airpointer®

Version 2.11 A

recordum®
Next Generation Environmental Monitoring Solutions

® recordum Messtechnik GmbH
Triesterstrasse 14 / Haus 1, Top 403, 2351 Wiener Neudorf, Austria
www.recordum.com

Contents

List of Figures

List of Tables

1. Introduction

CAUTION:

Please read this manual carefully. Operating the airpointer® according to this manual is essential for safe and proper function. Otherwise the safety in use may be influenced.

1.1. General

Thank you for purchasing the airpointer®.
This device is a self contained measuring platform for one or more air pollutants.
The airpointer® is constructed for indoor and outdoor use and continuous operation.
Key features comprise:

- Several analyzing modules can be built in: SO_2, $NO/NO_2/NO_x$, O_3, CO, H_2S, VOC, electrochemical sensors, NH_3, TDS (Traffic sensor data), PM10 or PM2,5, and sensors for indoor air quality (IAQ) measurement, upgradeable.
  Taylor it to your specific needs with our unique SIP (sensor interface platform).
- SO_2, NO_x, O_3, CO sensors use the respective EU reference method.
- Complete meteorology available (optional).
- Housing made of double-wall coated aluminum plate, providing excellent isolation from temperature and electrical radiation.
- Two standard cylinder locks for main door and maintenance door, which could also be part of a key system.
- Compact system, easy to operate and maintain.
- Internal air condition and temperature management system, providing optimized energy consumption.
- Low power consumption of 340/490W (depending on version), 670W max.
- Rugged, unobtrusive, burglar proof and weatherproof design.

- No need for special preparation of measuring site.
- Operation control and data view via web browser and Internet
- Analyzing modules on drawers for easy expansion of the system as well as good serviceability. Cables and tubing protected against mechanical damage.
- Internal zero air supply for periodical zero check or calibration. Optional span modules are available.
- The powerful data management systems allows implementation of additional monitoring devices including particulate matters like the TEOM/FDMS or β-gauge analyzers.
- Made in Austria, Europe

NOTE
For operation according to US EPA requirements refer to section 8 of this manual

2. SAFETY MESSAGES

Your safety and the safety of others is very important. We have provided many important safety messages in this manual. Please read these messages carefully. A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of each symbol is described below:

	**GENERAL SAFETY HAZARD: Refer to the instructions for details on the specific hazard.**
	**CAUTION: Electrical shock hazard.**
	**ATTENTION: Sharp surface.**
	**ATTENTION: Device is heavy. To avoid personal injury, use several persons to lift and carry it.**
	**CAUTION: Hot Surface Warning.**

	**CAUTION: Ozone is a toxic gas.**
	**CAUTION: Toxic gas! Take precautions!**
	**ATTENTION: UV light! May cause injuries.**
	**CAUTION: Vacuum inside the device!**
	**ATTENTION: Do NOT dispose with ordinary trash!**
	**RECYCLING**

3. How to Use This Manual

The airpointer® has been designed to offer a maximum of serviceability, reliability and ease of operation. Its CPU continually checks operating parameters such as temperature, flow, pressure and critical voltages. The instrument's modular design requires a corresponding special handling of this manual. Parts of this manual, which relate or only apply to a specific module are marked as those. Not all of these modules may be installed in your device. Text passages that apply for the various modules installed are marked as following:

SO_2	Sulfuric Oxide Module
NO_x	Nitrogen Oxide Module
CO	Carbon Monoxide Module
O_3	Ozone Module

If no mark is given, the text is not specifically related to a module. Therefore, depending on your configuration some of the text passages may not be valid for your device. Where necessary, the range of validity is marked with the symbols given above. Other symbols are used to clarify text passages which refer to certain environments (e.g. if referring to special Internet browsers: Internet Explorer®, Mozilla, etc.).

For some instructions relating to the operation of software a special syntax is used: The meaning of the arrow ($\twoheadrightarrow$) is: Press the button or select the menu or folder given to the left side of the arrow and follow the respective action to the right side next.

The first step after receiving the airpointer® should be to read the Chapter 'Getting Started' starting on page 5-1. It describes in detail which steps have to be taken in order to prepare the airpointer® for measurement and data acquisition. This sequence involves a direct connection of a computer with the airpointer® data processing unit. For a proper setup, please follow the instructions found in this chapter in exactly the order they are given there.

NOTE
Please change the default administrator password for the User Interface provided with your airpointer® (see section 7.7.9.3).

You will be asked to change the default administrator password for the User Interface provided with your airpointer®. This software provides an interface to handle data queries, visualization of data and operation as well as calibration of the airpointer®. However, apart from this action you will not need the User Interface for this startup sequence.

Later on, for normal operation you are offered several possible ways to communicate with the airpointer®. Please, see Chapter 'Connecting the airpointer®' starting on page 6-1 for details on how to do this.

We also recommend to read Chapter 'The Physical Fundamentals' starting on page 9-1 to get a better comprehension of the physical principles employed by the airpointer®.

In any case you should read Chapter 'Operation Details' starting on page 10-1, which supplements these explanations with all information necessary to properly understand the handling of the gas modules. Parallel to gathering this information, try to get familiar with the corresponding settings and handles in the User Interface.

After reading these chapters, you should be well-prepared for also handling more demanding actions via the User Interface. For this purpose, carefully read Chapter 'User Interface' starting on page 7-1.

Similar to any other instrument, the airpointer® needs some maintenance from time to time. Therefore, starting with the first day of operation, please, keep in mind the maintenance schedule (Table 11.1 on page 11-3). The steps, which have to be taken to perform these maintenance procedures are found in Chapter 11.

In case that you like to upgrade your airpointer® , see Table **??** on page **??**.

In the following, a brief description of all sections in this manual is given.

- **Table of Contents** Outlines the contents of the manual in the order the information is presented. This is a good overview of the topics covered in the manual. There is also a List of Tables and a List of Figures.

- **Specifications Section** This section deals with the specification of the airpointer® and with the warranty conditions. Here you can also find all certifications and declarations.

- **Getting Started Section** This section gives an insight in the business one has to do after receiving the airpointer®. It also explains the installation steps.

- **Connecting the airpointer®** This section gives an overview of possible ways to connect the airpointer® with e.g. a laptop.

- **User Interface** This section explains the calibration and handling of the airpointer®, the data acquisition and display facilitation via the User Interface. All steps that have to be taken in order to calibrate the airpointer® gas modules are described here. Here you can adjust an external analyzer to the airpointer®.

- **Operation in US-EPA FEM/FRM mode** This section gives an overview of the possible ways to configure your airpointer® in an US-EPA compliant mode. Furthermore it shows the specifications for US-EPA equivalency.

- **The Physical Fundamentals** This section develops a more deep understanding of the underlying physical principles of operation of each optional gas module (Ozone, CO, SO_2 and NO_x) used in the airpointer®. This is provided as basic background information for the user.

- **Operation Details** This section explains the main components of each optional gas module together with their principle of operation. A basic understanding of these principles is required to understand the information provided by these modules. This will also help you in performing any direct intervention in the airpointer® system in the course of troubleshooting or maintenance.

- **Maintenance** The Maintenance section explains the steps that have to be taken to assure a proper operation. The necessary maintenance steps are described together with their corresponding service intervals. The maintenance of the base unit and of the ozone, CO, SO_2 and NO_x module are included. The maintenance of further modules and sensors are described in the respective sections.

- **Internal Span Module (ISM)** In this chapter the internal span modules for ozone, CO, SO_2 and NO_x are described. If one of these modules is installed, an internal automatic calibration control with span gas can take place of the respective module.

- **Further Sensors** In this chapter further available sensors for the airpointer® are described, for example, meteorological or NH3 sensors. This description includes the technical specification, the mounting, the measurement technique, the calibration and the maintenance of the sensors.

- **Troubleshooting** In this section you will find precise guidelines for corrective procedures in case an error or malfunction occurs.

- **Software Protocols** Outlines the protocols, which allow the user to query the present value of any system and predetermined system variable without use of the User Interface.

- **Http - Download Interface** Additional to the User Interface there is the possibility for programmed request cycles. Here the protocol for programmed request cycles from your workstation is described.

- **The Index** Here you can find a list of characteristic terms and their referenced page number where they occur in the manual.

NOTE
For information on unpacking the instrument, please refer to 'Getting Started', Section 5.

4. Specifications

The airpointer® consists of the base unit and depending on the configuration of several gas modules plus a meteorology and communication unit. The base unit includes housing with pump, an air conditioner and a data logger (RDPP) plus software and two Ethernet 10/100 MBit/s Interfaces. Depending on the configuration of your airpointer®, several modules (SO_2, O_3, NO_x, CO, particle, H_2S, TDS (traffic data sensor), electrochemical and VOC analyzer) can be built in to measure various pollutants in ambient air. Refer to Section 5.5 for the location of the SO_2, O_3, NO_x, or CO module.
Additionally an internal calibration control (ISM - Internal Span Module) can be installed for the SO_2, O_3, NO_x, or CO Module on the respective module. The specifications and further information of the additional sensors and modules are given in the respective chapters.
For additional components and more information please ask your distributor.

- Meteorology (chapter 13)
  - Wind speed
  - Wind direction
  - Ambient temperature, pressure, relative humidity, CO_2, precipitation (hail, rain)
- Communication (chapter 6)
  - GPRS modem
  - Wireless LAN router
  - any other TCP/IP based system
- ISM (Internal Span Module) (chapter 12)
- VOC module
- H_2S module
- TDS - Traffic Data Sensor
- Electrochemical Analyzer
- Indoor Air Quality Kits (e.g., chapter 13.2.2)

4.1. General Specifications

Sample Flow Rate	Less than 3000cc/min depending on configuration additional about 2000cc/min for Particular Matter Monitor
Dimensions (H x D x W)	Base Unit 2D (up to two drawers): 890x782x400mm/35x30,8x15,8in Base Unit 4D (up to four drawers): 1120x782x400mm/44,1x30,8x15,8in Base Unit +PM (up to four drawers): 1200x782x615mm/47,2x30,8x24,2in
Weight	airpointer Base unit 2D: 65,8kg/145.1lbs airpointer Base unit 4D: 73,9kg/162,9lbs airpointer Base unit +PM: 110kg/242,5lbs O_3 Analyzing Module: 5,8kg/12,8lbs SO_2 Analyzing Module: 8,5kg/18,7lbs CO Analyzing Module: 9kg/19,8lbs NO_x Analyzing Module: 12,0kg/26,5lbs PM Analyzing Module: $<$ 4,0kg/8,8lbs
Operating Temperature Range	-20 to +42°C (sensor specs valid within this rage) Optional heater for -40°C available. For higher temperatures an additional shelter with additional air condition is available.
Power	two versions are available: 115V/60 Hz or 230V/50 Hz, min 10A fused. Typically 350W for three and 490W for four modules. Max. short term power consumption: 670W The +PM unit has a maximal consumption of 1100W
Configuration	Combination of several analyzer modules and various meteorological and other sensors are possible, upgradeable
Rate of protection	IP54 (measurement area), IP44 (pump room)
Sound pressure level	58 dB in 1 m distance
Rating of power socket at the main computer housing	115V/230V (depending on instruments version), max. 1A.

CAUTION:

Please ensure to connect your airpointer® to its correct voltage. Information can be found on its type label!

4.2. Overview Specifications of the Modules

	CO	O_3	NO_x	SO_2
Measurement Principle	Non-dispersive Infrared (NDIR) (EN 14626)	Ultraviolet Photometry (EN 14625)	Chemiluminescence (EN14211)	Ultraviolet Fluorescence (EN 14212)
Measurement Units	ppm, ppb, $\mu g/m^3$, mg/m^3	ppm, ppb, $\mu g/m^3$, mg/m^3	ppm, ppb, $\mu g/m^3$, mg/m^3	ppm, ppb, $\mu g/m^3$, mg/m^3
Dynamic Range	up to 10.000ppm	up to 200ppm	up to 20ppm	up to 10ppm
Lower Detectable Limit	0.04ppm	0.5ppb	0.4ppb	0.5ppb
Zero Noise	0.02ppm RMS	0.25ppb RMS	0.2ppb RMS	0.25ppb RMS
Zero Drift (24 hours)	< 0.1ppm	< 1.0ppb	< 0.4ppb	< 1.0ppb
Span Drift (24 hours)	± 1% of reading >10ppm	± 1% of reading >100ppb/month	± 1% of reading >100ppb	± 1% of reading >100ppb
Response time	< 60 seconds	< 30 seconds	< 60 seconds	< 90 seconds
Precision	± 0.1 ppm	1ppb	1% of reading or 1 ppb (whichever is greater) @<500ppb	1% of reading or 1 ppb (whichever is greater)
Linearity	± 1% of reading < 1000 ppm	± 1% of reading >100ppb	± 1% of reading >100ppb	± 1% of maximum >100ppb
Sample flow rate	approx. 550ml/min	approx. 550ml/min	500ml/min / 60 (O3 Generator)	550ml/min

4.3. Warranty

Prior to shipment, the equipment is thoroughly inspected and tested. Should functional failure occur, we assure our customers that prompt service and support will be available. All equipment originally manufactured by recordum® Messtechnik GmbH found to be defective will be repaired or replaced subject to the following considerations.

4.3.1. Coverage

All equipment is warranted for 12 months, consumables not included. Any warranty is limited to 12 months. Warranty is limited to equipment and does not cover losses such as data loss or its effects.
Warranty is to be understood as the substitution or repair at recordum® Messtechnik GmbH's or its distributors discretion without charge, including the cost of labor, of the component parts of the equipment recognized as defective at source owing to flaws in their manufacture.
All units or components should be properly packed for handling and returned freight prepaid to the distributor they were purchased from. After repair, the equipment will be returned, freight prepaid.
Our warranty commences with shipment of the equipment. After expiry of warranty period and throughout the equipment's life time, recordum® Messtechnik GmbH or its distributors readily provide on site service at reasonable prices similar to those of other manufacturers in the industry.

4.3.2. Equipment Not Manufactured by recordum® Messtechnik GmbH

Equipment provided but not manufactured, though normally offered by recordum® Messtechnik GmbH, is warranted and will be repaired to the extent and according to the current terms and conditions of the respective equipment manufacturer's warranty.

4.3.3. LEGAL NOTE

recordum® Messtechnik GmbH, ITS DEALERS, DISTRIBUTORS, SUB-CONTRACTORS, AGENTS OR EMPLOYEES SHALL NOT IN ANY EVENT BE LIABLE FOR ANY DAMAGES INCLUDING SPECIAL, DIRECT, INDIRECT, INCIDENTAL, EXEMPLARY OR CONSEQUENTIAL DAMAGES, EXPENSES, LOST PROFITS, LOST SAVINGS OR ANY OTHER DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE INSTRUMENT OR THE DOCUMENTATION.

4.4. Declarations and Certifications

qualityaustria
Succeed with Quality

CERTIFICATE

Quality Austria Training, Certification and Evaluation Ltd. awards this Quality Austria Certificate to the following organisation(s):

recordum Messtechnik GmbH
A-2340 Mödling, Jasomirgottgasse 5

This Quality Austria Certificate confirms the application and further development of an effective

QUALITY MANAGEMENT SYSTEM
complying with the requirements of standard
ISO 9001:2008

Registration No.: 03977/0
Date of initial issue: 3 November 2004
Valid until: 26 August 2014

Vienna, 1 December 2011

The validity of the Quality Austria Certificate will be maintained via annual surveillance audits and one renewal audit after three years.

Quality Austria Training, Certification and Evaluation Ltd.

Konrad Scheiber
General Manager

Eckehard Bauer, MSc
Specialist representative

The current validity of the certificate is documented exclusively on the Internet under http://www.qualityaustria.com/en/cert EAC: 18

Figure 4.1.: recordum® ISO Quality Management System Certificate

qualityaustria
Succeed with Quality

CERTIFICATE

Quality Austria Training, Certification and Evaluation Ltd. awards this Quality Austria Certificate to the following organisation(s):

recordum Messtechnik GmbH
A-2340 Mödling, Jasomirgottgasse 5

This Quality Austria Certificate confirms the application and further development of an effective

ENVIRONMENTAL MANAGEMENT SYSTEM
complying with the requirements of standard
ISO 14001:2004

Registration No.: 00395/0
Date of initial issue: 3 November 2004
Valid until: 26 August 2014

The validity of the Quality Austria Certificate will be maintained via annual surveillance audits and one renewal audit after three years.

Vienna, 1 December 2011

Quality Austria Training, Certification and Evaluation Ltd.

Konrad Scheiber
General Manager

Ing. Wolfgang Hackenauer, MSc
Specialist representative

The current validity of the certificate is documented exclusively on the Internet under http://www.qualityaustria.com/en/cert EAC: 18

Figure 4.2.: recordum® ISO Environmental Management System Certificate

recordum
Next Generation Environmental Monitoring Solutions

recordum Messtechnik GmbH

CE

Declaration of Compliance

Manufacturer:	recordum Messtechnik GmbH Jasomirgottgasse 5 Mödling, 2340 Austria Phone: +43(0)2236/860 562 Fax: +43(0)2236/860 562-61 Email: info@recordum.com

recordum Messtechnik GmbH declares that the product specified herein

Product name:	airpointer
Description:	Air pollution monitoring system
Product options:	SO_2, NO_x, O_3, CO, Meteo
Date of marking:	30^{th} of March 2005

in accordance with the directives	73/23/EEC 89/336/EEC

is in compliance with the following:

Product Safety Standards:

EN61010-1:2001 + Corrigendum:2002-08 + Corrigendum:2004-01

EMC Directive:

EN61326:1997 + A1:1998 + A2:2000 + A3:2003

Emission measurements	Susceptibility immunity tests
EN55022 Class B EN61000-3-2 EN61000-3-3	EN61000-4-2 EN61000-4-3 EN61000-4-4 EN61000-4-5 EN61000-4-6 EN61000-4-8 EN61000-4-11

Traugott Kilgus, Managing Director
30^{th} of March 2005, Mödling

4.5. User's Notes

5. Getting Started

CAUTION:

The airpointer® weighs about 80 to 110 kg (depending on the configuration)!
To avoid personal injury, we recommend at least three persons to lift and carry the airpointer®.

5.1. Overview

1. Unpacking (store the multi-ply board and the special wooden pallet for further reuse) (chapter 5.2).
2. Verify that all optional hardware ordered with the unit is installed (according to the included printed record) and inspect the interior (chapter 5.3).
3. Mounting (Take care of the required ventilation clearance and maintenance space) (chapter 5.4).
4. Remove the red shipping screws from the piston pump (chapter 5.3).
5. Mount the sample inlet and further optional equipment, like e.g.: GPRS antenna, wind sensor and sample inlet for the particle sensor, on top or at the side of the airpointer® (chapter 5.4).
6. If an optional Internal Span module for NO_x and/or SO_2 module is installed, then install the respective permtube. Generally, it is not included. You have to provide it in the desired concentration. Further information is given in chapter 12.

NOTE
The airpointer® should be on site in upright position for at least one hour before the first power-up.

7. Put all necessary cables (e.g.: power line, cable for the wind sensor) through the cable passage and the strain relief and connect them (Figure 5.17).

> **NOTE**
> **Check voltage and fuse!**

8. Boot up the airpointer® .

> **NOTE**
> **The airpointer® boots up, when the internal temperature is above 5°C.**

9. Connect your Laptop with the delivered cross patch cable with the LAN connector in the maintenance door. Boot up the laptop and configure your internet connection (chapter 5.6 and 5.7).

> **NOTE**
> **Make sure that you can log in as administrator at your laptop and at the airpointer® .**

Additional connection possibilities are described in chapter 6.

10. Configure your modem connection (optional, see chapter 6.2).
11. Connect your PC with the airpointer® via the recordum portal (portal.recordum.com – optional; it is delivered with a login setting) or via DynDNS daemon (give in the delivered address and log in, chapter 7.7.8.
12. Open the User Interface on your PC.
13. Change the password (chapter 7.7.9.3).
14. In the User Interface deviations of the measurement values outside the chosen warn and failure limits are shown.

> **NOTE**
> **The fail or warn sign is shown as red FAIL and orange WARN, respectively, overhead in the User Interface. If you click the sign you will get the correct side in the LinSens Service Interface with further details ('LinSens Service Interface'7.7.2.2.1). Failure messages are written in red and warn messages in orange.**

15. Wait until all warn and fail signs cease (this should require 15 to 30 minutes depending on the configuration). Then the green LED in the maintenance door lights (Figure 5.13) and the airpointer® is ready for operation.

16. Check the measured values, whether they are plausible (especial the temperature). All values should be within the chosen limits.

> **NOTE**
> **The value -9999,0 is equivalent to a non existing or inoperative value, analog to MS Excel.**

17. Perform a leak check. See chapter 11.10.

18. Perform a sample flow check. See chapter 11.11.

19. If possible test the air condition. Does it cool down the internal air with respect to the ambient air? If not, please make sure that the suction grills at the bottom of the airpointer® are clean and that there is enough ventilation space

20. Calibrate the airpointer® as described in chapter 7.6.7 'Calibration'.

21. Define the setpoints and the cycles for the Internal Span Module (chapter 12).

22. Leave the maintenance mode and start the measurement.

5.2. Unpacking the airpointer®

Follow these steps to unpack the airpointer®:

1. Remove the transparent weather protection foil.
2. Inspect the received packages (see Figure 5.1) for external shipping damage. If damaged, please advise the shipper first, then your distributor.
3. Do NOT cut the multi-ply board box. It can be reused for later shipment. Open the multi-ply board box (see Figure 5.2).

Figure 5.1.: The Package with the airpointer®

Figure 5.2.: Opened Multi-Ply Board Box.

4. Lift and remove the multi-ply board box.
5. Store the wooden pallet and the multi-ply board box for later reuse.

Figure 5.3.: Store the Multi-Ply Board Box for Later Reuse

Figure 5.4.: Cut the Plastic Retaining Bands

6. Unpack the airpointer® .
7. Check for content of delivery inside the enclosed boxes.
8. Cut the plastic retaining bands that fixes the airpointer® to the special wooden pallet (see Figure 5.4) and remove the transparent plastic protection (see Figure 5.5).
9. Put the device in an upright position.

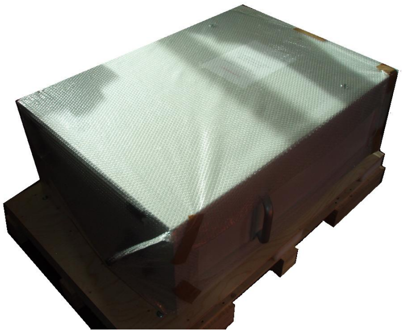


Figure 5.5.: airpointer® with Protection Removed

Figure 5.6.: Unpacked airpointer®

5.3. Checking the airpointer® after Unpacking

> **NOTE**
> **With the airpointer® you should have received a box with all of the accessories, including this manual.**

Checking the airpointer® after unpacking:

1. Put the device in an upright position, i.e. the name 'airpointer®' is readable and the sample inlet opening is on the top (see Figure 5.8). Open the main door of the analyzer and check for internal shipping damage.

   Included with your analyzer is a printed record of the final performance characterization performed on your instrument at the factory.

   > **NOTE**
   > **The included printed record is an important quality assurance and calibration record for this instrument. Please preserve it.**

2. Open the main door.

   > **CAUTION:**
   >
   > **The door opens with gas-pressure damper. Hold it down with one hand and open it slowly.**

   > **CAUTION:**
   >
   > **When opening the main door take care that you have enough space to open the door.**

3. Inspect the interior of the instrument to make sure all circuit boards and other components are in good shape and properly seated.

CAUTION:

Printed Circuit Assemblies (PCA) are static sensitive. Electrostatic discharges, too small to be felt by humans, are large enough to destroy sensitive circuits.
Before touching a PCA, fasten a properly installed grounding strap to your wrist or touch a bare metal part of the housing to discharge any electrostatic potentials.
Never disconnect electronic circuit boards, wiring harnesses or electronic sub assemblies while the unit is under power.

4. Check the connectors of the various internal wiring harnesses and pneumatic hoses to make sure they are firmly and properly seated.

5. Verify that all optional hardware ordered with the unit has been installed. These are checked on the printed list shipped with the analyzer.

CAUTION:

If you modify anything inside the airpointer®, check that the airpointer® is unplugged!

6. Once you have determined that no shipping damage exists and the unit includes all expected hardware options and you are at the designated installation site, remove the two red colored shipping screws from the bottom of the pump from the outside of the airpointer® (shown in Figure 5.7) before you switch on your airpointer®. Save these shipping screws.

CAUTION:

DO NOT reach inside the ventilation blades of the pump!

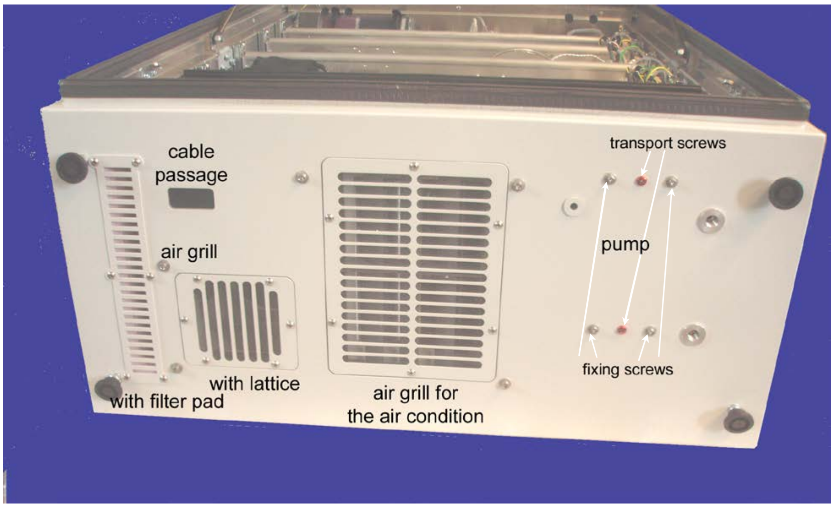


Figure 5.7.: Bottom of the airpointer®

7. Close the main door and secure the airpointer® if necessary.

> **NOTE**
> **Whenever you ship the airpointer® , re-install the shipping screws and use the special wooden pallet and the multi-ply box which you got with the airpointer® .**

5.4. Mounting the airpointer®

NOTE
For air quality measurement free air circulation is essential. Please refer to local requirements for selection of a good mounting site for the airpointer® .

Preparing the installation site and mounting the airpointer®:

1. Power connection 115V/60 Hz or 230V/50 Hz, min 10A fused (depending on version) is needed at the installation site.
2. Optionally, to establish Internet connection for the airpointer® preparations may be necessary. For further details, please refer to Chapter 6.
3. Loosen the screw for the sample inlet. Push the sample inlet into its final position (see Figures 5.8 to 5.9) and fasten the screw till the sample inlet cannot be rotated any more.

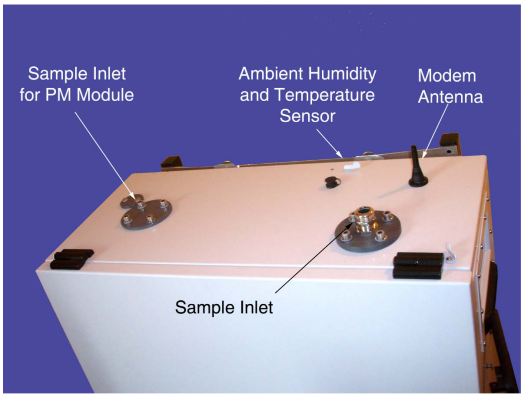


Figure 5.8.: Housing with Roof Passage

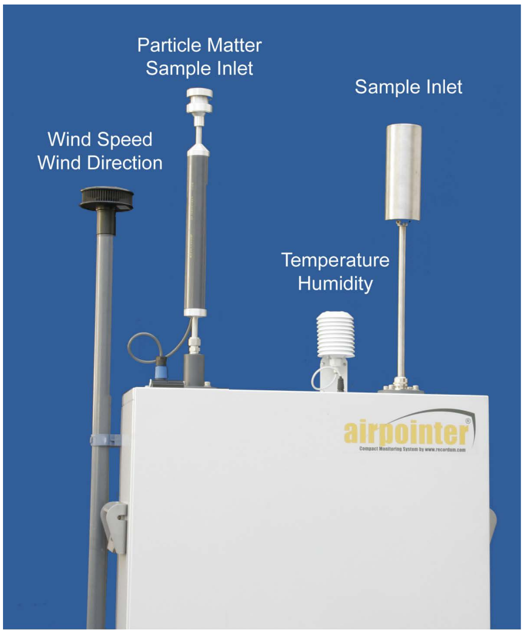


Figure 5.9.: Sample Inlet Mounted

4. Mount all external sensors (optional) and connect them. The wind sensor is fixed with a collar on the left side, all other sensors (e.g.: humidity and temperature), the modem and the sample inlet for particle measurement are mounted and connected on the top of the airpointer®.

NOTE
The cable for the wind sensor leads through the cable passage and the strain relief to the connector above the master switch (see Figure 5.17).

5. The airpointer® should be mounted stationary. We recommend to use one of three mounting kits available. Mounting Kit M for mast mounting (with variable or fixed diameter) and Mounting Kit W for wall mounting (see Figure 5.10).

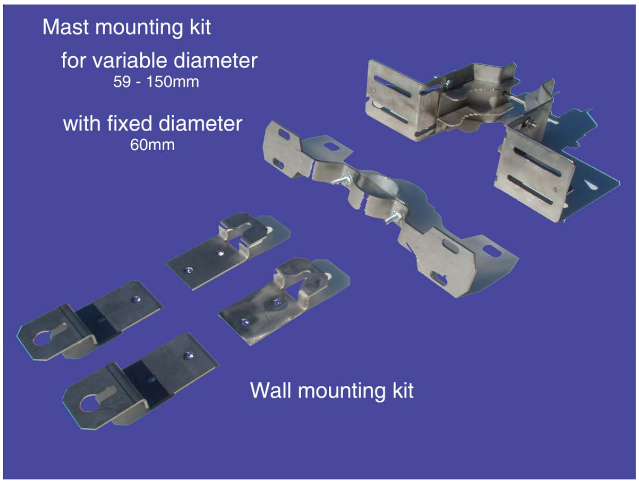


Figure 5.10.: Clamping claws and mounting brackets

Figure 5.11.: Fixation of Mounting Kit W for Wall Mounting on a frame

NOTE
Use the four M10 screws on the back side of the housing for Wall Mounting or Mast Mounting the airpointer®, only.

- **Wall Mounting Kit W:** Place each of the four wall mounting kits vertically and fix them with 2 M10 washers and screws delivered with the kit.
- **Mast Mounting Kit M:** Place each of the two mast mounting kits horizontally and fix them with 4 M10 washers and screws delivered with the kit.
- **Further Mounting possibilities:** Please ask your distributor for additional mounting possibilities (e.g.: lift mounting and trolley).

NOTE
The two handles on the left and on the right side of the airpointer® have only to be used for lifting the airpointer® . Do NOT use these handles for permanent fixation.

A certain ventilation clearance and maintenance space is required for the operation of the analyzer:

	Required clearance minimum [1]
Above the instrument housing [2]	≥70cm
Right side of the instrument (maintenance door)	≥30cm
Below the instrument[3]	≥50cm
In front of the airpointer 2D (main door)[4]	≥88cm
In front of the airpointer 4D (main door)[4]	≥110cm

Table 5.1.: Required Ventilation Clearance and Maintenance Space

CAUTION:

Ensure the airpointer® is operated in a sufficiently ventilated area. If the airpointer® contains a NO_x module, its pump outlet gas contains NO_2 and – in case the ozone scrubber does not work properly– also ozone. If sufficient ventilation cannot be assured, connect the pump outlet via tubing to a well ventilated area. If an airpointer® with NO_x module is used indoors use a charcoal scrubber (part number: 800-201300).

6. Check once again that the two red colored shipping screws from the bottom of the pump room are already removed (as shown in Figure 5.7). If not, please do so now as described in Section 5.3.
7. After finishing the mounting procedure read Section 5.5 to get familiar with the layout of the airpointer®. Then continue with Section 5.6.

[1] For air quality measurement free air-streams are essential. Please refer to local requirements for selection of a good site for the airpointer® .
[2] Minimum distance required for installation of the sampling head; for indoor use make sure that the clearance is large enough to allow undisturbed sampling.
[4] If you have less front space please contact your distributor for special solutions

5.5. airpointer® Layout

At various circumstances, text passages refer to components of the airpointer®. Figures 5.12 and 5.13 depict some of these components. Figure 5.12 shows the configuration inside the airpointer®, and Figure 5.13 shows the inside of the maintenance door. Depending on your configuration one or more of these components may not be installed.

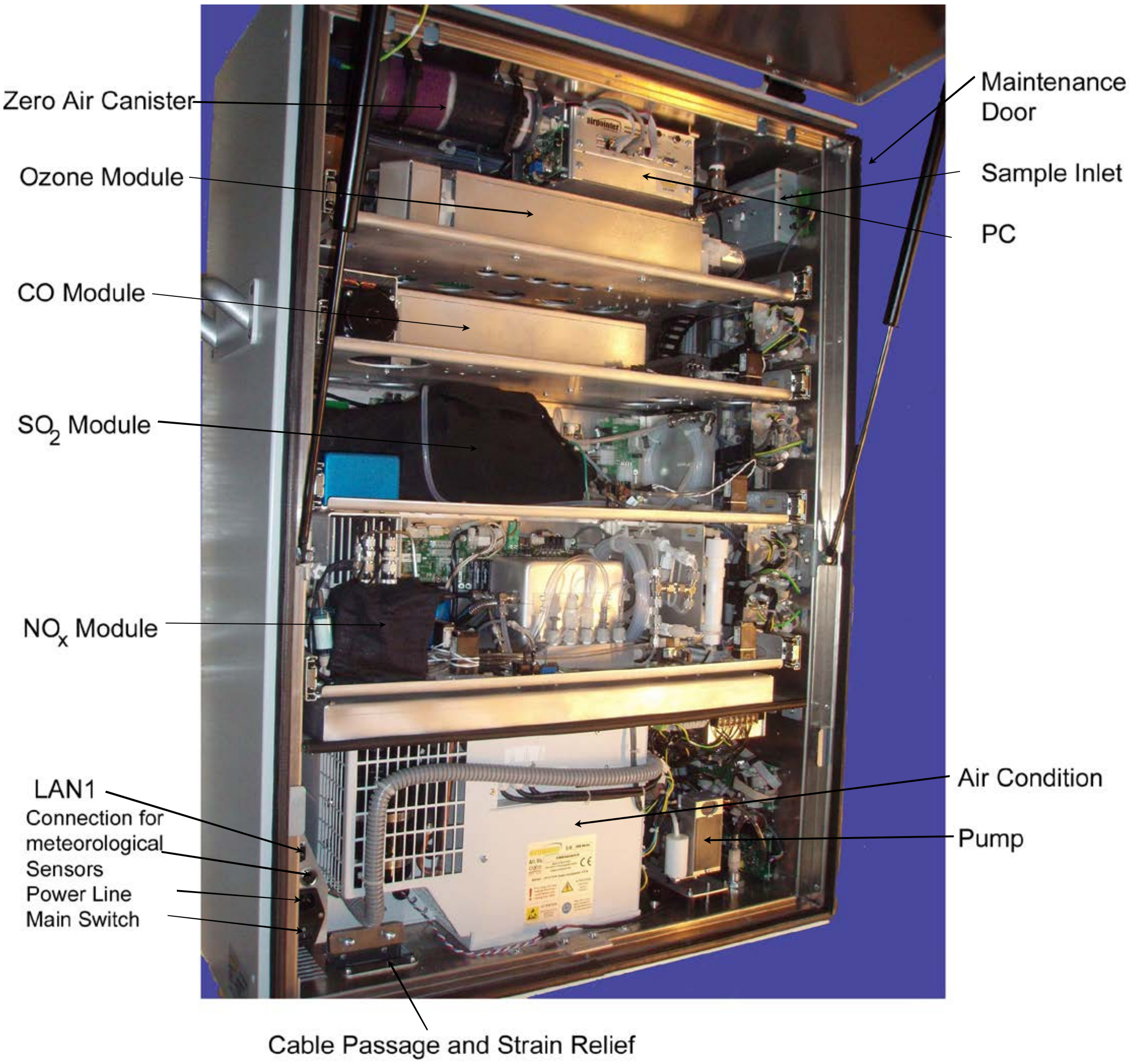


Figure 5.12.: Inside the airpointer® with four drawers (4D)

Figure 5.13.: Inside the Maintenance Door of the airpointer®

NOTE
The external power adapter is configured for maximum 100W and temporary use, only!

5.5.1. The Extended Lifetime Filter

There is the Option of getting an extended Lifetime Filter with an 8-times larger surface which will last more than 10 times longer than the regular filter.

This Extended Lifetime Filter can be further equipped by two options:

1. SamFilter Board Option

   which provides an additional pressure measurement for monitoring the contamination level.

2. High Humidity Option

   which consists of a heating unit and a water reservoir for moisture whereby condensation is avoided. Additionally there is an alarm sensor which prevents the reservoir from overflowing.

Figure 5.14.: The basic Extended Liftime Filter

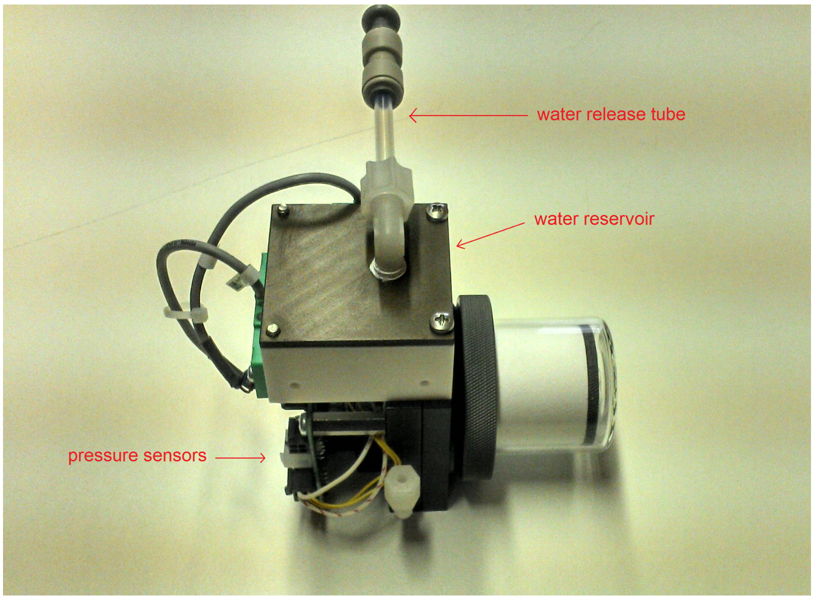


Figure 5.15.: An Extended Lifetime Filter with both options

5.6. Initial Start Up

The procedure in this section assumes that the airpointer® is on site and all sensors are installed. In order to guarantee a safe and proper operation of the airpointer® , several steps have to be taken prior to operation.

Follow these steps to assure a safe installation:

1. Place the airpointer® always in an upright position (now the name airpointer® is readable and the sample inlet opening is on the top (see also front page)).

2. Ensure sufficient space for air ventilation and maintenance access above, underneath, on the right side and in front of the device by following the installation hints (see Table 5.1).

3. To avoid damaging the cooling aggregate, let the airpointer® acclimate for at least 1 hour in an upright position before Power-Up.

CAUTION:

Let the airpointer® acclimate for at least 1 hour in an upright position before power up.

4. Ensure the airpointer® is operated in a sufficiently ventilated area. If the airpointer® contains a NO_x module (refer to safety messages in section 10.3), its pump outlet gas contain harmful gases (NO_2 and if the scrubber does not work properly ozone). If sufficient ventilation cannot be assured, connect the pump outlet via tubing to a well ventilated area or use a charcoal cartridge.

5. Open the main door.

6. Open the cable passage and the strain relief.

7. Lead the power line through the cable passage and connect it witch the power adapter (Figure 5.17). Close the strain relief and the cable passage.

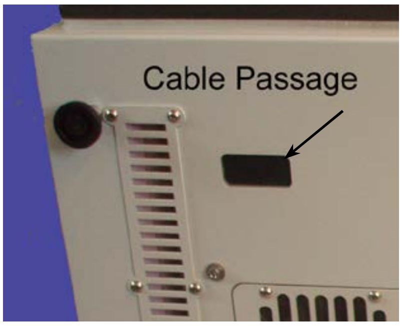


Figure 5.16.: Cable passage

Figure 5.17.: Cable passage and strain relief

8. Check the power supply voltage. A Power line 115V/60 Hz or 230V/50 Hz, min 10A fused (depending on version) is needed to operate the airpointer®. Lead the power cord through the cable passage (see Figure 5.17) and connect it with the main power socket (see Figures 5.17). The external power adapter in the maintenance access (see Figure 5.18) can be used to supply e.g. your notebook in the field (115VAC or 230VAC/1A maximum, depending on version, max 100W). This power socket can be used e.g. during maintenance, but should not be used continuously.
9. Make sure the airpointer® is connected to an appropriate grounded line.

CAUTION:

Do not install the airpointer® in a way that emergency disruption of the power supply is obstructed.

10. To power up the airpointer® press the Master Switch (see Figure 5.19).

NOTE
Two temperature sensors are checking the internal temperature of the airpointer®. In order to protect the hard disk the computer boots when the temperature is above 5°C.

11. Wait a few minutes while observing the status diodes (yellow and red LEDs light) until only the green LED lights up. The LEDs are located on the left side of the

maintenance access on the right side of the airpointer® housing (Figure 5.18). The pump has started by now.

Figure 5.18.: Additional Power Socket and Status Diodes below the maintenance door

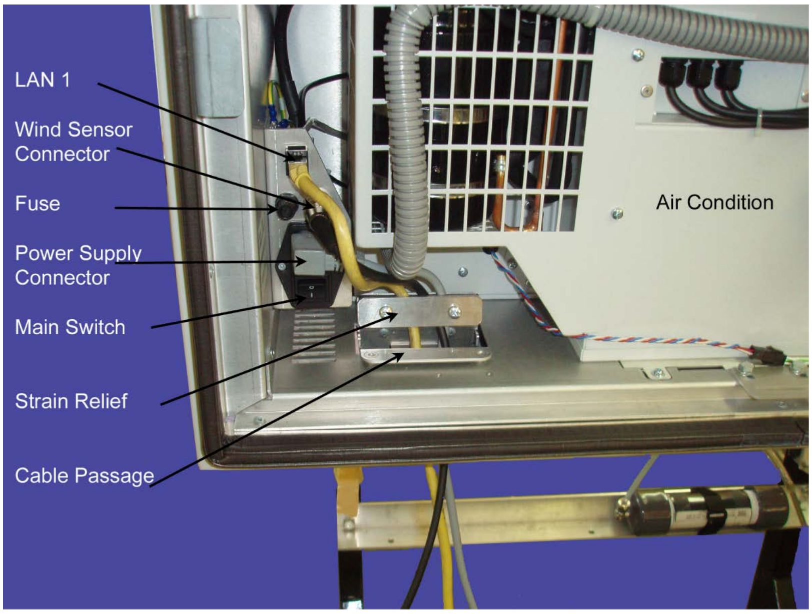


Figure 5.19.: Position of the Power Supply and Connector of the Master Switch, at the Left Bottom of the airpointer®

12. When the green LED ('Status OK') lights up (Figure 5.18), operating status is achieved.
13. Close main- and maintenance door.

CAUTION:

When closing the main door make sure that the power cord is not crimped. Use the cable passage.

At this point the airpointer® will already produce data which is stored on the internal hard-disk memory.

> **NOTE**
> **Now the internet connection can be configured. For the first time this has to be done on site.**

The User Interface of your airpointer® is completely implemented in software. It is called up by a web browser, where the connection with your airpointer® can be established by using one of the following ways (for more detail see chapter 6).
In terms of networking, the airpointer® can be regarded as a server providing special services by its various connectors.
In general, the connection with an airpointer®

- can be established directly with a cross patch cable,
- can be established as member of a local network,
- or can be established over an Internet connection.

5.6.1. Description of Status LEDs

At the left side of the maintenance access three Status LEDs are located (see Figure 5.18). If the system is running the LEDs have a definite status.

green: Everything is running normally. There is no status (warning or failure).

orange: There is at least one warning. For more details see the User Interface (section 7). After the login you can see next to the name of your airpointer® 'WARN' written in black letters. Click'WARN' and a window witch detail information will be open. Alternatively you can open the 'LinSens Service Interface' (7.7.2.2.1). If you open a new window in the User Interface the sign is updated.

red: There is at least one errors(fail). For more details use the User Interface (section 7). fter the login you can see next to the name of your airpointer® 'FAIL' is written in black letters. Click 'FAIL' and a window witch detail information will be open. Else you can open the 'LinSens Service Interface' (7.7.2.2.1). If you open a new window in the User Interface the sign is updated.

flashing: The LEDs are flashing when the airpointer® is operating in the maintenance mode. The color code is the same as described above.

all three light up: The airpointer® is shutting down (see section 5.8).

5.7. Establishing a Direct Connection to Your airpointer®.

NOTE
Please check that you can log in as administrator at your computer and at the airpointer® .

The following gives a detailed description on how to establish a first direct connection with your airpointer®. Figure 5.20 depicts a scheme of the connection. Use this type of connection, if you connect the first time to your airpointer®.

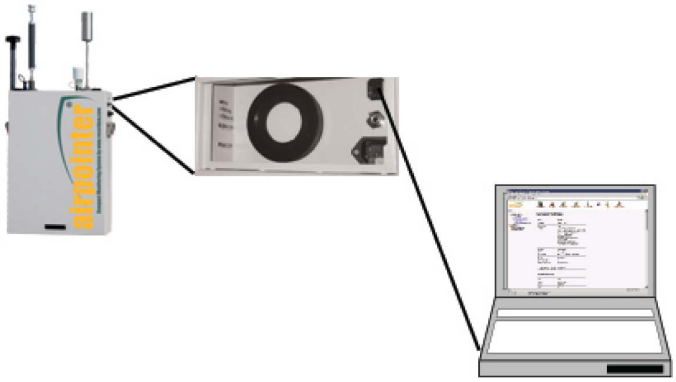


Figure 5.20.: Direct Connection

Connect your notebook using the supplied Cross Patch Network Cable (see Figure 5.21) with the LAN 2 (RJ-45 interface) in the maintenance access of your airpointer®.

Figure 5.21.: Cross Patch Cable

NOTE
The cross patch cable delivered with the airpointer® is only for direct connection of a computer (Notebook) to the RDPP using the port in the maintenance access. Do NOT use this Cross Patch Cable to connect the airpointer® to a local network (LAN) or other network devices.

Establish a connection via the Cross Patch cable

1. Open the maintenance door.
2. Connect your notebook with the delivered Cross patch cable with the LAN 2 (RJ-45 interface) in the maintenance door of the airpointer® (see Fig. 5.18).

NOTE
Please check that you can log in as administrator at your computer and at the airpointer® .

NOTE
First connect your notebook, then boot it up!

3. Boot up your notebook.

NOTE
Switch off the firewall, if any is running on your PC.

4. Change the network settings of your notebook, so that it can recieve a dynamic IP-address from a DHCP-Server (see chapter 5.7.1).
5. Adjust your webbrowser to the address of your airpointer® (chapter 5.7.3).
6. Open the internet browser, fill in the IP–address ‘http://172.17.2.140’ and press ‘Enter’ and wait till the Login site pops up. If the massage ‘Javascript has to be enabled for this website’ turns up go to chapter 5.7.3 to activate Java Script in your webbrowser. If the failure massage ‘The requested URL could not be retrieved’ turns up, then go to chapter 5.7.5.
7. Enter your login name and password as provided with the airpointer® . Your airpointer® is shipped with following default login and password [1]:

[1] airpointer® delivered before 1.12.2006 the password was set to: airpointer

Figure 5.22.: Input of the airpointer® address in the webbrowser

- **login:** admin
- **password:** 1AQuality

A sample user account is also provided with the airpointer®:

- **login:** user
- **password:** 1AQuality

8. The User Interface is now available.
9. Unplug the Cross Patch cable and close the maintenance door.

NOTE
Now you can configure an internet connection for your modem (optional, chapter 6.2). Additional connection possibilities are listed in chapter 6.

5.7.1. Network and Network Settings

Please make sure that your PCs network settings are set to obtain a dynamic IP-address from a DHCP server. The description in this chapter refers to Microsoft Windows™ XP.

Set the network connection of your PC to 'obtain an IP address automatically'.

1. **Power up your PC and log into an account with administrator rights.**
2. **Click on 'Start' → 'Control Panel' → 'Network and Sharing Center'.**
3. **Here click on 'Change Adapter Settings'.**
4. **Right-Click on your Local Area-connection and select 'Properties'.**
5. **In the central list, select 'Internet Protocol(TCP/IPv4)' and click on 'Properties'.**
6. **Select 'Obtain an IP address automatically' and 'Obtain DNS server address automatically'.**
7. **Confirm changes by clicking 'OK'.**

Figure 5.23 shows how the properties windows with correct settings.

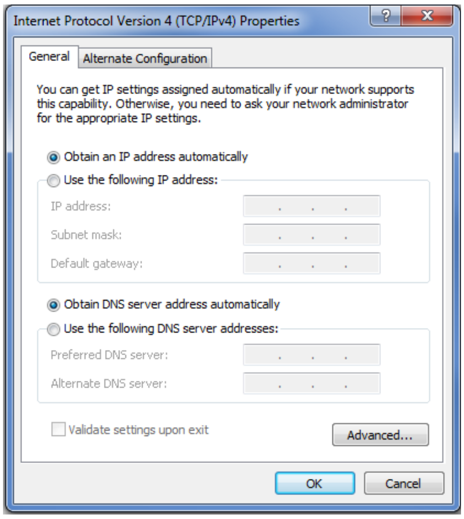


Figure 5.23.: Correct TCP/IP properties

5.7.2. Alternative Network and Network Settings

If the network connection does not work with the dynamic IP-address you have the possibility to set a fixed one.

Set the network connection of your notebook to 'Use the following IP address':

1. Power up your notebook and login to your Windows box using an account with administrative rights to make the necessary settings.

2. Note your current TCP/IP settings for later reuse.
3. Turn off your desktop firewall if one is running on your PC.
4. Make the necessary network settings:
   a) Press Start → Control Panel, 'Network and Sharing Center' and right click your Network Connection to open window.

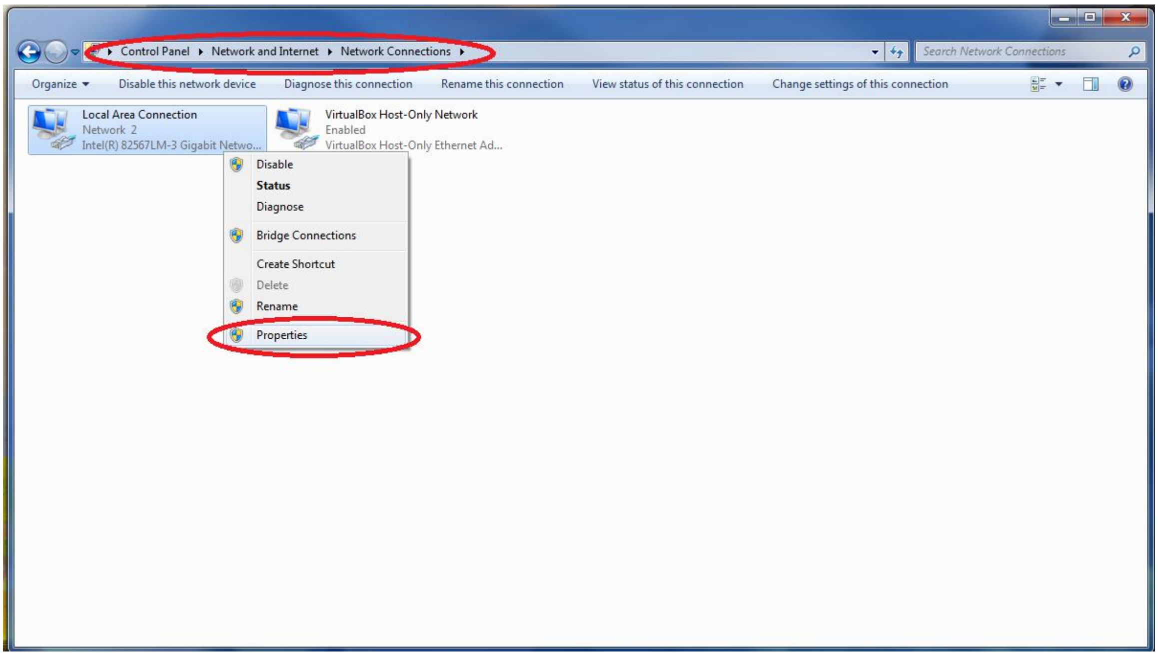


Figure 5.24.: Choose Network Connections

   b) Click right on the icon 'Network' in your taskbar and select Properties

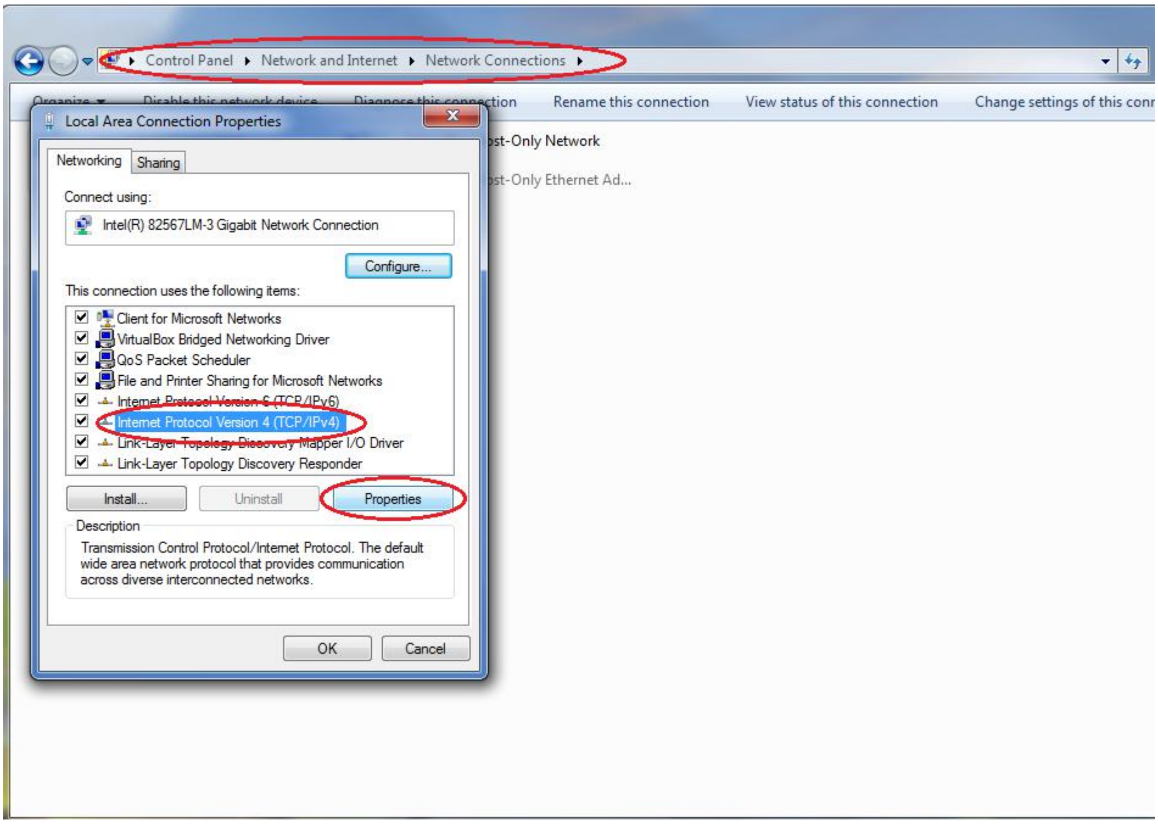


Figure 5.25.: Properties

c) Scroll down to Internet Protocol(TCP/IP), select this item and press Properties

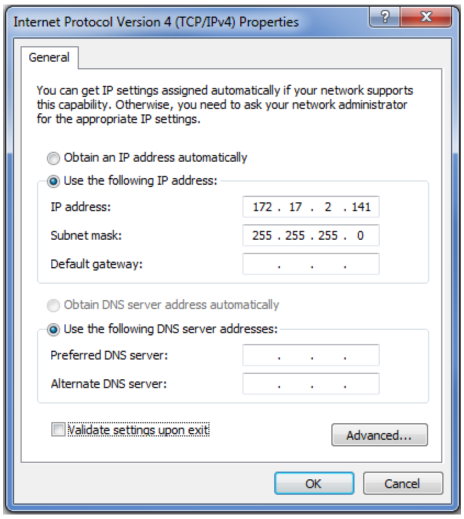


Figure 5.26.: TCP/IP Properties

d) Select ‘Use the following IP address’

e) Set ‘IP address’ to 172.17.2.141 and ‘Subnet mask’ to 255.255.255.0

f) Select ‘Obtain DNS server address automatically’.

5. Then, please check your web browser settings to connect to your airpointer® (see further down).

5.7.3. Web Browser Settings

The steps below are described in detail for Microsoft Internet Explorer and Mozilla Firefox. A list of supported web browsers can be found in Section 7.1.2 Supported Web Browsers.

5.7.3.1. Microsoft Internet Explorer

This section refers to Microsoft Internet Explorer version 5.5 or above.

Proxy settings:

1. Open Microsoft Internet Explorer.
2. Select menu Tools → Internet Options ß.
3. Open folder Connections ß.
4. Press LAN Settings... and check the box ☑ Bypass proxy server for local addresses. If no proxy is installed, leave the field for your proxy unmodified and skip step 5.
5. Press Advanced... and enter '172.17.2.140' into field 'Exceptions' (see Figure 5.27). Afterwards press OK 3 times.

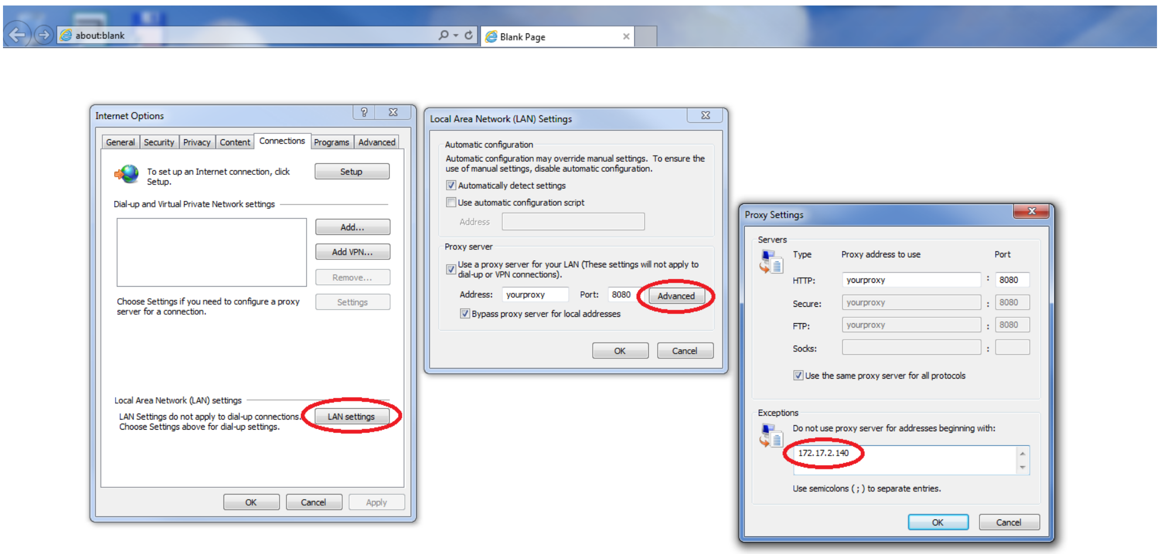


Figure 5.27.: Proxy Settings Exceptions (Internet Explorer)...

Java Script settings:

1. Select menu Tools → Internet Options ß.
2. Open folder Security ß.
3. Select Trusted Sites .
4. Uncheck ‘Require server verification (https:) for all sites in this zone’.
5. Below item ‘Add this web site to the zone’ enter the IP–address ‘http://172.17.2.140’ for the airpointer® (see Figure 5.28), press Add and then Close ß.

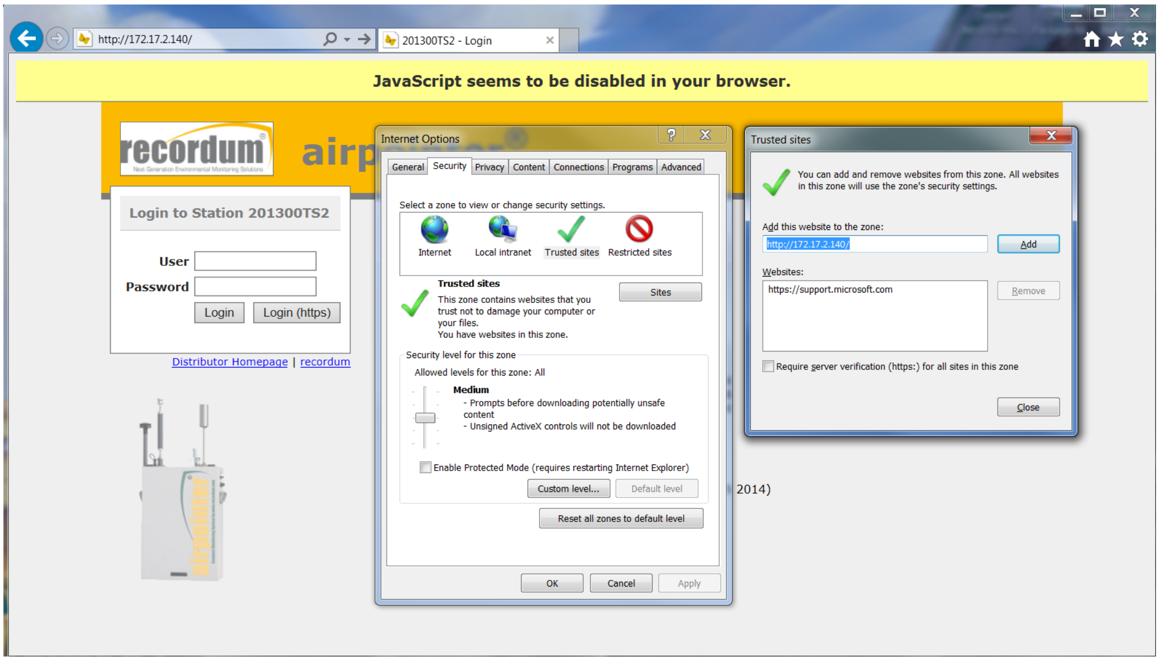


Figure 5.28.: Enable Java Script (Internet Explorer)

5.7.3.2. Mozilla Firefox

This section refers to Mozilla Firefox version 1.0.2 or above.

Proxy settings:

1. Open Mozilla Firefox.
2. Select menu Tools → Options ß.
3. In the folder 'Advanced' select the subfolder 'Network'.
4. Here you find 'Connection' where you press 'Settings'.
5. Enter '172.17.2.140' into field 'No Proxy for:' (see Figure 5.29) and press OK 2 times.

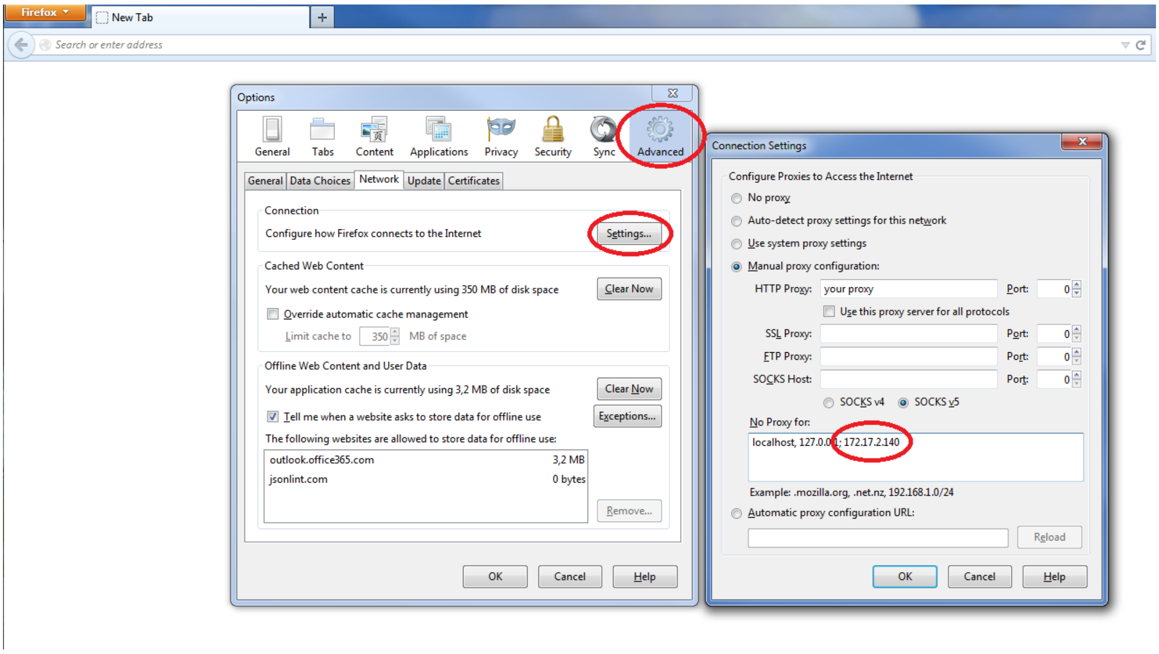


Figure 5.29.: No Proxy for – Settings (Mozilla Firefox)...

5.7.4. Point Your Web Browser to the airpointer® Address

Follow these steps to complete the start–up sequence:

1. Open your Internet browser, enter IP–address 'http://172.17.2.140' into your browser (see Figure 5.22), press the 'Return'–key on your keyboard and wait for the login page to come up (see Figure 5.31). If a screen like Figure 5.32 comes up, please refer to Section 5.7.3 above to enable JavaScript in your web browser. If you get an error message like 'The requested URL could not be retrieved', please refer to Section 5.7.5

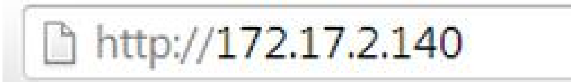


Figure 5.30.: Enter the airpointer® Address into the Web Browser

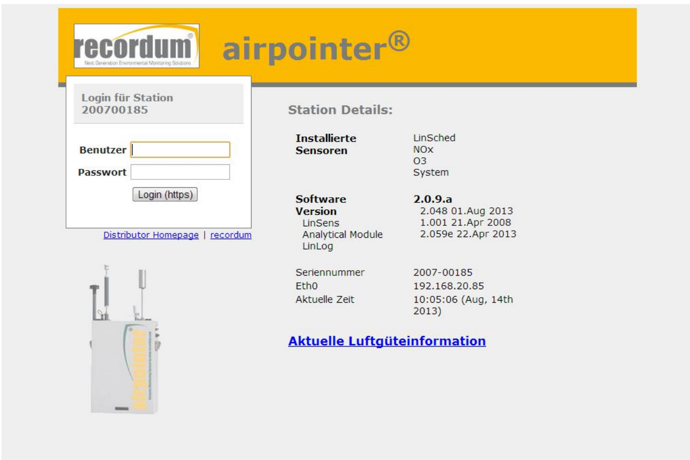


Figure 5.31.: Login Page to the User Interface of airpointer®

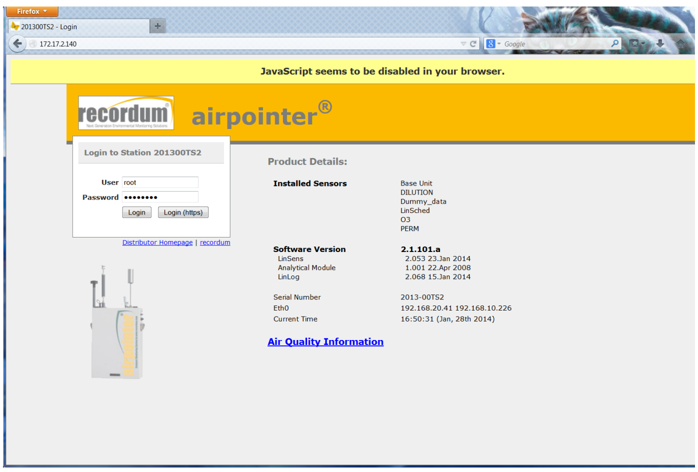


Figure 5.32.: JavaScript Is Not Enabled in Your Web Browser

2. Enter user login name and password as provided with the airpointer® and press the login button.

   Your airpointer® is shipped with the following default login and password[2]:

   - **login:** admin
   - **password:** 1AQuality

   A sample user account is also provided with the airpointer®:

   - **login:** user
   - **password:** 1AQuality

3. The User Interface is available now.

4. Change your password on your own behalf by clicking on menu item 'Setup'. Then, in the menu tree on the left side of the window select item 'User Interface' ↠ 'Personal Settings' and change to your desired password (see Section 7.7.9.3 'Personal Settings´).

5. This exits your initial startup settings. In order to correctly shut down the airpointer® read section 5.8.
   A detailed description on how to handle the User Interface of your airpointer® can be found in Chapter 7.

5.7.5. Refreshing the IP–Request in Case of Failure

If you see an error message, after entering the airpointer® address into your Internet browser, like: 'The requested URL could not be retrieved', it may be that your computer has not obtained an IP–address yet. This may happen,

- if you turn on your computer before connecting to the airpointer®
- if the start–up sequence of the airpointer® has not finished yet and you are trying to log in.
- if the notebook is not set to 'Receiving a dynamic IP-address'. Please go to chapter 5.7.1
- if 'Receiving a dynamic IP-address' does not work. Please go to chapter 5.7.2 for setting a fixed one

To avoid this failure, please wait for the start–up sequence to finish and restart your computer. This should establish a fresh IP–assignment.

Alternatively, you can use the following method:

1. Press Start and select item Run...
2. Type in 'cmd' and press OK. This opens the Command Interpreter.

[2] airpointer® delivered before 1.12.2006 the password was set to: airpointer

3. Type in the following command:

```
ipconfig /renew
```

and press the ‘Return’–key on your keyboard.

4. Check now your assigned IP–address by retyping ‘ipconfig’.

5.8. Shutting Down

Follow these steps to shut down the airpointer®:

1. Push up both Maintenance Switches (see Figure 5.33) simultaneously for about 15 seconds and wait for all three LEDs to light up.

Figure 5.33.: Maintenance switches

2. Release switches and wait for system shut down. Please wait until all LEDs are off, then press the master switch (see Figure 5.19). The system has shut down now.

6. Connecting the airpointer

NOTE
Please make sure that you can log in as administrator on your computer and the airpointer® .

NOTE
Please check the internet connection before you leave the airpointer®

The User Interface to your airpointer® is completely implemented in software. It is called up by a web browser, where the connection with your airpointer® can be established by using one of the following ways.
In terms of networking, the airpointer® can be regarded as a server providing special services by its various connectors.
In general, the connection with an airpointer®

- can be established directly with a cross patch cable,
- can be established as member of a local area network (LAN),
- or is established by an Internet connection.

While accessing via the Internet, a permanent access is a desirable condition. So in this case, only those kinds of Internet connections (or general network connections) may be considered suitable, which can ensure such a permanent connection. Therefore, classic dial connections by a dial modem can be disregarded. The following section will discuss the connection possibilities of airpointer®.

6.1. Direct Connection with a Cross Patch Cable

This is the easiest way to connect to your airpointer®. To estabish this connection you need to be on site (see Figure 6.1). You also use this type of connection, if you connect the first time to your airpointer® and have to make the initial settings (see section 5.7).

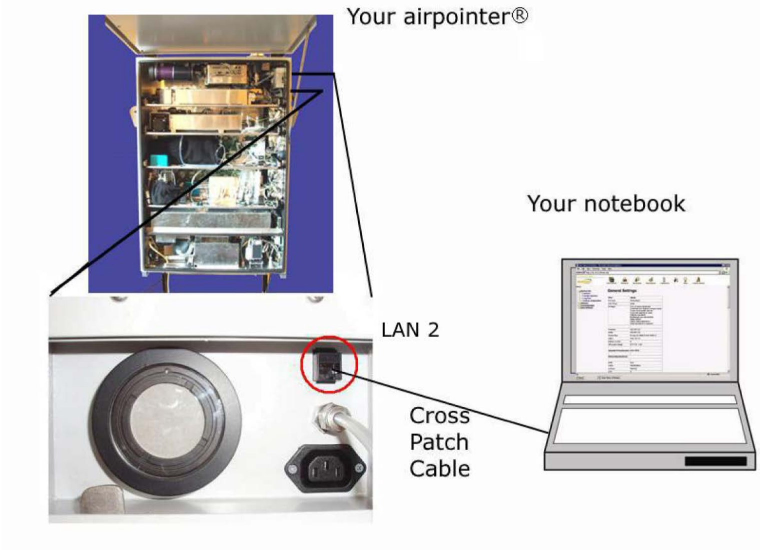


Figure 6.1.: Direct Connection

Connect your notebook using the supplied Cross Patch Network Cablewith the RJ-45 interface labeled 'LAN 2' behind the maintenance door of your airpointer®. Afterwards, set the network connection of your notebook to receiving a dynamic IP–address.
In the web browser you will then find the fixed IP–address http://172.17.2.140 for this connection (an instruction for any necessary browser settings of your notebook can be found in Section 5 'Getting Started').

6.2. Connection with a GPRS/3G Modem

Figure 6.2.: GPRS/3G Modem with SIM Card

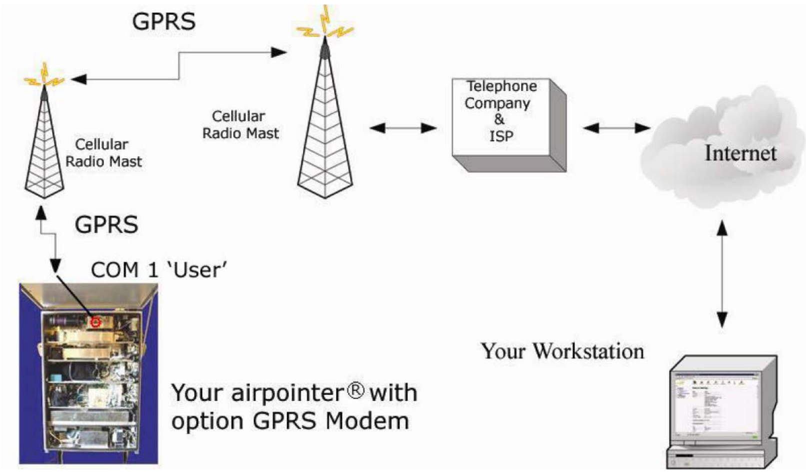


Figure 6.3.: GPRS Connection

The optional Module GPRS Modemcan be ordered from your distributor.
Additionally, you will need a GPRS/3G data access for mobile phones (SIM-card) (see Figure 6.2) from your local mobile phone network provider. Connecting to your airpointer® using GPRS through the serial interface COM1 'User' can be seen in Figure 6.3.

> **NOTE**
> **Please ask your provider for following data: accesspoint, username and password!**

Settings for the connection with a modem

1. First, configure your SIM card (The specifications are listed in section 6.2.1). Put the SIM card e.g., into your mobile phone and deactivate the PIN code.
2. Put the SIM card into the modem.

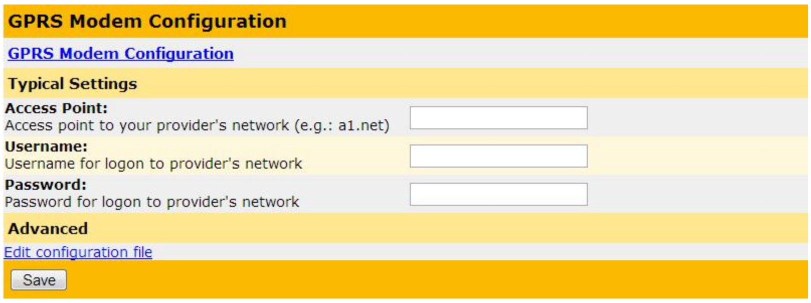


Figure 6.4.: Configuration of the provider settings of a modem

3. Configure the provider settings:
   In the User Interface please go to: 'Setup' → 'Communication' → 'GPRS Modem' → 'Config'
4. Check all three configuration files. Change them as needed:
   - Access Point: Replace e.g., a1.net with the 'access point' of your provider.
   - Replace username and password with the provider setting.
5. In the User Interface go to: 'Setup' → 'System Maintenance' → 'Service Manager' and restart 'Modem dialer'.

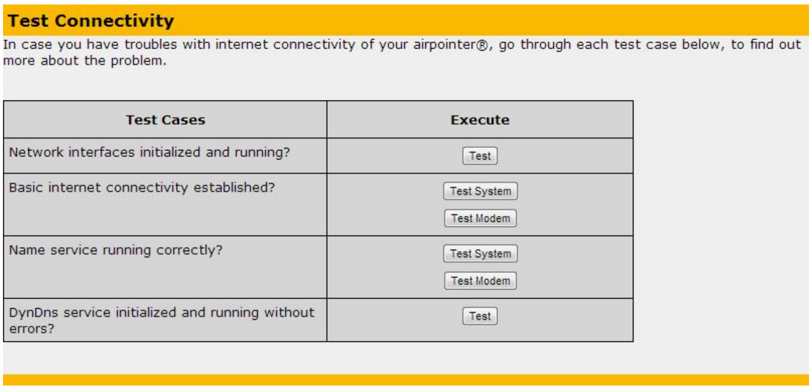


Figure 6.5.: Test the internet connection

6. Check the communication in 'Setup' → 'Communication' → 'Test Connectivity'. Click 'Basic internet connectivity established?' 'Test Modem'.
7. Now, you can disconnect the cross patch cable and close the maintenance door.

NOTE
Before leaving the airpointer® please check the internet connection.

6.2.1. SIM Card

Recommended specifications of your SIM card:

- At least 25 MB of monthly traffic volume
- GPRS – SIM Card
- Server function has to be possible. The GPRS end device has to get an publicly reachable IP address. This can either be a fixed IP address or a dynamic one.

> **NOTE**
> **If this is not the case, please contact your distributor.**

> **NOTE**
> **If your provider has installed a firewall, you will have to use the recordum® Portal**

- When you activate the SIM card, you have to deactivate the PIN code.

6.3. Connection with a Local Area Network

The airpointer® can be easily included in an already existing local area network (LAN). To do so, connect your airpointer® with the 'LAN 1' port and a Cat. 5 (or similar) network cable with your local 10Mbit/s or 100Mbit/s network (see Figure 6.6).

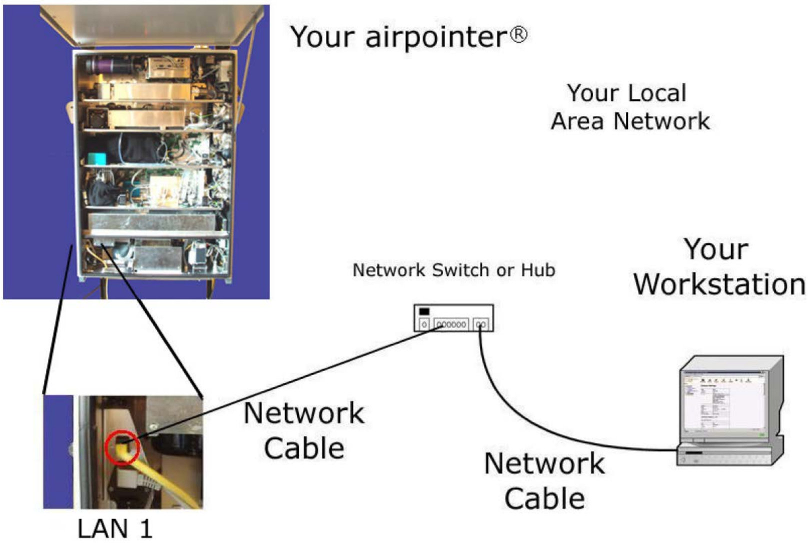


Figure 6.6.: LAN Connection

6.4. Connection with a Wireless LAN

Connecting with a Wireless LAN Router (see Figure 6.7) is one variation on connecting with a local area network. The connection settings for linking the Wireless LAN Router match those of a local area network.

Due to transmitting in a 2.4 GHz or 5 GHz frequency band, a free sight connection between airpointer® and receiver is required for the complete transmitter route. A point to point transmission via a distance of several kilometers can be achieved under favorable circumstances with directional antennas available for Wireless LAN Router.

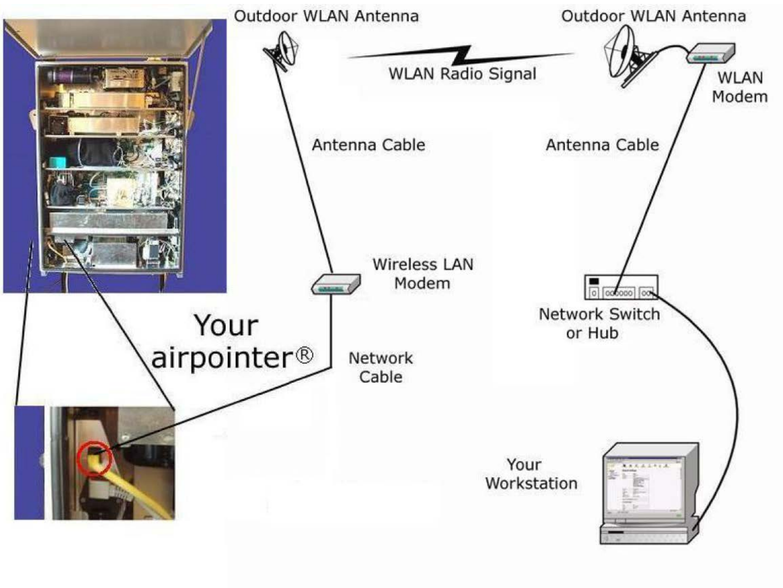


Figure 6.7.: Wireless LAN Connection

A special case of Wireless LAN connection with your airpointer® occurs, if notebooks with (integrated) Wireless LAN antenna are used as receivers. This way, a public point of information (or maybe a private, depending on the configuration of the Wireless LAN Router) can be established in the environment of your airpointer®.

Please contact your distributor for further information and availability.

6.5. Connection with a Cable Modem

If a broadband Internet connection via cable is available at the intended installation site of your airpointer®, the connection with the Internet can take place by means of a cable modem (see Figure 6.8). In this case, connecting the cable modem with the airpointer® is done by Ethernet according to the settings of a local area network.

Please contact your distributor for further information.

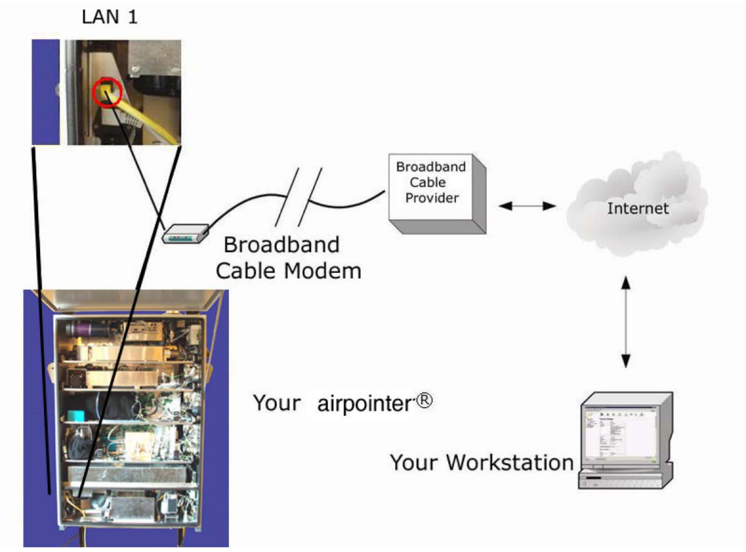


Figure 6.8.: Cable Modem Connection

6.6. Connection with an ADSL or SDSL Modem

Connecting to the Internet can be done by an ADSL or SDSL modem, in case a telephone line is available at the installation site of your airpointer® (see Figure 6.9).

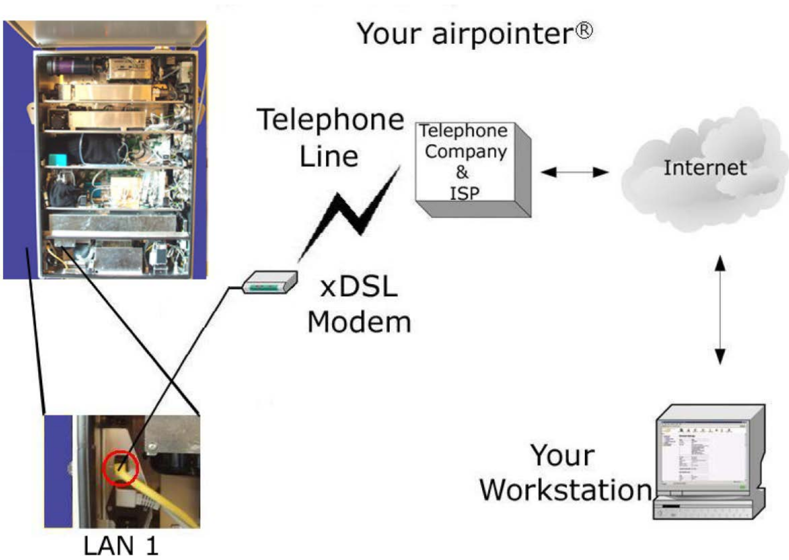


Figure 6.9.: ADSL and SDSL Connection

Please contact your distributor for further information and availability.

6.7. Connection with RS-232

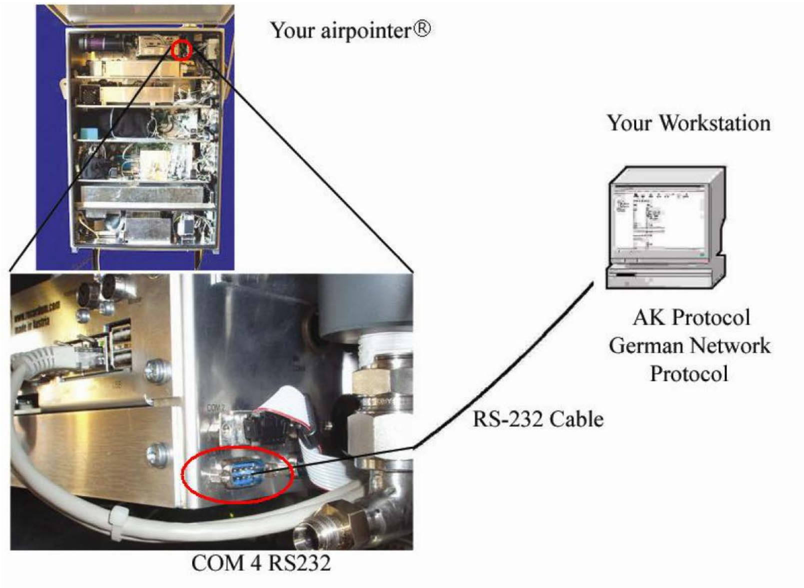


Figure 6.10.: Connection Using AK or German Ambient Network Protocol

Your airpointer® supports two serial communication protocols: AK Protocol and German Ambient Network Protocol. This kind of connection enables local computers or chart recorders to access the measurement data of your airpointer® (see Figure 6.10). These protocols are described in Appendix A ‘Software Protocols’.

6.8. Firewall Settings

A firewall is permanently running on your airpointer® for protection (particularly when a permanent Internet connection is established). It only allows to pass the protocols for the User Interface, an encrypting protocol –which can be used for software updates of your airpointer® – and two more specific protocols for the LinLog and LinSens Service Interface. This firewall is activated when connecting to the airpointer® via the RJ-45 network interface ’LAN 1’ and the serial interface COM1 ‘User’ (especially for the option GPRS Modem).

When connecting directly with the airpointer® by using the Cross Patch Cable to the RJ-45 network interface with the fixed IP–address 172.17.2.140, the firewall function will not be effective.

When connecting with the airpointer® by using the serial RS-232 interface COM4, transmission is done with the AK Protocol as well as the German Ambient Network Protocol.

Figure 6.11 depicts the relation according to the respective interfaces.

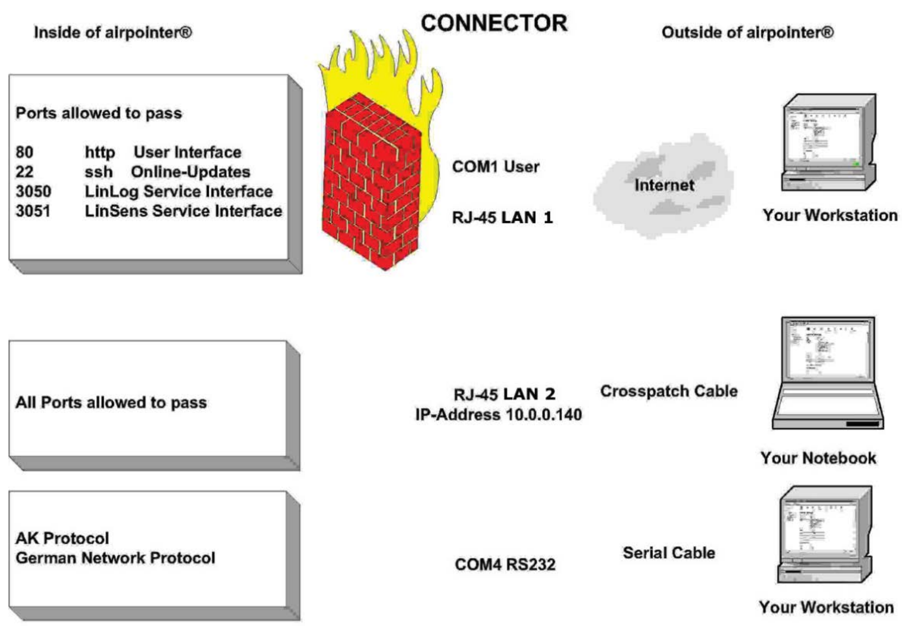


Figure 6.11.: Firewall Connection

7. User Interface

7.1. General

You can configure your airpointer® completely via software. It is accessed by a web browser, where the connection with your airpointer® can be established according to Chapter 6.
If you are connecting the first time to your airpointer® please refer to Section 5.7 to make the appropriate settings. The pre-installed password is listed on page 5-20.

> **NOTE**
> **Some settings are visible with a certain priority, only! The here described interface might only be visible for an Administrator.**

7.1.1. Login

For Login to the User Interface of the airpointer® you need a user name and a password. The pre-installed password is listed on page 5-20.
For a successful Login, Java Script has to be activated in your web browser. You will find setup instructions in the Chapter ‘Getting Started’ in Section 5.7.
The password is transferred by your web browser with a random encoding to the airpointer®. This ensures that for each login your password is transferred via Internet as a different string of characters. This string of characters is useless for a third person, who may be reading this by chance as well, because it can be used only once for your very own login.

7.1.2. Supported Web Browsers

The User Interface of airpointer® runs on most modern browsers. We tested the Software on the following. Note that it might be possible to use other browsers like e.g. Opera, though these will not be mentioned in this manual. The most basic requirement a browser should meet is the support of JavaScript. Older versions of the mentioned browsers might might work as well, but these may display the website not 100% correctly.

For Microsoft Windows™

- Internet Explorer (version 8 or above)
- Mozilla Firefox (version 11 or above)
- Google Chrome (version 18)

For Linux

- Mozilla Firefox (version 11 or above)

For Mac OS X™

- Mozilla Firefox (version 11 or above)
- Safari (version 5.1 or above)

7.1.3. Architecture of airpointer®'s

The User Interface of the airpointer® consists of modules which can be selected from a horizontally arranged tab bar.
The following modules are available:

Graph

The module 'Graph' enables the presentation of measurement signals. Single measurement signals of all installed sensors are shown in diagrams as well as designs (compilation of several measurement signals) created by users. You and/or other users can call up these designs in the module 'Graph', depending on the visibility assigned.

Download

In the module Download selected measurement data can be downloaded in chosen time frame. The download configuration can be saved locally.

Stationbook

This module provides a notepad for you. Your notes are visible to all users per default, you can also set single entries to be visible only to yourself.

Overview

This module is designed to give a quick summary of selected parameters. You can see your device's measurement data at a glance. See section 7.10 for details.

Calibration

The module 'Calibration' provides you with the items "'Valve Control"' and "'Calibration"'. With "'Valve Control"' the valves of the internal zero measurement and the internal span control (optional) can be controlled. In the menu "'Calibration"' the setpoints for the calibration can be set and the calibration can be tracked.

Setup

The module ‘Setup’ provides system information, configuration of sensors, system and interfaces of the airpointer®. Furthermore, user management of the User Interface to the airpointer® is available here. I.e. the user’s personal settings to the User Interface can be adjusted according to your wishes. In the subsection ’Rules & Actions’ periodical processes can be defined. In the module ’LinLog’ the software connection to external analyzers is located. You can select which parameter should be stored and make simple calculations. Furthermore, it is possible in the ‘Setup’ module to update the software and to install, uninstall, start and stop services of the server.

Logout

Click this tab to leave the User Interface of airpointer®.

7.1.4. Navigation Within Each Individual Module

Individual modules sometimes contain a menu tree for further navigation. This menu tree can be arranged in several levels. To open or close any subtree of the menu, simply click on the item. The next chapter will give you an explicit walkthrough of the individual modules.

NOTE
Remember that the airpointer® features a very flexible design and can have numerous hardware configurations, the screenshots in this chapter might not be 100% conform with your device. Your software depends on your hardware configuration.

7.2. Graph

The module ‘Graph’ enables the presentation of measurement signals. Single measurement signals of all sensors installed are shown in diagrams as well as designs (compilation of several measurement signals) created by users. You and/or other users can call up these designs in the module ‘Graph’, depending on the visibility assigned.

The functions of the module ‘Graph’ include:

1. Creation and View of Diagrams
2. View of the measurement signals of all installed modules and sensors
3. Trace of a measurement - automatic update of the view is possible
4. View of the airpointer®’s system parameters
5. View of the signals of externally installed sensors
6. Selection of time sequence (Weekly-, Daily-, 3-hour-, 1-hour- and Manual View)

7. Selection of time resolution (different average values)
8. Selection of the diagram (xy-graph, windrose, or radar graph)
9. Default setting of the y-axis, selection between automatic and manual
10. Selection of the picture size
11. Zoom of a part of the picture
12. Reading measurement values from the graph
13. Create tables of values including average values, minimum and maximum value

7.2.1. Menu Tree

To plot any data you have to start with selecting a data source in the menu tree. Clicking an item in the sub-menu will collapse or expand the underlying parameters to select. By selecting a parameter it will show up in the main part of the 'Graph' window. You have the choice to either select a pre-configured design or create a new one, both possibilities will be explained in the following paragraphs.

7.2.1.1. Selecting a User Defined Design

Selecting a User Defined Design You will find previously saved designs under 'My Designs'. If a design is already saved on the system, you can load the designs parameters into the main window, by clicking on it.

7.2.1.2. Selecting a Measurement Signal

Each of the items below 'My Designs' stands for a connected and configured measurement device. For the configuration of a connected device, see section 7.7. You can select an item and thereby add it to the plot as parameter. To add multiple parameters tick the corresponding check box in the main view. The airpointer® has some internal parameters, that can be displayed as well. These items can be found under 'System'.

7.2.2. Main Window

The main view lets you define multiple settings and plot the actual graph. To print a graph you have to start with selecting some data to plot, as explained in the previous section. After you selected a parameter you can define some settings for the graph, e.g. the time period to plot. The following paragraphs describe settings and functions of a plot and how to configure them.

7.2.2.1. Select the Type of Graph

Next to the label 'Graph' you can select the type of the graph from a dropdown menu. The available types are: XY-Graph, Wind Rose Graph, and Radar Graph. If you choose Wind Rose or Radar Graph a direction value has to be measured and selected as reference value. A direction value could be for example 'wind direction'.

7.2.2.2. XY-Graph

If you choose XY Graph, you can select up to six parameters. These parameters will be plotted versus the time axis. It is possible to configure a second Y axis under **'Advanced'**. Four types of the XY-graph are available: Line, Filled Line (the area below the measurement line is colored in the selected color), Steps, and Bar (in the selected color without border. The graphs of the measurement values are plotted in order of the values from top to bottom. The graphs which are plotted versus the Y2 axis lie under the graphs versus the Y1 axis. Therefore those measurement values can be hidden. If there is a break in the measurement, no values will be plotted and the graph is interrupted. If this is not desired, you can select 'No Gaps' on the right side of the graph selection under **'Advanced'**. With this option selected, the measurement values will be connected. If you do not want to show all parameters at once, deselect their graphs in the 'Advanced' tab.

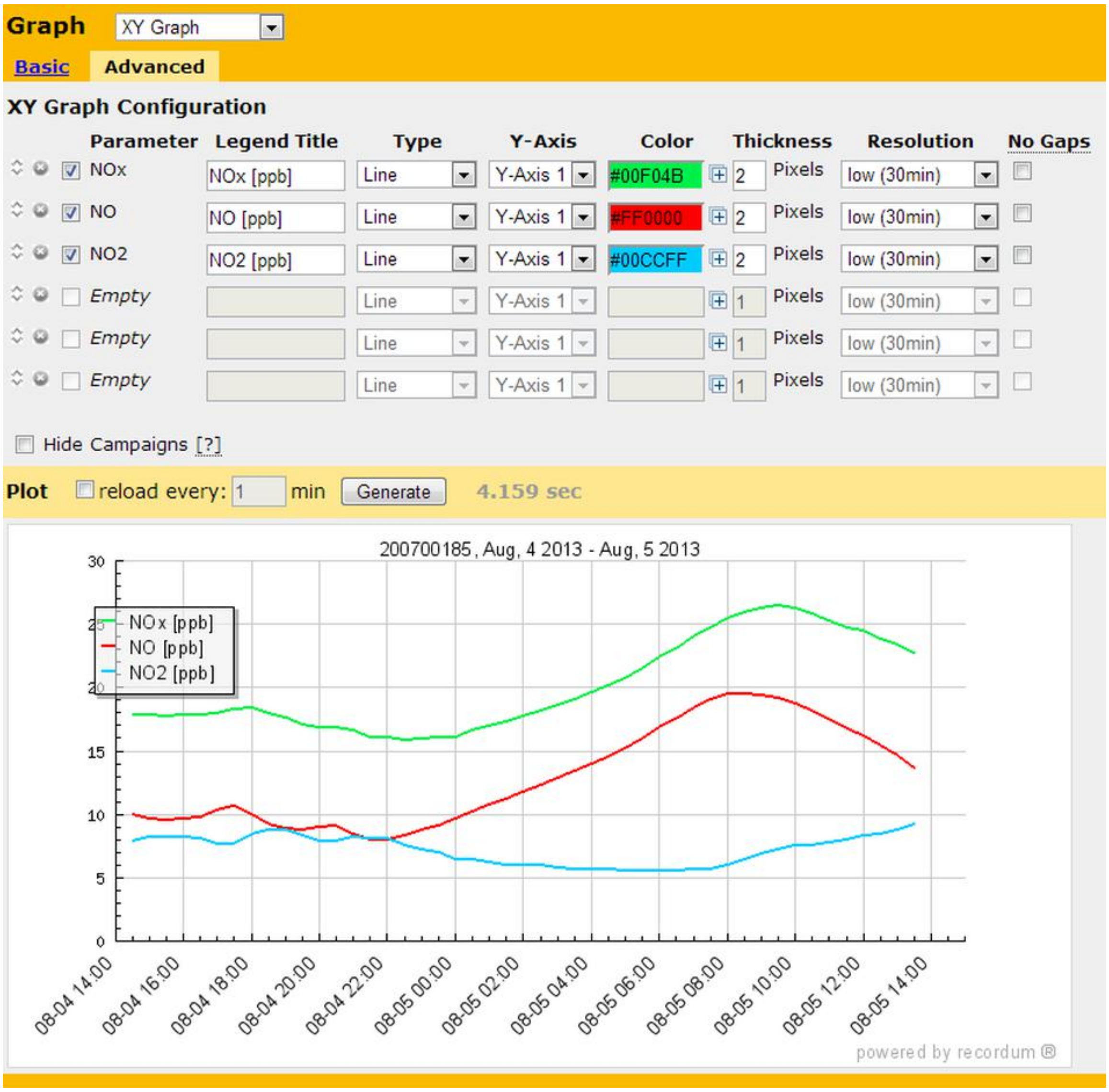


Figure 7.1.: Example of an XY Graph

7.2.2.3. Windrose Graph

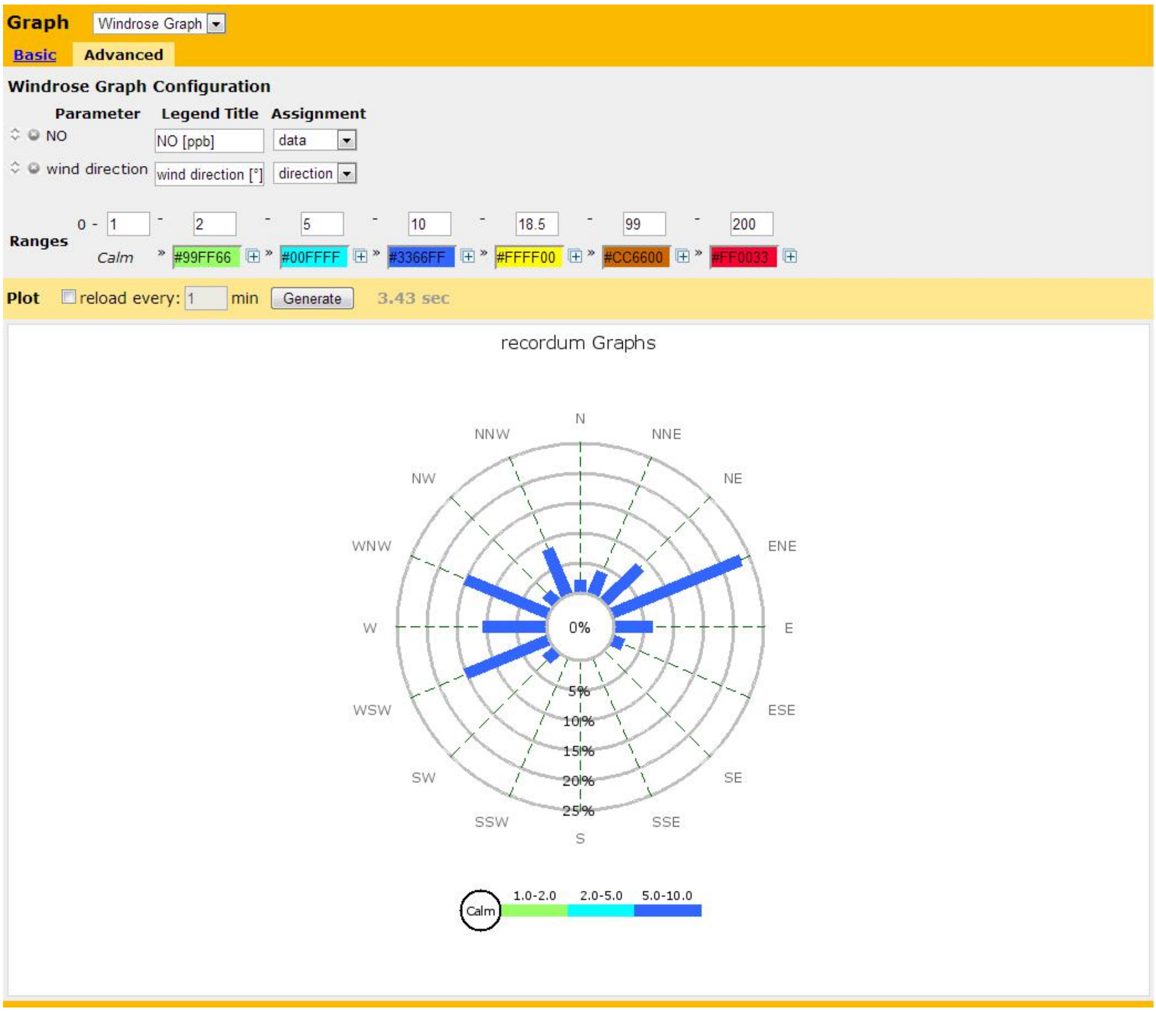


Figure 7.2.: Example of a Wind Rose Graph

If you plot your measurement values in a wind rose graph (as shown in Figure 7.2), the chosen data are plotted versus a direction value as e.g., wind direction. The parameter which indicates the direction has to be marked as ’direction’ under **’advanced’**, the other parameter as ’data’. You can only select two parameter for one diagram.
In the plot following values are encoded:

- The colored bars represent the measurement values. The color code is shown in ’Ranges’. The unit of the values in ’Ranges’ is the same as the unit of the measurement values which are marked as ’data’.
- The bars lie in wind direction.
- The total length of the bars indicates how often this direction was measured.
- The percentage values written inside the rings of measurement values show the percentage of measurement values which lie in this direction area during the measurement duration.

- Additionally, the single bars are color coded. The colors represent the measurement value. The height of the color bars represent how much percent of the measurement values in the respective direction lies in the respective measurement range. See Figure 7.4 and the respective description.

An example can be seen in Figure 7.4. In about 23% of the time the wind direction was ENE. When the wind blew in that direction the concentration of NO was between 5 and 10ppb.

7.2.2.4. Radar Graph

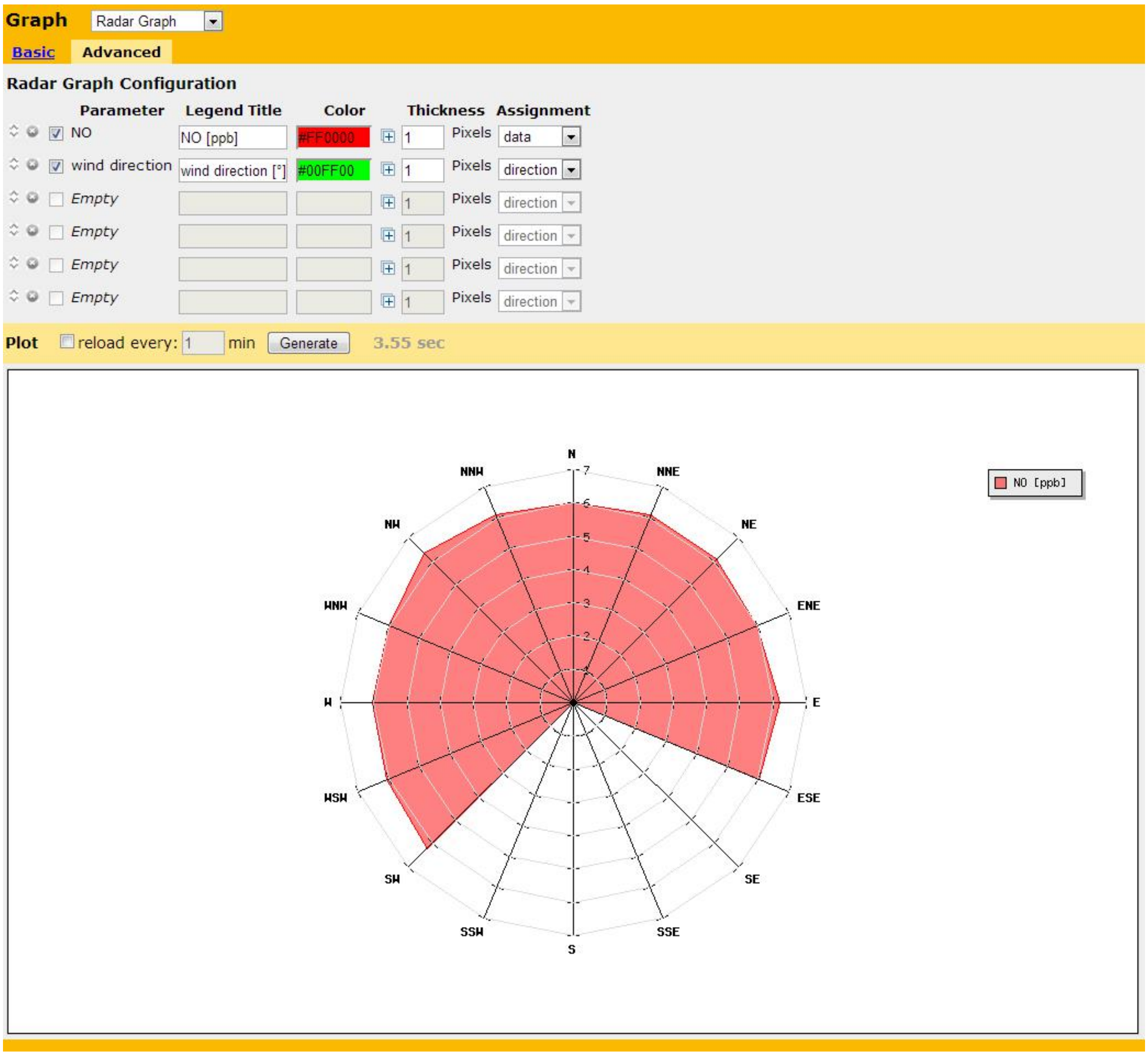


Figure 7.3.: Example for a Radar Graph

For a Radar Graph one can select up to six parameters. One of these has to be marked as 'direction' under **'Advanced'**. The other parameters are marked as 'data'. All measurement values are plotted in the respective units in the same range. This can lead to the effect that not all measurement values are visible. The parameters are shown color coded. The code can be changed in **'Advanced'**. The order of the plots is the same as the order of parameters in the list from top to bottom. The order can be changed by clicking the small up and down arrows on the left side of the parameter name in the menu **'Advanced'**. If you do not want to show all parameters at once, deselect their graphs in the 'Advanced' tab. In Figure 7.3 you can e.g. calculate the pollution burden in a specific direction.

7.2.2.5. Comparison: Wind Rose - Radar Graph

In the Figure 7.4 the NO measurement for a specific duration is plotted versus the wind direction. On the left side the plot is shown as wind rose, respectively on the right side as a radar graph.

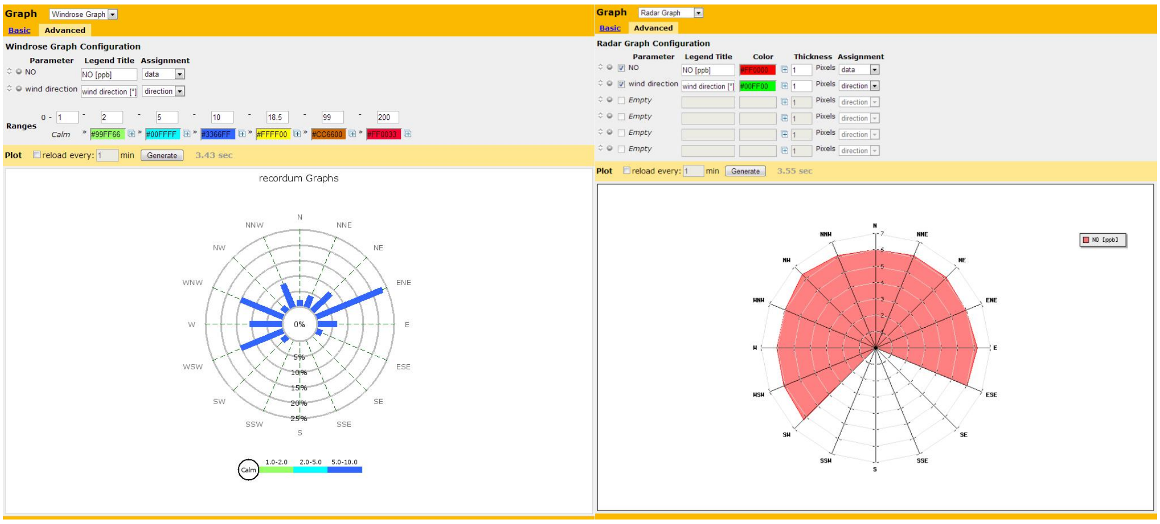


Figure 7.4.: Comparative plot of a NO measurement versus the wind direction shown in a Wind Rose (a) and a Radar Graph (b).

