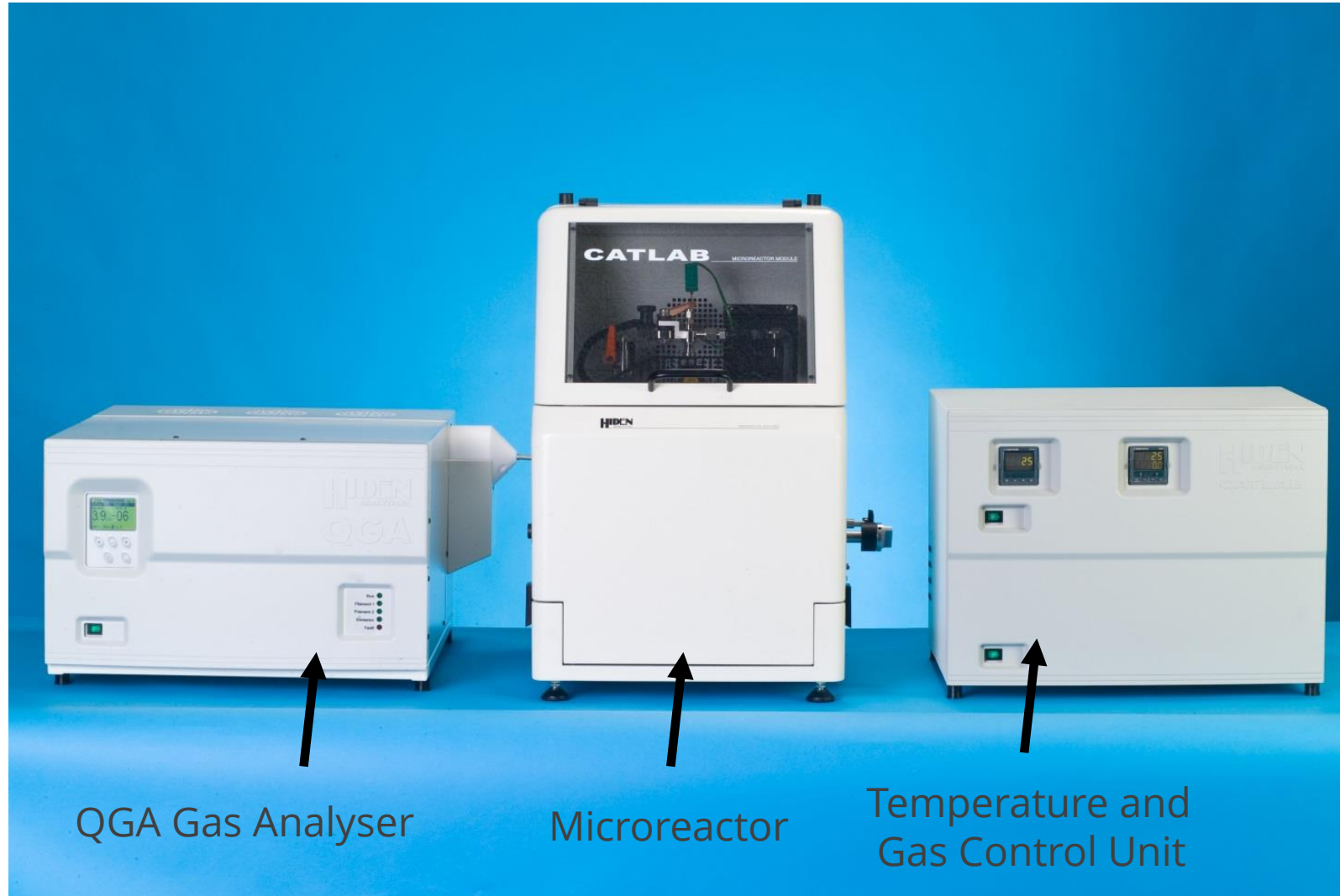


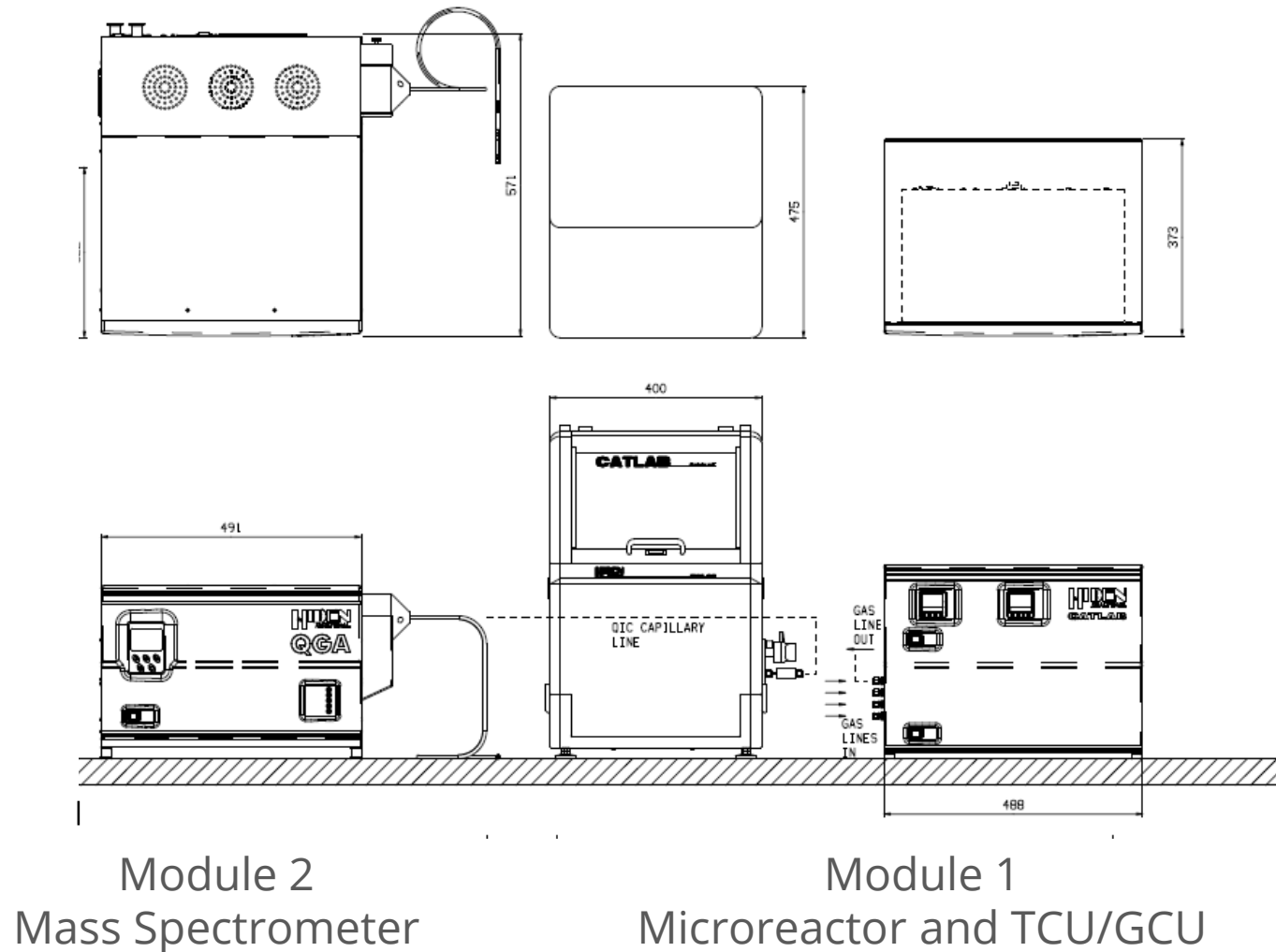
Hidden CATLAB

Integrated Microreactor-Mass Spectrometer
for Reaction Testing, TPD/R/O and
Pulse Chemisorption

