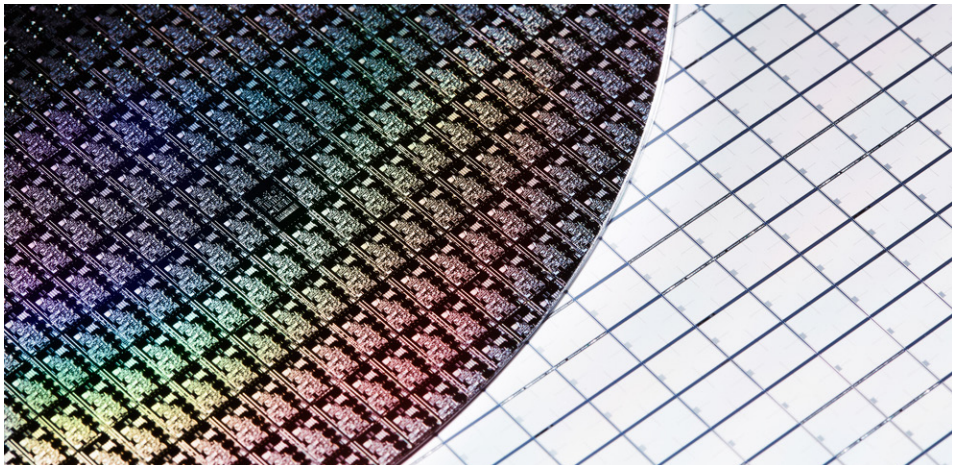
PRODUCT SPECIFICATIONS

APIX δQ and APIX Quattro

Ultra-High Purity Electronic Gas Analyzer

The Thermo Scientific™ APIX δQ electronic gas analyzer combines atmospheric pressure ionization mass spectrometry (API-MS) with advanced electronics and software to create an innovative, powerful and cost-effective system for quality control of bulk gases.



Features

- Fast online measurement (2 min analysis cycle time) enables immediate response to gas supply upset conditions
- Superior sensitivity with lower detection capability of <10 ppt provides gas analysis suitable for the most stringent quality requirements
- APIX Quattro offers fully integrated multi-analyzer operation providing rapid contamination detection for up to four ultra-high purity (UHP) gases

Thermo Scientific™ APIX δQ
Electronic Gas Analyzer

Introduction

The Thermo Scientific APIX δQ analyzer is the choice for continuous quality control of bulk gases in the semiconductor and electronics industries, due to its superior performance of API-MS, state-of-the-art electronics and powerful process analysis software.

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 δQ analyzer provides a more complete analysis of impurities in the electronics industry, including H2, CO, CO2, H2O, O2, CH4, Kr and Xe

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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.

Easily programmable short cut keys allow you to jump directly to frequently accessed functions, menus or screens. The larger interface screen can display up to five lines of measurement information while the primary screen remains visible.

Gas analysis applications

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

Principles of operation

The APIX δQ and APIX Quattro begin with sample gas flowing 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 are thermodynamically more favorably ionized than the bulk gases 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 quadruple mass spectrometer. A triple-filter unit is used that permits measurements up to 200 Daltons (atomic mass units) allowing the contamination species signals 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 individual species as low as 10 parts in 10^{12} (10 ppt).

