HIDEN ANALYTICAL

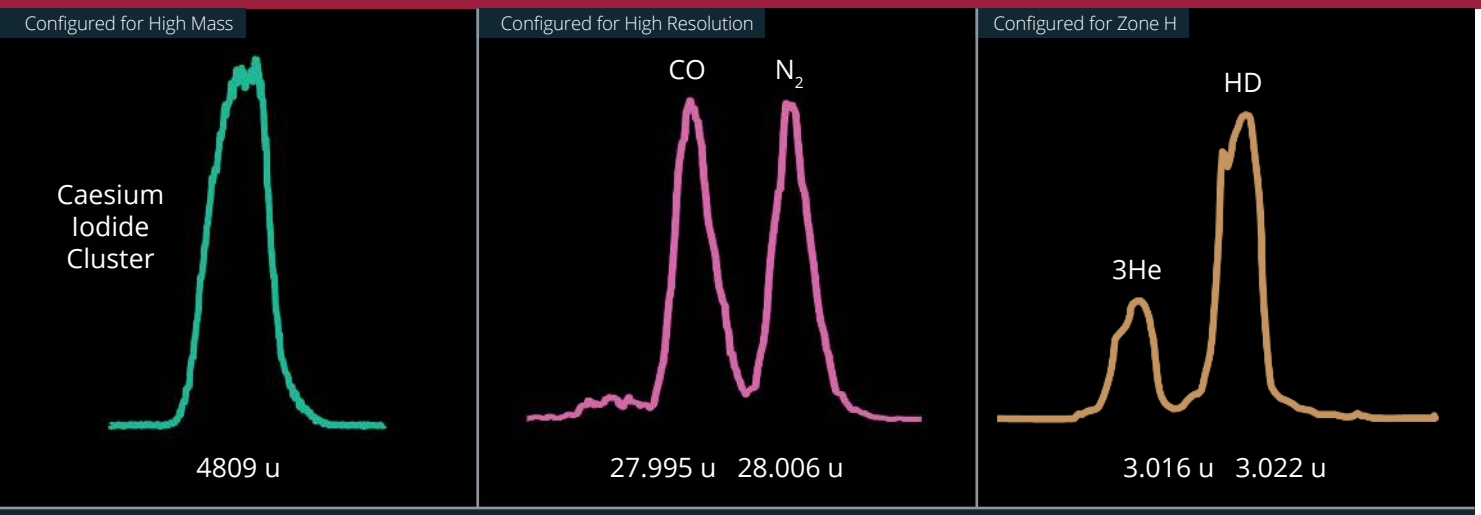



# Advanced Multi Zone Quadrupole Power Supply, AMZ-QPS

## 1000 Series RF Generators

- **Hiden AMZ-QPS shown in comparison with the QPS used with Single Filter Quadrupoles.**

# Detailed product information / introduction




## Advanced Multi Zone Quadrupole Power Supply, AMZ-QPS

The AMZ-QPS offers configurations that will maximise your performance - whatever your application.

Hiden's Advanced Multi Zone, High Power Quadrupole Power Supply complements the range of 9 and 20 mm (pole diameter) quadrupole mass filters.

Hiden instruments give the very best performance in terms of reliability, stability, mass range and resolving power and these attributes are a result of both the innovative design and the uncompromising quality of component selection used in the manufacture of the AMZ-QPS and the Quadrupole Filter itself.

## Applications:

- Cluster Analysis
- SIMS
- RGA
- Nuclear Fusion
- Geochronology
- Isotope Studies
- Plasma Ion Analysis
- Gas Analysis

