

The unrivaled performance of the Thermo Scientific APIX line of gas analyzers ensures fast, accurate and low detection ppt level impurity monitoring. As the first choice for continuous quality control of bulk gases, the analyzers combine atmospheric pressure ionization mass spectrometry (API-MS) with advanced electronics and software to create an innovative, powerful and cost-effective system.

## Thermo Scientific APIX $\delta$ Q and APIX Quattro Ultra-High Purity Electronic Gas Analyzers

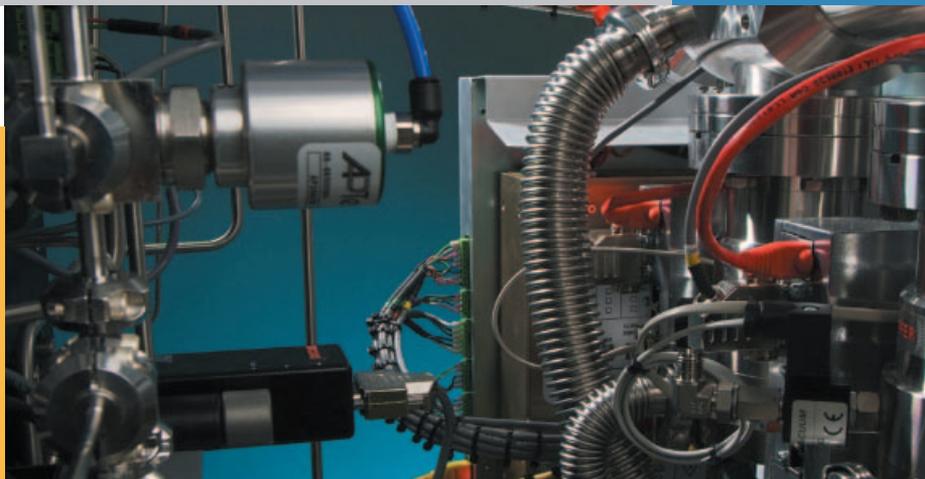


**Dual-Analyzer,  
Single-Bay Cabinet**



### Gas Analysis Applications

- UHP Nitrogen
- UHP Argon
- UHP Helium
- UHP Hydrogen



The superior performance of atmospheric pressure ionization mass spectrometers (API-MS) combined with state-of-the-art electronics and the most powerful process analysis software available makes the Thermo Scientific APIX line the analyzer system of choice for continuous quality control of bulk gases in the semiconductor and electronics industries.

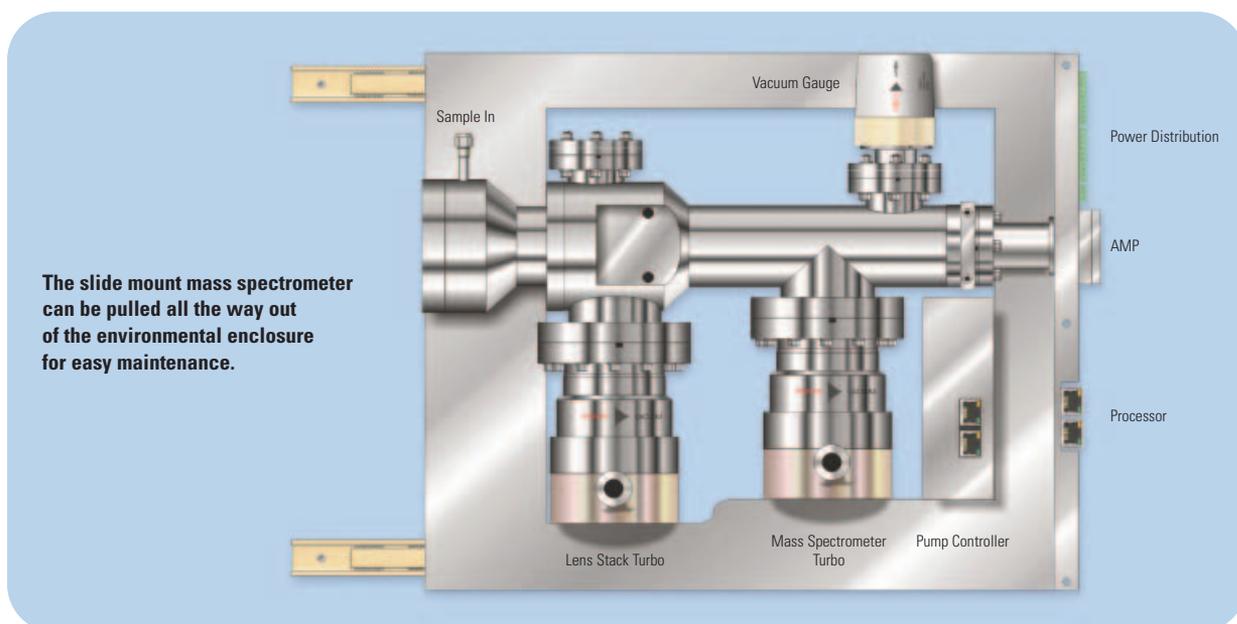
An API-MS offers a cost-effective alternative to conventional quality control techniques, allowing each bulk gas to be monitored for a range of potential contaminants, while achieving lower detection limits (up to 100 times better) than any other technology.

