



SF₆-Multimeter

Operating Manual (original version)

Type-No.: 3-038



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SF₆-Multimeter | 3-038

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Please read this operating manual before putting the device into operation. Thus operating faults can be avoided. In case of nonobservance of the operating manual the manufacturer cannot assume any liability or warranty.

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1. General information

1.1 Specific safety notes and standard symbols

In the following operating manuals specific safety warnings are given in order to draw your attention to residual risks which cannot be avoided during the operation of the device.

These residual risks contain dangers for

- Persons
- Product and machine
- The environment

The symbols used in the operating manuals should draw your attention specially to the safety notes! If the device is not used for the purposes for which it is intended there is the risk of danger. For this reason observe the safety notes:



This symbol refers to risks for persons (danger to life, danger of injury)



This symbol refers to risks for machines, material and the environment.



This symbol refers to electric shock

The most important aim of the safety notes is to prevent personal injuries.

- If the warning sign „**Danger**“, appears, danger from machines, materials and the environment are not excluded.
- If the warning sign „**Warning**“, appears, there is no danger for persons.

The corresponding symbol which is used cannot replace the text of the safety note. Therefore the complete text must always be read.



This symbol is not for safety notes, but for information to better understand the device.

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1.2 Initial operation

All personnel involved in the operation and repair of DILO devices should be specially trained and instructed.

For the initial operation of the SF₆-Multimeter no special measures must be taken.

For the measurement follow the instructions of chapter 4.5 "Individual measurement" or chapter 4.6 "Permanent measurement".

1.3 Correct use of the SF₆-Multimeter

The SF₆-Multimeter serves for the determination of the SF₆-volume percentage of moisture and SO₂ (sulphur dioxide) in the SF₆-gas. After the measurement the measuring values can be stored in the SF₆-Multimeter and if necessary they can also be transmitted immediately or later to a PC or Laptop.

The measuring gas is released via the open "gas outlet" stub on the back. For environmental protection a B151R20 discharge gas collection unit is available as option. With this unit the measuring gas can be collected completely. It is also possible to lead the used gas into the gas collecting bag. As the inlet valve of the SF₆-Multimeter closes in time and thus the measurement is interrupted an overpressure in the gas collecting bag cannot be generated.

In case of long-time application without using a discharge gas collection unit pay attention that the corresponding rooms are ventilated sufficiently.

The use of the device for different gas mixtures (SF₆-N₂/air or SF₆-CF₄) is only possible as option and by switching over.



Note

Do not close the "Gas outlet" during the operation of the device otherwise the measuring process is interrupted.

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1.4 Obligation to exercise due care

The device has been designed and constructed bearing in mind the standards to be observed as well as additional technical specifications.
Safe use of the machine can only be achieved if all the necessary measures are followed.

The operator has to ensure that

- the SF₆-Multimeter is only used for the purposes for which it is intended.
- the SF₆-Multimeter is only operated in accordance with the instructions and in good condition
- complete and legible operating manuals are available on site.
- only qualified personnel operates or repairs the SF₆-Multimeter.
- this personnel is regularly instructed in safety procedures and environmental protection and that this personnel is fully aware of the complete operating manuals and particularly in the safety notes.
- the safety and warning notes mounted on the SF₆-Multimeter are legible and not removed.



Danger

The parts inside the SF₆-Multimeter are under dangerous supply voltage in case of connected power connecting cable. Prior to opening the housing disconnect the device from the power supply and switch off the device so that it does not run with accumulators.



Danger

In the power supply of the device there are lithium ions accumulators. Do not damage the device otherwise short-circuits can be generated.

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1.5 Instructions for exchanging measuring gas modules

There are 3 modules in the SF₆-Multimeter of which the measuring gas module SF₆-volume percentage sensor and the module moisture SO₂-sensor can be exchanged in case a recalibration is necessary (point 7.1).

For exchanging a module 4 screws are to be loosened on the back (Ill. 7.1).

