User Manual

Version DRAFT-Mar 2015

STEP Industrial Analyzer

need new picture

STEP
Analytics USA

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Information in this document is subject to change without notice.

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1. PRODUCT OVERVIEW

1.1 Introduction

The STEP™ Series Industrial analyzer is able to detect gas compounds in ambient air , stack gases or process gas in the range of low ppb to mid ppm. The actual detection range will vary based on the chemical nature of the target compound and the device response and calibration settings..

1.2 STEP ™ Industrial Analyzer Product

The STEP™ industrial analyzer from STEP Analytics USA is a fully customizable, continuously operating gas analyzer designed for low to ultra-low level detection of either single or multi-component gases in ambient air, process gas streams or stack gases. It can be installed indoors in a standard rack mount enclosure or outdoors in a NEMA 4x enclosure. The analyzer is designed for un-attended operation and minimal user maintenance. The STEP ™ system enclosures are rated for general purpose use but can be equipped with an optional purge system for operation in hazardous locations up to Class-1 Division-1.

For Process gas monitoring the system is designed to measure low-level contaminants that can affect the efficiency of an industrial gas process. It can detect and react in real-time to concentration fluctuations that might impact the processing efficiency, feedstock utilization, catalyst poisoning or downstream corrosion. The STEP ™ system is designed to continuously sample in atmospheric pressure gas streams and in a wide variety of sample matrixes from hydrogen or hydrocarbon blends to ambient air. STEP™ process gas analyzers can be integrated with the full range of available sample pre-treatment systems including thermal reactors, chillers, vaporizers or sample dryers to optimize the analyzer to the needs of the application.

For Stack gas monitoring the system is designed for continuous emission monitoring (CEM) systems that offer turn-key, stack-to-analyzer solutions, based on IMS technology. The STEP ™ system can be used with all standard dilution or non-dilution sampling systems. Small variations in concentrations of the stack output are easy to monitor and track since the STEP ™ system analyzers use direct measurement based on the IMS detection system. STEP ™ system analyzers are designed to perform with the highest degree of reliability and accuracy when measuring hazardous air pollutants (HAPS) such as ammonia, chlorine, phosgene, HCN, HCl, HF, chlorine dioxide and other chemicals with the minimum down time and low consumable or user maintenance requirements.

1.3 For Your Safety

Strictly follow the Instructions for Use

Any use of the analyzers requires full understanding and strict observation of these instructions. The analyzers are only to be used for purposes specified here.

Liability for proper function or damage

The liability for the proper function of the instrument is irrevocably transferred to the owner or operator to the extent that the instrument is serviced or repaired by personnel not employed or authorized by STEP Analytics USA or if the instrument is used in a manner not conforming to its intended use. STEP Analytics USA cannot be held responsible for damage caused by noncompliance with the recommendations given above. The warranty and liability provisions of the terms of sale and delivery of Environics are likewise not modified by the recommendations given above.

1.4 Safety Information

Pay attention to the specific safety information associated with the appropriate symbol:

⚠ **Warning:**

A WARNING calls attention to a condition or possible situation that could cause injury to the operator or that could damage or destroy the product.

1.4.1 Radioactive Material

⚠	**Ionization source** The IMS detector uses a weak β source for ionization. The radioactive material cannot leave the sealed source housing or the scrubbers/filters that are internal to the analyzer.
⚠	**The device contains a small ionization source that uses Tritium (H3) with an activity level of 2.7 mCi or (100 MBq.) The analyzer is licensed as an Exempt distributable item in the US under license # XX-XXXXX-XXE and may be purchased and used without the need for a radioactive possession license by the user.**

1.4.2 Electrical Safety

⚠	**Do not remove any part of the housing** The analyzer internal electronics employs voltages as high as 2000 V. Do not remove outer covers; contact with the internal components could result in fatal shock!
⚠	**Electric overload** Use only electrical power that meets the specifications of the analyzer. Damage to the analyzer is possible if the power specifications are exceeded.

1.4.3 Operating Conditions

⚠	**Operating in explosive atmospheres** 19'' Rack-Mount System: Is not designed for use in an explosive atmosphere. The 19" rack mount device is not equipped for such applications and explosions may occur. Industrial Enclosure (NEMA 4X): Is designed for use in harsh or explosive atmospheres but for safe use the enclosure MUST be connected to an appropriate inert gas purge system.
⚠	**Operating temperature ranges** 19'' Rack-Mount System: -10 to +50°C (-14 to +122°F). Industrial Enclosure (NEMA 4X): Unit is a 19" Rack installed into third party, isolated and internally heated enclosure. -40 to +50°C (-40 to +122°F).
⚠	**Operating relative humidity** 0-90% (non-condensing).
⚠	During operation there is a constant 200 ml/min to 1.5 L/min air flow through the device based on the application. If the device is connected to a sampling or diluting system, this flow must be maintained. Otherwise the devices inlet or internal flow systems may be damaged or destroyed.

⚠	Avoid handling the detector's inlet area, to minimize potential contamination.

1.4.4 Storage Conditions

⚠	**Storage temperature ranges** 19'' Rack-Mount System: -10 to +50°C (+14 to +122°F). Industrial Enclosure (NEMA 4X), Unit is a 19" Rack installed into third party, isolated and internally heated enclosure. See Sect. 5.1.3 for details. -40 to +50°C (-40 to +122°F). Recommended storage temperature range for all products is from +10 to +30°C (+50 to +86°F).
⚠	**Storage humidity ranges** Recommended storage relative humidity range for all products is from 0% to 90% (non-condensing).
⚠	Do not store the detector in areas where there are strong odors (e.g. with chemicals or cleaning supplies).

1.4.5 Disposal of the Analyzer

While the STEP Industrial analyzer is classed as US NRC 'exempt' and can be disposed of in the general waste stream; however it is strongly preferred that the detector be returned to the manufacturer for end of use disposal. As such STEP Analytics USA will take back the STEP-Series products for proper disposal in the future with a nominal fee charged. The analyzer contains a small Tritium (H3) radioactive sealed source, as such it requires proper disposal. Please contact STEP Analytics USA for further information and assistance.

2. Special Notes

2.1 Power supply

The power requirement range of the device is –110 VAC up to 230 VAC (150W).

2.2 Do not remove covering or front panel!

Do not use the device without covers or front panel. Inner components contain high voltages up to 2500 volts and contact could result in fatal shock to personnel. If instructed to open the front panel or remove covers ensure that the system is powered off and disconnected from external power before proceeding.

2.3 Working in explosive atmospheres

The standard version of the device is not equipped for the use in explosive atmospheres. Industrial Enclosure (NEMA 4X): Is designed for use in harsh or explosive atmospheres but for safe use the enclosure MUST be connected to an appropriate inert gas purge system.

2.4 Electrical overload

Do not use voltages which are not specified for the device.

2.5 Gas flow

The device draws in air with a minimal flow rate of 200 ml/min up to 1.5 Lpm depending on the specific application. This flow must be constant, pressure and flow variations can result in analysis error or device failure. If the device shall be used within other systems, this gas flow must be guaranteed.

2.6 Use of dust filters

The device can be equipped with a dust filter. The filter consists of polypropylene with a Teflon-membrane, which protects the device from ingress of dust particles and liquids. The filter may need to be removed before a measurement is conducted to avoid distortions due to chemical interactions.

2.7 Change of the circulation filter

The circulation filter of the device needs to be replaced after approx. 6 months. The lifetime of the filter depends on the concentration of the measured substances and the frequency of measurement. The replacement will be conducted by STEP Analytics USA personnel or authorised staff.

2.8 Radioactive source

The detector cell of the device contains a weak radioactive source (see Appendix 5.2). The radiation does not penetrate the walls of the device. Do not open the detector cell.

3. Description of STEP IMS

3.1 Introduction

With the STEP Analytics USA monitoring system you receive a device usable for the detection of a variety of toxic gases and vapours. The unit meets the increasing regulatory demands regarding emission control of gaseous chemical substances and for continuous process controlling in industry as well as analyzer for actual environmental pollution and the detection of hazardous materials.

The principle of measurement is based on different drift velocities of ions within an electric field in air at normal pressure. Ambient air is directed to an ionization source and is ionized by weak radiation. Complex ions of type NH^+, NO^+, $(H_2O)_n H^+$ emerge that cause the positive reaction peak (RIP^+) in the spectrum. Negative ions of types O_2^- und $(H_2O)^-_m$ constitute the negative reaction peak (RIP^-). Both types of ions are always available in air.

If there are pollutant molecules like phosphor-organic compounds or alkyl halides in the air, a charge transfer between the reaction ions and the pollutant molecules (which we denote M) takes place. Simplified, this can be written:

$RIP^+ + M \rightarrow RIP + M^+$ (positive mode)
$RIP^- + M \rightarrow RIP + M^-$ (negative mode).

Due to electric pulses at the entrance grid (figure 1), the ions are directed from the radiation source to the drift tube. Depending on their physical features, ions move with different drift velocity within the homogeneous electric field. Accordingly, ions arrive at different times – their respective drift time – at the collector electrode and cause an electricity signal. Because the drift time is individual, it can be used to identify molecule ions M±, whereby the size of the signal at the collector electrode is proportional to the concentration of these molecules in the air. This principle can be seen in figure 1.

