MAG Quadropole Gas Analyzer

Operating Instruction

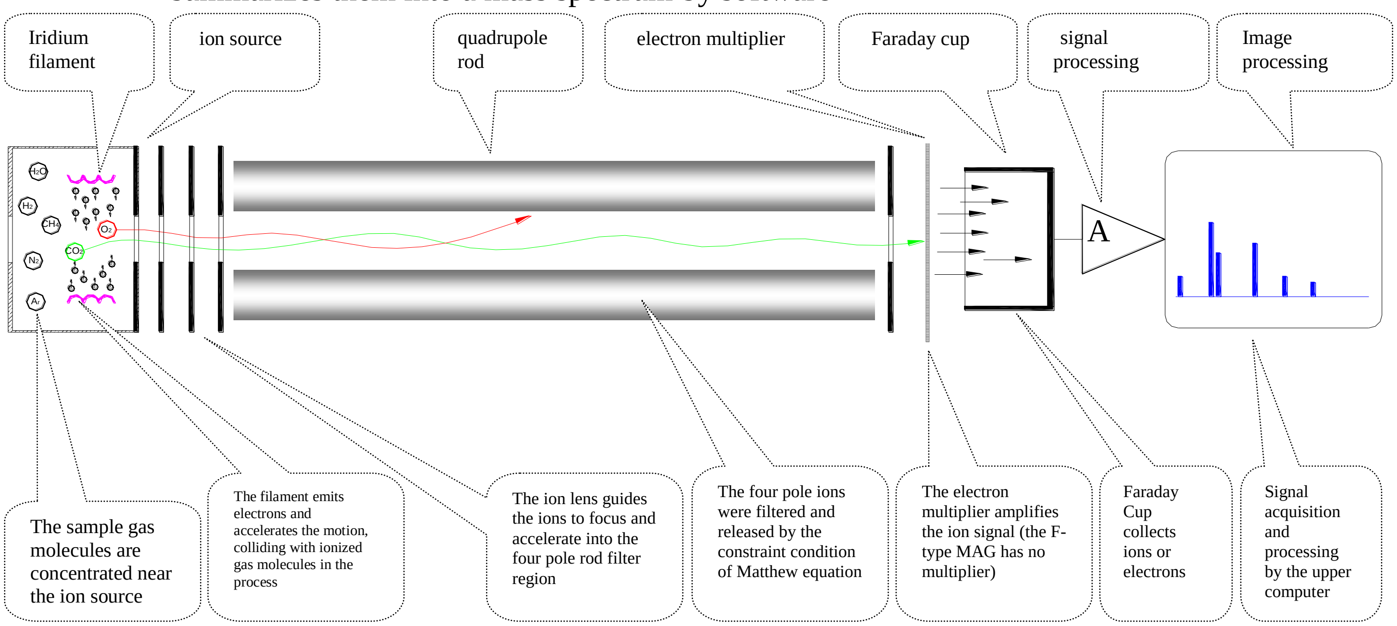
1. brief introduction

1.1 Product usage

The MAG four-pole mass spectrometer gas analyzer is used to measure the partial pressure of each component in the mixture.

The basic measurement principles and processes include

- The ionic source ionizes the gas molecules into ions or ionic groups
- The four-pole rod filters and classifies ions according to their mass charge ratio
- The electrical control unit measures the number of ions with each mass charge ratio and summarizes them into a mass spectrum by software



Each gas molecule possesses a unique mass characteristic, known as the material's fingerprint spectrum. By measuring the mass numbers of ionized gas molecules, we can precisely identify their types. The intensity of ion signals corresponding to specific mass numbers determines the partial pressure of the gas or its concentration within mixed gas components.

MAG analyzers can be used in environments with vacuum pressure less than 5.0X10-2Pa

- Analysis of process gas and background residual gas composition in vacuum system
- Vacuum system leak detection
- Source monitoring of vacuum system

By analyzing the variation of gas partial pressure in the vacuum system, the condition of vacuum environment process can be effectively monitored, and it provides an effective tool for various vacuum processes to achieve measurable, controllable and repeatable.

MAG analyzers can also be used in normal or even high pressure environments

With the addition of a small vacuum unit and capillary sampling fine-tuning valve, MAG can realize the monitoring of gas or volatile substances in normal pressure or even high pressure environment. Therefore, it is widely used in medical instruments, air pollution monitoring, pharmaceutical chemical brewing process monitoring, special gas leakage detection and other fields.

2. Product identification instructions

2.1 Label information

There is an information plaque at the indicated position on the back of all MGA products.

Model	MAG 200 M-0A
S. N.	13MAS863700
Date	Jan. 29, 2006

In order to communicate more effectively in after-sales service, please provide complete product nameplate information, including model and serial number.

2.2 Model description

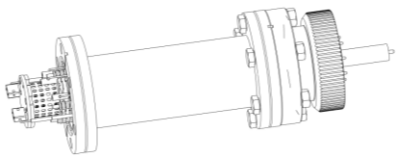
MAG 200 M-XXX

- XXX: Users customize a backup number
- M: F: Faraday Cup ion receiver M: Electron multiplier receiver
- 200: Maximum scan quality range: 100AMU, 200AMU, 300AMU
- MAG: MAG series four-pole mass spectrometry gas composition analyzer

2.3 Standard parts

When receiving the new package, the standard list should include the following main components and auxiliary parts.

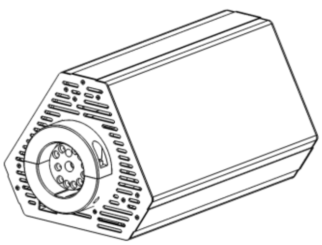
（1） Probe



The probe consists of five parts

- Source of ions: ion lens and electron-emitting lamp
- Four-pole: Select ions that filter the fixed mass ratio
- Ion receiver: receives ions, divided into a Faraday cup and an electron multiplier
- Vacuum interface: The standard interface is CF35 metal seal
- Electrical interface: The vacuum sealed terminal is plug and play connected to the ECU

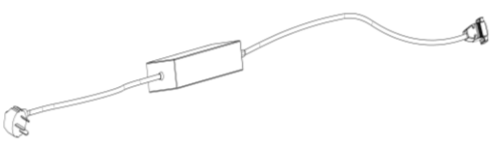
（2） Electronic control unit (ECU)



The ECU consists of five circuits

- DC high voltage circuit
- Radio frequency high voltage circuits
- Weak signal amplification circuit
- Communication interface circuit
- Digital processing center unit circuit

（3） Power adapter (Adapter)



Power adapter

- Convert the external AC 85~265/45~60Hz power supply to a +24VDC/3.0A DC voltage acceptable to MAG

（4） Communication cable (Comm. Cable)

Communication cable

- One end is a DB9 (public) plug, and the other end is a USB/RS485 converter, which converts the USB port signal of ordinary WinXP/07/08/09/10 computer into RS485 serial port signal to communicate with MAG
- Option: DB9 (mother) -USB/RS485 vacuum gauge cable for optional vacuum gauge accurate

（5） Application software (VAaccuRay)

VAaccuRay4.0 application software realizes the communication and data interface between computer and MAG.

3. Safety precautions

personal security

- high-handed

  There are more than 1000V DC and AC RF power supply in MAG probe and the electronic control unit. It is strictly prohibited to remove the probe and electronic control unit with live power without professional technical training personnel to prevent serious personal and property safety.

- Front-end grounding

  The front grounding terminal of the control unit, the probe shell and the vacuum chamber must be tightly connected with good contact wire (it is recommended to be braided copper wire), and be safely grounded to prevent leakage, induction, static electricity and other factors from causing personal and property safety.

- Means of use

  Toxic, inflammable and explosive, radioactive, dust and other harmful gases require additional protective measures. Please consult our engineers before use

technical security

- MAG is a system that works on high frequency, high voltage and weak current signals. The instrument includes the whole shell, internal component arrangement and parameter setting, which are mutually restricted and work together. Do not modify any parts inside the instrument, in order to avoid damage to the overall resonance conditions and failure of the instrument to work normally.
- If the vacuum pressure is higher than 5.0X10-2Pa and the filament is turned on for a long time, the filament will accelerate aging and fracture, and the surface of ion source lens structure is more prone to oxidation, which will affect the ion dissociation efficiency.
- No matter the external temperature is high or low, the small cooling fan at the tail of the instrument will improve the temperature uniformity of the internal environment of the instrument. Please pay attention to the fan ventilation port not to be blocked by external objects during use, which may lead to uneven local temperature inside the instrument and affect the stability of the whole system.
- During use, when the red warning (WARN) LED at the tail is lit, please turn off the power switch of the application software and the instrument, and then restart the work separately.

disclaimer

In the event of any of the following circumstances, our company will not be liable for the consequences and will cancel the warranty commitment:

- Failure to follow the requirements in this manual and improper use of this instrument
- Make any form of modification to the instrument, including disassembling the ECU chassis, adding or removing any parts
- Use an attachment that is not specified in this document

At the same time, users are fully responsible for the safety of media used in vacuum environments (including flammability, toxicity, radioactivity, etc.).

technically training

Provide training on basic theory, instrument use and application technology related to MAG products

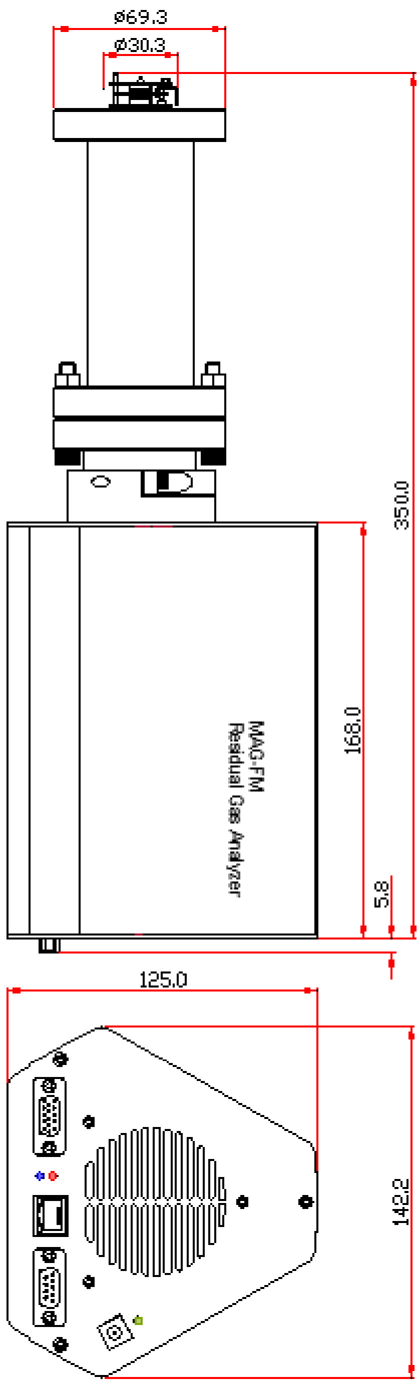
4. Technical performance indicators

4.1 Parameter table

model	**MAG100F**	**MAG200F**	**MAG300F**	**MAG100M**	**MAG200M**	**MAG300M**
Scan range (AMU)	1~100	1~200	1~300	1~100	1~200	1~300
resolution ratio	<1.0AMU @ 10% peak height					
repetitiveness	+ /-1% (stable test of N2 and O2 in air for 8 hours)					
Type of ion source	Option: open gate test ion source or closed ion source					
ion collector	Faraday cup			Electronic multiplier, gain>1000		
filament material	Double filament, iridium coated with yttria, 0.2mm in diameter					
Working pressure range	5.0X10-2Pa ~ UHV			5.0X10-3Pa ~ UHV		
Minimum measurable voltage	5.0X10-9Pa			5.0X10-12Pa		
Minimum detectable current	1.0X10-12A			1.0X10-15A		
scanning speed	2 milliseconds to 60 seconds per sampling point					
Probe baking temperature	200 ℃ Max			150 ℃ Max		
ECU working temperature	5 ℃ ~ 45 ℃; maximum relative humidity 98%					
utility software	VAccuRay 4.0					
communication interface	RS485 Modbus-RTU					
AUX synchronous port	2 channel analog input; 4 channel digital input; 4 channel digital output					
Vacuum interface	Conflat metal oxygen-free copper seal CF35 flange cutting edge seal, flange outer diameter 70.0mm					
Power Supply Voltage	+24VDC （+/-10%）/2.0A					
External dimensions (mm)	With probe: 350 L X 142W X 125H					
weight	ECU (including probe): 3.5kg, power adapter: 1.0kg					

The technical parameters of the specific model may be adjusted accordingly. Please refer to the technical specification shipped with the instrument for detailed indicators

4.2 External dimensions (mm)

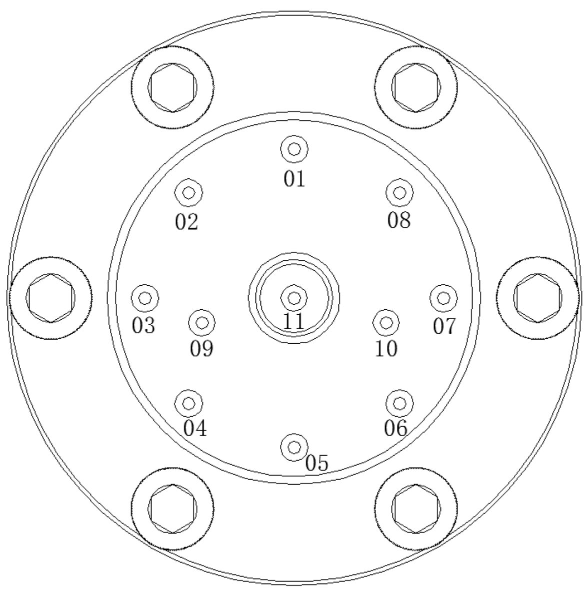


5. Hardware notes

The MAG series gas analyzer hardware is mainly composed of two parts: vacuum probe, electronic control unit.

