RC RGA Analyser Manual

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The Hiden Analytical Limited Web Site

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Amendment history

Issue	Date	Mod.	Changes
A	18 Nov 2008	M085-424	Major update of HA-085-005N for HAL 7 to create this manual.
B	12 Jan 2009	M085-430	Series 1000 RF Cable connections, Section 3.8.4.
C	11 Aug. 09	M085-442	Sections 7.2.9, 7.3.1 and 7.3.2
D	23 Nov 12	M085-496	Filament change re-written, PLC interfacing added.
E	3 March 14	M085-539	Status LED and other changes.
F	6 Oct 15	M085-578	CE Cert.
G	20 Jan 16	M085-596	CE Cert.
H	22 Feb 19	M085-688	Test points in Section 5.7 re-numbered.
J	22 Sept 20	085m749	Digital I/O line names.

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EC Declaration of Conformity

Manufacturer:	Hiden Analytical Limited
Details of Electrical Equipment:	HAL RC (2U) Series Mass Spectrometers.
Description:	Quadrupole Mass Spectrometer controller, RF generator, analyser probe and power supply.
Directives with which this equipment complies:	2004/108/EC (recast as 2014/30/EU by 20th April 2016) 2006/95/EC (recast as 2014/35/EU by 20th April 2016) 2011/65/EU (RoHS directive)
Harmonised standards applied in order to verify compliance with Directives:	BS EN 61010-1 2010 BS EN 61326-1:2013 BS EN 55011:2009+A1:2010 BS EN 61000-3-2:2014 BS EN 61000-3-3:2013 BS EN 61000-4-2:2009 BS EN 61000-4-3:2006+A2:2010 BS EN 61000-4-4:2012 BS EN 61000-4-5:2014 BS EN 61000-4-6:2014 BS EN 61000-4-11:2004
Test Reports issued by:	TRaC Moss View, Nipe Lane, Up Holland, West Lancashire WN8 9PY England TRaC Global 8 Century Court, Tolpits Lane Watford, Herts, WD18 9RS, England
Technical Construction File No.:	HA 080030
Year in which CE mark was affixed:	2008
Authorised Signatory:	Peter Hatton
Name:	P. J. Hatton
Position:	Managing Director
Date of Issue:	Issue G: January 2016
Place of Issue:	Warrington, England

HA-080-130 Issue G jan-16

The EC Declaration of Conformity document is available on request from Hiden Analytical Limited.

Contents

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RC RGA Analyser Operator's Manual

The purpose of this Manual is to describe Hiden Analytical Limited's range of RC Residual Gas Analysis (RGA) Analysers.

This Manual describes the system hardware for the whole range of instruments. The MASsoft Windows based software that is used with all the RC RGA systems is described fully in the MASsoft User Manual.

Copyright notice

Acknowledgements

All brand names and product names are trademarks, registered trademarks, or trade names of their respective holders.

Dimensions

The dimensions quoted in illustrations are millimetres, unless stated otherwise.

Instructions

For clarity, the instructions given in this Manual are presented in two columns. The left-hand column provides imperative instructions that are numbered sequentially to provide a step-by-step guide through the functions. The right-hand column describes the system's response (where appropriate) and gives any additional information that may be of relevance.

Importance of this Manual

This Manual should be regarded as part of the product described herein.

Amendments

This Manual will be updated, as necessary, to cover modifications to the product. Amendments may take the form of Addenda, which will be located at the front of the Manual, on coloured paper.

Technical assistance

Hiden Analytical Limited try to ensure the information presented in this manual is comprehensive, relevant and accurate. If the reader thinks there is a mistake, requires some clarification or needs further information please do not hesitate to contact Hiden.

Technical assistance can be obtained from the Hiden Analytical Limited Service Department which can be contacted on:

Email: service@hiden.co.uk

Tel: +44 (0)1925 445225

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In the U.S.A. and Canada, technical assistance can be obtained from Hiden Analytical Inc.:

Email: service@hideninc.com

Tel: 603 924 5008

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Toll-free phone: 1-888-96 HIDEN
Option 1 U.S.Sales Office
Option 2 U.S.A. & Canada Corporate Office & Service Department
Option 3 U.K. Manufacturing Facility

Details of worldwide local support can be found on the Hiden Analytical website: www.HidenAnalytical.com.

FCC Notices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note that FCC regulations provide that changes or modifications not expressly approved by Hiden Analytical Limited could void the user's authority to operate this equipment.

Shielded Cables: Use only shielded cables for connecting peripheral equipment to any Hiden Analytical Limited equipment; this reduces the possibility of interference with radio and television reception. Using shielded cable ensures that the appropriate FCC radio frequency emissions compliance of the equipment is maintained.

Chapter 1 Safety Information

Safety Information: Contents

1.1 Relevance

This manual relates to the Hiden Analytical Limited range of RC RGA quadrupole mass spectrometers.

This manual describes the hardware, installation procedure, trouble-shooting and maintenance.

The MASsoft software used in conjunction with the RC-RGA is described in the MASsoft Manual Set.

1.2 Warnings and cautions

In this manual WARNINGS and CAUTIONS have the following meanings and are denoted as shown.

WARNING

WARNINGS draw attention to procedures, practices, conditions or the like, which if not performed correctly or adhered to could result in injury to personnel.

CAUTION

CAUTIONS draw attention to procedures, practices, conditions which if not performed correctly or adhered to could result in damage to the equipment described in this manual and/or to peripheral equipment connected to the equipment described herein.

1.3 System use

WARNING

This equipment, when installed and connected as described in this Manual, is suitable for use as a Mass Spectrometer; any attempt to use it for any other purpose may expose the operator to injury, is liable to damage the instrument and will invalidate its Warranty.

If in doubt as to its suitability for an application, please contact Hiden Analytical Limited for advice.

WARNING

1. **The equipment must be fully installed and configured for normal operation before it is powered-up; failure to do this may cause injury to the operator and damage to the equipment.**
2. **The equipment must be earthed; failure to do this may cause injury to the operator and damage to the equipment.**

CAUTION

1. **Any connections to other equipment should be undertaken by suitably qualified personnel and must not compromise equipment safety.**
2. **Any equipment connected to any input/output port must operate at Safe Extra Low Voltage (SELV) levels (normally in the range -50 V to +50 V) in accordance with EN 61010:1993 to meet the requirements of the Low Voltage Directive (LVD) 73/23/EEC.**

CAUTION

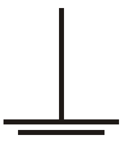
The mains power plug and socket is the primary disconnect device for the RC Interface and in some systems the Series 1000 RF Generator; it must be easily identifiable and accessible by the operator.

1.4 Symbols

1.4.1 General

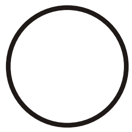
The following symbols may be found on the equipment:

Alternating current.

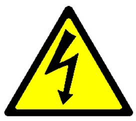


Earth terminal.

On (supply).



Off (supply).



Caution, risk of electric shock.

Background colour: yellow.

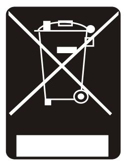
Symbol and outline: black.

This symbol is displayed adjacent to connectors carrying voltages greater than 1000 V.

Caution, refer to associated documents.

Background colour: yellow.

Symbol and outline: black

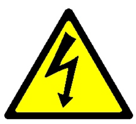


The WEEE directive symbol on the rear panel of the RC Interface unit.

The disposal of the equipment described in this manual MUST be in accordance with local regulations.

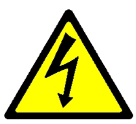
For EU member countries please contact Hiden Analytical Limited for advice.

1.4.2 Symbols on the RF Head



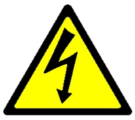
On the front panel next to the Probe connector indicates that hazardous voltages are present on this connector when the RF Head is powered on and disconnected from the Probe.

On the side panel next to the 37 way D-Type connector refers to the connector only being used to connect the RF Head to a Hiden Analytical RC Interface unit. The 37 way D-Type connector must not be used to connect the RF Head to other equipment.



On the side panel adjacent to the 37 way D-Type connector indicates hazardous voltages are present on the connector when the instrument is powered on.

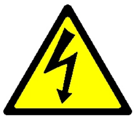
1.4.3 Symbols on the RC Interface unit



In three places on the rear panel adjacent to connectors SEM EL08, RF HEAD EL02 and ELECTRODES EL01 indicates that hazardous voltages are present on the connector when the unit is powered on and the mating connector disconnected.

On the rear panel adjacent to the ELECTRODES EL01 refers to this connector and the 37 way D-Type connector RF HEAD EL02 only being used to connect the RC Interface to a Hiden Analytical RF or Amplifier Head. These connectors must not be used to connect the RC Interface to other equipment.

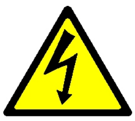
1.4.4 Symbols on the Series 1000 RF Generator



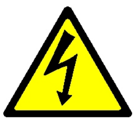
In three places on the front panel each indicates hazardous voltages are present on the adjacent high voltage connector when the unit is powered on and the mating connector disconnected.

On the front panel adjacent to the Control 02 connector refers to the connector only being used to connect the RF Generator to a Hiden Analytical Amplifier Head. The 9 way D-Type connector must not be used to connect the RF Generator to other equipment.

1.4.5 Symbols on the Feedthrough Adapter



On the Feedthrough Adapter cover indicates hazardous voltages are present inside the unit when powered on with the cover removed.



In three places indicates hazardous voltages are present on the adjacent high voltage connector when the unit is powered on and the mating connector disconnected.

Chapter 2 Introduction

Introduction: Contents

Introduction: Illustrations

Introduction: Tables

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2.1 Overview

This manual describes the hardware for the following instruments:

HALO 100-RC
HAL 100-RC
HAL 200-RC
HALO 201-RC
HAL 201-RC
HAL 301-RC
HAL 3F-RC
Series 1000-RC

Other instruments in the RC RGA Analyser range will be supplied with this manual and an additional manual addendum. The addendum will describe how any variations affect information given in this manual.

This manual relates to RC Interface units with serial numbers beginning with 9. Refer to Section 2.4.4.1 for details of the Serial Number.

The RC-RGA Analyser is usually used with the MASsoft software package which is fully described in the MASsoft Manual. Installation of the software is described in the Hiden Software Suite Installation Guide.

Where the RC RGA Analyser is supplied as part of a mass spectrometer system, such as an HPR-20 *QIC*, please read this manual in conjunction with other manuals supplied as part of the system.

This manual relates to RC-RGA instruments fitted with an analogue detector. For instruments fitted with a pulse counting detector please refer to the RC-PIC Analyser User Manual.

The Series 1000 RF Generator is described in the Series 1000 R.F.Generator User's Manual. References to the Series 1000 RF Generator is in this manual refer to the Mark 4 unit.

Manuals for earlier versions of the RC-RGA and Series 1000 RF Generator are available. Please contact Hiden Analytical Limited for advice.

2.1.1 Contents sheets

A Contents Sheet is supplied with each instrument at the front of the Hiden white ring binder containing this manual. This sheet lists the manuals relevant to the particular instrument.

The Configuration Section of the Contents Sheet gives the exact specification of the instrument.

2.2 System description

The range of RC RGA Analysers can be split into two groups; Standard Systems and Series 1000 Systems. Standard Systems use RF Heads that fit directly on to the RGA Probe. In Series 1000 Systems the RF Power Supply is a larger unit capable of higher output power and is therefore mounted remotely.

The Series 1000 System offers an increased mass range (up to 2500 amu), or increased sensitivity at lower masses, compared with the Standard System.

A complete Standard System comprises an RC Interface unit, a Radio Frequency (RF) Head, a RGA Probe (which is installed within the vacuum system) and all the required interconnection cabling, see Figure 2.1.

In Series 1000 systems the RF generator is not fitted in the Head; it is located in a separate RF Generator Unit, hence a complete Series 1000 System comprises an RC Interface unit, an Amplifier Head, an RF Generator Unit, a RGA Probe (which is installed within the vacuum system) and all the required interconnection cabling, see Figure 2.2.

In both Standard and Series 1000 Systems the instrument is operated via a Personal Computer (PC) running Hiden Analytical Limited's MASsoft application under Microsoft Windows. The PC may be supplied by Hiden Analytical Limited or provided by the user. The MASsoft application provides complete control and tuning of the instrument; also data acquisition, storage, recall and analysis within Microsoft's Windows Interface. MASsoft is described fully in the MASsoft user manual.

Instruments may be supplied for mounting directly in a vacuum chamber or as systems for sampling higher pressures. In a high pressure sampling system the RGA Probe is mounted in a chamber and includes pumps, valves and the associated drive units mounted in a small rack or cubicle.

The RGA Probe is designed for mounting inside a high vacuum system. Each Probe comprises a quadrupole mass analyser on which is mounted an electron-impact ion source, which creates ions from neutral particles, and a detector to measure the mass-resolved ion current. In general, Probes with a range up to 200 atomic mass units (amu) use a single quadrupole mass filter, while the higher performance Probes use a triple quadrupole mass filter.

For optimum performance, the RF (or Amplifier) Head is mounted on the Probe and is connected to it via a 12-way feedthrough. In Standard Systems the RF Head contains signal-conditioning electronics, an RF power supply (for the quadrupole mass filter) and wiring to connect the RC Interface-generated signals and voltages to the Probe. In Series 1000 Systems, the RF power is generated in a separate RF Generator Unit, not in the Amplifier Head.

In Standard Systems, the RC Interface is connected to the RF Head; in Series 1000 Systems the RC Interface is connected to the RF Generator Unit via the Amplifier Head. For both types of system the RC Interface may be mounted several metres away from the other units.

The RC Interface is standard for both types of system; it is a 2U rack-mountable unit containing the control computer, communications interfaces, mains power supply and the electronics which supply the voltages and control signals to the RF (or Amplifier) Head and Probe. RS232, USB or Ethernet Local Area Network (LAN) may be used to communicate with the control PC, which may be several hundred metres away from the RC Interface, depending on the link used.

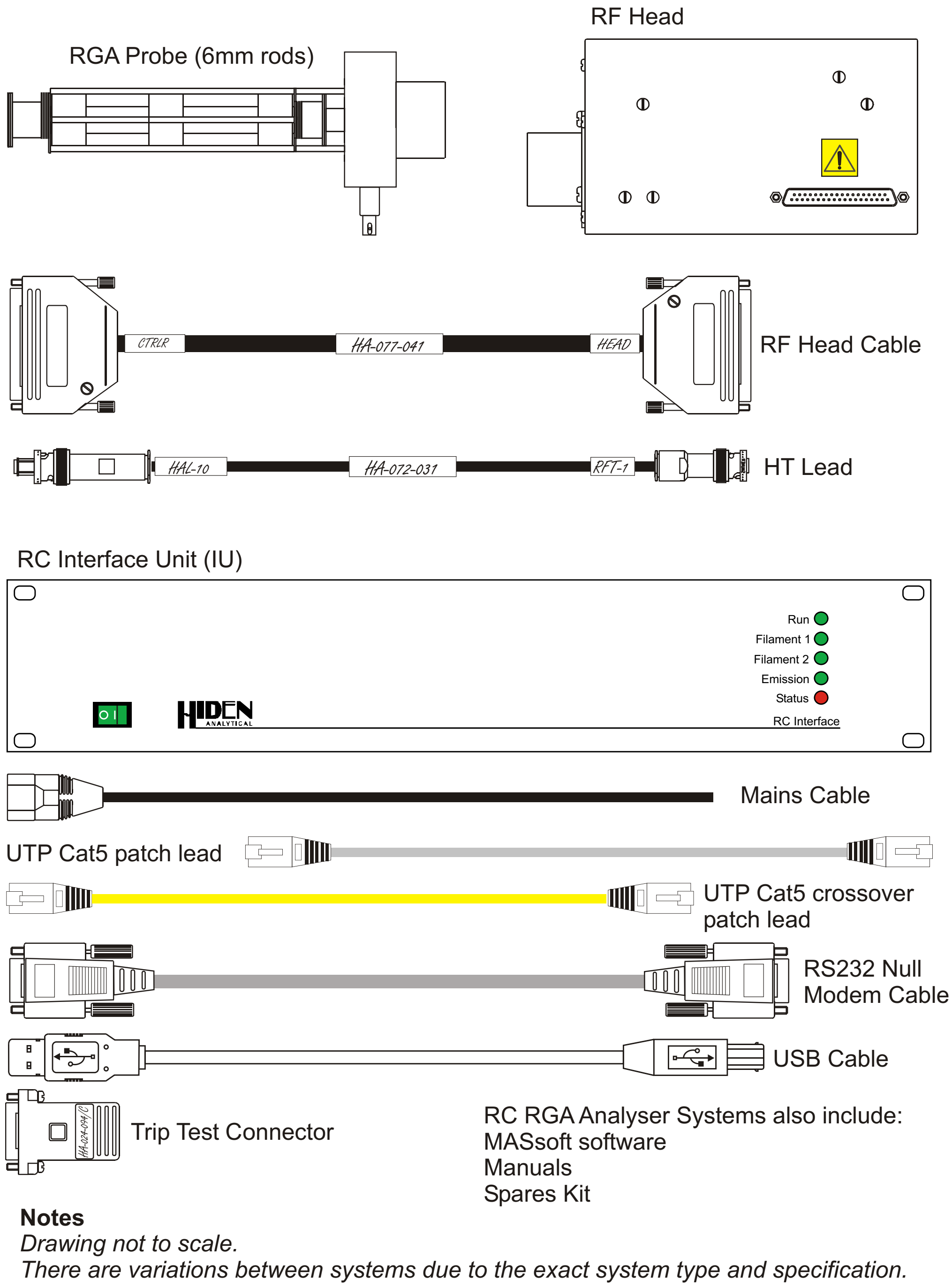

Figure 2.1 Typical standard RC RGA system

A typical Standard RC RGA system will comprises:

RGA Probe	With 6mm diameter filter rods. Exact Probe details will depend on the system specification.
RF Head	One of three types of RF Head are used in Standard systems.

RF Head Cable	Reference HA-077-041/3B (where the /3B refers to a 3 metre long cable). 37 way D-Type to 37 way D-Type cable used to connect the RC Interface to the RF Head. Standard length 3 metres, longer cables are available.
H.T. Lead	Reference HA-072-031/3A (where the /3A refers to the cable length in metres). Used to connect the RC Interface SEM supply to the Probe or RF Head. Standard length 3 metres, longer cables are available.
RC Interface unit	2U high control unit.
Mains Cable	To suit the country where the instrument will be installed.
Grey patch cable	UTP Cat5 patch cable with RJ45 connectors to connect the RC Interface unit to a network hub via its 10/100 Base-T interface.
Yellow patch cable	UTP Cat5 crossover patch cable with RJ45 connectors to connect the RC Interface unit directly to a PC's network port via the 10/100 Base-T interface.
RS 232 Cable	A standard null modem cable to connect the RC Interface to a PC comms port for RS232 serial communication. Terminated with 9 way female D-Type connectors.
USB Cable	A standard USB cable to connect the RC Interface USB MSC01 connector to a PC USB port.
Trip Test Connector	15 way D-Type connector for test use only, see Section 3.5.
Spares Kit	A kit of spares the contents of which will vary with system specification.
Hiden Software Suite disc	The MASsoft operating software is on the disc with the manuals in pdf format.
Hiden USB Drive	This contains custom settings and test files for the system. It is unique for each system.
Manuals	RC RGA Analyser Manual reference HA-085-118

Note

The above is typical of a standard RC RGA Analyser system. There will be variations from one system and another due to the exact specification. The components MUST be checked against the Packing List supplied with the system. Notify Hiden Analytical immediately of any missing or damaged items.
Claims for shipping damage must be made within 7 days.

A typical Series 1000 System comprises:

RGA Probe	With 9 or 12 mm diameter filter rods. Exact Probe details will depend on the system specification.
Feedthrough Adapter	May be supplied already fitted to the Probe. Allows various high voltage supply connections to be made.
Amplifier Head	Connects directly to the Probe.
Energy cable, short	Cable reference HA-078-023/A, a MHV to MHV high voltage cable assembly.
Energy cable, long	Cable reference HA-078-022/A, a MHV to MHV high voltage cable assembly.
RF Control Cable	Cable reference HA-062-051/A, a 9 way D-Type to 9 way D-Type cable assembly.
RF Cable	Two identical cable assemblies reference HA-078-021#m5/A (#m5 indicates 0.5 metres long).
Series 1000 RF Generator	A high power, remote RF Generator unit.
RF Head Cable	Reference HA-077-041/3B (where the /3B refers to a 3 metre long cable). 37 way D-Type to 37 way D-Type cable used to connect the RC Interface to the Amplifier Head. Standard length 3 metres, longer cables are available.
H.T. Lead	Reference HA-072-033/3A (where the /3A refers to the cable length in metres). Used to connect the RC Interface SEM supply to the Feedthrough Adapter. Standard length 3 metres, longer cables are available.
RC Interface unit	2U high control unit.
Mains Cables	Two mains cables to suit the country where the instrument will be installed.

Grey patch cable	UTP Cat5 patch cable with RJ45 connectors to connect the RC Interface unit to a network hub via its 10/100 Base-T interface.
Yellow patch cable	UTP Cat5 crossover patch cable with RJ45 connectors to connect the RC Interface unit directly to a PC's network port via the 10/100 Base-T interface.
RS 232 Cable	A standard null modem cable to connect the RC Interface to a PC comms port for RS232 serial communication. Terminated with 9 way female D-Type connectors.
USB Cable	A standard USB cable to connect the RC Interface USB MSC01 connector to a PC USB port.
Trip Test Connector	15 way D-Type connector for test use only, see Section 3.5.
Grounding Connector	SHV ground connector.
Spares Kit	A kit of spares the contents of which will vary with system specification.
Hiden Software Suite disc	The MASsoft operating software is on the disc with the manuals in pdf format.
Hiden USB Drive	This contains custom settings and test files for the system. It is unique for each system.
Manuals	RC RGA Analyser Manual reference HA-085-118 Series 1000 R.F.Generator User’s Manual reference HA-085-617

Note

The above is typical of a Series 1000 RC RGA Analyser system. There will be variations from one system and another due to the exact specification. The components MUST be checked against the Packing List supplied with the system. Notify Hiden Analytical immediately of any missing or damaged items.
Claims for shipping damage must be made within 7 days.

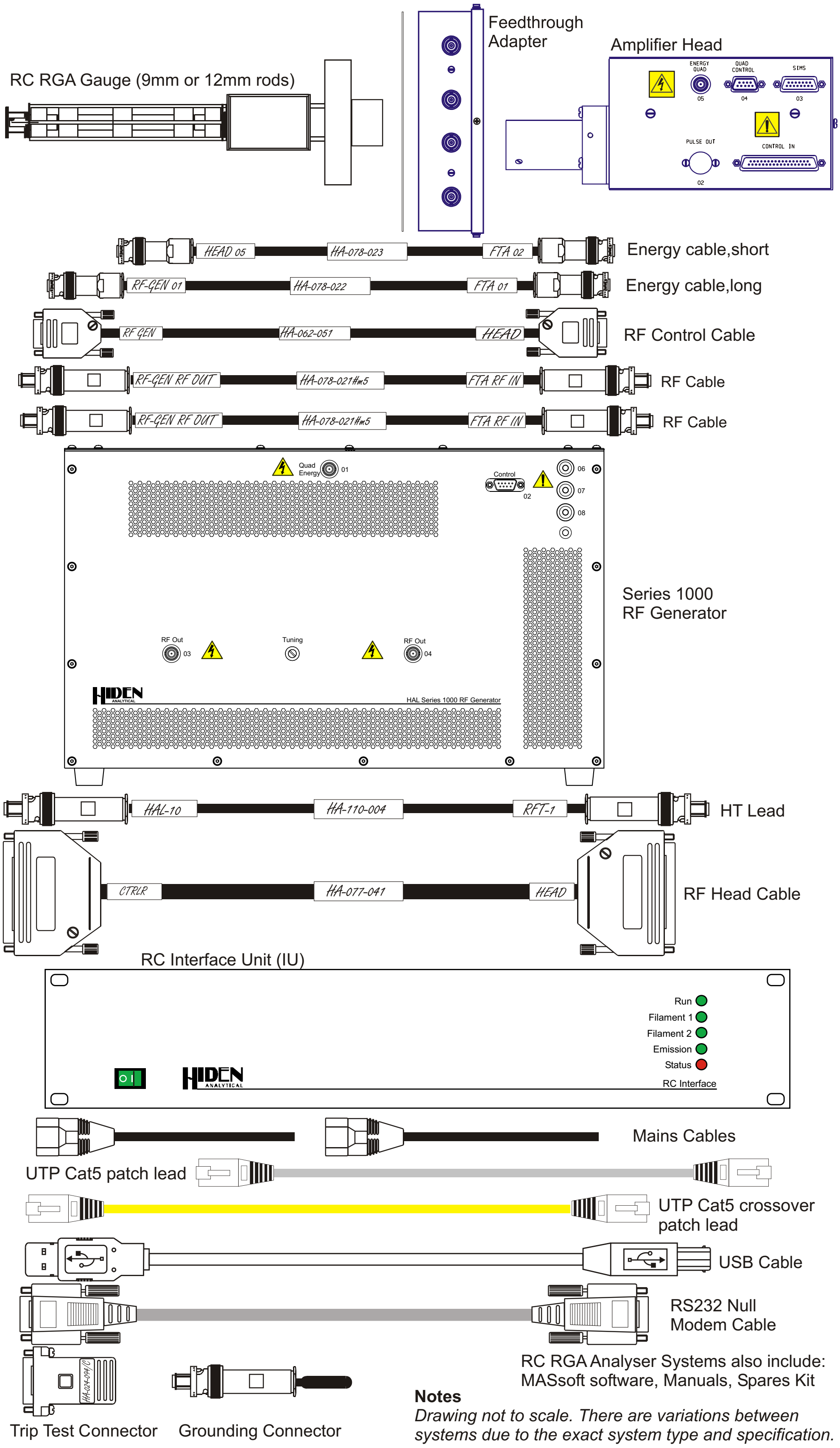

Figure 2.2 Typical Series 1000 system

2.3 Probe and Head description

2.3.1 Standard system

The RGA Analyser Probe contains an ion source, a quadrupole mass filter and a detector supported on a Conflat-type flange, allowing it to be mounted in a vacuum system. Several versions are available, ranging from a 100 amu Probe with a Faraday detector to a 510 amu unit with a dual Faraday/Single Channel Electron Multiplier (SCEM) detector. Probes fitted with a dual Faraday/channelplate detector are also available.

Channelplate and SCEM detectors are both Secondary Electron Multiplier (SEM) detectors.

HALO 100, HALO 201, HAL 200, HAL 201 and HAL 301 Probes use single quadrupole mass filters made of 6mm diameter rods. The HAL3F Probes use a triple filter. All the single filters are 125mm (5 inches) long except the HALO 100 and HAL 100 which use a 75mm (three inch) long filter.

A Faraday detector is fitted in the HALO 100 and HAL 200 Probes while the HALO 201 is fitted with a dual Faraday / Channel Plate detector. HAL 201, HAL 301 and HAL 3F Probes are fitted with dual Faraday / Single Channel Electron Multiplier detectors.

HALO 100 analysers have a maximum mass capability of 100amu. HAL 200, HALO 201 and HAL 200 analysers have a maximum mass of 200 amu. HAL 301 analysers have a maximum mass of 300 amu. HAL 3F analysers are offered with either 300 or 510 amu maximum mass capability.

All of the Probes have a DN-35-CF conflat flange type mounting except the HAL 3F Probes which use a DN-63-CF mounting. Adapters may be supplied with the instrument as an option.

Three types of RF Head are used in the RC RGA Analyser standard system range. In each case the RF Head mounts directly onto the Probe using a 12 pin vacuum feedthrough. The same RF Head is used with all the single filter Probes except the HALO 201 instrument where the RF Head is fitted with a high voltage connector. The supply voltage for the Channel Plate detector is fed from the RC Interface through the RF Head to pins on the 12 way feedthrough. Where the Probe is fitted with a Single Channel Electron Multiplier the high voltage supply connects directly to an MHV connector on the side of the Probe flange. The HAL 3F systems use a larger RF Head capable of delivering higher levels of RF power.

Power and control signals are supplied by the RC Interface using a cable connected to a 37 way D-Type connector on the RF Head.

Table 2.1 gives a summary of Probe and RF Head features.

System	Filter Type	Rod Length	Detector	Mass Range (amu)	Mounting Flange
HALO 100-RC HAL 100-RC	Single	3 inch (75mm)	Faraday	100	DN-35-CF
HAL 200-RC	Single	5 inch (125mm)	Faraday	200	DN-35-CF
HALO 201-RC	Single	5 inch (125mm)	Faraday / Channel Plate	200	DN-35-CF
HAL 201-RC	Single	5 inch (125mm)	Faraday / SCEM	200	DN-35-CF
HAL 301-RC	Single	5 inch (125mm)	Faraday / SCEM	300	DN-35-CF
HAL 3F	Triple		Faraday / SCEM	300 or 510	DN-63-CF

Table 2.1 Probe features summary

Figures 2.3 to 2.7 show details of the Probes and the recommended clearances inside and outside the vacuum chamber for Probe and RF Head mounting.

