

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.

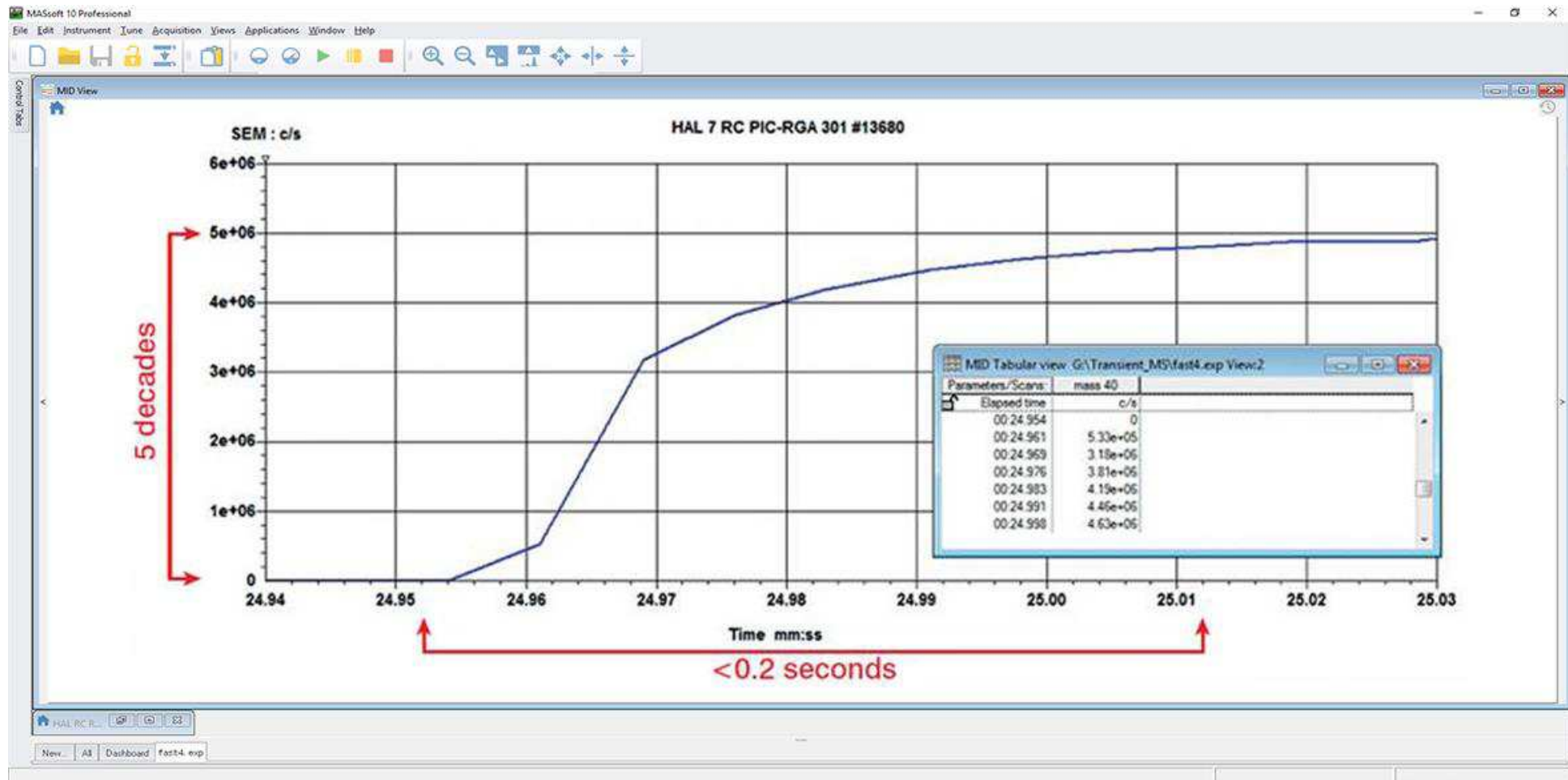
TMS – for Fast Event Studies

