

# 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.

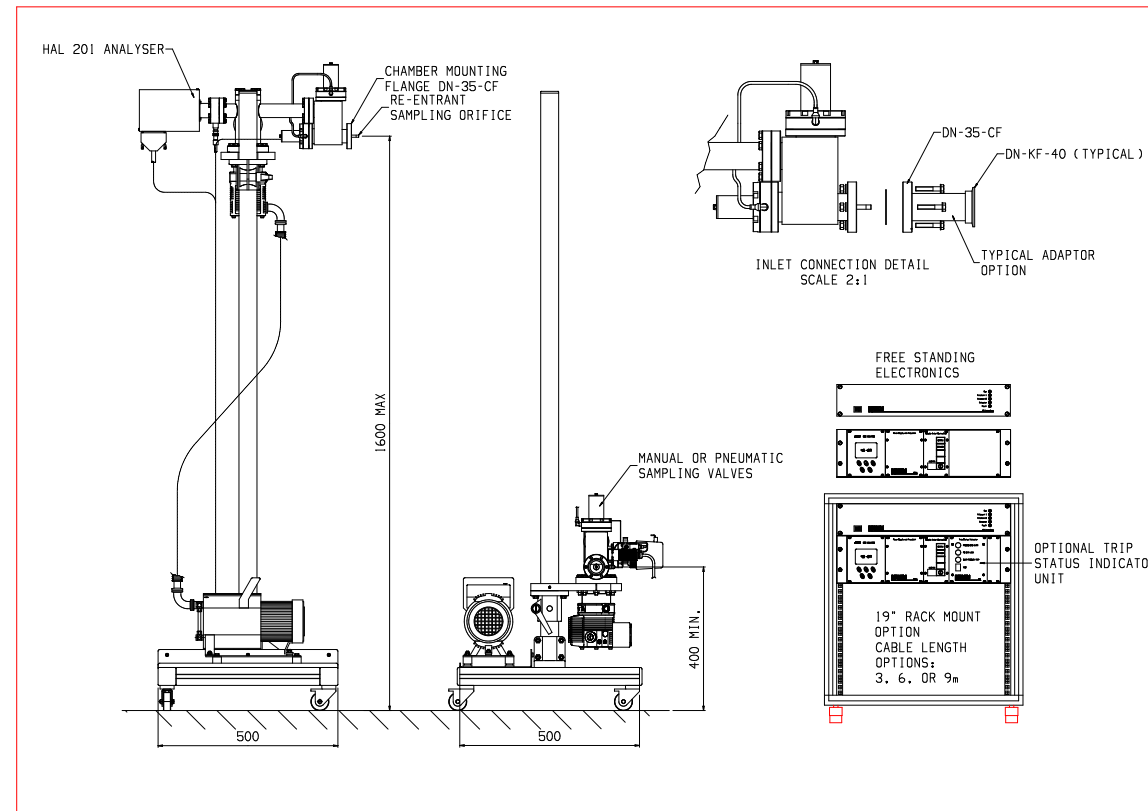
# HPR-30 vacuum process gas analyser

- 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

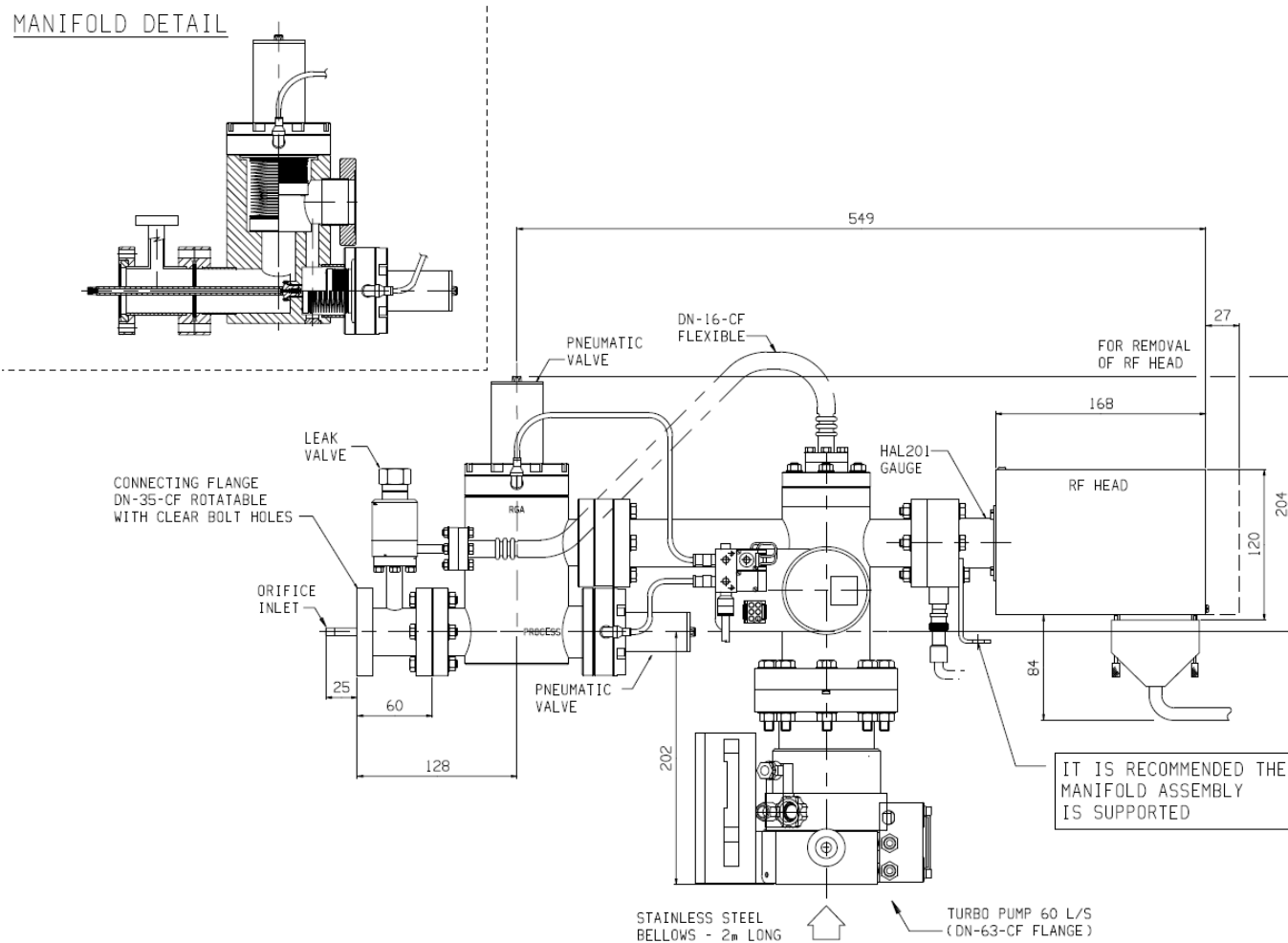