(a) In the Wind Rose Graph the length of the bars show on what percentage of the time the wind blew in that direction. With the color code it is shown how much NO was measured. The length of the color bars indicates the percentage of the NO measurement according the color code when the wind blew in the respective direction. In detail, the graph in Figure 7.4(a) shows that the wind blew often in the direction EstNorthEst (ENE) (approximately 23% of the measurement time). Whereas in the direction SouthWest (SW) there was rarely wind (about 1% of the measurement time).
(b) In contrast, in the Radar Graph the averaged value of the NO measurement during the selected time range for one direction is calculated and plotted versus the wind direction. This is independent of how often the wind blew in that direction. In the Plot 7.4(b) there is a similar amplitude all from SW to ESE. This indicates that the avarage value of the NO measurement was nearly the same for all wind directions measured.

The Advanced Tab lets you customize the drawing options of the graph. These depend on the type of graph you have selected in the 'Basic' tab. These options are for instance the type of the line to be drawn or the order of the parameters. Additionally it is possible to include or exclude campaigns. These can be defined in 'Setup' ↠ 'Extras'. Campaigns are time periods during which a specific action has taken place and which measurement values have been marked. If during the shown time period a campaign has taken place, this period is marked with a line parallel to the X axis in the XY-graph. The campaign is listed in the legend. If you do not want this, click 'Hide Campaign'.

Save this design click on this link to save the current configuration for later use.

Clear parameters reverts all settings you made back to an empty selection.

Time Options With the 'Quick'-option the measurement of the e.g., last days, can be shown. If you need other periods then the predefined, you can set a custom start/end time/date or interval with 'Period'. As standard the end point is set to 'Auto'. This means now and if you update your graph, it will have a new end point. With this selection it is possible to observe a measurement.

Resolution There are three possibilities to average the measurement values. High resolution means every minute, middle every 10 minute and low every 30 minutes. In this Interface you can select the resolution of all selected parameters at once. The change the resolution of a specific parameter go to **'Advanced'**.

Options Notice the three small icons, labeled "Options". Clicking these:

- Enables you display single values on the graph. Drag your cursor over the graph to see the values.
- Produces a table-view of the data. **Warning:** depending on your network connection and the data size this could take some time! If 'Show Summery' on top of the table is clicked, the minimum and the maximum of the parameters and the all over average are shown with date and time.
- Indicate if zoom is available. Zoom-in by dragging a box around the area you want to zoom into.

Generate When you are satisfied with the settings, click "Generate" to plot the graph. Notice the three small icons, labeled "Options". Clicking these:

- Enables you display single values on the graph. Drag your cursor over the graph to see the values.
- Produces a table-view of the data. Warning: depending on your network connection and the data size this could take some time!
- Indicate if zoom is available. Zoom-in by dragging a box around the area you want to zoom into.

If "reload every xx min" field is active, the graph is refreshed every selected minute. With this automatic redraw, it is possible to observe new measurement values, if the 'End' is set to 'auto'.

7.3. Download

NOTE
We recommend to download your data regularly.

The **'Download'** window houses a wizard which guides you through the download of your data. Roughly explained, the wizard runs through 3 steps:

1. Select the parameters to export and which average value to take,

2. Define settings for export, like e.g. time interval,

3. Set the file properties of the exported file.

CAUTION:

You can only download data with active group and parameter name. If you have changed the name, the old data cannot be downloaded any more.

Configurations

Before you start, keep in mind that you can save a configuration of download settings for later reuse. You can select an existing configuration from the list on the top part of the 'Download' window. To **save a new configuration** click 'Create' next to "New Configuration" and give the new configuration a name. Now proceed with Step 1 described below.

7.3.1. Step 1: Select parameters

Under "Select parameters" you can see a list of installed devices. Select the desired parameters and suitable average values. When you are satisfied with your selection scroll to the bottom of the page and click next. Figure 7.5 gives you an impression how your screen may look like.
The **'Quick Download'** option allows you to download data with the same parameters as the last download. This is useful when configuration does not change too often.

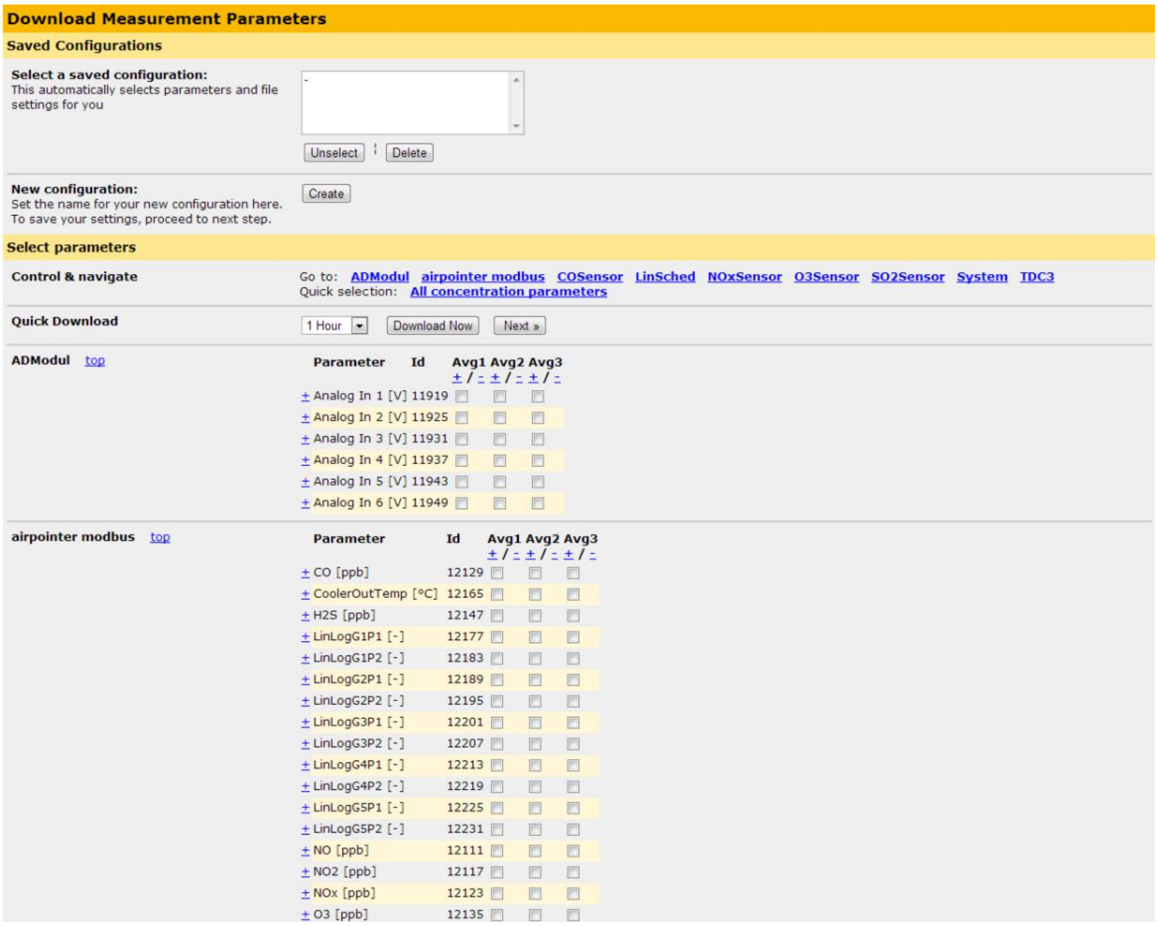


Figure 7.5.: Download Screen with dummy data

7.3.2. Step 2: Configure export settings

The next screen in the wizard (see figure 7.6) gives you the possibility to:

- **Delimit the time interval** of the exported data,
- **Define a Time Source (or reference).** In case one sensor does not deliver constant data, you can select another measurement signal as time reference. All selected values will be documented, but only when the reference parameter is available. Table 7.1 shows an example.
- Define multiple parameters for the output file such as the file type. Adjust these parameters to suit your needs for post processing your data, with e.g. MS Excel. The default configuration is:
  - Filetype: ".csv"
  - Seperator: ";"
  - File System "UNIX"
  - Decimal Separator: "Comma"

  Status flags:
- As an option, you can add **status flags** to every parameter value.

- **Fields surrounded by quotes:** As an option, you can put each single data field of the data file in a high comma, per default disabled.
- **Interpolate non existing values:** As an option, missing datasets are filled up. The y-value for missing values is set to -9999.
- **Compression**
  - Text only: no compression
  - Zip compression: To optimize the file size, the file is zipped as standard resulting in a file ending '.zip'. In this case, your work station needs a program for unpacking data to get the data file embedded compressed in the zip file.
  - Self-extracting Zip File: Here you can generate a self-unpacking zip file. This increases you file size by about 90 kB.

Average1		Average2		Average3	
time	value	time	value	time	value
15:00	23	15:00	21	15:00	19
15:01	26				
15:02	29				
⋮	⋮				
15:15	22	15:15	25		
15:16	16				
15:17	19				
⋮	⋮				
15:30	30	15:30	26	15:30	24

Table 7.1.: Example of Time Stamp Entries Used as Source for Two Possible Compilations for Download of Averages (see Tables 7.1(a) and 7.1(b)).

(a) 'Source of time data' set to 'Average1'

time	Average1	Average2	Average3
15:00	23	21	19
15:01	26		
15:02	29		
⋮	⋮		
15:15	22	25	
15:16	16		
15:17	19		
⋮	⋮		
15:30	30	26	24

(b) 'Source of time data' set to 'Average2'

time	Average1	Average2	Average3
15:00	23	21	19
15:15	22	25	
15:30	30	26	24

Table 7.2.: Examples of Compilations of the Data Shown in Table 7.1. Please note that the given values may as well represent averages from different sources of signals.

Make sure to define all parameters are fitting your needs. If you encounter difficulties reading or processing the downloaded file, check these parameters. You might want to consider platform specific changes (e.g. line endings). Furthermore you have the option to compress the data as .zip File to save bandwidth. If you created a new configuration, you now have the option to save the specified parameters to it. If you did not create a new configuration of just want to download the data click on "Next". This will prepare your file for download.

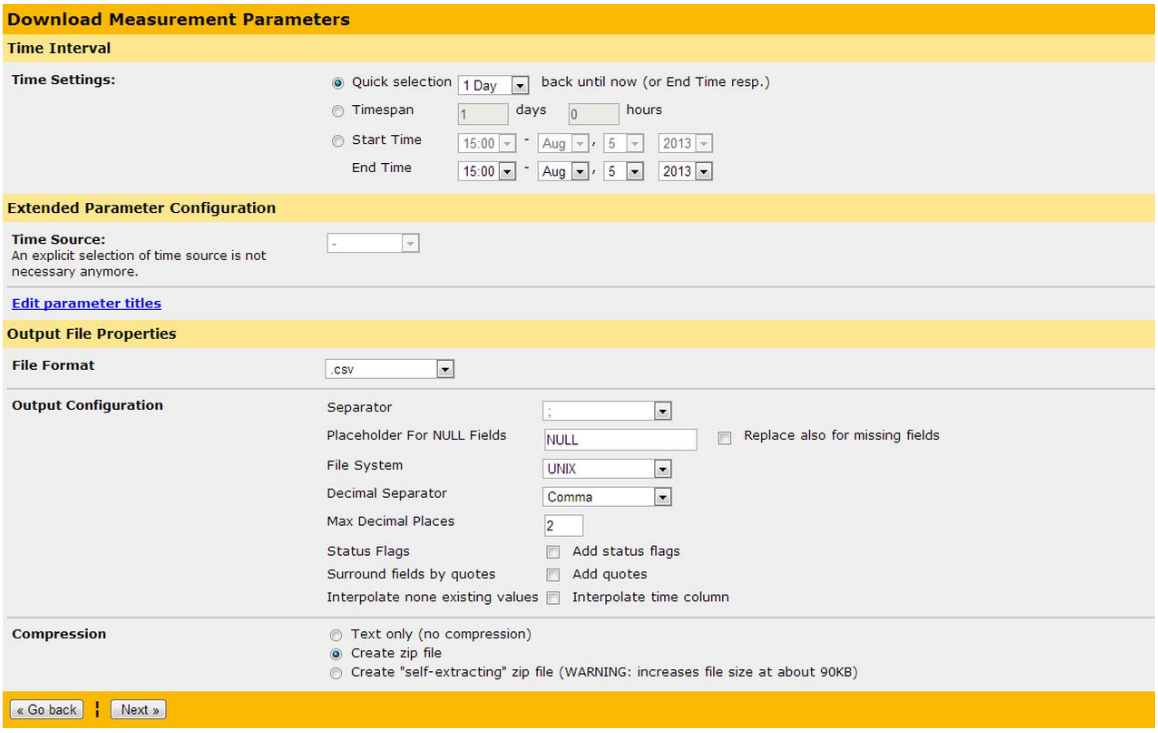


Figure 7.6.: Step 2 of download procedure

7.3.3. Step 3: Download the data

In the last screen a status bar indicates your files progress. Depending on the amount of data, this might take some time. If an error occurs, it will be displayed above the status bar. In the lower section you can see a brief summary on what data is been exported. When the file is complete, you may right-click on "Download data file" and choose "Save target as..." to finally get your file.

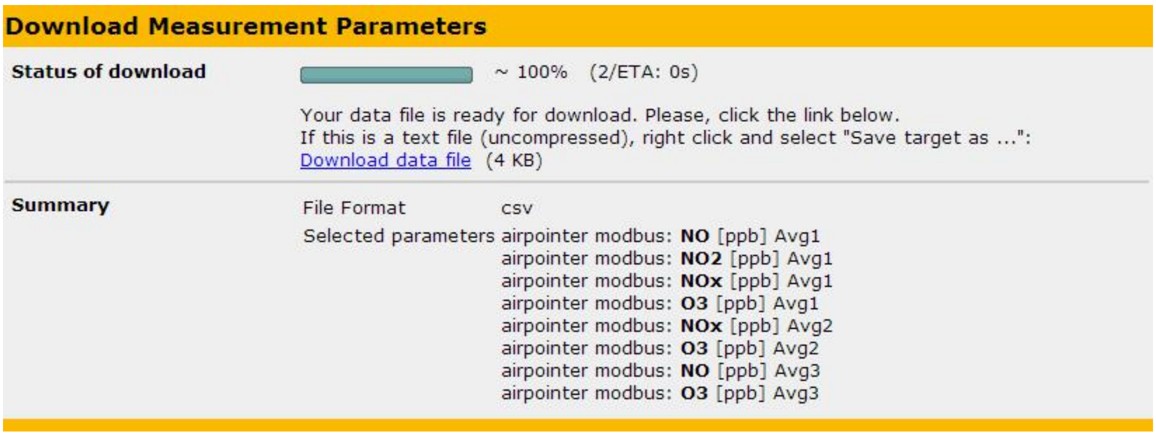


Figure 7.7.: File was successfully generated for download

7.4. Stationbook

This module provides a notepad for you. By default your notes are visible to all users. You can also set single entries to be visible only to yourself.
If you choose ‘Stationbook’ from the menu, all available entries are listed. By clicking on the title the whole note shows up, a full text search is available also. See Figure 7.8 for an example Stationbook filled with dummy data.

Figure 7.8.: The Stationbook Module

The main options are: Add, edit and delete a note. The user who added the note can set access rights, i.e. define whether others can read it.
Depending on the given rights, later editing and deleting of that particular note is also possible.
Recommended entries into the Stationbook are all operations resulting from the table Maintenance Schedule in the manual, and also:

- Relocation of your airpointer®
- Calibration accomplished on/by
- Filter replacements
- Service works
- Maintenance works
- Air condition control
- Possibly occurred errors
- Peculiarities

7.5. Overview

7.5.1. Sensors Overview

The idea behind this screen is to give the user a quick summary of selected measurement data and whether there is a fail state for a parameter. The status is set to be "Ok" in two occasions:

- There is no rule set for this Parameter value
- The values are within range which was set in the rule

If the values arent within range the status changes to "FS".

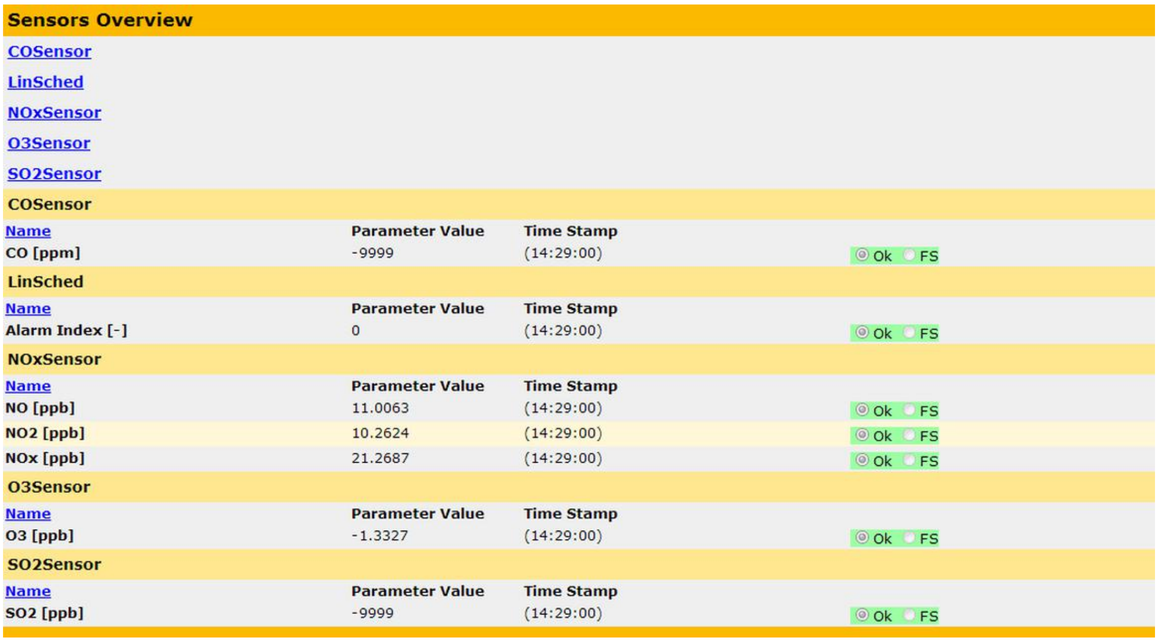


Figure 7.9.: Sensors Overview

To select the item to display:

- Go to **Setup**.
- Open **Configuration** from the subtree.
- Select **Parameters**.
- Select all parameters you want to appear in the overview by ticking their box in the "Overview" column.

It might practical to make the "Overview" your home-screen. That way you can see the selected parameters at a glance right after the login. If you want to setup the your startscreen:

- Go to **Setup**
- Open **User interface** from to subtree.
- Open **Personal Settings**
- Select "Overview" from the dropdown list labeled "Default module for startup".

7.5.2. Commands

With the "Commands" interface you can set individual modules into **maintenance mode**. Just press the corresponding button to do so. Furthermore it is possible to turn the (optional) Alarm Device on and off with a single click. If you have rules (see section 7.7.1) defined that require a **End User Acknowledge** you can reset *ALL* active rules here by clicking "Reset". As long as the cause for the rule is no longer present, any active rule will now be reset.

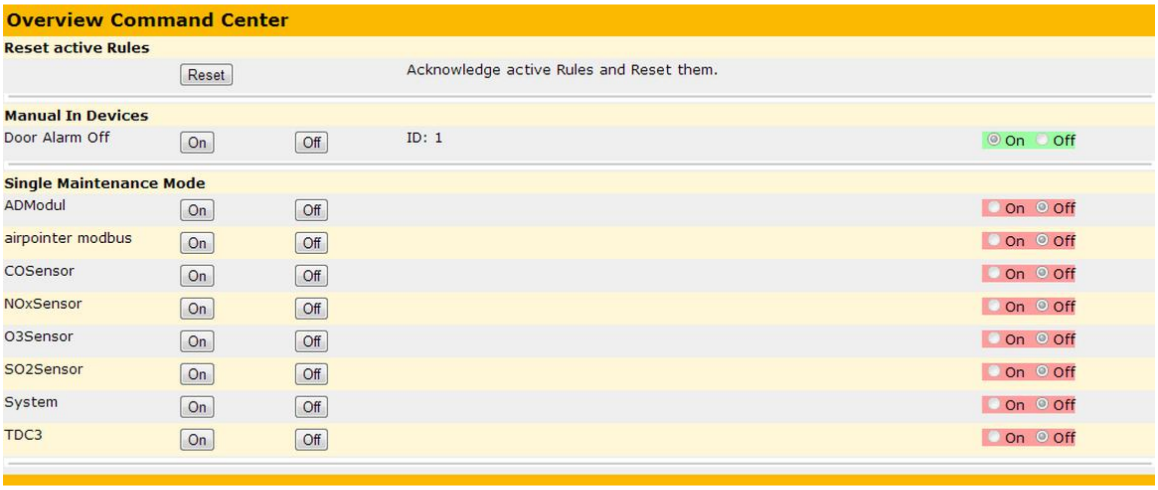


Figure 7.10.: Overview Commands

7.6. Calibration

7.6.1. General

If you are performing regulatory under EPA requirements, you must confirm that theairpointer® monitoring system internal settings are those for the "EPA-compliant" mode of operation. Refer to section 8.1 'EPA Requirements for Operationas FEM/FRM'. In order to insure that high quality, accurate measurement information is obtained at all times, the airpointer® must be calibrated prior to use. In this chapter you will find detailed guidelines to ensure a correct calibration.
To ensure a US EPA conform calibration, we strongly recommend that you obtain a copy of the publication Quality Assurance Handbook for Air Pollution Measurement Systems (USEPA Order Number: EPA-454/B-08-003 and the additional sections with USEPA Order Number: EPA-600/4-77-027a). We will refer to this as C and C
This handbook can be obtained from:

- EPA Technology Transfer Network (http://www.epa.gov/ttn/amtic)
- National Technical Information Service (NTIS, http://www.ntis.gov/)

Definition The calibration described in this section is defined as establishing a relationship between introduced gas samples and the adjusted measurement device.
This relationship is derived from the instrumental response to successive samples of different known concentrations. The airpointer® allows the definition of a zero point and a span point, hence a linear calibration relationship.

Equipment The device(s) supplying the zero air and Span calibration gases used must themselves be calibrated and that calibration must be traceable to an EPA/ NIST primary standard.
The reliability and usefulness of all data derived from airpointer® depends primarily upon its state of calibration. To ensure accurate measurements of the modules:

1. The airpointer® must be calibrated at the time of installation and recalibrated as necessary.
2. In order to insure that high quality, accurate measurement information is obtained at all times, the airpointer® must be calibrated prior to use.
3. Theairpointer® should be in operation for at least several hours (preferably overnight) before calibration so that it is fully warmed up and its operation has stabilized.
4. Calibration documentation should be maintained for each module. We suggest to use the "Stationbook" described in Section 7.4. Furthermore the USEPA suggests to store calibration documentation in a central backup file.

7.6.2. Calibration frequency

Due to physical properties all measurement instruments are subject to some drift and variation in internal parameters and therefore cannot be expected to maintain accurate calibration over long periods of time. That implies that it is necessary to check the calibration

relationship on a predetermined schedule. We suggest to calibrate the airpointer® approximately 4 times per year.
An analyzer should be calibrated (or recalibrated): C

- upon initial installation
- following physical relocation
- after any repairs or service that might affect its calibration
- following an interruption in operation of more than a few days
- upon any indication of analyzer malfunction or change in calibration
- at some routine interval

In addition, see Figure 12.1 in C Section 12.3 for a USEPA suggestion for drift limits.

7.6.3. Performing a calibration

The module 'Calibration' of the airpointer® software includes the following functions:

1. Start Calibration
2. Calibration of the PMT
3. Calibration of a module
4. Determination of the CE Factor
5. Test of the internal Zero Air

7.6.4. Start Calibration

This module provides you with the possibility to perform a calibration, to switch the calibration valves or to track a calibration of an external analyzer.

NOTE
Please check that you have administrator rights on the airpointer® .

In order to carry out a calibration login to the User Interface. After selecting 'Start Calibration' in the module 'Calibration', you get two subsections as described below.

NOTE
A calibration should only be carried out, if you have sufficient time!

The section calibration has two subsections:

1. Valve control

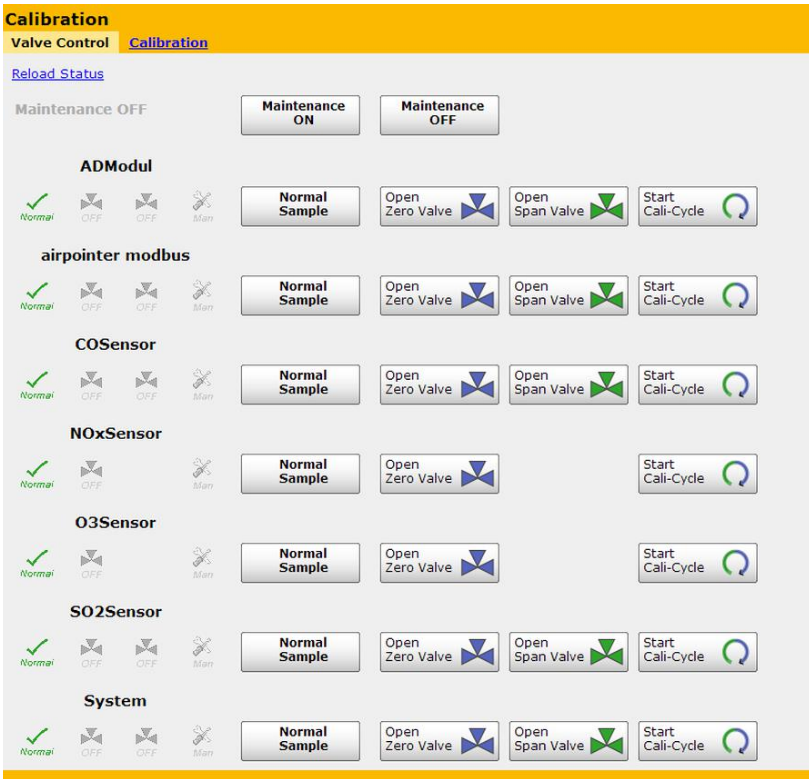


Figure 7.11.: Valve control

- If you click 'Reload Status' you will get the actual status (Maintenance ON or OFF), at once.
- Here you can activate and deactivate the maintenance mode with clicking 'Maintenance ON' and 'Maintenance OFF', respectively.
- This section provides you with the valve control (sample/Zero measurement) for the whole system (all modules are affected) or for just one module. This function is just available if the function 'CaliOn...' is activated for the system or the module, respectively (see 'Setup' ↠ 'Configuration' ↠ 'Module name' ↠ 'calibration setup' (see pages 7-91, 7-96, 7-100, 7-105). In Figure 7.11 only the system is shown. The modules look alike.
  - 'Normal Sample': Standard measurement of sample and span gas, respectively.
  - 'Open Zero valve': The valves switch to internal zero measurement. If this is valid for the 'System', then all moduls switch to internal zero measurement. If you click it for a specific module only this module will be affected.
  - 'Start Cali-Cycle': Start of the function control: internal zero measurement followed by internal span gas measurement if your airpointer® has 'Internal Span Module' (optional) installed. Else just an internal zero point control takes place.

> **NOTE**
> **Internal span measurement is only available if your airpointer® has an Internal Span Module installed - optional**

2. Calibration
   - Select the module
   - Set point of span gas and zero air.
   - Displayed measurement

7.6.5. Types of Calibration

A distinction is made between

1. Initial Calibration, hardware calibration (see Section 7.6.6) and
2. Calibration (see Section 7.6.7).

SO_2 NO_x

7.6.6. Initial Calibration, Hardware Calibration, PMT Calibration

When: This calibration has already been factory made. In contrast to a normal calibration these settings refer to the direct output of the hardware, excluding any further interpretation via software. Accordingly you have to perform your settings via potentiometers direct on the hardware. This is valid for calibration of all pressure sensors and the temperature sensor of the Molybdenum converter of the NO_x Module. The high voltage of the PMT of the SO_2 and the NO_x Module is adjusted via the user interface.
It will be necessary to repeat the calibration of the PMT if one of the following requirements is not fulfilled anymore:

In the 'NOx Sensor' *folder:*
(see airpointer® Setup ↠ Configuration ↠ NOx Sensor)

$0.3 < \text{NOSlope} < 3$
$0.3 < \text{NOxSlope} < 3$
$-50 < \text{NOOffset} < 50$
$-50 < \text{NOxOffset} < 50$

In the 'SO2 Sensor' *folder:*
(see airpointer® Setup ↠ Configuration ↠ SO2 Sensor)

$0.3 < \text{SO2Slope} < 3$
$-50 < \text{SO2Offset} < 50$

Procedure to calibrate the PMT:

1. Please log in as a member of the administrator group at the User Interface of the airpointer®.

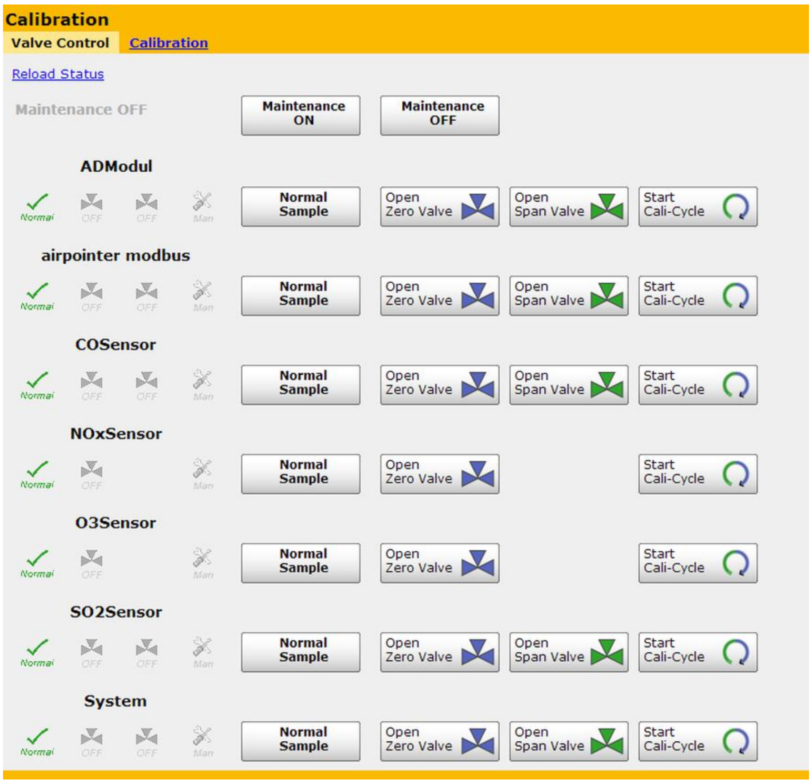


Figure 7.12.: Activate the Maintenance Mode

2. Maintenance Mode: It is highly recommended to mark the measurement data stored during the procedures described in the following using the 'Maintenance On' switch (see Figure 5.18) of the analyzer (it is activated by pressing the switch for 10 seconds). The respective status LEDs will change from constant to flashing light. You can exit the Maintenance mode by pressing the switch 'Maintenance Off' (see Figure 5.18) for 10 seconds. Alternatively, you can activate the Maintenance Mode of the airpointer® by activating User Interface ↠ Calibration ↠ Start Calibration ↠ Valve Control ↠ Maintenance ON.

3. Resetting the values for 'Slope' to 1 and 'Offset' to 0 will create a defined start point for the following settings.

   a) (NO_x) : In Setup ↠ Configuration ↠ NOx Sensor (see page 7-90), set the values for

NOOffset	0
NOSlope	1
NOxOffset	0
NOxSlope	1

   b) (SO_2) : In Setup ↠ Configuration ↠ SO2 Sensor (see page 7-105), set the values for

SO2Offset	0
SO2Slope	1

4. Apply Span gas to the system according to Section 7.6.7.2.

5. In the LinSens Service Interface, open folder ‘Actual’. As these values are updated almost every second, the results of your settings can be observed immediately.

6. Adjust the high voltage of the PMT (’NOx HV set’ and ’SO2 HV set’, respectively) in ’Setup’ ↠ ’Configuration’ ↠ ’NOx Sensor’ or ’SO2 Sensor’, respectively ↠ ’Calibration setup’ till the actual value refers the Span gas concentration for NO or SO2, respectively.

7. The calibration values are automatically stored and taken over.

8. Open the service manager ↠ ’measurement software’ and restart the software to adopt the boundaries to the new values

9. Next, please set the Maintenance Mode to ‘Off’, either by pressing the switch Maintenance Mode Off for 10 seconds (till the LEDs do not blink but light) or by selecting Calibration ↠ Start Calibration ↠ Valve Control ↠ Maintenance OFF in the User Interface.

10. Continue the calibration for the NO_x or SO_2 sensor using the procedure described in ‘Performing a Calibration’, Section 7.6.7.

7.6.7. Calibration of a module

When: This calibration should be carried out regarding your calibration rules and given calibration intervals or if any of the maintenance operations requires to do so (see section 7.6.2).

7.6.7.1. Calibration Philosophy of the airpointer® :

The airpointer® provides a simple possibility of dividing between applying span gas to the analyzer on-site and entering the calibration factors into the analyzer by the operator.
With the airpointer®, the person responsible for calibration does not have to be on-site anymore. Using the airpointer® User Interface and an Internet connection, this can be done remotely, even over a very far distance.
Entry of the calibration factors will be done by the person responsible for calibration after watching the calibration signals in the calibration assistant until a stable course can be seen. The user is on-site, applying span gas to the analyzer.

Naturally, entering the calibration factors can be done on-site as well. In this case, your notebook has to be connected with the cross patch cable to the airpointer® RJ-45 socket LAN2 in the maintenance access (see section ‘Getting Started’ in Section 5.7, Figure 5.20).

7.6.7.2. Various Possibilities of Applying Span Gas to the airpointer®

Figure 7.13.: Applying Calibration Gas to the airpointer® .

- **External, using the span gas inlet at the maintenance door (see Figure 7.13), Swagelok 1/4"**
  The span gas tube is screwed to the Swagelok 1/4". There is an internal T-piece for bypass for pressure compensation of the span gas. Thus, span gas flows through the T-piece to the sampling filter and further on to the sensors.

- **External, using the sampling hat**
  In this case, the complete sampling system is included. Applying span gas is done by a hood which is put on the sampling hat.

- **External, using the screwing for the sampling hat tube ⌀15 mm**
  After removing the high-alloyed sampling, span gas is applied using the PG screwing for the tube with a diameter of 15mm.

- **Internal, using the SPAN valve (optional)**
  Span gas is applied at the span valve which is available as an option for the airpointer®. Thus, span gas flows through the T-piece as pressure compensation of the SPAN valve and is then led further on to the sensors.

Once the appropriate pneumatic connections have been made, check all pneumatic fittings for leaks using the procedures defined in Section 11.10.

7.6.7.3. Required Span Gas Flow (and External Zero Air)

NOTE
In any case, use a separate and calibrated flow meter for ranges of 0 to 3000 ml/min to determine the analyzer's flow.
Never use the software display of the analyzer. This measurement only shows flow interruptions caused by clogging or loose tubing.

The required span gas flow for the airpointer® can be easily determined using the following table.

Module	Sample Flow[ml/min]
O_3	550
CO	550
SO_2	550
NO_x	500 /60 (O_3 Generator)
+ Excess	300

Table 7.3.: Calibration Gas Flows

The sum of the required span gas flow is calculated by the sum of the flows for the modules installed in your airpointer® plus the addition of an excess of 300ml/min. For example: Your airpointer® has a O_3 and SO_2 module installed. The required span gas flow is therefore: 550 (O_3) + 550 (SO_2) + 300 (excess) = 1400ml/min.
This value should be checked using your calibrated flow meter. You will find a detailed procedure for measuring the sample flow in the manual (see Section 11.11 'Performing a Sample Flow Check').

7.6.7.4. Various Possibilities of Applying Zero Air to the airpointer®

- **On the part of the customer**
  See above Section 7.6.7.2 'Various Possibilities of Applying Span Gas to the airpointer®'.

- **Using the airpointer®'s internal zero air supply.**
  Only to use for as function control

7.6.7.5. Handling of Zero Air and Span Gas

NOTE
Use your respective calibration devices and calibration rules.
Please take into consideration the interferences of O_3 and NO, otherwise mixtures are generally suitable as span gas as well.

To ensure an exact calibration, span gases are certified for a certain accuracy.
Span gas is a special mixture to reproduce a chemical composition of the gas to be measured, representing about 80% of the desired working range of the gas sensor. For example, for a range of 500 ppb, the span gas concentration should be 400 ppb of the gas to be calibrated.
Tubing of span gas and, if applicable, of zero air to the airpointer® should be made of Teflon® .

Zero Air

Zero Air is similar in chemical composition to the Earth's atmosphere but scrubbed of all components that might affect the analyzers reading.
For the airpointer® calibration you can use either the internal zero air or apply external zero air.
The internal zero air of the airpointer® is scrubbed of interfering components in three levels.

- At heated palladium on aluminium pills CO from zero air is oxidized to CO_2.
- Purafil® oxidizes NO to NO_2.
- Activated charcoal removes the O_3, SO_2 and NO_2 components.
- Additional scrubbers are placed on the Modules

NOTE
Using the internal zero air, humidity still present will not be dried. There is no special gas dryer in the internal zero air module.

Span Gas

All supplied span gas must be NIST[1] traceable and meet USEPA requirements. The vendor of the gas must participate in EPA Protocol Gas Verification Program. See C Section 12 for additional information.

[1] National Institute of Standards and Technology

7.6.7.6. Calibration Procedure

Preparatory Phase and Applying Gas

1. Activate the Maintenance mode for marking the measurement data for the calibration period by pressing the switch 'Maintenance On' (see Figure 7.14) for 10 seconds, the respective status LEDs will change from constant to flashing light. Alternatively, you can activate the Maintenance mode of the airpointer® by activating User Interface → Calibration → Start Calibration → Valve Control → Maintenance ON (see Figure 7.14).

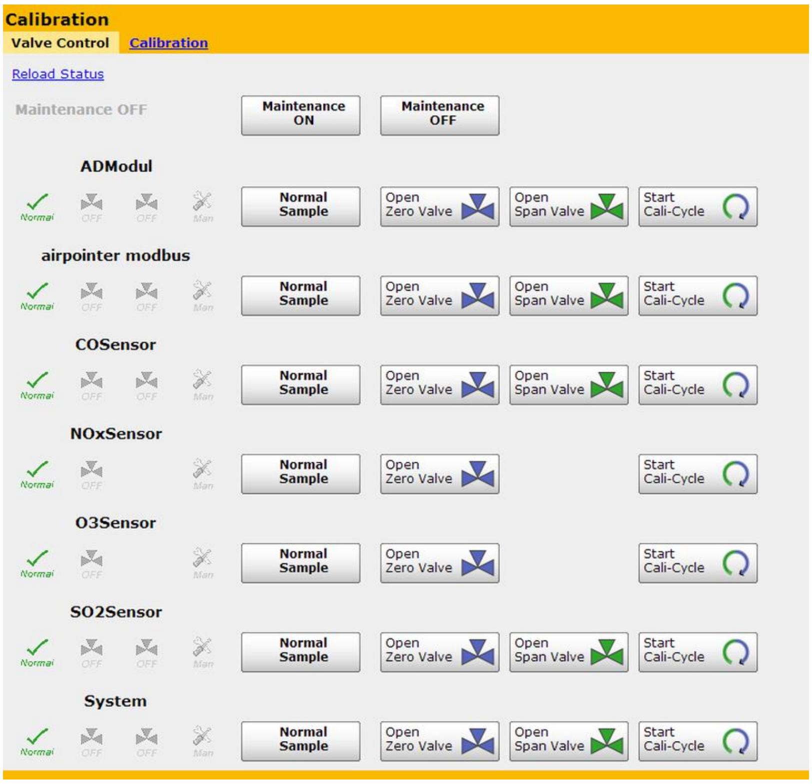


Figure 7.14.: Activate the Maintenance Mode

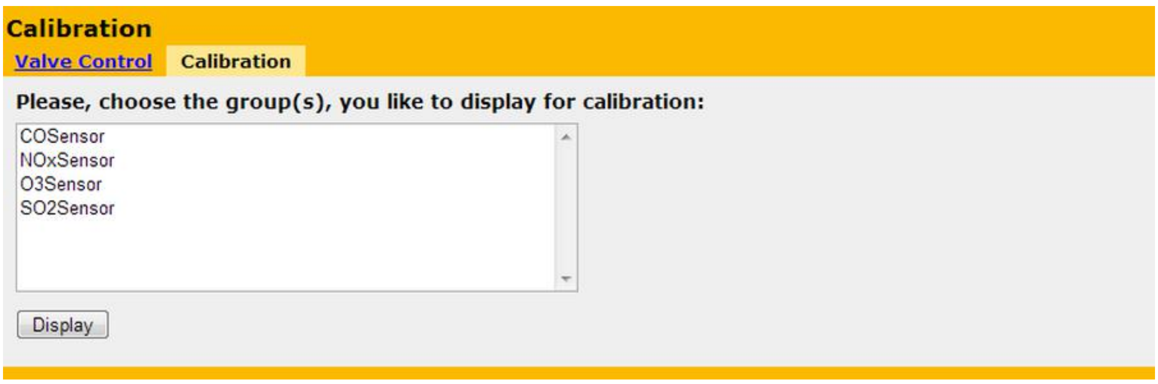


Figure 7.15.: Select a module for calibration

2. Select the module which you want to calibrate in the selection shown in User Interface ↠ Calibration ↠ Start Calibration ↠ Calibration and click 'Display'.

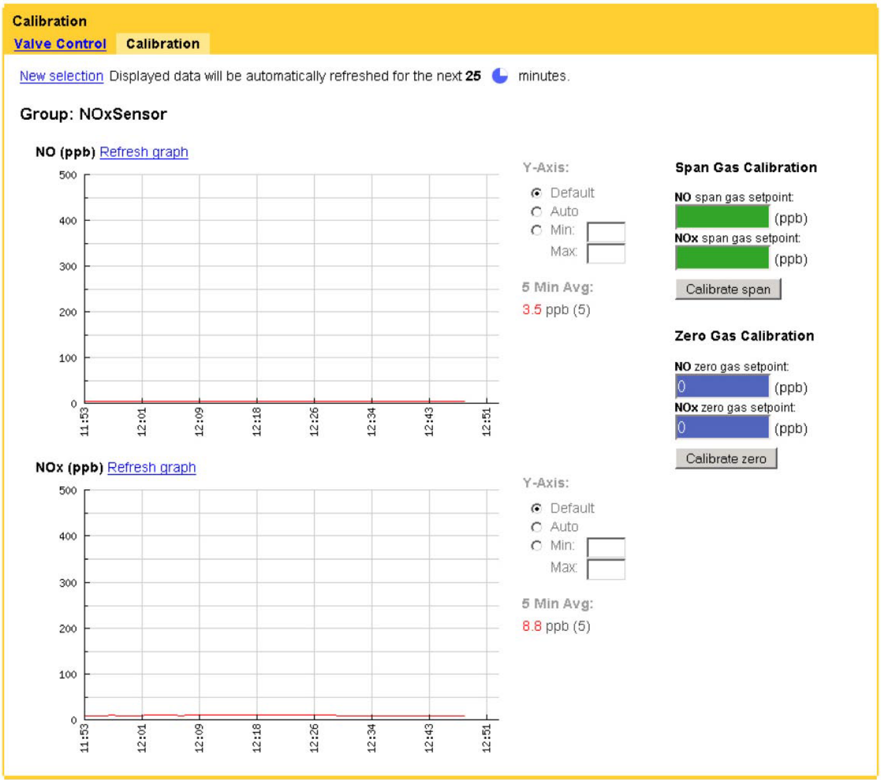


Figure 7.16.: Display of the calibration and input of the setpoints

3. Fill in the setpoint of your span gas in 'span gas setpoint' in given concentration.

4. Fill in the setpoint of the external zero gas in 'zero gas setpoint' in given concentration. For zero point measurement use external zero air. It can be connected in the same way as span gas.

NOTE
Use external zero air for zero calibration of a module.

5. Apply span gas to the airpointer® according to the possibilities stated. Select the gas flow needed for your airpointer® using Table 7.3.

6. Apply each span gas, wait for a stable measurement signal (about 10 to 15 minutes). The measurement graph is shown on this site.

NOTE
In the LinSens Service Interface folder 'Actual' values are updated almost every second and therefore a more precise observation is possible there. The results of your settings can be observed immediately.

When the measurement signal is stable, accept the calibration values by clicking 'calibrate span'. Next, apply zero air externally to the respective sensor. Again, wait for a stable measurement (about 10 to 15 minute) and then accept the calibration value (click 'calibrate zero'). Apply each span gas, wait for a stable measurement signal (about 10 to 15 minutes) and then accept the calibration values .
Repeat this procedure until the zero point deviation is within the required calibration tolerance.

7. The calibration values are automatically stored

8. Next, please set the Maintenance Mode to 'Off', either by pressing the switch Maintenance Off for 10 seconds (till the LEDs do not blink but light) or by selecting Calibration ↠ Start Calibration ↠ Valve Control ↠ Maintenance OFF in the User Interface.

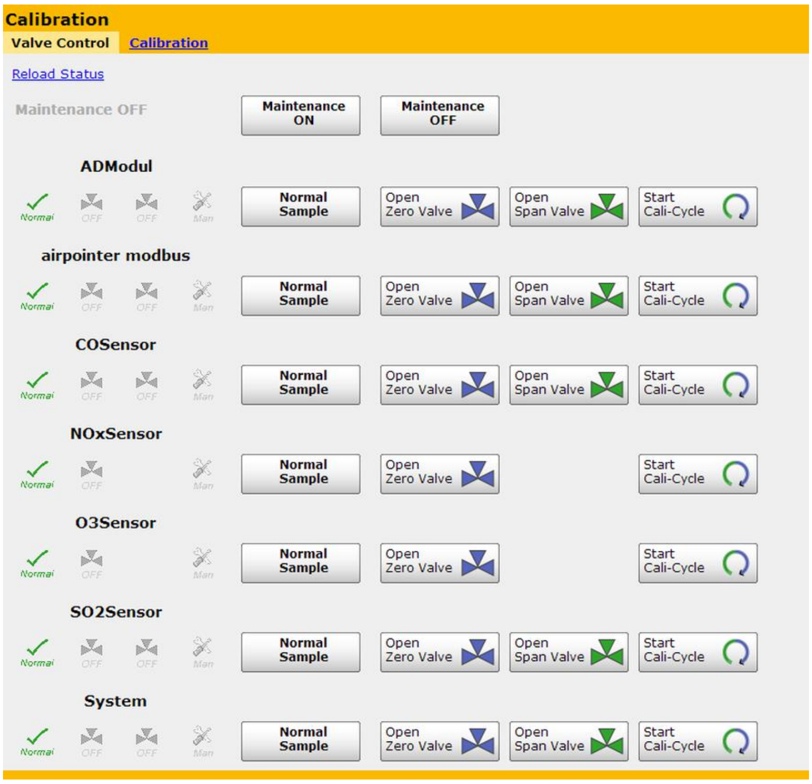


Figure 7.17.: Deactivate the Maintenance Mode

9. The calibration of the airpointer® is finished.

Depending on your chosen calibration philosophy the person responsible for calibration will accept the calibration factors either on-site or remotely with the opportunity to access the airpointer® using the Internet. To gain stable measurement values, the system should run at least five to ten minutes.

7.6.8. Determination of the CE Factor

Calibration of the NO_x sensor is done by applying NO Gas. For Checking the converter efficiency CE, please use a gas titration system (GPT). This converts NO span gas to NO_2 using Ozone. When using a perfect converter, the total amount of NO_x (the sum of NO + NO_2) should be constant before and after the conversion (see Figure 7.18). However, a real converter has an efficiency of < 1. Therefore, the converter efficiency CE results in

$$\mathrm{CE} = \frac{\text{Displayed Value NO}_x\text{ with GPT} - \text{Displayed Value NO with GPT}}{\text{Displayed Value NO}_x\text{ without GPT} - \text{Displayed Value NO with GPT}} \tag{7.1}$$

A typical accuracy for NO_x gas is 1% or 2%. NO standards should be mixed with nitrogen (N_2) to avoid a long term oxidation of NO to NO_2. NO_2 standards should be mixed with synthetic air to maintain the oxidation.

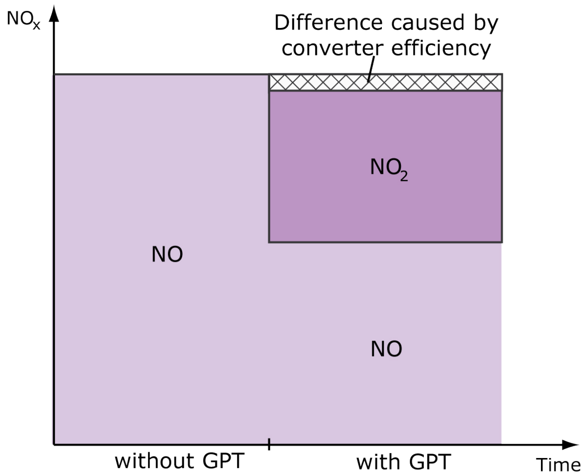


Figure 7.18.: Influence of the Converter Efficiency

To perform the CE calculation follow these steps:

1. Apply NO span gas to the system according to Section 7.6.7.2 using a GPT system with 'O_3' off.
2. In the LinSens Service Interface, open folder 'Actual'.
3. Wait until the displayed concentrations stabilize.
4. Write down the displayed values for the NO and NO_x concentrations.
5. Next, turn on 'O_3' of the GPT system and wait for stabilization of the values again.
6. Write down the displayed values for the NO and NO_x concentrations with GPT.

7. Use Equation 7.1 to calculate the CE.
8. Write the calculated CE value in section 7.7.5.5 (‘setup → configuration → NO_x Sensor’)

As example: If you have 400ppb NO and 200ppb Ozone and you get 200ppb NO, 200ppb NO_2 and 400ppb NO_X with deviation smaller than $\pm$ 40ppb the converter works properly.

7.6.9. Test the internal Zero Air:

Test the internal Zero Air

1. Apply Span gas to the airpointer®.
2. Read and note the concentration value.
3. Switch the valve to internal Zero Air and wait for ten minutes.
4. The concentration value should go to zero.
5. Read and note the value.

7.7. Setup

The ‘Setup’ module provides system information, configuration of sensors, system and interfaces of the airpointer®. Furthermore, user management of the User Interface to the airpointer® is available here. Here the user’s personal settings to the User Interface can be customized.
The functions of the module ‘Setup’ include:

1. Rules and Actions
2. System Info
3. System Maintenance
4. Extras
5. Configuration
6. LinLog
7. LinOut
8. Communication
9. User Interface

7.7.1. Rules and Actions

This feature enables you to define a set of conditions and what to do, if they become true.

7.7.1.1. Quick Setup

In this section we will give you a quick guide on how to setup a rule and action. In this example we want to define a threshold of the NO measurement value and get an email when this threshold is exceeded. See sections 7.7.1.4, 7.7.1.2 and 7.7.1.3 below for a detailed description of the actions and rules the airpointer® offers.

1. Define an "Action":
    - Select "Rules & Actions" from the menu on the left.
    - Select the type of action from the list. In this example we select Click on **Add** to define a new action.
    - Customize the new action. Refer to section 7.7.1.2 for a detailed description of the actions.
    - Press **Save** to keep the new action OR press **Delete** to abandon it.
    - You can define default values for actions as explained in section 7.7.1.4.
2. Define a "Rule":
    - Select "R&A Rules" from the menu on the left.
    - Select the type of rule you want to enable. Click on **Add** to define a new rule. All rules share the following attributes:

  - Name
  - Description
  - Active
  - Alarm Emphasis
  - Minimum Switch Time
  - Rule Repetition Time
  - End User Acknowledge
- Press **Save** to keep the new action OR press **Delete** to abandon it.

3. The rule is now set up. Next, you need to assign an action to the rule.
4. Assign an action to the rule.
   - Select your newly created rule.
   - Under "Assigned Actions" click on **Add**.
   - Select the action you want to assign to this rule from the list.
   - Click on **Save** to confirm your changes.

The setup is complete. Whenever the condition of the rule is fulfilled, the action is now triggered.

7.7.1.2. Actions

Before you define a rule you need to specify what to do if a rule (or condition) is fulfilled. After you defined a new action you can trigger it with the "Test" link next to its name. In most cases, an action is a notification sent to a member of staff, but an action can be flexible. The following settings must be specified for every action:

- **Name** Enter the name of the action here.
- **Description** enter a detailed description of the action.
- **Active** enable or disable an action. Any action must be set to "Active" in order to be assigned (see section 7.7.1.3) and executed.

As of this moment the following actions are available:

Digital Output If you have configered an Analyzer (7.7.6.1) with digital output you can define output here.

- Select the output port from the "Parameter" list.
- Specify whether the output is a flasher (i.e. a blinking light) or not.
- Specify whether the output is a single pulse or not.
- Digital Time On: specify the time the emitted signal is 1 (in seconds)
- Digital Time Off: specify the time the emitted signal is 0 (in seconds)
- Press **Save** to keep the new action
- Press **Delete** or **Back** to discard the new action

Eigenmeldungen This action triggers a system notification for a centralized network conforming to the UBIS© model of A-I-P[2].

Click the "Add" button to create a new action. The setup of an "Eigenmeldung" action is straight forward. Fill the parameters according to your UBIS© configuration. The fields with a bold label are mandatory entries. Choose "Save" or "Delete" with the respective button.

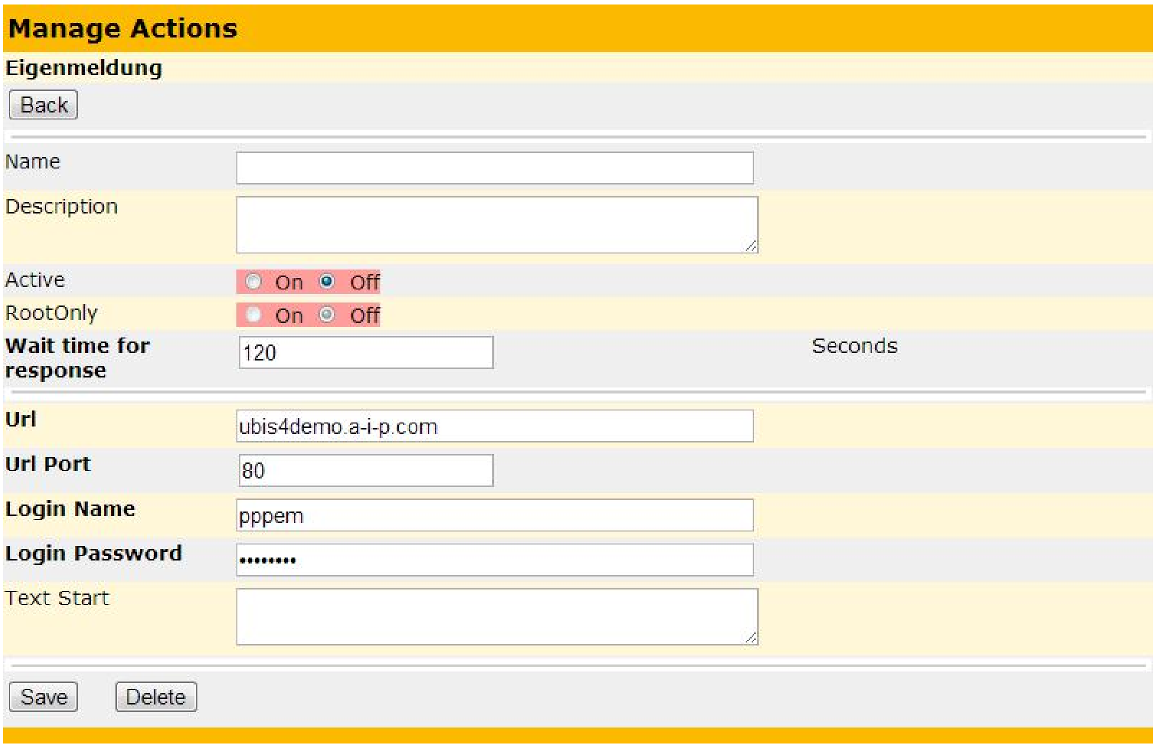


Figure 7.19.: Define an eigenmeldung-Action

E-mail In this case the action is a notification which is sent as e-mail. You can see a screenshot of the interface in figure 7.20. If you want to use the mailserver of the airpointer® enter "localhost" in the "Url" field. If you use the localhost you do not need to provide a login name or password. You must not necessarily change the "Time for response" this is an internal parameter.

To send a mail to multiple recipients, enter their addresses separated by Semicolon ";" in the "Recipient" field. The content of the three fields *Starting*, *Repeating* and *Stop* are displayed in the message's body whenever a condition or rule is valid for the first time, currently true or stopped being true respectively. Which of these states is entered depends also on the active rule defined. How to define a rule is explained in section 7.7.1.3. "Save" or "Delete" the action with the respective button.

[2]See `http://www.a-i-p.com` for more details.

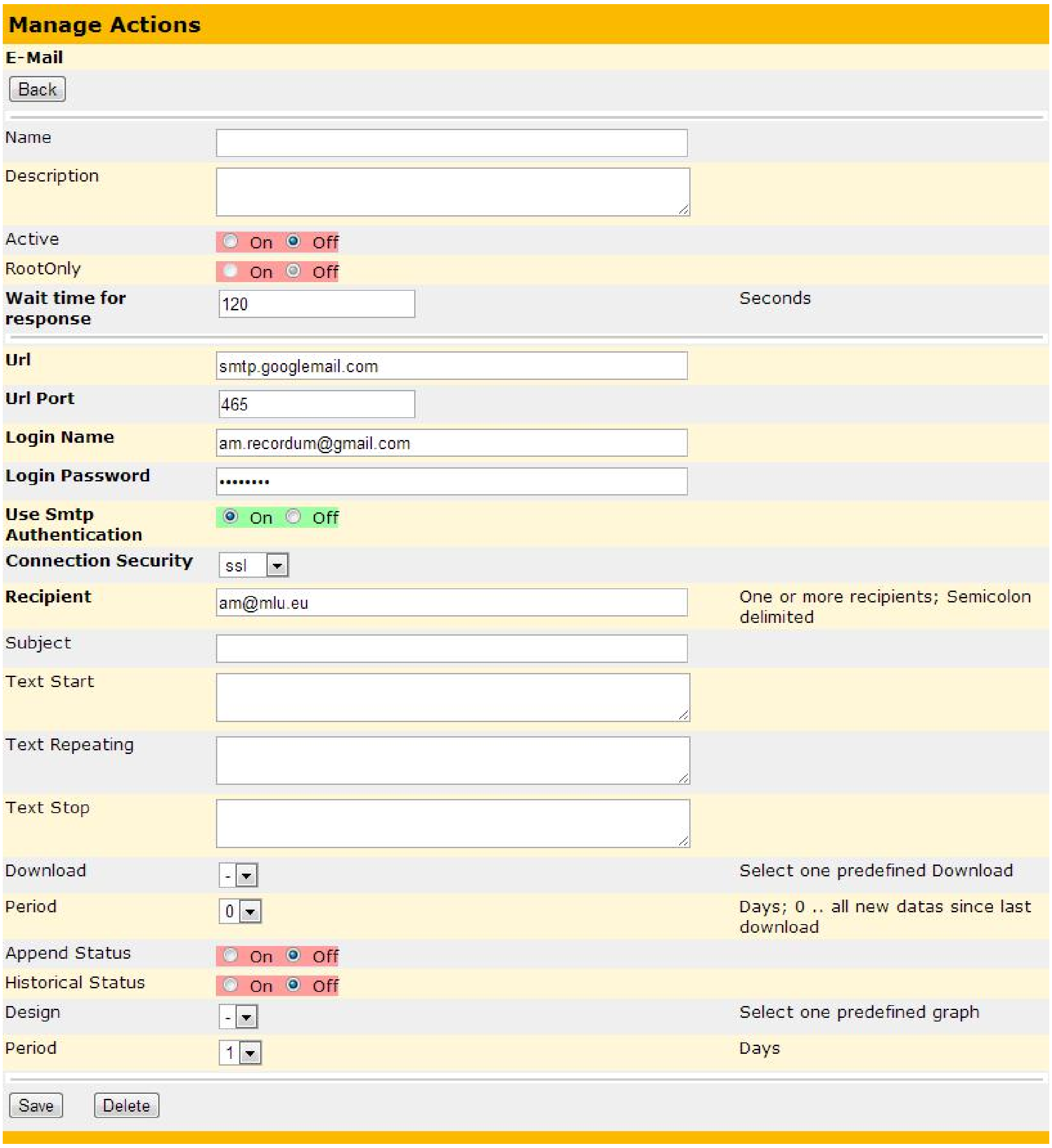


Figure 7.20.: Define an E-mail-Action

FTP Upload This feature allows yout to configure a FTP path and define which data should be uploaded.

Script This feature allows you to execute scripts given by the distributor. As far as you don't need any specific extensions the only script avaiable is the 'Backup Script'.

SMS This feature allows you to send a notification via text message.

Station Status This actions sets the airpointer® into the 'Global Station failure' mode. In this state measurement parameters will display a Failure State.

WaterSam Sample This action performs a new WaterSam sample. Specify the device to perform the sample from the **WaterSam** list.

7.7.1.3. Rules

In this section, the currently available rules are introduced. In general one can define boundaries for almost any parameter of the system. These can be used for instance for monitoring measurement data or system performance. Keep in mind, that a notification is only sent when an Action is defined and assigned to a valid rule. The following parameters are available for all rules:

- **Name** enter the name of the rule.
- **Description** enter a detailed description of the rule.
- **Active** enable or disable an rule. Any rule must be set to "Active" in order to become valid.
- **Alarm Emphasis** This parameter can be regarded as the "weight" of a rule. Any valid rule will add its emphasis value to the parameter *Alarm Index*. This parameter can be monitored by a **Measuring Signal Value**-rule (see below). As an example you could set the alarm emphasis value of a rule monitoring measurement value *A* to 50 and the value of another rule observing the value *B* to 50. You then could define an upper limit of the *AlarmIndex* parameter as 100, which will cause the third rule to be valid when rule A and B are valid.
- **Minimum Switch Time** specifies a time interval (in seconds) for the rule to stay in its current state AFTER it has switched state. E.g. the condition of a rule is triggered, the rule becomes active. Independently of the condition, the rule stays active for the time interval specified by the minimum switch time. The same holds for the disengagement of a rule. This prevents rules to be triggered too often in short time periods by fluctuating parameters.
- **Rule Repetition Time** defines a time interval to repeat a rule. E.g. a condition (for instance a measurement value is too high) is true over a long period of time, the rule is active. The triggers the assigned action after the specified repetition time (see e.g. E-mail action).
- Most of the rules allow to enable a parameter **End User Acknowledge.** With this function enabled, the user has to disengage the rule in the ’Overview’ module (see section 7.10).

Calibration Data Check Define a rule to observe the calibration data, i.e. the Zero or Span value.

- Select the **parameter** to monitor from the list.
- Select the **Value Type**: either 4 for Zero or 5 for Span value.
- Set **Check Higher** to monitor an upper bound for the selected parameter. Enter the bound in the Value 1 textfield.

- Set **Check Lower** to monitor a lower bound for the selected parameter. Enter the bound in the Value 2 textfield.
- If **Valid Maintenance** is set to On, the value is monitored, when the device is in maintenance mode. However, it does not imply that the rule is valid.
- If **Valid Failure Status** is set to On, the value is monitored when the parameter currently produces a Failure State. However, it does not imply that the rule is valid.
- Enable **Valid Data Global** to only monitor the value, if the availability of data is higher than 75%. E.g. for an average over 60 seconds, there must to be more than 45 samples available.
- You can also define a custom availability limit by enabling **Valid Data Check** and providing a value in **Valid Data Percent**.
- **Triggered when missing** enable this function to trigger the rule, if the parameter is missing.
- **End User Acknowledge** When this function is enabled, the user has to disengage the rule in the 'Overview' module (see section 7.10).

Combination Rule With this rule you can combine multiple rules. It allows a logical AND, i.e. all rules are true → combination rule is true and logical OR, i.e. at least one input rule is true → combination rule is true. Tick the rules you want to combine under "Assigned Rules".

- **End User Acknowledge** When this function is enabled, the user has to disengage the rule in the 'Overview' module (see section 7.10).
- **Combination Operator** Enter 0 for an AND combination, respectively 1 for an OR.

Door Contact Alert This rule provides a general purpose alarm system triggered by an arbitrary digital/analog input.

- Select the **Parameter** to trigger the alarm.
- **Reference Number** Additionally we provide the logic to suppress the actions of an active alarm. Specify the same internal reference number as a *Manual In* rule to connect those two. E.g. The bound *Manual In* rule provides the software switch to suppress the alarm actions, though these are still valid.
- Enable **Check Higher** to set an upper bound for the monitored parameter. If you selected a digital input a value of 0.5 in Value 1 will trigger the alarm.
- Enable **Check Lower** to set a lower bound for the monitored parameter. If you selected a digital input a value of 0.5 in Value 2 will toggle off the alarm.
- **Grace Time** specifies an interval (in seconds) between the detection of the alarm and the trigger, i.e. a countdown.

Intrusion Alert If your device comes with the optional intrusion alert kit, you can define a rule here which becomes true if the device has detected unauthorized access of the main door. Only available on airpointer®.

Maintenance Mode This rule becomes valid if the device is in maintenance mode. It is possible to enable **End User Acknowledge**. When this function is enabled, the user has to disengage the rule in the 'Overview' module (see section 7.10).

Manual In This rule provides software switches to be used by other type of rules. E.g. Define a *door contact alert rule* and a *Manual In* rule. Enter the same reference number for both rules. The switch is available under: Overview → Commands. You can now suppress the alarm by enabling the switch. Provide a **Fallback Time** to disengage the switch after a specified time.

Measuring Signal Status Check This rule can be used to observe the status e.g. "Fail" of a parameter.

- Select the **parameter** you want to observe from the dropdown list.
- Select the type of the value (0..Actual value, 1,2,3..Average 1,2,3, 4..Zero, 5..Span)
- Select if the rule should trigger whether the value is not missing.
- Enter the correct value in the bitmask for the fs (fail states) and bs (Betriebsstatus, operation mode) from the following tables:

Bit	description	set value (decimal):
Bit0	Flow	1
Bit1	Pressure	2
Bit2	Temperature	4
Bit3	Lam/Source/O3Gen/Flame/HVPS	8
Bit4	wrong SensorSignal/BadCal	16
Bit5	Warmup/ below detection limit/negative/Service required/Sensor lifetime expired/old value	32
Bit6	Cali check wrong	64
Bit7	Sum Fail	128

Table 7.4.: FS Status bits

Measuring Signal Value Check With this rule it is possible to observe a measurement value.

- Select the **parameter** to monitor from the list.
- Select the **Value Type**: either 4 for Zero or 5 for Span value.
- Enable **Check Higher** to monitor an upper bound for the selected parameter. Enter the bound in the Value 1 textfield.
- Enable **Check Lower** to monitor a lower bound for the selected parameter. Enter the bound in the Value 2 textfield.

Bit	description	set value (decimal):
Bit0	Maintenance	1
Bit1	Zero	2
Bit2	Span	4
Bit3	PurgeOut/ServiceMode	8
Bit4		16
Bit5	Unit	32
Bit6	Unit	64
Bit7	UserTest On	128

Table 7.5.: BS Status bits = Operation Status bits

- Enable **Check Rising** to check if the change (absolute value) during the defined time period exceeds the limit. Enter the limit in Value 3.
- Enable **Check Falling** to check if the change (absolute value) during the defined time period exceeds the limit. Enter the limit in Value 4.
- Define the time period for rise/fall interval (0 (off) .. 60 (max) Samples).
- If **Valid Maintenance** is set to On, the value is monitored, when the device is in maintenance mode. However, it does not imply that the rule is valid.
- If **Valid Failure Status** is set to On, the value is monitored when the parameter currently produces a Failure State. However, it does not imply that the rule is valid.
- Enable **Valid Data Global** to only monitor the value, if the availability of data is higher than 75%. E.g. for an average over 60 seconds, there must to be more than 45 samples available.
- You can also define a custom availability limit by enabling **Valid Data Check** and providing a value in **Valid Data Percent**.
- **Triggered when missing** enable this function to trigger the rule, if the parameter is missing.
- Enable **End Hysteresis** to allow the value to rise or fall to a certain level (and not the triggering limit) before the rule is disengaged. Enter a **Exceedance Level** and an **Undercut Level** for disengagement of the rule.

Station Status This rule becomes valid if your device is in Station Status. In this state, all measurement parameters are set to a Failure State.

System Start This rule becomes valid if your device is started.

Time This rule is active at a defined point in time. It can be used as "is-alive"-message for instance. You can define a day and a time, which causes the rule to be triggered every 24h at this time.

Time Interval This rule is active in a specified time interval. It can be used as e.g. "is-alive"-message or for backup automation. You can define a day and a time, which causes the rule to be triggered after the specified time interval.

USV Battery This rule is active when the device is powered by the USV Battery (optional). Since this battery can only be operated for a very limited amount of time, you can trigger a message to the service personal with this rule.

7.7.1.4. Defaults

This section allows you to specify the default values for some actions. Since the actions are likely to share most of the settings, well prepared default configurations might help to create new actions. This for instance is a configuration to send a mail from the device's own webserver:

```
url: localhost
url port: 25
```

The login name and password fields can be left blank. The wait time for response is an internal parameter in case an error occurs. Just as the remaining settings, it does not need be changed.

7.7.2. System Info

Here you will find detailed information about the airpointer®.The module System Info includes:

- General
- Service Interface
- Status History
- Log Files

7.7.2.1. General

Title

The title of this interface is commonly presented as: 'serial number' @ 'hostname'. For example: '2007-00185' @ 'airponter-2007-00185'

OS, Distribution and Kernel:

Here you will find the 'Operating System', the 'Distribution' and the 'Kernel' number.

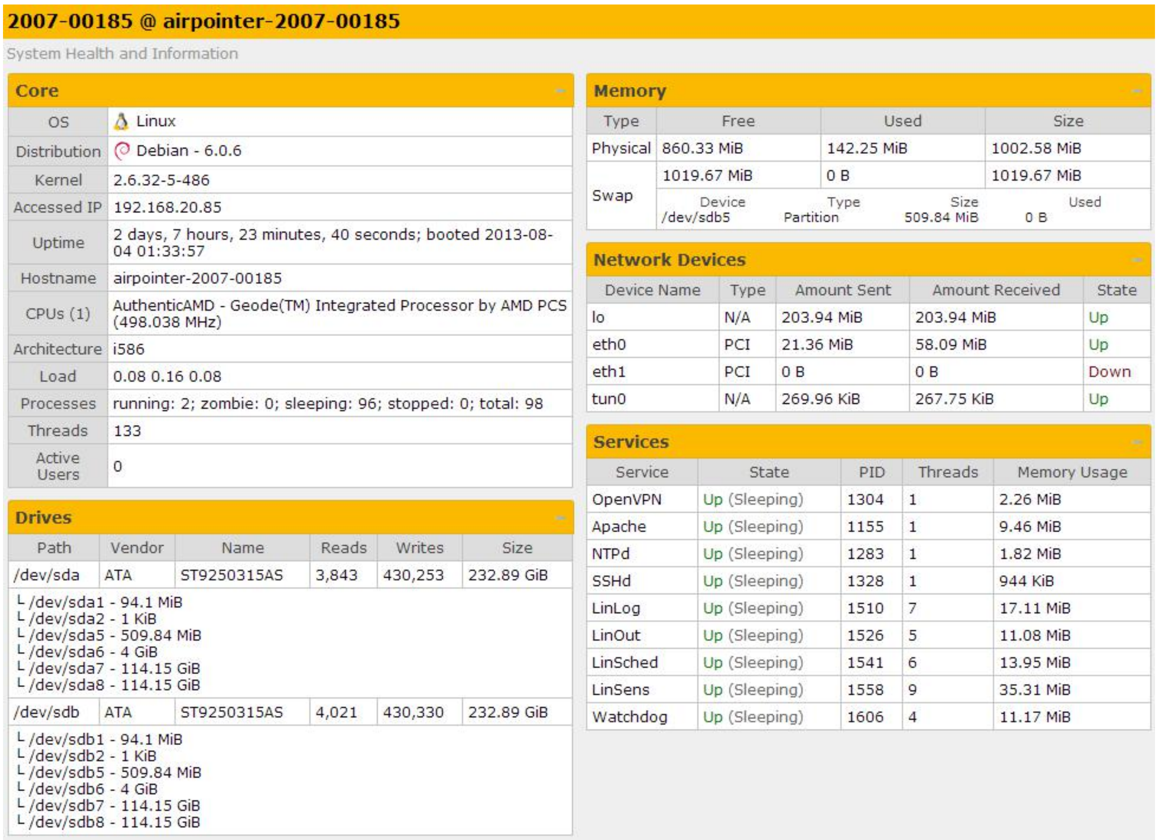


Figure 7.21.: Viewing General Settings

Accessed IP::

This is the IP-adress, trough which you currently accessed the airpointer® .

Uptime:

Time passed since the system's last restart.

Hostname:

This is the URL, where the airpointer® is accessable by a web browser.

CPUs:

This is the number of active processors in your system.

Architecture:

The architecture of the CPU. (f.e. i586 is 32bit)

Processes:

Here you can see the processes running on your system. They are divided into running, zombie, sleeping, stopped and total.

Threads:

Number of threads currently active.

Active Users:

This number does not relate to the number of logged on users to the User Interface but refers to intra-system processes.

Drives:

Here the harddrives are listed aswell as their total size and their partitions.

Memory:

The values display the utilization of the airpointer® 's (see Figure 7.21) memory.

Network Devices:

Different devices are listed here, depending on your access to the airpointer® and the optionally installed communication modules. 'Amount Sent' and 'Amount Recived' show the complete data transmitted so far for each respective device. 'eth0' is the system interface, 'eth1' the user interface of the airpointer®. 'tun0' refers to the OpenVPN tunnel and'ppp0' to the GPRS modem (as an option).

Services:

Here different services are listed, depending on which are installed and on your access to airpointer® . Furthermore you can see their current state and their memory usage.

Filesystem Mounts

Device	Mount Point	Filesystem	Size	Used	Free	Percent Used
/dev/md1	/	ext4	3.93 GiB	1.02 GiB (26%)	2.91 GiB (74%)	26%
/dev/md3	/backup	ext4	112.35 GiB	5.89 GiB (5%)	106.46 GiB (95%)	5%
/dev/md0	/boot	ext3	91.11 MiB	23.78 MiB (26%)	67.33 MiB (74%)	26%
/dev/md2	/var	ext4	112.35 GiB	6.71 GiB (6%)	105.64 GiB (94%)	6%
Totals:			228.73 GiB	13.65 GiB	215.08 GiB	6%

RAID Arrays

Name	Level	Status	Size	Devices	Active
/dev/md3	1 (Mirror)	Active	114.15 GiB	Device / State /dev/sdb8 Normal /dev/sda8 Normal	2/2
/dev/md2	1 (Mirror)	Active	114.15 GiB	Device / State /dev/sdb7 Normal /dev/sda7 Normal	2/2
/dev/md1	1 (Mirror)	Active	4 GiB	Device / State /dev/sda6 Normal /dev/sdb6 Normal	2/2
/dev/md0	1 (Mirror)	Active	94.09 MiB	Device / State /dev/sda1 Normal /dev/sdb1 Normal	2/2

Recordum Patches - Version: 2.0.10a

Name	Version	Date
recordum-update-2.0.10.a	2013.08.09.12.00	2013-08-09, 12:43:04
recordum-linout-1.0.0	2013.08.08.11.25	2013-08-09, 12:38:37
recordum-update-2.0.10	2013.08.09.13.30	2013-08-09, 12:38:21
recordum-update-2.0.10	2013.08.07.17.05	2013-08-08, 08:39:18
recordum-linsched-1.0.0	2013.08.07.10.45	2013-08-07, 09:49:26
recordum-update-2.0.10	2013.08.07.10.40	2013-08-07, 09:49:24
recordum-update-2.0.10	2013.08.07.10.30	2013-08-07, 09:35:48
recordum-linsens-2.0.0	2013.08.01.15.10	2013-08-07, 08:14:52
recordum-linsched-1.0.0	2013.08.07.09.00	2013-08-07, 08:14:42
recordum-patches-2.0.0	2013.08.07.09.00	2013-08-07, 08:14:41
recordum-update-2.0.10	2013.08.06.16.10	2013-08-07, 08:14:38
recordum-update-2.0.9.a	2013.07.23.11.45	2013-08-07, 08:14:37
recordum-update-2.0.9.a	2013.07.19.11.10	2013-07-22, 15:40:08
recordum-update-2.0.9	2013.07.18.15.50	2013-07-22, 15:39:30
recordum-maintenance-1.0.0	2013.07.15.10.30	2013-07-16, 09:39:53
recordum-update-2.0.9.a	2013.07.16.10.15	2013-07-16, 09:39:49
recordum-actions-1.0.0	2013.07.15.17.20	2013-07-16, 09:39:49
recordum-update-2.0.9	2013.07.16.10.10	2013-07-16, 09:39:12
recordum-watchdog-2.0.0	2013.07.02.11.15	2013-07-05, 12:53:06
recordum-maintenance-1.0.0	2013.07.02.14.20	2013-07-05, 12:53:02
recordum-actions-1.0.0	2013.07.05.13.20	2013-07-05, 12:52:58

Figure 7.22.: Viewing General Settings (continued)

Filesystem Mounts:

Mounted filesystems, mount point, filesystem, size, used and free space are listed here. Furthermore the blue bar shows the used space in percentage. If one partition tends to have over 90% used space, please inform your distributor's service to avoid potential data loss in the future.

RAID Arrays:

Here the RAID arrays, their level, size and state are listed.

airpointer® Patches:

Installed patches of the airpointer® software are listed here including the installation date. In bold figures the actual software version number is written.

7.7.2.2. Service Interface

Figure 7.23.: Invoking the Service Interface

7.7.2.2.1. LinSens Service Interface The LinSens Sensor Service Interface provides current sensors data of the airpointer®. Clicking one of these links will open the LinSens Sensor Service Interface in a new window.

The first line shows the operation mode of the airpointer®. Normal operation in black letters means everything is functioning well. Normal operation in red letters additionally displays the values considered to be faulty.

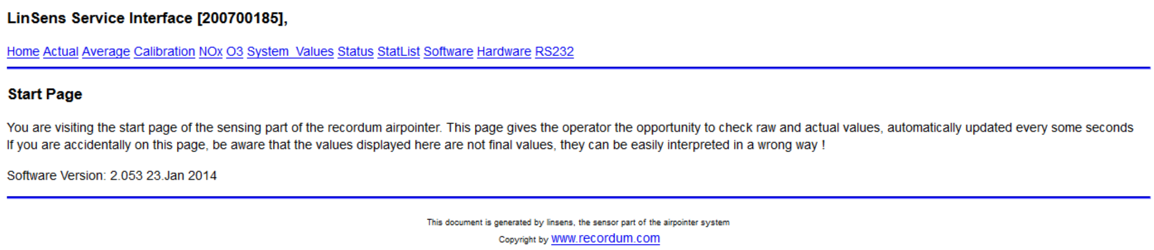


Figure 7.24.: View of the LinSens Service Interface

Home

This is the homepage with reference to the manufacturer.

Actual System Values

This survey shows the current values of all activated sensor modules (see Figure 7.25).

Actual System Values
no calibration active

System SensorInterface Board

RoomTempUp (4/35)	25.1	°C	PressPump (4/1)	316.5	mbar

Pump Control Board

AmbientTemp (4/8)	25.2	°C	DC5V (4/9)	5.17	V
PumpRoomTemp (4/7)	24.6	°C	DC12V (4/10)	12.0	V
FanPumpRoomRPM (4/13)	2700	rpm	DC15V (4/11)	14.9	V
FanSampleRPM (4/14)	3180	rpm	DCneg15V (4/12)	-15.1	V
Key 1 (4/43)	0		Key 2 (4/44)	0	

Clima Control Board

RoomTemp (4/18)	24.7	°C	CoolerOutTemp (4/19)	24.6	°C
Coolerpercent (4/20)	0.0	%	HeaterPercent (4/21)	0.0	%
ClimaActMode (4/22)	1	%	-		

Watchdog Board

DC5V_PC (4/26)	5.28	V	DC12V_Wtd (4/27)	11.87	V
Temp_PC (4/31)	25.5	°C	TempChipWatchdog (4/32)	20.9	°C
Countdown (4/28)	1459	sec	Restart in	00h 24min 19sec	
Restarts (4/29)	0		RestartSLT (4/30)	0	
FanUpSpeed (4/37)	3060	rpm			

Figure 7.25.: Actual Values Page

Parameter

The respective measurement signal.

Value

The current measurement value

Unit

and its appropriate unit.

BStatus

Status of operation, 0 = Normal operation

FStatus

Error status, 0 = OK. You will find a list of all possible error status values in the appendix A.2 ‘Software Protocols’, Section ‘German Network Protocol’ in the manual and in table 7.6.

SStatus

System status, 0 = OK

	BStatus (Operation mode)	**FStatus** (Fail Status)	**SStatus** (System Status)
Bit 0 (1)	Maintance	Flow	Timeout (Value too old)
Bit 1 (2)	Zero	Pressure	
Bit 2 (4)	Span	Temperature	
Bit 3 (8)	Origin Bit	Lamp / Source / O3Gen / Flame	
Bit 4 (16)		SensorSignals wrong / BadCal	
Bit 5 (32)		Warmup (WaterSens) / below detection limit / negative / Service required / Sensor Lifetime expired	
Bit 6 (64)		Cali check wrong	
Bit 7 (128)		Sum Fail	

Table 7.6.: Statustable

Average

LinSens Service Interface [200700185], normal Operation

Home Actual Average Calibration NOx O3 System Values Status StatList Software Hardware RS232

Average 1

Number	Parameter	Value	StdDev	Unit	Status: BS-FS-SS	Time	nVal / nShould	ID
G1P1	NO	-0.0	0.01	ppb	0 0 0	20140205 12:02:00	60/60	1
G1P2	NO2	0.5	0.01	ppb	0 0 0	20140205 12:02:00	60/60	2
G1P3	NOx	0.5	0.01	ppb	0 0 0	20140205 12:02:00	60/60	3
G3P1	O3	421.4	0.02	ppb	0 0 0	20140205 12:02:00	60/60	5

Average 2

Number	Parameter	Value	StdDev	Unit	Status: BS-FS-SS	Time	nVal / nShould	ID
G1P1	NO	0.0	0.03	ppb	0 0 0	20140205 12:00:00	300/300	1
G1P2	NO2	0.5	0.02	ppb	0 0 0	20140205 12:00:00	300/300	2
G1P3	NOx	0.6	0.05	ppb	0 0 0	20140205 12:00:00	300/300	3
G3P1	O3	421.5	0.11	ppb	0 0 0	20140205 12:00:00	300/300	5

Average 3

Number	Parameter	Value	StdDev	Unit	Status: BS-FS-SS	Time	nVal / nShould	ID
G1P1	NO	0.0	0.06	ppb	0 0 0	20140205 12:00:00	1800/1800	1
G1P2	NO2	0.6	0.03	ppb	0 0 0	20140205 12:00:00	1800/1800	2
G1P3	NOx	0.6	0.07	ppb	0 0 0	20140205 12:00:00	1800/1800	3
G3P1	O3	421.7	0.35	ppb	0 0 0	20140205 12:00:00	1800/1800	5

This document is generated by linsens, the sensor part of the airpointer system
Copyright by www.recordum.com

20140205 12:02:23

Figure 7.26.: Average Values Page

This page provides a survey of the current averaging for Average 1, Average 2 and Average 3 (see Figure 7.26). After having finished the averaging of the respective value, the value is entered into the database and the display shows the process for the chronologically following next averaging.

Parameter

The respective average value.

Value

The current measurement value

Unit

and its appropriate unit.

BStatus

Status of operation, 0 = Normal operation

FStatus

Error status, 0 = OK, You will find a list of all possible error status values in the appendix A.2 ‘Software Protocols’, Section ‘German Network Protocol’ in the manual and in table 7.6.

SStatus

System status, 0 = OK

n-valid

This is the number of the valid data used so far for the current averaging.

n

This is the total number of valid data used for the current averaging (see Figure 7.28).

Calibration

This page shows an overview of the available instruments for calibration data. (see Figure 7.27).

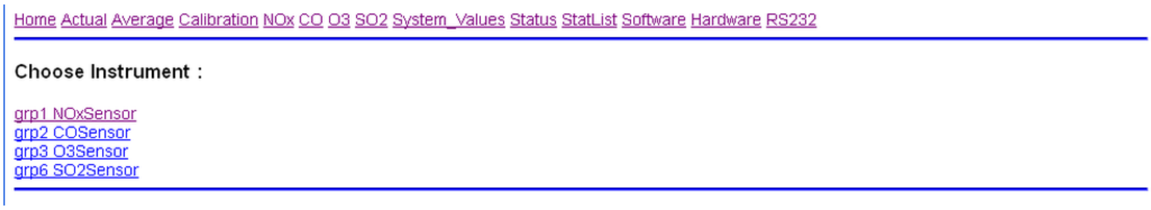


Figure 7.27.: Actual calibration values

NOTE
Values for span will only be shown, if the respective Internal Span module is installed.

NO_x

NO_x

Parameter	Value	Unit	Status: BS-FS-SS	
NO	0.6	ppb	0 0 0	
NO2	0.9	ppb	0 0 0	
NOx	1.5	ppb	0 0 0	

NO_all	0.6	ppb	NO_raw	0.9	ppb	NOStdDev	0.65		NO_Avg (300 sec)	1.2	ppb
NO2_all	0.9	ppb	NO2_raw	-0.7	ppb	NO2StdDev	1.04		NO2_Avg (300 sec)	0.8	ppb
NOx_all	1.5	ppb	NOx_raw	0.2	ppb	NOxStdDev	0.85		NOx_Avg (300 sec)	2.1	ppb

PMTSigNO	50.8	mV	PMTSigNOx	51.2	mV
PMTSigAuto0	60.9	mV			
PressNO	955.6	mbar	RCellPressNO	192.5	mbar
PressNOx	935.4	mbar	RCellPressNOx	193.8	mbar
FlowNOx	556.6	ml/min	FlowO3Gen	73.1	ml/min
Fan_NOx	3480	rpm	HVPS_NOx	630	V
PMTTemp	6.0	°C	PowerToPeltier	46.6	%
MolyT	314.5	°C	PowerToMoly	60.6	%
RCellT	50.0	°C	PowerToRCell	12.8	%
PermT	50.2	°C	PowerToPerm	60.6	%

NO Time Constant nr values to TC:	37	StdDev last 10 samples:	0.75
NO2 Time Constant nr values to TC:	37	StdDev last 10 samples:	1.07
NOx Time Constant nr values to TC:	37	StdDev last 10 samples:	0.96
NO Slope:	1.051	NO Offset:	-8.959
NOx Slope:	1.043	NOx Offset:	-8.702
NO2 CE:	1.000	O3Gen ON	

Figure 7.28.: Actual NO_x Values

This page shows the current data of the sensor module NO_x.

NO, NO2, NOx, Value, Unit, BStatus, FStatus, SStatus

These are the error coded measurement values as they are used for averaging. If there is an error status the value is set to -9999,9.

NO(all), NO2(all), NOx(all), Value, Unit

These are the current measurement values, independent of the respective error status.

NO(raw), NO2(raw), NOx(raw), Value, Unit

These are the raw values of the measurement data without time constants.

PMTSigNO, PMTSigNOx, PMTSigAuto0

Output signals of the Photomultiplier in [mV].

PMTSigAuto0 Avg of 3 Cycles

Average of 3 Cycles of the output signal PMTSigAutoO of the Photomultiplier in [mV]

PressNOx

Input pressure of the sensor in [mbar].

PressNO

Input pressure of the sensor in [mbar].

RCellPressNO

Input pressure in the reaction cell during NO measurement in [mbar].

RCellPressNOx

Input pressure in the reaction cell during NOx measurement in [mbar].

FlowNOx

Input flow of the sensor in [ml/min].

FlowO3Gen

Input flow through the Ozone generator in [ml/min].

PMTTemp, PowerToPeltier

Photomultiplier tube temperature in [°C] aswell in [%].

Fan

Fan speed for PMT in [rpm].

MolyT, PowerToMoly)

Temperature of the Mo-converter in [°C] aswell as percentage of the power supply to the Mo-converter.

HVPS

High voltage for the photomultiplier in [V].

RCellT, PowerToPCell

Temperature of the reaction chamber in [°C] aswell as percentage of the power supply to the reaction chamber.

NO Time Constant Nr Values to TC

Number of values for computing the time constant (5..100).

StdDev last 10

Standard deviation of the last ten measurement values.

NO2 Time Constant Nr Values to TC

Number of values for computing the time constant (5..100).

StdDev last 10

Standard deviation of the last 10 measurement values.

NOx Time Constant Nr Values to TC

Number of values for computing the time constant (5..100).

StdDev last 10

Standard deviation of the last 10 measurement values.

NO avg last 300 sec, Value, Unit

Average NO value of the last 5 minutes.

StdDev last 300 sec

Standard deviation of the last 5 minutes.

NO_2 avg last 300 sec, Value, Unit

Average NO_2 value of the last 5 minutes.

StdDev last 300 sec

Standard deviation of the last 5 minutes.

NO_x avg last 300 sec, Value, Unit

Average NO_x value of the last 5 minutes.

StdDev last 300 sec

Standard deviation of the last 5 minutes.

Slope NO, Offset NO

Calibration values of the last calibration

NO2 CE

CE factor of the last determination

Slope NO_x, Offset NO_x

Calibration values of the last calibration
Following parameters are only shown if a internal zero and/or span calibration takes place:

NO Last Zero, NO2 Last Zero, NOx Last Zero

Shows the results of the last internal zero calibration in ppb.

NO Last Span, NO2 Last Span, NOx Last Span

Shows the results of the last internal span calibration in ppb.

CO

CO

Parameter	Value	Unit	Status: BS-FS-SS	
CO	0.687	ppm	0 0 0	

CO_all	0.687	ppm	CO_raw	0.663	ppm	COStdDev	0.0203		CO_Avg (300 sec)	0.694	ppm	CalRatio (300 sec)	1.21459

COMeas	3276.5	mV	CORatio	1.2147	-
CORef	2740.5	mV			
CO Dark Ref	247.8	mV	CO Dark Measure	247.8	mV
PressCO	955.1	mbar	FlowCO	570.1	ml/min
SampleTempCO	49.5	°C	PDETemp	3.69	V
BenchT	50.0	°C	PowerToCOBench	3.4	%
WheelTCO	70.0	°C	PowerToWheel	31.3	%
COScrubberTemp	70.0	°C	PowerToCOScrubber	25.2	%
CO_cylinder	68.8	bar			

CO Time Constant nr values to TC:	1200	StdDev last 10 samples:	0.001
CO Slope:	0.735	CO Offset:	0.026116

Figure 7.29.: Actual CO Values

This page shows the current data of the sensor module CO (see Figure 7.29).

CO, Value, Unit, BStatus, FStatus, SStatus

This is the error coded measurement value as it is used for averaging.

CO(all), Value, Unit

This is the current measurement value, independent of the respective error status.

CO(raw), Value, Unit

This is the raw value of the measurement data without time constants.

CO Meas, CO Ref

Output signals of the IR detector in [mV].

CO Dark Measure, Co Dark Ref

Output signals of the IR detector in [mV] without light.

CORatio

Ratio of CO Meas to CO Ref.

CO_Speed

Speed of the GFC-Wheel in [rpm].

PDETemp

The temperature of the detection chip in [mV].

PressCO

CO sample chamber pressure in [mbar].

FlowCO

Volumeflow of CO in [ml/min].

BenchTCO

Bench temperature in [°C].

COScrubberTemp

Temperature of the CO Scrubber in [°C].

PowerToCOBench

Power to the heater of the bench in [%].

PowerToCOScrubber

Power to the heater of the scrubber in [%].

CO Time Constant Nr Values to TC

Number of values for computing the time constant (30..1200).

StdDev last 10

Standard deviation of the last 10 measurement values.

CO avg last 300 sec, Value, Unit

Average CO value of the last 5 minutes.

StdDev last 300 sec

Standard deviation of the last 5 minutes.

SlopeCO, OffsetCO

Calibration values of the last calibration.
Following parameters are only shown if a internal zero and/or span calibration takes place:

CO Last Zero

Shows the results of the last internal zero calibration in ppb.

CO Last Span

Shows the results of the last internal span calibration in ppb.

CO cylinder

The pressure in bar of the internal span gas cylinder is given here.

O_3

Parameter	Value	Unit	Status: BS-FS-SS	
O3	0.4	ppb	0 0 0	

O3_all	0.4	ppb	O3_raw	-0.9	ppb	O3StdDev	1.98	ppb	O3_Avg (300 sec)	0.5	ppb

PhotoOutMeas	4208.1	mV	PhotoOutRef	4207.7	mV
LampPower	31.0	%	Setpoint	4000.0 (+/- 250.0)	mV
Stabil	yes		(measurement needs stabil lamp)		
PressO3	954.7	mbar	SampleTempO3	35.3	°C
Flow	561	ml/min			
BenchTO3	58.0	°C	PowerToBenchO3	39.6	%

O3 Time Constant nr values to TC:	3	StdDev last 10 samples:	1.42
O3 Slope:	1.120	O3 Offset:	-2.800

Figure 7.30.: Actual Ozone Values

This page shows the current data of the sensor module O_3 (see Figure 7.30).

O3, Value, Unit, BStatus, FStatus, SStatus

This is the error coded measurement value as it is used for averaging.

O3(all), Value, Unit

This is the current measurement value, independent of the respective error status.

O3(raw), Value, Unit

This is the mean raw value of the measurement data without time constants.

PhotoOutMeas, PhotoOutRef

Output signals of the UV detectors in [mV].

LampPower

Power supply to the UV lamp in [%].

Setpoint

Nominal value of PhotoOutMeas in [mV].

PressO3

O3 sample chamber pressure in [mbar].

SampleTempO3

O3 sample chamber temperature in [°C].

Flow

Volumeflow of O_3 in [ml/min].

BenchTO3, PowerToBenchO3

UV lamp temperature in [°C] and share of power supply in [%]

O3 Time Constant Nr Values to TC

Number of values for computing the time constant (5..100).

StdDev last 10

Standard deviation of the last 10 measurement values.

O3 avg last 300 sec, Value, Unit

Average O_3 value of the last 5 minutes.

StdDev last 300 sec

Standard deviation of the last 5 minutes.

Stabil

Yes, or stable within seconds after readjustment.

SlopeO3, OffsetO3

Calibration values of the last calibration.
Following parameters are only shown if a internal zero and/or span calibration takes place:

O3 Last Zero

Shows the results of the last internal zero calibration in ppb.

O3 Last Span

Shows the results of the last internal span calibration in ppb.

Ozone Generator

Here the parameter for the ozonator of the Internal Span module are shown.

O3IZSCal

At the top of this site the link to the ozonator calibration site is given. For more details go to section in the chapter Internal Span Module

SO_2

Parameter	Value	Unit	Status: BS-FS-SS	
SO2	-0.9	ppb	0 0 0	

SO2_all	-0.9	ppb	SO2_raw	-0.1	ppb	SO2StdDev	0.39		SO2_Avg (300 sec)	-9999.0	ppb

PMTSigSO2	55.2	mV	HVPSSO2	461	V
RefDetSO2	3000.4	mV	Setpoint	3000.0 (+/- 0.0)	mV
PMTSigSO2Dark	46.8	mV	RefDetSO2Dark	86.2	mV
IntensitySO2	48.2	%	LampCurrSO2	32.6	mA
PressSO2	902.0	mbar			
FlowSO2	554.5	ml/min			
FanSO2	3420	rpm			
BenchTSO2	50.0	°C	PowerToBenchSO2	24.5	%
PMTTempSO2	6.2	°C	PowerToPeltierSO2	44.4	%
PermTSO2	50.0	°C	PowerToPerm	58.9	%

SO2 Time Constant nr values to TC:	54	StdDev last 10 samples:	0.10
SO2 Slope:	0.948	SO2 Offset:	10.078

Figure 7.31.: Actual SO_2 Values

This page shows the current data of the sensor module SO2 (see Figure 7.31).

SO2, Value, Unit, BStatus, FStatus, SStatus

This is the error coded measurement value as it is used for averaging.

SO2(all), Value, Unit

This is the current measurement value, independent of the respective error status.

SO2(raw), Value, Unit

This is the raw value of the measurement data without time constants.

PMTSigSO2

Output signal of the Photomultiplier in [mV].

PMTSigSO2Dark

Output signal of the Photomultiplier in [mV] with closed shutter.

RefDetSO2

Reference Detector SO2 in [mV].

RefDetSO2Dark

Reference Detector SO2 in [mV] with closed shutter.

RefDetSO2Setpoint

Nominal value for reference detector SO2 in [mV].

Intensity SO2 , LampCurrSO2

UV lamp power supply in [%].

HVPSSO2

High voltage for the Photomultiplier tube in [V].

PressSO2

SO2 sample chamber pressure in [mbar].

FlowSO2

Volumeflow of SO_2 in [ml/min]

BenchTSO2, PowerToBenchSO2

Temperature of the reaction chamber in [°C], percentage of the power supply to the reaction chamber.

SO2 Time Constant Nr Values to TC

Number of values for computing the time constant (5..100).

StdDev last 10

Standard deviation of the last 10 measurement values.

SO2 avg last 300 sec, Value, Unit

Average SO_2 value of the last 5 minutes.

StdDev last 300 sec

Standard deviation of the last 5 minutes.

SlopeSO2, OffsetSO2

Calibration values of the last calibration.

PreAmpGain

Factor of the preamplifier gain
Following parameters are only shown if an internal zero and/or span calibration is taking place:

SO2 Last Zero

Shows the results of the last internal zero calibration in ppb.

SO2 Last Span

Shows the results of the last internal span calibration in ppb.

System Values (see Figure 7.32)

LinSens Service Interface [200700185], normal Operation

Home Actual Average Calibration NOx O3 System_Values Status StatList Software Hardware RS232

Actual System Values
no calibration active

System SensorInterface Board

RoomTempUp (4/35)	24.8	°C	PressPump (4/1)	317.8	mbar

Pump Control Board

AmbientTemp (4/8)	24.7	°C	DC5V (4/9)	5.17	V
PumpRoomTemp (4/7)	24.2	°C	DC12V (4/10)	11.9	V
FanPumpRoomRPM (4/13)	2640	rpm	DC15V (4/11)	14.8	V
FanSampleRPM (4/14)	3090	rpm	DCneg15V (4/12)	-15.1	V
Key 1 (4/43)	0		Key 2 (4/44)	0	

Clima Control Board

RoomTemp (4/18)	24.6	°C	CoolerOutTemp (4/19)	24.4	°C
Coolerpercent (4/20)	0.0	%	HeaterPercent (4/21)	0.0	%
ClimaActMode (4/22)	1	%	-		

Watchdog Board

DC5V_PC (4/26)	5.28	V	DC12V_Wtd (4/27)	11.85	V
Temp_PC (4/31)	25.6	°C	TempChipWatchdog (4/32)	20.6	°C
Countdown (4/28)	1481	sec	Restart in	00h 24min 41sec	
Restarts (4/29)	0		RestartSLT (4/30)	0	
FanUpSpeed (4/37)	3030	rpm			

This document is generated by linsens, the sensor part of the airpointer system
Copyright by www.recordum.com

20140205 12:05:20

Figure 7.32.: Actual System Values

System SensorInterface Board

RoomTempUp

Temperature at the System SensorInterface Board in [°C].

Press Pump

Pump pressure in [mbar].

Pump Control Board

Ambient Temp

Indicator for ambient temperature in [°C].

Pump Room Temp (%)

(Fan running? 0=No, 100% =Yes) Pump room temperature in [°C].

Fan Pump Room

Fan rotation in pump room in [rpm].

Fan Sampling System

Fan rotation for sampling in [rpm].

DC Supply +5V, +12V, +15V, -15V

Supply voltages in [V].

Switch1, Switch2

Position of switch Maintenance On and switch Maintenance Off.

Clima Control Board

Room Temp

Temperature in analysis room in [°C].

Cooler Out Temp

Exit temperature of the air condition in [°C].

Cooler Power

Air condition running? 0 = No, 100% = Yes.

Heater Power

Heater running? 0 = No, 100% = Yes.

Act Mode

1. Cooling, 2. Heating.

WatchdogOn Board

+5V PC

Supply voltage for the PC in [V].

Temp PC

Temperature of the PC in [°C].

Countdown

Time until next reset of watchdog in [s].

Restarts since power on

Number of restarts since last turn-on procedure.

Restarts since last trigger

Number of restarts since last trigger.

+5V System

Actual voltage value of the system voltage in [V].

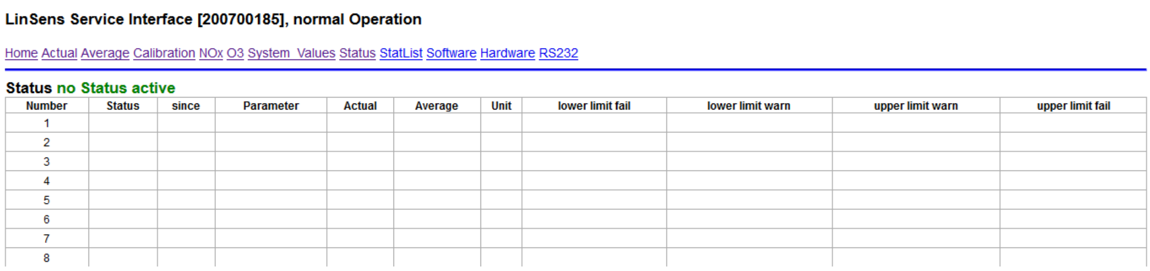
ChipTemp

Temperature of the watchdog in [°C].

Restart in 00:xx:xx

Time until next reset of watchdog in [hh:mm:ss].

Status (see Figure 7.33)



LinSens Service Interface [200700185], normal Operation

Home Actual Average Calibration NOx O3 System_Values Status StatList Software Hardware RS232

Status no Status active

Number	Status	since	Parameter	Actual	Average	Unit	lower limit fail	lower limit warn	upper limit warn	upper limit fail
1										
2										
3										
4										
5										
6										
7										
8										

Figure 7.33.: Status System

This table shows the current error status values, in case there are any at all. If an error occurs, the point in time when it was noted first and its respective parameter, i.e. the value, lower and upper limit, lower and upper error limit are displayed.

StatList

LinSens Service Interface [200700185],

Home Actual Average Calibration NOx O3 System_Values Status StatList Software Hardware RS232

Status List Page (press reload to update)

NOxSensor

G/P	Status	Parameter	Actual	Average	Unit	lower limit fail	lower limit warn	upper limit warn	upper limit fail	Board Adr
G1P1	OK	NO	0.1	0.1	ppb	-	-	-	-	-
G1P2	OK	NO2	0.4	0.4	ppb	-	-	-	-	-
G1P3	OK	NOx	0.5	0.5	ppb	-	-	-	-	-
G1P4	OK	PressNOx	847.1	847.2	mbar	300.0	-	-	1300.0	081
G1P5	OK	RCellT	50.0	50.0	°C	45.0	47.0	55.0	56.0	097
G1P6	OK	MolyT	325.1	324.9	°C	290.0	300.0	335.0	340.0	097
G1P7	OK	PMTTemp	-2.0	-2.0	°C	-8.0	-5.0	3.0	5.0	097
G1P10	OK	PMTSigNO	4247.8	4266.2	Hz	-	-	-	-	081
G1P11	OK	PMTSigNOx	4317.6	4326.0	Hz	-	-	-	-	081
G1P12	OK	PMTSigAuto0	4276.5	4235.7	Hz	5.0	-	-	150000.0	081
G1P13	OK	PowerToRCell	21.4	20.9	%	-	-	-	-	097
G1P14	OK	PowerToMoly	15.0	16.7	%	-	-	-	-	097
G1P15	OK	HVPS_NOx	-675	-675	V	-800	-750	-650	-600	081
G1P16	OK	NO_all	0.1	0.1	ppb	-	-	-	-	-
G1P17	OK	NO2_all	0.4	0.4	ppb	-	-	-	-	-
G1P18	OK	NOx_all	0.5	0.5	ppb	-	-	-	-	-
G1P19	OK	Fan_NOx	0	1214	rpm	100	300	4000	4200	097
G1P20	OK	PressNO	847.5	847.5	mbar	300.0	-	-	1300.0	081
G1P21	OK	NOStdDev	0.28	0.32		-	-	-	-	-
G1P22	OK	NO2StdDev	0.40	0.37		-	-	-	-	-
G1P23	OK	NOxStdDev	0.29	0.29		-	-	-	-	-
G1P24	OK	PowerToPeltier	91.4	91.9	%	-	-	-	-	097
G1P27	OK	RCellPressNO	319.8	318.6	mbar	100.0	-	-	600.0	-
G1P28	OK	RCellPressNOx	318.9	318.2	mbar	100.0	-	-	600.0	-
G1P29	OK	FlowNOx	1031.5	1031.9	ml/min	700.0	800.0	1600.0	1700.0	-
G1P30	OK	FlowO3Gen	95.7	95.6	ml/min	50.0	60.0	150.0	200.0	081
G1P38	OK	NO_raw	0.1	0.4	ppb	-	-	-	-	-

Figure 7.34.: An excerpt from the Status List Page

Status List Page shows the current error status (color coded) and value, unit, lower and upper error limit, lower and upper warning limit of each parameter from the system and the installed modules. If limits were set, OK, warning or fail status are shown. OK is written in green, warning in orange and fail in red.

NOTE
If a warn or fail status is shown, warn (in orange) or fail (in red) is written on the top left of the User Interface. This is a link to the site where the warn or fail parameter is listed.

Software (see Figure 7.35)

Software

Number	Name	Cycle Time avg [msec]	Cycle Time max [msec]	Cycle Time max since start [msec]	max at	last triggered	allowed timeout [sec]
0	Startup	11214	11214	11214	20140202 04:52:13	20140202 04:52:13	-
1	Startup syncsensors	1082	1082	1082	20140202 04:52:13	20140202 04:52:13	-
2	Startup Data, Param, Status Tables	1853	1853	1853	20140202 04:52:12	20140202 04:52:12	-
3	Write Database Thread	2	4	802	20140202 05:00:03	20140205 13:50:26	180
4	HTTP Thread	4	156	383	20140205 13:45:41	20140205 13:50:26	10
5	DataThread	35	36	191	20140204 13:30:00	20140205 13:50:26	30
7	Hardware Interface (If) Thread	37	79	553	20140202 15:45:00	20140205 13:50:26	60
8	Time in Hardware Interface Buffer	40	75	443	20140202 04:53:00	20140205 13:50:26	-
9	HW get all parameters	1463	1965	10610	20140203 08:47:37	20140205 13:50:25	-
10	ControlThread	100	102	374	20140202 15:45:00	20140205 13:50:26	60
11	StatusThread	35	37	105	20140202 12:28:00	20140205 13:50:26	180
12	Error Log Thread	10	15	68	20140202 04:52:32	20140205 13:50:26	60
14	CtrlDataIfThread	0	0	0	-	20140202 04:52:02	-

Internal Communication

RS232 Messages/sec	RS232 Messages/sec average	Boards missing	Entries in Hardware interface buffer	Entries in Write DB buffer	max Entries in Write DB	entries in Write DB Out	max Entries in Write DB Out
32	32	0	1	0	5	0	2

Software Version

Software Version LinSens	2.053	Date	23.Jan 2014
Analytical Module Version	1.001	Date	22.Apr 2008

Figure 7.35.: Software System

RS232 Messages/sec

Number of commands issued to the RS-232 bus. The lower part of the table shows commands issued last to the RS-232 bus.

Hardware (see Figure 7.36)

Hardware

n	Adress	Board	S/N	Software Version	Hardware Rev	Board Status	COM Errors	Confirmation error	active	Answer in [msec]	Last OK	do LR	last RL
1	000	Sensor Interface System			-	0	6	0	Fail	1005	-	-	-
2	001	SensorInterface NOx			-	0	6	0	Fail	1008	-	-	-
3	002	SensorInterface CO			-	0	6	0	Fail	1008	-	-	-
4	003	SensorInterface O3			-	0	6	0	Fail	1008	-	-	-
5	004	SensorInterfaceSO2			-	0	5	0	Fail	1008	-	-	-
6	031	PumpControl			-	0	5	0	Fail	1008	-	-	-
7	033	ValveHeater3 NOx			-	0	5	0	Fail	1008	-	-	-
8	034	ValveHeater3 CO			-	0	5	0	Fail	1008	-	-	-
9	035	ValveHeater3 O3			-	0	5	0	Fail	1008	-	-	-
10	036	ValveHeater3 SO2			-	0	5	0	Fail	1008	-	-	-

Internal Communication

RS232 Messages/sec	RS232 Messages/sec average	Boards missing	Entries in Hardware interface buffer	Entries in Write DB buffer
1	-9999	10	0	0

Software Version

Software Version LinSens	2.053	Date	23.Jan 2014
Analytical Module Version	1.001	Date	22.Apr 2008

Figure 7.36.: Hardware

Board, S/N, Software Version, COM Errors, Active

All boards installed in the airpointer® with their respective serial number, software version and current number of communication errors are listed here. Furthermore, whether the respective board is active or not.

Software Version LinSens

Version and date of the installed LinSens Software.

Modem Power

Supply for optional module GPRS Modem On / Off.

System time

Actual time of the airpointer®.

7.7.2.2.2. LinLog Service Interface :

LinLog Service Interface (see Figure 7.37) provides current data of airpointer®'s logger. Clicking the link displays the LinLog Service Interface in a new window. You can also reach the site, if you write

```
your airpointer's IP-address/linlog
```

into your browser's address bar.

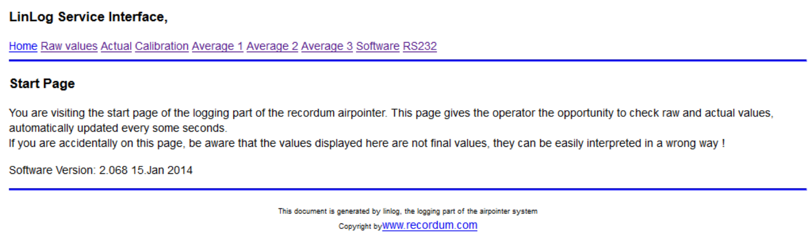


Figure 7.37.: View of the LinLog Service Interface

Home

This is the homepage with reference to the manufacturer.

Raw Values

Read in current values, arranged in groups.

Actual Values

Computed current values, arranged in groups.

Calibration

Choose group of calibration values

Average 1

Averaging of the computed current values for average 1, arranged in groups.

Average 2

Averaging of the computed current values for average 2, arranged in groups.

Average 3

Averaging of the computed current values for average 3, arranged in groups.

Software

Software

Number	Name	Cycle Time avg [msec]	Cycle Time max [msec]	Cycle Time max since start [msec]	max at	last triggered	allowed timeout [sec]
0	Startup	172	8617	8617	20140202 04:52:10	20140202 04:52:10	-
2	Error Log Thread	10	13	264	20140202 04:52:04	20140205 13:52:48	60
3	Write Database Thread	2	6	1122	20140202 05:00:04	20140205 13:52:48	180
4	HTTP Thread	3	20	28	20140205 12:27:52	20140205 13:52:47	10
5	DataThread	2	5	260	20140204 12:30:00	20140205 13:52:48	30
25	recordum modbus first src: 4	9	13	521	20140205 09:21:25	20140205 13:52:48	120
55	RSThread COM4 (55)	2980	4001	4019	20140205 02:44:05	20140205 13:52:45	60

Internal Communication

Entries in Write DB buffer	max Entries in Write DB	entries in Write DB Out	max Entries in Write DB Out
0	15	0	4

Software Version

Software Version LinLog	2.068	Date	15.Jan 2014

Figure 7.38.: Software Parameters

This page shows you some software parameters like software version number. The other parameters are for software developers.

RS232

Here you can check the communication via the COM ports. First, select a COM port (see Figure 7.39) to get an overview of the last communications via this port (see Figure 7.40). You can check if the communication timing (see page 7-128) is set correctly.

