



Mass Spectrometers for Residual Gas Analysis Applications (RGA)



MASS SPECTROMETERS

for Residual Gas Analysis Applications (RGA)

Residual gas analysers (RGA) provide a unique window into the vacuum environment for contamination monitoring, leak detection and analysis of the species of interest within the vacuum chamber, water vapour for example. The Hiden residual gas analysers are quadrupole mass spectrometers configured in a broad range of products to address applications in vacuum processing, science and technology.

Hiden residual gas analysers are equipped with software that is intuitive and multi-level offering simple fail-safe* operation for a novice user whilst incorporating a broad range of useful and advanced features for the vacuum expert.

THE VACUUM RESIDUALS ROUTINELY ANALYSED INCLUDE:

Hydrogen, measured at mass 2, and of specific interest in UHV where outgassing can be the limiting factor for achieving ultimate vacuum.

Helium, measured at mass 4, and used as a search gas for leak detection. Hiden residual gas analysers include a dedicated leak detect mode, for fast response analysis of helium.

Water Vapour, measured at mass 18, is the most difficult residual to pump to UHV level without baking or pumping the vacuum chamber for extended periods.

Nitrogen and Oxygen, measured at mass numbers 28 and 32, with additional peaks measured for confirmation at mass numbers 14 and 16. The measurement of significant signal for the 'air peaks' is often the first indication of a chamber leak.

Hydrocarbons are analysed at several masses across a mass scan and typically can be identified at mass numbers 69 and 71, 55 and 57, 41 and 43, and 15 for alkanes and alkenes. The residual gas analyser broad mass scan with high sensitivity allows the user to get detailed information regarding the contamination level of the chamber.

Volatile Organic Compounds, measured at species specific masses including mass 78 for benzene, 91 for toluene, 31 for ethanol, and 45 for isopropyl alcohol.

Hiden's residual gas analysers analyse the above species with a real-time data display to give the vacuum user immediate and updated information about the health and trends of the partial pressure of the key vacuum residuals. Data is used for routine vacuum chamber monitoring, leak detection, for analysis of vacuum processes, and for advanced research studies.

WHAT OUR CUSTOMERS SAY:

"... I strongly feel (based on experience) that, products supplied by Hiden can be fully relied upon for their quality and reliability and equally well for the support from the Hiden family, right from the point of planning to the point of implementation."



*On board safety features include overpressure protection for both filament and detector by internal measurement as well as connection for an external overpressure protection device.

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HAL 3F 1000



Standard gold source and the UHV vacuum fired source

RGA SERIES

All Hiden residual gas analysers are application tested and calibrated to provide the highest quality performance, and they are backed by a 3 year warranty and lifetime service support.

- | | |
|---|----------------------------|
| ▶ vacuum diagnostics | ▶ molecular beam studies |
| ▶ reactive sputtering closed loop control | ▶ semiconductor production |
| ▶ leak detection | ▶ UHV/XHV surface science |
| ▶ vacuum furnace monitoring | ▶ vacuum process analysis |
| ▶ contamination analysis | ▶ UHV TPD |

THE HIDEN RGA SERIES INCLUDES THREE SPECIFICATION LEVELS:

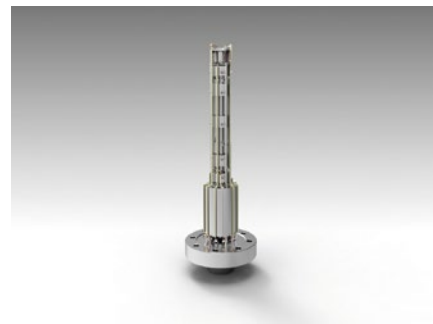
HALO - for residual gas analysis.

HAL/3F - triple filter mass spectrometers for analytical applications.

HAL/3F PIC - pulse ion counting detection for fast event studies.



HALO 100 RC



HAL/3F



HAL/3F PIC

CORE FEATURES/OPTIONS:

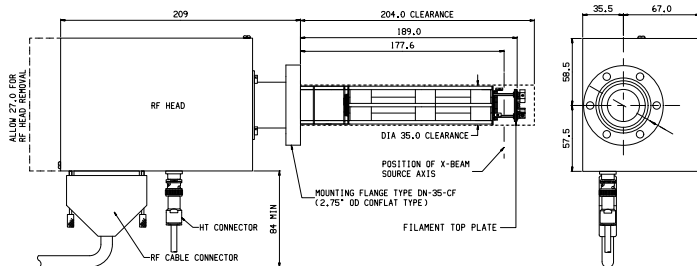
- ▶ mass range options: 50, 100, 200, 300, 510 amu
- ▶ ultra fast data acquisition - up to 650 measurements per second
- ▶ twin burnout-resistant oxide coated iridium filaments
- ▶ real-time background subtract
- ▶ range of ion source and shroud options
- ▶ integral mass library
- ▶ advanced analysis capability for complex gas interpretation
- ▶ high sensitivity helium leak detection, mass selectable for alternative search gases

HALO

for Residual Gas Analysis



HALO 201 RC



HALO Analyser and RF Head

- ▶ vacuum fingerprint: histogram & peak profile scan
- ▶ trend analysis: monitor multiple species > 80 partial pressure values in real-time
- ▶ leak detection
- ▶ zero blast and baseline drift are eliminated: compare and analyse vacuum chamber residual gas/vapour species

Detector options:

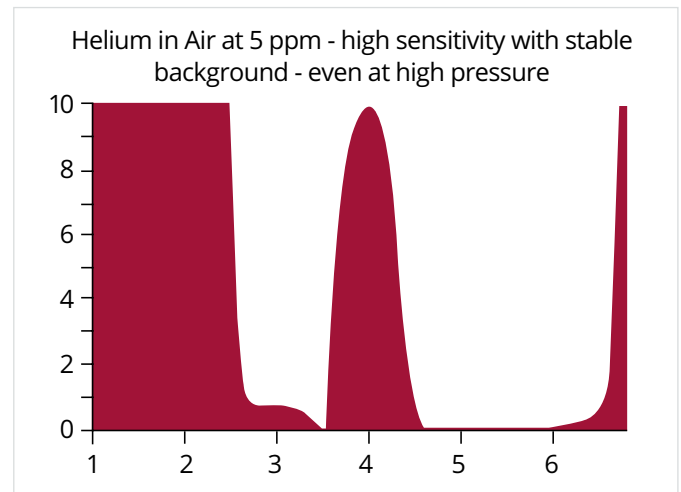
- Faraday-only, Faraday/Electron Multiplier

Sensitivity with:

- Faraday - detection to 1×10^{-11} mbar
- Electron Multiplier - detection to 2×10^{-13} mbar

Maximum Operating Pressure:

- 1×10^{-4} mbar



Hidden's RGA sensitivity for helium is 5 times* that of a typical analyser providing excellent leak detection performance.

