

HPR30 Series Orifice Sampling Process Gas Analysers



Residual Gas Analysis for Vacuum Process Analysis

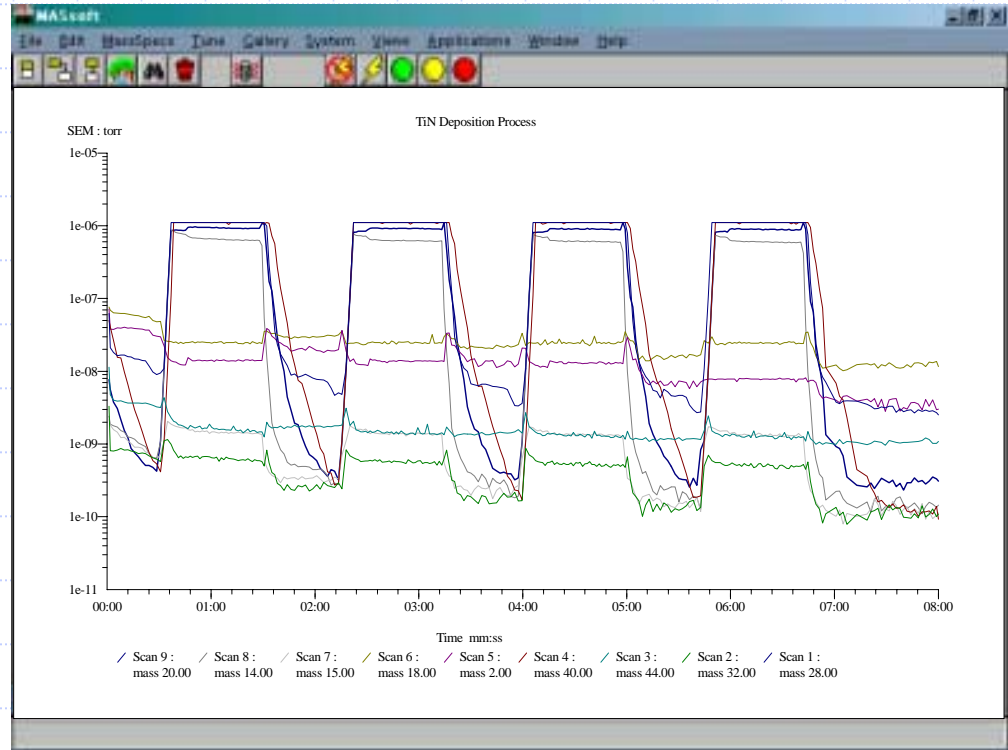
- Pumpdown Profiles
- Vacuum Diagnostics
- Base Pressure Residuals
- Leak Checking

