

Operating Manual

QMG 800

Quadrupole Mass Spectrometry System

074-827-P1-C

INFICON
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1 Warranty

WARRANTY AND LIABILITY - LIMITATION: Seller warrants the products manufactured by it, or by an affiliated company and sold by it, and described on the reverse hereof, to be, for the period of warranty coverage specified below, free from defects of materials or workmanship under normal proper use and service. The period of warranty coverage is specified for the respective products in the respective Seller instruction manuals for those products but shall not be less than one (1) year from the date of shipment thereof by Seller. Seller's liability under this warranty is limited to such of the above products or parts thereof as are returned, transportation prepaid, to Seller's plant, not later than thirty (30) days after the expiration of the period of warranty coverage in respect thereof and are found by Seller's examination to have failed to function properly because of defective workmanship or materials and not because of improper installation or misuse and is limited to, at Seller's election, either (a) repairing and returning the product or part thereof, or (b) furnishing a replacement product or part thereof, transportation prepaid by Seller in either case. In the event Buyer discovers or learns that a product does not conform to warranty, Buyer shall immediately notify Seller in writing of such non-conformity, specifying in reasonable detail the nature of such non-conformity. If Seller is not provided with such written notification, Seller shall not be liable for any further damages which could have been avoided if Seller had been provided with immediate written notification.

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3 Safety

3.1 Safety Precautions When Using This Instrument

All work described in this document may only be carried out by persons who have suitable technical training and the necessary experience or who have been instructed by the end user of the product.

Misuse of QMG 800 can damage the instrument and may cause bodily harm. The safety messages in this document are provided to protect the user, as well as to optimize QMG 800 performance. Before operating QMG 800, the user must read and understand all safety messages and take adequate precautions to mitigate hazards or equipment damage.

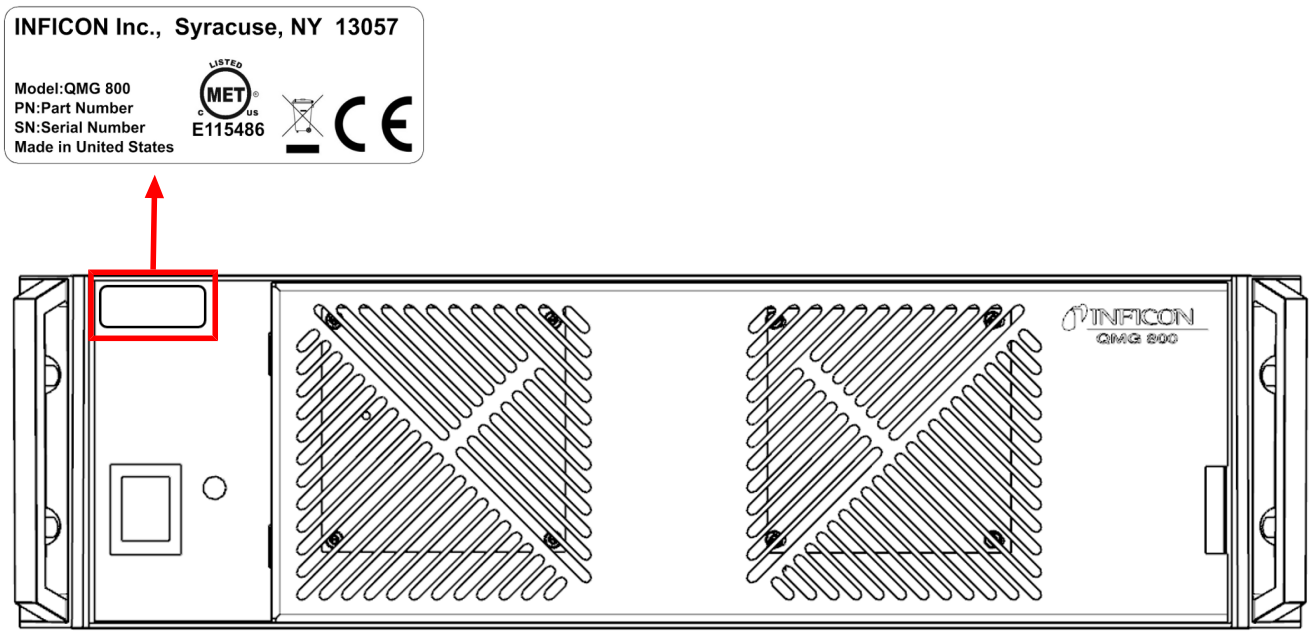
Please follow the relevant instructions and take the necessary precautions when handling the process media used.

Please obtain information before working with contamination. Please follow any relevant instructions and take the necessary precautions when handling devices used with contaminated parts.

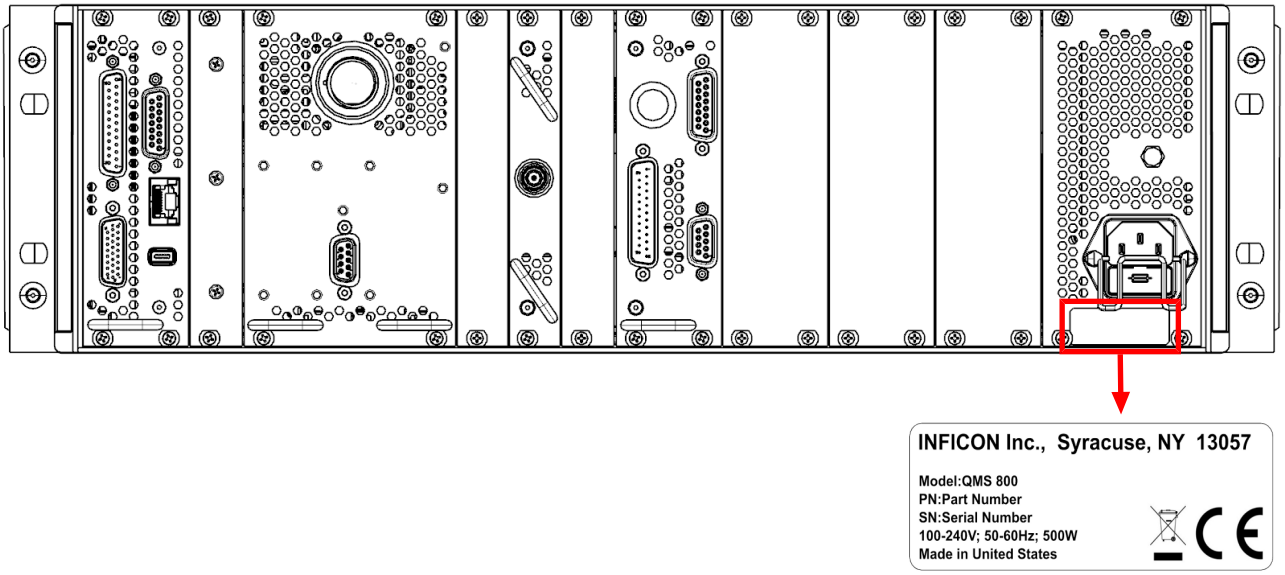
Pass these safety instructions on to other users.

3.2 System Marking and Identification

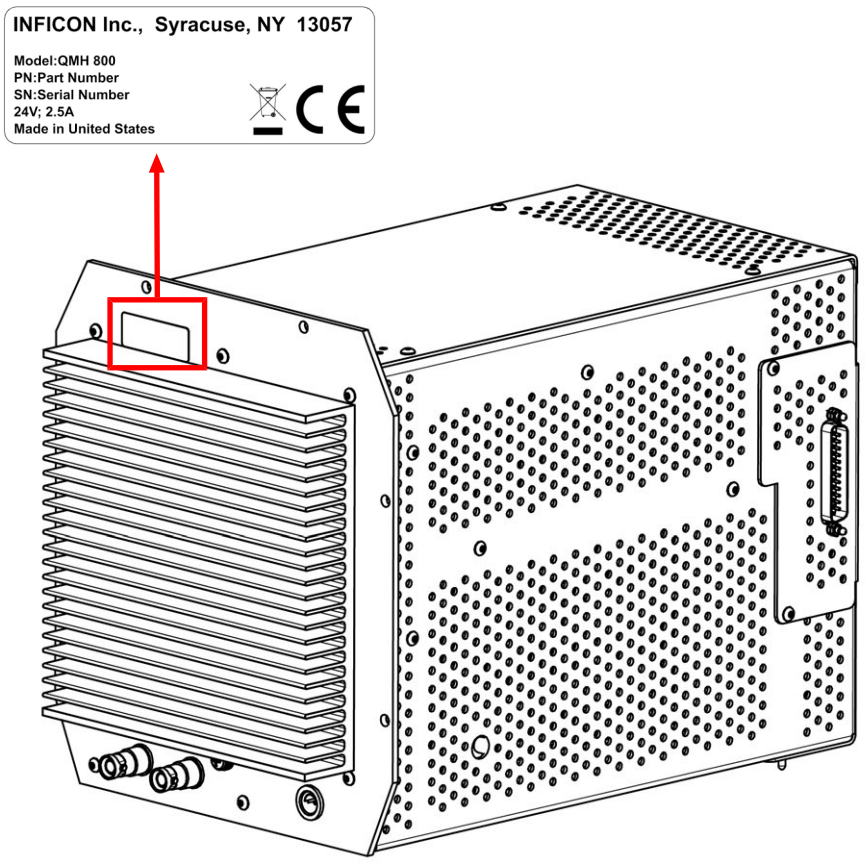
3.2.1 QMG System Label



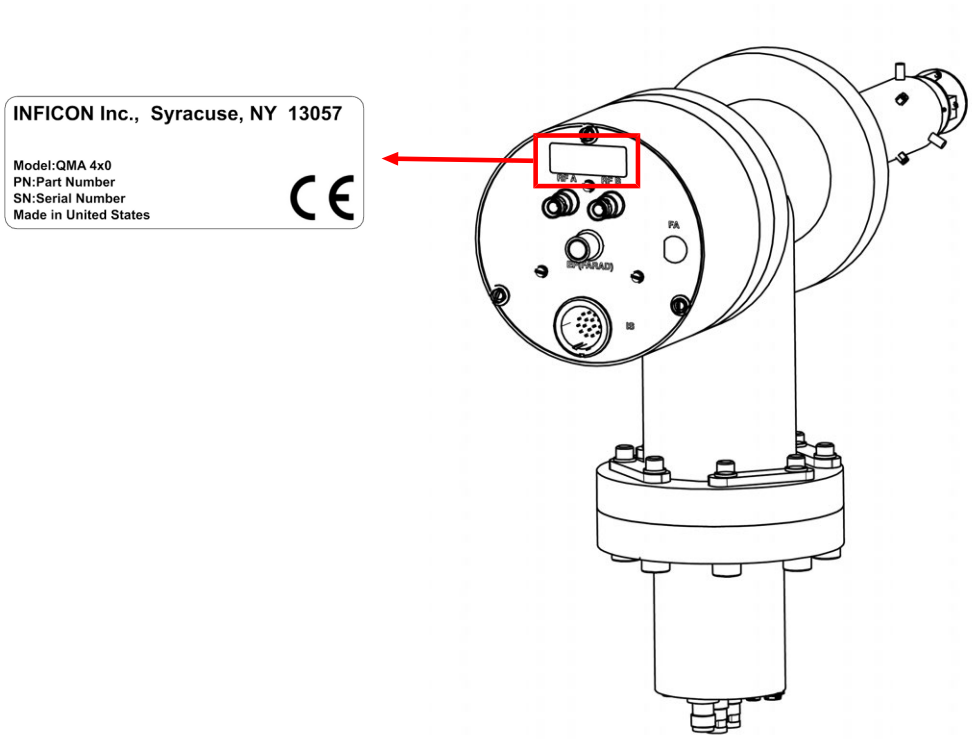
3.2.2 QMS Label



3.2.3 QMH Label



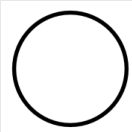
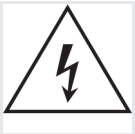
3.2.4 QMA Label



3.3 Explanation of Symbols Used

The following symbols may be found in the operating manual and on the equipment.

Symbol	Reference	Description
	ISO 7000/IEC 60417-5031 (2002-10)	Direct current
	ISO 7000/IEC 60417-5017 (2006-08)	Earth (ground) terminal
	ISO 7000/IEC 60417-5019 (2006-08)	Protective earth (ground) terminal
	ISO 7000/IEC 60417-5020 (2002-10)	Frame or chassis terminal
	ISO 7000/IEC 60417-5007 (2002-10)	On (Power)

Symbol	Reference	Description
	ISO 7000/IEC 60417-5008 (2002-10)	Off (Power)
	ISO 7000/IEC 60417-6042 (2010-11)	Caution, risk of electric shock
	ISO 7000/IEC 60417-5041 (2002-10)	Caution, hot surface
	ISO 7000/IEC 60417-0434B (2004-01)	Caution*
	ISO 7000/IEC 60417-2760 (2006-05)	Product information

*Documentation must be consulted in all cases where this symbol is marked.

3.4 Definition of Safety and Informational Messages

When using this document, please pay attention to the safety and informational messages found throughout. For the purposes of this manual they are defined as follows:



⚠ DANGER

This type of message indicates a hazardous situation that will result in death or serious injury if proper precautions are not taken.



⚠ WARNING

This type of message indicates a hazardous situation that could result in death or serious injury if proper precautions are not taken.



⚠ WARNING

This type of message indicates that dangerous electrical voltages are present that could result in personal injury if proper precautions are not taken.



⚠ WARNING

This type of message indicates that high temperatures are present that could result in personal injury if proper precautions are not taken.

⚠ WARNING

This type of message warns against actions that could cause extensive equipment and/or environmental damage.



⚠ CAUTION

This type of message indicates a hazardous situation that could result in minor or moderate injury if proper precautions are not taken.

⚠ CAUTION

This type of message cautions against actions that may cause an instrument malfunction, minor equipment damage, and/or the loss of data.

NOTICE

This type of message indicates information that is considered important but is not related to any type of hazard.



This type of message indicates information that is considered important but is not related to any type of hazard.

3.5 Intended Use

QMG 800 is a mass spectrometer designed for gas analysis in the high vacuum range. It may be used only for this purpose. The instructions in this operating manual and those of the accessories must be followed.



⚠ WARNING

QMG 800 is not intended to produce measurement results on which the safety of persons or material depend. For such applications the safety must be ensured by additional measures.



⚠ WARNING

Place equipment in a safe state before using tools to access or adjust hazardous parts.



⚠ CAUTION

The product is not for use in a manner not specified by the manufacturer. If the product is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



⚠ CAUTION

The product is part of the end user's application. Fire protection features should be provided by the end user.



⚠ CAUTION

When installing the product, make sure it is properly secured in case of a seismic event.

3.6 Liability and Warranty

INFICON assumes no liability and the warranty becomes null and void if the custodian or third parties:

- disregard the information in this document
- use the product in a non-conforming manner
- make any kind of changes (modifications, alterations, etc.) to the product
- use the product with accessories not listed in the corresponding product documentation

The custodian assumes the responsibility in conjunction with the process media used.

3.7 Training

For the optimal use of this product, INFICON offers application, operation, and maintenance courses. Your INFICON partner would be glad to provide the information.

3.8 Storage and Disposal

⚠ CAUTION

Inappropriate storage (static electricity, humidity, etc.) can damage electronic components. Store product in anti-static container. Observe the corresponding specifications in the Technical Data [▶ 19].



⚠ WARNING

Contaminated parts can be hazardous to personal health and the environment.

Prior to use, determine whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

⚠ WARNING

Products or parts thereof (mechanical and electric components, operating fluids, etc.) can be hazardous to the environment.

Dispose of such substances in accordance with the relevant local regulations.

3.8.1 Separating the Components

After disassembling the product, separate its components according to the following criteria:

Contaminated Components

Contaminated components (radioactive, toxic, caustic or biological hazard, etc.) must be decontaminated in accordance with the relevant national regulations, separated according to their materials, and disposed of.

Other Components

Such components must be separated according to their materials and recycled.

4 System Overview

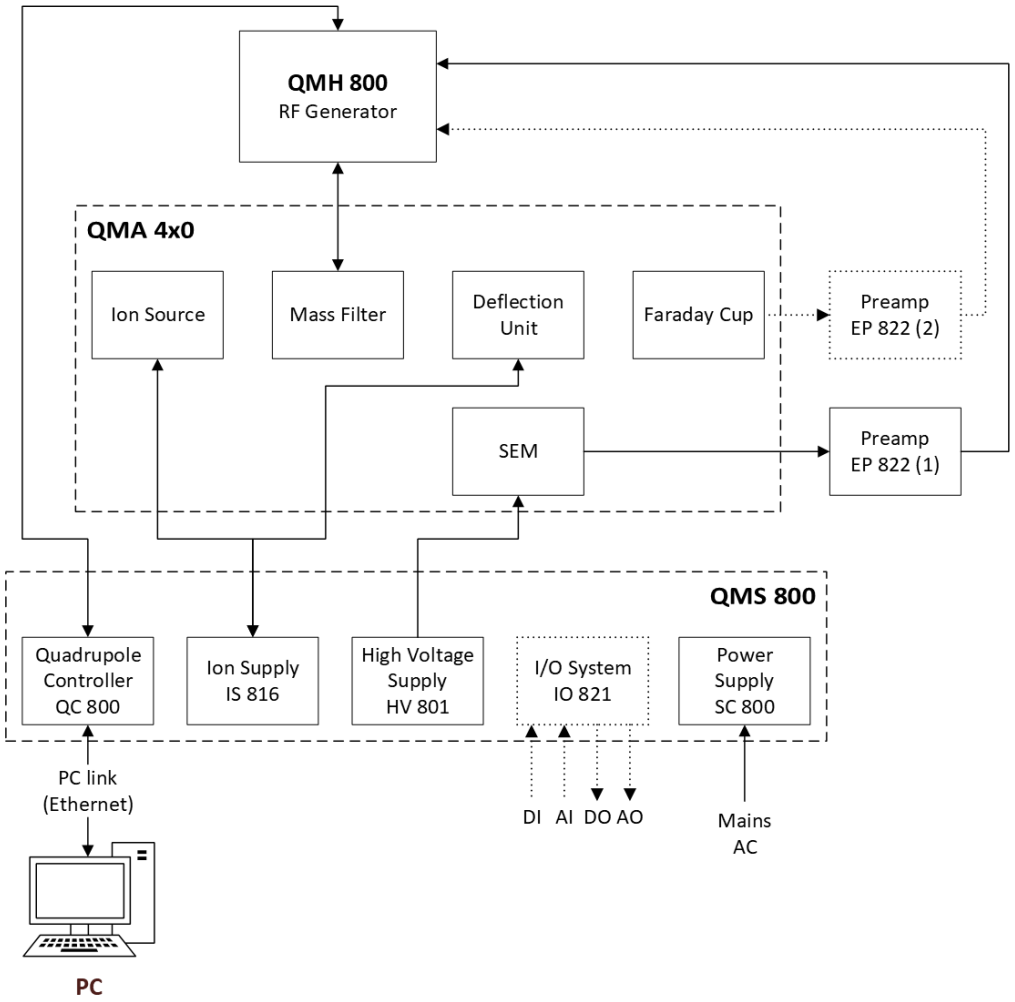
4.1 System Components

The QMG 800 comprises the controller QMS 800 (system chassis SC 800, including the modules: QC 800, IS 816, HV 801, optional IO 821). It also includes a radio-frequency (RF) generator (QMH 800), analyzer (QMA 4x0), and electrometer preamplifier(s) (EP 822).

