



# TELEDYNE ANALYTICAL INSTRUMENTS

## Model 8800NG Moisture Detection System

Detecting moisture  
in natural gas

# Detecting Moisture in Natural Gas



**8800NG system with electrically actuated calibration valve in stainless steel enclosure, certified for Class I, Div 2, Groups A, B, C, D, & T4 hazardous areas**

## Model 8800NG

### The Challenge

Excess moisture in natural gas causes problems such as pipeline, storage tank, and equipment corrosion, or gas hydrate formation. Measuring moisture in natural gas is not a difficult application, but reliably measuring it on a continuous basis is. Glycol carryover and entrained compressor oils can quickly damage insitu sensors.

Tri-ethylene glycol (TEG) is added to dry natural gas before it is sent downstream for commercial or industrial use. These glycols build up on the surface of the capacitance sensor and shift the sensor's readings.

### The Solution

**Teledyne's 8800NG Trace Moisture Analyzer** is unique in that it overcomes this problem through an on-board moisture calibration system allowing the operator to periodically check the calibration drift of the unit.

Additionally, the moisture sensor employs unique Hyper Thin Film (HTF)<sup>™</sup> technology incorporating three major structural improvements that provide increased sensitivity, greater stability, and a quicker response time when compared to conventional aluminum oxide sensors.

HTF sensors can tolerate many of the contaminants found in natural gas applications such as glycol that cause other sensors to quickly deteriorate and fail.

- **Detecting moisture in natural gas with on-board calibration capabilities**

- **Units available for Class I, Div 1, Div 2 areas, and ATEX certified units**

### Moisture Calibration System

Borrowing from a calibration procedure standard to other process measurement technologies, Teledyne offers a self-calibrating moisture system that periodically exposes the sensor to an NIST certified calibrating gas and automatically adjusts for observed deviations.

An instrument controlled valve is included in the sample system which allows the sensor to switch from process gas to an NIST traceable Nitrogen / Water blend bottle. The known water content of the bottle is stored in the instrument's memory along with a time schedule of verification / calibration.

Thus the measurement near the water content of the bottle is essentially with NIST traceable accuracy even if the contaminants in the process gas have caused the sensing element to drift. Further from the calibration point the accuracy diminishes slightly, but the high capacitance sensor keeps the measurement in specified tolerance.

### Features

- On-board moisture calibration system
- Detects moisture from -100° C to ambient dewpoint levels of +20° C on a continuous basis
- User-selectable moisture analysis readout display as Deg C, Deg F, ppm or in lbs of H<sub>2</sub>O/million cft or g/m<sup>3</sup>
- Microprocessor based
- Easily navigable menu to access user options and modify the units, values, or choices in the selected mode
- Extensive self-diagnostic features are performed at start-up as well as once every two minutes
- Indicator for sensor open, short or electronic system failure to alert the operator of a possible malfunction
- Field proven to work in challenging applications

### Options

- Two adjustable alarms
- Isolated 0-24mA or 4-20mA output or RS-232C serial interface
- Explosion proof for Class I, Division 1, Groups B, C & D

# Superior HTF Aluminum Oxide Technology

Accurate detection of trace levels of moisture has been a challenge to the natural gas industry, as high concentrations of water are present in the atmosphere; approximately 1% by volume in room air.

Teledyne is familiar with this challenge, having successfully developed one of the broadest lines of trace ppb / ppm O<sub>2</sub> analyzers commercially available. In developing our trace O<sub>2</sub> line, we have had to contend with the fact that 209,000 ppm of O<sub>2</sub> is present in the atmosphere – ready to jeopardize the analysis of typically less than 1 ppm of O<sub>2</sub>. Teledyne is utilizing 50 years of expertise in detecting trace oxygen to produce a trace moisture analyzer specific to the natural gas industry – Model 8800NG.

