



# Moisture and Hydrocarbon Dew-Point Measurement

Reliable moisture measurement for critical process control

# Moisture and Hydrocarbon Dew Point

Michell Instruments offers a comprehensive range of process analyzers for the petrochemical and natural gas industries



## 40 Years of Innovation in Moisture Instrumentation

For more than four decades, Michell hygrometers have been helping customers in the oil and natural gas processing and refining industries protect their systems, ensure safety and meet international quality standards.

Our position as global leaders in the design and manufacture of moisture and hydrocarbon dew-point instrumentation is based on our expertise in the basics of thermodynamic theory and practical experience in moisture measurement techniques. Michell Instruments' specialists and applications engineers are based around the world to provide support, and at the same time, gain a good understanding of customers' needs. This knowledge is used by our design engineers to create purpose-made robust products.

With four measurement technologies we always ensure that our customers have the right sensor for the job: there is no 'one size fits all'. Our process analyzer range uses the tried and tested Ceramic Moisture sensor for liquids and gases as well as the non-contact sensor of our new generation TDLAS analyzer for a class-leading lower detection limit. We developed the Dark Spot™ hydrocarbon dew-point sensor in collaboration with Shell Research, and this now the accepted industry standard for fully automatic measurements of natural gas quality. Our next generation Advanced Quartz Crystal Microbalance technology is designed to provide reliable, fast and accurate measurement of trace moisture content in a wide variety of process applications where keeping moisture levels as low as possible is of critical importance.

Our products are also backed up by global service and support. With locations on 6 continents and 56 countries, There is always a Michell subsidiary or distributor around — check [www.michell.com](http://www.michell.com) for your local partner.

### On-Line Process Analyzers: Universal Features

Michell's state-of-the-art, on-line analyzers help increase plant efficiency and safety in many petrochemical sites across the globe.

Comprehensive analyzer packages with a selection of standardized sampling systems or customized solutions to suit exact application and installation requirements.

- Choice of certified explosion-proof (EExd) or intrinsically safe (I.S.) measurement systems
- NEC/CEC Class 1 Division 1 approved
- ATEX/IECEx approved for Zone 1 and 2
- Unique Michell Calibration Exchange Service provides cost effective field maintenance of moisture measurement certified traceable to standards of NPL (UK) and NIST (USA)
- Systems compatible with aggressive samples such as sour natural gas
- Engineering and application specialists available through a global network of Michell offices and factory trained representatives

### Applications

#### Natural Gas

- Gas quality measurements to ensure compliance with transmission pipeline tariff specifications
- Natural gas glycol dehydration, storage and custody transfer
- Biomethane and shale gas processing for network injection
- Gas heater 'superheat' control of fuel gas to protect turbine power plants and save energy
- Protect turbo expanders and pipeline compressors from liquid impact damages

#### Petrochemical

- Monitoring recycle gases during catalytic processes to maximize catalyst life and productivity
- HDPE and LDPE process gases and liquids — ethylene, hexane, butane and many more
- LNG/LPG production and quality control
- Liquid benzene for styrene manufacture
- Fuel refining and custody transfer to avoid liquid water phase separation

# Moisture Sensing Technology: For Process Gases and Liquids

## Dark Spot™ Principle for Hydrocarbon Dew Point in Natural Gas



Dark Spot™ Principle

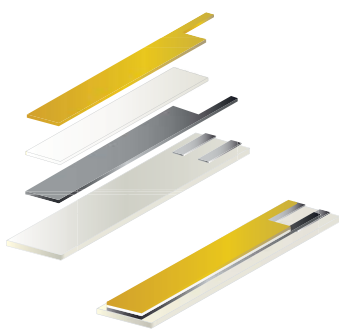
Michell's hydrocarbon dew-point technology uses the patented Dark Spot™ optical principle, a technique radically different from that of any other chilled mirror system. Sensitivity of the order of  $5\text{mg}/\text{m}^3$  of condensate enables the analyzer to detect the almost invisible films of condensate which are characteristic of hydrocarbon gases at dew point, due to their low surface tension and colorless appearance. The optical surface is the key element of the sensor cell and comprises an acid etched, semi-matt surface with a central conical shaped

depression. A collimated beam of visible red light is focused onto the central region of the optical surface to form an annulus ring of light.

Optical detection is made of light dispersed. As the sensor is cooled during a measurement cycle, hydrocarbon condensates form on the optical surface and its optical properties are modified — the reflected light intensity of the annulus ring increases and there is a dramatic reduction in the scattered light intensity within the dark spot region. This highly sensitive secondary effect is used to determine the hydrocarbon dew point.