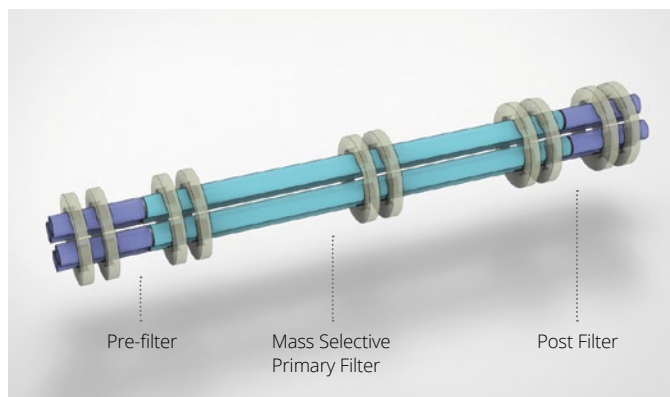
FEATURES:

- ▶ mass range options: 100, 200 and 300 amu
- ▶ detector options: Faraday or Faraday and Electron Multiplier
- ▶ PC Windows controlled
- ▶ **Automated Electronic Beam Shutter EBS™** optimises noise suppression
- ▶ **Automatic DeSat™ mode** for high speed scanning even in the presence of saturating signals

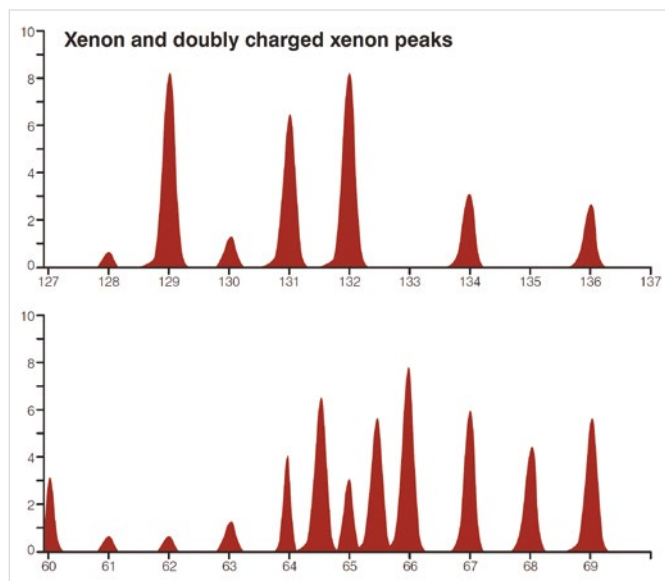
*Based on reference to published relative sensitivity data.

HAL/3F

Triple Filter Mass Spectrometer for Analytical Applications



Triple Filter Assembly.



3F Performance includes enhanced sensitivity for high mass species and increased resolution capabilities

- ▶ triple mass filter technology for high sensitivity with enhanced contamination resistance and abundance sensitivity
- ▶ application-specific ionisation sources for gas analysis, molecular beam measurement and UHV/XHV studies

Mass range options:

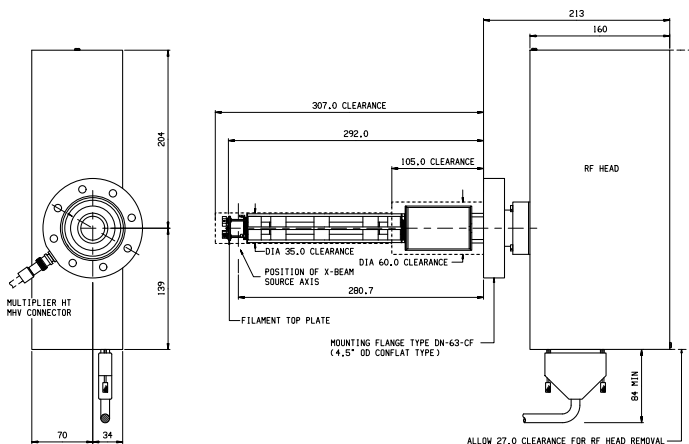
- 50, 200, 300 and 510 amu
- Series 1000 for mass range options up to 5000 amu

Detection limit:

- Faraday detector – 1×10^{-11} mbar
- Single Channel Electron Multiplier – 2×10^{-14} mbar

Maximum operation pressure:

- 2×10^{-4} mbar



HAL/3F Analyser and RF Head

FEATURES:

- ▶ mass range options: 50, 200, 300 and 510 amu
- ▶ detector: Faraday and Single Channel Electron Multiplier
- ▶ full control of field axis potential: ion source emission, electron energy, ion energy
- ▶ **Automated Electronic Beam Shutter EBS™** optimises noise suppression
- ▶ **Automatic DeSat™ mode** for high speed scanning even in the presence of saturating signals

HAL/3F PIC

Triple Filter Mass Spectrometer with Pulse Ion Counting Detection for Fast Event Studies

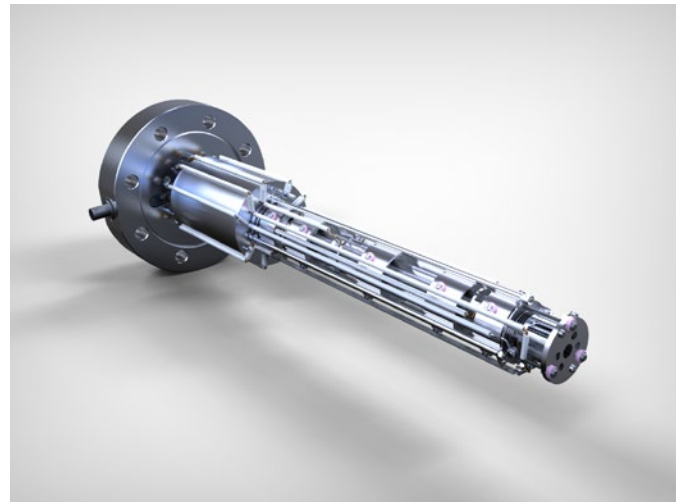
- ▶ Pulse ion counting detection for fast event studies including UHV TPD and for transient gas analysis
- ▶ 7 decade continuous measurement from 1 c/s to 10^7 c/s
- ▶ Multi-channel scaler detector option with time resolution to 50 nanoseconds

Mass range options:

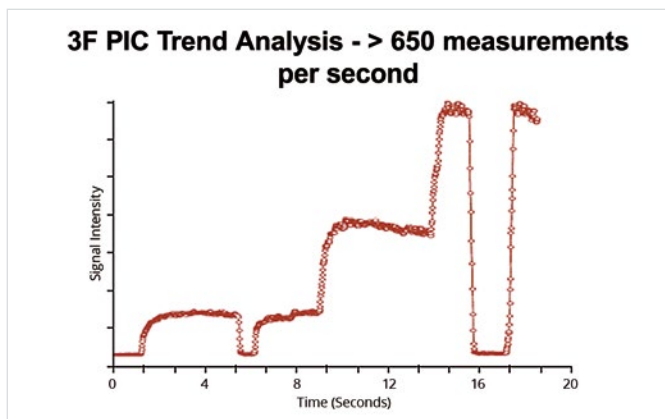
- 50, 300 and 510 amu
- Series 1000 for mass range options up to 5000 amu
- Detection limit with pulse ion counting detector $< 5 \times 10^{-15}$ mbar

Maximum operation pressure:

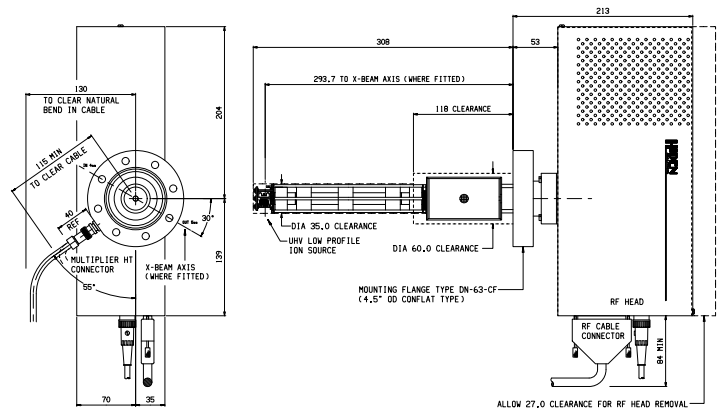
- 5×10^{-6} mbar
- 1×10^{-4} mbar with Faraday option



HAL/3F PIC



High quality transient data acquisition at PPM/PPB levels. Ideal for UHV TPD.