5. 1 Vacuum probe

The probe assembly comprises an ion source, ion lens, quadrupole, ion receiver, and vacuum-sealed flange with integrated electrical signal transmission terminals. Its primary function is to ionize gas samples in the vacuum environment for analysis. The ions are then filtered, categorized, and directed to the ion collector via the quadrupole and ion lens. Two types of ion collectors are available: a Faraday cup that directly collects ions and converts them into ionic currents, and an electron multiplier that first collects ions and multiplies them by 1000-10000 times to release electrons, which are subsequently converted into electrical currents through the Faraday cup.



MAG probe external lead

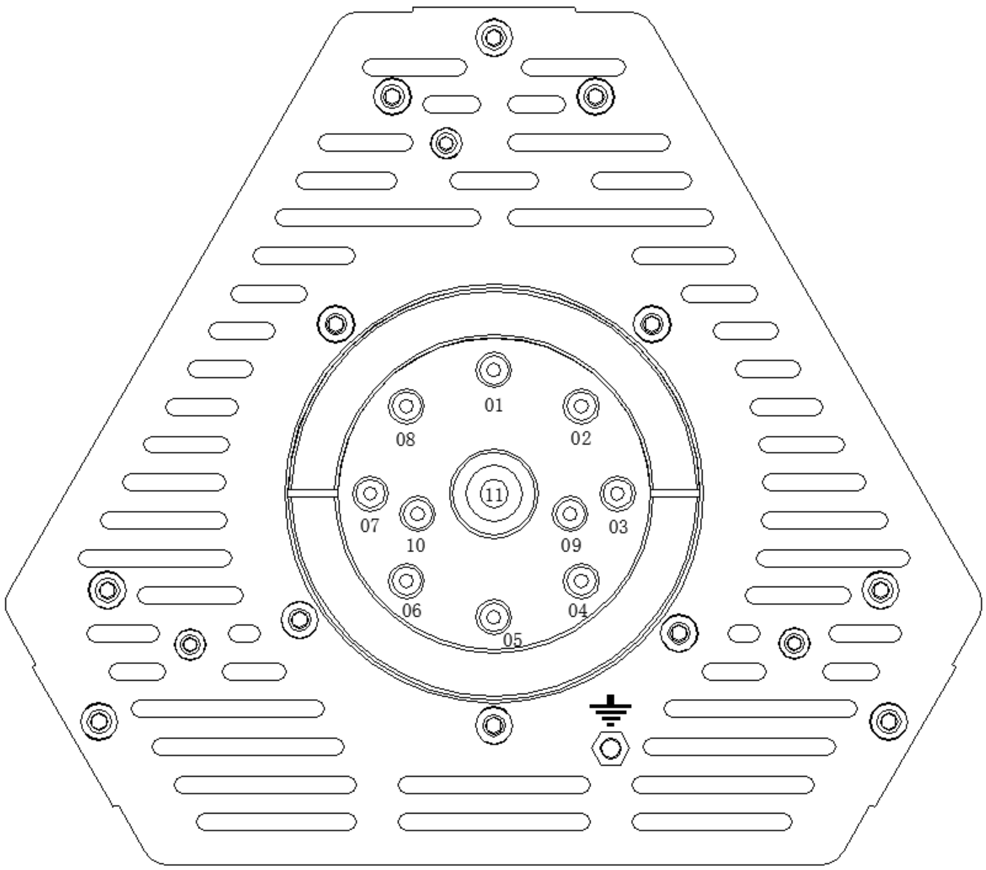
pin	symbol	Function of the four pole probe pin	Range of electricity
1	FOCUS	Ion source focusing electrode	+100 ~ +110VDC
2	EXTRACT	Electrode for external ion source	+50 ~ +100VDC
3	RF+	Four pole radio frequency electrode +	Radio frequency 0.00 ~ 1200.00Vpp
4	FilaCOM	Filament public electrode	+50 ~ +100VDC
5	RF-	Four-pole radio frequency electrode-	Radio frequency 0.00 ~ 1200.00Vpp
6	ANODE	Ion source anode electrode	+110 ~ +130VDC
7	FILA02	Filament 02 electrode	+50 ~ +100VDC
8	FILA01	Filament 01 electrode	+50 ~ +100VDC

9	HV+	Electron multiplier positive electrode +	-15VDC fixed
10	HV-	Negative electrode of electron multiplier-	-500 ~ -1000VDC can be set
11	DET	Ion signal collection electrode	Zero point

5.2 ECU

The control unit provides the groups of high voltage DC and radio frequency signals required by the vacuum probe, receives and analyzes weak ionic current signals, and provides various power supply, communication, synchronous control signal and other interfaces for user use.

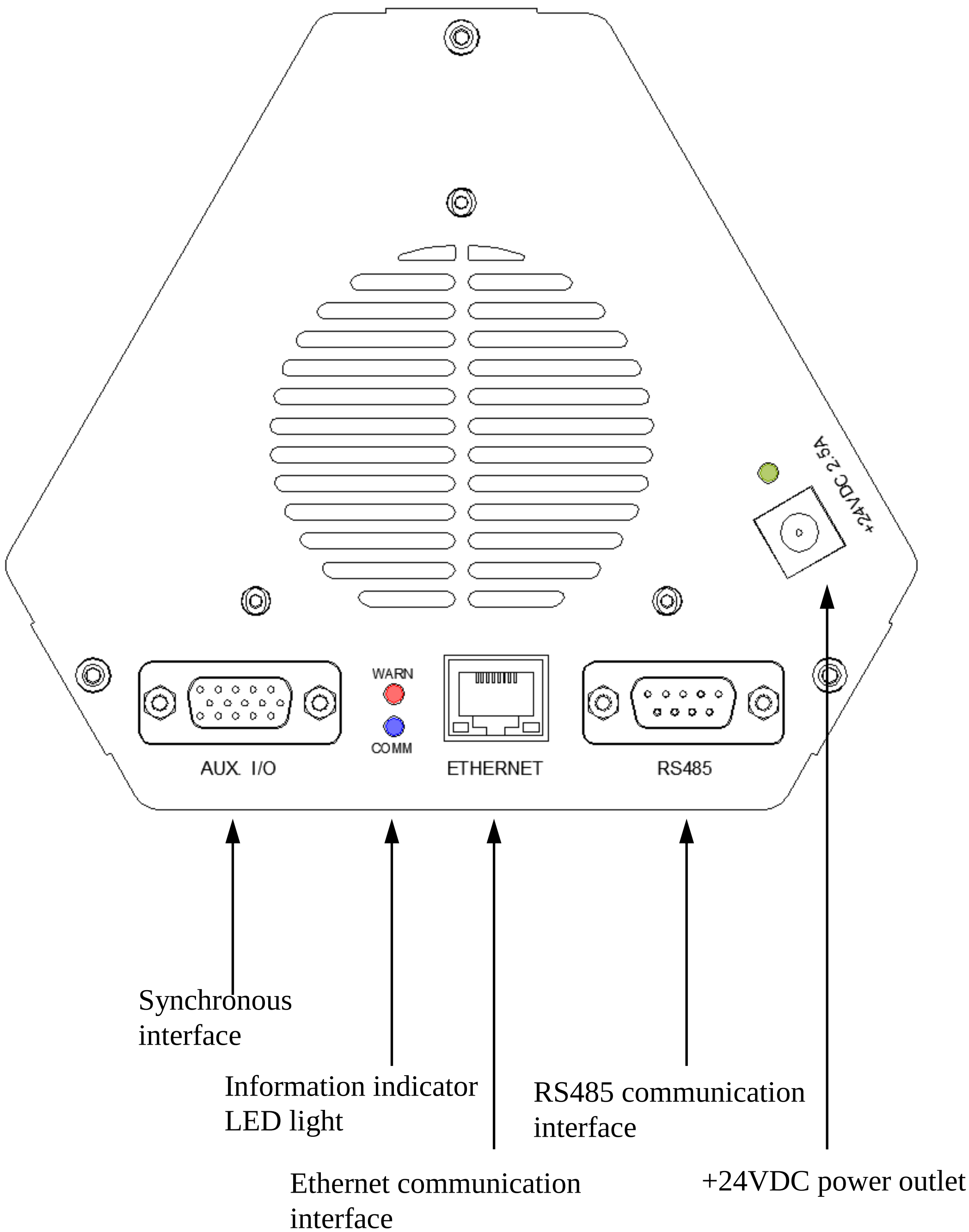
Front panel. Vacuum probe socket



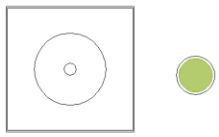
Four-pole probe socket, foot position function description refer to the previous section, pay attention to the mirror position

Back panel. Functional interfaces

The Faraday Cup receiver has the same backplane electrical interface as the MAG model electron multiplier receiver



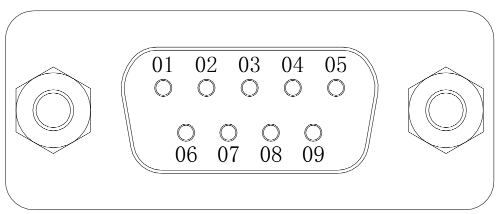
- +24VDC power outlet



Power supply socket, DC-007B 5.5*2.1 core gold plating, power requirement +24VDC (+/-10%)/2.5A.

When the green LED on the side is lit, it indicates that the internal positive high voltage has been started.

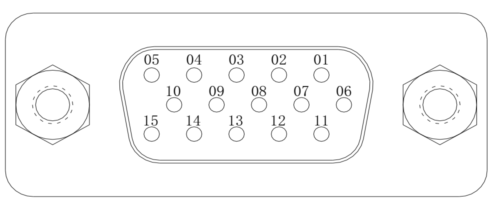
- RS485 communication interface (DSub9)



Pin1: Data-	Pin6: GND-ISO (isolated from the motherboard ground)
Pin2: Data+	
Pin3: NC	Pin7: NC
Pin4: NC	Pin8: NC
Pin5: NC	Pin9: NC

Port configuration: baud rate 115200, start bit 1, data bit 8, stop bit 1, parity bit no.

