

HiQuad™



New High-End Mass Spectrometer!

**Fast, Flexible
and Easy to Operate.**

PFEIFFER  **VACUUM**

A modular solution for mass spectrometry

With the new HiQuad™ mass spectrometer, Pfeiffer Vacuum combines high performance, flexibility and ease of operation.

As a stand-alone unit, the HiQuad™ can be optimally integrated into your application. Depending upon the application in question, it is possible to select:

- ▶ Mass ranges
- ▶ Rod diameters
- ▶ Ion sources
- ▶ Detectors
- ▶ Interfaces

This mass spectrometer achieves extremely high measurement speeds of up to 125 $\mu\text{s}/\text{amu}$.

It is characterized by the highest sensitivity and a wide dynamic range. This mass spectrometer is easy to operate with the aid of the Quadera® software.

These characteristics make the HiQuad™ suitable for both research & development applications as well as for integration into analytical systems.

We compile the right solution for your individual application!

Maximum performance in any number of applications



Semiconductor



Research & development



Surface analysis

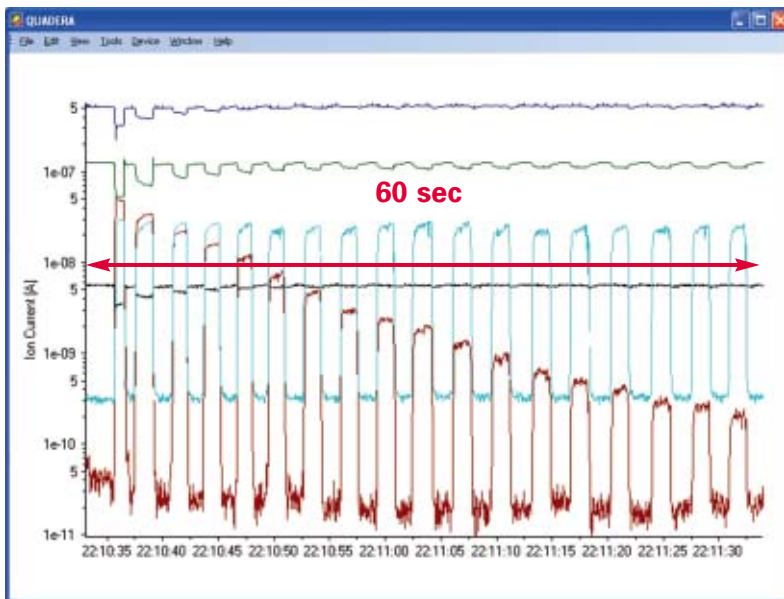


Gas analysis



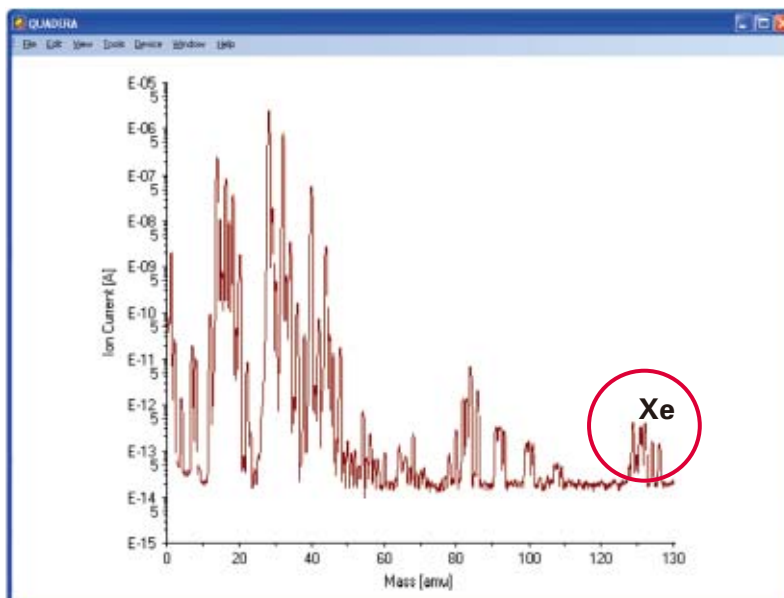
Advantages at a glance

- ▶ Modular, flexible design
- ▶ Simple operation with Quadera® software
- ▶ Extremely high measurement speed
- ▶ Maximum sensitivity and wide dynamic range
- ▶ Outstanding long-term stability
- ▶ Ethernet interface
- ▶ Integral Internet browser and OPC server for communicating with PC-based programs



High measurement speed – up to 125 $\mu\text{s}/\text{amu}$

Very fast measurements can be performed with the HiQuad™ mass spectrometer. This example shows the mass spec response during respiration analysis. N_2 , O_2 and CO_2 were detected with a very fast cycle time.