**Products: Condumax II On-Line, Condumax II Transportable**

## Advanced Ceramic Sensor for Moisture Content in Liquids and Gases



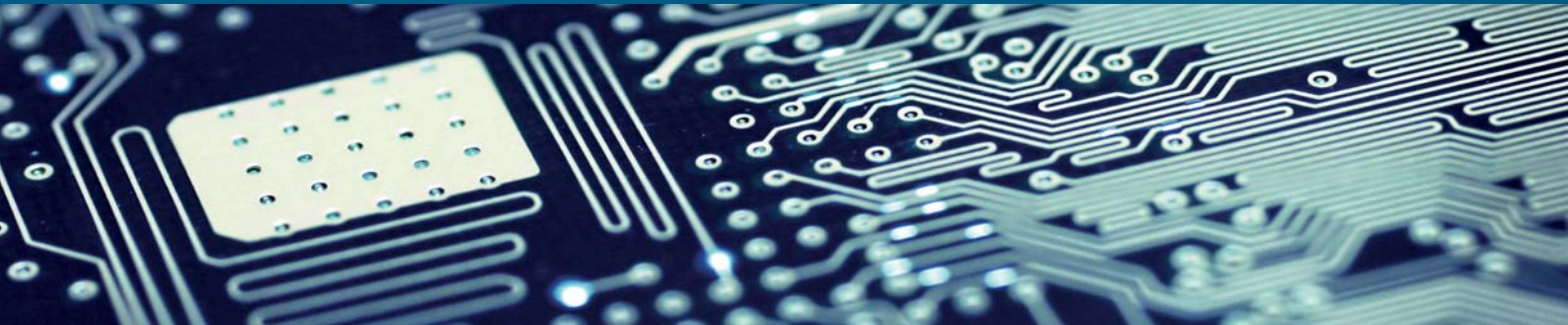
Michell's Advanced Ceramic Sensor

Michell's Advanced Ceramic Sensor technology provides reliable measurement of the water dew point and moisture content in both gases and liquids throughout natural gas and petrochemical industries. Our sensors are resilient to chemical attack and will not fail even when subjected to the most severe pressure shock. The ceramic sensor works by adsorbing water vapor in equilibrium with the fluid being measured into its porous active layer, sandwiched between two conductive plates.

High sensitivity even at ultra-low trace moisture levels is achieved by use of

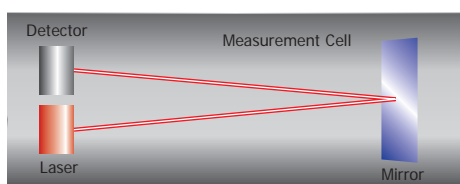
semiconductor techniques to achieve an extremely thin active layer, protected by a micro-porous metallic surface coating. Therefore the sensor responds rapidly to changes in applied moisture, both when being dried (on process start-up) and when called into action if there is moisture ingress into a process. All Michell Ceramic Moisture Sensors provide up to  $1^\circ\text{C}$  accuracy and excellent long-term stability in process applications. The unique Michell Calibration Exchange Service enables all our customers worldwide to maintain traceable certified calibration of our process moisture analyzers at modest cost with minimal spares stock and downtime.

**Products: Promet EExd, Promet I.S., Liquidew EExd, Liquidew I.S.**



# Moisture Sensing Technology: For Process Gases and Liquids

## Tuned Diode Laser Absorption Spectroscopy (TDLAS)



TDLAS Sensor

All Tuned Diode Laser Absorption Spectroscopy (TDLAS) products use the interaction between light and the molecules in a gas stream to determine the concentration of a given substance within that gas stream. In the case of the OptiPEAK TDL600, this is specifically water concentrations within a natural gas stream.

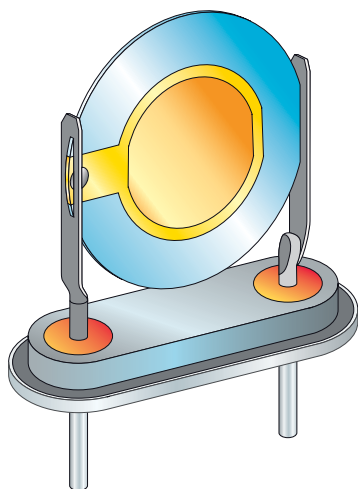
To achieve this, the laser is precisely tuned by careful control of the laser operating temperature and drive current to emit light at the specific resonant wavelength of water in the near infrared region of the electromagnetic spectrum. The wavelengths used are specific to water molecules and therefore laser energy causes the water molecules to vibrate and absorb energy.

This effect can be used to calculate the concentration of water in a background gas. The gas is passed into a sample cell, where the laser light travels through the gas to a detector. If water is present in the sample, laser energy will be absorbed. Using digital processing techniques, the size of the 'absorption peak' can be very accurately measured and can therefore determine the concentration of water within the background gas.