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

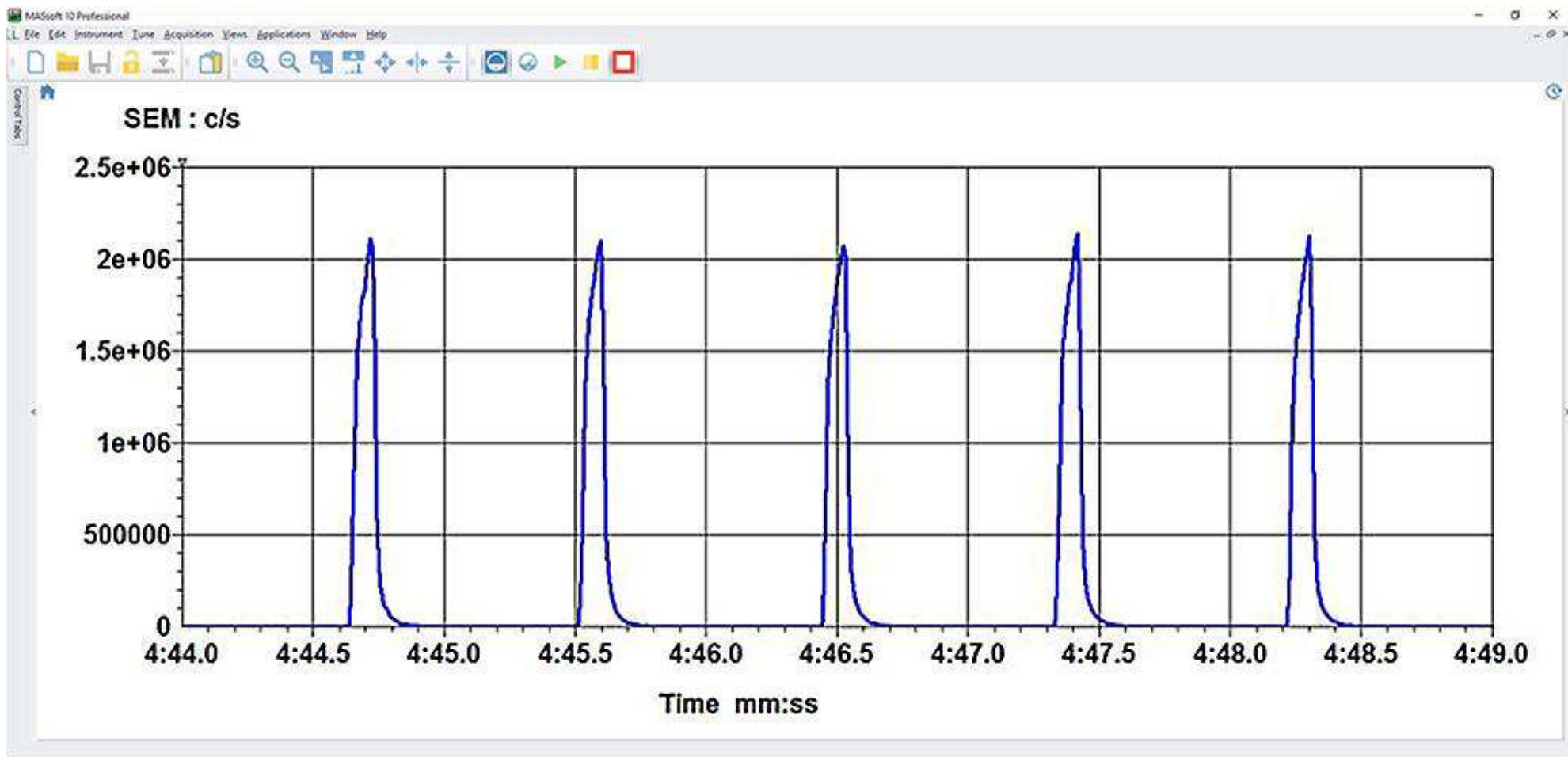


Ultra-fast response



