GPT mobile version

Manual
V.2.1a

December 2021

airQrate

MANUAL

Content:

1. Introduction

Thank you for choosing the airQrate precision calibrator as your new calibration system.

The airQrate offers a precise and user-friendly calibration of your ambient air and other monitors. The airQrate GPT mobile version is ideally suited for calibrating many types of analyzers with a single portable device.

Main features of the airQrate:

- high quality calibration modules
- digital high precision Mass Flow Controllers (MFC) and Mass Flow Meters (MFM)
- modular construction
- automatic programmable multi point calibration
- internal reporting system
- modern web based user interace
- user friendly operation via touch screen

This manual describes the airQrate specific functionality of the Recordum product family. In addition to this manual please refer to the airQlog manual supplied with your instrument. In the airQlog manual you will find the configuration of its data logging capability, basic configuration of the systems setting and other useful information, e.g. setting up the Internet connection or how to create Graphs and Downloads.

2. System description

The airQrate mobile version consists of a single GPT (Gas Phase Titration) module. It contains a MFM with power-controlled pump for the dilution air, a second MFC for the gas to be diluted, and an ozone generator. It includes a mixing chamber to ensure a sufficient mixing and residence time to complete the ozone reaction. The main application for the GPT module is the generation of a NO/NO_2 calibration gas mixture to determine the NO_2 converter efficiency in NO_X analyzers (*Figure 1*). In addition, thanks to the ozone generator it is capable to be used to calibrate ozone analyzers, and thanks to the 2 MF, it can be used as dilution module to calibrate numerous other analyzers, including SO2, CO, BTEX… The complete airQrate GPT mobile specifications can be found in annex 2.

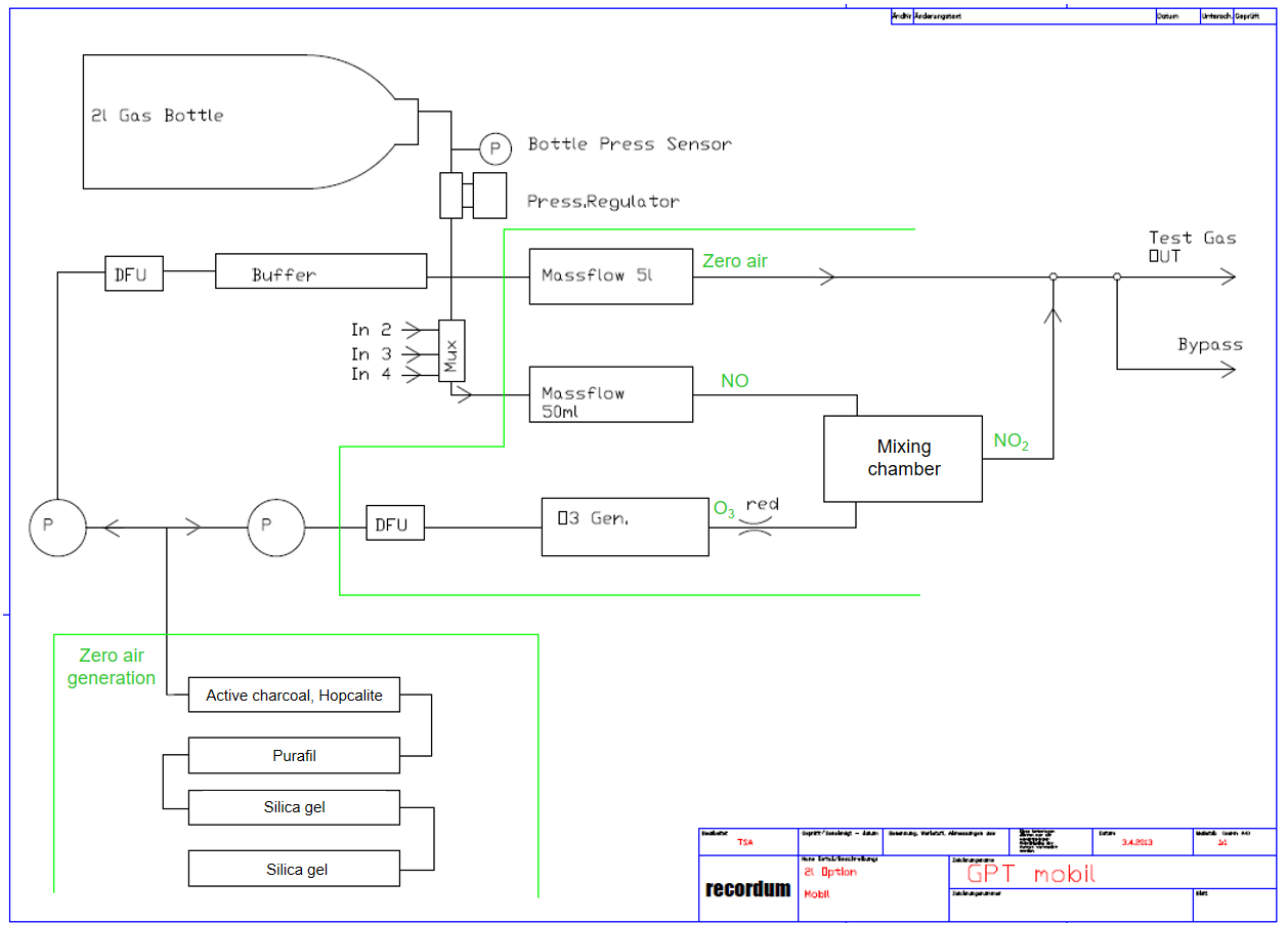


Figure 1: Pneumatic diagram of the AirQrate GPT mobile

As an option for highest precision and accuracy, the ozone generator can be controlled via a photometer (recommended for calibration of ozone monitors).

Another option available is the multiplexer (labelled as “MUX1 to MUX4” in the airQrate menus) (*Figure 2*), allowing to connect up to 3 external cylinders at

once to the same airQrate, additionally to the internal cylinder (*Figure 3*).

Figure 2: Front view of the mobile airQrate

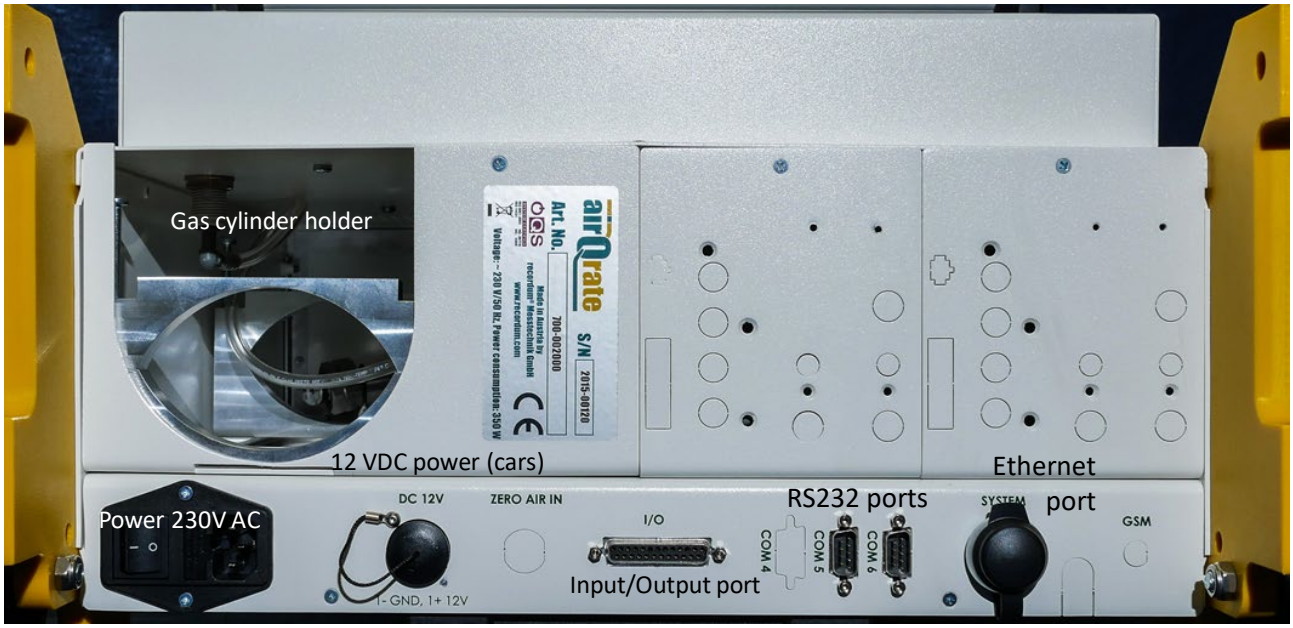


Figure 3: Back view of the mobile airQrate

3. Initial operation

Remove all caps from the gas in- and outlets

Plug the power cord

Activate the switch beneath the power plug

Press On/Off button at the front panel and wait for the login page to appear on the airQrate's screen.

3.1 Pneumatic connections

3.1.1. Installing the calibration gas cylinder

Install the cylinder inside the airQrate: loose the screws on the cover of the airQrate. Disconnect the zero-air quick connector and the electrical grounding in order to be able to remove the cover entirely (*Figure 4*).

Figure 4: Removing the cover of the mobile airQrate

Place the 2L calibration gas cylinder in the appropriate location, head towards the front of the airQrate

Connect the cylinder: connect the 2L calibration gas cylinder to the corresponding Swagelok fittings at the rear panel of the airQrate, without overtightening it (*Figure 5*).

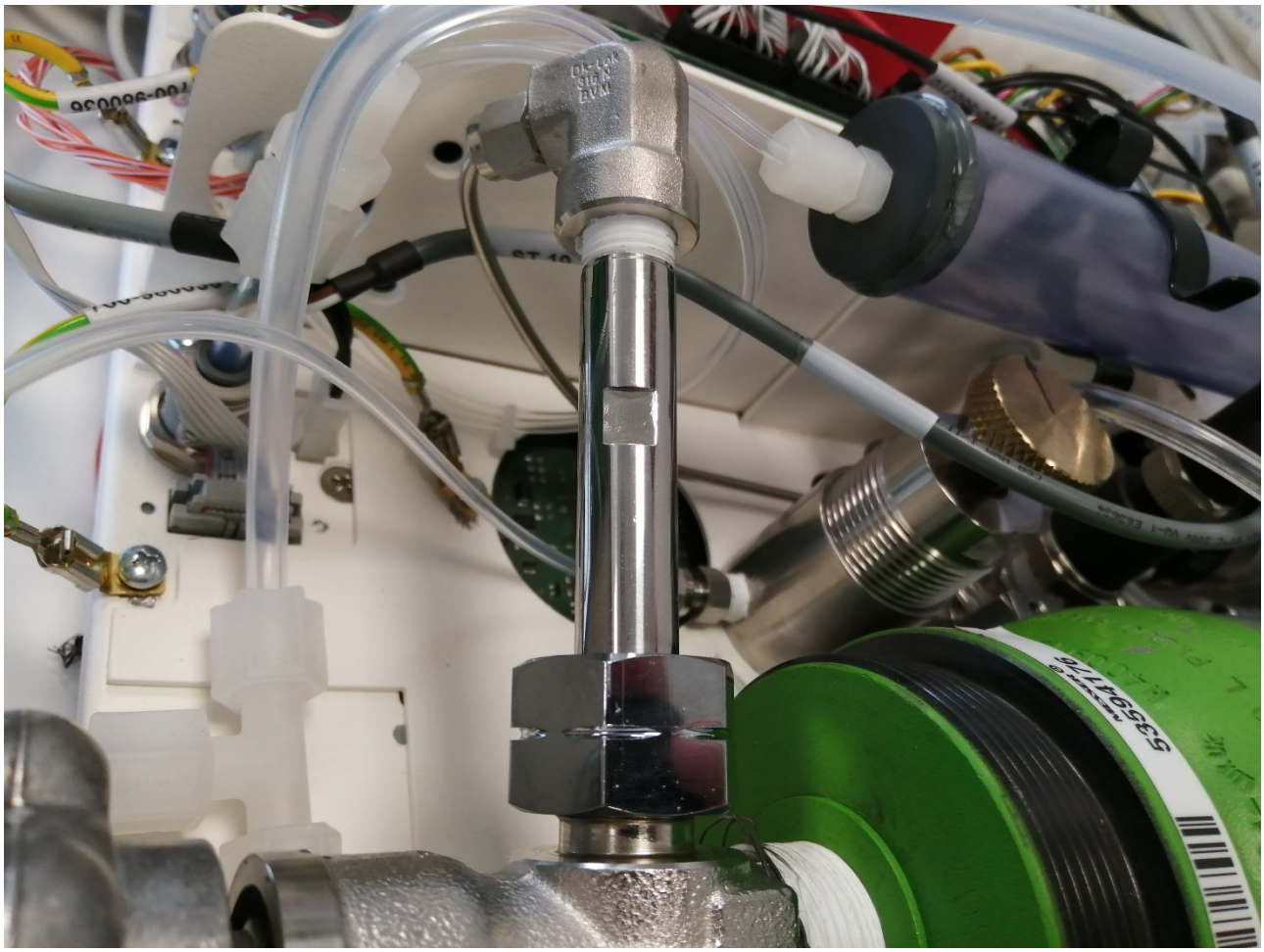


Figure 5: Connecting the internal cylinder

Leak-check the cylinder: open gently the cylinder and close it immediately. Check that the connector is not leaking using Snoop. If it is leaking, tighten slightly more the connector, then repeat the leak check.

Purge the high-pressure tubing: locate the calibration gas MFC in the airQrate. Loosen gently its 1/8” Swagelok connector to let some gas escape. Do not open the connector completely, as this could result in ambient air entering the tubing (*Figure 6*).

Figure 6: Purging the high-pressure tubing

After a few seconds, the noise of escaping gas gets weaker, indicating that the purge is complete, and the connector can be tightened again. This connector is located downstream from the pressure regulator, and therefore holds only 2 bars of pressure, so if not over tight or under tight, it should not leak (*Figure 7*). In case of doubt, it can also be leak-checked with Snoop, but care has to be taken to avoid making the electronics located underneath the connector wet. Tissue can be used for this purpose. This purge is especially important when using SO2 cylinders, as SO2 needs a humidity-free and dioxygen-free environment. The purge is needed only upon installation of a cylinder. Depending on the cylinder concentration, the standard gas may be harmful by inhalation, so the purge should be performed in a well-ventilated area.

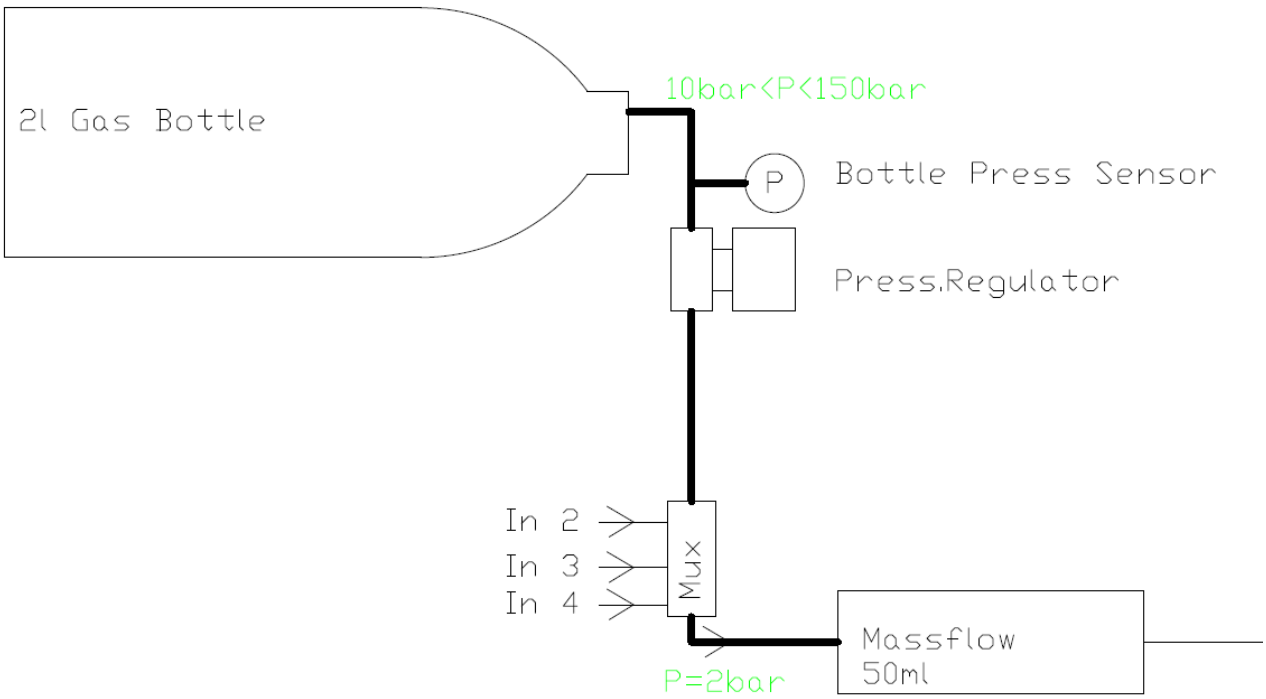


Figure 7: Pneumatic diagram of the high-pressure tubing of the mobile airQrate

Reopen the cylinder: open the cylinder valve completely minus 1 turn (360°).

