GADRO

GHLD SERIES HELIUM MASS SPECTROMETER

LEAK DETECTOR

INSTRUCTION MANUEL

MODEL: GHLD-600M

Build No： 2025V1.0

Revision： 2025.12

Figure 1　GHLD-600M

Foreword

Thank you for reading the following information:

Before installing and starting the trial operation of the helium mass spectrometer leak detector, please carefully read this instruction manual and the information below to ensure optimal conditions and safe operation from the very beginning.

Only by strictly and correctly using the helium mass spectrometer leak detector in accordance with this manual can its safe and effective operation be achieved.

This product must only be operated and maintained by trained personnel. It is the user's responsibility to carefully read and strictly adhere to the safety precautions described in the manual.

Icon Convention：

Warning

Indicates a potentially hazardous situation which, if not avoided, could result in injury.

Warning

Caution

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to persons or damage to the instrument.

Caution

Note

Indicates a situation or practice that is not hazardous but is important for the user to be aware of during routine operation.

Note

Performance parameter

Model	Performance parameter	Parameter value
GHLD-600M	Minimum Detectable Leak Rate	1.0×10^{-13} Pa·m³/s
	Leak Rate Display Range	1.0×10^{-2} ~ 1.0×10^{-13} Pa·m³/s
	Minimum Detectable Leak Rate (Sniffer Mode)	1.0×10^{-7} Pa·m³/s
	Leak Rate Display Range (Sniffer Mode)	1.0×10^{-2} ~ 1.0×10^{-7} Pa·m³/s
	Test Gas	He (Helium)
	Response Time	≤ 0.2 sec
	Startup Time	≤ 120 sec
	Test Port Pressure	2000 Pa
	Internal Pressure of Mass Spectrometer Tube	3×10^{-3} Pa
	Major Leak Test Function	Yes
	Wireless Handheld Screen	Optional
	Sniffer Probe (Hand Gun)	Optional
	Filament Switching Mode	Manual / Automatic
	Backing Pump	D16C / DRV16
	Molecular Pump	Leybold 90 / Pfeiffer 80
	Trolley Cart	Standard
	Dimensions (Leak Detector Unit)	870mm × 523mm × 1166mm

Contents

Ⅰ Safety Information

1. Instructions

Operators and maintenance personnel must be aware of all hazards associated with this product. They must also know how to identify and avoid hazardous or potentially dangerous conditions. Improper, incorrect, or negligent operation of the equipment may lead to serious consequences.

All operators or maintenance personnel must carefully read the operation/maintenance instructions and all supplementary materials. They must thoroughly review and strictly adhere to all warnings and cautions.

If there are any questions regarding safety, operation, and/or maintenance, please contact the nearest office for assistance.

2.Vacuum equipment and its cleaning

Maintaining cleanliness is crucial when servicing or maintaining the leak detector. Compared to general vacuum equipment, the maintenance of a leak detector requires stricter attention to the following matters:

Caution

The use of vacuum grease or silicone oil inside the product is strictly prohibited.

Wear powder-free rubber gloves to prevent dust or skincare oils from contaminating vacuum surfaces. The use of vacuum grease is not recommended, as it can absorb the test gas (He_2) and slowly release it during testing, leading to helium contamination.

If vacuum grease must be used, apply a small amount of genuine product sparingly.

3. Care of O-Rings

When removing, inspecting, or replacing O-rings, observe the following guidelines:

Note

It is recommended to replace all O-rings whenever they are removed during routine maintenance.

- When removing O-rings, carefully extract them by hand. Do not use metal tools to avoid scratching the sealing surfaces.
- Before installation, clean the surface of the O-ring with a lint-free or dust-free cloth to prevent contaminants from affecting the seal.
- Applying vacuum grease or other substances to the O-ring surface is strictly prohibited.

4. Care of Metal Seals

During daily use and maintenance, avoid contact with the sealing surfaces of metal seals. When handling, remove metal seals carefully by hand. Do not use metal tools to prevent damaging the sealing surface. During removal or replacement, ensure the sealing surface remains clean, free of dust and contaminants, to maintain the product's sealing integrity.

All metal seals should be stored in a clean room with their sealing surfaces protected. Metal seals generally do not require cleaning. If necessary, wipe them gently with a lint-free cloth dampened with alcohol.

5. General Requirements for Using the Leak Detector

Operating Environment:

- The product is designed for indoor industrial and laboratory use only.
- Operating temperature: 10°C to 40°C; relative humidity: ≤80%
- Operating voltage: Single-phase 220V ±10%, 50Hz
- Maximum operating current: 10A
- Altitude: Below 2000 meters

Warning

- Do not use in environments containing flammable or explosive gases.
- Do not disassemble or modify the product, as this may cause electric shock, injury, or product malfunction. For disassembly or modifications, contact the manufacturer or authorized service personnel.
- If smoke, unusual odors, or abnormal noises are detected, stop use immediately and contact after-sales service.
- The leak detector must not be used with hazardous gases. Ensure that the test object has been purged of hazardous gases before using the leak detector. When testing gases containing hazardous components, connect the leak detector's exhaust port to a ventilation system with purification capabilities.

6. Pumps

When operating or maintaining mechanical pumps and molecular pumps, strictly follow the instructions provided in their respective manuals.

7. Display Panel

The display panel consists of a display screen and operational buttons.

Note

The display screen is an LCD (liquid crystal display). During operation, gently touch it with your finger if needed. Do not use metal objects to press or touch the screen, as this may damage it.

The operational buttons are normally open metal switches. Press them gently with your finger during use. Do not use metal objects to operate the buttons, as this may cause damage.

Ⅱ Leak Detector Complete Unit

1. Introduction

GHLD-600M leak detector is a high-sensitivity, high-speed, and wide-range leak detection instrument. It consists of a turbo high-vacuum molecular pump, an external mechanical pump, a mass spectrometry analysis chamber, a valve assembly, electronic control boards, an operation panel, and other optional functional components.

The Leak Detector Complete Unit is designed to locate and quantify leak points in sealed objects. It uses helium, an inert gas, as the detection medium due to its non-toxicity, chemical inertness, low atmospheric concentration, small atomic size (allowing easy passage through leaks), non-flammability, and safety. Helium can be stored in containers of various sizes, making the instrument widely applicable across numerous industries.

★ Aerospace
★ Scientific Research
★ Military Industry
★ Automotive Refrigeration
★ Pressure Vessels
★ Analytical Instruments
★ Nuclear Industry
★ Power Plants
★ New Energy Industry
★ Semiconductor Industry
★ Precision Machining
★ High-Vacuum Equipment Engineering
★ Medical Instruments and Meters

2. Unpacking the Leak Detector

Inspect the exterior of the packaging case for any damage:

- Preserve any evidence or take photographs of damage to the outer case or the instrument.
- Promptly contact the delivery service or after-sales support personnel.
- Check the packing list and contents inside the packaging case.

3. Installation

- With the assistance of a helper, carefully slide the leak detector out of its packaging case.
- Take out the power cable and connect it to route power from the cart to the main unit of the leak detector.

4. Installation Requirements

4.1. Location of the Leak Detector

4.1.1. Ensure the instrument is close to a power outlet during operation.
4.1.2. Maintain a ventilation space of at least 15 cm behind the leak detector.
4.1.3. Operators must have sufficient safe space to operate the instrument.

4.2. Power Supply Requirements

4.2.1. Single-phase 220V ±10%, 50Hz.
4.2.2. The power outlet must be reliably grounded and connected to the building's protective grounding system.

4.3. Mechanical Pump Oil Level

The oil-sealed mechanical pump is pre-filled with the appropriate amount of oil prior to shipment. The oil level viewing window is located on the side of the mechanical pump.

When the pump is not running, the oil level should be at two-thirds (2/3) of the viewing window.
When the pump is running, the oil level should be at half (1/2) of the viewing window.

Please refer to the accompanying "Mechanical Pump Manual" for further details.

5. Gas path diagram of the GHLD

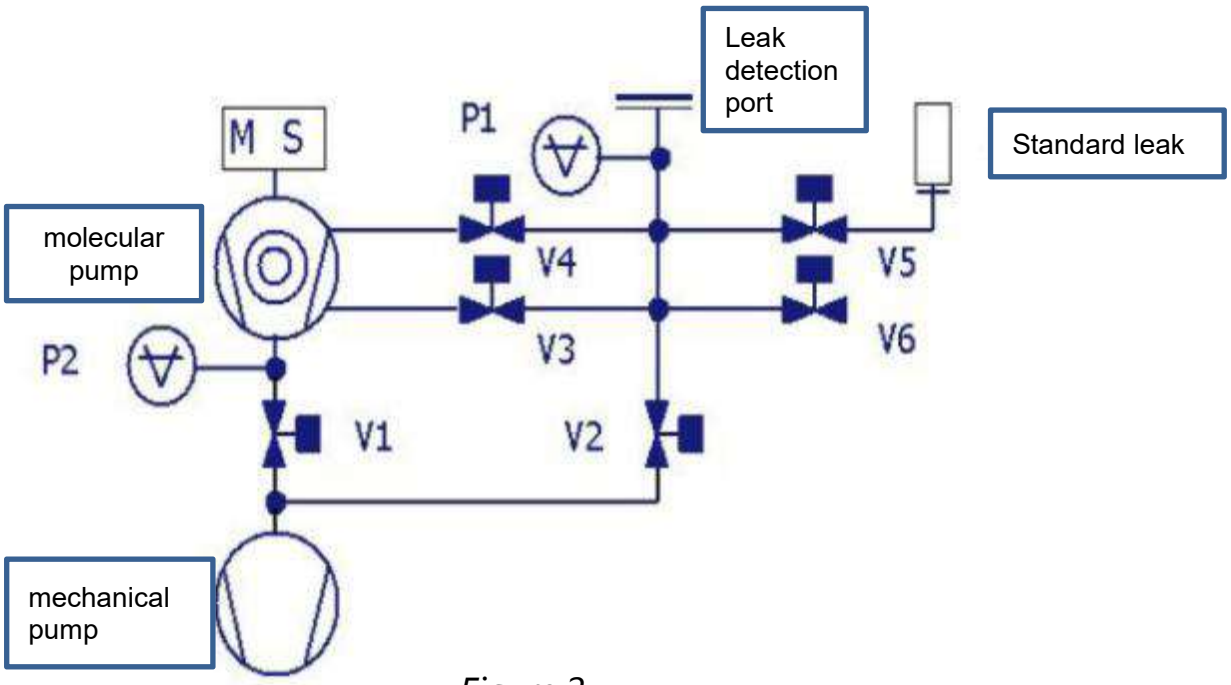


Figure 2

The graphic description

Figure 3

NO	Material Name	Description	NO	Material Name	Description
1	Mechanical Pump	Maintains vacuum for the molecular pump and leak detection port	8	V1	Leak Detection Valve for Rough Vacuum Stage
2	Molecular Pump	Maintains high vacuum for the mass spectrometer analysis chamber and leak detection port	9	V2	Pre-evacuation and Leak Detection Valve
3	MS	Mass Spectrometer Analysis Chamber	10	V3	Leak Detection Valve for Medium Vacuum Stage
4	P1	Pirani Gauge (Resistance Gauge Tube)	11	V4	Leak Detection Valve for High Vacuum Stage
5	P2	PSG500 Vacuum Gauge	12	V5	Built-in Standard Leak Calibration Valve
6	Standard Leak	Provides a calibrated reference leak rate	13	V6	Test Port Inlet Valve
7	Leak Detection Port	Standard KF25 interface for connecting the test workpiece			

Ⅲ Operation of GHLD

1. Leak detector operation panel

Figure 4

1.1 test leaks: used for leak detector and checked the connection mouth

1.2 show screen: used for leak detector runs, displaying information

1.3 film button: start, stop, zero to control the leak detector

2. Power on the leak detector

2.1. To determine whether the leak detector working environment conform to the requirements of the installation.

2.2. Confirm the leak detector has reliable grounding.

2.3. Confirm the leak detector vacuum line connection OK.

2.4. Connect the power cord of the leak detector properly.

2.5. Press the green switch on the trolley, to power the leak detector.

The display on the screen after the leak detector is powered on

Figure 5

3.The startup of the leak detector

After the power is supplied to the leak detector, it enters the startup process.