re-Entrant Sampling Orifice



Thin Film Deposition Monitoring HPR-30

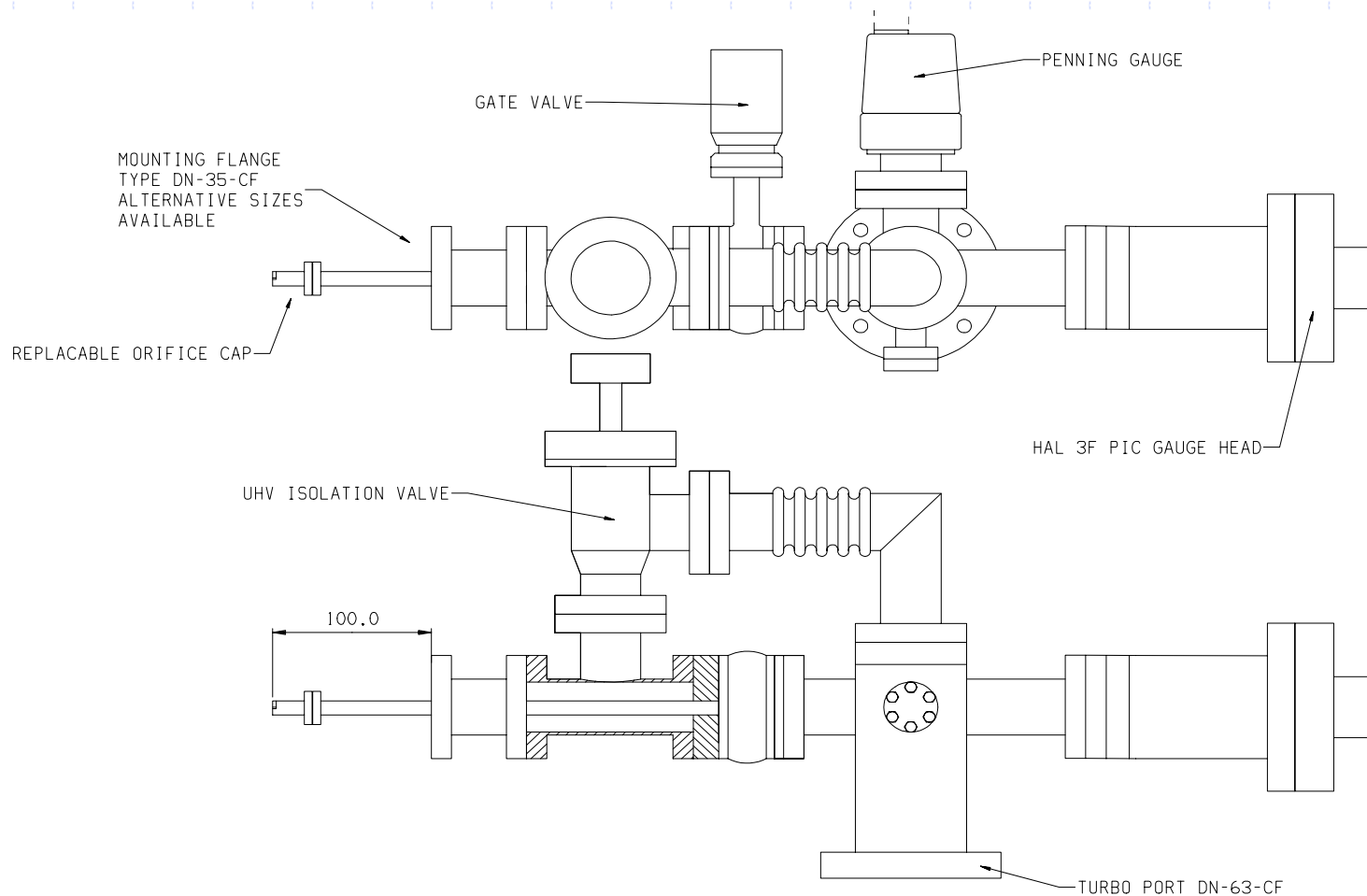
- Pumpdown Profiles
- Vacuum Diagnostics
- Base Pressure
- Residuals
- Backfill
- Sputter-On
- Bake-Out
- Leak Checking



Vacuum process sampling

- To analyse processes 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 should be optimised to maintain fast response time and maximum sensitivity.
- The HPR30 uses an orifice inserted into the process chamber with a high conductance path from orifice to RGA. A gate valve is used to isolate the RGA from process.

Vacuum process sampling



Dynamic Range and Sensitivity

- Quadrupole analysers have a dynamic range of in excess of 10^9
- Why is PPB detection not routine in all applications for all gases?
 - Spectral Interference from background species.
 - Spectral interference from the gas matrix.
 - Non ideal sample introduction.