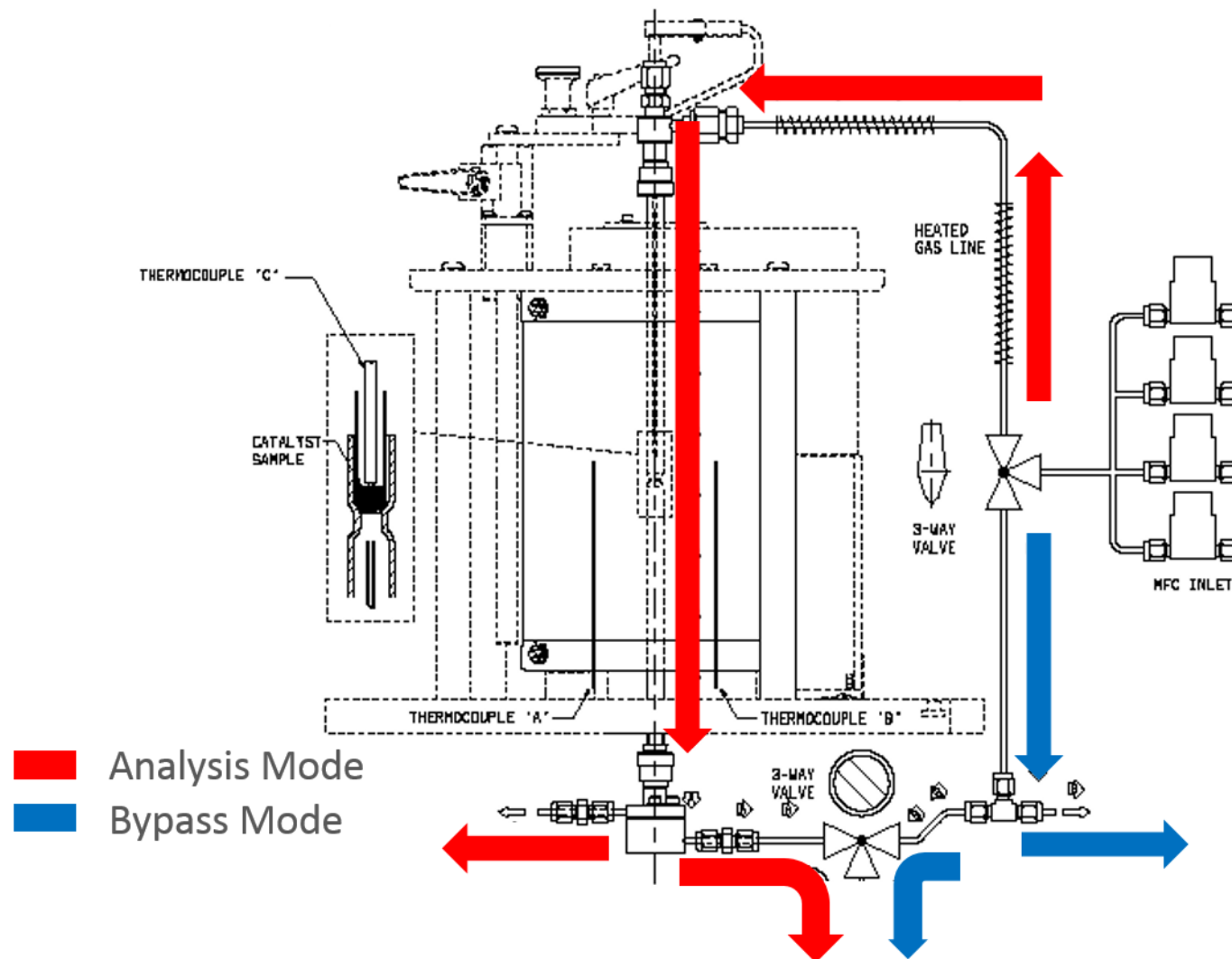
CATLAB Modules



Standard CATLAB Layout



CATLAB Schematic



CATLAB Options

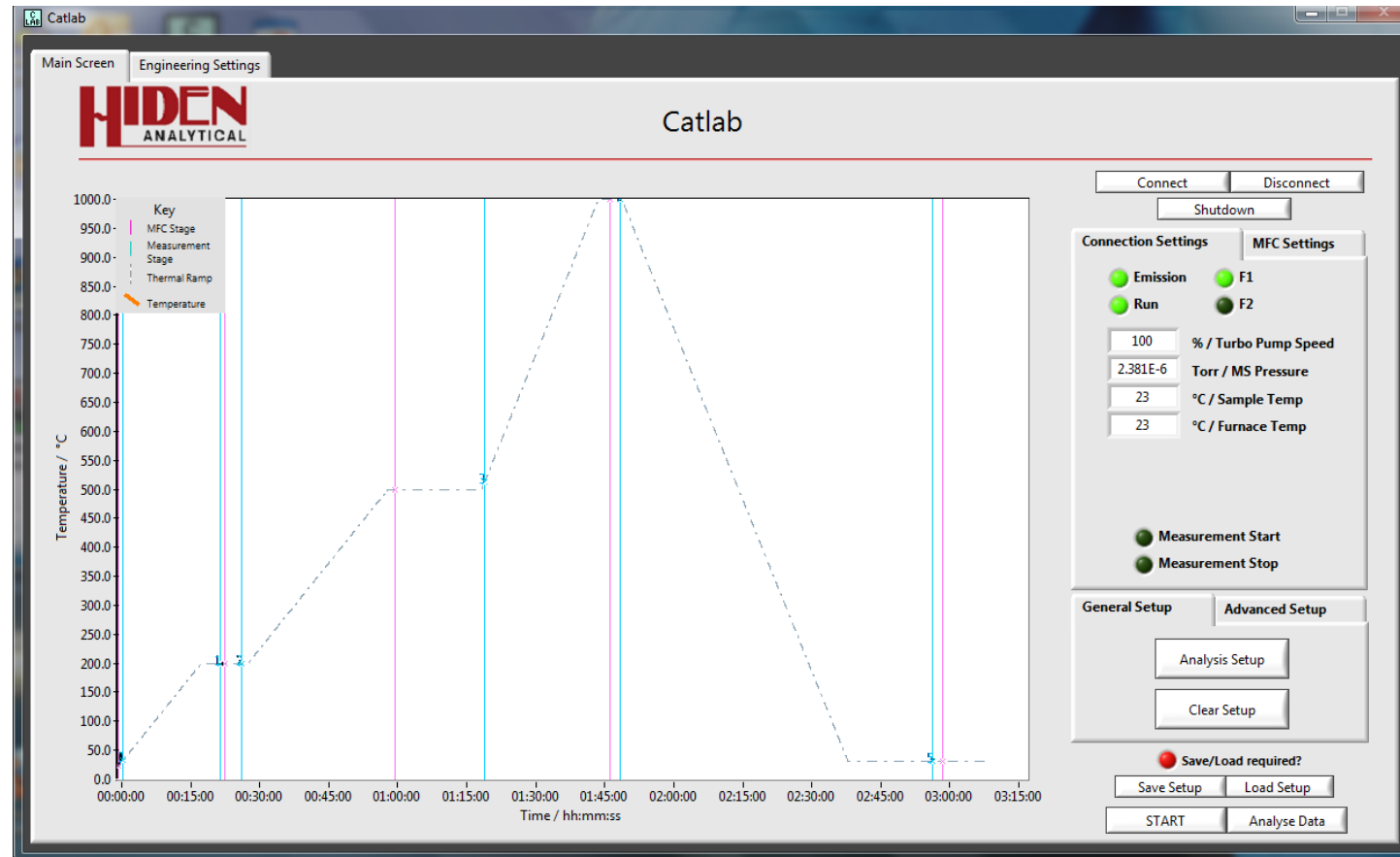
- Corrosion resistant upgrade - includes upgrade of one gas flow line and corrosive gas resistant sample line seals, and a gas dilution/purge valve mass spectrometer pumping system.
- Additional corrosion resistant feed lines if required.
- Additional 4 channel gas control unit integrated to provide 8 stream gas selection in total.
- Option to choose the maximum flow of each MFCs.
- Vapour Generation (gives vapour pressure equivalent to max liquid temperature ~30 °C). Other options available for higher flow rates.
- 300 amu mass range option. Mass range to 1000 amu available for specialised applications

