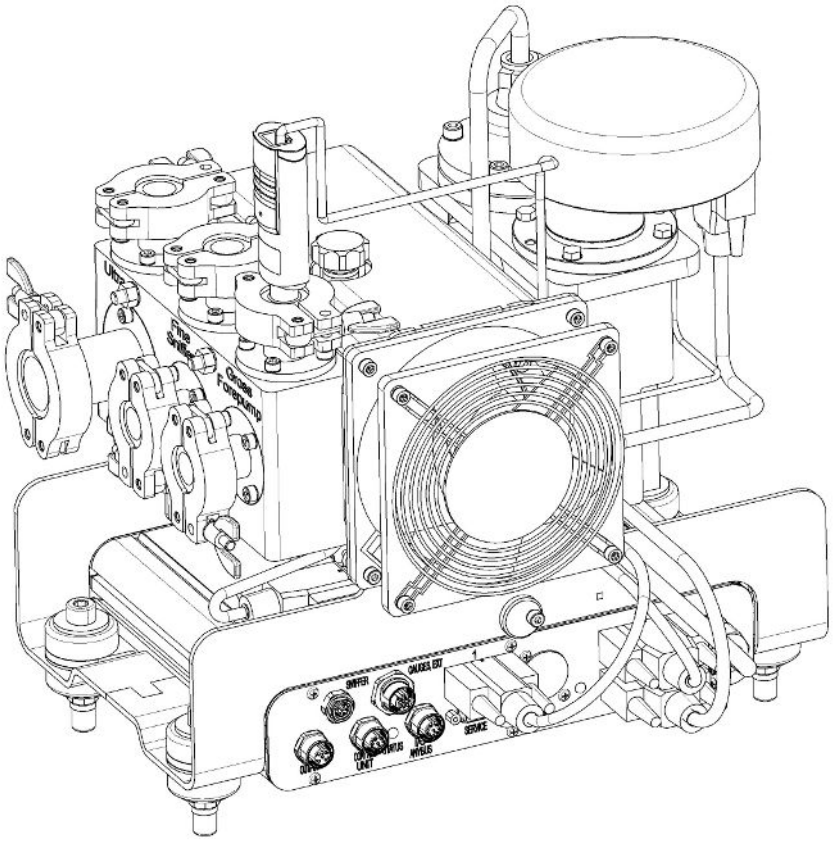


Translation of the original operating instructions

LDS3000, LDS3000 AQ

Mass spectrometer module

Catalog No.
560-300, 560-600

jiqa54en1-14-(2403)

From software version
MS-Modul 3.16

INFICON GmbH
Bonner Strasse 498
50968 Cologne, Germany

Table of contents

1 About this manual

This document applies to the software version stated on the title page.

Product names may occur in the document, which are added for identification purposes only and belong to the respective owner of the rights.

This operating manual describes the installation and operation of the LDS3000 mass spectrometer module. It is available in two variants:

- LDS3000
- LDS3000 AQ (accumulation), switchable to all other operating modes.

1.1 Other associated documents

Operating Manual Control Unit CU1000	jina54
Operating instructions bus module	jiqb10
Operating instructions I/O module	jiqc10
Operating instructions XL sniffer adapter	jinxa54
Interface protocols	jira54

1.2 Warnings

⚠ DANGER

Imminent hazard resulting in death or serious injuries

⚠ WARNING

Hazardous situation resulting in potential death or serious injuries

⚠ CAUTION

Hazardous situation resulting in minor injuries

NOTICE

Hazardous situation resulting in damage to property or the environment

1.3 Target groups

This instruction manual is intended for operators and technically qualified personnel with experience in leak detection technology and the integration of leak detectors in leak detection systems. In addition, the installation and use of the device require knowledge of electronic interfaces.

1.4 Definition of terms

Mention of helium in the manual

The device is a helium leak detector. If you want to use a forming gas instead of helium to detect the hydrogen contained therein, the information for helium also applies to hydrogen.

Accumulation

In connection with leak testing, it is about the enrichment of tracer gas over a definable period of time. This allows the detection of small leak rates without the use of a vacuum chamber. Helium or forming gas can be used.
When you talk about "AQ" in this manual, it's about accumulation mode. It is only available for devices in the AQ version.

Automatic tuning / mass setting

This function adjusts the mass spectrometer so that a maximum leak rate indicator is achieved. In order to detect a maximum ion current with the ion detector, the control computer adjusts the voltage for accelerating the ions within the selected mass range accordingly.

During each calibration, there is an automatic adjusted.

Operation mode

The leak detector distinguishes between the "Vacuum" and "Sniffing" operation modes. For the "Vacuum" operation mode, generally the tracer gas flows into the test object. The pressure in the test object is less than the ambient pressure.

In the "Sniffing" operation mode, the tracer gas flows out from the test object and is extracted with a sniffer probe. The pressure in the test object is greater than the ambient pressure.

FINE

FINE denotes the connection to the turbo molecular pump for inlet pressures up to 0.4 mbar. This is also used for the "Sniffing" operation mode.

Forming gas

Forming gas is a collective term for gas mixtures of nitrogen and hydrogen.

GROSS

GROSS donates the connection to the turbo molecular pump with the lowest sensitivity. This allows high inlet pressures (up to 15 mbar).

Internal helium background

The measurement system of the leak detector also contains a residual amount of helium. This creates an internal measurement signal component (background signal), which overlaps the display of the leak right from the beginning and thus disturbs the search for leaks.

So that this background signal can be suppressed, an internal "background suppression" can be activated with the factory settings.

Minimum detectable leak rate

The minimum detectable leak rate which can be detected by the leak detector under ideal conditions (< 5 x 10^{-12} mbar l/s).

ULTRA

ULTRA denotes the connection to the turbo molecular pump for the measurement range with the highest sensitivity at inlet pressures below 0.4 mbar (adjustable).

Background signal

Helium or hydrogen (as part of water) are natural components of air.

Operation mode "Vacuum": Before any leak detection, a certain amount of the adjusted tracer gas is already in the volume on the surfaces of the test chamber, supply lines, and even in the leak detector itself. This certain amount of tracer gas generates a measurement signal which is called the "Background signal". The ongoing evacuation of the test chamber continuously reduces this background signal.

Operation mode "Sniffing": Ambient air is continuously fed into the leak detector via the sniffer line. The amount of helium or hydrogen occurring naturally in air creates a constant background signal.

Foreline pressure

Pressure of the backing pressure between the turbo molecular pump and the backing pump.

ZERO

There is helium that is weakly bound to the surfaces of a specimen as a natural part of the ambient air and is pumped bit by bit into the measurement system of the leak detector. It produces a slowly decreasing measurement signal.

If you want to hide this background signal or the display of existing leaks, then use the ZERO function.

2 Safety

2.1 Intended use

The device is a modular leak detector for installation in industrial leak testing unit systems. The tracer gases that can be measured with the device are helium and hydrogen (forming gas).

The LDS3000 is suitable for overpressure and negative pressure testing, whereby in addition to the test in vacuum, a local test with a sniffer line is also possible.

The LDS3000 AQ is intended for the measurement of test gases when enriched in an external measuring chamber, but can also be rebuilt for all other purposes.

► You may only install, operate and maintain the device indoors in accordance with these operating instructions.

► Comply with application limits, see "Technical Data".

Incorrect usage

Avoid the following unintended uses:

- Use in radioactive areas
- Pumping off aggressive, flammable, explosive, corrosive, microbiological, reactive or toxic substances, creating a hazard
- Pumping down of condensible fluids and vapors
- Suctioning of liquids into the device
- Operation with excessive gas loads
- Operation with excessive foreline pressure
- Operation at too high ambient temperature
- Flushing with excessive flushing rate
- Usage of the pumps in plants where sudden loads and vibrations or periodic forces act upon the pump

2.2 Duties of the Operator

- Read, observe, and follow the information in this manual and in the work instructions provided by the owner. This concerns in particular the safety and warning instructions.
- Always observe the complete operating instructions for all work.
- If you have any questions about operation or maintenance that are not answered in this operating instructions, contact INFICON service.

2.3 Owner Requirements

The following notes are for companies or any person who is responsible for the safety and effective use of the product by the user, employees or third parties.

Safety-conscious operation

- Operate the device only if it is in perfect technical condition and has no damage.
- Only operate the device properly in accordance with this instruction manual, in a safety and risk conscious manner.
- Adhere to the following regulations and observe their compliance:
  - Intended use
  - Universally valid safety and accident prevention regulations
  - International, national and local standards and guidelines
  - Additional device-related provisions and regulations
- Only use original parts or parts approved by the manufacturer.
- Keep this instruction manual available on site.

Personnel qualifications

- Only instructed personnel should be permitted to work with and on the device. The instructed personnel must have received training on the device.
- Make sure that authorized personnel have read and understood the instruction manual and all other applicable documents.

2.4 Dangers

The measuring instrument was built according to the state-of-the-art and the recognized safety regulations. Nevertheless, improper use may result in risk to life and limb on the part of the user or third parties, or damage to the unit or other property may occur.

Hazards due to liquids and chemicals

Liquids and chemical substances can damage the instrument.

- Comply with application limits, see "Technical Data".

- Do not suck up liquids with the instrument.
- Avoid sniffing gases, such as hydrogen, above the lower explosion limit. The allowable composition of venal gas mixtures can be read in the safety data sheets of the respective manufacturers.
- Only use the device away from areas with a risk of explosions.

Danger for wearers of implants such as pacemakers

There are magnets in the mass spectrometer module. The magnetic fields can interfere with the function of the implant.

- Always keep at least 10 cm distance from the mass spectrometer module.
- In order not to fall below the minimum distance, avoid unpacking or mounting the mass spectrometer module.
- Furthermore, take into account distances specified by the manufacturer of the implant.

Dangers from electric power

The device is operated with electrical voltages of up to 24V. Inside the device there are voltages that are considerably higher. There is a danger to life from the contact of conductive parts inside the device.

- Disconnect the device from the power supply prior to any installation and maintenance work. Make sure that the electric power supply cannot reconnected without authorization.
- Before starting the leak test, disconnect electrically operated test objects from the power supply.

The device contains electric components that can be damaged from high electric voltage.

- Make sure before connecting to the power supply that the supply voltage is 24 V +/- 5%.

Kinetic energy

If the rotating parts in the turbo molecular pump are blocked because of some damage, high centrifugal forces must be absorbed. If this is not successful, the mass spectrometer module will breakaway and possibly cause damage to property or personal injury.

- Make sure the mount of the mass spectrometer module is able to absorb a braking torque of 820Nm.

Injury from bursting objects

There is risk of injury from bursting objects causes by a test object notwithstanding the vacuum pressure when a test object is connected.

- Take appropriate precautions.

Danger due to imploding measuring chamber

An external measuring chamber connected to an LDS3000 AQ is pumped off at approximately 60 sccm. Within normal measurement times (2 - 30 seconds) no dangerous negative pressure is generated.

If the measuring chamber is leak-proof, but not vacuum resistant, and continues to pump, it may implode. This can occur, for example, in a 1-liter measuring chamber after about 10 minutes.

- Do not continue pumping a measuring chamber after the measuring time has expired.
- Consider suitable protective measures!

3 Scope of delivery, transport, storage

Scope of delivery

Item	Quantity
Mass spectrometer module[1)]	1
Plug for 24V connection	1
Pressure sensor PSG500	1
Self-locking nuts	4
Plug for Output	1
Plug for Gauges Exit	1
Inlet module (LDS3000 AQ version only)	1
Adapter DN16 with throttle[2)] (LDS3000 AQ version only)	1
USB flash drive with instructions, 3D drawings and videos	1

1.) Includes either 560-300 LDS3000 or 560-600 LDS3000 AQ (accumulation).

2.) See "Select components and connect [▷ 39]".

► Please check the delivery for completeness after receiving the device.

Transport

NOTICE

Damage due to unsuitable packaging material

Transport in unsuitable packaging material can damage the device.

► Transport the unit only in the original packaging material.

► Keep original packaging material.

NOTICE

Damage to property due to missing attachment of the vibration damper

► Secure the vibration damper with the transport screws to prevent damage due to vibration.

Storage

► Always store the device in compliance with the technical data, see "Technical data [▷ 26]".

4 Description

4.1 Function

Objective

The mass spectrometer module is a detection device for the test gases helium and hydrogen. Integrated in test systems, the device is used to detect gas being emitted from a test object in order to indicate leaks.

The device can be used both as a vacuum leak detector and a sniffer leak detector. Sniffer lines with different lengths are available for the sniffer mode.

Mode AQ (Accumulation)

In order to be able to detect small leak rates without the use of a vacuum chamber, devices for the AQ mode are connected to an external measuring chamber. In the external measuring chamber, the tracer gas is enriched (accumulation).
The test object filled with helium or forming gas under pressure is brought into the measuring chamber or pressurized in the measuring chamber. If there is a leak in the test object, the concentration of helium or forming gas in the measuring chamber will increase. This increase is measured and output as a leak rate.

Device Interfaces

The mass spectrometer module is part of the leak detection system LDS3000 and LDS3000 AQ. Es can be operated in a test system together with a bus module or I/O module and a data cable without additional INFICON accessories.

The MSB box outputs data on digital interfaces to the control unit CU1000, I/O module IO1000 or bus module BM1000.

Other accessories

With the available accessories XL sniffer adapter and sniffer line SL3000XL, it is possible to capture leaks at a larger distance from the expected leak if the detection limit is deteriorated (operation in "high flow" mode).

4.2 Design of device

4.2.1 Entire device (LDS3000)

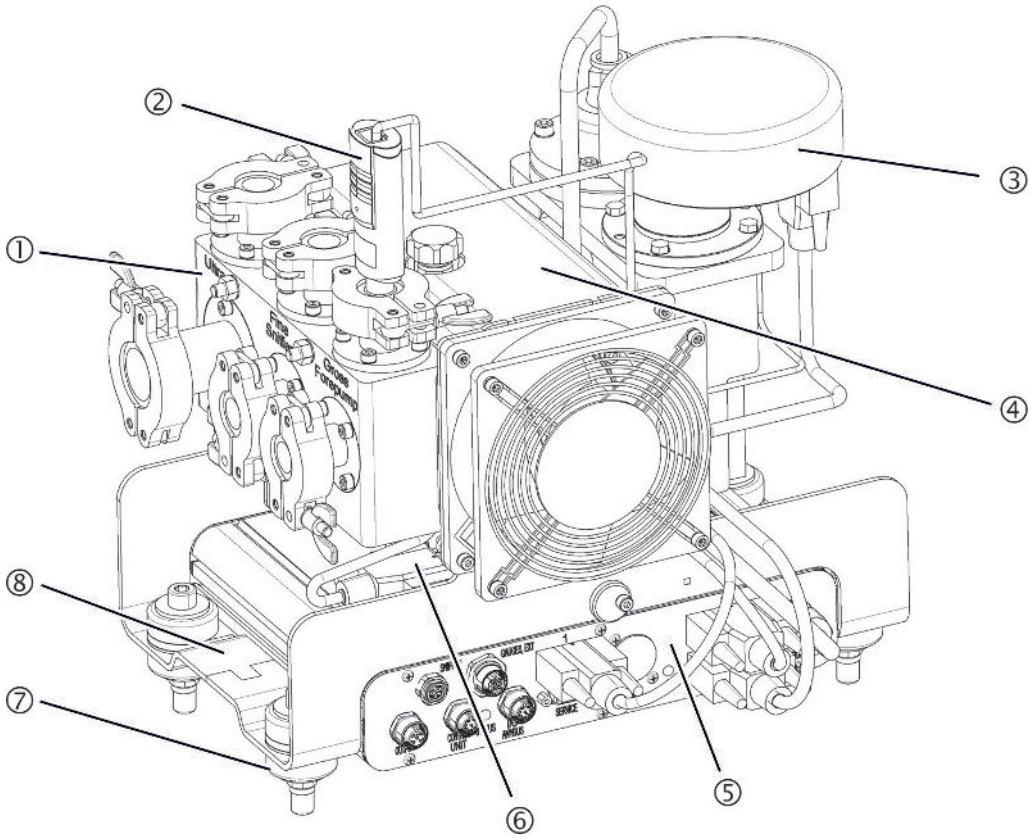


Fig. 1: Mass spectrometer module LDS3000

1	Connection block. Connections for test system, backing pump, pressure sensor PSG500, internal calibration leak and sniffer line, see also "Connection block [▶ 23]".
2	Pressure sensor PSG500 for measuring the pressure of the backing pump
3	Preamplifier of the mass spectrometer module
4	Turbo molecular pump with cooling unit
5	MSB box. Interfaces to the mass spectrometer module (see "MSB box [▶ 23]")
6	Inverter for turbo-molecular pump
7	Fasteners for installing the mass spectrometer module in a test system
8	Rating plate containing mass spectrometer module specifications

4.2.2 Entire device (LDS3000 AQ)

In the accumulation version, the mass spectrometer module is integrated into a special measurement setup by hardware and software.

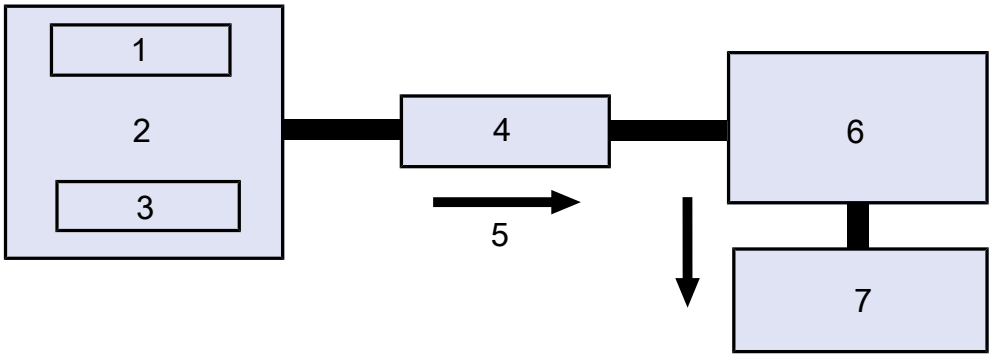


Fig. 2: LDS3000 AQ (schematic view)

1	Fan system
2	Test chamber at atmospheric pressure
3	Component to be tested
4	Connection
5	Sample gas flow (≈ 50 sccm)
6	LDS3000 AQ
7	Fore pump

For details of the measurement setup, see “Select components and connect [▶ 39]“.

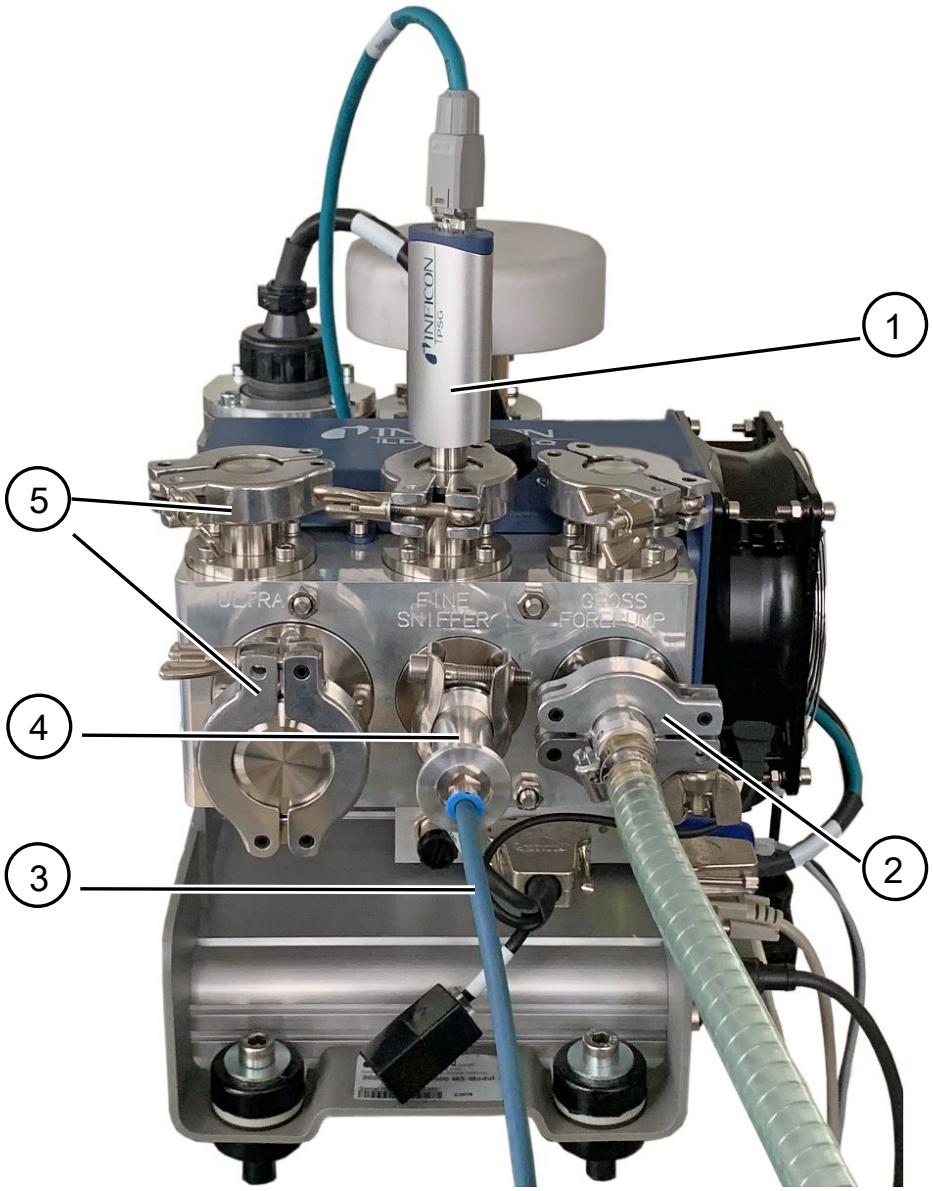


Fig. 3: Mass spectrometer module (execution accumulation)

1	Pressure sensor PSG500 for measuring the inlet pressure
2	GROSS throttle flange with connecting hose to backing pump
3	Hose to the measuring chamber
4	Inlet module
5	ULTRA connections blind flanged

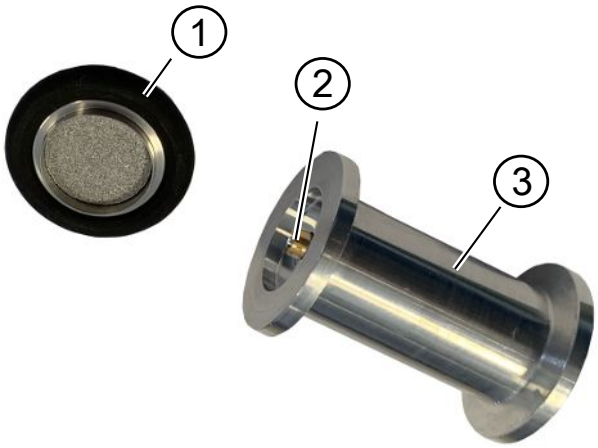


Fig. 4: Inlet module

	Inlet module. It can be mounted on the measuring chamber as well as on the mass spectrometer module.
1	Filter of the inlet module. A cleaning of the filter is not provided. Available as a replacement filter from INFICON under the order number 211-090. See also "LDS3000 AQ - maintenance relevant components [▶ 160]". Calibrate after changing the filter.
2	Throttle valve insert
3	Standard throttle

Accessories of the customer

To complete the measurement setup, missing parts can be provided by the customer.

If you want to use your own backing pump, make sure it is a dry backing pump with a gas flow greater than 60 sccm and a base pressure of less than 5 mbar. It should have its own power supply.

If you want to use your own control unit, please note that the wizard for performing the measurement settings, calibrating and setting the ZERO function is only located on the INFICON CU1000 control unit.

See also "Select components and connect [▶ 39]".

Optional accessories from INFICON

With the exception of the measuring chamber, the required parts are also offered by INFICON.

- Control unit CU1000 (including wizard for carrying out important settings)
- I/O1000 (The I/O module is a device interface between a leak detector and an external controller)
- BM1000 (The bus module is a device interface between e.g. the MSB box of the mass spectrometer module LDS3000 and an external controller.)
- Corrugated hose, available on the homepage of INFICON under "Vacuum components".
- ISO-KF connections (eg screw-in flange), available on the homepage of INFICON under "Vacuum components".

- ISO-K centering rings and seals, available on the homepage of INFICON under "Vacuum components".
- DIN rail power supply 24V, 10A from INFICON (catalog number 560-324) for the dry backing pump of INFICON.
- Dry backing pump from INFICON (catalog number 560-630).

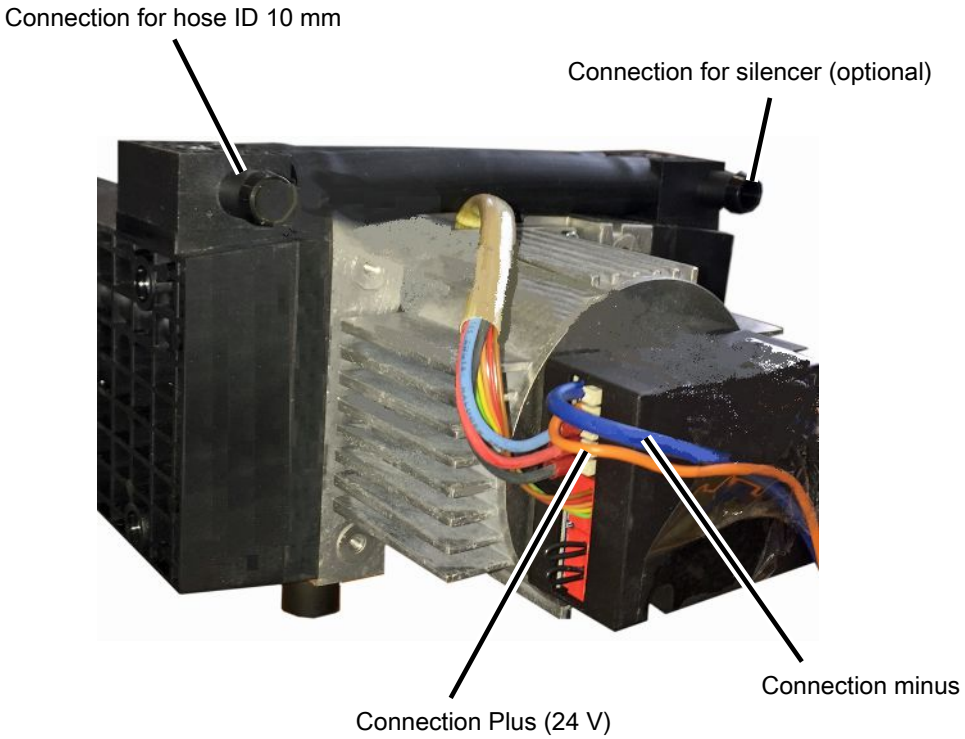


Fig. 5: Dry backing pump from INFICON

4.2.3 Connection block

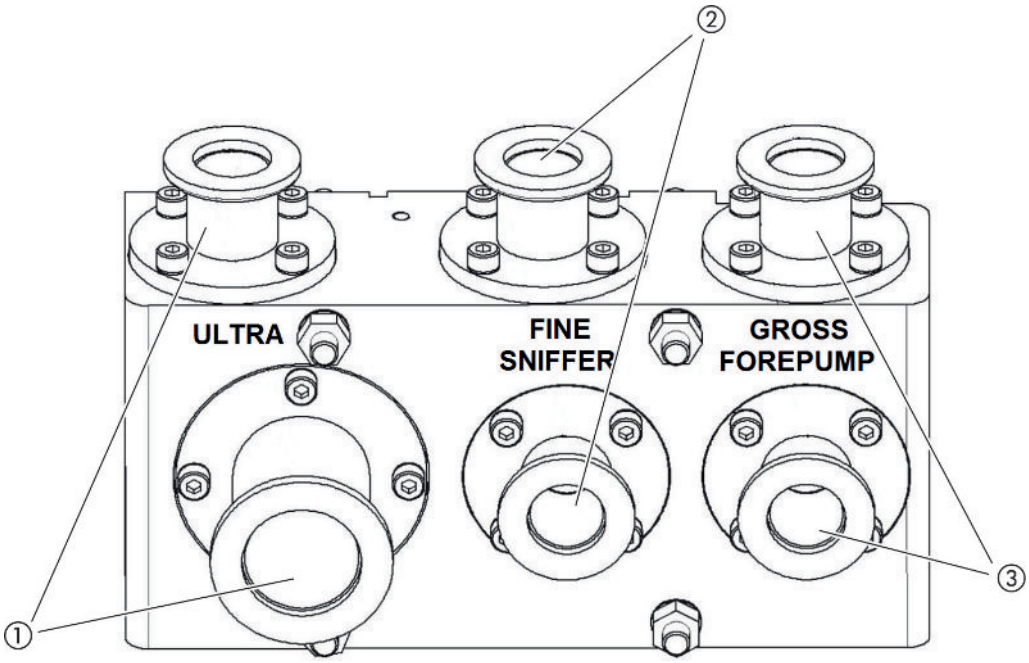


Fig. 6: Connection block

1	Connection ULTRA	3	Connection GROSS/FOREPUMP
2	Connection FINE/SNIFFER		

4.2.4 MSB box

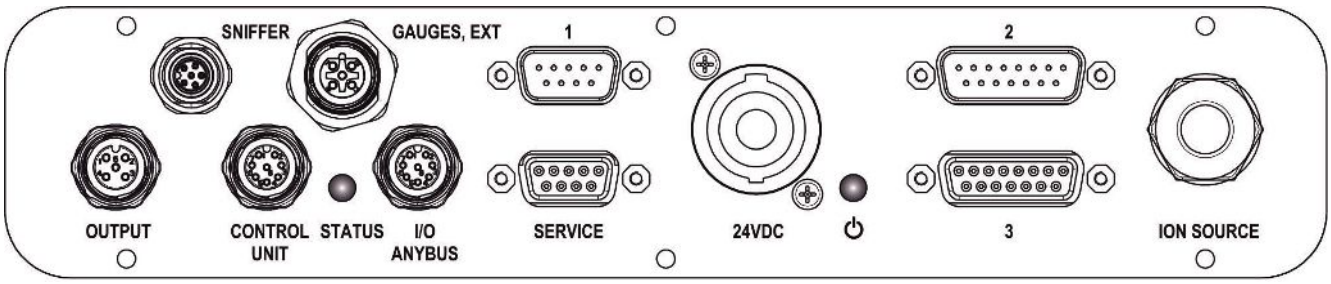


Fig. 7: MSB box connections

SNIFFER

Electrical connection for the sniffer line

GAUGES, EXT

Connection for optional external service gauges (0 - 10 V / 0 - 20 mA) for INFICON service

Connection plug arrangement	
1	+24-V-Output, max. 200 mA
2	Input for P3 service gauge, 0 - 10V
3	GND

4	Reference to input for P3 service gauge
5	20 mA input for P3 service gauge

1 (See also Figure MSB box)

Connection for pressure sensor PSG500, calibration leak and suppressor on the preamplifier (premounted, three-core cable)

2 (See also Figure MSB box)

Connection for inverter turbo molecular pump and fan turbo molecular pump (premounted, two-core cable)

OUTPUT

Connection for gas ballast and three valves

Connection plug arrangement	
1	Valve 2 (gas ballast), 24 V, max.1 A
2	Valve 3 (not used, reserve)
3	Valve 4 (not used, reserve)
4	Valve 6 (not used, reserve)
5	GND

CONTROL UNIT, I/O / ANYBUS

Connection for I/O module or bus module or control unit. Cable length of the INFICON data cable < 30 m. In order to avoid the display of incorrect measured values, the specified maximum cable length must be observed.

The connections “Control Unit” and “I/O / Anybus” have the same functions. You have the choice of connecting:

– Control unit CU1000 + I/O module IO1000

– Control unit CU1000 + bus module BM1000

SERVICE

RS232 connection for INFICON Service.

24VDC

Connection for 24 V power supply pack used to supply mass spectrometer module, control unit, I/O module and bus module. Cable length < 30 m.

STATUS

Status LED

The Power LED and Status LED indicate the status of the unit.

Power LED ⏻ / Status LED

The Power LED and Status LED indicate the status of the device.

Power LED	Status LED	Meaning
Off	Red	Device not ready for operation
Green	Blue	Turbo molecular pump is starting
Green	Orange	Emission is switched on
Green	Green	Emission is stable
Green	Violet	Rotation speed of the turbo molecular pump is not within the normal range
Green	Error codes of the status LED	Different activities of the unit
Green, flashes slowly		Supply voltage < 21.6 V
Green, flashes fast		Supply voltage > 26.4 V
Green, flashes	Off	Software is being updated
Green	Green, flashes	Software is being updated

3 (See also Figure MSB box)

Connection for preamplifier

ION SOURCE

Connection for ion source

4.2.5 Markings on the device

⚠ DANGER

Danger for wearers of implants such as pacemakers

Permanent magnets in the mass spectrometer module pose a health hazard. Implants can be influenced in their function.

► Always keep at least 10 cm distance from the mass spectrometer module.

► In order not to fall below the minimum distance, avoid unpacking or mounting the mass spectrometer module.

► Furthermore, take into account distances specified by the manufacturer of the implant.

		Device cannot be disposed of as normal domestic waste.