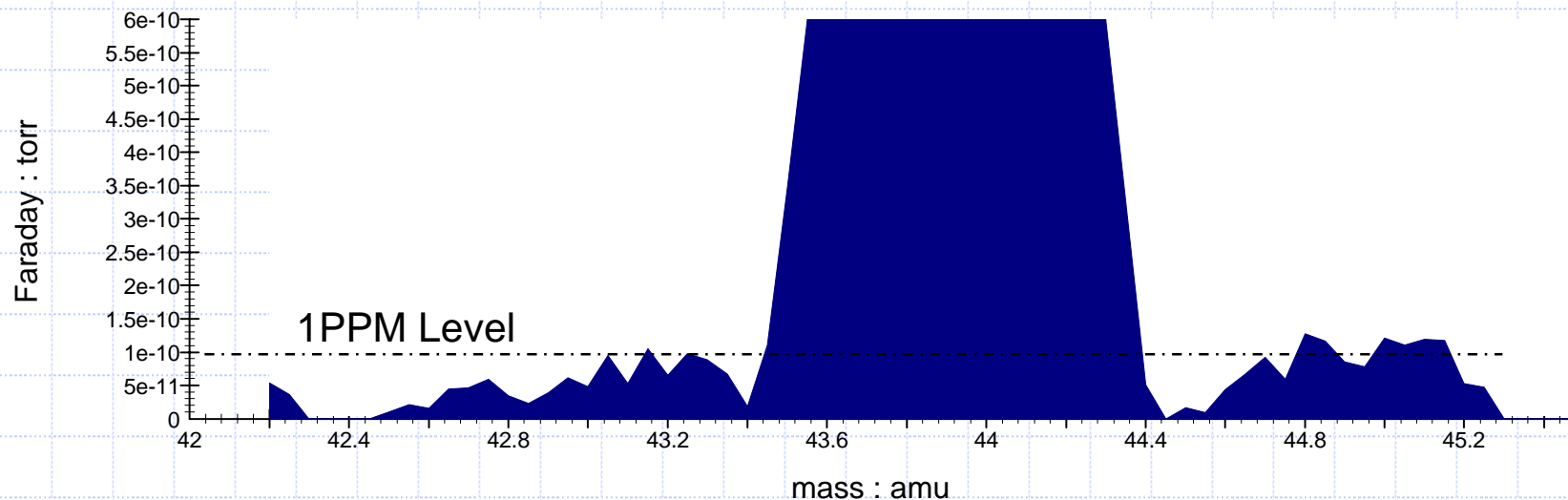
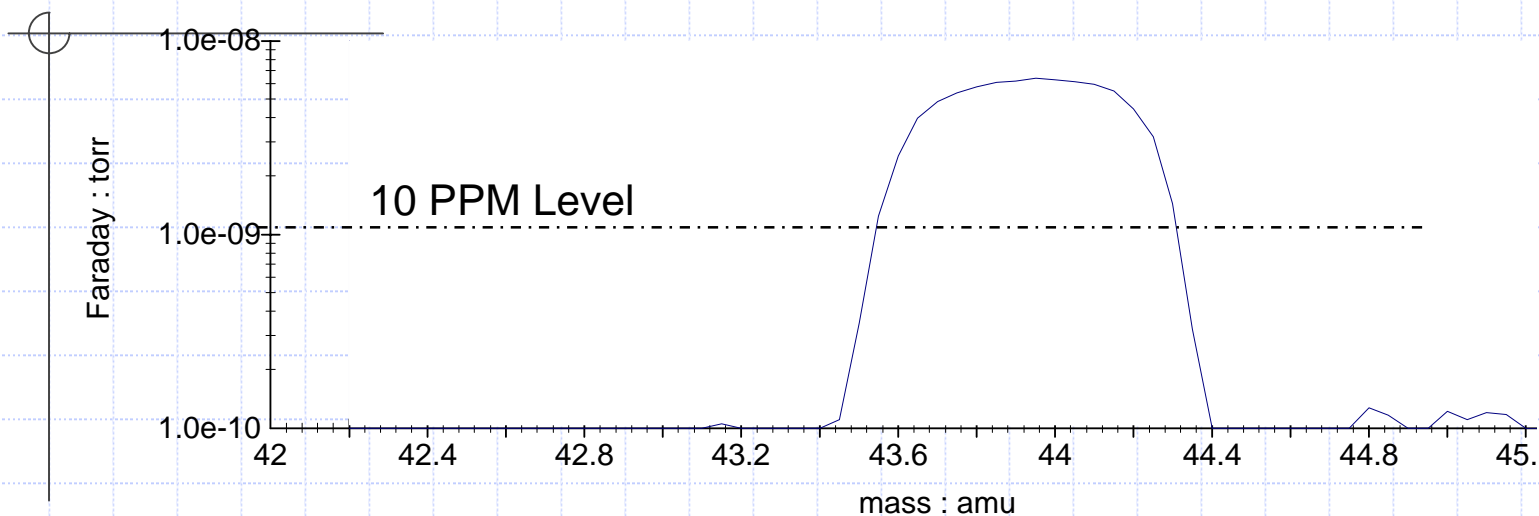
Interference from background gases

- The UHV vacuum manifold housing the quadrupole gauge has its own residual gas.
- The main components are water, hydrogen, pump oils and outgassing from the source filaments.
- A typical vacuum housing can be maintained at 1×10^{-9} torr, or a factor of 5 lower with the use of cryo-panels

Interferences from the gas matrix

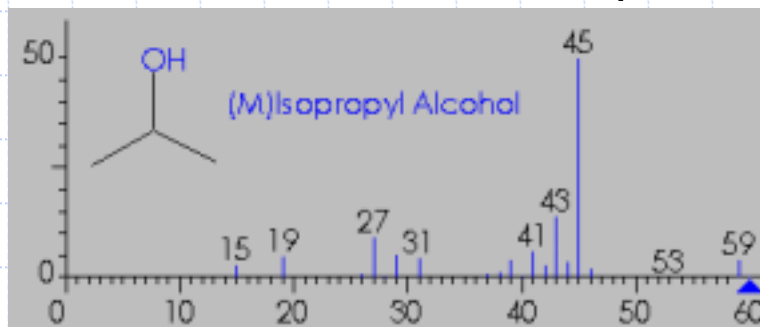
- The EI spectra from species of simple molecular structure become complex as the dynamic range is extended.
- N_2 has peaks at 7, 7.5, 14, 15, 28, 29, 30 and 42 for example.
- At PPB levels the tails from these peaks may affect the neighbouring peak as well.

