IonMobilitySpectrometer25

for Shimadzu GC-2010/2030 GC-Systems

User Manual

G.A.S. Gesellschaft für
analytische Sensorsysteme mbH

IonMobilitySpectrometer25 - User Manual

Version 2.1, March 2026

Valid from IMS25 Control Software Version 2.1

G.A.S. reserves the right to realize technical changes to the product without explicitly mentioning them**.**

CE-Marking according to:

International Standard EN ISO 17050-1:2004

European Union Low Voltage Directive 2006/95/EC

European Union Electromagnetic Compatibility Directive 2004/108/EC

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1 General Information

1.1 Information about the Manual

This manual describes a safe and adequate handling of the device. Following the instructions of the indicated safety aspects and instructions as well as the national and/or local rules and general safety regulations concerning the prevention of accidents are absolutely imperative.

Before starting the work with the device read the manual completely and thoroughly particularly the chapter security and respective safety references. Assure that you/the operator comprehends the terms described.

The manual is part of the device. It must be stored together with and next to the device at any time.

INFORMATION!

The graphics in this user manual are schematic and may differ from the actual conditions. The PC software screenshots in this user manual may differ from the actual conditions.

1.2 Explanation of Symbols

Important and safety-relevant references in this manual are characterized by symbols. These indications which are in-line with industrial safety must be respected and followed at any time.

INFORMATION

This symbol calls information, which are to be considered for efficient and perfect handling of the equipment.

WARNING

This symbol indicates references, which can lead to damages, malfunctioning and/or loss of the device.

DANGER

This symbol marks references, which can lead to health impairments, injuries, lasting body damages or to death due to electric current.

DANGER

This Symbol marks paragraphs, which describe potential dangers and damage due to exposure to radioactive radiation.

DANGER

This symbol marks paragraphs, which describe situations in which surface parts of the device can heat up to a point where touching it or bringing objects close to it may be hazardous.

1.3 Notation for dialogs, elements and references

Example Dialog:

System › **Connections** › **LAN File Transfer** › **Settings…** › **Test Connection**

Example Elements:

Gas Out, **Sample gas in**

Example: References

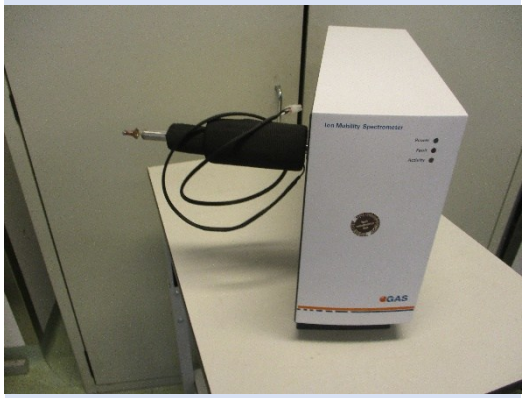
Advanced User Manual, **Chapter 5.1 Installation Reguirements**

Example: Information

keep the transport box

1.4 Scope of Supply

Assure that you have received the full scope of supply, verify by checking the packing list. If there is any part missing, please contact the GAS-hotline immediately.

Standard Scope of Supply	
	IonMobilitySpectrometer25 Device including mounted Transferline (1 piece)
	Power supply (1 piece) + power plug (1 piece)
	IMS25 Gas tube Kit • 2 x 3 mm PFA Tubes with 3 mm Swagelok-Connector (3 Pieces)

	Molecular sieve 200 ml with 1/8” connections (1 piece) with holder (different designs)
	Remote Cable (1 piece)
	USB Cable (1 piece)
	LAN Cable (1 piece)

IMS25 Blind plug Set (2 pieces)

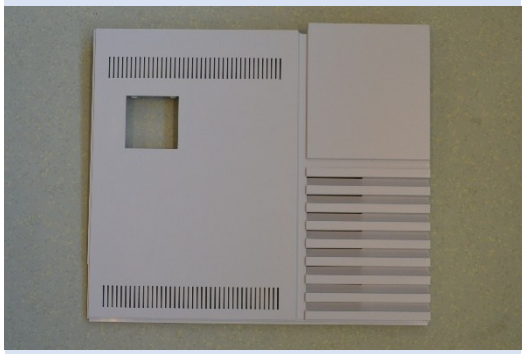
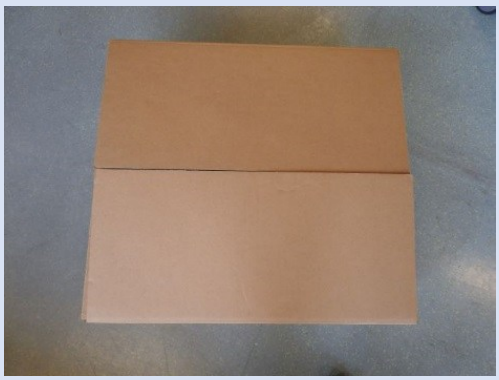
(Swagelok 3 mm Blind plug with red cap installed on device connectors)

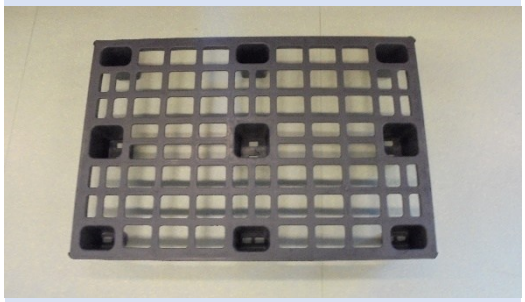
Torx Tool Kit

- Torx Screwdriver 20 mm (1 piece)

Document Map with Documents and Device User Manuals (1 piece)

USB-Stick Box with Software und Documents (1 piece)

	Custom Ketones Standard (1piece)
	Prepared side panel for Shimadzu gas chromatograph for versions 2010 or 2030 (1 piece)
	Shimadzu Transferline with accessories for versions 2010 or 2030 (1 piece)
	Transport box (1 piece)

	GC-IMS Transport palett (80 x 60 cm)

Optional Scope of Supply (only available if ordered)	
	Windows-compatible laptop computer (model might be different than shown) including software for control and evaluation. (optional)

1.5 Liability and Guarantee

This user manual describes the safe and proper handling of the device.

All data and reference within this manual are compiled under the valid regulations, the state-of-the-art as well as G.A.S. experiences of several years.

This user manual must be stored together with and close to the device at any time and accessible to all persons, who operate or handle the device at any time.

This user manual must be read carefully before starting to work with the device. G.A.S. does not assume any liability for damage and disturbances, resulting from disregard of the instructions contained in this user manual. All claims of any kind related to damage from a not intended use of the device will be rejected.

G.A.S. reserves the right to realize technical changes of the product due to improvements without explicitly mentioning them.

1.6 Copyright

1.7 Return and Disposal

For an adequate disposal, the device or/and its equipment must be returned to the G.A.S. or to a third party authorized by the G.A.S.! For questions please contact G.A.S.

1.8 Software Updates

If there are any software updates customers will be contacted by G.A.S. Gesellschaft für analytische Sensorsysteme mbH as soon as the updates are available. The updates are free of charge within the first 12 months after delivery. Users will be provided with information about the changes and instructions for executing the updates.

1.9 Customer Service

For questions concerning G.A.S. products a customer service is available:

G.A.S. Gesellschaft für analytische Sensorsysteme mbH
Otto-Hahn-Straße 15
44227 Dortmund
Germany
Phone: +49 (0) 231 / 97 42 - 65 50
Fax: +49 (0) 231 / 97 42 - 65 55
support@gas-dortmund.de

The telephone hotline is available from Monday to Friday from 9:00 to 16:00 hours. In urgent cases or if you use fax or email please provide a telephone number for callbacks.

2 Safety

2.1 Intended Use Only

WARNING!

Usage other than described in this manual may damage the device and/or harm persons involved.

Do not use the device for other purposes. Damages due to misuse are not covered by the guarantee. Such damage claims will be rejected.

The device and its equipment are not certified for the employment in areas with explosive gas air mixtures.

All claims or requirements of any kind against the manufacturer and/or its authorized persons that arise due to damages from a not intended use of the device will be rejected. All damages that arise from a not intended use are of the operator's responsibility.

The intended use of the equipment and its correct handling according are described in the operating instructions of this manual. Other parts than the parts belonging to the scope of supply, may only be used after G.A.S. approval.

2.2 Responsibility of Operator

The device may only be operated in a perfect technical condition. Before putting the device into operation the condition of the device and its equipment must be checked. The information and instructions provided in this manual have to be followed at any time.

Besides the instructions provided in this manual the local rules for the prevention of accidents, general safety regulations - valid for the area of application of the device - as well as the valid environmental-protection regulations must be considered and respected.

The responsible technicians and operators must make sure a failure-free use of the device. Responsibilities among the involved persons regarding installation, operation, maintenance and cleaning must be made clear.

2.3 Requirements of Personnel

Only authorized and trained technical personnel may work with the instruments. The operator must have received an instruction over existing and all possible dangers and should be regularly instructed in safety procedures and environmental protection and that the personnel is fully aware of the complete operating instructions and particularly the safety notes. Personnel that might be under the influence of drugs or alcohol are to be kept off the device at any time.

Technical personnel in this context are defined as skilled employees who are knowledgeable due to their educational background. In case the foreseen personnel do not have the necessary qualifications to operate the instrument, it must be trained. Further to that non-authorized personnel should not operate the device.

The competencies for the work on and with the device must be specified and kept undoubtedly at any time so that with respect to security issues no unclear situation might come up.

Any changes of the equipment, which impair security of the personnel, must immediately be reported to the operator and every person dealing with it.

2.4 Dangers

The device and its equipment are subject to an endangerment analysis. The construction and execution of the device corresponds to the current state-of-the-art. The device is reliable in service when operated according to its intended use.

INFORMATION!

If the housing of the device is damaged, the device must not be used anymore and must be returned to the G.A.S. by using the original transportation case.

DANGER

The IMS25 device contains a radioactive radiation Tritium source which in all EURATOM countries is below the exemption limit of 1 GBq for tritium acc. to Table B (column 2) of Article 26, of the Directive 2013/59 EURATOM of December 5th, 2013.

However, do not open the device! Do not try to recover malfunctions of the device! Malfunction recovery, repairs and any maintenance work may only be performed by G.A.S. or by qualified personnel authorized by G.A.S.

DANGER

The IMS25 and its equipment is not certified for the employment in areas with explosive gas air mixtures (Zone 0).

DANGER

Exercise great care in handling current-carrying parts like the power supply cord. Do not get directly in touch with current-carrying parts. Do not open the housing. Do not use damaged parts.

DANGER

When Nitrogen is used as drift gas and helium as carrier gas, ignition of a helium plasma may occur due to the high voltage present in conjunction with a radiation source. This can damage the IMS.

DANGER

This symbol marks paragraphs, which describe situations in which surface parts of the device can heat up to a point where touching it or bringing objects close to it may be hazardous.

3 Transport, Packing and Storage

3.1 Inspection after Transport

Check the supply immediately after delivery concerning its completeness and/or transport damages. If you detect externally visible transport damage, do not receive the supply, or only under reservation. State the extent of the damage on the provided delivery note and/or the transportation documents of the feeder. Generate a complaint. Logg a complaint of covered defect immediately after recognizing, as claims due to transport damages can only be made valid within the complaint periods (usually 7 days).

3.2 Packing

If no return agreement regarding the packing was agreed upon dispose the packaging material always in an environmentally friendly way and according to valid local regulations. If necessary, ask a recycling company.

INFORMATION!

It is recommended to **keep the transport box** for a safety return transport.

3.3 Storage and Transport

Store the device only under the following conditions:

- **When not in use store the equipment in the supplied casing**
- **Prevent unauthorized access**
- **Do not store outside**
- **Protect the equipment from moisture and dust**
- **Put protective caps on all gas sockets**
- **Avoid mechanical vibrations**
- **Do not expose the equipment to aggressive substances**

- **Protect the equipment from direct sun light**
- **Storage temperature: 5 to 40 °C**
- **Relative Air Humidity: 0- 90% RH, non-condensing**

The equipment should be moved only within the provided carrying case. By this means, transport damages can be avoided. The above-mentioned values are considered for an instrument transported in its original new packing.

WARNING!

Protective caps should be put on gas sockets in case the device is stored or transported.

4 Cleaning and Maintenance

Natural aging and the wear of certain components of the equipment require a regular cleaning and maintenance.

4.1 Cleaning

Clean the device only with a dry or easily damp cloth.

WARNING!

Do not use cleaning agents, which contain solvents, acids or bases.

4.2 Maintenance

INFORMATION!

Maintenance of the device should only be carried out at G.A.S. or through specially trained and by G.A.S. authorized personnel.

The recommended **maintenance interval is 24 months**.

5 Introduction

The IonMobilitySpectrometer25 by G.A.S. offers a diversified use of the technology according to individual application requirements. Besides the advantage of reasonable costs compared to fully equipped IMS instruments, this set-up allows to configure the analytical system around according to customer needs. The module is connected as an external sensor to a standard Gas Chromatograph.

Samples are ionized by the integrated tritium source with an intensity below the exemption limits according to the International Atomic Energy Authority (IAEA) and COUNCIL DIRECTIVE 2013/59/EURATOM. Its power input is 24 V DC and a digital USB 2.0 high speed digital interface is used for output.

The IonMobilitySpectrometer25 can be operated in negative or positive drift voltage mode. The reactant ion peaks (RIPs) and analyte ion peaks (AIPs) in the positive drift voltage mode will be displayed as maxima in the spectra. In the negative drift voltage mode both will be shown as minima. One of these modes may be more suitable do detect specific substances.

The sample is introduced via the injector port of the GC and its capillary column which is connected through a heated transferline to the IonMobilitySpectrometer25. In User mode the IonMobilitySpectrometer25 can be heated up to 120 °C. Technical parameters of the IMS sensor and the drift gas flow are controlled by the 'IMS25-Control' software run on an external computer.

INFORMATION!

If the IMS25 is to be operated in parallel with a mass spectrometer, special precautions must be taken with regard to the carrier gas.

Please contact G.A.S. support for assistance.

support@gas-dortmund.de

5.1 Working principle of IMS technology

Ion Mobility Spectrometry (IMS) is an analytical technology to separately detect gaseous compounds in a mixture of analytes. The separation is based on the specific drift times, that ionized compounds need to pass a fixed distance (drift tube) in a defined electric field.

Drift velocity: $v_d = KE$ Mobility: $K = \frac{L^2}{t_D U}$

$$K = \frac{3}{16}\sqrt{\frac{2\pi}{\mu k T}}\frac{Q}{n\sigma}$$

Q	*ion charge*
n	*drift gas number density*
μ	*reduced mass of the ion and the drift gas molecules*
k	*Boltzmann constant*
T	*drift gas temperatures*
σ	*ion's collision cross section with the drift gas*

Figure 1: Ion Mobility Spectrometer - Basic Relations

Compared to other techniques e.g. TOF-MS, ions travel at atmospheric pressure versus a flow of inert drift gas. The drift time of each substance is determined by its ion mass and geometric structure, as slowing collisions with the drift gas molecules are more frequent for sterically demanding structures. Therefore, IMS can even differentiate isomeric molecules. For detection, the resulting ion current is measured by an electrometer as a function of time.

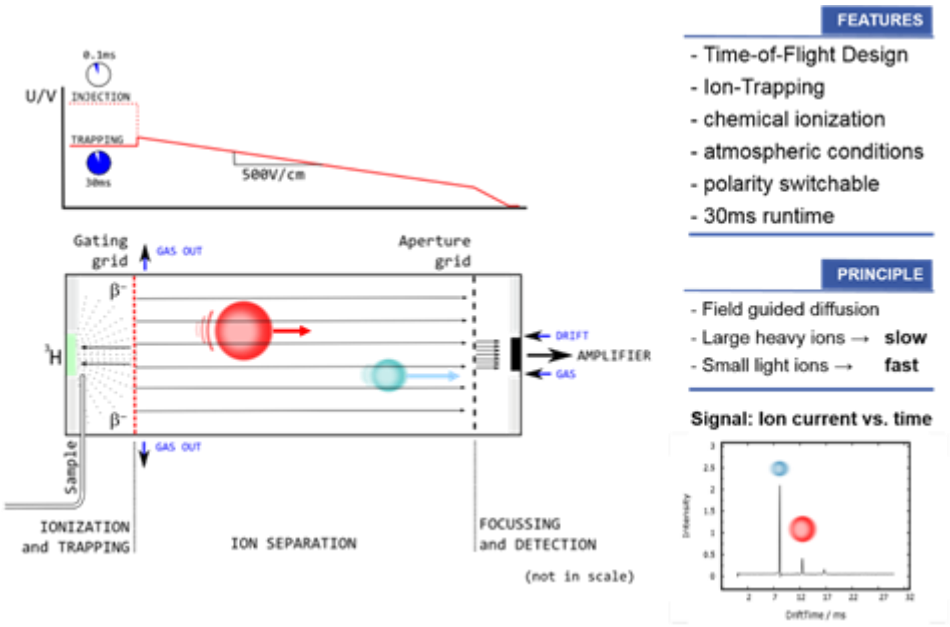


Figure 2: Ion Mobility Spectrometer -Working Principle

Atmospheric Ionization of molecules can be obtained by several techniques. G.A.S. uses photoionization with a 10.6eV UV-lamp or soft chemical-ionization initiated by a low-radiation tritium (^{3}H) source (below exemption limits of EURATOM). While the first directly produces positive ions, the latter generates *reactant ions* with the gas atmosphere by a cascade of reactions following the collision of a fast electron emitted from the *β*-radiator ^{3}H. The so-called Reaction Ion Peak (RIP) representing the total of all ions available is formed as a first step. In nitrogen and air, resp., the *reactant ions* can be described as $H^+(H_2O)_n$ and O_2-$(H_2O)_n$. Chemical ionization of analytes by *reactant ions* then result in the formation of specific analyte ions, when the affinity of the analyte towards the reactant ion is higher in case compared to water (using the positive ionization mode). The proton affinity of water is 691kJ/mol, so all molecules with a higher proton affinity will be ionized by a proton transfer, which is typically given for all heteroatom-organic compounds. The ionization takes place at ambient pressure, so that the analyte concentration is not diluted as compared to other analytical methods where a vacuum must be applied. Therefore, IMS is extremely sensitive. The detection limits typically are in the low ppb-range for *volatile organic compounds* (VOC).