4.3 Technical data

Mechanical data

	560-300, 560-600
Dimensions (L × W × H)	330 x 270 x 293 mm (13 x 10.6 x 11.5 in.)
Inlet flange	1 x DN25 KF 5 x DN16 KF

Electrical data

	560-300, 560-600
Power input	max.10 A
Operating voltage	24 V ⎓ +/-5%
Protection class	IEC/EN 60034-5 IP40 UL 50E Type 1

Physical data

	560-300, 560-600
Response time in Sniffer mode	GROSS: < 5 s, FINE/ULTRA: < 1 s
Maximum inlet pressure	0,2 mbar - 18 mbar
Run-up time	< 150 s

	560-300, 560-600
Detectable gases	Helium, hydrogen
Minimum detectable leak rate vacuum mode	< 5E-12 mbar l/s
Minimum detectable leak rate sniffer mode	< 1E-7 mbar l/s
Detectable masses	4He, H2, mass 3 (e.g. H-D, 3He or H3)
Ion source	2 longlife Iridium filaments, Yttrium-oxide coated

	560-600 (AQ mode)
Minimum detectable leak rate forming gas or helium	< 1 x 10^{-7} mbar l/s
Measurement range	6 decades
Pressure in test chamber	1 atm
Time constant of the leak rate signal	< 1 s

Ambient conditions

	560-300, 560-600
Permissible ambient temperature (during operation)	10 °C ... 45 °C
Max. altitude above sea level	2000 m
Permissible magnetic field max.	7 mT
Max. relative humidity above 40 °C	50%
Max. relative humidity from 31 °C to 40 °C	80% ... 50% (decreasing linearly)
Max. relative humidity to 40 °C	80%
Storage temperature	-20 °C ... 60 °C
Pollution degree	2

4.4 Factory settings

Parameter	Factory setting
AO upper limit exp.	1 x 10^{-5}
Operation mode	Vacuum AQ Mode 1 [1)]
AQ chamber volume	1 l [1)]
AQ measurement time	10 s [1)]
Zero time factor AQ	4 [1)]
Bus module address	126
Clogged pressure capillary monitoring - with XL Sniffer Adapter (low flow)	0.4 mbar 0.2 mbar
Broken pressure capillary monitoring - with XL Sniffer Adapter (low flow)	2 mbar 0.6 mbar
Clogged pressure capillary monitoring - with XL Sniffer Adapter (High Flow)	150 mbar
Broken pressure capillary monitoring - with XL Sniffer Adapter (High Flow)	400 mbar
Pressure unit (interface)	mbar
Emission	On
Filter leak rate threshold	1 x 10^{-10}
Filter ZERO time	5 s
Filter mode	I•CAL
Gas percentage in H_2 (M3, He)	100 % 5 % H_2 (-, 100 % He) [1)]
Gas ballast	Off
I/O module protocol	ASCII
Calibration request	On
Calibration factor VAC/SNIF Mx (for vacuum, sniffing and all masses)	1.0
Cathode selection	Auto Cat1
Compatibility mode	LDS3000 AQ [1)]
Config. Analog output 1	Leak rate mantissa
Config. Analog output 2	Leak rate exponent
Config. Analog output scaling	0.5 V / decade
Configuration of digital outputs	Pin 1: Trigger 1, inverted Pin 2: Trigger 2, inverted Pin 3: Trigger 3, inverted

Parameter	Factory setting
	Pin 4: Trigger 4, inverted Pin 5: Ready Pin 6: Error, inverted Pin 7: CAL request, inverted Pin 8: Open, inverted
Configuration of digital Inputs	Pin 1: Select dyn. / normal CAL Pin 2: Sniff Pin 3: Start/Stop, inverted Pin 4: ZERO Pin 5: External CAL Pin 6: Internal CAL Pin 7: Clear Pin 8: ZERO update Pin 9: – Pin 10: –
Leak rate unit SNIF, (display and interface)	mbar l/s
Leak rate unit VAC, (display and interface)	mbar l/s
Leak rate upper limit VAC (interface)	1.0×10^{-1}
Leak rate lower limit VAC (interface)	1.0×10^{-12}
Leak rate upper limit SNIF (interface)	1.0×10^{-1}
Leak rate lower limit SNIF (interface)	1.0×10^{-8}
Fan mode	Fan always on
Machine factor in standby	Off
Machine factor / Sniff factor	1.0 (for all masses)
Mass	4
Module on the I/O connection	IO1000
Nominal state TMP	On
calibration leak external SNIF	9.9×10^{-2}
calibration leak external VAC	9.9×10^{-2}
Calibration leak internal	9.9×10^{-2}
Open calibration leak internal	Off
Sniffer line detection	On
Sniffer key ZERO	On
Language	English
TMP rotation speed	1500 1000 [1)]

Parameter	Factory setting
Trigger level 1 (2, 3, 4)	1 x 10^{-5} mbar l/s 5 x 10^{-5} (1 x 10^{-5}) mbar l/s [1)]
Preamplifier test at CAL	On
Display warning as error (1 - 8)	No Entry
Maintenance warning	Off
ZERO with start	Off
ZERO mode	Suppress everything

1) in AQ mode

5 Mounting LDS3000

5.1 Adjust the position of the connections to the installation dimensions

Select location

Select the most helium-free environment possible for the measurement setup. For reliable measurements with the device, the helium content in the air must be less than 10 ppm.

By nature, air contains 5 ppm (0.0005%) helium.

Mount MSB box

In order to ideally match the installation position space, the MSB box can be turned and rotated.

The MSB box is seated in two guide rails and can be pushed into the housing from the left or from the right. It can also be rotated, if necessary, so that the labels are upside down.

The locking washer must be released to pull out the MSB box.

If the MSB box is to be pushed into housing from the other side, the locking washer must also be tightened on the other side of the housing. An appropriate threaded hole is available.

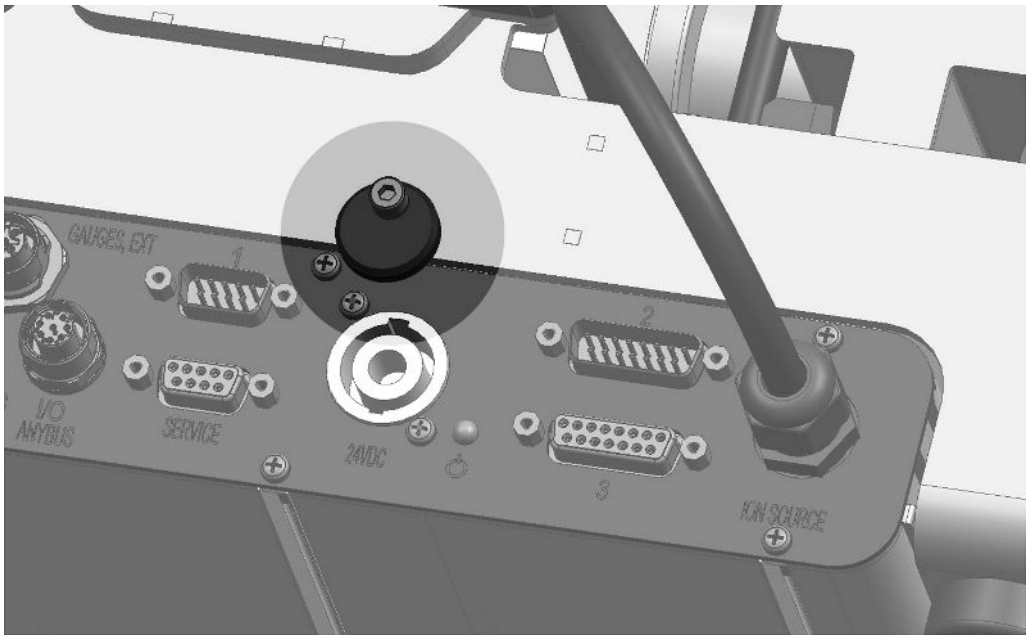


Fig. 8: Lock

5.2 Installing the mass spectrometer module on the test system

The mass spectrometer module can be mounted in any position.

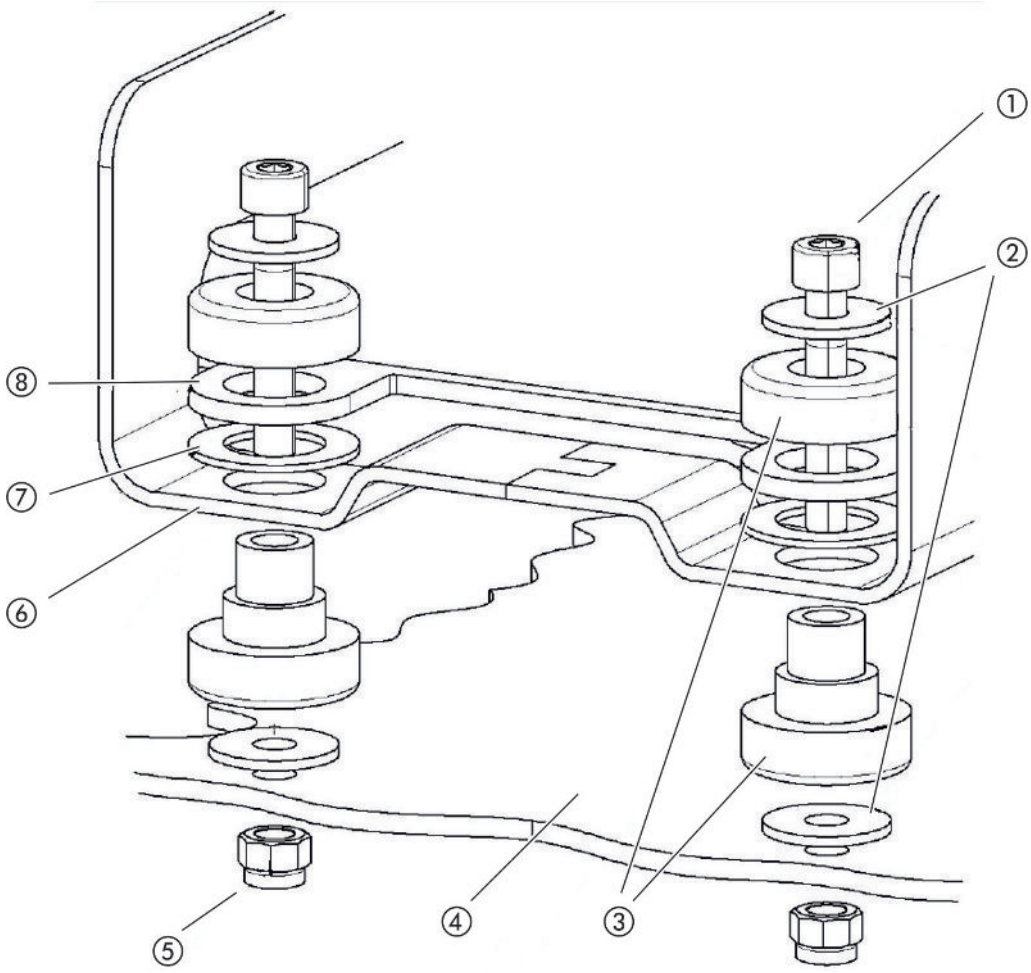


Fig. 9: Components of a fastener

1	Hexagon socket head screw M8 x 50	5	Nut M8 (self-locking)
2	Washer	6	Base frame
3	MO bearing	7	Spring rubber
4	Test system	8	MSB box guide

You will need:

- Self-locking nuts M8
- Open-end wrench, SW13
- Allen wrench SW6
- Holes for installation inside the test system

In delivery condition, the bearings are attached to the base frame with the hexagon socket screws and transport nuts. Use the supplied self-locking nuts for the installation of the mass spectrometer module – not the transport nuts.

The background must be stable.

⚠ WARNING

Severe injuries due to mass spectrometer module breaking out

If not screwed down properly, the mass spectrometer module can be caused to break out if the rotor of the turbo molecular pump suddenly locks up. This can result in injuries of the most severe kind.

► Make sure the mount of the mass spectrometer module is able to absorb a braking torque of 820Nm.

1. Drill through-holes:
   – X distance: 283 mm
   – Y-distance: 121,5 mm
   – Through hole in sheet: Ø 9 mm
   – Fixing screws: M8 x 50
2. Remove transport nuts.
3. Place the mass spectrometer module on top of the through-holes and screw it down using the fasteners as shown in the upper figure .

5.3 Select connection ULTRA, FINE, or GROSS

The operation mode of the vacuum connection and the rotation speed of the turbo molecular pump define:

- Minimum detectable leak rate (MDLR)
- Constantly permissible inlet pressure (p_{max})
- Pumping speed (S)

The following information applies to the use of helium as a tracer gas.

To reach the MDLR, the following conditions must be met:

- The LDS3000 must be in operation for at least 20 minutes.
- Ambient conditions must be steady (temperature, no vibrations/shocks, clean environment)
- The specimen must be operated with switched-off ZERO until to the background is stable. The ZERO function may be switched on only after that.

Connection		Turbo molecular pump rotation speed	
		1000 Hz	1500 Hz
ULTRA	MDLR:	5 x 10^{-12} mbar l/s	1 x 10^{-11} mbar l/s
	p_{max}:	0.2 mbar	0.2 mbar
	p_{max} short-term (< 3 s):	0.2 mbar	0.4 mbar
	S:	5l/s	6l/s
FINE	MDLR:	1 x 10^{-11} mbar l/s	5 x 10^{-11} mbar l/s
	p_{max}:	0.9 mbar	0.4 mbar
	p_{max} short-term (< 3 s):	0.9 mbar	0.7 mbar
	S:	1.8l/s	2.5l/s
GROSS	MDLR:	1 x 10^{-9} mbar l/s	2 x 10^{-8} mbar l/s
	p_{max}:	18 mbar	15 mbar
	S:	depends on the backing pump	

Exceedance of the constantly permissible inlet pressure generates the warning "TMP overheating".

NOTICE

Material damage due to pressure surges

Pressure surges exceeding the maximum inlet pressure will damage the mass spectrometer module.
- Do not exceed the maximum inlet pressure.

1. Set the operation mode vacuum connection and the rotation speed turbo molecular pump in accordance with the physical vacuum conditions found in the test system.
2. Connect the mass spectrometer module to the "ULTRA", "FINE" or "GROSS" connections on the vacuum system of the test system.
3. Set the speed of the turbomolecular pump, see also “Set the rotation speed of the turbo molecular pump [▷ 71]“.

5.4 Establish component connection

1. Connect pressure sensor PSG500 to one of the GROSS/FOREPUMP connections.
2. Connect the backing pump to the second GROSS/FOREPUMP connection.
3. For sniffer mode, connect the sniffer line to one of the FINE-/SNIFFER connections.
4. If available, connect internal calibration leak 560-323 to the second free flange (FINE or ULTRA) of the vacuum connection.

When using a sniffer valve: For the device to operate correctly upon opening of the sniffer valve, no additional line can be connected between the connection block and the sniffer valve or between the sniffer valve and the sniffer line.

5.5 Establish electrical connections

All electrical connections run from and to the MSB box.

NOTICE

Material damage if power supply pack has the wrong specifications or is connected improperly

A power supply pack that has the wrong specifications or is connected improperly can destroy the unit.

► Use a suitable power supply pack: Use a power supply pack that supplies an output voltage with electrically protective separation, output voltage: 24 V +/-5%, current carrying capacity: min. 10 A.

► Provide a short-circuit protection of 15 A for the supply of the LDS3000.

► Use a power cable with a large enough cross section.

► Ensure that the LDS3000 can be disconnected from the power supply in an emergency or for repairs:
Position the device so that you can always reach the plug for unplugging.
Alternatively, attach a marked and easily accessible disconnect device.

1. Connect the 24 V power cable to the included plug (connections: +24V on 1+ and GND on 1-).
2. Connect the power cable to the socket "24VDC". Cable length < 30 m.
3. Connect the control unit to the socket "Control Unit". Cable length of the INFICON data cable < 30 m.
4. Connect the I/O or bus module to the Socket "I/O" . Cable length of the INFICON data cable < 30 m.
5. Connect pressure sensor PSG500 and, if used, calibration leak 560-323 on the cable of socket "1". For socket 1 see “MSB box [▷ 23]“.
6. Connect the sniffer line to the socket "Sniffer" .
7. Connect gas ballast valve to the socket "Output".

6 Mounting LDS3000 AQ (Accumulation)

6.1 Adjust the position of the connections to the installation dimensions

Select location

Select the most helium-free environment possible for the measurement setup. For reliable measurements with the device, the helium content in the air must be less than 10 ppm.

By nature, air contains 5 ppm (0.0005%) helium.

Mount MSB box

In order to ideally match the installation position space, the MSB box can be turned and rotated.

The MSB box is seated in two guide rails and can be pushed into the housing from the left or from the right. It can also be rotated, if necessary, so that the labels are upside down.

The locking washer must be released to pull out the MSB box.

If the MSB box is to be pushed into housing from the other side, the locking washer must also be tightened on the other side of the housing. An appropriate threaded hole is available.

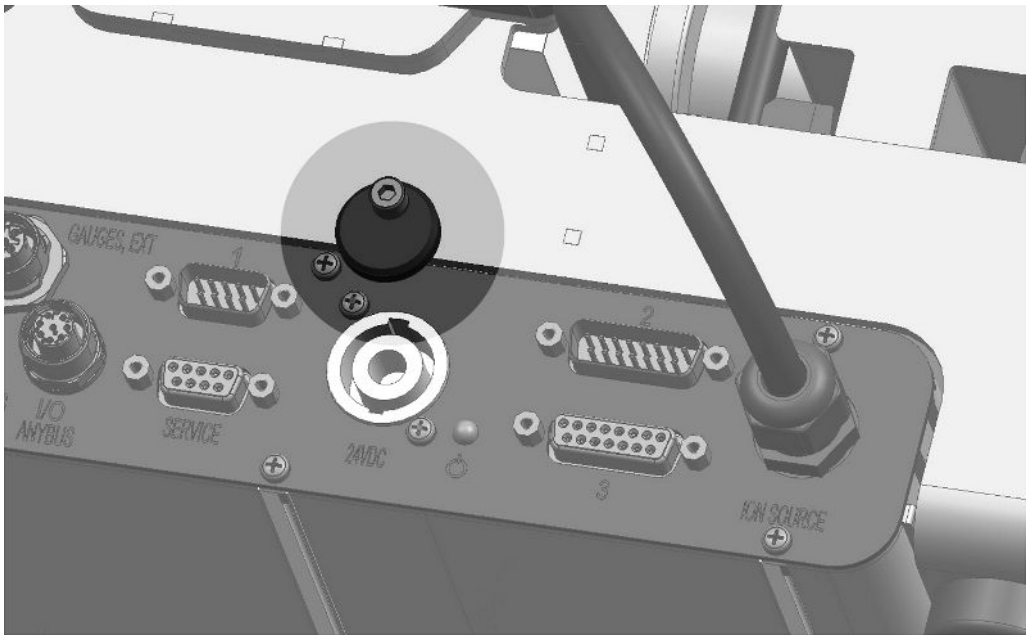


Fig. 10: Lock

6.2 Installing the mass spectrometer module on the test system

The mass spectrometer module can be mounted in any position.

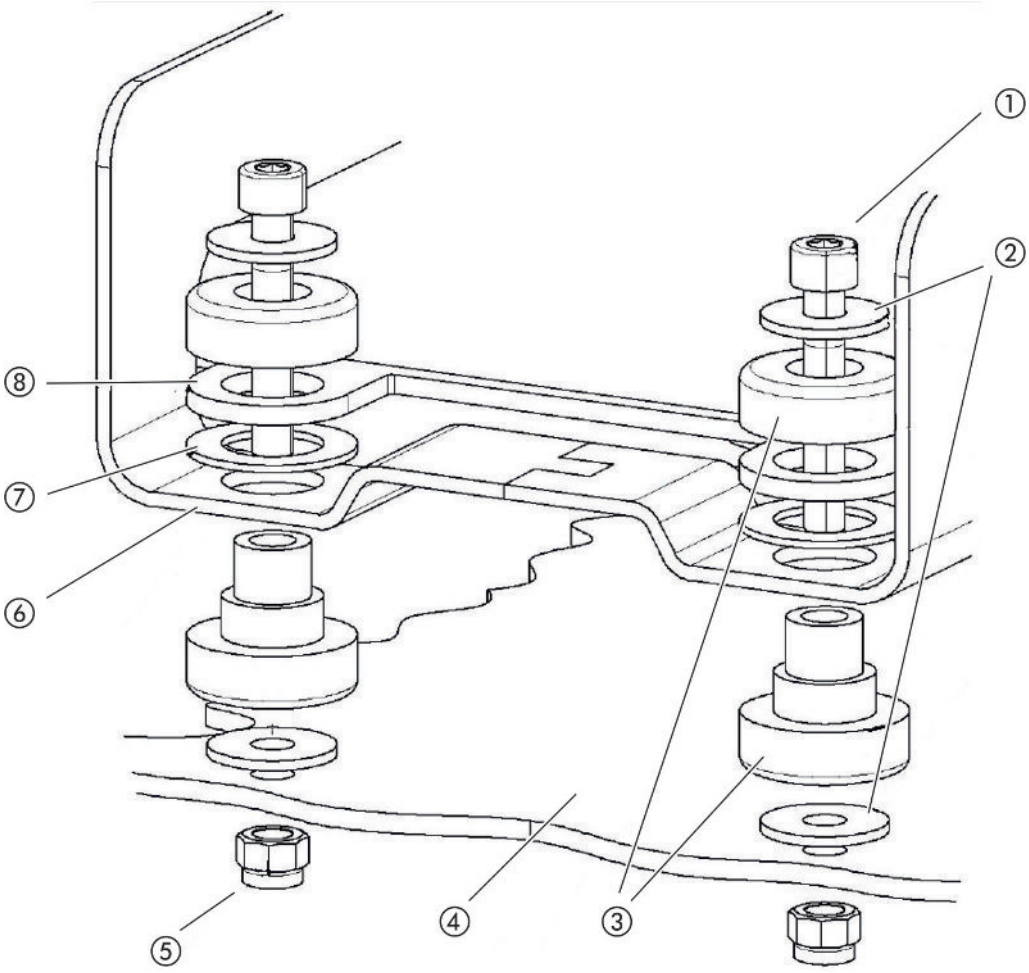


Fig. 11: Components of a fastener

1	Hexagon socket head screw M8 x 50	5	Nut M8 (self-locking)
2	Washer	6	Base frame
3	MO bearing	7	Spring rubber
4	Test system	8	MSB box guide

You will need:

- Self-locking nuts M8
- Open-end wrench, SW13
- Allen wrench SW6
- Holes for installation inside the test system

In delivery condition, the bearings are attached to the base frame with the hexagon socket screws and transport nuts. Use the supplied self-locking nuts for the installation of the mass spectrometer module – not the transport nuts.

The background must be stable.

⚠ WARNING

Severe injuries due to mass spectrometer module breaking out

If not screwed down properly, the mass spectrometer module can be caused to break out if the rotor of the turbo molecular pump suddenly locks up. This can result in injuries of the most severe kind.

► Make sure the mount of the mass spectrometer module is able to absorb a braking torque of 820Nm.

1 Drill through-holes:
– X distance: 283 mm
– Y-distance: 121,5 mm
– Through hole in sheet: Ø 9 mm
– Fixing screws: M8 x 50

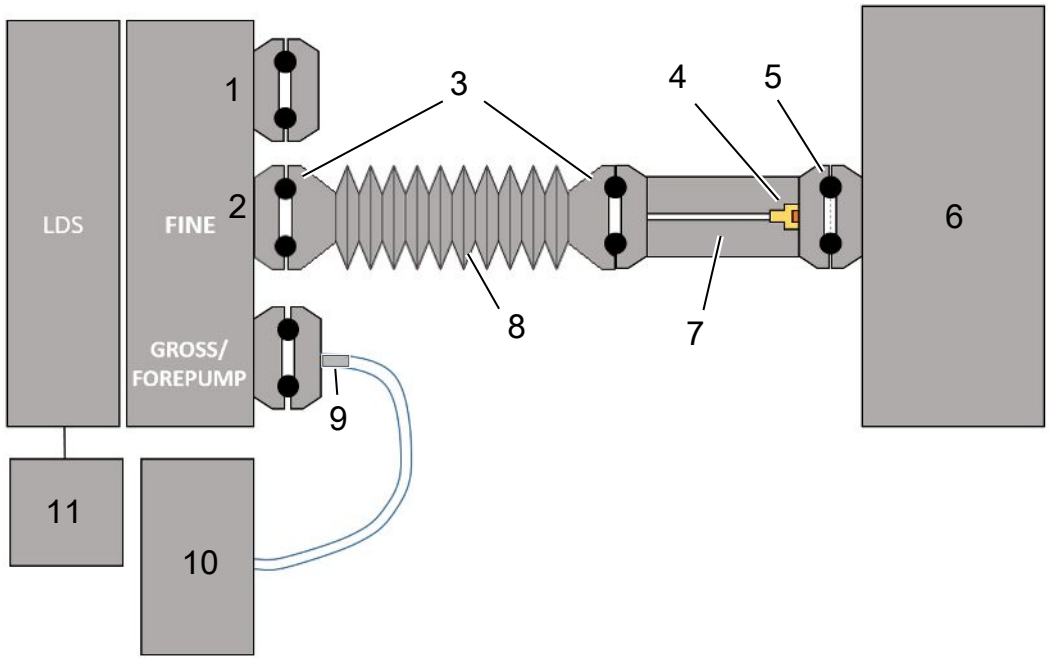
2 Remove transport nuts.

3 Place the mass spectrometer module on top of the through-holes and screw it down using the fasteners as shown in the upper figure .

6.3 Select components and connect

6.3.1 Variant 1

This setup is suitable for most users and is suitable for short measuring times.



1	Blank flange
2	Pressure sensor PSG500 for measuring the inlet pressure
3	KF sealing rings. ISO-K centering rings and seals. Not included in delivery. You can get them from INFICON's homepage under "Vacuum Components".
4	Throttle insert
5	ISO-KF centering ring with filter
6	The version with a single measuring chamber is shown. Not included in delivery.
7	Throttle flange. Alternatively connectable to the mass spectrometer module, see “Variant 2 [▶ 42]“.
8	KF corrugated hose. Not included in delivery.
9	GROSS throttle flange
10	Dry backing pump with separate power supply. Not included in delivery. You can order the "Diaphragm pump LDS AQ" from INFICON under the order number 560-630, furthermore the "DIN Rail Power supply 24 V, 10 A" under the order number 560-324.
11	Power supply unit 24 V. Not included in the scope of delivery.

✓ You have the mass spectrometer module (accumulation) from INFICON.

✓ You have a dry backing pump with its own power supply.
All dry vacuum pumps can be used with a gas flow of more than 60 sccm at a basic pressure of under 5 mbar. This manual describes how to use the dry INFICON backing pump (catalog number 560-630).

✓ You have a suitable measuring chamber.
Information about the measuring chamber can be obtained from INFICON.
Note that a measuring chamber that is leak-proof but not vacuum-resistant can implode if it is pumped further out than usual measuring times. See also "Carrying out a measurement [▷ 92]".

✓ You have the corresponding components for a setup according to variant 1. See the overview above.

1 Connect the pressure sensor PSG500 to the FINE port.

2 Mount the throttling flange on the measuring chamber.
Make sure that the throttle insert points towards the chamber.
Insert an ISO-KF centering ring with filter between the throttling flange and the measuring chamber. For details see also “LDS3000 AQ - maintenance relevant components [▷ 160]“.

3 To connect the FINE connection of the mass spectrometer module to the throttling flange, we recommend using a KF corrugated hose.

4 Install the GROSS throttle flange at the GROSS / FOREPUMP port of the mass spectrometer module.

5 Connect the open end of the GROSS throttle flange hose to the backing pump.

6 Establish the electrical connection of the backing pump.
When using the INFICON backing pump (catalog number 560-630), proceed as follows:

⇨ Determine if the plus and minus terminals on the terminal block are already connected to cables by the manufacturer.

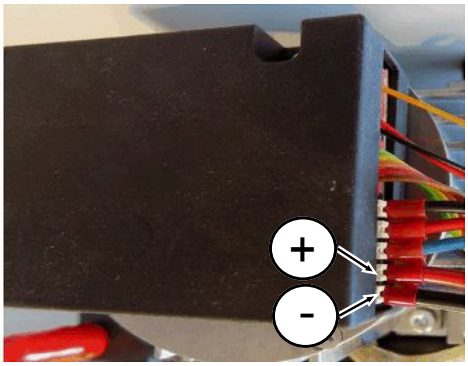


Fig. 12: Connection strip on the dry backing pump of INFICON

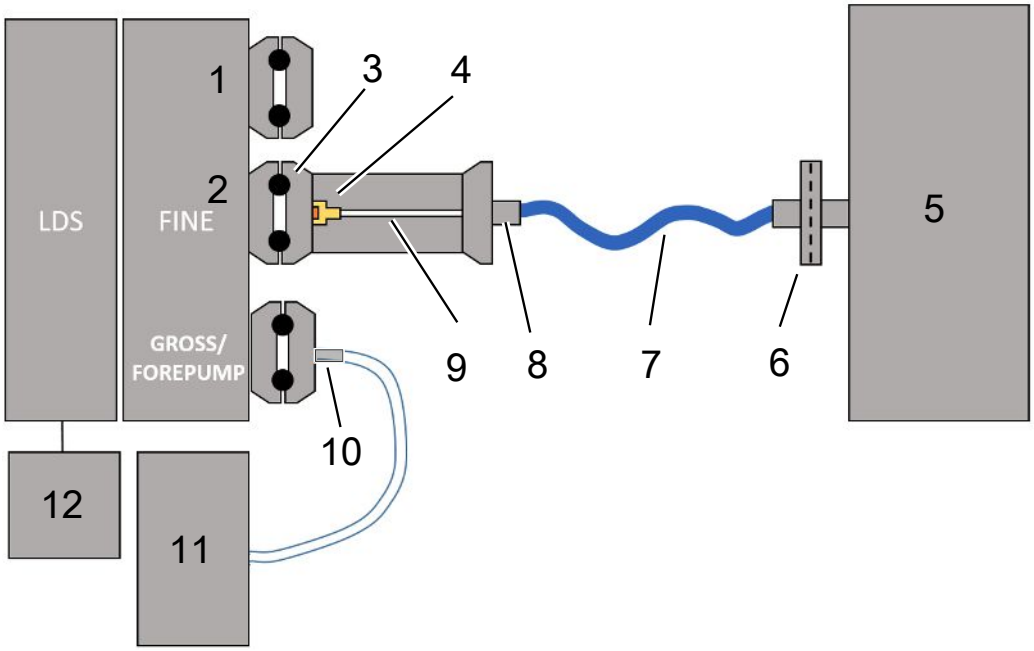
⇨ If so, connect plus and minus cables to a DC power source, 24 V +/- 10%, 5 A.

⇨ If not, insert the positive and negative cables with ferrules 8 mm AWG 18 with red insulation into the corresponding terminals and then connect the cables to a DC power source, 24 V +/- 10 %, 5 A.

The backing pump exhaust air opening should be as far as possible from the measuring chamber.

6.3.2 Variant 2

This variant is suitable for applications where the specimen is to be taken from a defined location within the chamber, for example particularly close to the test object.



1	Blank flange
2	Pressure sensor PSG500 for measuring the inlet pressure
3	ISO-KF centering ring without filter
4	Throttle insert
5	The version with a single measuring chamber is shown. Not included in delivery.
6	Filter unit 0.45 µm Pall
7	Original delivery hose (2 mm)
8	Festo adapter
9	Throttle flange
10	GROSS throttle flange
11	Dry backing pump with separate power supply. Not included in delivery. You can order the "Diaphragm pump LDS AQ" from INFICON under the order number 560-630, furthermore the "DIN Rail Power supply 24 V, 10 A" under the order number 560-324.
12	Power supply unit 24 V. Not included in the scope of delivery.

✓ You have the mass spectrometer module (accumulation) from INFICON.

✓ You have a dry backing pump with its own power supply.
All dry vacuum pumps can be used with a gas flow of more than 60 sccm at a basic pressure of under 5 mbar. This manual describes how to use the dry INFICON backing pump (catalog number 560-630).

✓ You have a suitable measuring chamber.
Information about the measuring chamber can be obtained from INFICON.
Note that a measuring chamber that is leak-proof but not vacuum-resistant can implode if it is pumped further out than usual measuring times. See also "Carrying out a measurement [▷ 92]".

✓ You have the corresponding components for a setup according to variant 2. See the overview above.

1 Connect the pressure sensor PSG500 to the FINE port.

2 Mount the throttling flange on the LDS FINE port.
Make sure that the throttle insert points in the direction of the LDS FINE port.
Insert an ISO-KF centering ring without filter between the throttling flange and the measuring FINE port. For details see also “LDS3000 AQ - maintenance relevant components [▷ 160]“.

3 Connect the chamber with the 2 mm tube. Depending on the application, it may be helpful to insert the tube into the chamber. The hose must be terminated towards the chamber with the 0.45 µm Pall filter unit.

4 Make the connection between the hose and the Festo adapter.

5 If necessary, insert the 2 mm hose into the measuring chamber. The hose can be shortened to the required length.

6 Install the GROSS throttle flange at the GROSS / FOREPUMP port of the mass spectrometer module.

7 Connect the open end of the GROSS throttle flange hose to the backing pump.

8 Establish the electrical connection of the backing pump.
When using the INFICON backing pump (catalog number 560-630), proceed as follows:

⇨ Determine if the plus and minus terminals on the terminal block are already connected to cables by the manufacturer.

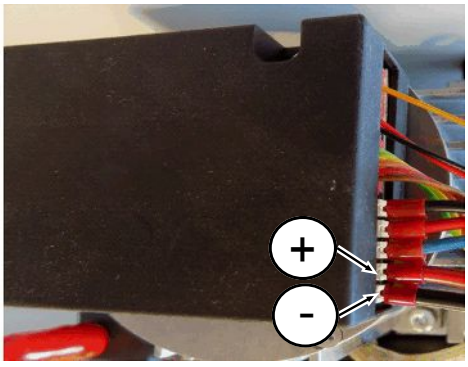


Fig. 13: Connection strip on the dry backing pump of INFICON

⇨ If so, connect plus and minus cables to a DC power source, 24 V +/- 10%, 5 A.

⇨ If not, insert the positive and negative cables with ferrules 8 mm AWG 18 with red insulation into the corresponding terminals and then connect the cables to a DC power source, 24 V +/- 10 %, 5 A.

