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1. General

The data acquisition software “MARS” (Multi Analyser Research Software) enables data logging of all relevant parameters from the sensor in a table and chart view. The general user mode (= not-advanced user mode) of this software can read all parameters and set zero and end points for the gas channels. It is also possible to activate and deactivate the radiation sources of the sensor.

INFORMATION

- a) This software was not only developed for data acquisition by the user but also for the production and calibration of sensors as well as for OEM manufacturers. Therefore, the software includes various functions that are not relevant for the standard data acquisition. **Therefore, features which are not applicable for a standard data acquisition are not described in this manual.**

For changing of calibration coefficients and some other critical parameters, the *Advanced User Mode* has to be entered. The necessary password is provided on request.

- b) This documentation has been prepared with the greatest possible care. However, it is intended **for specialist personnel** who are familiar with the principles of gas measurement technology. Basic questions about measurements of gas concentrations, cross-sensitivities etc. can therefore not be answered with this documentation. Please consult the relevant technical literature in this regard.

2. Scope of Supply

No. of Items	Item
1	Document folder including ... <ul style="list-style-type: none">• Calibration Certificate• Data Sheets• Software Manual
1	Sensor in aluminium table top casing
1	Plug-in power supply unit Input: 100-240 V-AC, 50/60 Hz, 0.4 A Output: 24 V-DC, 0.5 A, 12 W or 36 W (H ₂ S / UVRAS sensor)
1	Data acquisition software (on USB flash drive)
1	Connection cable: sensor ⇒ PC Standard: USB V2.0 A/B, 1 m Option: RS232, 3 m
3 m	Viton tubing Ø _i 4 mm / Ø _o 6 mm

3. System Requirements

- PC with operating system Windows® 7 or higher
- Recommended processor performance: ≥ 2 GHz
- Recommended random access memory (RAM): ≥ 4 GB
- 1 x USB port
- Monitor 17" (optimised for monitor resolution of 1280x 1024 pixels or higher)

4. Setup of Software

a) **Please note: The sensor must NOT be connected to the PC at this time.**

b) The software is provided on a USB flash drive. Insert the USB drive into the appropriate port of the computer and open the file directory.

c) Setup the USB driver by **right mouse click** on "\Driver Serial COM Port\CDM21228_Setup.exe" and **execute with administrator rights**.

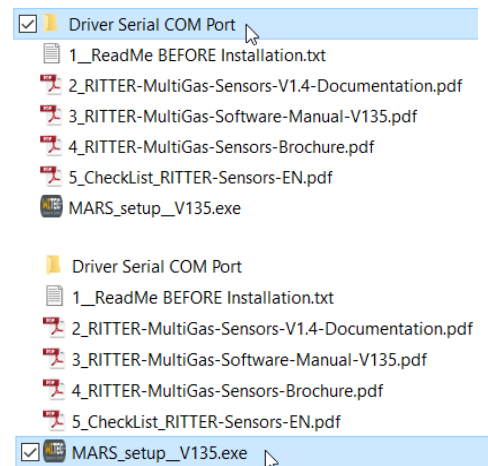
d) Start the software setup by **right mouse click** on "MARS_setup_Vxxx.exe" and **execute with administrator rights**.

e) Follow the instructions of the setup procedure.

f) After successful installation the software **must not** be started at this time. Otherwise the COM port of the connected sensor will not be recognized.

g) Execute the setup procedure of the sensor as described in the Operation Manual of the sensor, par. 5.3 ff "Setup".

h) Start the software "MARS_Tool.exe" by **right mouse click** and **execute with administrator rights**.



If several sensor modules are installed (e.g. 1 x IR module + 1 x UV module), the application must be opened several times according to the number of modules in several instances.

5. Software Features

5.1. Data Logging Tab

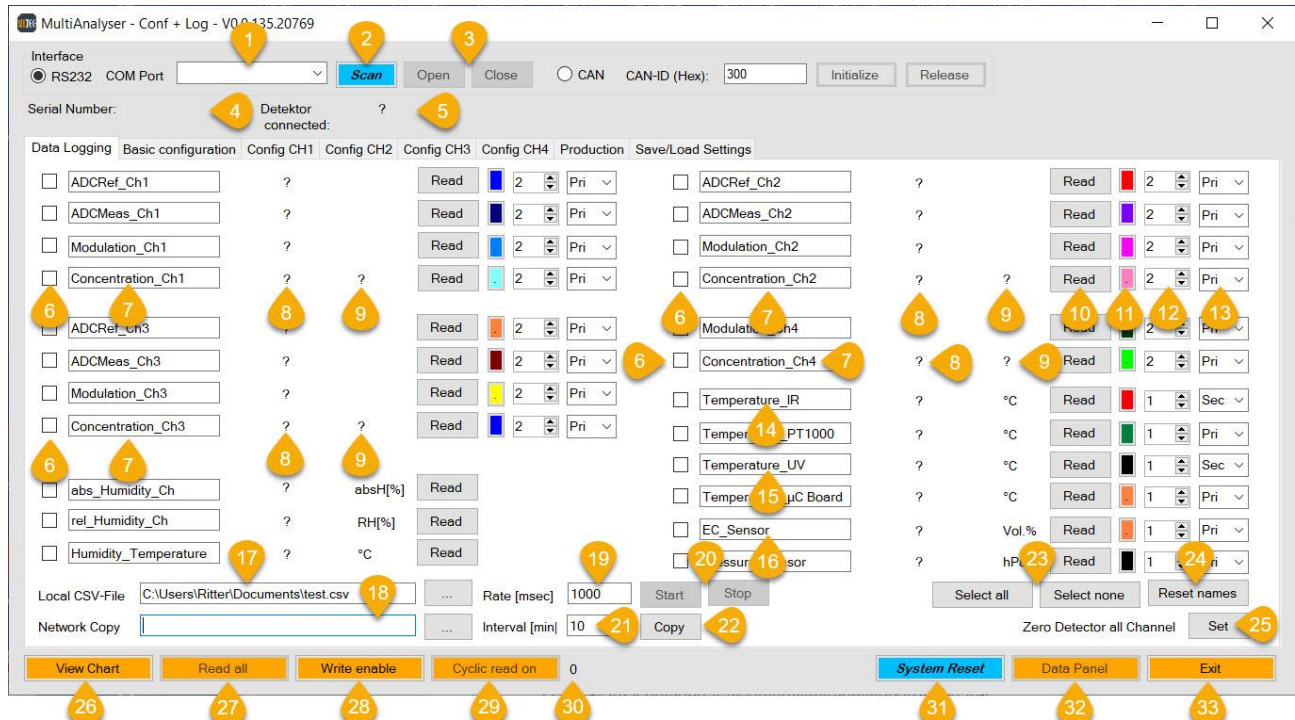


Figure 1: Data Logging Tab

- (1) Selects the serial COM port
- (2) Scans available sensor(s) and port(s)
- (3) Opens / closes selected COM port; reads configuration of sensor(s)
- (4) Displays serial number of the connected sensor
- (5) Display of sensor configuration
- (6) Designators for selection / de-selection of channel for data logging as well as for display of the measurement value in the table and chart view
- (7) Channel and function designators, editable (stored in configuration)
Example:
Default entry "Concentration_Ch1" can be changed to "CO2 Concentration Ch 1"
- (8) Measurement values
- (9) Dimension of measurement values
- (10) Manual one-time reading of measurement value (automatic reading: see (17), (19), (20))
- (11) Colour of the plotted line in chart view
- (12) Thickness of the plotted line in chart view
- (13) Selects primary (= left) axis or secondary (= right) axis for indication of measurement values in chart view
- (14) Temperature indication of IR sensor

