

# Oxygen Measurement and Analysis

Protect Processes, Reduce Costs  
and Maintain Quality

A decorative graphic consisting of a grid of small dots in red and blue, arranged in a pattern that appears to be a stylized representation of a measurement or analysis process. The dots are arranged in a grid that is slightly offset and has a wavy, undulating appearance, suggesting a dynamic or flowing process. The red dots are more prominent in the upper half, while blue dots are more prominent in the lower half.

## Oxygen Measurement and Analysis

### Quality Process Analyzers from Experts in Control Instrumentation

Precise measurement of oxygen is critical for processes in many industries, ranging from the purity of industrial gases and protecting against leaks in glove boxes to monitoring flue gas for optimum combustion efficiency. The requirements of various applications are very different, therefore we offer a range of analyzers to ensure that you can always select the best technology for your application.

#### Industries

- Industrial Gas Manufacture
- Air Separation
- Hydrocarbon Processing
- Pharmaceuticals
- Bulk & Specialty Chemicals
- Natural Gas & Biogas
- Additive Manufacturing
- Metals and Minerals
- Marine
- Laboratories and Research

#### Applications

- Inerting reactors or vessels
- Argon, helium or nitrogen purity
- Natural gas and biogas monitoring
- Combustion control on boilers and incinerators
- Cylinder filling and bottling plants
- Marine inert gas generation
- Carbon dioxide purity in breweries
- Annealing furnace

#### Benefits

- The right measurement technology for your application: thermoparamagnetic, electrochemical and zirconium oxide
- Control over your process for safety and quality
- Low cost ownership: the analyzers are designed for minimum maintenance
- Support from a worldwide network of service engineers and customer service teams

## Sensor Technologies

A range of sensor technologies unique to each instrument, maximizing measurement ranges and applications.

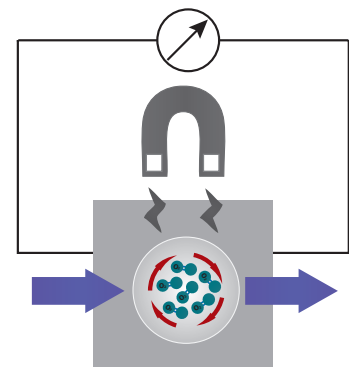
### Thermo-Paramagnetic

The thermo-paramagnetic sensor uses a combination of paramagnetic and thermal conductivity techniques to accurately measure the oxygen content within a process gas. Oxygen is a paramagnetic gas, which means that it is attracted to a magnetic field. It is this property that can be exploited to determine the level of oxygen in many background gases.

The magnetic susceptibility of oxygen increases or decreases inversely with its temperature. The thermo-paramagnetic analyzer uses a temperature-controlled measuring chamber and a strong magnetic field to create a flow of oxygen from the process gas (known as a 'magnetic wind') between a pair of thermistors. This 'magnetic wind' draws heat from the thermistors. The resulting change in the electrical resistance produces a signal that is proportional to the oxygen concentration in the sample gas.

#### Advantages of Thermo-Paramagnetic:

- No moving parts or consumable items which means lower cost of ownership
- Specifically calibrated to maximize the accuracy over the required range
- Resistant to corrosive sample gases
- Stable measurements
- Good balance of price and performance
- Compact design (especially for hazardous areas)
- Up to 6 months between calibrations



## Zirconium Oxide Based Sensors

Zirconium oxide sensors are based on the principle of a solid-state electrochemical cell. A layer of yttria-stabilized zirconium oxide is heated to between +600 °C and +700 °C, allowing oxygen ions to pass through it, from a higher concentration to a lower concentration. The movement of ions produces an electromotive force which is used to determine the oxygen concentration.

The greater the differential of oxygen on either side of the zirconium-oxide, the higher the voltage produced, allowing measurements from 100 % to less than one part per million. PST has four types to choose from; metallic sealed reference sensor (MSRS), air referenced zirconia, mini zirconium and micro ion pump sensor (MIPS).