QIC Series Gas Analysers



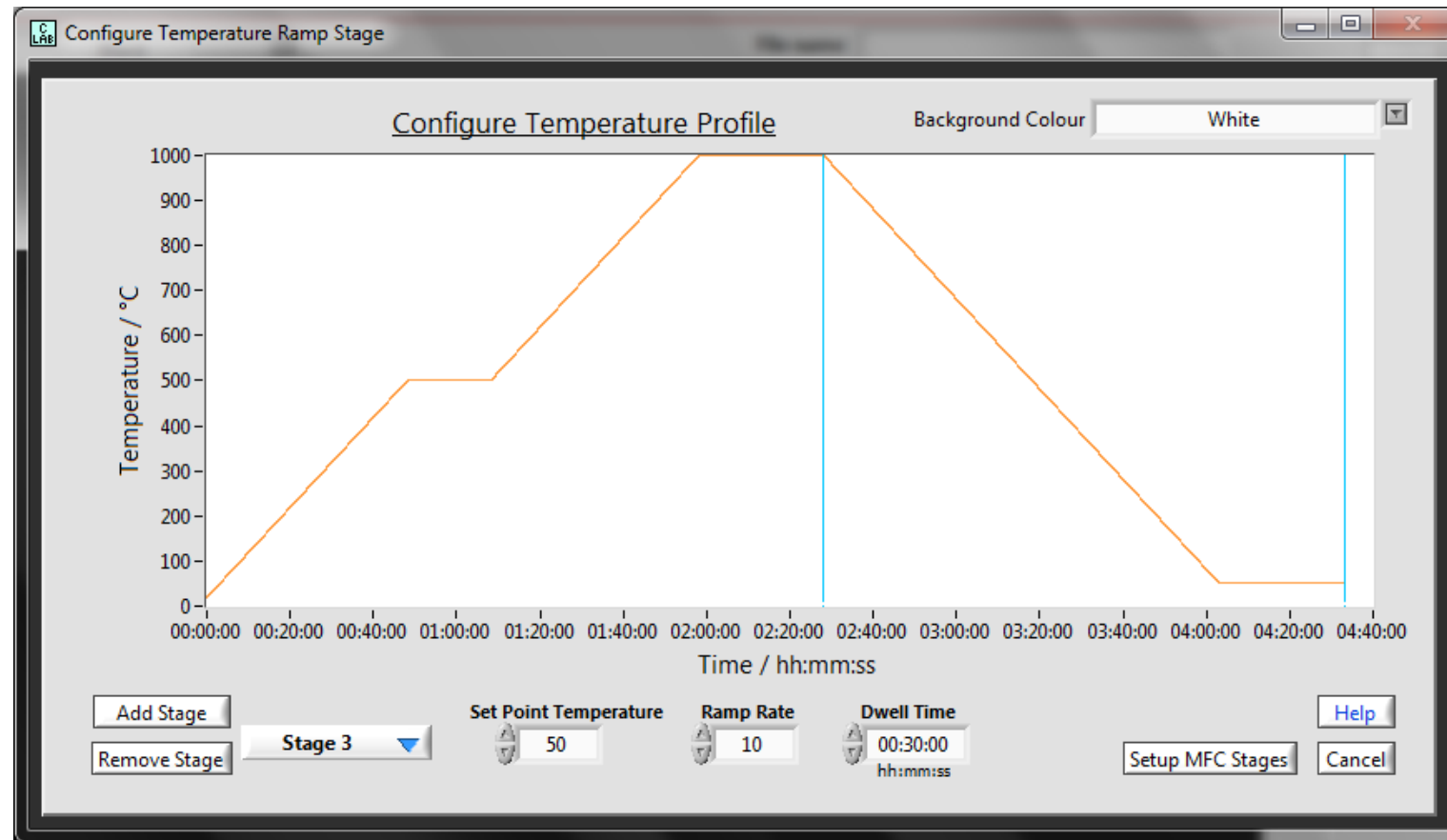
- 200 amu mass range, dual Faraday/ Electron Multiplier detector.
- Detection capability from 100 % to 0.1ppm.
- Fast scan speeds of 100 amu/s.
- <500 ms response time to changes in gas concentrations.
- Low dead volume, flexible heated inlet capillary for fast response to gases and vapours.
- Soft ionisation for analysis of complex mixtures and organics.
- Can be used as a stand-alone gas analysis system or in combination with other equipment i.e. Thermal Analysis.