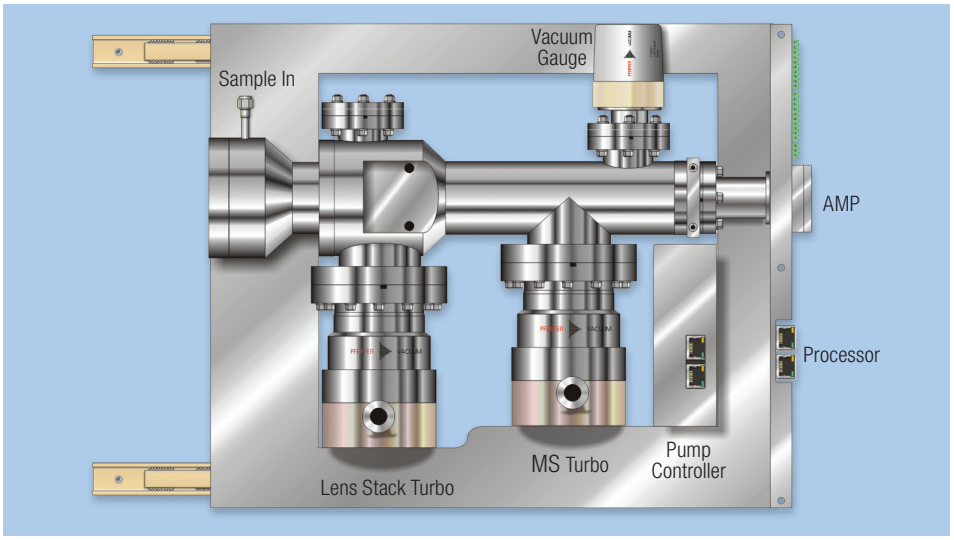


Figure 1. The slide mount mass spectrometer can be pulled all the way out of the environmental enclosure for easy maintenance.

Configuration

The APIX δQ configuration comprises a single-bay environmental enclosure containing the API-MS analyzer and the Air Liquide™ gas processor. The system can be offered with optional dry pumps for a clean room compatible solution. 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. The top-mounted hood can contain stream switching manifolds 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. 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.

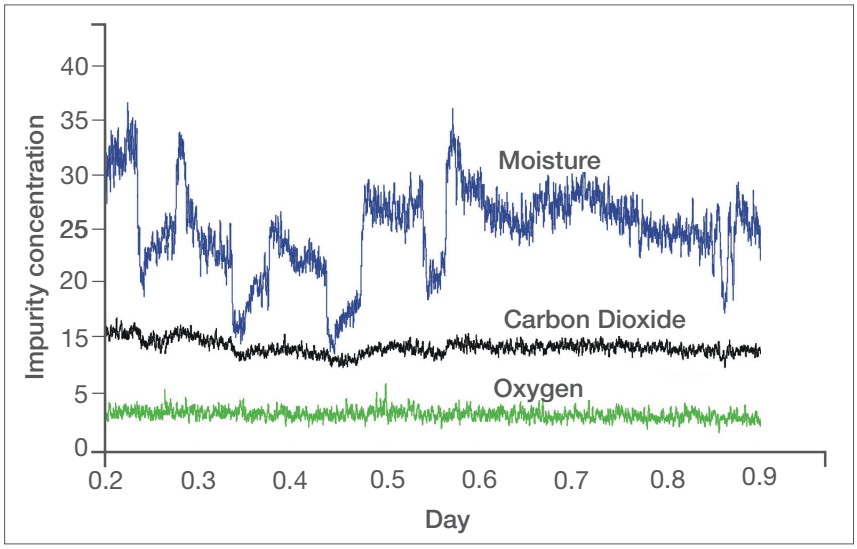
Each mass spectrometer is controlled by an embedded processor that runs a real-time operating system using battery-backed flash memory. The processor acts as a master to a series of internal controllers, interconnected by Ethernet cable. Each of these microcontrollers operates the individual subassemblies 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 he 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

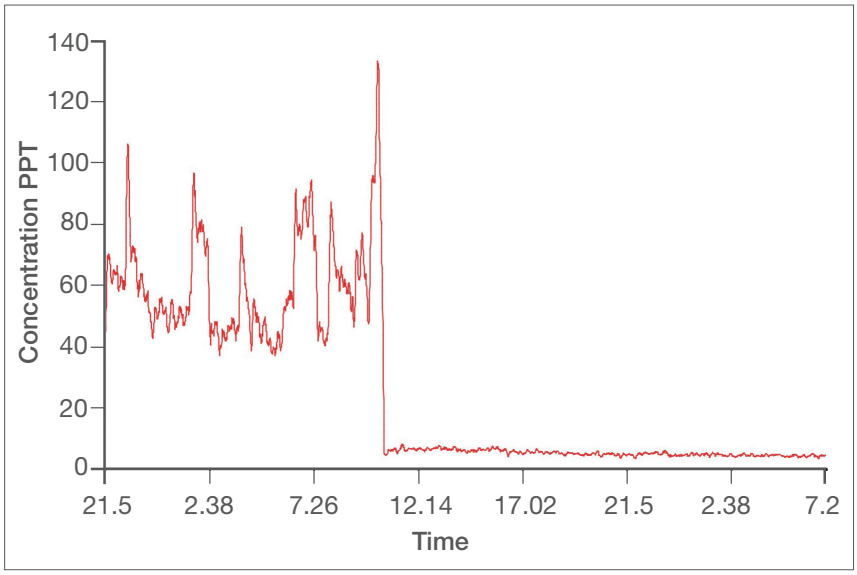
diagnostic information directly to the DCS or SCADA system. Each analyzer has two serial ports which can be configured for RS232, RS422 (4 wire, full duplex) or RS485 (2 wire, half duplex) communication. Each analyzer can be configured with an embedded OPC server for seamless communications with a Microsoft® host or with an industrial gateway protocol such as Modbus or Siemens®3964R. There are also options for analog and digital outputs if required.