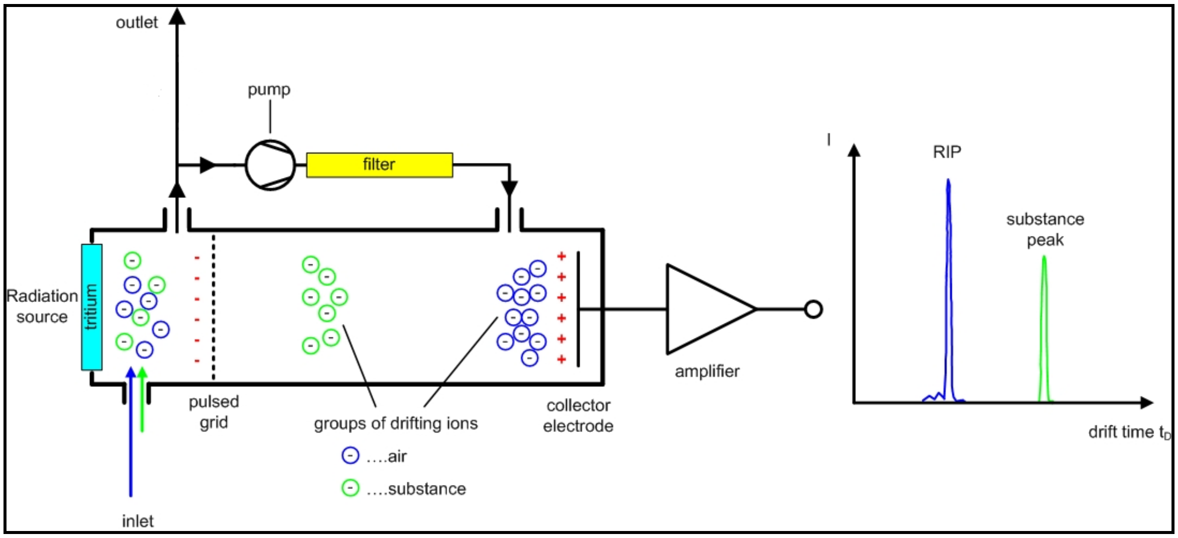

Figure 1: technical principle of Ion Mobility Spectrometry

The collector signal is enhanced and digitalized. Data is processed by a 32-bit microprocessor and transfer to the integrated microcomputer, for signal processing and display.

3.2 Structure of the IMS

The structure of the device is schematically pictured in figure 2.

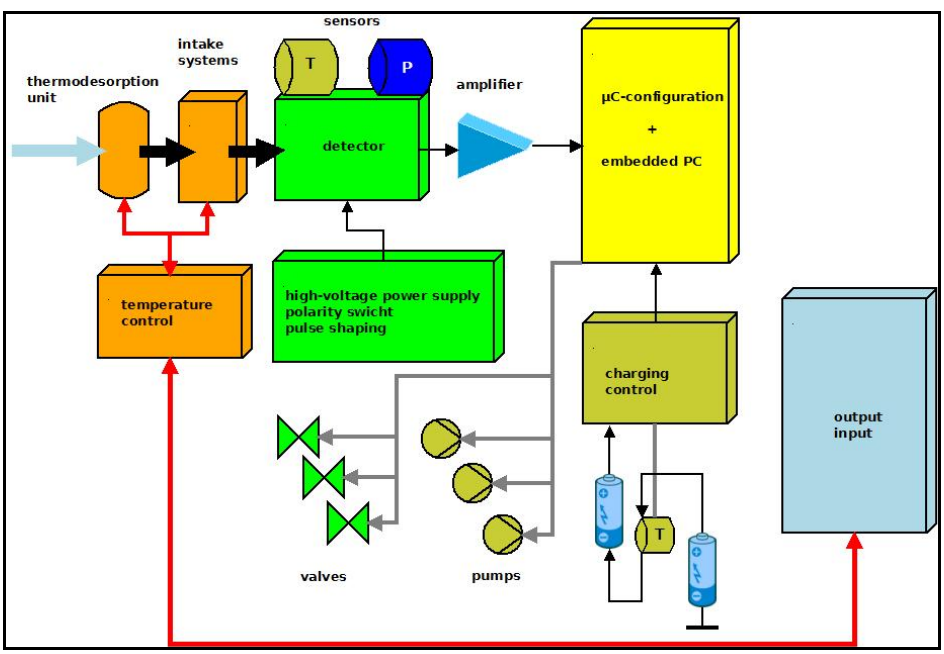

Figure 2: General schematic design of a Ion Mobility Spectrometer

3.2.1 Gas Pathway

Inlet system

The inlet sample flow is preset during assembly based on the specified application. During operation there is a constant 200 ml/min to 1.5 L/min air flow through the device based on the application. If the device is connected to a sampling or diluting system, this flow must be maintained. Otherwise the device inlet or internal flow systems may be damaged or destroyed. All pneumatic connections requires an outer tube diameter of ¼''. Fasten the fittings following the manufactures specifications.

Internal gas circulation

The IMS utilizes an internal gas circulation, or the 'drift' flow. The device is equipped with a pump, which generates the drift gas that is used within the sensor cell. In the case of using a external drift gas source, an air flow of 700ml/min and 200mbar pressure is required. (Contact STEP Analytics USA for device internal hardware settings and requirements for the use of external drift gas source.) The sample to be analyzed is periodically or manually integrated into the internal gas circulation, which passes the ionization source within the IMS cell. (The rate or cycle of sampling is process controlled and can be varied in a wide range or automated by defined time windows.) After passing through the measurement cell, the majority of the sample flow is directed to the system outlet while a portion is sent through the circulation filter by a internal pump. Here, water vapour and the sample will be removed by the action of molecular sieve to produce clean drift gas.

Circulation filter

The circulation filter can absorb water up to 10% of its dry weight. If humidity within the internal gas circulation exceeds 10ppm, the resolution of the spectrometer decreases. In case of continuous operation, the filter needs to be replaced after approx. 6 months. The circulation filter can be returned the Environics USA for regeneration.

Radiation Source

The radiation source consists of a stainless steel pin with an evaporated titanium layer in which 100 MBq Tritium is absorbed. A SiO_2-layer for additional wear protection as well as a conductive aluminium layer is deposited on top. The radiation source is one of the electrodes of the IMS cell and causes ionization at the adjoining gas layer. The entrance grid separates the ionization space and the drift tube

3.2.3 Electrical Parts

Amplifier

The ion flow is amplified by an impedance transformer. The time constant is circa 50 µs and the amplification factor is $5*10^9$ V/A.

Pulse unit

A particular pulse regime is used to improve resolution and sensitivity. The pulse width at the entrance grid is approximately 60 µs, the pulse height is 500 V. These pulses force 30-40% of the created ions into the drift region

A/D-Converter

The analogue signal from the amplifier outlet can be directly visualized by an oscilloscope. Each IMS-device contains a 3BNC-plug to display signal, trigger pulse and delayed trigger pulse directly from the converter system for use in service or troubleshooting by authorised personnel. The analogue signal is digitalized with high resolution for further analysis by the microprocessor.

Microprocessor

The internal control of the IMS is realized by a 32-bit ARM7 controller manufactured by Texas Instruments. This Controller performs the data collection, signal pre-processing and the transfer of the data to higher-level computer systems.

Integrated microcomputer

In the IMS a microcomputer (pITX) is integrated for controlling and signal processing.

3.3 Applications

The charge transfer of molecules and air ions (see the reaction functions as described in 2.1) depends on the proton or electron affinity of the respective molecules. The higher the affinity, the lower is the detection limit of a molecule.

The ions are identified by their mobilities. These ion mobilities depend on several characteristics of the molecules: mass, charge, charge distribution, cross section, structure, bonds etc. The mobility in general also depends on temperature and pressure found within the detection cell.

The exact identification of a compound M is only possible if its ions result in a separate peak in the spectrum.

Important application fields of the IMS for selected substances are given below:

Chimney gases: Cl_2, NH_3, HCN, NO_X, SO_2, HCl

Aldehydes: Formaldehyde, Acetaldehyde
Halogens and halogenated hydrocarbons: I2, Br2, Cl2, F2, Methylchloride, Chlorobenzene, Phosgene, (Chloromethyl)methyl ether, Dichlorethylene, etc.
Isocyanates and precursors: Toluene 2,4-diisocyanate, Toluene 2,4-diamine, Phosgene, Chlorine

Nitro compounds: DNT, TNT and other explosives

Chemical warfare agents: Soman, Sarin, Tabun, VX, Mustard, N-Mustard, Lewisite, HCN

Aromatics: Toluene, Xylenes, Phenol, Aniline, Ethyl benzene

Solvents: Acetone, Methanol, Ethanol, Phenol, Acrylonitrile, Dimethyl ether, Ethyl acetate, Butyl acetate

Semiconductor Compounds: Diborane, Phosphine, Arsine

Bad smells: H_2S, Mercaptains, Amines

3.5 Minimal detectable concentration (MDC)

The detection of a chemical substance is limited by the fluctuations of the ion stream. In general, a signal is still detectable if the signal amplitude is equal to the 3σ-value of the ion current fluctuations. Based on that, the MDC's of devices are calculated. Concentrations are dimensionless given in part per billion (ppb) or part per million (ppm). The conversion in a concentration with dimensions (mass per volume) as µg/m³ or mg/m³ is readily feasible. For instance, the maximum work allowable concentration (MAK) of hydrogen cyanide (HCN) is

$$M \quad (Bl \quad a) = A1 \; \frac{m}{m^3} u = 1 \; \frac{m}{m^3} 0K = 1s \; \frac{l\,1 \cdot 2\,\ddot{a}\,4\,9\,1}{M \cdot 1\;{}^{3} \cdot 1} = 9\,p_0^{2}\,a_0 = 9 \quad p_0 \,.$$

3.6 Interferences and how to avoid them

When mixtures of chemical compounds enter the ionization source, cross interferences may occur: the spectra of the single substances are changed due to interactions between the differing ions. There are many analytical situations in which interferences do not play an important role due to the separation of the interferent and the chemical being monitored in drift time, or due to differences in ion affinity. For example, if one or several compounds with strong affinities have to be detected among others with weak affinities. However, the detection of a compound with weak proton affinity in a matrix of compounds with large affinities requires a previous separation by means of an additional gas chromatographic column. In this way, e.g., it is feasible to detect benzene in the presence of high toluene concentrations for example.

