



*Elektromotoren und
Gerätebau Barleben GmbH*



GATRON

Cooperation partner, transformer gases



TECHNICAL MANUAL

Buchholz Gas Tester BGT 4.2

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1 General

The documentation is subject to copy right. All rights are reserved. The manual was compiled with greatest care, nevertheless errors cannot be excluded. Please, address any suggestions and comments to the manufacturer/vendor. The manufacturer reserves the right to modifications to the device and/or the technical specifications in this manual without prior notice.

The manual describes function, construction and operation of the Buchholz gas tester BGT 4.2, the software and the devices for gas sampling from the Buchholz relay. For the operation and function of the BGT 4.2, refer to the information in this documentation.

The values in the displays shown in this manual are just examples and no actual values measured.

Claims under warranty will be accepted only according to the General Conditions for the Supply of Products and Services of the Electrical and Electronics Industry (“Grüne Lieferbedingungen”) of the manufacturer/vendor.

2 Intended use

Gases can be formed in oil-filled electrical equipment due to natural ageing of oil and, more frequently, as a consequence of faults. In the event of a more severe fault the free gas in the oil rises and is collected in the Buchholz relay.

The BGT 4.2 is used to measure the concentrations of hydrogen, carbon dioxide, carbon monoxide, the total of hydrocarbons, and acetylene in the gas sampled from the Buchholz relay of electrical equipment. The gas to be measured (air for single-point calibration, Buchholz gas) is sampled by the Buchholz gas sampler (BGS) and fed into the BGT 4.2.

Moisture is not a relevant parameter for Buchholz gases and is not determined in the laboratory during the Buchholz gas analysis. Significant differences between the absolute humidity of air (partial water vapour pressure) and the Buchholz gas as may occur in areas of very high relative humidity combined with high temperatures, reduce the accuracy of analysis. The measurement of gas moisture with sensor 2 compensates this effect.



CAUTION

This manual does not claim to discuss safety issues as might occur in connection with sampling. Responsibility for complying with health, safety and environmental requirements is with the user of the device.

3 Safety instruction

The device was delivered in a technically sound condition. To maintain this condition and operate the device safely, make sure that the following instructions are complied with carefully.

- Operate the device always as described in this manual. Therefore, please read all sections of the manual carefully before using the device.
- Use the BGT 4.2 only for the intended purpose.
- The BGT 4.2 may be used by instructed personnel only.
- Do not use the BGT 4.2 in the event of any obvious defects.
- Make sure that any other safety instructions of this manual are complied with.



CAUTION

The casing of the device may only be opened by the manufacturer or an authorized service company. All warranty claims become void when the device is opened. Inside the device there are no parts which can be maintained or replaced by the user.

4 Scope of supply

The scope of supply includes the following (Fig. 1):

- | | |
|---|---|
| <ul style="list-style-type: none"> ① 1x Transport case ② 1x BGT 4.2 ③ Atomizer bulb with pressure valve, 65 ml ④ 1x Power supply unit for BGT 4.2 (100-240 V AC to 24 V DC) ⑤ 1x Inverter (12 V DC to 230 V AC), for vehicle socket ⑥ 1x BGS with 1x sealing plug | <ul style="list-style-type: none"> ⑦ 1x USB card reader incl. SD card (Fig 2), contains the data logger software with instructions ⑧ 1x Oil trap (Fig. 3) ⑨ Accessories set for BGS (Fig. 4): <ul style="list-style-type: none"> • 3x O-ring seals 3,00 x 2,00 mm, NBR • 3x O-ring seals 6,00 x 2,20 mm, NBR • 5x Septa, silicone rubber • 1x Septum plug |
|---|---|

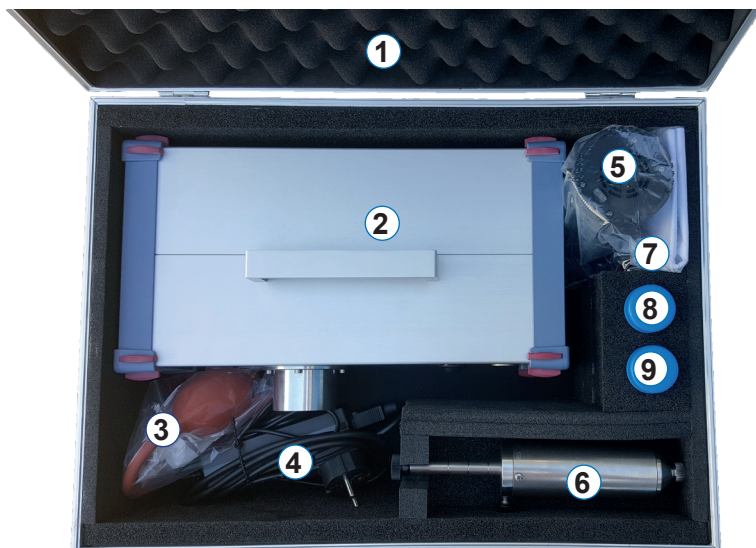


Fig. 1 - Opened transport case



Fig. 2 - USB card reader incl. SD



Fig. 3 - Oil trap



Fig. 4 - Accessories set for BGS

The following items are not shown, however they are included in the scope of supply:

- 1 Micro SD card
- Technical manual BGT 4.2
- Operating instructions BGS
- Operating instructions for inverter and USB card reader

The following items are not included in the standard scope of supply:

- Mini USB-USB cable for connection to a PC
- Country-specific plug adapter

5 Description of device

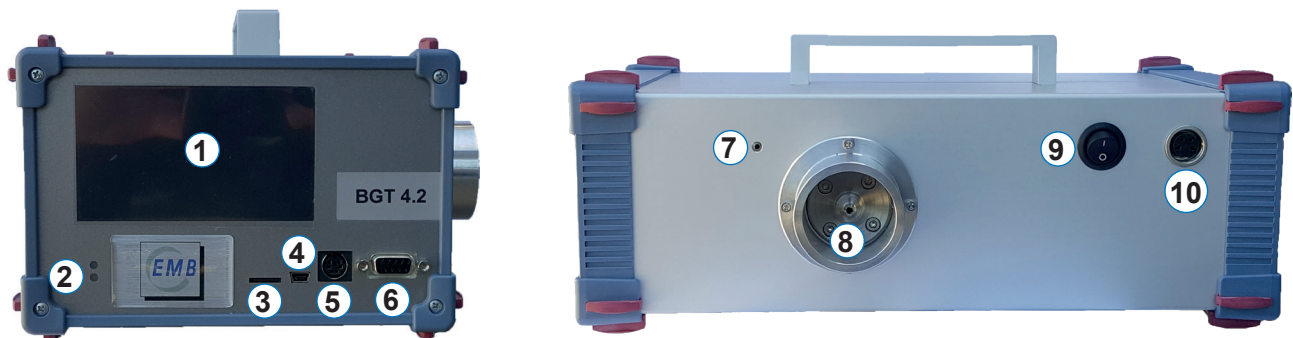


Fig. 5 - Front view and side view of BGT 4.2

Description of device / connections (Fig. 5):

- | | | | |
|---|--------------------|---|--------------------------|
| ① | Touchscreen | ⑥ | Service port VGA |
| ② | Status LED | ⑦ | Gas outlet |
| ③ | Micro SD card slot | ⑧ | Gas inlet |
| ④ | Mini USB port | ⑨ | ON/OFF switch |
| ⑤ | Service port | ⑩ | 24V DC connection socket |

6 Taking into operation



CAUTION

The BGT 4.2 should be used preferably in dry rooms. In case of outdoor use, the device must be protected against the ingress of condensate, rain and snow.

- Voltage supply is through an AC-DC adapter. A socket outlet with earthing contact is required for connection to power supply (100V – 230V AC, 50/60 Hz).
- The device can also be connected to a 12V DC onboard power supply via an additional inverter.
- The BGT 4.2 can be arranged both vertically and horizontally.
- Any arrangements with the gas inlet in a roughly vertical upward position should be avoided.



CAUTION

The ingress of liquid may cause severe damage to the BGT 4.2 or may even destroy it completely. Do not place any objects filled with liquid on the device or in the immediate vicinity.



CAUTION

When transferring the device from a place with low temperatures to a place with higher temperatures and humidity, condensate may form inside the device. In this case, switch on the BGT 4.2 only after equalization of temperature.

To avoid any time delay due to the necessity of temperature equalization, it is recommended to keep the BGT 4.2 in the driver's cabin during transport. Also, the device may be switched on in the vehicle via the inverter and the cigarette lighter socket so that the service temperature is reached already during transport.

After the device is switched on and the system initialized, the main screen is displayed. The device automatically starts to heat the sensors. The warm up time is 30 min. Afterwards the status LED changes from red to green, "Warming up" disappears and "Start calibration?" is displayed. The device is now ready for measurement. After disconnecting the voltage supply or switching off the BGT 4.2, the warm-up period of ca. 30 min starts again.

During the warming-up and stand-by periods various settings may be made.

The BGT 4.2 is equipped with a touchscreen. Operation is by touching the displayed buttons. If the device is connected with a PC via the USB port only (USB mode), the touch system responds very slowly.

7 Operation

7.1 Start display

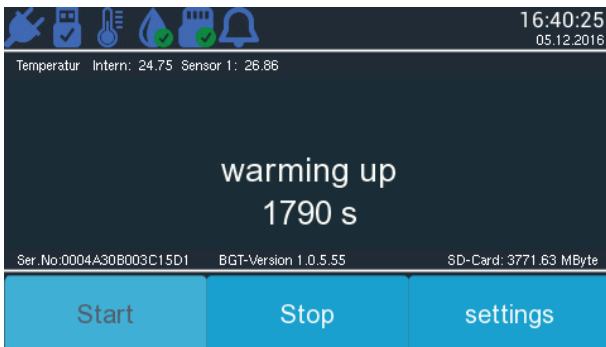


Fig 6 - Start display

Please note that the symbols and control elements shown may vary slightly depending on the software version and that not all symbols are assigned a function in each version.

