LUMASENSE™
TECHNOLOGIES

User Manual for Application Software 7650

BE6046-13

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Chapter 1

Introduction

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1.1 Introduction

The 7650 Basic Ventilation Software is used in combination with a Type 1512 or a Type 1412i and a Type 1403 to control Concentration Decay and Constant Dose methods for tracer gas measurements.

For further information regarding the use of the Type 1412i please refer to user manual BE6025. For further information regarding the use of type 1512 please refer to user manual BE6049 and for information regarding the Type 1403 user manual BE6045.

1.2 Connecting the Gas Monitor to the PC.

The 7650 uses the USB interface in order to communicate with the Type 1512 and Type 1412i Gas Monitor.

1.3 Connecting the Multipoint Sampler and Doser to the Gas Monitor.

The 1403 is connected to the 1512 or 1412i Gas Monitor by the USB interface, over which the 1403 receives the commands and data from the 7650, which controls the system.

1.4 Connecting Tubing to the 1512 or 1412i and 1403

All of the dosing and sampling procedures which the 1512 or 1412i and 1403 perform are done via tubing. The Doser valves on the 1403 is connected by tubing to the locations where dosing will be done. From each individual measurement location, a tube leads to the 1403 sampler channels, so that gas-samples can be drawn from each location ready for delivery to the gas monitor. The 1403 is connected to the 1512 or 1412i, so that the gas-samples can be delivered for analysis.

A full description of how to connect all necessary tubing to the 1512 or 1412i and 1403, and what kind of tubing to use, is given in the Instruction Manual BE6045 for the 1403.

Chapter 2

Installation of the 7650 Software

November 2018

When taking delivery of a Multipoint Sampler and Doser INNOVA 1403 the 7650 Basic Ventilation Software is delivered on an USB Memory Stick.

2.1 Installing the 7650 Basic Ventilation Software.

2.1.1 Computer requirements

The Software is targeted to work on a Desktop/Laptop PC environment running a Microsoft Windows Operating System.

Before installing the Software the PC must meet the following minimum requirements:

Processor	Intel dual-core i3 or compatible.
Operating System	Windows 7 (Service Pack 1) Windows 8.1 Windows 10
RAM	Minimum 4 GB Ram
Hard Disk	Up to 500 MB of available space may be required.
Display	HD resolution monitor 1366 x 768 pixel or higher with small fonts.
Total port connections	1 USB port
Connection to Gas Monitor	1 USB port

Table 2.1 Computer requirements

2.1.2 Installing 7650

Please refer to Appendix A how to perform the installation of the 7650 Basic Ventilation software.

After the installation is successfully completed the LumaSense – 7650 menu is created.

The 7650 program icon (Figure 2.1) is also placed on your desktop for easy access to the program.

Figure 2.1 7650 Basic Ventilation shortcut

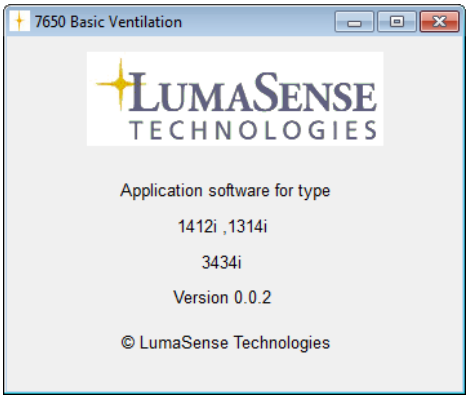
Chapter 3

Using the Program

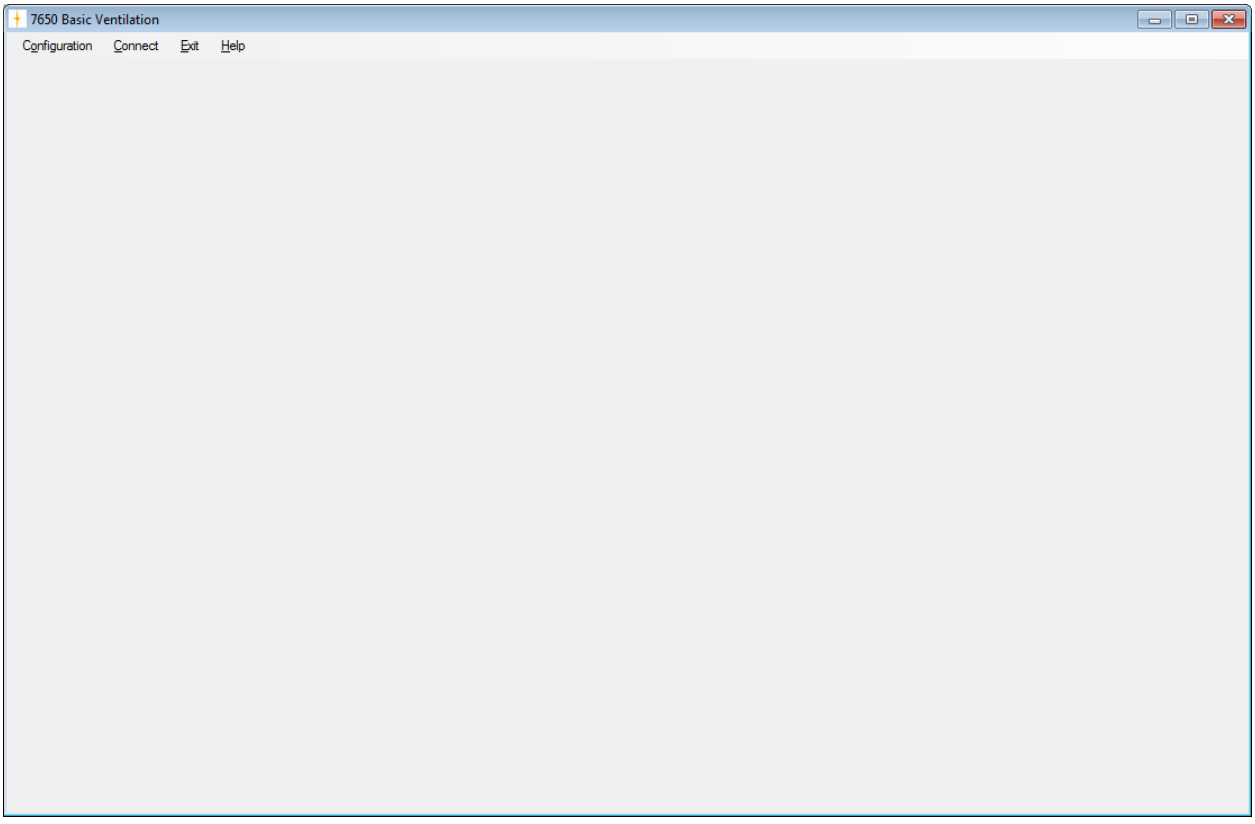
November 2018

3.1 7650 start-up

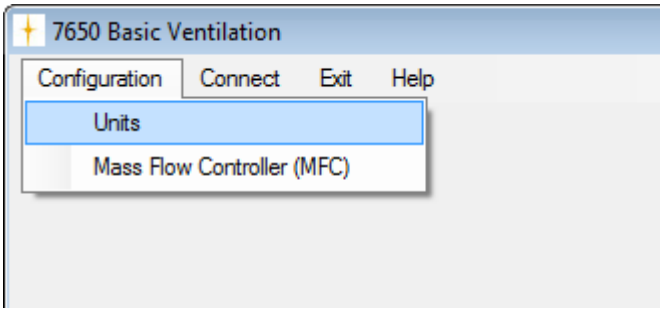
During the start-up of the **7650** application a splash screen will be shown.



The **7650** start-up window will appear when the application has started.



3.1.1 Program configuration menu



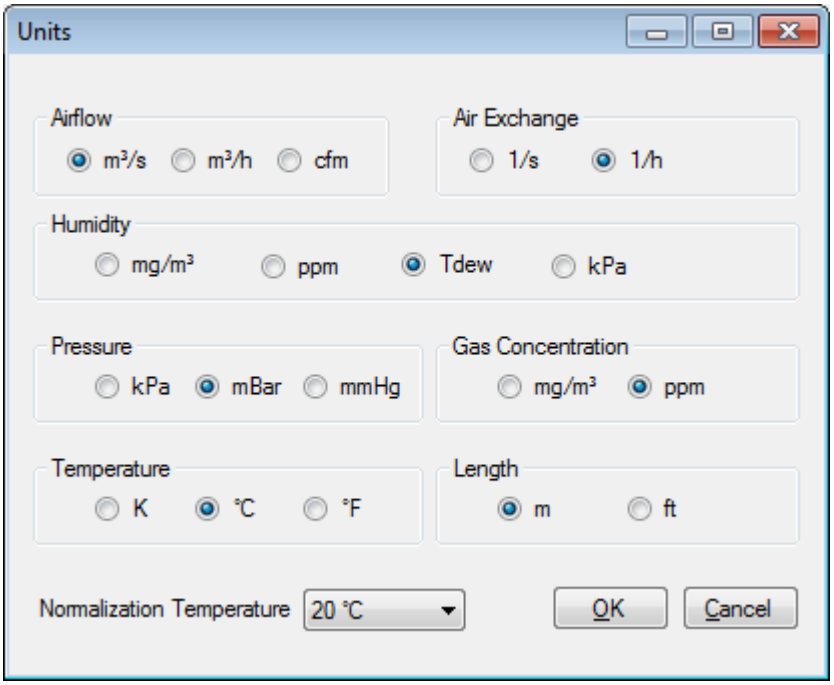
The very first time 7650 is started the **Units** menu item and the **Mass Flow Controller (MFC)** menu item needs to be configured.

The **Configuration** menu pull-down contains the **Units** menu and the **Mass Flow Controller (MFC)** menu items.

After making these configurations it is normally not necessary to change them again, as the units is by preference.

The chosen configuration will be stored so they need not to be set when restarting 7650.

3.1.2 Units menu item



The Humidity, Pressure, Gas Concentration, Temperature, Length and Normalization Temperature settings will be transferred to the gas monitor.

The selected units will be used by the gas monitor or the application itself, when calculating the respective values for:

- **Airflow**
- **Air Exchange**
- **Age of Air**

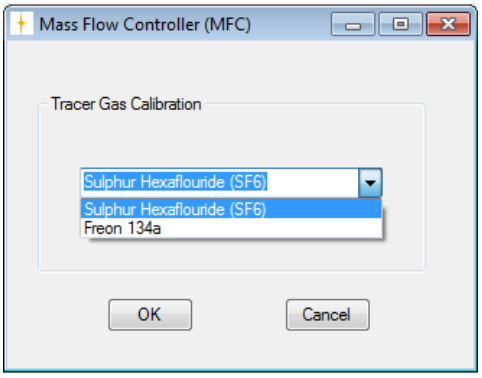
The default unit values are:

- Airflow : m^3/s
- Air Exchange : 1/h
- Humidity : Tdew
- Pressure : mBar
- Gas Concentration : ppm
- Temperature : °C
- Length : m

The default normalization temperature is 20 °C.

The selected unit and normalization temperature settings will be retained when restarting the **7650**.

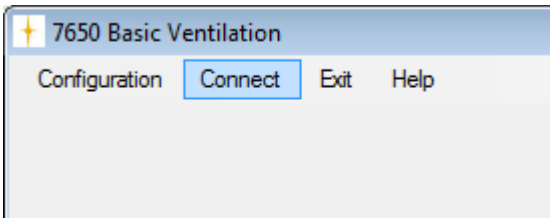
3.1.3 Mass Flow Controller (MFC) menu item



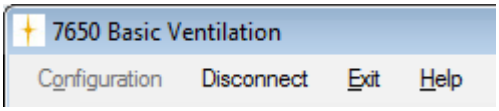
Press OK to select the Tracer Gas

The selected **Tracer Gas Calibration** setting will be retained when restarting the **7650**.

3.2 Connect menu item

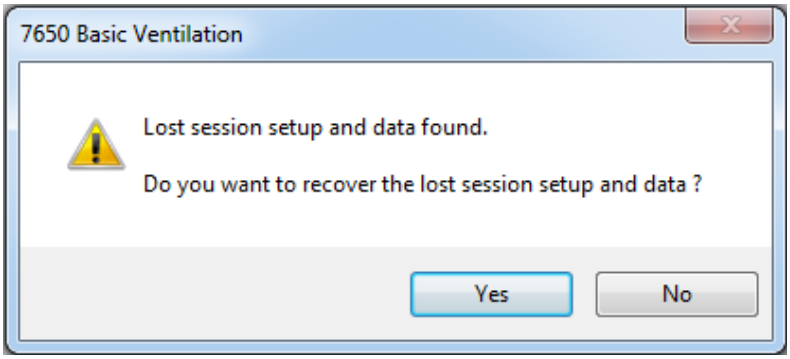


In order to connect to the Gas Monitor the file menu item **Connect** can be used.
The USB communication interface will be used when connecting to the Gas Monitor.
In case of a failed connect a popup error message box will be displayed.
After a successful connection to the Gas Monitor the **7650 Basic Ventilation** main window (see next section) becomes visible.
The **Configuration** file menu will be inactive (not changeable) after connecting to the Gas Monitor, implying that the **Units** cannot be changed while the 7650 is connected with the Gas Monitor.
After a successful connect to the Gas Monitor, the text of the **Connect** menu item changes into the text **Disconnect**, which then offers the option to make a disconnect from the Gas Monitor.

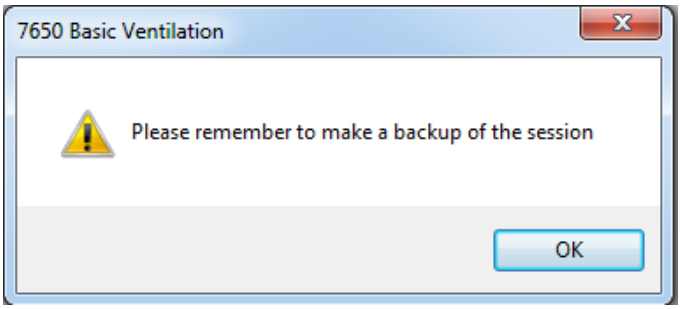


Please Note
Before disconnecting please, be aware that the measurements are not stored automatically. Therefore it is recommended to make a backup and export of the data (see Chapter 7) before **Disconnect** is selected.

If a previously unsaved measurement session is discovered during connect, you have the possibility to recover the lost session setup and data. This could happen if a measurement session was not backed up or if an unexpected power down of the PC occurred during the measurement session.

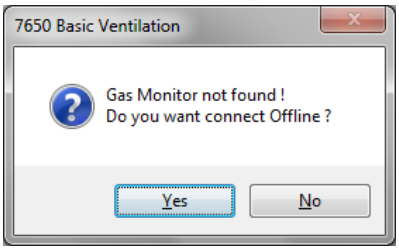


You will be prompted to make a backup of the setup and data (see Chapter 7 how to make a backup).



3.2.1 Connect offline

It is possible to connect without the gas monitor being present. In that case you will be asked to make an offline connect.



The purpose of the offline connect, is to restore a previous session (see Chapter 7), in order to view or make new calculations on a previously stored session.

Chapter 4

Main Window

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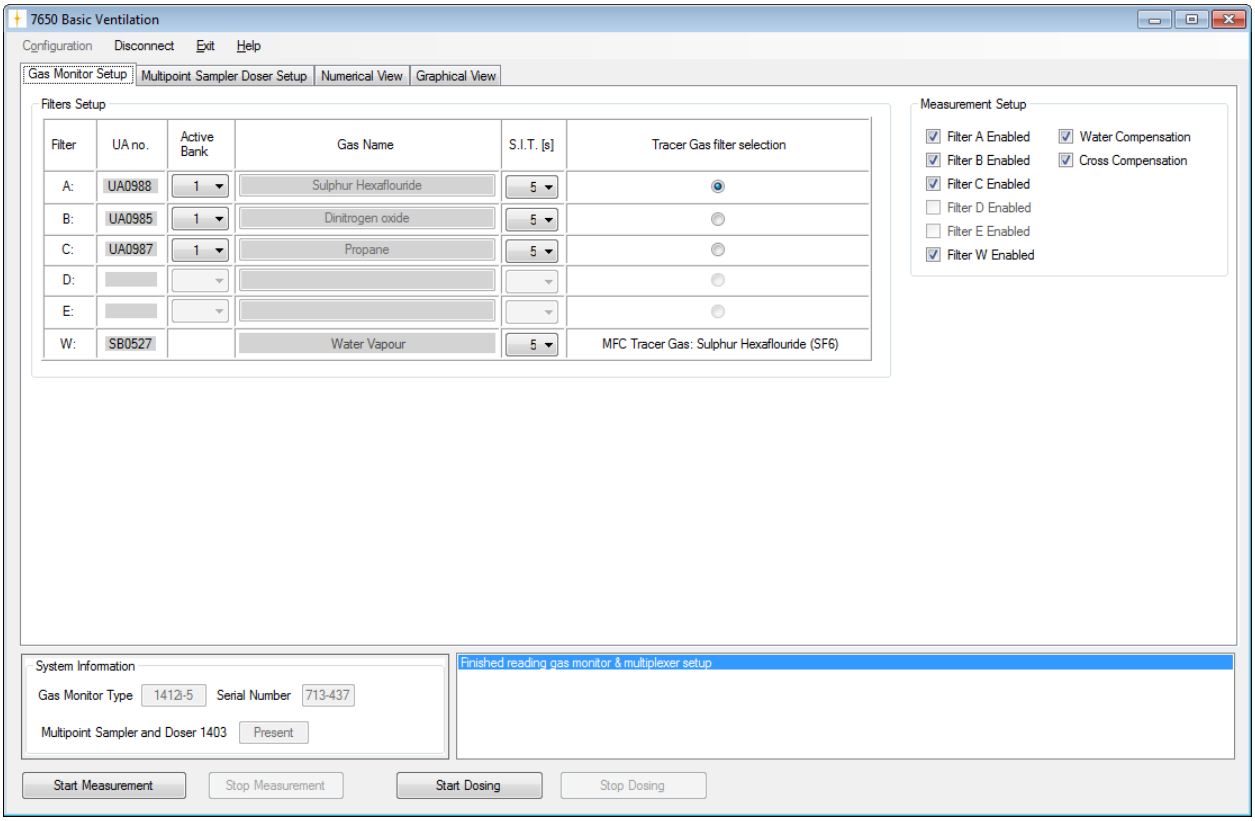
4 The Main window after connect

The **7650 Basic Ventilation** main window after having connected to the Gas Monitor:



The main window gives a full overview of the system setup.
Optical filters installed, the active filterbank number , gas name and the SIT used by the Gas Monitor.

The ***System Information*** field gives information of the instruments used for the application.

The ***Status Field*** gives status information during the session.

The Measurement setup gives the actual setup in this example :
Measurement of Sulphur Hexaflouride, Dinitrogen oxide , Propane and Water Vapor. It have been selected to measure with cross compensation and water compensation.

The tracer gas selected is Sulphur Hexaflouride and it can also bee seen that this is set-up in the Mass Flow controller (MFC).

The individual parts of the main window is described in more detail in the next chapter.

Chapter 5

Setup

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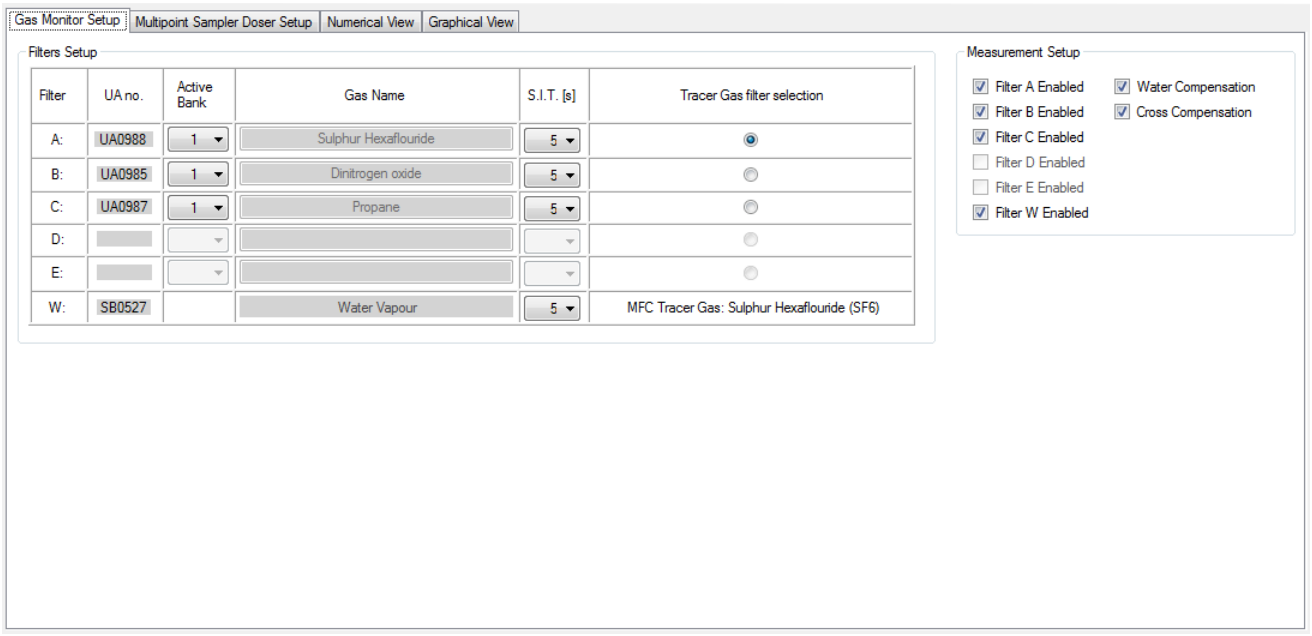
5 Setup

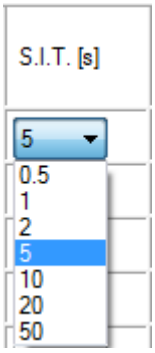
5.1 Gas Monitor Setup tab



The main purpose of the **Gas Monitor Setup** tab is to configure the Gas Monitor and select the measurement setup,
The filter settings and measurement setup in the Gas Monitor are automatically detected, when connecting to the Gas Monitor.
The table column **UA no.** will display the detected UA filter numbers. Furthermore, the **Gas Name** for each available filter will be displayed.
For the filters A-E, where an UA filter is detected, and for the filter W, the following columns become active (changeable):

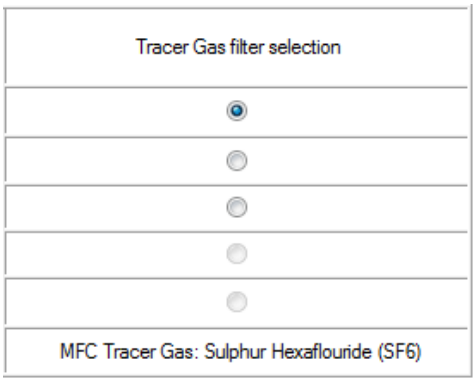
- **Active Bank** (1-5)
- **Tracer Gas** radio button selection
- **S.I.T.** (Sample integration time)

The **S.I.T.** (Sample Integration Time) can be set individually for each of the filter A to W, with a predefined value of 5 seconds.
The choice of S.I.T. values in seconds are

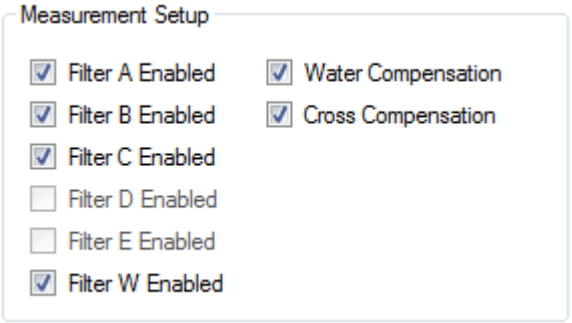


- 0.5 second
- 1 second (Fast)
- 2 seconds
- 5 seconds (Normal)
- 10 seconds
- 20 seconds (Low noise)
- 50 seconds

In the **Tracer Gas filter selection** column the tracer gas filter is identified by selecting one of the radio buttons.
For cross reference the name of the configured MFC Tracer Gas (see section 3.1.3) is displayed.
For convenience the **Tracer Gas filter selection** setting will be retained when restarting the **7650**.