CATLAB Control Software



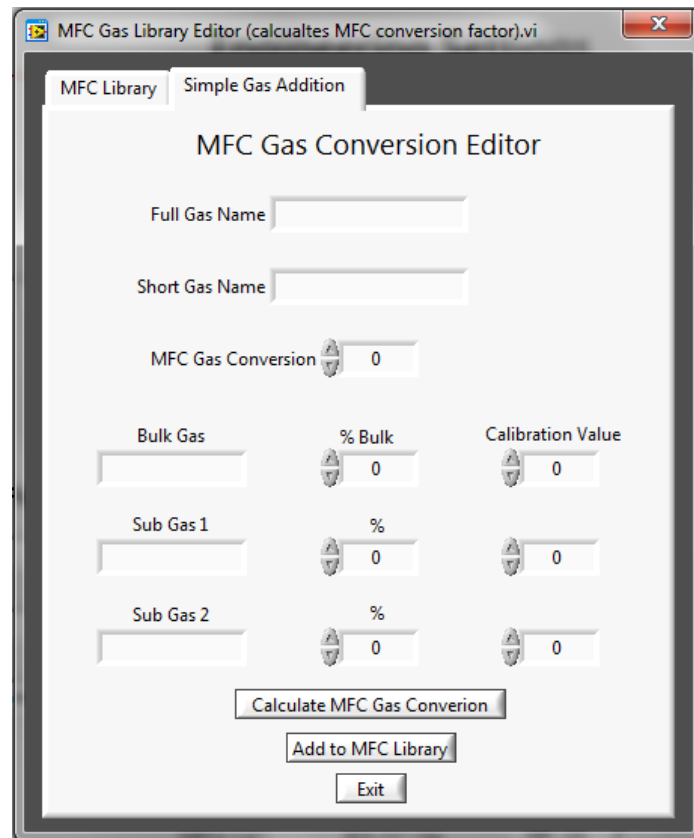
- Control of Mass Spectrometer, Temperature and Gas Flows in one software package