HAL/3F PIC Analyser and RF

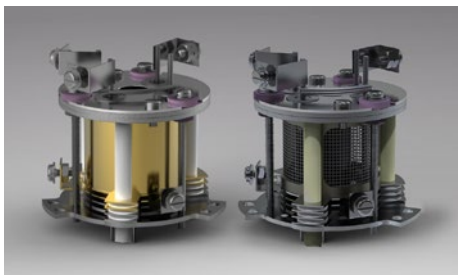
FEATURES:

- ▶ 7 decade dynamic range
- ▶ > 650 measurements per second
- ▶ detection to $< 5 \times 10^{-15}$ mbar
- ▶ signal gating for pulsed studies
- ▶ multi-channel scaler option with 50 nanoseconds time resolution
- ▶ PCA mode - Predictive count accumulation mode. Significantly extends electron multiplier life.

ION SOURCE OPTIONS



Standard and UHV low profile sources.



Standard gold source and the UHV vacuum fired source.



Laser cross beam source.

Hidden Analytical produces a wide variety of ion source types which can be fitted to our full range of RGAs. Ion source types are crucial to the performance of RGAs and having the ability to specify which source you require ensures our RGAs are custom configured for specific applications.

ION SOURCE OPTIONS

Standard RGA - A radially symmetric configuration for general applications.

UHV Low Profile - Optimised for UHV TPD studies enabling closer proximity of the ion source to the evolution surface.

Closed Sources - For high pressure studies with direct gas input used in conjunction with a differential pumping stage for the analyser.

Basic Cross Beam - The Basic Cross Beam source is used for analysis of molecular beams, where the beam may be liable to condense on ioniser surfaces. The source features an unobstructed pathway through the ionising region of the source. External shrouds are available to protect the quadrupole mass filter from condensing species.

XBS Cross Beam - The XBS Cross Beam is configured specifically for MBE deposition rate monitoring and control.

Laser Cross Beam Source - The Laser Cross Beam source includes two orthogonal unobstructed pathways for laser photon ionisation within the source cage region, providing an alternative to electron impact and electron attachment ionisation.

4 Lens Ion Optics with Integral Ioniser - Additionally enables analysis of low energy positive and negative ions generated externally to the analyser. For electron, photon and laser stimulated desorption studies.

Platinum Ion Source - This source is configured for improved operation in reactive gases. Radially symmetric, UHV compatible.

Gold Plated Ion Source - This source is configured to minimise the effects of source outgassing. Radially symmetric, UHV compatible. Available as Standard or Low Profile options.

Vacuum Fired Source - For UHV applications. Very low outgassing.

FEATURES:

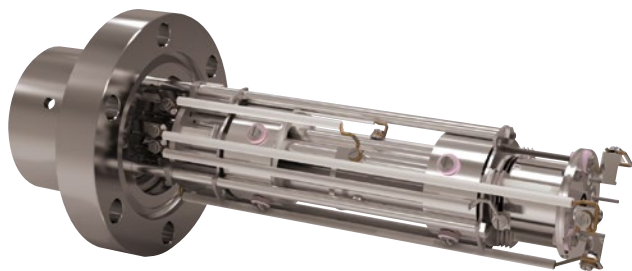
- ▶ standard filament material is oxide coated iridium
- ▶ other materials available on request
- ▶ ion source options are interchangeable
- ▶ open and closed sources available
- ▶ range of cross beam sources available
- ▶ standard and low profile options available

HMT

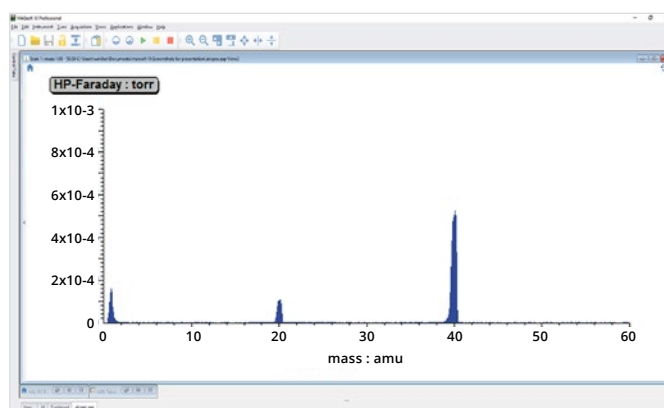
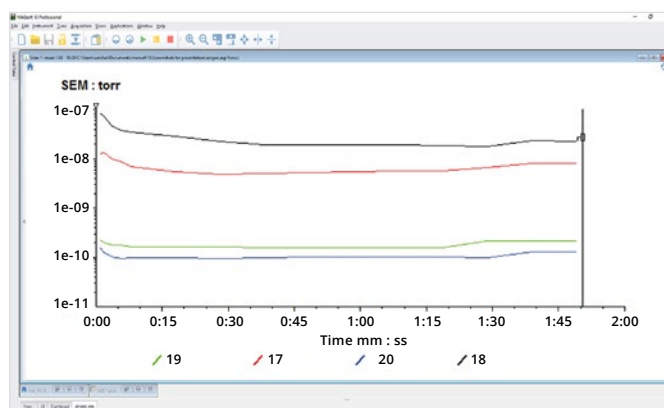
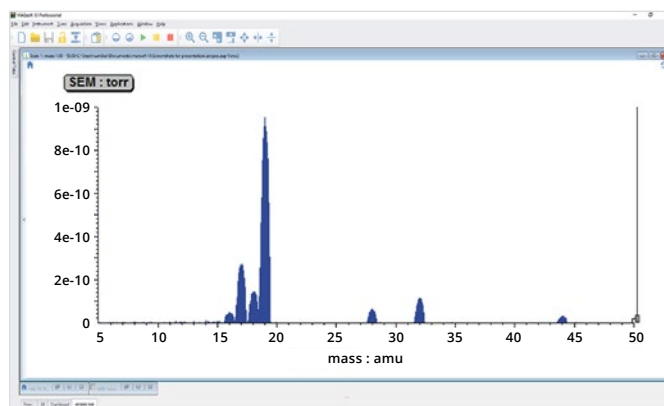
High Pressure Residual Gas Analyser

The Hiden HMT quadrupole mass spectrometer is a unique dual mode RGA system capable of operating at pressures up to 5×10^{-3} mbar without the need for differential pumping. Operation at this pressure is achieved using a specially designed ion source/quadrupole filter combination and software which corrects for abundance non-linearity. The unique high pressure specification makes the HMT ideal for process monitoring applications.

The HMT can also operate in RGA mode in the same way as a traditional quadrupole RGA. Dual Faraday and electron multiplier detectors provide partial pressure sensitivities down to the 10^{-13} mbar range.



