HPQ-2
Manual

LP101011 Rev 2.02
January 2002

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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EC DECLARATION OF CONFORMITY

Spectra SensorTech Ltd
Cowley Way
Crewe
Cheshire
CW1 6AG
United Kingdom

DECLARES THAT THE FOLLOWING PRODUCT :

LM75 HPQ2 Control unit

IS IN CONFORMITY WITH THE FOLLOWING EUROPEAN DIRECTIVES:

89/336/EEC ELECTROMAGNETIC COMPATIBILITY DIRECTIVE
73/23/EEC LOW VOLTAGE DIRECTIVE AS AMMENDED BY 93/68/EEC

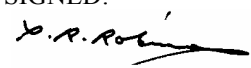
THE APPLICABLE STANDARDS ARE:

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 Spectra SensorTech Ltd.

SIGNED:



T.R.ROBINSON
EUROPEAN OPERATIONS MANAGER
DATE 1st JULY 2001

Additional Installation Maintenance and Operating Instructions

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

A) 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 grounding 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 other cables are required, or if longer serial communications cables are required, they must be supplied by Spectra SensorTech 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, Spectra SensorTech Ltd must be contacted for technical guidance.
6) The vacuum system on which the analyser/RF head is mounted must be earthed, preferably to the same earth as the control unit.

B) 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 Spectra SensorTech 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 only when running software supplied by Spectra SensorTech Ltd.

C) 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 Spectra SensorTech Ltd., unless special arrangements are made.
3) There are no user replaceable parts in the electronic equipment. Certain components are EMC and safety critical and must not be substituted. Replacement parts are available from Spectra SensorTech Ltd.
4) Equipment enclosures embody certain special fastening and bonding devices that affect EMC and safety performance. These must be correctly re-fitted after servicing.

Contents

Errata and addenda

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Section 1.
Introducing HPQ-2

HPQ-2 is a complete quadrupole residual gas analyser (RGA) designed to operate at higher pressures than traditional quadrupole instruments. The HPQ-2 system is based around an extremely compact quadrupole analyser which has an insertion length into the vacuum of 1 inch (25.4mm) and mounts on a CF35 (2 ¾ inch) Conflat flange. The HPQ-2 incorporates all of the electronics normally found in a separate control unit and RF power supply into one extremely compact unit, which fits directly onto the quadrupole analyser. A separate low voltage power supply connects to the HPQ-2 control unit.

The HPQ-2 is designed to be operated from an IBM compatible PC running either Process Eye or RGA for Windows software. Communication between the PC and the HPQ-2 is via either an RS232, RS422 or RS485 serial link. The complete HPQ-2 system will comprise; HPQ-2 analyser, HPQ-2 control unit, low voltage power supply, interconnecting cables, manual, tool kit and either RGA for Windows or Process Eye software. HPQ-2 may be used in multi-headed applications and this is detailed in the manual for the relevant software package.

This manual focuses on the HPQ-2 hardware and should be used in conjunction with the manual for the operating software, RGA for Windows or Process Eye.

1.1. Specifications

1.1.1. General

Mass Range Capability	2 to 80 amu
Detector System	Faraday Cup
Maximum Recommended Operating Pressure	1×10^{-2} mBar (8×10^{-3} Torr)

Maximum Permissible Operating Pressure	2×10^{-2} mBar (1.6×10^{-2} Torr)
Minimum Detectable Partial Pressure	1×10^{-10} mBar (8×10^{-11} Torr)
Mass Stability	Better than ±0.1 amu over 8 hours at constant ambient temperature
Resolution	<1.2 amu at 10% peak height
Total shipping weight	6.0kg

1.1.2. 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

1.1.3. 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 V1.6 or RGA for Windows V2.4
Power	24V DC 3A External supply included

Serial Communication	RS232, RS422, RS485
Baud Rate & Distance	RS232C 9600 baud, 15 metres (50ft) RS422 /485 115k baud,1.2km (4000ft)
Maximum RGA Heads	30

1.1.4. PC requirements

1 or 2 heads	Pentium 90MHz, 16MB RAM
3 to 9 heads	Pentium 120MHz, 24MB RAM
10 to 30 heads	Pentium 200MHz, 32 to 64MB RAM

Note: one RS232 or RS422 port is required for each HPQ-2 or one RS485 port is required for each 18 HPQ-2 units.

