

HPR-30

Vacuum Process Gas Analyser

**A differentially pumped RGA system for
vacuum process monitoring**

HPR-30 vacuum process gas analyser

- To analyse processes with high dynamic range operating at pressures $>10^{-4}$ Torr it is necessary to pump the RGA with its own pumping group and sample the process through a sampling connection
- The sampling connection to the process chamber is optimised to maintain fast response time and maximum sensitivity
- The HPR-30 uses an orifice inserted into the process chamber with a high conductance path from orifice to RGA



For monitoring gas composition and contaminants in sputtering, CVD, ALD, MOCVD, PECVD, PVD, evaporation, and optical coatings.

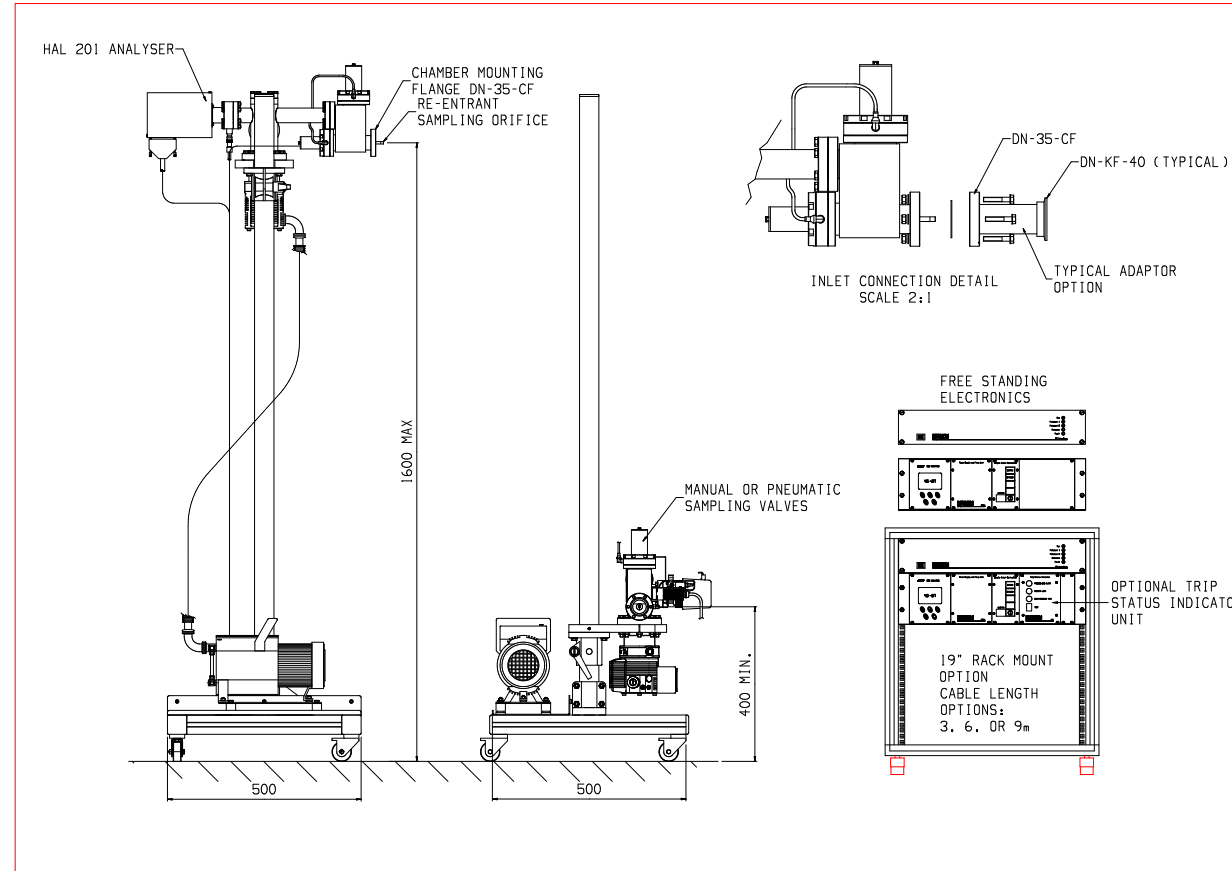
HPR-30 vacuum process gas analyser

- The re-entrant orifice provides for fast response, high sensitivity sampling
- A special high conductance sampling path provides for residual gas analysis when the chamber is at less than 10^{-3} mbar, or at base vacuum
- The re-entrant orifice is custom designed for special process monitoring requirements, for both process chamber configuration and process pressure
- Cart mounted system

The HPR 30 system includes a complete turbo molecular UHV pump set and Penning gauge with interlock protection in case of over pressure