Temperature Control

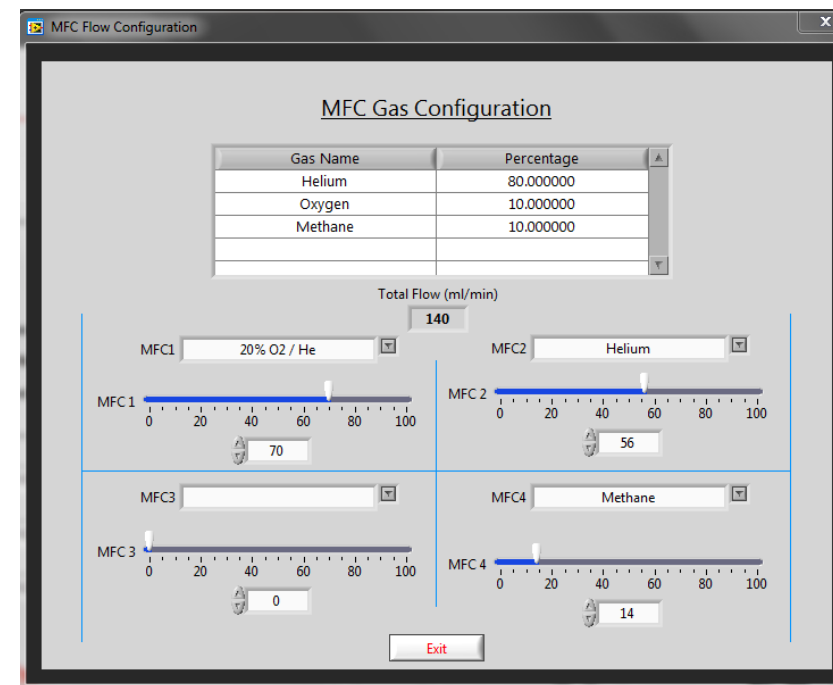


- Multi-stage temperature ramps

Gas Mixing Control

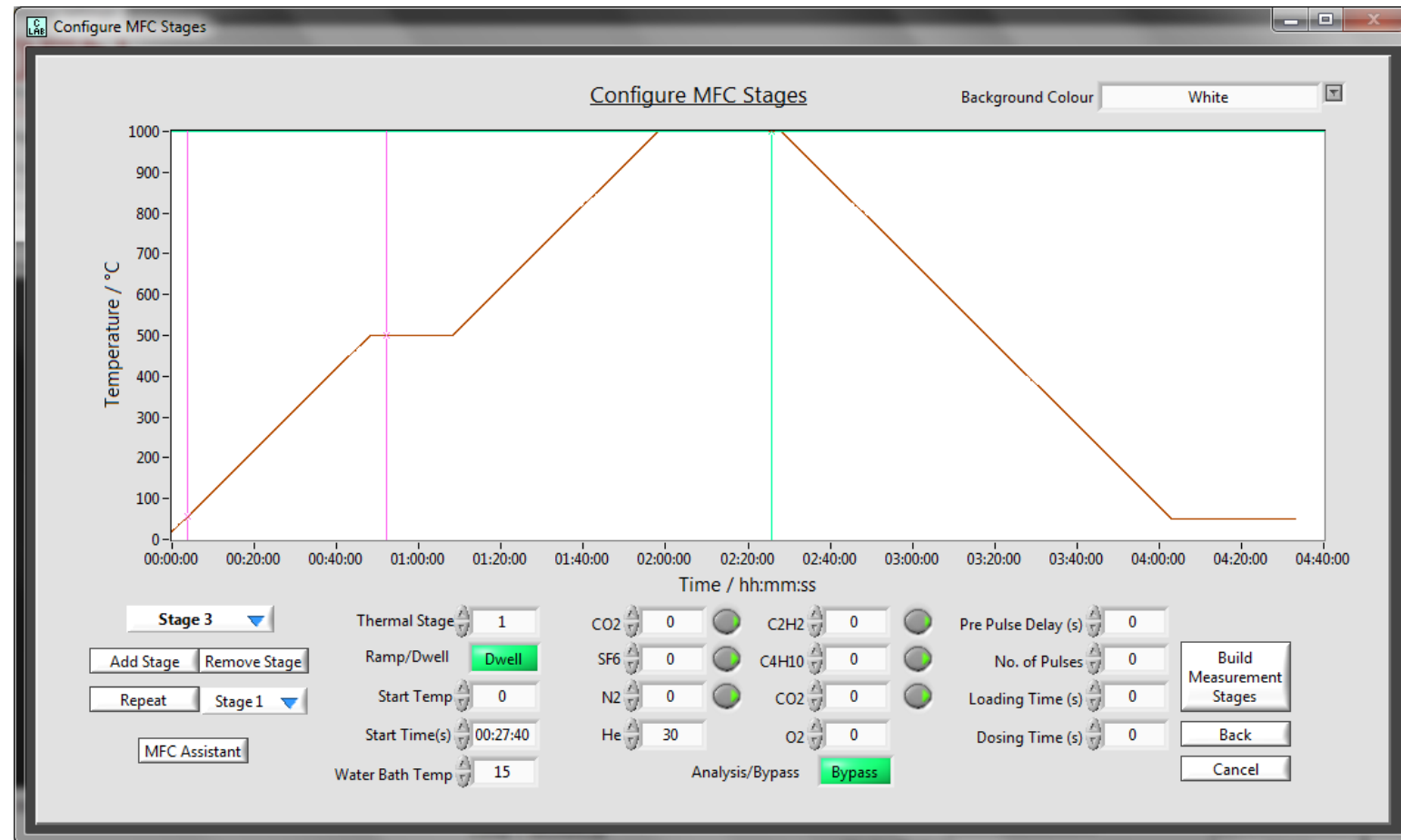


- MFC Gas Mix Library Editor



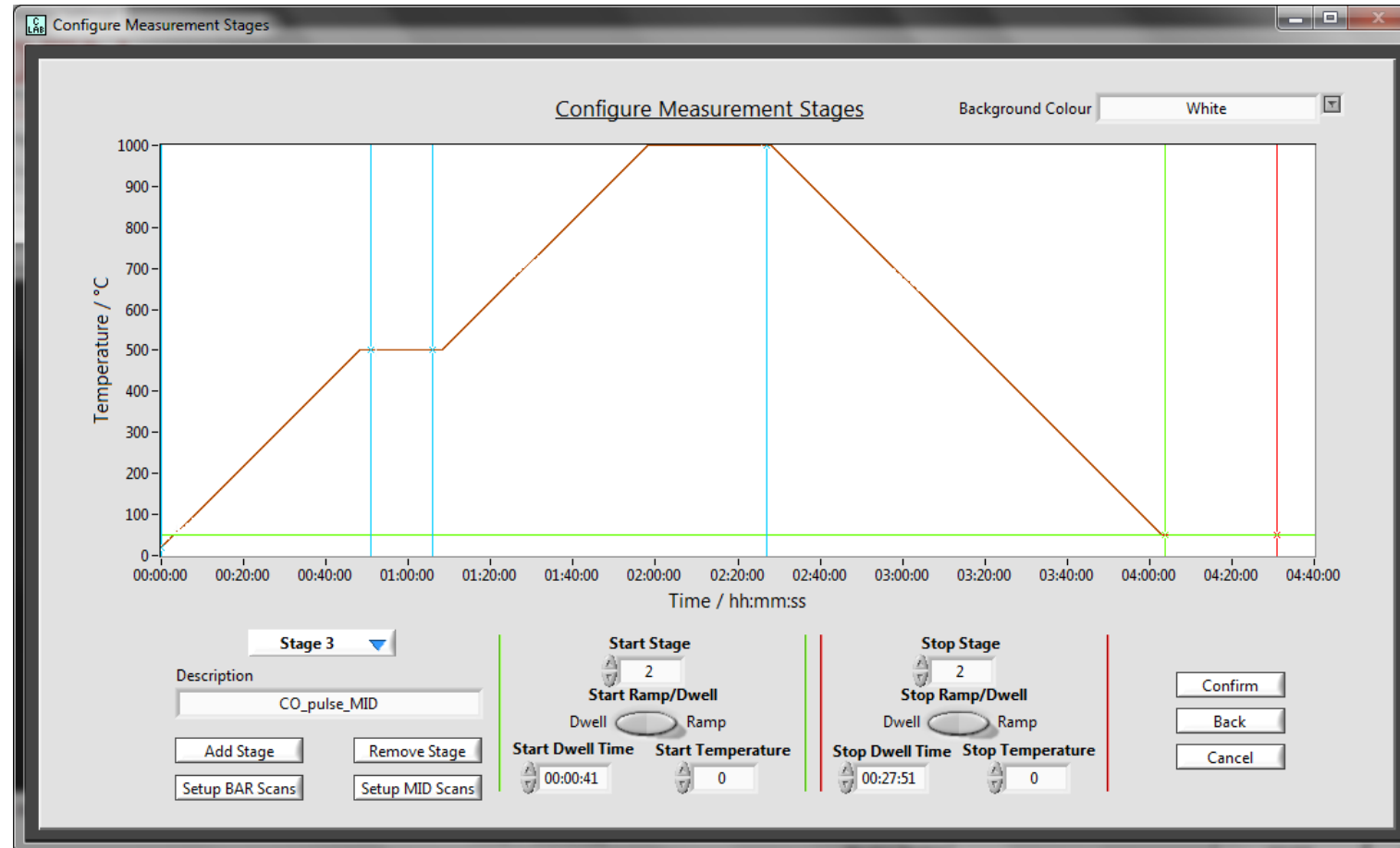
- Gas Mix Calculator

Gas Mixing Control



- Gas switching controlled by either temperature or time

MS Analysis Control



- Optimised multistage analysis - configure different analysis for different parts of the experiment

Mass Spectrometer Control

MID Setup

Gas	40	20	36	38	0	0	0	0	0	0
Gas 1 Argon	999	107	3	1	0	0	0	0	0	0
Gas 2 Hydrogen	999	100	0	0	0	0	0	0	0	0
Gas 3 Water	999	230	11	7	3	1	0	0	0	0
Gas 4 Oxygen	999	114	4	1	0	0	0	0	0	0
Gas 5	0	0	0	0	0	0	0	0	0	0
Gas 6	0	0	0	0	0	0	0	0	0	0
Gas 7	0	0	0	0	0	0	0	0	0	0
Gas 8	0	0	0	0	0	0	0	0	0	0