1.2. Control unit overview

The HPQ-2 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. Alternatively, power may be derived from a suitable Spectra Remote Vacuum Controller if the complete system incorporates one. The HPQ-2 control unit plugs directly onto the HPQ-2 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. The HPQ-2 control unit contains no user serviceable parts and the only manual adjustment is the volume control for the audio, which is mounted on the rear panel.

1.3. User interface

Please refer to Figure 1 for the arrangement of the connectors on the rear

panel. The pin numbers are marked on the various connectors.

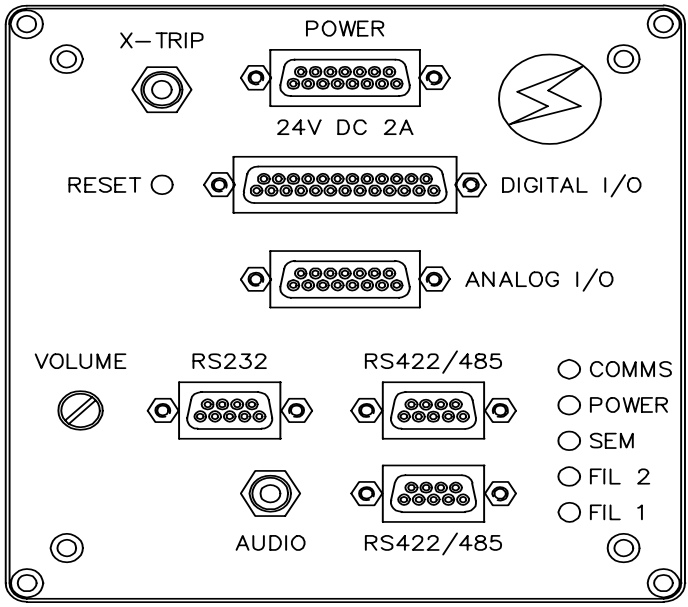


Figure 1 HPQ-2 rear panel

1.3.1. Power connector

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

Pin connections are:-

1, 2, 3 (joined together) +24 volts DC
9,10,11 (joined together) 0 volts (24 volt return)

The power input is 24 volts DC ± 10%, 3 Amps max.
The current drawn depends on the mass range and whether a filament is on or off.

The primary power circuit is fully isolated from the system ground.

1.3.2. Indicators

On the rear panel of the HPQ-2 control unit there are five LED indicators, their functions are described below.

1.3.2.1. Filament 1

This is a green LED labelled **FILAMENT 1** on the rear panel of the HPQ-2 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.

1.3.2.2. Filament 2

This is a green LED labelled **FILAMENT 2** on the rear panel of the HPQ-2 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.

1.3.2.3. SEM supply

This is an amber LED labelled **SEM** on the rear panel of the HPQ-2 unit. It is not implemented on this version of the HPQ-2.

1.3.2.4. Power on

This is a red LED labelled **POWER** on the rear panel of the HPQ-2 unit driven from the +5V supply. It will be illuminated when power is supplied to the HPQ-2 and the +5V rail is established.

1.3.2.5. Comms OK

This is a green LED labelled **COMMS** on the rear panel of the HPQ-2 unit. Its exact status is determined by the software but its basic function is to indicate that the serial link to the PC has been established.

1.3.3. RS232 connector

This is a 9 way D-Type socket labelled **RS232** on the rear panel of the unit. It is used to connect the HPQ-2 to the host computer when the RS232 interface is being used. This socket is also configured to provide a power feed for an Amplicon 490 fibre optic converter

Pin connections are:-

Pin 1,7,9		Not Connected
Pin 2	TXD	transmit data
Pin 3	RXD	receive data
Pin 4,6,8		Commoned and connected to fused +15V
Pin 5	0 volts	

1.3.4. 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 (+)

1.3.5. Audio output

This is a 3.5mm Jack socket mounted on the rear panel and labelled **AUDIO**. It is used to connect headphones, wireless headsets 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.