3.1.2. Uninstalling the calibration gas cylinder

Before shipping the AirQrate, the internal cylinder must be removed!

Remove the cover of the airQrate: loose the screws on the cover of the airQrate. Disconnect the zero-air quick connector and the electrical grounding in order to be able to remove the cover entirely.

Close the cylinder valve.

Purge the high-pressure tubing: locate the calibration gas MFC in the airQrate. Loosen gently the 1/8” Swagelok connector at its inlet to let some gas escape. Do not open the connector completely. After a few seconds, the noise of escaping gas gets weaker, indicating that the purge is complete, and the connector can be tightened again.

Disconnect and remove the cylinder from the airQrate.

3.1.3. Sampling line

Connect the airQrate to the analyzer: connect the analyzer via a 1/4"-PTFE tube with the respective calibration gas out port of the airQrate. The length of

the calibration gas tube should be as short as possible. Do not use a T-piece to vent the connection tube, excess will be vented through the bypass connector of the airQrate.

Check the excess flow of calibration gas: connect a flowmeter or a rotameter at the bypass outlet to verify that the calibration gas is provided in excess.

In the particular case of calibrating an airpointer: the sample inlet can act as a vent when gas is fed through the calibration inlet. A single vent is needed for the calibration. The absence of vent or the presence of 2 vents will lead to a wrong calibration, so either the sample inlet of the airpointer or the bypass of the airQrate must be capped. If the sample inlet of the airpointer is used as a vent, the excess flow cannot be measured, but it can be easily estimated: each module needs a maximum flow of 1 L/min, so the flows provided by the airQrate should be as follows:

- for 1 module: ~1.5 L/min
- for 2 modules: ~2.5 L/min
- for 3 modules: ~3.5 L/min
- for 4 modules: ~4.5 L/min

3.2. Electrical connections

3.2.1. Direct connection between the AirQrate and the analyzer

- Ethernet-connection (preferred): configure the airQrate according to the network setting of the analyzer to be connected. Plug the Ethernet cable into the “System” port at the airQrate’s rear panel. You can configure the network settings of the airQrate in the user menu at setup/communication/network.

- RS232-connection: connect the RS232-Port of the analyzer with a free COM-port at the airQrates rear panel. Please use the cable type needed for your analyzer (straight or cross link cable).

To configure the data acquisition system of the airQrate (to allow the airQrate to read the analyzer’s data), please refer to the airQlog manual supplied with this manual (LinLog configuration).

3.2.2. Direct LAN connection to an external Computer

Use the cross-link type network cable supplied with the airQrate and connect

the computer to the “User” port at the front panel of the airQrate before powering up the external computer.

4. Instrument configuration

4.1. User Interface

The internal touchscreen or an external computer can be used to operate the airQrate. Operated via the build-in screen, the airQrate offers only limited menu access. Therefore, we recommend configuring the unit by using an external computer connected to the airQrate.

- Via internal display: an automatic log-in procedure is preconfigured, you can start using the software directly after start-up.

- Via an external computer:

Open a Web Browser (e.g. Firefox or Chrome). Enter the airQrate IP-Address "172.17.2.140" in the address field of the browser and press <Enter>.

Enter "admin" in the field “user” (*Figure 8*).

The preconfigured password is "1AQuality". Enter it and press "Login". For security reasons, it is recommended to change it.

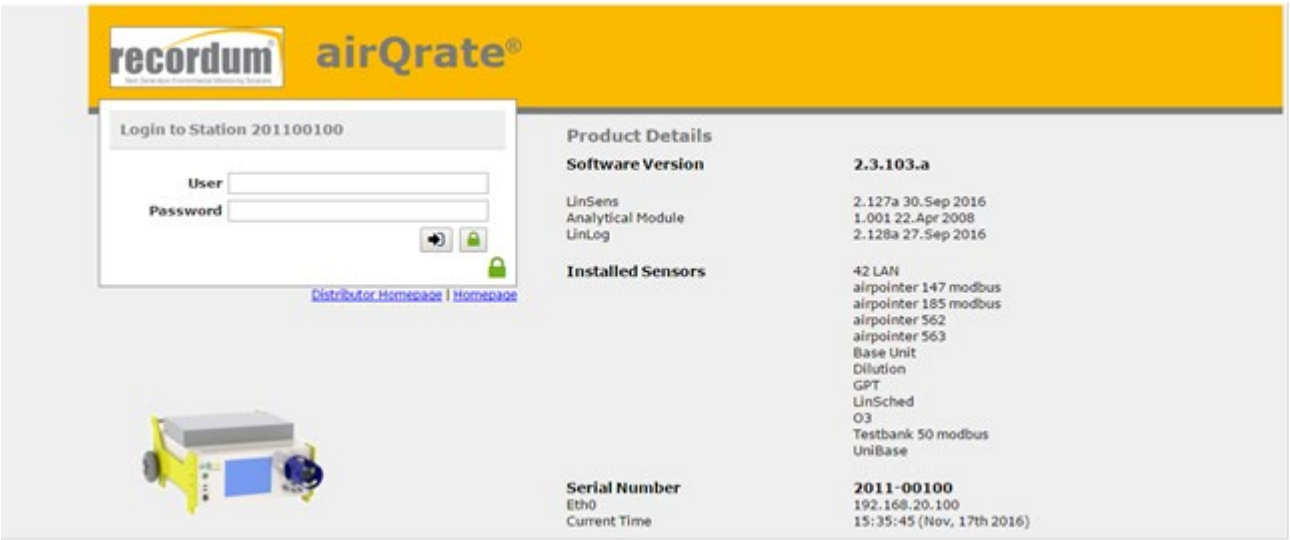


Figure 8: Log-in pageof the airQrate

4.2. Network configuration

To integrate the airQrate into an existing network, go to setup/communication/network and enter the relevant data in “Network” and “Nameserver” (*Figure 9*).

In case of doubt, please contact your network administrator for the correct settings.

The "System" Ethernet-Port at the rear panel can be configured as fixed IP or can be acquired via a DHCP-Server.

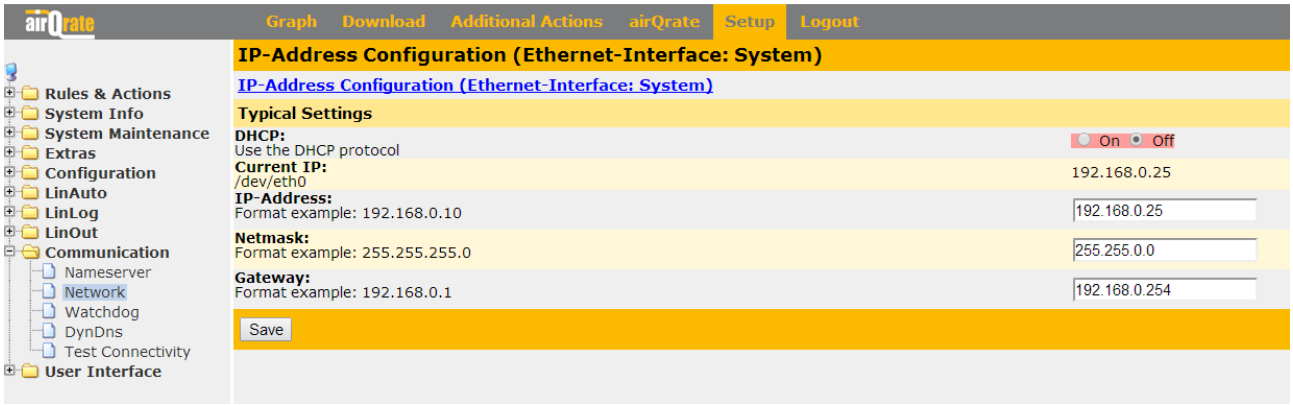


Figure 9: Network configuration

4.3. Gas configuration

Before being able to calibrate using your airQrate, you need to define among other things the nature and the concentration of the gas in the cylinder which will be used.

4.3.1. Gas compounds configuration

Go to airQrate/Preferences/Gas Configuration (*Figure 10*).

There are several preconfigured compounds to be found. Please check if the gas you want to calibrate with is already configured.

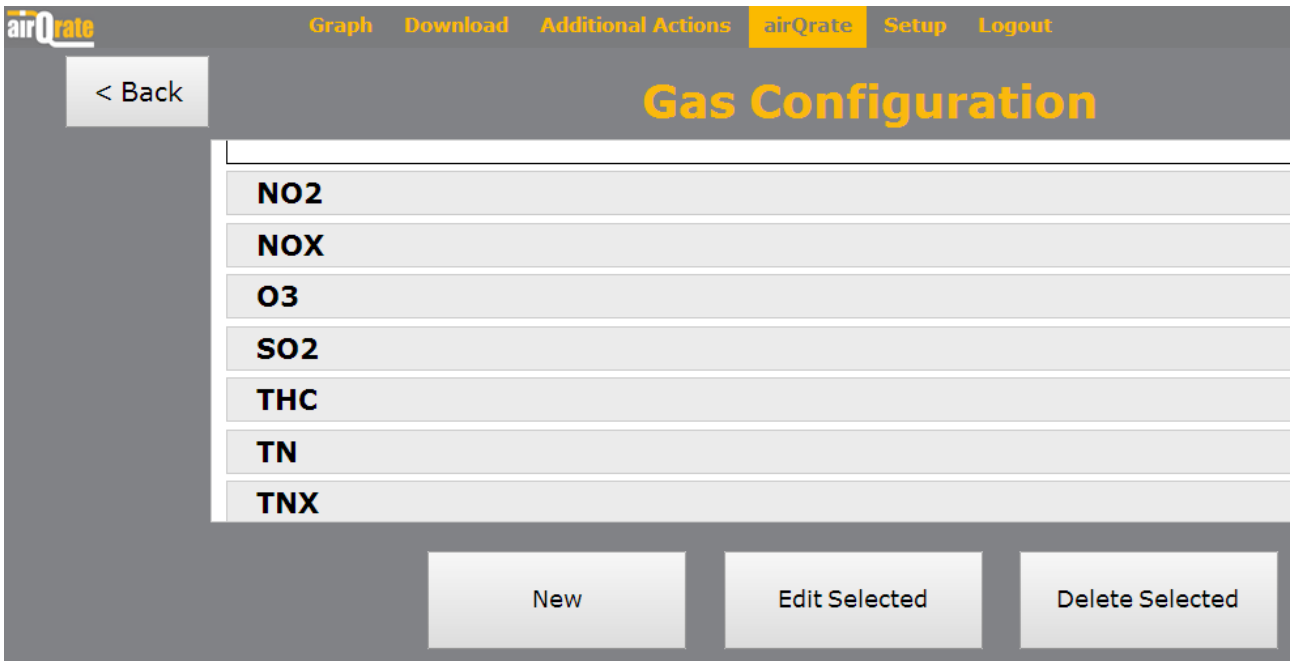


Figure 10: Gas configuration – list of preconfigured gases

If not press <New>, enter a name and the molecular weight and store your settings with <Save> (*Figure 11*).

To return to the Main Menu press <Back> and <Home>.

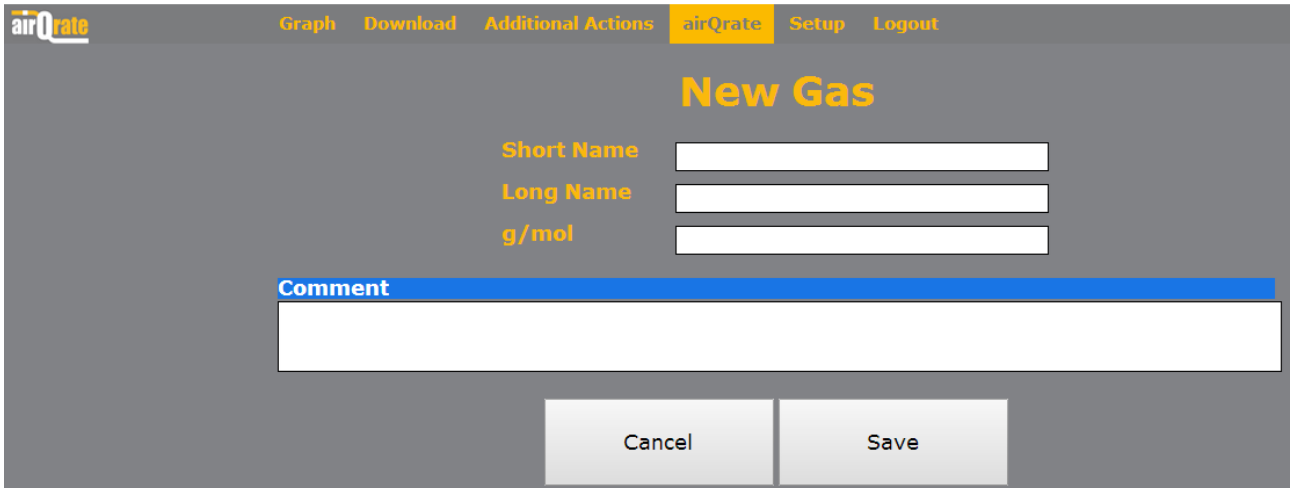


Figure 11: Gas configuration – add a new gas

4.3.2. Gas cylinder configuration

Go to airQrate/Preferences/Cylinder Configuration (*Figure 12*).

Press <New>.

Enter a name for the cylinder to be configured.

In the dropdown lists below you can choose the module the cylinder is

connected to, the mass flow controller, the connection port of the Multiplexer (if installed) and the compound.

Press <Add +>.

Enter the concentration of the calibration gas and its uncertainty. Choose the unit you want to express the concentration in.

Press <Save>.

Repeat the steps above until all the calibration gases of the cylinder are configured.

