



Mass Spectrometry Solutions

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HPQ3/HPQ3S

HIGH PRESSURE COMPACT QUADRUPOLE PROCESS MONITORS WITHOUT DIFFERENTIAL PUMPING

Residual Gas Analysis (RGA) is a routine diagnostic tool for any vacuum engineer but the traditional upper working limit of $1e-4$ mbar total pressure is restrictive for many process applications. The HPQ3 and HPQ3S RGAs from MKS allow operation far beyond this limit without the need for differential pumping. The field proven technology of the HPQ analyser coupled with the latest innovative electronics platform derived from the Microvision 2 family give data quality not previously seen in this class of instrument. The resulting system is less complex, with reduced installation requirements, offering a higher level of reliability at a substantially lower cost. In addition, the HPQ3S uses application validated correction algorithms to compensate for the sensitivity variation arising from ion-molecule interactions in the ion source at higher pressures. This allows reliable data to be obtained for specific gas species including water, oxygen, nitrogen, methane, helium and hydrogen in argon and other gas mixtures.

Applications

The HPQ3 and HPQ3S are suitable for a wide range of applications in PVD or for vacuum systems with inert residual gases including:

Monitoring

- Leak detection of vacuum lines, welds and seals
- Vacuum diagnostics
- Pump down monitoring
- Chamber bakeout monitoring
- Leak checking of coolant lines within a vacuum chamber
- Chamber contaminant monitoring, including hydrocarbons
- Verify the quality of process gases
- Monitor cryo-pump performance
- Rate-of rise testing

Control and Automation

- Interlocking equipment to stop activity when a leak occurs
- Sending alarms to control systems when contamination limits for chambers, gases or substrates are exceeded
- Linking RGA data into third party process control systems for SPC and complex analysis
- Providing reports and trending vacuum conditions in context with tool, process and product
- Closed loop control of sputter processes



RGA Technology Leadership

MKS was the first company to offer an RGA compatible with modern Ethernet based, web-enabled, wide area network installations. HPQ3 continues this development to a level that offers the highest flexibility and connectivity through the use of industry standard communication hardware and software. HPQ3 optimizes the roles required of a complex sensor by having two dedicated processors;

- An optimized, proprietary processor for data acquisition
- An industry standard CE operating system processor for external communications through field proven TCP-IP technology.

The advantages of this design approach are fast, accurate data from a robust RGA sensor using industry standard, flexible communication protocols. HPQ3 also provides a complete range of additional digital and analog connections for integrating into systems with flexible low cost solutions.

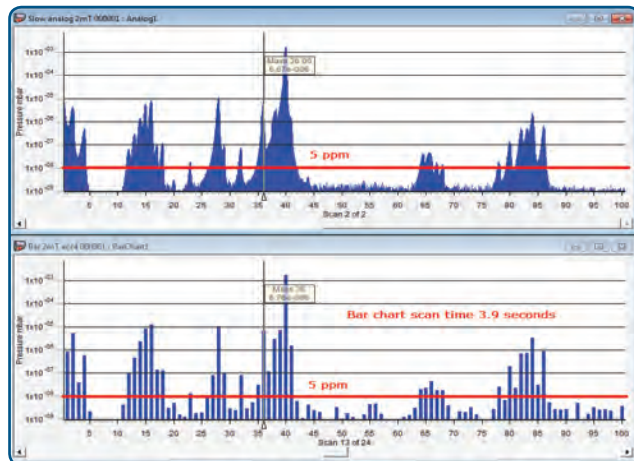
Sensor Leadership

The new RF design in the HPQ3 covers the 1-100amu mass range without compromising the quality of gas peak separation at very low mass or high mass. The field proven High Pressure Quadrupole analyser design in the HPQ3 retains the robust and inexpensive ion source design with dual filaments. This allows continuous uninterrupted operation without needing to regularly replace filaments before their normal expected lifetime.

The HPQ3 can be used for processes where data is required up to a total pressure of 1.3e-3mbar. For specific higher pressure applications up to 1e-2mbar the HPQ3S makes real-time corrections using a gauge pressure from the tool or by using a variety of optional independent gauges fitted to a custom F-Chamber designed for optimum performance with the HPQ3S.

Electronics Leadership

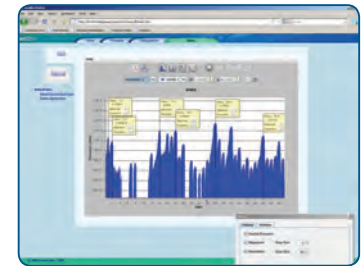
The patented wide dynamic range detector electronics allow detection of single figure parts per million chamber leaks or contaminants, even when simultaneously measuring major gas peaks in the e-3mbar range.