HMT

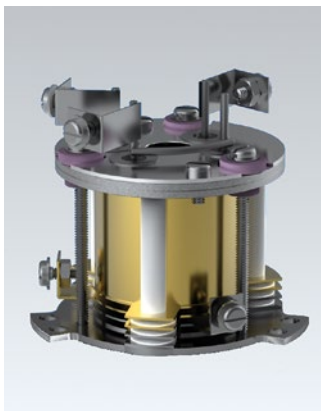


FEATURES:

- ▶ HMT mode for high pressure operation to 5×10^{-3} mbar
- ▶ RGA mode for high sensitivity operation to 10^{-13} mbar
- ▶ 100 amu mass range
- ▶ stability better than $\pm 1\%$ over 24 hours
- ▶ fast access mixed mode scanning
- ▶ real-time background subtraction

HAL

for Demanding UHV and XHV Applications



Gold plated ion source.



Vacuum fired ion source.

Radiation Resistant as standard. Radiation Hard option available.



HAL 201 with gold plated ion source.

FEATURES/OPTIONS:

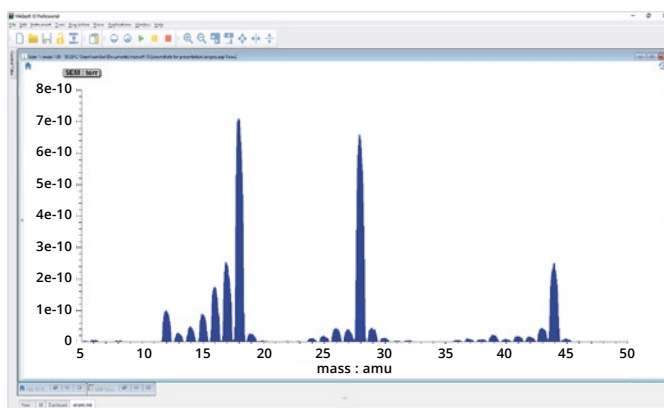
- ▶ mass range options: 100, 200 and 300 amu
- ▶ vacuum fired source for reduced ion source hydrogen outgassing
- ▶ gold plated ion source for reduced ion source peaks from electron stimulated desorption (ESD)
- ▶ electron impact ioniser with twin oxide coated iridium filament
- ▶ dual Faraday/Channeltron electron multiplier detector
- ▶ minimum detectable partial pressure of 5×10^{-14} mbar
- ▶ maximum operating pressure of 1×10^{-4} mbar
- ▶ radiation hard with remote RF version

The Hidden RGA for UHV are designed and configured for residual gas analysis in demanding UHV applications where critical measurements at UHV are required.

The HAL analyser can be configured either with a gold plated ion source for reduced ion source peaks from electron stimulated desorption (ESD) or with a vacuum fired UHV source for reduced hydrogen outgassing from the ion source. These specialised ion source configurations are ideally suited for applications where the total pressure is less than 5×10^{-10} mbar.

EPICS is the standard instrument control software used in many light sources around the world and the Hidden HAL system is fully compatible with EPICS software drivers.

- ▶ beam lines
- ▶ Tokamaks/Torus facilities
- ▶ particle accelerators
- ▶ synchrotrons
- ▶ UHV chambers



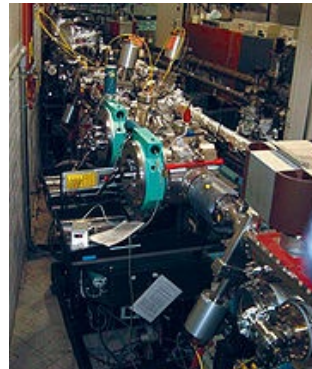
Typical profile spectrum for HAL system.

HAL 101X

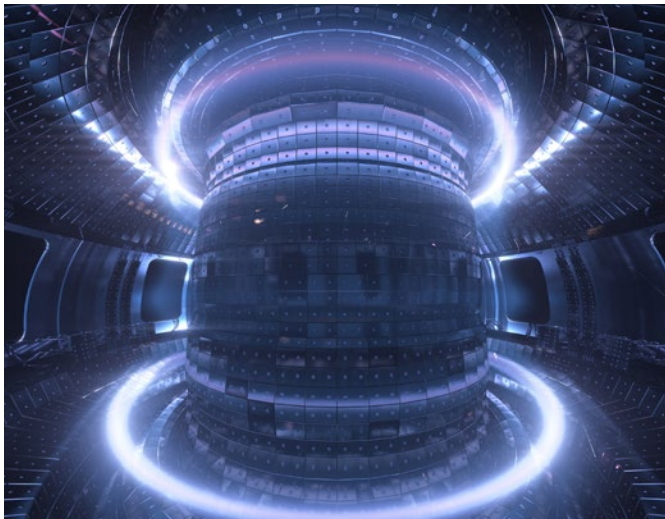
for Synchrotron/Accelerator and Tokamak/Torus Applications in Harsh Radiation Environments

Issues arise in situations involving very hard radiation environments due to the potential degradation of unprotected active electronic components, with protection typically requiring complex and bulky radiation shielding.

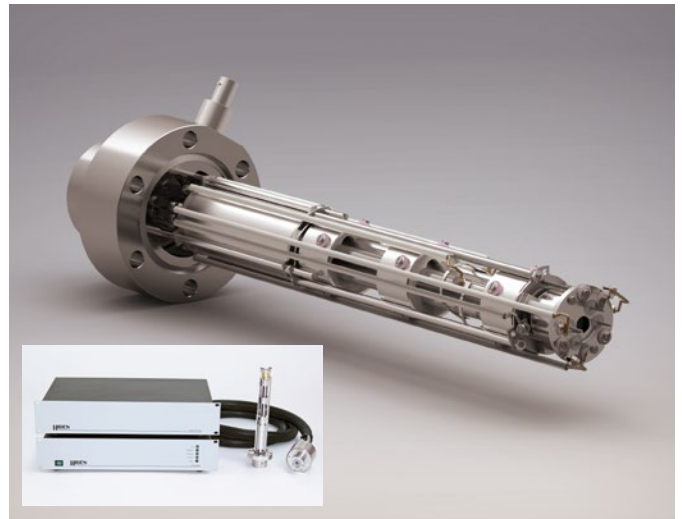
The new and innovative Hiden HAL 101X RGA avoids all radiation shielding requirements by employing an original technique to completely eliminate use of active electronic components in the vicinity of the RGA vacuum gauge element. Control electronics can be located up to a full 80 metres from the RGA gauge with no reduction in quadrupole mass filter frequency and with the full 100 amu mass range and performance relative to the standard close-coupled system.



National Synchrotron Light Source (NSLS-II) at Brookhaven National Laboratory (BNL) in Upton, New York.



