

Hidden HPR-20 TMS

Transient MS for Fast Event Gas Analysis



Introduction

The Hiden HPR-20 TMS is configured for continuous analysis of **gases and vapours** at pressures near **atmosphere**.

Operating to 200°C, the QIC (quartz inert capillary) flexible 1m capillary inlet provides fast response times of less than 150 ms.

The HPR-20 TMS system has a mass range of 200 amu (300, 510, 1000 amu options) and a detection capability from **100% to less than 5 ppb**.

The TMS system is optimised for fast response studies and can respond to changes in gas composition with a 5 decade response time in <200 ms.

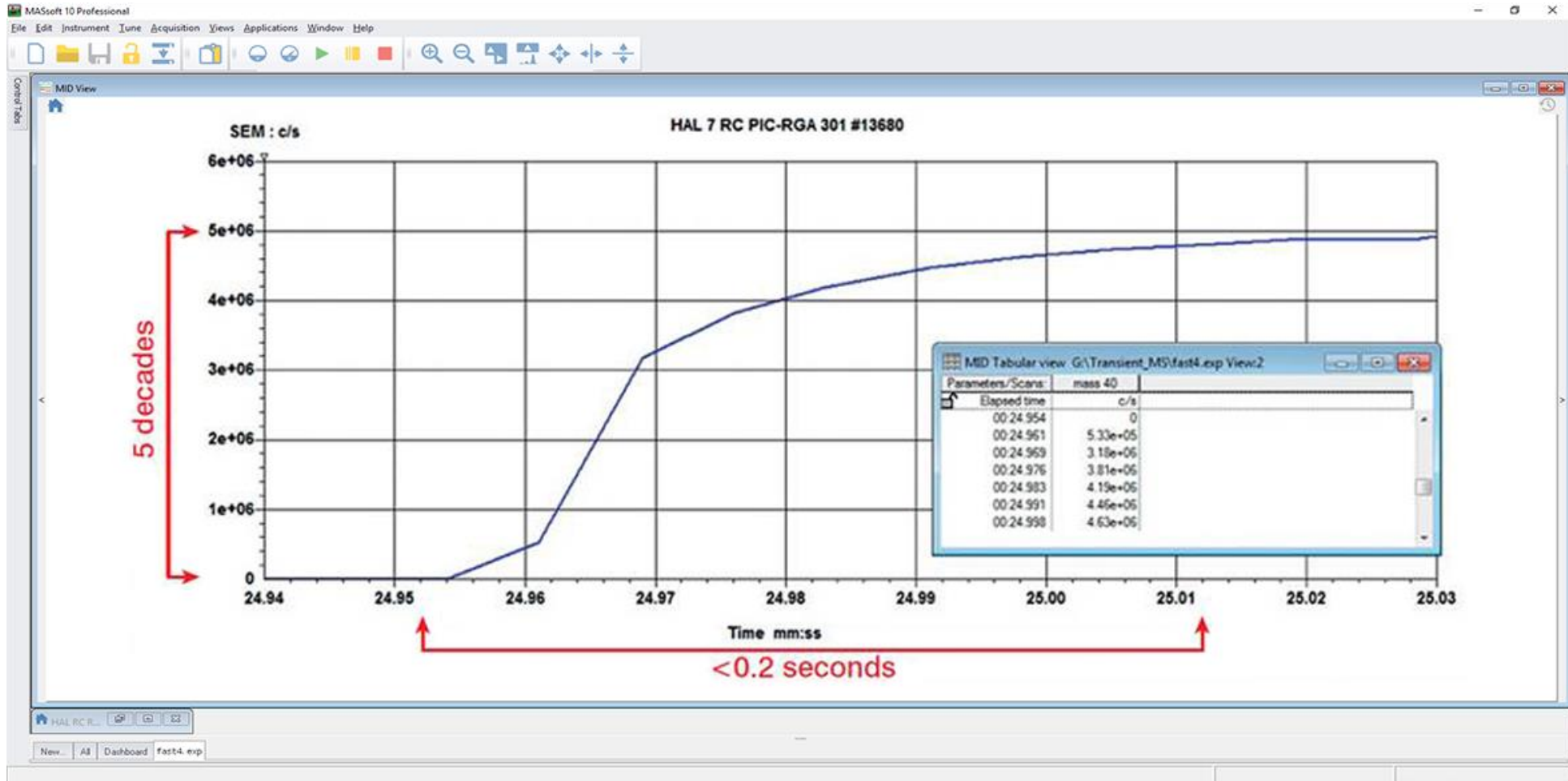
TMS – for Fast Event Studies

Features of the system to optimise the response for fast event studies include:

- Pulse Ion Counting detection with 7 decade continuous log scale
- 1m capillary gives <150 ms response time
- Open ion source increases pumping speed on ion source

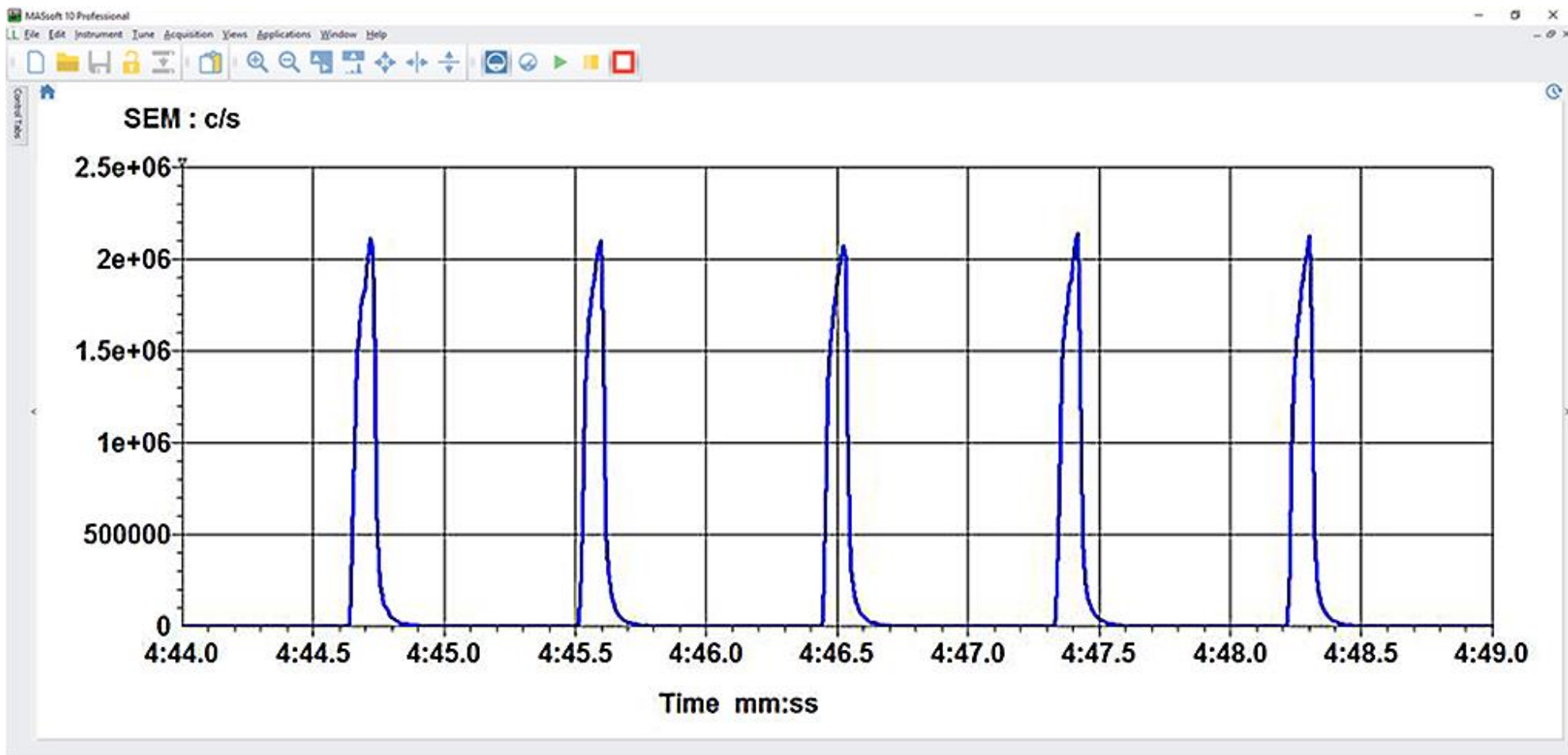


Ultra-fast response



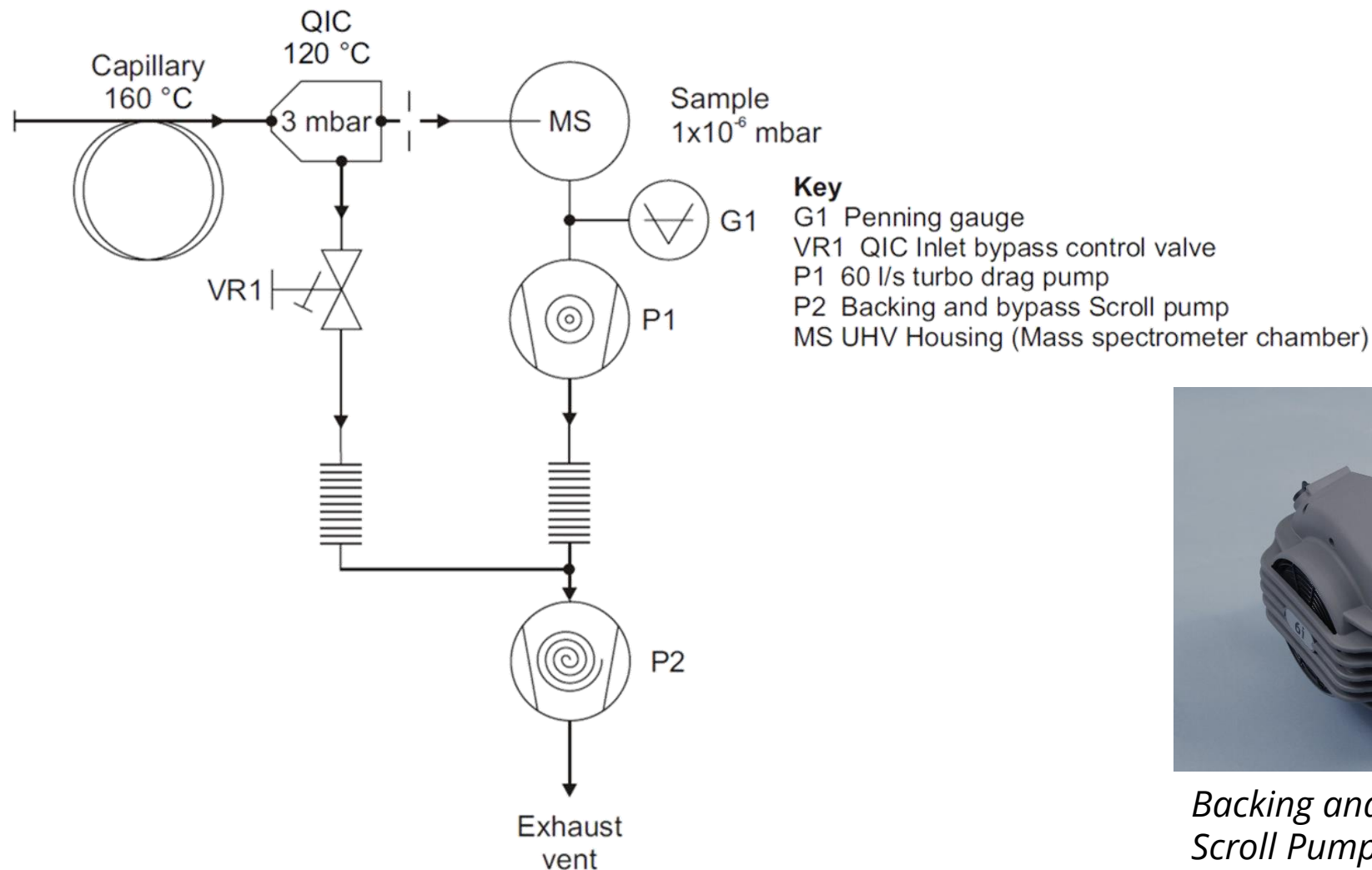
HPR-20 TMS: > 5 decades response in < 0.2 s

Ultra-fast response



The HPR-20 TMS tracks the changes in concentration of fast gas pulses with incredible response and accuracy over more than 5 decades. This data shows the measurement of 5 pulses in 5 seconds.