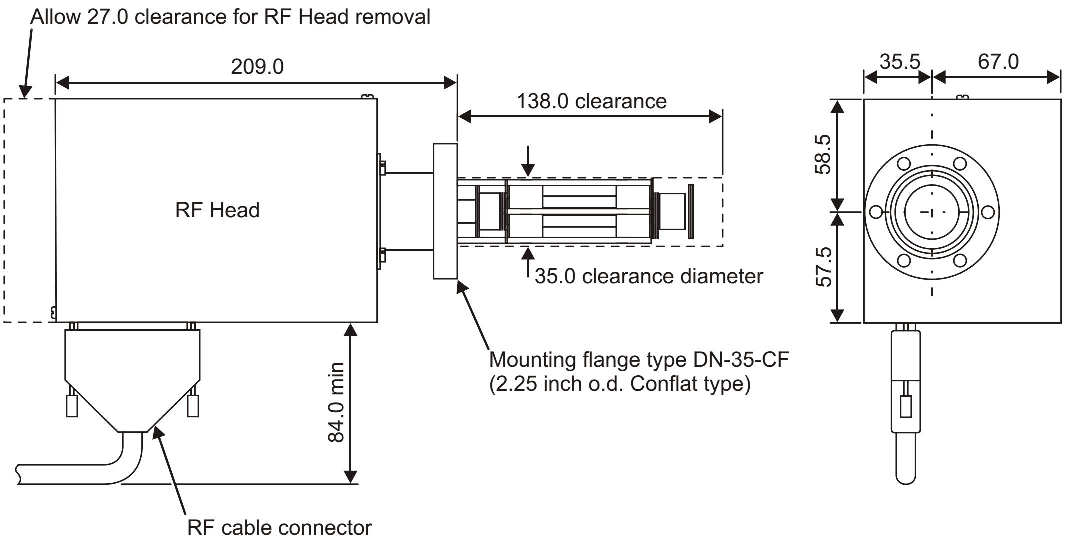

Figure 2.3 HALO 100 Probe and RF Head

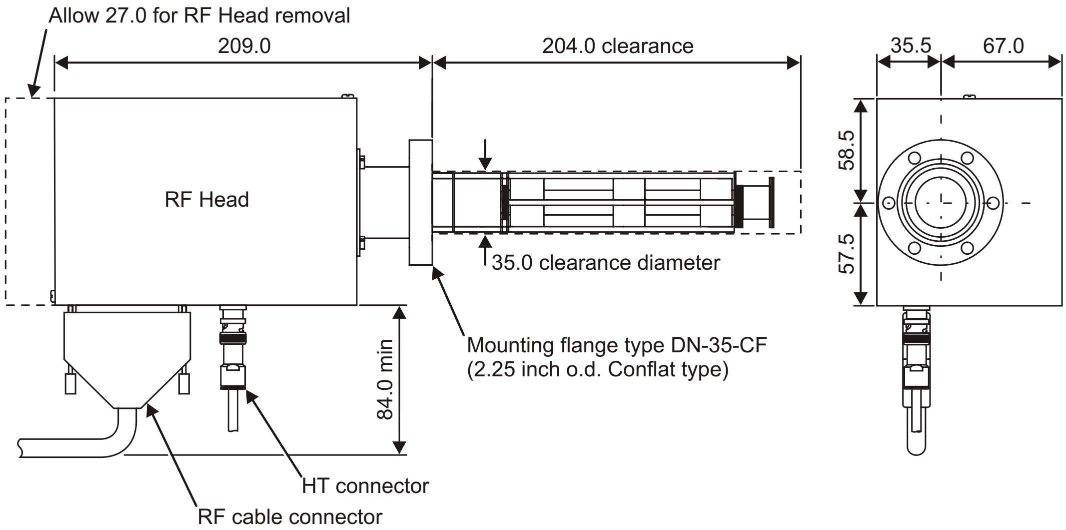

Figure 2.4 HALO 201 Faraday/channelplate Probe and RF Head

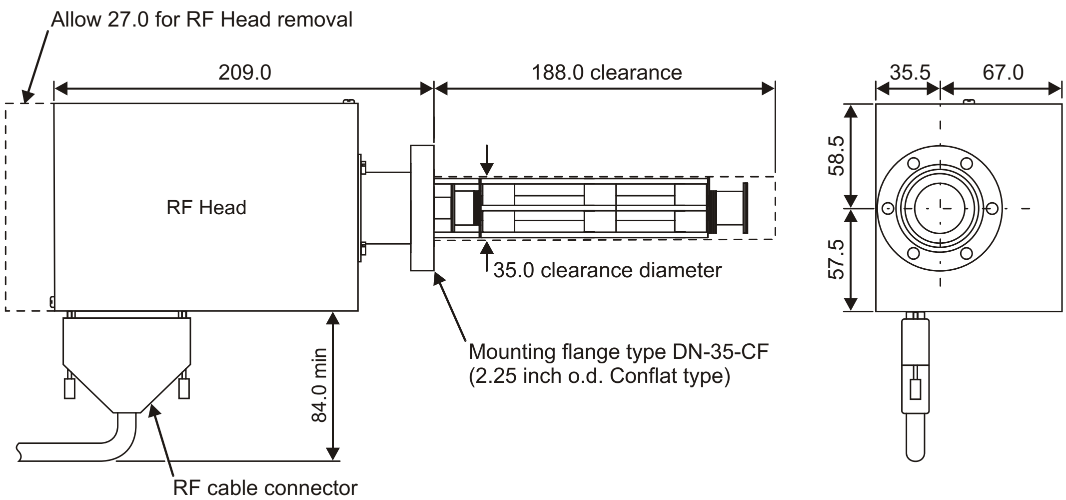

Figure 2.5 HAL 200 Probe and RF Head

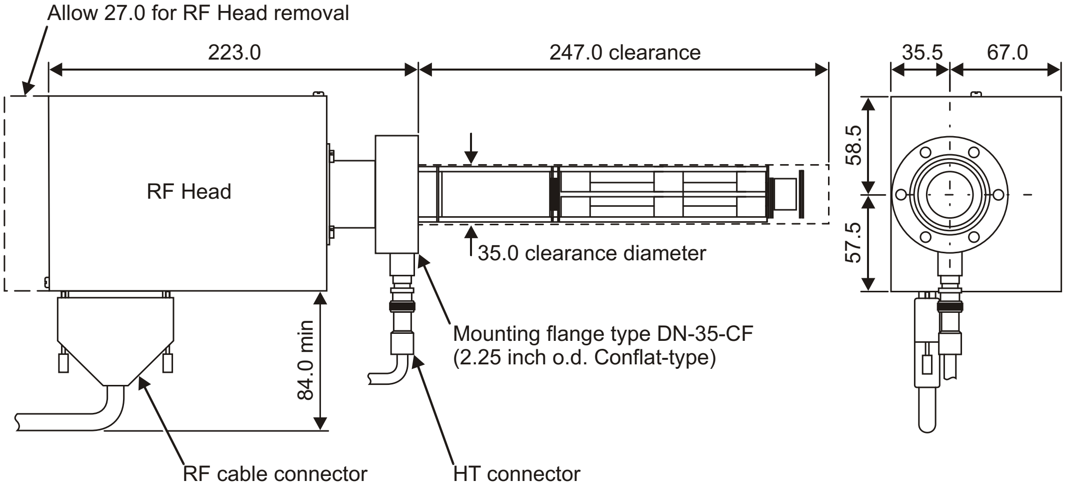

Figure 2.6 HAL 201/301 Probe and RF Head

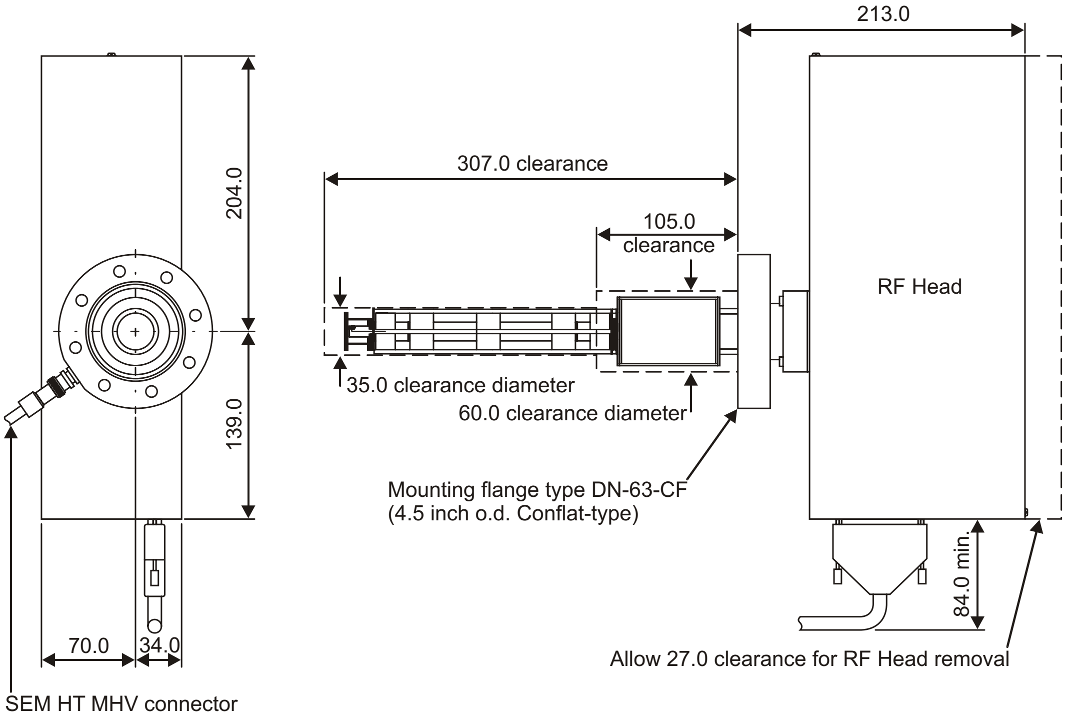

Figure 2.7 HAL 3F triple filter Probe and RF Head

2.3.2 Series 1000 System

The RGA Analyser Probe contains an ion source, a mass filter and a detector supported on a Conflat-type flange, allowing it to be mounted in a vacuum system. Series 1000 Probes use a contamination-resistant triple mass filter, with rods either 9 mm (3F-9) or 12 mm (3F-12) in diameter, with dual Faraday and SEM detectors.

With the exception of the RF power and the SEM High Tension (HT), signals are connected to the Probe via an Amplifier Head mounted directly on the Probe vacuum feedthrough. RF power is provided by the RF Generator Unit and SEM detector HT is provided by the RC Interface; both are fed to the Probe through a Feedthrough Adapter mounted on the rear of the Probe. Power and control signals are fed to the Amplifier Head via a cable from the RC Interface, which contains a microcomputer and communications interfaces for linking to the user interface PC.

Figures 2.8 and 2.9 show the Probe and Amplifier Head for Probes with 9 mm and 12 mm rods respectively; the recommended clearances inside and outside the vacuum chamber for Probe and Amplifier Head mounting are also shown.

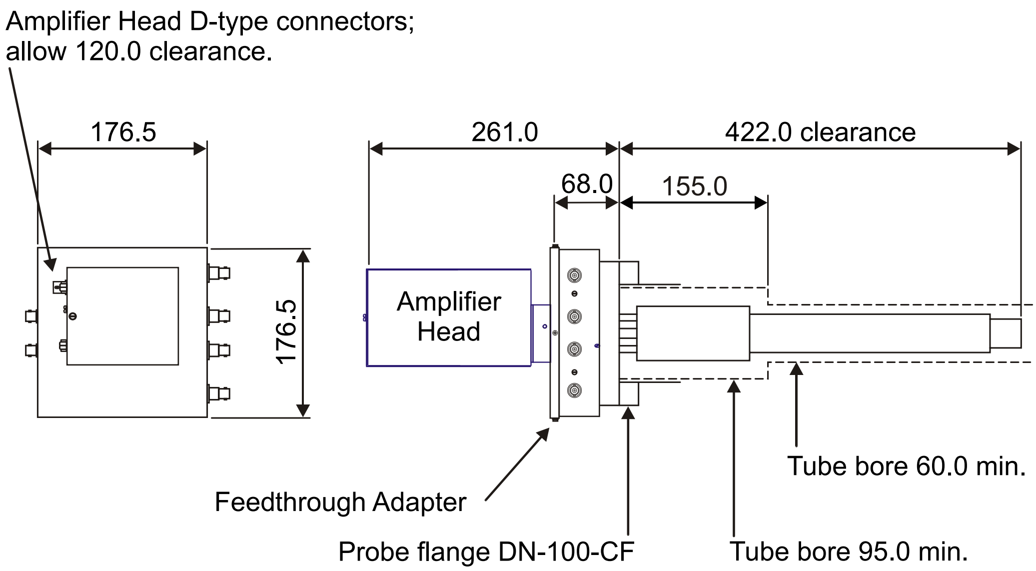

Figure 2.8 Series 1000 Probe (9 mm rods) and Amplifier Head

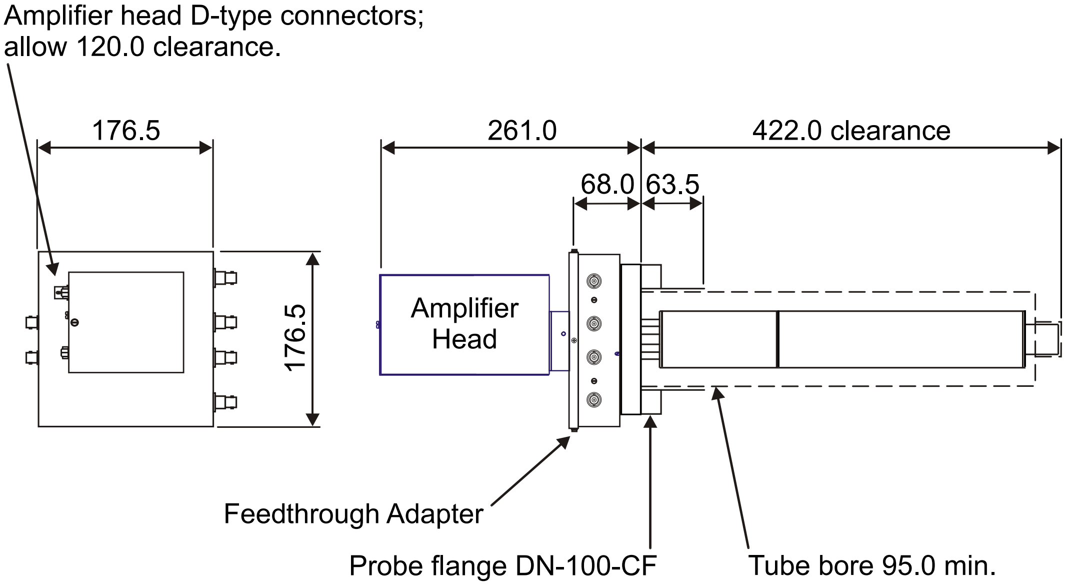

Figure 2.9 Series 1000 Probe (12 mm rods) and Amplifier Head

2.4 RC Interface unit description

2.4.1 General

All types of analyser use the same type of RC Interface unit; this is a 2U rack-mountable unit which is normally mounted within three metres of the Head and Probe units. Figure 2.10 shows the RC Interface front and rear panels. A power switch and five status lamps are on the front panel; the power and system connectors are on the rear panel.

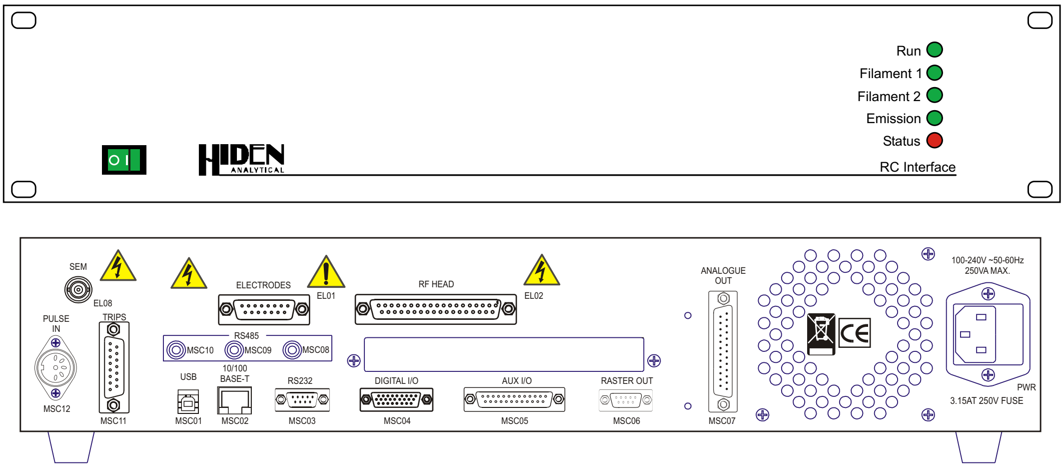

Figure 2.10 RC Interface unit front and rear panels

A 32-bit microcomputer, mounted on the Micro board, controls each RC Interface unit; it is responsible for executing the commands issued by the PC and reporting data back to the PC.

2.4.2 RC Interface unit front panel

The mains power switch is located at the lower left of the front panel; the switch glows green when the RC Interface is switched on and mains power is present.

Instrument status is indicated by the four green and one red Light Emitting Diodes (LEDs) on the right-hand side of the panel. The green **Run** LED will light when the **PowerUp** tool or **Go** tool on the **MASsoft** window Tool Bar is selected. In this condition the RC Interface can apply power to the Probe and thus scan and acquire data. The ionisation source status is shown by the **Filament 1**, **Filament 2** and **Emission** LEDs which indicate the filament(s) selected and whether the required emission has been obtained. The **Emission** LED will flash if the selected filament has failed, see Section 5.6. Internal faults may be indicated by the red **Status** LED; this LED will illuminate for a few seconds when the RC Interface is switched on.

2.4.3 RC Interface unit rear panel

Connectors for interfacing with the rest of the system components and for mains power input are mounted on the rear panel.

ELECTRODES EL01	15 way Female D connector	Not used in RC RGA systems. Provides additional power supplies to the RF Head for electrodes used in IMP and SIMS systems.
RF HEAD EL02	37 way Female D connector	Carries the signals to and from the RF/Amplifier Head mounted on the Probe.
SEM EL08	SHV	Provides high voltage power to the SEM detector. Not fitted on Faraday only instruments.
USB MSC01	USB Type B	Provides a Universal Serial Bus communications interface.
10/100 BASE-T MSC02	RJ45	Provides a 10 or 100 Base-T Ethernet LAN connection for communication between the RC Interface and the PC.
RS232 MSC03	9 way Male D connector	Provides an RS232 serial port for communication between the RC Interface and the PC.
DIGITAL I/O MSC04	26 way High Density D connector	Digital input/output circuits.
AUX I/O MSC05	25 way Female D connector	Carries analogue input signals and digital control signals. Described in the Input/Output Subsystem section.
RASTER OUT MSC06	9 way female D connector	Optional, used in SIMS systems, not used in RC RGA systems. Carries signals to control an Ion Gun.
ANALOGUE OUT MSC07	25 way male D connector	Provides access to the eight analogue outputs.
RS485 MSC08, 09, 10	3.5mm 3 pole jack sockets	Provides three RS485 serial interface connections for communication between the RC Interface and peripheral equipment.
TRIPS MSC11	15 way Female D connector	Carries trip signals in and out of the RC Interface. The protective “inhibit” trip uses this connector.

PULSE IN MSC12	3 pin DIN connector	Fitted but not used in RC RGA systems. Carries the detector output pulses from the RF/Amplifier Head.
PWR	IEC Mains connector	Mains power connection to the RC Interface.

2.4.4 Micro board

A microcomputer controls each RC Interface; it is responsible for executing the commands issued by the PC and reporting data back to the PC. The microcomputer comprises a microprocessor, various types of memory and interface circuits mounted on a single circuit board. This Micro board also contains the three communications interfaces.

The Hiden Micro board has and continues to evolve as the latest microcomputer technology is utilised.

To ensure the correct variant is identified when ordering spares, service or software upgrades please quote the Works Reference number and serial number in full (refer to Section 2.4.4.1).

2.4.4.1 Serial number label

The serial number label fitted to the rear panel of the RC Interface shows the instrument's Model Number, Serial Number and Works Reference number. A typical serial number label is shown in Figure 2.11.

Below the Serial No. box is a twelve digit number made up of six two digit hexadecimal numbers separated by colons, this is the microprocessor MAC address. In Figure 2.11 the MAC address is 00:01:C0:06:81:EA.

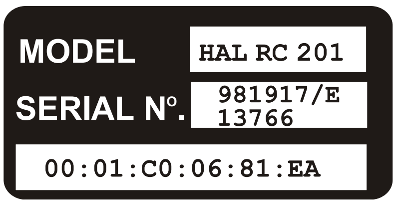

Figure 2.11 Typical Serial No. label

2.4.4.2 Works reference number

The works reference number (WR number) uniquely identifies each RC Interface unit. The WR number appears on the serial number label on the second line of the SERIAL No. box, 13766 in Figure 2.11. The WR No. is used by MASsoft. It is worth making a note of this number before installing the RC Interface if the rear panel will be inaccessible.

The unit's WR number can be obtained by using the TTY test program and typing the command:

pget ID

the WR number will be returned.

The TTY test program is described the TTY Serial test section of the Hiden Software Suite Installation Guide.

2.4.4.3 MAC address

The unit's MAC address can be obtained by using the TTY test program and typing the command:

pget net-address

the MAC address will be returned.

The TTY test program is described the TTY Serial test section of the Hiden Software Suite Installation Guide.

2.5 Series 1000 RF Generator Unit description

2.5.1 General

The Series 1000 RF Generator Unit is a free-standing unit which provides the RF and DC voltages required by the triple filter analyser. It is normally mounted close to the Analyser, to which it is connected by three screened cables. A further cable, connected via the Amplifier Head, provides ±15 V supplies and program voltages from the RC Interface.

The system connectors are mounted on the front panel, see Section 2.5.2.

The mains power is connected to the PWR connector which is located on the rear of the Series 1000 RF Generator Unit at the lower left.

2.5.2 Series 1000 RF Generator Unit front panel

See Figure 2.12.

Connectors, for interfacing with the rest of the system components, are mounted on the front panel.

The MHV connector, Quad Energy 01, provides the quadrupole energy link to the Probe.

The 9-pin male D-connector, Control 02, carries the control signals from the Amplifier Head.

Safe High Voltage (SHV) connectors, RF Out 03 and RF Out 04, carry RF power to the Feedthrough Adapter.

The Tuning control is used to achieve the best system performance, see Section 3.8.6.

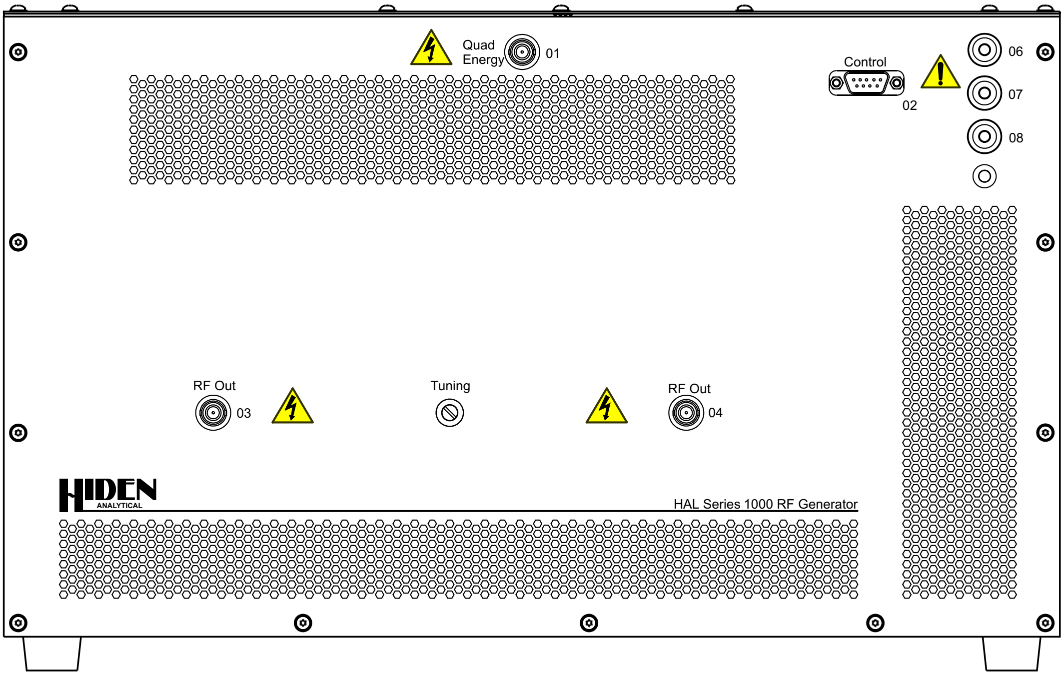

Figure 2.12 Series 1000 RF Generator Unit front view

2.6 Technical data

2.6.1 Electrical specification

2.6.1.1 RC Interface unit

Voltage: 100 to 240 V a.c. (~).

Frequency: 50 to 60 Hz.

Power: 250 VA maximum.

Mains fuse: 20 mm HRC, 3.15 A T, 250 V.

Installation category (over voltage category): II.

Pollution degree: 2.

Weight: 5 kg approximately

Dimensions: 445mm wide 88mm high 237mm deep
Front panel 482 mm wide 88mm high

2.6.1.2 Series 1000 RF Generator Unit

Voltage: 100 to 240 V a.c. (~).

Frequency: 50 to 60 Hz.

Power: 450 VA maximum.

Mains fuse: cannot be serviced by the user.

Installation category (over voltage category): II.

Pollution degree: 2.

Weight: 15kg approximately

Dimensions: 438mm wide 275mm high 277mm deep

2.6.2 Environmental data

Operating temperature range: 5 to 40 °C.

Storage temperature range: 0 to 50 °C.

Note:

The equipment can be stored temporarily at temperatures down to -10 °C.

Relative humidity range: 20 to 80 % non-condensing.

2.7 Identification

The type of RC Analyser can easily be determined from the serial number labels attached to the RF Head and RC Interface unit rear panel. See Figures 2.11 and 2.13.

The model number identifies the type of RC Analyser and should be one of the types listed in Section 2.1 of this manual. The model number on the RC Interface and RF Head serial number labels should be the same.

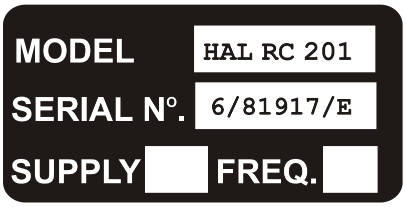

Figure 2.13 Typical RF Head serial number label

The quadrupole Probe serial number is engraved on the side of the mounting flange.

Before contacting Hiden Analytical for technical assistance please have all the information from all the serial number labels and the gauge serial number to hand.

Chapter 3 Installation

Installation: Contents

Installation: Illustrations

Installation: Tables

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3.1 General

This Chapter describes the System environmental and protection requirements and the installation of the System hardware.

3.2 Preparation

Before unpacking the Hiden Analytical Limited System, check for signs of shipping damage. If the packaging is damaged, notify the carrier immediately.

Check all the box contents against the packing list. If any parts are missing, notify the carrier and Hiden Analytical Limited immediately.

3.3 System use

WARNING

This equipment, when installed and connected as described in this Manual, is suitable for use as a Mass Spectrometer; any attempt to use it for any other purpose may expose the operator to injury, is liable to damage the instrument and will invalidate its Warranty.

If in doubt as to its suitability for an application, please contact Hiden Analytical Limited for advice.

3.4 Environment

3.4.1 Operating environment

In addition to the requirements of Section 2.6.2, please note the following:

1. The system should not be connected to noisy mains supplies such as those powering large motors, welding equipment, etc.
2. Electronic units should not be subjected to constant vibration or heavy shock.

3.4.2 Ventilation requirements

3.4.2.1 RC Interface unit

The RC Interface is forced-cooled by a fan venting through the rear panel. If the unit is to be rack mounted, the cabinet must be unsealed and well-ventilated. There must be a minimum of 20 mm clear space to the cabinet walls for at least 70 % of the length of the sides of the unit. There must be at least 100 mm clear space behind the unit.

Note:

The RC Interface feet must be removed if the unit is to be rack-mounted; this can be done by removing the screw in the centre of each foot.

When used as a desk-top unit, there must be a minimum of 20 mm clear space for at least 70 % of the length of the sides of the unit. There must be at least 100 mm clear space behind the unit.

3.4.2.2 Series 1000 RF Generator Unit

The Series 1000 RF Generator Unit is forced-cooled by fans venting through the top and rear panels. The unit is free-standing and must have at least 100 mm clear space to the front and rear.

3.4.2.3 Head Unit

At least 100 mm of clear space should be left round all faces of the Head Unit.

3.4.3 Electromagnetic compatibility

The Mass Spectrometer has been designed to meet the requirements of BS EN 50082-1:1992 and is suitable for use in residential, commercial and light industrial locations. This includes laboratories, workshops, service centres, etc., where the use of radio or television receivers may be expected to be within 10 m of the instrument.

To maintain the instrument’s Electromagnetic Compatibility (EMC) performance, the following points should be noted:

- Use the cables provided for interconnection between the parts of the instrument. These cables play a vital part in the instrument’s EMC performance; any alteration may compromise this performance.
- Do not operate with damaged cables. If the insulation or screening of any of the interconnection cables is damaged, the whole cable should be discarded and a new cable fitted.
- Always tighten the locking screws on the cable connectors to ensure that the pins and screen are making good contact.
- Do not operate with any panels removed or partially open. Always refit all screws and fastenings when refitting a panel.
- Do not disturb or remove any RF gaskets. Take care that any gaskets are not displaced when removing or refitting panels.
- Only use Hiden Analytical Limited approved replacement parts or components.
- Where user-supplied cables are used for interfaces they must have metal shell connectors provided with screw locks. The cable itself must be screened and the screen must be connected to each connector’s metal shell using a 360° clamp, not a twisted tail.

If there are any doubts or problems, contact Hiden Analytical Limited for further information and help.

3.5 Mass Spectrometer over-pressure protection

3.5.1 General

CAUTION

Operation of the Mass Spectrometer at pressures exceeding those specified below may damage both filaments and, more critically, from a cost/downtime viewpoint, the detector.

The recommended maximum operating pressures are as follows:

Filament: 1 x 10^{-4} Torr

Faraday detector: 1 x 10^{-4} Torr

SCEM detector: 5 x 10^{-6} Torr

Channelplate SEM detector: 1 x 10^{-6} Torr

Any available gauging provided on the vacuum system should be used to protect the System by using the RC Interface over pressure protection trip input, see Section 3.5.2.

3.5.2 System protection

The system contains an internal over pressure detector in the ion source; this can only operate when one, or both, of the Probe filaments is switched on. This detector offers system protection in the event of a pressure rise during operation, but it is still possible to switch a filament on under high pressure conditions and so damage it. For maximum protection, it is recommended that an external pressure gauge, such as an ion or cold cathode gauge, is linked to the RC Interface inhibit input.

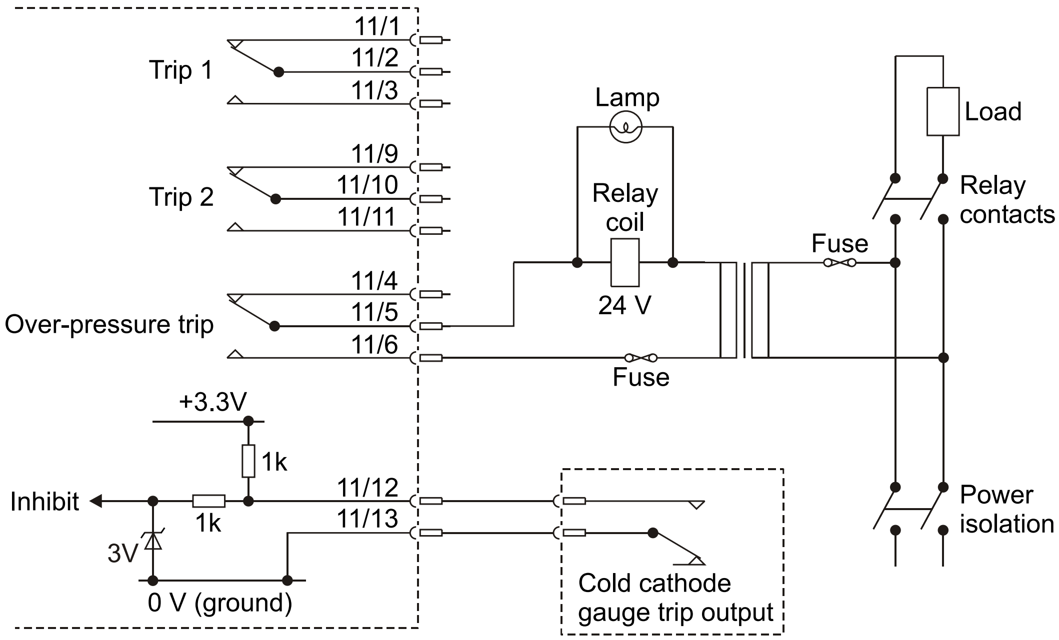
The RC Interface has a circuit which senses the inhibit input situated on the TRIPS MSC11 connector, at the rear of the unit, see Table 3.1. This input must be at logic 0 level, or linked to 0 V, in order to be able to turn on the mass spectrometer filament and SEM detector high voltage. Figure 3.1 shows the suggested trip circuit where the instrument is protected by the trip contacts of a cold cathode gauge and itself protects further equipment by linking to the RC Interface over-pressure trip contacts.

Where the basic unit is supplied without a vacuum system, a link is provided by a 15-pin D-connector, with pins 12 and 13 shorted together, plugged into the RC Interface TRIPS MSC11 connector. It is strongly recommended that this connector link is replaced by an over-pressure protection system. Partial protection may be obtained from a vacuum pump (turbo) controller with relay output sensing for pump on/off and for pump rotation speed at maximum, but this protection is not adequate in the event of limited over-pressure. For full protection, a total pressure gauge with programmable trip level and a relay output is recommended.

If a vacuum system has been supplied by Hiden Analytical Limited, the mass spectrometer inhibit input is connected to relay contacts on the vacuum pump controller or on a total pressure gauge such as a cold cathode or hot-filament ionisation gauge with appropriate trip levels set.

Note:

The over-pressure trip is not user-definable; it trips only if the inhibit input circuit has tripped, or the ion source pressure is too high and a filament is switched on.



Note:

Over-pressure trip contacts 11/5 and 11/6 are opened when a trip is detected.

Figure 3.1 Trip circuit operation

Pin number	Signal
1	Trip 1 output relay normally-closed contact
2	Trip 1 output relay common contact
3	Trip 1 output relay normally-open contact
4	Over pressure trip output relay normally-closed contact
5	Over pressure trip output relay common contact
6	Over pressure trip output relay normally-open contact
7	0 V
8	0 V
9	Trip 2 output relay normally-closed contact
10	Trip 2 output relay common contact
11	Trip 2 output relay normally-open contact
12	Inhibit input
13	0 V
14	Reset
15	0 V

Table 3.1 TRIPS MSC11 trip connector pin assignment

3.6 Filament operation at reduced electron energy

CAUTION

Using too high an emission value may damage the filament.

electron energy can be set to a minimum value of 6 eV. When **electron energy** is to be scanned from less than 20 eV, the emission current must be reduced in order to protect the filaments from damage due to excessive current demands.

Figures 3.2, 3.3 and 3.4 should be used as guides for safe operation of the filaments at reduced electron energies. Referring to Figure 3.2, for example, for an emission current of 400 A, the demanded filament current changes slowly with decreasing electron energy until the electron energy is approximately 18 eV. A rapid increase in demanded filament current then occurs due to changes in the emission characteristics. Running the filaments in this region may lead to filament damage. The onset of this region occurs at lower electron energy values as the emission current is decreased.