1.3.6. Analog I/O connector

The Analog Input / Output connector is a 15 way D-Type socket mounted on the rear panel of the HPQ-2 unit and labelled **ANALOG I/O**. It consists of;
one analog output 0 to +10V
four quasi-differential analog inputs 0 to ±10V with a maximum voltage on the return of ±0.5V.
±15V power outputs both fused at 100mA, fuses are self resetting.

Analog Connector Pin Connections

Pin	Function
1	-15V fused
2	Analog input 4 return
3	Analog input 3 return
4	Analog input 2 return
5	Analog input 1
6,7,14	Not Connected
8	0V analog
9	+15V fused
10	Analog input 4
11	Analog input 3
12	Analog input 2
13	Analog input 1 return
15	Analog output

Note that the total power consumption on each rail (+5V and ±15V) for both the Analog and Digital I/O ports must not exceed 100mA.

1.3.7. Digital I/O connector

The Digital I/O connector is a 25 way D-Type socket mounted on the rear panel of the unit and labelled **DIGITAL I/O.** It is used to provide alarm output signals and process trip signals. It can also be used to connect accessories such as a Remote Vacuum Controller, analogue output module, analogue input module and Valve Controller.

The Digital I/O port provides:

two 8 bit bi-directional ports
one interrupt / strobe input
+5V fused at 100mA
±15V fused at 100mA

DIGITAL I/O Connector Pin Assignment		
Pin	Description	Notes
1	H1 interrupt / strobe	
2	PA1	
3	PA3	
4	PA5	
5	PA7	
6	PB1	
7	PB3	
8	PB5	
9	PB7	
10	0V Digital	
11	0V Analogue	
12	-15V fused	
13	+15V fused	
14	PA0	
15	PA2	
16	PA4	
17	PA6	
18	PB0	
19	PB2	
20	PB4	
21	PB6	
22	+5V fused	
23	Not Connected	
24	Not Connected	
25	Not Connected	

Note that the total power consumption on each rail (+5V and ±15V) for both the Analog and Digital I/O ports must not exceed 100mA.

1.3.8. Reset switch

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 HPQ-2 control unit.

1.3.9. Volume control

This controls the volume of the audio tone generated by the external speaker in the Leak Check and Peak Jump Alarm modes. Note that in the Leak Check mode it is the frequency (pitch) of the audio tone which increases with increasing signal not the volume.

The volume control should be turned clockwise to increase the volume and turned anti-clockwise to decrease the volume.

1.3.10. External trip

The external trip connector is a 3.5mm Jack socket mounted to the right of the Power connector on the rear panel and labelled **X-TRIP.**

The external trip feature is used to protect the filaments from exposure to high pressures. It allows an independent total pressure gauge or a signal from a vacuum control system to be connected to the HPQ-2. It is the most effective of the trips available and we would always recommend its use. The external trip input can be driven in three ways.

1. Uncommitted relay contact
   This is a low voltage (+5V, 1mA) contact. The contact should be closed for normal operation, open to trip the filaments or if the protective equipment is switched off.

2. Open collector TTL drive
   The output transistor should be on for normal operation, open for trip or if the protective equipment is turned off.

3. Totem pole TTL drive
   The signal should be low for normal operation, high for a trip condition or if the protective equipment is switched off.

The external trip circuitry is fully isolated from the system ground.

Section 2.
Installation

This section deals with getting the equipment you have just bought out of its box and installing it on your system. If you have any questions or experience any difficulties, contact your local Spectra facility where the technical staff will be able to help you.

2.1. Unpacking and inspecting

2.1.1. Unpacking

When you receive the HPQ-2 carefully check each item before removing the foam packaging and plastic wrapping to ensure that no physical damage has occurred during shipment. Also make sure all items have been received by checking against the enclosed packing slip.

CAUTION

Do not open the analyser packaging at this stage.

2.1.2. Inspecting for visual damage

If there has been obvious damage during shipment or if there are items listed on the packing slip as shipped which are not in the box, immediately contact your local sales/service representative.