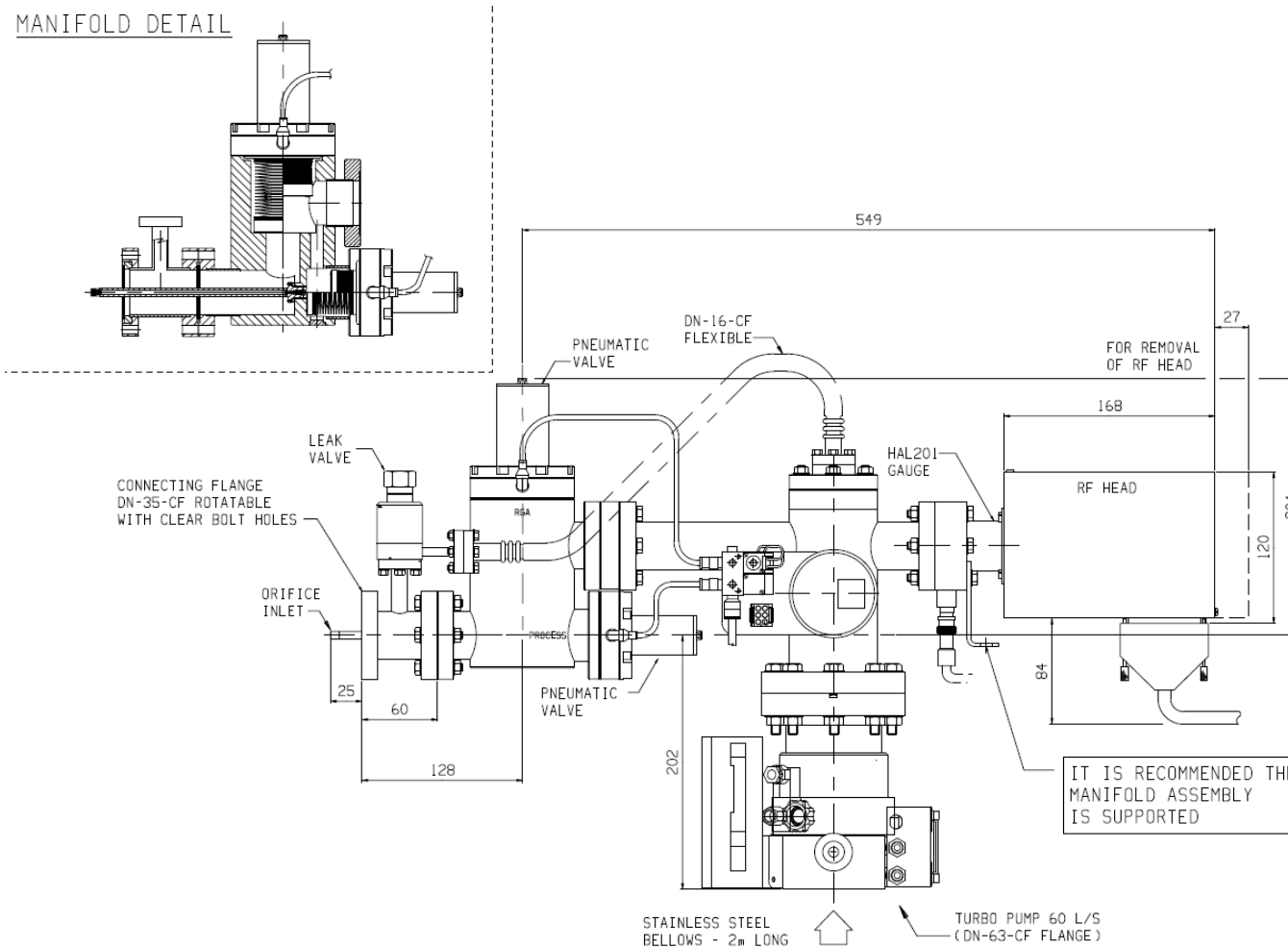


HPR 30 Cart - vacuum process analyser



The cart mounted design has a small footprint, adjustable height, and is easily moved from process tool to tool.

HPR 30 – Vacuum manifold detail

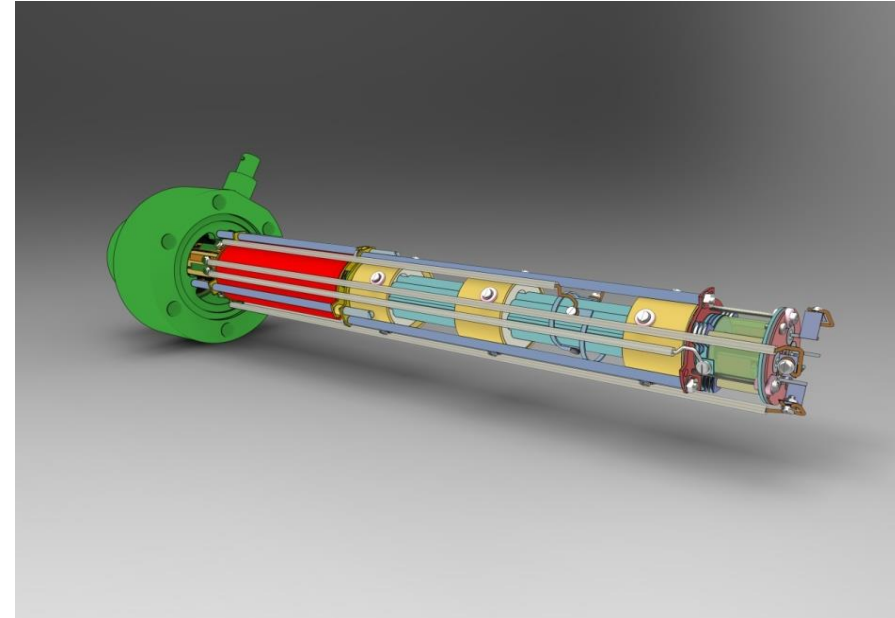


The leak valve option shown extends the sampling pressure range.