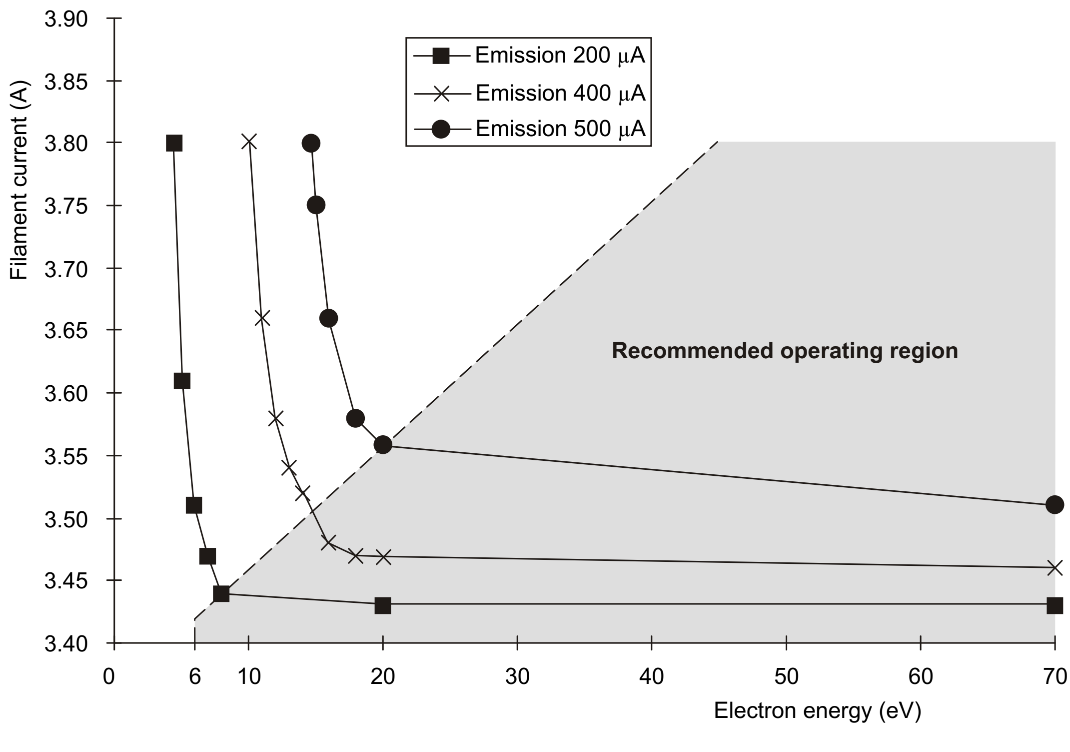


Figure 3.2 Variation in filament current with electron energy

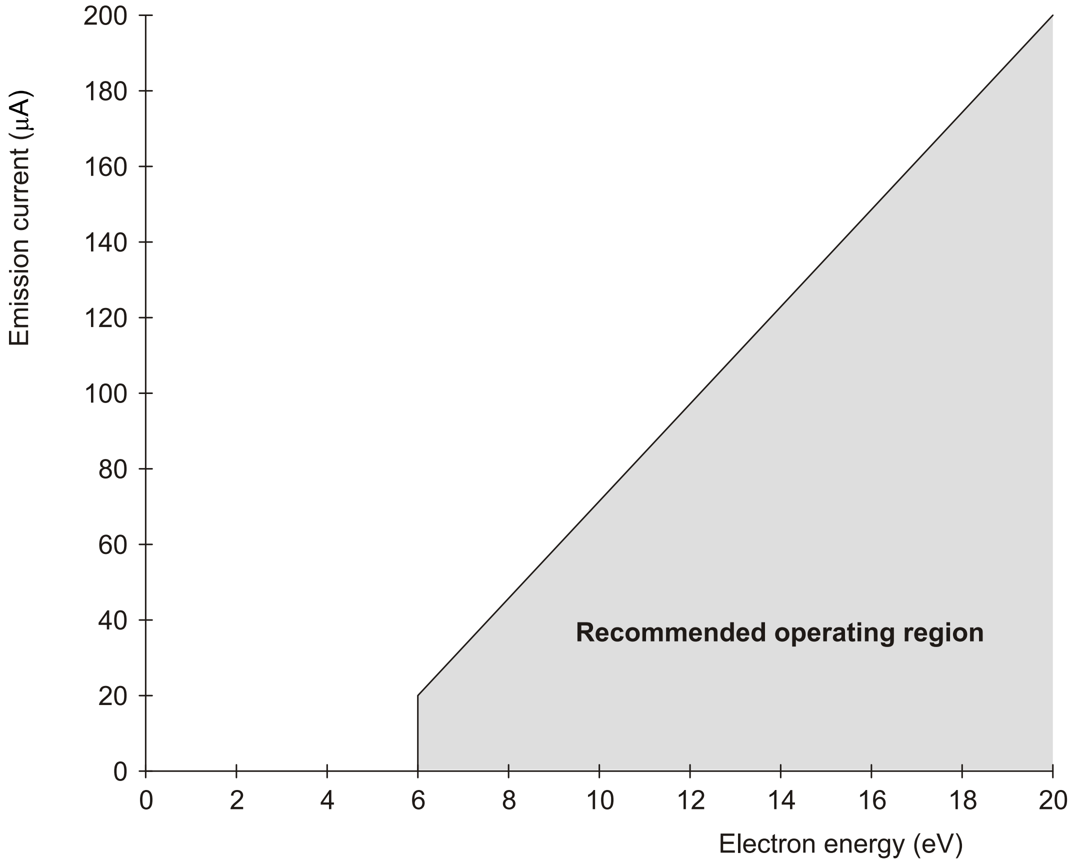


Figure 3.3 Emission current - minimum electron energy characteristic: 0 to 20 eV

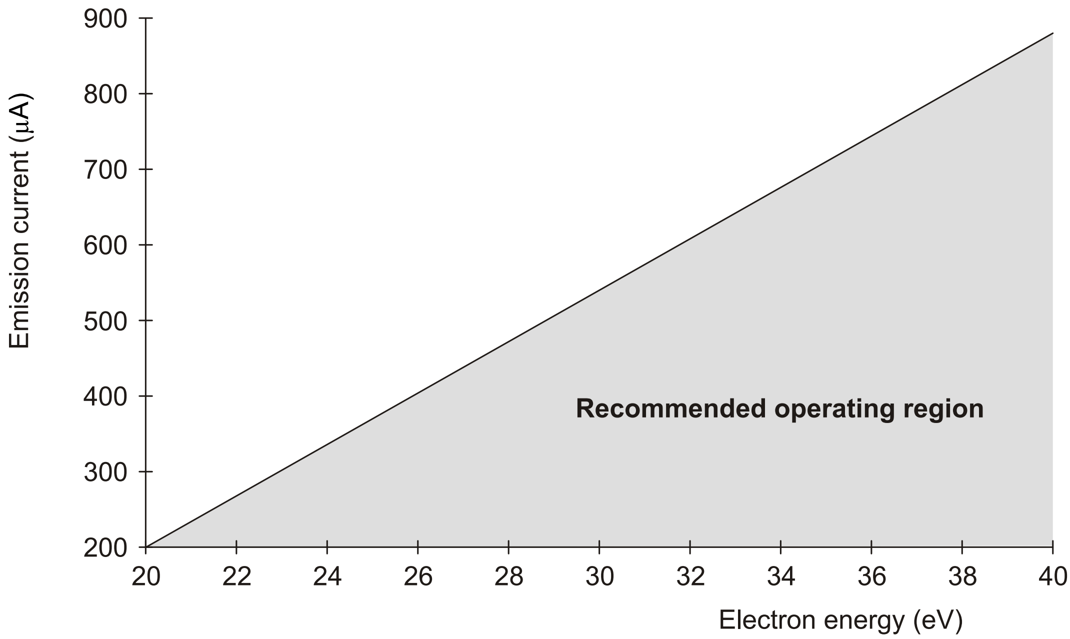


Figure 3.4 Emission current - minimum electron energy characteristic: 20 to 40 eV

3.7 Communications link

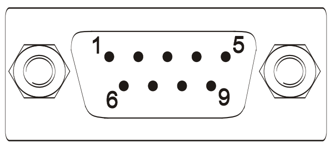
The RC Interface unit is equipped with a total of four external communications interfaces ONLY one of which will be used to connect it to the host computer or to the network. The RS485 ports are not suitable for RC Interface to host computer communication. The RS232, USB and network interfaces are described in this section.

The "Communications links guidelines" section of the "Hiden Software Suite Installation Guide" gives some basic guidelines for selecting the best communications link for a given system; however, if there is still any doubt about the best link to be used please contact Hiden Analytical Limited.

Refer to the Hiden Analytical Limited, “Hiden Software Suite Installation Guide” for details of how to configure the chosen communications link.

3.7.1 RS232 interface

RS232 MSC03	9 way male D connector	Provides an RS232 serial port for communication between the RC Interface and the PC.



Pin 1	no connection	Pin 6	no connection
Pin 2	Rx Data	Pin 7	RTS
Pin 3	Tx Data	Pin 8	CTS
Pin 4	no connection	Pin 9	no connection
Pin 5	0 V		

Figure 3.5 RS232 connector

The RS232 interface is only suitable in systems where one PC is connected to one local RC Interface.

To use the RS232 link, connector RS232 MSC03, on the RC Interface rear panel, must be connected to the PC using a null modem cable. A suitable cable is provided with the system.

Note:

For good EMC performance, the connectors must be fitted with metal shells, and the cable must be screened, with the screen connected to the shell at the point of entry via a 360° clamp (not wired via a tail). If the cable is not constructed in this way, the EMC performance of the whole system may be degraded, and may cause operational problems.

Specification:

Data rate: 115.2 kbaud.

Number of data bits: 8.

Number of stop bits: 1.

Parity: none.

At the above data rate, RS232 cable lengths are restricted to a maximum of 5 metres. Care should be taken to ensure that the power supplies for the RC Interface and the PC are taken from the same phase of the mains and that the supply is as noise-free as possible. The PC and RC Interface must also share a common earth.

To use the RS232 interface the USB connection must be unplugged. The RS232 interface is disabled if the unit is connected via the USB.

3.7.1.1 Baud rate

When using the RS232 the baud rate must be set in the HIDEN.INI file. The RC Interface communicates with the PC at 115200 baud. The setting of the baud rate is done automatically by the installation program.

Note

When using utilities like TTY Serial Test or the MSIU Test program the baud rate must be changed from the default of 19200 to 115200 (115.2 kbaud).

3.7.2 USB connection

The RC Interface can be connected to one of the PCs USB ports. A USB cable with Standard-A and Standard-B plugs, as supplied with the instrument, should be used.

The USB connection appears on the PC as another serial port. To use the USB connection the driver must be installed from the Hiden Software Suite disc.

CAUTION

The USB drivers must be installed BEFORE connecting the PC to the RC Interface via the USB port.

The PC may mis-identify the USB device if the RC Interface is connected to the PC before the USB Drivers are installed.

Once the USB drivers have been installed use the USB cable to connect the RC Interface to a PC USB port. The COM port associated with the USB connection can be determined from the Windows Device Manager.

To determine the USB connection:

1. On the Windows Taskbar click the **Start** button.

2.	On the **Settings** menu click **Control Panel**.	The **Control Panel** window will be displayed.
3.	In the **Control Panel** window double click **System**.	The **System Properties** dialog box will be displayed.
4.	Select the **Hardware** tab.	
5.	Click the **Device Manager** button.	The **Device Manager** window will be displayed.
6.	Expand the **Ports (COM & LPT)** branch.	To do this click on the branch + symbol.
7.	There will be an entry similar to "Hiden Analytical - HAL Interface Unit (COM#).	COMn indicates the COM port of the USB connection to the RC Interface.

Also refer to the "Finding a COM port" section of the Hiden Software Installation Guide.

The baud rate for the USB connection is 921600 baud.

The same utilities (TTY, MSIUtest) used for serial connection testing can be used with the USB connection.

3.7.3 Network connection

The 10/100 Base-T serial interface uses a standard RJ45 connector using UTP (unshielded twisted pair) cable to give a 10 or 100 Mbs (mega bit per second) network connection. This network connection supports a TCP/IP protocol.

If the RC Interface is connected to the network via a hub or network wall socket a straight through (grey) network cable should be used. A cross-over (yellow) cable must be used to connect the RC Interface directly to the network socket on a PC.

The instrument is provided with two cables. Use the yellow (cross-over) cable if the RC Interface is connected directly to the PC. Use the standard grey cable if the instrument is connected to a hub, router or network socket.

The RC Interface only supports the TCP/IP protocol, the DLC protocol is not supported.

For instructions on setting up TCP/IP refer to the TCP/IP Implementation manual. This document is available in PDF (Portable Document Format) on the Hiden Software Suite disc in the \manuals\tcp_ip folder.

3.7.4 RS485

The RS485 ports are not used for RC Interface to PC communication.

In some applications the RS485 ports are used to communicate with peripheral equipment.

3.8 Mechanical and electrical installation procedure

WARNING

1. **This equipment must be fully installed and configured for normal operation before it is powered-up; failure to do this may cause injury to the operator and damage to the equipment.**
2. **This equipment must be earthed; failure to do this may cause injury to the operator and damage to the equipment.**

CAUTION

1. **Any connections to other equipment should be undertaken by suitably qualified personnel and must not compromise equipment safety.**
2. **Any equipment connected to any input/output port must operate at Safe Extra Low Voltage (SELV) levels (normally in the range -50 V to +50 V) in accordance with EN 61010:1993 to meet the requirements of the Low Voltage Directive (LVD) 73/23/EEC.**

3.8.1 Assembling Conflat-type flange joints

Conflat-type flanges, also known as CF flanges, are stainless steel vacuum flanges incorporating a knife-edge and use a copper gasket to form an ultrahigh vacuum seal. The knife-edges cut into the softer gasket material and deformation of the copper fills any minute defects or machining marks in the stainless steel. A recessed groove in the flange helps retain and align the gasket during assembly and limits expansion during baking enabling the joint to remain leak tight at high temperatures.

CAUTION

The flange surfaces MUST NOT be touched by bare skin. Clean, powder-free, vinyl gloves must be worn whilst touching the component parts, including the copper sealing gasket.

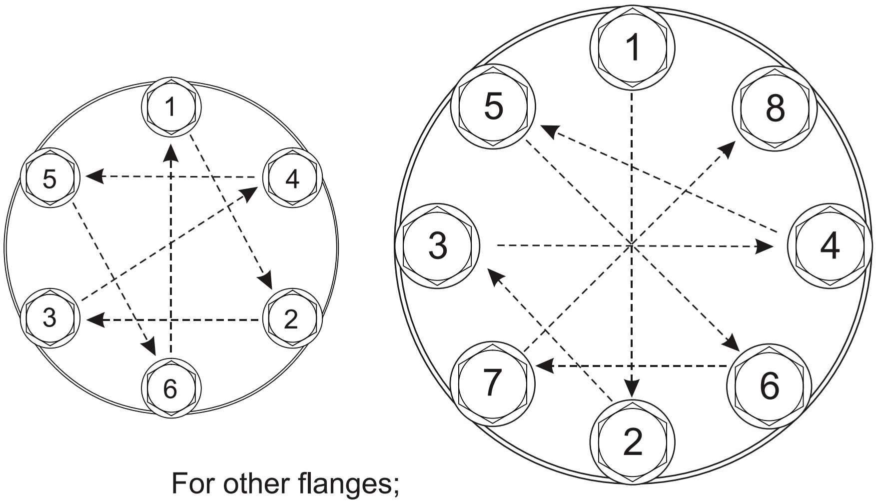
A Conflat-type flange joint is used to seal the Probe flange to the host vacuum system.

The copper gasket is a use once device so a new gasket must be used each time a seal is made.

To form a reliable, leak-tight seal it a essential that the two flanges remain parallel as the knife edges embed in the copper gasket.

Use the following procedure:

1. Check both flanges are clean and free of defects particularly that the knife-edges are free from nicks and scratches.
2. Fit a new copper sealing gasket into the recess of one of the flanges.
3. Fit the flange and gasket to the other flange, align the bolt holes.
4. Ensure the gasket is seated correctly and the two flanges are parallel.
5. Fit the fasteners (usually M6 or M8 bolts, nuts and washers) and tighten finger tight.
6. Using two spanners tighten opposing bolts a little (1/4 turn) at a time in the sequence shown in Figure 3.6.



For other flanges;
use a similar sequence to move
around the flange gradually
tightening opposing bolts

Figure 3.6 Flange bolt tightening sequence

7. Continue repeating the tightening sequence until all bolts exhibit strong resistance.

It is not necessary to achieve flange-to-flange contact. As a guide a flange gap of 0.4mm around the entire flange is typical. The normal tightening torque required to achieve a good seal is 7 to 9 Nm. over-tightening can cause problems later with gasket removal.

3.8.2 RC Interface installation

The RC Interface can be installed as either a rack-mounted unit or as a bench-top unit. As supplied, the RC Interface is fitted with feet for installation as a bench-top unit. The feet must be removed if the RC Interface is to be installed as a rack-mounted unit.

CAUTION

Supporting the RC Interface on the front panel flanges only may damage the case.

The RC Interface has front panel flanges fitted for retention in a rack. The weight of the unit should be supported by slide bars; the front panel flanges are used only to secure the unit to the rack.

3.8.2.1 Installation as a rack mounted unit

The RC Interface is supplied with feet fitted for use as a bench top unit.

To install the RC Interface as a rack mounted unit:

1. Turn the RC Interface upside down.
2. Remove the screw from the foot and then remove the foot.

   A flat bladed screw driver will be required.
3. Repeat Step 2. for the remaining three feet.

3.8.3 Standard System installation

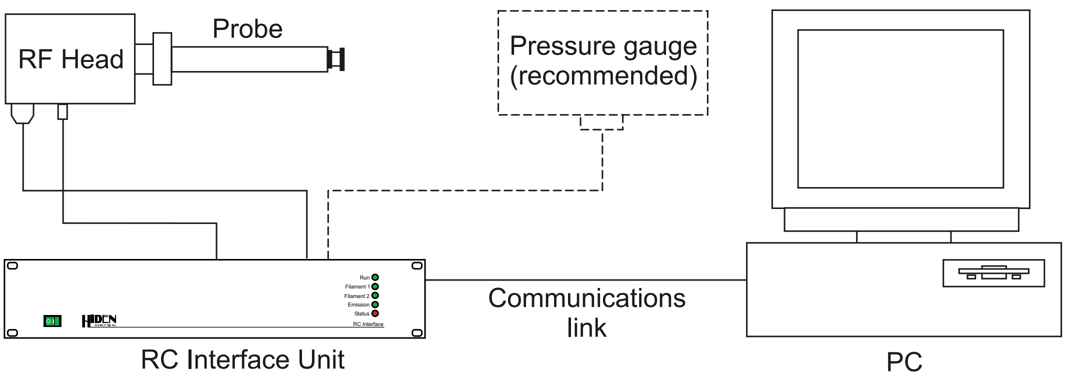


Figure 3.7 Typical standard system

This section of the manual describes the installation of a standard RC RGA system.

The complete installation procedure comprises:

- Install the RGA Probe on the host vacuum chamber
- Install the RC Interface
- Make the connections between the RF Head and the RC Interface
- Connect the RF Head to the Probe and make the electrical connections
- Connect the RC Interface to the PC, connect the RC Interface trip circuit
- Install MASsoft.

CAUTION

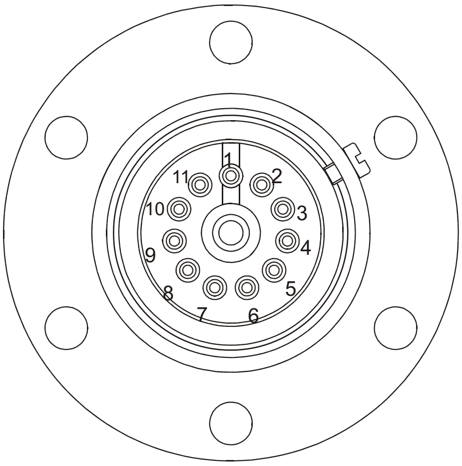
1. **The surfaces of the Probe which are normally inside the vacuum system MUST NOT be touched by bare skin; this would leave an oily deposit on the metal which could subsequently give large peaks in the mass spectrum. Clean, powder-free, vinyl gloves must be worn whilst touching the component parts.**
2. **Any tools used whilst working on the Probe must be perfectly clean and free from dust particles and oil.**

The Probe is supplied in custom packaging which should be retained and re-used if the Probe is returned to Hiden Analytical for servicing in the future. The packaging may include a plastic carton or metal shipping housing (depending on instrument type) and foam lined cardboard box.

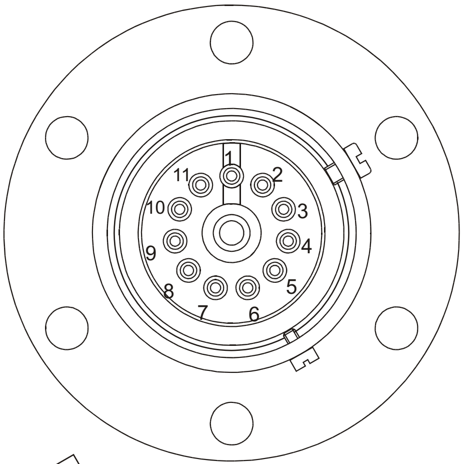
Where the Probe is to be installed in an existing chamber, follow all the steps. If Hiden Analytical Limited have supplied a system mounted in a chamber with pumps, start at Step 5.

1.	Remove the Probe from the shipping housing or protective packaging.	The Probe may be supplied in a metal shipping housing or plastic package depending on the Probe type. The shipping housing is bolted to the Probe flange. Retain the Probe packaging.
2.	Check the 12-way feedthrough connector for any short-circuits.	Pins 3, 6 and 9 should be connected to each other but not to ground, these are the filament connections. Pin 1 is connected to ground. All other pins should be open circuit to each other and to ground, see Figures 3.8 and 3.9 for the pin positions. If a short is found refer to Section 5.5.

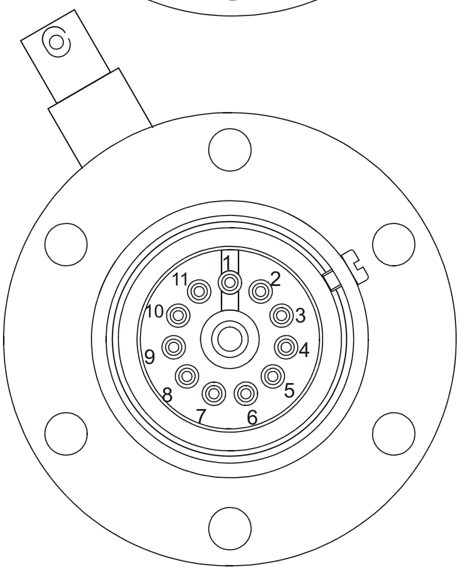
3.	Mount the Probe on the chamber.	Use a new copper gasket. The mounting flange will be a Conflat-type flange; see Section 3.8.1 for details of how to assemble the flange joint.
4.	If a total pressure gauge is to be mounted on the Probe it should be mounted on the gauge port using an elbow to prevent any interference with the detector.	
5.	Check the 12-way feedthrough connector again for short-circuits.	If a short is found refer to Section 5.5.



Feedthrough used on HALO100 and HAL200 gauges.
DN-35-CF (70mm) flange, single locating screw and no high voltage connector



Feedthrough used on HALO201 gauges.
DN-35-CF (70mm) flange, two locating screws and no high voltage connector



Feedthrough used on HAL201 and HAL301 gauges.
DN-35-CF (70mm) flange, single locating screw and a high voltage connector for the SCEM supply.

The pins are shown from the air side; the mating connector, on the RF Head, has mirror-image pin numbers.

Figure 3.8 Single filter Probe feedthroughs

HALO100 and HAL200 Probe Feedthrough Connections					
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
Centre	Detector Output	4	Source	8	No Connection
1	Ground	5	No Connection	9	Filament 2
2	RF+	6	Filament common	10	RF-
3	Filament 1	7	Focus	11	Suppressor

HALO201 Probe Feedthrough Connections					
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
Centre	Detector Output	4	Source	8	SEM LT
1	Ground	5	SEM HT	9	Filament 2
2	RF+	6	Filament common	10	RF-
3	Filament 1	7	Focus	11	Suppressor

HAL201 and HAL301 Probe Feedthrough Connections					
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
Centre	Detector Output	4	Source	8	No Connection
1	Ground	5	No Connection	9	Filament 2
2	RF+	6	Filament common	10	RF-
3	Filament 1	7	Focus	11	Suppressor

Table 3.2 Single filter Probe feedthrough connections

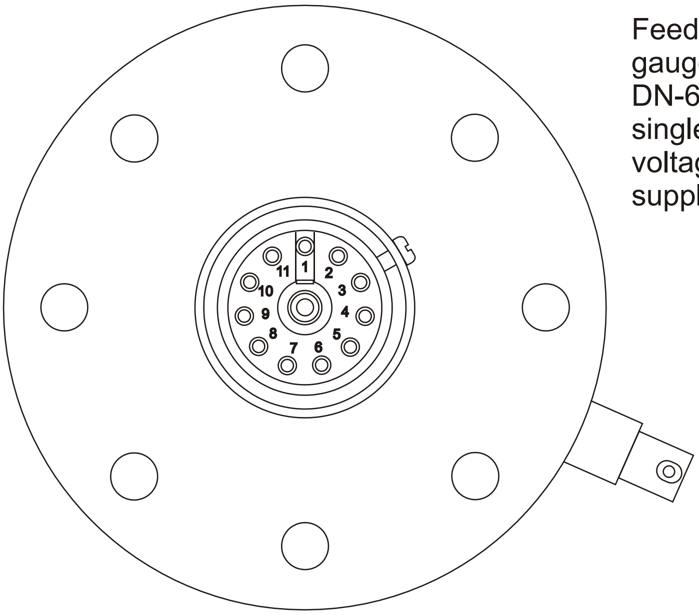


Figure 3.9 HAL3F Probe feedthrough

HAL3F Probe Feedthrough Connections					
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
Centre	Detector Output	4	Source	8	Pre/post Filters 2
1	Ground	5	Pre/post Filters 1	9	Filament 2
2	RF+	6	Filament common	10	RF-
3	Filament 1	7	Focus	11	Suppressor

Table 3.3 HAL3F Probe feedthrough connections

WARNING

Ensure that the RC Interface 37-way D connector, RF HEAD EL02, is fully tightened using a screwdriver; this connector carries hazardous voltages.

6. Connect the RF Head cable between the RC Interface RF HEAD EL02 connector and RF Head 37 way D-Type connector. All cables are marked with the correct connector number, see Figures 3.10 to 3.13.

7. If the Probe has a dual Faraday/SEM detector, connect the SEM HT lead to the RC Interface SEM EL08 connector. Connect the other end of the lead to either the RF Head or the Probe flange depending on the system type. If the Probe has a channelplate detector, the HT is fed via a Safe High Voltage (SHV) bayonet connector located on the RF Head. If the Probe is fitted with a SCEM detector, the HT is fed via an MHV connector located on the Probe vacuum flange.