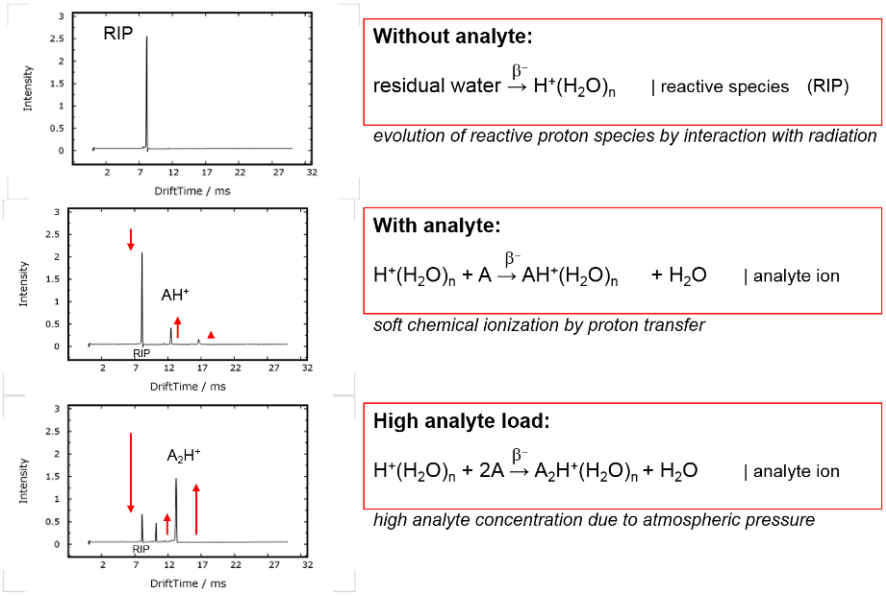


Figure 3: IMS Predominant Ionization (positive polarization)

The above figure exemplarily shows typical IMS spectra without analyte and with analyte. The RIP is formed as a sharp signal proving the cleanliness of the system and at a specific position that is used as internal standard. The spectrum containing analytes shows a decreased RIP, while new (analyte) peaks are correspondingly formed. The drift time is specific of an ion, therefore analyte identification is possible. The peak height and area correlate to the analyte concentration, so that a quantification is also possible.

Protone Affinities

Aromatic Amines	930.0 KJ/mol	Pyridine
Amines	899.0 KJ/mol	Methyl Amine
Phosphorous Compounds	890.6 KJ/mol	Trimethylphosphate
Sulfoxides	884.4 KJ/mol	Dimethyl Sulfoxide
	853.6 KJ/mol	Ammonia
Ketones	832.7 KJ/mol	2-Pentanone
Esters	821.6 KJ/mol	Methyl Acetate
Alkenes	805.2 KJ/mol	1-Hexene
Alcohols	789.2 KJ/mol	Butanol
Aromatics	750.4 KJ/mol	Benzene
	691.0 KJ/mol	**Water**
Alkanes	543.5 KJ/mol	Methane

Source: Gary Eiceman & Zeev Karpas, *Ion Mobility Spectrometry*, CRC Press, 2005, ISBN 0-8493-2247-2

Protone affinities of various VOCs can be found at the NIST chemistry webbook
http://webbook.nist.gov/chemistry/

Figure 4: Protone Affinities of VOC's

Complex analyte mixtures, like e.g. food flavours, often demand a second and independent separation step to separately analyse the multiplicity of compounds at low concentrations. Therefore G.A.S. -according to application- equips its IMS systems with gas chromatographic (GC) columns. The volatile compounds of samples under testing are pre-separated in time by a GC column. The discrete compounds are consecutively fed into the IMS ionization chamber, so that analyte and/or ion interactions are avoided.

Furthermore, a competition of analytes on the reactant ions is excluded, enhancing the sensitivity of the system for individual compounds.

The GC-IMS setup enables a twofold separation of analyte mixtures and the detection by the IMS electrometer. Since the IMS measurements are extremely fast (21 ms / spectrum) a continuous and high-resolution recording of analyte signals is provided.

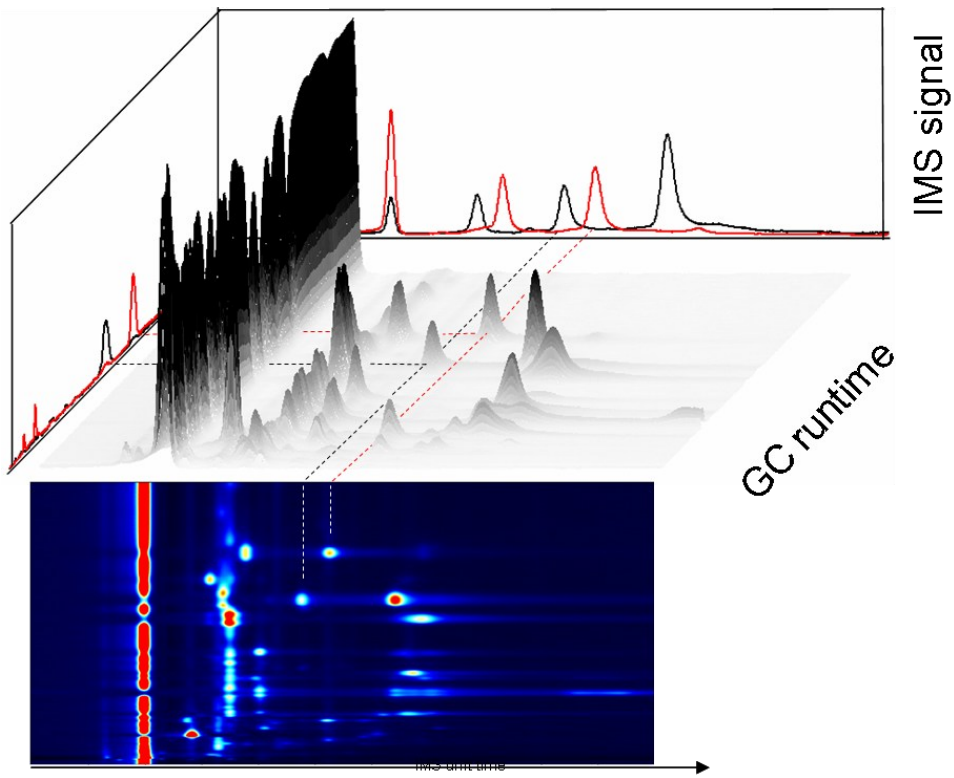


Figure 5: GC-IMS measurement 3D

The above figure sketches the GC-IMS measurement‘s 3D-dataset and the corresponding heatmap visualization.

FOCUS-IMS®

The FOCUS-IMS® is designed to optimize detection and mapping of fast temporal changes in sample feed. This is especially important for systems where IMS is coupled to temporal pre-separation techniques, like gas chromatography.

FOCUS-IMS®'s sample feed is guided straight onto the ionization source, which is mounted self-supporting perpendicularly to IMS drift tube. This ensures immediate ionization and detection of analyte molecules. Subsequent sample wash-out is ensured by wide exhaust pathways in-line to the drift gas flow and is driven by both consecutive carrier gas- and the drift gas flow.

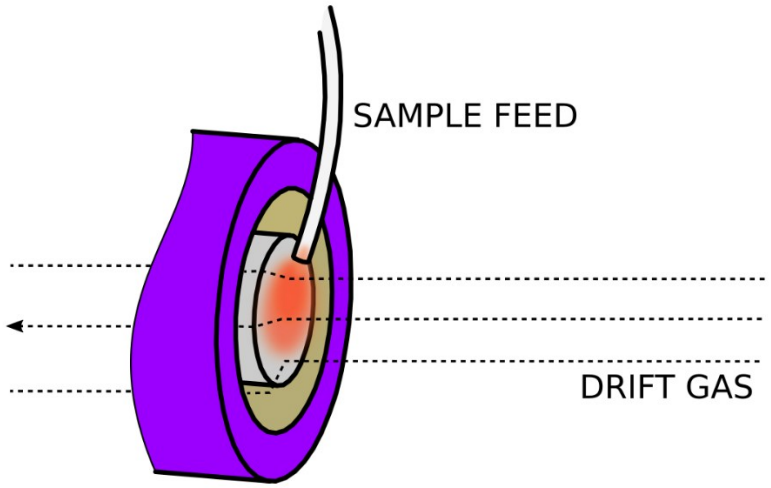


Figure 6: Schematic of the sample- and drift gas flow paths

The inherent detector's void volume is built by a 'bubble' of sample feed (carrier gas flow) in interplay with the drift gas flow. This 'virtual' void volume is smaller than the geometrical volume and is characterized by a decreased sample dwell time and subsequent to better detector signal mapping of changes in the sample feed. When coupled to gas chromatography a signal peak tailing due to residual sample is decreased.

Drift gas flows become a relevant parameter for the FOCUS-IMS®. High drift gas flows reduce sample dwell time and hence reduce the respective detector sensitivity. This can be utilized to tune the IMS response dynamically. The following image plots the chromatogram of the subsequent measurements of a homologous series of linear 2-ketones (#C 4-9). Drift gas flows are 50 - and 150 ml/min (left- and right-hand chromatogram). The chromatogram plotted in centre runs a drift gas flow of 150 ml/min and switches to 50 ml/min in a distinct run time (here: 2-heptanone).

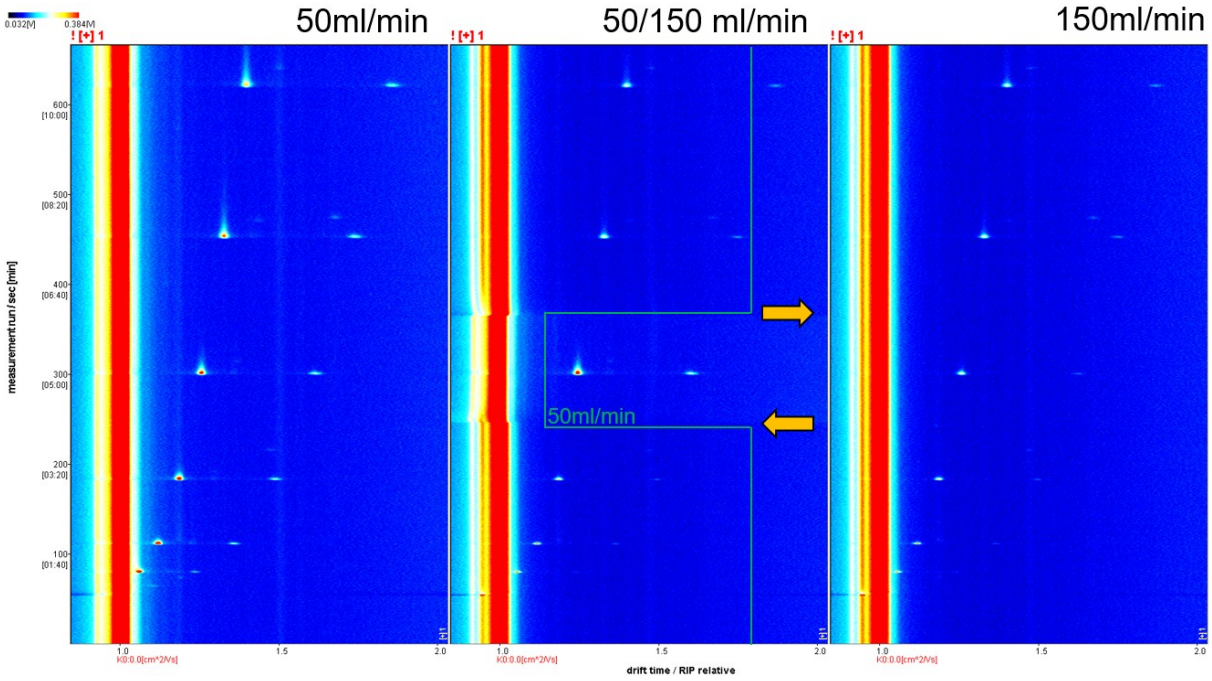


Figure 7: Chromatograms of 2-ketones (C 4-9) for varying drift gas flows

Reduced drift gas flows increase the signal peak heights. Dynamic change of flows within a GC run is possible to selectively tune sensitivity.

INFORMATION!

The drift gas flow is a relevant parameter for FOCUS-IMS® systems: **Elevated drift gas flows** will enhance temporal signal peak mapping and will reduce peak tailing.

Lowered drift gas flows will increase detector response and sensitivity

Reasonable starting value for drift gas flows in method development is 75 ml/min.

5.2 Setup

The schematic illustration shows the main gas directions and connections of the IonMobilitySpectrometer25 and the possibility to have a connection to a computer which is able to control the device.

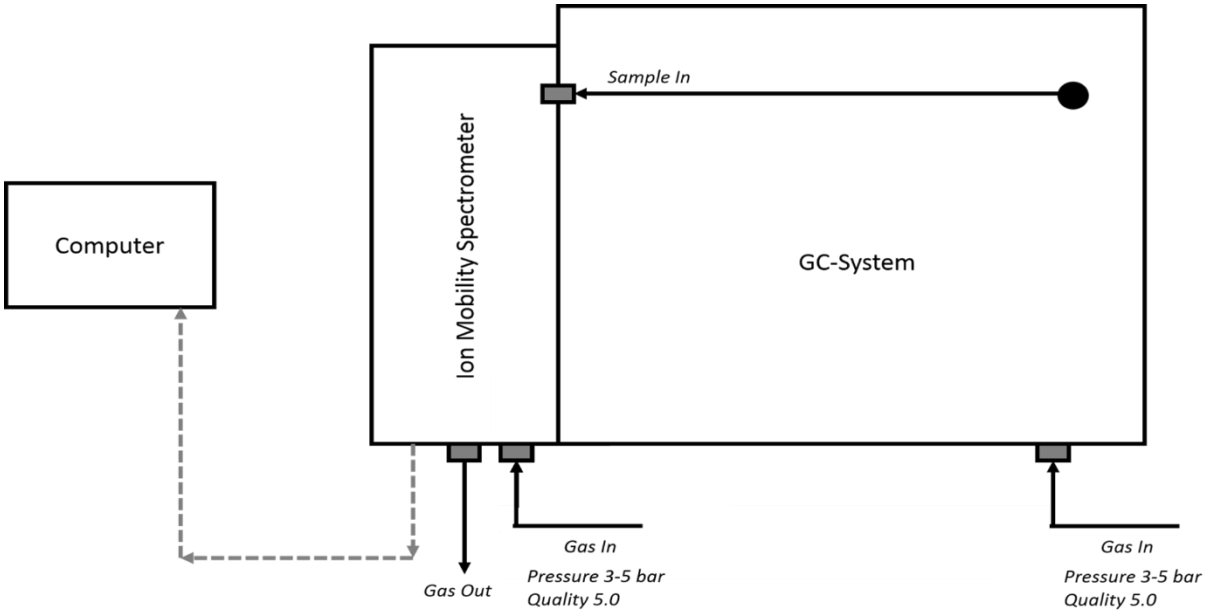


Figure 1: Schematic illustration of the device coupled to a GC

The drift gas is supplied via the **Gas-in port** at the back of the IonMobilitySpectormeter25 into the Ion Mobility Spectrometer. The gas flow is regulated by an electronic pressure controller. The recommended drift gas flow for a Focus-IMS® is 75 ml/min. Please use Nitrogen or synthetic air only. The gas purity of both must be at least of grade 5.0. If such quality is not available a moisture trap can be used between gas source and IonMobilitySpectrometer25 to increase the gas quality.

WARNING!

The maximum flow of the drift gas is 500 ml/min. Higher flow will damage the IMS sensor!

The sample gas is introduced into the IonMobilitySpectrometer25 via the **Sample In port with heated transfer line** at the side of the housing by using the carrier gas of the coupled GC system. The sample gas flow is controlled by the connected GC

system. The consumed drift gas and carrier gas can be vented to the Laboratory ventilation system by connecting an exhaust tube to the **Gas out** port.

WARNING!

Connect the Gas out to an adequate laboratory waste gas ventilation system/fumehood.