### MSRS:

- Capable of measuring oxygen in a wide variety of applications
- Can measure in pure helium
- The measurement is stable and very quick to recover from air to low ppm O<sub>2</sub>
- Only one calibration gas is required

### Mini Zirconium:

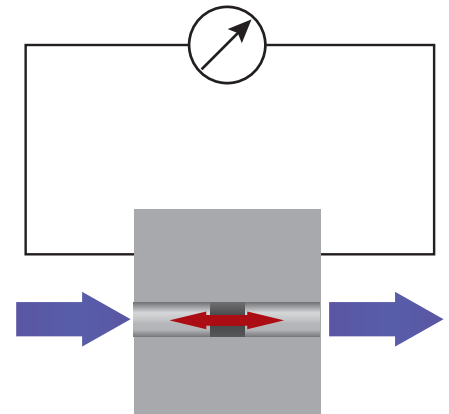
- Response time from air to ppm levels of oxygen in <10 seconds
- Service life for up to 3–5 years
- Low interference with other gases
- Small temperature dependence on the sensor signal
- Accuracy of ±1 ppm (0 to 50 ppm)

### Air Referenced Zirconia:

- Fast response
- Capable of measuring oxygen in a wide variety of applications
- Cost-effective
- Easy to calibrate
- Measuring range from 1ppm to 25 % or 0 to 96 %O<sub>2</sub>

### MIPS:

- Cost-effective transmitter that is simple to use
- Semi-automatic calibration feature (using air or a known gas)
- Short warm-up time compared to other zirconia sensors
- Measures 0.5 to 25 % or 0.5 to 100 %O<sub>2</sub>



## Electrochemical Sensors

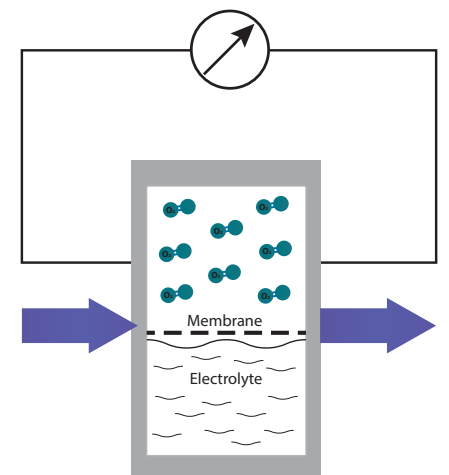
Galvanic sensors generally consist of four elements: a membrane, an electrolyte, a lead anode and a cathode. As the sample gas comes into contact with the sensor it diffuses through the membrane and any oxygen present reacts with the electrolyte conducting electrons to the cathode, generating a current. The more O<sub>2</sub> the stronger the current and the signal it generates.

There are several classes of sensor available, engineered to offer the optimum performance and maximum sensor life for the desired measurement ranges. Sensor variants include Pico-Ion and MS sensors for parts per billion oxygen; XLT sensors for CO<sub>2</sub> and acid gas backgrounds; -H sensors for use with H<sub>2</sub> or He backgrounds.

### Advantages:

- Measuring ranges available: 0 to 50 ppb up to 0 to 100 %O<sub>2</sub>
- Cost effective
- Small in size with low power consumption
- Simple to use and calibrate, in most cases with air
- Can measure trace oxygen in the presence of hydrocarbons or in flammable gases such as hydrogen

Solid-state ceramic electrochemical sensors operate on a very similar principle to the galvanic type. They are very chemically resistant and have a long operating life span.



## Process Oxygen Analyzers

### XTP601 – Oxygen Analyzer

**Technology: Thermo-Paramagnetic**

The XTP601 process oxygen analyzer helps to increase safety and enhance product quality. Based on the thermo-paramagnetic principle, it is rugged, reliable and gives precise measurements of oxygen in process gases. Typical applications include hydrocarbon storage tank or reactor blanketing, process control, natural gas monitoring and nitrogen/oxygen generator quality.

- Ranges available: 0...1 % up to 0...50 % & 20...100 % up to 90...100 %O<sub>2</sub>
- Meets the requirements of IEC61508 (SIL 2 Capable)
- Zero stability of better than 0.25 % of span per month
- Up to 6 months between calibrations
- LDL less than < 100 ppm O<sub>2</sub>
- Ideal for remote locations

### GPR-1800 (A)IS and GPR-2800 (A)IS Series

**Technology: Electrochemical**

The GPR-1800 series of ATEX certified intrinsically safe trace oxygen analyzers is designed for use in demanding process environments where the low detection limit of oxygen sensors can be well utilized. Our gas analyzers, are simple to use as well as easy and cost-effective to maintain thanks to the use of their maintenance-free galvanic oxygen sensors. The innovative liquid drain manifold, which is available as an option, protects and extends the sensor's life span in processes where liquids may be present in the sample gas reducing downtime caused by blocked filters.