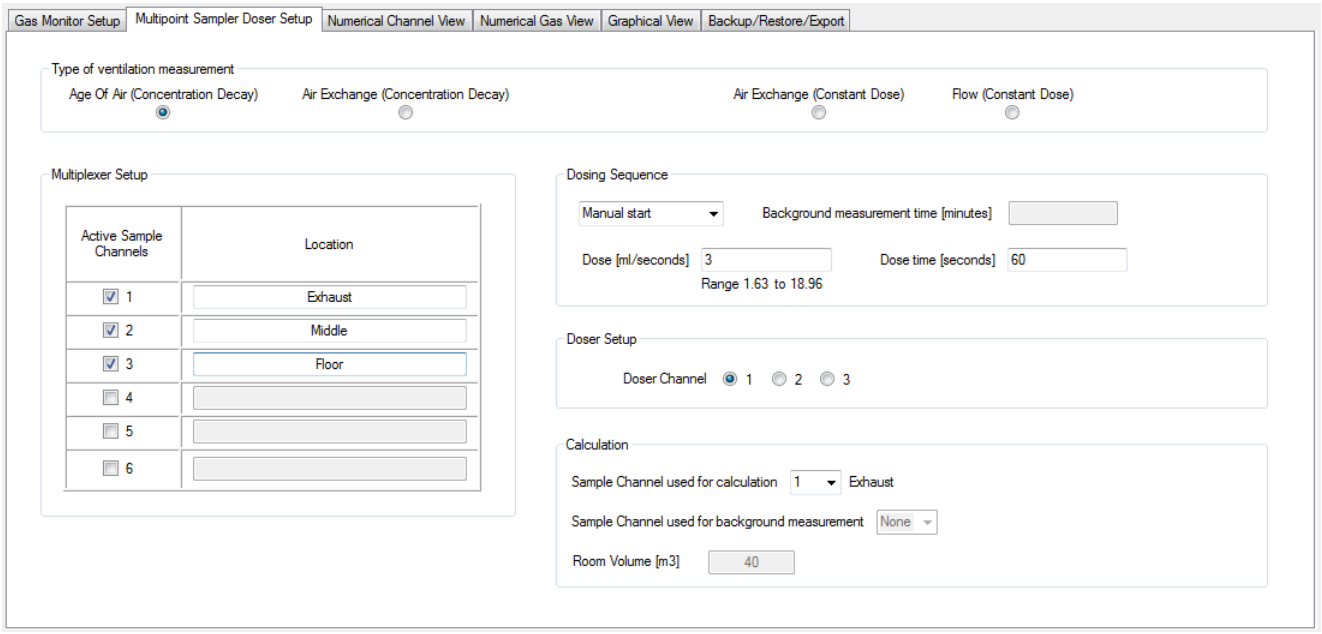


In the **Measurement Setup** group box, it can be ticked which of the **Filter**'s **A-W** shall be included in the measurement and whether **Water** or **Cross Compensation** shall be performed during the measurement.
The **Cross Compensation** tick box will be dimmed if only one of the **Filter**'s **A-W** is available.

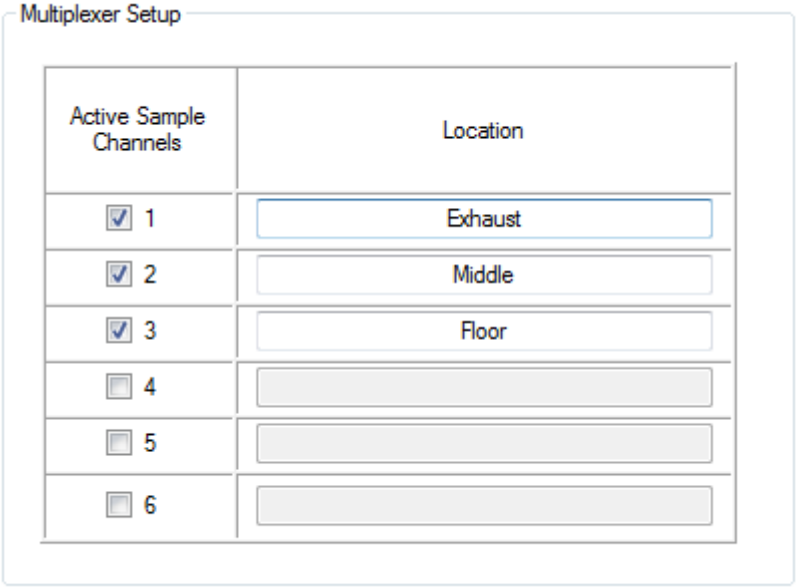


5.2 Multipoint Sampler Doser Setup tab

This tab defines the **Multipoint Sampler Doser** settings.

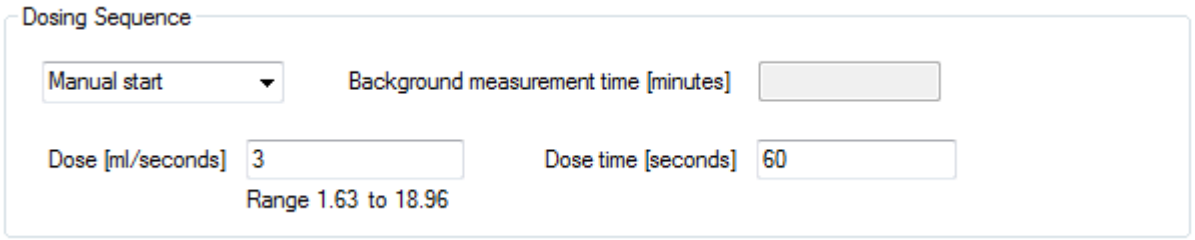


In the **Multiplexer Setup** group box the **Active Sample Channels** to be used during measurement can be selected and a **Location** description for each sample channel can be entered.

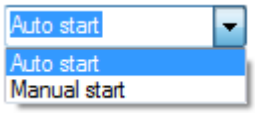


The **Type of ventilation measurement** group box defines which type of ventilation measurement is to be performed.
The selected **Type of ventilation measurement** setting will be retained when restarting the **7650**.

The **Dosing Sequence** group box defines the dosing settings, to be used during the ventilation measurement.



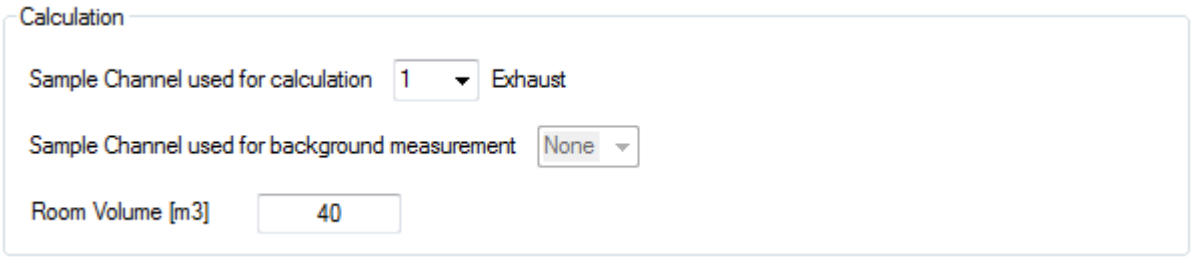
If **Auto start** is chosen the dosing will start automatically, after expiration of the time specified in the **Background measurement time** field. Otherwise, if **Manual Start** is chosen, the dosing can be started manually by using the **Start Dosing** button (see Chapter 8).



The **Dose** field sets the dose flow from the MFC (Mass Flow Controller) unit in the 1403 Multipoint Sampler and Doser. The allowed range for the dose flow will be specified.
The **Dose time** field sets for how long time the dosing will last. The maximum **Dose time** is 3600 seconds. The **Dose time** field is dimmed in case of a Constant Dose type of ventilation measurement has been selected.
The dosing can be stopped manually anytime by using the **Stop Dosing** button (see Chapter 8). The dosing can be started again in the same measurement by using the **Start Dosing** button (see Chapter 8).

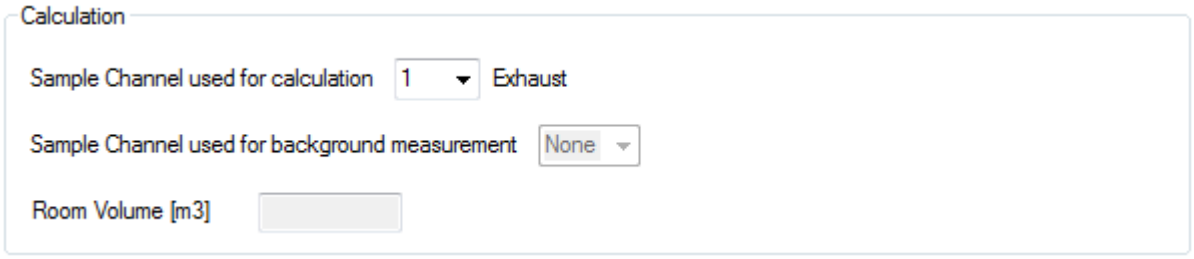
In the **Doser Setup** group box it can be selected, which **Doser Channel** valve to be opened during dosing.

In the **Calculation** group box the **Sample Channel used for calculation** can be defined.
The **Location** description for the selected sample channel will be shown.
The **Room Volume** field value defines the volume of the room to be used for calculation.
The **Sample Channel used for background measurement** is used for background correction.



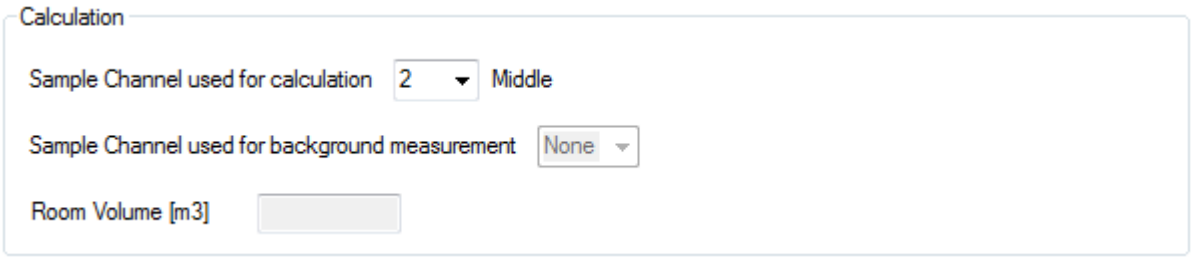
5.2.1 Age of Air Measurements (concentration decay)

If the **Age Of Air (Concentration Decay)** type of ventilation measurement is selected, the **Sample Channel used for calculation** select field will be active, in order to define a suitable sampling point for calculating the **Room Average Age Of Air** value in this type of measurement. The **Room Volume** and the **Sample Channel used for background measurement** are dimmed as they are not needed for calculation in this case.



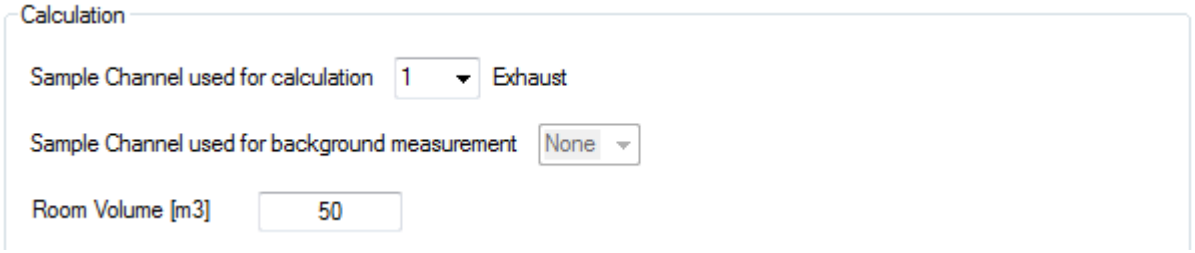
5.2.2 Air Exchange Measurement (concentration decay)

If the **Air Exchange (Concentration Decay)** type of ventilation measurement is selected, the **Sample Channel used for calculation** select field will be active, in order to define a sampling point for calculating the **Air Exchange Rate** value in this type of measurement. The **Room Volume** and the **Sample Channel used for background measurement** are dimmed as they are not needed for calculation in this case.



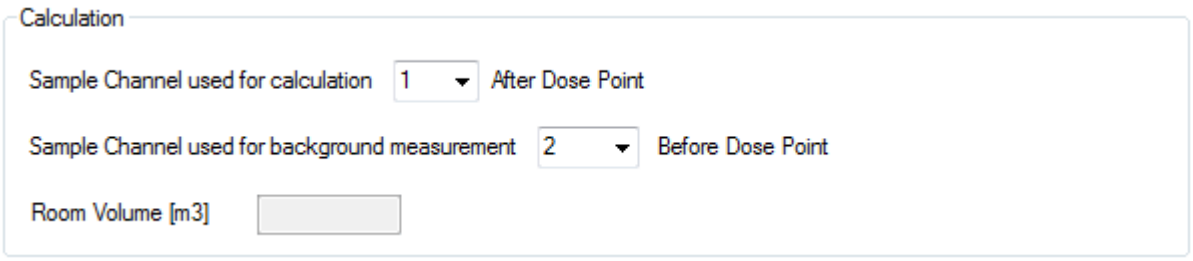
5.2.3 Air exchange (constant dose)

If the **Air Exchange (Constant Dose)** type of ventilation measurement is selected, the **Sample Channel used for calculation** select field value and the **Room** Volume field will be active, as the value is needed for calculating the **Air Exchange** in this type of measurement. The **Sample Channel used for background measurement** is dimmed as it is not needed for calculation in this case.



5.2.4 Air Flow (constant dose)

If the **Flow (Constant Dose)** type of ventilation measurement is selected the **Sample Channel used for calculation** select field will be active, in order to define a suitable sampling point for calculating the **Air Flow** in this type of measurement. The **Sample Channel used for background measurement** is used for background correction. For no background, correction set the **Sample Channel used for background measurement** to None. The **Room Volume** is dimmed as it is not needed for calculation in this case.



Chapter 6

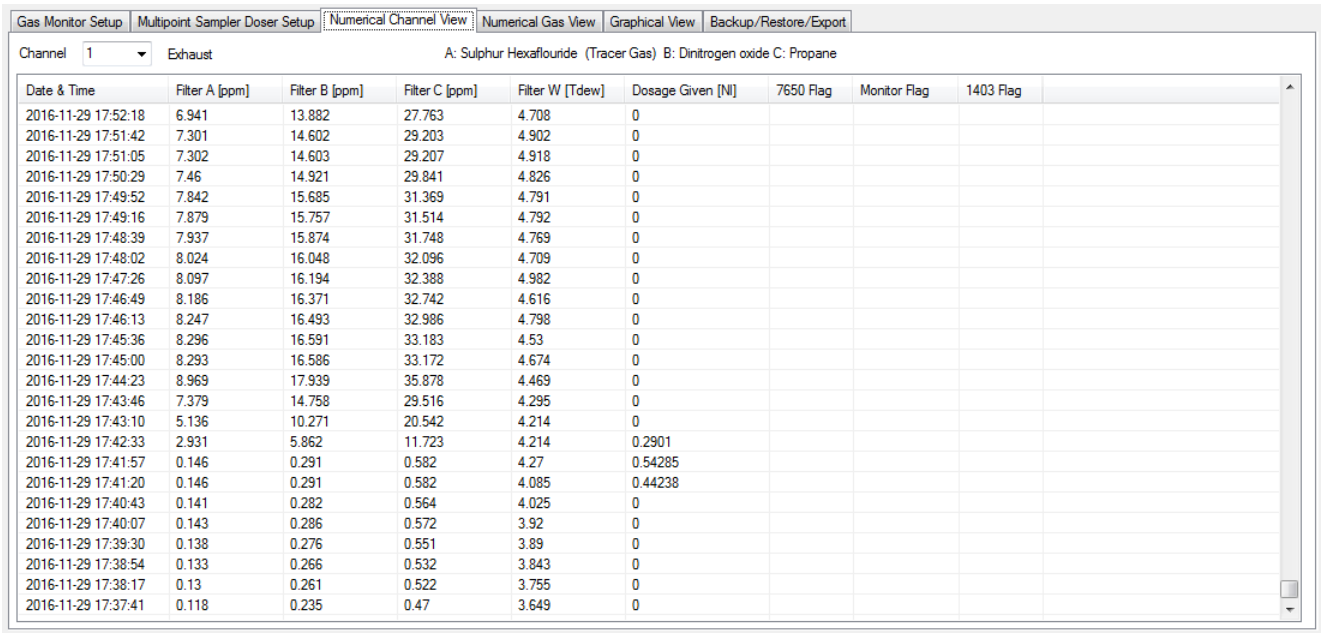
Numerical and Graphical Views

November 2018

6 Numerical and Graphical Views

6.1 Numerical Channel View tab

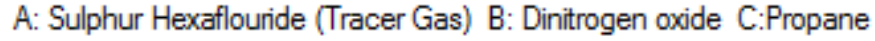
This tab contains the **Numerical Channel View**, which presents time stamped measurement data channel-wise in a table view during measurement.



Date & Time	Filter A [ppm]	Filter B [ppm]	Filter C [ppm]	Filter W [Tdew]	Dosage Given [Nl]	7650 Flag	Monitor Flag	1403 Flag
2016-11-29 17:52:18	6.941	13.882	27.763	4.708	0			
2016-11-29 17:51:42	7.301	14.602	29.203	4.902	0			
2016-11-29 17:51:05	7.302	14.603	29.207	4.918	0			
2016-11-29 17:50:29	7.46	14.921	29.841	4.826	0			
2016-11-29 17:49:52	7.842	15.685	31.369	4.791	0			
2016-11-29 17:49:16	7.879	15.757	31.514	4.792	0			
2016-11-29 17:48:39	7.937	15.874	31.748	4.769	0			
2016-11-29 17:48:02	8.024	16.048	32.096	4.709	0			
2016-11-29 17:47:26	8.097	16.194	32.388	4.982	0			
2016-11-29 17:46:49	8.186	16.371	32.742	4.616	0			
2016-11-29 17:46:13	8.247	16.493	32.986	4.798	0			
2016-11-29 17:45:36	8.296	16.591	33.183	4.53	0			
2016-11-29 17:45:00	8.293	16.586	33.172	4.674	0			
2016-11-29 17:44:23	8.969	17.939	35.878	4.469	0			
2016-11-29 17:43:46	7.379	14.758	29.516	4.295	0			
2016-11-29 17:43:10	5.136	10.271	20.542	4.214	0			
2016-11-29 17:42:33	2.931	5.862	11.723	4.214	0.2901			
2016-11-29 17:41:57	0.146	0.291	0.582	4.27	0.54285			
2016-11-29 17:41:20	0.146	0.291	0.582	4.085	0.44238			
2016-11-29 17:40:43	0.141	0.282	0.564	4.025	0			
2016-11-29 17:40:07	0.143	0.286	0.572	3.92	0			
2016-11-29 17:39:30	0.138	0.276	0.551	3.89	0			
2016-11-29 17:38:54	0.133	0.266	0.532	3.843	0			
2016-11-29 17:38:17	0.13	0.261	0.522	3.755	0			
2016-11-29 17:37:41	0.118	0.235	0.47	3.649	0			

The **Channel** combo box selects which of the sample channel data is being shown. The Location description is shown next to the selected sample channel.

The gas names for the available filters A-E is shown.



Time stamped measurement values for the available **Filter(s) A-W** is shown in their respective units.

The measured **Dosage Given** is shown.