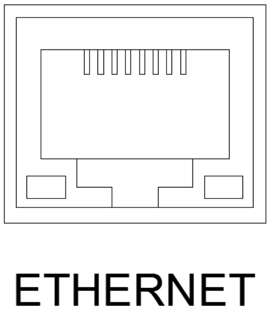
- AUX I/O synchronous auxiliary interface (DB15 VGA three-line master head)



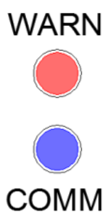
Pin1: Digital signal output 02 (user defined)
Pin2: Digital signal input 02 (user defined)
Pin3: UART-TX (additional backup communication)
Pin4: Analog input 01 0~+10VDC (user defined)
Pin5: +24VDC 0.5A power output
Pin6: Digital signal output 04 (user defined)
Pin7: Digital signal output 01 (user defined)
Pin8: Digital signal input 03 (user defined)
Pin9: UART-RX (additional backup communication)
Pin10: Analog input ground GNDA
Pin11: Digital signal output 03 (user defined)
Pin12: Digital signal input 01 (user defined)
Pin13: Digital signal input 04 (user defined)
Pin14: Analog input 02 0~+10VDC (user defined)
Pin15: Power input ground DNG

User definition: The logic level is 0/+5.0VTTL level, UART is 3.3V LTTL level, ADC is 12-Bit0.0~+10.0VDCinput, can be programmed to define the target according to customer requirements,   User definition: The logic level is 0/+5.0V TTL level, UART is 3.3V

- Ethernet communication interface



- Information indicator LED light



Blue LED: Communication indicator light, which is always on after startup. When the host computer and MAG establish RS485 communication, the blue light starts to flash, indicating normal communication.

Red LED: Warning indicator. When the red light is on, it indicates that the high-voltage radio frequency scan is out of tune. If the scan process is always on, the out-of-tune state needs to be corrected by adjusting the one-character screw in the ECU tuning hole.

6. installation and trial run

6.1 Hardware installation

The hardware installation of MAG series gas analyzer mainly includes vacuum probe installation, electronic control unit installation, power supply and communication cable installation.

6.1.1 Vacuum probe installation

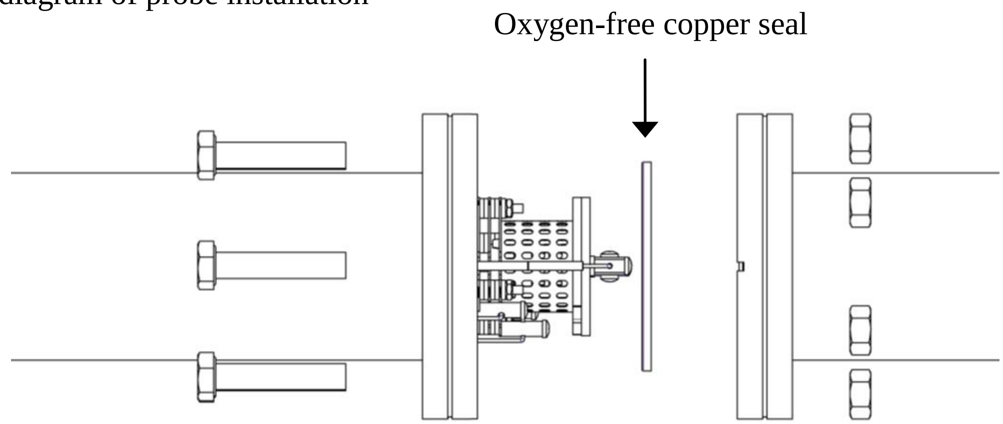
Probe installation precautions

- The probe ion source part is 30mm high and 35mm in diameter. This part will be inserted into the vacuum flange to be tested, and the interface flange design should meet the corresponding size requirements.
- The probe can be installed in any direction and Angle as needed, but the position reserved for the electric control unit and the space for the cable routing and status LED observation of the backplane of the electric control unit should be considered before installation.
- Do not touch any part of the vacuum side of the probe with bare fingers. If necessary, wear nitrile or latex gloves to prevent skin oil from contaminating the vacuum system.
- The MAG installed vacuum interface has a good grounding and is safely connected to the electronic control unit to ensure safe use.

The probe needs tools to install

- 1 unused clean CF35 oxygen-free copper seal
- Six M6 stainless steel hex socket screws are required, with their lengths determined by the type of CF35 vacuum interface flange. Specifically: CF35 threaded flanges require M6X25 screws, while CF35 perforated flanges need M6X35 screws. Each screw must be installed with a matching stainless steel washer of the appropriate size.
- 15mm L-shaped hex wrench
- 110mm open nut wrench

Schematic diagram of probe installation



Suggestion: After the probe is installed, use the short circuit detection function of the multimeter to check whether each terminal of the probe is short circuit with the shell, and whether there is a short circuit between each terminal. It is normal to have about 1 ohm resistance between the two filament terminals.

6.1.2 Installation of the ECU

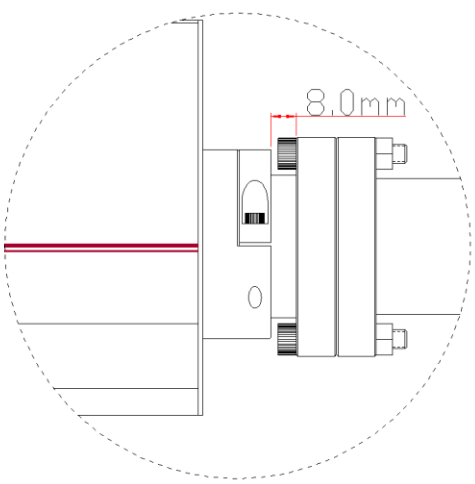
After the MAG probe is installed on the vacuum system, the MAG's electronic control unit (ECU) needs to be installed on the probe. The probe is electrically connected by inserting the vacuum sealed terminal pins at the rear into the socket in front of the ECU.

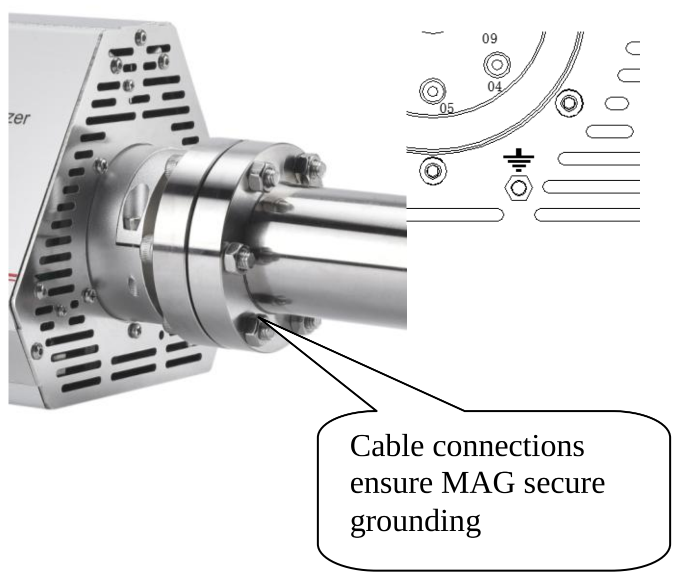
The installation steps are as follows:

（1） Observe the orientation of terminal Pin9 and Pin10 at the tail end of the probe, which should be consistent with the corresponding position in the ECU socket. The plug and socket have unique adaptability to the corresponding position.

（2） Loosen the two M4 bolts on both sides of the ECU socket. Secure the loose semi-circular frame by adjusting it, then slowly push the probe's terminal end into the ECU socket hole until the pins reach the socket's bottom. At this point, the CF35 flange at the probe's base should be approximately 8.0mm away from the socket's end. Next, use a hex key to alternately tighten the M4 bolts on both sides in a crisscross pattern.

（3） The attached winding grounding cable is fixed on the probe with M6 nut as shown in the figure, and fixed on the ECU end with M3 nut to ensure the safe grounding of the equipment.





Matters need attention

- Due to assembly tolerances in probe structures, each probe carries a tolerance in its load capacitance. Manufacturers calibrate the ECU to optimize tuning for specific probes during factory calibration. When replacing probes, users must recalibrate the optimal frequency using the AutoTune feature in the application software interface after powering on the device.

- The ECU operating environment temperature should not exceed 45°C and should have free flow of air circulation. Do not install the ECU near a large heat source or in a sealed environment to prevent excessive accumulation of heat affecting the working performance of the instrument.

6.1.3 External cable connections

Communication cable

The host computer and MAG require an RS485 communication cable to enable command transmission from the computer to the MAG and receive real-time data collected by the MAG. The MAG employs RS485 communication mode, which supports both point-to-point communication between a single computer and one MAG, as well as network communication configurations connecting the computer to multiple MAG units (up to eight).

- Single MAG Point-to-Point Communication: For computers running Windows XP, Windows 7, or Windows 10, connect the USB/RS485 converter module via a USB2.0 or higher port. Connect the DB9 male connector on the module's cable to the RS485 port on the MAG back panel, then secure it with screws. The default internal address for each MAG unit is set to 01, and the application software interface will always select Station 01.
- Multi-MAG Networking Configuration: For computers running Windows XP, 7, or 10, connect the USB/RS485 converter module via a USB2.0 port or higher. Connect the module's cable to the RS485 parallel node configuration mode. Secure the DB9 male connector at each node end to the RS485 socket on the MAG back panel using screws. Each MAG unit can be configured with up to 8 unique communication addresses (01-08). During software operation, select the corresponding Station 01-08 MAG units for system management.

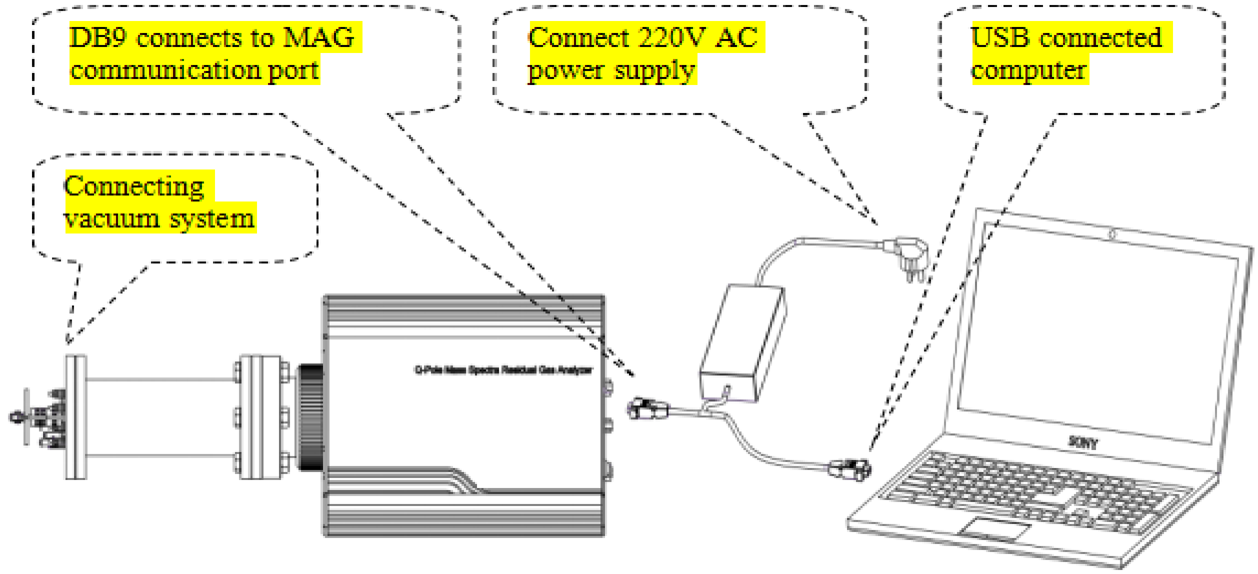
feed cable

The random configuration is equipped with a 90~260VAC input, +24VDC output, 45~65Hz, and a 100W power adapter.

（1） Connect the adapter cable DC 5.5*2.1 plug to the PWR+24VDC socket on the MAG back panel and tighten.