## Key Features

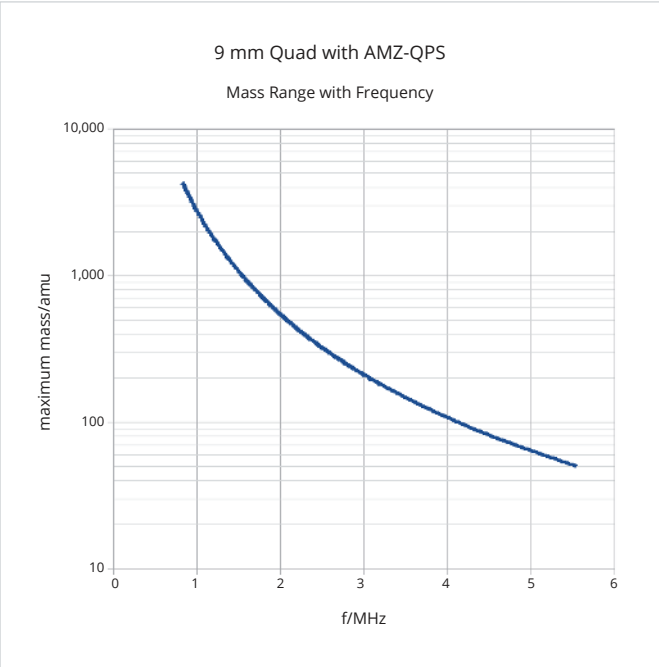
- Flexibility - optimises the balance between Resolving Power and Mass Range
- Mass Range to 5,000 amu
- Resolving Power, M/ΔM, to 4,000
- Peak Widths down to 0.003 amu
- Frequencies from 0.8 to 5 MHz
- Switchable Zones of Operation
- Pole Bias ('Energy') Capability
- Ultra Stable Voltage
- 100 Watts of True RF Power

# Example Data

## Understanding Resolution and Mass Range

Resolving Power is proportional to frequency while Mass Range is inversely proportional. But the ultimate levels of both will be determined by the amount of RF Power made available within the QPS.

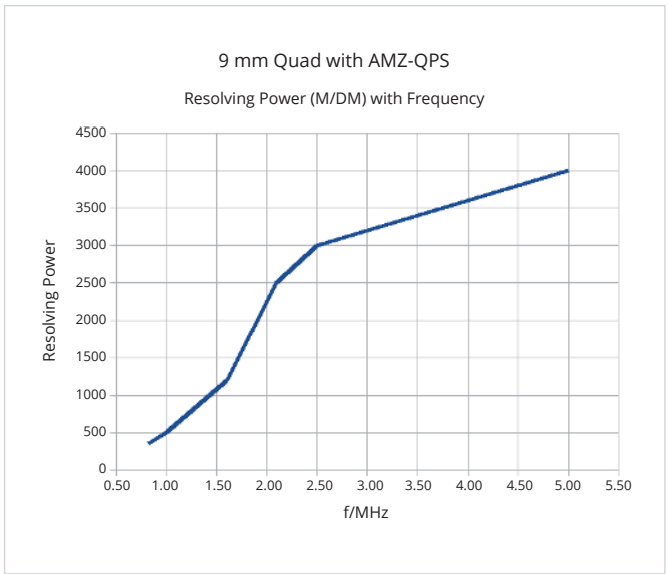
The QPS contains an electrical coil, into which RF Power is injected. When this coil is connected to the quadrupole, a resonance occurs and RF Power is then converted into the RF Voltage impressed onto the Quadrupole Filter rods.




The level and frequency of this voltage determines the mass measured.

At high frequency, a high voltage will occur at a low mass, while at low frequency it will occur at a high mass. So it's important that the QPS develops sufficient RF Power to provide a range of frequencies broad enough to suit your application.

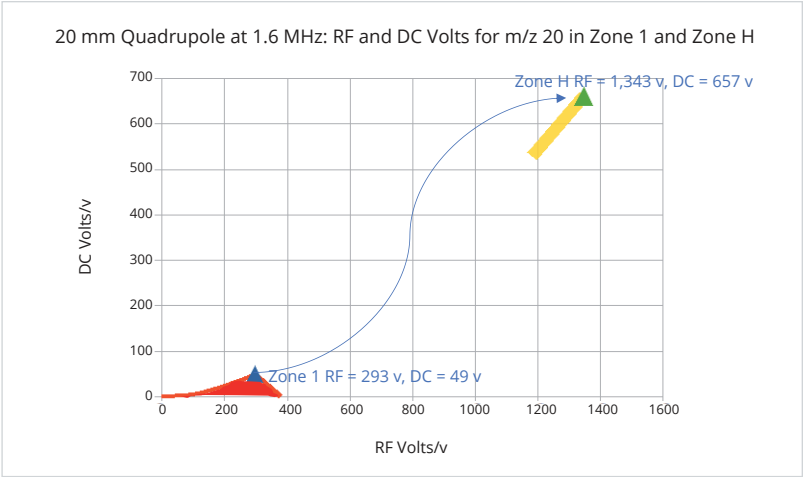
The mains power drawn by a QPS is not a direct a measure of its RF Power capability. You can, however, be sure that Hiden's AMZ-QPS provides up to 100 W of RF Power – enough to generate almost 4,000 V amplitude on each Quadrupole rod or 8,000 V amplitude between rod pairs!