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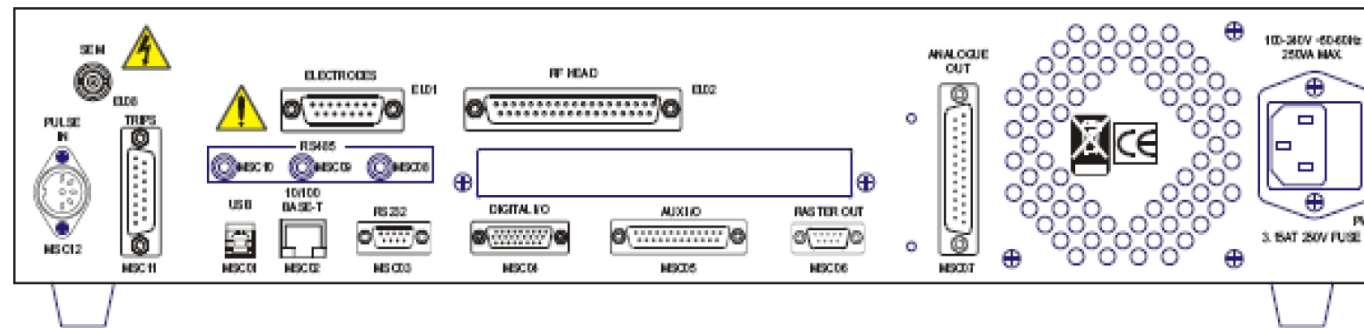
The mass spectrometer:

- The Hiden HAL201 RC residual gas analyser is included as standard:
- Mass range: 200 AMU
- Detector: Dual Faraday cup and single channel electron multiplier
- Ion source matched to HPR 30 sampling system
- Data acquisition speed up to 500 measurements per second
- MASsoft PC software



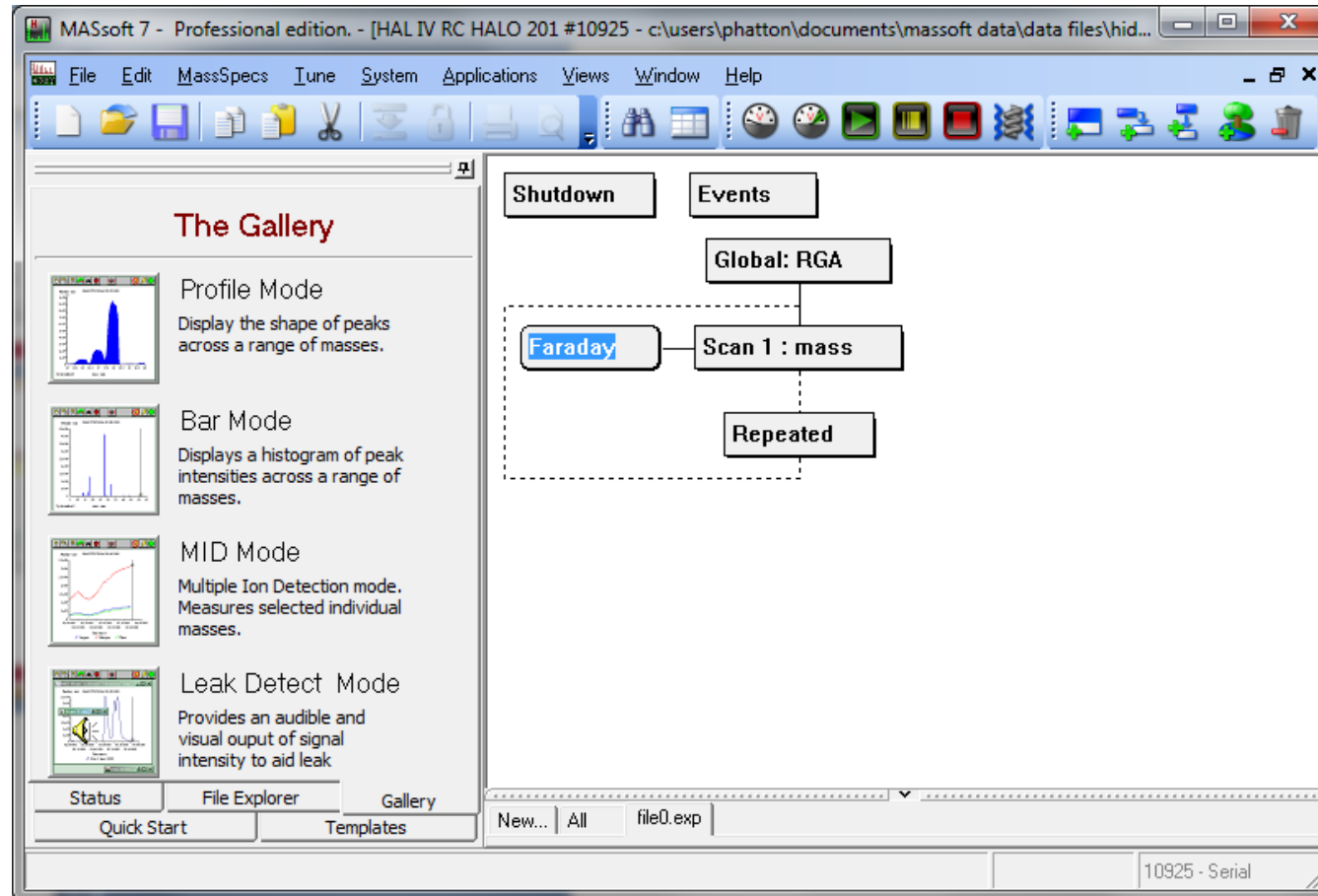
Mass range options: 300 AMU, 510 AMU or 1000 AMU

Mass Spectrometer Interface Unit



- 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 inputs and analogue signal output options