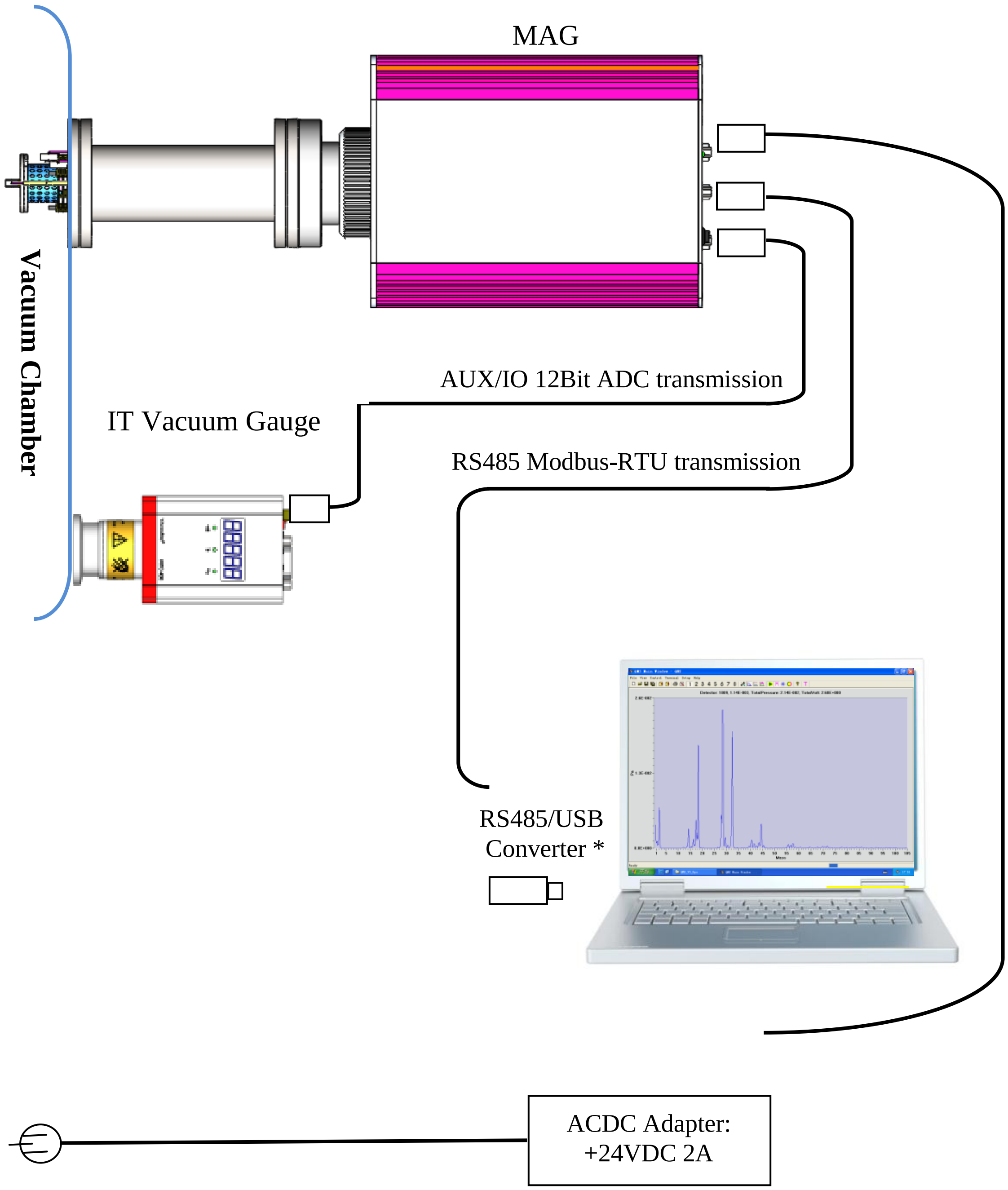
（2） Insert the AC three-core plug of the adapter into the AC power socket.

Note: Please confirm that the AC three-hole socket has good real grounding protection.



6.1.4 Synchronous detection of vacuum gauge (optional)

MAG provides a synchronized access option for universal compatible vacuum gauges, enabling precise measurement of the total pressure in vacuum chambers and subsequent calculation of partial pressures for individual gas components. The vacuum gauge is powered by a +24VDC supply from MAG, which receives 0~+10.0VDCanalog voltage signals to calculate vacuum pressure. The total pressure values are then processed through the VAccuRay 4.0 software for accurate measurement.



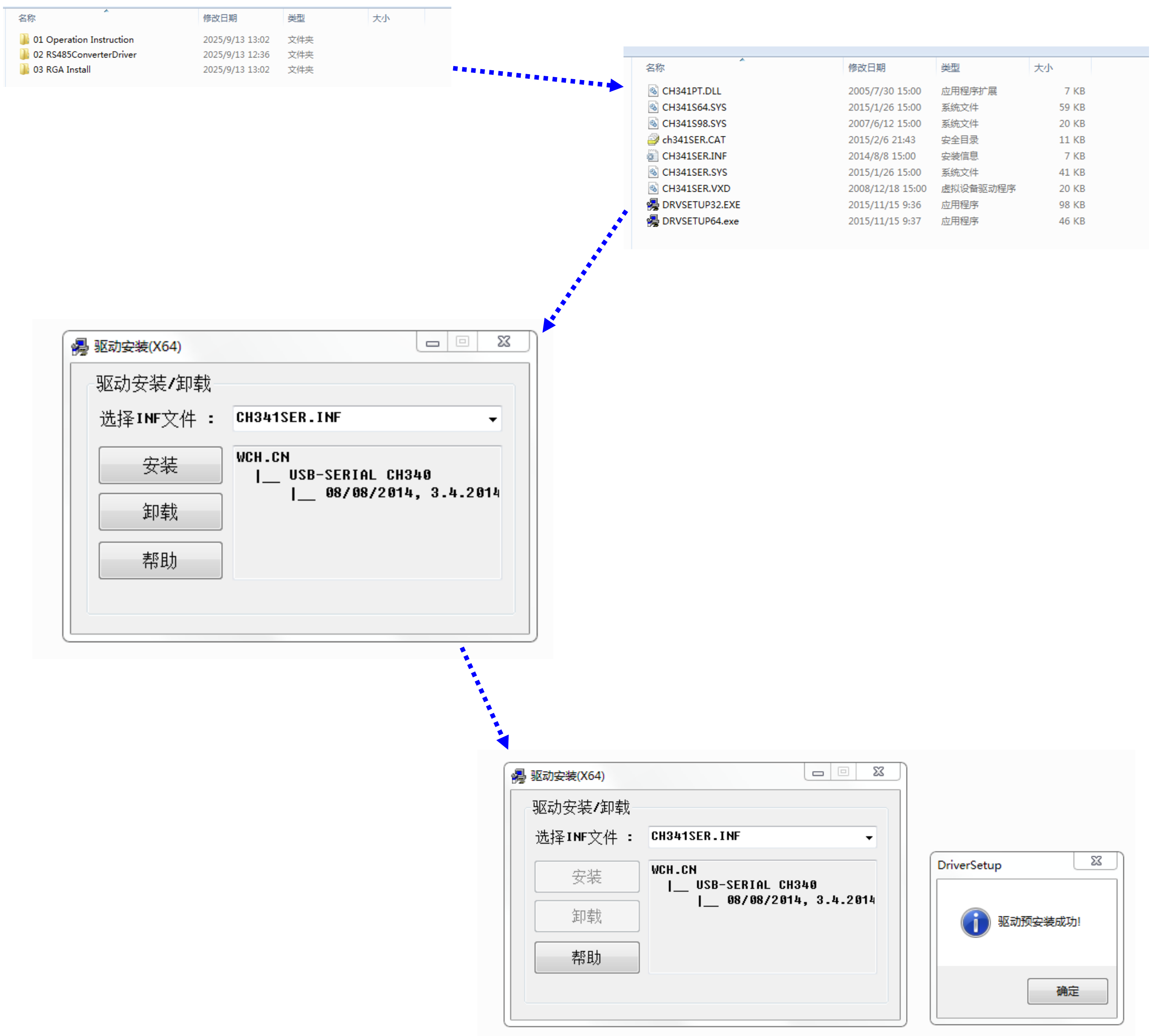
Overall Configuration and Connection

Note: Vacuum gauge is only for obtaining total pressure under partial pressure scan mode.

7. Software installation

Install USB/RS485 conversion module driver software

The USB/RS485 conversion driver is compatible with Windows XP, 07,08,10 operating systems. Open the software package provided with the device, select the corresponding driver software according to the number of bits of the installed computer operating system and click install.



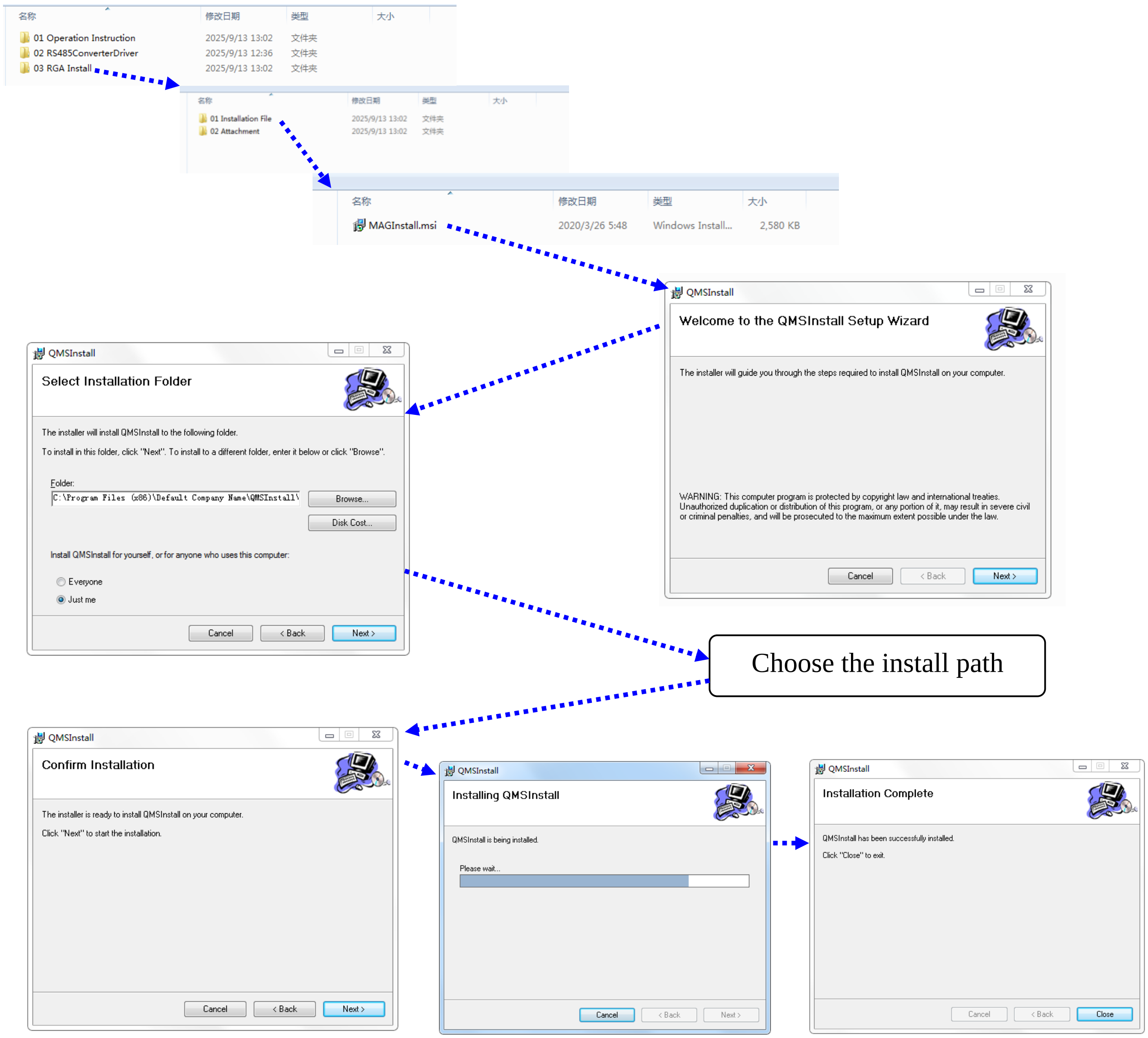
After installation, click OK.