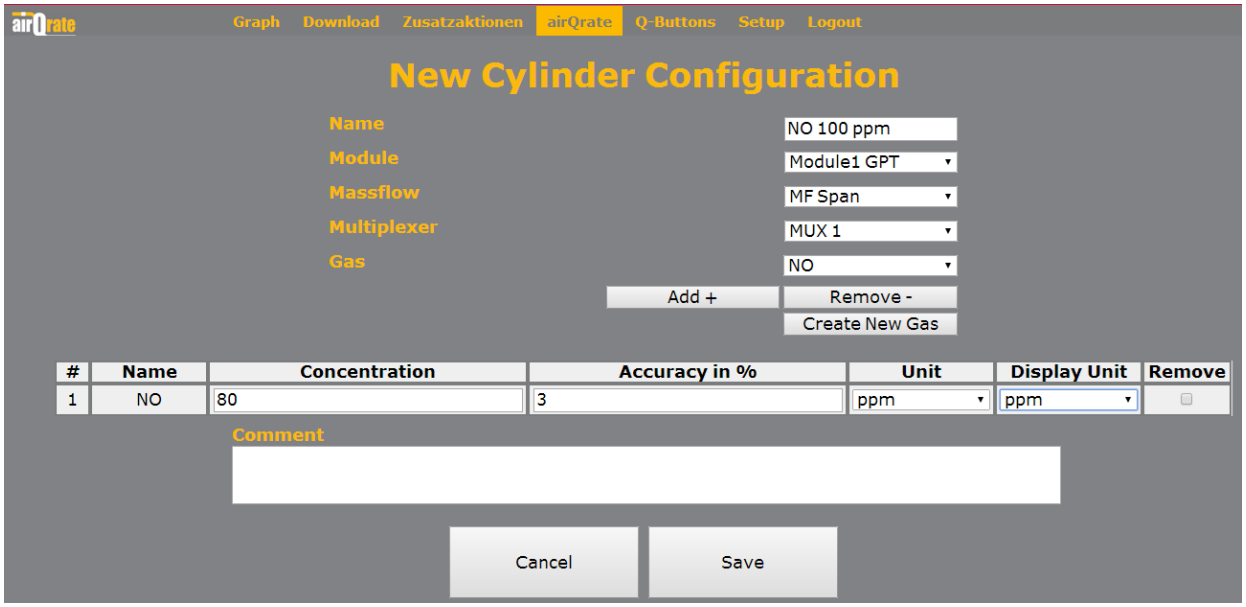


Figure 12: Cylinder configuration

4.4. Configuration of the data acquisition system [optional]

To allow the airQrate to read the data from the analyzer, the analyzer must be configured in the “Linlog configuration” section of the airQrate.

Go to Setup/LinLog/Configuration (*Figure 13*).

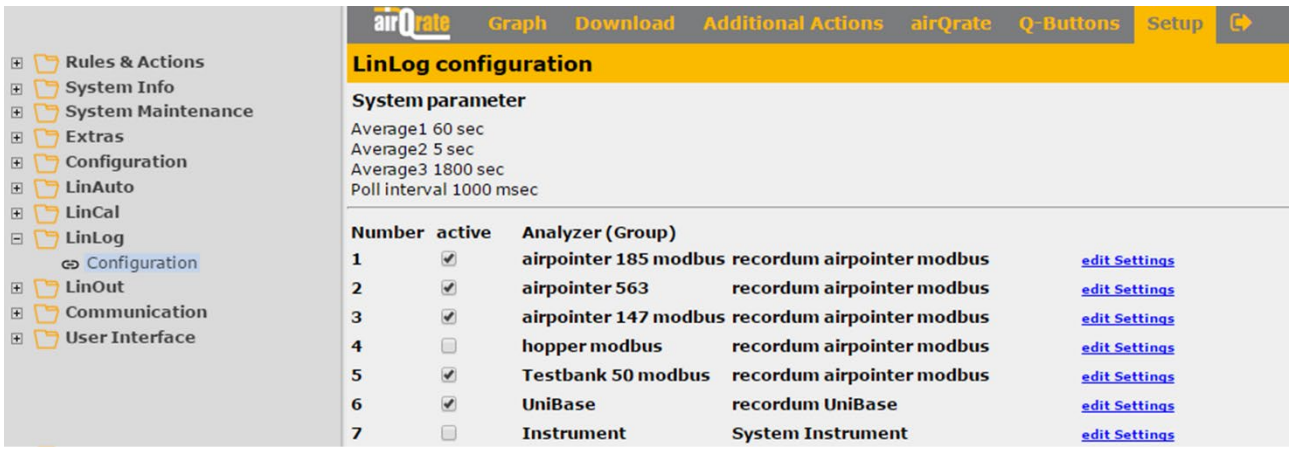


Figure 13: Linlog configuration

Press <Add Analyzer>.

Choose the brand and model of the instrument via the drop-down list and press <submit> (*Figure 14*).

In the following dialog press <OK>.

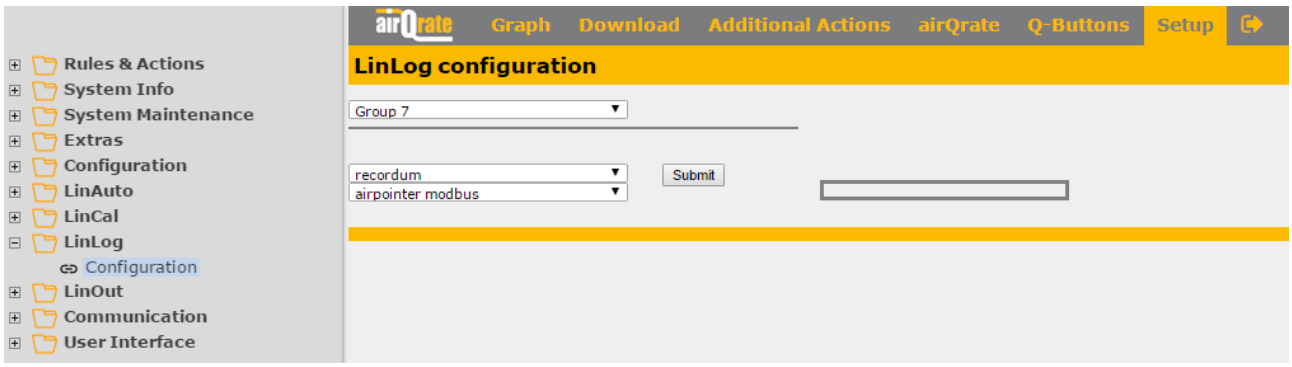


Figure 14: Linlog configuration – adding an analyzer

Enter the settings for the IP/COM-Port, for the parameter and its calculation setup, for the group setup and the calibration timing (*Figure 15*).

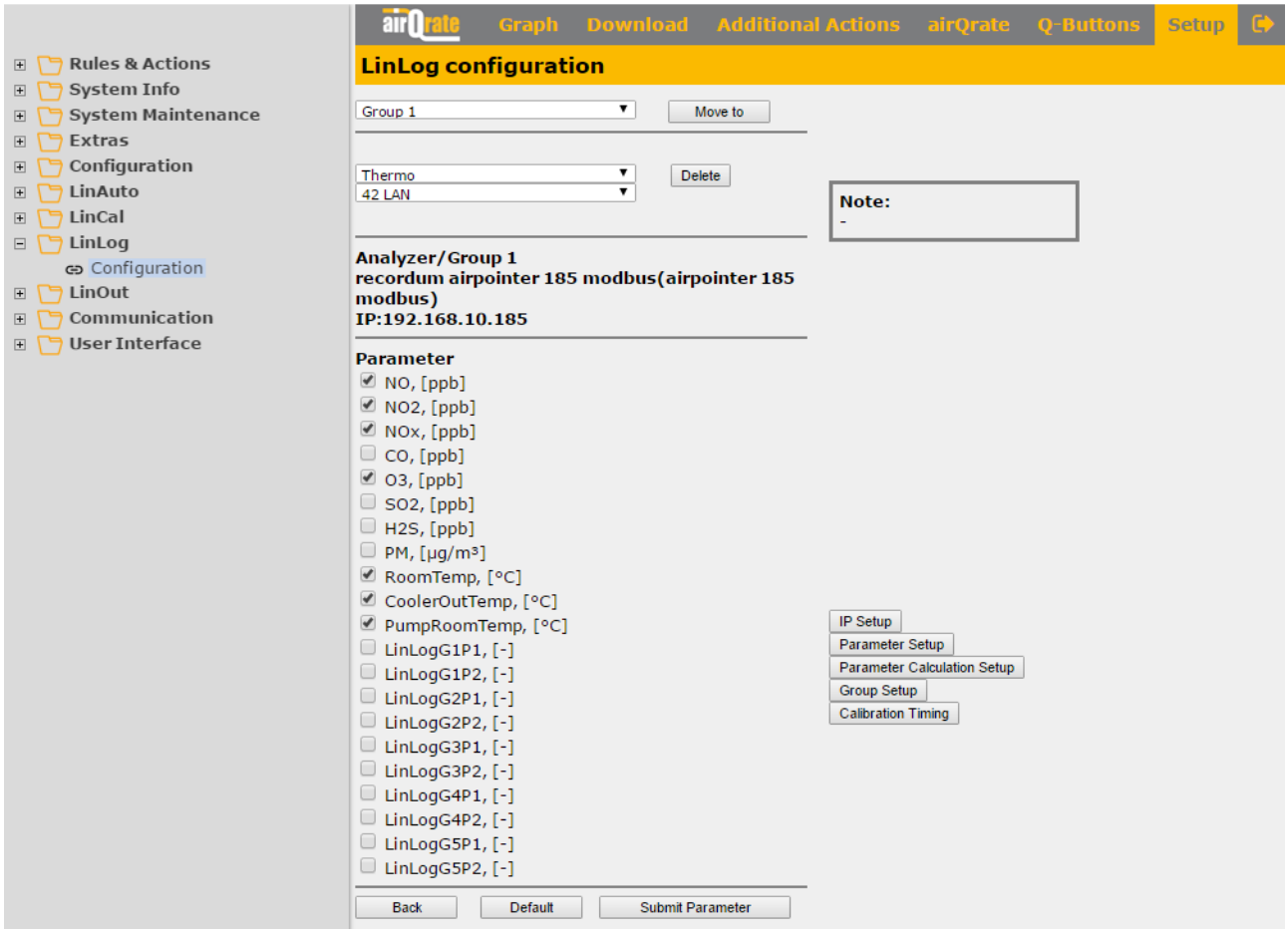
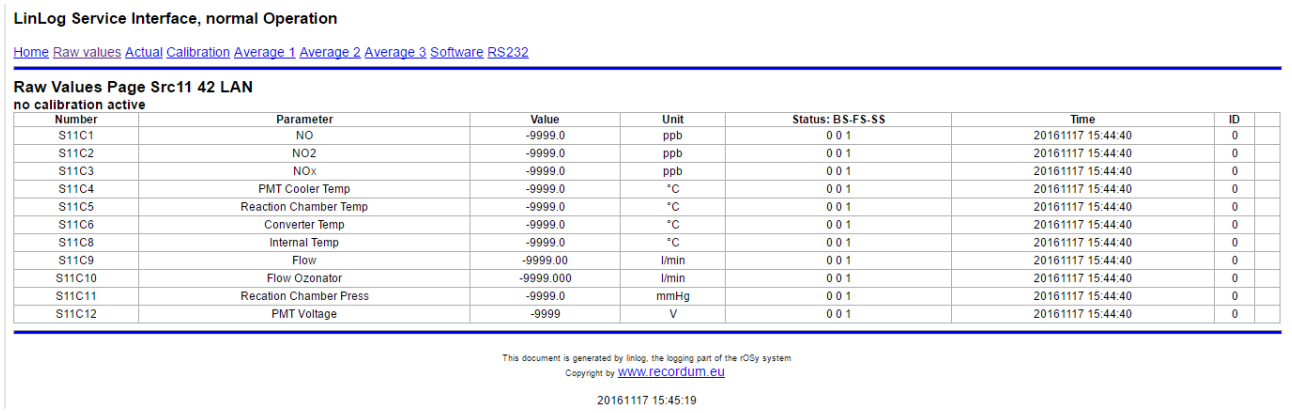


Figure 15: Linlog configuration – configuring a new analyzer

Check in Setup/System Info/Service Interface/LinLog/Raw Values if the communication between Analyzer and airQrate is correctly established (*Figure 16*).



LinLog Service Interface, normal Operation

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

Raw Values Page Src11 42 LAN

no calibration active

Number	Parameter	Value	Unit	Status: BS-FS-SS	Time	ID
S11C1	NO	-9999.0	ppb	0 0 1	20161117 15:44:40	0
S11C2	NO2	-9999.0	ppb	0 0 1	20161117 15:44:40	0
S11C3	NOx	-9999.0	ppb	0 0 1	20161117 15:44:40	0
S11C4	PMT Cooler Temp	-9999.0	°C	0 0 1	20161117 15:44:40	0
S11C5	Reaction Chamber Temp	-9999.0	°C	0 0 1	20161117 15:44:40	0
S11C6	Converter Temp	-9999.0	°C	0 0 1	20161117 15:44:40	0
S11C8	Internal Temp	-9999.0	°C	0 0 1	20161117 15:44:40	0
S11C9	Flow	-9999.00	l/min	0 0 1	20161117 15:44:40	0
S11C10	Flow Ozonator	-9999.000	l/min	0 0 1	20161117 15:44:40	0
S11C11	Recation Chamber Press	-9999.0	mmHg	0 0 1	20161117 15:44:40	0
S11C12	PMT Voltage	-9999	V	0 0 1	20161117 15:44:40	0

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20161117 15:45:19

Figure 16: Linlog interface

For more detailed information about the data acquisition system, refer to the airQlog manual, which is attached in electronic format with your instrument.

5. Basic Operation [for manual tasks]

5.1. Absolute-Mode and Transfer-Mode

The airQrate can be operated in 2 different modes:

- Absolute Mode-

In absolute mode, the zero-air flow and the concentration to be generated will be exactly entered by the user. The airQrate precisely calculates the flows and generates the concentration the user entered automatically.

-Transfer Mode-

The transfer mode works in 2 steps:

First, a calibrated analyzer is connected to the airQrate. Using a gas standard, the concentration generated by the AirQrate is determined. The settings of the airQrate are stored together with the actual output concentration as a transfer point.

Then, this transfer point -with completely identical airQrate settings- can be retrieved to calibrate another analyzer. As a result, the overall calibration uncertainty is minimized.

Only previously defined transfer points can be called via the Q-Button menu (see *paragraph 5.5*). Operation in absolute mode is not possible using the Q-buttons.

5.2. Absolute mode

5.2.1. Configuration of the calibration gas output

Press <airQrate>, then <Run> and confirm in the following dialog box (*Figure 17*).

Figure 17: Running a manual calibration in absolute mode

Press <Details>, then <Set Output for Selected Module> (*Figure 18*).

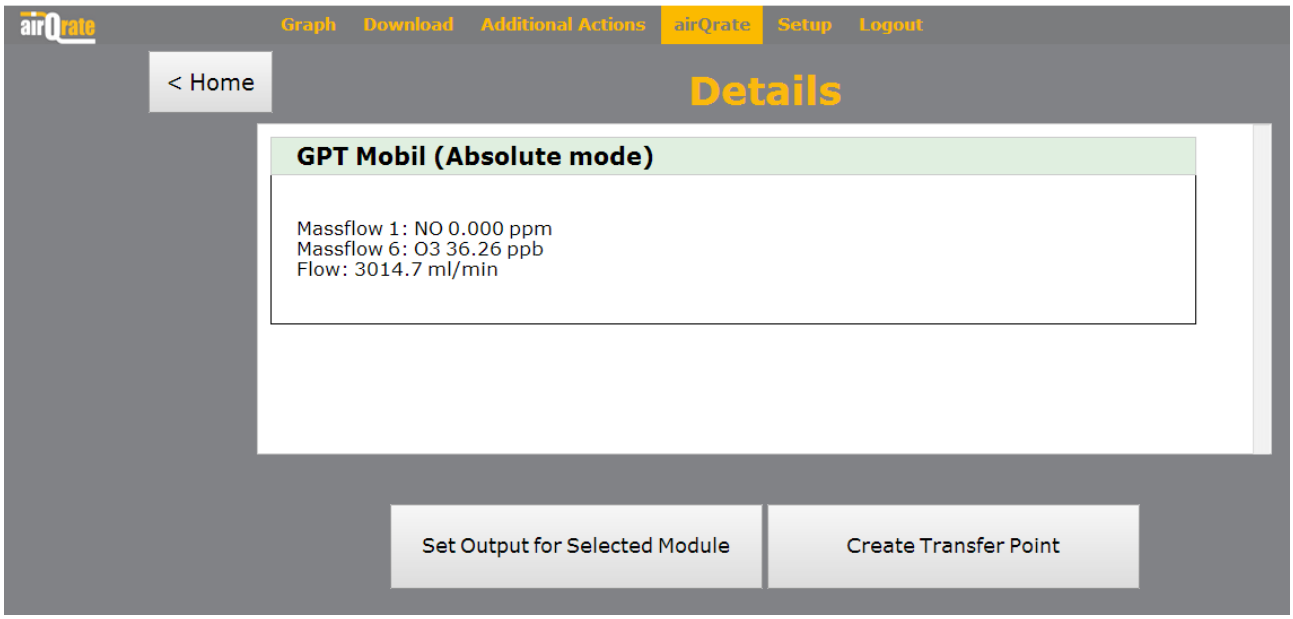


Figure 18: checking the output of the GPT module

In the following dialog boxes, select the connection of the calibration gas (MUX if the module in question is equipped with a multiplexer, otherwise choose MUX1), the gas, the calibration gas bottle and the total calibrating gas flow to be generated (*Figure 19*).