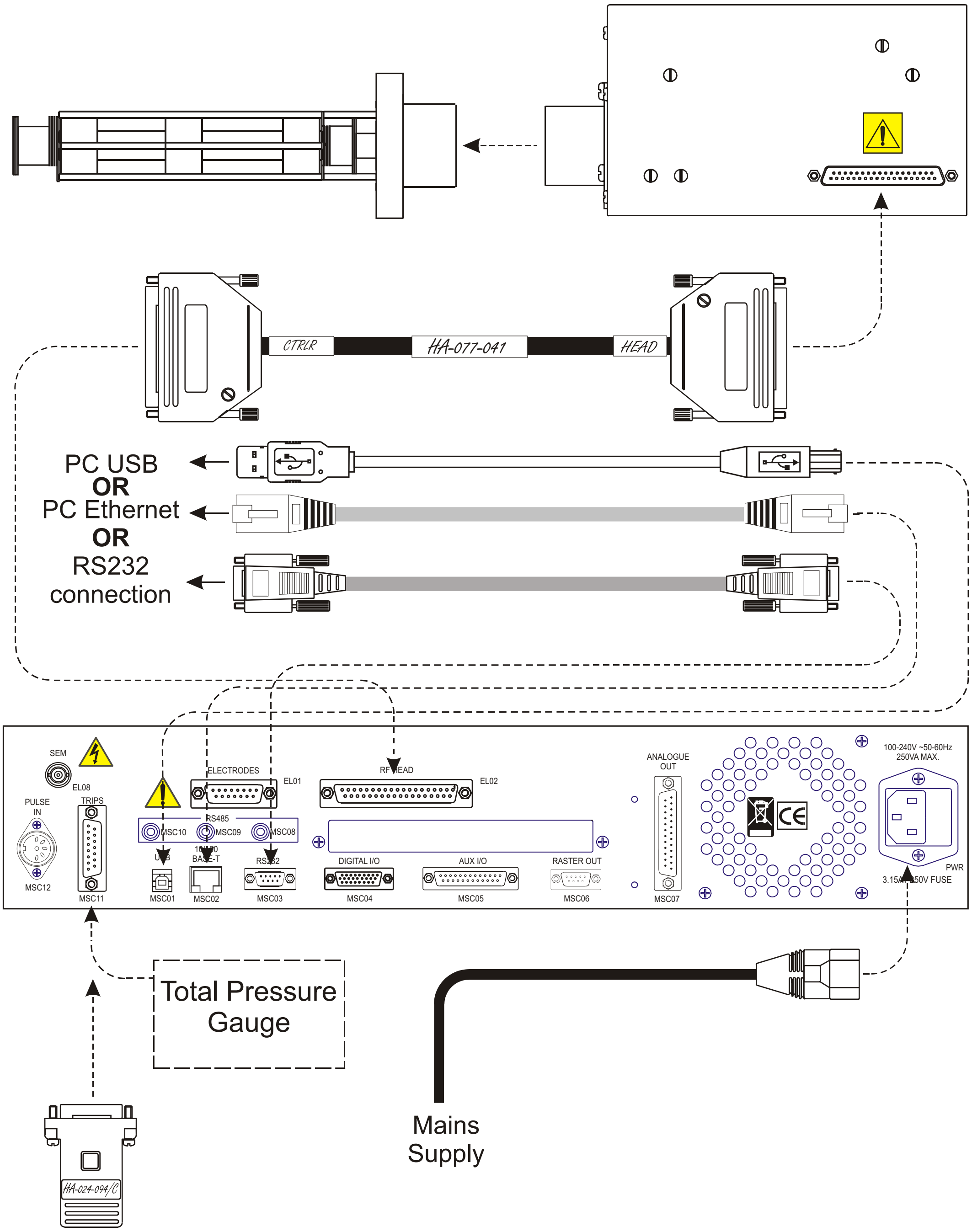


Figure 3.10 HALO100 and HAL200 system inter-connections

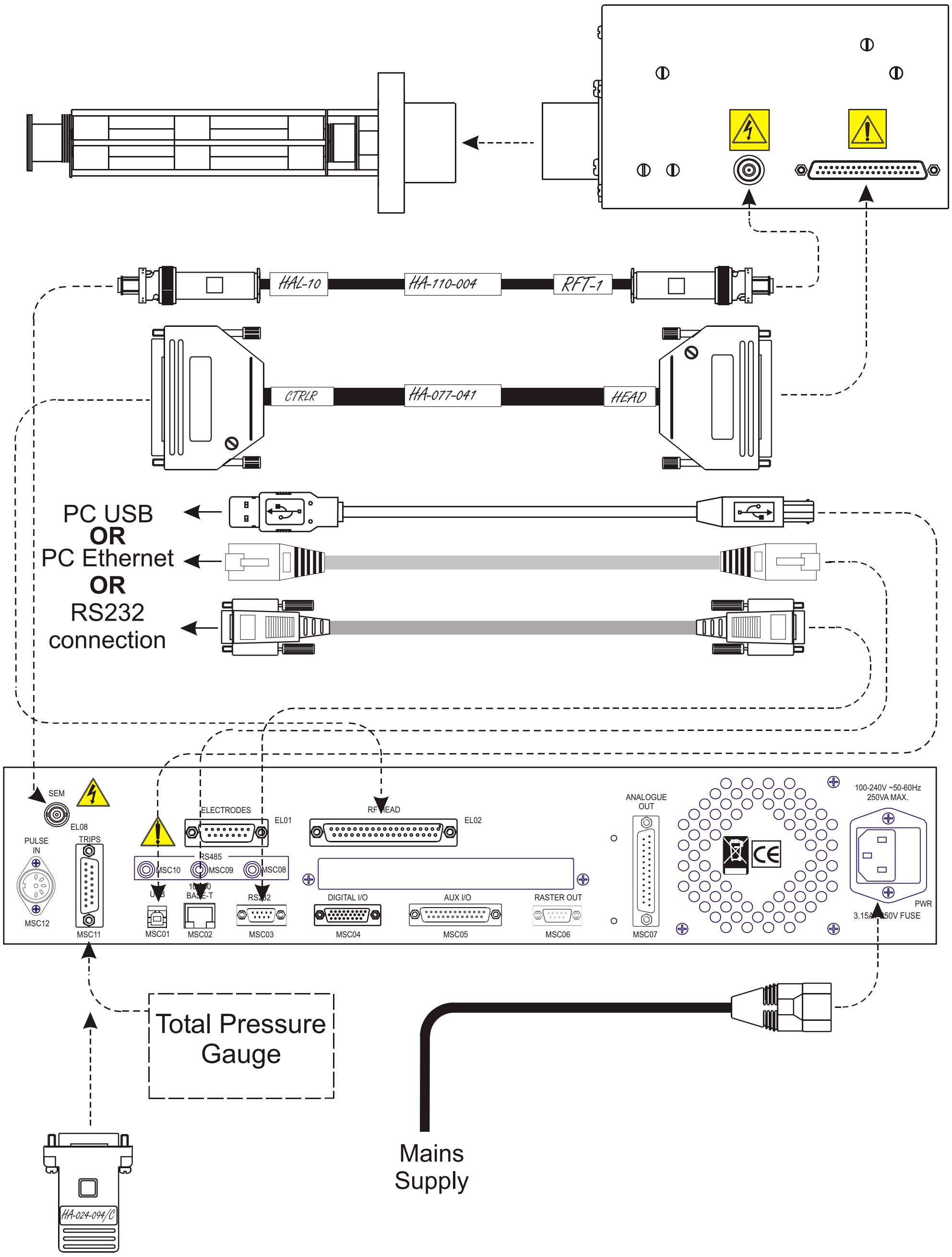


Figure 3.11 HALO201 system inter-connections

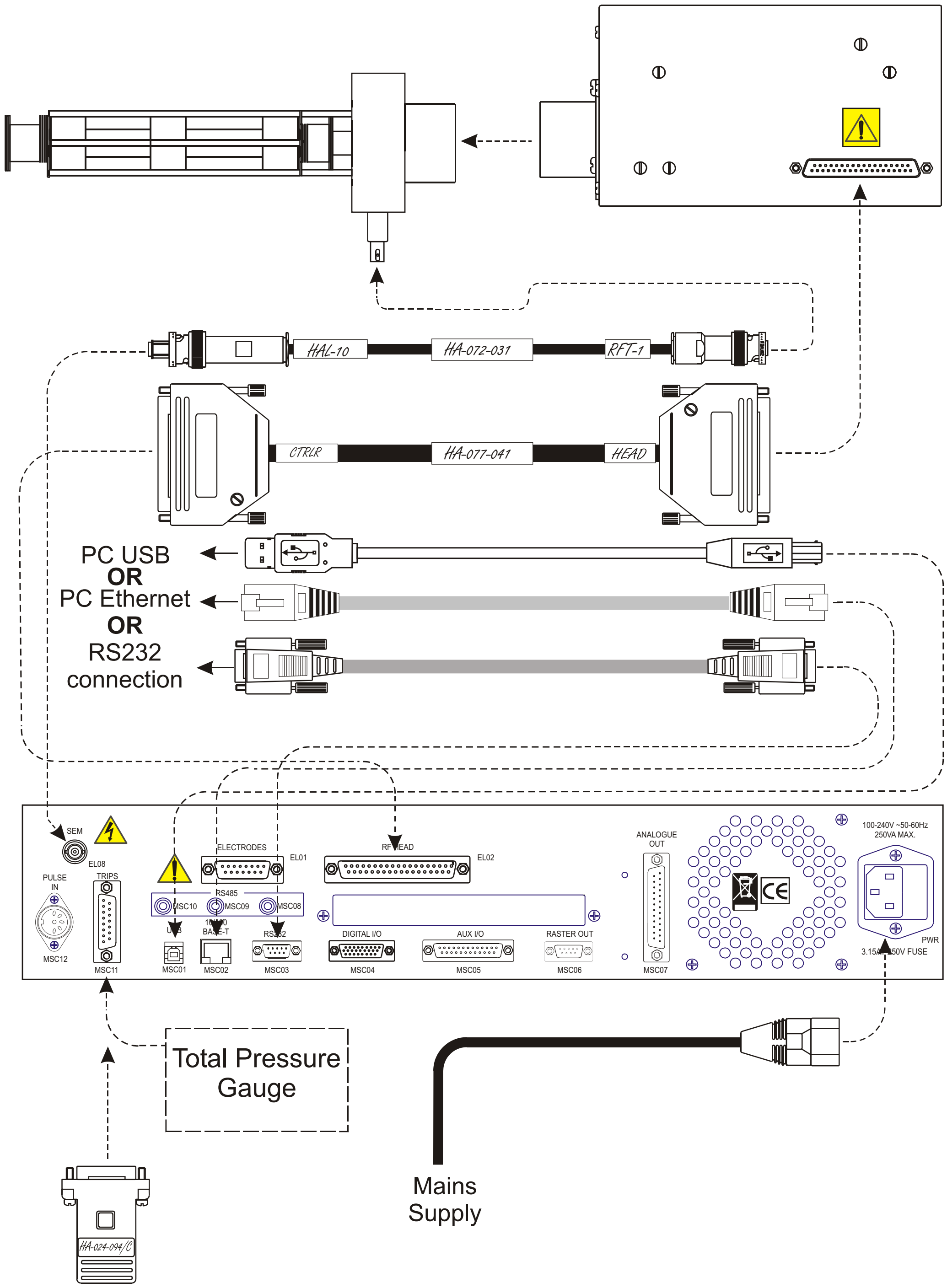


Figure 3.12 HAL201 system inter-connections

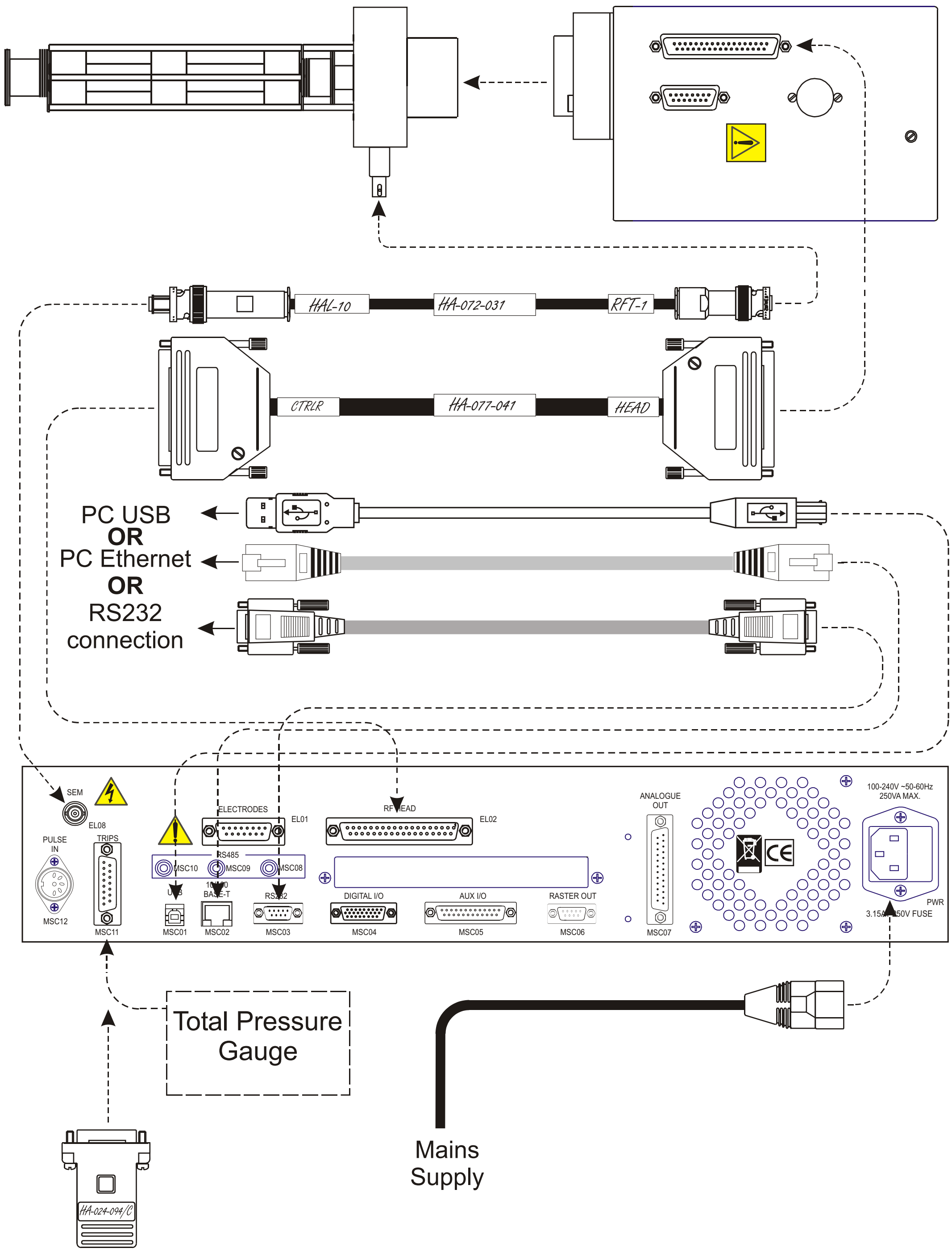
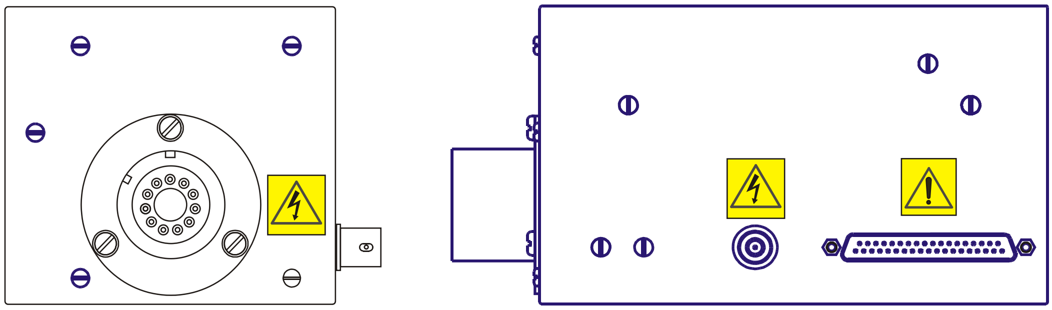


Figure 3.13 HAL 3F system inter-connections

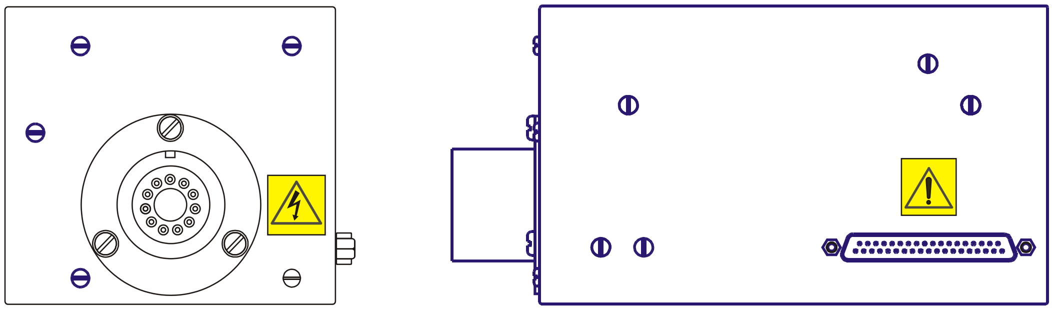
CAUTION

Ensure that the RF Head is correctly aligned when fitting to the Probe feedthrough connector; the centre pin is very fragile and can easily be damaged.

8.	Mount the RF Head on the Probe.	The RF Head mates directly with the vacuum feedthrough via the 12-way feedthrough connector. The centre pin on this connector is spring loaded and engages with the centre pin on the vacuum feedthrough. Ensure this is making a good connection. The 12-way feedthrough connector locates using a key-way machined in the connector surround. Fit the RF Head to the vacuum feedthrough so that the key-way engages.
9.	If fitted tighten the clamping screws that lock the RF Head in place on the Probe.	The screws may be M4 grub screws (requiring a 2mm Allen key) or thumbscrews.



HALO201 RF Head features two keyways and a High Voltage connector for the SEM supply



HALO100, HAL200, HAL201 and HAL301 RF Head features a single keyway and no High Voltage connector

Figure 3.14 HAL single filter Probe RF Heads

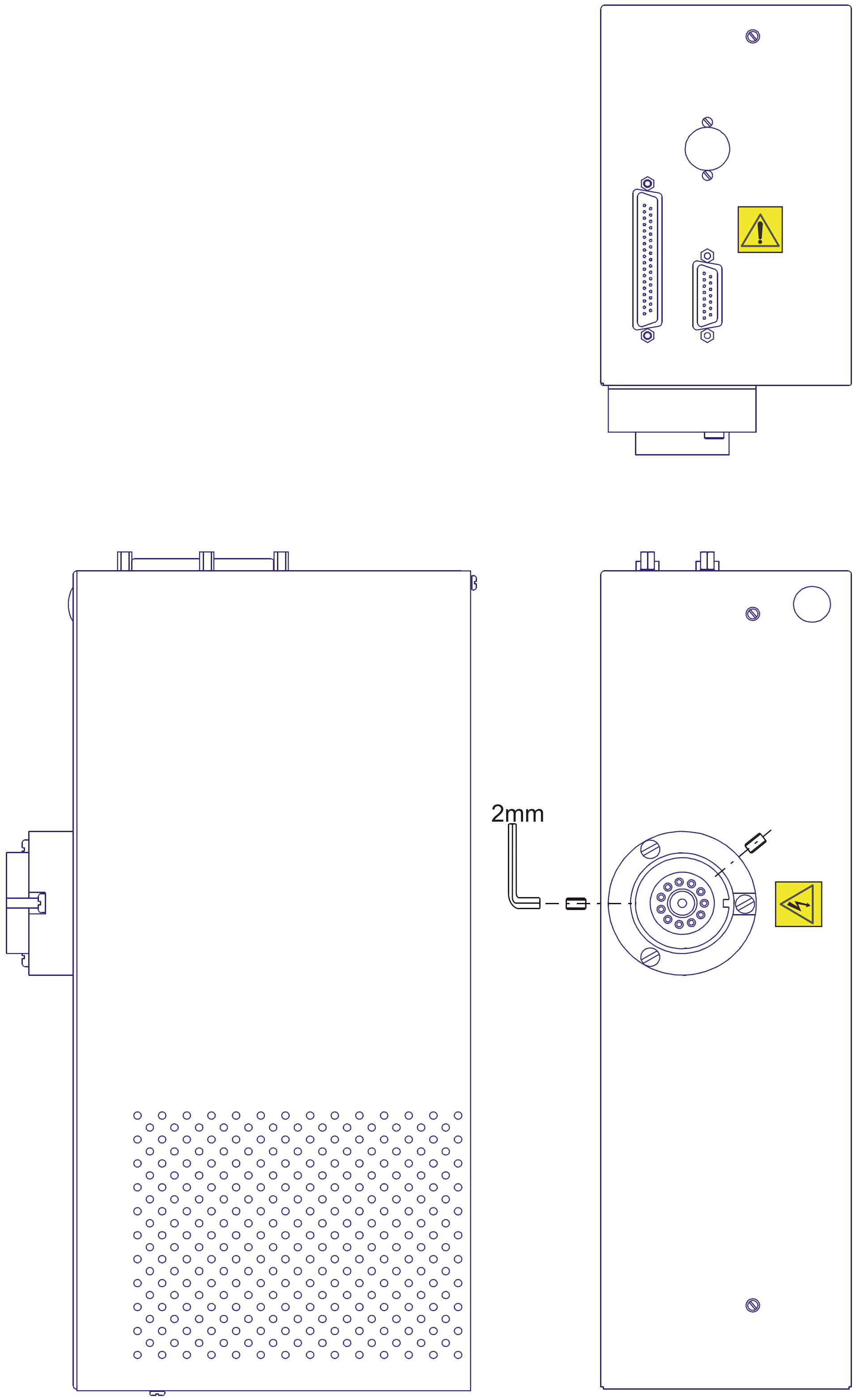


Figure 3.15 HAL 3F RF Head

10.	Using the communications cable provided, link the RC Interface to the PC comms. port (or network hub).	Communications may be via RS232, USB or 10/100Base-T, but only one type can be used at one time, see Section 3.7.
11.	If the RC Interface USB port is being used to communicate with the PC install the USB drivers from the Hiden Software disc.	Refer to Section 3.7.2. Install the drivers before switching on the RC Interface unit.

CAUTION

During normal operation, for safety purposes, the analyser must be interlocked to an independent total pressure gauge connected to the RC Interface TRIPS MSC11 connector. For test purposes only, a 15-pin connector, with pins 12 and 13 connected together, is provided; this offers no protection for the analyser.

12.	(Optional) For test purposes only, the 15-pin test connector, HA-024-094C may be connected to the RC Interface TRIPS 11 connector.	If this connector is not in place, it is not possible to turn on the Probe filaments or detector HT.
13.	For normal operation the RC Interface TRIPS 11 connector must be connected to an over-pressure protection system.	See Section 3.5.2.

CAUTION

The mains power plug and socket is the primary disconnect device for the RC Interface; it must be easily identifiable and accessible by the operator.

14.	When the rest of the mechanical and electrical installation is complete, connect the IEC320 cordset between the RC Interface PWR connector and a suitable 110 or 230 V a.c., 50 to 60 Hz mains power socket.	Check that the RC Interface is suitable for the local supply. The voltage rating is given below the PWR connector. The mains power socket must be easily accessible by the operator.

15. Install the MASsoft application by following the instructions in the Software Suite Installation Guide.

3.8.4 Series 1000 System installation

CAUTION

1. **The surfaces of the Probe which are normally inside the vacuum system MUST NOT be touched by bare skin; this would leave an oily deposit on the metal which could subsequently give large peaks in the mass spectrum. Clean, powder-free, vinyl gloves must be worn whilst touching the component parts.**
2. **Any tools used whilst working on the Probe must be perfectly clean and free from dust particles and oil.**

Filament power and ion transport lens voltages are fed via a 12-way feedthrough; RF power and the detector HT are fed through individual pins in the feedthrough flange. Access to these pins is provided by a Feedthrough Adapter fixed to the flange. Figure 3.16 shows the Probe feedthrough pins used on the analyser and the Feedthrough Adapter signals. Table 3.4 shows the pins and connectors used to carry the signals to the Probe.

The Feedthrough Adapter will be supplied fitted to the Probe. The Feedthrough Adapter must be removed to allow the Probe to be installed onto the host vacuum system then re-fitted in the correct orientation.

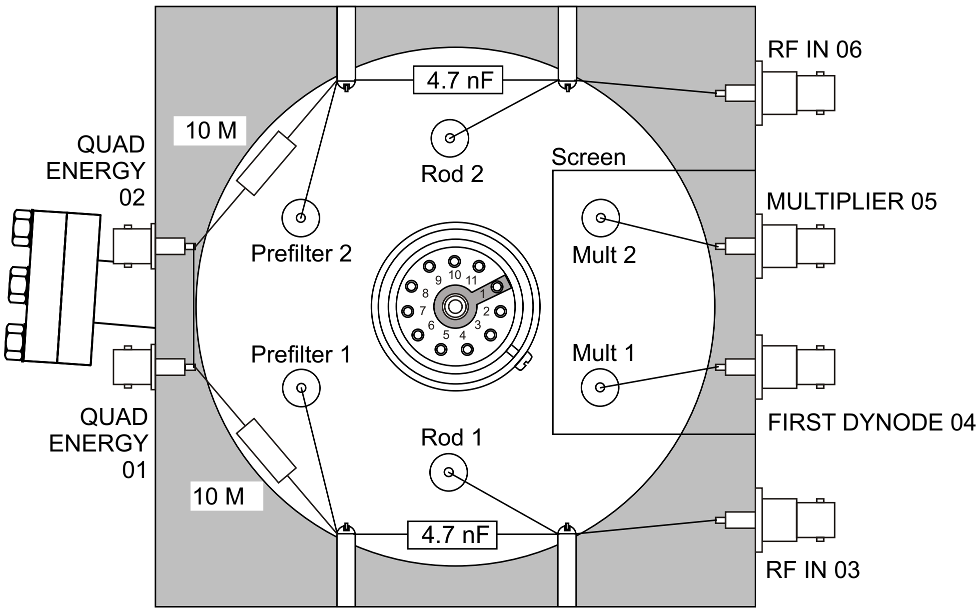
Where the Probe is to be installed in an existing chamber, follow all the steps. If Hiden Analytical Limited have supplied a system mounted in a chamber with pumps, start at Step 11.

1.	Remove the Feedthrough Adapter from the Probe.	Remove and retain the large foam cover which protects the Feedthrough Adapter. Note the orientation of the Feedthrough Adapter on the Probe flange, it will need to be re-fitted in the same orientation. Refer to Figure 3.16. Remove the cover by firstly removing the three retaining screws. Disconnect the six wires from the feedthrough pins. Remove the four cap head screws, using a 3mm Allen key, that secure the Feedthrough Adapter to its base plate. Lift away the Feedthrough Adapter. The Feedthrough Adapter base plate remains in place on the Probe flange.

2.	Remove the Probe from the shipping housing.	The Probe is supplied in a metal shipping housing bolted to the Probe flange.
3.	Check the 12-way feedthrough connector for any short-circuits.	Pins 3, 6 and 9 should be connected to each other but not to ground, these are the filament connections. Pin 1 is connected to ground. All other pins should be open circuit to each other and to ground, see Figure 3.16 for pin positions.
4.	Check the six feedthrough pins for any short circuits.	See Figure 3.16. The feedthrough pins connect to Rod 1 & 2, Prefilter 1 & 2, Mult 1 & 2. They should all be open circuit to each other and to ground. If a short is found refer to Section 5.5.
5.	Mount the Probe on the chamber.	The mounting flange will be a Conflat-type flange; see Section 3.8.1 for details of how to assemble the flange joint.
6.	If a pressure gauge is to be mounted on the Probe it should be mounted on the gauge port using an elbow to prevent interference with the detector.	
7.	Check the 12-way feedthrough connector and the six feedthrough pins again for short-circuits.	If a short is found refer to Section 5.5.

CAUTION

1. **Do not operate the equipment with the Feedthrough Adapter or Amplifier Head covers removed; high voltages are exposed when these covers are removed.**
2. **Do not operate the equipment with the RF cables disconnected; this may cause damage to the equipment as these cables carry high voltages.**



Note:

The pins are shown from the air side, and the mating connector, on the Amplifier Head, has mirror-image pin numbers.

Figure 3.16 Series 1000 Probe feedthrough and Feedthrough Adapter

Pin no.	Signal	Pin no.	Signal	Pin no.	Signal
Centre	Detector output	4	Source	8	Not connected
1	Ground	5	Not connected	9	Filament 2
2	Not connected	6	Filament common	10	Not connected
3	Filament 1	7	Focus	11	Suppressor

Table 3.4 Series 1000 Probe feedthrough connections

8. Mount the Feedthrough Adapter on the Probe flange, using the orientation shown in Figure 3.16.

The unit is oriented with respect to the 12-way feedthrough connector.

Secure the Feedthrough Adapter to its base plate with the four cap head screws.

9. Fit the six feedthrough covers to the six feedthrough pins.

See Figure 3.17.

The feedthrough covers may already be in place.

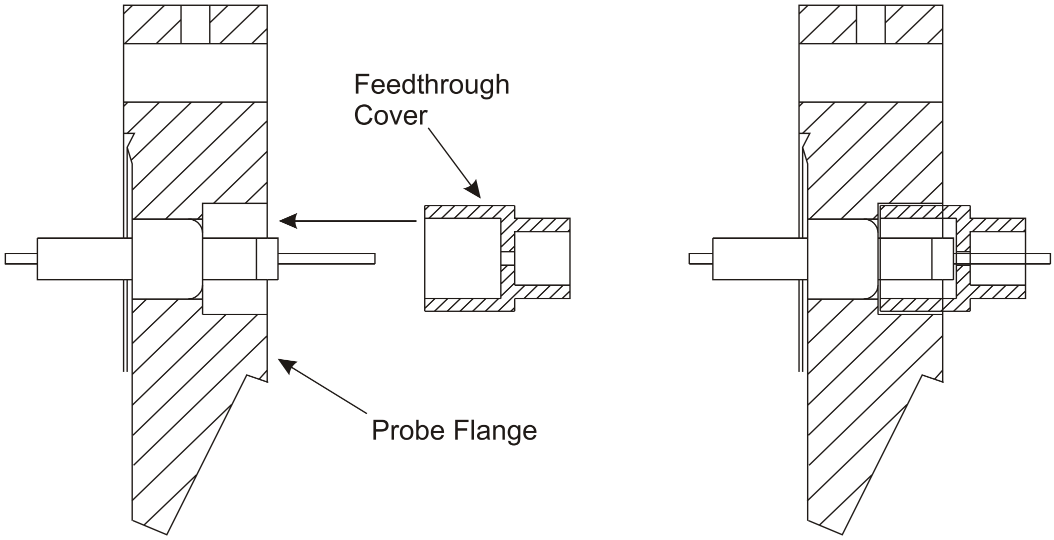


Figure 3.17 Fitting the feedthrough covers

10. Connect the six push-on connectors onto the feedthrough pins.

See Figure 3.16.

11. Fit the Feedthrough Adapter cover.

CAUTION

Ensure that the Amplifier Head is correctly aligned when fitting to the Probe feedthrough connector; the centre pin is very fragile and can be easily damaged.

12. Mount the Amplifier Head through the Feedthrough Adapter on to the Probe, ensuring that the Head is pushed fully onto the feedthrough connector and that the clamping screws are tight.

The Amplifier Head mates directly with the vacuum feedthrough via the 12-way feedthrough connector.

The centre pin on this connector is spring loaded and engages with the centre pin on the vacuum feedthrough. Ensure that this is making a good connection.

The 12-way feedthrough connector locates using a key-way machined in the connector surround. Fit the Amplifier Head to the vacuum feedthrough so that the key-way engages. Two grub screws (or thumbscrews) are used to lock the Amplifier Head in place, as shown in Figure 3.18.

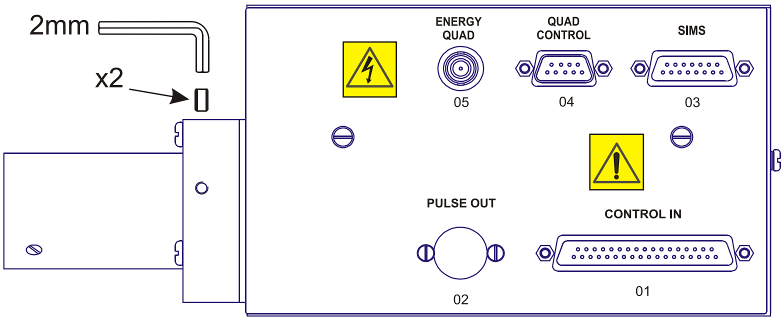


Figure 3.18 Series 1000 Amplifier Head detail

13. Connect the RF Generator Control 02 connector to the Amplifier Head QUAD CONTROL 04 connector using the RF Control Cable.

See Figure 3.19.

14. Connect the Amplifier Head QUAD ENERGY 05 connector to the Feedthrough Adapter QUAD ENERGY 02 connector using the short energy cable, HA-078-023/A.

See Figure 3.21.

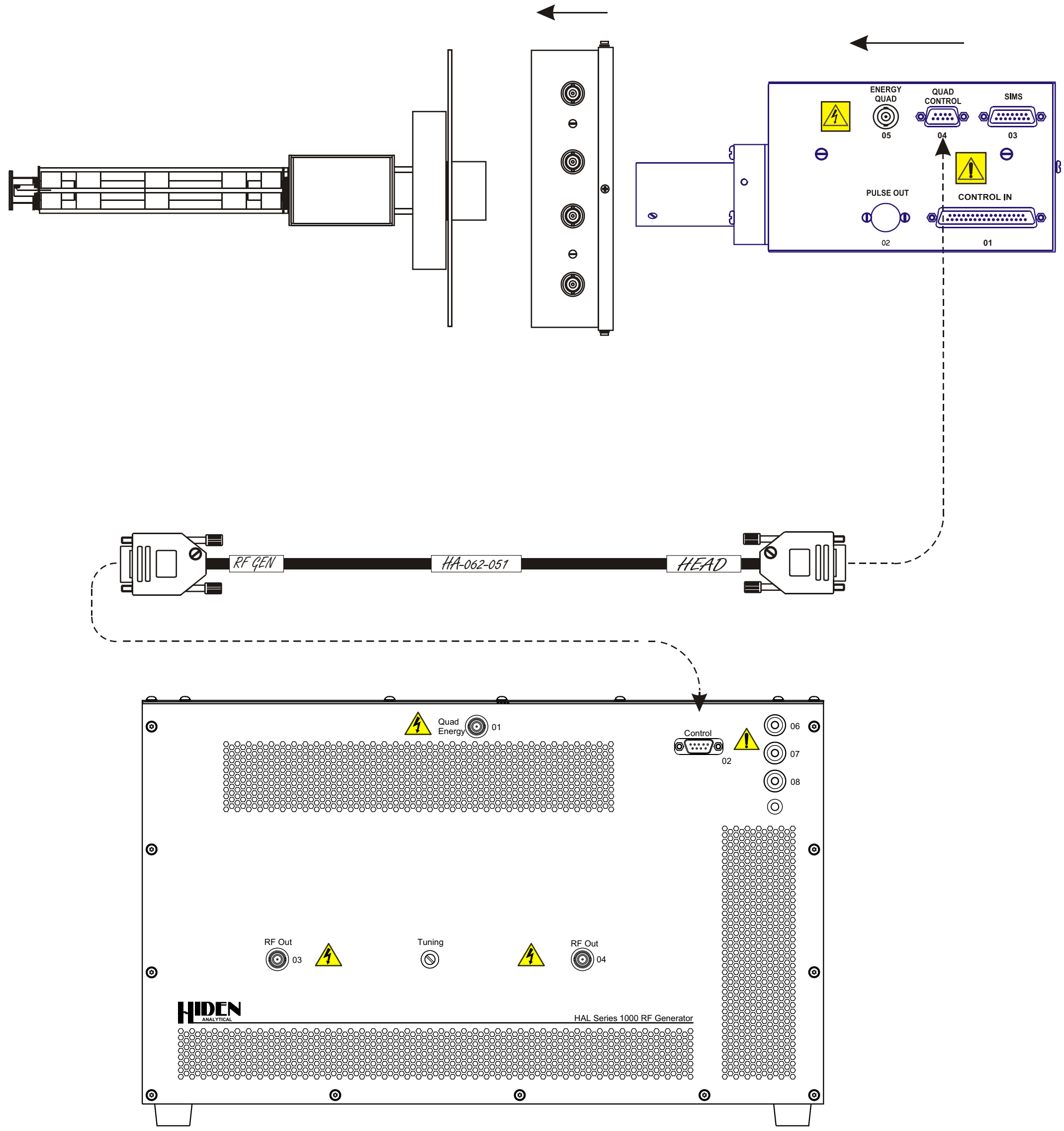


Figure 3.19 Amplifier Head connections

CAUTION

The RF cables supplied with the system are a set length and must not be modified.

15. The two RF Cables connect RF Generator Unit **RF Out 03** and **RF Out 04** to Feedthrough Adapter **RF IN 03** and **RF IN 06**.
The orientation of the connections is specified in the Configuration section of the Contents Sheet supplied with each instrument.

See Figure 3.20.

The RF coaxial leads may have their ends marked; ensure that the ends are connected the correct way round.
The two leads are of equal length and can, therefore, be connected to either of the RF connectors on the Feedthrough Adapter.
Instrument performance may be compromised if the leads are not connected as defined in the Contents Sheet Configuration section.

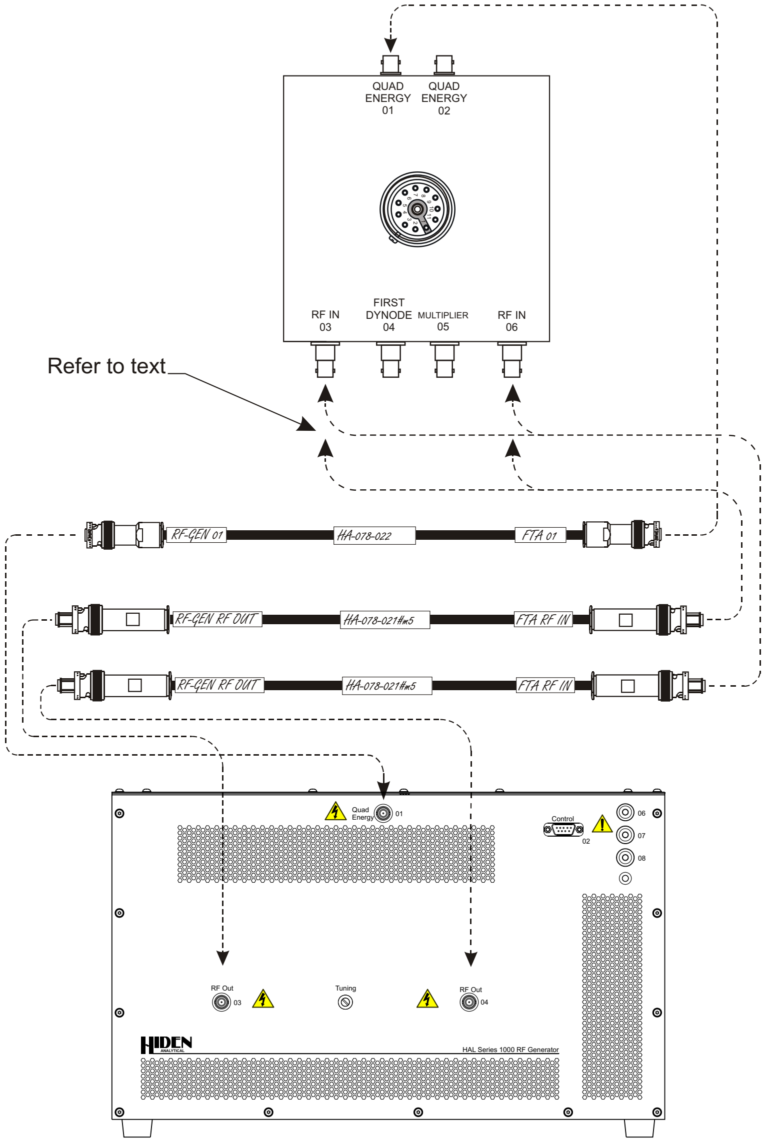


Figure 3.20 Feedthrough Adapter connections

WARNING

When connecting the System flying lead connectors, ensure that the RC Interface 37-way D connector, RF HEAD EL02, is fully tightened using a screwdriver; this connector carries hazardous voltages.