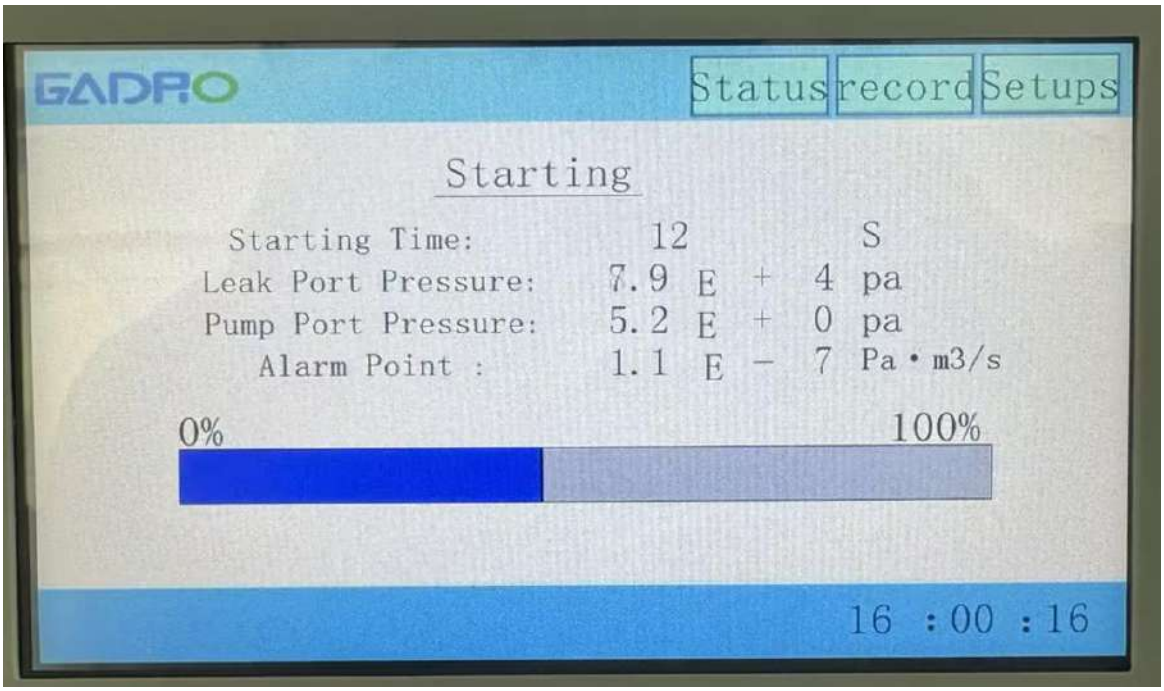


Figure 6

The startup time of the leak detector is ≤120 seconds.
The startup process of the leak detector involves the initiation of its main components and serves as a self-testing phase for these critical parts.

3.1 Startup Duration: The time required to initiate the leak detector's startup sequence.
3.2 Exhaust Port Pressure: The real-time vacuum level at the exhaust port of the molecular pump.
3.3 Leak Detection Port Pressure: The real-time vacuum level at the leak detection port.

4. The standby mode of the leak detector

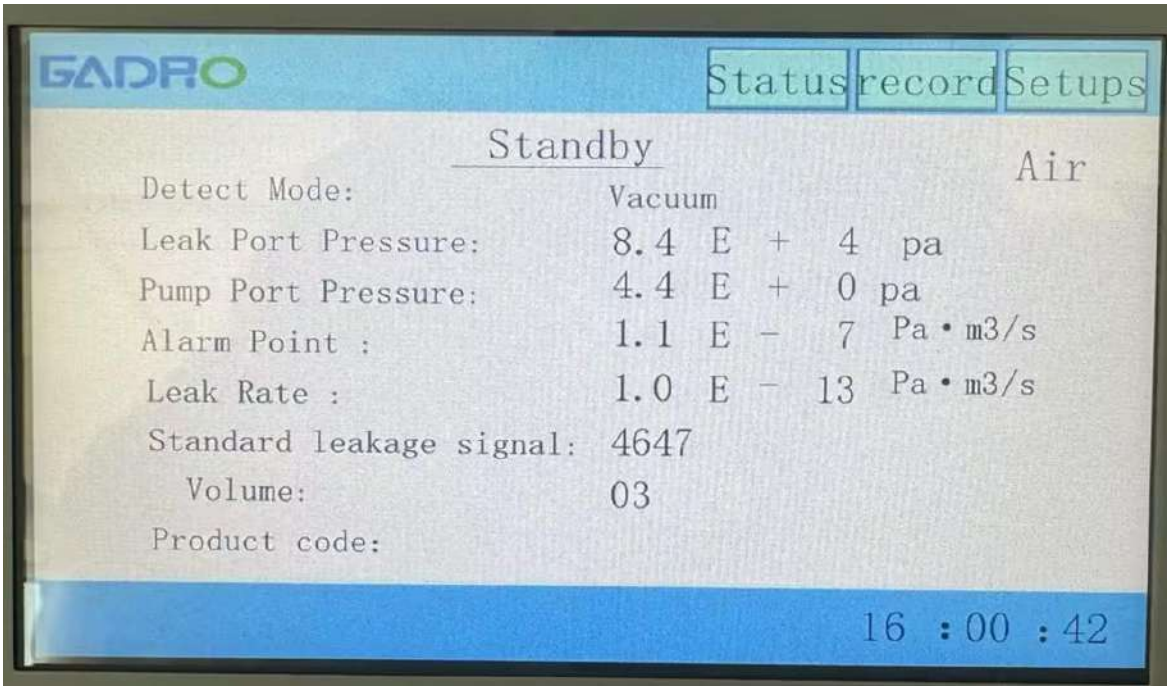


Figure 7

Standby Mode of the Leak Detector
The standby mode indicates that the leak detector has been successfully started up and is ready to enter the leak detection state.

4.1 **Leak Detection Mode**: Indicates the current working mode (vacuum mode) of the leak detector.
4.2 **Real-Time Leak Rate**: Displays the leak rate value of the detector before the stop condition.
4.3 **Alarm Threshold**: Shows the preset alarm value configured in the leak detector.
4.4 **Standard Leak Signal**: Displays the voltage value of the signal detected during calibration.
4.5 **Leak Detection Port Pressure**: Real-time vacuum level at the leak detection port.
4.6 **Exhaust Port Pressure**: Real-time vacuum level at the exhaust port of the molecular pump.

5. System parameter setting

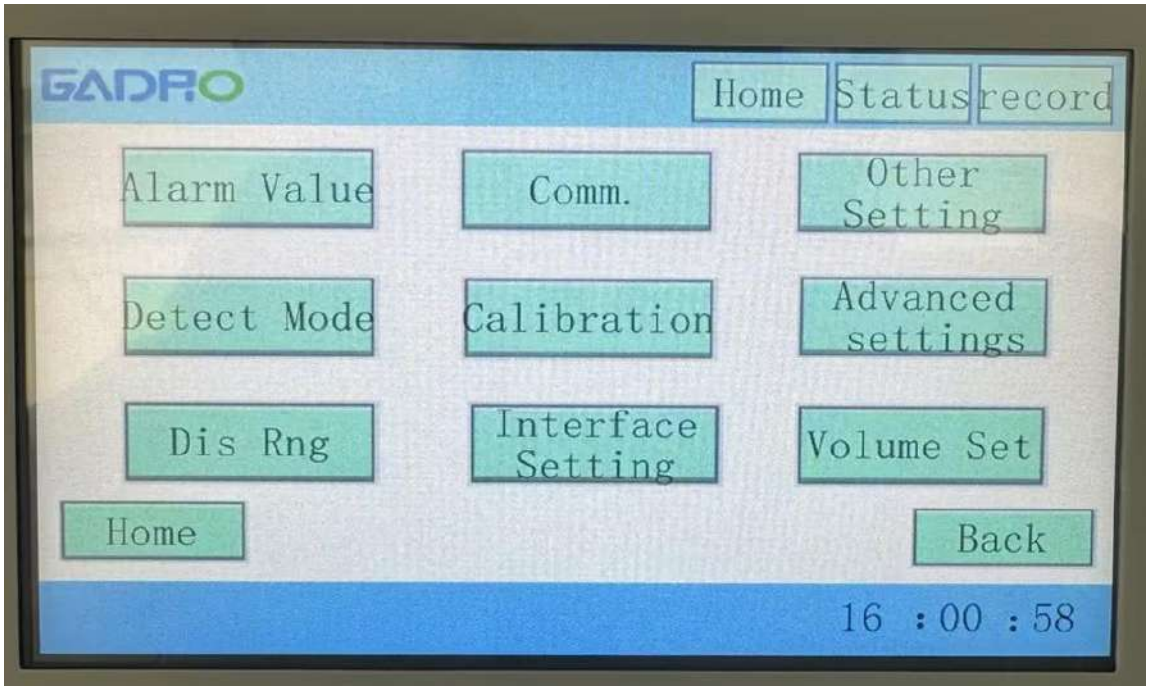


Figure 8

When the leak detector is in "Standby Mode", gently press the **"Setting"** button with your finger. A password input keypad will appear. Enter the initial password **"1"** on the keypad, then press the **"Confirmation"** button to access the settings interface.

5.1 Alarm setting value setting

In the settings interface, gently press the **"Alarm Threshold"** button to access the alarm threshold configuration menu.

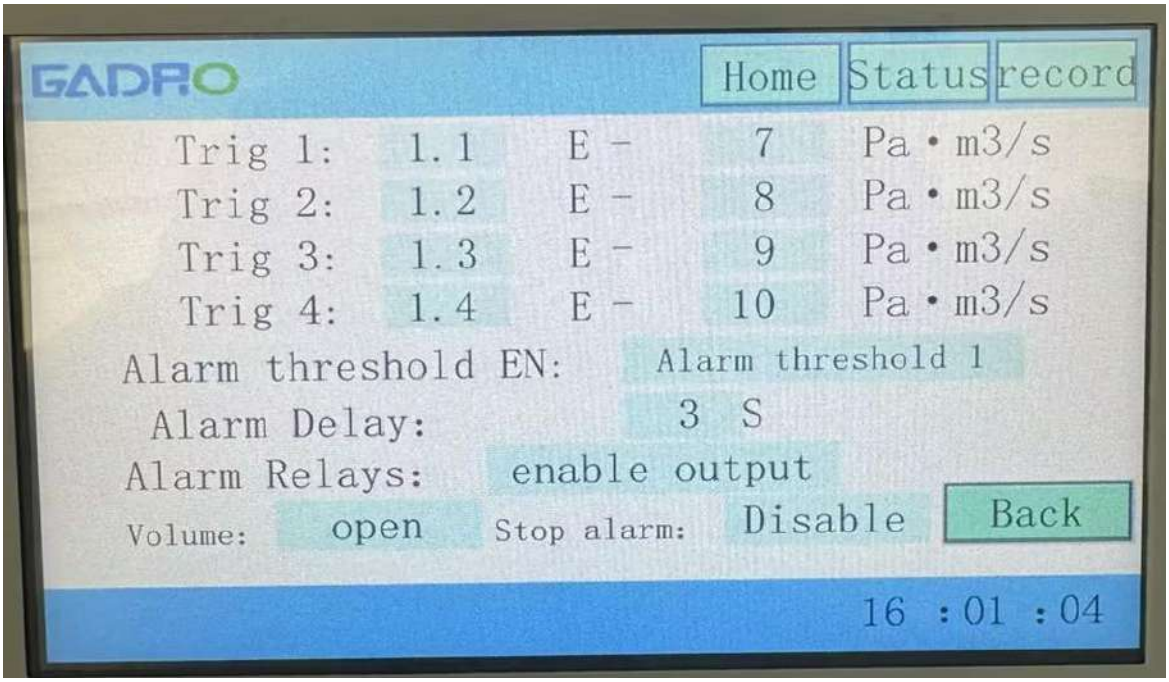


Figure 9

5.1.1 Alarm Threshold:
When the leak rate of the tested component exceeds the set value, the leak detector will trigger an alarm signal or audible alert.

5.1.2 Alarm Threshold Enable:
Determines whether the alarm threshold is active.

5.1.3 Alarm Delay Time:
Defines the delay time (in seconds) after the alarm threshold is reached before the alarm is activated.