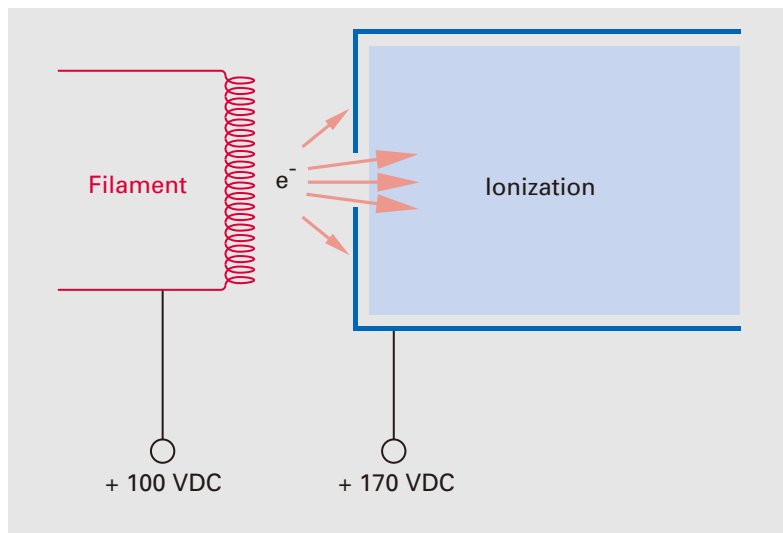
Wide dynamic range

This scan shows a spectrum for air. In addition to the primary components, consisting of N_2 , O_2 , Ar and CO_2 even minute concentrations of Xe are detected. The ion current at mass 136 is equivalent to a concentration of 7.8 ppb of Xe in air. And it is decades above the background noise level, enabling a wide dynamic range of 10 decades to be achieved.

Overview of technologies

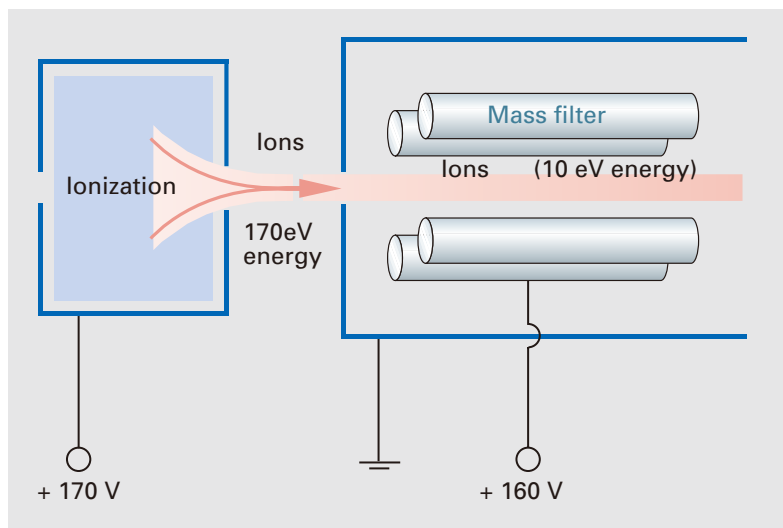
Biased ionization chamber

Biasing the ionization chamber results in an extremely low background signal. The electron-emitting filament is positively biased by 100 to 150 VDC relative to ground. This design prevents desorption of gas particles from the chamber walls, and thus the generation of an undesired background signal by electron stimulated desorption.



