

Table of Contents

| <u>Section</u> | <u>Page</u> |
|------------------------------|-------------|
| Principle of Operation | 2 |
| Applications | 4 |
| Features | 6 |
| Probe Versions / Accessories | 7 |
| Ordering Information | 11 |
| Technical Data | 12 |

Principle of Operation

Introduction

The BlueLevel Technologies Model AP/APX is a reliable industrial grade automatic level control instrument. It is used to detect the presence/absence of powders and granular materials as well as liquids and slurries at predetermined levels within bins, hoppers, silos, tanks and other types of vessels. The Model AP/APX operates efficiently within a wide array of industrial settings such as food, plastic processing, grain, feed, biofuel, seed, chemical, concrete, cement, chemical and many others. The Model AP/APX uses a time proven and reliable operating principle.

Use

The Model AP/APX can be used for high (full detection), low (empty detection) and intermediate (demand detection) level monitoring, as well as plugged chute detection, applications. These instruments operate based on a proven principle dating back to the 1980's. Time proven, enhanced over the decades, the RF admittance point level sensor is the next generation of capacitance based sensing level detectors.

Function

In a simple capacitance probe type sensing element, when the material level rises and covers the probe, the capacitance within the circuit between the probe and the medium/material (conductive applications) or the probe and the vessel wall (insulating applications) increases. This is due to the dielectric constant (k) of the material which causes a bridge imbalance. There are drawbacks, however, especially when there is coating on the probe between the active section and the wall of the vessel (grounding point).

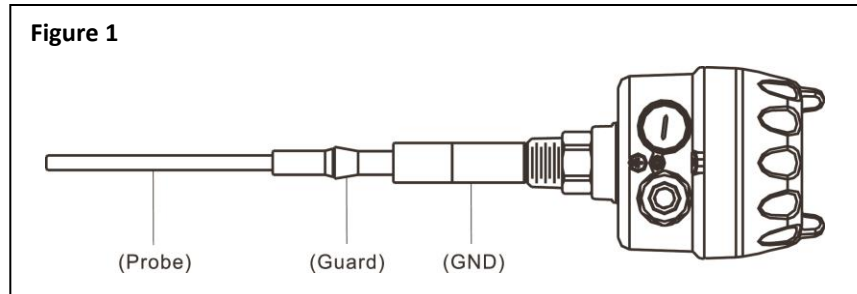
An RF Admittance point level sensor is the next generation of capacitance based level sensors. Although similar to the strict capacitance concept, the Model AP/APX RF admittance point level sensor employs a radio frequency signal and adds a shield circuit within the electronics unit. This shield circuitry enables the sensor to ignore the effect of buildup or material coating on the sensing element. The sensing element is mounted in the vessel and provides a change in RF admittance indicating presence or absence of material.

The driven shield technology of the sensor prevents the transmission of RF current through the coating on the sensing element. The only path to ground available for the RF current is through the material being measured.

The result is an accurate detection of the material presence/absence regardless of the amount of coating on the sensing element making it a versatile technology for level detection of a wide range of materials, liquids, solids and slurries.

The Model AP/APX is an RF admittance point level sensor consisting of active probe, guard (driven shield) and grounding section, which are separated by an insulating material as shown in Figure 1.

When the target material (also known as the “medium”) reaches the active probe section of the Model AP/APX probe, the material presence can be detected by the increase of admittance in an electronic circuit within the sensor as the target material replaces the air surrounding the active probe section.



The guard or driven shield section of the probe is located between the active section and grounding section of the probe. The guard section provides the Model AP/APX with automatic immunity to build-up of material between active and grounding sections of the probe, thereby eliminating false detection of material presence.

Applications

General

High, low and intermediate level indication and plugged chute detection are common applications within a wide variety of industries. In addition, these units can be provided for use in top or side mounting installations with or without mounting plates. BlueLevel Technologies provides white papers, technical articles and editorials about the use and considerations when selection level measurement and monitoring instrumentation at our website www.blueleveltechnologies.com. See Figure 2.