5.1.4 Alarm Relay:

Disabled: Alarm signal output is blocked.
Enabled: Alarm signal output is permitted.

5.1.5 Volume:

Mute: No audible alarm.
On: Audible alarm is active.

5.1.6 Alarm on Stop:

Disabled: No alarm signal output when the detector is stopped.
Enabled: Alarm signal output remains active even when the detector is stoppe

5.2 Leak detection mode setting

In the Settings interface, lightly touching "Leak detection mode" will enter the leak detection mode interface.

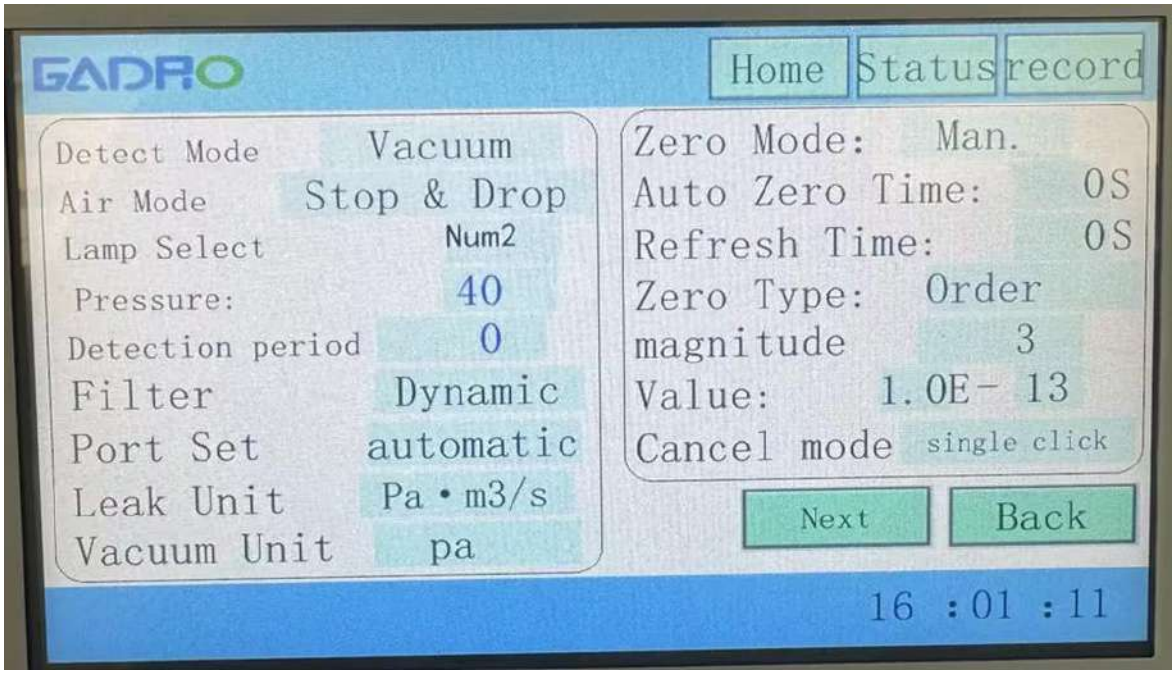


Figure 10

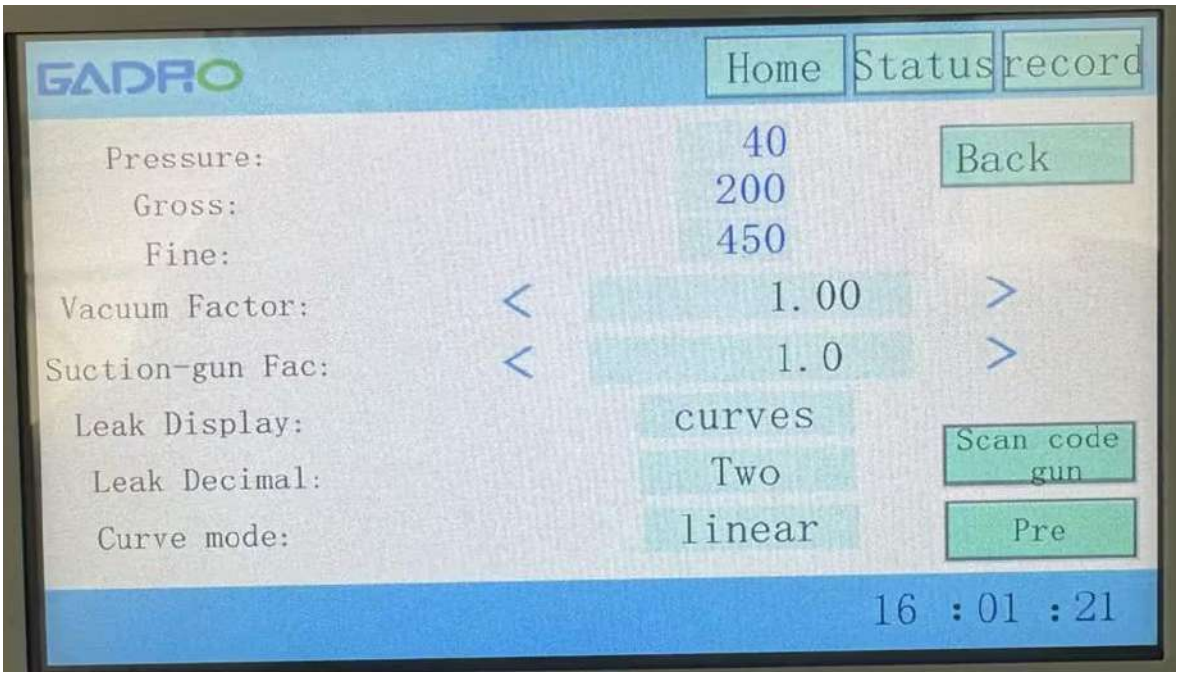


Figure 11

5.2.1 Leak Detection Mode:
Vacuum Mode: Negative pressure leak detection for workpieces
Sniffer Mode: Positive pressure leak detection for workpieces

5.2.2 Venting Mode:
Stop and Vent: When the stop button is pressed, valve V6 opens to release air into the leak detection port. Typically used for workpieces with small volumes.
Stop Without Venting: When the stop button is pressed, valve V6 remains closed, and the leak detection port maintains its vacuum level. Typically used for workpieces with large volumes.

5.2.3 Filament Selection:
Automatic: Automatic filament switching
Filament 1, Filament 2: Manual switching

5.2.4 Fine Detection Pressure: Refers to opening valve V4 after the vacuum level reaches the set value.

5.2.5 Detection Cycle: Refers to automatically stopping after running for the set number of seconds.

5.2.6 Filter Setting:
Dynamic Filter: High precision but slow response speed
Static Filter: High fluctuation but fast response speed

5.2.7 Precision Setting: Automatic, Low, Medium, High
Automatic: The system automatically controls the opening and closing of solenoid valves.
Low: The system automatically controls the opening and closing of V1 and V2, while V3 and V4 remain closed.
Medium: The system automatically controls the opening and closing of V1, V2, and V3, while V4 remains closed.
High: The system automatically controls the opening and closing of V1, V2, V3, and V4, similar to the automatic mode.

5.2.8 Leak Rate Unit: Pa·m^3/s, mbar·l/s, atm·cc/s

5.2.9 Vacuum Unit: mbar, Pa, atm, Torr

5.2.10 Zero Calibration Mode:
Manual: Gently press the zero calibration button, and the instrument enters zero calibration mode.
Automatic: After gently pressing the start button, the instrument will automatically enter zero calibration mode after the set time.

5.2.11 Automatic Zero Calibration Time: The cycle time for automatic zero calibration in automatic mode.

5.2.12 Background Refresh Time: The time interval for the software to collect and refresh data.

5.2.13 Zero Calibration Magnitude: After entering zero calibration mode, the displayed zero value is the exponent of the pre-calibration value minus the set value.

5.2.14 Zero Adjustment Button Mode: Configures the button operation method.

5.2.15 Fine Detection Pressure: Refers to opening valve V4 after the vacuum level reaches the set value.

5.2.16 Medium Detection Pressure: Refers to opening valve V3 after the vacuum level reaches the set value.

5.2.17 Medium Detection Pressure: Refers to opening valve V1 after the vacuum level reaches the set value.

5.2.18 Vacuum Factor: A software setting to correct the discrepancy between displayed and actual values. The default factory setting for vacuum mode is 1.0.

5.2.19 Sniffer Factor: A software setting to correct the discrepancy between displayed and actual values. The default factory setting for sniffer mode is 1.0.
If the user needs to modify it, simply tap the value field to bring up the numeric keypad, enter the desired value, and confirm.

5.2.20 Leak Rate Display: Leak rate display mode, either numerical or graphical.

5.2.21 Leak Rate Decimal Places: One or two decimal places.

5.2.22 Graph Mode: Linear or logarithmic.

5.3 Leak detection setting

In the Settings interface, gently touch the calibration Settings to enter the leak detection Settings interface.

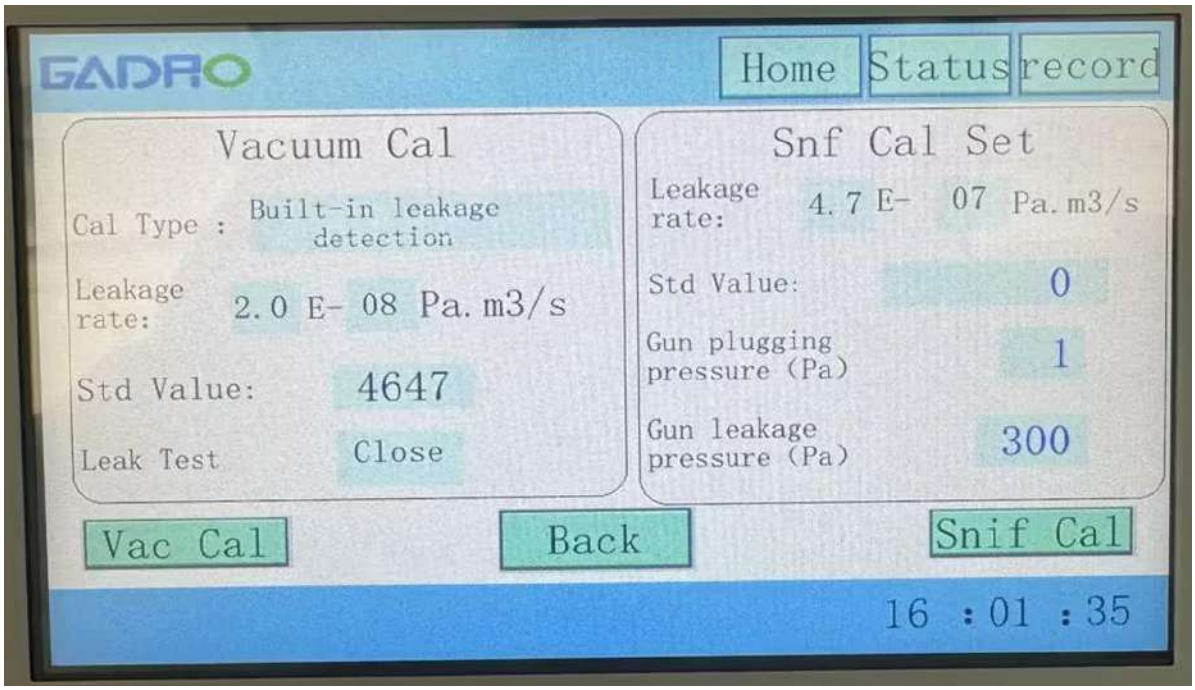


Figure 12

5.3.1 Sniffer Mode Calibration Setting: Uses a sniffer probe to detect a standard leak artifact to set the calibration value for the instrument. The value is typically set to 4.2E-7 Pa·m³/s.

5.3.2 Vacuum Mode Calibration Setting: Uses a standard Grade -8 leak artifact to calibrate the instrument.

5.3.3 Leak Artifact Type:

Internal: Uses the internal standard leak.

External with Switch: Refers to an external standard leak artifact that has its own switch.

External without Switch: Refers to an external standard leak artifact without its own switch.

5.3.4 Standard Leak Rate: The set value, which is the calibrated value marked on the standard leak artifact.

5.3.5 During Calibration:

If "Internal" is selected, open the calibration setting interface and gently tap the screen. The instrument will automatically complete the calibration.