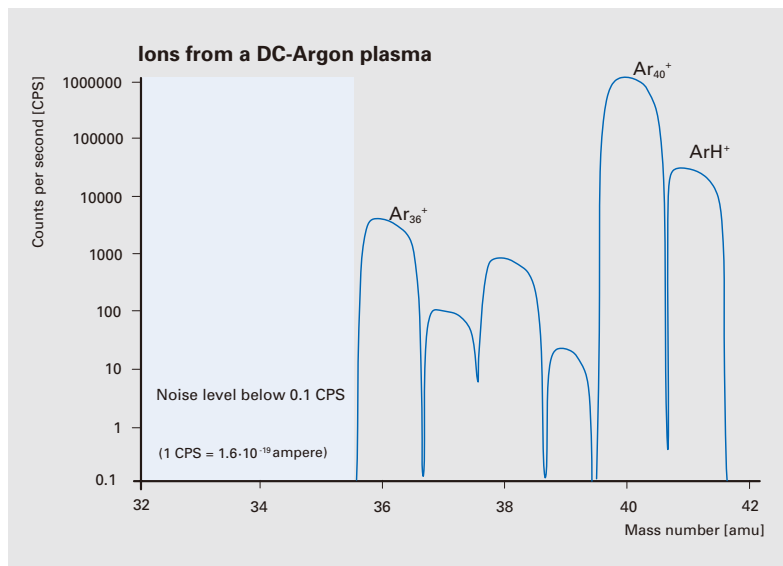
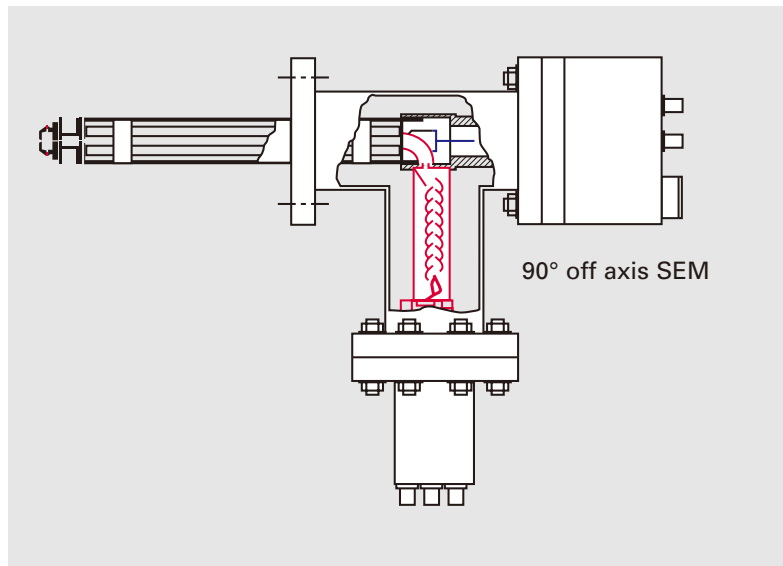
Field-axis technology

One of the most important factors in the performance of a mass spectrometer is the transmission of the ions from the ion source into the mass filter. With the aid of field-axis technology, the ions are able to cross the peripheral fields of the separating system without any noteworthy interaction. This enables a high level of sensitivity (A/mbar) to be achieved without the need for pre and post filters.



90° off-axis secondary electron multiplier (SEM)

The task of the secondary electron multiplier is to increase the sensitivity of the mass spectrometer. In the HiQuad™, the multiplier is attached in the vacuum at a right angle to the rod system. This prevents any radiation from the ion source reaching the detector and thus generating background noise. In combination with an ion-counting arrangement, it is also possible to achieve a wide dynamic range in addition to a low background noise level. The example illustrated below shows a very low background count rate while measuring ArH^+ ions generated in a plasma.



Quadera® – The HiQuad™ software



The Quadera® software serves as the interface between the mass spectrometer and the user. It excels as a result of its simple, intuitive operation. Repetitive measurement tasks can be automated by setting recipes and through the macro programming routines.