- Four measurement ranges
- LDL of 50 ppb (GPR-1800)
- Measures in CO<sub>2</sub> with XLT sensor
- Temperature compensation fitted as standard
- A range of sample panels available

### GPR-1500 and GPR-2500 Series

**Technology: Electrochemical**

A wall mounted oxygen analyzer in a NEMA enclosure, suitable for indoor or outdoor. This single channel oxygen meter can be used with flow-through O<sub>2</sub> cells for in-line gas analysis in safe as well as hazardous areas where ATEX approval is needed. The low detection limit of 0.05 ppm offers ultra-low oxygen measurement down to a range of 0 to 10 ppm. Ideal for clean gas applications and when used with the XLT oxygen sensor type it allows measurement in pure carbon dioxide.

- Four user-configurable oxygen measurement ranges 0...10 ppm up to 0...25 %O<sub>2</sub>
- General purpose or intrinsically safe with barrier models
- Fast recovery from exposure to air
- Two alarms with GPR-1500 A analyzer model



*Designed for use in hazardous areas*



*Cost effective and simple to use*



*Compact dimensions for flexible installation*



Manual or automatic actuation

### OxyExtract – In-Line Oxygen Measurement

**Technology: Solid State Ceramic Oxygen Sensor**

IECEX and ATEX certified, the OxyExtract has the ability to measure O<sub>2</sub> concentration directly in the process gas stream without the need for complex sampling systems. It is perfectly suited to safety critical applications within the chemical and pharmaceutical industries as the sensor can be removed or replaced without opening the process to ambient air.

- In-line oxygen measurement for safety critical applications
- ATEX approved for hazardous area applications
- Manual or automatic actuation
- Available in 316 stainless steel and hastelloy C22
- Tri-clamp and flanged process connections
- Ideal for remote locations

## Oxygen Analyzers for Industrial Gases

### P12-MS

**Technology: Electrochemical or Pico-Ion MS**

Using long-life Pico-Ion oxygen sensors, the PI2 trace oxygen analyzer provides accurate and stable measurements of oxygen down to low parts per billion. Low cost of ownership through minimal maintenance of this high-performance oxygen analyzer make measurement of oxygen down to low ppb level easy and affordable for customers.

- Measuring trace O<sub>2</sub> in ultra-pure Ar, H<sub>2</sub>, He and N<sub>2</sub>
- Low cost of ownership
- User friendly and easy to operate and maintain
- Fast recovery from process upsets
- Integrated bypass sample system as standard
- Auto calibration system with true zero feature via O<sub>2</sub> scrubber (Option on MS)

### GPR-1600, GPR-2600 or GPR-3100

**Technology: Electrochemical**

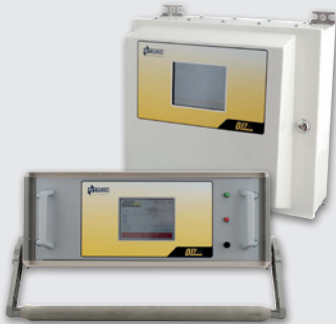
High-accuracy oxygen analyzers for monitoring gas in industrial processes from 0–10 ppm to pure O<sub>2</sub>. Utilizing high performance galvanic oxygen sensors these advanced instruments are simple to use with a common chassis, HMI and menu structure, so an operator only needs to learn operation of just one instrument for multiple gas analysis applications at various oxygen levels.

- Measuring ranges 0...10 ppm up to 0...100 % (model dependent)
- Easy to use HMI
- High accuracy (±0.02 ppm in lowest range)
- Four measurement ranges with manual or auto-ranging
- 24 month sensor life with normal usage
- Sample in CO<sub>2</sub> backgrounds with XLT sensor
- Available as bench-, 19" rack-, panel- and wall-mounted for flexible installation



LDL to less than 100 ppt

Easy to access sensor and flow control



Single or dual sensor models

### OxyOne – Oxygen Analyzer/Inerting System

**Technology: Zirconia and Electrochemical**

The OxyOne oxygen analyzer is a microprocessor based instrument capable of accepting multiple sensor inputs to control external user components or alarms based upon user configurable setpoint signal outputs.