The backing pump exhaust air opening should be as far as possible from the measuring chamber.

6.4 Establish electrical connections

All electrical connections run from and to the MSB box.

NOTICE

Material damage if power supply pack has the wrong specifications or is connected improperly

A power supply pack that has the wrong specifications or is connected improperly can destroy the unit.

► Use a suitable power supply pack: Use a power supply pack that supplies an output voltage with electrically protective separation, output voltage: 24 V +/-5%, current carrying capacity: min. 10 A.

► Provide a short-circuit protection of 15 A for the supply of the LDS3000 AQ.

► Use a power cable with a large enough cross section.

1. Mount the 24 V power supply cable to the enclosed plug (connections: +24V on 1+ and GND on 1-).
2. Connect the power supply cable to the "24VDC" socket.
3. Connect the operating unit to the "Control Unit" socket.
4. Connect the I/O or bus module to the "I/O" socket.
5. Connect the pressure sensor PSG500 to the cable of socket 1. For socket 1 see “MSB box [▷ 23]“.

7 Operation LDS3000

You can use the following accessories in combination with the mass spectrometer module:

- Control unit CU1000
- Bus module BM1000
- I/O module IO1000

With the available accessories XL sniffer adapter and sniffer line SL3000XL, it is possible to capture leaks at a larger distance from the expected leak if the detection limit is deteriorated (operation in "high flow" mode).
LDS3000 AQ devices can also be used if they are not operated in AQ mode.

Additional information on the control unit, the modules and the XL sniffer adapter is included in the documents:

- Operating Manual Control Unit CU1000
- Operating instructions I/O module IO1000
- Operating instructions bus module BM1000
- Operating instructions XL sniffer adapter
- Interface protocols LDS3000

The paths listed in the following sections refer to the operation of the mass spectrometer module with the control unit CU1000. If the bus module or the I/O module is used, the actions must be implemented within the scope of the protocol that is used.

The path information for the control unit always starts in the main menu.

⚠ WARNING

Danger to life and material damage due to unsuitable operating conditions

There is danger to life due to unsuitable operating conditions. The device can become damaged.

► Avoid changing the position of the device in an abrupt manner.

► Avoid extreme external vibrations and impact.

7.1 Switching the device on

1 Switch on the backing pump.

2 Establish the power supply to the mass spectrometer module.

⇨ System starts up automatically.

⇨ If an XL Sniffer Adapter and the CU1000 are connected, your will be asked after run-up, whether the "XL Sniffer Adapter" operation mode should be set. This does not apply to devices in AQ mode.

Longer run-up time for devices in AQ mode

To counteract falsification of the measurement results by an increased background value, the warm-up time after switching on is about 10 minutes.

Wait at least 60 minutes before determining the peak or before calibrating. See also "Carrying out a measurement [▷ 92]".

7.2 Default settings

Language selection

Select the display language. The factory setting is English. (The display on the handle of the SL3000XL sniffer line shows messages in English instead of in Russian and Chinese.)	
German, English, French, Italian, Spanish, Portuguese, Russian, Chinese, Japanese	
Control unit	Settings > Set up > Control unit > Language
LD protocol	Command 398
ASCII protocol	*CONFig:LANG

Setting date and time

Setting the date	
Format: DD.MM.YY	
Control unit	Settings > Date/Time > Date
LD protocol	Command 450
ASCII protocol	*HOUR:DATE

Setting the time	
Format: hh: mm	
Control unit	Settings > Date/Time > Time
LD protocol	Command 450
ASCII protocol	*HOUR:TIME

7.3 Selecting a unit for the leak rate

Leak rate unit display

Selecting the leak rate unit in the display for vacuum or sniff	
0	mbar l/s (factory setting)
1	Pa m^3/s
2	atm cc/s
3	Torr l/s
4	ppm (not VAC, not AQ)
5	g/a (not VAC, not AQ)
6	oz/yr (not VAC, not AQ)
7	sccm
8	sft^3/yr

Control unit	Display > Units (display) > Leak rate unit VAC (SNIF)
LD protocol	Command 396 (Index 0: Vacuum, Index 1: Sniffing)
ASCII protocol	Command *CONFig:UNIT:VACDisplay Command *CONFig:UNIT:SNDisplay

Leak rate unit interface

Selecting the leak rate unit of the interfaces for vacuum or sniff	
0	mbar l/s (factory setting)
1	Pa m^3/s
2	atm cc/s
3	Torr l/s
4	ppm (not VAC)
5	g/a (not VAC)
6	oz/yr (not VAC)
7	sccm
8	sft^3/yr

Control unit	Settings > Set up > Interfaces > Units (interface) > Leak rate unit VAC (SNIF)
LD protocol	Command 431 (vacuum) Command 432 (sniffing)
ASCII protocol	Command *CONFig:UNIT:LRVac Command *CONFig:UNIT:LRSnif

7.4 Select device for pressure

Pressure unit interface

Selecting the pressure device of the interfaces	
0	mbar (factory setting)
1	Pa
2	atm
3	Torr

Control unit	Settings > Set up > Interfaces > Units (interface) > Pressure unit
LD protocol	Command 430 (Vacuum/Sniff)
ASCII protocol	Command *CONFig:UNIT:Pressure

7.5 Select Compatibility Mode

To retrofit an existing leak detection system LDS1000 / LDS2010 with a LDS3000, activate the appropriate compatibility mode:

- Compatibility mode for LDS1000 or
- Compatibility mode for LDS2010

When changing to a compatibility mode all parameters are to be reset to factory settings and the device is to be restarted. The language is displayed according to the factory setting. To change the language, see “Default settings [▸ 46]“.

If you want to use the LDS3000 later in normal operation mode, make sure to save your parameters on a USB flash drive, see "Loading and saving parameters [▸ 64]". You can load the saved parameters again after you have switched to normal operation.

- LDS1000: Compatibility mode to retrofit an existing LDS1000 leak detection system with an LDS3000.
- LDS2010: Compatibility mode to retrofit an existing LDS2010 leak detection system with an LDS3000.
- LDS3000
- XL Sniffer Adapter

Control unit	Settings > Set up > Compatibility > Compatibility mode
LD protocol	Command 2594 (dec)
ASCII protocol	Command *CONFig:COMP

The following table shows the functional differences between and common features of LDS2010 and LDS3000:

	LDS2010	LDS3000
Trigger outputs	without joint reference	with joint reference
other outputs	with joint reference	with joint reference
Trigger 1 (sniffer LED, relay exit, audio signal)	Control of sniffer LED, PWM audio outputs an the control unit for active speakers	Control of sniffer LED, audio outputs an the control unit for active speakers
Limit Low / High (serial interfaces, display, analogue output)	Limit Low affects all outputs, Limit High only the display	separately adjustable for interface protocols, display and analog outputs
Gas ballast (3 settings)	**OFF:** Switches the gas ballast valve of the pump module off. **ON:** Switches the gas ballast valve of the pump module on until the next mains-off. If "CAL fashion" is unequal to 3 (menu item 26), the gas ballast valve can be controlled with digital input DynCAL. **F-ON:** Fixed on enables switching the gas ballast valve on permanently (power failure-proof and independent of the digital inputs).	0 = Off 1 = on, but controllable via digital input on IO1000 2 = on, but not controllable via digital input on IO1000
Control mode	LOCAL, RS232, RS485	None, control is also possible from all control locations.
LDS1000 compatibility mode 9.2	other functions	Default values and error messages (default values are output via interface, the touchscreen shows the original message - -> reason: new hardware can cause errors that did not exist with previous models)
Correcting the leak rate in Standby (machine factor)	adjustable (yes/no)	adjustable (yes/no)
ZERO with start		starting with V1.02 like LDS2010
Opening the sniffer valve	in SNIF after start	in SNIF after start
Rotation speed of turbo molecular pump	only 2 rotation speeds adjustable	Adjustable via serial interface from 750 Hz to 1500 Hz, via operator unit 1000 Hz and 1500 Hz
Address RS485	Yes, because bus capable	No, because not bus capable
Sniffer key on/off	selectable	selectable

	LDS2010	LDS3000
Default value for int. calibration leak	1E-15 mbar l/s	9.9E2 mbar l/s
Default value ext. calibration leak VAC/SNIF mode	1E-7 mbar l/s	9.9E2 mbar l/s
Setting range for int. calibration leak	10E-7	1E-9 ... 9.9E-1 mbar l/s
Machine factor adjustment	manually	manually/automatically
Machine / sniff factor value range	Machine factor: 1E-3...9.9E+3 Sniffer factor: 1E-3...9.9E+3	Machine factor: 1E-4...1E+5 Sniffer factor: 1E-4...1E+4
Pressure: Capillary surveillance 20		available, pressure adjustable
Analog output	fixed characteristics	freely configurable
Calibration request	Preamplifier temperature change 5 K or 30 min	Preamplifier temperature change 5 K or 30 min. or TMP rotation speed changed
Pressure / leak rates units (VAC/ SNIF) for all interfaces	yes	Control unit and rest separated
User permissions	3 levels over PIN on the control unit or key switch	4 levels through control unit or optional key switch
Key-operated switch	permanently installed	can, if required, be connected externally, see "Assigning the digital inputs of the I/O module [▶ 106]" (Key switch)

7.6 Select operation mode

The device has the following operation modes:

- Vacuum mode
- Sniffer mode
- XL Sniffer Adapter (sniffing mode with a high flow rate, XL Sniffer Adapter required).
  The device automatically switches over to the "XL Sniffer Adapter" if you connect an XL Sniffer Adapter.

Select operation mode	
0	VAC (vacuum)
1	SNIF (sniffing)
2	Operation mode XL Sniffer Adapter (display only)

Control unit	Operation mode vacuum operation or sniffing mode: Main menu > Functions > VAC / SNIF Operation mode XL Sniffer Adapter: Settings > Set up > Accessories > XL Sniffer Adapter
LD protocol	Command 401
ASCII protocol	Command *CONFig:MODE

On the LDS3000 AQ, the text "AQ" or the value "3" or "4" is displayed for the operation mode.

► With the LDS3000 AQ, you change the operation mode by changing the "Compatibility mode", see "Select Compatibility Mode [▸ 80]".

7.7 Select gas type (mass)

The machine, calibration and sniff factor are dependent on the configured mass and are saved in the mass spectrometer module.	
2	H_2 (Hydrogen, forming gas)
3	^{3}He or deuterated hydrogen (HD), not in AQ mode
4	^{4}He (Helium) (factory setting)

Control unit	Settings > Mass
LD protocol	Command 506 with value 2 (3, 4)
ASCII protocol	Command *CONFig:MASS 2 (3, 4)

With the LDS3000 AQ, it is best to change the gas type via the wizard, see "Making basic settings via the wizard [▸ 83]".

7.8 Calibrate device

7.8.1 Time and general preferences

NOTICE

Incorrect calibration because of operating temperature that is too low

Calibrating the device in the cold state can deliver incorrect measurement results.

► For optimum accuracy the device should have been turned on at least 20 minutes previously.

It is recommended to calibrate the device once per shift in the desired operating modes and for the desired gases. Thereafter you can switch between the operation modes and gases without re-calibrating.

Additionally applicable for operation with the XL Sniffer Adapter:

The device should be calibrated once per shift in LOW FLOW and in HIGH FLOW. Thereafter you can switch between the different flows without re-calibrating.

Calibration is also required after the following actions:

- Sniffer line replacement
- Filter replacement
- Prompt for calibration by the system

Switching off the preamplifier test

The device tests the installed preamplifier during calibration. You can switch off of the amplifier test. This increases the speed of the calibration, but reliability drops off.	
0	Off
1	ON
Control unit	Settings > Set-up > MS-module > Preamplifier > Test > Preamplifier test with CAL
LD protocol	Command 370
ASCII protocol	Command *CONFig:AMPTest (ON,OFF)

Enabling calibration request

If Calibration request is enabled, the device will prompt the operator to perform a calibration 30 minutes after it has been switched on and in case of temperature changes greater than 5°C.	
0	Off
1	ON

Control unit	Functions > CAL > Settings > CAL request. > Calibration request or Settings > Setup > Notifications > CAL request. > Calibration request
LD protocol	Command 419
ASCII protocol	*CONFig:CALREQ (ON,OFF)

Calibration warning Wrn650

The warning message Wrn650 "Calibration within the first 20 minutes is not recommended" can be allowed or suppressed.

0	OFF (suppressed)
1	ON (allowed)

Control unit	Functions > CAL > Settings > CAL request. > Calibration warning W650 or Settings > Setup > Notifications > CAL request. > Calibration warning W650
LD protocol	Command 429
ASCII protocol	*CONFig:CALWarn ON (OFF)

Calibration Features

The device can be calibrated in all its operation modes. A distinction is made between internal and external calibration.

Internal calibration can be performed using the optional built-in calibration leak. A separate calibration leak is needed for external calibration.

External calibrations have the advantage that they can be performed under conditions such as pressure and measuring time, which are similar to the later measurement.

internal	- with internal calibration leak - autotune (mass adjustment) - determine the calibration factor with the steady signal of the test leak - amplifier test - determination of the background. Adjust if necessary after calibrating the machine or sniffer factor, see "Setting machine and sniff factor [▷ 62] " - Not with the XL Sniffer Adapter
external	- Vacuum operation: with external calibration leak in test equipment - Sniffing mode: with external calibration leak - Consideration of the characteristics of the testing

	equipment (pressure, partial flow ratio) - Amplifier test - Autotune (mass adjustment) - Determine the calibration factor after the signal of the calibration leak has settled - Determination of the background
external-dynamic	- with external calibration leak in test equipment - Consideration of the characteristics of the testing equipment (pressure, partial flow ratio, measuring time) - Measuring time according to the dynamic waveform - Amplifier test - Determine the calibration before the signal of the test leak has settled - Determination of the background

7.8.2 Internal Calibration Configuration and Start

Prerequisite for the calibration with the internal calibration leak is the one-time entry of the leak rate of the calibration leak.

Leak rate of internal calibration leak

Define the leak rate of the calibration leak you wish to use during calibration. Calibration will not be possible unless you enter the value here.	
1E-9 ... 9.9E-1 mbar l/s	
Control unit	Settings > Configuration> Operating Mode > Vacuum > Reference leak int. > Calibration leak internal or Functions > CAL > Settings > Calibration leak int.
LD protocol	Command 394
ASCII protocol	Command *CONFig:CALleak:INT

Opening/closing the calibration leak

Opening/closing the calibration leak. This is automatically carried out with the internal calibration. If the calibration leak is opened using the control unit or the interface, then no internal calibration can take place. The calibration leak must first be closed again in this case.	
0	close
1	Open
Control unit	Functions > Valves > Open internal calibration leak
LD protocol	Command 12
ASCII protocol	Command *STATus:VALVE:TestLeak (ON, OFF)

► Start calibration
Operating unit: Functions > CAL > Intern
LD protocol: 4, Parameter 0
ASCII protocol: *CAL:INT
IO1000: CAL internal, see "Settings for I/O module IO1000 [▶ 97]"

⇨ Calibration is performed automatically.

7.8.3 External Calibration Configuration and Start

Requirement for the calibration with the external calibration leak is the one-time entry of the leak rate of the calibration leak and an open calibration leak.

In vacuum mode, the calibration leak is installed in or on the test system and opened before calibration.

In Sniffer mode, sniffing with the sniffer line is always performed on the open calibration leak.

Leak rate of external calibration leak vacuum

Define the leak rate of the calibration leak you wish to use during calibration. Calibration will not be possible unless you enter the value here. A specific leak rate must be set for each gas (mass).	
1E-9 ... 9.9E-2 mbar l/s	
Control unit	Settings > Set up > Operation modes > Vacuum > Ext. calibration leak > Mass 2 (3, 4) > external calibration leak VAC H2 (M3, He) or Functions > CAL > Settings > Ext. calibration leak (for current mass in selected unit)
LD protocol	Command 390
ASCII protocol	Command *CONFig:CALleak:EXTVac (for current mass in selected unit)

Leak rate of external calibration leak sniffing

Define the leak rate of the calibration leak you wish to use during calibration. Calibration will not be possible unless you enter the value here. A specific leak rate must be set for each gas (mass).	
1E-9 ... 9.9E-2 mbar l/s	
Control unit	Settings > Set up > Operation modes > Sniffing > Ext. calibration leak > Mass 2 (3, 4) > external calibration leak SNIF H2 (M3, He) or Functions > CAL > Settings > Ext. calibration leak (for current mass in selected unit)

LD protocol	Command 392
ASCII protocol	Command *CONFig:CALleak:EXTSniff (for current mass in device selected unit)

► LD and ASCII protocol: The status must be queried via: Command 260 or *STATus:CAL

1 Open external calibration leak or hold sniffer line to calibration leak.

2 Start measurement.

3 Wait until leak rate signal is tuned and stable.

4 Start calibration:
Control unit: Functions > CAL > Extern
LD protocol: 4, Parameter 1
ASCII protocol: *CAL:EXT
IO1000: see the figure below.

⇨ Request to "close calibration leak"

5 Vacuum mode: Close calibration leak inside the test system.
Sniffer mode: Remove sniffer line from calibration leak.

⇨ Leak rate signal decreases.

6 Confirm measured background value is stable:
Control unit: "OK"
LD protocol: 11, Parameter 1
ASCII protocol: *CAL:CLOSED
IO1000 see the figure below.

⇨ Calibration is completed if:
Control unit: Old and new calibration factor are displayed
LD protocol LD instruction 260 provides 0 (READY)
ASCII protocol: Command *STATus:CAL? provides IDLE
IO1000 see the figure below.

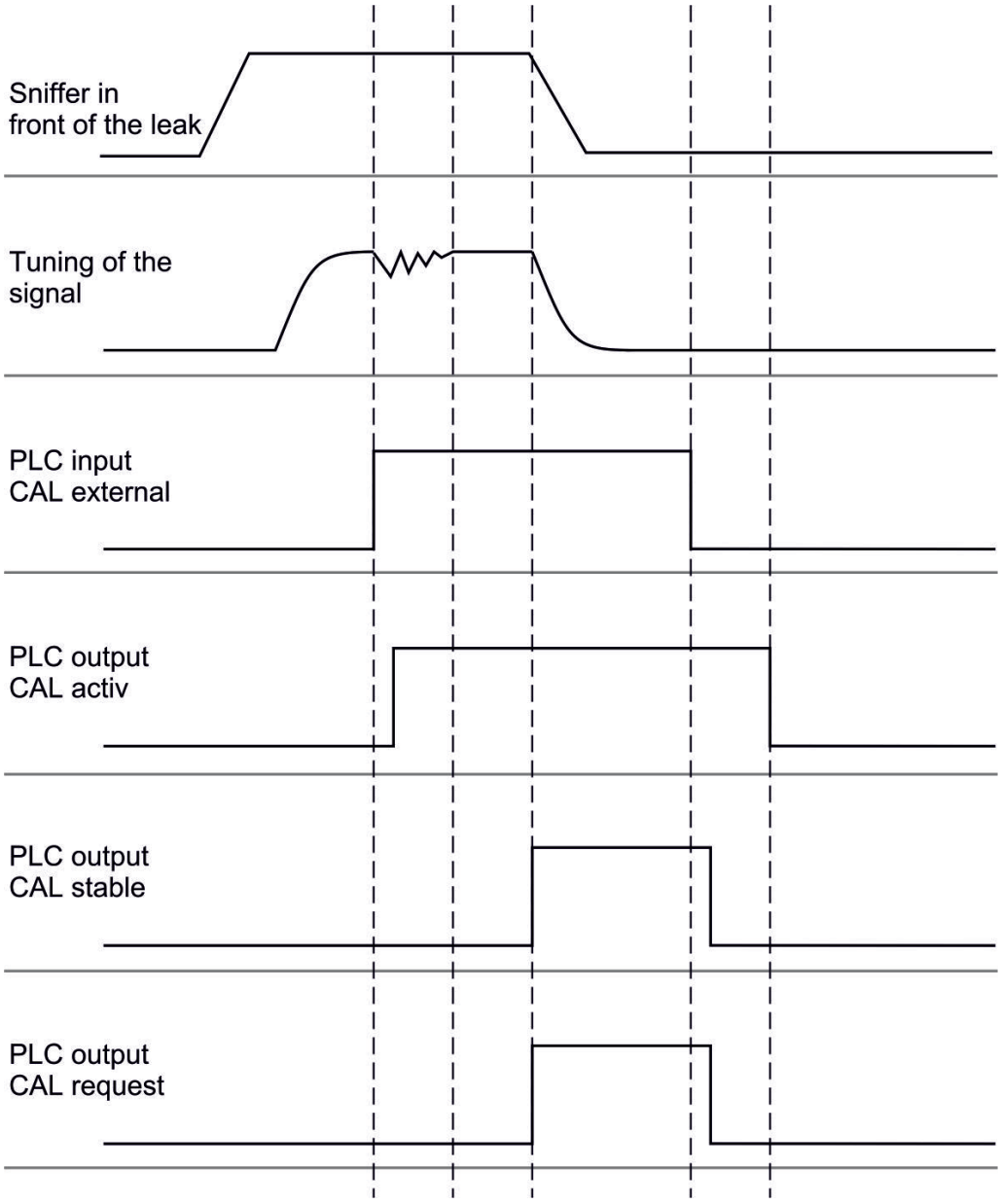


Fig. 14: External calibration with IO1000 using the example of sniffer line SL3000XL, description of PLC inputs and outputs: "Assigning inputs and outputs [▶ 97]"

7.8.4 Start external dynamic calibration

To taken into account the special time and pressure conditions of a test bench a dynamic calibration can be performed. No auto tuning takes place in the calibration mode. The time between opening the external calibration leak and activating the calibration can be selected so that it is optimally suited to the normal measurement sequence of the plant.

Requirements: One-time input of the leak rate of the calibration leak and an open calibration leak, see "External Calibration Configuration and Start [▶ 55]".

LD and ASCII protocol: The status must be queried via: Command 260 or *STATus:CAL?

1 Open external calibration leak or hold sniffer line to calibration leak.

2 Start measurement.

3 Wait until the leak rate signal is optimally suited to the normal measurement sequence of the plant.

4 Start calibration:
Control unit: Functions > CAL > Dynamic
LD protocol: 4, Parameter 2
ASCII protocol: *CAL:DYN
IO1000 see the figure below.

⇨ Request to "close calibration leak"

5 Vacuum mode: Close calibration leak inside the test system.
Sniffer mode: Remove sniffer line from calibration leak.

⇨ Leak rate signal decreases.

6 Confirm measured background value:
Control unit: "OK"
LD protocol: 11, Parameter 1
ASCII protocol: *CAL:CLOSED
IO1000 see the figure below.

⇨ Calibration is completed if:
Control unit: Old and new calibration factor are displayed
LD protocol LD instruction 260 provides 0 (READY)
ASCII protocol: Command *STATus:CAL? provides IDLE
IO1000 see the figure below.

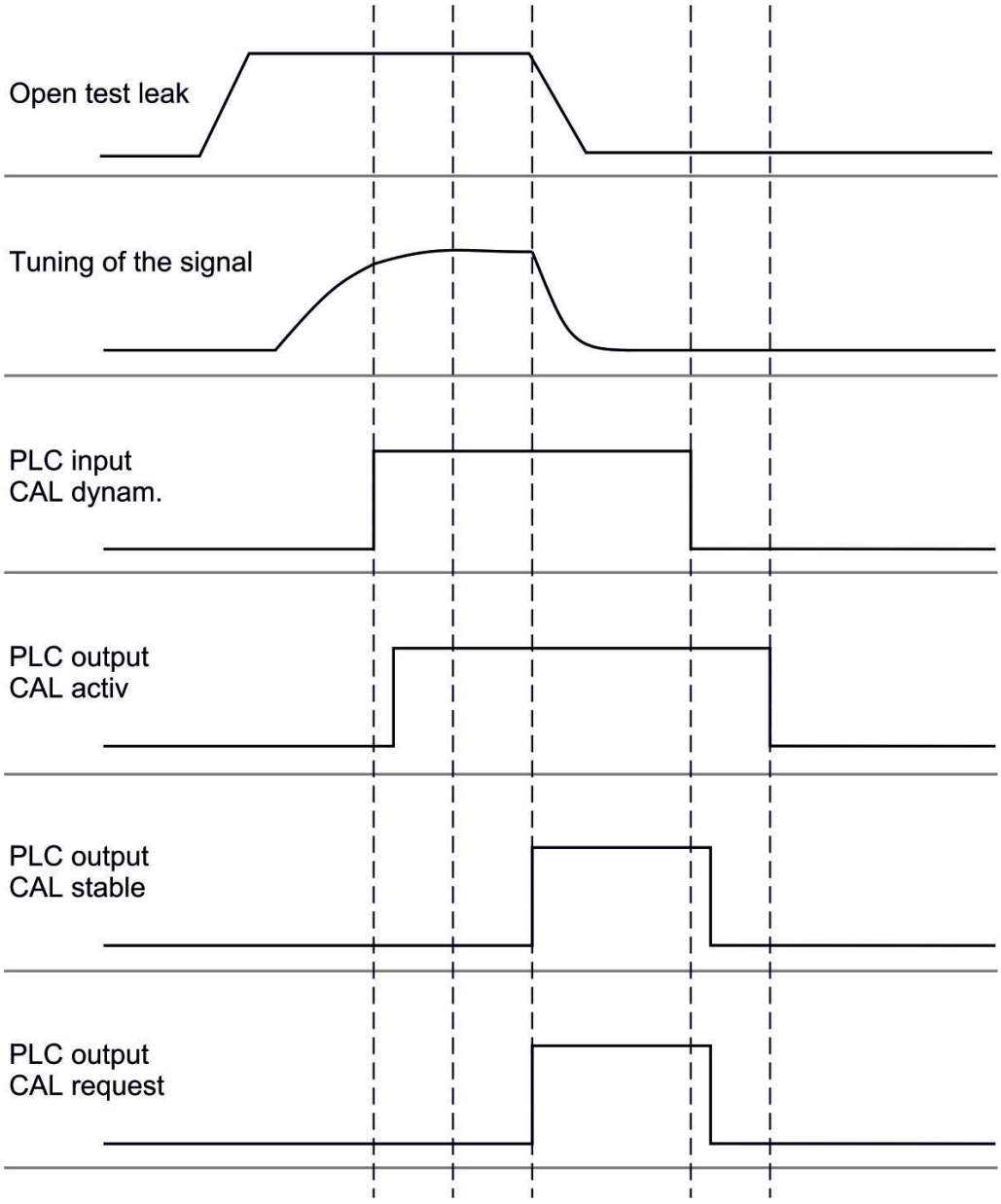


Fig. 15: Fig. 7 External dynamic calibration with IO1000 using the example of sniffer line SL3000XL, description of PLC inputs and outputs:"Assigning inputs and outputs [▷ 97]"

7.8.5 External calibration with sniffer line SL3000XL

The procedure complies with that of external or external dynamic calibration in sniffer mode.

Low flow and high flow must be calibrated separately.

To ensure optimal calibration with hydrogen or forming gas for low flow and high flow, the calibration leak must meet the following requirements:

– 100 % H_2: LR > 1 x 10^{-4}

– Forming gas (95/5): LR > 2 x 10^{-3}

For calibration, we recommend our calibration leak with catalog number 12322.

7.8.6 Check the calibration

To check whether a re-calibration is necessary, check the already existing.

7.8.6.1 Calibration using the internal calibration leak test

The test is only possible with the setting "Mass 4".

► Start test:
Control unit: Functions > CAL > Test int.
LD protocol: 4, Parameter 4
ASCII protocol: *CAL:PROOFINT
IO1000: CAL test internal, see "Settings for I/O module IO1000 [▷ 97]"

⇨ Test is performed automatically.

7.8.6.2 Calibration using the external calibration leak test

► LD and ASCII protocol: The status must be queried via: Command 260 or *STATus:CAL

1 Open external calibration leak or hold sniffer line to calibration leak.

2 Wait until leak rate signal is tuned and stable.

3 Start test:
Control unit: Functions > CAL > Test ext.
LD protocol: 4, Parameter 5
ASCII protocol: *CAL:PROOFEXT
IO1000 compare figure in "External Calibration Configuration and Start [▷ 55]".

⇨ Request to "close calibration leak"

4 Vacuum mode: Close calibration leak inside the test system.
Sniffer mode: Remove sniffer line from calibration leak.

⇨ Leak rate signal decreases.

5 Confirm measured background value is stable:
Control unit: "OK"
LD protocol: 11, Parameter 1
ASCII protocol: *CAL:CLOSED
IO1000 compare figure in "External Calibration Configuration and Start [▷ 55]".

⇨ Test is completed if:
Control unit: Result is displayed
LD protocol: As with the other steps, the status must be queried
ASCII protocol: As with the other steps, the status must be queried
IO1000 compare figure in "External Calibration Configuration and Start [▷ 55]".

7.8.7 Entering the calibration factor

The calibration is usually determined by the appropriate calibration routine. Therefore, it is usually not necessary to adjust the calibration factor manually.

An incorrectly set calibration inevitably leads to wrong leak rate indicator!

7.8.7.1 Calibration factor sniffing

Entry of the calibration factors for masses 2, 3, 4 in low flow and in high flow. The values will be overwritten during the next calibration. "High Flow-" or XL settings are available only in operation mode "XL Sniffer Adapter". The calibration factor for low flow also applies to sniffer applications that are not carried out in the operation mode "XL sniffer adapter".	
The calibration factors are managed separately to earth and to "High Flow" and "Low Flow". 0.01 … 100	
Control unit	Settings > Set up > Operation modes > Sniffing > Calibr. factor > mass 2 (3, 4, 2 XL, 3 XL, 4 XL) >calibration factor SNIF H2 (M3, He, XL H2, XL M3, XL He)
LD protocol	Commands 519, 521
ASCII protocol	Command *FACtor:CALSniff or *FACtor:CALSXL for the current mass

7.8.7.2 Calibration factor vacuum

Also applies to devices in AQ mode.

Entry of calibration factors for masses 2, 3, 4. The values will be overwritten during the next calibration.	
0.01 … 5000	
Control unit	Settings > Set up > Operation modes > Vacuum > Calibr. factor > mass 2 (3, 4) > calibration factor VAC H2 (M3, He)
LD protocol	Command 520
ASCII protocol	Command *FACtor:CALVac

7.8.8 Setting machine and sniff factor

The internal calibration will only calibrate the measurement system of a mass spectrometer module that is uncoupled from the test system. If the measurement system is operated in parallel to an additional pump system after an internal calibration though (following the partial flow principle), the measurement system will indicate a leak rate that is too low based on the partial flow ratio. With the help of a corrective machine factor for vacuum mode and a sniff factor for sniffer mode, the measurement system indicates the actual leak rate. The factors are taken into consideration along wit the ratio of effective pumping speed of the measurement system in a comparison to the pumping speed of the measurement system on the test system.

7.8.8.1 Setting machine and sniff factor manually

✓ Mass spectrometer module calibrated internally.

1 Measure external calibration leak using the test system.

⇨ The device indicates a leak rate that is too low based on the partial flow ratio.

2 Setting machine or sniff factor, see below.

⇨ The device indicates the actual leak rate.

Setting the machine factor

Devices in AQ mode:

The machine factor "1" is preset. This setting should not be changed.

Corrects a possible deviation between internal and external calibration in vacuum mode.

Should be at value 1.00 without the option internal calibration leak. After the value is changed, the leak rate resulting from the change is displayed. This simplifies adjustment.

Value range 1E-4...1E+5

Control unit	Settings > Set up > Operation modes > Vacuum > Machine factor > Mass 2 (3, 4) > machine factor VAC H2 (M3, He)
LD protocol	Command 522
ASCII protocol	Command *FACtor:FACMachine

Setting the sniff factor

Corrects a possible deviation between internal and external calibration in sniffer mode

Value range 1E-4...1E+4

Control unit	Settings > Set up > Operation modes > Sniffing > Sniff factor Mass 2 (3, 4) > Sniff factor H2 (M3, He)
LD protocol	Command 523
ASCII protocol	Command *FACtor:FACSniff

7.8.8.2 Setting machine and sniff factor using machine calibration

✓ Internal calibration leak connected.

✓ External calibration leak installed in or on the test system and closed.

✓ Leak rates of internal and external calibration leak are entered.

✓ LD and ASCII protocol: The status must be queried via: Command 260 or *STATus:CAL

1 Start machine calibration.
Control unit: Functions > CAL > Machine (Sniffer)
LD protocol 4, Parameter 3
ASCII protocol: *CAL:FACtor_Machine, *CAL:FACtor_Snif
IO1000 see figure in "External Calibration Configuration and Start [▶ 55]"

⇨ Internal calibration is performed automatically.

⇨ Request "Open calibration leak" (external calibration leak).

2 Open external calibration leak and valve (if present) between the leak detector and the system.

3 Confirm tuned and stable leak rate signal.
Control unit: "OK"
LD protocol: 11, Parameter 1
ASCII protocol: *CAL:ACKnowledge
IO1000 see figure in "External Calibration Configuration and Start [▶ 55]"

⇨ Request "Close calibration leak" (external calibration leak).

4 Close external calibration leak. Leave existing valve open.

5 Confirm tuned and stable leak rate signal.
Control unit: "OK"
LD protocol: 11, Parameter 1
ASCII protocol: *CAL:CLOSED
IO1000 see figure in "External Calibration Configuration and Start [▶ 55]"

⇨ Machine or sniff factor is determined.

7.9 Starting and stopping the measurement

Switches between measuring and standby operation
START = Standby --> Measuring
STOP = Measuring --> Standby

Control unit	Functions > Start/Stop
LD protocol	Commands 1, 2
ASCII protocol	Command *STArt, *STOp

During the measurement	During standby
ZERO is possible.	ZERO is not possible.
The trigger outputs switch depending on the leak rate and the trigger threshold.	The output at the trigger outputs is: Leak rate value exceeded threshold.
Sniff is possible.	Sniff is not possible.
External calibration is started during the activation of digital input CAL.	Internal calibration is started during the activation of digital input CAL.