Wide dynamic range and high sensitivity allow parts per million level detection even at high pressures

This is possible in a single scan or peak jump data acquisition with less than 20ms between the maximum and minimum signal levels and without the need for an expensive electron multiplier which needs frequent calibration and replacement.

- Prevents large peaks from causing false positive measurements on small peaks.
- Temperature stabilized critical components with improved signal stability and baseline drift allow the unit to be used without frequent recalibration if the vacuum chamber is stable but ambient air temperature fluctuates.
- Variable sensor conditions to match the needs of each process under different pressure conditions
- Each optimized sensor configuration is separately stored in the RGA and automatically recalled or recalibrated by software recipes.
- Flexible digital and analog I/O capability with a dedicated gauge port as standard.



Built-in web application for HPQ3 control and data acquisition

Software Leadership

In common with other MKS RGA products, the HPQ3 has a variety of software control options to match the requirements of all customer applications.

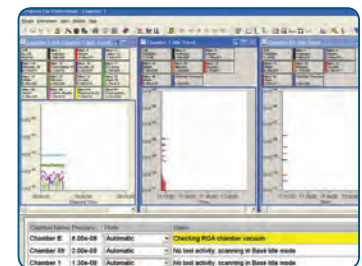
Built-in Web Server Application

A web interface using industry standard technology allows set-up and control of the HPQ3 from anywhere on a network. Using a non platform-specific web browser, calibration, operation and saving real time data to an export format is all possible. Using the documented Software Developer's Kit, ASCII protocol and TCP-IP communication, any third party software can send and receive commands and data from the HPQ3 and HPQ3S.

Process Eye Professional

A Windows-based comprehensive software platform offering complete control of all RGA parameters:

- Recipe driven control to allow the highest level of flexibility but with ease of use through the EasyView recipe and Recipe Wizard.
- Ability to link to other systems through a variety of mechanisms such as Modbus, ASCII, SECS protocols, serial communications, TCP-IP, file exchange and many others.
- Flexibility to run automatic and precisely-optimized data collection, alarm condition checking and closed loop control operations.



Process Eye Professional for flexible control through recipe-driven data collection



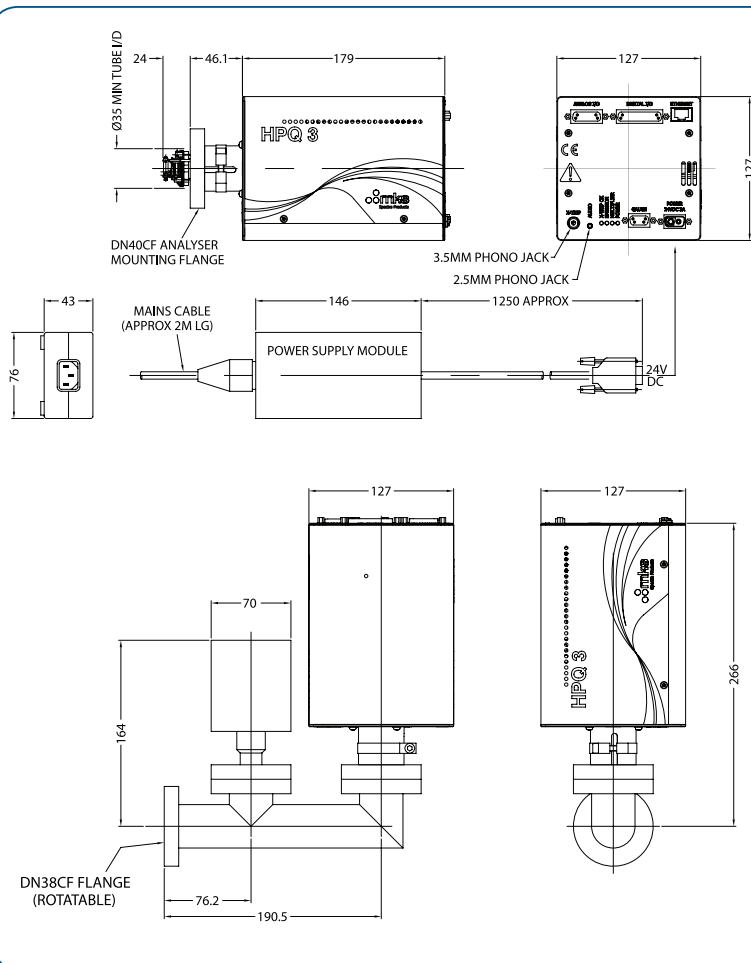
TOOLweb® RGA

A specialized, turn-key tool-integration software package (PC or server based) providing optimized methods to get the most reliable information from RGAs and other sensors on process tools:



TOOLweb RGA for complete integration with tool and factory process control

- Complete integration of RGA data with tool operation and FDC systems.
- Levels of interdiction from passive monitoring of the tool vacuum, to process critical go/stop control of individual process chambers
- Powerful web based reporting provides process engineers with highly valuable information to keep tools running at peak efficiency from anywhere on the network.



