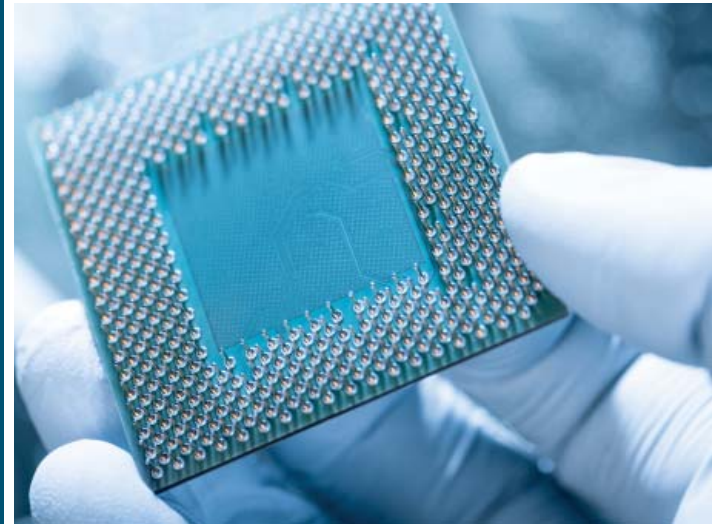
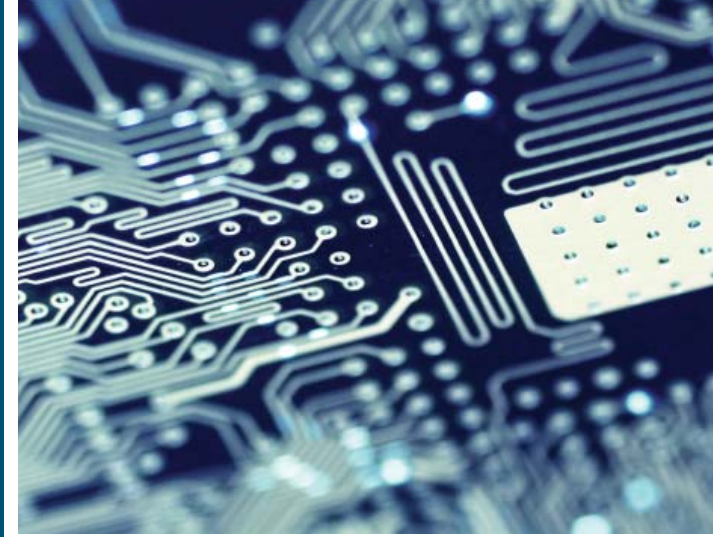




Measuring moisture in ultra-high-purity gases





Many applications require very high purity, inert gases to blanket or produce protective atmospheres. Moisture is the most common contaminant that needs to be removed, but because it is so prevalent in the atmosphere, simply drying the gas during manufacture is not always enough. The high purity gas must also be checked for purity after long periods of storage, tool downtime, as well as at points in the process to ensure moisture has not found its way back in.

This e-book looks at the possible solutions available for ensuring the purity of gases, and discusses the benefits of each as well as some of the pitfalls to look out for.

How dry does pure gas need to be?

Gas Type	Purity	Maximum moisture content
R744 Refrigerant Grade CO2	99.9%	< 10ppm
Synthetic Air	99.99%	≤ 5ppm
High Purity Nitrogen	99.999%	≤ 3ppm
High Purity Argon	99.9995%	≤ 0.5ppm
Neon	99.996%	<1ppm
Krypton	99.999%	<3ppm
Xenon	99.9995%	<0.1ppm
Oxygen	99.98%	<5ppm
Hydrogen	99.999%	<1ppm
Helium	99.999%	<5ppm

Appropriate moisture measurement technologies

Not all moisture sensors are capable of measuring trace moisture down to very low parts per million, but there is a range of options to suit the varying needs of processes and budgets.