5.3 Housing of the device

5.3.1 Front Panel

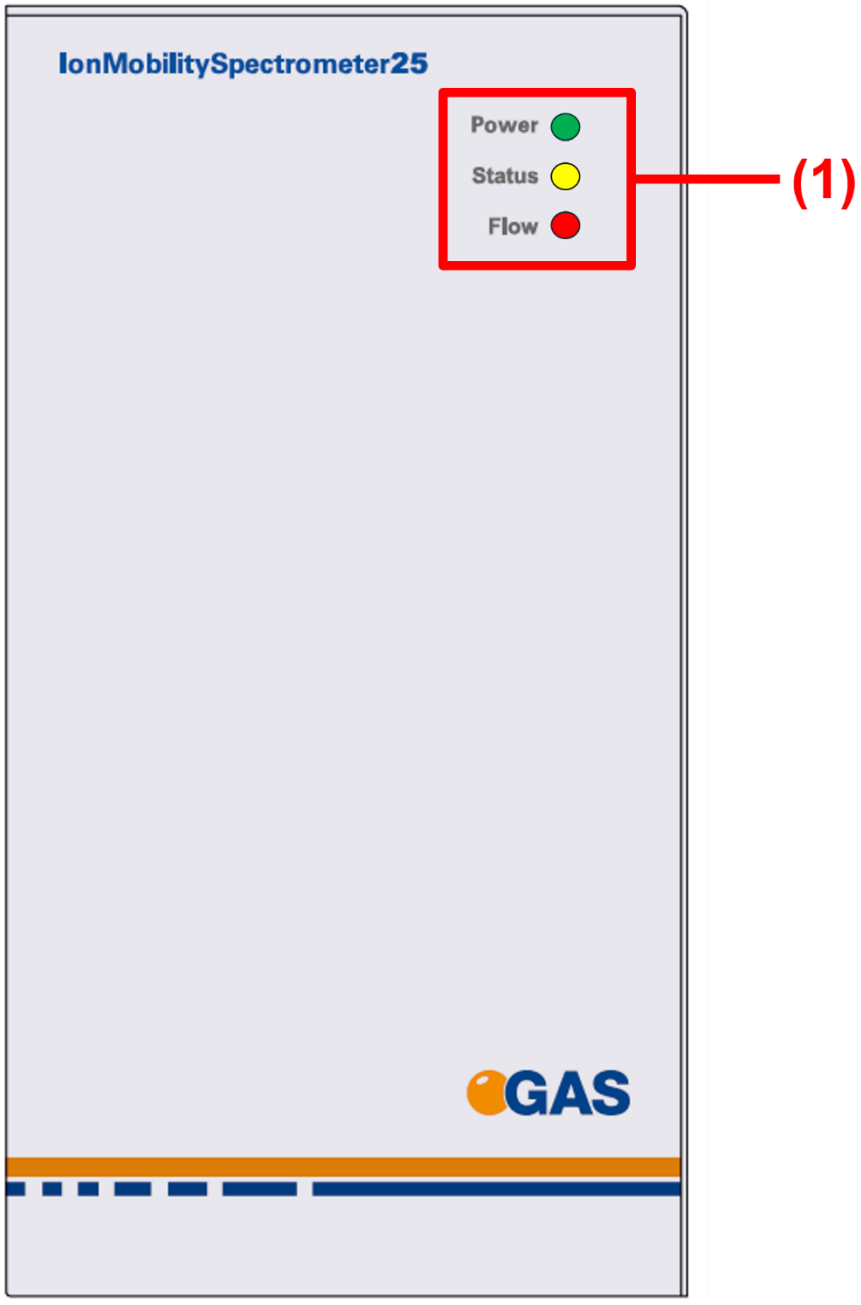


Figure 8: Housing of device - Front

1	**LED**	LEDs for Power, Status and Flow

5.3.2 Rear Panel

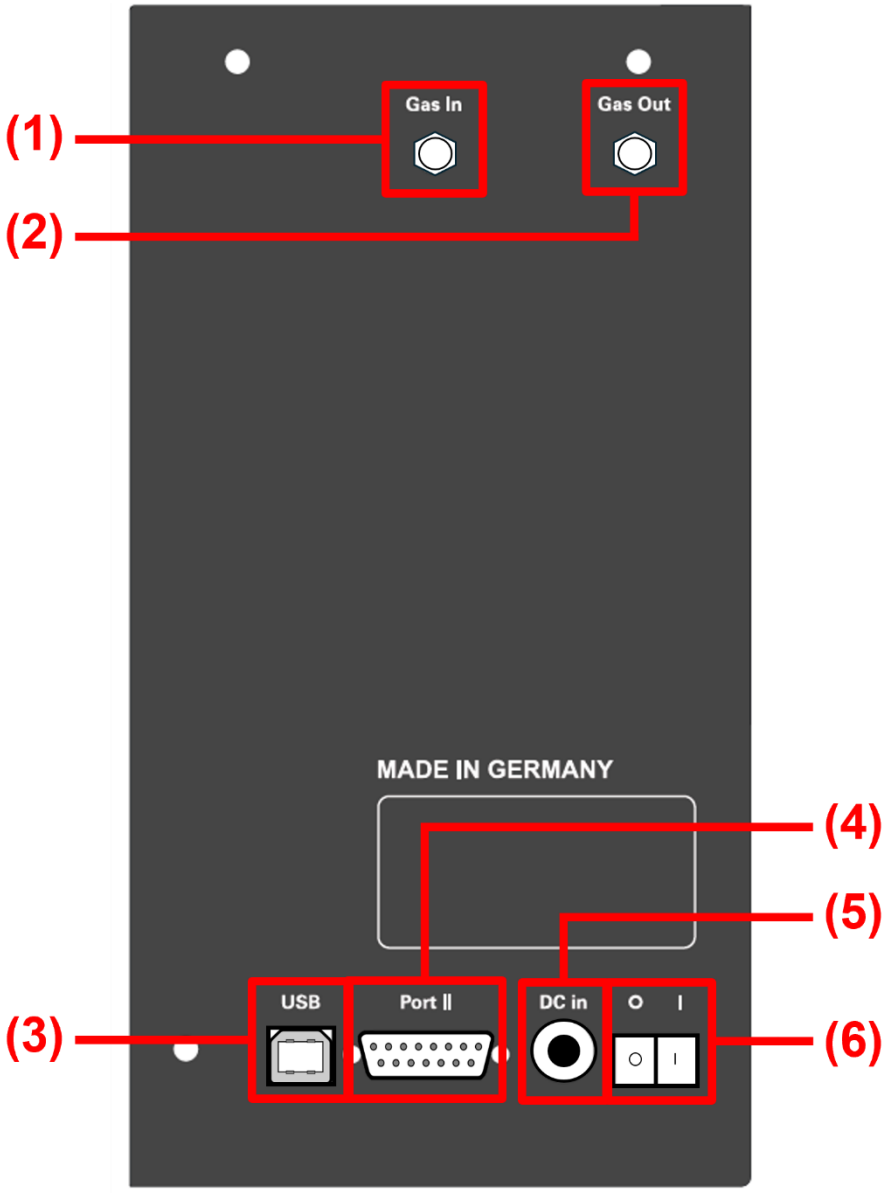


Figure 9: Housing of device - Rear

1	**Gas In**	3 mm stainless steel inlet plug for connecting the IonMobilitySpectrometer25 to a drift gas source.
2	**Gas Out**	3 mm stainless steel plug for connecting the IonMobilitySpectrometer25 to an adequate laboratory waste gas ventilation system/ fumehood.

3	**USB**	USB Socket for communication with a computer.
4	**Port II**	Remote connector for communication with a GC control board. **Optional, not in use at present.**
5	**DC In**	24V Connector to power the IonMobilitySpectrometer25.
6	**On / off switch**	To turn the device on or off.

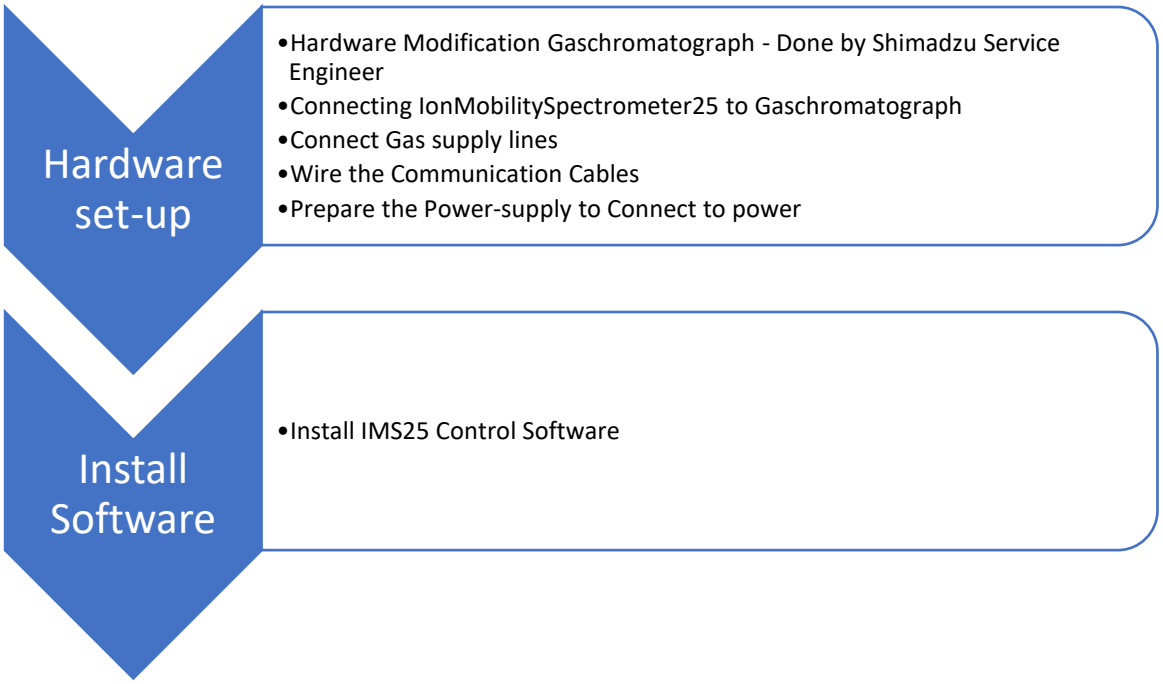
6 Installation Guide

WARNING!

A non-reversable modification of the Hardware is required: Shimadzu Service engineers are trained to make this Hardware modification.

G.A.S. assumes that the customer will arrange for the relevant Shimadzu service engineer to visit at this stage to carry out the hardware modification.
Please note that the hardware modification of your Shimadzu GC, namely the installation of a heated Shimadzu transfer line and the fitting of the IonMobilitySpectrometer25, must be carried out by an Shimadzu service engineer, an Shimadzu-accredited service engineer or a qualified GAS service engineer. If an unqualified and unauthorised person carries out the GC hardware modification, Shimadzu may void the warranty.

6.1 Overview: Steps before powering up the instrument



6.2 Hardware Modification Gaschromatograph:

WARNING!

A non-reversable modification of the Hardware is required: Shimadzu Service engineers are trained to make this Hardware modification.

INFORMATION!

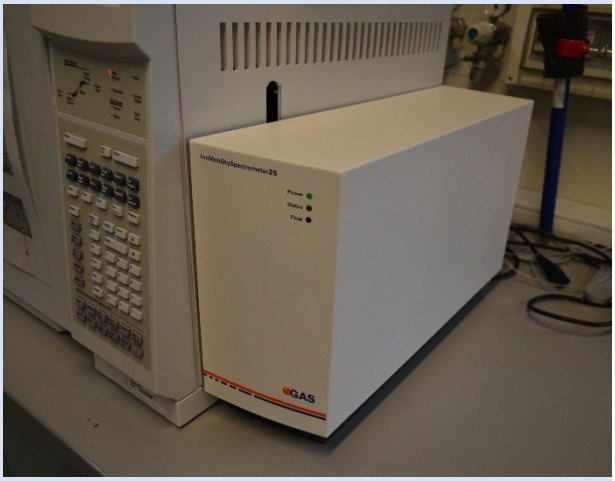
For further information, please refer to the relevant documents:

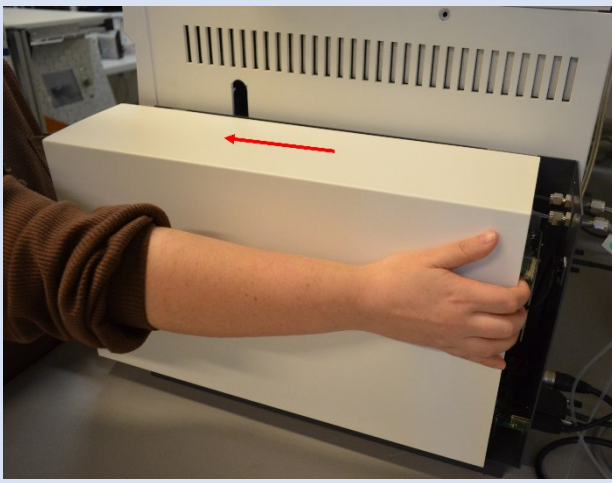
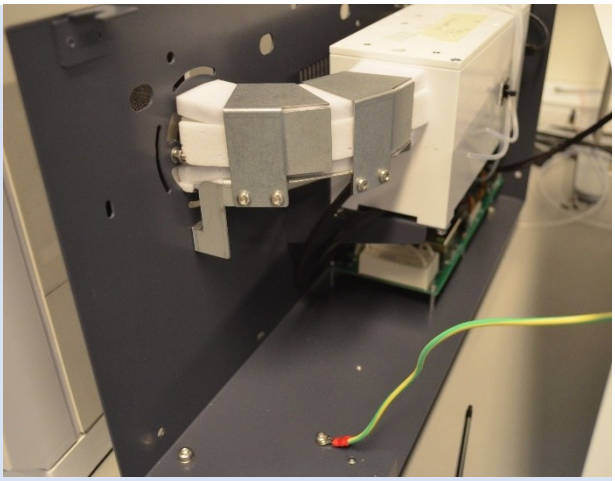
- Installation of heated Transferline Shimadzu
- Shimadzu Interface Heater Unit

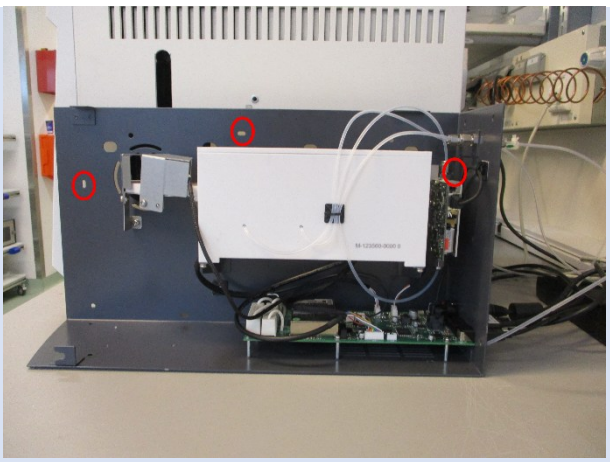
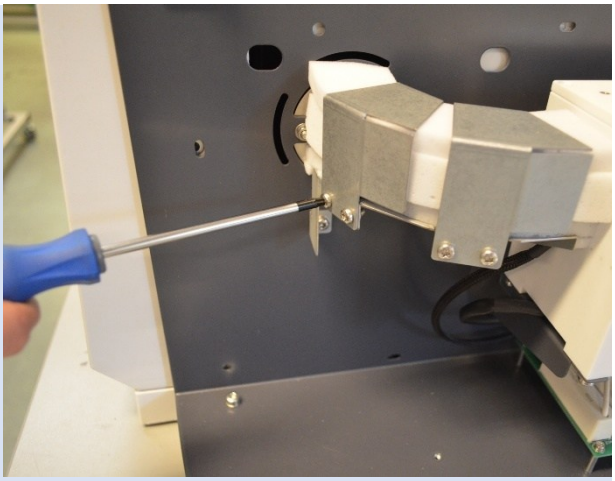
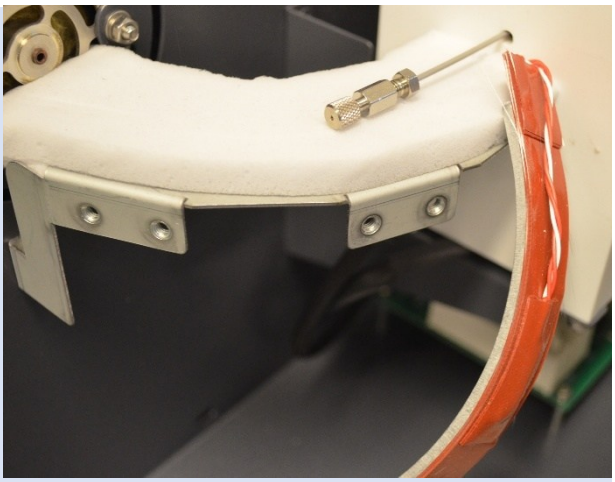
6.3 Installation of IonMobilitySpectrometer25:

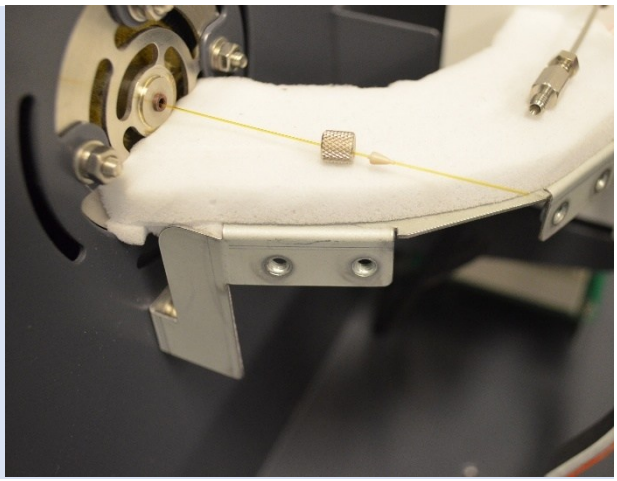
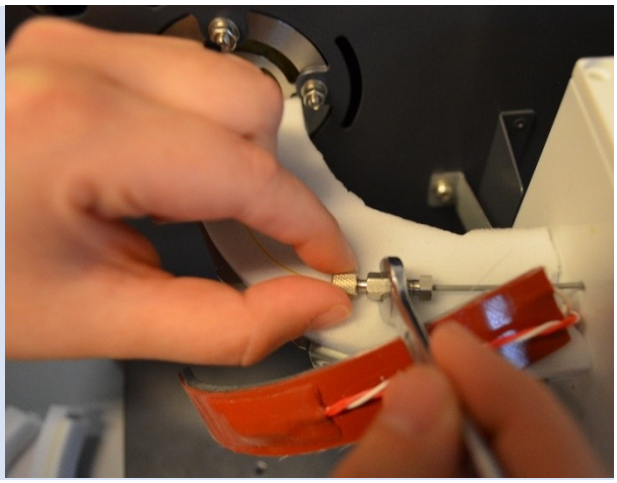
DANGER!

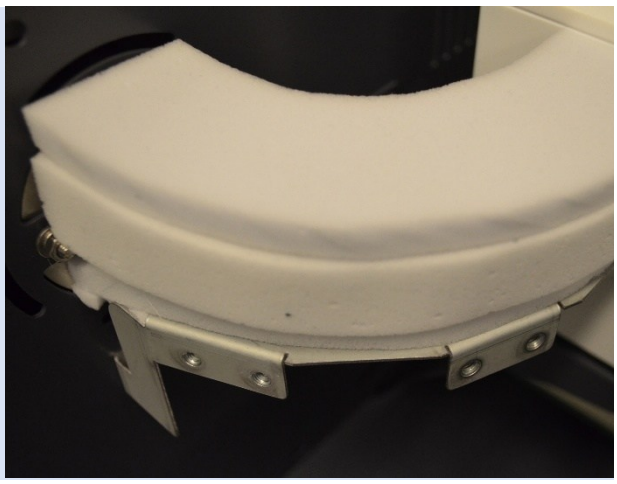
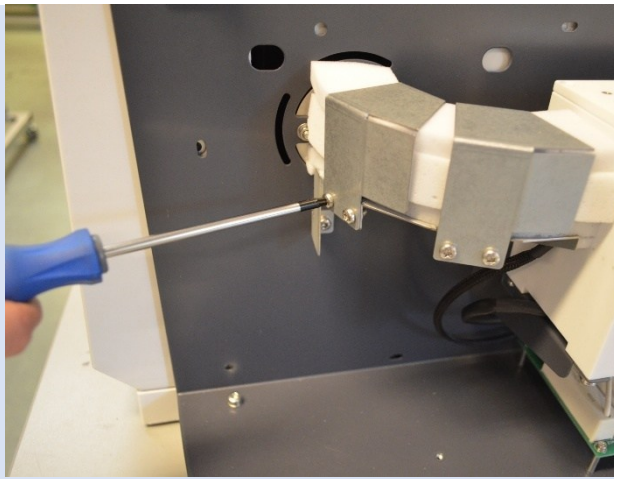
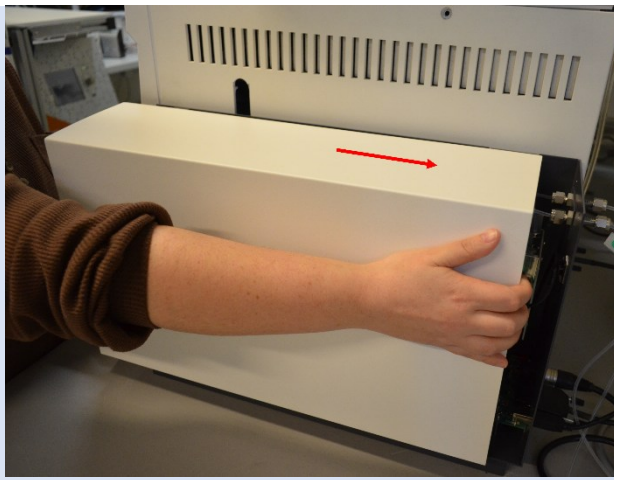
Before all work on the device switch off the device and pull out the power plug!