16.	Connect the RF Generator Quad Energy 01 connector to the Feedthrough Adapter QUAD ENERGY 01 using the long Energy cable, HA-078-022/A.	
17.	Connect the following cables: RC Interface RF HEAD EL02 to Amplifier Head Control In 01. RC Interface SEM EL08 to Feedthrough Adapter FIRST DYNODE 04.	See Figure 3.21.
18.	Fit the shorting link to Feedthrough Adapter MULTIPLIER 05.	See Figure 3.21.
19.	Using the communications cable provided, link the RC Interface to the PC comms. port (or network hub).	Communications may be via RS232, USB or 10/100Base-T, but only one type can be used at one time, see Section 3.7.
20.	If the RC Interface USB port is being used to communicate with the PC install the USB drivers from the Hiden Software disc.	Refer to Section 3.7.2. Install the drivers before switching on the RC Interface unit.

CAUTION

During normal operation, for safety purposes, the analyser must be interlocked to an independent pressure gauge connected to the RC Interface TRIPS MSC11 connector. For test purposes only, a 15-pin connector, with pins 12 and 13 connected together, is provided with the analyser; this provides no protection for the analyser.

21. (Optional) For test purposes only, the 15-pin test connector may be connected to the RC Interface TRIPS MSC11 connector.

If this connector is not in place, it is not possible to turn on the Probe filaments or detector HT.

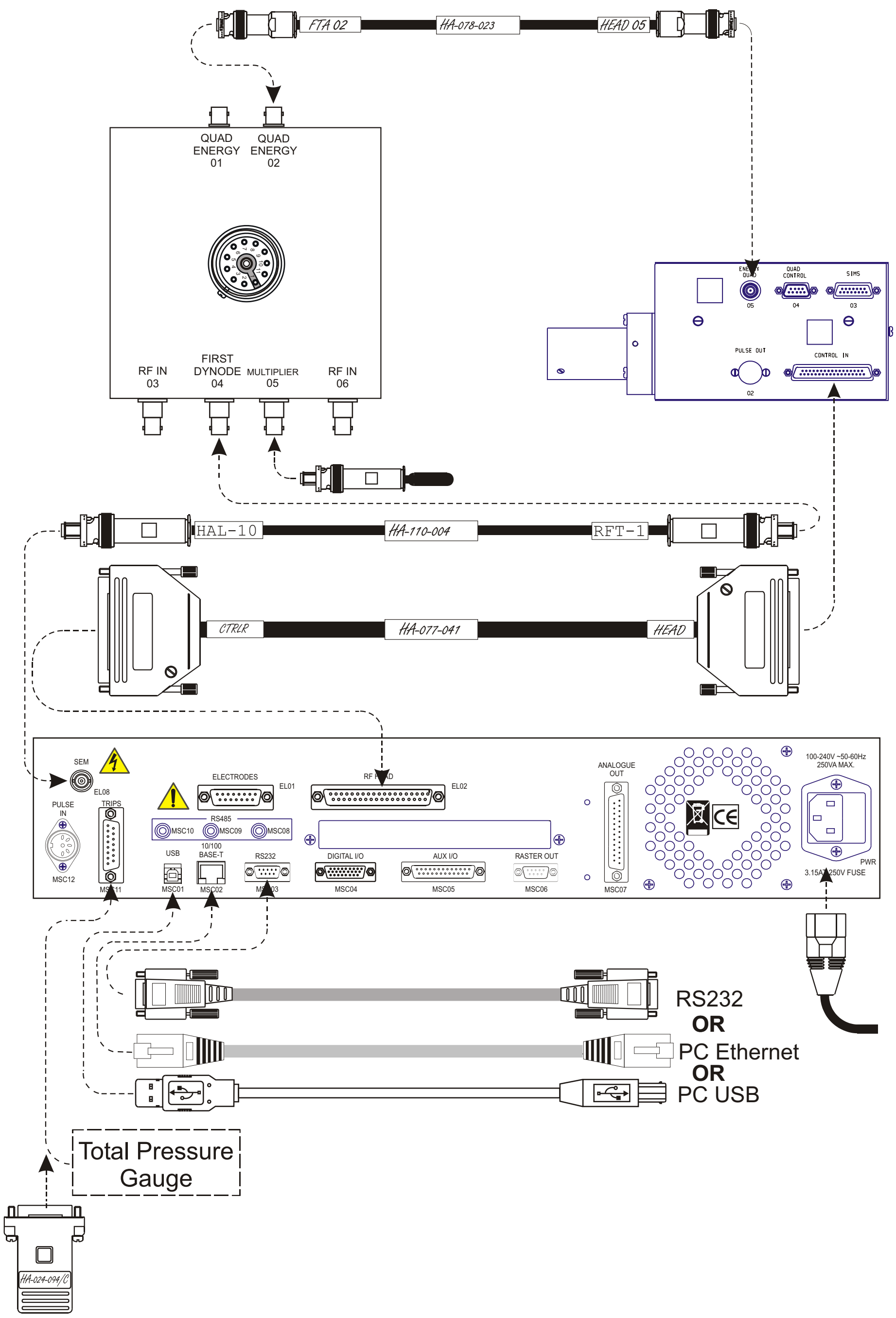


Figure 3.21 RC Interface connections

22. For normal operation the RC Interface TRIPS MSC11 connector must be connected to an over-pressure protection system.

    See Section 3.5.2.

CAUTION

The mains power plug and socket is the primary disconnect device for the RC Interface; it must be easily identifiable and accessible by the operator.

23. When the rest of the mechanical and electrical installation is complete, connect one IEC320 cord set between the RC Interface PWR connector and a suitable 110 or 230 V a.c., 50 to 60 Hz mains power socket.

    The mains power socket must be easily accessible to the operator.

CAUTION

The mains power plug and socket is the primary disconnect device for the RF Generator Unit; it must be easily identifiable and accessible by the operator.

24. Connect the second IEC320 cordset between the RF Generator Unit PWR connector and a suitable 110 or 230 V a.c., 50 to 60 Hz mains power socket.

    The mains power socket must be easily accessible by the operator.

25. Install the MASsoft application by following the instructions in the Software Suite Installation Guide.

26. Tune the RF Generator Unit to achieve maximum performance for the particular chamber geometry.

    See Section 3.8.6.

3.8.5 Series 1000 system inter-connection summary

Source	Connector	Description	Destination	Connector
RF Generator Unit RF Out 03	SHV	RF power	Feedthrough Adapter RF IN 03	SHV
RF Generator Unit RF Out 04	SHV	RF power	Feedthrough Adapter RF IN 06	SHV
RF Generator Unit Quad Energy 01	MHV	Ground	Feedthrough Adapter QUAD ENERGY 01	MHV
RF Generator Unit Control 02	9-pin D	Control signals	Amplifier Head Quad Energy 04	9-pin D
Feedthrough Adapter QUAD ENERGY 02	MHV	Ground	Amplifier Head Quad Energy 05	MHV
Feedthrough Adapter MULTIPLIER 05	MHV	Ground	Shorting link	MHV
RC Interface RF HEAD EL02	37-pin D	Amplifier Head signals	Amplifier Head Control In 01	37-pin D
RC Interface SEM EL08	SHV	SEM HT	Feedthrough Adapter FIRST DYNODE 04	MHV
RC Interface RS232 MSC03	9-pin D	Comms. link	PC RS232 port	-
RC Interface 10/100 BASE-T MSC02	RJ45	Comms. link	Ethernet 10BaseT LAN	RJ45
RC Interface USB MSC01	USB Type B	Comms. link	USB port	USB Type A
RC Interface TRIPS MSC11	15-pin D	Trip signal	Trips system	-

Table 3.5 Series 1000 System connections

3.8.6 Tuning the Series 1000 RF generator following installation

The Series 1000 system must be tuned, to suit the particular chamber geometry, following installation.

Note:

The RF generator can only be tuned properly when correctly connected to an appropriate Probe.

Refer to the Hiden Analytical manual "Series 1000 R.F.Generator User's Manual" reference HA-085-617 for details of the tuning procedure.

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Chapter 4 Detectors

Detectors: Contents

Detectors: Illustrations

4.1 General

If the Probe is fitted with a dual detector, it will have either a channelplate or a SCEM detector fitted. These SEM devices give high sensitivity with low background noise and, with correct usage, give a good lifetime in most operating environments.

In use, the SEM detectors are calibrated to give a gain of x100 (channelplate) or x1000 (SCEM) by selecting the operating voltage. Calibration is performed with respect to the Faraday detector; it may be done at any time and on any mass, see Section 4.4.

In operation, a high voltage of 800 V to 1000 V is applied across the detector, so it is advised that some form of protection be used to avoid accidental damage. The detector lifetime is dependent on the ion current measured; operation for long periods monitoring high partial pressures results in a shorter life than operation at low currents.

4.2 SEM over-pressure protection

CAUTION

1. **It is essential that customers provide protection for the detector at the maximum recommended operating pressure ($1x10^{-6}$ Torr for a channelplate detector, $5x10^{-6}$ Torr for a SCEM detector); operation at greater pressures may damage the detector, as protection is not provided internally.**
2. **Operation at a high partial pressure for extended periods may reduce the useful lifetime of the SEM detector.**

Faraday detectors can operate at any pressure, but the lifetime of a SEM detector is determined by the total ion current (charge) it measures. For example, the lifetime of a SEM detector monitoring a partial pressure of $1x10^{-8}$ Torr will be one hundred times longer than the same detector monitoring a peak at $1x10^{-6}$ Torr. Therefore, SEM detector lifetime will be extended if only large peaks are monitored, either with the Faraday detector, or, if they must be detected with the SEM, keeping the time at high partial pressure to a minimum.

Section 3.5.2 describes how to link the protection trip circuit to a pressure gauge, ideally mounted on the Probe itself, to protect the detector.

In use, the SEM is protected by the RC Interface software; should the partial pressure monitored exceed the maximum, the RC Interface will turn off the SEM voltage, stop scanning and write the message **Error 12: Pressure too high for SEM** in the MASsoft message window.

If this happens, the Faraday detector should be used to monitor the high pressure peak.

4.3 Bake-out

CAUTION

1. **All cables and the RF, or Amplifier Head must be removed from the System prior to bake-out.**
2. **The maximum bake-out temperature for the detector, <u>when under vacuum,</u> is 250 °C for Faraday/SEM Probes and 300 °C for Faraday-only Probes; the bake-out temperature for the whole Probe may be lower than this due to O-rings, etc. For frequent or extended bake-out, the maximum recommended temperature for a Faraday-only Probe is 250 °C.**
3. **Voltages must not be applied to the detector during bake-out.**

During bake-out it is recommended that the vacuum feedthrough is covered with aluminium foil for protection against draughts. This reduces the possibility of thermal shock on the feedthrough when rapid cooling from high temperature occurs; this may result in air leaks on the ceramic feedthrough.

See also Section 6.4.9.

4.4 SEM detector calibration

4.4.1 Calibration procedure

The following procedure can be used to calibrate the SEM detector with respect to the Faraday detector:

Note:

If the SEM detector is to be tuned on a regular basis it may be easier to set up a file for the purpose, see Section 4.4.2.

1.	Select **Gallery** from the **MASsoft** Control Tabs.	
2.	Select **PROFILE**.	The **Profile Mode** dialog box is opened, see Figure 4.1.
3.	Set the **Start mass** to equal *—1*.	Where *m* is the mass for which the SEM is to be calibrated.
4.	Set the **Stop mass** to equal *m+1*.	
5.	Set the **Samples per amu** to 10.	

6.	Check **Continuous scanning**.	When started, the scan will repeat until stopped by the user.
7.	Set the **Detector** to **Faraday**.	

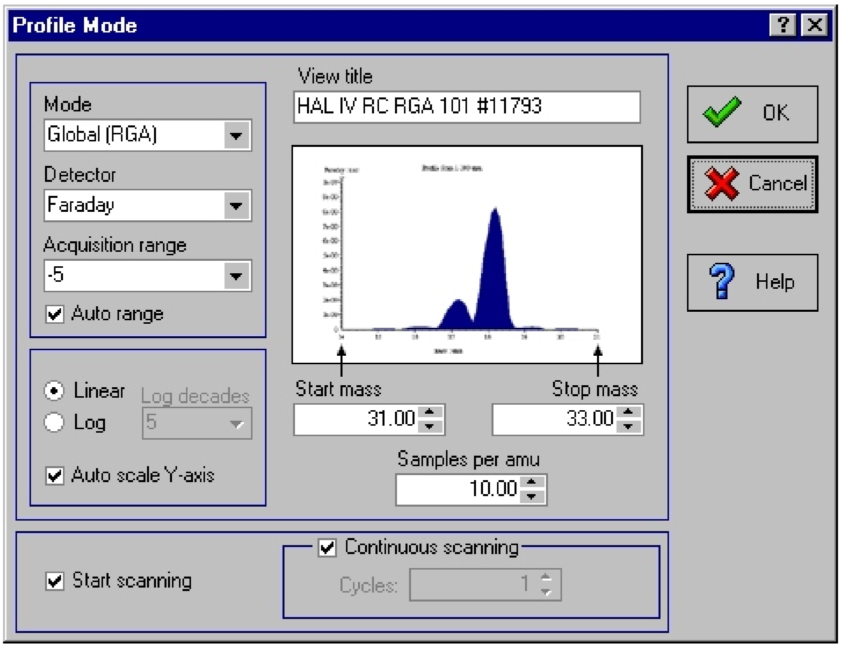

Figure 4.1 Profile Mode dialog box

8.	Ensure **Start scanning** is checked.	
9.	Click the **OK** button.	The scan will start.
10.	On the view, check that the partial pressure of the selected mass is within the range of the SEM detector and below its maximum operating pressure.	
11.	Note the partial pressure of the peak top.	
12.	Select the **MASsoft** window Tool Bar **Abort** tool.	The scan will stop.
13.	Click on the Scan Tree window to bring it to the front.	
14.	Double-click the scan tree **Input device** box.	The **Input Selection** dialog box is opened, see Figure 4.2.

15. Select the **SEM** detector in the **Available Inputs:** box.

16. Click the **OK** button.

17. Select the **MASsoft** window Tool Bar **Go** tool. — The selected mass is now acquired using the SEM detector and displayed on the view.

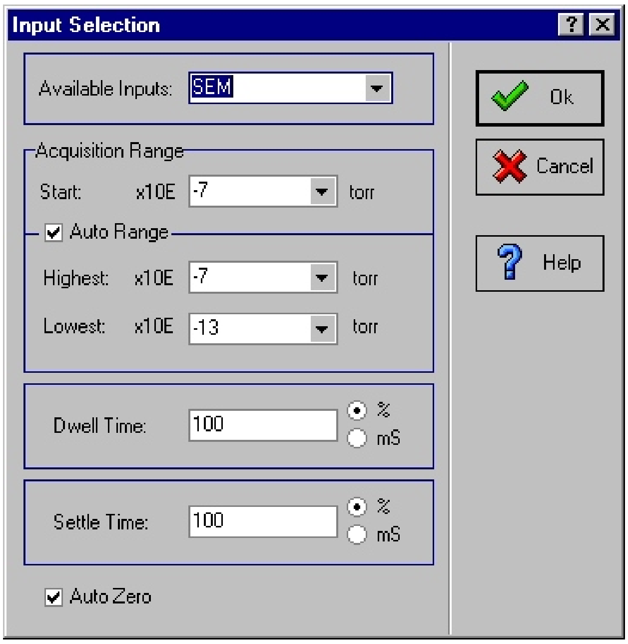

Figure 4.2 Input Selection dialog box

18. Click on the view to bring it to the front.

19. Select the **MASsoft** window Menu Bar **Tune**, **detector** command. — The **SEM tuning** facility is displayed.

20. Tune the SEM voltage so that the top of the selected peak is at the same pressure as shown when using the Faraday detector.

21. When the SEM voltage is finally set, stop the scan using **MASsoft** window Tool Bar **Abort** tool and close the mass spectrometer control window. — This ensures that the tuned voltage will be used in all subsequent **File**, **New** and **Gallery** operations.

4.4.2 Regular calibration of the SEM detector

If the SEM is to be calibrated regularly, the scan tree (shown in Figure 4.3) can be created and a View attached to each scan (refer to the MASsoft User Manual for details of how to create scan trees). The scan tree can be saved as a file (called SEMCAL for example).

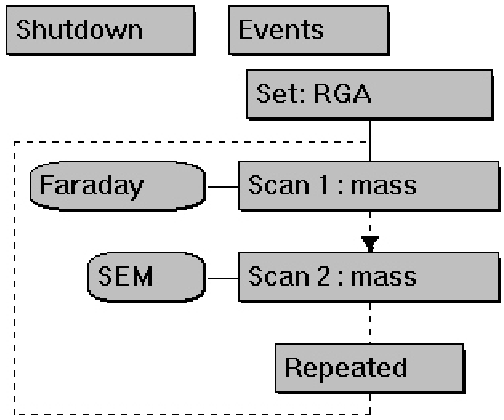

Figure 4.3 Scan tree for calibrating the SEM detector

Use the following procedure to calibrate the SEM:

1.	Open the SEM calibration file using the **File**, **Open** command on the MASsoft menu bar.	
2.	Click on the scan tree's **Global** box.	
3.	Click on the **Go** button.	The scan will start.
4.	On the **Tune** menu click **detector**.	The **SEM tuning** facility is opened.
5.	Use the **SEM tuning** facility to equalise the peak heights in the two views.	
6.	Click on the **Abort** button.	The scan will stop.
7.	On the **File** menu click **Exit**.	A prompt will appear, asking whether the file is to be saved.
8.	Click the **Yes** button.	The file is closed and new SEM voltage becomes the default value used for **File**, **New** and **Gallery** operations.

4.5 SEM detector renewal

Note:

The detector is a non-warranty item.

Customers are not advised to attempt changing this component as this involves modifying a standard device; this is not a simple procedure. Probes requiring detector replacement can be returned to Hiden Analytical Limited, where a new detector will be fitted and a system test performed.

4.6 Operating the SEM detector in aggressive environments

Quadrupole mass spectrometers can be successfully run in aggressive environments such as:

- Monitoring high process gas pressures.
- High pressure peaks mixed with the low pressure peaks which are to be monitored.
- Chemically active gases which attack the SEM's active coating.

While operation under these conditions can limit the lifetime of the detector, steps may be taken to reduce the damage to the system. Customers are strongly advised to take precautions to reduce the risk of detector damage:

- When the quadrupole system is not being used (i.e. shut down), ensure that the SEM voltage is switched off in the **Shutdown** environment. Do not have the voltage to the detector switched on unnecessarily.
- Run with the Probe pressure as low as pumping allows.
- Reduce the dwell time for acquisition.
- Increase the scan increment if using Profile mode (i.e. fewer samples across a peak).
- Split up **BAR** scans to avoid aggressive gases or large peaks, or use the **MID** (Multiple Ion Detection) mode.
- Keep monitored partial pressures as low as possible; avoid scanning intense peaks.
- Do not monitor "aggressive" gases for longer than necessary.
- Vent the mass spectrometer to dry air at convenient shut-down times to prolong the detector life.

4.7 Storage

Avoid storing the Probe for prolonged periods in high humidity environments as this can reduce the SEM detector lifetime.

Chapter 5 Trouble-shooting

Trouble-shooting: Contents

Trouble-shooting: Illustrations

Trouble-shooting: Tables

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5.1 General

5.1.1 Introduction

WARNING

1. **The procedures described in this Chapter must be performed by suitably qualified personnel with experience of high-voltage circuitry.**
2. **Take extreme care if equipment covers are removed during trouble-shooting; lethal voltages may be exposed.**

Procedures described in this Chapter are for fault location only; they are not required for normal operation. These procedures must be performed by suitably qualified personnel with experience of high-voltage equipment.

A complete Standard Analyser System consists of three main units: an RGA Probe, a Radio Frequency (RF) Head and an RC Interface unit. The RGA Probe is fitted to a suitable port in the vacuum system and supports the RF Head, which, in turn, is connected to the RC Interface via a multi-way cable. The RC Interface contains circuitry which provides the references and electrode supplies, and the control computer and its associated Input/Output (I/O) circuits. LEDs on the front panel show the state of the analyser and the filaments. The RC Interface is connected to a PC running the MASsoft application via a RS232 serial communications cable, a USB connection or an Ethernet LAN connection.

In a Series 1000 system the RF generator is located in a separate RF Generator Unit and is not fitted in the Head; hence a complete Series 1000 system consists of an RGA Probe, an Amplifier Head, an RF Generator Unit and an RC Interface.

Figure 5.1 shows the voltage sources and their references.

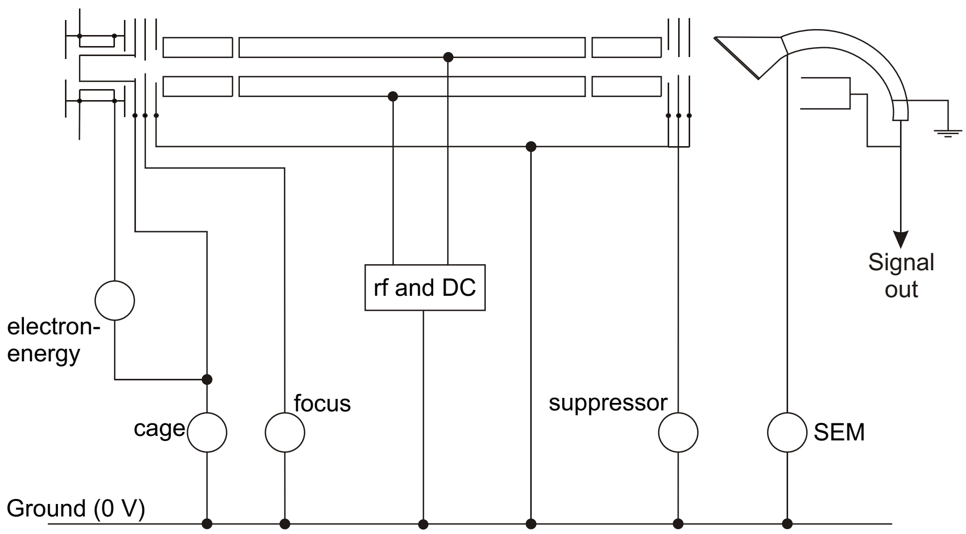

Figure 5.1 Voltage sources and references

Electrode	Description
electron-energy	The potential applied to the filaments which determines the energy of the electrons ionising the gas molecules within the ion source. The potential is measured with respect to the source cage voltage. The default setting is 70eV which means the voltage on the filaments will be -67V with respect to 0V when the cage voltage is at the default +3V w.r.t. 0V. In soft ionisation experiments and appearance potential work the electron energy is reduced. Electron energy is set in the range -4 to -150V by the **Environment variable**, **electron-energy**, see Figure 5.2. Low electron energy settings can reduce the life of the filaments, see Section 3.6.
cage	The voltage applied to the ion source cage which determines the energy of the ions exiting the source. The potential is measured with respect to 0V, the default setting is +3V. This can vary with ion source type, cross beam sources may use a cage voltage of +4.5V. Cage is set in the range 0 to +10V by the **Environment variable**, **cage**, see Figure 5.2.
focus	The voltage applied to the ion source focus plate. The voltage is negative to extract the positive ions from the source and into the quadrupole filter and to block the transmission of electrons. The default value is -90V with respect to 0V and must be set to at least the same voltage as the electron-energy. Focus is set in the range 0 to -200V by the **Environment variable**, **focus**, see Figure 5.2.
emission	Emission is measured as the flow of electron current from the filament to the source cage. The default setting for an analogue instrument is 1000uA (1mA). Reducing the emission current will proportionally reduce the detected signal. The emission current is set by the **Environment variable**, **emission**, see Figure 5.2. It can be set in the range 20 to 5000uA.
suppressor	The voltage applied to the suppressor plate. The voltage is fixed at -210V with respect to 0V.
SEM	The potential applied to the SEM detector. The required voltage is detector dependant and can be in the range 0 to -1kV for channelplate detectors and 0 to -2kV for SCEM detectors. The gain of the detector is determined by the applied voltage so increasing the voltage will increase the signal but the detector's lifetime will be reduced. The SEM voltage is set by the **Environment variable**, **multiplier,** see Figure 5.2.

Table 5.1 Probe voltage sources

Electrode	Description
rf and DC	A mixture of rf and DC voltages are applied to the quadrupole mass filter to select ions of specific mass to charge ratios. Both voltages are generated in the RF Head. Changing the peak rf voltage and the rf/DC ratio will alter the position of peaks on the mass scale and the ability to separate peaks from adjacent peaks (resolution). **Environment variable**, **resolution,** alters resolution throughout the mass scale. **Environment variable**, **delta-m,** alters the resolution of low mass peaks. **resolution** and **delta-m** can be set in the range -100 to +100. Negative values decrease the resolution; peaks will become broader and more intense with adjacent peaks tending to merge together. Positive values produce narrow, short peaks. Setting too high a positive value may result in all the peaks disappearing from the mass spectrum, giving the illusion that the instrument is not working.
mode-change -delay	A delay time in milliseconds to allow the emission to stabilise when switching between shutdown and RGA modes.

Table 5.2 Probe rf and DC potentials

Note

The polarity of the multiplier voltage is negative with respect to 0V even though this is not shown in the ***Environment Editor****.*

The most common faults are defective mains power, loose connectors or head unit, filament failure, no emission and low sensitivity; these are considered in the following Sections. If the fault cannot be located, please contact Hiden Analytical Limited for further advice.

5.1.2 Procedure for setting variables during troubleshooting

Certain of the test procedures described in this Chapter require the instrument variables to be set to specific values; this Section describes how to do this in MASsoft.

Note:

This procedure is also used when tuning the Series 1000 RF Generator Unit following installation, see Section 3.8.6.

1. Select the mass spectrometer using the Menu Bar **MassSpecs** command.

2. Select the Menu Bar **File**, **New** command. This creates a new, temporary, scan tree which is used only for setting the variable values.

3. Double click on the scan tree **Global** box.

This opens the **Global Environment Editor** dialog box, see Figure 5.2.

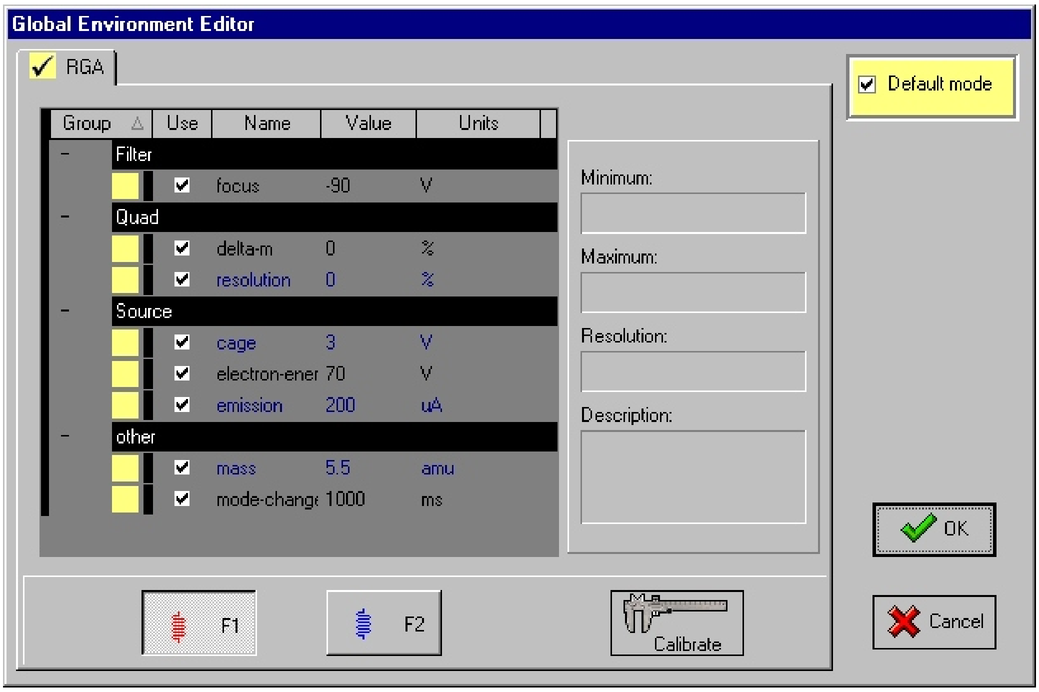

Figure 5.2 Global Environment Editor dialog box

Note

*As a precaution before making any changes make a note of the current **Environment variable** settings.*

4. Select the **RGA** tab.

For RGA instruments there will only be the one tab.

5. In the **Value** column select the current value of the variable to be set.

Make a note of the current value.

6. Enter the required value.

7. Repeat Steps 5. and 6. for any further variables requiring setting.

8. Select a filament by clicking one of the filament buttons, 

.

9. Click the **OK** button.

   The instrument mode and variable values are stored in the scan tree **Global** box.

10. Select the Tool Bar **PowerUp** tool, .

    This puts the mass spectrometer into a powered-up state using the instrument mode and variable values that have been specified in the scan tree **Global** box.

11. Make the measurements required by the test procedure.

12. Repeat steps 3. to 6. returning the variables to their original values.

13. Select the Tool Bar **Shutdown** tool, .

    The mass spectrometer is put into the Shutdown state.

5.2 Defective mains power

1. If the RC Interface power on/off switch does not light up when switched on, its mains fuse should be checked for continuity.

   The mains fuse is located in the IEC mains input connector on the rear panel of the RC Interface.

2. If the fuse is intact check the power cord and the power source.

3. (Series 1000 Systems only). If the RF Generator Unit is not functioning, check its main fuse for continuity.

   The mains fuse is located in the IEC mains input connector on the rear panel of the RF Generator Unit.

4. If the fuse is intact, check the power cord and the power source.

Note:

The RF Generator Unit may also stop functioning due to a thermal trip; see Section 5.8.

5.3 Loose connectors or Head

1. Check that all the system connectors are fully seated in their mating halves.

2. Check that the Head is pushed fully home onto the Probe and that its securing screws are tight.

5.4 System protection

The RC Interface Inhibit input available on the TRIPS MSC11 connector is normally connected to the trip contacts of a total pressure gauge (usually a cold cathode gauge) mounted on the vacuum chamber. The set point will be set to the maximum operating pressure of the Probe.

If the external trip is preventing the system from operating:

1. Check that the total pressure gauge set point is set to the correct value.

2. Check that the pressure in the RC-RGA Probe vacuum chamber is below the total pressure gauge set point.

3. Check that the system protection connector is in place in the RC Interface TRIPS MSC11 connector.

4. Check whether the protection has tripped. i.e. whether the protection is protecting the system by preventing it being turned on.

If the RC Interface Inhibit input is not at logic level 0 (TRIPS MSC11 pins 12 and 13 open circuit) the RC Interface will emit a long beep when it is switched on (the beep is 5 to 6 seconds long and is made 5 to 6 seconds after switching on the RC Interface). MASsoft will indicate an External Trip and it will not be possible to run a scan or switch the filaments on.

If the Inhibit input goes to logic level 1 (TRIPS MSC11 pins 12 and 13 open circuit) while the instrument is scanning MASsoft will give the External Trip warning message and the instrument will stop scanning. On the RC Interface the Run, Filament and Emission LEDs will be switched off.

The test connector, Hiden reference HA-024-094, supplied with the system, can temporarily be connected to the TRIPS MSC11 connector if the external trip device (typically a total pressure gauge) is suspected of causing the trip.

In MASsoft the "inhibit" device may be added to the status bar to monitor the state of the external trip.

5.5 Probe shorts

Carrying out some simple resistance checks on the RGA Probe with a suitable meter can sometimes locate a fault or problem. These checks should be done when the Probe is installed on the host vacuum system and after any Probe maintenance such as changing the filaments. Usually, a digital multimeter set to read ohms is used. The RC Interface unit is shut down and the RF Head removed from the Probe. For Series 1000 systems the RF Generator must be switched off.

When carrying out the checks two ranges of reading can legitimately be considered acceptable and any readings outside these ranges can be taken to indicate a fault. Any reading less than one ohm can be considered a short circuit and anything above 5 Meg ohm ($5x10^6$ ohm) can be considered open circuit.

For Series 1000 systems remove the Feedthrough Adapter cover and disconnect the wire from each of the six feedthroughs.

Please refer to Figures 3.8, 3.9 and 3.16, Tables 3.2, 3.3 and 3.4.

1.	Attach one meter lead to pin 1 on the 12 way feedthrough.	
2.	Connect the second lead to the Probe flange.	Pin 1 is ground, the meter should indicate a short circuit. If it does not there is probably a fault with the meter or meter leads or the positioning of the test probes. Contact Hiden for advise.
3.	With the first meter lead still connected to pin 1 connect the second meter lead in turn to pins 2 to 11 and the centre pin.	They should all be open circuit if not there is a short or partial short to earth. Refer to Section 5.5.1.
4.	For Series 1000 systems. With the first meter lead still connected to pin 1 connect the second meter lead in turn to the six feedthroughs.	They should all be open circuit if not there is a short or partial short to earth. Refer to Section 5.5.1.
5.	Attach the first meter lead to pin 2.	
6.	Connect the second meter lead in turn to pins 3 to 11 and the centre pin.	Each pin should read open circuit.
7.	For Series 1000 systems. With the first meter lead still attached to pin 2 connect the second meter lead in turn to the six feedthroughs.	Each pin should read open circuit.
8.	Repeat the above steps connecting the first meter lead to pin 3 then 4 and so on until all possible combinations have been checked.	All pins should be open circuit to each other except between the filament connections which are: Filament 1 pin 3 to 6 Filament 2 pin 9 to 6. Each filament has a resistance of approximately 1 ohm. Measuring between pins 3 and 9 measures the two filaments in series.