If "External without Switch" is selected, connect the external leak artifact to the detection port, change the set value to the calibrated value marked on the leak artifact, and then gently tap the screen. The instrument will automatically complete the calibration.

If "Sniffer Mode Calibration" or "External with Switch" is selected, first connect the sniffer probe or the external leak artifact, and then follow the instrument's prompts to proceed.

5.4 Communication Setup

Tap the "Communication" button lightly to enter the communication interface.

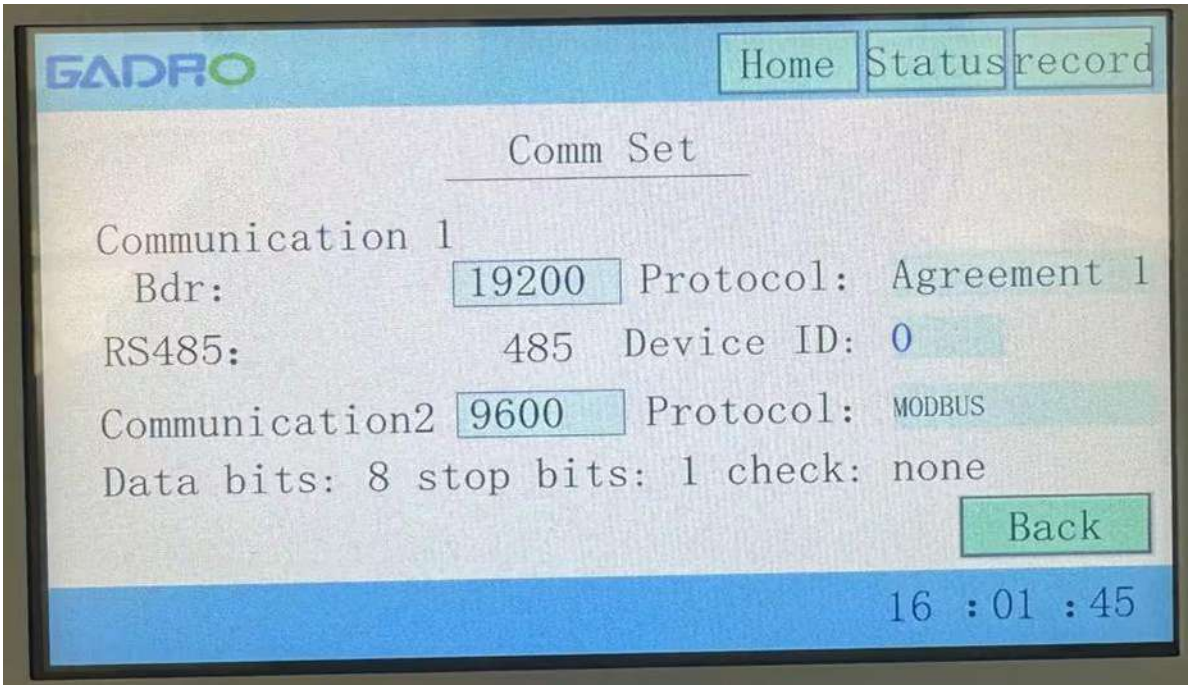


Figure 13

5.4.1 Communication Settings: External Serial Port, Remote Control Interface

5.4.2 Baud Rate: 9600, 19200, 38400, 57600, 115200

5.4.3 Protocol: Modbus, Protocol 1, N/A

5.4.4 Serial Port Type: RS485

Note: Only Protocol 1 is available for the communication protocol

5.5 Interface Setting

Touch the interface setting button lightly to enter the interface setting interface.

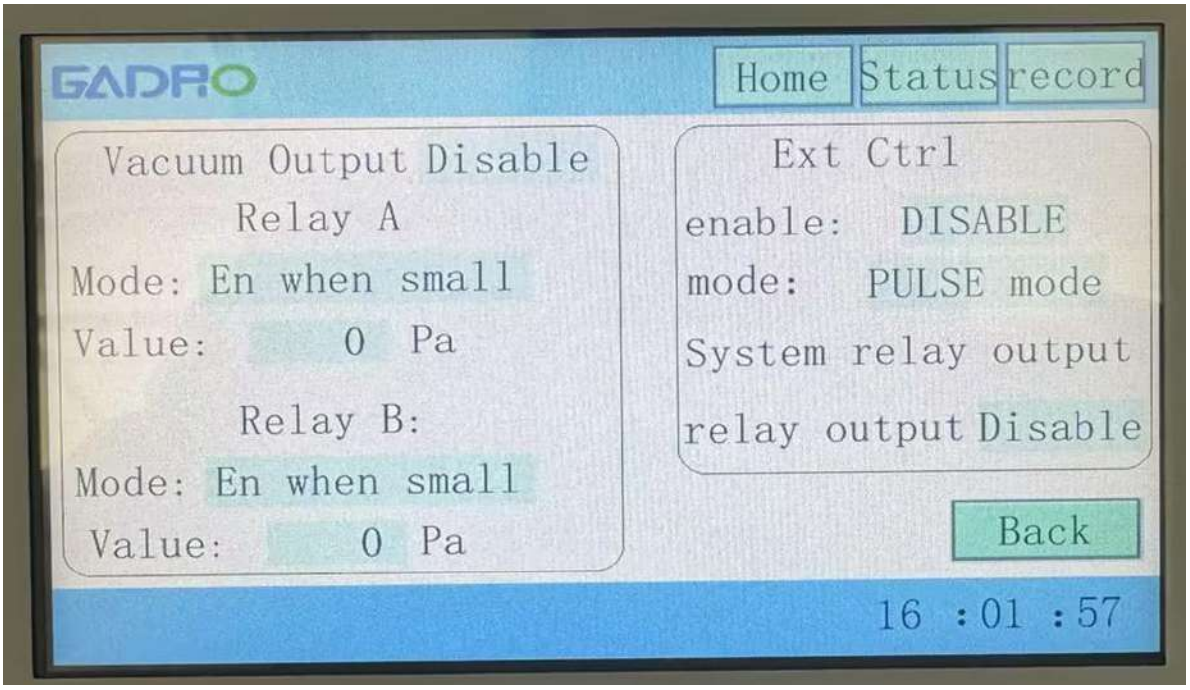


Figure 14

5.5.1 Vacuum Level Relay Output: Disabled, Enabled
Disabled: Disables the vacuum level relay output on the output board.
Enabled: Enables the vacuum level relay output on the output board.

5.5.2 Output Condition: Below Set Value, Above Set Value
Below Set Value: When the vacuum relay output is enabled, the relay outputs a vacuum signal if the vacuum level at the leak detection port is below the set value.
Above Set Value: When the vacuum relay output is enabled, the relay outputs a vacuum signal if the vacuum level at the leak detection port is above the set value.
Set Value: Configures the vacuum level at which the relay outputs a signal according to the user's requirement.

5.5.3 External Control Enable: Disabled, Enabled
Disabled: Disables external switch input signals from controlling the instrument.
Enabled: Allows external switch input signals to control the instrument.

5.5.4 Switch Mode: Pulse, Level
Pulse: When external control is enabled, the instrument can be controlled using an external pulse signal.
Level: When external control is enabled, the instrument can be controlled using an external level signal.

5.6 Miscellaneous Settings

In the setup interface, touch other Settings, set into the actual interface

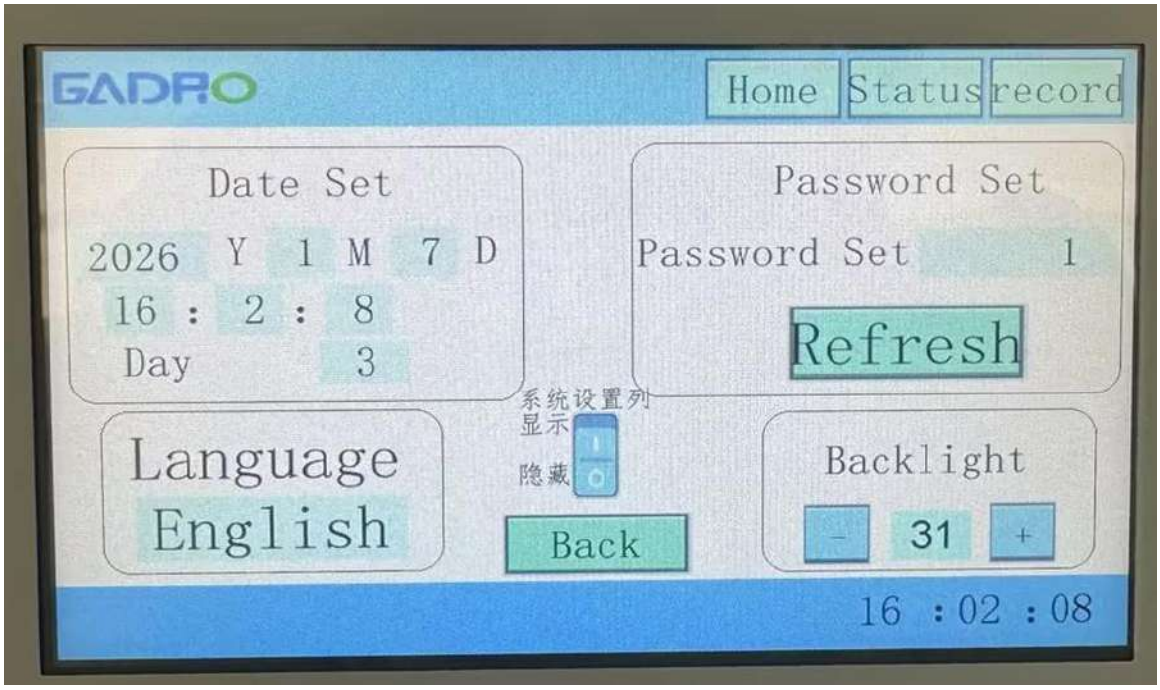


Figure 15

Tap the digital display to select the desired value and change the initial password to "1". Remember the changes well to avoid forgetting

5.7 Advanced settings

On the Settings interface, tap the advanced password lightly to enter the advanced Settings.

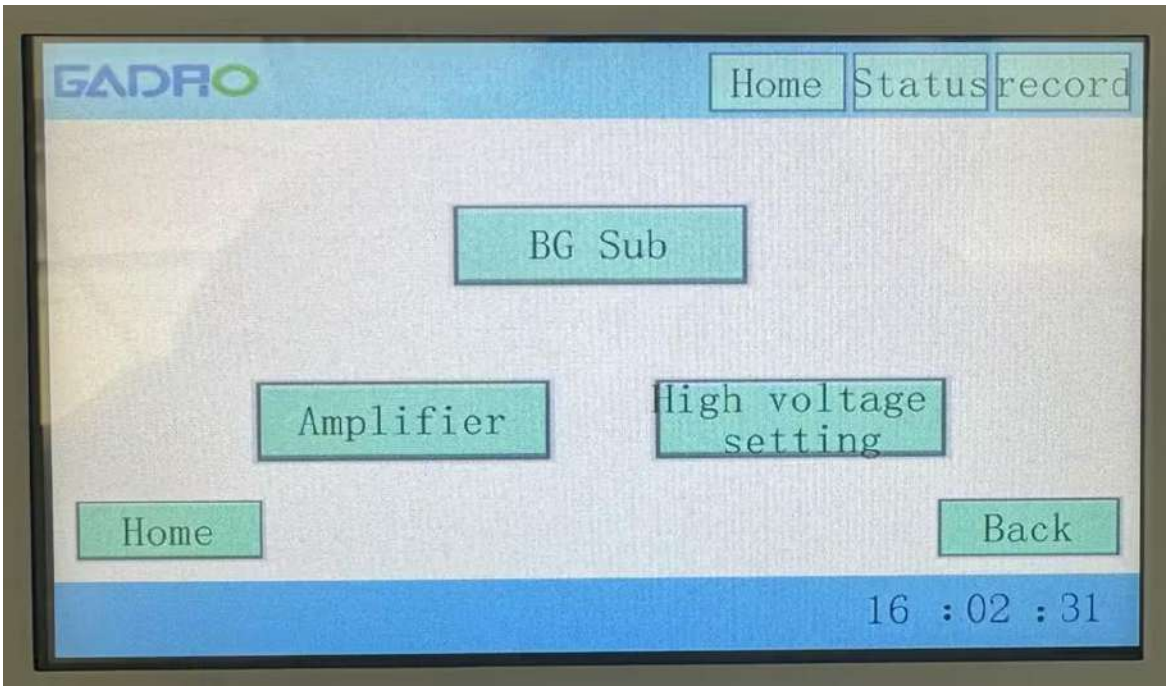


Figure 16

Key Considerations During Translation:

Clarity and Flow: The translation structures the sentences for natural English readability, moving from the condition ("Before accessing...") to the result ("...will appear").
Professional Tone: The language is formal and appropriate for a technical manual ("intended for use", "configure instrument parameters").
Precise Terminology: Technical terms like "interface," "parameters," and "debugging" are used accurately.
User Guidance: The final sentence is phrased politely and proactively ("please feel free to contact") to encourage users to seek help correctly rather than attempting changes themselves.