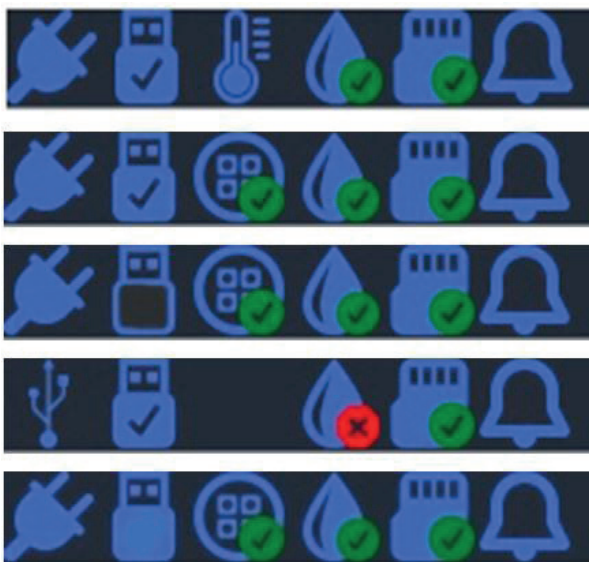


Fig. 7 - Symbols of the upper display line

1 st symbol	Plug	Device with power supply unit switched on
	USB symbol	Device OFF. Voltage supply from PC via USB interface
2 nd symbol	USB connection	Empty = no USB connection Filled = USB cable plugged in PC Ticked = connected with data logger software
3 rd symbol	Thermometer	Heating-up phase of sensor
	Sensor 1	Ticked = sensor ready for measurement
	No sign	Only with USB operation.
4 th symbol	Sensor 2	Ticked = sensor ready for measurement Crossed = sensor not ready for measurement, e.g. with USB operation
5 th symbol	SD card	Ticked = with micro SD card ready for operation Crossed = without micro SD card ready for operation
6 th symbol	Messages	Not used in BGT 4.2
Time	Format:	hh:mm:ss (no automatic summer/winter time changeover)
Date	Format:	dd/mm/yyyy (not switchable)

2nd line

- Internal device temperature in °C
- Temperature sensor 1 in °C

Middle field

The middle of the display provides information about the current program steps, command prompts, measured values and other information. The bar appears only during “Warming Up”.

4th line

- Serial number of device
- Version number of the software of the device
- Free space on the micro SD card if used

5th line

- Button to start the program or program section
- Button to abort the program
- Button to call up the setting menu not active during data recording (calibration and measurement)

7.2 Settings

7.2.1 General

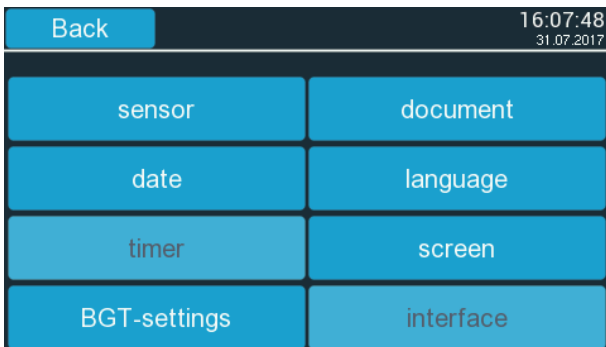


Fig. 8 – Display, settings

This menu allows you to make settings in the device software of the BGT 4.2. To return from a submenu to the previous menu press “Back”. If you change any settings, press “OK” to confirm. The buttons „timer“ and „interface“ are not used in BGT 4.2.

7.2.2 Date / time



Fig. 9 – Display, date and time settings

When selecting this menu, the current time and date are displayed. To change the displayed data, press “<” and “>” and confirm by pressing “OK”.

7.2.3 Language

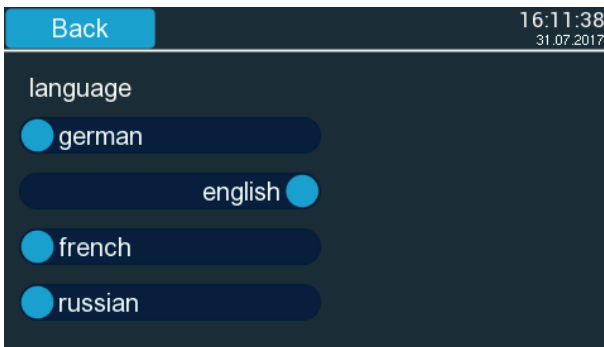


Fig. 10 – Display, selection of language

Select the system language in this submenu.

7.2.4 Screen



Fig. 11 – Display, screen settings

In this submenu you can select the display colour. You can further turn the display by 180 degrees and calibrate the touch. For that purpose press the relevant items on the display for a short moment.

7.2.5 Sensor

This submenu is intended for service by the manufacturer. The user is not permitted to make any changes.

7.2.6 BGT settings

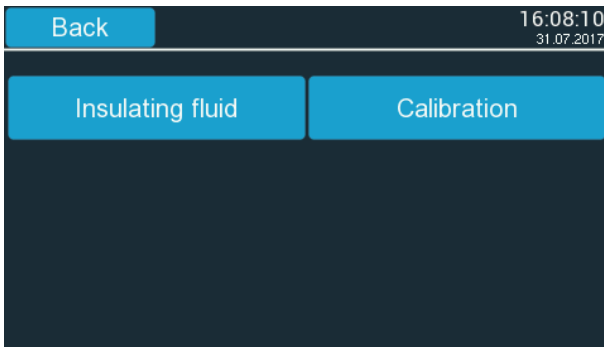


Fig. 12 - BGT settings

7.2.6.1 Insulating liquid

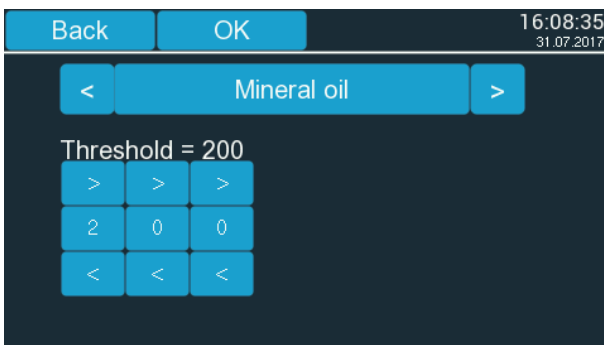


Fig 13 - Display, selection of insulating liquid and parameterization of H₂ limit value

By pressing “<” and “>” you can select mineral oil, synthetic ester or silicone oil as insulating liquid.

Parameterization covers the input of the specific limit values for the gases dissolved in the insulating liquid for the transformer or transformer type to be analyzed. The value set determines as from which concentration the measured value is displayed as “fault gas”. This does not have any impact on the measurement itself.

In BGT 4.2 parametrization is done for hydrogen only. By pressing the “<” and “>” buttons, the limit value for hydrogen dissolved in oil can be set between 0 and 999 ppm (v/v). The default setting is mineral oil, 200 ppm.

7.2.6.2 Calibration

This program allows two-point calibration of the BGT 4.2. For details, see section 9 “Maintenance/ calibration with H₂ by user”

7.2.7 Document

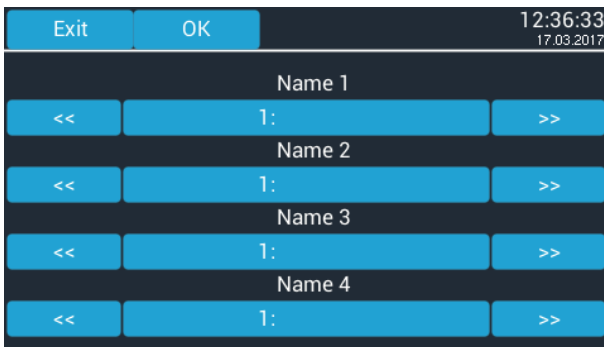


Fig. 14 – Display, input of additional information

In this submenu you can make settings on the device which are saved together with the measurement file. Up to four text boxes with max. 16 characters can be stored. In each of the four text boxes up to five values each can be stored. Selection is by pressing the “<<” and “>>” buttons. All text boxes are empty in the default setting.

The entries “Name 1” to “Name 4” cannot be changed on the device, but only with the help of the Windows software “BGT Logger” supplied (see section “BGT Logger for Windows”).

When pressing the text box selected, typical, switchable keyboard displays will be opened.