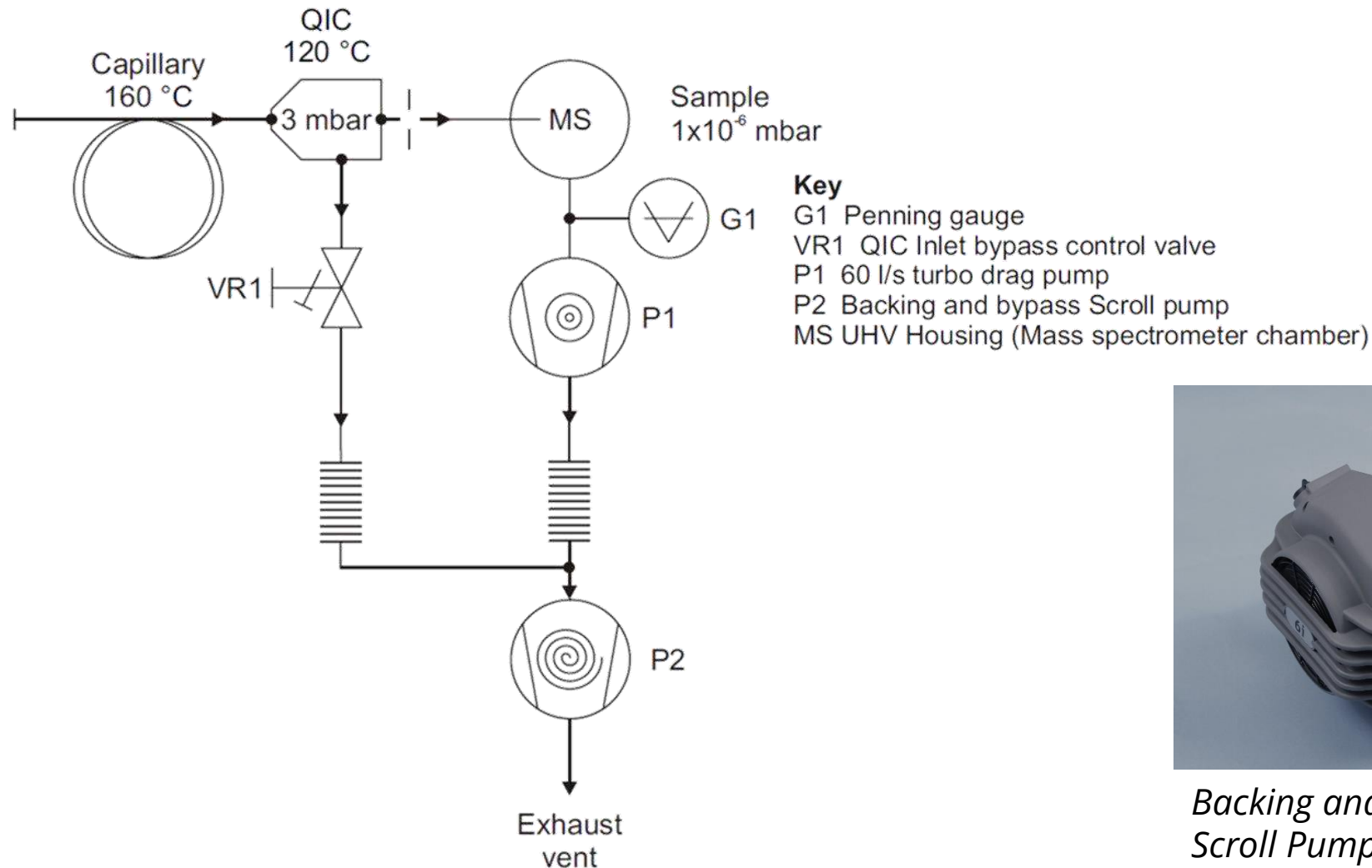
HPR-20 TMS: > 5 decades response in < 0.2 s

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.