# HPR-30 Cart – vacuum process analyser



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

# HPR-30 – Vacuum manifold detail



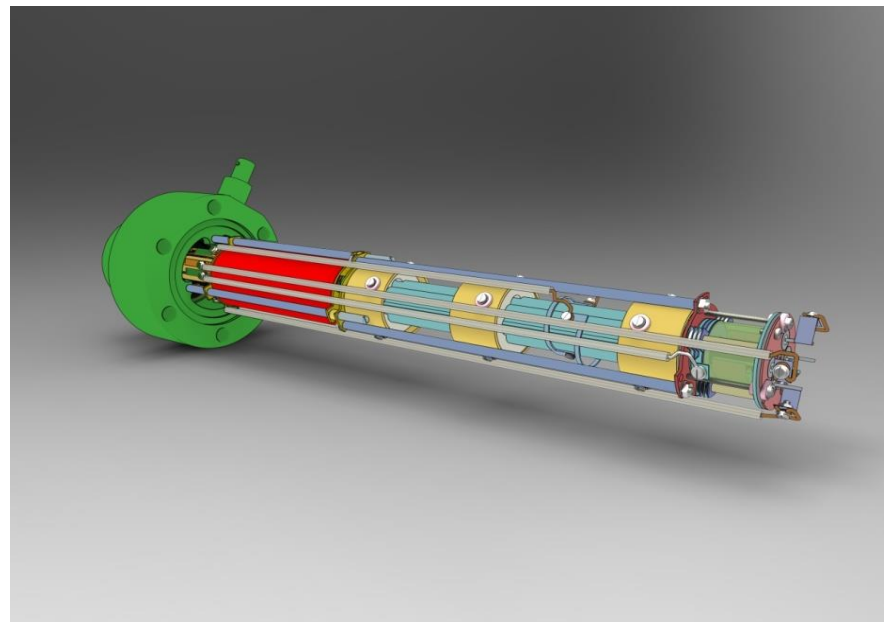
The leak valve option shown extends the sampling pressure range.