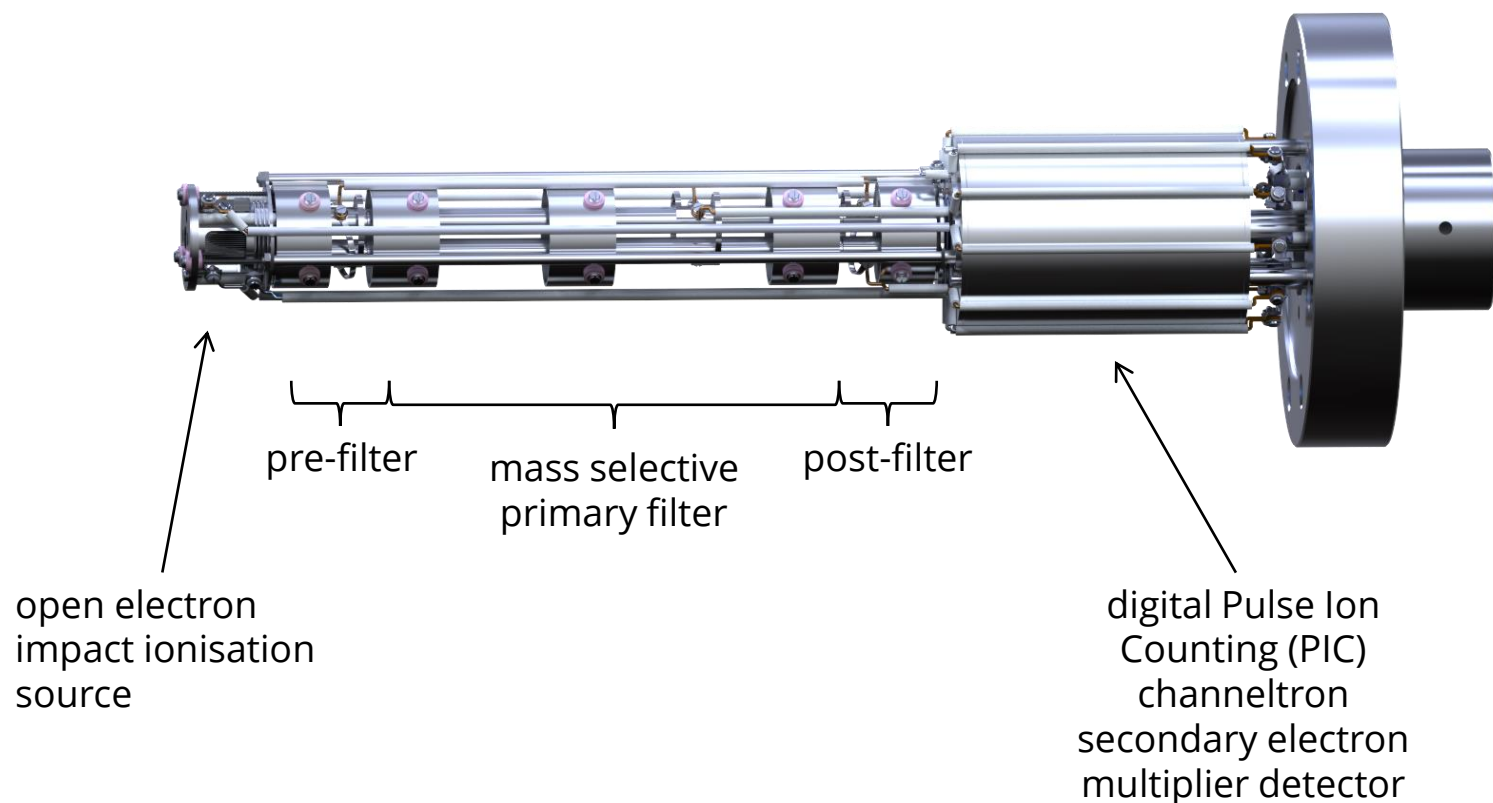
HPR-20 TMS Vacuum Schematic



*Backing and bypass
Scroll Pump*

HPR-20 TMS Analyser:

Hidden HAL 3F PIC Triple Filter Mass Spectrometer

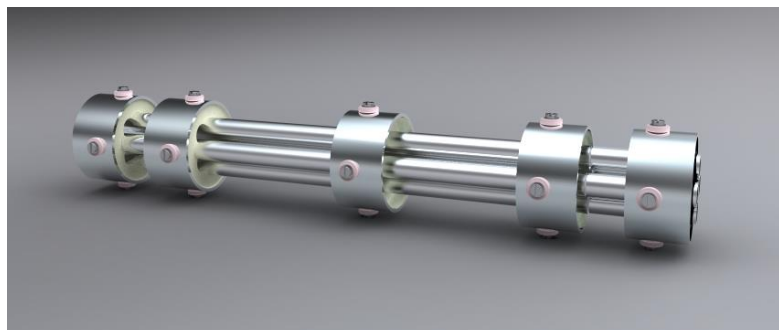


Triple Filter Mass Spectrometer

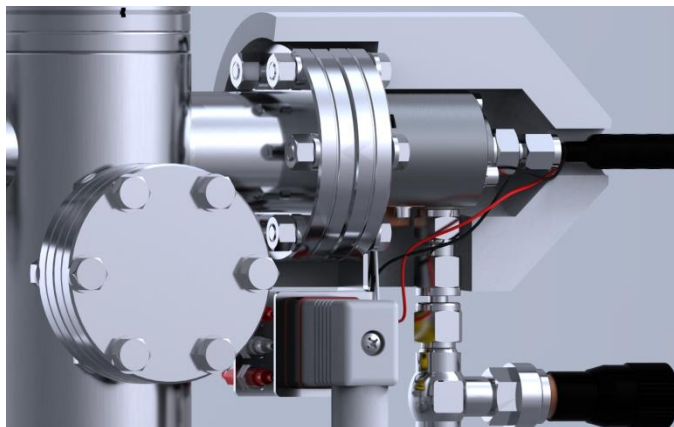
Why have a triple filter?