Home Raw values Actual Calibration Average 1 Average 2 Average 3 Software RS232

Choose COM Port :

COM4: 5030 Sharp.
(COM1 is first RS232 port)

This document is generated by linlog, the logging part of the airpointer system
Copyright by www.recordum.com

Figure 7.39.: Choose a COM port

RS232 Test Page COM4

12:28:35 OUT: #<127>
12:28:37 IN :
12:28:37 INFO: no answer (cnt 0/0)
12:28:37 OUT: JI<127>
12:28:39 IN :
12:28:39 INFO: no answer (cnt 1/1)
12:28:41 IN :
12:28:43 IN :
12:28:44 OUT: #<127>
12:28:46 IN :
12:28:46 INFO: no answer (cnt 2/2)
12:28:46 OUT: JI<127>
12:28:48 IN :
12:28:48 INFO: no answer (cnt 3/3)
12:28:50 IN :
12:28:52 IN :
12:28:53 OUT: #<127>
12:28:55 IN :
12:28:55 INFO: no answer (cnt 4/4)
12:28:55 OUT: JB<127>

Figure 7.40.: Communication

7.7.2.3. Status History

With this feature you can list failures and warnings at a chosen time period. This are the same failures and warnings as shown up to date in the LinSens Service Interface. When you have selected the period then click 'Show'.

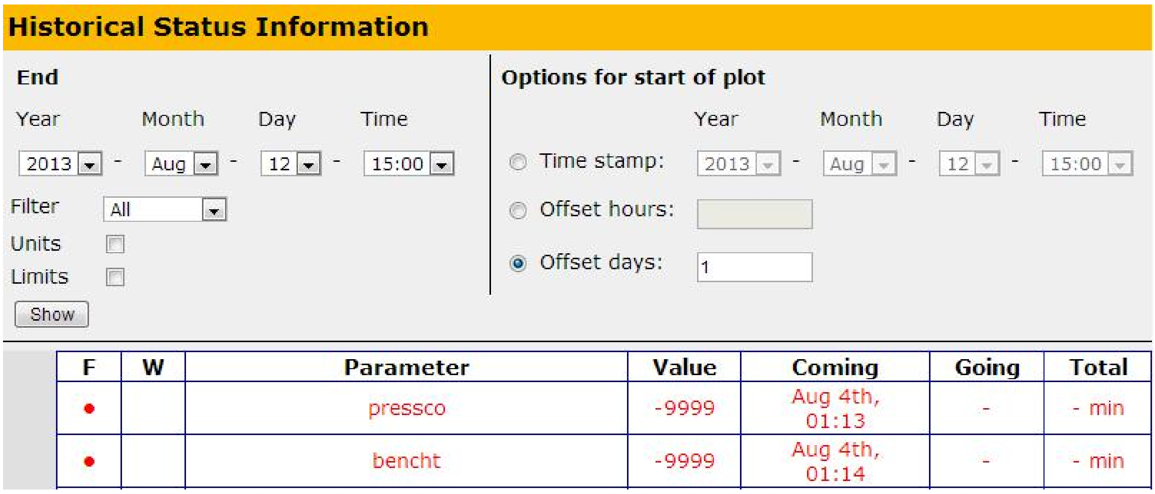


Figure 7.41.: Status History

End: For 'End', please select date and hour for finishing your selected time sequence.

Filter: Choose fails and warnings or just one of them.

Units: Optionally the units of parameters are shown.

Limits: Optionally the limits of parameters are listed.

Options for start of plot ‘Options for start of plot’ provides you with various features by setting the radio button in the particular line (see Figure 7.41):

Time stamp: Here you can enter an absolute date and hour (see ‘End’).

Offset hours: Entries here will be related to the date and hour of ‘End’, thus computing the start of the time sequence for your measurement data selection.

Offset days: Entries here will be related to the date and hour of ‘End’, thus computing the start of the time sequence for your measurement data selection.

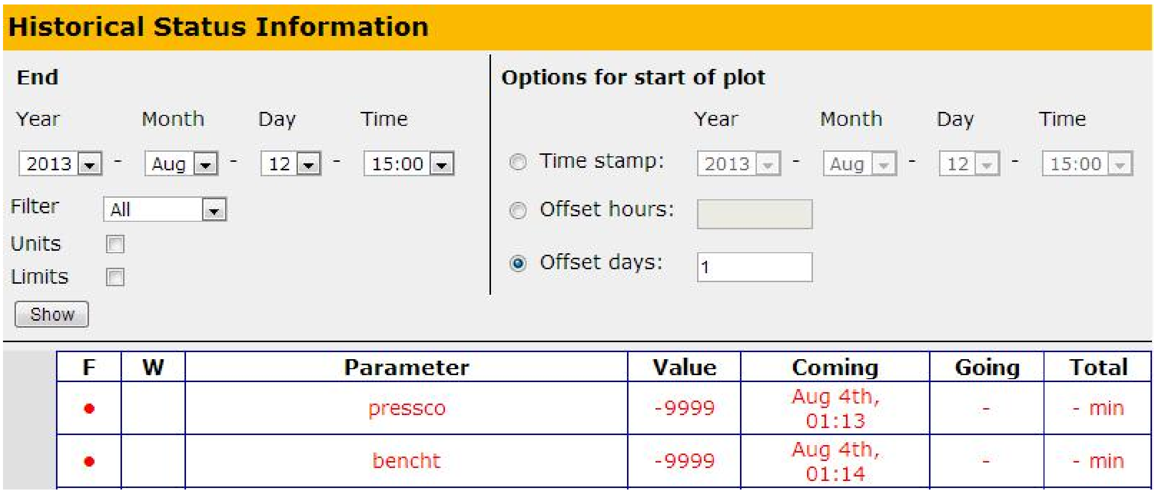


Figure 7.42.: Status History

F/W

F indicates a fail (red) and W indicates a warning (black).

Parameter/ Value

The name of the affected parameter is listed. In the following columns the value belonging to it and if chosen the unit is shown.

Coming/Going/Total

These columns show start and end date of the fails or warnings. The third column displays calculated duration of the period.

7.7.2.4. Log Files

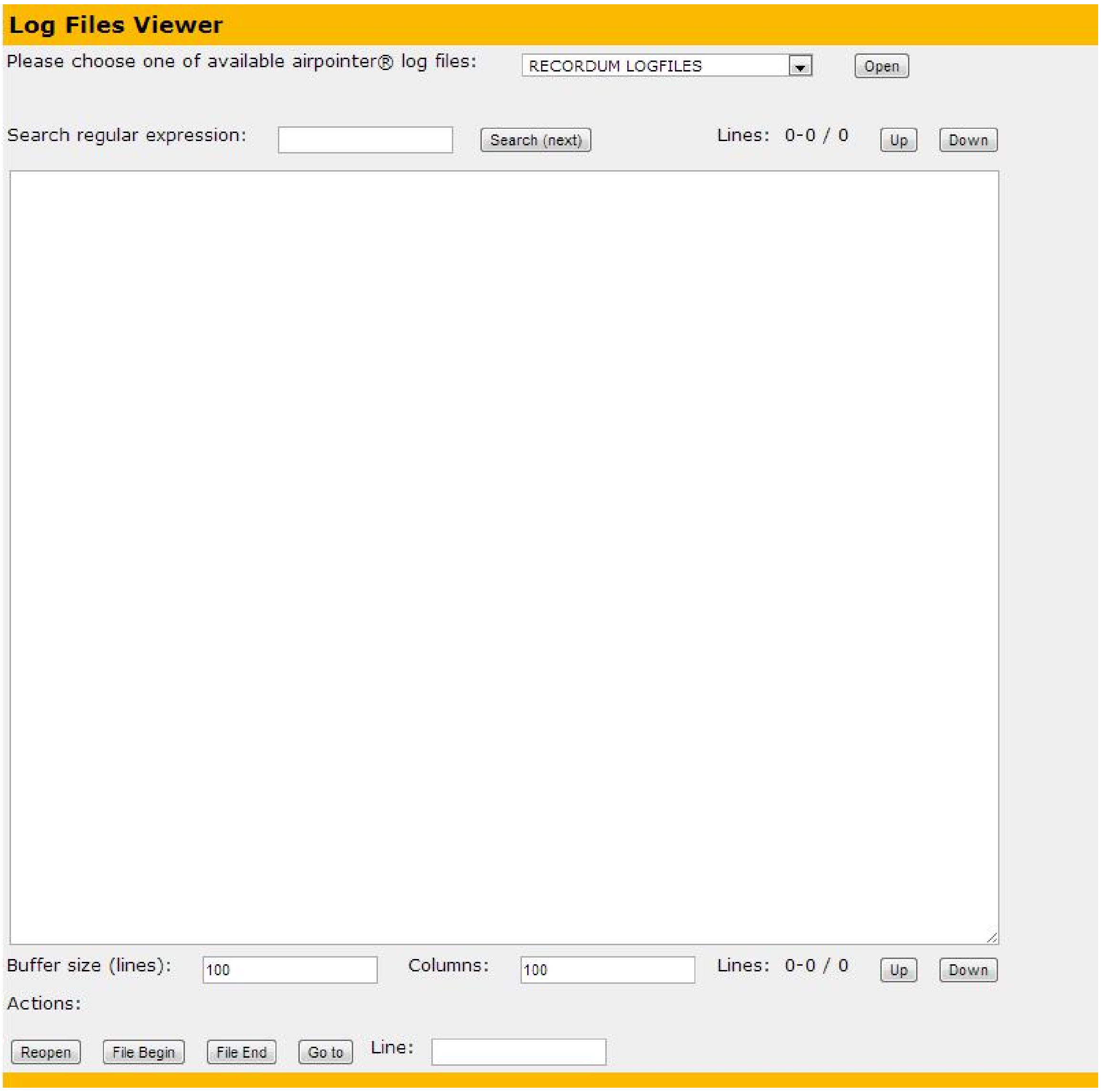


Figure 7.43.: The Log Files Viewer

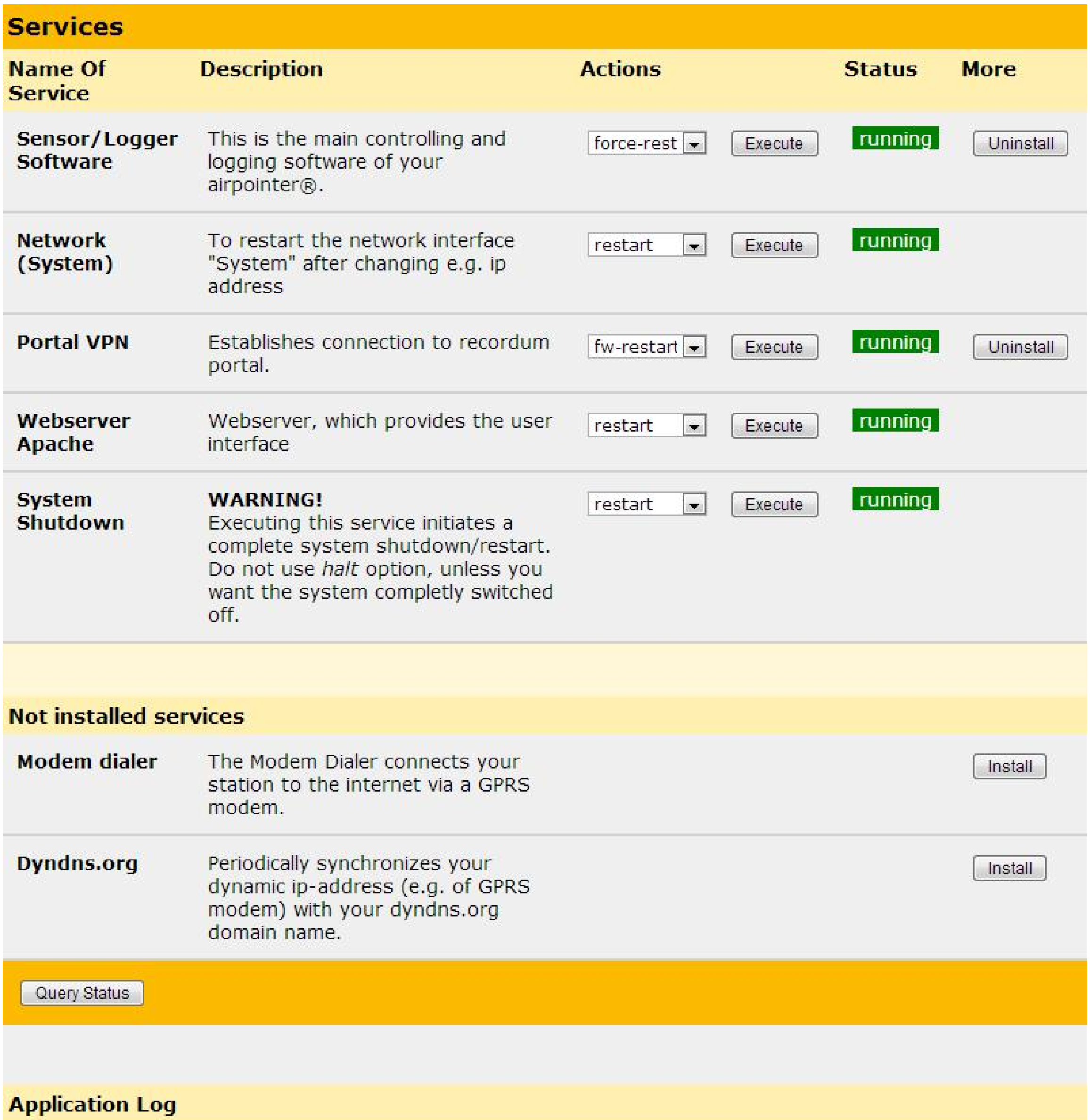
Here you can view the log files of the airpointer® (see Figure 7.43). Using the scroll box, you can select your data, clicking ‘Open’ displays this file in the window below. Using the buttons ‘Up’, ‘Down’, ‘File Begin’, ‘File End’ and ‘Go To Line’, where you can enter the respective line number, you can navigate within this file.

7.7.3. System Maintenance

The module System Maintenance includes:

- Service Manager
- Command Interface
- Software
- Backup

7.7.3.1. Service Manager



Services

Name Of Service	Description	Actions		Status	More
Sensor/Logger Software	This is the main controlling and logging software of your airpointer®.	force-rest	Execute	running	Uninstall
Network (System)	To restart the network interface "System" after changing e.g. ip address	restart	Execute	running	
Portal VPN	Establishes connection to recordum portal.	fw-restart	Execute	running	Uninstall
Webserver Apache	Webserver, which provides the user interface	restart	Execute	running	
System Shutdown	**WARNING!** Executing this service initiates a complete system shutdown/restart. Do not use *halt* option, unless you want the system completly switched off.	restart	Execute	running	

Not installed services

Modem dialer	The Modem Dialer connects your station to the internet via a GPRS modem.	Install
Dyndns.org	Periodically synchronizes your dynamic ip-address (e.g. of GPRS modem) with your dyndns.org domain name.	Install

Query Status

Application Log

Figure 7.44.: Service maintenance

In the Service Manager software available for the airpointer® is listed. The current status of the programs is shown. Here you can stop, start, restart, install or uninstall software. Additionally you can shut down the system in this module.

CAUTION:

We strongly suggest not to remove or change any installed service. This section is meant to be used for troubleshooting. If you have reason to believe that one of these services is causing a faulty behaviour, ask your distributor for assistance.

CAUTION:

If you uninstall 'Sensor/Logger Software' no data are stored any more!

To save resources single programs can be stopped. Per default, these will start automatically when the airpointer® is restarted. If you want to stop a program permanently, you have to uninstall it. Uninstalled programs are listed separately. You can install a program with the corresponding button next to the uninstalled item.

7.7.3.2. Command Interface

NOTE
This item should only be used in case of troubleshooting during service.

If you have at least administrator rights on the airpointer® this item will be available. Figure 7.45 shows this corresponding window.

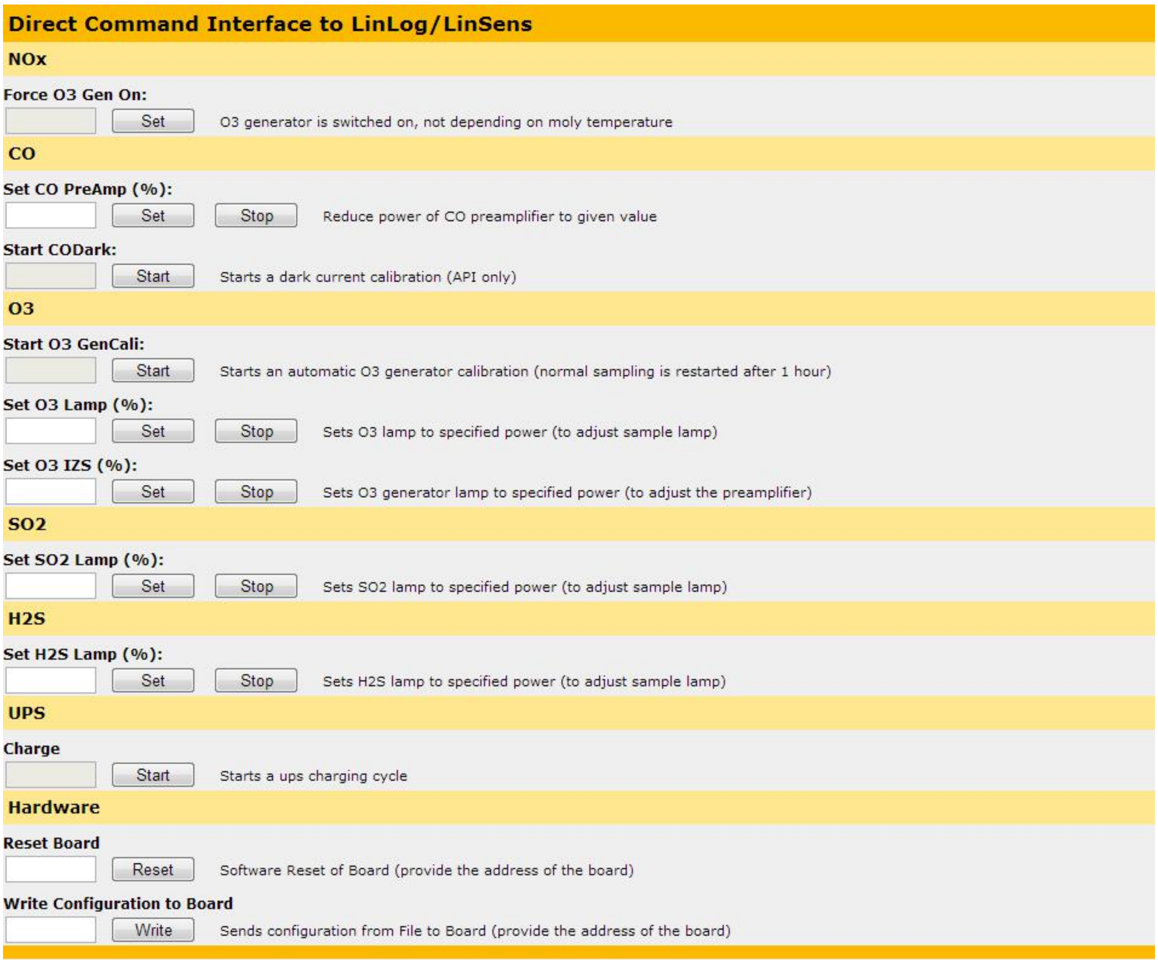


Figure 7.45.: Direct Command Interface of LinLog/LinSens

NOx

Force O3 Gen On

With this feature the ozone generator can be switched on even though the temperature of the ozone destroyer is too low.

CAUTION:

The exhaust gas may contain ozone!

CO

Set CO PreAmp (%)

Set the preamplifier of the CO module to a fixed value. This is used to adjust the potentiometer of the CO control board in the factory.

O3

Start O3 GenCali

Here you can start the measurement of the interpolation curve of the UV lamp of the Internal Span module of the ozone module. **Set O3 Lamp (%)**

Here you can choose a fixed value for the lamp voltage. Then there is no control cycle. This feature is used for adjustment of the UV lamp in the factory.

Set O3 IZS (%)

If this value is set, the ozone generator operates with a fixed voltage. This feature is used to adjust the preamplifier of the UV lamp in the factory.

SO2

Set SO2 Lamp (%)

Here you can choose a fixed value for the lamp voltage. Then there is no control cycle. This feature is used for adjustment of the UV lamp in the factory.

H2S

Set H2S Lamp (%)

Here you can choose a fixed value for the lamp voltage. Then there is no control cycle. This feature is used for adjustment of the UV lamp in the factory.

UPS

Charge

This feature meant to be a testing possibility for the airpointer® 's electronic system.

Hardware

Reset Board and Write Configuartion to Board (%)

With ‘Reset Board’ you can reset the software of the hadware board. By using ‘Write Configuration to Board’ you can write a new or individual for you designed config file to a hardware board.

7.7.3.3. Software Update

Software Updates can be downloaded quite easily. First hit ‘Scan’ to update the list for your instrument (see figure 7.46). Next hit ‘Download’ to effectivly download the newest updates. To finally install the updates press ‘Update’. If you hav any errors while updating hit ‘Fix’. ‘Test’ only shows you what updates could be downloaded and has no real relevance in everyday updating.

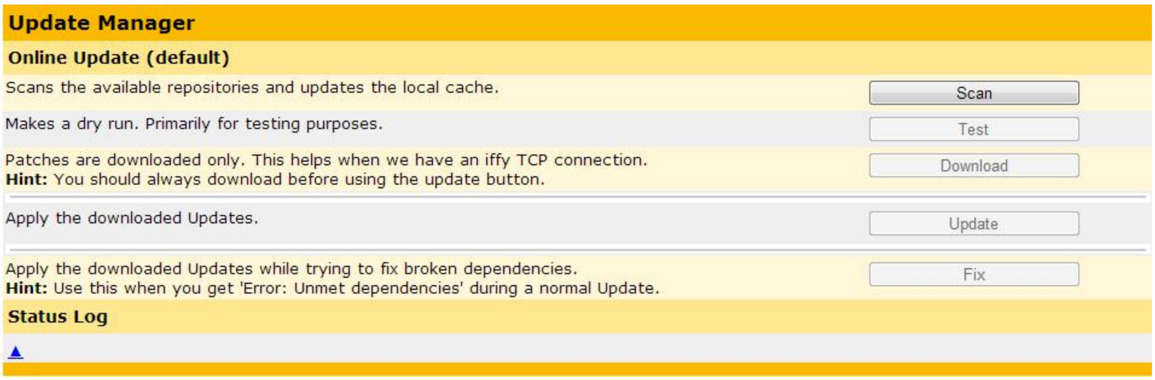


Figure 7.46.: Automatic Software Update

7.7.3.4. Backup

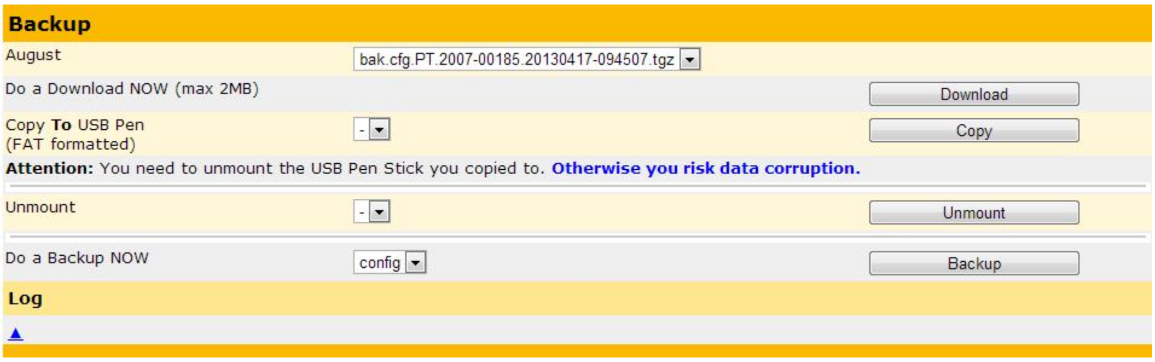


Figure 7.47.: Backup Configuration

This menu item provides you with backup copies of the airpointer® configuration (see Figure 7.47). Always execute this step after major changes in the system itself, e.g. new settings in the menu item 'Setup' ↠ 'Communication'.
Clicking 'Backup' will start the backup of the airpointer®'s system files automatically in the background. Once backuped you can either 'Download' the backup file to your harddisk or transfer it directly to an extern devie by clicking 'Copy'.

NOTE
You always have to unmount the device you copied the backup to. Otherwise you risk data corruption.

For any reconstruction of a former configuration of the system based on these backups, please contact your distributor.

7.7.4. Extras

7.7.4.1. Campaigns

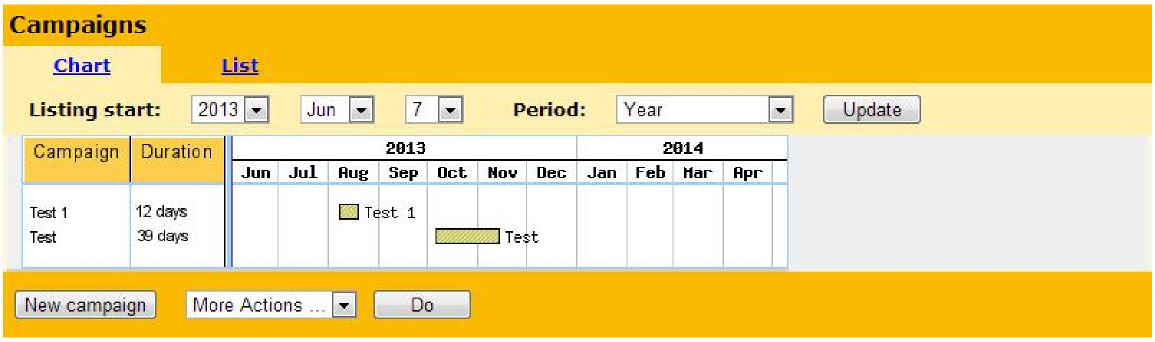


Figure 7.48.: Campaign Chart

With ‘Campaigns’ you can get a clear visualization of your collected data in a specific time frame. Think about positioning the device for a month in spot A and then moving it to spot B. Figure 7.48 shows you the chart representation of the two time frames (campaigns). The colored bars show the two campaigns where data was collected.

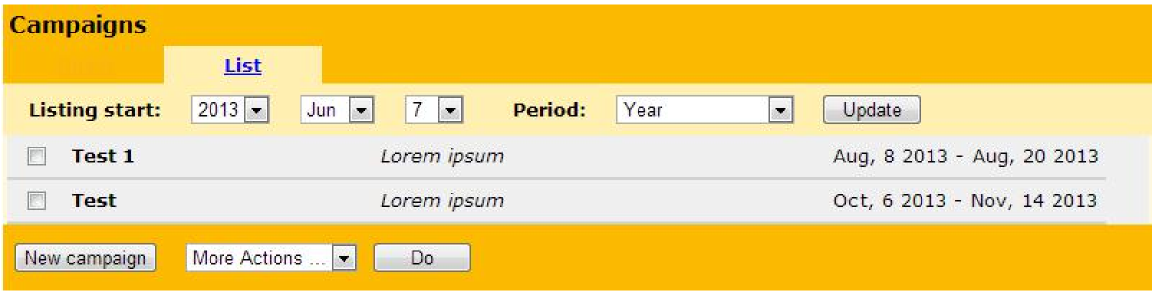


Figure 7.49.: Campaign List

7.7.5. Configuration

CAUTION:

Any change in the configuration influences the measurement. In doubt please ask your distributor.

NOTE

If you want to change the configuration parameters you have to have administrator rights at the airpointer® .

7.7.5.1. Calibration Parameters

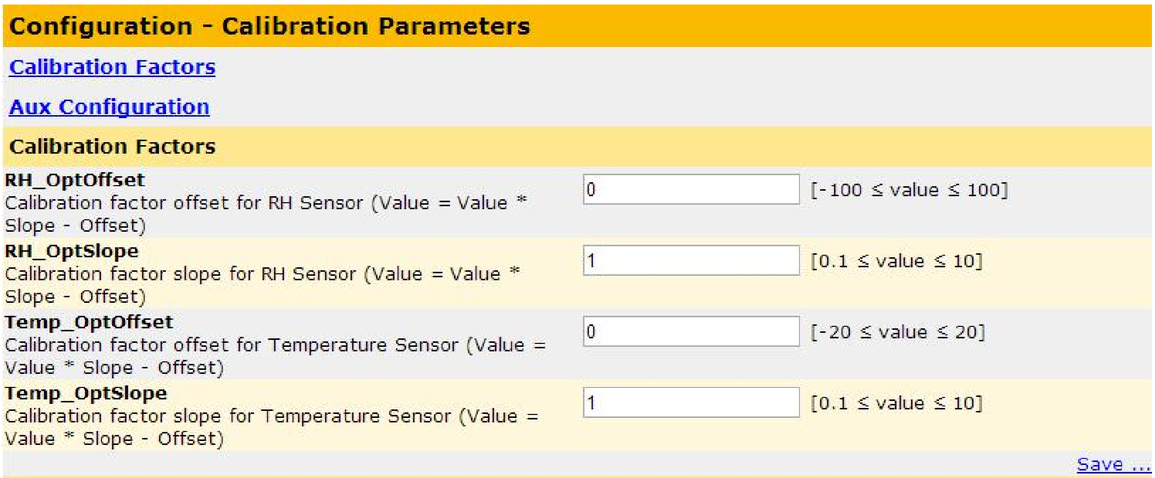


Figure 7.50.: Overview of the calibrations factors

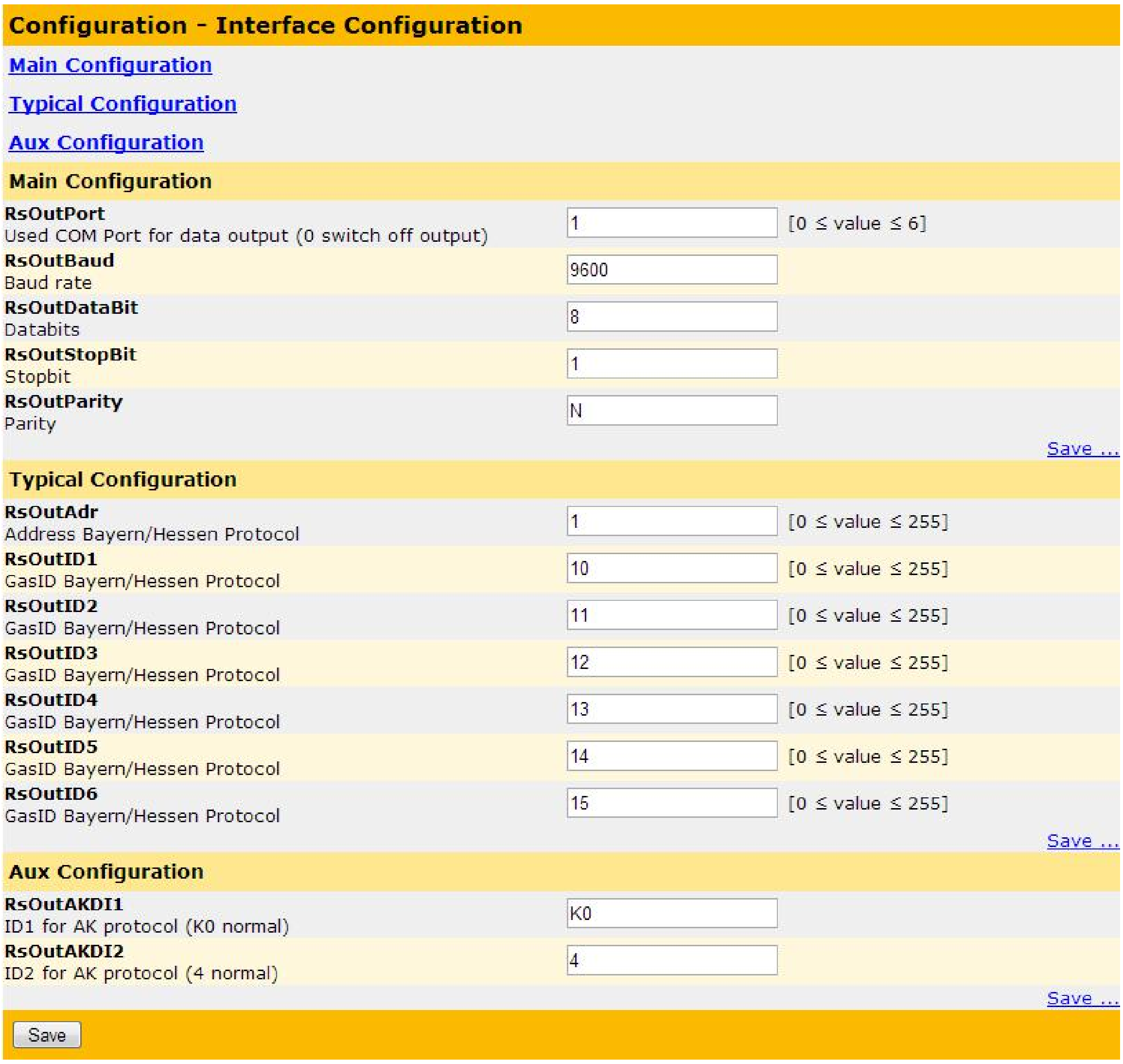
With 'RH_OptOffset' and 'RH_OptSlope' you can calibrate the "Realative Humidity sensor" with 'Temp_OptOffset' and 'Temp_Optslope' the "Temperature sensor". Both these sensors are optional. (OptionTemp/RHsensor $801-090001$)

Figure 7.51.: Overview of the Aux Configuration

If ones system has installed the Unibase-board, it is possible to recalibrate the different Analog_Ins by changing the ‘Offset’ and ‘Slope’ values.

7.7.5.2. Interface Configuration

Here you can change the default values for the network protocols AK Protocol und German Ambient Network Protocol. In picture 7.52 the parameters are listed and desribed. Further details are to be found in chapter 'Software Protocols'. A



Configuration - Interface Configuration

Main Configuration

Typical Configuration

Aux Configuration

Main Configuration		
RsOutPort Used COM Port for data output (0 switch off output)	1	[0 ≤ value ≤ 6]
RsOutBaud Baud rate	9600	
RsOutDataBit Databits	8	
RsOutStopBit Stopbit	1	
RsOutParity Parity	N	
		Save ...

Typical Configuration		
RsOutAdr Address Bayern/Hessen Protocol	1	[0 ≤ value ≤ 255]
RsOutID1 GasID Bayern/Hessen Protocol	10	[0 ≤ value ≤ 255]
RsOutID2 GasID Bayern/Hessen Protocol	11	[0 ≤ value ≤ 255]
RsOutID3 GasID Bayern/Hessen Protocol	12	[0 ≤ value ≤ 255]
RsOutID4 GasID Bayern/Hessen Protocol	13	[0 ≤ value ≤ 255]
RsOutID5 GasID Bayern/Hessen Protocol	14	[0 ≤ value ≤ 255]
RsOutID6 GasID Bayern/Hessen Protocol	15	[0 ≤ value ≤ 255]
		Save ...

Aux Configuration		
RsOutAKDI1 ID1 for AK protocol (K0 normal)	K0	
RsOutAKDI2 ID2 for AK protocol (4 normal)	4	
		Save ...

Save

Figure 7.52.: Overview of Interface Configuration

7.7.5.3. System Parameters

Here you can change the system parameters manually. In picture the parameters are listed and described. Here you can manually set the poll intervall, the length of the average values and times of e.g. the calibration.

Main configuration:

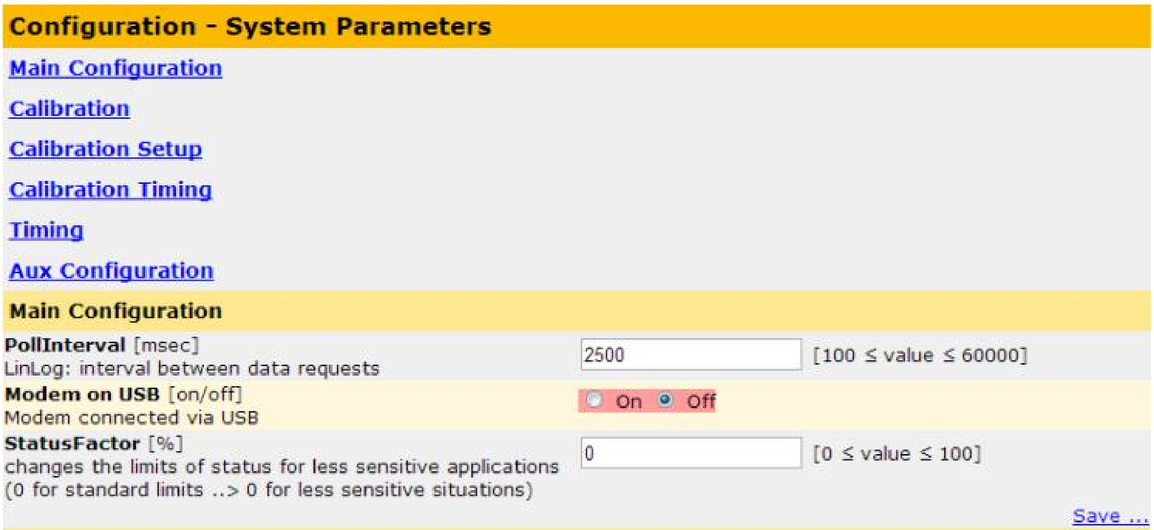


Figure 7.53.: Configuration of the System Parameters: Main Configuration

PollInterval

Here you can set the intervall between data request in the linlog.

Modem on USB

If you have connected a modem via USB you have to set this to ‘On’. Otherwise ther might be troubles recognizing your modem.

StatusFactor

This option lets you rise up the treshold value for status signals.

Calibration settings:

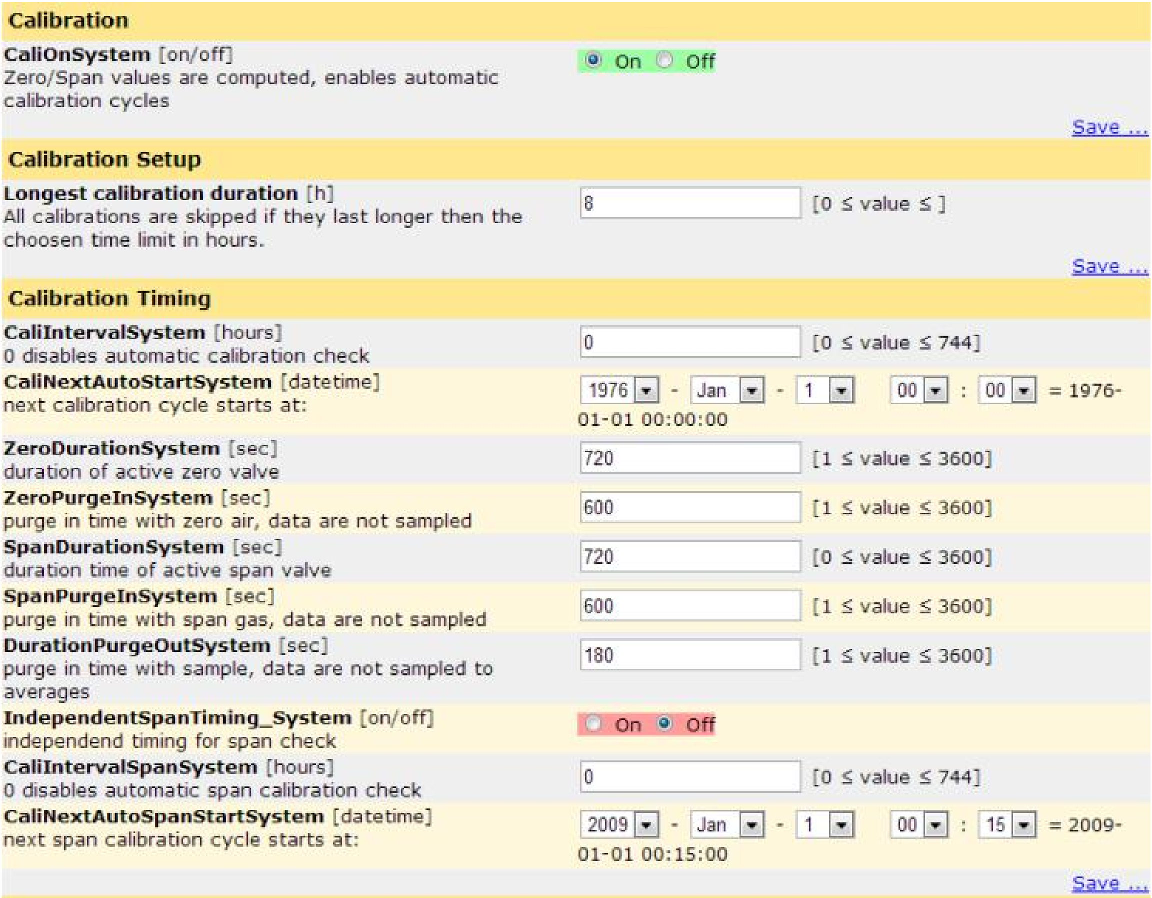


Figure 7.54.: Configuration of the System Parameters: Calibration settings

The calibration setup and timing for the whole system is set here. If these values are set they overrule the settings of the single modules. If there is no Internal Span Module installed the setup for span is ignored.

Averages, air condition and additional Settings:

Timing		
AverageTime1 Length of time in seconds to calculate timeaverage values, which are stored in the database (average value 1 < average value 2 < average value 3)	60	[60 ≤ value ≤ 3600]
AverageTime2 Length of time in seconds to calculate timeaverage values, which are stored in the database (average value 1 < average value 2 < average value 3)	300	[60 ≤ value ≤ 3600]
AverageTime3 Length of time in seconds to calculate timeaverage values, which are stored in the database (average value 1 < average value 2 < average value 3)	1800	[180 ≤ value ≤ 3600]
AC_Purge_Interval [min] Purge interval for airconditioner (fan off to let water drain out)	9999	
AC_Purge_Duration [sec] Duration for airconditioner purge	0	
UPS_wait4power [sec] timeframe which the instrument will wait until power is back	60	[0 ≤ value ≤ 900]
		Save ...

Figure 7.55.: Configuration of the System Parameters: Averages and air condition

Here one can choose the length of time in seconds to calculate timeaverage values, which are stored in the data base. And the purge interval and duration of the air condition.

Aux Configuration		
TooHotPumpTemp [°C] Limit of pump temperature	60	[0 ≤ value ≤ 150]
TooHotRoomTemp [°C] Limit of room temperature	45	[0 ≤ value ≤ 150]
PressCompensation4Flows [on/off] enables pressure compensation for flows	◉ On ○ Off	
DisplayNegHandling [on/off] In the Service Interface, the original values are shown in brackets if the behavior at zero routine has changed the value.	◉ On ○ Off	
Language main language for LinSens/LinLog (en,de)	en	
Min_RL_Interval [minutes] Min time between two RL commands (Soft reset of board) 0 turns off function	60	[0 ≤ value ≤ 1500]
Secure_http [on/off] Access to Service Interface only with login possible	◉ On ○ Off	
		Save ...
Save		

Figure 7.56.: Configuration of the System Parameters: Aux Configuration

Here one can set the maximal pump and room temperature, the handling of negative data and missing data during the automatic calibration check. Also you can set the language, accessibility andother general settings.

7.7.5.4. Sensors

Figure 7.57.: Overview of Interface Configuration

Main Configuration

Here you can activate and deactivate all the sensors installed on your systems.

7.7.5.5. NO_x sensor

NO_x

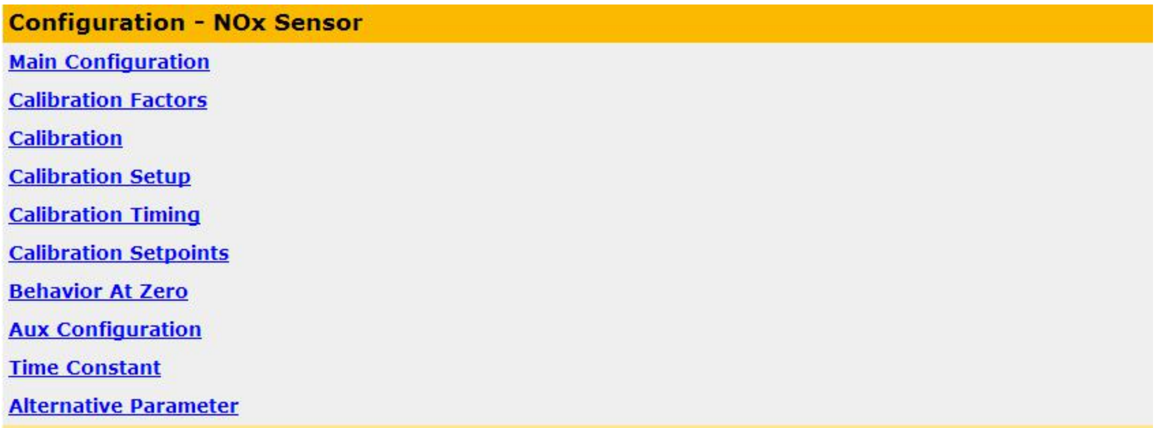


Figure 7.58.: Manual configuration of the NO_x module: menu

In this menu the settings for the NO_x module are accessible as shown in Figure 7.58. Now each menu item is described:

Main Configuration:

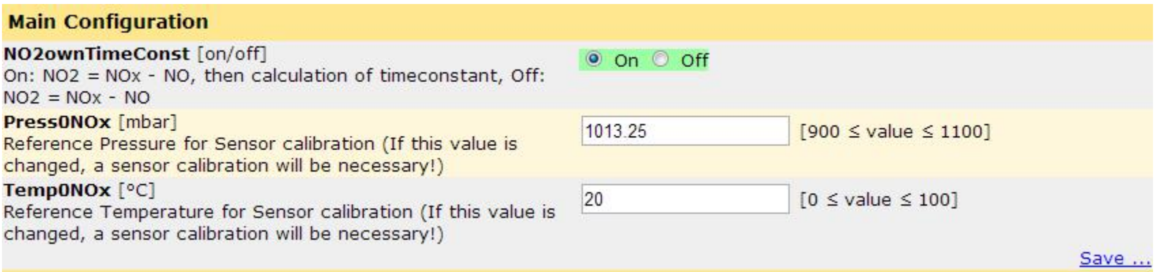


Figure 7.59.: Manual configuration of the NO_x module: Configurations

As shown and described in picture 7.59 you can set the settings for NO2ownTimeConst, Press0NOx and Temp0NOx. If you change any of this values the module has to be calibrated.

Calibration factors:

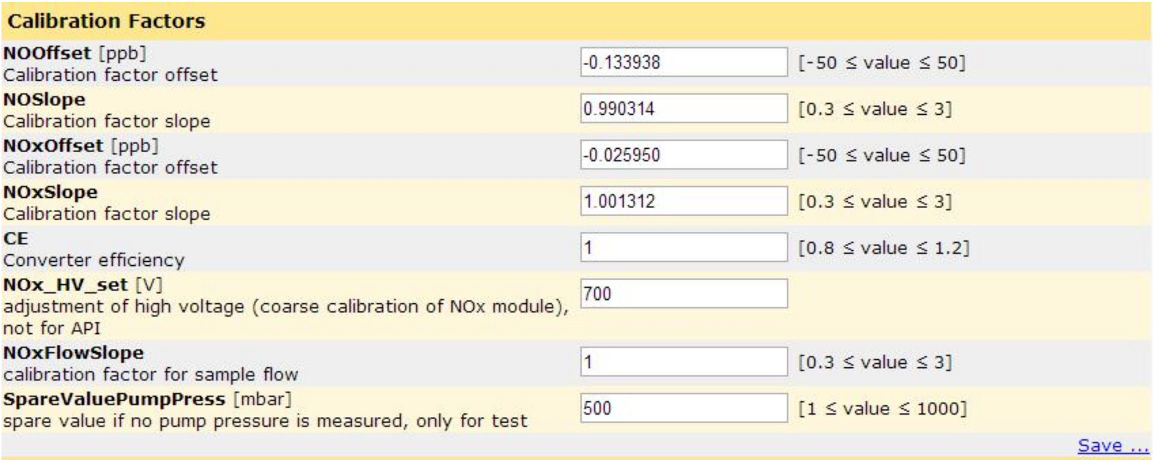


Figure 7.60.: Configuration of the NO_x module: Calibration setup

Figure 7.60 shows the result of the last calibration.The calibration factors are automatically adjusted after a calibration in the module ’calibration’. If needed you can also insert the factors manually, here. Also the ’converter efficiency CE’ can be changed here.

Configuration of the automatic internal calibration check (Internal Span Module): ’calibration setup’, ’calibration timing’ and ’calibration setpoints’ are listed here.

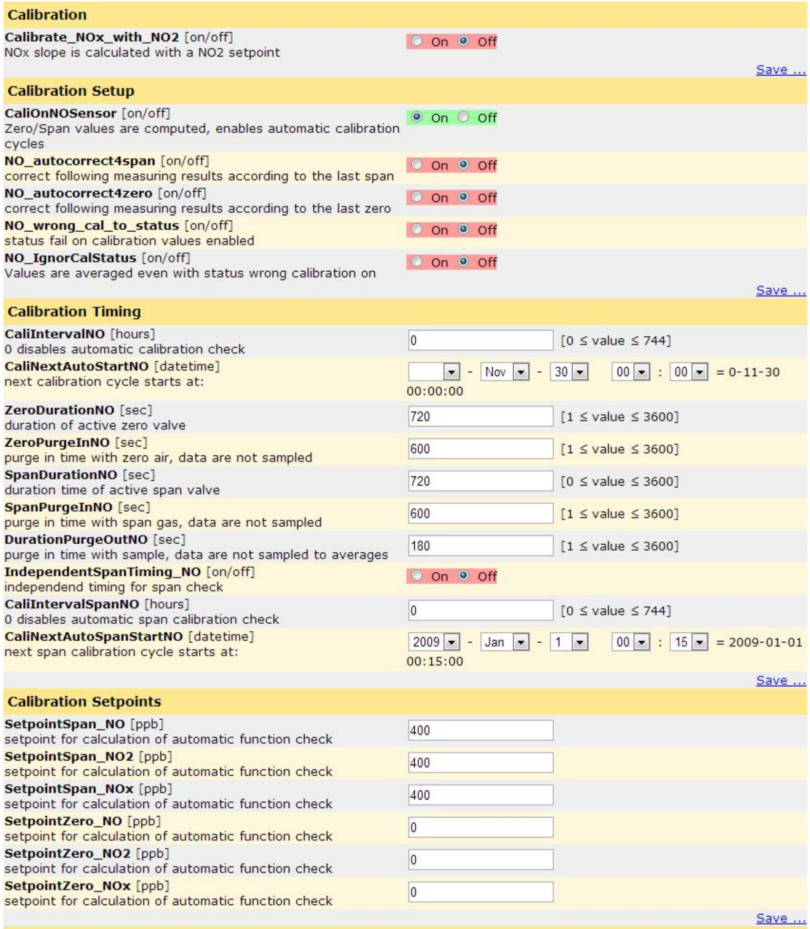


Figure 7.61.: Configuration of the Internal Span Module of the NO_x module

In the these items the automatic zero and span check can be configured. The automatic span check is available with the optional Internal Span Module, only. If there is no Internal Span Module just an automatic zero check takes place. The interval is given in ’CalintervalNO’, the settings for span are ignored.

Auxiliary configuration of the automatic calibration check:

Aux Configuration	
ZeroDiffWarn_NO [ppb] a warning is activated if the calibration value differ more than this value	10
ZeroDiffFail_NO [ppb] a status fail is activated if the calibration value differ more than this value	15
ZeroDiffWarn_NO2 [ppb] a warning is activated if the calibration value differ more than this value	10
ZeroDiffFail_NO2 [ppb] a status fail is activated if the calibration value differ more than this value	15
ZeroDiffFail_NOx [ppb] a status fail is activated if the calibration value differ more than this value	15
ZeroDiffWarn_NOx [ppb] a warning is activated if the calibration value differ more than this value	10
SpanDiffWarn_NO [ppb] a warning is activated if the calibration value differ more than this value	15
SpanDiffFail_NO [ppb] a status fail is activated if the calibration value differ more than this value	30
SpanDiffWarn_NO2 [ppb] a warning is activated if the calibration value differ more than this value	15
SpanDiffFail_NO2 [ppb] a status fail is activated if the calibration value differ more than this value	30
SpanDiffWarn_NOx [ppb] a warning is activated if the calibration value differ more than this value	15
SpanDiffFail_NOx [ppb] a status fail is activated if the calibration value differ more than this value	30
	Save ...

Figure 7.62.: Auxiliary configuration of the Internal Span Module of the NO_x module

As shown in Figure 7.62 the boundary values of the calibration check for warning and error messages can be set here. The settings for span are just valid if an Internal Span Module is installed.

Behavior at zero values:

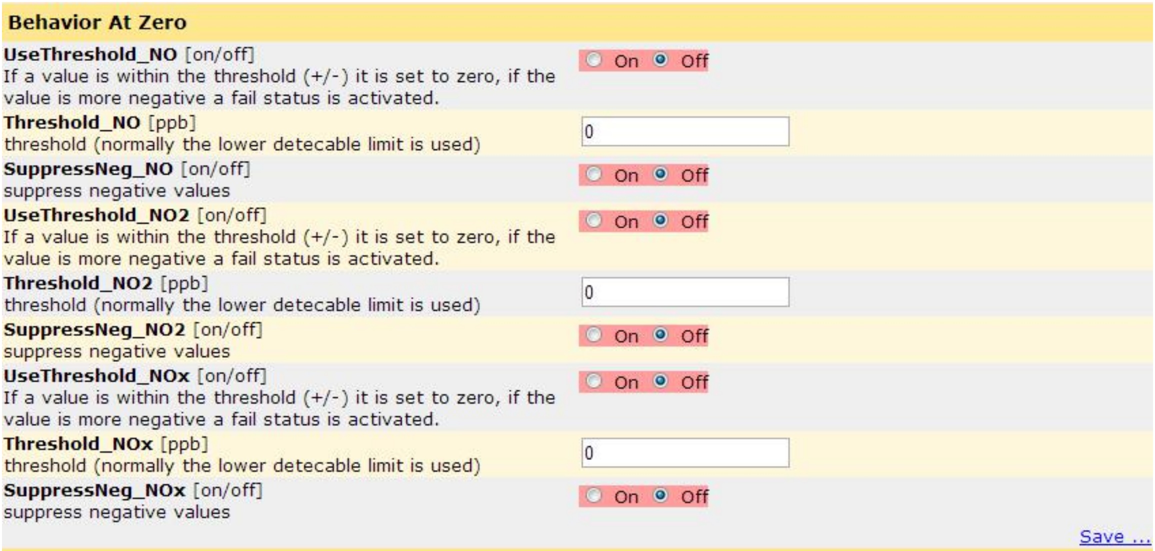


Figure 7.63.: Behavior of the NO_x module at measurement values around zero

In Figure 7.63 the parameters are listed which influence the handling of measurement values around zero. Here one can determine which values are set to zero and the handling of negative values.

Time constant and alternative parameter:

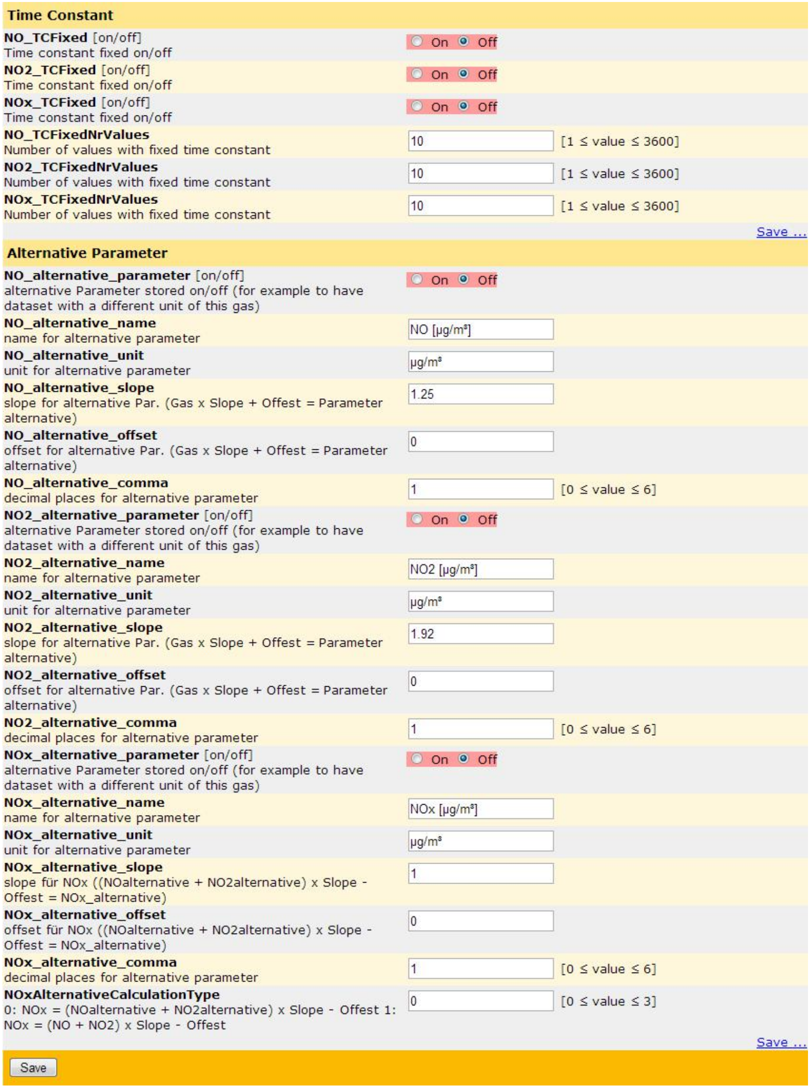


Figure 7.64.: Manual configuration of the NO_x module: Time constant and alternative parameter

As shown and described in Figure 7.64 the time constants and alternative parameters can be handled here. If one choose e.g., a fixed time constant a fixed number of measurement values is used for average independent of the slope of the change in the signal.
The alternative parameter give one the possibility to produce a data set with a different unit of the gas.

7.7.5.6. CO sensor

CO

Configuration - CO Sensor

- Main Configuration
- Calibration Factors
- Calibration Setup
- Calibration Timing
- Calibration Setpoints
- Behavior At Zero
- Aux Configuration
- Time Constant
- Alternative Parameter

Figure 7.65.: Manual configuration of the CO module: menu

In this menu the settings for the CO module are accessible as shown in picture 7.65. Now each menu item is described:

Main Configuration:

Main Configuration		
Press0CO [mbar] Reference Pressure for Sensor calibration (If this value is changed, a sensor calibration will be necessary!)	1013.25	[900 ≤ value ≤ 1100]
Temp0CO [°C] Reference Temperature for Sensor calibration (If this value is changed, a sensor calibration will be necessary!)	20	[0 ≤ value ≤ 100]
		Save ...

Figure 7.66.: Manual configuration of the CO module: Configurations

As shown and described in Figure 7.66 you can set the settings for Press0CO and Temp0CO. If you change these settings you have to calibrate the sensor.

Calibration factors:

Calibration Factors		
COOffset Calibration factor offset	-0.035867	[-50 ≤ value ≤ 50]
COSlope Calibration factor slope	1.172948	[0.5 ≤ value ≤ 3]
		Save ...

Figure 7.67.: Configuration of the CO module: Calibration setup

Figure 7.67 The calibration factors are automatically adjusted after a calibration in the module 'calibration'. If needed you can also insert the factors manually, here.

Configuration of the automatic calibration check:
'calibration setup', 'calibration timing' and 'calibration setpoints' are listed here.

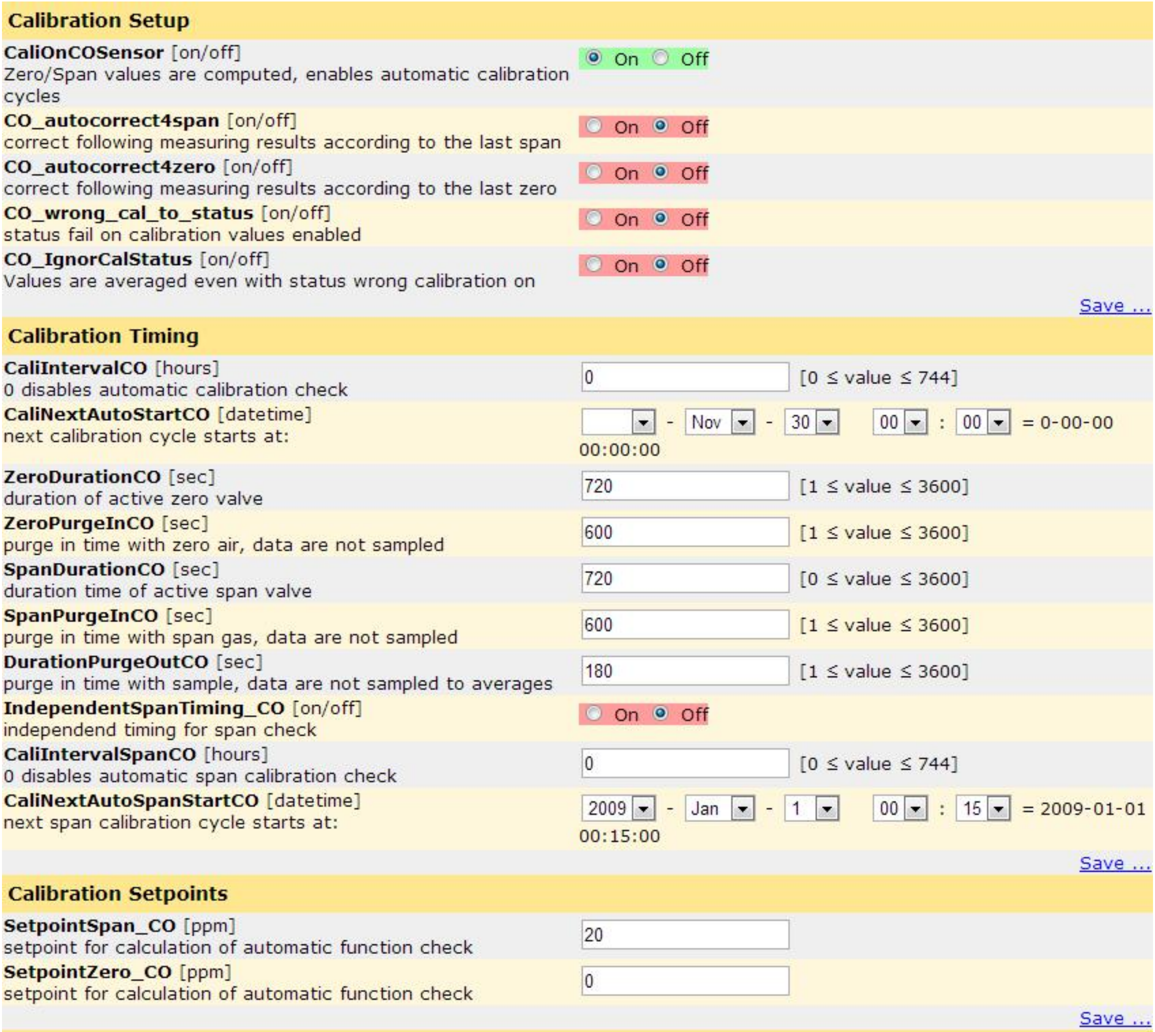


Figure 7.68.: Configuration of the Internal Span Module of the CO module

In the these items the automatic zero and span check can be configured. The automatic span check is available with the optional Internal Span Module, only. If there is no Internal Span Module just an automatic zero check takes place. The interval is given in 'CalintervalCO', the settings for span are ignored.

Auxiliary configuration of the automatic calibration check (Internal Span Module):

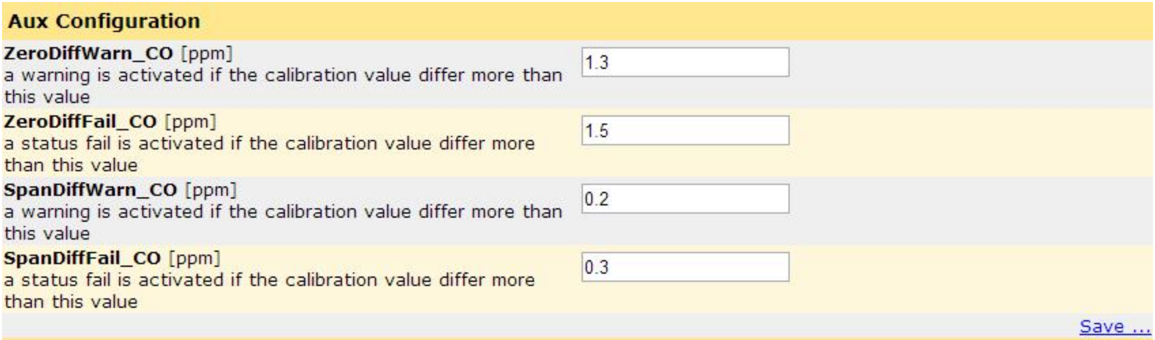


Figure 7.69.: Auxiliary configuration of the Internal Span Module of the CO module

As shown in Figure 7.69 the boundary values of the calibration check for warning and error messages can be set here. The settings for span are just valid if an Internal Span Module is installed.

Behavior at zero values:

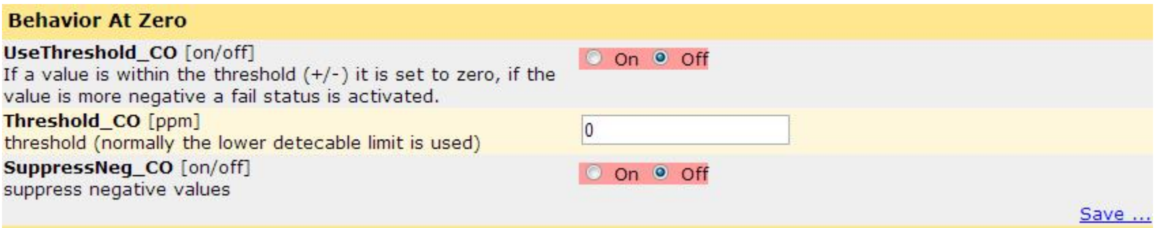


Figure 7.70.: Behavior of the CO module at measurement values around zero

As shown and described in picture 7.70 the time constants and the origin values can be handled here.

Time constant and alternative parameter:

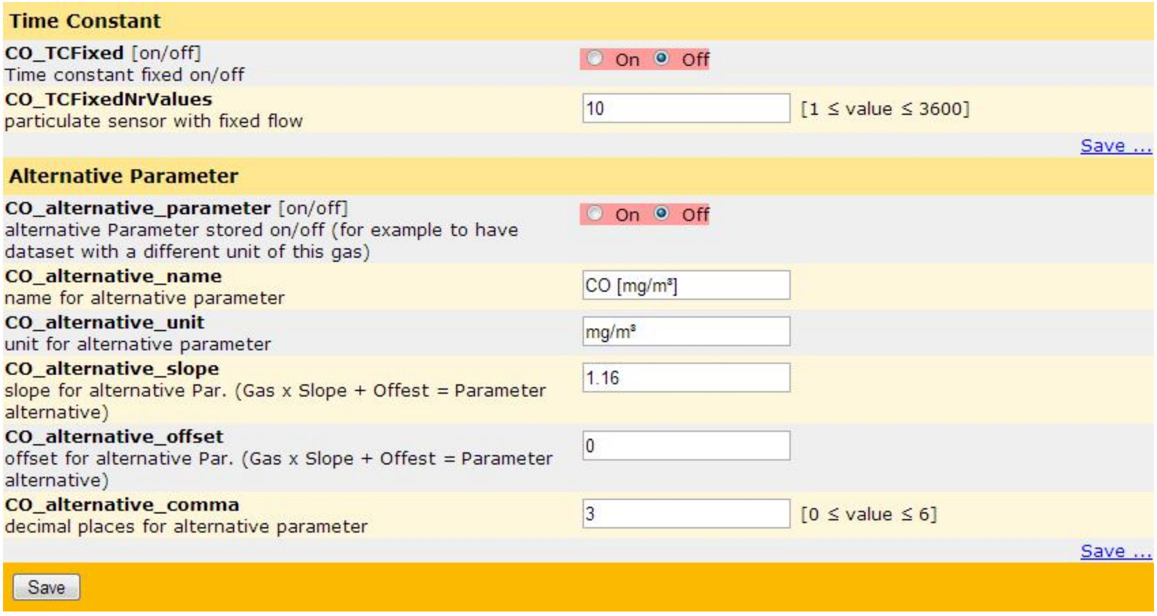


Figure 7.71.: Manual configuration of the NO_x sensor: Time constant and alternative parameter

As shown and described in Figure 7.71 the time constants and the origin values can be handled here.
If one choose e.g., a fixed time constant a fixed number of measurement values is used for average independent of the slope of the change in the signal.
The alternative parameter give one the possibility to produce a data set with a different unit of the gas.

7.7.5.7. O_3 sensor

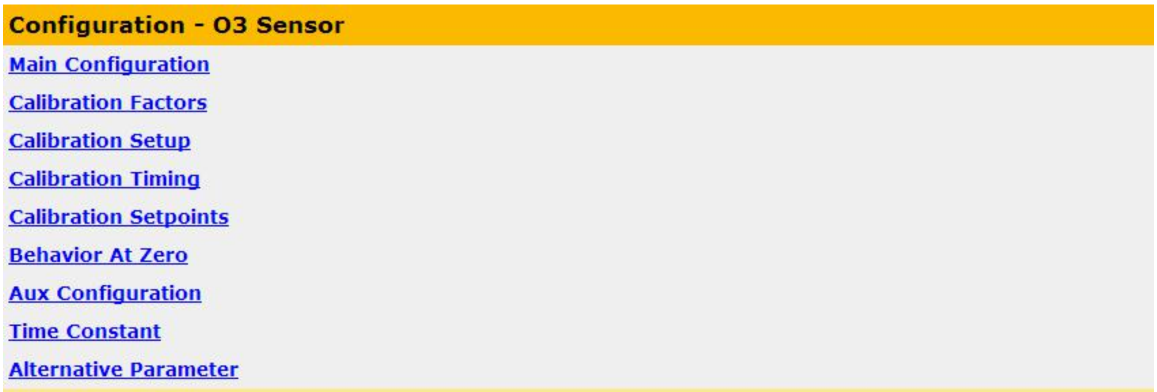


Figure 7.72.: Manual configuration of the O_3 module: menu

In this menu the settings for the O_3 module are accessible as shown in picture 7.72. Now each menu item is described:

Configuration factors:

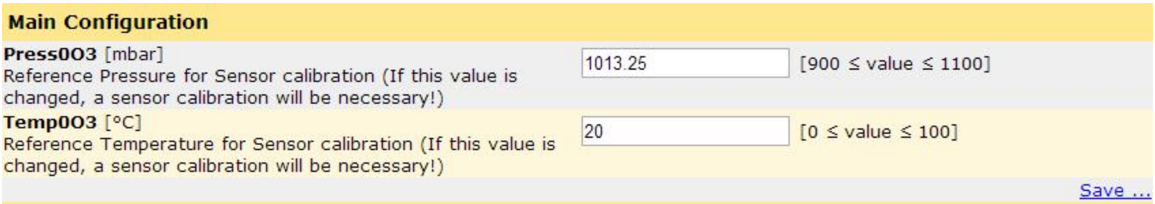


Figure 7.73.: Manual configuration of the O_3 module: Configurations

As shown and described in Figure 7.73 you can set the settings for Press0O3 and Temp0O3. If you change these settings you have to calibrate the sensor.

Calibration factors:

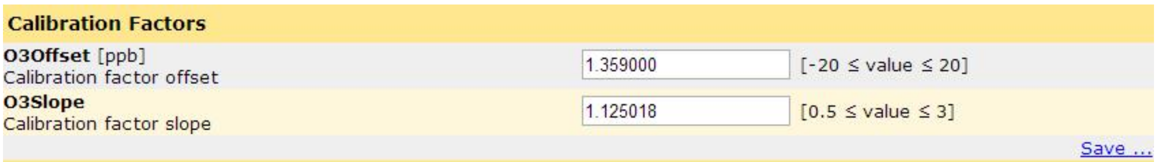


Figure 7.74.: Configuration of the Ozone module: Calibration setup

Figure 7.74 shows the result of the last calibration. The calibration factors are automatically adjusted after a calibration in the module 'calibration'. If needed you can also insert the factors manually, here.

Configuration of the automatic calibration check:
’calibration setup’, ’calibration timing’ and ’calibration setpoints’ are listed here.

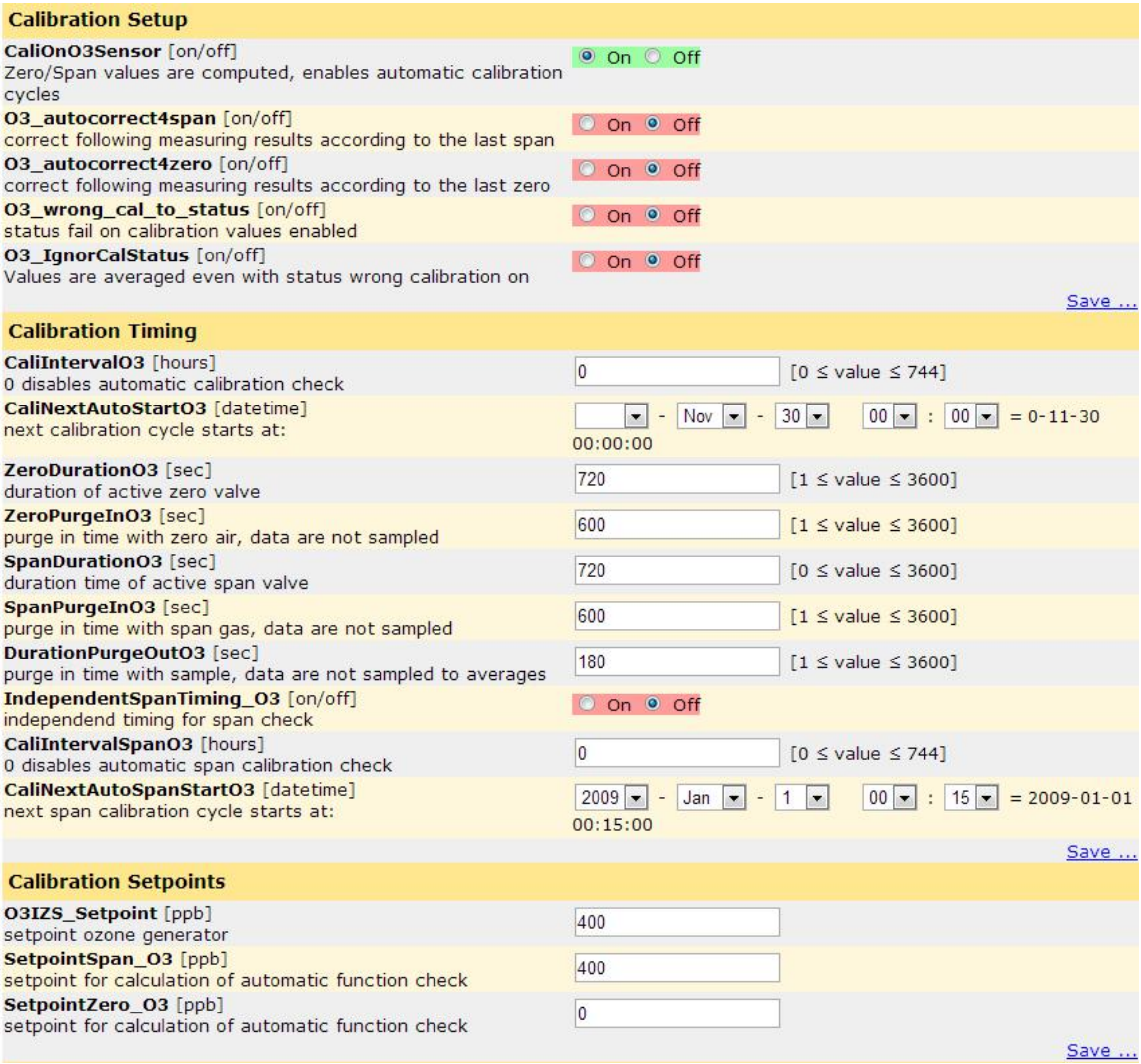


Figure 7.75.: Configuration of the Internal Span Module of the Ozone module

In the these items the automatic zero and span check can be configured. The automatic span check is available with the optional Internal Span Module, only. If there is no Internal Span Module just an automatic zero check

Auxiliary configuration of the automatic calibration check (Internal Span Module):

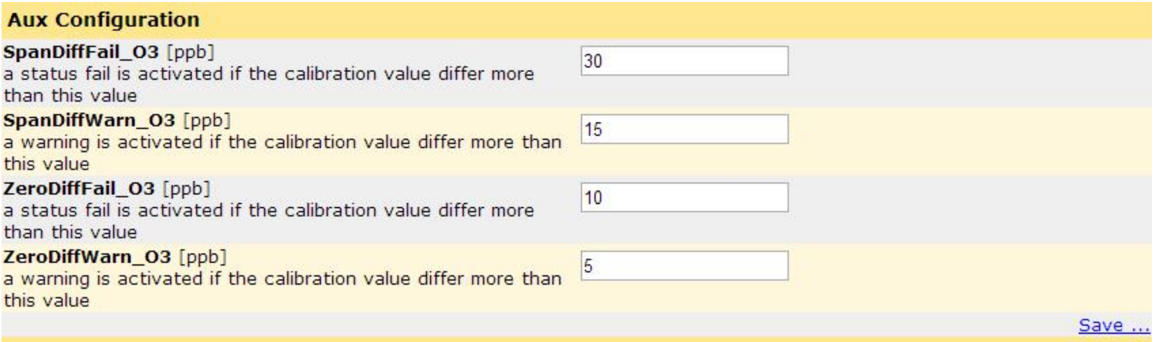


Figure 7.76.: Auxiliary configuration of the Internal Span Module of the Ozone module

As shown in Figure 7.76 the boundary values of the calibration check for warning and error messages can be set here. The settings for span are just valid if an Internal Span Module is installed.

Behavior at zero values:

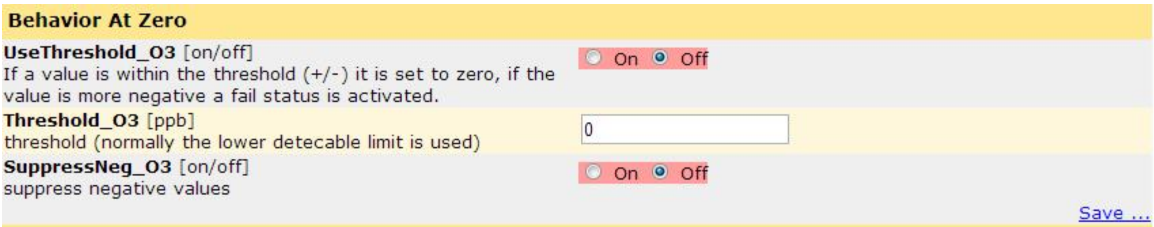


Figure 7.77.: Behavior of the Ozone module at measurement values around zero

As shown and described in picture 7.77 the time constants and the origin values can be handled here.

Time constant and alternative parameter:

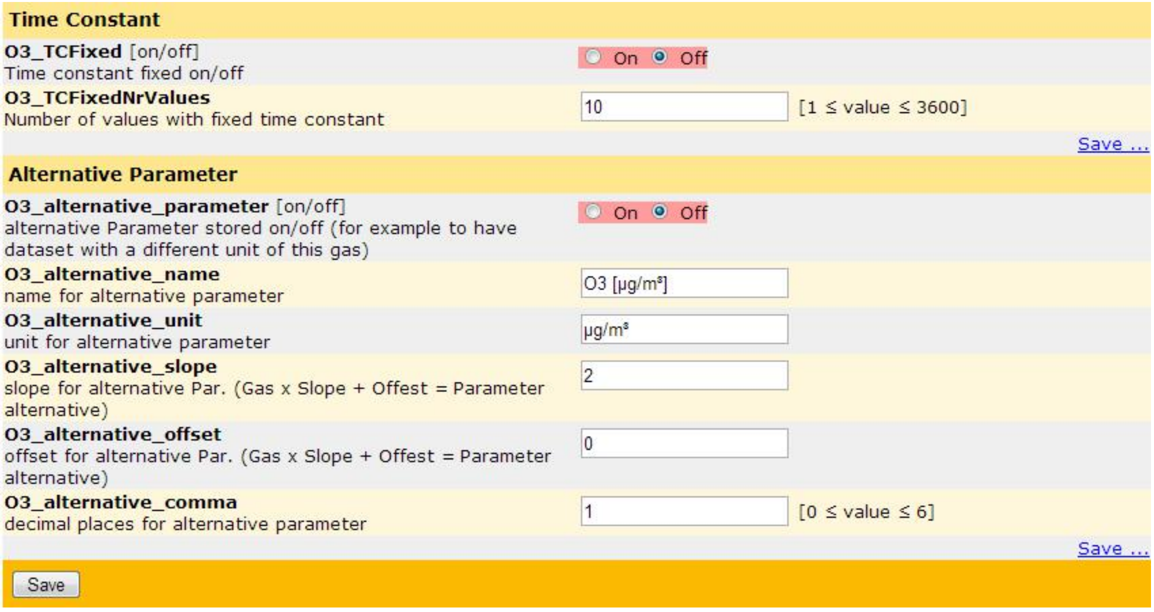


Figure 7.78.: Manual configuration of the O_3 module: Time constant and alternative parameter

As shown and described in Figure 7.78 the time constants and the alternative parameter values can be handled here.
If one choose e.g., a fixed time constant a fixed number of measurement values is used for average independent of the slope of the change in the signal.
The alternative parameter give one the possibility to produce a data set with a different unit of the gas.

7.7.5.8. SO_2 sensor

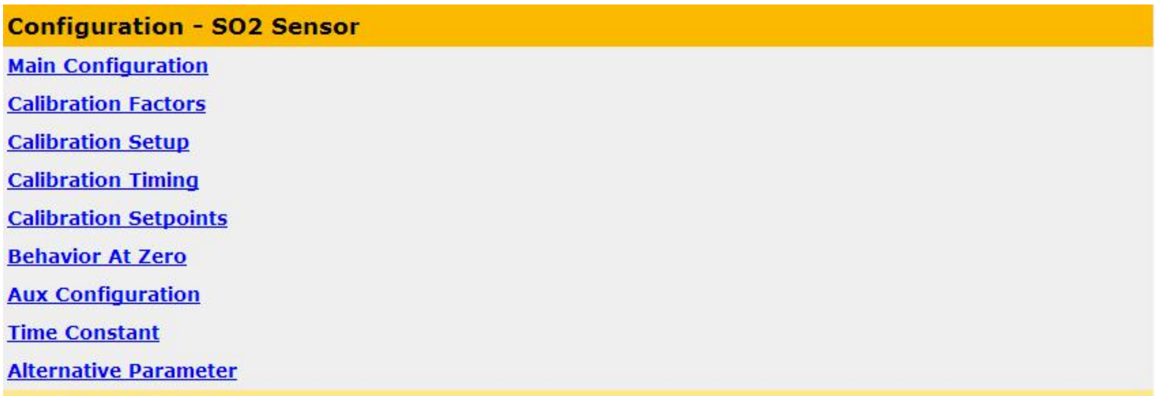


Figure 7.79.: Manual configuration of the SO_2 module: menu

In this menu the settings for the SO_2 module are accessible as shown in picture 7.79. Now each menu item is described:

Main Configuration:

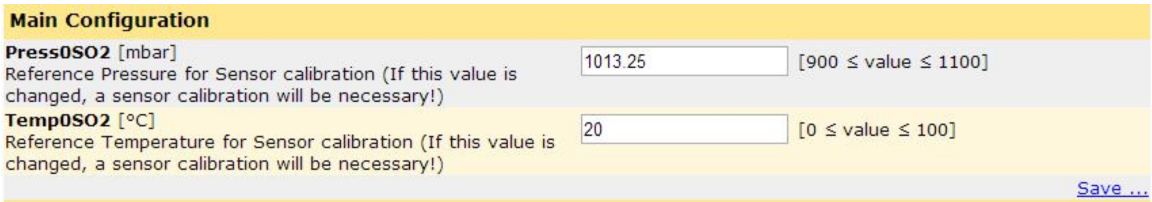


Figure 7.80.: Manual configuration of the SO_2 module: Configurations

As shown and described in Figure 7.80 you can set the settings for Press0SO2 and Temp0SO2. If you change these settings you have to calibrate the sensor.

Calibration factors:

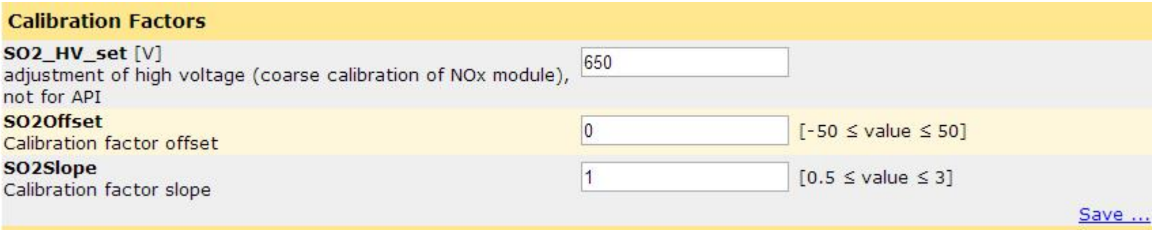


Figure 7.81.: Configuration of the SO_2 sensor: Calibration setup

In Figure 7.81 the settings for the manual calibration configuration of the SO_2 module is listed and described. The calibration factors are automatically adjusted after a calibration in the module ’calibration’. If needed you can also insert the factors manually, here.

Configuration of the automatic calibration check:
'calibration setup', 'calibration timing' and 'calibration setpoints' are listed here.

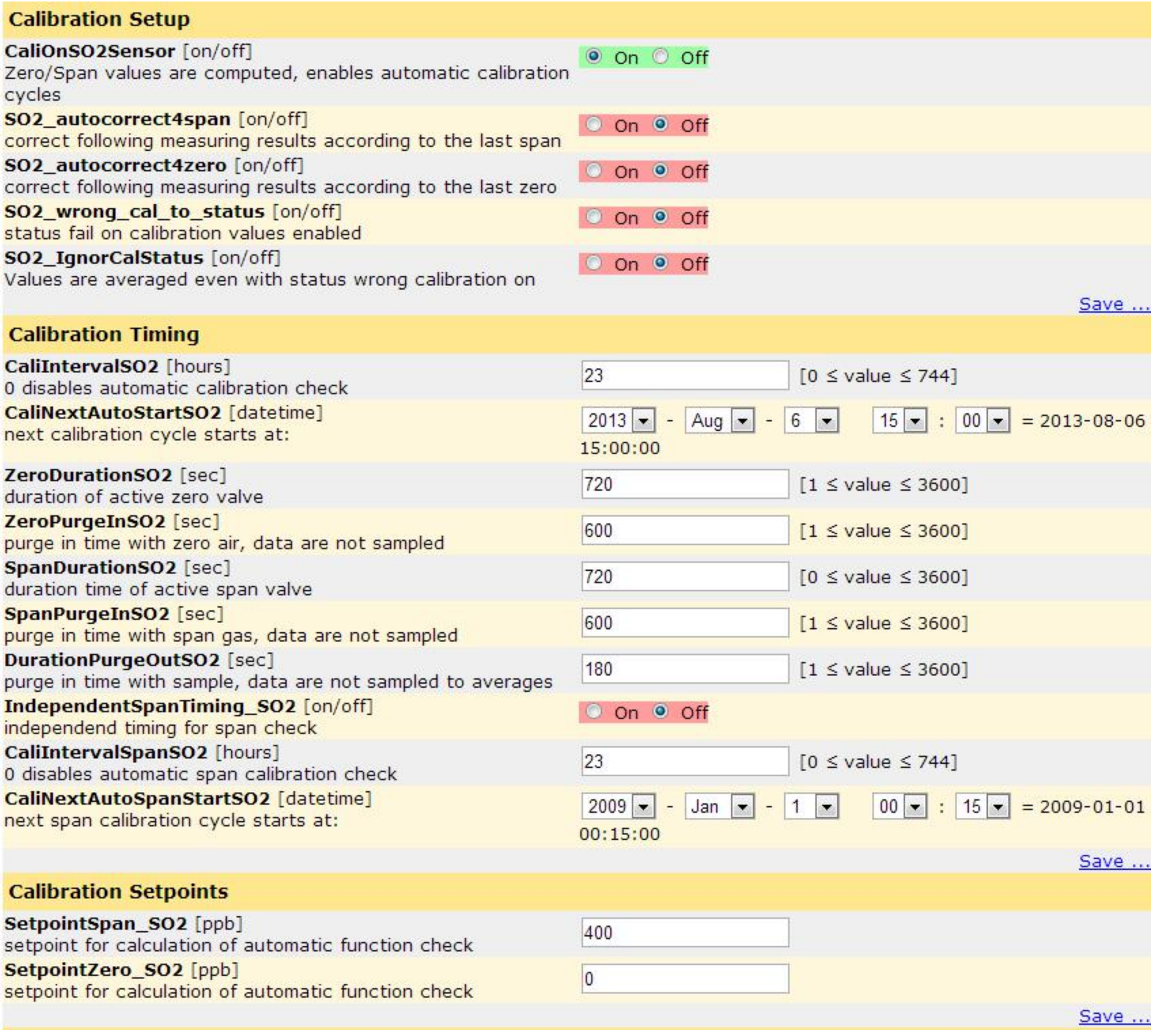


Figure 7.82.: Configuration of the Internal Span Module of the SO_2 sensor

In the these items the automatic zero and span check can be configured. The automatic span check is available with the optional Internal Span Module, only. If there is no Internal Span Module just an automatic zero check

Auxiliary configuration of the automatic calibration check:

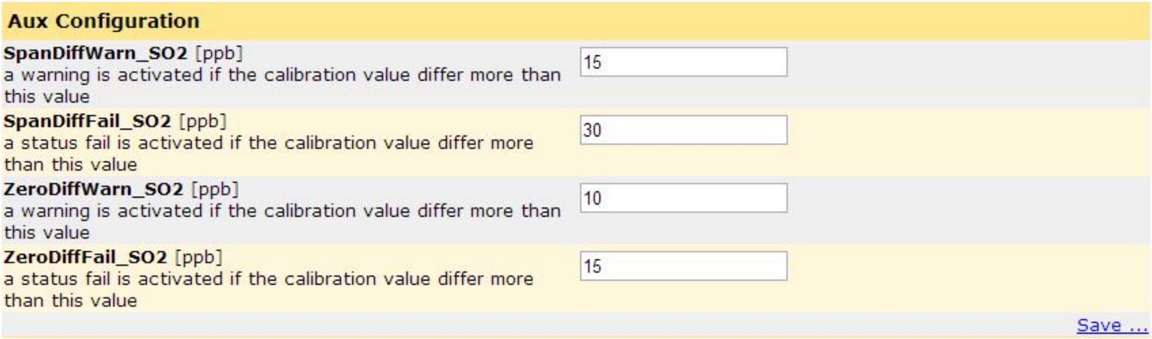


Figure 7.83.: Auxiliary configuration of the Internal Span Module of the SO_2 module

As shown in Figure 7.83 the boundary values of the calibration check for warning and error messages can be set here. The settings for span are just valid if an Internal Span Module is installed.

Behavior at zero values:

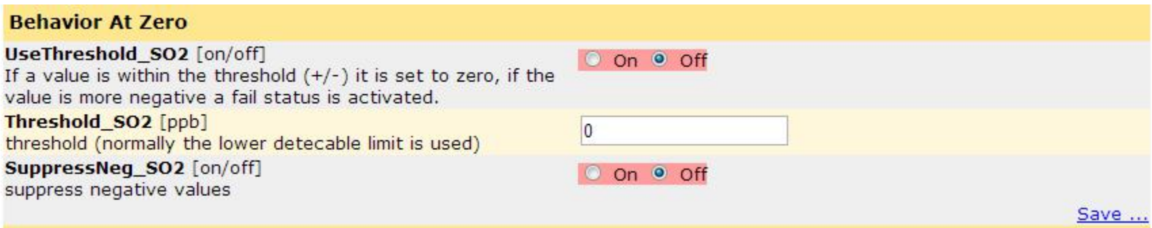


Figure 7.84.: Behavior of the SO_2 module at measurement values around zero

In picture 7.84 the parameters influencing the handling of values around zero are shown.

Time constant and alternative parameter:

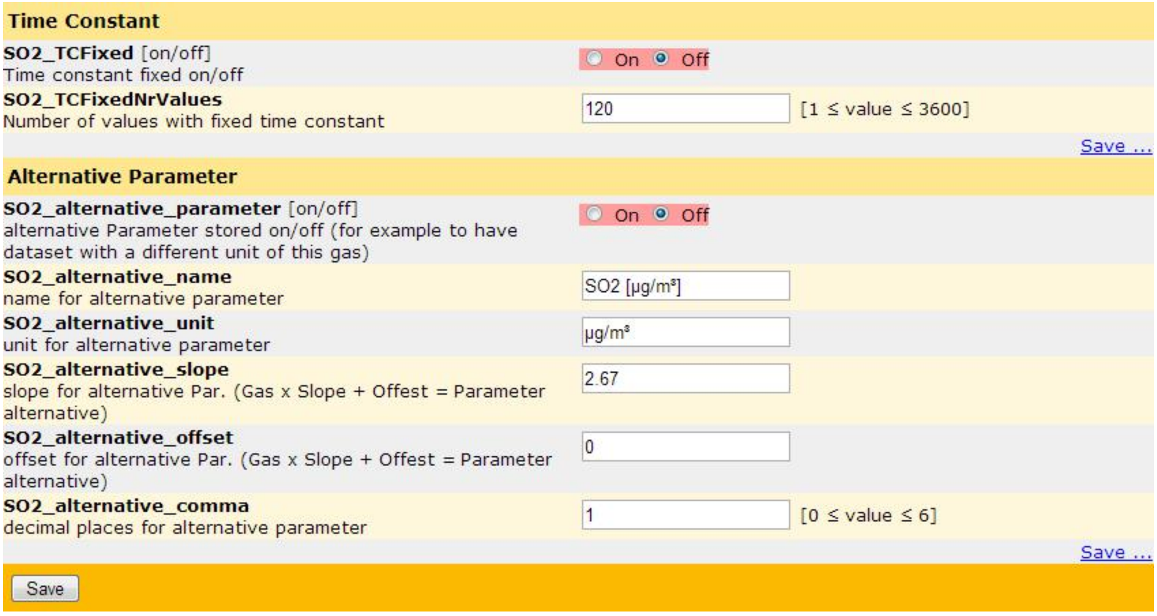
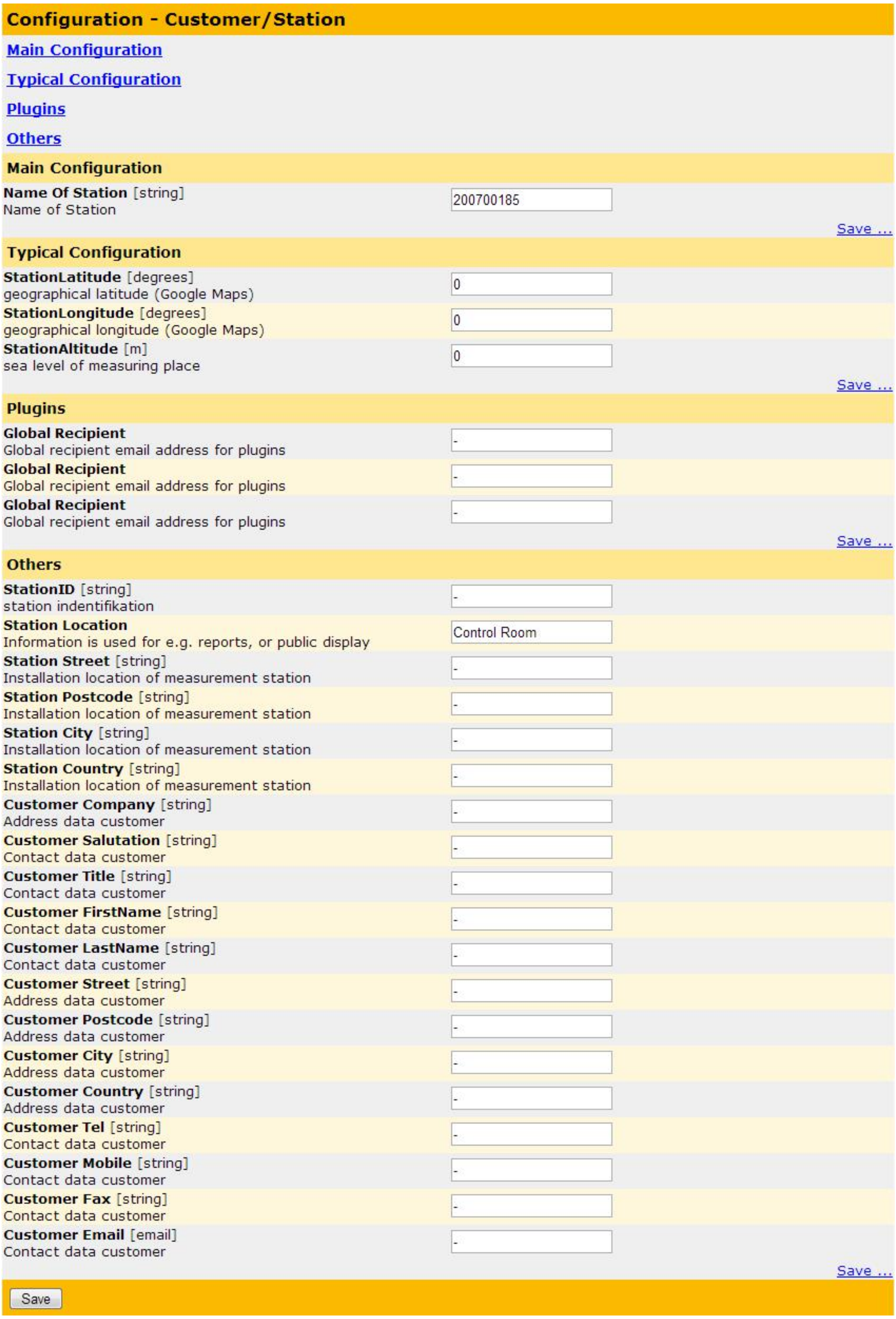


Figure 7.85.: Manual configuration of the SO_2 module: Time constant and alternative parameter

As shown and described in Figure 7.85 the time constants and alternative parameter values can be handled here. If one choose e.g., a fixed time constant a fixed number of measurement values is used for average independent of the slope of the change in the signal. The alternative parameter give one the possibility to produce a data set with a different unit of the gas.

7.7.5.9. Customer/Station



Configuration - Customer/Station

Main Configuration
Typical Configuration
Plugins
Others

Main Configuration	
Name Of Station [string] Name of Station	200700185
	Save ...
Typical Configuration	
StationLatitude [degrees] geographical latitude (Google Maps)	0
StationLongitude [degrees] geographical longitude (Google Maps)	0
StationAltitude [m] sea level of measuring place	0
	Save ...
Plugins	
Global Recipient Global recipient email address for plugins	-
Global Recipient Global recipient email address for plugins	-
Global Recipient Global recipient email address for plugins	-
	Save ...
Others	
StationID [string] station indentifikation	-
Station Location Information is used for e.g. reports, or public display	Control Room
Station Street [string] Installation location of measurement station	-
Station Postcode [string] Installation location of measurement station	-
Station City [string] Installation location of measurement station	-
Station Country [string] Installation location of measurement station	-
Customer Company [string] Address data customer	-
Customer Salutation [string] Contact data customer	-
Customer Title [string] Contact data customer	-
Customer FirstName [string] Contact data customer	-
Customer LastName [string] Contact data customer	-
Customer Street [string] Address data customer	-
Customer Postcode [string] Address data customer	-
Customer City [string] Address data customer	-
Customer Country [string] Address data customer	-
Customer Tel [string] Contact data customer	-
Customer Mobile [string] Contact data customer	-
Customer Fax [string] Contact data customer	-
Customer Email [email] Contact data customer	-
	Save ...

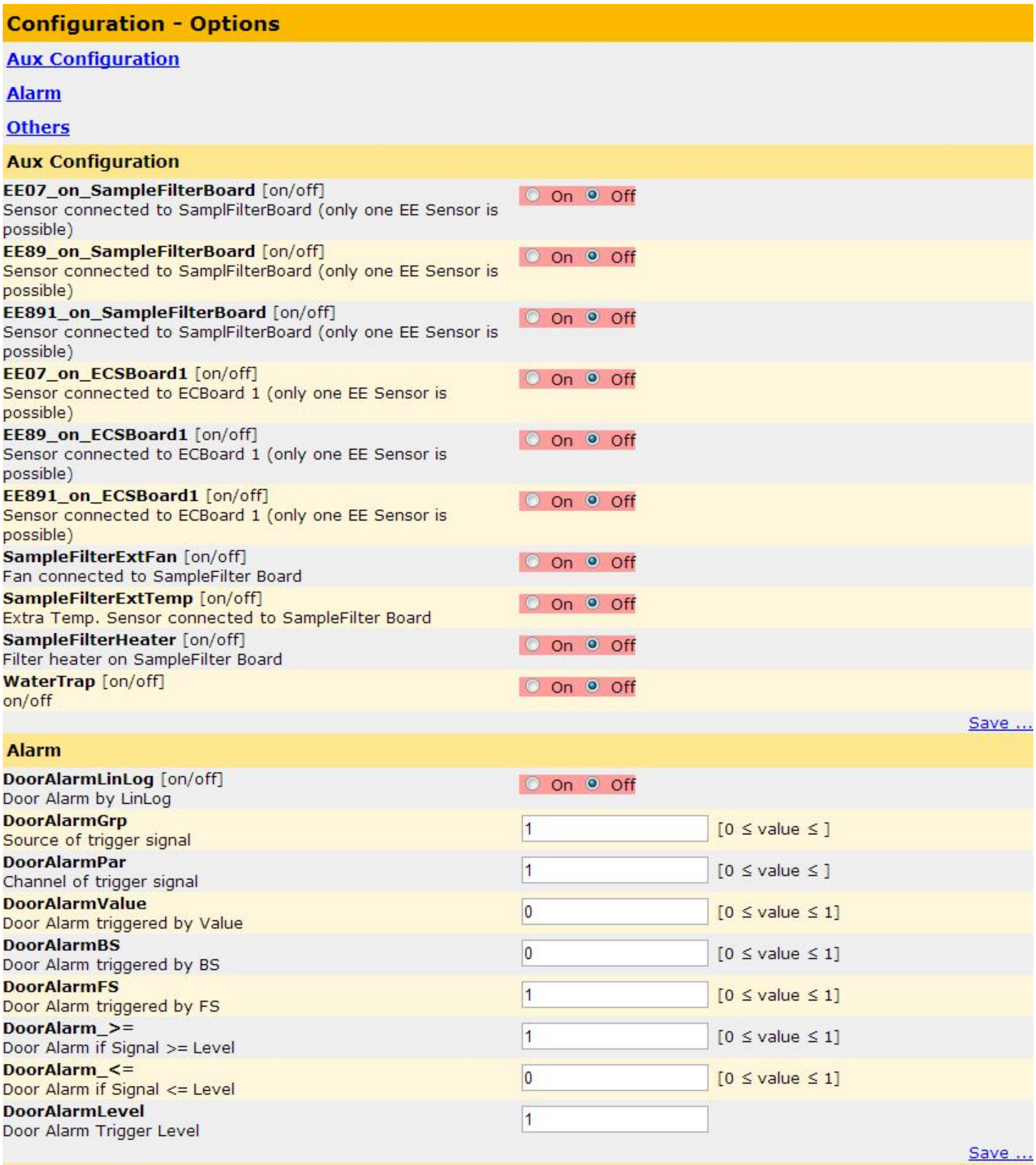
Save

Figure 7.86.: Overview of the Customer/Station Interface

In picture 7.86 the parameters for setting customer-specific datas (adress and contact data), installation site of the measuring station and name of station are listed, described and can also be changed.

7.7.5.10. Options

Here are the settings for optional modules of the airpointer® , as far as these are installed.



Configuration - Options

Aux Configuration

Alarm

Others

Aux Configuration

EE07_on_SampleFilterBoard [on/off] Sensor connected to SamplFilterBoard (only one EE Sensor is possible)	○ On ◉ Off
EE89_on_SampleFilterBoard [on/off] Sensor connected to SamplFilterBoard (only one EE Sensor is possible)	○ On ◉ Off
EE891_on_SampleFilterBoard [on/off] Sensor connected to SamplFilterBoard (only one EE Sensor is possible)	○ On ◉ Off
EE07_on_ECSBoard1 [on/off] Sensor connected to ECBoard 1 (only one EE Sensor is possible)	○ On ◉ Off
EE89_on_ECSBoard1 [on/off] Sensor connected to ECBoard 1 (only one EE Sensor is possible)	○ On ◉ Off
EE891_on_ECSBoard1 [on/off] Sensor connected to ECBoard 1 (only one EE Sensor is possible)	○ On ◉ Off
SampleFilterExtFan [on/off] Fan connected to SampleFilter Board	○ On ◉ Off
SampleFilterExtTemp [on/off] Extra Temp. Sensor connected to SampleFilter Board	○ On ◉ Off
SampleFilterHeater [on/off] Filter heater on SampleFilter Board	○ On ◉ Off
WaterTrap [on/off] on/off	○ On ◉ Off

Save ...

Alarm

DoorAlarmLinLog [on/off] Door Alarm by LinLog	○ On ◉ Off	
DoorAlarmGrp Source of trigger signal	1	[0 ≤ value ≤]
DoorAlarmPar Channel of trigger signal	1	[0 ≤ value ≤]
DoorAlarmValue Door Alarm triggered by Value	0	[0 ≤ value ≤ 1]
DoorAlarmBS Door Alarm triggered by BS	0	[0 ≤ value ≤ 1]
DoorAlarmFS Door Alarm triggered by FS	1	[0 ≤ value ≤ 1]
DoorAlarm_>= Door Alarm if Signal >= Level	1	[0 ≤ value ≤ 1]
DoorAlarm_<= Door Alarm if Signal <= Level	0	[0 ≤ value ≤ 1]
DoorAlarmLevel Door Alarm Trigger Level	1	

Save ...

Figure 7.87.: Configuration options: Aux configuration and alarm

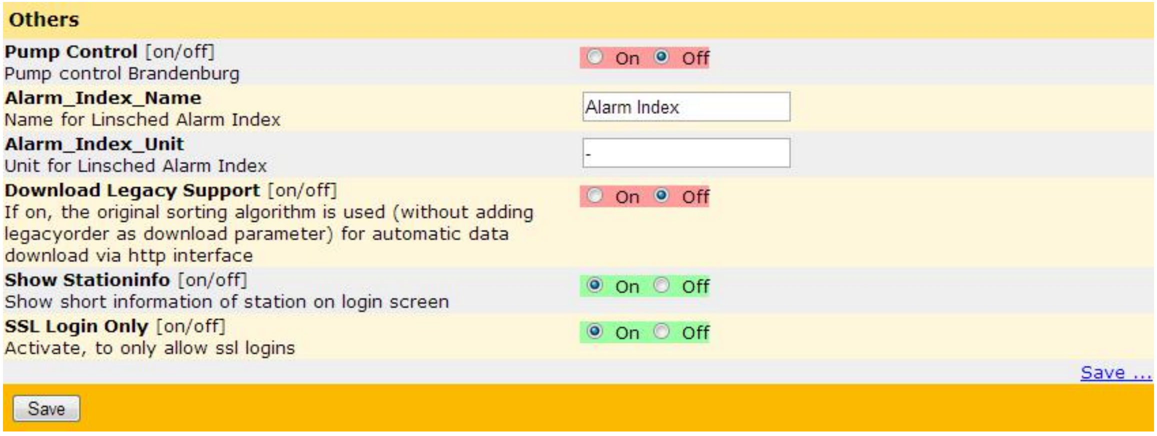


Figure 7.88.: Configuration options: Others

7.7.5.11. AQI Settings

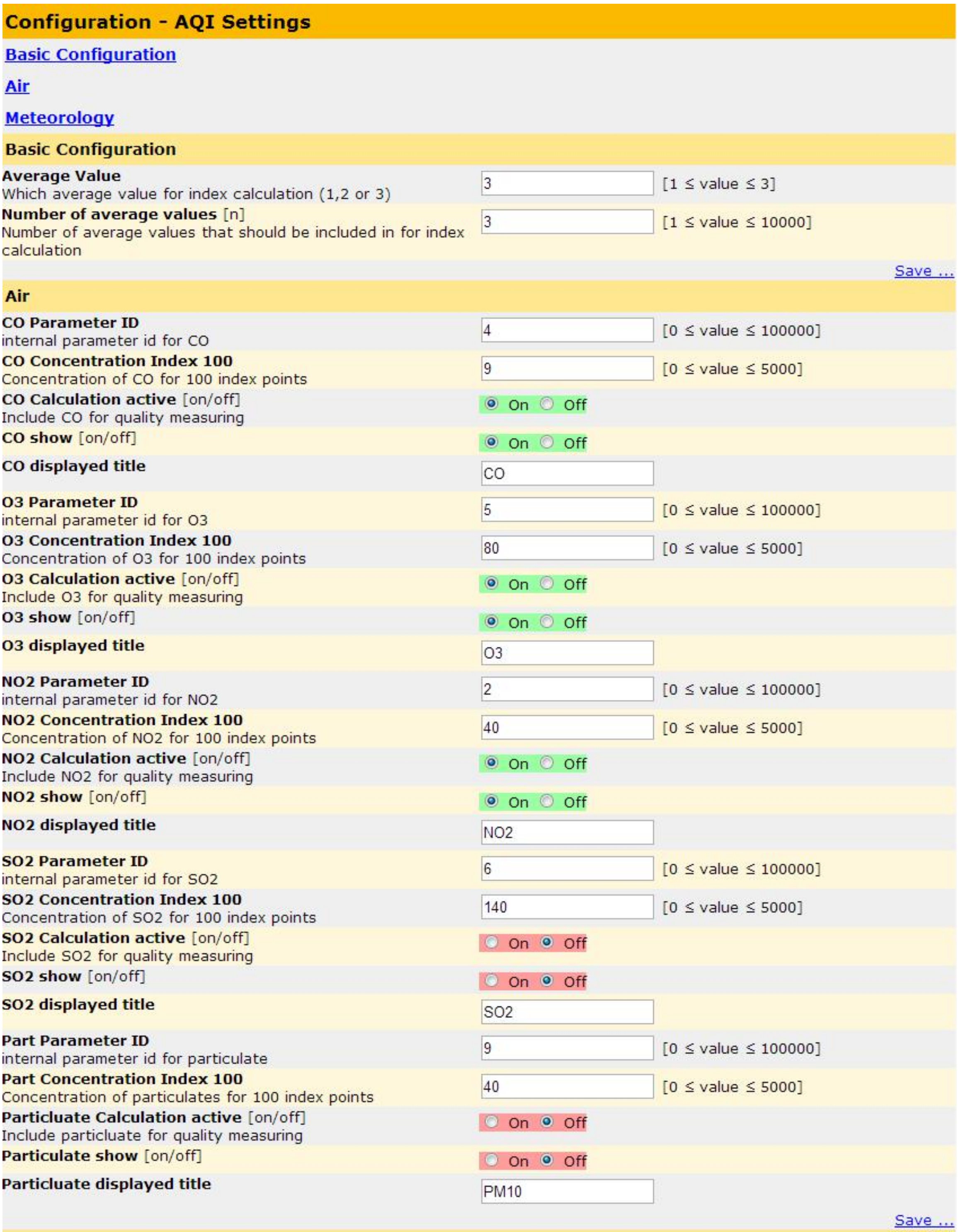


Figure 7.89.: AQI configuration overview

Here one can hide or make visible the sensor values to the public display. Furthermore it is possible to customize the values and hence their form of presentation.

Figure 7.90.: AQI configuration overview continued

If you want some metereogical data on your public screen, here you can add it.