Technology	Benefits	Is it for me?
Ceramic Impedance Sensor	Our Sensors have been developed especially for these high purity applications providing measurements down to low parts per billion. Historically proven as a suitable measurement technology with the benefit of being easy to install and maintain. Highly cost-effective.	The quality and simplicity of install of these sensors makes them a cost effective option. Typical installation is on UHP feed gas supplies to manufacturing tools
Chilled Mirror	Provides highly accurate, fundamental measurements of dew point. Capable of providing moisture content readings down to parts per billion.	For measurements of dew-point, Chilled Mirror Hygrometers provide the greatest accuracy and reliability. As a premium product, they are often used by gas manufactures as a standard during production for quality control.
Quartz Crystal Microbalance	Using quartz crystal technology, it provides precise measurements of moisture content down to 100 ppbV.	Another premium product, QCM analyzers require minimal maintenance. If the main interest is for moisture content rather the dew point temperature, then QCM technology is a good choice.
Thermal Conductivity Binary Gas analyzer	This technology is used to measure the purity of the gas itself, rather than moisture content. ie. oxygen in Nitrogen or Argon in Nitrogen	Choose this analyzer if determining the purity of the gas itself is the main concern, rather than looking for moisture content. Thermal Conductivity analyzers can be used to quickly discover leaks of air into a system and are often used as part of quality assurance during manufacture.



A vertical strip on the left side of the slide shows a close-up of numerous water droplets of various sizes on a dark, reflective surface. The droplets are in sharp focus in the foreground and become increasingly blurred as they recede into the background, creating a sense of depth. The lighting highlights the spherical shape and the reflection on the surface of each droplet.

Remember the importance of sampling!

The type of sensor or analyzer is only one part of the equation when it comes to making accurate measurements of moisture in high purity gas: the materials and components in the sampling system play a vital role. Choosing unsuitable materials or failing to provide adequate sample condition will greatly affect the reliability of the measurements.

Key questions to ask when specifying a sampling system are:

- What is the pressure of the gas to be sampled?
- How will the flow rate be managed?
- Is there the potential for particulates in the gas flow that need to be filtered out?
- Are the components chosen suitable for the purpose?

Your Michell representative will be able to provide advice on all aspects of sampling.

**Ultra high purity gas
options from Michell**



Pura Pure Gas Trace Moisture Transmitter – ceramic impedance technology

Recommended application: Semiconductor fabs

- This is the most cost-effective solution to measure moisture content down to 5ppb_v
- Its small size means it can be easily fitted to tools to make measurements in the process – for example gas boxes or valve manifold boxes.
- Fitted at point of use, post purifier the Pura provides additional confidence and helps avoid loss of yield of semiconductor fabs.
- Regular maintenance is cost-effective and simple with Michell's sensor exchange service.
- Stable and repeatable measurement
- Optional Hazardous Area Approval
- Simple installation
- VCR process connections
- Optional display / alarm unit
- Compact design
- Fast response to moisture events
- Analog output (sensor) and Digital output (monitor)

Your Michell representative will be able to provide advice on all aspects of sampling.