Top Mounting

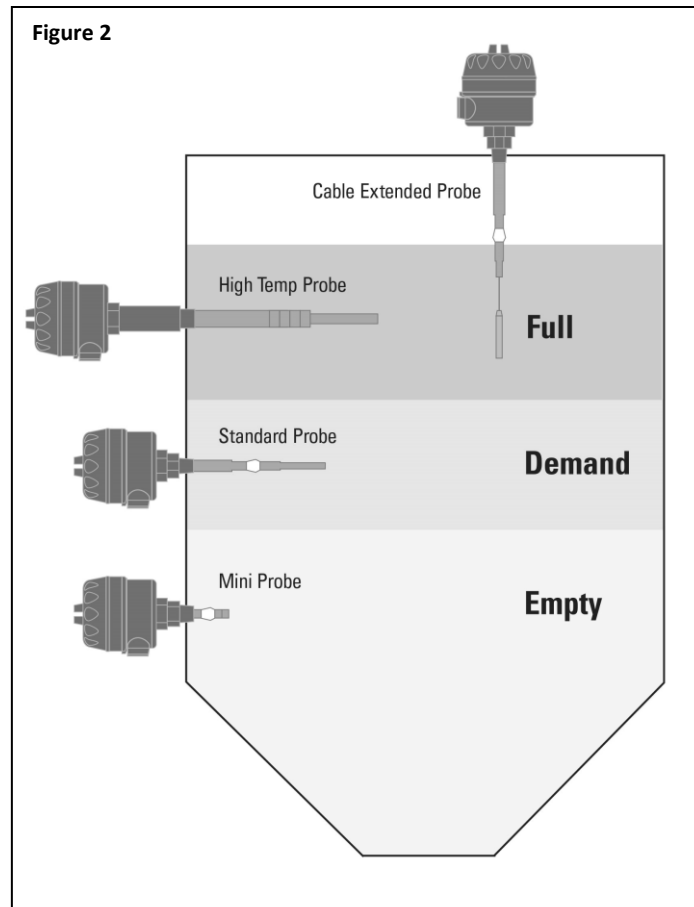
The mounting of Model AP/APX units can be from side or top of bins, including at oblique angles. All probe versions of the Model AP/APX can be top mounted but typically only the Standard, Cable Extended, High Temperature and Super High Temperature versions are top mounted. The Mini version is used primarily in side mount applications only because of the very short profile of the inserted probe element.

The Standard probe version (Figure 3) can be provide with 36" (914mm) stainless steel solid extensions that can be cut to length in the field and from the factory. They attach to the end of the standard probe active section using a slotted pin (provided). The overall insertion length of the Standard probe with a 36" (914mm) long extension is 50" (1.27m).

The Cable Extended probe version (Figure 4) is used exclusively for top mounting and can be provided with Teflon coated stainless steel flexible cable extensions for insertion lengths of up to 25ft (7.6m).

Side Mounting

All probe versions are designed for side mounting, with the exception of the Cable Extended probe version and the use of full length solid extensions with the Standard probe. These are for use in top mounted installations only. For dry freely flowing heavy materials in low level applications or where a low profile is required in side mount installations, consider using the Mini probe version with a short insertion length of only 2.5" (63mm). The use of half-coupling mounting plates are for side mounted installations. Do not use full-coupling mounting plates for side mounting.



Materials

Typical materials that can be monitored using the Model AP/APX RF admittance point level sensor include materials with bulk solid materials with density from approximately 15lbs/ft³ (240kg/m³) and up (exceptions exist as RF admittance technology is dependent on material dielectric constant and not density detection. The superior sensitivity of the Model AP/APX probes allows adjustment for a wide array of liquids, slurries and bulk solids. Example materials that can be monitored with the Model AP and APX RF admittance point level sensors include:

| | | |
|----------------|------------------|------------|
| Plastic Pellet | Food Ingredients | Feed |
| Grains | Cement | Nuts |
| Flour | Resins | Wastewater |
| Sand | Coal | Chemicals |
| Liquids | Oils | Powders |

Installation

BlueLevel Technologies Model AP/APX RF admittance point level sensors can be mounted in a variety of installations, including top and side mounting as previously discussed. In addition, the Model APX can be installed in Hazardous Locations according to electrical code and safety standards for Class I and II areas (Pending Agency Approval). Refer to the Technical Data section for specific details.

Special high process temperature applications can be accommodated by using either our Model AP/APX High Temperature or Super High Temperature probe versions that will allow internal bin process temperatures up to 842°F (450°C). These probes use specialty materials for insulator sections and extend the electronics enclosure further away from the probe mounting connection using stainless steel thermal block to help maintain the maximum ambient temperature of the electronics within specifications. Care should be taken during installations to ensure the ambient temperature is maintained at no more than 176°F (80°C). Process mounting connections for the High and Super High Temperature probes is different than that of the Standard, Cable Extended and Mini probe versions. Refer to the Technical Data section for specific details.

Refer to the Installation, Operation and Maintenance Instruction document supplied with the Model AP/APX for specific details and safety precautions.

Features

A wide range of Features make the Model AP/APX the best choice for applications where RF admittance and capacitance point level sensors are suitable, including liquids, slurries, powders and granular materials. The following is a list of primary features of the Model AP/APX product line.

- ✚ All Model AP units include Blue and Red high intensity LED's and a large impact-resistant lens for local visual indication of sensor Normal/Alarm status.
- ✚ Universal 20-250AC/DC power supply.
- ✚ DPDT relay output provides twice as much contact output capability than some other brands.
- ✚ Function test input is standard and allows for instrument functional check from remote location with contact closure.
- ✚ Material build-up immunity via driven shield circuitry helps protect against the impact of material adhesion between vessel wall and active probe section.
- ✚ Five probe versions handle virtually any application, i.e. Standard, Cable Extended, Mini, High Temperature and Super High Temperature.
- ✚ Food grade materials of construction used for Standard, Cable Extended and Mini probe versions.
- ✚ Mini probe version provides low profile with insertion length of only 2.5" (63mm).
- ✚ Cable Extended version provides a flexible probe assembly for top mounting with insertion lengths up to 25' (7.6m).
- ✚ Easy to setup and adjust with simple 2-step calibration.
- ✚ Fail-Safe output is switch selectable for either High or Low. This protects your process against conditions that might arise from power failure to the unit.
- ✚ Time delay adjustable from 0-30 seconds.
- ✚ High Temperature version uses PEEK insulators and stainless steel probe and thermal block for internal vessel temperatures up to 450°F (232°C).
- ✚ Super High Temperature version uses Ceramic insulators and stainless steel probe and thermal block for internal vessel temperatures up to 842°F (450°C).
- ✚ Model APX units include an explosionproof enclosure and are suitable for use in Hazardous Locations. Availability pending third party agency approval.
- ✚ Two ¾" NPT conduit entrances improve wiring access.