## The Heart of the Product – HYPER THIN FILM (HTF) Sensing Technology

The 8800NG uses field proven aluminum oxide (Al<sub>2</sub>O<sub>3</sub>) sensing technology to accurately detect trace moisture on either a continuous or spot checking basis. All Al<sub>2</sub>O<sub>3</sub> sensors share the same basic operating principle: the capacitance measured between the sensor's aluminum core and gold film deposited on the oxide layer varies with the water content.

The 8800NG employs unique Hyper Thin Film (HTF) technology, which offers three major structural improvements in Al<sub>2</sub>O<sub>3</sub> sensor design. These structural changes provide the user with increased sensitivity, greater stability, and a quicker response time when compared to other conventional aluminum oxide sensors on the market today.

### HYPER THIN FILM Layer

The thinner oxide layer of the HTF sensor results in higher capacitance changes (stronger signal generated than conventional sensors) because capacitance is inversely proportional to the distance of the capacitors' plates from each other (the distance between the aluminum core and the gold film deposited on the oxide layer).

The thinner layer also means water molecules will travel faster in and out of the sensor pores, thereby responding several times faster than conventional sensors.

### Barrier Layer

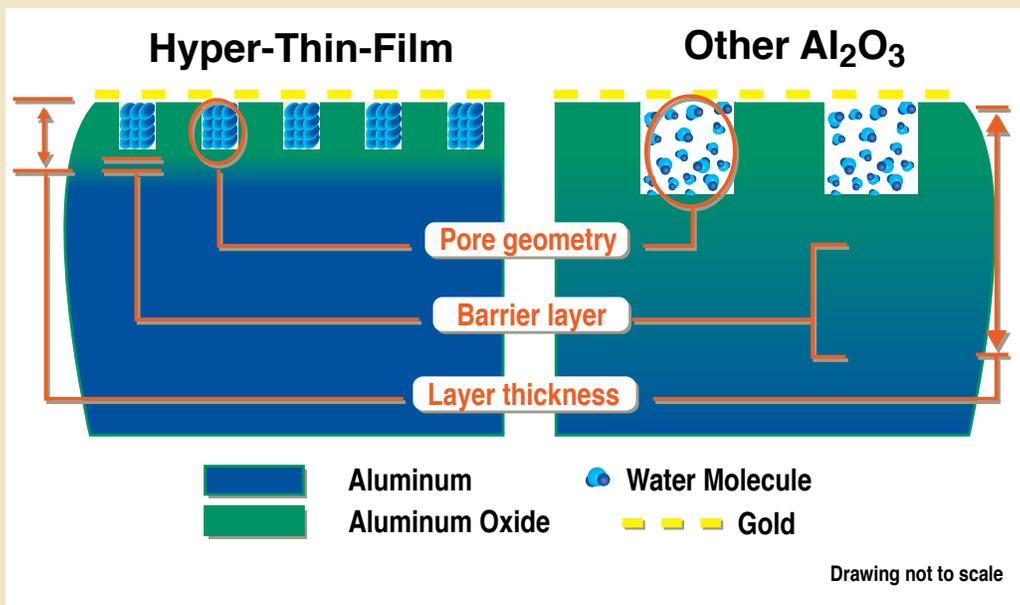
In HTF sensors, the transition between the aluminum oxide and the aluminum core is sharp and clearly defined. This inner barrier layer produces a capacitor with its electrodes very close together, which in turn leads to the sensor's high wet to dry capacitance ratio.

The benefit of the high wet to dry capacitance ratio is that drift in capacitance, due to undesirable factors, is much less significant. This is clearly a benefit when comparing HTF versus conventional sensors where temperature sensitivity and aging drift are concerned. An added benefit associated with this sharp transition in the barrier layer is a reduction in metal migration, one of the major causes of aging drift in conventional sensors.

### Pore Geometry

The most significant difference between HTF and conventional sensors is their pore geometry. While conventional sensors rely on hygroscopic Al<sub>2</sub>O<sub>3</sub> structures to attract water, HTF sensors instead rely on a pore geometry that slows the Brownian motion of the water molecules entering the pores.