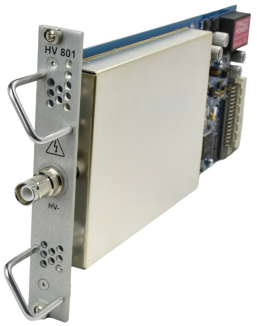
4.2 System Structure QMG 800

The following block diagram shows the general QMG 800 system structure. Depending on the application, various configurations are possible.

Individual modules are described in detail on the following pages. The block diagram below shows a configuration example.



4.3 QMG 800 Quadrupole Mass Spectrometer, Components, and Modules

QMS 800	Controller		Comprises the system chassis SC 800 and the modules described below.
SC 800	System Chassis		Comprises the power supply, internal bus plane, and system ventilation. It houses the modules described below.
QC 800	Quadrupole Controller		Comprises: • QMG 800 system controller and LAN–PC interface • Control circuits for the RF generator • Measuring signal processing
IS 816	Ion Source Supply		Supplies all necessary operating voltages for the ion source. • Programmable potentials, short-circuit proof • Polarity reversible for positive and negative ions • Normal mode/degas mode • Suitable for all ion source types of the QMA 4x0
HV 801	High Voltage Supply		Supplies high voltage to the SEM 217 for positive ion detection.

IO 821	I/O System		Provides programmable digital and analog inputs and outputs.

Other Components

EP 822	Electrometer Preamplifier		The EP 822 amplifies the very small ion current signals of the analyzer to voltage levels that are suitable for further processing. It is installed directly on the analyzer in order to minimize parasitic noise. • Compact, simple installation on QMA 4x0 • Low-noise, low-drift, little vibration sensitivity **NOTE:** On analyzers with 90° off-axis SEM, two EP 822 can be connected. This allows a simple software selection from Faraday to SEM mode.
QMH 800	RF Generator		Produces the high-frequency voltage required for mass separation.
QMA 4x0	Analyzer		Comprises the ion source, mass filter, ion collector, and housing. Ion collector types: • Faraday collector • SEM 217 (90° off-axis)

5 Technical Data

5.1 General

This information applies to all QMG 800 modules unless specified otherwise.

5.1.1 Environmental Requirements

5.1.1.1 Use

The instrument is for indoor use only.

5.1.1.2 Types of Protection

IP rating IP20

Overvoltage category II

5.1.1.3 Altitude Range

The instrument can be used up to an altitude of 2000 m (6561 ft.). Contact INFICON for operation instructions at higher altitudes.

5.1.1.4 Maximum Humidity

The instrument can be used at ≤80% relative humidity up to 31°C, decreasing linearly to 50% at 40°C.

5.1.1.5 Pollution Degree

Pollution degree of 2 (per IEC 61010-1:2010).

5.1.1.6 Operating Temperature

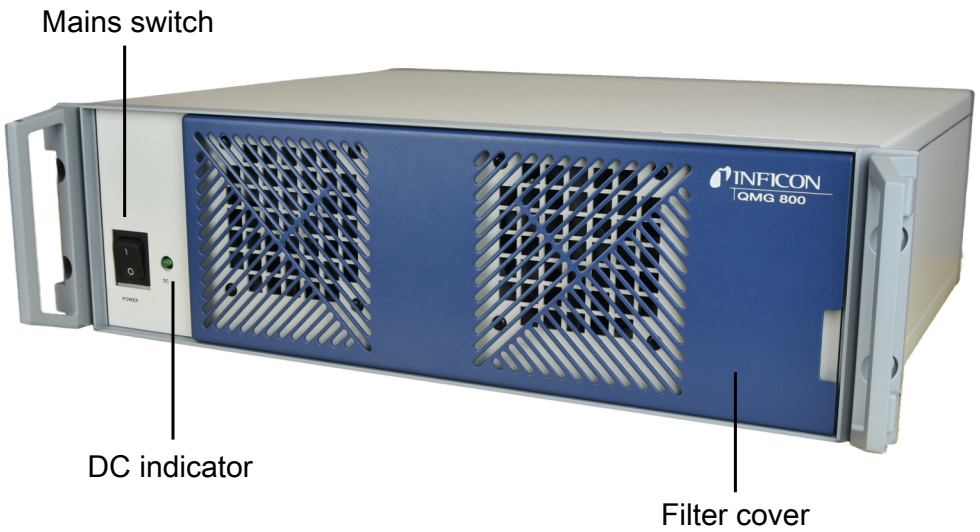
The maximum ambient operating temperature is 40°C (104°F). The minimum operating temperature is 5°C (41°F).

5.1.1.7 Storage Temperature

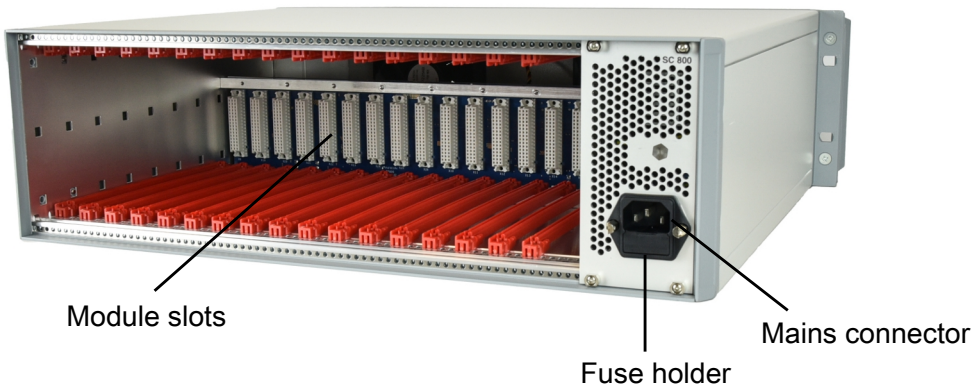
The storage temperature is between -40°C (-40°F) and 65°C (149°F).

5.2 System Chassis SC 800

5.2.1 Front Panel



5.2.2 Rear Panel

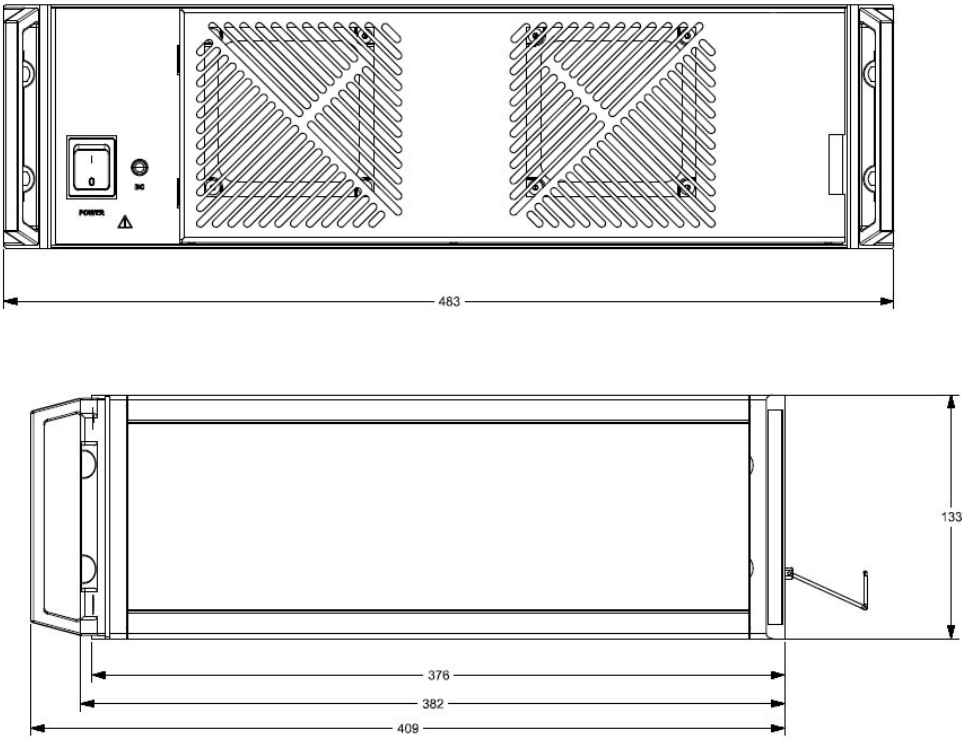


5.2.3 Module Slots

There are 18 module slots (4U each). For chassis slot configuration, see Installation/Replacement of Modules in QMS 800 [▷ 49].

5.2.4 Dimensions

The dimensions are 409 mm L × 483 mm W × 133 mm H.



5.2.5 Weight

The weight is 7.5 kg (without modules).

5.2.6 Power Supply

The electrical connections are a standard IEC320 power connection, 110 V (AC), three-pronged, grounded plug or a 230 V (AC), two-pronged plug with a ground contact. The plug can be U.S., U.K., European, or Israeli plug type.

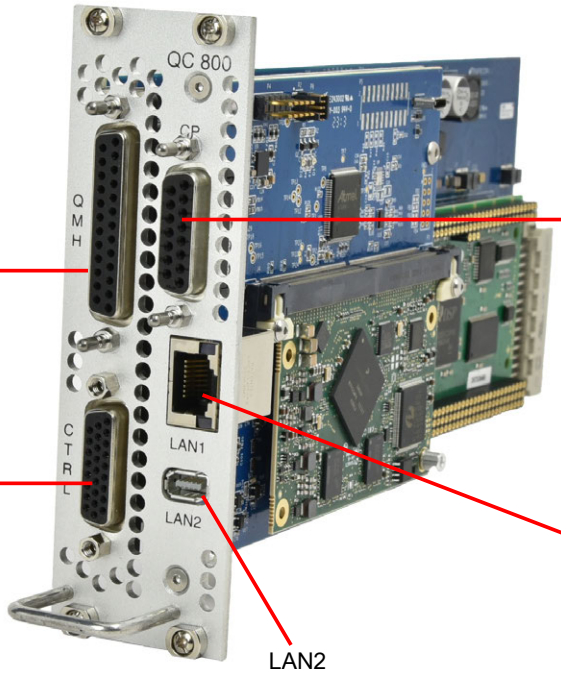


⚠ CAUTION

Do not replace the power cord with an inadequately rated cord. The cord must be rated 10 A or higher.

Mains voltage	100–240 V (AC), 50–60 Hz ± 10%
Power requirement	≤500 W
Connector	Mains connector with integrated fuse holder
Fuse	6.3 A HBC, 5 × 20 mm
Mains cable	Country specific

5.3 Quadrupole Controller QC 800



Compatibility	System chassis SC 800
No. of slots occupied	2
Modules per system	1
Slot No.	1 and 2 (left-hand side of system chassis)[1)]
Weight	0.4 kg

[1)] For chassis slot configuration, see Installation/Replacement of Modules in QMS 800 [▶ 49].

5.3.1 Operation Modes and Parameters

No. of measuring channels	128
Operation modes	*MONO- / MULTI-channel*
Measuring cycles	1–10,000 or *REPEAT*
Time required for a channel change	100–200 µs (at min. *PAUSE* in cycle)

5.3.1.1 Mass Scan Modes

mass-MODE	Measuring method
SCAN-N	Analog scan normal
SCAN-F	Analog scan with FIR filter for measuring value
STAIR-T	Scan bar graph in steps of 1 amu
SAMPLE	Single mass and MID (Multiple Ion Detection)
PEAK-L	Scan bar graph using level criterion
PEAK-F	Scan bar graph using FIR FILTER
ADJUST-C	Coarse search
ADJUST-F	Fine search

5.3.1.2 Mass Scale Resolution

	STEPS per mass	
Scan-SPEED	*FIX*-Range	*AUTO*-Range
125 µs/amu	8/amu	—
250 µs/amu	16/amu	—
0.5–1 ms/amu	32/amu	—
2–20 ms/amu	64/amu	32/amu
50 ms/u to 60 s/amu	64/amu	64/amu

5.3.1.3 Measurement Speeds

	EP 822 or external inputs	
mass-MODE	*FIX*-Range	*AUTO*-Range
SAMPLE	125 µs to 60 s	0.5 ms to 60 s
STAIR	125 µs/amu to 60 s/amu	2 ms/amu to 60 s/amu
SCAN	125 µs/amu to 60 s/amu	5 ms/amu to 60 s/amu
PEAK	125 µs/amu to 60 s/amu	5 ms/amu to 60 s/amu

NOTE: Any dwell time below 1 ms cannot currently be performed by FabGuard®.

5.3.1.4 Detector Types

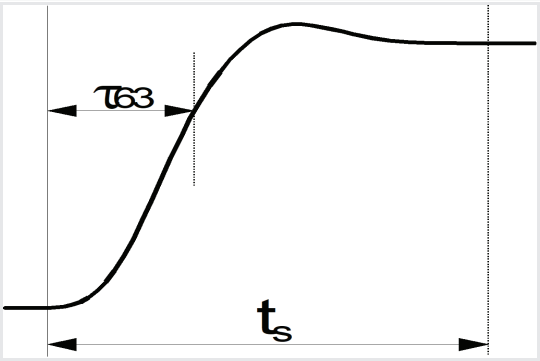
detect-TYPE	
FARAD	Faraday collector, EP 822
SEM	SEM (type configurable), EP 822
EXTERN 1	External analog input of QC 800 (EXT IN 1)
EXTERN 2	External analog input of QC 800 (EXT IN 2)
ANALOG-IN (1 … n)	Analog signal via IO 821 (analog channels 1 … *n*)

5.3.1.5 Measurement Ranges and Resolution

Detector type	Measurement ranges	Modes	Resolution
FARAD, *SEM*	10^{-12} to 10^{-5} A fsd	*FIX*- and *AUTO*-Range	16 bit[1)] (per range)
EXTERN	GAIN 1: ±10.240 V GAIN 10: ±1.024 V	*FIX*-Range	16 bit[1)]

[1)] Further increased by averaging.

5.3.1.6 Analog Filter

Filter type	Two-stage low pass Effective for preamp and external inputs
Filter time constant	Automatic or selectable in nine steps: 5, 18, 85, 400 µs 1.7, 8, 40, 180, 800 ms
Filter step response	 τ_{63}: filter time constant Settling time to ±1‰: $t_s \approx 4 \times \tau_{63}$

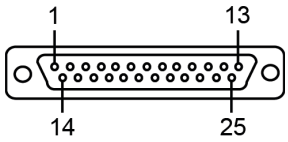
5.3.1.7 Digital Filter

NORMAL (N)	Low pass (average value)
FIR (F)	Finite Impulse Response

5.3.2 Electrical Connections

5.3.2.1 QMH Connector Pin Assignment

The connector for the RF generator (QMH 800) is a D-sub 25-pin female connector.



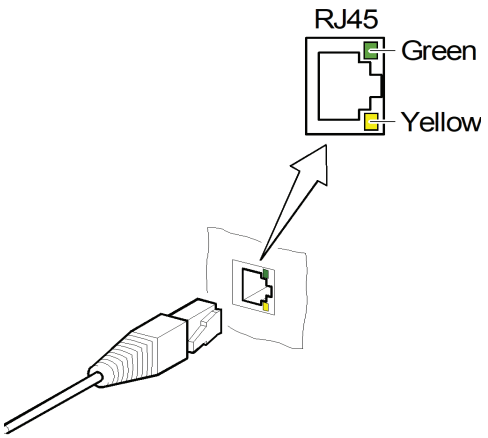
Pin	Signal	Pin	Signal
1, 2, 14	-24 V	9	RESERVE 1 H
3, 15, 16	+24 V	10	RF OK L
4, 6, 17, 19	0 V[1)]	11	MODE 1 H
5	SCAN+[2)]	23	MODE 2 H
18	SCAN-[2)]	12	RANGE 0 H
7	EP+[2)]	24	RANGE 1 H
20	EP-[2)]	13	EP 2 H
8	RESOL+[2)]	22	SCREEN
21	RESOL-[2)]	25	RESERVE 2 H

[1)] Line 0 V must have max. ±0.5 V_p against chassis GND.

[2)] Permissible common-mode signal: max. ±0.5 V_p for SCAN±, RESOL±, and EP±.

5.3.2.2 LAN Connections

LAN1: RJ45 Ethernet connector

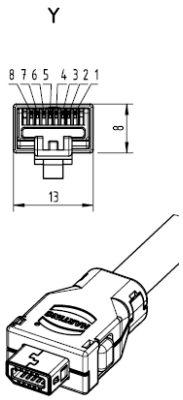


The interface status is indicated by two LEDs integrated in the RJ45 connector:

LED	Status	Meaning
Green	Lit	Data transfer rate 100 Mbit/s
	Dark	Data transfer rate 10 Mbit/s
Yellow	Lit (flickering)	Data transfer in progress
	Dark	No data transfer (or no connection)

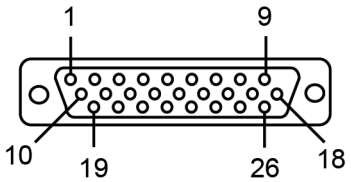
LAN2: HARTING ix Industrial® Ethernet connector

The HARTING ix Industrial is a miniature Ethernet connector with a data transfer rate of 1/10 Gbit/s.



5.3.2.3 CTRL Connector Pin Assignment

The CTRL connector is an HD-sub 26-pin female connector.