7.7.5.12. Time Settings

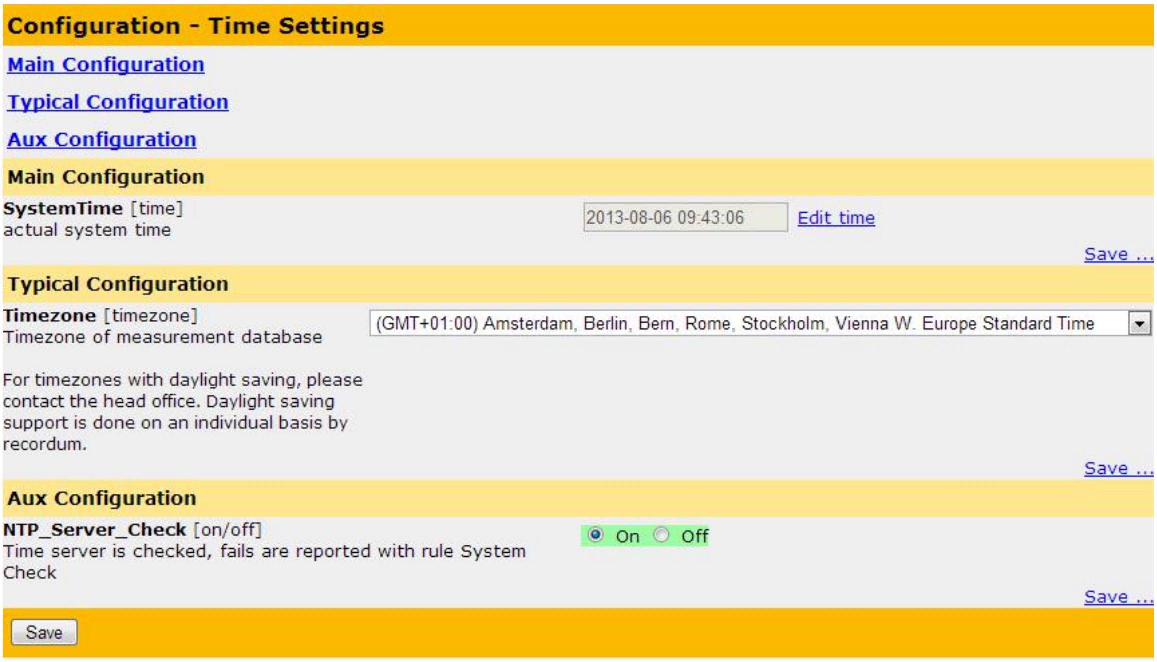


Figure 7.91.: Time settings

Here you have the possibility to synchronize automatically the local time of your airpointer® via internet with a publicly available time server (if internet connection is available). The mechanism automatically calculates the time out of the reported data by the given time servers as accurately as an atomic clock.
Additionally you can set here the time zone of the airpointer® , which is used for data acquisition. In picture 7.91 the parameters are listed and described.

7.7.5.13. Parameters

The following interface pages are divided in 8 columns:

1. **ID** This is a changeable ID for your personal use if you are connected to an external network and want to coordinate measurements.
2. **Internal ID** This is the non-varying not changeable ID of the parameter in the system.
3. **Name** This is the name of the parameter
4. **Visible** Here you can decide if a user logged in as "public" is able to see this parameter.
5. **Overview** Here you decide if the value is visible in the 'Overview'7.10 interface.
6. **Group, ParamId and software** Here you can see three values which serve for internal numbering

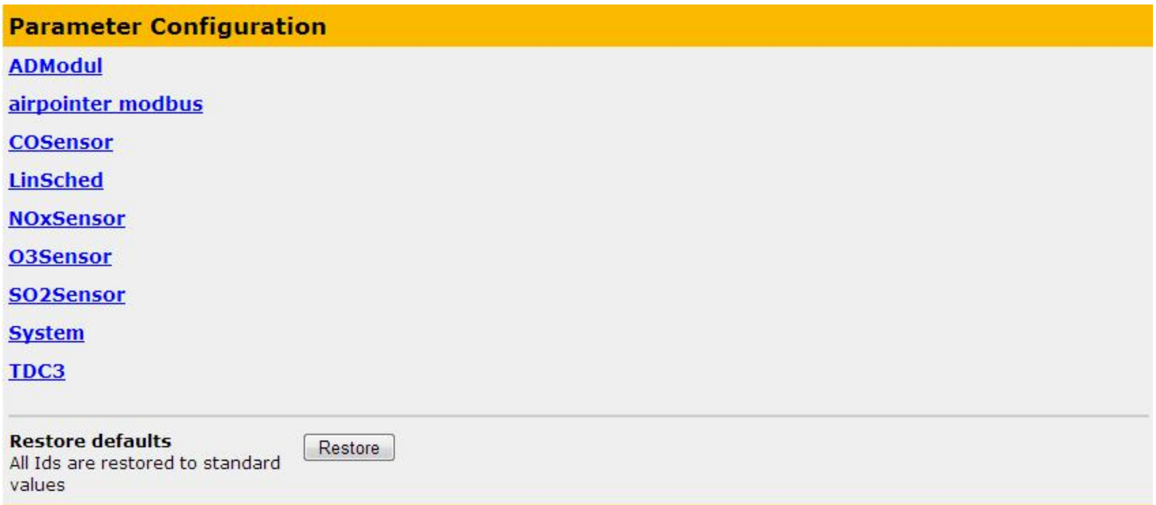


Figure 7.92.: Parameter overview: Part1

ADModul

	ID	Internal Id	Name	Visible	Overview	Group	ParamId	Software
☐	11919	11919	Analog In 1 [V]	☐	☐	1	1	LinLog
☐	11925	11925	Analog In 2 [V]	☐	☐	1	2	LinLog
☐	11931	11931	Analog In 3 [V]	☐	☐	1	3	LinLog
☐	11937	11937	Analog In 4 [V]	☐	☐	1	4	LinLog
☐	11943	11943	Analog In 5 [V]	☐	☐	1	5	LinLog
☐	11949	11949	Analog In 6 [V]	☐	☐	1	6	LinLog

Save Delete

airpointer modbus

	ID	Internal Id	Name	Visible	Overview	Group	ParamId	Software
☐	12129	12129	CO [ppb]	☐	☐	4	4	LinLog
☐	12165	12165	CoolerOutTemp [°C]	☐	☐	4	10	LinLog
☐	12147	12147	H2S [ppb]	☐	☐	4	7	LinLog
☐	12177	12177	LinLogG1P1 [-]	☐	☐	4	12	LinLog
☐	12183	12183	LinLogG1P2 [-]	☐	☐	4	13	LinLog
☐	12189	12189	LinLogG2P1 [-]	☐	☐	4	14	LinLog
☐	12195	12195	LinLogG2P2 [-]	☐	☐	4	15	LinLog
☐	12201	12201	LinLogG3P1 [-]	☐	☐	4	16	LinLog
☐	12207	12207	LinLogG3P2 [-]	☐	☐	4	17	LinLog
☐	12213	12213	LinLogG4P1 [-]	☐	☐	4	18	LinLog
☐	12219	12219	LinLogG4P2 [-]	☐	☐	4	19	LinLog
☐	12225	12225	LinLogG5P1 [-]	☐	☐	4	20	LinLog
☐	12231	12231	LinLogG5P2 [-]	☐	☐	4	21	LinLog
☐	12111	12111	NO [ppb]	☐	☐	4	1	LinLog
☐	12117	12117	NO2 [ppb]	☐	☐	4	2	LinLog
☐	12123	12123	NOx [ppb]	☐	☐	4	3	LinLog
☐	12135	12135	O3 [ppb]	☐	☐	4	5	LinLog
☐	12153	12153	PM [µg/m³]	☐	☐	4	8	LinLog
☐	12171	12171	PumpRoomTemp [°C]	☐	☐	4	11	LinLog
☐	12159	12159	RoomTemp [°C]	☐	☐	4	9	LinLog
☐	12141	12141	SO2 [ppb]	☐	☐	4	6	LinLog

Save Delete

Figure 7.93.: Parameter overview: Part2

COSensor

	ID	Internal Id	Name	Visible	Overview	Group	ParamId	Software
☐	23	23	BenchT [°C]	☐	☐	2	3	LinSens
☐	4	**4**	**CO [ppm]**	☑	☑	**2**	**1**	**LinSens**
☐	220	220	CO_AGC [V]	☐	☐	2	17	LinSens
☐	153	153	CO_all [ppm]	☐	☐	2	14	LinSens
☐	235	235	CO_cylinder [bar]	☐	☐	2	22	LinSens
☐	1106	1106	COIRSourceVoltage [V]	☐	☐	2	23	LinSens
☐	63	63	COMeas [mV]	☐	☐	2	9	LinSens
☐	1107	1107	COPowerToSpeed [%]	☐	☐	2	27	LinSens
☐	65	65	CORatio [-]	☐	☐	2	11	LinSens
☐	64	64	CORef [mV]	☐	☐	2	10	LinSens
☐	35	35	COScrubberTemp [°C]	☐	☐	2	20	LinSens
☐	407	407	CO_Span [ppm]	☐	☐	2	1	LinSens
☐	507	507	CO_Span_Setpoint [ppm]	☐	☐	2	1	LinSens
☐	221	221	CO_Speed [rpm]	☐	☐	2	18	LinSens
☐	173	173	COStdDev []	☐	☐	2	16	LinSens
☐	406	406	CO_Zero [ppm]	☐	☐	2	1	LinSens
☐	506	506	CO_Zero_Setpoint [ppm]	☐	☐	2	1	LinSens
☐	234	234	FlowCO [ml/min]	☐	☐	2	19	LinSens
☐	82	82	PowerToCOBench [%]	☐	☐	2	12	LinSens
☐	86	86	PowerToCOScrubber [%]	☐	☐	2	21	LinSens
☐	93	93	PreAmpCO [%]	☐	☐	2	15	LinSens
☐	11	11	PressCO [mbar]	☐	☐	2	2	LinSens

Save Delete

Figure 7.94.: Parameter overview: Part3

LinSched

	ID	Internal Id	Name	Visible	Overview	Group	ParamId	Software
[ ]	8900	**8900**	**Alarm Index [-]**	[x]	[x]	**0**	**0**	**LinSched**

Save Delete

Figure 7.95.: Parameter overview: Part4

NOxSensor

	ID	Internal Id	Name	Visible	Overview	Group	ParamId	Software
[ ]	145	145	Fan_NOx [rpm]	[ ]	[ ]	1	19	LinSens
[ ]	231	231	FlowNOx [ml/min]	[ ]	[ ]	1	29	LinSens
[ ]	232	232	FlowO3Gen [ml/min]	[ ]	[ ]	1	30	LinSens
[ ]	76	76	HVPS_NOx [V]	[ ]	[ ]	1	15	LinSens
[ ]	21	21	MolyT [°C]	[ ]	[ ]	1	6	LinSens
[ ]	1	**1**	**NO [ppb]**	[x]	[x]	**1**	**1**	**LinSens**
[ ]	2	**2**	**NO2 [ppb]**	[x]	[x]	**1**	**2**	**LinSens**
[ ]	151	151	NO2_all [ppb]	[ ]	[ ]	1	17	LinSens
[ ]	171	171	NO2StdDev []	[ ]	[ ]	1	22	LinSens
[ ]	402	402	NO2_Zero [ppb]	[ ]	[ ]	1	2	LinSens
[ ]	502	502	NO2_Zero_Setpoint [ppb]	[ ]	[ ]	1	2	LinSens
[ ]	150	150	NO_all [ppb]	[ ]	[ ]	1	16	LinSens
[ ]	170	170	NOStdDev []	[ ]	[ ]	1	21	LinSens
[ ]	3	**3**	**NOx [ppb]**	[x]	[x]	**1**	**3**	**LinSens**
[ ]	152	152	NOx_all [ppb]	[ ]	[ ]	1	18	LinSens
[ ]	172	172	NOxStdDev []	[ ]	[ ]	1	23	LinSens
[ ]	404	404	NOx_Zero [ppb]	[ ]	[ ]	1	3	LinSens
[ ]	504	504	NOx_Zero_Setpoint [ppb]	[ ]	[ ]	1	3	LinSens
[ ]	400	400	NO_Zero [ppb]	[ ]	[ ]	1	1	LinSens
[ ]	500	500	NO_Zero_Setpoint [ppb]	[ ]	[ ]	1	1	LinSens
[ ]	62	62	PMTSigAuto0 [Hz]	[ ]	[ ]	1	12	LinSens
[ ]	60	60	PMTSigNO [Hz]	[ ]	[ ]	1	10	LinSens
[ ]	61	61	PMTSigNOx [Hz]	[ ]	[ ]	1	11	LinSens
[ ]	22	22	PMTTemp [°C]	[ ]	[ ]	1	7	LinSens
[ ]	81	81	PowerToMoly [%]	[ ]	[ ]	1	14	LinSens
[ ]	94	94	PowerToPeltier [%]	[ ]	[ ]	1	24	LinSens
[ ]	80	80	PowerToRCell [%]	[ ]	[ ]	1	13	LinSens
[ ]	16	16	PressNO [mbar]	[ ]	[ ]	1	20	LinSens
[ ]	10	10	PressNOx [mbar]	[ ]	[ ]	1	4	LinSens
[ ]	214	214	RCellPressNO [mbar]	[ ]	[ ]	1	27	LinSens
[ ]	215	215	RCellPressNOx [mbar]	[ ]	[ ]	1	28	LinSens
[ ]	20	20	RCellT [°C]	[ ]	[ ]	1	5	LinSens

Save Delete

Figure 7.96.: Parameter overview: Part5

O3Sensor

	ID	Internal Id	Name	Visible	Overview	Group	ParamId	Software
☐	27	27	BenchTO3 [°C]	☐	☐	3	3	LinSens
☐	229	229	Flow_A [ml/min]	☐	☐	3	23	LinSens
☐	230	230	Flow_B [ml/min]	☐	☐	3	24	LinSens
☐	222	222	LampCurrO3 [mA]	☐	☐	3	22	LinSens
☐	87	87	LampPower [%]	☐	☐	3	13	LinSens
☐	5	**5**	**O3 [ppb]**	☑	☑	**3**	**1**	**LinSens**
☐	154	154	O3_all [ppb]	☐	☐	3	14	LinSens
☐	211	211	O3_A_raw [ppb]	☐	☐	3	20	LinSens
☐	212	212	O3_B_raw [ppb]	☐	☐	3	21	LinSens
☐	174	174	O3StdDev [ppb]	☐	☐	3	15	LinSens
☐	408	408	O3_Zero [ppb]	☐	☐	3	1	LinSens
☐	508	508	O3_Zero_Setpoint [ppb]	☐	☐	3	1	LinSens
☐	207	207	PhotoOutMeas_A [Hz]	☐	☐	3	16	LinSens
☐	208	208	PhotoOutMeas_B [Hz]	☐	☐	3	17	LinSens
☐	209	209	PhotoOutRef_A [Hz]	☐	☐	3	18	LinSens
☐	210	210	PhotoOutRef_B [Hz]	☐	☐	3	19	LinSens
☐	84	84	PowerToBenchO3 [%]	☐	☐	3	11	LinSens
☐	12	12	PressO3 [mbar]	☐	☐	3	2	LinSens
☐	29	29	SampleTempO3 [°C]	☐	☐	3	5	LinSens

Save Delete

Figure 7.97.: Parameter overview: Part6

SO2Sensor

	ID	Internal Id	Name	Visible	Overview	Group	ParamId	Software
☐	36	36	BenchTSO2 [°C]	☐	☐	6	3	LinSens
☐	217	217	FlasherHV [V]	☐	☐	6	24	LinSens
☐	228	228	FlowSO2 [ml/min]	☐	☐	6	27	LinSens
☐	77	77	HVPSSO2 [V]	☐	☐	6	5	LinSens
☐	92	92	IntensitySO2 [%]	☐	☐	6	14	LinSens
☐	218	218	PermTSO2 [°C]	☐	☐	6	25	LinSens
☐	72	72	PMTSigSO2 [Hz]	☐	☐	6	8	LinSens
☐	91	91	PowerToBenchSO2 [%]	☐	☐	6	12	LinSens
☐	219	219	PowerToPerm [%]	☐	☐	6	26	LinSens
☐	15	15	PressSO2 [mbar]	☐	☐	6	2	LinSens
☐	73	73	RefDetSO2 [mV]	☐	☐	6	9	LinSens
☐	6	**6**	**SO2 [ppb]**	☑	☑	**6**	**1**	**LinSens**
☐	155	155	SO2_all [ppb]	☐	☐	6	15	LinSens
☐	411	411	SO2_Span [ppb]	☐	☐	6	1	LinSens
☐	511	511	SO2_Span_Setpoint [ppb]	☐	☐	6	1	LinSens
☐	175	175	SO2StdDev []	☐	☐	6	17	LinSens
☐	410	410	SO2_Zero [ppb]	☐	☐	6	1	LinSens
☐	510	510	SO2_Zero_Setpoint [ppb]	☐	☐	6	1	LinSens

Save Delete

Figure 7.98.: Parameter overview: Part7

System

	ID	Internal Id	Name	Visible	Overview	Group	ParamId	Software
☐	31	31	AmbientTemp [°C]	☐	☐	4	8	LinSens
☐	69	69	ClimaActMode [%]	☐	☐	4	22	LinSens
☐	34	34	CoolerOutTemp [°C]	☐	☐	4	19	LinSens
☐	89	89	Coolerpercent [%]	☐	☐	4	20	LinSens
☐	134	134	Countdown [sec]	☐	☐	4	28	LinSens
☐	141	141	DC12V [V]	☐	☐	4	10	LinSens
☐	133	133	DC12V_Wtd [V]	☐	☐	4	27	LinSens
☐	142	142	DC15V [V]	☐	☐	4	11	LinSens
☐	140	140	DC5V [V]	☐	☐	4	9	LinSens
☐	132	132	DC5V_PC [V]	☐	☐	4	26	LinSens
☐	143	143	DCneg15V [V]	☐	☐	4	12	LinSens
☐	88	88	FanPumpRoomPercent [%]	☐	☐	4	15	LinSens
☐	71	71	FanPumpRoomRPM [rpm]	☐	☐	4	13	LinSens
☐	70	70	FanSampleRPM [rpm]	☐	☐	4	14	LinSens
☐	243	243	FanUpSpeed [rpm]	☐	☐	4	37	LinSens
☐	90	90	HeaterPercent [%]	☐	☐	4	21	LinSens
☐	131	131	MissingBoards [Boards]	☐	☐	4	25	LinSens
☐	13	13	PressPump [mbar]	☐	☐	4	1	LinSens
☐	32	32	PumpRoomTemp [°C]	☐	☐	4	7	LinSens
☐	135	135	Restarts []	☐	☐	4	29	LinSens
☐	136	136	RestartSLT []	☐	☐	4	30	LinSens
☐	33	33	RoomTemp [°C]	☐	☐	4	18	LinSens
☐	226	226	RoomTempUp [°C]	☐	☐	4	35	LinSens
☐	130	130	RSCommunikation [message/sec]	☐	☐	4	24	LinSens
☐	47	47	TempChipWatchdog [°C]	☐	☐	4	32	LinSens
☐	38	38	Temp_PC [°C]	☐	☐	4	31	LinSens

Save Delete

Figure 7.99.: Parameter overview: Part8

TDC3

	ID	Internal Id	Name	Visible	Overview	Group	ParamId	Software
☐	12045	12045	Class10 Motorcycle [n]	☐	☐	2	16	LinLog
☐	12051	12051	Class11 Van [n]	☐	☐	2	17	LinLog
☐	11991	11991	Class1 Car [n]	☐	☐	2	7	LinLog
☐	11997	11997	Class2 Car w Trailer [n]	☐	☐	2	8	LinLog
☐	12057	12057	Class32 small [n]	☐	☐	2	18	LinLog
☐	12063	12063	Class33 big [n]	☐	☐	2	19	LinLog
☐	12003	12003	Class3 Truck [n]	☐	☐	2	9	LinLog
☐	12009	12009	Class4 Truck w Trailer [n]	☐	☐	2	10	LinLog
☐	12015	12015	Class5 Bus [n]	☐	☐	2	11	LinLog
☐	12021	12021	Class6 Unknown [n]	☐	☐	2	12	LinLog
☐	12027	12027	Class7 Car [n]	☐	☐	2	13	LinLog
☐	12033	12033	Class8 Truck w Trailer [n]	☐	☐	2	14	LinLog
☐	12039	12039	Class9 Semi-trailer [n]	☐	☐	2	15	LinLog
☐	11967	11967	Length [m]	☐	☐	2	3	LinLog
☐	11973	11973	Occupancy [s]	☐	☐	2	4	LinLog
☐	11961	11961	Speed [kmh]	☐	☐	2	2	LinLog
☐	11985	11985	Status []	☐	☐	2	6	LinLog
☐	11979	11979	Time Gap [s]	☐	☐	2	5	LinLog
☐	11955	11955	Vehicles [n]	☐	☐	2	1	LinLog

Save Delete

Figure 7.100.: Parameter overview: Part9

7.7.5.14. Standards

The User Interface has a function to setup all measurement parameters to FRM/FEM (US-EPA) or EN approved mode. With a single click the airpointer® is ready to operate in compliance to e.g. US-EPA standards.

Figure 7.101 shows a system where some measurement parameters where edited. These differ from the default settings which are in conformity to US-EPA standards.

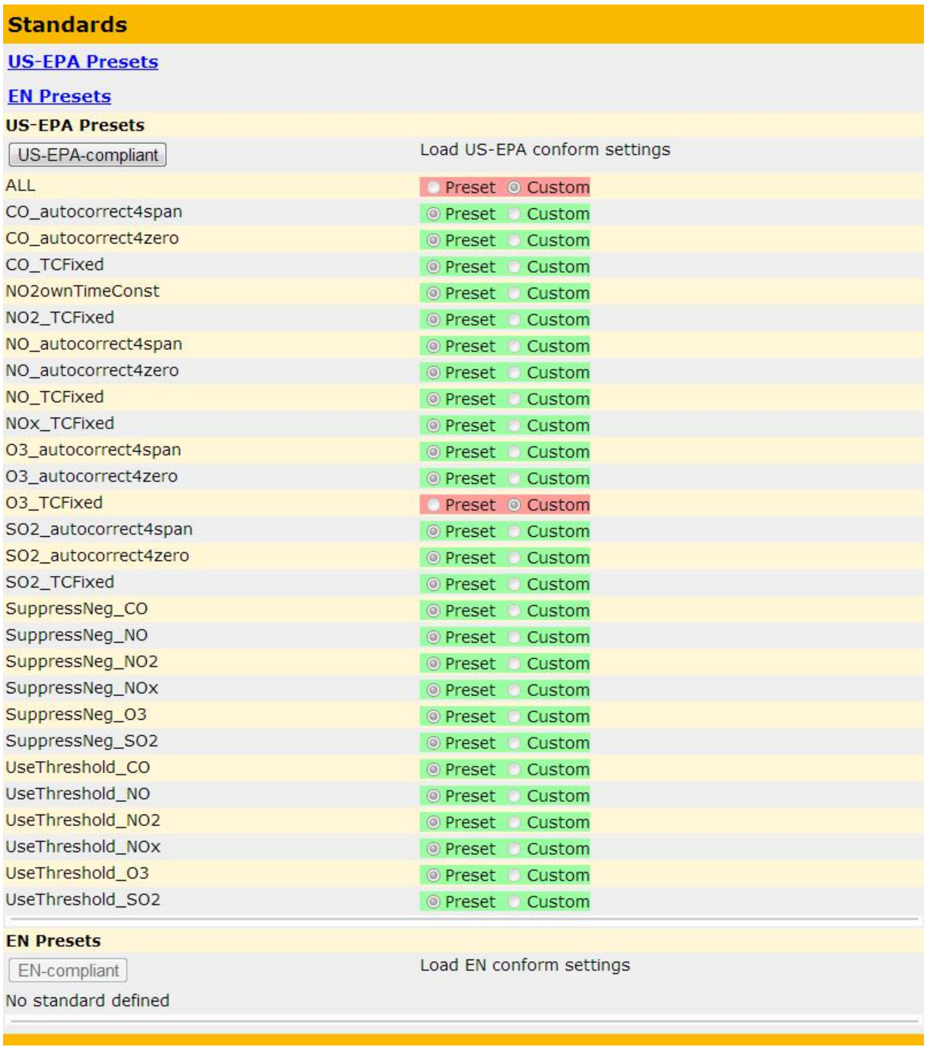


Figure 7.101.: Measurement Parameters not conforming to US-EPA presets

Click on **US-EPA compliant** to load the default parameters and therefore allow an EPA-conform measurement. Figure 7.102 shows the airpointer® with EPA compliant settings.

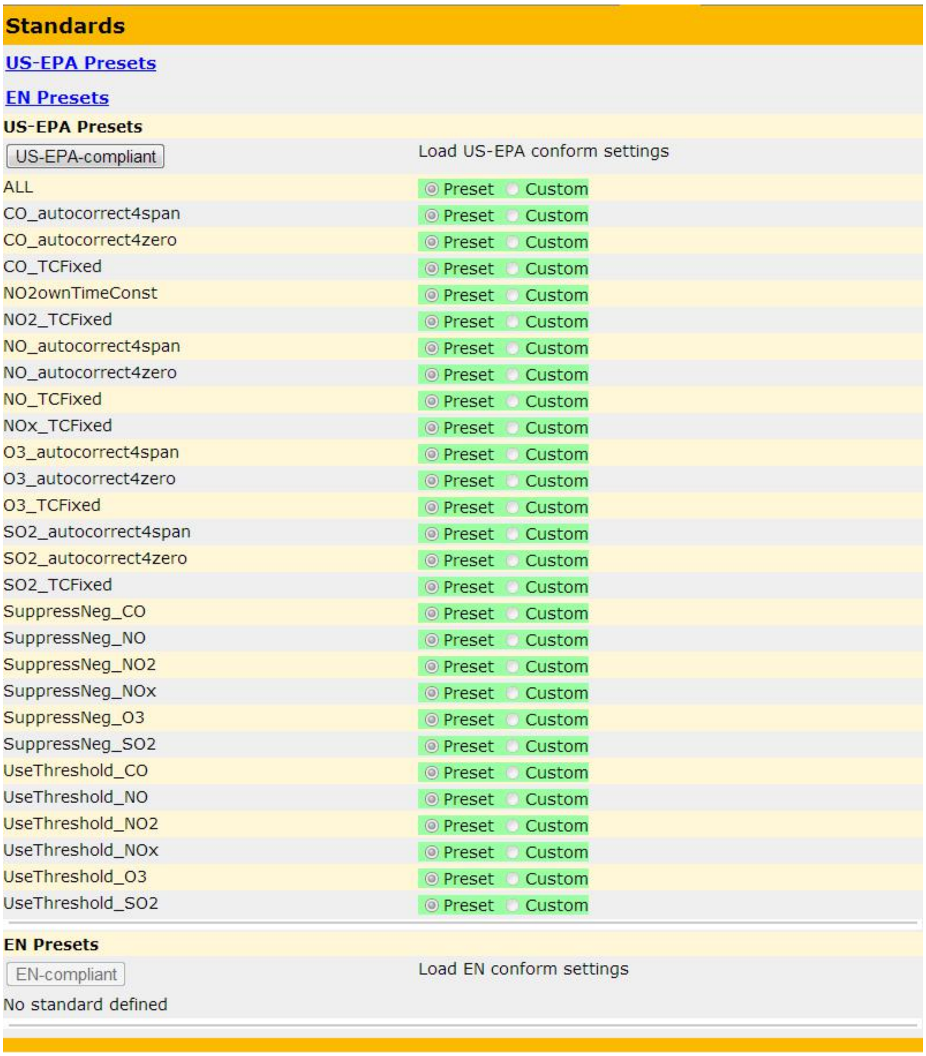


Figure 7.102.: All measurement parameters are in conformity to the US-EPA presets

7.7.5.15. Synchronization

The synchronization process takes place automatically, e.g.: after installation of a new analyzer. To install a new analyzer see Chapter 7.7.6 ‘LinLog’.

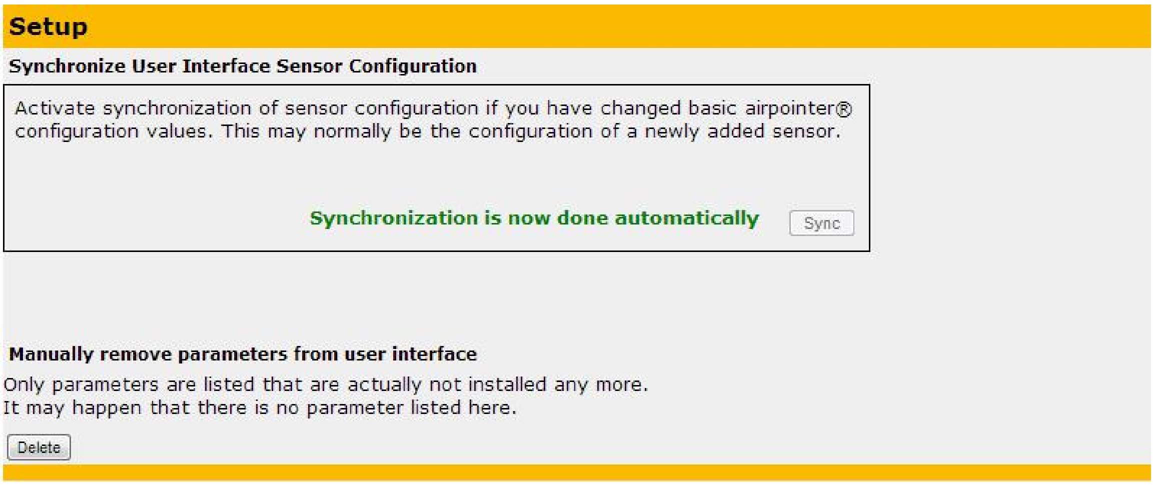


Figure 7.103.: Synchronization Interface

7.7.5.15.1. Manually remove parameters from user interface If you change your selection of used parameters the old ones are still listed e.g.: in the ‘Graph’ section (see section 7.2.2.1) marked with ’na’ but are not actualized. Here (see Figure 7.103) you find a list of these parameters.

If you are sure that you do not need one of these parameters any more you can permanently delete it from the list by clicking ’delete’. Then the parameter is not shown and the respective measurement data can not be downloaded any more.

CAUTION:

If a parameter is permanently deleted the respective measurement data can not be downloaded any more!

7.7.6. LinLog

7.7.6.1. Configuration

You have 6 COM ports available to connect analyzers. This part of the Software allows you to add, edit or delete these external devices. Furthermore it is possible to choose which parameters should be stored and added to calculation.
Figure 7.104 shows an overview of already connected devices. In the top part you see current system settings. To set these see Section 15.3.

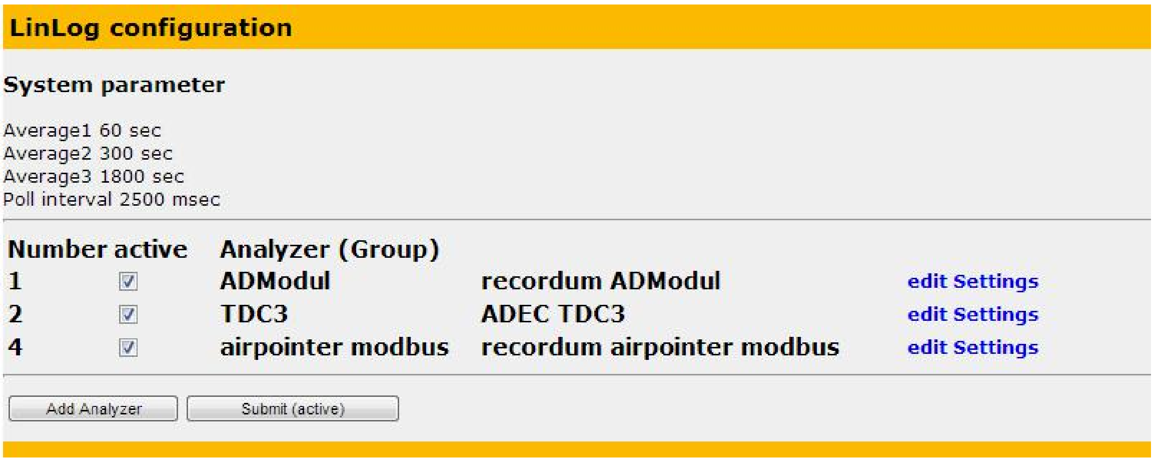


Figure 7.104.: Already connected devices (example)

The following list explains all available functions 7.104:

- **Add Analyzer:** Click to install a new analyzer.
- **Submit (active):** When you change the 'active' status of a device click 'submit' to confirm the change in status.
- **Restart to read in changes:** After editing the settings of an already connected device or after you have connected a new analyzer you have to restart the corresponding software to get the changes take effect by clicking this button.
- **Edit Settings** Change the settings of a device. See also section 7.7.6.1.

See the following section for a detailed explanation of these functions.

Add a new analyzer

> **CAUTION:**
>
> **Please choose the name of your device and the parameters carefully. If you change it afterwards you cannot download data which was saved with the old name any more!**

Click 'Add Analyzer' in Fig. 7.104 and you get Fig 7.105.

Figure 7.105.: Add new device

Select the company and the analyzer and submit your choice. If you want to connect the analyzer by LAN you have to choose the 'LAN' version listed.

> **NOTE**
> **If you do not find your device in the list, check whether the analyzer supports one of the standard protocols. If not, please contact your distributor.**

You get additional information about the analyzer as shown in Figure 7.105. The lines below the bars show you the number of your device, the brand and name of the analyzer and the COM Port to which it is connected. After initial creation it will show COM 0 (Baud,Data Bits, Stop Bit, parity) written in red. COM 0 is not a valid number and you have to change the COM port as shown at page 7-127. If you have chosen a LAN analyzer you can skip to 7.7.6.1.

Note:

Shows you how you have to configure the RS232 of your analyzer so that your analyzer and the airpointer® can communicate with each other.

Parameters:

NOTE
Only selected parameters are stored and can be downloaded! If you unselect a parameter it cannot be downloaded any more. This is also valid for values which have been stored till the change!

Below the parameters are listed which the airpointer® can read out. Mark all parameters which are of interest for you and click 'submit' to confirm your choice. Please keep in mind that you can only download parameters which you have chosen. If you change your selection of parameters, parameters which are not still selected cannot be downloaded anymore.

COM Port Setup
Choose COM Port: The Com Port is set to COM1 (see Figure 7.106). If this Com Port is not free you have to change it. All COM Ports are listed including which device or group is connected to it. Select the COM Port to which you have connected your device. Now click 'Finish!' and accept the preset parameters for the COM port.

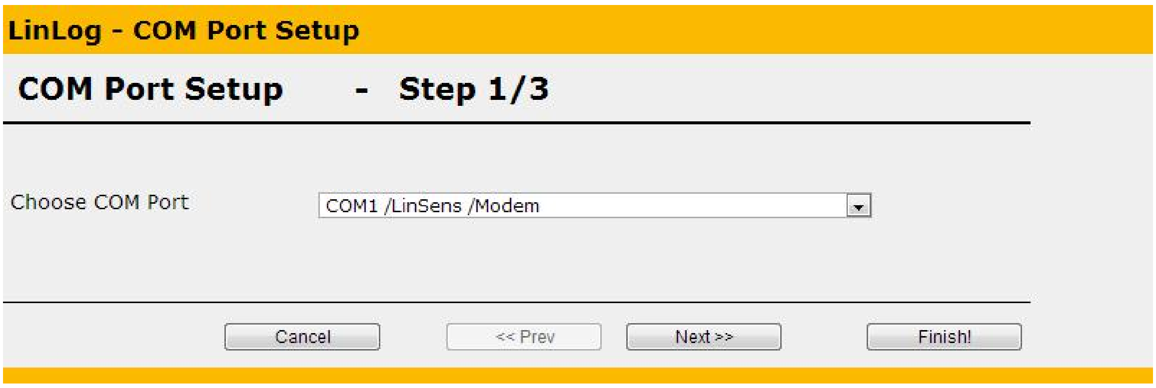


Figure 7.106.: Select the communication port: Step1

COM port Setup:
If you need expert settings for COM Port than you can go on with 'next' to set further details as shown in Figures 7.107 and 7.108.

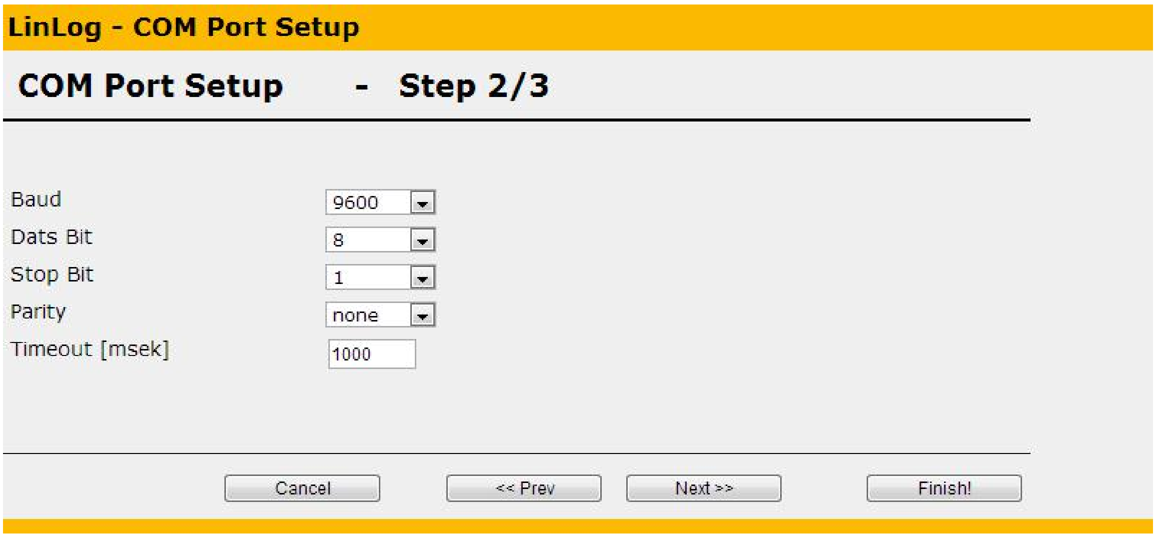


Figure 7.107.: Select the communication port: Step2

Timeout:

The time the airpointer® waits to get an answer from the device. A typical value is 1 second. You can check whether the time is set correctly, if you observe the communication of the RS232 interface.

Figure 7.108.: Select the communication port: Step3

You may also change low level RS232 communication protocols. Enter the appropriate settings for the COM port and click ’Finish!’ .

IP Setup

If you have added an analyzer bay LAN you have to edit your and the analyzers IP address manually.

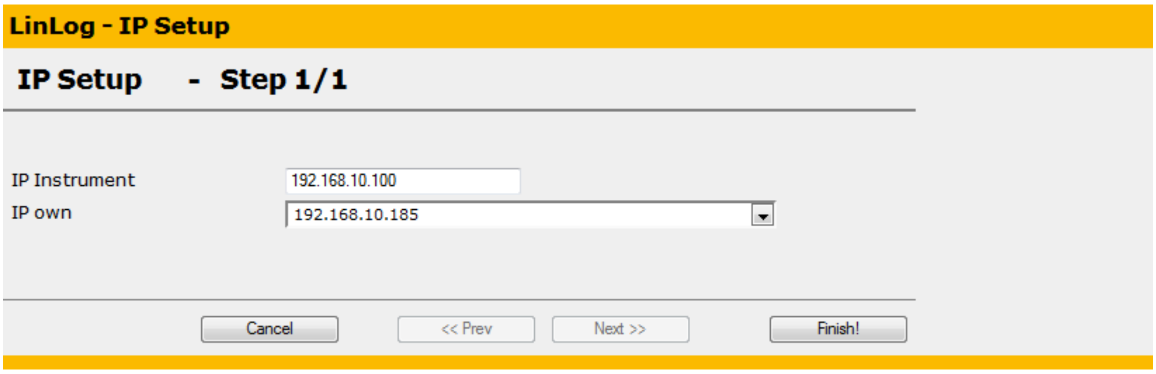


Figure 7.109.: select the IP address of your device and your analyzer

Calibration Timing:

The 'Calibration Timing' can be set for each source once. (It is no calibration but a calibration or function control.) The calibration of the analyzer is not changed.

Figure 7.110.: Select calibration timing: Step1

Starttime:

Select a date/time (year,month,day,hour) when the calibration control should start initially.

Interval:
Choose an interval when the calibration control should be repeated in hours.

Go on to Step 2 with 'next' to set timing during the function control.

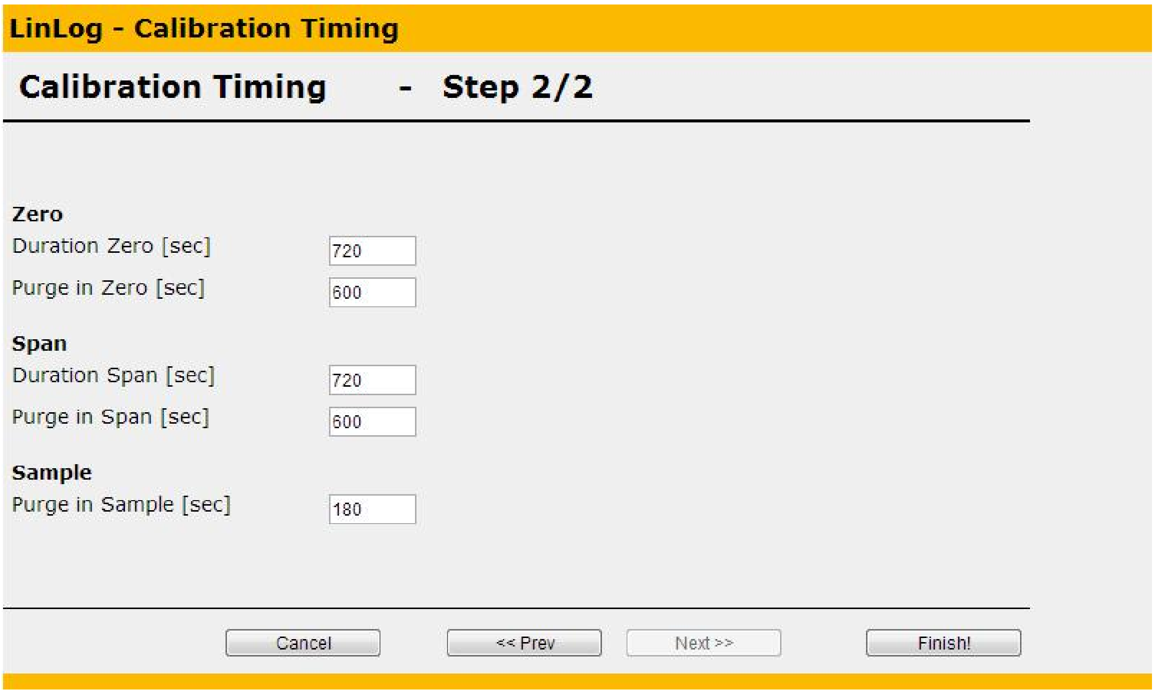


Figure 7.111.: Select calibration timings: Step2

Zero: The analyzer is set to Zero measurement
Duration Zero [sec]: How long the device is set to Zero measurement in seconds.
Purge in Zero [sec]: Duration of purge in in seconds.
The measurement values after the purge in time till the end of the duration time will be averaged. This value will be taken over as new zero value into the database.

Span: The device is set to Span measurement
Duration Span [sec]: How long the device is set to Span measurement in seconds.
Purge in Span [sec]: Duration of purge in in seconds.
The measurement values after the purge in time till the end of the duration time will be averaged. This value will be taken over as new span value into the database.

Sample: The device is set to sample measurement
Purge in Sample [sec]: Purge in time in seconds.
After the purge in time the standard measurement takes place till the next calibration control according to the set interval. The measurement values are stored in the database.

Parameter Setup:
The parameters of your analyzer (see in Figure 7.105) are listed (see Figure 7.112). Here you can rename a parameter and set slope and offset, averaging and calibration values.

Figure 7.112.: Choose Parameters: Step1

Select one parameter and go on with ’next’.

Step 2: see Figure 7.113.

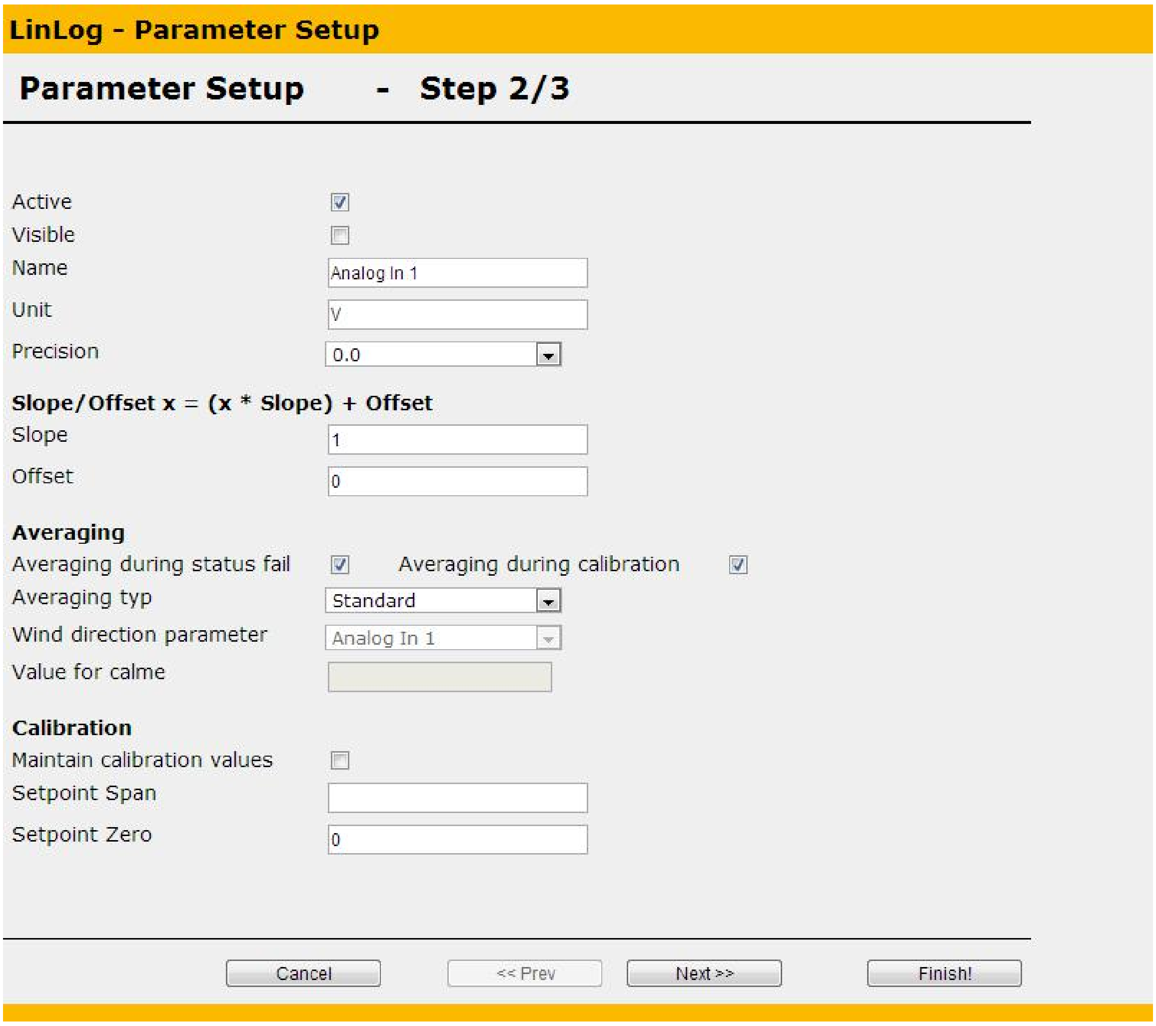


Figure 7.113.: Choose Parameters: Step2

Active: If you want to save this parameter click 'active'
Name: Select a name for this parameter
Unit: Write the unit in which your parameter is saved
Precision: The precision of the saved value (numbers after the separator)

CAUTION:

Please choose the name of your parameter carefully. If you change it afterwards you cannot download the values which were saved with the old name any more!

Slope/Offset:
Here you can set Slope and/or Offset for your parameter. This can be useful e.g.: to save all values in °C instead of Kelvin or vice versa.

Averaging:
Choose if 'Averaging during status fail' and/or 'Averaging during calibration' should take place and its values should be saved in the database.
Averaging type: Choose kind of averaging: standard, last value, wind speed vector or wind direction value.
Wind direction parameter and value for calm: if you have chosen wind speed vector or wind direction value you can set this parameters according to your needs.

Calibration:
Maintain calibration values: Click if you want so save the values during the calibration control.
Setpoint Span and Setpoint Zero: Fill in the values for your device.

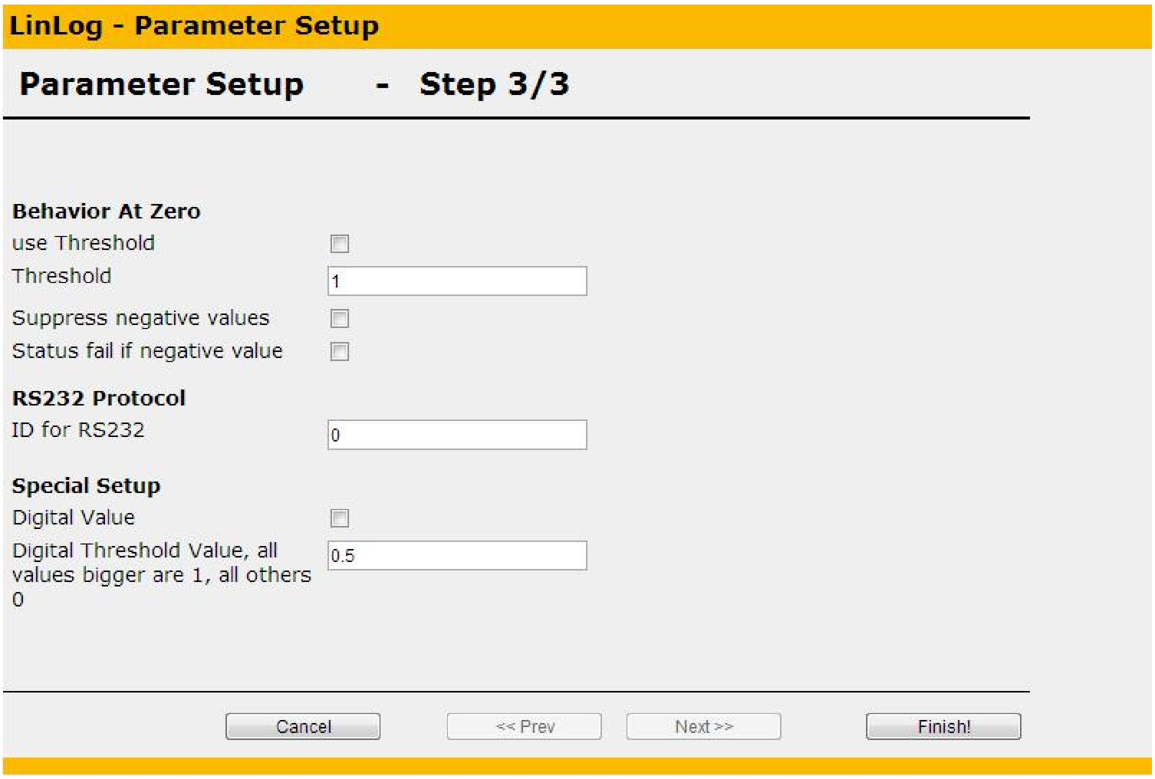


Figure 7.114.: Behavior at zero

Save the parameters of the 'Parameter Setup' by clicking 'Finish'.

Parameter Calculation Setup

You can carry out some calculations with parameters of connected analyzers. If you want to rename a parameter see page 7-132.

Step 1: Select one of listed parameters of the chosen analyzer an go on with 'next'

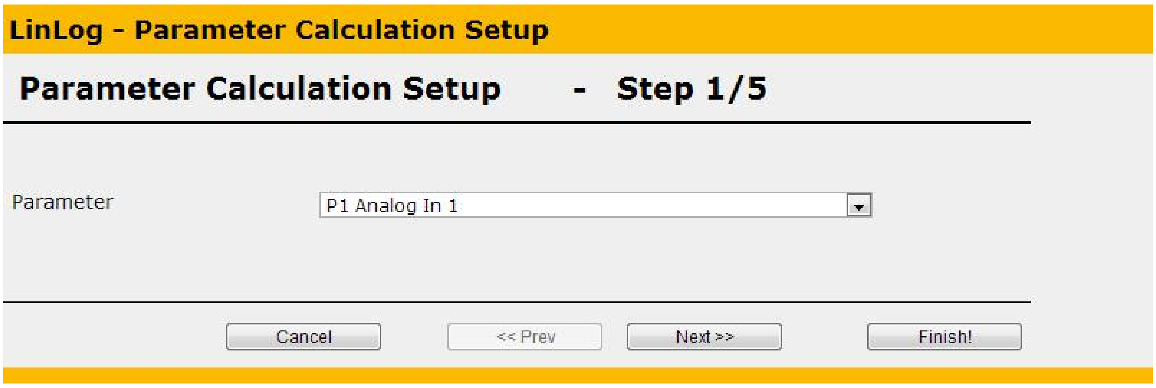


Figure 7.115.: Calculations: Step1

Step2: As shown in Figure 7.116 you can choose between a 'Fixed Value' or a measurement value. For the last click 'Input' and select a 'Source' (all possible sources/analyzers are listed) and a 'Channel' (all parameters are listed) and go an with 'next'.

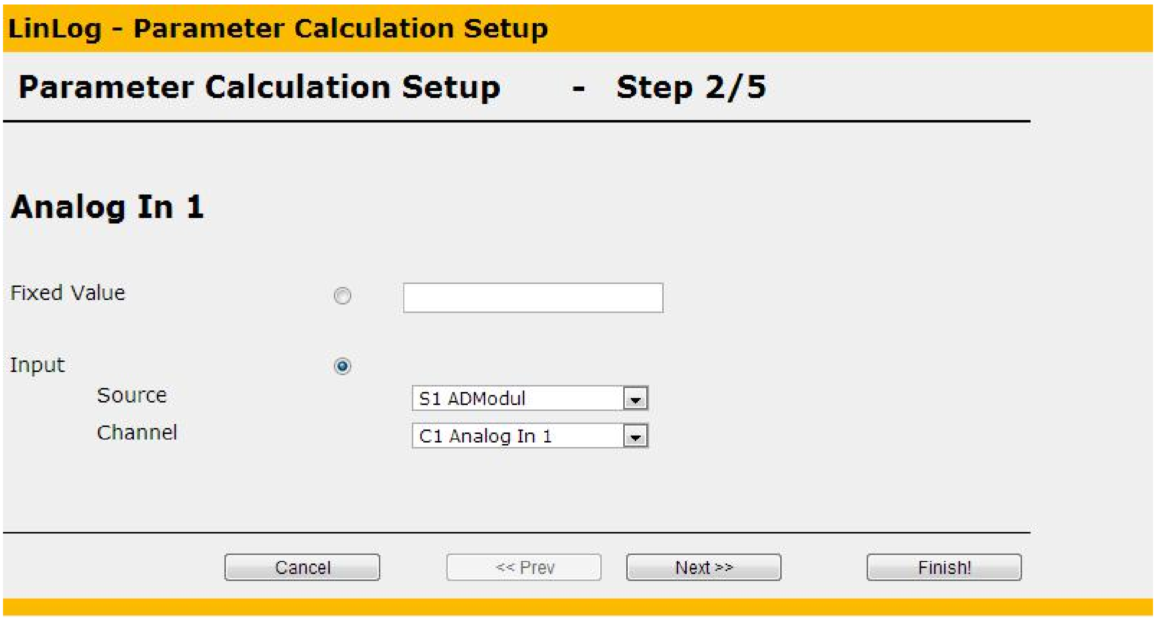


Figure 7.116.: Calculations: Step2

Step3 - Step5:
Here you can make some specialized calculations with your parameters.

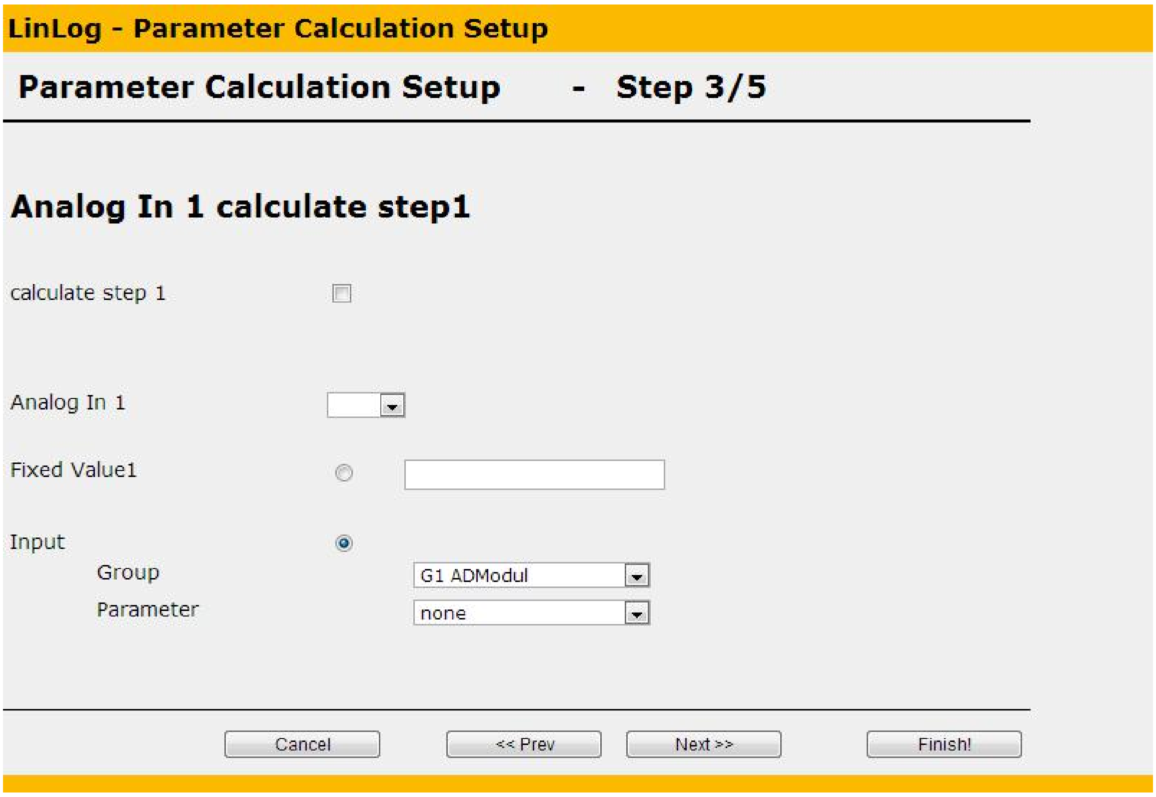


Figure 7.117.: Calculations: Step 3 - Step 5

- Click 'calculation step1'.
- Choose a calculation operation.
- If the calculation takes place with a fixed value fill in 'Fixed Value1'.
- Otherwise mark 'Input' and select a Group (analyzer) and a parameter from this group.

If you need a more specialized calculations go on with 'next' to step 4 and 5. Else go on with 'Finish!'. Then the calculations will be saved.

Group Setup

CAUTION:

Please choose the name of your device carefully. If you change it afterwards you cannot download the values which were saved with the old name any more!

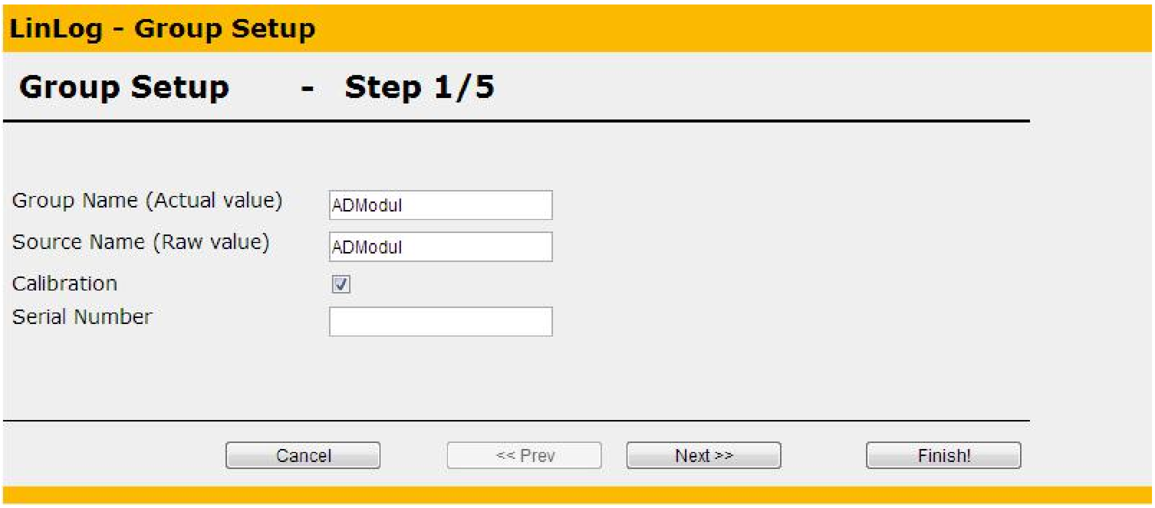


Figure 7.118.: Group: Step1

Group Name: Name of the device for the 'Actual Values'.

Source Name: Name of the device for the 'Raw Values'.

Calibration: Here you can select if a calibration control should take place. If yes, you have to fill in the 'Calibration Timing' (see page 7-130) to set up the calibration.

If you want to change the communication protocol proceed with 'next' (see Figure 7.119) otherwise store the changes with 'Finish!'.

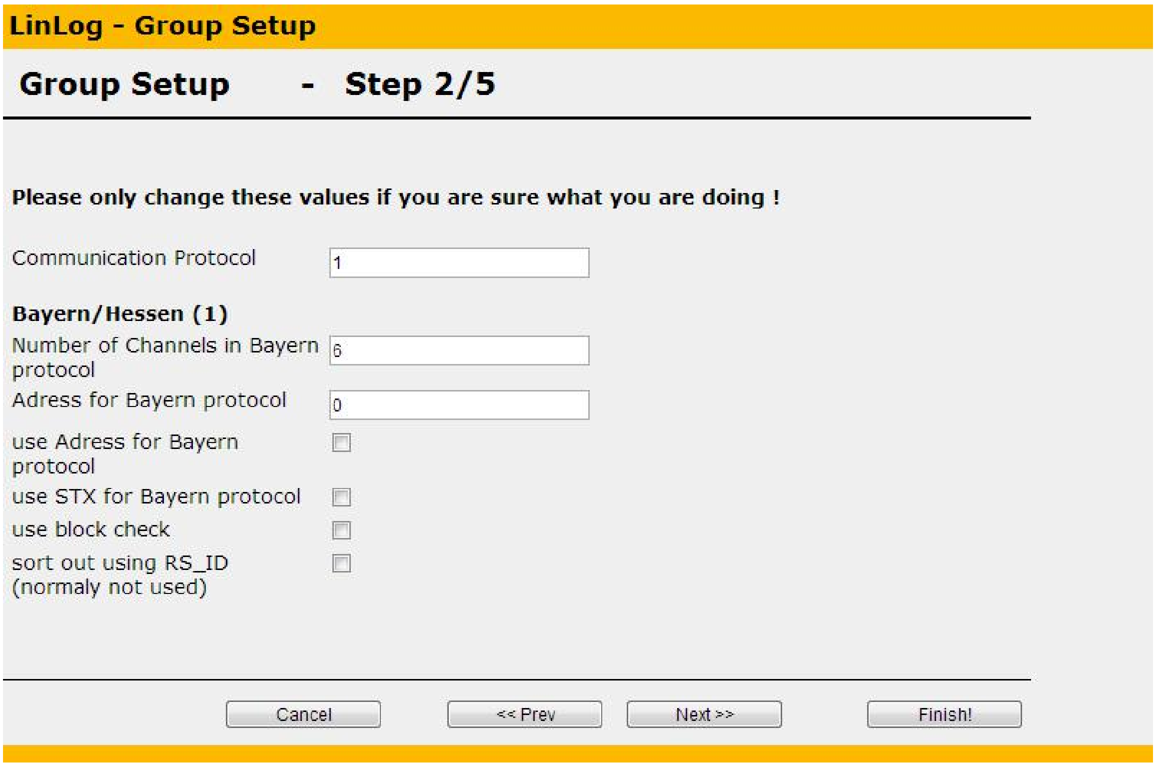


Figure 7.119.: Group: Step2

CAUTION:

Please only change the communication protocol if you are an expert!

Edit settings of an analyzer Choose the device you want to edit and click 'edit Settings'(see Fig. 7.104). You get Figure 7.105. Now you can change the settings as described in Paragraph 7.7.6.1.

NOTE
Only selected parameters are stored and can be downloaded! If you unselect a parameter it cannot be downloaded any more. This is also valid for values which have been stored before the change has been made!

Delete an analyzer Choose the device you want to delete and click 'edit Settings'(see Fig. 7.104). You get Figure 7.105. Now click 'Delete' beside the name of your device and confirm it.

7.7.7. LinOut

7.7.7.1. Configuration

Here you you get an overview of the parameters 'ID' , 'Register' and 'Name':

1. **ID**
   Here you find a number representing the internal channel.

2. **Register**
   This value stands for the modbus register number the internal channel is aligned to.

3. **Name**
   Here the values linked to the ID and its Register is shown.

LinOut Configuration

ID	Register	Name
1	0	NO
2	2	NO2
3	4	NOx
4	6	CO
5	8	O3
6	10	SO2
7	12	H2S
8	14	Part
9	16	
10	18	
11	20	
12	22	
13	24	
14	26	
15	28	
16	30	
17	32	RoomTemp
18	34	CoolerOutTemp
19	36	PumpRoomTemp
20	38	
21	40	NO
22	42	NO2
23	44	NOx
24	46	CO
25	48	O3
26	50	SO2
27	52	H2S
28	54	Part
29	56	
30	58	

Figure 7.120.: LinOut Values

LinOut Configuration:

---

1. **Modbus register**
   shows the number of the corresponding modbus register
2. **Parameter**
   here you can choose which value is to be shown
3. **Name**
   enables you to name the value as you like
4. **Unit**
   here you can change the output unit of the value
5. **Value Type**
   by choosing 1,2,3,4 or 5 you can change the actual properties of the value. 0 wil give you the actual value, 1,2 or 3 gives you an averaged value over a small amount (1), a medium amount(2) or a long amount of time. 4 gives you a zero value and 5 a span value.
6. **Comma**
   the number filled in represents the amount of decimal places
7. **Slope**
   is a multiplicative factor
8. **Offset**
   is an additive factor

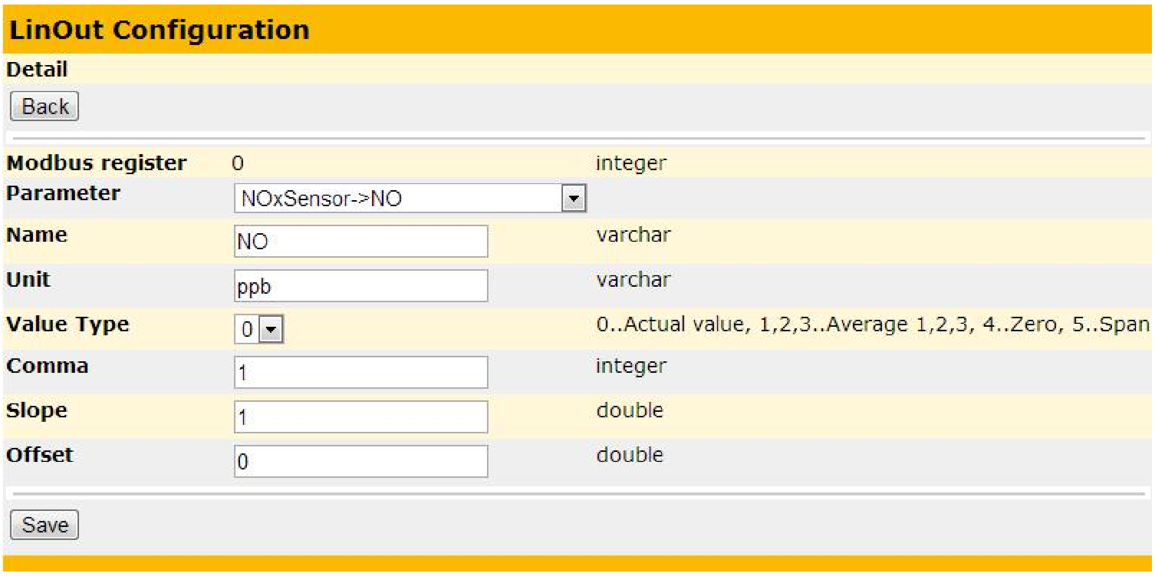


Figure 7.121.: LinOut Edit

7.7.8. Communication

Here you edit your settings on how to connect the airpointer® via a web browser.

> **NOTE**
> **All settings should only be made while being on-site and having connected your notebook using the RJ-45 connector LAN 2 in the maintenance access and the cross patch cable to the airpointer® (See 'Getting Started' in Section 5.7). Otherwise, you may permanently loose the remote access to the airpointer®!**

Please login as member of the group administrator of the airpointer® for the settings described in the following.

In case of any doubt concerning the terms used in this menu item, contact your network administrator.

> **NOTE**
> **All new settings can seriously damage your system! Only proceed in case you are absolutely sure! If in doubt, please consult your network administrator!**

7.7.8.1. Nameserver

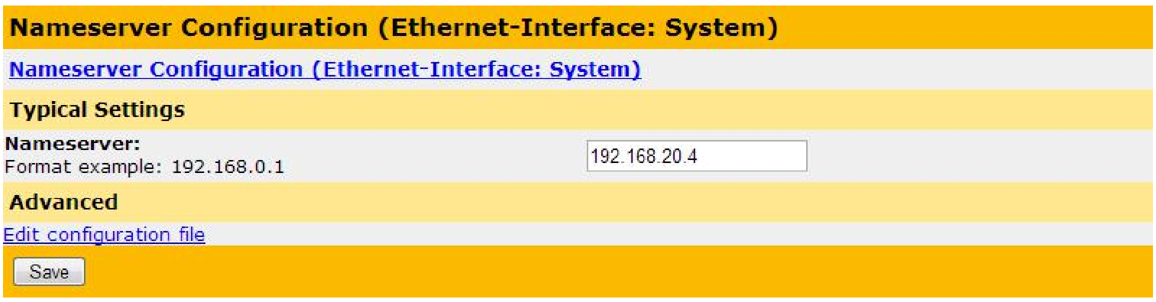


Figure 7.122.: Configuring Nameserver Settings

The standard settings can be configured as shown in Figure 7.122. Further details are listed if one click ' Edit configuration file' as shown in Figure 7.123.

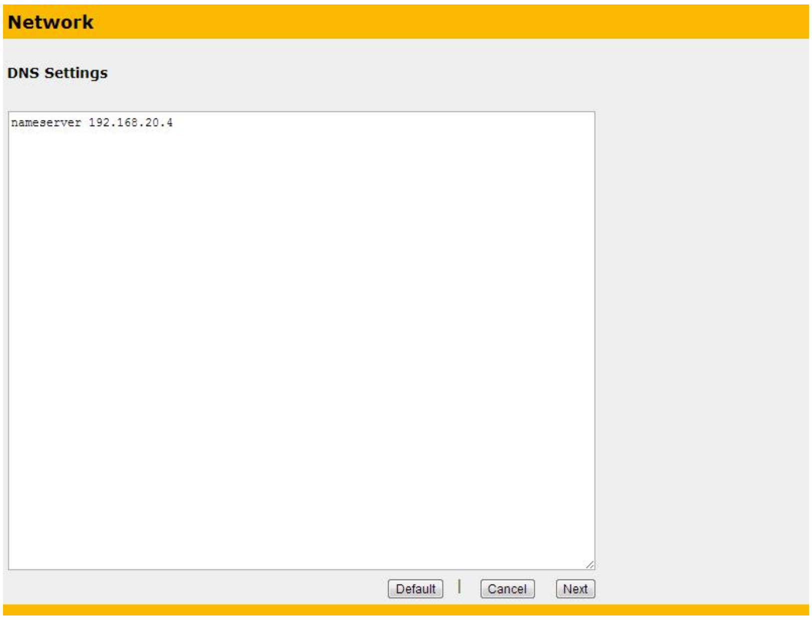


Figure 7.123.: Further Configuring DNS Settings

Please adjust only the following settings for the interface system according to your local network (see Figure 7.123). Your network administrator will provide you with the required data.
In this example your name server in the local network has the IP–address 192.168.0.4

```
nameserver 192.168.0.4
```

If this entry should not exist, please add it according to the example.
You can name up to three different servers.

7.7.8.2. Network

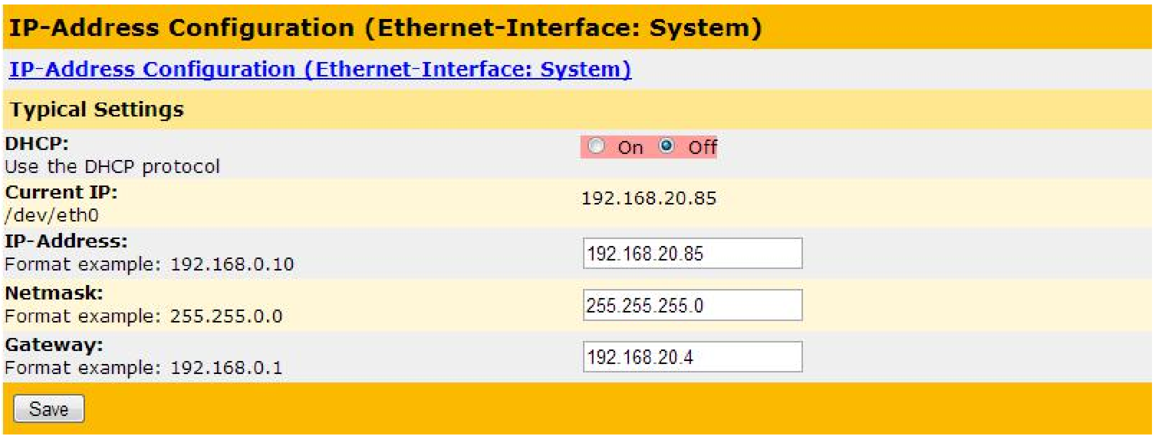


Figure 7.124.: Configuring Network Settings and IP Address of Network Interface 'System'

Settings made here relate to the network interface called ‘LAN 1’ in your airpointer® .
This interface is used if you want to integrate your airpointer® in a local network (LAN) (see Figure 7.124).
As an option, this interface can be used for connection with a Wireless LAN Router. Furthermore, you can establish via this interface an ADSL or SDSL connection to the Internet. You can connect the airpointer® to the Internet as well via this interface using a Cable Modem connection.
For further details concerning these special configurations of the airpointer® see Chapter 6 and please contact your distributor.
In the following you will find the settings for connecting the airpointer® to a LAN.

IP–Address The standard settings can be configured as shown in Figure 7.124.

All settings for the network interface will not be accepted, before newly starting the respective service by clicking ‘Start new’.
Please remember to only make changes of the interface if you are connected through the network interface ‘LAN 2’ (maintenance access) via Cross Patch Cable to the airpointer®.

7.7.8.3. DynDNS

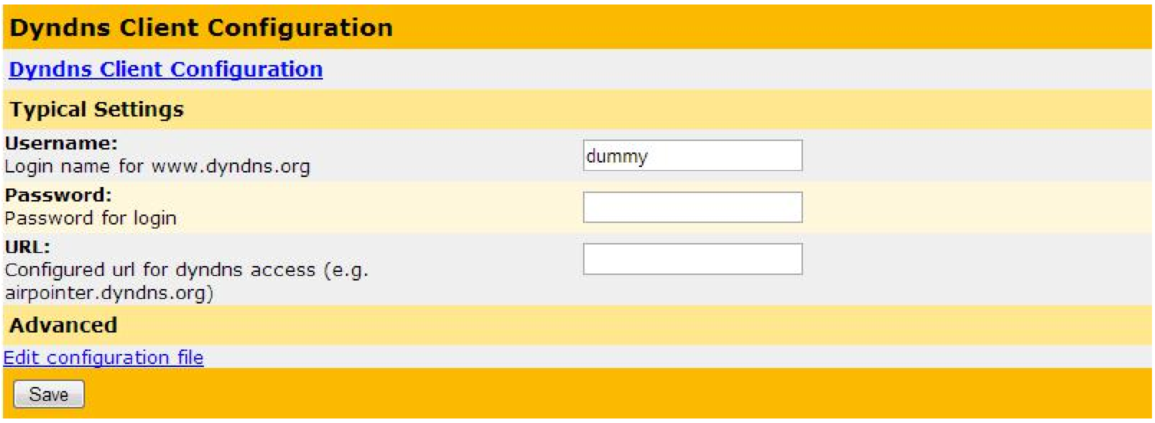


Figure 7.125.: DynDns Daemon

In case your airpointer® is connected via a GPRS Modem with the Internet Service Provider (ISP), the ISP assigns a dynamic IP–address, which will change. To make your airpointer® using a constant address, the DynDNS Service is used.
At that moment, when ISP assigns a new, dynamic IP–address to the airpointer®, a service on your airpointer® will report this new address to DynDNS.org (every 120 seconds, this service tests for a changed IP–address, so in the worst case your airpointer® can not be accessed for a maximum of 120 seconds after the ISP assigned a new, dynamic IP–address to the airpointer®). This procedure guarantees that you can always access your airpointer® via the Internet.

These services are provided for free by DynDNS.org for one e-mail address. The standard

settings can be configured as shown in Figure gprsdyn1. Further details are listed if one click ' Edit configuration file' as shown in Figure 7.126.

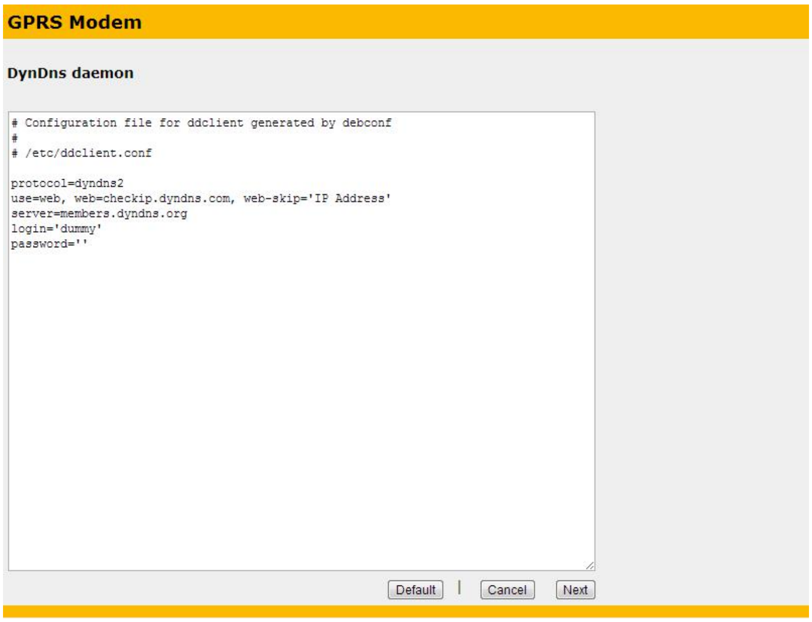


Figure 7.126.: Further details DynDns Daemon

How to gain the required DynDNS.org data:

1. Register on www.dyndns.org.
2. You will receive a confirmation mail to your mail address. After a successful log in you will select a name according to your wishes from Dynamic DNS, by which you later want to access your airpointer® via the Internet.
3. Please edit only the following settings (see also Figure 7.126):

```
login=your-login
password=your-password

server=members.dyndns.org,     \
protocol=dyndns2             \
your-dynamic-host.dyndns.org
```

login :

This is the user name of your registration with DynDNS.org.

password :

This is the password of your registration with DynDNS.org.

server :

Please do not make any changes here.

protocol :

Please do not make any changes here.

your-dynamic-host.dyndns.org :

Please change this line to your selected and registered name at DynDNS.org.

7.7.8.4. GPRS

Settings made here relate to the optional available GPRS Modem for your airpointer® . In the majority of cases you will only need to set these parameters according to your network provider settings.

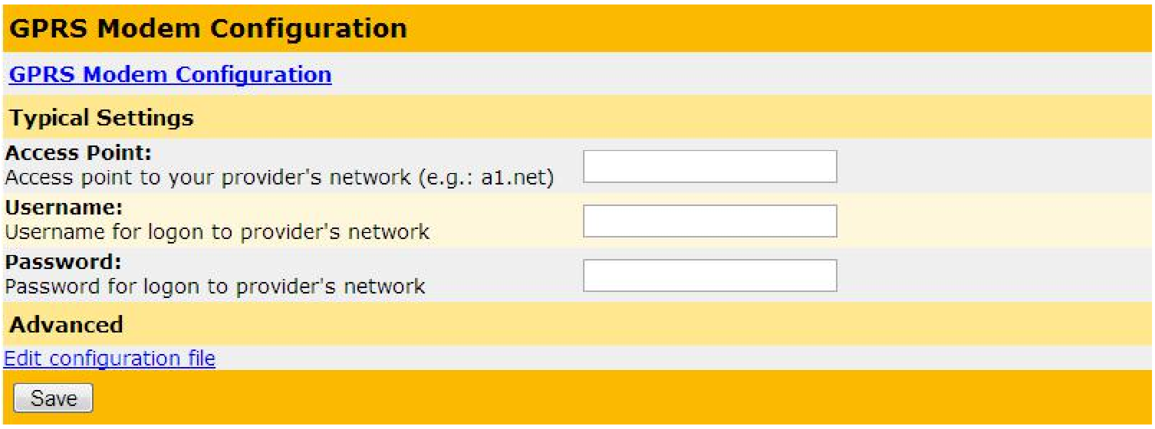


Figure 7.127.: Basic GPRS settings

In case you need advanced configuration, click on 'Edit configuration file'. In the following you will find a list of all editable parameters in the configuration file. Your local network provider will have information about these parameters for you.

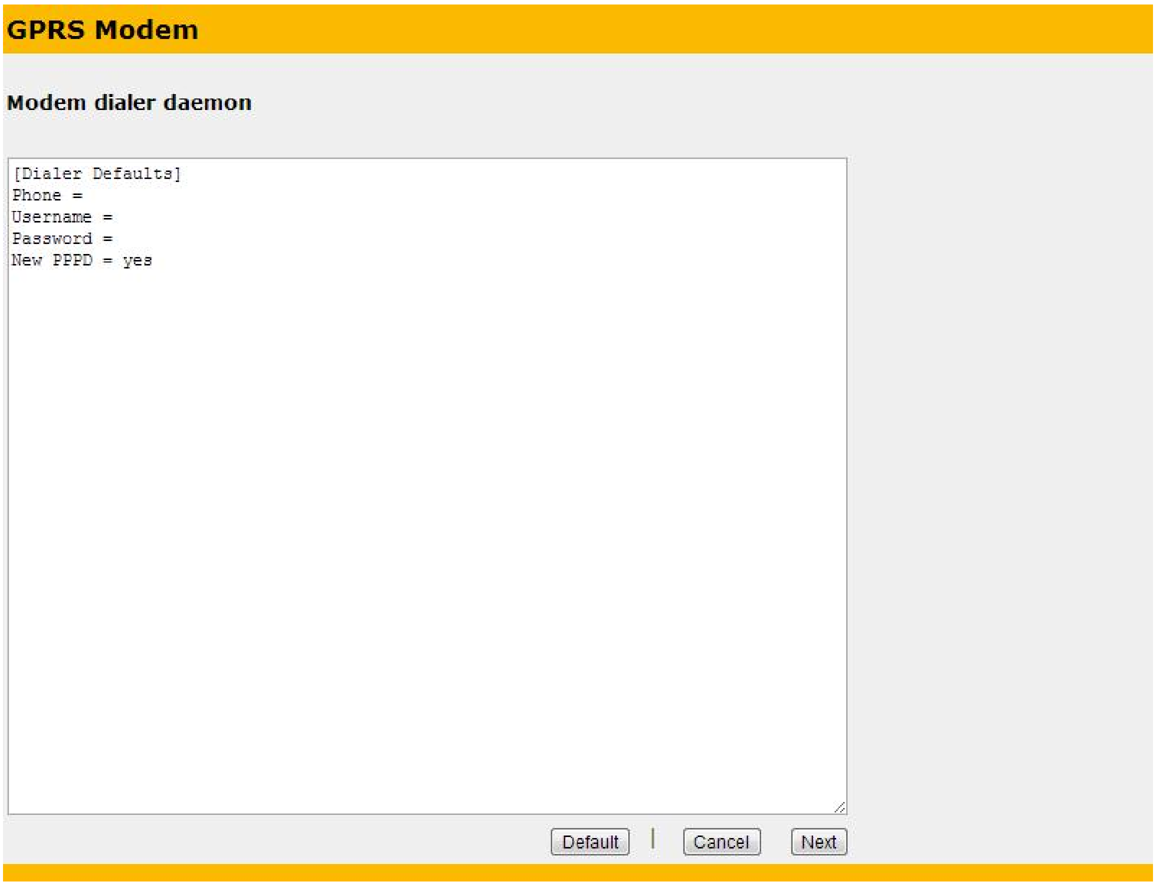


Figure 7.128.: Advanced GPRS settings

If the following entry does not exist in your configuration file, please add it. Clicking 'Default' enables to load the standard settings into the editor.

```
Init1 = ATZ
Init2 = AT+CGDCONT=1,ip,a1.net
Init3 = AT+CGQREQ=1,3,4,3,0,0

Phone = *99***1#
Username = ppp@a1plus.at
Password = whatever
Dial Command = ATDP
```

Init1 :

Do not change anything here, this command resets the modem.

Init2 :

Replace 'a1.net' by APN (Access Point Name) of your provider.

Init3 :

Do not change anything here, change the settings only according to your provider.

Phone :

Do not change anything here, change the settings only according to your provider.

Username :

Change the settings only according to your provider.

Password :

Change the settings only according to your provider.

Dial Command :

Change the settings only according to your provider.

7.7.8.5. Test Connectivity

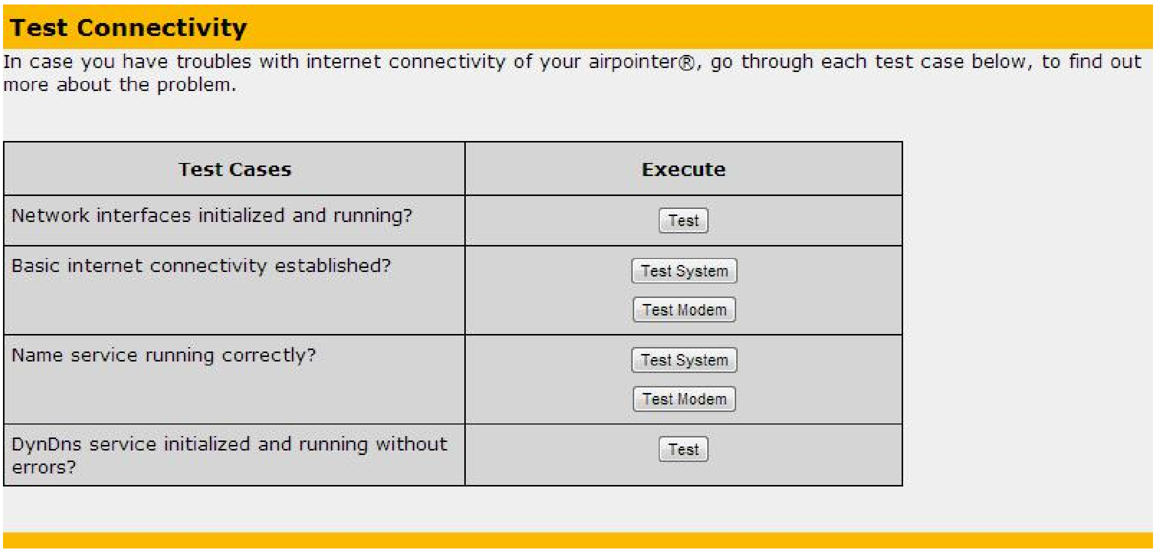


Figure 7.129.: Test Connectivity

In case of problems when connecting the airpointer® with the Internet, you can here systematically check some of the settings (see Figure 7.129).

NOTE
These tests can be made in any case while being onsite and having connected your notebook using the RJ-45 connector labeled LAN 2 and the cross patch cable to the airpointer® (See 'Getting Started' in Section 5.7).

For the following tests, please log in as member of the administrator group to the User Interface (http://172.17.2.140) of the airpointer®.
Click 'Test' in the respective line to carry out the tests described.

NOTE
We do recommend to carry out these tests from the beginning at the top to the end to narrow down the problem while trying to connect.

Network interfaces initialized and running?

This provides the initialized and running network interfaces for the time being

- System Interface
- User Interface
- Modem Interface

System Interface and User Interface must be running all the time. Should this be not the case, a hardware error of the respective network interface is likely to have occurred.
Further tests, in case the system should not be running:

1. Shut down the data acquisition system of your airpointer® by pressing both Maintenance Switches for at least 15 seconds.
2. Then press the switch Reset at the RDPP module to restart the data acquisition system.
3. Afterwards, repeat the test described above.
4. Now the System Interface should be running, if not, please contact your distributor's service.

The modem interface shows the status 'running' if a connection has been established with your mobile telephone network provider.
There is a variety of reasons if the modem interface shows 'not running'.

1. The option GPRS modem has not been installed in your airpointer®.
2. Has the SIM-card of your mobile telephone network provider been put in correctly?
3. Test the availability and signal-strength of the GPRS net of your mobile telephone network provider at the site of the airpointer®. The easiest way is using a mobile phone of the same provider.
4. The SIM-card of your mobile telephone network provider may be faulty or has not been cleared for GPRS. Please check the SIM-card in a mobile phone for proper function, especially GPRS function.
5. Did you deactivate the PIN query of your SIM-card? Again, the easiest way of checking is using your mobile phone.
6. Did you make all the GPRS settings in the menu item Setup ↠ Communication GPRS Modem ↠ Modem dialer daemon according to the instructions of your mobile telephone network provider? Please check these settings one more time. Ask the Helpdesk of your mobile telephone network provider concerning the settings of the configuration file. Especially, check the spelling of APN (Access Point Name), Phone, User name, Password, and furthermore, the additional parameter of Init1, Init2 and Init3, as well as the Dial Command.
7. In case you have the possibility, do use the SIM-card of an alternative network provider for testing.

Basic Internet connectivity established?

Depending on which interface you would like to test, click 'Test System' or 'Test Modem'. A Ping to an existing IP–address in the Internet will then be carried out.

System Interface

1. Should this Ping fail, check the setting of Setup ↠ Communication ↠ Network ↠ Gateway.
2. Furthermore, maybe there is no connection to the Internet using this network line at all, or the network cable has not been plugged in.

Modem Interface

If this Ping fails, but the test 'Internet connection existing?' for the modem interface has successfully established a connection with the Internet, please check again if the first test still shows a running modem interface.
Further tests, in case the system should not be running:

1. Shut down the data acquisition system of your airpointer® by pressing both Maintenance Switches for at least 15 seconds.
2. Then press the switch Reset at the RDPP module to restart the data acquisition system.
3. Afterwards, repeat the test described above.

Name service running correctly?

Depending on which interface you would like to test, click 'Test System' or 'Test Modem'. A Ping on www.recordum.com will be then carried out in the Internet for purpose of testing.

System Interface

1. Should this Ping fail, check the DNS setting for a valid and available name server in the local network.
2. Furthermore, maybe there is no connection to the Internet using this network line, or, the network cable has not been plugged in.

Modem Interface

If this Ping fails, but the test 'Internet connection existing?' for the modem interface has successfully established a connection with the Internet, the nameserver addresses of the modem have not been entered at all or in a wrong way.

Check in Setup ↠ Communication ↠ Network ↠ DNS (Nameserver addresses), whether the correct name server IP–addresses of your mobile phone network provider have been entered.
Normally, this entry is done automatically when successfully establishing a connection with the GPRS modem to your mobile phone network provider.
Anyway, you can enter a valid public nameserver address in this configuration file manually as well.

DynDns service initialized and running without errors?

This service provides the possibility of accessing your airpointer® using the Internet with your name selected and defined at DynDNS.
A successful entry of the forwarding of the current IP–address (assigned by your mobile phone network provider) looks the following:

```
Subject: status report from ddclient@airpointer
Date: Tue, 22 Mar 2005 13:03:40 -0100 (GMT+1)

SUCCESS: updating your-dynamic-host.dyndns.org: good: IP address set to
84.20.165.47
```

```
Subject: status report from ddclient@airpointer
Date: Tue, 22 Mar 2005 13:03:40 -0100 (GMT+1)

WARNING: cannot connect to members.dyndns.org:80 socket: IO::Socket::INET: Bad
hostname 'members.dyndns.org'
FAILED: updating airpointer.dyndns.org: Could not connect to members.dyndns.org
```

This message appears in case the DynDNS service could not establish a connection with DynDNS.
In this case, wait at least two minutes and then check again, if a successful connection with DynDNS could be established in the meantime (DynDNS is carried out each two minutes).

```
Subject: status report from ddclient@airpointer
Date: Tue, 22 Mar 2005 13:03:40 -0100 (GMT+1)

WARNING: caught SIGTERM; exiting
```

This message appears if the data acquisition system of your airpointer® has been shut down (or if single services with the GPRS modem have been automatically finished or restarted). It is a normal message and does not refer to an error.

7.7.9. User Interface

7.7.9.1. Groups

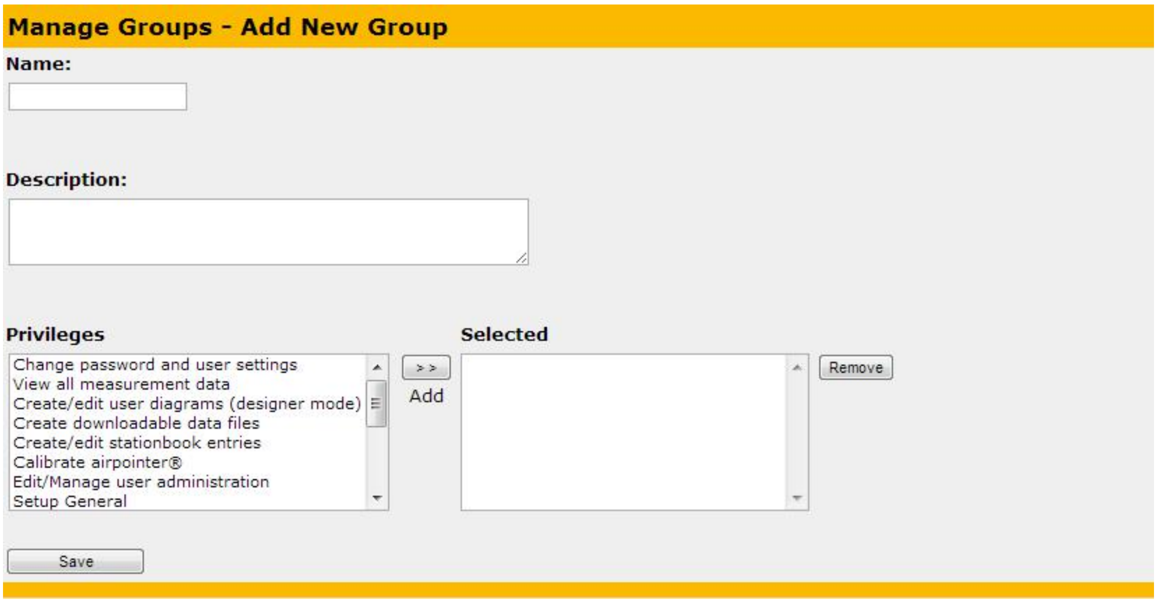


Figure 7.130.: Add New Group

The user administration of the User Interface of the airpointer® is divided into groups and users. All users are members of a group. The respective privileges for the visibility of the menu items are defined in the respective groups. The privileges of each single user depend on his belonging to the group.

7.7.9.1.1. New Group Here you can create one or more new groups according to your wishes. To do so, select a group name and as an option, a description. You will assign the privileges to the group by selecting the available privileges in the left field and add them to the current group by clicking '»'. You can take away privileges by selecting them in the right field and clicking 'Remove'. Creating a new group is reserved for users who are members of the group admin (or have similar privileges) (see Figure 7.130).

Figure 7.131.: Modify Group

7.7.9.1.2. Modify Group Here you can edit or delete already existing groups (see Figure 7.131). The standard groups ‘admin’ and ‘user’ can not be deleted. If you delete a group still containing members, only the group will be deleted, not the members themselves. These users are then assigned to the group ‘user’ (which can be edited later).

7.7.9.2. Users

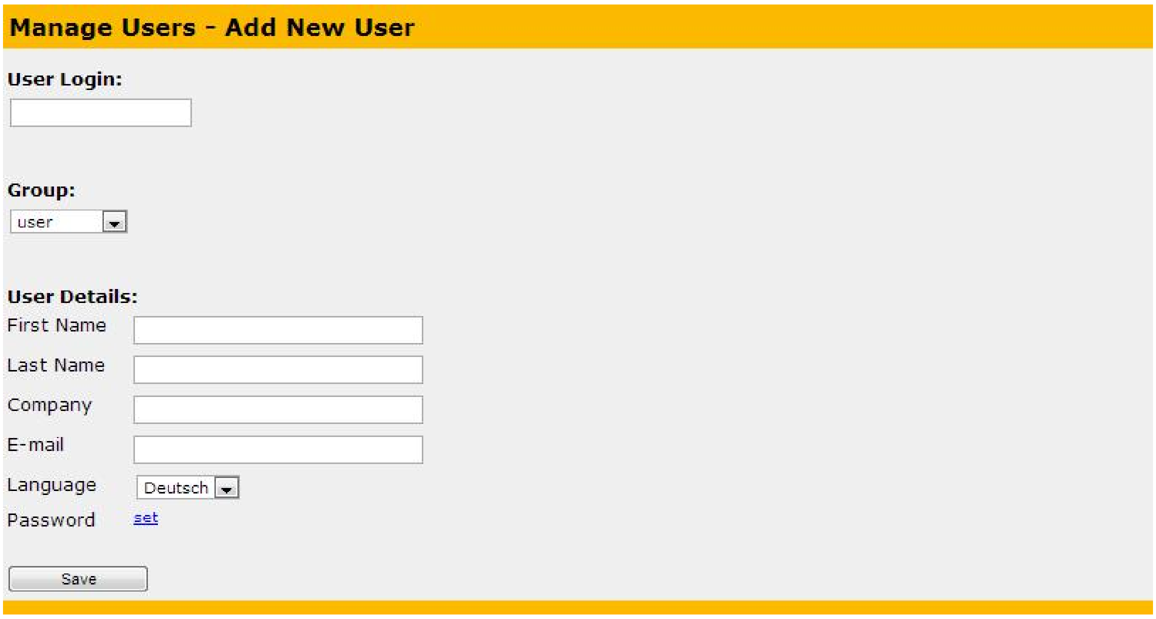


Figure 7.132.: Add New User

The user administration of the User Interface of the airpointer® is divided into groups and users. All users are members of a group. The respective privileges for the visibility of the menu items are defined in the respective groups. The privileges of each single user depend on his belonging to the group.

7.7.9.2.1. New User Here you can create users according to your wishes (see Figure 7.132). To do so, select a name for the user log in and assign it to the respective group.

Then enter name, surname, company and e-mail, these entries are optional.

For language, please select presetting for the language of the user surface for the respective user. Each user can change his language setting of the surface in the User Interface to the airpointer® at any time.

Password

Click 'set' and enter a password for the user just created. If you do not assign a password to the new user, the standard password 'airpointer' is used for this user. The user can change his password in the User Interface to the airpointer® at any time.

Creating a new user is reserved for users who are members of the group admin (or have similar privileges).

Figure 7.133.: Modify User

7.7.9.2.2. Modify User Here you can edit settings of already existing users by clicking the user name (see Figure 7.133).

The respective fields are analogous to those of creating a user.

Password

Here you can reset the password of the respective user, e.g. should the user have forgotten the password.

To do so, click 'set' and enter the password of the respective user.

Editing and deleting of an already existing user is reserved for users who are members of the group admin (or have similar privileges).

You can delete a user by ticking the respective user and clicking 'delete' (see also Figure 7.133).

7.7.9.3. Personal Settings

Figure 7.134.: Edit Personal Settings

Here you can edit your password to the User Interface of the airpointer®, and at any time change the language of the user interface for your account (see Figure 7.134).
You can define the start module as well, which is the module active after your log in.
The selection box 'Layout' provides you with selecting the layouts 'Simple' and 'Icons' of the User Interface to the airpointer®.
All these settings will be effective at once, a restart or a new login will be unnecessary in any case.

8. Operation in US-EPA FEM/FRM mode

The US-EPA designation for the airpointer® is only valid for the modules measuring the following gaseous compounds:

- SO_2
- NO, NO_x, NO_2
- CO
- O_3

8.1. EPA Requirements for Operation in FEM/FRM mode

Follow the instructions described in section 5.4 'Mounting and 5.6 'Initial start up'. The airpointer® automatically enters the measuring mode when it is switched on. Wait approximately one hour until all warnings have cleared. This will give you sufficient time to ensure the best possible temperature equilibration before taking any concentration reading.

If you are performing regulatory monitoring under EPA requirements, you must confirm that the airpointer monitoring system internal settings are those for the 'EPA-compliant' mode of operation. If you are not sure all settings are correct for FEM/FRM operation proceed to 'Setup' → 'Configuration' → 'Standards' in the user menu and press the button 'US-EPA-compilant' as described in section 7.7.5.14. This will load the settings required for measurements according the US-EPA standards. Before regular monitoring can be initiated, the airpointer® must be calibrated according to current US-EPA Standards to assure NIST traceability of the results. See chapter 7.6 "Calibration" for a guide on how to calibrate the device.
The airpointer® samples via the sample inlet described in chapter 5.6 and 10. It features a weatherproof temperature controlled housing for in- and outdoor measurements in an ambient temperature range from -20°C (-40°C with optional internal heater) to 40°C without any additional protection.
When operating at very high temperatures a shielding from direct sunlight is recommended. Special care has to be taken when the airpointer® is operated as an US-EPA FEM/FRM. Ensure the internal temperatures in the temperature controlled compartment of the housing are within the specified limits of 10°C to 45°C. This can be verified using the readings of the internal temperature sensors of the airpointer® located at the top (parameter „RoomTemp up") and bottom (parameter „RoomTemp"). This parameters can be accessed either via the internal airpointer® database (see Section 7.2.2.1 and 7.3) or real time data via the

service interface (see section 7.7.2.3). Both temperatures must be within 10°C to 45°C to be conform to US-EPA requirements.
The inner temperatures are stored as parameters into the airpointer®'s database. Access to current and historical data is possible at any time.

8.2. Routine Operation

Follow these steps to perform an environment sample.

1. If you use your device for the first time, please start by following the instructions in chapter 5 "Getting Started".
2. Before you start working with your airpointer®, the device has to be calibrated in accordance with US EPA's calibration specifications. See section 7.6 "User Interface - Calibration" for details.
3. Ensure no warning or error status is present. This can be verified either by the user interface as described in section 7.7.2.2.1 or via opening the maintenance door and checking the LED. If no red (failure) and yellow (warning) LED can be observed and only the green LED is lit, every parameter is in its limits. If a warning or failure is present, see page "StatList" in the LinSens interface (7.7.2.2.1) for details.
4. If all the preceding steps were performed, you can start to take ambient samples. Set your modules into the EPA compliant mode by pressing the corresponding button in 7.7 "User Interface → Setup → Configuration". See section 7.7.5.14 for details.
5. See section 7.2.2.1 "Graph" on how to display the collected data.

8.3. Specifications for US-EPA Equivalency

The CO, O_3, NO_x and SO_2 airpointer® modules are designated as reference or equivalent method when operated under the following conditions:

Parameter	Module			
	CO	O_3	NO_x	SO_2
US-EPA reference method	YES	–	YES	–
US-EPA equivalent method	–	YES	–	YES
Range	any range between $0-10$ ppm and $0-50$ ppm	any range between $0-.100$ ppm and $0-1.0$ ppm	any range between $0-.050$ ppm and $0-1.0$ ppm	any range between $0-.050$ ppm and $0-1.0$ ppm
Flow range	350-750 ml/min	350-650 ml/min	350-700 ml/min	300-650 ml/min
Pump Pressure (vacuum)	Lower than 550 mbar			
Internal Temperature range	From 10°C to 45°C			
Line voltage range	100-120 VAC or 220-240 VAC, at 50 or 60 Hz			
Filter Requirements	PTFE-Filter installed in the internal filter assembly			
Software Settings	1. Setup the device as described in sections 5.3, 5.4, 5.5 and 5.6 2. Ensure operating under US-EPA compliance by pressing "US-EPA-compliant" in Setup/Configuration/Standards/ as described in section 7.7.5.14 3. Wait sufficient time for temperature stabilizing (min. 1h) after powering up.			

Table 8.1.: Specifications for US EPA equivalency

Under the designation, the Analyzer may be operated with or without the following options:

- Internal span (ISM) option as module supplement which consists of:
  - Permeation oven for SO2 and NO2 modules including the related permeation tube
  - Ozone generator for Ozone module
- Internal dilution system with internal refillable span gas bottle for CO module

Note: Under the designation, the ISM option cannot be used as the source of calibration.

9. The Physical Fundamentals

The airpointer® gas modules utilize different types of optical detection principles. The following sections give an overview of the underlying optical principles and contribute to a better understanding of the results provided by the airpointer®. Figure 9.1 depicts a diagram of the wavelengths used by each gas module detector.

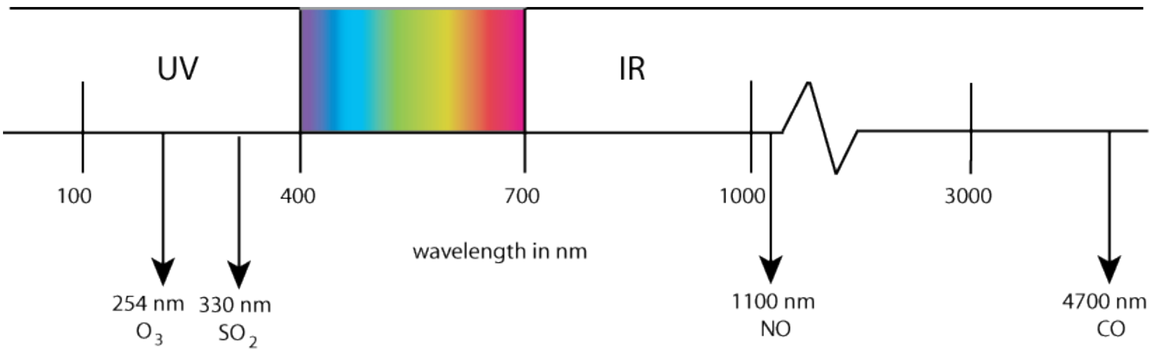


Figure 9.1.: Overview of Emitted or Absorbed Wavelengths of Measured Pollutants. The Centers of the Various Wavelength Ranges are Depicted Separately.

9.1. The Law of Absorption by Lambert and Beer

What we are going to try to illustrate in this section is the fact, that the intensity of an electromagnetic wave is depending on the density of the medium, in which the electromagnetic wave is propagating. In the case of a gas, the concentration of gas molecules can be related to the gas density by:

$$\rho = N \cdot M \quad , \tag{9.1}$$

where

ρ ... gas density $[kgm^{-3}]$

N ... number concentration of gas molecules $[m^{-3}]$

M ... weight of one gas molecule [kg]

The absorption of light during its passage through a homogeneous turbid media, e.g. a gas, is described by Lambert's and Beer's Law:

$$I(z) = I_0 \, e^{-\alpha \cdot z} \quad , \tag{9.2}$$

with

$I(z)$ ... intensity at position z [Wm^{-2}]
I_0 ... intensity at position z=0 [Wm^{-2}]
α ... absorption coefficient [m^{-1}]
z ... distance [m]

The absorption coefficient α depends on the material, the spectral range and on thermodynamic quantities, i.e., the pressure p_0 and temperature T_0.
If one is interested in the absorption of light produced by only one component of a mixture of gases and considering these parameters at some other ambient conditions p and T and introducing the concentration C (in units *volume/volume*) of this chemical species, the above equation may be written as:

$$I(C) = I_0\, e^{-\alpha \cdot C \cdot z \cdot T_0/T \cdot p/p_0} \tag{9.3}$$

with

T ... actual absolute gas temperature [K]
T_0 ... standard gas temperature = 273.15K
p ... actual absolute gas pressure [hPa]
p_0 ... standard gas pressure = 1013.25hPa
α ... absorption coefficient at standard conditions [μm^{-1}]
C ... concentration of gas molecules [ppm]

The standard values T_0 and p_0 may be depending on national and international regulations. As one can see, the intensity $I(C)$ decreases with increasing concentration and likewise the length of the measuring distance z has a significant influence on the intensity. Therefore—depending on the concentration that needs to be measured—the measuring tube has to be adopted to the appropriate dimensions. Figure 9.2 depicts the behavior of the measured intensity (I/I_0) vs. the gas concentration for ozone at various ambient conditions. At usual ambient concentrations this function is almost linear. In fact, the instrument uses this linear approximation to compute the concentration. This approximation is sufficient for accurate measurements within the desired range of interest:

$$I(C) \cong I_0 \cdot \left(1 - \alpha \cdot C \cdot z \cdot \frac{T_0}{T} \cdot \frac{p}{p_0}\right) \tag{9.4}$$

By rearranging equation 9.3 the concentration can be written as:

$$C = -\frac{10^9}{\alpha z} \cdot \frac{T}{T_0} \cdot \frac{p_0}{p} \cdot \ln \frac{I}{I_0} \tag{9.5}$$

or, using the linear approximation (equation 9.4):

$$C \cong -\frac{10^9}{\alpha z} \cdot \frac{T}{T_0} \cdot \frac{p_0}{p} \cdot \left(1 - \frac{I}{I_0}\right) \tag{9.6}$$

The factor 10^9 has the purpose to convert the unit into ppb (with α in m^{-1}) and the minus changes the algebraic sign to a positive value, because $\ln \frac{I}{I_0}$ is always negative in this case.

9.2. UV Absorption

O_3

Every atom consists of positive charges (protons) in its core and the same number of negative charges (electrons) in its shell. The atom as a whole is therefore electrically neutral. Each electron obtains a discrete energetic level (orbital). The orbitals of several atoms superpose each other in a way to get into an advantageous energetic state and form a molecule. By exciting the electrons with external energy they can be lifted to a higher level from where they actually are. Energetic excitation may be possible by UV rays. Their amount of energy was described by Max Planck with the following formula:

$$E = hc/\lambda = h\nu \quad (9.7)$$

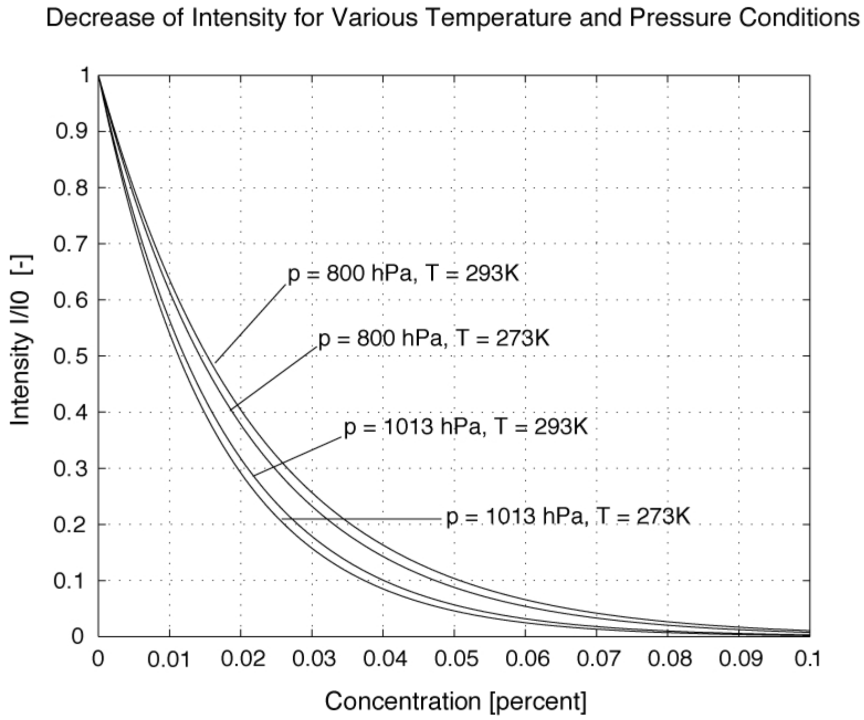


Figure 9.2.: The Law of Absorption by Lambert and Beer ($\alpha = 308\text{m}^{-1}$, $z = 0.2\text{m}$)

h ... Planck's constant ($6.6261 \cdot 10^{-34}$Js)
c ... speed of light ($3 \cdot 10^{8}$m/s)
λ ... wavelength of the UV rays
ν ... frequency of the UV rays

Because this excited state is not stable, the electron returns to its original state immediately and emits a photon to get rid of its additional energy. The gaps between the energetic levels vary depending on the kind of molecule. Therefore, you need different amounts of energy to excite the molecules. This leads to characteristic spectra of the emitted radiation so that one can easily distinguish among various compounds by measuring the emitted light (photons).