CAUTION

Most insurance claims for shipment damage must be placed within 7 days from the date of delivery - in WRITING. So don't let your HPQ-2 get buried in its box.

CHECK IT OUT !!

2.1.3. Inspecting the analyser

Please note that the warranty does not cover cleaning of the analyser.

CAUTION

The analyser is both fragile and very easily contaminated by the slightest touch from your fingers or undesirable surfaces. Please handle the analyser our way.

2.1.4. Removing the analyser cover

The analyser is shipped in a vac-formed envelope for protection. Carefully remove the tape and separate the envelope to allow access to the analyser.

Hold the analyser ONLY at the vacuum flange.

If you have to set the analyser down for a moment, carefully return it back to the plastic envelope for protection.

DO NOT LEAVE THE ANALYSER IN THIS CONDITION.

The rules of gravity are known to deviate from the norm around unattended analysers and it can easily fall off and smash if the work surface is bumped. It can also collect dust, which will give a very strange mass spectrum!

2.1.5. Inspecting the analyser

Hold the analyser with the quadrupole and ioniser structure vertically up. Carefully inspect all the observable insulators for damage.

Look at each lead from the flange to its termination point to ensure that it does not touch any other element of the analyser.

But note, the less you adjust or change, the lower the possibility of breaking something. Do not touch, adjust or bend the foil straps down inside the flange!

2.1.6. Replacing the analyser cover

To avoid possible damage to the analyser now is the time to put it back in its plastic envelope. Simply reverse the instructions in section **2.1.4. Removing the analyser cover**.

2.2. Installing the analyser

2.2.1. Checking the vacuum chamber dimensions

The vacuum chamber in which you intend to mount the analyser must have a 2.75 inch UHV Conflat flange fitted with a tube of 35.0mm (1.378 ") minimum inner diameter inclusive of a good welded joint.

The distance from the end of the analyser to its mounting flange is 1.0 inches (25.4mm).

There must be at least the distance given above free of obstructions inside the vacuum chamber. We recommend you to allow an extra 3mm (0.125 inch) just to be sure. If your chamber does not have that much room or only a small flange you should use a specially designed adapter so that the analyser can be mounted outside the chamber. Please contact your local Spectra facility for assistance.

2.2.2. Checking the system pressure

The HPQ-2 analysers must not be operated at pressures higher than 2 x 10^{-2} mBar (1.6 x 10^{-2} Torr).

If you intend to monitor a process where the pressure exceeds the above you must make sure you switch off the filaments. We would recommend using a cold cathode gauge or capacitance manometer with a set point and relay contacts connected to the external trip socket on the HPQ-2 control unit. It is permissible to expose the analyser to high pressure, even above atmosphere, but the filament must be switched off.

CAUTION - A worse problem exists in sputter processes where sputtering is meant to 'throw' materials around corners. If the quadrupole analyser extends into the 'throw area' of the sputtering deposition, it will rapidly become coated and cease to function properly. Turning off the power to the Quad during sputtering or etching will not prevent this contamination. It is most important to ensure that the analyser is shielded from his type of contamination.

Remember the warranty does not cover cleaning of the analyser.

2.2.3. Mounting the analyser

The standard 2 ¾ inch Conflat flange on the analyser can be sealed to the vacuum chamber with either a copper gasket or a Viton® gasket with a square cross section. Which one you choose depends on the ultimate pressure you expect in your system.

If it is not already clean then clean the gasket with suitable solvent and dry it. Remove the analyser from its shipping cover by following the instructions in section **2.1.4. Removing the analyser cover**. Slip the gasket over the quadrupole structure and set it in the grooves of the flange surface.

Carefully insert the analyser into the vacuum chamber ensuring that you do not allow the leads to touch the walls of the vacuum chamber. Make sure the gasket does not slip part way out of its slot as you push the two flanges together.

Rotate the flange until the locating key on the feedthrough housing tube is as

close to 9 o'clock as the bolt holes will allow. This will ensure that the HPQ-2 control unit is in its preferred position, although, it can be mounted in any orientation. The HPQ-2 will be more susceptible to drift in the location and height of peaks if it is mounted in a different orientation to that described above and it may not meet its published specification.