Probe Versions / Accessories Available

BlueLevel Technologies offers five probe versions and several accessories for the Model AP and APX RF admittance point level sensor. The available probe versions include Standard, Mini, Cable Extended, High Temperature and Super High Temperature. Accessories include Solid Shaft Extensions, Couplings and Mounting Plates.

Standard Probe

The Model AP/APX RF admittance Standard probe (Figure 3) has an overall insertion length of 12.8" (326mm) and the probe element materials are PTFE (Teflon) insulators and stainless steel active and guard/shield

Figure 3



sections. The probe assembly is sealed to withstand internal pressures to 588psi (40bar) and the Standard unit can be used with internal vessel process temperatures ranging from -40°F to +302°F (-40°C to +150°C). Ambient temperature limits are -40°F to +176°F (-40°C to +80°C). The Standard probe can be mounted from the top or side without regard to orientation or angle. However, downward mounting angle is preferred to allow material to natural shed away from the probe within the vessel. For top mounted installations requiring long insertion lengths a 36" (914mm) long solid extension can be provided. This extension can be cut to suit in the field. Alternately an extension coupling can be provided for those desiring to fabricate their own solid extension from 0.375" diameter stainless steel rod.

Mini Probe

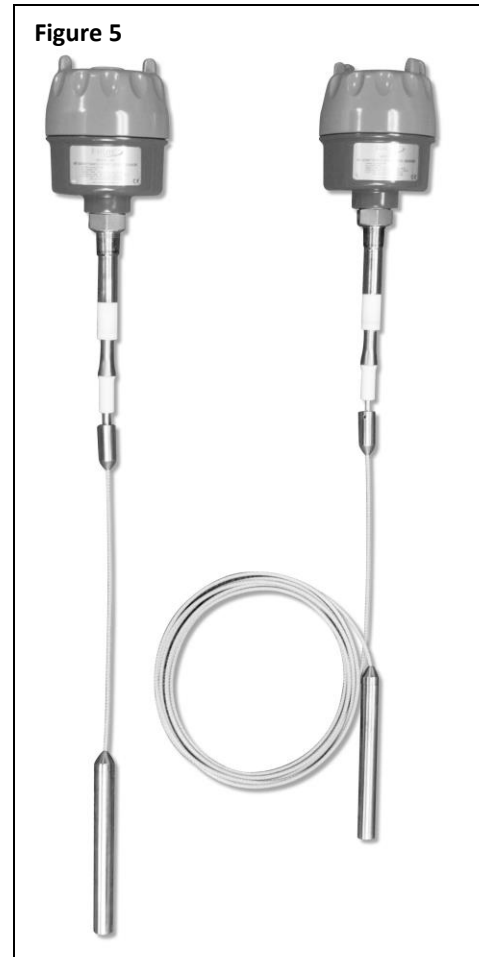
The Mini probe version (Figure 4) of the Model AP/APX is for use where a low internal vessel profile is required. The Mini version has an overall insertion length of only 2.5" (63mm) and the wetted materials of construction are the same as the Standard probe version, i.e. PTFE insulators and stainless steel active and guard sections. The Mini probe can be side or top mounted, though it is most commonly side mounted and the driven shield circuitry is included for material build-up immunity if accumulated between vessel wall and active probe section.

Figure 4



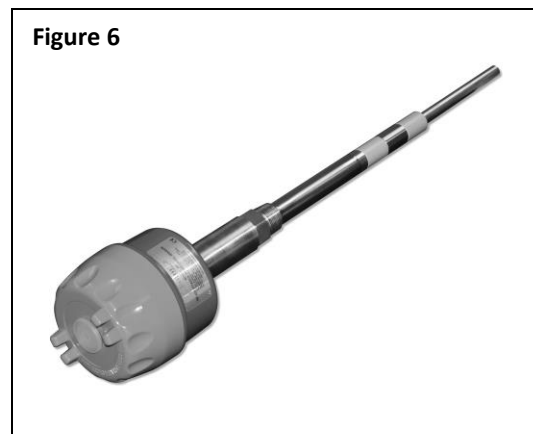
Cable Extended Probe

The sensing point for high level applications where only top mounting is capable or desired is usually some distance beneath the inside roof of the vessel. When the sensing point is greater than the Standard probe length a Cable Extended probe (Figure 5) can be considered, unless a solid extension can be used. Cable Extended probes should be considered when the overall insertion length is going to be > 36" (914mm). The Cable Extended probe can be provided with a maximum overall length of 25' (7.6m). The cable is 0.125" diameter stainless steel with a PTFE (Teflon) coating.