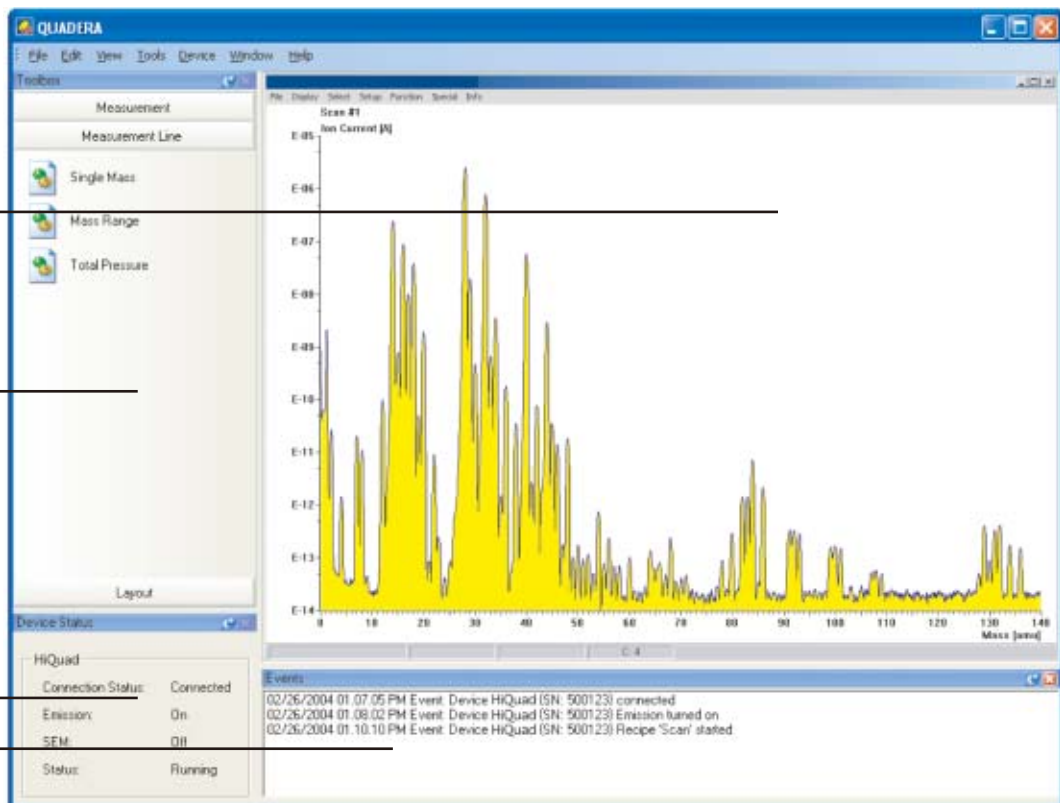
- ▶ Predefined recipes available, e.g. spectrum, trend, bar graph
- ▶ Easy-to-read mass spectrometer system presentation
- ▶ Automated measurement routines via the integral Visual Basic script editor
- ▶ Adaptation for special applications thanks to interchange with other programs