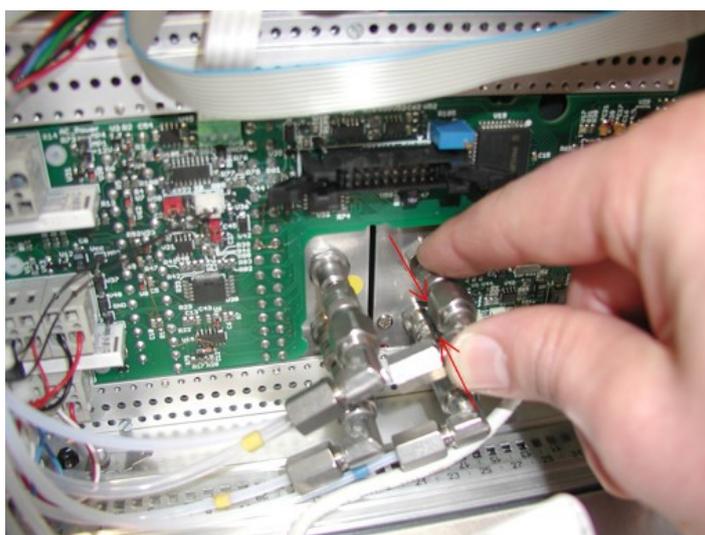


Prior to opening the housing switch off and unplug the device so that it is not battery-operated (exception chapter 8 elimination of fault).

Tilt the front cover by loosening both upper screws and pull off the flat strip line to the graphic display in the middle.

Opening of the upper coupling:

Press the fitting and the bushing of the coupling as illustrated. Then the fitting is opened. (see illustration 1.1).



Ill. 1.1 Opening of the upper coupling

Opening of the lower coupling:

Press the bushing of the coupling backwards. The fitting is opened.



Warning

The measuring gas module and the connecting hoses are marked by different colours. The connecting hoses and measuring gas modules of the same colours belong together and must not be mixed. When coupling again pay attention that coloured markings match with the colours on the measuring gas modules.



Note

The measuring gas module can only be pulled out from the back of the SF₆-Multimeter if both couplings are disconnected internally and the 4 screws of the measuring gas module on the back are unscrewed.



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2. Overview of SF₆-Multimeter

The SF₆-Multimeter allows the measurement of the SF₆-volume percentage, the gas moisture and the SO₂-concentration with one measuring process. After each measurement the measuring values can be stored, indicating the user name and a name of the measuring point.

The measuring values of the SF₆-volume percentage, the gas moisture and the SO₂-concentration are digitally indicated on the display. In the standard version the SF₆-volume percentage sensor is calibrated for SF₆/N₂ or SF₆/air and measures the SF₆-content in volume percent in such a gas mixture. The SF₆- volume percentage sensor works independently of air pressure and installation position.

The moisture sensor measures the dew point temperature of SF₆-gas in °C dew point. The measuring value of the dew point in °C can be automatically indicated or converted into all indicating units in case of modified setting. A conversion into the dew point under pressure in the compartment is also possible. Furthermore, the SF₆-Multimeter includes a temperature sensor which measures the temperature of the SF₆-gas.

The main components of the SF₆-Multimeter are as follows:

- a measuring gas module with an SF₆-volume percentage sensor,
- a measuring gas module with moisture and SO₂-sensor as well as
- a module with a power supply unit; the module with the power supply unit also includes accumulators
- a board with the central unit, pressure sensors and tubing with solenoid valve and pressure reducer,
- all components of the SF₆-Multimeter are installed in a portable and modular housing

The modular construction enables to send each single measuring gas module for verification, calibration or exchange to the manufacturer. In principle, it is also possible to measure with only one measurement gas module.

The SF₆-Multimeter is very easy to operate on the front side where the following can be found: the "Gas inlet", a graphic display (128x64 pixel), two LED control lamps, a navigation turning knob with integrated pressure point for navigation in the operating menu, two buttons (ON/OFF, **X**) as well as the "Purge" bypass valve which allows quick rinsing (with long connecting hoses) and shortening of the response time.

On the back there is the "Gas outlet" stub where the measuring gas flows through and can be collected for reuse. All modules are assembled from the back of the SF₆-Multimeter.

The lithium ions accumulator installed in the power supply unit enables net-independent working. Loading of the accumulator is done automatically if the device is connected to the power supply and switched on. Overloading or total discharging of the accumulator is impossible, which raises the lifetime considerably.

We recommend instructing the personnel on careful handling of SF₆-gas, moisture and SO₂ measurement.