# HPR-30 vacuum process gas analyser

## The mass spectrometer:

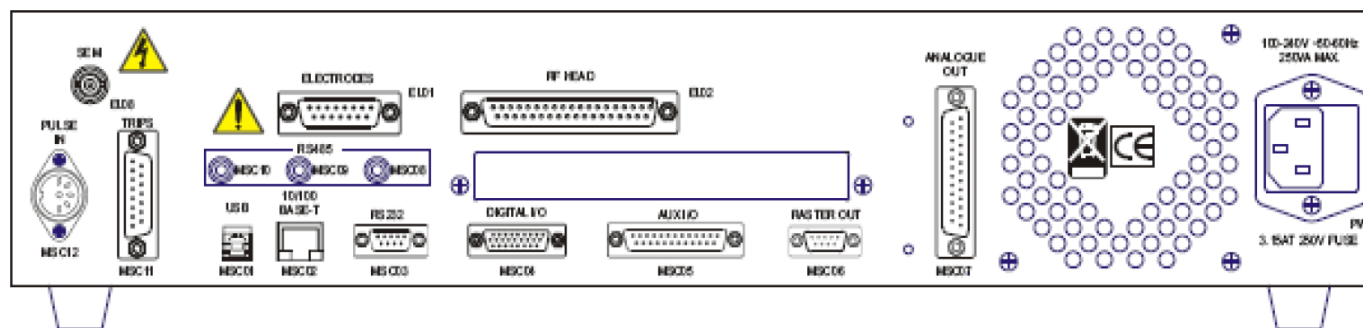
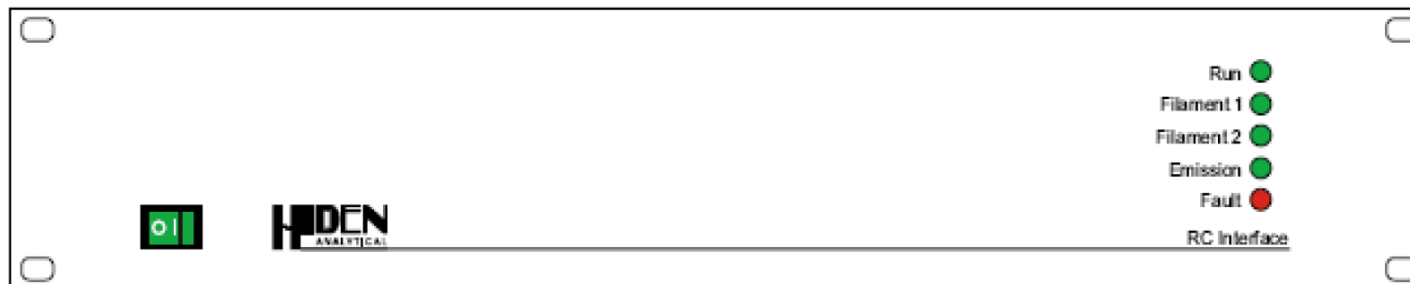
The Hiden HAL 201 RC residual gas analyser is included as standard:

- 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 650 measurements per second
- MASsoft Professional 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

The screenshot displays the MASoft 10 Professional software interface. The main window shows a scan sequence diagram with the following steps:

- Start** (Yellow circle)
- Faraday** (Grey oval)
- Scan 1 : mass 0.40 - 200.00** (Yellow rectangle)
- Repeated** (Diamond shape)
- Stop** (Grey circle)