Interferences from the gas matrix



Hydrocarbon Source Identification

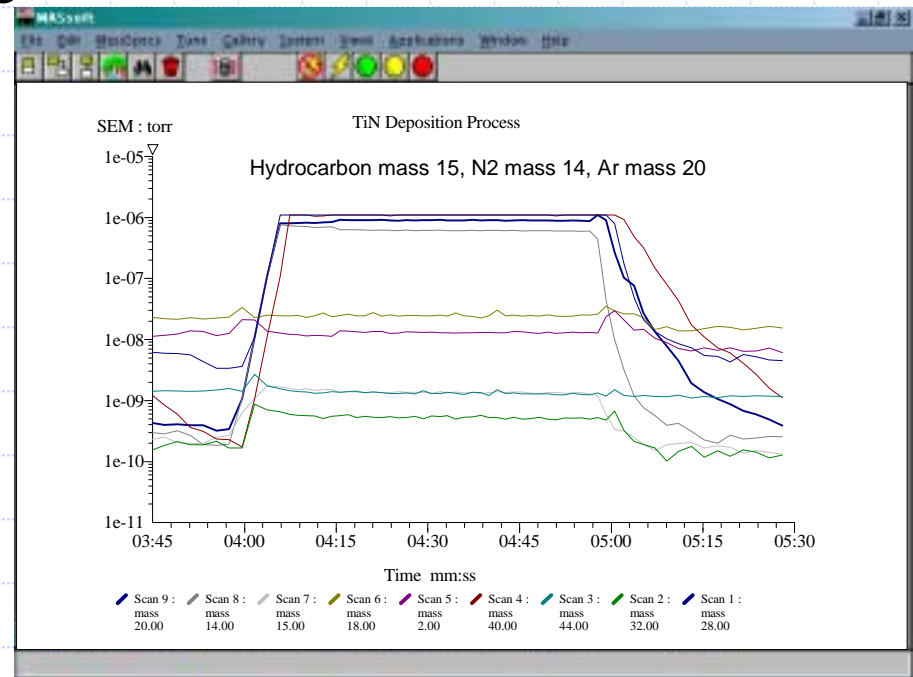
- **Backstreaming of oil vapour from pumps:** Vacuum pump oils are detected at masses 57, 55 and 43, and typically have peaks through the mass range with the characteristic 14 mass separation.
- **Vapour from cleaning fluid residue:** Cleaning fluids have lower molecular mass than pump oils. Characteristic peaks are found at masses less than 50 amu.
- **Vacuum Grease:** Silicone based vacuum grease used for 'O' ring lubricant have similar characteristic peaks as pump oils.