Tokamak Plasma Fusion Reactor



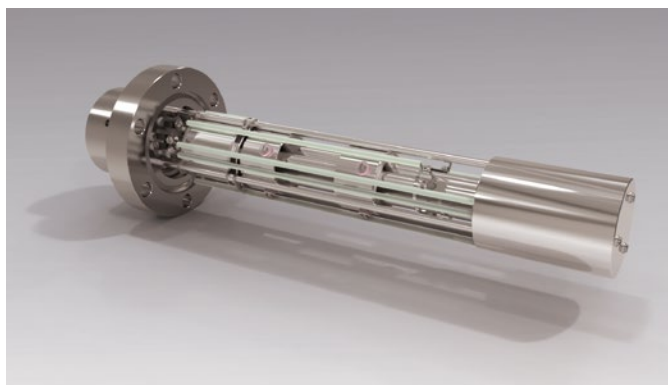
HAL 101X RGA

FEATURES:

- ▶ Includes Threshold Ionisation Mass Spectrometry (TIMS) mode for real-time quantification of hydrogen and helium isotopes
- ▶ multiple mass scanning modes
- ▶ real-time background subtraction
- ▶ automated mass scale alignment
- ▶ on-line adjustment of ion source and detector parameters
- ▶ individual mass channels can be monitored to identify any pressure divergence from user pre-set sensor levels

HALO 201 MBE

for Molecular Beam Epitaxy Applications



HALO 201 MBE analyser

The Hiden HALO systems are designed for RGA, gas analysis and process monitoring applications including leak detection, trend analysis and vacuum survey.

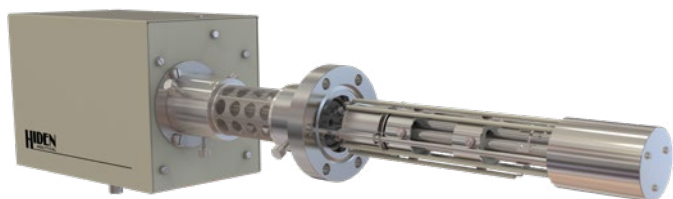
The MBE specific analyser is constructed from compatible materials, designed for prolonged use in MBE environments and includes, as standard, molybdenum wiring in place of copper and a contamination resistant ion source shroud.

► semiconductor

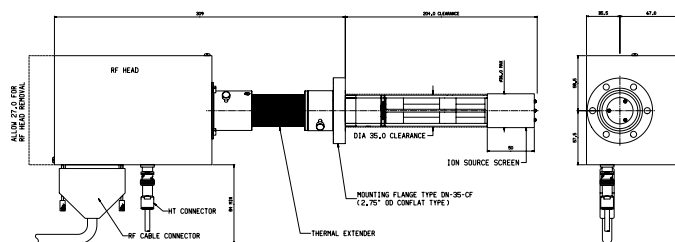
► oxides

► nitrides

► solar cells



HALO 201 MBE with thermal extender option



HALO 201 MBE analyser and RF head

FEATURES/OPTIONS:

- molybdenum wiring in place of copper wiring to improve RGA system lifetime in MBE environments
- contamination resistant ion source shroud
- dual Faraday/Channelplate electron multiplier
- minimum detectable partial pressure of 1×10^{-11} mbar (Faraday) and 2×10^{-13} mbar (Channelplate)
- thermal extender option for RGA operation during bakeout

XBS

Deposition Rate Monitor for Molecular Beam Analysis & Deposition Control

The Hiden XBS system is a quadrupole mass spectrometer designed for monitoring multiple beam sources simultaneously and uniquely offers beam acceptance through a 70° cone. Species-specific analogue signals are used for beam intensity output to the users' source control modules.

Beam acceptance apertures are configured individually for each specific process chamber source position, manufactured as replaceable plug-in elements to enable retrospective modification in event of chamber alteration. Purpose-designed with high contamination resistance for monitoring evaporating components and fragments in MBE processes. Manufactured with a triple stage mass filter and water-cooled fully-shrouded probe to protect the probe from the radiant heat sources and to inhibit probe contamination.

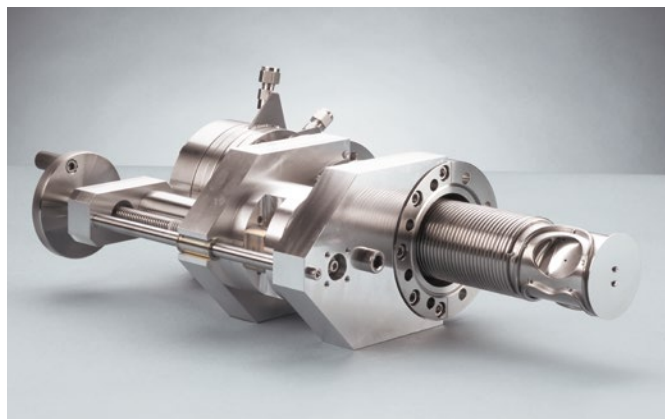
- ▶ **monitor and control in MBE processes**
- ▶ **molecular beam studies**
- ▶ **multiple beam source analysis**
- ▶ **photoionisation studies**
- ▶ **desorption/outgassing studies**
- ▶ **monitoring and diagnostics of contaminants in the process chamber**
- ▶ **high performance RGA with 3F series triple-stage mass filter**
- ▶ **high-sensitivity helium leak check mode for vacuum quality verification**

FEATURES:

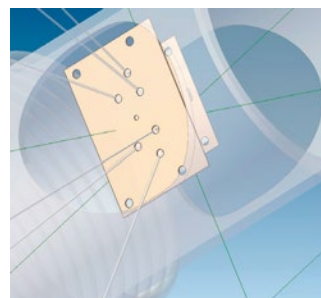
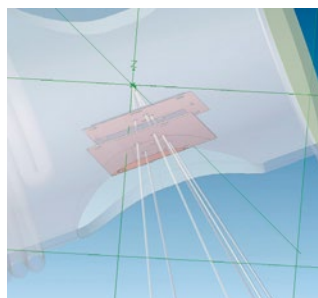
- ▶ high sensitivity - minimum detectable partial pressure 2.5×10^{-14} mbar
- ▶ mass range: 320 or 510 amu
- ▶ cross beam ion source, beam acceptance through +/- 35° to transverse axis
- ▶ beam acceptance apertures configured for beam source positions
- ▶ growth rate determination typically $< 0.01 \text{ \AA s}^{-1}$ (species dependent)
- ▶ optional water-cooled shroud



XBS probe



XBS probe with water-cooled shroud and Z-drive



3F PIC SERIES for UHV TPD

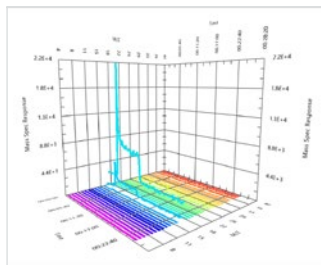
Hidden's 3F PIC Series quadrupoles are high precision triple filter analysers with digital detectors for ultimate sensitivity and time resolution in fast event studies such as UHV TPD. 3F PIC Series analysers are available with UHV compatible mass filter shrouds and a low profile ion source for close positioning to the desorption surface.

Application specific software enables the user to control temperature ramp profiles and collect data in the same program (TPDsoft) or to simply collect MS data and temperature in the same program (EGAssoft).

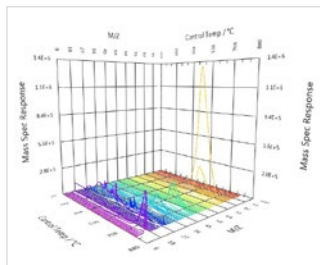
Both analogue and digital inputs are provided for synchronous acquisition start and sample temperature data display alongside mass channel data.



3F PIC with quartz shroud



3D bar data view in TPDsoft.



