

SWG 100

BIOcompact

USER MANUAL



Die leeren Seiten der Bedienungsanleitung sind kein Fehler
sondern herstellungsbedingt erforderlich!

The blank pages of the operating instructions are not a mistake
but due to manufacturing required!

Пустые страницы в инструкции по эксплуатации не ошибка,
а требуется производством!

Les pages vides sont pas fauses, mais dûs à la production requise!

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Inspect Shipment for Damage

Carefully inspect the entire shipment for damage in the presence of the shipper's agent, removing packaging material if necessary. Note any damage to packaging and/or goods on Packing List and have it signed by the shipper's agent prior to accepting the shipment. Submit damage claim to MRU immediately.



NOTE: Damage claims not received by MRU within 3 days of receipt of shipment will not be accepted.

The products described in this manual are subject to continuous development and improvement and it is therefore acknowledged that this manual may contain errors or omissions. MRU encourages customer feedback and welcomes any comments or suggestions relating to the product or documentation.

Please forward all comments or suggestions to the Customer Feedback Department at the following address:

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This manual is intended solely as a guide to the use of the product.

MRU shall not be liable for any loss or damage whatsoever arising from content errors or misinterpretation of information's from this manual or any mis-use resulting from the use of this manual.

FOR MORE INFORMATIONS ABOUT COMPANY MRU PLEASE VISIT OUR WEBSITE

www.mru.eu

1. General Information

1.1. Weather and environmental conditions

The SWG100 BIOGAS analyser is designed for ambient temperatures of +5°C to +45°C (without cabinet heater) resp. -10°C to +45°C (with cabinet heater).

The analyser is designed for indoor mounting. In case of outdoor mounting it is important that the analyser is sufficiently protected against rain, sun and wind. In case of outdoor mounting under extreme environmental conditions like high humidity, salty sea air, etc. further protective measures are necessary. These should be clarified with the manufacturer (MRU).

Any additional protective measures for outdoor mounting have to be provided by the plant operator. The manufacturer (MRU) consults the plant operator in choosing appropriate protective measures.

NOTE



The SWG100Biogas analyser is designed for sampling biogas with condensate of max. 14ml/min.

If the sample biogas will be very wet (high condensate of more than 14ml/min), then – to protect the SWG100-Biogas analyser – please consider special precautions to remove the condensate.

If you not have your own feasible solution for this topic, please ask MRU.

1.2. Installation instructions

Installation instructions, which are described in chapter 3 of the operation manual, have to be strictly adhered to.



⚠ WARNING

Please check correct installation before powering up the analyzer!
Please operate the analyzer only in upright position!

1.3. General important instructions for the plant operator

To guarantee continuous operation of the SWG100 BIOGAS analyser, the functions, processes and operation of the analyser have to be monitored regularly by the plant operator – especially in case of any initial installation. Thus it will be possible to take suitable measures to improve the availability and life time of the analyser.

As the plant operator gains more experience concerning the maintenance requirements of the analyser, the monitoring frequency may be reduced to more extended periods of time.

It is important that the filter-units, listed in chapter 6 of the operation manual, are checked regularly and, if necessary, service parts are changed.

IMPORTANT

In case of **not intended use** the guarantee will void. Regular controls, inspections and the exchange from polluted and exhausted filters by the operator are also an important part of the determinations "**not determined use**"- see chapter 6 regular maintenance work.

1.4. Important information about the user's operation manual

The users/operation manual is an important part of this delivery. It will explain how to use this analyzer properly and sets forth safety and environmentally friendly procedures.

It is the responsibility of all users to read and familiarize themselves with this manual, paying particular attention to the safety instructions.

The most important safety details are clearly marked with an attention sign.

1.5. Safety Information

The following safety procedures must be followed at all times. They are significant and essential part of this manual. Failure to follow safety procedures can result in the loss of your warranty claims.

Biogas or other similar gases (landfill gas, bio-methane, coal seam gas etc) is containing flammable gas component **CH₄** and toxic gas component as well (**H₂S** and **CO₂**).

Analyzers is continuously sampling a certain volume (approx 50l/h) of the sample gas, and is venting it to ambient air.

For this reason, there are two aspects which must be considered:

Toxicity danger of sample gas



▲ WARNING

Toxic gas

Sample gas can contain toxic substances, which are harmful for health and can even cause death.

- It is the responsibility of analyzer user to ensure that person is skilled and trained in safety aspects of gases being analyzed and procedures to follow while using this instrument.
- Local regulations for possible exposition to toxic gases have to be known and obeyed by the user of the analyzer
- Using a personal gas detector inside the biogas plant is highly recommended since **H₂S** in higher (very dangerous) concentration cannot be detected by human nose. Only small concentrations around few ppm can be detected by human nose
- **CO₂** gas is heavier than air and therefore operator shall avoid working at underground levels. Beside of that **CO₂** is also odorless!
- It is not allowed using the biogas analyzer in confined space or rooms without forced ventilation.
- Sample gas exiting the analyzer will flow in the ambient air and only outdoor use or forced ventilation rooms are suitable for using the biogas analyzer.

Flammable gas



▲ WARNING

Flammable gas

Biogas contains Methan (CH₄), which can be flammable.

Regarding flammable gases (e.g. CH_4 methane) and hazardous area of operating the instruments, user must also be able to recognize the area classification and be aware of using the instrument there. This area classification is country specific, please observe and notice it.

- Stationary analyzers are allowed to be mounted in hazardous area zone 2 only if they have the certificate of compliance. These instruments shall never be located in confined places or rooms without forced ventilation.

Only trained personnel should carry out installation of stationary instrument and/or maintenance, service and repair. Opening the stationary analyzer cabinet can expose personnel to injuries and shocks from mains voltage!

Safety regulations

The analyzer may only be used as indicated in this manual. Our analyzers are checked according to the following regulations:

VDE 0411 (EN61010) and DIN VDE 0701 before they leave the MRU GmbH factory.

MRU technical products are designed and manufactured according to DIN 31000/ VDE 1000 and UVV = VBG 4 of the professional guilds for fine mechanics and electrical engineering.

MRU GmbH assures that the analyzer complies to the essential requirements of the legal regulations of the member states of the electro-magnetic compatibility (89/336/EWG) and to the low-voltage regulations (3/23/EWG).

Specific safety regulations

No part of the analyzer, or any other metal parts & accessories shall be used as electric conductors.

The analyzer shall not be used in or under water.

The analyzer shall not be placed near or directly exposed to open fire or heat.

The analyzer shall avoid dropping.

▲ WARNING



Acid substances

Moisture or condensate, being pumped out of the condensate outlet port can be slightly acidic.

- In case of skin contact IMMEDIATELY: clean affected parts of the body.
- Avoid getting liquid in eyes.

Please carefully clean all parts that come into contact with the condensate.

1.6. Packing

Packing regulation of 12.07.1991

If your local waste facility does not accept MRU packing materials for disposal, you may return it to MRU or our local sales representative. Packing materials returned to MRU must be returned prepaid.

1.7. Return of hazardous waste

Waste Disposal>Returns/Warranty -

MRU GmbH is required to accept the return of hazardous waste such as electro-chemical sensors that cannot be disposed of locally. Hazardous waste must be returned to MRU prepaid.

1.8. Return of analyzer

MRU GmbH is required to accept the return, for proper disposal, of all analyzers delivered after 13th of August 2005. Analyzers must be returned to MRU prepaid.

1.9. MRU guarantee conditions

MRU granted of the analyzer SWG100 BIOGAS a guarantee of 12 month.

1. 6 month on MRU spare parts.
2. The term of the guarantee conditions starts as of the invoice date.
3. Excluded from the guarantee conditions are damages, which occurred by:
 - Improper use.
 - Improper application.
 - Improper mounting.
 - Deliberate or negligent destructions.
 - External influence for example fall, hits, solvents, acids, gases, by normal wear or transport damages. This applies also for defects, which are caused from high pollution and/or moisture (condensate) in the gas route or on the sensors.
4. As well excluded from the guarantee conditions are typical consumable- and spare parts.
5. The guarantee condition denatured immediately, if no original consumable parts are installed. The guarantee is only for original MRU consumable parts and sensors.
6. With the replacement of the type plate or the serial- number of the devices all guarantee conditions will be invalid.
7. The service of a guarantee conditions will not enlarge the guarantee time. Demands because of consequential damages are excluded.
8. The transport costs for round trip takes the consignor or the warrantee.
9. MRU reserves the right, to determine individual conditions or exceptions. These will be separated informed.

MRU GmbH

01.09.2014

2. Analyzer Description

1.10. Intended use

The instrument is intended for analyzing the composition of biogases / landfill gases and determine the concentration of several components like CH₄, CO₂, O₂ and H₂S. The instrument may optionally be equipped to monitor several sites in time sharing technique (cyclical one by one sampling).

In particular, the instrument is not foreseen to serve as a gas detector or safety device.

1.11. Possible applications and analyzer options

The biogas analyzer SWG100 is the industrial measuring solution to be used with:

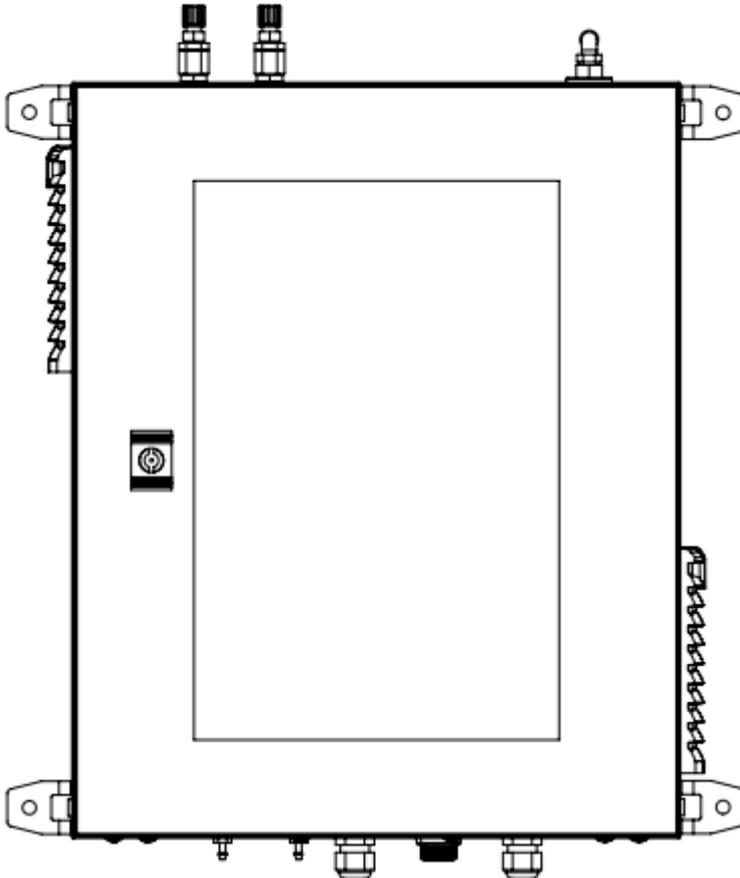
- biogas (anaerobic digestion) plants
- cogeneration heat and power engines (CHP)
- municipal or industrial waste water treatment sites
- coal seam gas sites (coal bed methane)
- food and animal waste processing plants
- biomethane (gas to grid) plants
- landfill sites.

This analyzer can be equipped with additional options and/or additional accessories to full fill multiple other measuring tasks such as

- CH₄ and CO₂ NDIR measurement
- O₂ measurement with long-life EC cell
- H₂S measurement with EC cell
- Multiple sampling point switchover from 1x up to maximum 2x sites
- Module with 4 channel analog outputs/inputs 4-20mA, with 2x "fail safe" alarm relays
- Converter module of RS485 into Profibus
- Cabinet heater for freeze protection

Ask our sales representatives for available options and accessories or check out our MRU website.

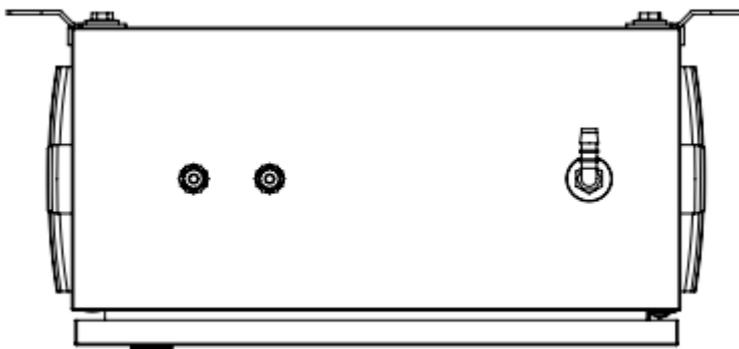
1.12. Outside view of analyzer



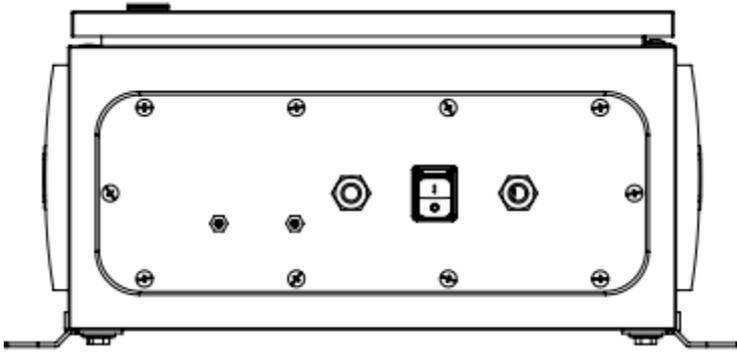
Reference

1	Display (color, with backlight)
2	Keypad
3	Cabinet lock

Top side

**Reference:**

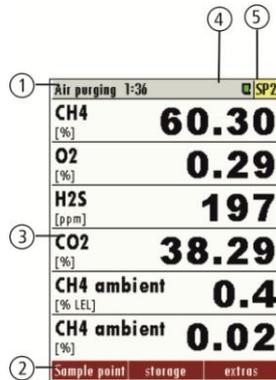
1. Vent outlet port, female 1/4in thread.
2. Sample gas inlet 1 female 1/8in thread.
3. Sample gas inlet 2 female 1/8in thread (optional). Maximum are 3 sample gas inlets.

Bottom side**Reference:**

1. Cal./Zero gas inlet port for .
2. Condensate outlet port.
3. Inlet cable gland M16 for power supply.
4. Inlet cable gland M16 for I/O module.
5. Cabinet ventilation fan.

1.13. Display and keypad

All information required to operate the analyzer is displayed as shown below.



1	Menu indication bar – “air purging” or – “gas sampling” or – “measurement”
2	Function key bar – F1 “sample point” – F2 “storage” – F3 “extras”
3	Display area of - Menu - Measurement value,...
4	SD-Card symbol - Indication green → read- and write access - Indication yellow → only read access (SD-Card write protected)
5	Sample point number

	Prepare Power-Down: Press this key before you disconnect mains. The analyzer will store changed user settings and other operational data and will purge the sensors
	Function Keys : Activates the functions seen on the display (2 function key bar)
	Menu key: Will show all available functions in the window that is currently in use – also those which have an individual key on the key pad like the printer and the three function keys.
	ESC : abort or return to the menu above
	Arrow keys: context dependent functions, e.g. scroll in between lines, change values, change view, ...
	OK : confirmation key, select a marked menu point
	Screen shot : press this key in order to store a screen shot of the current display contents onto the SD card

1.14. Measurement menu

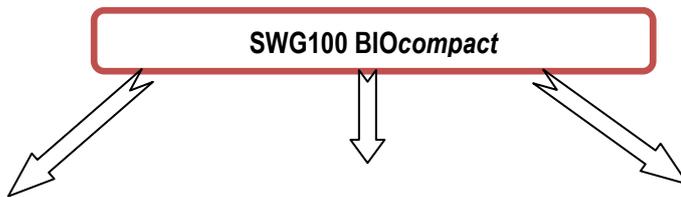
The measurement menu is the main root of the menus. Here you can see the current measurement values, the current sampling point number and the status of the zeroing process while it's active. Via pressing the function keys F1-F2-F3 you can reach other menus:

- F1: Menu Sample Point Switching
- F2: Menu Storage
- F3: Menu Extras

Menu Memory
Menu Extras

all tasks for the management of the data memory available.