Pin	Signal word	Signal type	Description
1	GND	GND	Via 100 Ω to GND
10	GND	GND	Via 100 Ω to GND
26	GND	GND	Via 100 Ω to GND
2	RUN IN	TTL input	Input for external start of measuring cycle, low true, internal pull-up 5.6 kΩ to +5 V
14	SYNC IN	TTL input	Reserved for future use, low true, internal pull-up 5.6 kΩ to +5 V
15	IN 0	TTL input	Internal pull-up 5.6 kΩ to +5 V (can only be used if jumper J2 is in place)
3	IN 1	TTL input	Internal pull-up 5.6 kΩ to +5 V (can only be used if jumper J4 is in place)
16	IN 2	TTL input	Internal pull-up 5.6 kΩ to +5 V
23	OUT 0	TTL output	
11	OUT 1	TTL output	
25	SYNC OUT+	TTL output	Positive edge marking start of measurement, scope trigger
13	SYNC OUT-	GND	Reference point SYNC OUT+,via 200 Ω to GND
4	EXT IN 1+	Analog input	Terminals for external voltmeter (differentially), max. ±10 V, with low-pass filter/amplifier
17	EXT IN 1-	Analog input	
5	EXT IN 2+	Analog input	Terminals for external voltmeter (differentially), max. ±10 V, with or without low-pass filter/amplifier
18	EXT IN 2-	Analog input	

Pin	Signal word	Signal type	Description
6	ELM OUT+	Analog output	Output of low-pass filter/amplifier, ±10 V, max 0.1 mA via 200 Ω
19	ELM OUT–	GND	Reference point for ELM OUT+, via 200 Ω to GND
7	AO MON 0+	Analog output	User configurable output[1)], ±10 V, 12 Bit, max. 0.1 mA via 200 Ω
20	AO MON 0–	GND	Reference point for AO MON 0+, via 200 Ω to GND
8	AO MON 1+	Analog output	User configurable output[2)], ±10 V, 12 Bit, max. 0.1 mA, via 200 Ω
21	AO MON 1–	GND	Reference point for AO MON 1+ via 200 Ω to GND
9	SCO+	Analog output	Output "mass number," 0–10 V, 16 Bit, max. 0.1 mA, via 200 Ω
22	SCO–	GND	Reference point for SCO+, via 200 Ω to GND
12	EP OUT+	Analog output	Electrometer signal, max. 0.1 mA, via 200 Ω
24	EP OUT–	GND	Reference point for EP OUT+, via 200 Ω to GND

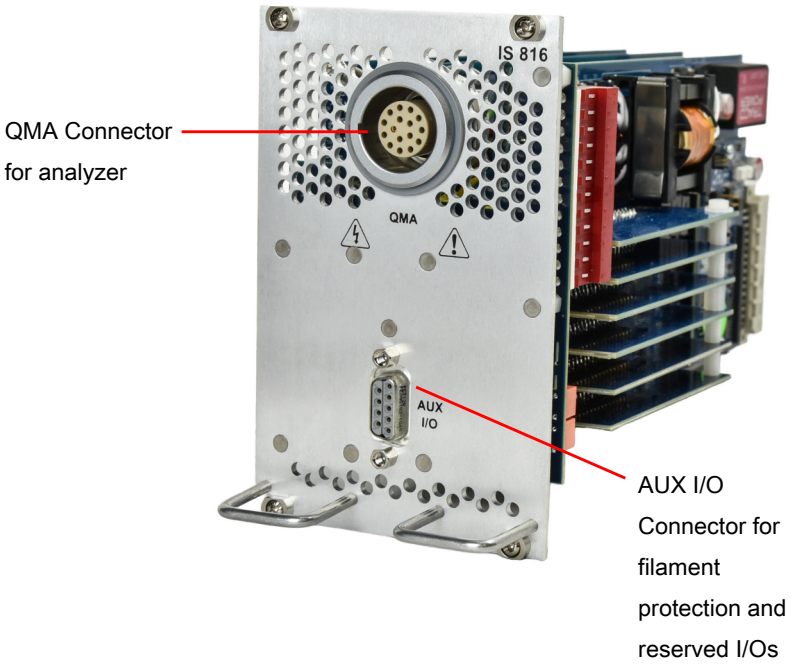
[1)] Reserved for Range Code of detector in monitor mode:

Detector range	Output voltage
1×10^{-5} A	8 V
1×10^{-6} A	7 V
1×10^{-7} A	6 V
1×10^{-8} A	5 V
1×10^{-9} A	4 V
1×10^{-10} A	3 V
1×10^{-11} A	2 V
1×10^{-12} A	1 V

[2)] Reserved for intensity signal in monitor mode (various configurations are possible):

- Linear (±10 V/decade)
- Logarithmic (±10 V FS, 1–10 decades)

5.4 Ion Source Supply IS 816



General	
Compatibility	System chassis SC 800
No. of slots occupied	4
Modules per system	2 maximum
Slot No.	4-7
Weight	1 kg

Filament power supply	
Voltage	0–10 V
Current	Max. 5 A
Power	Max. 50 W
Operation modes	Fil 1, Fil 2
Filament protection	0–5 A

Emission	
Normal	0–10 mA
Degas	0–20 mA

5.4.1 Potentials



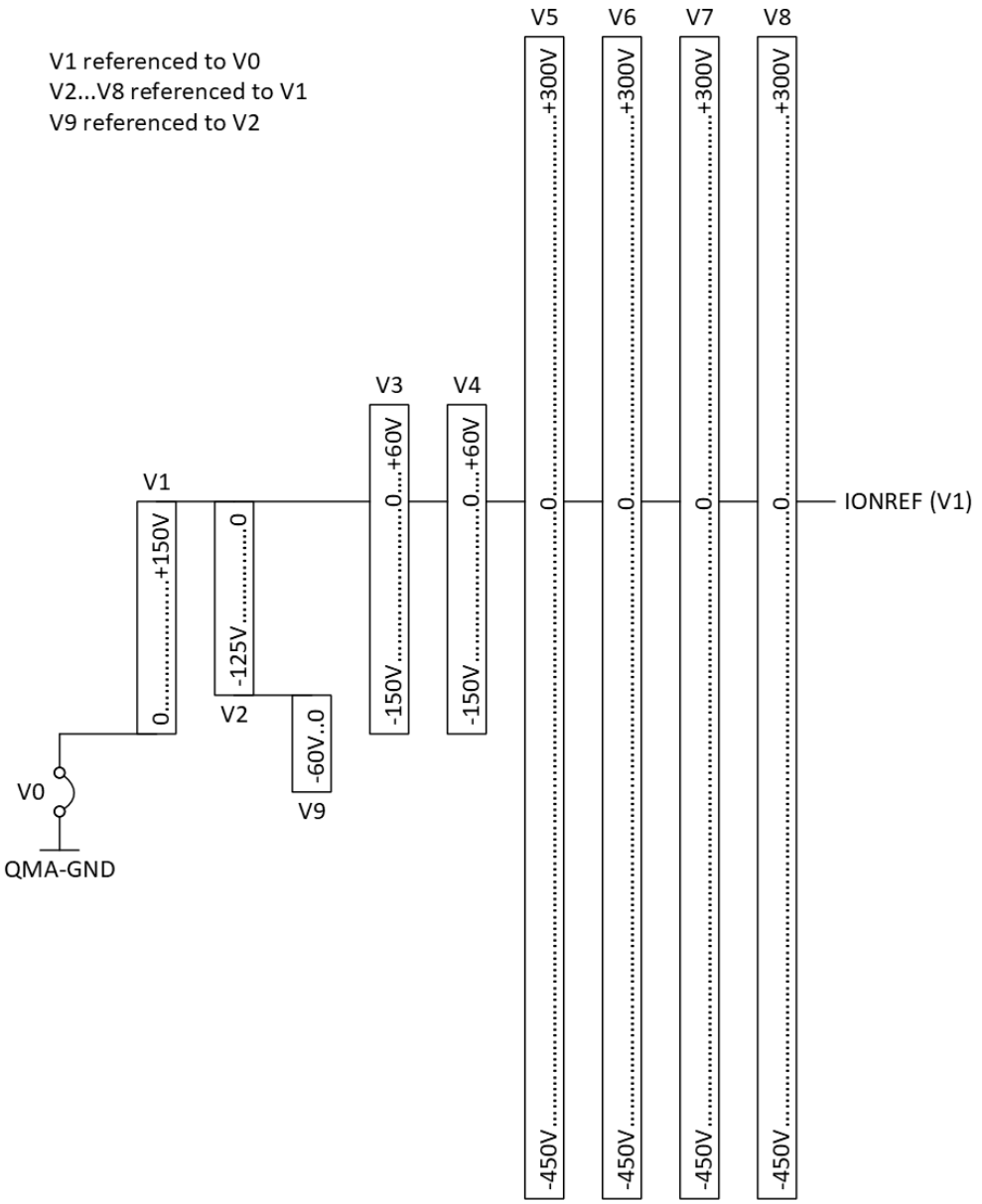
⚠ WARNING

QMS 800 must not be switched on without a correctly connected QMA cable.

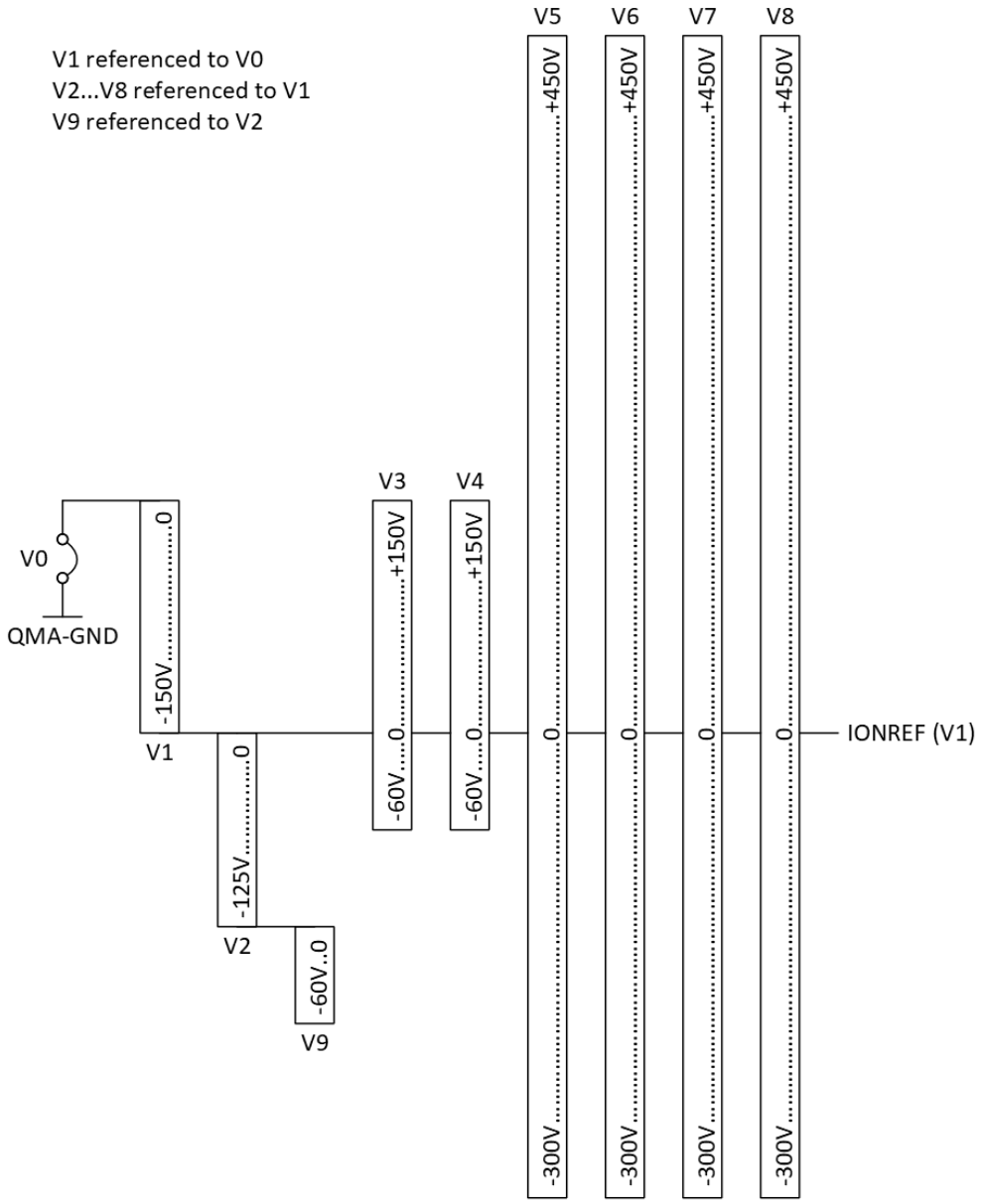
⚠ WARNING

The maximum current of the external voltage source V0 has to be reliably limited to ≤2 mA.

5.4.1.1 Ion Potentials at Max. Pos. IONREF (+150 V), Positive Polarity



5.4.1.2 Ion Potential at Max. Neg. IONREF (–150 V), Negative Polarity



	Electrode Name	Range	Nominal Current	Resolution	Offset	Gain Error	Potential at Degas[1)]
V0		[2)]					
V1	IONREF	–150 to +150 V	±2.5 mA	20 mV	±120 mV	1.6%	+550 V
V2	CATH	0 to –125 V	–10 mA	10 mV	±60 mV	1.6%	+7 V
V3	FOCUS		±3 mA	20 mV	±120 mV	1.6%	0 V
V4	F-AXIS		±3 mA	20 mV	±120 mV	1.6%	0 V
V5	EXTRACT		±100 µA	58.82 mV	±240 mV	1.6%	0 V
V6	DEF-I	[3)]	±100 µA	58.82 mV	±240 mV	1.6%	0 V
V7	DEF-O	[3)]	±100 µA	58.82 mV	±240 mV	1.6%	0 V
V8	Res		±100 µA	58.82 mV	±240 mV	1.6%	0 V
V9	WEHNELT	0 to –60 V	–500 µA	3.92 mV	±30 mV	1.6%	0 V

[1] Referenced to V0.

[2] Normally V0 is connected to QMA GND (vacuum system GND). For special applications V0 may be raised to max. ±200 V respective to QMA GND.

[3] In Faraday mode, V6 and V7 are connected to QMA GND.

5.4.2 Electrical Connections

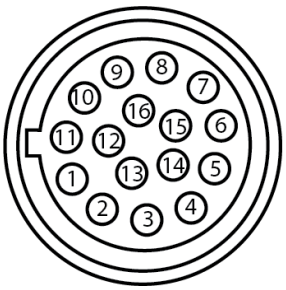


⚠ WARNING

QMS 800 must not be switched on without a correctly connected QMA cable.

5.4.2.1 QMA Connector Pin Assignment

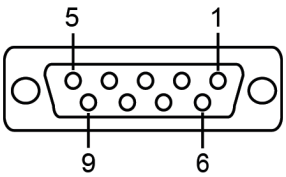
The QMA connector is a circular 16-pin LEMO® female connector.



Pin	Signal	Description
1	QMA GND	
2	SPEC SRC RET	Reference signal for SPEC SRC ON
3	V6, Inner Deflection	
4	V3, Focus	
5	V9, Wehnelt	
6	V5, Extraction	
7	Filament +	
8	Filament - / Cathode	
9	Filament Common	
10	V4, Field Axis	
11	V0, Ref GND	
12	Screen	
13	V8, Reserve	
14	V1, Ion Ref	
15	SPEC SRC ON	+24 V if activated, max. 200 mA
16	V7, outer Deflection	

5.4.2.2 AUX I/O Connector Pin Assignment

The AUX I/O connector is a D-sub 9-pin female connector.

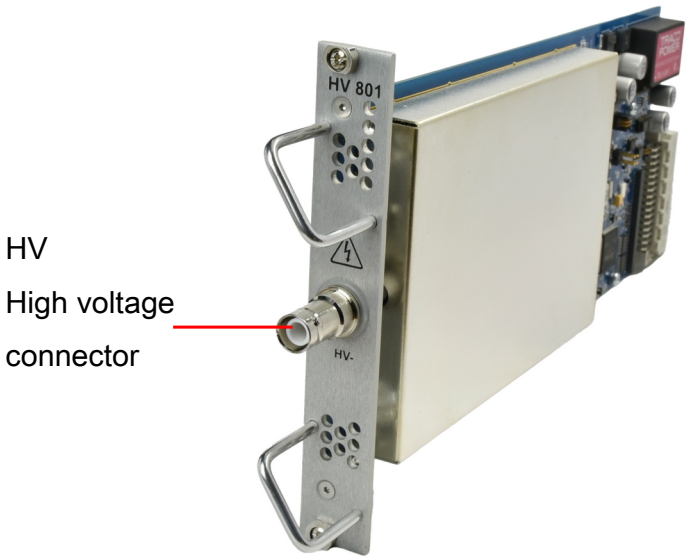


Pin	Signal	Signal type	Description
1	EXT PROT	24 V digital input	Filament protection input[1]
2	GND	GND	
3	DI RES 1	TTL input	
4	DI RES 3	TTL input	
5	DO RES 1	TTL input	
6	DO RES 2	TTL input	
7	DO RES 3	TTL input	

Pin	Signal	Signal type	Description
8	DO RES 4	TTL input	
9	n.c.	—	

[1] Must be connected to GND via a floating contact while Extern_Protection is activated (internal pull-up resistor 5.6 KΩ to +24 V), otherwise the emission will be switched off.

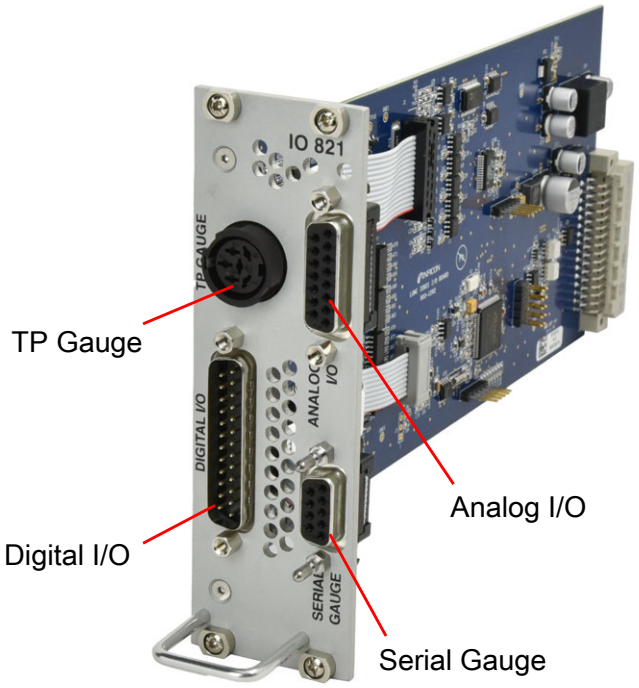
5.5 High Voltage Supply HV 801



General	
Compatibility	System chassis SC 800
No. of slots occupied	1
Modules per system	4 maximum
Slot No.	9
Weight	0.3 kg

High voltage power supply	
SEM voltage HV-	-30 to -3500 V (ripple 10 mV typical)
Resolution	219 mV
Load	≥15 MΩ
Current limit	≤1 mA
Source impedance	≈0 Ω
Settling time	0.3 s (0.1%, switching on, R_L = 15 MΩ)
Admissible voltage difference (between chassis and QMA GND)	≤0.5 V

5.6 I/O System IO 821



General	
Compatibility	System chassis SC 800
No. of slots occupied	2
Modules per system	1
Slot No.	11 and 12
Weight	0.2 kg

Analog Interfaces

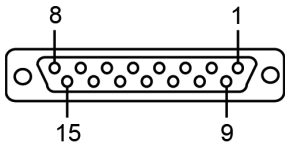
	Number	Configuration	In/Out Voltage	Digital Resolution
Input	5	Differential	±10 V	14 bit
Output	4	Single ended	0–10 V	14 bit

Digital Interfaces

	Number	Voltage/Current	Power
Input	4	24 VDC ±20%, typically 2 mA	Internal or external
Output	16	24 VDC ±20%, max 3 A for a group of 8 outputs	External

5.6.1 Analog I/O Pin Assignment

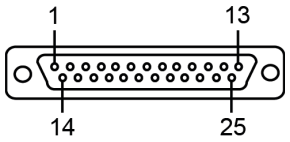
The Analog I/O connector is a D-sub 15-pin female connector.