Page 2

Save Load

Exit

Show Advanced Settings

Show Limits

- MID Scan setup for known species
- Automatic overlap removal

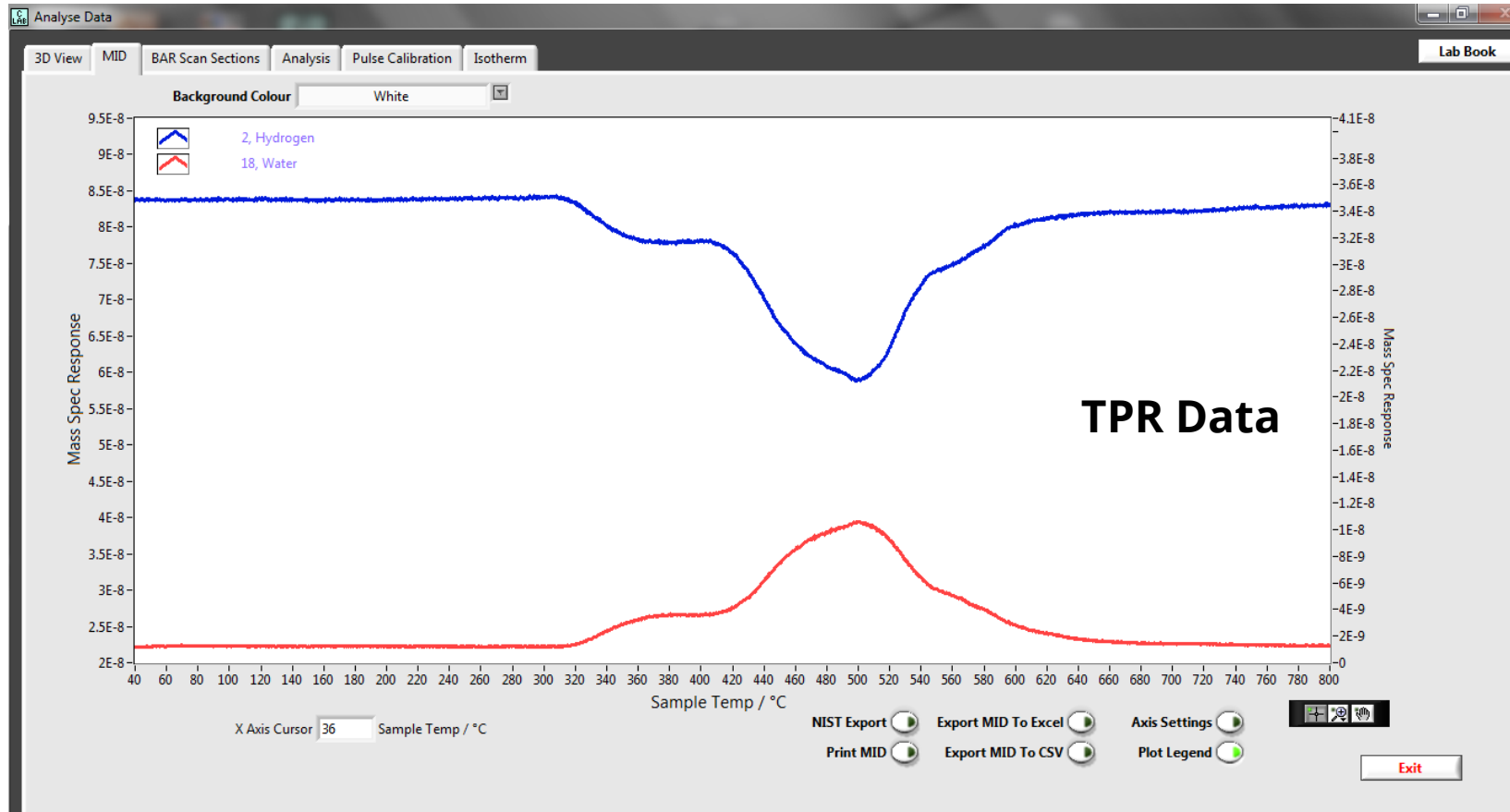
Mass Spectrometer Control

The screenshot displays the 'BAR Scan Setup' window, which is used for configuring mass spectrometer scans. The window features a title bar with standard Windows controls and a main area titled 'Bar Scan Settings'. Below this title, there are three distinct sections for configuring different scans: the main 'Bar Scan' and two subscans, 'Bar Subscan 2' and 'Bar Subscan 3'. Each section contains a series of controls: an 'Enabled' checkbox (all are checked), 'Start Mass' and 'Stop Mass' numeric inputs with associated up/down arrows, an 'Increment' numeric input with up/down arrows, a 'Detector' dropdown menu (all set to 'SEM'), 'Autorange High' and 'Autorange Low' numeric inputs with up/down arrows, a 'Start Range' numeric input with up/down arrows, an 'AutoZero' checkbox (all are checked), 'Electron Energy' and 'Emission Current' numeric inputs with up/down arrows, a 'Settle Speeds' dropdown menu (all set to 'Normal'), and a 'Dwell Time' dropdown menu (all set to 'Normal'). At the bottom of the window, there are three buttons: 'Save', 'Load', and 'Exit'.

	Start Mass	Stop Mass	Increment	Detector	Autorange High	Autorange Low	Start Range	AutoZero	Electron Energy	Emission Current	Settle Speeds	Dwell Time
Bar Scan	1	30	1	SEM	-7	-11	-8	ON	70	500	Normal	Normal
Bar Subscan 2	35	50	1	SEM	-7	-11	-8	ON	70	500	Normal	Normal
Bar Subscan 3	100	200	1	SEM	-7	-11	-8	ON	70	500	Normal	Normal

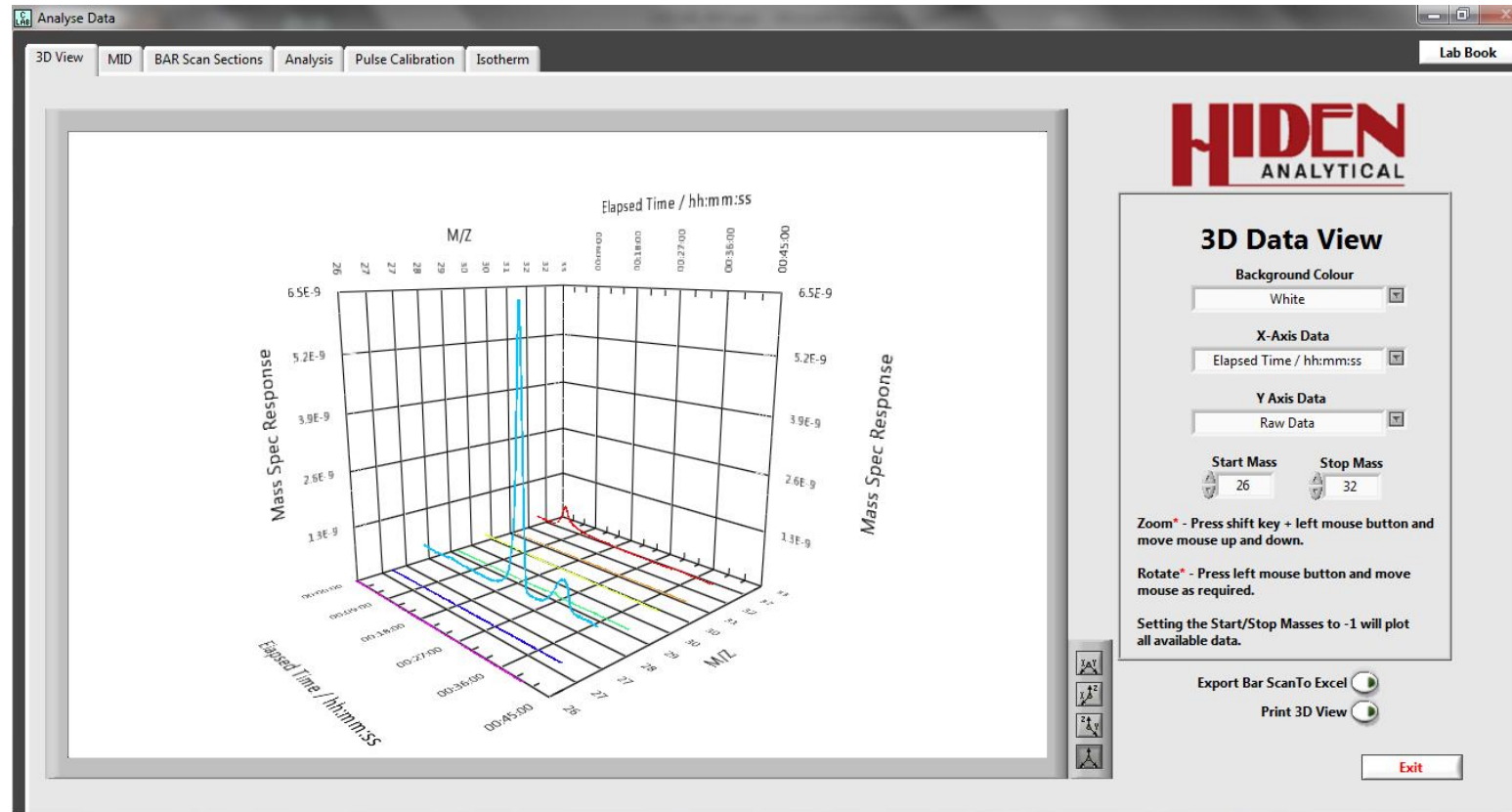
- Multiple Bar scans can be configured for optimised sampling of unknowns