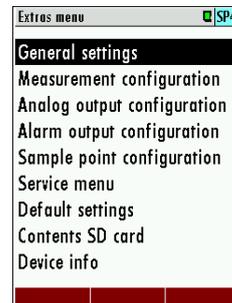
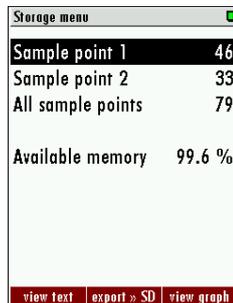
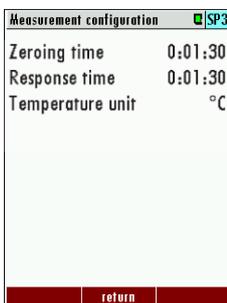
all the other available tasks – for management and customizing your analyzer.



Please read chapter 5 for details.

Please read chapter 5 for details.

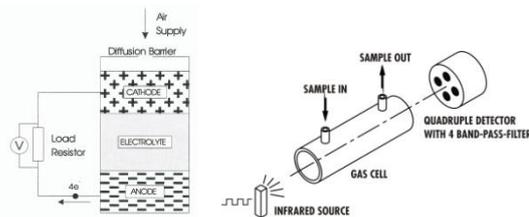
Please read chapter 5 for details.



No matter which menu is currently active you will return to the measurement menu by pressing the ESC key several times.

1.15. Principle of operation

- Sample gas from one or more sampling points is fed into the analyzer by dedicated ports. Internally mounted electric valves select one point at a time to feed sample gas to the analysis unit.
- The instrument is equipped with a non-dispersive infrared (NDIR) bench for analysis of CO₂ and CH₄. Two separate infrared detectors for each CO₂ and CH₄ are included, each operating with a different optical path length and stabilized by referring to a reference detector. The IR source is a highly efficient and stable IR emitter, pulsed at a frequency of several Hertz. By design NDIR technique offers good stability and selectivity together with long life time of sensor (only limited by corrosion or dust, which can be prevented or removed by regular servicing the instrument).
- The instrument is optionally equipped with a number of electro-chemical sensors ECS in order to detect gas components like oxygen O₂ or H₂S. Those sensor offer a reliable and effective way to detect the target gases. They are typically of limited life time (several years) but may be easily replaced once the end-of-life is reached.
- In regular time intervals the instrument automatically switches to purge the sensors with fresh (ambient) air for re-adjust the zero point.



1.16. Changing the Stand- By time of the sample gas pump

The **SWG100 BIOcompact** can have a maximum of 3 sample gas points. To preserve the sample gas pump, the analyser has a stand- by time, starting after a measurement cycle. In the menu **sample point configuration** the different times of the entire measurement cycle are given. The menu can be found on the path **EXTRAS / SAMPLE POINT CONFIGURATION**. This stand- by time has a minimal relation of 80% to 20%. That means that the gas sample pump is maximal 20% of the total cycle time in operation the other 80% of the total cycle time in Stand-By time.

For example: SWG100 BIOcompact with 1 sample point

Zeroing time:	5:00 min.
Sample point 1:	11:00 min.
Purging time:	5:00 min.

Sample point configuration	
Zeroing time	5:00
Sample point 1	0:11:00
Purging time	5:00
Stand-By time	1:24:00
Total cycle duration	1:45:00

details auto-config

Running time of sample gas pump 21:00 min.

This result a total time of 21 minutes where the gas sample pump runs. The 21 minutes are 20 % of the entire time. The stand-By time is minimal 80%. This result a Stand-By time of 84 min or 1:24:00. The total cycle duration is 105 min. or 1 h 45 min.

The user is able to change the Stand-By time with the right arrow key. The steps to extend the Total cycle duration are 30 min.

In the example above means this that the first extend is from 1 h 45 min. to 2:00 h. The next extend is 2 h 30 min. and so on. The maximal Total cycle duration is 24:00:00.

1.17. Manually zeroing and switching sample points

For the manually zeroing and switching the sample points please use the F1-key of the measuring menu.

1.18. Cabinet ventilation

As soon as the analyzer is powered up the cabinet is permanently ventilated by means of the integrated fan. This will prevent any explosive atmosphere inside the analyzer in case of inside leakages. The fan is monitored and the analyzer will not operate when the flow speed falls below a certain threshold (system alarm is triggered).

1.19. Sample gas flow

The analyzer supports multiple sample points to be monitored. Those points may differ in the pressure range inside the gas pipe by several hPa. In order to establish a constant sample gas flow over all sites, the analyzer's gas pump is regulated. In it's initial state the analyzer supports a pressure range as given in the technical data sheet. For pressurized site the flow restrictor orifice (# 65114) must be screwed in the female 1/8in thread.

2. Analyzer mounting and installation

2.1. Content of your order

Your analyzer is delivered in a carton box and is protected with special edged protectors. Please do preserve the packing of your analyzer, for possible back shipment.

2.2. Correct mounting of the SWG-100 BIOGAS

The analyzer can be mounted indoor or outdoor. The device is designed for the mounting on wall or on steel rack. The follow sketch shows the dimensions, which the analyzer needs for the correct mounting.

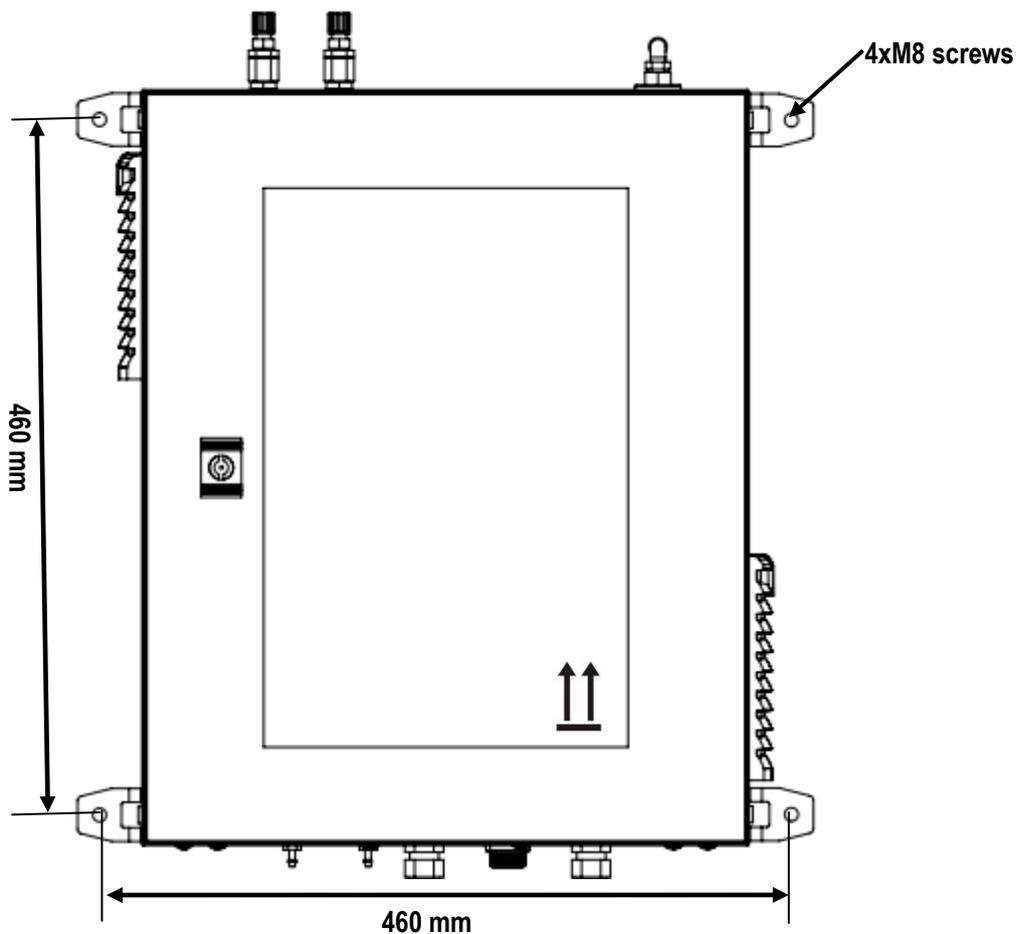


⚠ WARNING

Operation of the analyzer

Only operate the analyzer in an upright position.

Only power the device up after it is correctly mounted.



General installation rules

- Mount the device on a solid wall or steel rack.
- Be sure, that the air circulation is not obstructed.
- Let enough room for the tubing or piping.

For outdoor installation

Ensure that the analyzer is mounted on a rain and sun protected place (weather shade).

For indoor installation:

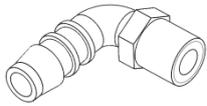
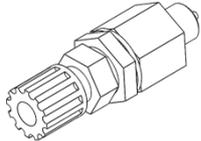
Ensure that the analyzer is installed on a dry and clean place. Be sure that the room is permanently vented with fresh air (forced ventilation).

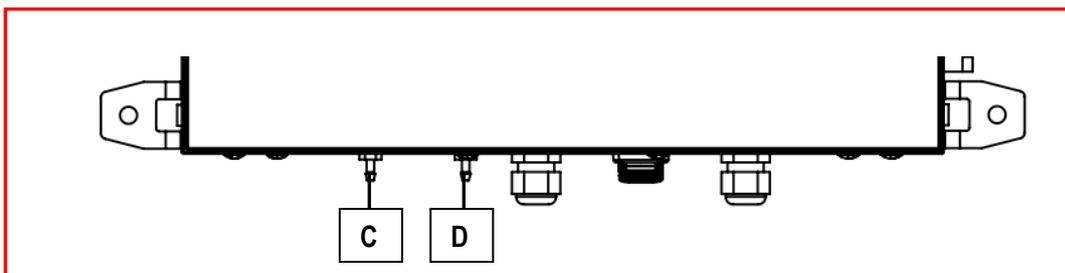
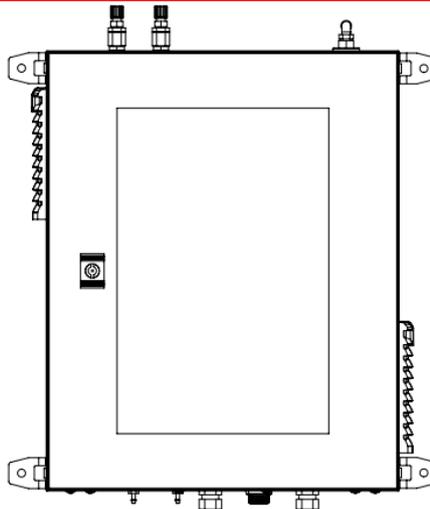
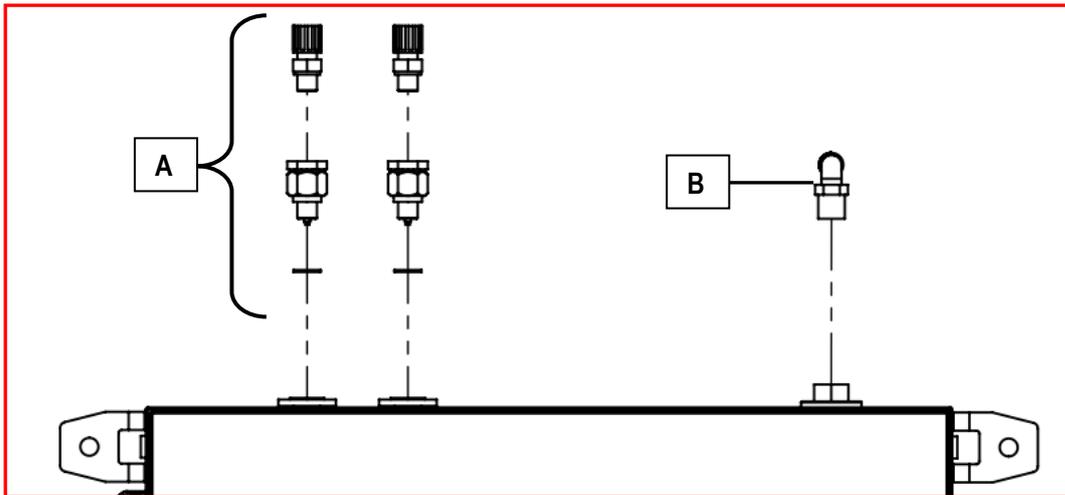
Connect the VENT gas-outlet of the device to ambient by using adequate tube with min Ø8mm ID.



2.3. Flexible tube connectors

The analyzer has the follow flexible tube connectors, which must be correct mounted at the analyzer.

	Beschreibung	Position
	1/4 G outer thread 90°	Sample gas outlet (VENT) (5)
	1/8 G outer thread / DN 4/6mm	Calibration gas inlet (2)



Reference:

- A. Sample gas inlet with integrated narrow passage for PTFE DN6/4mm (compression fitting).
- B. Sample gas outlet (VENT) 90° angled R1/4. Plug in-nipple for flexible silicon tube (inner diameter: 10 mm).
- C. Condensate outlet: Plug in-nipple for DN6/4 flexible tube.
- D. Zero gas inlet: Plug in-nipple for DN6/4 flexible tube.

2.4. Connection of main power supply



⚠ WARNING

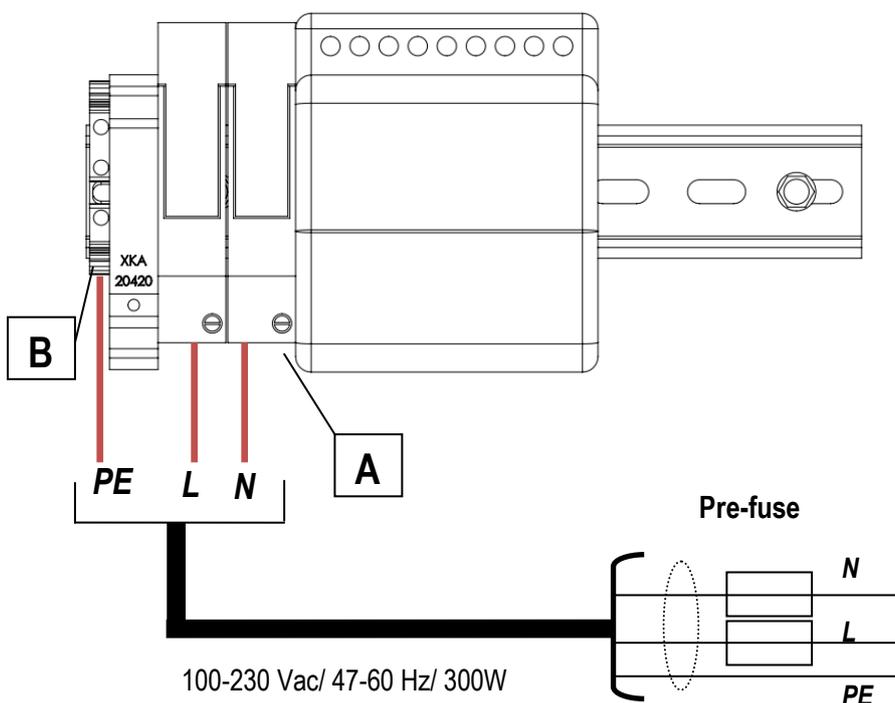
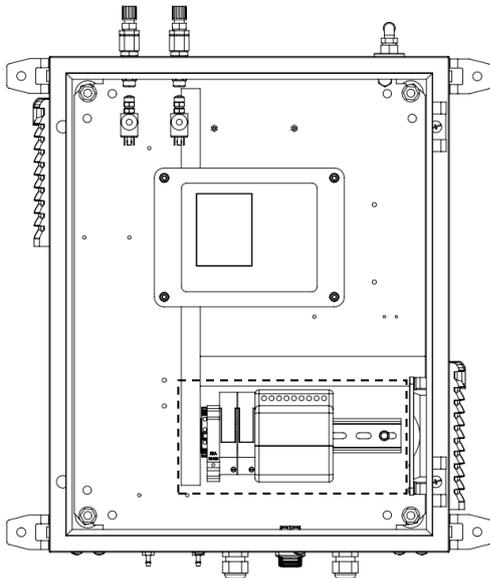
Electric voltage

Power the system down and protect for reconnecting, before start maintenance work.

The analyser needs a main power supply of 100-230 VAC/ 47-60 Hz.
The power supply may be found on the hat-rail.

Exactly:

- L and N phase on the circuit breaker (see A in sketch below).
- PE on the connection terminal (see B in sketch below).



