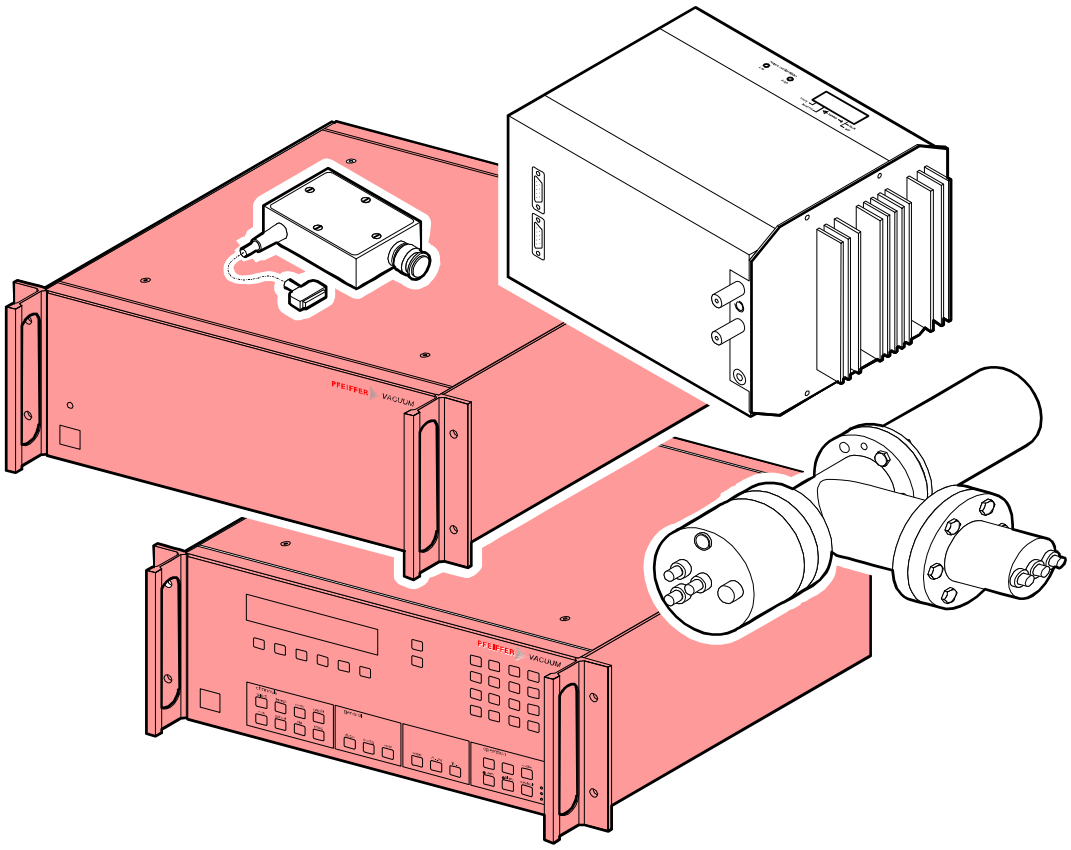
Operating Instructions
Incl. Declaration of Conformity

PFEIFFER VACUUM

# Quadrupole Mass Spectrometer System
# QMG 422



## Validity

This document applies to QMG 422 systems with QMS 422 and QMI 422 control units equipped with the modules listed on → 🗎 65, some of which come with their own operating instructions.

It is valid for firmware numbers:

| | |
|---|---|
| DSP / PRG No. | **BG 509 732 -..** |
| QMS / PRG No. | **BG 509 733 -..** |
| CS 422 / PRG No. | **BG 509 734 -..** |

The above numbers can be read out with *config-TEST* or the Quadstar 422 software. The letter (A...Z) at the end of the number represents the modification index which indicates the firmware level. This operating manual remains valid as long as only the index changes. In most cases the function is enhanced but also additional functions may be included that are not described in this edition.

We reserve the right to make engineering changes without notice.

# Contents

# 1 Safety

## 1.1 Symbols used

**DANGER**

Information on preventing any kind of physical injury.

**WARNING**

Information on preventing extensive equipment and environmental damage.

**Caution**

Information on correct handling or use. Disregard can lead to malfunctions or minor equipment damage.

**Skilled personnel**

Instructions marked with this symbol may only be carried out by persons who have suitable technical training and the necessary experience to do it safely.

*italic-ITALIC:ITALIC* *Function-PARAMETERNAME:PARAMETERVALUE*
Example: *mass-FIRST:12* (starting mass 12 of the mass scan)

## 1.2 Intended use

The QMG 422 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 user's guide and in those of the accessories must be conscientiously followed.

**DANGER**

The QMG 422 is not intended to produce measurement results on which the safety of persons or large assets depend. For such applications the safety must be ensured by additional measures.

## 1.3 Safety information

Adhere to the applicable regulations and take the necessary precautions for the process media used.

When returning products that have been exposed to the vacuum for maintenance or repair, enclose a declaration of contamination.

Adhere to the forwarding regulations and prescriptions of the countries and forwarding agencies concerned.

Before handling any used instruments or components, find out whether they are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Pass on the safety information to other users.

## 1.4 Liability and warranty

Pfeiffer Vacuum 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.

## 1.5 Courses

**Courses**

Pfeiffer Vacuum offers application, operating and maintenance courses for the best use of this product. Please inquire with your local Pfeiffer Vacuum partner.

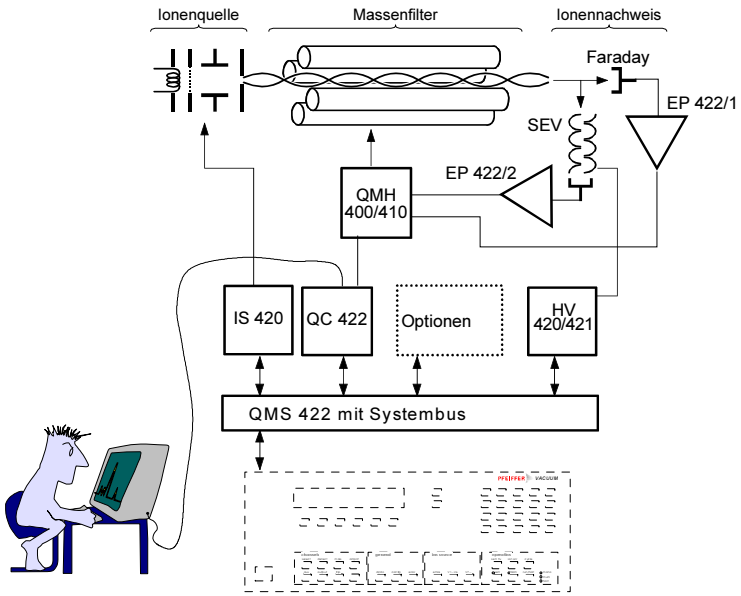
# 2 Overview

## Family 400

The QMG 422 comprises two equipment families:

In the family 400 the analyzers QMA 400 and QMA 430 (8 mm rod diameter) and QMA 410 (16 mm rod diameter) and the HF generators QMH 400/410 with mass ranges of 128 to 2048 amu are used.

400 This symbol refers to information that is applicable only to Series 400 components.




For an explanation of the abbreviations see Sections 2.3 to 2.7

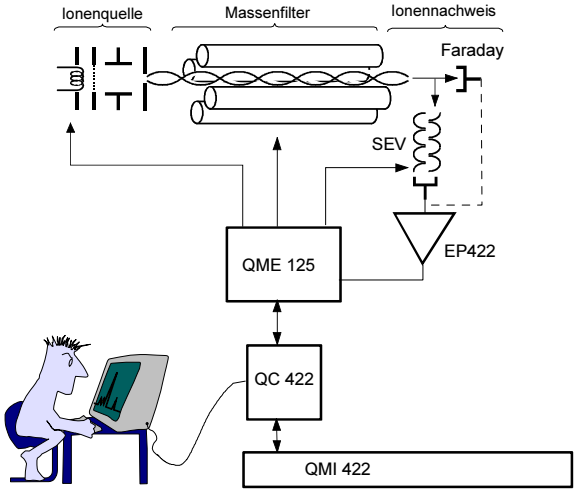
For ion counting the CP 400 ion counter preamplifier rather than the EP422/2 electrometer is used.

With a QMI 422 rather than QMS 422 no system bus, IS 420 ion source supply, HV 420/421 high voltage supply and options are available.

## Family 125

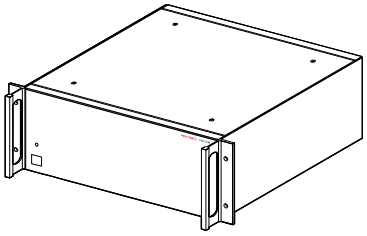
The family 125 uses the QME 125 mass filter electronics with the mass ranges 100 and 200 amu and QMA 125 analyzers with 6 mm rod diameter.

125 This symbol refers to information that is applicable only to Series 125 equipment.




With QMS 422 rather than QMI 422 the system bus and consequently the options are also available for this family.

## 2.1 QMS 422 control unit

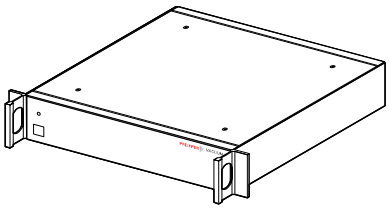


The basic unit comprises the power supply, QC 422 quadrupole controller and the system bus.

For family 400 components the IS 420 and HV 420 or HV 421 are installed.

Input/output modules can be installed in either family.

## 2.2 QMI 422 control unit

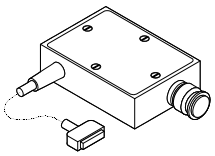


The QMI 422 comprises the power supply and QC 422 quadrupole controller and allows computer operation of family 125 equipment.

QMH/QMA 400 can be operated, but without ion source and SEM supply.

The only option available is the AO 421 analog output or IC 421 ion counter.

## 2.3 EP 422 Electrometer preamplifier



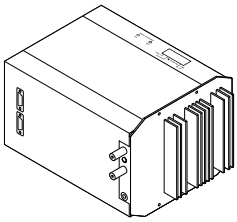
The EP 422 amplifies the very small ion current signals of the analyzer to voltage levels that are suitable for further processing. It is installed directly on the analyzers in order to minimize parasitic noise.

- Compact, simple installation on QMA
- Low-noise, low-drift, little vibration sensitivity
- Fast response and quick recovery form overdriving

400 On analyzers with 90°off-axis SEM, two EP 422 can be connected. This allows simple changeover from Faraday to SEM mode.

## 2.4 Family 400 components

### QMH 400/410

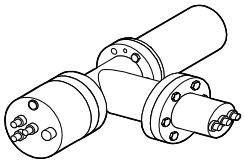


The HF generator produces the high-frequency voltage required for mass separation (→ 🕮 [1]).

| QMH type | Range | QMA type | Rod ø |
|---|---|---|---|
| QMH 400-1 | 128 amu | QMA 410 | 16 mm |
| QMH 400-5 | 300 amu | QMA 430 | 8 mm |
| QMH 400-5 | 512 amu | QMA 400 | 8 mm |
| QMH 410-1 | 1024 amu | QMA 400 | 8 mm |
| QMH 410-2 | 2048 amu | QMA 400 | 8 mm |
| QMH 410-3 | 340 amu | QMA 410 | 16 mm |
| QMH 402 | 16 amu | QMA 410 | 16 mm |

Note: In the following QMH 400 or QMA 400 always refers to all types if nothing else is specified.

### QMA 400/410/430



The 400 analyzer comprises the ion source, mass filter, ion collector and housing (→ 🕮 [2]).

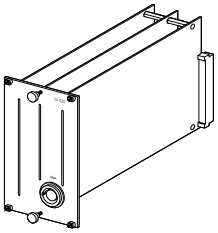
Ion collector types:

SEM 217: 90° off-axis with integrated Faraday

SEM 218: 90° off-axis with integrated Faraday and separate conversion dynode CD

On request: Faraday collector only

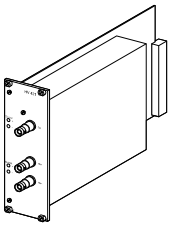
### IS 420



The ion source supply is installed in the QMS 422. and supplies the ion source with the necessary operating voltages.

- Programmable potentials, short-circuit-proof.
- Polarity reversible for positive and negative ions
- Normal mode/degas mode
- Suitable for all ion source type of the QMA 400

### HV 420 / HV 421



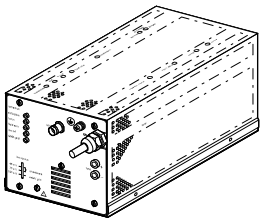
The high-voltage supply is installed in the QMS 422 and supplies the SEM with the necessary high voltage.

HV 420: For positive ions with SEM 217

HV 421: For positive and negative ions with SEM 217 or for positive ions with the separate conversion dynode of the SEM 218.

## 2.5 Family 125 components

### QME 125

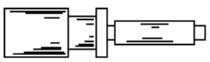


The mass filter electronics QME 125 → 🕮 [3] comprises the ion source supply, high frequency generator and SEM high voltage supply.

QME 125-1: Mass range 100
QME 125-2: Mass range 200

A special version with 6 m cable between QME 125-1 and QMA 125 is available.

### QMA 125

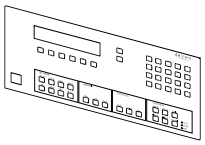


The QMA 125 analyzer → 🕮 [4] comprises the ion source, mass filter, ion collector and housing.

3 Ion collector types are available:
Faraday, Faraday/Channeltron, 90° SEM

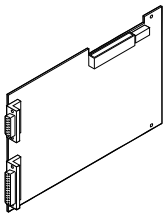
## 2.6 Options

### CS 422



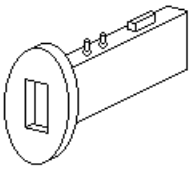
The operator console of the CS 422 is installed in the QMS 422 and allows manual operation.

### AO 421 / IC 421



The analog output AO 421 and the ion counter IC 421 are mounted on one board which is directly installed in the QC 422 (without system bus).

### CP 400



The ion counter preamplifier comprises the pulse coupling, amplifier and pulse height discriminator with adjustable threshold.

It is installed directly on the QMA with 90°off-axis SEM and is connected to the IC 421.

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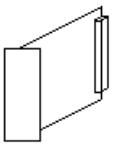
### Input/Output

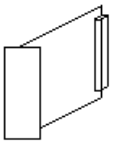


AI 421: 16 channel analog input module

DI 420: 32 bit digital input module

DO 420A: 32 bit digital output module

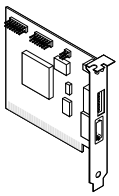
### Vacuum measurement



PI 420: Dual Pirani module for coarse and fine vacuum (→ 🕮 [8]).

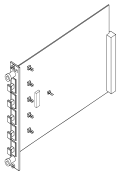
PE 420: Penning module for high vacuum (→ 🕮 [9]).

### OPA 200



OPA 200 network controller board for the ARCNET® local area network (LAN). It is installed in the PC (→ 🕮 [6]).

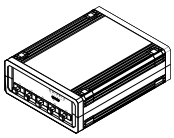
### OH 421



5-Port optical hub (star distributor) for the ARCNET® local area network (LAN)

Up to 255 nodes can be cascaded

### OHA 200



5 or 10 port optical hub (star distributor) for the ARCNET® local area network (LAN) (→ 🕮 [7]).

# 3 Technical data

## 3.1 General

This information applies to all components unless specified otherwise.

**Ambient conditions**

| | |
|---|---|
| Temperature | Storage: –40 °C ... +65 °C / Operation: +5 °C ... +40 °C |
| Relative humidity | ≤80% up to +31 °C, decreasing linearly to 50% at +40 °C |
| Use | indoors, altitude up to 2000 m |
| Type of protection | IP 30: protection >2.5 mm against particles<br>no protection against water |

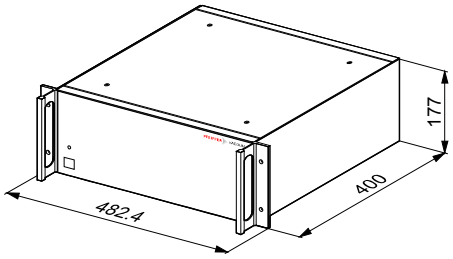
**Standards**

| | |
|---|---|
| Safety | EN 61010-1: Protection class 1, pollution degree 2,<br>overvoltage category II |
| EMC | EN 50081-2, EN 50082-2 |

## 3.2 QMS 422 control unit

Power: 90 ... 265 VAC, 47 ... 63 Hz, 300 $W_{max}$

Dimensions:




Weight: 9.6 kg with QC 422 (without additional modules)

Number of slots: Total 17, used by QC 422: 3

## 3.3 CS 422 operator console

Matching to QMS 422

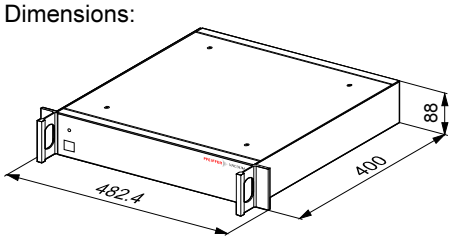
Backlit LCD display, 4 lines of 40 characters each, 5 status LEDs, membrane keyboard

Weight: 0.75 kg

## 3.4 QMI 422 control unit

Power: 90 ... 265 VAC, 47 ... 63 Hz, 200 $W_{max}$

Dimensions:




Weight: 6.5 kg with QC 422

## 3.5 QC 422 quadruple controller

| | |
|---|---|
| Slots | 3 (with and without AO 421 or IC 421) |
| Number per unit | 1 |
| Weight | 0.67 kg without / 0.9 kg with AO/IC421 |
| Number of measurement channels | 64 |
| Operating modes | *MONO / MULTI* channel |
| Measurement cycles | 1 ... 10'000, or *REPEAT* |
| Channel switching time | 1.5 ... 3 ms (with min. *PAUSE*) |

*Mass scan modes*

| mass-*MODE* | Purpose |
|---|---|
| *SCAN-N* | Analog scan normal |
| *SCAN-F* | Analog scan with FIR filter for measured value |
| *STAIR* | Scan Bargraph |
| *SAMPLE* | Single mass and MID (Multiple Ion Detection) |
| *PEAK-L* | Peak search with level criterion |
| *PEAK-F* | Peak search with FIR FILTER |

*Mass scale resolution*

| | *STEPS* per mass 1) | |
|---|---|---|
| *SPEED* | *FIX*-Range | *AUTO*-Range |
| 0.5... 1 ms/u | 16/u | --- |
| 2 ...5 ms/u | 32/u | --- |
| 10...20 ms/u | 64/u[2)] | 16/u |
| 50...100 ms/u | 64/u[2)] | 32/u |
| 0.2...60s/u | 64/u[2)] | 64/u[2)] |

[1)] See STEPS → 43 [2)] 32 at mass range 2048

*Measurement speeds*

| | EP 422 or ext. input | | Ion counter |
|---|---|---|---|
| mass-*MODE* | *FIX*-Range | *AUTO*-Range | *AUTO*-Range |
| *SAMPLE* | 0.5 ms ... 60 s | 0.5 ms ... 60 s | 1 ms ... 60 s |
| *STAIR* | 0.5 ms/u ... 60 s/u | 2 ms/u ... 60 s/u | 2 ms/u ... 60 s/u |
| *SCAN* | 0.5 ms/u ... 60 s/u | 10 ms/u ... 60 s/u | 20 ms/u ... 60 s/u |
| *PEAK* | 0.5 ms/u ... 60 s/u | 10 ms/u ... 60 s/u | 20 ms/u ... 60 s/u |

*Detectors*

| detect-*TYPE* | |
|---|---|
| *FARAD* | Faraday collector, EP 422 |
| *SEM* | SEM (type configurable), EP 422 |
| *ION-CNT* | Ion counter, CP 400 / IC 421 |
| *EXTERN* | External analog input of the QC 422 |
| *PIRANI* | Pirani |
| *PENNING* | Cold cathode |
| *A-INPUT* | Analog signal via AI 421 module |

*Measurement ranges and resolution*

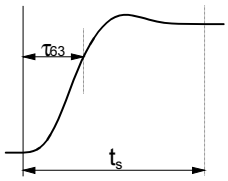
| Detector type | Meas. ranges | Modes | Resolution |
|---|---|---|---|
| *FARAD,SEM* | $10^{-12}$ ...$10^{-5}$ A fsd | *FIX*- and *AUTO*-Range | 16 bit * (per range) |
| *EXTERN* | GAIN 1: ±10.240V<br>GAIN 10: ±1.024V | *FIX*-Range | 16 bit * |
| *ION-CNT* | 10-2...108 cps, meaning full use up to 106...107 cps | *AUTO*-Range | in mass-*MODE*:<br>*SAMPLE*: 1/*DWELL*<br>*STAIR*: 2u/*SPEED*<br>*SCAN*: *STEPS/SPEED* |

*) Further increased by averaging

Analog filter

| Type | Two-stage lowpass, effective for electrometer and external input |
|---|---|
| Filter time constant | automatic or selectable in eight steps:<br>18 , 85 , 400 µs / 1.7, 8, 40, 180, 800 ms |

Filter step response




$\tau_{63}$: Filter time constant

Settling time to ±1‰:

$t_s \approx 4 \times \tau_{63}$

Digital filter

| | |
|---|---|
| NORMAL (N) | Low pass (average value) |
| FIR (F) | Finite Impulse Response |
| AVERAGE | Average formed across several measurement cycles |

## Ion sources

400 — Also refer to → 16

| | |
|---|---|
| Types | Axial, cross beam, grid, sputter process monitor, Spec+, Spec- |
| Parameter sets | 4 per ion source |
| Potentials | V1 ... V9 |

125 — Also refer to → [3]

| | |
|---|---|
| Types | Axial, cross beam, grid, sputter process monitor |
| Emission | Standard: 0.07 ... 2 mA; Degas: 0.7 ... 20 mA / 500 V |

## Switching functions

| | |
|---|---|
| *trip-TYPE: ABS* | 2 absolute switching functions per channel |
| *trip-TYPE: HYST* | 1 hysteresis switching function per channel |
| Reaction time with DO 420A | <1 ms after measurement is completed |

