

Condumax II

Hydrocarbon Dew-Point Analyzer

Automatic, on-line measurement of hydrocarbon and water dew point in natural gas.



Highlights

- Fully automatic on-line analysis
- Objective, highly repeatable measurement
- 0.5°C hydrocarbon dew-point accuracy
- Fundamental chilled mirror principle
- Patented detection technique
- Self-cleaning
- No purge or cooling gas needed
- Optional water dew-point analysis
- Modbus RTU
- IECEx, ATEX, c CSA_{US} and GOST Ex certifications

Applications

- Natural gas processing
- Protection of turbo-expander plant
- Gas quality measurements at custody transfer
- Transmission pipeline monitoring
- Confirmation and control of fuel gas 'superheat' to turbine power plant

Hydrocarbon Dew Point: A Critical Natural Gas Quality Parameter

For natural gas producers, pipeline operators and direct contract buyers, hydrocarbon dew point is difficult to measure and control – but it is vital to avoid custody transfer disputes frequently resulting in shut-ins due to today's tighter contractual limits.

Accurate hydrocarbon dew-point measurement and control has emerged as THE issue at gas quality conferences, including the AGA. The need for harmonization of analysis methods to ensure consistent best practice is being promoted by research groups within independent organizations such as API in North America and GTE and GERG in Europe.

These groups are evaluating the relationship between direct hydrocarbon dew-point measurement, the manual Bureau of Mines (BOM) method, potential hydrocarbon liquid content (PHLC) and analytical techniques such as gas chromatography (GC) with various Equations of State (EOS) software packages.

The direct chilled mirror technique incorporated in the Michell Instruments' Condumax II is the definitive method of measuring hydrocarbon dew point, and is preferred by most gas producers, pipeline operators and direct contract buyers around the world. Since 1986, the original Condumax enabled users to make direct fundamental measurements automatically, on-line, with minimal maintenance demands in service and with a level of objectivity previously impossible to achieve. Condumax II extends this capability, adding the latest features and specifications to a proven and patented measurement technique. Condumax II offers the user the opportunity to standardize on a hydrocarbon dew-point measurement technology that provides excellent correlation to PHLC, EOS calculations of extended composition analysis by laboratory GC and the BOM method in an instrument that is simple to install and virtually maintenance free.

The Dark Spot™ Measurement Principle

Condumax II uses a patented chilled mirror optical measurement technique that is radically different to that of any other instrument. Sensitivity of better than 1 ppm molar ($1\text{mg}/\text{m}^3$) of condensed hydrocarbons enables the analyzer to detect the almost invisible films of condensate that are characteristic of hydrocarbon gases at dew point, due to their low surface tension and colorless appearance. The result is a breakthrough in accuracy and repeatability.

The optical sensor comprises an acid etched, semi-matt stainless steel "mirror" surface with a central conical-shaped depression, which is chilled during a measurement cycle. Collimated visible red light is focused onto the central region of the optical surface. In the dry condition, the incident light beam is dispersed by the matt surface providing a base signal to the optical detector. During a measurement cycle, hydrocarbon condensate is formed on the optical surface and it becomes reflective due to the low surface tension of the condensate. An annular ring of light forms around the detector and there is a dramatic reduction in the scattered light intensity within the central Dark Spot™ region.