- (15) Temperature indication of UV sensor
- (16) Measurement value of EC sensor (O₂ sensor)
- (17) Storage path and file name for data logging file
- (18) Storage path for copy of data logging file to network (optional)
No entry: No copy
- (19) Time interval for logging the data in milliseconds, minimum 100 ms
- (20) Starts / stops data logging into file [name].csv
- (21) Interval for copy of data logging file to network (optional)
- (22) Starts copy of data logging file to network (optional)
- (23) Selects / de-selects all channels for data logging and chart view
- (24) Resets all designators to default
- (25) Sets all channels to zero (with inert gas N₂, H₂), see par. 7.1
- (26) Opens chart view in separate window
- (27) Reads all measurement values
- (28) Enables advanced user mode - password protected. Password is provided on request only.
- (29) Starts measurement cycle independently from data logging. Useful for chart view and direct feedback values
- (30) Received data frames
- (31) Restarts the complete sensor
- (32) Shows the measurement values in combination with a chart (see par. 8.1)
- (33) Exits the software

5.2. Basic Configuration Tab

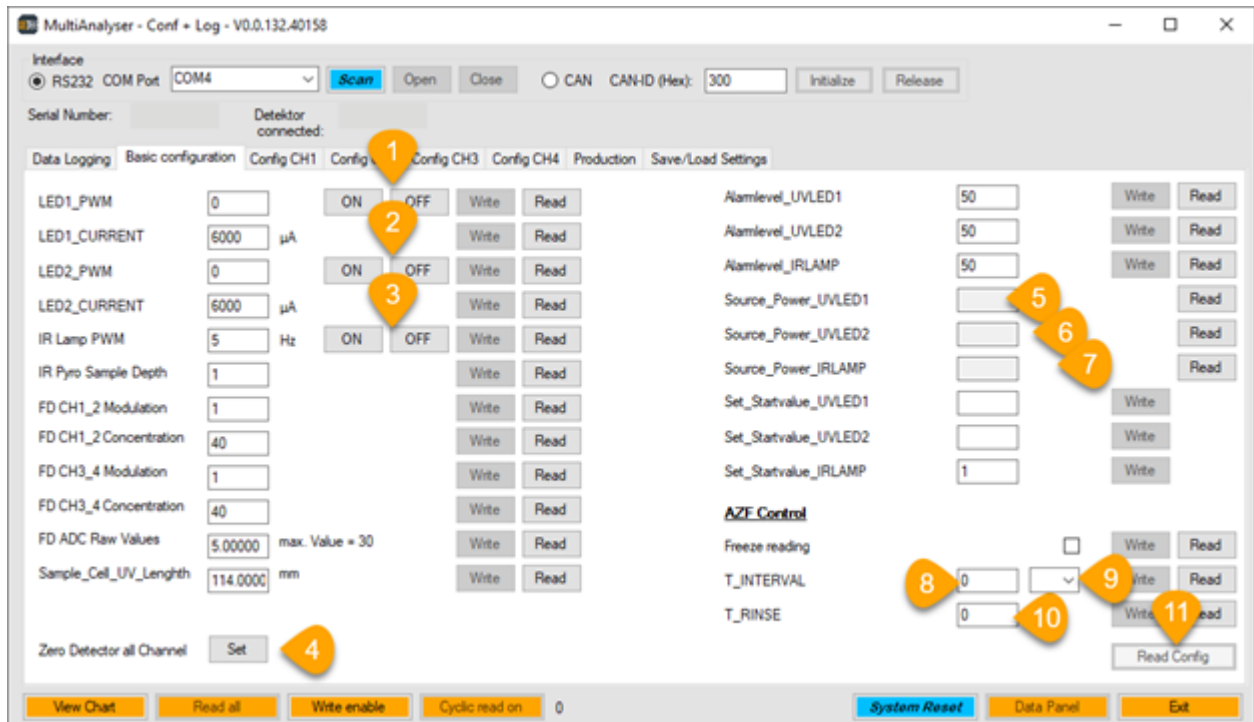


Figure 2: Basic Configuration Tab

- (1) Turns on/off radiation source: UV LED 1
- (2) Turns on/off radiation source: UV LED 2
- (3) Turns on/off radiation source: IR Source
- (4) Sets all channels to zero (with N₂, H₂)
- (5) Percentage of radiation power: UV LED 1
- (6) Percentage of radiation power: UV LED 2
- (7) Percentage of radiation power: IR Source & EDL → indicators for aging
- (8) Time interval in which the zero point is to be set
- (9) Selection of minutes [min] hours [h] or days [d] for time interval
- (10) Time [sec] for rinsing the sensor at each interval
- (11) Reads all basic configuration settings

5.3. Configuration Tabs

The four *Configuration Tabs* for the different channels/gases are very similar to each other. The highlighted fields are explained in the “Config CH1” tab (Figure 3) only. These fields are identical in all tabs.