MS Data Display



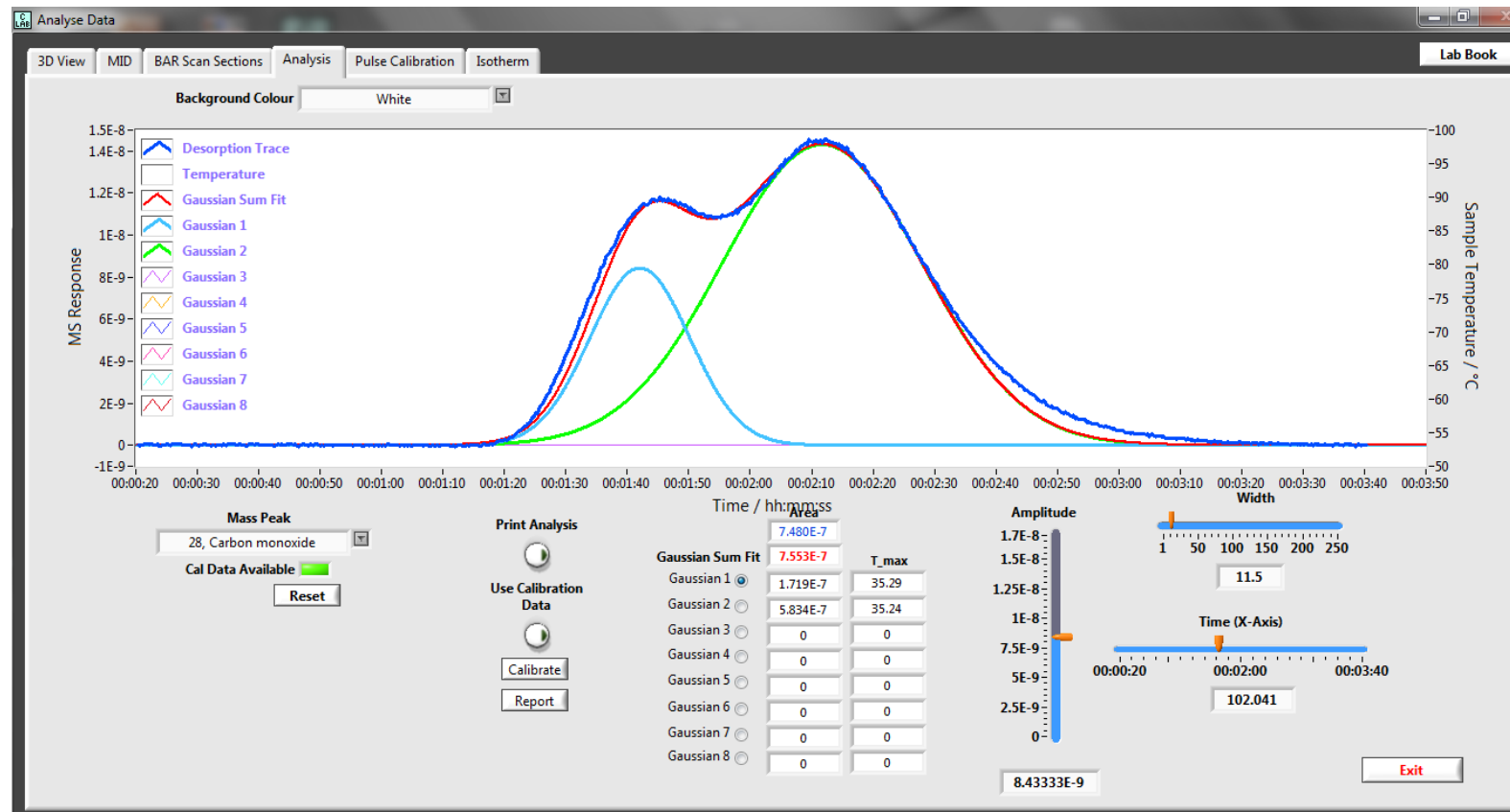
- Data plotted with x-axis as time or temperature

MS Data Display



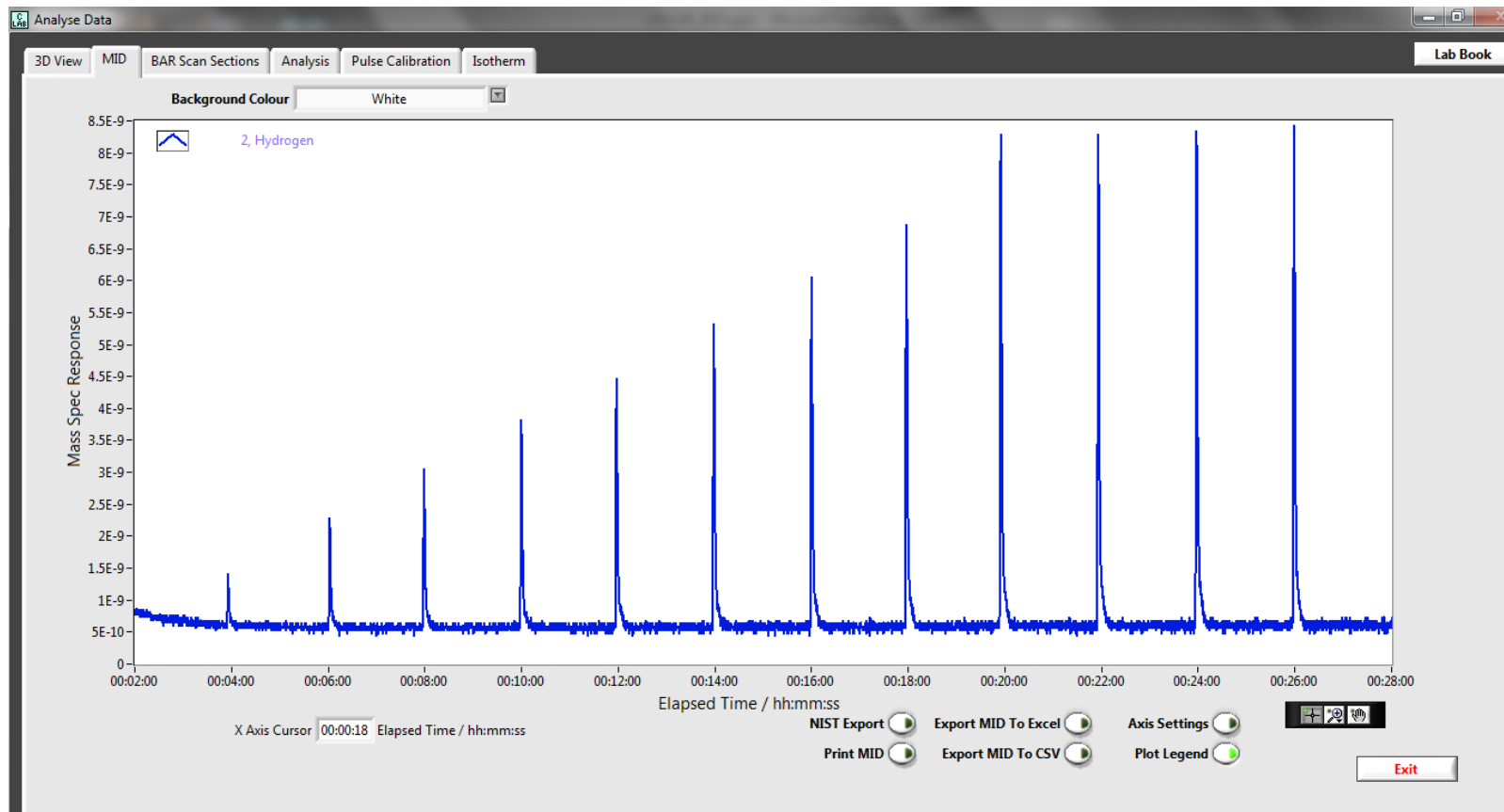
- 3D Bar Graph mode for easy identification of bar mode trends