Main window

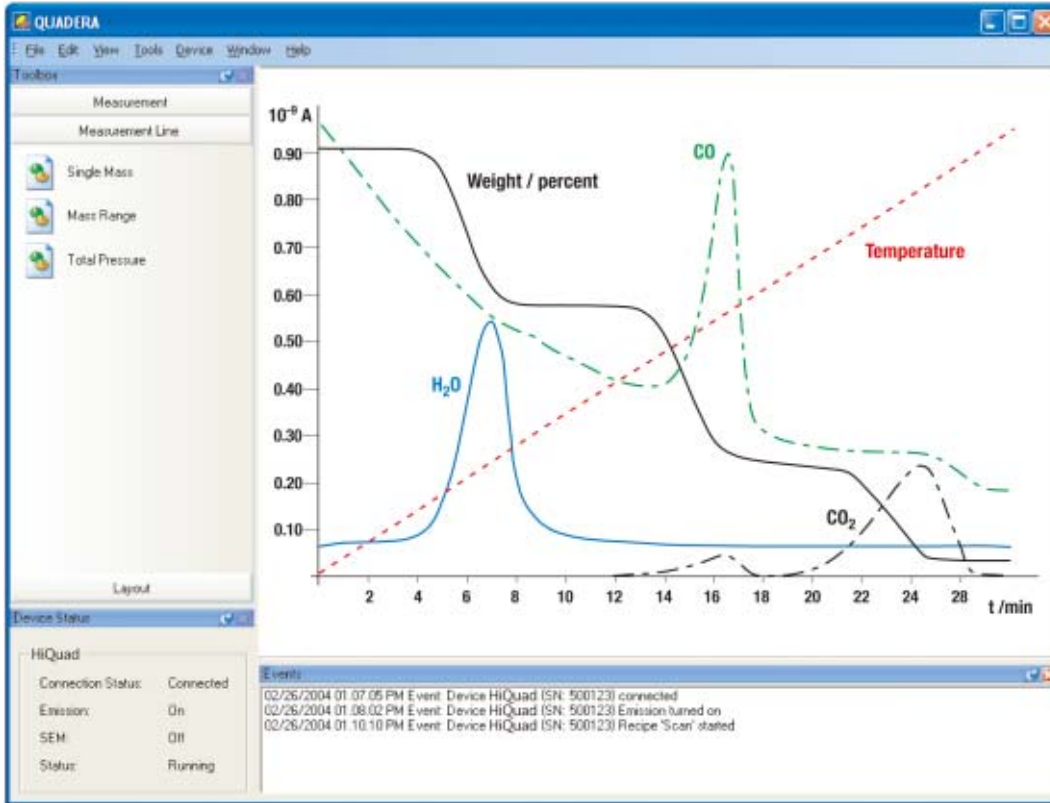
Tools, aids

Status

Messages

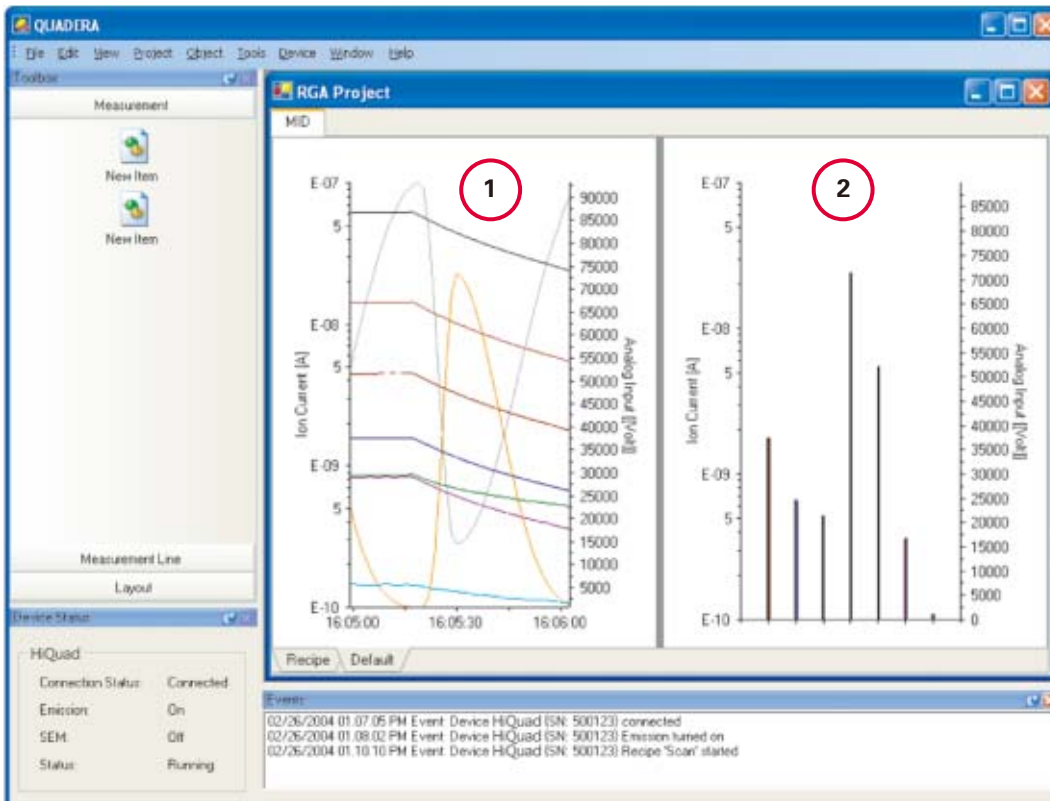


The measured data are shown in the center of the screen. Tools are arranged at the left, and the status of the instrument is indicated at the lower left. Important messages are displayed in the form of text messages.



It is possible to display mass spectrometer data together with external data, such as temperature, sample weight, etc.

The example in the illustration shows coupling with a thermobalance.



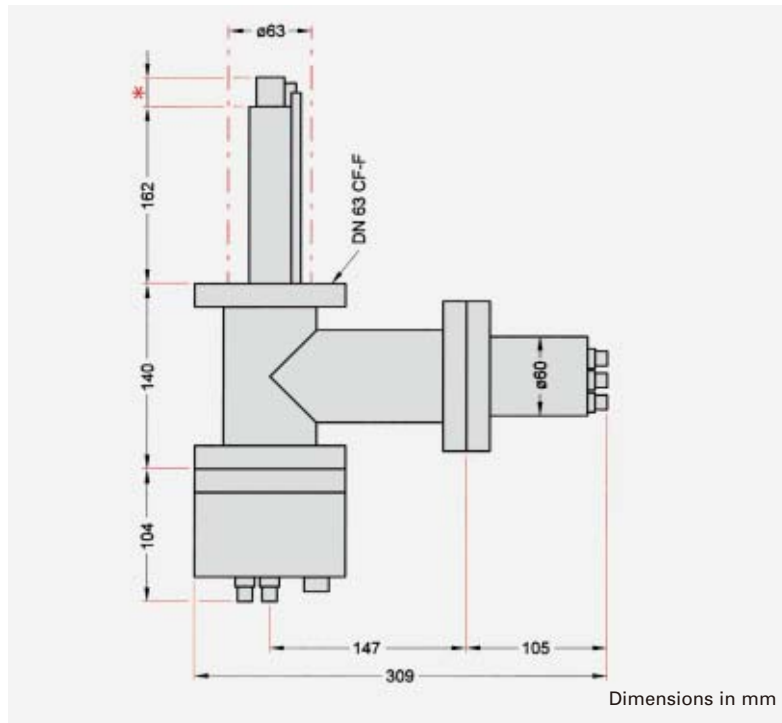
Different user-defined views of the same measurement can be displayed simultaneously.