5.8 History

Tap the record button lightly to enter the record interface.

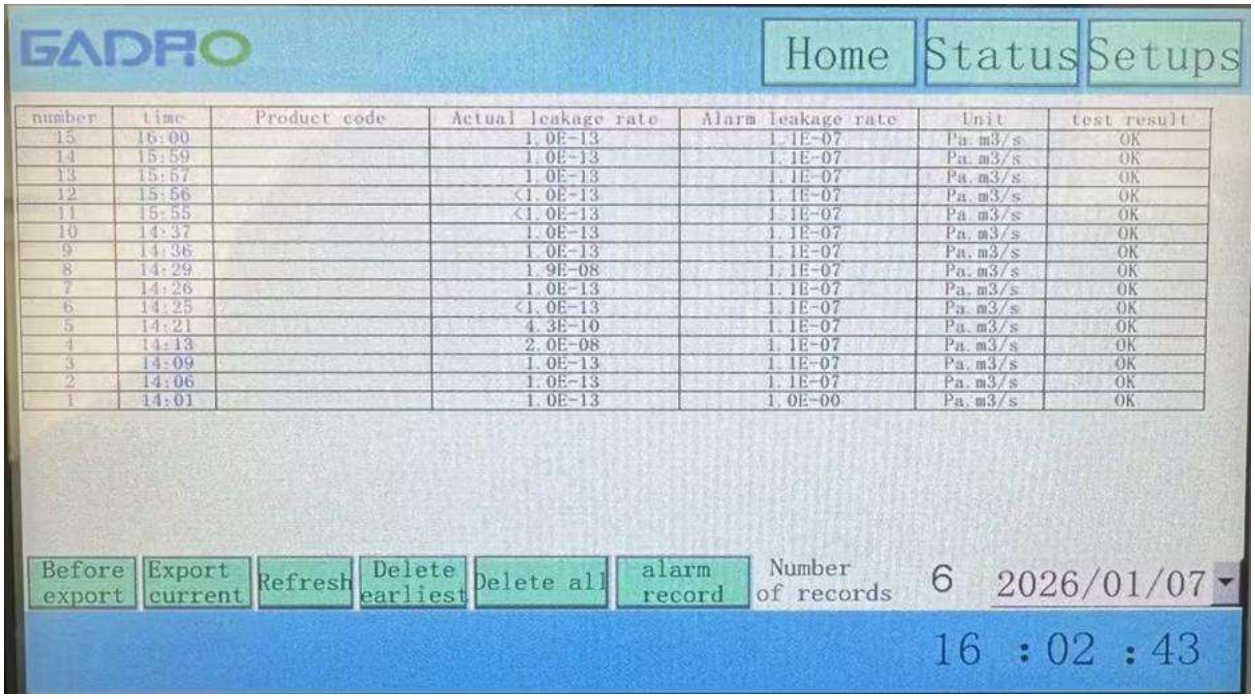


Figure 17

History Records: This function records the leak rate detected by the leak detector during every test cycle.

The recorded value is compared against the alarm threshold, and a test result (OK/NG) is output.

Export: To export the recorded data, simply insert a USB drive into the USB port located on the side of the touchscreen. Then, tap the 'Export' button to transfer the data to the USB drive. The recorded data can be read by inserting the USB drive into a computer.

Delete: This function deletes the recorded data and clears the data memory.

6. The main interface displays

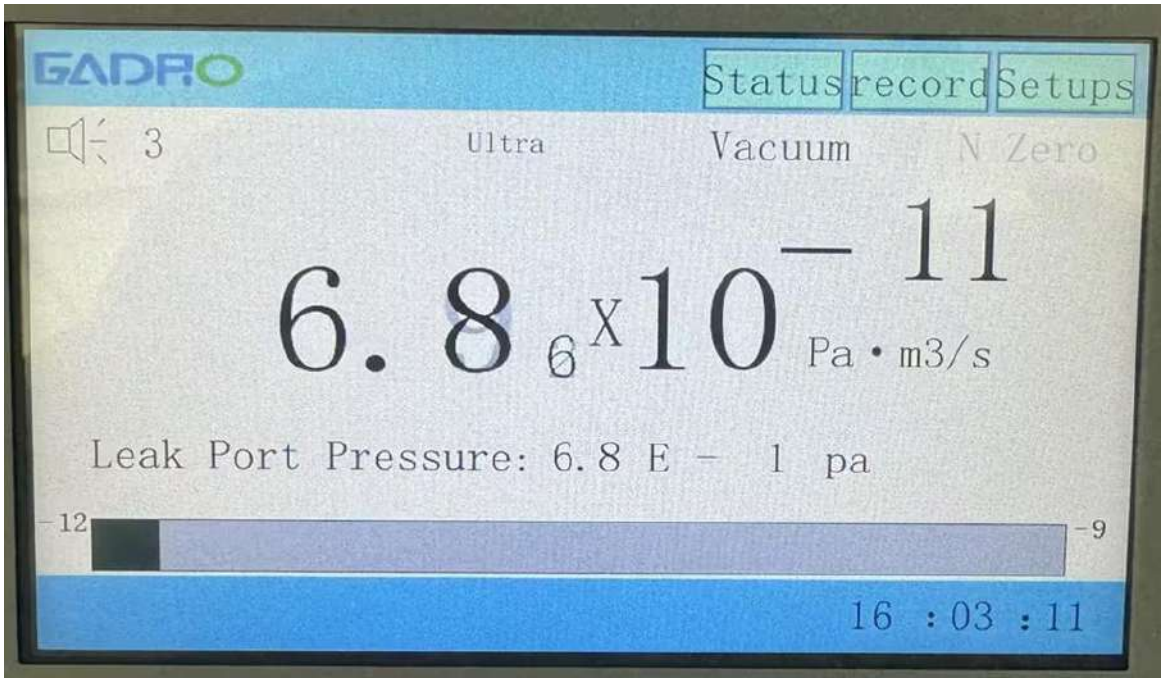


Figure 18

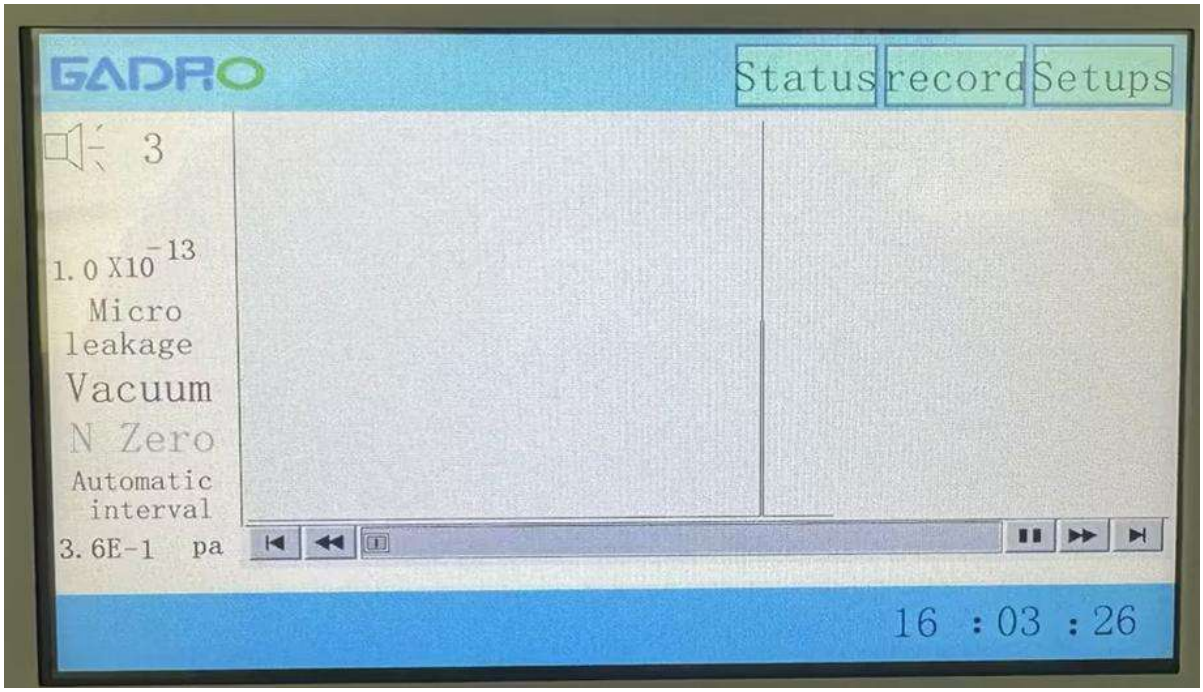


Figure 19

7. Status interface description

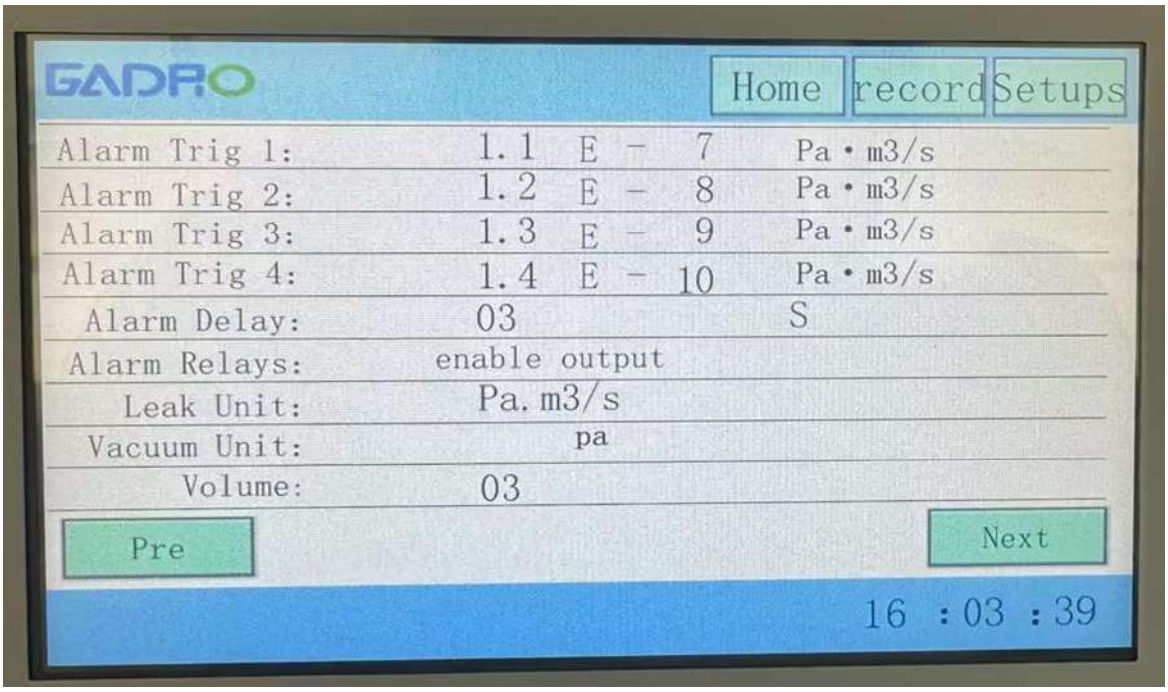
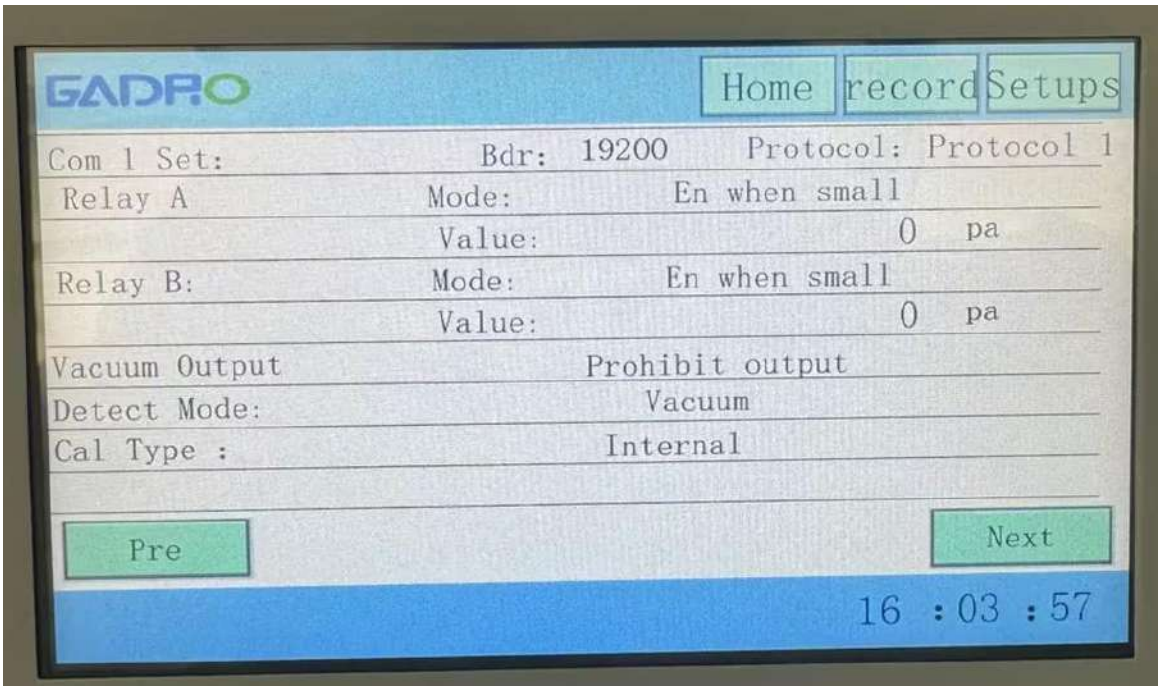