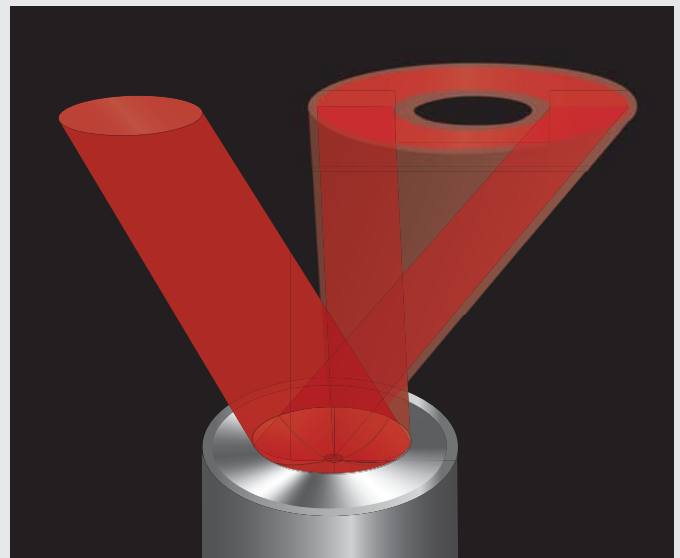
This secondary effect is monitored and interpreted. The Dark Spot™ detection technique utilizes the physical characteristic of hydrocarbon condensate that makes it so difficult to detect in a manual visual dew-point meter (BOM). When a predetermined layer of condensate has been detected, the instrument records the temperature of the optical surface as the hydrocarbon dew point. In the subsequent recovery cycle, the optical surface is actively heated typically to $+50^\circ\text{C}$ to evaporate the condensates back into the flowing gas sample. This fully automatic process is complete in under ten minutes.

Sensor Cell

The design of the Condumax II sensor cell is critical to its dynamic performance. This cell combines the optical detection system, Dark Spot™ sensor, thermocouple and three-stage Peltier heat-pump in a stainless steel cell assembly. The cell carries an operating pressure rating of 100 barg and achieves a measurement depression range (ΔT) of up to -55K from the analyzer operating temperature.

Flow De-coupling

A flow de-coupling method is used in order to achieve maximum accuracy. Discrete measurement cycles, at user definable intervals, lock a fixed sample of the hydrocarbon gas mixture into the sensor cell. As the optical surface is chilled, sequential condensation of hydrocarbon components occurs with the heaviest hydrocarbons condensing first. Thus a flowing sample would lead to a falsely high indication of the hydrocarbon dew-point temperature of the gas. The fixed sample method used in the Condumax II ensures representative condensation of all hydrocarbon components and prevents preferential drop-out of heavy ends that occur with flowing samples often used by other measurement methods.



Dark Spot™ Measurement Principle

Intelligent Control

The Condumax II has a fully automatic, intuitive and intelligent control system that improves accuracy, sensitivity and reproducibility under any operating condition. A three-stage Peltier heat-pump under powerful digital command allows Condumax II to vary its chill rate to enable detection of the smallest amount of condensate on the optical surface.

During start-up, Condumax II will perform a measurement cycle at a standard chill rate in order to "range-find" the hydrocarbon dew-point level. On subsequent cycles, the previous measured value is used to determine an optimized chill rate that will cause the sensor surface to cool quickly in the initial phase, but reduce its chill rate to 0.05°C/sec as it approaches the hydrocarbon dew point. This gives the user previously unattainable levels of precision and reproducibility and allows easy harmonization with other HCDP measurement techniques or measurement practices of individual users. Condumax II can also operate in Condensate Mode in order to give reliable PHLC measurement. In conventional dew-point measurement mode, analysis is performed at the cricondenthem condition or at user required pressure level.

Condumax II also enables the user to determine the phase envelope of their gas through direct measurements at varying pressures. Condumax II is designed for easy operation, with innovative touch-screen control of all functions through the simple user menu that can be viewed in complete safety within the hazardous area environment on the high-resolution vacuum fluorescent alphanumeric display.