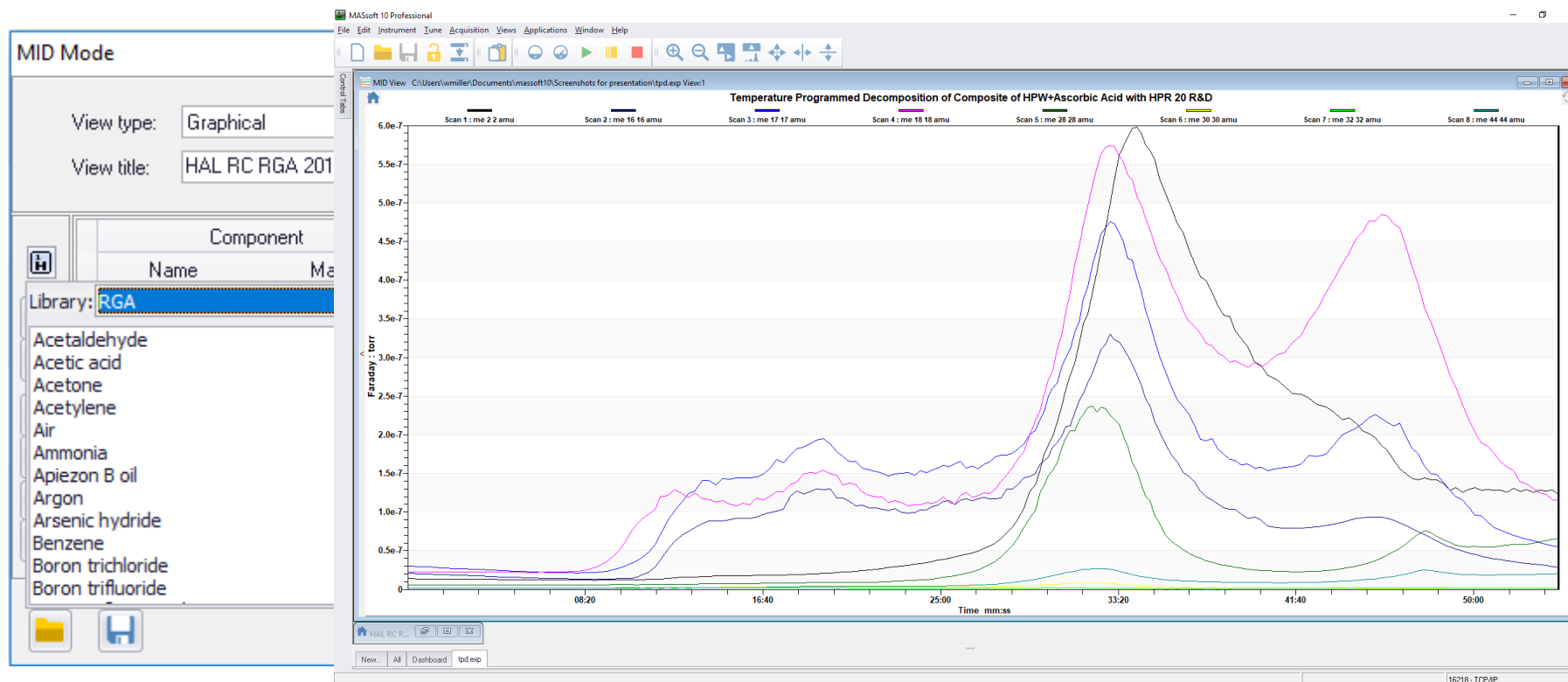
The interface includes a menu bar (File, Edit, Instrument, Tune, Acquisition, Views, Applications, Window, Help) and a toolbar with various icons. On the left, there is a 'Control Tabs' panel with 'Easy Scans' selected, containing options for Profile Scan, Bar Scan, MID Scan, and Leak Detect Scan. Below this are sections for Scan Editor, Automation, Trips, and Alarms. A status bar at the bottom indicates 'No file is in control of this instrument' and 'The instrument is Protected'. The bottom right corner shows '16218 - TCP/IP'.