Bolt the feedthrough flange to the vacuum chamber flange using the torque appropriate for the gasket material used.

Please do not throw the aluminium shipping cover or the two piece foam packing surrounding it away. If at a future date you need to return the analyser for service it is vital it is shipped in its original packaging to avoid potentially very expensive damage.

2.3. Connecting the control unit

Before installing the HPQ-2 control unit find the 4mm AF Allen key shipped with the instrument. It will either be in the toolbox or attached to the control unit.

CAUTION

The following instructions must be observed to ensure the instrument complies with the Electromagnetic Compatibility Directive (EMC Regulations).
Also, the performance of the instrument may be de-graded in terms of noise immunity if the following instructions are not observed.

2.3.1. Installation

Using the 4mm Allen key slacken the bolt on the clamping ring on the RF/analyser connector so that the clamping ring is loose and free to move easily.

Rotate the clamping ring on the RF/analyser connector so that the slot (which will be directly below the threads of the M5 socket set screw) lines up with the keyway on the connector tube. Hold the HPQ-2 control unit so

that the keyway lines up with the locating key on the analyser flange.

Gently slide the control unit on to the analyser. TAKE GREAT CARE the pins on the vacuum feedthrough are easily damaged. DO NOT force the control unit on to the analyser.

When all of the pins are engaged, push the control unit firmly onto the analyser to ensure electrical continuity. The last 3mm (1/8") is important. When correctly fitted the front face of the RF/analyser connector should butt up against the analyser flange.

Using the 4mm Allen key tighten the socket set screw on the clamping ring. The socket set screw should be tightened sufficiently so that the whole unit is rigidly secured to the analyser.

If any problems arise due to electromagnetic emissions from this unit, first check the tightness of this clamp.

2.2.4. Electrical connections

The serial communications link between the HPQ-2 and host computer may conform to either RS232, RS422 or RS485 and this will determine which of the connectors is used. The RS485 interface is only supported by Process Eye 1.6 software and not by RGA for Windows.

RS232 Using the cable supplied connect the 9 way D-Type plug to the 9 way D-Type socket labelled **RS232** on the rear panel of the HPQ-2 control unit. The other end of the cable should be connected to the host computer.

RS422 Using the cable supplied connect the 9 way D-Type plug to the 9 way D-Type socket labelled **RS422/485** on the rear panel of the HPQ-2 control unit. The other end of the cable should be connected to the host computer.

RS485 The cable from the preceding HPQ-2 in the daisy chain should be connected to the 9 way D-Type socket labelled **RS422/485** on the rear panel of the HPQ-2 control unit. The cable to the next unit in the daisy chain should be connected to the 9 way D-Type plug labelled **RS422/485** on the rear panel of the HPQ-2 control unit.

Insert the 15 way D-Type socket on the output lead of the power supply unit into the 15 way D-Type plug labelled **POWER** on the rear panel of the HPQ-2 control unit.
Attach the line cord to the power supply. The power supply will automatically set itself to operate with the local line voltage.

When the power is switched on the LED on the rear of the HPQ-2 will illuminate.

Care should be taken in routing and securing all cables. Avoid running the serial cables next to mains power cables.

2.2.5. Baking

The HPQ-2 control unit should not be exposed to temperatures above 40^{o}C so it should be removed from the analyser during baking. The analyser may be baked up to 250^{o}C but care should be taken to avoid exposing the ceramic feedthrough to sudden changes in temperature.

Section 3.
Analyser maintenance

3.1. General overview

The HPQ-2 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 either your vacuum system or of some other "interesting" gasses introduced via an inlet.

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 Spectra 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 HPQ-2 analyser can be broken down into four separate areas by virtue of their function.

3.1.1. 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.

3.1.2. 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.

3.1.3. 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.

3.1.4. 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.

3.1.5. 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 filter is very accurately aligned by skilled personnel using specialised tools and jigs.

Under no circumstances should any of the screws holding the rods in position be loosened. Do not touch, adjust or bend the metal foil straps inside the flange.

If they are we can guarantee that the analyser will no longer work. The only remedy would be a factory re-build.

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 you local Spectra facility.

