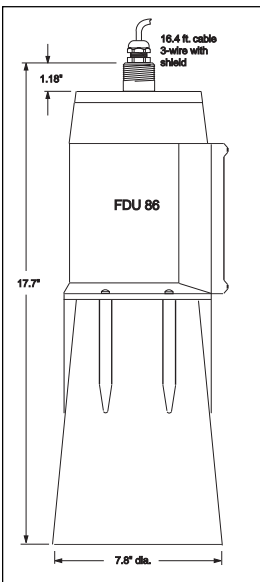
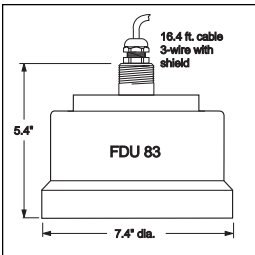
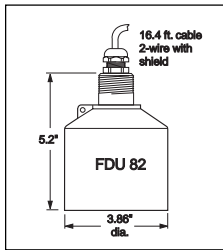
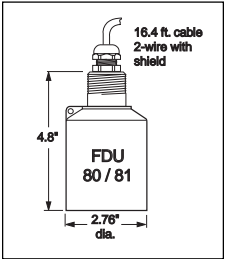
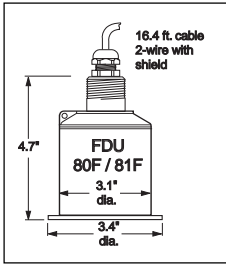
Transmitter FMU 86X

Enclosure	Field, NEMA 4X (IP 65), corrosion-resistant reinforced plastic with nine punch-out conduit entries. Optional panel mount (144 x 144 mm) or rack mount (19", 21 HP); both include keypad and display.
Display	4-1/2 digit LCD with vertical and horizontal matrix position display and bar graph (%). Optional backlit matrix display.
Communication	Plug-in options supporting INTENSOR or HART serial communication via the 4 to 20 mA loop or RS 485 interface (DMS ready)
Sensor Input	One or two (FMU 862 only) sensor channels of any combination
Weight	Field mounted, 5.7 lbs (2.6 kg). Panel, 2.2 lbs (1 kg). Rack, 2.8 lbs (1.3 kg).
Electrical Classification	General purpose
Resolution	0.03" (1 mm) or 0.1% of measuring span (which ever is greater)
Power Input	90 to 146 VAC, 50/60 Hz; 180 to 276 VAC, 50/60 Hz; 20 to 30 VDC
EMI / RFI Effects	1% for maximum measuring span at 10 V/m (10 kHz to 1 GHz) to NAMUR, IEC 801-3
Overfill/Underfill Input	Support connections to external voltage free make-or-break contacts or PNP switches
Power Consumption	15 VA maximum
Operating Temperature	-4°F to + 140°F (-20° to +60°C)
Storage Temperature	-24°F to + 176°F (-40° to + 80°C)
Humidity	95% average annual humidity
Drift	Temperature, negligible; load, negligible
Shock Resistance	2g (10 to 55 Hz) and 15g for 11 ms per DIN40 040, type W
Relay Outputs	3 or 5 SPDT, 4A at 250 VAC programmable relays including fault indication, limit switches, totalizer driver (FMU 861 and 862 only), sampler activation (FMU 861 and 862 only)
Analog Outputs	1 or 2 (FMU 862 only) isolated 4 to 20 mA @ 600 Ohms maximum. Output current limit, 24 mA
Indicators	Yellow LED for each relay, lighting during de-energized state; green LED indicating proper operation
Totalizer	Optional 6-digit (non-resettable, FMU 861 and 862 only)
Keypad Interface	6 tactile feedback keys to access operator matrix. V and H keys for vertical and horizontal movement. Other keys for data entry.
Recommended Cable	18-AWG, two-conductor with maximum 25 Ohms and 60 nF per conductor, maximum 1000 feet
Optional Accessories	FAU 40 sensor positioner, all-weather cover, pipe-mount kit.
Dimensions	Refer to diagram below



Technical Data (con't)