Press <Run> To start generating standard gas.

For the generation of NO2 using the GPT, NO and O3 must simultaneously be selected.

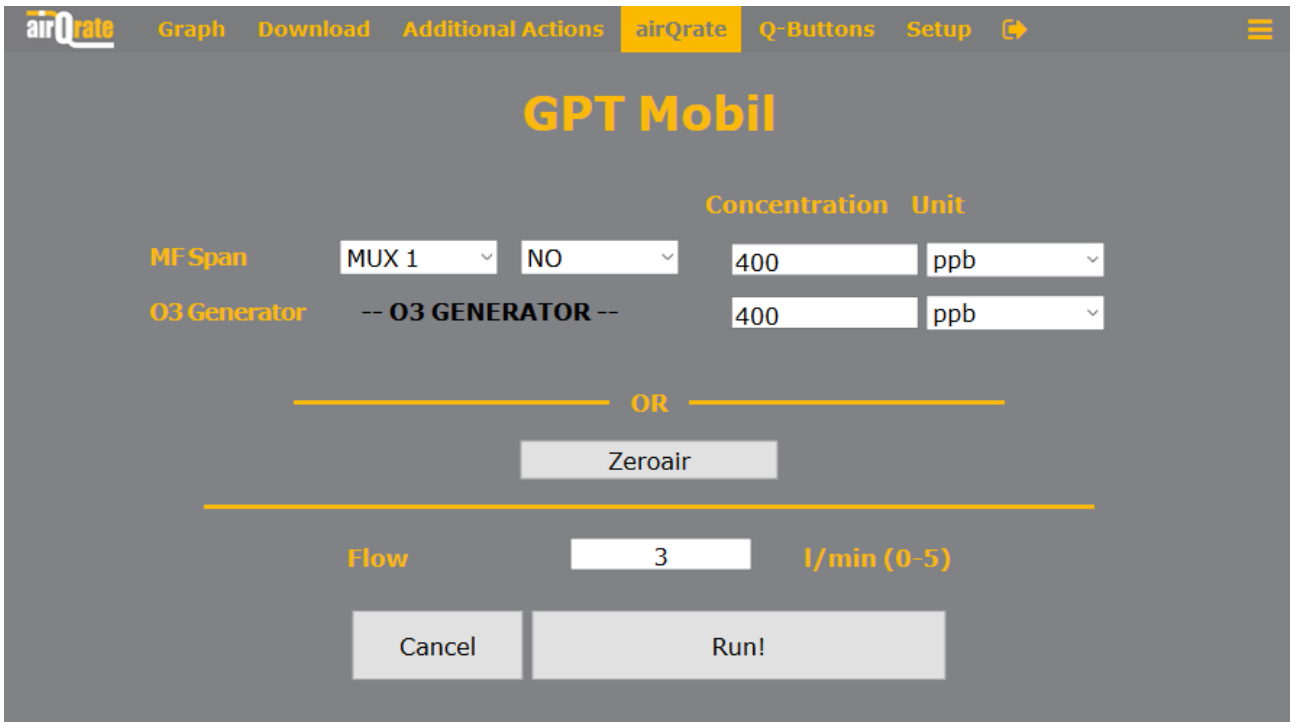


Figure 19: generating NO2 using the GPT module

5.3. Transfer mode

5.3.1. Create and edit a transfer point

Generate calibration gas in the absolute mode as described in *paragraph 5.2.1*. Connect your external standard to the calibration gas output.

Go to the <airQrate> menu, press <Details> and click <Create Transfer point>

and confirm this in the following dialog box.

Click <Details>, select the module for which you want to create a transfer point and click the <Create Transfer Point> button.

Fill in the appropriate fields, under "Current Output", enter the concentrations indicated by your external standard. Save the transfer point (*Figure 20*).

You can edit the saved transfer point by clicking on <Preferences> / <Configure Transfer Values>, selecting the appropriate module in the "Select Module" field, clicking on the transfer point and then selecting the <Edit Selected> button.

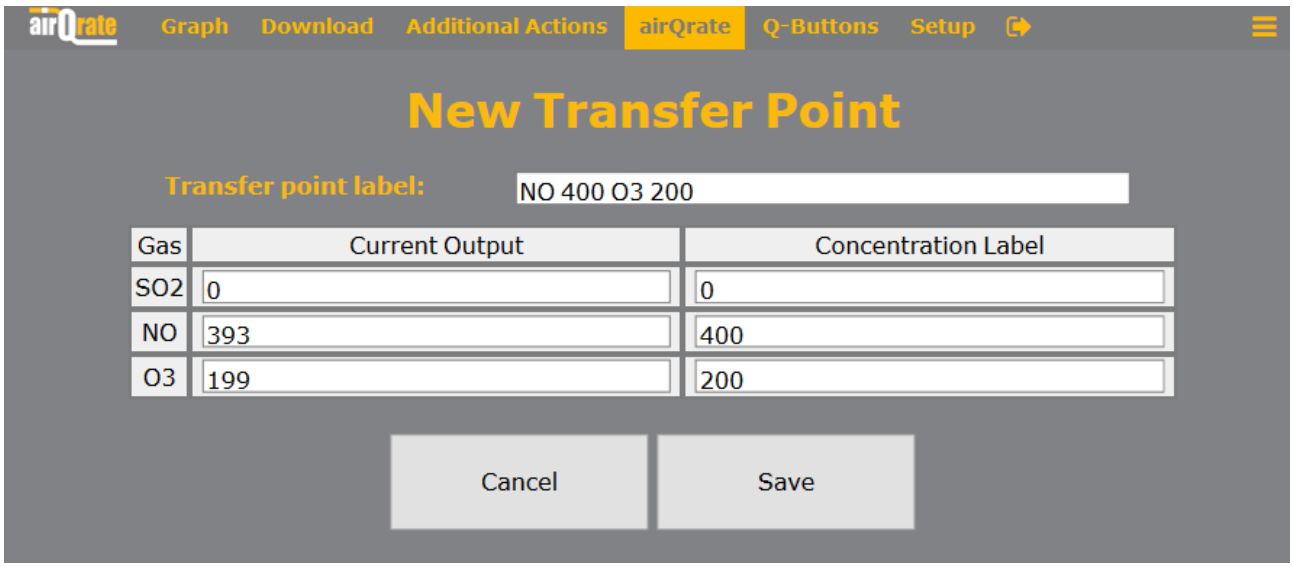


Figure 20: Running a manual calibration in transfer mode

5.3.2. Call up a transfer point

Press the <Transfer> button on the main menu, select the desired transfer point and press <Run Transfer Mode with selected Value>

5.4. Overview

Under airQrate / Overview you can follow the most important internal parameters online (*Figure 21*).

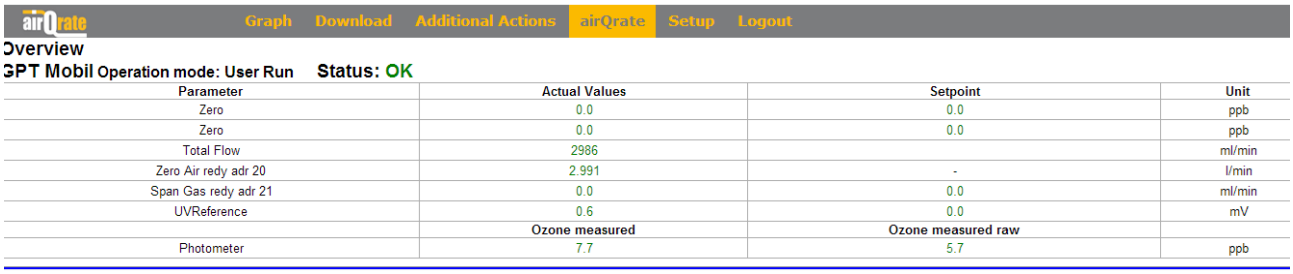


Figure 21: Run overview

5.5. Q (Quick)-Buttons

The airQrate provides user-definable buttons, which, after their configuration, can be used to operate the system simply by pressing a button. The buttons can be found in the Q-Buttons menu item (*Figure 22*).

Different actions can be triggered with the help of the Q-Buttons depending on your configuration, and for each type of task, a different background color of the Quick button is used:

- Standby (purple)
- Zero air task (green)
- Transfer point for generating a test gas concentration (blue)
- Execute a preconfigured calibration sequence, also known as a “job” (yellow)

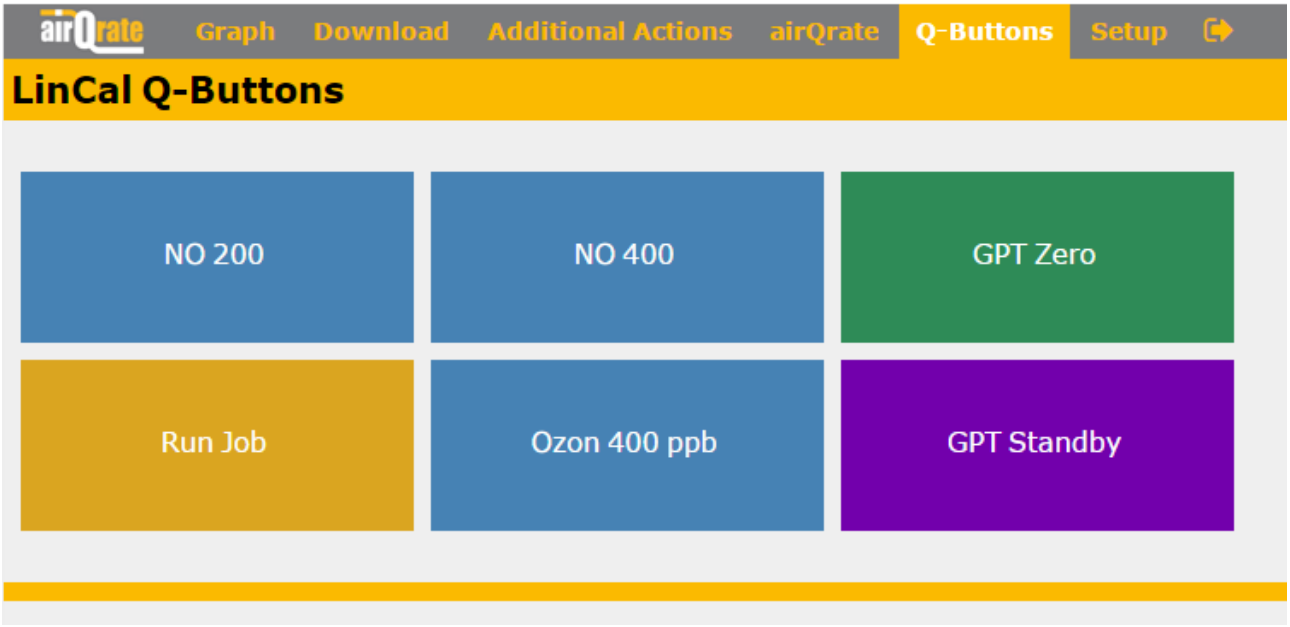


Figure 22: Q-buttons menu

Q-Buttons can be managed (i.e: created, edited, activated and deleted) under Setup / LinCal / Q-Buttons (*Figure 23*).

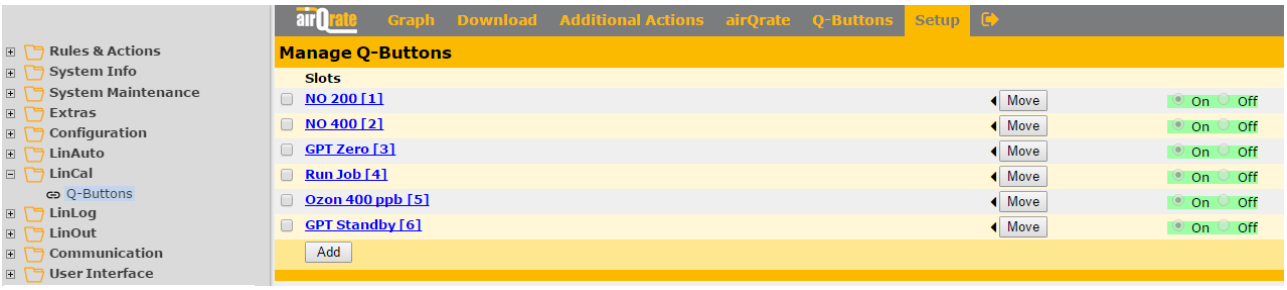


Figure 23: Managing Q-buttons

5.5.1. Create a Q-Button

Go to Setup / LinCal / Q-Buttons to access Q-Button Management, click <Add>. Give a meaningful description, e.g. the concentration and the module.

Fill out the editable fields and use the possible settings in the dropdown lists.

The transfer points and the jobs, which are to be controlled by the Q button,

must already be configured. Activate or deactivate the Q button and close the entries with <save>. To create a transfer point, refer to paragraph 5.3.1. To create a job, refer to chapter 6.

5.5.2. Edit a Q-Button

Under Setup / LinCal / Q-Buttons, click on the link of the Q-Button to be edited.

5.5.3. Order of the Q-Buttons in the overview

Under Setup / LinCal / Q-Buttons, select the button to be changed to the far left. Click on the link of the Q button to be edited. Use the left-arrow keys on the page to move the selected buttons to the selected position and appear in this sequence in the Q-Button menu. Only 9 Q-buttons can be displayed simultaneously, so only the first 9 Q-buttons on the list will be visible.

5.5.4. Activate/Deactivate a Q-Button

Under Setup / LinCal / Q-Buttons, click on the link of the Q-Button to be edited. Set the menu item "Active" to <On> or <Off> and press the <Save> button.

6. Advanced Operation [for automated tasks]

6.1. Presentation

The programming of automatic calibration sequences is done in the Setup / LinAuto menu and its sub-items. Its purpose is to be fully autonomous once programmed, thus saving time and eliminating the risk of human error.

This programming includes both the configuration of the calibrator part and the data acquisition of the device to be examined. The novelty of this feature is that the airQrate also records data about other Recordum products (airpointer and airQlog), without interrupting the connection of the meter / datalogger.

If calibration sequences without evaluation by the airQrate is needed, the points necessary for the data acquisition do not need to be edited.

The programming of the sequences, the data acquisition and the data evaluation is relatively complex and should only be carried out by advanced users. Recordum also offers ready-made templates for various tests (for example, a lack of fit test according to the relevant EN directives), which can also be modified by the user himself. However, the execution of the programmed sequences (also known as jobs) can also be launched via quick buttons. Thus, every user can easily start preconfigured tests including evaluation and report without prior knowledge.

For a better understanding of the structure of a job, the terminology must be explained:

Collector: a collector is an interface to a group of instruments, like a data logger, an Airpointer, or an airQrate

Instrument: usually, an analyzer

Job: an execution of a program for a specific collector, either via a Q-button or via the classic airQrate interface

Program: a program is a sequence of block with a given dilution flow (zero air flow)

Block: a block is a sequence of steps with a given duration

Step: a step is defined by a concentration and a duration

Q-button: a Q-button is a programable shortcut to run a program

Calibrator module: one of the airQrate module

Module: the mobile airQrate “GPT mobile” version only has one module

The structure of a job is illustrated in *Figure 24*.