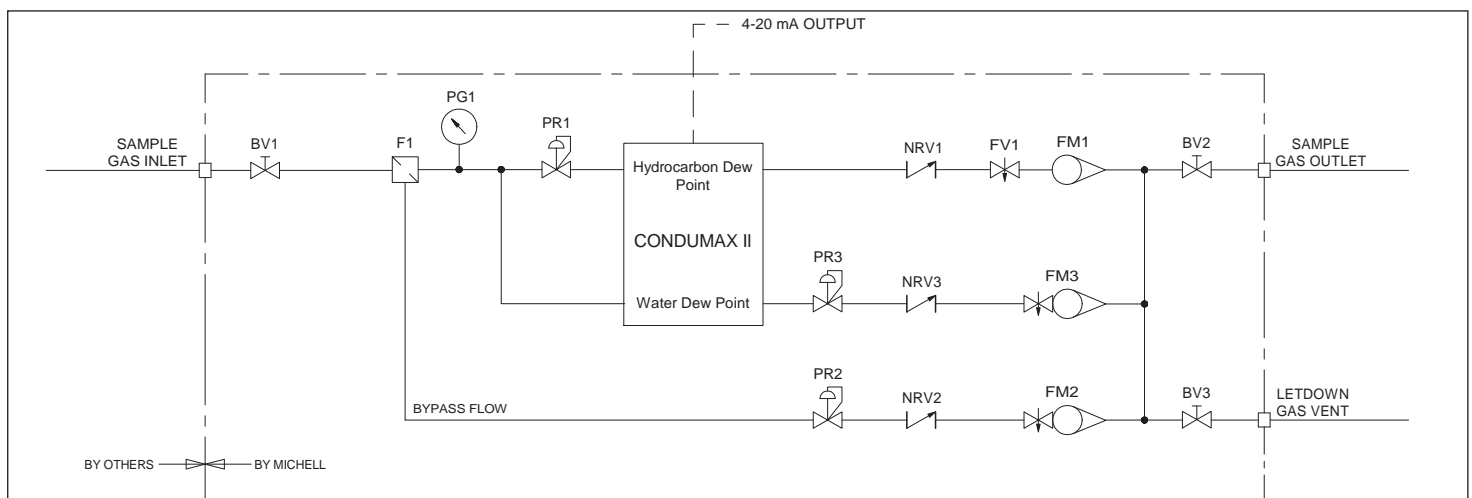
Sampling system features

- Microporous membrane filter
- Heated pressure regulator
- Heated enclosure (option)
- Sample connections
- Optional combined water and hydrocarbon dew-point analysis
- 0.5°C hydrocarbon dew-point accuracy
- Fully automatic on-line analysis
- Modbus RTU



Condumax II Sampling System (outdoor version)

Condumax II Sampling System



System Description

Main Unit

The Condumax II Main Unit contains all of the critical components in a single explosion proof/flameproof enclosure for installation in Zone 1 or 2 (Class 1, Div. 1 and 2 areas). The Dark Spot™ sensor cell and optional water dew-point sensor are mounted inside the unit in conjunction with the pressure transducers, flow switches, measurement electronics and display. Flame arrestors on the gas inlet and outlet ports provide safety protection. Electrical connections are made through cable glands at the base of the enclosure. The main unit is a fully functional hydrocarbon dew-point analyzer and requires only a clean, pre-conditioned gas sample and AC power for its operation.

Simultaneous Water Dew-Point Analysis

Water dew-point measurement is of equal importance to hydrocarbon dew point for all gas producers and pipeline operators. Optional second measurement channel utilizing the advanced Michell Ceramic Moisture Sensor, proven in over 1,000 petrochemical natural gas plant installations worldwide, to provide continuous on-line analysis to enable Condumax II to confirm conformance to both dew point gas quality specifications.

Sampling System

Indoor and outdoor sampling systems are available, providing comprehensive sample conditioning of natural gas at any pressure up to 138 barg for the standard design. The sampling system includes pressure regulation, flow control and most importantly micro-porous membrane filtration with by-pass arrangement and condensate drain to give fast response and protection from liquid hydrocarbon/glycol contamination. Dual channel sampling is available for the combined hydrocarbon/water dew point analyzer package.

The outdoor version is housed in an IP66 rated, insulated stainless steel enclosure. The optional thermostatically controlled heating ensures reliable operation with no condensate or water drop-out prior to measurement. For both the indoor and outdoor sampling systems, the Condumax II Main Unit is mounted integral to the Sampling System.



Condumax II Main Unit

Human Interface

The Condumax II is designed to be flexible in terms of measurement display and connectivity to other equipment. As standard, Condumax II provides a multi-function vacuum fluorescent display on the Main Unit that shows all measurement parameters and allows the user to adjust certain control parameters, view log data, max/min statistics etc. In addition, Condumax II provides two 4-20 mA outputs, configurable from the Main Unit user interface for any combination of measurement parameters. A digital output using Modbus RTU protocol is provided, for connection to an external computer, DCS or PLC system located in a safe area. Active X controls are an available option for integration in DCS systems.