1
Signal vs. time.

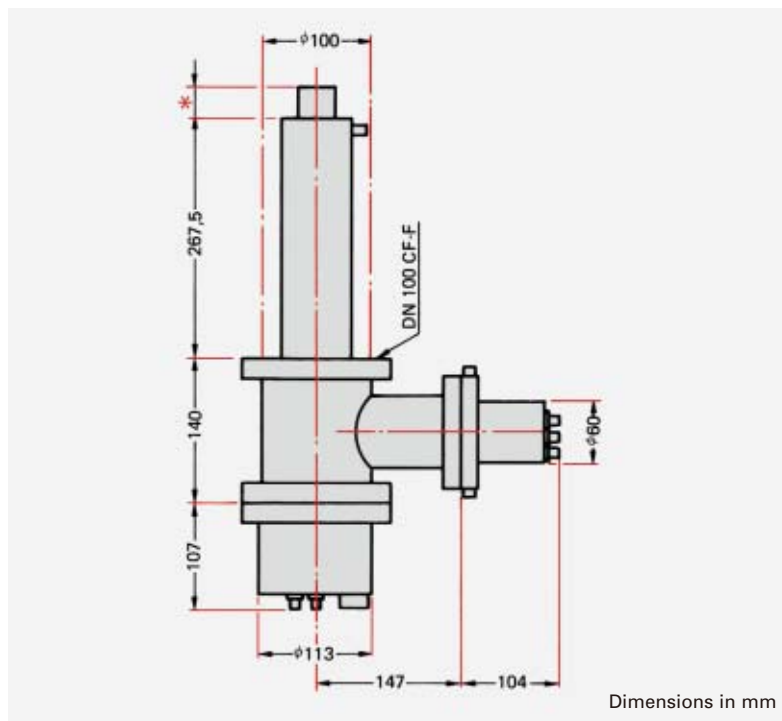
2
Bargraph scan of different masses.

Dimensions

**QMA 400,
QMA 430
with 90° off axis
SEM**



**QMA 410
with 90° off axis
SEM**



- * - Axial ion source = 26 mm
- Grid ion source = 27 mm
- Cross-beam ion source = 35.5 mm (23.5 mm to the center of the sensitive volume)
- Gas-tight cross-beam ion source = 48 mm (axial gas connection)
- Three-lens ion optics = 129 mm
- Cross-beam ion source with axial ion optics = 43.5 mm
- Cross-beam ion source with three-lens ion optics = 171 mm

Technical data

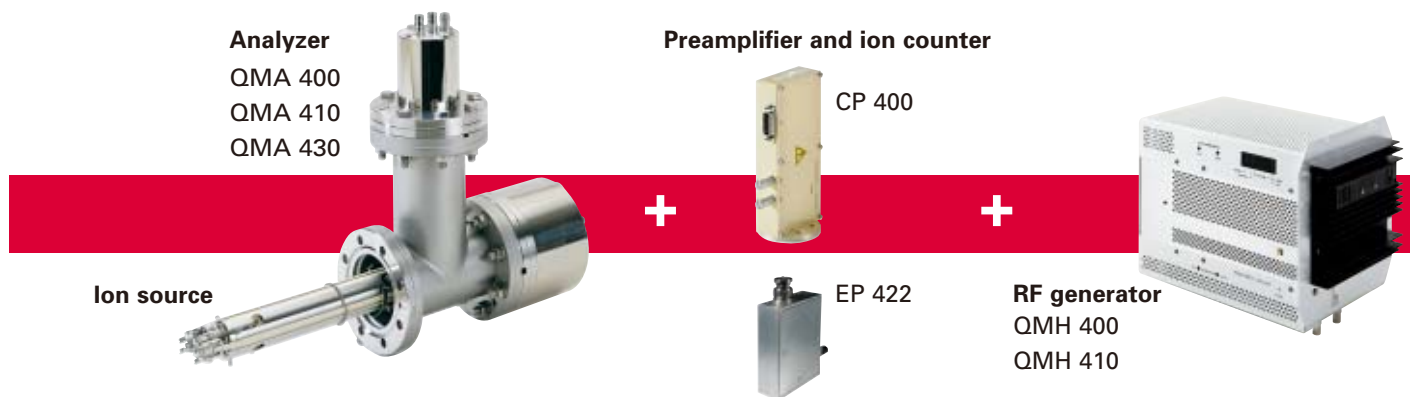
Mass range in amu			1-128
Detection limit, min.		mbar	$5 \cdot 10^{-16}$
Sensitivity for Ar, min. ¹⁾		A/mbar	$1 \cdot 10^{-3}$
Operating pressure, max.	Faraday, max.	mbar	$1 \cdot 10^{-4}$
	SEM, max.	mbar	$1 \cdot 10^{-5}$
Partial pressure ratio with SEM		ppb	< 0.3
Analyzer			QMA 410
Rod system, material/diameter		mm	Mo/16
Radio frequency generator (RF)			QMH 400-1
Electrometer preamplifier			EP 422
Operating temperature/analyzer		°C	150
Bakeout temperature/analyzer		°C	400 ²⁾
Connection flange			DN 100 CF-F