3.7 Overloading of the IMS

The input concentration of an IMS typically ranges from low ppb to mid or high ppm range dependent on the nature of the chemicals in question and the response of the system to that chemical. *Overloading by high concentrations must be avoided!*

As mentioned above, the IMS operation requires low water vapor concentrations in the internal air flow, usually below 10 ppm. The sampling of very humid gases will shorten the lifetime of the circulation filter and thus affect the device performance.

3.8 Technical data

1.	Dimensions	483 x 437 x 138.4 mm (19" x 17.2" x 5.5")
2.	Mass	10kg (22 lbs)
3.	Detectable gases, sensitivity	see appendix 8, page 33 for partial list.
4.	Display and signal outlet	7 inch Touch Display, USB (PC), LAN(PC), Current Loop(self or loop powered)
5.	Alarms	per definition
6.	Measurement range	1000-times MDC
7.	state of readiness	LED green (electronic), Display(operating system)
8.	Temperature of operation	-10°C up to 50 °C
9.	Humidity	0 - 90 % relative humidity
10.	Power supply	110 VAC up to 230 VAC (150W)
11.	Power consumption	35W/70W without/with heating
12.	Ionization source	see appendix 8, page 37 for example of source certificate.
13.	Data storage	160 GB hard drive, USB-stick

4. Operating instructions

4.1 Control and connection elements

The main elements for control and connections are shown in the following figures 3 and 4.

<u>Front panel:</u>

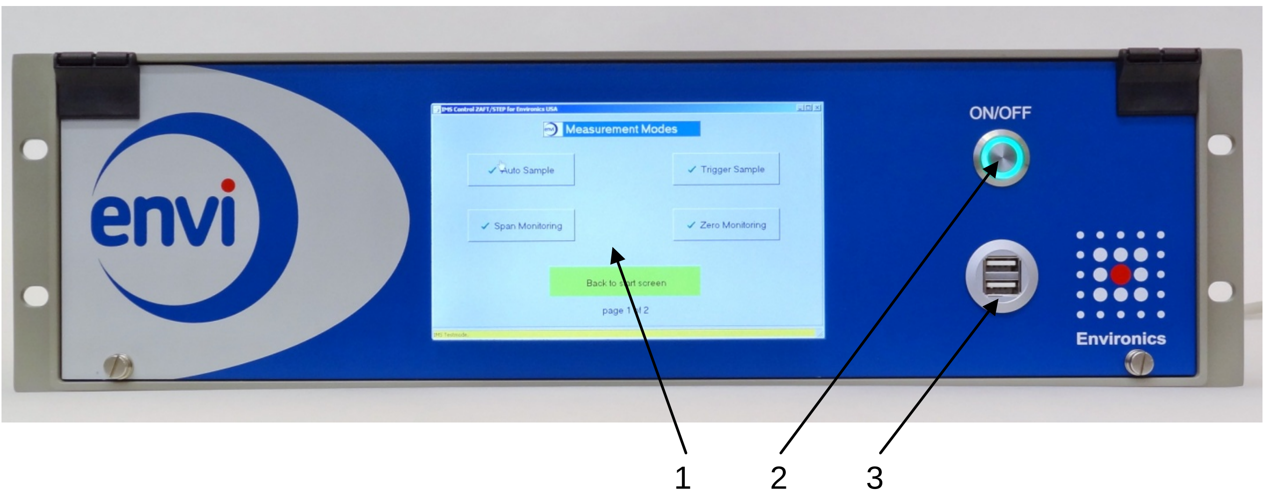

figure 3: Control elements at the front panel of the IMS

1) Display
2) ON/OFF switch
3) USB connection (x2)

Back panel:

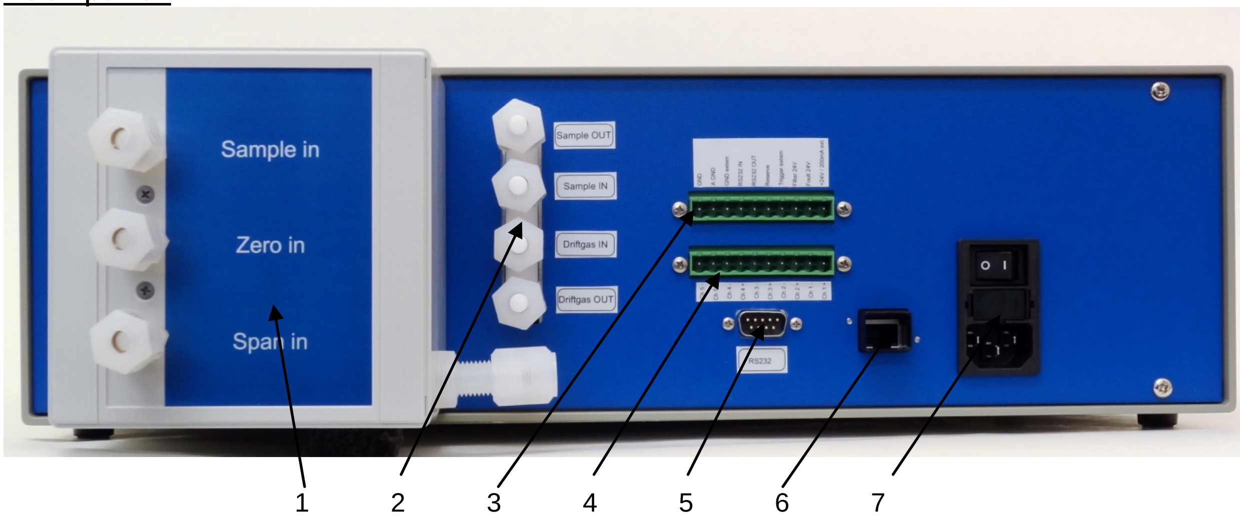

figure 4: Control and connection elements at the back panel of the IMS
(This picture shows the Span module installed)

1) Span module, installed
2) Gas connections
3) Input/output relays
4) 4-20 output
5) RS232 connection
6) Ethernet connection
7) Fused power input module

4.2 Initial start-up

Before initial start-up ensure the correct power supply and connections to the system. In case of power supply exceeding the requested range the fuse may fail, or system damage may occur.

Connect the sample tube to the sample inlet, vent the exhaust line according to the requirements applicable for the sample stream.

Refer to the following diagram in section 4.2.1, figure 5 for details of the 4-20 output connection.

After the correct power supply is connected, you can switch on the main power switch at the rear panel. For connection see 4.1 rear panel diagram, figure 3 above. Before using the current loop you should check/change the setting of the current loop board.

The IMS-device can be turned on at the ON/OFF switch (figure 3). The green LED within the switch will light. The Start-up process includes integrated self tests, cleaning, heating and internal function testing of the system. After 60 sec the display will be activated and shows the actual status of start up. Depending on the setup the heating process can take up to 30 minutes.

4.2.1 4-20 Output setup

See the following diagram for setup. (Figure 5)