9.3. UV Fluorescence – Light Scattering

SO_2

Fluorescence is an optical phenomenon in cold bodies, in which a molecule absorbs a high-energy photon by exciting an electron, and reemits it as a lower-energy (longer-wavelength) photon. Thus the electron does not fall back to its initial state. The energy difference between the absorbed and emitted photons ends up as molecular vibrations (heat) and the electron returns to the ground state (see Figure 9.3). Usually, the absorbed photon is in the ultraviolet and the emitted light is in the visible range. The process of uptake of electromagnetic radiation followed by an immediate release of this energy in form of directionally spread light intensity is called 'scattering'. Normally this process does not change the wavelength of light, which is called 'elastic scattering'. In this respect, Fluorescence is a special kind of light scattering with a change of wavelength involved (called 'inelastic scattering').

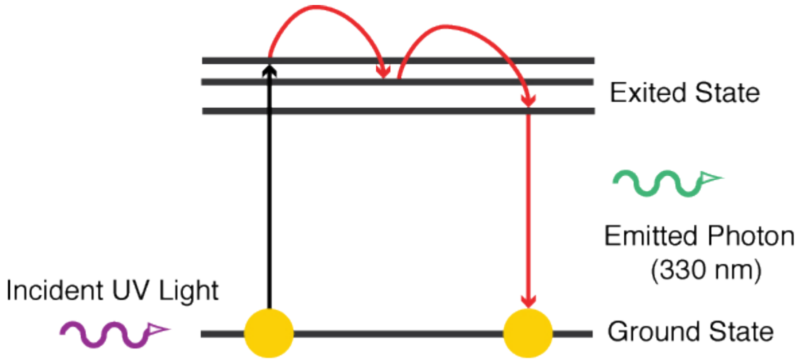


Figure 9.3.: An Excited Molecule Emits its Energy as a Light Pulse – Fluorescence.

9.4. IR Absorption

CO

From a macroscopic point of view, molecules are—just like the atoms—electrically neutral. The free electrons of the atoms form an 'electron cloud' that spreads all over the molecule and compounds the atoms. However, the electrons do not spread evenly, but accumulate in centers of charge. The reason for this is the different electronegativity of the elements, i.e., they attract the negative charges differently strong. Therefore, at microscopic dimensions at the scale of the atoms, most molecules have an electrical polarization and this leads to the development of a dipole momentum. E.g., water molecules (H_2O) have their negative center of charge on the side of the oxygen atom, because oxygen has a higher electronegativity than hydrogen. Symmetric molecules do not have such a permanent dipole momentum. However, Infrared (IR) rays may force them to vibrate so that the centers of charge start to shift and cause a temporary dipole momentum.
IR rays are far too weak to excite electrons like UV rays. Absorption in the IR spectrum usually is not caused by transitions of electrons, but by the induction of dipole momenta. The molecules in gases vibrate and rotate. Therefore, the dipole momentum is continuously changing and an electromagnetic wave develops just like in an open oscillating circuit (i.e., an antenna). If the incident IR ray is just in opposite phase to the excited ray, the two waves annihilate each other (destructive interference), which means that the incident rays are absorbed.
The masses of the atoms also have to be taken into account. To illustrate this, you can

imagine the molecule as a compound of punctiform masses, which are attached to each other by scroll springs. The heavier the atoms are, the slower they vibrate and hence absorb in the longer wave IR spectrum. Any remaining radiation may be measured with a detector. The spectrum yields information about the constitution of the molecule.

9.5. Chemiluminescence

NO_x

Chemiluminescence is energy release in form of electromagnetic radiation during a chemical reaction. The initial reaction results in electrically exited molecules which release their excess energy by emitting a photon and dropping to a lower energy level. The light intensity produced is directly proportional to the concentration of exited molecules. The involved processes are similar to those of light absorption and scattering but using chemical energy as the exiting source instead of an external light source.

9.6. Photometry

Independent of the spectral range of the measurement, the basic construction of the detector remains the same. A light source emits rays of the desired wavelength (mercury lamps in the UV range, heating wires for IR measurements). The light is absorbed by the gas sample following Lambert's and Beer's Law of absorption. Optical filters pass only the characteristic wavelength of the gas component of interest. Finally, the receiver R converts the optical input into an electronic signal.

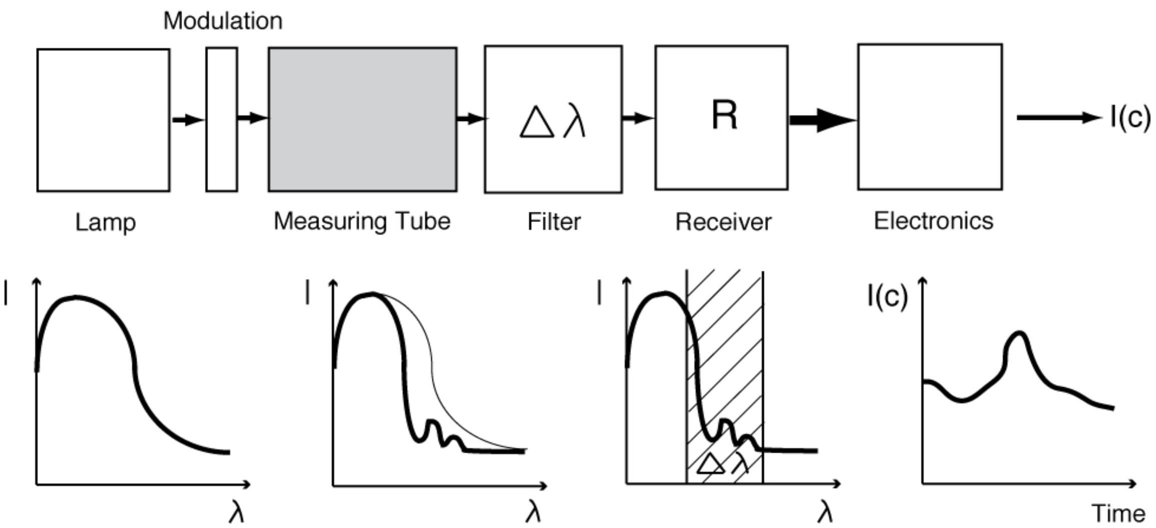


Figure 9.4.: Principle of Optical Light Detection

Figure 9.4 depicts the scheme of the so-called one-ray-method. Two measurements are executed in regular time spans. First, the transmitted radiation is measured when the rays pass through the sample. Thereafter, the sample is cleaned from the polluting substance and the measurement is repeated. This gives the comparison value. The difference of these two signals gives the change in radiation that is caused by the polluting substance.
If frequencies are needed that are already absorbed by air, the measuring tube has to be kept at a vacuum before letting in the gas sample.

9.7. Influences on the Measurement

Ideally, the characteristic detection curve of an optical gas sensor is a linear function for the commonly used two-ray-method. But because Lambert's and Beer's law is—strictly seen—only correct for an infinitesimal small bandwidth, i.e. rays of one discrete wavelength, irregularities occur in the characteristic curve. Even the use of filters just reduces the bandwidth to the same finite value. Furthermore, the absorption coefficient as well as the sensitivity of the detector depends on the spectral range. However, these irregularities can be compensated with adequate electronics for the data processing.
The more molecules are in the course of the beam, the higher will be the concentration that is measured. There is a linear relationship between the number of molecules and the pressure over a wide range, known as the ideal gas law:

$$p V = N k T \tag{9.8}$$

p ... pressure [Pa]
V ... volume [m^3]
N ... number of molecules in volume V[-]
k ... Boltzmann's constant ($1.380658 \cdot 10^{-23} J/K$)
T ... temperature [K]

However, for higher pressures one has to take into account that the molecules have a finite expansion. This leads to non-linear effects, which can be considerably significant depending on the kind of gas.

9.8. Units in Air Pollution Measurement and their Conversion

The units commonly used in air pollution issues are:

- → milligram per cubic meter (mg/m^3)
- → microgram per cubic meter ($\mu g/m^3$)
- → parts per million ($ppm, 10^{-6}$ volume/volume) and
- → parts per billion ($ppb, 10^{-9}$ volume/volume)

They can be converted into each other using the ideal gas law (9.8) yielding:

$$C_i = C_j \cdot M \cdot u \cdot \frac{p}{k \cdot T} = C_j \cdot A_{temp} \quad (9.9)$$

$$A_{temp} = M \cdot u \cdot \frac{p}{k \cdot T} \quad (9.10)$$

where

C_i	...	concentration in $[mg/m^3]$
C_j	...	concentration in $[ppm]$
p	...	absolute pressure $[Pa]$
T	...	absolute temperature [K]
k	...	Boltzmann's constant ($1.380658 \cdot 10^{-23} J/K$)
u	...	atomic mass unit ($1.66 \cdot 10^{-27} kg$)
M	...	molecular mass in multiples of u [-]
A_{temp}	...	factor [kg/m^3]

The table below shows factor A_{temp} for standard pressure p= 1013.25 hPa and temperatures 0°C (273.15 K), 20°C (293.15 K) and 25°C (298.15 K).

Substance	M [-]	$A_{273.15\,K}$	$A_{293.15\,K}$	$A_{298.15\,K}$
SO_2	64.062	2.857	2.662	2.618
H_2S	34.080	1.520	1.416	1.393
NO	30.006	1.338	1.247	1.226
NO_2	46.005	2.052	1.912	1.880
NH_3	17.031	0.760	0.708	0.696
CO	28.010	1.249	1.167	1.145
O_3	47.997	2.141	1.995	1.961

9.8.1. Concentration as function of pressure and temperature

$$
\begin{aligned}
C_i\,[mg/m^3] \cdot \frac{1}{A_{temp}} &\rightarrow C_j\,[ppm] \\
C_i\,[\mu g/m^3] \cdot \frac{1}{A_{temp}} &\rightarrow C_j\,[ppb] \\
C_j\,[ppm] \cdot A_{temp} &\rightarrow C_i\,[mg/m^3] \\
C_j\,[ppb] \cdot A_{temp} &\rightarrow C_i\,[\mu g/m^3]
\end{aligned}
\tag{9.11}
$$

Further, any concentration (mass per volume) given for some ambient condition 1 may be translated to a concentration valid for some other ambient condition 2 by:

$$
\frac{C_1}{C_2} = \frac{p_1 \cdot T_2}{p_2 \cdot T_1} \quad , \tag{9.12}
$$

where

$C_{1,2}$ ... number or mass concentration in state 1 and 2, respectively
$T_{1,2}$ ... absolute temperature in state 1 and 2, respectively
$p_{1,2}$ ... absolute pressure in state 1 and 2, respectively

Please note that in contrast to concentrations given in units 'mass per volume' (e.g. $\mu g/m^3$), concentrations given in units 'volume per volume' (e.g. ppb or ppm) do not change due to a change of reference (standard) temperature or pressure.

NOTE
The airpointer® provides concentration data in units 'volume per volume' (ppb or ppm). These values are compensated for pressure and temperature influences already.

However, sometimes concentration data are also given in units 'mass per volume'. To convert the concentration provided by the airpointer (native units: ppm or ppb) to units of the form 'mass per volume' use Equation 9.9.
To convert such data, which is given for a certain reference temperature and pressure to other standards use Equation 9.12. E.g. to convert a O_3 concentration of $50\mu g/m^3$ (23.36ppb) given for p=1013.25hPa and T=293.15K (20°C) (European Standard) to p=1013hPa and T=298K (US EPA Standard) the above formula yields:

$$
\text{conc. } O_{3_{p=1013hPa,\,T=298K}} = 50\mu g/m^3 \cdot \frac{1013 \cdot 293.15}{1013.25 \cdot 298} = 50\mu g/m^3 \cdot 0.9835 = 49.18\mu g/m^3
$$

As one can see, the difference of these two standards results in a respective concentration difference of less than 1.7percent.

9.8.2. Factors According to European Standards for Ambient Air Quality

In case of European standards (EN) there is a slightly different definition for the standard temperature and standard pressure. These values are T_0 = 293K and p_0 = 1013hPa.

For EN one $\mu g/m^3$ of substance corresponds to:

Substance	Concentration in ppb
SO_2	0.38
H_2S	0.71
NO	0.80
NO_2	0.52
NH_3	1.41
CO	0.86
O_3	0.50

Correspondingly, for EN one ppb of substance corresponds to:

Substance	Concentration in $\mu g/m^3$
SO_2	2.66
H_2S	1.42
NO	1.25
NO_2	1.91
NH_3	0.71
CO	1.16
O_3	2.00

10. Operation Details

10.1. Sampling

The airpointer® is intended for measurement of ambient air. To prevent large airborne particles and rain from contaminating the analyzer, a special sample inlet head is put upstream of the analyzer inlet.

Figure 10.1.: Sample Inlet

However, this sample inlet head may be removed to establish a direct connection to an external sample source. In any case, sample and calibration gases should come into contact with PTFE (Teflon®), FEP, glass or stainless steel materials only.
Attach a sample inlet line to the sample inlet port. Ideally, the pressure of the sample gas should be equal to ambient atmospheric pressure.

NOTE
In applications where the sample gas is received from a pressurized manifold, a vent must be provided to equalize the sample gas with ambient atmospheric pressure before it enters the analyzer. The vented gas needs to be routed outside the immediate area or shelter surrounding the instrument.

CAUTION:

Maximum pressure of any gas at the sample inlet should not exceed 50 mbar above ambient pressure and ideally should equal ambient atmospheric pressure.

10.2. Gas Flow Schematics

The Gas Flow Diagrams in Figures 10.2 to 10.5 illustrate the gas flow inside the airpointer®. The pneumatic control and a short description of the operation of each gas module is given below.

10.2.1. Gas Flow of the System Part

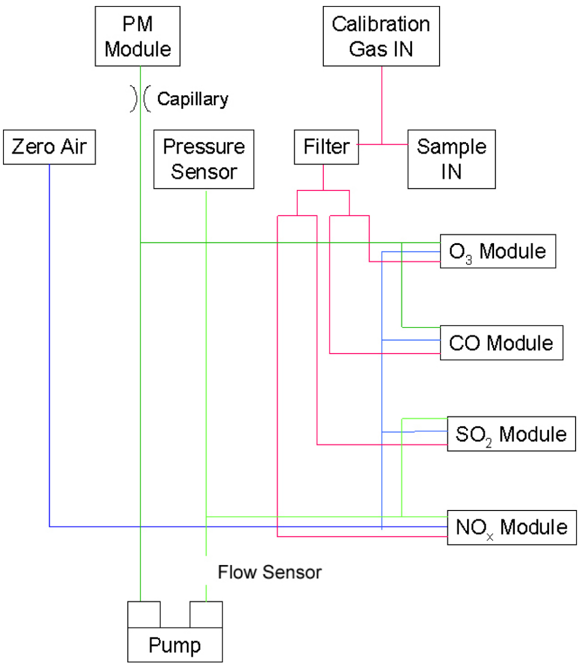


Figure 10.2.: Flow Diagram of System Part of an airpointer® 4D with four drawers and five modules.

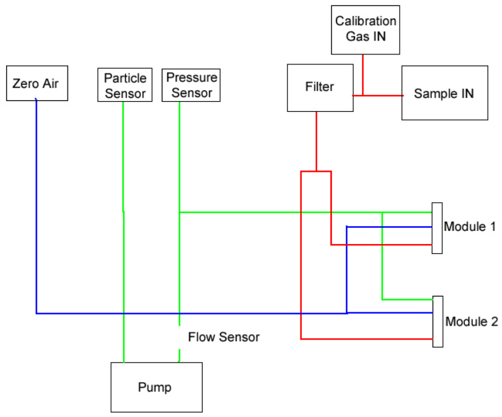


Figure 10.3.: Flow Diagram of System Part of an airpointer® 2D with two drawers and three sensors.

1. The ambient air enters the airpointer® through the Sample Inlet (Sample IN).
2. The sample gas goes to the Inlet Filter and from there to the Modules, where the various measurements are done. Then the flow goes through the System Pump and exits the device.
3. Additional ambient air enters the airpointer® through the Zero Air Canister and a DFU Filter. The Zero Air flows to each module. The Zero Air Valve is integrated into each module.

The airpointer® version 2D with a particulate sensor (see Fig.) there has a double headed pump. Without a particulate sensor there is a single headed pump and all green lines are combined. In that case the pressure of all modules is monitored.

10.2.2. Gas Flow of the O_3 Sensor

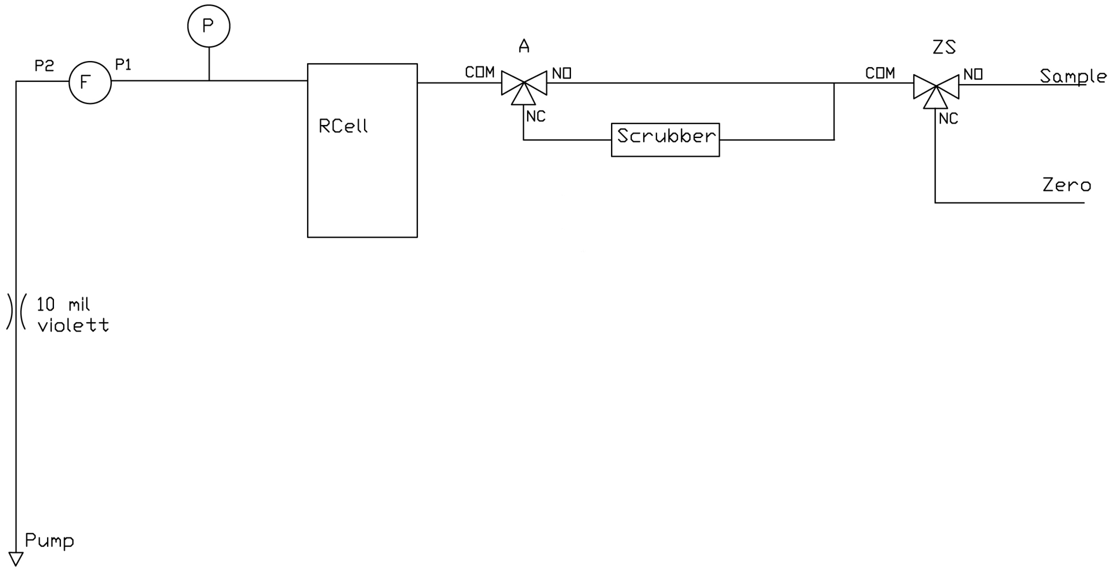


Figure 10.4.: Flow Diagram of O_3 Module

1. The Main Valve Ozone in NO mode:
   a) The sample gas goes directly to the Optical Bench.
   b) Afterwards it is drawn through the Critical Flow Orifice to the System Pump.
2. The Main Valve Ozone in NC mode:
   a) The gas goes through the O_3–Scrubber and from there to the Optical Bench and to the System Pump.
3. Flow and pressure are monitored (indicated by Ⓕ and Ⓟ).

10.2.3. Gas Flow of the CO Sensor

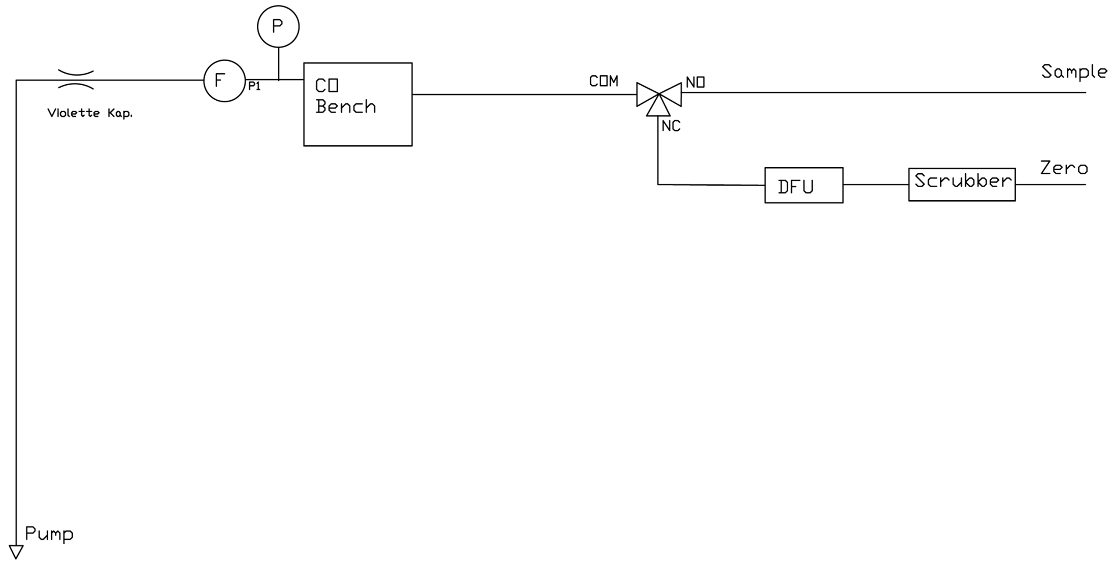


Figure 10.5.: Flow Diagram of CO Module with IZS

1. The sample air flows to the Optical Bench.
2. From there it is drawn through the Critical Flow Orifice to the System Pump.
3. Flow and pressure are monitored (indicated by Ⓕ and Ⓟ).

10.2.4. Gas Flow of the SO_2 Sensor

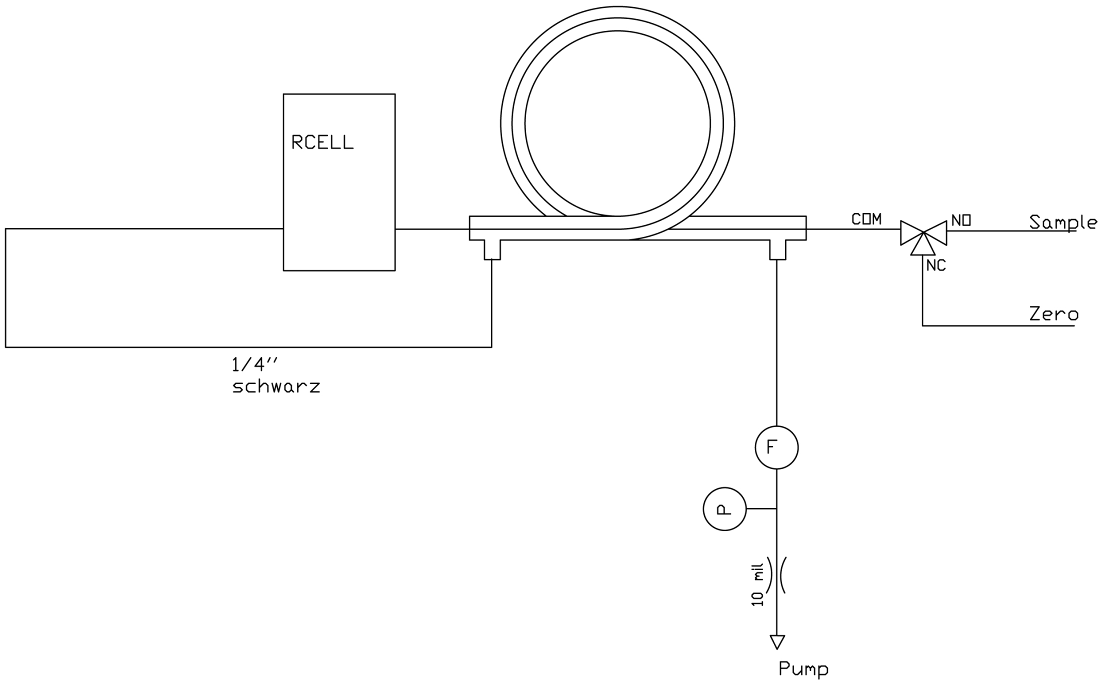


Figure 10.6.: Flow Diagram of SO_2 Module

1. The ambient air from the System Part reaches the Kicker, which removes hydrocarbons from the sample air. The Kicker works similarly to the Perma Pure® Dryer of the NO_x module, the membrane is different. The SO_2 molecules pass through the hydrocarbon Kicker unaffected.

2. From the Kicker the gas flows to the SO_2 Reaction Cell from where it is drawn through the Critical Flow Orifice back to the "'shell side"' of the Kicker and then to the System Pump.

3. Flow and pressure are monitored (indicated by Ⓕ and Ⓟ).

10.2.5. Gas Flow of the NO_x Sensor

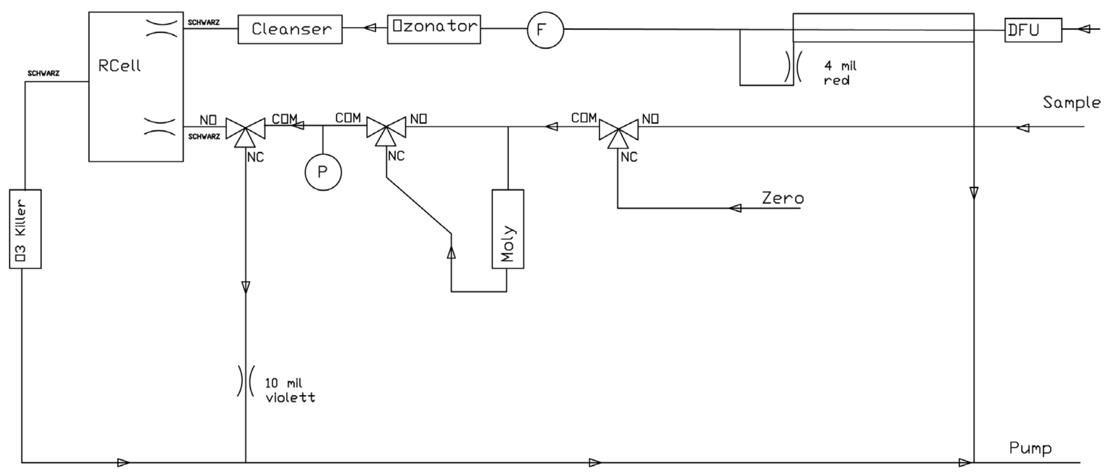


Figure 10.7.: Flow Diagram of NO_x Module

1. The sample gas from the System Part reaches the Auto Zero Valve which switches between Sample and Zero.
2. The NO/NO_x and the Auto Zero Valve in normal open (NO) mode:
   a) The gas goes through to the Auto Zero Valve and enters the NO_x Reaction Cell.
   b) Ambient air is drawn through the DFU–Filter and through the inner line of the Perma Pure® Dryer.
   c) One part of this flow is returned through the Critical Flow Orifice to the outer line of the Dryer and on to the System Pump.
   d) The dried air from the inner line of the dryer reaches the O_3–Generator and finally enters the NO_x Reaction Cell, where it reacts with the sample gas (NO–measurement).
   e) Afterwards the gas goes to the Ozone Destroyer to keep the gas free of O_3.
   f) The gas from the dryer and the Reaction Cell goes to the System Pump and leaves the airpointer® .
3. When the NO/NO_x Valve is in NC mode:
   a) The gas converted in the Molybdenum Converter goes through the NO/NO_x-valve and on through the Auto Zero Valve to the Reaction Cell (NO_x – measurement).

4. Auto Zero Valve in NC mode:
   a) Sample Gas cannot reach the Reaction Cell. Only O_3 from the generator flows through the Reaction Cell. This flow provides the Zero Offset measurement.
   b) This O_3 is drawn through the Destroyer to the System Pump.
   c) At the same time the sample gas from the Auto Zero Valve is drawn through the Critical Flow Orifice to the System Pump.
5. Flow and pressure are monitored (indicated by Ⓕ and Ⓟ).

10.2.6. Gas Flow of the NO_x Sensor

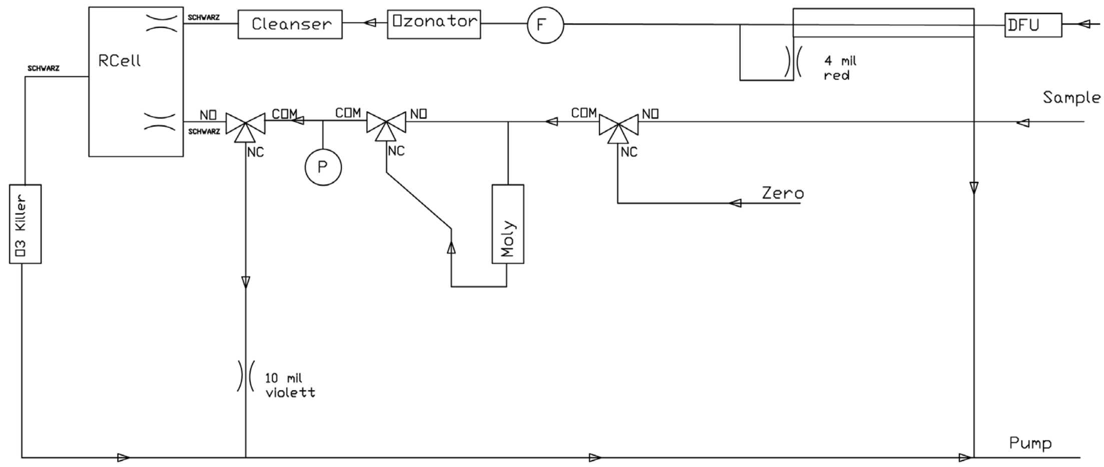


Figure 10.8.: Flow Diagram of NO_x Module

1. The sample gas from the System Part reaches the Auto Zero Valve which switches between Sample and Zero.
2. The NO/NO_x and the Auto Zero Valve in normal open (NO) mode:
    a) The gas goes through to the Auto Zero Valve and enters the NO_x Reaction Cell.
    b) Ambient air is drawn through the DFU–Filter and through the inner line of the Perma Pure® Dryer.
    c) One part of this flow is returned through the Critical Flow Orifice to the outer line of the Dryer and on to the System Pump.
    d) The dried air from the inner line of the dryer reaches the O_3–Generator and finally enters the NO_x Reaction Cell, where it reacts with the sample gas (NO–measurement).
    e) Afterwards the gas goes to the Ozone Destroyer to keep the gas free of O_3.
    f) The gas from the dryer and the Reaction Cell goes to the System Pump and leaves the airpointer® .
3. When the NO/NO_x Valve is in NC mode:
    a) The gas converted in the Molybdenum Converter goes through the NO/NO_x-valve and on through the Auto Zero Valve to the Reaction Cell (NO_x – measurement).

4. Auto Zero Valve in NC mode:
   a) Sample Gas cannot reach the Reaction Cell. Only O_3 from the generator flows through the Reaction Cell. This flow provides the Zero Offset measurement.
   b) This O_3 is drawn through the Destroyer to the System Pump.
   c) At the same time the sample gas from the Auto Zero Valve is drawn through the Critical Flow Orifice to the System Pump.

5. Flow and pressure are monitored (indicated by Ⓕ and Ⓟ).

10.3. The NO_x Module

NO_x

CAUTION:

Ensure the airpointer® is operated in a sufficient ventilated area. If the airpointer contains a NO_x module and the internal scrubbers are not working properly, its pump outlet gas may contain harmful gases. If sufficient ventilation cannot be assured, connect the pump outlet via tubing to a well ventilated area.

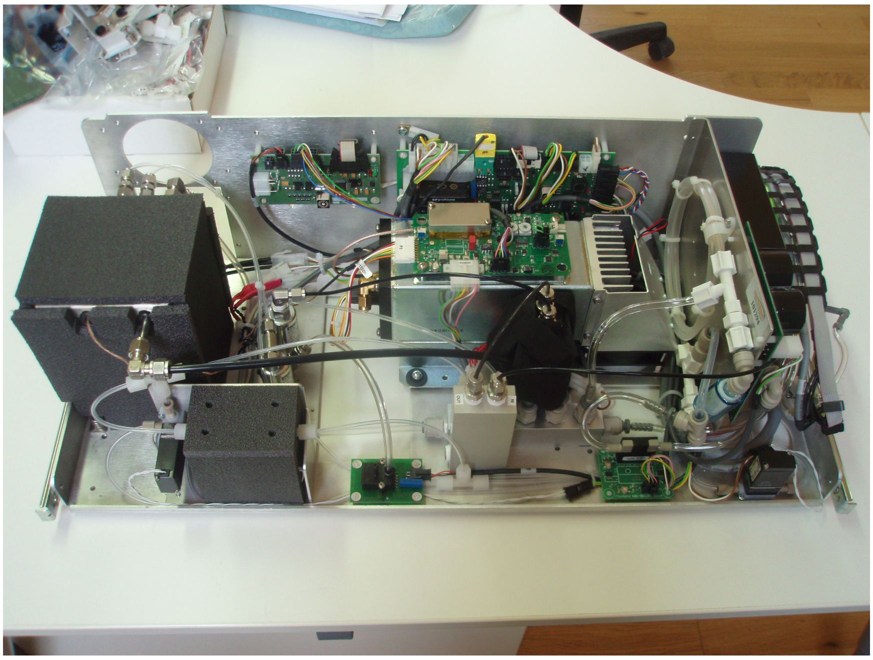


Figure 10.9.: Complete NO_x Module

10.3.1. Chemiluminescence

The device measures the concentration of NO and NO_x in a gas sample and is able to calculate the concentration of NO_2. In this case, the method of gas phase titration (GPT) is applied, i.e. the analyzer measures the chemiluminescence of nitrogen monoxide when it reacts with ozone:

$$NO + O_3 \rightarrow NO_2^* + O_2 \tag{10.1}$$

An oxygen molecule and an excited NO_2 molecule are created. The last one will emit its energy as a light pulse with a characteristic wavelength $\lambda = c/\nu$ of 1100nm :

$$NO_2^* \rightarrow NO_2 + h\nu \tag{10.2}$$

The intensity can be measured with a photomultiplier (Section 10.8) and so the concentration can be calculated.
Any NO_2 contained in the gas is not detected in the above process since NO_2 does not react with O_3 to undergo chemiluminescence. In order to measure the concentration of NO_2 or NO_x (which is the sum of NO and NO_2 in the sample gas), the device periodically switches the sample gas stream through a converter cartridge filled with molybdenum (Mo) chips (Figure 10.10) heated to a temperature of 315 °C. The heated molybdenum reacts with NO_2 in the sample gas and produces a variety of molybdenum oxides and NO according to Equation 10.3.

$$\mathrm{Mo} + 3\,\mathrm{NO_2} \rightarrow 3\,\mathrm{NO} + \mathrm{MoO_3} \tag{10.3}$$

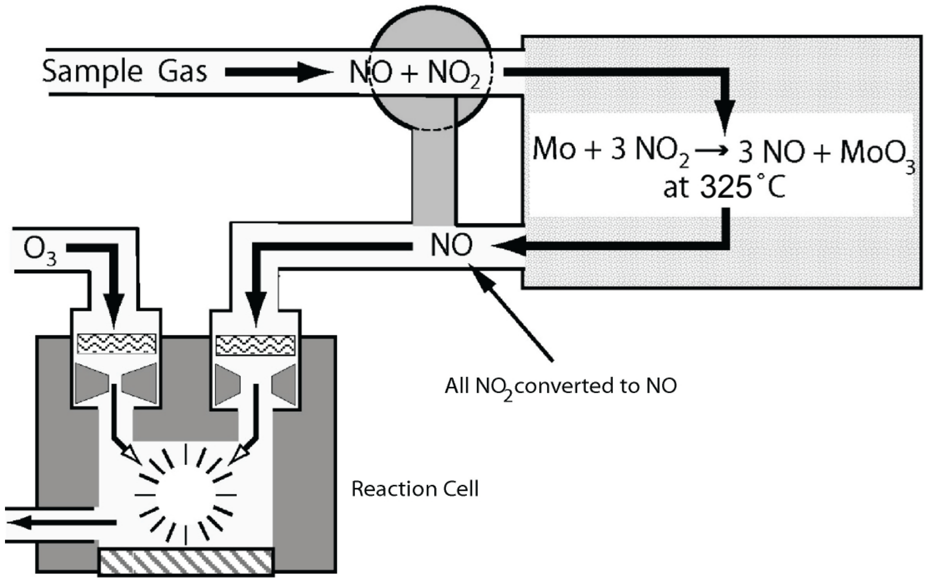


Figure 10.10.: NO_2 Conversion Principle

Once the NO_2 in the sample gas has been converted to NO, it is routed to the reaction cell where it undergoes the chemiluminescence reaction described in Equations 10.1 and 10.2. By converting the NO_2 in the sample gas into NO, the analyzer can measure the total NO_x (NO+NO_2) content of the sample gas. By switching the NO_2 converter in and out of the sample gas stream every 8 seconds, the airpointer® is able to quasi-continuously measure both the NO and the total NO_x content. The NO_2 concentration, finally, is not measured but calculated by simply subtracting the known NO content of the sample gas from the known NO_x content. Another critical component in the method by whichairpointer® detects chemiluminescence is the optical filter that is placed between the reaction cell and the PMT. This filter is a high pass filter that is only transparent to wavelengths of light above 645 nm. In conjunction with the response characteristics of the PMT, this filter creates a very narrow window of wavelengths of light to which the device will respond. The narrowness of this band of sensitivity allows the airpointer® to ignore extraneous light and radiation that might interfere with the device's measurement. For instance, some oxides of sulfur can also undergo chemiluminescence when in contact with O_3 but emit light at shorter wavelengths (usually around 260 nm to 480nm).

10.3.2. Auto Zero

Inherent in the operation of any PMT is a certain amount of noise. This is due to a variety of factors such as black body infrared radiation given off by the metal components of the reaction cell, unit to unit variations in the PMT units and even the constant universal background radiation that surrounds us at all times. In order to reduce this amount of noise and offset, the PMT is kept at a constant temperature of 10°C (45°F) by a thermo-electric cooler (TEC, see Section 10.8.1).

While this intrinsic noise and offset is significantly reduced by cooling the PMT, it is not eradicated. To determine how much noise remains, the device diverts the sample gas flow directly to the vacuum manifold without passing the reaction cell once every minute for about 8 seconds (Figure 10.11). During this time, only O_3 is present in the reaction cell, effectively turning off the chemiluminescence reaction. Once the chamber is completely dark, the airpointer® records the output of the PMT and keeps a running average of these values ('PMTSigAutoZero'). This average offset value is subtracted from the raw PMT readings while the instrument is measuring NO and NO_x to arrive at a corrected reading.

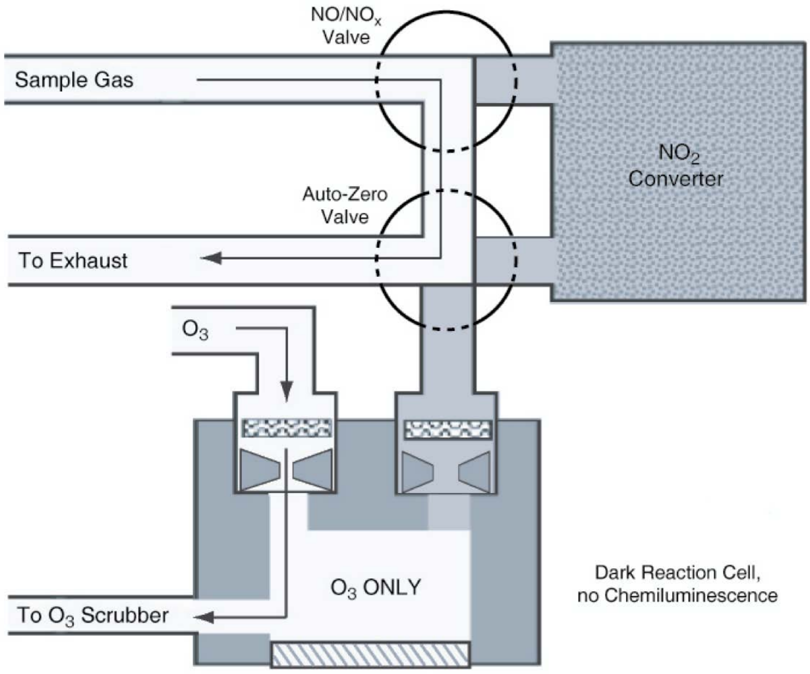


Figure 10.11.: Reaction Cell During the Auto Zero Cycle

10.3.3. Specific Pneumatic Operation for the NO_x Module

10.3.3.1. Ozone Gas and Air Flow

Because of the instability and toxicity of ozone, it is necessary to generate this gas inside the analyzer. This requires a dry air supply and special filtering before the gas is introduced into the reaction cell. Due to its toxicity, O_3 must also be removed from the gas stream before it can be vented through the exhaust outlet.

CAUTION:

Ozone (O_3) is a toxic gas. Always make sure that the plumbing of the O_3 generation and supply system is maintained and leak-free. Please ensure the catalytic ozone-killer located in the converter-housing is working properly. Otherwise the pump outlet gas may contain harmful concentrations of Ozone.
The catalytic ozone-killer may produce several milligrams of NO_2/min under certain circumstances. Therefore a good dilution of the airpointer´s pump outlet gas has to be assured. Alternatively the outlet gas can be connected to a charcoal cartridge.

10.3.3.2. O_3 Generator

The airpointer® uses a corona discharge (CD) tube for creating its O_3. Corona discharge generation is capable of producing high concentrations of ozone efficiently and with low excess heat. Although there are many cell designs, the fundamental principle remains the same (Figure 10.12). The device utilizes a dual-dielectric design. This method utilizes

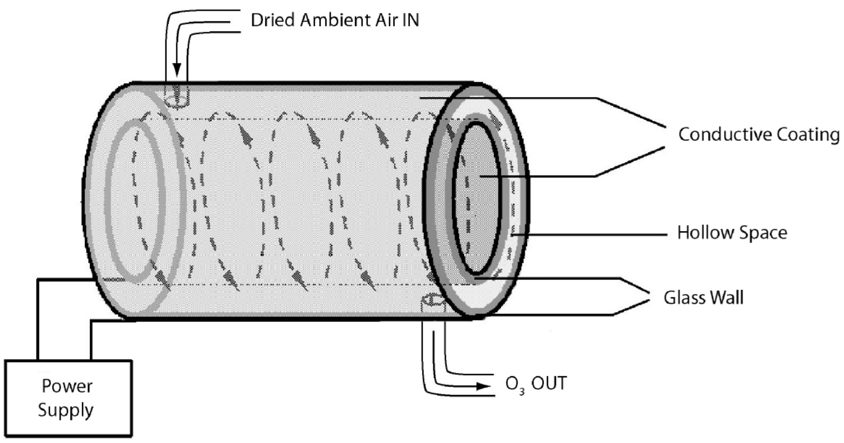


Figure 10.12.: Ozone Generator Principle

a glass tube with hollow walls. The outermost and innermost surfaces are coated with electrically conductive material. The air flows through the glass tube, between the two conductive coatings, in effect creating a capacitor with the air and glass acting as the dielectric. The layers of glass also separate the conductive surfaces from the air stream to prevent reaction with the O_3. As the capacitor charges and discharges, electrons are created and accelerated across the air gap and collide with the O_2 molecules in the air stream splitting them into elemental oxygen. Some of these oxygen atoms recombine with O_2 to O_3. The quantity of ozone produced is dependent on factors such as the voltage and frequency of the alternating current applied to the CD cells. When enough high energy electrons are produced to ionize the O_2 molecules, a light emitting, gaseous plasma is formed, which is commonly referred to as a corona, hence the name corona discharge generator.

10.3.3.3. Perma Pure® Dryer

The air supplied to the O_3 generation system needs to be as dry as possible. Normal room air contains a certain amount of water vapor, which greatly diminishes the yield of ozone produced by the ozone generator. Also, water can react with other chemicals inside the O_3 Generator to produce chemicals that damage the optical filter located in the reaction cell such as ammonium sulfate or highly corrosive nitric acid. To accomplish this task the airpointer® uses a Perma Pure® single tube permeation dryer. The dryer consists of a single tube of Nafion® , a DuPont™co-polymer similar to Teflon® that absorbs water very well but not other chemicals. The Nafion® tube is located within an outer, flexible plastic tube. As gas flows through the inner Nafion® tube, water vapor is absorbed into the membrane walls. The absorbed water is transported through the membrane wall and evaporates into the dry, purge gas flowing through the outer tube countercurrent to the gas in the inner tube (Figure 10.13).

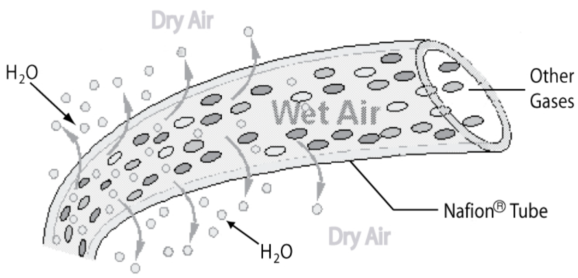


Figure 10.13.: Semi-Permeable Membrane Drying Process

This process is called per-evaporation and is driven by the humidity gradient between the inner and outer tubes as well as the flow rates and pressure difference between inner and outer tubing. Unlike micro-porous membrane permeation, which transfers water through a relatively slow diffusion process, per-evaporation is a simple kinetic reaction. Therefore, the drying process occurs quickly, typically within milliseconds. The first step in this process is a chemical reaction between the molecules of the Nafion® material and water, other chemical components of the gases to be dried are usually unaffected. The chemical reaction is based on hydrogen bonds between the water molecule and the Nafion® material. Other small polar gases that are capable of hydrogen bonds can be absorbed this way, too, such as ammonia (NH_3) and some low molecular amines. To provide a dry purge gas for the outer side of the Nafion tube, the device returns some of the dried air from the inner tube to the outer tube (see Figures 10.14 and 10.13). When the analyzer is first started, the humidity gradient between the inner and outer tubes is not very high and the dryer's efficiency is low at first. However, it improves as this cycle reduces the moisture in the sample gas and settles at a minimum humidity.

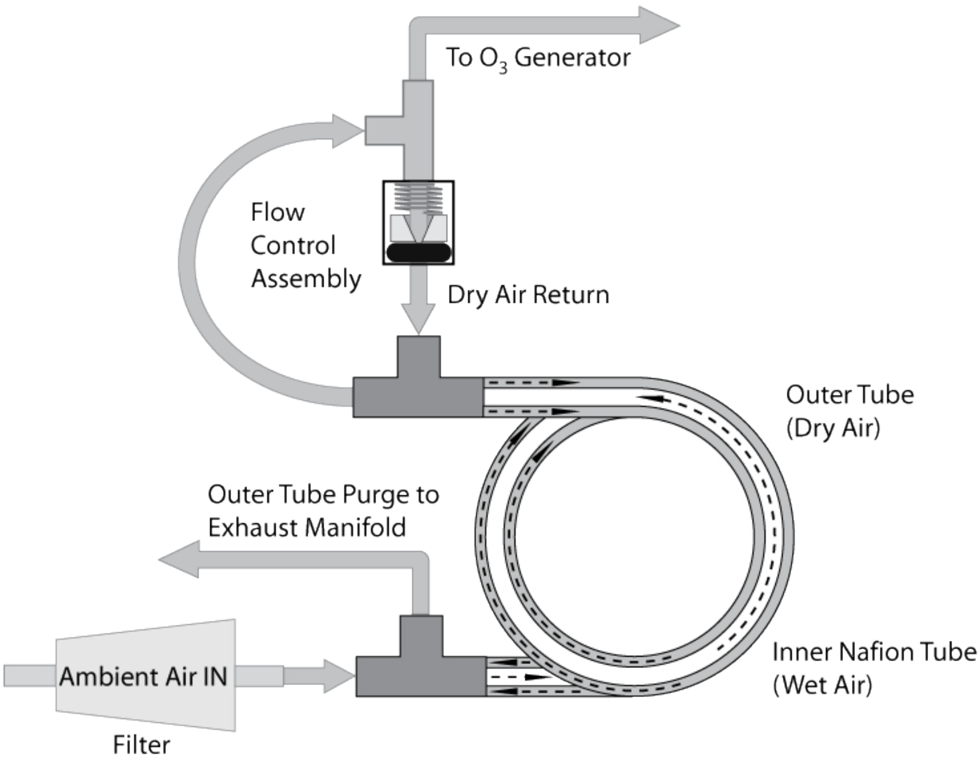


Figure 10.14.: Scheme of the Perma Pure® Dryer

Just like on startup, if the instrument is turned on after having been off for more than 30 minutes, it takes a certain amount of time for the humidity gradient to become high enough for the Perma Pure® Dryer to adequately dry the air. The Perma Pure® Dryer used in the airpointer® is capable of adequately drying ambient air to a dew point of $\leq$ -5 °C at a flow rate of 1 standard liter per minute (slpm) or down to $\leq$ -15 °C at 0.5 slpm. The Perma Pure® Dryer is also capable of removing ammonia from the sample gas up to concentrations of approximately 1 ppm.

10.3.4. Measurement Interferences

It should be noted that the chemiluminescence method is subject to interferences from a number of sources. The airpointer® has been successfully tested for its ability to reject interference from most of these sources. Table 10.1 lists gases, which might interfere with the detection of NO in the component.

10.3.4.1. Direct Interference

Some gases can directly alter the amount of light detected by the PMT due to chemiluminescence in the reaction cell. This can either be a gas that undergoes chemiluminescence by reacting with O_3 or because the gas reacts with other compounds and produces excess NO.

10.3.4.2. Third Body Quenching

Other molecules in the reaction cell can collide with the excited $NO_2^{\star}$, preventing the chemiluminescence of equation 10.2, a process known as quenching. CO_2 and H_2O are the most common quenching interferences, but N_2 and O_2 also contribute to this interference type. Quenching is an unwanted phenomenon and the extent to which it occurs depends on the properties of the collision partner. Larger, more polarized molecules such as H_2O and CO_2 quench NO chemiluminescence more effectively than smaller, less polar and electronically 'harder' molecules such as N_2 and O_2.
The concentrations of N_2 and O_2 are virtually constant in ambient air measurements.

10.3.4.3. Light Pollution

The device sensitivity curve includes a small portion of the visible light spectrum; hence, it is important to make sure that the reaction cell is completely sealed with respect to light. To ensure this, all pneumatic tubing leading into the reaction cell is either opaque (vacuum exit tubing) in order to prevent light from entering the cell, or light penetration is prevented by stainless steel filters and orifices (gas entries).

Table 10.1.: List of Major Interferences of NO_x Measurement

Gas	Interference Type	Rejection Method
CO_2	Dilution: Viscosity of CO_2 molecules causes them to collect in aperture of Critical Flow Orifice altering flow rate of NO.	If high concentrations of CO_2 are suspected, special calibration methods must be performed to account for the effects of the CO_2.
	3rd Body Quenching: CO_2 molecules collide with NO_2^* molecules absorbing excess energy kinetically and preventing emission of photons.	
SO_x	Some SO_x variants can also initiate a chemiluminescence reaction upon exposure to O_3 producing excess light.	Wavelengths of light produced by chemiluminescence of SO_x are screened out by the rejection method.
	Chemically reacts with NH_3, O_2 and H_2O in O_3 generator to create $(NH_3)2SO_4$ (ammonium sulfate) and NH_3NO_2 (ammonium nitrate) which form opaque white deposits on optical filter window. Also forms highly corrosive HNO_3 (Nitric Acid).	Most of the ammonium sulfate and ammonium nitrate produced is removed from the sample gas by an air purifier located between the O_3 Generator and the reaction cell.
	3rd Body quenching: SO_x molecules collide with NO_2^* molecules absorbing excess energy kinetically and preventing emission of photons.	If high concentrations of SO_x are suspected, special calibration methods must be performed to account for the effects of the SO_2.
H_2O	3rd Body quenching: H_2O molecules collide with NO_2* molecules absorbing excess energy kinetically and preventing emission of photons.	Analyzers operating in high humidity areas must have some method of drying applied to the sample gas supply.
	Chemically reacts with NH_3 and SO_x in O_3 generator to create $(NH_3)2SO_4$ (ammonium sulfate) and NH_3NO_2 (ammonium nitrate) which form opaque white deposits on optical filter window. Also forms highly corrosive HNO_3 (nitric acid).	Removed from the O_3 gas stream by the Perma Pure® Dryer (Section 10.3.3.3 for more details).
NH_3	Direct Interference: NH_3 is converted to H_2O and NO by the NO_2 converter. Excess NO reacts with O_3 in reaction cell creating excess chemiluminescence.	If a high concentration of NH_3 is suspected, steps must be taken to remove the NH_3 from the sample gas prior to its entry into the NO_2 converter.
	Chemically reacts with H_2O, O_2 and SO_x in O_3 generator to create $(NH_3)2SO_4$ (ammonium sulfate) and NH_3NO_2 (ammonium nitrate) which form opaque white deposits on optical filter window. Also forms highly corrosive HNO_3 (nitric acid).	The Perma Pure® dryer built into the airpointer® is sufficient for removing typical ambient concentration levels of NH_3.

10.4. The SO_2 Module

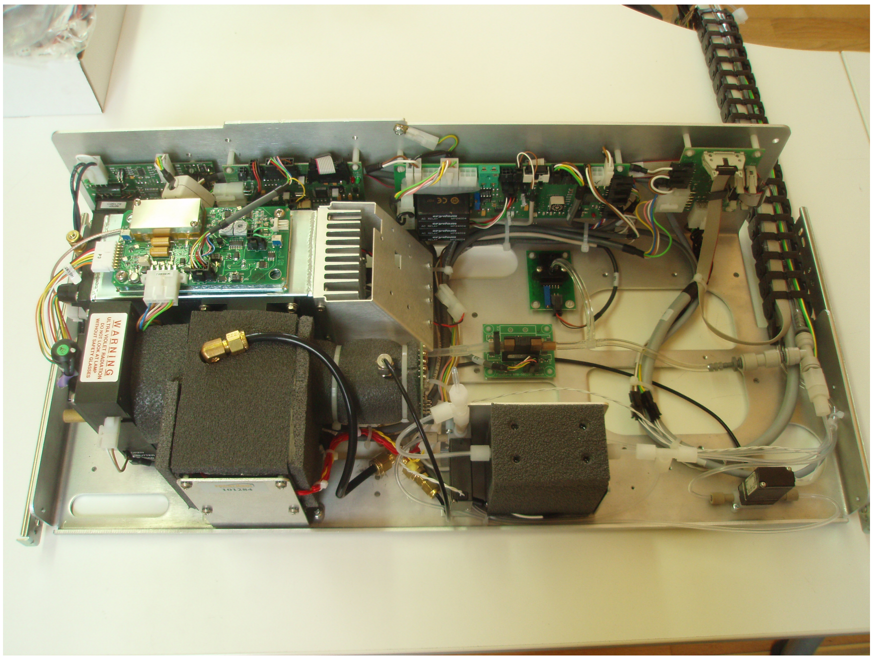


Figure 10.15.: Complete SO_2 Module

10.4.1. SO_2 Ultraviolet Fluorescence

The SO_2 module of the airpointer® measures the amount of sulphur dioxide in a sample. This is done by exciting the SO_2 molecules by ultraviolet light with a wavelength of 214nm and then measuring their fluorescence.

$$SO_2 + h\nu \rightarrow SO_2^{\star}$$

The use of UV light causes the particles to absorb energy which is emitted as a light pulse (photon) shortly afterwards. The photons have a wavelength of 330nm and can be recorded with a detector.

$$SO_2^{\star} \rightarrow SO_2 + h\nu'$$

10.4.2. The UV Light Path

The optical design of the component's sample chamber optimizes the fluorescent reaction between SO_2 and UV light (see Figure 10.16). Furthermore, it assures that only UV light resulting from the decay of $SO_2^{\star}$ into SO_2 is sensed by the instrument's fluorescence detector.

UV radiation is generated by a lamp specifically designed to produce a maximum amount of light of the wavelength needed to excite SO_2 to $SO_2^{\star}$ (214nm). A special reference detector circuit constantly measures the lamp intensity. A Photomultiplier Tube (PMT) (see Section 10-35) detects the UV emitted by the $SO_2^{\star}$ decay and outputs an analog signal. Several focusing lenses and optical filters make sure that both detectors are exposed to an optimum amount of only the desired wavelengths of UV. To assure further that the PMT only detects light emitted by the decaying SO_2^*, the pathway of the excitation UV and field of view of the PMT are perpendicular to each other. The inner surfaces of the sample chamber are coated with a layer of black Teflon® to absorb stray light.

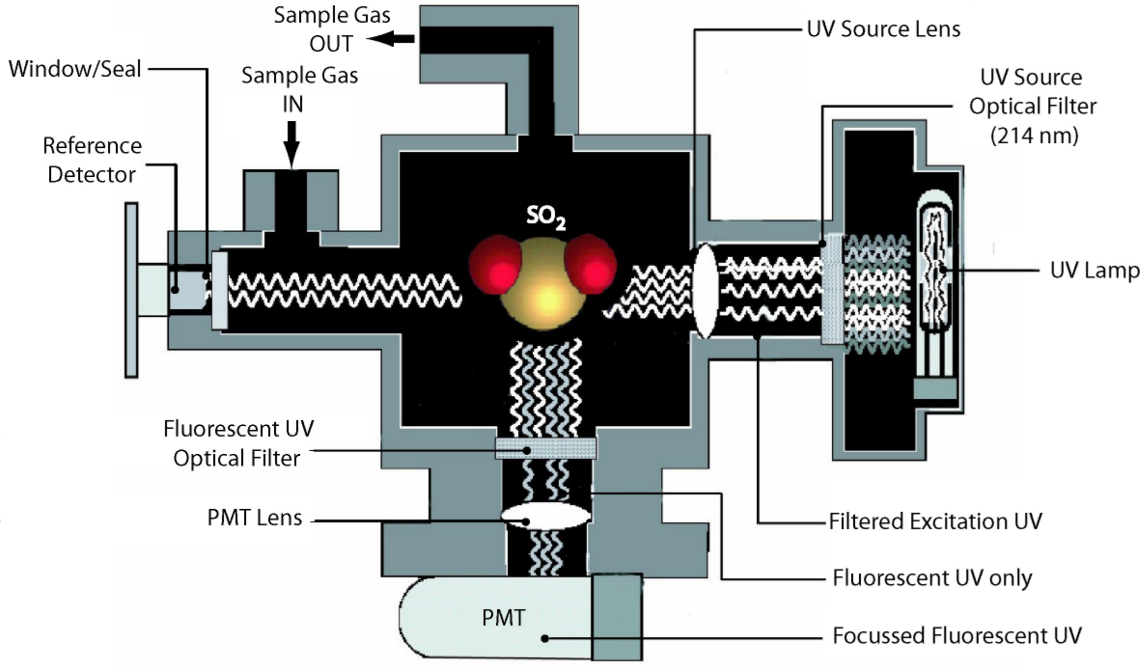


Figure 10.16.: UV Light Path

10.4.3. UV Source Lamp

The source of excitation UV light is a low pressure zinc-vapor lamp. An AC voltage heats up and vaporizes zinc contained in the lamp element creating a light-producing plasma arc. Zinc-vapor lamps are preferred to the more common mercury-vapor lamps for this application because they produce very strong emission levels at the wavelength required to convert SO_2 to $SO_2^{\star}$, i.e., 213.9 nm. The intensity of the lamp is controlled by the UV lamp control on the side of the sensor. It ensures that the intensity of the lamp is constant and increases the current from time to time until the maximum value is reached. At this point one can consider changing the lamp. You can check the value using the Service Interface (see Figure 7.7.2.2). Open the folder 'SO2' and control the 'Power Lamp' value. If it is about to reach 100% , you should change the lamp (see page 11-33). However, the brightness distribution along the active area of the lamp surface may change with operation time, thereby also producing a drop of detected intensity. A slight change of the lamp window orientation may again increase the detected intensity. Therefore, first try changing the orientation of this window, only if this does not improve the intensity, replace the lamp with a new one (see Section 11.7.1 on how to perform these steps).

NOTE
Check the intensity of the lamp regularly!

The lamp used in the SO_2 module is constructed of a vacuum jacket surrounding a double-bore lamp element (see Figures 10.18 and 10.17). The vacuum jacket isolates the plasma arc from most of the external temperature fluctuations. The jacket also keeps the thermal energy created by the operating lamp. This helps the lamp to heat up and maintains a proper vaporization temperature. Light is emitted through a 20mm x 5mm portal.

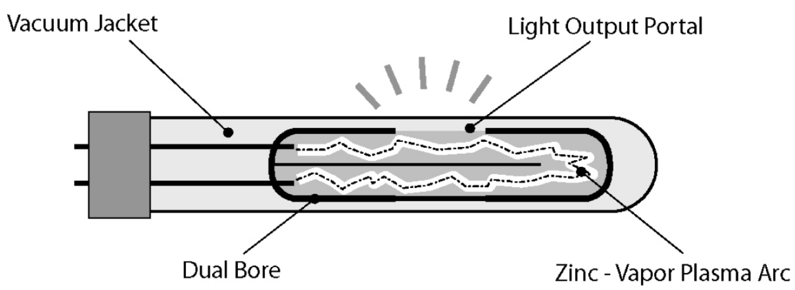


Figure 10.17.: UV Source Lamp Schematic

Figure 10.18.: UV Source Lamp

10.4.4. The Reference Detector

A vacuum diode acts as a UV detector that converts UV light to a DC current. It is used to measure the intensity of the excitation UV source lamp. Its location, directly across from the source lamp at the back of a narrow tube-shaped light trap, places it directly in the path of the excitation UV light. A window transparent to UV light provides an air-proof seal that prevents ambient gas from contaminating the sample chamber. Due to the shape of the light trap and the fact that the detector is blind to wavelengths other than UV, no extra optical filtering is needed.

10.4.5. UV Lamp Shutter and PMT Offset

Inherent to the operation of both the reference detector and the PMT are electronic offsets. The degree of offset differs for each detector and PMT and can vary during the time of use. To account for these offsets the device includes a shutter, located between the UV Lamp and the source filter that cuts off periodically the UV light from the sample chamber (every 5 minutes). The analyzer records the outputs of both the reference detector and the PMT during this dark period and includes them into the SO_2 concentration calculation.

- The reference detector offset is stored and viewable via the Service Interface as the test function RefDetSO2Dark.
- The PMT offset is stored as and viewable via the Service Interface as the test function PMTSigSO2Dark.

10.4.6. Optical Filters

The analyzer uses two stages of optical filters to enhance performance. The first stage conditions the UV light used to excite the SO_2 by removing frequencies of light that are not needed to produce $SO_2^{\star}$. The second stage protects the PMT detector from reacting to light not produced by the $SO_2^{\star}$ returning to its ground state.

10.4.6.1. UV Source Optical Filter

Zinc-vapor lamps output light at other wavelengths than the 214nm required for the $SO_2 \rightarrow SO_2^{\star}$ transformation including a relatively bright light of the same wavelength at which $SO_2^{\star}$ fluoresces as it returns to its SO_2 ground state (330 nm). In fact, the intensity of the light emitted by the UV lamp at 330nm is so bright, nearly five orders of magnitude brighter than that resulting from the $SO_2^{\star}$ decay, it would drown out the $SO_2^{\star}$ fluorescence. To solve this problem, the light emitted by the excitation UV lamp passes through a bandpass filter that screens out photons with wavelengths outside the spectrum required to excite SO_2 into $SO_2^{\star}$ (see Figure 10.19).

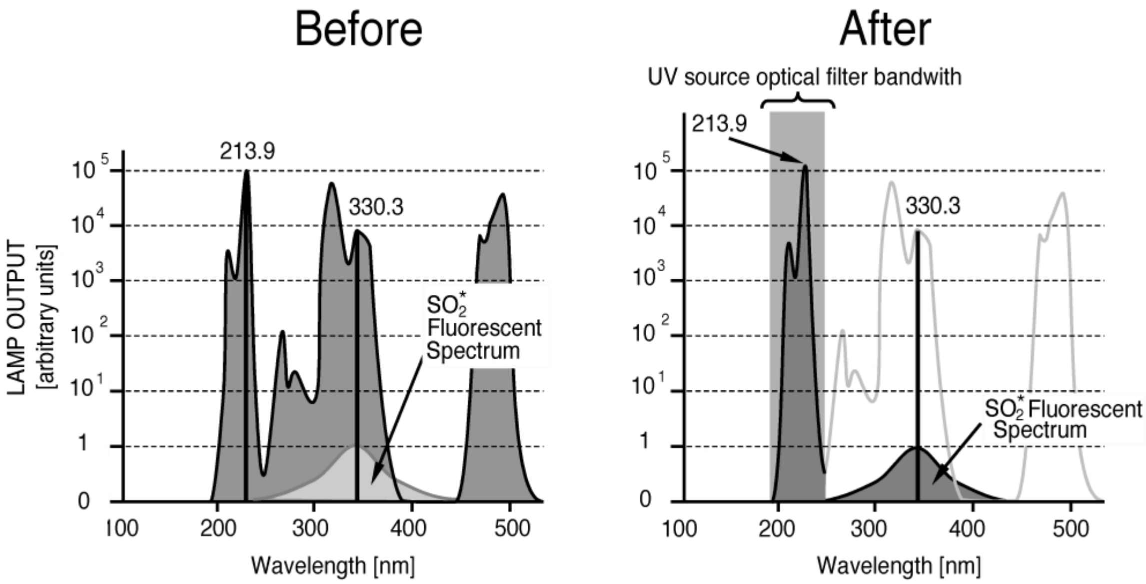


Figure 10.19.: Excitation Lamp UV Spectrum Before/After Filtration

10.4.6.2. PMT Optical Filter

The PMT reacts to a wide spectrum of light which includes much of the visible spectrum and most of the UV spectrum. Even though the 214 nm light used to excite the SO_2 is focused away from the PMT, some of it scatters in the direction of the PMT as it interacts with the sample gas. A second optical bandpass filter placed between the sample chamber (Figure 10.16) and the PMT strips away light outside of the fluorescence spectrum of decaying $SO_2^{\star}$ (Figure 10.20) including reflected UV from the source lamp and other stray light.

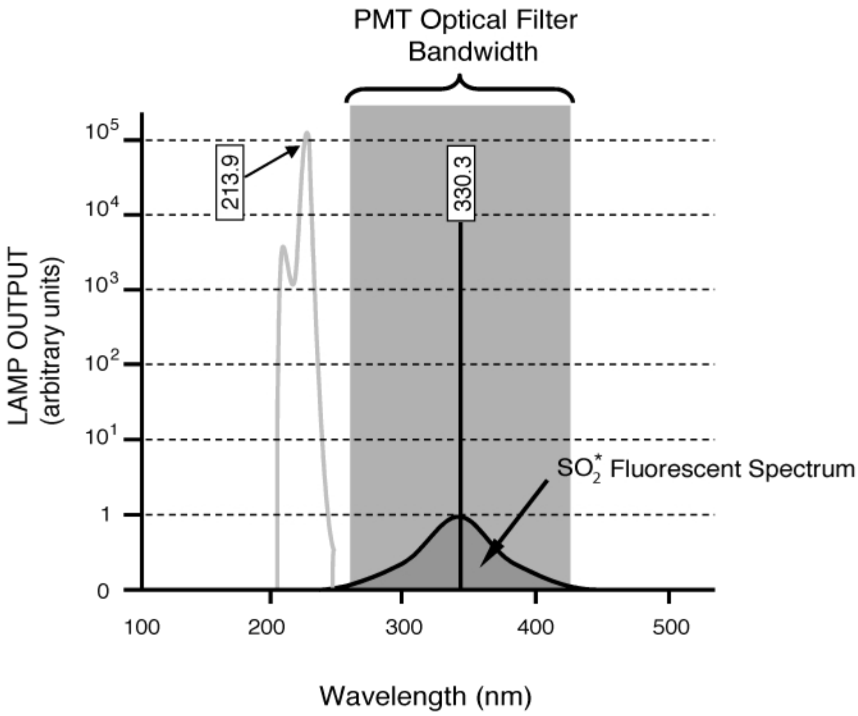


Figure 10.20.: PMT Optical Filter Bandwidth

10.4.7. Optical Lenses

Two optical lenses are used to focus and optimize the path of light through the sample chamber. A lens located between PMT and the sample chamber collects as much of the fluoresced UV created there as possible and focuses it on the most sensitive part of the PMT's photo cathode. Another lens located between the excitation UV source lamp and the sample chamber collimates the light emitted by the lamp into a steady, circular beam and focuses that beam directly onto the reference detector. This allows the reference detector to accurately measure the effective intensity of the excitation UV. This also makes sure that all light emitted by the UV source lamp that is not absorbed by the SO_2 is passed through the 214nm filter and reaches the reference detector. Furthermore, this technique eliminates the effect of flickering, inherent in the plasma arc that generates the light. Conversely, this also makes sure that the volume of sample gas affected by the excitation beam is similar to the volume of fluorescing $SO_2^\star$ being measured by the PMT, eliminating a possible source of measurement offset.

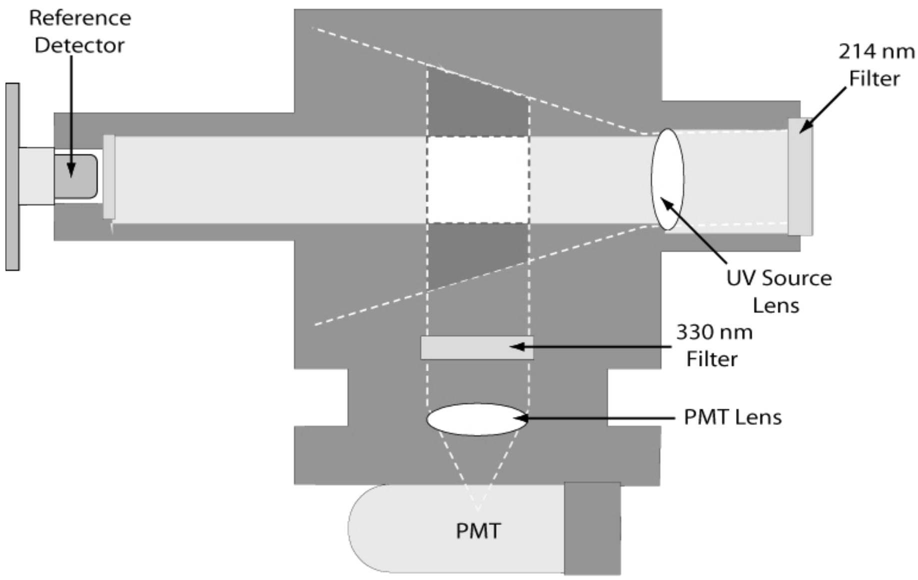


Figure 10.21.: Effects of Focusing Source UV in Sample Chamber

10.4.8. Measurement Interferences

It should be noted that the fluorescence method for detecting SO_2 is subject to interference from a number of sources. The airpointer® has been successfully tested for its ability to reject interference from most of these sources.

10.4.8.1. Direct Interference

The most common source of interference is from other gases that fluoresce in a similar fashion to SO_2 when exposed to UV Light. The most significant of these is a class of hydrocarbons called poly-nuclear aromatics (PNA) of which xylene and naphthalene are two prominent examples. Nitrogen oxide fluoresces in a spectral range near to SO_2. For critical applications where high levels of NO are expected, an optional optical filter is available that improves the rejection of NO (contact distributor for more information). The airpointer® utilizes several methods for rejecting interference from these gases. A special scrubber (kicker) mechanism removes any PNA chemicals present in the sample gas before it can reach the sample chamber. The exact wavelength of light needed to excite a specific non-SO_2 fluorescing gas is removed by the source UV optical filter. The light given off by nitrogen oxide and many of the other fluorescing gases is outside of the bandwidth passed by the PMT optical filter.

10.4.8.2. UV Absorption by Ozone

Because Ozone absorbs UV Light over a relatively broad spectrum it could cause a measurement offset by absorbing some of the UV emitted by the decaying $SO_2^{\star}$ in the sample chamber. airpointer® prevents this from occurring by having a very short light path between the area where the $SO_2^{\star}$ fluorescence occurs and the PMT detector. Because the light path is so short, the amount of O_3 needed to cause a noticeable effect would be much higher than could be reasonably expected in any application for which this instrument is intended.

10.4.8.3. Dilution

Certain gases with higher viscosities can lower the flow rate through the critical flow orifice that controls the movement of sample gas through the analyzer, reducing the amount of sample gas in the sample chamber and thus the amount of SO_2 available to react with the UV light. While this can be a significant problem for some analyzers, the design of the airpointer® is very tolerant of variations in sample gas flow rate and therefore does not suffer from this type of interference.

10.4.8.4. Third Body Quenching

While the decay of $SO_2^\star$ to SO_2 happens quickly, it is not instantaneous. Therefore, it is possible for the extra energy possessed by the excited electron of the $SO_2^\star$ molecule to be given off as kinetic energy during a collision with another molecule. This in effect heats the other molecule slightly and allows the excited electron to move into a lower energy orbit without emitting a photon. In this regard the most significant molecules are nitrogen oxide (NO), carbon dioxide (CO_2), water vapor (H_2O) and molecular oxygen (O_2). In ambient applications the quenching effect of these gases is negligible. For stack applications where the concentrations of some or all of these may be very high, specific steps **must** be taken to remove them from the sample gas before they enter the analyzer.

10.4.8.5. Light Pollution

SO_2

Because the device measures light as a means of calculating the amount of SO_2 present, obviously stray light can be a significant interfering factor. The airpointer® removes this interference source in several ways.

- The sample chamber is designed to be completely light tight to light from sources other than the excitation UV source lamp.
- All pneumatic tubing leading into the sample chamber is completely opaque in order to prevent light from being piped into the chamber by the tubing walls.
- The optical filters discussed in Section 10.4.6 remove UV with wavelengths extraneous to the excitation and decay of SO_2 and $SO_2^\star$, respectively.
- Most important, during instrument calibration the difference between the value of the most recently recorded PMT offset (see Section 10.4.5) and the PMT output while measuring zero gas (calibration gas devoid of SO_2) is recorded as the test function PMTSigSO2Dark. This offset value is used during the calculation of the SO_2 concentration. Since this offset is assumed to be due to stray light present in the sample chamber, it is also multiplied by the SLOPE. PMTSigSO2Dark is viewable via the Service Interface (see Section 7.7.2.2) in folder ‘SO2’, the SLOPE via the User Interface: menu item ‘Configuration’→‘SO2 Sensor’, variable ‘SO2Slope’ and in ‘Servic Interfac/SO2’.

10.5. The O_3 Module

O_3

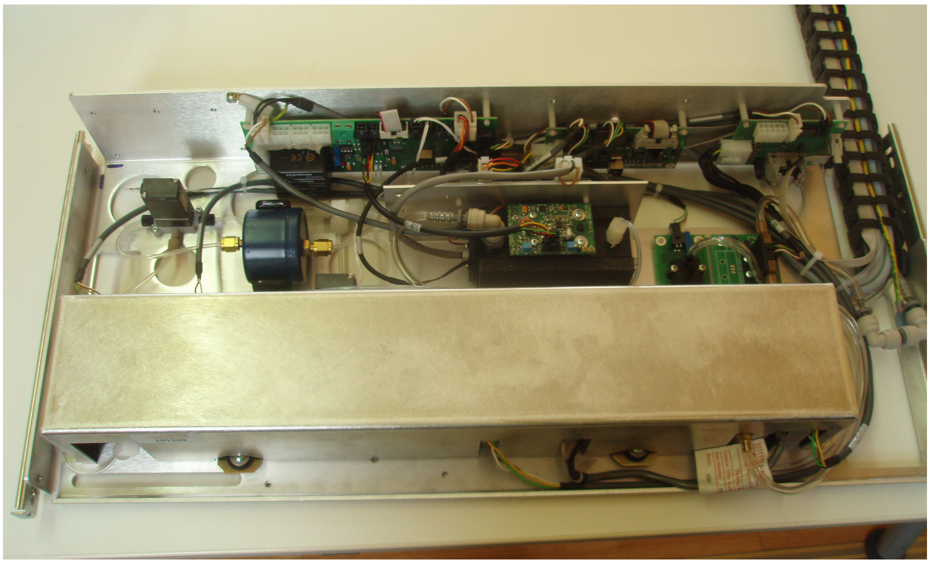


Figure 10.22.: Complete O_3 Module

10.5.1. The Absorption Path

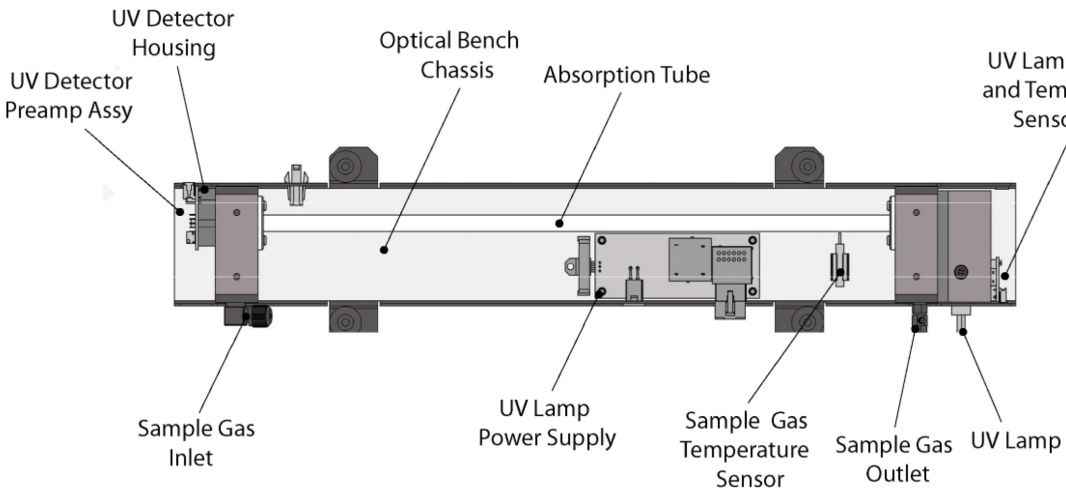


Figure 10.23.: Optical O_3 Bench

The airpointer®'s ozone analyzer in a nutshell:

- Measures each of the variables: Sample Temperature, Sample Pressure, the intensity of the UV light beam **with** and **without** O_3 present,
- Inserts known values for the length of the absorption path and the absorption coefficient, and
- Calculates the concentration of O_3 present in the sample gas.

In the most basic terms, the airpointer® uses a high energy, mercury vapor lamp to generate a beam of UV light. This beam passes through a window of material specifically chosen to be both non-reactive to O_3 and transparent to UV radiation at 254 nm and into an absorption tube filled with Sample Gas. Because ozone is a very efficient absorber of UV radiation, the absorption path length required to create a measurable decrease in UV intensity is short enough (approximately 42 cm) to pass the light beam only one time through the absorption tube. Therefore, no complex mirror system is needed to lengthen the effective path by bouncing the beam back and forth.

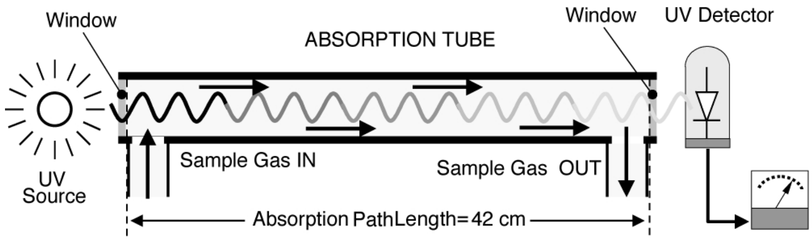


Figure 10.24.: O_3 Absorption Path

Finally, the UV passes through a similar window at the other end of the absorption tube and is detected by a specially designed vacuum diode that only detects radiation at or very near a wavelength of 254 nm. The selectivity of the detector is high enough that no extra optical filtering of the UV light is needed. The detector assembly reacts to the UV light and outputs a voltage that varies in direct relationship with the light's intensity. This voltage is digitized and sent to the instrument's CPU to be used in computing the concentration of O_3 in the absorption tube.

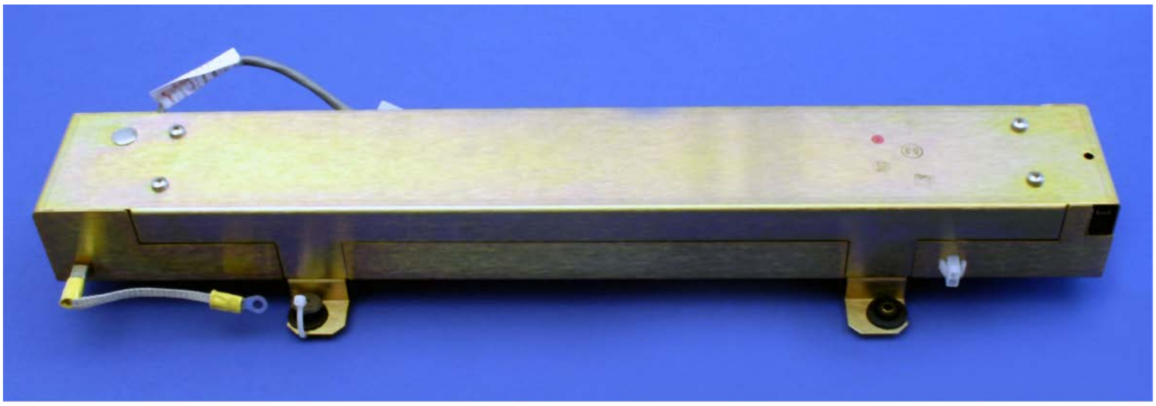


Figure 10.25.: Ozone Bench

10.5.2. The Reference / Measurement Cycle

In order to solve the Beer-Lambert equation it is necessary to know the intensity of the light passing through the absorption path both when O_3 is present and when it is not. The device accomplishes this by alternately sending the Sample Gas directly to the absorption tube or passing it through a chemical scrubber that removes any present O_3. Refer to

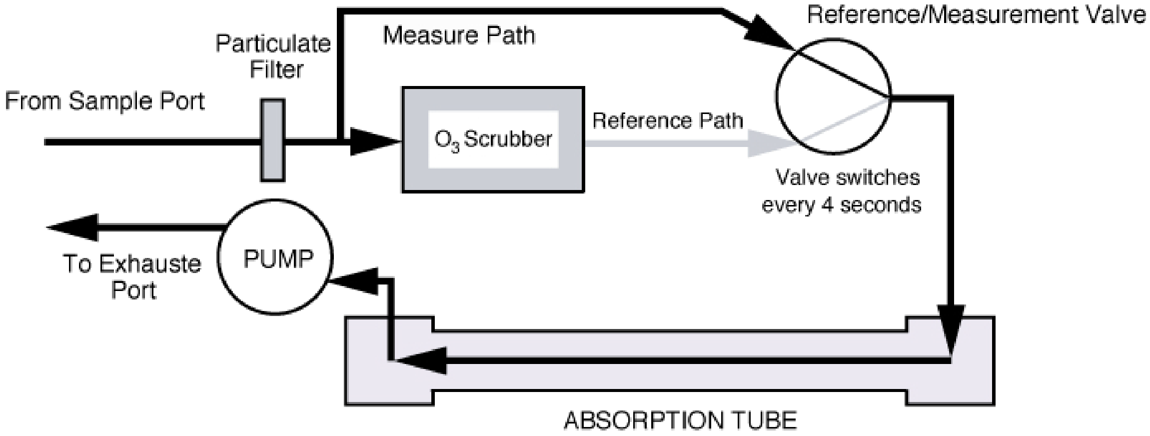


Figure 10.26.: Reference / Measurement Gas Cycle

Table 10.2 for the steps of the Measurement / Reference Cycle.

Table 10.2.: Measurement / Reference Cycle

Time Index	Status
0 seconds	Measure/Reference Valve opens to the Measure Path.
0–2 seconds	Wait Period. Ensures that the absorption tube has been adequately flushed of any previously present gases.
3–4 seconds	Analyzer measures the average UV light intensity of O_3 bearing Sample Gas (I) during this period.
5 seconds	Measure/Reference Valve opens to the Reference Path.
5–6 seconds	Wait Period. Ensures that the Absorption tube has been adequately flushed of O_3 carrier gas.
7–8 seconds	Analyzer measures the average UV light intensity of non-O_3 carrier Sample Gas (I_0) during this period.
CYCLE REPEAT EVERY 8 SECONDS	

CO

10.6. The CO Module

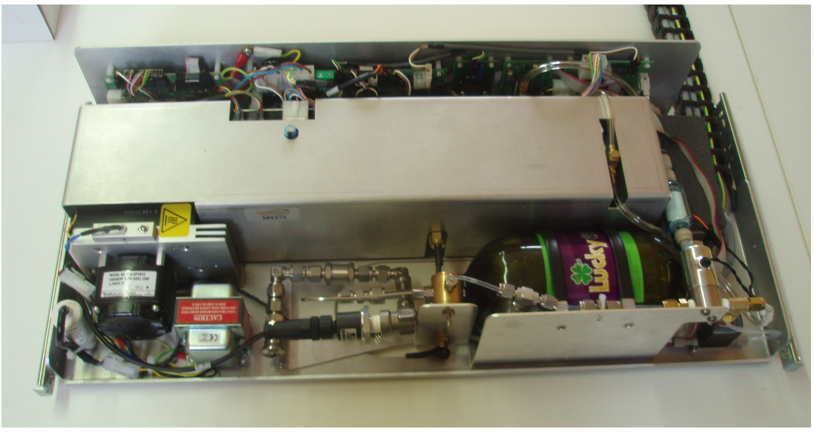


Figure 10.27.: Complete O3 and CO Bench

10.6.1. Operating Principle

In the most basic terms, this component uses a high energy heated element to generate a beam of broad-band IR light with a known intensity at 4.7µm wavelength (measured during Instrument calibration). This beam is directed through multi-pass cell filled with sample gas. The sample cell uses mirrors at each end to reflect the IR beam back and forth through the sample gas to generate a 14 meter absorption path (see Figure 10.28). This length was chosen to give the analyzer maximum sensitivity to fluctuations in CO density. Upon exiting the sample cell, the beam shines through a band-pass filter that allows only light at a wavelength of 4.7µm to pass. Finally, the beam strikes a solid-state photo-detector that converts the light signal into a modulated voltage signal representing the attenuated intensity of the beam.

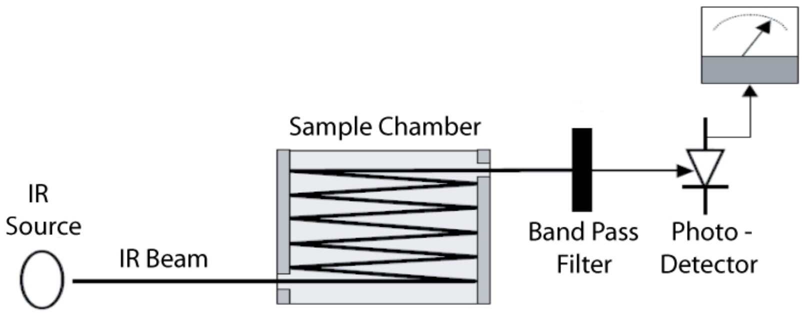


Figure 10.28.: Measurement Fundamentals

10.6.2. Gas Filter Correlation

Unfortunately, several gases also absorb light at 4.7 µm. Among these are water and carbon dioxide, both of which are much more common gases, compared to CO. To overcome interfering effects of these, as well as of other gases, the airpointer® adds another component to the IR Light path called a Gas Filter Correlation (GFC) Wheel (see Figure 10.29).

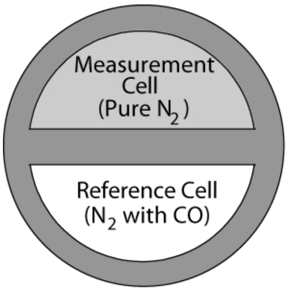


Figure 10.29.: GFC Wheel

A GFC Wheel is a metallic wheel into which two chambers are carved. The chambers are sealed on both sides with material transparent to 4.7µm IR radiation creating two airtight cavities. Each cavity is filled with specially composed gases. One cell is filled with pure N_2 (the Measure Cell). The other is filled with a combination of N_2 and a high concentration of CO (the Reference Cell). As the GFC wheel spins, the IR light alternately passes through the two cavities. When the beam is exposed to the Reference Cell, the CO in the gas filter wheel strips the beam of most of the IR at 4.7 µm. When the light beam is exposed to the Measurement Cell, the N_2 in the filter wheel does not absorb IR light. This results in a fluctuation in the intensity of the IR light striking the photo-detector (see Figure 10.30) that outputs a signal of the detector resembling a square wave.

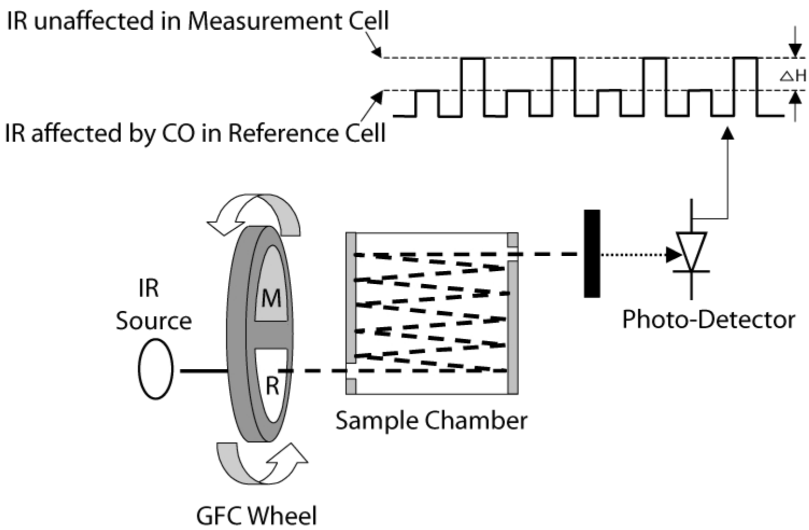


Figure 10.30.: Measurement Fundamentals Using a GFC Wheel

The device determines the amount of CO in the sample chamber by computing the ratio between the peak of the Measurement pulse (CO MEAS) and the peak of the Reference

Pulse (CO REF). If no gases exist in the Sample chamber that absorb light at 4.7 µm , the high concentration of CO in the gas mixture of the Reference Cell will attenuate the intensity of the IR Beam by approximately 20% giving a M/R Ratio of 1.2 : 1. Adding CO to the Sample Chamber causes the peaks corresponding to both cells to be attenuated by a further percentage (see Figure 10.31). Since the intensity of the light passing through

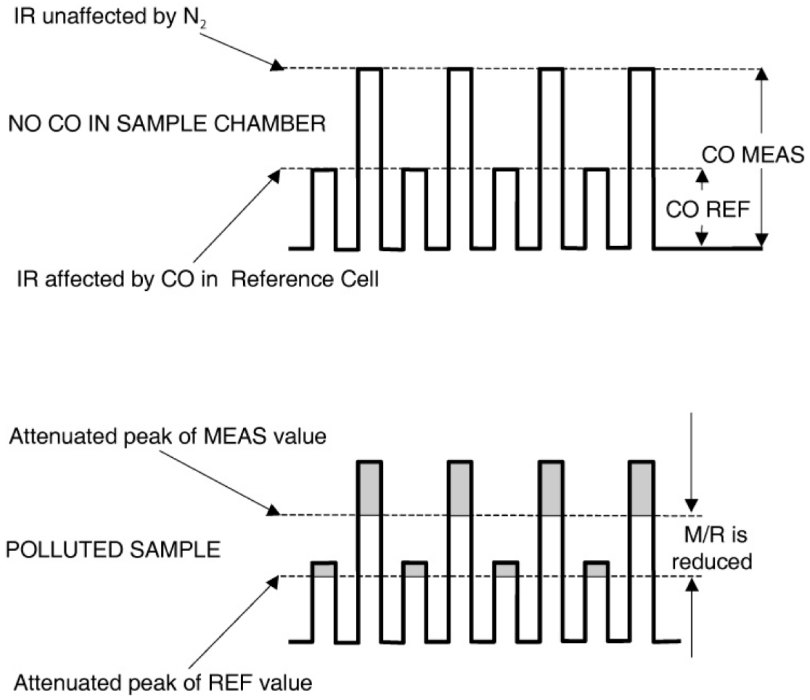


Figure 10.31.: Effect of CO in the Sample on CO MEAS and CO REF

the Measurement Cell is greater, the effect of this additional attenuation is greater. This causes CO MEAS to be more sensitive to the presence of CO in the Sample Chamber than CO REF and the ratio between them (M/R) to move closer to 1:1 as the concentration of CO in the Sample Chamber increases. Once the airpointer® has computed this ratio, a look-up table is used, with interpolation, to linearize the response of the instrument. This linearized concentration value is combined with calibration 'SLOPE' and offset values to produce the CO concentration which is then normalized for changes in sample pressure.
If an interfering gas, such as CO_2 or H_2O vapor is introduced into the Sample Chamber, the spectrum of the IR beam is changed in a way that is identical for both the Reference and the Measurement Cells, but without changing the ratio between the peak heights of CO MEAS and CO REF. In effect, the difference between the peak heights remains the same (see Figure 10.32). Thus, the difference in the peak heights and the resulting M/R ratio is only due to CO and not to interfering gases. In this way, Gas Filter Correlation rejects the effects of interfering gases and so the analyzer responds only to the presence of CO.

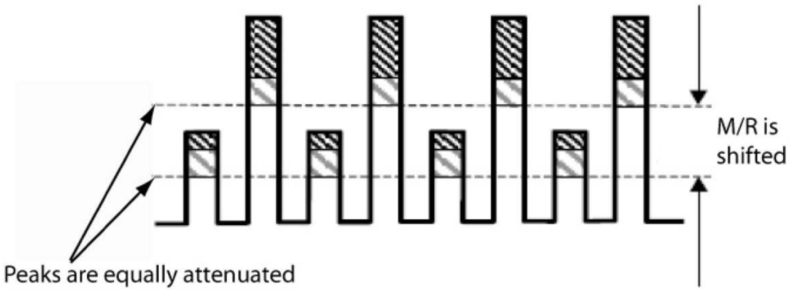


Figure 10.32.: Effects of Interfering Gas on CO MEAS and CO REF

To improve the signal-to-noise performance of the IR Photo-Detector, the GFC wheel also incorporates an optical mask that chops the IR beam into alternating pulses of light and dark at six times the frequency of the Measure/Reference signal (see Figures10.33 and 10.34). This limits the detection bandwidth helping to reject interfering signals from outside this bandwidth improving the signal to noise ratio.

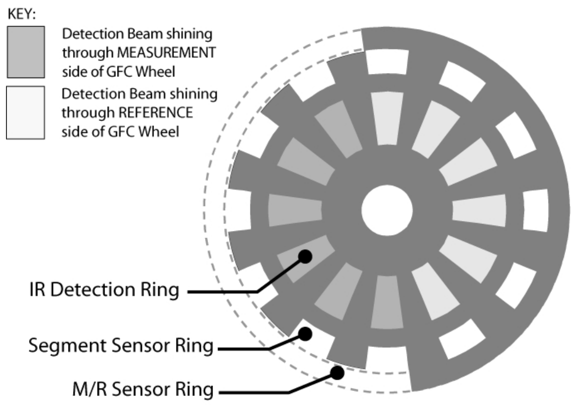


Figure 10.33.: Optical Mask for Improved S/N

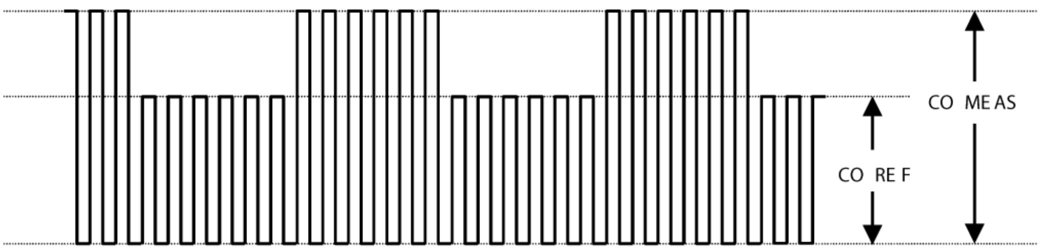


Figure 10.34.: Chopped IR Signal

10.7. Base Unit

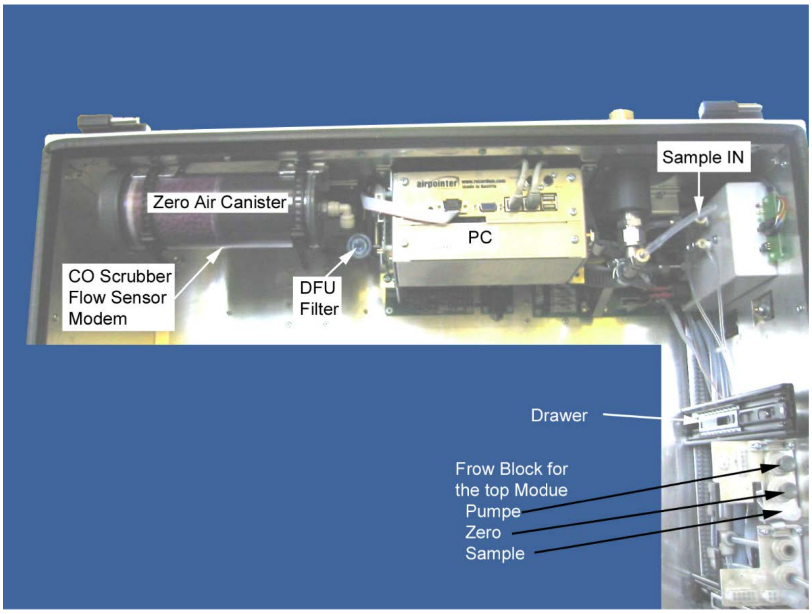


Figure 10.35.: System Parts

This part of the airpointer® leads the gas to be measured to the various measuring modules. It is located at the top of the airpointer® . The gas flow through the module is shown in Figure 10.2. It also creates Zero Air, which is needed for various measurements in the modules. In Figure 10.35 one can see all of the system components of the airpointer®. For details of various components refer to the dedicated sections.

- **The Flow Sensor** measures the total gas mass flow through all installed modules drawn through the System Pump.
- **The Sample Inlet** is the location where the Sample Inlet Filter is connected to the system components.
- **The Zero Air Scrubber** has to be replaced after a certain period of time. For details see Section 11-16.

10.8. The Photomultiplier Tube Detector (PMT)

NO$_x$
SO$_2$

The airpointer® uses a photomultiplier tube (PMT) to detect specific emission spectra of the pollutants. The only differences between the PMTs in the different modules are the optical filters to detect the specific wavelength of the emitted light. A typical PMT is a vacuum tube containing a variety of specially designed electrodes (Figure 10.36). Photons from the reaction are filtered by an optical high-pass filter, enter the PMT and strike a negatively charged photo cathode causing it to emit electrons. A high voltage potential across these focusing electrodes directs the electrons toward an array of high voltage electrodes, the so called dynodes. The dynodes in this electron multiplier array are designed in a way that each stage multiplies the number of emitted electrons by emitting multiple, new electrons. The greatly increased number of electrons emitted from one end of the electron multiplier is collected by a positively charged anode at the other end, which creates a usable current signal. This current signal is amplified by the preamplifier board and then reported to the RDPP. A significant performance characteristic of the PMT is the voltage potential

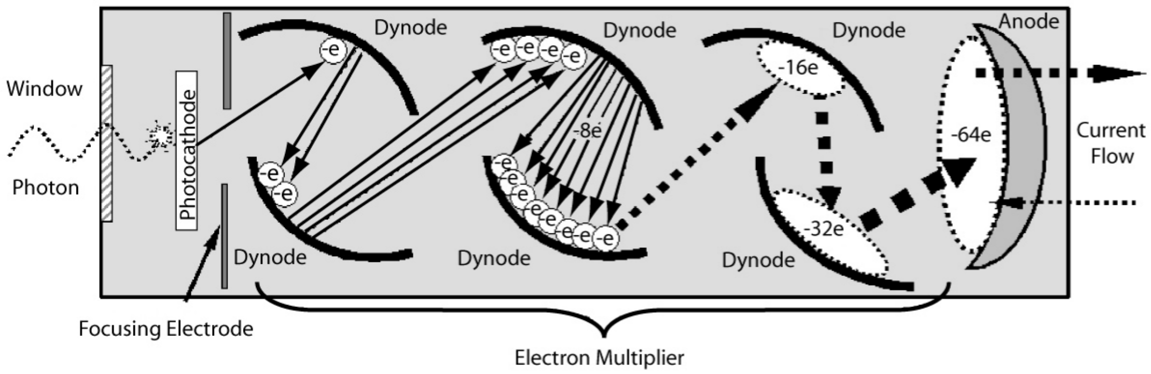


Figure 10.36.: Scheme of a Photomultiplier Tube

across the electron multiplier. The higher the voltage, the greater is the number of electrons emitted from each dynode of the electron multiplier, making the PMT more sensitive and responsive to small variations in light intensity, but it also increases random noise (dark noise).

The PMT is housed inside the sensor module assembly (Figure 10.37). This assembly also includes the high voltage power supply (HVPS) required to drive the PMT, a LED used by the instrument's optical test function, a thermistor that measures the temperature of the PMT and various components of the PMT cooling system including the thermo-electric cooler (TEC).

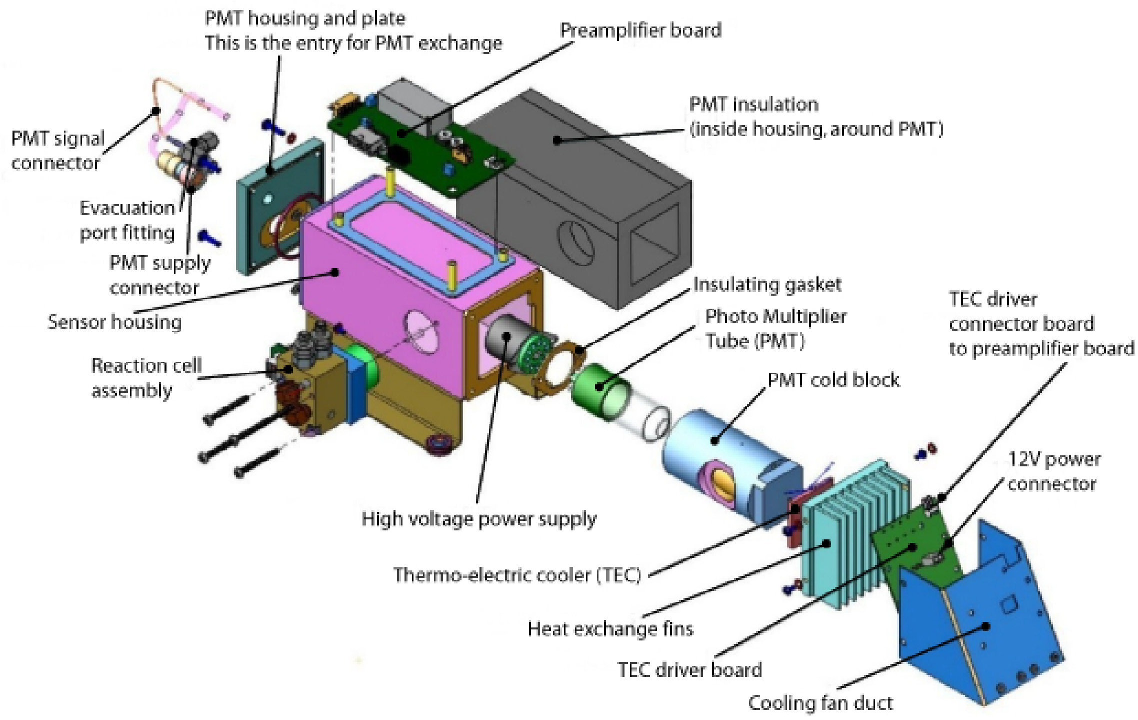


Figure 10.37.: Sensor Assembly

10.8.1. PMT Temperature

PMT temperature should be low and constant. It is more important that this temperature is maintained constant than it is to maintain it low. The PMT cooler (see Figure 10.38) uses a Peltier thermoelectric element supplied with 12V DC power. The temperature is controlled by a proportional temperature controller located on the preamplifier board. Voltages applied to the cooler element vary from 0.1 to 12 V DC. The temperature set point (hard-wired into the preamplifier board) will vary by $\pm$ 1 °C due to component tolerances. The actual temperature will be maintained to within 0.1 °C around that set point. The Service Interface enables the user to watch that temperature drop from about ambient temperature down to its set point of 10 °C ('PMTTemp'). If the temperature fails to drop after 20 minutes, there is a problem in the cooler circuit.

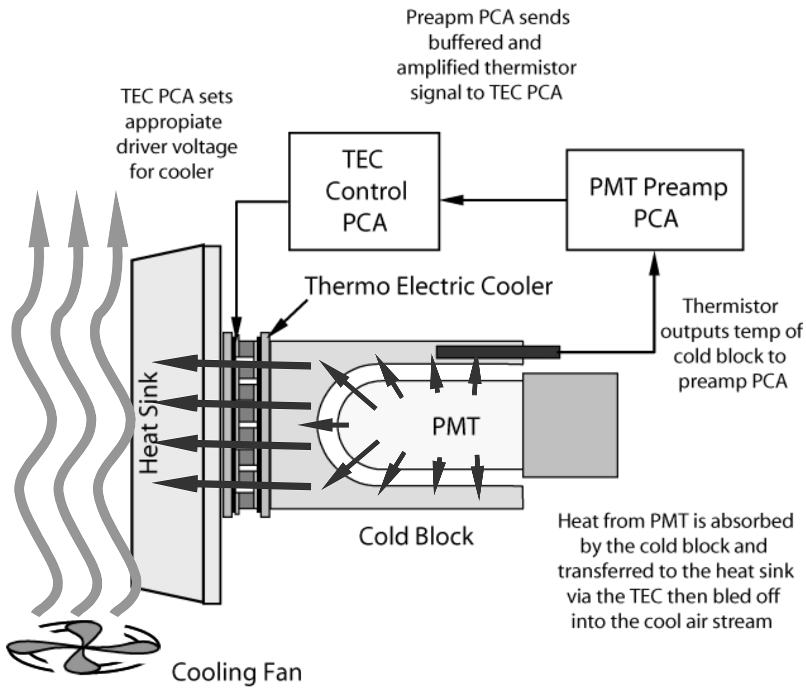


Figure 10.38.: PMT Cooling System

10.9. The IR Sensor

CO

A photoconducting sensor is used in the airpointer® to measure IR absorption. It accurately detects the 4.7µm wavelength due to NDIR Detection (Non-Dispersive Infra-Red Detection), which means that an optical filter is placed in front of the detector to pass mainly the 4.7µm rays.

The sensor itself consists of a semiconductor. When the IR rays hit the sensor surface, positive or negative charges—dependent on the type of semiconductor—are forced to move and cause a current flow. This manifests by the drop of electrical resistance and is measured via a bias. The bias is kept at a constant value. When the resistance drops, the current increases (Ohm's Law). This current is measured and hence the resistance and furthermore the concentration of IR-absorbing molecules in the sample chamber can be calculated. For a detailed description of the measurement process refer to Section 10.6.

10.10. Scrubbers

10.10.1. Hydrocarbon Scrubber (Kicker)

SO_2

It is very important to make sure the air supplied to the sample chamber is clean of various gases that may influence the measurement (e.g. in the SO_2 module the hydrocarbons). To accomplish this task, the airpointer® uses a single tube permeation scrubber. The scrubber consists of a single tube of a specialized plastic that absorbs hydrocarbons very well. This tube is located within an outer flexible plastic tube shell. As gas flows through the inner tube, hydrocarbons are transported through the membrane wall into the free of hydrocarbon purge gas that is flowing through the outer tube. This process is driven by the hydrocarbon concentration gradient between the inner and outer of the tubes. In the device, some of the cleaned air from the inner tube is returned to be used as the purge gas in the outer tube (see Figure 10.39).

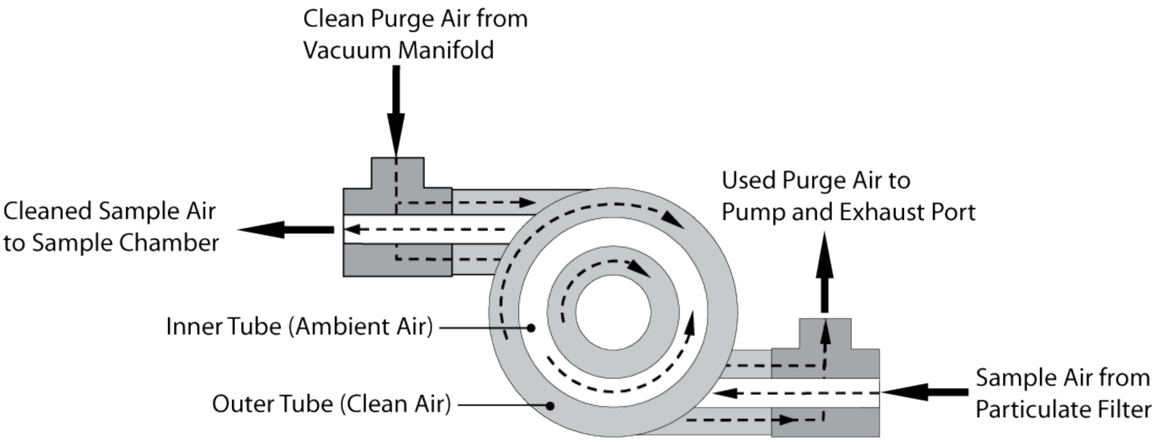


Figure 10.39.: Hydrocarbon Scrubber Scheme

This means that when the analyzer is first started, the concentration gradient between the inner and outer tubes is not very high and the scrubber's efficiency is relatively low. When the instrument is turned on after having been off for more than 30 minutes, it takes a little time for the gradient to become high enough for the scrubber to efficiently remove hydrocarbons from the sample air.

10.10.2. Ozone Destroyer

NO_x

O_3 as unstable compound reduces O_2 rather quickly, however, the breakdown is not fast enough to ensure that it is completely removed from the exhaust gas stream of the device by the time the gas exits the analyzer. Because of the high toxicity of O_3, a special catalytic ozone scrubber is used to ensure that the exhaust stream is free of any residual O_3.
The catalyst is a combination of 60–75% manganese dioxide, 11–14% copper oxide and 8–18% aluminum oxide. Besides its efficiency, this catalyst produces no toxic or hazardous gases as it converts ozone to oxygen and does not pose an explosion hazard like charcoal scrubbers.
This O_3 scrubber is located inside the NO_2 converter housing next to the NO_2 converter in

Figure 10.40.: Ozone Exhaust Scrubber

order to utilize residual heat given off by the converter heater. Whereas the catalyst is 100% efficient at converting ozone to oxygen at room temperature, heating it significantly reduces the necessary residence time for 100% efficiency (the time, the gas must be in contact with the catalyst). Therefore, this efficiency can also be maintained at higher gas flow rates. Because this is a true catalytic converter, there are no maintenance requirements as would be required for charcoal-based scrubbers.

11. Maintenance

NOTE
The operations outlined in this chapter must be performed by qualified maintenance personnel only. Please make sure that you can log in as administrator at your computer and at the airpointer® .

Predictive diagnostic functions including data acquisition, failure warnings and alarms built into the airpointer® allow the user to determine when repairs are necessary without performing unnecessary, preventive maintenance procedures. These messages are viewable via the Service Interface outlined in Section 7.7.2.2. Therefore, regularly start the service interface and check for warning and error messages!

NOTE
Regularly start the service interface and check for warning and error messages.