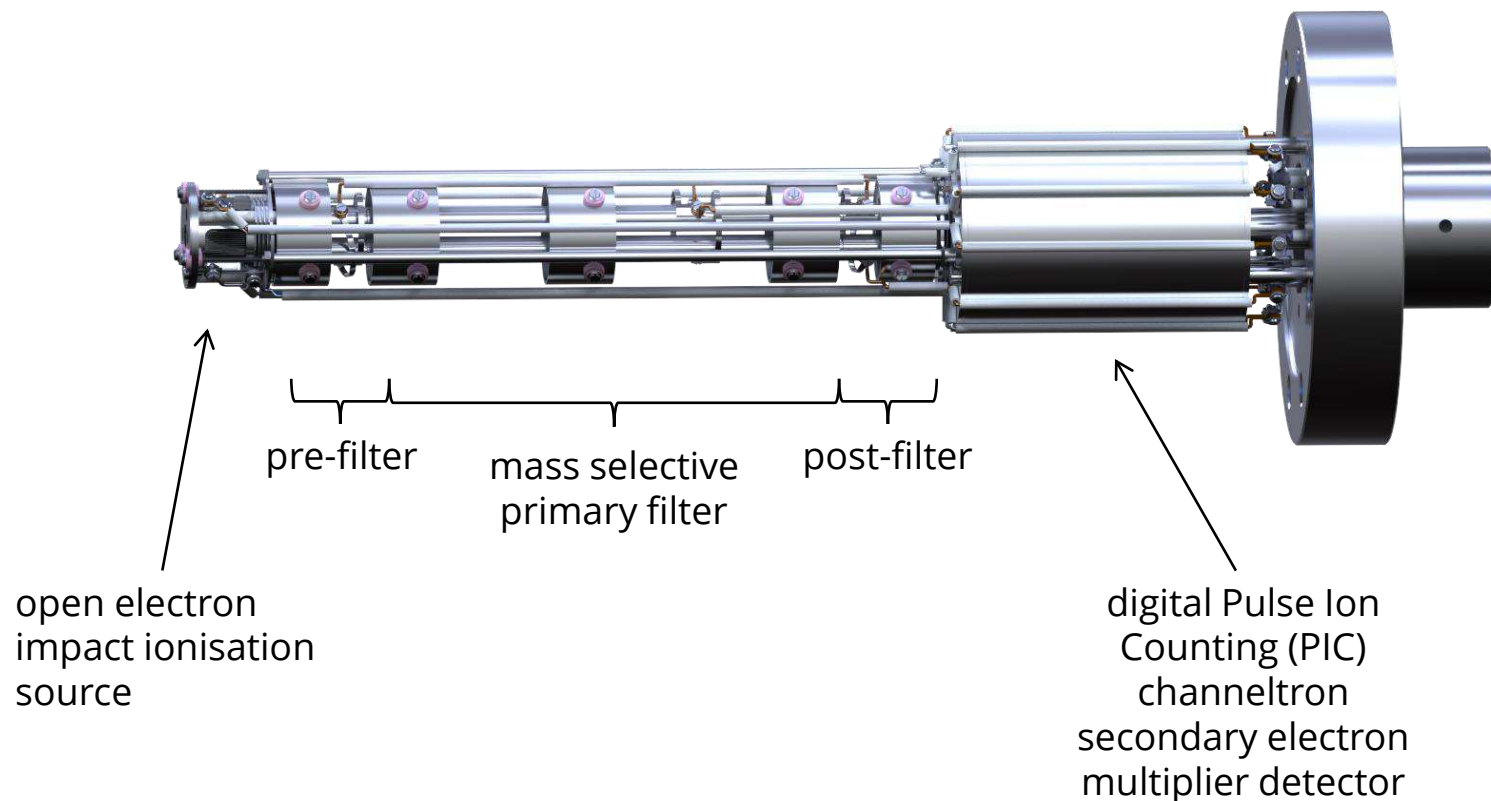
HPR-20 TMS Vacuum Schematic



*Backing and bypass
Scroll Pump*

HPR-20 TMS Analyser:

Hidden HAL 3F PIC Triple Filter Mass Spectrometer

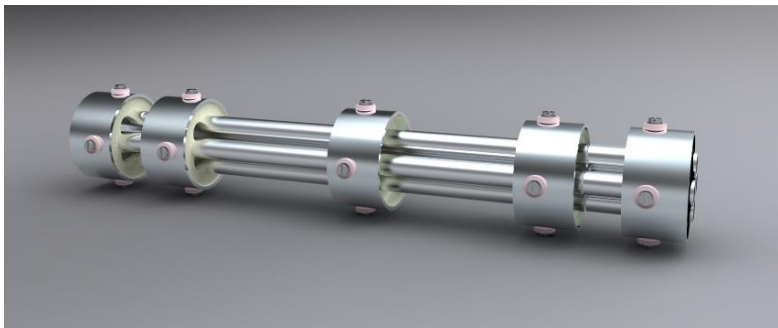


Triple Filter Mass Spectrometer

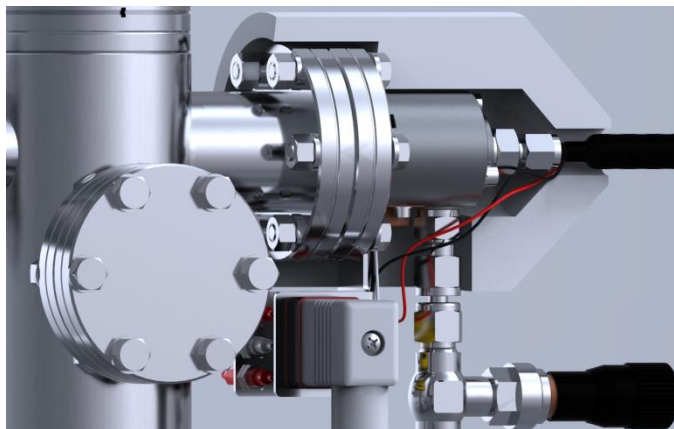
Why have a triple filter?

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.