RGA Spectrum of IPA

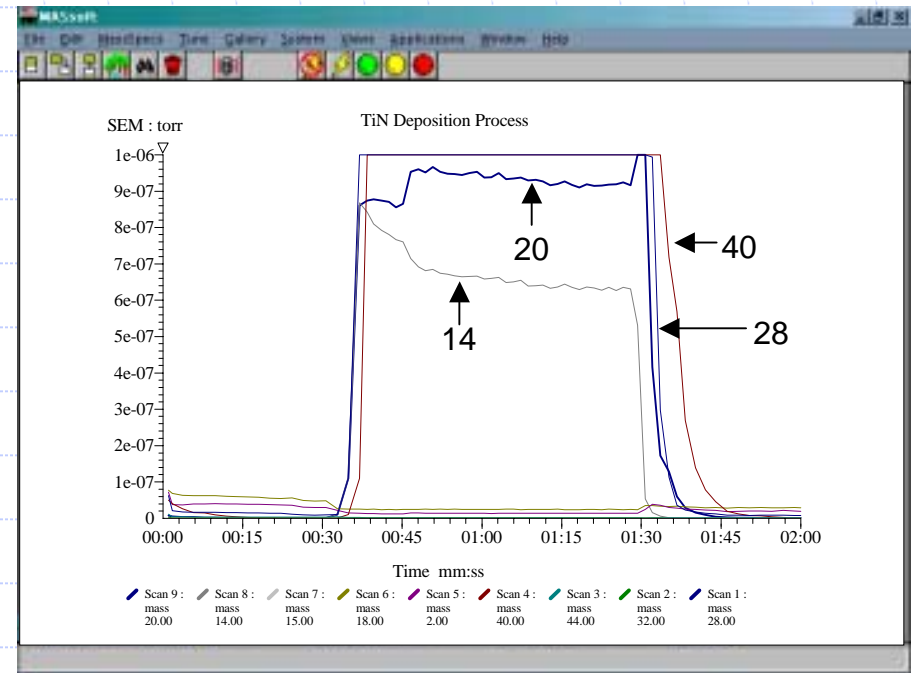
TiN Deposition: A Wafer Cycle Profile

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



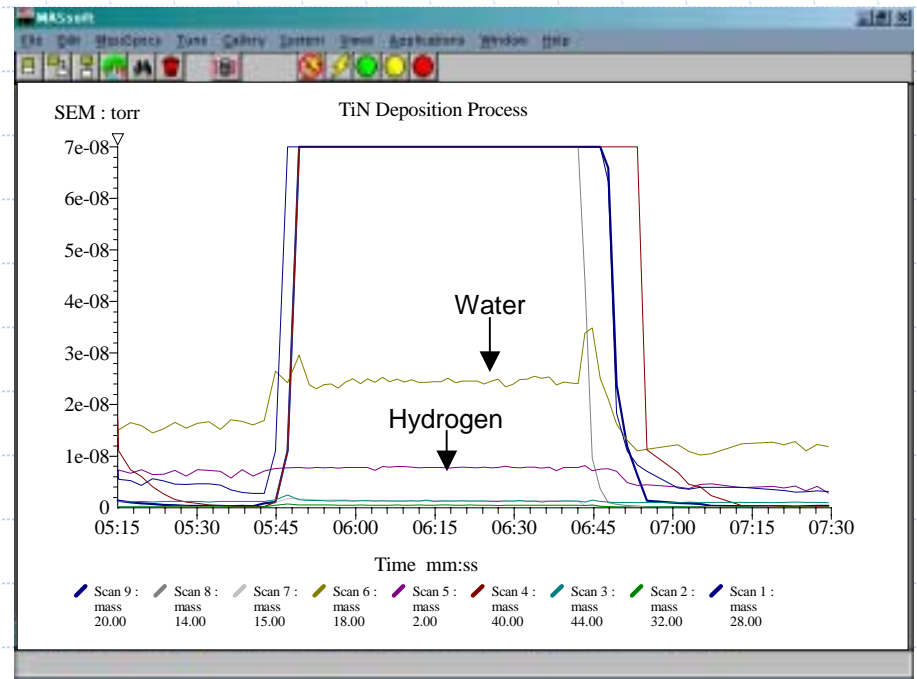
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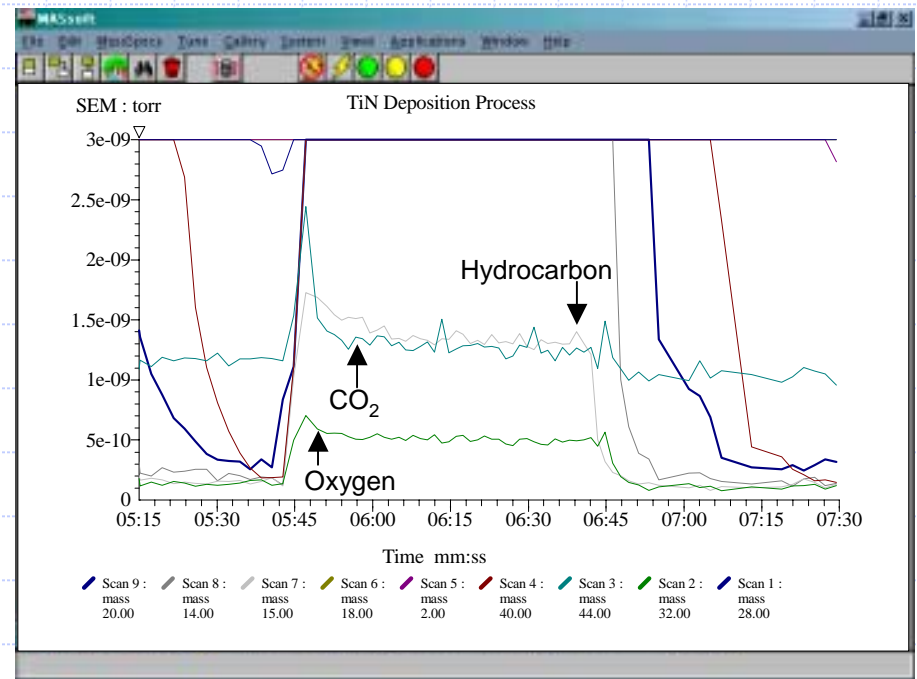
Primary Contaminant Analysis