At the service interface a red 'FAIL' or a black 'WARN' is written beside the name of your airpointer® (top left), if there is a fail or a warning, respectively. The note is updated when you open a new side.
There is, however, a minimal number of simple procedures that, when performed regularly, will ensure that the analyzer continues to operate accurately and reliable over its lifetime.

NOTE
Please check the internet connection before you leave the airpointer®

11.1. Maintenance Schedule

Some of the parts inside the airpointer® have to be maintained regularly. Check Table 11.1 for service intervals and Figures 11.1 and 11.2 for the location of the parts inside the airpointer®. Please note that the time intervals strongly depend on the environmental conditions of the device's location and may be seen as a suggestion.

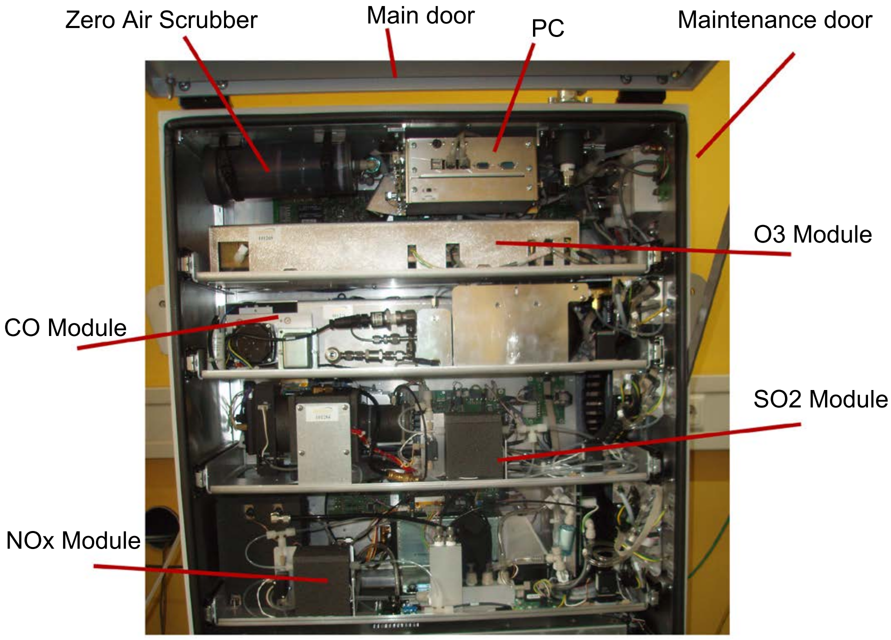


Figure 11.1.: Inside the airpointer® with four slides (4D) top

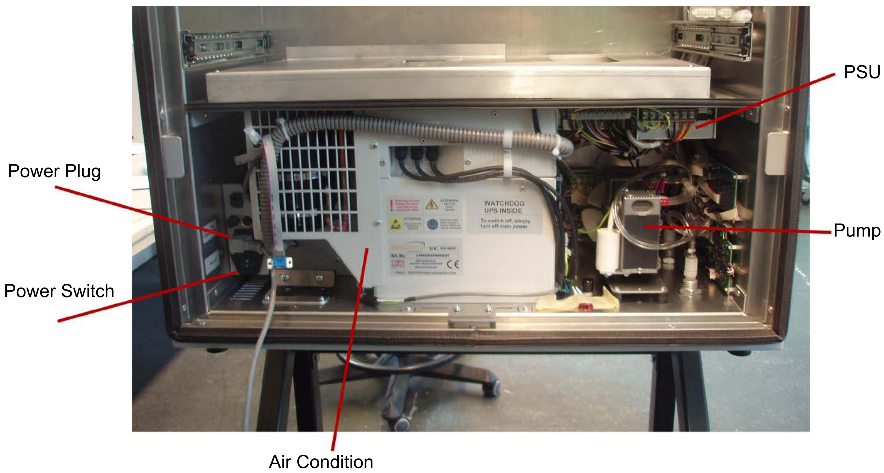


Figure 11.2.: Inside the airpointer® with four slides (4D) bottom

Item	Figure	Module	Calibration required?	Frequency	Page	To Do
Zero/Span Calibration	—	all	No	4/year recom.	7-28	Calibrate
Sampling System	—	Base Unit	No	1/year	—	Wipe out
Sample Particulate Filter	—	Base Unit	No	1-4/month	11-12	Change
DFU Filter (Zero Air)	11.1	Base Unit	No	1/year	—	Change
Zero Air Scrubber	11.1	Base Unit	No	1-4/year	11-16	Replace Purafil® and charcoal
O_3 Scrubber	11.21	O_3	Yes	1/3-4 years	11-24	Change
O_3 Bench	11.21	O_3	Yes	1/year	11-26	Clean
Reaction Cell	11.32	NO_x	Yes	1/year	11-41	Clean
Molybdenum Converter	11.32	NO_x	Yes	1/4-6 years if CE < 0.95	11.8.1	Change cartridge
Critical Flow Orifice	11.32	NO_x	Yes	1/year	11-46	Clean
Air Conditioning ventilation grids	11.2	Base Unit	No	6/year	11-19	Clean
Pump	11.2	Base Unit	No	1/year	11-22	Use pump rebuild kit
All Components	—	—	Yes	1/year	11-49	Calibrate, leak check

Table 11.1.: Maintenance Schedule

11.2. Maintenance Procedures

> **NOTE**
> **The service procedures in this manual are restricted to qualified service representatives.**

The access for users allows to change the sample particulate filter, to directly connect a laptop (LAN2), to connect a calibration gas, switch the maintenance switches and provides a power socket.

> **CAUTION:**
>
> **Risk of electrical shock. Disconnect power before performing any operations that require entry into the interior of the airpointer®.**

Figure 11.3.: The airpointer® with closed doors

Figure 11.4.: Maintenance door

The following sections includes maintenance information and replacement procedures of following units:

1. General
2. Base Unit
3. O_3 Module
4. CO Module
5. SO_2 Module
6. NO_x Module

CAUTION:

Do not use alcohol or other solvents for cleaning the sample wetted components!

CAUTION:

Some internal components can be damaged by small amount of static electricity. A properly grounded antistatic wrist must be worn while handling any internal component.

CAUTION:

Take care that screws and tools do not fall into the airpointer®! Loose screws or tools can damage the airpointer®!

11.3. General

11.3.1. Main door

Use the following procedure to open the main door:

1. Unlock the main lock with your key.(see Nr. 1 at Figure 11.5)

2. Unlock the two secondary locks consecutivly by performing a 90° rotation with the key.(see Nr. 2 at Figure 11.5) The two locks are open in vertical position and locked in horizontal position.

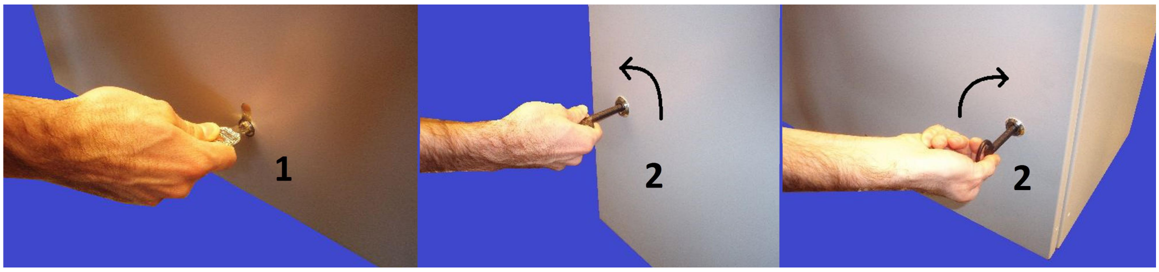


Figure 11.5.: Open and close main door

> **CAUTION:**
>
> **Take care that you have enough space to open the door.**

Use the following procedure to close the main door:

1. Close the door slowly.

2. Close the door and look the two locks and the main lock.

> **CAUTION:**
>
> **You can always lock your airpointer® by only using the main lock or the secondary locks independently of each other.**

11.3.2. Maintenance door

Use the following procedure to open the maintenance door:

1. Unlock the lock with your key.
2. Pull the door.

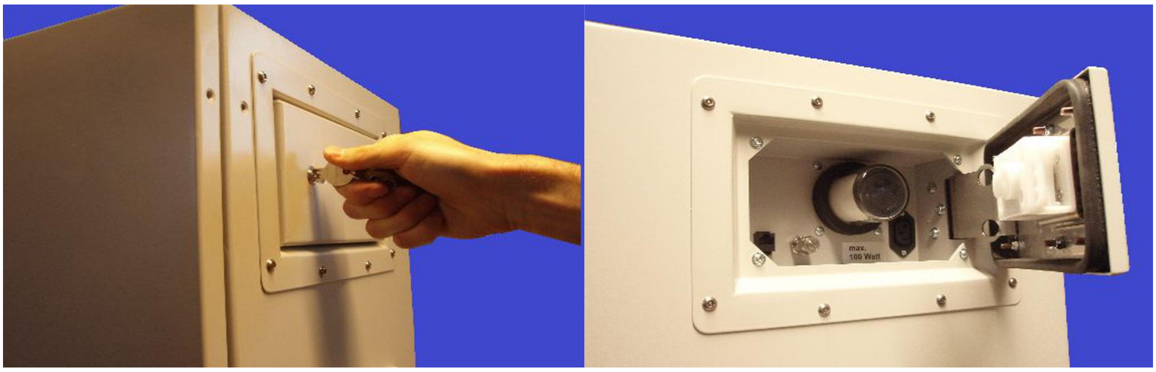


Figure 11.6.: Open and close the maintenance door

Use the following procedure to close the maintenance door:

1. Close the door.
2. Lock the door with your key.

11.3.3. Slide a Module

For most of the maintenance procedures it is sufficient to slide out the module.

Use the following procedure to slide a module:

1. Hold the Module on the left and right side and slide it out carefully.

NOTE
Pull and push simultaneously on both sides!

2. When you slide in a module be careful not to quench any tubing or cable.
3. The module arrests with a light click

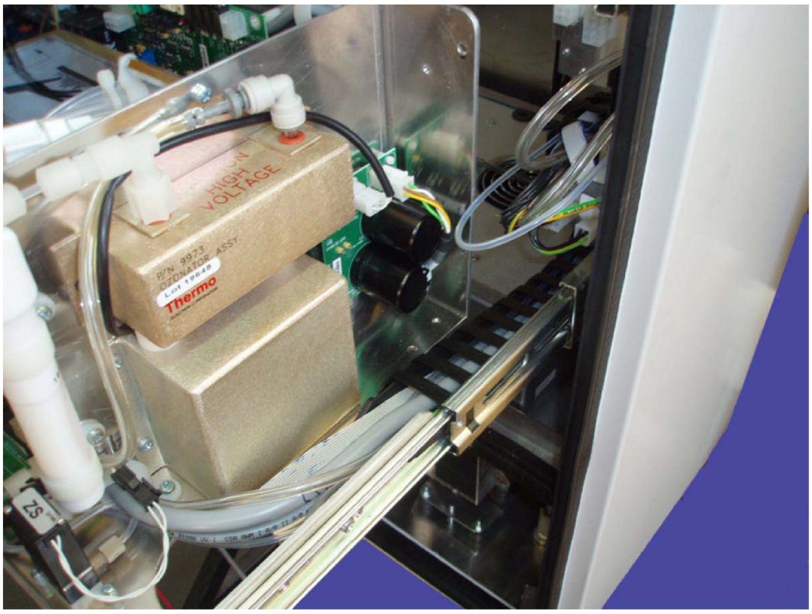


Figure 11.7.: Push and pull the module on both sides simultaneously

11.3.4. Lift a Module out or in

For most of the maintenance procedures it is sufficient to slide out the module. If you want to completely lift out a module use the following procedure.

NOTE
Note on which drawer the module was placed and where and how the chain with the tubings and cables is linked with the flow block of the base unit.

Use the following procedure to lift out a module:

1. Slide out the module as far as possible.
2. Loose the 7 connections of the connection chain on the right side. There are 3 tubes (Pump, Zero and Sample, 3 cables and one grounding).
3. The Zero and Pump Connection are fixed by two quick release fasteners which can be released by pushing down the grey ring.(see figure below). The Sample connection has to be screwed.
4. Loose the clamp of the connection chain (quench).
5. Press the levers in both drawers up (left) or down (right) and simultaneously slide completely out the module.

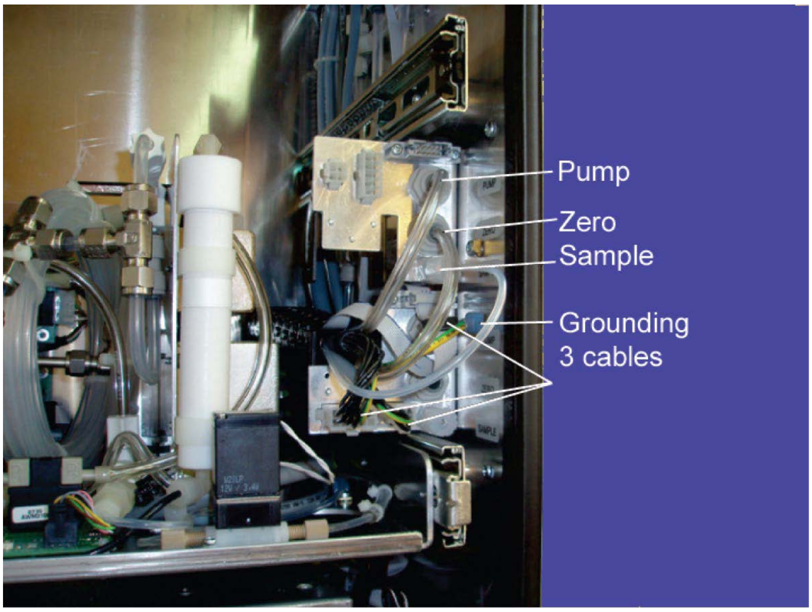


Figure 11.8.: Disconnect the seven connections of the connection chain.

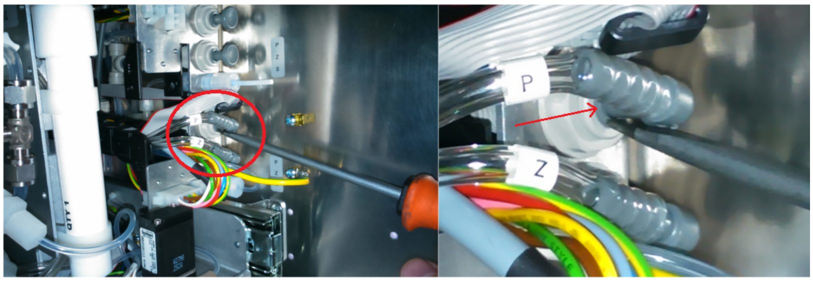


Figure 11.9.: Pushing down the grey ring with a screwdriver

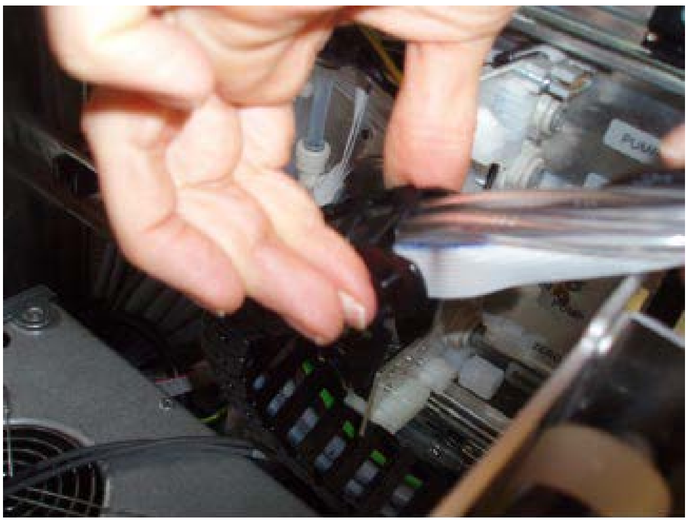


Figure 11.10.: Loose the clamp

Figure 11.11.: Press the small levers in both drawers up (left) or down (right).

> **CAUTION:**
>
> **Be aware of the weight of the Module! The weight is listed in chapter 4 'Spezification'.**

<u>Use the following procedure to lift in a module:</u>

1. Locate the drawer and the flow block of the module and slide out the drawers a bit.
2. Hold the module with one arm near the drawers and arrange the connection chain. It should lei in the holder.

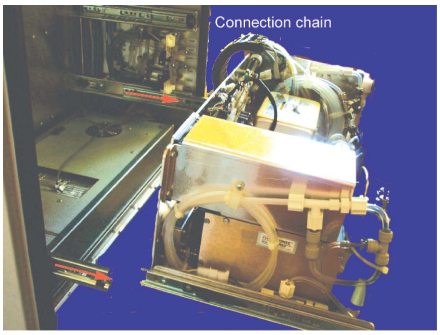


Figure 11.12.: Slide out the drawers a bit

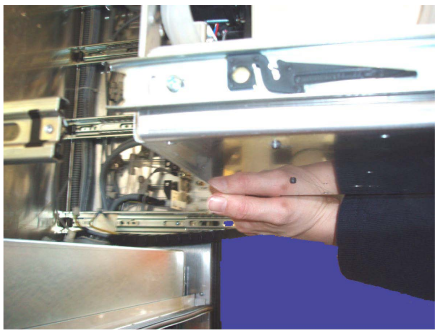


Figure 11.13.: Hold the module with one arm near the drawers

NOTE
Be careful not to squeeze any tubings or cables!

3. Slide in the module as far as possible. There is a light click at the end.
4. Connect the 7 connections on the right side. There are 3 tubes (Pump, Zero and Sample), 3 cables and one grounding.
5. Fix the connection chain into the clamp.

11.4. Maintenance of Base Unit (System parts)

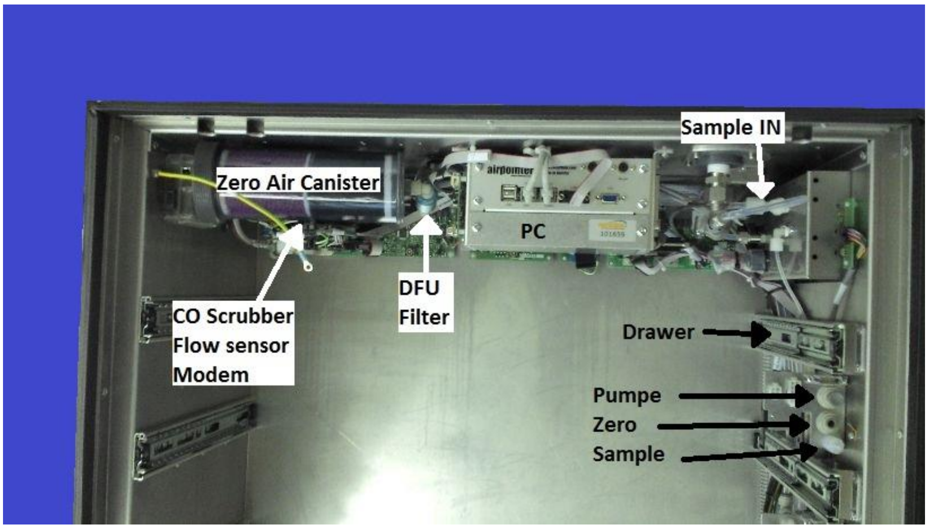


Figure 11.14.: System Components

This subsection includes following maintenance information and replacement procedures:

1. Sample Particulate Filter Inspection and Replacement
2. Visual Inspection and Cleaning
3. DFU Filter Replacement
4. Zero Air Scrubber Maintenance
5. Louvers Inspection and Cleaning
6. Cleaning the Cooling Aggregate
7. Air Condition
8. Pump Maintenance

11.4.1. Sample Particulate Filter

The particulate filter should be inspected regularly for signs of plugging or excess dirt. If contaminated, replace the filter following the procedure outlined below. It should be replaced according to the service interval in Table 11.1 even without obvious signs of dirt. This is because filters with a pore size between 1 and 5 μm can clog while retaining a clean look. We recommend handling the filter and the wetted surfaces of the filter housing with gloves and tweezers.

Follow these steps to change the sample particulate filter:

1. Open the maintenance door and locate the sample particulate filter (see Figure 11.4)
2. See Figure 11.15 for an exploded view of the filter assembly.

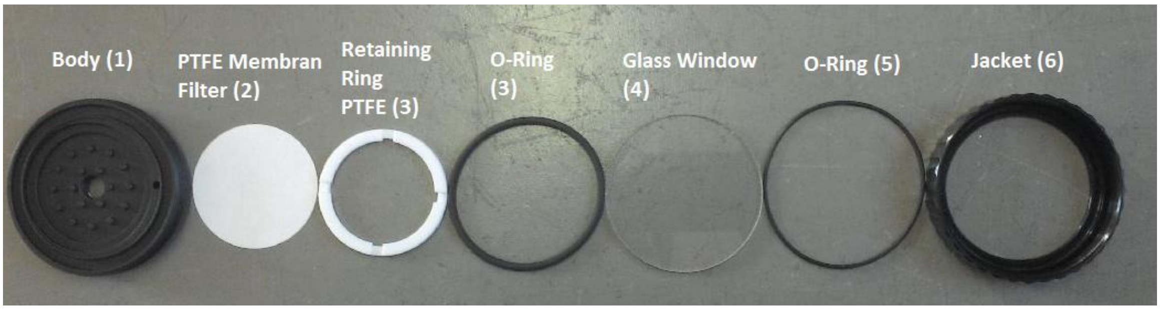


Figure 11.15.: Parts of the Sample Particulate Filter

3. Carefully open the jacket (6) with the glass window (4) which is attached by one O-Ring (5) and remove the retaining ring (3) and the filter element (2). In the side of the retaining ring is an additional O-Ring (3). The Body (1) itself stays in the airpointer® . We recommend cleaning the glass window and O-Rings at least once monthly, weekly in very polluted areas.

NOTE
Clean with a soft cloth and if needed clean water.

4. If the O-Rings are porous replace them. After cleaning the O-Rings reinstall them.
5. Install a new filter element, carefully centering it in the bottom of the holder.

CAUTION:

Do not touch any part of the housing, filter element, PTFE retaining ring, glass cover and the O-Ring with bare hands.

6. Reinstall the PTFE O-Ring (Returning Ring) with the notches facing up (important!). Place the glass window, then screw on the nut and hand-tighten the assembly. Inspect the (visible) seal between the edge of the glass window and the O-Ring to assure proper gas tightness.
7. Perform a Sample Flow Check as described in Section 11.11.

11.4.1.1. Extended Liftime Sample Filter

If your airpointer® is equipped with the Extended Liftime Sample Filter the maintenance procedure does not change. If your airpointer also contains the High Humidity Option you should also regularly check the water level in the water reservoir. Release the water due the tube on a regular basis.

11.4.2. Visual Inspection and Cleaning

The instrument should be inspected occasionally for obvious visible defects, such as loose connectors, loose fittings, cracked or clogged Teflon® lines, and excessive dust or dirt accumulation. Dust and dirt can accumulate in the instrument and can cause overheating or component failure. Dirt on the components prevents efficient heat dissipation and may provide conducting paths for electricity. The best way to clean the inside of the instrument is to first carefully vacuum all accessible areas and then blow away the remaining dust with low pressure compressed air. Use a soft paint brush or cloth to remove stubborn dirt.

11.4.3. DFU Filter

Right of the Zero Air Scrubber a DFU Filter is located (see Figure 11.16).

NOTE
Make sure that the airpointer® is not in ZERO calibration mode. To do so, do not perform any ZERO calibration using the User Interface.

Follow these steps to change the DFU supply particulate filter:

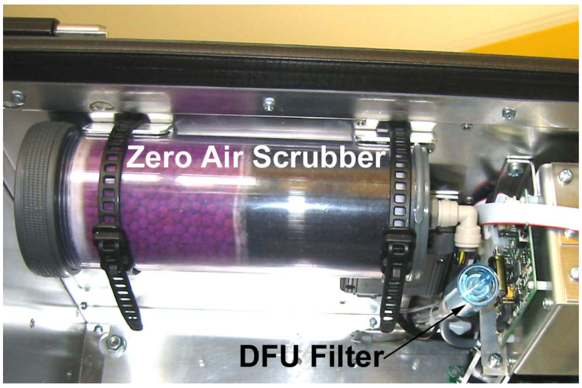


Figure 11.16.: Location of the DFU Filter

1. The DFU Filter is fasten with a quick release fastener at both ends. Press the dark gray ring into the gray holder and unplug the filter on one side. Repeat the same procedure at the other end.

2. Replace the DFU Filter and reconnect it

11.4.4. Replacing the Zero Air Scrubber

CAUTION:

Purafil® contains an aggressive and poisonous chemical compound (potassium permanganate)! Make sure you wear appropriate protection gloves. Take care for sufficient ventilation and do not inhale any dust from it.

The internal zero air scrubber contains two chemicals, pink Purafil® and black charcoal (scrubbs O_3, SO_2, NO_2 and CO). The Purafil® scrubs NO in the ambient air. The chemicals need to be replaced periodically. This procedure can be carried out while the instrument is running.

NOTE
Make sure that the airpointer® is not in ZERO calibration mode. To do so, do not perform any ZERO calibration using the User Interface.

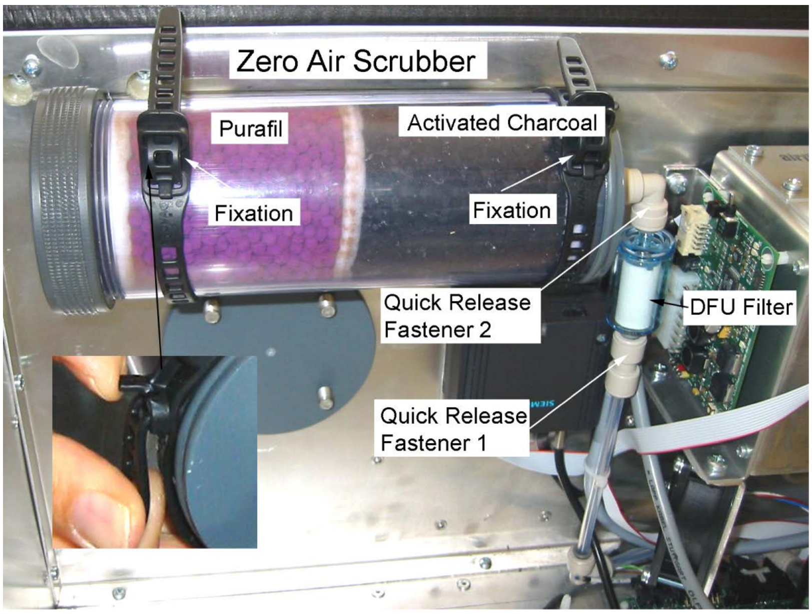


Figure 11.17.: View of the Zero Air Scrubber

Follow these steps to change the Zero Air Scrubber:

1. Locate the scrubber at the top left of the airpointer®. Figure 5.12 shows the location, Figures 11.17 and 11.18 the assembly.

2. Remove the old scrubber:

   - Open the quick release fastener 1 (press the dark gray ring into the gray holder and unplug)

   - Loose the fixation on the left side about 2 holes (see small picture in Figure 11.17).

   - Open the fixation on the right side and pull out the zero air scrubber with the DFU filter

3. Remove the small DFU particle filter from the cartridge (Quick Release Fastener 2).

4. Unscrew the top of the scrubber canister and discard the Purafil® and charcoal contents.

CAUTION:

Make sure to abide to local laws about discarding these chemicals. Do not dispose them with ordinary trash.

5. Refill the scrubber. Take care to refill the scrubber in the correct order. First fill with charcoal at the bottom, then place the white filter pad and the Purafil® chemical on top.

6. **Put a new filter pad on top of that, then close the cartridge with the screw-top cap.**

7. Tighten the cap on the scrubber—hand-tight only.

8. Connect a new DFU Filter

9. Put the scrubber assembly into the left fixation, fix the right fixation and tighten the left.

10. Reconnect the Quick Release Fastener 1.

11. Perform a Sample Flow Check as described in Section 11.11.

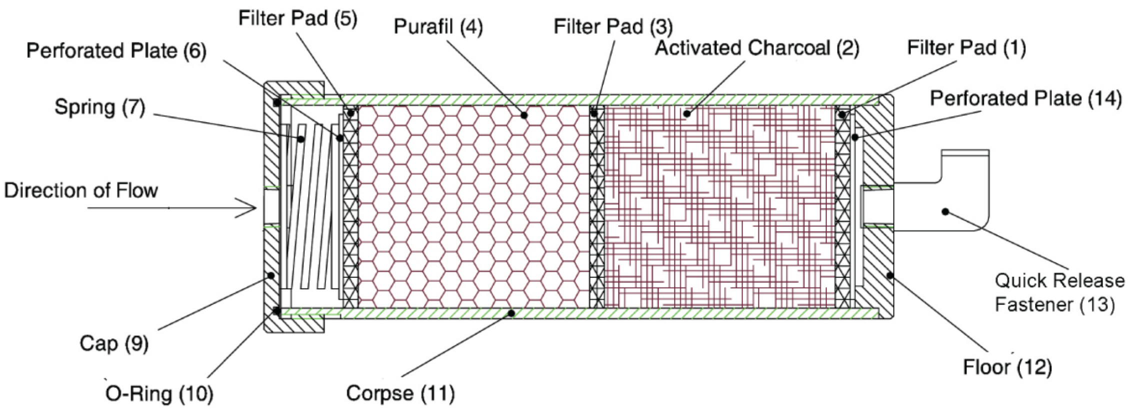


Figure 11.18.: Zero Air Scrubber Assembly

11.4.5. Inspection and Cleaning of the ventilation grids

Follow these steps for inspection and cleaning of the air inlet grilles:

1. Open the main door and power down the airpointer®
2. Locate the grids at the bottom of the airpointer® (see figure 11.19.
3. Unscrew the holding screws of both grilles (six each).
4. Remove the grilles.
5. Clean the inner grids by blowing dust away with low pressure compressed air. Use a soft paint brush to remove stubborn dirt.
6. Reinstall the grilles and fasten the screws.
7. Power up the airpointer® and close the main door.

Figure 11.19.: Ventilation grids of the airpointer

11.4.6. Maintenance of the Air Condition

An experienced worker should need approximately 30 minutes for assembling and another 30 minutes for disassembling the air condition.

Follow these steps to extract the air condition:

1. 1. Tools you will need:
    - Ratchet with 7mm socket
    - Allen key in sizes: 2,5/3/4
    - Phillips screwdriver: PH2
    - wire cutter
2. Remove the bottom module (NO_x) for easier access
3. Remove the cover by unscrewing the 4 screws and the tape.
4. Remove the 2 NTCs
5. Remove the pump:
    - Loosen the holding screws from the bottom.
    - Unplug the grounding
    - Unplug the 3 tubes
    - Unplug the power chord
6. Remove the Power Supply Unit (PSU):
   Start with untightening the 2 screws in the front. Then gently pull the PSU out. Notice that the unit is still connected, but to change the AC just leave it in the case, as shown in figure (bla).
7. Disconnect the gray air tube:
    - loosen the 2 screws on the right side
    - cut the cable ties
    - loosen the screw on left side with the ratchet
8. Remove the panel by unscrewing the 8 screws
9. Remove the control cables
10. Remove the control board by disconnecting the narrow gray cable. Then carefully lever out the board.
11. Unscrew the 5 screws at the bottom of the case.
12. Remove the AC:
    You can now safely remove the air condition. Note: if the cables in the back of your device are not fixed by a tape this might be the perfect moment to do so. This will save you some trouble during the re-installation of the AC unit.

Follow these steps to reassemble the air condition

1. Put the air condition in the case:
   Start by inserting the air condition device in the airpointer. To make the installation of the top cover easier, do not insert any screws at this point.

2. Connect the control board:

   Reconnect the control board with the narrow grey plug. Make sure the cable stays on the backside of the board, i.e. between the board and the air condition.

3. Connect the air condition:
   - fasten the 3 screws holding the air tube and install a cable tie to the air tube
   - connect the power chord

4. Insert the top panel and fasten it with 8 screws.

5. Carefully insert the Power supply unit into its bay.

6. Connect the NTCs:
   To connect the NTC insert the cable in the small hole and plug them in on the top of the air condition.

7. Connect the fan with the corresponding plug in the back

8. Connect the numbered plugs to the control board. Make sure that the numbers on the plug match the port.

9. Connect the grounding and power cable with cable tie to fan. This step makes sure that these cables do not touch anything they rather should not.

10. Insert the pump:
    - Connect the power chord of the pump
    - Connect the pumps tubes
    - Connect the grounding to the pump
    - Fasten the 4 screws holding the pump

11. Fasten the air condition

12. To complete the installation, insert the top cover. Fix the top cover with 4 screws.

CAUTION:

Cleaning supplies
A general industrial detergent or degreaser intended for painted and plastic parts may be used on all surfaces to remove dirt and oil accumulations.

CAUTION:

Disconnect power cable while using any liquid cleaners! Extreme care must be taken when using such cleaners around electrical components and connections.

CAUTION:

Do not use solvents or cleaners not specifically intended for ABS plastic or painted parts as these may be damaged!

General inspection and cleaning should be carried out twice annually. When operating the unit in dirty conditions, the unit should be inspected more frequently (monthly) and cleaned as necessary. If continuing operational problems occur, check heat exchanger fins and air channels for obstruction.

11.4.7. System Pump

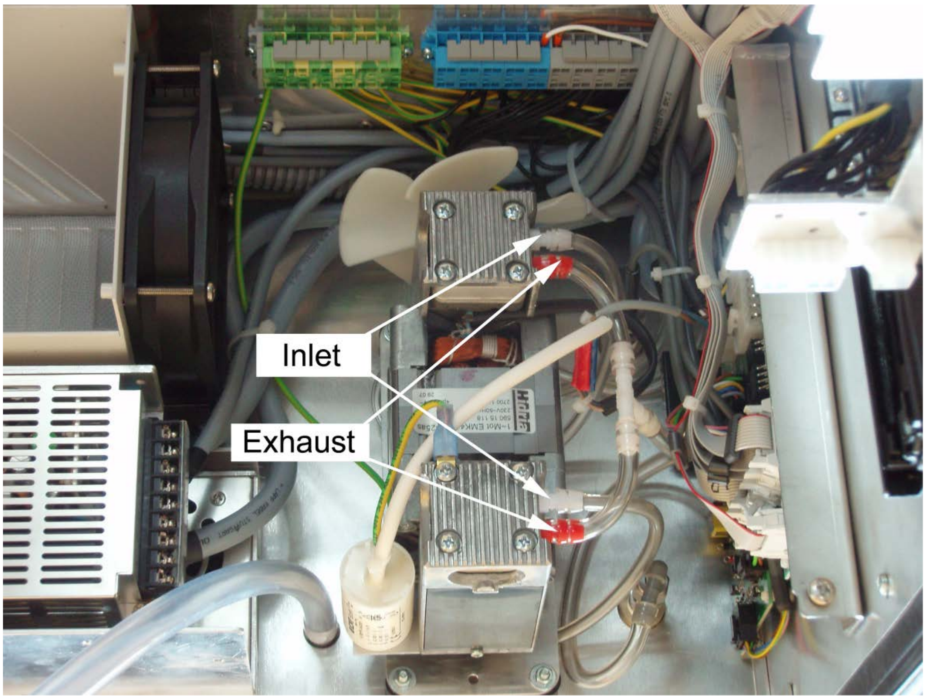


Figure 11.20.: Picture of the double piston pump from the top

11.4.7.1. Extraction of the pump

The sample pump head periodically wears out and must be replaced when the pressure is critically high. This is indicated by a warning message using the Service Interface (value ‘Press Pump’ in folder ‘System Values’). A pump rebuild kit is available from the factory. A flow and leak check after rebuilding the system pump is recommended.

11.4.7.2. Double Piston Pump

The double headed pump is the same model as the single piston pump just with two heads. Note that, the maintenance of the double piston pump is completely analogous to the single piston model. You just need two "Pump Rebuild Kits" and repeat the extraction procedure for each piston. Caution: DO NOT reach inside the ventilation blades of the pump!

11.5. Maintenance of the O_3 module

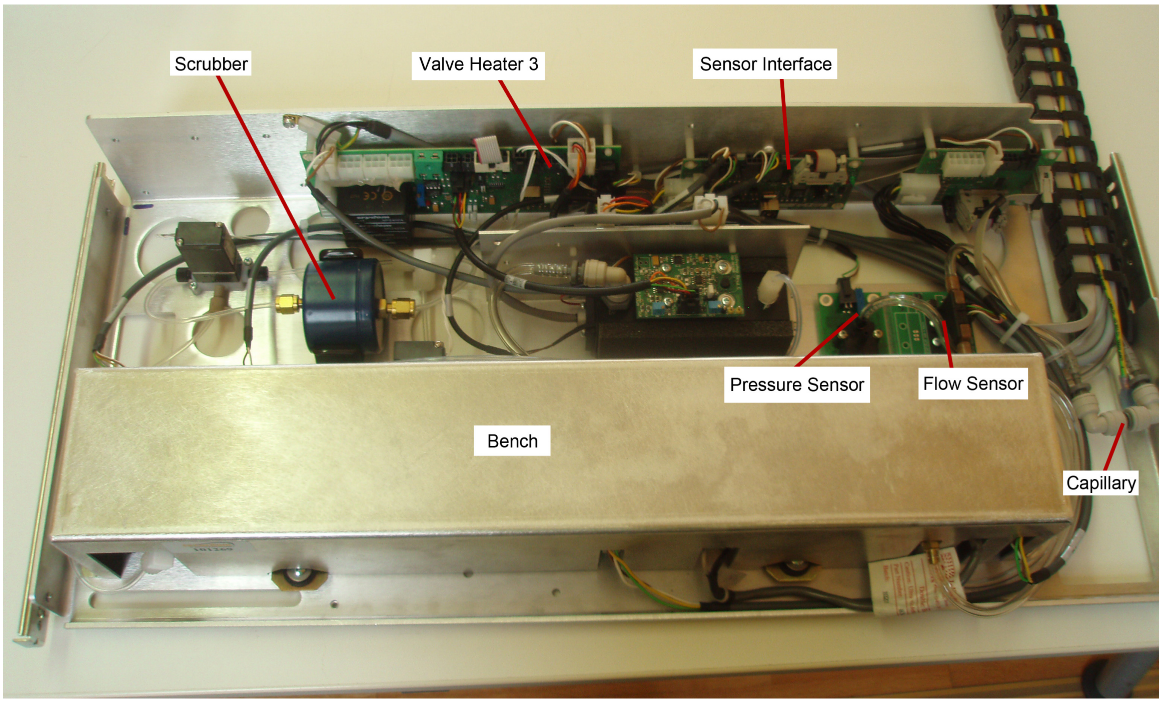


Figure 11.21.: Complete O_3 Module

NOTE
The service procedures in this manual are restricted to qualified service representatives.

CAUTION:

Risk of electrical shock. Disconnect power before performing any operations that require entry into the interior of the airpointer®.

CAUTION:

Do not use alcohol or other solvents for cleaning the components conducting gas!

CAUTION:

Some internal components can be damaged by small amount of static electricity. A properly grounded antistatic wrist must be worn while handling any internal component.

CAUTION:

Take care that screws and tools do not fall into the airpointer® ! Loose screws or tools can damage the airpointer® !

This section includes following maintenance information and replacement procedures:

1. Replacing the O_3–Scrubber
2. Cleaning the O_3–Bench
3. Cleaning the Critical Orifice
4. Maintaining the capillaries is described in section 11.9

11.5.0.3. Replacing the O_3–Scrubber of the Ozone Module

O_3 **Follow these steps to change the O_3–Scrubber:**

1. Locate the scrubber inside the airpointer® (see Figure 11.22). Figure 11.4 depicts the location of the unit (between Section G and H).
2. Disconnect the two 1/8'' tubes on the front and the back side of the scrubber.
3. Remove the old scrubber by taking it out of the black clamp.
4. Insert the new scrubber the same way you located the old one.
5. Attach the tubes to the scrubber.
6. Perform a Sample Flow Check as described in Section 11.11.

Figure 11.22.: O_3–Scrubber

11.5.1. Cleaning the O_3–Bench

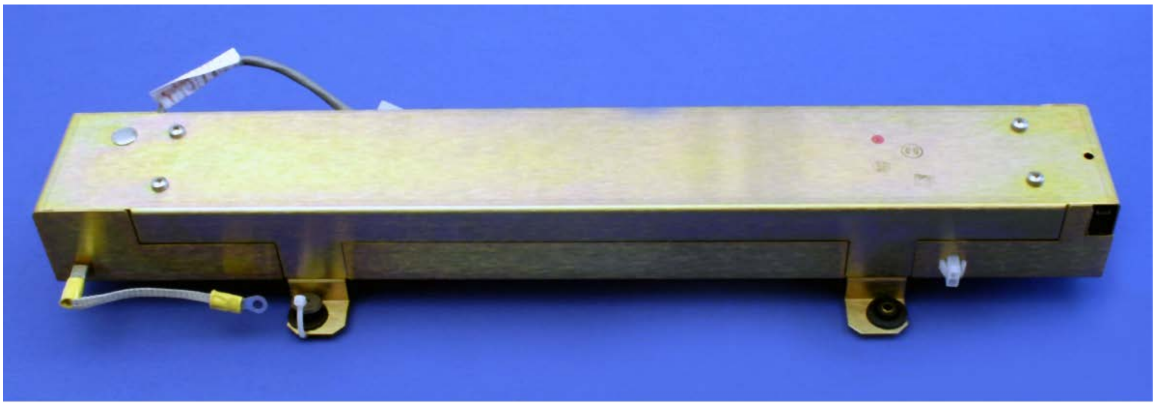


Figure 11.23.: Ozone Bench without Thermal Insulation

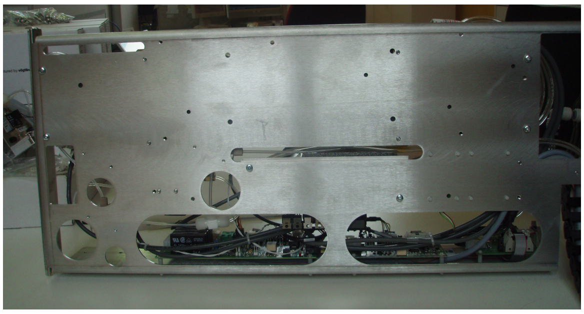


Figure 11.24.: Bottom of O_3 Bench. Loosen the screws to open the bench.

Follow these steps to clean the O_3–Bench (see Figure 11.23):

1. Shut down the airpointer® and open the housing.

2. Locate the O_3–Bench (Section G in Figure 11.4).

3. Remove the cover with thermal isolation from the optical bench.

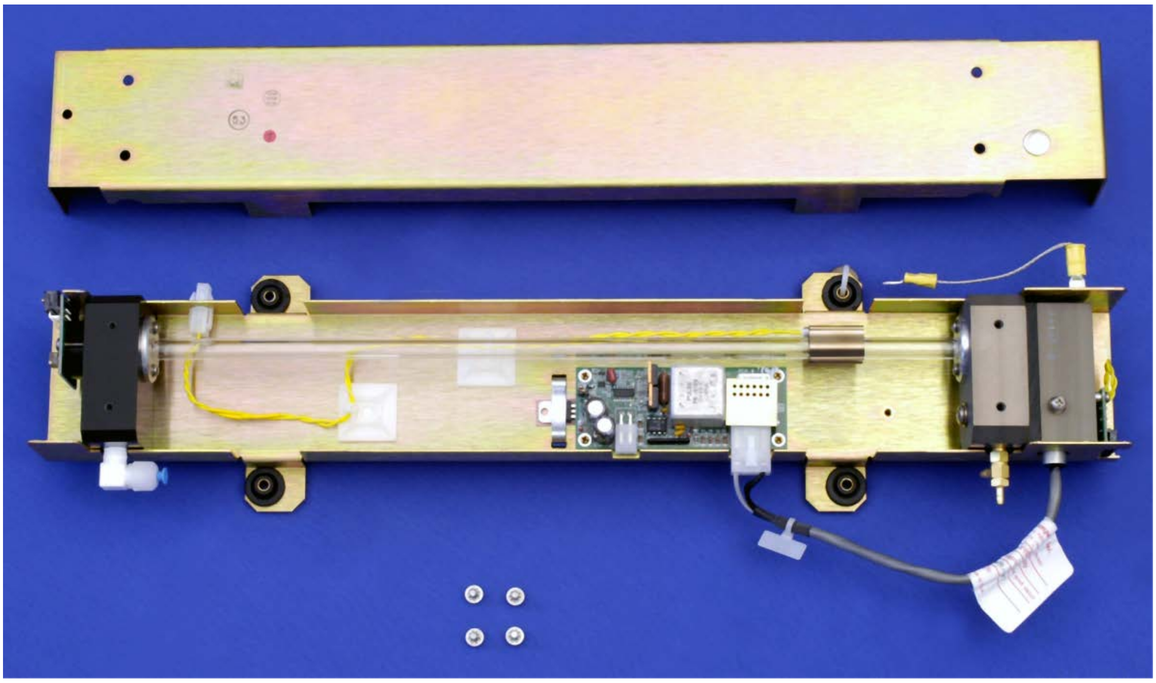


Figure 11.25.: Ozone Bench with Cover Removed

4. Remove the four screws from the absorption tube retaining rings at both ends of the absorption tube (see Figure 11.25).

5. Using both hands, rotate the glass tube to free it, then carefully slide the tube toward the lamp housing. The front of the tube can now be slid past the detector block and out of the instrument (see Figure 11.26).

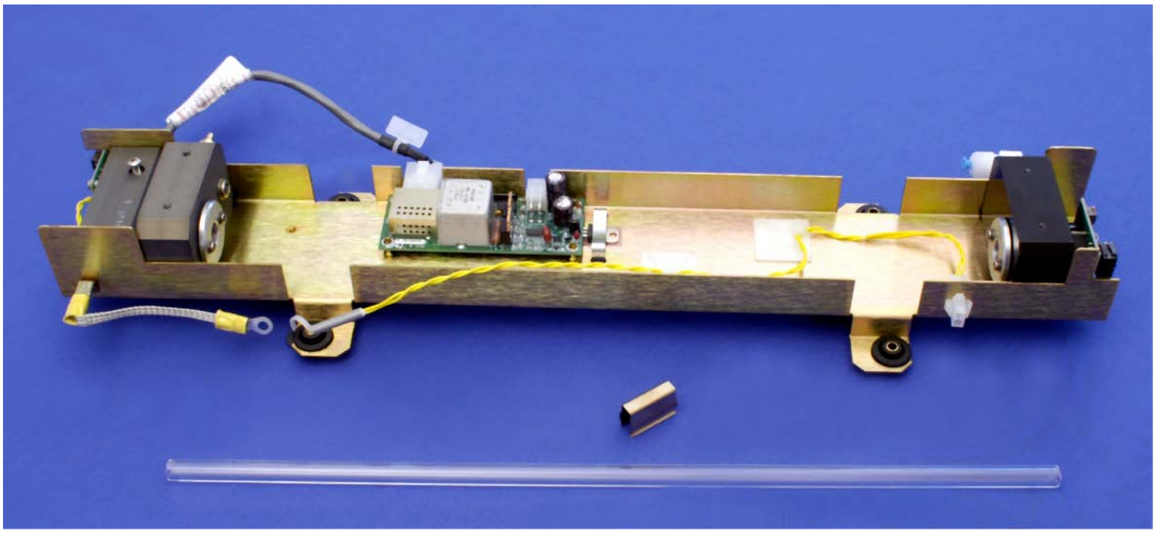


Figure 11.26.: Ozone Bench Disassembled

CAUTION:

Do not cause the tube to bind against the metal housings. The glass tube may break and cause serious injury.

6. Clean the tube at first with a dry, lint free cloth (e.g., Teflonsheet). If this does not work, repeat cleaning with a wet cloth. If persistent dirt is still left, clean with soapy water by running a swab from end to end. Rinse with clean water afterwards, then let it air-dry. Check the cleaning job by looking down the bore of the tube. It should be free from dirt and lint.

7. Inspect the O-Rings that seal the ends of the optical tube (these O-Rings may stay seated in the manifolds when the tube is removed.) If there is any noticeable damage to these O-Rings, they should be replaced.

8. Reassemble the tube into the lamp housing and perform a Sample Flow Check described in section 11.11.

> **NOTE**
> **It is important for proper optical alignment that the tube be pushed all the way down (detector end) of the optical bench when it is reassembled.**

11.6. Maintenance of the CO module

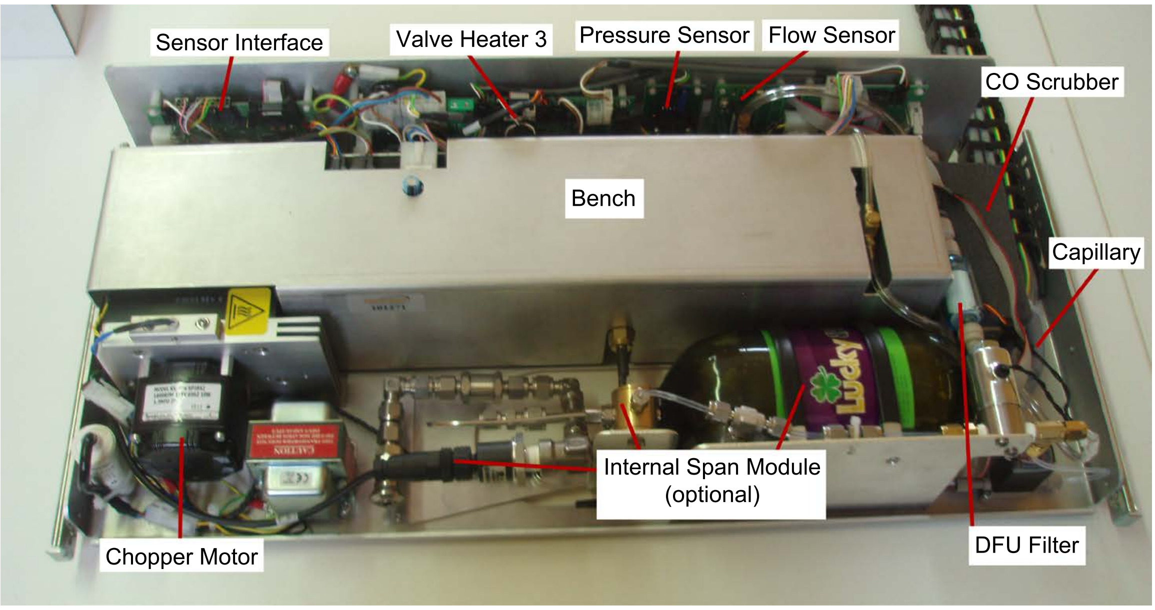


Figure 11.27.: Complete CO Module

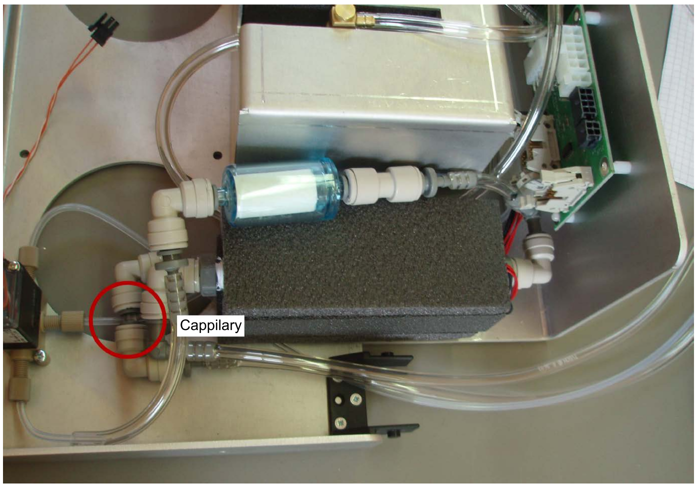


Figure 11.28.: Location of the Capillary inside the CO Module

NOTE
See section 11.9 for a description how to maintain the capillary. Keep in mind that the service procedures in this manual are restricted to qualified service representatives.

CAUTION:

DO NOT attempt to clean the mirrors in the optical bench. These mirrors do not come in contact with the sample gas and should not be cleaned. An attempt to clean the mirrors could damage them.

CAUTION:

Risk of electrical shock. Disconnect power before performing any operations that require entry into the interior of the airpointer®.

CAUTION:

Do not use alcohol or other solvents for cleaning the components conducting gas!

CAUTION:

Some internal components can be damaged by small amount of static electricity. A properly grounded antistatic wrist must be worn while handling any internal component.

CAUTION:

Take care that screws and tools do not fall into the airpointer® !
Loose screws or tools can damage the airpointer® !

11.7. Maintenance of the SO_2 module

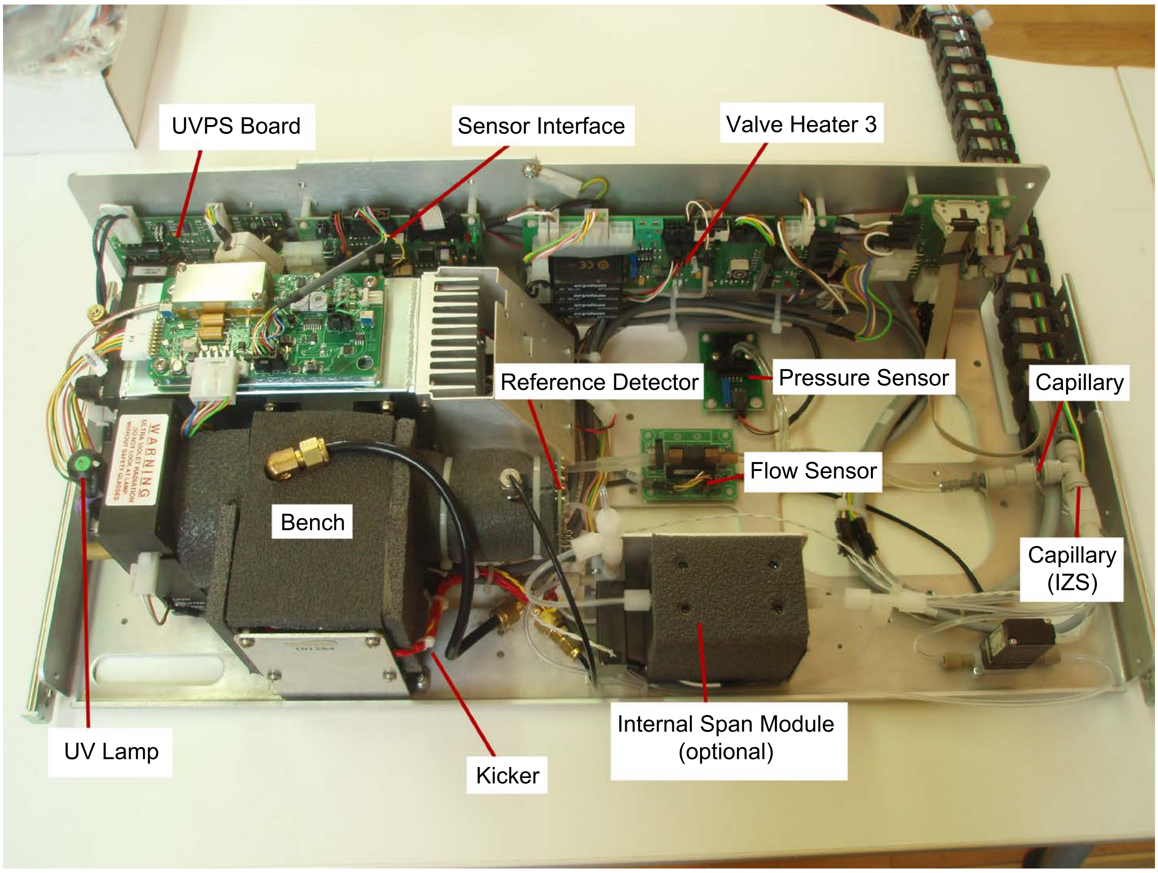


Figure 11.29.: Complete SO_2 Bench

NOTE
The service procedures in this manual are restricted to qualified service representatives.

CAUTION:

Risk of electrical shock. Disconnect power before performing any operations that require entry into the interior of the airpointer®.

CAUTION:

Do not use alcohol or other solvents for cleaning the components conducting gas!

CAUTION:

Some internal components can be damaged by small amount of static electricity. A properly grounded antistatic wrist must be worn while handling any internal component.

CAUTION:

Take care that screws and tools do not fall into the airpointer® ! Loose screws or tools can damage the airpointer® !

This section includes following maintenance information and replacement procedures:

1. Replacing the SO_2 UV Lamp
2. Cleaning the Critical Orifice
3. Maintaining the capillaries is described in section 11.9

11.7.1. Replacing the SO_2 UV Lamp

CAUTION:

Attention: UV light! May cause injuries.

Follow these steps to replace the UV lamp :

SO_2

1. Power down the airpointer®
2. Locate the SO_2 module (see Figure 11.29) with the UV lamp inside the airpointer® (see Figure 5.12, front part of Section B).
3. Loosen the fixation (see Figure 11.30).

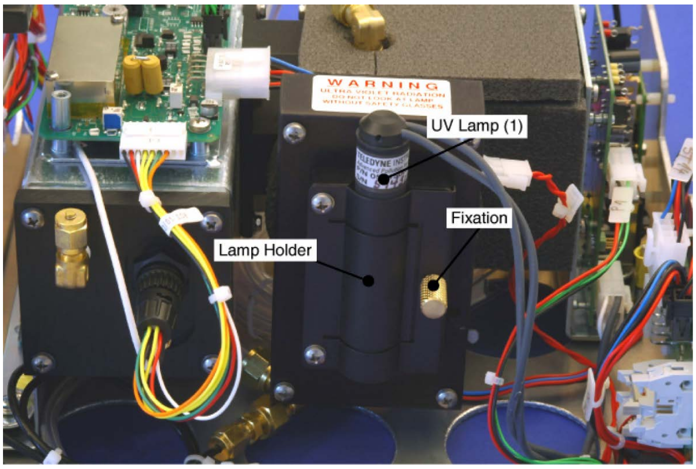


Figure 11.30.: Location of the UV lamp

4. Disconnect the power cable of the UV lamp by removing the Molex MiniFit JR plug from the ST1 port of the UV power supply (see Figure 11.31).

Figure 11.31.: Location of the UV Lamp Power Connector

5. Carefully remove the old lamp from its place. If the lamp does not move out of its place, try loosening the two recessed head screws of the lamp holder also and move the lamp by pulling and turning the lamp left and right until it moves out.

6. Place a new UV lamp into the lamp holder and reconnect the power cable. Do not fasten the Fixation too tight—the lamp is not adjusted yet!
7. Restart the airpointer®
8. Let the UV lamp warm up for at least 30 minutes.
9. Adjust the lamp now. To do so connect a computer to the airpointer® and start the Service Interface as outlined in Section 7.7.2.2
10. Locate the entries 'RefDetSO2' and 'Power Lamp' in folder 'SO2' in the sensor interface.
11. Turn the lamp up, down, left and right while observing these entries. The numbers should change as you move the lamp. Move the lamp until the value 'RefDetSO2' reaches a maximum. This number measures the signal strength of the reference detector. It should rise at least above 2000 mV (the exact value is depending on settings, see value 'RefDetSO2Setpoint' in folder 'SO2').
12. Now continue and try to reach an as small value of the 'Power Lamp'–value as possible keeping the value 'RefDetSO2' nearly constant. This number measures the necessary lamp control–power as a percentage of the maximum value. The lower this value becomes, the longer the lifetime of the lamp and the better the S/N-ratio of the signals will be.
13. The final orientation of the lamp should now be such that one of the two windows of the UV lamp points toward the reference detector. It may well be that the results are better with the other side of the window pointing toward the reference detector. Therefore, in order to optimize the operation of the lamp you should also try to turn the lamp 180° and repeat the adjustment above. Decide for the orientation with the lower power consumption of the lamp.
14. Fasten all screws and the fixation of the lamp holder again.
15. Calibrate the instrument.

11.8. Maintenance of the NO_x module

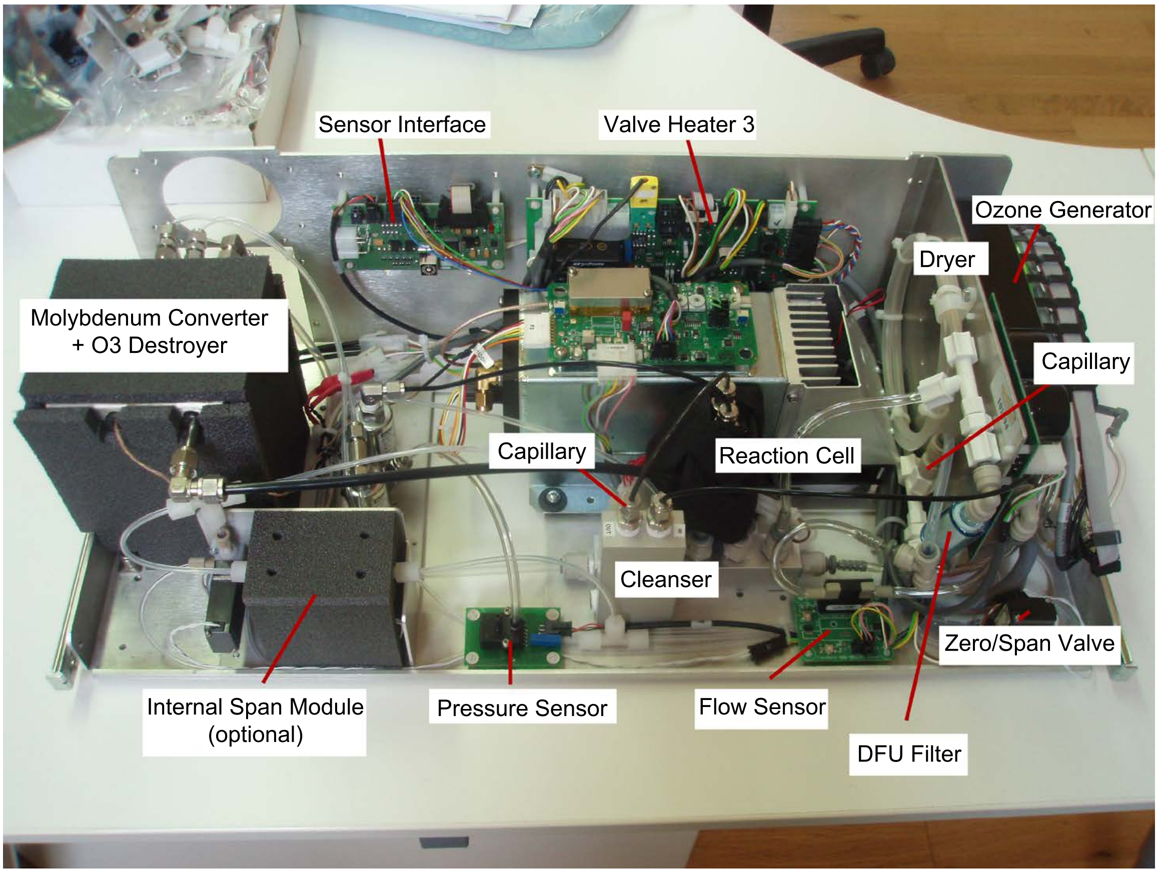


Figure 11.32.: Complete NO_x Bench

NOTE
The service procedures in this manual are restricted to qualified service representatives.

CAUTION:

Risk of electrical shock. Disconnect power before performing any operations that require entry into the interior of the airpointer®.

CAUTION:

Do not use alcohol or other solvents for cleaning the components conducting gas!

CAUTION:

Some internal components can be damaged by small amount of static electricity. A properly grounded antistatic wrist must be worn while handling any internal component.

CAUTION:

Take care that screws and tools do not fall into the airpointer® ! Loose screws or tools can damage the airpointer® !

This section includes following maintenance information and replacement procedures:

1. Replacing the Molybdenum Converter
2. Cleaning the NO_x Reaction Cell
3. Critical Orifices
4. Maintaining the capillaries is described in section 11.9

11.8.1. Replacing the Molybdenum Converter

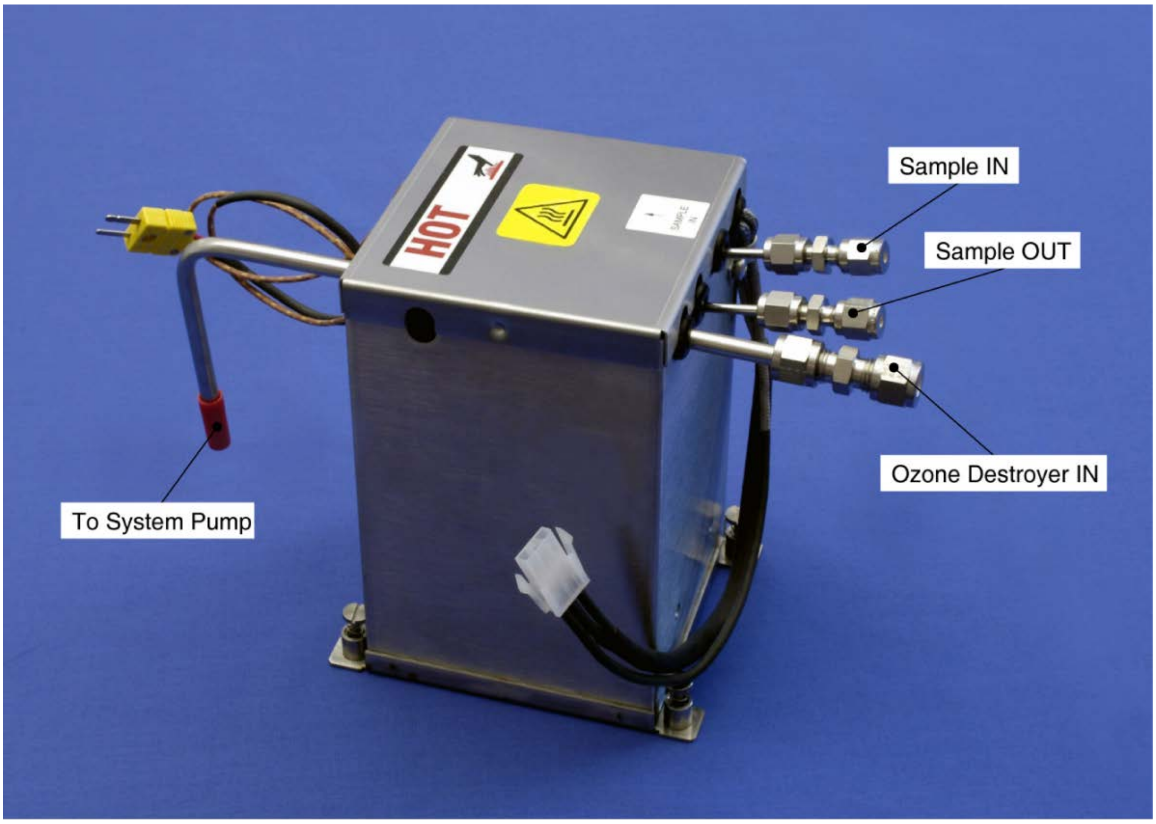


Figure 11.33.: The Molybdenum Converter Module

NO_x

The Molybdenum converter is located in the NO_x module (see Figure 5.12 for the location, Figure 11.33 for the assembly). The converter is designed for replacement of the cartridge only, the heater with built-in thermocouple can be reused.

Over time, the molybdenum in the NO_2 converter oxidizes and loses its original capacity of converting NO_2 into NO, eventually resulting in a decreased converter efficiency (CE). Even though we recommend to change the converter if CE drops below 95%, the analyzer's firmware allows to adjust minor deviations of the CE from 1.000 and enables to report the true concentrations of NO_2 and NO_x. Converter efficiency is stored in the instrument's memory as a decimal fraction that is multiplied with the NO_2 and NO_x measurements to calculate the final concentrations for each. Periodically, this efficiency factor must be measured and—if it has changed from previous measurements—entered into the analyzer's memory. Refer to Page 7-31 and Section 7.6.8 on how to perform this task. Note that EPA applications do not allow an analyzer to be operated if efficiency is below 96 % or above 102%, even though the analyzer would allow adjusting for larger discrepancies.

CAUTION:

The converter operates at 315 °C. Severe burns can result if the assembly is not allowed to cool. Do not handle the assembly until it is at room temperature. This may take several hours.

Follow these steps to change the Molybdenum Converter:

1. **Shut down the airpointer® and allow the converter to cool.**
2. **Slide out the NO_x module. Open the housing and locate the converter.**
3. **Remove the top lid of the converter as well as the top layers of the insulation until the converter cartridge can be seen. (See Figure 11.34 and 11.35)**

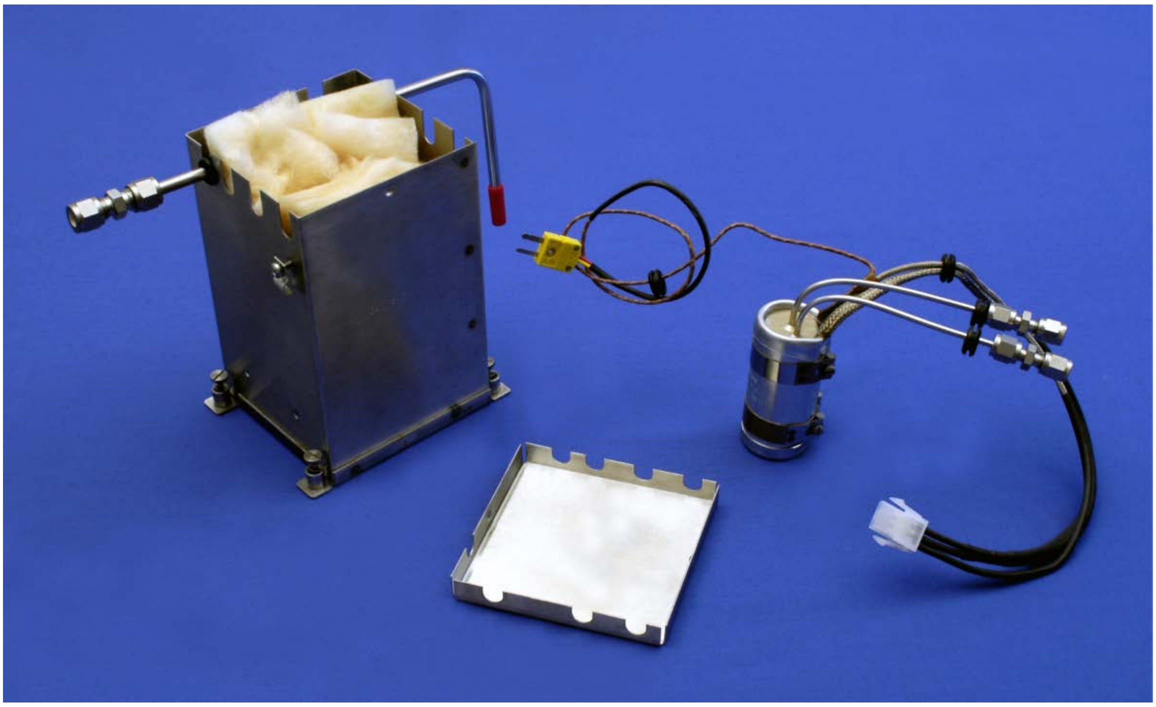


Figure 11.34.: The Converter and the Housing

4. **Remove the tube fittings from the converter.**
5. **Disconnect the power and the thermocouple of the converter. Unscrew the grounding clamp of the power leads with a screwdriver.**
6. **Remove the converter assembly (cartridge and band heater, see Figure 11.35) from the can. Make a note of the alignment of the tubes relative to the heater cartridge.**

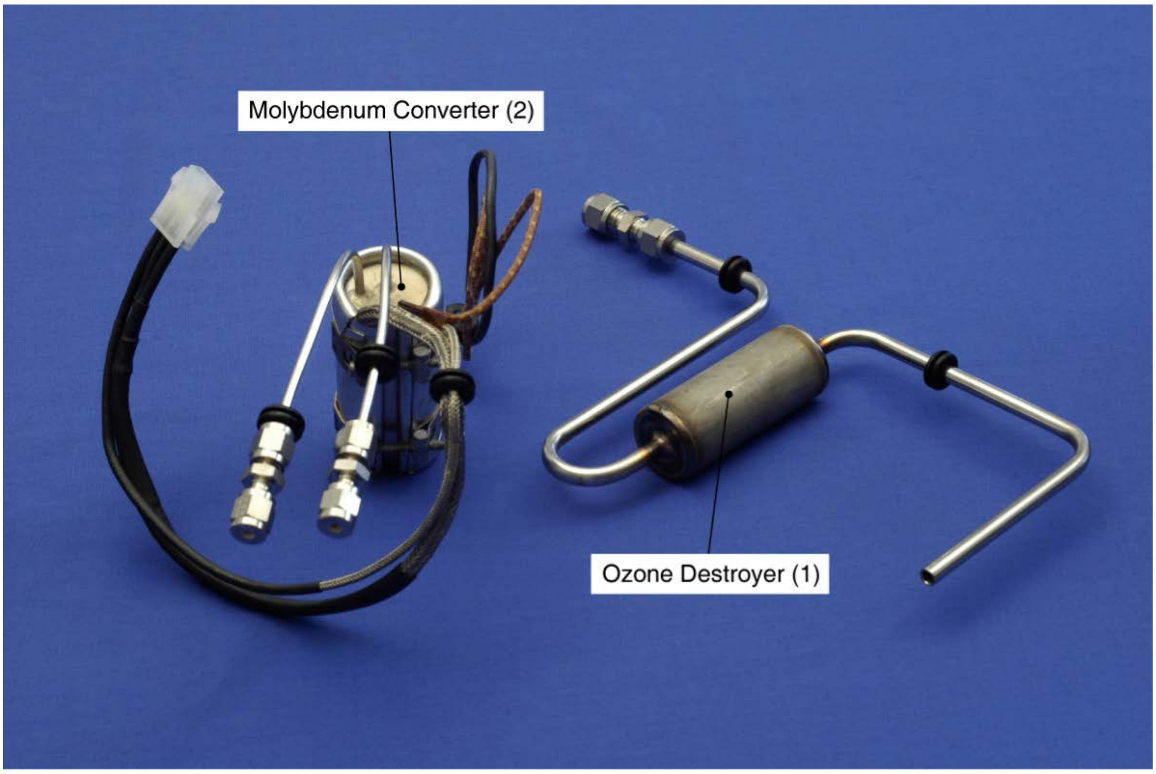


Figure 11.35.: The Converter and the Ozone Destroyer.

7. **Unscrew the band heater and loosen it, take out the old converter cartridge.**
8. **Put the band heater in the new replacement cartridge. For easier way of the thread you can grease it with a high-temperature anti-seize agent such as copper paste.**

> **NOTE:**
> **Make sure to use proper alignment of the heater with respect to the converter tubes (See Figure 11.33).**

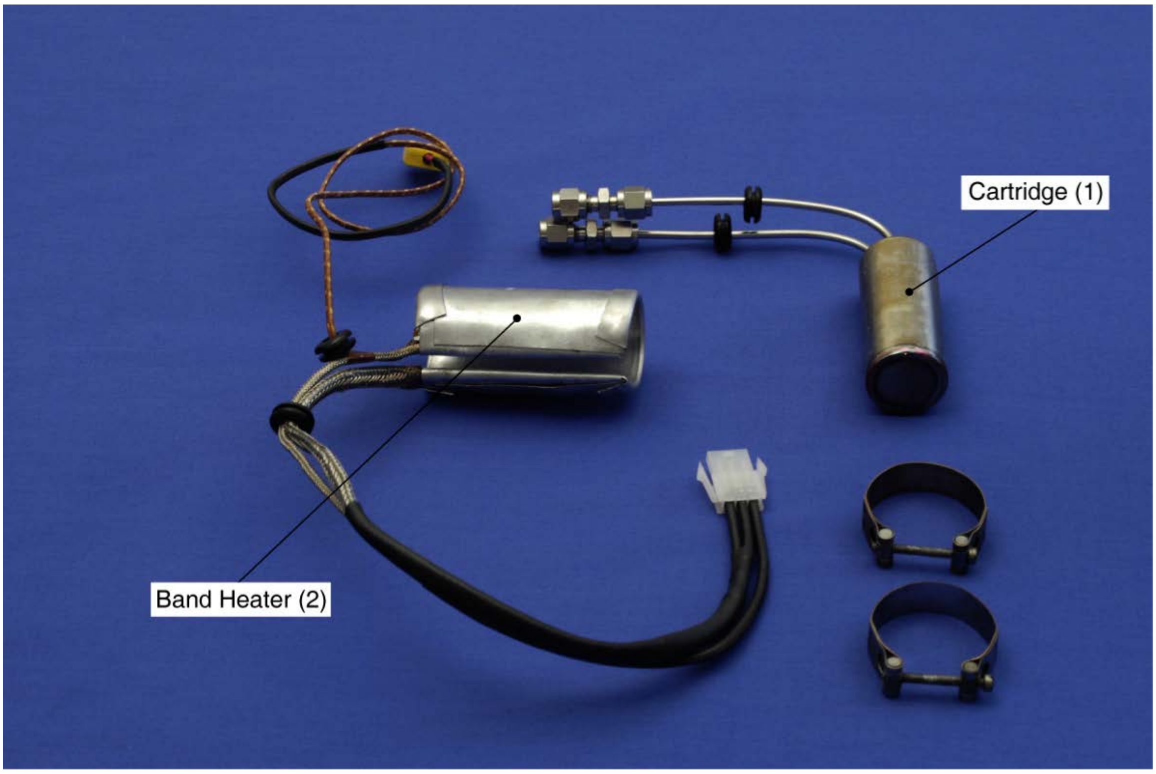


Figure 11.36.: Cartridge and Band Heater

9. **Replace the converter assembly, route the cables through the holes in the can and reconnect them properly. Reconnect the grounding clamp around the heater leads for safe operation.**

10. **Reattach the tube fittings to the converter and replace the insulation and top lid of the can.**

11. **Slide in the NO_x module and power up the airpointer®.**

12. **Allow the converter to burn-in for 24 hours, then recalibrate the instrument (see Section 7.6.7.6).**

11.8.2. Cleaning the NO_x Reaction Cell

The reaction cell should be cleaned at least once a year. A dirty reaction cell will cause excessive noise, drifting zero or span values or low response. To clean the reaction cell (Figure 11.37) it is necessary to remove it from the sensor housing following the steps below.

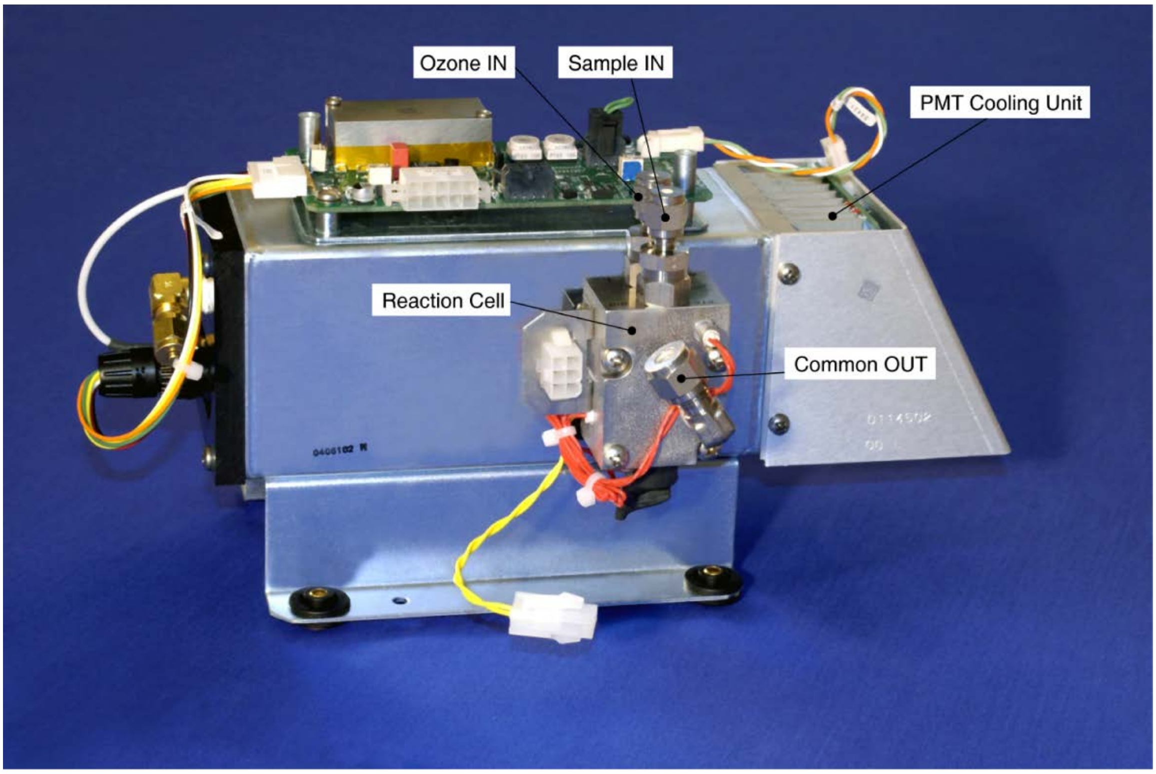


Figure 11.37.: NO_x Sensor with Reaction Cell

Follow these steps to clean the reaction cell:

1. **Shut down the airpointer®, disconnect plug from mains and open the housing.**

2. **Locate the NO_x module (Section D in Figure 5.12). The NO_x Reaction Cell is mounted to the NO_x sensor housing.**

3. **Disconnect the black 1/4" exhaust tube (connected to the Vacuum Fitting, see Figure 11.42) and the 1/8" sample and ozone air tubes (connected to the two Orifice Assemblies) from the reaction cell. Disconnect the heater/thermistor cable (see Figure 11.39).**

4. **Remove four screws holding the reaction cell to the PMT housing and lift out the cell and manifold.**

> **NOTE:**
> **Prevent light from entering the Photomultiplier Tube (PMT)! While removing the reaction cell, cover the PMT window with an opaque plate (see Figure 11.38).**

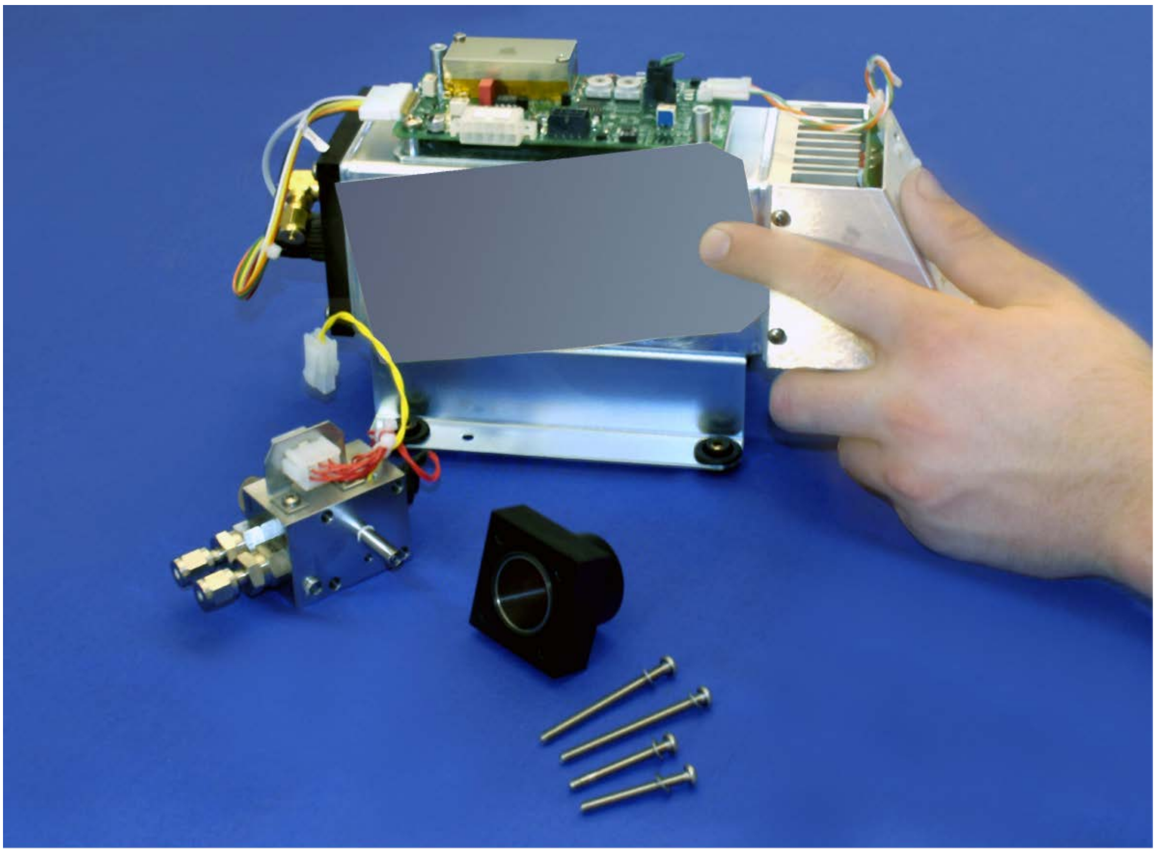


Figure 11.38.: Cover PMT Window with an Opaque Plate

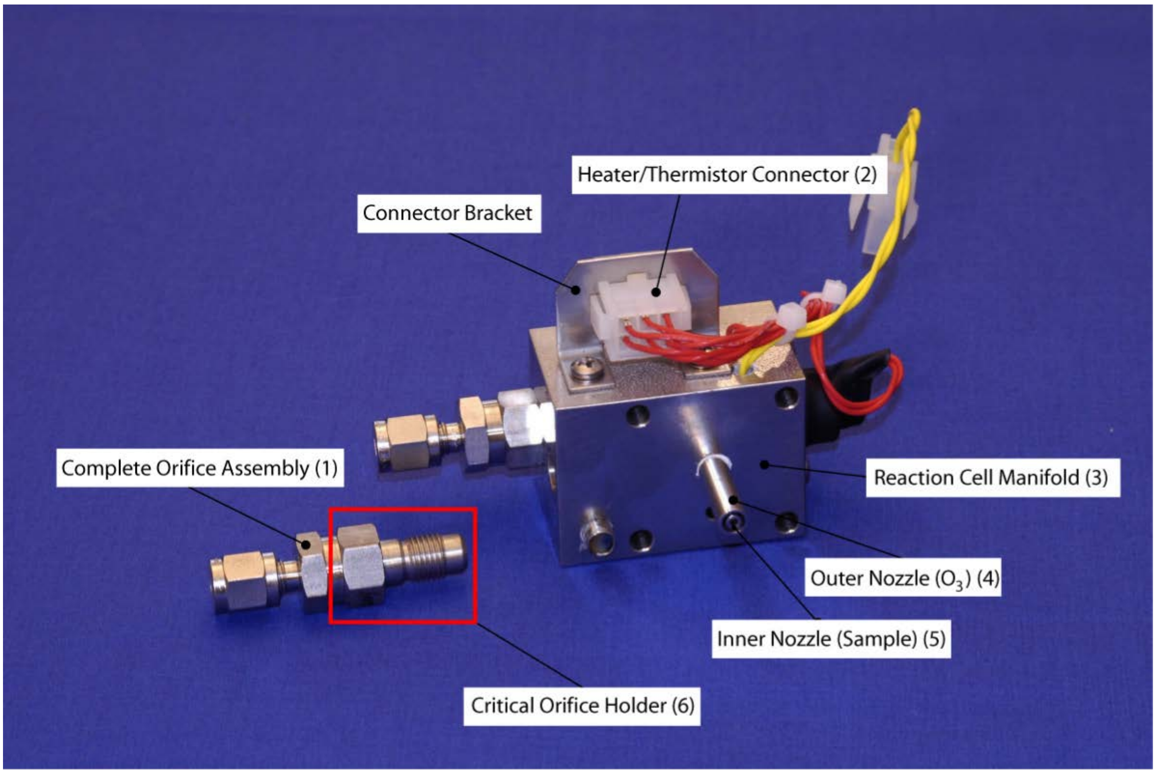


Figure 11.39.: Reaction Cell Manifold

5. **The reaction cell will separate into two halves, the stainless steel manifold assembly and the black plastic reaction cell with window, stainless steel cylinder and O-Rings (See Figures 11.40 and 11.41).**

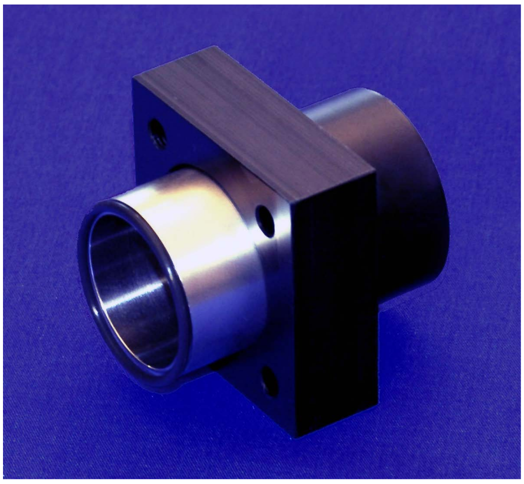


Figure 11.40.: Reaction Cell

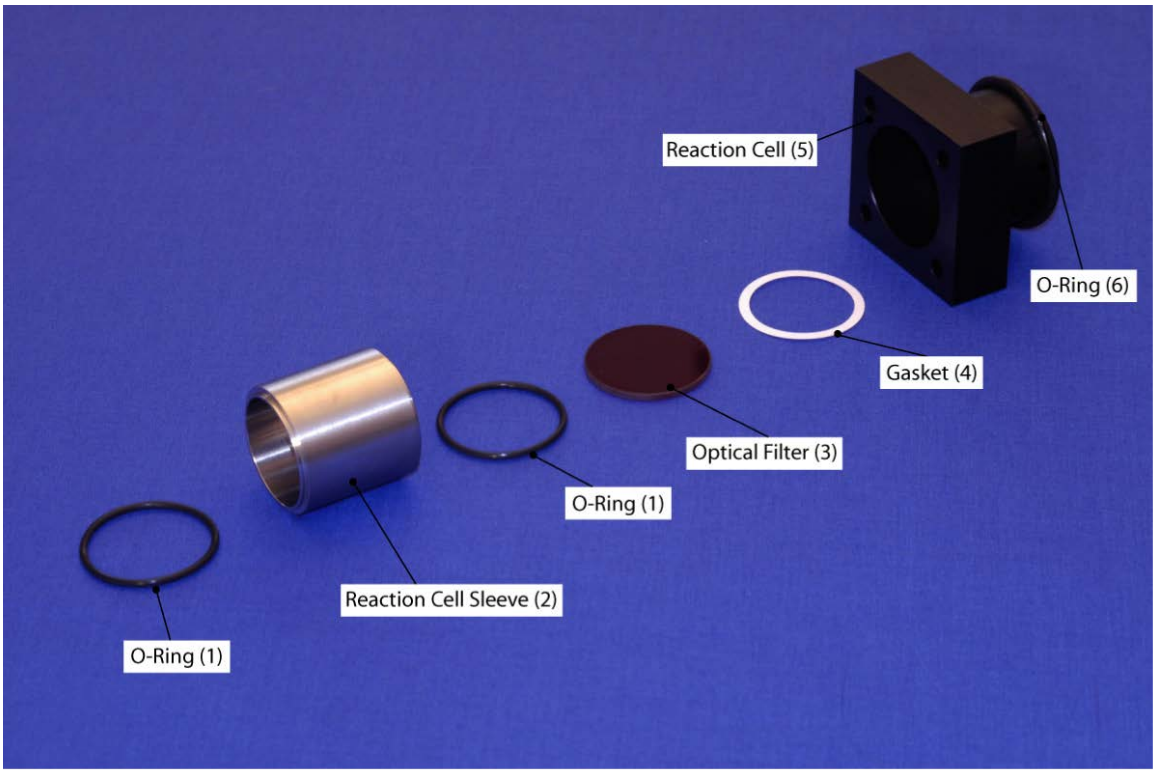


Figure 11.41.: Reaction Cell Disassembled

> **CAUTION:**
>
> **Do not touch the optical filter with bare hands!**

6. **The reaction cell (both plastic part and stainless steel cylinder) and the glass window (optical filter) should be cleaned with water and a clean tissue and air dried thereafter.**

7. **After cleaning the reaction cell, it is recommended to clean the ozone and sample flow orifices (see Section 11.8.3). If this is done during the annual exchange, the O-Rings and the sintered filter should also be changed.**

> **NOTE:**
>
> **Do not remove the sample and ozone nozzles (see figure 11.39 (4) and (5)). They are Teflon® threaded and require a special tool for reassembly. If necessary, the manifold with nozzles attached can be cleaned in an ultrasonic bath.**

8. **Reassemble in proper order and reattach onto sensor housing. Reconnect pneumatics and heater connections, then reattach the pneumatic sensor assembly and the cleaning procedure is complete.**

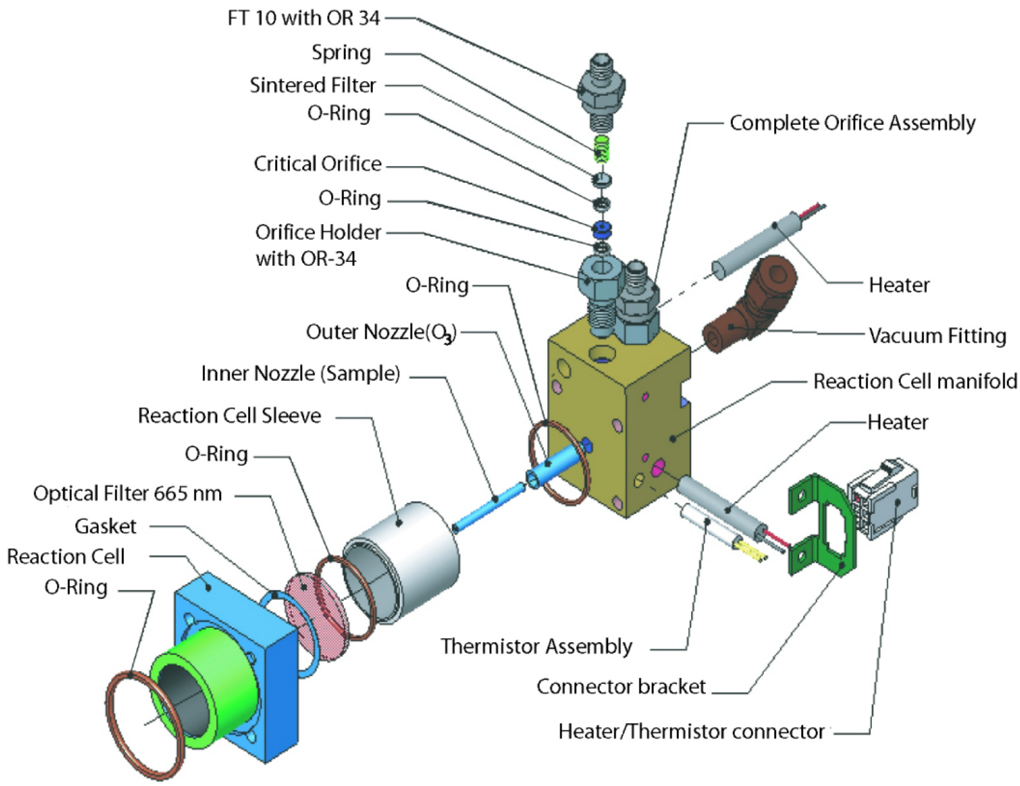


Figure 11.42.: Reaction Cell Assembly

9. **Allow the system to burn-in for 24 hours, then recalibrate the instrument (see Section7.6.7.6).**
10. **Perform a Sample Flow Check as described in Section 11.11.**
11. **The analyzer span response may drop 10–15% in the first 10 days due to some conditioning of the reaction cell window. This is normal but requires additional calibration.**

11.8.3. Cleaning/Changing the Critical Flow Orifices

There are several critical flow orifices installed in the airpointer®. The top of Figure 11.42 shows the two most important orifice assemblies, located on the NO reaction cell NO_x. Despite the fact that these flow restrictors are protected by sintered stainless steel filters, they can, on occasion, clog up, particularly if the instrument is operated without sample filter or in an environment with very fine, sub-micron particle-size dust. The airpointer® makes use of a special type of orifice holder that makes changing the orifice very easy.

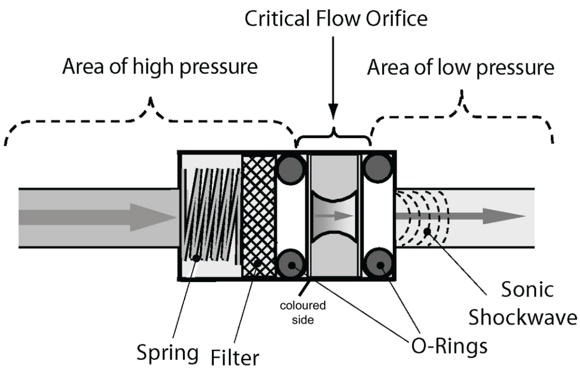


Figure 11.43.: Critical Flow Orifice of the NO Reaction Cell Scheme

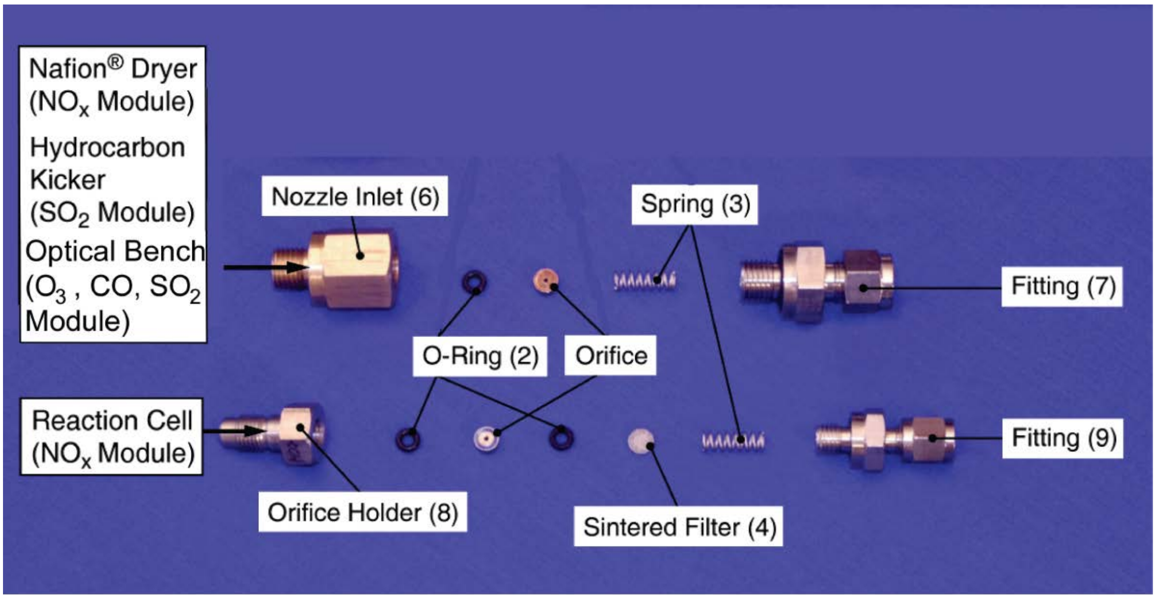


Figure 11.44.: Critical Flow Orifice Assemblies

11.8.3.1. Cleaning/Changing the Critical Flow Orifices of the NO_x Reaction Cell

Follow these steps to clean or replace the critical flow orifices of the NO_x Reaction Cell:

1. **Shut down the airpointer® and open the housing and the reaction cell (Figure 11.42).**
2. **Unscrew the 1/8" sample and ozone air tubes from the reaction cell.**

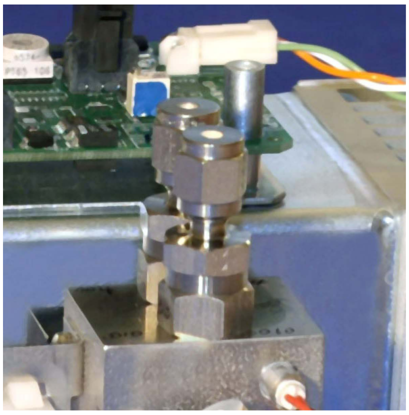


Figure 11.45.: Orifice Holders of the NO_x Reaction Cell

3. **Unscrew the orifice holder with a 9/16" wrench. This part holds all components of the critical flow assembly as shown in Figure 11.44.**
4. **Take out the components of the assembly:**
   One spring, one sintered filter, two O-Rings and the orifice.
5. **Discard the two O-Rings and the sintered filter. Clean the critical flow orifice in an ultrasonic cleaner for about 30 minutes using water. Air-dry the parts.**
6. **Reassemble the parts as shown in Figure 11.44 and reconnect them to the reaction cell manifold.**
7. **Reconnect all tubing, power up the analyzer and, after a warm-up period of 30 minutes, perform a Sample Flow Check as described in section 11.11.**

11.9. Maintenance of a glass capillary

NOTE
These procedure affects all modules. See corresponding sections for the location of the capillary on the module.

Follow these steps to maintain a capillary

1. Turn off the device and unplug the power chord.
2. Open the airpointer® and locate the module/capillary to replace.
3. Rempove the optional cover of the capillary capillary.
4. Pull the capillary out.
5. Inspect the capillary and replace or clean it if necessary.
6. Pull cover over the capillary and reinstall it.
7. Repeat the procedure if the module has more than one capillary.
8. Reinstall the module.
9. Reconnect the power and turn on the instrument.

11.10. Performing Leak Checks

11.10.0.2. Vacuum Leak Checks

There are two methods of performing leak checks which deliver different accuracy. The on-board leak check is fast and easy to-do but only tells you if there is a major leak. Otherwise it is possible to get a 'Leak Checker' by which you can detect even small leaks.

Performaning an onboard leak check

1. First start the airpointer® and allow the flow to stabalize.
2. Cap the port of the sample filter
3. After several minutes, when the pressures have stabilized, start the User Interface using a browser and Internet. Login and locate the values for 'PressNOx', 'PressO3', 'PressSO2', 'PressCO', 'PressPump'.

4. Compare the individual pressure values to the pump pressure. If the module values are close to the pump pressure and the flow tends to zero there is no major leak.

Using the 'Leak Checker'

1. First start the airpointer® and allow the flow to stabalize.
2. Plug the 'Leak Checker' to the port of the sample filter
3. After several minutes the pressures should have stabalized. If the pressure keeps absolutely stable there is no leak. Depending on the amount of decrease there is a small or major leak.

11.10.1. Checking for Light Leaks

When reassembled or operated improperly, the airpointer® can develop small leaks around the Photomultiplier Tube (PMT), which may cause stray light from the analyzer surrounding to enter the PMT housing.

CAUTION:

This procedure can only be carried out with the airpointer® running and its housing opened. This procedure should only be carried out by qualified personnel.

Follow these steps to detect light leaks:

1. Supply zero gas to the airpointer®.
2. Open the User Interface to your airpointer® and go to Setup ↠ System Info ↠ Service Interface and open the LinSens Service Interface (see Section 7.7.2.2). In the LinSens Service Interface (see Figure 7.24) open folder NOx.

NO_x

3. In case of the NO_x PMT, note down the values for (folder 'NOX'):
   - PMTSigNO
   - PMTSigNOx
   - PMTSigAutoZero

SO_2

4. In case of the SO_2 module, note down the value for (folder 'SO2'):
   - PMTSigNO

5. With the instrument still running, open the airpointer® housing.

CAUTION:

Take extra care not to touch any of the inside wiring with the metal cover or your body. Do not drop screws or tools into a running analyzer!

6. Shine a powerful flashlight or portable incandescent light at the inlet and outlet fitting and at all of the joints of the reaction cell as well as around the PMT housing. The PMT value should not respond to the light, the PMT signal should remain steady within its usual noise.

7. If there is a PMT response to the external light, symmetrically tighten the reaction cell mounting screws or replace the 1/4" vacuum tubing with new, black PTFE tubing (this tubing will fade with time and become transparent). Light leaks can also be caused by O-Rings being left out of the assembly.

8. If tubing was changed, carry out a leak check.

11.11. Performing a Sample Flow Check

CAUTION:

Always use a separate calibrated flow meter capable of measuring flowsin the 0–3000cc/min range to measure the gas flow rate through the analyzer.
DO NOT use the software of the instrument. This measurement is only for detecting major flow interruptions such as clogged or plugged gas lines.

Follow these steps to check the Total Sample Flow:

1. Attach the Flow Meter to the Sample Inlet of the airpointer® housing. Ensure that the inlet to the Flow Meter is at atmospheric pressure.
2. Compare the Flow Meter reading with the total sample flow according to Table 11.2.— The sample flow is dependent on the module. Therefore, add up the flow rates of all modules installed in your configuration of the airpointer®. Then compare this total flow rate with that of the Flow Meter reading. The values should be the same within $\pm$ 10% .
3. If the external flow meter shows the correct value, compare this value with the one of the internal flow sensor. Again, both values should be the same within $\pm$ 10% .
4. If the value indicates an error, check fittings and pipes for tight and proper connection and repeat all maintenance steps. After every replacement make a leak check!

Module	Sample Flow Rate [$cm^3 min^{-1}$] $\pm$ 10%
O_3	550
CO	550
SO_2	550
NO_x	500 / 60 (O_3 Generator)

Table 11.2.: Module Sample Flow Rates

Follow these steps to check the Module Sample Flows:

1. With the instrument still running, open the airpointer® housing.

> **CAUTION:**
>
> **Take extra care not to touch any of the inside wiring with the metal cover or your body. Do not drop screws or tools into a running analyzer!**

2. Locate the sample inlet of each module (noted as "'Sample"'). Each module installed in the airpointer® has a separate sample inlet.

Figure 11.46.: Connection of the Flow Channel of a Module to the airpointer®

3. Disconnect the Sample channel leading to the module sample inlet and attach a Flow Meter to this end of the sample tube leading to the module. Ensure that the inlet to the Flow Meter is at atmospheric pressure.

4. Compare Flow Meter reading with the sample flow according to Table 11.2.—The sample flow is dependent on the module. The values should be the same within $\pm$ 10% .
5. Reinstall everything.
6. If the value indicates an error, check fittings, pipes and tubes for tight and proper connection and repeat all necessary maintenance steps. After every replacement perform a leak check!

12. Internal Span Module

NOTE
The Internal Span Module is used for internal function control of the span calibration. The internal zero calibration control is integrated in the respective module and can take place even when an Internal Span Module is not installed. The settings for span are ignored then.

NOTE
Do NOT use the Internal Span Module and the internal zero air to calibrate your airpointer® . For calibration conforming to standards (Chapter 7.6) use external zero air and external span gas.

For the modules 'NO_x', 'SO_2', 'CO', and 'O_3' Internal Span Modules are available. The Internal Span Module is a module which produces or provides span gas for internal function control. It is used to control automatically, if the airpointer® operates within the chosen limits or if a module has to be recalibrated.
With the automatic function control a zero check is performed and then followed by a span check. The calibration of the airpointer® is described in Chapter 7.6.

This section contains the following items:

1. Starting up the Internal Span Module of the NO_x or the SO_2 module.

2. Setup of the Internal Span Module for the system.

3. Input of parameters via the User Interface (see also section 7.7.5) using the SO_2 Internal Span Module as example.

4. Tolerance limit definition for the function control.

5. Description of the Internal Span Module of the modules: Function and maintenance.

12.1. Starting up the Internal Span Modules of the NO_x and the SO_2 module

SO_2 NO_x

The Internal Span Module is delivered without a permtube. Before starting the internal span module a permtube of selected permeation rate has to be installed (see section 12.5.3.3 and 12.5.4.3)!

> **NOTE**
> **The Internal Span Modules of the SO_2 and the NO_x modules are delivered without a permtube!**

12.1.1. Types of permtubes

- wafer device
- Standard permtube

12.1.2. Installation of a permtube

The installation of a permeation tube is described in section 12.5.3.3 and 12.5.4.3.

> **CAUTION:**
>
> **A permtube must not be installed when the airpointer® is powered off! This could cause damage to the device!**

12.2. Setup of the Internal Span Module for the system

> **NOTE**
> **If the CaliIntervalSystem value is grater than zero, the setup of the system parameter will be valid for all modules of the airpointer® . The function control of all modules (CO, SO_2, Ozone and NO_x module) is then given via this parameters. The individual setup of the modules is ignored. If one or more modules have no Internal Span Module installed then only a zero control will be performed in these modules.**

The Internal Span Module is configured through the User Interface. In section 7.7.5.3: ’Setup’ ⇢ ’Configuration’ ⇢ ‘System Parameters’ the configuration for the Internal Span Module is set. In that section the automatic zero point and span gas control is configured. The configuration of the system parameter is valid for the whole system. Only if CaliIntervalSystem is set to zero, the setup in ’Setup’ ⇢ ’Configuration’ ⇢ ’"’Module name"” will be active. If a module has no internal span modul installed, the setup for span control will be ignored. All modules of the airpointer® have a zero valve. An automatic zero point control can be carried out even without an Internal Span Module.

12.2.1. Activation and basis configuration (Calibration setup)

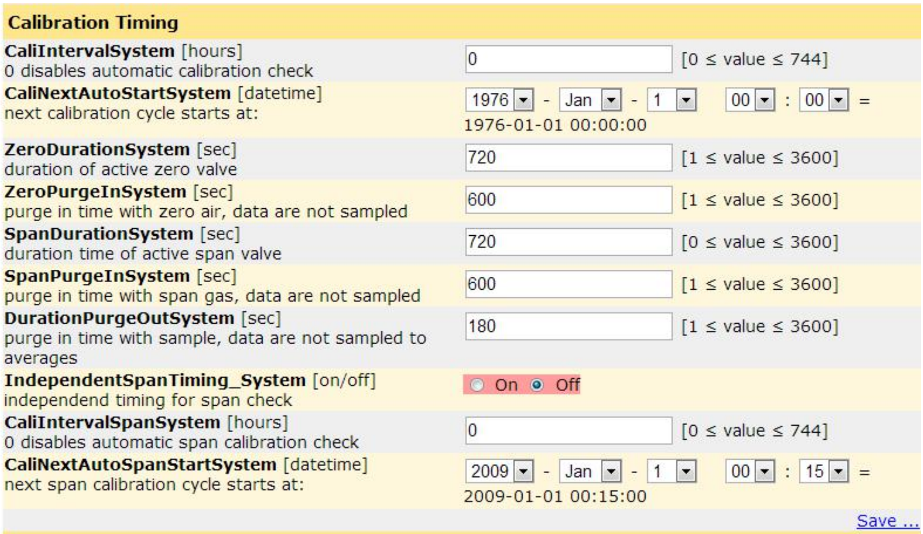


Figure 12.1.: System calibration setup of the internal span modul

In this section the basic configuration as listed in Figure 12.1 is set:

- Make sure that ’CaliONSystem’ is set to ’On’.

NOTE
For function and zero point control ’CaliONSSystem’ has to be set to ON!

NOTE
Only if ’CaliOnSystem’ is set to ’ON’ the system will be listed for manually valve control in ’User Interface’ ⇢ ’Calibration’ ⇢ ’start calibration’ ⇢ ’valve control’.

- ’Longest calibration duration’ means that all calibrations are skipped, if they last longer then the chosen time limit in hours. After this period the calibration will be switched off and the airpointer® returns to the normal measuring mode.

12.2.2. Timing of the function control (calibration timing).

In this section the timing of the internal span modul is selected. First a zero point control and then a span control takes place.

- In ’CaliIntervalSystem’ the interval between two function controls is given in hours.

> **NOTE**
> **If ’CaliIntervalSystem’ value is set to zero, the automatic calibration check of the whole system is disabled. The setup configured for each module is valid then.**

> **NOTE**
> **If this value is set to 24, the function control will start at the same time every day. The time is selected in ’CaliNextAutoStartSystem’.**

- The start time of the next function control is given in ’CaliNextAutoStartSystem’
- ’ZeroDurationSystem’ gives the duration during which the zero valve is active.
- ’ZeroPurgeinSystem’ gives the duration of the purge in time with zero gas. The data are not used during that period.

> **NOTE**
> **The time difference between ’ZeroDurationSystem’ and ’ZeroPurgeinSystem’ is the measurement time of the zero control.**

- ’SpanDurationSystem’ gives the duration during which the span valve is active.