- Fail safe oxygen measurement
- Dual oxygen sensor inputs
- Sensor trending & sensor life predictor
- RS 485 modbus communication
- Auto-calibration
- Data & alarm logging
- User configurable addressable alarms
- Rack, bench or wall mounted IP 65 enclosure



Monitors low level O<sub>2</sub>

### XZR400 Series – Trace Oxygen Analyzers

**Technology: MSRS**

The XZR400 series detects trace oxygen in inert background gases. Designed for applications in industrial gas production, welding, laboratories and cylinder filling. The main application is monitoring for low level (<4 ppm) O<sub>2</sub> in nitrogen, argon, helium, carbon dioxide and other inert gases to verify their purity. The fast response of the MSRS enables users to respond quickly to leaks and prevent contamination in silicon wafer production. The very low sample gas requirements (1 to 3 NI/hr) of the XZR400 makes it ideal for measuring expensive gases such as krypton or xenon.

- Measures oxygen from 0.1 ppm to 25 % or 100 %O<sub>2</sub>
- Simple and easy operation through touch screen HMI and universal power supply
- Fast response time (<2 seconds for sensor)
- Zero stability of better than 0.25 % of span per month
- High accuracy with built-in barometric pressure compensation
- Stable sensor with repeatability of ±0.1 % of reading
- 4...20 mA output and digital communications available
- Alarm relays for concentration, flow, and general fault available

Combined O<sub>2</sub> and H<sub>2</sub>O analyzer



### AM Trace Benchtop – Oxygen & Dewpoint Analyzer

**Technology: Zirconia and thick film polymer sensor**

AM Trace is a benchtop oxygen and moisture analyzer designed for additive manufacturing and laboratory-based applications. The electronic flow sensor allows you to reliably monitor the flow of gas into the analyzer. AM Trace utilises touchscreen technology and front facing inputs/outputs to integrate into any system with ease.

- Lightweight transportable case with handle
- Accurately monitors oxygen and moisture levels in the AM build chamber
- User-friendly touch-screen interface includes status notifications
- RS-485 serial communications
- Relay output for alarm / sounder beacon configuration
- Optional built-in pump to extract sample from process
- Measuring range of 1 ppm to 25 % <10 ppm to 2 %H<sub>2</sub>O

## SilO2 – Oxygen Analyzer

### Technology: Zirconia or Electrochemical

The SilO2 analyzer is designed to measure oxygen concentration on safety critical applications within the chemical, pharmaceutical and additive manufacturing industries. Applications include centrifuges, reactor vessels, mills, dryers, etc.

- Analyzer and sensor meets the requirements of IEC61508 (SIL2 Capable)
- Easy to read display of measured oxygen levels
- Push button calibration
- Solid state ceramic technology for harsh process applications
- Analogue output with RS485 option included
- Plug connector interface wiring terminals
- Inbuilt galvanic isolation barrier

## Microx – Oxygen Analyzer

### Technology: Zirconia or Electrochemical

The Microx is a highly reliable and cost-effective oxygen analyzer with a linearized 4 to 20 mA output and 3 alarm outputs. It has a minimum detection range of 0...1,000 ppm up to 0...25 % oxygen. This compact analyzer utilizes zirconia technology to give a reliable and fast response time, long life and no drift from oxygen measurement.

- Measurement range: 0...1 %, 0...1000 ppm up to 0...96 %O<sub>2</sub>
- Display resolution: 0...0.1 %
- Low cost compact oxygen analyzer
- LCD display and 4 button multifunction keypad
- Analogue 4 to 20 mA output for retransmission of measured signal
- RS232 communications provided
- 24VDC power supply (mains power optional)
- 3 configurable alarm relay contacts

## Gasenz – Ambient Oxygen Analyzer

### Technology: Zirconia or Electrochemical

The GASENZ monitor is designed for monitoring oxygen deficient atmospheres in any work area, where the risk of asphyxiation may occur where the use of inert gases such as N<sub>2</sub> or CO<sub>2</sub> pose a risk of asphyxiation if O<sub>2</sub> levels fall below safe levels.

- Measurement range: 0...25 %O<sub>2</sub>
- Low cost compact ambient oxygen monitor
- LCD display and 4 button multifunction keypad
- Analogue 4...20 mA output for retransmission of measured signal
- 70...230 VAC operating power options
- Long life, low maintenance zirconia sensor option
- Low cost compact ambient oxygen monitor



## Oxygen Transmitters

### Minox i – Intrinsically Safe Oxygen Transmitter

**Technology: Electrochemical**

IECEX and ATEX certified, the Minox i is a highly reliable and cost-effective two-wire, loop-powered transmitter with a linearized 4 to 20 mA output. The standard offering has a detection measurement range of 0...25 % oxygen. This compact transmitter utilizes advanced galvanic fuel cell technology that provides a long sensor life with a high level of accuracy and stability.