FDU Sensors



Type	FDU 80 F	FDU 81 F	FDU 80	FDU 81
Measuring Range				
Liquids	16 ft (5m)	29 ft (9m)	16 ft (5m)	29 ft (9m)
Solids	N/A	N/A	6.5 ft (2m)	16 ft (5m)
Blocking Distance	12" (0.3m)	20" (0.5m)	12" (0.3m)	20" (0.5m)
Electrical Classification	Cl I, Div 1, Grps A-G	Cl I, Div 1 Grps A-G	Cl I, Div 1 Grps A-G	Cl I, Div 1 Grps A-G
Operating Frequency at 72°F (23°C)	58 kHz	44 kHz	58 kHz	44 kHz
Beam Angle	8°	8°	8°	8°
Housing Material	Tefzel (ETFE)	Tefzel (ETFE)	Polypropylene	Polypropylene
Operating Temperature	-40° to +203°F * (-40 to +95°C)	-40° to +203°F * (-40° to +95°C)	-4° to +140°F (-20° to +60°C)	-4 to +176°F (-20° to +80°C)
Extended Temperature **	N/A	N/A	-40° to +140 (-40° to +60°C)	-40° to +176°F (-40° to +80°C)
Operating Pressure Max.	58 psia (4 bar)	58 psia (4 bar)	29 psia (2 bar)	29 psia (2 bar)
Protection	NEMA 6P (IP68) submersible	NEMA 6P (IP68) submersible	NEMA 6P (IP68) submersible	NEMA 6P (IP68) submersible
Relative Humidity	100%	100%	100%	100%
Mounting	1" NPT, G1A, or slip-on flange	1" NPT, G1A, or slip-on flange	1" NPT or G1A	1" NPT or G1A
Weight	1.1 lbs (0.5 kg)	1.1 lbs (0.5 kg)	1.2 lbs (0.55 kg)	1.3 lbs (0.6 kg)
Temperature Sensor	Standard	Standard	Standard	Standard
Heating	N/A	N/A	Optional ***	Optional ***

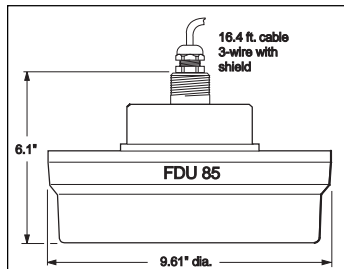
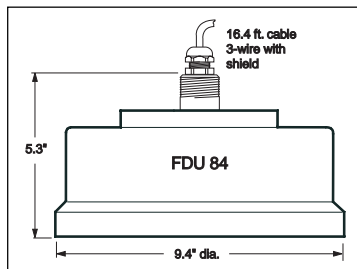
* Temperature limits: sterilization for 30 minutes, maximum temperature is +275°F (+135°C)