Dimensional Drawings —

Note: Unless otherwise specified, dimensions are nominal values in millimeters.

Specifications

Mass Range	1-100 amu
Detector	Faraday
Filaments	Twin. Tungsten or Thoria Coated Iridium
Maximum Recommended Operating Pressure	HPQ3: 1e-3 Torr (1.3e-3 mbar) HPQ3S: 8e-3 Torr (1e-2 mbar) – Application dependant
Maximum Transient Burst Pressure	4e-2 Torr (5e-2 mbar) – gas dependant
Ion Source Sensitivity	5e-5 A/mbar
Minimum Detection Limits (3σ baseline noise at 300ms integration)	Partial Pressure: 8e-11 Torr (1e-10 mbar) Concentration: 5ppm at 1e-3 Torr (1.3e-3 mbar)
Mass Stability	±0.1 amu over 8 hours at stable ambient
Resolution	Better than 10% valley for peaks of equal height across mass range
Bakeout Temperature	250°C with electronics removed
Operating Temperature	200°C at flange with electronics <40°C
Sensor Insertion Length	25mm
Mounting Flange	DN38CF (70mm/2.75inch OD) Conflat
Housing	Application specific, options include CF and KF elbows or custom F-Chamber for HPQ3S with Gauge.
Electronics Weight on Flange	1.7kg
Power	24V DC, 3A external universal voltage supply (included)
Maximum Operating Conditions	Electronics: 10-40°C, 80% RH (non condensing)
Communication	10/100 Base-T Ethernet, static or automatically assigned IP addresses
Compliance	CE



Specifications

Data Acquisition Method	Dedicated real time acquisition processor
Data Collection Methods	<ul style="list-style-type: none"> • Analog scanning, partial or full mass range 8, 16 or 32 points/amu • Barchart scanning, partial or full mass range • Peak-jump collection of any combination of peaks at up to 15 per acquisition set • Complete recipe control to link multiple acquisitions into a single scan (Process Eye Professional and TOOLweb RGA only)
Number of Stored Source Settings	<ul style="list-style-type: none"> • 6 sets including ion source parameters, alignment, resolution, detector calibrations • Stored in electronics and recalled by Process Eye Professional or TOOLweb RGA
Software Controlled Tuning Parameters	<ul style="list-style-type: none"> • Electron energy, 20 to 100eV • Emission current, 0 to 2 mA • Ion energy, 0 to 10V • Ion extraction, 0 to -130V • Filter pole bias, 0 to -10V to +10V
Filament Protection	Dedicated X-Trip with optional pressure sensor for use with cryo-pump isolation valve. Filament interlocked to gauge OK for HPQ3S.
Data Acquisition Speed	< 3ms per point for analog or barchart scanning
Settling Time to 1 ppm of Maximum Signal	<20ms
Control Method	CE operating system processor with web-server interface
Command Structure	Documented SDK and ASCII command protocols
Software	<ul style="list-style-type: none"> • Built-in web applications allowing RGA control and data acquisition using a platform independent web browser without the need for dedicated installed software • Process Eye Professional and TOOLweb RGA Windows software packages for Windows XP, Vista or Win7 (32 and 64bit.)
Interfaces	<ul style="list-style-type: none"> • RJ45 socket: 10/100 Base-T Ethernet • 25 way D-type female: 16 configurable TTL I/O, includes power for ±15V (100mA), +24V 100mA) and ±3.3V 100mA) • 15 way D-type female: 4 analog in (-11V to +11V 22bit), 2 analog outputs (0-10V 12bit), includes power for ±15V 100mA) • 9 way D-type female dedicated vacuum gauge port: -11 to +11V 22bit analog input, 1 digital input (gauge OK), 1 digital output (gauge enable) and gauge power +24V (500mA) • 3.5mm jack socket: Opto-isolated input for filament protect or control with auto detection of presence of the jack plug as failsafe • 2.5mm jack socket: Audio output for use with speaker and wired or wireless headphones

Ordering Information

Ordering Code Example: 993-41X-09Y	Code	Example Configuration
HPQ3	993-410-09Y	993-410-090
HPQ3S	994-41X-09Y	

Filament Selection (Y)

Tungsten	0	0
Thoria coated iridium	1	

HPQ3S Gauge Option (X)

Simple elbow and no gauge (pressure from customer source)	0	A
F-Chamber with GP Micro-ion gauge	A	
F-Chamber with MKS 909A ion gauge	B	

Additional gauge options are available. Please consult factory for ordering information.

Software Options

All HPQ3 and HPQ3S are delivered with Process Eye Professional and web based software as standard. For the Software Developer's Kit, tool integration through TOOLweb RGA or recipe development assistance for Process Eye, please contact your local MKS office for applications advice.



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