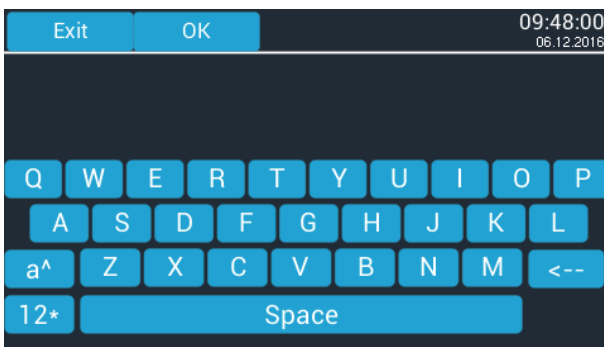


Fig. 15 – Display, input keyboard

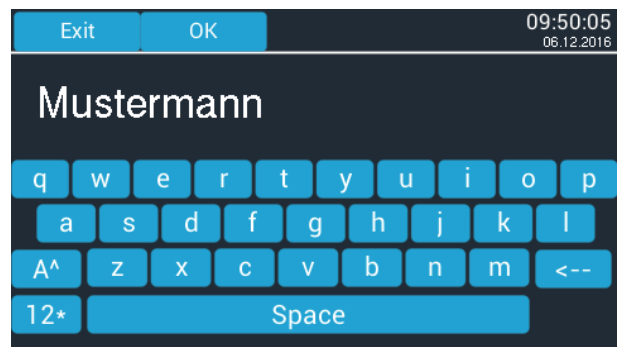


Fig. 16 – Display, input, text box 2

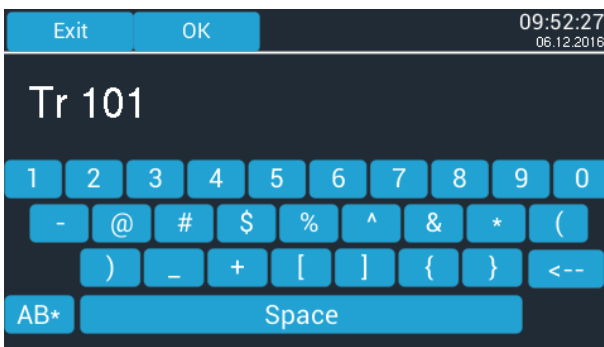


Fig. 17 – Input, text box 4

In the following example
in text box 1 (Name 1), position 1, "Hans" was saved,
in text box 2 (Name 2), position 1, "Mustermann",
in text box 3 (Name 3), position 2, "UW Prenzlau" and
in text box 4 (Name 4), position 4, "Tr 101".



Fig. 18 – Display with additional information

8 Buchholz gas analysis

8.1 General

The Buchholz gas analysis always consists of two successive measurements. First, one-point calibration of the measuring device with air is carried out which is followed by the actual measurement. The analysis consists of two purging steps and a measuring step. As a first purging step the fully extended piston rod of the BGS is pushed in as far as to the second mark (approx. 1.5 marking spacing) and in the subsequent steps by one marking spacing each. When the piston is pushed in, one defined gas quantity each is fed into the measuring instrument. This is indicated audibly by one or two sounds of a horn. The gas should be fed in directly after the respective signal is given. Undefined gas feed-in and prolonged interruptions between two steps can affect the accuracy of the analysis.



Fig. 19 – BGS with fully extended piston rod

It is recommended to additionally purge the BGT 4.2 during the warm-up phase or before starting the calibration. For that purpose a BGS filled with air is screwed onto the device and the piston rod pushed in slowly as far as to stop position without pressing any button.

Calibrations/measurements can be discontinued at any time by pressing “Stop”. The system starts anew with the step “Start calibration?”. If Buchholz gas has been fed in already, additional purging is necessary (at least three whole BGS volumes).

The hydrogen concentrations displayed (up to 5,0 % by volume) are based on Buchholz gas with an oxygen concentration of 12% by volume. Deviations from this value can cause an absolute error of max. $\pm 0.16\%$ by volume hydrogen.



NOTE

If a second BGS or an atomizer bulb is not available, the BGS must first be used for purging and single-point calibration of the BGT 4.2 with air. It can be filled with Buchholz gas by sampling from the Buchholz relay only when this has been done.

It is recommended to use a second BGS for the measurement of Buchholz gas. In this case the Buchholz gas measurement can be carried out immediately after the calibration with air. This can improve the accuracy of the analysis. If the residual gas left in the BGS after the measurement is to be sent to a laboratory for complete analysis, there is no risk of storing a measuring instrument that is not available for use.

8.2 Preparation of Buchholz gas analysis



CAUTION

Make sure that you comply with the local safety instructions for working with electrical equipment and sampling gas from the Buchholz relay.

Make sure that you are familiar with the operating instructions of the BGS.

To prepare the Buchholz gas analysis, check the BGS including the oil trap for correct function. After bleeding of the Buchholz relay as described in the instructions, a small oil quantity is left in the closed test valve that is not displaced by the collection of gas in the Buchholz relay. The oil trap serves as the opening plug of the BGS and prevents the ingress of this residual oil from the test valve of the Buchholz relay into the BGS.

Check the oil trap as follows:

- If there is oil in the oil trap, drain it.
- Visually check the O-ring seal in the screw-in opening, replace it if damaged.
- Visually check the hose, replace it if damaged.

Check tightness of the BGS as follows:

- Remove the sealing plug, loosen the knurled screw.
- Visually check the O-ring seal in the screw-in opening, replace it if damaged.
- Screw the oil trap into the BGS (check valve opens).
- Pull out the piston rod as far as to stop position.
- Unscrew the oil trap (check valve closes).
- Push the piston rod manually into the cylinder as far as to the second mark at least.
- Release the piston rod.
- The BGS is leak tight and can be used only when the pressure in the piston pushes the rod back into its original position.

The supplied atomizer bulb can be used for rinsing and the one-point calibration with air of the BGT 4.2 instead of a BGS.

Check the efficient functioning of the atomizer bulb as follows:

- Visually check the atomizer bulb including the hose, do not use it if damaged.
- Tightness check:
Close the hose end by a finger,
press the atomizer bulb multiple times briefly by the other hand:
The bulb has to return into the starting shape without a noticeable intake noise caused by the pressure valve.
- Pressure valve check:
Close the pressure valve by a finger,
compress the atomizer bulb almost completely, let off the hand:
The bulb must not return into the starting shape.
- Hose connection check:
Plug the hose on the gas inlet nozzle of the BGT 4.2:
If the hose end is too loose on the nozzle (hose opening expanded), cut a small piece.

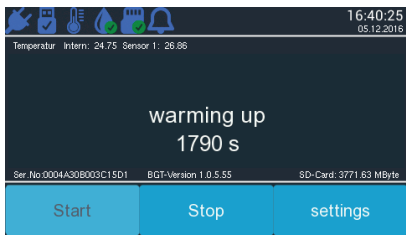
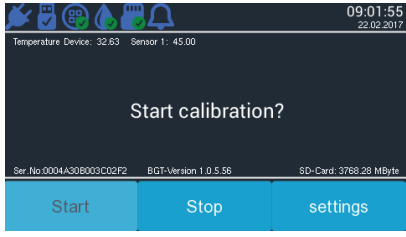
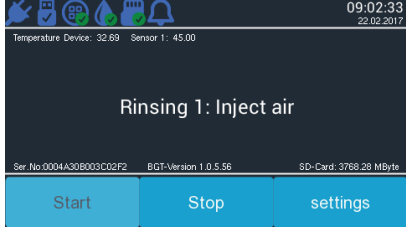
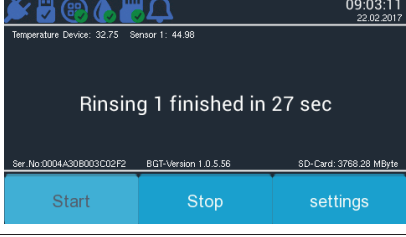
For the rinsing of the BGT 4.2 and for the one-point calibration with air the atomizer bulb hose has to be plugged on the gas inlet nozzle. The air injection into the BGT 4.2 is carried out by an almost complete compression of the atomizer bulb. Five air inputs by the compression of atomizer bulb can be done instead of the injection of a whole BGT volume of air. The volume of the air input into the BGT 4.2 carried out by pushing the piston rod of the BGS approximately 1 until 1.5 marking spaces matches the air volume of one atomizer bulb compression.

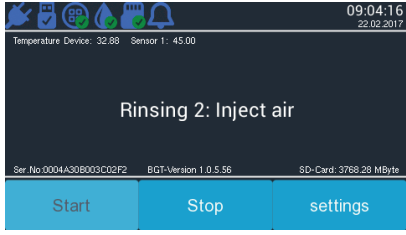
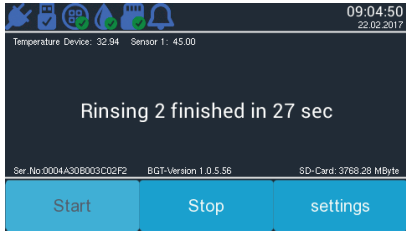
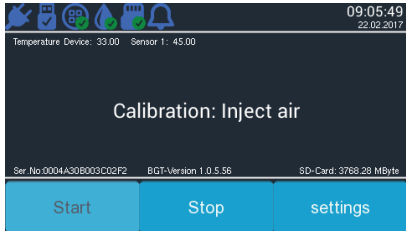
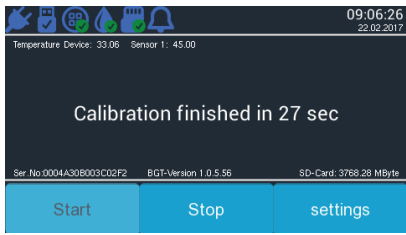
8.3 Buchholz gas analysis



NOTE

In derogation from any of the following figures, measurement is carried out without an USB cable connected to a PC; the relevant symbol is empty.

