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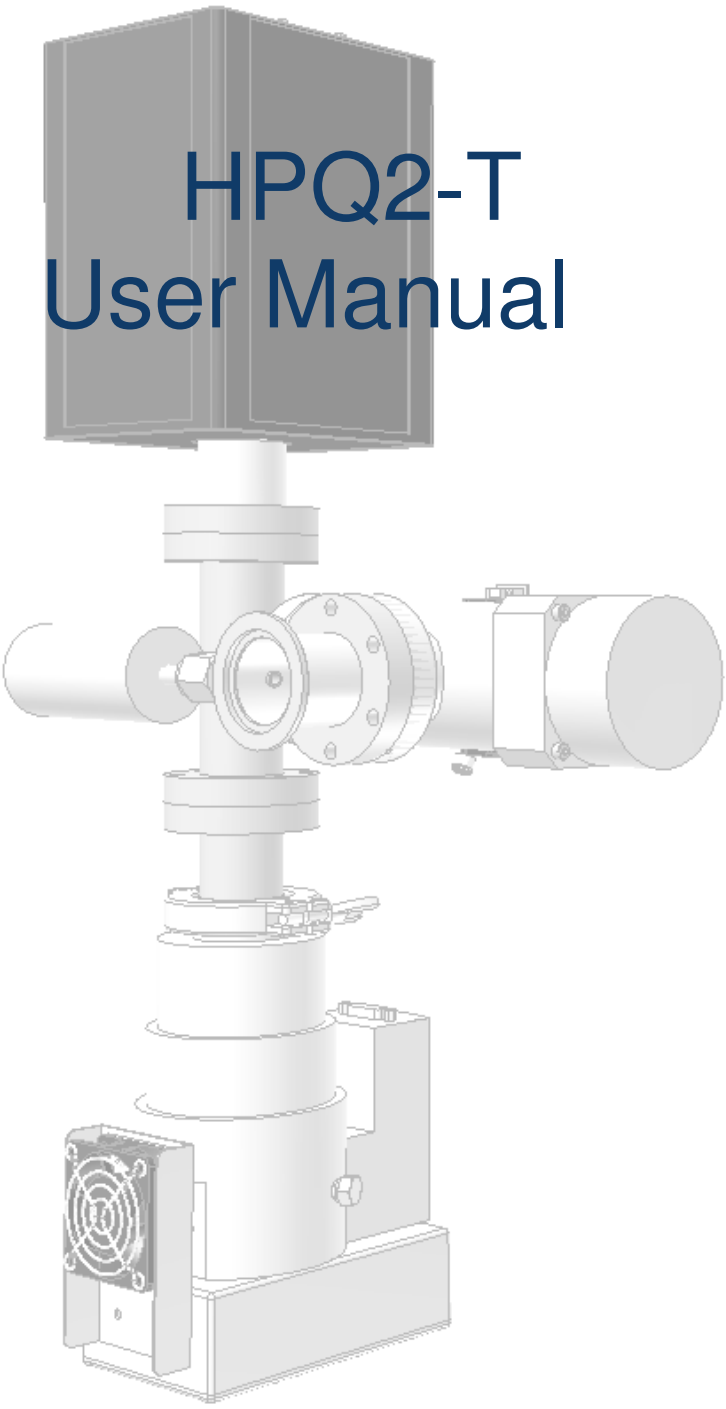
Technology for Productivity

Spectra Products

HPQ2-T
User Manual



As part of our continuous product improvement policy, we are always pleased to receive your comments and suggestions about how we should develop our product range. We believe that the manual is an important part of the product and would welcome your feedback particularly relating to any omissions or inaccuracies you may discover.

You can send your comments to:-

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Contents

Declaration of Conformity

MKS Instruments UK Ltd, Spectra Products.
Cowley Way
Crewe
Cheshire
CW1 6AG
United Kingdom

DECLARES THAT THE FOLLOWING PRODUCT:

LM111 HPQ2-T DPS

IS IN CONFORMITY WITH THE FOLLOWING EUROPEAN DIRECTIVES:

2004/108/EEC ELECTROMAGNETIC COMPATIBILITY DIRECTIVE
2006/95/EC LOW VOLTAGE DIRECTIVE

THE APPLICABLE STANDARDS ARE:

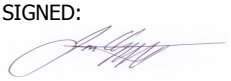
EN 61326:1998 ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL & LABORATORY USE

EN 61010-1:1993 SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL & LABORATORY USE

WARNING

This apparatus shall not be used in the residential, commercial, and light industrial environment unless further mitigation measures are taken.
For advice please contact MKS Instruments, Spectra Products

SIGNED:



J.M.Higgins
GENERAL MANAGER

1. Safety

IP20 to EN60529

The protective earth conductor of the power cord must be connected to the power source protective earth terminal.
There are no operator replaceable parts within the 24VDC power supply unit or the HPQ2 unit.

Connectors

The connectors for external circuits are for use only with MKS Spectra equipment, or equipment which has no accessible hazardous live parts.
The external circuits must comply with the requirements of EN61010-1 section 6.6.1.

Ports for connection of accessories do not carry hazardous potentials.

Do not position the 24VDC power supply so that it is difficult to unplug the supply power cord.

Installation Category II comprises mains powered, local level appliances.

Warning labels

On the front panel refers to:

a. Accessible hazardous voltages on analyser connector, when not mated to the analyser, which may result in a non-hazardous electric stock if touched.

b. Tuning adjustment holes, which are not for operator use.

On the rear panel refers to:

a. Read all instructions carefully before use.

b. The control unit and signal ports are designed for connection to MKS Spectra accessories via MKS Spectra supplied cables.
There are no accessible hazardous voltages or currents on these ports.
MKS Spectra must be consulted before any non-MKS Spectra supplied cables or accessories are connected to these ports.

Ventilation

Openings in the front, top and bottom panels must not be obstructed.
Allow a minimum clearance of 50mm all round. Do not exceed the maximum operating ambient temperature.

Additional Installation Maintenance and Operating Instructions

In order to comply with European regulations, the following procedures must be followed:

Installation

1. The installation procedures given in the operating and technical manuals must be followed in addition to these instructions.

2. The mains power cable must conform to local regulations and must have a protective earth (PE) conductor securely connected to the power plug protective earth contact.

3. The short earthing braid supplied with some products, must be fitted between the terminal on the RF head and one of the CF40 vacuum flange bolts.

4. Only cables supplied with the equipment may be used for interconnections. If extension cables are required to obtain a greater separation between control unit and RF head, or if longer serial communications cables are required, they must be supplied by MKS Instruments Ltd.

5. Cables attached to all other ancillary signal and control ports must have a length of less than 3 metres. If greater length is required, MKS Instruments Ltd. must be contacted for technical guidance on possible EMC and safety issues.

6. The vacuum system on which the analyser/RF head is mounted must be earthed, to a protective earth, preferably to the same protective earth as the control unit.