5.5.1 Probe short to earth

There are two types of short to earth on the Probe; an internal short between one part of the Probe and an earthed part of the Probe and, more commonly, a short between part of the Probe and the wall of the vacuum chamber. The type of short can easily be determined by removing the Probe from the vacuum chamber and repeating the tests. If the short remains it is a internal short, if it disappears it is an external short between part of the Probe and the vacuum chamber.

For further advice please contact Hiden Analytical Limited with the results of the meter tests.

5.5.2 Probe shorts between pins

If a short is found between a Probe pin and a pin that is not ground please contact Hiden Analytical with the result.

5.6 Filament failure/no emission

5.6.1 General

WARNING

1. **The procedures described in this Section must be performed by suitably qualified personnel with experience of high-voltage circuitry.**
2. **Take extreme care if equipment covers are removed during trouble-shooting; lethal voltages may be exposed.**

Filament and emission status is shown by the LEDs on the front panel of the RC Interface. When a filament is selected, the appropriate LED should light, followed shortly by the emission LED to indicate that the requested emission current has been achieved. The emission LED will flash if there is an emission failure; the following tests should then be applied.

There are several possible failure causes, the most likely being covered in Sections 5.6.2 to 5.6.5.

5.6.2 Filament open or short circuit

1.	Check between pins 3, 6 and 9 in the 12-way feedthrough connector using a resistance meter.	The resistance should be approximately one ohm; there should be no electrical contact with any other part of the Probe, or to earth.

5.6.3 Electron energy set too low

1.	Check the value of **electron-energy** in the **Environment Editor** dialog box.	It should normally be 70 eV with a minimum of 12 eV. At low levels, insufficient electrons from the filament will reach the ionisation source cage to give a stable emission level, and the preset emission level must be reduced. When the instrument is not scanning the voltage should be set **electron-energy** voltage plus 5.0 V. With the instrument scanning, the voltage should be the set **electron-energy** voltage plus the **cage** voltage.

Note:

*Some instruments do not have **electron-energy** or **cage** as editable variables; the voltages are set at 70 eV and 3 eV respectively.*

5.6.4 Pressure too high

Operating at a pressure greater than $1x10^{-6}$ Torr for a channelplate detector, or $5x10^{-6}$ Torr for a SCEM detector, can damage the detector; pressures greater than $1x10^{-4}$ Torr can damage the filaments, either of which will necessitate removing the Probe from the vacuum system for repairs. Check the filaments as in Section 5.6.2. If the recommended protection system has been implemented, check that the pressure gauge trips at a suitable pressure and that it is correctly linked to the RC Interface Inhibit input, see Section 3.5.2.

5.7 Lack of sensitivity

5.7.1 General

There can be many reasons for a signal detection problem; the most likely reasons are described in the following Sections.

The Test Points in the following Sections relate to:

Single Filter RF generator PCB Model No. HA-077-302

Triple Filter RF generator PCB Model No. HA-049-332.

The Model No. can be found on the white PCB label, see Figure 5.3.

For other Model No.s please contact Hiden Analytical for advice and alternative information.

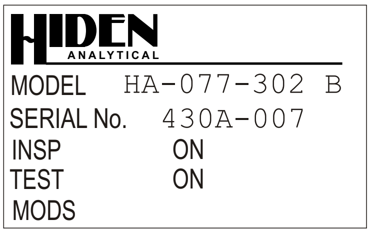

Figure 5.3 Typical PCB label

5.7.2 RF tuning (Standard System)

WARNING

1. **The procedures described in this Section must be performed by suitably qualified personnel with experience of high-voltage circuitry.**
2. **Take extreme care if equipment covers are removed during trouble-shooting; lethal voltages may be exposed.**

If peaks appear at low mass but are missing at high mass, check the RF Generator tuning; the method used differs for single filter and triple filter (3F) instruments, see Sections 5.7.2.1 and 5.7.2.2 respectively.

5.7.2.1 RF tuning: single filter instruments

1. Switch off the RC Interface.
2. Remove the RF Head cover. See Figure 5.4.

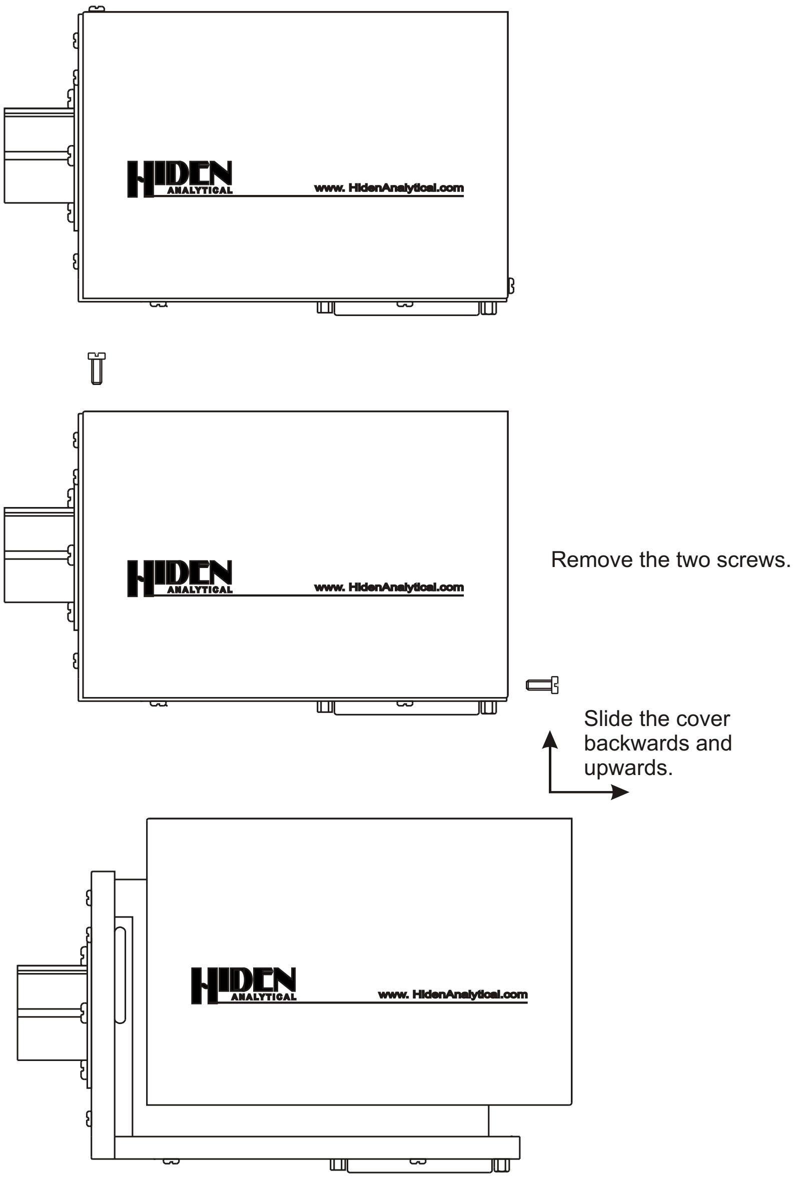

Figure 5.4 RF Head cover, single filter instruments

3. On the RF generator PCB (the large PCB in the RF Head), monitor the voltage between TP4 and TP6. This voltage corresponds to the RF generator power amplifier current.

4. Switch on the RC Interface.

5. Set the instrument to a **mass** of 5 amu. Use the procedure described in Section 5.1.2.

6. Perform a **MID** scan with a **Dwell Time** of 6 seconds. — The monitored voltage should be approximately 40 mV for the 10 s period.

7. Repeat Step 6, using a mid-mass value, i.e. 50 amu for a 100 amu instrument, 100 amu for a 200 amu instrument.

8. Tune the monitored voltage to a minimum value by using the slug in the RF transformer, T1, on the RF PCB. — Use a non-inductive adjusting tool.

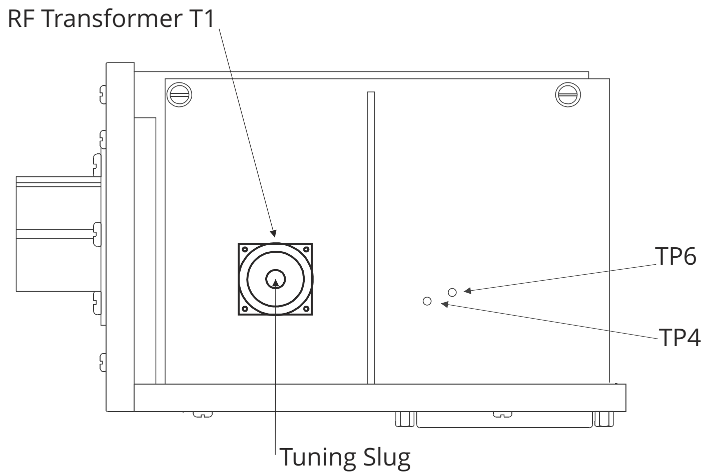

Figure 5.5 RF Head single filter instruments

9. Repeat Steps 6 and 7 at the maximum mass for the instrument. — Typical tuned values for the monitored voltage are:

   300 mV for a 100 amu instrument.

   600 mV for a 200 amu instrument.

5.7.2.2 RF tuning: triple filter instruments

1. Switch off the RC Interface.

2. Remove the RF Head cover. — See Figure 5.6.

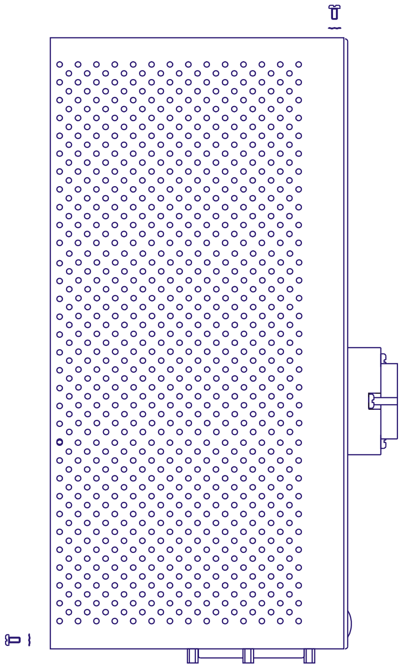

Figure 5.6 RF Head cover, triple filter instruments

3.	On the RF generator PCB (the large PCB in the RF Head), monitor the voltage between TP46 and TP47.	This voltage corresponds to the RF generator power amplifier current.
4.	Switch on the RC Interface.	
5.	Set the instrument to a **mass** of 5 amu.	
6.	Perform a **MID** scan with a **Dwell Time** of 6 seconds.	The monitored voltage should be approximately 10 mV for the 10 s period.

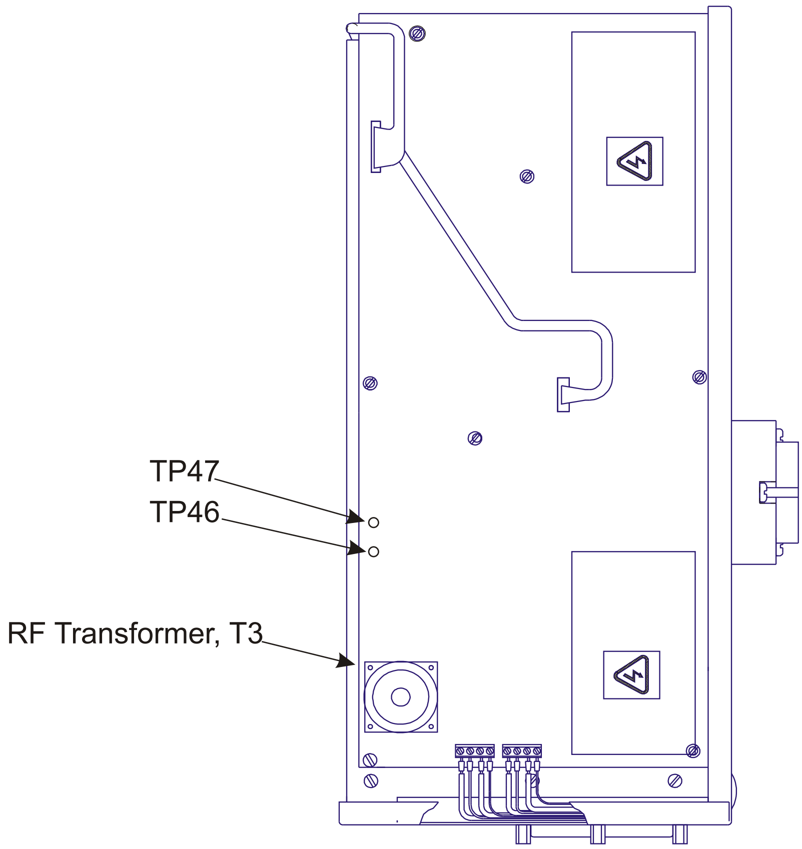

Figure 5.7 RF Head triple filter instruments

7. Repeat Step 6 throughout the mass range using mass values in 100 amu steps.

   For each mass value, tune the monitored voltage to a minimum value by using the slug in the RF transformer, T3, (with the large black heatsink attached) on the RF PCB.

   Typical tuned values for the monitored voltage are:

   350±100 mV at mass 300 amu.

   400±100 mV at mass 510 amu.

   Use a non-inductive adjusting tool.

5.7.3 RF tuning (Series 1000 System)

Refer to the Hiden Analytical manual “Series 1000 R.F.Generator User’s Manual” reference HA-085-617 for details of the tuning procedure.

5.7.4 Mass filter voltages

Quadrupole mass filters work with a mixture of RF and DC voltages on the rods, and the RF/DC ratio determines the mass resolution of the unit. If this ratio is wrong, the peaks will either be very wide or may disappear. The variables **delta-m** and **resolution** allow some control over the ratio.

Note:

delta-m *and* **resolution** *cannot be adjusted on some instruments.*

1. Switch off the RC Interface.
2. Remove the RF Head Cover.
3. Switch on the RC Interface.
4. Set the instrument to a **mass** near the top mass. — Use the procedure described in Section 5.1.2.
5. Set the **delta-m** and **resolution** variables to zero.
6. For single filter Heads, go to Step 9; for a triple filter Head, continue with Step 7.
7. Make the measurements shown in Table 5.3 on the RF generator PCB (the large PCB in the RF Head). — The ±DC voltage levels measured are dependant on the mass range of the instrument.

Instrument	Set mass (amu)	TP3	TP4
200 amu	195	49.7±1.0 V	-49.7±1.0 V
300 amu	295	59.9±1.0 V	-59.9±1.0 V

Note:

The voltages are measured with respect to TP11.

Table 5.3 Triple filter Head voltages

8. If there is no DC voltage, or it is incorrect, check the supply rails as follows as shown in Table 5.4.

Test Point	Voltage
TP8	114±10 V
TP2	-114±10 V

Note:

The voltages are measured with respect to TP11.

Table 5.4 Triple filter Head supply rail voltages

9. For single filter Heads, make the measurements shown in Table 5.5 on the RF generator PCB (the large PCB in the RF Head). The ±DC voltage levels measured are dependant on the mass range of the instrument.

Instrument	Set mass (amu)	TP16	TP15
100 amu	95	25.9±1.0 V	-25.9±1.0 V
200 amu	195	53.3±1.0 V	-53.3±1.0 V

Note:

The voltages are measured with respect to TP6.

Table 5.5 Single filter Head voltages

10. If there is no DC voltage, or it is incorrect, check the supply rails as follows as shown in Table 5.6.

Test Point	Voltage
TP8	4.70±0.25 V
TP9	55.00±2.00 V

Note:

The voltages are measured with respect to TP6.

Table 5.6 Single filter Head supply rail voltages

5.7.5 High voltage outputs

WARNING

1. **The procedures described in this Section must be performed by suitably qualified personnel with experience of high-voltage circuitry.**
2. **Great care must be taken during the following tests; the measurements are of extremely high voltages.**
3. **A voltmeter with a high voltage (HV) probe capable of measuring up to 3000 V must be used.**

CAUTION

Ensure that the MHV connector, when disconnected, cannot come into contact with any object that is liable to cause a short-circuit.

Where a dual Faraday/SEM detector is fitted to the instrument, the SEM high voltage supply on the rear of the RC Interface (connector SEM EL08) is connected to the Probe using a coaxial cable fitted with MHV connectors.

1. Make a note of the current value of the **multiplier** voltage in the global **Environment Editor** dialog box.

2. Disconnect the SEM supply coaxial cable from Probe feedthrough radial MHV connector or the RF Head MHV connector.

3. Run the MSIU Test program (in the Hiden Applications program group).

4. Send the following three commands to the RC Interface

   lset enable 1
   lset multiplier 1000
   lini SEM

   press the carriage return key after each command.

   Ensure the baud rate is set to 115200 by selecting **Settings, Serial..., Baud Rate:** from MSIU Test menu bar.

   This procedure sets the **multiplier** voltage to 1000 V.

   Refer to the Hiden Software Suite Installation Guide, for details of how to use the **MSIU Test** application**.**

5. Measure the voltage at the probe end of the cable with respect to ground.

   The voltage should be 1000 V ±10 V.

6. If the voltage is incorrect, switch off the instrument, disconnect the coaxial cable from the RC Interface and check that the inner and outer conductors are not short-circuited.

7. If the cable is not faulty, there may be a problem with the SEM supply in the RC Interface; contact Hiden Analytical Limited for assistance.

8. On completion of the tests:

   Reconnect the coaxial cable between the RC Interface SEM EL08 connector and the Probe feedthrough radial MHV connector.

   Set the global environment **multiplier** voltage back to the original value.

   See Step 2.

5.8 Series 1000 RF generator thermal trip

The Series 1000 RF generator unit has a thermal switch attached to the heatsink for the output transistors; it operates at a temperature of 70 ºC and shuts down the generator's power supply units. The thermal trip is reset by turning the RF generator unit off and then back on.

5.9 Series 1000 Systems: Incorrect mass spectrum

Refer to the Hiden Analytical manual “Series 1000 R.F.Generator User’s Manual” reference HA-085-617 for details of troubleshooting.

5.10 Problems when an RC Interface is switched on

The following may occur when an RC Interface is switched on:

1. If all connections are correct:

   After a short delay of about five seconds, the RC Interface will make a short “beep”.

2. If the TRIPS circuit or RF Amplifier Head circuits are not connected:

   After a short delay of about five seconds, the RC Interface will make a "beep" of about five seconds duration.

3. When using an RS232 communications link, if the link is short circuited, or a “Break” signal is received:

   The RC Interface will continually try to reboot without success.

5.11 Difficulty contacting mass spectrometers

Under certain circumstances, using the **System**, **Explore** command will not locate the available instruments. This may be due to a number of causes which are described in this Section.

5.11.1 Link physically broken

Check that the link hardware (i.e. adapter PCBs, connectors, cables, etc.) is in good condition and is working. Ensure that connectors are plugged into the correct sockets on the PC and RC Interface.

One of the link diagnostics programs (in the **Hiden Applications** program group) can be used to check the link operation.

Refer to "The Hiden link diagnostics programs" section in the Hiden Software Suite Installation Guide for further information.

5.11.2 PC not working

PC adapter cards or communications ports usually have some associated software which can be run to check their correct operation. Check communications by linking to (for RS232) or accessing (for LAN operation) a different instrument or server.

5.11.3 RC Interface not responding

To check the RC Interface, assuming that the PC and link hardware have checked out successfully, run the **MSIU Test** application (in the **Hiden Applications** program group) on the PC and send commands directly to the RC Interface from the keyboard. Typing ***help*** followed by a ***carriage return*** should return help text on the screen.

Refer to "The Hiden link diagnostics programs" section in the Hiden Software Suite Installation Guide for further information.

5.11.4 Clearing link parameters

If the above tests do not find the fault, the link parameters can be cleared by selecting "**Select instrument for re-interrogation**" in the Comms configuration utility then starting MASsoft.

5.12 Upgrading firmware

The RC Interface does not use EPROMs to store its program code. The flash memory used to store the firmware can be upgraded by downloading new software.

Downloading new firmware is fully described in the "Upgrading the Firmware" section of the Hiden Software Suite Installation Guide.

5.13 Leak checking

Once the Probe has been installed the seal between the Probe and the host vacuum system should be leak checked.

The mass spectrometer's ability to detect gas species is used to find any leaks on the seal or any other vacuum seals on the host system. The mass spectrometer is configured to monitor a probe gas (helium is the most common leak checking gas) which is carefully sprayed over the vacuum seal. Any signal detected by the mass spectrometer will be due to the leak check gas entering the system through the leak.

A helium cylinder fitted with a regulator and a length of hose is required for leak checking.

Another gas such as argon can be used if helium is not available. Any grade of gas may be used.

To leak check:

1. Start MASsoft.
2. Select Leak Detect from the Gallery.
3. Set the Mass: to 4 (if using helium) or an appropriate mass for the leak checking gas (mass 40 for argon). Refer to the Leak Detect scan section in the MASsoft User Manual for further details regarding the configuration of MASsoft.
4. Adjust the helium cylinder regulator to give a gentle flow of gas. Spraying large amounts of helium over the vacuum system will make it difficult to precisely locate any leaks.
5. Spray helium around the Probe flange seal. Start at the top and work downwards.

Chapter 6 Maintenance Procedures

Maintenance Procedures: Contents

Maintenance Procedures: Illustrations

6.1 General

CAUTION

These procedures must be performed by suitably qualified personnel with experience of high-vacuum systems.

6.2 Equipment case cleaning

WARNING

All equipment must be switched off and disconnected from the mains power supply before cleaning commences.

CAUTION

When cleaning the equipment cases, the cloth used must be damp only, NOT wet; cleaning solvents must not be used.

The equipment cases (RC Interface, and where appropriate, the Series 1000 RF Generator Unit) may be cleaned with a damp, lint-free cloth.

6.3 Maintaining system safety

The following points should be checked every two years in order to maintain safe operation of the equipment.

Item	Test	Pass condition
1. Mains leads and connectors.	a) Visual inspection.	No damage to cable or connectors.
	b) Mains plug.	Correct fuse fitted.
	c) Attempt to pull the cable from the IEC connector.	No movement.

Note:

If the lead or one of its connectors is damaged it must be discarded and a replaced by a suitably approved cordset with a moulded IEC 320 socket and mains plug; the cable must contain a double layer of insulation and must have an adequate current capacity for the application.

2. Mains on/off switch.	Visual inspection.	Correct operation, no damage.
3. Conducting case.	a) Visual inspection.	No damage.
	b) Using an earth tester which will check resistance and pass a current of at least twice the fuse rating, check between the mains plug earth, the RC Interface case, RF Generator Unit case (if applicable) and the Head metalwork.	Earth resistance must be less than 0.1 ohm.
	c) High voltage insulation 500 V a.c. minimum test, check between the mains plug live and earth.	No fault indicated after 5 seconds.
4. Accessible fuse holders.	Visual inspection.	No damage.

The above information has been derived from the United Kingdom Health and Safety Executive Guidance Note PM32.

6.4 Regular maintenance

The Probe is fully Ultra-High Vacuum (UHV) compatible, the construction permitting bake-out to a recommended maximum of 250 °C for dual detector Probes and 300 °C for Faraday-only Probes. It is designed to enable the unit to be fully dis-assembled and re-assembled, but, although details are available for users with adequate facilities, this operation should normally be considered a factory service.

The only routine maintenance occasionally required is filament renewal, described in Section 6.4.1. Contamination of the ion source may occur in harsh vacuum environments; cleaning or replacement of the source components is relatively straightforward. Removal of the ion source from the Probe is described in Section 6.4.7 and dis-assembly of the ion source is described in Section 6.4.8.

Note:

The ion source can be dis-assembled while still mounted on the Probe.

6.4.1 Filament renewal

The Probe will be either a standard Probe or a Series 1000 Probe. To replace the filaments the Probe must be removed from the host vacuum chamber, for Series 1000 Probe this procedure is slightly more involved.

The Probe incorporates either a standard ion source with a single mounting plate fitted with twin filaments or a low profile ion source fitted with twin, side entry filaments. In either case both filaments may be operated simultaneously for degas purposes.

WARNING

The filaments have a powder oxide coating which must not be ingested as it is toxic.

CAUTION

1. **The surfaces of the Probe which are normally inside the vacuum system MUST NOT be touched by bare skin; this would leave an oily deposit on the metal which could subsequently give large peaks in the mass spectrum. Clean, powder-free, surgical gloves must be worn whilst touching the component parts or renewing the filaments.**
2. **The Probe must be carefully laid on a horizontal surface, covered with a clean sheet of aluminium foil, whilst being worked on.**
3. **Any tools used whilst working on the Probe must be perfectly clean and free from dust particles and oil.**
4. **The filament wire must not be touched by other objects; this can dislodge the coating and reduce the filament life.**

6.4.2 Requirements

A pair of fine-tipped tweezers and a jeweller's screw driver are required to change the filaments.

Depending on flange type either a pair of 10mm or a pair of 13mm spanners are needed to remove the Probe flange mounting bolts.

A 2mm hexagonal socket driver and a small flat bladed screw driver may be required.

New filaments and a new copper gasket to suit the Probe flange are needed.

6.4.3 Standard probe removal

To remove a standard probe from the host vacuum chamber:

1.	Shut down the RC RGA system and the host vacuum system.	
2.	Disconnect the RF Head from the RGA Probe.	Depending on type the RF Head may be secured with grub screws or thumbscrews. A 2mm hexagonal socket driver will be required to slacken the grub screws.
3.	Disconnect the SEM supply cable from the Probe.	There may be no SEM cable connected to the Probe depending on system type.
4.	Remove the RGA Probe from the host vacuum system.	Depending on the Probe base flange type two 10mm or two 13mm spanners will be required. Leave the used copper gasket in place as it will protect the flange knife edge. Place the Probe assembly on a clean, flat work surface.

6.4.4 Series 1000 probe removal

To remove a Series 1000 probe from the host vacuum chamber:

1.	Shut down the RC RGA system and the host vacuum system.	
2.	Remove the Amplifier Head.	Users may wish to first remove the three cables connected to the Amplifier Head. There are two D-type connectors and an MHV bayonet connector. The Amplifier Head is secured by either three thumbscrews or three grub screws. A 2mm hexagonal socket driver is needed to slacken the grub screws.
3.	Note the location of the five coaxial cables connected to the Feedthrough Adapter before disconnecting them.	
4.	Remove the Feedthough Adapter cover by first removing the three slotted screws that secure it.	

5.	Disconnect the six wires from the six feedthrough pins and remove the six plastic feedthrough covers.	See Figures 3.16 and 3.17.
6.	Remove the Feedthough Adapter from the Probe flange.	Remove the four M4 cap head screws that secure the Feedthrough Adapter to its base plate. The base plate remains in place on the Probe flange.
7.	Make a note of the Mass Spectrometer Probe feedthrough flange orientation.	The Probe will need to be fitted in the same orientation.
8.	Remove the M8 nuts, bolts and washers that secure the Probe flange to the chamber flange.	Use two 13mm spanners. There mat be sixteen or twenty bolts depending on the flange size.
9.	Carefully slide the mass spectrometer probe out of the mass spectrometer chamber.	The used copper gasket can be left in place for now, it will protect the knife edge.

6.4.5 Filament replacement - standard ion source

The standard ion source is fitted with a single circular plate to which the two filaments are mounted. The filament plate is clearly visible at the top of the probe. See Figure 6.1.

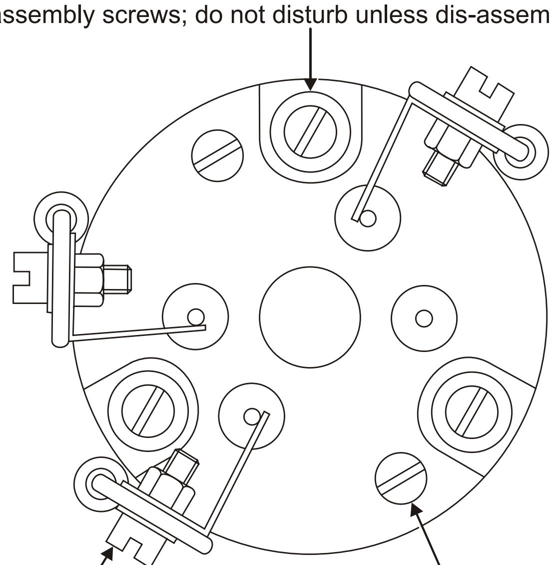

Figure 6.1 Filament mounting plate

Three leads connect to the two filaments, two of the filament supports are internally connected. The filament mounting plate is retained by two screws.

CAUTION

Three ion source assembly screws are accessible on the mounting plate and are recognisable by the ceramic bushes through which they pass. These screws must not be disturbed during routine filament renewal.

To change the filament assembly:

1. Slacken, but do not remove, the three peripheral screws clamping the filament leads to the assembly.

2. Slide the leads away from the screws.

3.	Remove the two screws retaining the mounting plate.	
4.	Lift off the filament assembly.	
5.	Place the new filament assembly in position.	Ensure that the new filament assembly is fitted in the same orientation as the assembly removed in Step 4.
6.	Refit the two mounting screws.	
7.	Reconnect the three filament leads.	
8.	Check visually for any connecting leads which may be electrically shorted to other parts of the Probe.	
9.	With a suitable meter, check that the resistance between the Filament 1 copper lead and the filament plate (Filament common) and between the Filament 2 lead and the filament plate is approximately 1 ohm.	See Figure 6.2. The filament and its leads must have NO electrical contact with any other part of the Probe.
10.	Re-fit the Probe onto the chamber by following the instructions in Section 3.8.3 or 3.8.4.	Use a new copper gasket. All Probe feedthrough connections must be check for short circuits before fitting the RF or Amplifier Head. Refer to Section 5.5.

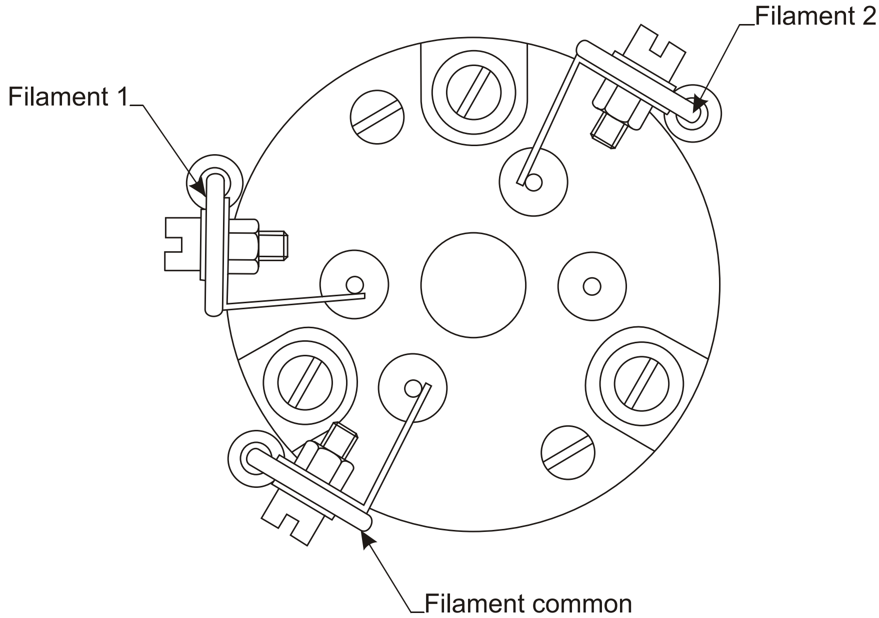

Figure 6.2 Filament wires

6.4.6 Filament replacement - low profile ion source

The side-mounted filament assembly is shown in Figure 6.3 the ion source assembly is shown in Figure 6.4.

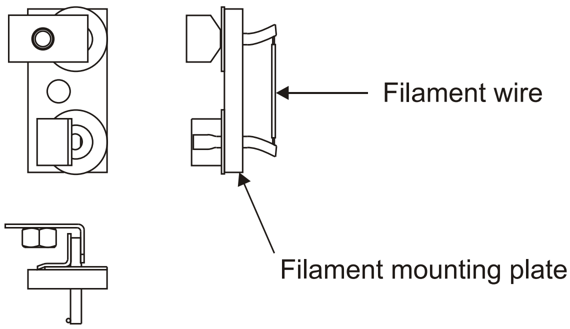

Figure 6.3 Side mounted filament assembly

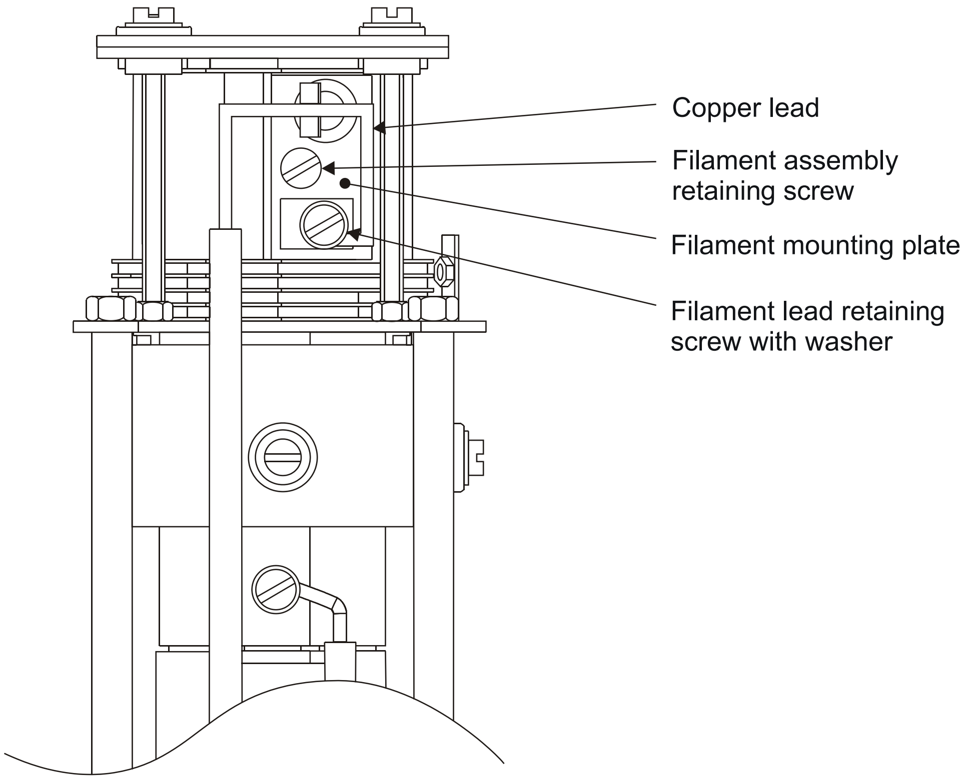

Figure 6.4 Ion source assembly, side mounted filaments

To replace the filaments:

1. Remove the M1.6 filament lead retaining screw and washer.

2. Move the end of the filament lead to one side, so that it clears the filament assembly.

   This gives access to the central filament assembly retaining screw.