Thermo Scientific™ GasWorks® software

The Thermo Scientific GasWorks software 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. The software installation can be checked at anytime to ensure that it is verifiably complete and correct. Software updates can be uploaded remotely.

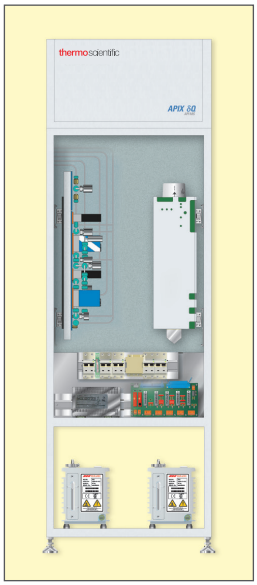


This graph shows the daily temperature effects observed at a semiconductor fab over a period of seven days.

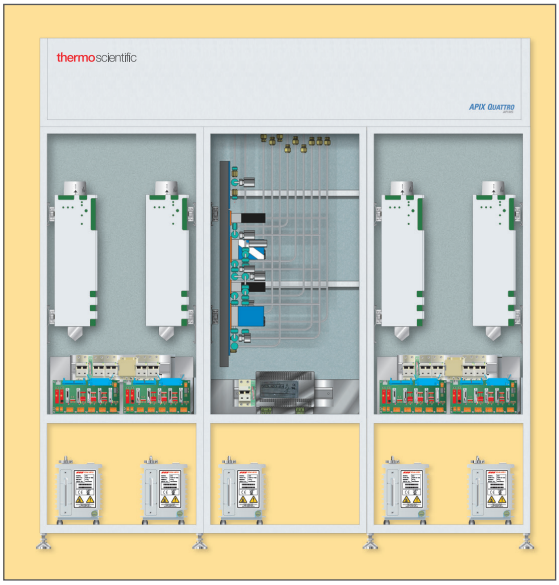


The trace shows relatively high methane concentrations in the “pure” nitrogen and an effective repair which resulted in the methane returning to normal levels well below 10 ppt.

Instrument Layout



The APIX δQ configuration is comprised of a single-bay environmental enclosure containing the API-MS analyzer and the Air Liquide gas processor.



The Thermo Scientific™ 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 sample gas connections and any stream switching manifolds. Stream selection can be manually controlled or fully automated.

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Thermo Scientific APIX δQ and APIX Quattro Electronic Gas Analyzer

Specifications	
Bulk gas suitability	H_2, N_2, Ar, He
Impurities monitored	H_2, CH_4, H_2O, CO, N_2, O_2, Ar, CO_2, Kr and Xe (depending on bulk gas)
Ion source	Atmospheric pressure ionization
Ion source background	Less than 10 ppt
Mass range	2-200 amu
Amplifier and dynamic range	100 MHz pulse counting type
Detector	Pulse counting channel electron multiplier
Detection noise	10 counts in 10^6
Lower Detection limits	Bulk N2: 10 ppt for O2, CH4, CO2, Kr and Xe; 30ppt for H2O, 50ppt for CO; 150ppt for H2 Bulk Ar: 10 ppt for O2, CH4, CO, CO2, Kr and Xe; 30ppt for H2O; 100ppt for H2 Bulk He: 10 ppt for O2, CH4, CO, CO2, N2, Ar, Kr and Xe; 30ppt for H2O; 50ppt for H2 Bulk H2: 10 ppt for CH4 and CO2; 30ppt for O2 and H2O; 150ppt for N2+CO combined
Analysis time	Cycle time 2 minutes
Stream switching time (typical)	15 minutes to < 1 ppb
Serial connections	RS232, RS422, RS485
Dimension	APIX δQ: 1.9 m (H) × 0.7 m (W) × 0.65 m (D) (74.80 in × 27.56 in × 25.59 in) APIX Quattro: 1.9 m (H) × 2.1 m (W) × 0.65 m (D) (74.80 in × 82.68 in × 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
Communication protocols	Modbus, Siemens 3964R, OPC, VGCP, PVGCP

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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