# Example Data

## Unleashing the Power of Zone H Operation

Hiden's AMZ-QPS gives unique access to a powerful operating mode offering extreme resolving power at low masses – operation in stability Zone H.

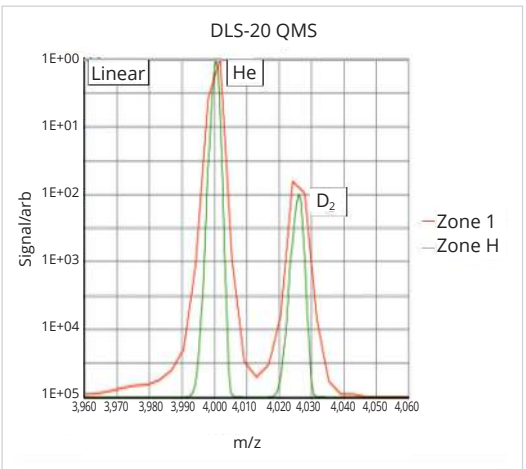



The chart uses coloured areas to indicate the 'regions' of RF and DC volts that will provide a stable path for m/z 20.

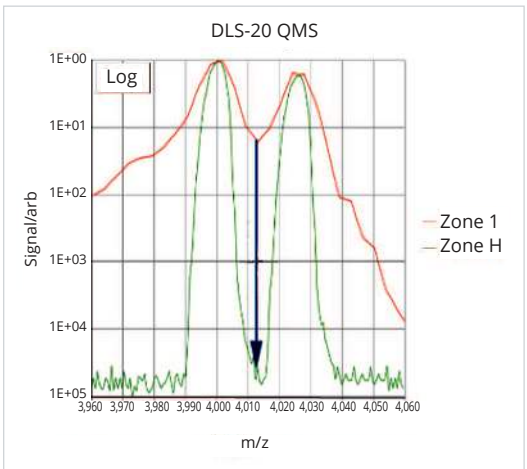
Voltage combinations within the red region will transmit m/z 20 in Zone 1, and within the yellow in Zone H.

Hiden's advanced software suite allows the user to apply scans in Zone 1 or Zone H, even within the same experiment.

## Resolving He and $D_2$ in Zone 1 and H




The red trace shows He and $D_2$ acquired in Zone 1 and the green in Zone H.

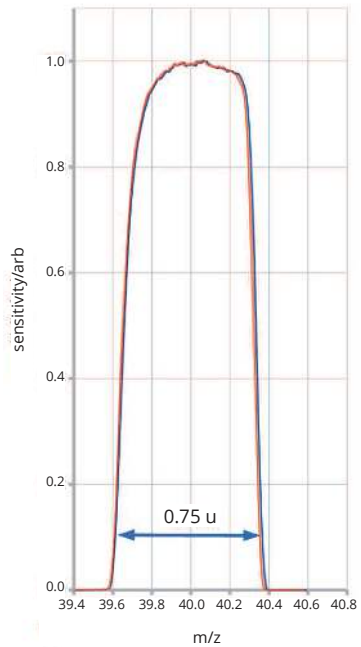



In Zone H the valley separation of He and $D_2$ continues for 5 decades, making possible the measurement of 1 ppm He in $D_2$.