Set the serial port in the computer device manager: COM4

Porter's ratio: 115200; start bit: 1; data bit: 8; stop bit: 1; parity bit: None

Installation of VAccuRay 4.0 application software

The VAccuRay 4.0 application is compatible with Windows XP, 7, 8, and 10 operating systems. Open the software package that comes with the device, click on the installation file VAccuRayV3.msi, and select the corresponding driver software based on the bit number of your computer's operating system before clicking install.



After installation, the MAG application executable file VAccuRay03.exe is generated in the installation path. Double-click to run the file and establish communication with MAG, which can send execution instructions and receive data results.

For the customer who already have old version software installed, please copy the files in the Attachment folder to the installation folder in order to update the software.

8. Start the upper electric motor

After completing the hardware and software installation described in the previous chapters, carefully check the following precautions before inserting and connecting the power supply to the MAG back panel:

- Check that the probe, electronic control unit, communication cable, power cable, and optional vacuum gauge are all properly installed and connected.
- Whether there is reasonable air circulation around the system, and whether there is space on the MAG panel to allow the fan to suck out cooling air.
- Whether the computer is running properly.
- Check the safety grounding of AC input power supply to ECU.
- Whether the pressure of the vacuum system meets the requirements of MAG operation

  Faraday Cup model: vacuum pressure <5.0X10-2Pa Faraday Cup model: vacuum pressure <5.0X10-2Pa

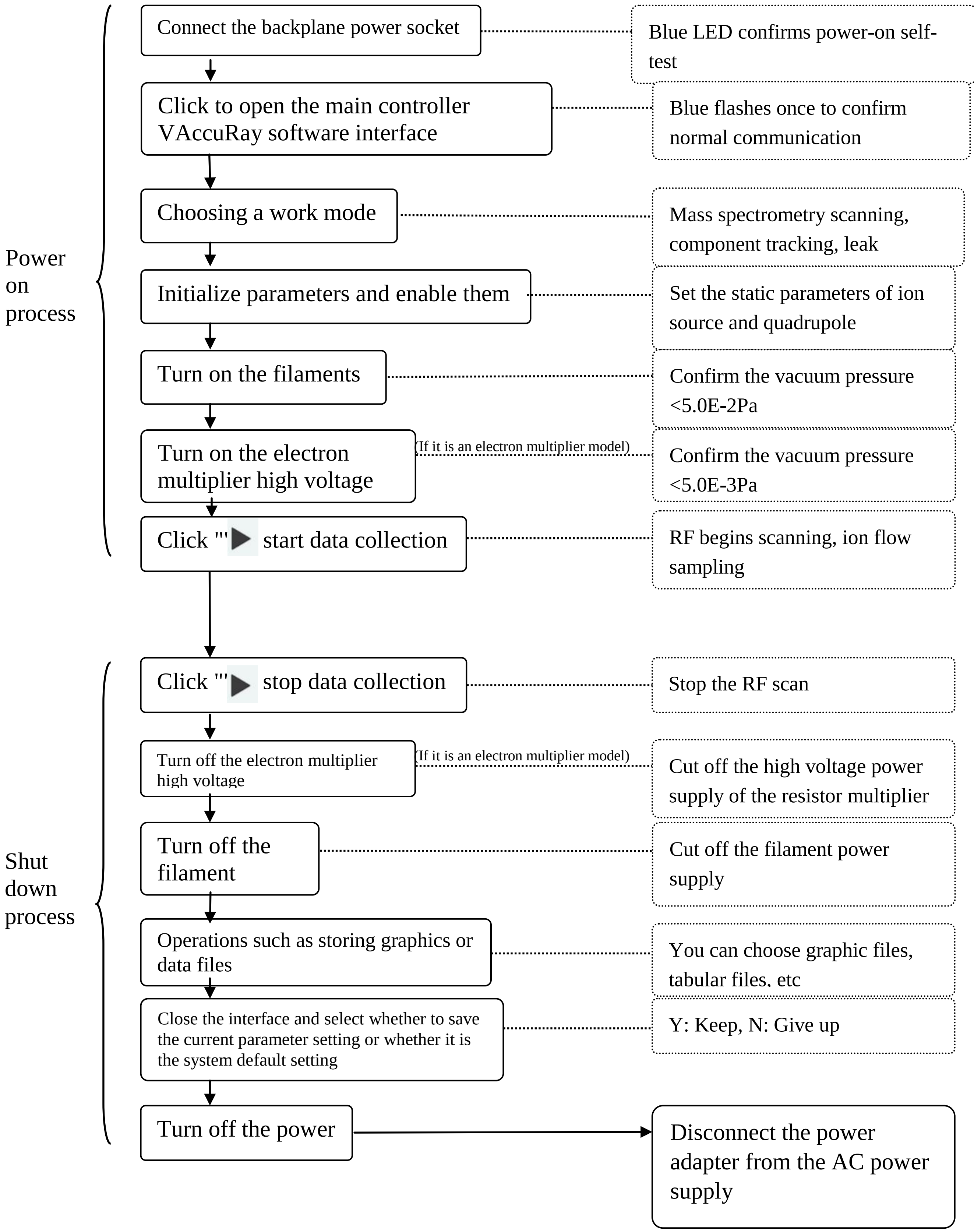
  Model of electron multiplier: vacuum pressure <5.0X10-3Pa Model of electron multiplier: vacuum pressure <5.0X10-3Pa
- Before MAG is manufactured, the structural coefficient, electronic components and system parameters of each component are adjusted to the best state. Please do not change the Settings at will. If you need to modify the Settings during use, please understand the relevant principles and Settings range, and carefully read the relevant content in the instruction manual.

Turn on the power switch. At this time, the blue LED (COM) on the MAG back panel is lit, indicating that the power is connected normally and the internal communication self-test is passed.

Open the computer application VAccuRay04.exe, and the operation main interface appears. At the same time, the blue LED (COMM.) on the back of MAG flashes once, indicating that the communication between the host and MAG is normal.

MAG gas analyzer WinXP, 07,08,10 compatible main

9. Introduction to MAG startup and shutdown procedures



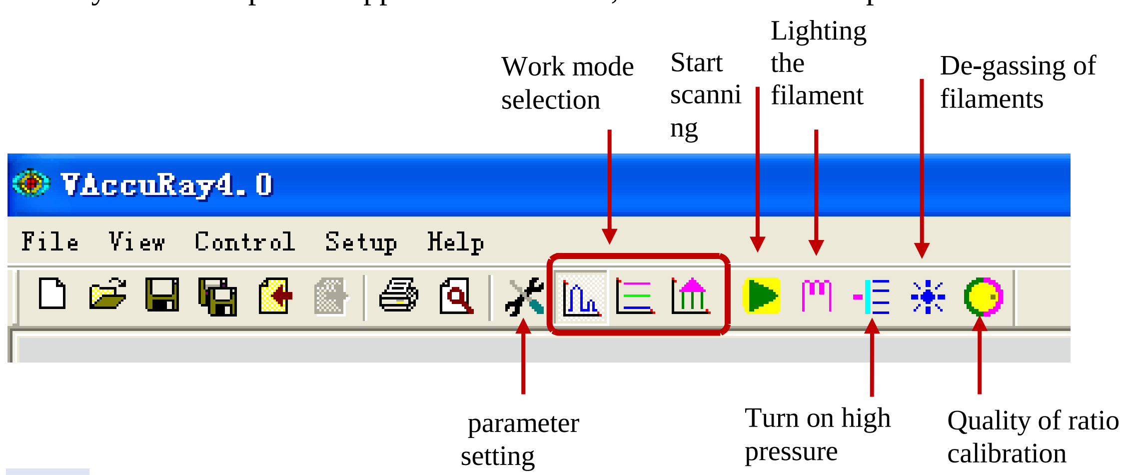
10. **VAccuRay4.0 application interface usage**

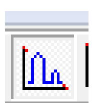
All internal parameter setting, data acquisition and monitoring of MAG are completed by MAG's own firmware and the VAccuRay4.0 software of the upper computer.

VAccuRay4.0 has three main operating modes

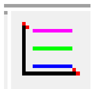
- Mass spectrum scanning mode: scan the mass ratio and give the ion current intensity or partial voltage signal to form the mass spectrum.
- Component tracking mode: the ion flow or partial pressure measurement is carried out simultaneously for up to 8 gas components, and the trace curve of each component changes with time is given.
- Gas leak detection mode: select a specific leak gas, MAG real-time monitoring system of the target gas components in the small content to detect whether there is a leak in the system, after calibration, can be quantitative leakage detection.

Click VAccuRay04.exe to open the application interface, first select MAG operation mode.

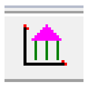




Scanning mode: The system scans along the x-axis (measured in AMU) from low to high mass-to-charge ratios while simultaneously measuring ion current variations (measured in A) to generate mass spectra of residual components in the system. VAccuRay can be configured in partial pressure mode, where total system pressure is measured and partial pressures (measured in Pa) are calculated for each component. Additionally, VAccuRay supports scanning specific mass spectral ranges or individual components. Scanning mode: The system scans along the x-axis (measured in AMUs) from low to high mass-to-charge ratios while simultaneously measuring ion current variations (measured in A) to generate mass spectra of residual components in the sample. VAccuRay can be configured for partial pressure measurement mode, where total system pressure is measured and individual component partial pressures are calculated using partial pressure calculations (measured in Pa). Additionally, VAccuRay supports scanning specific mass spectral ranges or individual components.



Tracking mode: Select up to 8 components and monitor the changes of these gas components in the system in real time. If necessary, the content of gas components can be automatically adjusted and controlled through MAG's AUX signal.
Since only specific components are detected, it is impossible to calculate the partial pressure of the whole spectrum, and the vertical coordinate of the tracking mode is only the ion current unit (A).



Leak detection mode: Select special leak detection gas and perform leak detection on the target with the same operation method of ordinary helium mass spectrometer. If quantitative measurement is required, the system should be calibrated with special gas standard source in advance. Leak detection mode: Select special leak detection gas and perform leak detection on the target with the same operation method of ordinary helium mass spectrometer leak detector. If quantitative measurement is required, it is necessary to pre-calibrate the system with special gas standard source.

Introduction to main menu operations

File menu

1） Clear:

Clear the graphics in the existing interface and open a new interface. After opening the new interface, you need to reselect the system configuration, including site location (1~8), detection working mode (Spectrum, Trend, Leak), boundary conditions, etc., and reconfigure the hardware parameters (Device Setup).

2） Open Configuration:

Open the configuration file. Open the working configuration file saved by the user through Save Configuration. The file is located in the QMS installation directory with the suffix.qms. The default configuration file of the application software is the.qms file saved when exiting the application software last time.

3） Save Configuration:

Save the current configuration to the default configuration file with the file extension.qms, including site selection, working mode, boundary conditions, parameter Settings, etc. Save the file content as the default configuration when opening the application software next time.

4） Save as Configuration:

Save the current configuration to a new path and configuration file name, with the file extension.qms.

5） Import Data:

Import the previously saved graphic file in the VAccuRay environment, with the file extension.dat.

6） Export Data:

Save the current graphic file to the specified path with the file extension.dat.

7） Print:

Prints the graphics of the current interface.

8） Print preview:

Preview the current print graphics.

9） Print setup:

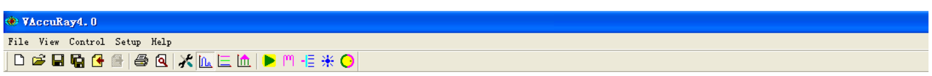
Printer Settings.

10） Exit:

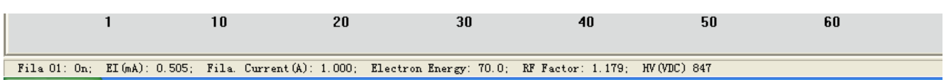
Exit the application. If exiting from a newly configured environment, the system will prompt you to select the path and filename for saving the configuration file. If exiting from an existing configuration environment, the system will ask "Save changes to file?" Select "Yes" to save the current configuration to the default file, and "No" to discard the changes.

View menu

1） Standard Toolbar: Select whether to display the standard toolbar. The toolbar icon is the shortcut key for some drop-down menus.



2） Status Bar: Select whether to display the status bar. The status bar is located at the bottom of the software environment interface, primarily serving as a customized information display area for clients. It includes operational parameters such as filament current, emission current, filament current, electron energy, RF factor, and electron multiplier high voltage.