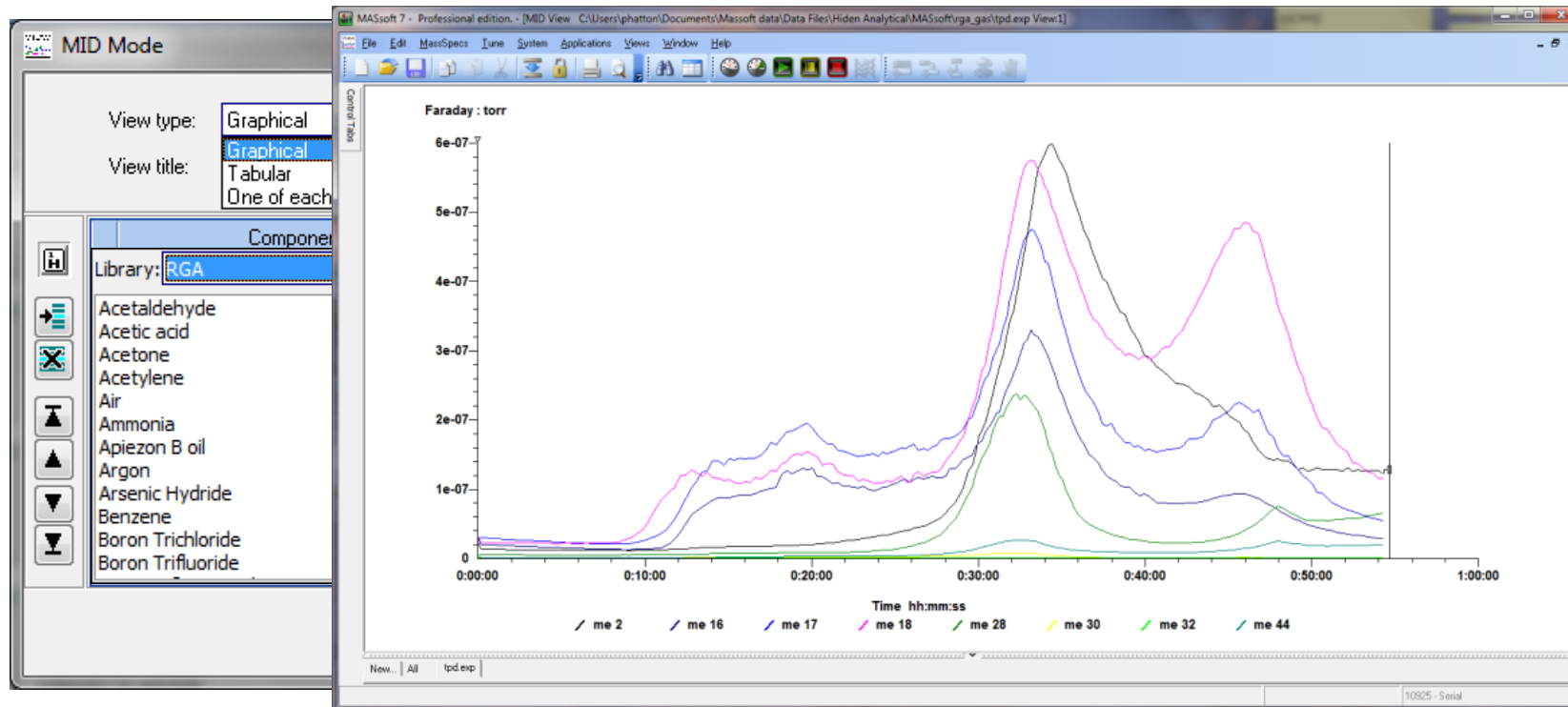
Mass Spectrometer software – easy start



Pre set modes of operation, templates and full control of mass spectrometers parameters.