3. Remove the filament assembly retaining screw and carefully lift the filament assembly clear of the Probe.

CAUTION

The two filament assemblies in each ion source are not identical; when fitting the new filament ensure that it is of the same type as the filament that has been removed.

4.	Fit the new filament, ensuring that it is of the same type as the filament that has been removed.	The procedure for fitting the new filament is the reverse of that for removing the old one.
5.	Check visually for any connecting leads which may be electrically shorted to other parts of the Probe.	
6.	With a suitable meter, check that the resistance between the copper lead and the filament assembly/mounting cylinder is approximately 1 ohm.	The filament and its leads must have **NO** electrical contact with any other part of the Probe.
7.	If necessary replace the other filament.	
8.	Re-fit the Probe onto the chamber by following the instructions in Section 3.8.3 or 3.8.4.	Use a new copper gasket. All Probe feedthrough connections must be check for short circuits before fitting the RF or Amplifier Head. Refer to Section 5.5.

6.4.7 Removal of ion source from probe

1.	Remove the RGA Probe from the host vacuum system.	Follow steps 1. to 4. in Section 6.4.1.
2.	Slacken, but do not remove, the three peripheral screws clamping the filaments leads to the assembly.	See Figure 6.1.
3.	Slide the leads away from the screws.	
4.	Remove the screws and washers that secure the two stainless steel supply leads to the ion source.	
5.	Remove the three nuts which secure the ion source assembly to the vacuum gauge head.	
6.	Taking care not to lose the large ceramic washer below the ion source assembly, lift the ion source assembly clear of the vacuum gauge head.	

7. Follow the procedure in Section 6.4.8 if the ion source assembly is to be dismantled.

8. Re-assembly of the ion source to the vacuum gauge head is the reverse of the above procedure.

6.4.8 Ion source dis-assembly

WARNING

The filaments have a powder oxide coating which must not be ingested as it is toxic.

CAUTION

1. **The surfaces of the Probe which are normally inside the vacuum system MUST NOT be touched by bare skin; this would leave an oily deposit on the metal which could subsequently give large peaks in the mass spectrum. Clean, powder-free, surgical gloves must be worn whilst touching the component parts or renewing the filaments.**
2. **The Probe must be carefully laid on a horizontal surface, covered with a clean sheet of aluminium foil, whilst being worked on.**
3. **Any tools used whilst working on the Probe must be perfectly clean and free from dust particles and oil.**
4. **The filament wire must not be touched by other objects; this can dislodge the coating and reduce the filament life.**

A pair of fine-tipped tweezers and a jeweller's screw driver are required.

The ion source components are shown in Figure 6.5.

1.	Remove the RGA Probe from the host vacuum system.	Follow steps 1. to 4. in Section 6.4.1.
2.	Slacken the three peripheral screws clamping the filament leads to the assembly.	See Figure 6.1.

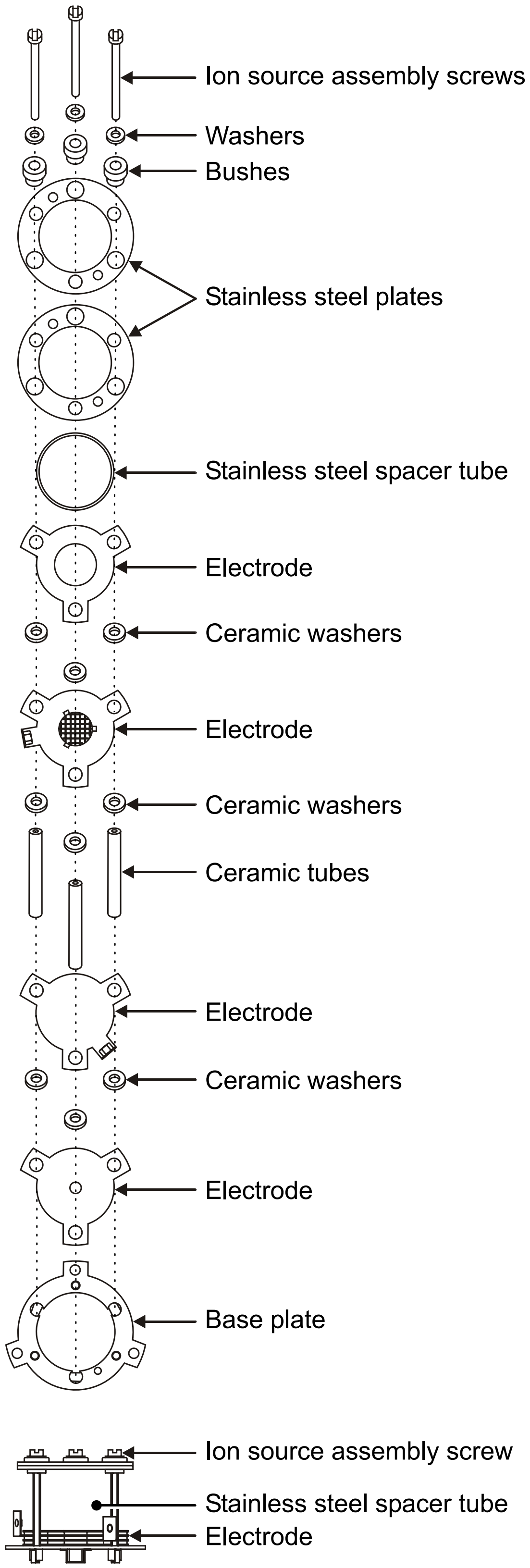

Figure 6.5 Standard ion source assembly

3. Slide the leads away from the screws.

4. Remove the two screws retaining the mounting plate.

5. Lift off the filament assembly.

6. Remove the screws and washers that secure the two stainless steel supply leads to the ion source.

7. Remove the three ion source assembly screws complete with washers and pink bushes.

8. Remove the two stainless steel plates from the top of the ion source.

9. Remove the stainless steel spacer tube.

10. Carefully remove the thin stainless steel electrodes by sliding them over the three ceramic tubes.

    There are three white ceramic washers between each of the electrodes; these must be removed in sequence with the electrodes.

    When the last (fourth) electrode has been removed, a large white ceramic washer will remain; this should not be removed unless renewal is required.

11. Re-assembly of the ion source is the reverse of the above procedure.

6.4.9 Bake-out

CAUTION

1. **The maximum bake-out temperature for the Probe when under vacuum is 250 °C for dual detector Probes and 300 °C for Faraday-only Probes. The bake-out temperature for the whole Probe may be lower than this due to 'O' rings, etc.**
2. **The Head, all cables and, on Series 1000 Systems, the Probe Feedthrough Adapter, must be removed from the system prior to bake-out.**
3. **Voltages must never be applied to the detector during bake-out.**
4. **Avoid temperature differentials across the ceramic feedthroughs. These can be caused by misplaced heaters or air draughts and can crack the ceramic. Draughts may be avoided by covering the feedthroughs carefully with aluminium foil.**
5. **If the filaments are to be energised during bake-out, the current applied must not exceed 2.5 A.**

The Probe may be cleaned by heating it under vacuum. In most systems, heating tapes may be wrapped around the metalwork containing the Probe, or the relevant parts of the system may be enclosed in a purpose-built oven.

For operation at UHV and parts per billion (ppb) gas analysis applications, Hiden Analytical Limited recommend that the filaments be energised during bake-out. This can be done by using a suitable adjustable power supply connected to pins 3 and 9 on the 12-way feedthrough via a 1 ohm resistor capable of dissipating at least 3.75 W.

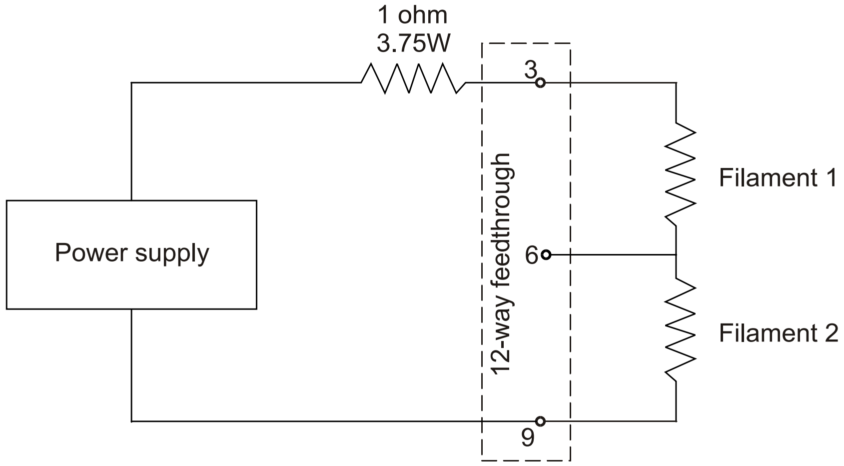

Figure 6.6 Circuit for energising the ionisation source filaments during bake-out

6.5 Accessing the Control Board

The user should only need to gain access to the Control Board to change the setting of link LK1.

CAUTION

The following procedure must be performed by suitably qualified personnel with experience of high-vacuum systems.

To gain access to the Control Board:

1.	Switch off the RC Interface and disconnect from the mains supply.	Wait for two minutes for capacitors to discharge.
2.	Remove the RC Interface cover.	Remove the two screws on each side of the unit then slide the cover backwards and lift clear.

Inside the RC Interface there are two circuit boards mounted on top of each other. The upper board is the Power Supply Board and underneath this is the Control Board. To the left (as viewed from the front) is the power supply unit.

3.	Disconnect from the Power Supply Board the following connectors: The multi way power supply connector from connector J5 The cooling fan cable from connector J6 The SEM lead from connector J8 The two ribbon cables from connectors J4 and J3 on the front edge of the board.	
4.	Remove the three M3 screws that secure the board to the case.	These screws are towards the front of the board. Refer to Figure 6.7.

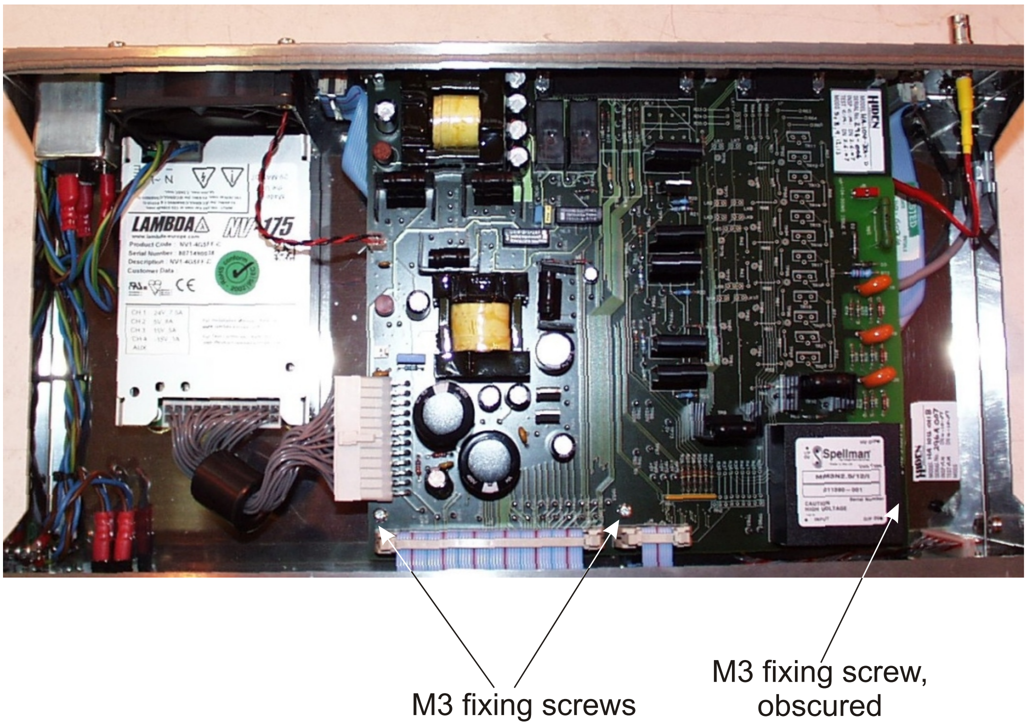

Figure 6.7 Control Board fixing screws

5. From the rear panel remove the three screws that secure the brackets on the rear edge of the Control Board to the rear panel.

See Figure 6.8.

If fitted remove the cover from the D-type connector ELECTRODES EL01.

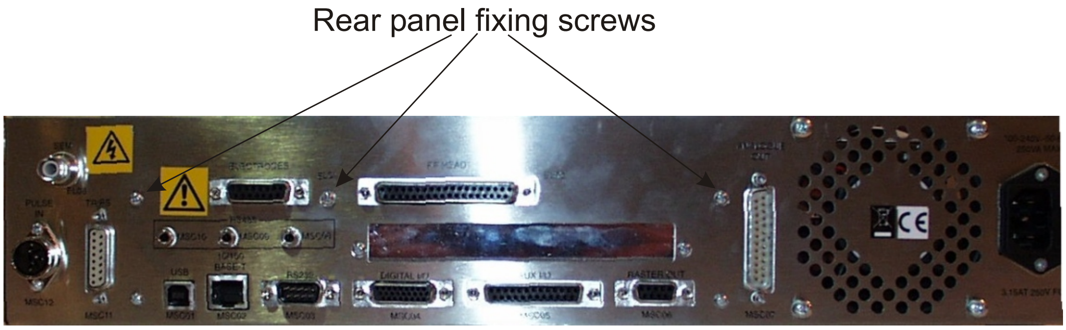

Figure 6.8 Rear panel control board fixing screws

6. Lift out the Power Supply Board.

The ribbon cable connector may need easing out of the way.

The position of link LK1 is shown in Figure 6.9.

Reverse the instructions above to re-assemble the RC Interface.

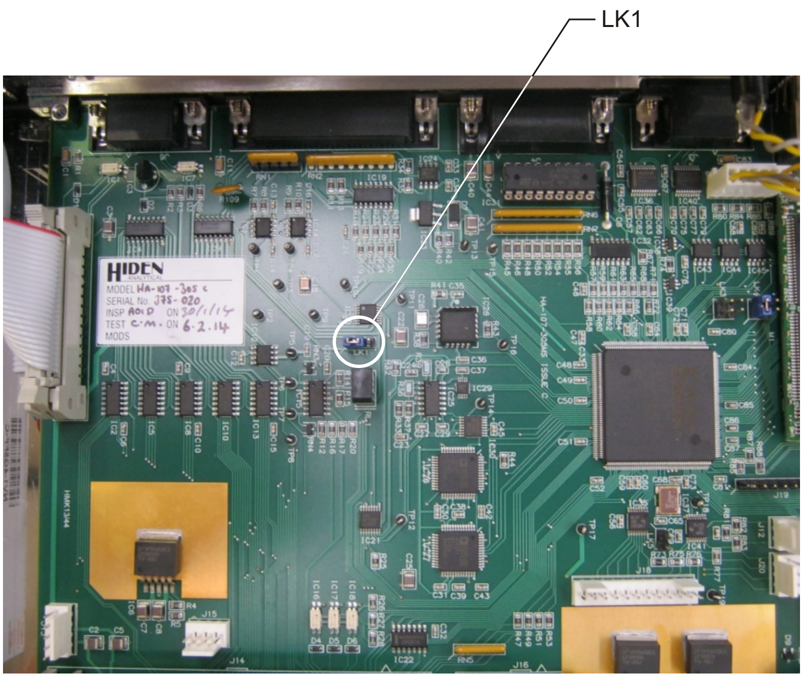

Figure 6.9 Link LK1

6.6 Returning equipment for servicing

Occasionally, it may be necessary to return the Probe or the complete system for servicing.

CAUTION

A completed Contamination Status form MUST be sent to Hiden Analytical Limited before returning the equipment.

Contamination Status forms are available from Hiden Analytical Limited and can be downloaded from the website support page at www.hidenanalytical.com.

The Probe should be carefully packaged to retain cleanliness and protect fragile parts from shock damage during transit. Particular attention should be paid to metal/ceramic feedthroughs such as the 12 way feedthrough and any radial high voltage feedthroughs. Use the shipping housing and packaging in which the Probe was originally supplied. This may be a plastic carton or metal shipping housing and a foam lined cardboard box.

Electronics units should be wrapped in suitable shock absorbing material such as “bubble wrap”, foam etc. then placed in a suitable box or crate with a generous gap in which it is recommended foam or other shock absorbing material is placed. Modules should be packaged so they cannot collide in transit. Where appropriate cover the modules with a layer of polythene or similar to avoid ingress of dust, packaging materials etc..

Vacuum Equipment should be packed such that all surfaces normally exposed to vacuum remain protected and clean. A housing covering the vacuum surfaces is highly recommended, or suitable low plasticiser plastic bags etc. The delicate assemblies within Hiden Analytical Limited vacuum equipment must be protected from shocks or forces during transit.

It is recommended that vacuum equipment be sealed in suitable bags to keep out moisture and contamination. The equipment should be generously wrapped in shock absorbing materials and placed in a close fitting box. This box should then be placed in a larger box or crate surrounded by a generous amount of shock absorbing material.

Where sufficient/suitable packaging materials are unavailable to the sender, these may be supplied by Hiden Analytical Limited on request.

Equipment must be insured by the owner for full replacement value for delivery and return to and from Hiden Analytical Limited.

Damage to equipment in transit due to inadequate or inappropriate packing could result in a low cost service becoming an expensive repair. If in any doubt please do not hesitate to contact Hiden Analytical Limited for advice.

Chapter 7 Input/Output Subsystem

Input/Output Subsystem: Contents

Input/Output Subsystem: Illustrations

Input/Output Subsystem: Tables

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7.1 Introduction

CAUTION

1. **Any connections to other equipment must be undertaken by suitably qualified personnel and must not compromise equipment safety.**
2. **Any equipment connected to any input/output port must operate at Safe Extra Low Voltage (SELV) levels (normally in the range -50 V to +50 V) in accordance with EN 61010:1993 to meet the requirements of the Low Voltage Directive (LVD) 73/23/EEC.**

The ancillary circuits described in this Section are not required for normal operation; they enable the instrument to be linked to other equipment.

External input, output and control systems available on the mass spectrometer include:-

- LVTTL level acquisition gating inputs.
  These may be used to externally control data acquisition.
- Two auxiliary analogue inputs for user parameter monitoring and external mass control.
  These may be used to acquire data from external equipment and store it with data from the Mass Spectrometer, see Section 7.2.3.
  The auxiliary2 analogue input may also be used to allow external control of the instrument’s mass variable, see Section 7.2.5.
- Analogue output of monitored functions.
  This analogue output is associated with the analogue input circuits; it may be used to output the signal from a selected source, which can be either of the two available inputs or a voltage proportional to the ion current measured by the detector, see Section 7.2.2.
- Five digital channels.
  These may be configured as inputs or outputs. When configured as inputs they can be used to control and synchronise the Mass Spectrometer with externally generated signals and events; when configured as outputs they may be used to drive external devices in response to internal events occurring during data acquisition, see Section 7.2.9.

The above facilities are accessed on connector AUX I/O MSC05 on the rear of the RC Interface. Figure 7.1 and Table 7.1 show the signal allocations for this connector.

7.2 AUX I/O connector MSC05

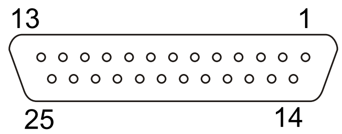


Figure 7.1 RC Interface AUX I/O MSC05 pin organisation

Pin	Signal	Pin	Signal
1	Mass	14	Mass signal common
2	Electrometer output	15	Analogue output common
3	Auxiliary1 input positive	16	Auxiliary1 input negative or common
4	Auxiliary2 input positive	17	Auxiliary2 input negative or common
5	System ground	18	Count Rate DAC
6	System ground	19	Pulse output
7	0V (pulse output)	20	+5 V
8	External gate inverse input	21	External gate input
9	0 V (D)	22	+5 V
10	Digital channel IO1	23	Digital channel IO2
11	Digital channel IO3	24	Digital channel IO4
12	0 V (D)	25	Digital channel IO5
13	System ground		

Table 7.1 RC Interface AUX I/O MSC05 pin assignments

7.2.1 Scan Reference Monitor signal

Description	Signal positive	Signal negative or common
Scan Reference Monitor (Mass) signal	pin 1	pin 14

Table 7.2 Scan reference monitor signal pin assignment

This is currently unavailable. Please contact Hiden Analytical Limited for further advice.

7.2.2 Acquisition signal

The acquisition signal output may be used to monitor the signals read by the instrument from the RF Head amplifier signal (SEM or Faraday detector signal).

The Electrometer output signal is available on the AUX I/O MSC05 connector pin 2 with pin 15 providing the 0V reference.

The Count Rate DAC output (AUX I/O MSC05 connector pin 18) is not used with analogue instruments.

7.2.3 Auxiliary analogue inputs

7.2.3.1 Introduction

This description is split into hardware and logical device sections to emphasise the difference between the physical circuit and the access parameters used in the software. In this context, “physical circuit” refers to the actual circuit, connector pin numbers and input voltage ranges, which are fixed; “logical devices” refers to the names and ranges assigned to the inputs, which may be changed.

Typical uses of the auxiliary analogue inputs are for thermocouples, Pirani gauges, etc.

7.2.3.2 Hardware

CAUTION

Do not apply an input voltage of greater than ±20 V on any pin; this may cause internal damage to the RC Interface.

A schematic diagram of the analogue input/output circuits is shown in Figure 7.2.

7.2.3.3 Input circuits

The two analogue inputs (auxiliary1 and auxiliary2) are available on the RC Interface AUX I/O MSC05 connector, and use the circuit shown in Figure 7.2. The pin assignments are shown in Table 7.3.

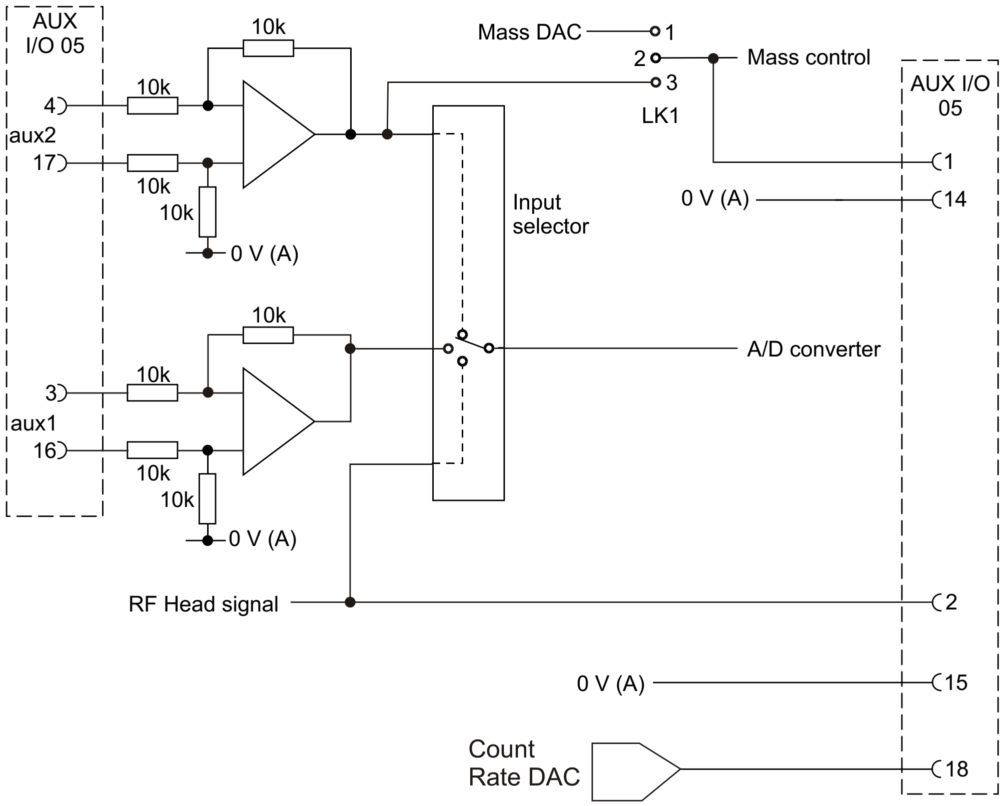


Figure 7.2 Auxiliary input/output circuits

Description	Signal positive	Signal negative or common
Auxiliary 1	pin 3	pin 16
Auxiliary 2	pin 4	pin 17

Table 7.3 Auxiliary analogue inputs pin assignment

7.2.3.4 Input circuit specification

Each of the inputs can accept voltages in the range ±10 V and presents a load impedance of 20 kohm differential- or 10 kohm single-ended mode.

7.2.3.5 Cabling

The analogue inputs may be driven in either differential- or single-ended mode. Differential mode gives better performance, and should be used where possible, but some voltage sources may not be capable of providing a differential drive. In these cases, the source signal should be connected to the analogue input "Signal +ve" pin and the 0 V signal to the "Signal -ve or common" pin.

Where an input is driven by Hiden Analytical Limited equipment, a suitable link cable is provided. If the user links their own equipment to an input, care must be taken to maintain the EMC performance of the RC Interface. For good EMC performance, the cable connectors must be fitted with metal shells and the cable must be screened, with the screen connected to each shell at the point of entry via a 360º clamp (not wired via a tail). The EMC performance of the whole system may be degraded if the cable is not constructed in this way and may cause operational problems and/or a degraded noise performance.

7.2.4 Logical device

The logical device is the representation of an input used by the software; it comprises a name, a value range and an associated units name. Access to the input is by selecting the name in the input device's edit dialog box, at which time the value range and value units name are displayed. The value range for the input is mapped onto the physical input range (±10 V), so that the input is read in the correct variable units.

7.2.4.1 Specification

For general-purpose instruments (i.e. where the auxiliary inputs have not been assigned to a specific variable), the two inputs are named **auxiliary1** and **auxiliary2**. In this case each input is read in units of volts and the scale range is ±10 V.

Where an auxiliary input has been assigned to read a specific variable, the name and unit of the input are the same as that of the variable, and the scale range matches the ±10 V physical input to the logical range of the variable.

For example, if **auxiliary1** is assigned to read temperature from a thermocouple interface, the name given to the input is **Temperature,** reading units K (degrees Kelvin). If the thermocouple interface output is 0 V for a temperature of -100 °C and +10 V for a temperature of 1000 °C, the logical range for the input is set at 173 to 1273. Thus when the input is read, values are returned as **Temperature** in the range 173 to 1273 K.

When an auxiliary input is read, the value returned is proportional to the average of the voltage on the input during the dwell time of the read. For a steady d.c. signal this is the voltage level, but where there is a drift, or an a.c. or noise component, the value depends on the ratio of the d.c. and a.c. components and the a.c. phase during the sampling dwell time.

7.2.4.2 Reading the inputs

Data may be read from one or both auxiliary inputs by creating a scan and selecting the appropriate input as the scan's input device. A scan is necessary (normally scanning the dummy device **none**) as it is the object used to acquire data from a device, and must therefore be created to read the input.

Any type of scan may be used to read the input, but a **MID**-type scan reads only one value and is the best type to choose if a trend of the input versus time is required. Other types of scan (such as **BAR** or **PROFILE**) read more than one value from the input, depending on the number of steps set into the scan.

Figure 7.3 shows a scan tree which reads the intensity of **mass 44** and then the value of input **auxiliary1**. Any output device may be selected as the scanned variable, but choosing mass with the same value as the previous scan or the **none** device is recommended.

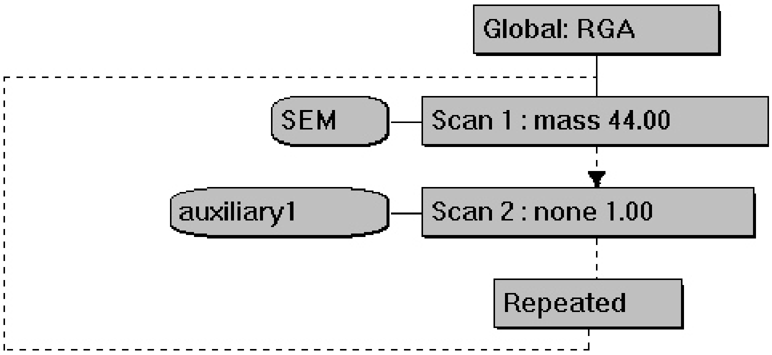


Figure 7.3 Simple scan tree to read an auxiliary port

If required, more scans may be added to this scan tree as shown in Figure 7.4. In this scan tree, the intensities of masses 44, 28 and 18 are acquired, along with data from the two auxiliary inputs which have been assigned to read the temperature and the pH value of the specimen.

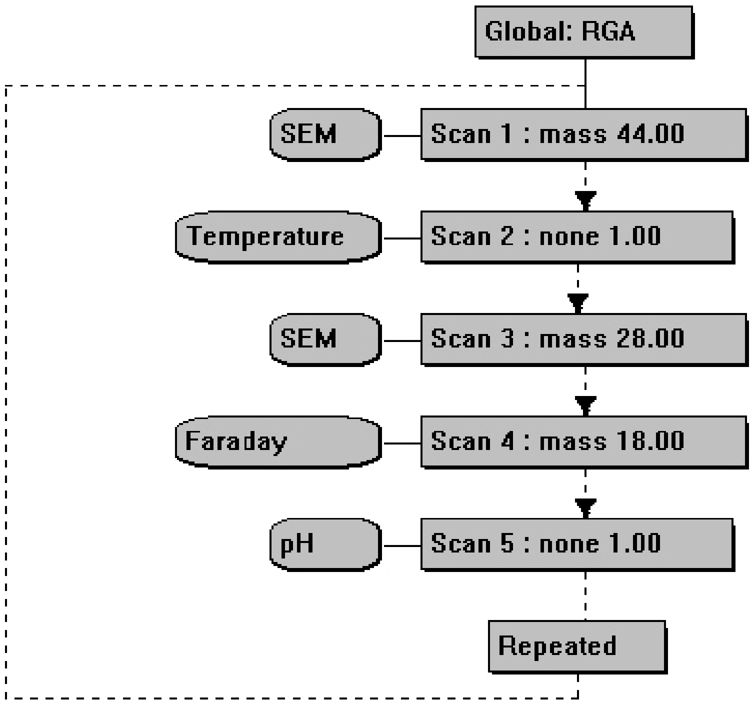


Figure 7.4 Expanded scan tree to read both auxiliary ports

7.2.4.3 Input circuit gain switch

Both auxiliary inputs connect to the analogue to digital converter via a unity gain amplifier.

When monitoring **auxiliary1** or **auxiliary2** range has a full scale reading at ±10 V.

7.2.4.4 Viewing the data

A view window may be created for each scan to display the data acquired into the scan.

Where several scans (including those reading auxiliary inputs) have been created as **MID** scans, it is possible to display all their data on the same view. This allows direct evaluation of the effect of the measured variable on the other scan inputs, but if the acquired values for the auxiliary scans are very different to those for the other scans, the smaller values may be lost in the displayed X-axis, unless viewed on a log scale. Using one view per scan ensures that each data set is displayed on the optimum Y-axis.

7.2.4.5 Exporting the data

Data acquired from the auxiliary inputs may be exported to other Windows™ applications such as Excel™ using the **Export** option on the **File** menu. To export auxiliary input data with mass spectral data, the scan tree should be made up of **MID**-type scans and data from all the required scans displayed on one view. Even if some of the data disappears into the displayed X-axis, the exported data contains the correct values.

Refer to the MASsoft User Manual for further information on exporting data.

7.2.5 External mass input

The mass variable of the instrument can be controlled using an external 0 to 10 V signal connected to the **auxiliary2** input. To enable this, pins 1 and 2 of LK1 must be linked, see Figure 7.2. LK1 is located on the Control board (the bottom PCB on the right hand side of the RC Interface when viewed from the front); this PCB carries the AUX I/O MSC05 connector.