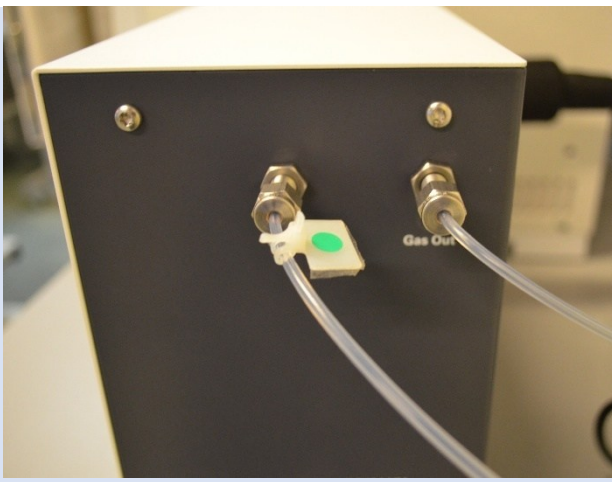
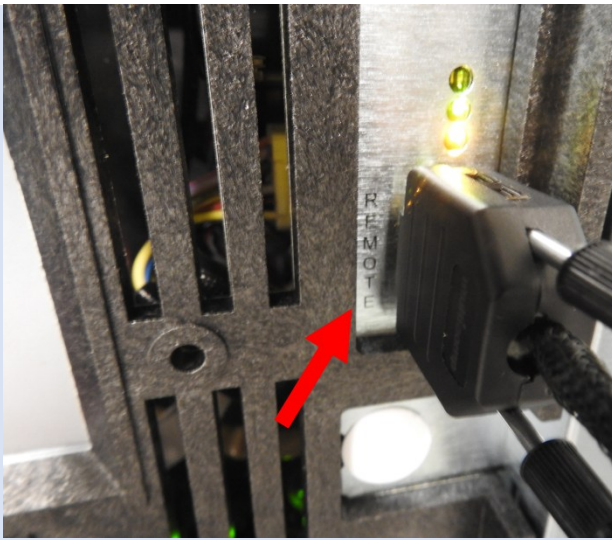
1		Positioning of the IonMobilitySpectrometer25 on the right side.

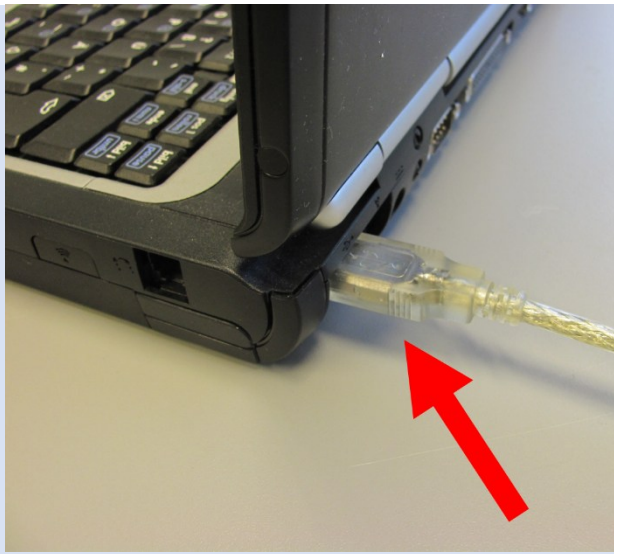
2		Remove the three housing screws on the rear of the device.
3		Pull the housing forward...
4		...and place next to the device.

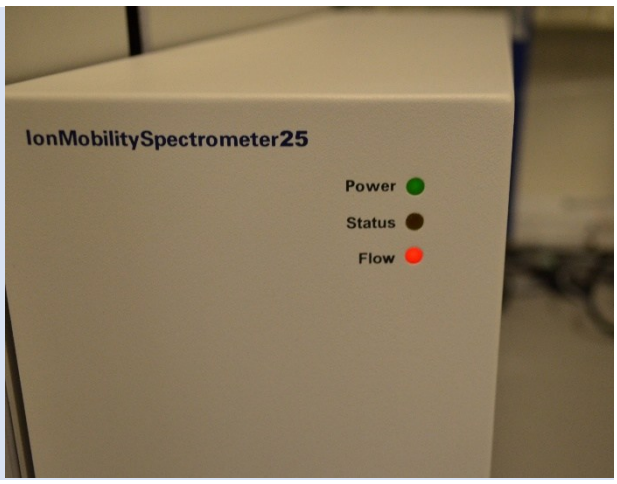
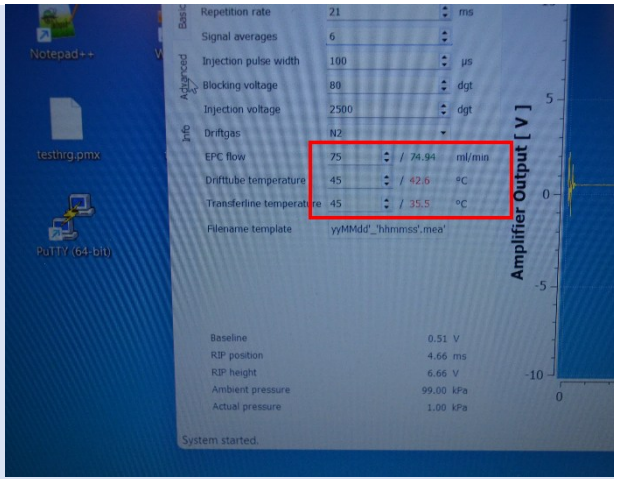
5		Screw the IMS to the side panel at the mounting points.
6		Loosen the screws on the metal brackets and remove the metal brackets of the inlet line.
7		Remove insulation and set the heater aside.

8		Push the column from the GC oven towards the IonMobilitySpectrometer25
9		Slide the screw connection with the correct ferrule onto the column...
10		...and fasten the column securely to the connector.

11		Reinstall and mount heating and insulation parts.
12		Fix the metal brackets back on using the screws.
13		Replace the housing and screw it to the rear of the housing.

14		Connect the drift gas hose to the 3mm Swagelok **Gas In** connection at the front of the device. Connect a waste-tube to the 3 mm stainless steel **Gas Out** connection at the rear of the device to an adequate laboratory waste gas ventilation system (fumehood).
15		Connect one side of the remote cable to Port II connector at the rear of the IonMobilitySpectrometer25
16		Connect the other side of the remote cable to Remote connector at the rear of the GC*. **The picture shows the remote connector of an Agilent GC 7890B.*

17		Connect one end of the USB cable to the USB port at the rear of the device.
18		Connect one end of the USB cable to the USB port of a computer.
19		Connect the power supply to the **DC in** connection at the rear of the device and switch the device on.

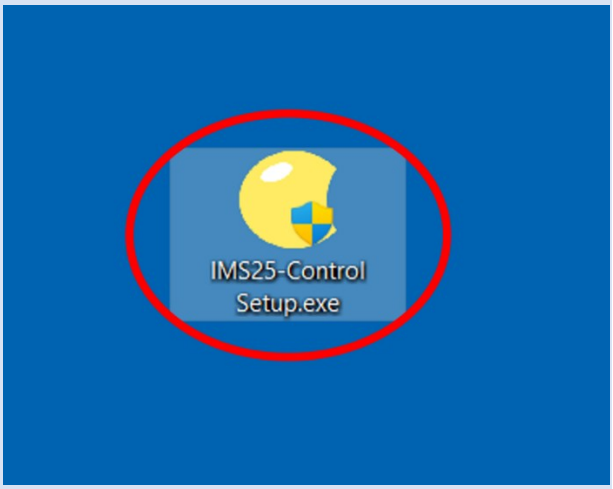
20		After switching on, the device still has no flow. The flow indicator light on the front of the device is red.
21		Start the ‘IMS25-Control’ software and enter the necessary parameters (Software installation see chapter 6.4.).

6.4 ‘IMS25-Control’ Software Installation

INFORMATION!

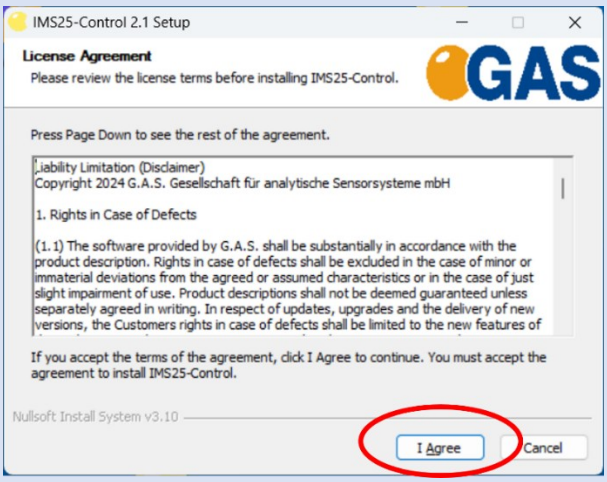
Before using the IonMobilitySpectrometer25 for the first time the software and associated drivers must be installed.

1



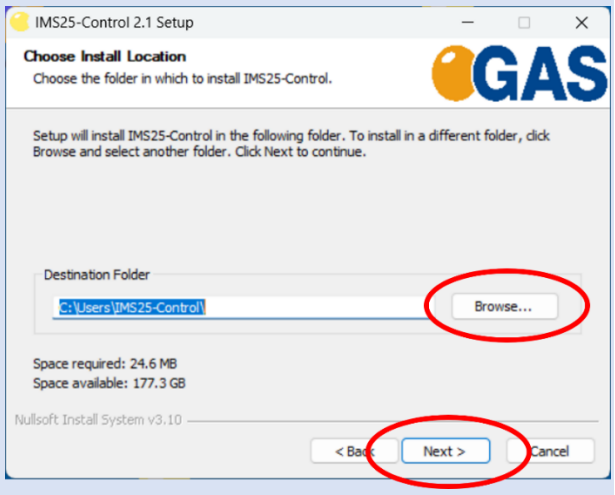
Start the ‘IMS25-Control’ Setup.exe to install the program.

2



Accept the license terms.

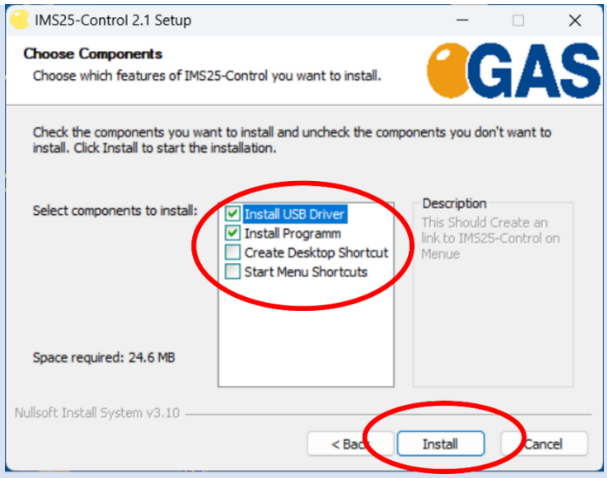
3



To change the standard destination folder for installation click on **'Browse'** (optional step!).

Continue by selecting **'Next'**.

4



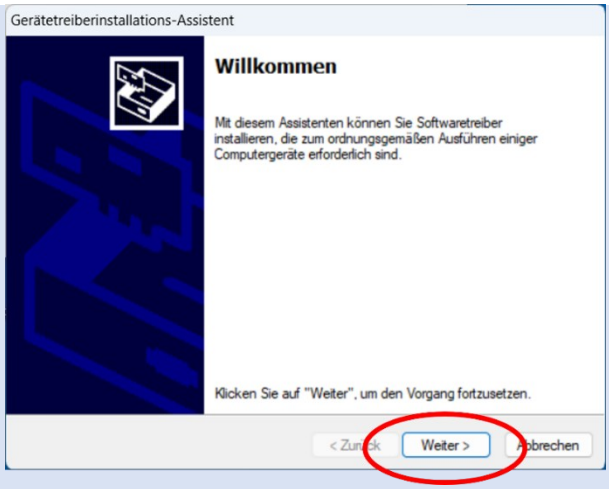
Choose the components to install by checking or unchecking the corresponding boxes.

Install Programm should be checked.

Install USB Driver should be selected during the first installation.

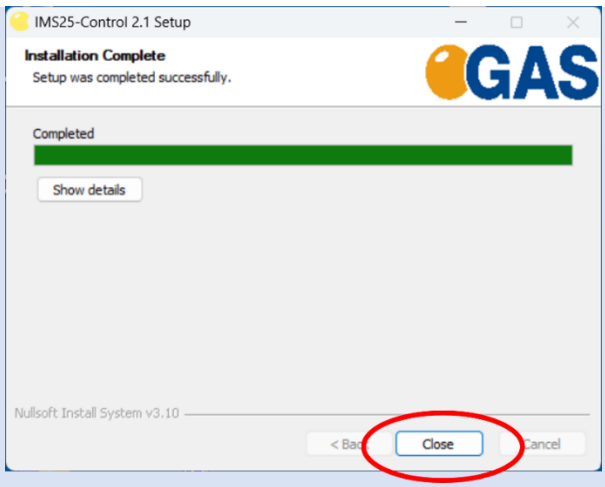
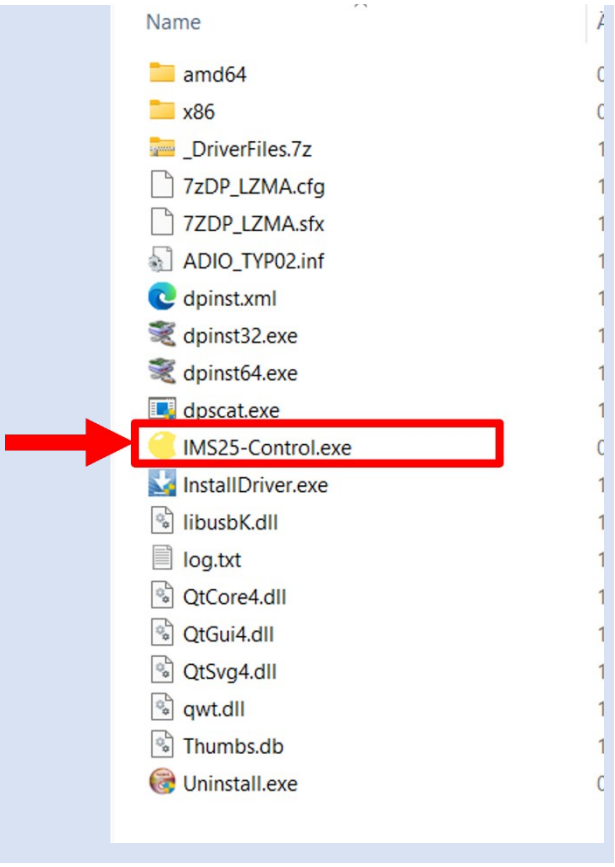
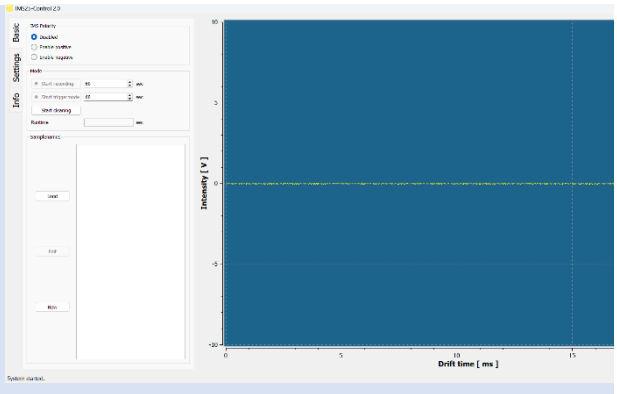
Continue by selecting **'Install'**.

5



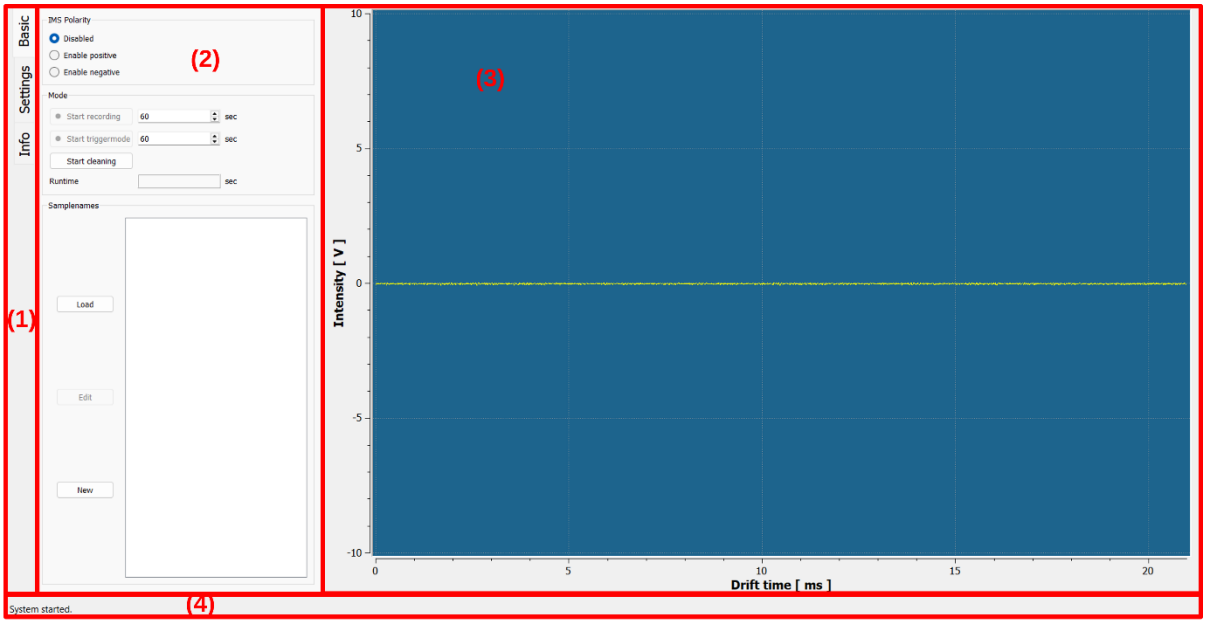
If selected, the USB device driver is installed first.

Select **'Continue'**.

6		Select the **'Close'** button to complete the installation procedure.
7		In the destination folder, open the file IMS25-Control.exe to start the software. **This step only works after the hardware is completely installed (chapter 6.3).**
8		The standard screen of the software opens.

7 IMS25-Control Software

7.1 Main Screen



1	**Window selection bars**	Allows the selection of the following sub-windows: • Basic (Standard window) • Settings • Info
2	**Current settings / Information window**	Displays the current setting / information window of the selected sub-window.
3	**Online monitoring window**	Displays the current measurement.
4	**Status bar**	Displays status information.