The APIX line provides a more complete analysis of impurities, including H<sub>2</sub>, CO, CO<sub>2</sub>, H<sub>2</sub>O, O<sub>2</sub>, CH<sub>4</sub>, Kr and Xe with other impurities available. With the advent of 300 mm wafer manufacturing placing even tighter impurity

controls on gas quality standards, this technology will continue to be the preferred method for ppt level detection.

### Features and Benefits

- Fast online measurement (typically <5 s) enables immediate response to gas supply upset conditions
- Fully integrated multi-analyzer analysis provides rapid contamination detection
- Superior sensitivity with lower detection capability of <10 ppt provides gas analysis suitable for the most stringent quality requirements today and in the future
- Backup capability allows each API-MS to support multi-stream analysis during individual API maintenance
- Industry standard communications protocols for plant control and integration (OPC, DDE, Modbus, Siemens 3964R, PROFIBUS, etc.)



### Principles of Operation

The APIX  $\delta Q$  and APIX Quattro employ positive ion API-MS, a technique that is widely used by the electronics industry for determining trace contaminants in ultra-high purity gases. The sample gas flows into the ion source at slightly higher than atmospheric pressure. A corona discharge is produced by a needle maintained at a high voltage which is located close to an orifice plate that forms the entrance to the lens stack. This results in a stream of electrons which flow from the orifice plate to the needle. The electrons react with the bulk gas which causes ionization of a large number of bulk gas molecules. Fortunately, the rare contaminating molecules that might occur in the bulk gas require less energy to become ionized than do nitrogen, hydrogen, helium or argon. For this reason, when any contaminating molecule appears in the sample stream, there is a very high probability that it will react with a bulk gas ion. When this reaction occurs, the charge is transferred to the contaminant which then becomes ionized. This charge transfer results in a very high proportion of the contaminant molecules becoming ionized. In fact, the efficiency is about 1,000 times that of other ionization techniques that operate within the vacuum chamber of the mass spectrometer.

A proportion of the sample gas, complete with the ionized contaminants, passes through a series of pressure reducing lenses before it enters the quadrupole mass spectrometer. A triple-filter unit is used that permits measurements up to 300 Daltons (atomic mass units) allowing the complete contamination spectrum to be measured at the detector. The pulse counting amplifier has a noise level of just 10 counts per  $10^6$ , when combined with the API source, enabling detection of 12 individual species as low as one part in  $10^{12}$  (1 ppt).