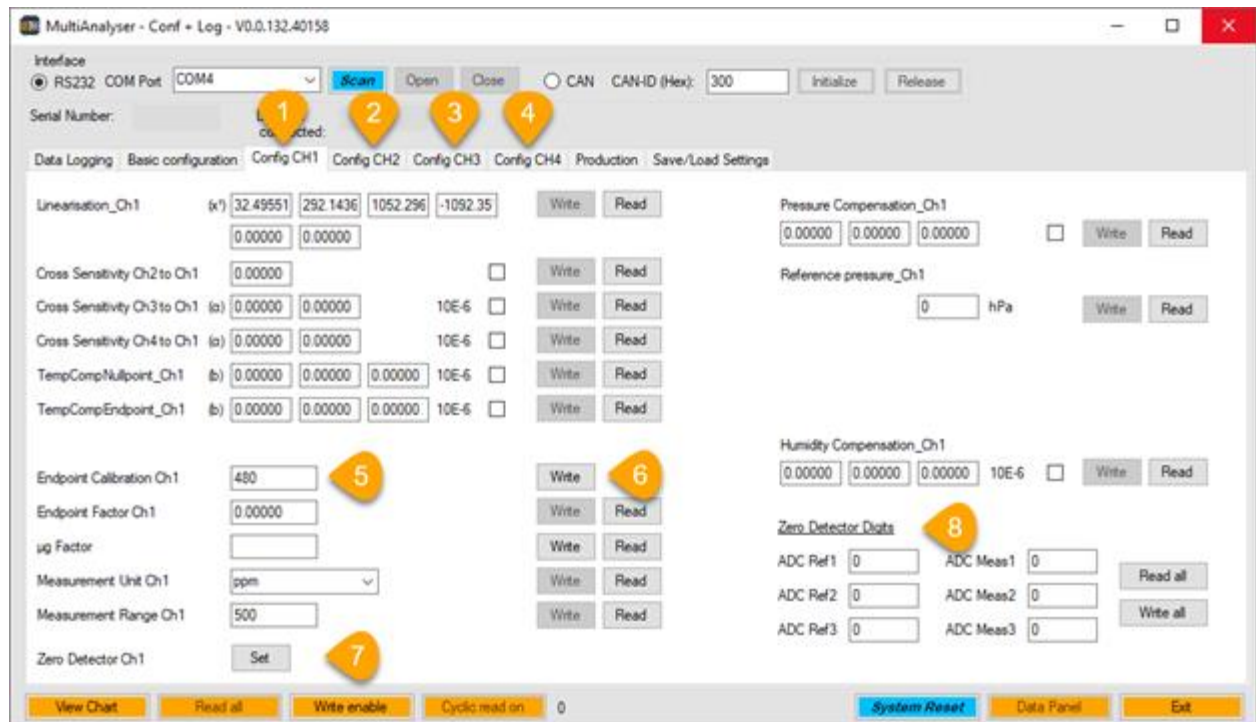


Figure 3: Tab “Config CH1”

- (1) Config CH1
- (2) Config CH2
- (3) Config CH3
- (4) Config CH4
- (5) Concentration of the test gas at the end point setting (may deviate max. $\pm 10\%$ F.S.)
- (6) Sets the endpoint
- (7) Sets the zero point for the gas in the current tab → important for carrier gas dependencies
- (8) Raw values after setting of the last zero point

5.4. Production Tab

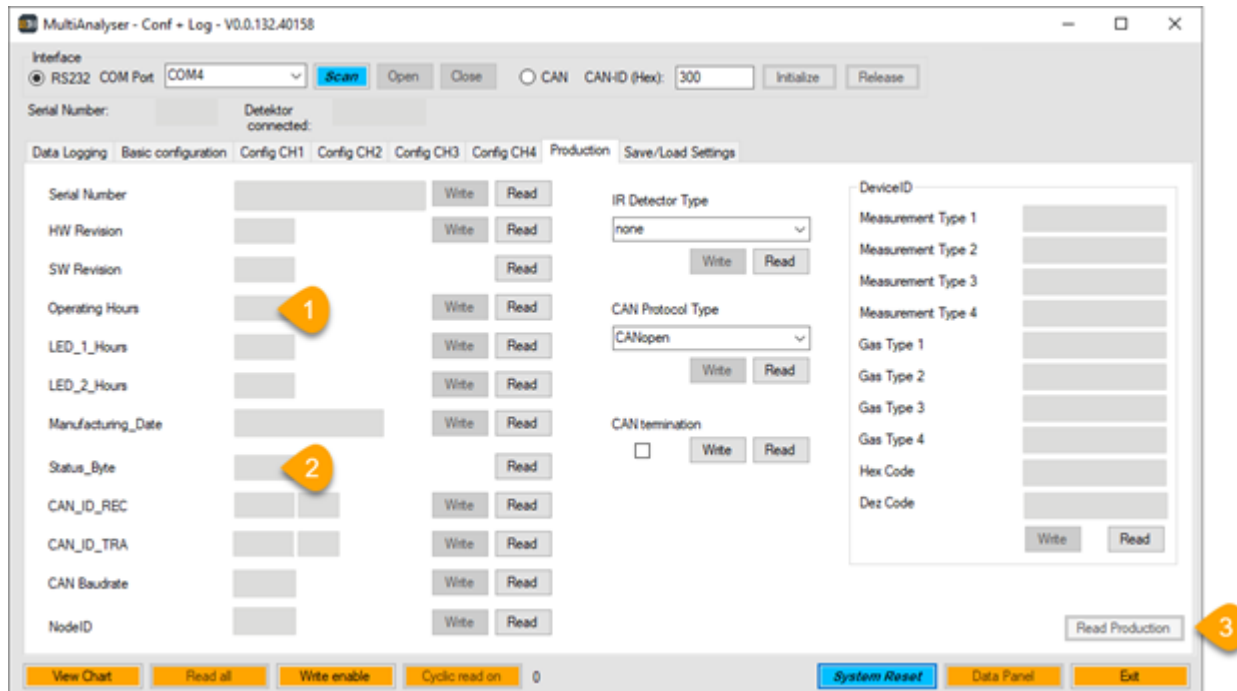


Figure 4: Production Tab

- (1) Counter for the operating hours of the sensor
- (2) *Status Byte* of the sensor (see below)
- (3) Reads all production settings / information

5.4.1. Status Byte

IR /EDL detected	NA	UV LED1 detected	UV LED2 detected	IR /EDL Level error	NA	UV LED1 Level error	UV LED2 Level error	Status code bin	Status code hex	Status code dez
Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7			
0	1	0	0	1	1	1	1	11110010	4F	79
1	1	0	0	1	1	1	1	11110011	CF	207
1	1	0	0	0	1	1	1	11100011	C7	199
0	1	1	0	1	1	1	1	11110110	6F	111
0	1	1	0	1	1	0	1	10110110	6D	109
0	1	1	1	1	1	1	1	11111110	7F	127
0	1	1	1	1	1	0	0	00111110	7C	124
0	1	1	1	1	1	0	1	10111110	7D	125
0	1	1	1	1	1	1	0	01111110	7E	126
1	1	1	0	1	1	1	1	11110111	EF	239
1	1	1	0	0	1	0	1	10100111	E5	229
1	1	1	0	0	1	1	1	11100111	E7	231
1	1	1	0	1	1	0	1	10110111	ED	237
1	1	1	1	1	1	1	1	11111111	FF	255
1	1	1	1	0	1	0	0	00101111	F4	244
1	1	1	1	0	1	0	1	10101111	F5	245
1	1	1	1	0	1	1	1	11101111	F7	247
1	1	1	1	0	1	1	0	01101111	F6	246
1	1	1	1	1	1	0	0	00111111	FC	252