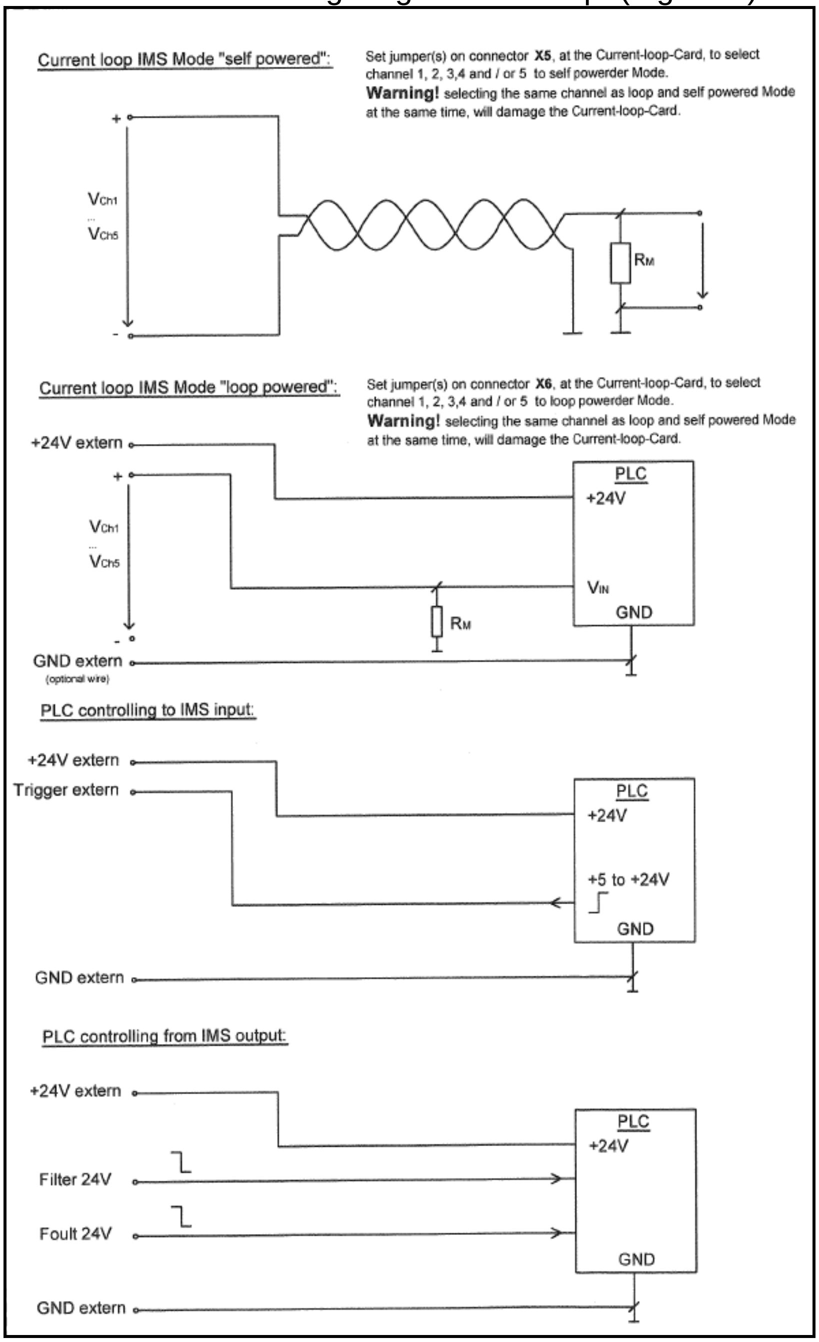

Figure 5

The following diagram relates to the basic setup of the 4-20 as powered or unpowered and is done as part of the initial assembly of the system by Environics USA personnel.

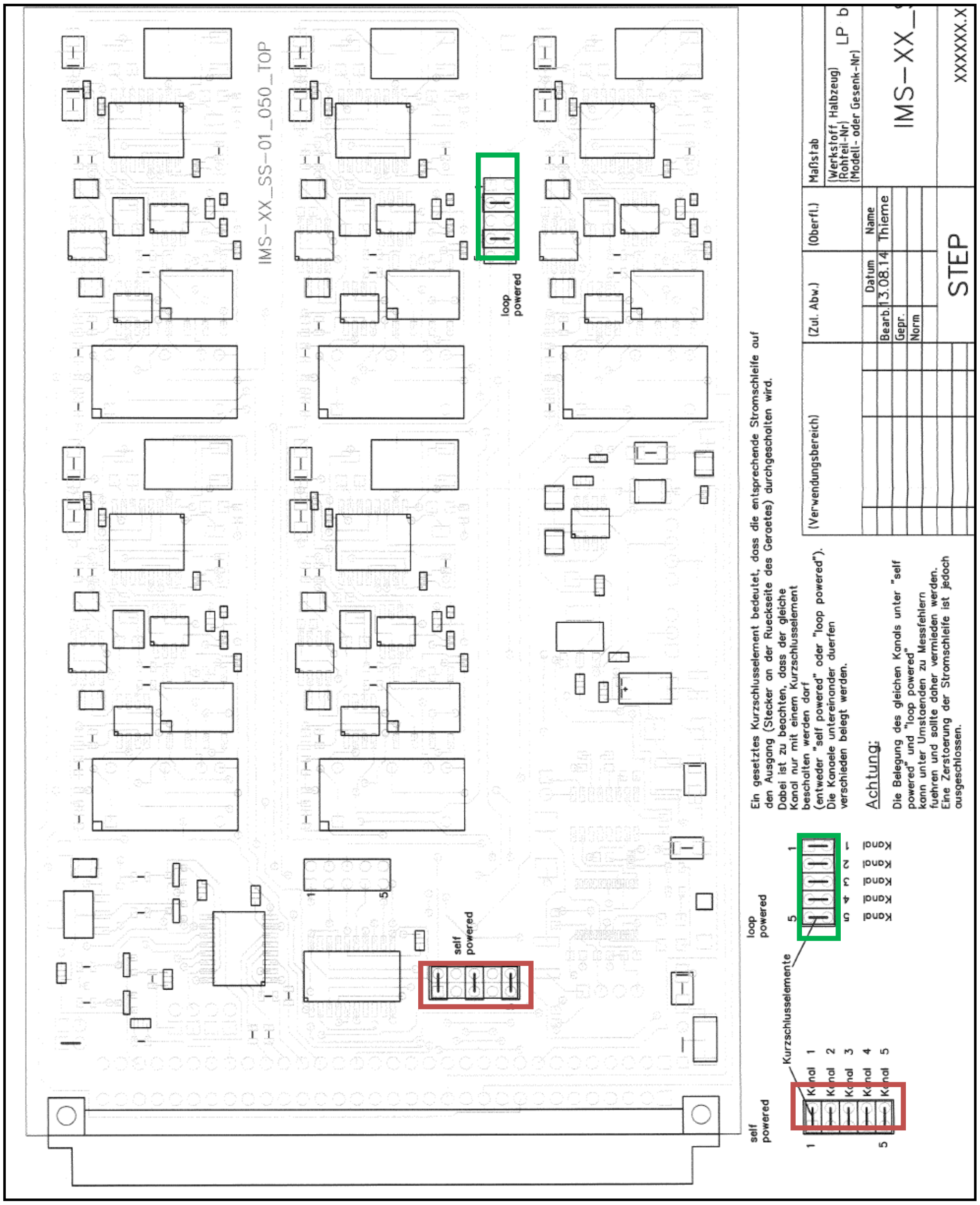

Figure 6

4.3 Software

The software is developed for easy handling and minimum user input. Commands can be entered directly in on the touch screen or a USB keyboard or mouse can be connected to the system using the front USB ports.

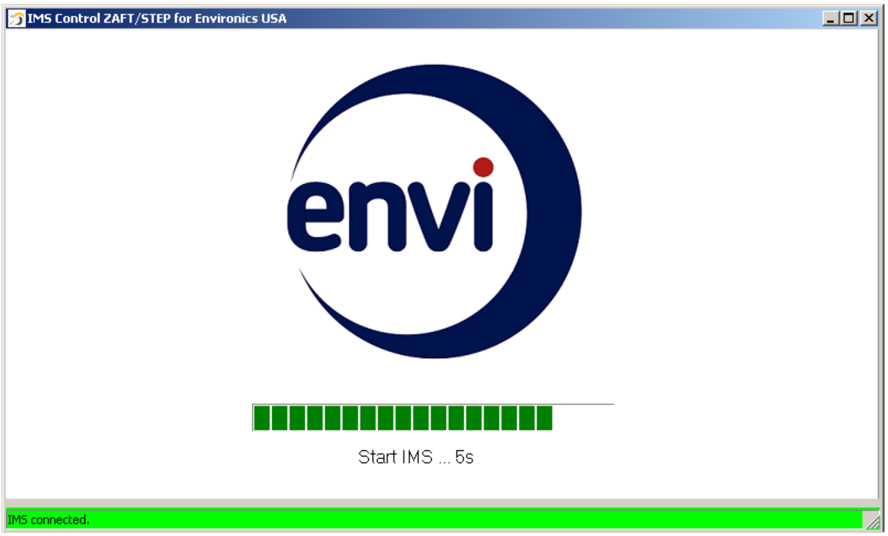

Figure 7

If “Start IMS… “ screen appears, the device is ready for heating.

Figure 8

The heating process can take several minutes up to 30 min depending on settings and environmental conditions.

In the following figure you see the start screen.

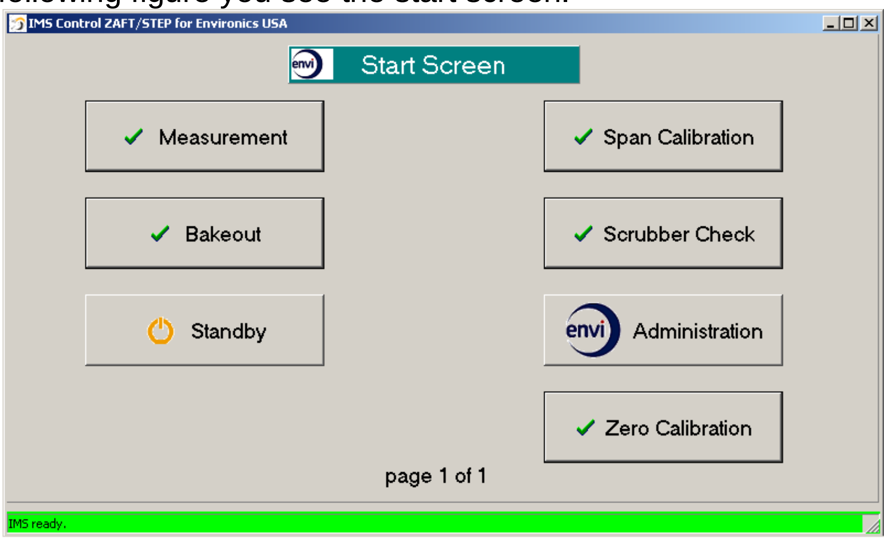

Figure 9

The administration mode is password protected. There are device setting options included. The calibration functions are also protected with a different password. They can be used by technical staff to change the calibration of the device.