Operation

1. The equipment is not authorised for use as a critical component in a life support or safety critical system without the express written approval of MKS Instruments Ltd.

2. All instructions given in the operating manual must be followed.

3. Adjustments are strictly limited to those accessible from the control panel and computer keyboard and only when running software supplied by MKS Instruments Ltd.

Maintenance

WARNING-DANGEROUS VOLTAGES EXIST INSIDE THE EQUIPMENT

1. Maintenance functions must only be carried out by competent persons.

2. During the warranty period, faulty equipment must be returned to MKS Instruments, Spectra Products Ltd., unless special arrangements are made.

3. There are no user serviceable parts in the electronic equipment. Certain components are EMC and safety critical and must not be substituted. Replacement parts are available from MKS Instruments, Spectra Products Ltd.

4. Equipment enclosures embody certain special fastenings and bonding devices that affect EMC and safety performance. These must be correctly re-fitted after servicing.

2. Introducing HPQ2-T

The HPQ2-T is a complete differentially pumped quadrupole residual gas analysis system, designed to operate at higher pressures than traditional HPQ2 instruments.

The HPQ2-T is designed to be operated from an IBM compatible PC running Process Eye Professional software. Communication between the PC and the HPQ2-T is via an RS232, RS422, RS485 or Ethernet, depending on the system configuration supplied.

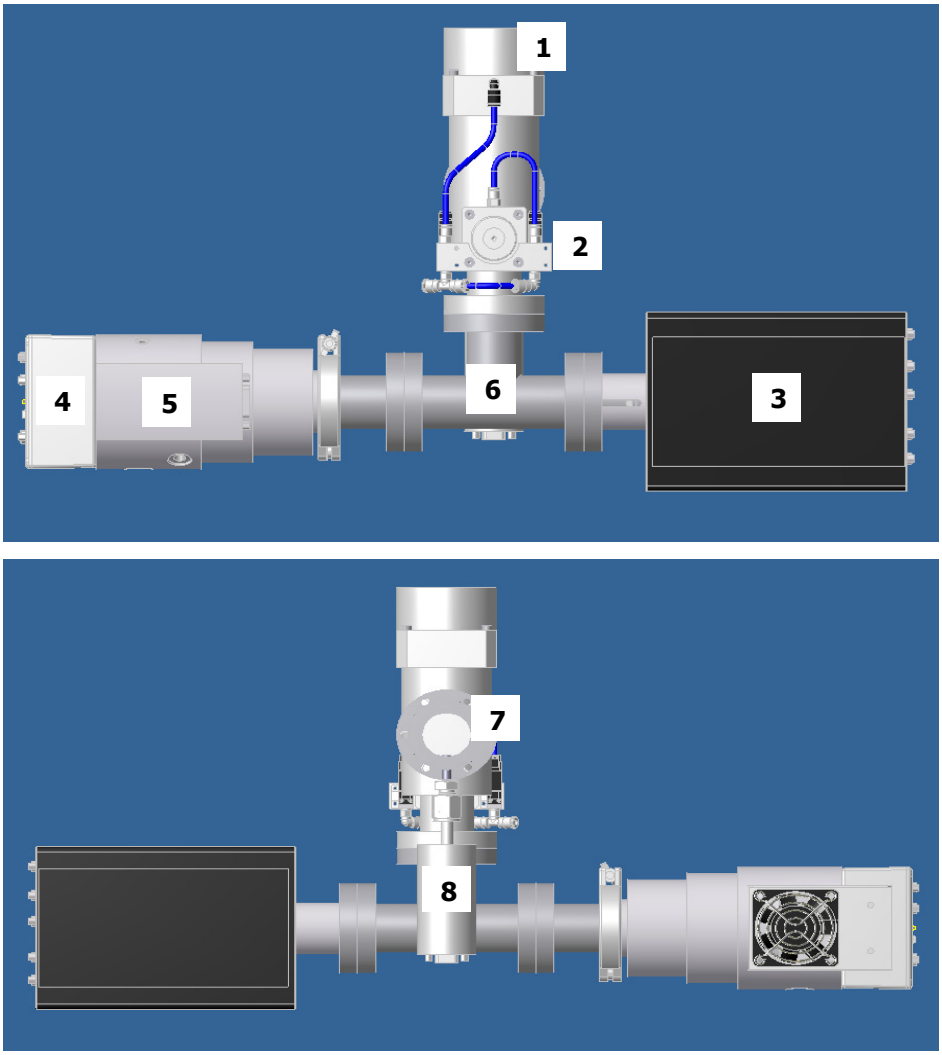
The complete HPQ2-T system surprises of;

HPQ2 analyser
HPQ2/HPQ2-IP control unit
925 Gauge
RGA Chamber
Interface Module
Pfeiffer TMU071 TMP
Low voltage power supply (system)
Low voltage power supply (RGA)
Interconnecting cables
Manual
Tool kit
Process Eye Professional software
CF70 or KF40 fitting (option)
Diaphragm backing pump (option)

This manual focuses on the HPQ2-T hardware and should be used in conjunction with the Process Eye Professional manual.