Refer to Section 6.5 for details of how to accessing the Control board.

Note:

Link LK1 pins 2 and 3 are linked when the RC Interface leaves the factory.

The input specification for this signal is as described for **auxiliary1** in Section 7.2.3. If the signal is connected to AUX I/O MSC05 pin 4 and the common to pin 17, 0 V to -10 V corresponds to zero to maximum mass. Connecting the signal to AUX I/O MSC05 pin 17 and the common to pin 4 reverses this, so that 0 V to +10 V corresponds to the full mass range of the instrument.

To use this facility, the **Global** environment should be edited to set the required operating variables, ignoring the mass value. When this is correct, select the **PowerUp** tool, , or use the Menu Bar **System**, **Setup Scan** command to load the values into the instrument. The mass variable can now be varied externally.

7.2.6 Foreground/background delay

The Foreground Delay Monitor and Background Delay Monitor signals are not used in RC-RGA instruments.

7.2.7 External gating signals

External gating is not used in RC-RGA instruments.

7.2.8 Pulse output

This output is not used in RC-RGA instruments.

7.2.9 Digital input/output channels

Five LVTTL (low voltage transistor-transistor logic) compatible digital channels are available for use with the MASsoft events and trips handler. These channels are normally configured as inputs; they can be configured as outputs by the user, see Section 7.2.9.5.

When configured as inputs the channels can be used to control and synchronise the mass spectrometer with externally generated signals and events; when configured as outputs they may be used to drive external devices in response to internal events occurring during data acquisition

These channels are normally accessed via an events sequence. Refer to the MASsoft User Manual and the MASsoft Events Sequences Guide for details of event sequences. Both manuals can be found on the Hiden Software Suite disc.

7.2.9.1 Hardware

Figure 7.5 shows the circuit for each channel.

The input/output is low voltage TTL (LVTTL). The logic levels are TTL compatible, negative logic. 0 to 0.8V is logic 1 (true), 2.2V to 3.3V is logic level 0 (false). When used as an output "false" is pulled up to 3.3V.

CAUTION

The digital input/output channels are not compatible with 24V logic used in some PLCs.

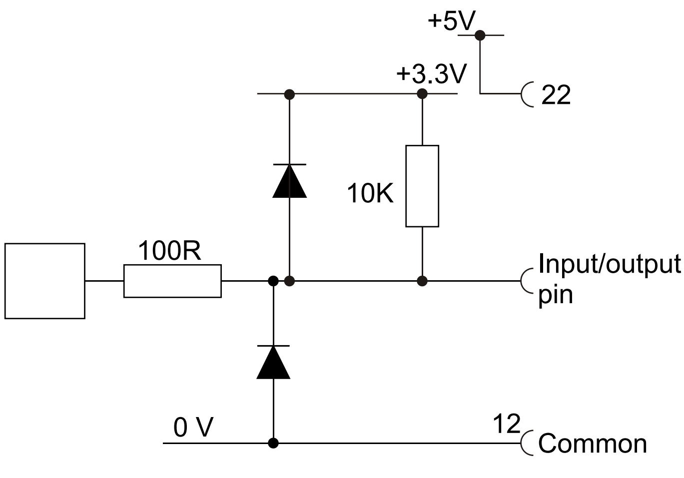


Figure 7.5 Digital input/output circuit

The signals are connected on the RC Interface AUX I/O MSC05 connector as shown in Table 7.4.

Device Name	Signal positive	Signal negative
IO1	pin 10	pin 12
IO2	pin 23	pin 12
IO3	pin 11	pin 12
IO4	pin 24	pin 12
IO5	pin 25	pin 12

Table 7.4 Digital input/output circuit pin assignment

7.2.9.2 Output specification

Maximum drive current from output (sink)	10mA
Maximum drive current from output (source)	10mA
Logic 1 (active low) output voltage	<0.4V
Logic 0 (active low) output voltage	2.4V to 3.3V
TTL Fan-out	2

7.2.9.3 Input specification

Maximum input voltage	3.6V
Logic 1 (active low) input voltage	<0.8V
Logic 0 (active low) input voltage	2.2V to 3.3V

7.2.9.4 Logical devices

The logical device is the mechanism used by the software to control the hardware. Each input/output is assigned a named logical device by which it may be read or set. Refer to Table 7.4. The same device name is used to read the device when it is configured as an input and the set the device when it is configured as an output.

The logical devices are accessed via the MASsoft event sequence editor dialog boxes.

When configured as an input, 1 will be returned for a logical 0 LVTTL level (0 V) or the input short-circuited to common. 0 will be returned for a logical 1 LVTTL level (3.3V) or the input open-circuit.

Note:

The inputs are not "debounced", so that when used with a switch or relay contact, it may be necessary to add a debounce term to the trip list and event sequence.

When configured as an output, setting the output to **1** drives the LVTTL output low (0 V); setting the output to **0** drives the LVTTL output high (3.3 V).

7.2.9.5 Configuring the digital channels as outputs

The digital channels are normally configured as inputs; use the following procedure to configure them as outputs:

1. In MASsoft, create an event sequence containing a **Set event**.

   Refer to the MASsoft User Manual and the MASsoft Events Sequences Guide for details of event sequences. Both manuals can be found on the Hiden Software Suite disc.

2. Double click the **Set event** icon.

   The **Set Editor** dialog box is opened, see Figure 7.6.

3. Select **Device** in the **to destination** frame.

4. Select **IO_direction** in the **to destination** frame list box.

5. Select **Constant** in the **Set value from** frame.

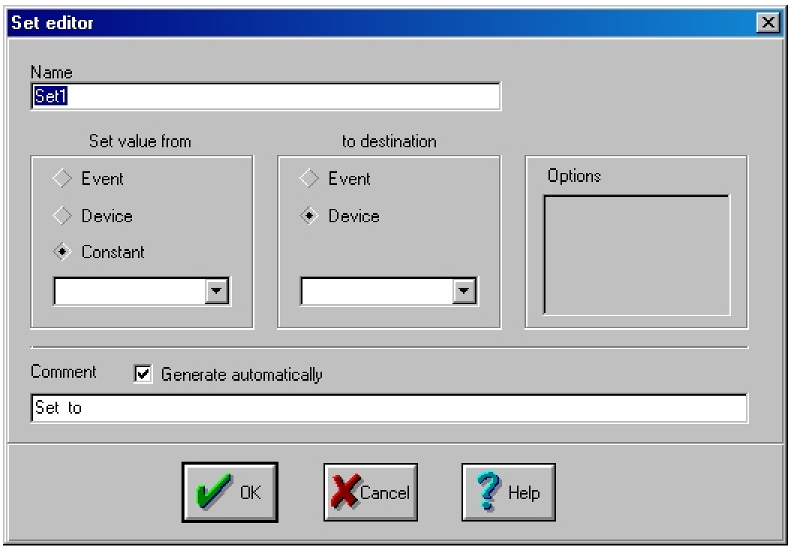


Figure 7.6 Set editor dialog box

6. Enter the appropriate value for the channel or channels to be configured as outputs, in the associated list box, see Table 7.5.

Channel	Value
IO1	1
IO2	2
IO3	4
IO4	8
IO5	16

Note:

To configure several channels simultaneously, enter a combination of the above values, e.g. enter 21 (= 1 + 4+16) to configure IO1, IO3 and IO5 as outputs.

Table 7.5 Values for configuring the digital channels as outputs

7. Click the **OK** button.

7.3 Digital I/O scan control

This Section describes a method for controlling a scan by using an external signal on one of the digital input/output channels.

Note

In previous issues of the RC-RGA Manual this section appeared as the Appendix "Controlling a Scan using a Digital Input/Output Channel".

7.3.1 Hardware connections

The user must supply a TTL level signal, labelled **Run,** on one of the digital input/output channels. When **Run** = 0 at the start of a scan, the current scan tree will hold; when subsequently **Run** = 1, the current scan tree will start and acquire data. When the **Run** signal is next set to 0, the scan will abort, but will be immediately restarted by MASsoft (in the paused state, see Section 7.3.2).

The TTL signal should be connected to the AUX I/O MSC05 connector pin 10, with the signal common to pin 12, see Section 7.2.9.

7.3.2 MASsoft settings

CAUTION

Command events should be used under the guidance of Hiden Analytical Limited and with great care, as operation of the RC Interface unit can be compromised by the use of an inappropriate command.

Refer to the MASsoft User Manual for details of how to set-up the following.

A scan tree must be created to acquire the required data. The **Automatic scan restart** option must be selected in the **Scan structure cycles** dialog box.

To synchronise data acquisition with the external TTL signals, an Event sequence is required. The event sequence shown in Figure 7.7 can be used as an example.

The sequence, headed **Control**, runs the synchronisation; it runs when a scan is started. Its first command, **Holdscan**, pauses the scan generators, so no acquisition takes place.

Following this, **RunChk** checks if the **Run** signal is active. If not, this loop repeats itself after a 10 ms delay. If the signal goes active, the command **debounce_delay** runs and inserts a 10 ms delay to debounce the signals. Following this, **?Run** checks if the **Run** signal is still active; if yes, **Startscan** releases the acquisition to take data.

At this point **Stop1?** monitors the **Run** signal with a 10 ms loop delay **LoopDel**. If **Run** goes inactive, **StopScan** operates to abort the scan tree run immediately, but the event sequence branches to **Control** and again pauses the next scan started by MASsoft. Since the **Automatic scan restart** option in the **Scan structure cycles** dialog box is set, MASsoft will immediately restart the scan, but in the paused state.

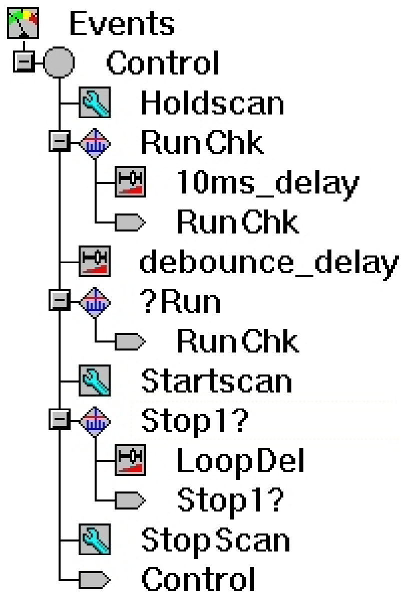


Figure 7.7 Event sequence

7.3.3 System operation

1. Load a suitable experiment file into MASsoft.

2. Set the **Run** signal to logic 0.

3. Select **Save Option**s from the **File** menu.

   The **Save Option**s dialog box is opened, see Figure 7.8. This is used to specify which iterations are to be saved for later use.

4. Select the appropriate button in the **Iteration store options** frame.

   If the selected option requires additional information, a default is displayed; overwrite the default if another value is required.

5. Click the **OK** button.

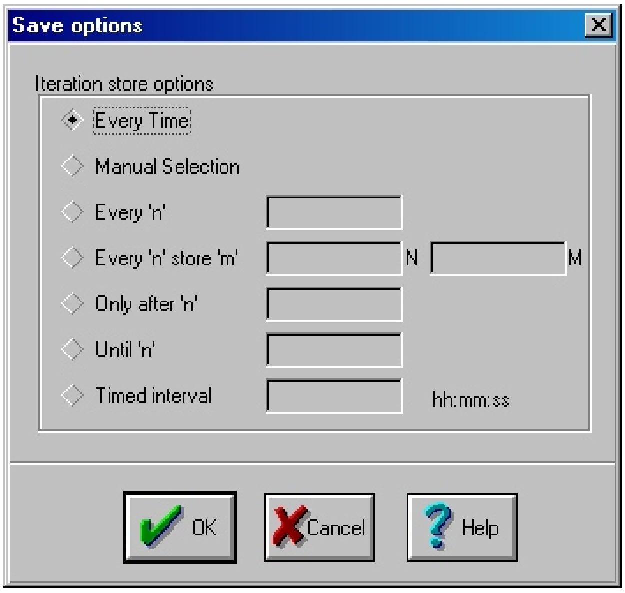
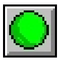
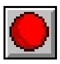


Figure 7.8 Save options dialog box

6.	Select the **Go** tool (green),  .	Scanning will start. When the mass spectrometer control window status bar shows the message **Acquiring data**, the system is ready to begin reading partial pressures.
7.	Manipulate the **Run** signal as required to control the scan.	
8.	Select the **Abort** tool (red)  to end the scan.	This must be done before loading another experiment file.

7.3.4 Event sequence description

The contents of the event editor dialog boxes for the above sequence are edited as follows:

NAME	EVENT TYPE	TITLES IN EDIT DIALOG BOX	CONTENTS OF EDIT DIALOG BOX
Control	Event sequence marker, inserted automatically when the first event is inserted.	**Name** **Run at scan start**	**Control** Selected.
Holdscan	Command event.	**Name** **Execute M.S.I.U. command** **Print result to**	**Holdscan** **sset state Wait:** **None**
RunChk	Limit event.	**Name** **Type of trip** **Data source** **Upper limit** **Lower limit** **Perform action when limits exceeded**	**RunChk** **> Greater than upper limit** **Device IO1** **0** **0** **Not selected**
10mS_delay	Set event.	**Name** **Set value from** **to destination**	**10mS_delay** **Constant 10** **Device delay**
jump to RunChk	Branch, inserted automatically with limit event.	**Jump to**	**RunChk**
debounce_delay	Set event.	**Name** **Set value from**	**debounce_delay** **Constant 10**

NAME	EVENT TYPE	TITLES IN EDIT DIALOG BOX	CONTENTS OF EDIT DIALOG BOX
		to destination	**Device delay**
?Run	Limit event.	**Name** **Type of trip** **Data source** **Upper limit** **Lower limit** **Perform action when limits exceeded**	**?EndScan** **>Greater than upper limit** **Device IO1** **0** **0** Not selected
Startscan	Command event.	**Name** **Execute M.S.I.U. command** **Print result to**	**Startscan** **sset state** **None**
Stop1question	Limit event.	**Name** **Type of trip** **Data source** **Upper limit** **Lower limit** **Perform action when limits exceeded**	**Stop1question** **< Less than lower limit** **Device IO1** **0** **1** Not selected

7.4 DIGITAL I/O MSC04

The DIGITAL I/O MSC04 connector provides eight digital input channels and eight open collector digital output channels. The pin assignment is given in Table 7.6.

Pin	Device Name	Signal	Pin	Device Name	Signal
1	PI1	Digital Input 1	14	PO4	Digital Output 4
2	PI2	Digital Input 2	15	PO5	Digital Output 5
3	PI3	Digital Input 3	16	PO6	Digital Output 6
4	PI4	Digital Input 4	17	PO7	Digital Output 7
5	PI5	Digital Input 5	18	PO8	Digital Output 8
6	PI6	Digital Input 6	19		Digital Output 9 (see note)
7	PI7	Digital Input 7	20		Digital Output 10 (see note)
8	PI8	Digital Input 8	21		0V
9		0V	22		Local RS232 Transmit
10		+5V	23		Local RS232 Receive
11	PO1	Digital Output 1	24		Local RS232 0V
12	PO2	Digital Output 2	25		0V
13	PO3	Digital Output 3	26		0V

Table 7.6 Digital I/O MSC04 pin assignments

Note

1. *The **Local RS232** port (Pins 22, 23 and 24) is designed to provide a serial communications interface to peripheral Hiden equipment. DO NOT use these connections without first contacting Hiden Analytical Limited for advice.*
2. *Digital Output 9 and Digital Output 10 are for use with Hiden peripheral equipment only. DO NOT use these connections without first contacting Hiden Analytical Limited for advice.*
3. *The MSC04 Digital I/O channels are compatible with 24V Process Control Logic.*
4. *The total load for the +5V supply is 1A.*

7.4.1 Output specification

Maximum voltage (open collector transistor): 30 V.

Maximum current drive from output: 500 mA.

Maximum power dissipation per output: 1 W.

Total power dissipation: 2W

Note:

1. *Only one output per package can dissipate the maximum power at any time.*
2. *The outputs are configured as active low, the "true" (1) state is with the transistor conducting.*

7.4.2 Input specification

Maximum input voltage: 30 V.

Maximum current from +5 V output pin: 50 mA.

Low state less than 0.8V.

High state greater than 2.4V (TTL compatible).

The inputs may be factory configured as active low or active high.

Note:

+5 V is provided on DIGITAL I/O MSC04 pin 10, and 0 V is provided on pins 9, 25 and 26 for use with the digital inputs and outputs.

7.4.3 Interfacing with digital I/O

Each input and each output is assigned a named "logical device" by which it may be read or set. See Table 7.6.

Each input pin is assigned an input device name which can be read but not set.

Each output pin is assigned an output device name which can be set and read. When read the output device returns the last value to which it was set.

The inputs and outputs are entirely independent and have individual device names.

The inputs cannot be re-configured as outputs nor can the outputs be re-configured as inputs.

7.4.4 PLC interfacing

Figures 7.9 and 7.10 show suggested methods for interfacing the control unit digital input/output to a PLC.

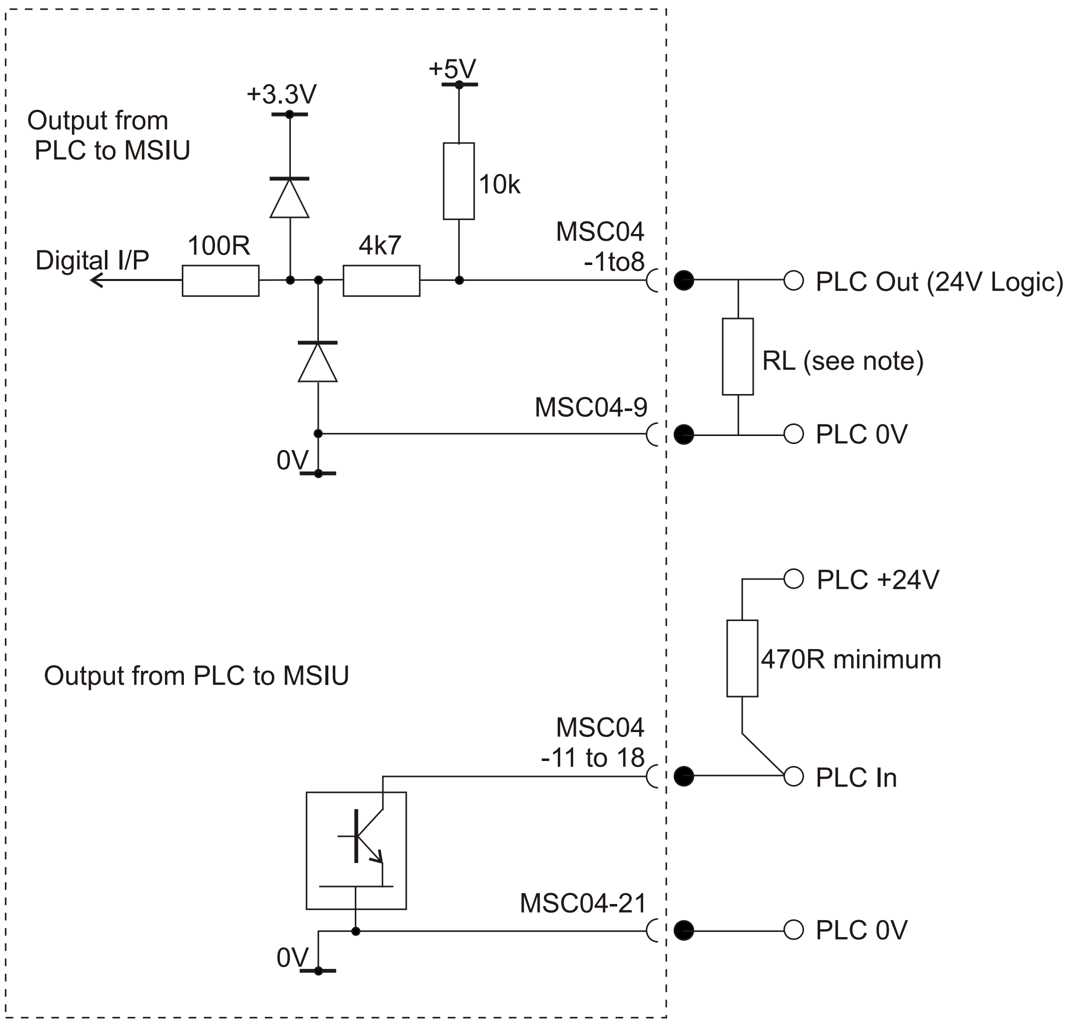


Figure 7.9 PLC interfacing, non-isolated

Note

A load resistor (RL) may be required to ensure the PLC output drops below 0.1V in the low state.

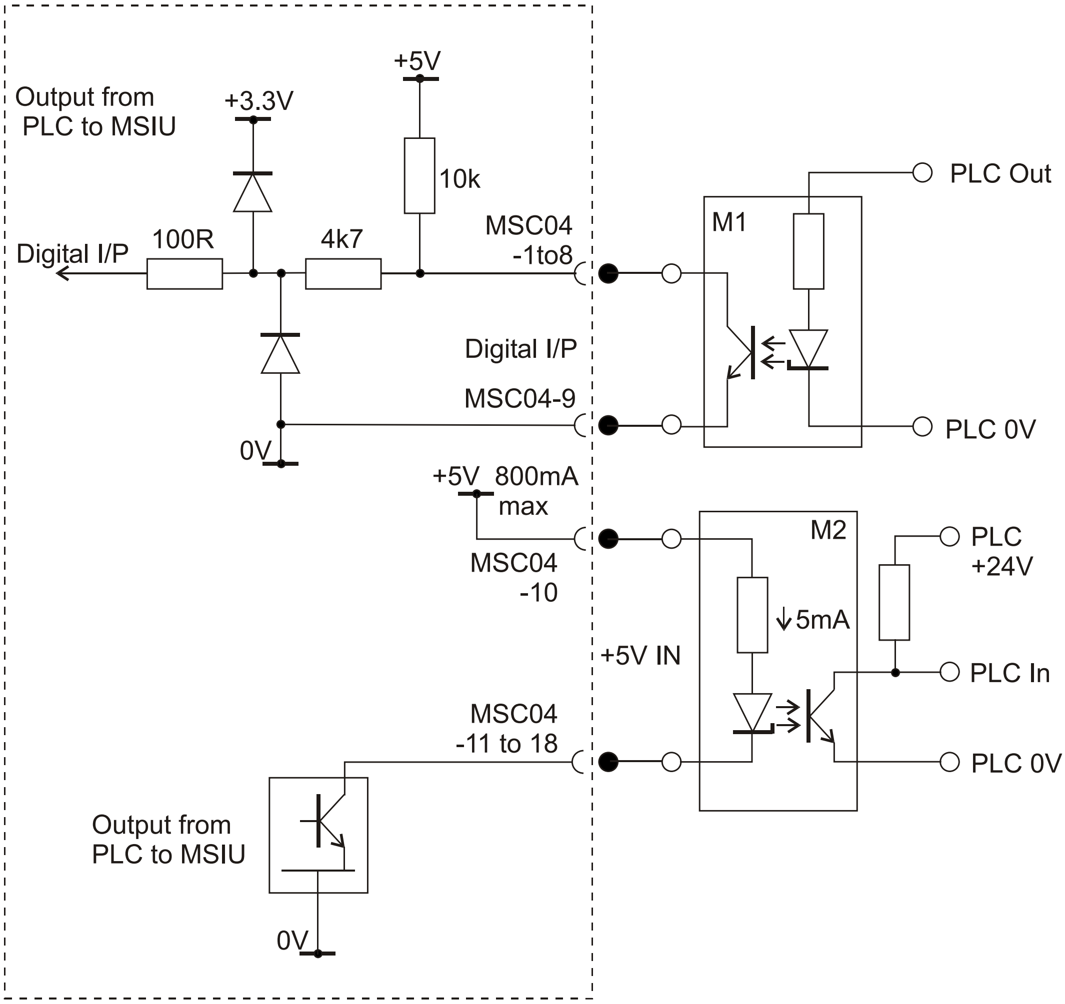


Figure 7.10 PLC interfacing, opto-isolated

7.5 ANALOGUE OUT MSC07

Pin number	Output channel	Pin number	Output channel
1	Channel 1	14	Channel 9
2	Channel 2	15	Channel 10
3	Channel 3	16	Channel 11
4	Channel 4	17	Channel 12
5	Channel 5	18	Channel 13
6	Channel 6	19	Channel 14
7	Channel 7	20	Channel 15
8	Channel 8	21	Channel 16
9	0V	22	0V
10	0V	23	0V
11	!EXT_EN opto isolated	24	0V
12	!EXT-EN opto isolated	25	0V
13	Reference potential		

Table 7.7 Analogue out MSC07 pin assignment

Note

Pins 11 and 12 are used to enable an External Electrode Supply (not used in RC-RGA systems), contact Hiden Analytical Limited for further information.

The Analogue Output signals provided on the ANALOGUE OUT MSC07 connector are the same as those generated by the optional External Interface Card in HAL 4 and HAL 5 units and described in the manual "External Interface Card User Manual" reference HA-085-049.

As standard none of the Analogue Output channels will be configured. Optionally, eight or sixteen Analogue Output channels many be provided. The ANALOGUE OUT MSC07 connector is always fitted, even when no Analogue Output channels are available.

The ANALOGUE OUT MSC07 connector provides eight or sixteen programmable voltage channels to drive external equipment and processes. Voltages on each of the channels may be set at d.c. levels in the MASsoft Scan Tree environments, may be scanned as part of the Scan Tree, or may be programmed using values read from one or more input devices. Refer to the MASsoft User Manual for further information on Scan Trees.

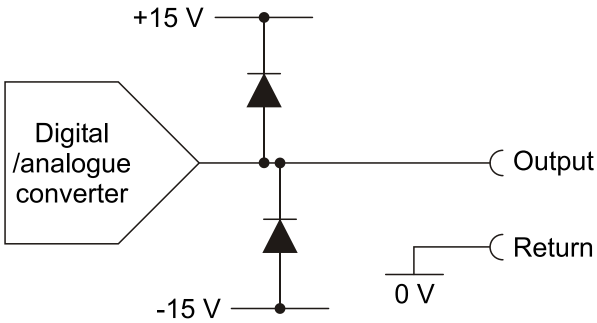


Figure 7.11 Analogue output circuit

7.5.1 Specification

Digital/analogue converter resolution: 14 bit.

Full scale voltage range: 10 V.

Maximum output current: 10 mA.

7.5.2 Accessing the input/output ports

Access to the input/output (I/O) ports is controlled via the normal MASsoft user interface; this Section describes how to program, write and read the ports. In order to understand the concepts and terms used here, it is recommended that Hiden Analytical Limited Manual MASsoft Manual is read first.

7.5.2.1 Logical devices

The logical device is the representation of a port used by the software; it comprises a name, a value range and an associated units name. Access to a port is by selecting the name in the appropriate MASsoft edit dialog box, when the value range and value units name will be displayed. The value range is mapped onto the physical range (in some cases, particularly the digital I/O, they are the same), so that the port can be read or written in its natural units.

7.5.2.2 Analogue outputs

Logical devices for the analogue outputs are named **channel_1** to **channel_16**; they are normally scaled for a ±10 V range with the units name **volts.** The names and range are programmed into the control unit firmware by Hiden Analytical during manufacture and cannot be altered by the user. Alternative, application specific, analogue output names, ranges and units may be programmed into the firmware by Hiden Analytical if applicable but again they may not be altered by the user.

Where Hiden Analytical Limited has assigned an analogue output to a specific variable, the name of the output and its units name will be the same as the variable; the value range will normally be scaled to match the physical ±10 V range of the output. For example, if an output is to drive a temperature controller where a 0 V to 10 V input signal sets a temperature of 0 °C to 1000 °C in furnace 1, the output could be named **furnace_1** with a range of 0 to 1000 and a units name **°C**.

In MASsoft, values may be set into the analogue outputs via an environment (shutdown, global or local), a scan, or an event sequence.

When set via an environment, the analogue output will have a constant value, which is entered using the appropriate **Environment Editor** dialog box. See Figure 7.12 for an example of a global **Environment Editor** dialog box.

When set via a local environment, the analogue output value can be varied depending on its position in the scan tree, so that any process variables driven via these outputs can be varied synchronously with scanning.

To monitor the effects of changing a variable on the partial pressures of gases in a process or desorbed from a surface, the analogue outputs can be scanned, as shown in Figure 7.13.

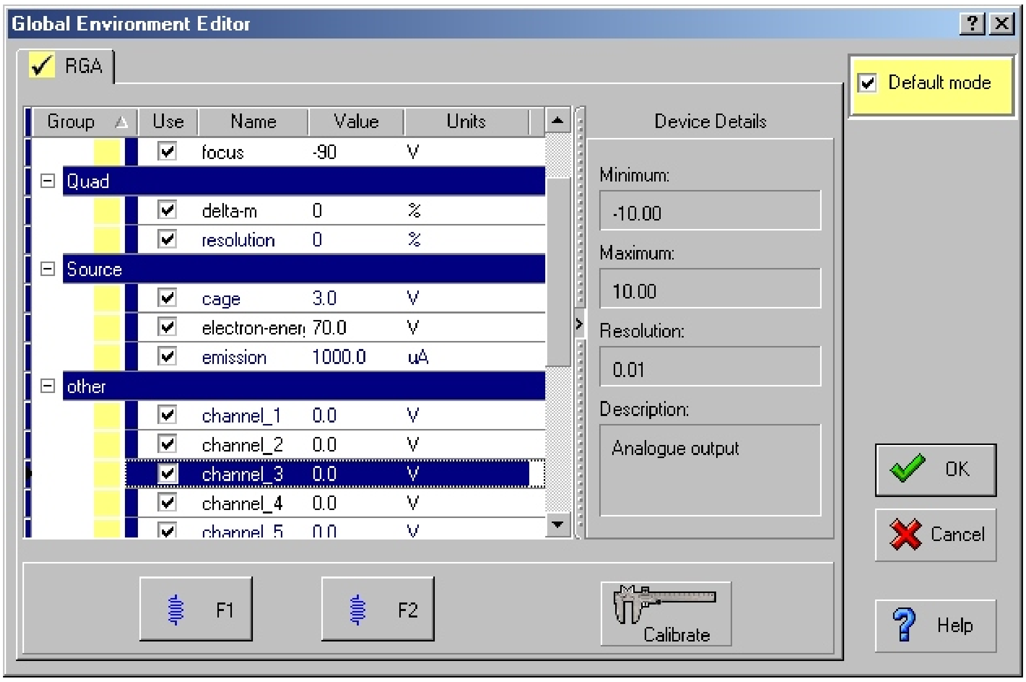


Figure 7.12 Environment Editor dialog box

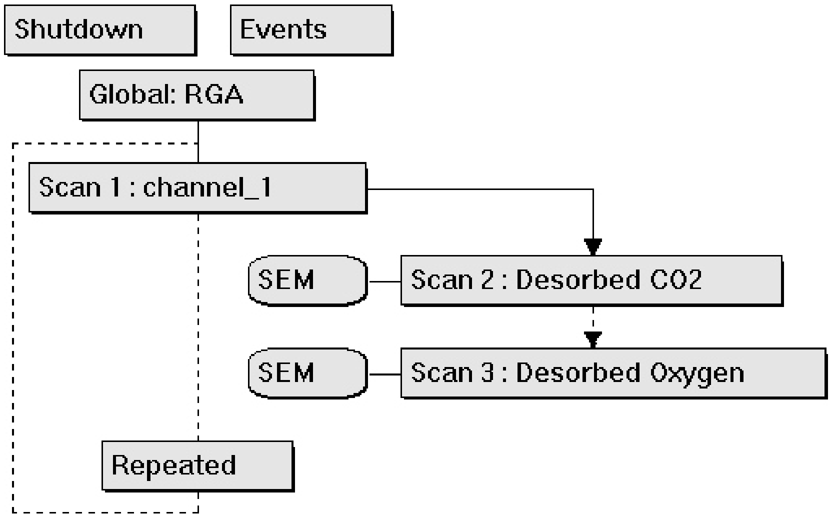


Figure 7.13 Scanning an analogue channel

Note that if the analogue channel name does not appear in the **Available to Scan:** list box in the **Scan Editor** dialog box (opened by double-clicking on the scan), it can be typed into the text box.

Finally, the analogue outputs may be set using the event sequence handler.

Please refer to the Analogue Outputs section of the MASsoft Events Sequences Guide.

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Glossary

Abbreviations

The following abbreviations are used in this manual:

amu	Atomic mass unit
EMC	Electromagnetic Compatibility
EPROM	Erasable Programmable Read-Only Memory
HAL	Hiden Analytical Limited
HT	High Tension
HV	High Voltage
IC	Integrated Circuit
I/O	Input/Output
IU	Interface Unit
LAN	Local Area Network
LED	Light Emitting Diode
LVD	Low Voltage Directive
LVTTL	Low Voltage Transistor-Transistor Logic
MHV	Medium High Voltage
MID	Multiple Ion Detection
MSIU	Mass Spectrometer Interface Unit
PC	Personal Computer
PCB	Printed Circuit Board
RF	Radio Frequency
RGA	Residual Gas Analysis
SCEM	Single Channel Electron Multiplier
SELV	Safe Extra Low Voltage
SEM	Secondary Electron Multiplier
SHV	Safe High Voltage
TTL	Transistor-Transistor Logic
UHV	Ultra High Vacuum
UTP	Unshielded Twisted Pair

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Index