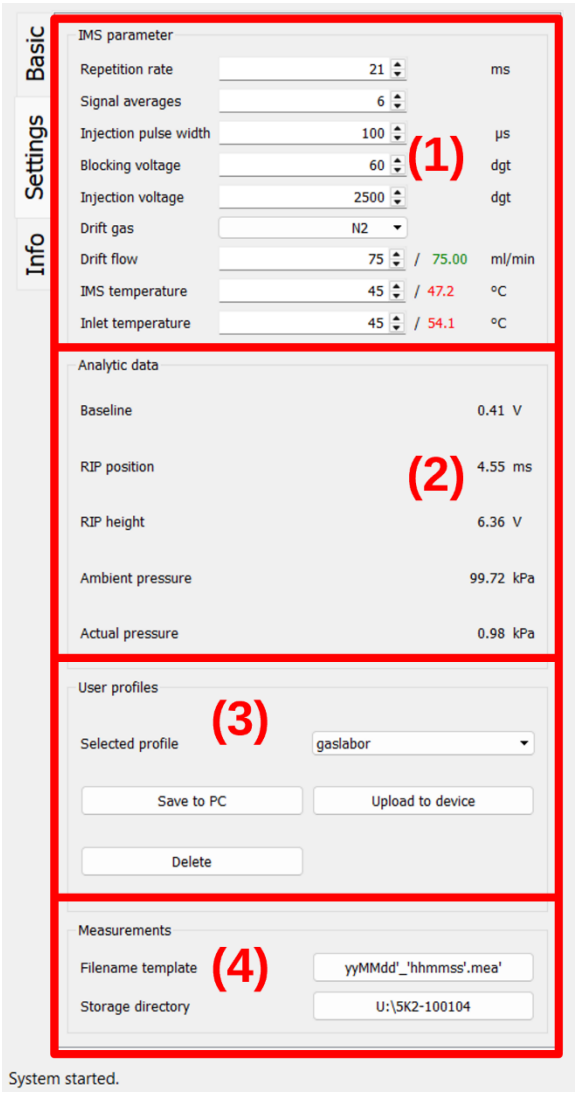
7.2 Basic Window

1	**IMS Polarity check boxes**	The Drift voltage polarity can be set by using the checkboxes: - disabled - positive polarity - negative polarity
2	**Start Recording box**	Enables the measurement recording. With this box the live monitoring of measurements can be recorded. By clicking this box, the recording starts immediately.
3	**Recording time Set point**	The duration of the measurement can be set. The unit is seconds.

4	**Start triggermode box**	Enables the measurement recording in remote mode. If a trigger signal is present, the recording starts immediately by activating this box by clicking on it.
5	**Triggermode Recording time Set point**	The duration of the measurement in remote mode can be set. The unit is seconds.
6	**Start Cleaning box**	Enables the device to be cleaned. The Driftgas flow is set to 200 ml/min and the IMS and Inlet temperature is set to their maxima of 140 °C.
7	**Runtime box**	The time is displayed here during a measurement.
8	**Samplenames**	Here you can describe your Sample. VOCal will show the Samplename in the metadata. Selecting the New button opens an input window here, the sample names can be entered as a list that can be saved as a txt file. Selecting the Load button a stored text file can be loaded. Selecting the Edit button a stored text file can be edited.

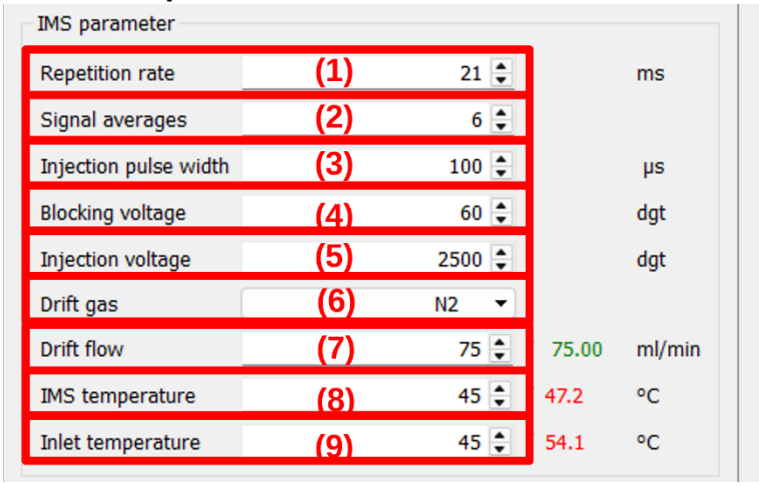
7.3 Settings Window

The settings window is divided into four areas:



1	**IMS Parameter**	In this area several IMS parameter can be set.
2	**Analytic data**	In this area current analytical parameters are displayed.
3	**User profiles**	User-specific settings can be saved in this area.
4	**Measurements**	Filename template and Storage directory can be set.

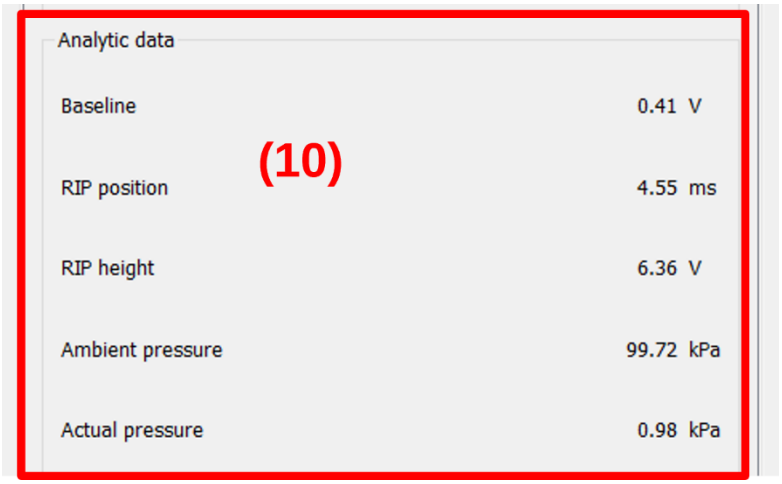
7.3.1 IMS parameter



1	**Repetition rate**	Enables the repetition rate. The default value is 21 ms. This setting does not need to be changed.
2	**Signal averages**	The number of averages can be set. The averaging value determines how many raw spectra are averaged to generate one single spectrum as result in the stored measurement file.
3	**Injection pulse width**	The injection pulse width can be set. Values are given in microsecond (µs). The default value is 100 µs This setting does not need to be changed.
4	**Blocking voltage**	The blocking voltage can be set. The default value is sensor dependent and preset. This setting does not need to be changed by the user.
5	**Injection voltage**	The injection voltage can be set. The default value is sensor dependent and preset. This setting does not normally need to be changed by the user.
6	**Drift gas**	Following drift gases can be set here: -Air -N_2 -He -H_2 -O_2 -CO_2 **Normally N_2 or Air is used.**

7	**Drift flow**	The drift gas flow can be set here, and the current flow is displayed next to it. The values are in millilitre per minute. Valid values: 0 - 500 ml/min The recommended value is 75 ml/min. The colours (green or red) indicate whether the setpoint has been reached or not.
8	**IMS temperature**	The inlet temperature can be set here, and the present inlet temperature is displayed next to it. The values are in degree Celsius. Valid values: 0 – 120 °C The standard value is 45 °C.
9	**Inlet temperature**	The inlet temperature can be set here, and the present inlet temperature is displayed next to it. The values are in degree Celsius. Valid values: 0 – 120 °C The standard value is 45 °C. The colours (green or red) indicate whether the setpoint has been reached or not.

7.3.2 Analytic data



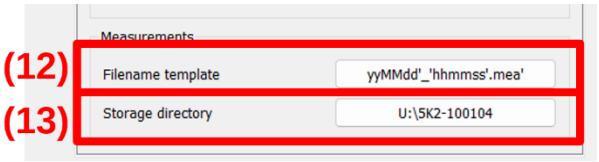
10	**Statistics window**	Different values of the actual measurement are displayed. The following values are displayed: - Baseline - RIP position - RIP height - Ambient pressure - Actual pressure

7.3.3 User profiles

11	**User profiles**	User-specific IMS parameters can be created and selected. Settings can be saved as a profile and temporarily stored in the program. **Selected profiles:** A saved profile can be selected.

		Save to PC: A profile name can be specified and saved in the program. **Upload to device:** A saved profile can be selected from the selection table and loaded. **Delete:** A profile selected in the selection table can be deleted.

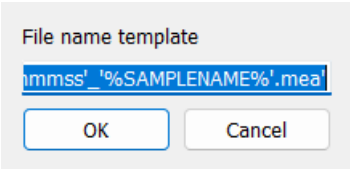
7.3.4 Measurements



12	**Filename template**	An individual filename template can be chosen.
13	**Storage directory**	A storage location can be set.

7.3.4.1 Filename template window

By selecting the ‘Filename template’ button, the following window will be displayed:



The default Filename template is yyMMdd’_’hhmmss’.mea’_’%SAMPLENAME%’.

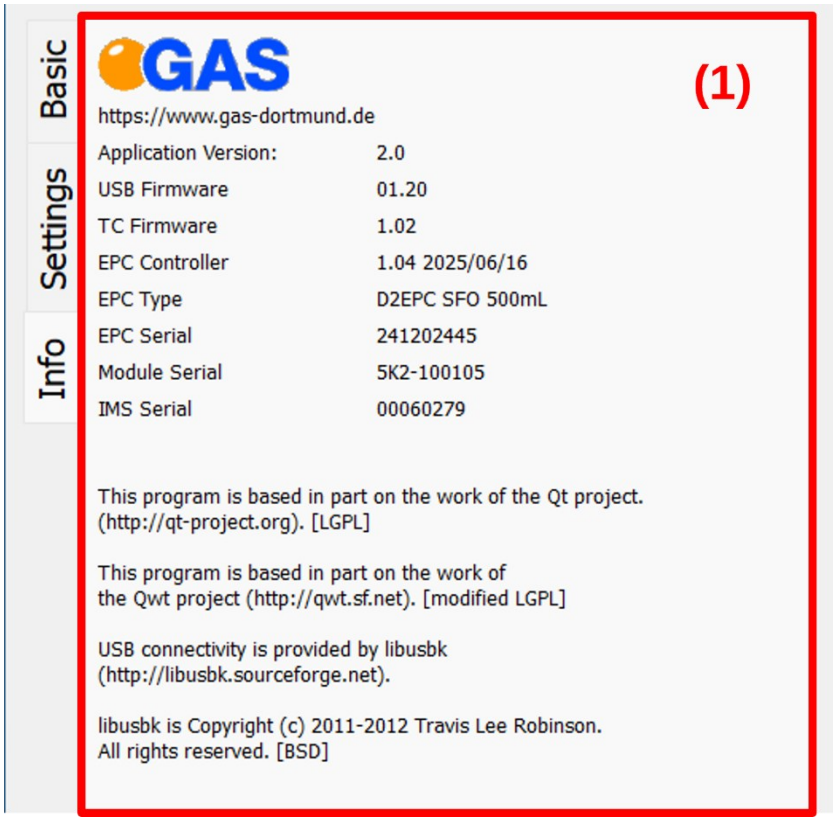
The %SAMPLENAME% index causes the sample name to be appended to the name from an existing sample list.

The default Filename template can be edited. The characters written between apostrophes (‘…’) are taken over. All characters that are allowed by the windows operating system can be used. The following table shows the valid values that are evaluated by the system:

Value	Description
%SAMPLENAME%	Name of sample from list. Quoted text is transferred as it is.
%SAMPLEINDEX%	the Sample number (only in triggermode)
d	the day as number without a leading zero (1 to 31)
dd	the day as number with a leading zero (01 to 31)
ddd	the abbreviated localized day name (e.g. 'Mon' to 'Sun').
dddd	the long localized day name (e.g. 'Monday' to 'Sunday').
M	the month as number without a leading zero (1-12)
MM	the month as number with a leading zero (01-12)
MMM	the abbreviated localized month name (e.g. 'Jan' to 'Dec').
MMMM	the long localized month name (e.g. 'January' to 'December').
yy	the year as two digit number (00-99)
yyyy	the year as four digit number
h	the hour without a leading zero (0 to 23 or 1 to 12 if AM/PM display)
hh	the hour with a leading zero (00 to 23 or 01 to 12 if AM/PM display)
H	the hour without a leading zero (0 to 23, even with AM/PM display)
HH	the hour with a leading zero (00 to 23, even with AM/PM display)
m	the minute without a leading zero (0 to 59)
mm	the minute with a leading zero (00 to 59)
s	the second without a leading zero (0 to 59)
ss	the second with a leading zero (00 to 59)
z	the milliseconds without leading zeroes (0 to 999)

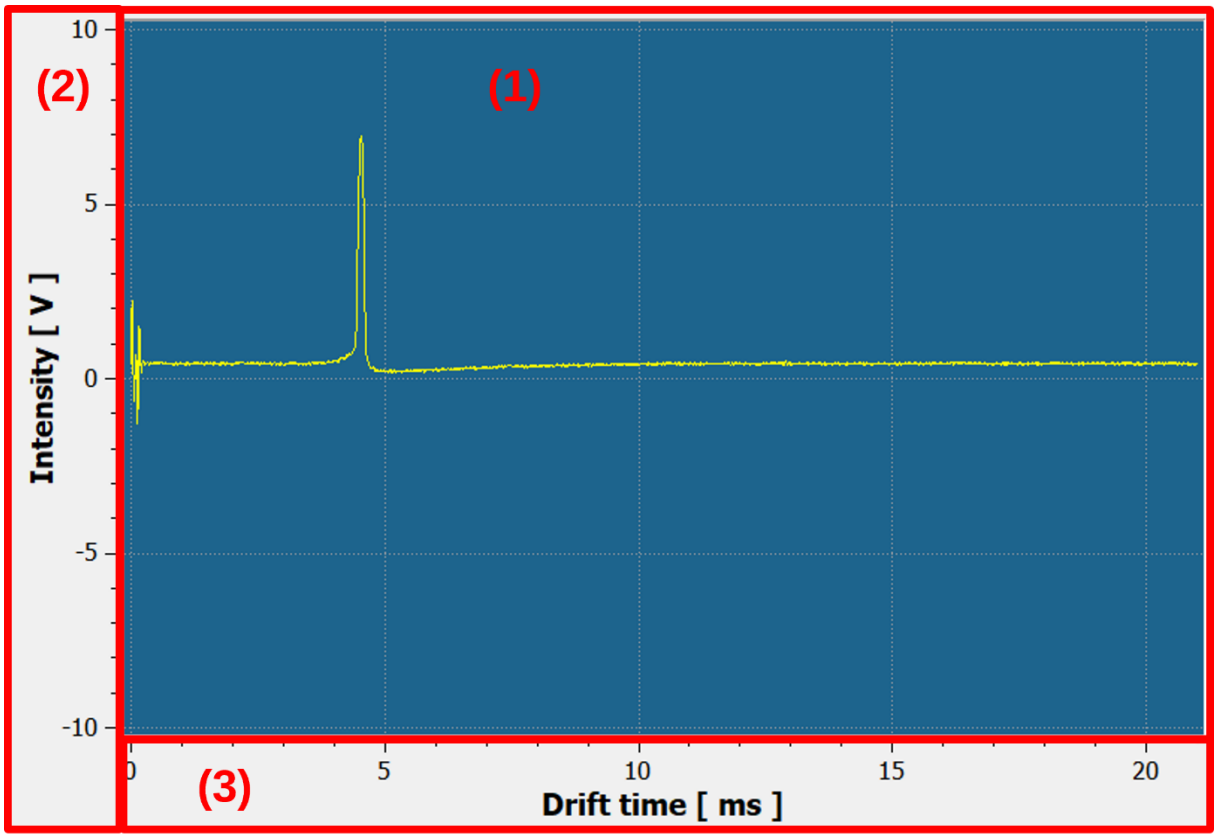
zzz	the milliseconds with leading zeroes (000 to 999)
AP or A (ap or a)	interpret as an AM/PM (am/pm) time. AP must be either "AM" or "PM" (“am” or “pm”).

7.4 Info Window



1	**Info window**	Shows general Software and hardware information.

7.5 Monitoring window

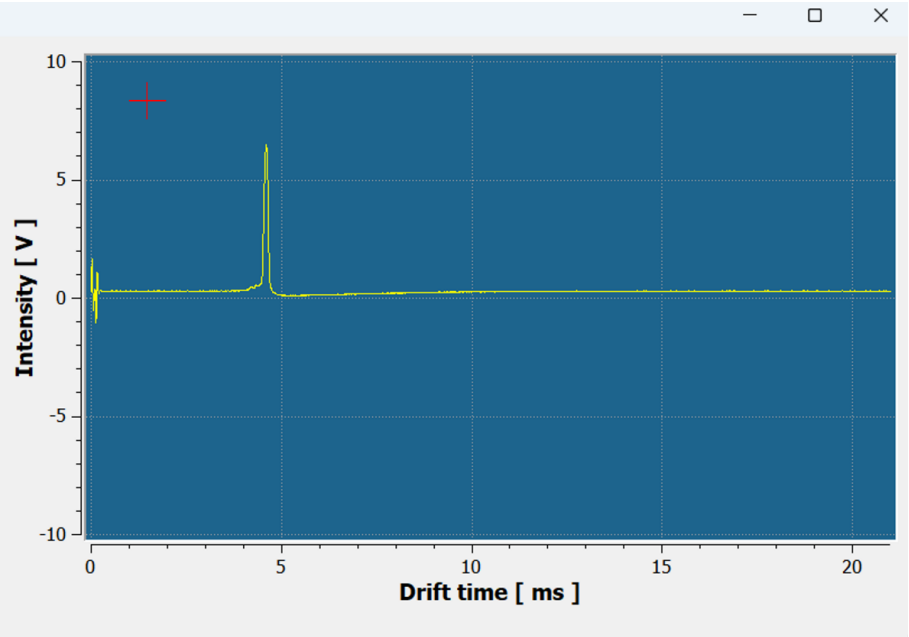


Next to the **Current settings / Information window** the monitoring of the actual detector signal is shown in Single IMS Spectrum View.