3. System Overview

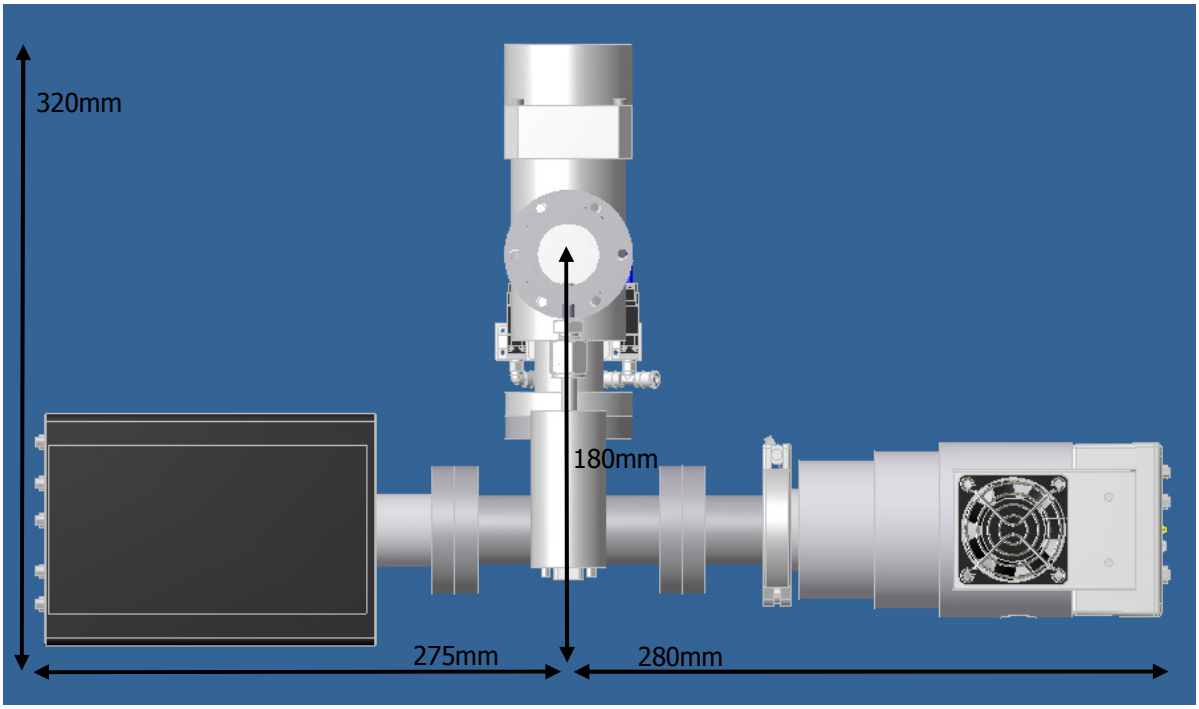
Main Components

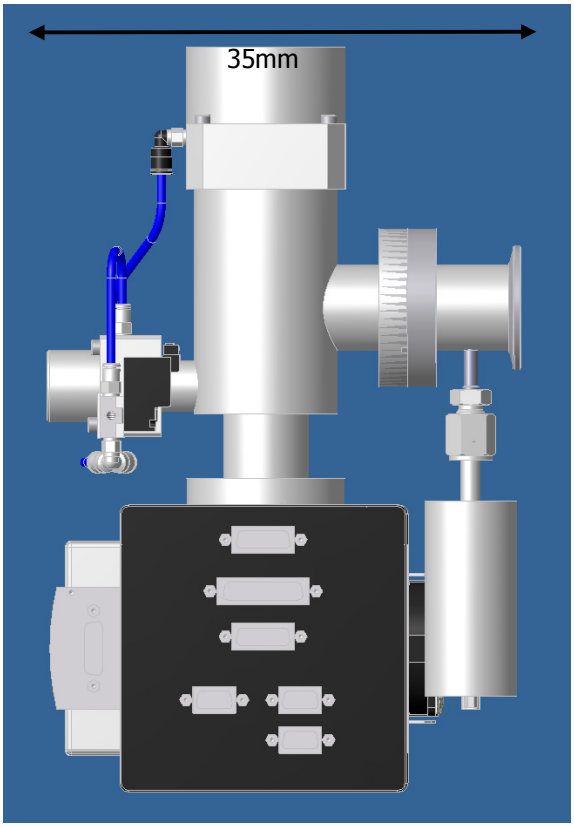


Item:

1 – MKS LoPro Valve
2 – Pneumatic Control
3 – HPQ2 RGA
4 – Interface Module
5 – Turbo Molecular Pump
6 – Sampling Chamber
7 – Process Chamber Mounting Flange (CF70 or KF40)
8 – MKS-925 Micro Pirani Gauge

Dimensions





General

Mass Range Capability	2 to 80 amu
Detector System	Faraday Cup
Maximum Operating Pressure (standard)	0.1 Bar (75mT)
Minimum Detectable Partial Pressure	$1.3e^{-10}$ mBar ($1e^{-10}$ Torr) at baseline pressures of $7.5e^{-4}$ mBar (<0.6 mTorr)
Mass Stability	Better than ±0.1 amu over 8 hours at constant ambient temperature
Resolution	<1.2 amu at 10% peak height

Analyser

Maximum Bakeout Temperature	250^0C
Mounting Flange	2 ¾ inch Conflat (CF35)
Insertion Length	1.0 inch (25.4mm)
Ion Source Sensitivity	5 x 10-5 A/Torr
Electron Energy	40 and 70 eV nominal (adjustable from PC)
Emission Current	0.1 and 0.7mA nominal (adjustable from PC)
Filaments	2, independent, Tungsten or Thoriated Iridium

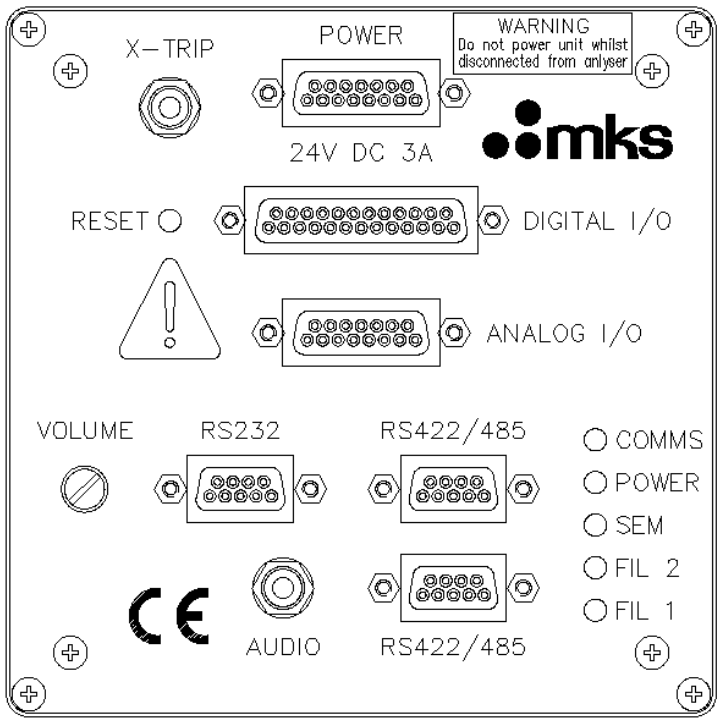
Control unit

Control Unit Weight	2.3kg
Dimensions	127mm x 127mm x 182mm
Overall length	229mm
Maximum Ambient Operating Pressure	35^0C non-condensing
PC Software	Process Eye Professional
Power	24V DC 3A External supply included
Communication	RS232, RS422, RS485, Ethernet
Baud Rate & Distance	RS232C 9600 baud, 15 metres (50ft) RS422 /485 115k baud,1.2km (4000ft)

Control Unit Overview

The HPQ2 control unit is a single unit incorporating all the necessary power supply and data acquisition electronics for the residual gas analyser.
Power is derived from a dedicated low voltage power supply which is supplied as part of the standard package. The control unit plugs directly onto the quadrupole analyser via the connector mounted on the front panel of the unit. All external connections including the power supply and serial communications link are made via connectors mounted on the rear panel of the control unit. Two variants are available offering the choice of serial or Ethernet communications.

Rear Panel Description (Serial)



Connectors

Power
This is a 15 way D-Type socket labeled POWER on the rear panel of the unit to connect to the low voltage power supply unit.

Pin connections are:

Pin 1, 2, 3	+24 volts DC
Pin 9, 10, 11	0 volts (24 volt return)
Connector Shell	Functional Earth

The power input is 24 volts DC ± 10%, 2 Amps max.

Digital I/O
A 25-way D-type connector – See "Connecting the System".

Analog I/O
A 15-way D-type connector - See "Connecting the System".

RS232
This is a 9-way D-Type socket labelled RS232. It is used to connect the HPQ2-T to the host computer when the RS232 interface is used.