Figure 20


GADRO
Home
record
Setups
Com 1 Set:
Bdr: 19200
Protocol: Protocol 1
Relay A
Mode:
En when small
Value:
0 pa
Relay B:
Mode:
En when small
Value:
0 pa
Vacuum Output
Prohibit output
Detect Mode:
Vacuum
Cal Type :
Internal
Pre
Next
16 :03 :57

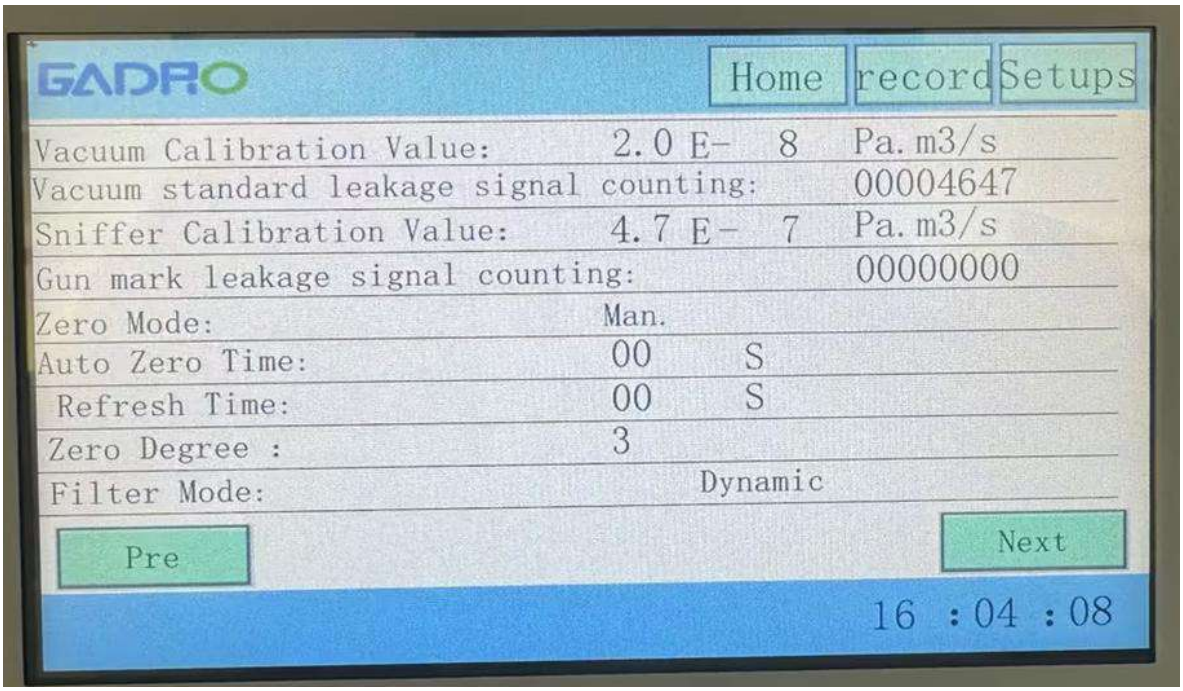
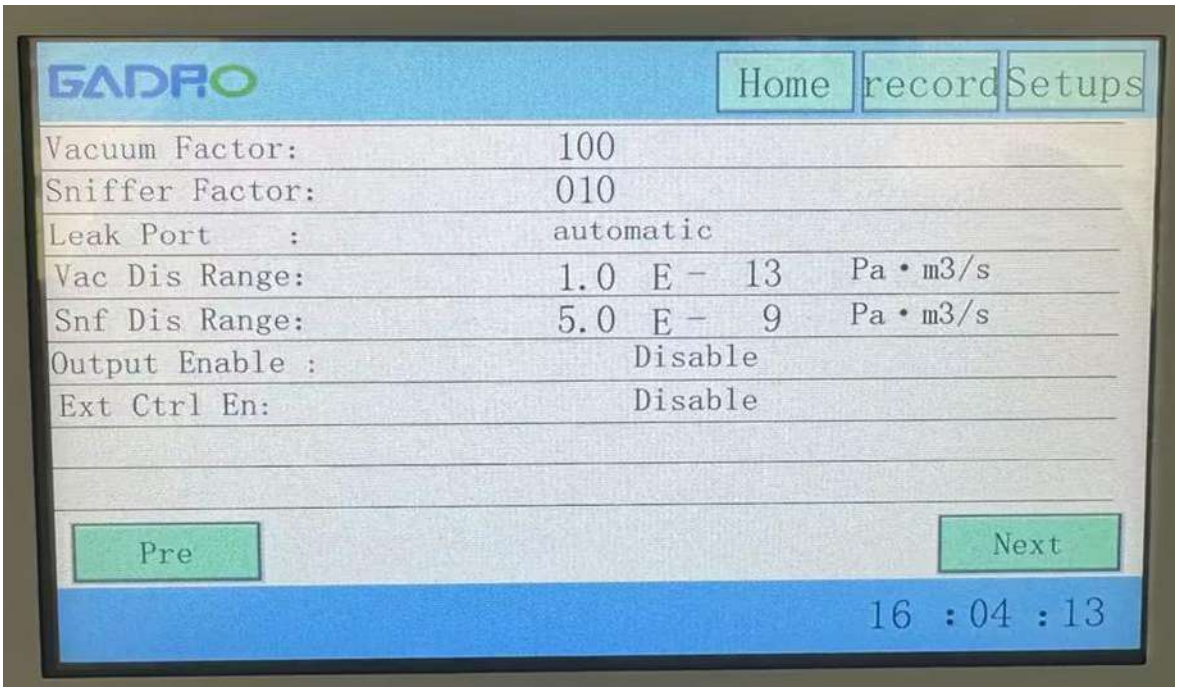
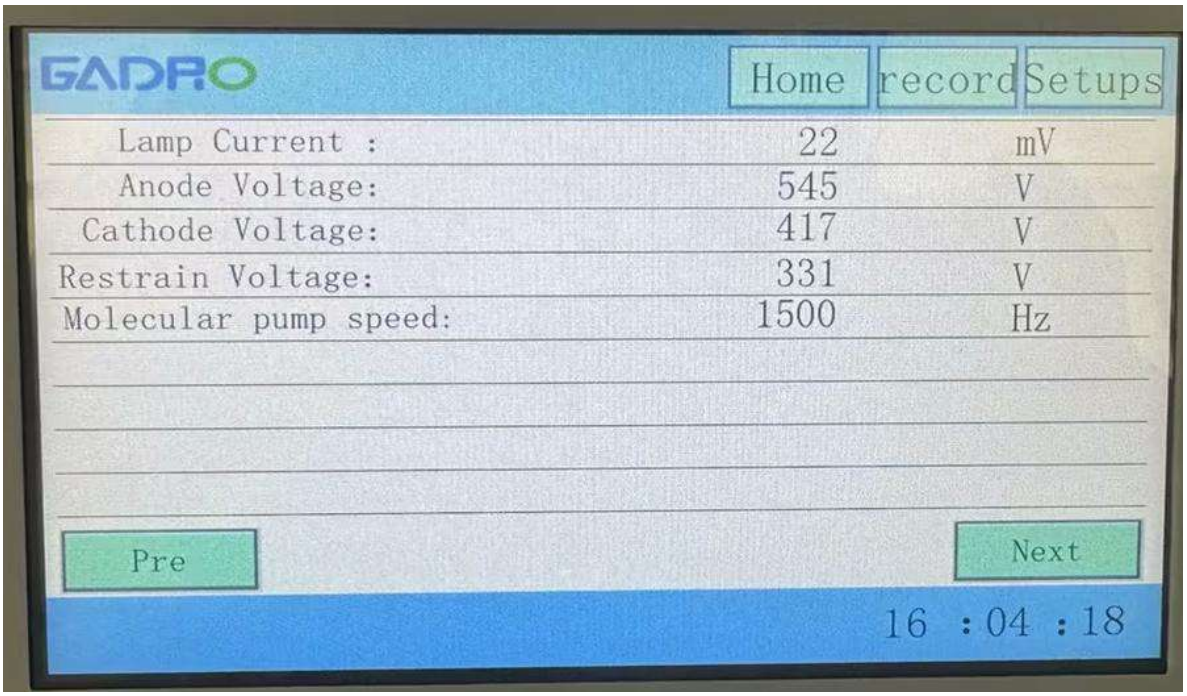

GADRO
Home
record
Setups
Vacuum Calibration Value:
2.0 E- 8
Pa.m3/s
Vacuum standard leakage signal counting:
00004647
Sniffer Calibration Value:
4.7 E- 7
Pa.m3/s
Gun mark leakage signal counting:
00000000
Zero Mode:
Man.
Auto Zero Time:
00
S
Refresh Time:
00
S
Zero Degree :
3
Filter Mode:
Dynamic
Pre
Next
16 :04 :08

Figure 2


GADRO
Home
record
Setups
Vacuum Factor: 100
Sniffer Factor: 010
Leak Port : automatic
Vac Dis Range: 1.0 E - 13 Pa • m3/s
Snf Dis Range: 5.0 E - 9 Pa • m3/s
Output Enable : Disable
Ext Ctrl En: Disable
Pre
Next
16 :04 :13


GADRO
Home
record
Setups
Lamp Current : 22 mV
Anode Voltage: 545 V
Cathode Voltage: 417 V
Restrain Voltage: 331 V
Molecular pump speed: 1500 Hz
Pre
Next
16 :04 :18