Pin	Description	Pin	Description
1	Analog input, channel 1 (–)	9	Analog input, channel 1 (+)
2	Analog input, channel 2 (–)	10	Analog input, channel 2 (+)
3	Analog input, channel 3 (–)	11	Analog input, channel 3 (+)
4	Analog input, channel 4 (–)	12	Analog input, channel 4 (+)
5	Analog input, channel 5 (–)	13	Analog input, channel 5 (+)
6	Analog output, channel 1	14	Analog output, channel 3
7	Analog output, channel 2	15	Analog output, channel 4
8	GND reference of analog outputs		

5.6.2 Digital I/O Pin Assignment

The Digital I/O connector is a D-sub 25-pin male connector.

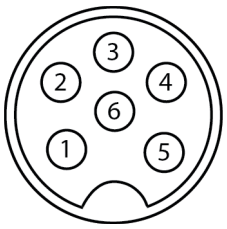


Pin	Description	Pin	Description
1	Digital output, channel 1	14	Digital output, channel 9
2	Digital output, channel 2	15	Digital output, channel 10
3	Digital output, channel 3	16	Digital output, channel 11
4	Digital output, channel 4	17	Digital output, channel 12
5	Digital output, channel 5	18	Digital output, channel 13
6	Digital output, channel 6	19	Digital output, channel 14
7	Digital output, channel 7	20	Digital output, channel 15
8	Digital output, channel 8	21	Digital output, channel 16
9	GND for digital outputs 1 to 16 (DO_0V)	22	Supply voltage for digital outputs 9 to 16 (DO_V+, external)
10	Supply voltage for digital outputs 1 to 8 (DO_V+, external)	23	GND reference (0 V) for digital inputs
11	Digital input, channel 1	24	+24 V for digital input
12	Digital input, channel 2	25	Digital input, channel 4
13	Digital input, channel 3		

- Input requires floating contact.
- Input control requires an external voltage (e.g., PLC output).
- The load R_L can be a relay, a solenoid valve, or an indicator lamp.

5.6.3 TP Gauge Pin Assignment

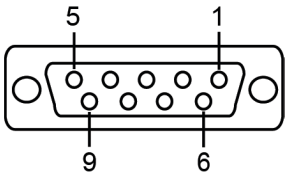
The TP Gauge connector is a circular 6-pin female connector.



Pin	Description
1	Identification/Degas
2	GND
3	Analog input (+)
4	Analog input (-)
5	GND
6	+24 V

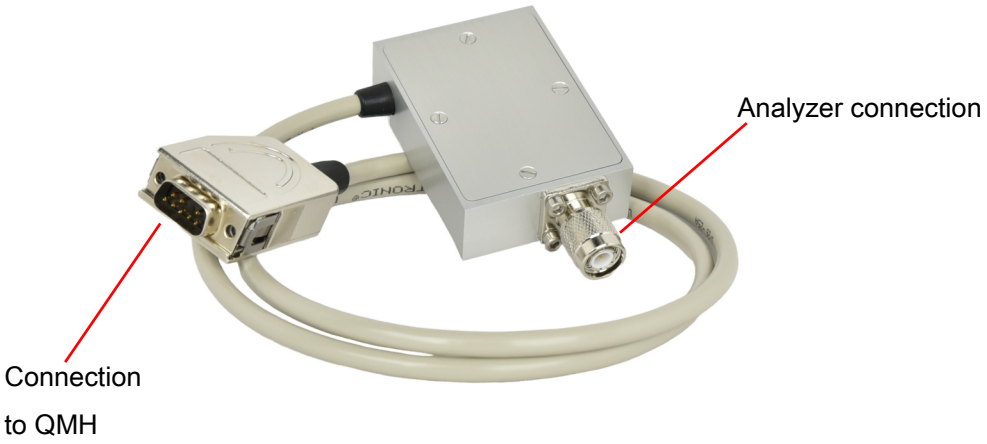
5.6.4 Serial Gauge Pin Assignment

The Serial Gauge connector is a D-sub 9-pin female connector.



Pin	Description
1	NC
2	RS232 TXD
3	RS232 RXD
4	PROG
5	GND
6	+24 V
7	RS485 D-
8	RS485 D+
9	NC

5.7 Electrometer Preamplifier EP 822



General	
Location	Directly connected to analyzer
Interfaces	QMH and QMA
Modules per system	2 maximum
Weight	0.15 kg

Power Supply	(Provided by QMH 800)
Voltage	±16 V (0.2 V, ≤10 mV ripple)
Current	±10 mA

5.7.1 Amplifier Specifications

Input/output	
• Input current	→ Table below
• Input impedance	100 kΩ
• Output voltage	-10 to 10 V
• Output current	≤2 mA
Drift	Offset doubling per 10°C temperature increase
Noise	Typically 2 × 10^{-13} A_{pp} (unfiltered)

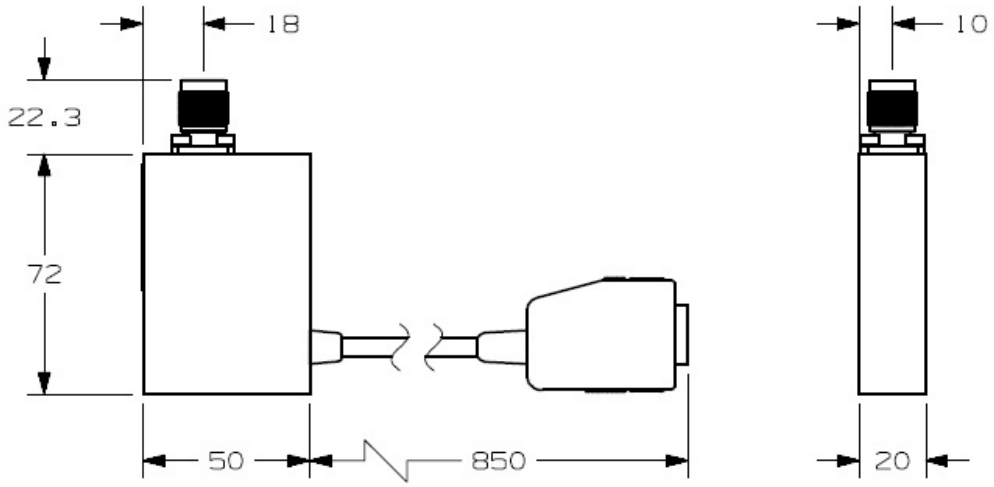
Range	Sensitivity	Tolerance at 25°C	Rise time 10-90%	Offset at 25°C
±10^{-5} A	10^{-6} A/V	±1%	50 µs	±0.5 mV
±10^{-7} A	10^{-8} A/V	±1%	90 µs	±0.5 mV
±10^{-9} A	10^{-10} A/V	±2%	1.9 ms	±2 mV
±10^{-11} A	10^{-12} A/V	±2%	2.6 ms	-50 to 150 mV

Connectors	
Input	Connector type: TNC coaxial connector
Output	D-sub 9-pin male connector

Ambient temperatures	
Storage	-40 to 70°C
Operation	0–50°C

5.7.2 Dimensions

The dimensions are 20 mm L × 50 mm W × 94.3 mm H.



5.8 RF Generator QMH 800



The QMH 800 RF generator generates the voltages required for operating a quadrupole mass filter:

- RF component with quartz-stabilized frequency
- Superimposed DC component

High-quality RF circuits ensure low power consumption and low self-produced heat. A constant-temperature oven keeps the temperature influences low. The QMH must be connected to a precision-matched RF load. This is done by connecting the analyzer using the supplied RF cables with accurately defined capacitance. Manufacturing tolerances can be compensated for. During operation and setup, the matching condition is monitored and signaled by means of indicator lights. The QMH is protected against overheating and destruction resulting from a mismatched RF load, a short circuit, or during no-load operation. The field axis potential is supplied externally. Connections ep1 (Faraday) and ep2 (SEM) are used to connect two EP 822 electrometer preamplifiers.

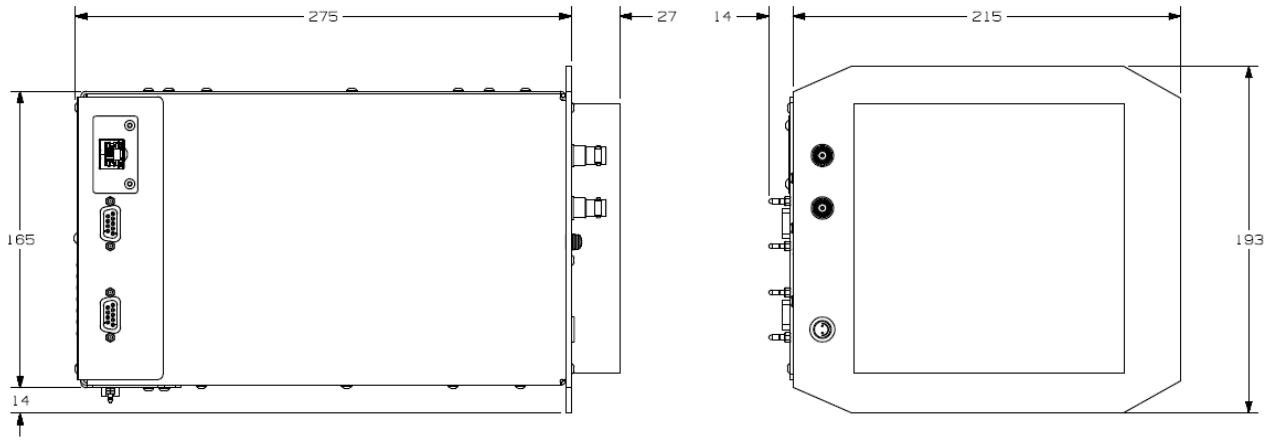
The QMS control unit supplies the power and control signals and contains the electronics for processing the electrometer signals. With the QMS control unit, the following functions of the QMH can be used:

- Mass number M (RF amplitude)
- Peak width ΔM
- RF OFF
- Electrometer range
- Electrometer signal 1 and/or 2

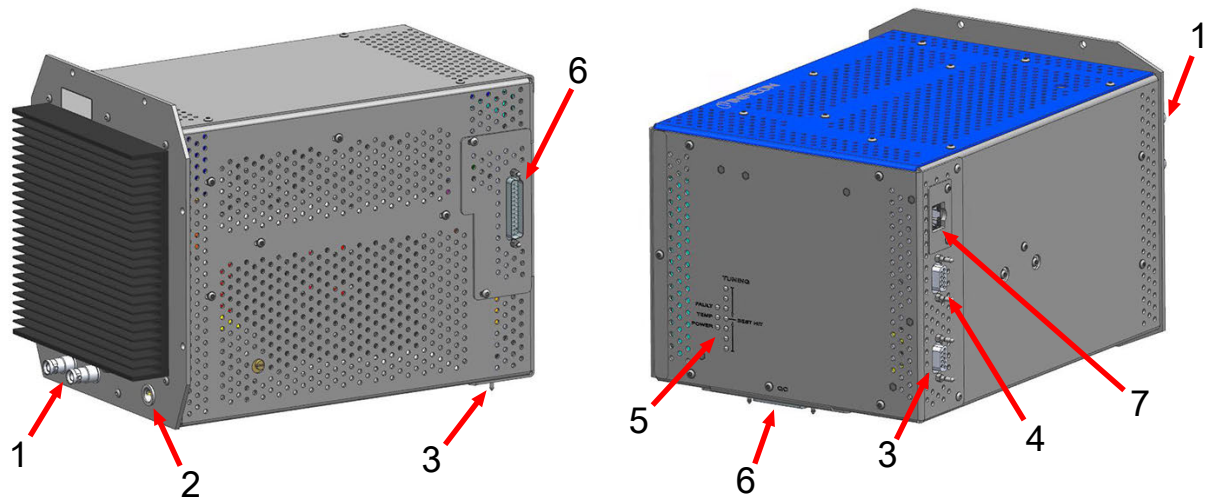
The instrument reports operational readiness or error status to the QMS control unit.

5.8.1 Dimensions

The dimensions are 302 mm L × 193 mm W × 229 mm H.



5.8.2 Structure



1	Connections for RF coaxial cables **RF+ and RF–**	5	**Tuning** indicator
2	Connection for field axis voltage **FA**	6	Connection for control unit **QMS**
3	Connection for electrometer pre-amplifier **ep2 (SEM)**	7	Connection for communication **LAN 2**
4	Connection for electrometer pre-amplifier **ep1 (Faraday)**		

5.8.3 Electrical Data

Frequency	2.25 MHz
RF amplitudes RF+, RF–	1.5–2350 Vp
DC- voltage (spectrum)	±0.5–394 V (DC)
DC voltage (integral)	±<0.5 V (DC)
RF load between RF+ and RF–	52 ± 3 pF
Admissible imbalance RF+/RF–	≤3 pF
RF load at cable ends l=0.7 m	34.5 ± 2
Admissible imbalance at cable ends	≤1 pF
Admissible loss factor of the RF load	≤0.0017
Apparent power of the RF load max.	8.1 kVA
Supply voltage	+24 ±0.5 / -24 ±0.5 V (DC)
Power input (with max. admissible detuning) • Oven cold • Oven warm • With RF OFF	 • ≤ 2.5 A • ≤ 2.3 A • ≤ 0.9 A
Inherent power dissipation, oven warm, with max. admissible detuning	≤100 W
Temperatures • Overtemperature[1)] of the housing surface • Self-heating time • Tripping threshold of the thermostatic overload circuit breaker	 • Typical 30°C, max. 35°C • ≈15 min (heat sink), ≈60 min (housing) • ≈100°C

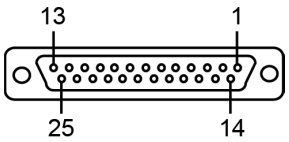
[1)] Overtemperature = increase relative to ambient air temperature

Field axis voltage FA	Max. admissible ±500 V; current must be limited to ±2 mA max.
Electrometer amplifier connections	Integrated power supply, range and signal selection remote controlled
Protection of the RF outputs	Against inadmissible detuning as well as no-load operation and short circuit
Output voltage in no load operation	Field axis potential + RF 50 Vp max.
Fuses	2.5 A slow, ø5×20 mm

5.8.4 Connections

5.8.4.1 QC Connections to QC 800 Control Unit

At the QMH 800 there is a D-sub 25-pin male connector to allow for a variable length connection to the QC 800 control unit.



Pin	Signal word[1)]	Signal direction[2)]	Level	Impedance
1, 2, 14	−24 V	IN	See Technical Data	Feed/supply
3, 15, 16	+24 V			
4, 6, 17, 19	0 V[3)]		GND	10 Ω (see chassis)
5	SCAN+[4)]		0–10.24 V	100 kΩ
18	SCAN−[4)]		0 V	
7	EP+[4)]	OUT	0 V	47 Ω
20	EP−[4)]		0 to ±16 V	
8	RESOL+[4)]	IN	0–10.24 V	100 kΩ
21	RESOL−[4)]		0 V	
9	RESERVE 1 H	IN	Digital CMOS[5)]	100 kΩ
10	RF OK L	OUT		2.2 kΩ
11	MODE 1 H	IN		100 kΩ pull down
23	MODE 2 H			
12	RANGE 0 H			
24	RANGE 1 H			
13	EP 2 H			
22	SCREEN	—	GND	33 Ω (see chassis)
25	RESERVE 2 H	IN	Digital CMOS[5)]	100 kΩ pull down

[1)] Signal word descriptions:

Signal word	Level	Function of QMH
SCAN±	0–10.24 V	MASS = (SCAN/10.24 V) × M_{max}
RESOL±	0–10.24 V	$\Delta M = \Delta M_{min} + (RESOL/10.24\ V \times \Delta M_{max})$
EP±	0 to ±16 V	Output signal of electrometer preamplifier (EP)

[2)] Signal directions:

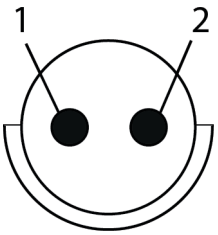
- IN = QMH is receiver
- OUT = QMH is transmitter

[3)] Line 0 V must have max. ±0.5 V_p against chassis GND.

[4)] Permissible common-mode signal: max. ±0.5 Vp for SCAN±, RESOL±, and EP±.

[5)] Digital CMOS level: L: 0–0.75 V (DC), H: 11.0–12.7 V (DC).

5.8.4.2 FA Connection to QMA



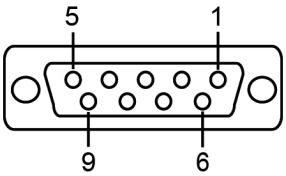
Pin	Signal word	Signal direction	Level	Impedance
1	FA	IN	Max. ±500 V / 2 mA_{max}	9 MΩ
2	Unassigned	—	—	—
Housing	GND	IN	GND, shielding	—

5.8.4.3 RF+/RF– Connections to QMA

Signal word	Signal direction	Level and load
RF+ and RF–	OUT	Adapted load
Housing	OUT	GND, shielding
Plug: coaxial, SHV		

5.8.4.4 EP Connection to EP 822

The connector for EP 822 is a D-sub 9-pin female connector.



Pin	Signal word	Signal direction[1)]	Level[2)]
1	EP GND	IN	0 V
2	+16 V	OUT	+16 V ± 0.2 V / 27 mA_{max}
3	0 V EP	OUT	EP GND
4	–16 V	OUT	–16 V ± 0.2 V / 12 mA_{max}
5	EXP 5 L	OUT	Digital
6	EP out	IN	0 to ±16 V
7	SCREEN	—	Chassis GND
8	EXP 7 L	OUT	Digital
9	EXP 9 L	OUT	Digital

[1)] Signal directions:

- IN = QMH is receiver
- OUT = QMH is transmitter

[2)] Digital level:

- L: 0–0.75 VDC
- H: 16.5–17.0 V (DC) with external pull-up >5 kΩ against +16 V
- The levels are relative to 0 V EP
- With the exception of EP OUT and EP GND, the two plugs are connected in parallel.