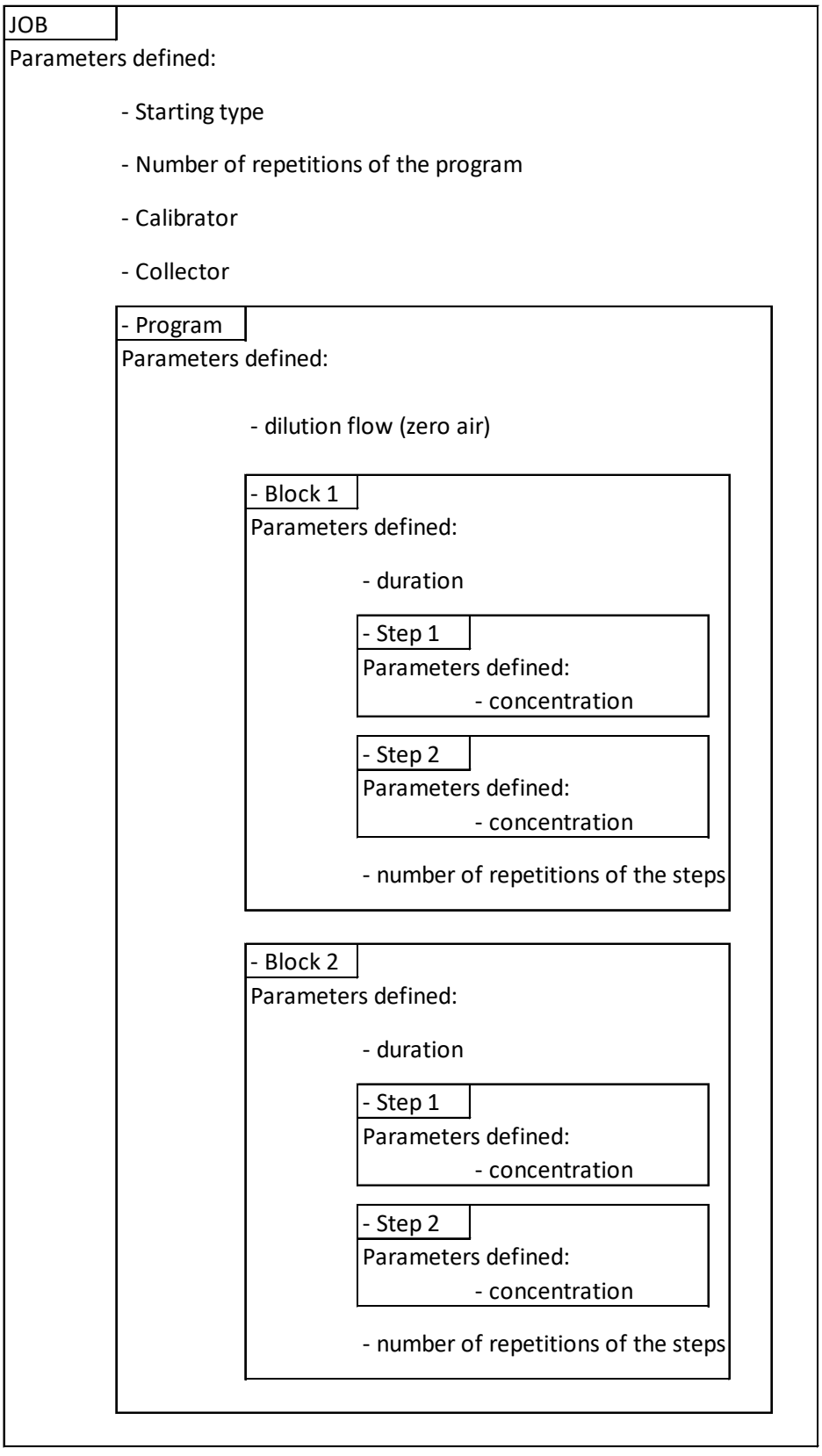


Figure 24: Structure of a Program run as a Job

The procedure for the creation of jobs follows the sub-items of the “LinAuto” menu from top to bottom. It is explained in the following points. All input fields with an asterisk (*) are mandatory fields and must contain an entry.

6.1.1. ***What***

In this section, the interface to a group of analysers to be calibrated is described. It contains 3 sub-sections: “Location”, “Collectors”, and “Instrument”.

6.1.1.1. Location

After pressing <Add>, enter a name for the location of the calibration. It can be the ID of a monitoring station, its GPS coordinates, or it can simply be “mobile”. Press <save> after the entry.

6.1.1.2. Collectors

This is where you configure the device to perform the data capture during the test.

In the simplest case, this is the airQrate itself, if the instrument to be calibrated is already connected to the data acquisition of the airQrate and configured, as described in *paragraph 4.4*.

In this case, enter a name (for example, airQrate), the logger type "airQrate", and the internal IP of the airQrate 127.0.0.1. Then press the magnifying glass (search) to the right of the IP number. If everything is correctly configured, the serial number of the airQrate automatically appears in the following field.

If the data is to be collected via another Recordum system (for example, airpointer, airQlog or, as in the example below, another airQrate in the network), enter its IP and press the magnifying glass symbol. The serial number of the device in question appears automatically for confirmation (*Figure 25*).

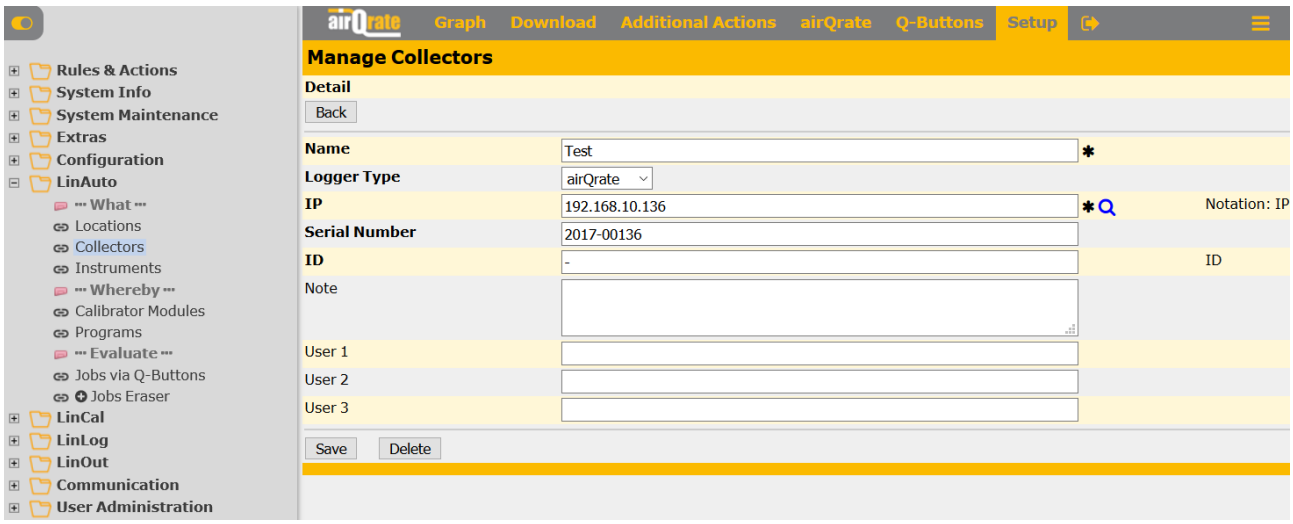


Figure 25: Collectors section

6.1.1.3. Instruments

To configure connected devices, press <Add>. In the "Instrument" drop-down list, you will get an overview of the available devices. The most common choice here in the case of an airQrate GPT mobile unit is “GPT mobile”.

Choose the appropriate device and save your entry.

6.1.2.***Whereby***

In this section, the way to calibrate the analysers described in “***What***” is explained. It contains 2 sub-sections: “Calibrator modules”, and “Program”. In the case of the airQrate mobile GPT, only the “Programs” section can be edited.

6.1.2.1. Programs

The automatic sequence control of the calibrator is programmed here. A program consists of one or more blocks, which themselves consist of one or more steps; for a better understanding, a list of pre-set blocks which can be used as part of programs are shown in *Annex 1*: Pre-set types of blocks

The “Programs” menu displays an overview of all program sequences stored in the device, arranged according to the respective installed modules.

By clicking on the link that represents the program in question, you can modify the program or view details, and create a new program using the <Add> button (*Figure 26*: Programs section).

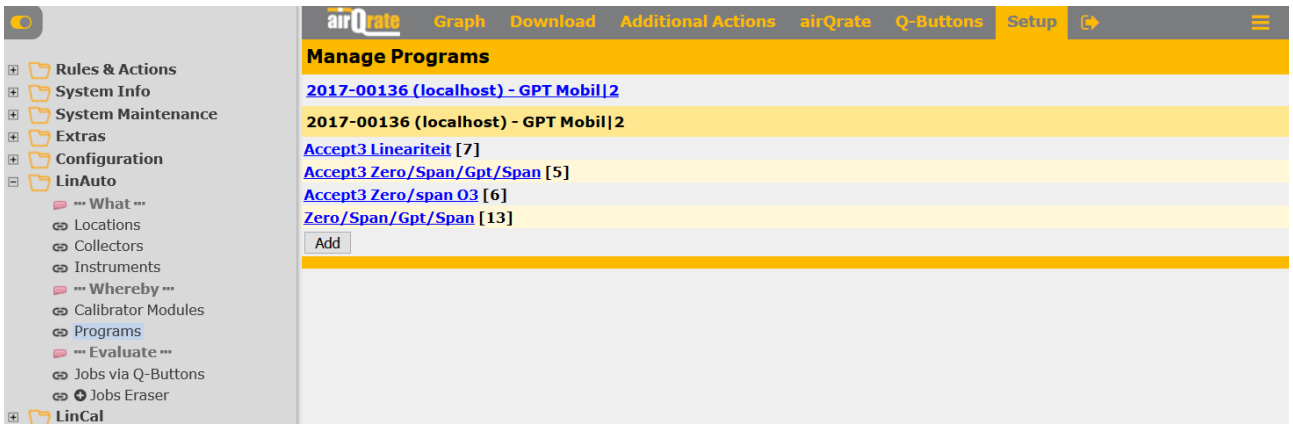


Figure 26: Programs section

Clicking on <Add> opens a window in which you can define the name of the program and the zero-air flow (*Figure 27*). For most airQrates models, the zero-air flow should be between 500 ml/min and 5000 ml/min. Refer to *paragraph 3.1.3* for more details. The input is to be concluded with <Save>.

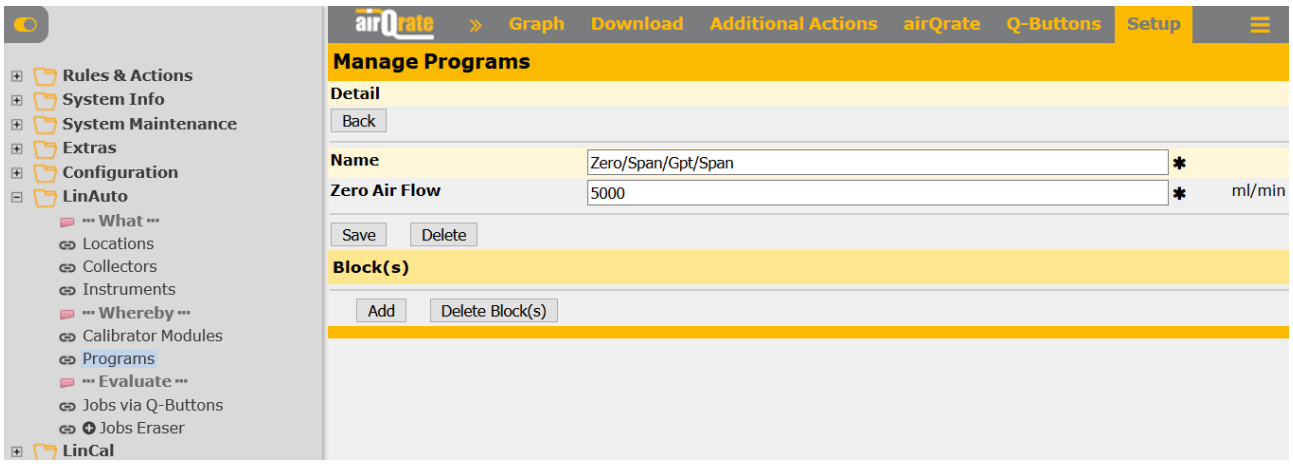


Figure 27: Programs section - managing programs

Afterwards, the overview menu appears again. Clicking on the link to the new program will open the window again. Now you can add blocks to the program. Clicking on <Add> opens a window to create a new program block (*Figure 28*: Programs section - creating blocks).

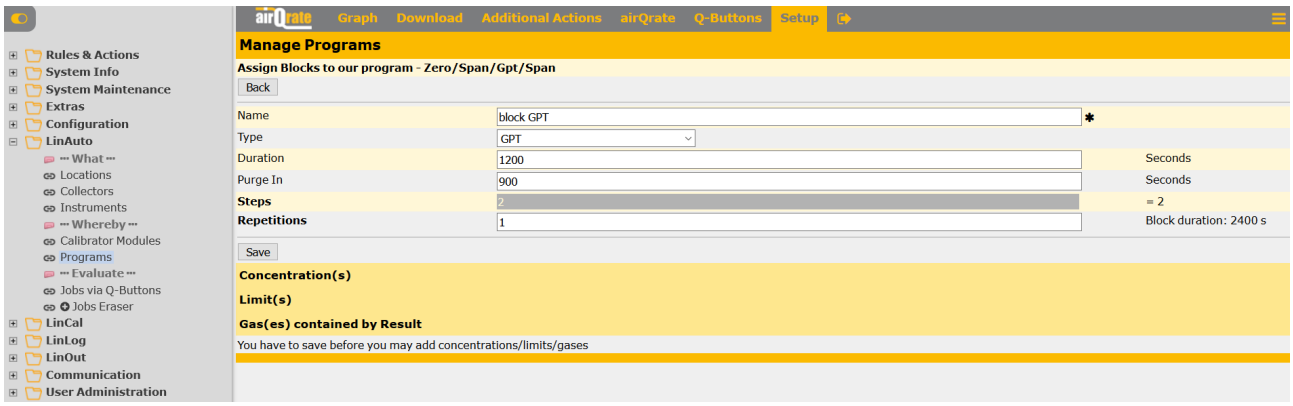


Figure 28: Programs section - creating blocks

First, you must assign a freely selectable name (avoid special characters) to the relevant block.

As “**type**”, several selection options are available, which also defines the number of program steps within the block.

For example, a block of type "Stability span" or “User calibrate span” only contains a single step, a gas phase titration (GPT) always contains two steps (first only NO and then NO / NO2 mixed) and the type "linearity" contains at least three steps (one for each concentration). This has to do with the evaluation of the data of the measuring device, for example a linearity determination requires at least three different concentrations. In stability zero, the airQrate moves automatically to the next block when this block is complete, regardless of the success of the test. The difference between “Stability span” and “User calibrate span” is that for the latter, the operator is expected to acknowledge the result before the airQrate starts the next block. More details about the types of blocks can be found in *Annex 1*: Pre-set types of blocks.

"**Duration**" is the duration of each step in the block.

For some blocks, the “**purge in”** time (which is the time it takes until the signal becomes completely stable) can also be defined. The data obtained during the purge-in time will not be used for the evaluation. The duration of the purge must be shorter than the duration of the step.

"**Steps**" is the number of steps within the block (the number of changes in concentration).

"**Repetitions**" is to set the number of times the block is being repeated during the program. The "block duration" displayed on the right of the “repetitions” field is calculated automatically from the processing time multiplied by the number of steps and the number of repetitions.

Before the individual concentrations are entered, the input is to be concluded with <Save>.