Data Analysis



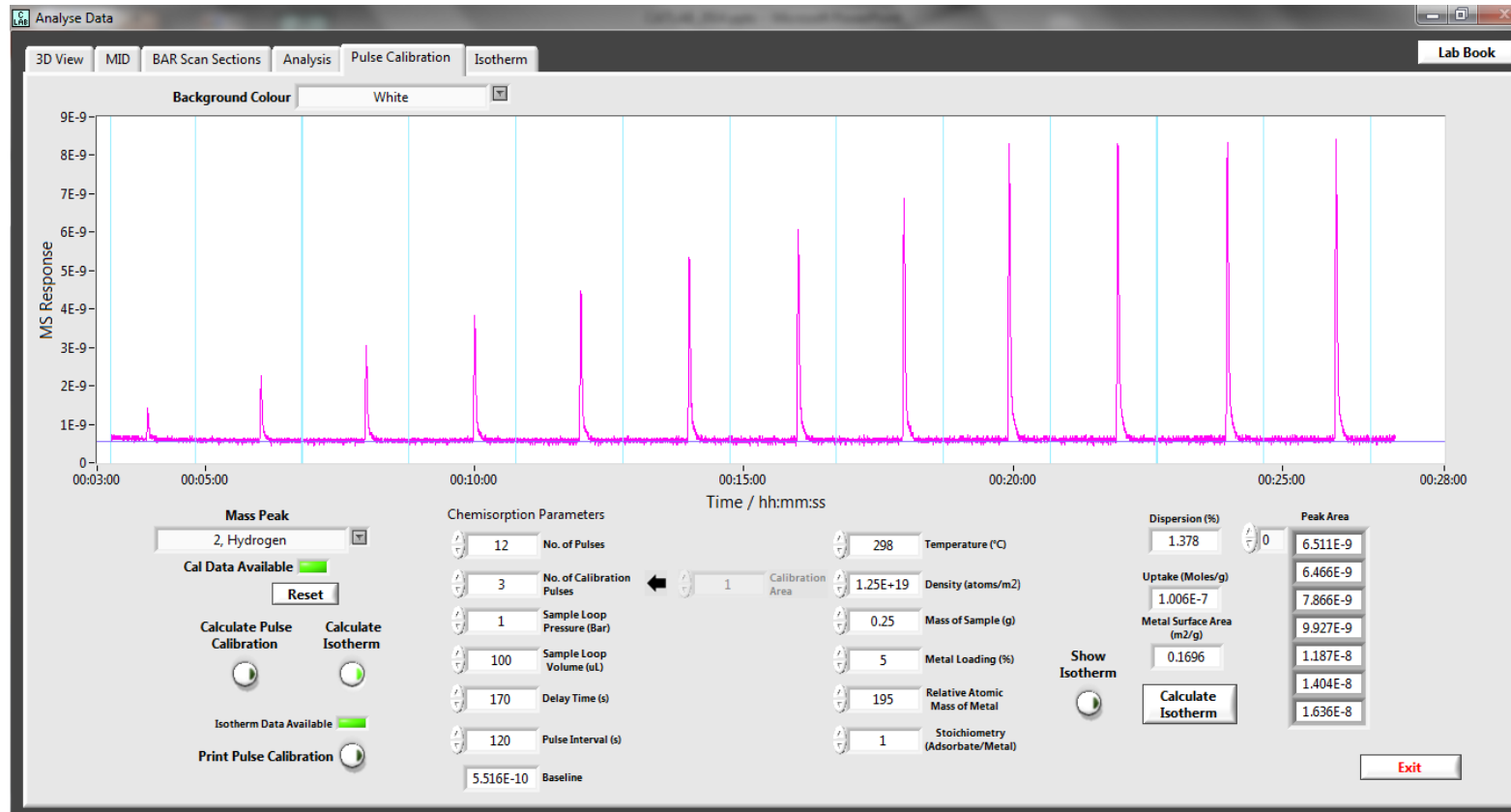
- Peak fitting analysis routines
- Integrated area
- Baseline subtraction

Pulse Chemisorption



- Injection of single gases or multiple reactants

Pulse Chemisorption Quantification



- Uptake measurements
- Dispersion calculation
- Metal surface area
- Pulse Adsorption Isotherm

Selected CATLAB Users



PDVSA



UCL
Université
catholique
de Louvain



ETH zürich

- Johnson Matthey
- Texas A&M University
- Hong Kong University
- Cambridge University
- Bayreuth University
- Research Complex at Harwell
- Sao Paolo University
- Bulgarian Academy of Sciences
- Université Catholique de Louvain
- Kunming University
- ETH Zurich
- PDVSA



Johnson Matthey



The University of Hong Kong



UNIVERSITY OF
CAMBRIDGE

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- **The effect of coke deposition on the activity and selectivity of HZSM-5 zeolite during ethylbenzene alkylation reaction in the presence of ethanol.** *Catal. Sci. Technol.*, 2014, **4**, 1017-1027. S. S. Khattaf, C. D'Agostino, M. N. Akhtar, N. O. Al-Yassir, N. Tan and L. F. Gladden.
- **Reaction Kinetics of C₃H₆ Oxidation for Various Reaction Pathways Over Diesel Oxidation Catalysts** .*Topics in Catalysis*, December 2013, Volume 56, Issue 18-20, pp 1916-1921. H. Oh, I. S. Pieta, J. Luo, W. S. Epling
- **An investigation of the role of surface nitrate species in the oxidation of propene on a Pt-based diesel oxidation catalyst..** *Catal. Sci. Technol.*, 2013, **3**, 2349-2356 , S. Chansai, R. Burch, C. Hardacre, H. Oh, and W. S. Epling.
- **Molybdenum oxide on Fe₂O₃ core-shell catalysts; probing the nature of the structural motifs responsible for methanol oxidation catalysts** .*ACS Catal.*, **2014**, 4 (1), pp 243–250, C. Brookes , P. P Wells , G. Cibir , N. Dimitratos , W. Jones , D. J. Morgan , and M. Bowker.
- **Chiral Co(II) metal-organic framework in the heterogeneous catalytic oxidation of alkenes under aerobic and anaerobic conditions.** *ACS Catal.*, 2014, 4, pp 1032–1039 Giulia Tuci, Giuliano Giambastiani, Stephanie Kwon, Peter Curran Stair, Randall Q. Snurr and Andrea Rossin

Summary

- Integrated microreactor and mass spectrometer
- Both microreactor and mass spectrometer manufactured by Hiden
- Single integrated software package to control MS and microreactor
- Ideal for catalyst characterisation and reaction testing
- Designed for optimum mass spectrometer performance