Pin connections are:

Pin 1, 7, 9	Not Connected
Pin 2	TXD transmit data
Pin 3	RXD receive data
Pin 4, 6, 8	Fused +15V
Pin 5	0 volts

RS422/485 plug and socket
These are a 9-way D-Type socket and a 9-way D-Type plug labelled RS422/485.

Pin connections are:

Pin 1	0V (for termination network)
Pin 2, 3, 7	Not Connected
Pin 4	RXD (-)
Pin 5	RXD (+)
Pin 6	+5V fused (for termination network)
Pin 8	TXD (-)
Pin 9	TXD (+)

Audio output
This is a 3.5mm Jack socket mounted labelled AUDIO. It is used to connect headphones or an external speaker so that audio tones generated in some of the modes can be heard. e.g. Leak checking tone and audio alarms.
The minimum load impedance should be 8 ohms and the power handling is 2 watts max.

X-Trip
See "Connecting the System"

Indicators

Filament 1
This is a green LED labelled FILAMENT 1 on the rear panel of the HPQ2 unit. It will be illuminated when filament 1 is selected and the emission is established. If the emission is not at the selected value, it will be extinguished.

Filament 2
This is a green LED labelled FILAMENT 2 on the rear panel of the HPQ2 unit. It will be illuminated when filament 2 is selected and the emission is established. If the emission is not at the selected value, it will be extinguished.

Power
The indicator is lit when power is supplied to the HPQ2 unit.

Comms
This indicator flashes on comms activity.

Controls

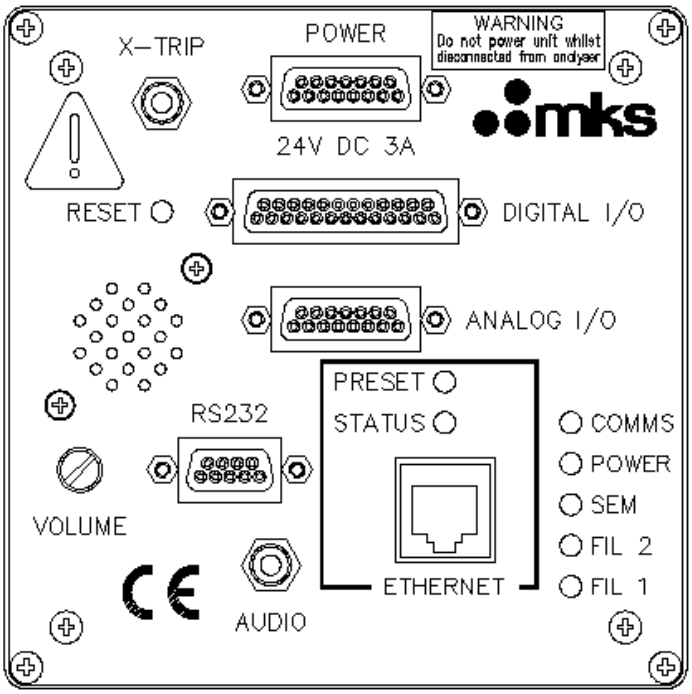
Reset

The reset switch is accessible through a hole in the rear panel and is labelled RESET. Pressing the switch performs a hardware reset on the microprocessor in the HPQ2 unit.

Volume Control

This controls the volume of the audio tone generated by the external speaker in the Leak Check and Peak Jump Alarm modes. Turn clockwise to increase the volume and turn anti-clockwise to decrease the volume.

Rear Panel Description (Ethernet)



Connectors

Power
This is a 15 way D-Type socket labeled POWER on the rear panel of the unit to connect to the low voltage power supply unit.

Pin connections are:

Pin 1, 2, 3	+24 volts DC
Pin 9, 10, 11	0 volts (24 volt return)
Connector Shell	Functional Earth

The power input is 24 volts DC ± 10%, 2 Amps max.

Digital I/O
A 25-way D-type connector – See "Connecting the System".

Analog I/O
A 15-way D-type connector - See "Connecting the System".

RS232
Not used.

Ethernet
RJ45 type connector used to connect the HPQ2 to the host PC.
Use the following Cat5 cables:
If connecting directly to the host PC – use a "crossover" or "cross-wired" cable, or the supplied adaptor.
If connecting via a network, hub or switch, use a standard patch cable

Audio output
This is a 3.5mm Jack socket mounted labelled AUDIO. It is used to connect headphones or an external speaker so that audio tones generated in some of the modes can be heard. e.g. Leak checking tone and audio alarms.
The minimum load impedance should be 8 ohms and the power handling is 2 watts max.

X-Trip
See "Connecting the System"

Indicators

Filament 1
This is a green LED labelled FILAMENT 1 on the rear panel of the HPQ2 unit. It will be illuminated when filament 1 is selected and the emission is established. If the emission is not at the selected value, it will be extinguished.

Filament 2
This is a green LED labelled FILAMENT 2 on the rear panel of the HPQ2 unit. It will be illuminated when filament 2 is selected and the emission is established. If the emission is not at the selected value, it will be extinguished.

Power
The indicator is lit when power is supplied to the HPQ2 unit.

Comms
This indicator flashes on comms activity.

Controls

Preset
The Preset switch is accessible through a hole in the rear panel and is labelled PRESET. Pressing the switch performs a hardware reset on the microprocessor in the HPQ2 unit.

Status
The Status switch is accessible through a hole in the rear panel and is labelled STATUS. This switch is used in conjunction with the Preset switch to carry out certain service functions, such as resetting the units internal IP address which is described below.

To reset the IP address of the unit:
Press the Preset switch, immediately press and hold the Status switch until the unit emits a beep. The unit has now reverted back to its default IP address of 192.168.0.250.

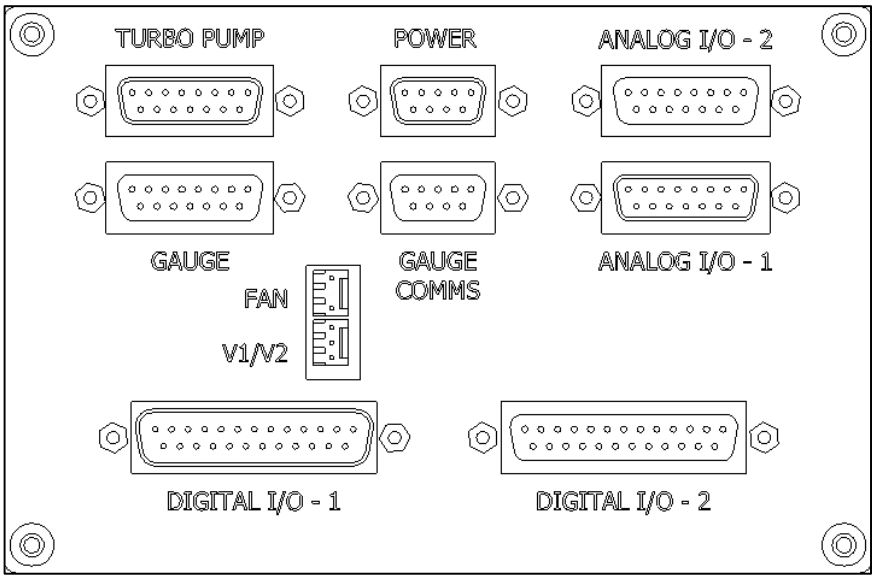
Note: If the unit was configured for DHCP, then the Status switch must be held for approximately 90 seconds.