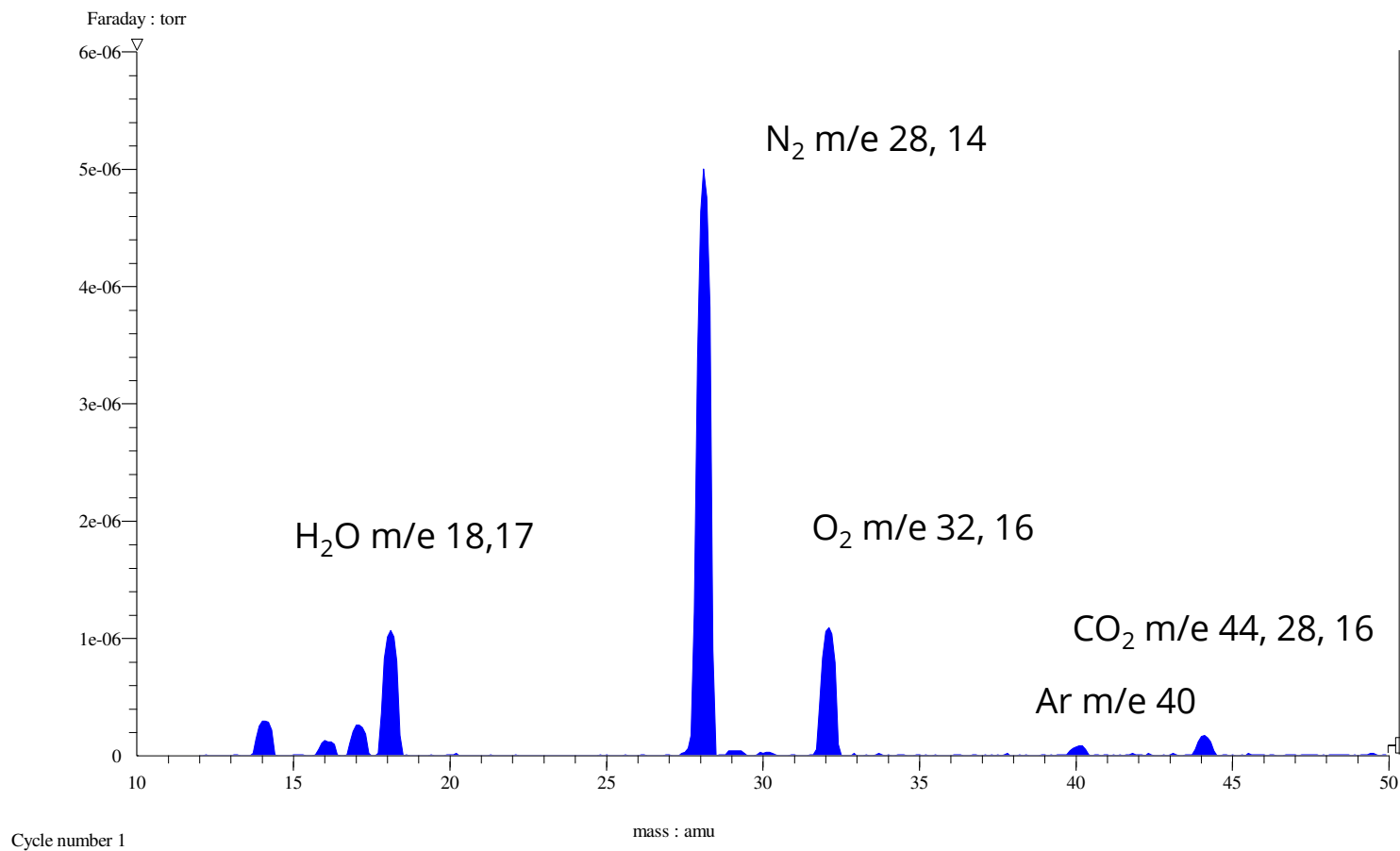


QIC Inlet Technology



- | | | |
|--------------------------------------|---|--------------------------------|
| 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.