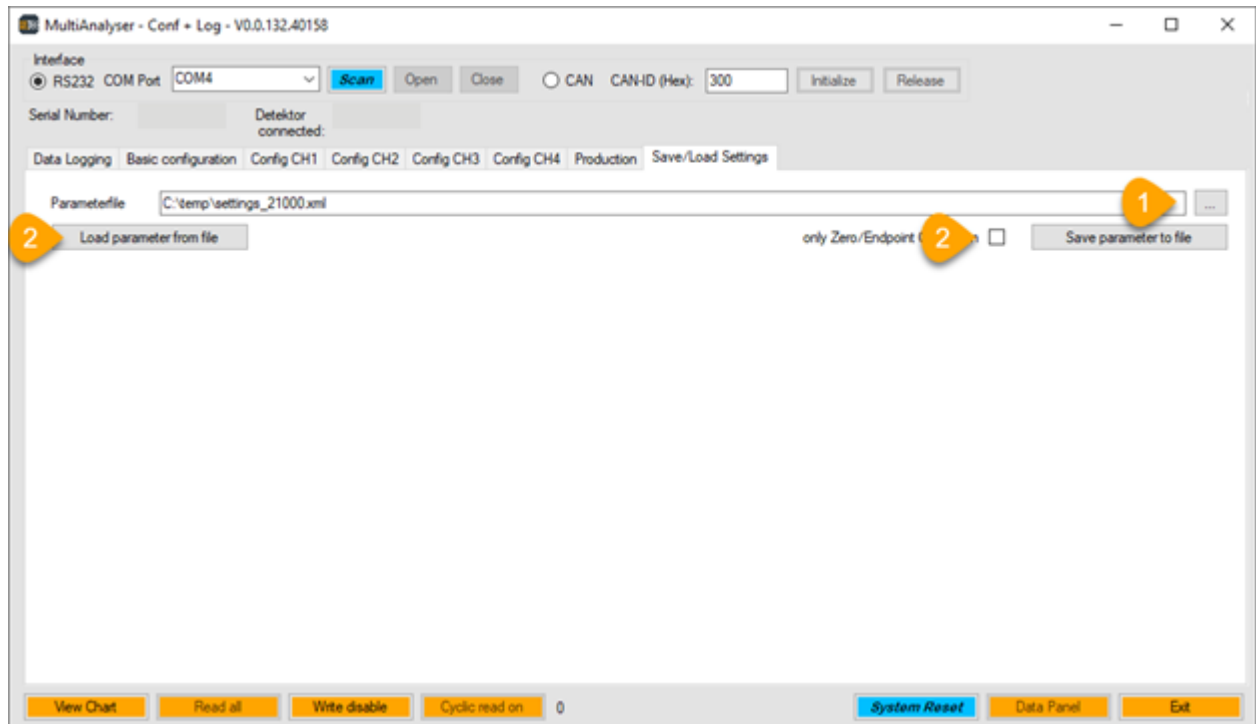


Figure 5: Save/Load Settings Tab

5.5. Save/Load Settings Tab

Save settings:

- (1) Select a storage path and *.xml file name for the settings to be saved.
- (2) Click the button [save parameter to file].

Load settings:

- (1) Select the storage path and the *.xml settings of the desired file.
Optionally, set the checkbox to reset the zero-/endpoints only.
- (2) Click the button [Load parameter from file].

Note: The *.xml file can be edited with a standard XML viewer.

6. Coupling the Sensor and Starting a Measurement

6.1. RS232 and USB Protocol

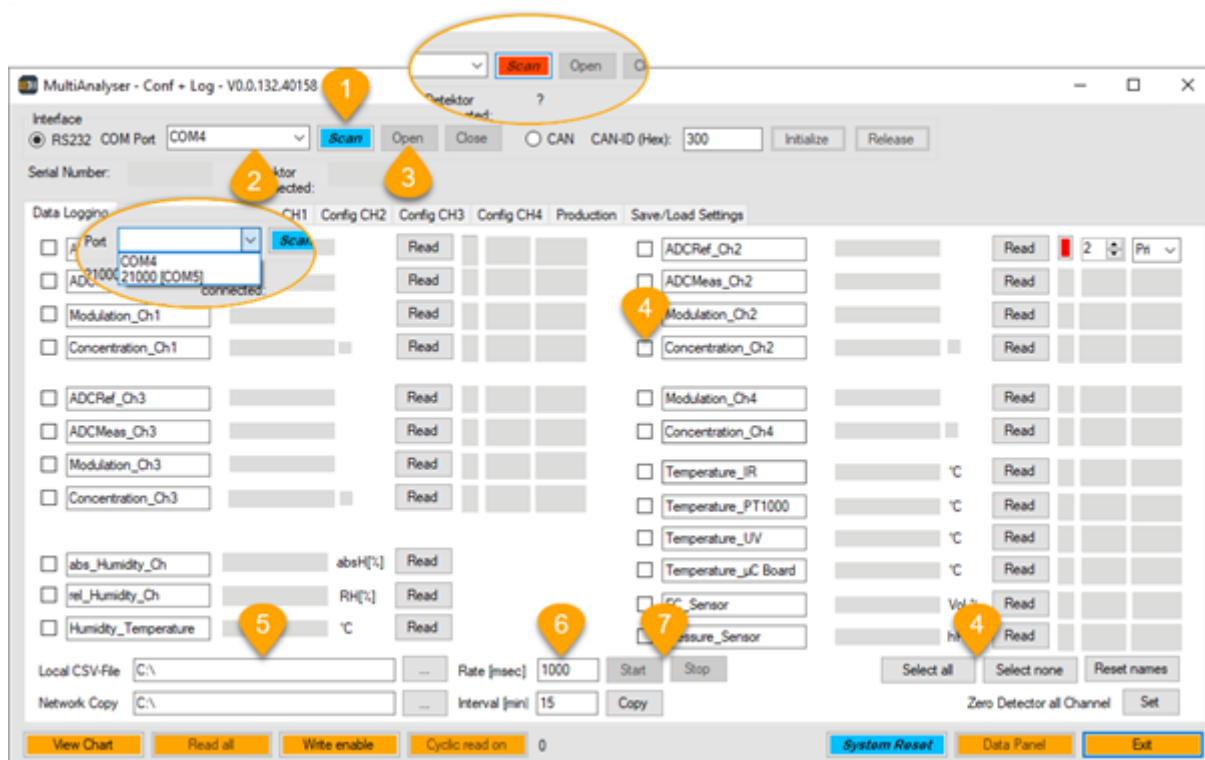


Figure 6: Starting a measurement

- (1) Click the button [Scan]. The colour changes from blue to red while scanning the COM ports of your PC. When ready the button changes to blue again.
- (2) Click the dropdown menu and select the sensor's serial number which is stated on the sensor label located at the bottom side of the sensor casing.
- (3) Click the button [open] → serial number and sensor configuration are displayed.