High Temperature Probe

The Standard, Mini and Cable Extended probes can be used with internal vessel process temperatures up to a maximum of 302°F (150°C). For applications where the internal process temperature is higher than this the Model AP/APX RF admittance point level sensor is available in a High Temperature probe version (Figure 6) that extends the electronics enclosure away from the process connection, uses a stainless steel thermal block to dissipate thermal conductivity and replaces the probe insulator material with a high temperature PEEK (Polyether Ether Ketone) material.



The High Temperature version Model AP/APX probe can be used where internal vessel process temperatures can be as high as 450°F (232°C). Note that the maximum allowable ambient temperature of the electronics enclosure must still be maintained at or below 176°F (80°C).

Super High Temperature Probe

When the internal vessel process temperature is at an extreme condition and exceeds the maximum rating of the Model AP/APX High Temperature probe, the Model AP/APX Super High Temperature probe version (Figure 7) may be used. This probe utilizes a longer extension of the electronics enclosure from the process connection, a longer stainless steel thermal barrier and changes the probe insulator material to Ceramic, thereby allowing the Super High Temperature probe to be used where internal vessel process temperatures can reach a maximum of 842°F (450°C). Note that the maximum allowable ambient temperature of the electronics enclosure must still be maintained at or below 176°F (80°C).

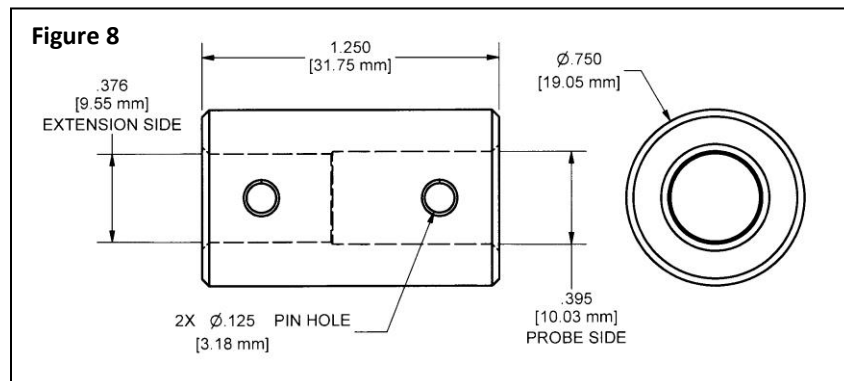


Hazardous Location Option

The Model APX is the RF admittance point level sensor version certified conforming to North American standards (CSA and FM) for use in hazardous vapor and dust locations. This version does not include the cover lens for the LED indicators, while the LED's are resident on the circuit board inside the unit. The availability of the Model APX hazardous location unit is PENDING APPROVAL of certification agency.

Solid Extension Coupling

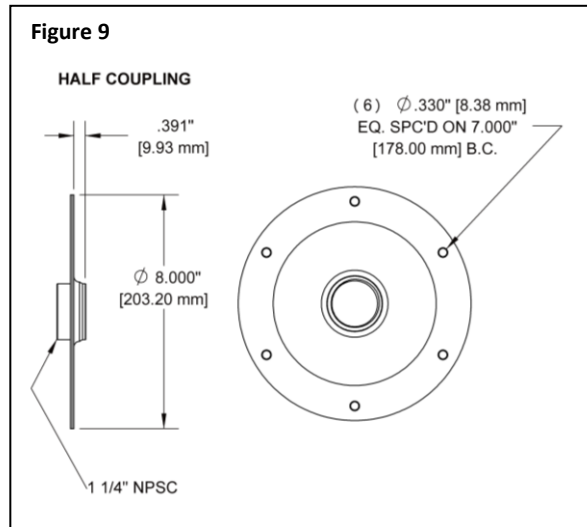
A 36" (914mm) long solid stainless steel rod extension is available for use with the Model AP/APX Standard probe as previously discussed. If a solid rod extension will be provided by others for attachment to the Model AP/APX Standard probe the solid extension coupling (Figure 8) will still be required. This part is available as an accessory item, part number 441001.



Mounting Plates

Half Coupling Mounting Plates (Figure 9) are available for use to install the Model AP/APX RF admittance point level sensors when a 1 1/4" NPT process connection has been chosen or is the standard for the probe. Refer to technical data section and dimensions for detail.

Half-Coupling, Powder Coated Steel - PN 410012
Half-Coupling, 304 Stainless Steel - PN 410012-01