Two main advantages:

1. Strict control over the quadrupole entrance and exit fields provides **enhanced sensitivity for high mass transmission** and **increased abundance sensitivity**
2. **Enhanced long-term stability**. The bulk of the deselected ions from the quadrupole ioniser deposit harmlessly on the RF-only pre-filter stage, minimising contamination on the mass selective primary filter.

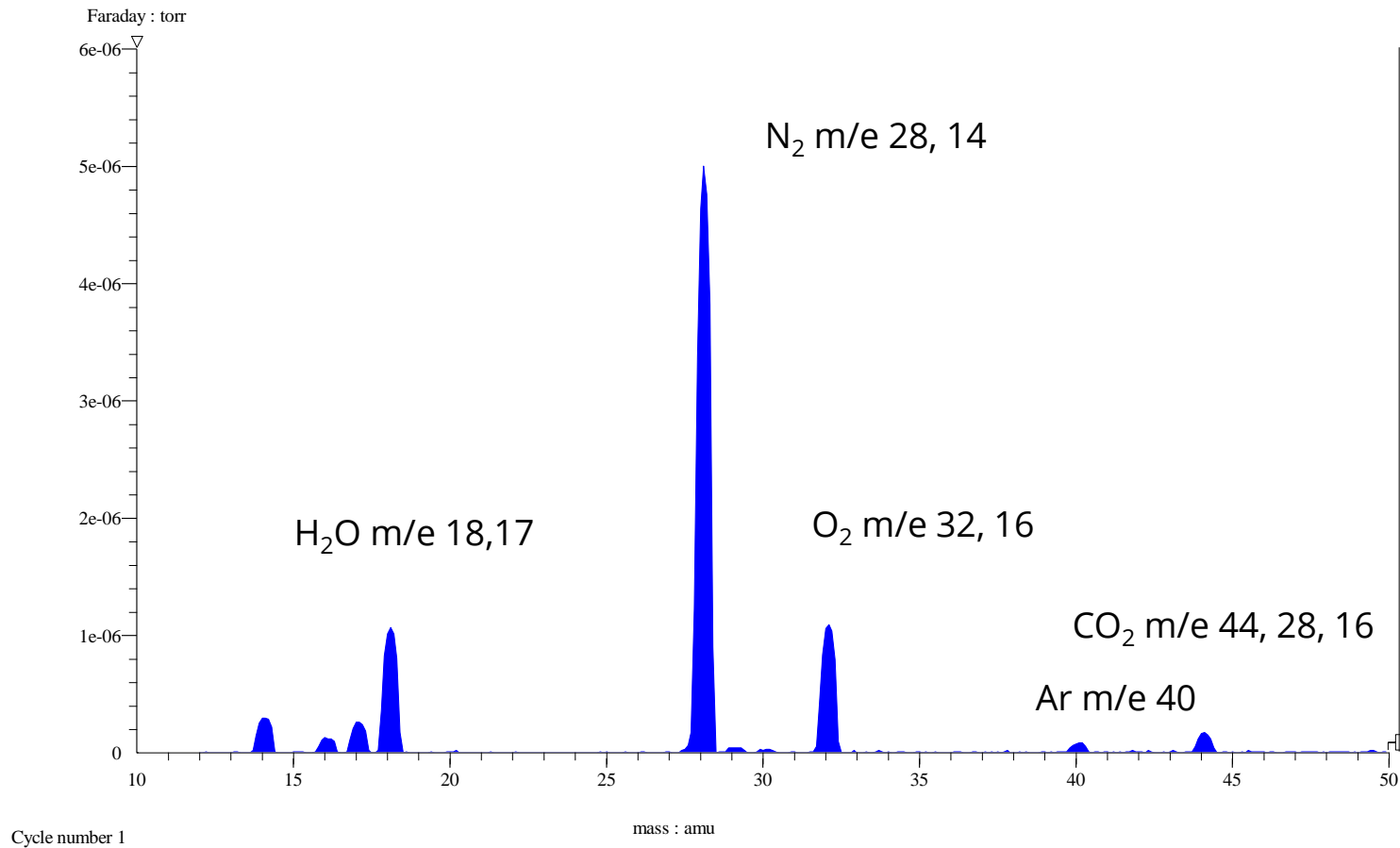


QIC Inlet Technology



- Quartz and Platinum Wetted Surfaces → No memory effects
- Heated Capillary → No condensation effects
- Flow Matched → Optimum response / recovery
- Minimal Internal Volume → PPB detection
- Interchangeable Sampling Capillaries → Analysis from 10 mbar to 2 Bar

Typical Mass Spectrum of Air



Note: Different species can have the same mass e.g. CO, N₂ m/e 28

Soft Ionisation

Unique to Hiden gas analysis systems, soft ionisation allows users to selectively ionise different gases by setting the ionisation energy for a particular mass.