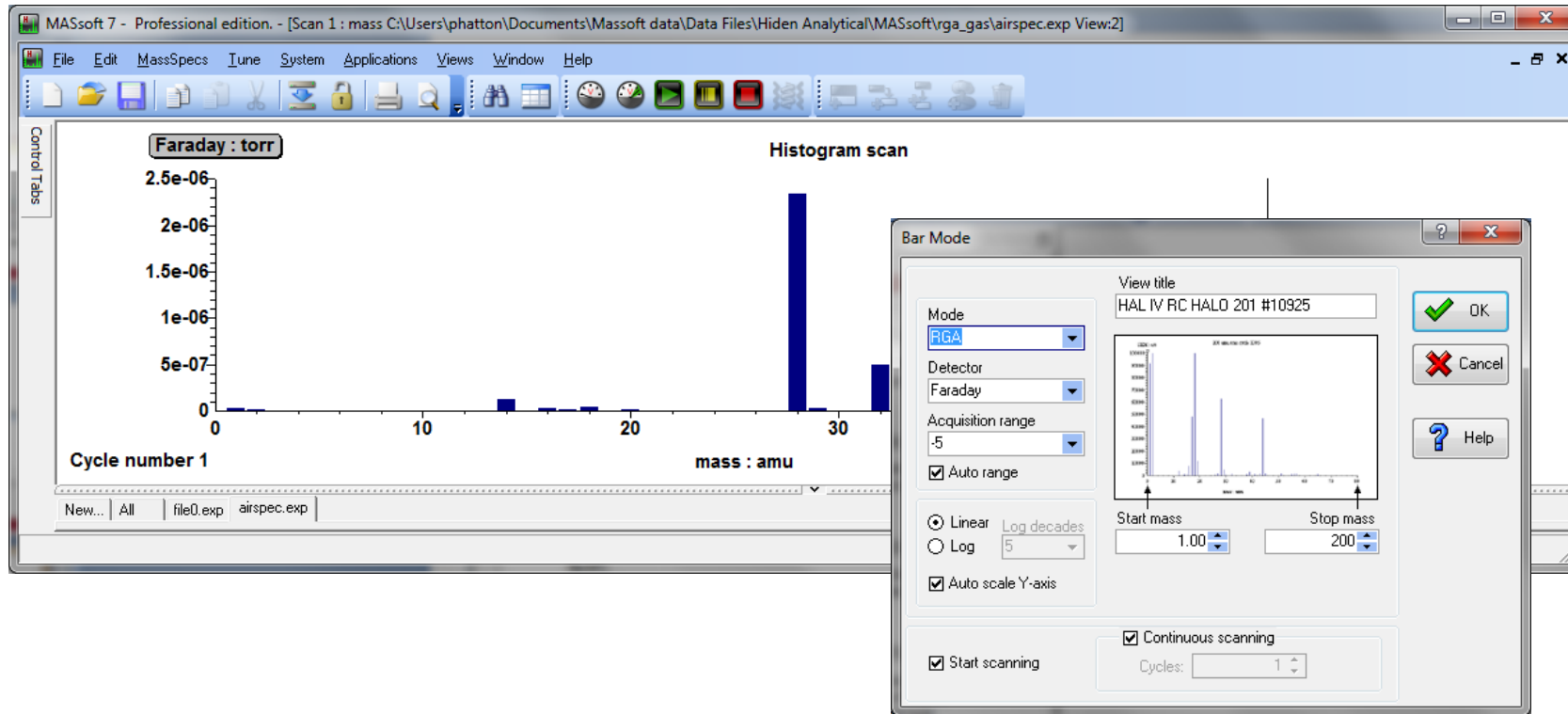
Trend Analysis

- Unlimited number of mass channels
- Full mass spectrometer control on a per channel basis
- Automatic mass peak selection from on board user editable library
- Quantitative analysis with user editable algorithms



Mass Spectrometer – mass scanning -1

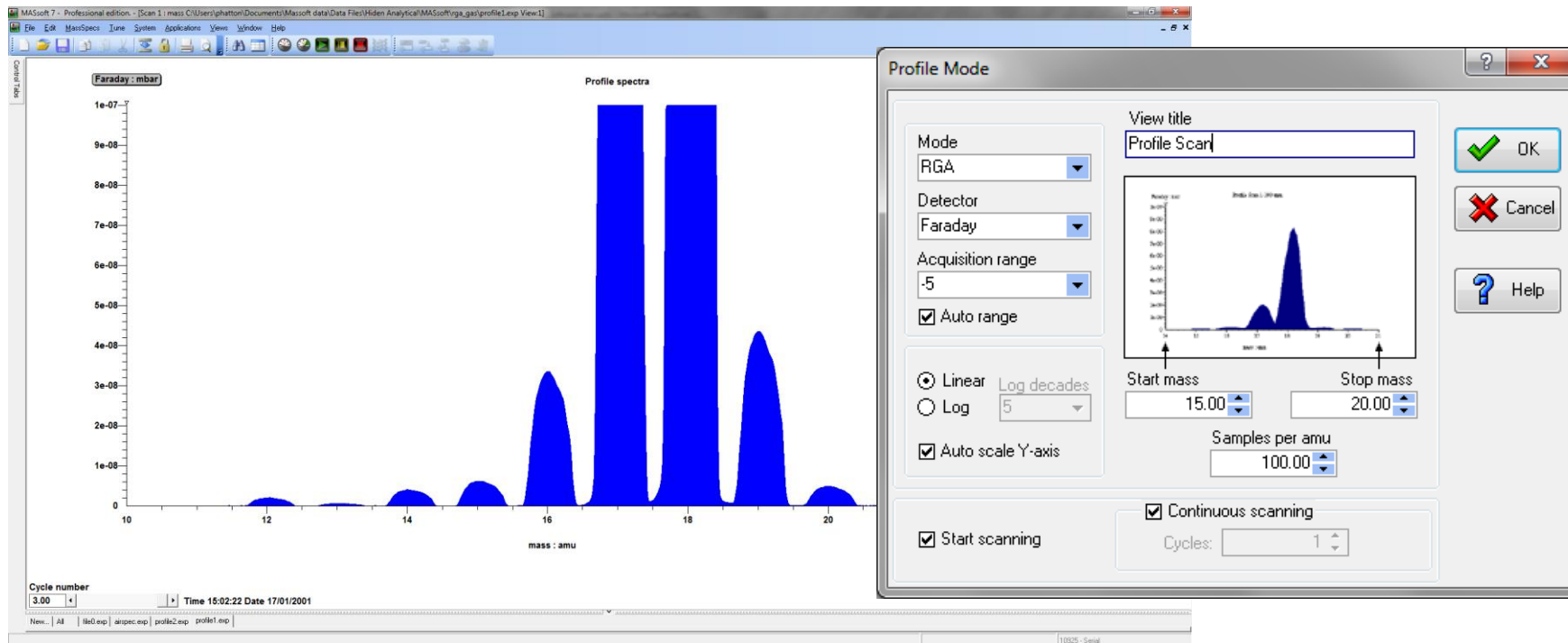
- Histogram scanning mode



- Extract trend analysis for any mass peak(s) within the scan
- New 4, 6 or 8 decade dynamic range scan