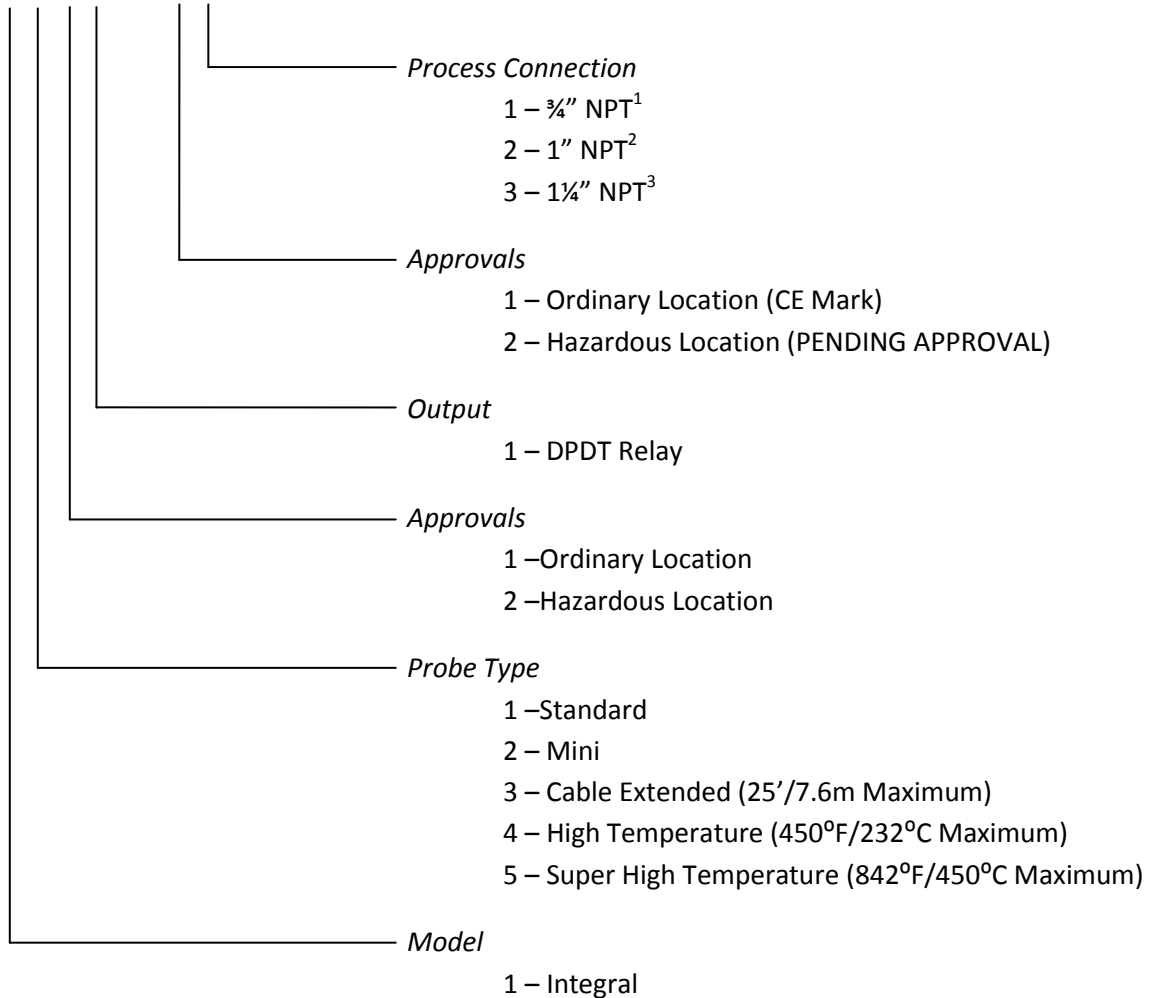


Ordering Information

Model AP/APX RF Admittance Point Level Sensor

Part Number Structure

4 4 - 1 X X X - 1 X X



¹ Standard, Mini and Cable Extended Probe Types only; NOT AVAILABLE for High and Super High Temperature probes

² MUST be selected for the High Temperature Probe Type. NOT AVAILABLE for all other probe types.