# QPS Stability

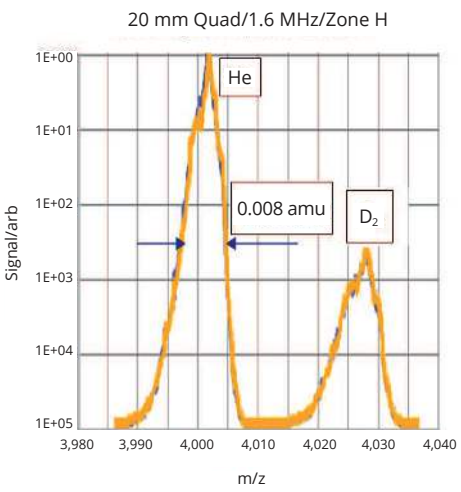
Hiden's AMZ-QPS is designed to provide the highest stability of RF and DC voltages. This is important because both resolution and peak position will shift if either of these voltages are not stable. So it's this level of stability that ensures your measurements will be independent of QPS drift – giving you full confidence in your results.

## QPS Stability – Zone 1 at Argon




This chart shows scans of the Argon peak at mass 40 - with 18 hours of time separation between the red and blue scans. The difference in both mass position and resolution is almost imperceptible – demonstrating the stability of both RF and DC voltages generated within the QPS.

## QPS Stability – Zone H at Helium and Deuterium



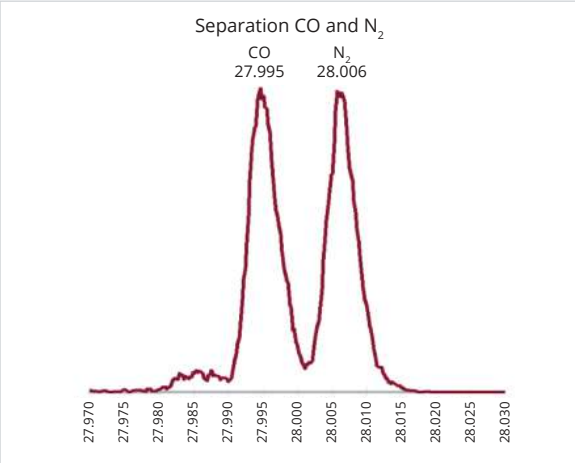

This chart shows scans of He and $D_2$ - with 22 hours of time separation between the blue and yellow scans. Again, the difference in both mass position and resolution is almost imperceptible – proving that stability is independent of Zone of operation.

# Example Data

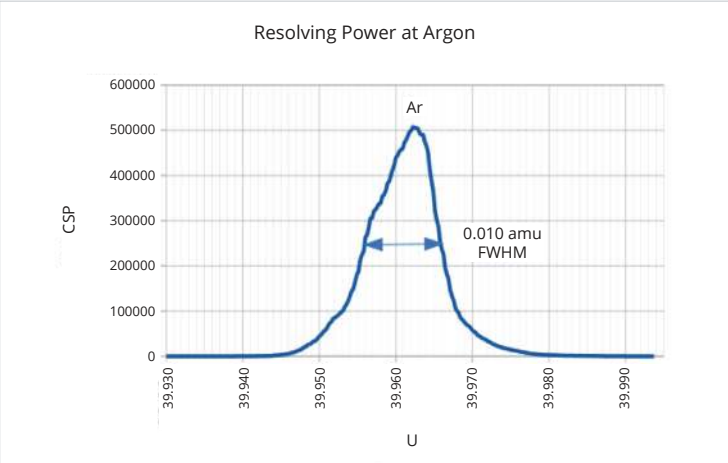
The following examples illustrate both the range and the flexibility of solutions offered by the AMZ-QPS.

## Example 1: High Frequency - for Resolving Power

The AMZ-QPS is shown configured for 5 M Hz/50 amu and driving a 9 mm Quad. High frequency operation maximises the Quad's resolving power. Data shown in this example illustrates the highest performance achieved. For your specific requirement please contact your sales representative.