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

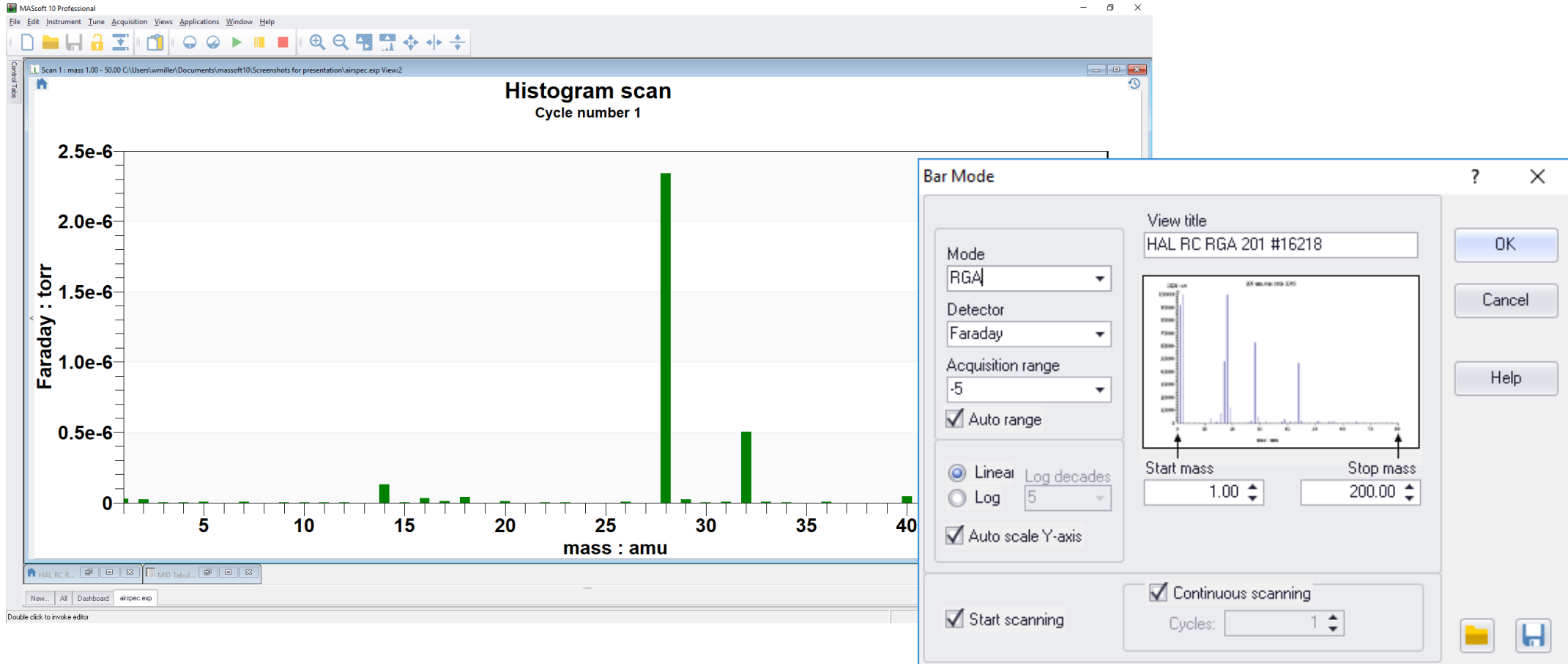


# Trend Analysis

- 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



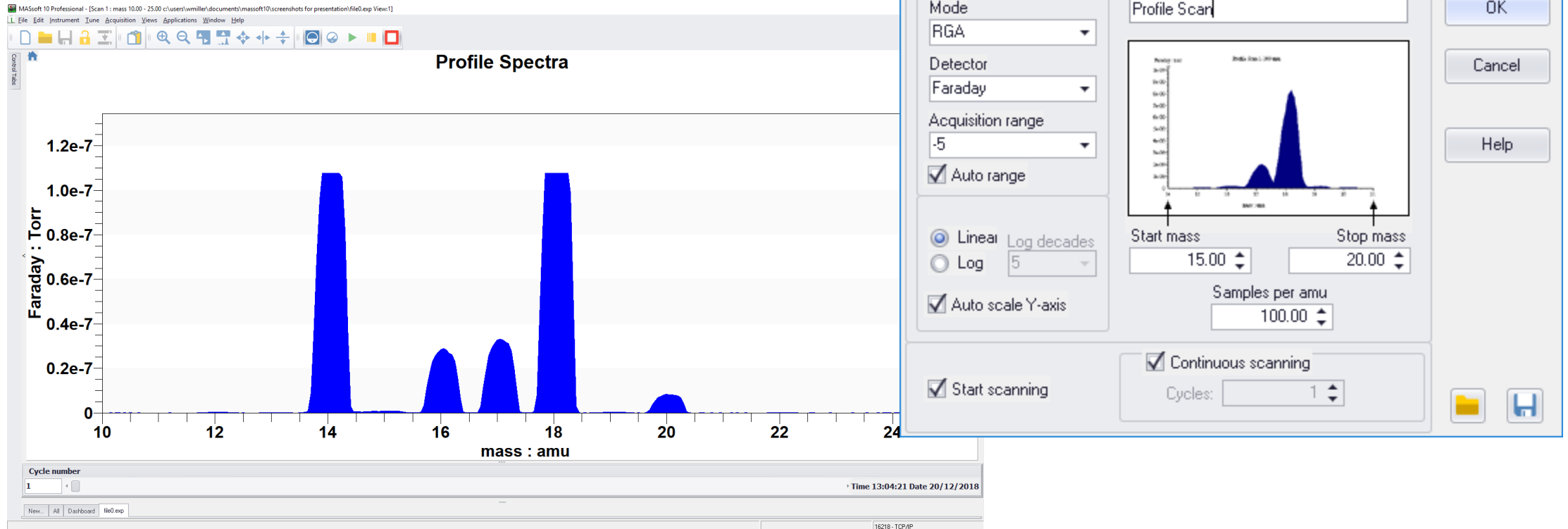
# Mass Spectrometer – mass scanning -1



- 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

The screenshot displays the MASsoft 10 Professional software interface. The main window is titled "MASsoft 10 Professional - [HAL\_RC\_RGA 201 #16218 - c:\users\wmlle\documents\massoft10\screenshots for presentation\file1.exp - Shutdown]". The interface includes a menu bar (File, Edit, Instrument, Tune, Acquisition, Views, Applications, Window, Help) and a toolbar with various icons for file operations and instrument control.

On the left side, there is a "Control Tabs" panel with "Easy Scans" and "Quick Start" sections. The "Easy Scans" section includes:
 

- Profile Scan:** Display the shape of peaks across a range of masses.
- Bar Scan:** Displays a histogram of peak intensities across a range of masses.
- MID Scan:** Multiple Ion Detection Mode. Measures selected individual masses.
- Leak Detect Scan:** Provides and audible and visual output of signal intensity to aid leak detection.

The central area shows a flowchart for scan control. It starts with a "Start" node, leading to a "Faraday" detector, then to a "Scan 1 : mass 0.40 - 200.00" step, which is repeated. The flowchart ends at a "Stop" node. The current operating mode is "RGA".