Enable/disable correction of the leak rate in Standby

In vacuum mode, the machine factor can be activated or deactivated during the correction of the leak rate for Standby. The sniffer valve is closed in Sniffer mode in Standby. The Sniff factor is therefore canceled in this setting.	
0	OFF (machine factor is not considered in Standby.)
1	On (machine factor is considered in Standby.)

Control unit	Settings > Set up > Operation modes > LR correction > Machine factor in standby
LD protocol	Command 524
ASCII protocol	–

7.10 Loading and saving parameters

You can use a USB flash drive on CU1000 to backup and restore the control unit and mass spectrometer module parameters.

Save parameter:

► "Functions > Data > Parameter > Save > Save parameter"

Loading parameters:

✓ The currently set compatibility mode must match the compatibility mode in the parameter file. See also Select Compatibility Mode [▷ 48].

► "Functions > Data > Parameter > Load > Load parameter"

7.11 Copying measurement data, deleting measurement data

The measurement data can be saved to a USB flash drive with CU1000.

- “Functions > Data > Recorder > Copy > Copy files”

The measurement data can be deleted on the CU1000.

- “Functions > Data > Recorder > Delete > Delete files”

7.12 Suppressing gas backgrounds with "ZERO" functions

ZERO can be used to suppress undesired helium backgrounds. If "ZERO" is enabled, the currently measured leak rate value will be interpreted as a helium background and subtracted from all subsequently measured values. The background value suppressed by ”ZERO” is adjusted automatically if the background changes inside the device. The background value is automatically adjusted depending on the set ZERO time, except for filter setting I•CAL, see "Measurement result display with signal filters [▷ 68]".

Activating and deactivating “ZERO”

Activating/deactivating "ZERO"	
0	On
1	Off
Control unit	Function > ZERO > ZERO
LD protocol	Command 6
ASCII protocol	Command *ZERO

Activating and deactivating "ZERO with start”

ZERO with Start suppresses the helium background automatically when a measurement is started.	
0	On
1	Off
Control unit	Settings > ZERO/Filter > ZERO > ZERO with start
LD protocol	Command 409
ASCII protocol	Command *CONFig:ZEROSTART

Setting ZERO mode

Determines the degree of the helium background suppressed by ZERO (only with filter "fixed" and "2-stage").	
0	all decades
1	1 – 2 decades
2	2 – 3 decades
3	2 decades
4	3 – 4 decades
5	19/20 of the helium background are suppressed
Control unit	Settings > ZERO/Filter > ZERO > ZERO mode
LD protocol	Command 410

ASCII protocol	Command *CONFig:DECADEZero

Deactivating the ZERO key on the sniffer

Deactivation of the ZERO key (ZERO adjustment) prevents that the measurement is influenced inadvertently.	
0	On
1	Off
Control unit	Settings > Set up > Operation modes > Sniffing > Sniffer > Keys > ZERO key sniffer
LD protocol	Command 412
ASCII protocol	Command *CONFig:BUTSniffer

7.13 Suppressing decreasing gas backgrounds with EcoBoost

EcoBoost with helium as test gas is available for LDS3000 in vacuum mode, not for LDS3000 AQ.

EcoBoost with hydrogen or forming gas as the test gas is at an early stage of development. To switch the gas type from helium to hydrogen, see "Select gas type (mass) [▷ 51]". The function may therefore still contain errors that may make productive use inadvisable. INFICON expressly reserves the right to change or remove the function in future software versions.

EcoBoost supplements existing ZERO functions, see also “Suppressing gas backgrounds with "ZERO" functions [▷ 65]“.

EcoBoost is optimized for detecting leaks when the background is decreasing due to pumping down. The more the background decreases during the measurement, the more useful the function is. For this purpose, a prediction of the future course is calculated on the basis of the signal course of the last two seconds and taken into account in the leak rate calculation.

Procedure

✓ You have set EcoBoost.
Control unit: Settings > EcoBoost > EcoBoost settings“, Button “On“
LD protocol: 410 (value = 6)
ASCII protocol: `*CONFig:DECADEZero:ECOBOOST`

✓ You have replaced the "Favorite 1" or "Favorite 2" button in the favorites window with "EcoBoost". For the setting, see “Touch screen settings [▷ 125]“, "Assigning favorite keys". Since this setting, an EcoBoost button has been available for operation in the measurement display of the CU1000.
Otherwise, the ZERO button would be missing in the measurement display and you would have to use the way via the menu "Function > ZERO > EcoBoost", Button “On”.

1. Pump down the vacuum chamber to the maximum inlet pressure of the selected LDS3000 port.
2. Open the valve to the LDS3000.
3. Wait 3 seconds and then activate EcoBoost as follows.
   Control unit: Via an ideally set up favorite key, see above.
   LD protocol: 6 (value = 1)
   ASCII protocol: `*ZERO(:ON)`
   PLC input: Set input with assigned function "ZERO" or "ZERO pulse" to "active". See also "Assigning the digital inputs of the I/O module [▶ 106]".
   Field Bus: Perform a normal ZERO with ZeroMode 0 over cyclic data on the field bus (i.e. bit 2 and bit 3 in the low byte of the command word must be 0)

   ⇨ Further note on the behavior of EcoBoost:
   To be able to activate this function when EcoBoost is set, the background signal must decrease evenly during this period and the status message for EcoBoost must report an "STABLE".
   Control unit: The status display for EcoBoost shows "STABLE"  . See also "Touchscreen elements [▶ 122]".
   LD protocol: 493
   ASCII protocol: `*STATus:STABLE?`
   PLC output: Evaluate output with assigned function "ZERO stable", see also “Assigning the digital outputs of the I/O module [▶ 108]“.

   ⇨ If the status message for EcoBoost does not go to "ISTABLE" and you cannot activate this function, use the standard ZERO function of the LDS3000 on stable background, see also "Suppressing gas backgrounds with "ZERO" functions [▶ 65]".
   Control unit: The status display shows "UNSTABLE“  . See also "Touchscreen elements [▶ 122]".
   LD protocol: 493
   ASCII protocol: `*STATus:STABLE?`
   PLC output: Evaluate output with assigned function "ZERO stable". See also "Assigning the digital outputs of the I/O module [▶ 108]".

   ⇨ After activation, the leak rate drops by a factor of between 10 and 100, depending on the pump speed and the volume of the measuring chamber.
4. Apply helium to your leak/test object.

⇨ If your nominal leak rate is ten times greater than the displayed background, your leak is displayed. Smaller leaks can also be found.

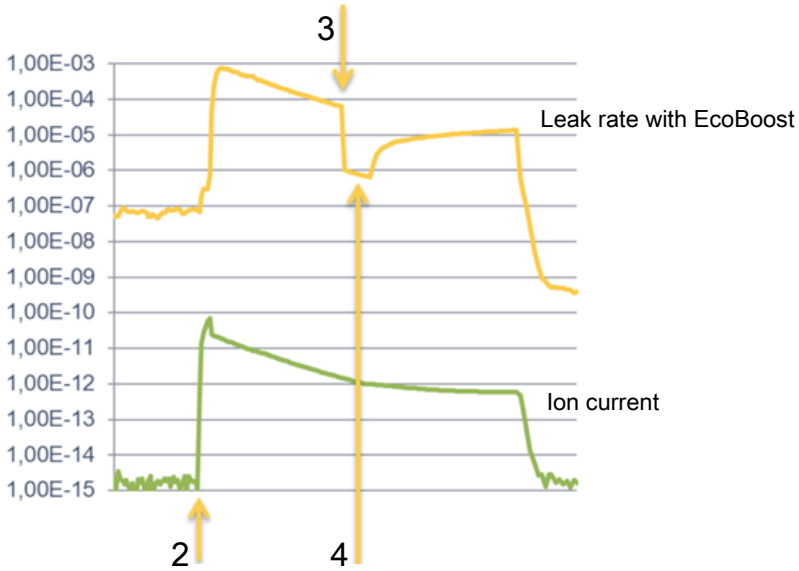


Fig. 16: Example of measurement curves (EcoBoost)

1	Action step 1, see above text for "Procedure": Pumping down the vacuum chamber (without illustration)
2	Action step 2: Open valve
3	Action step 3: EcoBoost activation
4	Action step 4: Apply helium to test object

Known behavior:

- If the substrate is almost stable, the suppression is only a factor of 10. In this case, use the standard ZERO function of the LDS3000. See also "Suppressing gas backgrounds with "ZERO" functions [▷ 65]".
- If EcoBoost is activated without the "STABLE" message, the device uses a background prediction from the signal of the last 2 seconds. This can lead both to false alarms and to a leak being overlooked.
- If the pumping speed drops too much after activating EcoBoost, a leak is indicated. Do not use EcoBoost near the final pressure of the backing pump used.
- Do not switch off any additionally used pump for the measuring chamber after you have activated EcoBoost. Otherwise, a leak will be indicated.

7.14 Measurement result display with signal filters

Select signal filter

With the signal filters, the leak rate indicator regarding slope and noise behavior can be influenced.

– Generally select signal filter I•CAL for the operation mode "Vacuum".

– Generally select signal filter I-Filter for the operation mode "Sniff".

– If the signal filter should simulate the time behavior of older units, then select filter "Fixed" or "2-Zone".

I•CAL	The leak rates are averaged at time intervals that are optimized for the range of the leak rates. The algorithm used offers excellent sensitivity and response time. Use of this setting is strongly recommended.
fixed	The leak rates are averaged at fixed intervals of 0.2 seconds.
2-zone	The filter is compatible with LDS1000 and LDS2000. The averaging period is switched depending on the filter leak rate threshold.
I-Filter	Filter optimized for sniffer mode. (Default with XL Sniffer Adapter set)
I-Filter slope suppress.	Same as I-Filter, but with additional slope suppression. The edge suppression corrects the measurement changes during the warm-up phase.
Control unit	Settings > ZERO/Filter > Filter > Filter mode
LD protocol	Command 402
ASCII protocol	Command *CONFig:FILTER

Setting the filter leak rate threshold

Leak rate background in mbar l / s for the averaging period. The averaging period is 10.24 s below this value. Above this value, the averaging period is 160 ms. Setting applies only to filter "2-stage".	
1E-11 ... 9.9E-3	
Control unit	Settings > ZERO/Filter > Settings > Filter 2-zone
LD protocol	Command 403
ASCII protocol	Command *CONFig:LRFilter

Setting filter ZERO time

Update interval for the offset value with negative leak rate signal (except for I•CAL filter).	
Resolution 0.1 s (50 = 5.0 s)	
Control unit	Settings > ZERO/Filter > Settings filter > ZERO time
LD protocol	Command 411
ASCII protocol	Command *CONFig:ZEROTIME

7.15 Control of the Gas Ballast Valve of the Backing Pump

The mass spectrometer module can control an electric 24 V gas ballast valve of the backing pump via the "Output" connection.

Controlling the gas ballast valve

Controlling the gas ballast valve using digital outputs.	
0	Off
1	On
2	Continuously on
Control unit	Functions > Valves > Gas Ballast
LD protocol	Command 228
ASCII protocol	–

7.16 Selecting display limits

Display range

Lowering and raising the display limits: If very small leak rates are not of interest for your application, raising the lower limit of the display can facilitate the assessment of the leak rate indicator.
– up to 15 decades in VAC – up to 11 decades in SNIF – up to 8 decades in AQ mode If an unsuitable setting causes the usable range to be less than the decade, the upper limit is shifted until a visible decade remains. Note: The current display limits are shown in the control unit when setting between the two parameters. Using the command 399 with the LD protocol the current display limit can be read out.

Control unit	Display > Display limits
LD protocol	Command 397
ASCII protocol	Command: *CONFig:DISPL_LIM:HIGH Command: *CONFig:DISPL_LIM:LOW

7.17 Setting trigger values

The mass spectrometer module has four independent trigger values. If the measured leak rate exceeds the set trigger values, the corresponding digital outputs of IO1000 are activated. In addition, exceeding the Trigger 1 on the control unit is highlighted. In the AQ mode, the calculation at the recommended measuring time refers to the trigger value 1.
1 / 2 / 3 / 4

Control unit	Setting > Trigger > Trigger 1 (2, 3, 4) > Trigger level

LD protocol	Command 385
ASCII protocol	Command *CONFig:TRIGger1 (2, 3, 4)

7.18 Setting capillary surveillance

Pressure value capillary clogged

You set a minimum pressure value in order to detect if the 25/300-sccm capillaries are blocked. If the value is fallen short of, the system issues warning 540. Error message 541 is output with strong lower deviation.	
1E-3 ... 18 mbar	
Control unit	Settings > Set up > Operation modes > Sniff > Capillary > Blocked > Pressure capillary blocked
LD protocol	Command 452
ASCII protocol	Command *CONFig:PRESSLow

Pressure value capillary broken

You set a maximum pressure value in order to detect if the 25/300-sccm capillaries are blocked. If the value is exceeded, the system issues warning 542.	
1E-3 ... 18 mbar	
Control unit	Settings > Set up > Operation modes > Sniff > Capillary > Broken > Pressure capillary broken
LD protocol	Command 453
ASCII protocol	Command *CONFig:PRESSHigh

Detection of a missing sniffer line

Automatic detection of a missing sniffer line. This function should be deactivated if a sniffer line that is not automatically detected is used.	
0	On
1	Off
Control unit	Settings > Set up > Operation modes > Sniff > Sniffer > Messages > Sniffer line detection
LD protocol	Command 529
ASCII protocol	–

7.19 Set the rotation speed of the turbo molecular pump

In some applications, it may be advisable to reduce the rotation speed of the turbo-molecular pump, to increase the sensitivity of the device. As a result, however, the maximum allowable inlet pressure decreases at the GROSS, FINE and ULTRA connections. After changing the rotation speed recalibration is required!

For devices in AQ mode, see “Set the rotation speed of the turbo molecular pump [▷ 95]“.

Rotation speed of turbo molecular pump in Hertz	
1000 1500	
Control unit	Settings > Setup > MS module > TMP > Settings > TMP rotational speed
LD protocol	501
ASCII protocol	*CONFig:SPEEDTMP

7.20 Cathode Selection

Selecting a cathode

The mass spectrometer includes two cathodes. In the factory setting the device uses cathode 1. If it is defective, the device automatically switches to the other cathode. With this setting it is possible to select a certain cathode.	
0	CAT1
1	CAT2
2	Auto Cat1 (automatic switching to cathode 2, factory setting)
3	Auto Cat2 (automatic switching to cathode 1)
4	OFF
Control unit	Settings > Set up > MS module > Ion source > Cathode selection
LD protocol	530
ASCII protocol	*CONFig:CAThode *STATus:CAThode

7.21 Settings for the XL sniffer adapter

For operation with the XL Sniffer Adapter you have to use the

– SL3000XL sniffer line,

- Select the "XL Sniffer Adapter" operation mode, see "Select operation mode [▷ 50]".

Function of right sniffer key

Activate or deactivating the right key of the SL3000XL sniffer line (switching between low flow and high flow). Deactivating the key prevents an inadvertent influencing of the measurement.

Control unit	Settings > Set up > Operation modes > Sniff > Sniffer > Keys > Sniffer flow key
LD protocol	Command 415
ASCII protocol	Command *CONFig:HFButton

Search Function

When the search function is activated, the alarm is automatically connected to Trigger 2 as soon as it is switched to High Flow.

- Switched-off Search Function: Alarm, when Trigger 1 is exceeded.
- Switched-on Search Function and operation in Low Flow: Alarm, when Trigger 1 is exceeded.
- Switched-on Search Function and operation in High Flow: Alarm, when Trigger 2 is exceeded.

0	Off
1	On

Control unit	Setting > Trigger > Search
LD protocol	Command 380
ASCII protocol	Command *CONFig:SEARch

In the SL3000XL the following are dependent on the trigger used; the leak rate bar, changing the background lighting, the beeper and changing the sniffer tip lighting.

Sniffer LEDs: Brightness

Set the brightness of the LEDs designed to illuminate the spot under examination. This setting refers to the measurement process without LED alarm configuration, see below.

From "0" (off) to "6" (max.)

Control unit	Settings > Set up > Operation modes > Sniff > Sniffer > LED > Sniffer LED brightness
LD protocol	Command 414
ASCII protocol	Command *CONFig:BRIGHTness

Sniffer LEDs: Alarm configuration

Behavior of the LEDs on the sniffer, when trigger value 1 is exceeded.

Off	No response
Flashing	The LEDs are flashing
Brighter	The LEDs shine with maximum brightness.

Control unit	Settings > Set up > Operation modes > Sniff > Sniffer > LED > Sniffer LED alarm config.
LD protocol	Command 413
ASCII protocol	Command *CONFig:LIGHTAlarm

Sniffer beep: Alarm configuration

Response by the beep on the sniffer if the trigger value is exceeded.	
Off	No response
Trigger	Acoustic signal / vibration alarm
Control unit	Settings > Set up > Operation modes > Sniff > Sniffer > Beep > Sniffer Beep
LD protocol	Command 417
ASCII protocol	Command *CONFig:BEEP

Display of the hydrogen percentage

The sniffing with forming gas involves the use of hydrogen. The hydrogen percentage is taken into consideration with this specification. This will increase the displayed leak rate by the corresponding factor. You can also set the gas percentage for other gases (M3, He).	
0 ... 100 %	
Control unit	Settings > Set up > Operation modes > Sniff > Gas percentage > Mass2 > Gas percentage H2
LD protocol	Command 416
ASCII protocol	Command *CONFig:PERcent

Auto standby interval

Defines the duration in minutes until standby is activated. If the device operates in high flow, the filters of the sniffer line will foul up more quickly. Auto standby switches to low flow for protection. Moving the sniffer line automatically switches the previously selected flow back on.	
From "0" (off) to "60" (max.)	
Control unit	Settings > Set up > Operation modes > Sniff > Auto standby > Interval auto standby
LD protocol	Command 480
ASCII protocol	Command *CONFig:STANDBYDel

Pressure value XL capillary clogged (high flow)

You set a minimum pressure value in order to detect if the XL capillary (high flow, 3000 sccm) is blocked. If the value is fallen short of, the system issues warning 550. Error message 551 is output with strong lower deviation.	
100 ... 300 mbar	
Control unit	Settings > Set up > Operation modes > Sniff > Capillary > Blocked XL > Pressure capillary blocked XL
LD protocol	Command 455
ASCII protocol	Command *CONFig:PRESSXLLow

Pressure value XL capillary broken (high flow)

You set a maximum pressure value in order to detect a disruption in the XL capillary (high flow, 3000 sccm). If the value is exceeded, the system issues warning 552.	
200 ... 600 mbar	
Control unit	Settings > Set up > Operation modes > Sniff > Capillary > Broken XL > Pressure capillary broken XL
LD protocol	Command 456
ASCII protocol	Command *CONFig:PRESSXLHigh

Select flow

Select low flow or high flow. Comment: The selection can also be made with the right sniffer key or assigned to one of the favorite keys of the control unit.	
Small (low flow) Large (high flow)	
Control unit	Settings > Configuration > Operating Mode > Flow > Flow Control or Functions > Flow > Flow Control
LD protocol	Command 229
ASCII protocol	Command *CONFig:Highflow

7.22 Display equivalence leak rate

Scope

- The explanations on the equivalence rate only refer to sniffing operation.

- When using a CU1000 control unit, read the extended options for displaying the equivalence rate, see “Display equivalence leak rate for other gas [▷ 134]“.

If you measure with the test gases helium or hydrogen, but want to display another gas with its leak rate, use a correction factor for the test gas used.

Calculate the equivalence factor, see “Calculate equivalence factor [▷ 75]“.

Make the necessary settings on the device, see “Set equivalence factor and molar mass [▷ 76]“.

7.22.1 Calculate equivalence factor

The equivalence factor is not calculated by the software of the device. Calculate the equivalence factor using the following formula:

$$\text{Eqivalence factor} = \frac{\eta_{test}}{\eta_{equi}} * \frac{(p_{equi})^2 - 1}{(p_{test})^2 - 1}$$

ηTest	Dynamic viscosity of test gas (helium or H_2)

η_{equi}	Dynamic viscosity of the equivalent gas
p_{test}	Absolute pressure of the test gas in the test object in bar
p_{equi}	Absolute pressure of the equivalent gas in the test object in bar

Example

An air conditioning system is to be checked for leaks.

The system is first filled with 2 bar (absolute) helium and checked for leaks. Later the plant will be filled with R134a. The operating pressure is 15 bar (absolute).

The dynamic viscosity of helium is 19.62 µPa*s.

The dynamic viscosity of R134a is 11.49 µPa*s.

In order to obtain an R134a equivalent leak rate display during the helium leak detection, the following equivalence factor must be entered:

$$\text{Equivalence factor} = \frac{\eta_{test}}{\eta_{equi}} * \frac{(p_{equi})^2 - 1}{(p_{test})^2 - 1} = \frac{19{,}62}{11{,}49} * \frac{15^2 - 1}{2^2 - 1} \approx 127$$

7.22.2 Set equivalence factor and molar mass

✓ The equivalence factor is known. See also "Calculate equivalence factor [▷ 75]".

✓ The test gas used is specified (hydrogen or helium, mass 2, 3 or 4).

✓ The molar mass of the equivalence gas you want to display is known.

1. Control unit: Settings > Set up > Operation modes > Equivalence rate
2. “Gas factor” button
   ⇨ (LD protocol: Command 469)
3. Select "Mass 2", "Mass 3" or "Mass 4" according to your test gas.
   ⇨ If the test gas is set to helium, the window "Equivalent Gas Factor He" opens.
4. Set the equivalence gas factor.
5. Control unit: Settings > Set up > Operation modes > Equivalence rate
6. “Molar mass" button
   ⇨ (LD protocol: Command “470”)
7. Select "Mass 2", "Mass 3" or "Mass 4" to match your test gas as described above.
   ⇨ If the test gas is set to helium, the window "Molar mass equivalent gas He" opens.
8. Set your molar mass.

⇨ If the equivalence factor is not equal to 1 or the molar mass is not set to factory settings, the equivalence factor is displayed both on the calibration result and on the measurement screen.

7.23 Reset settings

Mass spectrometer module

The settings of the mass spectrometer module can be reset to factory settings.	
0	Load factory settings
10	Reset the settings for compatibility mode LDS1000
11	Reset the settings for compatibility mode LDS2010
12	Reset the settings for XL sniffer adapter mode
Control unit	Functions > Data > Parameters > Reset > Control unit settings Functions > Data > Parameters > Reset > MSB settings Functions > Data > Parameters > Reset > Parameter access level
LD protocol	Command 1161
ASCII protocol	Command *RST:FACTORY Command *RST:SL3000

The following applies to the control unit: Based on the currently set mode, the associated value for resetting the settings for this mode is automatically selected.

The following applies to LD or ASCII protocol: Resetting the settings for a certain mode automatically activates this mode, see also "Select Compatibility Mode [▶ 48]".

8 Operation LDS3000 AQ (Accumulation)

8.1 Switching the device on

1. Switch on the backing pump.
2. Establish the power supply to the mass spectrometer module.

⇨ System starts up automatically.

⇨ If an XL Sniffer Adapter and the CU1000 are connected, your will be asked after run-up, whether the "XL Sniffer Adapter" operation mode should be set. This does not apply to devices in AQ mode.

Longer run-up time for devices in AQ mode

To counteract falsification of the measurement results by an increased background value, the warm-up time after switching on is about 10 minutes.

Wait at least 60 minutes before determining the peak or before calibrating. See also "Carrying out a measurement [▶ 92]".

8.2 Default settings

Language selection

Select the display language. The factory setting is English. (The display on the handle of the SL3000XL sniffer line shows messages in English instead of in Russian and Chinese.)	
German, English, French, Italian, Spanish, Portuguese, Russian, Chinese, Japanese	
Control unit	Settings > Set up > Control unit > Language
LD protocol	Command 398
ASCII protocol	*CONFig:LANG

Setting date and time

Setting the date	
Format: DD.MM.YY	
Control unit	Settings > Date/Time > Date
LD protocol	Command 450
ASCII protocol	*HOUR:DATE

Setting the time	
Format: hh: mm	
Control unit	Settings > Date/Time > Time

LD protocol	Command 450
ASCII protocol	*HOUR:TIME

8.3 Selecting a unit for the leak rate

Leak rate unit display

Selecting the leak rate unit in the display for vacuum or sniff	
0	mbar l/s (factory setting)
1	Pa m^3/s
2	atm cc/s
3	Torr l/s
4	ppm (not VAC, not AQ)
5	g/a (not VAC, not AQ)
6	oz/yr (not VAC, not AQ)
7	sccm
8	sft^3/yr

Control unit	Display > Units (display) > Leak rate unit VAC (SNIF)
LD protocol	Command 396 (Index 0: Vacuum, Index 1: Sniffing)
ASCII protocol	Command *CONFig:UNIT:VACDisplay Command *CONFig:UNIT:SNDisplay

Leak rate unit interface

Selecting the leak rate unit of the interfaces for vacuum or sniff	
0	mbar l/s (factory setting)
1	Pa m^3/s
2	atm cc/s
3	Torr l/s
4	ppm (not VAC)
5	g/a (not VAC)
6	oz/yr (not VAC)
7	sccm
8	sft^3/yr

Control unit	Settings > Set up > Interfaces > Units (interface) > Leak rate unit VAC (SNIF)
LD protocol	Command 431 (vacuum) Command 432 (sniffing)
ASCII protocol	Command *CONFig:UNIT:LRVac Command *CONFig:UNIT:LRSnif

8.4 Select device for pressure

Pressure unit interface

Selecting the pressure device of the interfaces	
0	mbar (factory setting)
1	Pa
2	atm
3	Torr

Control unit	Settings > Set up > Interfaces > Units (interface) > Pressure unit
LD protocol	Command 430 (Vacuum/Sniff)
ASCII protocol	Command *CONFig:UNIT:Pressure

8.5 Select Compatibility Mode

As LDS3000 AQ user you make your choice between

- AQ Mode 1 or
- AQ Mode 2

When changing to a compatibility mode all parameters are to be reset to factory settings and the device is to be restarted. The language is displayed according to the factory setting. To change the language, see “Default settings [▶ 78]“.

If you want to switch the LDS3000 to another mode now and switch back to the previously set mode at a later time, save your parameters on a USB stick beforehand, see "Loading and saving parameters [▶ 93]". After switching back to the previously set mode, you can load the saved parameters again.

- AQ Mode 1: This mode is only available for devices for AQ. It is preset for AQ devices. Switching to other modes is possible.
  Selecting this mode results in an endlessly continuous measurement. The result of a measuring cycle must therefore be time-adjusted manually. To obtain a stable measurement result, you must at least wait for the measurement time. To set the measuring time, see “Making basic settings via the wizard [▶ 83]“. For measurement operation, see “Carrying out a measurement [▶ 92]“.
- AQ Mode 2: This mode is only available for devices for AQ. Switching to other modes is possible.
  Selecting this mode causes the AQ measurement to be terminated after the set measuring time has elapsed. The result of the cycle measurement can be read until the manual restart of another measuring cycle. To set the measuring time, see “Making basic settings via the wizard [▶ 83]“. For measurement operation, see “Carrying out a measurement [▶ 92]“.
- LDS1000: Compatibility mode to retrofit an existing LDS1000 leak detection system with an LDS3000.

• LDS2010: Compatibility mode to retrofit an existing LDS2010 leak detection system with an LDS3000. • LDS3000 • XL Sniffer Adapter	
Control unit	Settings > Set up > Compatibility > Compatibility mode
LD protocol	Command 2594 (dec)
ASCII protocol	Command *CONFig:COMP

The following table shows the functional differences between and common features of LDS2010 and LDS3000:

	LDS2010	**LDS3000**
Trigger outputs	without joint reference	with joint reference
other outputs	with joint reference	with joint reference
Trigger 1 (sniffer LED, relay exit, audio signal)	Control of sniffer LED, PWM audio outputs an the control unit for active speakers	Control of sniffer LED, audio outputs an the control unit for active speakers
Limit Low / High (serial interfaces, display, analogue output)	Limit Low affects all outputs, Limit High only the display	separately adjustable for interface protocols, display and analog outputs
Gas ballast (3 settings)	**OFF:** Switches the gas ballast valve of the pump module off. **ON:** Switches the gas ballast valve of the pump module on until the next mains-off. If "CAL fashion" is unequal to 3 (menu item 26), the gas ballast valve can be controlled with digital input DynCAL. **F-ON:** Fixed on enables switching the gas ballast valve on permanently (power failure-proof and independent of the digital inputs).	0 = Off 1 = on, but controllable via digital input on IO1000 2 = on, but not controllable via digital input on IO1000
Control mode	LOCAL, RS232, RS485	None, control is also possible from all control locations.

	LDS2010	LDS3000
LDS1000 compatibility mode 9.2	other functions	Default values and error messages (default values are output via interface, the touchscreen shows the original message - -> reason: new hardware can cause errors that did not exist with previous models)
Correcting the leak rate in Standby (machine factor)	adjustable (yes/no)	adjustable (yes/no)
ZERO with start		starting with V1.02 like LDS2010
Opening the sniffer valve	in SNIF after start	in SNIF after start
Rotation speed of turbo molecular pump	only 2 rotation speeds adjustable	Adjustable via serial interface from 750 Hz to 1500 Hz, via operator unit 1000 Hz and 1500 Hz
Address RS485	Yes, because bus capable	No, because not bus capable
Sniffer key on/off	selectable	selectable
Default value for int. calibration leak	1E-15 mbar l/s	9.9E2 mbar l/s
Default value ext. calibration leak VAC/SNIF mode	1E-7 mbar l/s	9.9E2 mbar l/s
Setting range for int. calibration leak	10E-7	1E-9 ... 9.9E-1 mbar l/s
Machine factor adjustment	manually	manually/automatically
Machine / sniff factor value range	Machine factor: 1E-3...9.9E+3 Sniffer factor: 1E-3...9.9E+3	Machine factor: 1E-4...1E+5 Sniffer factor: 1E-4...1E+4
Pressure: Capillary surveillance 20		available, pressure adjustable
Analog output	fixed characteristics	freely configurable
Calibration request	Preamplifier temperature change 5 K or 30 min	Preamplifier temperature change 5 K or 30 min. or TMP rotation speed changed
Pressure / leak rates units (VAC/ SNIF) for all interfaces	yes	Control unit and rest separated
User permissions	3 levels over PIN on the control unit or key switch	4 levels through control unit or optional key switch
Key-operated switch	permanently installed	can, if required, be connected externally, see "Assigning the digital inputs of the I/O module [▷ 106]" (Key switch)

8.6 Making basic settings via the wizard

We recommend using the AQ Wizard for important settings and calibration. The following information refers to a CU1000 that has been adapted for use with the LDS3000 AQ.

If you want to deviate from the standard settings or want to find out more about interface protocol commands, please refer to further chapters of this manual for details.

AQ Wizard

To start the AQ wizard, press on the display of the CU1000

Main menu > Functions > Assistant

Alternatively press the word “Wizard” at the bottom of the display.

Make your entries in the windows that are called one after the other.

1. Chamber volume
   (net volume)
   The unit of volume can be selected under Main Menu > Settings > Setup > Op. modes > AQ > Volume unit.
   (LD protocol: Command 1763
   ASCII protocol: *CONFig:AQ:VOLume)
2. Trigger level 1
   (LD/ASCII protocol: See "Setting trigger values [▶ 70]")
3. Mass
   (selection between helium or forming gas)
   (LD/ASCII protocol: See "Select gas type (mass) [▶ 51]"
4. Percentage of gas
   (for example, the hydrogen content in forming gas)
   (LD/ASCII protocol: See display of hydrogen content in “Settings for the XL sniffer adapter [▶ 72]“
5. Measurement time
   (The time can be freely adjusted, but there is also a recommendation, depending on parameters.)
   (LD protocol: Command 1765
   ASCII protocol: *CONFig:AQ:TIME)

   When the compatibility mode “AQ Mode 1“ is set, an endless continuous measurement is performed. The measuring cycle or the result of a measurement must be read manually from the continuous measurement. To obtain a stable measurement result, you must at least wait for the measurement time.

   When the compatibility mode “AQ Mode 2“ is set, the AQ measurement is

terminated after the set measuring time has elapsed. The result of the cycle measurement can be read until the manual restart of another measuring cycle. To set the compatibility mode, see “Select Compatibility Mode [▶ 80]“.

Alternatively, you can make your settings in the following places:

“Main menu > Settings > Set up > Operation modes > AQ”

“Main menu > Settings > Mass”

8.7 Determine peak

To obtain the most accurate measurement results, you should always determine the current "peak" before calibration. At the end of this process, the value for the old anode voltage is replaced by the value for the new anode voltage.

The adjustment uses air-helium or air-hydrogen. An adjustment only with nitrogen is not possible.

The following information about the display refers to a CU1000 that has been adapted for use with the LDS3000 AQ.

✓ To prevent falsification of measurement results due to an increased background value, you have waited for at least 60 minutes to warm up.

1 Main menu > Functions > CAL > Peak.

2 Confirm with “OK.”

⇨ The "CAL peak" window opens.

3 Remove the calibration leak from the chamber.

4 If the compatibility mode “AQ Mode 1“ has been set, wait until the background signal is stable and then start the adjustment with "OK". See also "Select Compatibility Mode [▶ 80]".

⇨ (LD protocol: 4, Parameter 7 (peak adjust AQ)
ASCII protocol: *CAL:PEAK)
IO1000: "Peakfind” input

⇨ (LD and ASCII protocol: The status must then be queried via command 260 (State Calibration) or *STATus: CAL)

5 If the compatibility mode “AQ Mode 2“ has been set, start the adjustment directly with "OK".

⇨ After adjustment, the old and new anode voltage are displayed.