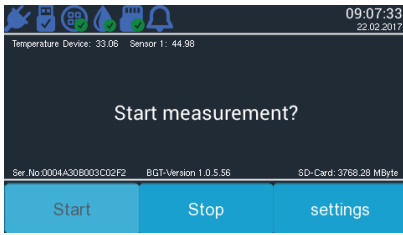
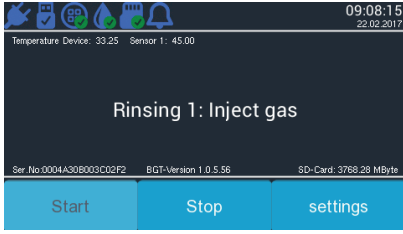
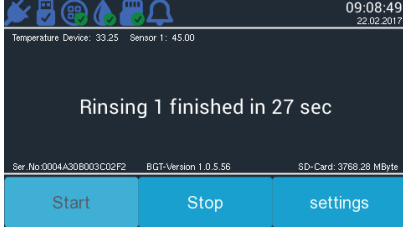
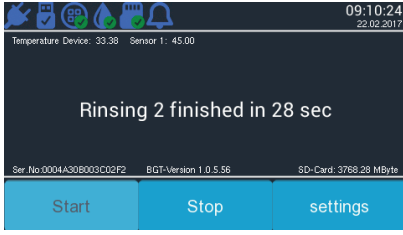
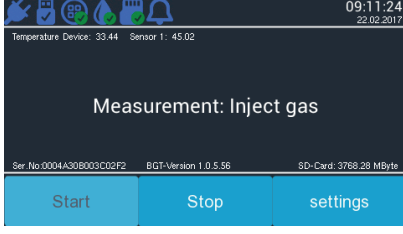
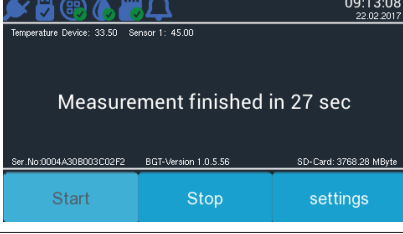
Step	Action	Figure
Calibration with ambient air:		
1	<ul style="list-style-type: none"> Switch on the device. Wait. Make adjustments, if required. 	
2	<ul style="list-style-type: none"> Fill the BGS with air. Screw it hand-tight onto the BGT 4.2. Press "Start". or <ul style="list-style-type: none"> Plug the atomizer bulk on the nozzle. Press „Start“. 	
3	<ul style="list-style-type: none"> Push in the piston rod as far as to the second mark. or <ul style="list-style-type: none"> Compress the atomizer bulk once. 	
4	<ul style="list-style-type: none"> Wait. Count down from 30 sec. 	

5	<ul style="list-style-type: none"> • Push in the piston rod as far as to the third mark. <p>or</p> <ul style="list-style-type: none"> • Compress the atomizer bulk once. 	
6	<ul style="list-style-type: none"> • Wait. • Count down from 30 sec. 	
7	<ul style="list-style-type: none"> • Push in the piston rod as far as to the fourth mark. <p>or</p> <ul style="list-style-type: none"> • Compress the atomizer bulk once. 	
8	<ul style="list-style-type: none"> • Wait. • Count down from 30 sec. 	





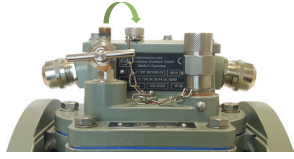
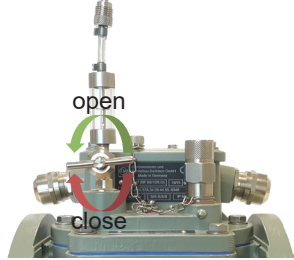


NOTE

If you work with one BGS only, and without an atomizer bulk, unscrew it from the BGT 4.2 after the message “Start measurement?” has appeared and drain the gas from the Buchholz relay (also see section 8.4 of this manual).
 The BGT 4.2 remains ON without further pressing of any button.

Buchholz gas measurement:		
9	<ul style="list-style-type: none"> Loosen the knurled screw on the piston rod of the BGS. Unscrew the sealing plug of the BGS. Screw the BGS filled with Buchholz gas hand-tight onto the BGT 4.2. Press "Start". 	
10	<ul style="list-style-type: none"> Push in the piston rod as far as to the second mark. 	
11	<ul style="list-style-type: none"> Wait. Count down from 30 sec. 	
12	<ul style="list-style-type: none"> Push in the piston rod as far as to the third mark. 	
13	<ul style="list-style-type: none"> Wait. Count down from 30 sec. 	
14	<ul style="list-style-type: none"> Push in the piston rod as far as to fourth mark. 	
15	<ul style="list-style-type: none"> Wait. Count down from 30 sec. 	

<p>16</p> <ul style="list-style-type: none"> • Display of results. 		<p>09:14:09 22.02.2017 Temperature Device: 33.58 Sensor 1: 45.00 <0,05 Vol% CO2 <0,05 Vol% CO <0,10 Vol% CH4 <0,05 Vol% C2H2 <0,3 Vol% H2 Ser. No.0004A30B003C02F2 BGT-Version 1.0.5.56 SD-Card: 3768,28 MByte Continue</p> <p>09:30:11 22.02.2017 Temperature Device: 34.31 Sensor 1: 44.98 <0,05 Vol% CO2 0,85 Vol% CO <0,10 Vol% CH4 0,37 Vol% C2H2 4,26 Vol% H2 Fault gas Ser. No.0004A30B003C02F2 BGT-Version 1.0.5.56 SD-Card: 3768,28 MByte Continue</p>
<p>If you wish to measure another gas sample, press “Continue”, if not, switch off the device.</p>		
<p>17</p> <ul style="list-style-type: none"> • If “Continue” was pressed, the analysis starts anew with calibration (step 2). 		<p>09:15:04 22.02.2017 Temperature Device: 33.69 Sensor 1: 45.00 Start calibration? Ser. No.0004A30B003C02F2 BGT-Version 1.0.5.56 SD-Card: 3768,28 MByte Start Stop settings</p>

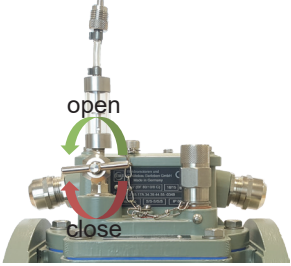

8.4 Sampling of gas from the Buchholz relay

Step	Action	Figure
1	<ul style="list-style-type: none"> Screw the oil trap hand-tight into the BGS. Push in the piston rod completely. 	
2	<ul style="list-style-type: none"> Remove the oil trap from the BGS. 	
3	<ul style="list-style-type: none"> Unscrew the cap nut on the test valve of the Buchholz relay. Wipe the test valve of the Buchholz relay with a cloth. 	
4	<ul style="list-style-type: none"> Screw the oil trap hand-tight onto the test valve of the Buchholz relay. 	
5	<ul style="list-style-type: none"> Open the test valve of the Buchholz relay for a short moment (turn anticlockwise) to purge the test valve and oil trap with Buchholz gas. 	
6	<ul style="list-style-type: none"> Swiftly screw the BGS hand-tight onto the oil trap; the check valve in the BGS opens. 	
7	<ul style="list-style-type: none"> Open the test valve of the Buchholz relay (turn anticlockwise). The pressure of the oil column in the conservator of the transformer may push out the piston with the piston rod as far as to stop position so that the gas is transferred from the Buchholz relay into the BGS. At low pressure the piston must be pulled out slowly. 	



CAUTION

Observe the oil trap continually while the BGS is filled.
As soon as oil enters the oil trap, close the test valve of the Buchholz relay and terminate the sampling process.

8	<ul style="list-style-type: none"> Close the test valve of the Buchholz relay (turn clockwise). 	
9	<ul style="list-style-type: none"> Remove the BGS from the oil trap. This closes the check valve in the BGS. The oil trap remains screwed onto the test valve. 	
10	<ul style="list-style-type: none"> Push the piston rod of the BGS by hand into the piston at least as far as to the first mark, fix it using the knurled screw and screw in the sealing plug. This step is not necessary when an onsite measurement is carried out immediately afterwards. 	
11	<ul style="list-style-type: none"> Unscrew the oil trap from the test valve of the Buchholz relay. 	
12	<ul style="list-style-type: none"> Close the test valve by fitting the cap nut. 	



NOTE

The gas left in the Buchholz relay should be kept for further sampling. It should be drained completely only after completion of the measurement.

13	<ul style="list-style-type: none"> Close the test valve of the Buchholz relay.
14	<ul style="list-style-type: none"> Drain the oil trap and wipe using a cloth.

9 Maintenance / calibration with H₂ by user

The device is maintenance-free. If not used, it should be stored in the transport case in a dry and dust-free environment.

The device was calibrated carefully over the whole measuring range by the manufacturer. When used as intended, sensitivity of the measuring cell does normally not change, even when the device has been used for many years.

Irrespective of how often the device is used, it should be calibrated with hydrogen at intervals of not more than four years. Calibration can be carried out by the user as two-point calibration. Alternatively, the device can be sent to the manufacturer for complete calibration.

The menu item “Calibration” opens a program that allows the user to calibrate the device with hydrogen. However, two-point calibration does not calibrate the entire measuring range, but only the range up to ca. 20% by volume that is of relevance for the identification of faults.



NOTE

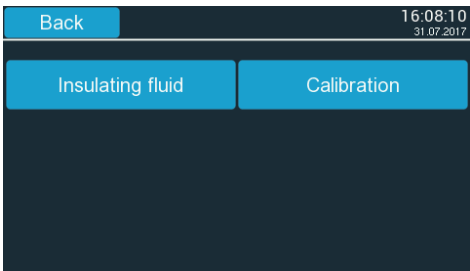
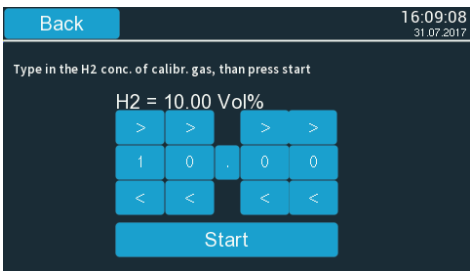
Calibrations must be carried out carefully, by experienced staff and using suitable equipment.