2.5. I/O modules: Installation and setting

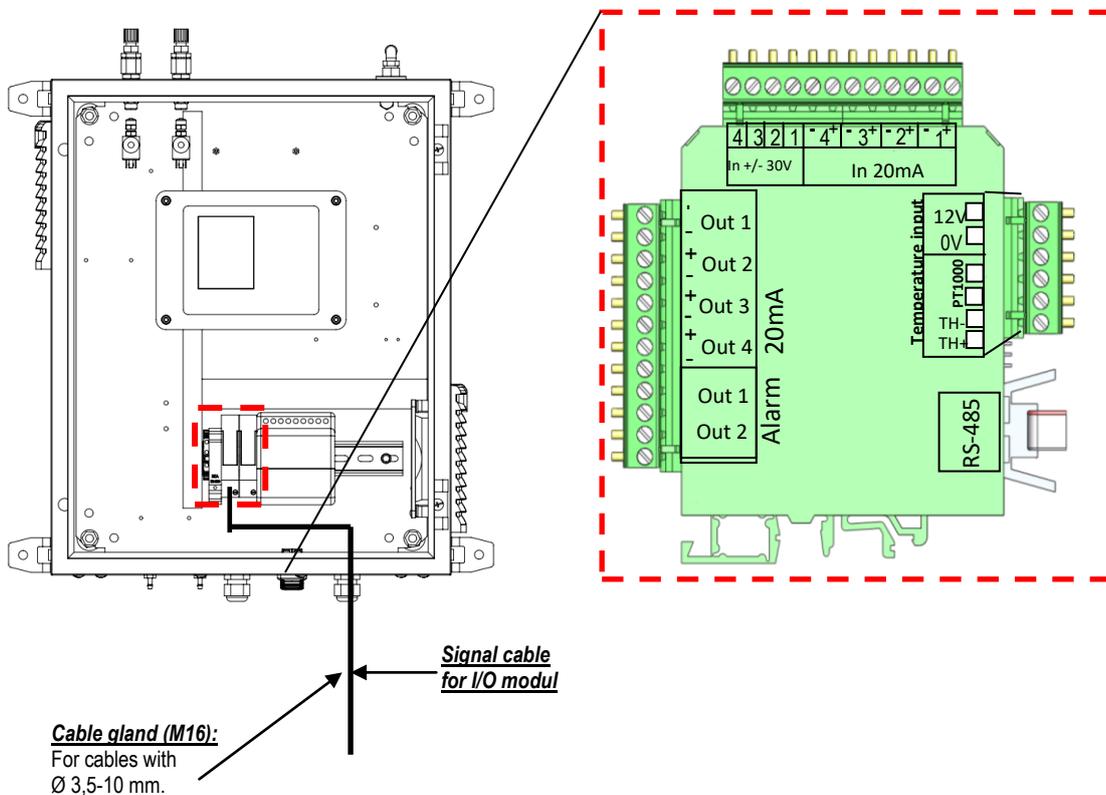
The IO module is for monitors and operates the analyser from remote. An IO module has the following features:

- Transmit 4-20 mA output.
- Trigger alarm outputs.
- Reads one PT1000.
- Reads one thermo couple.
- Reads current inputs signals (for sensors with max. 20 mA output signals).
- Reads voltage input signals (for sensors with max. 30 V output signals).
- External control of the analyser.

Important: One IO module is only able to give signals from one sample point out. This means, that every sample point needs it own IO module, if the measurement values from the sample points should be transmitted.

Connection of the I/O module

The option IO module can be found at the hat-rail. The position is shown at the sketch below.



NOTE: analog output current 4-20mA load resistor is max. 500Ohm
analog output does not require power supply

alarm relays Out1 and Out2 contacts are "fail safe" type:

- open contact in case of alarm or power failure
- closed contact for normal operation

Plug connector definition:
⚠ WARNING
Electric voltage

Power the system down and protect for reconnecting, before start maintenance work.

Slit screws

Stripping length: 7 mm

Tightening torque min.-max.: 0,5-0,6 Nm

Conductor cross sections, which can be used:

Type of electric line	Conductor cross section min.-max.
Solid	0,2-2,5 mm ² (30-12 AWG)
Stranded	0,2-2,5 mm ² (30-12 AWG)
Solid with ferrule (with/ or without plastic)	0,25-2,5 mm ²

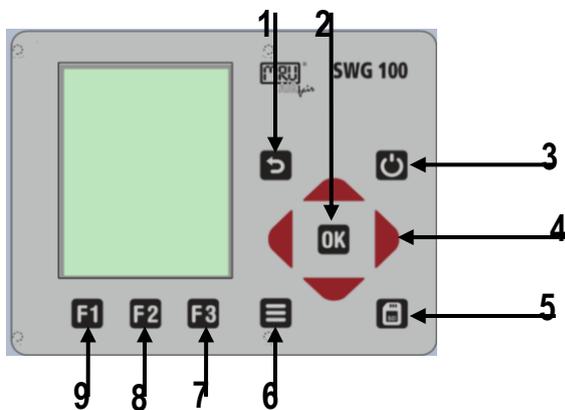
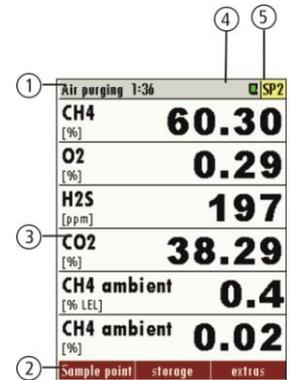
Information for cables, which go through the cable gland M16:

It is recommended to use only electric lines with ferrules.

3. Operation of the analyzer (HMI)

All information required to operate the analyzer is displayed as shown below.

1	Menu indication bar - "air purging" or - "gas sampling" or - "measurement"
2	Function key bar - F1 "sample point" - F2 "storage" - F3 "extras"
3	Display area of - Menu - Measurement value,...
4	SD-Card symbol - Indication green → read- and write access - Indication yellow → only read access (SD-Card write protected)
5	Sample point number



#	Symbol	Description
1		ESC : abort or return to the menu above
2		Prepare Power-Down : Press this key before you disconnect mains. The analyzer will store changed user settings and other operational data and will purge the sensors
3		Arrow keys : context dependent functions, e.g. scroll in between lines, change values, change view.
4		OK : confirmation key, select a marked menu point.
5		Screen shot : press this key in order to store a screen shot of the current display contents onto the SD card.
6		Menu key : Will show all available functions in the window that is currently in use – also those which have an individual key on the key pad like the printer and the three function keys.
7-9		Function Keys : Activates the functions seen on the display (2 function key bar)

4. Manual: Analyzer commissioning

After installation and power-up of the analyzer few steps should be processed in order to operate the instrument properly.

- Check the country and language.
- Check the date and time of the instrument.
- Configuration of the alarm relays.
- Configuration of the Modbus.
- Configuration of the external control via relay contacts (I/O module).
- Configuration of the analog outputs at the I/O module.
- Configuration of the AUX inputs at the I/O module.
- Configuration of the alarm outputs at the I/O module.
- Configuration of the auto calibration.

4.1. Check country and language

Important note:

In case the analyzer shows a language you don't understand, you may swap the language to English by pressing the menu key and selecting the function 'Set English language'.

Use the menu `EXTRAS – GENERAL SETTINGS`.

The analyzer will automatically set some country-typical things like the language, the date format, the temperature unit, the daylight saving time function and the CSV-export settings.

4.2. Check date and time of the instrument

The analyzer stores automatically measurement values including timestamps. Therefore the instruments' system clock should be set correctly.

Use the menu `EXTRAS – GENERAL SETTINGS – DATE & TIME`.

In case the date & time is not correct, press the key F2=modify, change date & time and then press the key F2=store.

Note:

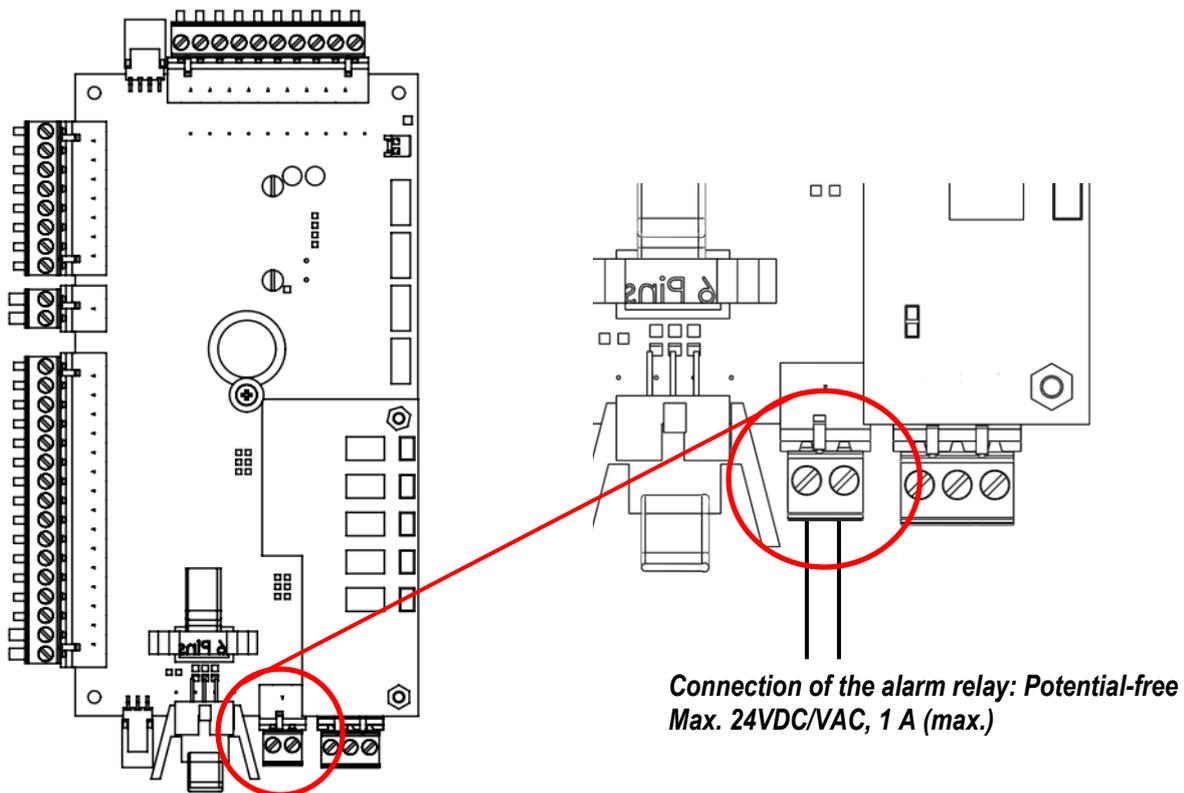
According to the selected country (see previous chapter) the analyzer automatically switch the daylight saving time in spring and autumn. This function is active for most European countries. Whenever the daylight saving time is currently active, then you'll see a '*' in the time line of the menu, thus 'Time *' instead of 'Time'.

4.3. Configuration of the alarm relays

On the main PCB there is one “system alarm” relay with “fail safe” NO contact which will trigger in following conditions:

NOTE:

- Analyzer system alarm relay is a potential-free contact, which max. 24VDC/VAC and a current of 1 A (max.).



Plug connector definition for the system alarm relay

Slit screws

Stripping length: 7 mm

Tightening torque min.-max.: 0,5-0,6 Nm

Conductor cross sections, which can be used:

Type of electric line	Conductor cross section min.-max.
Solid	0,2-2,5 mm ² (30-12 AWG)
Stranded	0,2-2,5 mm ² (30-12 AWG)
Solid with ferrule (with/ or without plastic)	0,25-2,5 mm ²

Information for cables, which go through the cable gland M16:

It is recommended to use only electric lines with ferrules.

Following analyzer errors will produce a system alarm (open contact of System Alarm relay)

1. Main board is offline (internal RS485 bus communication failure)
2. Main board is in the "bootloader" phase
3. Gas leakage inside analyzer cabinet (CH4 > 20% to 50% LEL)
4. Condensate alarm (contacts resistance < 35kΩ)
5. Low fan rotation (speed rotation < 900U/min)
6. Sample flow alarm (sample flow < 20 l/hr)
7. Gas cooler high alarm (temperature > +10°C)
8. Gas cooler low alarm (temperature < +2°C)
9. Cabinet high temperature (> +55°C)
10. Cabinet low temperature (< +5°C)

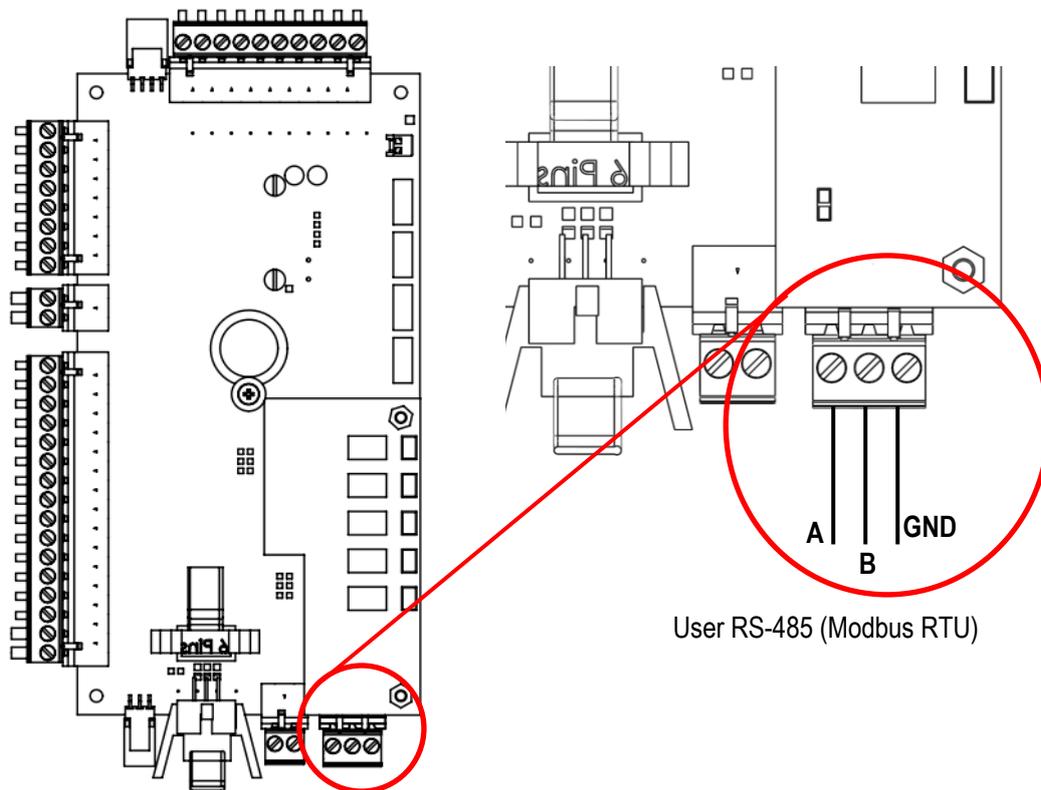
Errors **1 to 5** alarm will force a measurement stop (all analog outputs are on hold or at 2mA, depending on configuration).

Errors **5 to 10** will be displayed as warning message only; analog outputs of active sampling point are live, all others are on hold.

4.4. Configuration of the Modbus

The Modbus connector can be found on the PCB-mainboard (see sketch below).

NOTE: for specification of Modbus (RTU) data transfer over RS485, please observe appendix.



Plug connector definition for the system alarm relay

Slit screws
 Stripping length: 7 mm
 Tightening torque min.-max.: 0,5-0,6 Nm

Conductor cross sections, which can be used:

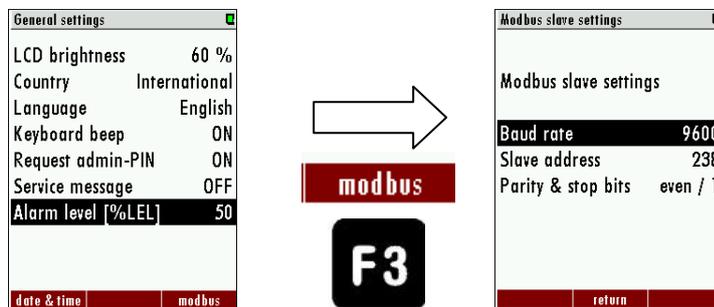
Type of electric line	Conductor cross section min.-max.
Solid	0,2-2,5 mm ² (30-12 AWG)
Stranded	0,2-2,5 mm ² (30-12 AWG)
Solid with ferrule (with/ or without plastic)	0,25-2,5 mm ²

Information for cables, which go through the cable gland M16:

It is recommended to use only electric lines with ferrules.

Configuration at the analyzer

1. Open the path EXTRAS/ GENERAL SETTINGS.
2. Press F3 "Modbus".
3. The Modbus store settings will be open. The user can commission the slaves settings.



4.5. Configuration of the external control (Option: IO module)

This feature requires an I/O module (optional) and the function must be activated.