5.8.5 Operating Data with Quadrupole Analyzer

Analyzer type	QMA 400[1)]
Rod system	8 mm
Mass range M_{min} to M_{max} [2)]	0.5–512 u
Resolution setting range	
• Constant peak width remote controlled with RESOLUTION signal, ΔM_{10}	• 0.3–7 u
• Constant resolution, adjustable: resolution coarse, ΔM/M	• 0–2% (ΔM > 0.3 u)
• Resolution switched off, remote controlled, INTEGRAL, ΔM/M	• 1.3 (M >10 u)
• For lower masses, adjustable: resolution low, ΔM_{LOW}/M	• 0.1–1.3 ($\Delta M_{LOW} \leq \Delta M$)
Waiting time after set point jump	See Appendix A [▶ 75]
Error variables dM and dΔM at M_{max} [3)]	
Jump drift, $M_{min} \rightarrow M_{max}$	≈0.05 u
Long-time drift, per 100 h	≈0.03 u
Short-time drift, per 1 h	≈0.01 u
Temperature drift (ambient) per °C	≈0.01 u
Mech. shock, drift per 10 G	≈0.02 u
Linearity	See graph below of linearity deviation of M and ΔM_{10}

1) With QMA 430 the specifications apply only up to mass 300.

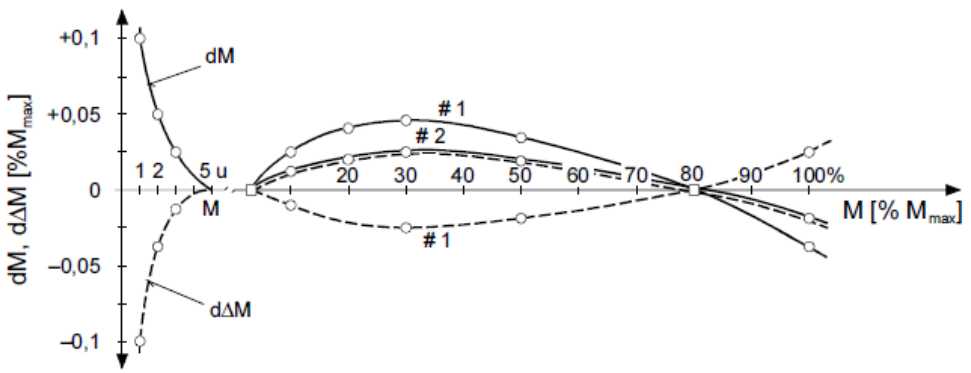
2) Full peaks up to M_{max} – 1 can thus be represented.

3) Without tuning error, stability error, nonlinearity of the control signal, measured with QMA 400 (see Appendix B [▶ 76] for measurement method).

The error variables relate to voltage values of RF and DC component; they have been adjusted to mass units in order to make them more understandable.

The power-on drift of the analyzers (EMISSION with cold analyzer set to «ON») of dM = approx. -0.02 %/h during 4–5 h, as well as additional influences of the analyzer, have not been taken into consideration in the information on the error variables dM and dΔM (see #1 in graph below).

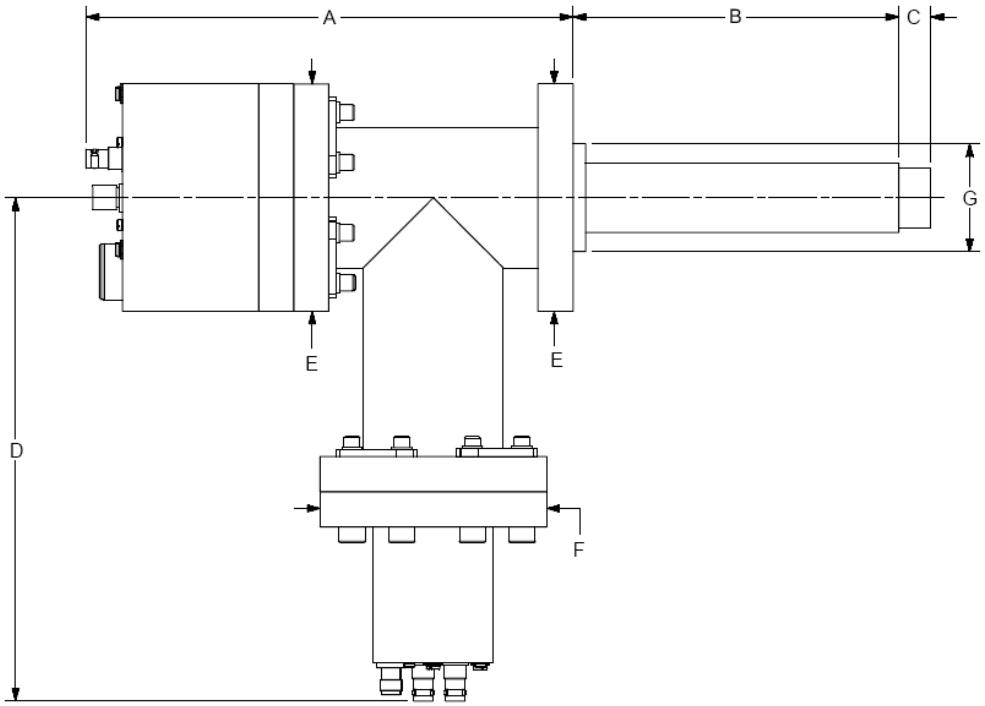
The heating of the QMA by the applied RF power increases by a power of 2 relative to the mass number and therefore becomes relevant only in the upper third of the mass scale (see #2 in graph below). It has about the same effect as the heating by the ion source.



5.9 Analyzer QMA 4x0



5.9.1 Dimensions and Weight



Dimensions are given in millimeters.

	QMA 400	QMA 430
A	244	244
B	162	162
C	[1]	[1]
D	251	251
E	DN 63 CF	DN 63 CF
F	DN 63 CF	DN 63 CF
G	Ø63	Ø63
Weight	10.7 kg	10.7 kg

[1] See Ion Sources and Gas Connections [▶ 46].

5.9.1.1 Ion Sources and Gas Connections

Dimensions are given in millimeters.

Ion Sources	C	H[1)]
Axial	26	—
Cross-beam (CB)	35.5	23.5
CB gas tight[2)]	48[3)]	23.5
Grid	27	—

[1)] H is the distance to the center of the sensitive volume.

[2)] With axial gas connection.

[3)] Without gas admission line (outer diameter of gas admission line is 3 mm).

Gas Connections	
CB gas tight 1 axial connection	Bore in glass ceramic for tube with outer diameter 3 mm

5.9.2 Analyzers QMA 400 and 430

The installation instructions for the analyzers QMA 400 and 430 are described in detail in a separate operating manual: QMA 4x0 for QMG 800 Operating Manual (074-832-P1-A).

⚠ CAUTION

Users should read the QMA 4x0 for QMG 800 Operating Manual (074-832-P1-A) before attempting to install or run the analyzer QMA 4x0.

6 Installation



⚠ WARNING

If the product presents any visible damage, do not put it into operation and make sure it is not inadvertently put into operation. Use of damaged equipment can be extremely hazardous.



⚠ WARNING

The local line voltage ratings must correspond to the nominal voltage of the product (→ product nameplate). A 3-conductor power cable with protective ground must be used. The power outlet must have a protective ground contact. Extensions without protective ground conductor are inadmissible.

To ensure continuity of the protective ground, always connect the power cable before all other cables. Conversely, unplug all other cables before the power cable. Do not yet switch on the equipment.



⚠ CAUTION

When installing the product, make sure it is properly secured in case of a seismic event.

⚠ CAUTION

Make sure all screws and strain reliefs are tightened to ensure reliable contact of connectors.

6.1 QMG 800 Overall System

Install the analyzer in accordance with the information in the respective operation instructions.

All components involved must be grounded to a single point. Utilization of a single power distributor is recommended. The only exception is the PC.



⚠ CAUTION

Ensure that the QMA, vacuum chamber, and equipment are always connected to the protective ground.

Hazardous voltages up to 600 V (DC) are present on the QMA. If this unit can be touched by the user when the vacuum system is open, additional protection is required, for example:

1. mechanical protection against contact
2. forced disconnection of the QMG 800 line voltage by means of a door contact

The electrode system of the QMA must not be subjected to hazardous external voltages (from direct contact, arcing, plasma, ion or electron beams, etc.). If such danger hazards exist in the vacuum system, appropriate protection measures must be taken (arrangement of components, shielding, grounding, etc.) that reliably preclude such influences.

Refer to the standards applicable to your system.

When the QMA is in operation, hazardous voltages up to 600 V (DC) are present. Under unfavorable conditions, other built-in components in the vacuum chamber (e.g., gauge heads) can be subjected to this voltage. If, as a result, such components become dangerous to touch (also take into consideration the lines and the connected equipment), they must be arranged or protected in such a way that no contact, no arcs, and no charge carrier flow can occur.

6.2 Installation of QMS 800

QMS 800 can be built into a 19-inch rack frame or alternatively can be used as a desktop unit.

6.2.1 Rack Installation

QMS 800 is designed for installation in a 19-inch rack frame according to DIN 41 494 standard.

⚠ WARNING

Ensure adequate air circulation.

In rack installations, the temperature inside the rack must not exceed 40°C. The air filters inside the unit should be periodically checked and serviced.



⚠ CAUTION

Protection category of the rack

If the product is installed in a rack, it is likely to lower the protection category of the rack (protection against foreign bodies and water), for example, the IEC 60204-1 regulations for switch cabinets. Take appropriate measures for the rack to meet the specifications of the protection category.

6.2.2 Use as a Desktop Unit

For use as a desktop unit, four plastic feet (supplied with the unit) have to be fitted to the bottom panel of the unit.

⚠ WARNING

Ensure adequate air circulation.

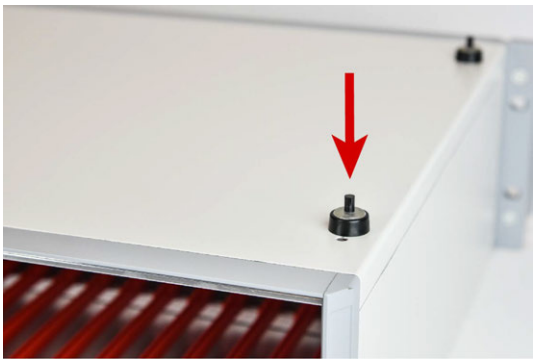
In desktop installation, the air should be able to enter through the front panel inlets and exit through the rear panel slots without obstruction. The air filters inside the unit should be periodically checked and serviced.

6.2.2.1 Installation of Plastic Feet

1. Turn the unit over and insert the plastic feet into the four holes as shown.



2. Push in the protruding plastic pins completely with a screwdriver handle or a similar tool of appropriate size.



3. The feet are now locked in the bottom plate. Turn the unit back to the upright position.

6.3 Installation/Replacement of Modules in QMS 800



⚠ WARNING

Work on an open unit may only be performed by trained personnel.

Switch off the unit before any manipulations on the equipment. Wait 60 seconds and detach all cables (power cable last). For commissioning, perform these steps in reverse order.

⚠ WARNING

Work may only be performed on electrostatic discharge (ESD)-protected benches while observing appropriate working methods.

The modules should always be stored in anti-static packages. Defects caused by the disregard of this warning will void the warranty.

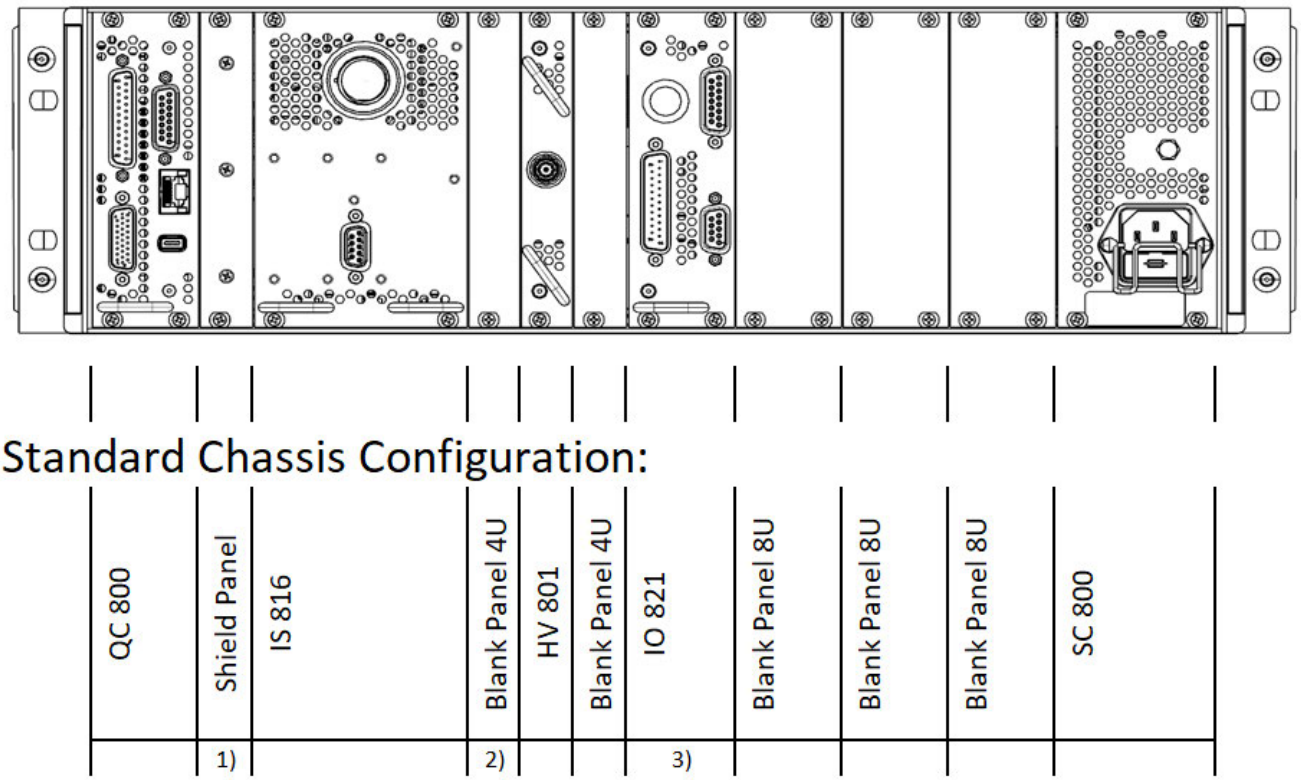
Required Tool

- Pozidriv screwdriver, size 1

Modules are installed in the order shown below (standard configuration).

All screws must be tight for a firm mechanical support and reliable electrical contact.

Unused slots must be covered with correctly fitted blank panels to ensure safety and adequate ventilation of the unit.



1) Always install a shield between QC 800 and IS 816.

2) Always install a blank panel to the right of the IS 816.

3) If the optional IO 821 is not equipped, the slot must be covered by one blank panel (8U).

6.4 Electrometer Preamplifier EP 822

The EP 822 is located directly at the analyzer.

1. Connect the EP 822 into the corresponding connector at the QMA, located at the SEM217 (ep2) and/or the Faraday cup (ep1).
2. Make sure the EP 822 is not touching adjacent connectors.
3. Fasten the knurled nut.
4. Connect the control cables to the connectors ep1 and/or ep2 at the QMH 800.

NOTICE

For optimum signal stability, the EP 822 must be protected from vibrations, temperature fluctuations, high temperature, humidity, and strong magnetic alternating fields.

6.5 Analyzers QMA 400 and 430

The installation instructions for the analyzers QMA 400 and 430 are described in detail in a separate operating manual: QMA 4x0 for QMG 800 Operating Manual (074-832-P1-A).

⚠ CAUTION

Users should read the QMA 4x0 for QMG 800 Operating Manual (074-832-P1-A) before attempting to install or run the analyzer QMA 4x0.

6.6 RF Generator QMH 800

⚠ CAUTION

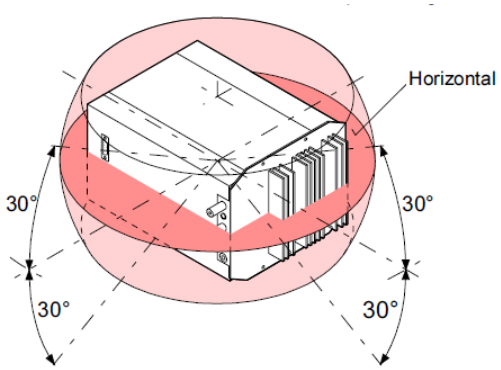
Do not operate or store the RF generator in an environment that is subject to dust, high humidity, mechanical vibrations, and extreme fluctuations of the ambient temperature.

For maintenance and cleaning instructions, see Maintenance of RF Generator [▷ 71].

6.6.1 Installing the QMH 800

Mounting plane

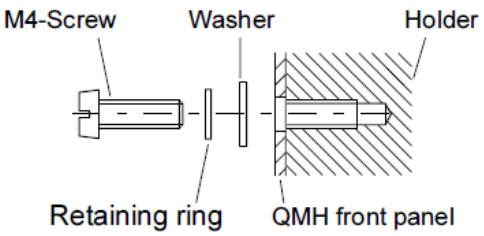
Install the QMH horizontally or with a maximum inclination of 30° in a vibration-free location. The distance to the QMA can be ≈ 0.5 m (cable lengths 0.7 m).



With the holder belonging to the QMH, the QMH can be fastened to the flange. If possible, mount it in such a way that the indicator lights on the back are easily visible.