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2.1 Technical data



ill. 2.1 SF₆-Multimeter with standard accessories

Dimensions: (with handle on the front side)

Length (L): 450 mm
 Width (B): 280 mm
 Height (H): 185 mm

Weight: 9.6 kg

Dimensions: transport case

Length (L): 540 mm
 Width (B): 460 mm
 Height (H): 305 mm

Weight: 10.5 kg



ill. 2.2 transport case



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General data:

Input pressure:	pe 0.5 – 10 bar
Operating temperature:	-20°C - +40 °C
Operating voltage:	90 – 264 V /50-60Hz, max. 28 W Power supply must be protected via a residual current device (RCD) with a max. operating current of 30mA.
Interfaces:	USB (slave)
Mains fuse:	2 x 1 A/T (inert)
Duration of measurement (individual measurement):	6 – 15 min. (adjustable)
Limit value (volume percent) (potential-free):	0.0 – 99.9 vol.-% Limit
value (dew point) (potential-free):	-60 °C - +10 °C
Accumulator:	lithium-ions accumulator (for about 6-8 h working time) 14.4 V; 4.5 Ah, 4S2P, 64.8 Wh
Flow rate (all sensors):	17.5 – 20.5 lN SF ₆ /h = 106 – 125 g SF ₆ /h
Max. number of measuring values to be stored:	100
Input pressure sensor:	± 0.5% FS, i. e. max. ± 0.08 bar
Output pressure sensor:	± 0.5% FS, i. e. max. ± 5 mbar
<u>Volume percentage sensor:</u>	
Measuring media:	SF ₆ /N ₂ or SF ₆ /air gas mixture (3-038- R020/R021/R022) and SF ₆ /CF ₄ gas Mixtures (3-038-R030/R031/R032)
Measuring range:	0.0 to 100.0 vol.-% SF ₆
Measuring accuracy:	± 1 vol.-% for gas mixtures SF ₆ /N ₂ or SF ₆ /air ± 2 vol.-% for gas mixtures SF ₆ /CF ₄
Measuring condition:	measurement is carried out under atmospheric pressure
Flow rate:	0.3 – 0.5 lN SF ₆ /h = 1.8 – 3.1 g SF ₆ /h
Operating temperature:	-20 °C to +40 °C
Recommended calibration interval:	every 2 years



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Moisture sensor:

Measuring range:	-60 °C to +20 °C dew point temperature
Measuring accuracy:	± 2 °C at - 40°C to + 10°C dew point temperature ± 3 °C at < - 40°C dew point temperature
Measuring condition:	Measurements are carried out at atmospheric pressure. The device converts dew points under pressure.
Flow rate:	16 – 17 lN SF ₆ /h = 98 – 104 g SF ₆ /h
Operating temperature:	-20 °C to +60 °C

SO₂-sensor:

Measuring ranges:	0 ... 100 ppmV, resolution 1 ppmV 0 ... 20 ppmV, resolution 0.1 ppmV 0 ... 500 ppmV, resolution 1
ppmV Measuring accuracy:	< ± 2 % from the end value
Operating temperature range:	- 20 °C to + 45 °C
Response time:	T90 (final value 90%) < 20 s
Long time stability:	0,5 ... < 2 % signal degradation per month (linear)
Recommended calibration interval:	2 years (see indication on the menu)
Protection against SO ₂ overcharge:	automatically
Flow rate:	1-3 lN SF ₆ /h = 6 – 18 g SF ₆ /h

Modules:

	Order no.
SF ₆ -volume percentage sensor module	3-038-10, 3-038-11
Moisture SO ₂ sensor module	3-038-60, 3-038-62, 3-036-63
Power supply module	3-038-01



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2.2 Accessories

The SF₆-Multimeter includes:

- housing with handle for transportation and placing
- 4 m long connecting hose with DILO couplings DN8 and DN20
- Power plug with 2 m long connecting cable
- USB connecting cable
- connecting plug for Out vol.-% moisture
- CD-ROM with software for evaluation and reading of the measured values and saving on the PC
- transport case

1 operating manual (multilingual)



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3. Functional description

3.1 Function of the SF₆ volume percentage sensor

The measuring principle is based on the evaluation of the different velocities of sound of gases. The velocity of sound in air is normally about 330 m/s, while in SF₆-gas it is only about 130 m/s. The velocity of sound measured in the measuring cell is temperature compensated and converted into SF₆ volume percent by means of a microprocessor.