If several sensor modules are installed (e.g. 1 x IR module plus 1 x UV module) and the application is opened several times in several instances, please switch to the other instances one after the other and repeat steps (1) to (3) there.

- (4) Click the checkboxes of the corresponding gas channels or the button [Select all/ Select none].
The assignment of the measurement channels is stated in the provided *Calibration Protocol*. Example:

Measurement Channels

Channel	Gas	Range	Sample Cell (Cuvette)
CH1	--	--	--
CH2	CO ₂ (in CH ₄)	0 – 100 %	50 mm
CH3	CH ₄ (in CO ₂)	0 – 100 %	50 mm
CH4	--	--	--

- (5) Choose a storage path and file name for the data logging file.
- (6) Choose a measurement interval (min. 100 ms).

- (7) Click on the button [start]. If the data file already exists, the user can select to override the file or add the new data to already existing data. Click the button [stop] to end the recording to the data file.

6.2. CANbus Protocol

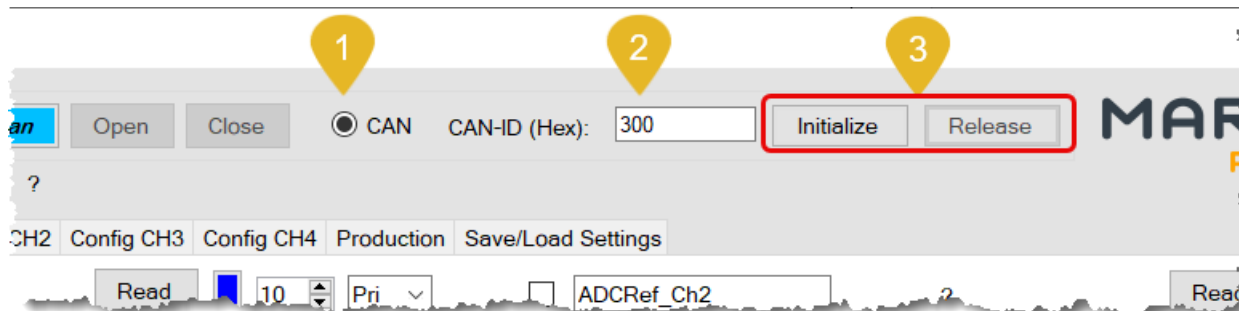


Figure 7: Initialization of the sensor with CANbus protocol

- (1) Select the [CAN] interface.
- (2) Enter the CAN-ID "300" if not already set by default.
- (3) Connect the sensor with the provided connection cable with the respective port of the computer and click "Initialize".
(Click "Release" after termination of data acquisition.)
- (4) Pin assignment of connection cable:



RJ45-lead	Signal	Description	Colour *)
1	CAN_GND	Ground	white
2			brown
3			green
4	CAN_H	Dominant High	yellow
5	CAN_L	Dominant Low	grey
6			pink
7			blue
8			red

*) Wire colours of the included connection cable

If several sensor modules are installed (e.g. 1 x IR module plus 1 x UV module) and the application is opened in multiple instances, please switch to the other instances and repeat steps (1) to (3) there.

Then proceed as described in par. 6.1 (4) to (7).

6.3. MODbus Protocol (RTU)

(1) Settings

Baudrate	115200 Baud
Databits	8
Stopbit	1
Parity	None
Float Definition	IEEE754
Available Register	Read Holding Register 0x03 Read input Register 0x04 Write single Register 0x06

(2) Command List

Normal operating mode

These commands are important for the main function of the detector.

Description	MODBUS Register	Number of Register	Format Type	Unit	Access
Concentration channel 3	30001	2	FLOAT	ppm,Vol.%,µg	Read
Concentration channel 4	30003	2	FLOAT	ppm,Vol.%,µg	Read
Concentration channel 1	30005	2	FLOAT	ppm,Vol.%,µg	Read
Concentration channel 2	30007	2	FLOAT	ppm,Vol.%,µg	Read
Set zero detector [all Channel] zeropoint stored*	40011	1	BOOL	-	Write
Set zero calibration channel 1 zeropoint stored*	40012	1	BOOL	-	Write
Set zero calibration channel 2 zeropoint stored*	40013	1	BOOL	-	Write
Set zero calibration channel 3 zeropoint stored*	40014	1	BOOL	-	Write
Set zero calibration channel 4 zeropoint stored*	40015	1	BOOL	-	Write
Set Span Calibration channel 1	40016	1	FLOAT	ppm[Vol.%]	Write
Set Span Calibration channel 2	40018	1	FLOAT	ppm[Vol.%]	Write
Set Span Calibration channel 3	40020	1	FLOAT	ppm[Vol.%]	Write
Set Span Calibration channel 4	40022	1	FLOAT	ppm[Vol.%]	Write

(3) Sensor information

Description	MODBUS Register	Number of Register	Format Type	Unit	Access
Serial Number	40001	1	UINT16		Read
Config ID	40002	1	UINT32		Read
Hardware Revision	40003	1	UINT16		Read
Software Revision	40004	1	UINT16		Read
Operating hours	40006	2	UINT32		Read
Manufacturing date	40010	1	UINT16		Read

7. Zero and End point calibration

For highly accurate gas measurements a regular check of the zero point and end (span) point is necessary.

Recommended recalibration intervals:

a) IR sensors:

- Zero point: Weekly with inert gas, e.g. Nitrogen
The setting of the zero point is described in par. 7.1 below.
- End point (full scale): Every 3 months with suitable calibration gas
The setting of the end point is described in par. 7.2 below.

b) UV sensors:

- Zero point:
 - Concentrations < 300 ppm: Every 48 hours with inert gas, e.g. Nitrogen
 - Concentrations \geq 300 ppm: Every 24 hours with inert gas, e.g. Nitrogen
 The setting of the zero point is described in par. 7.1 below.
- End point (full scale): Every 3 months with suitable calibration gas
The setting of the end point is described in par. 7.2 below.

In case of deviation (e.g. > 2% of span) the MARS Tool features an uncomplicated setting of the zero and span point.