## RS-232-C interface

| | |
|---|---|
| Detailed description | Also refer to → 🗎 [5] |
| Measured data buffer | 256 kB |
| Protocol | ASCII or binary protocol (according to SECS-1 standard)<br>1 start, 8 data, 1 stop bit, no parity |
| Connector | 9 pin D-sub, see (→ 🗎 25). |
| Baud rate | 300 *), 1200, 2400, 4800, 9600, 19200 baud |
| Cable length | ≤15 m, shielded for baud rate 19200 baud<br>>15 m, shielded at reduced baud rate |

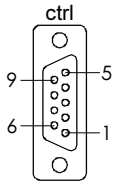
*) Only in conjunction with ASCII protocol

## LAN interface

| | |
|---|---|
| Type | ARCNET® with fiber optics |
| Connection | JIS F07 / TOSLINK |
| Type of fiber | PCF 200/230 or 200/300 or APF 980/1000 µm |
| Distance | → 🗎 26 |
| Baud rate | 2.5 Mbit/s |
| Wavelength | 800 nm |
| Length of fiber-optic conductor | 0 ... 1000 m |
| Transmission distance | 3000 $m_{max}$ (cascaded) |

## Connections on QC 422

Connector **ctrl**




View towards QC
D-Sub, 9-pin female

| Pin | | |
|---|---|---|
| 5 | ELM OUT+ | Analog output of the electrometer signal<br>0 ... ±10,24 V, $R_{out}$ : 2× 200 Ω, short-circuit proof<br>Analog input in place of electrometer signal. |
| 9 | ELM OUT– | ±10,24 V, common mode signal: ±2 $V_{max}$, $R_{in}$ = 2× 50 kΩ<br>see detect-*TYPE:EXTERN* 45 |
| 4 | EXT IN– | |
| 8 | EXT IN+ | Input for ext. measurement cycle start<br>TTL, int. pull-up 4.7 kΩ to +5 V.<br>see cycle-*TRIG* 44 |
| 3 | RUN IN | |
| 7 | -- | |
| 2 | EXT PROT | Input for filament and SEM protection<br>TTL, int. pull-up 4.7 kΩ to +5 V.<br>see config-*CTRL/SEM+FIL* 43 |
| 6 | GND D | |
| 1 | GND D | |

**RS 232**
Serial interface → 25

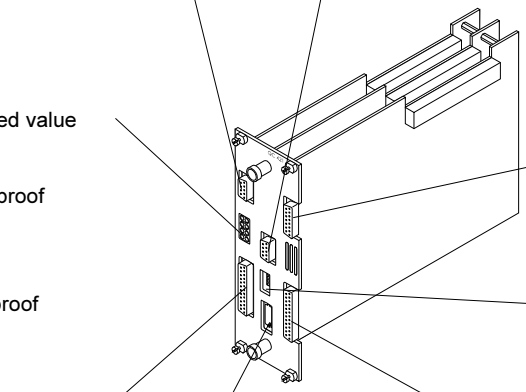
**sync**
Trigger signal for recording instrument
TTL, $R_{out}$ >1 kΩ

**elm**
see above
connector **ctrl**: ELM OUT

**mon** (Monitor)
Analog output of the measured value after digital processing.
0 ... ±10.24 V
$R_{out}$ : 2× 200 Ω, short-circuit proof

**scan**
Analog mass number signal
0 ... +10.24 V
$R_{out}$ : 2× 200 Ω short-circuit proof

Laboratory sockets, ø2 mm



**CP** (Option)
Connection for CP 400

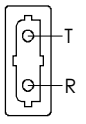
**key**
(not used)

**AO** (Option)
12 Analog outputs
0 ... ±10.24 V, 1 $mA_{max}$
12-Bit, monotonic
Gain: ± 1.7%, Offset: ±21 $mV_{max}$
$R_{out}$ : 2× 200 Ω, short-circuit proof
Rise time: 10 µs to 99%

**QMH/QME**
Connector for QMH 400/410
or QME 125

**LAN**
Fiberoptic network interface for high transmission rates and long distances

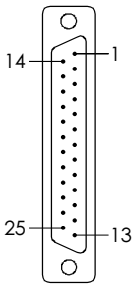
TOSLINK TODX 296, duplex
Typ JIS F07




T Transmit
R Receive

View towards QC

D-Sub
25 pin male




View towards QC

| Pin | | Pin | |
|---|---|---|---|
| 1 | CH 1+ | 14 | CH 1– |
| 2 | CH 2+ | 15 | CH 2– |
| 3 | CH 3+ | 16 | CH 3– |
| 4 | CH 4+ | 17 | CH 4– |
| 5 | CH 5+ | 18 | CH 5– |
| 6 | CH 6+ | 19 | CH 6– |
| 7 | CH 7+ | 20 | CH 7– |
| 8 | CH 8+ | 21 | CH 8– |
| 9 | CH 9+ | 22 | CH 9– |
| 10 | CH 10+ | 23 | CH 10– |
| 11 | CH 11+ | 24 | CH 11– |
| 12 | CH 12+ | 25 | CH 12– |
| 13 | open | | |

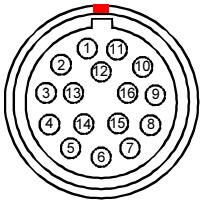
For EMC reasons only shielded cables may be used on D-Sub connectors. The shield must be connected to chassis ground. The opposite end may not have a different ground potential.

## 3.6 IS 420 Ion source supply

| | | |
|---|---|---|
| Slots | 5 | |
| No. of IS 420 per unit | max. 1 | |
| Supply | 5 V / 0.6 A; ±24 V / 2 A (2.4 A with Degas) | |
| Fuses | F1, F2 | → 🗎 65 |
| Filament supply | 0...10 V / 5 $A_{max}$ / 50 $W_{max}$ | with Fil1+2: 1.4...2 V on Fil2 |
| Filament modes | 1 / 2 / 1+2 (1 in operation, 2 preheated) | |
| Protection | 0 ... 5 A | Resolution 10 mA |
| Emission normal | 0 ... 2 mA | Resolution 10 µA |
| Emission Degas | 0 ... 20 mA | Resolution 0.1 mA |
| Signal SPEC SRC ON | 23 V / 70 mA | $R_i$ = 110 Ω |
| Ion source cable | Connector PEEK +260 °C | Cable SIR -25...+180 °C |
| Weight | 1.45 kg | |

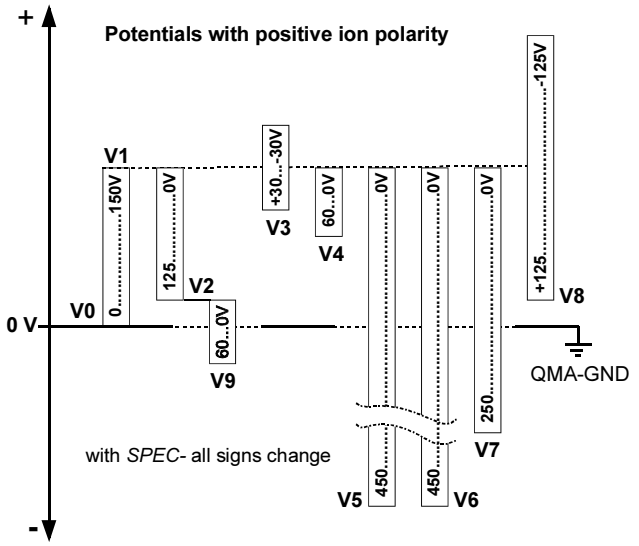
With ion src-*TYPE*:*SPEC*± and *EMISS:OFF* SPEC SRC ON becomes active. A relay for changing over the ion source lines can be actuated.

Connector towards IS 420




| | | | |
|---|---|---|---|
| 1 | QMA GND | 9 | Filament common |
| 2 | SPEC SRC RET | 10 | V4, Field axis |
| 3 | V6, Deflection inner | 11 | V0, Ref.Gnd |
| 4 | V3, Focus | 12 | Screen |
| 5 | V9, Wehnelt | 13 | V8, Reserve |
| 6 | V5, Extraction | 14 | V1, Ionref |
| 7 | Filament + | 15 | SPEC SRC ON |
| 8 | Filament – / Cathode | 16 | V7, Deflection outer |

| | Electrode name | Ref. direction | Range [V] | Increm. [V] | Current [$mA_{max}$] | Degas potential to V0 [V] |
|---|---|---|---|---|---|---|
| *V1* | *IONREF* | V1-V0 | 0 ... 150 | 1 | ±2 | +550 |
| *V2* | *CATH* | V1-V2 | 0 ... 125 | 0.5 | +2 | +7 |
| *V3* | *FOCUS* | V1-V3 | -30 ... +30 | 0.25 | ±2 | +550 |
| *V4* | *F-AXIS* | V1-V4 | 0 ... 60 | 0.25 | ±0.5 | 0 |
| *V5* | *EXTRACT* | V1-V5 | 0 ... 450 | 2 | ±0.1 | 0 |
| *V6* | *DEF-I* | V1-V6 | 0 ... 450 | 2 | ±0.1 | 0 |
| *V7* | *DEF-O* | V1-V7 | 0 ... 250 | 1 | ±0.1 | 0 |
| *V8* | --- | V1-V8 | -125 ... +125 | 1 | ±0.1 | 0 |
| *V9* | *WEHNELT* | V2-V9 | 0 ... 60 | 0.25 | ±0.1 | +7 |




Voltage tolerances:
±1.8% of the value
±1‰ of the range

With *detect-TYPE:FARAD*, V6 and V7 are at QMA-GND.

V0 may be connected to an external potential of max. ±200 VDC to GND.

**DANGER**

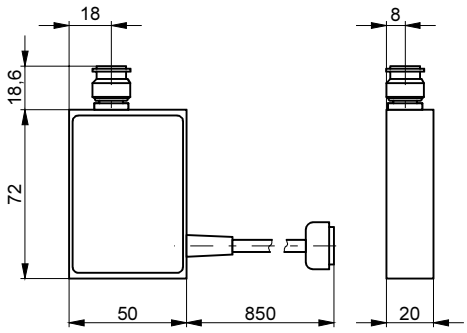
The external voltage source for V0 must be reliably limited to 2 $mA_{max}$ and isolated for 750 V.

The relay connected to SPEC SRC ON and SPEC SRC RET incl. lines must be isolated for 750 V and be protected against accidental contact.

## 3.7 EP 422 Electrometer

| | |
|---|---|
| Interface to | QMH 400/410, QME 125 |
| Voltage supply | ±16 VDC, ± 0.2 V / 10 $mA_{max}$ / ripple 10 $mV_{max}$ |
| Output | ±10 V / 2 $mA_{max}$ |
| Input impedance | 100 kΩ |
| Input connector | Type TNC |
| Output connector | D-Sub 9-pin |
| Temperature | Operation: 0 ... 50°C, Storage: -40 ... +70°C |
| Weight | 150 g |

Dimension

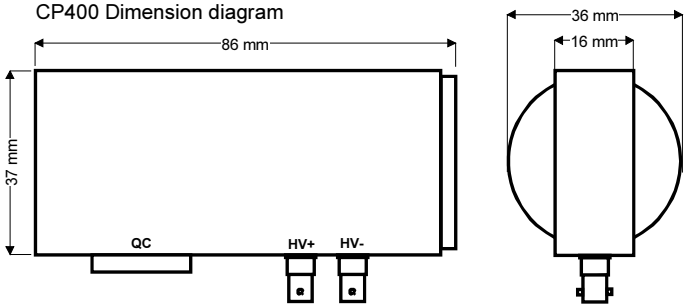



| Measurement range | Sensitivity | Tolerance at 25 °C | Rise time 10...90 % | Offset at 25 °C |
|---|---|---|---|---|
| ±$10^{-5}$ A | $10^{-6}$ A / V | ±1% | 50 µs | ±0.5 mV |
| ±$10^{-7}$ A | $10^{-8}$ A / V | ±1% | 90 µs | ±0.5 mV |
| ±$10^{-9}$ A | $10^{-10}$ A / V | ±2% | 1.9 ms | ±2 mV |
| ±$10^{-11}$ A | $10^{-12}$ A / V | ±2% | 2.6 ms | -50 ... +150 mV |
| Drift | Offset doubles with each 10°C of temperature increase | | | |
| Noise | typ. 2×$10^{-13}$ $A_{pp}$ unfiltered | | | |

## 3.8 CP 400 Ion counter preamplifier

| | | | | |
|---|---|---|---|---|
| Input | Installed directly on SEM feed-throughs of the QMA<br>Pulse width 10 $ns_{typ}$ / pulse height 1...5 mV<br>Impedance 50 Ω / double pulse resolution ≤20 ns<br>Protection against arcs in SEM with HV 420/421, QME 125 | | | |
| High voltage | SHV connector HV+ and HV-<br>HV+: 6.7 kV to GND<br>HV–: 6 kV to GND<br>SEM: 3.5 kV between HV+ and HV– | | | |
| Output | ECL level complementary | | | |
| Discriminator threshold | Control voltage LEVEL+ to LEVEL–<br>0.1 ... 1 V corresponds to pulse height 1 ... 5 mV; common mode ±0.5 $V_{max}$ | | | |
| QC connector<br>D-Sub 15 male | Pin 1<br>2<br>3<br>4 | QMA-GND<br>Identification<br>OUT–<br>OUT+ | Pin 5<br>6<br>7<br>8<br>9 ... 15 | V+ (+12...15V / 0.12 A)<br>LEVEL–<br>LEVEL+<br>V– (-12...15 V / 0.05 A)<br>not connected |
| Weight | 0.5 kg | | | |

CP400 Dimension diagram




## 3.9 HV 420 High voltage supply

| | | |
|---|---|---|
| Slots | 2 | |
| Number per unit | max. 1 | not simultaneously with HV 421 |
| Supply | 5 V / 0.4 A ; +24 V / 0.15 A ; -24 V / 0.05 A | |
| Fuse F1 | → 🗎 65 | |
| SEM voltage HV- | 0 ... -3500 V | Resolution 1 V, ripple <10 $mV_{pp}$ |
| Admissible load | 15 MΩ | Current limitation <1 mA |
| Internal resistance | 620 kΩ | |
| Settling time | 0.8 s to 0.1% | |
| HV connector | SHV | Signal ground from QMA via HV cable |
| HV test connection | 1 V pro 1 kV | $R_i$ = 2 kΩ |
| Potential isolation | 0.5 $V_{max}$ | Between chassis and QMA-GND |
| Weight | 0.42 kg | |

## 3.10 HV 421 High voltage supply

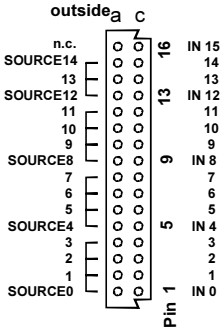
| | | |
|---|---|---|
| Slots | 3 | |
| Number per unit | max. 1 | not simultaneously with HV 420 |
| Supply | 5 V / 0.2 A ; +24 V / 0.2 A ; -24 V / 0.2 A | |
| HV connector | SHV | |
| SEM voltage HV–/HV+ | 0 (-750[1])...-3500 V | Resolution 1 V, ripple <10 $mV_{pp}$ |
| Admissible load | 17 MΩ | Current limitation 0.8 mA |
| Settling time | <0.7 s | to 1% |
| CD voltage to GND | -6300 V | Adjustable -4.7 ... -6.4 kV<br>Ripple <10 $mV_{pp}$ |
| Admissible load | 100 MΩ | Current limitation < 0.5 mA |
| Bias voltage HV– | +3.1 / -3.1 kV | For *SPEC*– / *SPEC*+ adjustable 2.4...3.2 kV |
| Test terminals | 1 V per 1 kV | CD Test also for HV– |
| Weight | 1.7 kg | |

[1] In *SPEC*+ mode

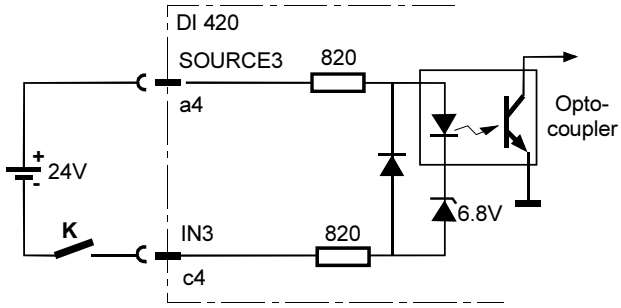
## 3.11 DI 420 Digital Input

| | |
|---|---|
| Slots | 1 |
| Number per unit | max. 2 |
| Supply | 5 V / 0.45 A |
| Number of inputs | 32 |
| Input signals | 24 VDC ±25% / 10 mA, low true |
| Switching threshold | 10.6 ... 16 $V_{typ}$ |
| Insulation | 30 $V_{eff}$ / 60 VDC to GND and between input groups |
| Protection | +35 V / -30 V continuous; 100 V max. 1 s |
| Connector | 2, 16 inputs each, 32-pin DIN 41612 type C/2 |
| Weight | 0.24 kg |

**J1/J2 pin assignment viewed from outside**




Example: Input N3 controlled with contact K

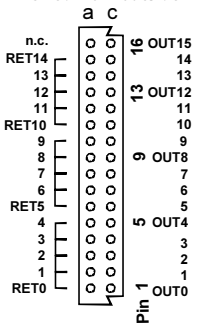



SOURCE0..3 / 4...7 / 8...11 / 12...15 are internally connected, common plus poles of the 4 insulated input groups. SOURCE15 has no pin of its own.

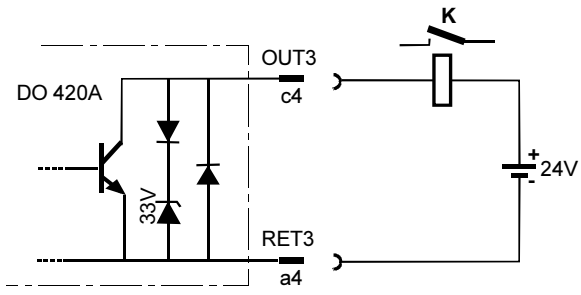
## 3.12 DO 420A Digital Output

| | |
|---|---|
| Slots | 1 |
| Number per unit | max. 3 |
| Supply | 5V / 0.4 A |
| Outputs | 32, open collector Darlington drivers |
| Output signal | max. 28 VDC / 100 mA, $U_{sat}$<1.7 V @ 100 mA, low true |
| Protection | Zener diode 33V/1W and parallel diode 1A |
| Insulation | 30 $V_{eff}$ / 60 VDC to GND and between groups |
| Connector | 2, 16 outputs each, 32-pin DIN 41612 type C/2 |
| Weight | 0.24 kg |

**J1/J2 pin assignment viewed from outside**




Example: Relay control with output OUT3

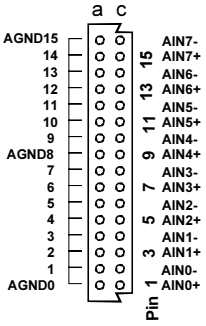



RET0..4 / 5...9 / 10...15 are internally connected, common negative poles of the 3 insulated outputs groups. RET15 has no pin of its own.

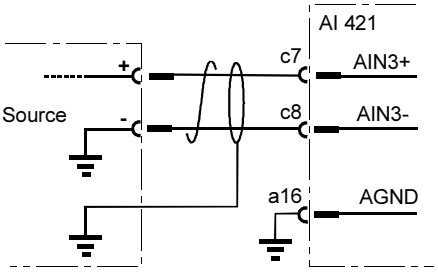
## 3.13 AI 421 Analog Input

| | |
|---|---|
| Slots | 1 |
| Number per unit | max. 1 |
| Supply | 5V / 1 A |
| Inputs | 16, differential, $I_{in}$ <±150 nA @70 °C |
| Measurement range | -10.24 ... +10.235 VDC, linear -10.0 ... +10.0 V |
| Resolution | 12 bit monotone |
| Accuracy | ±0.1% FSR |
| Measurement interval | 40 ms for all 16 inputs |
| Protection | 70 V to AGND, max. 8 inputs simultaneously |
| Insulation | 30 $V_{eff}$ / 60 VDC between AGND and GND |
| Connector | 2, 8 inputs each, 32-pin DIN 41612 type C/2 |
| Weight | 0.3 kg |

**J1/J2 pin assignment viewed from outside**




Example: Connection to input AIN3




Analog ground AGND must be connected to an admissible potential (see above “Insulation”), preferably to ground.

The cable must be shielded. Ground the shield, but not to AGND.

Twisted-pair conductors for each input provide the best signal-to-noise ratio. Open inputs produce unpredictable values.

## 3.14 OH 421 Optical Hub

| | |
|---|---|
| Slots | 1 |
| Number per unit | any |
| Voltage supply | +5 V ±2.5%, 200 mA typical |
| Connection points | 5 |
| Optical interfaces | → 14 |
| Weight | 0.17 kg |

# 4 Installation

## 4.1 QMS/QMI 422

**DANGER**

Before you connect the equipment make sure that the line voltage corresponds to the specifications on the 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!**

**WARNING**

In rack installations the temperature inside the rack must not exceed 40ºC. Ensure adequate air circulation.

The air filters inside the unit should be periodically checked and serviced (refer to 64).

In desktop installation the air should be able to enter through the lateral inlets and exit through the rear panel slots without obstruction.

## 4.2 Overall system

Install peripheral components such as the analyzer, QMH 400/410, QME 125 etc. in accordance with the information in the respective user's guides.

All components involved must be grounded to a single point. Utilization of a single power distributor is recommended. The only exception is the computer, but only if it is connected to the QC 422 by means of a fiber-optic link.

**Skilled personnel**

Make sure that the QMA, the vacuum chamber and the entire equipment is always connected to the protective ground.

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

- Mech. protection against contact
- Forced disconnection of the QMS/QMI 422 line voltage by means of a door contact

The electrode system of the QMA must not be subjected to hazardous external voltages (from contact, arcing, plasma, ion or electron beams, etc.). If such danger hazards in the vacuum system appropriate protection measures must be taken there (arrangement, shielding, grounding, etc.) that reliably preclude such influences. In addition the QMS/QMI 422 must have a permanent ground connection (no plug!). On the QMS 422 the ground terminal is located behind the power inlet, on the QMI 422 there is an M4 thread on the rear panel. Prepare this ground connection from yellow/green stranded copper wire:

- 2.5 $mm^2$ if mech. protected (according to DIN VDE 110 T540)
- 4.0 $mm^2$ if unprotected

Also refer to the standards applicable to your system.

**Skilled personnel**

When the QMA is in operation, hazardous voltages up to 600 VDC 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.