Control menu

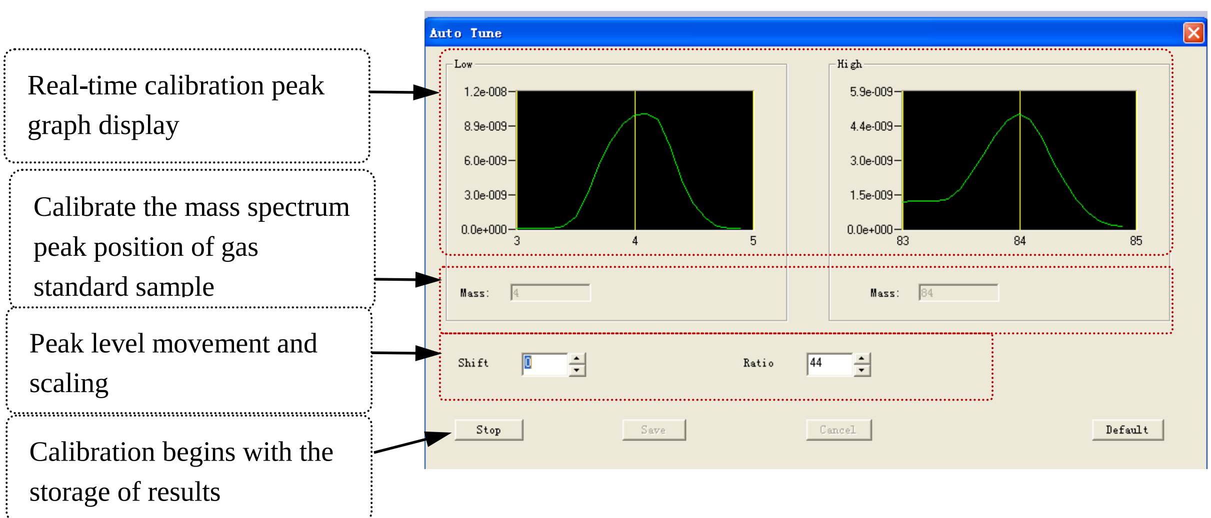
1） Scan: Start/Stop scanning. The scan read values in different working modes depend on parameter Settings. Spectrum mode acquires mass spectral peaks within a predetermined range, Trend mode captures the temporal variation of selected spectral peaks, and Leak mode measures the time-dependent changes in selected gas leakage rates.

2） Filament: Turn on/off the filament. Start the filament to work at the set emission current. Note that the system will prompt to confirm that the vacuum pressure is less than 5.0E-2Pa before the filament starts, so as to prevent the filament from being burned out due to high pressure.

3） CEM: Turn on/off the high voltage of the electron multiplier. This is only effective for the M-type QMS. Note that the system will prompt confirmation that the vacuum pressure is less than 5.0E-3Pa before turning on the high voltage to prevent the electron multiplier from being broken down and burned out due to excessive pressure.

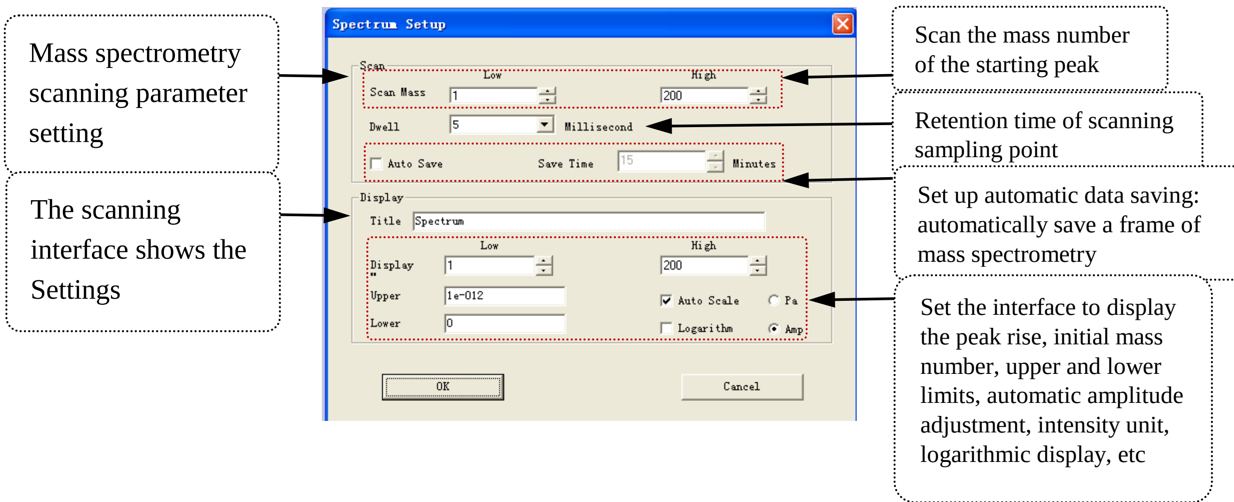
4） Degas: Turn on/off degassing. Degas is used to increase the emission current and ion lens potential and direction, allowing high-energy electrons to bombard the surface of the ion source to remove adsorbed gases. Each degassing operation automatically continues for 90 seconds.

5） Mass Calibration: Perform mass number position calibration on the X-axis. Under vacuum conditions, introduce two standard gas samples or at least identifiable H2O/N2. Open the Mass Calibration interface and select the ion source region to determine the two standard sample gas charge-to-mass ratios. Enter these values into the peak positions. Click "Start" to initiate dynamic scanning. During this process, adjust the horizontal shift (Shift) and ratio scaling (Ratio) values repeatedly based on real-time peak position deviations against standard mass spectrometry reference points until the real-time spectrum peaks align with the standard reference positions. Complete the mass number calibration operation and save the calibration parameters to the instrument.

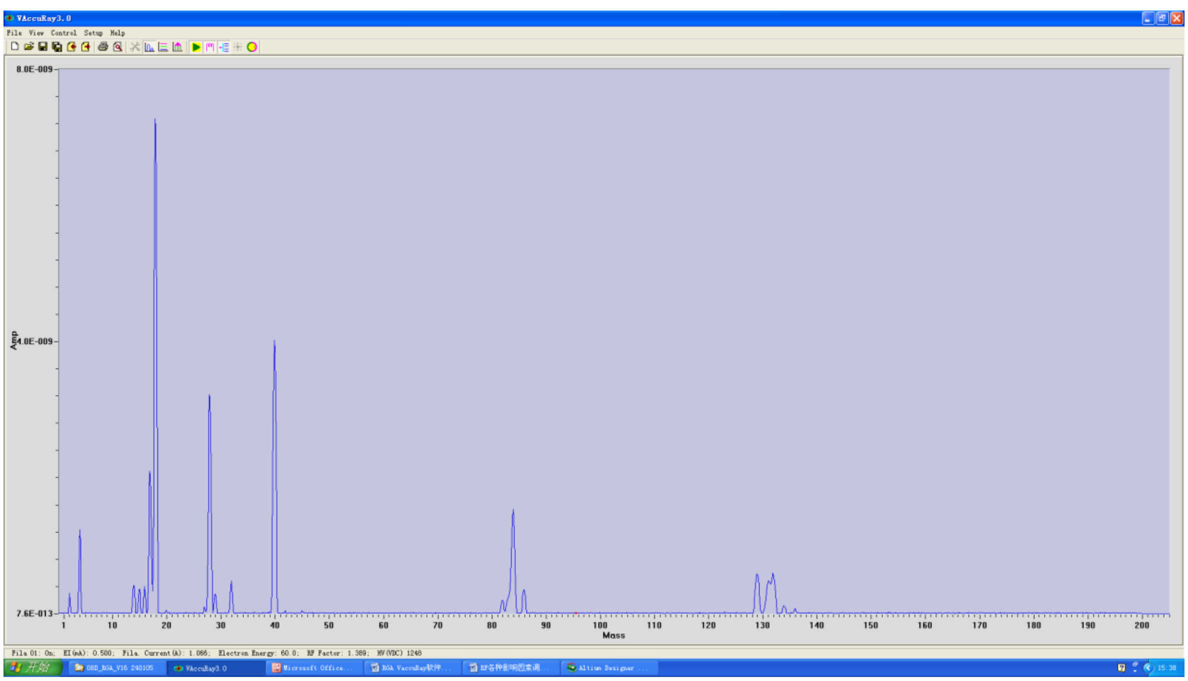


Setup menu

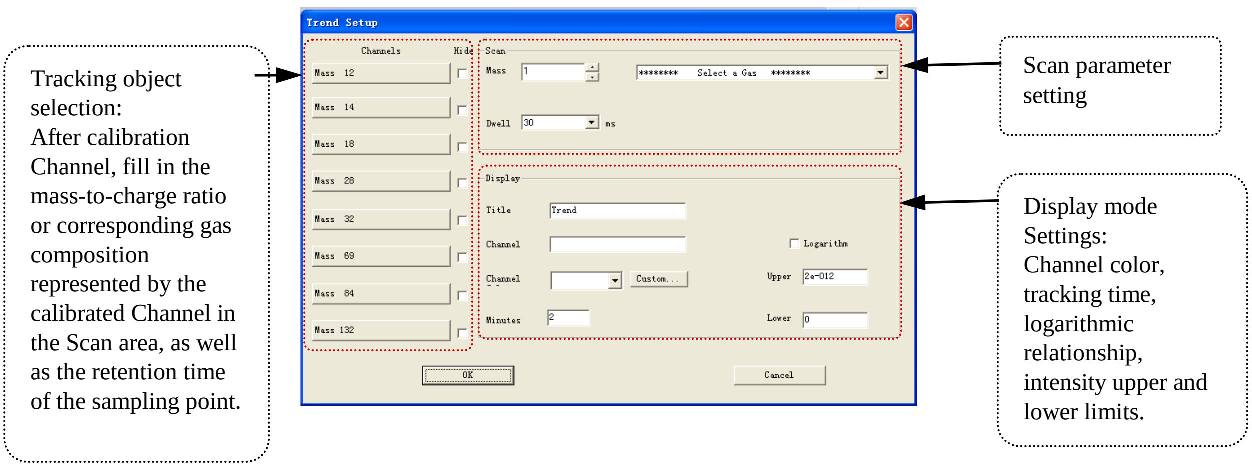
1） Spectra Scan: Settings for the mass spectrometry scan. Spectra Scan: Settings for the mass spectrometry scan.