This feature can be used for the external control of the analyzer. With the help of the external control follow operations can be done:

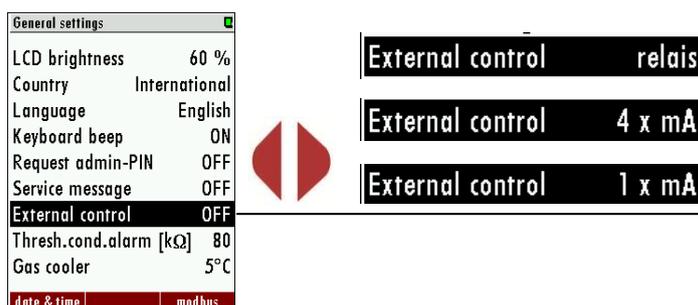
- Externally controlled sampling point selection,
- Stand-by.

The commands will be given by a 4-bit binary number, which will be built through four external signals. The pins for the signal are shown in the sketch below. It exists two different types to set the four pins:

- Potential free relay contacts.
- 4-20 mA signal inputs.
- Through one 4...20mA input.

The settings-menu can be found at the path: EXTRAS/GENERAL SETTINGS-> EXTERNAL CONTROL.

The user can set three different types for the external control. The types can be found at the sketch below.

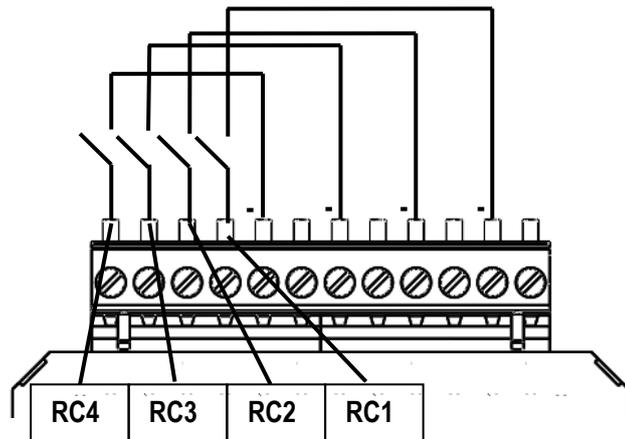


Connection of the external control via relay contact

This feature can be used for externally controlled sampling point selection, zeroing and stand-by, using external potential free relay contacts, see also diagram in §4.4

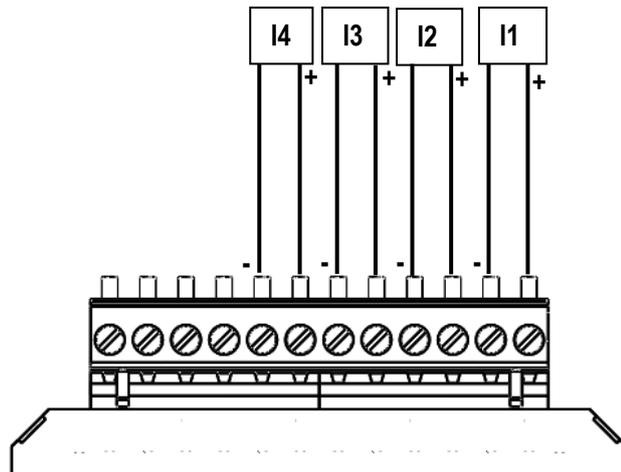
The relay contacts build a 4-bit binary number: **RC4 - RC3 - RC2 - RC1** open=0, closed=1.
Let us tell this number 'status number'.

General settings	
LCD brightness	60 %
Country	Deutschland
Language	English
Keyboard beep	ON
Request admin-PIN	OFF
Service message	OFF
External control	relais
Thresh.cond.alarm [kΩ]	80



Connection of the external control via 4-20 mA input signals

General settings	
LCD brightness	60 %
Country	International
Language	English
Keyboard beep	ON
Request admin-PIN	OFF
Service message	OFF
External control	4 x mA
Thresh.cond.alarm [kΩ]	80
Gas cooler	5°C



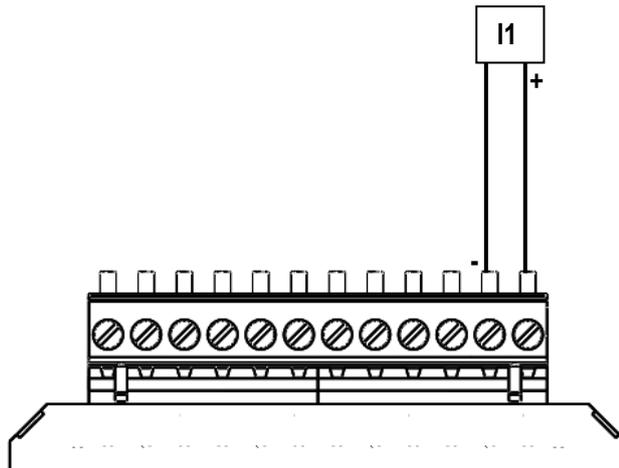
The signal inputs built a 4-bit binary number: **I4 – I3 – I2 – I1**: 0-11 mA=open=0; 11/12-20 mA=closed=1.

Connection of the external control via one 4-20 mA input signal

The user has the opportunity to control the analyzer with only the first 4-20mA input (see sketch below). The different commands will be given by the changing of the current signal. The offset-signal is 4 mA. Every 1 mA step describes a condition of for the external control. Overall the analyzer can take 16 different statuses. The first status is by 5 mA (4 mA+1 mA) the second is by 6 mA (4 mA + 2 mA) and so on until the 20 mA signal is reached.

General settings	
LCD brightness	60 %
Country	International
Language	English
Keyboard beep	ON
Request admin-PIN	OFF
Service message	OFF
External control	1 x mA
Thresh.cond.alarm [kΩ]	80
Gas cooler	5°C

date & time ext.ctl. modbus



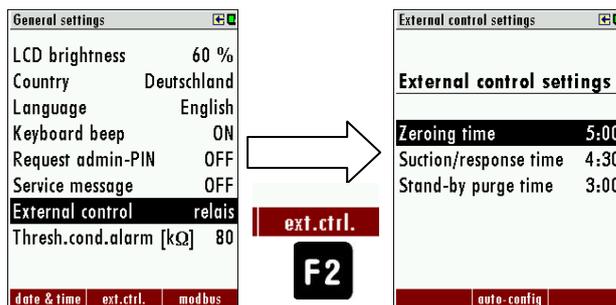
The connection of the one 4-20 mA signal is a two-wire connection.

Configuration at the analyzer

1. Open the path: EXTRAS/GENERAL SETTINGS.
2. Switch the menu-point “External control” from “OFF” to “Relais”/“4x mA” or “1 x mA” (dependent from the connected signal input.). When the external control is activated an arrow symbol will appear at the title line.



3. If a valid input state (>0) is present, an arrow in the title line will appear. The analyzer is now slave and will perform the measurement until it gets another command from the master unit. Some external control settings can be configured. This can be found at the path: EXTRA/GENERAL SETTINGS then **F2**= ext.ctrl. The user has the opportunity to set the zeroing time, suction/response time and stand-by purge time.



Case 1: Stand-by

The Stand-by modus will be activated if the input state is higher than the number of sample points (example: 4 sample points and input state 5...15). The Stand-by modus has the following pass:

- Purging with zero gas (for the configured duration)
- Standby until the input state is below or equal the number of sample points (e.g. 4 sample points and input state 1.4)

Stand-by - purging 2:23	
O2 [%]	20.89
CO2 [%]	0.04
H2S [ppm]	0
CH4 [%]	0.00
CH4 internal [%]	0.00
CH4 internal [% LEL]	0.0

Stand-by	
O2 [%]	20.89
CO2 [%]	0.04
H2S [ppm]	0
CH4 [%]	0.00
CH4 internal [%]	0.00
CH4 internal [% LEL]	0.0

Case 2: External control of a sample point

-Zeroing: First the zeroing will be done. The duration of the zeropoint can be set at the menu ext. ctrl. (see point “**configured at the analyzer**” in the same chapter).

-Gas sampling: The gas sampling is for purging the entire system and give the analyzer enough time for response. (Response time). To set the suction/ response time, see point “**configured at the analyzer**” in the same chapter.

-Measurement: The measurement will be started after the response/ suction time is finished. It will be only abort, if the user changes the status of the external signal sources. The chart below shows the possible statues, which can be set at the analyzer:

Status of external signal source					Status number	Description
RC4/I4	RC3/I3	RC2/I2	RC1/I1	I [mA]	-	-
0	0	0	0	4	0	Automatic sampling point switching
0	0	0	1	5	1	Analyzer is sampling the point SP1 (*1, *2)
0	0	1	0	6	2	Analyzer is sampling the point SP2 (*1, *2)
0	0	1	1	7	3	Analyzer is sampling the point SP3 (*1, *2)
0	1	0	0	8	4	Analyzer is sampling the point SP3 (*1, *2)
0	1	0	1	9	5	Analyzer is sampling the point SP4 (*1, *2)
0	1	1	0	10	6	Analyzer is sampling the point SP5 (*1, *2)
0	1	1	1	11	7	Analyzer is sampling the point SP6 (*1, *2)
1	0	0	0	12	8	Analyzer is sampling the point SP7 (*1, *2)
1	0	0	1	13	9	Analyzer is sampling the point SP8 (*1, *2)
1	0	1	0	14	10	Analyzer is sampling the point SP9 (*1, *2)
1	0	1	1	15	11	Analyzer is sampling the point SP10 (*1, *2)
1	1	0	0	16	12	Analyzer is "stand-by" (*3)
1	1	0	1	17	13	Analyzer is "stand-by" (*3)
1	1	1	0	18	14	Analyzer is "stand-by" (*3)
1	1	1	1	19	15	Analyzer is "stand-by" (*3)

(*1): Whenever the selected sample point will be changed, then the analyzer will start a zeroing before measuring the new sample point.

(*2): Not only status numbers 4 to 15, but all status numbers larger than the number of installed sample points will start the "stand-by" (example: when you have 4 sample points, then status numbers 5 to 15 will trigger "stand-by").

(*3): When the status number changes to a "stand-by" number, then the analyzer will purge the sensors, then it will close all solenoid valves and switch off the gas pump. When the status number changes back to a value less or equal to the number of installed sample points, then a "set to zero" cycle will start and afterwards the selected sample point will be measured.

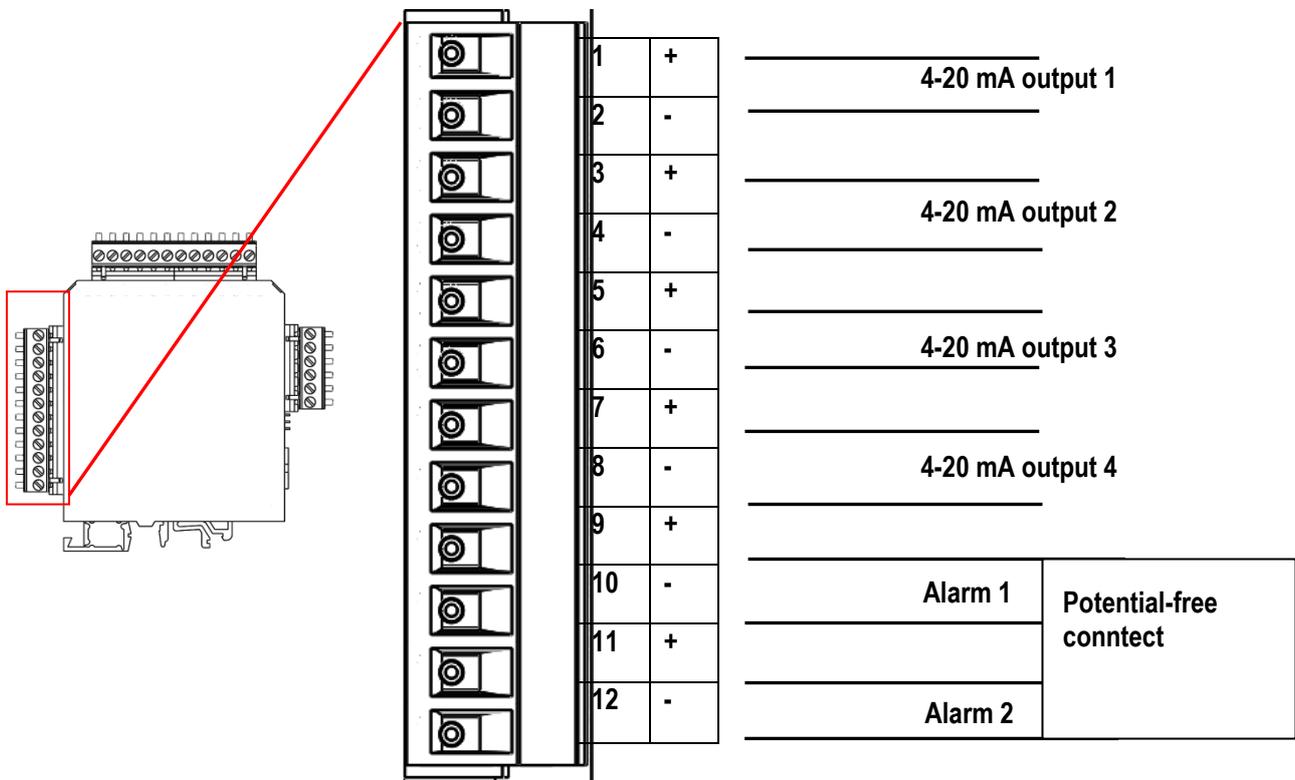
Note: The "stand-by" status can easily be used to initiate just a zeroing without any "stand-by" and without changing the sample point.

Example : - status number=1 (for any time period, recommended max. 1 hour)
 - status number=15 (for a few seconds, recommended min. 10 seconds)
 - status number=1 (for any time period, recommended max. 1 hour)

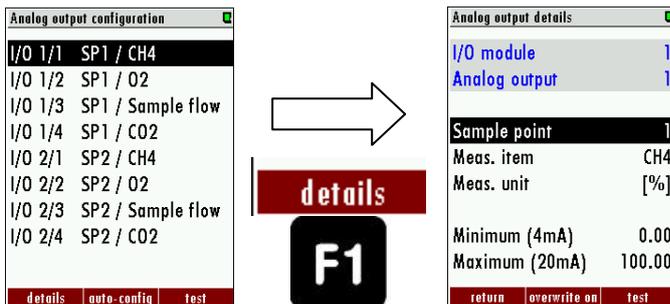
After installation and power-up of the analyzer few steps should be processed in order to operate the instrument properly.

4.6. Configuration of the analog outputs at the I/O module

Each I/O module provides 4 channel analog 4-20mA outputs, which are able to provide the measuring values via 8 wire cable to a remote PLC or DCS.



1. Use the menu EXTRAS – ANALOG OUTPUT CONFIGURATION.



2. At the menu the user can:
 - a. Select the sample point.
 - b. The measurement item.
 - c. The measurement unit.
 - d. The equivalent concentration for 4 mA and for 20 mA.

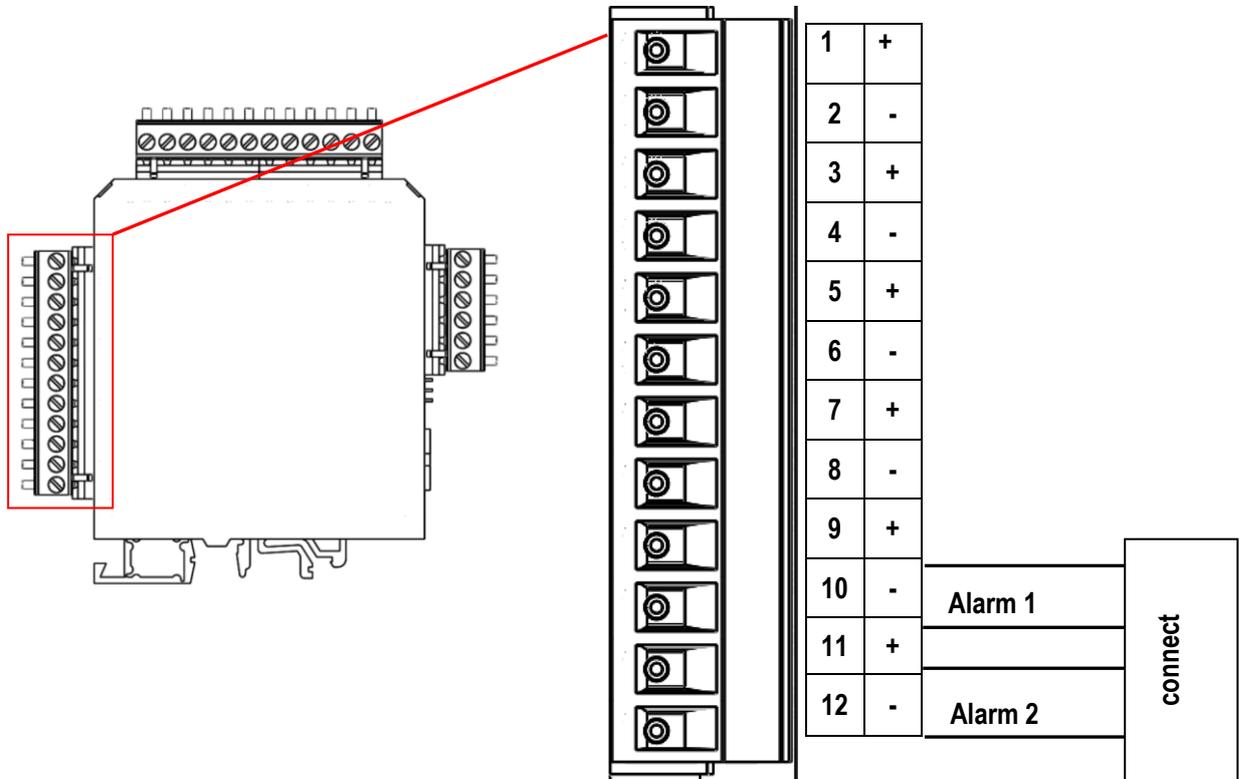
Assign measuring value and the min and max value to each analog output channel.