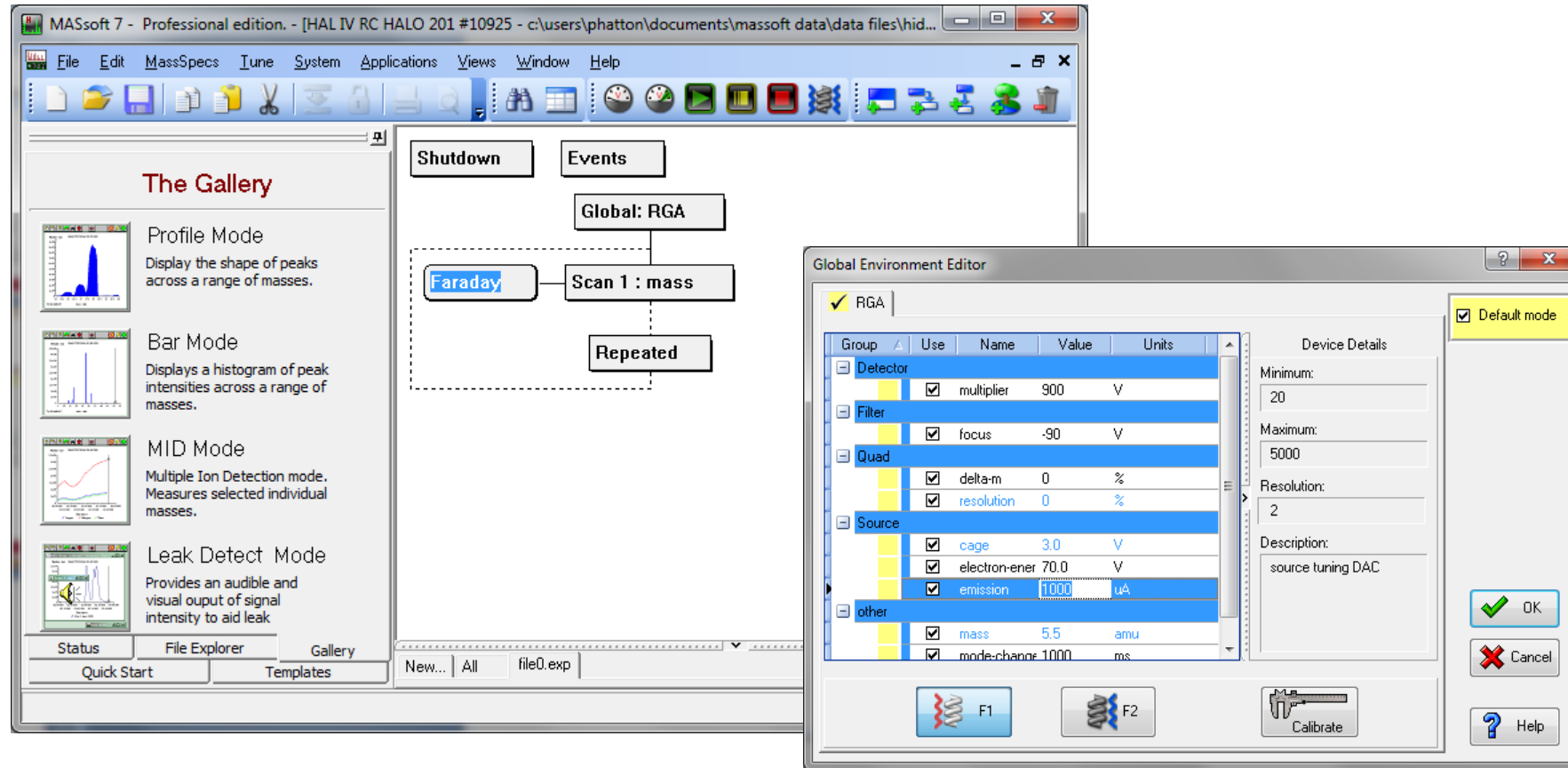
Mass Spectrometer – mass scanning-2

- Peak profile diagnostic mode



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

MS Control



Pre set modes of operation, templates and full control of mass spectrometers parameters.

MS Control

The screenshot displays the MASsoft 7 Professional edition interface. On the left, a 'Control Tabs' panel shows a sequence of scan steps: Shutdown, Events, Global: RGA, Faraday (Scan 1: mass), SEM (Scan 2: mass), Faraday (Scan 3: m), SEM (Scan 4: m), Faraday (Scan 5: m), Faraday (Scan 6: m), and Repeat. A 'Scan Editor' dialog box is open over the 'Scan 1: mass' step. The dialog box contains the following fields and options:

- Scan Mode: Global (RGA)
- Available to Scan: mass
- Minimum Value: 0.40 amu
- Maximum Value: 200.00 amu
- Minimum Increment: 0.01 amu
- Description: scanable quad control DAC
- Buttons: OK, Cancel, Advanced..., Help
- Legend: Bar, Profile, MID
- Scan Legend: mass
- Start Value: 0.40 amu
- Stop Value: 200.00 amu
- Increment Value: 0.01 amu
- Steps: 19961
- Relative Sensitivity: 1.000
- Relative SEM: 1.000

At the bottom of the window, a taskbar shows open files: New..., All, file0.exp, airspec.exp, profile1.exp, file1.exp. The status bar at the bottom right indicates '10925 - Serial'.