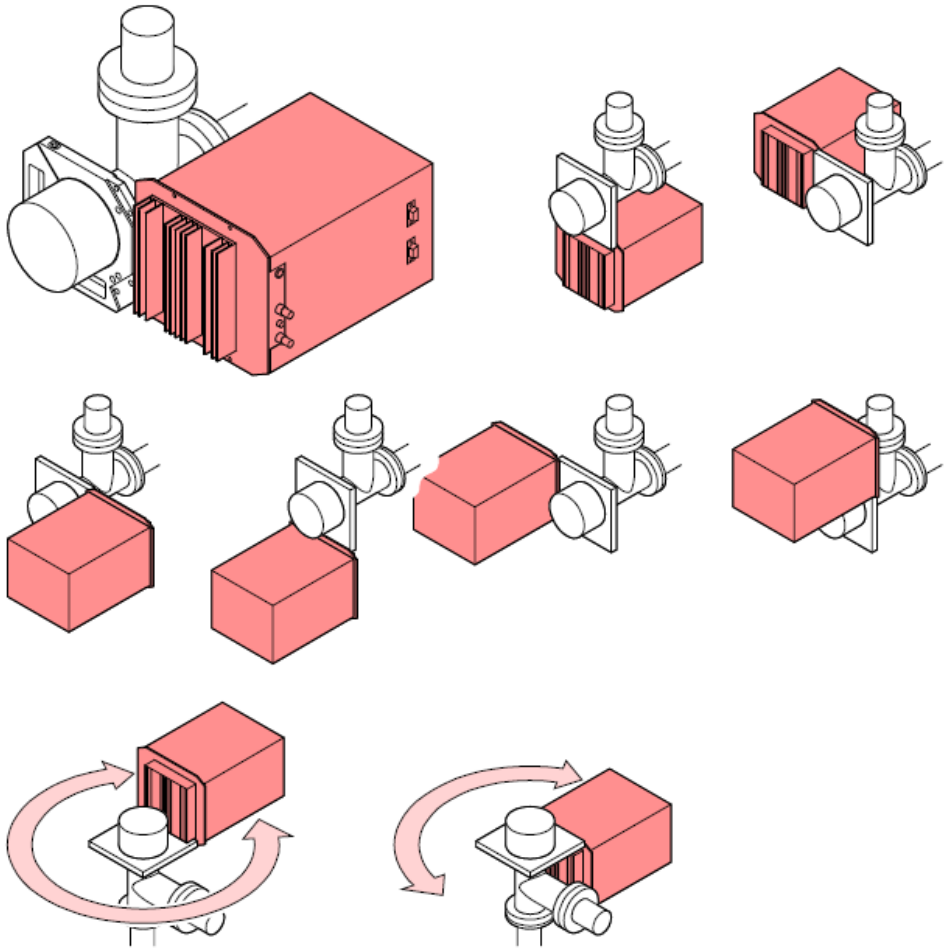
Installation with holder

It is advantageous to preinstall the holder to the QMH on a workbench as follows:



Now mount the pre-assembled unit to the QMA.

The holder is also suitable for mounting the EP 822.



Temperature conditions

The air surrounding the RF generator should not get hotter than 50°C during operation (measured at a distance of 30 cm).

The air circulation must not be obstructed. If the unit is installed in additional housings, corresponding precautions should be taken.

To achieve optimum measurement accuracy, avoid temperature fluctuations.



⚠ CAUTION

If water or coolant hoses are routed in the vicinity of the RF generator, drip or splash water protection should be provided.

6.6.2 Electrical Connections

6.6.2.1 Ground Connection

The housing of the RF generator must be connected to ground. If the RF generator is mounted with the holder to a properly grounded QMA flange this requirement is fulfilled.

If other mounting methods are used or if the flange of the QMA is not reliably grounded, the QMG must be connected to the protective ground at the M4 screw identified with ⏚. Establish this ground connection with a yellow/green or uninsulated, stranded copper lead:

- 2.5 mm^2 if mechanically protected (DIN VDE 110T540)
- 4.0 mm^2 if not protected

Make sure the contact is vibration-proof and use washers and locknuts.

For trouble-free operation a single, central ground point for all interconnected subsystems (pumping station, controller, computer, recording devices, etc.) is urgently recommended. A common power distributor is highly suitable for this purpose.



⚠ CAUTION

The maximum admissible voltage between the QMH and the controller housing is 0.5 V_{peak}.

6.6.2.2 Control Cable QC



⚠ CAUTION

Plug in and detach the QC control cable of the QMH only when the controller is turned off.

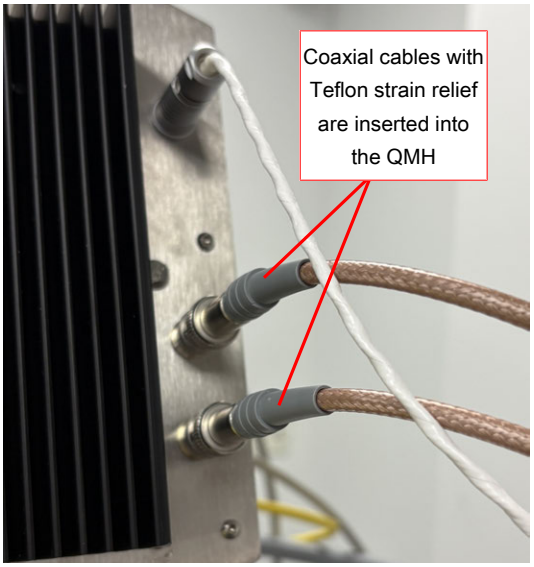
6.6.2.3 Cable RF+, RF-

Connect the RF+ and RF- sockets of the QMH via the two supplied 0.7 m coaxial cables to the RF A and RF B sockets of the QMA.

If the polarity is important, this is indicated on the supplied test report.

Only cables supplied by INFICON with a fixed length and capacitance may be used.

Insert the plug equipped with a gray Teflon® strain relief into the QMH to ensure bakeability there.



⚠ CAUTION

Remove electronics before bakeout of temperatures above maximum operating temperature.

⚠ CAUTION

Ensure that the cables are not kinked. If the cables are too short, change the installation arrangement.

⚠ CAUTION

The electrode system of the QMA may not be subjected to hazardous external voltages (due to contact, plasma, ion or electron beams, etc.).

If such sources of danger exist in the vacuum chamber, protective measures (better arrangement, shielding, ground connection, etc.) must be taken that reliably preclude such influences.

⚠ CAUTION

Low, weak external voltages can damage the electronics or lead to unreliable measurement results.

Take protective measures to preclude such influences.

6.6.2.4 Field Axis Voltage FA

Normally you connect the FA sockets to the QMH and QMA by means of the supplied cables. In this way, the field axis voltage is supplied via the ion source cable to the controller. The FA voltage setting is specified in the test report of the overall system.



⚠ CAUTION

For safety reasons, the external FA voltage must be limited to a maximum of 2 mA.

If you do not use the supplied cable, a shielded cable is needed. The shield is to be connected to the housing (refer to FA Connection to QMA [▶ 43]).

6.6.2.5 Electrometer Amplifier ep1, ep2

For measuring with the Faraday cup (positive ions), connect the electrometer amplifier (that fits your controller) to ep1 (faraday).

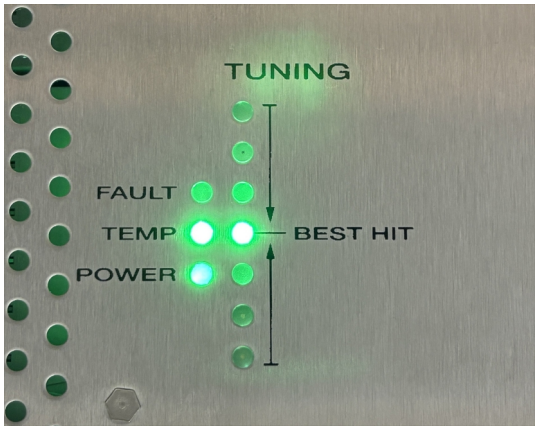
NOTICE

If EP1 Faraday connection is not installed, the ground cap must be installed for proper function.

For measuring an SEM signal, connect it to ep2 (sem).

Both electrometer amplifiers may be connected simultaneously.

6.6.3 QMH 800 Status Indicators



QMH 800 has several external status indicators.

Indicator name	Description
POWER	QMH present power level (intensity varies as system scan across mass range)
TEMP	RF oven at operational set point (READY)
FAULT (RED)	QMH in faulted state (power too high, temperature too high)
BEST HIT	Best possible resonance adjustment (set at mid-scale; 150 AMU for 300 AMU full scale; 250 AMU for 512 AMU full scale)
TUNING	Indicates extent of resonance operating left and right of ideal resonance (best hit)

Note that the resonance is set at factory by adjustment of the air capacitor:

- Set at 150 AMU for 300 AMU full scale; set at 250 AMU for 512 AMU full scale
- Adjusted for minimum power (11.5–12.5 W)
- Matched voltage 2.5 V (±0.5 V)

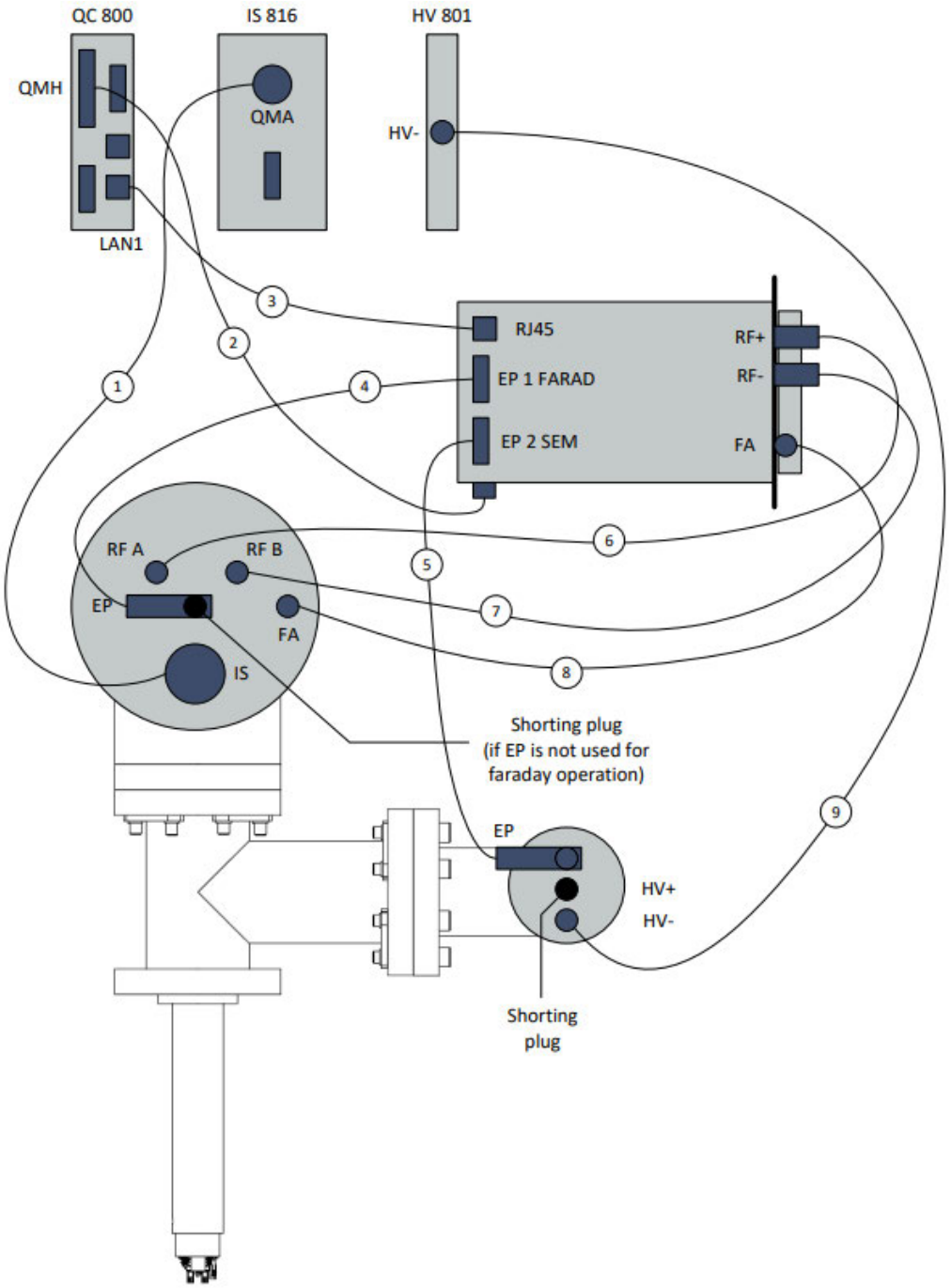
6.7 System Wiring

Required Cables

	Description	Length	Part Number
1	Interconnection IS 816 to QMA 4x0	1.5 m	600-1665-P1S
		3 m	600-1665-P3S
		10 m	600-1665-P10S
2	Interconnection QC 800 to QMH 800	1.5 m	600-1653-P1S
		3 m	600-1653-P3S
		10 m	600-1653-P10S
3	Communication interconnection (Ethernet) QC 800 to QMH 800	1.5 m	600-1654-P1S
		3 m	600-1654-P3S
		10 m	600-1654-P10S
4	Interconnection EP 822 (1) to QMH 800	0.85 m	Permanently fixed to the EP 822
5	Interconnection EP 822 (2) to QMH 800	0.85 m	Permanently fixed to the EP 822
6	RF interconnection QMH 800 to QMA 4x0	0.7 m	450-990
7	RF interconnection QMH 800 to QMA 4x0	0.7 m	450-990
8	Interconnection QMA 4x0 to QMH 800	0.7 m	BG541962-T
9	Interconnection HV 801 to QMA 4x0	1.5 m	600-1656-P1S
		3 m	600-1656-P3S
		10 m	600-1656-P10S

Required Plugs

Description	Part Number
EP shorting plug (type TNC)	B4728138BC
HV shorting plug (type SHV)	B4728891B9



6.8 PC Connection

Since the QMS 800 does not have a local control panel, it is operated via a personal computer (PC) interface or as a device in a network. The QMS 800 can be connected to a PC or network via the LAN interface on the QC 800 module. Use the RJ45 Ethernet cable supplied with QMS 800 or equivalent to establish communication.

7 Operation

7.1 Initial Start-Up



⚠ WARNING

Verify the correct installation of all system components and compliance with technical data before equipment is switched on.

7.1.1 Before Start-Up

NOTICE

Consult operating instructions of all system components involved before you start up the system.

Before the system is started, check the following:

- Mains switch of QMS 800 is in the OFF (O) position
- Correct installation of all system components and modules
- Correct condition of vacuum/process chamber
- Correct wiring of system components
- LAN link to PC (directly or via network) installed
- Mains cable to QMS 800 installed
- PC ready for operation according to software instructions

⚠ CAUTION

In complete (factory configured) systems, settings and parameters have been optimally aligned. Do not change them unfounded.

7.1.2 Switching On

After the conclusion of the checks listed above, the system can be switched on.

1. Switch the mains switch on the QMS 800 front panel to ON (I). The DC indicator next to the mains switch will illuminate.
2. After a waiting time of 5 minutes or less, the green TEMP indicator on QMH 800 will illuminate.
3. Turn the PC on and start the FabGuard application software. A flickering yellow light in the RJ45 LAN connector socket (QC 800 rear panel) indicates that data communication is in progress.

NOTICE

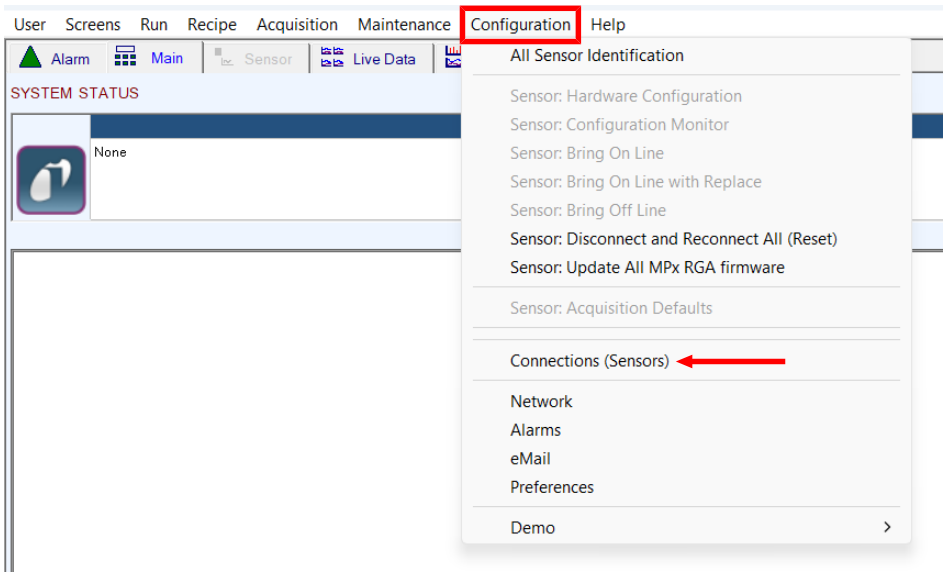
If this indicator remains dark, a communication error has to be suspected. In this case, check the cables and components along the communication path. Also check the PC for correct configuration and installation (application software, firewall status, etc.).

4 FabGuard will then guide the user through the subsequent steps of the start-up procedure (configuration, measurement range, etc.).

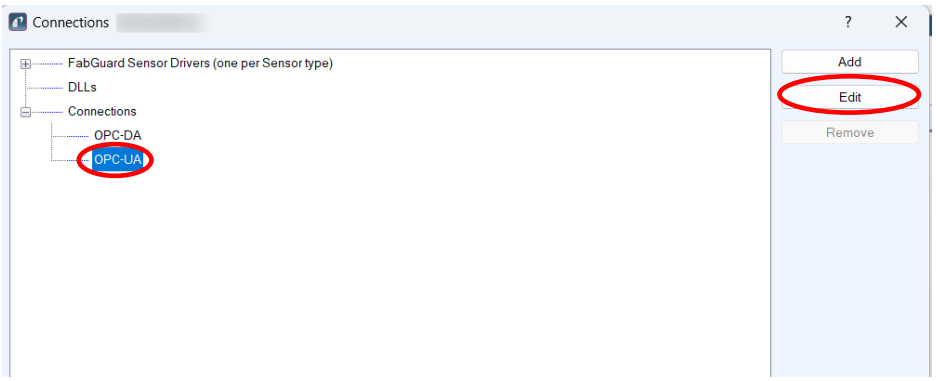
7.2 Connecting QMG 800 to FabGuard Software

Upon opening FabGuard application software, the user can follow these steps to create a connection between the hardware and the software:

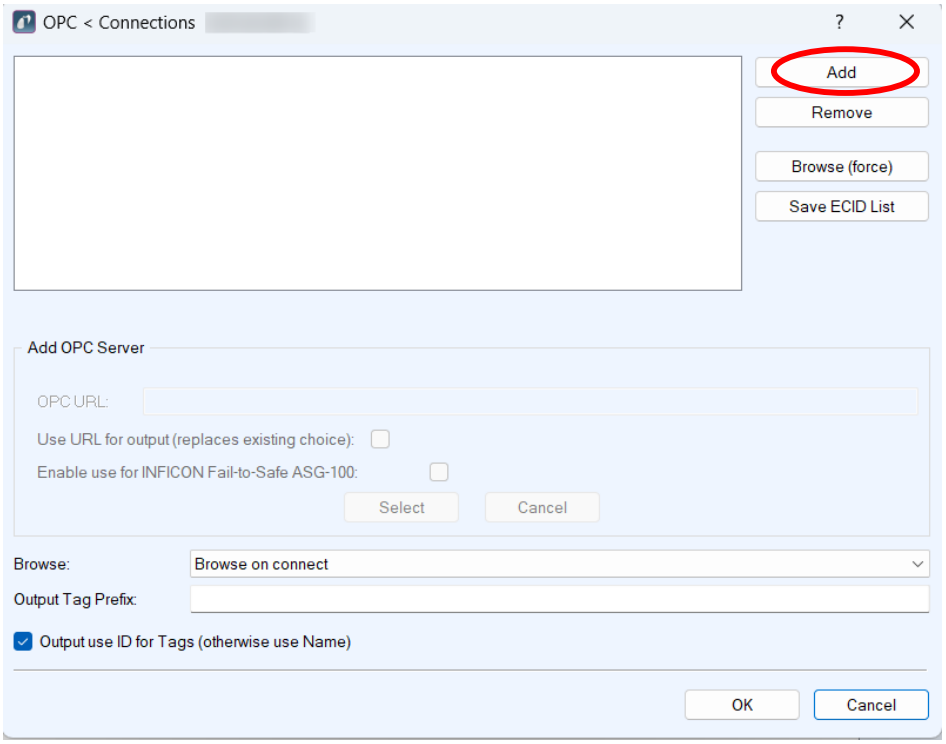
1 In the top menu bar, click **Configuration > Connections (Sensors)**.