Note:

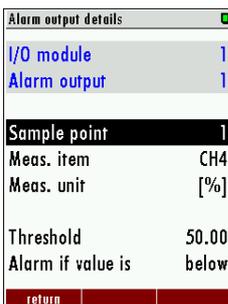
You may use the function 'auto-config', which will install typical settings. Then check the settings and modify them if needed.

4.7. Configure alarm output of I/O module

Each I/O module provides 2 alarm relay contacts (see previous page) normally open contacts (fail safe type) which will send alarm status via 4 wire cable to a remote PLC or DCS.



Use the menu **EXTRAS – ALARM OUTPUT CONFIGURATION**.

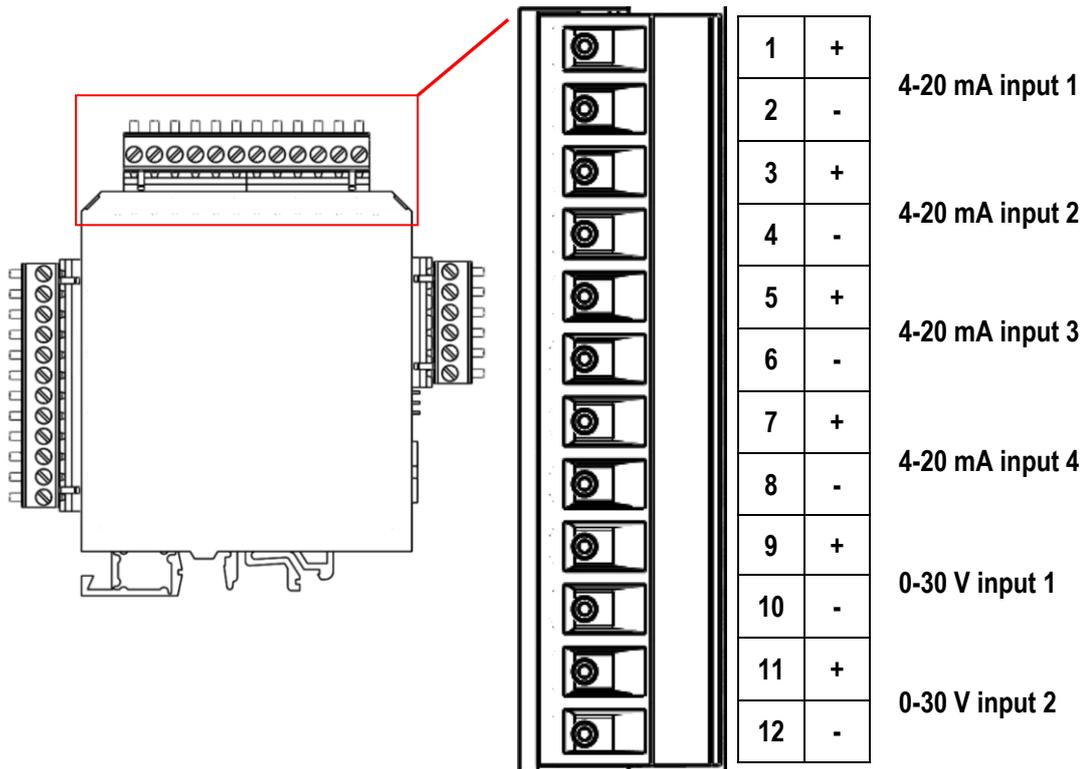


Assign sampling point, measuring value, threshold value and the alarm direction (LO alarm, hen below threshold or HIGH alarm when above threshold).

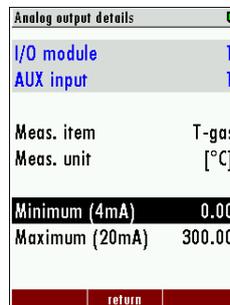
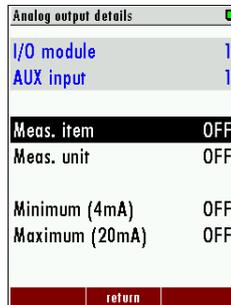
Note:

You may use the function 'auto-config', which will install typical settings. Then check the settings and modify them if needed.

4.8. Configure the AUX-input on software-side:



1. Open the menu point AUX input configuration which can be found under the path: EXTRAS/ AUX INPUT CONFIGURATION.



2. All possible inputs are listed in the following screen. Every IO module is able to read in four signals.
3. To configure an AUX input on the software side, select an AUX-input with the arrow keys and confirm it with **OK**.
4. The screen **AUX INPUT DETAILS** appears. In this menu the AUX-input can be given a name (Meas. item) and a unit (under Meas. unit) which can be selected with the arrow keys. The measurement item can be named by the user. To set the measurement unit rotates with the left/ right arrow keys.
5. Important for the AUX-inputs is the measurement range. The range is set with the two points "Minimum 4 mA" and "Maximum 20 mA".
6. Before the menu is left, a request to save the configuration will appear.

4.9. Cycle configuration

Path and default setting

EXTRA/ MEASUREMENT CYCLE CONFIG.

When the menu "MEASUREMENT CYCLE CONFIG." is selected the user definable setting for the measurement cycle will appear (see screenshot below).



Measurement cycle config. - 20:00	
Zeroing	5:00
Measurement SP1	5:00
Measurement SP2	5:00
Measurement SP3	5:00

Screenshot shows default setting, when the „MEASUREMENT CYCLE CONFIG.“ will be started the first time.

General information

The menu point "CYCLE CONFIGURATION" allows the user to configure an individual measurement cycle. Every installed sample point can be configured. For the configuration the user has the following phases, which can be selected:

- Zeroing.
- Purging.
- Stand-by.
- Measurement SPx (SPx stands for Sample point 1, 2...).

The configuration is performed with the three function keys **F1**, **F2** and **F3**.

- **F1:** Delete a phase.
- **F2:** Make an Auto-config.
- **F3:** Insert a new phase.
- **OK:** View/change phase details
- **Left/right:** Change the phase type.



NOTE

In a flexible tube, with a inner-diameter of 4 mm (DN4/6) the sample gas has a speed of 0,8 m/s. This parameter can be used to In der Leitung mit DN4/6 beträgt die Geschwindigkeit des Gases: $v=0,8$ m/s.

Auto configuration

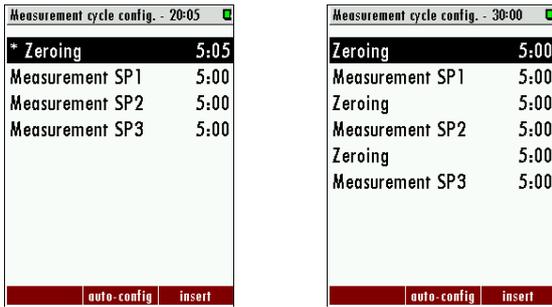
With **F2** the "Auto-config." can be selected. The user can select one of two default cycle configurations.

- One zeroing / cycle.
- One zeroing / sample point.

The first program is for applications where the different measurement points have almost the same gas concentrations. The zeroing is not necessary at every change of the measurement SPX.

The second program is for applications where the different measurement points have different gas concentrations. A zeroing is recommended after every measurement point change.

The screenshots below show the "One zeroing / cycle" and "One zeroing / sample point" in comparison.

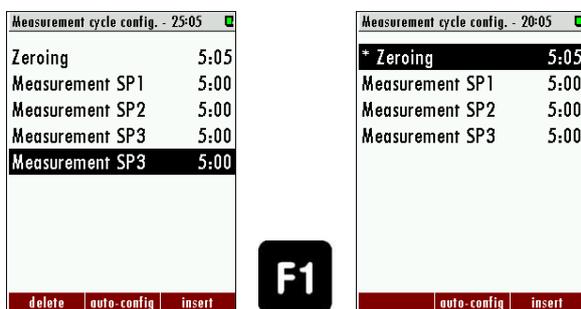


The two auto-configurations, which can be selected.

Depending on the analyser type, the first or the first and second phase cannot be deleted, deactivated or moved to another position.

Delete a phase

With **F1** a phase can be deleted. To do this, select the phase, which should be deleted and press **F1**.

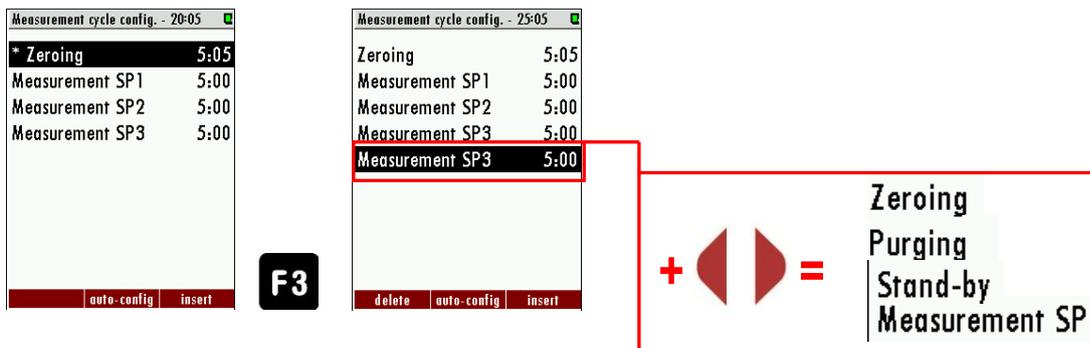


Screenshot shows how a phase can be deleted. In this example the last phase "Measurement SP3" is deleted.

Insert a phase

With **F3** a new phase is inserted in the measurement cycle. With the **right/left arrow keys** the different phase types can be selected.

In the title-bar the entire cycle time is shown. It is called "Measurement cycle config."
With **OK** the "Cycle phase details" can be shown and changed.



Configuration of the phase details

In this chapter the different cycle phase details will be explained.

Zeroing (Cycle phase details): In the cycle phase detail "ZEROING" the zeroing time can be configured.



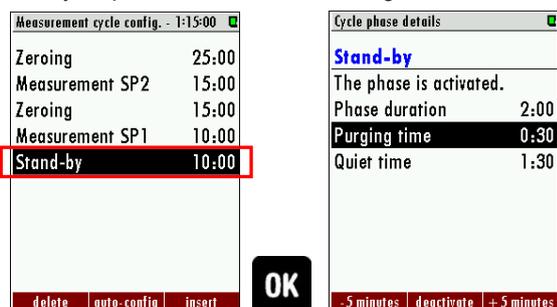
ZEROING	
Measuring site valves	Valves closed
Zeroing valve	Valve open
Duration	2min to 1 h
Recommendation	5min., in general not to be changed by user as depending only on analyzer internal setup

Measurement SPX (Cycle phase details): In the cycle phase details of “Sample point X” the measurement time and the suction delay can be configured. Each sample point can be configured individually. In the cycle phase details the following times can be set:



MEASUREMENT SPx	
Measuring site valves	Valve of selected site is open, others closed
Zeroing valve	Valve closed
Duration	Phase duration: 2 min. to 24 h Suction/response time: 30 sec. to 1h Pure measurement: calculated H2S-low: Activated/protect (Optional)

Stand-by (cycle phase details): In the cycle phase details “Stand-by” the sleep mode time can be configured. In the cycle phase details the following times can be set:



- **Phase duration:** Entire Stand-by time (Purging time + Quiet time = Phase time).
- **Purging time:** The time, to purge the analyser with ambient air, through the zero gas inlet.
- **Quiet time:** The time, where the analyser is in the pure stand-by mode.

STAND-BY	
Measuring site valves	Valves closed
Zeroing valve	Valve closed
Duration	Phase duration: 2 min to 24h Purging time: 30 sec. to 1h Quiet time: calculated

Purging (cycle phase details): The purging is a separate configuration point to purge the analyser with ambient air through the zero gas inlet. It can be helpful, if the analyser must switch between a sample point with different sample gas concentrations.



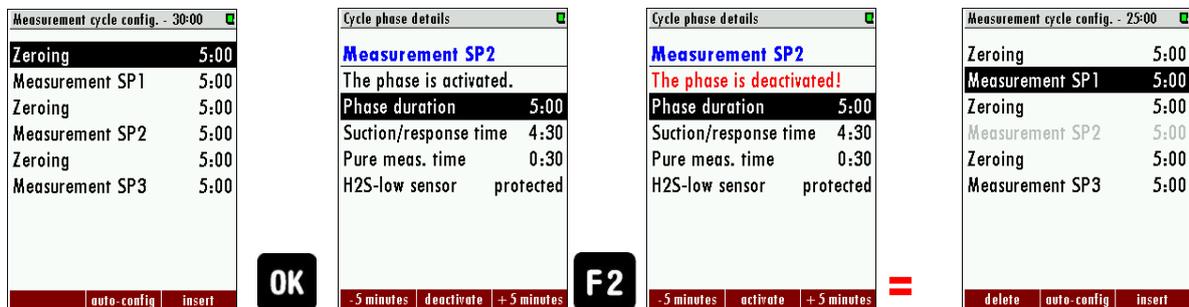
PURGING	
Measuring site valves	Valves closed
Zeroing valve	Valve open
Duration	30 sec. to 1 h

Activated/deactivated a phase

The user has the opportunity to deactivate a phase in the measurement configuration cycle. This could be necessary for example if a sample point is temporarily not in use. The activation and deactivation of a phase can be done in the cycle phase details of the concerning phase.

Example for the deactivation of a phase

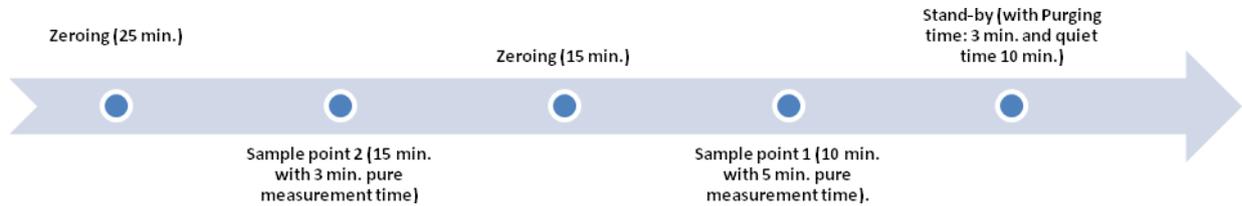
In this example the “Measurement SP2” will be deactivated. The deactivated phase is grey out.



Example for a measurement cycle configuration

In this chapter an individual measurement cycle should be created with the features described at the chapters below.

The measurement cycle should have the following sequence:



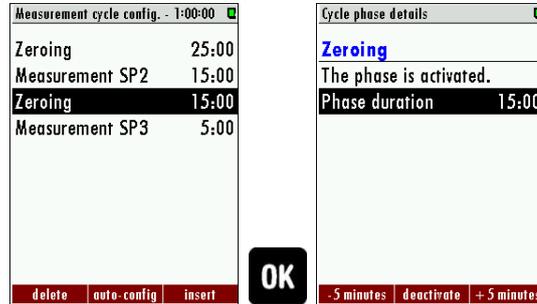
Following points must be done to configure the individual measurement cycle:

1. Open the measurement cycle config. menu: Path: EXTRA/ MEASUREMENT CYCLE CONFIG.
2. The default measurement cycle will appear. Open the cycle phase detail of the first zeroing and adjust the phase duration at 25 min.

3. Leave the cycle phase detail and select the second point. Switch with the **left/right arrow keys** until the measurement SP2 is selected.

4. Open with the **OK** key the cycle phase detail of the measurement SP2. Adjust the duration-phase at 15 min. and the suction/response time until the pure meas. time has the value of 3 min. Use for this operation the **arrow keys**.