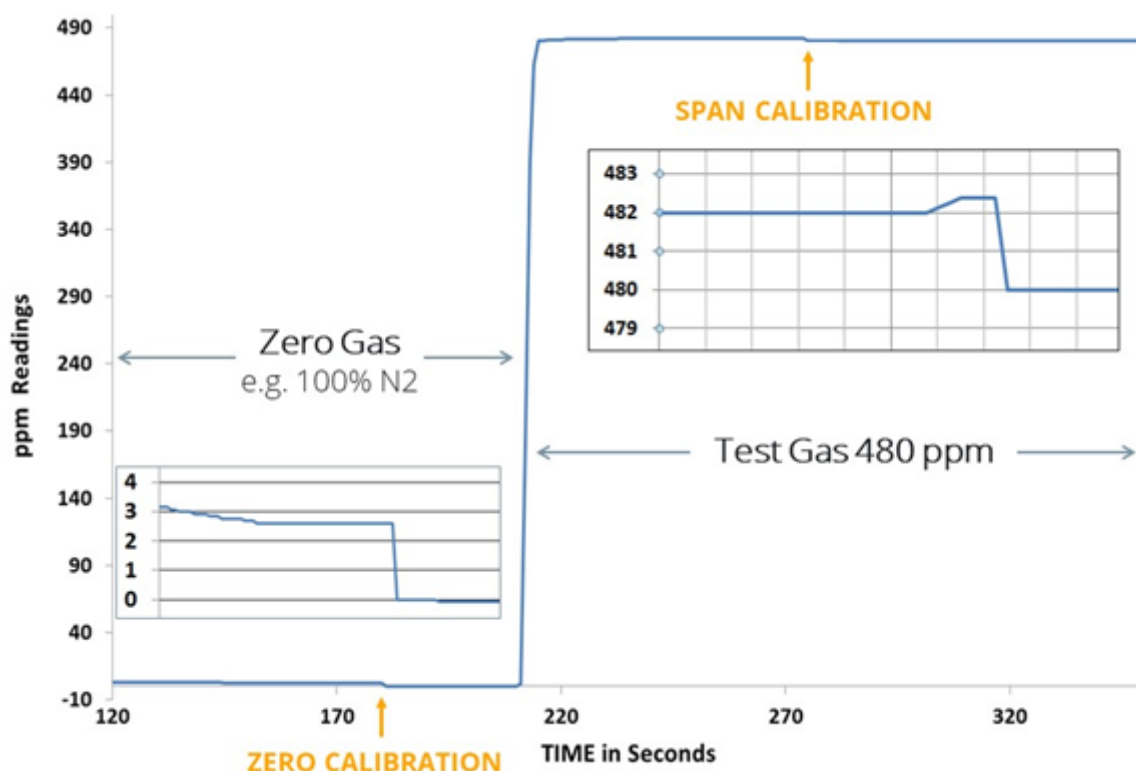


Figure 8: Concentration readings during zero and span point calibration

7.1. Zero-point calibration

Purge the entire gas measurement system with a sufficient volume (1l/min) of zero gas (e.g. N₂, Ar, H₂ or cleaned air) and wait until the gas concentration reading is stable (<1% F.S.).

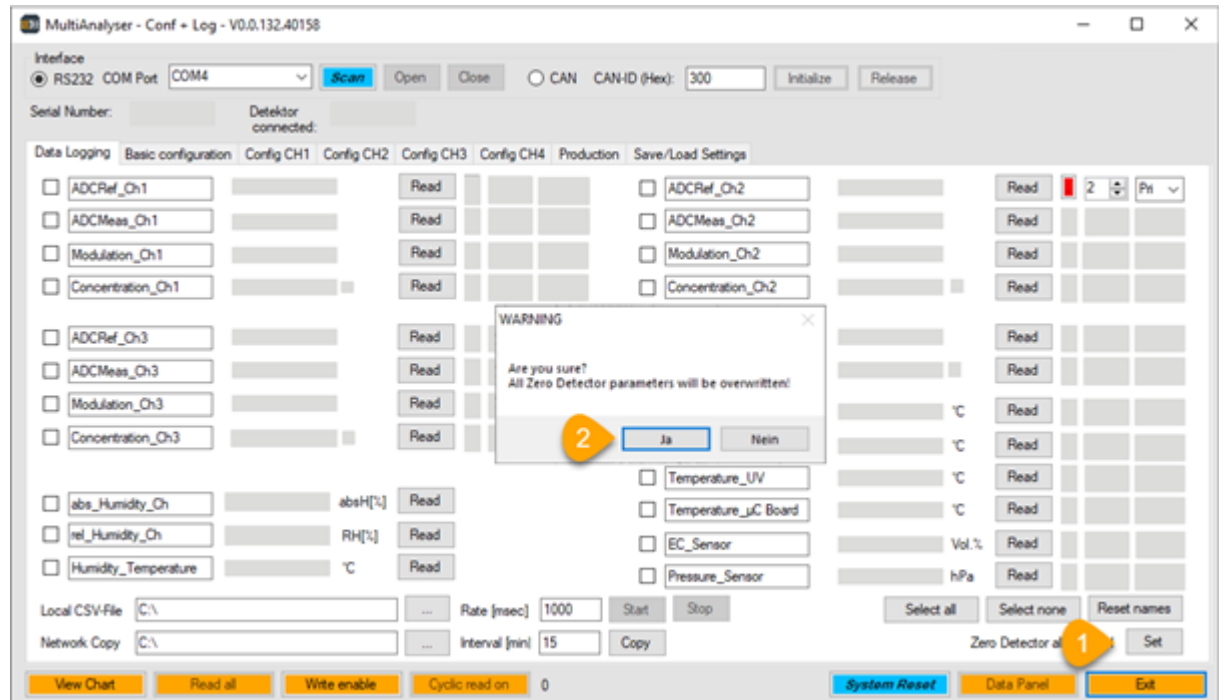


Figure 9: Zero-point calibration

- (1) Click the button [Set] next to *Zero Detector all Channel*.
- (2) Click the button [Yes/Ja] to do a zero-point calibration → the concentration reading is now 0.0000 ppm.

7.2. End-point calibration

Setting the end point necessitates the use of a well-known concentration of test gas. If a certified test gas bottle (cylinder) is used, the gas concentration value can be found on the label or in the provided certificate (e.g. 480.00 ppm CO₂).

- Before applying the end point calibration, it is important to do a zero-point calibration with N₂ (inert gas) to set the offset to zero.
- Make sure that the test gas concentration does not deviate more than 10% from F.S.
- Purge the entire gas measurement system with a sufficient volume (1 l/min) of test gas and wait until the gas concentration reading is stable (< 1% of span).