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

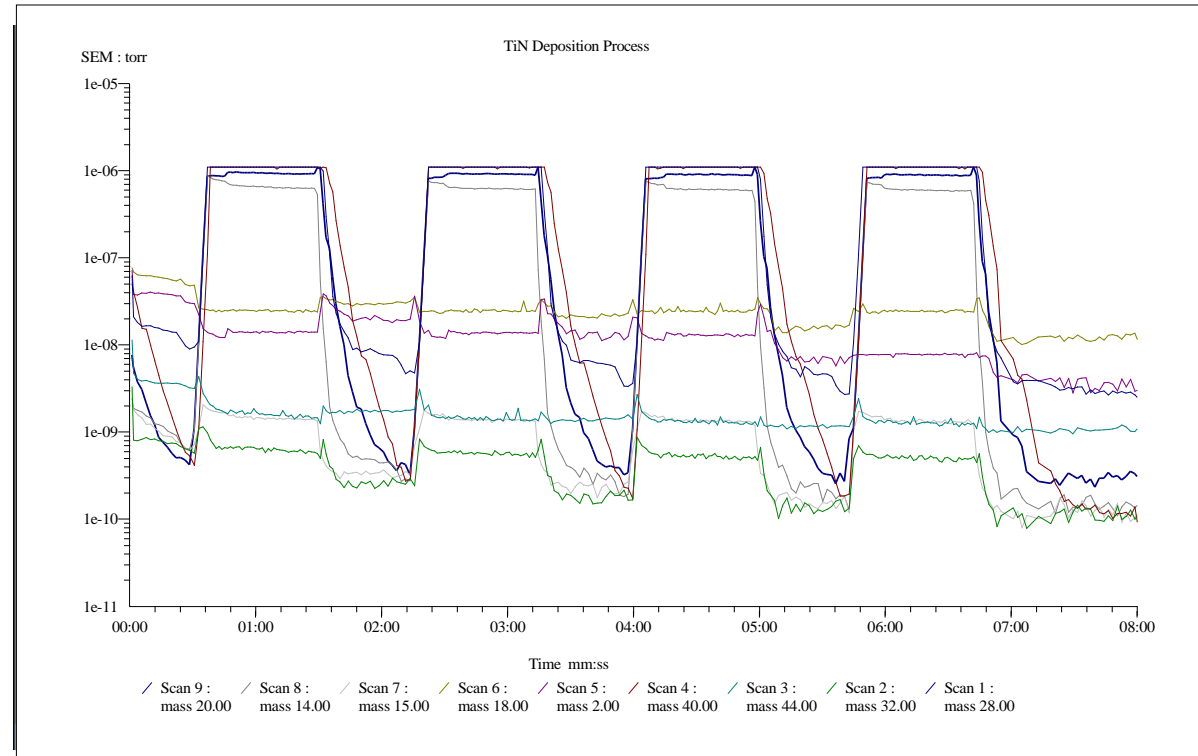
Events provides control of:

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

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Data examples

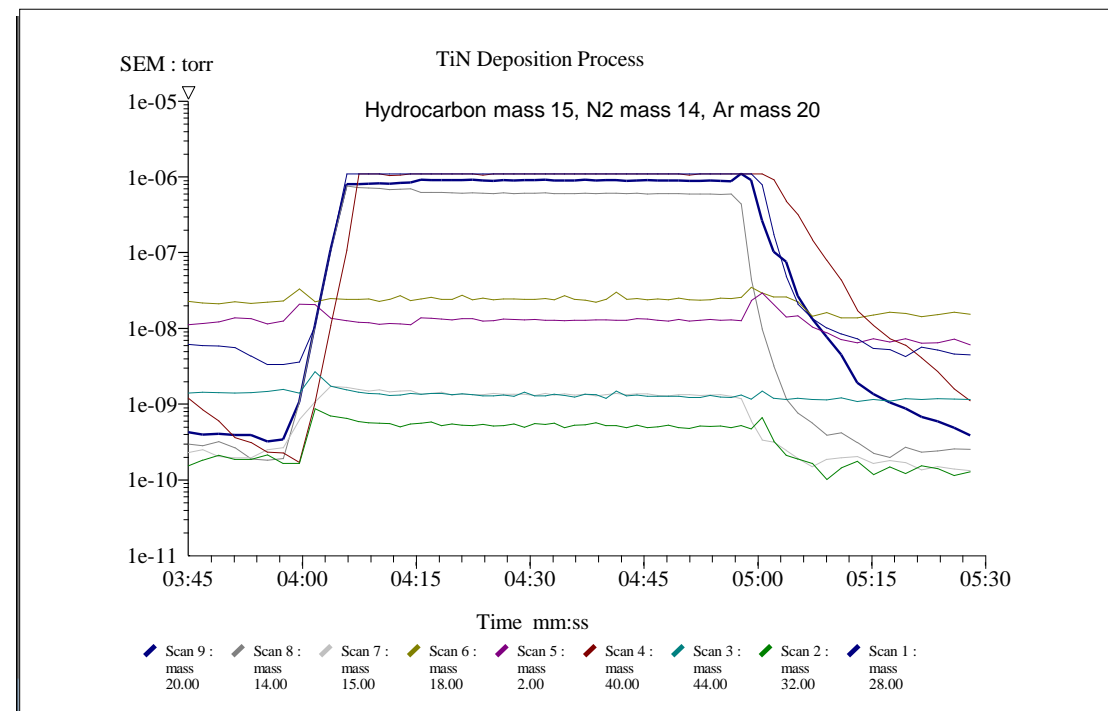
- Pump down Profiles
- Vacuum Diagnostics
- Base Pressure
- Residuals
- Backfill
- Sputter-On
- Bake-Out
- Leak Checking



Trend Analysis of: water, hydrogen, hydrocarbons
CO₂, Ar, N₂ in four titanium nitride deposition cycles.