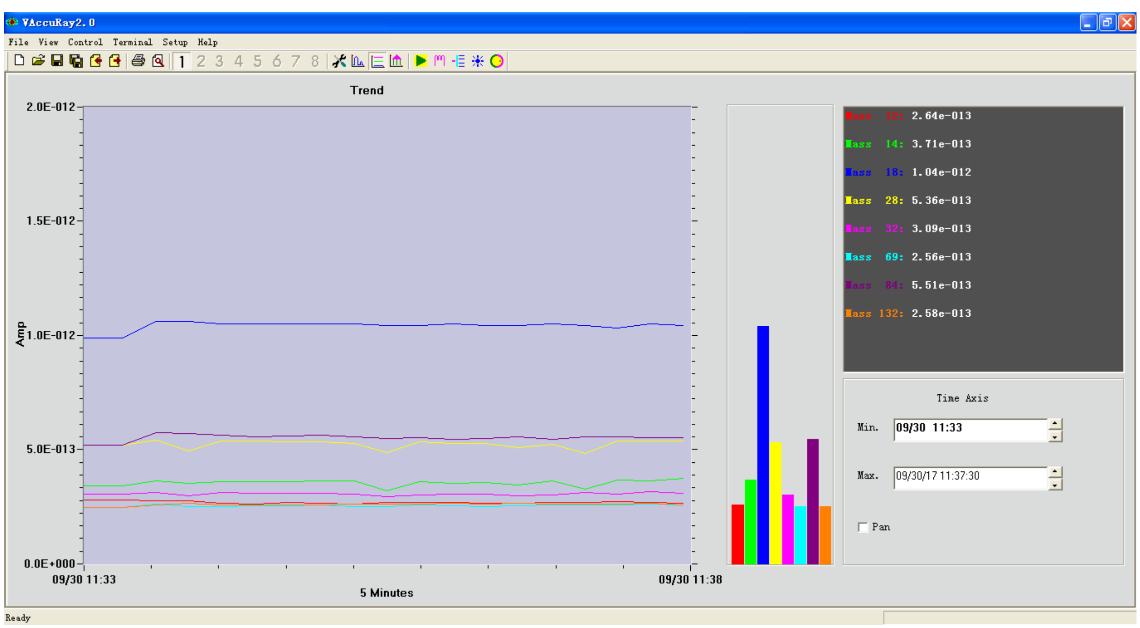
Mass spectrometry scan interface display (e.g. vacuum background +He+Ar+Kr+Xe inert gas injection)



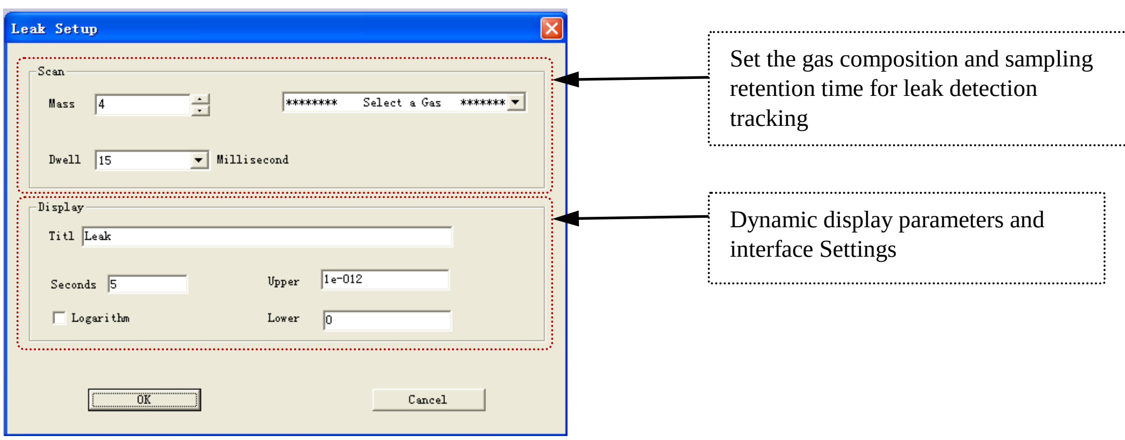
2） Trend: Dynamic trend of components. You can select up to 8 tracked components at most, and the process of real-time change of partial pressure (or relative intensity) of multiple components with time is displayed in the form of trend curve. Trend: Dynamic trend of components. You can select up to 8 tracked components at most. The process of real-time change of partial pressure (or relative intensity) of multiple components with time is displayed in the form of trend curve.



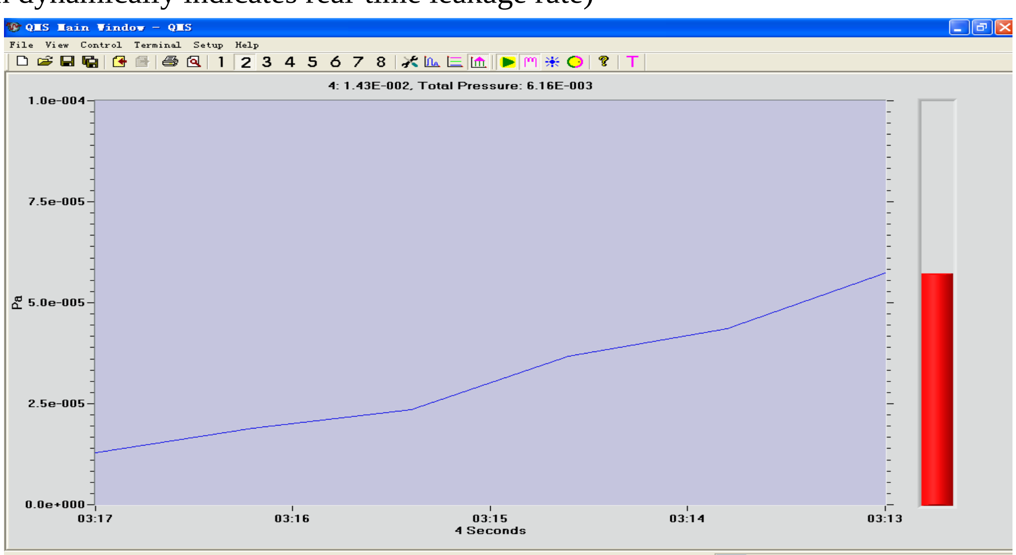
Trend tracking interface display (e.g. 12,14,18,28,32,69,84,132AMU 5 minute trend)



3） Leak Detection: Single-component leak detection. By selecting sensitive gas mass-to-charge ratios and connecting the QMS to a vacuum system, this method enables internal pressure-based leakage detection or external pressure-based spray detection of sensitive gases in sealed chambers. Unlike traditional helium mass spectrometry leak detectors, QMS can utilize multiple gases as sensitive source gases for leak detection. Through calibration of ion current patterns with standard leaks, quantitative leak detection can be achieved. Leak Detection: Single-component leak detection. By selecting sensitive gas mass-to-charge ratios and connecting the QMS to a vacuum system, this method enables leak detection in sealed chambers through either internal pressure-based leakage or external pressure-based spray sensitive gas detection. Unlike traditional helium mass spectrometry leak detectors, QMS can utilize multiple gases as sensitive source gases for leak detection. Through calibration using standard leaks and ion current analysis, quantitative leak detection can be achieved.

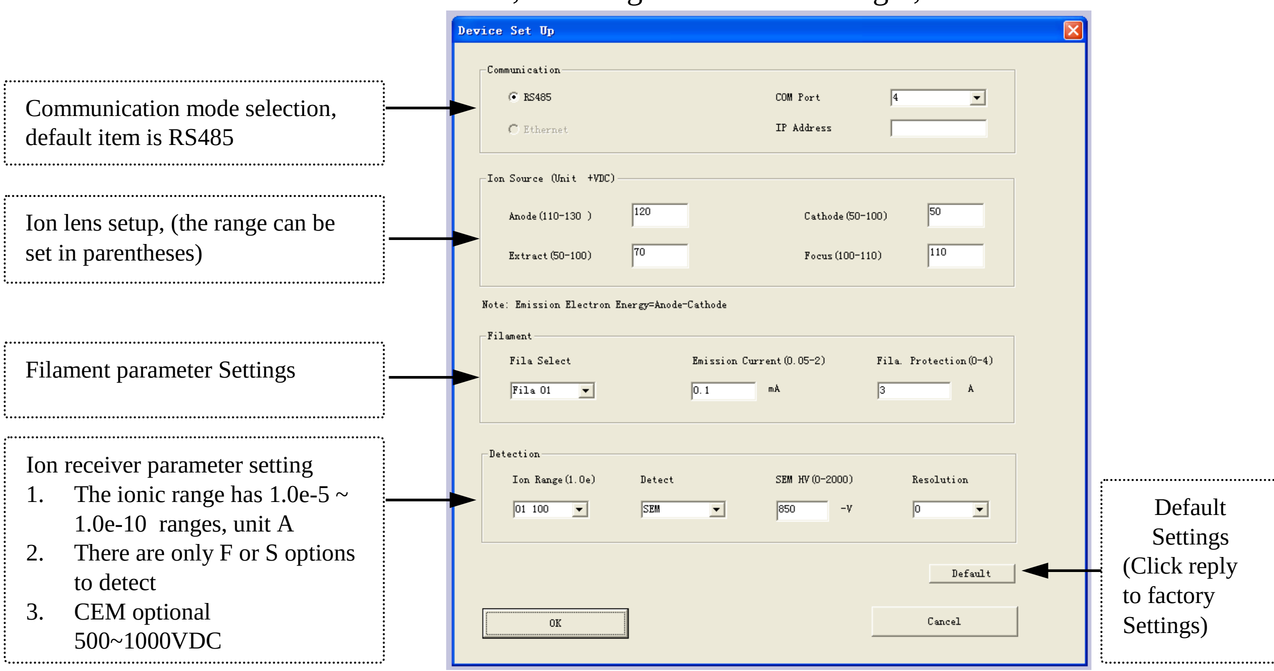


Leak detection mode interface display (e.g., 4AMU He gas sample leak detection process, red column dynamically indicates real-time leakage rate)



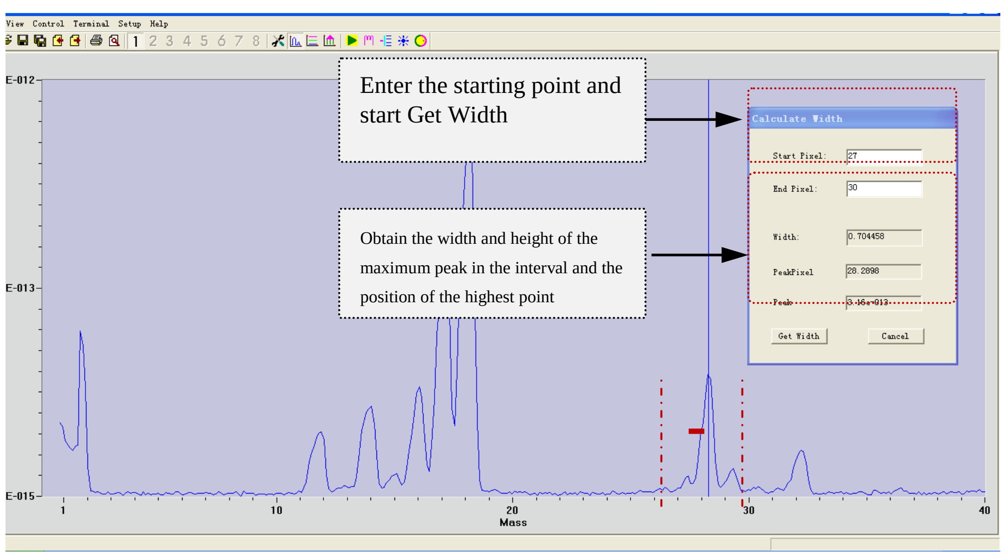
4） Device Setup Device hardware parameter Settings. Device Setup Device hardware parameter Settings.

In the three working modes, the hardware parameters of the instrument must be preset before starting the scanning operation, including the electrode potential of the lens, filament emission current, scanning line reference height, etc.



5） Calculate Width Peak width measurement.

6） After scanning pause, open the spectral peak measurement tool, input the point position before and after the pre-measured peak, and press Get Width. The toolbar returns the half-peak width, the highest peak position and the highest peak intensity of the largest peak in the starting interval.



6) Permission/service This function is only provided for equipment maintenance by the manufacturer.