- 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



Sub PPM detection capability

- All data from major to minor constituents collected simultaneously
- Detection to sub 10^{-10} Torr
- Auto start/stop of data collection with all data saved
- Each gas may also have an independent view graph
- Process control through intelligent trips

PPB Detection Levels

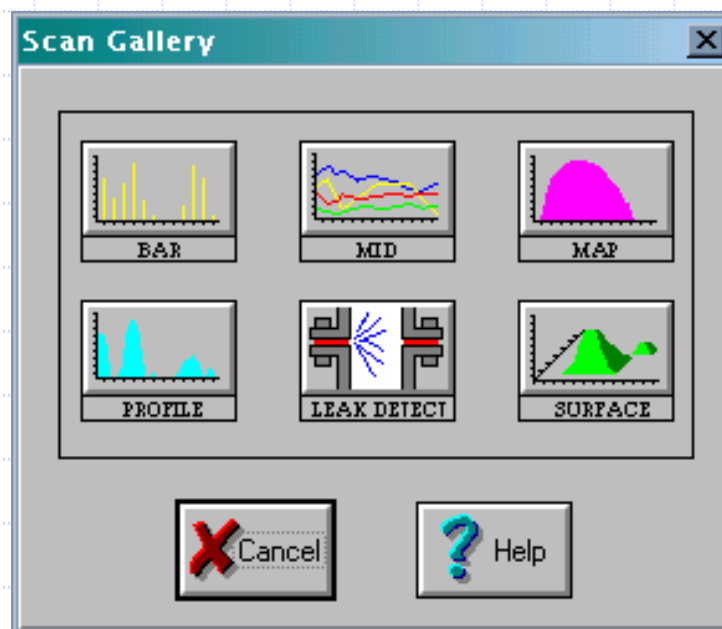
MASsoft - [MID Tabular view C:\HIDEN\H2HPPMAR.EXP View:3]

File Edit MassSpecs Tune Gallery System Views SPC Window Help

Parameters/Scans:	ppm Hydrogen 1	ppm Air 1	ppm Water 1	ppm Methane 1	ppm Oxygen 1	ppm CO2 1
Real time						
7:57:32 pm	31	3	4	0.7	0.4	0.7
7:58:42 pm	32	2	3	0.5	0.04	0.6
7:59:55 pm	33	3	3	0.7	0.5	1
8:01:14 pm	34	2	3	0.5	0.5	0.9
8:02:27 pm	37	4	3	0.5	0.3	0.6
8:03:40 pm	36	2	4	0.5	0.08	0.8
8:04:53 pm	32	3	3	0.9	0.2	0.9
8:06:06 pm	35	2	3	0.4	0.3	0.8
8:07:19 pm	34	2	3	0.7	0.4	0.5
8:08:32 pm	35	1	5	0.8	0.4	0.7
8:09:57 pm	37	2	3	0.6	0.3	0.7
8:11:15 pm	33	3	2	0.7	0.2	0.8
8:12:28 pm	34	3	3	0.7	0.2	1
8:13:41 pm	34	3	4	0.8	0.2	0.6
8:15:00 pm	32	2	2	0.9	0.1	0.8
8:16:19 pm	32	2	4	0.6	0.2	0.5
8:17:38 pm	33	3	4	0.6	0.2	0.6
8:18:51 pm	36	2	3	0.8	0.5	0.7
8:20:04 pm	31	3	4	0.8	0.3	0.8
8:21:23 pm	32	2	3	0.8	0.2	0.8
8:22:36 pm	35	3	4	0.5	0.4	0.7
8:23:49 pm	33	3	4	0.8	0.3	1
8:25:02 pm	37	2	3	0.8	0.3	0.8
8:26:15 pm	33	2	4	0.7	0.2	0.7
8:27:40 pm	31	2	4	0.5	0.3	0.8
8:28:59 pm	33	2	4	0.4	0.3	0.8
8:30:12 pm	37	3	2	0.5	0.2	0.9
8:31:25 pm	29	2	2	0.8	0.3	0.7