## 4.3 EP 422

Connect the EP 422 to the corresponding connector on the QMA. Position it in such a way that it does not touch the surrounding connectors and firmly tighten the knurled nut.

Connect the control cable to the **EP** connector of the QME 125 (→ 🗎 24) or the **ep1** or **ep2** connector (see p.23) of the QMH 400. Lock the connector with the slide.

For optimum signal stability the EP 422 must be protected from vibrations, temperature fluctuations, high temperature, humidity and strong magnetic alternating fields.

The Teflon cable (max. 200 °C → 🗎 65) allows remote operation if the temperature on the QMA is too high. The EP 422 must be mounted outside the hot area (M3 threads on the housing). The cable must not be subjected to vibrations. Increased noise levels must be expected.

125 The same applies for the QME 125-1 with 6 m cable length, however the maximum cable temperature is 70 °C.

## 4.4 CP 400

**DANGER**

The CP 400 may not be operated with a high voltage supply that can deliver hazardous voltages or currents.

Switch the unit off and detach all cables before you open the cover.

Operation of the equipment with the cover removed is not allowed.

The inside of the CP 400 may not be touched or contaminated. Finger smudges can cause noise pulses or even arcing.

Remove the SEM connector plate of the QMA (→ 🕮 [2], [4]).

Remove the 6 screws A and the cover of the CP 400.

Unfasten the 3 screws C so that the full cross-section of the sockets is exposed. Caution, do not lose the screws!

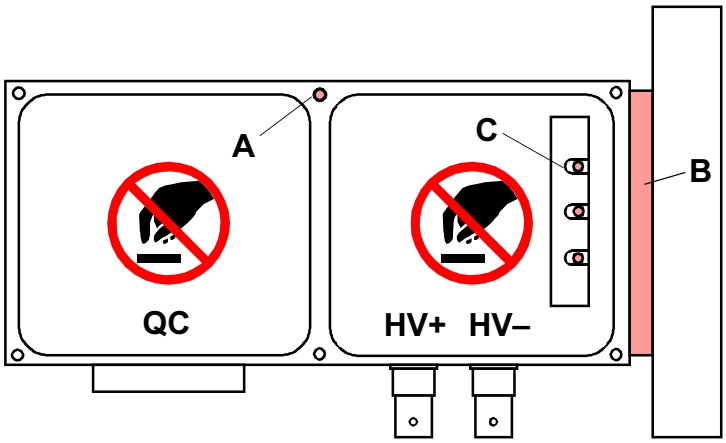
Carefully slide the CP 400 over the feedthroughs; the latter must not be stressed because they can break!

Fix the CP 400 with the 4 screws B.

Tighten the 3 screws C.

Fasten the cover with all 6 screws A including washers.

For conversion to EP 422 operation perform the above steps in reverse order.




## 4.5 Cabling with QMA 400

Cable the system in accordance with the following tables
Short TNC and short SHV = short circuit plugs

### 1. Faraday cup

Configuration config-SYSTEM-DETECT:FARAD

| Module | Connector | Connection | l [m] | Module | Connector | Comments |
|---|---|---|---|---|---|---|
| QC422 | QMH | control cable QMH | 3 | QMH | (QC) | Optional extension 7m |
| IS420 | QMA | Ion source | 3 | QMA | IS | or 10m |
| QMH | RF+<br>RF– | Radio frequency | 0.7 | QMA | RF A<br>RF B | Polarity see test report |
| QMH | FA | Field axis | 0.7 | QMA | FA | |
| EP422 | Input | Meas. signal | --- | QMA | EP(FARAD) | |
| | --- | control cable | 0.8 | QMH | ep1/farad | |

### 2. SEM 217, HV 420 or HV 421

In addition to 1. Configuration config-SYSTEM-DETECT:SEM

| Module | Connector | Connection | l [m] | Module | Connector | Comments |
|---|---|---|---|---|---|---|
| HV42x | HV– | High voltage | 3 | QMA | HV– | or 10 m |
| HV421 | HV+ | short SHV | --- | --- | --- | |
| | CD | remains open | | | | |
| --- | --- | short HV | --- | QMA | HV+ | |
| EP422 | Input | Meas. signal | --- | QMA | EP(SEM) | |
| | --- | control cable | 0.8 | QMH | ep2/sem | |
| | | short TNC | --- | QMA | EP(FARAD) | if only 1 EP |

### 3. SEM 218 (CD-SEM)

In addition to 1. Configuration config-SYSTEM-DETECT:CD-SEM

| Module | Connector | Connection | l [m] | Module | Connector | Comment |
|---|---|---|---|---|---|---|
| HV421 | CD | High voltage CD | 3 | QMA | CD | or 10 m |
| | HV– | High voltage | 3 | QMA | HV– | or 10 m |
| | HV + | short SHV | --- | --- | --- | |
| EP422 | Input | Meas. signal | --- | QMA | EP(SEM) | |
| | --- | control cable | 0.8 | QMH | ep2/sem | |
| | | short TNC | --- | QMA | EP(FARAD) | if only 1 EP |

**4. SEM 217, HV 420 and ion counter**

In addition to 1. Configuration config-SYSTEM-DETECT:SEM

| Module | Connector | Connection | l [m] | Module | Connector | Comments |
|---|---|---|---|---|---|---|
| HV420 | HV– | High voltage | 3 | CP400 | HV– | or 10 m |
| --- | --- | short SHV | --- | CP400 | HV+ | |
| | | short TNC | --- | QMA | EP(FARAD) | if no EP |
| QC422 | CP | control cable | 3 | CP400 | QC | or 10 m |

**5. SEM 218, HV 421 and ion counter**

In addition to 1. Configuration config-SYSTEM-DETECT:H-SEM

| Module | Connector | Connection | l[m] | Module | Connector | Comments |
|---|---|---|---|---|---|---|
| HV421 | CD | remains open | | | | |
| | HV– | High voltage | 3 | CP | HV– | or 10 m |
| | HV+ | High voltage | 3 | CP | HV+ | or 10 m |
| | | short TNC | --- | QMA | EP(FARAD) | If no EP |
| QC422 | CP | control cable | 3 | CP400 | QC | or 10 m |

## 4.6 Cabling with QMA 125

The **polarity** switch on the QME 125 must be in the "+" position.

**1. Faraday cup**

Configuration config-SYSTEM-DETECT:FARAD

| Module | Connector | Connection | l [m] | Module | Connector | Comments |
|---|---|---|---|---|---|---|
| QC422 | QME | control cable QME | 3 | QME | QMS | or 10/20 m |
| QME | QMA | Analyzer | 0.2 | QMA | QME | ev. 6 m |
| EP422 | Input | Meas. signal | --- | QMA | EP | ev. 6 m |
| | --- | control cable | 0.8 | QME | EP | |

**2. Channeltron**

In addition to 1. Configuration config-SYSTEM-DETECT:CH-TRON

| Module | Connector | Connection | l [m] | Module | Connector | Comments |
|---|---|---|---|---|---|---|
| QME | HV - | High voltage | 0.3 | QMA | HV - | ev. 6 m |

**3. 90° SEM**

In addition to 1. Configuration config-SYSTEM-DETECT:SEM

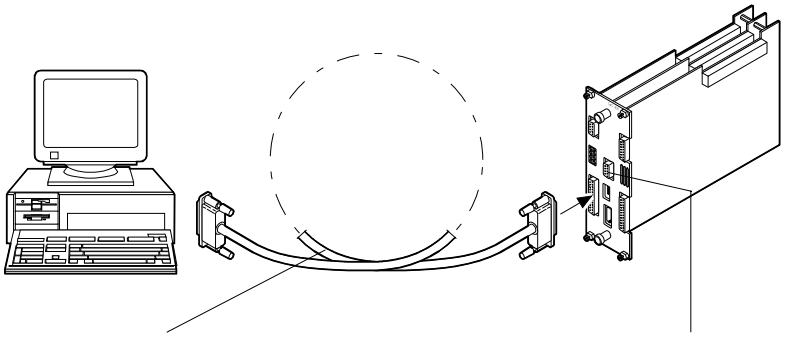
| Module | Connector | Connection | l [m] | Module | Connector | Comments |
|---|---|---|---|---|---|---|
| QME | HV - | High voltage | 0.3 | QMA | HV - | ev. 6 m |
| EP422 | Input | Meas. signal<br>short TNC | --- | QMA | EP(SEM)<br>EP | in SEM mode |
| EP422 | Input | Meas. signal<br>short TNC | --- | QMA | EP<br>EP(SEM) | in Faraday mode |
| | --- | control cable | 0.8 | QME | EP | |

### 4. 90° SEM and ion counter

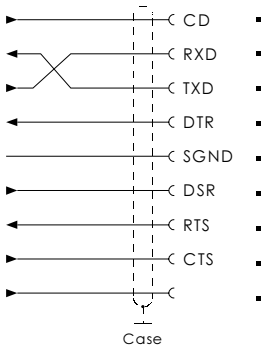
In addition to 1. Configuration config-SYSTEM-DETECT:SEM

| Module | Connector | Connection | l [m] | Module | Connector | Comments |
|---|---|---|---|---|---|---|
| QME | HV - | High voltage | 0.3 | CP | HV - | ev. 6 m |
| | | short SHV | --- | CP | HV + | |
| QC422 | CP | Ion counter | 3 | CP | QC | |
| EP422 | Input | Meas. signal | --- | QMA | EP | |
| | | short TNC | --- | QMA | EP | without EP422 |
| d.o | --- | control cable | 0.8 | QME | EP | |

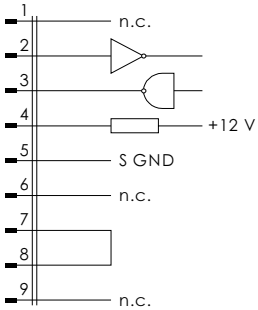
## 4.7 RS-232-C interface



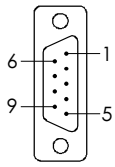
RS-232-C Link cable 9-pin (Null modem)




Circuit in QC 422




D-Sub connector




Front view of QC

Pin assignment

9-pin, male

1 not connected
2 Received Data
3 Transmitted Data
4 Data Terminal Ready
5 Signal Ground
6 not connected
7 Pin 8
8 Pin 7
9 not connected
Case=shield

## 4.8 LAN interface

### Configuring the transmission distance

On the QC 422 check the setting of jumper X20 and correct it, if necessary. Installation/removal of QC 422 (→ 🗎 ).

X20 determines the **Transmission power**, it is determined by the **receiver of the remote station** and the type of fiber-optic (FO) conductor..

The factory default setting **medium** provides a broad compatibility range when old and new FO modules are mixed.

**Procedure:**

Determine the length and type of the FO conductor (glass fiber PCF or plastic fiber APF).

Determine the FO module types to be interconnected:

Modules with serial number: ....W.... or higher (“W“ is increased annually) are equipped with the new FO module type (applies to all component types)

In case of doubt (e.g. after a module has been replaced) open the unit and read off the FO module type, that is, No. TODX 29? on the FO connector.

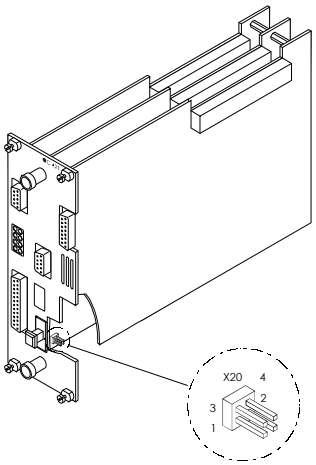
This is necessary because the receivers of earlier LAN modules can be overdriven in short distances, with the new modules this is no longer the case.

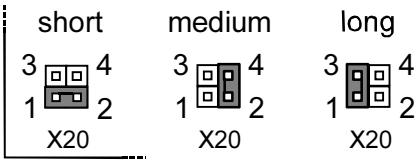
Set jumper X20 on the **transmitter side** as shown in the table and the diagram:

| Setting X20 | New FO module TODX 296 | Old FO module TODX 294 | Old PC interface with SMA connectors |
|---|---|---|---|
| short | 0...500 (0...1.4) m | 0...150 (0...1.2) m | not allowed |
| medium *) | 0...750 (0...2.2) m | 0...400 (0...2.0) m | 0...50 m |
| long | 0...1000 (0...3.0) m | 400...700 (0...3.0) m | 0...300 m |

These values apply to PCF glass fibers, the values in (...) for APF plastic fibers.

*) Factory setting



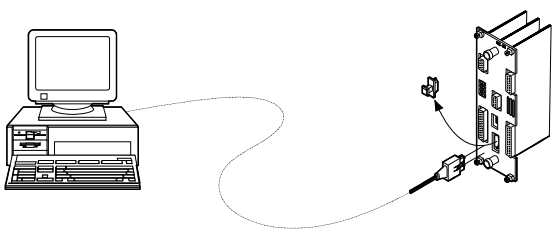




In case of transmission problems test the adjacent setting in order to compensate possible atypical attenuation of the FO conductor.

### Cabling PC-QMG

Install the PC interface board into the PC according to its Operating manual.

Remove the protective caps from the fiber optic connectors and establish the fiber optic link.



Do not kink the fiber optic conductor. The minimum bending radius is 15 mm

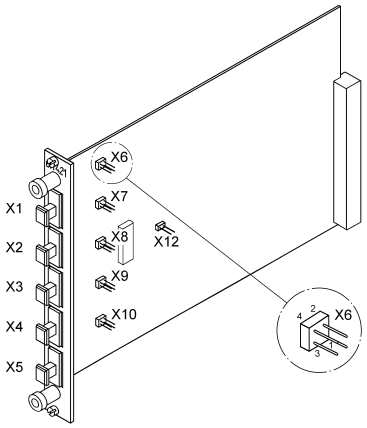
## OH 421

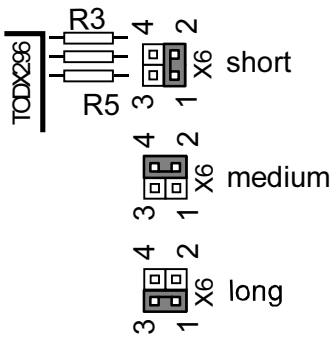
Installation/removal → 29, there is no address setting.

**Settings:**

| Jumper | Function | Purpose |
|---|---|---|
| X12: IN *) | Central hub | First hub directly linked to the PC<br>FO connectors X1 ... X5 are peer-to-peer |
| X12: OUT | Expansion hub | Connected to other hub<br>Connect X1 always in the direction toward the PC!<br>FO connectors X2 ... X5 are peer-to-peer |
| X6...X10 | Transmitter distance setting for connectors X1 ... X5<br>For FO lengths refer to table on 26 | |

*) OH 421 No. BG 442 455-T without X12 can only be used as central hub.

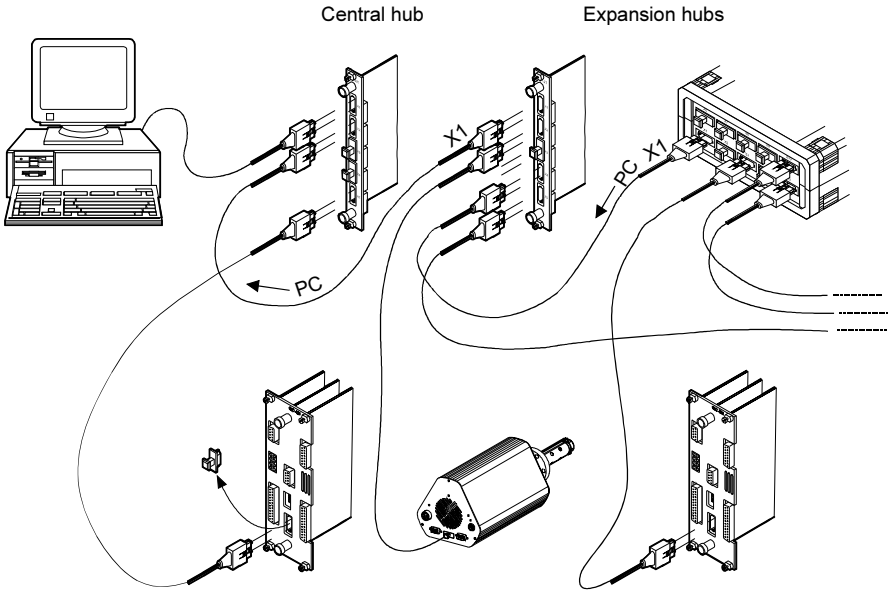



X7...X10 same as X6

## Network

Unused FO connectors should always be closed off with a dummy plug to prevent disturbance by parasitic light.




QC 422, QC 421, QMS 200, OH 421, OHA 200, OH 200 and OPA 200 are compatible.

Note the technical specifications concerning FO conductor lengths and total transmission distance.

Set up all transmitters according the table on 26.

The 1st hub must be configured as the central hub, all others as expansion hubs.

## 4.9 Installing/removing options

Options are factory installed if they have been ordered together with the system. They can also be installed in the field at any time.

**Skilled personnel**

Work on open equipment may only be performed by specialists.

Switch off the unit before any manipulations on the equipment. Wait 10 s and detach all cables (power cable last). For commission perform these steps in reverse order.

**WARNING**

Work may only be performed on ESD protected benches while observing appropriate working methods.

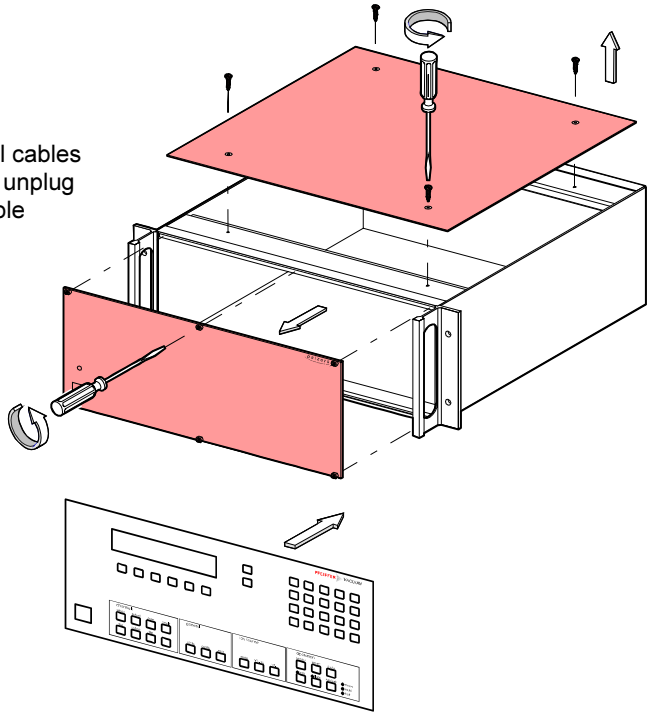
The modules should always be stored in antistatic bags.

Defects caused by the disregard of this warning will void the warranty.

### CS 422

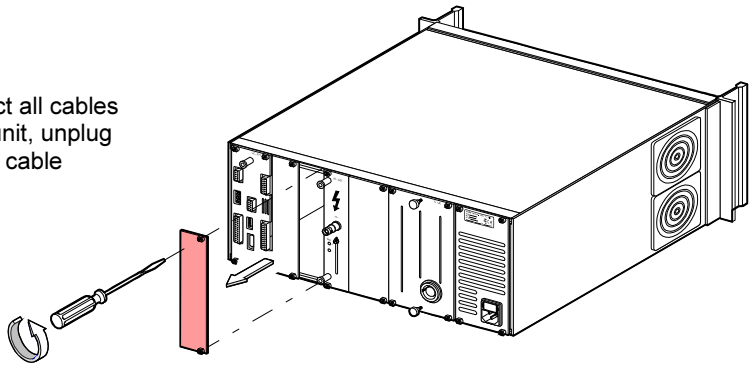
1. Detach the power plug on the QMS 422, wait 10 s
2. Remove the cover panel
3. Unfasten 6 screws of the front panel.
4. Detach the electrical connections of the front panel:
   - Ground connection
   - Flat-pin terminal on the power switch (note the pin assignment)
   - LED connection of the bus board (connector J20)
5. Establish the electrical connections on the CS 422:
   - Ground connection (sequence: head of screw, lock washer, plain washer, cable lug, plain washer
   - Wiring to the power switch, same pin assignment as before.
   - Flat cable to bus board (connector J20)
6. Fasten the front panel
7. Mount he cover panel

Disconnect all cables from the unit, unplug the power cable



## Bus modules

Disconnect all cables from the unit, unplug the power cable



To prevent damage to the connectors the module to be installed must be accurately pushed into the circuit board guides.

Firmly tighten the screws. Loose screws cause malfunctions.

**DANGER**

As hazardous voltages are present inside the unit empty slots must be closed off with blanking plates (→ 🗎 65).

Never connect or detach cables while the equipment is switched on.

Never install or remove modules when the equipment is switched on. After power off wait 10 s before you touch or move any modules.

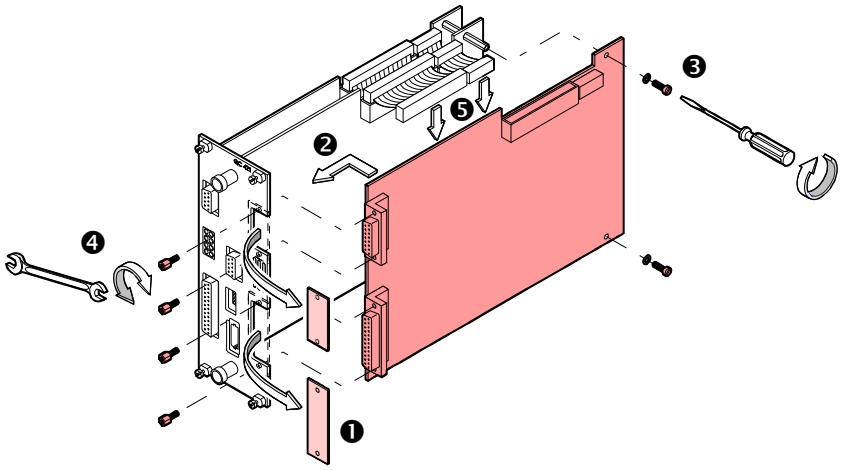
Always tighten the screws firmly!

Before installation check the module address according to the specifications of the individual modules.

### AO 421 / IC 421

The analog output AO 421 and the ion counter IC 421 are mounted on one board.