Technical Specifications

Hydrocarbon Dew-Point Measurement	
Measuring technique	Dark Spot™ fixed sample analysis. Direct photo-detection of hydrocarbon condensate at hydrocarbon dew-point temperature
Sensor cooling	Automatic via 3-stage Peltier effect electronic cooler under adaptive control
Maximum range	Up to Δ -55K measurement depression from Main Unit operating temperature
Accuracy	±0.5°C hydrocarbon dew point (single and multiple condensable component analysis)
Sample flow	0.03 m³/hr (0.5 NI/min) - alarm standard
Measurement frequency	6 cycles/hour (recommended) 12 cycles/hour (maximum)
Water Dew-Point Measurement (optional)	
Measuring technique	Michell Ceramic Moisture Sensor
Units – moisture content	°C and °F water dew point; lbs/MMscf; mg/m³, ppm _v
Resolution	0.1°C, 0.1°F
Range	Calibrated from -100 to +20°C dew point
Accuracy	±1°C from -59 to +20°C dew point ±2°C from -100 to -60°C dew point
Sample flow	0.06 to 0.3 m³/hr (1 to 5 NI/min) - alarm standard
Pressure Measurement(s) Hydrocarbon dew-point analysis pressure Optional water dew-point process pressure	
Units	MPa, barg, psig
Resolution	0.1 MPa and barg, 1 psig
Range	HC dew point: 0 to 100 barg Water dew point: 0 to 200 barg
Accuracy	±0.25% FS
Hydrocarbon Dew-Point Analyzer	
Resolution	Hydrocarbon and water dew point: 0.1°C
Sample gas supply	Natural gas up to 100 barg, pressure regulated in sampling system
Enclosure	EExd cast enclosure with removable glass window viewing port. Internally heated for condensation protection
Sample gas connections	1/8" NPT (ATEX / IECEx) or 1/4" NPT (CSA) female ports for both hydrocarbon and water dew-point channels; Sampling system: 6mm OD or 1/4" OD
Operating environment	Indoors/Outdoors -20 to +50°C Max 95% RH
Power supply	90 to 260 V AC 50/60 Hz, 125 W Main Unit; 300W c/w indoor sampling system; 400W c/w outdoor sampling system
Weight	Main Unit 22.5kg 60kg (approx) c/w Sampling system (indoor) 75kg (approx) c/w Sampling system (outdoor)
Integrated display/ keyboard	Touch screen with vacuum fluorescent display
Outputs	Modbus RTU, RS485 @ 9600 baud rate. Two 4-20 mA linear (non-isolated) outputs, user configurable for any combination of dew point or pressure parameters
Alarms	Process and analyzer status via software register and display annotation. Integrated low flow alarms for each sample flow. Analyzer status fault flag 23 mA on mA output 1

Certification

Hazardous area certification	ATEX: II 2G Ex d IIB + H2 Gb IECEX: Ex d IIB + H2 Gb Tamb -40°C to +45°C T4 Tamb -40°C to +60°C T3 cCSAus: Class I, Division 1, Group B, C, & D T4 *TC TR: 1Ex d IIB+H2 T4, T3 Gb
Pattern approval	GOST-R, GOST-K, GOST-T

*Available to customer specific order (consult Michell Instruments)

For full details of configurations and options, please refer to the **Condumax II Order Codes** list. Available from the Michell Instruments website or from your local Michell Instruments office.