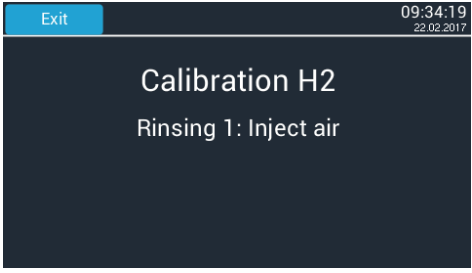

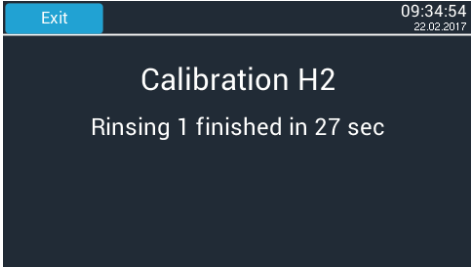
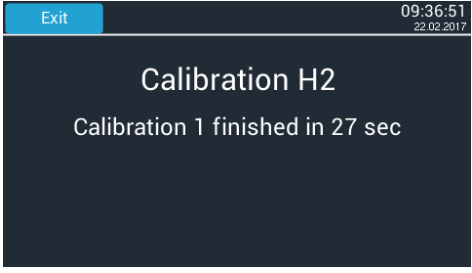
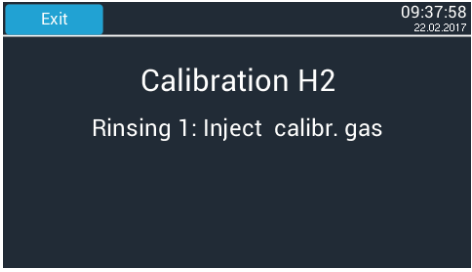
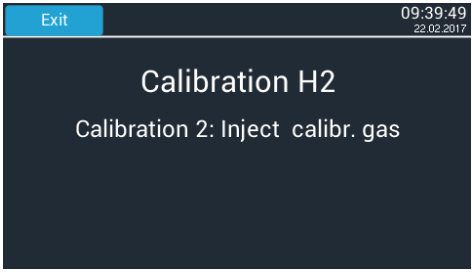
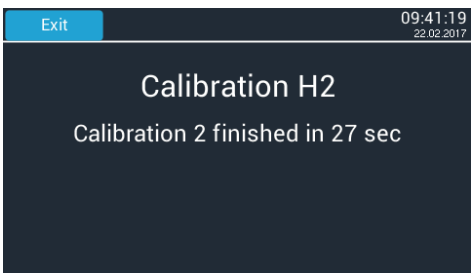
Calibration gas of a hydrogen concentration between 9.00 and 11.00% by volume, preferably 10% by volume, the residual volume is nitrogen.

The hydrogen calibration process is identical to that of the Buchholz gas analysis, except that the BGS is filled with calibration gas instead of Buchholz gas. Purge the gas sampling equipment and the BGS appropriately to ensure that the hydrogen concentration in the BGS corresponds to the specified calibration gas concentration.

It is recommended to use two BGS units to carry out the measurements immediately one after the other.

Proceed as follows:

Step	Action	Figure
1	<ul style="list-style-type: none"> Press “settings” on the start screen. Press “BGT-settings” on the next screen. Select “Calibration”. 	 <p>The screenshot shows a dark blue interface with a 'Back' button at the top left. The top right corner displays the time '16:08:10' and the date '31.07.2017'. Below the 'Back' button are two main menu items: 'Insulating fluid' and 'Calibration', both highlighted in a lighter blue color.</p>
2	<ul style="list-style-type: none"> Enter the hydrogen concentration of the calibration gas by pressing “<” and “>”, e.g. 9.20. Press “Start”. 	 <p>The screenshot shows a dark blue interface with a 'Back' button at the top left. The top right corner displays the time '16:09:08' and the date '31.07.2017'. Below the 'Back' button, the text reads 'Type in the H2 conc. of calibr. gas, than press start'. The current value is 'H2 = 10.00 Vol%'. A numeric keypad is visible with buttons for '>', '<', '1', '0', '.', '0', '0', '<', '<', and a 'Start' button at the bottom.</p>

<p>3</p>	<p>The window as shown under section 3 for the Buchholz gas analysis is opened; it covers additionally “Calibration H2”.</p> <ul style="list-style-type: none"> Follow the instructions on the display. 	
<p> Only selected steps are shown in the following.</p>		
<p>4</p>	<p>Analogous to step 4 of the Buchholz gas analysis.</p> <ul style="list-style-type: none"> Wait. Count down from 30 sec. 	
<p>5</p>	<p>Analogous to step 8 of the Buchholz gas analysis.</p> <ul style="list-style-type: none"> Wait. Countdown from 30 sec. <p>“Calibration 1” means calibration with air.</p>	
<p>6</p>	<p>Analogous to step 10 of the Buchholz gas analysis.</p> <ul style="list-style-type: none"> Enter the calibration gas now. → Push in the piston rod as far as the second mark. 	
<p>7</p>	<p>Analogous to step 14 of the Buchholz gas analysis.</p> <ul style="list-style-type: none"> Push in the piston rod as far as to the fourth mark <p>“Calibration 2” means calibration with calibration gas.</p>	
<p>8</p>	<p>Analogous to step 15 of the Buchholz gas analysis.</p> <ul style="list-style-type: none"> Wait. Countdown from 30 sec. 	

Representation of result:

If the calibration value differs from the manufacturer's calibration value by more than $\pm 10\%$, calibration has failed (Fig. 20). If the difference is less than that, the new value will be saved and the internal calibration curve adjusted (Fig. 21).

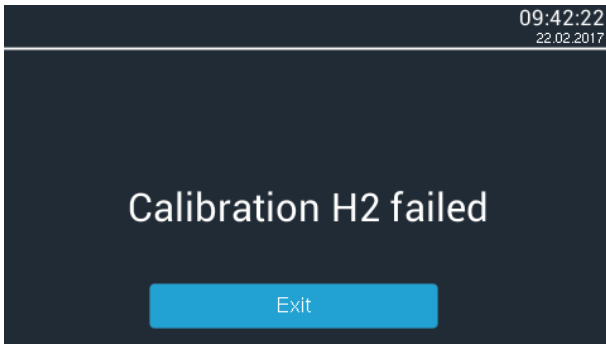


Fig. 20 – Display, calibration H₂ failed

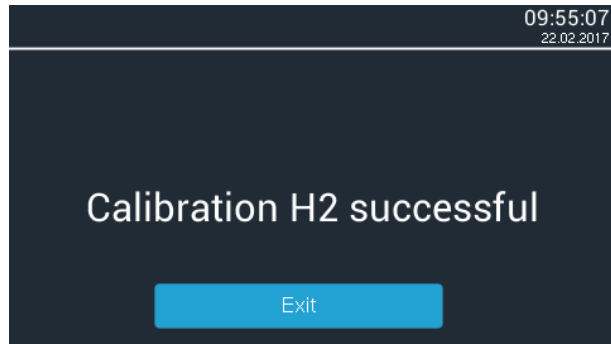


Fig. 21 – Display, calibration H₂ successful

Press “Exit” to leave the program item.

Failure of calibration with H₂ may be caused by:

- Calibration was not carried out correctly. Check the concentration data of the calibration gas and the gas sampling equipment. Before a new calibration, purge the gas routes of the BGT 4.2 thoroughly with air (at least two full BGS units). If you use only one BGS, it has to be purged before use.
- The measuring cell has been damaged severely, e.g. by entry of oil into the gas routes. In this case the device has to be sent to the contracting party for repair.
-

If you are not sure why calibration has failed, contact the manufacturer/vendor and send him all files of the calibration attempts (see BGT logger).

10 BGT Logger with Windows

In as-delivered state the BGT 4.2 is provided with a micro SD card. You can carry out measurements, even when the device does not have a micro SD card. In this case, the results are only displayed at the end of the measurement, however, they are not stored.

The “BGT” logger program on the data carrier supplied with the device allows you

- to change the settings of the device,
- carry out software updates for the BGT (normally not required),
- view results of stored measurements,
- create reports, save and print.

This program requires Windows XP or a higher version. Also note the information on the documents for the card reader enclosed.

Open the program folder and follow the installation instructions.

The main screen will be opened. Examples are shown in the figures below. These may differ depending on the software version.