On the right side, an "Edit File Settings" dialog box is open, showing "Operating Modes" settings. The "RGA" mode is selected. The settings include:
 

- Detector:**
  - curtal-clipping: 0 (1 = None)
  - multiplier: 860 V None
- Filter:**
  - focus: -90 V None
- Quad:**
  - delta-m: 0 % None
  - resolution: 0 % None
- Source:**
  - cage: 3.0 V None
  - electron-energ: 70.0 V None
  - emission: 1000. uA None

At the bottom of the interface, there is a status bar with "No file is in control of this instrument" and "The instrument is Shutdown". The bottom right corner shows "16218 - TCP/IP".

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

# MS Control

The screenshot displays the MASoft 10 Professional software interface. The main window shows a scan sequence editor with a flowchart starting from a 'Start' node and proceeding through six scans. Each scan is associated with a detector (Faraday or SEM) and a mass range (e.g., 'Scan 1 : mass 0.40 - 200.00'). A 'Scan Editor' dialog box is open, allowing configuration of scan parameters. The dialog includes a 'Variable' dropdown set to 'mass', a 'Scan Legend' field, and input fields for 'Start Value', 'Stop Value', 'Increment Value', 'Steps', 'Relative Sensitivity', and 'Relative SEM'. A 'Variable Details' panel on the right provides information about the 'mass' variable, including its name, maximum and minimum values, resolution, and a description: 'Controls the mass-to-charge ratio (m/z) of ions transmitted by the quadrupole mass filter'. The interface also features a 'Control Tabs' sidebar with options for Scan Editor, Automation, Trips, and Alarms, and a status bar at the bottom indicating 'No file is in control of this instrument' and 'The instrument is Shutdown'.

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

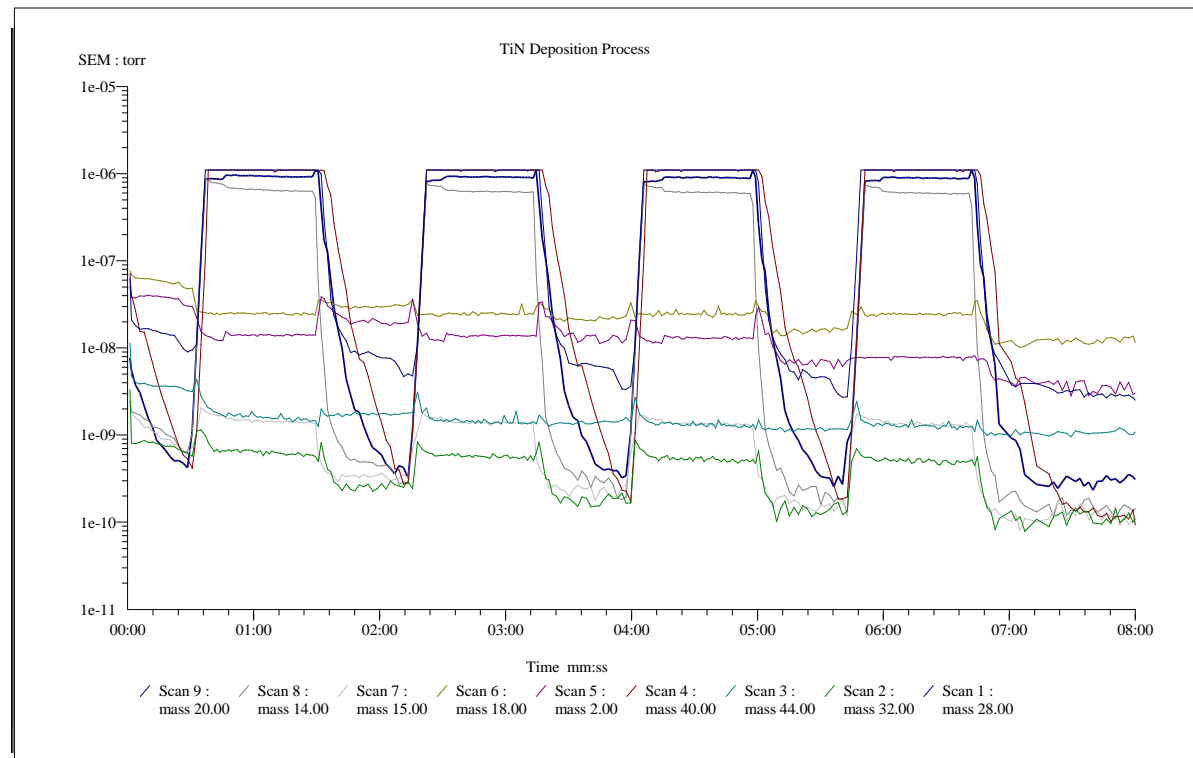
Events provides control of:

- 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

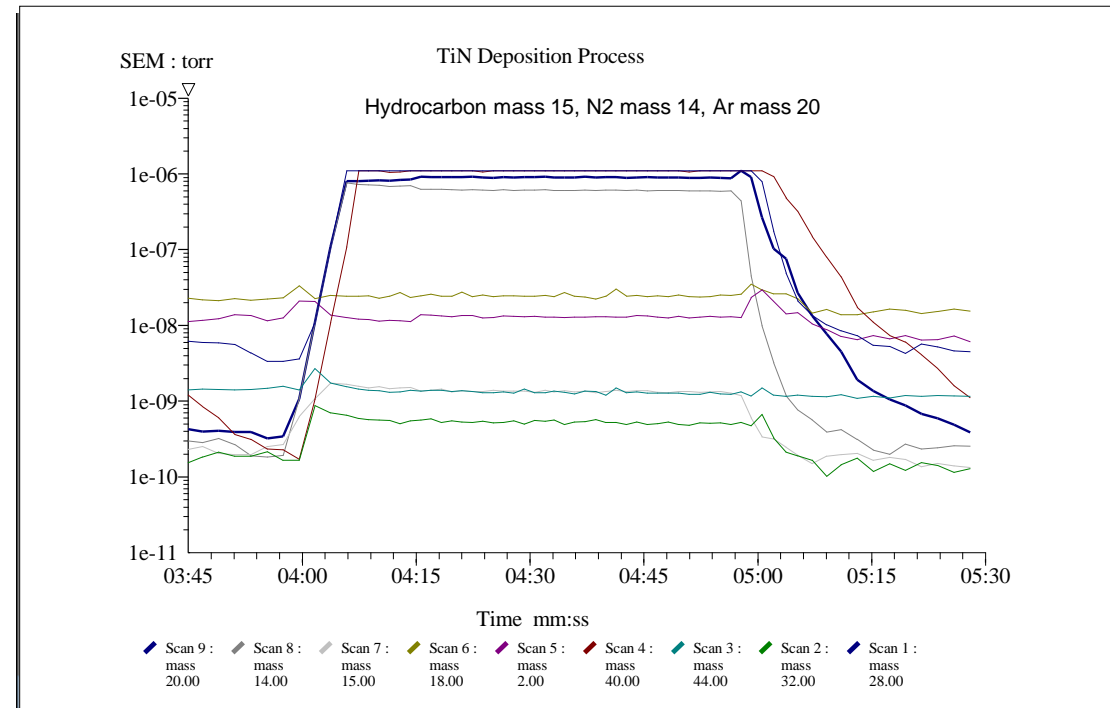
- Pump down Profiles
- Vacuum Diagnostics
- Base Pressure
- Residuals
- Backfill
- Sputter-On
- Bake-Out
- Leak Checking



Trend Analysis of: water, hydrogen, hydrocarbons  
CO<sub>2</sub>, Ar, N<sub>2</sub> in four titanium nitride deposition cycles.