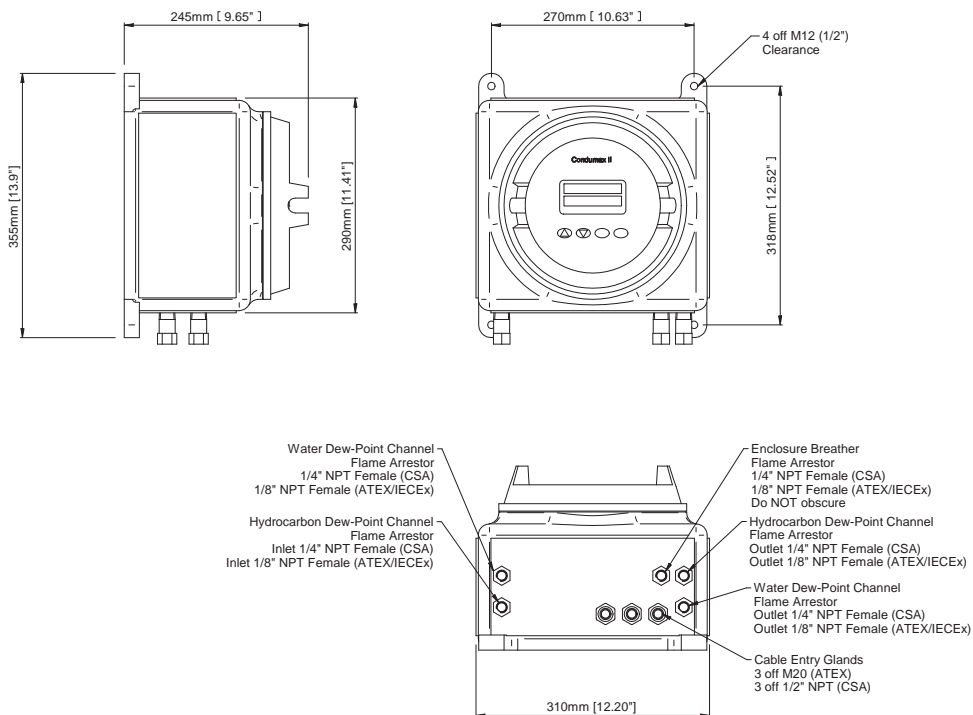
Condumax II Transportable Hydrocarbon & Water Dew-Point Analyzer



A complete transportable natural gas dew-point analysis system for field spot-check measurements. Periodic online operation when located in a temperature maintained analyzer house. Measurements and functionality are instantly accessible through integrated alphanumeric display and touch-glass HMI interface including log of dew point readings for operator review.

For more information, please contact your local Michell Instruments office, or visit our website www.michell.com.

Main Unit

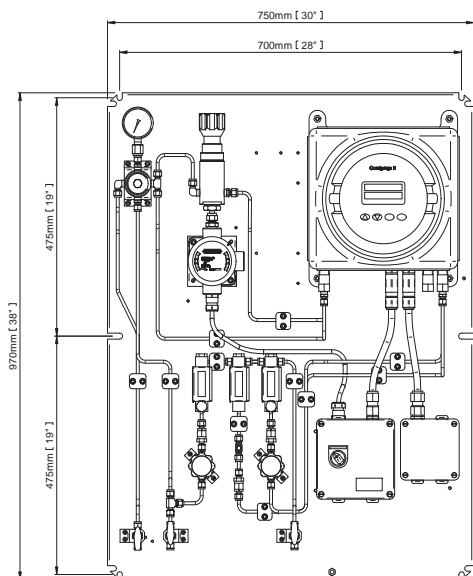


Sampling Systems

Indoor Versions

316 Stainless Steel Panel

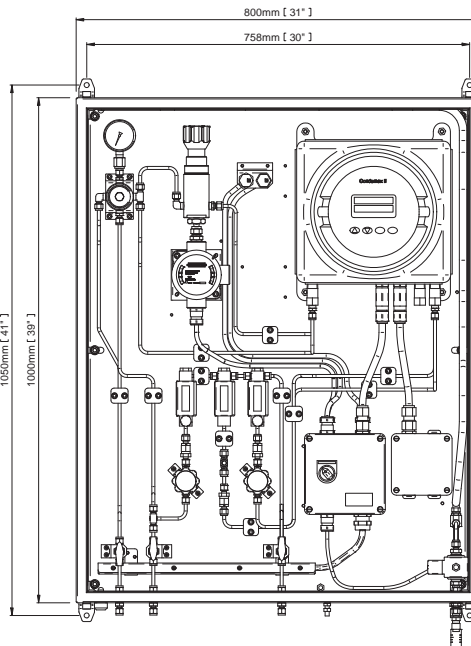
Condumax II HC and water dew-point analyzer with sampling system for indoor installation.