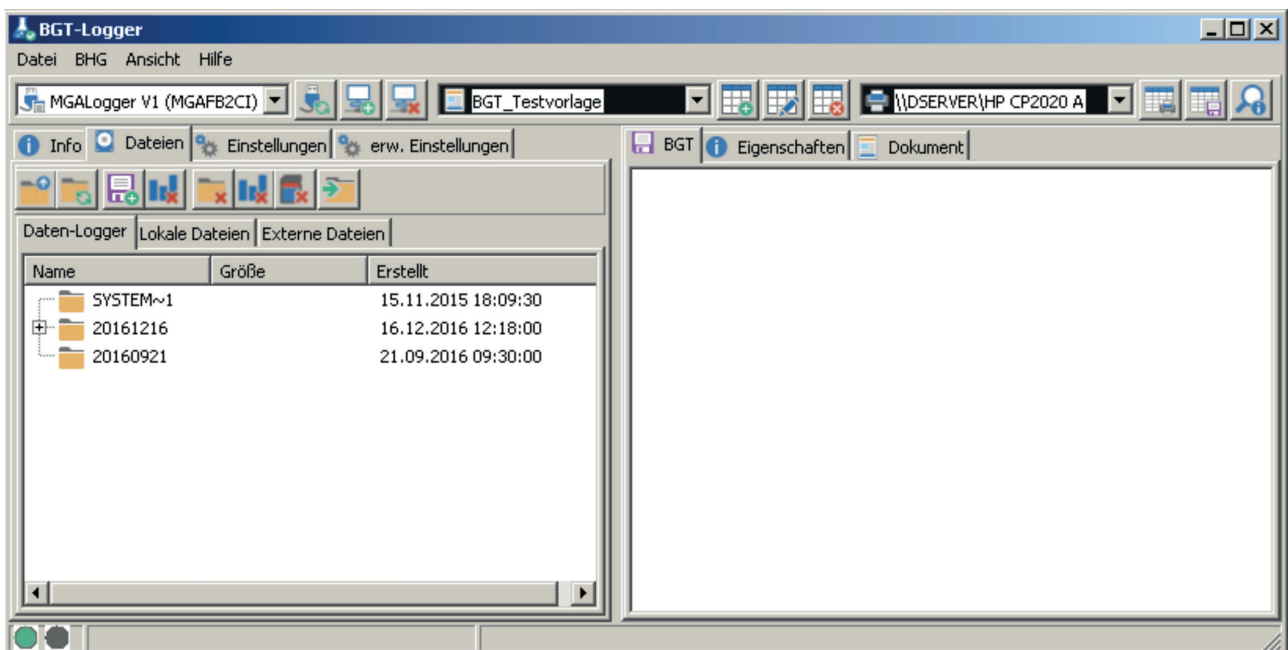
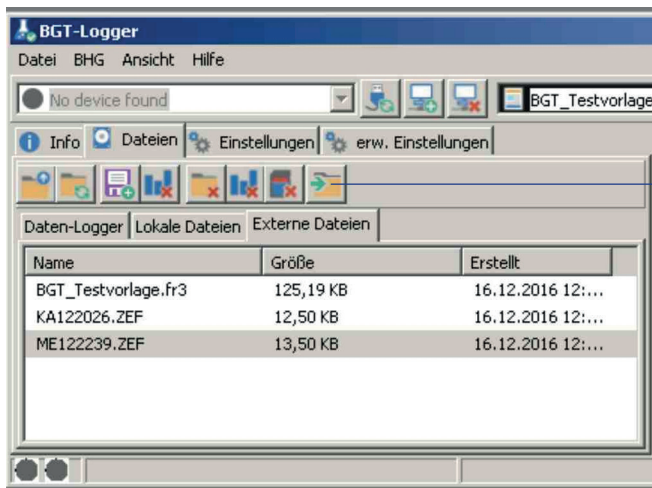


Fig. 22 – BGT logger software

The green point (at the bottom, left) in Fig. 22 appears once the connection with BGT 4.2 has been made. The folders on the memory card in BGT 4.2 are displayed.



Symbol "Import file"

Fig. 23 – BGT logger, display of external files (without BGT connection)

In the window "Dateien" you can select, open, save, copy and move files. Figs. 22, 23 and 24 show the file structure of BGT 4.2. All files created on the same day are automatically stored in a folder with this date (yyyy/mm/dd). The files are assigned two letters (KA for calibration with air, ME for measurement) and the time of saving (hh:mm:ss).

If you wish to open and edit a file, click on the file. If the files have not yet been imported during the current session (no green tick in the symbol), this process can take some time. A progress bar appears at bottom left.

For external data backup you may save the folders/files on another disk. For that purpose remove the micro SD card from the slot, place it in the card reader included in the scope of supply and plug it into a USB port of the PC. Direct data transfer from the BGT 4.2 to a PC disk is not possible. To edit files stored externally, go to the folder "Externe Dateien" of the BGT logger (Fig. 23) and click on the symbol "Datei importieren".

If you click on "BGT" on the right side, the result of the measurement activated on the left side will be shown (Fig. 24).

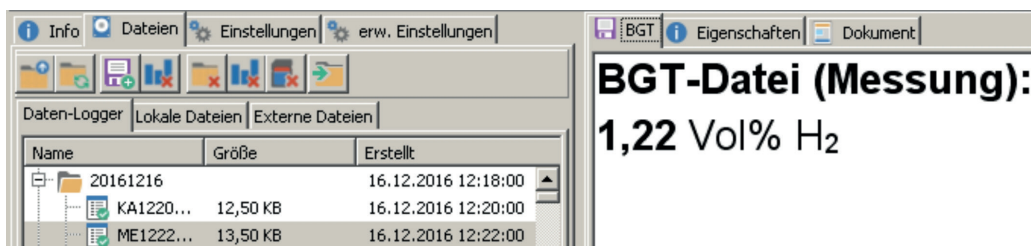


Fig. 24 – BGT logger- display of measured values



NOTE

Do not forget to re-insert the micro SD card into the BGT 4.2. Without the card being inserted, the data cannot be stored!

The window “Info” provides a survey of the hardware connected. These data are informative and cannot be changed.

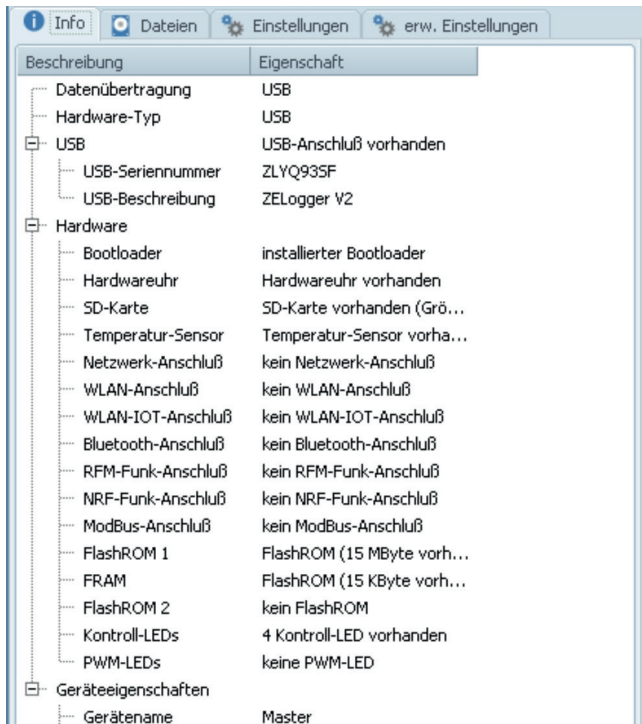


Fig. 25 – BGT logger, device information

Under “Einstellungen” (Fig. 26) you can also change settings and enter additional, internal variables. There are two options for editing an entry. Click on a field, wait for a short time and click again to open the editor mode where the field can be edited. You can also click on the field and then press the F2 button. The field will change to the editor mode.

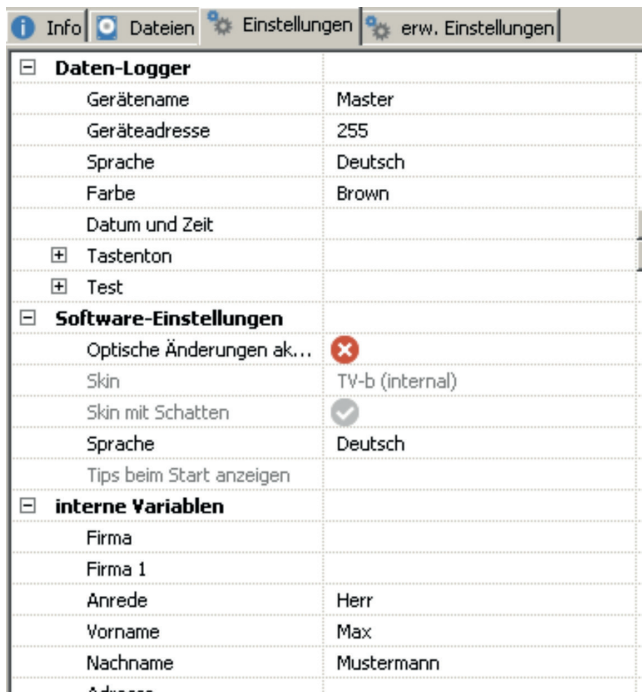


Fig. 26 – BGT logger, settings

Under “erweiterte Einstellungen” the settings described under “Einstellung: Dokument” can be made (“Name 1” is equivalent to „Property 1“, etc.).

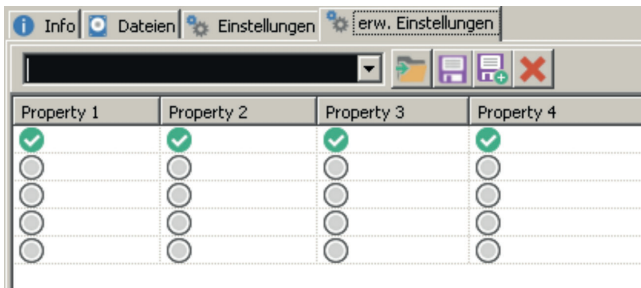


Fig. 27 – BGT logger, “erweiterte Einstellungen”

Under “Eigenschaften“ information about the measurement is displayed which is of no relevance to the user.

Under “Dokument” you can create, store or print documents.

Select a template, in the present case the BGT test template, and click on “Dokument ändern”.



Fig. 28 – BGT logger, editing a document

The document designer with the selected template opens.

The parameters of the device set (Fig. 29) and the files (Fig. 30) can be used for the design of the document.

A detailed description of the document designer is not given here.

Fig. 31 shows a document created using the test template and the settings of the internal variables for the measurement ME122239.zef of 16 December 2016 (Figs. 23 and 24). The empty section at the bottom of the page in A4 portrait is not shown.