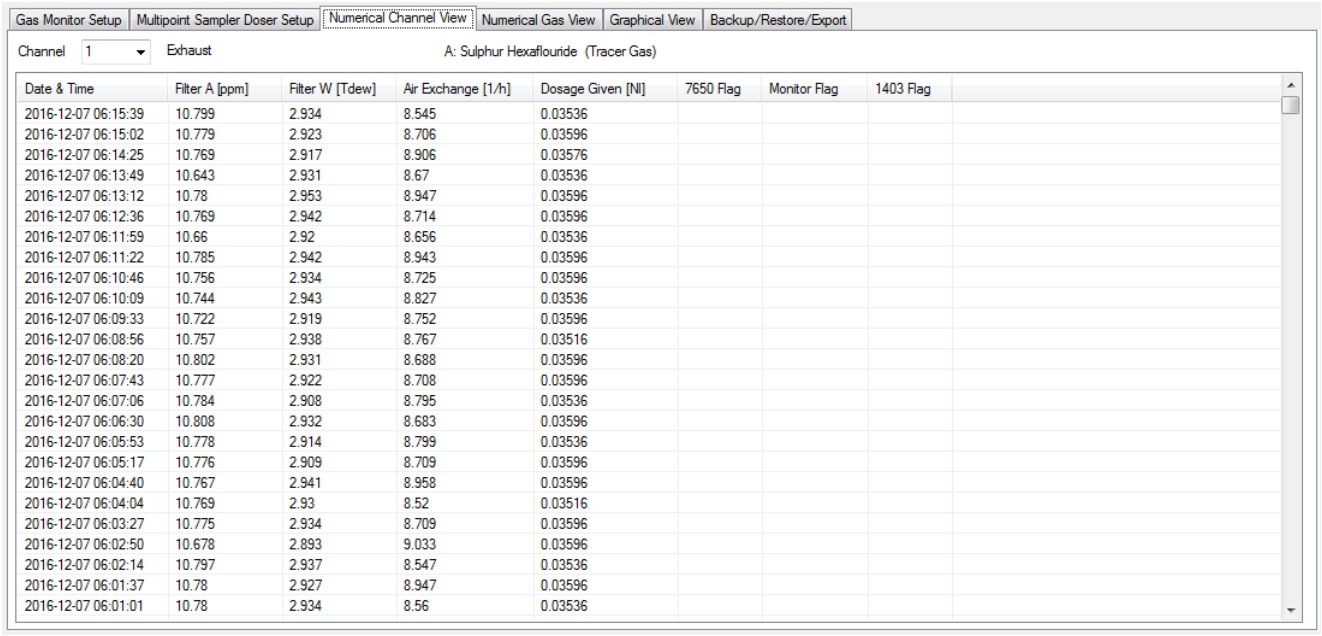
Any error/warning flags are shown as **7650 Flag** (application), **Monitor Flag** (Gas Monitor) or **1403 Flag** (1403 Multipoint Sampler and Doser). The meaning of the flags are described in the **Description of Flags tab** section in Appendix B

6.1.1 Concentration Decay Numerical Channel View

For the **Age Of Air** (**Concentration Decay)** and **Air Exchange** (**Concentration Decay)** type of ventilation measurements, the **Numerical Channel View** will be presented as shown in the figure in section 6.1.

6.1.2 Air Exchange (Constant Dose) Numerical Channel View

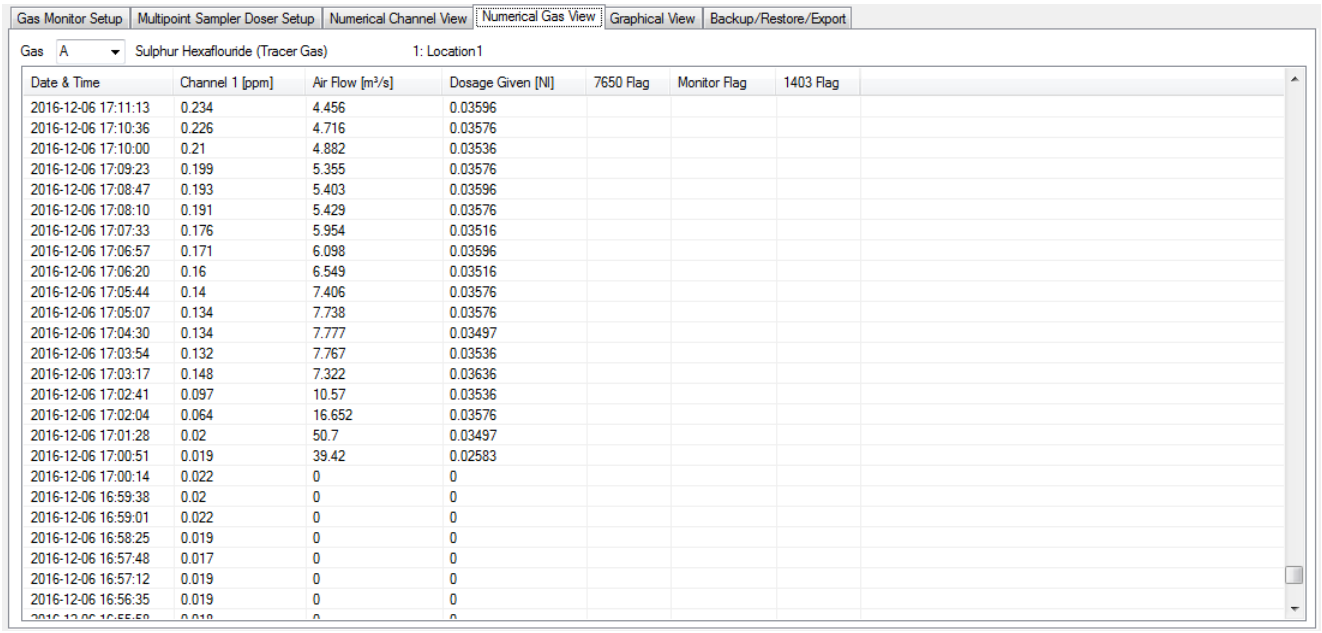
For the **Air Exchange** (**Constant Dose)** type of ventilation measurement the **Air Exchange** is also calculated and shown in the **Numerical Channel View.**



Date & Time	Filter A [ppm]	Filter W [Tdew]	Air Exchange [1/h]	Dosage Given [Nl]	7650 Flag	Monitor Flag	1403 Flag
2016-12-07 06:15:39	10.799	2.934	8.545	0.03536			
2016-12-07 06:15:02	10.779	2.923	8.706	0.03596			
2016-12-07 06:14:25	10.769	2.917	8.906	0.03576			
2016-12-07 06:13:49	10.643	2.931	8.67	0.03536			
2016-12-07 06:13:12	10.78	2.953	8.947	0.03596			
2016-12-07 06:12:36	10.769	2.942	8.714	0.03596			
2016-12-07 06:11:59	10.66	2.92	8.656	0.03536			
2016-12-07 06:11:22	10.785	2.942	8.943	0.03596			
2016-12-07 06:10:46	10.756	2.934	8.725	0.03596			
2016-12-07 06:10:09	10.744	2.943	8.827	0.03536			
2016-12-07 06:09:33	10.722	2.919	8.752	0.03596			
2016-12-07 06:08:56	10.757	2.938	8.767	0.03516			
2016-12-07 06:08:20	10.802	2.931	8.688	0.03596			
2016-12-07 06:07:43	10.777	2.922	8.708	0.03596			
2016-12-07 06:07:06	10.784	2.908	8.795	0.03536			
2016-12-07 06:06:30	10.808	2.932	8.683	0.03596			
2016-12-07 06:05:53	10.778	2.914	8.799	0.03536			
2016-12-07 06:05:17	10.776	2.909	8.709	0.03596			
2016-12-07 06:04:40	10.767	2.941	8.958	0.03596			
2016-12-07 06:04:04	10.769	2.93	8.52	0.03516			
2016-12-07 06:03:27	10.775	2.934	8.709	0.03596			
2016-12-07 06:02:50	10.678	2.893	9.033	0.03596			
2016-12-07 06:02:14	10.797	2.937	8.547	0.03536			
2016-12-07 06:01:37	10.78	2.927	8.947	0.03596			
2016-12-07 06:01:01	10.78	2.934	8.56	0.03536			

6.1.3 Flow (Constant Dose) Numerical Channel View

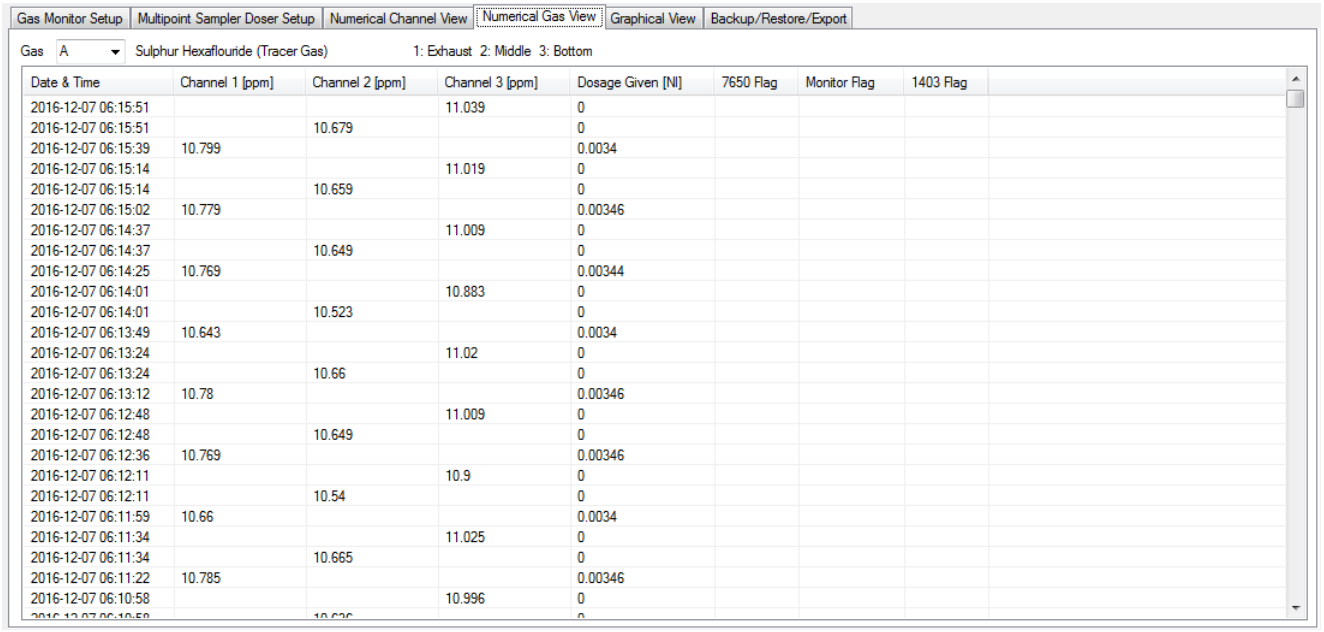
For the **Flow** (**Constant Dose)** type of ventilation measurement the **Air Flow** is also calculated and shown in the **Numerical Channel View.**



Date & Time	Channel 1 [ppm]	Air Flow [m³/s]	Dosage Given [Nl]	7650 Flag	Monitor Flag	1403 Flag
2016-12-06 17:11:13	0.234	4.456	0.03596			
2016-12-06 17:10:36	0.226	4.716	0.03576			
2016-12-06 17:10:00	0.21	4.882	0.03536			
2016-12-06 17:09:23	0.199	5.355	0.03576			
2016-12-06 17:08:47	0.193	5.403	0.03596			
2016-12-06 17:08:10	0.191	5.429	0.03576			
2016-12-06 17:07:33	0.176	5.954	0.03516			
2016-12-06 17:06:57	0.171	6.098	0.03596			
2016-12-06 17:06:20	0.16	6.549	0.03516			
2016-12-06 17:05:44	0.14	7.406	0.03576			
2016-12-06 17:05:07	0.134	7.738	0.03576			
2016-12-06 17:04:30	0.134	7.777	0.03497			
2016-12-06 17:03:54	0.132	7.767	0.03536			
2016-12-06 17:03:17	0.148	7.322	0.03636			
2016-12-06 17:02:41	0.097	10.57	0.03536			
2016-12-06 17:02:04	0.064	16.652	0.03576			
2016-12-06 17:01:28	0.02	50.7	0.03497			
2016-12-06 17:00:51	0.019	39.42	0.02583			
2016-12-06 17:00:14	0.022	0	0			
2016-12-06 16:59:38	0.02	0	0			
2016-12-06 16:59:01	0.022	0	0			
2016-12-06 16:58:25	0.019	0	0			
2016-12-06 16:57:48	0.017	0	0			
2016-12-06 16:57:12	0.019	0	0			
2016-12-06 16:56:35	0.019	0	0			

6.2 Numerical Gas View tab

This tab contains the **Numerical Gas View**, which presents time stamped measurement data gas-wise in a table view during measurement.



Date & Time	Channel 1 [ppm]	Channel 2 [ppm]	Channel 3 [ppm]	Dosage Given [Nl]	7650 Flag	Monitor Flag	1403 Flag
2016-12-07 06:15:51			11.039	0			
2016-12-07 06:15:51		10.679		0			
2016-12-07 06:15:39	10.799			0.0034			
2016-12-07 06:15:14			11.019	0			
2016-12-07 06:15:14		10.659		0			
2016-12-07 06:15:02	10.779			0.00346			
2016-12-07 06:14:37			11.009	0			
2016-12-07 06:14:37		10.649		0			
2016-12-07 06:14:25	10.769			0.00344			
2016-12-07 06:14:01			10.883	0			
2016-12-07 06:14:01		10.523		0			
2016-12-07 06:13:49	10.643			0.0034			
2016-12-07 06:13:24			11.02	0			
2016-12-07 06:13:24		10.66		0			
2016-12-07 06:13:12	10.78			0.00346			
2016-12-07 06:12:48			11.009	0			
2016-12-07 06:12:48		10.649		0			
2016-12-07 06:12:36	10.769			0.00346			
2016-12-07 06:12:11			10.9	0			
2016-12-07 06:12:11		10.54		0			
2016-12-07 06:11:59	10.66			0.0034			
2016-12-07 06:11:34			11.025	0			
2016-12-07 06:11:34		10.665		0			
2016-12-07 06:11:22	10.785			0.00346			
2016-12-07 06:10:58			10.996	0			

The **Gas** combo box selects which of the sample filter data is being shown. The gas name is shown next to the selected filter.

The location names for the available channels are shown.

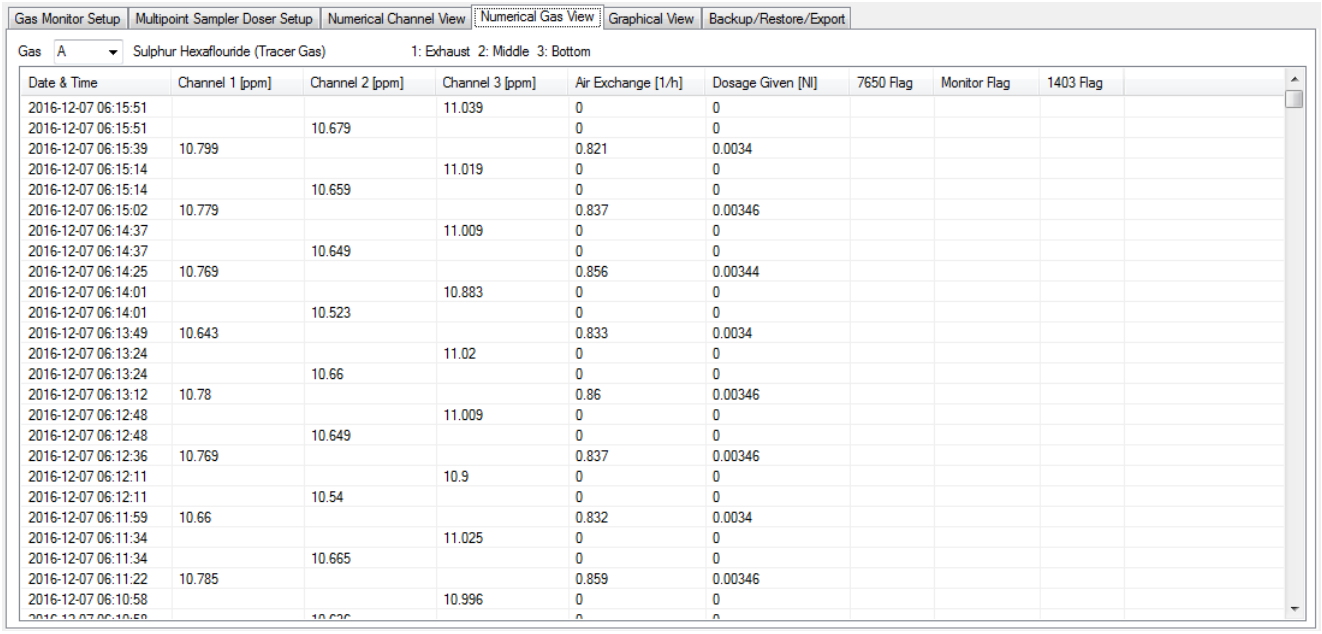
Time stamped measurement values for the available **Channel(s)** is shown with the appropriate unit.
The measured **Dosage Given** is shown.
Any error/warning flags are shown as **7650 Flag** (application), **Monitor Flag** (Gas Monitor) or **1403 Flag** (1403 Multipoint Sampler and Doser). The meaning of the flags are described in the **Description of Flags tab** section in AppendixB

6.2.1 Concentration Decay Gas View

For the **Age Of Air** (**Concentration Decay)** and **Air Exchange** (**Concentration Decay)** type of ventilation measurements, the **Numerical Gas View** will be presented as shown above.

6.2.2 Air Exchange (Constant Dose) Numerical Gas View

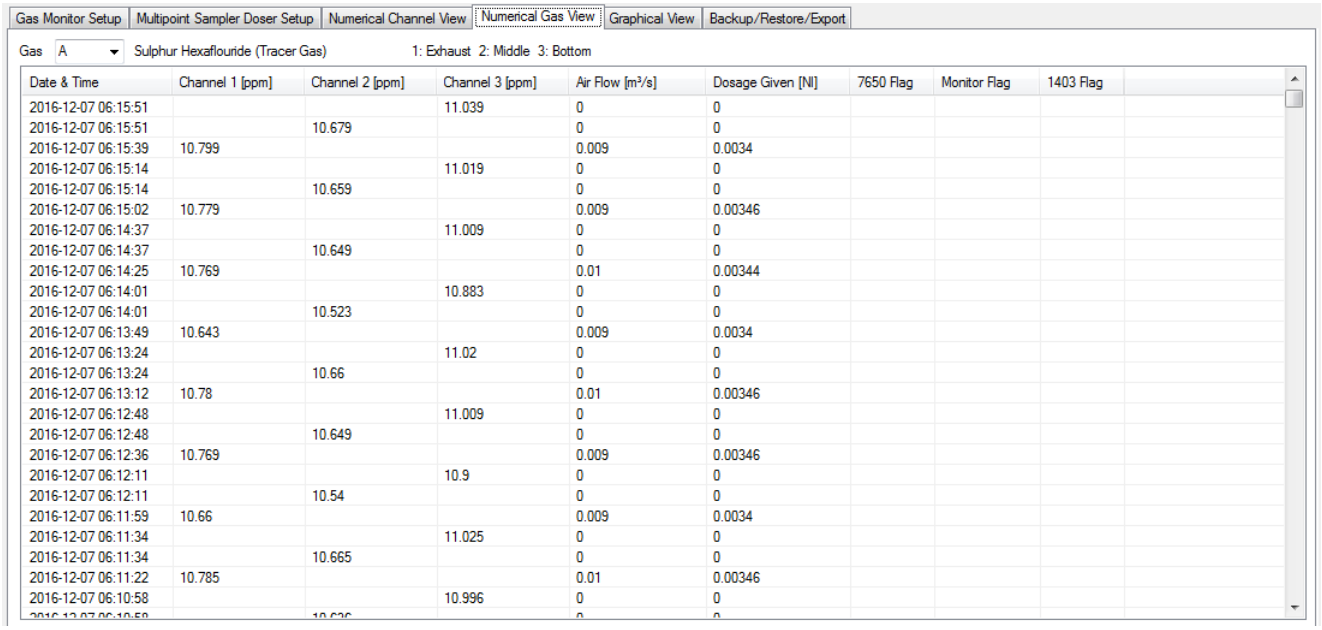
For the **Air Exchange** (**Constant Dose)** type of ventilation measurement the **Air Exchange** is also calculated and shown in the **Numerical Gas View.**



Date & Time	Channel 1 [ppm]	Channel 2 [ppm]	Channel 3 [ppm]	Air Exchange [1/h]	Dosage Given [Nl]	7650 Flag	Monitor Flag	1403 Flag
2016-12-07 06:15:51			11.039	0	0			
2016-12-07 06:15:51		10.679		0	0			
2016-12-07 06:15:39	10.799			0.821	0.0034			
2016-12-07 06:15:14			11.019	0	0			
2016-12-07 06:15:14		10.659		0	0			
2016-12-07 06:15:02	10.779			0.837	0.00346			
2016-12-07 06:14:37			11.009	0	0			
2016-12-07 06:14:37		10.649		0	0			
2016-12-07 06:14:25	10.769			0.856	0.00344			
2016-12-07 06:14:01			10.883	0	0			
2016-12-07 06:14:01		10.523		0	0			
2016-12-07 06:13:49	10.643			0.833	0.0034			
2016-12-07 06:13:24			11.02	0	0			
2016-12-07 06:13:24		10.66		0	0			
2016-12-07 06:13:12	10.78			0.86	0.00346			
2016-12-07 06:12:48			11.009	0	0			
2016-12-07 06:12:48		10.649		0	0			
2016-12-07 06:12:36	10.769			0.837	0.00346			
2016-12-07 06:12:11			10.9	0	0			
2016-12-07 06:12:11		10.54		0	0			
2016-12-07 06:11:59	10.66			0.832	0.0034			
2016-12-07 06:11:34			11.025	0	0			
2016-12-07 06:11:34		10.665		0	0			
2016-12-07 06:11:22	10.785			0.859	0.00346			
2016-12-07 06:10:58			10.996	0	0			

6.2.3 Flow (Constant Dose) Numerical Gas View

For the **Flow** (**Constant Dose)** type of ventilation measurement the **Air Flow** is also calculated and shown in the **Numerical Gas View.**