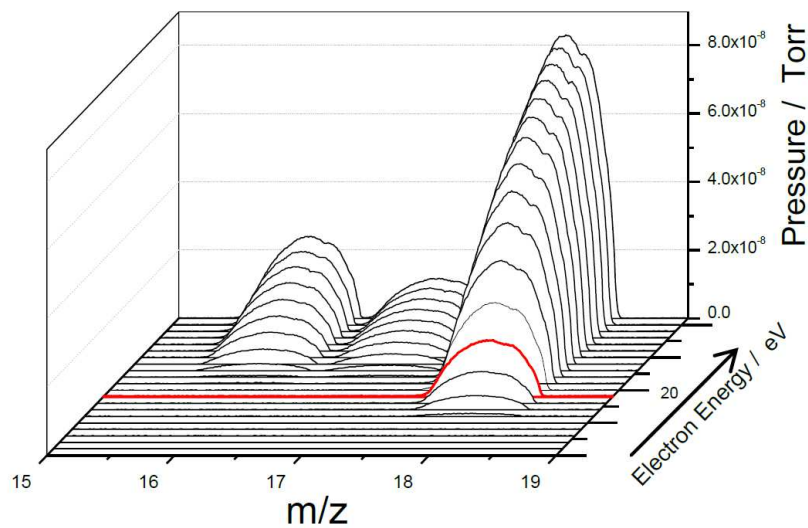


Figure 1 A: m/z vs Electron energy- $\text{H}_2\text{O}/\text{Air}$

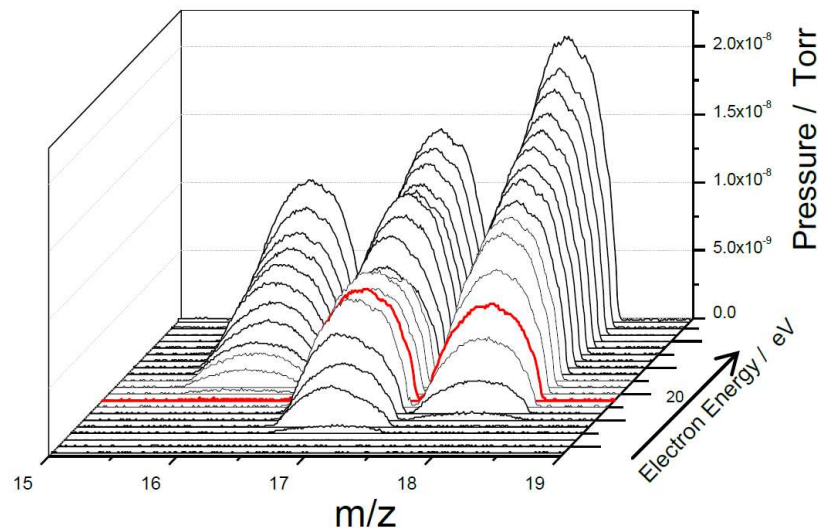
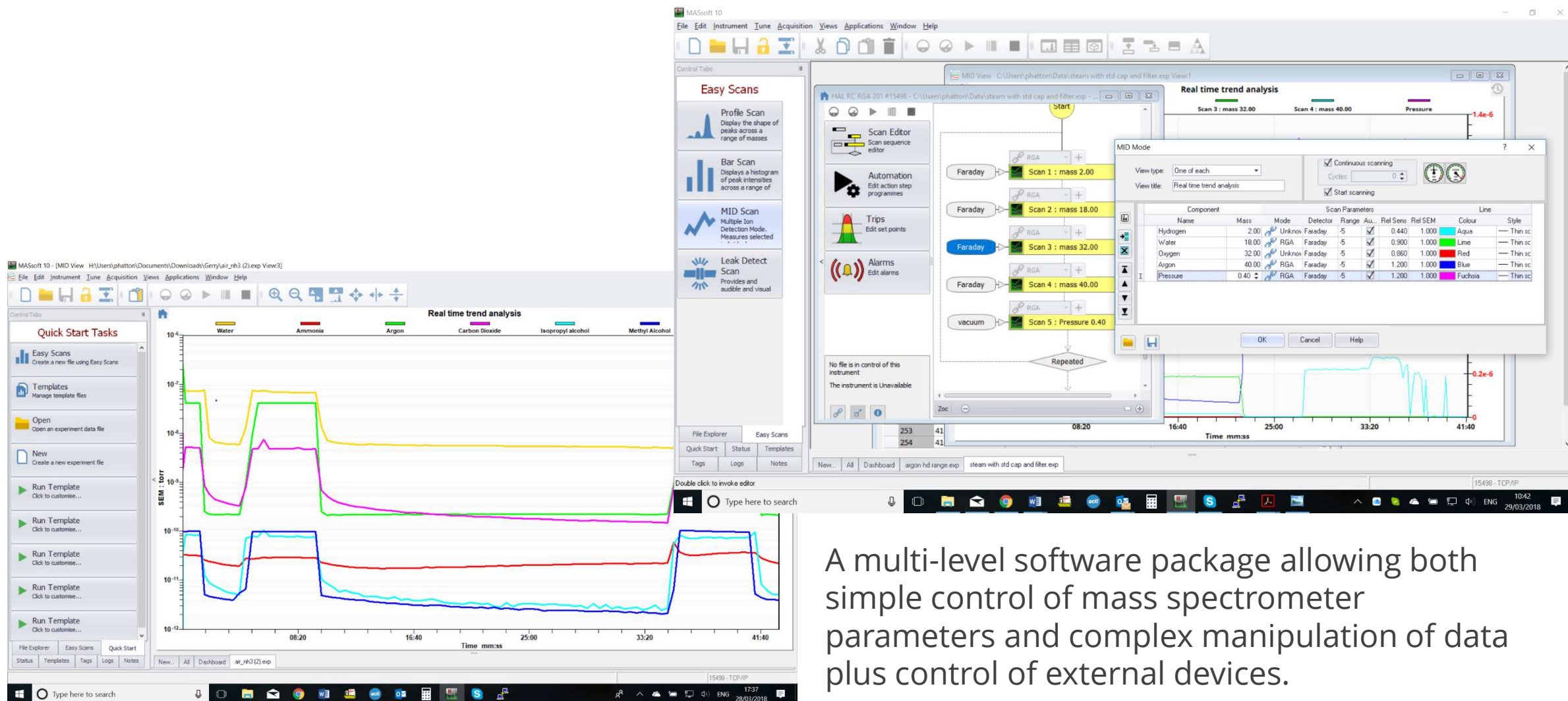