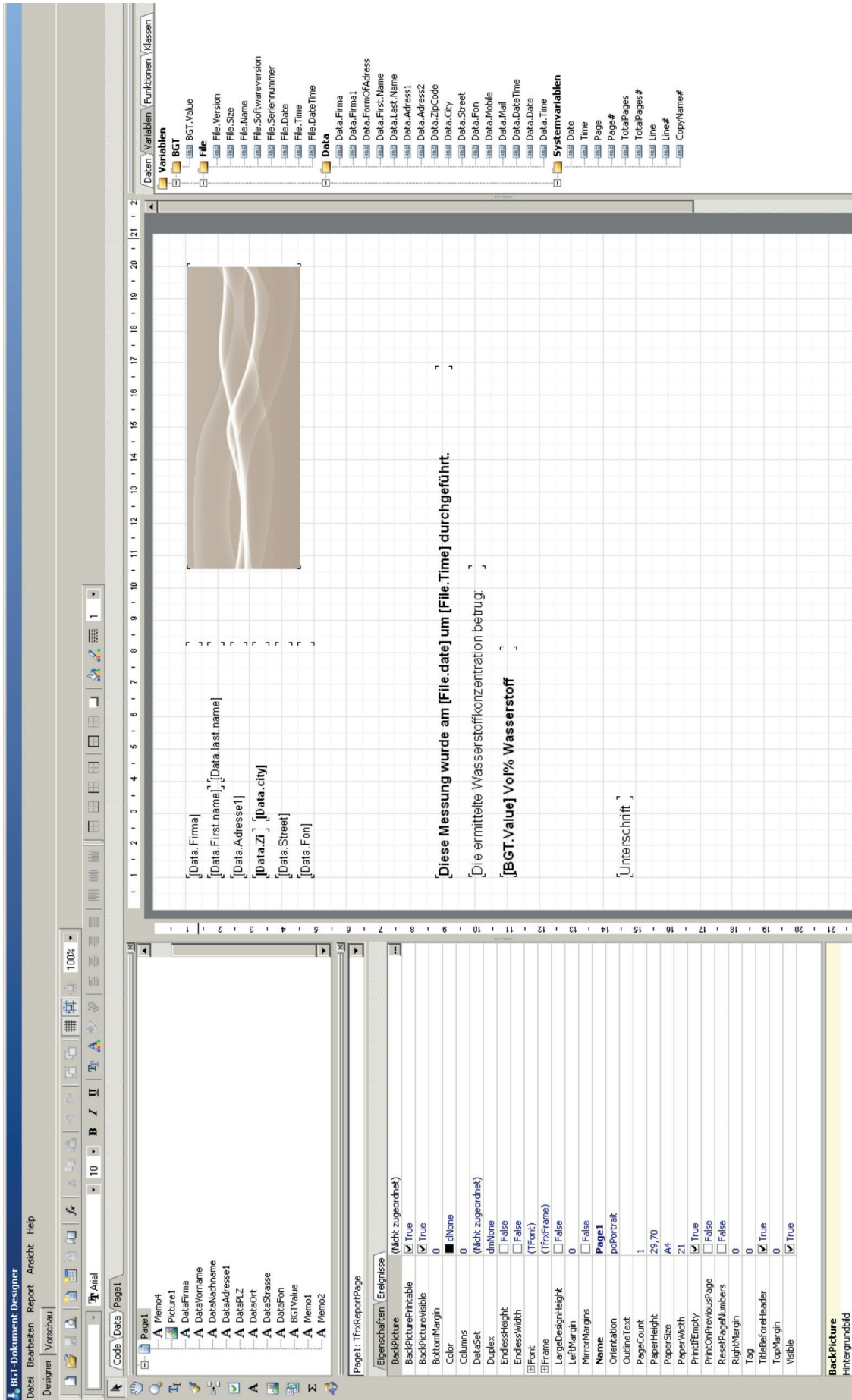


Fig. 29 – BGT logger, document designer with open BGT test template

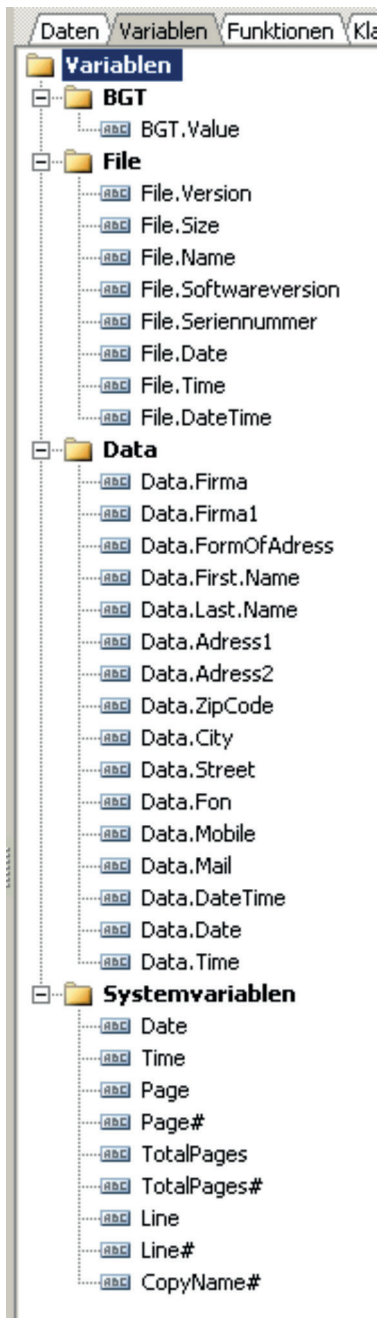


Fig. 30 – BGT logger, variables which can be used for document creation

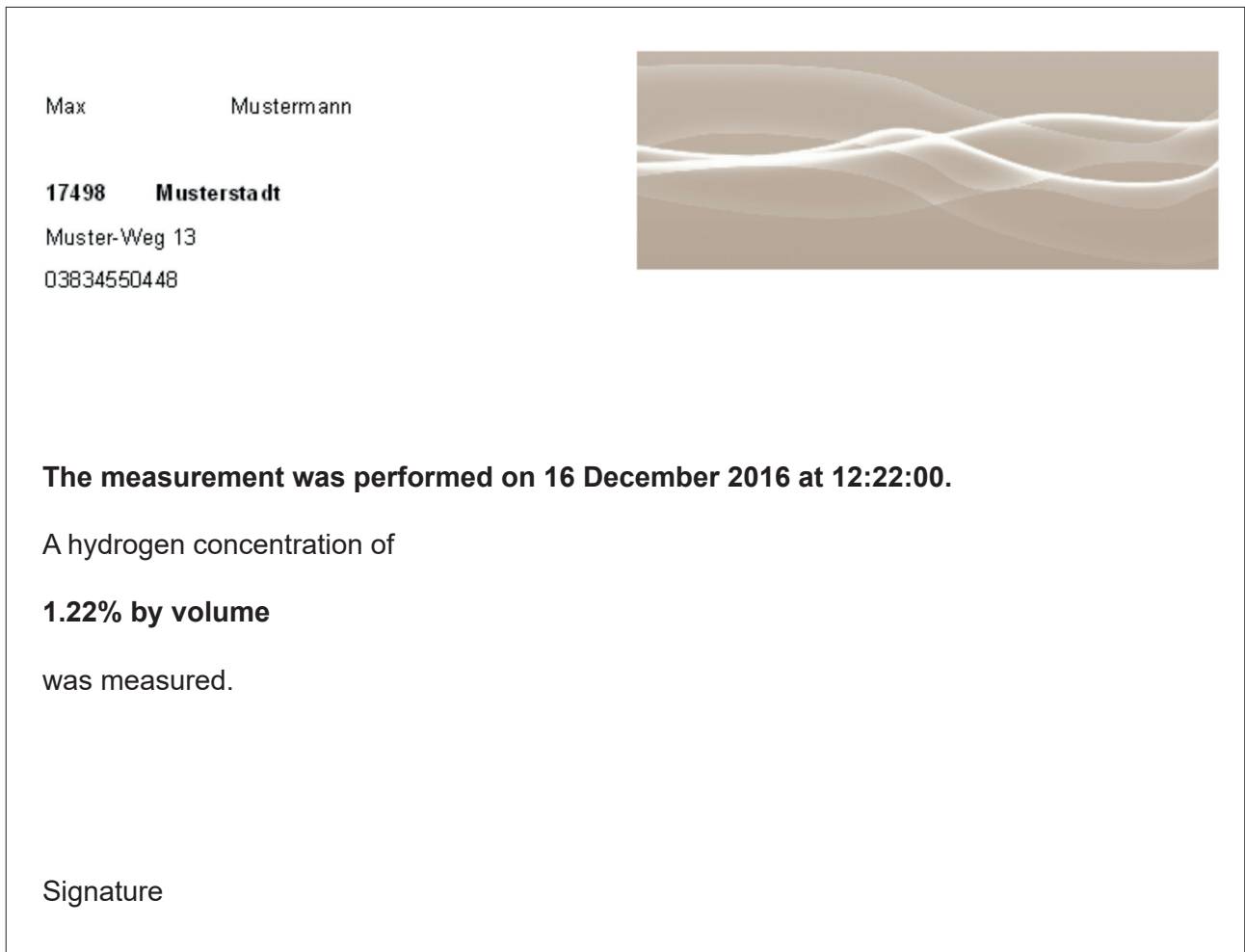


Fig. 31 – BGT logger, example of document

If a software update is required, select “Hilfe” and click on “Update”. Follow the instructions given.