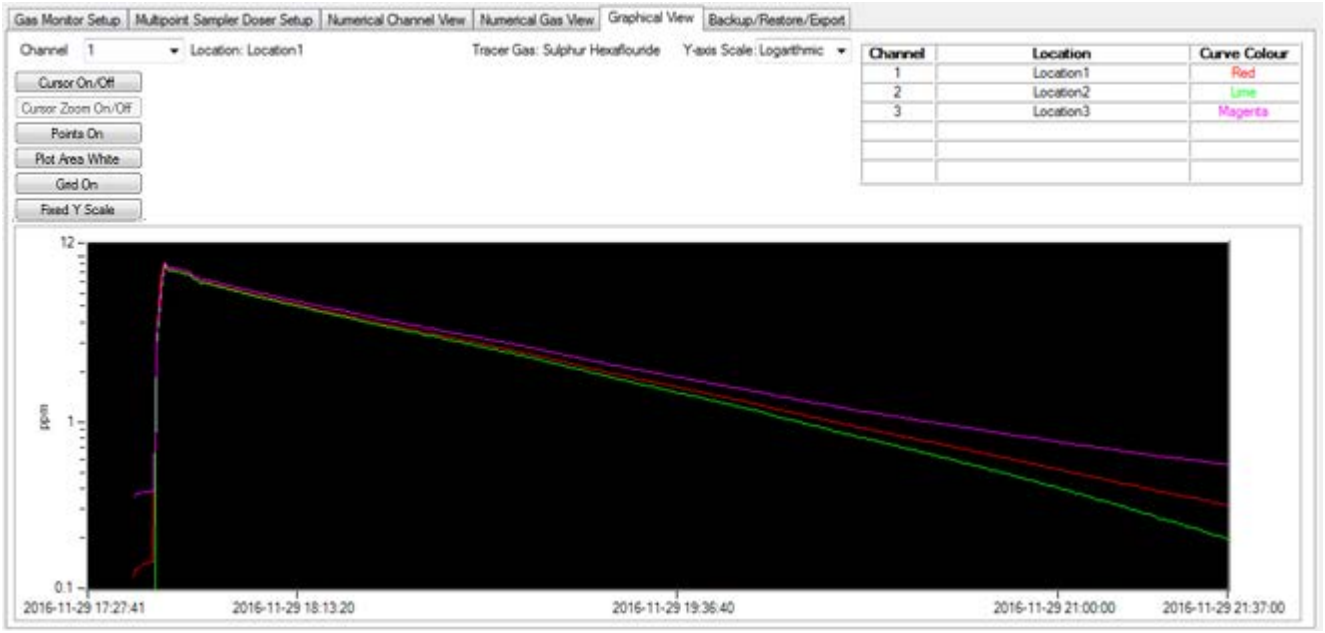


Date & Time	Channel 1 [ppm]	Channel 2 [ppm]	Channel 3 [ppm]	Air Flow [m³/s]	Dosage Given [Nl]	7650 Flag	Monitor Flag	1403 Flag
2016-12-07 06:15:51			11.039	0	0			
2016-12-07 06:15:51		10.679		0	0			
2016-12-07 06:15:39	10.799			0.009	0.0034			
2016-12-07 06:15:14			11.019	0	0			
2016-12-07 06:15:14		10.659		0	0			
2016-12-07 06:15:02	10.779			0.009	0.00346			
2016-12-07 06:14:37			11.009	0	0			
2016-12-07 06:14:37		10.649		0	0			
2016-12-07 06:14:25	10.769			0.01	0.00344			
2016-12-07 06:14:01			10.883	0	0			
2016-12-07 06:14:01		10.523		0	0			
2016-12-07 06:13:49	10.643			0.009	0.0034			
2016-12-07 06:13:24			11.02	0	0			
2016-12-07 06:13:24		10.66		0	0			
2016-12-07 06:13:12	10.78			0.01	0.00346			
2016-12-07 06:12:48			11.009	0	0			
2016-12-07 06:12:48		10.649		0	0			
2016-12-07 06:12:36	10.769			0.009	0.00346			
2016-12-07 06:12:11			10.9	0	0			
2016-12-07 06:12:11		10.54		0	0			
2016-12-07 06:11:59	10.66			0.009	0.0034			
2016-12-07 06:11:34			11.025	0	0			
2016-12-07 06:11:34		10.665		0	0			
2016-12-07 06:11:22	10.785			0.01	0.00346			
2016-12-07 06:10:58			10.996	0	0			

6.3 Graphical View tab

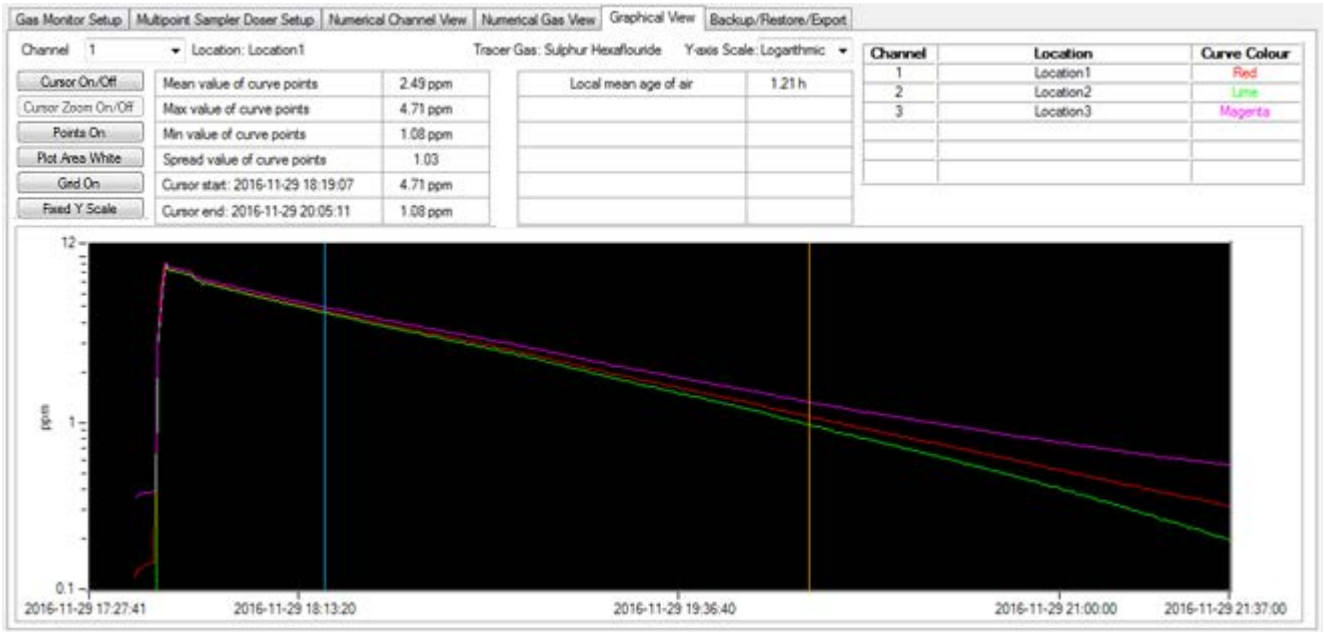
This tab contains the **Graphical View**.
The behaviour of the graphical view will be different for each type of ventilation measurement.

6.3.1 Age of Air (Concentration Decay) graphical view



The graph displays tracer gas curves for all the available channels in the multiplexer setup.
The **Curve Colour** for each of the curves is specified.
The Y-axis shows the unit for the concentration.
The **Y-axis scale** can be chosen to either logarithmic or linear scaling. For the **Decay** type of ventilation measurement the logarithmic Y-axis type will be preselected.

Channel	Location	Curve Colour
1	Location1	Red
2	Location2	Lime
3	Location3	Magenta



The **Points On** button toggles the display of measurement points.
The **Plot Area White** button changes the background colour of the plot area.
The **Grid On** button will show a grid in the graph window.
The **Fixed Y Scale** button will fix the vertical Y axis meaning that new incoming concentration values will not change the Y axis range.
2 vertical Cursors can be toggled either on or off in the graph display by pressing the **Cursor On / Off** button.
The start cursor is in blue colour and the end cursor is in orange colour.
The cursors can be moved horizontally with the purpose to select a part of a curve.
When the cursors in on, the following display becomes visible:

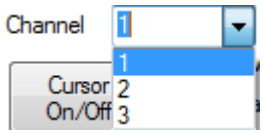
Mean value of curve points	2.49 ppm	Local mean age of air	1.21 h
Max value of curve points	4.71 ppm		
Min value of curve points	1.08 ppm		
Spread value of curve points	1.03		
Cursor start: 2016-11-29 18:19:07	4.71 ppm		
Cursor end: 2016-11-29 20:05:11	1.08 ppm		

The date & time and tracer gas value, selected by the start cursor and the end cursor is shown.
The **Mean value of curve points**, **Max value of curve points**, **Min value of curve points**, **Spread value of curve points** and **Local mean age of air** are calculated for the curve values selected by the cursors.

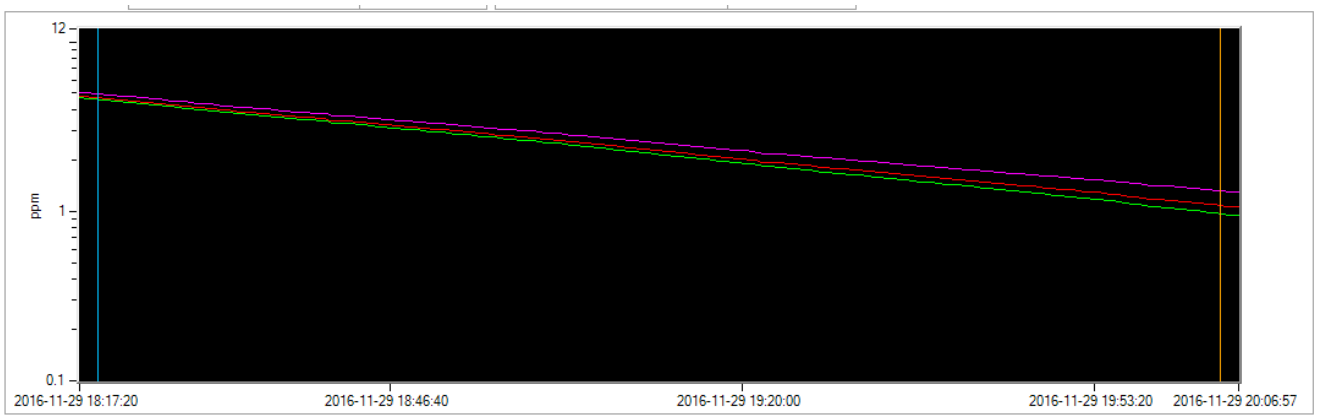
For calculation of the Local Mean Age of Air

- *Use the logarithmic Y-axis scale*
- *Use the cursors to select a part of the curve with a linear decay*

The above displayed values are based on the selected channel curve, which is chosen with the channel selection:

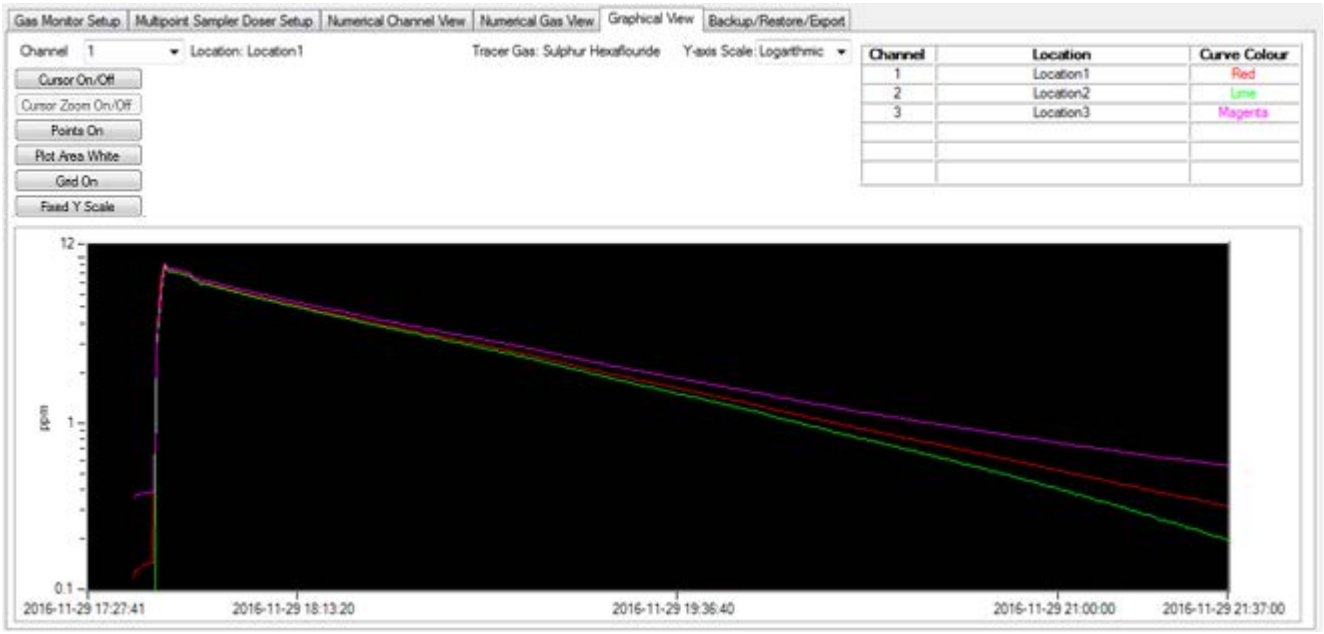


The display can be zoomed with the **Cursor Zoom On / Off** button, to display the curve points selected by the cursors.

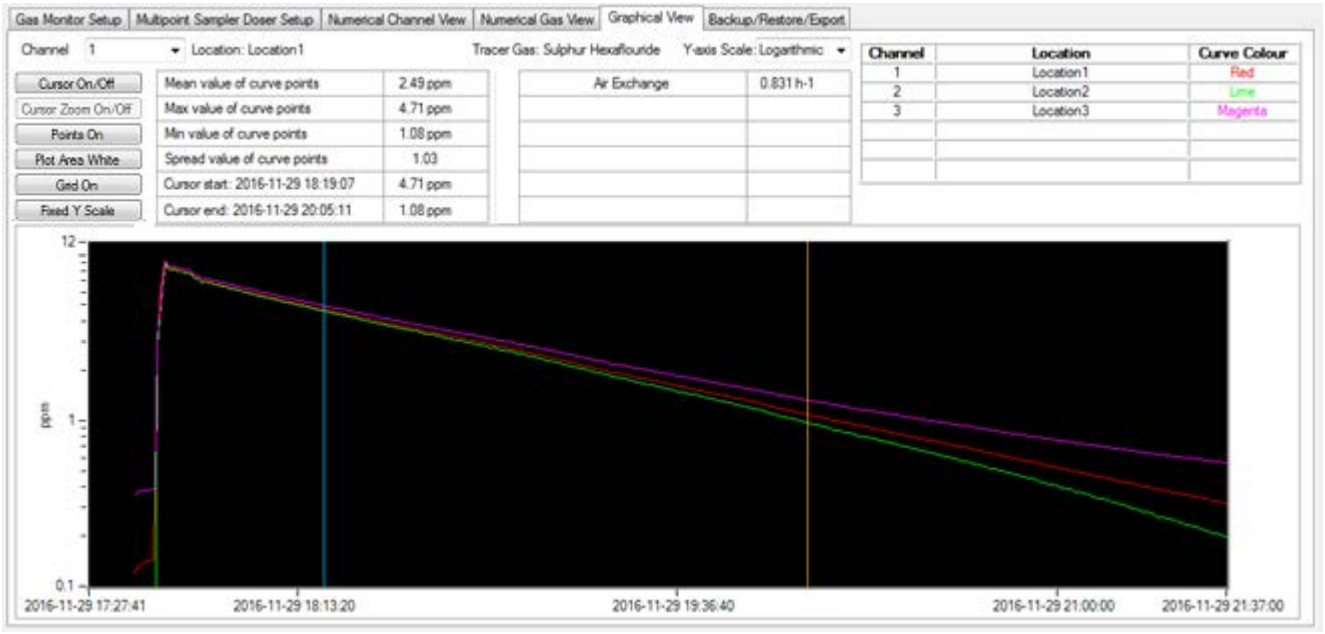


All the measured curve points can be shown again by pressing the **Cursor Zoom On / Off** button again.

6.3.2 Air Exchange (Concentration Decay) graphical view



The graph displays tracer gas curves for all the available channels in the multiplexer setup.
The **Curve Colour** for each of the curves is specified.
The Y-axis shows the units for the concentration.
The **Y-axis Scale** can be chosen to be either logarithmic or linear scaling. For the **Decay** type of ventilation, measurement the logarithmic Y-axis type will be preselected.



The **Points On** button toggles the display of measurement points.
The **Plot Area White** button changes the background colour of the plot area.
The **Grid On** button will show a grid in the graph window.
The **Fixed Y Scale** button will fix the vertical Y axis meaning that new incoming concentration values will not change the Y axis range.
2 vertical Cursors can be toggled either on or off in the graph display by pressing the **Cursor On / Off** button.
The start cursor is in blue colour and the end cursor is in orange colour.
The cursors can be moved horizontally with the purpose to select a part of a curve.
When the cursors in on, the following display becomes visible:

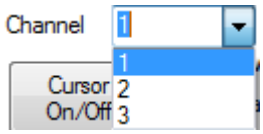
Mean value of curve points	2.49 ppm	Air Exchange	0.831 h-1
Max value of curve points	4.71 ppm		
Min value of curve points	1.08 ppm		
Spread value of curve points	1.03		
Cursor start: 2016-11-29 18:19:07	4.71 ppm		
Cursor end: 2016-11-29 20:05:11	1.08 ppm		

The date & time and tracer gas value, selected by the start cursor and the end cursor is shown.
The **Mean value of curve points**, **Max value of curve points**, **Min value of curve points**, **Spread value of curve points** and **Air Exchange** are calculated for the curve values selected by the cursors.

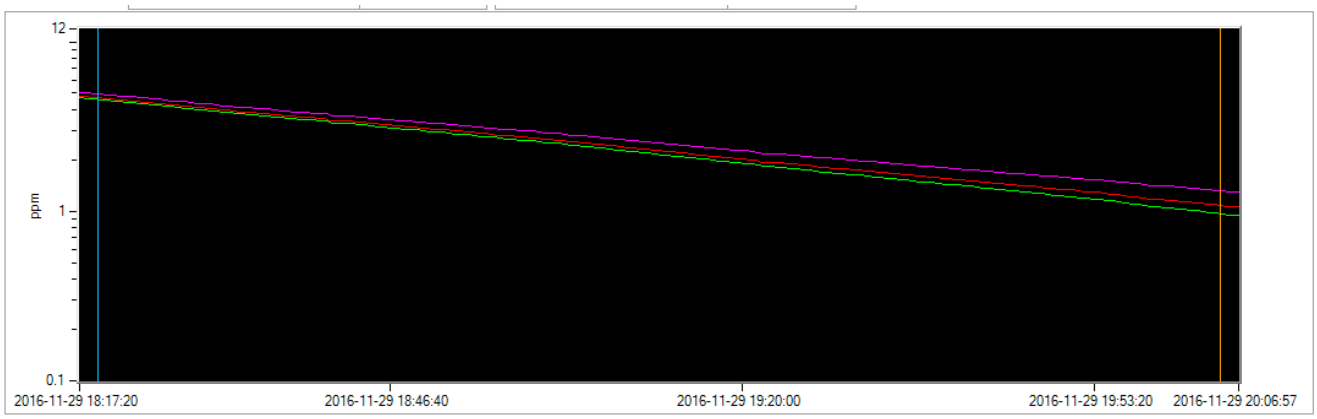
For calculation of the Air Exchange.

- *Use the logarithmic Y-axis scale*
- *Use the cursors to select a part of the curve with a linear decay*

The above displayed values are based on the selected channel curve, which is chosen with the channel selection.

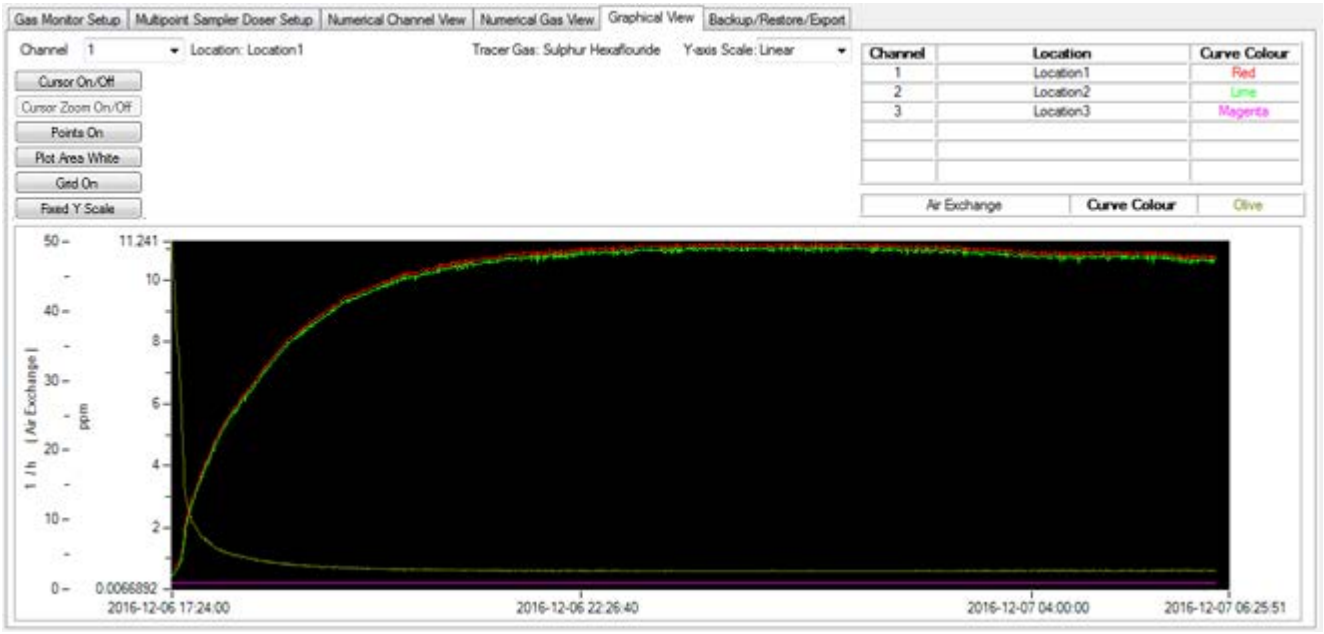


The display can be zoomed with the **Cursor Zoom On / Off** button, to display the curve points selected by the cursors.