This powerful technique can simplify the analysis of otherwise complex cracking patterns from multi-component gas/vapour mixtures.

The ionisation energy can be altered from 4 to 150 eV, in 0.1 eV increments. Standard operation is at 70 eV.

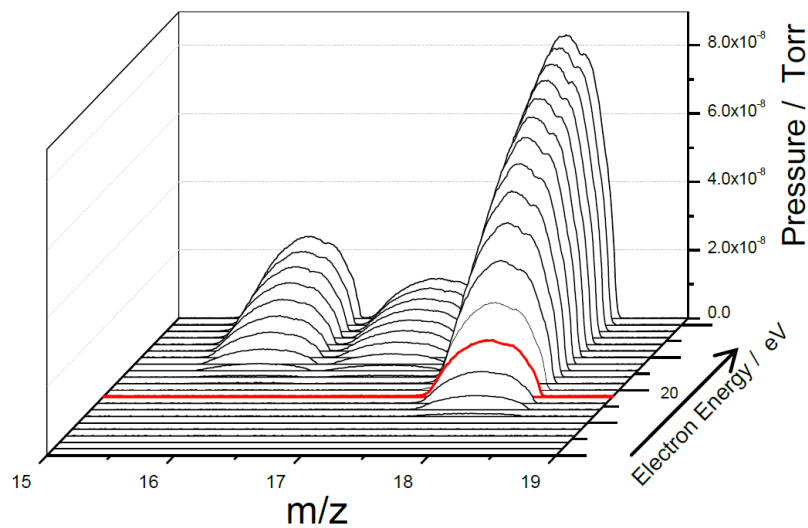


Figure 1 A: m/z vs Electron energy-H₂O/Air

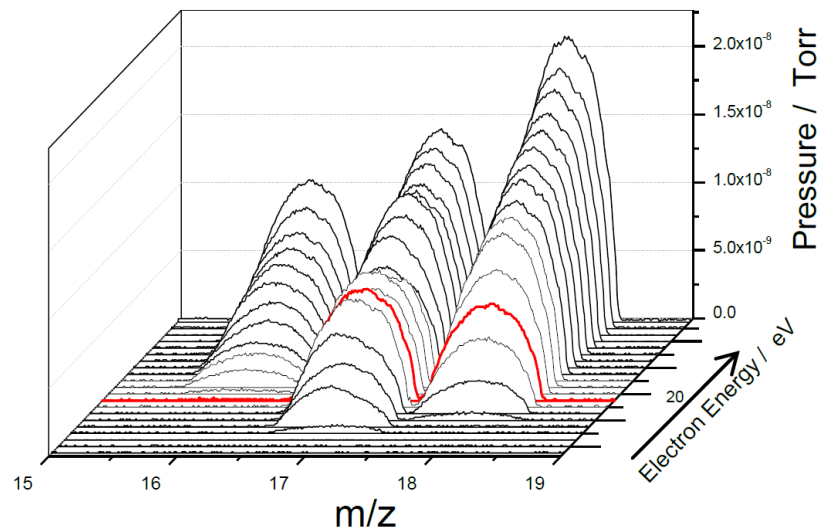


Figure 1 B: m/z vs Electron energy-NH₃/ H₂O/Air mix

MASsoft Professional control software

The screenshot displays the MASsoft Professional control software interface. The main window shows a 'Real time trend analysis' plot with SEM (y-axis, 10⁻¹² to 10⁻⁴) versus Time (x-axis, 08:20 to 41:40). The plot shows several peaks corresponding to different components: Water (yellow), Ammonia (red), Argon (green), Carbon Dioxide (purple), Isopropyl alcohol (cyan), and Methyl Alcohol (blue). A 'Quick Start Tasks' panel is visible on the left, and a 'Scan Editor' panel is on the right. A 'MID Mode' dialog box is open, showing a table of scan parameters.

Component	Name	Mass	Mode	Detector	Range	Au.	Rel Sene	Rel SEM	Colour	Line	Style
Hydrogen		2.00	Unknown	Faraday	-5	✓	0.440	1.000	Aqua	---	Thin sc
Water		18.00	RGA	Faraday	-5	✓	0.900	1.000	Lime	---	Thin sc
Oxygen		32.00	Unknown	Faraday	-5	✓	0.860	1.000	Red	---	Thin sc
Argon		40.00	RGA	Faraday	-5	✓	1.200	1.000	Blue	---	Thin sc
Pressure		0.40	RGA	Faraday	-5	✓	1.200	1.000	Fuchsia	---	Thin sc

A multi-level software package allowing both simple control of mass spectrometer parameters and complex manipulation of data plus control of external devices.