The HTF sensor design results in more dielectric in the pores and consequently a higher capacitance. An added benefit is derived from the fact that HTF pore geometry does not significantly change over time. Conventional Al<sub>2</sub>O<sub>3</sub> structures, however, are not stable and collapse slowly into non-hygroscopic structures. As a result, conventional sensors are subject to higher drift rates and require frequent re-calibration.



NOTE: HTF Al<sub>2</sub>O<sub>3</sub> high capacitance sensors are manufactured with great uniformity allowing sensors to be freely interchanged in the field without factory re-calibration or changing of EPROMS, as required with conventional Al<sub>2</sub>O<sub>3</sub> sensors.

Graphic representation of HTF vs. Other Al<sub>2</sub>O<sub>3</sub> sensors

# The Teledyne Advantage

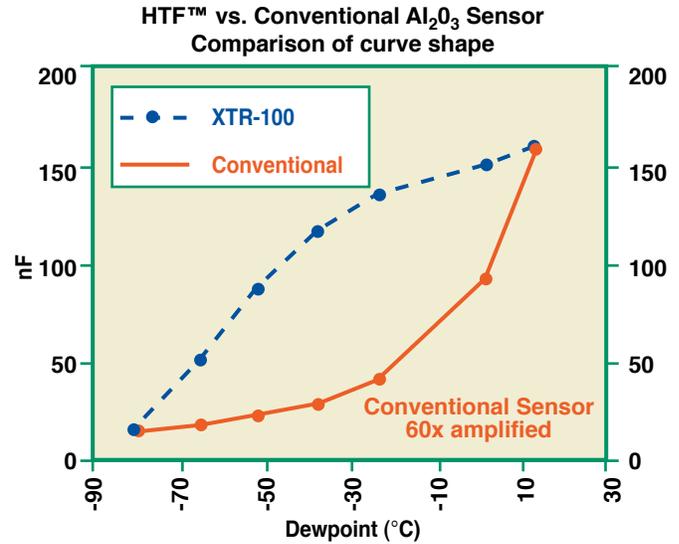
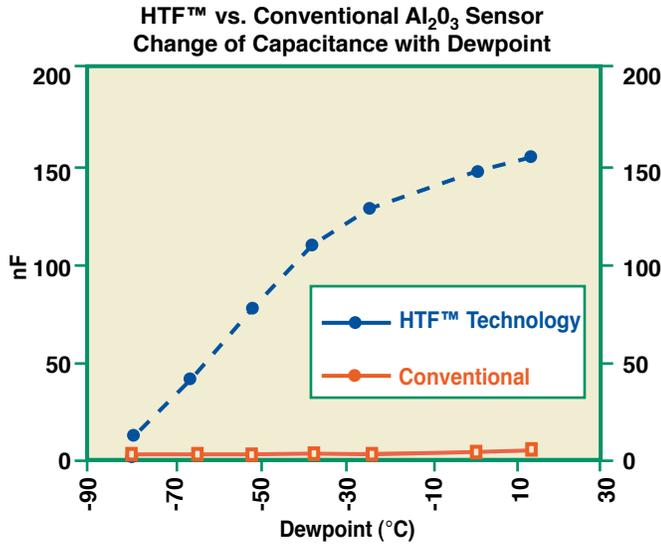
Having confidence in Teledyne's 8800NG moisture system only requires a look at five significant features.

1. Accuracy
2. Sensitivity
3. Speed
4. Temperature and Stability
5. Autocal and Temperature

## 1. Accuracy

Teledyne XTR-100 sensors are produced in a robotized manufacturing system and vigorous QC procedures assure high uniformity. One curve correction function fits all sensors, making them freely interchangeable.