The Bake out mode is for the cleaning the device in the case of contamination or over load. If the device will not be needed for measuring, you can place the system into the standby mode.

4.3.1 Measurement modes

Depending on the setting of the device this mode includes the following measuring modes. Auto, trigger sample and direct sample. Using the first two modes the valve will be open and closed in a cycle. (i.e. 10 sec open, every 30 sec.) In direct sample mode the valve is permanently open and the measurement values will be averaged every 10 sec. These time and valve settings can only be changed in the administration mode.

There are span monitoring and zero monitoring modes included to allow for the calibration to be checked or adjusted based on a external reference source. It is recommended to check the calibration once a month. The following figures show the screen in these modes.

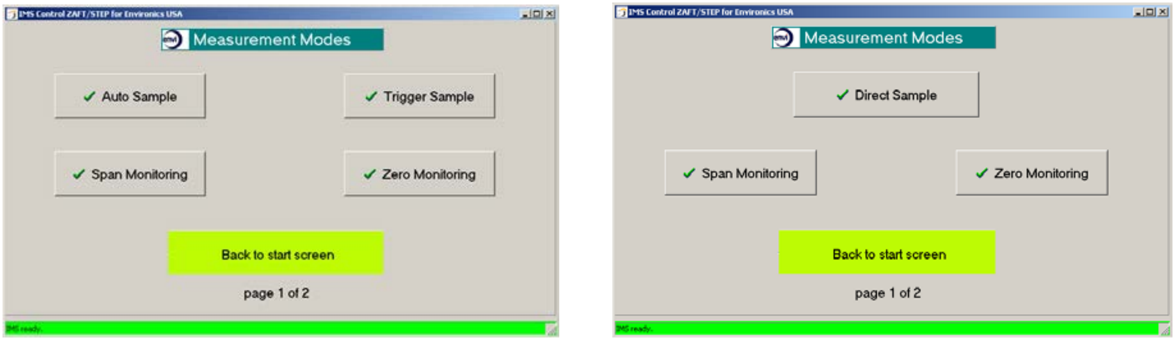

Figure 10

The measured concentration will be displayed as follow.

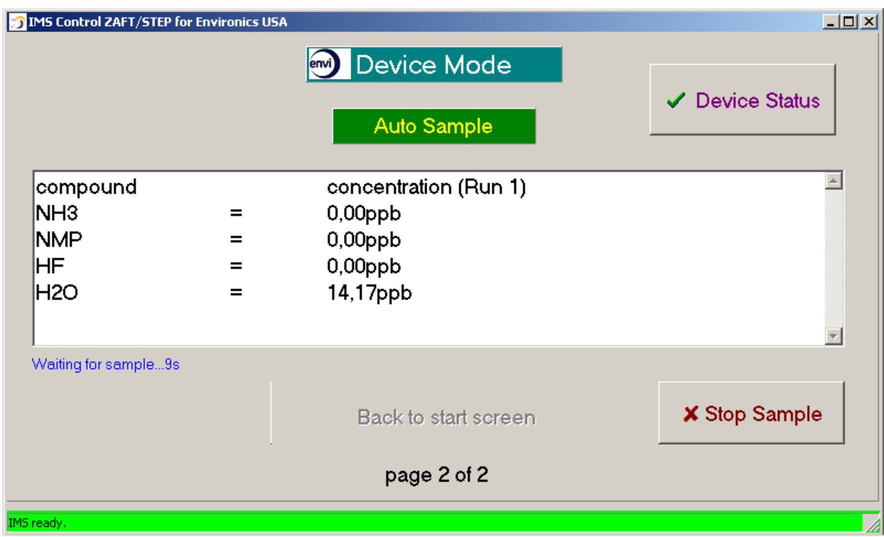

Figure 11

In every measurement mode you can use the Device Status button to get an overview over the current device status. It also shows a graph of the measured concentrations during the last 8h. Using this page has no influence for the measurement itself. Use the Stop Sample button to end the measurement and enable the back to start screen button.

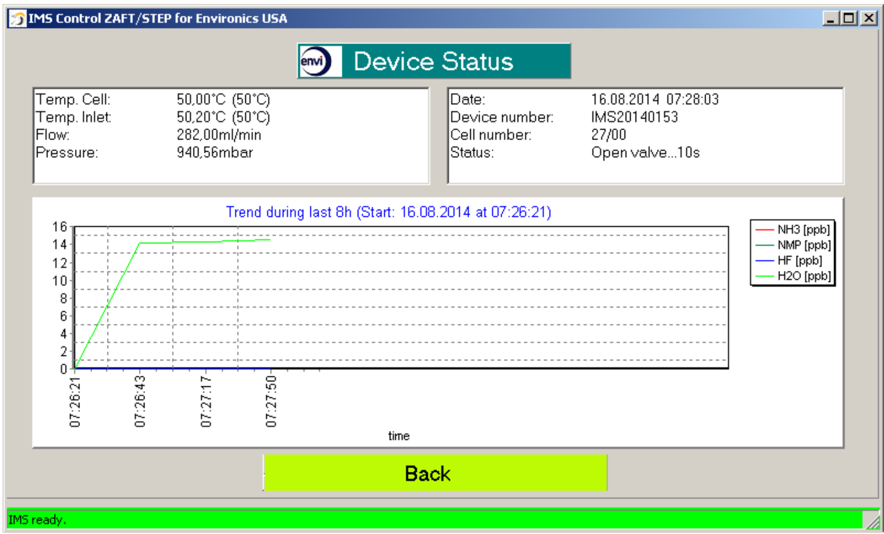

Figure 12

4.3.2 Calibration modes

You will be guided through the procedure by the software. At the start of this process you will be required to enter the correct password to access this function, as can be seen in the following picture.

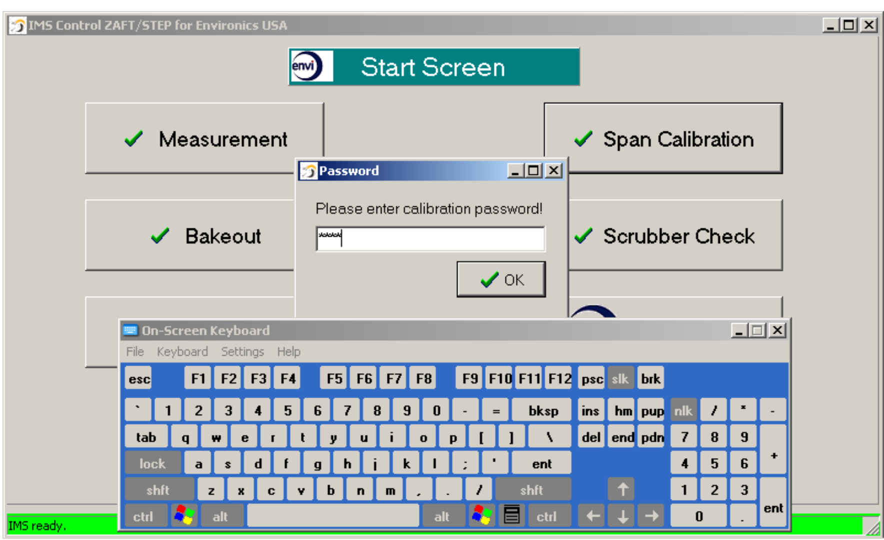

Figure 13

After entering the password you can select the chemical concentration present in the span gas. Once this is done the system will ask you to confirm the specified concentration before starting the Span calibration process. If you skip without confirming the calibration has no effect. The calibrations will be saved.

As part of the Span calibration process you will also have the option of adjusting the current loop or setup of the output mode. If you tell the system to proceed the device will do the calibration and ask you to confirm the new span factor. If you skip without confirming the calibration has no effect. The calibrations will be saved.

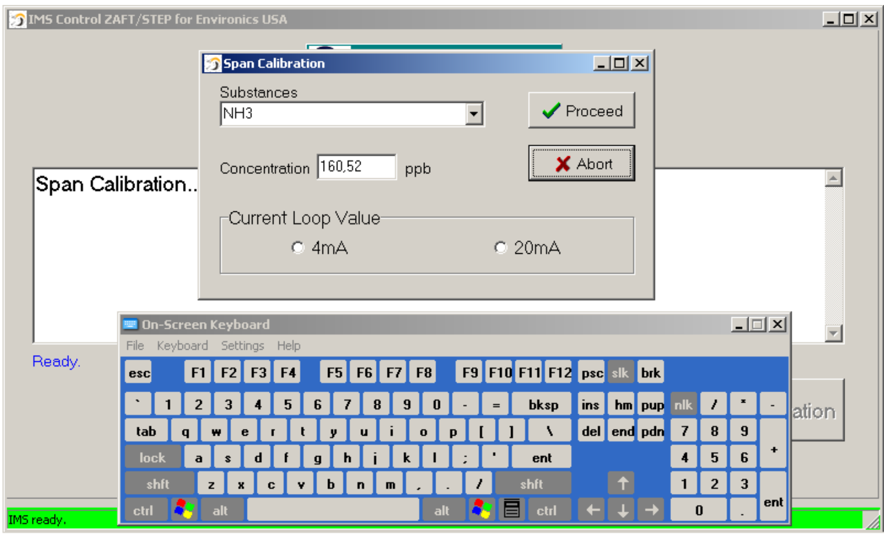

Figure 14

4.3.3 Admin mode

In this password protected mode all device settings can be changed.