2 In the Connections window that opens, select **OPC-UA**, click **Edit**, and then click **Yes**.

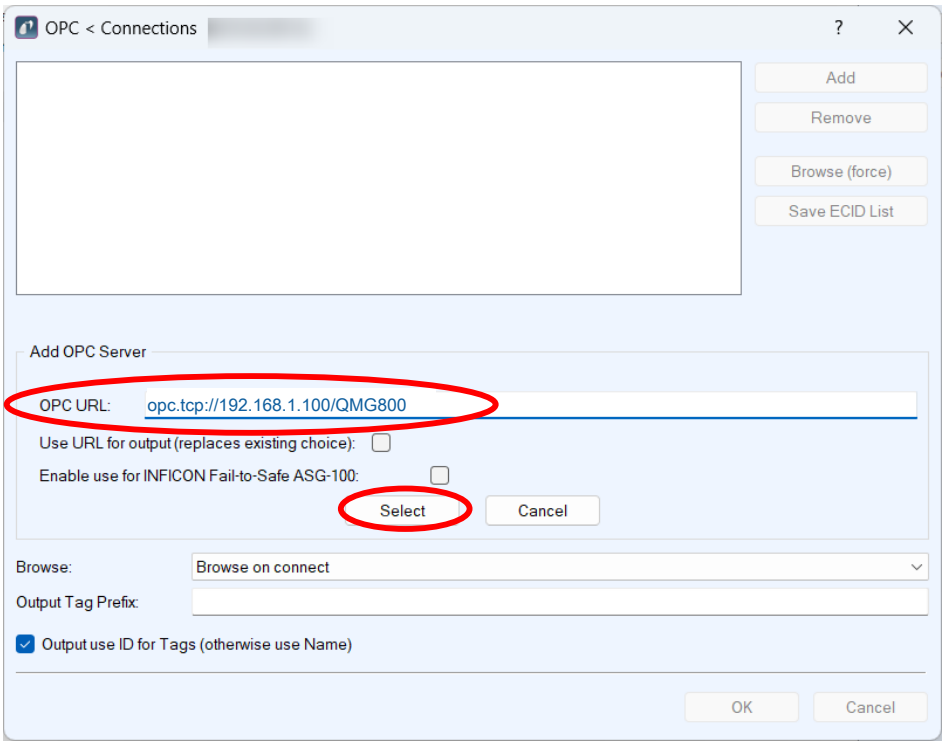


3 In the OPC < Connections window that opens, click **Add**.



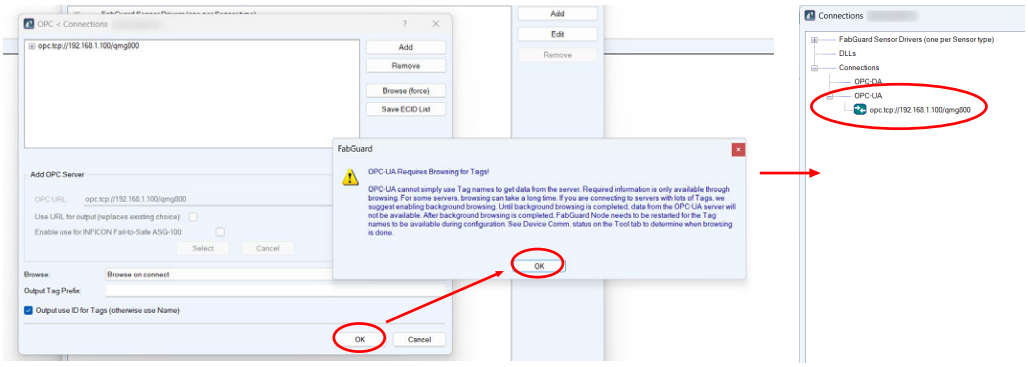
4 Enter the OPC URL. This should look something like "opc.tcp://*<IP Address of System>*/QMG800." Click **Select**.

⇨ The factory default IP address is 192.168.1.100.



5 Click **OK** and then click **OK** in the alert window that opens.

⇨ If connection is established properly, a blue connection symbol will appear next to the added connection.



NOTICE

If the connection fails, check that QMG 800 is networked properly with the FabGuard computer (see General Networking Information [▷ 62]).

7.3 Safe Mode

QMG 800 has Safe Mode to prevent plasma creation in the vacuum chamber that the sensor is exposed to. When Safe Mode is enabled, the filament and the SEM are disabled. All ion source voltages are set to 0 and their respective power supplies are disabled.

Additionally, Safe Mode disables the high voltage supplies in the QMH 800.

In order to operate the QMG 800, Safe Mode must be turned off (see QMG 800 Extra Functions [▷ 66] for information on how to enable/disable Safe Mode).

7.4 General Networking Information

QMG 800 communicates via Ethernet. Devices on an Ethernet network have two identifying addresses: an IP address and a MAC address.

- IP addresses are assigned to identify individual devices on a network. Each device on an Ethernet network, including the host computer, must have a unique IP address. IP addresses can be reassigned to other devices on the network as long as each device has a unique IP address.
- MAC addresses are unique for each device. MAC addresses are never duplicated.

7.4.1 IP Addresses

IP addresses can be either static or dynamic.

- Static (manual) IP addresses are set by the user and are changeable by the user. Static IP addresses are preferred.
- Dynamic (automatic) IP addresses are automatically set by a host or by a server on a network. Dynamic IP addresses can be set through dynamic host communication protocol (DHCP).

When using static IP addresses on a large network (for example, on a company network), a block of addresses should be reserved for static IP address use and prohibited from being assigned by the DHCP server (host). This will avoid duplicate IP address conflicts.

⚠ CAUTION

Use static IP addresses with QMG 800. Using DHCP, the host server may generate a new IP address if QMG 800 is taken offline and then returned online or if there is an IP address conflict on the network.

If the QMG 800 IP address is randomly changed during data acquisition, FabGuard will not reconnect to the new sensor IP address. This will result in a loss of communication and a loss of data.

QMG 800 follows the IPv4 IP address convention. An example IP address is 192.168.1.100. Each of the four parts is referred to as an "octet." The IP address consists of a network prefix and a host protocol.

7.4.2 Subnetworking

An IP network can be split into multiple subnets. Subnetting sets a region of the IP address as a network prefix for all IP addresses inside the subnet through a subnet mask. The subnet mask determines which octets of the IP address are used as the network prefix.

In order for two network devices to communicate, they must be on the same subnet, be connected to the same internet network and have the same network prefix.

If two devices have different network prefixes, the two devices are on different subnets.

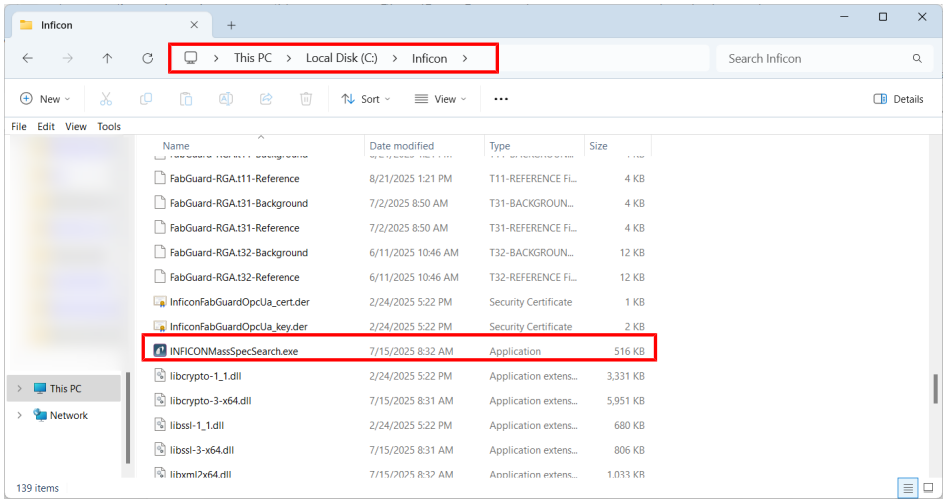
	Example 1	Example 2	Example 3
IP address	192.168.1.104	192.168.1.105	192.168.1.150
Subnet mask	255.255.255.0	255.255.0.0	255.255.255.192
Network prefix	192.168.1.0	192.168.0.0	192.168.1.128
Host protocol	0.0.0.104	0.0.1.105	0.0.0.22

7.5 Using INFICON Mass Spec Search Utility (IMSSU)

The INFICON Mass Spec Search Utility (IMSSU) is helpful in locating active QMG 800 systems connected to the network regardless of IP address. It is installed upon installation of FabGuard software and can be found following the steps below:

1 Navigate to the location where FabGuard was installed.

⇨ INFICON recommends installing FabGuard software directly to the PC's Local Disk (C:) under a folder called "Inficon."

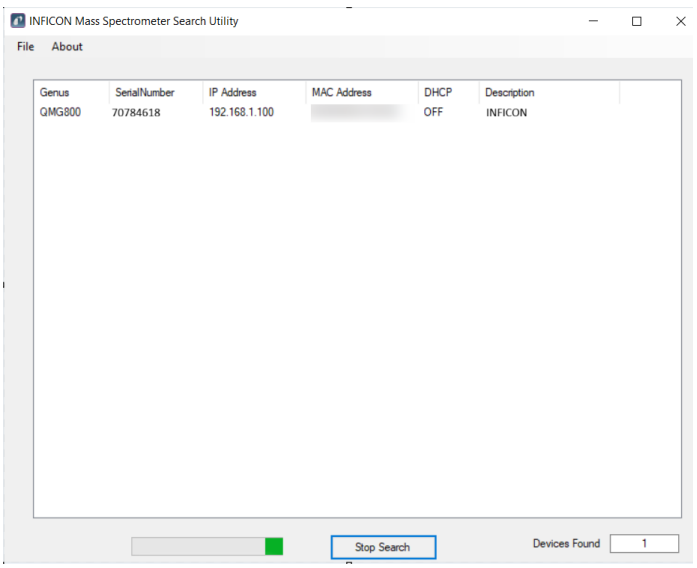


2 Double-click the INFICONMassSpecSearch.exe file to launch the application.

You can also use the Windows search function to quickly find the application instead of manually navigating to it.

3 Upon launch, the search utility will attempt to locate any INFICON system connected to the PC.

⇨ From here, the user will be able to perform a few different operations, such as updating the IP address, subnet mask, and gateway of the QMG 800 system.



NOTICE

If the search utility states that no systems are found, click the Stop Search button at the bottom of the screen. Click Search (Clears List) to restart the search.

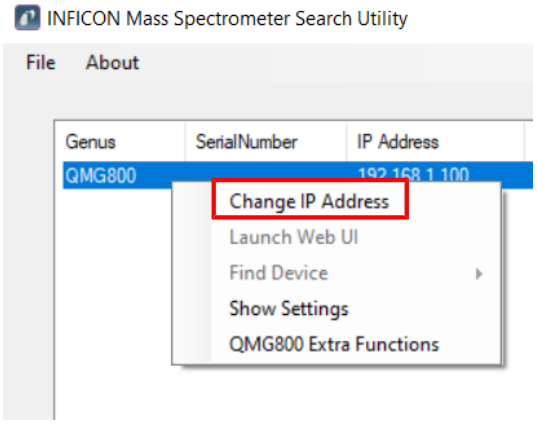
7.5.1 Changing the IP Address

The default QMG 800 IP address is 192.168.1.100 with a subnet mask of 255.255.0.0.

NOTICE

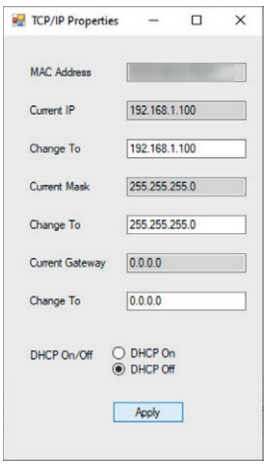
When connecting to an existing local network, there must be a static IP address for each QMG 800 RGA. Contact the network administrator for IP address assignments.

1 In the IMSSU, right-click on the instrument name and select **Change IP Address**.



2 In the TCP/IP Properties window, enter the desired data following IPv4 protocols (as described in Subnetworking [▷ 63]) in the “Change To” fields.

⇨ Keep the “DHCP On/Off” setting selected as “DHCP Off” to prevent the IP address from being automatically reassigned.



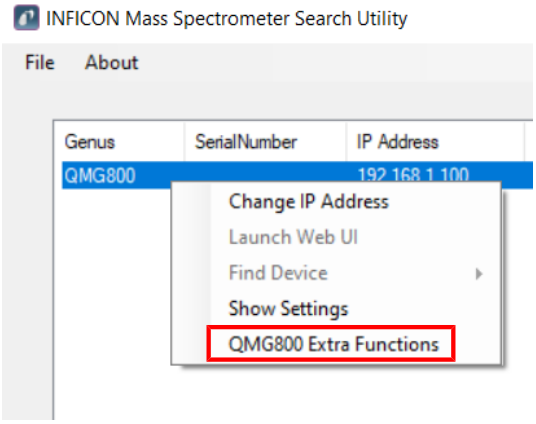
3 Click **Apply**.

4 Power cycle the device to apply the IP address to the system.

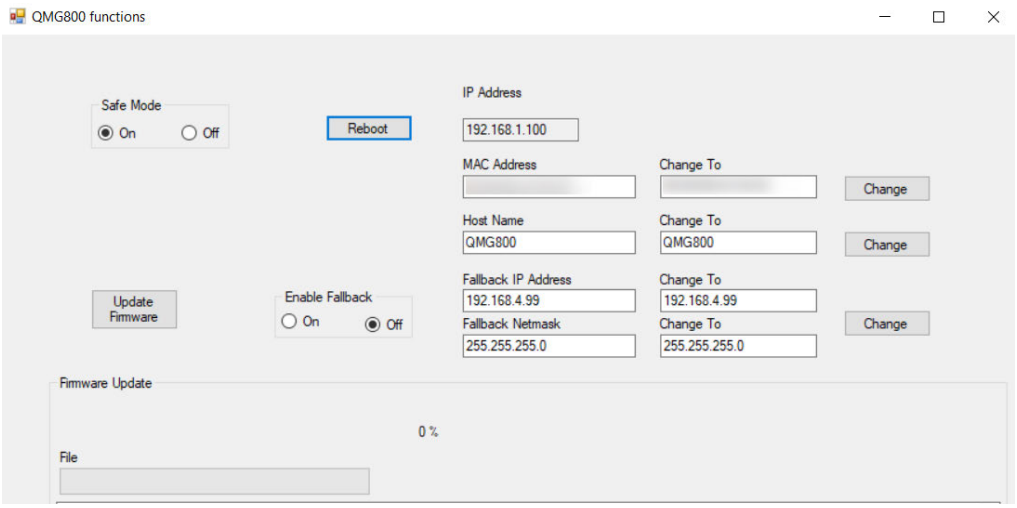
7.5.2 QMG 800 Extra Functions

The QMG 800 system has an extra functions option in the search utility to provide the user with more configurability.

1 In the IMSSU, right-click on the instrument name and select **QMG800 Extra Functions**.



2 In the QMG800 functions window, the user may access additional features, including the ability to update the IP address, turn Safe Mode On and Off, and update the system firmware.



NOTICE

INFICON recommends Safe Mode remain turned "On" unless the system is in operation.

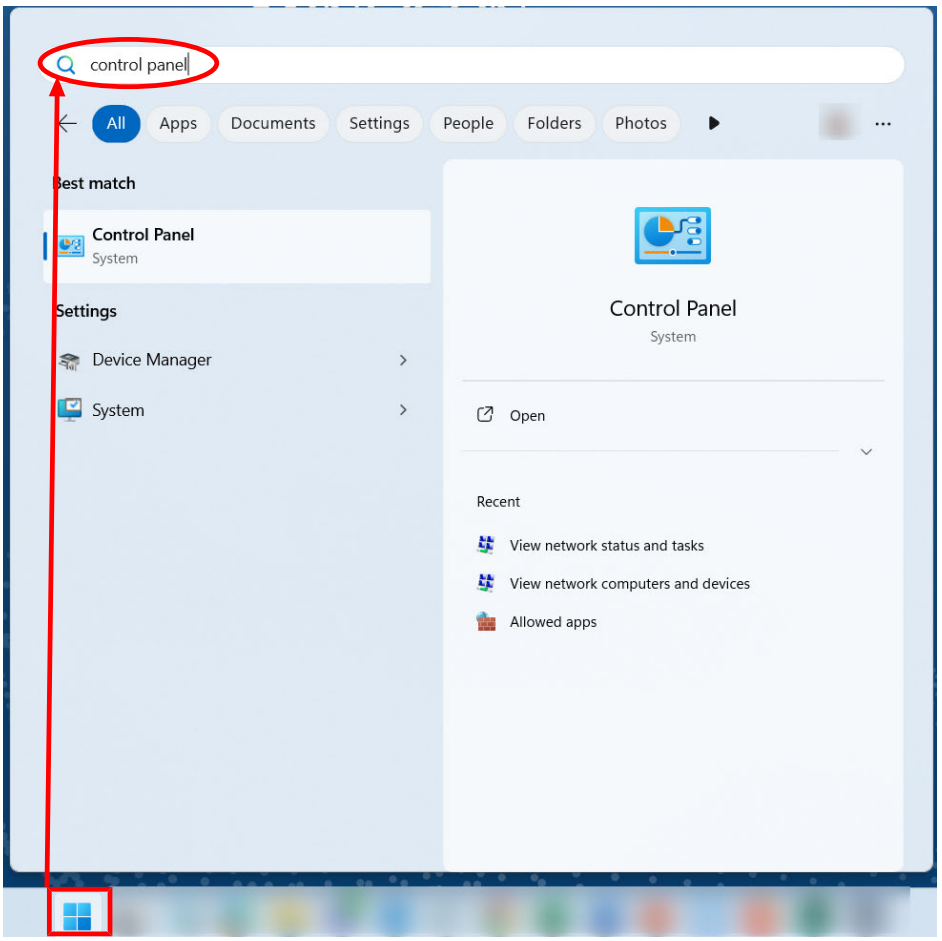
7.6 Change the Computer IP Address

An alternative to changing the QMG 800 IP address is to change the host computer's IP address to allow communication between the host computer and QMG 800.