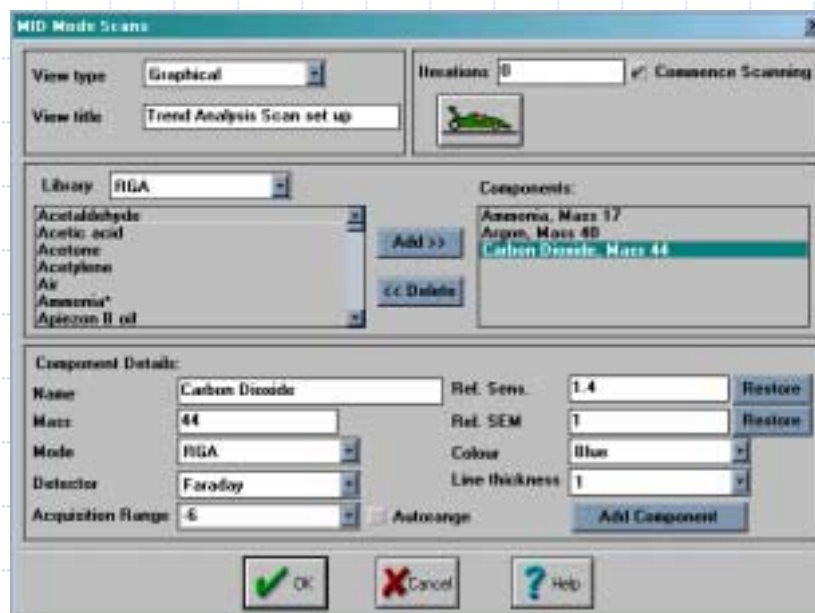
software examples: Scan Gallery

- simple 'Scan Gallery' provides rapid, easy to use set up of different types of scans.
- only 3 clicks of the mouse required to acquire mass spectra from MASsoft startup program.



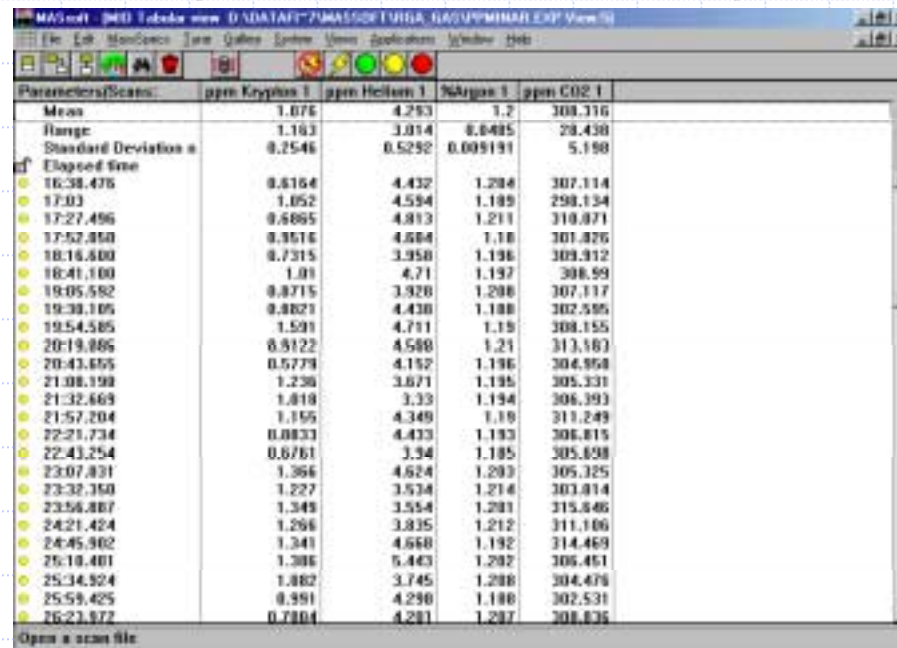
software examples: Multiple Ion Detection Mode