S8000RS High Precision Chilled Mirror Hygrometer

Recommended application:
Measurement standard for high-purity gas manufacture

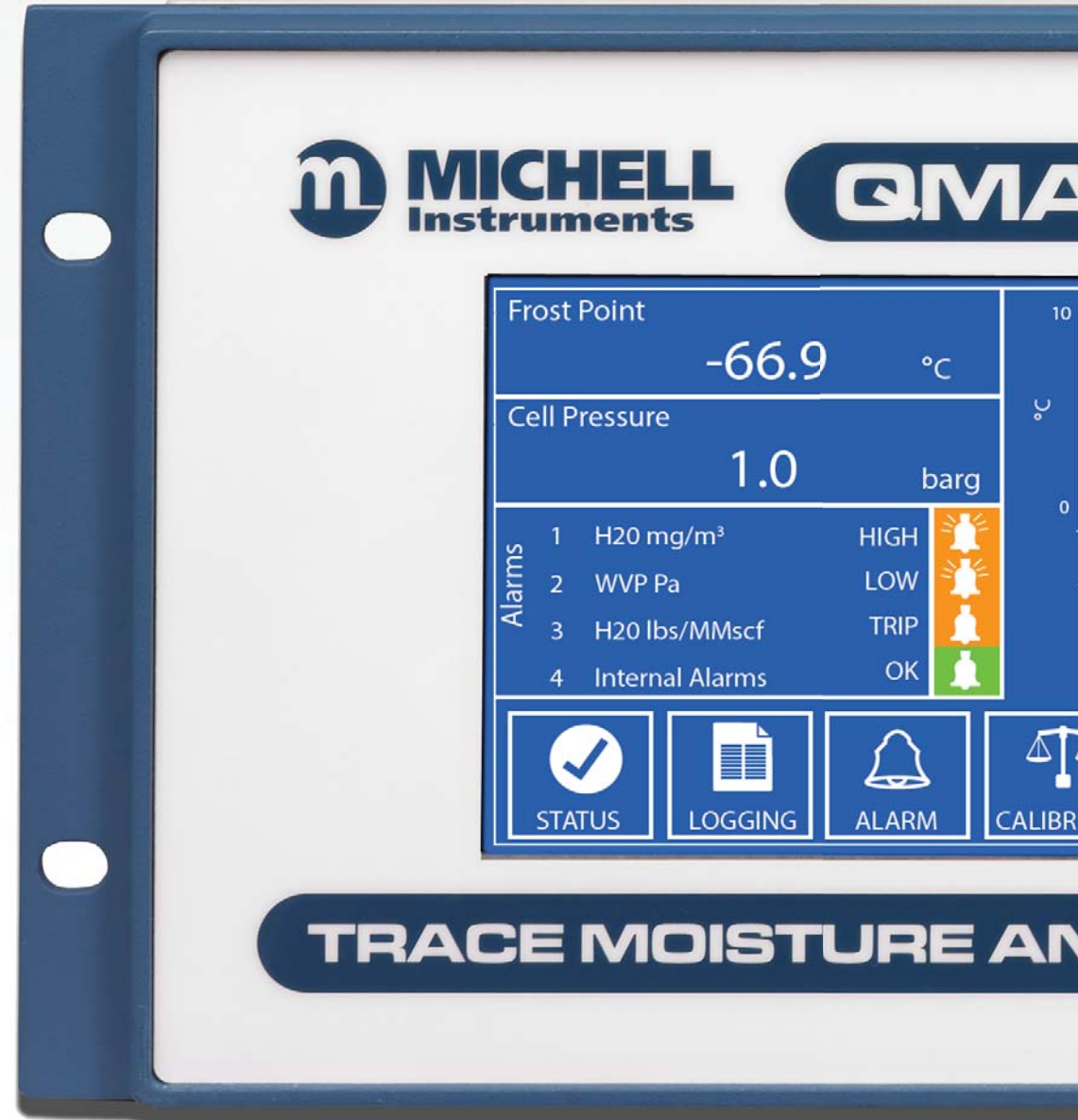
- Accuracy of $\pm 0.1^{\circ}\text{C}$
- Precision measurement to -90°C dew point (100 ppb)
- Sensor head optimised for fast response to low moisture levels
- High measurement sensitivity
- Microscope for visual inspection of condensate on mirror
- Ethernet or USB connections
- SD card datalogging
- Simple configuration and operation via touch screen interface
- Compact 19" x 4U package for flexibility of installation



QMA401 Trace Moisture Analyzer

Recommended application: monitoring quality in air separation plants

- Precision measurement from 100ppb_v to 2000 ppm_v
- Simple, low cost, on-site maintenance
- Accuracy of 0.1ppm_v or 10% of reading, whichever is greater
- Reliable measurement even in varying sample conditions - analyzer corrects automatically for flow variations
- Unaffected by changes in background gas composition
- Long intervals between maintenance
- Dryer can be replaced by the user in 10 minutes
- Intuitive user interface
- Ethernet or USB digital communications
- SD card datalogging
- Optional internal sample handling and bypass loop



XTC601 Binary Gas Analyzer

Recommended application: product quality in air separation plants

- Touch-screen display allows calibration or adjustment without the need for a hot works permit
- Accuracy of better than $\pm 2\%$ full scale
- Ranges available: 0–5 up to 0–100%, 0–1% for H₂ or He
- Stability $\pm 0.5\%$ per month (of span)
- Compact and rugged design with an EExd enclosure and two off 4–20 mA output
- Optional light guide following NAMUR standard
- Suitable for use in ATEX, IECEx, TC TR Ex & CSA_{US}
- Low cost of ownership due to minimal maintenance



Why Choose Michell?



With over 40 years of expertise in developing sensors and instrumentation for measuring humidity and trace moisture, we provide our customers the security of working the leading manufacturer in the field. As well as offering the largest number of sensing technologies available from a single manufacturer, we have a global presence with multiple manufacturing locations across Europe.

Our head office is located in Ely, UK and we have a North America sales and service headquarters located in Rowley (MA).

Michell facilities are located in 10 countries with an extensive network of factory trained application and service engineers, subsidiaries and distributors stretching across 56 countries.



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