- Measurement range: 0...25 % O<sub>2</sub>
- Industry standard 4...20 mA output
- 24 VDC Power supply
- M12 Electrical connection
- Process connection KF40 as standard with optional flowcell
- ATEX certified for gas and dust groups (G&D)

### SenzTx – Oxygen Sensor Transmitter

**Technology: Zirconia or Electrochemical**

The SenzTx oxygen sensor transmitter is available with a choice of measurement technologies and process connections enabling the measurement of Oxygen in many applications. Configured with an Electrochemical sensor the SenzTx can be used to measure in low ppm(v) measurement applications while being powered through the 4-20mA loop making integration very easy. The Zirconia sensor enables fast response from exposure to ambient conditions, no measurement drift and longer sensor calibration interval and life.

- Measurement ranges cover : 0...10 ppm(v) / 0...96 % O<sub>2</sub>
- Industry standard 4...20 mA output
- RS485 Modbus communication
- In-line KF-40 or extractive flow through process connection options
- Self contained transmitter enables easy install and maintenance

### XTP501 – Thermo-Paramagnetic Oxygen Analyzer

**Technology: Thermo-Paramagnetic**

The XTP501 industrial oxygen analyzer helps to enhance product quality. Based on the thermo-paramagnetic principle, it is rugged, reliable and gives precise measurements of oxygen in process gases. Typical applications include cylinder testing, process control and nitrogen/oxygen generator quality.

- Ranges available: 0...1 % up to 0...25 % & 20...100 % up to 90...100 % O<sub>2</sub>
- Intrinsic error of better than 1 % of span (0.2 % O<sub>2</sub> in the suppressed zero ranges)
- Zero stability of better than 0.25 % of span per month
- Up to 6 months between calibrations
- LDL less than < 100 ppm O<sub>2</sub>



## Handheld and Portable O<sub>2</sub> Analyzers

### GPR-1000, GPR-1100, GPR-1200, GPR-2000 and GPR-3500

#### Technology: Electrochemical

A range of portables offering trace oxygen measurements from 0.1 ppm through to purity applications at 100% oxygen. These rugged portable instruments share the same advanced sensor technology as the online process oxygen analyzers ensuring confidence in their reliability and accuracy. Using the same HMI and menu structures for portable and online analyzers makes it extremely easy for operators to use both types of instruments on their site without need for extra training.

- Measurement ranges from 0...10 ppm up to 0...100 %O<sub>2</sub> (model dependant)
- ATEX versions available for ranges up to 25 %O<sub>2</sub> rated for gas groups IIC
- Up to 30 days battery life (40 hours with pump)
- Rugged – made to last in field operation
- 24 to 32 months sensor life span (in normal use)
- Lightweight – 2.5 kgs to 6 kgs
- XLT sensor options for CO<sub>2</sub> backgrounds



Internal pump option



Lightweight, rugged and highly portable

### Yellow Box – Portable Analyzer

#### Technology: Zirconia

The Yellow Box is a compact, intelligent, transportable oxygen analyzer providing an affordable and versatile solution for portable high purity oxygen measurement applications. Housed in a rugged high impact case and with microprocessor based electronics, the Yellow Box is the instrument of choice for demanding applications where a portable, accurate, fast and reliable high purity analysis is required.

- Measuring trace O<sub>2</sub> from 0 to 1,000 ppm up to 0 to 96 %O<sub>2</sub>
- Low cost of ownership
- User-friendly and easy to operate and maintain
- Fast response time from ambient air to low PPM oxygen
- Integrated and flow control

### PALM O<sub>2</sub> – Handheld Oxygen Analyzer

#### Technology: Electrochemical

The Palm O<sub>2</sub> can be used for welding gases, breathing air tanks and area monitoring for personnel safety. This cost-effective device has a range of accessories to allow ease of use in the different applications.