Volume Control
This controls the volume of the audio tone generated by the external speaker in the Leak Check and Peak Jump Alarm modes. Turn clockwise to increase the volume and turn anti-clockwise to decrease the volume.

4. Connecting the System

Interface Module Connections

All the system interconnections are made between the various system components and the Interface Module



Label	Connector Type	Destination
Turbo Pump	15W D-Type	Turbo Pump Controller
Gauge	15W D-Type	925 Gauge
Power	9W D-Type	103 Watt Power Supply
Gauge Comms	9W D-Type	Service Personnel Only
Analog IO -1	15W D-Type	Analog IO Port on HPQ2 Control Unit
Analog IO -2	15W D-Type	For external connections
Digital IO -1	25W D-Type	Digital IO Port on HPQ2 Control Unit
Digital IO -2	25W D-Type	For external connections
Fan	2-Pin connector	Turbo Pump Cooling Fan
V1 / V2	3-Pin connector	Pneumatic Control - Valve1 & Valve2
X-Trip	Flying Lead to jack plug	X-Trip socket on HPQ2 Control Unit

Analog IO Connector Pin Assignments

The Analog I/O port provides 1 Analog output 0 to +10V, 4 quasi-differential Analog inputs (0 to ±10V with a maximum voltage on the return of ±0.5V) and ±15V power outputs both **fused at 100mA**

Pin	Function
1	-15V fused
2*	Reserved by system
3	Analog input 3 return
4	Analog input 2 return
5	Analog input 1
6,7,14	No Connection
8	0V Analog
9	+15V fused
10*	Reserved by system
11	Analog input 3
12	Analog input 2
13	Analog input 1 return
15	Analog output

Digital IO Connector Pin Assignments

The Digital IO Connector provides 4 Opto-isolated inputs requiring a 24VDC input to switch and 8 Opto-isolated capable of switching 24VDC at **50mA maximum**

Pin	Description	Notes
1	No Connection	No Connection
2	PA6	Opto-Isolated Input
3	PA4	Opto-Isolated Input
4	PA7	Opto-Isolated Input
5	PA5	Opto-Isolated Input
6	PB6	Opto-Isolated Output
7	PB4	Opto-Isolated Output
8	PB0	Opto-Isolated Output
9	PB2	Opto-Isolated Output
10	PB7	Opto-Isolated Output
11	PB5	Opto-Isolated Output
12	PB3	Opto-Isolated Output
13	PB1	Opto-Isolated Output
14	PA6 Return	
15	PA4 Return	
16	PA7 Return	
17	PA5 Return	
18	PB6 Return	
19	PB4 Return	
20	PB0 Return	
21	PB2 Return	
22	PB7 Return	
23	PB5 Return	
24	PB3 Return	
25	PB1 Return	

5. Mounting the System

The components used in the HPQ2 T system share a common mounting flange and are orientated around a Tee-chamber. This provides a flexible mounting configuration which can be changed to suit almost any situation, the only limitation being the orientation of the turbo molecular pump, which must be mounted horizontally or vertically downwards only. If mounted horizontally, the fore line port MUST face down.

The system is supplied with either a KF40, or a CF70 flange for connection to the process chamber, the Tee chamber employs CF70 flanges. Further fittings, such as elbows can be used to adapt the system to your requirements.

It is important to support the HPQ2-T while securing it to your chamber. Ensure that only copper or silver-plated copper gaskets are used if using a CF fitting, or a suitable material for you process if using a KF fitting.

In the standard configuration the HPQ2-T is self-supporting, but support maybe needed if the configuration is changed.

Mount the HPQ2-T to your chamber before making the electrical connections. Once the system is securely mounted, make the connections between the interface module and the various system components before finally connecting the mains supply to the system and setting up Process Eye Professional.

Begin to pump-down your process chamber while observing the pressure indicated by the HPQ2-T's gauge in the Status display and monitor the function of the system according to the logic tables on page 22.

6. Operation

The HPQ2-T system is fully automated and requires no user intervention during operation. The working pressures and various set-points are pre-configured to the agreed specification at the factory. All that is required is for the system to be mounted to the process chamber and power applied.

Note:
****If the HPQ2-T is supplied with a separate backing pump, the turbo pump will start as power is applied. Do not attempt to move or mount the HPQ2-T with the turbo pump running****

The HPQ2-T's operational flow is as follows:

HPQ2-T system backed by process chamber

Process chamber at atmosphere – HPQ2-T not running

Process chamber at Set Point 1 – HPQ2-T turbo starts

Process chamber at process pressure – HPQ2-T valve 2 open and sampling data

Process chamber at baseline pressure – HPQ2-T valve 1 open and sampling data

HPQ2-T system backed by separate pump

Process chamber at atmosphere – HPQ2-T turbo starts when power is applied

Process chamber at Set Point 1 – HPQ2-T running

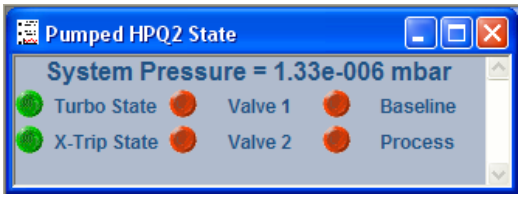
Process chamber at process pressure – HPQ2-T valve 2 open and sampling data

Process chamber at baseline pressure – HPQ2-T valve 1 open and sampling data

7. Software

Status Display

In addition to the normal Process Eye Professional views, an additional status dialog is present which provides information to the user regarding the current status of the HPQ2-T system.