3.2 Function of the moisture sensor

The moisture sensor is based on the absorption of water molecules in a special ceramic substrate. Therefore the electric capacity of the sensor element changes which is registered by the evaluation electronics and is converted into a standard signal.

3.3 Function of the SO₂ sensor

The electrical conductivity of the electro-chemical sensor used changes as soon as SO₂-gas molecules react with the sensor. The cross sensitivity to other gases is very low – dependant on the gas type.

The SF₆-gas passed diffuses into the SO₂ sensor where it reacts with the electrode to be measured due to the oxidation process in accordance with the following equation:

Equation 1: **measuring process**

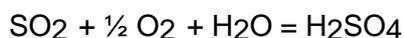


The backplate electrode tries to compensate the reaction on the electrode to be measured like a certain balance by means of oxygen reduction where water is produced.

Equation 2: **compensation reaction**



Two reactions reflect the total reaction of the measuring cell as follows:



If SO₂ exists in the SF₆-gas to be examined, equation 1 changes its electro-chemical potential so that electrodes are released. Consequently a voltage change is detected, which is converted into the ppm_v-values.

The SO₂-sensor contains a transmitter board which enables temperature compensation and calibration for the measuring range.

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3.4 Function of the temperature measurement

The temperature of the measuring gas recorded by the device is effected by an integrated temperature sensor (in gas flow direction) near the moisture sensor. As the flow rate is too low, there is practically no cooling-down of the gas by expansion.

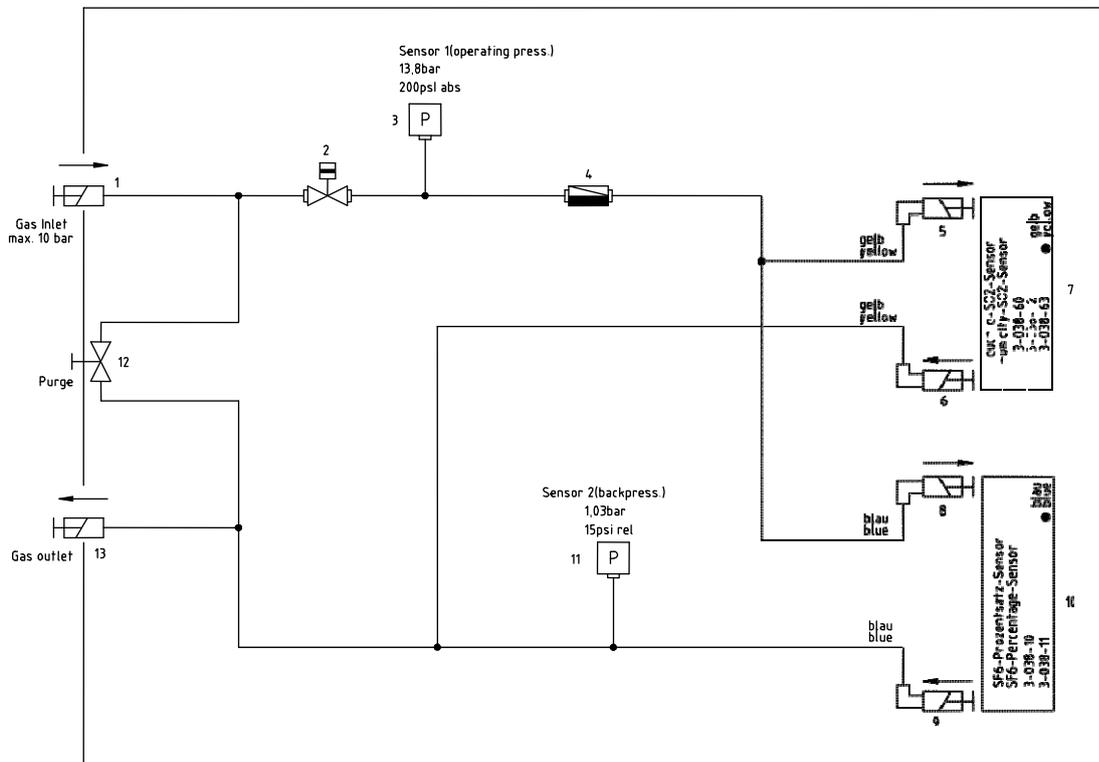


Note

The gas temperature in the gas compartment and the measured gas temperature can deviate from each other as the gas temperature is measured inside the device and not directly at the gas compartment. This could have an influence on the calculated gas density. For the calculation of the gas density a possible N₂ or CF₄ content is taken into consideration.