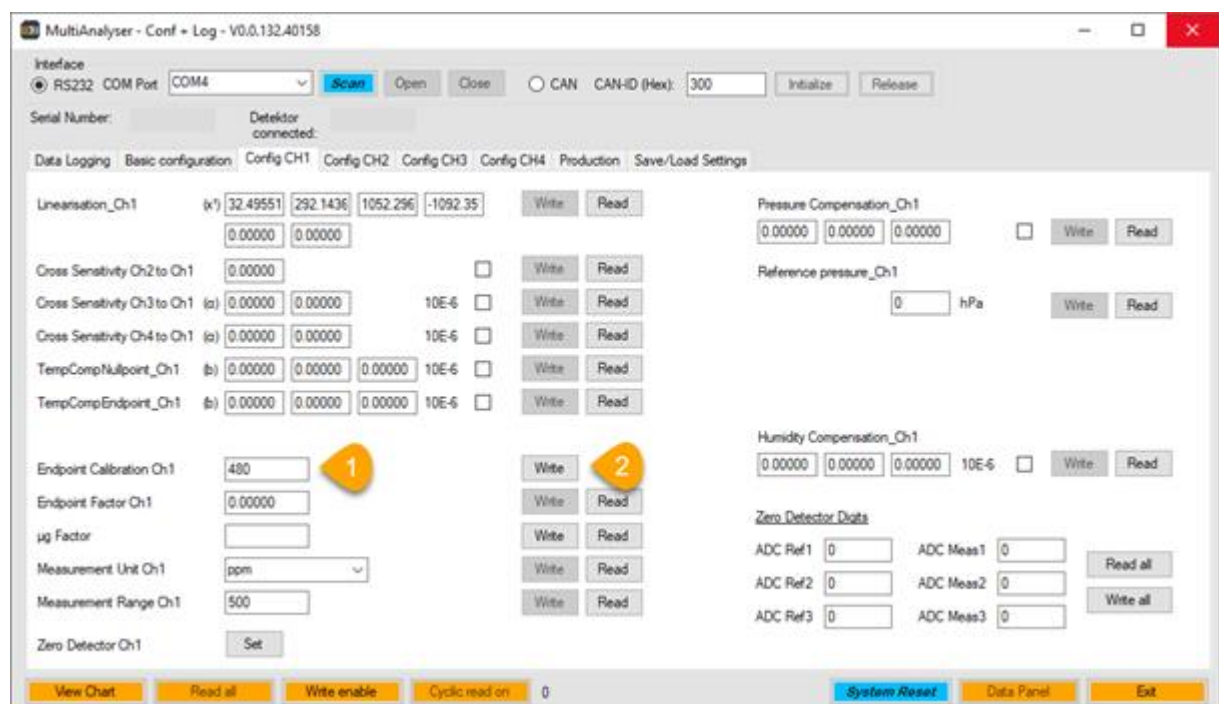


Figure 10: End point calibration

- Enter the test gas concentration in the textbox.
- Click the button [write] to perform the end point calibration.

8. Advanced User Mode

To enter the advanced user mode a password is required. This password is provided on request only. When activated, the advanced user mode allows the user to change additional parameters.

Basic configuration

- LED current
- Filter depth
- Alarm Level Sources
- AZF Settings

Config CHs

- Linearization Coefficients
- Temperature Compensation Coefficients
- Measurement Unit
- Measurement Range
- Cross Sensitivity
- µg Factor
- Pressure Compensation Fields

Save/Load Settings

- Save settings
- Reload zero/endpoint calibration
- Overwrite all settings with a new settings file (maintenance)

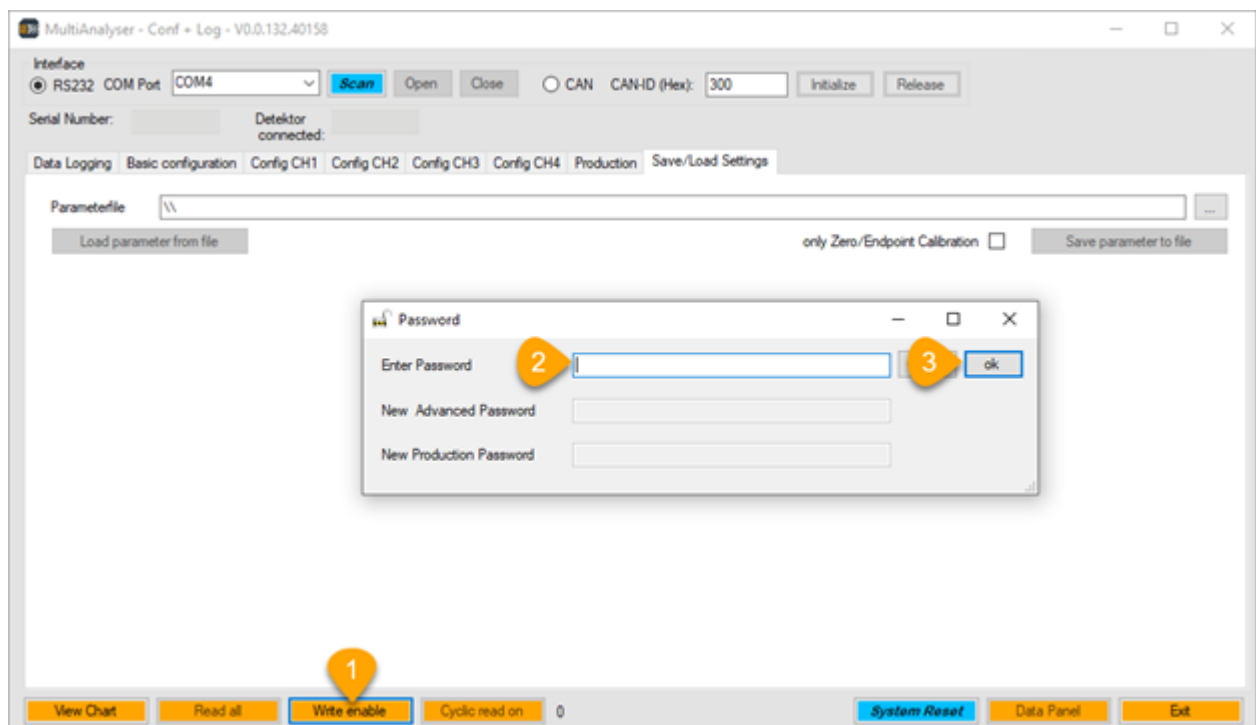


Figure 8: Advanced user mode

In any tab:

- (1) Click the button [Write enable].
- (2) Type the password.
- (3) Click the button [ok].

Note: Please save the sensor settings before changing any parameters (see par. 5.5 Save/Load Settings Tab).

8.1. Panel View with Data Panel

The *Panel View* enables the user to show the relevant measurement signal in the front panel design mode. This can be useful to demonstrate measurements or run diagnostics on the sensor.

To open the *Data Panel*, click the button [Data Panel] (see Figure 1 button no. 32).

Note: Before the *Panel View* can be used a connection with the sensor must be established first (see par. 6).