HPR-20 TMS - Applications

- Fast event studies
- Reaction kinetics
- Selective Catalytic Reduction (SCR)
- Steady State Isotopic Transient Kinetic Analysis (SSITKA)
- High speed switching analysis
- Operando studies
- SpaciMS



Applications: Catalysis Research

A kinetic study of the effect of H₂ on the Selective Catalytic Reduction of NO_x with octane using isotopically labelled ¹⁵NO, using an HPR-20 QIC TMS system.

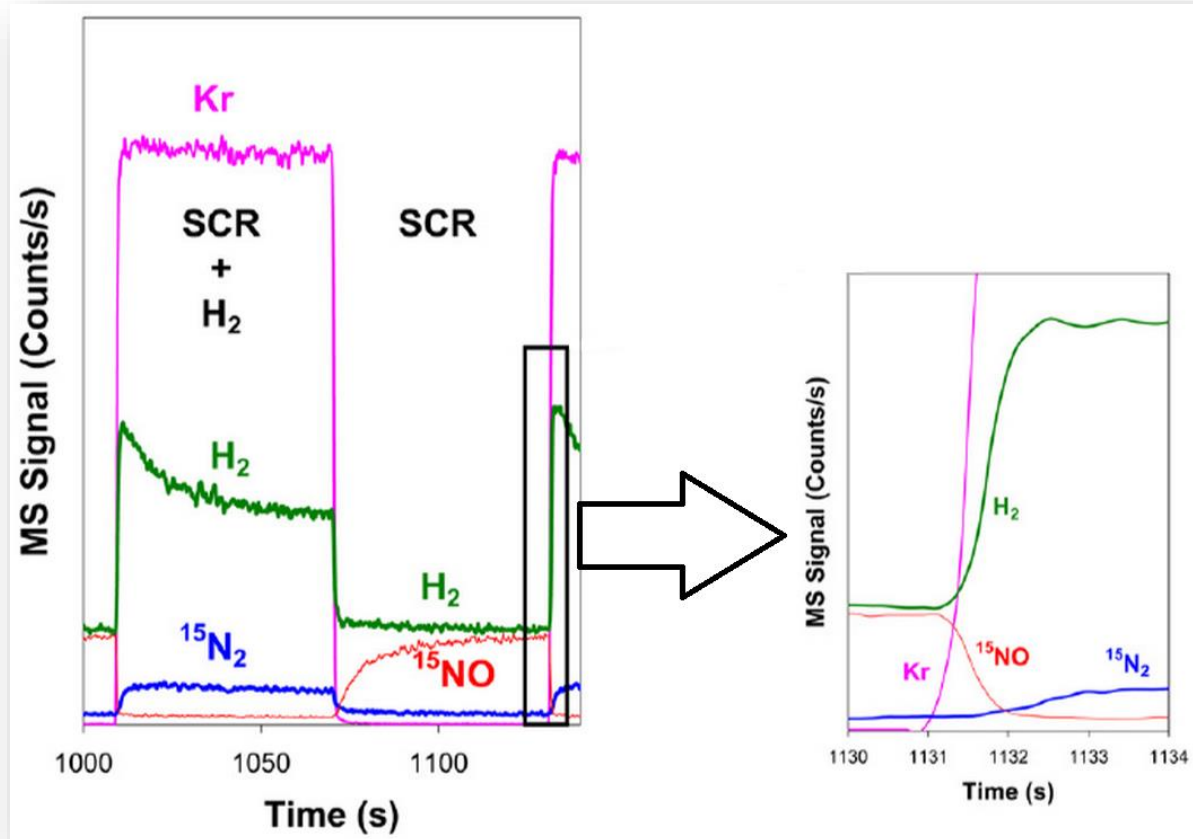
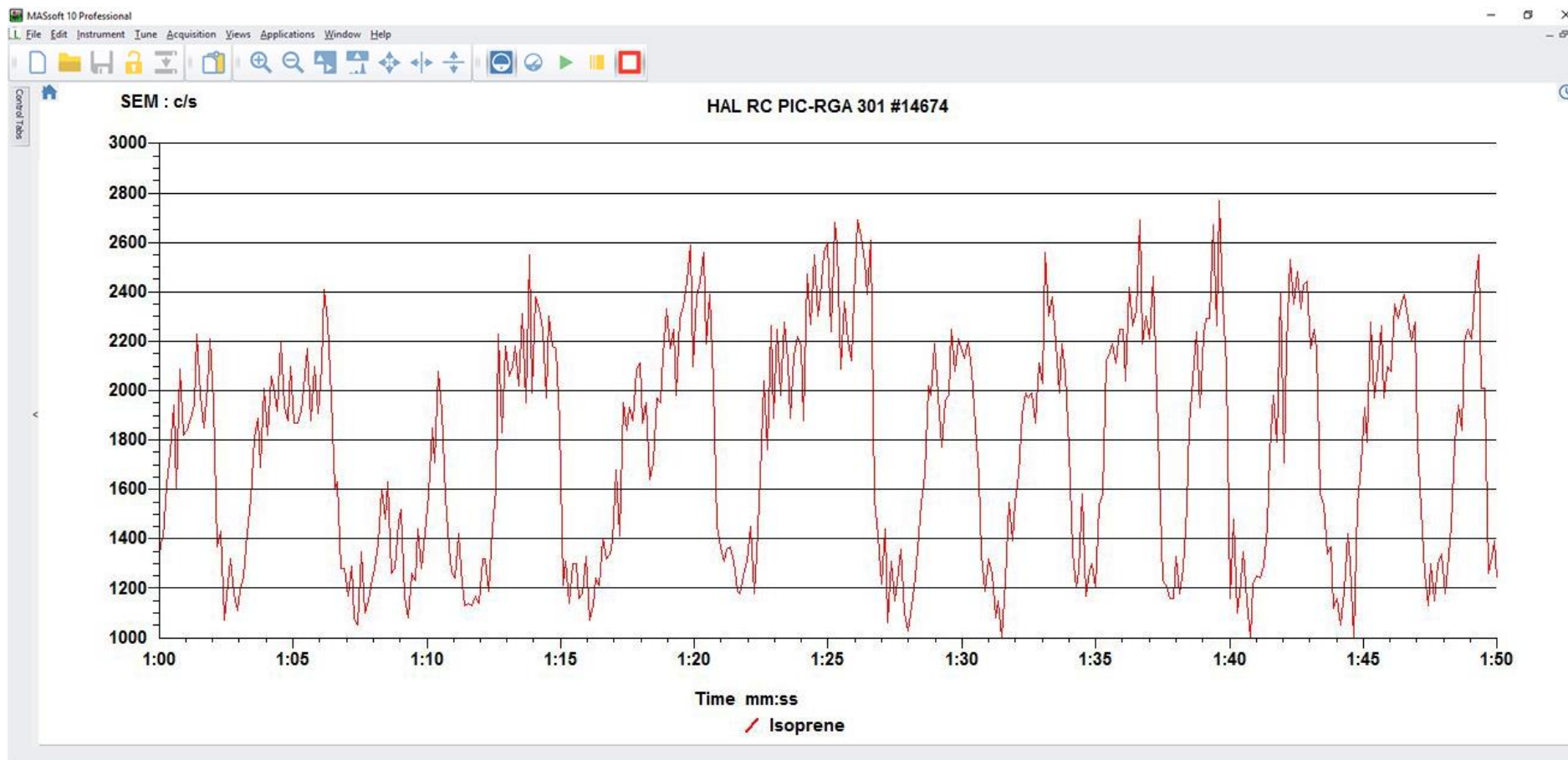