1	**Screen**	Single IMS Spectrum View
2	**Y-axis left**	Signal intensity in volt
3	**X-axis**	Drift time in milliseconds

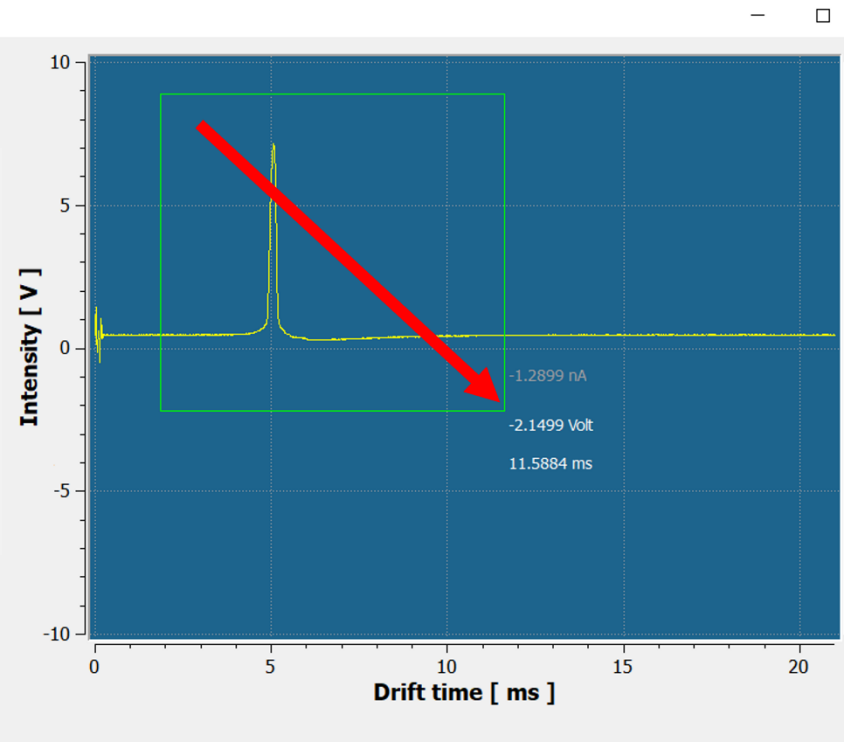
7.5.1 Zooming

1.



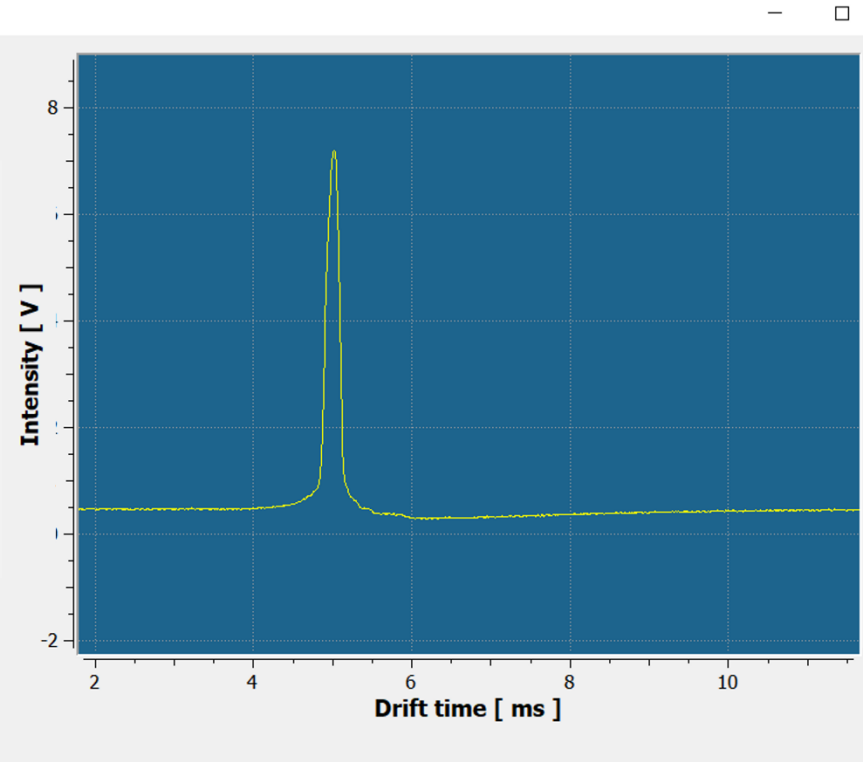
Move the mouse into the screen. The mouse cursor will be displayed as a list of values.

2.



Click with the left mouse button into the screen and keep the left mouse button pushed.
Drag your mouse from top left to bottom right. The selection bar is outlined in green.

3.



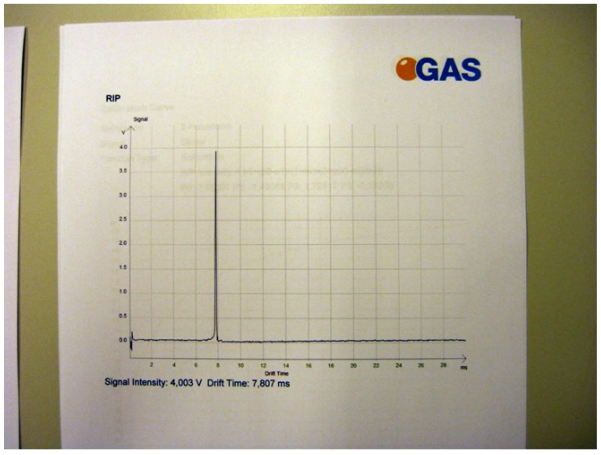
Releasing the left mouse button the view is zoomed into the selection bar. To minimize the view, move the mouse into the screen and click the right mouse button . The view return to the previous view. By repeated clicking the right mouse button you can go backwards step by step.

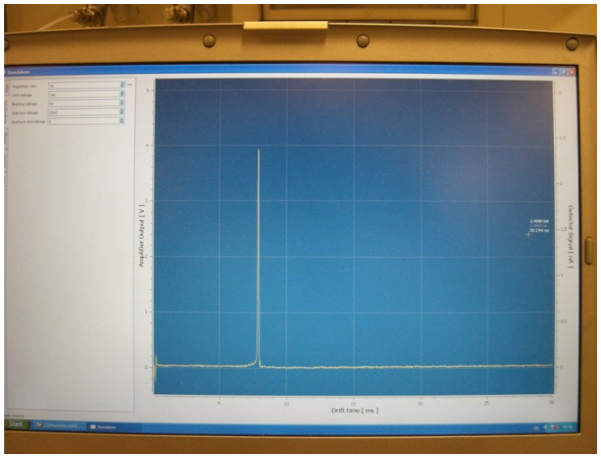
8 System Operation

8.1 Start operating the Ion Mobility Spectrometer

As a first step the device has to be cleaned to reach proper conditions. The cleaning period is depending on how long the device was switched off. Install the device, (Chapter 6.3) and set the working **input pressure** of the drift gas to **4-6 bar (rel.)**. Install the 'IMS25-Control' software (Chapter 6.4), select the cleaning Button and setup a cleaning time of minimum 15 hours.

After cleaning and cool down of the System (~2 hours) the RIP in the positive drift voltage mode should reach **~80% of the RIP-Height** displayed in the delivered **Analytical Approval** under additional conditions.





If this is not the case, check the quality of your gas and/or install additional purification cartridges and start the cleaning procedure again

INFORMATION!

This information is based on the assumption that the device has not been switched off longer than 14 days.

Only use stainless steel pressure reducer, PTFE tubes with 3 mm outer diameter and 3 mm Swagelok connectors.

Ensure that you use **Nitrogen 5.0**.

To ensure a high purity of the gas install the provided moisture trap

8.2 Measurement default values

The following table shows possible and useful values to run a measurement. All values are adaptable and can be changed. Certain values like the drift time voltage are sensor specific and should therefore not be changed. Other values like the recording time should be adjusted to individual needs (see table below).

Parameter	positive Polarity	negative Polarity
Recording time (sec)	60**	60**
Repetition rate (ms)	21*	21*
Signal averages	6**	6**
Injection pulse width (µs)	100*	100*
Blocking voltage	50*	-10*
Injection voltage	2500*	-2000*
Drift gas	N2**	N2**
Drift flow (ml/min)	75**	75**
IMS temperature (°C)	45**	45**
Inlet temperature (°C)	45**	45**

* individual default value (usually need not be changed)
** example value (should be adjusted to individual needs)

8.3 Possible value range

All parameters of the IonMobilitySpectrometer25 can be set in the 'IMS25-Control' software. The following table shows the possible value range.

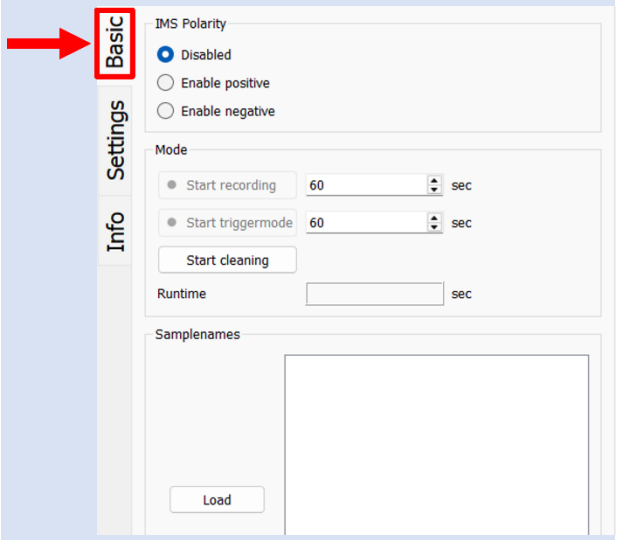
Parameter	Value range
Recording time (sec)	0 - 86400
Trigger time (sec)	0 - 86400
Cleaning (h)	1 - 24
Repetition rate (ms)	2- 200
Signal averages	0 - 99
Injection pulse width (µs)	0 - 2000
Injection voltage (dgt)	0 - 4095
Drift gas	**Air**, **N2**, He, H2, O2, CO2
Drift flow (ml/min)	0-500
IMS temperature (°C)	0-120
Inlet temperature (°C)	0-120

INFORMATION!

Note that wrong values could damage the sensor. Be careful when setting these. In case of doubts, please contact the G.A.S. hotline.

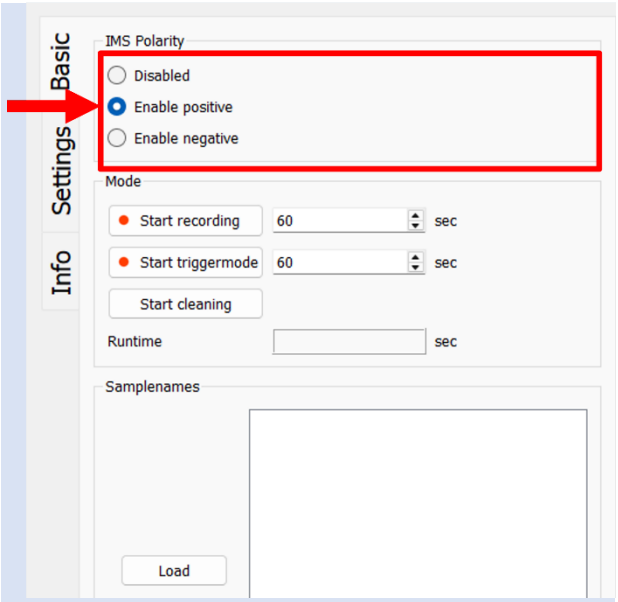
8.4 General IMS Parameter settings

1



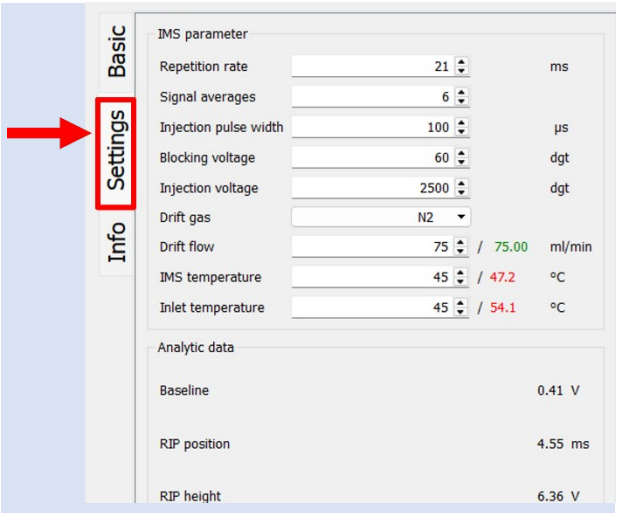
Select the **'Basic'** Window.

2



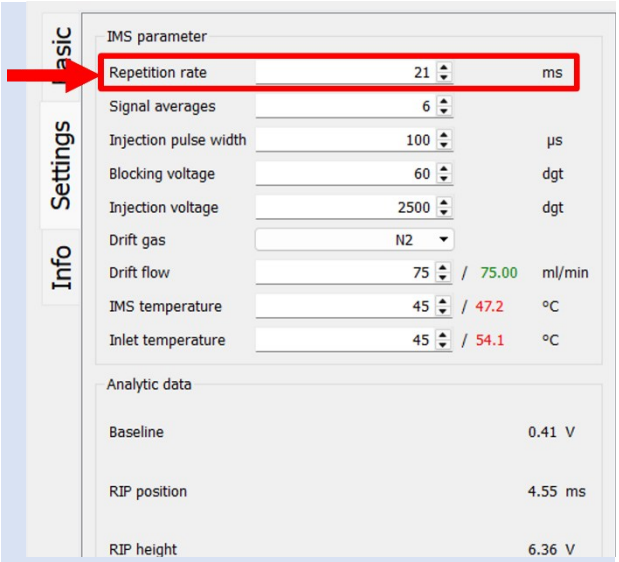
Activate the Drift voltage polarity.

3



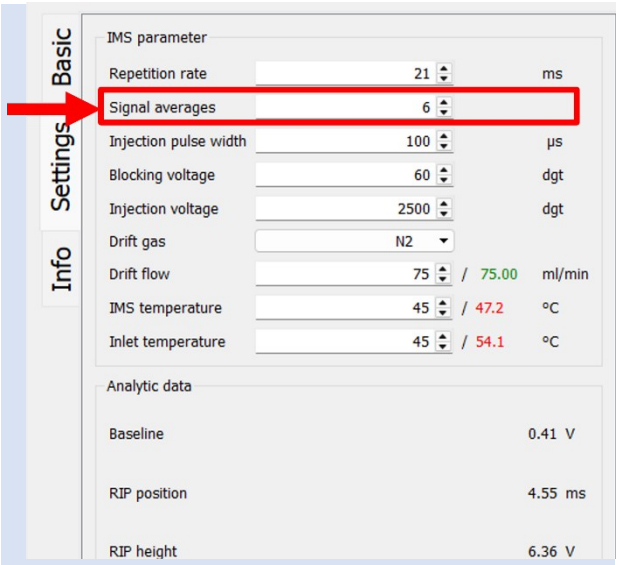
Select the **'Settings'** window.

4



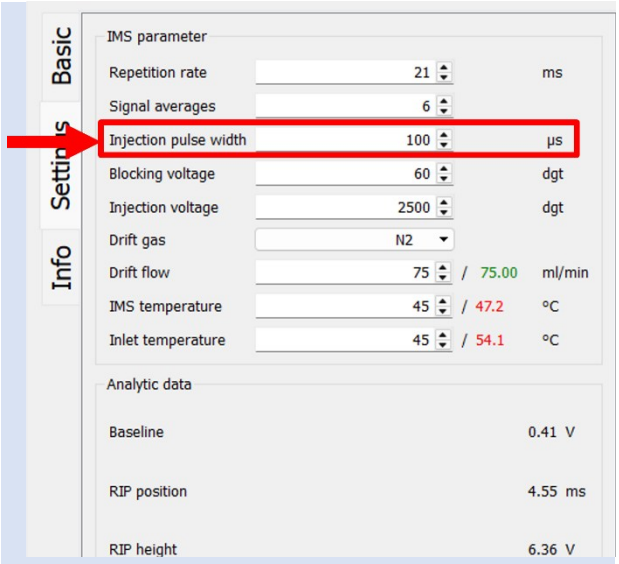
Setting of the ‘Repetition rate’. The default value is 21 ms. This setting does not need to be changed.

5



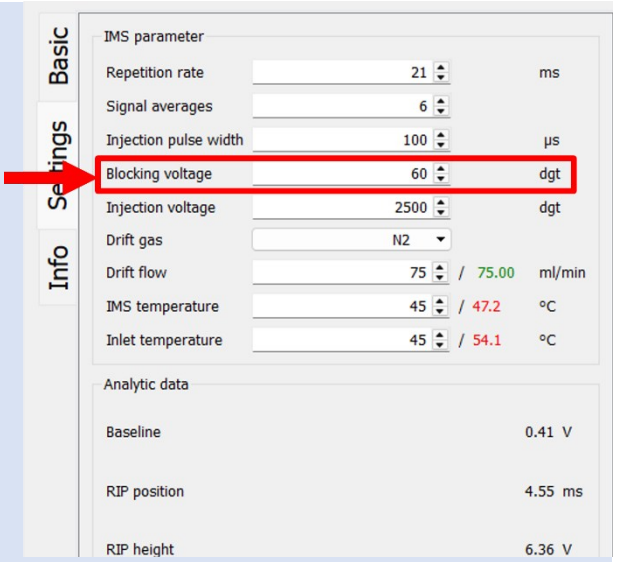
Setting of the ‘Signal averages’. The default value after switching on the system is 0. Typical settings are 6 or 12.

6



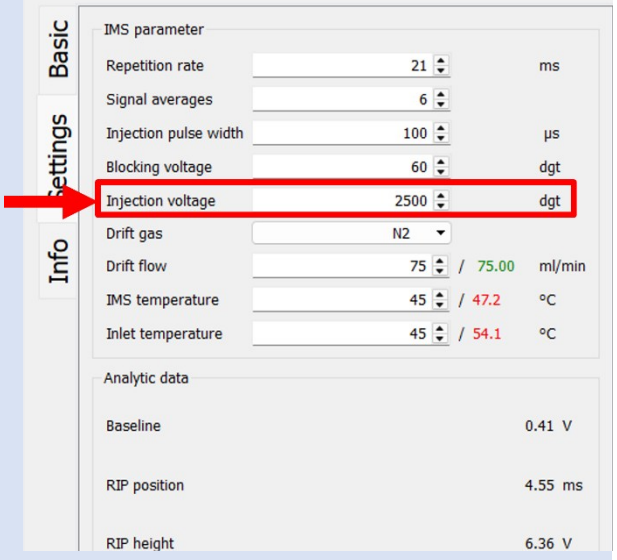
Setting of the ‘Injection pulse width’. The default value is 100 µs.

7



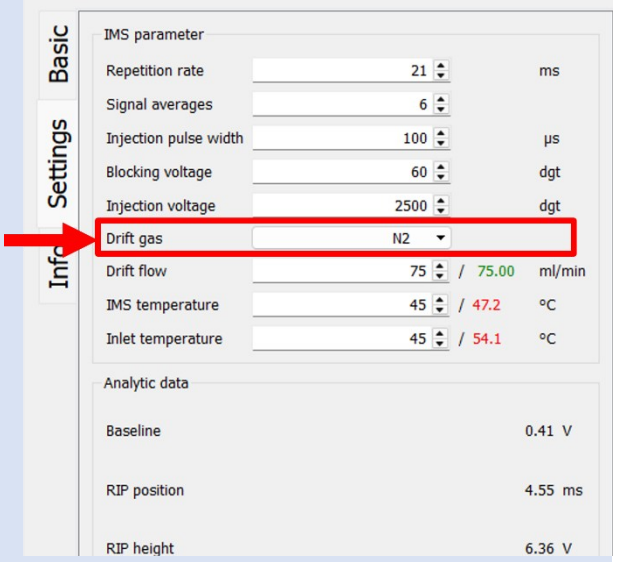
Setting of the 'Blocking Voltage'. The default value varies between sensors and has been uploaded as factory default value preset. This setting can be adjusted by the user if necessary.