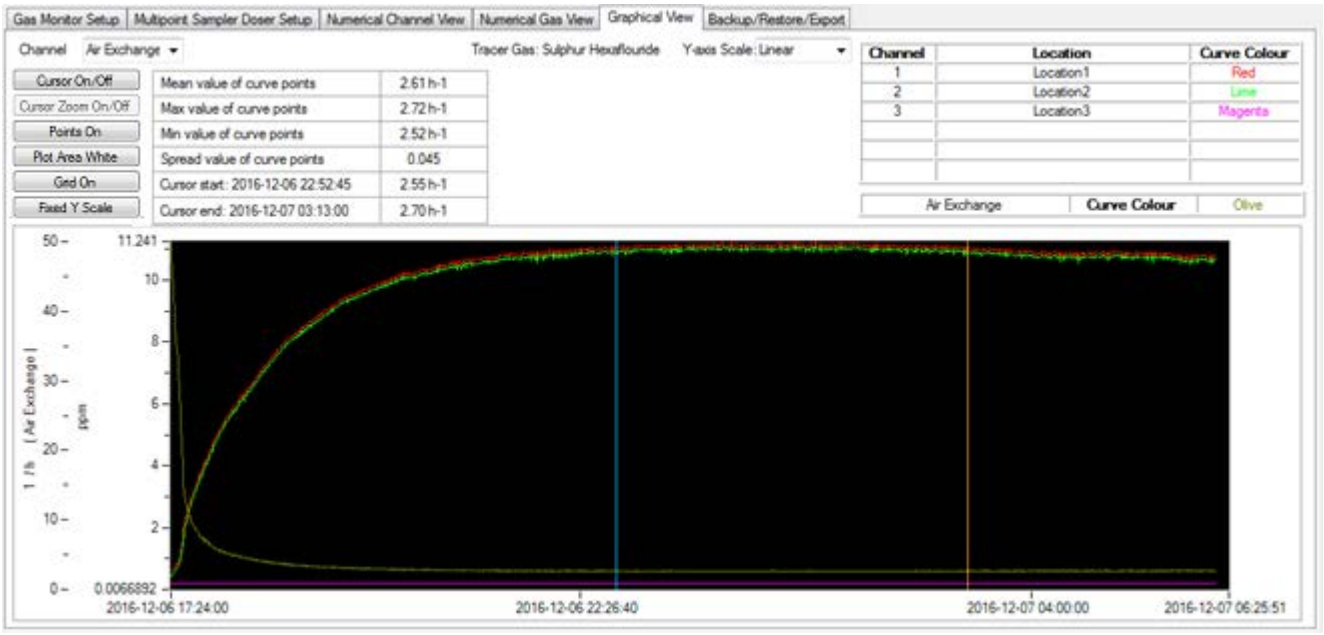


All the measured curve points can be shown again by pressing the **Cursor Zoom On / Off** button again.

6.3.3 Air Exchange (Constant Dose) graphical view



The graph displays tracer gas curves for all the available channels in the multiplexer setup.
A curve for the **Air Exchange** is also shown.
The **Curve Colour** for each of the curves is specified.
The Y-axis shows the units for the concentration and the air exchange.
The **Y-axis Scale** can be chosen to be either logarithmic or linear scaling. For the **Constant Dose** type of ventilation measurement the linear Y-axis type will be preselected.



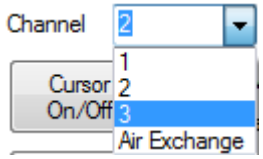
The **Points On** button toggles the display of measurement points.
The **Plot Area White** button changes the background color of the plot area.
The **Grid On** button will show a grid in the graph window.

The **Fixed Y Scale** button will fix the vertical Y axis meaning that new incoming concentration values will not change the Y axis range.
2 vertical Cursors can be toggled either on or off in the graph display by pressing the **Cursor On / Off** button.

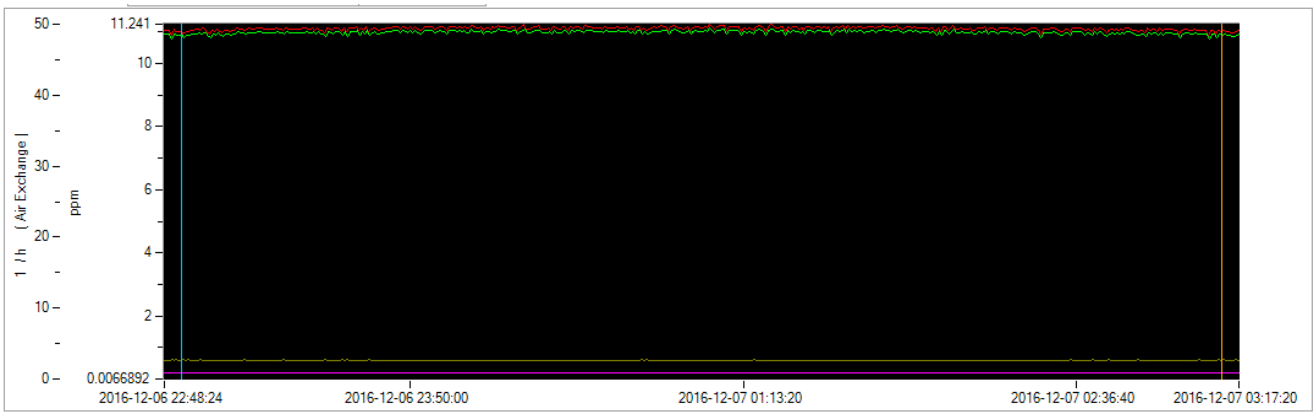
The start cursor is in blue colour and the end cursor is in orange colour.
The cursors can be moved horizontally with the purpose to select a part of a curve.
When the cursors in on, the following display becomes visible:

Mean value of curve points	2.61 h-1
Max value of curve points	2.72 h-1
Min value of curve points	2.52 h-1
Spread value of curve points	0.045
Cursor start: 2016-12-06 22:52:45	2.55 h-1
Cursor end: 2016-12-07 03:13:00	2.70 h-1

The date & time and tracer gas (or air exchange) value, selected by the start cursor and the end cursor is shown.
The **Mean value of curve points**, **Max value of curve points**, **Min value of curve points** and **Spread value of curve points** are calculated for the curve values selected by the cursors.
The above displayed values are based on the selected channel curve (or air exchange curve), which is chosen with the channel selection.

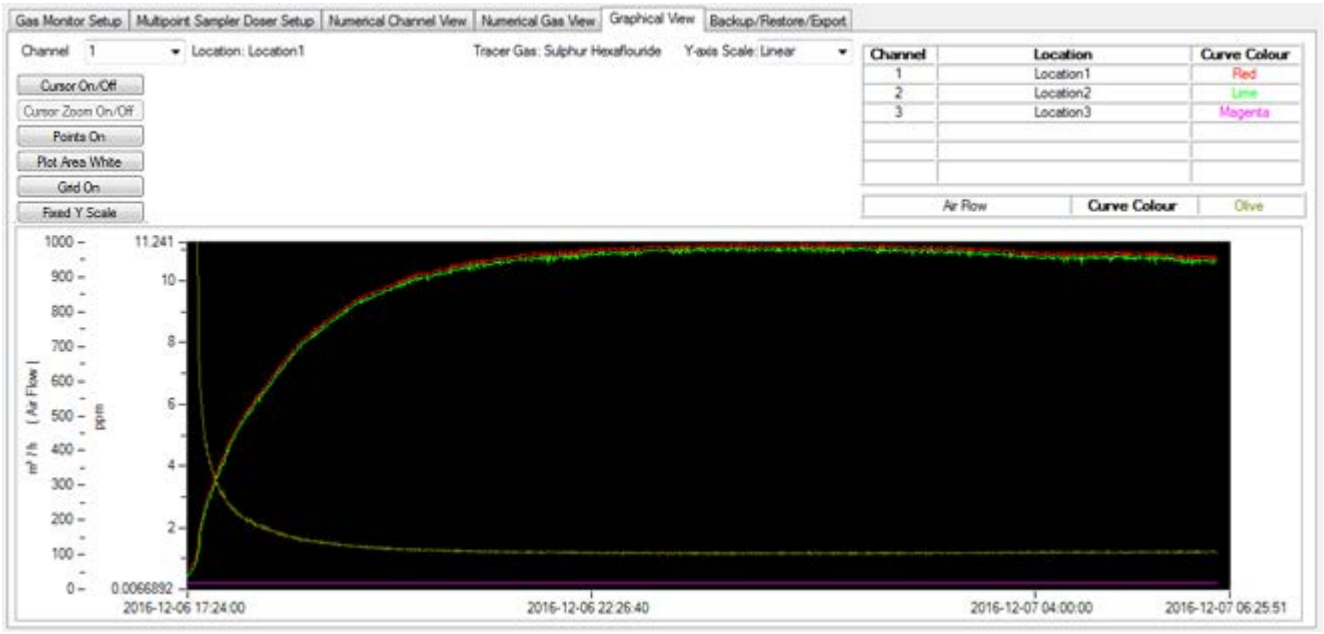


The display can be zoomed with the **Cursor Zoom On / Off** button, to display the curve points selected by the cursors.

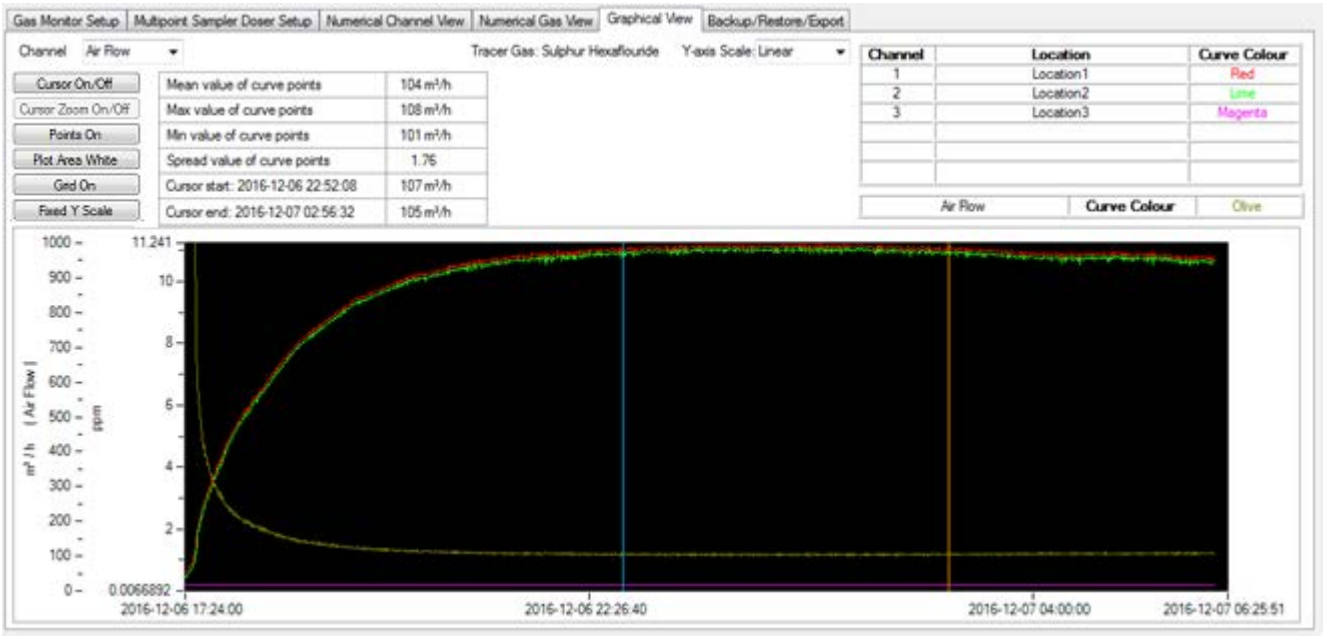


All the measured curve points can be shown again by pressing the **Cursor Zoom On / Off** button again.

6.3.4 Flow (Constant Dose) graphical view



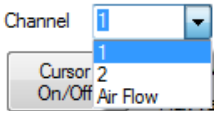
The graph displays tracer gas curves for all the available channels in the multiplexer setup and an air flow curve.
A curve for the **Air Flow** is also shown. For the calculation of the **Air Flow**, the channel selected in the **Multipoint Sampler Doser Setup** for calculation is shown in parenthesis.
The **Curve Colour** for each of the curves is specified.
The Y-axis shows the units for the concentration and air flow values.
The **Y-axis Scale** can be chosen to be either logarithmic or linear scaling. For the **Constant Dose** type of ventilation measurement the linear Y-axis type will be preselected.



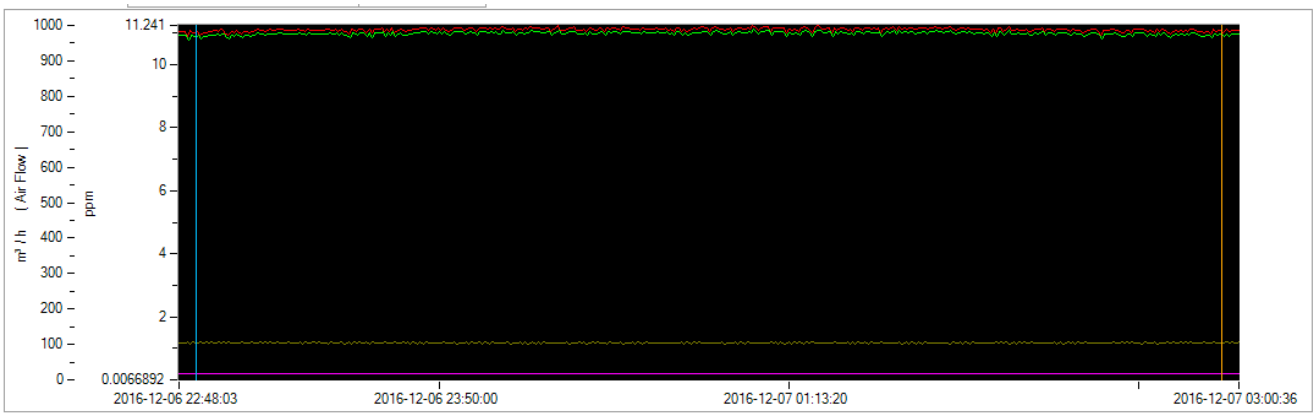
The **Points On** button toggles the display of measurement points.
The **Plot Area White** button changes the background colour of the plot area.
The **Grid On** button will show a grid in the graph window.
The **Fixed Y Scale** button will fix the vertical Y axis meaning that new incoming concentration values will not change the Y axis range.
2 vertical Cursors can be toggled either on or off in the graph display by pressing the **Cursor On / Off** button.
The start cursor is in blue colour and the end cursor is in orange colour.
The cursors can be moved horizontally with the purpose to select a part of a curve.
When the cursors in on, the following display becomes visible:

Mean value of curve points	104 m³/h
Max value of curve points	108 m³/h
Min value of curve points	101 m³/h
Spread value of curve points	1.76
Cursor start: 2016-12-06 22:52:08	107 m³/h
Cursor end: 2016-12-07 02:56:32	105 m³/h

The date & time and tracer gas (or Air Flow) value, selected by the start cursor and the end cursor is shown.
The **Mean value of curve points**, **Max value of curve points**, **Min value of curve points** and **Spread value of curve points** are calculated for the curve values selected by the cursors.
The above displayed values are based on the selected channel (or Air Flow) curve, which is chosen with the channel (or Air Flow) selection.



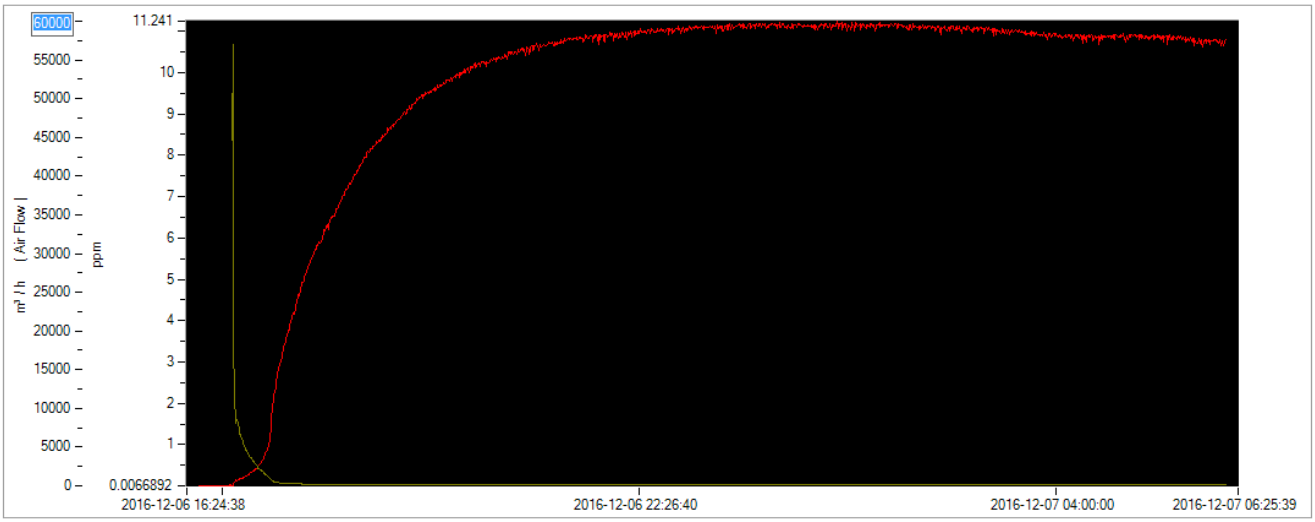
The display can be zoomed with the **Cursor Zoom On / Off** button, to display the curve points selected by the cursors.

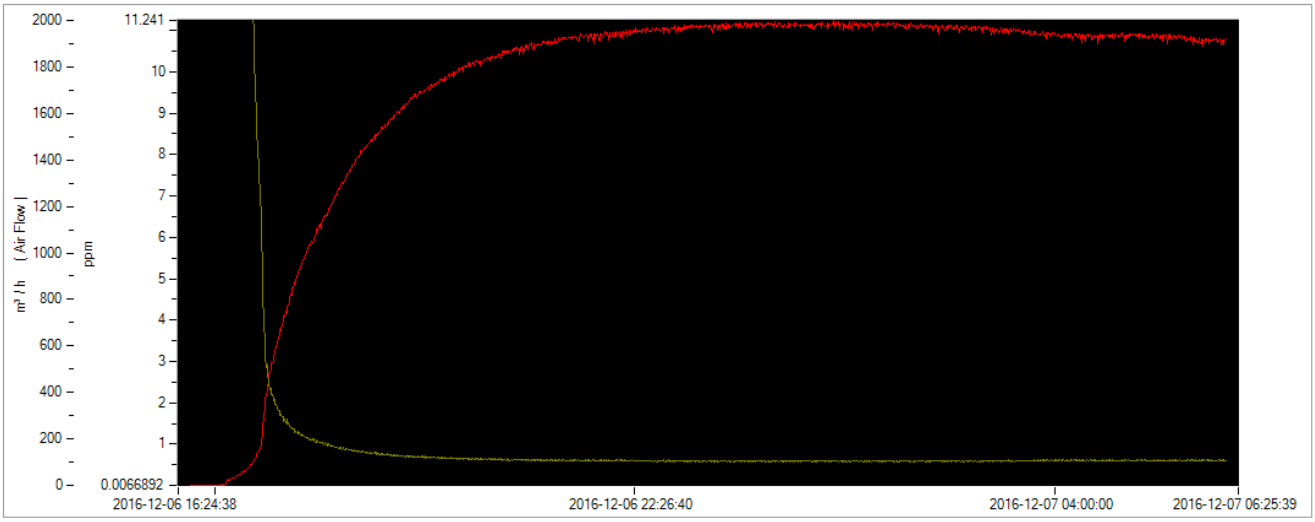


All the measured curve points can be shown again by pressing the **Cursor Zoom On / Off** button again.

6.3.5 Changing the Y-axis range in the graphical view

It is possible to change the Y-axis range in the graphical view, in order to better visualize certain Y-axis values.
This can be achieved either by changing the minimum or maximum value of the Y-axis in question.
In the example below, the maximum value for the Y-axis (Air Flow) is changed from 60000 m^3/h to 2000 m^3/h, by clicking the maximum value 60000 and changing it to 2000.





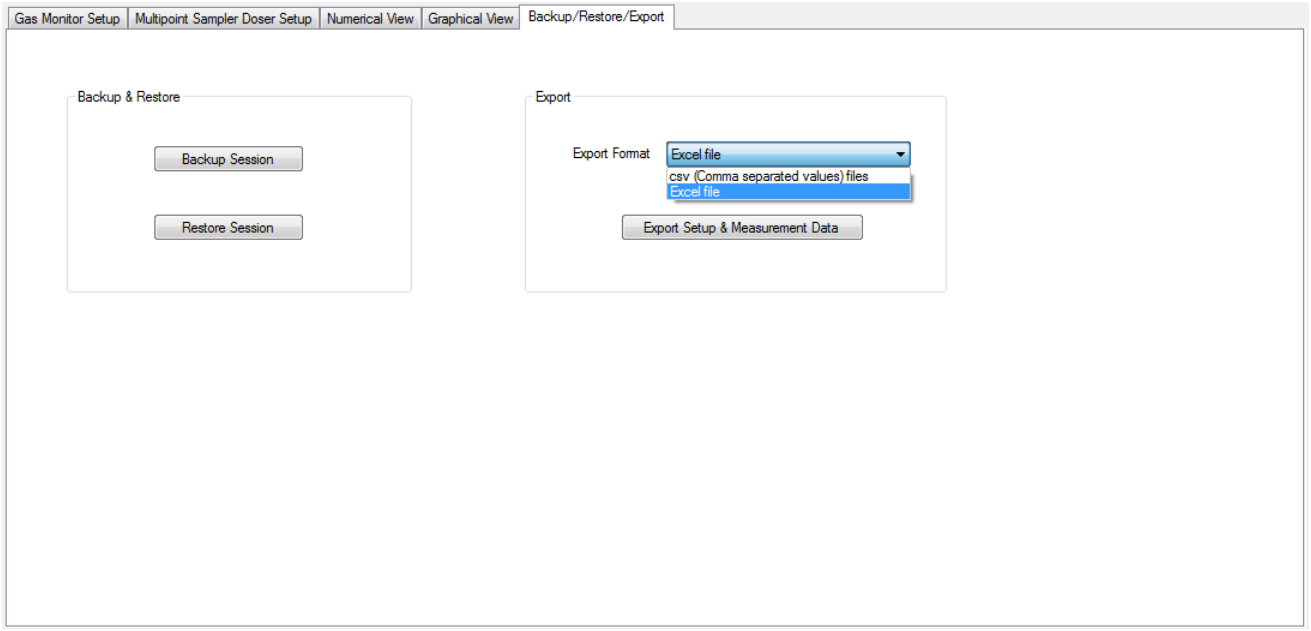
Chapter 7

Backup / Restore / Export

November 2018

7 Backup / Restore / Export

This tab contains the **Backup / Restore / Export** functionality.



In the Backup & Restore group box the **Backup Session** button is intended to backup setup and measurement data for the current session to be retrieved later using the **Restore Session** button.