¹⁾ Faraday in deflection unit, standard resolution, cross-beam ion source with magnet, emission 1 mA

²⁾ With magnet, max. 300 °C

³⁾ Stability < 0.1 % in eight hours, contribution to adjacent mass number ⁴⁰Ar/41

Scope of delivery



1-340	1-300	1-512 ²⁾	1-1024	1-2048
$1 \cdot 10^{-15}$	$2 \cdot 10^{-15}$	$1 \cdot 10^{-15}$	–	–
$5 \cdot 10^{-4}$	$2 \cdot 10^{-4}$	$5 \cdot 10^{-4}$	$2 \cdot 10^{-4}$	$1 \cdot 10^{-4}$
$1 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-4}$
$1 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$1 \cdot 10^{-5}$	$1 \cdot 10^{-5}$
< 0.5	< 1	< 0.5	< 5	< 20
QMA 410	QMA 430	QMA 400	QMA 400	QMA 400
Mo/16	Stainless steel/8	Mo/8	Mo/8	Mo/8
QMH 410-3	QMH 400-5	QMH 400-5	QMH 410-1	QMH 410-2
EP 422	EP 422	EP 422	EP 422	EP 422
150	150	150	150	150
400 ²⁾	400 ²⁾	400 ²⁾	400 ²⁾	400 ²⁾
DN 100 CF-F	DN 63 CF-F	DN 63 CF-F	DN 63 CF-F	DN 63 CF-F

Control unit

HiQuad™



Software

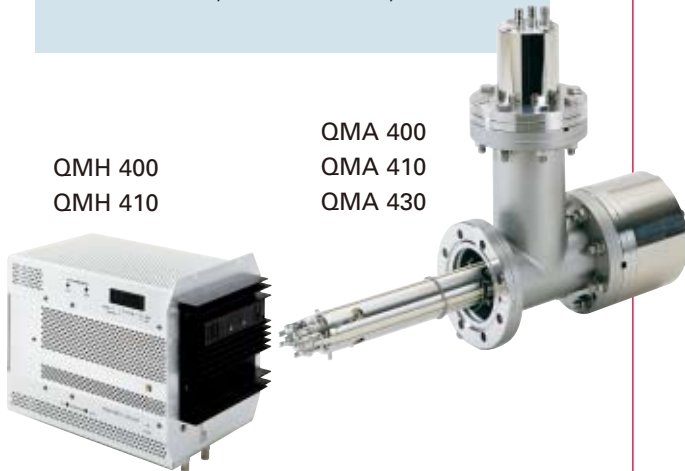


Order number structure

PT Q 1 a b c d e f g

a - Analyzer/mass range

- 2 - QMA 410 / 1 – 128 amu / QMH 400-1
- 3 - QMA 410 / 1 – 340 amu / QMH 410-3
- 4 - QMA 430 / 1 – 300 amu / QMH 400-5
- 5 - QMA 400 / 1 – 512 amu / QMH 400-5
- 6 - QMA 400 / 1 – 1024 amu / QMH 410-1
- 7 - QMA 400 / 1 – 2048 amu / QMH 410-2



g - Interface options

- 0 - None
- 1 - IO 700
- 2 - CAN Open

f - Preamplifier and ion counter

- 0 - None
- 1 - EP 422
- 2 - CP 400
- 3 - EP 422 + CP 400
- 4 - 2 x EP 422



EP 422



CP 400

bc - Ion source

- 01 - Axial ion source
- 02 - Cross-beam ion source
- 03 - Cross-beam ion source with magnet
- 04 - Gas-tight cross-beam ion source
- 05 - Gas-tight cross-beam ion source with magnet
- 06 - Grid ion source