8.8 Store leak rate of calibration leaks

Enter the specifications for the used calibration leak once. A specific leak rate must be set for each gas (mass).
Range: 1E-9 ... 9.9E-2 mbar l/s

Minimum size for leak rate of the calibration leak

In order to perform a stable calibration, we recommend a minimum size for the leak rate of the used calibration leak.

If the measurement time proposed by the AQ Wizard is maintained, the leak rate should not fall below the following value:

- When using forming gas, the selected setpoint (Trigger 1)

- When using helium 1/5 of the selected setpoint (Trigger 1)

If the leak rate of the used calibration leak is too small, an error message will be issued to start or finish the calibration.

The following information refers to a CU1000 that has been adapted for use with the LDS3000 AQ.

✓ The desired unit in which you want to enter the leak rate is set. If the unit of leak rate displayed in your system differs from the unit indicated on the calibration leak, at least temporarily set the unit as indicated on the calibration leak. See also "Selecting a unit for the leak rate [▷ 47]".

1 Main menu > Functions > CAL > Settings > Ext. calibration leak

2 Enter the desired gas and the associated leak rate.
(LD protocol: Command 390
ASCII protocol: *CONFig:CALleak:EXTVac)

8.9 Calibrate device

8.9.1 Time and general preferences

NOTICE

Incorrect calibration because of operating temperature that is too low

Calibrating the device in the cold state can deliver incorrect measurement results.

► For optimum accuracy the device should have been turned on at least 60 minutes previously.

It is recommended to calibrate the device once per shift in the desired operating modes and for the desired gases. Thereafter you can switch between the operation modes and gases without re-calibrating.

Further, calibration is required after a calibration prompt by the system.

Switching off the preamplifier test

The device tests the installed preamplifier during calibration. You can switch off of the amplifier test. This increases the speed of the calibration, but reliability drops off.

0	Off
1	ON
Control unit	Settings > Set-up > MS-module > Preamplifier > Test > Preamplifier test with CAL
LD protocol	Command 370
ASCII protocol	Command *CONFig:AMPTest (ON,OFF)

Enabling calibration request

If Calibration request is enabled, the device will prompt the operator to perform a calibration 30 minutes after it has been switched on and in case of temperature changes greater than 5°C.	
0	Off
1	ON
Control unit	Functions > CAL > Settings > CAL request. > Calibration request or Settings > Setup > Notifications > CAL request. > Calibration request
LD protocol	Command 419
ASCII protocol	*CONFig:CALREQ (ON,OFF)

Calibration warning Wrn650

The warning message Wrn650 "Calibration within the first 20 minutes is not recommended" can be allowed or suppressed.	
0	OFF (suppressed)
1	ON (allowed)
Control unit	Functions > CAL > Settings > CAL request. > Calibration warning W650 or Settings > Setup > Notifications > CAL request. > Calibration warning W650
LD protocol	Command 429
ASCII protocol	*CONFig:CALWarn ON (OFF)

See also

Setting machine and sniff factor [▶ 90]

8.9.2 Entering the calibration factor

The calibration is usually determined by the appropriate calibration routine. Therefore, it is usually not necessary to adjust the calibration factor manually.

An incorrectly set calibration inevitably leads to wrong leak rate indicator!

8.9.3 Calibration factor vacuum

Also applies to devices in AQ mode.

Entry of calibration factors for masses 2, 3, 4. The values will be overwritten during the next calibration.	
0.01 … 5000	
Control unit	Settings > Set up > Operation modes > Vacuum > Calibr. factor > mass 2 (3, 4) > calibration factor VAC H2 (M3, He)
LD protocol	Command 520
ASCII protocol	Command *FACtor:CALVac

8.9.4 Calibrate

Please also note the general instructions for calibration, see “Calibrate device [▷ 52]“.

Requirements for all procedures

- You have an external calibration leak.
- The information on the calibration leak is entered, see also “Store leak rate of calibration leaks [▷ 84]“.
- To prevent falsification of measurement results due to an increased background value, you have waited for at least 60 minutes to warm up.
- The current "peak" was determined, see also “Determine peak [▷ 84]“.

Control unit CU1000

1. Place the open calibration leak in the measuring chamber and close the measuring chamber.
2. Main menu > Functions > CAL > external
   ⇨ The leak rate of the calibration leak will be displayed and a question to start the calibration.
3. To start the calbration confirm with “OK“.
4. Follow the instructions on the screen.

LD or ASCII protocol, IO1000

1 Place the open calibration leak in the measuring chamber and close the measuring chamber.

2 Only applies to the “AQ Mode 1“: For a stable leak rate signal, wait at least the duration of the set AQ measurement time.

3 Start the calibration
LD protocol: Command 4, Parameter 1
ASCII protocol: *CAL:EXT
IO1000: Input "CAL external", see also the following figure

⇨ If helium is used, proceed to the last step (no. 8).

4 For a background determination of forming gas (hydrogen), then query the status:
LD protocol: Command 260 (State Calibration)
ASCII protocol: *STATus:CAL

⇨ Wait until it reaches the following state:
LD protocol: Command 260 State 75 “WAIT_ZERO_AQ“
ASCII protocol: *STATus:CAL? on “CLOSE“
IO1000: Input "CAL stable", see also the following figure

5 Remove the calibration leak from the measuring chamber and close the measuring chamber.

6 For a stable leak rate signal, wait at least the duration of the set AQ measurement time.

7 Start the background measurement.
LD protocol: Command 11, Parameter 1 (Continue calibration)
ASCII protocol: *CAL:CLOSED
IO1000: Input "CAL external", see also the following figure

8 Then query the status:
LD protocol: Command 260 (State Calibration)
ASCII protocol: *STATus:CAL

⇨ Wait until it reaches the following state:
LD protocol: Command 260 State 0 “READY“
ASCII protocol: *STATus:CAL? on “IDLE“
IO1000: Output "CAL active", see also the following figure

⇨ The calibration is completed.

⇨ In case of error:
LD protocol: Command 260 State 51...59 (error conditions)
ASCII protocol: *STATus:CAL? on “FAIL“
IO1000: Output "Error or Warning”

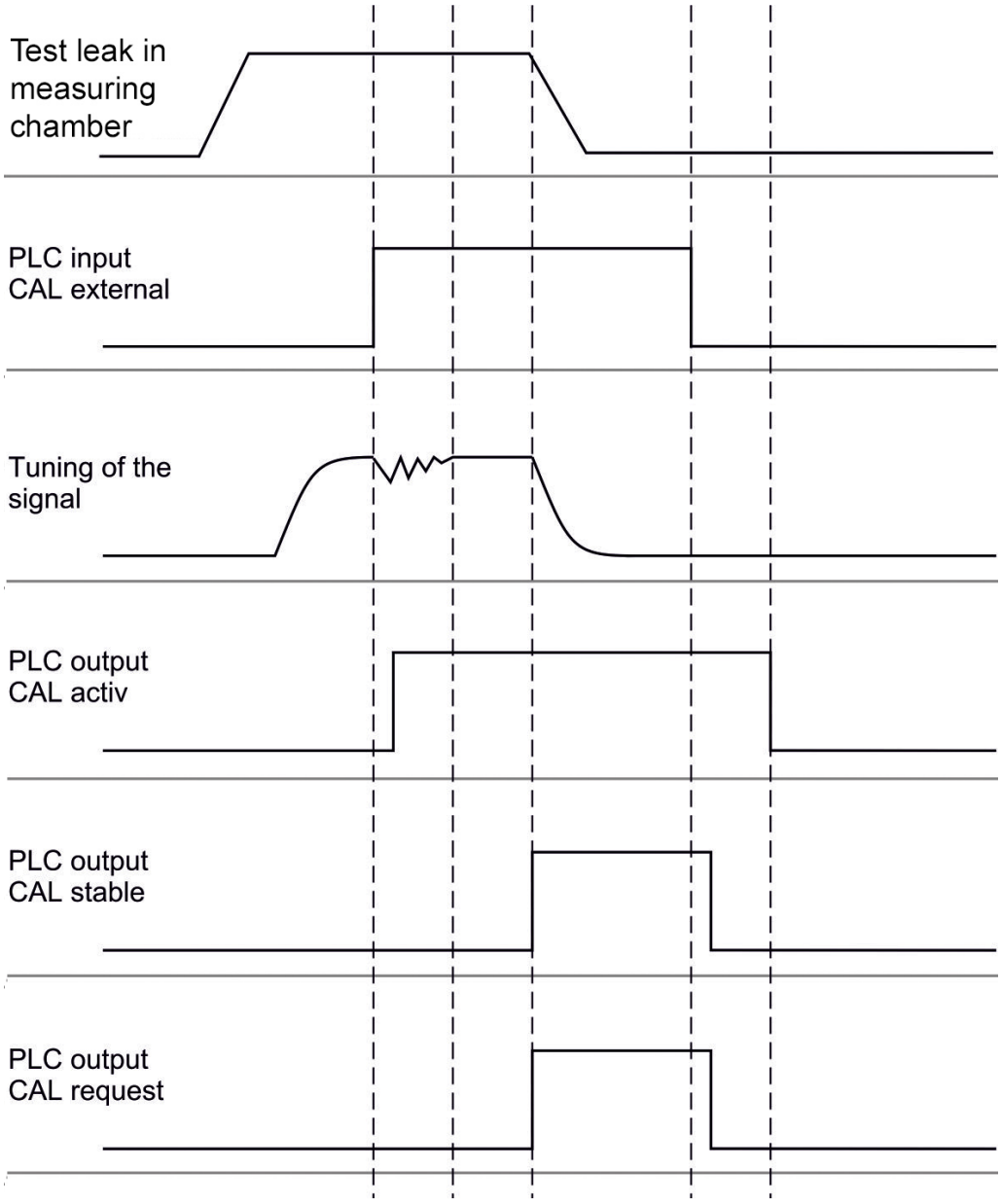


Fig. 17: External calibration with IO1000 on a device for AQ mode. Description of the PLC inputs and outputs see “Assigning inputs and outputs [▶ 97]“.

8.10 Start and stop measurement (AQ Mode 2)

Applies only to “AQ Mode 2“. See also "Select Compatibility Mode [▶ 80]".

In order to have a Start or Stop button available in the standby window of the CU1000 to operate a measuring cycle, replace the "Favorite 1" or "Favorite 2" key in the Favorites window with "Start/Stop". Otherwise, the Start/Stop buttons would be missing in the standby window and you would have to use the "Functions > Start/Stop" menu.

For the setting, see “Touch screen settings [▶ 125]“, "Assigning favorite keys".

Switches between measuring and standby operation	
START = Standby --> Measuring STOP = Measuring --> Standby	
Control unit	Functions > Start/Stop
LD protocol	Commands 1, 2
ASCII protocol	Command *STArt, *STOp

See also

Carrying out a measurement [▶ 92]

8.11 Perform ZERO

After the run-up of the LDS3000 AQ and the choice of forming gas as gas type, the existing hydrogen in the vacuum system initially ensures that a rising curve is visible on the display (AQ Mode 1). This display can be misunderstood as a sign of leakage.

To remove distorting traces of hydrogen, wait about 30 minutes after starting up the device to measure.

To eliminate the residual offset, execute ZERO AQ. ZERO AQ is not used to suppress measurement signals.

✓ Mass is hydrogen (forming gas).
If no hydrogen (forming gas) is entered, you can set it under "Main menu > Settings > Mass" or via "Wizard" at the bottom of the measurement window display.

✓ There is neither a test specimen nor a calibration leak in the measuring chamber.

1 Main menu > Functions > ZERO AQ

2 Follow the instructions on the screen.

⇨ LD and ASCII protocol: After removing the test specimen or test leak, first wait for the measuring time (AQ Mode 1).

⇨ LD protocol: Command 6, Parameter 1; ASCII protocol: *ZERO:ON

⇨ IO1000: Input ZERO

8.12 Setting machine and sniff factor

The internal calibration will only calibrate the measurement system of a mass spectrometer module that is uncoupled from the test system. If the measurement system is operated in parallel to an additional pump system after an internal calibration though (following the partial flow principle), the measurement system will indicate a leak rate that is too low based on the partial flow ratio. With the help of a corrective machine factor for vacuum mode and a sniff factor for sniffer mode, the measurement system indicates the actual leak rate. The factors are taken into

consideration along wit the ratio of effective pumping speed of the measurement system in a comparison to the pumping speed of the measurement system on the test system.

8.12.1 Setting machine and sniff factor manually

✓ Mass spectrometer module calibrated internally.

1 Measure external calibration leak using the test system.

⇨ The device indicates a leak rate that is too low based on the partial flow ratio.

2 Setting machine or sniff factor, see below.

⇨ The device indicates the actual leak rate.

Setting the machine factor

Devices in AQ mode:

The machine factor "1" is preset. This setting should not be changed.

Corrects a possible deviation between internal and external calibration in vacuum mode. Should be at value 1.00 without the option internal calibration leak. After the value is changed, the leak rate resulting from the change is displayed. This simplifies adjustment.	
Value range 1E-4...1E+5	
Control unit	Settings > Set up > Operation modes > Vacuum > Machine factor > Mass 2 (3, 4) > machine factor VAC H2 (M3, He)
LD protocol	Command 522
ASCII protocol	Command *FACtor:FACMachine

Setting the sniff factor

Corrects a possible deviation between internal and external calibration in sniffer mode	
Value range 1E-4...1E+4	
Control unit	Settings > Set up > Operation modes > Sniffing > Sniff factor Mass 2 (3, 4) > Sniff factor H2 (M3, He)
LD protocol	Command 523
ASCII protocol	Command *FACtor:FACSniff

8.13 Carrying out a measurement

⚠ WARNING

Danger due to imploding measuring chamber

An external measuring chamber connected to an LDS3000 AQ is pumped off at approximately 60 sccm. Within normal measurement times (2 - 30 seconds) no dangerous negative pressure is generated.

If the measuring chamber is leak-proof, but not vacuum resistant, and continues to pump, it may implode. This can occur, for example, in a 1-liter measuring chamber after about 10 minutes.

► Do not continue pumping a measuring chamber after the measuring time has expired.

► Consider suitable protective measures!

✓ The device is switched on.

✓ The compatibility mode “AQ Mode 1“ or “AQ Mode 2“ has been set (in the CU1000 in the "Compatibility" window, confirmed with "OK").

✓ “AQ Mode 2“ only: In order to have a Start or Stop button available in the standby window of the CU1000 to operate a measuring cycle, you have replaced the "Favorite 1" or "Favorite 2" button with "Start/Stop" in the Favorites window. Otherwise, the Start/Stop buttons would be missing in the standby window and you would have to use the "Functions > Start/Stop" menu. For the setting, see “Touch screen settings [▷ 125]“, "Assigning favorite keys".

✓ The peak has been determined, see “Determine peak [▷ 84]“.

✓ The calibration was done, see “Calibrate [▷ 87]“.

✓ ZERO AQ has been determined, see “Perform ZERO [▷ 90]“.

1. If you are measuring with forming gas, make sure that the device has been running for at least half an hour. This time is needed to perform stable measurements.

   ⇨ If you measure with helium, this waiting time is about 10 minutes.

2. Place the test object in the measuring chamber and close the measuring chamber. The test object should not be placed on the areas that may be leaking.

   ⇨ Either a test object filled with helium or forming gas under pressure is brought into the measuring chamber or pressurized in the measuring chamber.

3. If the compatibility mode “AQ Mode 1“ has been set, wait for the set measuring time. Start or Stop buttons are not used in AQ Mode 1.

⇨ The leak rate is calculated and displayed. Due to the endlessly running measurement, the result of a measuring cycle must be time-adjusted manually.

⇨ If the test object leaks, the display shows an increasing leak rate.

4 If the compatibility mode “AQ Mode 2“ has been set, press the "Start" button in the "Standby" window of the CU1000.

⇨ In the measurement window, you can follow the current measurement, wait for the end of the measurement cycle or press "Stop". The remaining measuring time is displayed.

⇨ At the end of the measuring cycle, the result of the last measurement is displayed.

⇨ Depending on whether a set setpoint value is exceeded or not, the result "Leak tight" is displayed with a green background or "Leaky" with a red background.

5 Remove the test object from the measuring chamber and continue the measurements with step 2.

8.14 Loading and saving parameters

You can use a USB flash drive on CU1000 to backup and restore the control unit and mass spectrometer module parameters.

Save parameter:

► "Functions > Data > Parameter > Save > Save parameter"

Loading parameters:

✓ The currently set compatibility mode must match the compatibility mode in the parameter file. See also Select Compatibility Mode [▷ 48].

► "Functions > Data > Parameter > Load > Load parameter"

8.15 Copying measurement data, deleting measurement data

The measurement data can be saved to a USB flash drive with CU1000.

- “Functions > Data > Recorder > Copy > Copy files”

The measurement data can be deleted on the CU1000.

- “Functions > Data > Recorder > Delete > Delete files”

8.16 Adjust ”Zero time factor AQ”

Applies only to “AQ Mode 1“. See also “Select Compatibility Mode [▷ 80]“.

In order to avoid apparently negative leak rates when measuring with forming gas, the leakage rate display is adjusted to 0 after a certain time (zero time factor AQ x measuring time).

Zero time factor AQ can be set under:

Main menu > Settings > Set up > Operation modes > AQ > Measurement time

The default value is 4 and can be changed to 1...10 in integers.

(LD protocol: Command 1767
ASCII protocol: *CONFig:AQ:ZEROTime)

8.17 Selecting display limits

Display range

Lowering and raising the display limits: If very small leak rates are not of interest for your application, raising the lower limit of the display can facilitate the assessment of the leak rate indicator.
– up to 15 decades in VAC – up to 11 decades in SNIF – up to 8 decades in AQ mode If an unsuitable setting causes the usable range to be less than the decade, the upper limit is shifted until a visible decade remains. Note: The current display limits are shown in the control unit when setting between the two parameters. Using the command 399 with the LD protocol the current display limit can be read out.

Control unit	Display > Display limits
LD protocol	Command 397
ASCII protocol	Command: *CONFig:DISPL_LIM:HIGH Command: *CONFig:DISPL_LIM:LOW

8.18 Set pressure monitoring

Min. pressure AQ mode

A minimum pressure value is set to detect clogging of the throttle. If the value is fallen short of, the system issues warning 556. Error message 557 is output with strong lower deviation.
5E-2 ... 0.45 mbar

Control unit	Settings > Setup > Operation modes > AQ > Pressure limits > Min. pressure > Min. pressure AQ mode
LD protocol	Command 532
ASCII protocol	Command *CONFig:PRESSACCULow

Max. pressure AQ mode

A maximum pressure value is set to detect a defective or missing throttle. If the value is exceeded, the system issues warning 520.	
0.5 ... 1 mbar	
Control unit	Settings > Setup > Operation modes > AQ > Pressure limits > Max. Pressure > Max. Pressure AQ mode
LD protocol	Command 533
ASCII protocol	Command *CONFig:PRESSACCUHigh

8.19 Set the rotation speed of the turbo molecular pump

Rotational speed of the turbo molecular pump

For measurements with hydrogen / forming gas, it may be useful to set the turbo molecular pump of the LDS3000 AQ to 1250 Hz.

This is always the case if fluctuating environmental conditions such as humidity have a greater influence on the signal quality than the lower signal strength (greater calibration factor) for hydrogen / forming gas at 1250 Hz operation.

After changing the rotation speed recalibration is required!

Rotation speed of turbo molecular pump in Hertz	
1000 1250	
Control unit	Settings > Setup > MS module > TMP > Settings > TMP rotational speed
LD protocol	501
ASCII protocol	*CONFig:SPEEDTMP

8.20 Cathode Selection

Selecting a cathode

The mass spectrometer includes two cathodes. In the factory setting the device uses cathode 1. If it is defective, the device automatically switches to the other cathode. With this setting it is possible to select a certain cathode.	
0	CAT1
1	CAT2
2	Auto Cat1 (automatic switching to cathode 2, factory setting)
3	Auto Cat2 (automatic switching to cathode 1)
4	OFF

Control unit	Settings > Set up > MS module > Ion source > Cathode selection
LD protocol	530
ASCII protocol	*CONFig:CAThode *STATus:CAThode

8.21 Reset settings

Mass spectrometer module

The settings of the mass spectrometer module can be reset to factory settings.	
0	Load factory settings
10	Reset the settings for compatibility mode LDS1000
11	Reset the settings for compatibility mode LDS2010
12	Reset the settings for XL sniffer adapter mode
14	Reset the settings for LDS3000 AQ

Control unit	Functions > Data > Parameters > Reset > Control unit settings Functions > Data > Parameters > Reset > MSB settings Functions > Data > Parameters > Reset > Parameter access level
LD protocol	Command 1161
ASCII protocol	Command *RST:FACTORY Command *RST:SL3000

The following applies to the control unit: Based on the currently set mode, the associated value for resetting the settings for this mode is automatically selected.

The following applies to LD or ASCII protocol: Resetting the settings for a certain mode automatically activates this mode, see also "Select Compatibility Mode [▶ 80]".

9 Using the expansion module (LDS3000, LDS3000 AQ)

9.1 Selecting the type of expansion module

Selecting the expansion module

Selecting the type of module connected to the I/O connection	
I/O module Bus module	
Control unit	Settings > Configuration > Interfaces > Device Selection > Module on I/O connection or Settings > Configuration > Accessories > Device Selection. > Module on I/O connection
LD protocol	–
ASCII protocol	–

9.2 Settings for I/O module IO1000

9.2.1 General interface settings

Setting the interface protocol

Setting the protocol for the module connected to the I/O connection. This setting can be overwritten with the DIP switch on the IO1000.	
LD ASCII – Binary LDS1000	
Control unit	Settings > Set up > Interfaces > Protocol > I/O module protocol
LD protocol	2593
ASCII protocol	*CONFig:RS232

9.2.2 Assigning inputs and outputs

Assigning analog outputs of the I/O module

The analog outputs of I/O module IO1000 can with assigned with different measurement value displays.
Possible functions: see the following table

Control unit	Settings > Set up > Interfaces > I/O module > Analog outp. > Config. Analog outputs 1/2
LD protocol	Commands 222, 223, 224
ASCII protocol	Command *CONFig:RECorder:LINK1 Command *CONFig:RECorder:LINK2 Command *CONFig:RECorder:SCALE Command *CONFig:RECorder:UPPEREXP
Limit values can be defined for the output voltages.	
VAC:	Min. 1 x 10^{-13}...1 x 10^{-1} mbar l/s Max. 1 x 10^{-12}...1 x 10^{-1} mbar l/s
SNIF:	Min. 1 x 10^{-9}...1 x 10^{-1} mbar l/s Max. 1 x 10^{-8}...1 x 10^{-1} mbar l/s
Control unit	Settings > Set up > Interfaces > LR limits
LD protocol	Command 226 (Vac) Command 227 (Snif)
ASCII protocol	Command *CONFig:LIMITS:VAC Command *CONFig:LIMITS:SNIF

Functions, assignment of analog outputs:

Off	The analog outputs are switched off (Output voltage = 0 V).	
Pressure p1 / Pressure p2	1 ... 10 V; 0.5 V / decade; 1 V = 1 x 10^{-3} mbar	
Leak rate mantissa	1 ... 10 V; linear; in the selected unit	Useful only if the other analog output is assigned "Leak rate exponent".
Leak rate exponent	1 ... 10 V; 0.5 V / decade; Step function; 1 V = 1 x 10^{-12}; in selected unit	Useful only if the other analog output is assigned “Leak rate mantissa” or “Leak rate ma. Hys." is occupied.
Linear leak rate	x ... 10 V; linear; in the selected unit	

The upper limit (= 10 V) is set via the parameter "Upper limit exponent". The lower value is always 0 (leak rate), which corresponds to 0 V output voltage. The exponent of the upper limit can be set in entire decades, such as 1 x 10^{-4} mbar l/s.

Settings > Set up > Interfaces > I/O module > Analog scale > AO exponent upper limit.

This setting is for both analog outputs, if an appropriate output function is selected. Depending on the selected leak rate unit there is a different absolute limit.

The selected range can be additionally narrowed by the limits, which is valid for all interfaces, see above.

Leak rate log.	x ... 10 V; logarithmic; in the selected unit	
The upper limit (= 10 V) and the scale (V / decades) are set via the parameters "Upper limit exponent" and "Scale for leak rate". For example: Upper limit set to 1 x 10^{-5} mbar l/s (= 10 V). Scale set to 5 V / decade. Lower limit is at 1 x 10^{-7} mbar l/s (= 0 V). The logarithmic output function of both the slope in V / decade as well as the upper limit (10 V limit) can be set. This results in the minimum displayable value. The following slopes are available: 0.5, 1, 2, 2.5, 3, 5, 10 V/The higher the selected slope value, the smaller the displayable area. The logarithmic settings are the most useful when several decades can be displayed, so a setting of <10 V / decade. The upper limit is the same for both analog outputs. In both of the following figures the 1 V / decade and 5 V / decade with different upper limit settings are exemplified. Depending on the selected leak rate unit there is a different absolute limit. The selected range can be additionally narrowed by the limits, which is valid for all interfaces, see above.		
Via interface	The output voltage can be specified for tests with the LD protocol command 221.	
Leak rate Ma. Hys.	0.7 ... 10 V; linear; in the selected unit	Useful only if the other analog output is assigned "Leak rate exponent". Through an overlap of the mantissa in the range 0.7 to 1.0, a constant jumping between two decades is prevented. 0.7 V corresponds to a leak rate of 0.7 x 10^{-x}. 9.9 V corresponds to a leak rate of 9.9 x 10^{-x}.
Pressure p1 (1 V / Dec.)/ Pressure p2 (1 V / Dec.)	1 ... 10 V; 1 V / decade; 2.5 V = 1 x 10^{-3} mbar; 8.5 V = 1000 mbar	
Leak rate log. H./ Leak rate exp. Inv.	Special function. Use only on the recommendation of INFICON.	

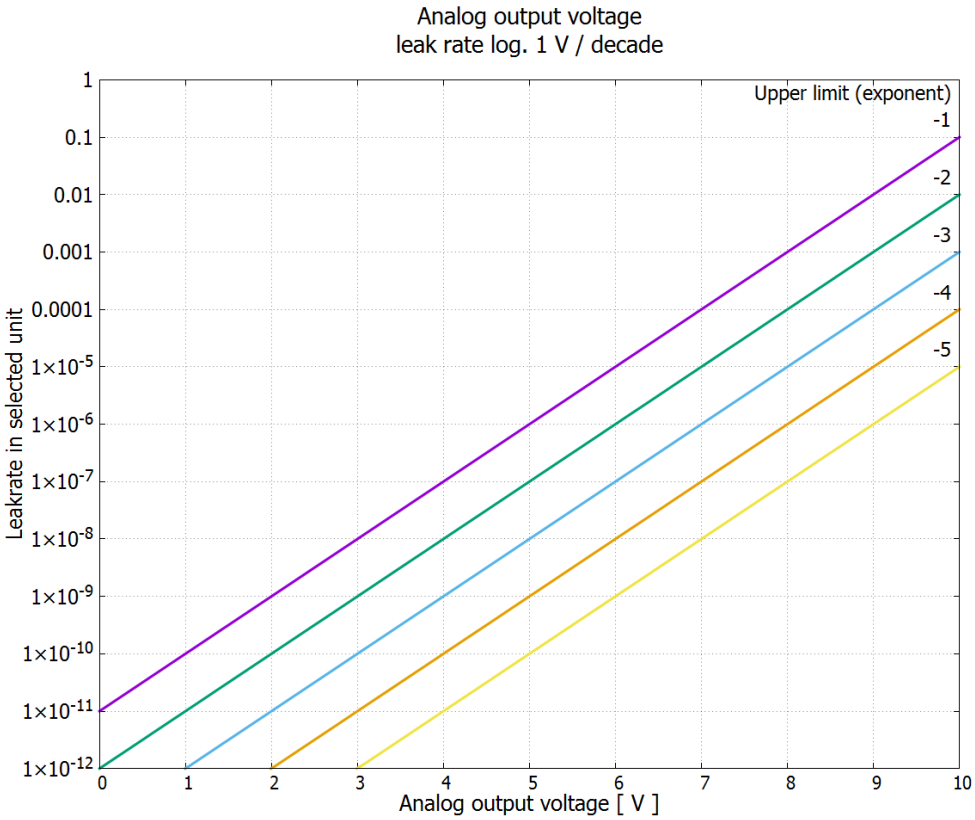


Fig. 18: Analog output voltage leak rate log. 1 V / decade

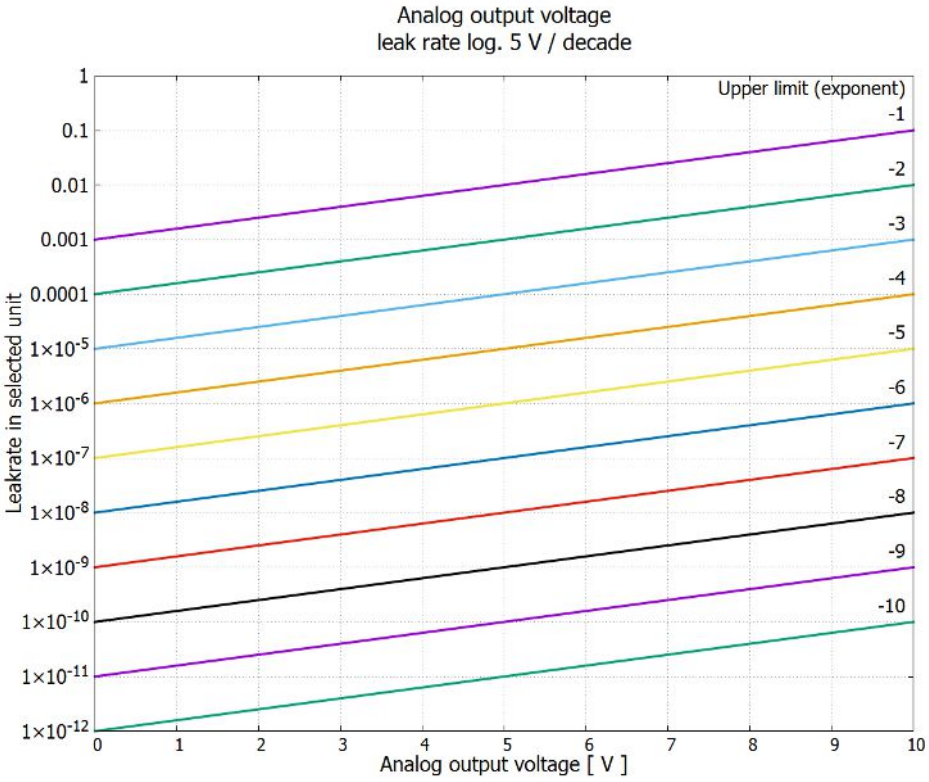


Fig. 19: Analog output voltage leak rate log. 5 V / decade

Output voltages in case of error

The following voltages will be applied at the analog outputs in the event of an error:

Compatibility mode	Voltage
LDS1000	0V
LDS2010	10V
LDS3000	10.237V

Configuration (LDS2010-compatible)

The following table can be used for the transmission of settings from LDS2010 to LDS3000.