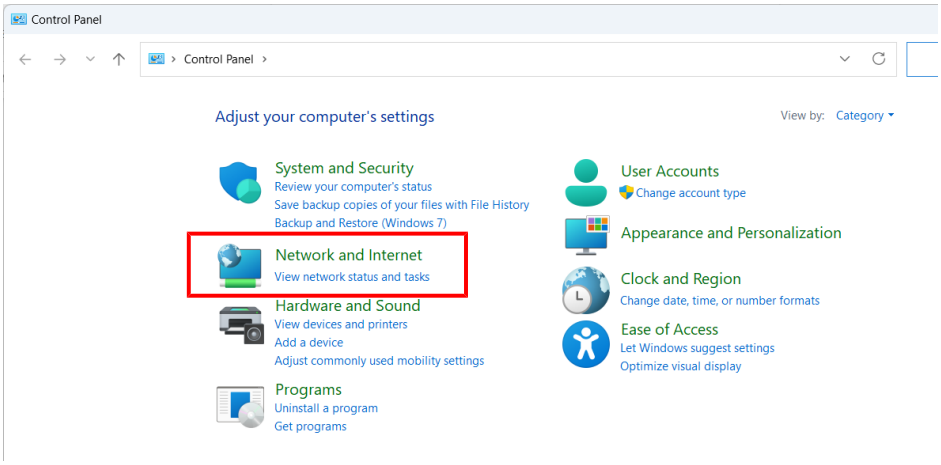
To change the computer's IP address in Windows® 10 or 11, follow the steps below:

✓ Changing the IP address of the host computer requires administrator rights.

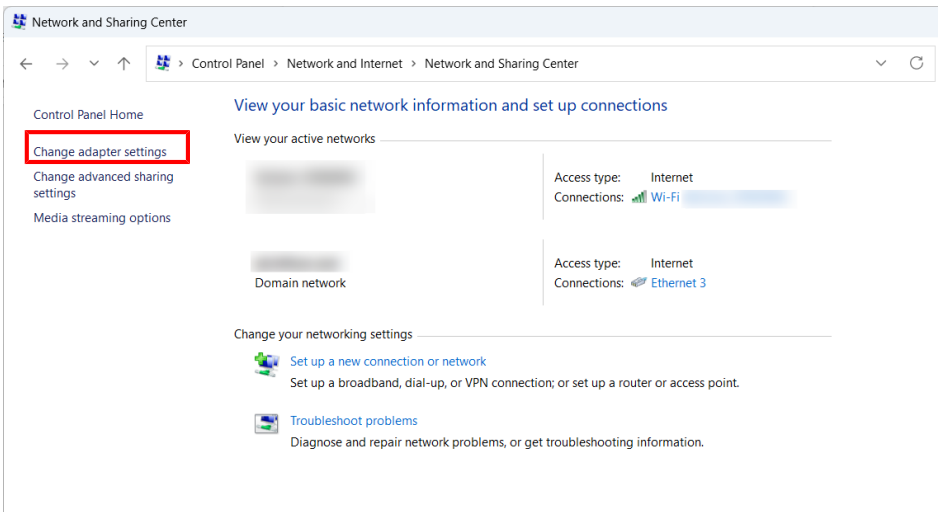
1 Use the Windows search bar (located either in the main toolbar next to the Start icon or available by clicking the Start icon) to search for the Control Panel application. Open the Control Panel application.



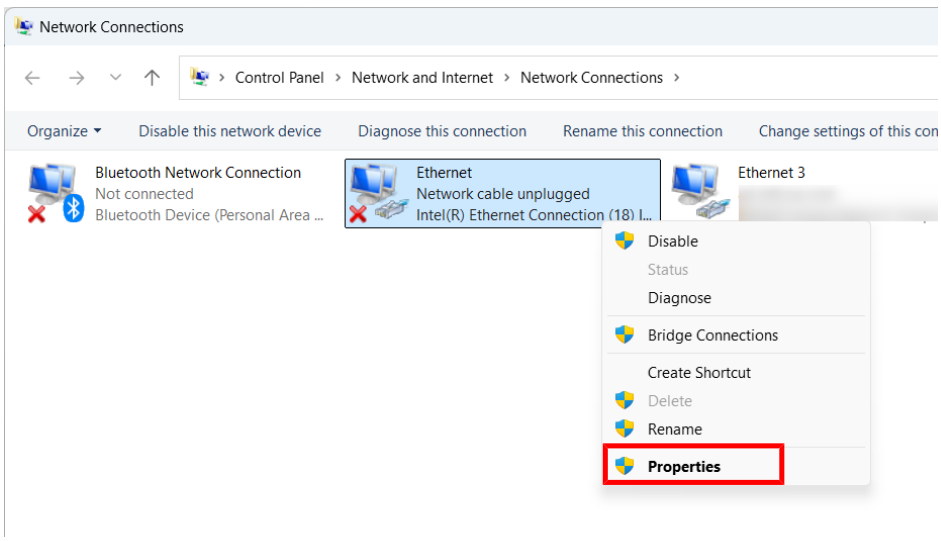
2 Under "Network and Internet," click **View network status and tasks** to open the Network and Sharing Center.



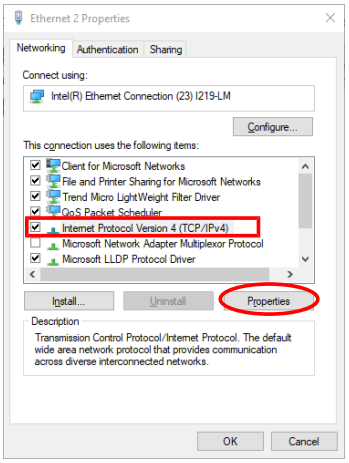
3 In the left-hand menu, click **Change adapter settings**.



4 Right-click on the Ethernet connection for QMG 800 and select **Properties**.



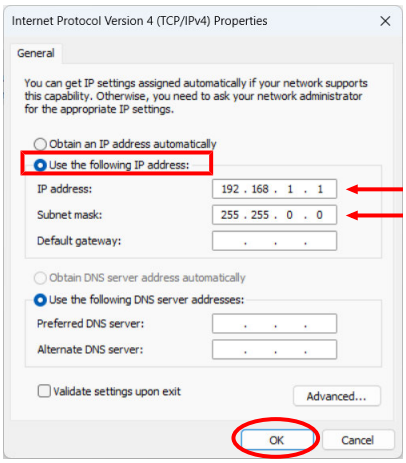
5 Select **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties**.



6 In the Internet Protocol Version 4 (TCP/IPv4) Properties window, select **Use the following IP address** and input the chosen IP address.

⇨ INFICON recommends using the IP address format **192.168.1.XXX**, where XXX can be any octet as long as it is unique to the network and is not the same as the QMG 800 IP address.

7 Enter **255.255.0.0** in the Subnet mask field and click **OK**.



8 Exit from all of the windows and connect the QMG 800 (refer to Connecting QMG 800 to FabGuard Software [▷ 60]).

To change the IP address back to the default settings, follow steps 1–6 and reset the properties to their original settings.

8 Maintenance



⚠ WARNING

Work on an open unit may only be performed by skilled personnel.

Switch off the unit before any manipulations on the equipment. Wait 60 seconds and detach all cables (power cable last). For commissioning, perform these steps in reverse order.

⚠ WARNING

Work may only be performed on electrostatic discharge (ESD)-protected benches while observing appropriate working methods.

The modules should always be stored in anti-static packages. Defects caused by the disregard of this warning will void the warranty.

8.1 Maintenance of the Air Filter

In most cases, an occasional vacuum cleaner treatment of the dust filter through the filter cover front panel grid will be adequate.

In severe cases where the occasional cleaning is not sufficient, it is recommended to vacuum the dust filters directly.

1. Lift the notched side of the filter cover and swing it open to an angle of approximately 45°.



2. Unhook the filter cover front panel grid.



3. Vacuum the stainless-steel dust filters and wipe down the inside of the filter cover front panel grid.
4. Reinstall the filter cover on the QMS 800.

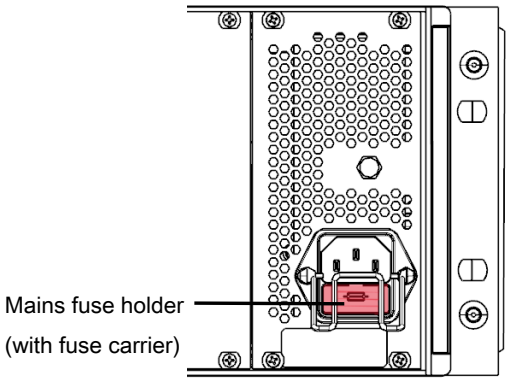
8.2 Replacing the Mains Fuse

A defective mains fuse will cause the DC indicator to stay dark even if mains voltage is applied and the mains switch is in the ON position (I).

⚠ WARNING

A defective mains fuse usually indicates a serious problem in the unit or in the system. If the fuse blows again after replacement, it is strongly recommended to contact INFICON.

View on SC 800 rear panel



1. Switch QMS 800 off and remove its mains cable.
2. Open the fuse carrier of the mains fuse holder.
3. Replace defective fuse (6.3 A HBC, 5 × 20 mm) and push the fuse carrier back into the mains fuse holder.
4. Make sure the mains switch power is in the OFF (O) position.
5. Reconnect the mains cable.
6. Switch on the system.

8.3 Maintenance of RF Generator

NOTICE

The warranty becomes null and void if QMH 800 is opened.

Under normal conditions, the RF generator QMH 800 requires no maintenance.

The need for recalibrating the mass scale and resolution is indicated by the analysis of the measured values.

If high RF losses occur due to storage in high humidity, the problem can be remedied by drying at a maximum of 70°C or by longer operation with maximum possible saturation.

External cleaning



⚠ CAUTION

Turn off controller and detach cables prior to cleaning QMH 800.

A slightly moist cloth will usually suffice for cleaning the outside of the unit. Do not use any aggressive scourging cleaning agents under any circumstances.



⚠ CAUTION

No liquid may get into the unit. Allow the unit to dry thoroughly before reconnecting and putting back into operation.

Internal cleaning

Severely contaminated units should preferably be cleaned by your nearest INFICON service center (see Service and Technical Support [▶ 73]).

If you nevertheless decide to perform the cleaning yourself, remove the dust from the inside of the QMH by carefully blowing it out with compressed air. The compressed air must meet the following specifications:

- Free of oil
- Dry
- Free of particles > 30µm
- Gauge pressure < 2 bar

Do not bend or move wires or components; this can cause damage to the instrument.

8.4 Tuning

⚠ CAUTION

Tuning is only required is the system tune has drifted out of application requirements or if factory tune is not sufficient for application needs.

QMG 800 can be tuned using FabGuard software. Tuning can be found under the sensor maintenance window. For more detailed information on how to tune an RGA, please utilize FabGuard Help that was installed with the supplied version of FabGuard.

9 Service and Technical Support

9.1 How to Contact Customer Support

Worldwide customer support information is available under **Contact** at www.inficon.com:

- Sales and Customer Service
- Technical Support
- Repair Service

When reporting an issue with QMG 800, please have the following information readily available:

- the QMG 800 part number and serial number (see System Marking and Identification [▷ 9] for location of labels containing this information)
- a description of the problem
- an explanation of any corrective action already attempted
- the exact wording of any error messages

For technical support, visit www.inficon.com and select **Contact >> Service & Support**. Select your region and product to obtain support contact information. To submit a repair request in North America, fill out a Service Request form at https://service.inficon.com/.

9.2 Returning an Instrument to INFICON

Do not return any component of your instrument to INFICON without first obtaining a Return Material Authorization (RMA) number from a Customer Support Representative. To obtain an RMA, fill out and submit a Service Request form (refer to How to Contact Customer Support [▷ 73]). Service Request forms must be approved by INFICON before an RMA number is issued.

If you deliver a package to INFICON without an RMA number, your package will be held and you will be contacted. This will result in delays in servicing your instrument.

Prior to being given an RMA number, you may be required to complete a Declaration of Contamination (DOC) form if your instrument has been exposed to certain materials. DOC forms must be approved by INFICON before an RMA number is issued. INFICON may require that the instrument be sent to a designated decontamination facility, not to the factory.

10 Replacement Parts

When ordering, always indicate:

- all information on the product nameplate
- description and ordering number according to list

Part Number	Description
46-0022	Blank panel 4U (20 mm)
46-0023	Blank panel 8U (40.33 mm)
30-0017	M2.5 × 12.3 mm cross recess/slotted screw (for blank panels)
600-1190-P1	Cable, Ethernet communication, 1 m
600-1190-P4	Cable, Ethernet communication, 4.3 m
600-1190-P8	Cable, Ethernet communication, 7.6 m
600-1190-P15	Cable, Ethernet communication, 15.3 m

11 Appendix A: Behavior as a Function of Time

Step response

If the mass number changes suddenly from M_1 to the new value M_2, time is required for the new state to stabilize. The measurement signal within the transition range must be eliminated because it has no relationship to the new mass number.

The necessary waiting time depends on M_1 and M_2, on the jump direction, on the QMH type, and on the required measurement accuracy.

Particularly for high measurement speed the waiting time should be optimized through experiments. Only in this way can the best compromise be found between speed and measurement accuracy.

The following approximate values apply to unit resolution (ΔM_{10} = 1 u), until the detector signal has attained 98% of the ultimate value. They apply only to the behavior of the QMH. Ion detection delays have not been taken into consideration.

The waiting time t_w required for QMH stabilization is calculated as follows:

$t_w = t_1 + t_2 \times |M_2 - M_1|$ [ms]

M_L	5 u	5 u
Type of jump	$M_1 > M_2$	$M_2 > M_1$
M_1 and/or $M_2 \geq M_L$	$t_1 = 2$, $t_2 = 0.01$	$t_1 = 2$, $t_2 = 0.02$
M_1 and $M_2 < M_L$	$t_1 = 4$, $t_2 = 0.5$	$t_1 = 4$, $t_2 = 1$
$M_2 - M1 < 0.5$ u	0.15 ms/u	0.15 ms/u

For smaller mass jumps ($M_2 - M_1 < 0.5$ u), the above formula is no longer valid; the delay t_d caused by the finite change speed of RF and DC signals must be applied.

Continuous small jumps ($M_2 - M_1 < 0.1$ u) have the effect of a linear scan signal ramp.

Fast mass scans

In fast mass scans with a linear ramp function, the mass scale lags relative to the input signal (dM) and a deviation of the peak width (dΔM) occurs.

At the fastest scan speed of 0.5 ms/u in an upward scan direction ($M_1 < M_2$), the following applies:

$dM_{0.5}$	0.2 u
$d\Delta M_{0.5}$	0.15 u

For downward scans, the signs become negative.

For slower scan speed, the formula is:

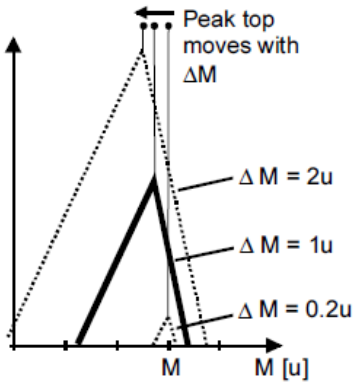
$dM = dM_{0.5} \times 0.5$ / SPEED [ms/u] and $d\Delta M = d\Delta M_{0.5} \times 0.5$ / SPEED [ms/u]

12 Appendix B: Calibration Method for Mass Number M and Line Width ΔM

The position of the peak maximum on the mass scale is often used for determining the mass number of a peak. However, this method is subject to error. For more accurate information concerning the mass scale and peak width, a definition of the corresponding measurement method is needed.

Apparent peak position and line width

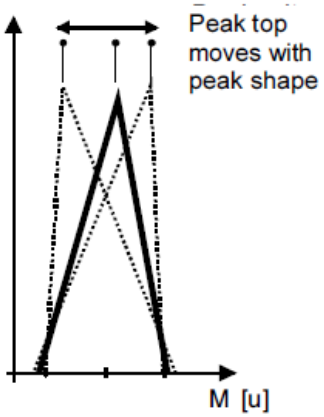
The apparent mass position depends on the line width ΔM (that is, on the resolution). This shift of the peak maxima with the line width is a natural phenomenon of the quadrupole mass spectrometer. For this reason the position of the peak top on the mass scale is not an accurate indicator of the mass number.



Apparent peak position and peak shape

The apparent position of the peak maximum varies, depending on the peak shape.

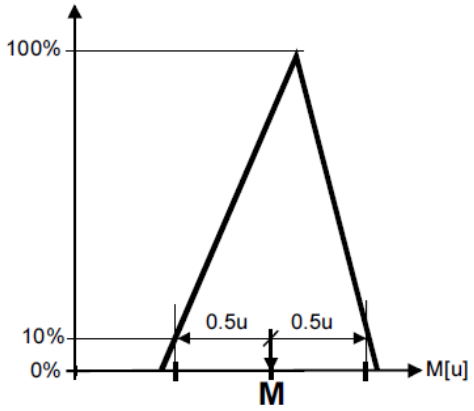
Different peak shapes can occur at different positions of the mass scale even if all other parameters remain constant. The peak shape also varies as a function of the mass range, the individual mass filter, or the ion source.



Definition

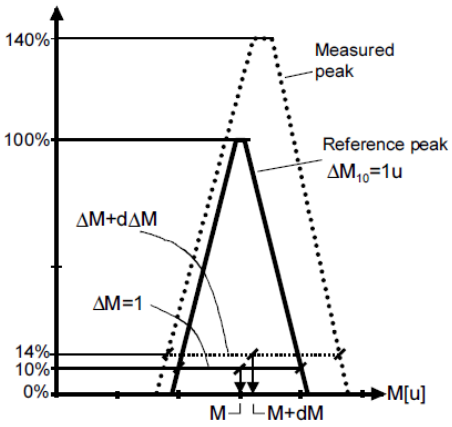
Calibration method for mass number M and line width ΔM:

- The line width ΔM_{10} = 1 u is measured at 10% of the peak height.
- The mass number is in the middle of the ΔM_{10} line.
- The middle of this 10% line is used as the reference value for the mass number.



Deviations of M and ΔM

This diagram illustrates how the deviations from the reference values are determined, where dM is the deviation from the nominal value of mass position M, and dΔM the deviation from the nominal value of the line width ΔM.



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