Outdoor Versions

Stainless Steel Enclosure

Condumax II HC and water dew-point analyzer within sampling system for outdoor installation. Options fitted in version shown: Enclosure cooling and heating.



General Note: Outline dimensions for HC dew point only versions are also the same as shown.

Michell Instruments Ltd 48 Lancaster Way Business Park, Ely, Cambridgeshire, CB6 3NW

Tel: +44 (0) 1353 658000, Fax: +44 (0) 1353 658199, Email: uk.info@michell.com, Web: www.michell.com/uk

Michell Instruments adopts a continuous development programme which sometimes necessitates specification changes without notice. Issue no: Condumax II_97149_V7_UK_0216

OptiPEAK TDL600

Moisture in Natural Gas Analyzer

The next generation TDLAS Analyzer for automatic online measurement of moisture in variable compositions of natural gas and biomethane. 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. This non-contact technology requires minimal maintenance, even in demanding applications such as changing methane concentrations or sour gas. The analyzer is fully hazardous area certified and delivers class-leading measurement performance, stability and detection sensitivity.



Highlights

- D-MET system: Factory-ready for varying gas compositions. For example, after stream blending or injection of shale gas or biomethane to a network.
- Operating range down to 1 ppm_v
- Sour gas compatible
- Simple installation and setup
- Low maintenance
- IECEx, ATEX and cMETus certified for EExd flameproof
- Integrated sample handling
- Proven Michell Instruments quality: 40 years of expertise in moisture measurement built into the design

Applications

- Natural gas glycol dehydration
- Natural gas transmission monitoring
- Custody transfer
- Natural gas storage
- Offshore export pipeline natural gas
- LNG receiving / re-gasification plants
- Vaporized NGL
- Biomethane

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 1000 analyzer installations in sites across the globe. Today Michell Instruments offers customers in the oil and gas industry a suite of complementary moisture and hydrocarbon dew-point analyzers and systems.

The OptiPEAK Difference

Performance

- High accuracy with lower detection limit of <1 ppm_v
- Range of 1 to 1000 ppm_v

The OptiPEAK TDL600's lower detection limit (LDL) of less than 1 ppm_v makes the instrument a class leader in single path TDLAS moisture analyzers currently commercially available.

The maintenance-free, simple dual pass cell offers reliable measurement results throughout its range. It combines sensitivity and robustness without the high top-end range limit which could make the analyzer likely to saturate quickly at higher moisture levels. This is sometimes the case with comparable, costly and difficult to maintain multi-pass (Herriot) cells. With its accuracy of 1 ppm_v the analyzer is future proof and comfortably exceeds the requirements of the main international natural gas quality harmonization guidelines in Europe and United States.

- D-MET — active gas composition compensation for multi-source dynamic gas streams: ready to work with shale gas and biomethane.

Natural gas stream compositions can vary. In some applications it is difficult to use an older generation TDL instrument which can only be tuned to one defined gas composition. Michell Instruments' next generation TDL hygrometers overcome this limit. The OptiPEAK TDL600 utilizes the innovative D-MET System, dynamic background gas compensation. For the user, this means that the moisture measurement is virtually independent of changes in the methane level. No further manual correction factors are required.

Reliability

- Signal drift reduction — built-in, continuous laser optimization

Tunable diode lasers can drift. This inherent property of diode lasers can lead to reduction in sensitivity and drift in measured readings. The OptiPEAK's built-in continuous laser optimization system ensures that the laser remains locked to the correct water absorption peak for the highest measurement integrity at all times.

- High-accuracy temperature control

For the optimal performance of any TDL hygrometer the temperature stability is of highest concern. The OptiPEAK series not only utilizes the highest quality laser with exceptional life span, but also has a sophisticated multi-stage control system to maintain the temperature of the laser to within tight limits.