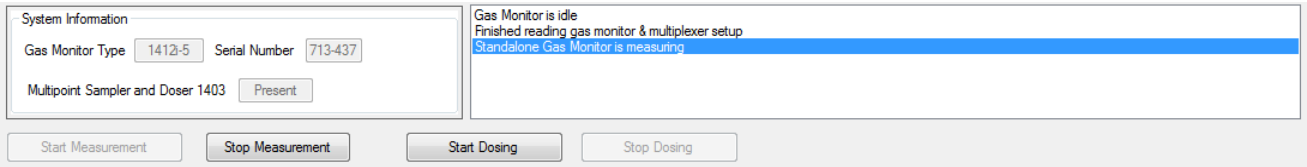
With the **Export Setup & Measurement Data** button the setup and measurement data can be exported to either an Excel file or to csv (comma-separated) files.
The content of the Excel and csv files is described in Appendix B.

Chapter 8

Control buttons

November 2018

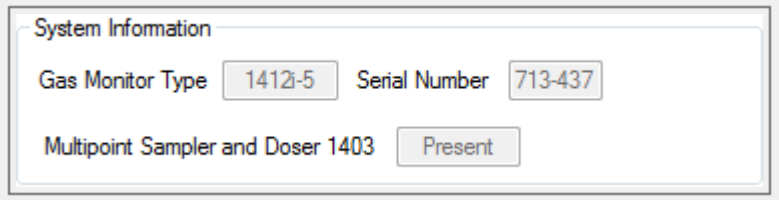
8 Control buttons, Status text box and System Info



The control buttons at the bottom of the 7650 application window gives the possibility to **Start** or **Stop** the measurement and to **Start** or **Stop** the dosing.

The status text list box above the control buttons to the right will present status messages, when the control buttons has been activated.

The **System Information** group box will present the **Gas Monitor Type** and its **Serial Number** and show the presence of the **Multipoint Sampler and Doser 1403**.



Appendix A

Installation Guide

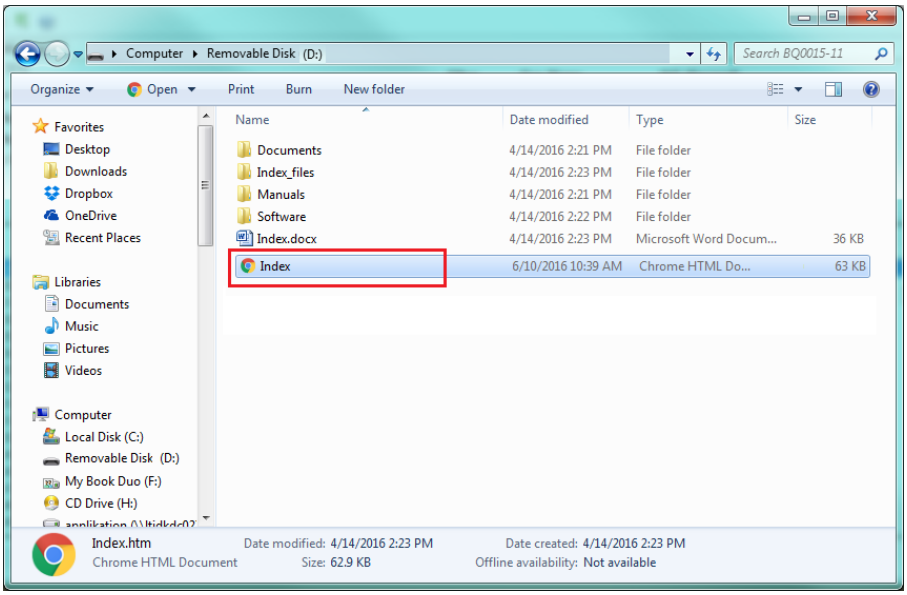
November 2018

Installation of 7650 Basic Ventilation

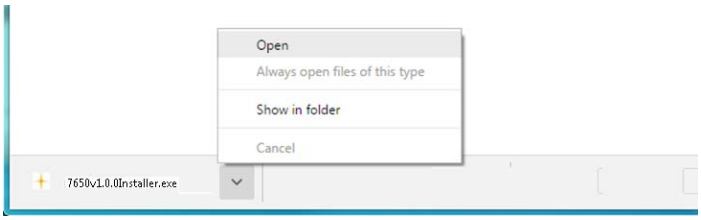
1. When installing the **7650 Basic Ventilation** software you must be logged in as Administrator that means that you must have "administrator" rights.

   Please also note that you must have Administrator rights or Power User rights to run the 7650 Basic Ventilation application after installation.

2. Start the installation of 7650 Basic Ventilation. Insert the USB memory key containing the 7650 Basic Ventilation software into an USB port and open **Windows Explorer.** Locate the **Removable Disk** associated with the USB memory key. Double-click the **Index** file in order to open its contents in your browser.



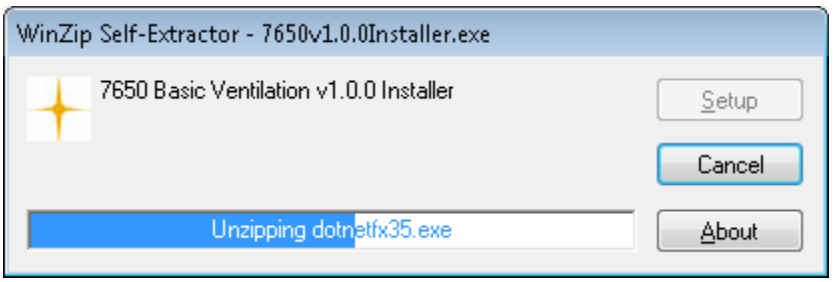
Now click to select the appropriate 7650 Basic Ventilation software for installation. You might get a warned that this type of file can harm your computer, which can be skipped. At the bottom of your browser window you can start the installation by selecting the **Open** option.



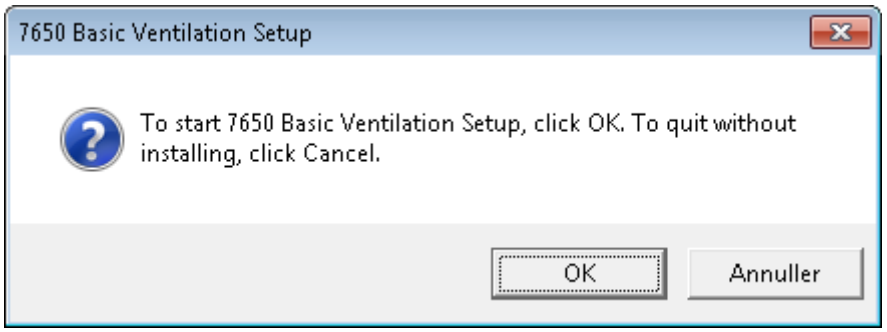
The installation file will automatically install all the necessary packages required to run the 7650 Basic Ventilation application.

The installer will start unpacking with the following window.

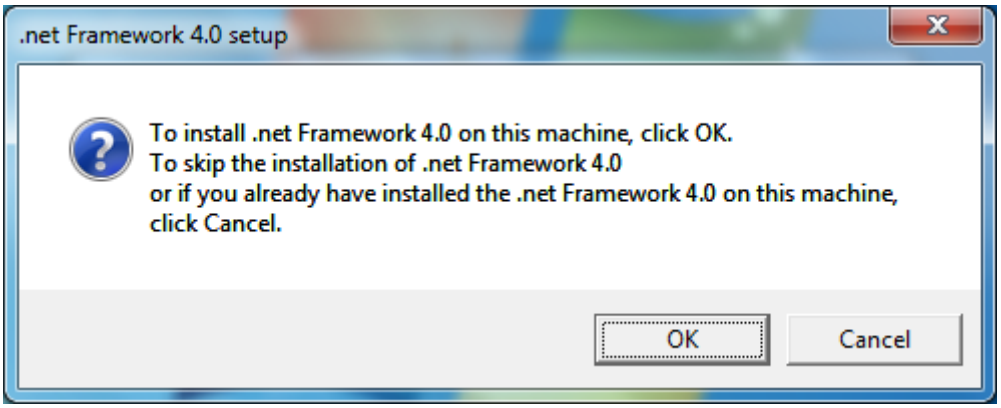
Please wait.



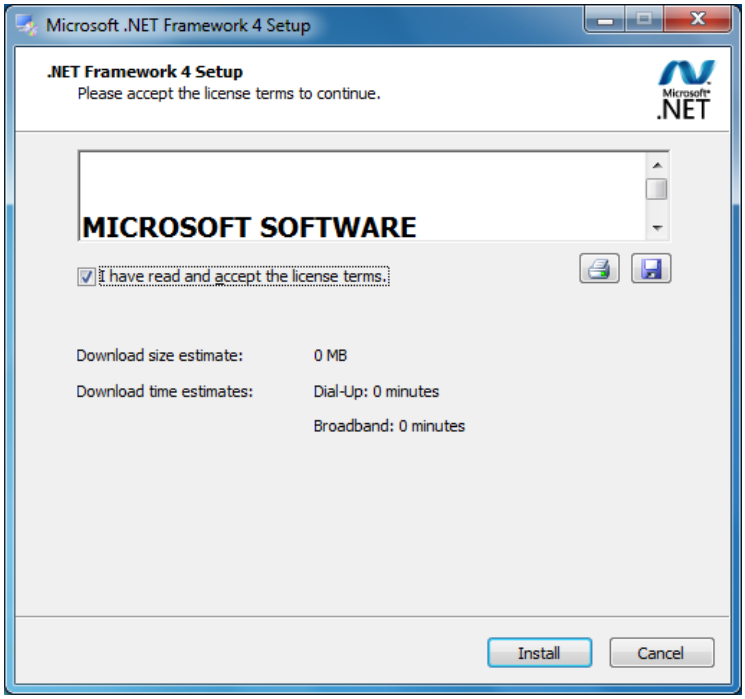
After a while the following window appears. Press the **OK** button to continue.

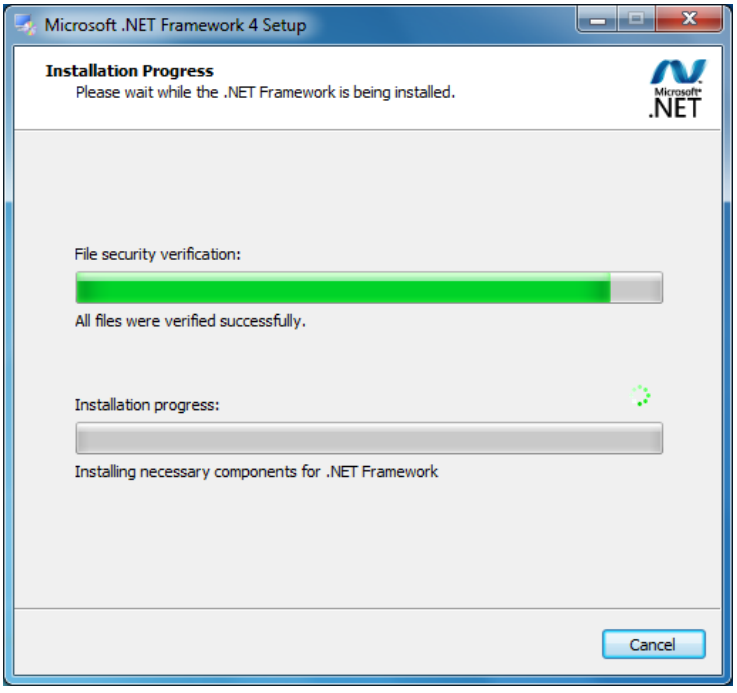


3. If the .NET Framework 4.0 is not present in your Windows installation you will be prompted to install this feature. Press the **OK** button to install this feature **or** if the feature is already installed press the **Cancel** button and proceed to step number 7 below.

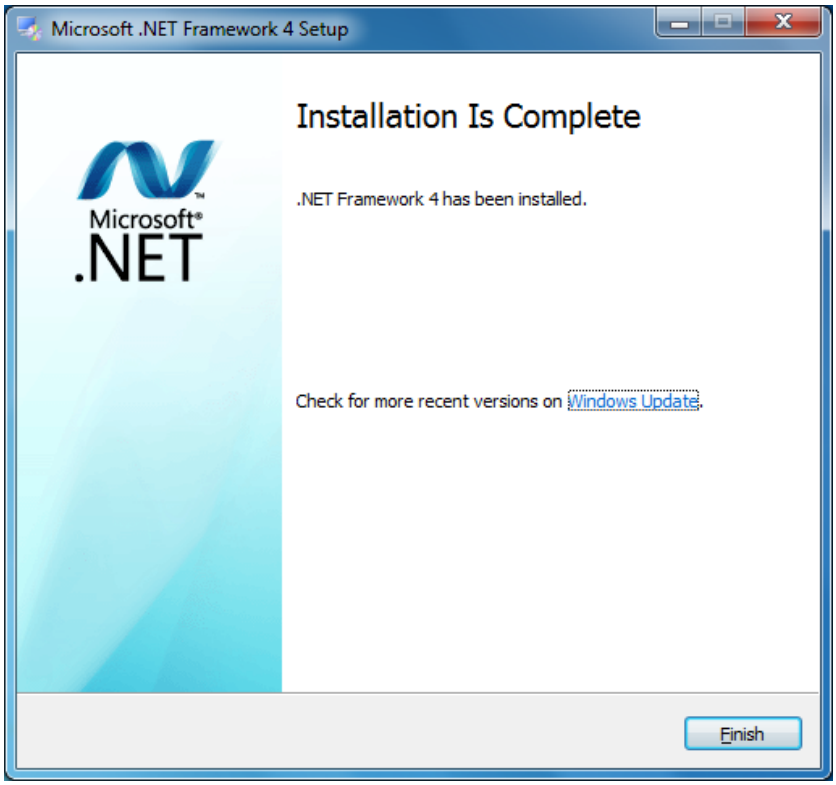


4. Tick the 'I have read and accept the license terms' and press the **Install** button and wait for the installation to be finished.

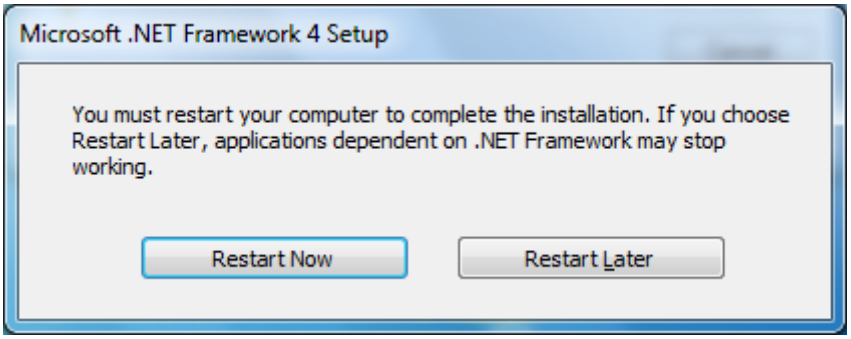




5. Press the **Finish** button after the .NET Framework 4.0 feature has been successfully installed.

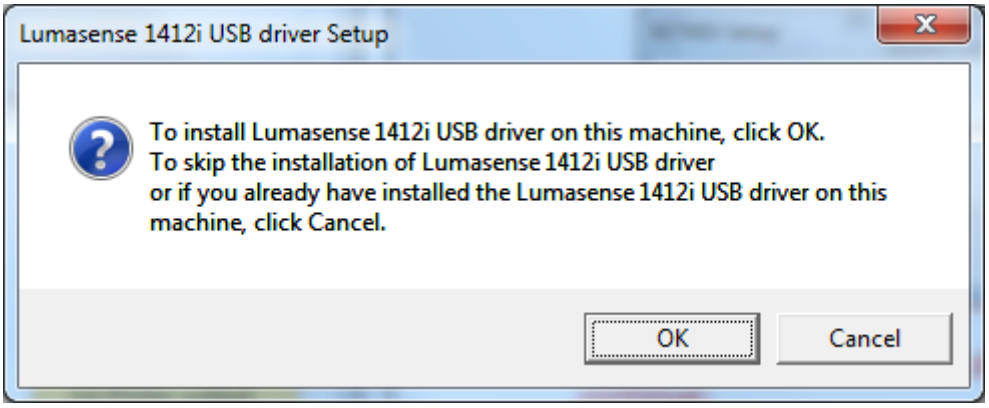


6. If you get the following message you must press the **Restart Now** button to make a restart. After restart of the PC also do a restart of the installation from the above step number 2 without installing the .net Framework 4.0 again.

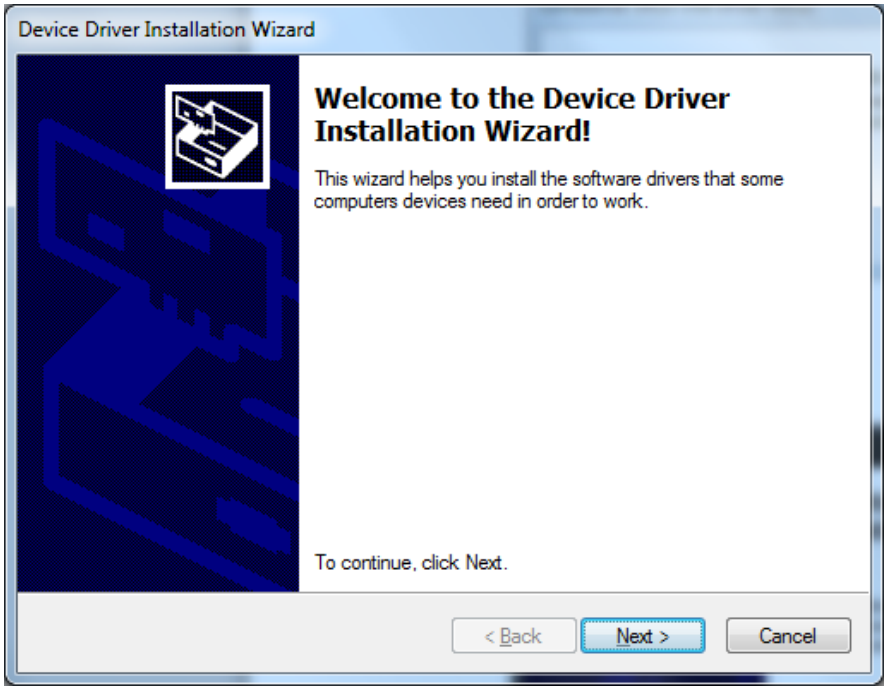


7. Now you are prompted to install the Windows USB driver for the gas monitor.

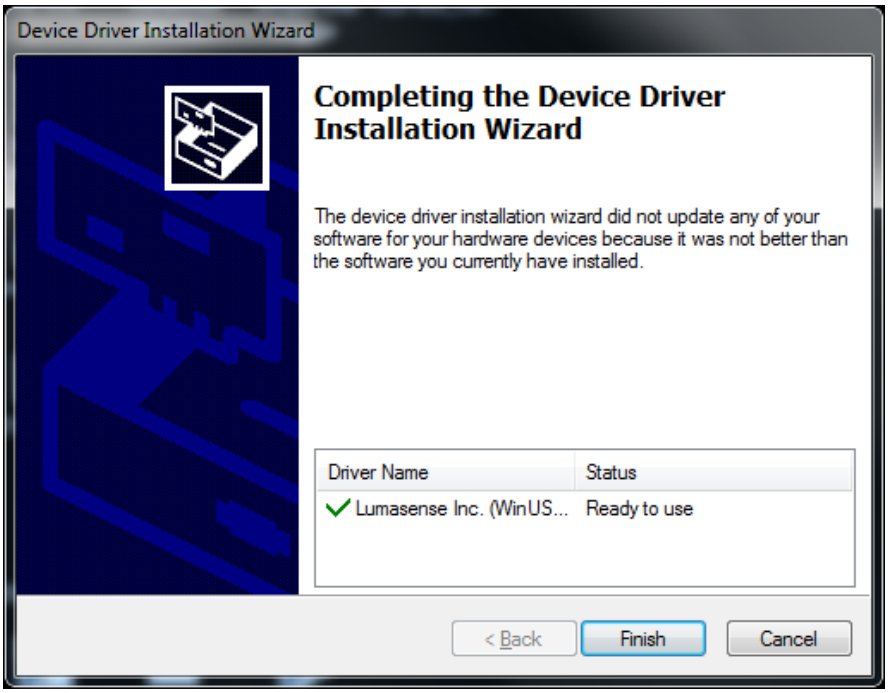
If the USB driver for monitor has been installed due to a previous 7650 installation you can skip this by pressing the **Cancel** button, otherwise please press the **OK** button to continue.



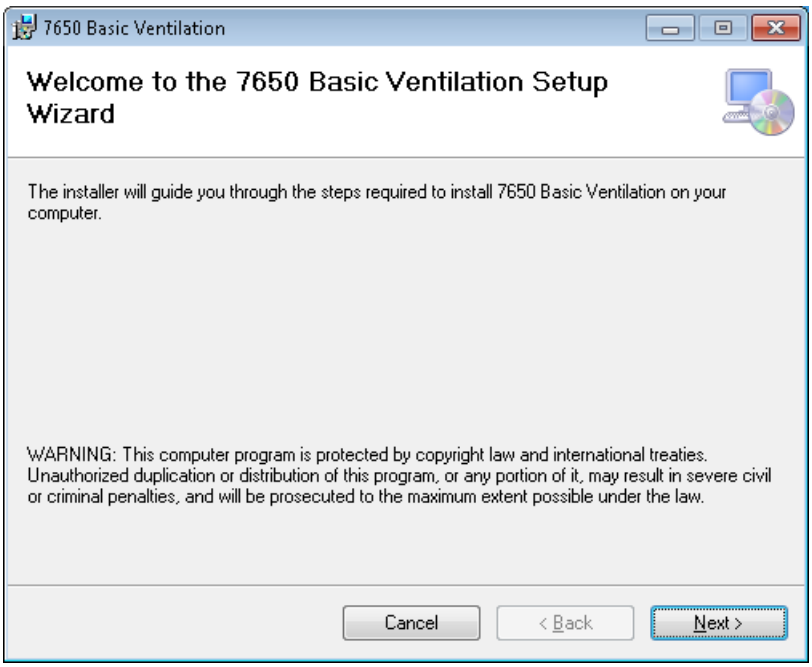
Press **Next** to start the USB driver installation.