- 0...100 %O<sub>2</sub> measurement range
- Fast response time of T90 in <10 seconds
- Long sensor life up to 60 months
- Battery life up to 13,000 hours of continuous use



Integrated or remote sensors

## Combustion Control for Packaged Boilers

### XZR500 – Oxygen Analyzer for Combustion Control

**Technology: MSRS**

A rugged zirconium-oxide analyzer to measure percentage level (0...25 %) oxygen in combustion processes. The analyzer is supplied with a control unit and sensor head and the required inter-connecting cable. The sample can be extracted to the sensor and returned to the flue via the Pitot effect, so instrument air may not be required. The analyzer uses our MSRS technology and operates without the need for an air reference.

- Measures 0...25 %O<sub>2</sub> in flue gas
- Sample temperature up to +1,300 °C
- Multiple sample probe materials to match process
- Barometric pressure compensation
- Single or dual 4...20 mA outputs

### OXY-FLEX Series – Oxygen Transmitter for Combustion Control

**Technology: MIPS**

A compact and cost effective zirconium-dioxide transmitter to measure percentage level oxygen in combustion processes, excess air monitoring, bakery ovens and many more applications. The unit is configurable to measure either 0-25 % or 0-100 % oxygen and offers manual or automatic calibration to suit the customer's needs.

- Configurable outputs: 4...20 mA and 0...10 V DC or RS232 comms interface
- Cycling 3.3 V DC logic output allows direct monitoring of the O<sub>2</sub> sensor for diagnostic purposes
- Can be calibrated in normal air, 20.7 % O<sub>2</sub>, or in any other known O<sub>2</sub> concentration
- Selectable output filtering allows fast and dynamic or slow and stable output
- Externally triggered automatic or manual calibration
- Sample temperature from -100 °C / -148 °F to +400 °C / 750 °F
- IP66 certified enclosure in either Aluminum or Stainless Steel
- Certified CE, UKCA, ISO9001



## Related Products

### XTC601 – Binary Gas Analyzer

**Technology: Thermal-Conductivity**

The XTC601 binary gas analyzer utilizes the thermal conductivity property to accurately measure one of the two gases present in the sample. The instrument is very stable which gives the user confidence in measurement. This is important in safety applications such as CO<sub>2</sub>/H<sub>2</sub> membrane monitoring. The analyzer can be supplied with a fixed or flowing reference.

- Suitable for use in ATEX, IECEx, TC TR Ex & CCSAUS certified
- Hydrogen cooled generator variant with 3 calibration maps
- Optional light guide following NAMUR standard
- IP66 rated enclosure
- Compact and rugged design with an EExd enclosure and 4-20 mA output
- Stability ±0.5 % per month (of span)





Compact footprint

**GPR-7500 and GPR-7100 – Hydrogen Sulphide Analyzers**

**Technology: Electrochemical**

The GPR-7500 analyzer utilizes the low-power electro-chemical sensor technology to provide a cost-effective and easy to maintain online-installation hydrogen sulfide measurement in a small package. The GPR-7100 is a portable H<sub>2</sub>S analyzer version preferably used for spot checking the process or temporary usage during servicing or commissioning of a permanent installation gas analyzer.

- ATEX & UL certified variants
- Accurate to <2 % of scale with an LDL of 0.1 ppm H<sub>2</sub>S IP66 rated enclosure
- Dedicated sample handling systems are included
- 24 month typical sensor life (simple to exchange)

**Diving**

Analytical Industries Inc. supply a comprehensive range of sensors for the diving market for use in scuba equipment including commercial and military re-breathers. They also supply hand held and portable oxygen analyzers for dive cylinder testing. The Trimix unit also measures helium and displays the balance gas.

- Handheld analyzers for O<sub>2</sub> or CO
- Trimix analyzer measures O<sub>2</sub>, He and balance gas
- Handheld units with intergrated or remote sensors
- Replacement sensors for diving and rebreather equipment



**Medical**

Analytical Industries Inc. is a market leader in medical sensors for respiratory, anesthesia, incubator, ventilator and lung function equipment. We also supply portable and hand held oxygen and O<sub>2</sub> devices for hospital and clinical applications.

- Handheld analyzers for O<sub>2</sub>
- Handheld units with intergrated and remote sensors
- Replacement sensors for medical devices including respiratory, anesthesia & incubators



**Sample Systems**

**Michell Instruments**

XTP601 with PS601 sample system including liquid dump and eductor.



**Analytical Industries Inc.**

GPR-1800 AIS LD for natural gas with liquid drain system.



**Ntron Gas Measurement**

Extractive sample system for pharmaceutical applications.





Improving the world, one measurement at a time™

[ProcessSensing.com](http://ProcessSensing.com)

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