> **NOTE**
> **If the ’SpanDurationSystem’ is set to zero, no span gas control takes place! With this setup it is possible to make an automatic zero control without an automatic span control.**

- ’SpanPurgeinSystem’ gives the duration of the purge in time of the span gas. The data are not used during that period.

NOTE
The time difference between ’SpanDurationSystem’ and ’SpanPurgeinSystem’ is the measurement time of the span control.

- ’DurationPurgeOutSystem’ gives the duration of the purge in time of the sample gas. The data are not used during that period.

12.3. Setup of the Internal Span Module - example: SO_2 module

12.3.1. Activation and basic adjustments (Calibration settings)

In this subsection the basic adjustments for the internal span modul are explained as shown in Figure 12.2:

- Take care that ’CaliONSO2Sensor’ is set to ’On’.

> **NOTE**
> **For function control or zero control ’CaliONSO2’ must be set to ’ON’!**

> **NOTE**
> **Only if ’CaliOnSO2Sensor’ is set to ’ON’, the SO_2 module will be listed for manual valve control in ’User Interface’ ↠ ’Calibration’ ↠ ’Start calibration’ ↠ ’Valve Control’.**

- If ’SO2 autocorrect4span’ is set to ’On’, the measurement values will be corrected according to the last span control. It is recommended to choose ’Off’.

> **NOTE**
> **It is recommended to set ’SO2 autocorrect4span’ to ’Off’.**

- If ’SO2 autocorrect4zero’ is set to ’On’, the measurement values will be corrected according the last zero control.

- If ’SO2 wrong cal to status’ is set to ’On’, the warn and fail status flags will be shown according to the chosen limits (see ’aux configuration’ below).

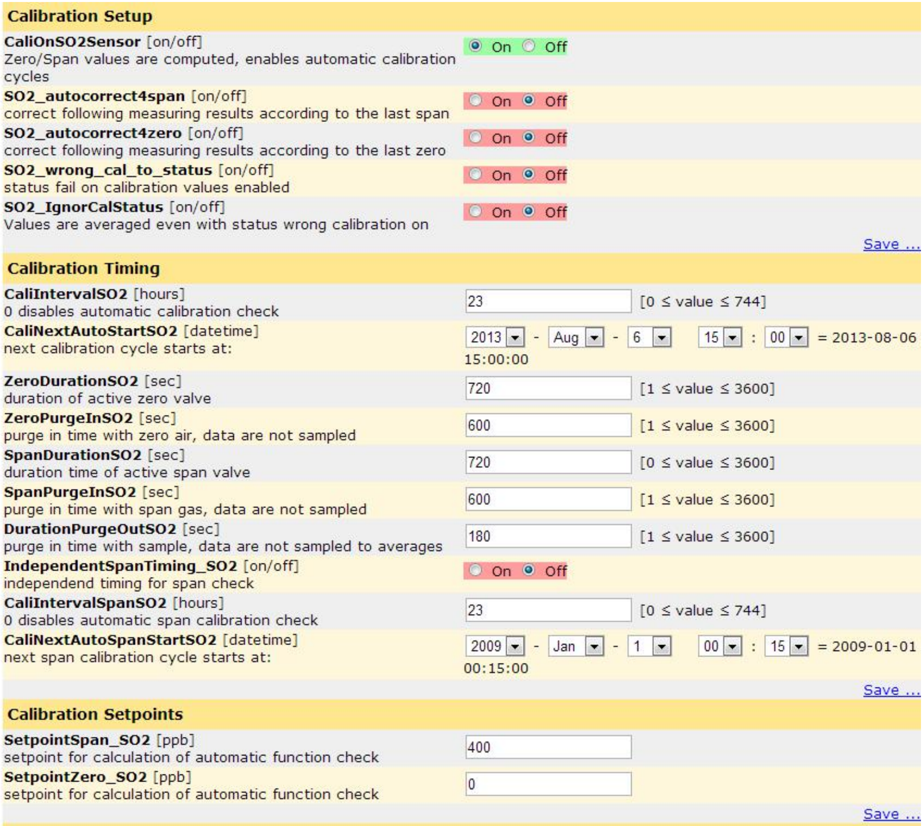


Figure 12.2.: Configuration of the automatic calibration check

12.3.2. Timing of the function control (Calibration timing)

> **NOTE**
> **Only if 'CaliIntervalSystem' is set to zero, the setup of the modules will be valid. Else the timing of the function control of all modules together is configured in 'CaliIntervalSystem'.**

In this subsection the configuration of the timing of the automatic function control is shown. First a zero control takes place and then a span control. The description below is just valid if 'CaliIntervalSystem'is set to zero. Else the configuration as given in section 7.7.5.3 ('System parameters') is valid.

- 'CaliIntervalSO2' determines the interval between two function controls.

> **NOTE**
> **If the value for 'CaliIntervalSO2' is set to zero, no function control takes place.**

> **NOTE**
> **If the value for 'CaliIntervalSO2' is set to 24, the function control will take place every day at the same hour. The hour is determined in 'CaliNextAutoStartSO2' as starting time.**

- The starting time of the next function control is given under 'CaliNextAutoStartSO2'
- 'ZeroDurationSO2' gives the duration during which the zero valve is active.
- 'ZeroPurgeinSO2' gives the duration of the purge in time with zero gas. The data are not used during that period.

> **NOTE**
> **The time difference between 'ZeroDurationSO2' and 'ZeroPurgeinSO2'is the measurement time of the zero control.**

- 'SpanDurationSO2' gives the duration during which the span valve is active.

> **NOTE**
> **If the 'SpanDurationSO2' is set to zero, no span gas control takes place! With this setup it is possible to perform an automatic zero control without an automatic span control.**

- 'SpanPurgeinSO2' gives the duration of the purge in time of the span gas. The data are not used during that period.

> **NOTE**
> **The time difference between 'SpanDurationSO2' and 'SpanPurgeinSO2' is the measurement time of the span control.**

- 'DurationPurgeOutSO2' gives the duration of the purge in time of the sample gas. The data are not used during that period.

12.3.3. Input of the setpoints (Calibration setpoints)

In this subsection the setpoints for zero and span control are configured. The setting of this values is given in subsection 12.4. The limits given in 'aux configuration' are related to this setup values.

- The setpoint for the span gas control has to be entered in 'SetpointSpan SO2'. The setpoint is given by measurement of the internal span gas after a calibration of the airpointer® with external span gas. The internal span gas is diluted.The dilution is not precisely controlled. Therefore the concentration of the internal span gas has to be measured.
- In 'SetpointZero SO2' the setpoint of the zero control is set. Mostly it is set to zero.

12.3.4. Determination of warn and fail limits ('aux configuration')

In this subsection the configuration of the limits for warn and fail massages is shown. If the measurement value during the function control is not within these limits (setpoint +/- deviation) and if 'SO2 wrong cal to status' is set to 'On', a warn or fail flag is set.

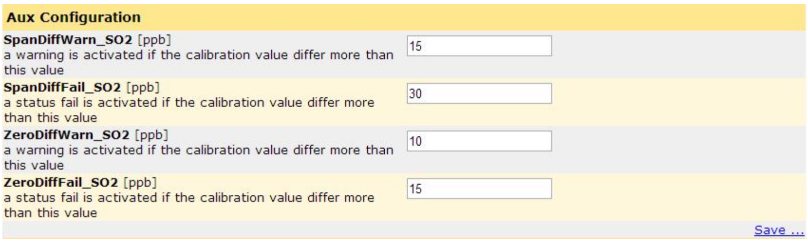


Figure 12.3.: Supplementary configuration

12.3.5. Additional remarks to the other modules:

12.3.5.1. O_3 module

Under 'Calibration setpoint' the concentration of the internal span gas has to be set. Put the desired value into 'O3IZS setpoint' (the default value is 300ppb). The airpointer® calculates the necessary light intensity according to an internal interpolation curve of the UV-lamp. For the function control 'SetpointSpan O3' has to be set, too.

NOTE
If you change the UV-lamp a new O_3 generator calibration has to be performed.

12.3.5.2. CO module

For the CO module the same settings have to be made as described for the SO_2 module. In the names for the settings SO2 is substituted with CO.

12.3.5.3. NO_x module

In 'Calibration setpoints' the setpoints for NO_2 and NO_x have to be set. According, in 'aux configuration' limits for both gases have to be set.

12.3.6. Manual start of the function control cycle

If you want to start a function control cycle manually go in the 'User Interface' to 'Calibration' ↠ 'Start calibration' ↠ 'Valve control' and select the module which you want to test and click 'Start Cali-Cycle' (see chapter 7.6). During the function control first a zero point test and then a span gas test takes place. The routine of the function control is the same as described in the chapter above.

NOTE
If the specific module is not listed, please check if 'CaliOn Sensor' is set to 'ON' (User Interface: 'Setup' ↠ 'Configuration' ↠ '"'Module name"' ↠ 'calibration setup').**

To bring enable changes in the setup you have to reboot the LinSens Service Interface ('Setup' ↠ 'System Maintenance' ↠ 'Service Manager' ↠ 'Sensor/Logger Software' force-restart). Afterwards refresh the website, by clicking F5 on e.g. Windows.

12.4. Determine the setpoints

12.4.1. Setpoint of the internal zero air

The setpoint for the zero measurement is zero.

12.4.2. Setpoint of the internal span gas

The internal span gas is diluted and depends on the flow. To determine the concentration of the internal span gas for function control the module has to be calibrated with external span gas of known concentration. Afterwards the concentration of the internal span gas can be measured and the setpoint for the internal function control can be determined.

Setpoint for the internal span gas

1. Connect external span gas to the airpointer® as described in chapter 7.6.7.2.

2. Perform an external calibration (see chapter 7.6.7).

3. After the calibration go in ’User Interface’ to: ’Calibration’ ↠ ’Start calibration’ ↠ ’Valve control’ and select ’Maintenance ON’ to mark the following measurements.

4. Start a cycle with ’Start Cali-Cycle’ and take the result as setpoint. The result is listed in ’LinSens Interface’ ↠ ’Calibration’ under the respective sensor as zero and span or in ’module’ ↠ ’**last Span’.

NOTE
At the ozone module the setpoint is selected and the necessary voltage for the UV lamp is calculated from the internal ozone generator curve.

Figure 12.4.: Valve control and cycle

5. OR (instead of 4) determine the span concentration manually:
   a) Click at the just calibrated module 'Open span valve'.
   b) Go to 'Setup' ⇢ 'System Info' ⇢ 'Service Interface' ⇢ 'LinSens Service Interface' ⇢ 'Average Value Page'. This page shows the averaged values of the measurement values of all active modules (see figure 12.5).
   c) Wait till the 300s averaged value of the active module is stable. Write down this value.
   d) Go in the 'User Interface' to 'Calibration' ⇢ 'Start Calibration' ⇢ 'Valve Control' and choose 'Normal sample' and 'Maintenance OFF' to continue with measurement of ambient air.
   e) Enter the value noted at 'Setup' ⇢ 'Configuration' ⇢ '"'Module"' ⇢ 'Calibration setup' ⇢ 'Calibration setpoints' in 'SetpointSpan **'.

LinSens Service Interface [200700185], normal Operation

Home Actual Average Calibration NOx O3 System_Values Status StatList Software Hardware RS232

Average 1

Number	Parameter	Value	StdDev	Unit	Status: BS-FS-SS	Time	nVal / nShould	ID
G1P1	NO	-0.0	0.01	ppb	0 0 0	20140205 12:02:00	60/60	1
G1P2	NO2	0.5	0.01	ppb	0 0 0	20140205 12:02:00	60/60	2
G1P3	NOx	0.5	0.01	ppb	0 0 0	20140205 12:02:00	60/60	3
G3P1	O3	421.4	0.02	ppb	0 0 0	20140205 12:02:00	60/60	5

Average 2

Number	Parameter	Value	StdDev	Unit	Status: BS-FS-SS	Time	nVal / nShould	ID
G1P1	NO	0.0	0.03	ppb	0 0 0	20140205 12:00:00	300/300	1
G1P2	NO2	0.5	0.02	ppb	0 0 0	20140205 12:00:00	300/300	2
G1P3	NOx	0.6	0.05	ppb	0 0 0	20140205 12:00:00	300/300	3
G3P1	O3	421.5	0.11	ppb	0 0 0	20140205 12:00:00	300/300	5

Average 3

Number	Parameter	Value	StdDev	Unit	Status: BS-FS-SS	Time	nVal / nShould	ID
G1P1	NO	0.0	0.06	ppb	0 0 0	20140205 12:00:00	1800/1800	1
G1P2	NO2	0.6	0.03	ppb	0 0 0	20140205 12:00:00	1800/1800	2
G1P3	NOx	0.6	0.07	ppb	0 0 0	20140205 12:00:00	1800/1800	3
G3P1	O3	421.7	0.35	ppb	0 0 0	20140205 12:00:00	1800/1800	5

This document is generated by linsens, the sensor part of the airpointer system

20140205 12:02:23

Figure 12.5.: Averaged measurement values of all active module

12.5. Operation and Maintenance

12.5.1. Internal Span Module of the O_3 module

O_3

The ozonator of the Internal Span Module of the O_3 module produces ozone with an UV lamp. This ozone is used for span gas function control. Put the desired ozone concentration in ppb into 'O3IZS Setpoint' in 'Setup' ↠ 'Configuration' ↠ '"'Module"' ↠ 'Calibration setup' ↠ 'Calibration setpoint'. The airpointer® calculates with an internal interpolation curve the necessary voltage for the UV lamp. If the lamp is changed or if the ozone module has to be recalibrated because of too high deviations a new interpolation curve has to be measured! A new interpolation curve has also to be created when there is a change in see level of several hundred meter.

NOTE
With an internal interpolation curve the desired concentration is automatically translated into the necessary voltage for the UV lamp. If the lamp is changed or if the ozone module has to be re-calibrated because of too great deviations a new interpolation curve has to be performed!

12.5.1.1. Location

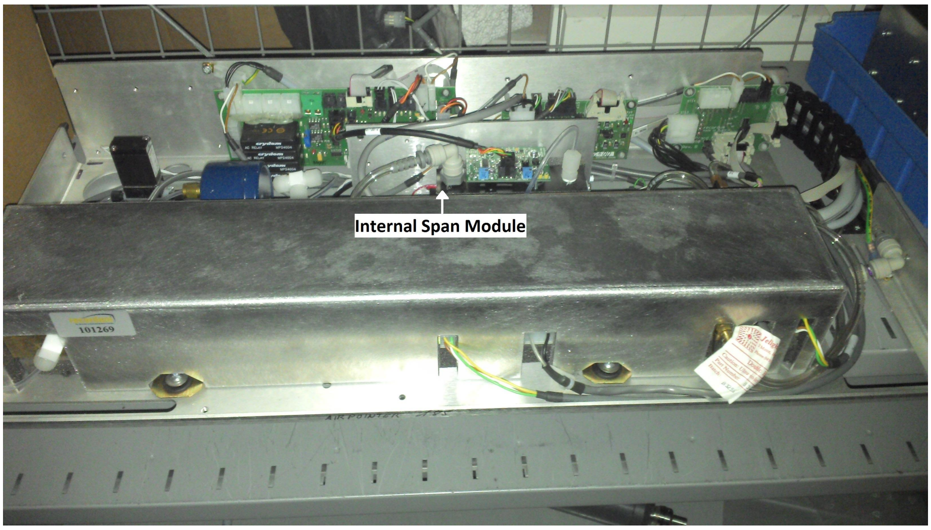


Figure 12.6.: Location of the Internal Span Module in the ozone module

The Internal Span Module of the ozone module is located behind the optical bench.

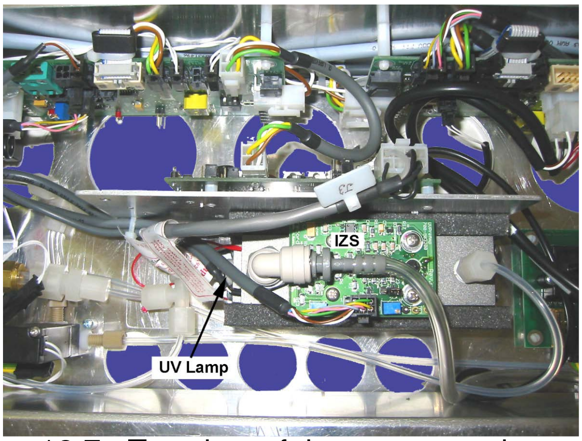


Figure 12.7.: Top view of the ozone module with installed Internal Span Module

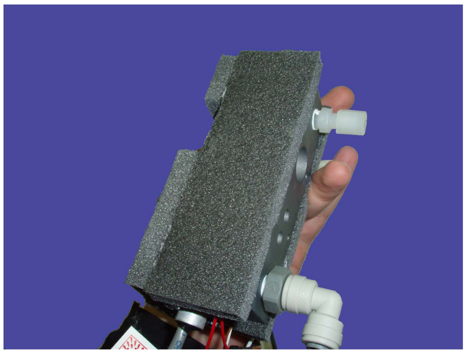


Figure 12.8.: Dismounted internal span modul with thermal insulation

12.5.1.2. Flow diagram

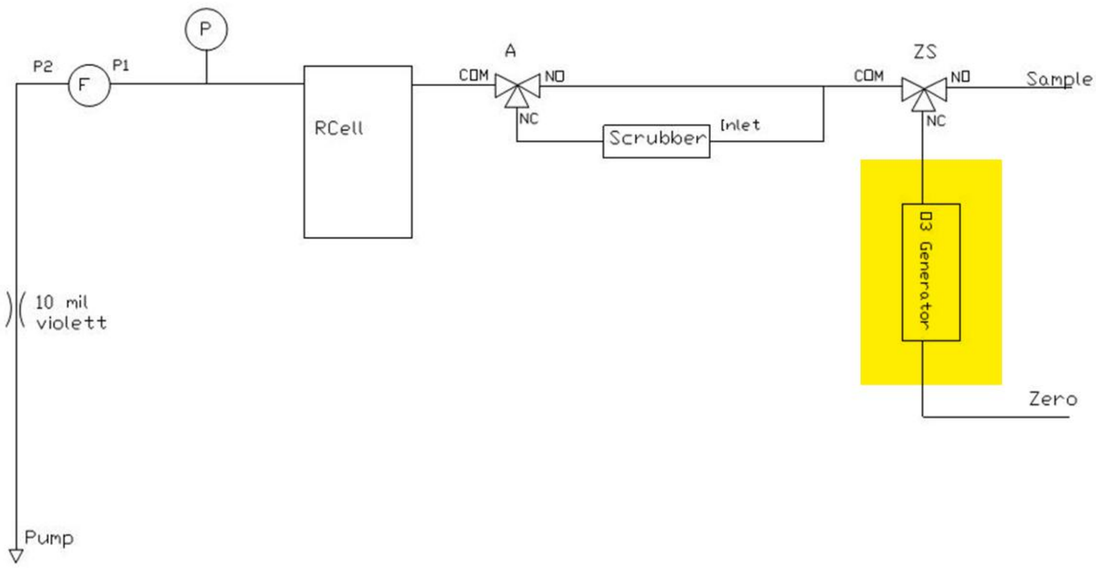


Figure 12.9.: Flow diagram of the ozone module with Internal Span Module

In Figure 12.9 the flow diagram of the ozone module with Internal Span Module is shown. The O3 generator for the internal span gas is located in front of the zero valve. If internal span gas is needed, it will be generated from the internal zero air. If zero air is needed the UV lamp will be switched off.

NOTE
If the UV lamp is switched off, in 'LinSens Interface' ↠ 'O3' ↠ 'Ozone generator' the value for 'Power Lamp' is set to -9999.

The description of the other parts of the flow diagram is given in chapter 10.2.2 'Gas Flow of the O_3 Analyzing Module'.

12.5.1.3. Maintenance of the UV lamp

The UV lamp of the ozonator has to be replaced every several years.

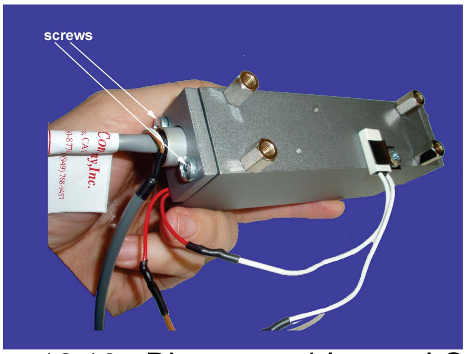


Figure 12.10.: Dismounted Internal Span Module without thermal insulation

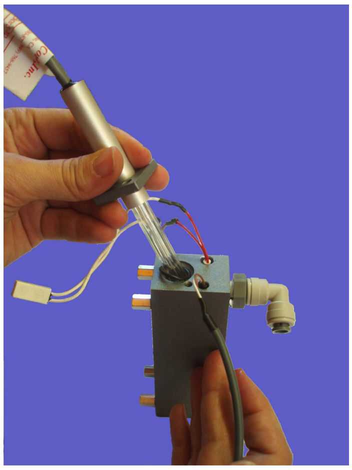


Figure 12.11.: Exchange of the UV lamp

Follow these steps to change the UV lamp

1. Shut down the airpointer® and unplug the power line.
2. Locate the O_3 Module and slide it out.
3. Locate the Internal Span Module on the module.
4. On the right side in Figure 12.10 there are the two red screws visible. Unscrew both.
5. Pull the UV lamp carefully out and replace it.
6. Push the new UV lamp into the mounting and screw the screws.
7. Slide in the module and switch on the airpointer® .
8. Create a new interpolation curve for the new lamp (see below). Start the '03 generator calibration' feature.

> **NOTE**
> **When the UV lamp is replaced, a new interpolation curve has to be created.**

9. Determine the setpoint for the internal span function control.

12.5.1.4. Ozone generator calibration / Creation of an interpolation curve for the UV lamp

The status of the ozone generator is shown in the 'LinSens Serviceinterface' → 'O3' under Ozone Generator at the bottom of that site.

> **NOTE**
> **To create the interpolation curve you have to have administrator rights on the airpointer® !**

O_3 generator calibration

1. Calibrate the ozone module with external span gas.
2. Go in the User Interface to: 'Setup' → 'System Maintenance' → 'Command Interface' and start the process by clicking 'Start O3 GenCali'. The Command Interface is described in chapter 7.7.3.2.

> **NOTE**
> **The creation of interpolation curve takes about an hour.**

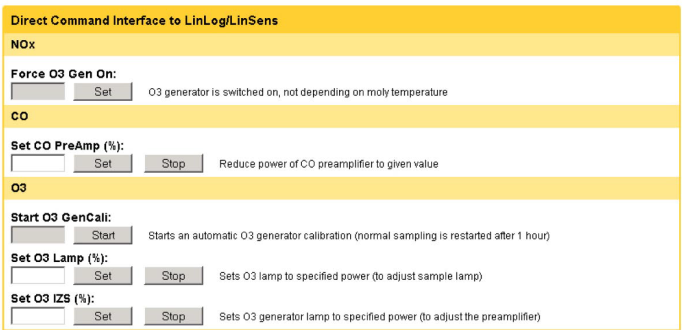


Figure 12.12.: Create the interpolation curve

3. The interpolation curve is created automatically. The process takes about an hour. Afterwards the sample measurement starts.

4. It is a multipoint measurement. The intensity values are stored with the corresponding concentration values. The interpolation curve is visible on the 'LinSens Service Interface': click on the 'O3IZSCali' site the link to 'O3' page. You can find this point in the User Interface under: Enter the Interface as shown 7.7.2.2.1 ↠ 'O3' ↠ 'O3IZSCali'. The parameters for the interpolation curve are listed under 'Stored IZS Cal Parameter'.

Actual Ozon IZS Values
no calibration active

O3_all (3/14)	5.3	ppb	O3_raw (3/34)	5.3	ppb	O3StdDev (3/15)	0.15	ppb	O3_Avg (300 sec)	5.4	ppb

Ozone Generator LampCtrl

Setpoint IZS	400.0	ppb	Setpoint Lamp	4000.0 (+/- 1.0)	mV
O3GenPower (3/31)	0.0	%	O3GenIntensity (3/29)	72.2	mV
O3GenLampCurr (3/28)	0.2	mA	O3GenPress (3/25)	964.7	mbar
O3GenTemp (3/26)	50.0	°C	O3GenTPower (3/27)	51.0	%
IZS Lamp Control:	change s0.000 d0.000 p0.000 up	%	Delta Act/Set	0.000/1.000	mV

Sequence

Duration/PurgeIn	Elapsed time	Setpoint	Compensated	Measured
1200/1020 sec	-	2000.0 mV	-	- ppb / - mV
480/300 sec	-	1500.0 mV	-	- ppb / - mV
480/300 sec	-	1000.0 mV	-	- ppb / - mV
480/300 sec	-	500.0 mV	-	- ppb / - mV
480/300 sec	-	250.0 mV	-	- ppb / - mV
480/300 sec	-	125.0 mV	-	- ppb / - mV

Stored Parameters (press reload to update)

0.0 mV	0.0 ppb
2000.0 mV	1000.0 ppb

Figure 12.13.: Stored values for interpolation

12.5.2. Internal Span Module of the CO Module

For the CO module a small cylinder of span gas is required for span function control. For stable pressure output two pressure valves are used. The first one reduces the pressure to about 3-5 bar, the second one is used to determine the concentration of the span gas (about 0,5 bar). A pressure sensor observes the pressure in the cylinder. A warn flag is shown in the User Interface when the cylinder has to be refilled and a fail flag if the cylinder is empty, respectively.

12.5.2.1. Location

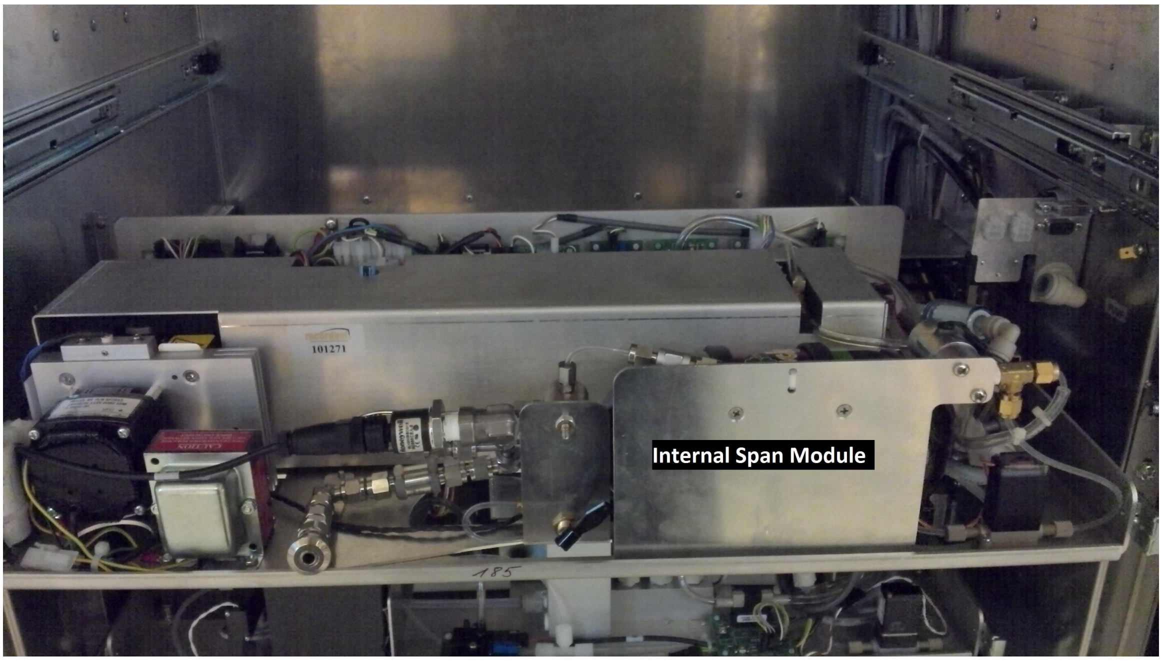


Figure 12.14.: Location of the Internal Span Module on the CO module

The Internal Span Module on the CO module is located in front of the optical bench. On the right side there is the release valve. It is used to release the gas e.g.: in case of transport in an airplane.

12.5.2.2. Flow diagram

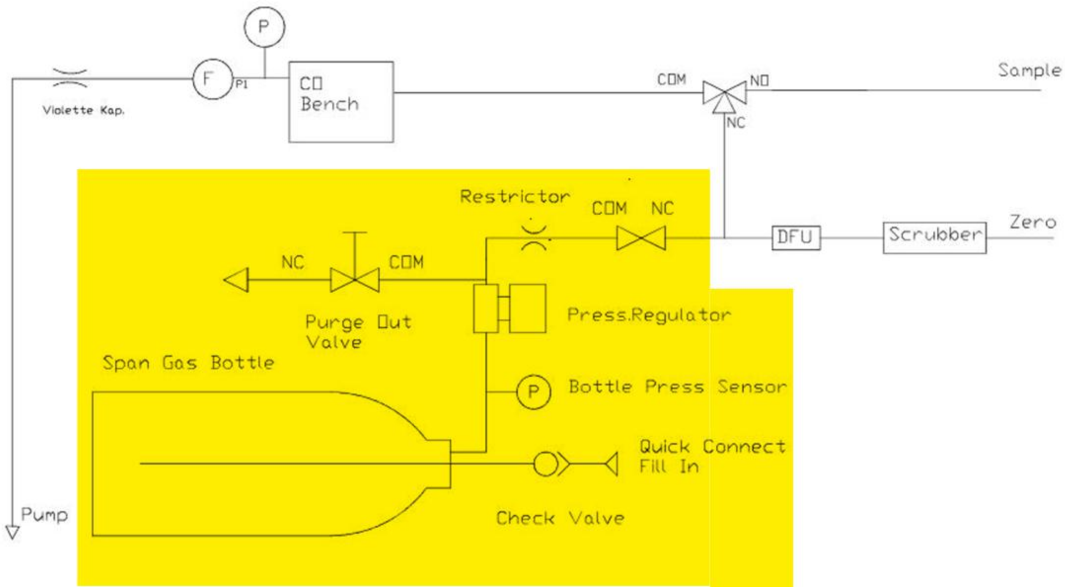


Figure 12.15.: Flow diagram

The Internal Span Module is located between DFU filter and zero valve. The span gas flows through two pressure valves and an restrictor to the zero valve.

12.5.2.3. Safety regulations for the gas cylinder

The used gas cylinder contains pressurized gas. The safety notices for gas cylinders must be followed! Else your life can be endangered!

CAUTION:

Improper use, filling, storage, violation from safety regulations can lead to damage of property, severe damages and death!

- Do NOT change the connections!
- The gas cylinder must not be exposed to temperatures above 50°C.

CAUTION:

If the cylinder was exposed to temperature above 50°C, it must be tested hydrostatically. If the cylinder was exposed to temperature above 72°C the cylinder must be disposed!

- When you fill the cylinder pay attention to its capacity! On the gas cylinder the maximum pressure is written. Pay attention that the label is always easy to read and the limits are kept.

NOTE
On the gas cylinder the maximum pressure, the expire date and the maintenance interval are written. Pay attention that they are kept and easy to read.

NOTE
The gas cylinder must be tested every 5 years!

12.5.2.4. Refilling the gas cylinder

The gas cylinder can be refilled.

CAUTION:

Check the expire date and the date of the next maintenance before you refill the cylinder!

CAUTION:

Check that the gas cylinder is in good shape. If you find any sign of corrosion, damages due to heat or if the cylinder has been dropped than the cylinder has to be tested hydrostatically!

CAUTION:

If the condition of the cylinder is not definitely good, let it be tested by a qualified body!

Refilling the gas cylinder

1. Locate the CO module and the gas cylinder.

2. Inspect the gas cylinder for visible wear, expire date (label), and maintenance date (see above).

3. The valve for the refill is on the right side.

4. As a rule span gas cylinders are filled with a maximum pressure of 150 bar. The small gas cylinder is specified up to 200 bar. Nevertheless check the gas pressure in the span gas cylinder before you refill the small one.

> **CAUTION:**
>
> **The maximum pressure of the gas cylinder is 200 bar. Use a barometer when the cylinder is refilled with a span gas cylinder with higher pressure!**

5. Connect the external CO gas cylinder and fill the small internal one. Take care of the maximum pressure. It is written on the gas cylinder.

> **CAUTION:**
>
> **You must NOT fill the gas cylinder above the maximum pressure! Else there is danger of damage of property, health, and life!**

6. Remove the span gas cylinder and the pressure sensor.

7. Determine the setpoint for span control as described above and adjust the setpoint to your needs with the pressure valve 2.

12.5.2.5. Maintenance of the gas cylinder

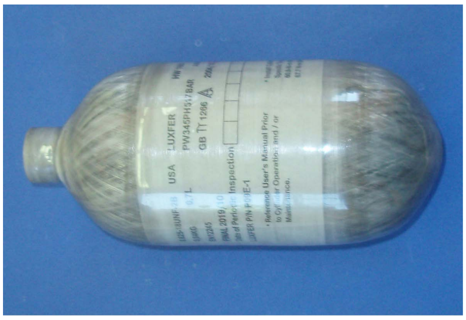


Figure 12.16.: Gas cylinder of the CO-module

The expired date is written on the label on the gas cylinder. There is also the possibility to write down the checks. The gas cylinder must be inspected hydrostatically from an expert every 5 years.

NOTE
The gas cylinder has to be inspected every 5 years by a qualified body!

CAUTION:

The gas cylinder has an expire date. Please exchange the gas cylinder in time!

12.5.3. Internal Span Module of the SO_2 module

The span gas for the function control is produced with a permtube. The permeation rate of permtube determines the concentration of the span gas. The delivered amount per minute is written on the package. The actual concentration value depends on the flow. The concentration is determined as described in section 12.4.2 and is put as setpoint. If the setpoint is not reached any more, the permtube might need to be replaced.
The operating temperature is set to 50°C ('LinsensServiceInterface' ↠ "'module"' ↠ 'PermTemp').

12.5.3.1. Location

The Internal Span Module is located in front of the optical bench and has a thermal insulation.

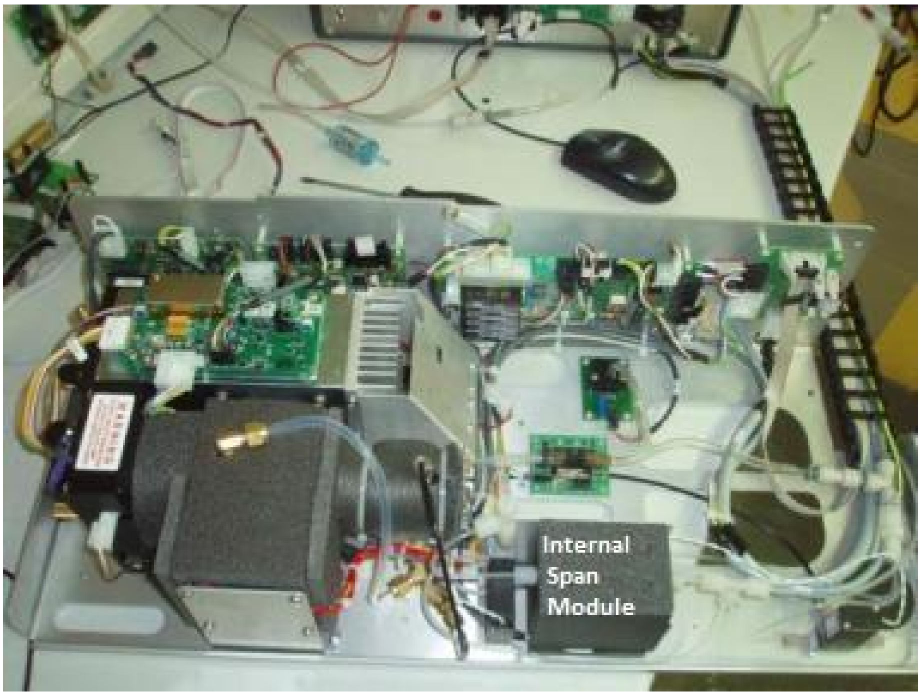


Figure 12.17.: Location of the Internal Span Module of the SO_2 module

12.5.3.2. Flow diagram

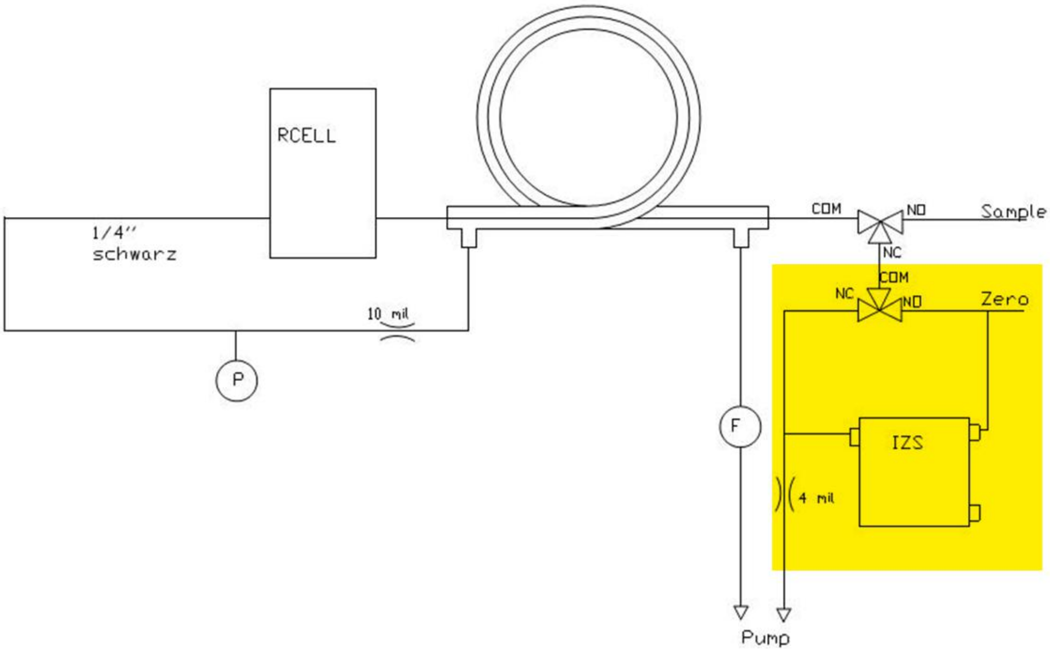


Figure 12.18.: Flow diagram

The Internal Span Module is located in front of the zero valve at the same side as the internal zero air. Depending on the valve position span gas or zero air reaches the hydrocarbon scrubber (kicker) and the reaction chamber.

12.5.3.3. Exchange of the permtube

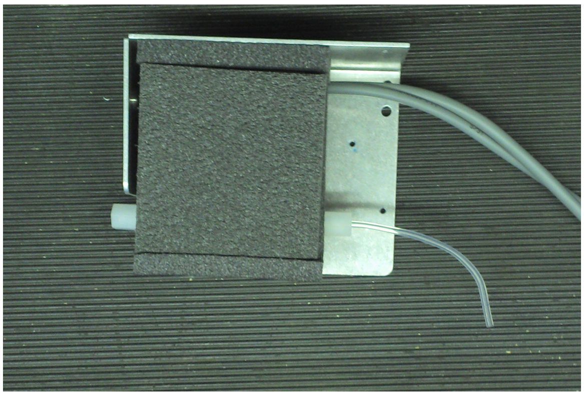


Figure 12.19.: Removed Internal Span Module with thermal insulation

Follow these steps to change the permtube

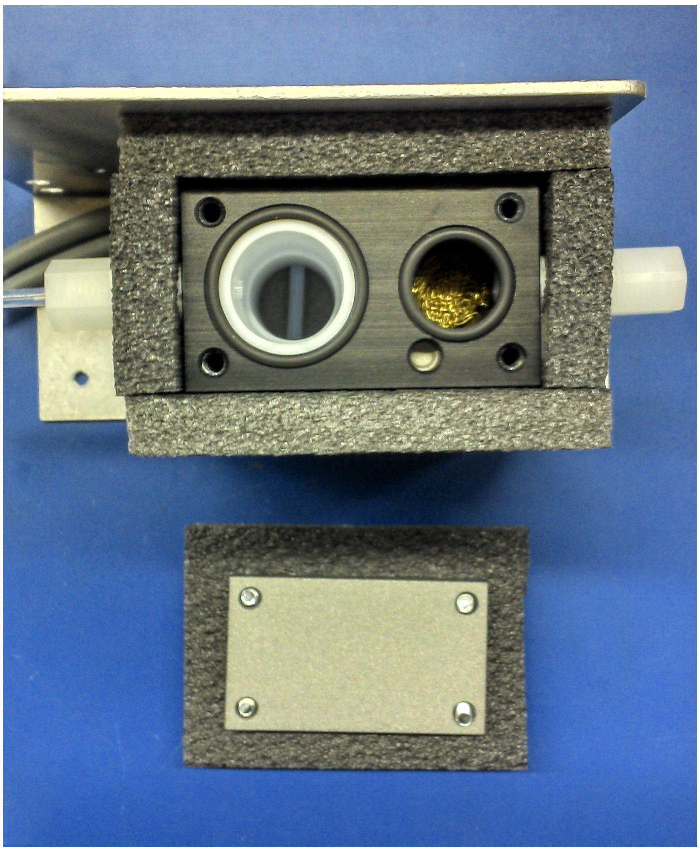


Figure 12.20.: Internal Span Module with unscrewed top and thermal insulation

1. Turn off the airpointer® and unplug it.
2. Locate the SO_2 module and slide it out.
3. Locate the Internal Span Module.
4. Unscrew the top with the thermal insulation (4 screws).
5. Pull out the permtube.

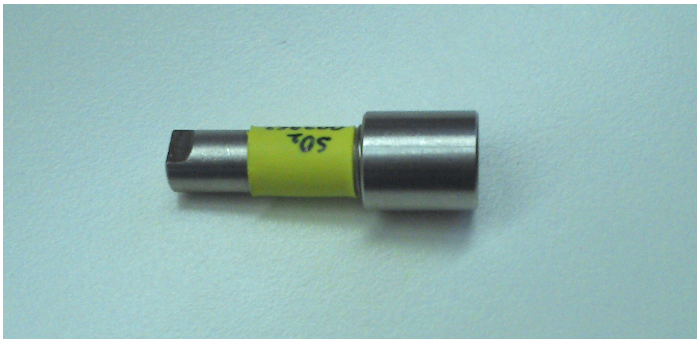


Figure 12.21.: Permeation tube

6. Exchange the permtube.

> **NOTE**
> **Do NOT touch the top of the permtube!**

7. Reinstall the permtube in the Internal Span Module and screw on the top.
8. Slide in the module and turn the airpointer® on.
9. Wait at least 4 hours to stabilize the temperature, better will be a night, before you start a measurement.

> **NOTE**
> **A change in the temperature of +10° will lead to a concentration change of factor 2!**

10. Calibrate the airpointer® and determine the setpoints for the internal function control.

12.5.4. Internal Span Module of the NO_x module

The span gas for the function control is produced with a permtube. The permeation rate of permtube determines the concentration of the span gas. The delivered amount per minute is written on the package. The actual concentration value depends on the flow. The concentration is determined as described in section 12.4.2 and is put as setpoint. If the setpoint is not reached any more, the permtube might need to be replaced.
The operating temperature is set to 50°C ('LinsensServiceInterface' ↠ "'module"' ↠ 'PermTemp').

12.5.4.1. Location

The Internal Span Module is located in front of the molybdenum converter and has a thermal insulation.

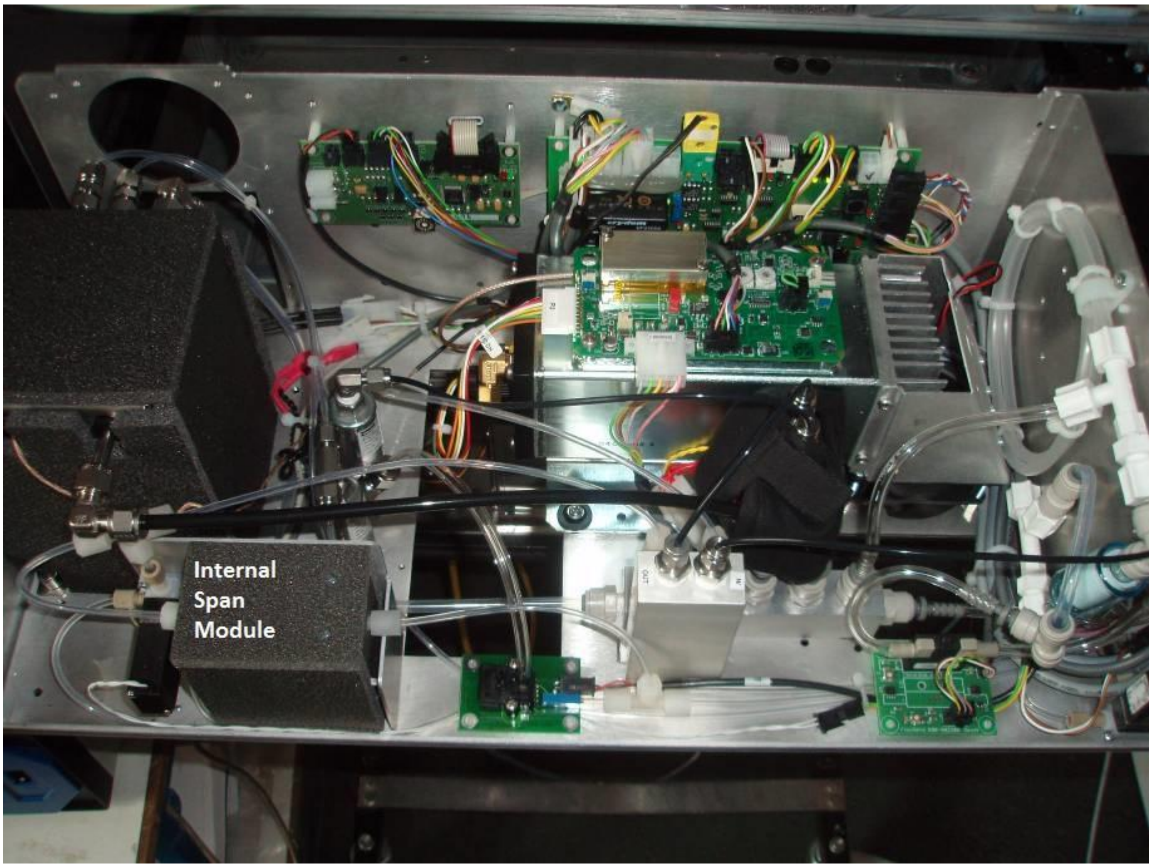


Figure 12.22.: Location of the Internal Span Module of the NO_x module

12.5.4.2. Flow diagram

The Internal Span Module is located before the zero valve on the same side as the zero air. Depending on the switch of the valve zero air or span gas reaches the Perma Pure® dryer.

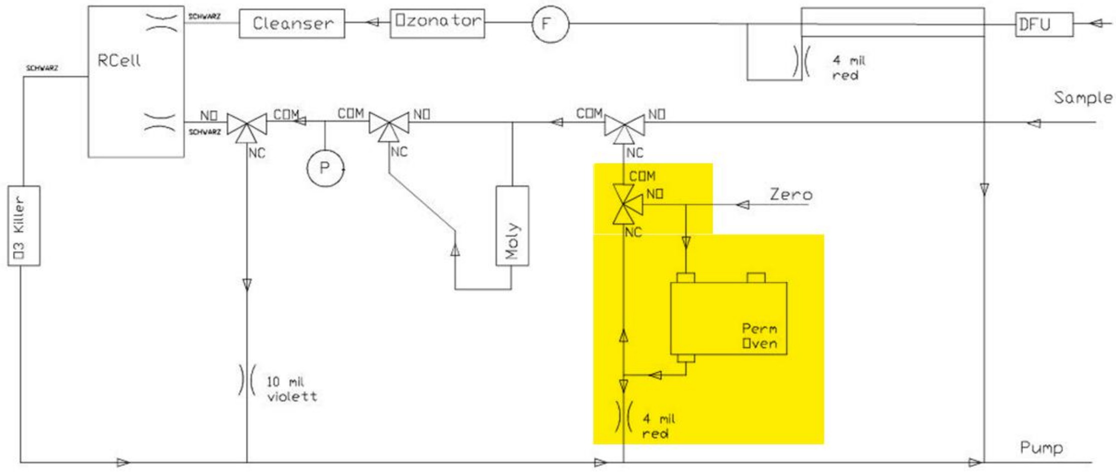


Figure 12.23.: Flow diagram

12.5.4.3. Exchange of the permtube

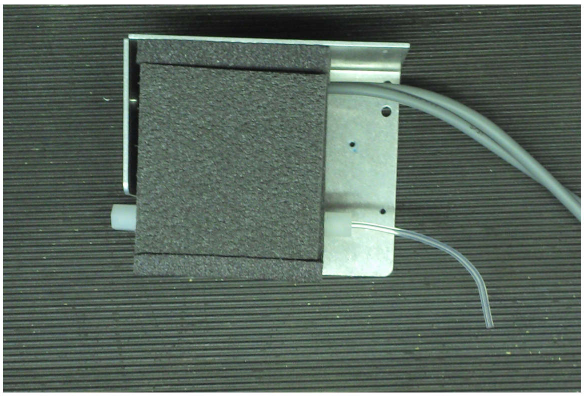


Figure 12.24.: Removed Internal Span Module with thermal insulation

Follow these steps to change the permtube

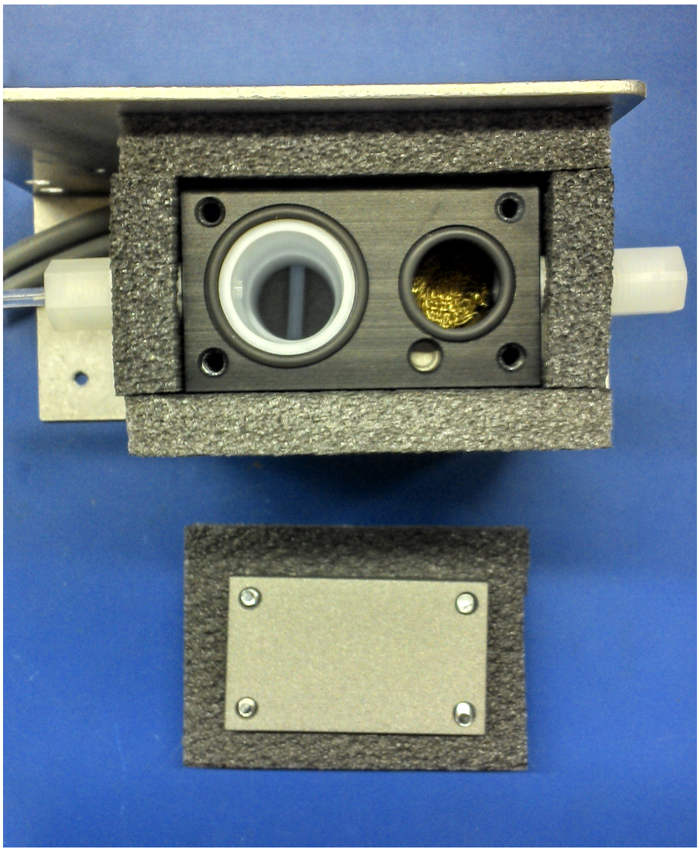


Figure 12.25.: Internal Span Module with unscrewed top and thermal insulation

1. Turn off the airpointer® and unplug it.
2. Locate the NO_x module and slide it out.
3. Locate the Internal Span Module.
4. Unscrew the top with the thermal insulation (4 screws).
5. Pull out the permtube.

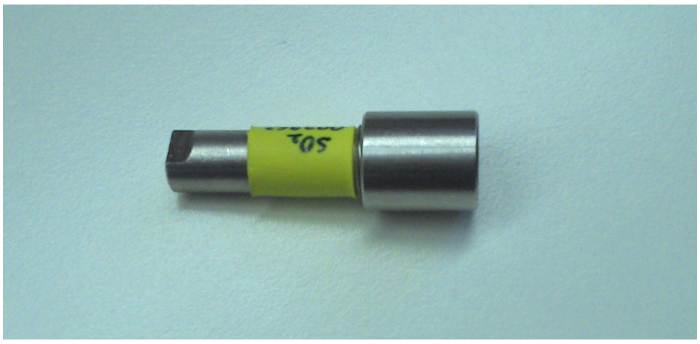


Figure 12.26.: Permeation tube

6. Exchange the permtube.

> **NOTE**
> **Do NOT touch the top of the permtube!**

7. Reinstall the permtube in the Internal Span Module and screw on the top.
8. Slide in the module and turn the airpointer® on.
9. Wait at least 4 hours to stabilize the temperature, better will be a night, before you start a measurement.

> **NOTE**
> **A change in the temperature of +10° will lead to a concentration change of factor 2!**

10. Calibrate the airpointer® and determine the setpoints for the internal function control.

13. Meteorological Sensors

13.1. Wind and Precipitation Sensors

This chapter includes following sections:

13.1.1. Overview of available meteorological sensors

13.1.1.1. Sensors from Lufft

Figure 13.1.: 5 Wind Sensors from Lufft

13.1.1.1.1. Overview of the Lufft Family

	WS200UMB	WS300UMB	WS400UMB	WS500UMB	WS600UMB
Air temperature		o	o	o	o
Humidity		o	o	o	o
Air pressure		o	o	o	o
Precipitation			o		o
Wind direction	o			o	o
Wind speed	o			o	o
Compass	o			o	o
Dimensions					
Diameter, height [mmm, mmm] Weight [kg]	150, 194 0.8	150, 223 1.0	150, 279 1.3	150, 287 1.2	150, 343 1.5
Current consumption and power input					
Sensor Heating	ca.50mA/ 1.2VA at 24VDC 833mA/20VA at 24VDC	ca.145mA/ 3.5VA at 24VDC	ca.170mA/ 4.1VA at 24VDC 833mA/20VA at 24VDC	ca.150mA/ 3.6VA at 24VDC 833mA/20VA at 24VDC	ca.175mA/ 4.2VA at 24VDC 1.7A/40VA at 24VDC

13.1.1.2. Gill, and Vaisala Sensors

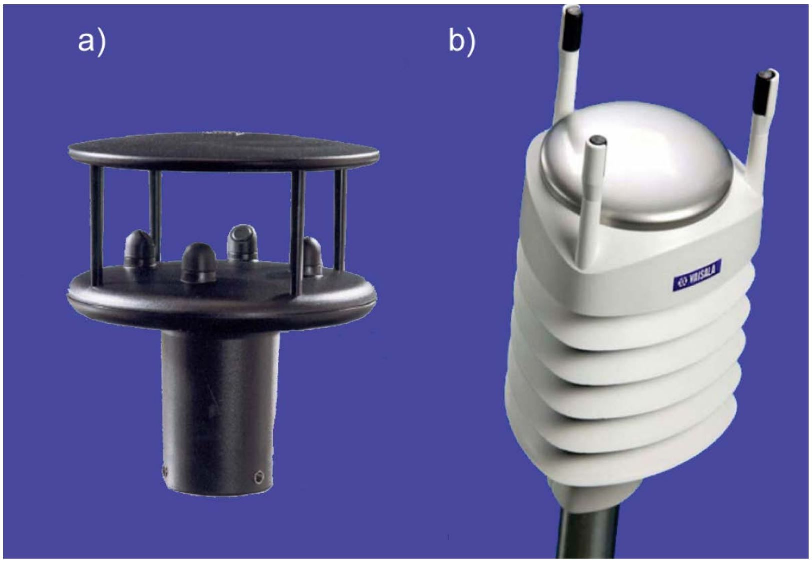


Figure 13.2.: Wind Sensor from a)Gill, b) Vaisala

13.1.2. Key Features and Secifications

13.1.2.1. Key Features

Gill	Vaisala
Ultrasonic technology	Ultrasonic technology
Wind direction, wind speed	Wind direction, wind speed
	Amount of precipitation (rain or hail), temperature, relative humidity, kind of precipitation (rain or hail)
Rugged construction	
No moving parts	No moving parts
Maintenance free	Minimum of maintenance
No on-site calibration	No on-site calibration

	Lufft Depending on version	**Gill**	**Vaisala**
Measurement of	Wind direction Wind speed Temperature, pressure, RH Precipitation	Wind direction Wind speed	Wind direction Wind speed Temperature, relative humidity (RH) Precipitation amount and kind (rain, hail)
Wind speed Accuracy Resolution Response time Sampling Rate Minimal wind speed	0 - 60 m/s ±0.3m/s or ±3% (0....35 m/s) ±5% 0.1m/s 10seconds/ 1 second with restriction 0.3 m/s	0 - 60 m/s (>35m/s) RMSE±2% 0.01m/s	0 - 60 m/s ±0.3m/s or ±3%, whichever is greater for the measurment range of 0-35m/s ±5% at 36-60m/s 0.1m/s 0.25s
Wind direction Accuracy Resolution Response time	0 - 359,9° 3°RMSE from 1.0m/s ±3° at 20°C, others 0.1°	0 - 360° ±3° 1°	0 - 360° ±3° 1° 0.25 seconds
Humidity Accuracy Resolution Sampling Rate	0-100%RH ±2% RH 0.1%RH 1 minute	-	0-100%RH ±3% at 0-90%RH ±5% at 90-100%RH 0.1%RH
Pressure Accuracy Resolution	300-1200 hPa ±1.5hPa 1hPa	-	600-1100 hPa ±5hPa at 0-30°C ±1hPa at -52 - +60°C

	Lufft Depending on version	**Gill**	**Vaisala**
Air temperature	-50 - +60°C		-52 - +60°C
Accuracy			±0.3°C at +20°C
Resolution	0.1°C (-20°...+50°), otherwise 0.2°C		0.1°C
Precipitation			
Measuring Range Drop size	0.3...5.0mm		
Accuracy	±1.5hPa		±5hPa at 0-30°C
Liquid precipitation resolution	0.01mm		
Precipitation types	rain, snow		rain, hail
Repeatability	typically >90%		
Response Threshold	0.01mm		
Sampling Rate	Event-dependent on reaching response threshold		
Compass			
Measurement Process	Integrated electronic compass		
Measurement Range	0...359°		
Resolution	1.0°		
Sampling Rate	5 min		

13.1.2.2. Further Specifications

	Lufft Depending on version	**Gill**	**Vaisala**
Dimensions			
Diameter, height	see below	142mm, 160mm	115mm, 238mm
Weight	see below	0.45kg	0.65kg
Material Precipitation sensor plate	S	LURAN S KR 2861/IC ASA/PC	Polycarbonate + 20% glas fiber Stainless steel (AISI316)
Operating temperature	-50 - +60°C	-35 - +70°C	-52 - +60°C
Storage temperature		-50 - +70°C	-60 - +70°C
Relative humidity	0 - 100%RH	<5% - 100%	0-100%
Housing protection class	III(SELV), IP64	IP65	IP55
EMC		EN 6100-6-2:2001 EN 6100-6-3:2001	EN61326: 1997 + Am1:1998 + Am2:2001 EMC and Generic environment
Supply voltage	+24VDC ± 10% 12VDC with restrictions	9 - 30 VDC	5-30VDC (SDI-12)
Power consumption	50 - 175 mA, see below	14 - 44 mA	13mA at 30VDC max cont. 3mA at 12VDC typical
Heating voltage	883mA/20VA resp. 1.7A/40VA		12VDC ±20%, 1.1A max 24VDC±20%, 0.6A max
Output signal		RS232, RS422, RS485	SDI-12,RS-232,RS-485,RS-422
Communication protocol		NMEA 0138 v3, SDI-12	SDI-12 v1.3,ASCII automatic/polled, NMEA 0138 v.3.0 with every option

13.1.3. Getting Started

13.1.3.1. Unpacking the Sensor

> **NOTE**
> **The meteorological sensor is a sensitive measurement device. Please be careful and do not let it drop.**

> **NOTE**
> **Be very careful with the three antennas on top of the Vaisala sensor. These are the wind sensors and they must not be twisted.**

13.1.3.2. Installation Site

Installation Site

1. Pay attention to free and unobstructed air stream.

> **NOTE**
> **Pay attention to free and unobstructed air stream.**

2. Have in mind that the location site should be free from turbulence caused by nearby objects, such as trees or buildings.
3. For a more exact wind measurement the wind sensor can be mounted on an aluminum mast (the airpointer® can also be mounted on that mast). When ordering, inform your distributor if you would like to mount the sensor on a rod. The cable length has to be calculated respectively.

> **NOTE**
> **Pay attention to properly grounding of the device and the mast.**

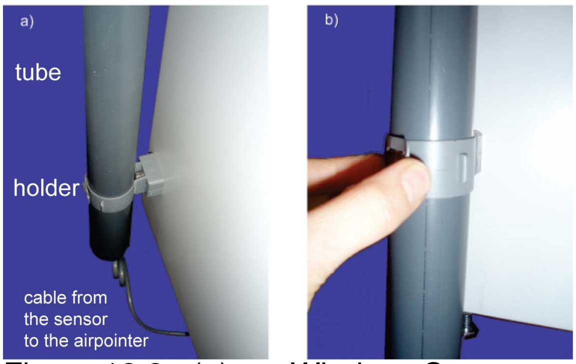


Figure 13.3.: (a) Wind Sensor Holder. The sensor is mounted on top of the tube .
(b) Open the holder for the tube.

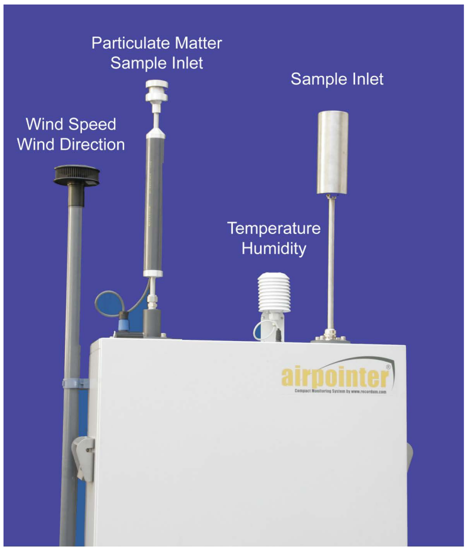


Figure 13.4.: On the left side: Wind sensor

4. If you have a sensor with precipitation measurement take care that no splash water can reach the sensor.
5. If using the Gill sensor, check the installation to ensure that the sensor is not affected by other equipment operating locally, which may not confirm to current standards, e.g. radio/radar transmitter, boa engines, generators etc.
6. For Lufft sensor with precipitation measurement take to position the device at a suitable distance from other systems incorporating a 24GHz radar sensor, such as traffic counting devices on overhead gantry signs. Otherwise cross effects and system malfunctions may occur. In the final analysis, the distance to other measuring systems also depends on their range of coverage and signal strength.

13.1.3.3. Mounting the Sensor

Mounting

1. Remove the covers from the bores on the let side of the airpointer® .
2. Screw the holders included in delivery into the bores on the left side of the airpointer® .
3. Thread the cable of the sensor through the delivered tube.
4. Mount the sensors form Vaisala or Gill with three screws at the top of the tube (Figure 13.5 and Figure 13.17,respectively).

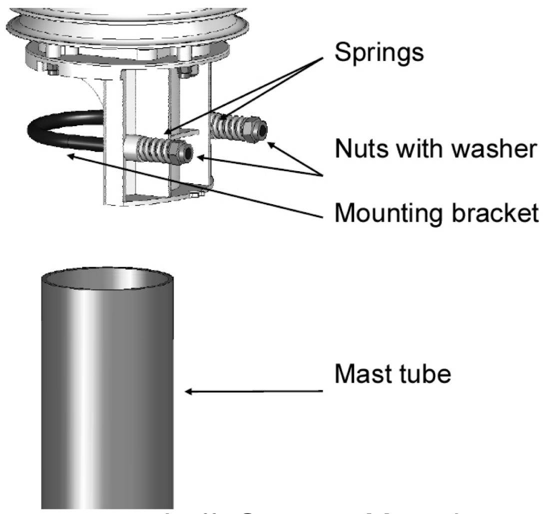


Figure 13.6.: Lufft Sensor: Mounting and North Alignment

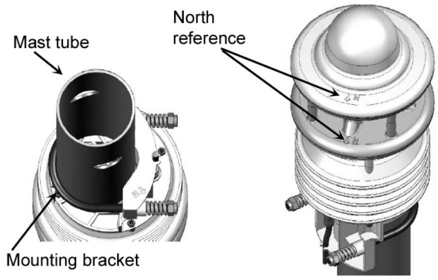


Figure 13.7.

5. Push the senor from Lufft onto the top of the mast from above. Tighten the nuts evenly until contact is made with the springs but the senor can still be moved easily (see Figure 13.6)

Figure 13.5.: Fixing Screws of the Vaisala Sensor

6. Mount the tube with the wind sensor on the left side of the airpointer® . It is fixed with two collars (see Figure 13.3). Turn the tube so that the north mark of the sensor points north (Figures 13.8 and 13.9 show the north mark of the sensors). At the Lufft sensor - align it to the North (north mark are on the top of the sensor. See Figure 13.7) and tighten both nuts with 3 revolutions.

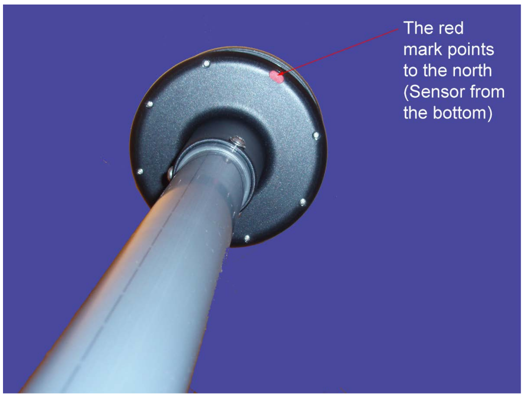


Figure 13.8.: North mark on the Gill sensor: The red point on the bottom side points north

Figure 13.9.: North mark on the Vaisala sensor: The arrow on the bottom of the sensor points north

NOTE
For measuring the wind direction in an accurate way the sensor has to be aligned exactly to point north! A north mark is indicated on the sensor.

NOTE
As the magnetic North Pole indicated by the compass differs from the Geographic North Pole, account must be taken of the declination (variation) at the location when aligning the sensor. Depending on the location, the variation can be more than 15° (in North America for example). In Central Europe the variation can be largely ignored at present (< 3°). You can find further helpful information on this subject on the Internet.

7. Open the cable gland of the airpointer® (2 screws at the bottom of the housing (see Figure 13.10)). Then open the strain relief.

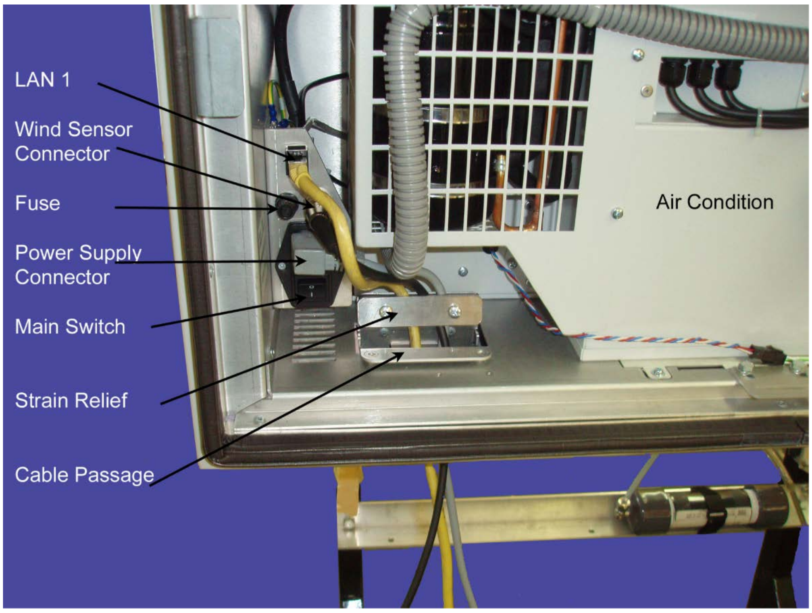


Figure 13.10.: Strain relief and position of the wind sensor connector and of the main switch at the bottom left of the airpointer®

8. Pull the cable of the wind sensor through the cable gland and the strain relief in the same way as the power supply.
9. Connect the cable of the wind sensor with the respective connector above the main switch (see Figure 13.10)
10. Close the strain relief and the cable gland (expanded rubber and panel).
11. To power up the airpointer® press the main switch (see Figure 13.10).
12. Let the airpointer® run in. The wind sensor takes 10 minutes till its measurement is stable.
13. Close the main door of the airpointer® .

CAUTION:

By closing the main door take care that the cables are not crimped. Use the cable gland.

13.1.4. Installation on the User Interface

If the meteorological sensor has been ordered initially, the sensor will already be installed and all internal connections made. Just the mast with the sensor has to be mounted and installed as described in the previous section. You may now start with the measurement.

> **NOTE**
> **If the wind sensor was ordered with the initial order the sensor is now working and the measurement data will be stored.**

As soon as the airpointer® is in operation mode, the measurement data are stored. You find the setup of your wind sensor in the User Interface under 'Setup' ↠ 'LinLog' ↠ 'LinLog Configuration' (User Manual chapter 7.7.6). Click the selected sensor 'Edit Settings'. Now the parameters of the sensor are listed. Changes are just taken over if one clicks 'Submit Parameter'. If you do not want to change anything you can go back by clicking 'Back'. The changes in LinLog take effect after a restart or a click on 'execute' in the User Interface in 'Setup' ↠ 'System Maintenance' ↠ 'Service Manager' ↠ 'Sensor/Logger Software'.

> **NOTE**
> **The changes in LinLog take effect after a restart or one click 'execute' in the User Interface in 'Setup' ↠ 'System Maintenance' ↠ 'Service Manager' ↠ 'Sensor/Logger Software'.**

13.1.4.0.1. Wind Sensor Subsequently Ordered :
After the mounting the mast and the sensor, the sensor has to be installed in the User Interface in the following way:

Connecting the Software

1. Go to the User Interface of the airpointer® on your computer.
2. Go to 'User Interface' ↠ 'Setup' ↠ 'LinLog' ↠ 'LinLog Configuration' (see also chapter 7.7.6) and select 'Add analyzer'.
3. Select 'Vaisala' on the list in the second line and 'WXT510' from the list in the third line. Afterwards confirm the selection by clicking 'submit'.
4. Now select the COM Port 6 for meteorological sensor: Therefor go to 'Com Port Setup' and select COM6 as gateway. Click 'Finish!' to confirm the selection.
5. Submit the changes as following:
   In the User Interface, select 'Setup' ↠ 'System Maintenance' ↠ 'Service Manager' and click 'Execute' at 'Sensor/Logger Software'. All changes are valid now.

6. If you want to make further changes on the parameters of your sensor, please read chapter 'LinLog'. In the following section the most important parameters are described. The default represents the normal use.

13.1.4.1. Parameter Setup

The 'Parameter setup' is given under 'User Interface' → 'Setup' → 'LinLog' → 'LinLog Configuration' → 'edit Settings' (at the respective analyzer) → 'Parameter setup'. More details you will find in the manual in chapter 7.7.6 'LinLog'. For the parameter setup of the wind sensor one has to consider the following:

1. The 'value for calms' (Figures 13.11 and 13.12): Depending on the sensitivity of the wind senor or because of legal declarations it can be necessary to set a lower limit for wind speed measurements: 'value for calms'. Wind speed values below the selected limit are set to zero with the wind direction being left undefined.
   The default value is set to 0.5 m/s. With an ultrasonic transducer (like in the Vaisala

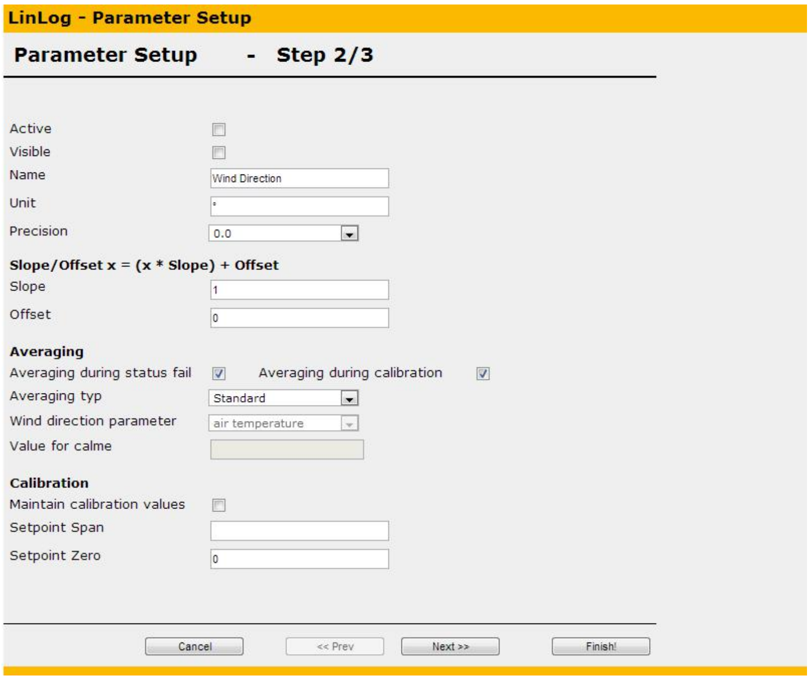


Figure 13.11.: Wind Speed, Averaging, Calms

   and the Gill sensor) it may be reasonable to set this value to zero.

2. For 'averaging' of wind speed and direction the average must be calculated with 'wind speed vector' and 'wind dir vector', respectively. Else measurements around 0° and 360° will lead to wrong averaging. 0° represents north wind.

3. Rain sensor: By measuring the amount of rain the signal rises continuously till a reset sets the value to zero. The signal differences are summed up. In analog sensors with analog output there is always noise. This noise results in a signal difference

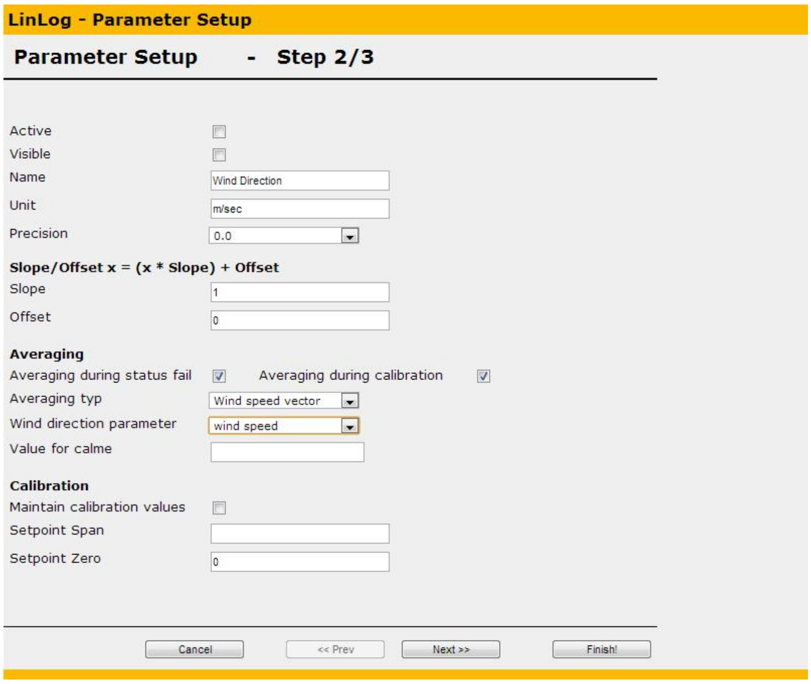


Figure 13.12.: Wind Direction, Averaging, Calms

with the reset and therefor in an incorrect precipitation. Here, a lower limit (threshold) for precipitation (in mm) can be set (Figure 13.13) on the next page (Parameter Setup Step 3/3). For example, a signal difference lower than 1mm can be interpreted as noise and not as precipitation. The interpretation of the measurement values is shown in Figure 13.14.

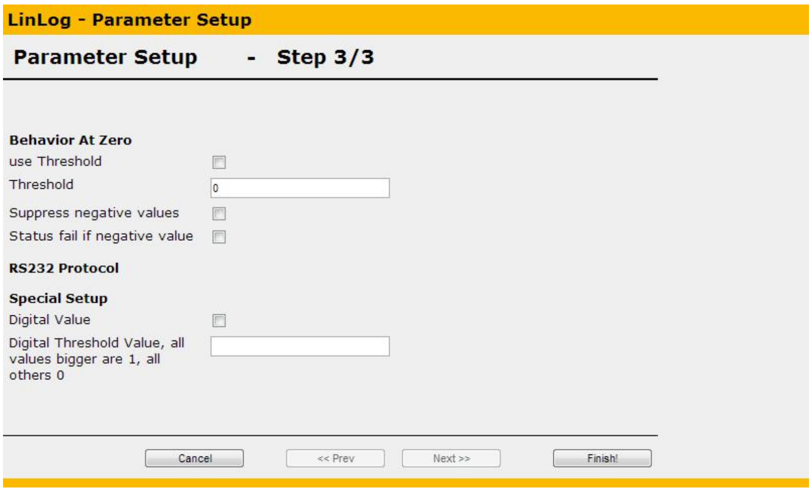


Figure 13.13.: Threshold, suppress Negative Values

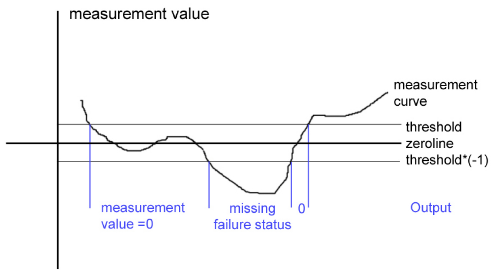


Figure 13.14.: Measurement Curve with Threshold

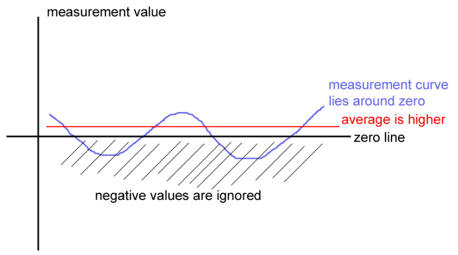


Figure 13.15.: Measurement Curve with Suppressed Negative Values

4. It is recommended to NOT select 'suppress negative values'. Suppressed negative values will lead to shifted average values around zero (see Figure 13.15).

> **NOTE**
> **It is recommended to NOT select 'suppress negative values'. Suppressed negative values will result in shifted average values about zero (see Figure 13.15).**

13.1.5. Cleaning

Please pay attention that the device is clean. If nescessary, the sensor has to be cleaned from the outside (the time schedule is depending on the environmental conditions). Use a soft cloth, water, and a soft detergent, if it is necessary. Solvents should not be used, and care should be taken to avoid scratching the surface. The sensor must be allowed to defrost naturally after being exposed to snow or icy conditions, do NOT attempt to remove ice or snow with a tool. Remove leaves and similar things.

> **NOTE**
> **If a Gill sensor is used, do NOT remove the black 'rubber' transducer caps.**

> **NOTE**
> **Be extremely careful when cleaning the wind sensors. They must not be rubbed or bended.**

13.1.6. Lufft Sensor

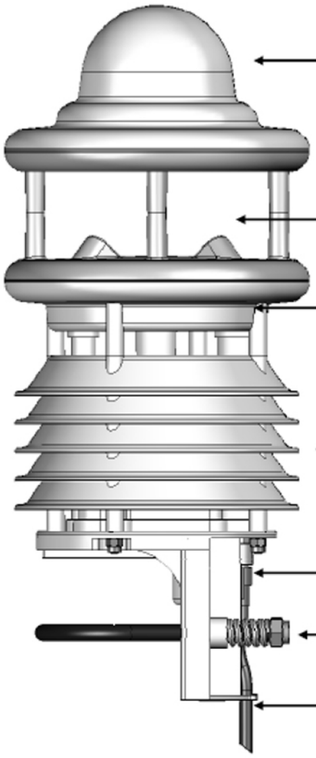


Figure 13.16.: Scheme of the Lufft Sensor WS600

13.1.6.1. Principle of Operation

13.1.6.1.1. Air Temperature and Humidity Temperature is measured by way of a highly accurate NTC-resistor while humidity is measured using a capacitive humidity sensor. In order to keep the effects of external influences (e.g. solar radiation) as low as possible, these sensors are located in a ventilated housing with radiation protection. In contrast to conventional non-ventilated sensors, this allows significantly more accurate measurement during high radiation conditions. Additional variables such as dewpoint, absolute humidity and mixing ratio are calculated from air temperature and relative humidity, taking account of air pressure.

13.1.6.1.2. Air Pressure Absolute air pressure is measured by way of a built-in sensor (MEMS). The relative air pressure referenced to sea level is calculated using the barometric formula with the aid of the local altitude, which is user-configurable on the equipment.

13.1.6.1.3. Precipitation Tried and tested radar technology from the R2S-UMB sensor is used to measure precipitation. The precipitation sensor works with a 24GHz Doppler radar, which measures the drop speed and calculates precipitation quantity and type by correlating drop size and speed.

13.1.6.1.4. Wind The wind meter uses 4 ultrasound sensors which take cyclical measurements in all directions. The resulting wind speed and direction are calculated from the measured run-time sound differential.

13.1.6.1.5. Compass The integrated electronical compass (only device version 023 or higher) can be used to check the north-south adjustment of the sensor housing for wind direction measurement. It is also used to calculate the compass corrected wind direction.

13.1.6.1.6. Heating The precipitation sensor and wind meter are heated for operation in winter.

NOTE
The heating is designed for ambient temperatures down to -10°C, below -10°C the function can not be ensured under all conditions.

13.1.6.2. Calibration and Maintenance

13.1.6.2.1. Calibration:
An annual calibration check by the manufacturer is recommended for the humidity sensor (not on WS200-UMB). It is not possible to remove or replace the humidity sensor. The complete compact weather station must be sent to the manufacturer for testing.

13.1.6.2.2. Maintenance:
In principle the equipment is maintenance-free. However, it is recommended to carry out a functional test on an annual basis. When doing so, pay attention to the following points:

- Visual inspection of the equipment for soiling
- Check the sensors by carrying out a measurement request
- Check the operation of the fan (not on WS200-UMB)

13.1.7. Gill Wind Sensor

13.1.7.1. Calibration

13.1.7.2. Principle of Operation

The wind sensor from Gill has two pairs of ultrasonic transducers which are located normally to each other. The sensor measures the time taken for a ultrasonic pulse to travel from the North transducer to the South transducer, and compares it with the time for a pulse to travel from South to North transducer. Likewise, times are compared between West and East and East and West transducer. The wind speed and direction can then be calculated from differences in times of flight on each axis. The calculation is independent of factors such as temperature.

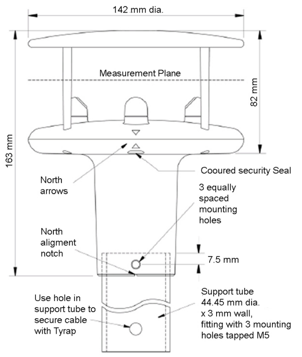


Figure 13.17.: Gill Sensor: Size and Compass Points

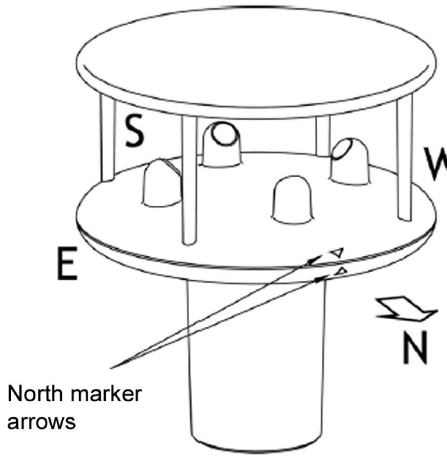


Figure 13.18.: Gill Sensor with Compass Points

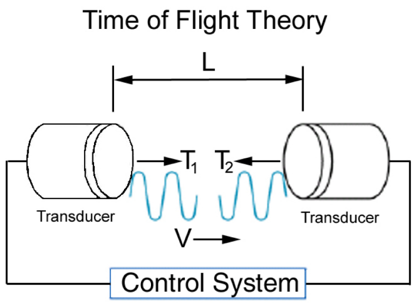
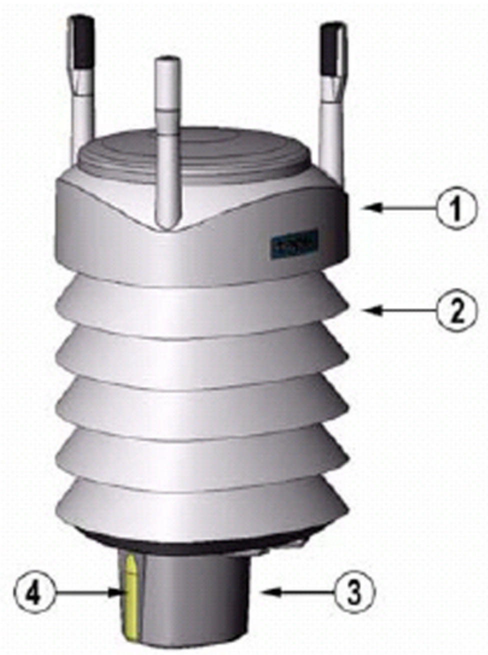


Figure 13.19.: Gill Sensor - Principle of Operation

13.1.7.3. Calibration

There is no calibration necessary as long as the sensor is not disassembled. If the sensor has been disassembled, the sensor will have to be send in. Do NOT remove the black "‘rubber"’ cups from the transducers.

13.1.8. Vaisala Precipitation Sensor



1 Top of the transmitter
2 Radiation shield
3 Bottom of the transmitter
4 Screw cover (before mounting they have to be removed)

Figure 13.20.: Exterior view of the Vaisala sensor

The weather transmitter is a small and lightweight transmitter that offers six weather parameters in one compact package. It measures wind speed and direction, precipitation (rain and hail), temperature, atmospheric pressure, and relative humidity. The last three are packed together in the PTU module and are located inside the sensor.

13.1.8.1. Wind Speed and Direction - Principle of Operation

The wind sensor has an array of three equally spaced ultrasonic transducers on a horizontal plane. Wind speed and wind directions are determined by measuring the time it takes the ultrasonic to travel from each transducer to the other two.

The wind sensor measures the transit time (in both directions) along the three paths established by the array of transducers. This transit time depends on the wind speed along the ultrasonic path. For zero wind speed, both the forward and the reverse transit times are the same. With wind along the south path, the up-wind direction transit time increases and the down-wind transit time decreases.

The wind speed is calculated from the measured transit times using following formula:

$$v_w = 0.5 \text{x} L \text{x} (\frac{1}{t_f} - \frac{1}{t_r}) \quad (13.1)$$

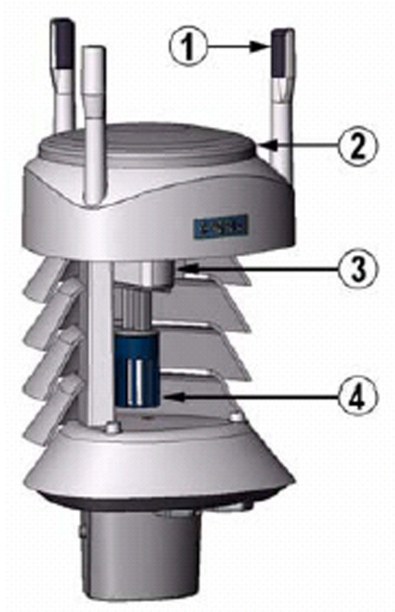


Figure 13.21.: Exterior view of the Vaisala sensor without outer shell

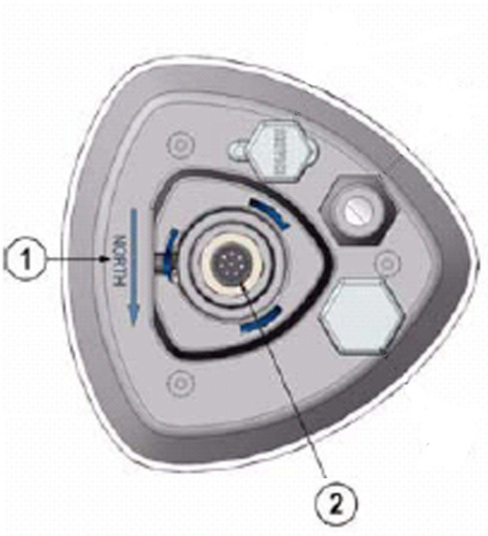


Figure 13.22.: Bottom view of the Vaisala sensor

where: v_w ... Wind speed in measurement direction
L ... Distance between the two transducers
t_f ... Transit time in forward direction
t_r ... Transit time in reverse direction

Measuring the six transit times allows v_w to be computed for each of the three ultrasonic paths. The computed wind speeds are independent of altitude, temperature, and humidity, which are canceled out when the transit measurement times are measured in both directions, although the individual transit times depend on theses parameters.
Using v_w values of two array paths is enough to compute wind speed and wind direction. A signal processing technique is used so that wind speed and wind direction are calculated from the two array paths of best quality.

NOTE
Wind speed and wind direction will NOT be calculated if the wind speed is below 0.05m/s.

13.1.8.2. Precipitation - Principle of Operation

The precipitation sensor comprises of a steel cover and a piezoelectric sensor mounted an the bottom surface to the cover. The precipitation sensor detects the impact of individual raindrops. The impact signal is proportional to the volume of the drops. Hence, the signal of each drop can be converted directly to accumulated rainfall. Advanced noise filtering technique is used to filter out signals originating from other sources than raindrops.
The measured parameters are accumulated rainfall, rain current and peak intensity, and the duration of the rain event. Detection of each individual drop enables computing of rain amount and intensity with high resolution.
The sensor is capable of distinguishing hail from raindrops. The measured hail parameters are cumulative amount of hails, current, and peak hail intensity, and the duration of a hail shower.

NOTE
Snow can not be measured.

13.1.8.3. PTU - Principle of Operation

The PTU module contains separate sensors for pressure, temperature, and humidity measurement.
The principle of operation of the pressure, temperature, and humidity sensors is based on an advanced RC oscillator and two reference capacitors against which the capacitance of

the sensors is continuously measured. The microprocessor of the transmitter compensates for the temperature dependency of the pressure and humidity sensors.
The PTU module includes a capacitive silicon BAROCAP® sensor for pressure measurement, a capacitive ceramic THERMOCAP® sensor for air temperature measurement, and a capacitive thin film polymer HUMICAP® 180 sensor for humidity measurement.

13.1.8.4. Calibration

The sensor has to be sent in for calibration.

13.1.8.5. Replacing the PTU Module

1. Turn off the power.

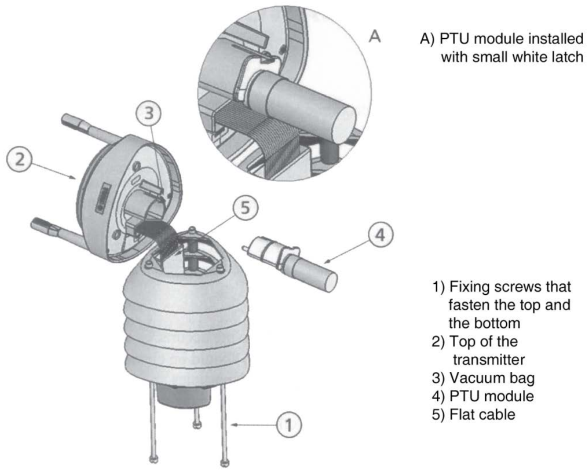


Figure 13.23.: Scheme of the open Vaisala sensor

2. Loosen the three fixing screws at the sensor bottom assembly.
3. Pull off the transmitter top.
4. Release the small white latch (see Figure 13.34) and remove the PTU module. Remove the vacuum bag protecting the PTU module.
5. Connect the new PTU module.

> **NOTE**
> **Avoid contacting the white filter cap with your hands while inserting the PTU module.**

6. Replace the top and tighten the three fixing crews that fasten the top to the bottom.

NOTE
When reattaching the top, make sure that the flat cable does not get stuck or squeezed between the top and the funnel for the flat cable.

13.1.9. Troubleshooting

Wind measurement failure	Check the fuse. It is located on the right side of the power supply below the black cap (Figure 13.10).
Wind direction failure	Check if the sensor is aligned to north.
Wind measurement failure	Check if there is a blockage between the wind transducers (trash, leaves, branches..) and remove it.
Pressure, relative humidity and temperature failure	Check if the PTU module (Vaisala) is connected properly and if there is no water in the PTU module.
Error during wind measurement (Lufft)	• The device is being operated well above the limit of the ambient conditions • Very strong horizontal wind or snow • The wind meter sensors are very dirty • The wind meter sensors are iced over → check the heating funcion • There could be foreign objects within the measuring section of the wind meter • One of the wind meter's sensors is faulty
Measurement temperature appears too high/measured humidity appears too low	Check the operation of the fan on the underside of the device.

Table 13.1.: Troubleshooting

User Notes

13.2. Temperature, Relative Humidity, Pressure, and CO_2 Sensor

13.2.1. Small Size Ambient Temperature and Relative Humidity Sensor

This sensor is a compact transmitter for relative humidity and ambient temperature. The sensor is delivered with a radiation shield.

Figure 13.24.: Sensor w/o radiation shield

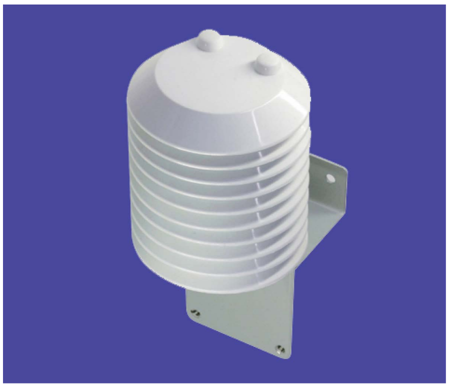


Figure 13.25.: Sensor with radiation shield

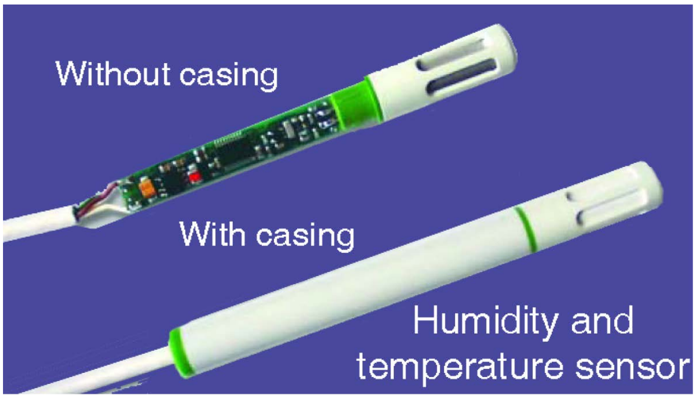
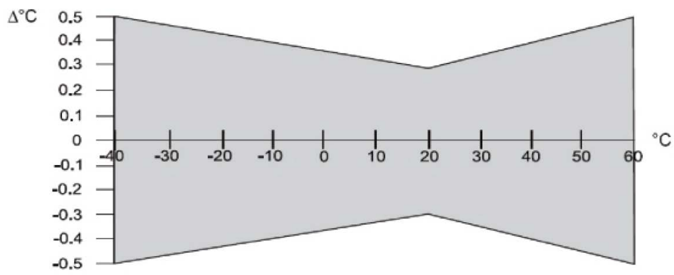


Figure 13.26.: Interior view of the sensor

The main features of the senor are small size and low power consumption. Further features are listed in specifications.

NOTE
If you want to connect a new sensor with your airpointer® please contact recordum® . The connector is configured specially.

13.2.1.1. Specifications

Relative humidity	
Operating range	0...100% RH
Accuracy at 20°C, 12V DC	±3% RH (10...90% RH), ±5% RH (<10% RH and >90% RH)
Temperature dependence	d.RH = -0,00035 x RH x (T-20°C)
Long term stability at 20-30°C, 20-80% RH	1% per annum
Output appropriate 0...100% RH	0-1V $-0.2\text{mA} < I_L < 0.2\text{mA}$
Temperature	
Sensor	Pt1000 (Tolerance class A, DIN EN 60751)
Output appropriate -40...60°C	0-1V $-0.2\text{mA} < I_L < 0.2\text{mA}$
Accuracy at 12V DC	
Temperature range Operating temperature	-40...+60°C
Storage temperature	-40...+65°C
Features	
Supply voltage	4.5V DC - 30V DC
Current consumption	Typically 1.5mA
Housing	Polycarbonate / IP65 in vertical mounting (filter cup upside)
Humidity sensor	Connection leads phosphor bronze with tin/lead coating
Sensor protection	Membran filter
Electromagnetic compatibility	EN 61000-6-3, EN 61000-6-1

13.2.1.2. Installation and Measurement

Sensor with radiation shield is screwed on top of the airpointer® with four M10 screws. Combine the respective connectors (Figure 13.27 and 13.28). Software comes preinstalled on the delivered system. As soon as the airpointer® is ready, measurement takes place and the values are stored. In the User Interface the RH-sensor is listed under 'Setup' ↠'Configuration'. Here you can modify the configuration of the sensor. In the 'Setup' ↠'LinSens Service Interface' and under 'Graph' the current measurement can be observed. If you want to **deactivate the sensor**, select 'Setup' ↠'Configuration' ↠'Sensors' and click 'RH Temp' ↠'Off'. Afterwards the User Interface has to be restarted by selecting 'Setup' ↠'System Maintenance' ↠'Service Manager' and clicking 'Sensor/Logger Software' ↠'Execute'.

Most of the time the airpointer® can be updated with this sensor. For further details please contact your distributor or recordum® directly.

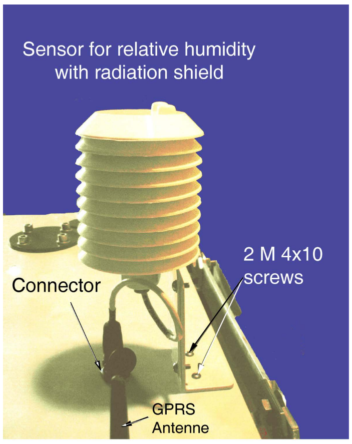


Figure 13.27.: Side View of the mounted sensor

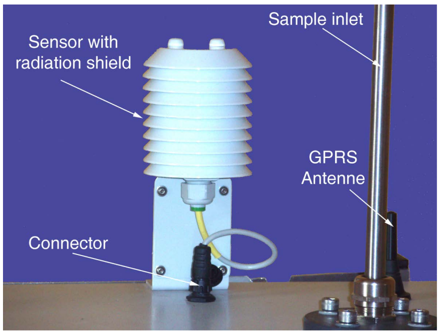


Figure 13.28.: Front view of the mounted sensor

13.2.1.3. Maintenance

13.2.1.3.1. Changing the Sensor

> **NOTE**
> **Please order a new sensor from recordum® . The connector has to be configured specially for the airpointer® .**

Changing the sensor

1. Turn off the airpointer® and disconnect it (chapter 5.8).
2. Unlock the connector and the two 4x10 screws (Figure 13.27).
3. Loosen the attachment screws (Figure 13.28) and pull the sensor carefully out of the radiation shield.
4. Slide the new sensor in and tighten the attachment screws.
5. Reattach the sensor to the roof of the airpointer® and lock the connection. Restart the airpointer® .

13.2.1.3.2. Cleaning the Sensor

> **NOTE**
> **Do not touch or rub the sensor surface.**

Cleaning the sensor

1. Turn off the airpointer® and disconnect it (chapter 5.8).
2. Unlock the connector and the two screws (Figure 13.27).
3. Loosen the attachment screws (Figure 13.28) and pull the sensor carefully out of the radiation shield.
4. The humidity sensor can be cleaned by rotating it in pure isoproyl alcohol, industrial grade. Do not touch or rub the sensor surface. After cleaning with isopropyl alcohol, immerse it in water and let it dry.
5. Slide the cleaned sensor in and tighten the attachment screws.
6. Reattach the sensor to the roof of the airpointer® and close the connection. Restart the airpointer® .

13.2.1.4. Calibration

For calibration the sensor has to be sent in.

13.2.2. Indoor Sensor for CO_2, Relative Humidity and Temperature

This sensor combines CO_2, relative humidity (RH) and temperature (T) measurement in one modern and user-friendly housing. The CO_2 measurement is based on the infrared principle. A patented auto-calibration procedure compensates for the aging of the infrared source and ensures outstanding long term stability.

NOTE **Mechanical load and incorrect handling can damage the sensor.**

13.2.2.1. Specifications 1

Measurement values	
CO_2	
Principle of operation	Non-dispersive infrared technology (NDIR)
Sensor	Dual source infrared system
Operating range	0...2000ppm
Accuracy at 20°C and 1013 mbar	0...2000ppm: $< \pm$(50ppm +2% of measuring value)
Response time t_{63}	$<$ 90 sec.
Temperature dependence	Typically 2ppm CO_2/°C
Long term stability	Typically 20ppm/a
Sample rate	Approx. 0,5 min
Relative humidity	
Principle of Operation	capacitive
Working range	10...90% RH
Accuracy at 20°C	±% RH (30...70% RH) ±5% (10...90% RH)
Temperature accuracy at 20°C	±0.3°C

13.2.2.2. Specifications 2

Analogue Outputs 0...2000/0...100% rF / 0...50°C	0 - 5V -1mA < I_L < 1mA
Switching Output Max. switching voltage	 50V AC / 60V DC
Max. switching load	1A at 50V AC and 1A at 30V DC
Min. switching load	1mA at 5V DC
Contact material	Ag+Au coated
General	
Supply voltage SELV	24V AC ±20% 15 - 35V DC
Power requirement	< 3 W
Warm-up time	< 5 min
Electromagnetic compatibility	EN 61000-6-3, EN61326-1+A1+A2:05.2002, EN 61000-6-1
Operating temperature range	0...90% RH (non condensing) / -5...55°C
Storage temperature range	0...90% RH (non condensing) / -20...60°C
Housing material	PC
Protection	IP20

13.2.2.3. Mounting

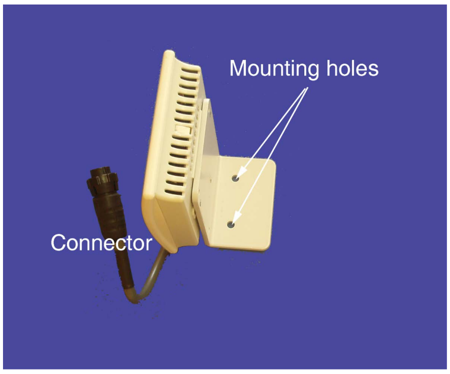


Figure 13.29.: The Sensor is Mounted in Upright Position.

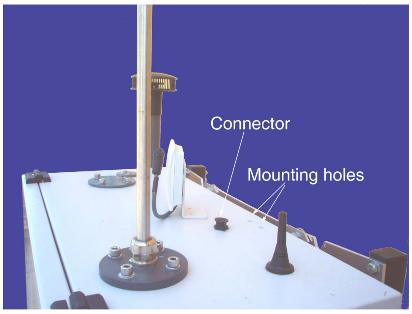


Figure 13.30.: The Sensor is Prepared for Roof Mounting.

If the sensor has been ordered initially, all parameters for measurement are already set. Mount the sensor with the delivered screws on top of the airpointer® (Figure 13.30). Plug in the connector. The software is already prepared for measurement.

≈ 40,000ppm	Proportion in exhaled human breath (20l CO_2/h)
5.000ppm	Limit of CO_2 concentration at the workplace
> 1,000ppm	Fatigue and reduced concentration
1,000ppm	Recommended CO_2 level of indoor air
400ppm	Fresh, natural ambient air

Table 13.2.: Guiding Values for CO_2 Concentration

As soon as the airpointer® is ready for operation, measurement values are stored. In the User Interface,the CO_2 Sensor is listed in EC Sensor Board 1 under 'Setup' ↠ 'Configuration'. Here one can change the configuration of the sensor. The measurement can be observed in the LinSens Service Interface or under 'Graph'. If the senor has to be deactivated, select 'Setup' ↠ 'Configuration' ↠ 'Sensors' in the User Interface and click 'EC SensorBoard 1' 'Off'. Afterwards, the User Interface has to be restarted: Select 'Setup' ↠ 'System Maintenance' ↠ 'Service Manager' and click 'Sensor/Logger Software' 'Execute'.

13.2.2.4. Principle of Operation

13.2.2.4.1. Motivation for CO_2 Measurement:

Carbon dioxide (CO_2) is a gaseous compound of the Earth's atmosphere. The concentration of CO_2 in ambient air is about 0.04% or 400ppm. With each breath, humans convert oxygen (O_2) into carbon dioxide. Although carbon dioxide is invisible and odourless, an increased CO_2-content will be apparent because humans will notice increased fatigue and reduced concentration. In rooms with high occupancy such as conference rooms and theaters, negative effects become all the more evident. Modern climate control can assure optimal air quality by adjusting the supply of fresh air based on the measurement of CO_2 concentration in the indoor air. The CO_2 concentration is regarded as a significant criterion of indoor air quality.

13.2.2.4.2. CO_2 Measurement:

CO_2 measurements are performed with a non-dispersive infrared (NDIR) absorption sensor. The NDIR sensor provides the following features:

- Less sensitive to pressure variations
- Less sensitive to vibrations and acoustic interference
- Auto-calibration
- Easy drift compensation with stable IR reference source

- Use of just one common IR filter
- Only one IR detector required
- Simple and reliable design

The CO_2 sensor uses a two-source two-beam procedure to detect a certain wavelength of the infrared light.
The two IR sources have distinct operation cycles.
One IR source operates to measure the CO_2 concentration and generates an IR signal every 30 seconds. The second IR source, the reference source, is used for auto-calibration only. This source is activated twice every 24h resulting in virtually no aging and therefore negligible drift. The almost drift-free signal of the reference source is used to offset potential drifts of the measuring source.

13.2.2.4.3. Humidity Measurement:

Air is a mixture of different gases. Under normal environmental conditions the gases have an ideal behaviour, i.e. each gas molecule can act independently from all others. Dalton's law is valid. The total pressure of a gas is the sum of the partial pressures:

$p[\mathrm{mbar, hPa}] = p_{N_2} + p_{O_2} + p_{Ar} + ...$

The partial pressure p is defined as the pressure of a gas, if it would occupy alone the whole volume of the gas mixture. Water in its gaseous phase (vapour) is also a component of air mixture. Under normal conditions it behaves like an ideal gas. With Dalton's law p becomes:

$p[\mathrm{mbar, hPa}] = p_{N_2} + p_{O_2} + p_{Ar} + ... + e$
or $p[\mathrm{mbar, hPa}] = p_{da} + e$
e.... partial pressure of (water) vapour
p_{da}...... partial pressure of dry air

The concentration of water vapour in air is limited. There is a maximum partial pressure of vapour which depends on temperature. Air at high temperature can take more vapour than at low temperature. For equilibrium at temperature T the vapour concentration (or partial water pressure e, or number of water molecules per m^3) is the maximum concentration which can exist at this temperature and cannot be exceeded. A higher concentration would lead to condensation, after a short time the former balance would be regained. This vapour concentration is called saturated concentration or in terms of partial pressure saturation vapour pressure above water e_{ws} at temperature T. The saturation pressure above water e_{ws} has an exponential dependence on T. It is (except small corrections) independent of the air pressure above the water surface.

Relative Humidity RH [% RH]:
The saturation vapour pressures are a function of temperature. These values are maximum values and cannot be exceeded. Usually, the partial vapour pressure is lower. Relative humidity RH is defined as the ratio between the current partial vapour pressure e and the saturation vapour pressure above water e_{ws}:
RH = $(e/e_{ws}) * 100$ [%RH]

13.2.2.5. Maintenance

13.2.2.5.1. Opening the Housing

Press pin A until cover can be opened (Figure 13.32).

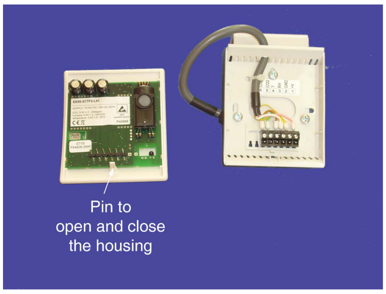


Figure 13.31.: Opened Sensor

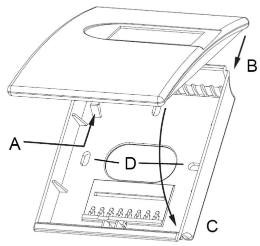


Figure 13.32.: Dimensions 85x100x26mm (WxHxD)

13.2.2.5.2. Closing the Housing:

Attach the cover to notch B and move it towards C (Figure 13.32) until pin A snaps into place.

13.2.2.6. Calibration

Due to its reliability and long time stability, under normal operation conditions the relative humidity and temperature sensor do not require any maintenance. For use in a high polluted environment, the filter cap shall be replaced periodically with a new original one.
For high accuracy requirements under extreme humidity and temperature operating conditions, the transmitters can be recalibrated periodically. For recalibration the sensor has to be sent in. The graph in Figure 13.2.2.6 shall be used as a guideline for the recalibration interval.

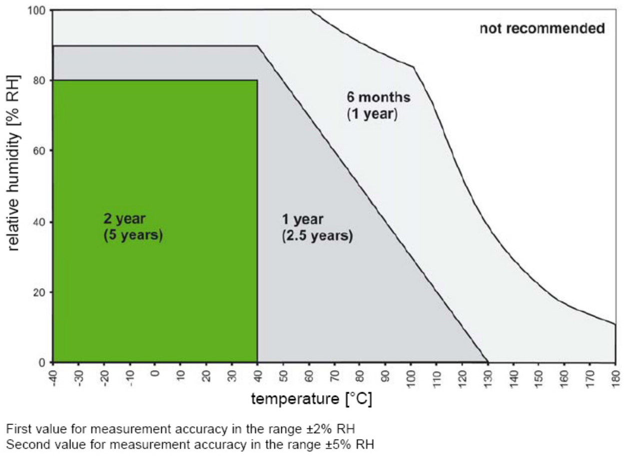


Figure 13.33.: Recalibration Interval for Humidity Sensor

13.2.3. Ambient Air Pressure Sensor

The ambient air pressure inside and outside the airpointer® is identical. Therefore, the ambient air pressure sensor is located inside the airpointer® . The ambient air pressure sensor is an additional pressure sensor which is located behind the pump pressure sensor. It is mounted in double-layer method. The sensor is connected to the valve board behind the zero air canister. This valve board is available in the airpointer® of the second generation if there is a particulate matter module, a VOC module, or a ambient air pressure sensor installed.

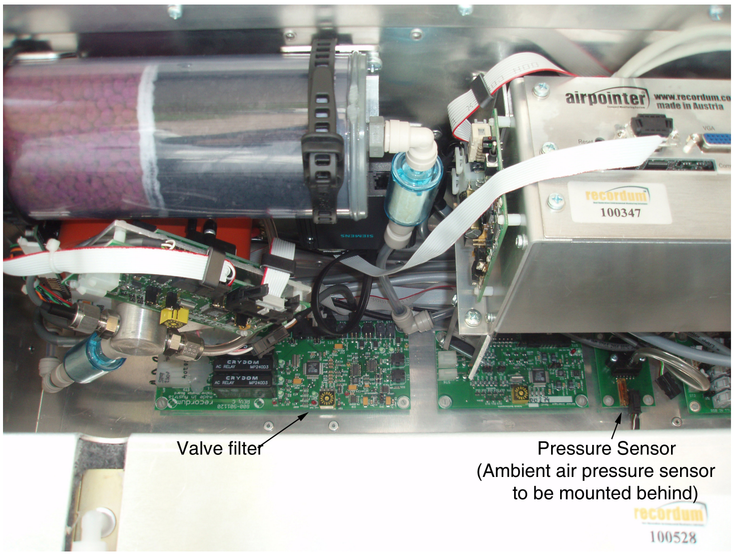


Figure 13.34.: Localization of the ambient air pressure sensor (behind the pump pressure sensor, not figured)

If the ambient air pressure sensor has been ordered initially, all installations have already been performed and the ambient pressure will be measured as soon as the airpointer® is ready for operation. The pressure sensor (Amb Press SysSensor) is listed in the User Interface under 'Setup' ↠'Configuration'. Here the configuration of the sensor can be changed. The measurement can be observed when selecting 'Calibration' ↠'Live Display' or in the LinSens Service Interface. If the sensor has to be deactivated, select 'Setup' ↠'Sensors' - 'Configuration' ↠'Sensors' and click 'Amb Press SysSensor' 'Off'. Afterwards, the User Interface has to be restarted. Therefore, go to 'Setup' ↠'System Maintenance' ↠'Service Manager', and click 'Sensor/Logger Software' 'Execute'.