In the tab '*Spectrum*' you can see the primary measurement signal. You can check visually the system. There is also a manual control feature, which needs to be activated. Before leaving the admin mode you must check that manual control is disabled.

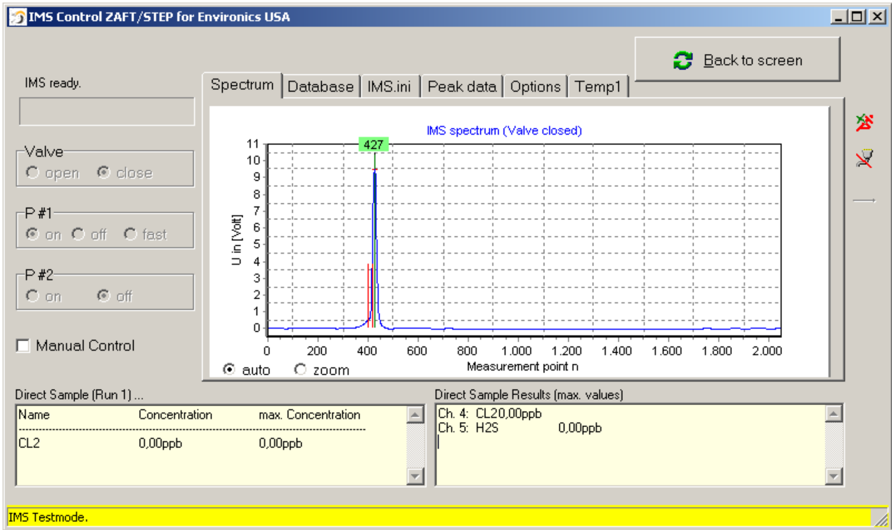

Figure 15

In the tab '*Database'* there is a table of substances. The alarm concentration, the current loop channel of all saved substances can be chanced or set. In the column select you can set which of the substances shall be measured. To confirm your settings you must use the apply button.

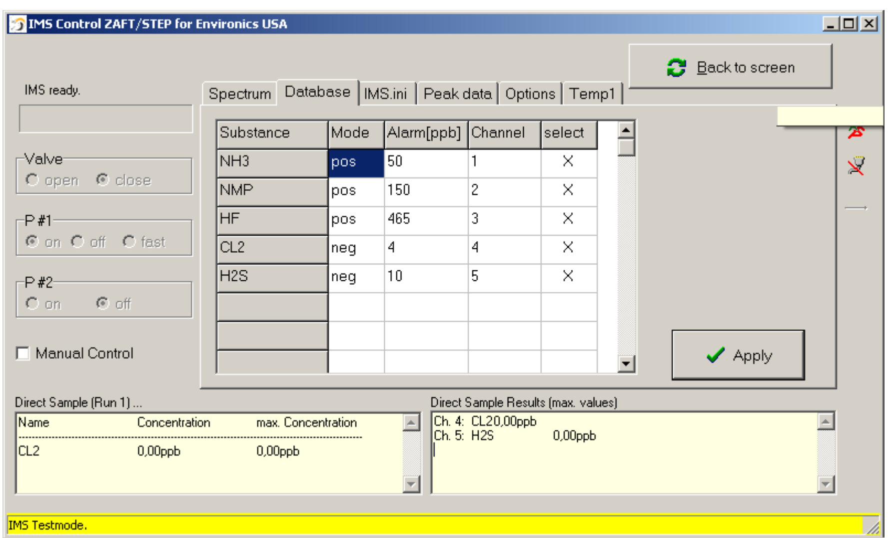

Figure 16

The tab '*IMS.ini*' shows the INI, the file that the device settings are saved.

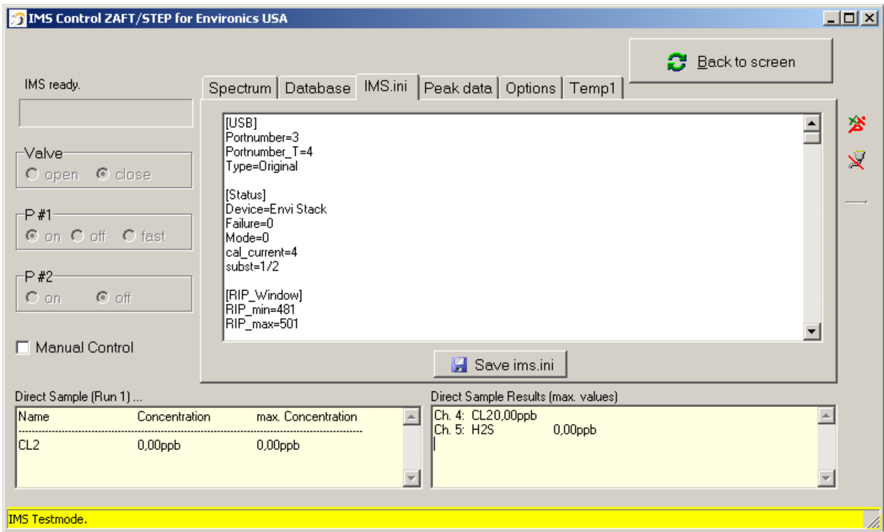

Figure 17

In the next tab called '*Peak data'* are all detected peaks out of the actual spectrum listed together with some internal values, like pressure, flow, and other internal system data.

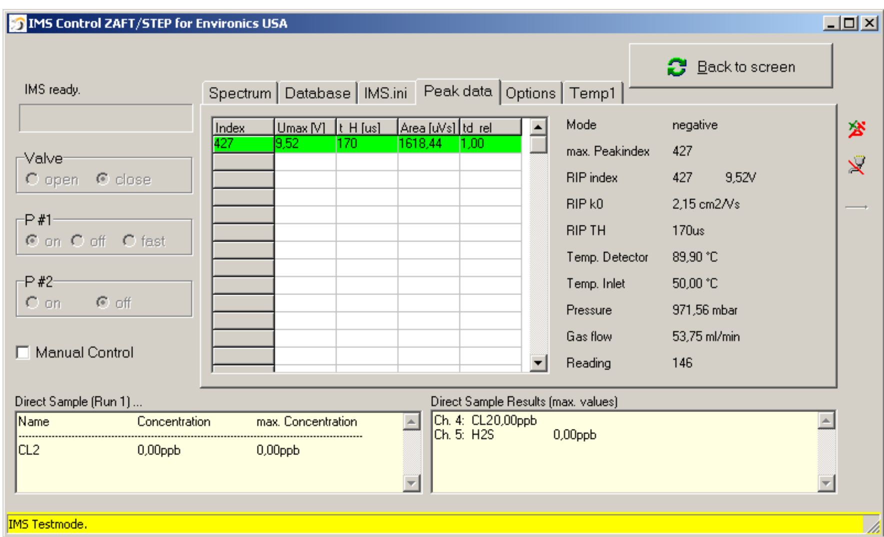

Figure 1

The tab '*Options* 'includes some settings belonging to the analysing of the spectrum.
Here you can also enable Zero calibration and Direct sample options.

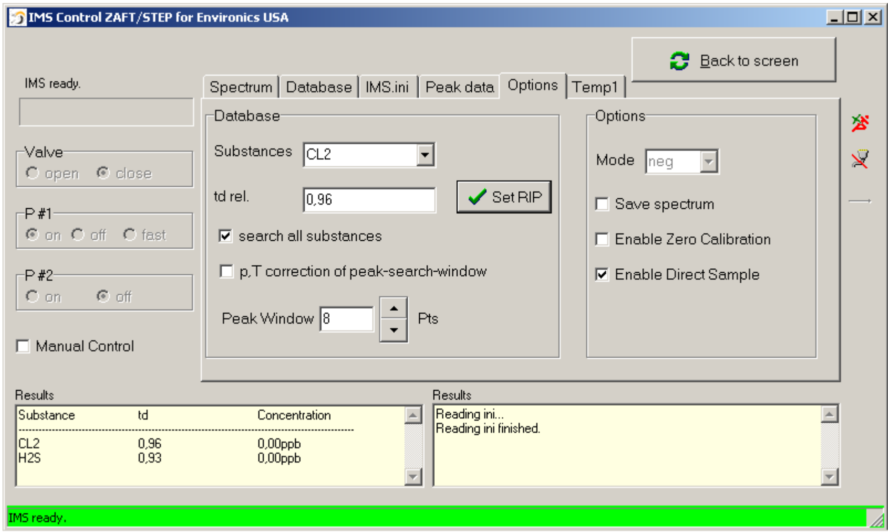

Figure 19

The last tab '*Temp1'*, shows the actual temperatures of detector, inlet and sample box, if equipped.