** Extended temperature from -4° to -40°F increases signal attenuation, refer to page 6 for information.

*** If heating option is selected, an external temperature sensor and DC power supply is required.

Type	FDU 82	FDU 83	FDU 84	FDU 85	FDU 86
Measuring Range					
Liquids	65 ft (20m)	82 ft (25m)	N/A	N/A	N/A
Solids	33 ft (10m)	49 ft (15m)	82 ft (25 m)	147 ft (45m)	230 ft (70 m)
Blocking Distance	29" (0.8m)	36" (1m)	29" (0.8m)	29" (0.8m)	62" (1.6 m)
Electrical Classification	Cl I, Div 1, Grps A-G	Cl II, Div 1 Grps E-G	Cl II, Div 1 Grps E-G	Cl II, Div 1 Grps E-G	Cl II, Div 1 Grps E-G
Operating Frequency at 72°F (23°C)	29 kHz	30 kHz	21 kHz	17 kHz	11 kHz
Beam Angle	8°	4°	4°	5°	5°
Housing Material	Polypropylene	Polypropylene	Polypropylene	Polypropylene	UP
Operating Temperature	-4° to +176°F (-20 to +80°C)	-4° to +176°F (-20° to +80°C)	-4° to +176°F (-20° to +60°C)	-4 to +176°F (-20° to +80°C)	-40° to +300°F (-20° to +150°C)
Extended Temperature *	-40° to +176°F (-40° to + 80°C)	-40° to +176°F (-40° to + 80°C)	-40°F to +176°F (-40° to + 80°C)	-40° to +176°F (-40° to +80°C)	N/A
Operating Pressure Max.	29 psia (2 bar)	22 psia (1.5 bar)	22 psia (1.5 bar)	22 psia (1.5 bar)	44 psia (3 bar)
Protection	NEMA 6P (IP68) submersible	NEMA 6P (IP68) submersible	NEMA 6P (IP68) submersible	NEMA 6P (IP68) submersible	NEMA 6P (IP68) submersible
Relative Humidity	100%	100%	100% at 140°F 95% at 176°F	100% at 140°F 95% at 176°F	100%
Mounting	1" NPT or G1A,	1" NPT or G1A,	1" NPT or G1A	1" NPT or G1A	1" NPT or G1A
Diaphragm	N/A	316TI SS	316TI SS	Al / PE	AL / PTFE
Diaphragm Seal	N/A	EPDM	EPDM	EPDM	Silicone
Weight	2.6 lbs (1.2 kg)	6.8 lbs (3.1 kg)	10.4 lbs (4.7 kg)	11 lbs (5 kg)	11 lbs (5 kg)
Temperature Sensor	Standard	Standard	Standard	Standard	Standard
Heating	N/A	N/A	N/A	N/A	N/A

* Extended temperature from -4° to -40°F increases signal attenuation, refer to page 6 for information.



Ordering Information

FMU 86X Transmitter

FMU 86 -

- 1 Transmitter
 - 0 Single channel level
 - 1 Open channel flow
 - 2 Dual channel level / flow
- 2 Electrical Classification
 - R General purpose, FM NEMA 4
- 3 Enclosure
 - 1 Field enclosure
 - 2 Blind enclosure with plug for remote controls
 - 7 Mounting plate cover for remote controls
- 4 Controls and Display
 - FMU 860 ONLY**
 - A Integral controls and display
 - C 19" rack-mounted controls and display
 - D 144 x 144 panel-mount controls and display
 - E Integral controls and illuminated display
 - G 19" rack-mounted controls and illuminated display
 - H 144 x 144 panel-mounted controls and illuminated display
 - K No controls or display
 - FMU 861 ONLY**
 - B Integral controls, display and totalizer
 - C 19" rack-mounted controls and display
 - D 144 x 144 panel-mount controls and display
 - F Integral controls, illuminated display and totalizer
 - G 19" rack-mounted controls and illuminated display
 - H 144 x 144 panel-mounted controls and illuminated display
 - K No controls or display
 - FMU 862 ONLY**
 - A Integral controls and display
 - B Integral controls, display and totalizer
 - C 19" rack-mounted controls and display
 - D 144 x 144 panel-mount controls and display
 - E Integral controls and illuminated display
 - F Integral controls, illuminated display and totalizer
 - G 19" rack-mounted controls and illuminated display
 - H 144 x 144 panel-mounted controls and illuminated display
 - K No controls or display
- 5 Relays
 - 1 3-SPDT
 - 2 5-SPDT
- 6 Power Supply
 - A 180 to 276 VAC, 50/60 Hz
 - B 90 to 146 VAC, 50/60 Hz
 - C 20 to 30 VDC
- 7 Communication
 - 1 Without remote communication
 - 2 With INTENSOR interface
 - 3 With HART interface
 - 4 With RS-485 interface (DMS ready)
 - 8 Without remote communication, can be field upgraded to HART