8



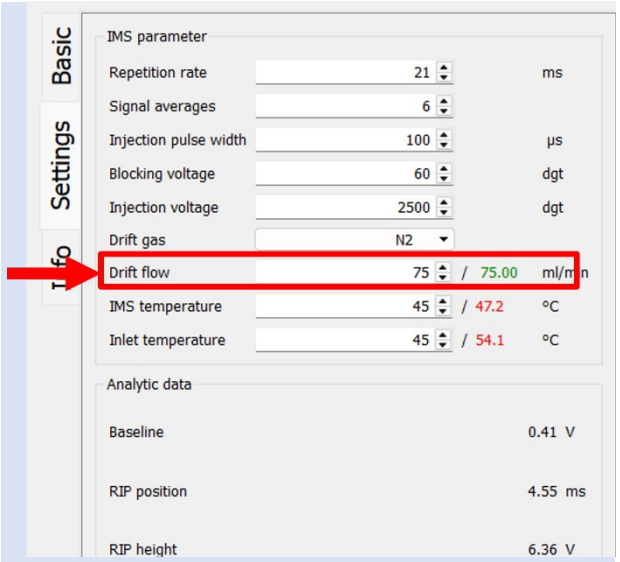
Setting of the 'Injection voltage'. The default value varies between sensors and has been uploaded as factory default value preset. This setting can be adjusted by the user if necessary.

9



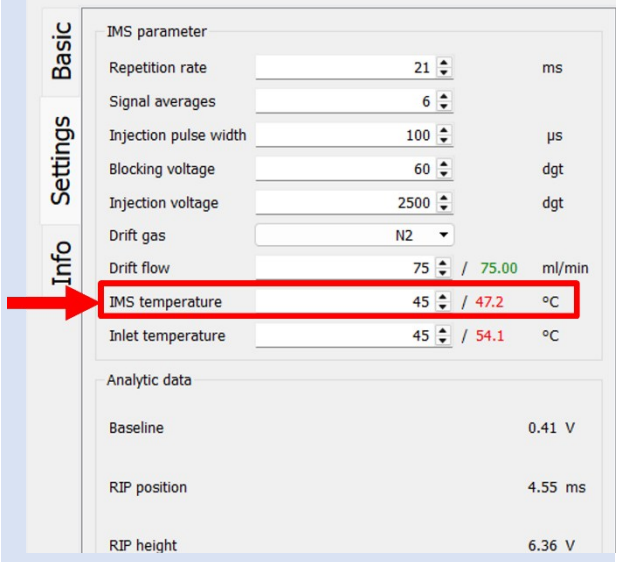
Setting of the 'Drift gas'. The default value is N2. Typical drift gases are nitrogen or synthetic air.

10



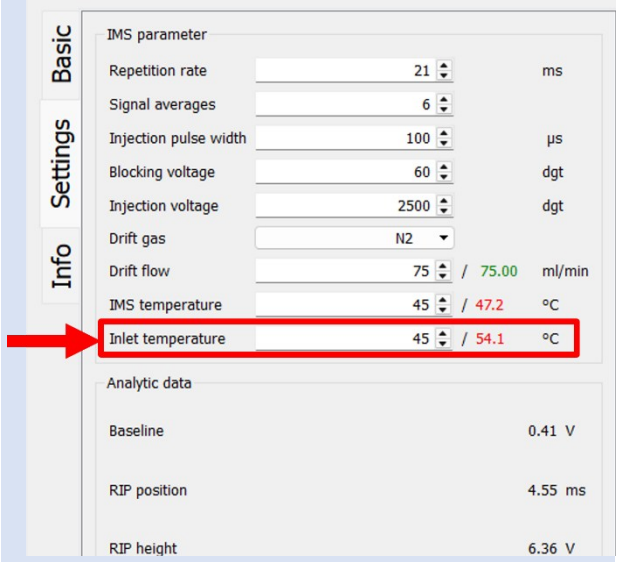
Setting of the 'Drift flow'. The default value after switching on the system is 0 ml/min. A recommended Drift flow for Focus-IMS® is 75 ml/min.

11



Setting of the 'IMS temperature'. The default value after switching on the system is 0°C. Typical settings are depending on the application. A recommended IMS temperature for Focus-IMS® is 45 °C.

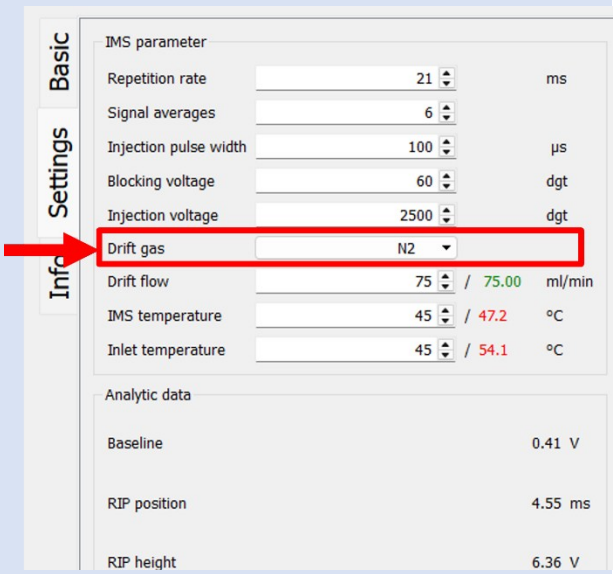
12



Setting of the 'Inlet temperature'. The default value after switching on the system is 0°C. Typical settings are depending on the application.

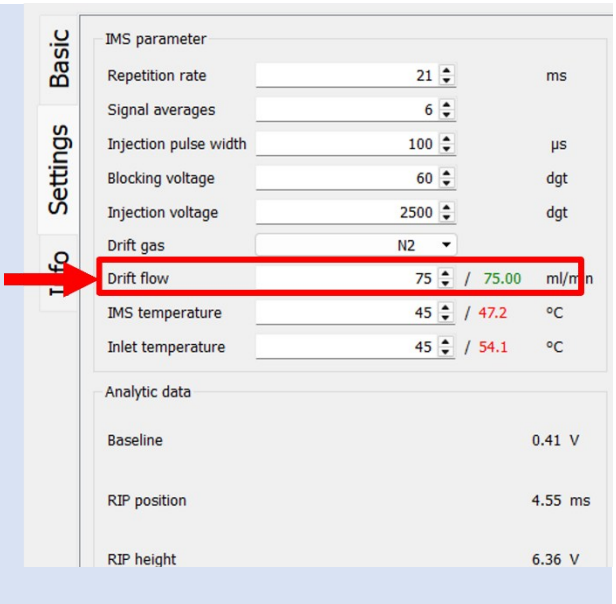
8.5 Recording a measurement

1

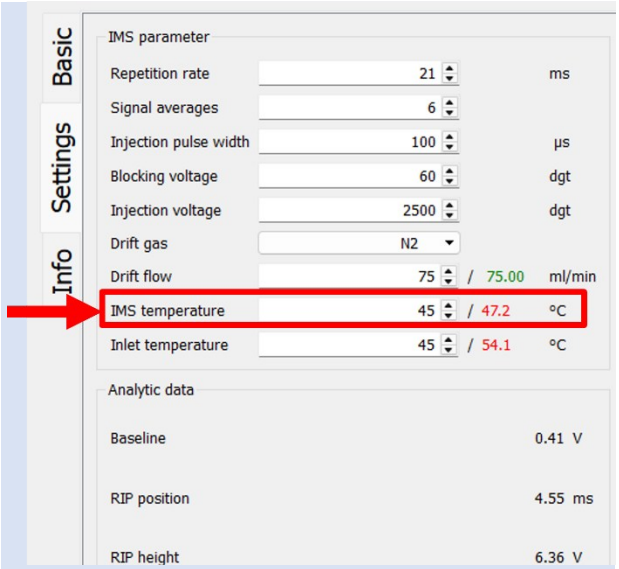
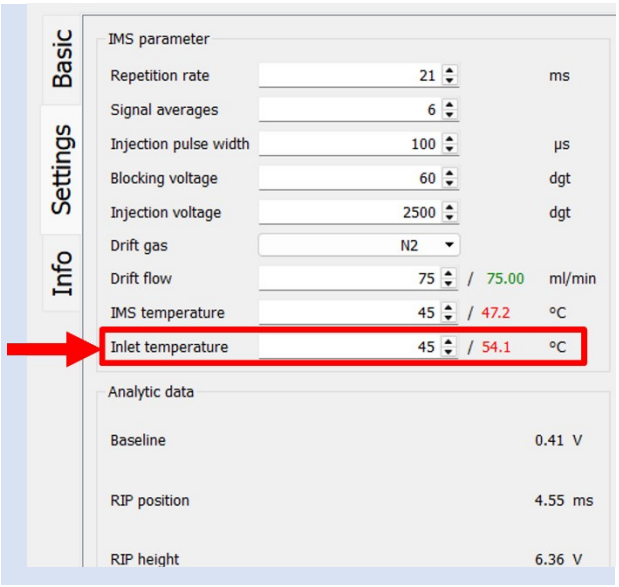


Check the type of ‘Drift gas’ set.

2



Check the value of ‘Drift flow’.

3		Check the 'IMS temperature'.
4		Check the 'Inlet temperature'.

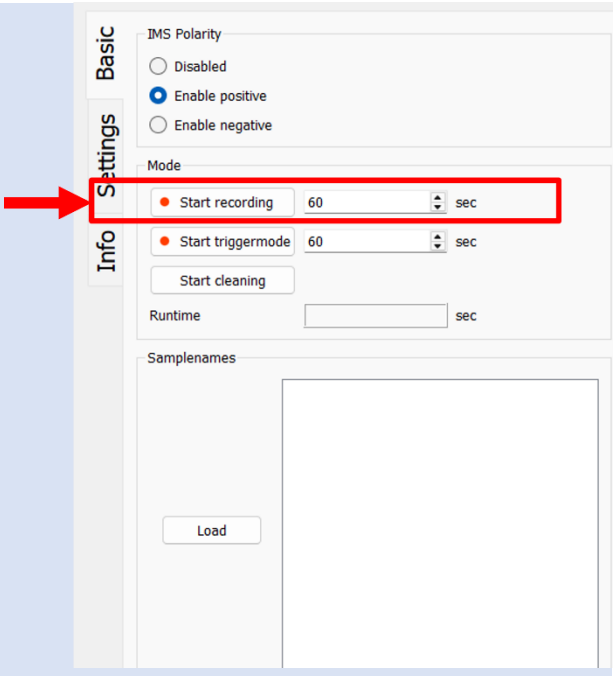
5

Create or load a sample name list:

New: Create a new sample name list

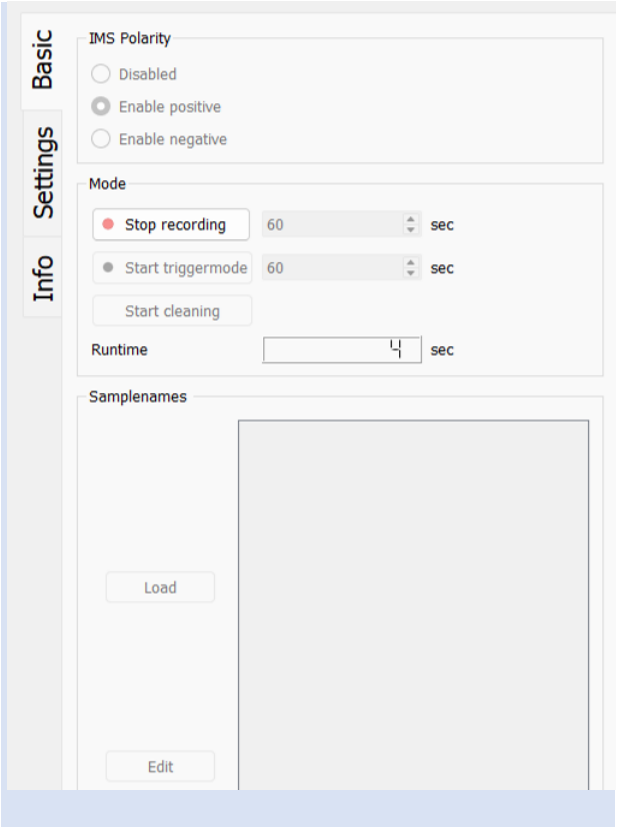
Load: Load a stored sample list txt-file.

6



Adjust recording time and **'Start recording'**.

7



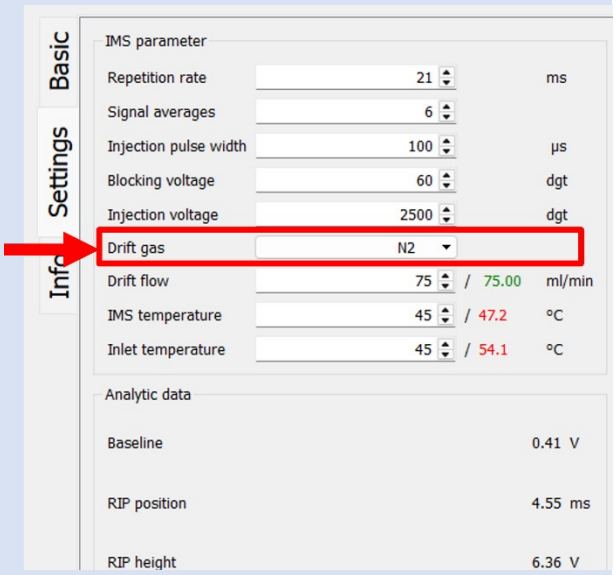
The measurement starts and will be stopped automatically after the set duration. You can abort the recording any time by pressing **'Stop recording'**.

8.6 Remote mode recording

INFORMATION!

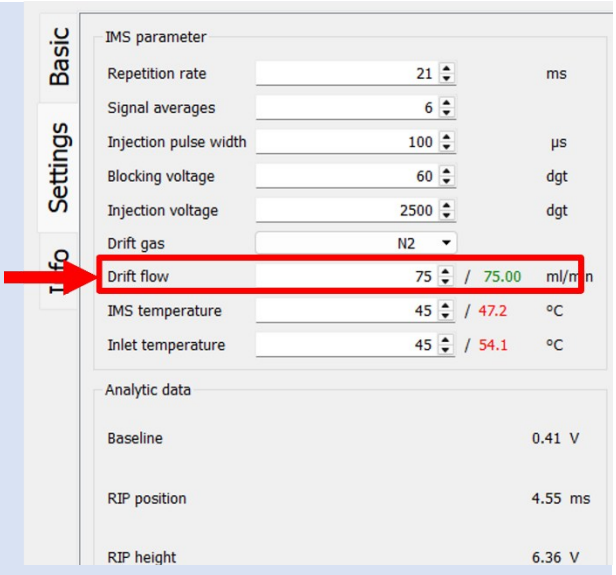
The IonMobilitySpectrometer25 must be properly connected to a device to be able to send an external trigger signal to start the recording.

1

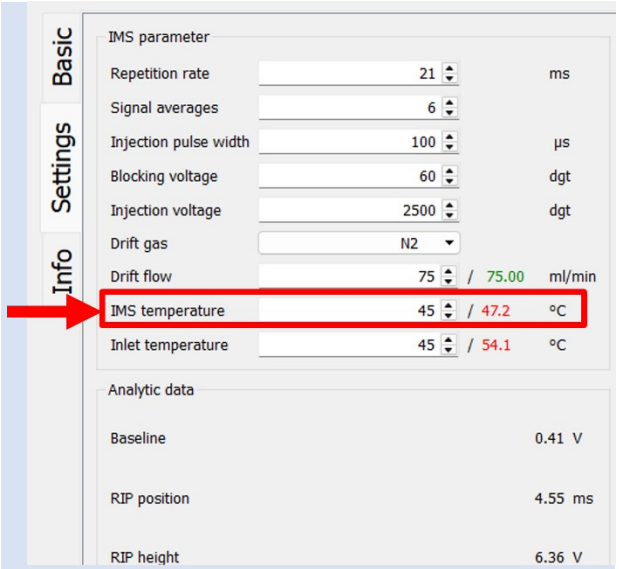
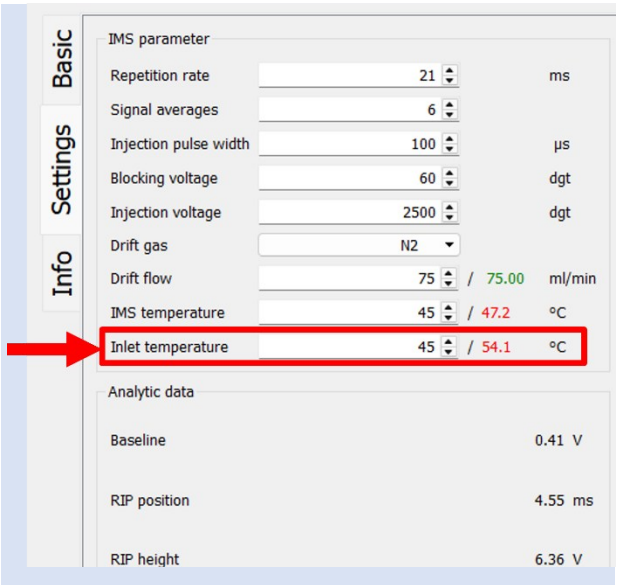


Check the Drift gas.

2



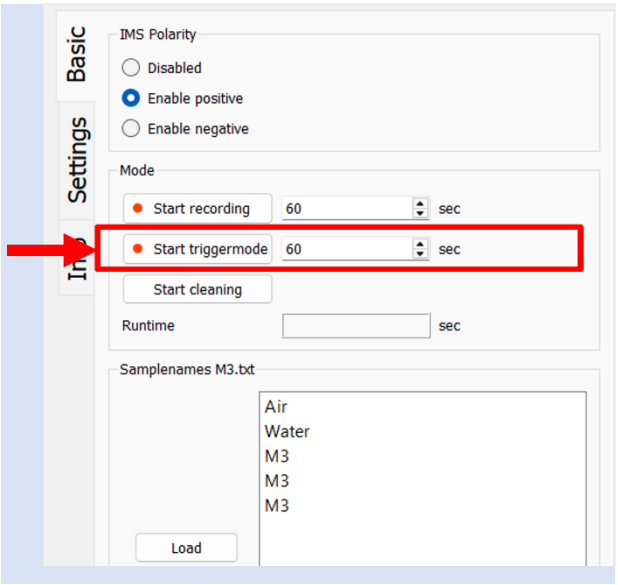
Check the Drift flow.