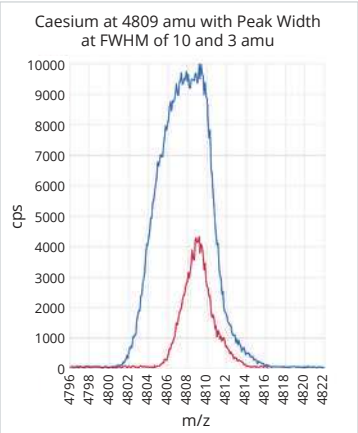

The effect of High Frequency on Resolving Power is demonstrated here by the separation of CO from $N_2$ – peaks just 0.011 amu apart.




The frequency of 5 MHz is capable of a resolving power (M/ΔM) at Argon of 4,000.

## Example 2: Low Frequency - for High Mass Range

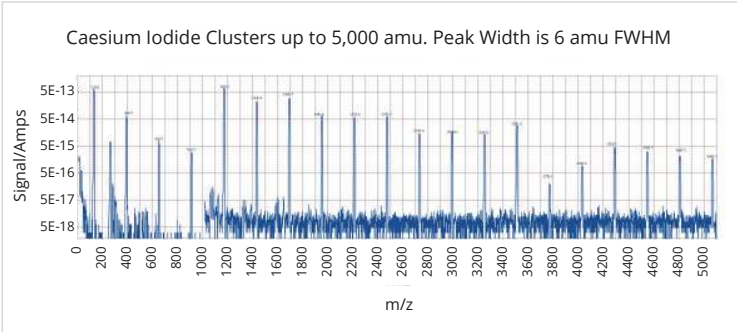
The AMZ-QPS is configured for 820 kHz/5,000 amu/9 mm Quad




In this configuration masses as high as 5,000 amu are now within reach of the Quadrupole.

The ability to resolve this high mass at FWHM of 3 amu demonstrates superb Resolving Power - even at this reduced operating frequency.

This degree of resolving power indicates the incredible parallelism of the Quadrupole Rods achieved by Hiden's advanced manufacturing processes.




Clusters produced from electron bombardment of Caesium Iodine provide a continuous spectrum at integer masses up to 5,069 amu.

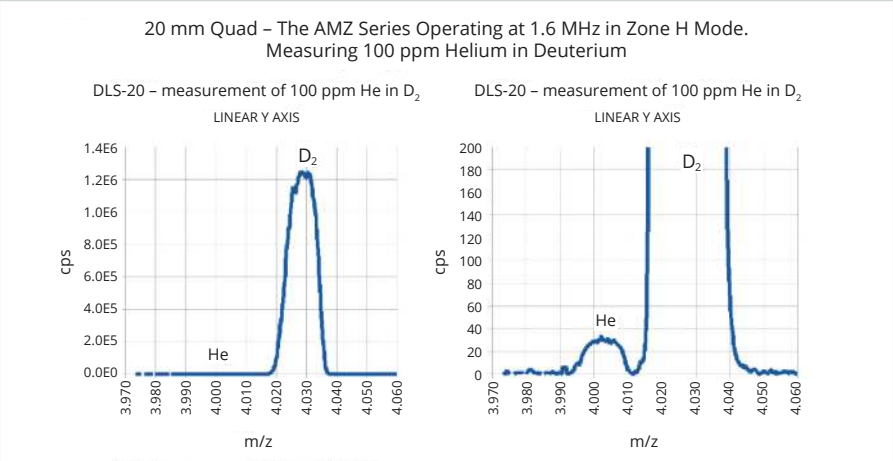
# Example 3: Zone H - for Resolving Power at Low Mass

## Dual-Mode for High Resolution

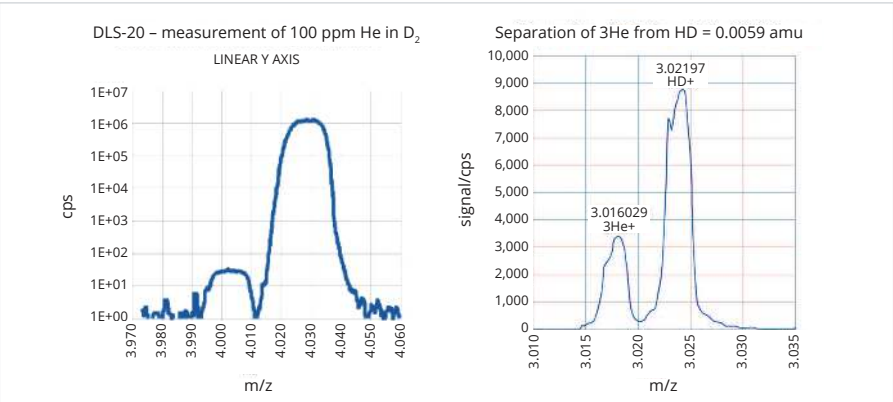
Hiden's AMZ-QPS is unique in offering this special high-resolution mode option. Where a mass interference exists, such as at He and $D_2$, the AMZ-QPS is able switch into the 'Zone H region of stability', which provides for incredible mass separation, even down at 10 ppm levels.