The program overview appears. Click on the <Edit Block> link to return to the configuration of the block. Now the individual steps can be entered.

Clicking on <Add> under “Concentration(s)” opens a new window (*Figure 29*).

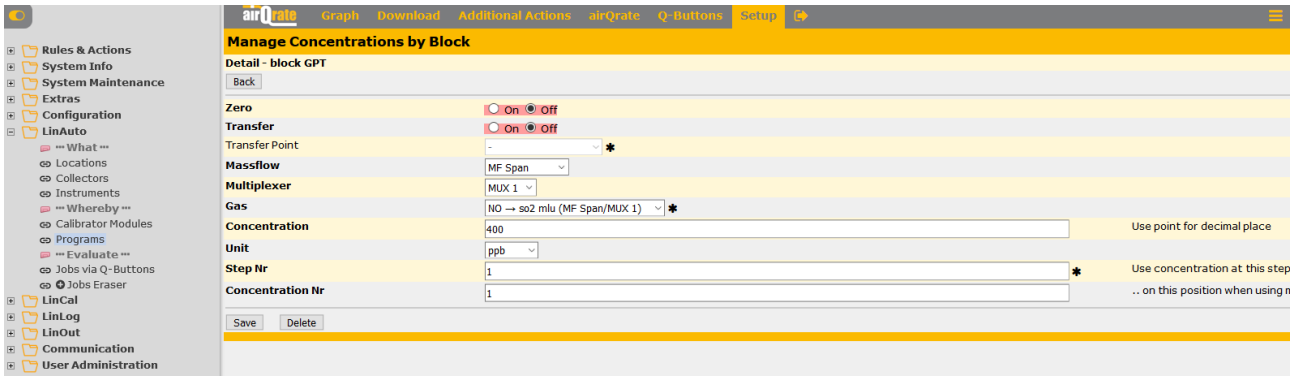


Figure 29: Programs section - managing blocks

Here, either zero air, a preconfigured transfer point, or a concentration can be entered directly. For direct input, the MF, the multiplexer, the gas, the concentration, and the unit must be selected.

It is also necessary to specify in which step of the block this concentration is to be generated. In some steps, it is necessary to specify several concentrations, e.g. for the GPT: NO and ozone. Therefore, several concentration numbers can be assigned in a single step.

The input is completed with <Save>. Further concentrations can be configured via concentration / <add> in the “Concentration(s)” block.

For example, a GPT block looks as shown in *Figure 30*.

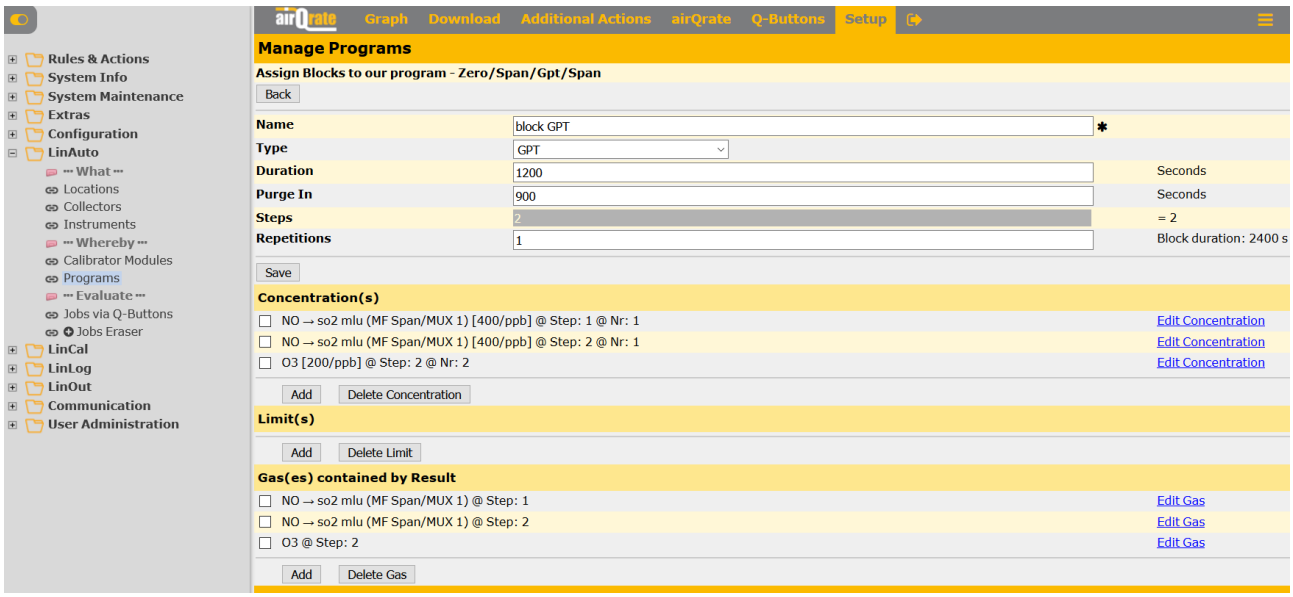


Figure 30: Programs section - Setting concentrations for blocks

After this, you must click on <Save> in the “Manage Concentrations by Block” menu and click on <Save> in the following program menu to save all entries.

6.1.3. ***Evaluate***

Jobs are started either manually in the main menu <airQrate>/<Jobs> or via Q-buttons.

6.1.3.1. Starting Jobs manually

In the <airQrate> tab, select <Jobs>.

The configuration menu opens as shown in *Figure 31*.

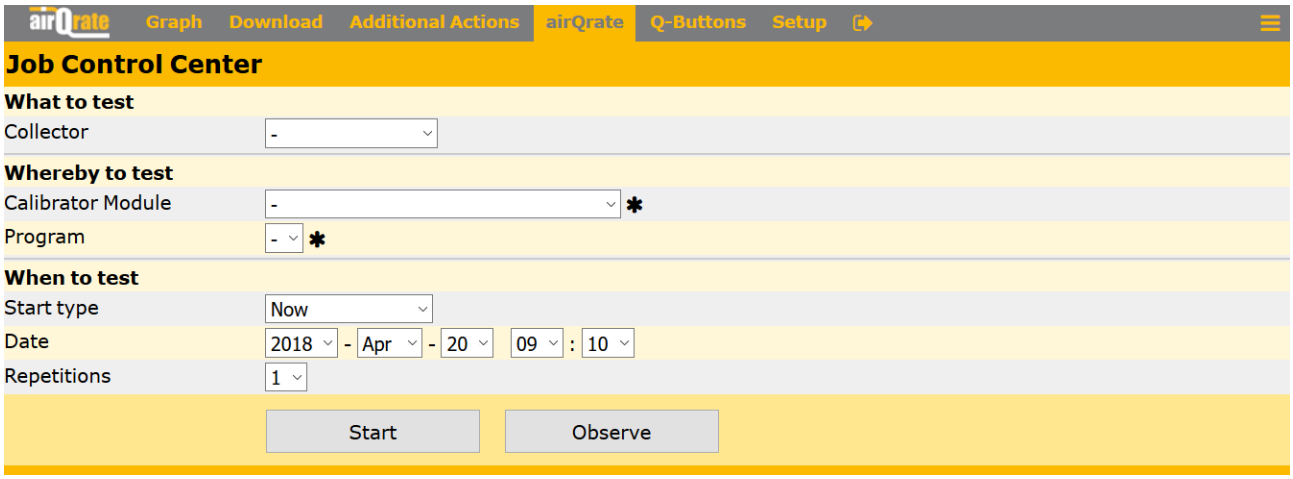


Figure 31: Running programs as jobs manually

For automatic evaluation, it is important to define the data logger (collector of the data). If this is not desired, the <-> drop-down box can be selected.

Under "Whereby to test", the relevant module must be selected in the calibrator, for the airQrate “GPT mobile” version, the most common choice is the GPT module.

Under "Program" is the program to be executed. "When to test" offers 2 options: "Now" or "At selected time".

The number of repetitions of the job sequence can be set from 1 to 9.

Clicking <Start> starts the job. Under <Observe> you can check the progress of the program (*Figure 32*). Press <Stop> to stop the program.

Figure 32: Job control center

The progress of the program can also be followed by clicking on the <Setup> tab and selecting System info / Service interface / LinAuto (*Figure 33*: Linauto). The program currently running appears in orange, the next program(s) appear in black, and the already completed program(s) appear in blue.

LinAuto Service Interface, normal Operation

Home Actual Job 0 Job Data 0 Software

Job Press reload when Job has changed

Instrument under test

Program

Accept3 Zero/Span/Gpt/S **Program running** **Start:** **20180419 10:51:36** **Expected end:** **20180419 13:46:35**

ID		Name	Type	Actual step/Steps	Actual repetion/Repetions	Actual Block(Started)	Actual Block(Duration/Finished)
1	3	zero 45min	STAB_ZERO	1/1	1/1	20180419 10:51:36	44min 05sec
2	4	span 60min	STAB_SPAN	-/1	-/1	-	-
3	5	gpt 30min	STAB_SPAN	-/1	-/1	-	-
4	6	span 40min na gpt	STAB_SPAN	-/1	-/1	-	-

Module **Operation mode: Auto Run**

Calibration unit: 127.0.0.1 **Module:** 2

Gas produced	Estimated accuracy
SO2 0.000 ppm	-
NO 0.000 ppm	-
O3 0.000 ppb	-

Figure 33: Linauto interface

6.1.3.2. Starting a job via Q-Button

In the <Setup> tab, select Linauto / ***Evaluate*** / Jobs via Q-buttons. The configuration menu opens as shown in *Figure 34*.

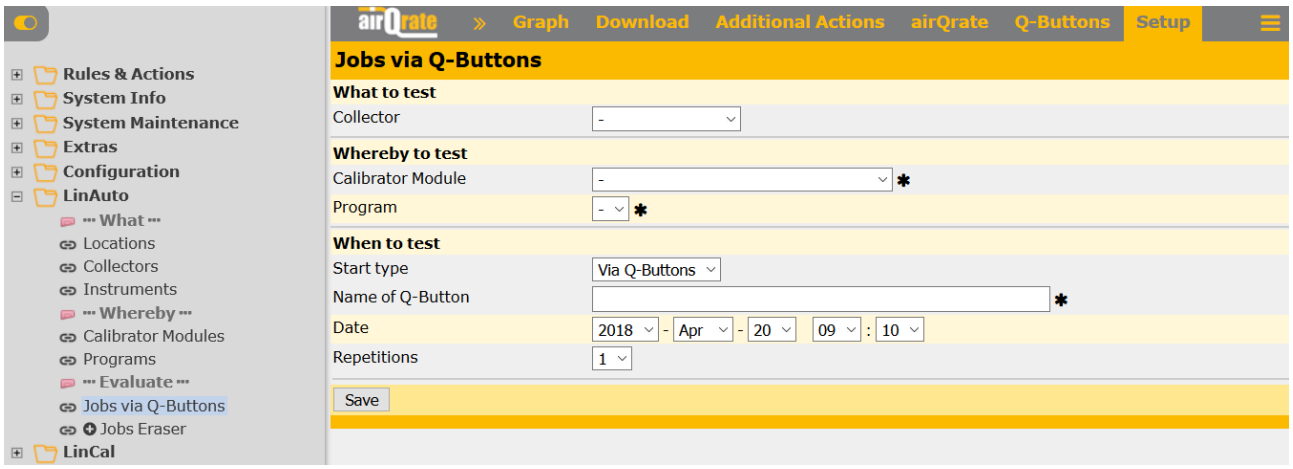


Figure 34: Running programs as jobs via the Q-buttons

All the fields are identical as the manual start of the jobs, except for the start type, in which only “Via Q-buttons” option can be selected here. For details about the fields, refer to *paragraph 6.1.3.1*.

Via <Start>, you can configure a Q-Button. The start button should only be pressed once; there is no confirmation message. Then, simply leave the menu and go to Setup / LinCal / Q-Buttons.

Press <Add>, enter a name for the Q-button and select jobs in the type list and choose the job in the Job list. Set the Q-button to “Active” and click <Save>.

In the main menu point "Q-Buttons", the newly created button is now visible, and the program can be called up.

7. Calibration

7.1. Calibration of mass flowmeter / mass flow controller

The mass flowmeters / controllers are digitally controlled and are therefore free of transmission errors by analogous components. A traceable calibration of the mass flow measuring devices should therefore preferably be carried out directly at the internal component by the manufacturer (Vögtlin).

However, the airQrate also allows multi-point calibration of the MFC / MFM directly via the internal software. A calibration function in the form of a polygonal line is laid over the actual MFC / MFM control. Intermediate values are interpolated linearly.

No calibration function is implemented in the delivery state.

The creation of a calibration function is as follows:

1. From the menu, go to airQrate / Preferences / Mass Flow Calibration. Select the relevant module and the MFC / MFM in the dropdown fields (*Figure 35*).

2. Click on "Enable configuration" and confirm by clicking on <OK>.

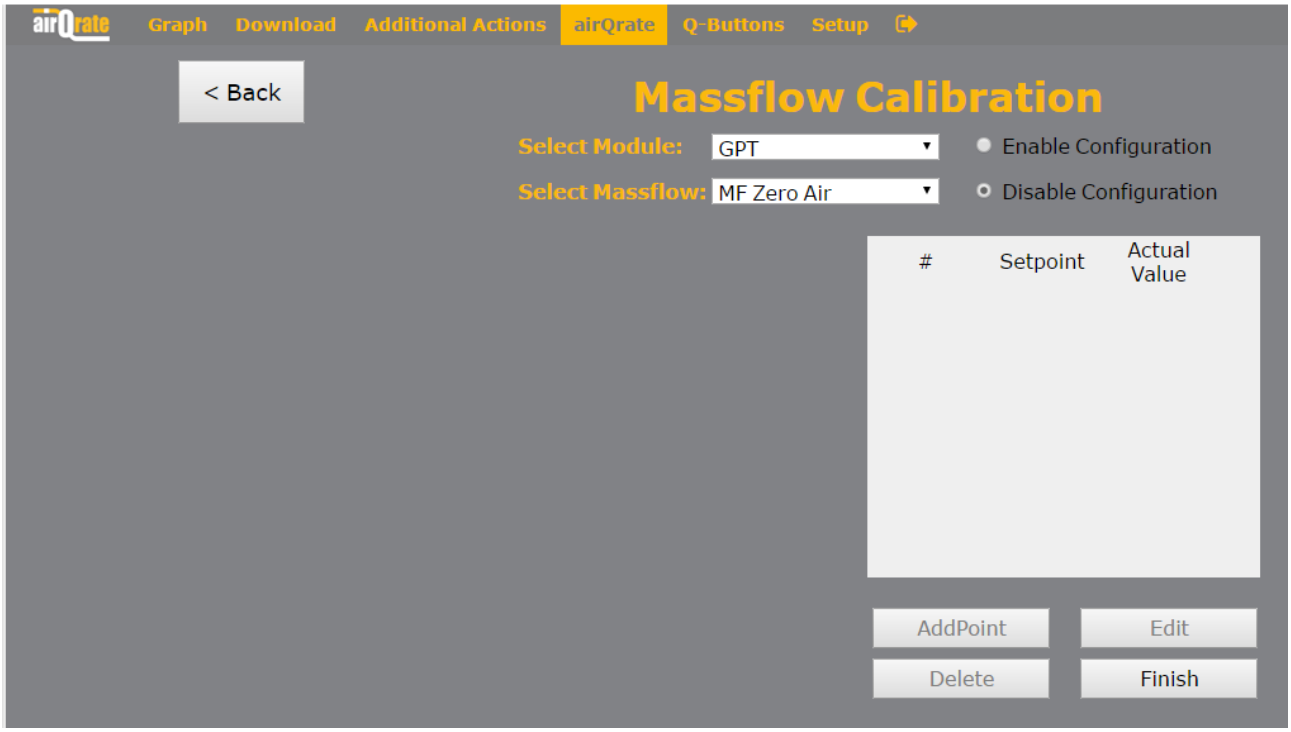


Figure 35: Recalibrating Mass Flow

3. Open the airQrate housing cover and locate the MFC / MFM to be calibrated.

4. Measure the flow through the MFC / MFM with your reference flowmeter. To do so, you must disconnect the Swagelok connection at the output of the MFC.