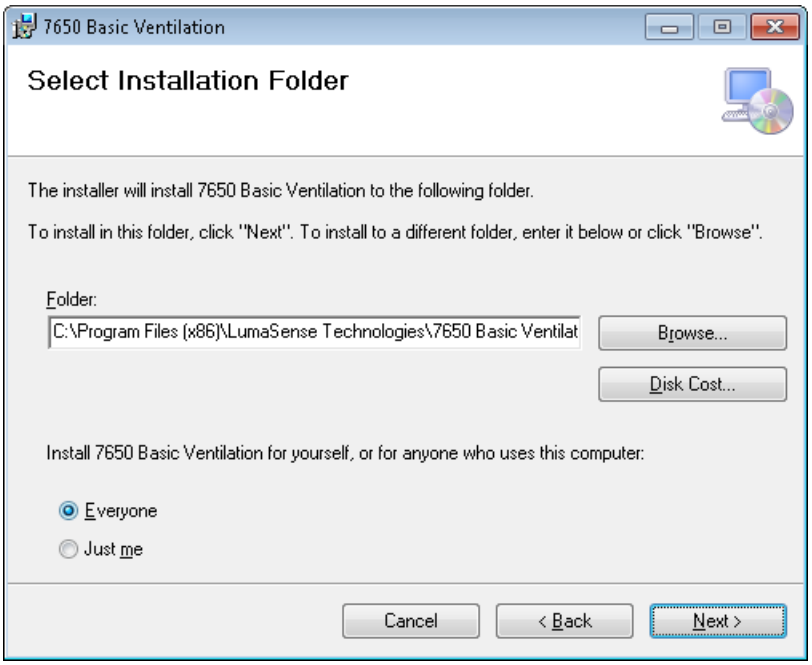
Press **Finish** to end the USB driver installation



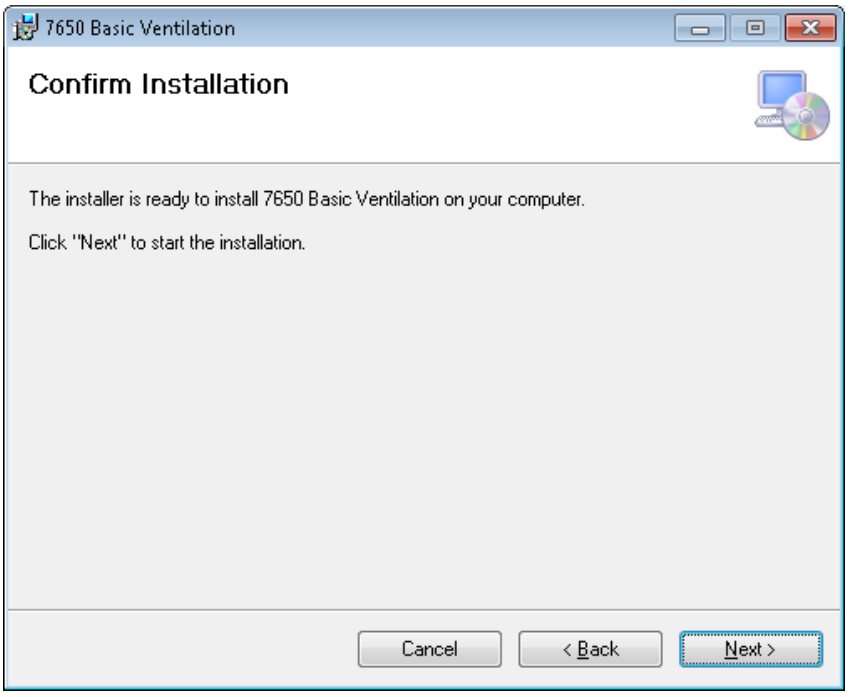
8. Finally the 7650 application is installed. Press **Next** to start installation of 7650 Basic Ventilation software.



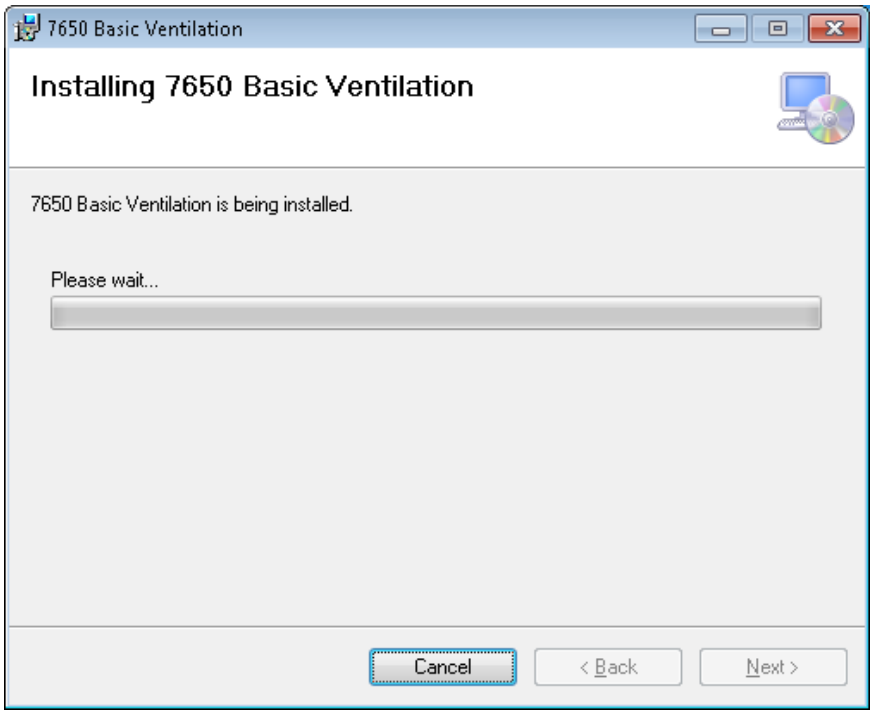
Select install for **Everyone** and press **Next**



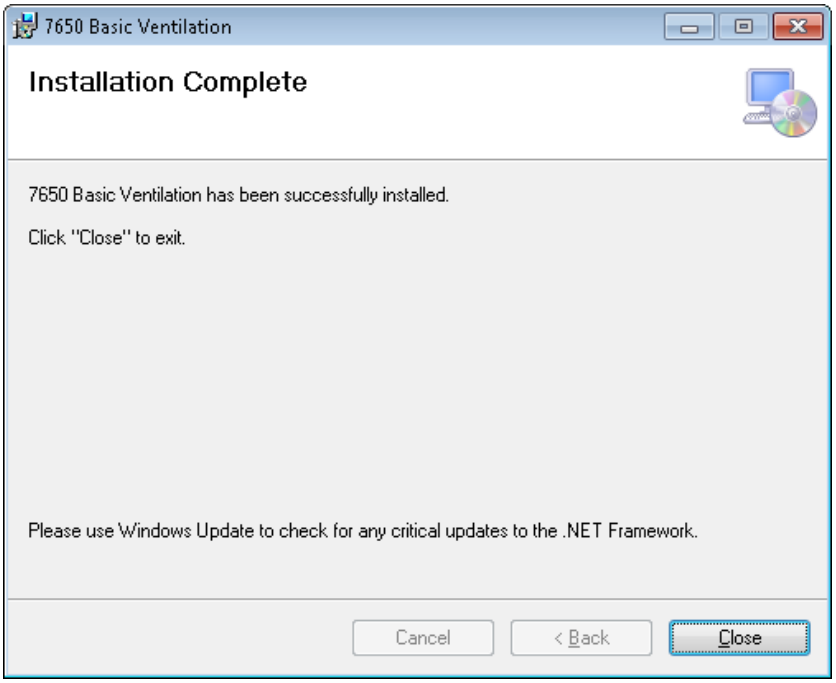
Select **Next** to confirm installation of 7650 Basic Ventilation software



Wait for the 7650 Basic Ventilation application to be installed.



After installation of 7650 press **Close.**



Appendix B

Excel and csv file description

November 2018

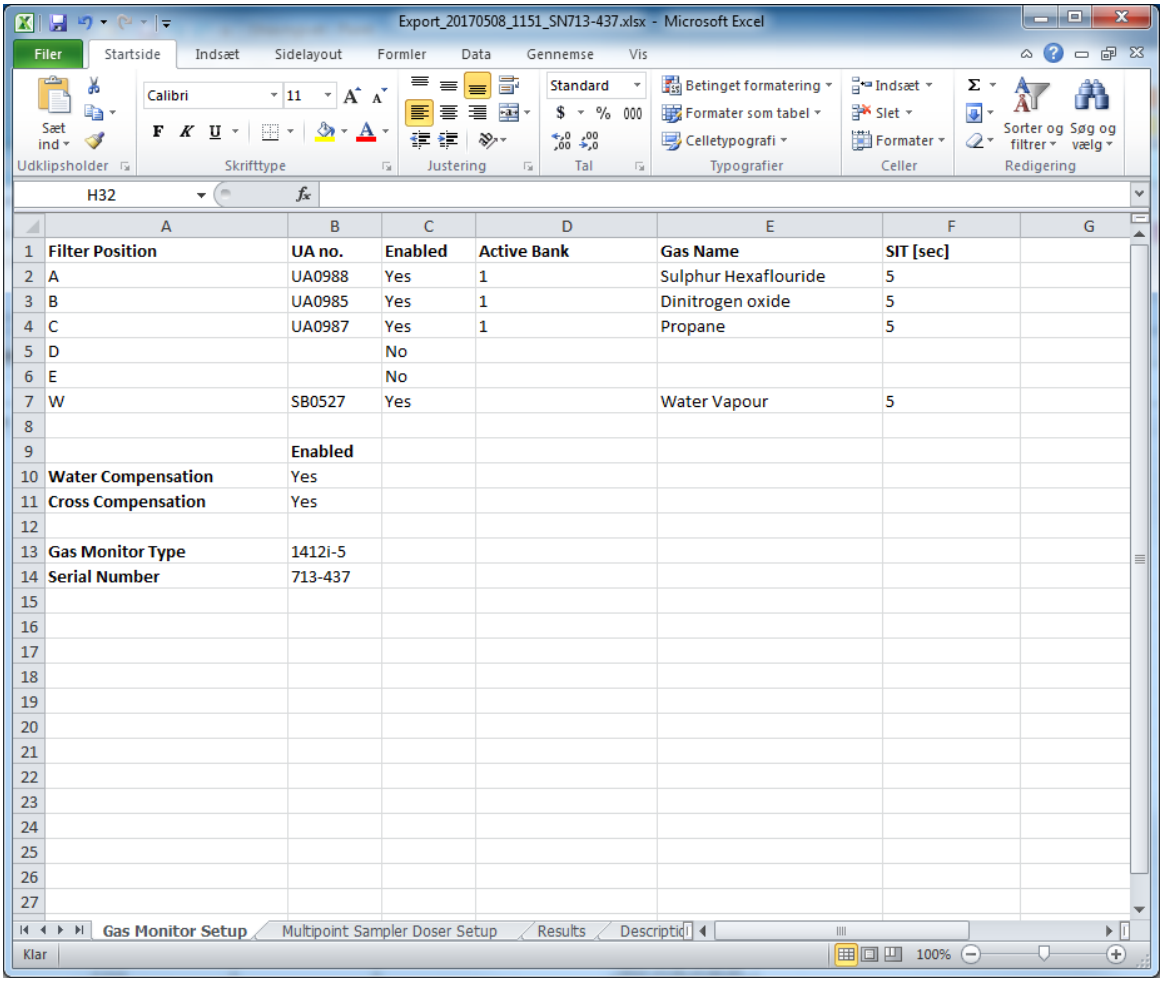
Appendix B – Excel and csv file description

The generated Excel file will contain several tabs:

1. Gas Monitor Setup
2. Multipoint Sampler Doser Setup
3. Results. Presenting ventilation calculation results including a graph display.
4. Description of 7650, Monitor and 1403 flags.
5. One tab for each active channel presenting gas values and 7650, Monitor and 1403 flags. For Constant Dose type of ventilation measurements also Air Exhange or Air Flow values.

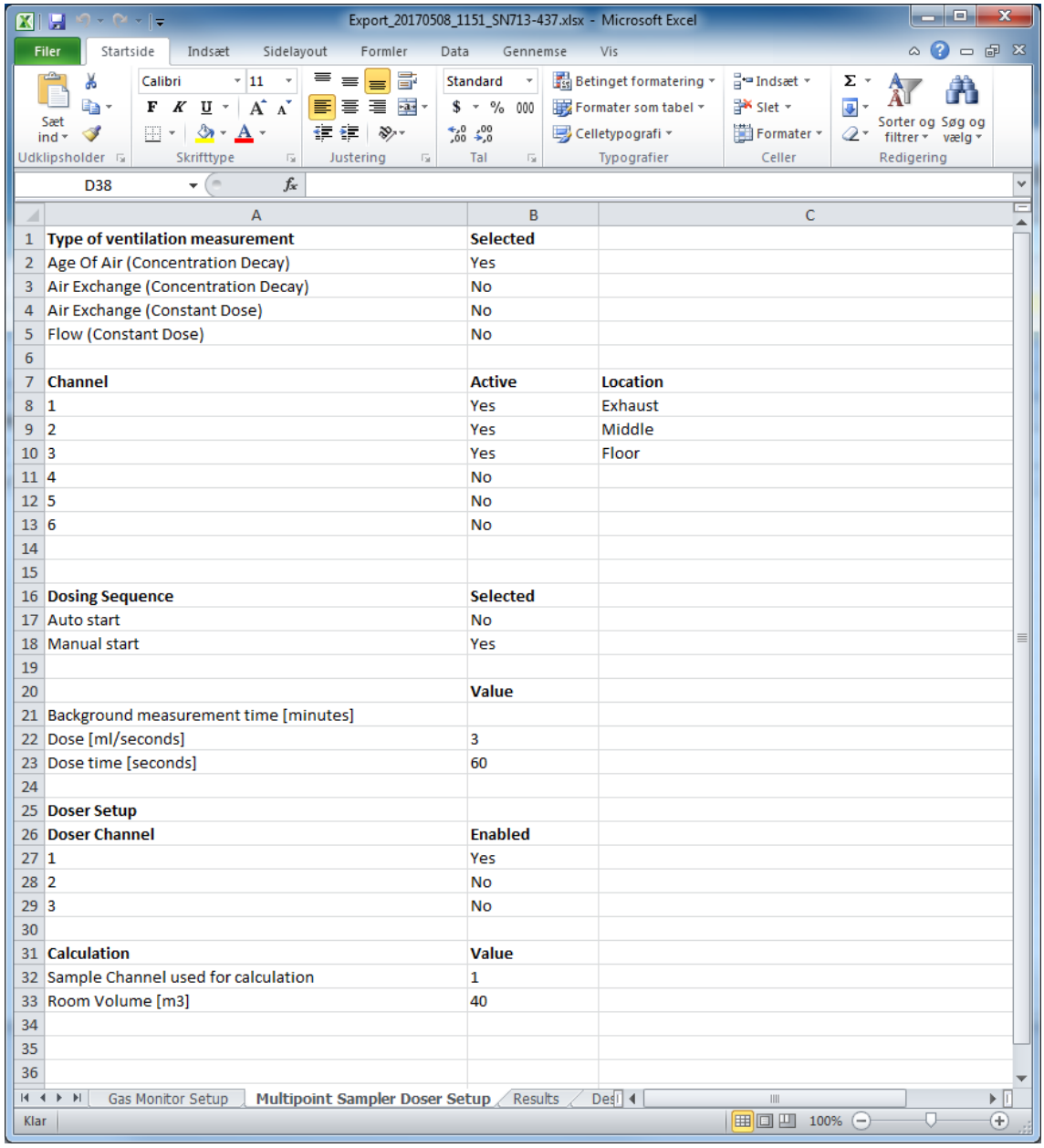
If a csv-file is generated each of the above mentioned Excel tabs will be as separate files, because the csv-file (text) format does not allow tabs to be generated.

Gas Monitor Setup tab



	A	B	C	D	E	F
1	**Filter Position**	**UA no.**	**Enabled**	**Active Bank**	**Gas Name**	**SIT [sec]**
2	A	UA0988	Yes	1	Sulphur Hexaflouride	5
3	B	UA0985	Yes	1	Dinitrogen oxide	5
4	C	UA0987	Yes	1	Propane	5
5	D		No			
6	E		No			
7	W	SB0527	Yes		Water Vapour	5
8						
9		**Enabled**				
10	**Water Compensation**	Yes				
11	**Cross Compensation**	Yes				
12						
13	**Gas Monitor Type**	1412i-5				
14	**Serial Number**	713-437				

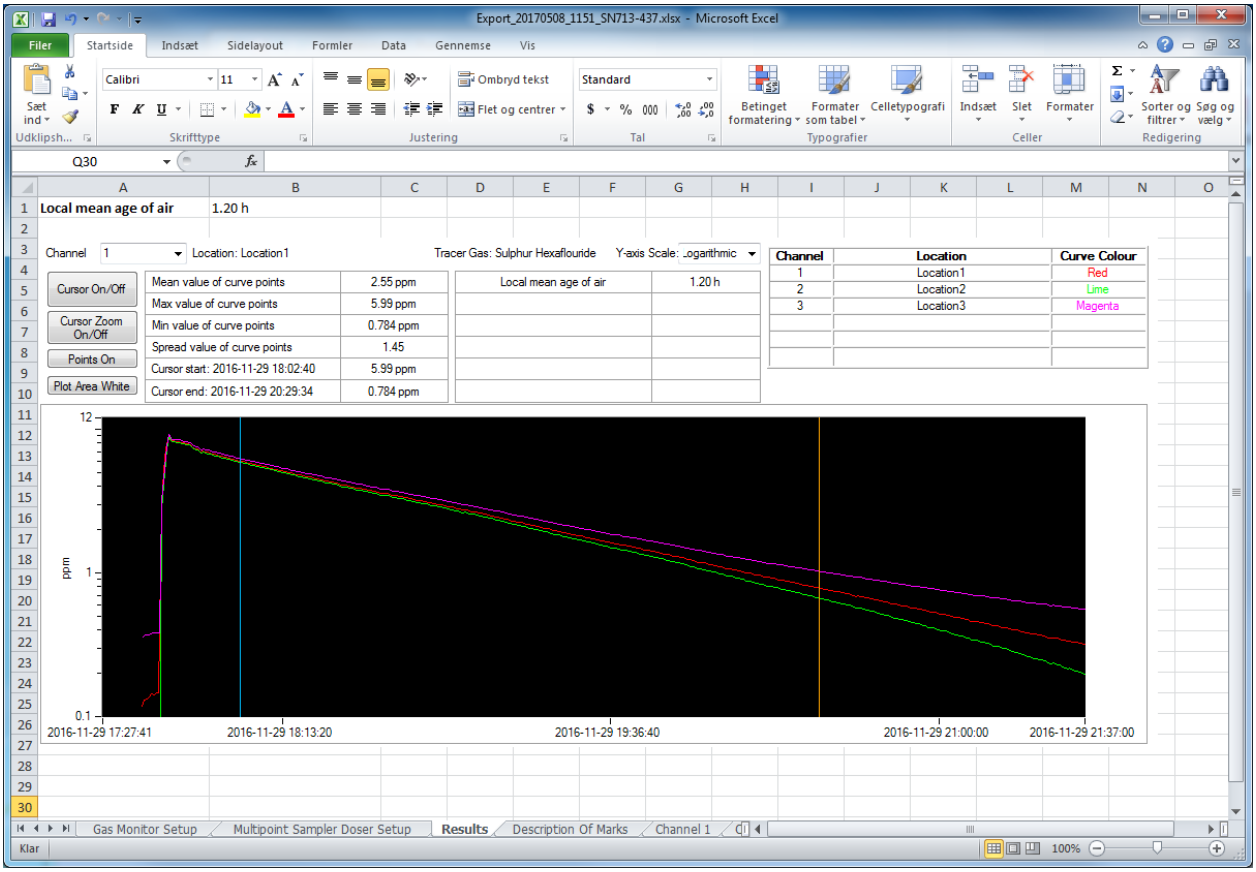
Multipoint Sampler Doser Setup tab



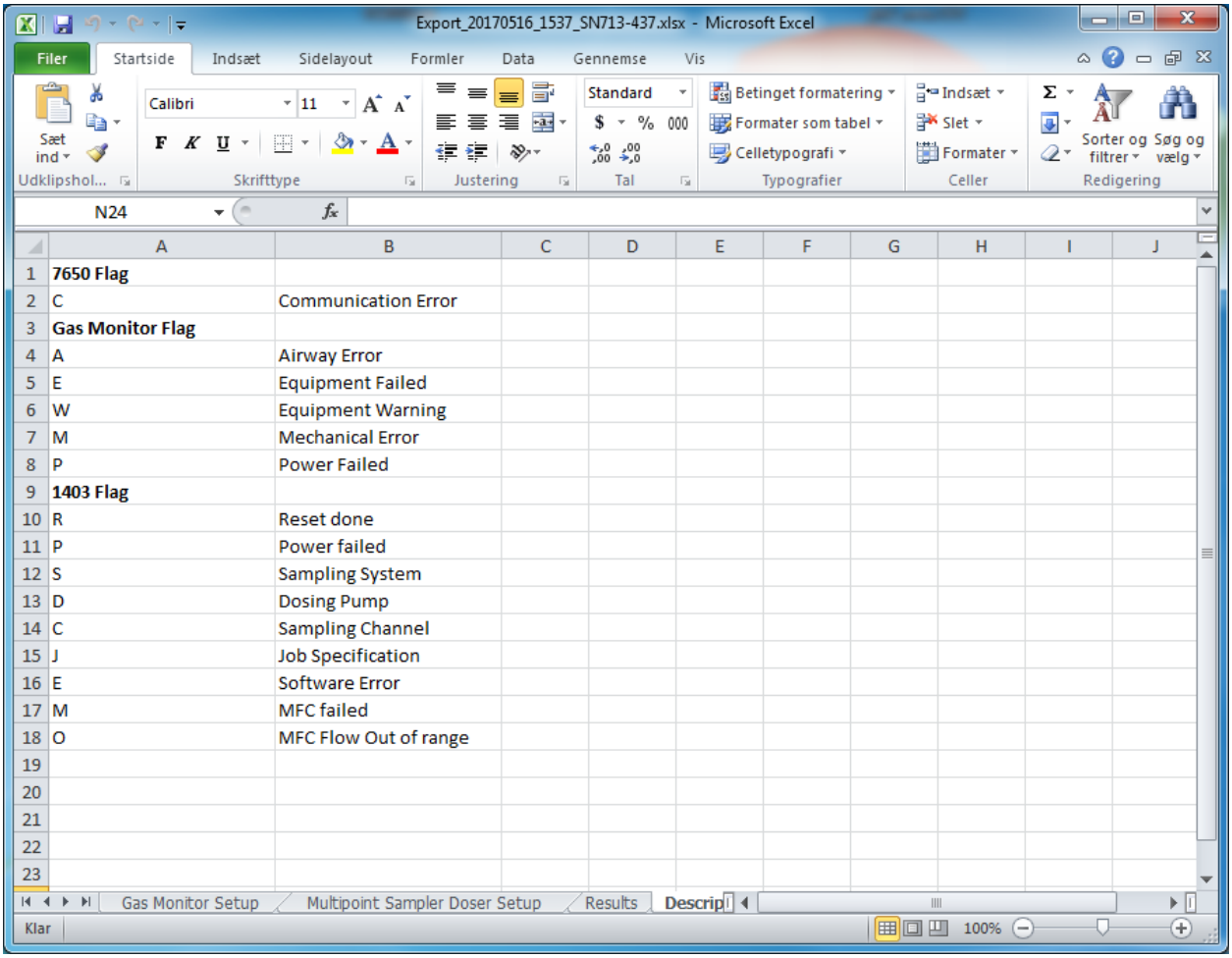
Export_20170508_1151_SN713-437.xlsx - Microsoft Excel