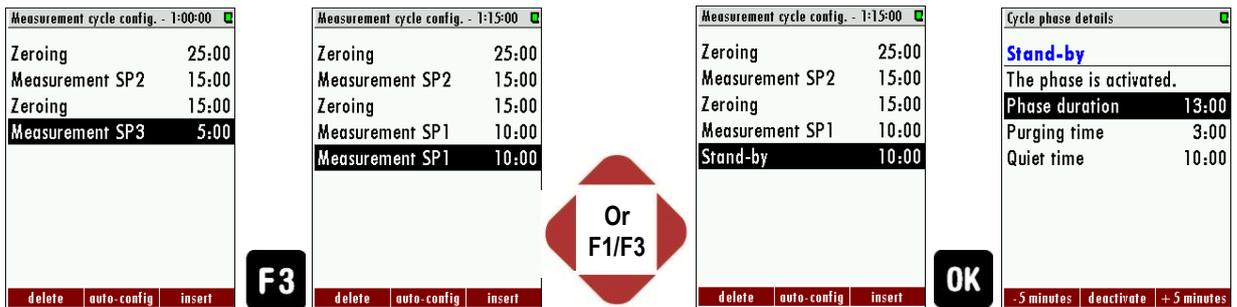
- Leave the cycle phase detail and select the next phase. Select with the **left/right arrow keys** the phase “zeroing” and go in the cycle phase detail. Adjust the phase-duration at 15 min. and leave the cycle phase detail.



- Switch to the next point and select with the **left/right arrow key** the measurement SP1. Go in the cycle phase detail of the measurement SP1. Here adjust the duration-phase 10 min. and the pure measurement time: 5 min.



- At last push **F3** key for insert a new phase and select with the left/right arrow key the “Stand-by” phase. Go into the cycle phase detail and adjust the Purging time at 3 min. and the Quiet-time at 10 min.



Leave the menu and safe the adjustments. The individual configuration is done.

5. Operating the analyzer

5.1. Administrator PIN code

All functions and menus which may disturb the analyzer's normal measurement can be protected against unauthorized access by activating the administrator PIN code request.

We highly recommend activating this function, when unauthorized persons could access the analyzer.

The PIN code is: **F1 - F1 - F3 - F2 - Up - Down**

The PIN code request can be activated and deactivated in the menu Extras/General settings:
The deactivation of the PIN code request requires at least one time PIN code input.

Once the user has input the correct administrator PIN code the analyzer will stay in administrator mode (password free) for 10min after last time key acting. Each key acting will trigger another 10min password free operation.

5.2. Power-On of analyzer

When the analyzer is connected with mains (Power-On) it will start the system boot process which usually takes very few seconds. Then the display will show the self-test menu.

5.3. Self-Test

The first menu to be displayed after Power-On is the self-test menu. The analyzer won't leave this menu before all sub-systems will be connected and the gas cooler (option) has reached the target operation temperature.

During the self-test phase

- the gas pump is switched off
- all analog outputs will deliver 2mA
- all alarm outputs will have alarm status (open contacts)

Usually the self-test will be left automatically as soon as all conditions for measurement are satisfied. Then the first zeroing will be started.

If one of the internal RS485 bus participants are issuing alarm (faulty) status, the user can still leave the self-test manually by pressing F2='forward' (PIN code requested), even if not all sub-systems or the gas cooler are ready.

NOTE: this is for service purpose only!

General settings	
LCD brightness	60 %
Keyboard brightness	30 %
Country	England
Language	English
Helping hints	ON
Keyboard beep	ON
Request admin-PIN	OFF
date & time	
modbus	

5.4. Main menu measurement

This menu is the root of all menus and will be shown automatically as soon as the self-test is finished. The title bar you can see on the left the current measurement cycle status and how long it lasts and the actual sampling point number. In the middle section of the actual measurement values are displayed.

Measurement 6:14		SP1
CH4 [%]	58.13	
O2 [%]	0.33	
H2S [ppm]	196	
CO2 [%]	40.46	
CH4 ambient [% LEL]	0.4	
CH4 ambient [%]	0.02	
Sample point	storage	extras

Representation during the status "measurement"

The title bar you can see on the left "measurement" and the remaining measurement duration, and the right **light blue highlighted** sampling point number SPx (x = 1 to 2) that is being measured. In the middle section of the menu, the current (live) values are displayed.

Representation outside the status of "measurement"

The title bar you can see on the left "air purging" or "gas sampling SPx" and the remaining duration of the current status. On the top right you can see the **yellow highlighted** sampling point number SPx previously measured or that you have selected for display and their measuring values are hold until it is measured again. In the middle section of the menu hold measured values of these measurement sites are displayed.

Air purging 4:42		SP2
CH4 [%]	60.52	
O2 [%]	0.26	
H2S [ppm]	197	
CO2 [%]	38.08	
CH4 ambient [% LEL]	0.4	
CH4 ambient [%]	0.02	
Sample point	storage	extras

Change the Display Zoom / Standard

Two display modes are available:

- standard view mode with 6 values per page, up to 4 pages (indicating up to 24 values)
- zoom view mode with 2 values per page, up to 6 pages (indicating up to 12 values)

The indication mode can be swapped with the menu key and the selection of zoom view or standard view.

For devices with just one measuring point the switching is additional possible with the arrow keys up / down.

Change the displayed page

Use the arrow keys left / right can be changed in both display modes the page. The new page number is displayed in the title bar for a moment just after the successful change.

Change sampling point displayed

For analyzers with several measuring points can used the arrow keys up / down the displayed (not measured) measuring point can be changed. In this way you can get an overview very quickly over the last measured values for all points. In the background, the analyzer uses the measurement cycle continues uninterrupted. However, once a measurement phase is completed, the display automatically switches to the actual measurement location.

Manual zeroing and selection of measurement points

For analyzers with just one measuring point, the status of "measuring" by pressing the F1 key = "zero" will be canceled and the next manual zeroing be initiated.

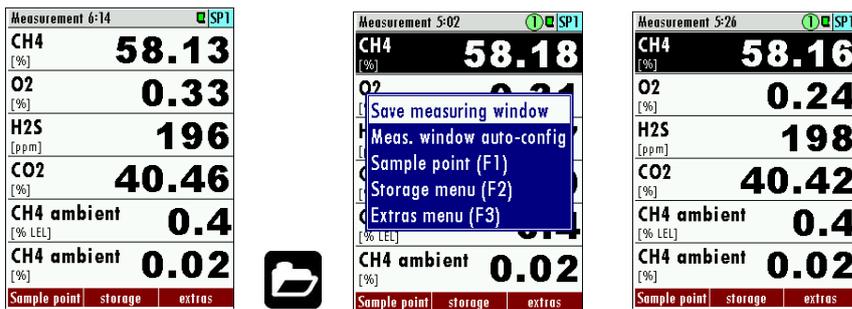
For analyzers with several sampling points can by pressing the F1 key = "number" manually the next sampling point can be selected. This is then measured as soon as possible.

Configuration of the measurement window (display content)

The measuring values selection and arrangement is user free configurable in both display modes.

Press the content menu key and select the function 'Define measuring window'. A cursor (inverted line) will appear. The cursor can be moved with the arrow keys up and down. The arrow keys left and right will change the measuring value in the selected line. When the cursor is moved over the top or under the bottom line, then the next definable page will show up.

As soon as you have finished the configuration, press the ESC key (or press again the menu key and select the function 'Save measuring window'). You will be asked, whether the changed settings shall be stored or discarded. Select 'keep them' in order to store your changes.



5.5. Data Storage

The analyzer makes use of an internal flash memory to store measurement values automatically.

FRI 31.10.2014 11:07:04		SP1
CH4	57.80	
[%]		
CO2	41.58	
[%]		
H2S	284	
[ppm]		
O2	0.3	
[%]		
Net cal. val.	18.3	
[MJ/kg]		
Gross cal. val.	20.3	
[MJ/kg]		
previous	delete	next

Data storage strategy is as follows:

- The analyzer may store up to 20,000 measurement points (including all relevant data).
- At the end of each measurement cycle (per sampling point) the current values will be stored.
- The memory is used as a ring buffer. As soon as the memory is completely occupied, the latest measurements will replace the oldest measurements.

Specifically:

If the used memory is 99%, then the oldest 20% of the measurements will automatically be exported to SD card in CSV format and then deleted from the memory. In case the SD card export doesn't succeed (SD Card missing or read-only), then only the oldest 4% of the measurements will be deleted. The file names reflects the date of the most recent measurement contained in the export file, e.g. "20141031.csv".

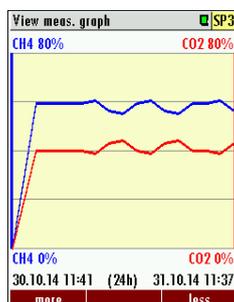
Example:

An analyzer with 2 sample points and a total configured cycle time of 32 minutes saves $2 * 24 * 60 / 32 = 90$ measurements per day (45 of each sample point). So the ring buffer will provide measurements of the last $20000 / 90 = 222$ days (more than 7 months).

Data Storage Menu

The data storage menu can be reached by pressing F2='storage' in the measurement menu:

The menu provides an overview of stored measurements of each sample point and of the memory usage.



View stored measurements in text mode

This function can be reached from the Data Storage Menu by selecting one or all sample points and by pressing F1='view text':

When entering the menu the latest stored measurement will be displayed. With the keys F1='previous' and F3='next' the measurements can be browsed (F3 will lead to the oldest measurement when the latest was displayed before - wrap-around).

You may delete a single measurement here, usually you won't need this function. The arrow keys have the same function than in the measurement menu.

View stored measurements in graphic mode

This function can be reached from the Data Storage Menu by selecting one sample point (not all) and by pressing F3='view graph':

Two curves for one pair of data are shown at the same time in one diagram. The used scales are determined automatically and can't be changed by the user.

The offered pairs of data are determined by the setting of the zoom values in the measurement menu. The displayed pair of data can be changed by pressing the arrow keys up or down.

When entering the menu the measurements of the last 24 hours will be displayed. This interval can be changed by pressing the keys F1='more' or F3='less'.

Export of measurements to SD card

This function is used to export the measurements from the analyzer to a PC. The used format is CSV (comma-separated values). Many computer programs are able to read this format, e.g. spreadsheet calculation programs.



The CSV format is not exactly the same in all countries. The analyser selects a fitting format variation according to the selected country. Nevertheless the CSV output can be changed individually by the function 'CSV settings', which can be found using the content menu key in the Data Storage Menu.

This function is only available, when a SD card is inserted and is not write protected. The export can be started in the Data Storage Menu by selecting one or all sample points and by pressing F2='export >> SD'.

The created files have names like 'BIOxxxx.csv', in which the xxxx are continuing 5 digit numbers with leading zeros.

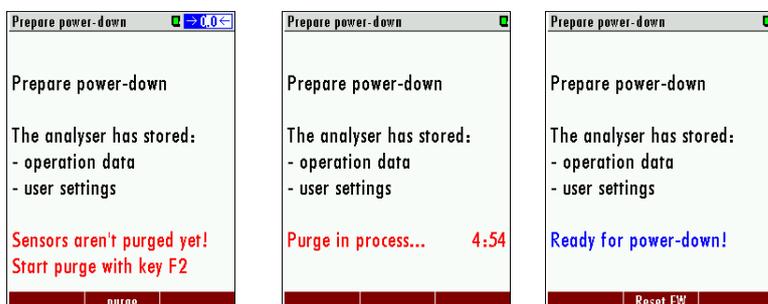
The 1st line of the created file is a column header with the following information: Sample point number, Date, Time and all measurements. The following lines contain the data.

5.6. Power-Down of analyzer

Before the analyzer is disconnected from mains, it should be prepared for the Power-Down, because

- operational data should be stored
- eventually changed user settings should be stored
- the sensors should be purged with fresh air

Press the OFF key in any menu in order to prepare the analyzer for the Power-Down. The analyzer will store operational data and user settings and will offer to start a sensor purge cycle:



Start the purge cycle with the **F2** key (PIN code requested). The analyzer will purge the sensors with fresh air and will indicate a count-down. Then the analyzer will be ready for power-down.

Now it's not possible anymore to continue directly the ordinary measurement process. Only power-down by disconnecting mains or a software restart by pressing **F2**'Reset FW' is offered.

Note:

You also may enter this menu by pressing the **OFF** key and leave it by pressing the **ESC** key (without starting the purge cycle) , when you just want to store operational data and user settings.

5.7. Backup/restore all individual user-settings

It's a quite amount of work to configure the analyzer, especially when the analyzer provides several sample point and several IO-modules and when the analog outputs are used. Therefore we recommend to backup all your found settings on the SD card.

In order to backup the settings, do the following:

- use the menu **EXTRAS**.
- insert an SD card (without write-protection)
- press the menu key and select the function 'Export user settings'

The analyzer will write the backup file 'settings.usr' to the SD card.

In order to restore the settings, do the following:

- use the menu **EXTRAS**.
- insert an SD card containing the backup file 'settings.usr'
- press the menu key and select the function 'Import user settings'

The analyzer will replace the current settings by the settings from the backup file.

5.8. Default configuration

Use the menu **MEASUREMENT -> EXTRAS -> DEFAULT SETTINGS** for the default configuration:

DEFAULT CONFIGURATION				
Parameter	Analog output 4-20mA		Alarm output relay contact open	
	4mA	20mA		
CH4 [%]	0	100	less than	50
O2 [%]	0	25	more than	1
H2S [ppm]	0	1000	more than	300
CO2 [%]	0	100	more than	50
	0	500	more than	500
CH4 ambient [%]	0	5	more than	1
CH4 ambient [%LEL]	0	100	more than	20
Temperature sensor [°C]	0	50	more than	50
Fan rotation [rpm]	0	2000	less than	1200
Pump rotation [rpm]	0	5000	less than	1500
Sample flow [l/hr]	0	60	less than	30
Temperature cooler [°C]	0	20	more than	10
Net calorific value [MJ/kg]	0	40	less than	30
Gross calorific value [MJ/kg]	0	40	less than	30
Net calorific value [MJ/m3]	0	40	less than	30
Gross calorific value [MJ/m3]	0	40	less than	30

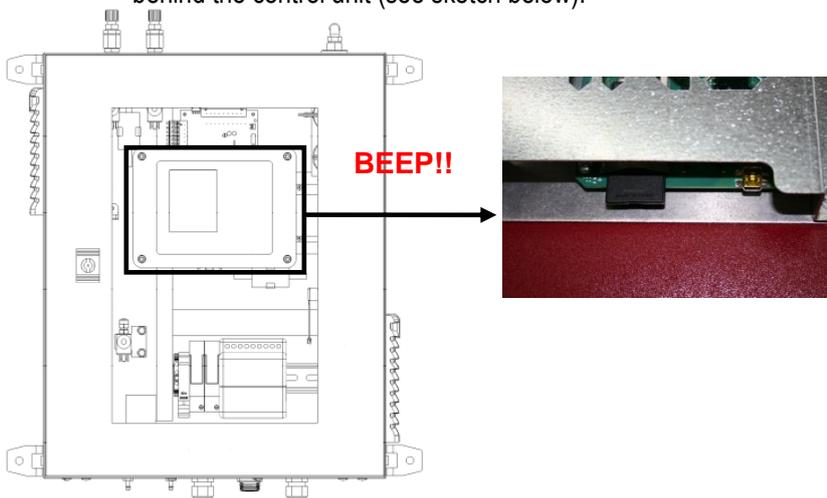
5.9. Update the firmware

The analyzer and different installed options can be updated, if it is necessary. Following options can be updated:

- The firmware from the analyzer.
- The firmware from the pcb- mainboard.
- The firmware from the NDIR-bench.
- The firmware from the installed I/O modules.

General steps for the firmware-update

1. Copy the actual firmware for the analyzer or the firmware from the option on a SD-card. Be sure, that the firmware is in the main root of the SD-card. All firmware updates have the ending "fwb".
2. Put the SD-card on the card slot on the operation unit. The card slot can be found behind the control unit (see sketch below).



3. If the SD-card is recognized, the analyzer will make a noise.
4. Open the path: `EXTRA/DEVICE INFO`. Dependent from the firmware update it can be necessary to open the different submenus.

Update the analyzer (Firmware-Updates with filename "1106.fwb")

1. Open the path: `EXTRA/DEVICE INFO`

Main-device info	
MRU SWG100 BioGas	
Firmware version	1.03.60
Meas kernel version	1.03
Bootloader version	V1.00.04
Serial number	080503
Manuf. date	28.10.2014
Operating hours	2975.3
Adjustment date	17.11.2014
sub-syst. details sub-syst.	