5. Click "Add Point". Enter a setpoint value in the upper input field and press <Test this value>. Acknowledge all displayed dialog boxes with <OK> (*Figure 36*).

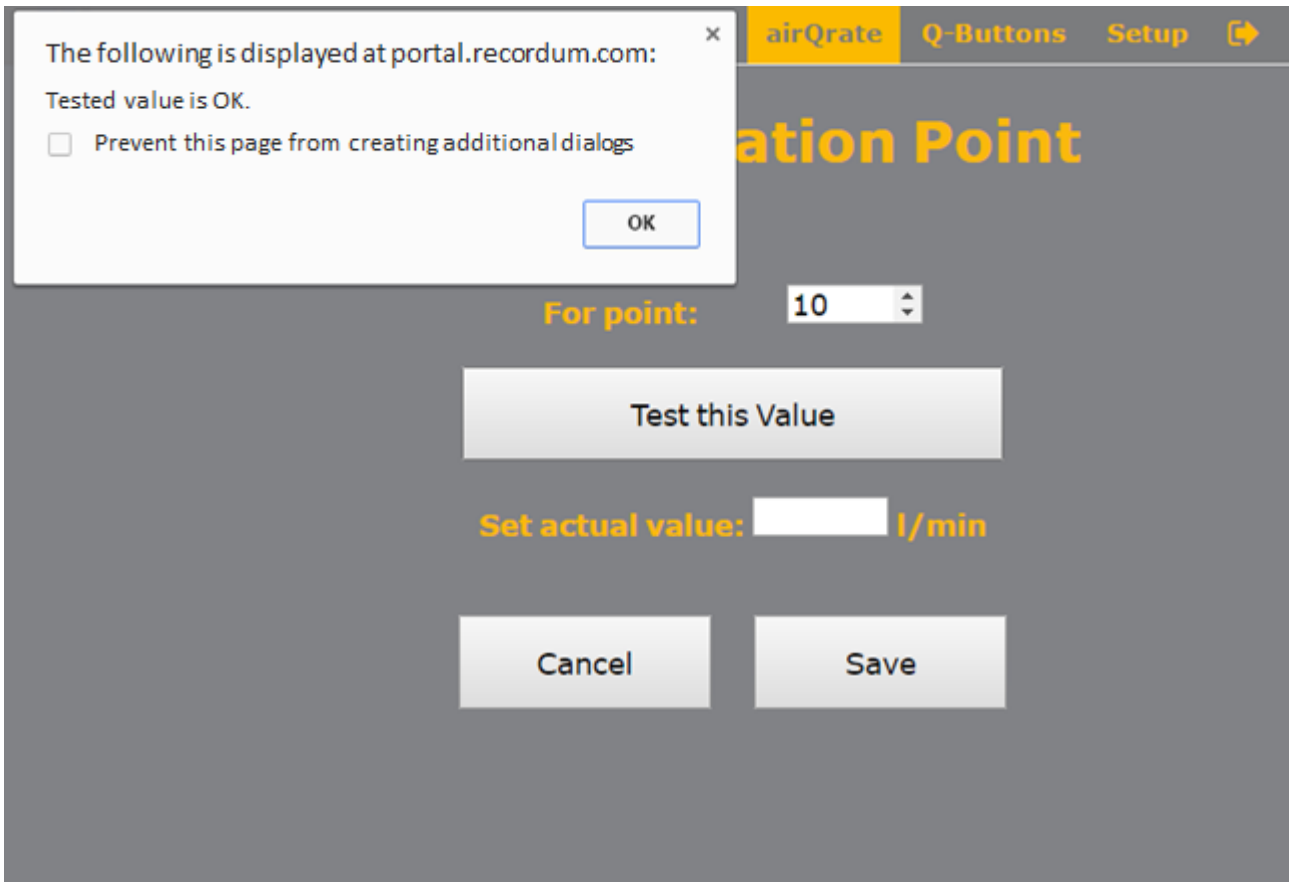


Figure 36: Adding points to the calibration curve of the MF

6. Enter the value measured with your standard under "set actual value" and press <Save>.

7. Perform 5. and 6. for several points within the measuring range of the MFC / MFM. It is important that the entire measuring range is covered.

8. When a sufficient number of points are calibrated, press <Finish>

The calibration values are displayed both numerically and as a graph (*Figure 37*).

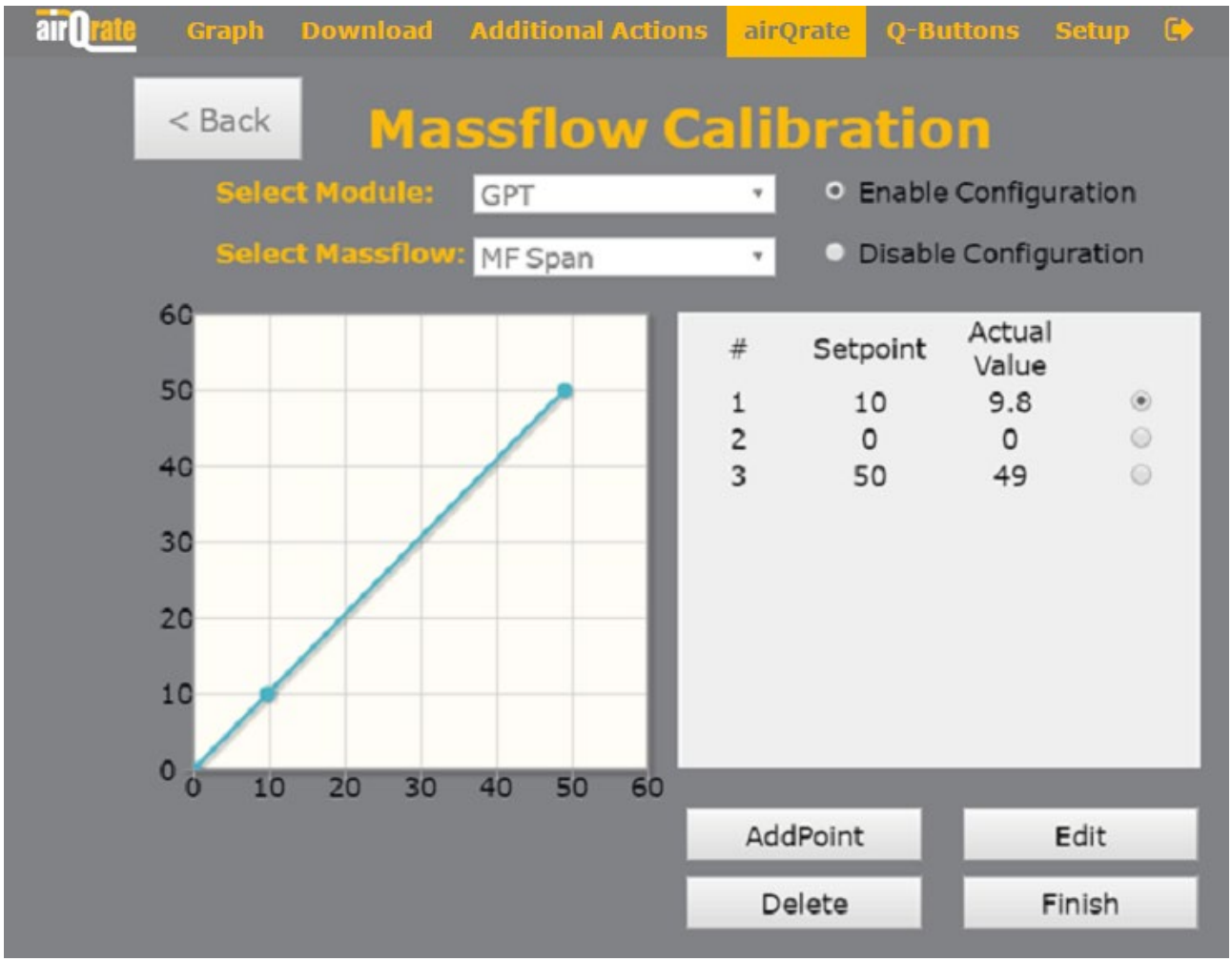


Figure 37: Calibration curve of the MF displayed as a graph and as numerical values

In addition to the creation of calibration points, points can also be edited or deleted.

7.2. Calibration of the ozone generator

The ozone generator can also be calibrated in the Massflow calibration menu. A calibration function in the form of a graph is applied. Intermediate values are interpolated linearly.

The ozone generator is already pre-calibrated in the delivery condition. Since some parameters change over time in operation, calibration may be necessary at regular intervals.

The creation of a calibration function is as follows:

1. Connect a calibrated ozone analyzer to the airQrate outlet. If the airQrate is equipped with an internal photometer, this can also be used for calibration.

2. Go to airQrate / Preferences / Mass Flow Calibration in the menu. Select the

relevant module and the O3 generator from the drop-down fields.

3. Click on "Enable configuration" and confirm all the dialog boxes with <OK>.

4. The function shown above represents the generated ozone quantity (in ppb * l, y-axis)) against the measuring signal of the UV reference detector in the ozone generator (in mV, y axis).

5. Under Zero Air Flow, set an adequate high flow rate and confirm with <Transmit> (*Figure 38*). The internal photometer already has a flow rate of approx. 1 L/min, which must be subtracted from the total flow.

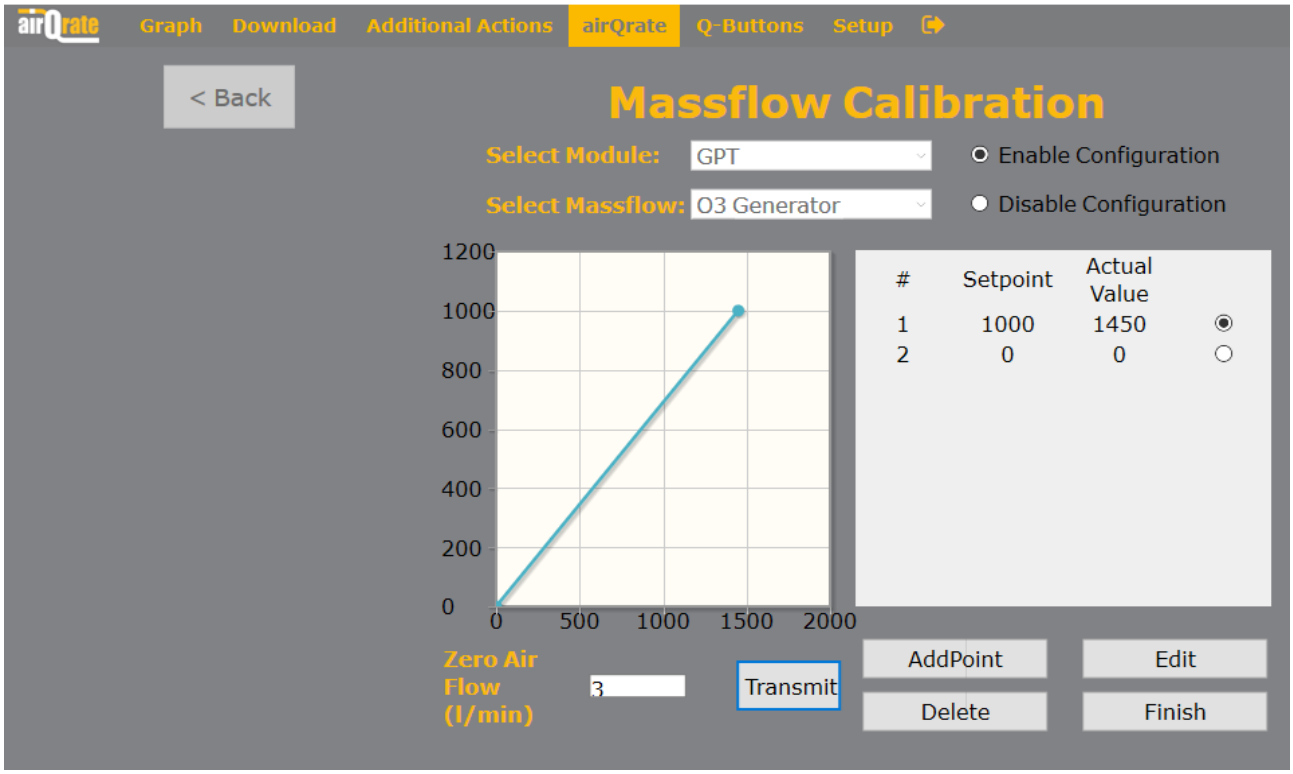


Figure 38: Recalibrating the ozone generator

6. Use <Add Point> to add another calibration point. Use <Edit> to edit the already existing point, which is marked in the adjacent field.

7. In the following dialog box, enter the desired signal at the ozone generator reference detector, and then go to <Test this value>.

8. Measure the ozone concentration in the calibration gas generated with an external ozone analyzer or the internal photometer.

9. Wait until the generated ozone concentration is stable (at least 10 minutes), enter the ozone output concentration under "Set actual value" and confirm with <Save>.

When all the points are entered, switch to "Disable Configuration" on the Mass flow calibration screen, and then click <Finish>.

In addition to the creation of calibration points, points can also be edited or deleted.

7.3. Calibration of the ozone photometer [Optional]

The built-in ozone photometer is calibrated using a calibrated ozone analyzer, which is connected to the test gas outlet.

1. From the main menu, go to <airQrate>, find the module with the ozone photometer and click <Run>. Confirm the message with <OK> and click <Details> and then <Set Output for Selected Module> (*Figure 39*).

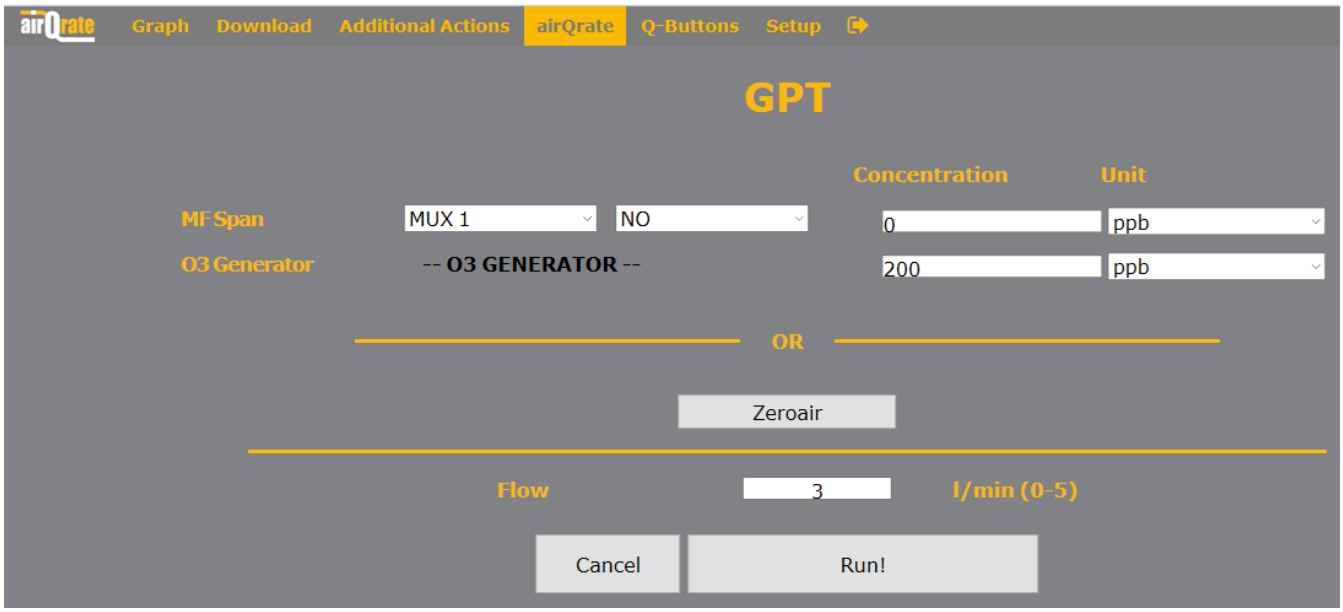


Figure 39: Recalibrating the ozone photometer

2. Set the desired ozone concentration. The NO concentration must be zero at the GPT module. Set a flow of at least 3l / min and click <Run!>.