In this mode, the AMZ-QPS creates much higher RF and DC volts which provides for the unmatched performance of species separation, even when just 0.006 amu apart.

The AMZ-QPS now configured for 1.6 MHz, dual zone, 20/200 amu mass range with a 20 mm Quad




Here it is switched into Zone H, which enables separation down to 1 ppm of He in $D_2$.




The resolving power is further demonstrated by the separation of 3He from HD – peaks just 0.005 amu apart.

# System Configuration & Options

## Choosing your configuration

**While referring to the following Tables**

- First identify your maximum mass
- Then decide which is of greatest importance:

- For best Minimum Detectable and Speed of Acquisition *– choose the Quad Filter/Frequency combination with highest Sensitivity for your mass range*
- For best Abundance Sensitivity* and Resolving Power *– choose the Quad Filter/Frequency combination with highest Resolution for your mass range (*Abundance Sensitivity is important if you need to measure a low-level species adjacent in mass to a high-level species)*



| TABLE 1 - FOR MASS RANGE | | | |
|---|---|---|---|
| RF Frequency/MHz | Mass Range (amu) with Quadrupole Rod Diameter and with Zone of Operation | | |
| | 9 mm | 20 mm | |
| | ZONE 1 | ZONE 1 | ZONE H |
| 0.820 | 10-5,000 | 2-1,000 | - |
| 1.00 | 2-2,500 | 2-600 | - |
| 1.60 | 2-1,000 | 1-200 | 1-20 |
| 2.10 | 2-510 | 1-100 | - |
| 2.50 | 1-300 | 1-60 | - |
| 5.00 | 1-50 | 1-10 | - |

| TABLE 2 - FOR SENSITIVITY | | | |
|---|---|---|---|
| RF Frequency/MHz | Sensitivity (mA/hPa) with Quadrupole Rod Diameter and with Zone of Operation. In SEM mode, sensitivity will be increased by a factor of $10^1$ or $10^2$ | | |
| | 9 mm | 20 mm | |
| | ZONE 1 | ZONE 1 | ZONE H |
| 0.820 | 0.075 | 1 | - |
| 1.00 | 0.1 | 2 | - |
| 1.60 | 0.2 | 5 | 0.02 |
| 2.10 | 0.4 | 8 | - |
| 2.50 | 0.5 | 8 | - |
| 5.00 | 0.5 | 8 | - |

| TABLE 3 - FOR RESOLVING POWER | | | | | | |
|---|---|---|---|---|---|---|
| RF Frequency/MHz | Resolving Power (M/ΔM) with Quadrupole Rod Diameter and with Zone of Operation | | | | | |
| | 9 mm | | 20 mm | | | |
| | ZONE 1 | | ZONE 1 | | ZONE H | |
| 0.820 | 1,600 | @5,000 u | 800 | @1,000 u | - | - |
| 1.00 | 500 | @40 u | 500 | @40 u | - | - |
| 1.60 | 1,200 | @40 u | 1,200 | @40 u | 1300 | @4 u |
| 2.10 | 2,500 | @40 u | 2,500 | @40 u | - | - |
| 2.50 | 3,000 | @40 u | 3,000 | @40 u | - | - |
| 5.00 | 4,000 | @40 u | 1,000 | @10 u | - | - |