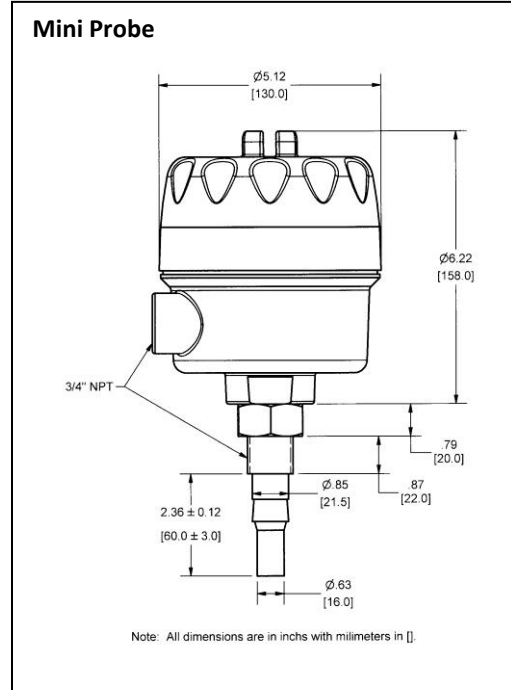
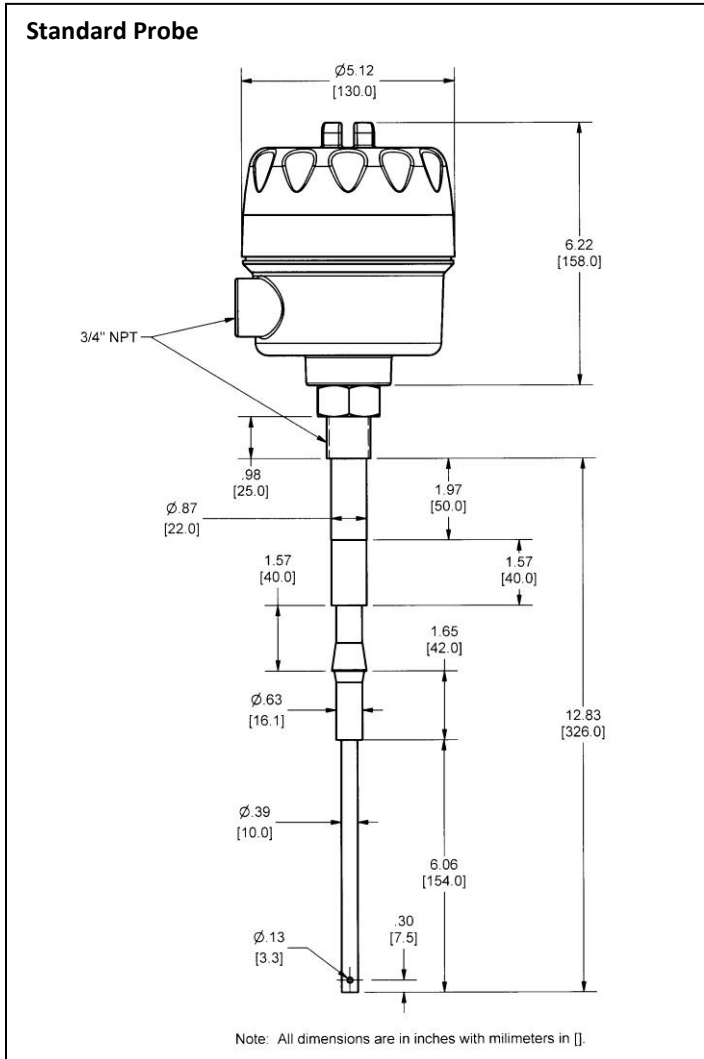
³ MUST be selected for Super High Temperature Probe Type. NOT AVAILABLE for all other probe types.

Technical Data

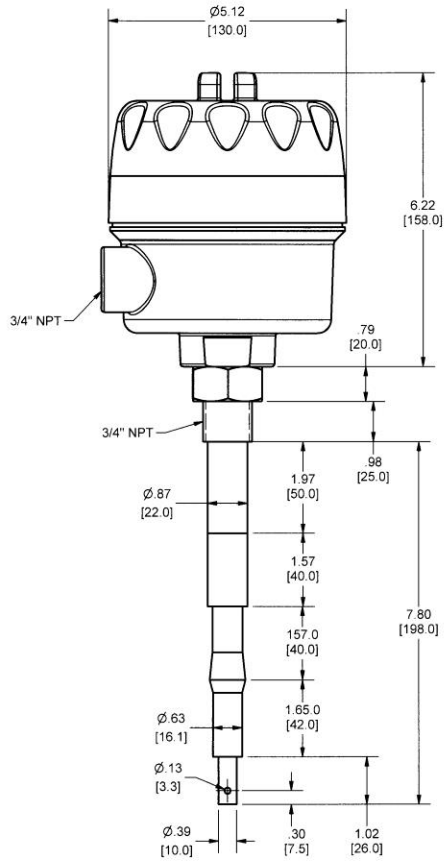
| | |
|---------------------------------------|--|
| Power Supply: | 20-250VAC/VDC, 50/60Hz |
| Power Consumption: | 25VA |
| Ambient Temperature: | -40°F to +176°F (-40°C to +80°C) |
| Process Temperature: | |
| Standard Probe | -40°F to +302°F (-40°C to +150°C) |
| Mini Probe | -40°F to +302°F (-40°C to +150°C) |
| Cable Extended Probe | -40°F to +302°F (-40°C to +150°C) |
| High Temperature Probe | -40°F to +450°F (-40°C to +232°C) |
| Super High Temperature Probe | -40°F to +842°F (-40°C to +450°C) |
| Maximum Pressure: | |
| Standard Probe | 284psi (20bar) |
| Mini Probe | 284psi (20bar) |
| Cable Extended Probe | 284psi (20bar) |
| High Temperature Probe | 284psi (20bar) |
| Super High Temperature Probe | Atmospheric (1bar) |
| Enclosure: | NEMA 4X, IP65, Powder Coated Die-Cast Aluminum |
| Sensitivity: | 0.3pF |
| Adjustment: | Hi/Lo Range; Potentiometer |
| Output: | DPDT Relay, 5A @ 240VAC, Fail-Safe on Power Failure |
| Fail-Safe Selection: | Switch Selectable, High or Low |
| Time Delay: | Adjustable, 0-30 Seconds |
| Remote Test: | Remote Contact Closure |
| Process Connection: | |
| Standard, Mini, Cable Extended Probes | ¾" NPT 304 Stainless Steel 1¼" NPT 316 Stainless Steel (optional) |
| High Temperature Probe | 1" NPT 304 Stainless Steel |
| Super High Temperature Probe | 1¼" NPT 304 Stainless Steel |