If the sensor war ordered later, the hardware has to be installed and the software has to be activated (to do so, select 'Setup' ↠'Sensors' ↠'Configuration' ↠'Sensors', and click 'Amb Press SysSensor' 'On'). For hardware installation and any other questions, please contact the service personnel of recordum® .

13.3. Users Note

14. Particulate Matter (PM) Module

A number of studies have shown short term cardiovascular effects related to PM, a direct relation between the number of heart attacks and the PM-concentration has been proven. Long term effects are caused by the toxicity of the particles itself, their potential to carry and hold toxic compounds in the respiration system and irritation of the immune system due to their continuance deep in lungs and bronchial tubes. PM10 and PM2.5 are not a single compound but the mass concentration of all particles smaller than 10μm (PM10) or 2.5μm (PM2.5), respectively, in diameter suspended in the ambient air. Especially in areas with high traffic related pollution the threshold values for these pollutants are frequently exceeded, thus making these pollutants of major public interest. The PM module of the airpointer® uses a well proven optical method, the nephelometry. It uses a light-scattering photometer with a near-IR LED, a silicon detector hybrid preamplifier and a source reference detector. A sample heater minimizes humidity effects. The light scattered is proportional to the particle concentration. This is a fast particle concentration measurement with high precision and very low detection limit. There might be a dependency on particle properties for the calculation of the mass concentration. For switching from TSP to PM10 to PM2.5 measurements, you simply have to change the optional available size selective sampling head.

Sources: WHO Regional Publications, European Series, No. 91, "'Air quality guidelines for Europe"', 2nd edition, 2000;
GESTIS Stoffdatenbank (http://www.hvbg.de/d/bia/fac/stoffdb/index.html); U.S. Environmental Protection Agency (www.epa.gov)

14.1. Key Features

The PM Module comprises the following key features:

- High sensitivity
- Excellent linear response
- Very fast response characteristic
- Mitigation of aerosol artifacts
- Long-life optics and detectors

For further questions please contact the service personal of your distributor.

14.2. Specifications

Principle of Operation	Nephelometry
Ranges	dynamic, up to 2500 μg/m3
Lower Detectable Limit	< 1 μg/m3
Zero Drift (24 hours)	< 1 μg/m3
Span Drift (24 hour):	+/-1% of reading
Response Time	$<$ 60 seconds
Precision	1 μg/m3
Sample Flow Rate	2 l/min

14.3. Sample Flow

Ambient air enters the airpointer® through the sample inlet of the PM module. In the basic equipment it is roofed with a TSP head. If you want to measure PM2.5 or PM10, exchange the TSP head for the respective sampling head. PM10 and PM2.5 sampling heads are optionally available. The sample size selection takes place in the sample head. The sample inlet tube is heated up to 50°C to reduce humidity. Below the sample inlet tube the nephelometer is located inside the airpointer® . In the nephelometer light is scattered on the particles. Temperature and pressure are measured as well. Then the sample is drawn through a DFU filter and a capillary. The sample exits the airpointer® via the pump.

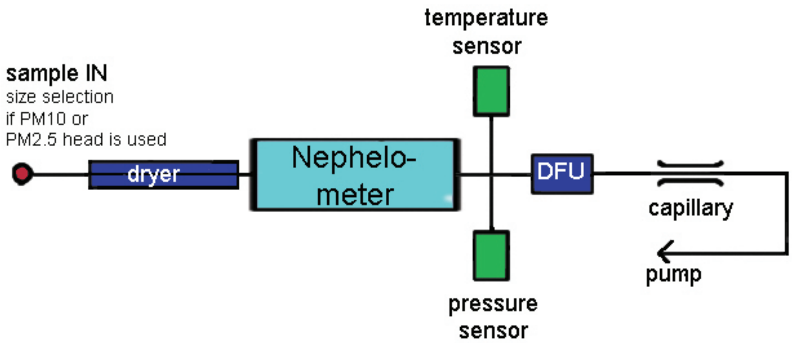


Figure 14.1.: Flow Diagram of the PM Module

The sample flow through the nephelometer is about 2 l/min.

14.4. Mounting the PM Module

If the PM module has been ordered with the initial order of the airpointer® , the PM module is already installed and all internal connections have been made. Just the sample inlet tube and head have to be installed.
In most cases a subsequent installation of the PM module is possible. Please ask your distributor for more information.

14.4.1. Mounting the Sample Inlet

Mounting

1. Unpack the delivered sample inlet tube including the heater, the thermal insulation, and the sampling head. In Figures 14.12, 14.13, and 14.14 three available sampling heads are shown.

2. At first, the impactor plates of the PM10 and PM2.5 sampling heads have to be filled with fat (see 14.7).

3. Loosen the screw for the sample inlet. Push the sample inlet into its final position and fasten the screw until the sample inlet cannot be moved any more(Figure 14.2).

Figure 14.2.: Connector for the Sample Inlet on the Top of the airpointer®

4. Remove the cup. Connect the the plug. Hold the plug as shown in Figure 14.3. Note that the plug can be turned in two places. With a wrong turn, rain might seep into the airpointer® . Hand-tighten the connection only, otherwise the socket might be damaged.

NOTE
If you connect or disconnect the plug, hold tight the top part and only turn the lower part, else rain can seep into the airpointer® .

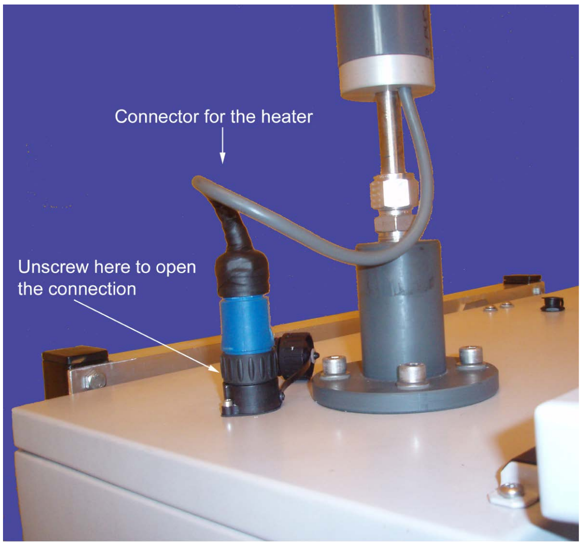


Figure 14.3.: Connect and Disconnect the Plug

NOTE
Take care that the O-rings are in place.

5. At the choosing of the installation site please pay attention to free and unobstructed airflow.

NOTE
Pay attention to free and unobstructed airflow when choosing the installation site.

6. To start the airpointer® , press the main switch (bottom left inside the airpointer® , see chapter 10 (Maintenance))

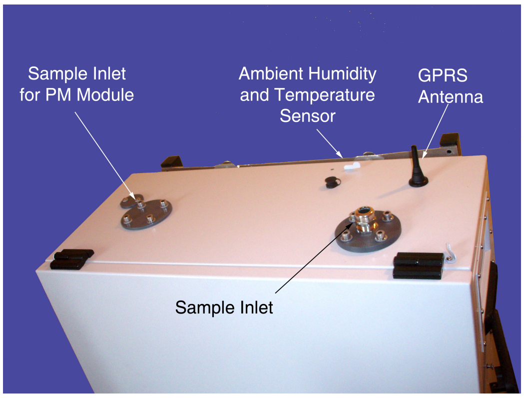


Figure 14.4.: Top View of the Housing without Sensors and Inlets

Figure 14.5.: Top View of the Housing with Sensors (On the left side: Sample Inlet of the PM Module with PM10 Sampling Head)

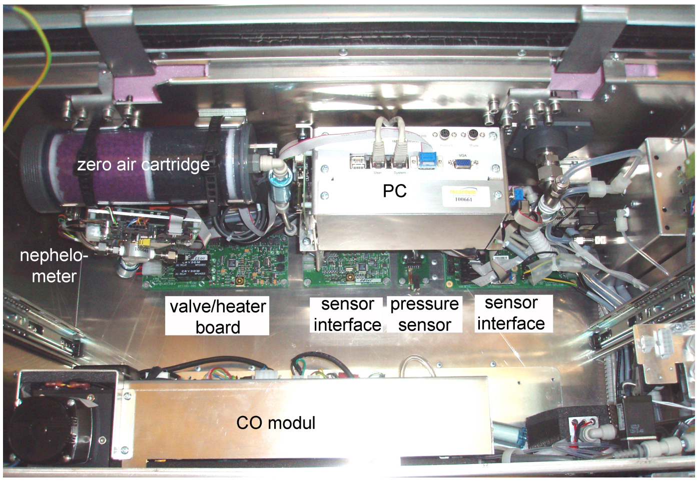


Figure 14.6.: Built-in Nephelometer

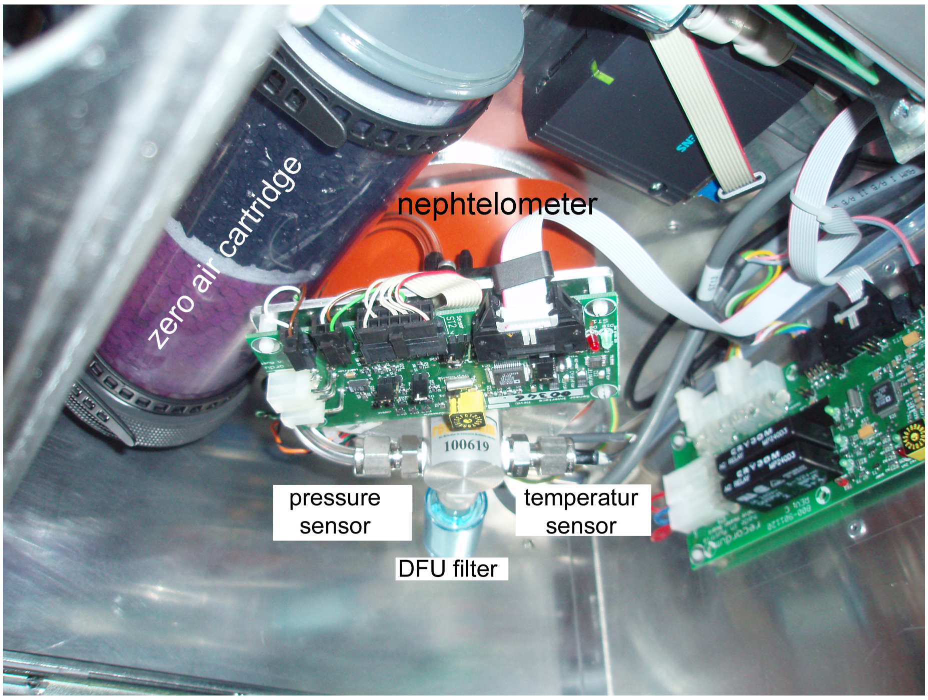


Figure 14.7.: The Position of the Nephelometer

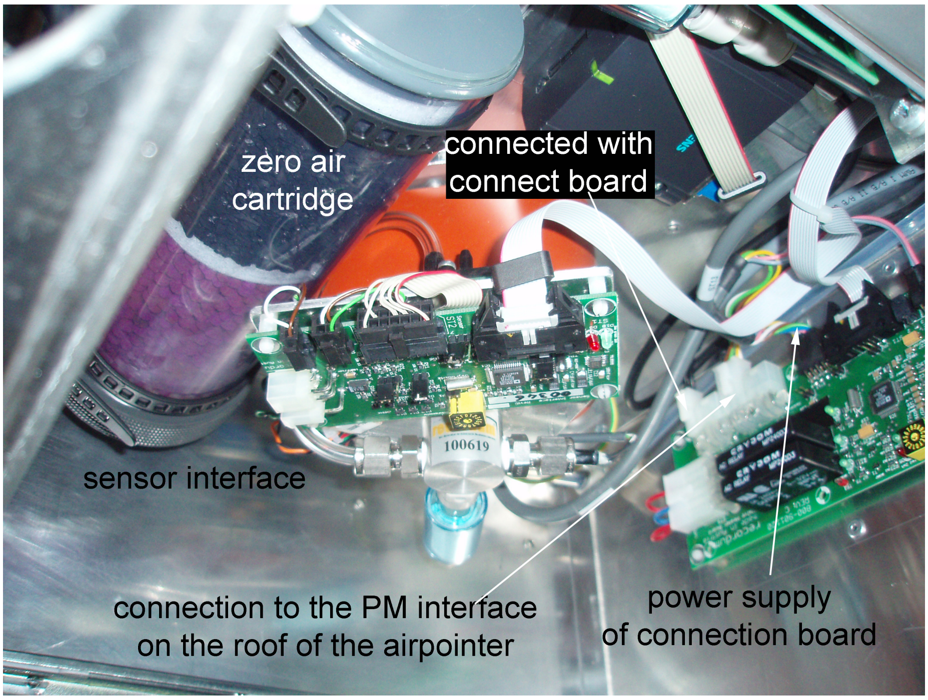


Figure 14.8.: Wiring of the Nephelometer

14.5. Principle of Operation: Nephelometry

The PM sensor of the PM module of the airpointer® is a nephelometer. With a nephelometer the PM concentration is measured due to scattering light. The particles will not be weighed. Therefore the measurement is indicative and is based on an optical method.

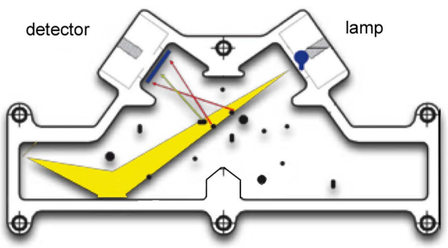


Figure 14.9.: Scheme of a Nephelometer

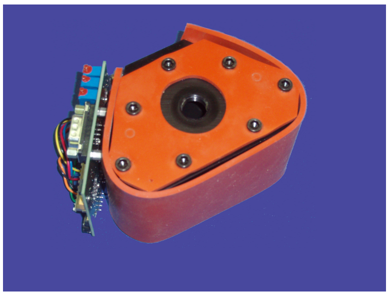


Figure 14.10.: Exterior View of a Nephelometer

A nephelometer consists of an aluminum block, a light-scattering photometer with a near-IR LED, a silicon detector, a hybrid preamplifier and a source reference detector. A sample heater minimizes humidity effects. The optical system measures the light scattering of the aerosols when they passing through the 880nm light beam. The light scattered is proportional to the particle concentration and independent of the sample rate. A continuous 1 minute average and a dynamic average value are measured. This is a fast particle concentration measurement with high precision and very low detection limit. There might be a dependency on particle properties for the calculation of the mass concentration. Additionally, temperature and pressure are measured.

The size selection takes place in the sample head. The sample inlet consists of the sample head, a heated tube (heated up to 50°C). Due to the heated tube the relative humidity (RH) is low. Therefore the particles do not agglomerate and do not contaminate the measurement cell. In the standard fitting, the PM module is equipped with a TSP head. To switch from TSP to PM10 or PM2.5 measurement you simply have to change to the respective size selective sample head.

14.6. Calibration

Because the PM measurement of the airpointer® is not a volume based measuring method, the exact sample rate is not important for the calibration. The flow calibration is necessary if a size selective precipitation should take place. Therefore, just a flow control and a calibration of the PM module are necessary.

The particle concentration is calculated as follows:

$$\text{Concentration} = \text{slope} * \text{measurement value} + \text{offset} \tag{14.1}$$

Calibration of the PM module

1. A flow control has to be performed as described in chapter 14.8.
2. The particulate sensor (PM sensor) measures under working conditions and not standard ones. Please check that in the 'User Interface' - 'Setup' - 'Sensors' - ' Configuration' - 'Particulate Sensor' 'PartToStandardCond [on/off] ' is set to 'Off' (see Figure 14.11).
3. For a two point calibration a zero point measurement and a measurement with known PM concentration is necessary.

> **NOTE**
> **Prior to the zero point calibration, switch to the maintenance mode: User Interface - 'Calibration' - 'Valve control' - 'Maintenance ON'.**

Zero Point Calibration

a) For zero point measurement put a zero air filter (e.g., two DFU filter connected in series) instead of the sample head on the sample inlet and measure the PM free air. Wait until the measurement is stable.

b) Enter the new offset in User Interface - 'Calibration' - 'Calibration' - 'zero gas calibration'- 'zero gas setpoint' or into 'User Interface' - 'Setup' - 'Sensors' - 'Configuration' - 'Particulate Sensor' - 'calibration factors' - 'PartOffset'.

c) Check if a new zero measurement value is zero, if not please repeat the procedure.

4. The second calibration point is obtained from measurement of a known source or from parallel measurement with a calibrated device. Take care that the same particle size is measured with both devices.

> **NOTE**
> **The parallel measurement should last at least 12-24 hours.**

For the second measurement value a PM load of $> 100\mu$g/m^3 is required. The parallel measurement should last at least 12-24 hours. The measurement can be observed via 'Live Display' or 'LinSens Service Interface'.

Measurement of Known Concentration

a) Perform a parallel measurement with a reference device or a transfer standard.

b) Calculate the correction factor f manually as follows:

$$\mathsf{f} = \text{measurement value (airpointer)}/\text{measurement value (reference)} \quad (14.2)$$

c) Calculate the new values for offset and slope as following:

$$\text{slope}_{\text{new}} = \frac{\text{slope}_{\text{old}}}{\mathsf{f}} \quad (14.3)$$

$$\text{offset}_{\text{new}} = \frac{\text{offset}_{\text{old}}}{\mathsf{f}} \quad (14.4)$$

d) Go to User Interface' - 'Setup' - 'Sensors' - 'Configuration' - 'Particulate Sensor' - 'calibration factors' 'PartOffset' and enter the new values into the respective boxes.

5. To finish the calibration switch back to normal measurement mode as follows: 'Calibration' - 'Valve control' click 'Maintenance OFF'.

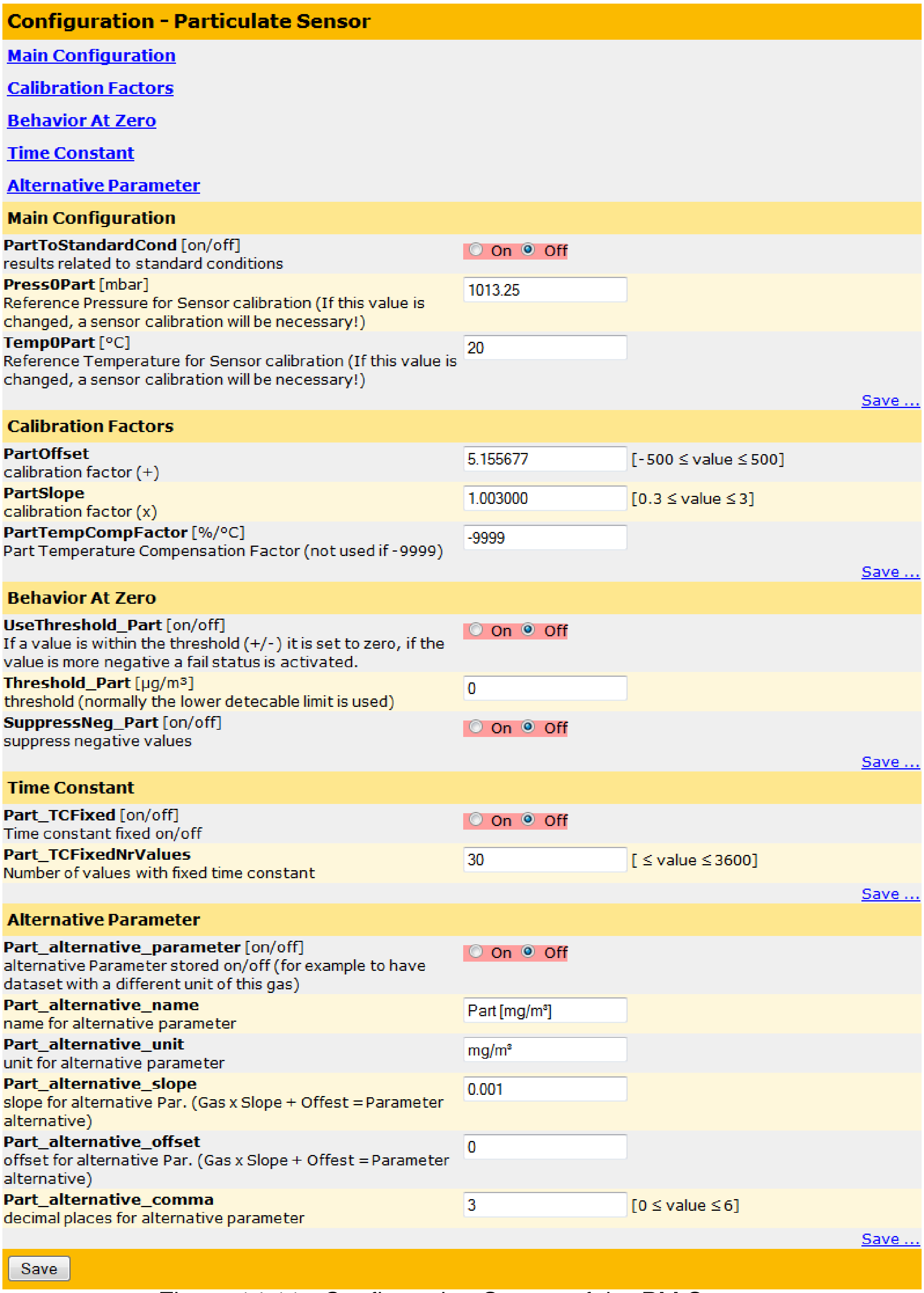


Figure 14.11.: Configuration Screen of the PM Sensor

14.7. Maintenance

NOTE
After a restart of the airpointer® the PM module has to burn in for one hour.

14.7.1. Three Sampling Heads for the PM Measurement

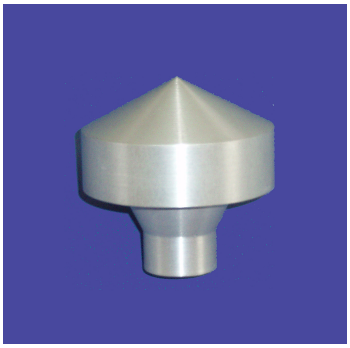


Figure 14.12.: Sampling Head TSP

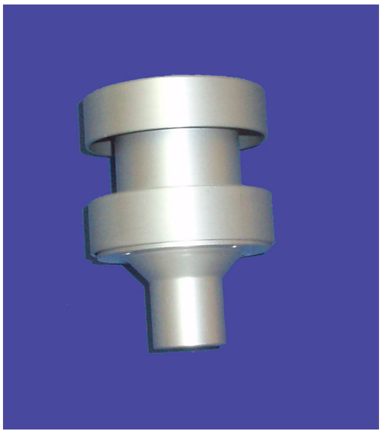


Figure 14.13.: Sampling Head PM10

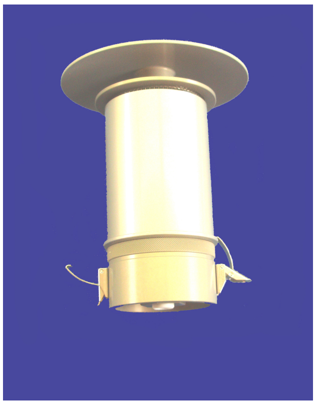


Figure 14.14.: Sampling Head PM2.5

14.7.2. TSP Head

If a PM module is ordered it is delivered with a TSP head on the sample inlet as a standard. Therefore the total particle concentration is measured. The TSP head is more or less maintenance free. It is sufficient to remove it from the inlet and clean it with a moister smooth cloth or cotton wool pad inside and outside from time to time[1].

Figure 14.15.: TSP Head

14.7.3. PM10 Head

Before you attach the PM10 head to the sample inlet, the impactor plate has to be filled in with grease. Acid free fat, like e.g.: silicon grease, can be used. This grease fixes the larger particulate matters on the impactor plate. The impactor plate has to be cleaned and to be filled with new grease regularly, approximately every month[1]. Depending on the local PM load of the area the interval can be larger or smaller.

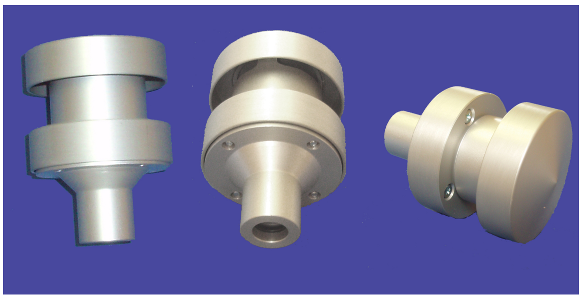


Figure 14.16.: PM10 Head

[1]The time interval depends strongly on the environmental conditions. Therefor it can be considerably smaller or larger than mentioned!

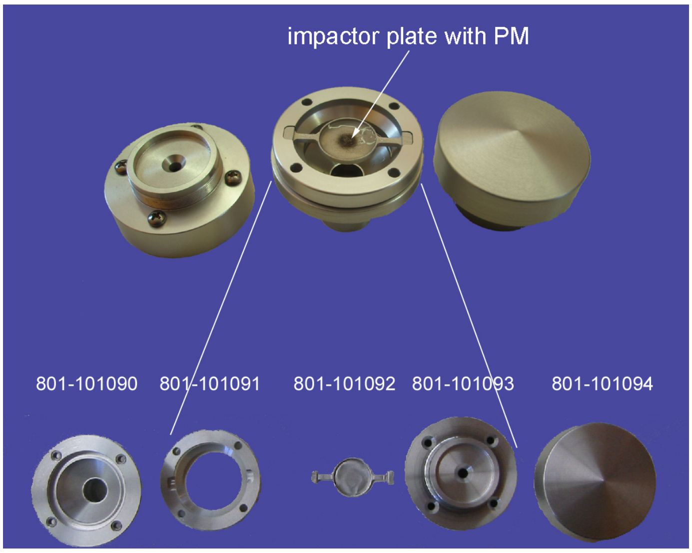


Figure 14.17.: PM10 Head Disassembled

Cleaning of the PM10 head:

1. Remove the PM10 head from the sample inlet.
2. Disassemble the sampling head.
3. Clean the parts with a moist cloth and clean the impactor plate.
4. Put new grease on the impactor plate and reassemble the head.
5. Attach the PM10 head to the sample inlet.

14.7.4. PM2.5 Head

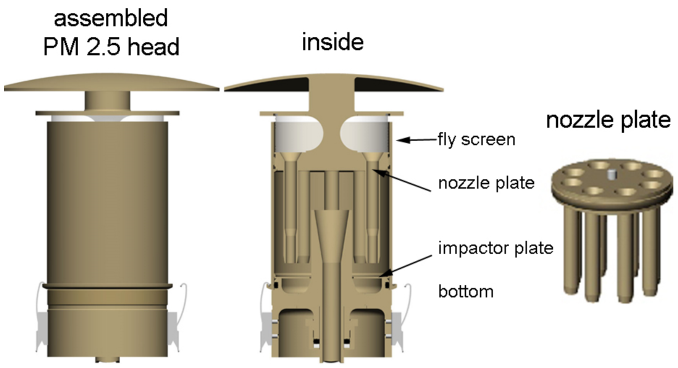


Figure 14.18.: Exterior and Interior View of the PM2.5 Head

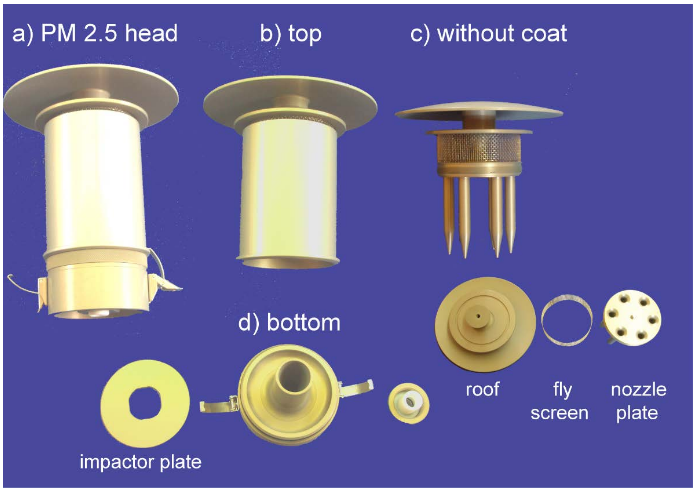


Figure 14.19.: PM2.5 Head Disassembled

The PM2.5 pre-separator is constructed as a 1-stage impactor. An autonomous continuous measurement is possible. The impactor plate has to be greased with acid free grease (e.g.: silicon grease) prior to measurement. The median point Dp50 ('cut-point') of the probe separation plot is at an aerodynamical particle diameter of 2.5 μm. It will be achieved at a flow rate of 2 l/min (30 m^3/h). In order to keep the weight low, the tube is completely made of aluminum. All surfaces are treated with the long lasting proven and tested 'Ematal'. The Ematal surfaces have not shown any negative effects so far on the particle substances of contents to be analyzed.

14.7.4.1. Specification

Separation characteristic	2.5 μm
Flow rate	2 l/min
hline Line Separation	1-stage impactor
Dimensions	d = 148 mm, h = 240 mm
Material	Ematal aluminum or stainless steal
Weight	1.1 kg

14.7.4.2. Maintenance

NOTE
In case of longer sampling in moist environment it is recommendable to inspect the impactor plate for condensate.

The PM2.5 head has to be cleaned regularly and the impactor plate has to be greased regularly.
Maintenance of the pre-seperator: To avoid effects of released particles, the cannon surface of the impactor plate has to be permanently covered with a thin fat layer, which has to be periodically renewed. As grease you might use for example BAYSILON paste, high-vacuum grease, medium-viscous (35 g tube) and silicon high-vacuum grease, medium Merck 100 g, Article 7922 LAB. Thereby the life cycle depends upon the proportion of particles in the sampled air. It is recommended to clean the impactor plate after 14 sampling days, by the time the average total dust volume (TSP) on the installation side is approx. 70 to 80 g/m^3[1]. With lower TSP, the cleaning interval can be longer, with higher TSP it will be shorter. You can extend the cleaning interval results by rotating the moveable impactor plate, resting on the holder, by approx. 15° (approx. 2 cm). Acceleration nozzles then point at the 'clean' areas between rough dust deposit settled in a circular form of the previous sampling operation. The impactor plate can simply be removed after opening the probe upper part . It has to be cleaned with a clean cloth and its cannon surface has to be greased. An approx. 5 cm long band of grease should be equally spread on the surface area by using a spatula. To ease this maintenance in the field, the impactor plate can be replaced by another plate prepared in the laboratory. Acceleration nozzles, probe casing liners, as well as a liner behind the impactor plate

[1] The time interval depends strongly on the environmental conditions. Therefor it can be considerably smaller or larger than mentioned!

with the above mentioned TSP condition have to be cleaned after 30 days of operation. In case of longer sampling in moist environment it is recommended to inspect the impactor plate for condensate.

Cleaning of the Pre-separator an the Impactor Plate of the PM2.5 Head

1. Open the clamps.
2. Alternatively, remove the PM2.5 head from the sample inlet and then open the clamps.
3. Remove the top of the head from the bottom.
4. Remove the impactor plate. It is seated loosely on the bottom part of the head.
5. Clean the pot below the impactor plate.
6. Clean the impactor plate and coat it with acid-free fat. An approx. 5 cm long band of grease should be equally spread on the area, using a spatula. To ease this maintenance in the field, the impactor plate can be replaced by another plate prepared in the laboratory.
7. Put the cleaned and greased impactor plate back.
8. Reattach the top of the head to the bottom and close the clamps.
9. If necessary, reattach the head to the sample inlet.

Cleaning of the PM2.5 Head

1. Remove the PM2.5 head from the sample inlet and open the clamps.
2. Remove the top of the head from the bottom.
3. Clean and grease the impactor plate. Clean the pot below the impactor plate.
4. Disassemble the top part. The roof can be loosened from the nozzle plate like a cap from a bottle. To loosen it, turn the nozzle plate while holding it with one end and the roof with the other. Be careful, the fly screen is not fixed and it might drop down when removing the roof. The top disassembles into roof, fly screen (it is just plugged), and nozzle plate. All parts have to be cleaned. For cleaning one can use window cleaning agent or acetone, a soft lint-free cloth and a pipe cleaner for the nozzles. Afterward, flash with clean water and dry with compressed air. The nozzles have to be completely dry, otherwise they might be obstructed by particles.

NOTE
Be careful that the fly screen does not drop down when you loose the roof from the nozzle plate. It could be damaged.

5. Clean all parts from the outside with a moister cloth, check if the nozzles are free. Else clean them and use compressed air to dry them. To clean the head use a dry cloth. If necessary one can use window cleaning agent. Take care that the parts are dry before you put them together. You must not use solving or rubbing agents!

NOTE
Take care that the nozzles are completely dry before you reassemble the head.

6. Reassemble the top part of the head in reversed order. Take care that the fly screen is not squeezed and that the screw connection does not cant.
7. Attach the top to the bottom part and close the clamps.
8. Attach the PM2.5 head to the top of the sample inlet.

14.7.5. Changing the DFU Filter

Every three months to once a year the DFU filter at the exit of the nephelometer has to be changed[1]. Therefore loose the quick release, release the filter and apply a new one.

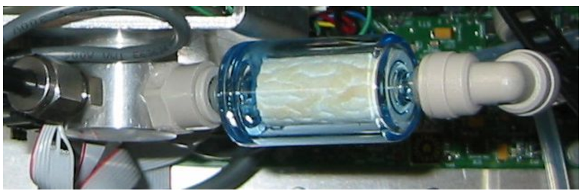


Figure 14.20.: DFU Filter at the Exit of the Nephelometer

[1] The time interval depends strongly on the environmental conditions. Therefor it can be considerably smaller or larger than mentioned!

14.7.6. Changing the Capillary

Behind the DFU filter a capillary is located. If it is polluted it has to be changed. Loose the quick release fastener from the respective side of the DFU filter. Remove the capillary and replace it. Reconnect the tube.

NOTE
Pay attention to the color code of the capillary. The color is a code for the flow rate.

NOTE
Do NOT touch the narrow side of the capillary.

14.7.7. Cleaning of the Sample Inlet Tube

The sample inlet tube has to be cleaned with a soft, lean-free cloth from the inside once a year with the annual maintenance. Afterwards dry it with compressed air.

14.8. Flow Rate Measurement

The flow through the PM module has to be measured with an external device every second week. Therefore connect the sensor with the sample inlet or loose the quick connection between nephelometer and DFU filter and connect the sensor. If the flow rate is too low, change the DFU filter and the capillary.

To check whether the sampling head is unblocked, monitor the pressure of the PM module. A significant change in pressure when removing the head is a sign that the sample head has to be cleaned.

NOTE
Check the flow rate through the PM module with an external device at regular intervals.

14.9. User's Notes

15. Troubleshooting

The airpointer® has been designed in a way that problems can be rapidly detected, evaluated and repaired. During operation, it continuously performs diagnostic tests and provides the ability to evaluate its key operating parameters via the user interface, without disturbing monitoring operations.
A systematic approach to troubleshooting will generally consist of the following steps:

1. Note any warning or failure messages and take corrective action as necessary.

2. Examine the values of all parameters stored in the database and their performance over time. Use the menu item "Graph" for this purpose. Take corrective action as necessary.

3. Verify that the DC power supplies are operating properly by looking at these values in the user interface or by checking the appropriate voltages at the appropriate test points.

4. **SUSPECT A LEAK FIRST!**
   Customer service data indicate that the majority of all problems are eventually traced to leaks in the internal pneumatics of the airpointer® or the diluent gas and source gases delivery systems.

5. Check for gas flow problems such as clogged or blocked internal/external gas lines, damaged seals, punctured gas lines, damaged/malfunctioning pumps, etc.

15.1. First action

First inspection of an airpointer® with suspected problems should include the check of mains power, switches and fuses. Open the maintenance and the main door and check carefully for loose items. Ensure the analyzing modules and their components are properly mounted. Confirm all connection sitting in their place firmly and no bent cables and tubes are present. Observe there is no abnormal noise or vibration during operation.

15.2. Communication problems

15.2.1. Troubleshooting direct LAN connection via cross patch network cable

If you fail to connect your computer via cross patch network cable according chapter 5.7. proceed as follows:
Ensure you are logged in your computer as administrator and you are really using a cross cable. Run the program cmd.exe on your Windows-Computer.

1. Type "ipconfig" <Enter> at the prompt. Check the settings for IPv4-adress and subnet mask. If Ipv4 is 172.17.2.? (e.g. ?=141) and the subnet mask is 255.255.255.0 enter "ping 172.17.2.140" at the prompt of the cmd.exe

2. If you get a response and not 100% lost packages open your browser window and type http://172.17.2.140 in the address field. If your Browser does not show the airpointer® login page the proxy settings in your browser might be misconfigured. Configure it for direct connection without using a proxy.

3. If you get a "100 % lost packages" from the ping command enter "ipconfig /renew" at the prompt and check if the connection is working now (see 1.).

4. If this is not successful set the IP-address manually: In your computer open the properties of your LAN network-connection. Open the IPv4 configuration settings and disable "obtain IP-address automatically". Type for the IP-Address: "172.17.2.141", for subnet mask "255.255.255.0" and for standard gateway "172.17.2.140". Close the windows and check if the connection is working now (see 1.).

5. If the connection still does not work open the airpointers main door and locate the watchdog board left of the airpointers main computer. There is a green and a red LED at the front of the board. The red one should blink (board is powered). The green one should flicker which shows the communication between the main computer and the board (LinSens is running). If the LEDs blink correctly power cycle your Windows-Computer and retry with 1.

6. If the green LED is not flickering power down the airpointer® and connect a VGA- Monitor to the VGA connector of the airpointers computer. Power on the airpointer® and observe the messages during startup. If everything is properly set you should see the Linux operation system starting up without major error messages. At the end of the startup process you should see a prompt for a login.

7. Consult your distributor if you see the airpointers computer is not starting up properly.

15.2.2. Troubleshooting Internet connection problems using a modem

To test the connectivity goto Setup/Communication/ Test Connectivity and press the Test-button to test if Network interfaces are running. If successful you should see an "active" message for the modem interface connection:

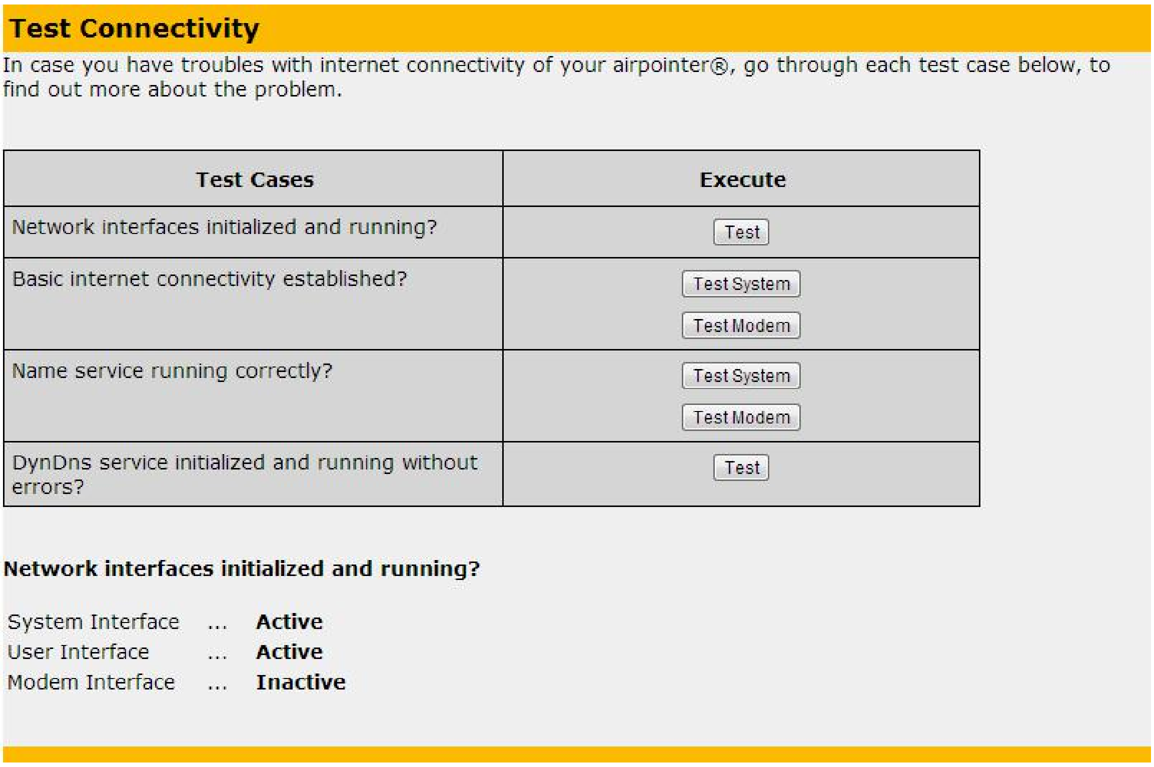


Figure 15.1.: Test connectivity - part 1

If you hit the Test Modem-button for "Basic internet connectivity established" theairpointer® is forced to ping a webserver and records the result as follows:

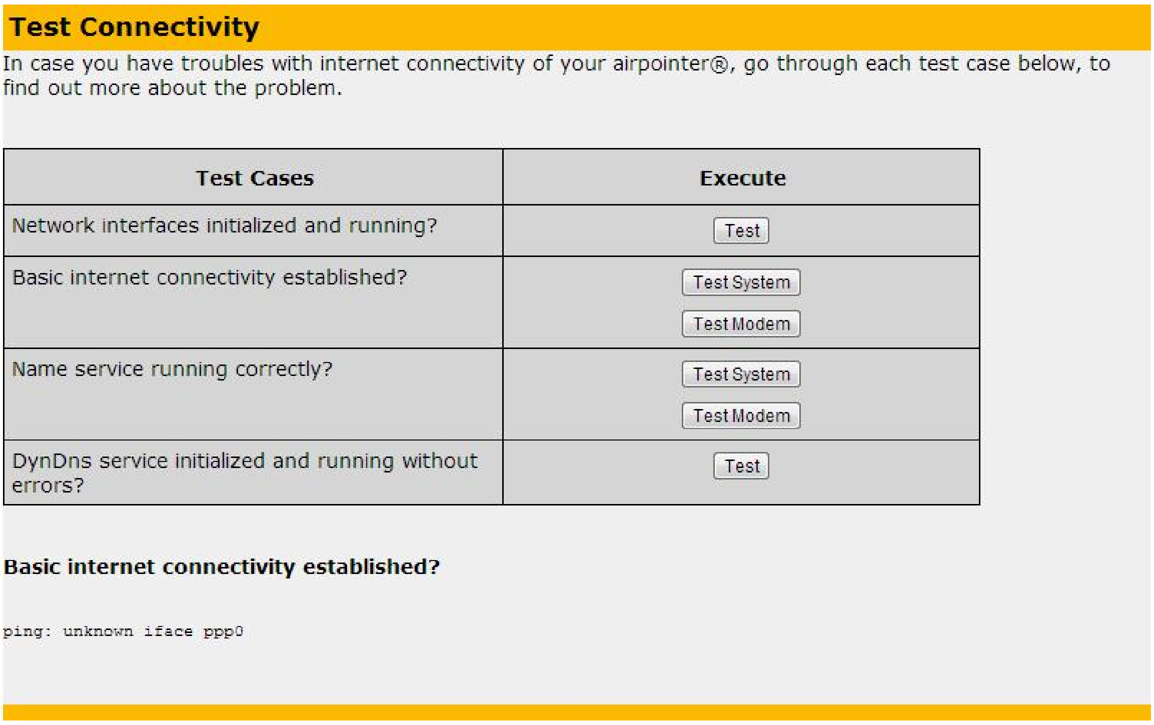


Figure 15.2.: Test connectivity - part 2

If successful (not 100 % loss) the modem connection should work. If not ensure your Modem is powered (LED at the Modem is lit) and a SIM-card is installed properly. The request for a pin at the SIM card must be disabled. You can use a cellular phone, install the SIM-card and disable the request for a PIN if needed.

Restart the Modem dialer in Setup/System Maintenance/Service Manager and wait one minute.

Open the wvdial-logfile in Setup/System Info/Log Files. It is one of the last of the files that can be chosen. This File logs the communication between the Modem and the airpointers computer. If connection problems occur it can be used to isolate the problem.

Take special attention to the response to ATZ (if not answered by OK the modem itself may have a problem), the answer to the command including the access point name (if not OK the access point, the user name or the password may not be compatible to the SIM you are using) or the end of the file (If not "Connected... Press Ctrl-C to disconnect" the connectivity may not be the best).

Edit the modem configuration in Setup/Communication/GPRS Modem to the appropriate settings. If you use a GPRS Modem you usually should enter the accesspoint, user name and password in the "Typical settings" field. If you use a 3G/UMTS-Modem you will get an error message (Unexpected error while parsing configuration file) and enter the correct settings under "Advanced" in pressing the link to "Edit configuration file". Please refer to your distributor if you need any assistance.

15.2.3. Pneumatic leaks

The leak check procedure is described in section 11.10.

15.2.4. Flow problems

Each module has its own flow path. For gas flow schematics of the specific modules and the system refer to section 10.2. In general, flow problems can be divided into three categories:

- Flow is too high
- Flow is greater than zero, but is too low, and/or unstable
- Flow is zero (no flow)

When troubleshooting flow problems, it is essential to confirm the actual flow rate without relying on the flow indicated in the user interface. The use of an independent, external flow meter to perform a flow check is essential.

15.2.4.1. Zero or low sample flow

If the pump is operating but the module reports a low or zero gas flow, proceed with the following steps:

- Check for actual sample flow
- Check pressures
- Carry out a leak check

To check the actual sample flow, open the airpointers main door. Disconnect the sample tube from the sample port at the connect port in front right of the specific module. Ensure that the module is in basic sample mode and not in calibration. Attach a flow meter to the tube to measure the actual flow.
It should be around:

Module	Sample Flow Rate $[cm^3 min^{-1}] \pm 10\%$
NO_x	500(NO) / 1000(NO_x)
SO_2	570
O_3	600
CO	600

If a proper flow exists, there is a bad/maladjusted flow sensor (SO_2, CO and O_3-module only, for the NO_x-module refer to the NO_x specific table below): Locate the flow sensor board at the module. Nearby the flow sensor there is a potentiometer that can be used to adjust the flow sensor reading to match the flow measured with the external flow meter.

CAUTION:

The potentiometer is very sensitive and can be damaged easily, please rotate it slowly and carefully!

If there is no flow or low flow, check that the sample pressure is at or around ambient atmospheric pressure. If not, please look for blocked tubing, orifices or clogged sample filters.
In addition a heavy leakage downstream of the flowsensor could lead to low or zero flow reading.

15.2.4.2. High Sample flow

Flows that are significantly higher than the allowed operating range (typically $\pm$ 10 % of the nominal flow) should not occur unless a pressurized sample, zero or span gas is supplied directly to the sample line. Be sure excess pressure and flow is vented before the module inlet tubing. Measure the flow with an external flowmeter. If a proper flow exists (see above for correct values), there is a bad/maladjusted flow sensor (SO_2, CO and O_3-module only): Locate the flow sensor board at the module. Nearby the flow sensor there is a potentiometer that can be used to adjust the flow sensor reading to match the flow measured with the external flow meter.

CAUTION:

The potentiometer is very sensitive and can be damaged easily, please rotate it slowly and carefully!

When supplying sample, zero or span gas at ambient pressure, a high flow would indicate that one or more of the critical flow orifices are physically broken (very unlikely case), bypassed, allowing more than nominal flow, or were replaced with an orifice of wrong specifications. If the flows are more than 15 % higher than normal, we recommend that the technician locates and corrects the reason of the flow problem.

15.3. Calibration problems

This section provides information regarding possible causes of various calibration problems.

15.3.1. Negative concentrations

Negative concentration values may be caused due to the following:

- A slight, negative signal is normal when the module is operating under zero gas and the signal is drifting around the zero calibration point. This is caused by the normal zero noise and may cause reported concentrations to be negative for a few seconds at a time, but should alternate with similarly high, positive values.
- A faulty calibration is the most likely explanation for negative concentration values. If the zero air contained some pollutant gas (contaminated zero air or a worn-out zero air scrubber) and the analyzing module was calibrated to that concentration as "zero", the module may report negative values when measuring air that contains little or no pollutant. The same problem occurs, if the module was zero-calibrated using ambient air or span gas or if it was calibrated before a stable zero value was reached.
- NO_x Module: Negative concentrations may occur if the autozero valve is leaking or not switching properly. Please refer to the module specific chapter below.
- CO Module: Negative concentrations may occur if the modules zero offset is drifting slightly over time. If the negative drift is excessive a leakage in the gas filter wheel should be considered.

15.3.2. No response

If the instrument shows no response (display value is near zero) even though sample gas is supplied properly and the instrument seems to perform correctly:

- Confirm response by supplying span gas directly to the module.
- Check the sample flow rate for proper value.
- Check for disconnected cables to the sensor module.
- Leak check the module.
- SO_2 Module: Check PMT and HVPS, Check if UV-lamp is lit.
- NO_x Module: Ensure the ozonator is working, check PMT and HVPS
- CO Module: Ensure gas filter wheel is rotating, check if IR-source is lit.

- O_3 Module: Ensure the main switching valve is working properly and free of internal leaks. Check if UV-lamp is lit.

15.3.3. Unstable zero and span

Leaks in the airpointer® or in the external gas supply and vacuum systems are the most common source of unstable and non-repeatable concentration readings.

- Check for leaks in the pneumatic systems as described in Section 11.10. Consider pneumatic components in the gas delivery system outside the airpointer® such as a change in zero air source (ambient air leaking into zero air line or a worn-out zero air scrubber) or a change in the span gas concentration due to zero air or ambient air leaking into the span gas line.
- Once the airpointer® and the module passes a leak check, perform a flow check (refer to Section 11.10 to ensure that the instrument is supplied with adequate sample gas.
- Confirm the relevant parameters as well as sample pressure and sample temperature readings are correct and steady.
- Verify that the sample filter element is clean and does not need to be replaced.

15.3.4. Inability to calibrate Span

After pressing the "calibrate span" button in the calibration menu you will be informed If the calibration was successful. If not, the actual concentration must be outside of the range of the expected span gas concentration, which can have several reasons.

- Verify that the expected concentration is set properly to the actual span gas concentration in the "span gas setpoint" field above the "calibrate span" button.
- Confirm that the pollutant span gas source is accurate.
- If you are using bottle calibration gas and have recently changed bottles, bottle to bottle variation may be the cause.
- Check for leaks in the pneumatic systems as described in Section 11.10. Leaks can dilute the span gas and, hence, the concentration that the module measures may fall short of the expected concentration.
- NO_x and SO_2 Module: If the physical, low-level calibration has drifted (e.g. changed PMT response) or was accidentally altered by the user, a low-level calibration may be necessary to get the module back into its proper range of expected values. One possible indicator of this scenario is a slope or offset value that is outside of its allowed range.

15.3.5. Non-linear response

The airpointer® was factory calibrated and should be linear to within 1 % of full scale. Common causes for non-linearity are:

- Leaks in the pneumatic system. Leaks can add a constant of ambient air, zero air or span gas to the current sample gas stream, which may be changing in concentrations as the linearity test is performed. Check for leaks as described in Section 11.10.
- The calibration device is in error. Check flow rates and concentrations, particularly when using low concentrations. If a mass flow calibrator is used and the flow is less than 10 % of the full scale flow on either flow controller, you may need to purchase lower concentration standards.
- The standard gases may be mislabeled as to type or concentration. Labeled concentrations may be outside the certified tolerance.
- The sample delivery system may be contaminated. Check for dirt in the sample lines or sample chamber.
- Calibration gas source may be contaminated.
- Dilution air contains sample or span gas.
- Sample inlet may be contaminated with pollutant exhaust from this or other analyzers. Verify proper venting of the exhaust.

15.4. Other performance problems

Dynamic problems (i.e. problems which only manifest themselves when the module is monitoring sample gas) can be the most difficult and time consuming to isolate and resolve. The following section provides an itemized list of the most common dynamic problems with recommended troubleshooting checks and corrective actions.

15.4.0.1. Excessive noise

Excessive noise levels under normal operation usually indicate leaks in the sample supply or the module itself. Ensure that the sample or span gas supply is leak-free and carry out a detailed leak check as described earlier in this chapter. Another possibility of excessive signal noise may be the preamplifier board, the high voltage power supply, the PMT (SO_2 and NO_x) or other detectors, lamps and power supplies (O_3, CO) or the wheel motor in the CO Module.

15.4.0.2. Slow response

If the airpointer® starts responding too slowly to any changes in sample, zero or span gas, check for the following:

- Dirty or plugged sample filter or sample lines.
- Sample inlet line is too long.
- Dirty or plugged critical flow orifices. Check flows, pressures and, if necessary, change orifices (refer to Section 11).
- Wrong materials in contact with sample - use Teflon materials only.
- Dirty sample chamber.
- Insufficient time allowed for purging of lines upstream of the analyzer.
- Insufficient time allowed for calibration gas source to become stable.

15.5. airpointer subsystems and analyzing modules

15.5.1. Troubleshooting using the status list

For the following procedure you need extraordinary rights. If needed your distributor will provide you acces to all following interfaces. In the status list all parameters monitored are summarized for each airpointer® component installed. Usually only parameters with warning and/or fail limits are relevant for end users troubleshooting. In the status list all Parameters within limits are green colored. Warnings are marked by yellow, failures by red colored values.

15.5.1.1. System

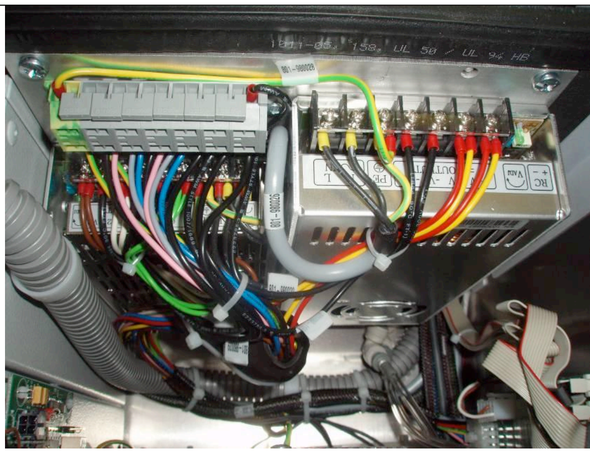
The parameters monitored and stored in the airpointers database are internal housing temperatures, the sampling system, cooler function, internal communication and supply voltages.

System

G/P	Status	Parameter	Actual	Average	Unit	lower limit fail	lower limit warn	upper limit warn	upper limit fail	Board Adr
G4P1	OK	PressPump	450.2	452.1	mbar	25.0	50.0	550.0	600.0	-
G4P7	OK	PumpRoomTemp	40.7	40.7	°C	-	0.0	50.0	-	031
G4P8	OK	AmbientTemp	39.5	39.4	°C	-	-50.0	60.0	-	031
G4P9	OK	DC5V	5.31	5.31	V	-	4.50	5.50	-	031
G4P10	OK	DC12V	11.6	11.7	V	-	10.5	13.5	-	031
G4P11	OK	DC15V	15.2	15.2	V	-	13.0	17.0	-	031
G4P12	OK	DCneg15V	-15.2	-15.2	V	-	-17.5	-12.5	-	031
G4P13	OK	FanPumpRoomRPM	2610	2618	rpm	-	1000	4000	-	031
G4P14	OK	FanSampleRPM	3030	3074	rpm	-	1000	4000	-	031
G4P15	OK	FanPumpRoomPercent	84	84	%	-	-	-	-	031
G4P18	OK	RoomTemp	28.8	28.9	°C	-	10.0	40.0	-	030
G4P19	OK	CoolerOutTemp	21.3	21.4	°C	-	4.0	35.0	-	030
G4P20	OK	Coolerpercent	100.0	100.0	%	-	-	-	-	030
G4P21	OK	HeaterPercent	0.0	0.0	%	-	-	-	-	030
G4P22	OK	ClimaActMode	1	1	%	-	-	-	-	030
G4P24	OK	RSCommunikation	23	27	message/sec	-	-	50	-	-
G4P25	OK	MissingBoards	0	0	Boards	-	-	-	1	-
G4P26	OK	DC5V_PC	5.17	5.17	V	-	4.00	6.50	-	253
G4P27	OK	DC12V_Wtd	11.43	11.46	V	-	10.00	14.00	-	253
G4P28	OK	Countdown	1497	1469	sec	-	-	-	-	253
G4P29	OK	Restarts	0	0		-	-	-	-	253
G4P30	OK	RestartSLT	0	0		-	-	-	-	253
G4P31	OK	Temp_PC	46.6	46.6	°C	-	10.0	50.0	-	253
G4P32	OK	TempChipWatchdog	37.4	37.4	°C	-	-	-	-	253
G4P35	OK	RoomTempUp	31.8	31.8	°C	-	-	-	-	000
G4P36	OK	DoorContact	1	1	-	-	-	-	-	-
G4P37	OK	FanUpSpeed	3060	3067	rpm	-	1000	4000	-	253
G4P38	OK	U_Batt	11.04	11.08	V	-	11.00	18.00	-	253
G4P39	OK	Temp_Batt	37.6	37.6	°C	5.0	10.0	60.0	-	253

Figure 15.3.: System parameters

Parameter	Corrective action	
	< limit	> limit
PressPump	**1.** Check pump pressure sensor Disconnect pump from power supply, pump pressure must increase to approx. ambient pressure. **2.** Check for blocked tubing (vacuum tube to pump). **3.** Check pressure sensor reading with an external pressure sensor. **4.** Calibrate with potentiometer on pressure sensor board. **5.** Exchange pressure sensor or system-sensorinterfaceboard, if needed	**1.** Perform leak check, see section 11.10 **2.** Check pump pressure sensor by measuring the pump vacuum with an external pressure sensor **3.** Calibrate with potentiometer on pressure sensor board **4.** Rebuild pump **5.** Exchange pump
PumpRoomTemp	**1.** Check pump room temperature sensor with external thermometer. **2.** If sensor and signal processing is ok no further action needed	**1.** Check if pump room is properly vented. Make sure there is sufficient free space below the airpointer (min 50 cm). Replace the filter fleece, it can be removed from the outer bottom of the airpointers housing Special torx type tool is needed to remove the screws **2.** Check pump room temperature sensor with external thermometer **3.** Shield airpointer from direct sunlight
AmbientTemp	**1.** This is only an indication for the ambient temperature, not a real measurement. If you need to monitor the ambient temperature, a special sensor is available **2.** Avoid using the airpointer out of its ambient temperature specifications	
	3. Below -20°C the "-40°C-Option" is needed for proper operation **4.** Please keep in mind after start up the airpointer might need some time before its inner temperature reaches 5°C and the computer is powered up	**3.** Shield airpointer from direct sunlight

Parameter	Corrective Action
DC5V	 **1.** Check 5 V at the main power supply in the pump room (left one) with external voltmeter. **2.** If adjustment is needed modify the voltage by the potentiometer directly at the power supply. To take possible voltage losses into account you should adjust it to 5.20 V **3.** Replace power supply if adjustment is not possible.
DC12V	**1.** Check 12 V at the main power supply in the pump room (right one, see photo above) with external voltmeter. **2.** If adjustment is needed modify the voltage by the potentiometer directly at the power supply. To take possible voltage losses into account you should adjust it to 12.8 V **3.** Replace power supply if adjustment is not possible.
DC15V	There is one power supply for 5V, 15V and -15 V. Refer to "DC5V"-line for troubleshooting.
DCneg15V	There is one power supply for 5V, 15V and -15 V. Refer to "DC5V"-line for troubleshooting.

Parameter	Corrective action	
	$<$ limit	$>$ limit
FanPumpRoomRPM	**1.** Remove fan from its mounting position and check if it is rotating **2.** Replace fan **3.** Replace pump control board	**1.** Power cycle the airpointer **2.** Replace fan **3.** Replace pump control board
FanSampleRPM	**1.** Remove wired frame of the airpointers bottom and check if the sample fan is rotating **2.** Replace fan **3.** Replace pump control board	**1.** Remove fan from its mounting position and check if it is rotating **2.** Replace fan **3.** Replace pump control board
Room Temp	**1.** Check room temperature sensor with external thermometer, replace if necessary **2.** If externally measured room temperature is above warning limit replace clima control board **3.** If ambient air temperature is very low install "-40°C-option"	**1.** Check room temperature sensor with external thermometer, replace if necessary **2.** If externally measured room temperature is below warning limit replace clima control board **3.** Is ambient air temperature too high? **4.** Shield airpointer from direct sunlight **5.** Check cooler: - Is cooled air blown out of the cooler? - Remove cooler and clean it - Check cooling fans - Replace cooling liquid - Replace cooler
CoolerOutTemp	**1.** Check if cooler outlet is iced **2.** Check temperature sensor at cooler	**1.** Check cooler out temperature sensor with external thermometer, replace if necessary **2.** If externally measured room temperature is below warning limit replace clima control board **3.** Check cooler: - Is cooled air blown out? - Remove cooler and clean it - Check cooling fans - Replace cooling liquid - Replace cooler
Missing boards		**1.** Power cycle the airpointer **2.** Check wiring **3.** Exchange missed board

Parameter	Corrective action	
	< limit	> limit
DC5V_PC	**1.** Check 5V supply at watchdog board at ST1 Pin 2/3 **2.** Adjust to 5.1V at main 5V power supply **3.** Measure 5V at ST2 between Pin 3 and 4 of the watchdog board with an external voltmeter **4.** Adjust to 5.2V with the small potentiometer located at the watchdog board	
DC12V_Wtd	This voltage is the watchdog supply voltage. It will be measured at the watchdog board and can be adjusted by a potentiometer at the 12V main power supply. Refer to "DC12V"-line for troubleshooting	
Temp_PC	PC is started up if a minimum of 5°C inner temperature is reached	**1.** Check if upper fan is rotating. It is located behind the computer **2.** Check if internal airpointer temperature is not too high
FanUpSpeed	**1.** Fan is located behind the computer, check if it is rotating. Replace if necessary **2.** Replace watchdog board	**1.** Restart airpointer **2.** Fan is located behind the computer, check if it is rotating. Replace if necessary **3.** Replace watchdog board
U_Batt	Most likely the batteries are defective. Try to start a charge cycle via Setup/System Maintenance/Command Interface. Press "Start" to initiate an UPS charge cycle. If U_Batt-warning pops up again the batteries needs replacement	
Temp_Batt	**1.** Check RoomTempUp-parameter to see if it is very hot or cold inside the airpointer **2.** If temperature rises during charge too much this may indicates a defective battery	

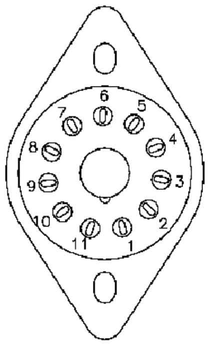
15.5.1.2. SO_2 Module

SO2Sensor

G/P	Status	Parameter	Actual	Average	Unit	lower limit fail	lower limit warn	upper limit warn	upper limit fail	Board Adr
G6P1	OK	SO2	0.6	0.6	ppb	-	-	-	-	-
G6P2	OK	PressSO2	807.8	807.8	mbar	300.0	500.0	1200.0	1300.0	004
G6P3	OK	BenchTSO2	50.0	50.0	°C	45.0	47.0	57.0	60.0	036
G6P4	OK	PMTTempSO2	6.0	6.0	°C	0.0	2.0	8.0	10.0	036
G6P5	OK	HVPSSO2	418	418	V	100	300	1100	1200	004
G6P8	OK	PMTSigSO2	57.7	57.8	mV	-	-	-	4999.0	-
G6P9	OK	RefDetSO2	3000.3	3000.2	mV	500.0	2100.0	3300.0	4999.0	-
G6P10	OK	PMTSigSO2Dark	54.1	54.1	mV	1.0	10.0	200.0	4999.0	-
G6P11	OK	RefDetSO2Dark	90.5	90.5	mV	1.0	10.0	200.0	4999.0	-
G6P12	OK	PowerToBenchSO2	21.8	21.5	%	-	-	-	-	036
G6P13	OK	FanSO2	2700	2579	rpm	100	300	4000	5000	036
G6P14	OK	IntensitySO2	56.4	56.4	%	-	-	-	-	-
G6P15	OK	SO2_all	0.6	0.6	ppb	-	-	-	-	-
G6P16	OK	LampCurrSO2	33.7	33.7	mA	1.0	10.0	45.0	48.0	004
G6P17	OK	SO2StdDev	0.26	0.26		-	-	-	-	-
G6P25	OK	PermTSO2	49.9	49.9	°C	45.0	47.0	53.0	55.0	036
G6P26	OK	PowerToPerm	30.9	30.8	%	-	-	-	-	036
G6P27	OK	FlowSO2	389.1	392.6	ml/min	200.0	300.0	650.0	850.0	036
G6P32	OK	SO2_raw	0.3	0.4	ppb	-	-	-	-	-
G6P34	OK	RefDetSO2Act	90.6	2755.0	mV	-	-	-	-	036
G6P35	OK	PMTSO2Act	53.3	57.8	mV	-	-	-	4999.0	004
G6P36	OK	PowerToPeltierSO2	46.4	46.6	%	-	-	-	-	036

Figure 15.4.: SO_2 Parameters

Parameter	Corrective Action	
	< limit	> limit
PressSO2	**1.** Check pressure sensor. Disconnect tube from pressure sensor, pressure must increase to approx. ambient pressure **2.** Check for blocked lines or parts from sample filter to valves and tubing **3.** Check pressure sensor reading with an external pressure sensor **4.** Calibrate with potentiometer on pressure sensor board **5.** Exchange pressure sensor or sensor interface board if needed	**1.** Ensure system is not pressurized due to external gas supply **2.** Check pressure sensor. Disconnect tube from pressure sensor, pressure must increase to approx. ambient pressure **3.** Check pressure sensor reading with an external pressure sensor **4.** Calibrate with potentiometer on pressure sensor board **5.** Exchange pressure sensor or sensor interface board if needed
BenchTSO2	**1.** Check Parameter "PowertoBenchSO2" from Service interface. If at or near 100 % check heater resistance. There are two heaters with approx. 300 Ohms resistance each. If resistance is at infinity replace heater. **2.** Check thermocouple. Typical resistance is approx. 33 kOhms at room temperature. Replace if necessary. **3.** Swap valve heater3 board	**1.** Check thermocouple. Typical resistance is approx. 33 kOhms at room temperature. Replace if necessary. **2.** Swap valve heater3 board
PMTTempSO2	**1.** Check if PMT fan is operating continously (parameter Fan_SO2) **2.** Check if red LED on top of TEC (=Thermo Electric Cooler) control board, located above SO_2-fan is glowing. If not, power supply (12V) is not present **3.** Measure the voltage between the test points on TEC control board: - beween T2 and T3 = 0V DC and T1/T2 = 0V DC: open circuit or failed control PCA board - T2/T3 =0V and T1/T2 <> 0V DC most likely the TEC is shortened. Replace TEC	

<table>
<tr><th>Parameter</th><th>Corrective Action</th></tr>
<tr><td>HVPS_SO2</td><td>
1. Feed SO_2 span gas with a known concentration in excess via airpointers calibration port
2. Goto setup/configuration/SO_2 Sensor/Calibration Factors
3. Set the slope to 1 and offset to 0
4. Open Service Interface LinSens/SO2 in a different browser window
5. Locate the HVPS switches (fine and coarse) on the preamplifier board. Lower the HVPS coarse to its minimum and the HVPS fine to its maximum. Increase the PMT coarse and PMT fine switch to a value so the SO_2-concentration in the service interface matches the span gas concentration
Note: Do not overload the PMT by accidentally setting both adjustments switches to their maximum setting. Start at the lowest setting and increments slowly. Wait 10 seconds between adjustments.
6. Wait for stable concentration
7. Perform zero and span calibration. If you are within limits for HVPS you are done. If not proceed.
8. Check and swap HVPS (PMT socket)
The HVPS is located in the interior of the sensor module and is plugged into the PMT tube. It requires 2 voltage inputs. The first is +15 V, which powers the supply. The second is the programming voltage which is generated on the preamplifier board
9. This power supply has 10 independent power supply steps, one to each pin of the PMT. The following test procedure below allows you to test each step:
- Turn off the instrument
- Remove the cover and disconnect the 2 connectors at the front of the SO_2 sensor module. Remove the end cap from the sensor (4 screws)
- Remove the HVPS/PMT assembly from the cold block inside the sensor (2 plastic screws)
- Re-connect the 7 pin connector to the sensor end cap, and power-up the airpointer
10. Note HVPS_SO2 in the Service interface
11. Divide the displayed HVPS voltage by 10 and test the pairs of connector points as shown in the figure


<table>
<tr><th>HVPS PINS</th><th>VOLTAGE</th></tr>
<tr><td>11–1</td><td>70</td></tr>
<tr><td>1–2</td><td>70</td></tr>
<tr><td>2–3</td><td>70</td></tr>
<tr><td>3–4</td><td>70</td></tr>
<tr><td>4–5</td><td>70</td></tr>
<tr><td>5–6</td><td>70</td></tr>
<tr><td>6–7</td><td>70</td></tr>
<tr><td>7–8</td><td>70</td></tr>
<tr><td>8–9</td><td>70</td></tr>
</table>
12. Check the overall voltage (should be equal to the HVPS value displayed on the front panel and the voltages between each pair of pins of the supply
13. EXAMPLE: If the HVPS 700 V the pin-to-pin voltages should be 70 V
14. Turn off the instrument power, and reconnect the PMT, and then reassemble the sensor
15. If any faults are found in the test, swap HVPS
16. Check and swap HVPS preamplifier-board
17. Check and swap PMT
</td></tr>
</table>

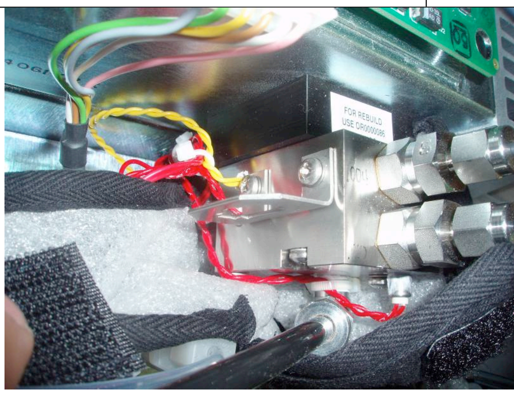
Parameter	Corrective Action
RefDetSO2	**1.** Check parameter "Intensity SO2". If at or near 100% loose the lamp clamp slightly so the lamp can be rotated and moved **2.** Check if UV-lamp is lit. If not check supply voltage of the lamp (approx 170V) at ST1 PIN 6-8 of the UVPS board. Do not remove the lamp plug for measurement. **3.** Check if lamp current is within limits. **4.** If lamp is lit rotate and move lamp while observing RefDetSO2. **5.** Peak lamp by moving and rotating to achieve the lowest Intensity at the RefDetSO2 setpoint. Note RefDetSO2 is controlled via lamp current/Intensity automatically. This will make it slightly harder to peak the lamp correctly. Wait until automatic control has stabilized the RefDetSO2 signal after every adjustment of the lamp. **6.** If RefDetSO2 setpoint cannot be achieved or the intensity is at or near 100% replace UV-Lamp. **7.** Replace Reference detector board if necessary
FlowSO2	See section 15.2.4 "Flow Problems" above

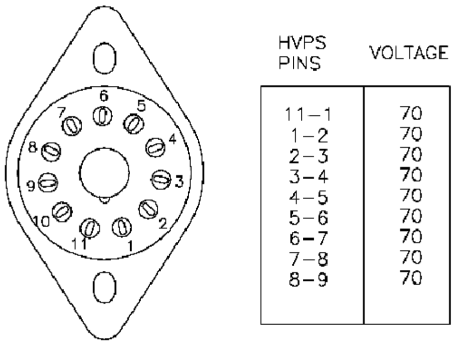
15.5.1.3. NO_x Module

NOxSensor

G/P	Status	Parameter	Actual	Average	Unit	lower limit fail	lower limit warn	upper limit warn	upper limit fail	Board Adr
G1P1	OK	NO	-2.5	-2.3	ppb	-	-	-	-	-
G1P2	OK	NO2	16.0	12.5	ppb	-	-	-	-	-
G1P3	OK	NOx	14.1	13.6	ppb	-	-	-	-	-
G1P4	OK	PressNOx	856.1	856.1	mbar	300.0	-	-	1300.0	001
G1P5	OK	RCellT	50.0	50.0	°C	45.0	47.0	55.0	56.0	033
G1P6	OK	MolyT	315.0	315.0	°C	290.0	300.0	335.0	340.0	033
G1P7	OK	PMTTemp	6.0	6.0	°C	0.0	2.0	8.0	10.0	033
G1P10	OK	PMTSigNO	51.6	51.0	mV	-	-	-	-	001
G1P11	OK	PMTSigNOx	69.0	65.1	mV	-	-	-	-	001
G1P12	OK	PMTSigAuto0	46.0	46.5	mV	5.0	-	-	250.0	001
G1P13	OK	PowerToRCell	17.3	17.3	%	-	-	-	-	033
G1P14	OK	PowerToMoly	47.8	47.7	%	-	-	-	-	033
G1P15	OK	HVPS_NOx	611	611	V	100	300	1100	1200	001
G1P16	OK	NO_all	-2.5	-2.3	ppb	-	-	-	-	-
G1P17	OK	NO2_all	16.0	12.5	ppb	-	-	-	-	-
G1P18	OK	NOx_all	14.1	13.6	ppb	-	-	-	-	-
G1P19	OK	Fan_NOx	2490	2789	rpm	100	300	4000	5000	033
G1P20	OK	PressNO	839.3	839.2	mbar	300.0	-	-	1300.0	001
G1P21	OK	NOStdDev	13.08	13.31		-	-	-	-	-
G1P22	OK	NO2StdDev	6.85	6.62		-	-	-	-	-
G1P23	OK	NOxStdDev	11.48	12.31		-	-	-	-	-
G1P24	OK	PowerToPeltier	50.0	50.1	%	-	-	-	-	033
G1P25	OK	PermT	50.0	49.9	°C	45.0	47.0	53.0	55.0	033
G1P26	OK	PowerToPerm	34.8	35.0	%	-	-	-	-	033
G1P27	OK	RCellPressNO	451.5	452.1	mbar	100.0	-	-	600.0	-
G1P28	OK	RCellPressNOx	450.2	452.0	mbar	100.0	-	-	600.0	-
G1P29	OK	FlowNOx	446.7	446.5	ml/min	300.0	350.0	700.0	800.0	-
G1P30	OK	FlowO3Gen	80.6	80.5	ml/min	50.0	60.0	150.0	200.0	033

Figure 15.5.: NO_x Parameters

<table>
<tr><td>Parameter</td><td colspan="2">Corrective Action</td></tr>
<tr><td></td><td>< limit</td><td>> limit</td></tr>
<tr><td>PressNOx</td><td>1. Check for clogged sample filter
2. Check for clogged or clamped tubes
3. Check pressure sensor reading with an external pressure sensor, calibrate with potentiometer on pressure sensor board
4. Replace pressure sensor and/or sensor interface 2 board</td><td>1. Check pressure sensor reading with an external pressure sensor, calibrate with potentiometer on pressure sensor board if needed
2. Check signal processing (sensor interface 2 board) and pressure sensor by attaching a vacuum pump to the tube to the pressure sensor
3. Replace pressure sensor and/or sensor interface 2 board</td></tr>
<tr><td>RCellT</td><td colspan="2">
1. Check Parameter "PowertoRCell" from Service interface. If at or near 100% check heater resistance. There are two heaters with approx. 1.2 kOhm resistance (red cables in photo above). If resistance is at infintity replace heater
2. Check thermocouple. Typical resistance is 33kOhms at room temperature (yellow cable in photo above)
3. Swap valve heater3 board</td></tr>
<tr><td>MolyT</td><td colspan="2">1. Check the heater. The resistance between any two of the three contacts shall be between approx. 500 to 1000 Ohms. Replace heater in case of measuring near zero or continuity
2. Check thermocouple and its cables. If Moly temp reads near zero or near 500°C most likely the thermocouple is defective. Disconnect the thermocouple from the valve/heater board (yellow K-plug) and measure the voltage between the leads. It should be between 12mV @ 315°C and 0mV @ room temp, so it can be tested at higher temperatures best. Test the continuity across the leads. It should read near zero
3. Exchange valve heater3 board</td></tr>
<tr><td>PMTTemp</td><td colspan="2">1. Check if PMT fan is operating continuously (parameter Fan_NOx)
2. Check if red LED on top of TEC (=Thermo Electric Cooler) control board, located above NO_x-fan is glowing. If not, power supply (12V) is not present
3. Measure the voltage between the test points on TEC control board:
- beween T2 and T3 = 0V DC and T1/T2 = 0V DC: open circuit or failed control PCA board
- T2/T3 =0V and T1/T2 <> 0V DC most likely the TEC is shortened. Replace TEC
4. Check PMT Preamp board, replace if necessary</td></tr>
</table>

<table>
<tr><td>Parameter</td><td colspan="2">Corrective Action</td></tr>
<tr><td></td><td>< limit</td><td>> limit</td></tr>
<tr><td>PMTSigAuto0</td><td>Check if Ozone Generator is working</td><td>1. Check Auto-Zero valve for correct switching and internal leaks
2. Clean reaction cell</td></tr>
<tr><td>HVPS_NOx</td><td colspan="2">1. Feed NO span gas with a known concentration in excess via airpointers calibration port
2. Goto setup/configuration/NOx Sensor/Calibration Factors
3. Set CE to 1, all slopes to 1 and offsets to 0
4. Open Service Interface LinSens/NOx in a different browser window
5. Locate the HVPS switches (fine and coarse) on the preamplifier board. Lower the HVPS coarse to its minimum and the HVPS fine to its maximum. Increase the PMT coarse and PMT fine switch to a value so the NOx-concentration in the service interface matches the span gas concentration
Note: Do not overload the PMT by accidentally setting both adjustments switches to their maximum setting. Start at the lowest setting and increments slowly. Wait 10 seconds between adjustments.
6. Wait for stable concentration
7. Perform zero and span calibration. If you are within limits for HVPS you are done. If not proceed.
8. Check and swap HVPS (PMT socket)
The HVPS is located in the interior of the sensor module and is plugged into the PMT tube. It requires 2 voltage inputs. The first is +15 V, which powers the supply. The second is the programming voltage which is generated on the preamplifier board
9. This power supply has 10 independent power supply steps, one to each pin of the PMT. The following test procedure below allows you to test each step:
- Turn off the instrument
- Remove the cover and disconnect the 2 connectors at the front of the NO_x sensor module. Remove the end cap from the sensor (4 screws)
- Remove the HVPS/PMT assembly from the cold block inside the sensor (2 plastic screws)
- Re-connect the 7 pin connector to the sensor end cap, and power-up the airpointer
10. Note HVPS_NOx in the Service interface
11. Divide the displayed HVPS voltage by 10 and test the pairs of connector points as shown in the figure


12. Check the overall voltage (should be equal to the HVPS value displayed on the front panel and the voltages between each pair of pins of the supply
13. EXAMPLE: If the HVPS 700 V the pin-to-pin voltages should be 70 V
14. Turn off the instrument power, and reconnect the PMT, and then reassemble the sensor
15. If any faults are found in the test, swap HVPS
16. Check and swap HVPS preamplifier-board
17. Check and swap PMT</td></tr>
</table>

Parameter	Corrective Action	
	$<$ limit	$>$ limit
Fan_NOx	**1.** Check if fan is rotating. It is located under the radiator at the PMT-housing **2.** Check cables **3.** Replace fan **4.** Replace sensorinterface board	**1.** Power cycle airpointer **2.** Check if fan is rotating. It is located under the radiator at the PMT-housing **3.** Checks cables **4.** Replace fan **5.** Replace sensorinterface board
RCellPressNO	**1.** Note: Rcell pressure sensor is identical to pump pressure sensor **2.** Check pump pressure sensor Disconnect pump from power supply, pump pressure must increase to approx. ambient pressure **3.** Check for blocked tubing (vacuum tube to pump). **4.** Check pressure sensor reading with an external pressure sensor **5.** Calibrate with potentiometer on pressure sensor board **6.** Exchange pressure sensor or sensor interface board if needed	**1.** Note: Rcell pressure sensor is identical to pump pressure sensor **2.** Leak check, see section 11.10 **3.** Check pump pressure sensor by measuring the pump vacuum with an external pressure sensor **4.** Calibrate with potentiometer on pressure sensor board **5.** Rebuild pump **6.** Exchange pump
RCellPressNOx	**1.** Note: Rcell pressure sensor is identical to pump pressure sensor **2.** Check pump pressure sensor Disconnect pump from power supply, pump pressure must increase to approx. ambient pressure **3.** Check for blocked tubing (vacuum tube to pump). **4.** Check pressure sensor reading with an external pressure sensor **5.** Calibrate with potentiometer on pressure sensor board **6.** Exchange pressure sensor or sensor interface board if needed	**1.** Note: Rcell pressure sensor is identical to pump pressure sensor **2.** Leak check, see section 11.10 **3.** Check pump pressure sensor by measuring the pump vacuum with an external pressure sensor **4.** Calibrate with potentiometer on pressure sensor board **5.** Rebuild pump **6.** Exchange pump

Parameter	Corrective Action	
	< limit	> limit
FlowNOx	**1.** Flow is not measured, it is calculated via the pressure difference between PressPump and PressNOx **2.** Check PressNOx. If significantly lower than ambient pressure search for blocked inlet e.g. due to blocked sample filter or bended tube **3.** Check pressure sensor calibration (System and NO_x) **4.** Measure the flow with an external flowmeter. If flow is within limits edit NOxFlowSlope in Setup/Configuration/NOx Sensor in user interface until flow is displayed correctly **5.** Check for sufficient pump vacuum. If necessary rebuild pump **6.** Clean or replace flow orifice and replace sintered metal filter	**1.** Flow is not measured, it is calculated via the pressure difference between PressPump and PressNOx **2.** Check pressure sensor calibration (System and NO_x) **3.** Measure the flow with an external flowmeter. If flow is within limits edit NOxFlowSlope in Setup/Configuration/NOx Sensor in user interface until flow is displayed correctly **4.** Clean or replace flow orifice and replace sintered metal filter
FlowO3Gen	**1.** Flow should be approx. 80-100 ml/min. Measure with external flowmeter. If flow is within limits adjust potentiometer at flow sensor board carefully (very sensitive) until the external reading is matched. **2.** Check for blocked tubes or DFU-Filter **3.** Clean or replace flow orifice and replace sintered metal filter	**1.** Flow should be approx. 80-100 ml/min. Measure with external flowmeter. If flow is within limits adjust potentiometer at flow sensor board carefully (very sensitive) until the external reading is matched. **2.** Check for flow shortcuts in the ozone permapure dryer

15.5.1.4. CO Module

COSensor

G/P	Status	Parameter	Actual	Average	Unit	lower limit fail	lower limit warn	upper limit warn	upper limit fail	Board Adr
G2P1	OK	CO	0.174	0.173	ppm	-	-	-	-	-
G2P2	OK	PressCO	852.1	853.8	mbar	300.0	-	-	1080.0	034
G2P3	OK	BenchT	50.0	50.0	°C	43.0	45.0	56.0	58.0	034
G2P4	OK	WheelTCO	70.0	70.0	°C	63.0	65.0	73.0	75.0	034
G2P5	OK	PDETemp	3.72	3.72	V	0.10	-	-	4.90	002
G2P6	OK	SampleTempCO	49.6	49.6	°C	30.0	35.0	55.0	57.0	002
G2P9	OK	COMeas	3722.0	3724.8	mV	500.0	1000.0	4950.0	5000.0	002
G2P10	OK	CORef	3108.4	3110.7	mV	500.0	1000.0	4950.0	5000.0	002
G2P11	OK	CORatio	1.2143	1.2144	-	1.0100	1.0500	1.2500	1.3000	-
G2P12	OK	PowerToCOBench	4.0	4.2	%	-	-	-	-	034
G2P13	OK	PowerToWheel	16.7	16.6	%	-	-	-	-	034
G2P14	OK	CO_all	0.174	0.173	ppm	-	-	-	-	-
G2P15	OK	LampPowerCO	-	-	%	-	-	-	-	-
G2P16	OK	COStdDev	0.0172	0.0182		-	-	-	-	-
G2P19	OK	FlowCO	414.0	415.7	ml/min	300.0	350.0	750.0	850.0	034
G2P20	OK	COScrubberTemp	70.0	70.0	°C	-	60.0	80.0	-	034
G2P21	OK	PowerToCOScrubber	30.1	30.1	%	-	-	-	-	034
G2P22	OK	CO_cylinder	92.5	92.5	bar	-	10.0	200.0	-	034

Figure 15.6.: CO Parameters

Parameter	Corrective Action	
	$<$ limit	$>$ limit
PressCO	**1.** Check for clogged sample filter **2.** Check for clogged or clamped tubes **3.** Check pressure sensor reading with an external pressure sensor, calibrate with potentiometer on pressure sensor board **4.** Replace pressure sensor and/or sensor interface board	**1.** Check pressure sensor reading with an external pressure sensor, calibrate with potentiometer on pressure sensor board if needed **2.** Check signal processing (sensor interface board) and pressure sensor by attaching a vacuum pump to the tube to the pressure sensor **3.** Replace pressure sensor and/or sensor interface board
BenchT	**1.** Check Parameter "PowertoCOBench" from Service interface. If at or near 100% check heater resistance. Heater is mounted to the bottom of the Absorption bench and consists of two elements. It can be checked at ST 6 of the valve heater3 board. There should be approx 76 Ohms between Pin 1 and 5 and 330 Ohms between Pin 4 and 5. Replace heater if needed. **2.** Check thermocouple. Typical resistance at room temperature is 31 kOhms at ST11 at valve heater3 board **3.** Swap valve heater3 board	**1.** Check thermocouple. Typical resistance at room temperature is 31 kOhms at ST11 at valve heater3 board **2.** Swap valve heater3 board
WheelTCO	**1.** Check Parameter "PowerToWheel" from Service interface. If at or near 100 % check heater resistance. The heater can be checked at ST 8 of the valve heater3 board. There should be approx 300 Ohms resistance. Replace heater if needed. **2.** Check thermocouple. Typical resistance at room temperature is 33 kOhms at ST19 at valve heater3 board **3.** Swap valve heater3 board	**1.** Check thermocouple. Typical resistance at room temperature is 33 kOhms at ST19 at valve heater3 board **2.** Swap valve heater3 board

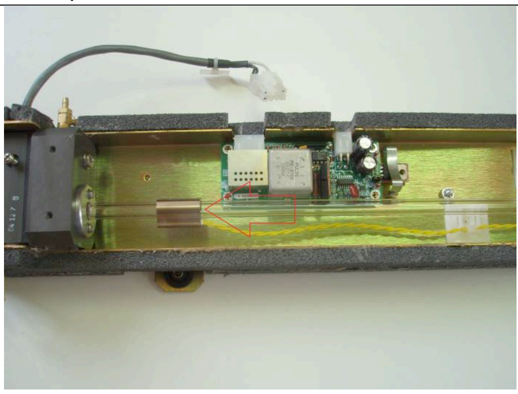
Parameter	Corrective Action	
	< limit	> limit
CO Meas/CO Ref	**1.** Check if source is lit. Carefully loose source mounting screws, move source slightly and look if it glows. Peak source to maximum output by carefully loose the mounting screws and move it slightly **2.** Check if wheel motor is turning. Check for power to the motor (approx. 88VAC) at pins 1 and 3 **3.** Remove cover of Sync/demodulato-Board on top of the bench and see if both status LED´s (D1 and D2) are flashing. If yes, failure is most likely the IR-detector. If not the optocoupler or the sync/demod-board is defective **4.** Check optocoupler by measuring the frequency at TP1 and at TP2 on the with an oscilloscope or an frequency counter. It should be 25 Hz at TP1 and 300Hz at TP2 for 50Hz operation. If not replace optocoupler **5.** Adjust potentiometer VR1 at the sync/demodulator board to 4500mV CO Meas@ Zero gas	**1.** Source maybe too bright. Carefully loose the mouning screws and move source slightly **2.** Adjust potentiometer VR1 at the Sync/Demodulator board to 4500mV CO Meas@ Zero gas
CO ratio	**1.** Check if CO Meas/CO Ref is within limits. If not proceed troubleshooting above **2.** Check if wheel motor is turning. Check for power to the motor (approx. 88VAC) at pins 1 and 3 **3.** Check optocoupler by measuring the frequency at TP1 and at TP2 on the with an oscilloscope or an frequency counter. It should be 25 Hz at TP1 and 300Hz at TP2 for 50Hz operation. If not replace optocoupler **4.** Replace filter wheel (unlikely)	**1.** Check if CO Meas/CO Ref is within limits. If not proceed troubleshooting above **2.** Check optocoupler by measuring the frequency at TP1 and at TP2 on the with an oscilloscope or an frequency counter. It should be 25 Hz at TP1 and 300Hz at TP2 for 50Hz operation. If not replace optocoupler **3.** Replace filter wheel (unlikely)
FlowCO	See section 15.2.4 "Flow Problems" above	

15.5.1.5. O_3 Module

O3Sensor

G/P	Status	Parameter	Actual	Average	Unit	lower limit fail	lower limit warn	upper limit warn	upper limit fail	Board Adr
G3P1	OK	O3	14.7	15.0	ppb	-	-	-	-	-
G3P2	OK	PressO3	850.0	852.2	mbar	300.0	500.0	1200.0	1300.0	003
G3P3	OK	BenchTO3	58.0	58.0	°C	46.0	48.0	65.0	68.0	035
G3P5	OK	SampleTempO3	45.5	45.5	°C	0.0	10.0	60.0	75.0	003
G3P8	OK	PhotoOutMeas	3810.5	3810.4	mV	500.0	1000.0	4950.0	5000.0	003
G3P9	OK	PhotoOutRef	3810.7	3810.7	mV	500.0	1000.0	4950.0	5000.0	003
G3P10	OK	PhotoOut16	2500.0	2500.0	mV	-	-	-	-	035
G3P11	OK	PowerToBenchO3	20.1	20.0	%	-	-	-	-	035
G3P13	OK	LampPower	39.6	39.6	%	-	-	-	-	-
G3P14	OK	O3_all	14.7	15.0	ppb	-	-	-	-	-
G3P15	OK	O3StdDev	3.29	3.12	ppb	-	-	-	-	-
G3P23	OK	Flow	524	526	ml/min	200	300	650	850	035
G3P25	OK	O3GenPress	995.1	994.8	mbar	300.0	500.0	1200.0	1300.0	035
G3P26	OK	O3GenTemp	50.1	50.1	°C	46.0	48.0	65.0	68.0	035
G3P27	OK	O3GenTPower	10.8	11.3	%	-	-	-	-	035
G3P28	OK	O3GenLampCurr	0.4	0.4	mA	-	-	22.0	24.0	035
G3P29	OK	O3GenIntensity	196.6	196.6	mV	-	10.0	4950.0	-	035
G3P31	OK	O3GenPower	0.0	0.0	%	-	-	-	-	-
G3P32	OK	O3 [µg/m³]	29.5	30.0	µg/m³	-	-	-	-	-
G3P33	OK	O3 [µg/m³]_all	29.5	30.0	µg/m³	-	-	-	-	-
G3P34	OK	O3_raw	10.2	15.2	ppb	-	-	-	-	-
G3P1	OK	O3 - last Zero (setpoint: 0.0)	-0.8	-0.8	ppb	-10.0	-5.0	5.0	10.0	-
G3P32	OK	O3 [µg/m³] - last Zero (setpoint: 0.0)	-	-	µg/m³	-	-	-	-	-
G3P1	OK	O3 - last Zero (setpoint: 400.0)	1124.8	1124.8	ppb	-30.0	-15.0	15.0	30.0	-
G3P32	OK	O3 [µg/m³] - last Zero (setpoint: 800.0)	-	-	µg/m³	-	-	-	-	-

Figure 15.7.: O_3 Parameters

Parameter	Corrective Action	
	< limit	> limit
PressO3	**1.** Check for clogged sample filter **2.** Check for clogged or clamped tubes **3.** Check pressure sensor reading with an external pressure sensor, calibrate with potentiometer on pressure sensor board **4.** Replace pressure sensor and/or sensor interface board	**1.** Check pressure sensor reading with an external pressure sensor, calibrate with potentiometer on pressure sensor board if needed **2.** Check signal processing (sensor interface board) and pressure sensor by attaching a vacuum pump to the tube to the pressure sensor **3.** Replace pressure sensor and/or sensor interface board
BenchTO3	**1.** Check heater for resistance between the leads. Replace in case of measuring zero or continuity. **2.** Check thermocouple. Replace if necessary **3.** Replace valve heater3 board	
SampleTempO3	 **1.** The location of the sample temperature sensor is marked in the photo above. Check thermocouple for approx. 33KOhms resistance at room temperature. Replace if necessary **2.** Replace sensor interface board **3.** Verify reason for sample temp being out of range (e.g. heated sample tube?)	

Parameter	Corrective Action	
	$<$ limit	$>$ limit
PhotoOutMeas PhotoOutRef	**1.** Clean absorption tubes with pressurized, dry air free of oil or deionized water. Let the tubes dry before re-installation **2.** Check if UV-lamp is lit by loosen the retaining screw and by sliding it carefully out of its housing **Caution: Do not look into the lamp without special UV-protection glasses. UV-light may harm your eyes!** **3.** If UV lamp is off verify 15V-supply voltage to UV-power supply board at ST6 of the sensor interface board is present. If ok exchange lamp, if still not lit swap UVPS-board **4.** If UV-lamp is lit peak lamp to max. PhotoOutMeas by adjusting its position and orientation in its holder. **5.** Check UV-detector. The gain for the UV-detector can be adjusted via a potentiometer at this board. If instrument is too noisy after adjustment replace UV-lamp **6.** Replace sensor interface board	**1.** UV-Source output is controlled via software **2.** Check for heavy lamp intensity fluctuations **3.** Replace UV-lamp **4.** Replace UV-detector **5.** Replace sensor interface board

A. Software Protocols

To establish the highest possible degree of flexibility, the airpointer® supports three serial communication protocols: The *AK Protocol* the *German Ambient Network Protocol* and *modbus*. These protocols enable a locally available computer to obtain information electronically from an analyzing unit similar to analog outputs. These protocols are described in this appendix. Use serial port 'COM 4' (see Figure A.1) for communication via these protocols.
However, use and implementation of these protocols assume a thorough understanding of the principles of serial communication.

Normal operation via Internet and browser does not require any understanding of these protocols.

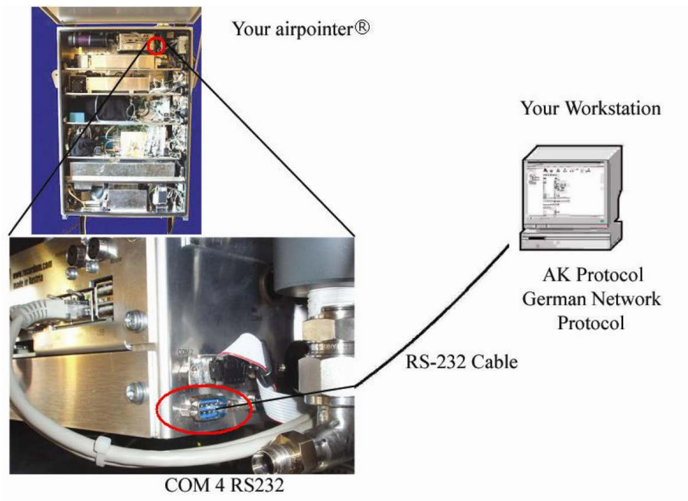


Figure A.1.: COM Port For Communication via AK and German Ambient Network Protocol

A.1. AK Protocol

The AK Protocol allows the user to query the present value of any system variable remotely. Table A.1 depicts the detailed structure of the so-called *Ask Register Command* (AREG) used for queries of current system variables of the airpointer®.

Transmission to Instrument			Response from Instrument			
Byte	Example	Description	B	No Err	Error	Description
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	4	1-digit Station Number.	2	4	4	1-digit Station Number.
3	A	Ask Register command.	3	A	A	4-digit Ask Register command.
4	R		4	R	R	
5	E		5	E	E	
6	G		6	G	G	
7	␣	Space.	7	␣	␣	Space.
8	K	2-digit Channel Number.	8	0	0	Number of current status conditions.
9	0		9	␣	␣	Space.
10	␣	Space.	10	9	S	Program Register Code of the variable whose value is being requested. The PRC may be up to 3 digits long and is not in the response.
11	9	Program Register Code of the variable whose value is being requested. The PRC may be up to 3 digits long. Do not right-fill if the PRC is less than 3 characters long.	11		E	
12			12		<ETX>	
13			13	␣	<CR>	Space.
14	<ETX>	ASCII code 003.	14	9	<LF>	Current value of the variable referenced by the Ask Register command. NOTE: This value can be of varying length.
15			15	7		
16			16	4		
17			17	.		
18			18	3		
19			19	8		
20			20	<ETX>		ASCII code 003.
21			21	<CR>		Up to 3 digits appended to the end of the response transmission.
22			22	<LF>		
23	For description of Status Byte (PRC 041) refer to Table A.6(a)		23			
24			24			
25			25			
26			26			
27			27			
28			28			

Table A.1.: AK Protocol

	Value	Description		Value	Description
Concentrations	1	NOConcentration	Chip Temperatures	48	ChipTSO2
	2	NO2Concentration		49	TempChipSO2
	3	NOxConcentration		50	ChipTNOx
	4	COConcentration		51	TempChipNOx
	5	O3Concentration		52	ChipTCO
	6	SO2Concentration		53	TempChipCO
Pressures/Flow	10	PressNOx		54	ChipTO3
	11	PressCO		55	TempChipO3
	12	PressO3RefMeas		56	ChipTSys
	13	PressSys		57	TempChipSys
	14	Flow		58	TempChipPump
	15	PressSO2		59	TempChipClima
Temperatures	20	RCellT	Signals	60	PMTSigNO
	21	MolyT		61	PMTSigNOx
	22	PMTTempNOx		62	PMTSigAutoO
	23	BenchTCO		63	COMeas
	24	WheelTCO		64	CORef
	25	PDETemp		65	Ratio
	26	SampleTempCO		66	PhotoOutMeas
	27	BenchTO3		67	PhotoOutRef
	28	ScrubberO3		68	PhotoOut16
	29	Sample TempO3		69	ClimaActMode
	30	System Temp (pump)		70	FanSampleRPM
	31	Ambient Temp		71	FanPumpRoomRPM
	32	PumpRoom Temp		72	PMTSigSO2
	33	Room Temp		73	RefDetSO2
	34	CoolerOut Temp		74	PMTSigSO2Dark
	35	ScrubberCO		75	RefDetSO2Dark
	36	BenchTSO2		76	HVPS_NOx
	37	PMTTempSO2		77	HVPS_SO2
	41	Status			

Table A.2.: Program Register Codes (Byte 11) of AK Protocol for Data Requests (AREG Command)

	Value	Description		Value	Description
Power to Heaters/Lamp	80	RCellPercent	Concentration Raw Values	120	NOraw
	81	MolyPercent		121	NO2raw
	82	BenchCOPercent		122	NOxraw
	83	WheelPercent		123	COraw
	84	BenchO3Percent		124	O3raw
	85	O3ScrubberPercent		125	SO2raw
	86	COScrubPercent		130	RSCommunication
	87	IntensityO3		131	MissingBoards
	88	FanPumpRoomPercent		140	DC+5 V
	89	ClimaCoolerPercent		141	DC+12 V
	90	ClimaHeaterPercent		142	DC+15 V
	91	BenchSO2Percent		143	DC-15 V
	92	IntensitySO2		145	FanNOxRPM
Peltier Clima	100	THSAirInside		146	FanSO2RPM
	101	THSOutside		150	NO(all)
	102	THSPeltier1		151	NO2(all)
	103	THSPeltier2		152	NOx(all)
	104	THSPeltier3		153	CO(all)
	105	THSPeltier4		154	O3(all)
	106	THSPeltier5		155	SO2(all)
	107	THSPeltier6			
	108	PowerPeltier			
	109	FanInside			
	110	FanOutside			
	111	ActMode			
	112	TempChipPeltier			

Table A.3.: Program Register Codes (Byte 11) of AK Protocol for Data Requests (AREG Command) (continued)

A.2. German Ambient Network Protocol

recordum®'s implementation of the German Ambient Network Protocol (see Table A.4 allows the user to request the values of predetermined system variables. Due to the definition of this protocol, it is not possible to remotely select a system variable to be queried.

Transmission to Instrument			Response from Instrument			
Byte	Example	Description	B	No Err	Error	Description
1	<STX>	ASCII code 002.	1	<STX>	<STX>	ASCII code 002.
2	D	The DA command signifies a request for data from the instrument.	2	M	M	Response identifier to the DA command.
3	A		3	D	D	
4	8	3-digit Instrument Identifier. These three bytes are optional.	4	0	0	Number of variables transmitted by the instrument. May be 01, 02, 03.
5	4		5	1	1	
6	5		6	␣	␣	Space.
7	<ETX>	ASCII code 003.	7	8	8	3-digit Instrument Identifier
8	<CRC>	High byte followed by low byte of CRC. The CRCs may be replaced by a single <CR> character.	8	4	4	
9	<CRC>		9	5	5	
			10	␣	␣	Space.
DEFINITION OF CRC BYTES The CRC bytes above (bytes 8 and 9) are the hexadecimal representation of the 'exclusive or' of bytes 1 through 7. The high byte CRC is transmitted as byte 8 and the low byte is sent as byte 9.			11	+ or -	+	Value of variable being transmitted, in the format ±NNNN+EE. For example, a value of 63.7 is represented as +0637-01. If syntax error exists or the value of the variable is 0, the instrument returns +0000+00.
			12	n	0	
			13	n	0	
			14	n	0	
			15	n	0	
			16	+ or -	+	
CURRENT OPERATING MODE (Bytes 20, 21) The two-digit hexadecimal representation of the current operating mode is determined as followed: Mode 1 2 Mode 2 4 Mode 3 8 Mode 4 10 (decimal 16) Mode S 0 Mode X 20 (decimal 32)			17	e	0	
			18	e	0	
			19	␣	␣	Space.
			20	1	1	2-digit hexadecimal representation of current instrument operating mode (descr. at left and in Table A.6(b))
			21	0	0	
			22	␣	␣	Space.
			23	0	0	2-digit hexadecimal representation of current instrument status condition(see description at left and in Table A.6(a).)
			24	0	0	
			25	␣	␣	Space.

Table A.4.: German Ambient Network Protocol

<table>
<tr><td rowspan="2"></td><td>26</td><td>0</td><td>0</td><td rowspan="3">3-digit Location ID</td></tr>
<tr><td>27</td><td>0</td><td>0</td></tr>
<tr><td rowspan="10">CURRENT STATUS CONDITION (Bytes 23, 24)

The 2-digit hexadecimal representation of the current status condition is computed by summing up the numeric values for all current status conditions. Bytes 23 and 24 are both equal to 0, if no current status condition exists.

0 OK No current status conditions.

For a description of the Status Bits refer

to Table A.6(a)</td><td>28</td><td>1</td><td>1</td></tr>
<tr><td>29</td><td>␣</td><td>␣</td><td>Space.</td></tr>
<tr><td>30</td><td>0</td><td>9</td><td rowspan="3">3-digit PRC of the variable being transmitted, zero-filled from the left. These bytes are not defined in the German Ambient Network Protocol, but are included for informational purposes.</td></tr>
<tr><td>31</td><td>0</td><td>9</td></tr>
<tr><td>32</td><td>8</td><td>9</td></tr>
<tr><td>33</td><td>␣</td><td>␣</td><td rowspan="3">These bytes are not defined in the German Ambient Network Protocol, and are reserved for future definition.</td></tr>
<tr><td>34</td><td>␣</td><td>␣</td></tr>
<tr><td>35</td><td>␣</td><td>␣</td></tr>
<tr><td>36</td><td>␣</td><td>␣</td><td>Space.</td></tr>
<tr><td>37</td><td><ETX></td><td><ETX></td><td>ASCII code 003.</td></tr>
<tr><td></td><td>38</td><td><CRC></td><td><CRC></td><td rowspan="2">High byte and low byte of CRC. The CRCs are replaced by a single <CR> if transmit byte 8 was <CR>.</td></tr>
<tr><td rowspan="4">DEFINITION OF CRC BYTES

The CRC information in bytes 38 and 39 is the hexadecimal representation of the "exclusive or" of all response bytes. The high byte of the CRC is transmitted as byte 38 and the low byte is sent as bye 39.</td><td>39</td><td><CRC></td><td><CRC></td></tr>
<tr><td>40</td><td><CR></td><td><CR></td><td rowspan="3">Up to 3 digits appended to the end of the response transmission.</td></tr>
<tr><td>41</td><td><LF></td><td><LF></td></tr>
<tr><td>42</td><td></td><td></td></tr>
</table>

Table A.5.: German Ambient Network Protocol (continued)

Entry	Gas
1	NO
2	NO_2
3	NO_x
4	CO
5	O_3
6	SO_2

Table A.6.: Order of Variables Reported by the German Ambient Network Protocol (with Response Byte 4='0' and 5='6')

(a) Status Bits

Bit	Fail Status
0	Flow
1	Pressure
2	Temperature
3	Lamp/Source
4	Sensor Signals
5	
6	
7	Sum Fail

(b) Mode Bits

Bit	Operation Mode
0	Maintenance
1	Zero
2	Span
3	Origin
4	
5	
6	
7	

Table A.7.: Reference for ‘Status’ and ‘Mode’ in AK and German Ambient Network Protocol

A.3. Modbus

Modbus is an openly published serial communications protocol developed for industrial applications. It enables communication for many devices connected to the same network.
We at recordum® use the so called 'TCP Modbus'. Modbus is capeable of the most common data types like bit, integer and floats. The airpointer® Modbus only uses floats as data type.
In general you need to set the Modbus registers in your LinOut Interface 7.7.7. The LinOut Interface provides the local values from your device which can be transported via Modbus to other devices. The default config shipped to you serves for most operations.

NOTE
If you want to work with Modbus you always have to know the IP address of your device and its port(The standard port is 1502)

For further information about the Modbus system you can visit `http://en.wikipedia.org/wiki/Modbus`.

B. HTTP - Download Interface

HTTP – Download Interface

Page: info.php
[airpointer IP|Name]/download/info.php
Call „info.php" to get a list of all possible parameters.

Page: download.php
[airpointer IP|Name]/http_if/download.php
Request measurement data via calling „download.php". You have to provide at least all mandatory GET-parameters (tstart, tend, ~~colT~~) and one avg[1|2|3] parameter.

Authentication - Parameters for info.php and download.php

GET-Parameter	*Value*	*Description*
loginstring	String	Login name of existing (recommended: low-privileged) user
user_pw	String	Password for login

GET - Parameters for download.php:

GET-Parameter	*Value*	*Description*
tstart	YYYY-MM-DD,hh:mm:ss	Start time, Example value: 2005-09-08,10:09:00
tend	YYYY-MM-DD,hh:mm:ss	End time (cp. tstart)
colT	[P_id],[avg]	Not used any more, since version 1.9.2b17. (Except in case that legacyorder is set) Time reference column, Example (parameter id: 3, average source: 2): 3,2
avg1 [opt.]	[P_id],[P_id],...	Parameter ids to download from average 1 source
avg2 [opt.]	[P_id],[P_id],...	Parameter ids to download from average 2 source
avg3 [opt.]	[P_id],[P_id],...	Parameter ids to download from average 3 source
null [opt.]	String	Fill nullfields with *String* (default is: NULL)
del [opt.]	[Delimiter]	Field delimiter, possible values (default is: SEMI): SEMI;COMMA;TAB;SPACE
dec [opt.]	[DecimalSeparator]	Decimal separator, possible values (default is: COMMA): COMMA, POINT
interpolate [opt.]	none	If set, missing timevalues are interpolated
quotes [opt.]	none	If set, fields are surrounded by double quotes
nohtml [opt.]	none	If set, only csv data is sent back to client, no html code
status [opt.]	none	If set, status bytes are added to each query value
legacyorder [opt.]	none	If set, old sorting algorithmus for parameters is used If set, also deprecated param „colT" must be specified

GET-Parameter	*Value*	*Description*
NEW (Xml related) (to use with http_if/download.php)		
type	[return_type]	Set, how returned data should be structured: xml, csv (default: xml)
async	[async_type]	Pseudo-asynchronous/asynchronous and compressed download: Only with type=xml, query then returns url to compressed (zip) xml file that can then be downloaded Values: 1 or 2
readystate	[filename]	Query the state of the download file. Used in asynchronous mode 2. Returns a status of OK or WAITING

Pseudo Asynchronous Mode (type 1):
(available since version 1.3.15)

After invoking the special download url, the call lasts until the file with requested measurement data will have been generated. An xml document is returned that includes a filename where the composed data can be downloaded.

Fully Asynchronous Mode (type 2)
(available since version 1.3.16)

The url with download parameter selection is invoked but unlike with type 1 the request returns immediately and sends back an xml document with the filename of the data file. Afterwards consecutive calls to download.php should follow with the GET parameter „readystate=[filename]". Those calls will return the status of generation (either OK or WAITING). A status OK indicates, the file is ready for download.
See example below.

Simple Example:

Invoke download for NO2 (ParamId: 2) and CO (4) of all average values (i.e. 1,2 and 3) for the time period between 1st September 2005, 3p.m. and 5th September 2005 3a.m., using „NULL" to fill NULL-fields. The domain name of the airpointer is like „airpointer.domain.at", a registered user's login is „max", the user's password is „secret" and this user has at least „Create downloadable data files " privileges.
Remember: Don't forget to encode the URL string approriately!

-> *Request from application:*
http://airpointer.domain.at/http_if/download.php?loginstring=max&user_pw=secret&tstart=2005-09-01,15:00:00&tend=2005-09-05,03:00:00&avg1=2,4&avg2=2,4&avg3=2,4&null=NULL

Fully Asynchronous Mode Example:

Invoke download for NO2 (ParamId: 2) and CO (4) of average 1 values for the time period between 1st August 2010, 3p.m. and 2nd August 2010 3p.m.

a) Invoke data request:

-> *Request from application:*
http://airpointer.domain.at/http_if/download.php?loginstring=max&user_pw=secret&tstart=2010-08-01,15:00:00&tend=2010-08-02,15:00:00&avg1=2,4&type=xml&async=2

-> *Response from instrument:*

```
<?xml version="1.0" encoding="iso-8859-1"?>
<AirpointerMonitorData>
  <REQUEST>
    <STATUS>WAITING</STATUS>
    <FILE>/download/tmpdata/20100804_094532_NameOfStation_46235.xml</FILE>
  </REQUEST>
</AirpointerMonitorData>
```


b) Check if file is ready for download by consecutively invoking readystate request:

-> *Request from application:*
http://airpointer.domain.at/http_if/download.php?
readystate=/download/tmpdata/20100804_094532_NameOfStation_46235.xml

-> *Response from instrument (data file not ready yet):*

```
<?xml version="1.0" encoding="iso-8859-1"?>
<AirpointerMonitorData>
  <REQUEST>
    <STATUS>WAITING</STATUS>
    <FILE>/download/tmpdata/20100804_094532_NameOfStation_46235.xml</FILE>
  </REQUEST>
</AirpointerMonitorData>
```


-> *Response from instrument (data file ready):*

```
<?xml version="1.0" encoding="iso-8859-1"?>
<AirpointerMonitorData>
  <REQUEST>
    <STATUS>OK</STATUS>
    <FILE>/download/tmpdata/20100804_094532_NameOfStation_46235.xml.zip</FILE>
  </REQUEST>
</AirpointerMonitorData>
```


c) After receiving `<STATUS>OK</STATUS>` download the created data file (use the file name from the xml response):

-> *Request from application:*
http://airpointer.domain.at/download/tmpdata/20100804_094532_NameOfStation_46235.xml.zip

NOTE: The data file is a compressed xml file in zip format (you may also download in plain xml format by omitting „.zip“ as file extension in the request url)

C. References

[USEPA, 1977] USEPA (1977). Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, volume 2. National Technical Information Service.

[USEPA, 2008] USEPA (2008). Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, volume 2. National Technical Information Service.

Index