Figure 1. Mass spectrometer response for ¹⁵N₂, ¹⁵NO, H₂ and Kr when switching 0.72% H₂ in and out of a SCR feed stream over the catalyst at 300°C.

Ref: J. P. Breen, R. Burch, C. Hardacre, C. J. Hill and C. Rioche (2007). *J. Catal.*, 2007, 246, 1, p1-9.

Applications: Breath Analysis

Breath by Breath Analysis of Expired Isoprene during Exercise



HPR-20 TMS data showing breath by breath isoprene levels during an exercise test.

Hiden HPR-20 Users



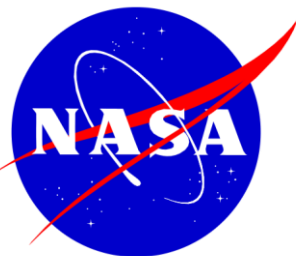
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Summary

- Specifically designed for fast event studies – less than 150 ms response time
- Bench-top triple filter quadrupole mass spectrometer gas analysis system
- Real-time, multi-species analysis – 5 PPB to 100%
- Soft ionisation for reduced spectral fragmentation and simplified data interpretation



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- A photograph of a modern, two-story office building with a grey facade and large glass windows. The building has a prominent entrance on the left side. A large, semi-transparent white circle is overlaid on the left side of the image, containing text. The sky is clear blue, and there are some trees and bushes in the foreground.
- www.HidenAnalytical.com
 - The Hiden website is an excellent resource with product pages, brochures, catalogues, product pages with some application notes, presentation and other information.
 - Contact +44 1925 445225 for direct support.