| | |
|--|---|
| Local Indication (Model AP only): | Red – Alarm, Blue - Normal |
| Conduit Entry: | Two (2) ¾" NPT |
| Materials of Construction: | |
| Standard, Mini and Cable Extended Probes | 304 Stainless Steel, PTFE |
| High Temperature Probe | 304 Stainless Steel, PEEK |
| Super High Temperature Probe | 304 Stainless Steel, Ceramic |
| Weight | |
| Standard Probe | 4.6lb (2.09kg) |
| Mini Probe | 4.1lb (1.86kg) |
| Cable Extended Probe (less cable assembly) | 4.7lb (2.14kg) |
| High Temperature Probe | 7.1lb (3.23kg) |
| Super High Temperature Probe | 9.7lb (4.41kg) |
| Certifications | |
| Model AP | CE Mark, Ordinary Locations |
| Model APX | FM Approved, Hazardous Locations (PENDING) |

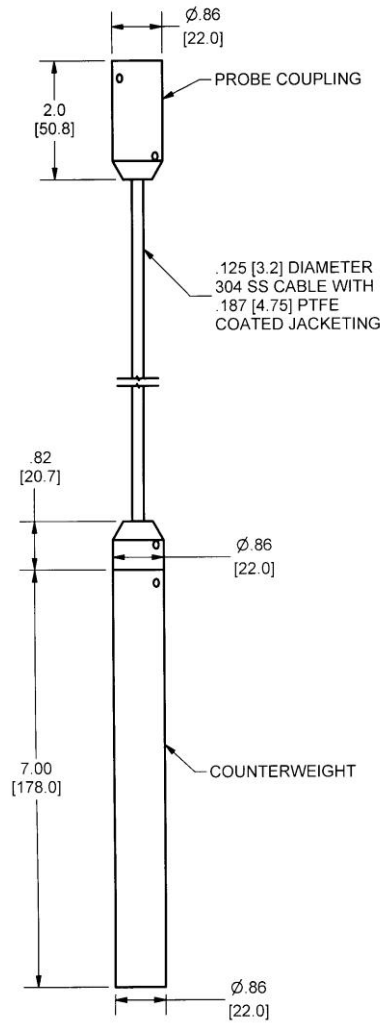
Dimensions



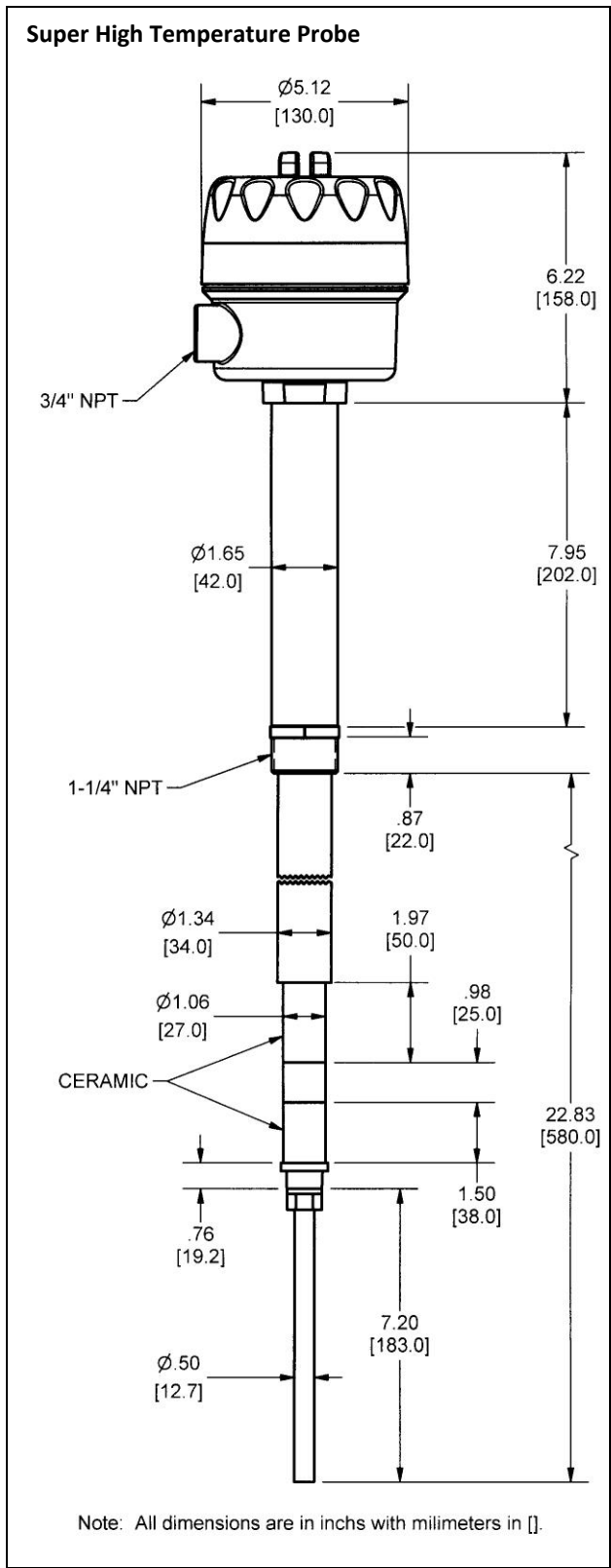
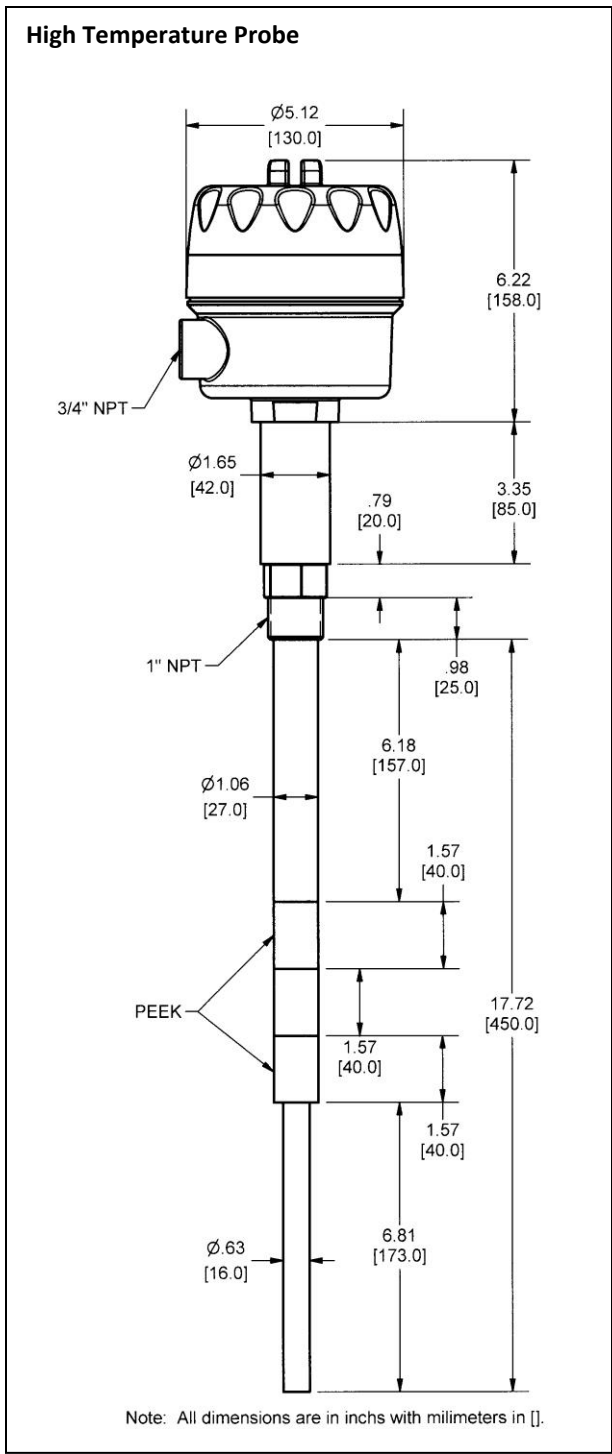
Cable Extended Probe



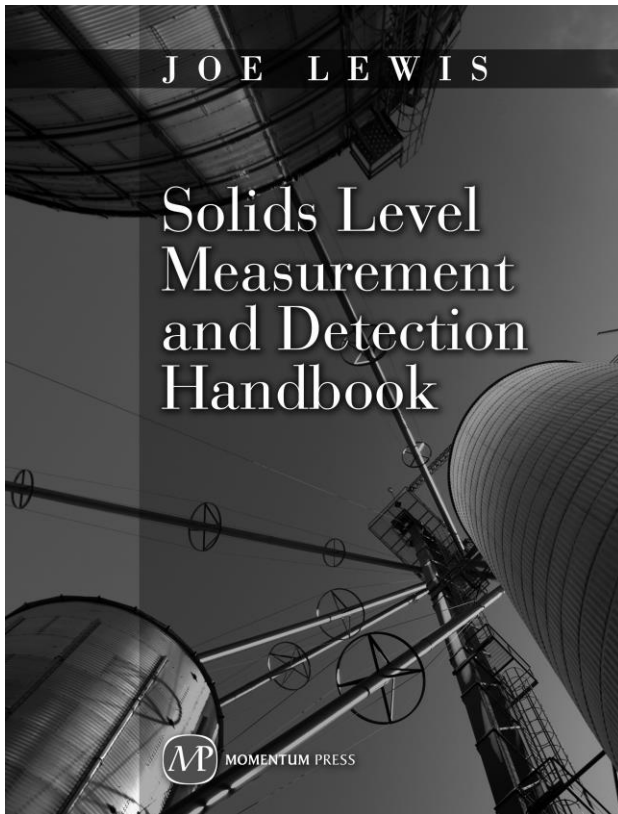
Note: All dimensions are in inches with millimeters in [].



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Only BlueLevel Technologies, Inc. brings you proven and practical expertise in level measurement and detection. We wrote the book and bring this expertise to you with every contact.



Solids Level Measurement and Detection Handbook,
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