- Disconnect the power cable and wait 10 sec.
- Install/remove the QC 422 as described above
- Remove the connector cover(s) ❶ according to the option to be installed.
- Install the AO/IC 421 as shown in the illustration. Install the hexagon pins ❹ without washers and secure them with Loctite.

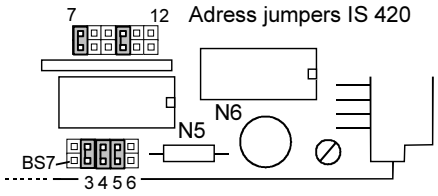


## IS 420

Check address setting:

Address 175 500(octal)

Jumpers A3,4,5,7,10 inserted on IC 420

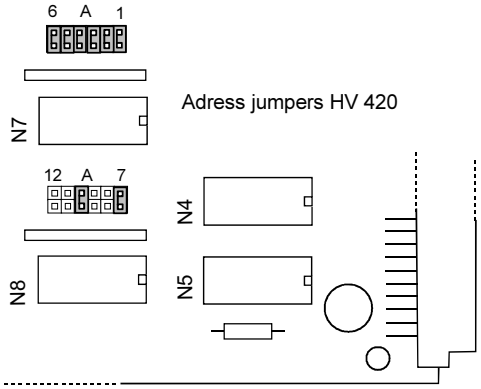



## HV 420

Check address setting:

Address 175 400(octal)

Jumpers A1,2,3,4,5,6,7,10 inserted




## HV 421

The address 175 404 is fixed. Jumpers: X6 all OUT, X7 IN, X8:2-4 connected.

Jumper plugs are inserted on the SHV terminals, depending on the operating mode of the SEM (→ 🗎 23).

### Setting the CD voltage

The CD or bias voltage can be set with trimmer R4. Measure the value with a DVM on **CD-test**. Before making any adjustments switch off the unit and remove the HV 421. One counterclockwise rotation reduces the CD voltage by approx. 150 V or the bias voltage by approx. 80 V. Reinstall, re-measure and correct the setting, if necessary. Do not change the settings of any other trimmers!

## DI 420

Up to 2 DI 420 can be installed.

Address setting: Jumpers A6, 9, 10 inserted

| | |
|---|---|
| DI 420 #1 | 174 600(octal), rotary switch position 0 |
| DI 420 #2 | 174 604(octal), rotary switch position 1 |

For connecting the inputs see technical specifications 🗎 19

## DO 420A

Up to 3 DO 420A can be installed. (DO 420 is not suited)

Address setting: Jumpers A9,10 inserted

| | |
|---|---|
| DO 420 #1 | 174 700(octal), rotary switch position 0 |
| DO 420 #2 | 174 704(octal), rotary switch position 1 |
| DO 420 #3 | 174 710(octal), rotary switch position 2 |

For connecting the outputs see technical specifications 🗎 19

## AI 421

One AI 421 can be installed (AI 420 is not suited)

Jumper setting:

Jumpers: A6, 7, 9, 10, B, C, D, E inserted

Address 174 400(octal), rotary switch position 0

For connecting the inputs see technical specifications 🗎 20

## PI 420 / PE 420

PI 420: Address: 174 000, see also → 🕮 [8]

PE 420: Address: 174 100, see also → 🕮 [9]

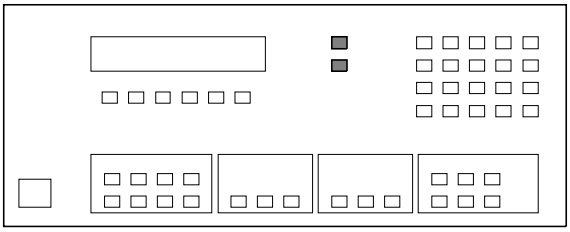
# 5 Description

## 5.1 Operator console

In the basic version of the QMS 422 and on the QMI 422 the front panel contains only a power switch and the corresponding LED.

The CS 422 operator console is available as an option. It can easily be retrofitted and is highly recommended for learning purposes, e.g. for software development. Even if you do not have a CS 422 you should carefully read the following information. This will enhance your understanding also in computer mode.

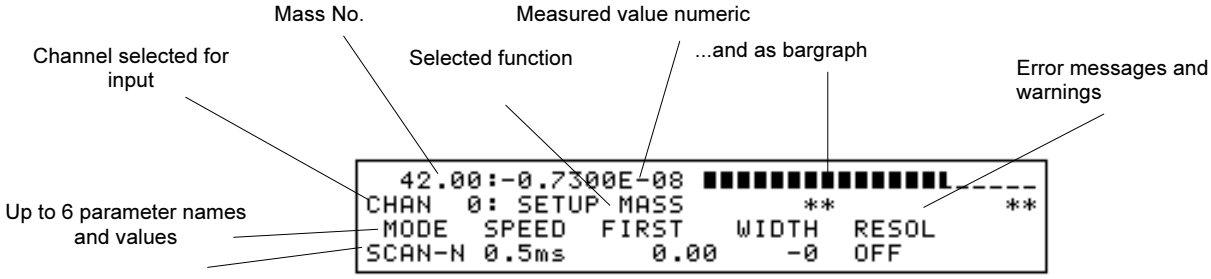
### Contrast setting



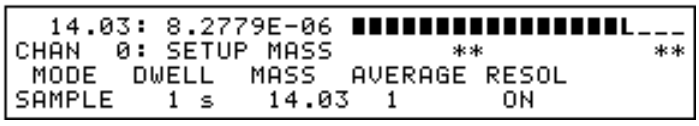
With the   keys you can optimize the display contrast.

### Parameter display

After a function has been selected, e.g. (*mass* key) the function (SETUP MASS), its parameters (here *MODE*, *SPEED*...*RESOL*) and parameter values and the measured value of the selected channel are displayed.



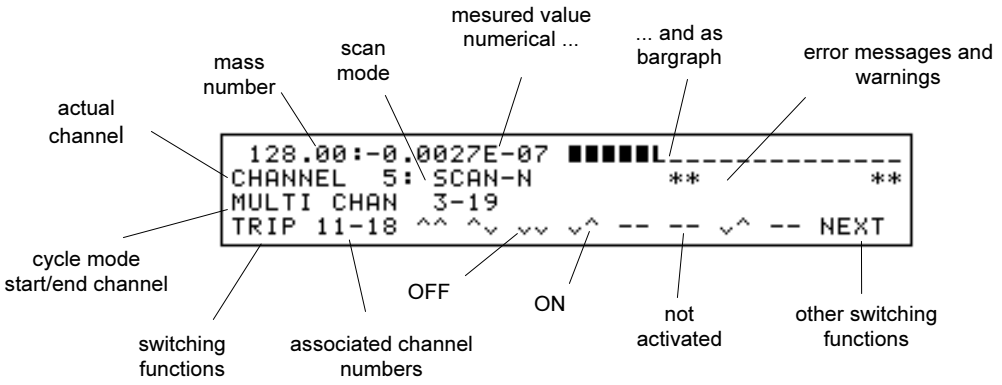

Parameter menus depend on the parameter state; in the picture below a changeover to *MODE:SAMPLE* has been made




In computer mode the parameters are displayed for approx. 30 s when a key is pressed. Input operations are disabled. Subsequently the measured value display reappears automatically.

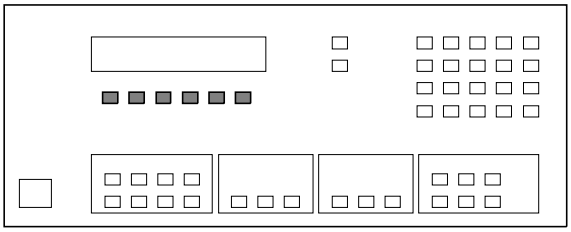
## Measured value display

After the start (**run** key) of the measurement cycle the measured value of the momentary measurement channel is displayed. In multichannel mode (*cycle-MODE:MULTI*) the progression of the channels can be seen (possibly with gaps in fast processes)




In computer mode the display is updated for monitoring purposes.

## Softkeys

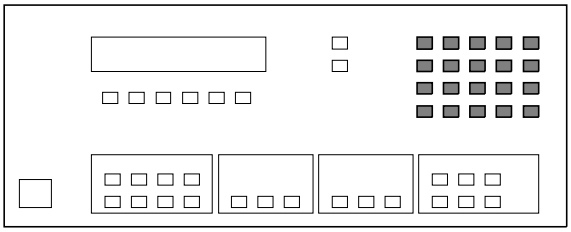


Choose the parameter to be entered with one of the 6 softkeys. After the key has been pressed the parameter value flashes.

If the parameter has only two values (e.g. ON/OFF or ×1/×10) you can change it by simply pressing the soft key again.

Parameter values are entered or changed via the numeric keypad.

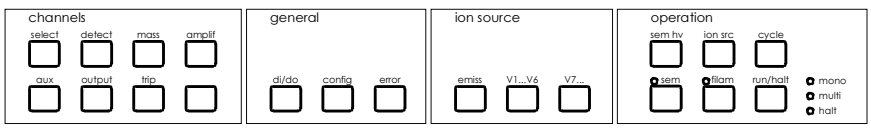
## Number pad



| | | | |
|---|---|---|---|
| 0 ... 9 | numeric keys | +/– | change sign |
| . | decimal point | exp | exponential entry |
| del | cancel and return to measured value display | ↵ | Accept new value (Enter) |
| ^ v | Change parameters in small increments ... | | |
| ^^ vv | ... and in large increments. When the keys are pressed continuously the entire value range is scanned. The new value becomes effective without ↵ | | |

## Function groups

The operation is subdivided into four **function groups:**



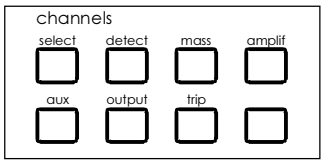

Their function is described in the next Chapter.

Each group comprises several function keys for calling a function (e.g. *mass* in the *channels* group). Each function contains up to 6 parameters.

## 5.2 Functions

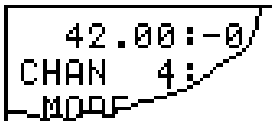
Parameters for operating the mass filter and for ion detection can be stored in up to 64 channels. When the measurement is performed the channels are processed sequentially and cyclically.

### *Channels* group




Control keys for all parameters of a measurement channel

**select**




Choose a channel for parameter input.

All values entered under **channels** relate to this **selected** channel.

**detect**

Determines the signal source (detector, e.g. Faraday or SEM).

**mass**

Mass scan parameters such as mass number, speed, etc.

**amplif**

Measurement amplifier parameters, measurement ranges, Autorange/Fixrange....

**aux**

Enable or skip the channel during the measurement operation and copy parameter sets to different channels.

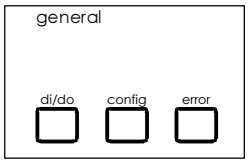
**output**

Parameters for analog output of measured values, e.g. linear or logarithmic.

**trip**

Parameters of the switching functions of each measurement channel.

### *General* group




Keys for general settings such as configuration, initialization, maintenance and service, and processing of error messages.

**di/do**

Operation of DI-/DO-Bits.

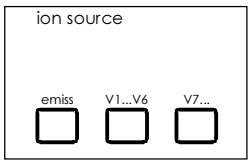
**config**

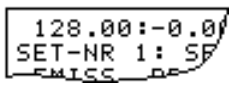
Input and display of system and equipment configuration.

**error**

Error messages are displayed here in detail.

### *ion source* group




Parameters of the selected ion source set. The set is chosen under *operation-ion src* and displayed here.

**emiss**


Emission current and filament protection

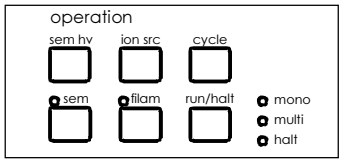
**v1...v6**

400 Ion source voltages V1...V6.

**v7...**

400 Ion source voltages V7...V9.

***operation* group**




Control keys for operation of:

- SEM
- ion source
- measurement process

**sem hv**

*sem hv* defines the global SEM high voltage. It is effective in all channels for which no individual voltage is specified.

**sem**

Switch SEM high voltage on/off

The *sem* LED is on when the high voltage is switched on and flashes when it is inhibited by the EXT-PROT signal on the **ctrl** connector.

**ion src**

400 Ion source mode: Filament selection, degas, etc.

The ion source parameters are channel-independent and are selected as a complete set. This allows fast parameter change.

The ion source parameters of the set belonging to the active filament can be reviewed in the *ion source* group.

125 Control of ion source supply for QME 125

**filam**

Switch filament on/off

The *filam* LED is on when the emission is on and flashes when it is inhibited by the EXT-PROT signal on the **ctrl** connector.

**cycle**

Choose measurement cycle mode or offset or adjustment measurement. Input of the corresponding parameters.

**run/halt**

START / STOP of the measurement defined under *cycle*.

The *mono* or *multi* LED is on while the measurement cycle is running and flashes while waiting for external triggering by the RUN-IN signal on the **ctrl** connector.

The *halt* LED is on when the measurement cycle is stopped and flashes if the measurement cycle has been stopped by external triggering.

## 5.3 Parameter list

The parameters below are listed in alphabetic order by name.

Notation:

***DETECT (config-SYSTEM)***

Parameter — of the function — possibly subfunction(s)

Additional information on the utilization, the advantages and disadvantages of individual settings can be found in Chapter 6.

### ADJ-TYP (cycle)

| *ADJ-TYP* | Type of search with *cycle-FUNCT:ADJUST* |
|---|---|
| *COARSE* | Coarse search → 52 |
| *FINE* | Fine search → 54. |

### AI-CH (detect)

| *AI-CH* | Only with *detect-TYPE:A-INPUT* |
|---|---|
| *0 ... 15* | AI 421 channel number to be measured |

### AO-CH (output)

| *AO-CH* | Not with *detect-TYPE:PIRANI, PENNING, A-INPUT* |
|---|---|
| *1 ... 12* | Output channel of AO 421 or IC 421 for the measured value of the selected channel. |
| *NONE* | No analog output assigned |

In *halt* condition the outputs are set to 0 V, except when they are seized by computer outputs.

### AO-MODE (output)

Format selection for analog output to AO / IC 421 and ***mon*** (→ 55).

**Electrometer in Fix-Range:**

| *AO-MODE* | *amplif-MODE:FIX* and *detect-TYPE:FARAD,SEM,EXTERN* |
|---|---|
| *LIN* | Linear output in selected measurement *RANGE* |
| *LOG 3D* | Logarithmic, 3 decades, 3⅓ V / dec. within *RANGE* |

**Electrometer in Auto-Range:**

| *AO-MODE* | *amplif-MODE:AUTO, AUTO-D* and *detect-TYPE:FARAD,SEM* |
|---|---|
| *LIN* | Linear output within range selected with *O-RNG* |
| *LOG 3D* | Logarithmic, 3 decades, 3⅓ V / dec. within range selected with *O-RNG* |
| *LOG 8D** | Logarithmic, 8 decades, 1.25 V / dec. across all ranges |

*) With *mass-MODE:SCAN* or *PEAK* and *SPEED* <100 ms/u, with *STAIR* < 10ms/u a changeover to 3 decades occurs automatically

**Ion counter:**

| *AO-MODE* | *LOG-DEC* | *detect-TYPE:ION-CNT* |
|---|---|---|
| *LIN* | ----- | Linear output within the range selected with *O-RANGE* |
| *LOG* | *3 DEC* | Logarithmic, 3 decades, 3⅓ V / dec. within the range selected with *O-RANGE.* |
| *LOG* | *10 DEC** | Logarithmic, 10 decades, 1 V / dec. $10^{-1}$...$10^{8}$ cps |

*) With *mass-MODE:SCAN* or *PEAK* and *SPEED* < 50 ms/u a changeover to 3 decades occurs automatically.

### AVERAGE (mass)

Moving average across measurement cycles → 51

| *AVERAGE* | Only with *mass-MODE:SAMPLE* and *detect-TYPE:FARAD,SEM,ION-CNT,EXTERN* |
|---|---|
| *1* | No averaging across measurement cycles |
| *2, 4, 8... ...512, 1024* | Number of measurement cycles for forming average |

BAUD (config-CTRL)

| *BAUD* | Only with *config-CTRL-MODE:ASCII, BIN and MODEM* |
|---|---|
| *300, 1200, 2400<br>4800, 9600, 19200* | Baud rate of the RS232 interface, can always be set on the CS 422 (300 baud only with ASCII protocol) |

BEGIN (cycle)

| *BEGIN* | With *cycle-FUNCT:CYCLE and cycle-MODE:MULTI* |
|---|---|
| *0 ... 63* | Start channel of the measurement cycle with *cycle-MODE:MULTI* |

BIT (di/do-DIG-OUT)

See DIG-OUT

CALIB (amplif)

| *CALIB* | Calibration factor for measured value. |
|---|---|
| $\pm 1E^{-10}$ ... $\pm 9{,}99E^{+10}$ | The raw measured value is multiplied times *CALIB* |

Can be used for either normalizing a measured value, e.g. from 7.7 V to 10 V (100%) or for conversion from [A] to [mbar].

In the following cases multiplication takes place only with the mantissa of *CALIB*:

- For the computer interface with *amplif-MODE:FIX* or *detect-TYPE:EXTERN* and *mass-MODE:SCAN* or *PEAK*
- Always for the analog signals on the AO/IC 421 and *mon*

CATH (v1...v6)

→ *V2*

CLEAR (di/do-DIG-OUT)

→ DIG-OUT

CLEAR (error)

Deletes all pending error messages

CLEAR (cycle-FUNCT-OFFSET)

Sets all offset values to zero and consequently disables offset correction

COPY TO CH (aux)

| *COPY TO CH* | Copies parameters of the selected channel to another channel |
|---|---|
| *0 .. 63* | Target channel for copying process |
| *SURE ?* | Confirm copy function by pressing ↵ |

COPY TO ALL (aux)

| *COPY TO ALL* | Copies the parameters of the selected channel to the channels *cycle-BEGIN...-END.* |
|---|---|
| *SURE ?* | Confirm copy function by pressing ↵ |

COPY TO SET (ion src)

| *COPY TO SET* | Copies the IQ set activated under *ion src-FIL1 or FIL2* |
|---|---|
| *SET 0 .. SET 3* | Target set for the copying process (only with *ion src-MODE:NORMAL)* |

CP-LEV (amplif)

| *CP-LEV* | Only with *detect-TYPE:ION-CNT* |
|---|---|
| *0.10 .. 1.00 V* | Response threshold of the CP 400 → 17 |

CS 422 (config)

→ under *TEST*

CTRL (config)

See BAUD, MODE, NODE or SEM+FIL

CTRL (ion src)

| *CTRL* | Only with *ion src-MODE:DEGAS* |
|---|---|
| *STOP* | Switch Degas off |
| *START* | Switch Degas on |
| *SURE ?* | Confirm Degas activation with ↵ |
| *RUN* | Degas switched on |

CYCLES (cycle)

| CYCLES | With *cycle-FUNCT:CYCLE* |
|---|---|
| *REPEAT (0)* | The measurement cycle is repeated endlessly. |
| *1 ... 10'000* | Number of measurement cycles to be executed |

D-EMIS (ion src)

| | D-EMIS | With *ion src-MODE:DEGAS* |
|---|---|---|
| 400 | *0.0 ... 20.0 mA* | Emission current in Degas mode. |

D-PROT (ion src)

| | D-PROT | With *ion src-MODE:DEGAS* |
|---|---|---|
| 400 | *0.00 ... 5.00 A* | Maximum filament current in Degas mode |

D-TIME (ion src)

| D-TIME | With *ion src-MODE:DEGAS* |
|---|---|
| *MANUAL (0)* | Degas runs until stop command is given |
| *1 ... 99 min* | Degas duration. The remaining time is displayed. |

DEF-I (v1...v6)

Deflection inside, see *V6*

DETECT (config-SYSTEM)

| | DETECT | Specification of the existing signal source (ion collector) |
|---|---|---|
| | *FARAD* | Faraday collector |
| | *SEM* | 90° SEM |
| 400 | *CD-SEM* | 90° SEM with conversion dynode |
| 400 | *H-SEM* | High SEM, only with *config-SYSTEM-OPTION:CP* |
| 125 | *CH-TRON* | Channeltron/Faraday combination |

DIG-IN (di/do)

Status indication of the DI 420 input bits, not dependent on measurement channel. *NEXT* switches to the next 32 bits.

DIG-OUT (di/do)

Display / manual operation of the DO 420A output bits, not dependent on measurement channel.

| | |
|---|---|
| *BIT* | Choose DO bit to be operated |
| *SET* | Set DO bit |
| *CLEAR* | Clear DO bits |
| *NEXT* | Advance to next 32 DO bits |

DISP-T (config)

See *TEST-CS 422*

DO-A, DO-B (trip)

Assignment of a switching function A or B to any bit of a DO 420A. If several switching functions are assigned to the same bit they are combined in an AND function → Section 6.14.

| DO-A, DO-B | With *mass-MODE:SAMPLE or detect-TYPE:PIRANI, PENNING; A-INPUT* |
|---|---|
| *OFF* | No assignment, output remains high impedance |
| *0 ... 95* | Assignment of the switching functions to the DO 420A output bit |

The DO 420A outputs can also be operated manually or via interfaces.

DSP (config)

See *TEST*

DWELL (mass)

Measurement time on mass number *MASS* with *mass-MODE:SAMPLE*

**Electrometer or Extern:**

| *DWELL* | *detect-TYPE:FARAD, SEM or EXTERN* |
|---|---|
| *0.5, 1, 2, 5, 10, 20, 50 ms*<br>*0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 60 s* | The measured value is determined by averaging across the DWELL time. |

**Ion counter:**

| *DWELL* | *detect-TYPE:ION-CNT* |
|---|---|
| *1 ms ... 60 s* | Counting rate = pulse count / *DWELL* |

E-PROT (emiss)

| 400 *E-PROT* | Filament protection |
|---|---|
| *0.00 ... 5.00 A* | When the set current threshold is exceeded the filament is switched off and an error message is output. |

EMI-CUR (ion src)

| 125 *EMI-CUR* | Switch between displaying emission current and electrometer value. |
|---|---|
| *OFF* | Display electrometer value |
| *ON* | Display emission current |

The measurement cycle must be stopped (halt).