3		Check the IMS temperature.
4		Check the Inlet temperature.

5

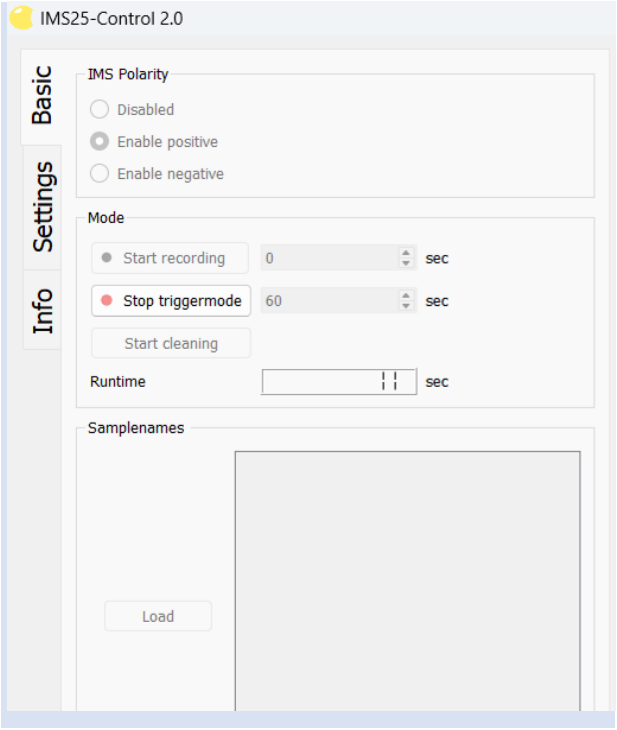
Label the sample (single name or sample name list).

6



Set the GC runtime in sec and click on the **'Start triggermode'** button.

7



As soon as an external trigger signal is received the recoding starts.

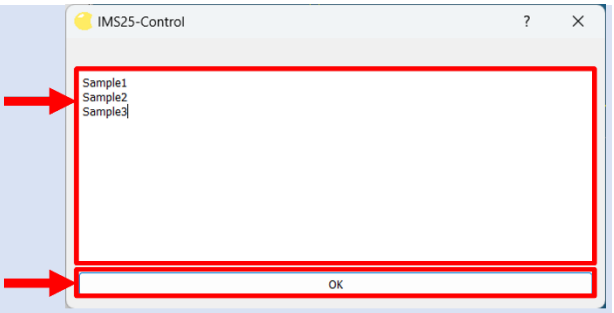
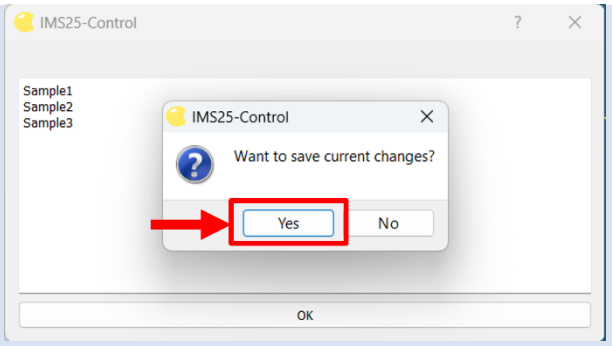
INFORMATION!

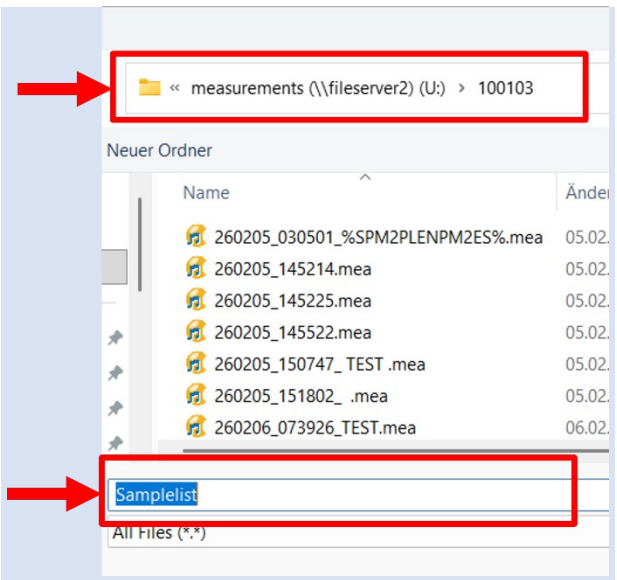
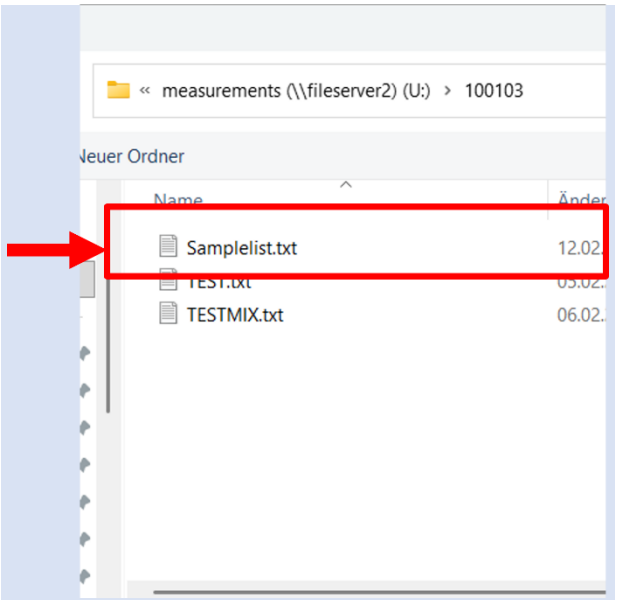
The maximum duration of the trigger is limited to 24 hours after activation. After that, the trigger mode must be reactivated.
The device is not suitable for continuous monitoring.

8.7 Working with Samplenames

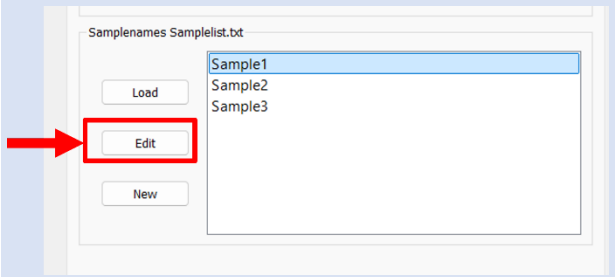
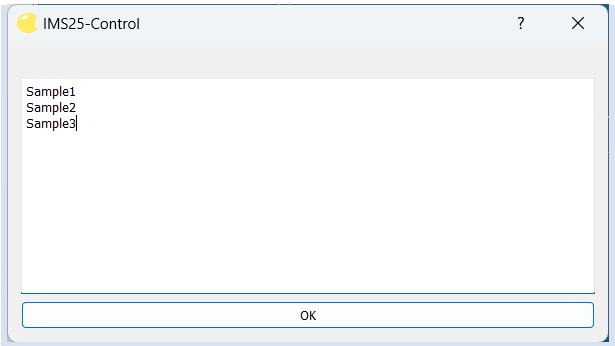
Sample name lists help to clearly identify samples. The sample name lists are simple txt files that can be created, edited and loaded using the IMS25 control software.
The sample names are stored in the metadata and also appended to the file names using the standard template.

8.7.1 Creating Samplenames lists

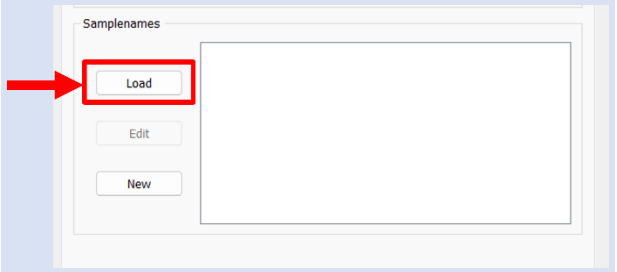
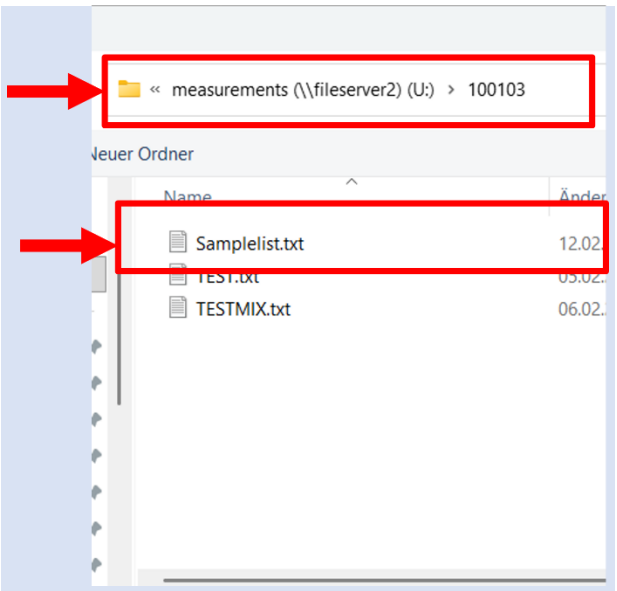
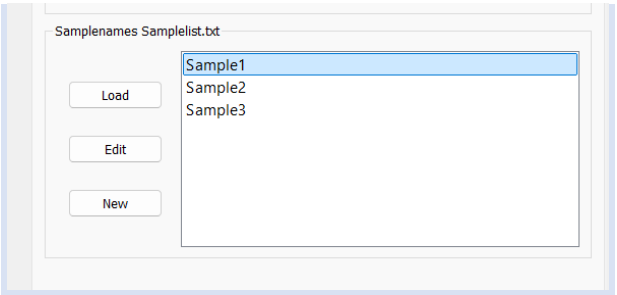
1		Select **New**.
2		Enter the sample names. Each sample name is completed by pressing the RETURN key. Press **OK** to save.
3		Select **Yes**.

4		Enter a name for the list. The list will be saved as txt-file in the path set in the software.
5		View of the saved list.

8.7.2 Editing Samplenames lists

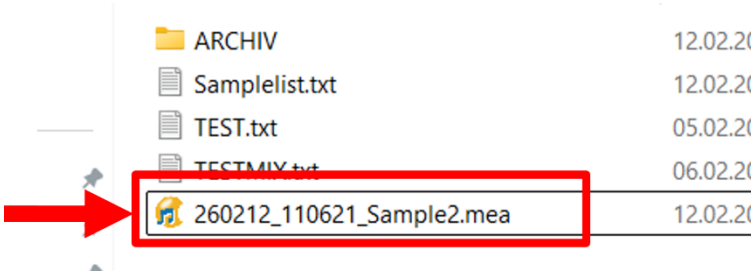
1		Select **Edit**.
2		Edit the open list. Select **OK** to save the list.

8.7.3 Loading Samplenames lists

1		Select **Load** to choose an existing list.
2		The path preset in the software will open and a file can be selected.
3		View of the loaded list.

8.7.4 Samplenames attributes

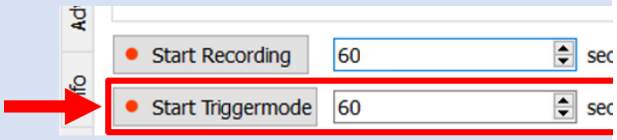
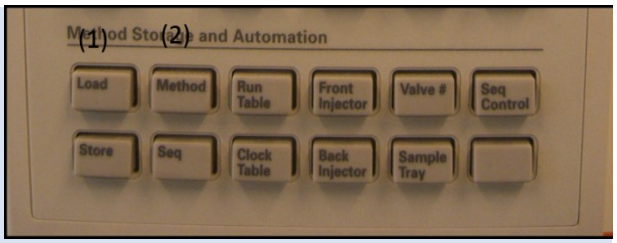
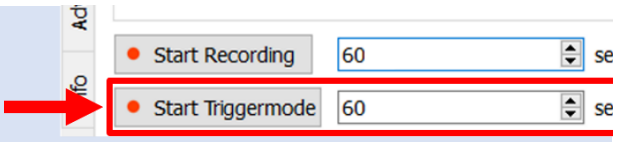
The sample names are stored in the metadata and also appended to the file names using the standard template.



META Data / Attributes

Attribute	260212_110621_Sample2.mea
Chunk averages	0
Chunk sample count	3150
Chunk sample rate	150 [kHz]
Chunk trigger duration	100 [µs]
Chunk trigger repetition	21 [ms]
Chunk voltrange	10.000 [V]
Chunks count	0000000239
Class	"manual/pos/unprocessed"
Drift Gas	"nitrogen"
EPC gas settings	"IMS: N2"
End flow EPC IMS	75.001 [ml/min]
End pressure EPC IMS	0.764 [kPa]
Flow EPC IMS	"750 750 749 750 750 750 750 750 750" [ml/min*10]
Flow IMS setpoint	0.000 [ml/min]
Flow record interval	500 [ms]
Machine serial	"5K2-100103"
Machine type	"IMS25"
Pressure Ambient	"96075 96075 96075 96075 96075 96075 96075 96075 96075 96075" [kPa*1000]
Pressure EPC IMS	"764 764 764 764 764 764 764 764 764 764" [kPa*1000]
Pressure record interval	500 [ms]
Sample	"Sample2"
Sensor block	60 [dgt]
Sensor data	"00060287, 05/2025, 10984_100MBq_630_19714Cp"
Sensor drift	238 [dgt]
Sensor drift voltage	2700 [V approx]
Sensor inject	2500 [dgt]
Software version	"2.1"
Start ambient pressure	96.075 [kPa]
Start flow IMS	74.999 [ml/min]
Start pressure EPC IMS	0.764 [kPa]
Start temp 1	45 [°C]
Start temp 2	45 [°C]
Status	"valid"
Temp 1 setpoint	45 [°C]
Temp 2 setpoint	45 [°C]
Timestamp	"2026-02-12T11:06:21"
nom Drift Potential Difference	2700 [V]
nom Drift Tube Length	53000 [µm]

9 Exemplary workflow manual injection

1		In IMS25-Control Software: Setup the GC runtime in seconds (corresponds with the runtime of the GC method).
2		On GC-System: (1) Press **Load** to select a method (2) Press **Method**
3		Select Method number and press **ENTER**
4		In the IMS25-Control Software: Activate **'Start Triggermode'** and enter the GC runtime in seconds (corresponds with the runtime of the GC method).

5		Select **'Start'** to start the measurement.
6		Inject a sample.

10 Technical data:

Electrical	
DC Input	24V DC +-10%, 12 W (unheated IMS) 30 W (heated IMS) 5A Fused
Signal output	Analog conditioned sensor Signal (Range +/-10 V) TTL Trigger Output for synchronisation or isolated USB 2.0 High Speed digital interface 14 bit, 150 kS/s Bulk data stream (up to 400 kS/s optional)
Control interface	USB 2.0, 2 Interrupt endpoints APG-Like Interface for interoperation with a GC or synchronization to external sampling system (RS232 optional) (TTL compatible inputs for mode selection optional)
Temperature controller (optional)	2 Channel PI Controller for PT100 up to 140°C +-0.1 K accuracy +-1 K display accuracy
Gas connections	
Gas In	3 mm or 1/8" stainless steel (Other connectors available on request)
Gas out	3 mm or 1/8" stainless steel (Other connectors available on request)
Sample In	Heated transfer line GC side
Dimension	
Housing	Height: 331 mm Width: 143 mm Depth: 475 mm

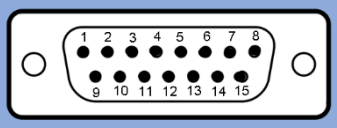
Ionisiation Source Specification	
	**INFORMATION!** • The permission and exempt limits are regulated by the International Atomic Energy Agency (IAEA) in accordance with the COUNCIL DIRECTIVE 2013/59/EURATOM.
Ionisation source	Radioactive - Tritium ^{3}H (ß⁻ Radiation)
Source Type	**Tritium ^{3}H, Solid-state bonded**
Activity	Below the exemption limit of 1 GBq for tritium acc. To Table B (column 2) of Article 26, of the Directive 2013/59EURATOM of December 5th, 2013
Full Duration Half Maximum (FDHM)	12.3 years
Bracking radiation	**2 x 10 $^{-7}$ (mSv / h x GBq)** $H_{Brake} = A \times h_{Br} \times (1m / r)^2$ $hBr = 0.257 \times 10^{-4} \times (E\beta max / MeV) \times 2$
Attenuation of Radiation	**Air: 4 mm** Water: < 100 µm Tissue: < 100 µm Below the exemption limit of a dose rate of 1 µSv/h at a distance of 0.1 m from any accessible surface of the apperatus acc. to Article 26, of the Directive 2013/59 EURATOM of December 5th, 2013
Mounting Location and Type	**Fixed inside the device and not accessible from the outside. The source cannot be touched directly.**

IMS Parameters	
Drift tube length	53 mm
Electrical field strenght	500 V/cm
Resolution	~ 45
Operating temperature	35–120°C
Ionisation source	Radioactive - Tritium ^{3}H (ß⁻ Radiation)
Data aquistion	• Sample-Rate: 150 kHz • Resolution: 14 bits • Trigger-duration: 100 µs • Trigger-repetition rate: 30 ms • Transimpendance: 3 V/nA typ.
Drift voltage	2,7 kV Positive/negative Driftvoltage switchable
IMS25-Control Software	
Minimal System requirements	Windows 7 (32 or 64 bit) 1 High Speed USB2.0 port
Data storage	Data storage in "mea" format suitable for post processing with G.A.S. VOCal Software
Licences	This software is based in part on the work of the Qt project, http://www.qt-project.org licensed under LGPL2.1. The license is included in verbatim in the Archive containing the software.

	This software is based in part on the work of the Qwt project, http://qwt.sf.net, licensed under a modified LGPL. The license is included in verbatim in the Archive containing the software. USB connectivity is provided by libusbK, http://libusbk.sourceforge.net/UsbK3/index.html, licensed under BSD license included in verbatim in the archive containing the software.

External Connectors

Connector Port II



15 Pin Sub-D male connector

Pin	Signal Name
1	reserved
2	reserved
3	IMS Signal Frameset (output)
4 *	Signal Ground
5	Pullup (4,7 kOhm to +5V)
6 *	#START (input)
7	PREPARE
8	Pullup (4,7 kOhm to +5V)

9	reserved
10	reserved
11	Analog IMS Signal (output)
12	Signal Ground
13	Pullup (4,7 kOhm to +5V)
14	READY IN
15	READY OUT

Do not apply voltages in excess of 5V to any Ion Mobility Spectrometer signal. GPIO/#START are 5V tolerant CMOS inputs. Exceeding these ratings will damage the Ion Mobility Spectrometer main board.

*** Connecting PIN 4 and 6 simulates a trigger signal.**