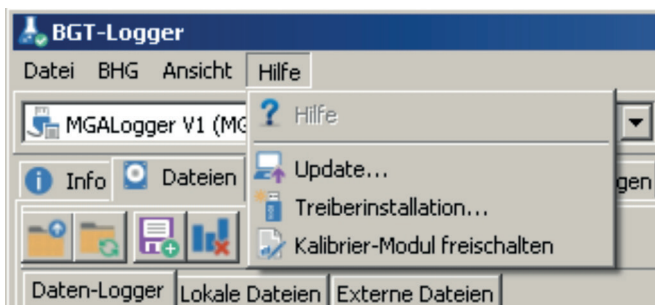


Fig. 32 – BGT logger, software update

11 Technical data

Parameter	Value/data
BGT 4.2	
Power supply	100-240 V / 50-60 Hz power supply unit 24V DC / 230 V AC AC-DC inverter for vehicle 24V DC internal onboard system
Power input	50 VA, approx. 25 W internal, controlled
Keyboard / display	Touchscreen / colour LCD
Degree of protection	IP 40
Casing material	Aluminium alloy
Weight	Approx. 3.5 kg Approx. 7.9 kg incl. transport case and accessories
Dimensions transport case	460 x 340 x 200 mm
Ambient conditions	Storage Measurement
• Temperature	-20 °C to 60 °C -20 °C to 45 °C
• Relative humidity	< 95 % < 95 %
Gas consumption per measurement	Approx. 65 ml air and approx. 65 ml Buchholz gas
Sensors	Thermal conductivity measuring cell, tempered Gas moisture sensor max. 4 NDIR-sensors

Gas	Measuring range (25 °C, 1013 hPa)	Accuracy (25 °C, 1013 hPa) after running-in period of 30 min
H ₂ (Hydrogen)	> 0.3 vol.% to 5.0 vol.% > 5.0 vol.% to 95.0 vol.%	±10 % rel. ±0,1 vol.% (Gas with 12 Vol% O ₂ , rest N ₂) ±10 % rel. (Gas with 0 - 21 Vol% O ₂ , rest N ₂)
CO ₂ (Carbon dioxide)	> 0.05 vol.% to 10.0 vol.%	±10 % rel. ±0,05 vol.% (Gas with 0 - 21 Vol% O ₂ , rest N ₂)
CO (Carbon monoxide)	> 0.05 vol.% to 25.0 vol.%	±10 % rel. ±0,05 vol.% (Gas with 0 - 21 Vol% O ₂ , rest N ₂)
CH ₄ + (*)	> 0.05 vol.% to 10.0 vol.%	±10 % rel. ±0,05 vol.% (Gas with 0 - 21 Vol% O ₂ , rest N ₂)
C ₂ H ₂ (Acetylene)	> 0.05 vol.% to 10.0 vol.%	±10 % rel. ±0,05 vol.% (Gas with 0 - 21 Vol% O ₂ , rest N ₂)

* CH₄+: all gaseous hydrocarbons without C₂H₂, calibrated as methane.

Influence of recurrent gases on the readings of the CH₄+sensor		
Gas	actual-concentration / vol.%	Displayed as CH₄+ / vol.%
CH ₄ (Methane)	0,10	0,10
C ₂ H ₆ (Ethane)	0,10	0,16
C ₂ H ₆ (Ethane)	2,00	6,00
C ₂ H ₄ (Ethylene)	0,10	0,04
C ₃ H ₈ (Propane)	0,10	0,09
C ₃ H ₆ (Propylene)	0,10	0,09

BGS	
Volume	100 ml
Length, piston extended	250 mm
Outside diameter	42 mm
Material	Stainless steel
Weight	ca. 480 g
Degree of protection	IP 40
Storage life of gas	5 days
Ambient conditions <ul style="list-style-type: none"> • Ambient temperature • Relative humidity 	Storage and use -20°C to 60°C < 95%

12 Failure Gases

A gas alarm signal of the Buchholz relay is given - What to do?

1. Collect a gas sample from the Buchholz relay immediately.

Why immediately?

If there is free gas in the Buchholz relay, transformer oil and gas are in close contact.

Therefore some gas constituents will dissolve in the oil, modifying the composition of the gas collected. Typical fault gas patterns will disappear.

Acetylene (C_2H_2), ethane (C_2H_6), ethylene (C_2H_4) and carbon dioxide (CO_2) are very soluble gases, hydrogen (H_2), carbon monoxide (CO) and methane (CH_4) are less soluble gases in transformer oil.

2. Analyse the Buchholz gas as soon as possible by means of BGT 4.1 or BGT 4.2.

Why as soon as possible?

The analysis results can be included in making a solid decision about the further transformer operation without delay.

3. Which results can be obtained from the Buchholz gas analysis?

Due to the analysis can be distinguished, if the incident

- was caused by a serious fault in the transformer or
- has been occurred due to air accumulation in the Buchholz relay.

To make a decision „Fault gas or Air“ the measurement of the hydrogen concentration in the Buchholz gas (BGT 4.1) is enough. Any kind of fault in the oil causes the formation of hydrogen.

4. What kind of fault sources can be distinguished?

Cause of failure	Gases evolved (key gases)	Fault gas pattern Measurement by BGT 4.2				
		H_2	CO_2	CO	CH_4+	C_2H_2
Discharges of high energy (e.g. arcs, break downs, short circuits)	C_2H_2 , H_2	X	-	-	-	X
Discharges of low energy (e.g. partial disch., sparking disch., corona discharges)	H_2 , CH_4	X	-	-	X	-
Thermal faults	C_2H_4 , CH_4 , H_2 , C_2H_6	X	-	-	X	-
Involvement of the solid (cellulosic) insulation	CO, also: CO_2	-	(X)	X	-	-
Air bubbles	none	-	-	-	-	-

It is generally difficult to distinguish between faults caused by discharges of low energy and thermal faults on the knowledge of the Buchholz gas composition only. Both faults cause the formation of the less soluble gases hydrogen and methane. On the other hand the very soluble key gases for thermal faults ethylene and ethane may not reach the gas collecting relay.

Also in Buchholz gases caused by air accumulation can be low fault gas concentrations.

These fault gases evaporated out of the oil into the gas bubbles during the bubble rise to the collecting relay.

In oil transformers do not exist faults which affect the solid insulation only.



Elektromotoren und Gerätebau Barleben GmbH



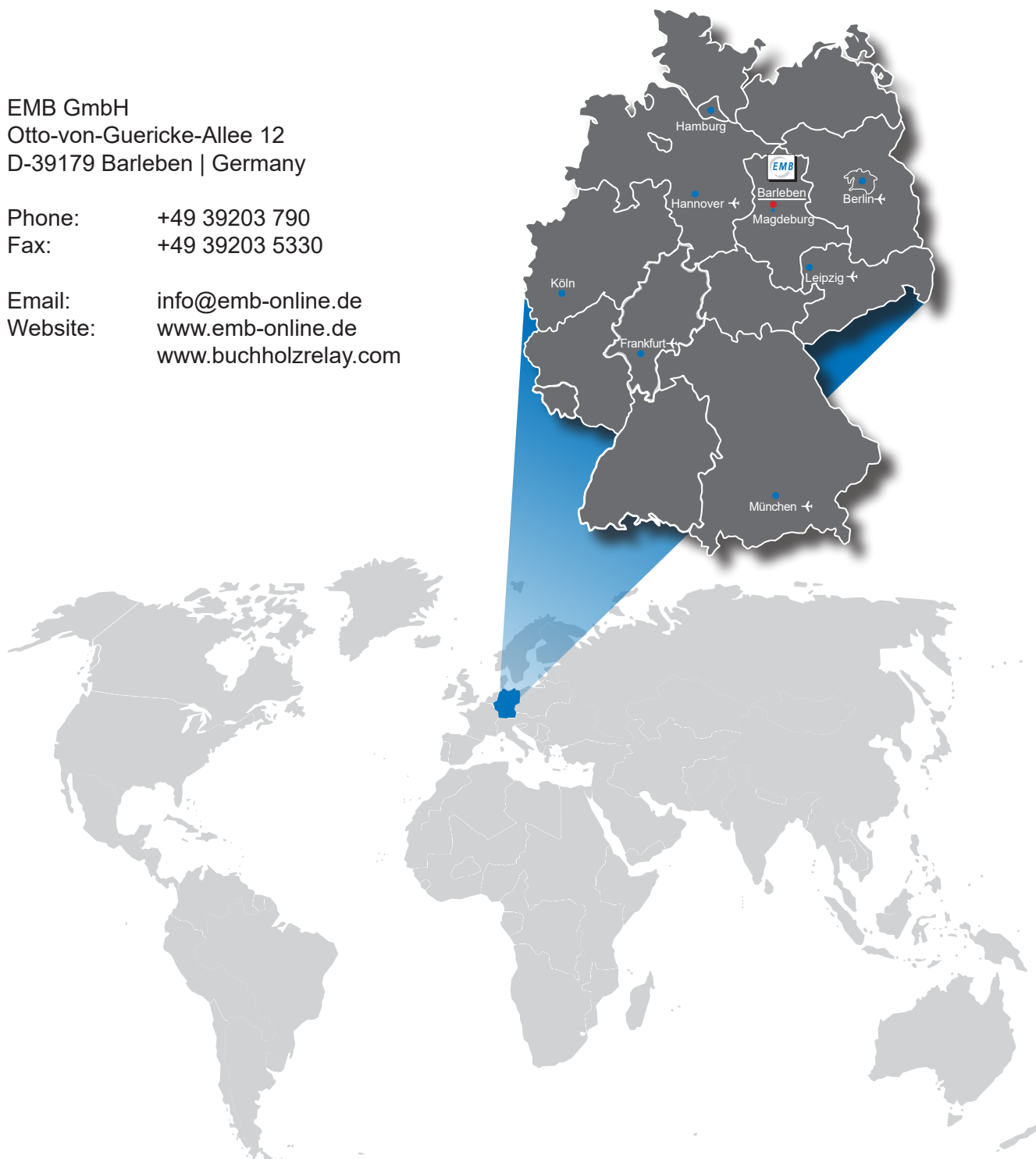
GATRON

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