LDS2010 setting. Menu item 22	Analog output channel	Function LDS2010	Function LDS3000	Scaling of the leak rate	Upper limit (10 V = ...)
1	1	Leak rate mantissa in used unit. 1 ... 10V	Leak rate mantissa	irrelevant	irrelevant
1	2	Leak rate exponent (step function) in used unit. . 1 ... 10 V, 0.5 V / Decade, 1 V = 1E-12	Leak rate exponent	irrelevant	irrelevant
2	1	Leak rate log. in used unit. 1 ... 10 V, 0.5 V / Decade, 1 V = 1E-12	Leak rate log.	0.5V/dec.	1E6 [used unit]
2	2	Pressure p1 log. in used unit. 1 ... 10 V, 0.5 V / Decade, 1 V = 1E-3 mbar	Pressure p1	irrelevant	irrelevant
3	1	Leak rate mantissa in mbar·l/s 1 ... 10V	Leak rate mantissa	irrelevant	irrelevant
3	2	Leak rate exponent (step function) in mbar·l/s 1 ... 10 V, -1 V / Decade, 0 V = 1E0 mbar l/s	LR exponent inverted	irrelevant	irrelevant
4	1	Leak rate log. 0 ... 10 V, 1 V / Decade, 0 V = 1E-10 mbar l/s	Leak rate log.	1V/dec.	1.00E+00
4	2	Pressure p1 log. in mbar 1 V / decade, 2.5 ... 8.5 V, 2.5 V = 1E-3 mbar, 5.5 V = 1E0 mbar	p1 1V/dec.	irrelevant	irrelevant
5	1	Leak rate mantissa in used unit. 1 ... 10 V rise, 0.7 ... 10 V fall	LR mantissa hyst.	irrelevant	irrelevant
5	2	Leak rate exponent in used unit. 1 ... 10 V, 0.5 V / Decade, 0 V = 1E-14	Leak rate exponent	irrelevant	irrelevant

LDS2010 setting. Menu item 22	Analog output channel	Function LDS2010	Function LDS3000	Scaling of the leak rate	Upper limit (10 V = ...)
6	1	Leak rate log. in Pa·m³/s 0 ... 10 V, 1 V/Decade, 0 V = 1E-12 Pa·m³/s = 1E-12 mbar l/s	Leak rate log.	1V/dec.	1E-2 mbar l/s
6	2	Pressure p1 log. in Pa 1 V / decade, 2.5 ... 8.5 V, 2.5 V = 1E-3 mbar	p1 1V/dec.	irrelevant	irrelevant
8	1	Leak rate log. in Pa·m³/s 0 ... 10 V, 1 V/Decade, 0 V = 1E-12 Pa·m3/s = 1E-12 mbar l/s	Leak rate log.	1V/dec.	1E-2 mbar l/s
8	2	Pressure p2 log. in Pa 1 V / decade, 2.5 ... 8.5 V, 2.5 V = 1E-3 mbar	p2 1V/dec.	irrelevant	irrelevant
9	1	Pressure p1 log. in Pa 1 V / decade, 2.5 ... 8.5 V, 2.5 V = 1E-3 mbar	p1 1V/dec.	irrelevant	irrelevant
9	2	Pressure p2 log. in Pa 1 V / decade, 2.5 ... 8.5 V, 2.5 V = 1E-3 mbar	p2 1V/dec.	irrelevant	irrelevant
10	1	Leak rate log. in mbar l/s 0 ... 8 V, 2 V / Decade, 0 V = 1E-3 mbar l/s	Leak rate log.	2V/dec.	1E+2 mbar l/s
10	2	Leak rate log. in mbar l/s 0 ... 10 V, 3 V / Decade, 0 V = 1E-3 mbar l/s	Leak rate log.	Special 1	1E+1 mbar l/s
11	1	Leak rate log. in mbar l/s 0 ... 8 V, 2 V / Decade, 0 V = 1E-4 mbar l/s	Leak rate log.	2V/dec.	1E+1 mbar l/s
11	2	Leak rate log. in mbar l/s 0 ... 10 V, 3 V / Decade, 0 V = 1E-4 mbar l/s	Leak rate log.	Special 1	1E+0 mbar l/s
12	1	Leak rate log. in mbar l/s 0 ... 8 V, 2 V / Decade, 0 V = 1E-5 mbar l/s	Leak rate log.	2V/dec.	1E0 mbar l/s
12	2	Leak rate log. in mbar l/s 0 ... 10 V, 3 V / Decade, 0 V = 1E-5 mbar l/s	Leak rate log.	Special 1	1E-1 mbar l/s
13	1	Leak rate log. in mbar l/s 0 ... 8 V, 2 V / Decade, 0 V = 1E-6 mbar l/s	Leak rate log.	2V/dec.	1E-1 mbar l/s

LDS2010 setting. Menu item 22	Analog output channel	Function LDS2010	Function LDS3000	Scaling of the leak rate	Upper limit (10 V = ...)
13	2	Leak rate log. in mbar l/s 0 ... 10 V, 3 V / Decade, 0 V = 1E-6 mbar l/s	Leak rate log.	Special 1	1E-2 mbar l/s
14	1	Leak rate log. in mbar l/s 0 ... 8 V, 2 V / Decade, 0 V = 1E-7 mbar l/s	Leak rate log.	2V/dec.	1E-2 mbar l/s
14	2	Leak rate log. in mbar l/s 0 ... 10 V, 3 V / Decade, 0 V = 1E-7 mbar l/s	Leak rate log.	Special 1	1E-3 mbar l/s
15	1	Leak rate log. in mbar l/s 0 ... 8 V, 2 V / Decade, 0 V = 1E-8 mbar l/s	Leak rate log.	2V/dec.	1E-3 mbar l/s
15	2	Leak rate log. in mbar l/s 0 ... 10 V, 3 V / Decade, 0 V = 1E-8 mbar l/s	Leak rate log.	Special 1	1E-4 mbar l/s
16	1	Leak rate log. in mbar l/s 0 ... 8 V, 2 V / Decade, 0 V = 1E-9 mbar l/s	Leak rate log.	2V/dec.	1E-4 mbar l/s
16	2	Leak rate log. in mbar l/s 0 ... 10 V, 3 V / Decade, 0 V = 1E-9 mbar l/s	Leak rate log.	Special 1	1E-5 mbar l/s
17	1	Leak rate log. in mbar l/s 0 ... 8 V, 2 V / Decade, 0 V = 1E-10 mbar l/s	Leak rate log.	2V/dec.	1E-5 mbar l/s
17	2	Leak rate log. in mbar l/s 0 ... 10 V, 3 V / Decade, 0 V = 1E-10 mbar l/s	Leak rate log.	Special 1	1E-6 mbar l/s
18	1	Leak rate log. in mbar l/s 0 ... 8 V, 2 V / Decade, 0 V = 1E-11 mbar l/s	Leak rate log.	2V/dec.	1E-6 mbar l/s
18	2	Leak rate log. in mbar l/s 0 ... 10 V, 3 V / Decade, 0 V = 1E-11 mbar l/s	Leak rate log.	Special 1	1E-7 mbar l/s
20	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1 mbar l/s	Linear leak rate	irrelevant	1E1 mbar l/s
20	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-3 mbar l/s	Leak rate log.	1V/dec.	1E7 mbar l/s

LDS2010 setting. Menu item 22	Analog output channel	Function LDS2010	Function LDS3000	Scaling of the leak rate	Upper limit (10 V = ...)
21	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1E-1 mbar l/s	Linear leak rate	irrelevant	1E0 mbar l/s
21	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-4 mbar l/s	Leak rate log.	1V/dec.	1E6 mbar l/s
22	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1E-2 mbar l/s	Linear leak rate	irrelevant	1E-1 mbar l/s
22	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-5 mbar l/s	Leak rate log.	1V/dec.	1E5 mbar l/s
23	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1E-3 mbar l/s	Linear leak rate	irrelevant	1E-2 mbar l/s
23	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-6 mbar l/s	Leak rate log.	1V/dec.	1E4 mbar l/s
24	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1E-4 mbar l/s	Linear leak rate	irrelevant	1E-3 mbar l/s
24	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-7 mbar l/s	Leak rate log.	1V/dec.	1E3 mbar l/s
25	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1E-5 mbar l/s	Linear leak rate	irrelevant	1E-4 mbar l/s
25	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-8 mbar l/s	Leak rate log.	1V/dec.	1E2 mbar l/s
26	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1E-6 mbar l/s	Linear leak rate	irrelevant	1E-5 mbar l/s
26	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-9 mbar l/s	Leak rate log.	1V/dec.	1E1 mbar l/s
27	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1E-7 mbar l/s	Linear leak rate	irrelevant	1E-6 mbar l/s
27	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-10 mbar l/s	Leak rate log.	1V/dec.	1E0 mbar l/s
28	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1E-8 mbar l/s	Linear leak rate	irrelevant	1E-7 mbar l/s

LDS2010 setting. Menu item 22	Analog output channel	Function LDS2010	Function LDS3000	Scaling of the leak rate	Upper limit (10 V = ...)
28	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-11 mbar l/s	Leak rate log.	1V/dec.	1E-1 mbar l/s
29	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1E-9 mbar l/s	Linear leak rate	irrelevant	1E-8 mbar l/s
29	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-11 mbar l/s	Leak rate log.	1V/dec.	1E-1 mbar l/s
30	1	Leak rate lin. In mbar l/s 0 ... 10 V, 1 V = 1E-10 mbar l/s	Linear leak rate	irrelevant	1E-9 mbar l/s
30	2	Leak rate log. in mbar l/s 0 ... 4 V, 1 V / Decade, 0 V = 1E-11 mbar l/s	Leak rate log.	1V/dec.	1E-1 mbar l/s

Analog input readout

– No function can be configured for the analog input.

– It is reserved for future applications.

– LD command 220 can be used to read out the voltage value on the analog input.

9.2.2.1 Assigning the digital inputs of the I/O module

The digital inputs PLC-IN 1 ... The available functions can be assigned in any way necessary to the 10 I/O module.

– Active signal: typically 24V

– Inactive signal: typically 0 V.

The 24V output of the I/O module can be used as an active signal.

Every function can be inverted.

Possible functions: see the following table

Control unit	Settings > Set up > Interfaces > I/O module > Digital inputs > Configuration PLC Input
LD protocol	Command 438
ASCII protocol	*CONFig:PLCINLINK:1 (2 ... 10)

Key-operated switch

An external key switch with up to three switching outputs can be connected via three PLC inputs. The key switch can be used to select the access level of the operator of the control unit.

Button 1 - Operator

Button 2 - Supervisor

Button 3 - Integrator

Example for a suitable key switch: Hopt+Schuler, No. 444-05

Functions, assignment of digital inputs:

Function	Flank/ state:	Description
No function	–	No function
CAL dynam.	inactive→ active: active→ inactive:	Start external dynamic calibration. Apply value for background and finish calibration.
CAL external	inactive→ active: active→ inactive:	Start external calibration. Apply value for background and finish calibration.
Internal CAL	inactive→ active:	Start internal calibration.
SNIF/VAC	inactive→ active: active→ inactive:	Enable sniffer mode. Enable vacuum mode.
START	inactive→ active:	Switch to Meas. (ZERO is possible, all trigger outputs switch depending on the leak rate.)
Stop	inactive→ active:	Switch to Standby. (ZERO is not possible, all trigger outputs will return "Leak rate threshold value exceeded".)
ZERO	inactive→ active: active→ inactive:	Switch ZERO on. Switch ZERO off.
ZERO pulse	inactive→ active:	Switching ZERO on or off.
Delete	inactive→ active:	Erase warning or error message / cancel calibration.
Gas ballast	inactive→ active: active→ inactive:	Open gas ballast valve. Close gas ballast valve unless always open.
Selection dyn/ norm	inactive→ active: active→ inactive:	External calibration mode with activation of digital input "CAL": External dynamic calibration (without auto tune, allowing for the measuring times and pump cycle times set via the digital inputs) External normal calibration (with auto tune, not considering the system-specific measuring times and pump cycle times)
Start / Stop	inactive→ active: active→ inactive:	Switch to Meas. (ZERO is possible, all trigger outputs switch depending on the leak rate.) Switch to Standby. (ZERO is not possible, all trigger outputs will return "Fail".)
Key 1	active:	User "Operator"
Key 2	active:	User "Supervisor"
Key 3	active:	User "Integrator"
CAL	inactive→ active:	When set to Standby, the device will start an internal calibration. When set to Meas, the device will start an external calibration.

Function	Flank/ state:	Description
ZERO update	inactive→ active:	Update or switch on ZERO
	active→ inactive:	No function
Calibration leak open	inactive→ active:	Open internal test leak
	active→ inactive:	Close internal test leak
calibration leak on pulse	inactive→ active:	Open internal test leak if closed or close if open
Flow	inactive→ active:	Switch flow of SL3000XL to 3000 sccm (XL adapter)
	active→ inactive:	Switch flow of SL3000XL to 300 sccm (XL adapter)
CAL machine	inactive→ active:	Determining the machine factor or of the sniff factor
Internal CAL check	inactive→ active:	Check calibration with internal calibration leak
External CAL check	inactive→ active:	Check calibration with external calibration leak
Start / Stop impulse	inactive→ active:	Switching between measuring operation and standby
Mass 2 / Mass 4	inactive→ active:	Activate mass 4
	active→ inactive:	Activate mass 2
Peakfind	inactive→ active:	Start peak determination (AQ only)

9.2.2.2 Assigning the digital outputs of the I/O module

The digital outputs PLC-OUT 1 ... The available functions can be assigned in any way necessary to the 8 I/O module. Every function can be inverted.
Possible functions: see the following table

Control unit	Settings > Set up > Interfaces > I/O module > Digital outputs > Configuration PLC Output
LD protocol	Command 263
ASCII protocol	*CONFig:PLCOUTLINK:1 (2 ... 8)

Functions, assignment of digital outputs:

Function	State:	Description
Open	open:	always open
Trigger 1	closed:	Value exceeded leak rate threshold Trigger 1
	open:	Value fell below leak rate threshold Trigger 1

Function	State:	Description
Trigger 2	closed:	Value exceeded leak rate threshold Trigger 2
	open:	Value fell below leak rate threshold Trigger 2
Trigger 3	closed:	Value exceeded leak rate threshold Trigger 3
	open:	Value fell below leak rate threshold Trigger 3
Trigger 4	closed:	Value exceeded leak rate threshold Trigger 4
	open:	Value fell below leak rate threshold Trigger 4
Ready	closed:	Emission switched on, calibration process inactive, no error
	open:	Emission switched off or calibration process active or error
Warning	closed:	Warning
	open:	no warning
Error	closed:	Error
	open:	no error
CAL active	closed:	Device is to be calibrated.
	open:	Device is not to be calibrated.
CAL request	closed:	and no external calibration: Calibration request (with temperature change from 5°C or 30 minutes after the start-up or if default rotation speed was changed)
	closed:	and external calibration or "CAL check": Request "Open or close external calibrated leak"
	open:	no request
Run-up	closed:	Run-up
	open:	no run-up
ZERO active	closed:	ZERO switched on
	open:	ZERO switched off
Emission on	closed:	Emission switched on
	open:	Emission switched off
Measure	closed:	Measuring (ZERO is possible, all trigger outputs switch depending on the leak rate.)
	open:	Standby or emission disabled (ZERO is not possible, all trigger outputs will return "Leak rate threshold value exceeded".)
Standby	closed:	Standby (ZERO is not possible, all trigger outputs will return “Leak rate threshold value exceeded”.)
	open:	Measuring (ZERO is possible, all trigger outputs switch depending on the leak rate.)

Function	State:	Description
SNIF	closed:	SNIF
	open:	VAC
Error or warning	closed:	Error or warning
	open:	No error or warning
Gas ballast	closed:	Gas ballast is active
	open:	Gas ballast is inactive
Calibration leak open	closed:	calibration leak is active
	open:	calibration leak is inactive
CAL stable	closed:	“Open or close external calibration leak" prompt (see "External Calibration Configuration and Start [▶ 55]“)
	open:	Assignment not stable or calibration is inactive
Cathode 2	closed:	Cathode 2 is active
	open:	Cathode 1 is active
ZERO stable	closed:	EcoBoost message stable
	open:	EcoBoost message not stable
		See also "Suppressing decreasing gas backgrounds with EcoBoost [▶ 66]".

9.3 Settings for bus module BM1000

Address of bus module

Setting the bus module address. (Node address with Profibus, MACID with DeviceNet)	
0 ... 255	
Control unit	Settings > Set up > Interfaces > Bus module > Address
LD protocol	326
ASCII protocol	–

10 Warning and error messages (LDS3000, LDS3000 AQ)

The device is equipped with extensive self-diagnostic functions.

Error messages

Errors are events that the device cannot correct itself and that force interruption of its operation. The error message consists of a number and a descriptive text.

After you have removed the cause of the error, start operation again with the restart button.

Warnings

Warnings warn of device states that can impair the accuracy of measurements. Operation of the device is not interrupted.

Confirm acknowledgment of the warning with the OK key or the right key on the sniffer handle.

The following table displays all the warnings and error messages. It lists possible causes for the malfunction and instructions on how to eliminate these.

Please note that work marked with an asterisk must be carried out only by service staff that is authorized by INFICON.

Warning (Wrn) Error (Err)	Error message LDS3000	Error number		Limit values	Cause
		LDS1000 Protocol	Binary or ASCII protocol compatibility mode LDS1000/ LDS2010		
1xx system error (RAM, ROM, EEPROM, clock, ...)					
Wrn102	Timeout EEPROM MSB Box (Parameter number)	84	43		EEPROM on IF board or MSB defective
Wrn104	An EEPROM parameter is initializing	84	43		Following software update or EEPROM defective
Wrn106	EEPROM parameter initializing	84	43		Following software update or EEPROM defective
Wrn110	Clock not set	16	16		Jumper for clock not set, battery drained, clock defective
Wrn122	No response from the BUS module	99	99		Connection to BUS module interrupted

Warning (Wrn) Error (Err)	Error message LDS3000	Error number		Limit values	Cause
		LDS1000 Protocol	Binary or ASCII protocol compatibility mode LDS1000/ LDS2010		
Wrn123	Unsupported configuration INFICON from BM1000	99	99		The selected configuration is not supported by the connected INFICON BM1000-fieldbus type.
Wrn125	I/O module not connected	99	99		Connection to I/O module interrupted
Wrn127	Wrong bootloader version	99	99		Boot loader not compatible with application
Err129	Incorrect device (EEPROM)	99	99		EEPROM does not contain any compatible data
Err130	Sniffer not connected	99	99		The sniffer line is not electrical connected. See also "Setting capillary surveillance [▶ 71]".
Wrn132	SL3000 not supported	99	99		Only the SL3000XL may be used with the XL Sniffer Adapter
Wrn150	Pressure sensor 2 is not connected	62	146		Pressure sensor P2 not connected or defective. IF-Board or MSB defective.
Wrn153	The version of the CU1000 software is outdated	99	99		Update of CU1000 software recommended
Wrn156	Wrong ID AQ mode	99	99		Wrong ID AQ mode
2xx operating voltage error					
Wrn201	U24_MSB too low	24	120	21.6V	24V power supply pack
Wrn202	U24_MSB too high	24	120	26.4V	24V power supply pack
Wrn203	24V_PWR12 voltage out of range (TL_valve/ GB_valve)	24	120	20V 30V	Short circuit at valve 1 (calibrated leak) or valve 2 (gas ballast)
Wrn204	24V_PWR34 voltage out of range (valve 3/4)	24	120	20V 30V	Short circuit at valve 3 or valve 4
Wrn205	24V_PWR56 voltage out of range (Sniff_valve/valve6)	24	120	20V 30V	Short circuit at valve 5 (sniff) or valve 6

Warning (Wrn) Error (Err)	Error message LDS3000	Error number		Limit values	Cause
		LDS1000 Protocol	Binary or ASCII protocol compatibility mode LDS1000/ LDS2010		
Wrn221	Internal voltage 24V_RC voltage out of range	24	120	20V 30V	Short circuit 24V at the control unit output
Wrn222	Internal voltage 24V_IO voltage out of range	24	120	20V 30V	Short circuit 24V at IO output
Wrn223	Internal voltage 24V_TMP voltage out of range	24	120	20V 30V	Short circuit 24V of the TMP
Wrn224	Internal voltage 24V_1 (Pirani) voltage out of range	24	120	20V 30V	Short circuit 24V Pressure sensor PSG500 (1,2,3), sniffer line
Wrn240	Voltage +15V out of range	24	120		+15V too low, IF board or MSB defective
Wrn241	Voltage -15V out of range	24	120		-15V too low, short circuit at preamplifier, IF board or MSB defective
Err242	+15V or -15V voltage shorted	24	120		+15V or -15V too low, short circuit at preamplifier, IF board or MSB defective
Wrn250	REF5V voltage out of range	24	120	4.5V 5.5V	+15V or 5V too low, short circuit at preamplifier, IF board or MSB defective
Err252	REF5V voltage shorted	24	120		+15V or REF5V too low, short circuit at preamplifier, IF board or MSB defective
3xx detection system (offset preamplifier, preamplifier test, emission, cathode test)					
Wrn300	Anode voltage too low	41	132	7V < the setpoint	Short circuit anode voltage, pressure in mass spectrometer too high, IF board, MSB or ion source defective
Wrn301	Anode voltage too high	40	131	7V > the setpoint	MSB defective
Wrn302	Suppressor voltage too low	39	130	297V	Short circuit suppressor, IF board or MSB defective

Warning (Wrn) Error (Err)	Error message LDS3000	Error number		Limit values	Cause
		LDS1000 Protocol	Binary or ASCII protocol compatibility mode LDS1000/ LDS2010		
Wrn303	Suppressor voltage too high	38	129	363V	MSB defective
Wrn304	Anode-cathode voltage too low	36	127	40V	Short circuit anode-cathode, IF board or MSB defective
Wrn305	Anode-cathode voltage too high	35	126	140V	MSB defective
Err306	Anode voltage faulty	36	127	40 V deviation from the default value	The anode voltage does not match the default value or the set value is outside the allowable setting range.
Wrn310	Cathode 1 is defective	45	136		Cathode defective, line to cathode interrupted, IF board or MSB defective
Wrn311	Cathode 2 is defective	46	137		Cathode defective, line to cathode interrupted, IF board or MSB defective
Err312	Cathode defective	47	138		Cathode defective, line to cathode interrupted, IF board or MSB defective
Wrn332	System helium contaminated	62	146		Leak rate too negative (e.g., below - 0.15 * Trigger 1). The reaction time of the warning can be adjusted. See "Adjust ”Zero time factor AQ” [▶ 93]"
Wrn334	Sudden increase in leak rate	62	146		Gross leak
Err340	Emission error	44	135	< 90% of the target value > 110% of the target value	Emission was stable previously, pressure probably too high, message after 15s

Warning (Wrn) Error (Err)	Error message LDS3000	Error number		Limit values	Cause
		LDS1000 Protocol	Binary or ASCII protocol compatibility mode LDS1000/ LDS2010		
Wrn342	Cathodes not connected	47	138		Both cathodes defective during self-testing after switch on or plug not connected
Wrn350	Suppressor not connected	39	130		Supressor cable is not plugged in or defective during the self-test after switching on
Wrn352	Preamplifier not connected	33	60		Preamplifier defective, cable not plugged in
Err358	Preamplifier oscillates between 2 ranges	31	123		Signal varies too much (see command 1120) Preamplifier defective
Wrn359	Overdriven preamplifier	31	123		Signal too large preamplifier defective
Wrn360	Preamplifier output too low	31	123	<-70 mV at 500 GΩ	Poor ion source or contaminated mass spectrometer
Wrn361	Preamplifier offset too high	31	123	>+/-50 mV at 500 GΩ, >+/-10 mV at 15 GΩ, <+/-10 mV at 470 MΩ, <+/-9 mV at 13 MΩ	Preamplifier defective
Wrn362	Preamplifier range error	31	123		Preamplifier or MSB box defective
Wrn390	500 G outside the range	31	123	450 GΩ 550 GΩ	Preamplifier defective, error at the suppressor, IF board or MSB defective
4xx TMP fault (also temperature)					
Err400	TMP fault number	49	15		
Wrn401	TMP warning number	49	15		
Err402	No communication with TMP	49	15		Cable to TMP / TMP defective, IF board or MSB defective

Warning (Wrn) Error (Err)	Error message LDS3000	Error number		Limit values	Cause
		LDS1000 Protocol	Binary or ASCII protocol compatibility mode LDS1000/ LDS2010		
Err403	TMP rotation speed too low	53	142	< 95% of the target value	Pressure too high, TMP defective
Err404	TMP current consumption too high	49	2	3A	
Err405	No TMP run-up	60	61	5 min.	Pressure too high, TMP faulty
Err410	TMP temperature too high	49	2		Cooling failed, check MSB module operating conditions
Wrn411	High TMP temperature	49	2		Cooling failed, check MSB module operating conditions
Err420	TMP voltage too high	49	2		Power supply defective, TMP defective
Wrn421	TMP voltage too low				Cable cross-section 24 V supply for MSB modules too low, output current 24-V power supply too low (I <10 A), power supply defective, TMP defective
Err422	TMP no run-up time	49	2	8 min.	TMP foreline pressure too high, VV pump final pressure too high, leakage high vacuum system, flood valve not close, TMP bearing damage, TMP flawed
Err423	TMP pressure rise	49	2		Inrush of air, flood valve defective or incorrectly dimensioned
5xx Pressure and flow errors					
Wrn500	Pressure sensor not connected	58	144	0.5V	Pressure sensor PSG500 P1 not connected, IF board or MSB defective
Wrn502	XL Sniffer adapter not connected	58	144		XL Sniffer Adapter not connected or defective, IF board or MSB defective.
Wrn520	Pressure too high	73	148	18 mbar	Pressure p1 too high
Wrn521	Pressure rise, anode voltage collapse	73	148	< Setpoint - 20V	Pressure p1 too high, message after 1.4s

Warning (Wrn) Error (Err)	Error message LDS3000	Error number		Limit values	Cause
		LDS1000 Protocol	Binary or ASCII protocol compatibility mode LDS1000/ LDS2010		
Wrn522	Pressure rise, emission collapsed	73	148	< 90% of the target value > 110% of the target value	Emission was stable previously, pressure p1 too high, message after 5s
Wrn540	Pressure too low, Sniffer blocked	63	62	Sniffer flow warning parameter	Sniffer clogged, sniffer valve defective,filter clogged
Err541	Sniffer blocked (p1)	62	146		Sniffer blocked, sniffer valve defective (pressure lower than half of the configured warning value), filter clogged
Wrn542	Sniffer broken	64	147		Sniffer broken
Wrn550	Pressure too low, XL Sniffer blocked	63	62		Clean or replace the high flow capillary of the sniffer line. Replace dirty filter.
Wrn552	XL Sniffer broken	64	147		Replace the high flow capillary of the sniffer line.
Wrn554	XL Sniffer P2 too small	63	62		Pressure on SL3000XL too low in low flow.
Wrn556	Throttle added	63	62		Pressure too low (p1)
Err557	Throttle blocked	62	146		Pressure too low (p1)
6xx Calibration errors					
Wrn600	Calibration factor too low	81	153	0.01	Calibration leak or machine factor set incorrectly
Wrn601	Calibration factor too high	81	153	10000	Calibrated leak or machine factor set incorrectly, partial flow factor too high
Wrn602	KalFaktor lower than last calibration	81	153	< 50% of the old value	Calibrated leak, machine factor or partial flow factor has changed

Warning (Wrn) Error (Err)	Error message LDS3000	Error number		Limit values	Cause
		LDS1000 Protocol	Binary or ASCII protocol compatibility mode LDS1000/ LDS2010		
Wrn603	KalFaktor higher than last calibration	81	153	> 200% of the old value	Calibrated leak, machine factor or partial flow factor has changed
Wrn604	Int. Cal. not possible, lack of calibration leak control	81	153		calibration leak is not enabled
Wrn605	Difference during calibration too small	78	151		Calibration leak defective or signal too weak.
Wrn610	Machine factor too low	81	153	1.00E-04	Machine factor adjustment inaccurate
Wrn611	Machine factor too high	81	153	1.00E+04	Machine factor adjustment inaccurate, partial flow factor too high
Wrn612	Machine factor lower than last time	81	153	< 50% of the old value	Partial flow factor has changed
Wrn613	Machine factor greater than last time	81	153	> 200% of the old value	Partial flow factor has changed
Wrn625	Int. calibration leak not set	99	99		Leak rate of int. calibration leak is still set to factory setting
Wrn626	Ext. Calibration leak not set	99	99		Leak rate of calibration leak is still set to factory setting
Wrn630	Calibration request	99	99		Among other things when changing the speed specification or preamplifier temperature by 5°C since the last calibration

Warning (Wrn) Error (Err)	Error message LDS3000	Error number		Limit values	Cause
		LDS1000 Protocol	Binary or ASCII protocol compatibility mode LDS1000/ LDS2010		
Wrn650	Calibration is not recommended in the first 20 minutes	0	0		A calibration during the first 20 minutes after starting (warm-up phase) the leak detector is not recommended. The warning message can be turned off: - LD protocol: Bef 429 – ASCII: *CONFig:CALWarn (ON,OFF)
Wrn670	Calibration error	81	153		Since a problem has occurred during the calibration, you have to recalibrate.
Wrn671	Peak not found	81	153		The signal was too restless during the peak search. Calibration has been aborted.
Wrn680	Deviation to the calibration detected	0	0		The verification of calibration has shown that you should recalibrate.
7xx temperature errors (preamplifier, electronics)					
Wrn700	Preamplifier temp. too low	33	60	2°C	Temperature too low
Wrn702	Preamplifier temp. too high	32	124	60°C	Temperature too high
Err709	MSB Temperature too low	55	99	-21°C	Temperature too low or temperature sensor defective
Wrn710	MSB temperature too high	54	44	55°C	Temperature too high
Err711	Max. MSB temperature exceeded	54	44	65°C	Temperature too high
8xx not used					
9xx maintenance messages (e.g. TMP)					
Wrn901	TMP maintenance	99	99	4 years	TMP maintenance necessary
Wrn910	Maintenance diaphragm pump	99	99		8000 hour maintenance of diaphragm pump required

10.1 Illustration of error codes with the help of the status LEDs

Any errors or warnings occurring in the MSB box will be indicated both as an error code by the control unit and as a blink code by the Status LED.

The blink code is preceded by a long white signal. This is followed by an error or warning number. An error number is indicated by means of red signals, while a warning number is displayed using orange signals (the orange signals have a strong green tinge, however):

-> Blink code start: long white signal

- Hundreds digit: 0 ... 9 red signals for error or 0 ... 9 orange signals for warnings
- Break: blue signal
- Tens digit: 0 ... 9 red signals for error or 0 ... 9 orange signals for warnings
- Break: blue signal
- Units digit: 0 ... 9 red signals for error or 0 ... 9 orange signals for warnings

The blink code is repeated cyclically.

For example: The pressure is too high.
-> Error code = Warning 520
-> Blink code of the status LED: White (long), 5·orange, blue, 2·orange, blue

10.2 Display warnings as errors

Up to 8 arbitrary warning messages can be upgraded to error messages.

Unlike warnings, errors lead to an interruption in the operation of the device. Thus, by upgrading warnings to errors, you can prevent an operator from ignoring these warnings and continuing to work with the device.

Upgrading selected warnings to errors

✓ You have the INFICON control unit CU1000.

1 "Settings > Setup > Notifications > Warning -> Error"

2 Make your settings in the "Display warning as error" window.

⇨ Select the desired "List entry no." from the numbers 1 - 8.

⇨ From the number list of warnings below, select the number that should become an error message. If the numbers are held down longer for selection, the number is incremented in steps of ten.

⇨ To change a warning that has been upgraded to an error, enter the desired new warning number under the same "List entry no.".

⇨ For your overview, the text of the warning in question is displayed in the lower part of the window.

3 Confirm with “OK.”

⇨ Alternatively, exit the window without saving by pressing the "X" button.

Undoing the upgrading of warnings to errors

1 "Settings > Setup > Notifications > Warning -> Error"

2 Make your settings in the "Display warning as error" window.

⇨ Select the used "List entry no." with the assigned warning number from the digits 1 - 8.

⇨ Set a value below 100 in the displayed number overview of warnings. This will cause "No entry" to be displayed.

3 Confirm with “OK.”

11 Operating CU1000 (optional)

11.1 Touchscreen elements

11.1.1 Measurement display elements

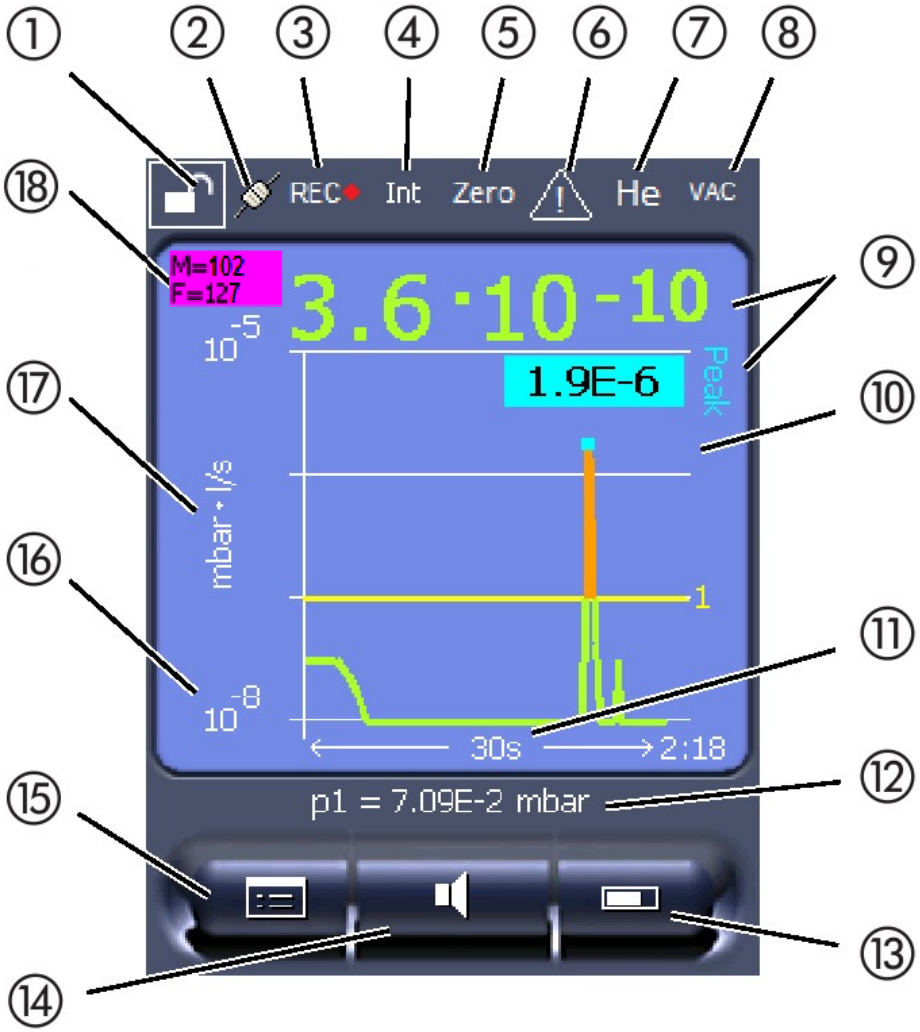


Fig. 20: Measurement display

1	Keyboard lock	2	Communication status	3	Data recording
4	Operator	5	ZERO	6	Message
7	Tracer gas	8	Operation mode	9	Leak rate with peak hold function
10	Graphic representation of the leak rate and the peak hold function	11	Time axis	12	Foreline pressure
13	Button "Favorite 2"	14	Button "Favorite 1"	15	Menu
16	Value axis	17	Measurement unit	18	Display equivalence leak rate

1 - Keyboard lock

The control unit is locked or unlocked by pressing and holding the icon for the keyboard lock.

2 - Icon for the communication status

- Icon connected: The device communicates with the mass spectrometer module.
- Icon disconnected: The device does not communicate with the mass spectrometer module.

Establish communication:

1. Reset control unit.
2. Checking the status of the mass spectrometer module.
3. Check cable connection.

3 - Icon for the data recording

The measurement is recorded.

4 - Ser

The registered operator is shown abbreviated.

Display	Meaning
Ope	Operator
Sup	Supervisor
Int	Integrator
Ser	SERVICE

For more information, see “Operator types and authorizations [▶ 129]“.

5 - Zero

Background suppression is active.

6 - Caution icon

Active warnings are stored in the unit.

The active warnings can be displayed via the menu "Info > History > Active warnings".

7 - Tracer gas

Set tracer gas and tracer gas concentration percentage.