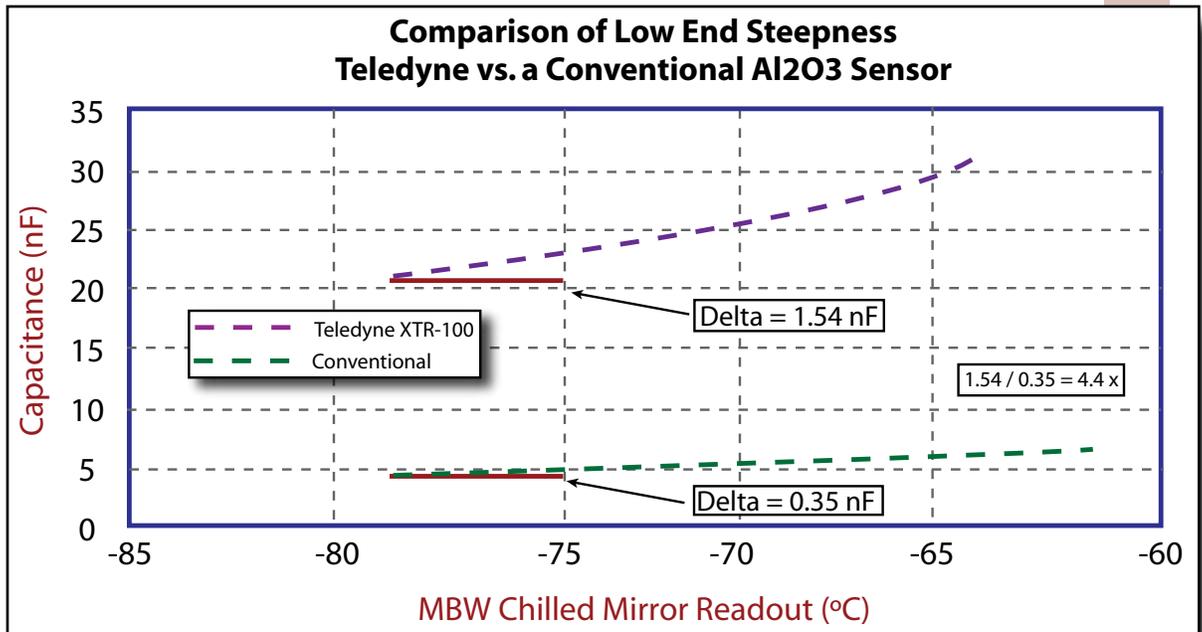
Our competitors' sensors vary widely one from the other, and their response curves sometimes cross over. To provide accurate readings, each of their sensors needs an individualized curve correction function.



The change of capacitance with moisture of HTF sensors over the full measurement range is 60 times larger than that of conventional sensors. However, because of the improved linearity of HTF sensors at the low end, capacitance changes with moisture are about 600 times larger than that of conventional sensors. The larger sensitivity makes HTF sensors more stable and resistive to other influences such as temperature, electrical noise, and long term drift.