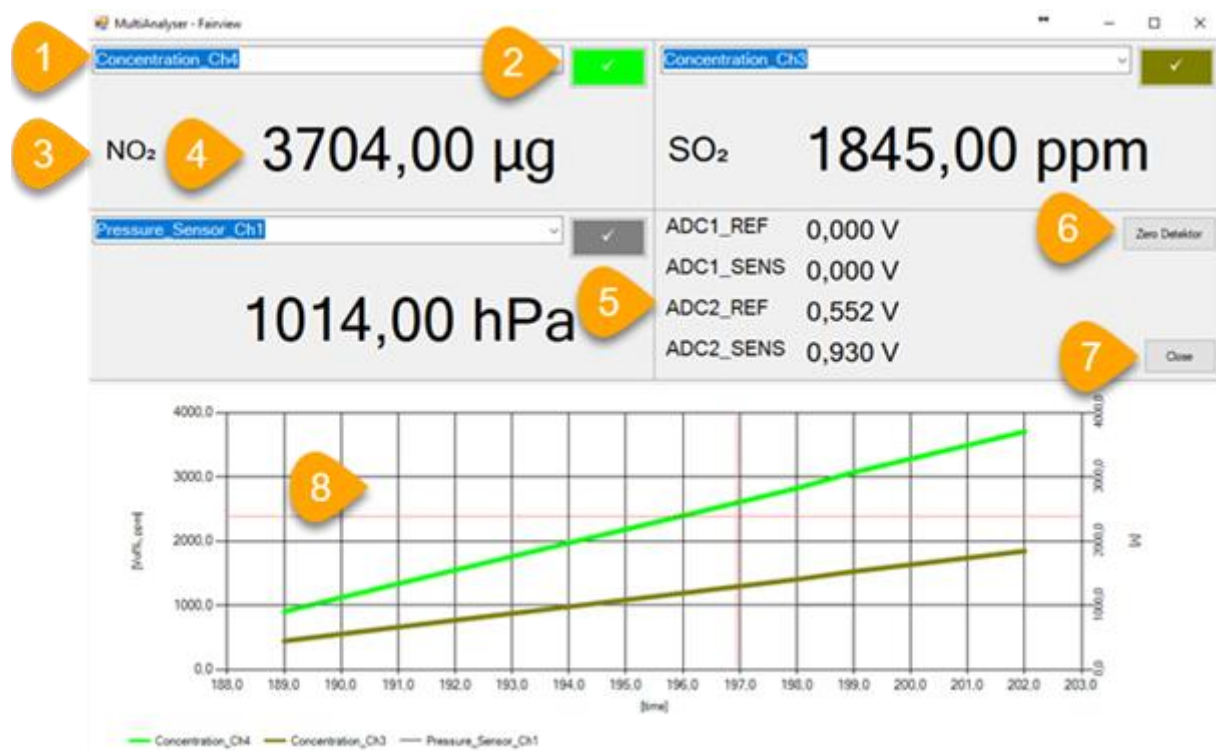


Figure 9: Data Panel View

- (1) Data Channel Selection
- (2) Activate/ deactivate data logging
- (3) Gas component of the selected channel
- (4) Actual gas concentration readings
- (5) Raw data values (preamp signals)
- (6) Sets all channels to zero (with inert gas N₂, H₂)
- (7) Closes the *Panel View*, all settings will be saved
- (8) Signal plot

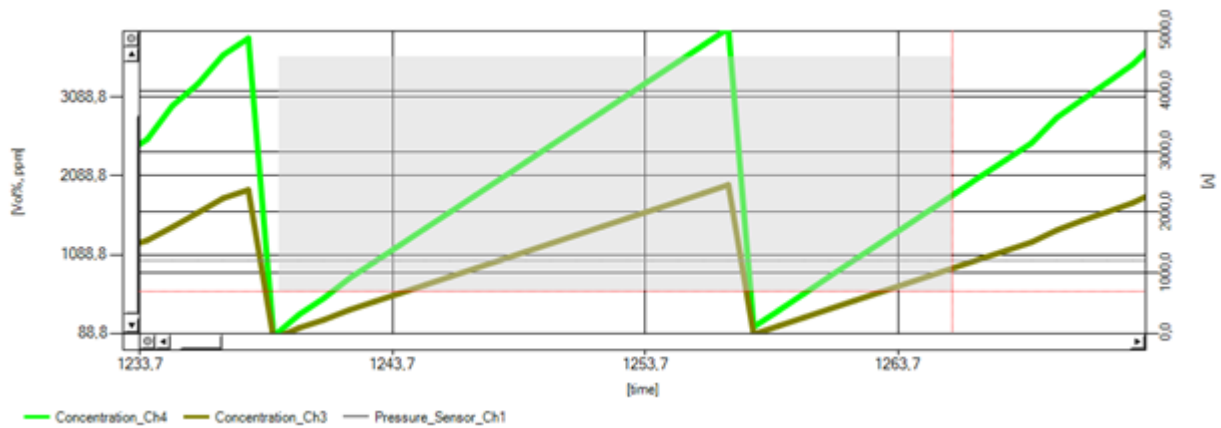


Figure 10: Data Panel with zoom function

Keep the left mouse button pressed to enlarge the selected area.

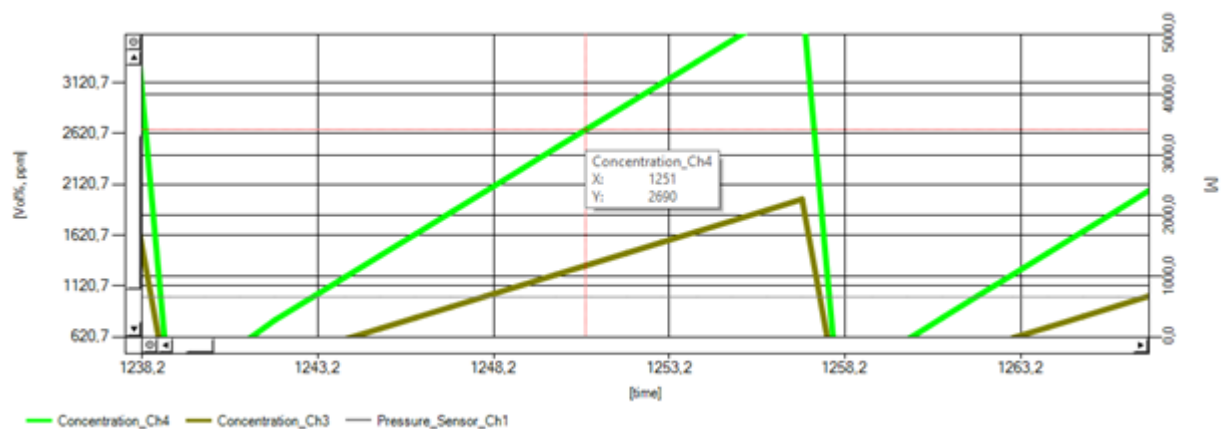


Figure 11: Data Panel with detailed information

Navigate the cursor to a position on the graph to display detailed information.