EMISS (emiss)

| 400 *EMISS* | Emission current set point |
|---|---|
| *OFF* | Emission switched off |
| *0.01 ... 2.00 mA* | Emission current |

END (cycle)

| *END* | With *cycle-FUNCT:CYCLE and cycle-MODE:MULTI* |
|---|---|
| *0 ... 63* | Ending channel of the measurement cycle with *cycle-MODE:MULTI* |

EPROM-T (config)

See *TEST-CS 422, TEST-DSP* and *TEST-QMS*

EXTRACT (v1...v6)

See *V5*

F-AXIS (v1...v6)

See *V4*

FIL1, FIL2 (ion src)

Assignment of an ion source parameter set to filament 1 or 2. Applies also to the assignment with *SPEC±* (without filament).

| *FIL1, FIL2* | With *ion src-MODE:NORMAL* |
|---|---|
| *SET 0 ... SET 3* | Assignment of the ion source parameter set |

FILAM (ion src)

Filament selection for ion sources containing two filaments

| 400 *FILAM* | Not with *config-SYSTEM-IS-TYP:AXIAL* |
|---|---|
| *1* | Filament 1 |
| *2* | Filament 2 |
| *1+2* | Filament 1 in operation, filament 2 is pre-heated.<br>If filament 1 is defective filament 2 is automatically activated. This results in a brief fading of the emission. |

| 125 *FILAM* | **filament select** switch on QME 125 → 🕮 [3] set to **remote** ! |
|---|---|
| *1* | Filament 1 in normal operation / 1+2 with DEGAS |
| *2* | Filament 2 |

FILTER (amplif)

Time constant of the analog filter for the electrometer signal

| *FILTER* | With detect-TYPE:FARAD, SEM and EXTERN |
|---|---|
| *18 µs ... 800 ms* | Manual setting for special requirements. Choose a filter value that is appropriate to the measuring speed. |
| *AUTO* | The analog filter is automatically set as follows: |

| *SPEED* [ms/u] *DWELL* [ms] | *FILTER* | *SPEED* [s/u] *DWELL* [s] | *FILTER* |
|---|---|---|---|
| 0.5 / 1 | 18 µs | 0.2 / 0.5 | 8 ms* |
| 2 / 5 | 85 µs | 1 / 2 | 40 ms** |
| 10 / 20 | 400 µs | 5 / 10 | 180 ms |
| 50 / 100 | 1.7 ms | 20 / 60 | 800 ms |

*) Minimum value in *RANGE* $10^{-11}$ **) Minimum value in range *RANGE* $10^{-12}$

With *amplif-MODE:AUTO* or *AUTO-D* an optimum filter is automatically used.

With *mass-MODE:SAMPLE* (MID mode) a fast filter results in faster settling times which means that *PAUSE* can be shortened.

Signals above the maximum range of ±10.24 V (e.g. noise) are clipped. In this case the subsequent processing (e.g. averaging) may possibly be incorrect. In critical cases the electrometer signal must be analyzed with an oscilloscope or with Quadstar 422 in *mass-MODE:SCAN-N* so that it can be optimized.

With *mass-MODE:SCAN-F* the FIR filter provides for additional filtering.

FILTER (config)

See *TEST-SERVICE*

FIRST (mass)

Starting mass number of the mass scan

| *FIRST* | With *mass-MODE: SCAN, STAIR* and *PEAK* |
|---|---|
| *0.00 ... max. 2047.99* | The maximum value depends on the mass range |

The mass number is displayed as a decimal value; internally steps of 1/64 u are used. At high *SPEED* the resolution decreases to 1/32 or 1/16 (→ 12).

FOCUS (v1...v6)

See *V3*

F.S.+/ F.S.– (config)

See *TEST-SERVICE*

FUNCT (cycle)

| *FUNCT* | Measurement cycle mode, can only be changed in *halt* condition |
|---|---|
| *CYCLE* | Normal measurement operation |
| *ADJUST* | Adjustment to peak top with *mass-MODE:SAMPLE* →6.12 |
| *OFFSET* | Offset correction of the EP 422 → 47 |

GAIN (amplif)

| *GAIN* | With *detect-TYPE:EXTERN* |
|---|---|
| *×1, ×10, ×-1, ×-10* | Post-amplification factor for the Extern signal |

INIT (config)

| *RESET* | Load standard parameters (according to *config-SYSTEM)* → 66 |
|---|---|
| *FACTORY* | Load standard parameters set by pressing ↵ |
| *SURE ?* | Confirm with ↵ , the old parameters are irretrievably lost! |

IONREF (v1...v6)

See *V1*

IS-TYP (config)

| IS-TYP | Specify the ion source installed in the QMA. |
|---|---|
| *AXIAL* | Axial ion source |
| *CB* | Cross-beam ion source |
| *GRID* | Grid ion source |
| *SPM* | Sputter process monitor ion source |
| 400 *SPEC+* | Special ion source positive ions |
| 400 *SPEC–* | Special ion source negative ions |

KEY-T (config)

See *TEST-CS 422*

LEVEL-A, -B (trip)

Threshold values of the switching functions

| *LEVEL-A*<br>*LEVEL-B* | *TYPE* | With *mass-MODE:SAMPLE or*<br>*detect-TYPE:PIRANI,PENNING,A-INPUT* |
|---|---|---|
| *1×10$^{-24}$.....* | *ABS* | Threshold value of the switching function A or B |
| *.....9,99×10$^{+24}$* | *HYST* | Upper (A) and lower (B) threshold |
| | *OFF* | Switching function off |

If with *TYPE:HYST* : LEVEL-A < 1.1×LEVEL-B this minimum hysteresis is automatically set.

LOG-DEC (output)

See AO-MODE: ion counter → 35

MASS (cycle)

With cycle-FUNCT:ADJUST and cycle-MODE:MONO, See below MASS(mass)

MASS (mass)

In SAMPLE (MID) mode measurement takes place on this mass number during the measurement time *DWELL* and the average value of the measurement signal is formed.
The measurement resolution is up to 24 bits (mantissa)

| *MASS* | With *mass-MODE:SAMPLE* |
|---|---|
| *0.00 ... max. 2047.99* | The maximum value depends on the mass range |

MASS-R (config-SYSTEM)

Configuration specification of the existing measurement rage (HF generator)

| *MASS-R* | *QME-Typ* | *MASS-R* | *QMH-Typ* | *MASS-R* | *QMH-Typ* |
|---|---|---|---|---|---|
| *100* | *QME 125-1* | *128* | *QMH 400-1* | *1024* | *QMH 410-1* |
| *200* | *QME 125-2* | *512* | *QMH 400-5* | *2048* | *QMH 410-2* |
| | | *300* | *d.o.+QMA 430* | *340* | *QMH 410-3* |

MODE (amplif)

Operating mode of the electrometer amplifier

| *MODE* | With *detect-TYPE:FARAD* and *SEM* |
|---|---|
| *AUTO* | Automatic changeover across all measurement ranges, very universal |
| *AUTO-D* | Automatic changeover down to the lower search limit *RANGE-L*. |
| *FIX* | Manual range selection for fastest measurements |

MODE (config-CTRL)

| *MODE* | Controlling interface |
|---|---|
| *CS 422* | Console CS 422 |
| *ASCII* | RS-232-C in ASCII format |
| *BIN* | RS-232-C in binary format |
| *MODEM* | RS-232-C with modem in binary format |
| *LAN* | Arcnet interface |

Each interface can switch to itself and thereby interrupt others.

MODE (config)

See *TEST-SERVICE*

MODE (cycle)

| *MODE* | Measurement cycle mode. The cycle is started/stopped with *run/halt* |
|---|---|
| *MONO* | Single channel measurement in selected channel |
| *MULTI* | Measurement of the channels between *BEGIN* and *END*. Channels that are in *aux-STATE:SKIP* state will be skipped. |

MODE (ion src)

| *MODE* | Ion source mode |
|---|---|
| *NORMAL* | Normal operation with the parameters defined in the ion source set. |
| *DEGAS* | Degas mode. The necessary parameters are entered directly. |

MODE (mass)

Mass scan mode, for details refer to 🗎 50

| *MODE* | Not with *detect-TYPE:PIRANI, PENNING* and *A-INPUT* |
|---|---|
| *SCAN-N* | Normal spectrum from the start mass *FIRST* across the scan width *WIDTH* at the speed set with *SPEED.* |
| *SCAN-F* | Same, with FIR filter. |
| *STAIR* | Spectrum with integer mass jumps |
| *SAMPLE* | Measurement on mass *MASS* with averaging across *DWELL* time. |
| *PEAK-L* | Peak search (Level criterion) from *FIRST* via *WIDTH* with the speed *SPEED.* Significant data reduction because only the intensities and mass number of detected peaks are output. |
| *PEAK-F* | Same, with FIR filter. |

MONITOR (output)

Format of the measured value at the analog output *mon*

| *MONITOR* | Not with *detect-TYPE:PIRANI, PENNING* and *A-INPUT* |
|---|---|
| *LIN / LOG* | See *AO-MODE* |
| *RNG-CODE* | Range-Code: E-12=1V.. E-5=8V (only for test purposes) |

NEG (config)

See *TEST-SERVICE*

NEXT (di/do)

Display next 32 bits with *DIG-IN* and *DIG-OUT*

NEXT (error)

Next error message, if more than one exists.

NODE (config-CTRL)

| *NODE* | Only with *config-CTRL-MODE:LAN* |
|---|---|
| *1 ... 255* | ARCNET node address |

OFFSET (config)

See *TEST-SERVICE*

OFFSET (cycle-FUNCT)

Offset correction, see *FUNCT(cycle)*

OPTION (config-SYSTEM)

| *OPTION* | Configuration input for CP 400 ion counter preamplifier |
|---|---|
| *NO* | No CP 400 |
| *CP* | CP 400 exists |

O-RNG (output)

Output-Range of AO 421 and *mon*, see *AO- MODE*

| *O-RNG* | with *detect-TYPE:ION-CNT* or *amplif-MODE:AUTO, AUTO-D* |
|---|---|
| *E-1 ... E+8* | In ion counter mode |
| *E-5 ... E-12* | In electrometer mode |

PAUSE (amplif)

Measurement pause during channel change (→ 🗎 49).

Not with *detect-TYPE:PIRANI, PENNING* and *A-INPUT*.

The actual pause time is displayed if it can be calculated. AUTO is displayed with *amplif-MODE:AUTO* or *AUTO-D*. However, *P-CAL* is still effective.

Press the *PAUSE* soft key to get to the *P-CAL* submenu.

P-CAL (amplif-PAUSE)

| *P-CAL* | |
|---|---|
| *0.0 ... 9.9* | Pause time calibration factor → 🗎 49 |

PE-CTRL (detect)

| *PE-CTRL* | With *detect-TYPE:PENNING* |
|---|---|
| *OFF* | Penning switched off |
| *ON* | Penning switched on (wait for ignition, pressure dependent) |

PI-CH (detect)

| *PI-CH* | With *detect-TYPE:PIRANI* |
|---|---|
| *0 / 1* | Pirani channel to be measured |

POS (config)

See *TEST-SERVICE*

PRG-NR (config)

See *TEST-CS 422, -DSP* and *-QMS*

QMA (config-SYSTEM)

| *QMA* | | Configuration input of the QMA type based on which the unit recognizes the family |
|---|---|---|
| *125* | 125 | QMA with 6 mm rod system |
| *400* | 400 | QMA with 8 mm rod system |
| *410* | 400 | QMA with 16 mm rod system |
| *430* | 400 | QMA with 8 mm rod system (stainless steel) |

QMS (config)

See *TEST*

QMS-HW (config)

The unit detects its modules automatically, as far as possible, and displays them.

RAM-T (config)

See *TEST-CS 422, -DSP* and *-QMS*

RANGE (amplif)

| *RANGE* | With *amplif-MODE:FIX* and *detect-TYPE:FARAD* or *SEM* |
|---|---|
| *E-12 ... E-5* | Manual electrometer range selection |

RANGE-L (amplif)

| *RANGE-L* | With *amplif-MODE:AUTO-D* and *detect-TYPE:FARAD* or *SEM* |
|---|---|
| *E-12 ... E-5* | Lower search limit with *AUTO-D* |

RESET (config)

See *INIT*

RESOL (mass)

400 Setting of the mass peak separation (resolution)

| *RESOL* | With *detect-TYPE:FARAD, SEM, ION-CNT, EXTERN* |
|---|---|
| *OFF (0)* | Integral mass spectrum (DC OFF) |
| *1 ... 255* | Mass peak separation. The peak width is approximately proportional to the set number. Unit resolution at 20...30 (with QMH 400-1: ≈100) |

Often unit resolution suffices, that is, resolution of the adjacent peaks.

Decreasing the mass peak separation (larger number!) causes wider peaks and higher sensitivity.

| 125 *RESOL* | Changeover Spectrum/Integral |
|---|---|
| *OFF* | Integral mass spectrum (DC OFF) |
| *ON* | Normal mass spectrum (DC ON) |

RETURN (....)

Return from a submenu to the preceding menu

SELF (config)

See *TEST-SERVICE*

SELF/CH (config)

See *TEST-SERVICE*

SEM (detect)

Channel related SEM high voltage

| *SEM* | With *detect-TYPE:SEM, ION-CNT, EXTERN* |
|---|---|
| *SEM-HV (0)* | The global value entered with *sem hv-SEM-VOLTAGE* is applicable. |
| *1 ... 3500 V* | Individual SEM high voltage for the selected measurement channel. |

The individual SEM high voltage leads to long settling times and makes sense only in special cases.

With High SEM (*config-SYSTEM-DETECT:H-SEM*) the minimum value is 750 V (→ 🖹 18).

SEM+FIL (config-CTRL)

| | |
|---|---|
| *SEM+FIL* | Control of filament and SEM supply |
| *INTERN* | Control with CS 422 or interface. |
| *EXTERN* | Control with EXT-PROT signal on **ctrl** connector:<br>• Contact open: SEM+FIL switched off.<br>• Contact closed: SEM+FIL switched on. |
| *EXT-PROT* | Switch-off with EXT-PROT signal on **ctrl** connector:<br>• Contact open: Switch-off and inhibition of switch-on.<br>• Contact closed: Enables switching on SEM+FIL via CS 422 or interface. |

SEM-VOLTAGE (sem hv)

Global SEM high voltage. It is valid for all measurement channels for which no individual setting has been defined with detect-SEM:SEM-HV.

| | |
|---|---|
| *SEM-VOLTAGE* | Not with *config-SYSTEM-DETECT:FARAD* |
| *0 ... 3500 V* | Global SEM high voltage |

With High SEM (*config-SYSTEM-DETECT:H-SEM*) the minimum value is 750 V
→ 18

SERVICE (config)

See TEST

SET (di/do)

See DIG-OUT

SET (ion src)

See FIL1, FIL2

SIMUL (config)

| | |
|---|---|
| *SIMUL* | Simulation spectrum for test purposes (→ 48). |
| *OFF* | Simulation switched off. |
| *INTERN* | Simulation via QC internal measurement path. |
| *EXTERN* | Simulation via QC external connection. Only for factory use, additional hardware required. |

If no error message exists the warning SIMULATION is displayed.

SPEED (mass)

Speed for mass scan

| *SPEED* | Not with *mass-MODE:SAMPLE* or *detect-TYPE:PIRANI, PENNING, A-INPUT* |
|---|---|
| *0.5, 1, 2, 5, 10, 20, 50 ms/u*<br>*0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 60 s/u* | With detect-TYPE:FARAD, SEM, EXTERN and *amplif-MODE:FIX* |
| *10 ms/u ... 60 s/u* | With detect-TYPE:FARAD, SEM, EXTERN and *amplif-MODE:AUTO, AUTO-D* |
| *2 ms/u ... 60 s/u* | With *detect-TYPE:ION-CNT* and *mass-MODE:STAIR* |
| *20 ms/u ... 60 s/u* | With *detect-TYPE:ION-CNT* and *mass-MODE:SCAN* and *PEAK* |

STATE (aux)

| | |
|---|---|
| *STATE* | Enable or skip a channel in multichannel mode |
| *SKIP* | Skip channel. |
| *ENABLE* | Measure channel. |

STEPS

Reduces the number of measured values/u transmitted via the interface with mass-MODE:SCAN to ½ or ¼; this parameter can only be operated via the interface.

SYSTEM (config)

From the system configuration defined here the unit determined the possible operating modes and parameter sets.

Expansion with bus modules is detected automatically by the unit.

See sub menus *QMA, MASS-R, IS-TYP, DETECT, OPTION.*

TEST (config)

Test and alignment programs for service purposes.

The individual tests are initiated with the soft keys, endless tests are terminated with del. During a test the word BUSY is displayed, the result in shown in the status line for approximately ten seconds.

| | |
|---|---|
| ***CS 422*** | Test of the CS 422 console with: |
| DISP-T | Endless test of the LC display. After the test has been canceled the Display-RAM test result is displayed. |
| *EPROM-T* | After the EPROM test the result is displayed and the checksum is displayed at the soft key. |
| *KEY-T* | Endless test of the keyboard. Consecutively press all keys to display the corresponding value. |
| *PRG-NR* | The program number of the installed firmware (program version) is displayed. |
| *RAM-T* | After the RAM test the result is displayed. |
| ***DSP-...*** | Test of the signal processor: EPROM-T, PRG-NR, RAM-T as above |
| ***QMS-...*** | Test of the system controller:: EPROM-T, PRG-NR, RAM-T as above |
| ***SERVICE*** | Test programs only for factory use |

THRESH (mass)

With mass-MODE:PEAK-L and PEAK-F or with cycle-FUNCT:ADJUST

THRESH (...ADJUST)

Minimum intensity at which a peak is detected by the peak processor and adjust algorithm.

| *THRESH* | *amplif-MODE:FIX and detect-TYPE:FARAD, SEM or EXTERN* |
|---|---|
| *0.01, 0.03, 0,1... 30 % f.s.d* | With Fixrange in % of the full scale deflection |

| *THRESH* | *amplif-MODE: AUTO or AUTO-D and detect-TYPE:FARAD, SEM* |
|---|---|
| *1E-15, 1E-14.... 1E- 8* | With Autorange in [A] |

| *THRESH* | *detect-TYPE:ION-CNT* |
|---|---|
| *1E0, 1E1.... 1E7* | In ion counting mode in counts per seconds [cps] |

TRIG (cycle)

| *TRIG* | Selection of measurement cycle start |
|---|---|
| *INTERN* | Start/Stop is performed via CS 422 or interface. |
| *EXT-AUTO* | Start on positive slope of the ext. start signal RUN-IN (see p 11). The cycle runs until terminated with *halt* or the specified number of measurement cycles has been attained. |
| *EXT-NORM* | Start on positive edge of RUN-IN. The cycle runs as long as RUN-IN is high, or until it is terminated with *halt* or the number of measurement cycles specified with *CYCLES* has been attained. |
| *EXT-SNGL* | Start on positive edge of RUN-IN. The unit must first be armed with *run*. The cycle runs until it is terminated with *halt* or the number of measurement cycles specified with *CYCLES* has been attained. |

## TYPE (detect)

| *TYPE* | Selection of signal source, depends on the configuration |
|---|---|
| *FARAD* | Electrometer signal from Faraday collector |
| *SEM* | Electrometer signal with SEM |
| *ION-CNT* | Ion counter |
| *EXTERN* | External analog signal in place of EP 422 signal. Filter and processing functions of the QC 422 are used. |
| *PIRANI* | Total pressure measurement with Pirani module |
| *PENNING* | Total pressure measurement with Penning module |
| *A-INPUT* | Analog signals on AI 421. Filter and processing functions of the QC 422 are not used. |

## TYPE (ion src)

400 Changeover to special ion sources. The electrode names are replaced by "V1...V9" and all potentials are made accessible.

| *TYPE* | With *ion src-MODE:NORMAL* |
|---|---|
| *xyz* | Normal ion source according to *config-SYSTEM:IS-TYP* |
| *SPEC+* | Special ion source, detection of positive ions |
| *SPEC–* | Special ion source, detection of negative ions. The potentials of the IS 420 and the bias voltage of the HV 421 with *config-SYSTEM-DETECT:H-SEM* are inverted. |

With *SPEC±* and *EMISS* = 0 the SPEC-SRC-ON signal on the *QMA* connector of the IS 420 is active. In this way an external relay for changing over the ion source electrodes can be controlled.

## TYPE (trip)

| *TYPE* | Mode of switching functions (→ 6.14) |
|---|---|
| *OFF* | Switching function not active. The DO bit is available for other applications. |
| *ABS* | A and B are independent switching functions with one threshold value each. |
| *HYST* | A and B form a switching function with hysteresis. status changes when the upper or lower threshold value is exceeded. |

## V1... V9

400 The V... designations appears with *ion src-TYPE :SPEC±,* with standard ion sources the electrode names are displayed.

See tech. Data 16

## WEHNELT (ion src)

See *V9*

## WIDTH (mass)

Mass scan width of the measurement channel

| *WIDTH* | Not with *mass-MODE:SAMPLE* or *detect-TYPE:PIRANI, PENNING, A-INPUT* |
|---|---|
| *-2047 ... +2047* | The maximum value depends on the mass range |

Negative *WIDTH* results in a backward scan. In this way small peaks that are 1 mass above a very large peak can be measured more effectively.

# 6 Operation

The following description is applicable to units equipped with CS 422 operator console. They apply analogously also without CS 422.

## 6.1 Initial start up

**DANGER**

Before you switch on the power make sure that all components have been installed correctly (see Chapter Installation) and that the installation conforms to the technical data → 11 subseq.

The main power switch is located in the lower left-hand section of the front panel.

After power on the unit performs a self-test and after a few seconds responds with a beep. Press any key to activate the measurement or parameter display.

In complete (factory aligned) systems the values that have been determined as optimal are stored in the controller. Do not modify these, go directly to 6.4.

After a change of the ion source setting, a filament change, replacement of components, etc. the following steps should be performed.

### Configuration

Configure the unit as follows if the system you are putting into service has not been factory aligned.

- In the function group *general* press the *config* function.
- Choose *SYSTEM* with the corresponding softkey.
- Press QMA softkey and enter your QMA type with by pressing [^] [v].
- Press *MASS-R*, enter the mass range by pressing [^] [v].
- Under *DETECT* enter the ion collector type of your analyzer and under *IS-TYP* enter the existing ion source type.
- If you use the CP 400 set *OPTION* to *CP* with [^].
- Confirm the configuration input by pressing the *RETURN* softkey.