The functions of this display are detailed below:

System Pressure
The current process chamber pressure taken from the 925 total pressure gauge

Turbo State
Green – Turbo pump ON
Red – Turbo pump OFF
Amber – On not at speed
Yellow – Stalled

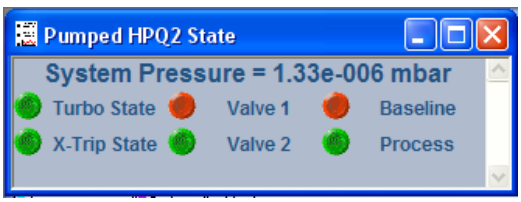
X-Trip State
Green - Filaments ENABLED
Red - Filaments DISABLED

Valve 1 & Valve 2
Green – Valve 1/2 OPEN
Red – Valve 1/2 CLOSED

Baseline
Green – Baseline pressure at set point
Red – Baseline pressure not at set point

Process
Green – Process pressure at set point
Red – Process pressure not at set point

Example;
Here we can see that the process chamber is at process pressure:



Filaments are enabled
Valve 2 is open
RGA is taking data

System Logic

Key:
SP – Set Point
V1 – Valve 1
V2 – Valve 2
BL – Baseline
PR - Process

Condition	Turbo State	X-Trip State	V1	V2	BL	PR
Not running	RED	RED	RED	RED	RED	RED
@ TMP SP	AMBER	RED	RED	RED	RED	RED
TMP @ speed	GREEN	GREEN	RED	RED	RED	RED
@ PROC SP	GREEN	GREEN	RED	GREEN	RED	GREEN
@ BASE SP	GREEN	GREEN	GREEN	RED	GREEN	RED
TMP @ stall	YELLOW	GREEN	GREEN	RED	GREEN	RED

Condition	Information	Pressure
TMP On Set Point	Backed by process tool	10 Torr
TMP On Set Point	External backing pump	760Torr
PROCESS Set Point (V2)		100mTorr
BASELINE Set Point (V1)		1mTorr
Hysteresis (default)		10%

8. Analyser Maintenance

General Overview

The HPQ2-T quadrupole analyser is the front end of your mass-spectrometer, it produces electrical signals which when presented to your electronics enable them to display in a meaningful fashion the content of your vacuum system.

Before embarking on any analyser maintenance you should have all the necessary parts and tools ready. If you are in any doubt about the work that you wish to undertake please contact your local MKS facility, ask for the service department and have the serial number of the analyser ready. The serial number is engraved on the analyser flange and will begin with the letters "LM".

The HPQ2-T analyser can be broken down into four separate areas by virtue of their function.

1. The ion source or ioniser

This is located at the top (furthest from the flange) of your analyser and its function is to take a representative sample of molecules and atoms from your vacuum chamber, convert them into ions and present them to the quadrupole filter.

2. The quadrupole filter

This is the centre section of your analyser. Its function is to take the ion beam generated in the source and separate the various ions by their mass to charge ratio (m/e) and present the single selected m/e to the collector.

3. The collector

This area of your quadrupole analyser is "hidden" inside the flanged housing. Its function is simply to convert the filtered ion beam presented by the quadrupole filter into a small electrical current which can be passed to the electronics for amplification and subsequent display to the outside world.

4. The flanged housing

This is the only part of your analyser that you will see under normal operating conditions. Comprising of an industry standard 2.75" Conflat® flange, with an electrical feedthrough which carries the various supplies and signals to and from the quadrupole analyser.

Maintenance of Your Analyser

Most, if not all, quadrupole analysers have areas of inherent weakness requiring periodic maintenance. This should be viewed as similar to automobiles which from time to time require oil changes etc. to protect the performance of the engine. Just like the automobile the frequency with which this work has to be carried out depends upon many factors such as the number of miles driven, the climate, the average length of journey and the speed at which the vehicle is usually driven.

Similarly with quadrupole analysers the type and cleanliness of the vacuum system, the hours of operation and the type and pressure of sample being analysed play a large part in determining the maintenance frequency. Apart from these considerations there are times when the analyser will require maintenance and these are when "accidents" happen i.e. when someone vents the vacuum system to air with the filament still switched on or when someone forgets to turn on the water cooling for the oil diffusion pump etc. These occurrences only vary in the magnitude of the disaster that ensues.

Routinely there is only one area of the analyser that requires any maintenance. This is the ion source. The ion source contains two filaments, only one of which will be in use at any one time. The filament is heated to approximately 2000 deg K at which temperature it emits electrons which are used to produce the ions required by the quadrupole filter. At this high temperature there are two deleterious effects.

The filament material slowly evaporates and condenses upon the surrounding surfaces. This effect is extremely slow but would require from time to time the cleaning of the surrounding source plates and ceramics and the replacement of the filaments.

The second effect is similar to the first except that the vacuum under which the source is operating has either a high oxygen or water content. Then, instead of metal being deposited upon the surrounding source plates a layer of metal oxides is deposited. These, being insulators, have a far more noticeable effect upon the performance of the source and therefore a more frequent cleaning program should be undertaken.

CAUTION
THE QUADRUPOLE'S FILTER IS ACCURATELY ALIGNED USING SPECIALIST TOOLS AND JIGS.

UNDER NO CIRCUMSTANCES SHOULD THE FILTER ASSEMBLY BE DISMANTLED.

In the remainder of this section we describe how to replace filaments, replace the ion source and clean the ion source as an assembly. The HPQ-2 analyser has been designed to allow these jobs to be carried out with minimal training and specialised equipment. Further analyser maintenance, is not described in this manual as we feel this is only possible after training by Spectra personnel. If you have any doubts about analyser maintenance please call your local MKS facility.

Failed Filaments

The filament status is constantly monitored by the power supply electronics and the operating software. This is done by measuring the flow of electrons emitted by the hot filament, referred to as the emission current, and flowing to the ion source cage. This is normally maintained at a fixed value between 0.1mA and 1mA. The current flow through the filament is increased until the value of emission current is reached. If, however, the control electronics reaches the limit of its filament current supply capability and the emission current has still not reached the required level a filament fail condition will exist. In the vast majority of cases this will be due to a blown filament, more correctly described as an open circuit filament. There are conditions such as a heavily contaminated ion source which will result in a filament fail when the filament is not open circuit. So, checking that the filament is open circuit is worth doing before going to the trouble of removing the analyser from your vacuum system.

Ohmmeter Analyser Checks

There are a number of circumstances when carrying out some simple checks with an ohmmeter can be well worthwhile. If you suspect a failed filament or want to check for shorts following some maintenance, a lot of time can be saved by performing some simple checks.

In carrying out these checks we can legitimately accept two ranges of meter readings as possibly acceptable and anything outside these ranges as being a definite fail. Any readings less than 1 ohm we can take as a short and any reading above 5 Meg Ohm as being open circuit. The following assumes that the analyser is still on the vacuum system and goes through all the possible tests.

Tools required:-

Ohmmeter with leads

Please refer to Page 31 for the analyser pin numbers.

Checking for shorts

1. Attach the first meter lead to pin 1 of the analyser feedthrough.

Connect the second meter lead to the analyser flange, you should have a short circuit. If not, you have a serious problem or more likely a faulty meter.

3. Connect the second meter lead to each of pins 2 to 12 on the analyser feedthrough in turn. Each one should give an open circuit. If not, you have a short to earth.

There are basically two types of short to earth; an internal short between one part of the analyser and an earthed part of the analyser, or more commonly a short between part of the analyser and the vacuum chamber. In either case remove the analyser from the vacuum chamber and repeat the test. If the result is the same than you have an internal short and should contact your local Spectra facility. Otherwise you have a short to the vacuum chamber, check the dimensions of the vacuum chamber around the quadrupole analyser or try refitting the analyser in a slightly different orientation.