Display	Meaning
He	Helium (^{4}He)
H2	Hydrogen
M3	E.g. H-D, ^{3}He or H_3

8 - Operation mode

Configured operation mode

Display	Operation mode
VAC	Vacuum
SNIF	Sniffing
LOW FLOW	XL sniffer adapter in LOW FLOW
HIGH FLOW	XL sniffer adapter in HIGH FLOW
Standby	XL sniffer adapter in HIGH FLOW on standby

9 - Leak rate

Current measurement for the leak rate.

10 - Graph

Graphic display of the leak rate Q(t).

11 - Time axis

Time axis of the leak rate Q(t).

12 - Primary vacuum pressure (not with operation mode XL Sniffer Adapter)

Backing pressure p1.

13 - Button "Favorite 2"

You can assign preferred parameters to this button, see “Touch screen settings [▷ 125]“. In the figure in “Measurement display elements [▷ 122]“, the "Favorite 2” button is assigned to the "Measurement view" function as an example.

14 - Button "Favorite 1"

You can assign preferred parameters to this button, see “Touch screen settings [▷ 125]“. In the figure in “Measurement display elements [▷ 122]“, the "Favorite 1” button is assigned the "Volume" function as an example.

15 - Icon for the menu

All functions and parameters of the control unit can be accessed using the "Menu" key .

A full display of the menu of the menu is included as a file on the USB flash drive supplied with the LDS3000.

16 - Value axis

Value axis of the leak rate Q(t).

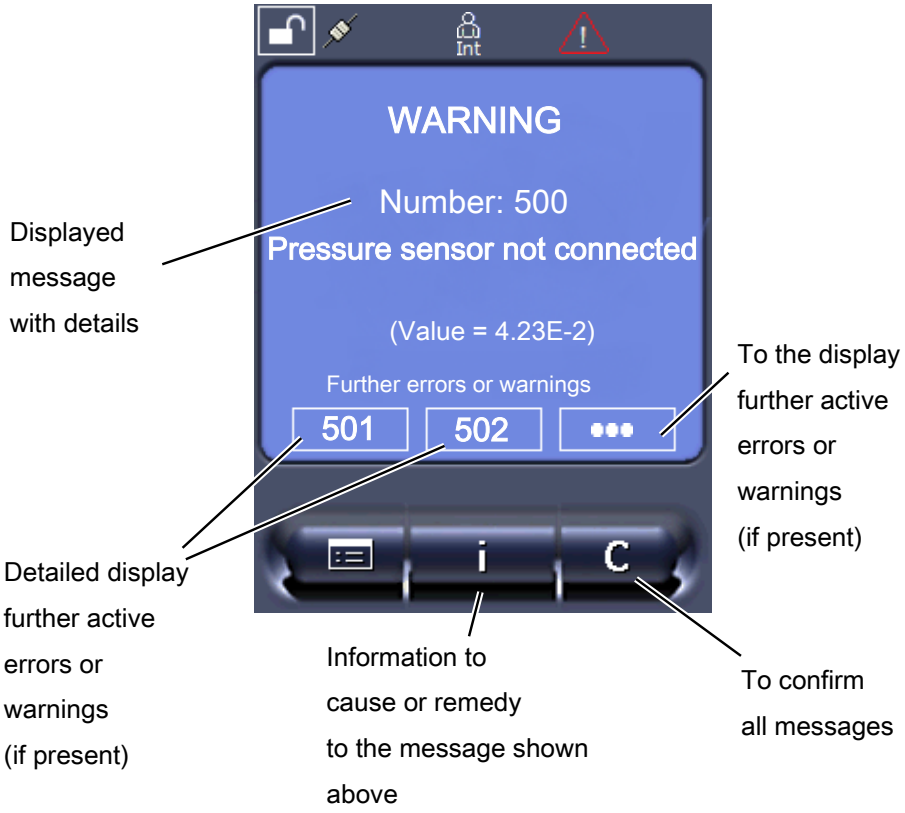
17 - Device of measurement

Device of measurement of the value axis.

18 - Display equivalence leak rate

Correction factor for the test gas used.

11.2 Elements of the error and warning display



You will find an overview of possible errors and warnings in the operating instructions of the LDS3000 (mass spectrometer module), chapter "Warning and error messages".

11.3 Settings and functions

Settings and functions of the control unit are explained in the following. You will find the settings and functions of the mass spectrometer module LDS3000 you can set using the control unit in the operating instructions of the mass spectrometer module.

11.3.1 Touch screen settings

The touch screen grays out the parameters if

- the user is not authorized to change the values, see also “Operator types and authorizations [▶ 129]“.
- an older version of the software run by mass spectrometer module LDS3000 does not support this parameter.

Scaling of the Q(t)axis

Linear or logarithmic	
Lin. Log.	
Control unit	Display > Q(t) axis > Linear or logarithmic

Number of decades with logarithmic view	
1 2 3 4	
Control unit	Display > Q(t) axis > Decades

Autoscale	
Disabled: You can change the display by pressing on the intersection of the coordinate axes and then swiping your finger along the desired axis and releasing it, or if you press on the end of the desired coordinate axis and swipe along in the direction of the intersection of the axes and release. On: The display is automatically adjusted depending on the leak rate.	
Control unit	Display > Q(t) axis > Auto scale

Scaling of the time axis

Scaling of the time axis	
15 s 30 s 60 s 120 s	240 s 480 s 960 s
Control unit	Display > Time axis > Time axis scale

Display units

Device of pressure	
mbar Pa	atm Torr
Control unit	Display > Units (display) > Pressure unit

Measured value display

Type of graphic display

	Diagram Bar graph	
	Control unit	Display > Measurement view > Measurement view mode
	Numeric representation of the measurements	
	Off On	
	Control unit	Display > Measurement view > Show value
Display brightness	Display brightness	
	20 ... 100 %	
	Control unit	Display > Brightness > Display brightness
Trigger display on the touch screen	Selection of the trigger (leak rate threshold) displayed on the touch screen.	
	1 2 3 4	
	Control unit	Settings > Trigger > Trigger sel.
Assigning favorite buttons	The favorite buttons offer direct access to individual functions. They can be assigned with access control "Supervisor" or higher by the user. Favorite 1: Middle button (see the figure in “Measurement display elements [122]“). Favorite 2: Right button Favorite 3: Button on the bottom right of the main menu.	
	Volume Display settings Start/Stop Measurement view ZERO (at AQ instead of ZERO: ZERO AQ, at EcoBoost instead of ZERO: EcoBoost) CAL	Flow switching Check CAL At AQ additionally: AQ Wizard Gas equivalent - - - (= without function)
	Control unit	Settings > Favorites > Favorite 1 (2, 3)
Displaying warnings on the touchscreen	The display of warnings on the touchscreen can be allowed or suppressed.	

	Off On
Control unit	Settings > Set up > Control unit > Messages > Show warnings

Show calibration note

Suppress or allow the calibration note with the following content: • Leak rate of the applied calibration leak • No calibration should take place during the first 20 mins	
OFF (suppressed) ON (allowed)	
Control unit	Settings > Set up > Control unit > Messages > Show calibration notes

Show calibration request

The display of the calibration request can be permitted or suppressed. To activate or deactivate the calibration request as such, see "Activating the calibration request".	
OFF (suppressed) ON (allowed)	
Control unit	Settings > Set up > Control unit > Messages > Show calibration request

Setting the audio alarm

Output of an acoustic signal depending on the leak rate	
--- No sound Proportional: The frequency of the audible signal is proportional to the bar graph display or diagram height. The frequency range is 300Hz to 3300Hz. Setpoint: The pitch is proportional to the leak rate. The signal sounds if the leak rate exceeds the selected trigger value. Pinpoint: The sound of the acoustic signal changes its frequency within a specific range of leak rates. Range: A decade below the selected trigger threshold up to one decade above. The sound keeps at a constant low and a constant high frequency below and above this range, respectively. Trigger: If the selected trigger threshold is exceeded, a two-pitch signal sounds.	
Control unit	Settings > Set up > Control unit > Audio > Audio alarm mode

Behavior with warnings or error messages: If the touch screen shows a warning or an error, then a two-pitch signal sounds simultaneously.

Automatic switch off of the touch screen

The touch screen can be switched off automatically after a specific time without any operation to save energy.

30 s 1 min 2 min 5 min	10 min 30 min 1 h ∞ (=never)
Control unit	Settings > Set up > Control unit > Energy > Display off after

11.3.2 Operator types and authorizations

There are four different operator types that are distinguished by different authorizations. The integrator is registered ex works.

Additional operators can be registered. The following table shows options for individual operator types to register new operator types.

Operator registration

Viewer	Operator	Supervisor	Integrator
-	Operator Viewer	Supervisor Operator Viewer	Integrator Supervisor Operator Viewer

For the types "Integrator", "Supervisor" and "Operator", a four-digit PIN must be assigned during registration (0000 ... 9999). "0000" is assigned to all operators ex works.

If an operator keeps the pin "0000", this operator will always be registered is during the start up of the system (without PIN query).

A key-operated switch can be used in addition to a PIN if an I/O module is connected. The key-operated switch is connected to the I/O module via three digital inputs (see operating instructions of the LDS3000).

The following table shows the authorizations of individual operator types.

Function	Viewer	Operator	Supervisor	Integrator
Changing parameters	-	x	x	x
Changing the display of error information	-	x	x	x
Calling up factory settings	-	-	-	x
Entering maintenance history	-	-	-	x

The menu "Service" is accessible only to INFICON service staff.

Load parameters	The saved/backed-up parameters of control unit CU1000 and of the mass spectrometer module can be loaded from a USB stick.	
	Control unit	Function > Data > Parameters > Load
Save parameters	The parameters of control unit CU1000 and of the mass spectrometer module can be saved to a USB flash drive.	
	Control unit	Function > Data > Parameters > Save
Display error information	The type of error information can be set differently for each operator type. The Integrator always receives the complete information. Number: Message number text: Brief description Info: Expanded message information	
	• Only numbers • Number and text • Number, text and info	
	Control unit	Function > Data > Parameter > Error info Viewer (Operator, Supervisor)
Parameter list display and change	Parameters can be displayed as an alphabetical list with names and current value s. Each list entry is a button which, when pressed, will open the parameter's set-up dialog box.	
	Control unit	List > Parameters list **or:** Functions > Data > Parameters > List
Display list of parameter change authorizations	Parameters can be displayed as an alphabetical list with names and current change authorizations. Each list entry is a button which, when pressed, will change access control. Changes are possible in accordance with the hierarchy of the operator.	
	Control unit	Functions > Data > Parameters > Parameter Access

11.3.2.1 Logging out the operator

The operator activates access level "Viewer" to log out. "Access Ctrl > Viewer"

11.3.3 Reset settings

Mass spectrometer module	The settings of the mass spectrometer module can be reset to factory settings.	
	Control unit	Functions > Data > Parameters > Reset > MSB settings
Access controls	The authorization for changing parameters can be reset to factory setting.	
	Control unit	Functions > Data > Parameters > Reset > Param. Access control

Control unit

The control unit settings can be reset to factory settings.	
Control unit	Functions > Data > Parameters > Reset > Control unit settings

11.3.4 Recording data

The data is saved as a TXT file. Each TXT file contains the following information:

- Date created
- Software version
- Serial number
- Start time
- Time stamp (measurement indicates offset in seconds in relation to start time)
- File name
- Time stamp (offset in seconds in relation to start time)
- Leak rate (expressed in selected unit)
- Pressure p1 (expressed in selected unit)
- Device status

Switching on/off

Switching data recording on/off	
• Off • On	
Control unit	Functions > Data > Recorder > Settings > Data recording

Record interval

Time interval between data recordings	
• 100 ms, 200 ms, 500 ms, 1 s, 2 s, 5 s	
Control unit	Functions > Data > Recorder > Settings > Record interval

Memory location

The data stored in the control unit can be saved to a USB stick. The memory in the control unit is limited to the recording of a 24-hour measurement. Each time after one hour has elapsed, the file is closed and recording continues in the next file.	
• USB flash drive • Control unit	
Control unit	Functions > Data > Recorder > Settings > Storage location

Copy data

Copy data from the internal memory of the control unit to a connected USB stick.	
Control unit	Functions > Data > Recorder > Copy > Copy files

Delete data

Delete data in the internal memory of the control unit

Control unit	Functions > Data > Recorder > Delete > Delete files

11.3.5 Calling up information

Different information and states of the system can be called up with the info menu.

Measurement values	• Preamplifier • Environment • TMP
Temperature	• Electronic • TMP
Energy and operating hours	• Energy values: Information on consumption values • Operation hours: Display for operating hours • Supply voltages: Information on internal supply voltages • Power supply: Information on the supply voltages of the components
History	• Error, error history / warning history • Calibration, calibration history • TMP error, TMP history • Warnings, active warnings • Maintenance, maintenance history
Control unit	• Version control unit: Information on the software version • Memory: Information on available memory • Settings: Control unit settings. • Serial port wired: Information on the communication connection • Data exchange: Information on the data exchange between mass spectrometer module and the control unit
Mass spectrometer module	• MSB (1): Information on the software version • MSB (2): Information on operating parameters • TMP controller (1): Information on the turbo molecular pump • TMP controller (2): Information on the turbo molecular pump, continued • Ion source: Information on the ion source used • Preamplifier: Information on the preamplifier • Preamplifier test: Information on the preamplifier test.
Interfaces	• I/O module (1): Information on the software version, inputs and outputs • I/O module (2): Visualized information to the digital inputs

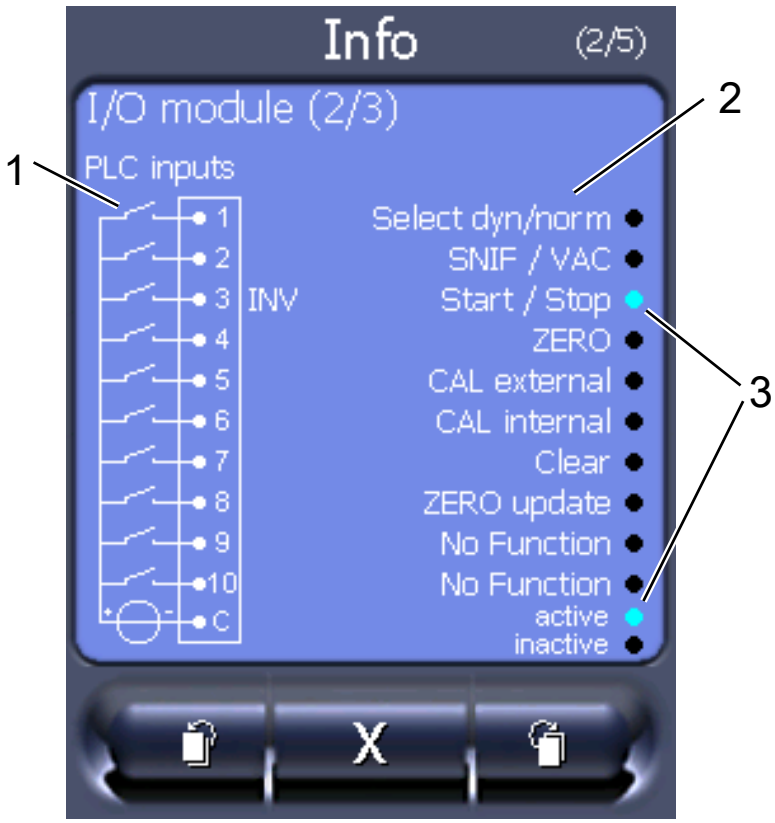


Fig. 21: I/O module (2): Visualized information to the digital inputs

1	Input signal condition	2	Configured function (INV = Function is inverted)
3	Status of the function (active or inactive)		

- I/O module (3): Visualized information to the digital outputs

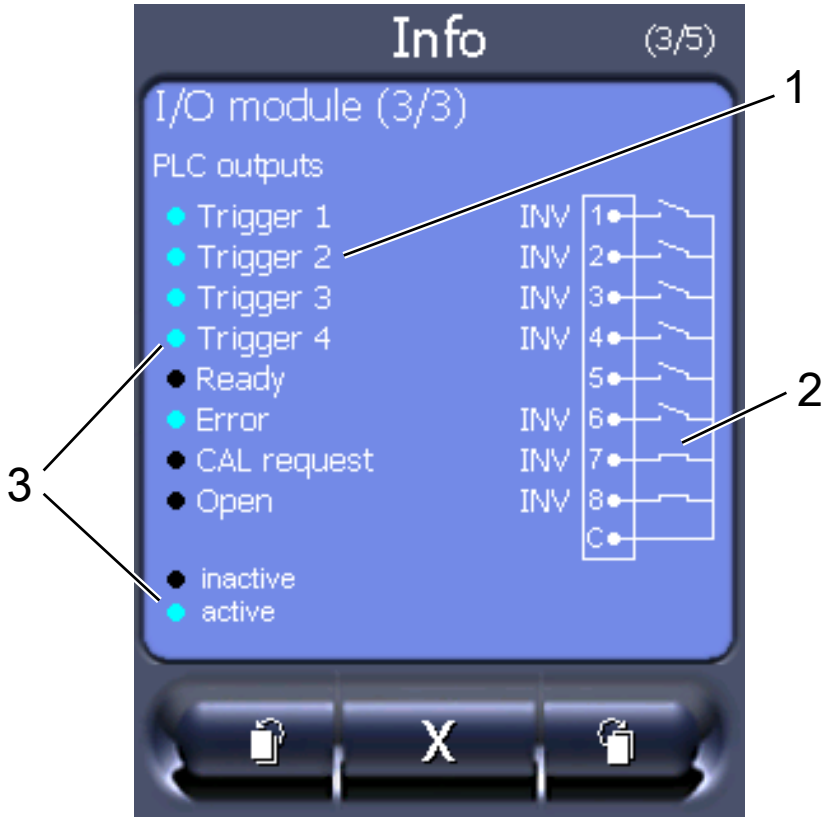


Fig. 22: Visualized information to the digital outputs

1	Configured function (INV = Function is inverted)	2	Output signal condition
3	Status of the function (active or inactive)		

- Bus module (1): Information on the bus module
- Bus module (2): Information on the bus module, continued

11.3.6 Display equivalence leak rate for other gas

Scope

The explanations on the equivalence rate only refer to sniffing operation.

If you measure with the test gases helium or hydrogen, but want to display another gas with its leak rate, use a correction factor for the test gas used.

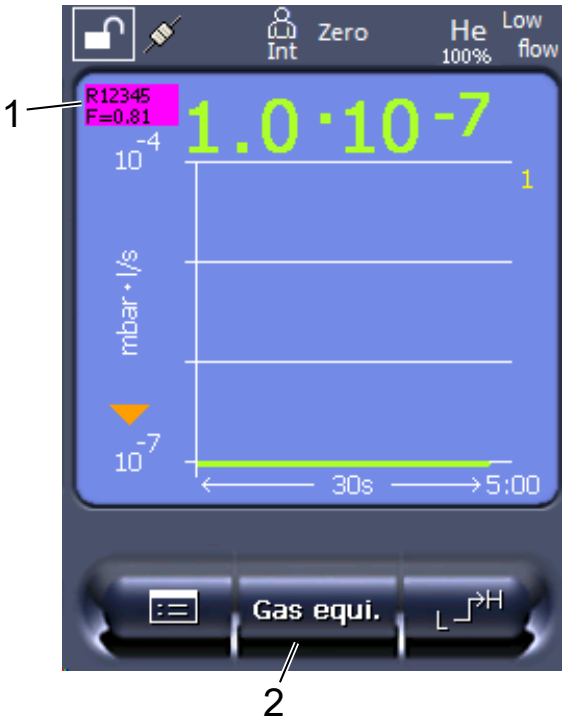


Fig. 23: Measurement screen with displayed equivalence leak rate and configured favorites key

1	Display of gas name and equivalence factor
2	Favorites button for fast configuration of "gas equivalent selection" after set up, see "Touch screen settings [▶ 125]", ”Assigning favorite buttons”.

You have a choice of two methods:

- To conveniently set the correction factor, use the "Gas equivalent selection [▶ 135]". There, the correction factor can be selected from a self-defined list, see "Configure gas list [▶ 136]", or switched back to the tracer gas.
- Alternatively, it is possible to calculate and configure the correction factor. For information on calculation, see "Calculate equivalence factor [▶ 137]". For information on configuring the device, see "Set equivalence factor and molar mass [▶ 138]".

11.3.6.1 Gas equivalent selection

1 Control unit: Settings > Set up > Operation modes > Equivalence leak rate > Gas equi.".

2 In the window "Gas equivalent selection", you can respond to different situations:

⇨ If the desired gas equivalent is already stored (numbers 1 to 4), select the desired gas equivalent number and confirm with "OK". The gas name and the equivalence factor of this gas equivalent are then displayed at the top left in the measuring window. You can perform measurement.

⇨ If the desired gas equivalent is not stored, it must be configured, see "Configure gas list [▶ 136]".

⇨ If you do not find a suitable entry in the 4 gas equivalents and also do not want to change these, you can calculate the correction factor as an alternative. In the window "Gas equivalent selection" select the entry "User-defined" and configure the correction factor, see "Set equivalence factor and molar mass [▶ 138]".

⇨ If you want to switch from the display of the gas equivalent in the measuring window back to the measurement value of the measuring gas, select "Switch off" and confirm with "OK".

The options "Switch off" and "Gas equivalent no. 1...4" overwrite parameters, see "Set equivalence factor and molar mass [▶ 138]".

If you select the option "User-defined", parameters then have to be configured, see "Set equivalence factor and molar mass [▶ 138]".

11.3.6.2 Configure gas list

You can predefine up to 4 equivalence gases and assign names to them. The equivalence gases can then be selected in the gas equivalent selection, see "Gas equivalent selection [▶ 135]".

1 Control unit: Settings > Set up > Operation modes > Equivalence leak rate > Configure gas list

2 Select one of the numbers 1 to 4.

⇨ A set of parameters is displayed for each stored gas. If there is an unused entry, "No Entry" is displayed.

3 Press the button "Edit".

⇨ If you want to detect one of the gases from the stored gas library, press the desired entry. See also "Gas library [▶ 139]".

⇨ If the desired gas is not stored, scroll to the end of the gas library and select "User-defined gas". Then, assign a name of your choice in the window "Equivalence gas name" and confirm your choice. Then enter the molar mass and viscosity factor of the equivalence gas. For all gases that are not available in the gas library, please feel free to contact INFICON.

4 Make your customer-specific entries in the following windows, which are brought up by the assistant, first "Absolute pressure equivalence gas".

⇨ Corresponds to the absolute pressure of the equivalence gas in the test object in bar.

5 Window "Measuring mass".

⇨ This is the mass of the tracer gas (helium, mass 3 or hydrogen)

6 Window "Percentage of measuring gas".

⇨ This is the gas proportion of the tracer gas in percent, e.g. for forming gas (95/5) it would be 5%.

7 Window "Absolute pressure measuring gas".

⇨ Corresponds to the absolute pressure of the tracer gas in the test object in bar.

Example

An air conditioning system is to be checked for leaks. The system is first filled with 2 bar (absolute) pure helium and checked for leaks. Later the plant will be filled with R134a. The operating pressure is 15 bar (absolute).

This results in the following values for the above-specified parameters:
Absolute pressure equivalence gas = 15.0
Measuring mass = 4
Percentage of measuring gas = 100.0
Absolute pressure measuring gas = 2.0

11.3.6.3 Calculate equivalence factor

The equivalence factor is not calculated by the software of the device. Calculate the equivalence factor using the following formula:

$$\text{Eqivalence factor} = \frac{\eta_{test}}{\eta_{equi}} * \frac{(p_{equi})^2 - 1}{(p_{test})^2 - 1}$$

ηTest	Dynamic viscosity of test gas (helium or H_2)
ηequi	Dynamic viscosity of the equivalent gas
ptest	Absolute pressure of the test gas in the test object in bar
pequi	Absolute pressure of the equivalent gas in the test object in bar

Example

An air conditioning system is to be checked for leaks.

The system is first filled with 2 bar (absolute) helium and checked for leaks. Later the plant will be filled with R134a. The operating pressure is 15 bar (absolute).

The dynamic viscosity of helium is 19.62 µPa*s.

The dynamic viscosity of R134a is 11.49 µPa*s.

In order to obtain an R134a equivalent leak rate display during the helium leak detection, the following equivalence factor must be entered:

$$\text{Equivalence factor} = \frac{\eta_{test}}{\eta_{equi}} * \frac{(p_{equi})^2 - 1}{(p_{test})^2 - 1} = \frac{19{,}62}{11{,}49} * \frac{15^2 - 1}{2^2 - 1} \approx 127$$

11.3.6.4 Set equivalence factor and molar mass

✓ The equivalence factor is known. See also "Calculate equivalence factor [▶ 137]".

✓ The test gas used is specified (hydrogen or helium, mass 2, 3 or 4).

✓ The molar mass of the equivalence gas you want to display is known.

1 Control unit: Settings > Set up > Operation modes > Equivalence rate

2 “Gas factor” button

⇨ (LD protocol: Command 469)

3 Select "Mass 2", "Mass 3" or "Mass 4" according to your test gas.

⇨ If the test gas is set to helium, the window "Equivalent Gas Factor He" opens.

4 Set the equivalence gas factor. In the example (see “Calculate equivalence factor [▶ 137]“) for 127:

5 Control unit: Settings > Set up > Operation modes > Equivalence rate

6 “Molar mass" button

⇨ (LD protocol: Command “470”)

7 Select "Mass 2", "Mass 3" or "Mass 4" to match your test gas as described above.

⇨ If the test gas is set to helium, the window "Molar mass equivalent gas He" opens.

8 Set your molar mass. In the example for 102:

⇨ If the equivalence factor is not equal to 1 or the molar mass is not set to factory settings, the equivalence factor is displayed both on the calibration result and on the measurement screen.

Fig. 24: Top left: Display of Molar Mass (102) and Equivalence Factor (127)

11.3.7 Gas library

The operating software of the device contains a list of approx. 100 gases which could be relevant in the refrigeration industry.

The list is stored in the nonvolatile flash memory of the operating unit and can be updated. The user can access this list while pre-defining the equivalence gases, see "Configure gas list [▷ 136]". The user can then select from the pre-defined gases during gas equivalent selection, see "Gas equivalent selection [▷ 135]".

The library of the device has the following factory-defined content:

Gas designation (max. 8 digits)	Other designations	Molecular mass (amu)	Helium viscosity factor	Hydrogen/mass 3 viscosity factor
R11	$CFCl_3$	137.4	0.515	1.15
R12	CF_2Cl_2	120.9	0.591	1.319
R12B1	CF_2ClBr Halon 1211	165.4	0.523	1.167
R13	CF_3Cl	104.5	0.857	1.913
R13B1	CF_3Br Halon 1301	149	0.852	1.902
R14	CF_4	80	0.857	1.913
R21	$CHFCl_2$	102.9	0.535	1.194
R22	CHF_2Cl	86.5	0.632	1.411

Gas designation (max. 8 digits)	Other designations	Molecular mass (amu)	Helium viscosity factor	Hydrogen/mass 3 viscosity factor
R23	CHF_3	70	0.704	1.571
R32	CH_2F_2	52	0.632	1.411
R41	CH_3F	34	0.551	1.23
R50	CH_4 Methane	16	0.556	1.241
R113	$C_2F_3Cl_3$	187.4	0.484	1.08
R114	$C_2F_4Cl_2$	170.9	0.545	1.217
R115	C_2F_5Cl	154.5	0.627	1.4
R116	C_2F_6	138	0.709	1.583
R123	$C_2HF_3Cl_2$	152.9	0.54	1.205
R124	C_2HF_4Cl	136.5	0.581	1.297
R125	C_2HF_5	120	0.653	1.458
R134a	$C_2H_2F_4$	102	0.591	1.319
R141b	$C_2H_3FCl_2$	117	0.464	1.036
R142b	$C_2H_3F_2Cl$	100.5	0.494	1.103
R143a	$C_2H_3F_3$	84	0.561	1.252
R152a	$C_2H_4F_2$	66.1	0.515	1.15
R170	C_2H_6 Ethane	30.1	0.479	1.069
R218	C_3F_8	188	0.627	1.4
R227ea	C_3HF_7	170	0.627	1.4
R236fa	$C_3H_2F_6$	152	0.55	1.228
R245fa	$C_3H_3F_5$	134	0.52	1.161
R290	C_3H_8 Propane	44.1	0.433	0.967
R356	$C_4H_5F_5$	166.1	0.561	1.252
R400	Mixture of 50% R12 50% R114	141.6	0.571	1.275
R401A	Mixture of 53% R22 13% R152a 34% R124	94.4	0.607	1.355
R401B	Mixture of 61% R22 11% R152a 28% R124	92.8	0.612	1.366

Gas designation (max. 8 digits)	Other designations	Molecular mass (amu)	Helium viscosity factor	Hydrogen/mass 3 viscosity factor
R401C	Mixture of 33% R22 15% R152a 52% R124	101	0.602	1.344
R402A	Mixture of 38% R22 60% R125 2% R290	101.6	0.647	1.444
R402B	Mixture of 60% R22 38% R125 2% R290	94.7	0.642	1.433
R403A	Mixture of 75% R22 20% R218 5% R290	92	0.642	1.433
R403B	Mixture of 56% R22 39% R218 5% R290	103.3	0.647	1.444
R404A	Mixture of 44% R125 52% R143a 4% R134a	97.6	0.607	1.355
R405A	Mixture of 45% R22 7% R152a 5.5% 142b 42.5% RC318	111.9	0.622	1.388
R406A	Mixture of 55% R22 4% R600a 41% R142b	89.9	0.566	1.263
R407A	Mixture of 20% R32 40% R125 40% R134a	90.1	0.637	1.422
R407B	Mixture of 10% R32 70% R125 20% R134a	102.9	0.647	1.444

Gas designation (max. 8 digits)	Other designations	Molecular mass (amu)	Helium viscosity factor	Hydrogen/mass 3 viscosity factor
R407C	Mixture of 10% R32 70% R125 20% R134a	86.2	0.627	1.4
R407D	Mixture of 23% R32 25% R125 52% R134a	91	0.612	1.366
R407E	Mixture of 25% R32 15% R125 60% R134a	83.8	0.622	1.388
R407F	Mixture of 40% R134a 30% R125 30% R32	82.1	0.67	1.496
R408A	Mixture of 7% R125 46% R143a 47% R22	87	0.602	1.344
R409A	Mixture of 60% R22 25% R124 15% R142b	97.4	0.607	1.355
R409B	Mixture of 65% R22 25% R124 10% R142b	96.7	0.612	1.366
R410A	Mixture of 50% R32 50% R125	72.6	0.673	1.502
R410B	Mixture of 45% R32 55% R125	75.6	0.673	1.502
R411A	Mixture of 1.5% R1270 87.5% R22 11% R152a	82.4	0.617	1.377

Gas designation (max. 8 digits)	Other designations	Molecular mass (amu)	Helium viscosity factor	Hydrogen/mass 3 viscosity factor
R411B	Mixture of 3% R1270 94% R22 3% R152a	83.1	0.62	1.388
R411C	Mixture of 3% R1270 95.5% R22 1.5% R152a	83.4	0.627	1.4
R412A	Mixture of 70% R22 5% R218 25% R142b	92.2	0.602	1.344
R413A	Mixture of 9% R218 88% R134a 3% R600	104	0.581	1.297
R414A	Mixture of 51% R22 28.5% R124 4% R600a 16.5% R142	96.9	0.586	1.308
R415A	Mixture of 82% R22 18% R152a	81.7	0.622	1.388
R416A	Mixture of 59% R134a 39.5% R124 1.5% R600	111.9	0.576	1.286
R417A	Mixture of 50% R134a 46% R125 4% R600a	106.7	0.61	1.362
R422D	Mixture of 65.1% R125 31.5% R134a 3.4% R600a	112.2	0.622	1.388

Gas designation (max. 8 digits)	Other designations	Molecular mass (amu)	Helium viscosity factor	Hydrogen/mass 3 viscosity factor
R438A	Mixture of 45% R125 44.2% R134a 8.5% R32 1.7% R600 0.6% R601a	104.9	0.617	1.377
R441A	Mixture of 54.8% R290 36.1% R600 6% R600a 3.1% R170	49.6	0.398	0.888
R442A	Mixture of 31% R32 31% R125 30% R134a 5% R227ea 3% R152a	81.8	0.629	1.404
R448A	Mixture of 26% R32 26% R125 21% R134a 20% R1234yf 7% R1234ze	99.3	0.625	1.395
R449A	Mixture of 25.7% R134 25.3% R1234yf 24.7% R125 24.3% R32	87.2	0.622	1.388
R450A	Mixture of 58% R1234ze 42% R134a	109	0.592	1.321
R452A	Mixture of 59% R125 30% R1234yf 11% R32	103.5	0.612	1.366
R452B	Mixture of 67% R32 26% R1234yf 7% R125	72.9	0.639	1.426

Gas designation (max. 8 digits)	Other designations	Molecular mass (amu)	Helium viscosity factor	Hydrogen/mass 3 viscosity factor
R454C	Mixture of 22% R32 78% R1234yf	90.8	0.62	1.384
R500	Mixture of 74% R12 26% R152a	99.3	0.581	1.297
R501	Mixture of 75% R22 25% R12	93.1	0.627	1.4
R502	Mixture of 49% R22 51% R115	111.6	0.647	1.444
R503	Mixture of 40% R23 60% R13	87.3	0.709	1.583
R504	Mixture of 48% R32 52% R115	79.3	0.678	1.513
R505	Mixture of 78% R12 22% R31	103.5	0.612	1.366
R506	Mixture of 55% R31 45% R114	93.7	0.561	1.252
R507	Mixture of 50% R125 50% R143a	98.9	0.612	1.366
R508A	Mixture of 39% R23 61% R116	100.1	0.729	1.627
R508B	Mixture of 46% R23 54% R116	95.4	0.729	1.627
R513A	Mixture of 44% R134a 56% R1234yf	108.7	0.582	1.299
R600	C_4H_{10} Butane	58.1	0.377	0.842
R600a	C_4H_{10} Iso-Butane	58.1	0.377	0.842

Gas designation (max. 8 digits)	Other designations	Molecular mass (amu)	Helium viscosity factor	Hydrogen/mass 3 viscosity factor
R601	C_5H_{12} Pentane	72.2	0.341	0.761
R601a	C_5H_{12} Iso-Pentane	72.2	0.336	0.75
R601b	C_5H_{12} Neopentane	72.2	0.337	0.752
R601c	C_5H_{12} Cyclopentane	70.1	0.337	0.752
R1233zd	$C_3H_2ClF_3$	130.5	0.558	1.246
R1234yf	$C_3H_2F_4$	114	0.624	1.393
R1234ze	$C_3H_2F_4$	114	0.619	1.382
R1243zf	$C_3H_3F_3$	96	0.6	1.339
Ar	Argon	40	1.127	2.516
CO_2	R744	44	0.744	1.661
H_2	Hydrogen	2	0.448	1
H_2O	R718	18	0.459	1.025
He	Helium	4	1	2.232
HT135	Galden HT135	610	1	2.232
Kr	Krypton	84	1.275	2.846
N_2	Nitrogen	28	0.892	1.991
Ne	Neon	20.2	1.586	3.54
NH_3	R717	17	0.505	1.127
O_2	Oxygen	32	1.03	2.299
SF_6		146.1	0.765	1.708
Xe	Xenon	131.3	1.153	2.574
ZT130	Galden ZT130	497	1	2.232

Table 1: Gas library V3.24

11.3.8 Updating the software

Software updates from INFICON are installed with the aid of a USB flash drive. The update function of the device can be found under "Functions > Data > Update".