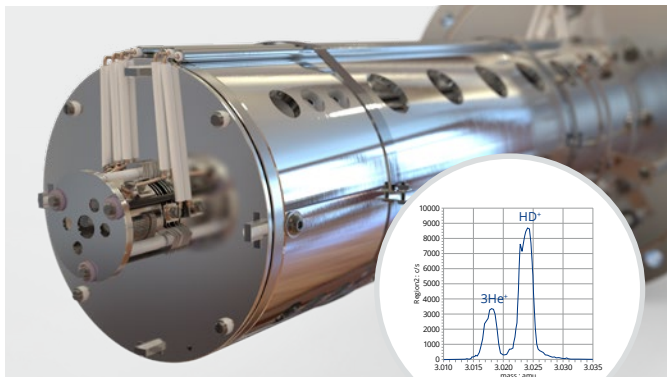
Display MS response vs. temperature.

FEATURES:

- ▶ low profile ion source
- ▶ range of shrouds
- ▶ fast data acquisition
- ▶ up to 650 data points per second
- ▶ wide dynamic range
- ▶ MCS mode option for time resolution to 50 ns
- ▶ 7 decade continuous log scale
- ▶ gating input for pulsed gas studies down to 100 ns gating resolution

DLS SERIES

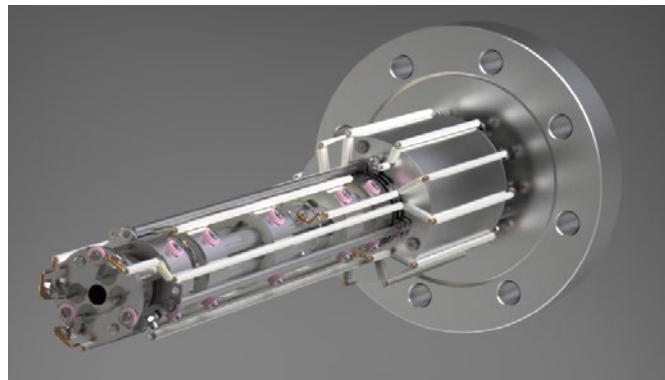
Ultra-high Resolution Mass Spectrometers for the Study of Hydrogen Isotopes and Applications in Nuclear Fusion Research



DLS-20

Unique dual-zone switching ultra-high resolution mass spectrometer for the analysis of hydrogen and helium isotopes and light gases.

- ▶ Industry first 20 mm rod diameter quadrupole mass filter for ultra-high mass resolution
- ▶ Software switchable dual-zone RF power supply for Zone H ultra-high resolution 1-20 amu operation and Zone I ultra-high stability 1-200 amu operation
- ▶ 0.006 amu mass separation in real time
- ▶ Sensitivity of both He in D_2 and D_2 in He is 1 ppm
- ▶ ^3He quantification in HD



DLS-10

Mass spectrometer specifically developed for the research and quantification of light gases and hydrogen isotopes by mass.

- ▶ 1-10 amu mass range
- ▶ Zone H ultra-high resolution operation for the separation and quantification of hydrogen and helium isotopes
- ▶ Sensitivity of both He in D_2 and D_2 in He is 10 ppm

DLS-1

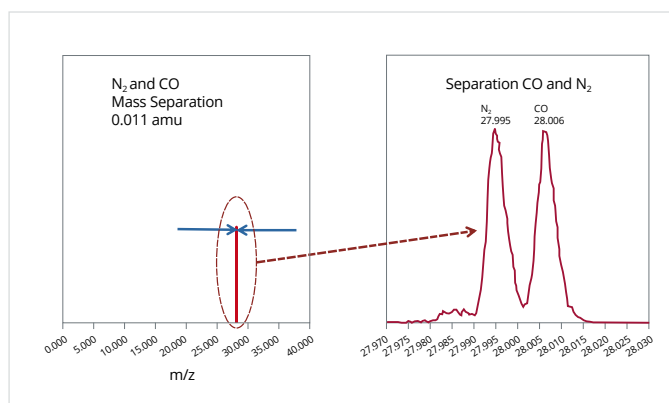
Mass spectrometer for real-time quantitative analysis of complex gas and vapour mixtures in fusion applications.

- ▶ 1-100 amu mass range
- ▶ Software driven recipes using threshold ionisation mass spectrometry (TIMS) for the real-time quantification of hydrogen and helium isotopes and deuterated hydrocarbons
- ▶ Sensitivity of D_2 in He of 100 ppm

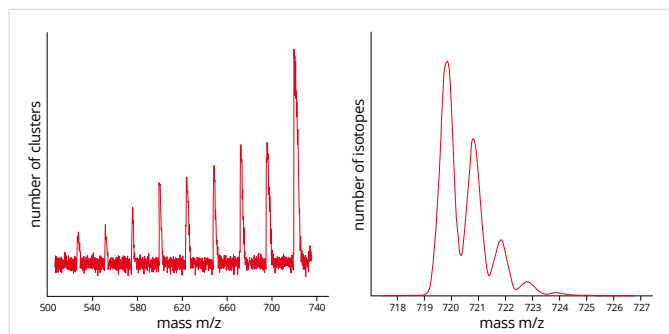


1000 SERIES RGA

9 mm quadrupole for scientific research applications



High resolution mass separation of N₂ and CO at 28 amu with Hiden 9 mm 3F 1000 Series mass spectrometers.



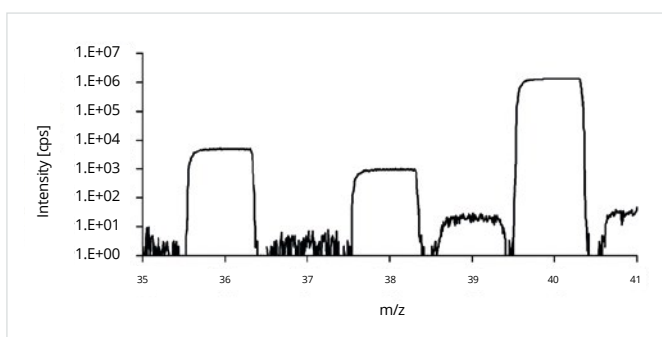
High mass transmission: Fullerene (C₆₀) vapour isotope fragment analysis.



The HAL 3F 1000 Series systems are designed for gas analysis in high precision scientific and process applications.

The triple filter quadrupole minimises contamination from unwanted ions, where pre and post filters operate at RF only. In combination with the longer primary mass filter and wider rod diameter of 9 mm, this results in increased: mass resolution, ion sensitivity, stability for precision/ratio measurements and high mass transmission.

HAL 3F 1000



High stability for precision isotope ratio measurements: ⁴⁰Ar/³⁹Ar geochronology research[1].

FEATURES:

- ▶ 9 mm molybdenum rod design
- ▶ mass range options: 50, 300, 510, 1000 and 5000 amu
- ▶ increased mass resolution, high mass transmission and ion stability
- ▶ full electron energy control 0-150 eV for complementary Threshold Ionisation Mass Spectrometry TIMS analysis mode
- ▶ with high sensitivity PIC detector and optional Faraday detector

HAL 1000 series 9 mm: Researchers[1] concluded that the Hiden system outperformed their expectations, and is comparable to the magnetic sector instrument they routinely use in this field of research.