Simplicity

- Human Machine Interface (HMI)

The TDL600 provides a highly intuitive, color, menu-driven interface, utilizing a capacitive touch pad. This allows operation and interrogation of the analyzer in the field with no need for a hot-works permit. Navigation is easy and there is no need for a stylus.

- Easy integration into existing control systems

The OptiPEAK TDL600 is equipped with 3 programmable 4–20 mA analog outputs and a digital output utilizing the widespread ModBus Protocol for easy connection to a SCADA or other user-defined data acquisition system.

- Integrated sampling system

The OptiPEAK series is supplied with a high quality, in-house designed, sample conditioning system that is optimized for the applications in natural gas as well as the high speed of response of the analyzer.

- Remote application software supplied as standard

Allows remote control and configuration of the analyzer to simplify operations on large, distributed locations.

Reduced cost of ownership

- Minimum installation and maintenance

With its integrated sampling system and small footprint, the OptiPEAK TDL600 can be easily retrofitted into existing plant infrastructure. Due to the inherent stability of the instrument, regular field calibration is not required under normal operating conditions. The analyzer will perform reliably for many years with just basic maintenance and housekeeping.

- Built-in self verification

The OptiPEAK TDL600's innovative self-verification and self-compensation system checks itself against calibration data on every update cycle, adjusting if necessary, without the need for an additional gas reference cell. This function is extremely useful after a system upset — there is no need for a lengthy setup procedure.



Sample Conditioning Systems

A well designed sampling system is key to achieving correct measurement and reliable long-term operation of any natural gas moisture analyzer. The sample conditioning system of the OptiPEAK TDL600 applies state-of-the-art filtration and multi-stage pressure reduction to present a clean, wholly gaseous phase representative sample for continuous analysis. Systems that disregard the requirements for adequate sample conditioning will fail to achieve the levels of accuracy promised in the analyzer data sheet and also may be very costly for the user in the longer term.

Whilst the fast response speed of TDL based analyzers is an important advantage, it is also widely accepted that the quality of the sample conditioning system design and its finish determine the performance of the entire measuring system. This is particularly valid for measurement of trace water vapor in single or double digit ppm ranges where the adsorption and desorption of the water molecules from surfaces in the conditioning system has to be considered.

Michell Instruments have 40 years of experience with low moisture measurements in process applications. The OptiPEAK series instruments are supplied with a high quality sample conditioning system that is optimized for applications in natural gas, as well as the high speed of response of the analyzer.



Our products are also backed up by global service and support. With locations on 6 continents and 56 countries, Michell Instruments offers an extensive network of factory trained application engineers ready to analyze your application and deliver the solution. This allows us to assure customer satisfaction throughout your products lifetime.

If you can't find a product to fit your application contact your local Michell Instruments office, or visit our website www.michell.com — we're here to help.



The Moisture Specialists:

We have the solution for your moisture sensing needs

With 5 proprietary moisture sensing technologies, Michell Instruments will tailor solutions to best fit the specifics of your application, as well as the project budget.

Relative Humidity Sensors:

Designed for a broad range of heavy industrial and process industries.

Ceramic Sensor Technology:

3rd generation of metal oxide for natural gas applications at high pressure (CNG) and economical, easy gas processing applications.

Chilled Mirror:

For precise reference measurements at the highest accuracy and NPL or NIST traceability.

Quartz Crystal Microbalance:

For fast, precise measurement at low ranges in changing backgrounds.

TDLAS:

For fast, precise and low maintenance measurement in natural gas from 1000 ppm_v down to 1 ppm_v.