An update is possible,

- if one or several updates are available on the USB flash drive, but only one update per type at most (control unit, MSB box, I/O module),
- if these parts are also connected free of disturbances and have an update function.

The corresponding buttons in the update menu such as "Control Unit", "MSB Box", and "I/O Module" are active and can be activated individually.

NOTICE

Aborted connection

Loss of data due to disconnection

► Do not switch off the device and do not remove the USB flash drive while the software is being updated!

► Switch the device off and back on after a software update has taken place.

11.3.8.1 Updating the software of the control unit

The software is contained in two files with the same file name, but with different file name extensions (".exe" and ".key").

1. Copy the files into the main directory of a USB stick.
2. Connect the USB flash drive to the USB port on the device.
3. Select: "Functions > Data > Update > Control unit".
   ⇨ Do not switch off the device and do not remove the USB flash drive while the software is being updated!
4. Check the version information.
5. Select the "Start" button to start the update. Do not switch off the device and do not remove the USB flash drive while the software is being updated!
6. Follow the instructions on the touchscreen and wait until the update is complete.

11.3.8.2 Checking and updating the software version of the MSB box

The current software is available from the Inficon support.

The functions of the XL Sniffer adapter set are taken into consideration in system software version 2.11 or higher.

1. Copy the file with the file name extension ".bin" into the root directory of a USB stick.
2. Connect the USB flash drive to the USB port on the device.
3. Select: "Functions > Data > Update > MSB".
   ⇨ The display shows information on the current and the new software version as well as on the boot loader.
4. Check the version information.
   ⇨ Select the "Start" button to start the update.

⇨ Do not switch off the device and do not remove the USB flash drive while the software is being updated! Do not switch off the device and do not remove the USB flash drive while the software is being updated!

5 Follow the instructions on the touchscreen and wait until the update is complete.

6 If the system displays warning 104 or 106, confirm with "C".

11.3.8.3 Updating the software of the I/O module

The software of the I/O module can be updated from the control unit if the mass spectrometer module has at least the software version "MS module 1.02".

1 Copy the file with the file name extension ".bin" into the root directory of a USB stick.

2 Connect the USB flash drive to the USB port on the device.

3 Select: "Functions > Data > Update > I/O module"

⇨ The display shows information on the current and the new software as well as on the current boot loader.

4 Check the version information.

5 Select the "Start" button to start the update.

⇨ Do not switch off the device and do not remove the USB flash drive while the software is being updated!

6 Follow the instructions on the touchscreen and wait until the update is complete.

⇨ The following tips are shown after selecting the "Start" button on the touchscreen:

- Connect and switch on the IO1000.
- Activate boot mode (switch DIP S2.3 on and off once).
- When the STATUS LED flashes green, press OK.

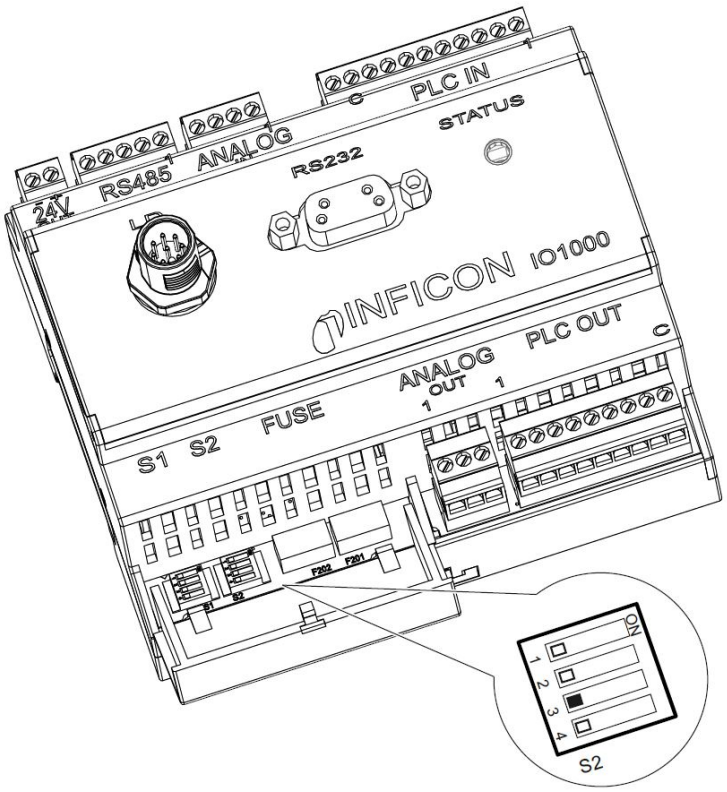


Fig. 25: DIP switch on the I/O module

12 Maintenance

The mass spectrometer module is a leak testing unit that is intended for industrial applications. The device is composed of parts and assemblies that are, for the most part, low maintenance.

Servicing the mass spectrometer module merely requires that you change the oil reservoir of the turbo molecular pump and check the fan on the turbo molecular pump.

We recommend that you sign a service agreement with INFICON or one of INFICON's authorized service partners.

12.1 Returning the device for maintenance, repair or disposal

⚠ WARNING

Danger to health

Contaminated devices could endanger the health of INFICON employees.

► Fill in the declaration of contamination completely.

► Attach the declaration of contamination to the outside of the packaging.

► Contact the manufacturer and send in a completed declaration of contamination before return shipment.

⇨ You will then receive a return number and a shipping address.

The declaration of contamination is a legal requirement and serves to protect our employees. INFICON sends devices which are sent without a completed declaration of contamination back to the sender. See "Declaration of Contamination [▷ 166]".

12.2 General maintenance information

The maintenance work that needs to be performed on the mass spectrometer module is grouped into three service levels:

- Service level I: Customer without any technical training
- Service level II: Customer with technical and INFICON training
- Service level III: INFICON Service

⚠ DANGER

Risk of death from electric shock

There are high voltages inside the device. Touching parts where electrical voltage is present can result in death.

► Disconnect the device from the power supply prior to any maintenance work.

NOTICE

Material damage from pollution

The mass spectrometer module is a precision measurement device. Even little pollution can already damage the device.

► Make sure that the working environment is clean and you use clean tools whenever performing any maintenance work.

12.3 Change oil reservoir of turbo molecular pump

12.3.1 Introduction

Spare part kit oil wick cartridge, scope of delivery: Oil wick cartridge with small O-ring (1 piece), Porex rods (8 pieces), O-ring for cover model A*) (1 piece), O-ring for cover model B*) (1 piece)	P/N: 200003801
Face spanner for model A*)	P/N: 551-200
Allen wrench 3 mm, as torque wrench with 3 Nm for assembly, for model B*)	
Threaded screw M5 as aid for model B*)	

*) To distinguish between models A and B, see the following illustration “Flood the turbo molecular pump [▶ 152]“.

The turbo molecular pump is filled with an operating fluid for the lubrication of the ball bearings. The oil reservoir must be replaced every 4 years at the latest. With extreme strain of the pump or in unclean processes, the lubricant reservoir must be replaced at shorter intervals.

The cover of the oil reservoir can be unscrewed only when the turbo molecular pump is flooded.

► Follow the steps in the order of the next chapters.

12.3.2 Flood the turbo molecular pump

1. Shut down mass spectrometer module, see "Decommissioning [▶ 163]".
2. Wait until turbo molecular pump is drained (at least 1 min).
3. Disconnect 24 V power supply pack from MSB box.
4. Allow the turbo molecular pump to cool down if necessary.
5. Remove turbo molecular pump.
6. Open the ventilation screw slowly.

   ⇨ Turbo molecular pump is flooded until it reaches atmospheric pressure.

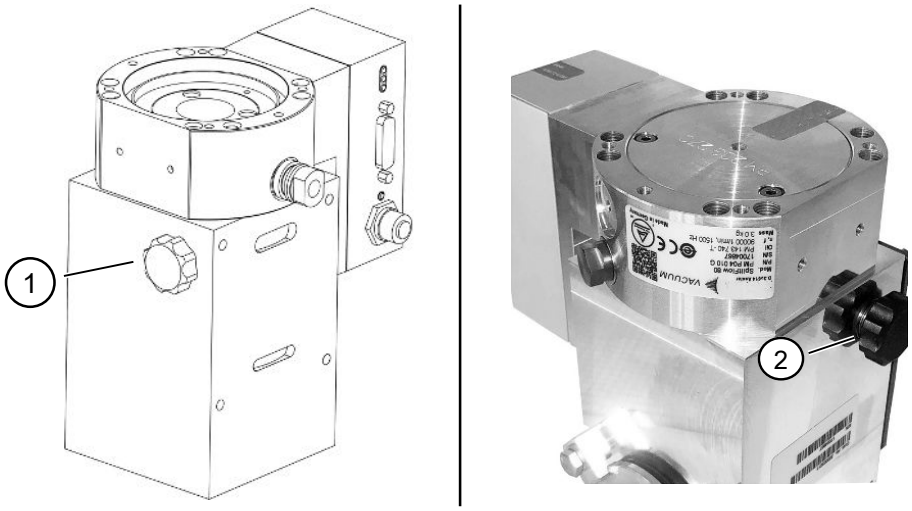


Fig. 26: Turbo molecular pump SplitFlow 80 with different covers

1	Ventilation screw on model A	2	Ventilation screw on model B

12.3.3 Removing old oil wick cartridge

⚠ WARNING

Danger of poisoning due to harmful substances

The oil wick cartridge and parts of the turbo molecular pump can be contaminated with toxic substances that are contained in the pumped media.

► Take suitable safety precautions.

► Decontaminate contaminated parts prior to any maintenance work.

► Dispose of old oil reservoirs in compliance with applicable regulations.

NOTICE

Damage to the turbo molecular pump due to loosening of screws

To remove the oil reservoir, unscrew only the cover. Do not loosen any screws underneath the cover! Otherwise the pump will be irreparably damaged.

Model A

✓ Cover corresponds to model A, see illustration of the turbo molecular pump SplitFlow 80 in “Flood the turbo molecular pump [▷ 152]“.

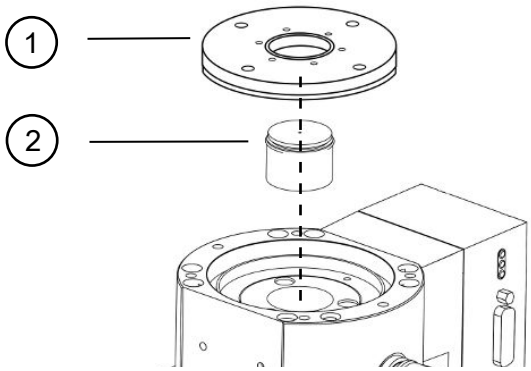
✓ Face spanner, P/N: 551-200

✓ Two screwdrivers

✓ Mass spectrometer and turbo molecular pump flooded.

1 Unscrew the cover (1) using a face spanner.

2 Use two screwdrivers to lift out the oil reservoir (2). Do not loosen any screws!



1	Cover	2	Oil reservoir

Model B

✓ Cover corresponds to model B, see illustration of the turbo molecular pump SplitFlow 80 in “Flood the turbo molecular pump [▶ 152]“.

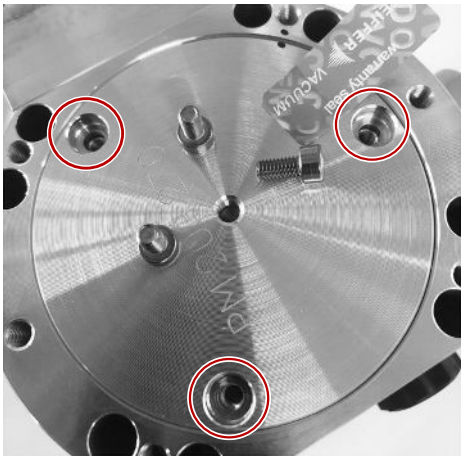
✓ Allen wrench 3 mm

✓ Two screwdrivers

✓ Mass spectrometer and turbo molecular pump flooded.

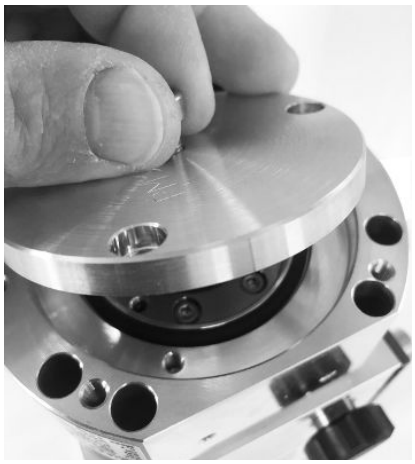
1 Remove the affixed guarantee seal.

2 Unscrew the 3 screws (M4) of the cover with the Allen key.



3 Screw a threaded screw (M5) a few turns into the empty central threaded opening of the aluminum cover.

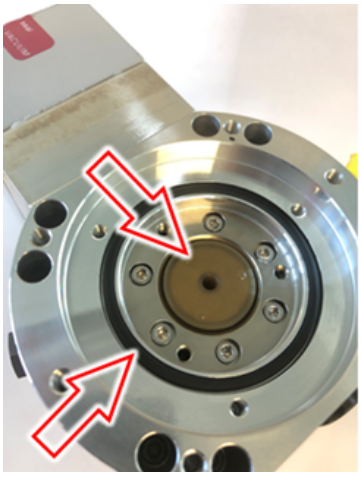
4 Use the screw to lift the cover.



5 Use the two screwdrivers to remove the O-ring and the oil wick cartridge.

⇨ Do not damage the sealing surfaces by scratching them!

⇨ To avoid damaging the TMP, do not loosen any other screws around the oil wick cartridge.



12.3.4 Exchange Porex rods

NOTICE

Material damage due to cleaning liquids

Cleaning liquids can damage the unit.

► Do not use any cleaning liquids.

► Use a clean, lint-free cloth.

✓ Tweezers

✓ Porex rods

1 Pull out old Porex rods (1) (8 pieces) with tweezers.

2 Remove any contaminants found on the turbo molecular pump and the cover using a clean, lint-free cloth.

3 Insert new Porex rods (1) (8 pieces) with tweezers.

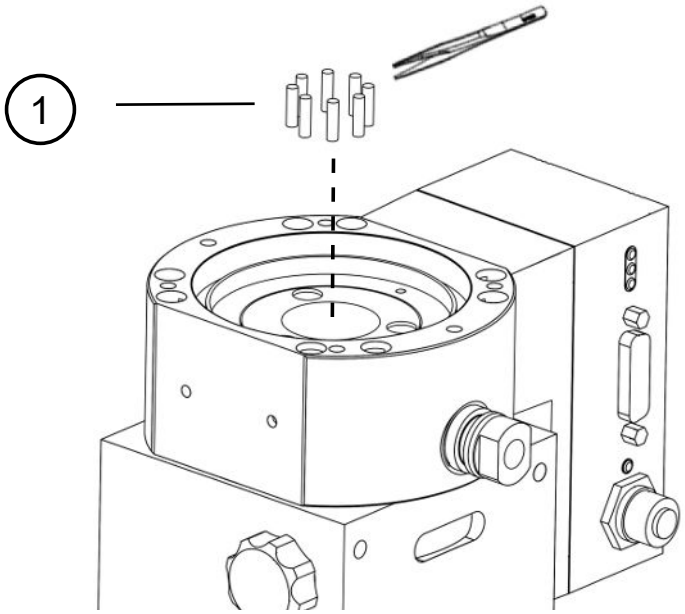


Fig. 27: The figure shows model A, model B analog

1	Porex rods

12.3.5 Inserting a new oil reservoir

NOTICE

Material damage if o-ring is mounted improperly

An improperly mounted o-ring can cause leaks. The device will experience malfunctions and become damaged.

► Carefully insert the O-ring of the cover.

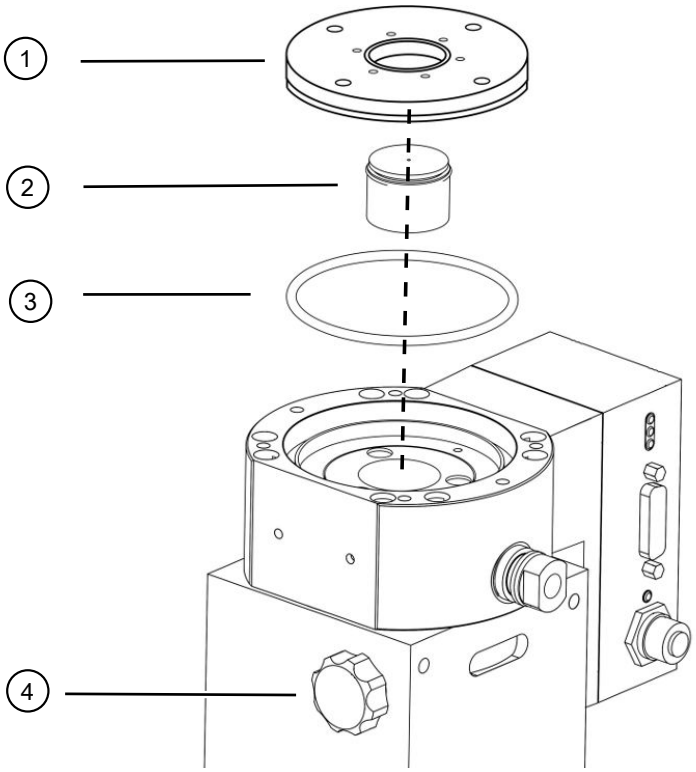


Fig. 28: The figure shows model A

1	Cover	2	Oil reservoir with O-ring
3	O-ring for cover	4	Ventilating screw

Model A

✓ Face spanner

✓ New O-ring for cover

✓ New oil reservoir

✓ The new oil reservoir contains a sufficient level of operating fluid. Do not fill in any more operating fluid.

1 Check the expiration date of the new oil reservoir (2).

2 Do not push the new oil reservoir (2) into the pump at full height, but only up to the O-ring of the oil reservoir.

⇨ The new oil reservoir is correctly positioned by screwing in the cover (1).

3 Remove the old O-ring (3) from the cover.

4 Insert a new O-ring (3) for the cover.

5 Screw in the cover (1) with a face spanner without any effort.

⇨ To prevent the threads from tilting, place the cover (1) on it and slowly turn it counterclockwise until the threaded ends of the cap and pump fit into each other. As soon as this is achieved, the cover will slightly sink back into the pump. This position allows the threads to mesh better.

6 Tighten the cover with a torque of 13 Nm +/-10%.

7 Hand-tighten the ventilation screw (4).

8 Install the turbo molecular pump.

9 Put the mass spectrometer module into operation.

Model B

✓ Allen wrench 3 mm, as torque wrench with 3 Nm for assembly

✓ New O-ring for cover

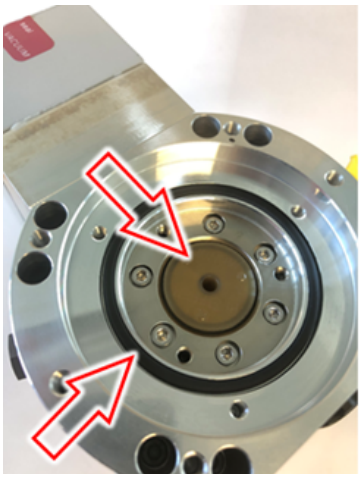
✓ New oil reservoir

✓ The new oil reservoir contains a sufficient level of operating fluid. Do not fill in any more operating fluid.

1 Check the expiration date of the new operating fluid reservoir.

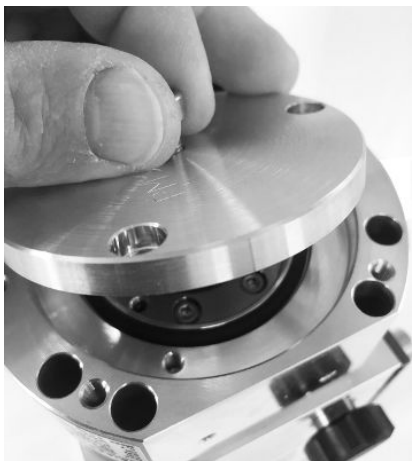
2 Do not push the new oil wick cartridge into the pump at full height, but only up to the O-ring of the oil wick cartridge.

⇨ The new oil wick cartridge will be positioned correctly when you screw in the cover.

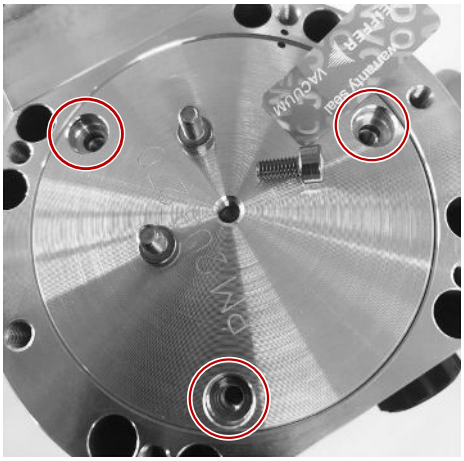


3 Insert a new o-ring for the cover.

4 Replace the cover using a threaded screw (M5).



5 Screw in the 3 screws (M4) of the cover with the Allen key and a torque of 3 Nm.



6 Tighten the ventilation screw by hand.

7 Install the turbo molecular pump.

8 Put the mass spectrometer module into operation.

12.3.6 Confirm maintenance work

✓ Control unit installed

✓ Access = Integrator

► Confirm maintenance work on control unit: "Authorization > Integrator > Maintenance > Maintenance Work“

12.4 LDS3000 AQ - maintenance relevant components

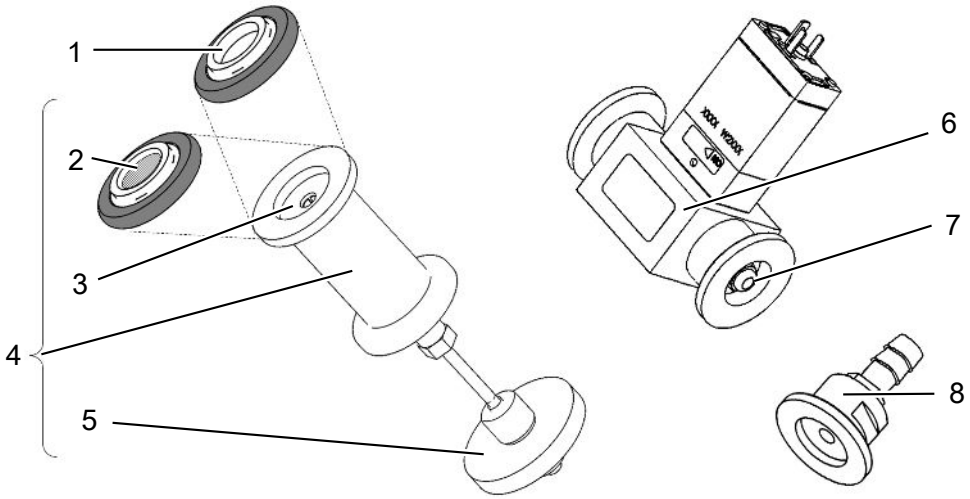


Fig. 29: Throttle for AQ

	Designation	Quantity	Order number
1	ISO-KF centering ring without filter. Only to be used for connection according to variant 2 (with filter unit 0.45 µm Pall, pos. N° 5). See "Variant 2 [▶ 42]".	1	211-059
2	ISO-KF centering ring with filter. Only to be used for connection according to variant 1 (without installation of filter unit 0.45 µm Pall, pos. N° 5). See "Variant 1 [▶ 39]".	1	211-090
3	Throttle insert LDS AQ spare part	1	200009029
4	Throttle flange LDS AQ complete	1	200009030
5	Filter unit 0.45 µm Pall. Only to be used for connection according to variant 2. See "Variant 2 [▶ 42]".	4	200009847
6	Valve LDS AQ. To be used only when connecting a second chamber for switching.	1	200008464
7	Replacement filter for valve LDS AQ (pos. N° 6)	10	200009701
8	GROSS throttle flange - 1.02 mm. To be used with both variants. See "Variant 1 [▶ 39]" and "Variant 2 [▶ 42]".	1	200008532

12.5 Maintenance plan

If the maintenance work of the maintenance plan is not carried out, the warranty for the mass spectrometer module is void.

Explanation of the maintenance plan:

- I Customer or higher level
- II Customer with instruction or higher level
- III INFICON Service Technician
- X Carry out maintenance as per operating hours or duration
- X_1 Maintenance after operating hours, not after duration
- X_2 Maintenance by duration, not by operating hours
- X_3 Dependent on environmental influences, operating conditions, pollution and application process

Maintenance work	**Operating hours**	24	4000	8000	16000	24000	36000	**Service level**
	Duration		1/2 year	1 year	2 years	3 years	4 years	
Turbo molecular pump	Replace operating fluid reservoir (spare part no. 200003801)				X_3			I and II
	Revision: Change bearing and replace operating fluid reservoir (spare part no. 200003800 or 200003800R)						X_2	III
	Clean fan and check for proper operation			X_3				I and II
Accessories	Clean sniffer valve			X				III
	Calibrate internal calibration leak			X_2				III
Internal calibration	Perform internal calibration	X_1						I
External calibration	Perform external calibration	X_1						I
Leak test MS module	Perform helium leak test on MS module			X				III
AQ filter *) valve/ throttle	Control condition. Replace if necessary		X_3					I
- valve filter - ISO KF filter ring - 0.45 µm Pall	Replace preventively		X_3	X				I

*) Applies only to LDS3000 AQ:
Unsuitable environmental influences or operating conditions as well as contamination and the type of application process can reduce the recommended maintenance

interval of the AQ filter used to less than 8000 hours or 1 year. Depending on the type of setup, different AQ filters are in use, see "LDS3000 AQ - maintenance relevant components [▶ 160]".

Reduced flow/pressure caused by clogged filters may result in warning or error messages. In this case, premature replacement of the filter is required.

13 Decommissioning

13.1 Shutting down the leak detector

1. Switch off the leak detector on the power supply pack.
2. Wait until the turbo molecular pump has stopped running.

13.2 Disposing of the mass spectrometer module

The owner can dispose of the device or it can be sent to INFICON.

The device consists of materials that can be recycled. This option should be exercised to prevent waste and also to protect the environment.

► For disposal, always comply with local and regional environmental and safety regulations.

13.3 Send in mass spectrometer module for maintenance, repair or disposal

⚠ WARNING

Danger due to harmful substances

Contaminated devices could endanger health. The contamination declaration serves to protect all persons who come into contact with the device.

► Fill in the declaration of contamination completely.

1. Contact the manufacturer and send in a completed declaration of contamination before return shipment.
   ⇨ You will then receive a return number and the shipping address.
2. Use the original packaging when returning.
3. Before sending the device, attach a copy of the completed contamination declaration. See Declaration of Contamination [▷ 166].

14 Appendix

14.1 CE Declaration of Conformity

INFICON

CE

EU Declaration of Conformity

We – INFICON GmbH - herewith declare that the products defined below meet the basic requirements regarding safety and health and relevant provisions of the relevant EU Directives by design, type and the versions which are brought into circulation by us. This declaration of conformity is issued under the sole responsibility of INFICON GmbH.

In case of any products changes made, this declaration will be void.

Designation of the product:

Mass spectrometer module

Models: **LDS3000**

LDS3000 AQ

Catalogue numbers:

560-300

560-600

The products meet the requirements of the following Directives:

- ***Directive 2014/30/EU (EMC)***
- ***Directive 2011/65/EU (RoHS)***

Applied harmonized standards:

- ***EN 61326-1:2013***
  Class A according to EN 55011
- ***EN IEC 63000:2018***

Cologne, August 18th, 2023

p.p. i.V.
Dr. H. Bruhns, Vice President LDT

Cologne, August 18th, 2023

pro
Sauerwald, Research and Development

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www.inficon.com
E-mail: leakdetection@inficon.com

14.2 Declaration of Incorporation

EC DECLARATION OF INCORPORATION

We – INFICON GmbH - herewith declare that the products defined below meet the basic requirements regarding safety and health and relevant provisions of the relevant EU Directives by design, type and the versions which are brought into circulation by us. This declaration of conformity is issued under the sole responsibility of INFICON GmbH.

In case of any products changes made, this declaration will be void

Designation of the product:

Mass spectrometer module

Models: **LDS3000**

LDS3000 AQ

Catalogue numbers:

560-300

560-600

The products meet the requirements of the following Directives:

- ***Directive 2006/42/EC (Machinery)***

Applied harmonized standards:

- ***EN ISO 12100:2010***
- ***EN ISO 61010-1:2010+A1:2019***

The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of this Directive (2006/42/EC), where appropriate.

The manufacturer will electronically transmit, in response to a reasoned request by the national authorities, relevant information on the partly completed machinery.
The relevant technical documentation is compiled in accordance with part B of Annex VII.

Authorised person to compile the relevant technical files:
Heinz Rauch, INFICON GmbH, Bonner Strasse 498, D-50968 Cologne

The following essential health and safety requirements according to Annex II of Directive 2006/42/EC were fulfilled:
1.1.2, 1.1.3, 1.1.5, 1.2.1, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.6, 1.5.8, 1.5.9, 1.5.10, 1.5.11, 1.5.13, 1.6.1, 1.6.3, 1.7.1, 1.7.2, 1.7.3, 1.7.4

Cologne, August 18th, 2023

p.p.
Dr. H. Bruhns, Vice President LDT

Cologne, August 18th, 2023

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Sauerwald, Research and Development

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14.3 Declaration of Contamination

Declaration of Contamination

The service, repair, and/or disposal of vacuum equipment and components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay.
This declaration may only be completed (in block letters) and signed by authorized and qualified staff.

1 Description of product

Type _____
Article Number _____
Serial Number _____

2 Reason for return

_____
_____
_____

3 Operating fluid(s) used (Must be drained before shipping.)

_____
_____

4 Process related contamination of product:

toxic	no ❑ 1)	yes ❑
caustic	no ❑ 1)	yes ❑
biological hazard	no ❑	yes ❑ 2)
explosive	no ❑	yes ❑ 2)
radioactive	no ❑	yes ❑ 2)
other harmful substances	no ❑ 1)	yes ❑

The product is free of any substances which are damaging to health yes ❑

1) or not containing any amount of hazardous residues that exceed the permissible exposure limits

2) Products thus contaminated will not be accepted without written evidence of decontamination!

5 Harmful substances, gases and/or by-products

Please list all substances, gases, and by-products which the product may have come into contact with:

Trade/product name	Chemical name (or symbol)	Precautions associated with substance	Action if human contact

6 Legally binding declaration:

I/we hereby declare that the information on this form is complete and accurate and that I/we will assume any further costs that may arise. The contaminated product will be dispatched in accordance with the applicable regulations.

Organization/company _____
Address _____ Post code, place _____
Phone _____ Fax _____
Email _____
Name _____

Date and legally binding signature _____

Company stamp

Copies:
Original for addressee - 1 copy for accompanying documents - 1 copy for file of sender

14.4 RoHS

Restriction of Hazardous Substances (China RoHS)

有害物质限制条例（中国 RoHS）

	LDS3000, LDS3000 AQ: Hazardous Substance LDS3000, LDS3000 AQ: 有害物质					
Part Name 部件名称	Lead (Pb) 铅	Mercury (Hg) 汞	Cadmium (Cd) 镉	Hexavalent Chromium (Cr(VI)) 六价铬	Polybrominated biphenyls (PBB) 多溴联苯	Polybrominated diphenyl ethers (PBDE) 多溴联苯醚
Assembled printed circuit boards 组装印刷电路板	X	O	O	O	O	O
Throttles 节气门	X	O	O	O	O	O
Valve 阀门	X	O	O	O	O	O
Fan 风扇	X	O	O	O	O	O

This table is prepared in accordance with the provisions of SJ/T 11364.
本表是根据 SJ/T 11364 的规定编制的。

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.
O：表示该部件所有均质材料中所含的上述有害物质都在 GB/T 26572 的限制要求范围内。

X: Indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.
X：表示该部件所使用的均质材料中，至少有一种材料所含的上述有害物质超出了 GB/T 26572 的限制要求。

(Enterprises may further provide in this box technical explanation for marking “X” based on their actual circumstances.)
（企业可以根据实际情况，针对含“X”标识的部件，在此栏中提供更多技术说明。）

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