This non-contact technology requires minimal maintenance, even in demanding applications such as changing methane concentrations or sour gas.

**Product: OptiPEAK TDL600**

## Quartz Crystal Microbalance



Quartz Crystal Microbalance Sensor

The Quartz Crystal Microbalance (QCM) technology for moisture measurement is based on monitoring the frequency modulation of a hygroscopic-coated quartz crystal with specific sensitivity to water vapor.

Bulk adsorption of water vapor onto the coated crystal causes an increase in effective mass. This change in mass modifies the oscillation frequency in a very precise and repeatable manner and the frequency change is in direct proportion to the water vapor pressure. The moisture concentration can therefore be measured as a change in the oscillation frequency, with respect to a reference crystal.

The sorption process is fully reversible with no long-term drift effect, giving a highly reliable and repeatable measurement.

**Product: QMA601**



## Product Guide

### Hydrocarbon Dew Point in Natural Gas

Hydrocarbon dew point, along with moisture, is a critical parameter for determining natural gas quality and meeting international standards such as ISO/TR 11150.



#### Condumax II

Continuous on-line measurement of the hydrocarbon dew-point temperature of natural gas. Optional water dew point for simultaneous measurement of both parameters with the sample analyzer system.

- Fully automatic on-line analysis
- Objective, highly repeatable measurement
- 0.5°C hydrocarbon dew-point accuracy
- Patented detection technique based on the fundamental chilled mirror principle
- Self-cleaning
- No purge or cooling gas needed
- Optional water dew-point analysis
- ModBus RTU
- IECEx, ATEX, cCSAus and TC TR Ex certifications



#### Condumax II Transportable

Transportable natural gas dew-point analyzer system with integrated sample conditioning and connection hoses for operation in the field.

- Field transportable self-contained dew-point analyzer system
- Simultaneous hydrocarbon and water dew-point measurements in a single analyzer
- Automatic objective measurements by industry proven principles
- Parameter specific sensors ensure continuity of hydrocarbon and water dew-point readings
- Self-contained sample handling, conditioning and analysis package
- 0.5°C hydrocarbon dew-point accuracy
- Patented detection technique based on the fundamental chilled mirror principle



## Product Guide

### Moisture in Natural Gas

Controlling moisture is crucial to ensure the quality of natural gas during processing, storage and transmission. Gas from new sources — such as Shale Gas and Biomethane — is becoming more common and adds new challenges to ensuring quality and compliance with regulations as varying compositions of gas can affect moisture readings.

Michell's next generation of TDLAS analyzer has been designed to provide reliable moisture measurements despite changes in background composition.



#### OptiPEAK TDL600

The OptiPEAK TDL600 Tuneable Diode Laser Analyzer employs the latest techniques in laser absorption spectroscopy and signal processing power to offer a robust high-performance analyzer, designed specifically for the measurement of moisture in natural gas.

- High accuracy with lower detection limit of less than 1 ppm<sub>v</sub>
- Range of 1–1000 ppm<sub>v</sub>
- The OptiPEAK TDL600's lower detection limit (LDL) of less than 1 ppm<sub>v</sub> makes the instrument a class leader in single path TDLAS moisture analyzers currently commercially available.
- D-MET — active gas composition compensation for multi-source dynamic gas streams: shale gas and biomethane ready



## Product Guide

### Moisture in Process Gases

The control of moisture is critical for the operational safety and efficiency of the plant equipment in upstream through to downstream processes.

The QMA601 is the result of Michell Instruments' continuous effort to improve Quartz Crystal Microbalance technology. The new analyzer utilizes a new generation of precision crystal oscillators guaranteeing a highly accurate measurement which is completely insensitive to changes in background gas composition.

While other moisture technologies are being stretched at sub-ppm trace moisture levels, the new QMA601 can offer reliability, simplicity and greatly reduced cost of ownership from trusted and proven Quartz Crystal technology.



#### QMA601

The next generation Advanced Quartz Crystal Microbalance analyzer from Michell Instruments is designed to provide reliable, fast and accurate measurement of trace moisture content in a wide variety of process applications where keeping moisture levels as low as possible is of critical importance.

- Precision measurement from 0.1 to 2000ppm<sub>v</sub>
- Accuracy of  $\pm 0.1$ ppm<sub>v</sub> at  $< 1$ ppm<sub>v</sub> and 10% of reading from 1 to 2000ppm<sub>v</sub>
- Maintenance-free for 3 years
- Built-in verification of customer process gas
- IECEx, ATEX, TR CU Ex certified for Exd flameproof, cCSAus (pending) certified for explosion proof
- Intuitive, color HMI with touch-screen keypad; no 'hot work' permit required
- 14 internal alarms
- 21 predefined carrier gases and 3 user-defined gases



## Product Guide

### Moisture in Process Gases

Moisture is a contaminant in many processes involving oil, gas and petrochemicals. Michell's process moisture analyzers use Michell's Advanced Ceramic Sensor technology to ensure the best moisture measurement technique for each application.