4. Attach the first meter lead to pin 2 of the analyser feedthrough. Connect the second meter lead to each of pins 3 to 12 on the analyser feedthrough in turn. Each one should give an open circuit. Now attach the first meter lead to pin 3 and check to pins 4 to 12. Proceed around the feedthrough until all possible connections have been checked.

All pins should show open circuit to all other pins EXCEPT pin 4 to pin 8, pin 4 to pin 10 and pin 8 to pin 10 which should show short as these are the filament connections (see the next section). If any of the pins do show short to another pin contact your local service centre with the results of your testing and they will advise you as to how to proceed.

Checking Filaments

If you suspect a blown filament, for instance the control unit shows filament fail, carry out the following test before removing the analyser from the vacuum system.

1. Connect meter lead one to analyser feedthrough pin 8 which is the common connection to both the filaments.

2. Connect the second meter lead to pin 4 (Filament 1). You should have a short circuit, the resistance of the filament is about 0.5 ohms when it is cold.

3. Now connect the second meter lead to pin 10 (Filament 2) again your meter should indicate a short circuit.

If either or both filaments are blown the meter will indicate an open circuit and the filaments should be replaced.

If the meter reading suggests that the filament is good but the control unit shows a filament fail the most likely cause would be a break down in electrical continuity. Examine the RF/analyser connector on the front of the HPQ-2 control unit, check that none of the gold sockets are pushed out of place.

Changing Filaments

The HPQ-2 quadrupole analyser is fitted with a dual, self-aligning filament assembly. This assembly consists of a circular plate fitted with three small feedthroughs. Between these feedthroughs on the under side of the filament plate are attached the filament wires. When we talk about filaments and replacement filaments it is this assembly to which we are referring. Changing filaments is probably the most common maintenance procedure that has to be undertaken with quadrupole analysers but the analyser has been designed to make the task as quick and easy as possible.

Tools required
Here is a list of the tools and equipment you will require. We recommend that you assemble the following items before you start. Remember that the instrument was supplied with a tool kit, which contained some of the things you will need.

A small jewellers screwdriver (2mm)
A pair of tweezers
A small pair of smooth jawed needle nosed pliers
A pair of clean cotton gloves
A clean bench on which to work
An Ohmmeter
A clean container in which to put small parts
Replacement filament
Some method of holding the analyser securely in an upright position, a small vice is ideal.
A pen and paper on which to make notes and sketches

As the HPQ-2 is very small it is not really necessary to hold it in a vice as long as you are reasonably careful.

*** Always wear cotton gloves when working on the analyser ***

Removing the Filaments

1. Remove the analyser from the vacuum chamber making sure you do not touch any of the exposed surfaces. Place the analyser on the bench so that the ion source is uppermost, secure it in a vice if you prefer take care not to over tighten the jaws.

2. The filament assembly is located at the very top of the analyser and the electrical connections are made by two barrel connectors. Make a note of the orientation of the barrel connectors.

3. Hold one of the barrel connectors firmly with your pliers and slacken both screws undoing them 1 to 1½ turns. Lift away the barrel connector and put it in your container.

4. Repeat step 3 to remove the other barrel connector.

5. Remove the two M1.6 x 3 slotted pan head screws which hold the filament assembly in place on the ion source and put them in your container. This is easily done if you carefully undo the screw fully, then, lift it away using your tweezers.

6. Make a note of which way round the filament assembly is fitted onto the ion source then lift away the filament assembly.

It is worthwhile at this stage checking to see if the source requires any attention especially if the filament(s) have broken because of an over pressure situation in your vacuum system. With the filaments removed you have a clear view of the source cage where the signs to look for are powdery deposits of tungsten oxides. These will vary in colour but may be brown, blue, canary yellow or white depending upon the precise circumstances which led to their formation. If these oxides are present it is recommended that you refer to the section on source removal and cleaning before proceeding any further.

Fitting New Filaments

The fitting of new filaments is simply the reversal of the procedure for removing them. Care should be exercised at all stages to ensure that no shorts are introduced and that the analyser is kept clean.

1. Place the filament assembly in the correct orientation onto the top of the source ensuring that the filament wire does not touch any part of the source and thus potentially cause damage. Be careful to fit the filament plate into the top of the cylindrical foil repeller without bending the foil.

2. Refit the two M1.6 x 3 pan head screws that fasten the filaments to the ion source.

3. Place a barrel connector over one of the filament connection wires and gently pull the wire towards the ion source and fit the barrel connector to the appropriate feedthrough. Tighten the two screws on the barrel connector. Be sure the wire up to the barrel connector stays close to the analyser body.

4. Repeat step 3 for the other filament connection.

5. Check with your Ohmmeter for shorts.

6. Replace the analyser into your vacuum housing and again check for shorts or grounding to the outer vacuum housing.

Ion source - replacing and cleaning

The HPQ-2 analyser design permits the removal of the ion source as one complete assembly which can be replaced or cleaned as an assembly. The ion source automatically aligns on the main analyser assembly allowing it to be easily replaced without the need for any special jigs.

Removing the Ion Source

Once again you are advised to get the necessary tools together before you start this job.

Tools required:

A small jewellers screwdriver (2mm)
A pair of tweezers
A small pair of smooth jawed needle nosed pliers
A 0.89mm (0.035") Allen key
A pair of clean cotton gloves
A clean bench on which to work
An Ohmmeter
A clean container in which to put small parts
Replacement filament(s)
Replacement source parts if necessary
A pen and paper on which to make notes and sketches
Some method of holding the analyser in an upright position, a small vice is ideal.

1. Remove the analyser from the vacuum system, place it on the bench in an upright position, secure it in a vice if you prefer.

2. Remove the filament assembly as described on Page 27.

3. Locate the three barrel connectors attached to three of the plates which form part of the ion source. Undo the screws on these barrel connectors 1 to 1½ turns.

4. Undo the two very small socket set (Allen) screws that are positioned in the side of the source mounting collar at the base of the source assembly. These may be partially obscured by connecting wires.

5. The source is now free from the rest of the assembly and can be removed and placed onto the bench.

Cleaning the Ion Source

The ion source may be cleaned as a complete assembly as described below.

Equipment required:

Isopropyl alcohol
Ultra-sonic bath
Clean glass beaker
Drying oven or heat gun

Using an ultra-sonic bath can loosen some of the screws in the ion source carefully examine any used isopropyl alcohol before throwing it away in case there are some screws in the beaker.

1. Remove the ion source from the analyser as described on Page 29.

2. Place the ion source in the beaker and fill with sufficient isopropyl alcohol (ipa) to fully immerse the ion source. Place in the ultra-sonic bath for 10 to 15 minutes.

3. Replace the ipa and place in the ultra-sonic bath for a further 10-15 minutes.

4. Remove the ion source and rise with clean ipa and place in a drying cupboard for at least an hour to dry off all ipa residue. If a drying cupboard is not available use a heat gun to dry the ion source.