## 2. Sensitivity

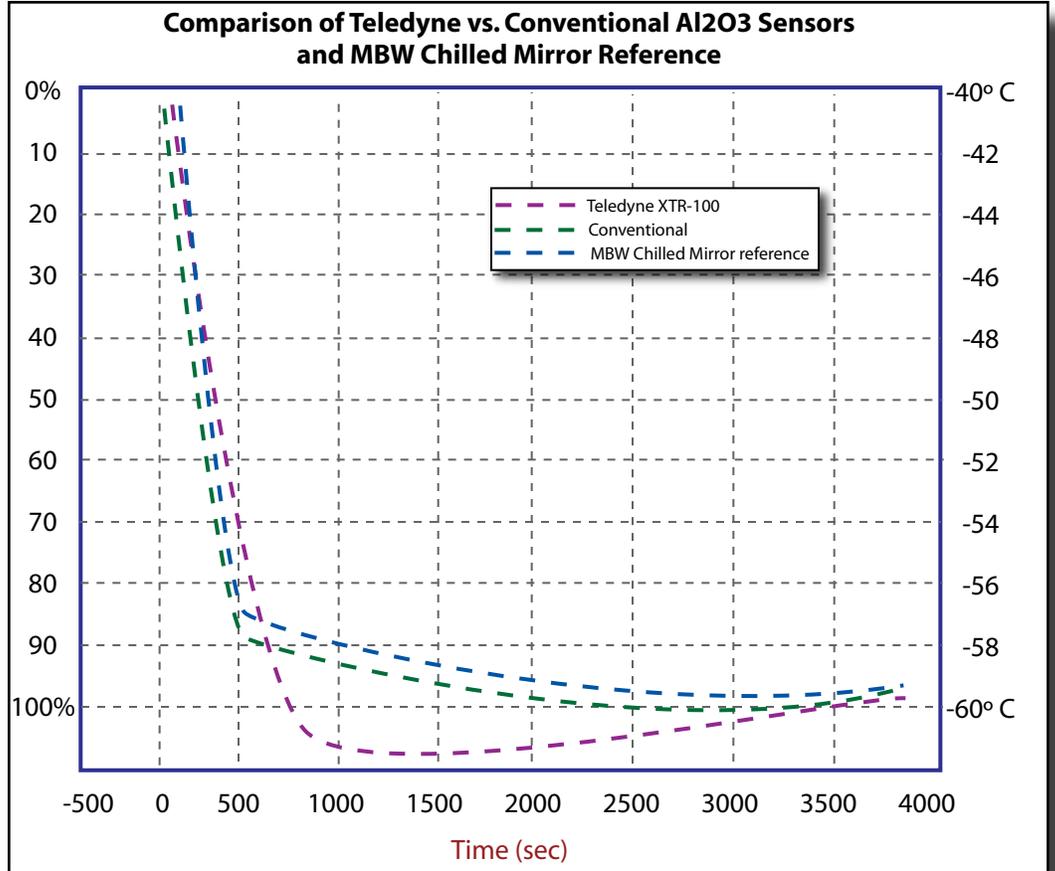
The response of Teledyne's XTR-100 sensor at the low end (where it counts) is about 4 times larger than that of our competitors'. And the measurement range reaches down to 100°C or 0.014 ppmv. Higher sensitivity at the low end results in better linearity over the full range, providing improved results when used with existing analog



# The Teledyne Advantage

## 3. Speed

The XTR-100 sensor responds significantly faster to a step change. From  $-40^{\circ}\text{C}(\text{dp})$  to  $-60^{\circ}\text{C}(\text{dp})$  (dry down) the conventional sensor takes about 77% longer to complete 63% of the step change and about 51% longer to complete 90% of the step change.