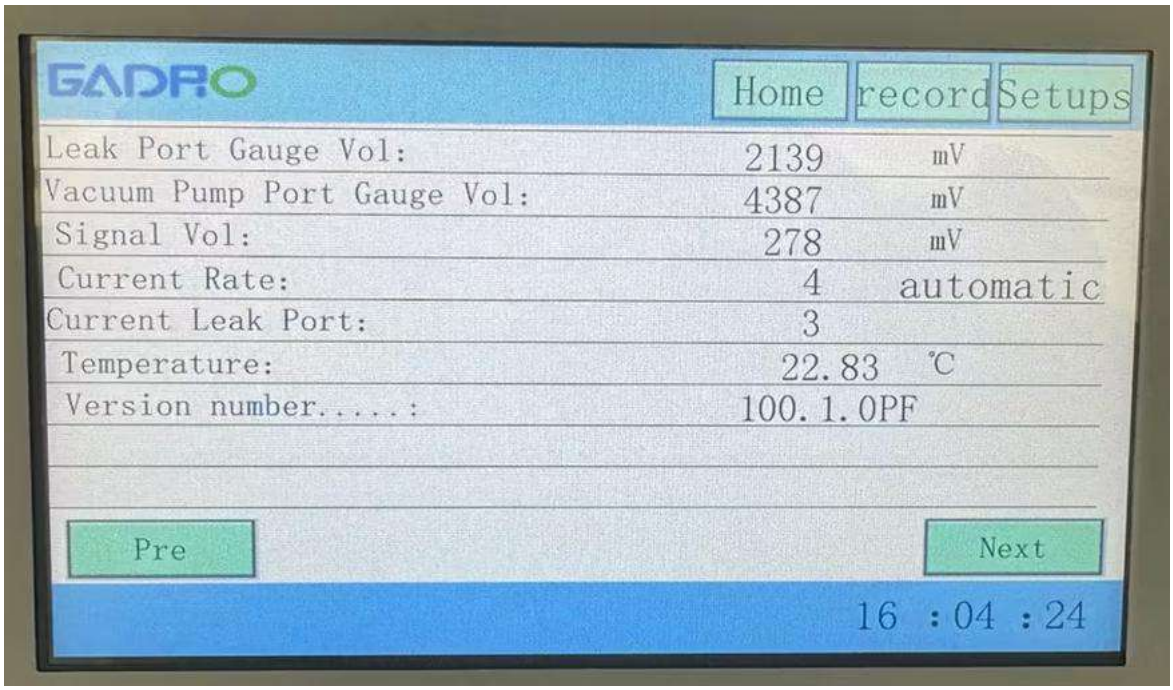


Figure 22

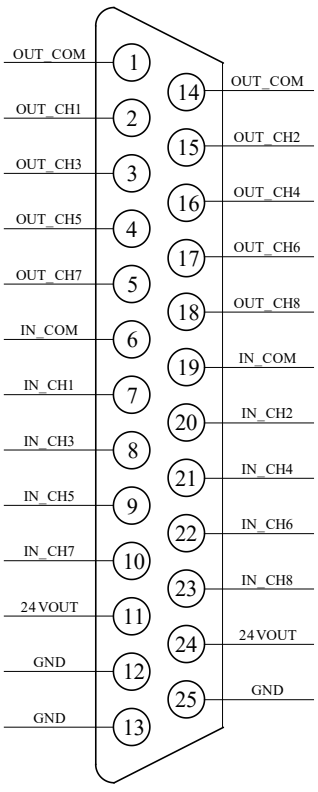
Status interface: Displays the Settings and operating parameters inside the instrument. It is convenient for users and after-sales personnel to check.

8. External control output signal interface

1	Filter power supply interface	4	485 Backup interface
2	24V interface	5	External input/output interface
3	485 interface	6	Break the gap

Figure 23

8.1 Interface definition and location



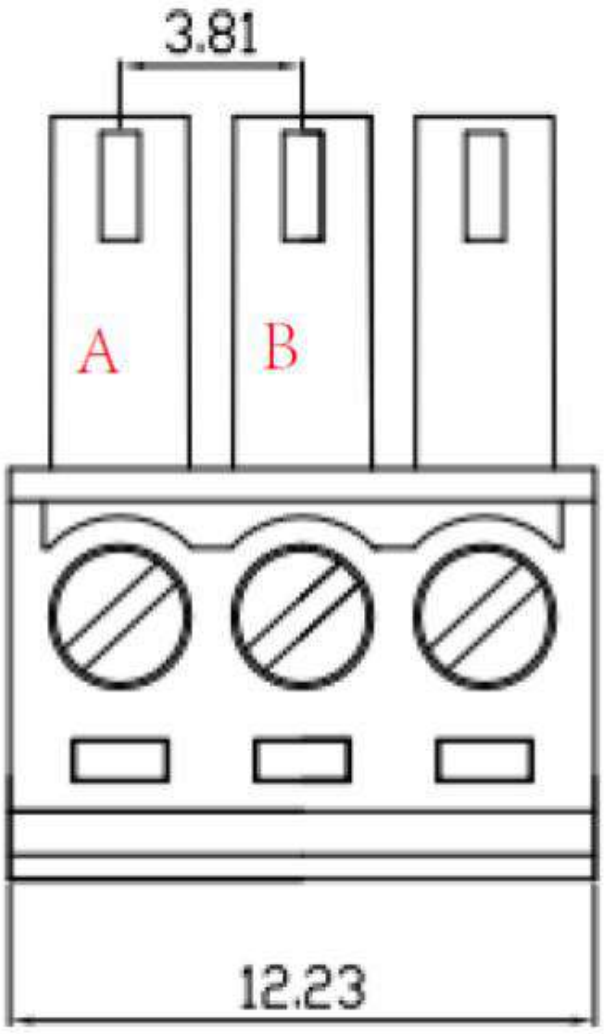
通道号	**Original Term**	**Translated Term**
IN_CH1	触发模式	Trigger Mode
IN_CH2	电平模式	Level Mode
IN_CH3	定标CAL	Calibration (CAL)
IN_CH4	定标CAL（1）	Calibration (CAL) (1)
IN_CH5	真空模式 / 吸枪模式	Vacuum Mode / Sniffer Mode
IN_CH6	(0 / 1)	(0 / 1)
IN_CH7	调零	Zero Adjustment
IN_CH8	调零(1)	Zero Adjustment (1)
Note: 1, level mode, using calibration must make IN_CH5 0, must use the stop signal to remove calibration status, namely IN_CH4.		

Channel Num	**Signal definition**
OUT_CH1	Alarm Threshold 1 Output
OUT_CH2	Alarm Threshold 2 Output
OUT_CH3	Alarm Threshold 3 Output
OUT_CH4	Alarm Threshold 4 Output
OUT_CH5	Vacuum Level 1 Output
OUT_CH6	Vacuum Level 2 Output
OUT_CH7	Standby Output
OUT_CH8	Error Output

Figure 24

8.2 485 interface

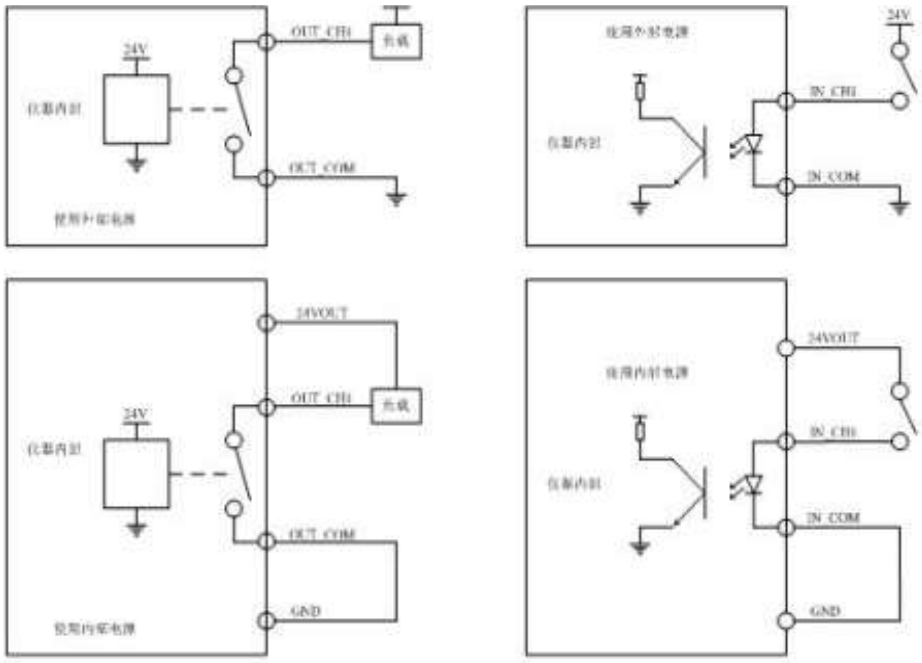
Interface: 3P connector



RS485 interface

8.3 Output Interface Usage

When testing, you can use the buzzer setting of a multimeter for the test.



IV. Commonly Used Leak Detection Methods

Using helium as a tracer gas, there are multiple detection methods. The appropriate method is typically determined based on the actual working conditions of the test piece. It is recommended to maintain the same pressure differential and usage conditions during testing as those in actual application. For example, vacuum objects should be tested in a vacuum environment, while pressure vessels should be tested under pressurized conditions.

1. Negative Pressure Detection

Negative pressure detection involves using a vacuum pump or the leak detector itself to evacuate the test piece to a vacuum state. Once a certain pressure is reached, the leak detector controls its internal valves to initiate testing. The following methods are then applied:

1.1 Spraying Method

A pressure reducer or flow meter is used to adjust the helium to a specific flow rate. A spray gun connected to the helium source is then used to spray helium onto suspected leak points of the test piece. The display value of the leak detector is observed to determine whether leaks exist.
This method can identify leak locations and relative leak rates.

1.2 Bell Jar Method

The test piece is covered with a plastic bag or bell jar, which is then filled with helium to surround the test piece with helium gas. The display value of the leak detector is observed for a certain period to determine the overall leak rate of the test piece.
This method can measure the overall leak rate of the test piece.

2. Positive Pressure Detection

Positive pressure detection involves filling the test piece with a certain amount of helium or a mixture of helium and nitrogen. The sniffing method or bell jar method is then used to test for leaks or measure the leak rate.

2.1 Sniffing Method

A specialized helium sniffing probe is attached to the leak detection port of the leak detector. The probe is then used to detect helium at suspected leak points on the test piece. The display value of the leak detector is observed during detection to identify leaks.
This method can detect leak locations and relative leak rates.

2.2 Bell Jar Method

The test piece is filled with pressurized helium or a mixture of helium and nitrogen. A bell jar is then used to cover the test piece, and the leak detector evacuates the bell jar. Helium leaking from the test piece is detected by the leak detector, and the leak rate is quantified.
This method can measure the overall leak rate of the test piece.

3. Backpressure Method

The backpressure method is primarily used for electronic components or small workpieces.
This method is somewhat similar to the bell jar method in negative pressure detection.
First, the test piece is placed in a pressurized helium tank of a certain volume. The tank is then pressurized with helium and held for a period. After removing the test piece, any residual helium on its

surface must be cleared. The test piece is then placed in a bell jar or detection tank for leak testing. The display value of the leak detector is read after a certain period, which represents the leak rate of the test piece.

Ⅴ. Instrument Maintenance and Care

1. Power-On Test

If the leak detector is not used for an extended period, it is recommended to power it on every 2-3 weeks for testing. After 2-3 hours of operation, recalibrate the instrument.

2. Mechanical Pump Maintenance

2.1 Pump Oil

Normal oil should be clean and transparent. If the oil appears dark, it should be replaced.
If gas or liquid is dissolved in the oil, it may affect the pump's ultimate pressure. To degas, close the intake port, open the gas ballast valve, and run the pump continuously for 30 minutes.

2.2 Oil Change

It is recommended to change the oil after the first 100 hours of operation.
For subsequent operation under low pressure with clean gas, change the oil every 2,000-3,000 hours or annually. However, if the pump is used to handle contaminated or corrosive process gases, or operates under high inlet pressure or high temperature, adjust the oil change frequency based on specific working conditions.

Tools required: 8mm hex wrench.
Change the oil while the pump is still warm after shutdown.
Remove the drain plug and drain the used oil into a suitable container. When the oil flow slows, reinstall the drain plug, briefly start the pump (for up to 10 seconds), shut it down again, remove the drain plug, and drain the remaining oil.
Reinstall the drain valve (check the gasket and replace if damaged).