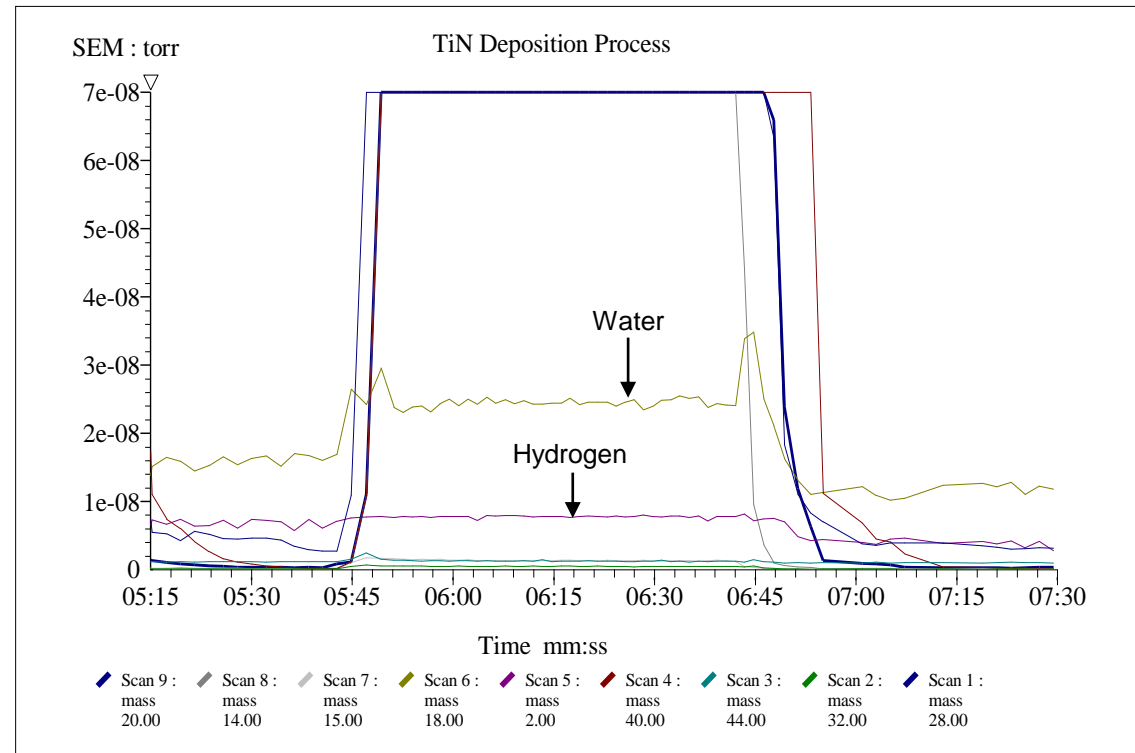
# TiN Deposition: A Wafer Cycle Profile

- TiN Process Endura PVD
- Reagent Gas Levels Monitored
- 8mTorr process pressure
- Ultrapure Ti Target
- 60:40 N<sub>2</sub> to Ar



# Primary Contaminant Analysis

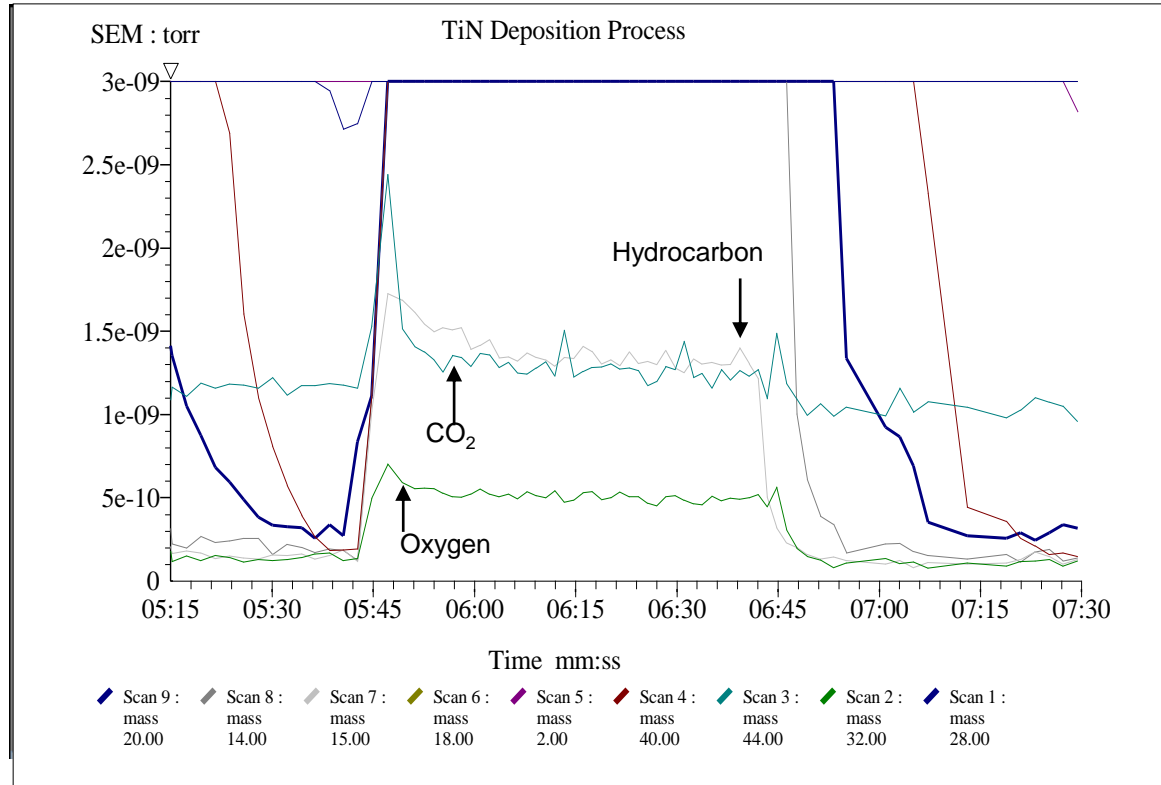
- Zoom in on the process run data to reveal the primary process contaminants
- Water at 0.1%
- Hydrogen at 0.05%





# Low Level Process Contaminants

- Further zoom to examine ppm level contaminants
- In process hydrocarbon background at 100ppm
- CO<sub>2</sub> 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®

HITACHI



BOSCH

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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 "HIDEN ANALYTICAL" sign on its side. The sky is clear blue, and there are green trees and bushes in the foreground. A large, semi-transparent white circle is overlaid on the left side of the image, containing the text.
- [www.HidenAnalytical.com](http://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.