Figure 1 B: m/z vs Electron energy- $\text{NH}_3/\text{H}_2\text{O}/\text{Air}$ mix

MASsoft Professional control software



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.

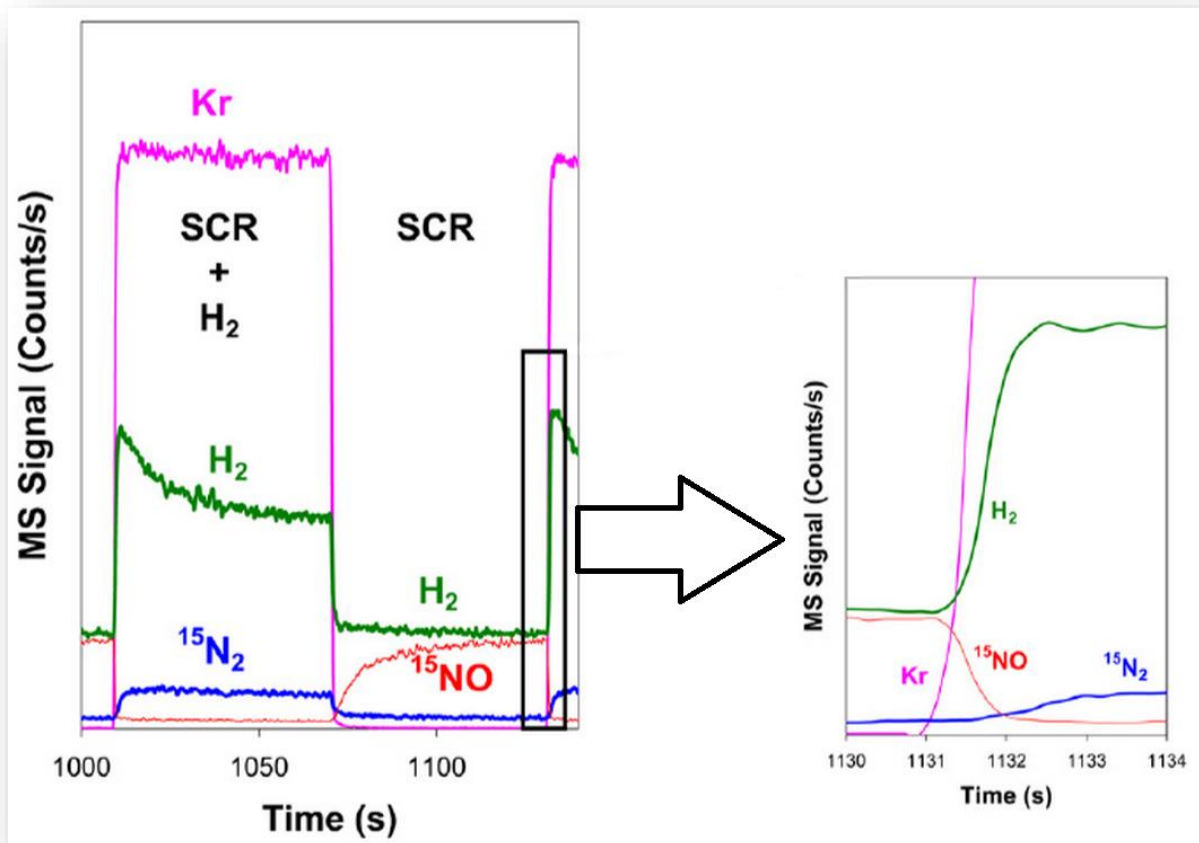
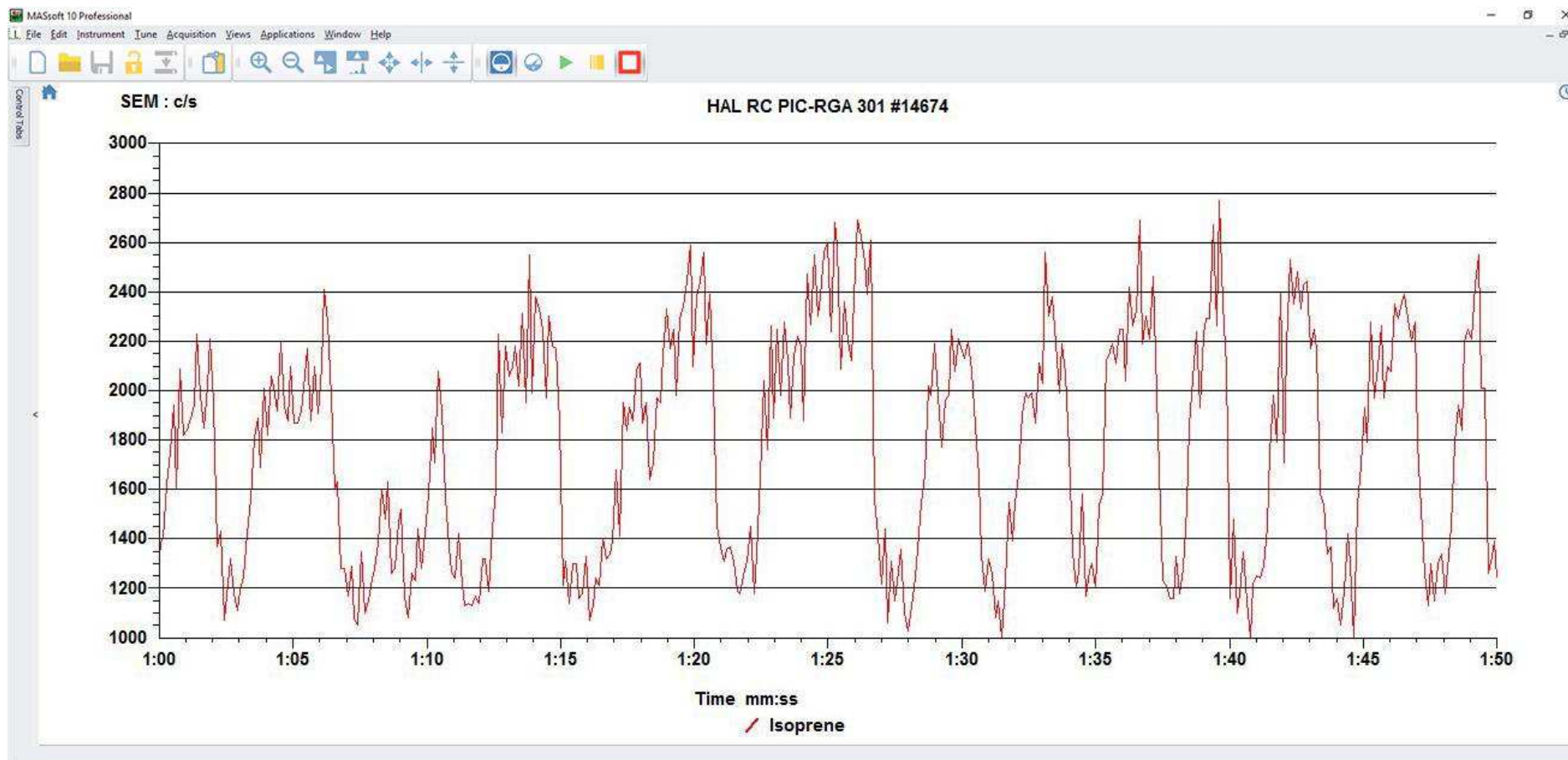


Figure 1. Mass spectrometer response for ¹⁵N₂, ¹⁵NO, H₂ and Kr when switching 0.72% H₂ in and out of a SCR feed stream over the catalyst at 300°C.

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.

Hidden HPR-20 Users



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA



SUZUKI



Imperial College
London



ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich



NASA
Dow Chemical
Exxon-Mobil
Imperial College
MIT

University of British Columbia
University of Queensland
BASF

Seoul National University
Suzuki

University of Cambridge
Beijing Institute of Technology

Samsung
ETH Zürich
KAUST
Durham University
Siemens
Shell



Massachusetts
Institute of
Technology



Durham
University



SIEMENS



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 glass entrance on the left and a long row of windows on the right. A sign with the "HIDEN ANALYTICAL" logo is mounted on the upper part of the building. The building is surrounded by greenery, including trees and bushes, under a clear blue sky. A large, semi-transparent white circle is overlaid on the left side of the image, containing the text of the list.
- 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.