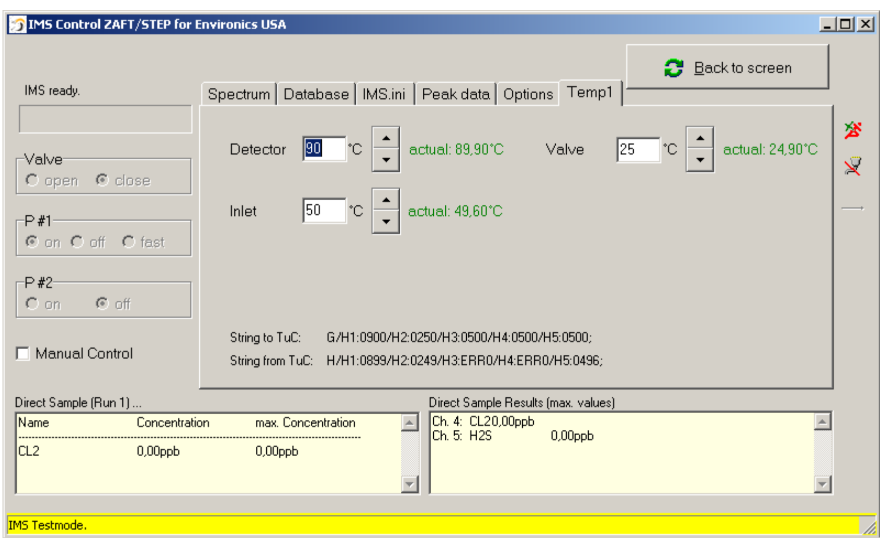

Figure 20

5. Installation and Operation

5.1 Installing the Unit

Due to the different installation requirements of each site and application, these installation notes are to be considered guidelines with the understanding that the minimum install requirement is that the analyzer is securely mounted at the point of application and protected from damage.

The Rack configuration (standard config) of the system is designed to be installed into a standard 19" rack mount and secured to the rack frame by bolting or some other secure method. Once the unit is fixed in place the sample inlet and outlet lines as well as power and data connections are made following the information provided in this manual and any specific customization instructions relating to the particular application and installation location.

The NEMA 4X case is provided with through case mounting openings to allow the case to be bolted to a secure location at the point of application by direct bolting or through the use of mounting adapters or brackets to provide for secure installation. (See figure 21 for drawings of the NEMA 4X case for reference.) Once the unit is fixed in place the sample inlet and outlet lines as well as power and data connections are made following the information provided in this manual and any specific customization instructions relating to the particular application and installation location.

5.1.1 General

Please check the environmental and operational conditions on location (refer to section 1.4.3 for details.) Ensure that there is adequate space for gas and electrical connections to be made and for future access to the system for maintenance.

⚠ Always ensure secure mounting of the device.
If the device comes loose it may injure people as well as damage itself.

⚠ Install /service the devices only when disconnected from the main power supply

5.1.2 Mechanical installation of 19’’ Rack-Mount Systems

It is recommended to mount the 19” rack-mount system before you make the gas and electrical connections. All cables and tubing to the system connects to the back panel of the analyzer. (Refer to figure 4 for details.) Ensure that there is adequate space for gas and electrical connections to be made and for future access to the system for maintenance.

Materials needed:

- 4 screws or bolt sets that fit to your rack and the mounting slots on the analyzer
- A screw driver or wrenches that fit to the screws or bolt sets used.

Procedure:

1. Move the device into the rack and align the drillings in the devices front panel with the screw threads of your rack.
2. Use the screws to fasten the device to the rack.

5.1.3 Mechanical installation of Industrial Enclosures (NEMA 4X)

It is recommended to mount the NEMA 4X housing before you make gas or electrical connections. The mounts are already installed on the housing. The housing can be installed vertically on the wall using the holes of the mounts (Figure 21). The holes in the mounts have a diameter of 9.5 mm. All cables and tubing to the system connects to the back panel of the analyzer. (refer to figure 4 for details.) Ensure that there is adequate space for gas and electrical connections to be made and for future access to the system for maintenance.

Materials needed:

Note: Use the adequate type of screw anchors in regard of the wall where the analyzer will be installed.

- A screw driver or wrenches that fit to the screws or bolt sets used.
- A drilling machine with a drill bit of the same diameter as the screw anchors

Procedure:

1. Mark the position of the mount holes at the wall (refer to Figure)
2. Drill the holes to take up the screw anchors.
3. Insert the screw anchors into the drilled holes.
4. Align the holes of the devices mounts with the screw threads of the screw anchors.
5. Use the screws to fasten the device to the wall.
6. Ensure that the wall mounts are installed flush against the mounting surface

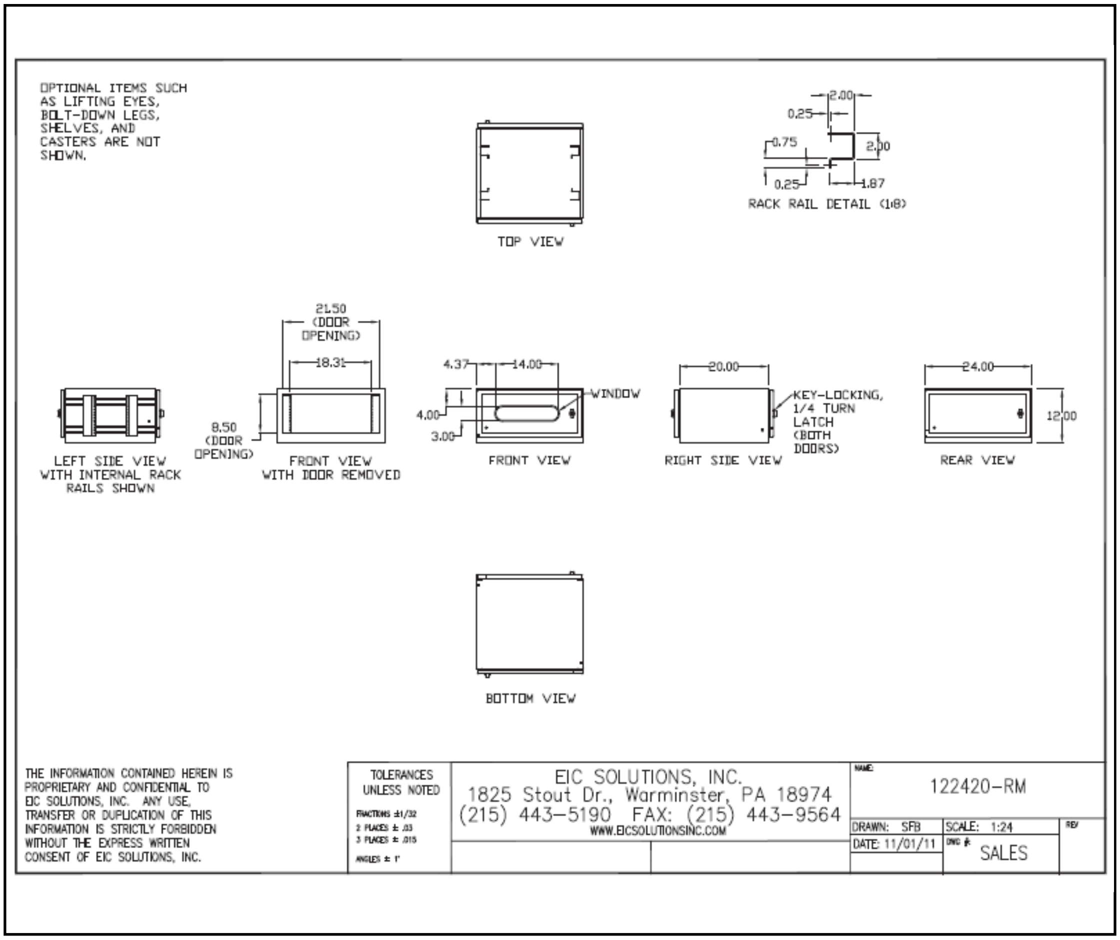

Figure 21: NEMA 4X housing, Assembly dimensions (in millimeters)

5.1.4 Tubing installation

Please remove the pipe caps and connect the device to your tubing system. It is recommended to remove the pipe caps just before you intend to connect the corresponding tubing.

⚠ **Do not mistake the gas in- and outlets!**

⚠ **It is recommended to use PTFE tubing only. If a different kind of tubing is used the manufacturer does not guarantee the proper operation of the system!**

The gas pipe connections are equipped with Swagelok fittings. If you are not familiar with the Swagelok connection system, please review the following explanation how to connect tubing to a fitting.

Materials needed:

- 1/4-inch tubing
- 1/4-inch Swagelok screw nuts, as well as suitable front and back ferrules
- Two 9/16-inch wrenches

Procedure:

To create leak-proof, torque-free seals at all tubing connections:

1. Assemble the fitting parts.
   - Place a Swagelok nut, back ferrule, and front ferrule on the tubing.
2. Join the tubing to the manifold fitting.
   - Insert the tubing and fitting into the manifold fitting.
   - Make sure that the front ferrule is touching the female (manifold) fitting.
   - Slide the nut over the ferrule.
   - Finger-tighten the nut.
3. Position the tubing.
   - Push the tube fully into the manifold fitting, then withdraw it approximately 1–2 mm.

<u>Note:</u> **If you do not withdraw the tubing, it will flare in the fitting when you tighten the nut. In this case it may crack.**

4. Mark both Swagelok fittings with a pencil line to observe the tightening in Step 5.
5. Tighten the fittings.
   - Hold the female (manifold) fitting steady with one wrench and tighten the tubing nut with the other.
   - For 1/4-inch fittings, tighten 1 1/4 turn

Please check the pipe system and/or the connections for leak tightness

⚠ **Always ensure that the power supply is not connected to the supply cable before the mechanical and tubing installations have been completed!**

5.1.5 Electrical installation

The general electrical installation only needs the connection to the power supply.

⚠ **Always ensure that the power supply is not connected to the supply cable before the mechanical and tubing installations have been completed!**

The power and data connections to other devices are made following the information provided in this manual and any specific customization instructions relating to the particular application and installation location. All cables and tubing to the system connects to the back panel of the analyzer. (Refer to figure 4 for details.) Ensure that there is adequate space for gas and electrical connections to be made and for future access to the system for maintenance.