3. Go to <Additional Actions> in the main menu. Open the directory tree by means of the button on the top right corner (≡) and go to <Calibration>.

4. Select the <Calibration> tab and select the O3 sensor.

5. Click <Display>.

6. Wait until the ozone concentration is perfectly stable for more than five minutes. Calibration is always based on the last 5-minute moving average (*Figure 40*).

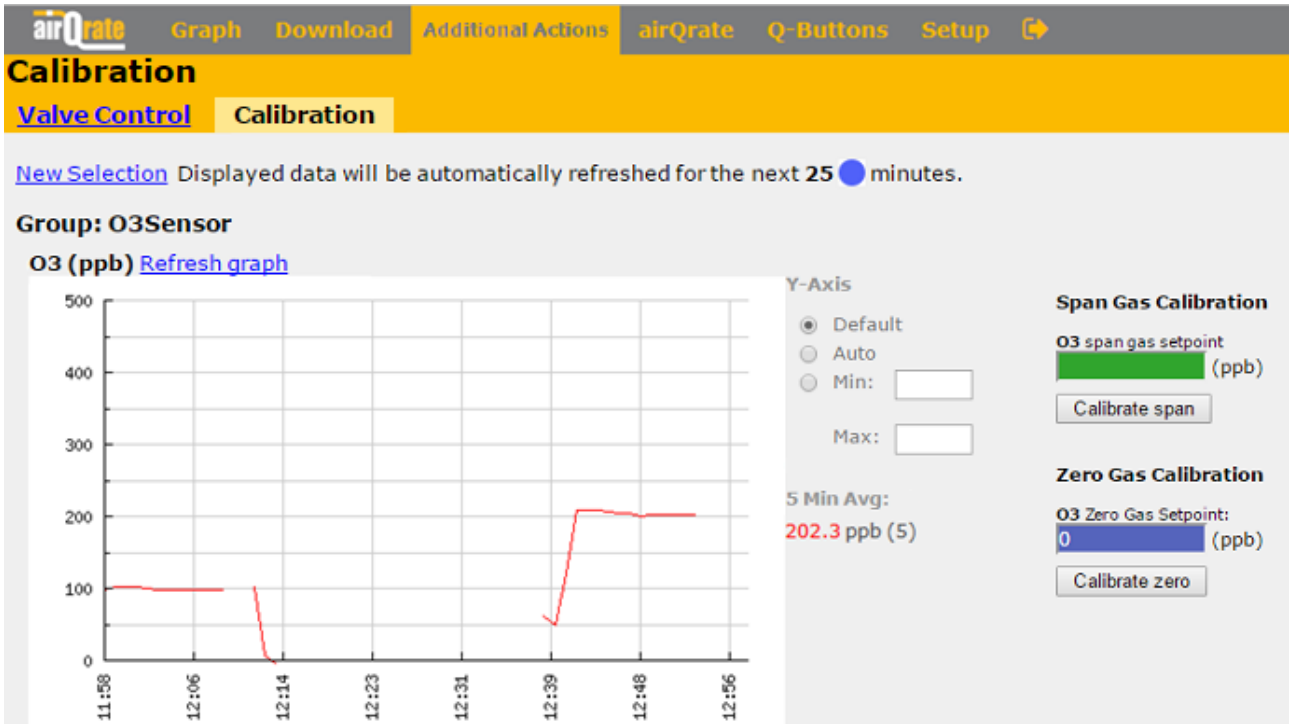


Figure 40: Ozone concentration displayed as a graph

7. Enter the concentration in the field "O3 span gas setpoint", which indicates the externally connected reference device. Press <Calibrate span> and confirm the calibration request.

8. Maintenance

Apart from the calibration of mass flowmeters and controllers, we recommend carrying out a leak test while checking the flow measuring device. For this purpose, pressures up to two bars can be used safely. Whenever maintenance is performed, we recommend writing it down in the stationbook, located in the <Additional Actions> tab, to keep track of the changes.

8.1. Zero air generator

The drying agent must be regenerated at regular intervals. The drying agent used by Recordum is a silica gel with an indicator turning from orange to yellow. Two drying agent cartridges can hold at least 40g of water; this corresponds to 48h of sampling air at 25°C/25%RH at 2.5 l/min, or 6h at 30°C/72%RH at 5

l/min). For regeneration, the drying agent should be removed from its cartridge and treated at about 120 ° for a minimum of two hours. Then, placed back in its original cartridge.

The cartridges filled with activated charcoal, purafil, and in some cases hopcalite, should be changed at regular intervals.

For all fillings, care must be taken to ensure that the cartridges are fully filled to ensure that all the air interacts with the filling in the horizontal working position.

If the silica gel was not reconditioned in a timely manner, humidity can cross the cartridge and reach the active charcoal, the purafil and the hopcalite. In this case, the quality of the zero air may be compromised, and all 3 agents must be reconditioned or replaced. Active charcoal and hopcalite can be reconditioned in the same way as the silica gel: at least 2 hours at 120°C, but the purafil degrades at high temperature, and therefore must be reconditioned during at least 2 hours at 60°C. After reconditioning, the cartridges must always be repositioned in the same order and in the same position (*Figure 41*).

Figure 41: Cartridges generating zero air

8.2. Pumps and DFU filters

The two internal DFU filters should be exchanged annually, the pumps for the

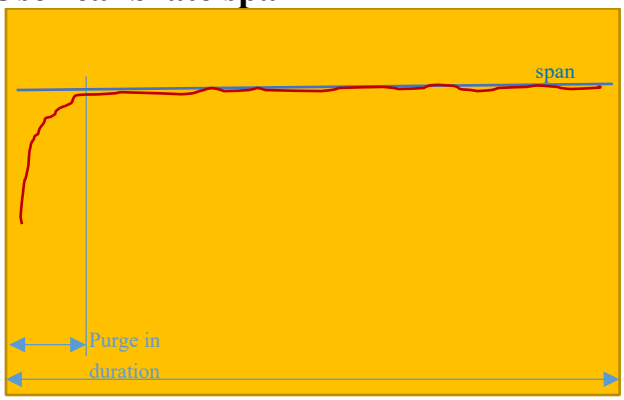
zero-gas supply and the ozone generator should be replaced preventively every two years.

8.3. Ozone photometer

If an ozone photometer is installed, we recommend a preventive replacement of the measuring gas pump every two years.

Annex 1: Pre-set types of blocks

User calibrate span

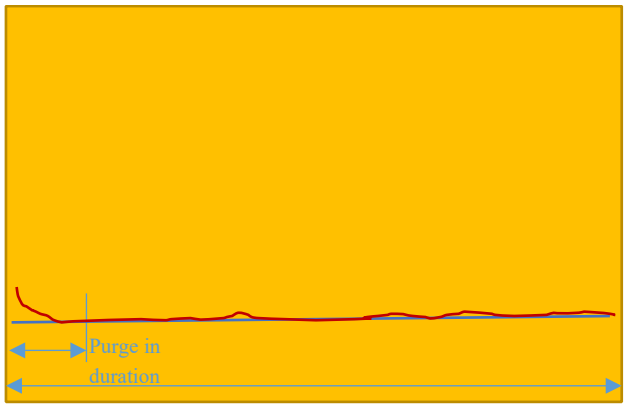


Run configurations:
Duration
Duration purge in
Span concentration
(1 step)

Measurements:
Noise of signal
Drift of signal
Value of signal

In User calibrate span, the success of the data must be acknowledged by the user before the airQrate can move to the next block

User calibrate zero

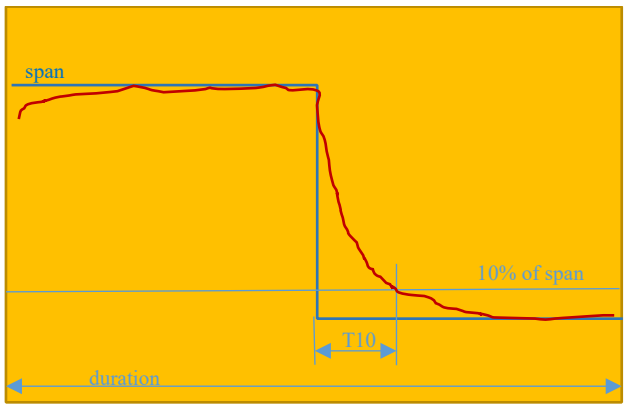


Run configurations:
Duration
Duration purge in
(1 step)

Measurements:
Noise of signal
Drift of signal
Value of signal

In User calibrate zero, the success of the data must be acknowledged by the user before the airQrate can move to the next block

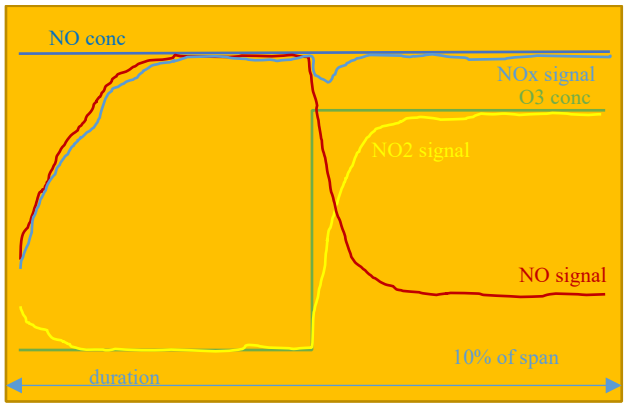
Fall down



Run configurations:
Duration
Duration on span
Span concentration
(2 steps: span and zero)

Measurements:
Time until signal reaches level, typically 10%

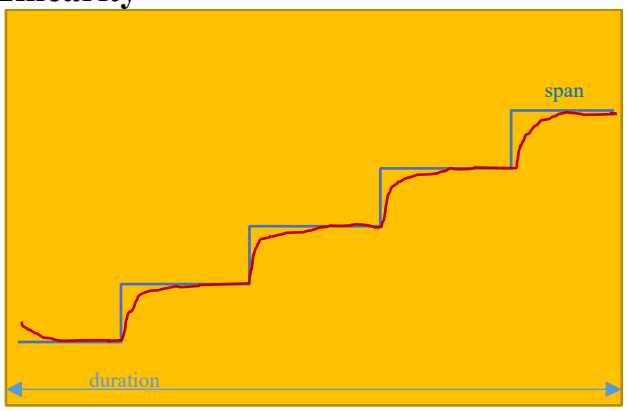
GPT



Run configurations:
Duration
Duration on span
NO concentration
Ozone concentration
(2 steps: without and with ozone generation)

Measurements:
Percentage of NOx lost

Linearity



Run configurations:
Duration
Purge in (each step)
Number of steps (≥ 3)
Span concentration for each step

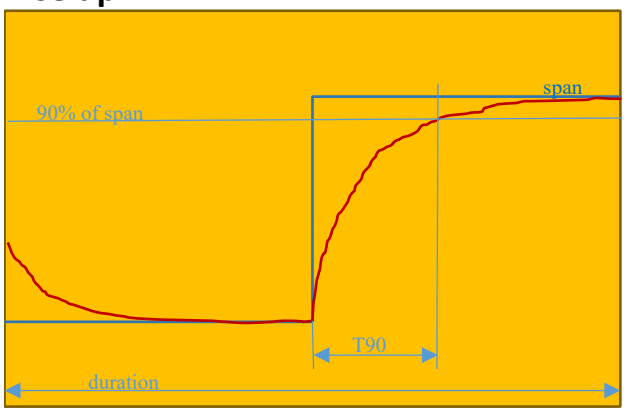
Measurements:
Noise of signal per step
Value of signal per step
Lack of fit

Repeatability standard deviation ZS

Run configurations:
Duration
Span concentration
(2 steps: span and zero)
Number of repetitions (=number of consecutive measurements)

Measurements:
Time until signal reaches level, typical 90%

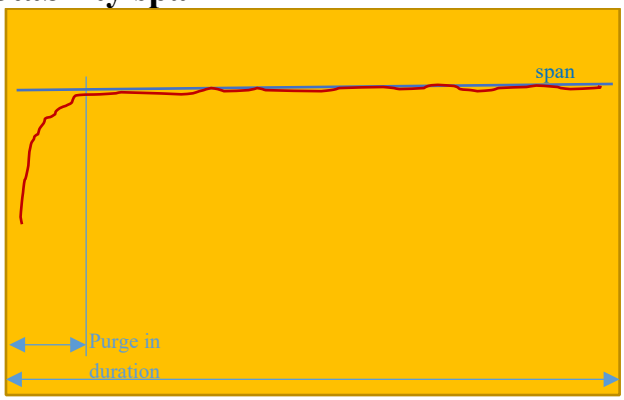
Rise up



Run configurations:
Duration
Duration on zero
Span concentration
(2 steps: zero and span)

Measurements:
Time until signal reaches level, typical 90%

Stability span

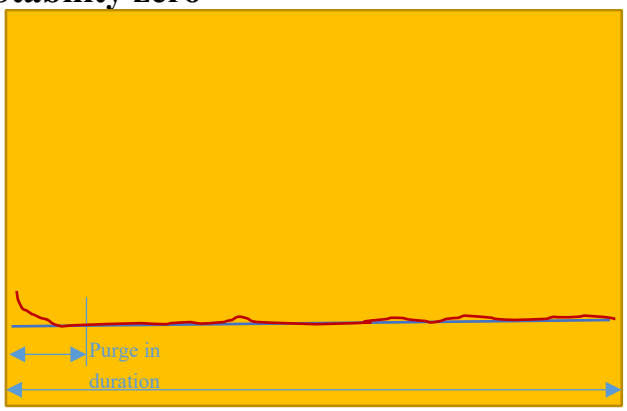


Run configurations:
Duration
Duration purge in
Span concentration
(1 step)

Measurements:
Noise of signal
Drift of signal
Value of signal

In stability span, the airQrate moves automatically to the next block when this block is complete, regardless of the success of the test

Stability zero

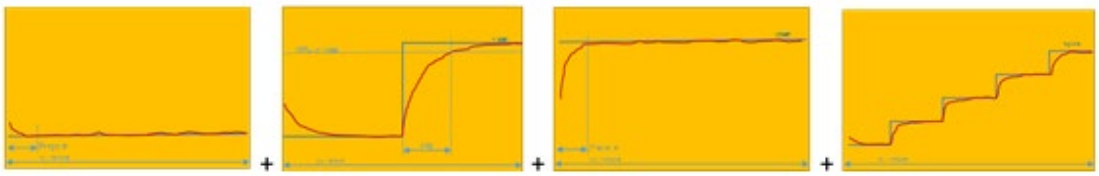


Run configurations:
Duration
Duration purge in

Measurements:
Noise of signal
Drift of signal
Value of signal

In stability zero, the airQrate moves automatically to the next block when this block is complete, regardless of the success of the test

Example of a program containing 4 blocks



Annex 2: AirQrate specifications

airQrate	**Mobile version**
Zero air requirement	Internal zero gas generation
Dilution (Zero) air flow rate	0-5 SLPM
Calibration (Span) air flow rate	0-50 ml/min, optional 0-100 ml/min, 0-200 ml/min
Flow measurement accuracy	+/- 1% FS
Repeatability of dilution	+/- 0.2% FS
Linearity of dilution	+/- 0.5% FS
Long term drift of dilution	<1%/year
Ozone Generator	
Ozone output	100 ppb l / min– 5 ppm l / min
UV-detector for stable output	Standard
Precision (5 min av.)	2 ppb *
linearity	1 % *
drift	< 1ppb/7 days

** with photometer option installed*