F2

Main device details	
Number of sample points	2
Number of I/O modules	2
O2 sensor (EC type 3)	
H2S sensor (EC low-3)	
CO2 sensor (NDIR)	
CH4 sensor (NDIR)	
CH4 sensor (pellistor)	
Measurement up to 24h	
Auto-calibration count	1
FW update	

F2

2. Press **F2 = details** to open the details for the main device menu.
3. Press **F2 = FW update**. The analyzer will start the update from the SD-card.

Update the pcb-mainboard (Firmware-Update with filename "1106mb.fwb")

1. Open the path: EXTRA/DEVICE INFO

Or F3

F2

F2

2. Press **F3 = sub.syst.** to open the menu "SUB SYSTEMS INFO".
3. Press **F2 = details**, to open the details from the mainboard. Be sure, that the device is "Mainboard" to update the pcb-mainboard.
4. The Update will start from the SD-card, if a firmware with the filename "1106mb.fwb" is at the SD-card.

Update the NDIR-bench (Firmware-Update with filename "1106ndir.fwb")

1. Open the path: EXTRA/DEVICE INFO

Or F3

Or F1/F3

F2

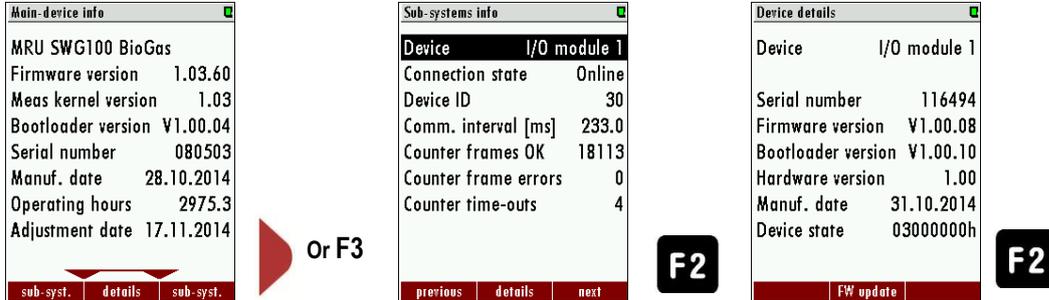
Or F1/F3

F2

2. Press **F3 = sub.syst.** to open the menu "SUB SYSTEMS INFO".
3. Press **F2 = details**, to open the details from the NDIR bench. Be sure, that the device is "NDIR bench" to update the NDIR-bench.
4. The Update will start from the SD-card, if a firmware with the filename "1106ndir.fwb" is at the SD-card.

Update the IO modules (Firmware-Update with filename "1106iom.fwb")

1. Open the path: EXTRA/DEVICE INFO



2. Press **F3 = sub.syst.** to open the menu "SUB SYSTEMS INFO".
3. Press **F2 = details**, to open the details from the I/O module. Be sure, that the device is "Mainboard" to update the I/O module.
4. The Update will start from the SD-card, if a firmware with the filename "1106iom.fwb" is at the SD-card.

6. Service and maintenance

For a reliable function and high measurement quality it is necessary to inspect and service the analyzer regularly.

Besides the regular routine control by the operator (see chapter 8.1.-) the producer recommends a regular half year maintenance, which must be carried by a qualified specialist.

6.1. Preparing and information about the maintenance

It is important to power off the mains supply before the maintenance can be started. Even if the main fuse is powered off, dangerous voltage is present.

It can be required to cut off the electric supply and safe this from an accidental switch-on.

By maintenance works on the gas analyzer dangerous and toxic gases may leak. The gas supply must be cut-off.

It is important to comply with the national directives, which are the country specific.

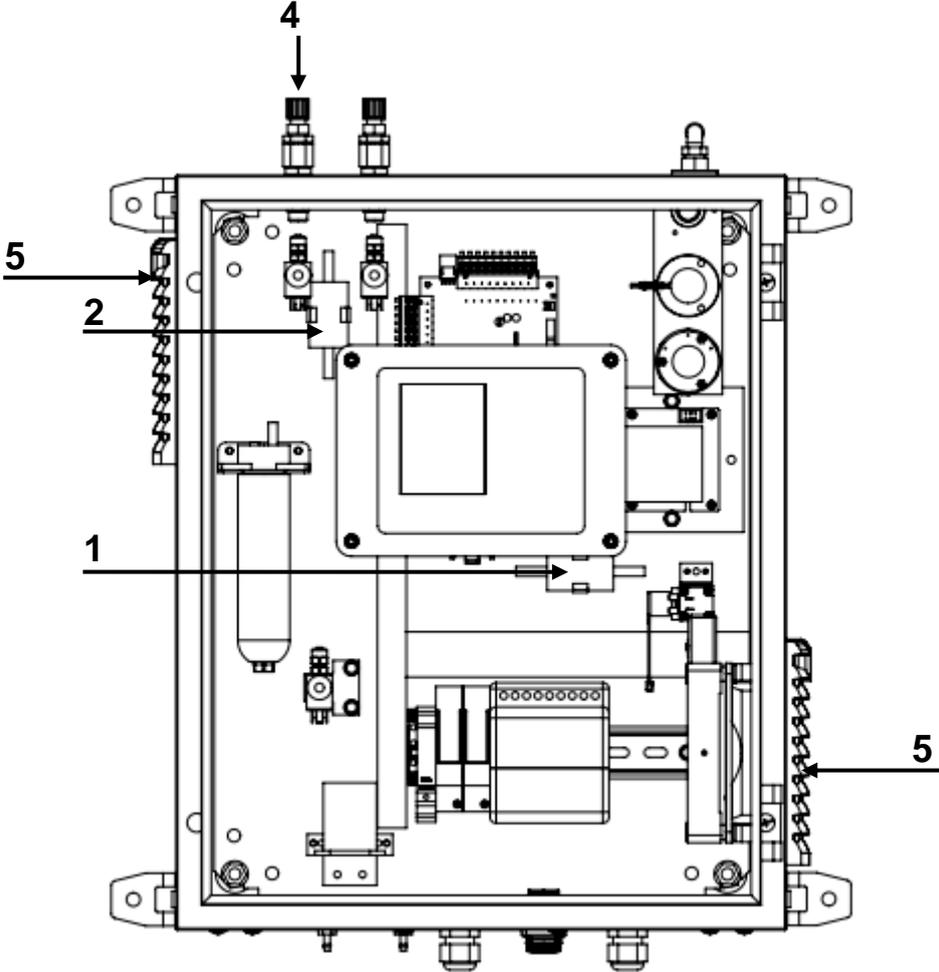
6.2. Regular maintenance works by the operator

All inspections- and maintenance works are dependent from individual operating conditions, and site. The specified intervals below are only benchmarks.

Review	Recommended intervals	Actions
Moisture in the analyzer.	Weekly	Remove the moisture. Call vendor specialist.
Dirt and depositions in analyzer.	Weekly	Remove the dirt, prevent further penetration of dirt. Inform vendor.
Dirt and moisture in the filter- unit	Weekly	Exchange the filter- unit.
Testing the gas pipes of leakage with "sniffer" ..	Weekly	Tighten or exchange the gas pipe if it is necessary
Inspecting the conditions of the gas filters	Every month	Exchange if is necessary

In the follow chapters there will be introduced some service parts, which are important for the reliable operation. These parts are independent from the regular checks and must be replaced in a regular interval of minimum 6 month.

6.3. Position and overview of the service-parts



#	Image	name	Interval	Quantity	Offer-number
1		Dust- and particle filter	New state: white Used: dark/black Life time: 6 month, dependend from the dust- and dirt concentration. Visual inspection is necessary.	1 piece	65533
2		Dust- and particle filter (fine filter)	New state: white Used: dark/black Life time: 12 month, dependend from the dust- and dirt concentration. Visual inspection is necessary.	1 piece	66088
3		PTFE-filer	New state: white Must be changed, if the PTFE filter is blocked. The analyzer shows the warning " Gas flow is too low ".	2 pieces	51513
4		Sinterfilter	New state: sintered surface Must be changed, if the PTFE filter is blocked. The analyzer shows the warning " Gas flow is too low ".	2 pieces	65988
5		Filter mat for the fan-unit	New state: white Used: dark/black, dependend from the dust- and dirt concentration. Visual inspection is necessary.	1 UP (5 pieces)	60320

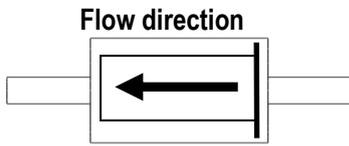
Position 1 and 2: Dust- and particle filter (#65533 and #66088)

Required materials: Dust- and particle filter (#65533 and #66088) contained in the service set.

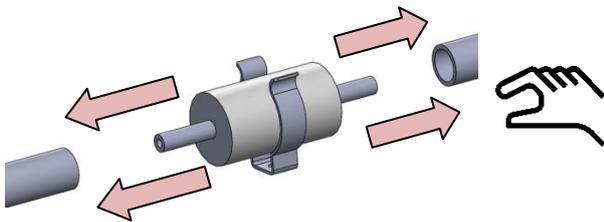
Required tools: needle-nose pliers.

Exchange interval: Exchange necessary, if the filter gets dark or black.

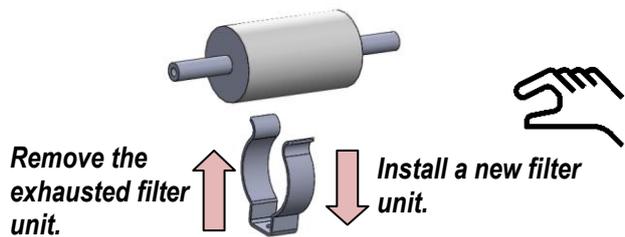
Mounting direction:



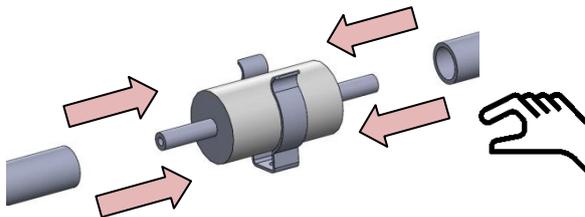
Steps:



Pull the viton-tubes from the filter unit with the hand. If it is necessary, pliers can be used to solve the tubes from the filter unit.



Remove the exhausted filter unit from the clip.



Plug the viton tubes on the filter unit. Push the filter unit on the clip.

Position 4: Sinterfilters (#65988)

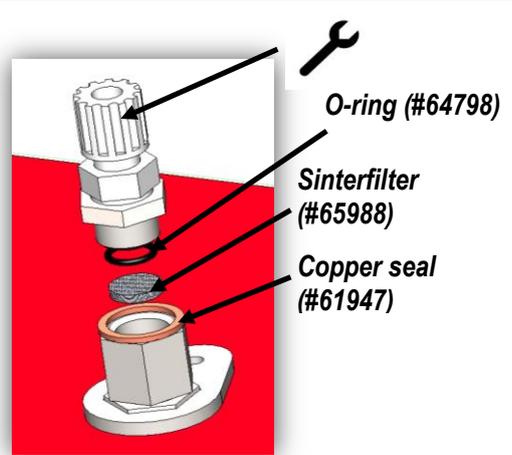
Required materials: Sinterfilters (65988), contained in the service-set.

Required tools: Spanner (range:17)

Exchange interval: Every 2 month, dependent from the dust- and pollution load.

Steps:

1. Remove the gas tube. Be sure, that no process gas emits in the environment. The upper part from the nozzle can be removed with a spanner (range 17).
2. Inside of the nozzle is a sinter filter tablet with an o-ring. Remove the exhausted sinter filter tablet and the o-ring and exchange both parts to a new one. The compensation parts can be found in the service-set.
3. The gas tube can now connect with the nozzle again.



Position 5: Filter mats (#60320)

Required materials: 2x filter mats (#60320) contained in the service-set.

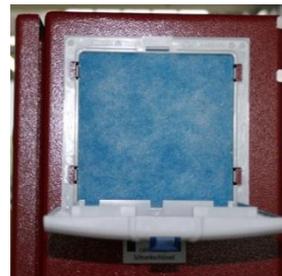
Exchange interval: Exchange necessary, if filter revolution is reduced.

Steps:

Open the filter-unit by pulling the blue lash.



Replace the exhausted filter mat through a new one.



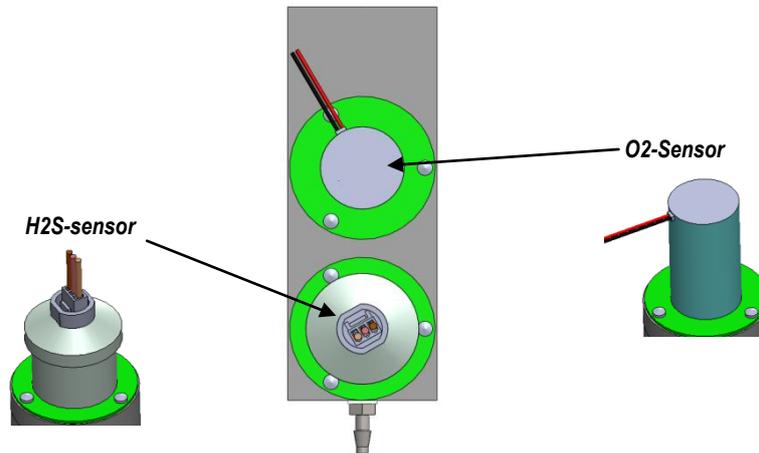
Close the cover from the filter unit.



6.4. Exchange of electrochemical sensors

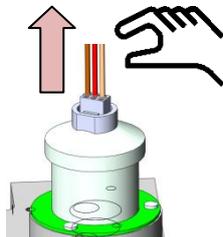
The position of the electrochemical sensor in the SWG-100 BIOGAS is shown in the sketch below.

Depending from the design of the electrochemical sensors there exist two ways to exchange the sensors.

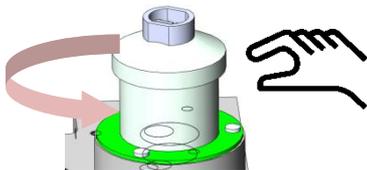


Exchanging the H₂S or the O₂ sensor.

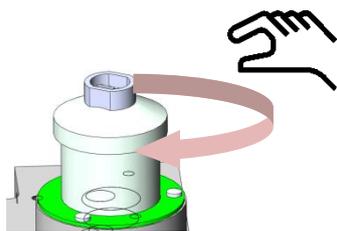
- Remove the cable form the sensor.



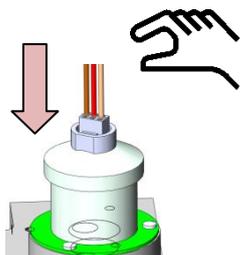
- Remove the old sensor.



- Mount the new sensor hand-tight to the sensor module.



- Plug the cable to their previous position.



Troubleshooting

Error	Possible causes	Solutions
Display does not work.	- System is not power-up.	- connect main power supply. - power up automatic fuse. - contact customer support.
Analyzer powers down by itself.	- The fan is defect. - Filter mat from the fan is clogged. - The protect switch has been triggered.	- exchange the fan. - exchange the filter mat. - Internal short circuit. Contact an electrician to determine cause of defect.