## 4. Temperature Coefficient

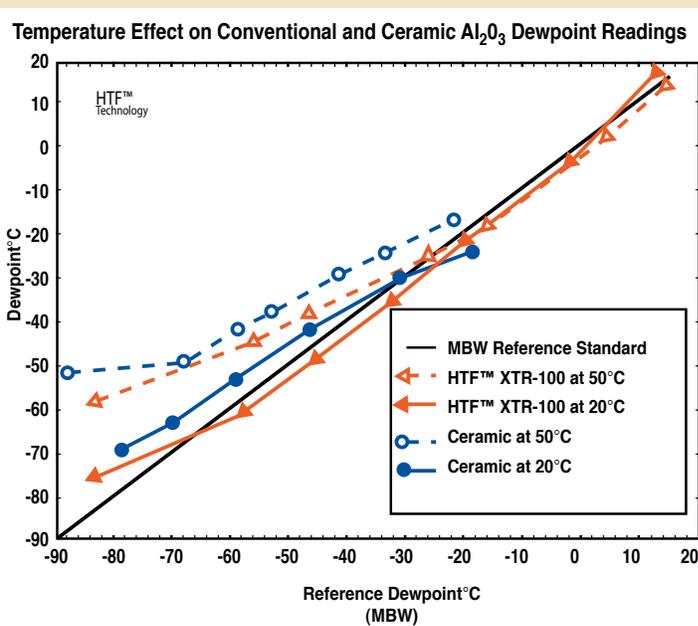
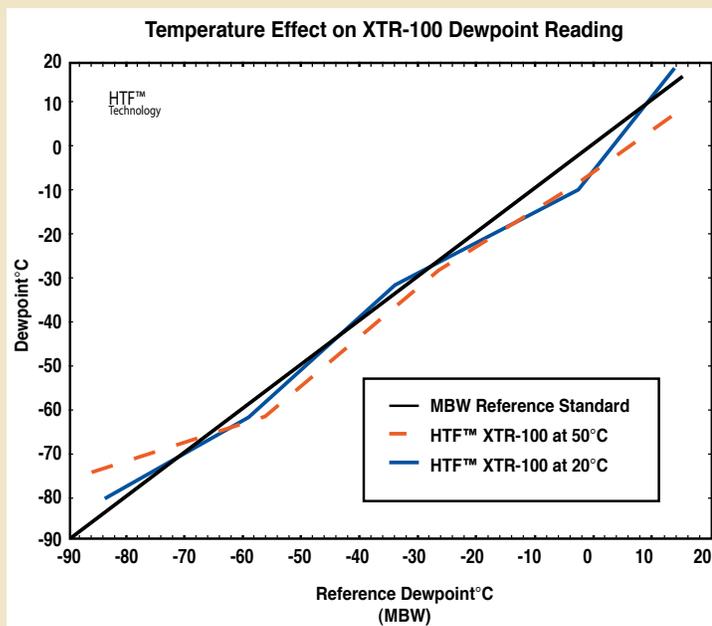
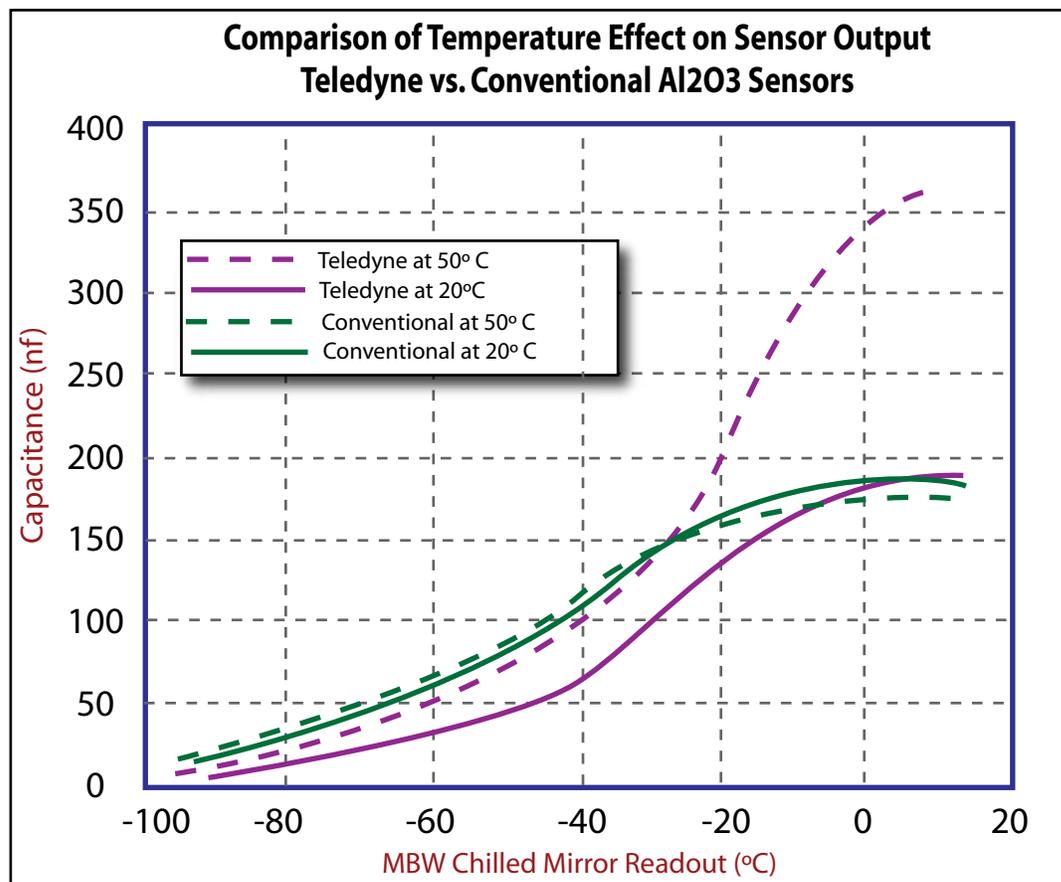
Teledyne sensors have a small and uniform temperature coefficient ( $.07^{\circ}\text{C}(\text{dp}) / 1^{\circ}\text{C}(\text{t})$ ) throughout their full range. The conventional Al<sub>2</sub>O<sub>3</sub> sensors' temperature coefficient at the low end is  $.09^{\circ}\text{C}(\text{dp}) / 1^{\circ}\text{C}(\text{t})$ . However, above  $-30^{\circ}\text{C}(\text{dp})$  the temperature coefficient starts to climb rapidly until the sensor is rendered useless.