- Scan up to 100 different masses simultaneously.
- Choose masses from the internal library.
- View data as graphical views, tabular views or both at the same time.
- Output in preferred units i.e. partial pressure, %, ppb



software examples: Tabular View

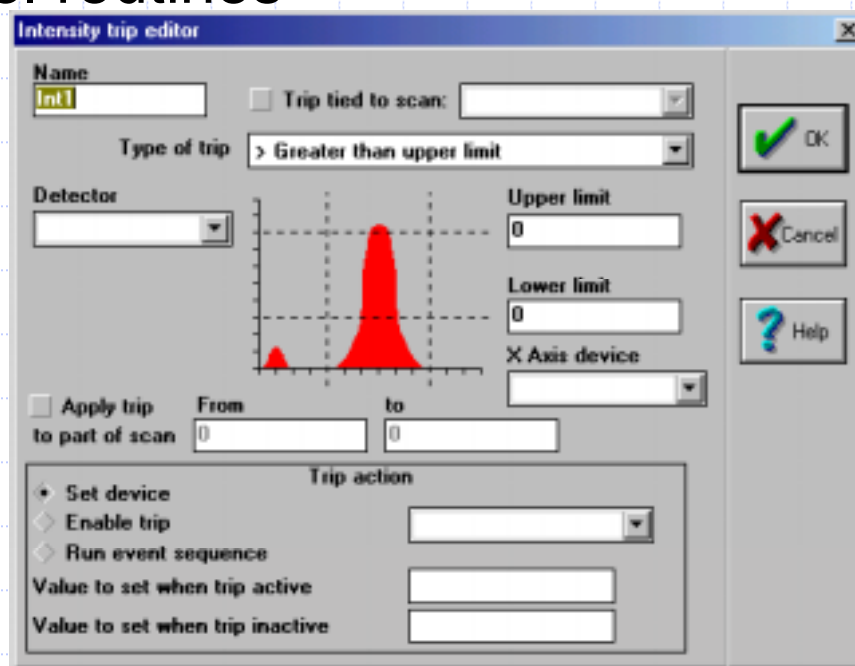
- Results as a function of time in mixed units (ppm and %).
- the yellow markers indicate the range of data that has been selected for statistical analysis.
- Mean, Range and Standard Deviation from this analysis are shown at the top of the view and updated in real time.



Parameters/Scans	ppm Krytox 1	ppm Heliox 1	%Argon 1	ppm CO2 1
Mean	1.076	4.293	1.2	308.316
Range	1.193	3.014	0.0485	29.438
Standard Deviation s	0.2546	0.5292	0.009191	5.198
Elapsed time				
16:38.476	0.6164	4.432	1.284	307.114
17:03	1.052	4.594	1.189	298.134
17:27.496	0.6895	4.813	1.211	318.871
17:52.850	0.9516	4.884	1.18	301.826
18:16.800	0.7315	3.950	1.196	309.912
18:41.100	1.01	4.71	1.197	308.99
19:05.582	0.8715	3.928	1.208	307.117
19:30.106	0.8821	4.430	1.188	302.585
19:54.585	1.591	4.711	1.19	308.155
20:19.886	0.9122	4.588	1.21	313.163
20:43.855	0.5779	4.157	1.196	304.958
21:08.198	1.236	3.671	1.195	305.331
21:32.469	1.818	3.33	1.194	306.393
21:57.204	1.195	4.348	1.19	311.249
22:21.734	0.8833	4.433	1.183	306.815
22:43.254	0.6761	3.34	1.185	305.898
23:07.831	1.366	4.624	1.203	305.325
23:32.350	1.227	3.534	1.214	303.814
23:56.887	1.349	3.554	1.201	315.846
24:21.424	1.296	3.835	1.212	311.186
24:45.902	1.341	4.668	1.192	314.469
25:10.481	1.386	5.443	1.282	306.451
25:34.924	1.882	3.745	1.288	304.678
25:59.425	0.991	4.290	1.188	302.531
26:23.972	0.7804	4.281	1.287	308.836

software examples: I/O Events Editor

- powerful Events Editor allows trip, threshold and alarm levels to be set easily on screen. Output to screen, audible beep or integral TTL and 0-10V analogue switches.
- used for 'out of limit' alarm indicators or sophisticated process control routines



software examples: LabVIEW™ Drivers

- The Hiden drivers are automatically self-configuring, with all mass spectrometer control parameters grouped within LabVIEW™ for convenient programming for the full application range .



why choose Hiden Analytical?

Company Profile

Hiden Analytical was founded in 1981 and is presently situated in a 23,000 sq. ft. manufacturing plant in Warrington, England with a staff of 65 persons.

Hiden Analytical Inc, a wholly-owned subsidiary of Hiden Analytical Ltd, was formed in New Hampshire on January 1st 1996 to establish a domestic USA sales / service centre.



- **sales & service on 4 continents with:**
- 20 years manufacturing experience and...
- over 100 staff publications in peer reviewed journals
- over 200 user publications in peer reviewed journals



Certificate No. 6738

why choose Hiden Analytical?

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