3.2. 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 reach. 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.

3.3. 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 ($5x10^6$ ohms) 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 Figure 2 for the analyser pin numbers.

3.3.1. Checking for shorts

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

2. 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 an other pin contact your local service centre with the results of your testing and they will advise you as to how to proceed.

3.3.2. 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.

3.4. 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.

3.4.1. Tools required

Here is a list of the tools and equipment you will require. We recommend that you assembly 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 reasonable careful.

3.4.2. Removal of 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.

3.4.3. Fitting of 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 see section **3.3. Ohmmeter analyser checks**.

You are now ready to pump down and continue operation of your HPQ-2.

3.5. 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.

3.5.1. Removing the ion source

Once again you are advised to get the necessary tools together before you start this job. It really does make life simpler.

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 in section **3.4.2. Removal of the filaments.**

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.

3.5.2. Cleaning the 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 in section **3.5.1. Removing the ion source.**

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 section **3.5.3. Re-fitting the ion source.**

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

3.5.3. 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 in section **3.4.3. Fitting of new filaments.**

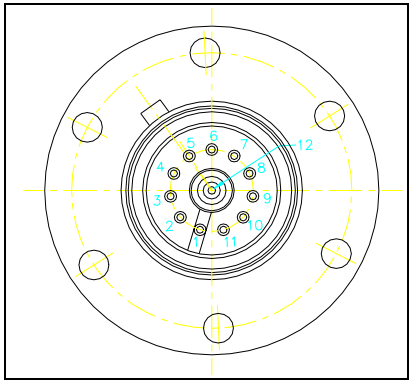
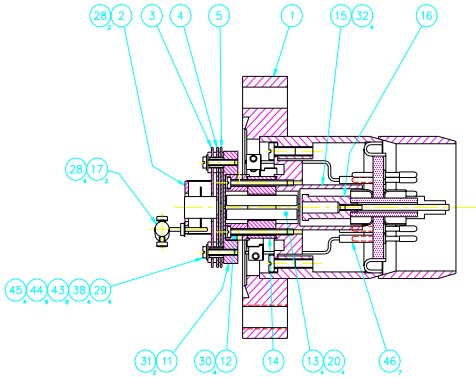


Figure 2 HPQ-2 analyser feedthrough

Feedthrough Pin Numbers	
Pin Number	**Function**
1	Earth
2	Source
3	not used
4	Filament 1
5	Extractor
6	not used
7	RF1
8	Repeller / Filament Common
9	not used
10	Filament 2
11	RF2
12	Collector

Pin 1 is the pin with the metal tag and is in the seven o'clock position in figure 1. The pins are numbered in a clockwise direction. Pin 12 is the centre pin.

Figure 3 HPQ-2 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.

Appendix 1.
Ion source parameters

The following table gives the default ion source settings for HPQ-2 in its three operating modes.

Instrument & Mode	ION SOURCE PARAMETER			
	Emission	**Electron Energy**	**Ion Energy**	**Extractor**
HPQ-2 RGA Mode	0.7mA or 0.39mA	70eV	7.0eV	-110V
HPQ-2 HP Mode	0.1mA	35eV	5.0eV	-58V
HPQ-2 Leak Mode	1.0mA	88eV	10.0eV	-130V

Emission Current in RGA Mode.
On older instruments (those with serial no. LM75-00298025 and below) the emission current should be set to 0.70mA.
On newer instruments (those with serial no.s LM75-00298026 and greater) the emission current should be set to 0.39mA.

This change results from changes to parts used in the ion source. An incorrect emission current setting will result in a loss of sensitivity.

Appendix 2.
Health & safety clearance form

1. This form must be used when returning analysers and other equipment for service.

2. A completed copy of this form should be faxed or sent by post to ensure that we have this information before we receive the equipment.

   A further copy should be handed to the carrier with the equipment.

3. Failure to complete the form or comply with the procedure will lead to delays in servicing the equipment.

RETURNS FORM

1. Please complete the form and fax or send by first class post to the appropriate 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 labelled.
2. The carrier has been informed of the hazardous nature of the consignment.

Signed: Title:

Date: Phone No