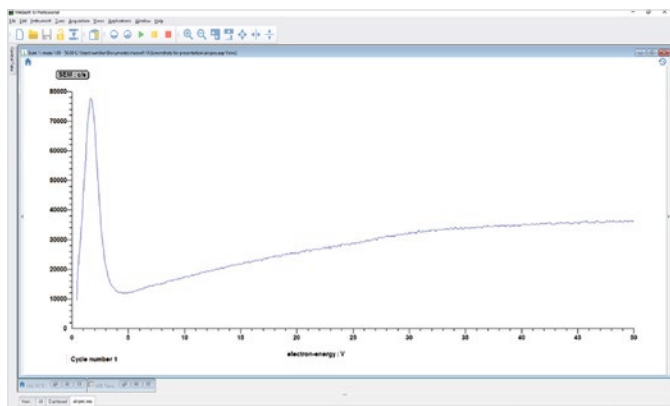
They measured the precision ratio of the ⁴⁰Ar/³⁹Ar isotopes over a two year period and concluded:

"Over two years the position of the flat peak centre did not move significantly even after maintenance events. For a ⁴⁰Ar beam size of 1 x 10⁶ cps, peak width is 0.9 amu at 10 cps and 0.84 amu at 5 x 10⁵ cps, clearly separating it from neighbouring masses. The stability of the Hiden QMS compares favourably to the MAP215-50. Air standard ⁴⁰Ar/³⁶Ar of the Hiden QMS 257.9±1.3 (n=34 since July 2006) compares to 293.1±3.3 (n=739) measured with the magnetic sector mass spectrometer instrument since the beginning of 2007."[1]

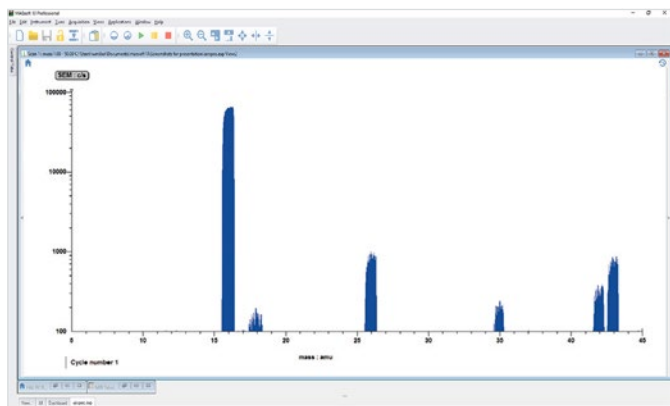
[1] Björn Schneider et al. 2009 Quaternary Geochronology 4 Pages 508-516

EPIC & IDP SERIES

for UHV Analysis of Neutrals, Radicals & Ions



O ions formed by dissociative electron attachment $e + N_2O \rightarrow N_2^+ O^-$.



Mass spectrum of negative ions formed by low energy electron attachment.

EPIC FEATURES:

- ▶ pole bias mid-axis potential
- ▶ positive and negative ion detection
- ▶ Electron Attachment Mass Spectrometry (EAMS)

IDP FEATURES:

- ▶ pole bias mid-axis potential
- ▶ positive and negative ion detection
- ▶ Electron Attachment Mass Spectrometry (EAMS)
- ▶ 4 lens ion optics

The Hidden EPIC and IDP have all the features of high performance RGAs - but with the addition of pole bias mid-axis potential and negative ion capability making them outstanding research grade mass spectrometers.

The EPIC system is factory-upgradeable for inclusion of an energy filter, either the Bessel box or Hidden 45° sector field type, ensuring compatibility with the Hidden plasma/SIMS series including the EQP, EQS, PSM and SIM probes.

The Hidden IDP is for the direct analysis of low energy ions and neutrals from UHV surface science techniques. Applications include electron stimulated desorption, photon stimulated desorption and thermal desorption studies.

▶ UHV surface science

▶ electron stimulated desorption

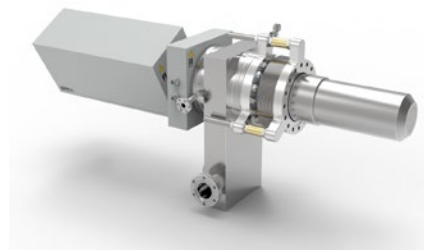
▶ photon stimulated desorption

▶ thermal desorption studies

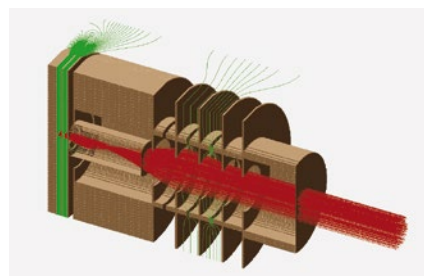
▶ radical analysis

▶ energy and biofuels

▶ time resolved studies



EPIC 1000 Series with shroud and aligner fitted.



Simulation showing the focussing properties of IDP 4 lens ion optics.

RGa CONTROL SOFTWARE

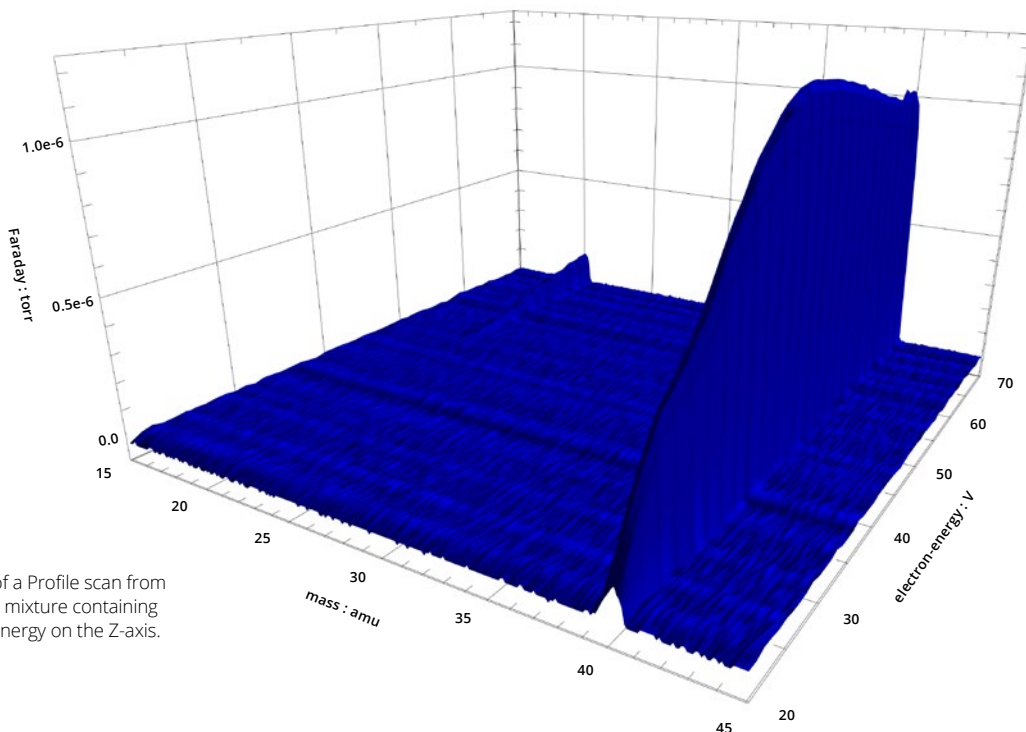
MASsoft & iRGA Software

All Hiden Residual Gas Analysers are supplied with MASsoft mass spectrometer PC control software.

MASsoft Professional software is intuitive and multi-level offering simple operation for a novice user whilst incorporating a broad range of useful and advanced features for the vacuum expert.