6. WARRANTY

STEP Analytics USA warranties that products manufactured or sold by Environics are free from defects in materials and workmanship. STEP Analytics USA standard warranty period is one (1) calendar year from the original delivery date.

6.1 Warranty instructions

In the case of a warranty issue the customer shall return failed analyzer using instructions detailed in paragraph; RETURN POLICY, below to the specified location, transportation charges prepaid, and STEP Analytics USA agrees to either repair or replace at its sole discretion, any analyzer or other product which under proper and normal use prove defective in material and/or workmanship within twelve (12) months after shipment. Those items repaired or replaced by STEP Analytics USA under warranty shall be returned to customer transportation charges prepaid. Repaired or replaced items shall only be warranted for the remaining duration of the original item. Those items that are deemed by STEP Analytics USA not to be defective or are determined to have failed due to misuse or abuse shall be returned to the customer at customer's expense, if the customer chooses not to pay for reasonable repairs. In respect to any claims by customer hereunder, STEP Analytics USA shall have no liability unless customer complies with instructions given by STEP Analytics USA.

6.2 Warranty exclusions

This warranty is contingent upon customer's proper use of the analyzer and/or other products in the application and operating environment for which they were intended by STEP Analytics USA. The warranty is not applicable to any products that have been modified or subjected to unusual physical, environmental, or electrical stress, or for which the original identification marks have been removed or altered. These warranty provisions do not apply to any damage resulting from combat, malicious damage, negligence, unauthorized maintenance or modification, accident, neglect, misuse, improper servicing, transportation, or normal wear and tear of the equipment. In addition, this warranty specifically excludes loss or damage to third parties and consequential damages of any kind.

Determination as to whether this warranty provision applies to damaged goods shall reside solely with STEP Analytics USA. Disposition of any damaged goods deemed outside of this provision shall be the responsibility of customer. The following consumable items are excluded from this warranty:

Scrubber(s) and scrubber seals and internal particulate filter(s)

6.3 Disclaimer of implied warranties

The express warranties contained in this agreement are the sole and exclusive warranties provided by STEP Analytics USA. STEP Analytics USA specifically disclaims any other warranties, express or implied including but not limited to warranties of merchantability or fitness for a particular purpose, as well as any warranties alleged to have arisen from custom, usage, or past dealings between the parties.

7. RETURN POLICY

STEP Analytics USA does not accept returns for refund, credit or exchange for any reason without prior approval. If a product is being returned for warranty or maintenance work STEP Analytics USA requires prior notification and approval before the shipment can be accepted. Problems with the analyzers may be reported by calling, faxing, or e-mailing, your local distributor or service personnel or STEP Analytics USA. See below for contact information:

Environics Oy SAMMONKATU 12 Mikkeli 50130 FINLAND Tel. +358 201 430 430 Fax +358 201 430 440 E-mail: customer.services@environics.fi	STEP Analytics USA, Inc. 1308 Continental Drive, Suite J Abingdon, MD 21009 USA Tel: +1 410 612-1250 Fax: +1 410 612-1251 E-mail: sales@environicsusa.com www.environicsusa.com	

After reporting the problem, follow the instructions given by the manufacturer.

8. Appendix

8.1 Table of selected chemical substances and approximate MDCs

Substance	MDC (ppb)	Ionization
Alcohols		
Butanol	10	☐(+)
Cresol	10	☐(+)
Cyclohexanol	10	☐(+)
Ethanol	10	☐(+)
Heptanol	10	☐(+)
Methanol	20	☐(+)
Tetrahydrofurfurylalcohol	10	☐(+)
Alcanes		
Cyclohexane	50	☐(+)
Heptane	50	☐(+)
Isooctane	50	☐(+)
Nonane	50	☐(+)
Aldehydes		
Butylaldehyde	10	☐(+)
Heptylaldehyde	10	☐(+)
Propionaldehyde	10	☐(+)
Amines		
Amphetamine	1	☐(+)
Diaminobutane	10	☐(+)
Diaminobutane	10	☐(-)
Diaminopropane	10	☐(+)
Diaminopropane	10	☐(-)
Dimethylformamide	1	☐(+)
1,1-Dimethylhydrazine	1	☐(+)
Dimethylurea	1	☐(+)
Hexamethylentetramine	10	☐(+)
Hexylamine	1	☐(+)
Hydrazine	10	☐(-)
Methylhydrazine	1	☐(-)
Methylhydrazine	1	☐(+)
Nicotine	2	☐(+)
Nonafluorobutylamine	1	☐(-)
Aromates		
Chlorophenol	10	☐(-)

Dimethoxybenzene	10	□(+)
Ethylbenzene	5	□(+)
Iodobenzene	10	□(-)
Nitrobenzene	10	□(-)
Phenol	10	□(-)

Substance	MDC (ppb)	Ionization
Carbonic acids		
Acetic acid	10	□(+) (□(-)
Formic acid		□(-)
Esters		
Ammoniumacetate	1	□(+)
Ethyl acetate	1	□(+)
Ethylacetoacetate	1	□(+)
Phthalic acid diethyl ester	1	□(+)
Phthalic acid dibutyl ester	1	□(+)
Phthalic acid dioctyl ester	1	□(+)
Ethers		
Diethylether	1	□(+)
Divinylether	1	□(+)
Halogenated hydrocarbons		
Amylchloride		□(-)
Amylchloride		□(+)
Chlorbromomethane		□(-)
Chloroacetonitrile		□(-)
Chlorotrimethylsilane		□(-)
Chlorodimethylether	5	□(-)
Dichlorethane	5	□(-)
Dibromethane		□(-)
Dibromobutane		□(-)
Dibromomethane		□(-)
Dibromopropane		□(-)
Isobutylchloride		□(-)
n-Butylchloride		□(-)
Methylchloride	1000	□(-)
Trichlorethylene		□(-)
Trichlorfluoromethane		□(-)
Vinyl chloride (VC)	100	□(+)
Ketones		
Acetone	1	□(+)
Acetophenone	1	□(+)
Acetyl acetone		□(+)

Acetyl acetone		□(-)
Benzophenone		□(+)
Cumene		ß(+)
Ethylmethylketone	1	□(+)
Hexanone		□(+)
Phosphor organic compounds		
Malathion		□(+)
Tributylphosphite	1	□(+)
Tricresylphosphate	3	□(+)
Pyridines		
Pyridine	10	□(+)
2-Dimethylpyridine	10	□(+)

Substance	MDC (ppb)	Ionization
Others		
Acrolein		□(+)
Ammonia	1	□(+)
Dibutylsulfite		□(+)
Carbon disulfide	5	□(-)
Chlorine	10	□(+)
Diborane	10	□(-)
Ethylene oxide	100	ß(+)
Hydrochloric acid	25	□(-)
Hydrocyanic acid	5	□(-)
Hydrogen sulfide	10	□(-)
Nitric oxide	50	□(-)
Nitrogen dioxide	5	□(-)
Phosgene low high	0,5 100	□(-)
Sulfur dioxide	10	□(-)
Sulfur hexafluoride	10	□(+)

Remarks:

1) MDCs are valid for compounds in synthetic air at 20 °C.
2) Further substances can be measured if required.

8.2 Certificate of the tritium radiation source of an IMS device

Certificate

of the tritium radiation source of an IMS device

IMS device No.:	………………
Source name:	H-3, No. ……
Source type:	quasi-enclosed radioactive substance (see also design approval B - 04/98)
Activity:	≤ 100 MBq
Reference date:	………..
Radiochemical:	no radioactive reaction product; inactive ^{3}He will be formed
Radiation type:	β^{-} emission
Radiation energy:	medium energy 5.68 keV maximum energy 18.70 keV
Half life period:	12.4 years physical 10 days biological, in terms of $^{3}H_2O$
Bremsstrahlungs-dose rate constant:	$9.9*10^{-9}$ mSv h^{-1} GBq^{-1} (at a distance of 1 m)
Equivalent dose:	< 0.1 mSv cm^{2} h^{-1} kBq^{-1}
Weakening/Decrease of radiation:	air: 1 mm; water: 1 µm; tissue: 6 µm
Location and assembly:	fixed inside of the IMS device; The radiation source is scoop-proof assembled and not accessible from the outside.
Local dose rate:	< 0.5 $\mu Sv h^{-1}$ at a distance of 0.1 m of the touchable surface of the measuring device
Source description:	The construction of the radiation source is accessible at the producer (technical drawing No. RID3.57-02:04) if required. The tritium is bound in form of titaniumtitride and shielded with silicium and aluminium layers for protection.

……………………
Date / Signature

8.3 Abbreviations and technical terms

Abbreviations and technical terms	Meaning
Dimer	complex consisting of two identical molecules
IMS	Ion Mobility Spectrometer
FWHM	full width at half maximum
LED	light emitting diode
MDC	minimal detectable concentration
Monomer	single molecule
n/a	not available
ppb	parts per billion (10^{-9})
ppm	parts per million (10^{-6})
RIP	reaction ion peak
SPS	memory programmable control
$T_{Monomer, Dimer, RIP}$	drift time of monomer, dimer or reaction ions
UV	ultraviolet (radiation)
V DC	Volt, direct current
ß	beta radiation (fast electrons)
ß(-)	ionization by a tritium radiation source, negative mode
ß(+)	ionization by a tritium radiation source, positive mode