### QMH 400/410

Please refer to the QMH 400/410 user's guide (→ 🕮 [1]).
Complete factory supplied systems have already been optimally aligned. Do not change any settings without valid reason. Optimize **tune** if **best hit** does not light up.

### QME 125

Please refer to the user's guide of the QME 125 → 🕮 [3] and QMA 125 → 🕮 [4], but do not change any factory settings.

Set the **filament select** switch to **remote** and **polarity** to **"+"** (→ 🕮 [3]).

## 6.2 Filament protection

400 Optimize the filament current cut-off point for optimum protection of the filament.

a) Switch off the emission: press *filam*, the *filam* lamp goes out

b) Ensure that the pressure is $\leq 10^{-4}$ mbar.

c) Switch on *filam: filam* light turns on.

d) If *Emission error* *) is displayed continue with f).

e) If this is not the case, switch off *filam*, reduce *emiss-E-PROT* with ⌄⌄ by 0.1 A and turn *filam* on again; repeat until *Emission error* appears.

f) *Switch off filam*, increase *emiss-E-PROT* with ⌃⌃ by 0.1 A and turn *filam* on again; repeat until *Emission error* no longer appears.

*) In case of **ERROR** press the *error* key to read out the type of error.

If the switching threshold is abnormally high a fault exists in the ion source, the vacuum system, or the unit. Investigate the cause in order to prevent destruction of the filament.

If a new filament has been installed re-optimize after a few hours.

The *D-PROT* cut-off point for DEGAS is set analogously.

## 6.3 Degas

Please refer to the user's guide of the QMA and the ion sources. Switch to Degas only if the conditions specified there are fulfilled.

400 Optimize the filament protection for Degas mode as described above, however with *ion src-D-PROT* rather than *emiss-E-PROT.*

Switch on Degas with *ion src-CTRL:START* and confirm with ↵.

125 → 🕮 [4] and [3]

## 6.4 Offset correction

The EP 422 is an amplifier for very small currents. Its zero (offset) must be corrected occasionally. This is intentionally not performed automatically to prevent periodic dead times in data acquisition.

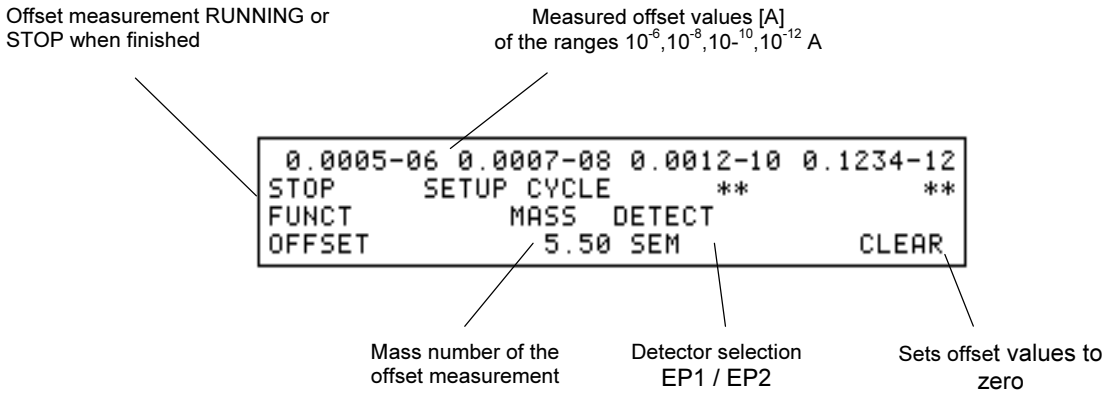
Perform an offset correction when the system is put into service for the first time, after the system (particularly the EP 422) has attained a stable temperature.

Subsequent repetition is advisable if deviations from the zero line occur.

Zero line shifts are often caused by ion and electron currents; the offset correction does not compensate these.

Choose *cycle-FUNCT:OFFSET* and start the offset measurement with *run* .

The following appears:




Perform the measurement for SEM and Faraday if both EP 422 are installed. If only one EP 422 exists choose DETECT according to the current operating mode.

The mass number should be selected in such a way that no ion current occurs.

With *CLEAR* you can disable the offset correction; the offset values are set to zero.

The values of the ranges $10^{-5}$, $10^{-7}$, $10^{-9}$, $10^{-11}$ A are not displayed, they are available at the interfaces.

400 For offset measurement the SEM voltage is switched off automatically, *RESOL* = 1, *F.A.* = 0 V and *EMISS* = 10 µA are set. If you switch *filam* off, measurement takes place without emission.

125 For offset measurement the SEM voltage and the emission are switched off automatically.

## 6.5 Ion counter

With the IC 421 and CP 400 ion counter the measured value is displayed as a quasi-logarithmic bar across ten decades. The range is always selected automatically; for linear analog output the display range is selected with O-*RNG*.

The discriminator threshold of the CP 400 preamplifier is set with *amplif-CP-LEV*. Recommended value: 0.1...0.3 V with *SEM-VOLTAGE : 2500 V*.

The ion polarity is selected by choosing the ion source type *ion src-TYPE:SPEC+* for positive ions or *SPEC–* for negative ions.

## 6.6 Extern input

With *detect-TYPE:EXTERN* you can capture analog measured values of a different unit in place of the EP 422. Connect the signal to the EXT IN pins of the **ctrl** connector on the QC 422 (see p.11)

*amplif-GAIN* determines the gain (×±1/×±10).

## 6.7 Simulation

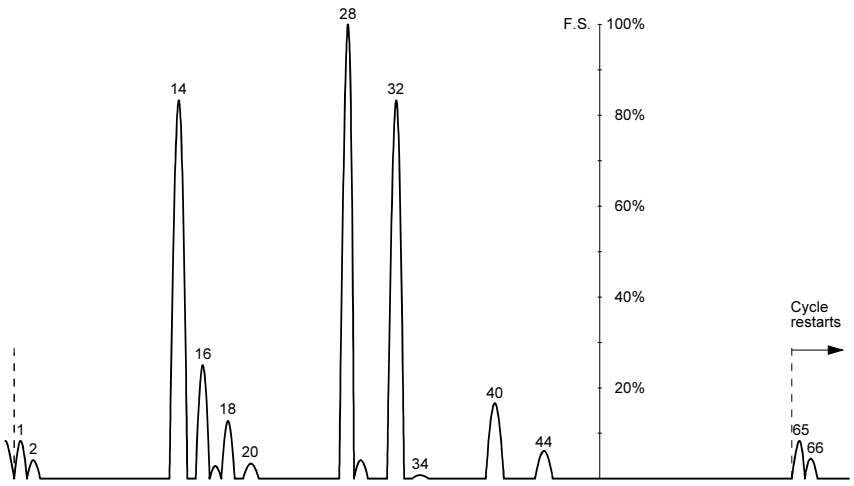
For experiments and tests a simulated spectrum according to the following diagram is available with *config-SIMUL:INTERN*. Use it to familiarize yourself with the operating procedures. For this purpose you do not need a vacuum system and also no equipment such as QMH or QMA.

The spectrum is generated as an HF generator control signal **scan** and inserted into the QC 422 electrometer signal path. It can be used in all *mass modes*.

For normal measures the simulation must be switched off: *config-SIMUL:OFF*.

Only the detector types *FARAD* and *SEM* are admissible.

*config-SIMUL:EXTERN* is reserved for factory tests.




The peak intensities for *RANGE* $10^{-5}$, $10^{-7}$, $10^{-9}$ and $10^{-11}$ are identical. The intensity is amplified by a factor of 10 for the intermediate ranges. The spectrum is repeated periodically from mass 64.

## 6.8 Measurement cycle

With *cycle-MODE* choose single channel *(MONO)* or multichannel *(MULTI)* mode.

The measurement cycle is started and stopped with *run/halt* and its state is indicated with the *mono, multi* and *halt* LEDs.

The number of measurement cycles is chosen with *cycle-CYCLES:* 1...10000 or repeating (0).

You can choose external control with *cycle-TRIG.*

### HALT

The measurement cycle is stopped. The unit measures in *mass-MODE:SAMPLE* (even if a different *MODE* has been entered) in the selected channel on the mass defined with *MASS* (or *FIRST)* at the speed selected with *DWELL* (or *SPEED)*.

The switching functions are OFF, the signals on ***elm, mon*** and ***AO*** are available.

### MONO

Single channel mode: enter *cycle-FUNCT:CYCLE* and *cycle-MODE:MONO*.

The unit measures in the measurement channel chosen with *select*. If the channel is changed in the *run* state the measurement is cancelled and the new channel is started.

*MONO* is suitable for measurement tasks in manual mode. A separate channel is programmed for each task. This means that the parameters are continually available. You can quickly change the measurement task by changing the channel.

### MULTI

Multichannel mode: enter cycle-FUNCT:CYCLE and cycle-MODE:MULTI

The 64 channels can be programmed with any parameters. The channels located between *cycle-BEGIN* and *cycle-END* are processed sequentially if they are not set to *STATE:SKIP.*

It is advantageous to first optimize each channel involved in MONO mode.

With the *aux-COPY* function load additional channels with the parameters of the first optimized channel. Subsequently you only need to adapt a few parameters of the individual channels.

To achieve the shortest measuring time the channels with identical detector type, electrometer range and SEM voltage should directly follow each other.

The measurement cycle time CYCLE-TIME consists of the measurement and pause times of the involved channels. It is measured by the built-in clock.

The clock starts with *run*, stops with *halt* and is displayed by pressing *cycle*. With *cycles-CYCLES:1* (no. of cycles =1) you measure the time for one cycle.

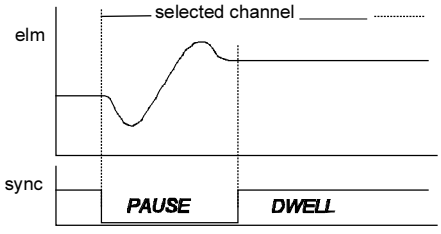
### PAUSE

When the channel is changed in MULTI channel mode the data acquisition must pause until the new measured value is stable. The pause time is set automatically by the QC 422 based on *RANGE*, *FILTER*, *MASS*, *SEM* voltage and *detect-TYPE*.

The pause time is displayed under the softkey *amplif-PAUSE*. If you want to achieve shorter cycle times or greater accuracy you can optimize it with *amplif-P-CAL*. The minimum value is 1 ms with *P-CAL:0.0*.

You can reduce *P-CAL* in each channel until its measured value deviates inadmissibly. The preceding channel should not have a measured value that is almost identical, otherwise there is practically no transient response and the value of *P-CAL* would be too small. Change e.g. *MASS* of the preceding channel by ½ u to determine whether or not its measured value is without influence on the one of the selected channel.

With the oscilloscope (triggering on the falling slope of **sync**) the transient response during the pause can be observed at **elm** and (see also 55).



## 6.9 Electrometer modes

The range of the electrometer preamplifier can be selected in 3 different ways:

**AUTO**

With *amplif-MODE:AUTO* the electrometer range is set automatically across all decades. This results in a huge dynamic response of over 10 decades or 200 dB. Use *AUTO* whenever possible. In this way you achieve the best resolution of the measured value and no overdriving of the amplifier can occur.

**AUTO-D**

With *amplif-MODE:AUTO-D* (Auto down) the range is limited in the downward direction. This is usefully for noisy measurement signals and can lead to faster measurements. You can define the available dynamic response with *RANGE-L.*

**FIX**

With *amplif-MODE:FIX* choose the measurement range with *RANGE* manually. This allows fastest measurements with a limited dynamic response.

With Scan-*SPEED* < 10 ms/u there is only Fixrange.

For the most accurate measurements (e.g. isotope ratios) Fixrange is recommended because the mutual tolerances of the measurement ranges are eliminated or can be calibrated.

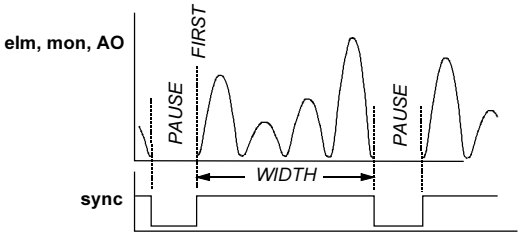
In the following diagram of the measurement signals the raw signal ***elm*** (→ 🖹 55) is represented always in *FIX*-RANGE because it is difficult to follow in *AUTO*-RANGE.

In all operating modes the measured values (except on **elm**) are multiplied times *CALIB* before they are output.

## 6.10 Mass scan modes

**SCAN-N**

The *mass-MODE:SCAN-N* (SCAN-Normal) mode is used for recording an analog spectrum across the range defined with *FIRST* and *WIDTH.*




The number of steps per mass depends on *SPEED* and the mass range (→ 🖹 12).

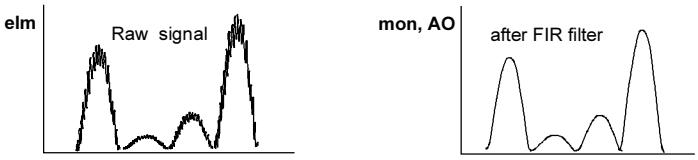
With *SCAN-N* the average value of the mass signal is output with each mass step.

Example: With *SPEED* 100 ms/u and mass scale resolution 1/64 u there is an integration time per step of 100 ms/u × 1/64 u = 1.56 ms

With *SCAN-N* you obtain a direct image of the measured values captured by the measuring amplifier or the ion counter. This mode is particularly suitable for analyzing raw data, e.g. for optimizing parameter values.

**SCAN-F**

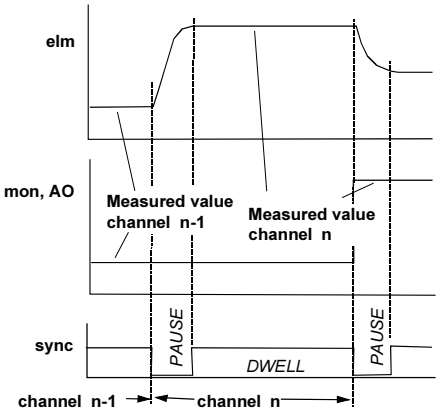
With SCAN-F the measured values are additionally subjected to an FIR filter algorithm (Finite Impulse Response).



The FIR filter largely eliminates noise and interference so that also very small peaks can be detected against the background. Statistical intensity fluctuations which on account of the 90° SEM arrangement frequently account for the major portion of the noise are particularly well suppressed by the FIR filter. For this reason you should always use *SCAN-F*, except in the few special cases were raw data are actually required.

## SAMPLE

With *mass-MODE:SAMPLE* the measurement is performed on the constant mass number *MASS*. In most cases it will be set to a peak top (*ADJUST* → 6.12




After the *DWELL* time has expired the measured value averaged across this time is output

## AVERAGE

With *AVERAGE >1* a moving average (M) is formed across the number (n) of measurement cycles since *RUN*. Beginning with the first measurement cycle it supplies a value that becomes more stable with increasing number of cycles. In this way *DWELL* can be shortened without significant impairment of the filter effect (faster settling time).

The following recursive formulas apply:

a) $n < AVERAGE : M_{new} = M_{old} + (M_{new} - M_{old}) / n$

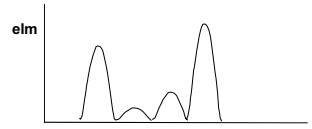
b) $n \geq AVERAGE : M_{new} = M_{old} + (M_{new} - M_{old}) / AVERAGE$

Time constant of the averaging: $\tau \approx AVERAGE \times$ cycle time

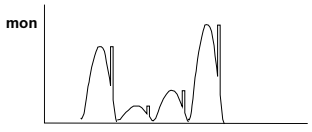
## PEAK

The *mass-MODE:PEAK* (peak processing) is an intelligent data reduction process which searches the spectrum for peaks in real time mode. Instead of 64 measured values/u only the **intensity and mass number** of detected peaks are output on the computer interface.

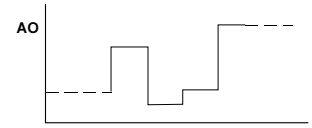
Mass scan is same as with *SCAN*




The marker at **mon** means that a peak of the displayed height has been detected




The value at **AO** remains until a new peak is detected




Peak Processing runs with all *SPEED* settings. The peak search extends across the range defined with *FIRST* and *WIDTH.* The peak criteria of *ADJ-TYP:COARSE* apply (→ Section 6.12).

There are two methods:

- With ***PEAK-L*** (Level) the peak processing algorithm is applied to the normal spectrum (*SCAN-N*).
- With ***PEAK-F*** the peak processing algorithm is applied to the measured values processed with the FIR filter. This is advantageous because parasitic signals have largely been removed from the measured values so that a very low *THRESH* can be used.

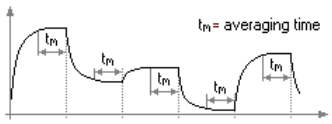
**STAIR**

With *mass-MODE:STAIR* integer mass jumps across the range *FIRST... WIDTH* are performed. A bargraph spectrum is created.

After each mass jump the average value across approx. half the dwell time is formed.

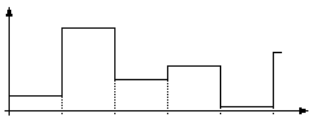
Example: With *SPEED* 100 ms/u the averaging time is ≈ 50 ms

**elm**




**AO, mon**

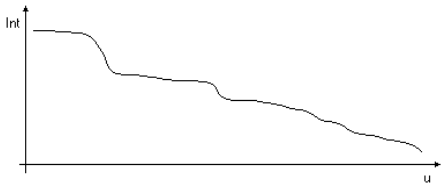
The measured value appears after the average has been formed, that is, delayed by one mass



The start mass of each channel must be on a peak maximum. See ADJUST (→ 🗎 52). If the peak maximums are not hit, large measuring errors are unavoidable. For this reason you should limit *WIDTH* per channel to approx. 10% of the mass range. In this way you can compensate deviations of the mass scale by correcting the corresponding starting mass *FIRST*.

## 6.11 Integral spectrum

With *mass-RESOL:OFF* an integral spectrum is created that can be used, e.g. for total pressure measurement.




## 6.12 Adjust

With *cycle-FUNCT:ADJUST* you can automatically optimize the mass number *MASS* to the peak maximum in *SAMPLE* (or *STAIR*) mode.

The measurement channel must be set to *aux-STATE:ENABLE*.

This possibility is advantageously used, for example, to optimize the system after turn on and particularly after several parameters have been changed.

**Adjust COARSE**

With *ADJ-TYP:COARSE* a range of ±½ u around the mass number *MASS* is normally searched for a peak. The search range will possibly be enlarged by ±¼ u.

If possible use *amplif-MODE AUTO* for *ADJUST*, it will be easier to obtain a result.

**Peak criteria:**

Four criteria must be met for a peak to be detected:

a) $I_{max} > 2\ I_{min}$

b) $I_{end} < 0.5\ I_{max}$

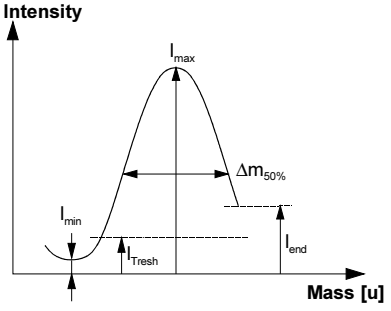
c) $I_{max} > I_{tresh}$

d) $\Delta m_{50\%} \geq ⅛$ u [*)] at ½ $I_{max}$

[*)] ¼ u with *mass-MODE:PEAK*

Time:

$t_{Adjust} \approx$ 0.5...1.25 *DWELL*



**Start:**

Stop measuring cycle: *run/halt:halt*

Choose *mass-MODE:SAMPLE*

Choose *cycle-FUNCT:ADJUST*

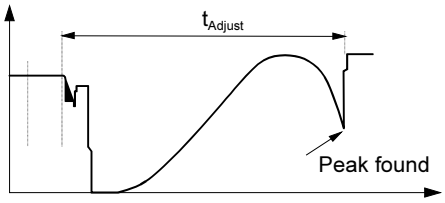
Choose *cycle-MODE:MONO* or *MULTI*

Choose *cycle-ADJ-TYP:COARSE*

Start *ADJUST* measurement: *run/halt:run*

**Procedure:** Signal **mon**

With successful Adjust the mass number *MASS* of the measured channel is updated with the new value. If unsuccessful it remains unchanged.




**Status message:** After expiration a status message is displayed:

Symbols Status code

```
ADJUST STOP      STATUS CH 14: →  000001
        SETUP CYCLE      **          **
FUNCT  MODE ADJ-TYP THRESH RANGE  MASS
ADJUST MONO  COARSE 0.01%  1E-05   13.46
```

The 3 main parameters *THRESH, RANGE, MASS* can be entered here directly. You do no have to switch back to the *channels* group.

Symbols:

**OK** The adjust was successful

→ Increase *MASS* slightly

← Decrease *MASS* slightly

↑ Increase Intensity or lower *THRESH*

↓ Decrease Intensity

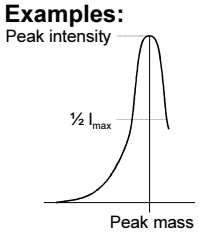
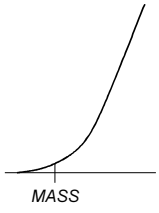
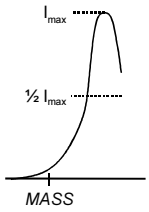
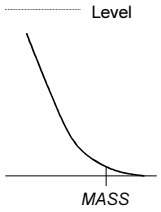
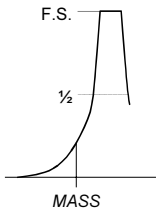
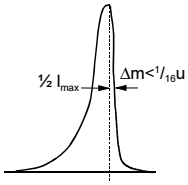
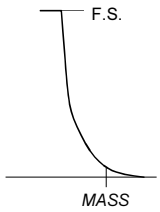
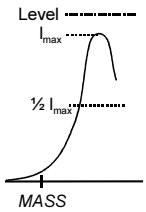
**I** Peak too narrow (e.g. parasitic pulse or poor peak shape). Repeat ADJUST. If unsuccessful: investigate peak shape.