MASsoft introduces a new feature for creating 3D graphs.

A 3D Graphical View can be created and viewed either while collecting data or after the experiment has been completed. The 3D plot views can be rotated and the angle view can be adjusted by the user.



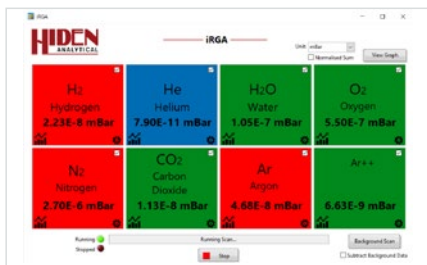
A 3D Graphical View of a Profile scan from 15 to 45 amu of a gas mixture containing argon, with electron energy on the Z-axis.

SOFTWARE FEATURES:

- ▶ template driven quick start operation
- ▶ multiple RGA operation over ethernet link
- ▶ real-time data display with zoom feature
- ▶ mixed mode scanning including trend analysis view of selected species from broad mass scans
- ▶ statistical analysis and peak integration
- ▶ accessible data with copy/paste functions and automated data export
- ▶ auto mass alignment
- ▶ integrated mass spectral library



RC RGA interface

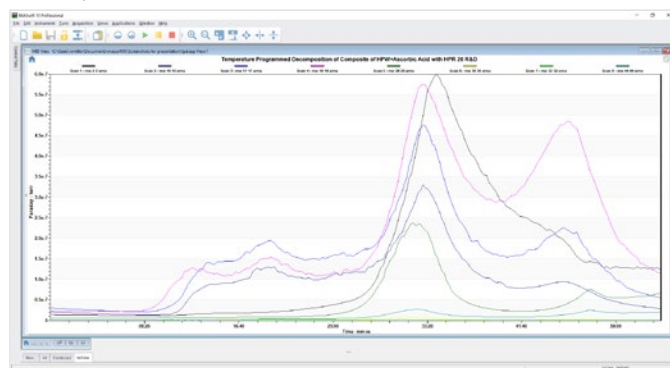


iRGA simple scan.

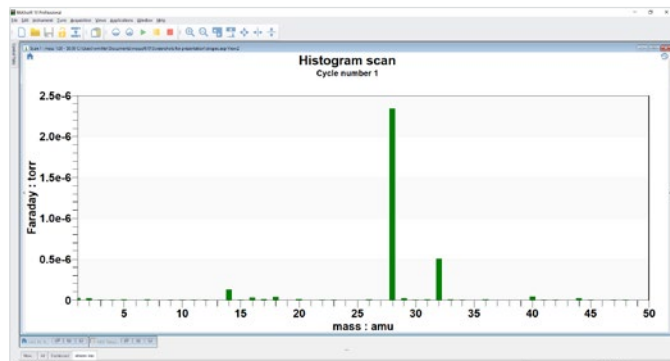
iRGA – Intuitive RGA program for simple monitoring of the partial pressures of residual gases and vapours in your vacuum chamber.

MASsoft Professional PC software provides mass spectrometer data acquisition and control, providing a user friendly interface for the acquisition of mass spectrometer data. Behind the simplicity of the point and click automatic scan gallery are layers of flexibility allowing users to acquire, store and present mass spectrometer data in formats directly suited to their application.

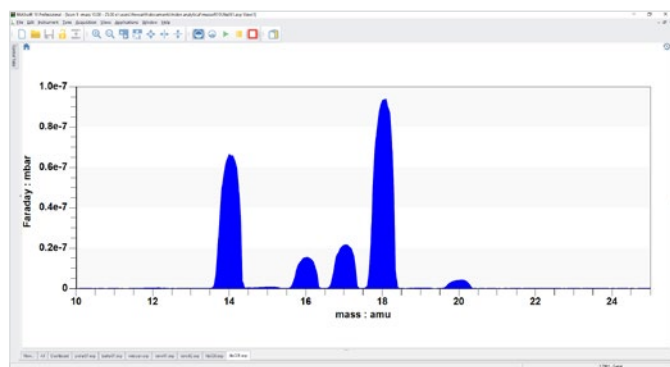
- ▶ background subtract - for real-time comparison of vacuum quality
- ▶ extract trend analysis for any mass peak(s) within the scan
- ▶ 4, 6 or 8 decade high dynamic range scan modes
- ▶ derived data values for data presentation in % or PPM for example



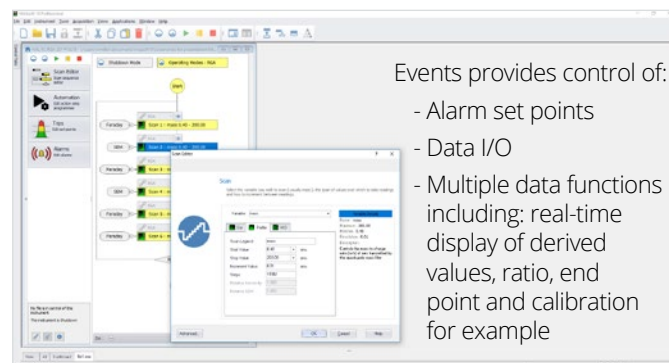
Trend analysis



Mass scan - histogram



Mass scan - profile



Events provides control of:

- Alarm set points
- Data I/O
- Multiple data functions including: real-time display of derived values, ratio, end point and calibration for example

MASsoft control - fully editable scan sequence with selectable: scan mode, detector and mass spectrometer parameters set individually for each scan in the sequence.

RGA MASS SPECTROMETER INTERFACE INCLUDES:

- ▶ ethernet TCP/IP, USB and RS232 communication links
- ▶ I/O subsystem with: multi-protocol RS485 links for external devices, mass flow controllers, CO analyser, total pressure gauges for example
- ▶ 5 channel TTL for process control/automatic start - stop trigger
- ▶ analogue data input and output options

HiddenAPPLICATIONS

Hidden's quadrupole mass spectrometer systems address a broad application range in:

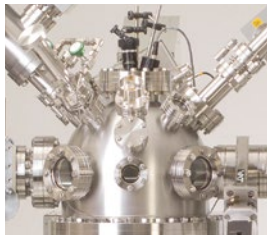
GAS ANALYSIS

- ▶ dynamic measurement of reaction gas streams
- ▶ catalysis and thermal analysis
- ▶ molecular beam studies
- ▶ dissolved species probes
- ▶ fermentation, environmental and ecological studies



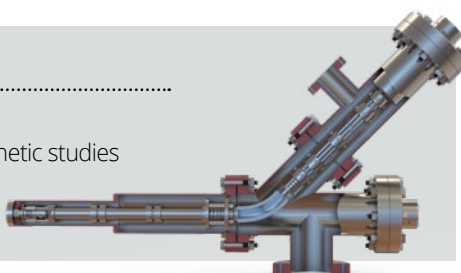
SURFACE ANALYSIS

- ▶ UHV TPD
- ▶ SIMS
- ▶ end point detection in ion beam etch
- ▶ elemental imaging – 3D mapping



PLASMA DIAGNOSTICS

- ▶ plasma source characterisation
- ▶ etch and deposition process reaction kinetic studies
- ▶ analysis of neutral and radical species



VACUUM ANALYSIS

- ▶ partial pressure measurement and control of process gases
- ▶ reactive sputter process control
- ▶ vacuum diagnostics
- ▶ vacuum coating process monitoring



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