	A	B	C
1	**Type of ventilation measurement**	**Selected**	
2	Age Of Air (Concentration Decay)	Yes	
3	Air Exchange (Concentration Decay)	No	
4	Air Exchange (Constant Dose)	No	
5	Flow (Constant Dose)	No	
6			
7	**Channel**	**Active**	**Location**
8	1	Yes	Exhaust
9	2	Yes	Middle
10	3	Yes	Floor
11	4	No	
12	5	No	
13	6	No	
14			
15			
16	**Dosing Sequence**	**Selected**	
17	Auto start	No	
18	Manual start	Yes	
19			
20		**Value**	
21	Background measurement time [minutes]		
22	Dose [ml/seconds]	3	
23	Dose time [seconds]	60	
24			
25	**Doser Setup**		
26	**Doser Channel**	**Enabled**	
27	1	Yes	
28	2	No	
29	3	No	
30			
31	**Calculation**	**Value**	
32	Sample Channel used for calculation	1	
33	Room Volume [m3]	40	
34			
35			
36			

Results tab


Export_20170508_1151_SN713-437.xlsx - Microsoft Excel
Local mean age of air
1.20 h
Channel
Location: Location1
Tracer Gas: Sulphur Hexaflouride
Y-axis Scale: Logarithmic
Cursor On/Off
Cursor Zoom On/Off
Points On
Plot Area White
Mean value of curve points
2.55 ppm
Max value of curve points
5.99 ppm
Min value of curve points
0.784 ppm
Spread value of curve points
1.45
Cursor start: 2016-11-29 18:02:40
5.99 ppm
Cursor end: 2016-11-29 20:29:34
0.784 ppm
Local mean age of air
1.20 h
Channel
Location
Curve Colour
1
Location1
Red
2
Location2
Lime
3
Location3
Magenta
ppm
12
1
0.1
2016-11-29 17:27:41
2016-11-29 18:13:20
2016-11-29 19:36:40
2016-11-29 21:00:00
2016-11-29 21:37:00
Gas Monitor Setup
Multipoint Sampler Doser Setup
Results
Description Of Marks
Channel 1
Klar
100%

Description of Flags tab



	A	B
1	**7650 Flag**	
2	C	Communication Error
3	**Gas Monitor Flag**	
4	A	Airway Error
5	E	Equipment Failed
6	W	Equipment Warning
7	M	Mechanical Error
8	P	Power Failed
9	**1403 Flag**	
10	R	Reset done
11	P	Power failed
12	S	Sampling System
13	D	Dosing Pump
14	C	Sampling Channel
15	J	Job Specification
16	E	Software Error
17	M	MFC failed
18	O	MFC Flow Out of range
19		
20		
21		
22		
23		

Table B.1. Error and warning Flags

Flag	Flag Description
7650:	
C	Communication error
1512/1412i:	
A	Airway error
E	Equipment failed
W	Equipment warning
M	Mechanical error
P	Power failed
1403:	
R	Reset Done Flag
P	Power Fail Flag
S	Sampling System Flag
D	Dosing Pump Flag
C	Sampling Channel Flag
J	Job Specification Error
E	Software Error Flag
M	MFC failed
O	MFC Flow out of range

7650 Flag.

Communication Error is generated when 7650 detects a communication error with the 1512 or 1412i.

1512/1412i Gas Monitor Flag.

Airway Error is generated by the “Air Shunt Blocked. Sample aborted”, “Air Flow Too Low” or “Airway System Blocked” incidents. These errors cause a beep from the 1412’s speaker.

Equipment Failed is generated by the “Internal Temperature Out Of Range”, “Internal Program Error Found”, “No Index-Mark from Filter Carousel”.

Equipment Warning is generated by the “Back-up Battery Low”, “Error Detected In Clock Settings”, “Error Detected in Calibration Factors”, “Error Detected in Source Memory”, “Error Detected in Background Memory”, “Error Detected in Config./Format Parameters”, “Error Detected in Task-Setup Parameters” or “Error Detected In Internal Memory” incidents.

Mechanical Error is generated by the 1412 Error flags “Chopper Failed”, “IR-Source Temperature Out Of Range or “Pump Test Failed” incidents.

Power Failed is generated by the 1412 Error flag “Reset Activated”, which is set when power has been cut to the 1412.

For a more detailed description of the Gas Monitor error and warnings please consult the Instruction Manual for the Photoacoustic Gas Monitor 1412i (BE6025)and 1512 (BE6049).

1403 Flag

The 1403 monitors the function of the following parts. If any error is detected the error will be reported in the User Software 7650 during operation please refer to user manual BE6046.

Reset Done Flag
Indicates that the 1403 has completed a reset, following either the **R**eset_**S**ystem interface job or switching-on the 1403. This flag is reset when the Warning Flags are read-out from the 1403.

Power Fail Flag
Is set if the 12Vdc power supply is out of specifications. This flag is reset when the voltage is back within the above range, or by resetting the 1403, or switching the 1403 off/on. If the error is persistent, have the 1403 serviced.

Sampling System Flag
Is set if, during the self-test if the pressure across the sampling pump is less than 40kPa. This indicates that either the pump is not working correctly, or that the sampler system is not sufficiently air-tight. This flag is reset by the next self-test routine (if the results of the test are satisfactory), or by resetting the 1403, or switching the 1403 off/on. If the error is persistent, have the 1403 serviced.

Dosing Pump Flag
Is set if the pressure generated by the carrier-air pump is less than 10kPa above ambient pressure. This indicates that the carrier-air pump is not working correctly. The flag is reset when the pressure generated by the pump is over 15kPa above ambient pressure, or by resetting the 1403, or switching the 1403 off/on. If the error persists, have the 1403 serviced.

Sampling Channel Flag
Is set during the self-test or when drawing a sample with the 3-way valve set to **Waste Air Outlet**, if the pressure across the sampling pump is above 25kPa. This indicates that the sampler-system airways may be blocked. The flag is reset by reading-out the Error Flags, or by switching the 1403 off/on. If the error persists, have the 1403 serviced.

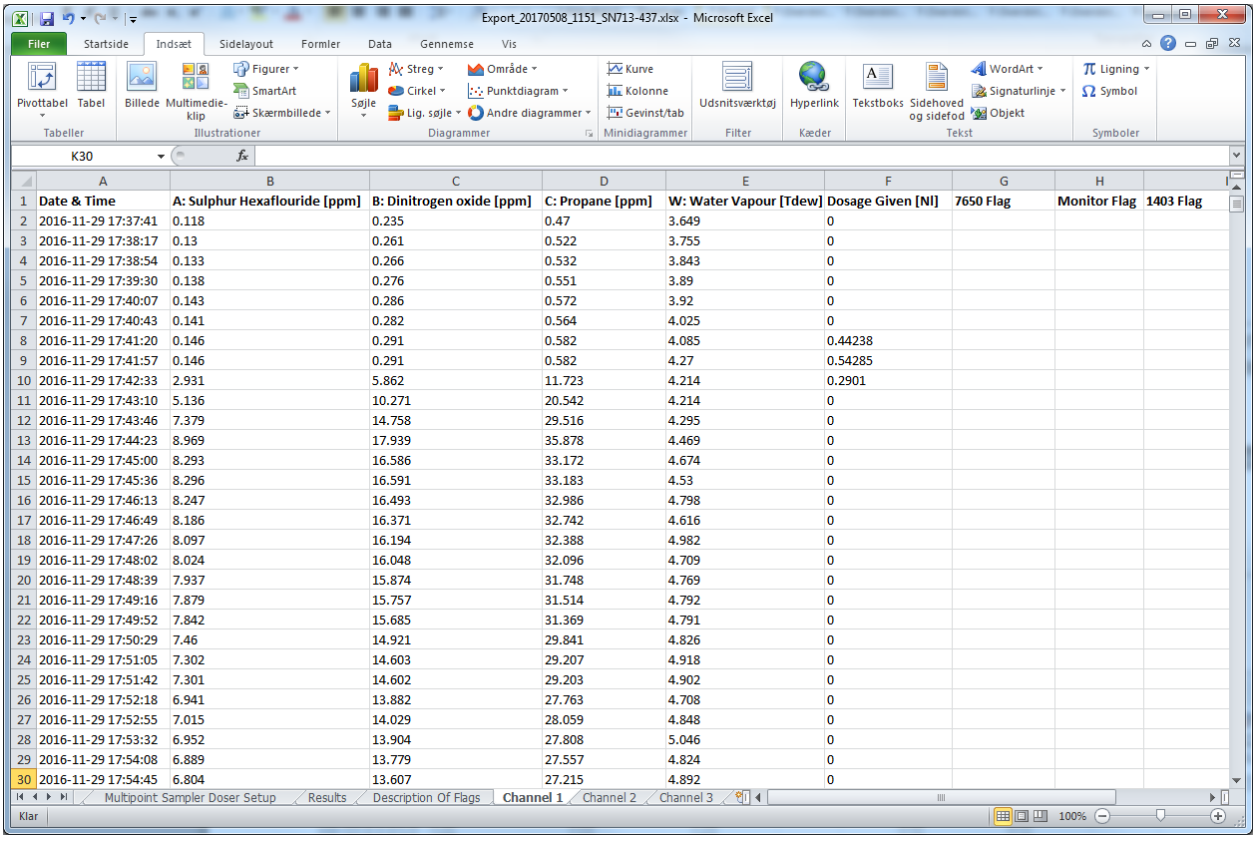
Job Specification Error
Is set if an interface job sent to the 1403 is not recognized. This can be due to an incorrect job header, incorrect syntax, or incorrect or missing data. A job cannot be carried out by the 1403 if this flag is set. The flag is reset by reading-out the Error Flags, or by switching the 1403 off/on.

Software Error Flag
Is set when the 1403's software develops an error when running. When this flag is set, the 1403 is reset automatically. The flag is reset by reading-out the Error Flags, or by switching the 1403 off/on. If the error persists, have the 1403 serviced.

MFC Failed
This is set if the 1403 fails in the communication with the build in Mass Flow Controller.

MFC Flow out of range
This flag is set if the MFC detect that the specified set flow is out of range. This could be caused by too low supply pressure of tracer gas to the system.

Channel tab



Export_20170508_1151_SN713-437.xlsx - Microsoft Excel

	A	B	C	D	E	F	G	H	I
1	Date & Time	A: Sulphur Hexaflouride [ppm]	B: Dinitrogen oxide [ppm]	C: Propane [ppm]	W: Water Vapour [Tdew]	Dosage Given [Nl]	7650 Flag	Monitor Flag	1403 Flag
2	2016-11-29 17:37:41	0.118	0.235	0.47	3.649	0			
3	2016-11-29 17:38:17	0.13	0.261	0.522	3.755	0			
4	2016-11-29 17:38:54	0.133	0.266	0.532	3.843	0			
5	2016-11-29 17:39:30	0.138	0.276	0.551	3.89	0			
6	2016-11-29 17:40:07	0.143	0.286	0.572	3.92	0			
7	2016-11-29 17:40:43	0.141	0.282	0.564	4.025	0			
8	2016-11-29 17:41:20	0.146	0.291	0.582	4.085	0.44238			
9	2016-11-29 17:41:57	0.146	0.291	0.582	4.27	0.54285			
10	2016-11-29 17:42:33	2.931	5.862	11.723	4.214	0.2901			
11	2016-11-29 17:43:10	5.136	10.271	20.542	4.214	0			
12	2016-11-29 17:43:46	7.379	14.758	29.516	4.295	0			
13	2016-11-29 17:44:23	8.969	17.939	35.878	4.469	0			
14	2016-11-29 17:45:00	8.293	16.586	33.172	4.674	0			
15	2016-11-29 17:45:36	8.296	16.591	33.183	4.53	0			
16	2016-11-29 17:46:13	8.247	16.493	32.986	4.798	0			
17	2016-11-29 17:46:49	8.186	16.371	32.742	4.616	0			
18	2016-11-29 17:47:26	8.097	16.194	32.388	4.982	0			
19	2016-11-29 17:48:02	8.024	16.048	32.096	4.709	0			
20	2016-11-29 17:48:39	7.937	15.874	31.748	4.769	0			
21	2016-11-29 17:49:16	7.879	15.757	31.514	4.792	0			
22	2016-11-29 17:49:52	7.842	15.685	31.369	4.791	0			
23	2016-11-29 17:50:29	7.46	14.921	29.841	4.826	0			
24	2016-11-29 17:51:05	7.302	14.603	29.207	4.918	0			
25	2016-11-29 17:51:42	7.301	14.602	29.203	4.902	0			
26	2016-11-29 17:52:18	6.941	13.882	27.763	4.708	0			
27	2016-11-29 17:52:55	7.015	14.029	28.059	4.848	0			
28	2016-11-29 17:53:32	6.952	13.904	27.808	5.046	0			
29	2016-11-29 17:54:08	6.889	13.779	27.557	4.824	0			
30	2016-11-29 17:54:45	6.804	13.607	27.215	4.892	0			

Appendix C

Calculating Key Values

November 2018

This appendix tells you:

How the 7650 calculates Key Values.
The following Key values can be calculated using 7650.

Concentration Decay method:

- Age of Air
- Air Exchange

Constant Dose method:

- Air flow
- Air Exchange

C.1 Calculating Key Values

This section shows the methods used by the 7650 to calculate the Key Values.
The 7650 uses data displayed in the Graphic Window (see section 6.3). In general, two cursors are used to define the interval of the curves that will be used for calculating Key values. For the constant dose type of measurements, it is possible to select not to use cursors. If the cursors are not used, calculations are performed using all of the data that can be seen on the curve.

There are three typical gas-concentration vs. time curves. These are shown in Fig.C.1.

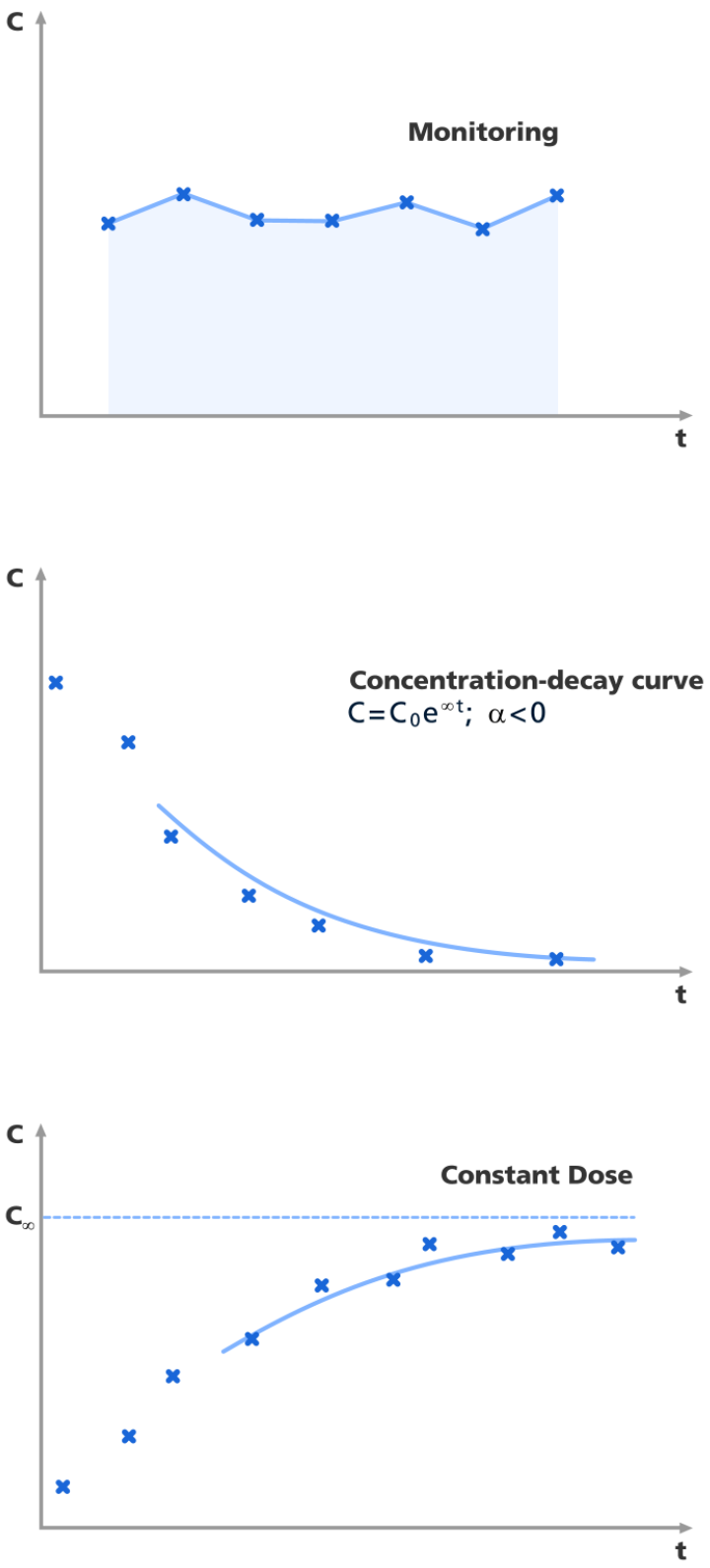


Fig.C.1 The three types of gas-concentration/time curve from which the 7650 can calculate Key Values

The following symbols, denoting points on the curves of measurement results, are used in the following calculations:

t_0, C_0 refer to the first measurement time and gas concentration in the cursor interval, respectively

t_i, C_i refer to a measurement time and gas concentration within the cursor interval, respectively

te, C_e refer to the last measurement time and gas concentration in the cursor interval, respectively

$t = 0, t_e$ are the times at the first and second cursors, respectively

The calculations performed by the 7620, using the data from the three typical curves, are described in the following three sections.

C.1.1 Values Calculated for All three Types of Curves

The following can be calculated irrespective of the type of curve using the two cursors.

Minimum value in the cursor interval:

Minimum value = minimum (C_i)

Maximum value in the cursor interval:

Maximum value = maximum (C_i)

Mean value of points in the cursor interval:

$$\text{Mean} = \sum_{i=0}^{N-1} (C_i / N)$$

where N = Number of valid measurements within the cursor interval.

Spread of values:

$$\text{Standard Deviation} = \sqrt{\frac{N \cdot \sum_{i=0}^{N-1} C^2{}_i - \left(\sum_{i=0}^{N-1} C_i \right)^2}{N(N-1)}}$$

C.1.2 Special Calculations for Concentration-decay Curve

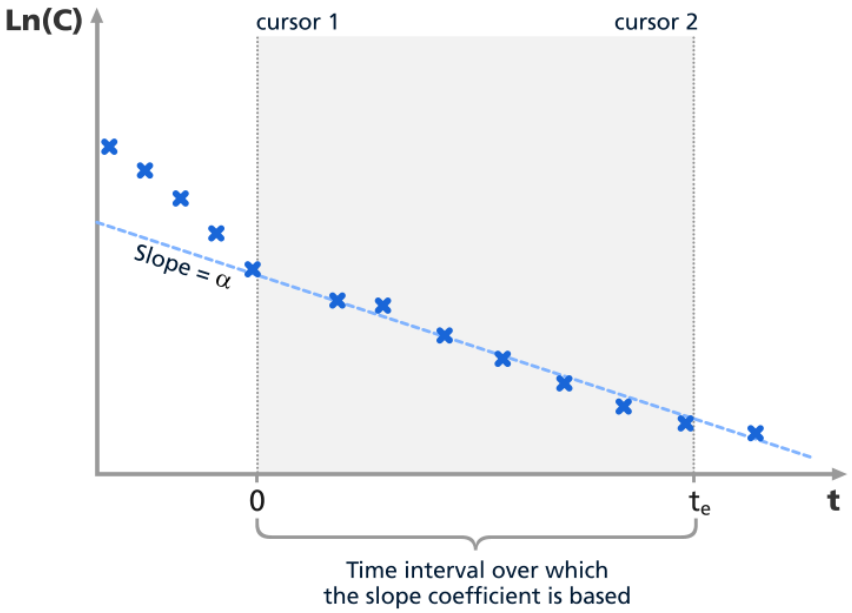


Fig.C.4 Concentration-decay curve

From the decay of the tracer gas concentration, the local mean age of air is calculated

$$Local\ mean\ age\ of\ air = \frac{\int_{t_0}^{\infty} C dt}{C_{t=0}}\ [h]$$

t time [hours]
$C_{t=0}$ initial tracer gas concentration [mg/m3]

$$\int_{0}^{\infty} C_t dt = \int_{t_0}^{t_e} C_t dt + \int_{t_e}^{\infty} C_t dt \cdot e^{-\lambda_{tail}(t-t_e)} dt$$

$$= \frac{1}{2}\Big((C_{t0} + C_{t0+1})\,(t_{0+1} - t_0) + \cdots + \big(C_{t0+(n-1)} + C_{t0+n}\big)\big(t_{0+n} + t_{0+(n-1)}\big)\Big) + \frac{C_{t=t_e}}{\lambda_{tail}}$$

where

$$\lambda_{tail} = \frac{\ln(C_{t0}) - \ln(C_{t=t_e})}{t_e - t_0}$$

C.1.3 Calculations for Constant Dose.

Room ventilation

The local mean age of air is calculated

$$Local\ mean\ age\ of\ air = \frac{C}{(q_V/V)}\ [h]$$

C measured tracer gas concentration [mg/m3]
q_V/V injection rate per cubic meter of space [mg/h/m3]

Flow in ducts

The air flow is calculated

$$Air\ flow = \frac{q_V}{(C_1 - C_0)}\ [m3/h]$$

q_V tracer gas injection rate [mg/h]
C_1 concentration at sampling point [mg/m3]
C_0 background concentration [mg/m3]

7650

LumaSense Technologies A/S
Energivej 30
DK-2750 Ballerup, Denmark

Tel.: (+45) 44 20 01 00
Fax: (+45) 44 20 01 01
http://www.lumasenseinc.com