Status code:

| | Peak width | Intensity | | Mass number *MASS* | | |
|---|---|---|---|---|---|---|
| | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| Bit=1: | too narrow | <*THRESH* | too high | too low *) | too high | too low |
| Symbol: | **I** | ↑ | ↓ | → | ← | → |

*) and intensity not dropped back to ½

**Examples:**

| | | | |
|---|---|---|---|
|  000000 : OK |  000001 : → increase *MASS* |  000100 : → increase *MASS* |  010010 : ↑ ← decrease *MASS* |
|  001000 : ↓ increase *RANGE* *) |  100000 : **I** Peak too narrow, repeat, investigate shape |  001010 : ↓ ← increase *RANGE* *) decrease *MASS* |  010100 : ↑ → *RANGE* *) or decrease *THRESH* and increase *MASS* |

*) or preferably use *amplif-MODE:AUTO*

## Adjust FINE

A peak maximum within the range of ± ⅛ u around the mass number *MASS* is searched. Also in this case *amplif-MODE:AUTO* is recommended.

**Peak criteria:**

a) $I_{max} > I_1 + 1{,}5\%$

b) $I_2 < I_{max} - 1{,}5\%$

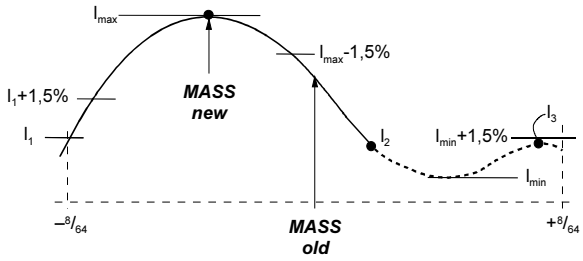
c) $I_{max}$ >THRESH

d) No overdriving

e) $I_3 < I_{min} + 1{,}5\%$

time:

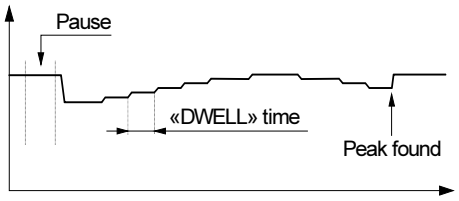
$t_{Adjust} \approx 16$ *DWELL*




**Start:** If you are not sure that a peak is located within the searched range, first perform an ADJUST COARSE.Start as described under COARSE, however with *cycle-ADJ-TYP:FINE*

**Procedure:** Signal ***mon***

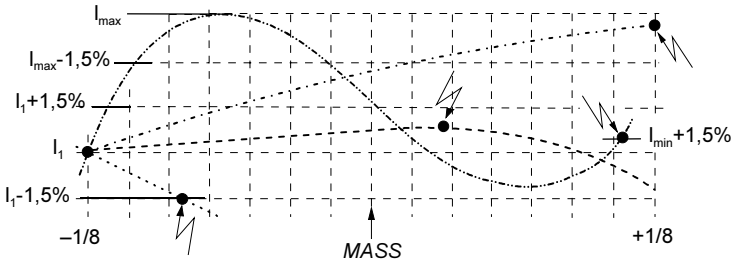
If Adjust was successful the *MASS* of the measured channel us updated with the new value, if it was unsuccessful it remains unchanged




**Status message:** As in ADJUST-COARSE, however, without information on mass number and peak width.
Bits 1, 2 and 5 are always zero.

| | --- | Intensity | | Mass number *MASS* | | |
|---|---|---|---|---|---|---|
| | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| Bit=1:<br>Symbol: | --- | <*THRESH*<br>↑ | too high<br>↓ | --- | --- | no Peak<br>→ ← |

**Examples of unsuccessful fine searches:**




## 6.13 Analog outputs

On the QC 422 there are some signal connections (see pin assignment 🗎 15).

Nowadays measurement data are generally acquired with computers. For investigating possible measuring problems (noise, transient response, etc.) and for special cases the analog signals can be very useful.

### Connectors

**elm**

Analog filtered electrometer signal. It can be readily evaluated only in *amp-MODE:FIX* (Fixrange). With *Autorange* it becomes difficult to follow. **elm** is highly suitable for assessing the quality of the raw measured values. The calibration factor *CALIB* has no influence on **elm**.

**mon**

Monitor sequentially supplies the measurement signals of all measurement channels after they have been processed by the signal processor. It also serves as the analog output of the ion counter and can be used in linear or logarithmic format.

**AO**

The AO/IC 421 option can output up to twelve analog measured values in linear or logarithmic format.

You can assign one or several measurement channels (*output-AO-CH*) to each of the twelve AO channels. If several measured values are assigned to the same AO channel they will be output sequentially.

Via the computer interface also data from the PC software can be output on the AO 421.

**sync**

Indicates the start of the measurement and is suitable for triggering an oscilloscope.

**scan**

Proportional to the momentary mass number
0...10.24 V for QMH 400/410; 0 ... 10.00 V for QME 125

The behavior of the above signals in the various operating modes is described beginning on 🗎 50.

### Output formats

The measured values at **mon** and **AO** have the following formats:

***LIN*** Linear

***LOG 3D*** Logarithmic across 3 decades

***LOG 8D*** Logarithmic across 8 decades

***LOG*** Logarithmic across 3 or 10 decades

The possible choices (operating mode dependent) can be found in the following tables, the scaling from the corresponding formulas and diagrams.

The formulas and graphics apply to positive measurement signals.

In the negative range the characteristics are mirror imaged at the zero according to the formulas a) ... e) and n) ... q)

Note: $\log = \log_{10}$ $Uo = U_{output}$ at **mon** or **AO**

Mass units: U: [V] I: [A] Counting rate: [cps] counts per second, $s^{-1}$

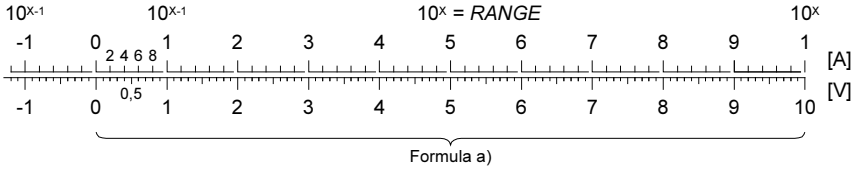
## Electrometer operation

detect-TYPE:FARAD, SEM

| *mass-MODE* | *output-AO-MODE, MONITOR* | *amplif-MODE* | Output format: Decades | Output format: V/Decade | Formulas |
|---|---|---|---|---|---|
| *SCAN-N*<br>*SCAN-F* | *LIN* | *FIX,AUTO*<br>*AUTO-D* | 1 | 10 | a) |
| *STAIR*<br>*PEAK-L* | *LOG 3D* | *FIX,AUTO* [1]<br>*AUTO-D* [1] | 3 | 3.333 | b), c), d) |
| *PEAK-F*<br>*ADJ-COARSE* [3] | *LOG 8D* | *AUTO* [2]<br>*AUTO-D* [2] | 8 | 1.25 | e) |
| *SAMPLE*<br>*ADJ-FINE* [3] | *LIN* | *FIX,AUTO*<br>*AUTO-D* | 1 | 10 | a) |
| | *LOG 3D* | *FIX* | 3 | 3.333 | b), c), d) |
| | *LOG 8D* | *AUTO*<br>*AUTO-D* | 8 | 1.25 | e) |

1) only for SCAN-*SPEED* 10...50 ms/u, with *STAIR* 2... 5 ms/u
2) only for SCAN-*SPEED* ≥ 100ms/u, with *STAIR* ≥ 10 ms/u
3) only at ***mon*** connector

***LIN*** a) for Uo: 0...10 V: $I = 0.1 \times RANGE \times Uo$

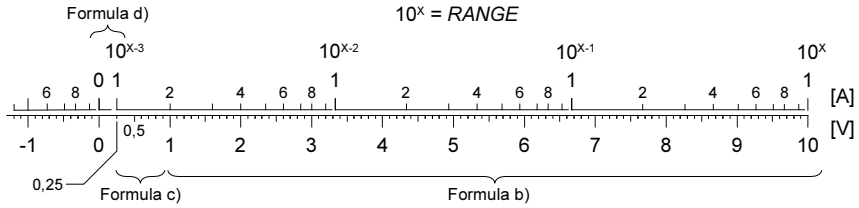



***LOG 3D*** b) for Uo: 1V ... 10V $I = 10^{-3} \times RANGE \times 10^{0.3\ Uo}$

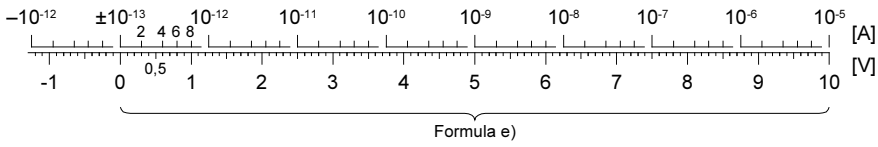
c) 0.25V ... 1V $I = 1.333 \times 10^{-3} \times RANGE \times (Uo+0.5)$

d) 0V ... 0.25V $I = 4 \times 10^{-3} \times RANGE \times Uo$

Applicable with *amplif-MODE:AUTO: RANGE = O-RNG*.




***LOG 8D*** e) for Uo: 0...10 V: $I = 10^{(0.8\ Uo - 13)}$

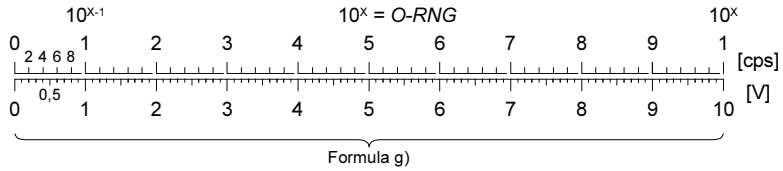



## Ion counting operation

*detect-TYPE:ION-CNT*

| *mass-MODE* | *output-AO-MODE, MONITOR* | *output-LOG-DEC* | Output format: Decades | Output format: V/Decade | Formulas |
|---|---|---|---|---|---|
| *SCAN, STAIR* | *LIN* | --- | 1 | 10 | g) |
| *SAMPLE* | *LOG* | *3 DEC* | 3 | 3.333 | h), i), k) |
| *PEAK ADJUST* [3] | | *10 DEC (>20 ms/u)* | 10 | 1 | l), m) |

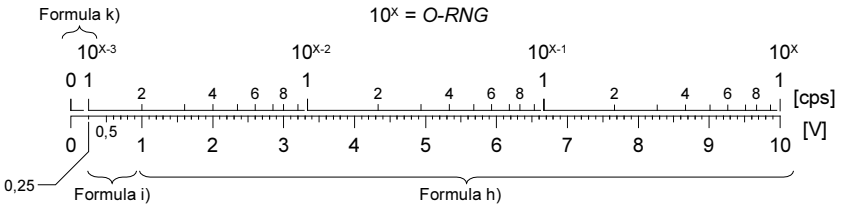
***LIN*** g) for Uo: 0 ... 10 V: Rate = 0.1 × O-RNG × Uo



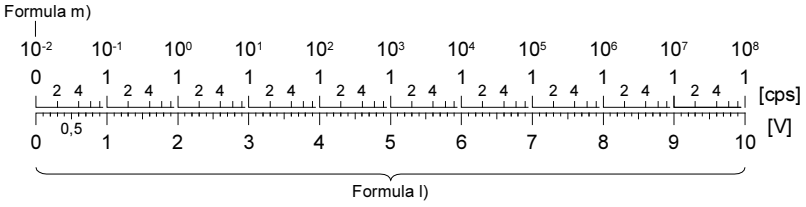

***LOG 3 DEC*** h) for Uo: 1V ... 10V Rate = $10^{-3}$ × O-RNG × $10^{0.3\ Uo}$

i) 0.25V ... 1V Rate =1.333 × $10^{-3}$ × O-RNG × (Uo+0.5)

k) 0V ... 0.25V Rate = 4 ×$10^{-3}$ × O-RNG × Uo




***LOG 10 DEC*** l) for Uo: 0V...10V Rate = $10^{(Uo - 2)}$

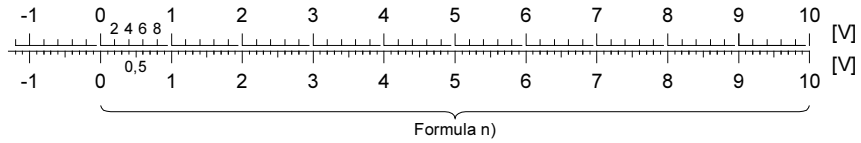



## Extern input

*detect-TYPE:EXTERN*

| *mass-MODE* | *output-AO-MODE, MONITOR* | Output format | | |
|---|---|---|---|---|
| | | Decades | V/Decade | Formulas |
| *SCAN, STAIR* | *LIN* | 1 | 10 | n) |
| *SAMPLE, PEAK* | *LOG 3D* | 3 | 3.333 | o), p), q) |

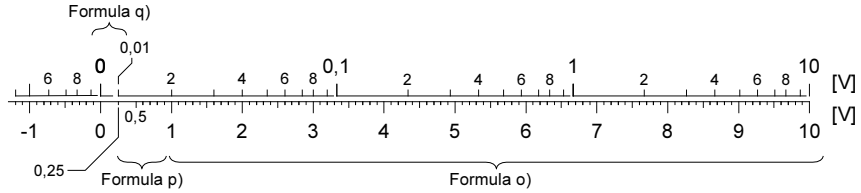
***LIN*** n) for Uo: 0V ... 10V $U_{Extern}$ = (1 / GAIN) × Uo




***LOG 3D*** o) for Uo: 1V ... 10V $U_{Extern}$ = (0.01 / GAIN) × $10^{0.3\ Uo}$

p) 0.25V ... 1V $U_{Extern}$ = (0.01333 / GAIN) × (Uo + 0.5)

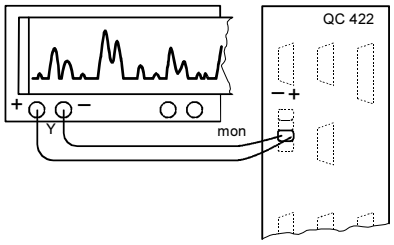
q) 0V ... 0.25V $U_{Extern}$ = (0.04 / GAIN) × Uo



## Recording

For recording analog measured values (spectra or versus time) the following possibilities exist:

### y/t Recorder



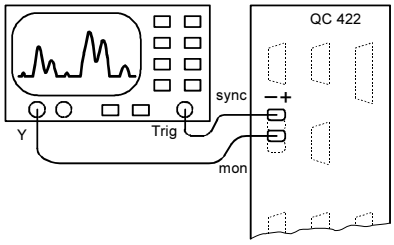

Paper feed should match SPEED, e.g. 1 mm/s for 1 s/u.

Sensitivity: 10 V for full scale deflection

Mirror imaged spectra can be inverted with *amplif-CALIB: -1*.

Instead of **mon** you can also use one or several **AO** outputs (→ 🗎 15).

### y/t - Oscilloscope




The same applies as for the y/t recorder.

Additional tips:

Choose a *WIDTH* that is somewhat larger (e.g. 14) than the range to be represented (e.g. 10 u) and optimize for minimum flicker!

**sync** triggers the oscilloscope with each start of the selected channel. Trigger manually to the positive slope, for *PAUSE* to the negative slope.

Digital storage scopes are advantageous

### x/y Recording

The **scan** output supplies the mass number signal (0 ... 10.24 V for the full mass range). x/y recording is only suitable for special cases.

## 6.14 Switching functions

With the TRIP switching functions measured values can be monitored in *mass-MODE:SAMPLE* or with *detect-TYPE:PI,PE,AI*.

With *halt* the state of the switching functions is OFF.

Each measuring channel has two switching functions: TRIP A and TRIP B.

These can be assigned to the output bits of the DO 420A modules as desired and also be interrogated via the computer interface.

If several switching functions are assigned to the same DO bit they are logically combined with an AND function. There is no warning if the DO bits are already assigned.

The DO 420A can also be controlled from the computer interface. Simultaneous assignment of switching functions is not advisable.

### Vacuum relay

Choose *trip-TYPE : ABS*

*Enter trip-LEVEL-A*

ABS-TRIP A switches ON when threshold A is exceeded

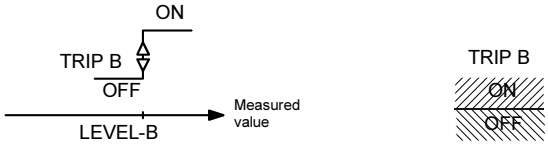

With *trip-DO-A:xx* assign a DO bit if DO 420A exists

### Overpressure relay

Choose *trip-TYPE : ABS*

Enter *trip-LEVEL-B*

ABS-TRIP B switches ON when threshold B is exceeded




With *trip-DO-B:xy* assign a DO bit if DO 420A exists.

## Window comparator

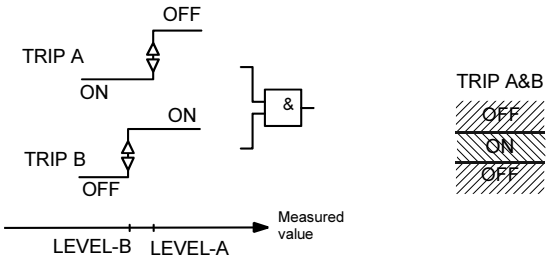
The window comparator is only possible in conjunction with the DO 420A module

Choose *trip-TYPE : ABS*

With *trip-LEVEL-A* enter the upper threshold

With *trip-LEVEL-B* enter the lower threshold

With *trip-DO-A:xx, trip-DO-B:xx* assign A and B to the same DO bit.




## Hysteresis function

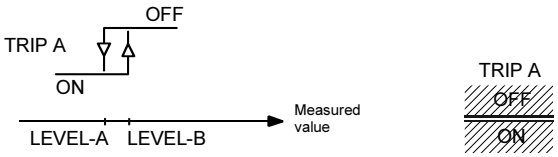
The hysteresis prevents fluttering with unsteady signals. The minimum hysteresis is 10%

Choose *trip-TYPE : HYST*

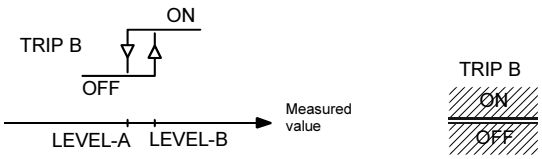
With *trip-LEVEL-A* enter the lower threshold

With *trip-LEVEL-B* enter the upper threshold

TRIP A switches ON when the signal drops below LEVEL-A and switches OFF when it exceeds LEVEL-B




TRIP B works inversely to A




With *trip-DO-A : xx, trip-DO-B : xy* assign the DO bits if DO 420A exists

## Window and hysteresis

This requires two measurement channels and one DO 420A.

With *select:x* choose the first measurement channel x

Choose *trip-TYPE : HYST*

With *trip-LEVEL-A* enter the lower threshold

With *trip-LEVEL-B* enter the upper threshold

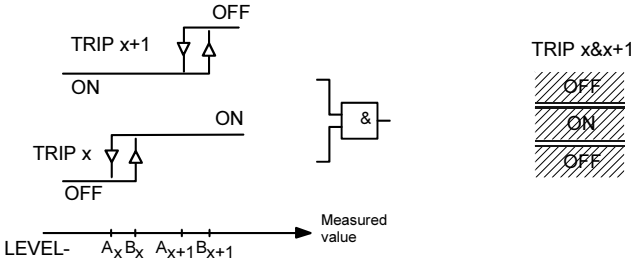
With *trip-DO-A* assign a DO bit

With *aux-COPY TO CH:x*+1 copy channel x to channel x+1

With *select:x+1* choose the measuring channel x+1

With *trip-LEVEL-A* enter the lower threshold

With *trip-LEVEL-B* enter the upper threshold




Many other combinations are feasible.

# 7 Troubleshooting

## 7.1 General

**Skilled personnel**

Work on an **open unit** (as specifically instructed in some parts of this Chapter) may only be performed by **skilled personnel.**

**Corresponding warnings are not given separately on each occasion!**

The relevant safety instructions given in the corresponding Chapters must be conscientiously followed.

Protection against electrostatic discharges (ESD) is absolutely essential, otherwise the Pfeiffer Vacuum warranty becomes null and void.

## 7.2 Warnings

Warnings related to operator action are displayed for approx. 10 sec.

| No | Warning | Meaning, comments |
|---|---|---|
| 1 | ** OP ERROR ** | Operator error, illegal entry |
| 2 | ** ↑ ONLY ↓ ** | Parameter change with ⏫ ⏶ ⏷ ⏬ |
| 3 | ** > MAX ** | Input value too large |
| 4 | ** < MIN ** | Input value too small |
| 5 | ** SYNTAX ! ** | Incorrect format |
| 6 | ** REMOTE ** | Unit set to computer operation |
| 7 | ** CH SKIP ** | Selected channel is in *aux-STATE:SKIP* |
| 8 | ** EXTERN ! ** | Control by external signal |
| 9 | ** HARDWARE ** | Necessary hardware does not exist |
| 10 | ** ENTER ONLY ** | Confirmation only possible with ↵ |
| | ** SIMULATION ** | Simulation mode activated |

| No | Warning | Meaning, comments |
|---|---|---|
| 17 | ** NO HV ** | No HV 420 or HV 421 exists |
| 18 | ** NO IS ** | No IS 420 exists |
| 19 | ** CANNOT DEG ** | *DEGAS* not possible with *FILAM:1+2* |
| 20 | ** NO AUTO ** | *FILAM:1+2* not selectable with *DEGAS* |
| 21 | ** ONLY F1 ** | Only one filament available |
| 22 | ** BUFFER ** | Buffer management not OK |

Other operator information is displayed in suitable locations.

## 7.3 Error messages

For many error types **ERROR !!** is displayed. To obtain detailed information press the *error* key.


*NEXT* displays the next error messages if more than one exists.

*CLEAR* deletes all messages (unresolved errors reappear immediately)

*RETURN* jumps to the preceding display information

Find out whether or not error messages are reproducible.

For this purpose switch all involved components OFF and ON again.

Restart the computer and the software.

For sporadic errors or errors that are difficult to reproduce → 63

The following tables help you to take appropriate action in response to reproducible error messages or faults.

This information and methods apply to the most probable cases, however, exceptions are feasible.