5. Check that all the screws in the ion source assembly are tight.

6. Re-fit the ion source by following the instructions in the next section.

If after two washes there are still deposits on the ion source it should be returned to an MKS service facility to be cleaned.

Re-fitting the Ion Source

Re-fitting the ion source is simply the reversal of removing it.

1. Position the ion source in the correct orientation above the analyser and then fit the three wires into the three barrel connectors on the various plates which make up the ion source. This is quite difficult and requires patience, so, take your time.

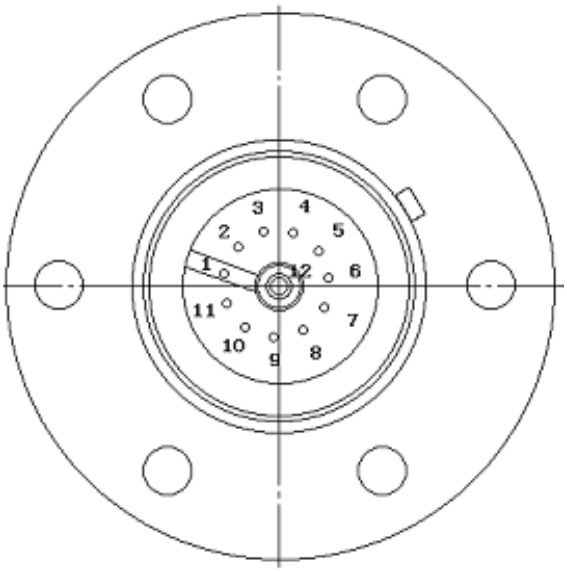
2. When the ion source is in place tighten the two socket set (Allen) screws in the source-mounting collar.

3. Tighten the screws in the three barrel connectors.

4. Re-fit the filament assembly by following the instructions on Page 28.

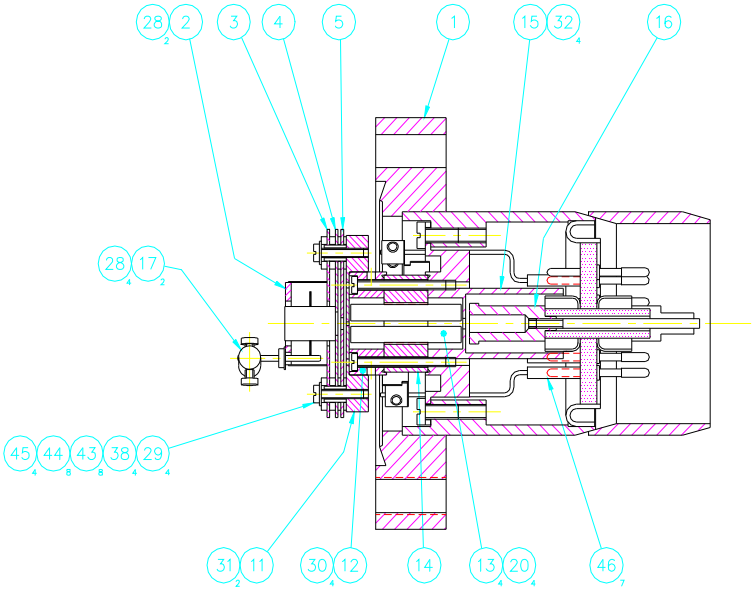
9. Exploded Views

Analyser Flange pin-outs



Pin Descriptions	
Pin	Connection
1	Earth
2	Source plate
3	No connection
4	Filament 1
5	Extraction plate
6	Suppressor plate
7	RF.1
8	Repeller plate / filament common
9	No connection
10	Filament 2
11	RF.2
12	Collector

Exploded View of the Analyser



HPQ-2 Analyser	
Reference	Part Description
1	Flange Sub Assembly
2	Filament Sub Assembly
3	Repeller Plate Sub Assembly
4	Source Plate Sub Assembly
5	Extraction Plate Sub Assembly
11	HPQ-2 Source Mounting Ring
12	HPQ-2 Filter Clamp Ring
13	HPQ-2 F/Electrode
14	Ceramic Filter Saddle
15	HPQ-2 Filter Mount
16	HPQ-2 Faraday Cup
17	HPQ-2 Filament Barrel Connector
18	HPQ-2 Connector
19	RF Loop for HPQ-2
20	Screw M1.6 x 5.6 modified
28	Screw M1.6 x 3 ch hd stainless steel
29	Screw M1.6 x 8 ch hd stainless steel
30	Screw M1.6 x 16 ch hd stainless steel
31	Screw M2 x 3 socket hd stainless steel
32	Screw M2.5 x 6 ch hd stainless steel
38	Washer Plain M1.6 stainless steel
43	Washer Ceramic 5.5 x 2.9 x 0.5mm
44	Ceramic Spacer 1mm White XDA080
45	Ceramic Tube 2.7 x 1.7 x 4.0mm long
46	Tube 0.076”dia x 0.056” id x .375” long Aly53
47	Alsint Tube 2mm x 1.2mm x 300mm long
48	Nickel Wire 1mm dia.
49	Stainless Steel Wire 22swg.

10. Returning Your Unit for Service

If you wish to return the instrument for service, please follow these simple guidelines.

Contact your local MKS Spectra service facility to obtain a Returns Material Authorisation (RMA) number. We will require some instrument details, such as the serial numbers, date of purchase and a detailed fault description.

Fill in the relevant sections of the Health and Safety Returns Form on the following pages, or we can provide you with a copy.

This form MUST accompany the instrument when returned, delays in providing this completed form will lead to delays in the servicing of the instrument.

Securely package all items to be returned, using the original packaging where possible and send to the address provided by the relevant service department.

Support Contact Numbers
Europe (UK) +44 (0) 1270 250150
USA +01 408-750-0347

RETURNS FORM

Please complete the form and fax or send by first class post to the appropriate MKS Spectra facility. Fax numbers and addresses can be found on the inside front page of this manual. Please ensure that we have this information before we receive the equipment. A copy should also be given to the carrier.

FAILURE TO COMPLETE THIS FORM OR COMPLY WITH THE PROCEDURE WILL LEAD TO DELAYS IN SERVICING THE EQUIPMENT

Please Complete The Following

Our RMA number: Customer P.O. No.

Customer Bill to Address:
Company
Department
Address

City
Zip/Postal Code

Customer Return to Address (if different from above):
Company
Department
Address

City
Zip/Postal Code
User's Name: Phone No.:

Equipment Shipped
Item 1: Serial No.:

Item 2: Serial No.:

Item 3: Serial No.:

Please describe the system fault in detail:

Details of all substances pumped or coming into contact with the returned equipment.
Chemical names:

Precautions to be taken in handling these substances:

Action to be taken in the event of human contact or spillage:

I hereby confirm that the only toxic or hazardous substances that the equipment specified above has been in contact with are named above, that the information given is correct and that the following actions have been taken:
1. The equipment has been securely packaged and labeled.
2. The carrier has been informed of the hazardous nature of the consignment.

Signed: Title:

Date: Phone No.