# Technical data




QUADRUPOLE POWER SUPPLY, AMZ-QPS SPECIFICATIONS

| | |
|---|---|
| **Size:** | Height: 268 mm |
| | Width: 438 mm |
| | Depth: 275 mm |
| **RF Output Voltage:** | Up to 3,900 Vpk |
| **DC Output Voltage:** | Up to 657 V |
| **Combined Output Voltage:** | Up to 4,557 Vpk |
| **RF Power generated:** | Up to 100 W |
| **Weight:** | 15 kg |
| **Electrical power requirements:** | Voltage: 100 to 240 V a.c. (~) |
| | Frequency: 50 to 60 Hz |
| | Power: 440 VA maximum |
| **Environmental data:** | Operating temperature range: 5 to 40 °C |
| | Storage temperature range: 0 to 50 °C |
| | The equipment can be stored temporarily at temperatures down to -10 °C |
| | Relative humidity range: 20 to 80% non-condensing |

# Products

## Products that include the AMZ-QPS

**1000 Series RF Generators**

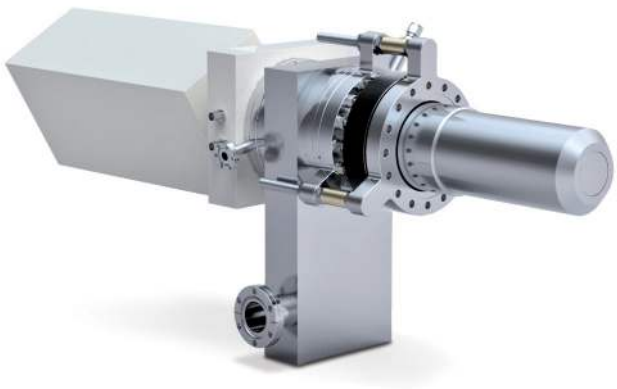
### Gas Analysers

- HPR-20 S1000
- HPR-20 EPIC
- HPR-20 DLS
- HPR-60 MBMS



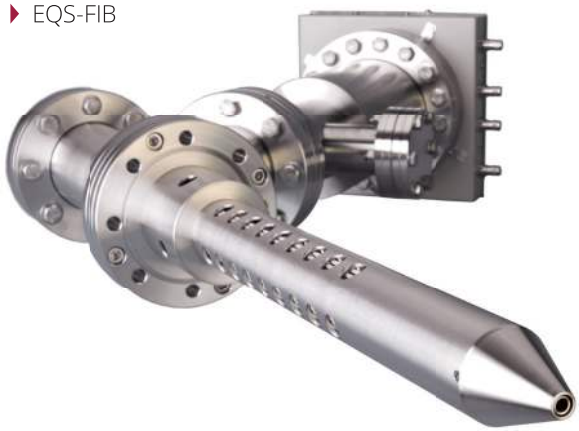

### Quadrupole mass spectrometers

- 1000 series PIC
- EPIC systems
- IDP systems



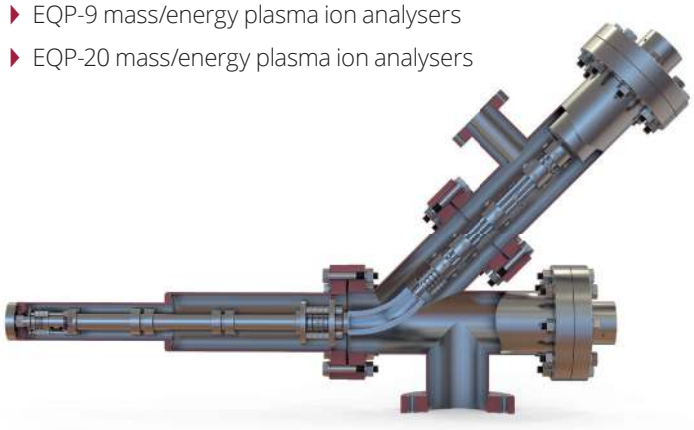
### SIMS (Secondary ion mass spectrometers)

- MAXIM
- EQS 1000
- EQS-FIB



### Plasma

- EQP-9 mass/energy plasma ion analysers
- EQP-20 mass/energy plasma ion analysers



# Hiden**APPLICATIONS**

Hiden'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
- ToF qSIMS and SIMS analysers
- 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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