Recommendation: If conditions allow, before adding new oil, run the pump and add approximately 100ml of new oil into the intake port. Briefly open and close the intake port 2-3 times (with 2-second intervals) to flush the pump chamber. Drain the flushing oil. The number of flushes can be determined based on the cleanliness of the drained oil. Finally, refill with an appropriate amount of new oil.

3. Standard maintenance spare parts list

No.	Material Name	Specification/Model	Quantity	Unit
1	O-Ring Rubber Seal	10×1.8	1	pc
2	O-Ring Rubber Seal	38.7×1.8	2	pcs
3	O-Ring Rubber Seal	11.2×2.65	1	pc
4	O-Ring Rubber Seal	12.5×2.65	1	pc
5	O-Ring Rubber Seal	15×2.65	1	pc
6	O-Ring Rubber Seal	18×2.5	1	pc
7	O-Ring Rubber Seal	22×2.5	1	pc
8	O-Ring Rubber Seal	33×2.5	2	pcs
9	O-Ring Rubber Seal	53×2.65	1	pc
10	O-Ring Rubber Seal	28×5.3	1	pc
11	Clamp	KF25	1	pc
12	Pump Oil	LVO 100	1	L
13	Ion Source		1	pc
14	Mainboard		1	pc
15	Ion Source Power Board		1	pc
16	Solenoid Valve Driver Board		1	pc
17	Fan		1 each	pc
18	Power Supply		1	pc

4. Analysis and Handling of Common Faults

Category	Fault Phenomena	Inspection and analysis methods
Power Supply	Leak detector does not operate after power-on	Does power socket have AC 220V ; Is power connections are in good condition ; Does the power switch output 220V; Is the fuse is burnt;
	No display after power-on	Check whether the connection lines of the display module are loose
Fan	Fan does not rotate	Check if the fan plug is loose; Check if the fan socket has 24V outlet; Check if the fan is functioning properly;
Mechanical Pump	Display is on but mechanical pump does not run	Check whether the mechanical pump switch is turned on; Check whether mechanical pump power cord connection is reliable;
	Abnormal noise from mechanical pump	Check the mechanical pump connecting clamp; Check whether leakage port is sealed; Check whether mechanical pump fan guard is out of shape;
	Mechanical Pump NG (No Good)	Check whether there is a big leak; Check whether mechanical pump oil has solidified;
Molecular Pump	Molecular Pump NG (No Good)	Check vent regulatory Check whether the output value of the exhaust port regulation is correct; Check the power supply of the molecular pump; Check the signal lines of the molecular pump; Check whether all interfaces of the molecular pump are properly connected;
Display	Display error / No display	Check whether the power supply and signal lines of the display screen are okay
Leak Detection Port Vacuum	Unable to evacuate the leak detection port	Check whether the vacuum degree output of the leak detection port is correct; Check whether electromagnetic valve V2 is open; Check whether the leakage port is sealed;
Filament / Ion Source	Filament not energizing	Check whether the molecular pump has been started and completed; Check if the ion source socket is loose;
	Ion source repeatedly powers on/off	Check if the wire sequence of the ion source socket is correct; Check whether the pins of the ion source are on or off;
Buttons	Buttons unresponsive	Check if the buttons are damaged; Check whether the button wires are connected; Check if any button has been pressed all the time;
	Instrument emits continuous beeping	

5. Analysis and handling of common error codes

Code	Meaning	Potential Cause	Troubleshooting Steps
11	Excessive repeated evacuation cycles during leak detection or calibration	1. Leak detection port pressure cannot be evacuated; port not properly connected or leak orifice malfunction. 2. Solenoid valve V2 not opened or partially opened.	1. Check for large leaks at the leak detection port; inspect the leak orifice. 2. Inspect solenoid valve V2.
16	Startup timeout	Molecular pump fails to power on normally.	Check the molecular pump.
20	Anode high voltage error	Lamp board detects error in ion source anode voltage.	Inspect/repair anode power supply, ion source cables, and filament board.
21	Emission current too low	Lamp board detects low ion source emission current.	Press the stop button and restart the system.
22	Emission current too high	Lamp board detects high ion source emission current.	Press the stop button and restart the system.
23	Lamp board 24V fault	Abnormal 24V voltage on the lamp board.	Inspect/repair the lamp board.
24	80V voltage fault	Abnormal 80V voltage on the lamp board.	Inspect/repair the lamp board.
25	Molecular pump not ready	Molecular pump has not completed startup.	Check foreline vacuum and perform self-diagnosis of the molecular pump.
26	Molecular pump communication fault	Main control board does not detect communication with the molecular pump.	Inspect/repair communication lines and main control board.
27	Molecular pump communication timeout	Main control board does not detect communication with the molecular pump for an extended period.	Inspect/repair communication lines and main control board.
36	Molecular pump speed too low	Molecular pump speed does not reach normal operating speed.	Check molecular pump power supply and connections.
30	Molecular pump error	Molecular pump overheating, pump damage, or abnormal power supply.	Check if the leak detection port vacuum level is too high; inspect molecular pump power supply and connections.
13	Mechanical pump inlet pressure too high	Abnormal vacuum in foreline pump and vacuum pipeline.	Check if the mechanical pump is operating and inspect the vacuum pipeline.

Code	Meaning	Cause	Troubleshooting
7	During Sniffer Mode calibration, the difference between the background and signal values is too small.	Low background value collected during calibration.	Check if the sniffer probe is clogged.
8	During Sniffer Mode calibration, the background value is greater than the signal value.	High helium background in the environment, or the standard leak is失效/failed, or the filament is aged.	Wait for the environmental background to decrease before recalibrating, or contact the manufacturer.
4	Calibration timeout; unable to acquire background.	High helium background in the environment, or the standard leak is失效/failed, or the filament is aged.	Wait for the environmental background to decrease before recalibrating, or contact the manufacturer.
11	Excessive repeated evacuation cycles during leak detection.	The vacuum level at the leak detection port cannot be pulled down.	Check if the vacuum line of the leak detection port is blocked.
28	Sniffer probe clogged.	Please check the sniffer probe filter.	Check if the leak detection port pressure is abnormal.
29	Sniffer probe leak.	After the leak detection port enters detection state, check if the port pressure is >300 Pa.	Check if the leak detection port pressure is abnormal.

6. Communication Protocol

Protocol Format
COMMAND <CR>
PARAMETER n1 n2 n3 ... <CR>
<CR> denotes carriage return (HEX value 0x0D). All data is transmitted in ASCII format.

Command to Read Leak Rate and Status
LR<CR>,G4<CR>
Return data format: LR=1.00E-09 MEAS<CR>
LR=1.00E-09 indicates the leak rate.
This is followed by a space and additional data, which may be:
MEAS: The leak detector is in measurement state.
STBY: The leak detector is in standby state.
CALI: The leak detector is in calibration state.
ACCL: The leak detector is in startup state.
ERXX: The leak detector is in error state (XX indicates the error code).
TSTC: The leak detector is in test leak calibration state.

Command for Leak Detector Zeroing
ZERO ON<CR>
Return data format: OK<CR>
The leak detector returns this after successful zeroing.

Command to Cancel Zeroing
ZERO OFF<CR>
Return data format: OK<CR>
The leak detector returns this after successfully canceling zeroing.

Command to Read Leak Rate
G1<CR>
Return data format: 1.00E-09 <CR>
1.00E-09 indicates the leak rate.

Command to Read Status
S1<CR>
Return data format: MEAS<CR>
MEAS: The leak detector is in measurement state.
STBY: The leak detector is in standby state.
CALI: The leak detector is in calibration state.
ACCL: The leak detector is in startup state.
ERXX: The leak detector is in error state (XX indicates the error code).
STOP: The leak detector is in paused state.

Command to Start Leak Detection
START<CR>
Return data format: OK<CR>
Return data list:

OK: Start command executed successfully.
ER01: Start command invalid (leak detector not in standby state).

Command to Stop Leak Detection
STOP<CR>
Return data format: OK<CR>
Return data list:
OK: Stop command executed successfully.
ER02: Stop command invalid (leak detector not in measurement state).

Command to Read Leak Detector Operating Status
S2<CR>
Return data format: 8 BYTE values <CR> (e.g., 00100001<CR>, high bit first, low bit last).
BYTE7: 0 = Current leak rate does not exceed alarm threshold; 1 = Current leak rate exceeds one of the four alarm thresholds.
BYTE6: 0 = Leak detector not in startup state; 1 = Leak detector in startup state.
BYTE5: Reserved.
BYTE4: Reserved.
BYTE3: Reserved.
BYTE2: 0 = Leak detector not in measurement state; 1 = Leak detector in measurement state.
BYTE1: 0 = External control disabled; 1 = External control enabled.
BYTE0: 0 = Vacuum mode; 1 = Sniffer mode.

Command to Read Leak Detector Relay Status
S3<CR>
Return data format: 8 BYTE values <CR> (e.g., 00100001<CR>, high bit first, low bit last).
BYTE7: Reserved.
BYTE6: 0 = Alarm threshold 1 relay not activated; 1 = Alarm threshold 1 relay activated.
BYTE5: 0 = Alarm threshold 2 relay not activated; 1 = Alarm threshold 2 relay activated.
BYTE4: 0 = Alarm threshold 3 relay not activated; 1 = Alarm threshold 3 relay activated.
BYTE3: 0 = Alarm threshold 4 relay not activated; 1 = Alarm threshold 4 relay activated.
BYTE2: Reserved.
BYTE1: Reserved.
BYTE0: 0 = System error relay not activated; 1 = System error relay activated.

Command to Read Current Leak Detection Port Pressure
G3<CR>
Return data format: 1.0E-5<CR>
1.0E-5 indicates the current vacuum level.

Command to Read Leak Rate Unit
G5<CR>
Return data format: 1<CR>
0 = Pa·m³/s
1 = mbar·l/s
2 = atm·cc/s

Command to Read Vacuum Unit
G6<CR>

Return data format: 1<CR>
0 = mbar
1 = Pa
2 = atm
3 = Torr

Command to Set Alarm Threshold 1
U13412<CR>
U1 indicates setting alarm threshold 1.
34 indicates the base value of the leak rate alarm threshold is 3.4.
12 indicates the exponent of the leak rate alarm threshold is 12.
U13412 sets alarm threshold 1 to 3.4E-12.
Alarm threshold base value range: 10–99.
Alarm threshold exponent range: 00–12.
Return data format: OK<CR>

Command to Set Alarm Threshold 2
U23412<CR>
Return data format: OK<CR>

Command to Set Alarm Threshold 3
U33412<CR>
Return data format: OK<CR>

Command to Set Alarm Threshold 4
U43412<CR>
Return data format: OK<CR>

Command to Set Filter Mode
U50<CR>
U5 indicates setting the filter mode.
0 indicates dynamic filtering.
1 indicates static filtering.
Return data format: OK<CR>

Serial Port Control for Calibration
EXT CAL<CR>
Normal return: OK<CR>
Error return: ER01<CR>

Serial Port Test Leak
TESTC<CR>
Normal return: OK<CR>
Error return: ER01<CR>

Command to Set Calibration Leak Rate
U81508<CR>
Return data: OK<CR>

Command to Set Leak Detection Mode

U91<CR>

0 = Automatic

1 = Low

2 = Medium

3 = High

Return data: OK<CR>

VI. Sniffer Probe Calibration Procedure:

1. Prepare the sniffer probe and a standard leak (magnitude -7).
2. Verify that the leak detection mode in "Leak Detection Settings" is set to "Sniffer Mode."
3. Navigate to the "Calibration Settings" in the "Settings" interface.
4. Set the "Calibration Leak Rate" in the "Sniffer Calibration Settings" according to the value specified on the standard leak.
5. Attach the sniffer probe to the leak detection port and open the standard leak artifact (magnitude -7).
6. Click "Start Sniffer Calibration."
7. Place the sniffer probe tip at the opening of the standard leak (magnitude -7).
8. Observe the "Current Signal" value in the upper right corner of the display. Once the signal stabilizes, click "Collect Signal" in the lower right corner of the display.
9. Move the sniffer probe tip away from the standard leak artifact and expose it to ambient air.
10. Observe the "Current Signal" value again. Once the signal stabilizes, click "Collect Background" in the lower right corner of the display.
11. After clicking "Collect Background," the display will show the "Standby" interface, indicating the sniffer calibration is complete.

Ⅶ. After-Sales Service and Customer Support

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