Help menu

1） Library: Mass spectrometry library data

There is a table of common gas substances with corresponding mass-to-charge ratio under the menu of the library. At the same time, when you click the right mouse button on the scanning interface, the possible substances with corresponding mass-to-charge ratio are also displayed in the status bar at the top.

mass charge ratio M/e	**Possible ions**	**Common residual gas molecules**	**explain**
1	H+	Hydrogen, hydrocarbons	
2	H2+	Hydrogen, hydrocarbons	H is re-polymerized from other molecules
12	C+	CO, CO2, hydrocarbons	
14	N2++，CO++，CH2+	N2, CO, hydrocarbons	
15	CH3+	Contains methyl hydrocarbons	
16	O2++，O+，CH4+	CH4, O2, oxide	
17 18	OH+ H2O+		H2O,16:17:18=1:5:20
20	Ar++，（H2O）		The abundance ratio of H2O(20) in O18 is 0.2%
22	CO2++		
27	C2H3+	hydrocarbon	
28	CO+，N2+，(CO)+		The 28 hydrocarbons are 5 to 10 times that of 27 When CO2 (44) is high, CO (28) is also high
29	C2H3+，(N2+), (CO)+		N13 abundance 0.3%, C13 abundance 1.1%
30	NO+		The contaminated system is immediately vacuumed
32	O2+		Air leakage performance 28:32=4:1
35	Cl+	Halogen reagents	
37	(Cl)+	Halogen reagents	
39	C3H3+	hydrocarbon	
40	Ar+, C3H4+	Hydrocarbons, Ar	The abundance of argon in the air is about 1%

41 42	$C_3H_5^+$ $C_3H_6^+$	hydrocarbon hydrocarbon	C3 hydrocarbons appear at 36 to 44, especially at 39,41, and 43
43	$C_3H_7^+$	hydrocarbon	
44	CO_2^+	Hydrocarbons, CO_2	Some of the C13 and O18 peaks of CO_2 are at 45 and 46
50	$C_4H_2^+$	Hydrocarbons, such as aromatic ones	
51	$C_4H_3^+$	Hydrocarbons, such as aromatic ones	
55 56 57	$C_4H_7^+$ $C_4H_7^+$ $C_4H_7^+$	hydrocarbon hydrocarbon hydrocarbon	Class C4 hydrocarbons contain more peaks of 55 and 57

11. RS485 Modbus-RTU communication instruction protocol

Communication Settings COM4

Porter's ratio: 115,200

Starting position: 1

Data bits: 8

Stop position: 1

Check bit: None

instruction format

1） read instruction ：

The host computer sends instructions to the mass spectrometer:

Mass spectrometer address	order	Register high address	Register low address	Data word length (8 bits high)	Data word length (low 8 bits 1~127)	CRC check (low 8 bits)	CRC check (8 bits high)
1-99	03	00	XX	00	XX	XX	XX

Mass spectrometer returns instructions:

Mass spectrometer address	order	Data byte length (2~254)	Data byte length (low 8 bits)	data	CRC check (low 8 bits)	CRC check (8 bits high)
1-99	03	00	XX	XX bytes	XX	XX

2）Write the instruction

The host computer sends instructions to the mass spectrometer:

Mass spectrometer address	order	Register high address	Register low address	Data word length (8 bits high)	Data word length (low 8 bits)	Data byte length
1-99	16	00	XX	00	2	4

data	CRC check (low 8 bits)	CRC check (8 bits high)
Four bytes (high first, low last)	XX	XX

Mass spectrometer returns instructions:

Mass spectrometer	order	Register high address	Register low address	Data word length (8 bits high)	Data word length (low 8 bits)	CRC check (low 8 bits)	CRC check (8 bits high)

address							
1-99	16	00	XX	00	2	XX	XX

Register address table

Register address (hex)	function	data format	type
20	device initialize	4-byte integer	write
21	Base Line	4-byte floating-point number	write
22	RF Offset	4-byte floating-point number	write
23	Simultaneous output analog 1	4-byte floating-point number	write
24	Simultaneous output analog 2	4-byte floating-point number	write
25	Filaments on/off	4-byte integer	write
26	Electronic multiplier on/off	4-byte integer	write
27	Digital output 1	4-byte integer	write
28	Digital output 2	4-byte integer	write
29	Emission	4-byte floating-point number	read-write
2a	Simulation input 1	4-byte floating-point number	a slight pause in reading
2b	Simulation input 2	4-byte floating-point number	a slight pause in reading
2c	Digital input 1	4-byte integer	a slight pause in reading
2d	Digital input 2	4-byte integer	a slight pause in reading
30	Start scanning with the starting Mass value and number	4-byte integer	write
31	Dwell Time (ms)	4-byte integer	write
32	DC and RF initialization	4-byte integer	write
33	DC and RF updates	4-byte integer	write
3f	Stop scanning	4-byte integer	write
40	Single scan point	4-byte floating-point number	a slight pause in reading

Special instruction notes

1）Set the mass spectrometer address

0x0 0x6 0x0 0x0 0x0 0x0 Address (1-99) CRL CRH

The return is 8 bytes, and the data is the same as above.

2） device initialize

Mass spectrometer address 0x10 0x0 0x2 0 0x0 0x2 0x4 0x0 0x0 0x0 0x1 CRL CRH

3) Turn on/off the filament

Mass spectrometer address 0x10 0x0 0x25 0x0 0x2 0x4 0x0 0x0 0x0 XX CRL CRH

XX is 0/1: on/off.

4) Turn on/off the electron multiplier

Mass spectrometer address 0x10 0x0 0x26 0x0 0x2 0x4 0x0 0x0 0x0 XX CRL CRH

XX is 0/1: on/off.

5) Set the starting Mass and the number of Mass to start scanning.

Mass spectrometer address 0x10 0x0 0x30 0x0 0x2 0x4 X1 X2 X3 X4 CRL CRH

X1 X2: The initial mass value, X1 high byte, X2 low byte.

X3 X4: The number of Masses scanned, X3 high byte, X4 low byte.

6) DC and RF initialization

Mass spectrometer address 0x10 0x0 0x32 0x0 0x2 0x4 0x0 0x0 X1 X2 CRL CRH

X1 X2: The initial mass value, X1 high byte, X2 low byte.

7) DC and RF updates

Mass spectrometer address 0x10 0x0 0x33 0x0 0x2 0x4 0x0 0x0 0x0 0x1 CRL CRH

8) Stop scanning

Mass spectrometer address 0x10 0x0 0x3f 0x0 0x2 0x4 0x0 0x0 0x0 0x1 CRL CRH

9) Read a single scan point

Mass spectrometer address 0x03 0x0 0x40 0x0 0x2 CRL CRH

Return value: mass spectrometer address 0x03 0x4 X1 X2 X3 X4 CRL CRH

X1X2X3X4: A 4-byte floating point number scanned, with X1 as the highest byte and X4 as the lowest byte.

remarks

Each Mass scan 10 points in this system. If the number of Masses to be scanned is set to 200, the data can be read by reading instructions to 2000.

12. tending

12.1 Replacement of filaments

When the filament breaks or the ion source decays due to aging, the filament needs to be replaced.

Note: The filament is an assembly including the tray bracket. The filament itself is a metal iridium wire with a diameter of 0.2mm and a yttrium oxide coating. Please wear gloves during unpacking and installation and do not touch the filament with bare hands.

Need tools

- 2mm hex wrench
- A small cross screwdriver for M2 round head screws

Replacement steps

1） Use a small one to loosen the three M2 screws corresponding to the filament pins.

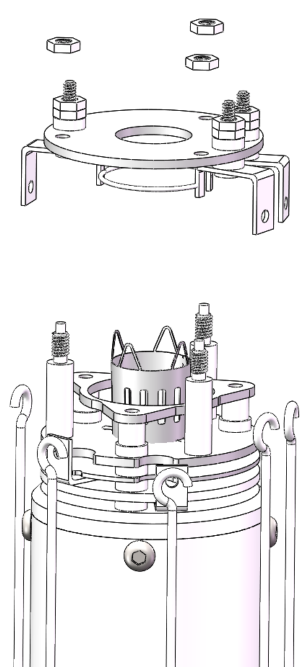
2） Use a hex key or needle-nose pliers to remove the three M2 hex nuts at the top of the filament terminal.

3） Remove the top filament holder disc vertically from the three studs.

4） The new filament holder will be placed and reset in its original position.

5） Install three M2 nuts at the top of the filament bracket and tighten them.

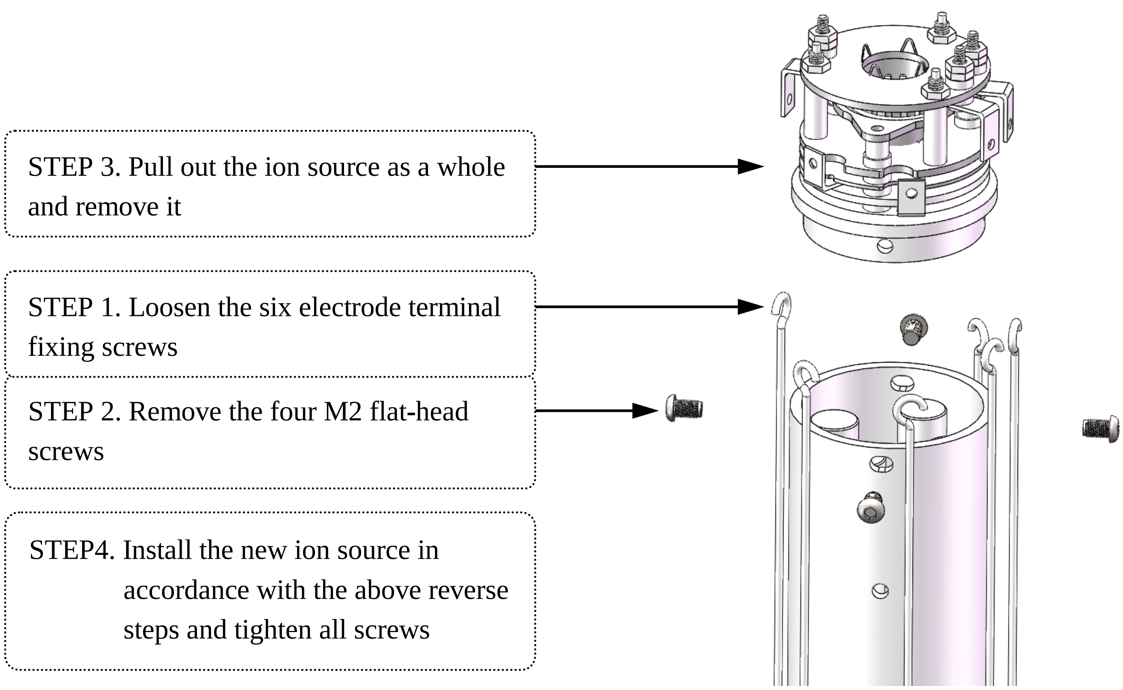
6） Install the three M2 screws corresponding to the filament terminal back to the original position and tighten them.



12.1 Ion source replacement

When the internal surface of the ion source is seriously oxidized and simple cleaning cannot restore the performance, the ion source needs to be replaced.

Note: The ion source is an assembly consisting of a filament, a grid, and various ion lens electrodes. Do not disassemble the assembly. Wear gloves during unpacking, removing old ion sources, and installing new ion sources. Do not touch the ion source assembly with bare hands.



12.3 Appendices

	description	model	P.N.
1	Faraday-type MAG, mass range 100AMU (including probe, ECU, cable and application software)	MAG100F	700-001
2	Faraday-type MAG, mass range 200AMU (including probe, ECU, cable and application software)	MAG200F	700-002
3	Faraday-type MAG, mass range 300AMU (including probe, ECU, cable and application software)	MAG300F	700-003
4	Electronic multiplier type MAG, mass range 100AMU (including probe, ECU, cable and application software)	MAG100M	700-004
5	Electronic multiplier type MAG, mass range 200AMU (including probe, ECU, cable and application software)	MAG200M	700-005
6	Electronic multiplier MAG, mass range 300AMU (including probe, ECU, cable and application software)	MAG300M	700-006
7	The Faraday Cup receives an ionic quadrupole mass spectrometer probe	MAG-PROF	700-007
8	The electron multiplier receives an ionic quadrupole mass spectrometer probe	MAG-PROM	700-008
9	Faraday type electric control unit, mass range 100AMU (including ECU, cable and application software)	MAG-ECU1F	700-009
10	Faraday type electronic control unit, mass range 200AMU (including ECU, cable and application software)	MAG-ECU2F	700-010
11	Faraday type electronic control unit, mass range 300AMU (including ECU, cable and application software)	MAG-ECU3F	700-011
12	Electronic multiplier type electronic control unit, mass range 100AMU (including ECU, cable and application software)	MAG-ECU1M	700-012
13	Electronic multiplier type electronic control unit, mass range 200AMU (including ECU, cable and application software)	MAG-ECU2M	700-013
14	Electronic multiplier type electronic control unit, mass range 300AMU (including ECU, cable and application software)	MAG-ECU3M	700-014
15	Filaments (including bracket disc and double filaments)	MAG-FIL02	700-015
16	Ion source (including filament, ion lens, etc.)	MAG-IOS02	700-016
17	Electronic multiplier (including external bracket)	MAG-SEM02	700-017
18	ACDC adapter +24VDC5A (cable length 2 meters)	MAG-ADP02	700-018
19	RS485/USB converter and cable (2 m)	MAG-URS02	700-019

Note: New product development and market demand are in continuous progress, model and number may be updated at any time, please refer to the latest quotation provided by the supplier for details.