FDU 80, 81, 82, 83, 84, 85, and 86 Sensor

FDU 8 -

- 1 Sensor
 - 0 FDU 80
 - 1 FDU 81
 - 2 FDU 82
 - 3 FDU 83
 - 4 FDU 84
 - 5 FDU 85 (it is recommended to order the FAU 40 sensor positioner)
 - 6 FDU 86 (it is recommended to order the FAU 40 sensor positioner)
- 2 Electrical Classification
 - R For nonhazardous areas
 - Q Class I, Div. 1, Grps A-G (FDU 80, 81, and 82 only)
 - P Class II, Div. 1, Grps E-G (FDU 83, 84, 85 and 86 * only)
 - J CENELEC EEx m II T5 (FDU 80, 81, and 82 only)
 - E DUST-Ex Zone 10 (FDU 83, 84, 85, and 86 only)
 - * -40° to +284°F (-40° to +140°C)
- 3 Process Connection
 - FDU 80, 81, 82 and 85 only
 - G G1A, polypropylene
 - N 1" NPT polypropylene
 - FDU 83 and 84 only
 - S G1A, 304 SS
 - V 1" NPT, 304 SS
 - FDU 86 only
 - G G1A, polypropylene
 - N 1" NPT, polypropylene
 - S G1A, 304 SS
 - V 1" NPT, 304 SS
- 4 Cable Connection
 - 1 15 foot (5 m) connection cable
 - A Cable, in feet (max. 1000 ft)
- 5 FDU 80 / 81 Options
 - A Standard
 - B Heater, 24 VDC (an external temperature sensor is required)

FDU 80F Sensor

FDU 80F -

- 1 Electrical Classification
 - R For nonhazardous areas
 - Q Class I, Div. 1, Grps A-G
 - J CENELEC EEx m II T5
- 2 Process Connection
 - G G1A, polypropylene
 - N 1" NPT
 - F 1" NPT, food version (3-A)
- 3 Cable Connection
 - 1 15 foot (5 m) connection cable
 - A Cable, in feet (max. 1000 ft)

FDU 81F Sensor

FDU 81F -

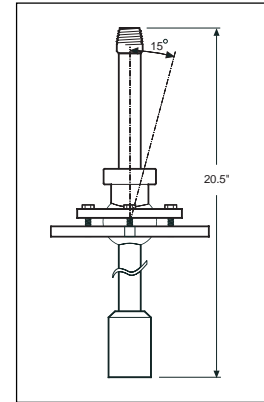
- 1 Electrical Classification
 - R For nonhazardous areas
 - Q Class I, Div. 1, Grps A-G
 - J CENELEC EEx m II T5
- 2 Process Connection
 - G G1A, polypropylene
 - N 1" NPT
 - F 1" NPT, food version (3-A)
- 3 Cable Connection
 - 1 15 foot (5 m) connection cable
 - A Cable, in feet (max. 1000 ft)

Accessories

FAU 40 Positioner

The sensor positioner is used on solids level applications when the best material level return echo will be achieved by angling the sensor. The sensor threads directly into the lower portion of the positioner.

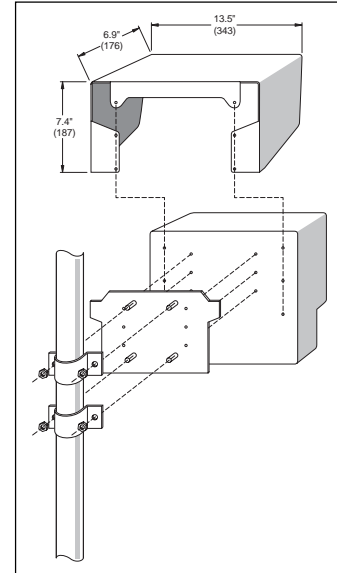
PN: FAU40-2N



Sun Roof

The sun/weather roof is used in outdoor installations for extra protection of the transmitter.

PN: 919567-0000



Pipe Mounting Kit

The pipe mounting kit is used to mount the field housing on a 2" horizontal or vertical pipe.

PN: 919566-0001

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1-800-428-4344
FAX: (317) 535-8498

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P.O. Box 901
Harvey, LA 70059
Phone: (504) 366-3264
FAX: (504) 366-3816

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Endress+Hauser
600 Kenrick, Ste. B-14
Houston, TX 77060
Phone: (281) 999-1991
FAX: (281) 999-1891

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