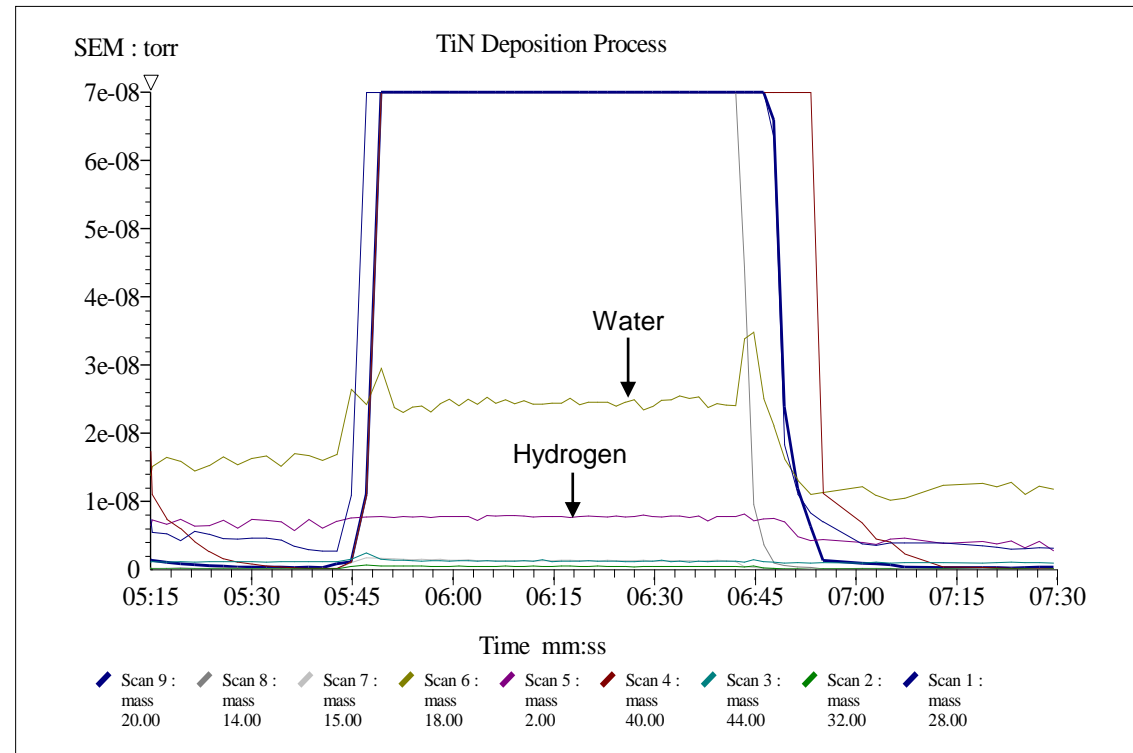
TiN Deposition: A Wafer Cycle Profile

- TiN Process Endura PVD
- Reagent Gas Levels Monitored
- 8mTorr process pressure
- Ultrapure Ti Target
- 60:40 N₂ to Ar



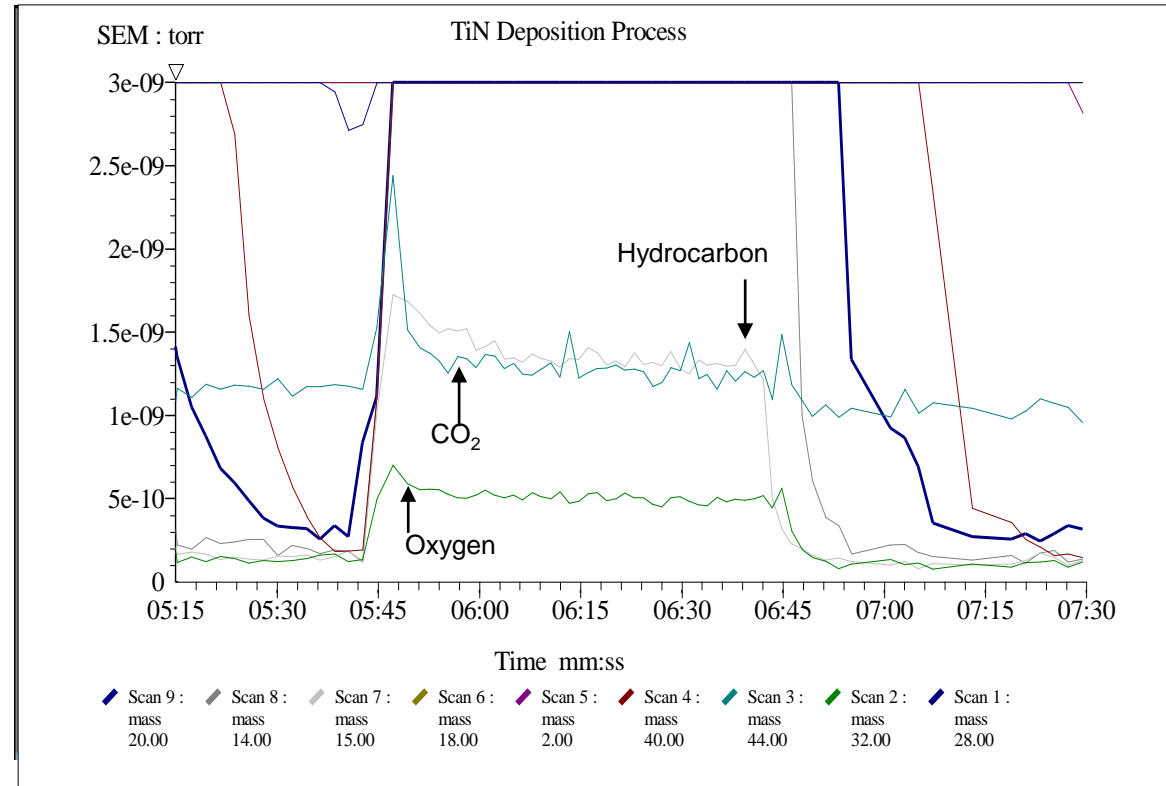
Primary Contaminant Analysis

- Zoom in on the process run data to reveal the primary process contaminants
- Water at 0.1%
- Hydrogen at 0.05%



Low Level Process Contaminants

- Further zoom to examine ppm level contaminants
- In process hydrocarbon background at 100ppm
- CO₂ at 120ppm



Installations the following sites use Hiden Gas Analysis Systems

USA

Applied Materials

Axelis

CVC/Veeco

DuPont

General Motors

IBM Research

Lawrence Livermore

Motorola

NIST

Semtech

UK/Europe

Bosch

IMEC

Motorola

Nortel Networks

Oxford Plasma Technology

Philips

Rolls Royce

SGS Thomson

Siemens

Surface Technology Systems

Asia Pacific

Canon

Hitachi Fundamental Res.

Hyundai

LG Electronics

NEC

Samsung

Sony Corporation

TDK

Tokyo Electron

Toshiba



Rolls-Royce®

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