# The Teledyne Advantage

## 5. Autocal and Temperature

Teledyne XTR-100 sensors are temperature stable at the wet end and thus they autocal accurately at any temperature.

Conventional Al<sub>2</sub>O<sub>3</sub> sensors, because of the high temperature coefficient at the wet end, have to be calibrated at a particular temperature in order to give the intended readout.



HTF aluminum oxide sensors offer excellent temperature stability over their full analysis range. Only below -70°C (dp) does the measurement become slightly temperature sensitive. Temperature coefficients remain small enough, however, to allow for software compensation. The temperature coefficients of conventional and ceramic sensors relative to their sensitivity to moisture are too large to allow for an accurate compensation through software.

# 8800NG Moisture System

## Specifications

Range by sensor type:

XTR-100 -100 to 20°C (-148 to 68°F)

XTR-65 -65 to 20°C (-85 to 68°F)

Sensor type: High capacitance HTF Al2O3

Output options: 0/4-20 mA, RS-232

Accuracy:  $\pm 3^{\circ}\text{C}$  ( $\pm 5.5^{\circ}\text{F}$ ) or  $\pm 1\%$  of span

Display: Backlit 3.5 digit LCD

Sensor temp range: -30 to 50°C (22 to 122°F)

Electronics temp range: -10 to 50°C (14 to 122°F)

Response time: Step change from -40 to -60°C:  
• 63% in 90 seconds  
• 90% in 450 seconds

Power requirements: 100 – 240 VAC, 50 or 60 Hz

Intrinsically safe option: Class I, Div 1 / 2 and ATEX standard

Mechanical : 14 mm x 1.25 mm connection threads, and of sensor 3/4" – 16 threads; flow cell with 1/4" tube fitting (option)

Readouts: Dew point in °F and °C, ppmv, gH2O/m3, lbs H2O / mmscf

Repeatability:  $\pm 0.5^{\circ}\text{C}$  ( $\pm 0.9^{\circ}\text{F}$ )

Capacitance: 15 nF to 200 nF

Pressure operating: Standard: 500 psi range (34 Bar)  
Optional: 5000 psi (340 Bar)

Electrical connection: Female BNC connector

Sensor cable: Coaxial cable (75Ω with max capacitance of 50 pF/M) N/A  
– sensor built in; Maximum cable length = 3000 feet

## **TELEDYNE ANALYTICAL INSTRUMENTS**

A Teledyne Technologies Company

16830 Chestnut Street  
City of Industry, California 91748, USA

TEL: 626-934-1500 or 888-789-8168  
FAX: 626-934-1651 EMAIL: ask\_tai@teledyne.com

[www.teledyne-ai.com](http://www.teledyne-ai.com)

## Warranty

Instrument is warranted for 1 year against defects in material or workmanship

NOTE: Specifications and features will vary with application. The above are established and validated during design, but are not to be construed as test criteria for every product. All specifications and features are subject to change without notice.