6.5. Technical specification

Allgemein		General
Deutsch	Angabe	English
Betriebstemperatur(ohne Frostschutzheizung)	+5°C ... +45 °C / 41 °F ... 113 °F	Operating temperature (w/o heating)
Betriebstemperatur (mit optionaler Frostschutzheizung)	-10 °C ... +45°C / 14 °F ... 113 °F	Operating temperature (with internal heating, option)
Rel. Luftfeuchtigkeit bei Betrieb, nicht-kondensierend	95%	Rel. Humidity, non-condensing
Lagertemperatur	-20°C ... +50°C / -4°F ... 122°F	Storage Temperature
Schutzart	IP52	Protection Class
Aufstellbedingungen	geschützt vor direkter Sonneneinstrahlung und Regen	Installation Requirements
	do not expose to direct sun light or rain	
Akku intern, Pufferzeit für Sensor Bias	NiMH, 3 Monate / 3 months	Internal Battery Pack, buffer time for sensor bias
Stromversorgung	100 - 240 V, 40 W	Power supply
Gewicht, typisch mit Sensoren, Gaskühler	13 kg	Weight, typically incl 2 sensors
Maße	400x500x300 mm	Size
Gehäusematerial	Aluminium	Housing material
max. Unterdruckbereich der Gaspumpe	300 hPa	Max suction range gas pump
typischer Gasdurchfluss	50 l/h	gas flow typ.
Schnittstellen		Interfaces
Deutsch		English
Benutzerschnittstelle	Angabe	User Interface
Anzeigetyp	3,5TFT	Display type
Anzahl gleichzeitig angezeigter Messwerte	6	Number of siultaneously displayed values
Tastatur mit Anzahl Tasten	12	Keyboard with qty of keys
Elektrische Aus-/Eingänge		Electrical I/O

Serielle Schnittstelle	RS485	Serial interface
Protokoll	Modbus RTU	Protocol
Typ Analogausgang	4 ... 20 mA	Type of analog output
Anzahl Ausgangskanäle pro I/O-Modul (optional)	4	Number of output channels per I/ modul (optional)
Typ Analogeingang	4 ... 20 mA	Typ of analog input
Anzahl Eingangskanäle pro I/O - Modul (optional)	4	Number of input channels per I/ modul (optional)
Anzahl Alarmausgänge pro I/O - Modul (über Relais)	2	Number of alarm ouput signal via relays
maximal mögliche Anzahl I/O - Module	2	Max number of I/O modules to be equipped
Systemalarm-Ausgang	Relaiskontakt	system alarm output
	relay contact	
Gas Ein- und Ausgänge		Gas input and ouput
Anzahl <u>parallel</u> zu überwachender Messstellen	1	Number of <u>simultaneously</u> monitored sampling points
Anzahl Messgaseingänge (serielle Umschaltung)	3	Number of sampling points (serial sampling point switching)
Gehäuseverschraubung Messgaseingang	G1/8	Screw joint sampling point
Gasausgang	G1/4	gas output
Frischluf (für Nullpunktnahme)		Fresh air (for zeroing)

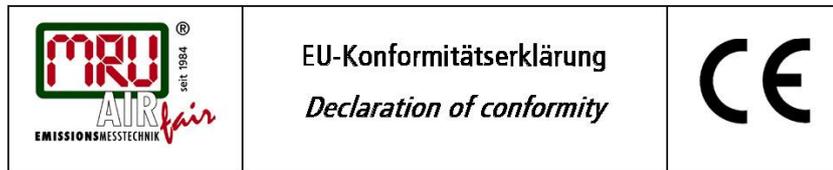
7. Technical specification: NDIR-benches

Nicht-dispersive Infrarotmessung (NDIR)	CO ₂ /CH ₄ /100 %	Non-dispersive Infrared Measurement (NDIR)
Nominaler Messbereich	0-100 Vol%	Nom. Measuring Range
Auflösung	0,01 Vol%	Resolution
Genauigkeit abs. /vom Messwert	± 0,3 Vol% /	Accuracy abs./reading
	3%	
Ansprechzeit T90	< 35 s	Response Time T90

8. Technical specification: Electrochemical sensors

Deutsch	Angaben zur Messgenauigkeit	English
Elektrochemischer Sensor	O2 Long Life	Electrochemical Sensor
Messbereich	0 .. 21 %	Measuring Range
Auflösung	0,01 %	Resolution
Genauigkeit abs.	± 0,2 Vol%	Abs. Accuracy
Ansprechzeit T90	< 20s	Response Time T90
Jahre erwartete Lebensdauer an Luft	2	Years expected lifetime (@air)
Elektrochemischer Sensor	H2S high10.000	Electrochemical Sensor
Messbereich	0-10000 ppm	Measuring Range
Auflösung	1 ppm	Resolution
Überlastbereich	< 50000 ppm	Overload Range
Genauigkeit abs.	± 50 ppm / 5% (0 ... 10000 ppm) 10% (> 10000 ppm)	Abs. Accuracy
Ansprechzeit T90	< 90s	Response Time T90
Jahre erwartete Lebensdauer an Luft	2	Years expected lifetime (@air) (Depending on chosen sensor)
(abhängig von gewähltem Sensor)		
Elektrochemischer Sensor	H2S low2000	Electrochemical Sensor
Messbereich	0-2000 ppm	Measuring Range
Auflösung	1 ppm	Resolution
Überlastbereich	< 5000 ppm	Overload Range
Genauigkeit abs.	< 5% (0...500 ppm) <15% (501...2500 ppm)	Abs. Accuracy
Ansprechzeit T90	< 35s	Response Time T90
Jahre erwartete Lebensdauer an Luft	2	Years expected lifetime (@air) (Depending on chosen sensor)
(abhängig von gewähltem Sensor)		

9. Declaration of conformity



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Bevollmächtigte Person, für die Zusammenstellung der technischen Unterlagen
Person authorized to compile the technical documents

Name / *name*: Dierk Ahrends
 Funktion / *function*: QM-Beauftragter / *QM- Representative*
 Firmenname / *company*: Messgeräte für Rauchgase und Umweltschutz GmbH
 Straße / *street*: Fuchshalde 8 + 12
 Ort / *city*: 74172 Neckarsulm
 Land / *country*: Deutschland / *Germany*

Produkt/Product

Bezeichnung / *designation*: Gasanalysator
Gas analyser
 Produktname / *name*: SWG100 BIO compact
 Funktion / *function*: Gasanalyse / *gas analysis*

Hiermit erklären wir, dass das oben beschriebene Produkt allen einschlägigen Bestimmungen entspricht, es erfüllt die Anforderungen der nachfolgend genannten Richtlinien und Normen:

We declare the conformity of the product with the applicable regulations listed below:

- EMV-Richtlinie / *EMV-directive* 2014/30/EU
- Niederspannungsrichtlinie / *low voltage directive* 2014/35/EU
- RoHS-Richtlinie / *RoHS directive* 2011/65/EU (RoHS II)

Neckarsulm, 01.07.2016



Erwin Hintz, Geschäftsführer / *Managing Director*

10. APPENDIX

10.1. Modbus via RS485 specification

General information

- The Modbus (slave function) requires the firmware version V1.01.70 dated 17.11.2014 or later.
- The analysers are able to work as modbus slave using the RS232 or RS485 port (possibly with external RS232/RS485 adapter)
- supports RS485 interface with 2/4 wires (half/full duplex)
- supports only the binary Modbus protocol (RTU)
- supports modbus command *Read Holding Register* (command no 3)
- supports modbus command *Read Input Register* (command no 4)
- the slave modbus address is user definable from 1 to 238
- communication parameter are user definable as follows:
 - 9600 baud
 - 19200 baud
 - even parity and 1 stop bit
 - no parity and 2 stop bits
- Multi byte values are transmitted in Motorola® byte order (Big-Endian). Only the CRC16 at the end of each frame is transmitted in Intel® byte order (Little-Endian).
In case you need Little-Endian byte order in the master's system:
 - 16bit values (occurs only in the frame): swap bytes 0<=>1
 - 32bit values (occurs only in the data): swap bytes 0<=>3 and swap bytes 1<=>2
- All addresses written in this document are decimal (not hexa-decimal)
- All readable data are 32bit values, therefore the analyser only accepts even addresses and even number of registers to be read.
- The maximal number of 32bit-values to be read with one single read command is 63 (126 modbus registers)
- Data types (used in table below):
 - U32 32 bit unsigned integer value (0...4.294.967.295)
 - FL 32 bit floating point value (reads -1E38, when not available).

Defined registers to be read by the master

protocol address	data type	numb. of registers	register content
			Status & Device info
0	U32	2	Analyser Status (more details read below)
2	U32	2	System Alarm (more details read below)
4	U32	2	Serial number
6	U32	2	Analyser type (11060 = SWG100biogas)
8	U32	2	Firmware version (e.g. 12345 = V1.23.45)
10	U32	2	Elapsed seconds since Power-On
12	U32	2	Counter Modbus Frame Error
14	FL	2	CH4 amb. [%]
16	FL	2	CH4 amb. [% LEL]
18	FL	2	T-sensor [°C/°F] (unit depends on user settings)
20	FL	2	Sample Flow [l/h]
24	FL	2	Case fan rotations [rpm]
26	FL	2	Gas pump rotations [rpm]
28	U32	2	not (yet) defined (read zero)
30	U32	2	not (yet) defined (read zero)
32	U32	2	not (yet) defined (read zero)
34	U32	2	not (yet) defined (read zero)
36	U32	2	not (yet) defined (read zero)
38	U32	2	not (yet) defined (read zero)
			Status & current measurement values (live values!)
40	U32	2	Analyser Status (more details read below)
42	U32	2	System Alarm (more details read below)
44	FL	2	O2 [%]
46	FL	2	CO2 [%]
48	FL	2	CH4 [%]
50	FL	2	H2S [ppm]
54	FL	2	Net calorific value [MJ/kg]
56	FL	2	Gross calorific value [MJ/kg]
58	FL	2	Net calorific value [MJ/m ³]
60	FL	2	Gross calorific value [MJ/m ³]
62	U32	2	not (yet) defined (read zero)
64	U32	2	not (yet) defined (read zero)
66	U32	2	not (yet) defined (read zero)
68	U32	2	not (yet) defined (read zero)

protocol address	data type	numb. of registers	register content
			Status & measurement values of sample point 1
70	U32	2	Analyser Status (more details read below)
72	U32	2	System Alarm (more details read below)
74	FL	2	O2 [%]
76	FL	2	CO2 [%]
78	FL	2	CH4 [%]
80	FL	2	H2S [ppm]
84	FL	2	Net calorific value [MJ/kg]
86	FL	2	Gross calorific value [MJ/kg]
88	FL	2	Net calorific value [MJ/m ³]
90	FL	2	Gross calorific value [MJ/m ³]
92	U32	2	not (yet) defined (read zero)
94	U32	2	not (yet) defined (read zero)
96	U32	2	not (yet) defined (read zero)
98	U32	2	not (yet) defined (read zero)
			Status & measurement values of sample point 2
100	U32	2	Analyser Status (more details read below)
102	U32	2	System Alarm (more details read below)
104	FL	2	O2 [%]
106	FL	2	CO2 [%]
108	FL	2	CH4 [%]
110	FL	2	H2S [ppm]
114	FL	2	Net calorific value [MJ/kg]
116	FL	2	Gross calorific value [MJ/kg]
118	FL	2	Net calorific value [MJ/m ³]
120	FL	2	Gross calorific value [MJ/m ³]
122	U32	2	not (yet) defined (read zero)
124	U32	2	not (yet) defined (read zero)
126	U32	2	not (yet) defined (read zero)
128	U32	2	not (yet) defined (read zero)
			Status & measurement values of sample point 3-10
...	add 30 to the addresses for each sample point

10.2. Analyser Status (address 0 and some mirror addresses)

The Analyser Status is a 32bit-word and must be interpreted bitwise.

Bit	Description
0	Power-On (until the first zeroing has been done)
1	System-Alarm, see table below
2	Air Purging (zeroing)
3	Gas Sampling (preparing measurement, not measurement!)
4-7	Currently sampled sample point number (1..2, reads 0 while air purging)
8-31	reserved for later applications (read zero)

Some status examples:

Decimal	Hexadecimal	Binary	state description
1	0001h	0000 0001	Power-On (self-test)
5	0005h	0000 0101	First Air Purging (Power-On + Air Purging)
24	0018h	0001 1000	Preparing meas. smp.pt.1 (Gas Sampling + smp.pt.1)
16	0010h	0001 0000	Measuring sample point 1
32	0020h	0010 0000	Measuring sample point 2

10.3. Analyser System Alarm (address 2 and some mirror addresses)

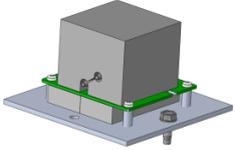
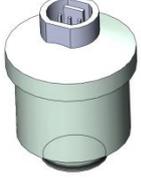
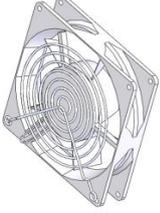
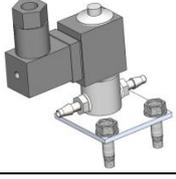
The Analyser System Alarm is a 32bit-word and must be interpreted bitwise.

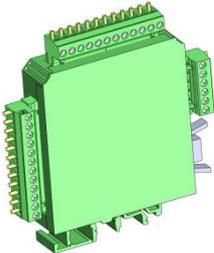
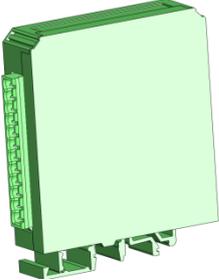
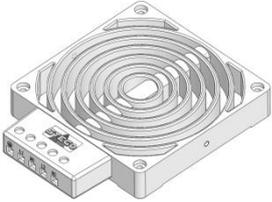
Bit	Description	Meas. halted
0	Mainboard Offline (some communication problems)	YES
1	Mainboard is in bootloader mode	YES
2	CH4 ambient > threshold value	YES
3	Condensate	YES
4	Sample flow < 20 l/h	-
5	Case fan rotations < 900 rpm	-
8	T-Sensor > 55°C	-
9	T-Sensor < 5°C	-
10-31	reserved for later applications	

Some system alarm examples:

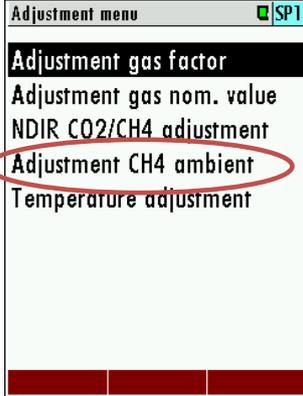
Decimal	Hexadecimal	Binary	state description
1	0001h	0000 0001	Mainboard is offline, measurement is halted
8	0008h	0000 1000	Condensate Alarm, measurement is halted
80	0050h	0101 0000	Sample flow < 20 l/h

10.4. Spare parts list

Article	Description – Serial number	Replacement every
	<p>NDIR CH₄/CO₂</p> <p>Infrared measuring device of CH₄ and CO₂</p>	5 years
	<p>Oxygen sensor</p> <p>Electrochemical sensor for measuring oxygen.</p>	5 years
	<p>H₂S_{high} sensor</p> <p>Electrochemical sensor for measurement of up to 2.000ppm</p>	2 years
	<p>Axial fan</p> <p>For ventilation of analyzer cabinet</p>	2 years
	<p>Solenoid valve</p> <p>Used for sampling point switching.</p>	2 years
	<p>CxHy gas detector</p> <p>Required for monitoring the CH₄ concentration inside analyzer cabinet</p>	3 years
	<p>Display and operation unit</p> <p>Control unit for the user.</p>	8 years

	<p><i>I/O-Module</i></p> <p><i>Used for analog output data transfer and sample point switching.</i></p>	<p>8 years</p>
	<p><i>I/O Module</i></p> <p><i>Used for analog output data transfer</i></p>	<p>8 years</p>
	<p><i>Heater</i></p> <p><i>Used for freeze protection of analyzer cabinet</i></p>	<p>5 years</p>

10.5. Alignment the CxHy gas detector (optional)



Adjustment menu [SP1]

- Adjustment gas factor
- Adjustment gas nom. value
- NDIR CO2/CH4 adjustment
- Adjustment CH4 ambient**
- Temperature adjustment

Adjustment CH4 ambient	
CH4 ambient	-0.064 %
Pellistor [mV]	-11.54
Zero offset [mV]	-10.00
Factor	1.000
Alarm level [%LEL]	50
default zero point	

Adjustment CH4 ambient	
CH4 ambient	-0.000 %
Pellistor [mV]	-11.29
Zero offset [mV]	-11.29
Factor	1.000
Alarm level [%LEL]	50
default zero point	

Adjustment CH4 ambient	
CH4 ambient	1.077 %
Pellistor [mV]	14.56
Zero offset [mV]	-11.29
Factor	1.000
Alarm level [%LEL]	50
default zero point	

Adjustment CH4 ambient	
CH4 ambient	1.000 %
Pellistor [mV]	14.65
Zero offset [mV]	-11.29
Factor	0.925
Alarm level [%LEL]	50
default zero point	



Cap for alignment

Adjustment CH4 ambient	
CH4 ambient	1.000 %
Pellistor [mV]	14.65
Zero offset [mV]	-11.29
Factor	0.925
Alarm level [%LEL]	50
default zero point	

Zero point of the HC-detector

Choose the point ADJUSTMENT CH4 AMBIENT in the ADJUSTMENT MENU. It will appear the follow menu (see picture).

- Check if there any HC substance in the environment (for example with a gas detector).
- Choose the point "Zero offset [mV]" in the "Adjustment menu". It will appear the option "Zero point" in the below bar on the right side.
- Turn on the "Zero offset [mV]" until the value of the "CH4 ambient" is 0,000%.

Span

- Put the cap on the sensor (see picture). Then give CH4 from a CH4 gas bottle on the sensor (example value 2 Vol.%).
- After the "CH4 ambient"- value won't change anymore turn on the field "Factor" until the bottle value will be set.
- Check the setting of the alarm barrier.
- Set the alarm on a desired size. (The application has an alarm level from 50 % LEL by delivery.)



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