### Configuration

The APIX  $\delta Q$  configuration is comprised of a single-bay environmental enclosure containing the API-MS analyzer and the Air Liquide gas processor. The standard cabinet is configured for a relatively clean, temperature controlled environment but there are a number of cooling and purging options that can accommodate more demanding environments when necessary.

The APIX Quattro configuration is comprised of two single-bay environmental enclosures which contain four API-MS analyzers and the third bay houses the Air Liquide gas processor that provides

automatic ppb or ppt calibration of the analyzers. Each of the four mass spectrometers is mounted on slides in order to be pulled forward for easy maintenance access. The top-mounted hood contains the stream switching manifolds which are used for sample gas connections, allowing multiple streams to be connected to each independent bulk gas analyzer. This stream selection can be manually controlled or fully automated. As each API-MS is independent and has multi-stream capability, it is possible to monitor four bulk gas types with three API-MS while one is undergoing routine annual maintenance.

The hood assembly in both configurations incorporates a hydrogen safety system that ensures the mass spectrometers are safely shutdown in the event of a hydrogen leak. This safety device works independently of the analyzer power supplies. If limited mobility is required, a set of wheels can be provided that allow the unit to be safely pushed from one test point to another.

Each mass spectrometer is controlled by an embedded processor that runs a real-time operating system using battery-backed flash memory. The processor acts as a master to a series of internal controllers, interconnected by Ethernet cable. Each of these microcontrollers operates the individual subassemblies such as the gas processor and multi-stream inlet. The gas processor requires only a single calibration cylinder and incorporates a moisture calibration from a permeation tube device.

Internal power distribution is monitored and controlled by the local analyzer network—a design feature that extends the diagnostic abilities to Thermo Scientific GasWorks® software. Each multi-processor analyzer network provides redundant communication channels to permit reliable, stand-alone operation without the need for a PC workstation, transmitting sample stream data and diagnostic information directly to the DCS or SCADA system. Each communication channel can be configured for point-to-point fiber optic connection or hard-wired for current loop, multi-drop connection. Each analyzer can be configured with an embedded OPC server for seamless communications with a Microsoft® host or one of several industrial gateway protocols (Modbus, Siemens®, Allen-Bradley®, etc.). If the unit needs to be hard-wired to analog monitoring and control loops or digital alarm hardware, OPTO 22 SNAP and OPTOMIX protocols are fully supported and a wide range of hardware modules are available.