#### Promet EExd

Wholly hazardous area installed analyzer system for critical process gas applications.



- EExd flameproof certified — ATEX, IECEx, cCSAus and TC TR Ex
- Complete hazardous area installation
- Single- or dual-channel measurements
- Moisture content, dew point and pressure
- Calibration traceable to NPL (UK) and NIST (US)
- Range  $-120$  to  $+30^{\circ}\text{C}$  dew point, 0.001 to 30000 ppm<sub>v</sub>
- Remote global access options
- Sour gas compatible
- Field calibration maintenance

#### Promet I.S.

A complete, turnkey hygrometer system for moisture measurement in critical process gas applications. Single and multi-channel control unit, in combination with Liquidew I.S. for moisture in gases and liquids.



- Simple, cost efficient operation and low-maintenance
- Immune to chemical attack from H<sub>2</sub>S, mercaptans and other sulphides
- Protected against glycol or other liquid contaminants
- Accurate direct dew-point measurement at process pressure up to 45 MPa (450 barg)
- Moisture range from ambient to ppb level with exhaustive list of hygrometric units, including key parameters of natural gas
- Two 4–20 mA configurable outputs and digital ModBus RTU based communication
- Calibration traceable to NPL (UK) and NIST (US)
- User programmable or real-time active pressure compensation for moisture content calculation
- Multichannel with up to four independent measurement channels



# Product Guide

## Moisture in Process Liquids

Accurate moisture measurements in process liquids ensure product quality, efficiency and safety in many petrochemical and refinery applications. Michell's moisture in liquids analyzers use the ceramic moisture sensing tile, which is highly resistant to contamination, with application-specific sample conditioning systems to ensure accuracy and efficiency.



### Liquidew EExd

The moisture in liquid analyzer that offers the complete moisture measurement package for critical petrochemical liquid applications.

- EExd flameproof certified — ATEX, IECEx, cCSAus and TC TR Ex
- Complete hazardous area installation
- Single or dual-channel measurements
- Moisture content, dew point and temperature
- 0.001 ppm<sub>w</sub> to saturation range capacity
- Preprogrammed and user-entered saturation concentration values
- Remote global access options

### Liquidew I.S.

Precise real-time measurement and control of process moisture conditions without the need for collection and analysis of liquid samples in a laboratory. Single and multi-channel control unit, in combination with Promet I.S. for moisture in gases and liquids.



- Simple, cost-efficient operation and low maintenance
- Retrofit functionality, easy to integrate into existing sampling or distribution systems
- High integrity moisture in liquid measurement from 0.01 ppm<sub>w</sub> to saturation point
- Multi-channel with up to four completely independent measurement channels
- Robust design for undisturbed operation in many nonpolar liquids over a long time
- Two 4–20 mA configurable outputs and digital ModBus RTU-based communication
- Replaceable sensor element with Michell's Calibration Exchange Service for reliable, cost-efficient calibration
- Calibration traceable to NPL (UK) and NIST (US)

# 40 Years of Experience with Moisture and Hydrocarbon Dew-Point Measurement in Natural Gas

The control of moisture and hydrocarbon dew point is critical for the operational safety and efficiency of the plant equipment in upstream through to downstream processes. We at Michell Instruments have been developing expert moisture sensing instruments and systems for 40 years. Over this time, we have gained extensive knowledge of applications in natural gas with over 1,000 analyzer installations in sites across the globe.

Today Michell Instruments offer to our customers in the oil and gas industry a suite of complementary moisture and hydrocarbon dew-point analyzers and systems.



## Extended Maintenance Agreement

An extended maintenance agreement includes full application support, annual traceable calibration or sensor exchange, free software upgrades and all repairs (if required). Because sensors need regular recalibration, customers soon recoup the additional cost of the agreement, as well as benefiting from peace of mind.



## Customization Projects

Where a standard product doesn't quite meet the needs of an application, Michell's team of design engineers will work with you to develop a specific solution. From specialised sampling systems to filters and connectors, Michell's 40 years of experience in moisture measurement enables us to find the best fit for specific moisture measurement needs.



## Other Product Ranges

Portable Instruments | Chilled Mirror Instruments | Dew-Point Transmitters

Calibration Instruments | Relative Humidity Instruments | Oxygen & Binary Gas Analyzers

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Michell Instruments adopts a continuous development programme which sometimes necessitates specification changes without notice.  
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