### 7.3.1 ERROR table

| No | Description | Possible cause / Test methods | Correction |
|---|---|---|---|
| 2 | Communication CS to QC | CS 422, its cable or QC 422 defective | Replace |
| 3<br>4<br>7 | CS 422 stack overflow<br>CS 422 idle error, op. syst. overloaded<br>CS 422 watchdog error | CS 422 defective | Replace |
| 14<br>15<br>16 | CS 422 Display RAM<br>CS 422 EPROM checksum incorr.<br>CS 422 RAM | run testprogram:<br>*config-TEST-CS422:EPROM-T* or *RAM-T* | Replace CS 422 if not ok |
| 17<br>18<br>19 | QMS controller stack overflow<br>Reset error<br>QMS controller watchdog error | QC 422 defective | Replace |
| 20 | QMS controller EPROM checksum | run testprogram:<br>*config-TEST-QMS:EPROM-T* | Replace QC 422 if not ok |
| 21<br>22<br>23 | QMS controller NOVRAM<br>QMS controller dual port RAM<br>QMS controller buffer RAM | run testprogram:<br>*config-TEST-QMS:RAM-T* | Replace QC 422 if not ok |
| 24<br>25 | DSP-EPROM checksum<br>DSP dual port RAM | run testprogram:<br>*config-TEST-DSP:EPROM-T* or *RAM-T* | Replace QC 422 if not ok |
| 26<br>27<br>28<br>29 | Monitor-DAC error<br>Resolution-DAC error<br>AO-DAC error<br>ADC error | Only for factory use with special instruments | |
| 33 | QMS controller idle error (Op. sys.) | QC 422 defective | Replace QC 422 |
| 34 | SEM error | SEM high voltage overloaded or defective<br>Cabling/jumper error<br>Faulty insulation<br>Arcing<br>SEM should have 18 MΩ<br>CD should have > 100 MΩ<br>Measure 1V per 1kV at test socket<br>Measure actual high voltage | <br>→ 🗎 23 and 24<br>Check by detaching cable<br>Switch off unit for 2 min.<br>Ohm meter<br>Insulation tester<br>DVM<br>High voltage probe |
| 35 | CD error | CD Voltage HV 421 overloaded or defective | See Error 34 |
| 36 | Ion source error | V1...V9 overloaded or defective<br>Switch off the unit, detach IS cable:<br>if error disappears<br>if error persists | <br><br><br>Check insulation of Cable /QMA<br>F1, F2 (on IS 420) or IS 420 defective |
| 37<br>38 | Filament 1 defective<br>Filament 2 defective | Test filament 1 or 2 (≈1 Ω) and cable | QMA 400 → 🕮 [2], IS 420 pin assignment → 🗎 16 |
| 39 | Emission error (Emission ≠ set point) | Pressure too high<br>Filament burnt out (QMA 125),<br><br>Filament transport protection not removed<br>Switch *emiss:OFF -...ON,* if unsuccessful<br>Adjust PROTECTION<br>Cable interrupted or insulation fault<br>Wiring in QMA interrupted or Insulation fault<br><br>Wrong settings | $p < 10^{-4}$ mbar<br>Check with ohm meter, replace, if defective; see QMA 125 → 🕮 [4]<br><br>Remove → 🕮 [2], [4]<br><br>→ 6.2 or QME 125 → 🕮 [3]<br><br>Measure<br>QMA 400 → 🕮 [2]<br>QMA 125 → 🕮 [4]<br>Test report and → 🕮 [2], [4] |
| 40 | CAN error | QC 422 defective (CAN for CS 422) | Replace QC 422 |
| 41 | Parameter lost | QC 422 NOVRAM defective | Replace QC 422 |
| 42 | Communication from QC to CS | CS 422, its cable or QC 422 defective | Replace |
| 43 | Communication QMS-controller / DSP | Quadrupole controller QC 422 defective | Replace QC 422 |
| 44 | Communication LAN | LAN communication not o.k. | Check connection, settings, parameters → 🗎 26,→ 🕮 [6] etc. |
| 45 | Communication RS-232-C | RS-232 communication not o.k. | Check connection, settings, parameters |
| 46 | RF error | QMH 4x0 in heat-up phase<br>Error message from QMH 4x0 | Heat-up time approx. 10 min.<br>QMH 4x0 → 🕮 [1] |

## 7.4 Measurement signal problems

| Problem | Possible cause / Test methods | Correction |
|---|---|---|
| No measurement signal with EP 422 or CP 400 | Try simulation | Replace QC 422 if not ok |
| | Cabling not o.k. | Check, see p. 23 u. 24 |
| | Wrong detector selection | Set *detect-TYPE* correctly |
| | No emission | Switch on *filam* |
| | Emission too low | Adjust: see test report |
| | No SEM high voltage | Switch on *sem:*, see also error 34.<br>QME 125 fuse F1 → 🕮 [3] |
| | SEM high voltage too low | Increase: *detect-SEM* channel dependent<br>*sem hv-SEM-VOLTAGE* channel independent<br>See also Error 34 for HV 420 |
| | No high voltage with HV 421 | See Error 34 |
| | Field axis voltage too low | See test report *v1..v6-F-AXIS (possibly V4)*<br>QME125 → 🕮 [3] |
| | Wrong ion source parameters | See test report, QMA400 → 🕮 [2],<br>QMA125 → 🕮 [4] |
| | Resolution too high: try integral spectrum with *mass-RESOL:OFF*. | If integral spectrum exists adjust resolution.<br>QMH 4x0 → 🕮 [1], QME 125 → 🕮 [3] |
| No measured value with EP 422 | EP in wrong connector of QMH | Check → 🗎 23 |
| | *SCAN-N* with 10 ms/u, *range* $10^{-9}$ A<br>Disconnect EP 422 from QMA, touch input with screwdriver | 50 (60) Hz signal should appear<br>Check signal with an oscilloscope, if not o.k. replace EP 422 |
| No measured value with CP 400 | Threshold too high | Decrease *amplif-CP-LEV* → 🗎 48 |
| Electrometer signal negative | EP1 and EP2 cable mixed up | Check, see p. 23 |
| | POLARITY switch on QME 125 set to "–" | Set POLARITY to "+" |
| Electrometer offset strongly mass dependent | Loose ground connection (EP input or below QMA connector plate) | Tighten / correct |
| | Open shielding below QMA connector plate | QMA 400 → 🕮 [2], QMA 125 → 🕮 [4] |
| Electrometer signal:<br>- not zero between peaks<br>- negative / small peaks missing | Offset not aligned | Perform offset correction → 🗎 47 |
| Offset in *range* $10^{-12}$ very high | Temperature of the EP 422 too high | Decrease |
| | Bad insulation collector to flange (good: >>1 GΩ) | Correct insulation fault → QMA 400 → 🕮 [2],<br>QMA 125 → 🕮 [4] |
| | Moisture in electrometer or on analyzer connector | Dry with warm air (no over 60 °C)<br>→ 🗎 64 |
| Electrometer signal sensitive to vibrations | Knurled nut loose on EP input<br>Shield below connector plate of QMA not correctly installed | Tighten<br>Correct shielding<br>QMA 400 → 🕮 [2], QMA 125 → 🕮 [4] |
| High noise signals with EP 422 | Analyze signal (*amplif-MODE:FIX, SCAN-N*, high *SPEED*) with PC or **elm** signal with oscilloscope | Remedy noise or choose slower *SPEED, DWELL* and/or increase *amplif-FILTER* |
| High counting rate with CP 400 also besides peaks | Corona or arcing in CP 400 or<br>in HV 420<br>in HV 421<br>in high voltage cables<br>in QMA or SEM | Open CP 400 and dry with war air (<50°C),<br>Remove dust.<br>Replace HV 421<br>Replace cable<br>QMA 400 → 🕮 [2], QMA 125 → 🕮 [4] |
| High counting rate with CP 400 also without high voltage | Poor ground connection, shielding open, coupling of parasitic signals, e.g. with isolated system set-up. | Correct<br>Establish shielding or decouple |
| Measurement signal:<br>-Limited to values <10 V<br>-Jumps to 10.24 V | With *SEM* and *FIX-range* $10^{-11}$ and $10^{-12}$ A | EP 422 overdriven<br>Use Autorange or *RANGE* $10^{-10}$ and higher<br>SEM voltage |

| Problem | Possible cause / Test methods | Correction |
|---|---|---|
| Unsatisfactory peak shape, poor sensitivity | Small emission (0.1 mA) cannot be set on QME 125 | Replace the insulators in the ion source, see QMA 125 → 🕮 [4] |
| | Ion source insulation in analyzer bad (good: >100 MΩ) | Replace the insulators in the ion source, see QMA 400 → 🕮 [2], QMA 125 → 🕮 [4] |
| Unsatisfactory peak shape, poor sensitivity | Ion source or rod system in analyzer contaminated or defective | Clean QMA 400 → 🕮 2], QMA 125 → 🕮 [4] |
| | SEM voltage too low | See Error 34 |
| | SEM contaminated or defective | Replace SEM, QMA 400 → 🕮 [2], QMA 125 → 🕮 [4] |
| Peaks become wider/narrower with increasing mass number | Incorrect setting of *resolution coarse* | Adjust QMH 4x0 → 🕮 [1], QME 125 → 🕮 [3] |

## 7.5 General problems

| Problem | Possible cause / Test methods | Correction |
|---|---|---|
| Fans not running, no indication on CS 422 or *power*-LED | Line voltage missing or too low | Check line voltage |
| | Power cable defective | Replace power cable |
| | Short circuit in external unit such as QMH 4x0 or QME 125 | Switch off / unplug ext. equipment / switch on again. If unsuccessful replace the defective unit. |
| | Short circuit on bus or in wiring<br>Defective power supply | Trace<br>Replace power supply (manufacturer's warranty becomes void if the power supply is opened) |
| Fans running, display on CS 422 is blank | Contrast strongly out of adjustment | Adjust contrast with ⌨ |
| | CS 422 or its cable defective | Replace |
| | QC 422 not correctly installed or defective | → 🗎 29 or replace |
| CS 422 keys dead | Control via interface | Manual control: *config-CTRL-MODE:CS 422* |
| QMH 4x0 connector does not fit into QC 422 | QMH cable with old locking device | Use adapter → 🗎 65 |
| Sporadic error messages | EMC problems | Correct the ground connection → 🗎 21<br>Detach QMG cable from noise sources<br>Identify noise source and eliminate noise<br>Use LAN (fiber optics) |
| | Line voltage dips | Check supply voltage quality |
| No ArcNet communication | Check status LEDs of the OPA 200, check FO connection | OPA 200 → 🕮 [6] |
| | FO connectors contaminated | Clean, e.g. with alcohol |
| | HUB has no power | Check |
| | Stray light | Mount caps on all unused FO connectors! |
| | Wrong settings | Check jumper settings on all LAN units<br>QC 422, OH 421 → 🗎 26 and → 🕮 [6], [7] |
| | Wrong node addresses | Correct |
| | QC 422 defective | Replace QC 422 |
| | Defective LAN port device | Reduce system to minimum and then rebuild it in steps |

## 7.6 Service interventions

If you are unable to remedy a fault or if you are not allowed to do so due to the lack of skilled personnel, please contact the responsible service location.

If you need advice or if you want to return the equipment for repair, please supply a comprehensive description of the error together with:

- Description of fault, e.g. hard copies, recorder charts and text
- Application conditions and operating modes under which the error occurs
- In case of sporadic errors all observations that could help to reproduce the error
- Type, series, software and firmware numbers of all components involved.

Products that have been exposed to vacuum conditions must always be accompanied by a completed declaration of contamination (→ 🗎 69).

# 8 Maintenance

The QMS 422 and QMI 422 have lateral ventilation inlets. Their filters are to be cleaned before the air circulation becomes obstructed. The cleaning interval depends on the local dust evolution. Dry dust can easily be removed with the aid of a vacuum cleaner.

**Skilled personnel**

If necessary remove the filters and wash them in a mild soap solution. Dry them well before you reinstall them!

Defective filters should be replaced (→ 🗎 65).

The installed fans should be checked semi-annually. Replace them if they are not running smoothly or are overly noisy.

Dusty circuit boards can be cleaned with compressed air (max. 2 bar). Make sure that no components get damaged or bent.

Moisture (condensation) in the EP 422 can lead to unstable behavior (offset fluctuations). Open the EP 422 and dry it with a hair dryer (max. 60 °C).

Refer to the maintenance instructions in all the user's guides of the components that form part of the system. See list of literature on 🗎 68.

# 9 Decommissioning

Please contact your Pfeiffer Vacuum service location on instructions of how to dispose of your system.

# 10 Spare parts and accessories

| | | Ordering number |
|---|---|---|
| QMS 422 | Basic unit without QC 422 | PT 444 580-T |
| CS 422 | Operator console | PT 444 650-T |
| | 1 Filter mat for QMS 422 | B 5099 154 FD |
| | 1 Ventilator for QMS 422 | B 5099 130 CD |
| | 1 Blanking plate, 4 subunits (20 mm wide) | BG 544 775-T |
| | Power supply for QMS 422 and QMI 422 (90...265 V) | B 5181 214 QY |
| QMI 422 | Control unit with QC 422 | PTM D27 280 |
| | 1 Air filter mat for QMI 422 | B 5099 154 FB |
| EP 422 | Electrometer | BG 444 570-T |
| | Input cable TNC/TNC, 200°C, l = 0.5 m | B 4564 401 EB |
| | Input cable TNC/TNC, 70°C, l = 6 m, low-noise | B 4564 401 E2 |
| | TNC short circuit plug (fits QMA) | B 4728 138 BC |
| QC 422 | Quadruple controller without options | BG 444 590 -T |
| AO 421 | Analog output (incl. connector) | BG 442 328-T |
| IC 421 | Ion counter and analog output | BG 442 320-T |
| | Ion counter preamplifier CP 400 | BG 442 210-T |
| | Cable CP 400-QC 422: 3m | BG 448 134-T |
| | Cable CP 400-QC 422: 10m | BG 448 199-T |
| Ion source supply IS 420 | | BG 512 900-T |
| | Ion source cable 3 m | BG 548 082-T |
| | Ion source cable 10 m | BG 548 083-T |
| | Fuses F1, F2 2.5 A slow | B 4666 444 |
| HV 420 | SEM high voltage supply | BG 546 040-T |
| | Fuse F1 0.2 AT | B 4666 422 |
| HV 421 | SEM high voltage supply | BG 442 250-T |
| | HV cable 3m | BG 541 978-T |
| | HV cable 10m | BG 541 979-T |
| AI 421 | Analog input (incl. connector) | BG 442 240 -T |
| DI 420 | Digital input | BG 512 830 -T |
| | 1 Connector housing | BG 531 194-T |
| | 1 Multipoint connector, solder version | B 4717 306 DL |
| DO 420A | Digital output | BG 512 842 -T |
| | Connector, see DI 420 | |
| PI 420 | Pirani module | BG 512 715 -T |
| PE 420 | Cold cathode module | BG 512 726 -T |
| OH 421 | Optical hub | BG 442 465-T |
| OPA 200 | Optical PC Arcnet interface | B 5278 503 KT |
| OHA 200 | Optical hub 5-port | PT 442 510-T |
| OHA 200 | Optical hub 10-port | BG 442 520-T |
| | Fiber-optic conductor PCF 10m | B 5159 615 2H |
| | Fiber-optic conductor PCF 20m | B 5159 615 2K |
| | Fiber-optic conductor PCF 50m | B 5159 615 2Q |
| | Fiber-optic conductor APF 1 m | B 5159 615 2C |
| | Fiber-optic conductor APF 3 m | B 5159 615 2D |
| | Other lengths on request | |
| Adapter for QMH 400 / QME125 with sliding lock | | B 4720 786 CD |

# Appendix

## A: Default parameter values

For activating the default parameters see Parameter *INIT*.

### Channels

| Parameter | Function | Default value | Parameter | Function | Default value |
|---|---|---|---|---|---|
| *AI-CH* | *detect* | 0 | *MODE* | *amplif* | FIX |
| *AO-CH* | *output* | 1 | *MODE* | *mass* | SCAN-N |
| *AO-MODE* | *output* | LIN | *MONITOR* | *output* | LIN |
| *AVERAGE* | *mass* | 1 | *O-RNG* | *output* | E-1 |
| *CALIB* | *amplif* | 1.000 E0 | *P-CAL* | *amplif* | 1.0 |
| *COPY TO XX* | *aux* | 0 | *PE-CTRL* | *detect* | OFF |
| *CP-LEV* | *amplif* | 0.00 V | *PI-CH* | *detect* | 1 |
| *DO-A* | *trip* | OFF | *RANGE* | *amplif* | E-5 |
| *DO-B* | *trip* | OFF | *RANGE-L* | *amplif* | E-5 |
| *DWELL* | *mass* | 1 s/u | *RESOL* | *mass* | 25 |
| *FILTER* | *amplif* | AUTO | *SEM* | *detect* | SEM-HV |
| *FIRST* | *mass* | 14.00 | *SPEED* | *mass* | 1 s/u |
| *GAIN* | *amplif* | ×1 | *STATE* | *aux* | ENABLE |
| *LEVEL-A* | *trip* | 1.00 E-6 | *THRESH* | *mass* | 0.3 %F.S. |
| *LEVEL-B* | *trip* | 1.00 E-5 | *TYPE* | *detect* | SEM |
| *LOG-DEC* | *output* | 3 DEC | *TYPE* | *trip* | ABS |
| *MASS* | *mass* | 14.00 | *WIDTH* | *mass* | +16 |

### General

| Parameter | Function | Default value | Parameter | Function | Default value |
|---|---|---|---|---|---|
| *BAUD* | *config* | 2400 Bit/s | *MODE* | *config* | CS 422 |
| *DETECT* | *config* | SEM | *NODE* | *config* | 176 |
| *IS-TYP* | *config* | CB | *OPTION* | *config* | NO |
| *MASS-R* | *config* | 512 | *QMA* | *config* | 400 |
| | | | *SEM+FIL* | *config* | INTERN |

### Ion source

400

| Parameter | Function | Axial | CB | Grid | SPM | Spec+/- |
|---|---|---|---|---|---|---|
| *E-PROT* | *emiss* | 4.40 A | 4.40 A | 4.40 A | 3.50 A | 0.00 A |
| *EMISS* | *emiss* | 1.00 mA | 1.00 mA | 1.00 mA | 0.50 mA | OFF |
| *V1* | *v1...v6* | 90 V | 90 V | 90 V | 40 V | 0 V |
| *V2* | *v1...v6* | 70.0 V | 70.0 V | 70.0 V | 40.0 V | 0 V |
| *V3* | *v1...v6* | +20.0 V | +20.0 V | 0.0 V | 0,0 V | 0 V |
| *V4* | *v1...v6* | 15 V | 15 V | 15 V | 3 V | 0 V |
| *V5* | *v1...v6* | 0 V | 250 V | 0 V | 0 V | 0 V |
| *V6* | *v1...v6* | 300 V | 300 V | 300 V | 110 V | 0 V |
| *V7* | *v7...* | 0 V | 0 V | 0 V | 0 V | 0 V |
| *V8* | *v7...* | 0 V | 0 V | 0 V | 0 V | 0 V |
| *V9* | *v7...* | 30 V | 0 V | 0 V | 30 V | 0 V |

## Operation

| Parameter | Function | Default value | Parameter | Function | Default value |
|---|---|---|---|---|---|
| *ADJ-TYP* | *cycle* | COARSE | *FIL1* | *ion src* | SET 0 |
| *BEGIN* | *cycle* | 0 | *FIL2* | *ion src* | SET 0 |
| *COPY TO SET* | *ion src* | SET 0 | *FUNCT* | *cycle* | CYCLE |
| *CYCLES* | *cycle* | REPEAT | *MODE* | *cycle* | MONO |
| *D-EMIS* | *ion src* | 10.0 mA | *MODE* | *ion src* | NORMAL |
| *D-PROT* | *ion src* | 4.00 A | *SEM-VOLTAGE* | *sem hv* | 1500 V |
| *D-TIME* | *ion src* | 10 min | *TRIG* | *cycle* | INTERN |
| *END* | *cycle* | 63 | *TYPE* | *ion src* | CB |
| *FILAM* | *ion src* | 1 | | | |

# B: Literature


🕮 [1] Operating instructions RF Generator QMH 400 / 410
BG 805 982 BE

🕮 [2] Operating instructions QMA 400 / 410 / 430 Analyzer
BK 805 983 BE

🕮 [3] Operating instructions Quadrupole electronics QME 125
BG 800 987 BE

🕮 [4] Operating instructions Analyzer QMA 125
BG 805 988 BE

🕮 [5] Communication protocol Quadrupole Controller QC 422
BG 805 986 BE

🕮 [6] User's guide Network Controller Board OPA 200
vina02d3

🕮 [7] Operating manual Optical Hub OHA 200

🕮 [8] Operating instructions Pirani module PI 420

🕮 [9] Operating instructions Penning Module PE 420


Ordering source
Pfeiffer Vacuum GmbH Emmeliusstrasse 33 D-35614 Asslar

# C: Index

**Note:**
**Information on the parameters can be found in the alphabetical list beginning on page 35**

# Declaration of Contamination

The service, repair, and/or disposal of vacuum equipment and components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay.
This declaration may only be completed (in block letters) and signed by authorized and qualified staff.

**1 Description of product**

Type _____
Part number _____
Serial number _____

**2 Reason for return**

_____
_____
_____

**3 Operating fluid(s) used** (Must be drained before shipping.)

_____
_____

**4 Process related contamination of product**

| | | |
|---|---|---|
| toxic | no ❑ 1) | yes ❑ |
| caustic | no ❑ 1) | yes ❑ |
| biological hazard | no ❑ | yes ❑ 2) |
| explosive | no ❑ | yes ❑ 2) |
| radioactive | no ❑ | yes ❑ 2) |
| other harmful substances | no ❑ 1) | yes ❑ |

The product is free of any substances which are damaging to health yes ❑

1) or not containing any amount of hazardous residues that exceed the permissible exposure limits

2) Products thus contaminated will not be accepted without written evidence of decontamination!

**5 Harmful substances, gases and/or by-products**

Please list all substances, gases, and by-products which the product may have come into contact with:

| Trade/product name Manufacturer | Chemical name (preferably with formula) | Precautions associated with substance | Action in case of human contact |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**6 Legally binding declaration:**

We hereby declare that the information on this form is complete and accurate and that we will assume any further costs that may arise. The contaminated product will be dispatched in accordance with the applicable regulations.

Organization/company _____

Address _____ Post code, place _____

Phone _____ Fax _____

E-mail _____

Name _____

Date and legally binding signature

_____

Company stamp

This form can be downloaded from our website.

Copies:
Original for addressee - 1 copy for accompanying documents - 1 copy for file of sender

Original: German BG 805 981 BD (0201)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