Technical Specifications

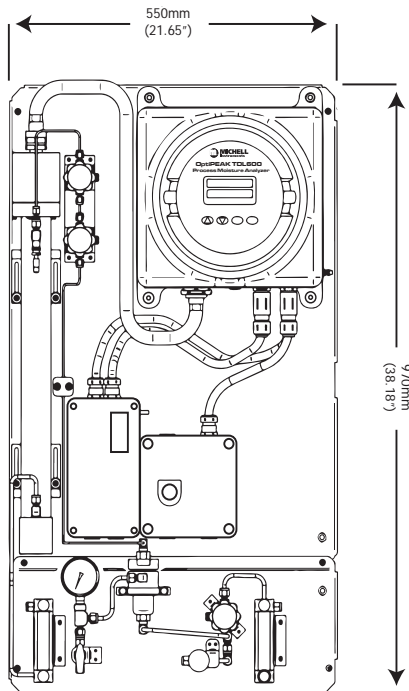
Measurement technology	TDLAS
Measurement range	1 ppm _v to 1000 ppm _v
Accuracy	±1% of reading >100 ppm _v ±1ppm _v <100 ppm _v
Repeatability	<1 ppm _v (long term stability <0.1 ppm _v /year)
Limit of detection	1 ppm _v
Available units	ppmv, lb/MMSCF, mg/Nm ³ , dew point °C or °F (ISO18453 or IGT#8)
Response speed	Optical response 0.2s Display update 2 to 3s
Operating temperature range	-20°C to +55°C
Electrical Specifications	
Supply voltage	110 V AC or 230 V AC 50/60Hz
Power requirements	
Indoor system:	80W
Outdoor system:	180W
Analog signals	
Input:	2 x 4–20 mA user configurable
Output:	3 x 4–20 mA, 3 alarms 250 V AC, 3A (volt-free contacts)
Digital communications	RS485 ModBus RTU
Data logging	Logs all process variables with a user selectable sample period in the range of 10s to 1 day

Local interface	4.3" color LCD with touch pad operation
Electrical connections	3 x M20 entries for cable glands
Calibration	
Factory method	3-point, traceable to NPL and NIST
Recommended calibration	None required, dependant on user or quality system requirements
Physical Specifications	
Sample flow rate	1 NI/min cell sample 1 to 5 NI/min sample filter by-pass
Inlet pressure	Maximum 2000 psig (138 barg)
Outlet pressure	Cell vent 0.7 to 1.4 bara Filter by-pass maximum 3 barg
Enclosure type/packaging	Aluminium alloy, explosion proof, polyester coated, IP66, NEMA 4
Gas connections	1/4" NPT (F)
Weight	40kg (88lbs) (without sampling system)
Sample system enclosure	304L or 316L stainless steel
Hazardous area certification	
ATEX:	II 2 G Ex d ib op is IIC T5 Gb
IECEX:	Ex d ib op is IIC T5 Gb Tamb -20°C to +60°C
cMETus:	Class I, Division 1, Groups A, B, C, D, T5, Tamb -20°C to +60°C, IP66
TC TR Ex:	1 Ex d ib op is IIC T5 Gb

Sampling Conditioning Systems

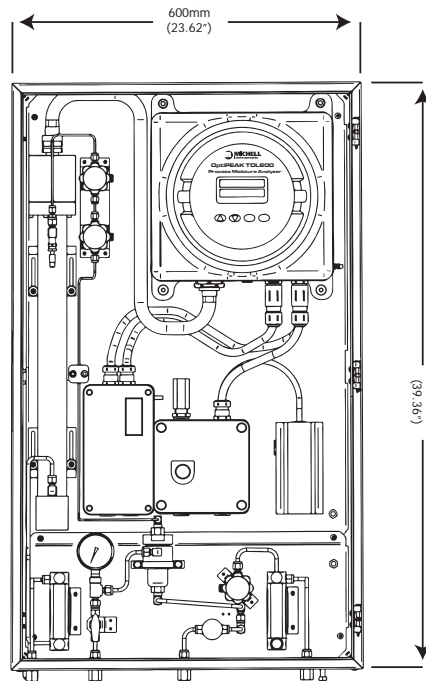
Indoor Version

OptiPEAK TDL600 with sampling system on panel mounting



Outdoor Version

OptiPEAK TDL600 and sampling system with enclosure, including heater



Michell Instruments Ltd 48 Lancaster Way Business Park, Ely, Cambridgeshire, CB6 3NW
 Tel: +44 (0) 1353 658000, Fax: +44 (0) 1353 658199, Email: uk.info@michell.com, Web: www.michell.com/uk

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