**Thermo Scientific APIX 80**

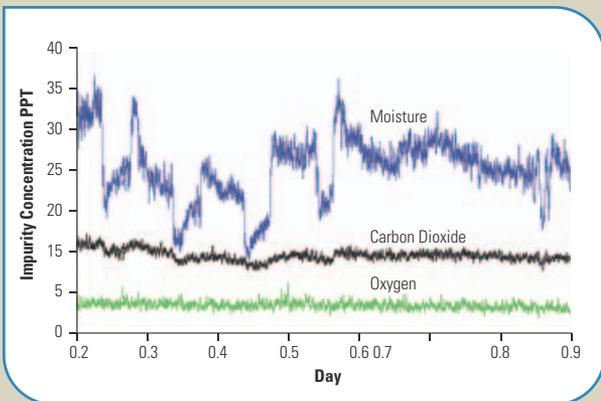


**Thermo Scientific APIX Quattro**



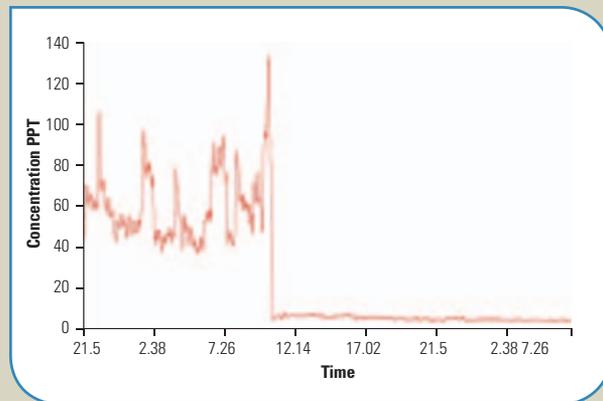
**Thermo Scientific GasWorks Software**

The Thermo Scientific GasWorks software suite provides an intuitive, information rich and flexible window into the operation of the mass spectrometer. Initial setup uses the remote computer which can then be used to display process measurement and diagnostic data, or it can be unplugged leaving the individual APIX to operate in full stand-alone mode. From conceptual design through several generations of production, fully accredited ISO 9001 quality procedures have been rigorously enforced by the software team. The software installation can be checked at anytime to ensure that it is verifiably complete and correct. Software updates can be uploaded remotely.



**Seven Day Contamination Trend—UHP Nitrogen**

This graph shows the daily temperature effects observed at a semiconductor fab over a period of seven days.



**Methane Contamination Trend—UHP Nitrogen**

The trace shows relatively high methane concentrations in the “pure” nitrogen supplied to a semiconductor fab. The APIX trace shows that an effective repair was completed which resulted in the methane returning to normal levels well below 10 ppt. This demonstrates the need for low ppt analysis.

Thermo Scientific APIX  $\delta$ Q and Thermo Scientific APIX Quattro

|  |  |   |
|--|--|---|
| General Specifications                     |  |   |
| Measurement Method                         | APIX $\delta$ Q:   | 1x triple filter  |
|  | APIX Quattro:  | 4x triple filter  |
| Mass Range                                 | 1-300 AMU  |   |
| Ion Source Type                            | Atmospheric pressure ionization  |   |
| Ion Source Background                      | Less than 1 ppt  |   |
| Amplifier and Dynamic Range                | 100 MHz pulse counting type  |   |
| Detector                                   | Pulse counting channel electron multiplier   |   |
| Detection Noise                            | 10 counts in $10^6$  |   |
| Detection Limit                            | < 10 ppt (component dependent)   |   |
| Analysis Time (typical)                    | < 1 second per component   |   |
| Stream Switching Time (typical)            | 15 minutes to < 1 ppb  |   |
| Bulk Gas Suitability                       | $H_2$ , $N_2$ , Ar, He   |   |
| Serial Connections                         | RS232, RS422, RS485  |   |
| Impurities Monitored                       | $H_2O$ , He, CO, $CQ$ , $H_2O$ , $O_2$ , $CH_4$ , Kr and Xe (other impurities available) |   |
| Dimensions                                 | APIX $\delta$ Q:   | 1.9 m (H) x 0.7 m (W) x 0.65 m (D) (74.80 in x 27.56 in x 25.59 in) |
|  | APIX Quattro:  | 1.9 m (H) x 2.1 m (W) x 0.65 m (D) (74.80 in x 82.68 in x 25.59 in) |
| Maximum Number of Components               | Not limited by software  |   |
| Maximum Number of Peaks                    | Not limited by software  |   |
| Maximum Number of Derived Values           | Not limited by software  |   |
| Maximum Number of Methods                  | Not limited by software  |   |
| Maximum Number of Sequences                | Not limited by software  |   |
| Maximum Number of Analog I/O               | No fixed limit   |   |
| Maximum Number of Digital I/O              | No fixed limit   |   |
| Maximum Number of Trend Windows            | No fixed limit   |   |
| Directly Supported Communication Protocols | Modbus, Siemens 3964, Siemens 3964R, DDE, OPC, VGCP, PVGCP                               |   |
| Additional Available Protocols             | Modbus+, Allen-Bradley DH, Allen-Bradley DH+   |   |

## Customer Care

Thermo Scientific instruments are recognized for outstanding performance and reliability. To ensure maximum uptime, we offer comprehensive service and support programs worldwide on all products via a network of factory-trained and highly qualified scientists and engineers. Our experts will keep your analyzer working to specification.

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