Ion optics

- 10 - Two-lens ion optics
- 11 - Three-lens ion optics
- 12 - Two-lens ion optics with cross-beam ion source
- 13 - Three-lens ion optics with cross-beam ion source



Axial ion source



Cross-beam ion source



Grid ion source



Three-lens ion optics

e - Detector and high-voltage power supply

- 1 - SEM 217 + HV 701
- 2 - SEM 217 + HV 702
- 3 - SEM 218 + HV 702

d - Filament

- 0 - None
- 1 - Tungsten
- 2 - Yttriated iridium
- 3 - Rhenium

Selection aid – Typical applications and solutions

PTQ1	a	bc
Applications	Analyzer/mass range	Ion source/ion optics
General gas analysis	3, 5	1
Particle-beam and general gas analysis	2, 3, 4, 5, 6, 7 ¹⁾	02, 03
Analysis of gases or gas mixtures; for trace analysis; less residual gas influence than with open ion sources	2, 3, 5	04, 05
Plasma technology, SIMS, photoionization	5	11
UHV residual gas analysis, desorption measurements	4, 5, 6 ¹⁾	06 ²⁾
Thermally desorbed ions, electron-induced desorption, SIMS, photoionization, plasma ions	3, 5, 6	10, 11

¹⁾ For mass range of 1 to 2048 amu, Analyzer QMA 400 with SEM 218 and HV 702 and EP 422

²⁾ With tungsten filament only

Ordering example:

PT Q 1 5 02 1 1 1 1

- 5** – QMA 400 / 1 – 512 amu
- 02** – Cross-beam ion source
- 1** – Tungsten
- 1** – SEM 217 + HV 701
- 1** – EP 422
- 1** – IO 700

a – Analyzer/mass range

The combination of analyzer and RF generator defines the mass range.

The smallest suitable mass range for the application should be selected. The larger-diameter, precision-manufactured rod system affords improved transmission and higher sensitivity.

- QMA 410: Molybdenum, 16 mm dia. rod system
- QMA 430: Stainless steel, 8 mm dia. rod system for mass range of up to 300 amu
- QMA 400: Molybdenum, 8 mm dia. rod system

bc – Ion source/ion optics

Selection of the correct ion source is a crucial factor in the measurements.

- Axial ion source: High sensitivity and good linearity
- Cross-beam ion source: For direct gas beam inlet, without wall interaction
- Cross-beam with magnet: High sensitivity
- Gas-tight cross-beam: Low gas consumption, high signal-to-noise ratio
- Grid ion source: Low outgassing and desorption rate
- Three-lens ion optics with beam stop: For detecting positive and negative ions
- Ion optics with cross-beam ion source: For detecting neutrals and ions

d	e	f	g
Filament	Detector and high-voltage power supply	Preamplifier and ion counter	Interface options
1, 2, 3	1	1, 4	1, 2
1, 2	1, 3	1, 4	1, 2
1, 2	1, 2	1, 4	1, 2
1, 2	1, 2	1, 2, 3, 4	1, 2
1, 2	1	1, 2	1, 2
0	2	2	1, 2

d – Filament

- Tungsten:
For UHV applications
- Yttriated iridium:
Low temperatures,
high resistance to air
inrushes
- Rhenium:
For residual gas analysis

e – Detector and high-voltage power supply

- SEM 217 + HV 701:
Secondary electron multiplier in combination with a high-voltage power supply for detecting positive ions
- SEM 217 + HV 702:
For measuring positive and negative ions
- SEM 218 + HV 702
Secondary electron multiplier with conversion dynode for detecting high masses

f – Preamplifier/ion counter

- EP 422:
Fast, sensitive preamplifier
- CP 400:
Ion counting down to 1 count per 10 seconds, wide dynamic range

g – Interface options

- IO 700 board with 8 analog inputs and 8 analog outputs; 0 to 10 V, 12-bit resolution, 32 digital inputs and 32 digital outputs
- CAN Open fieldbus

Vacuum is nothing, but everything to us!

Pfeiffer Vacuum has been setting technological milestones for creating, measuring and analyzing vacuum for over 100 years. Our comprehensive product range covers individual components to complex vacuum systems.

Quality and service worldwide from the inventor of the turbopump: Pfeiffer is the international market leader with more than 280,000 turbopumps sold to date.

Do you have questions about your application? Please ask us.



All data subject to change without prior notice. PK 0082 PE (April 2006)



Sales, consulting and service

- ▶ Worldwide on-site service
- ▶ Comprehensive in-factory and on-site training programs
- ▶ Modular service system ranging from spare parts to maintenance contracts

PFEIFFER  **VACUUM**