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3.5 Gas flow diagram



Pos.	Designation	Order no.
1	Coupling NW 5	1-05-1358-R012
2	Solenoid valve	1-05-1061-R006
3	Pressure sensor 200 psi abs.	1-05-1270-R005
4	Pressure regulator p _e 0.5 bar	1-05-1431-R001
5	Coupling piece 1/8" internal thread	1-05-1358-R014
6	Coupling 1/8" internal thread	1-05-1358-R013
7	Moisture SO ₂ sensor module	3-038-60 or 3-038-62 or 3-038-63
8	Coupling piece 1/8" internal thread	1-05-1358-R014
9	Coupling 1/8" internal thread	1-05-1358-R013
10	SF ₆ volume percentage sensor module	3-038-10 or 3-038-11
11	Pressure sensor 15 psi	1-05-1270-R003
12	Precise valve (rinsing valve)	1-05-1370-R001
13	Coupling plug	1-05-1358-R002

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4. Description of the menu and measuring process



Illustration 4.1: Front view of the SF₆-multimeter with its operating elements

Manual switching on and off of the SF₆-multimeter is carried out via the „ON/OFF“ button on front side (see ill. 4.1). The device is switched on if the yellow “Operating“ LED lights up.

The green “AC Power“ LED indicates that the SF₆-multimeter is connected to the power supply. For this purpose the mains switch on the power supply unit on the back of the SF₆-multimeter has to be switched on and the SF₆-multimeter must be connected to the power supply via the power cable. The accumulator is only charged if the device is turned on.

When turning on the device there is a noise. However this noise is normal as it results from the integrated diaphragm pump that starts running for a short time when switching on the device.

Mains operation

If the device is switched on and in mains operation the yellow “Operating“ LED, the blue display and the green “AC Power“ LED light up. In the upper line, right on the display a socket symbol (ill. 4.6) as well as the loading status in percent are indicated. In case the device is mains operated all sensors remain switched on permanently (measuring values are indicated permanently) and the device never turns off automatically.

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Battery operation

In battery operation only the yellow “Operating” LED and the blue display light up. On the display right on the top only the battery symbol and the loading status in percent (ill. 4.7) are indicated.

If the device is in battery operation and not in the measuring mode all sensors are switched off after 30 seconds in order to save accumulator time. This can be recognized from the fact that only placeholders „---.“ instead of measuring values are indicated on the display instead of the measuring values which are normally indicated permanently in Run mode as in mains operation.

In case neither the navigation turning knob nor a button is activated for more than 2 minutes (default) the device switches to the shutdown mode and turns off. During the 20 seconds shutdown phase there is a warning signal. If the navigation turning knob is activated during this time the device switches to battery operation again if not the device turns off automatically. In the “**Settings**” menu the **Switch-off time** (for battery operation) is selectable in the range of 1...15 minutes. (Default 2 minutes).



Note

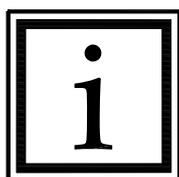
Manual switching off of the SF₆-Multimeter is effected by activating the “ON/OFF” button for about 3 seconds until a beep tone can be heard.

In battery operation the device switches off automatically (after running of the switch-off time if the navigation turning knob is no longer activated).

4.1 Navigation with the navigation turning knob

The navigation turning knob allows quick navigation in the menus and input of text. With the navigation turning knob different menu items can be selected (as from the base menu) by turning the knob.

The selected menu items are invertedly illustrated at the bottom of the display cell. The selected menu item is activated by pressing the navigation turning knob shortly. If it is another submenu it is opened, otherwise the selected command is carried out.



Note

In case the beeper is switched on an acoustic sound is released when another menu is selected during each turning step on the navigation turning knob. The acoustic sound is also released if there is a positive feedback after selection or important messages.

With the **X** button (ESC-key) an instruction is interrupted or it is put one menu level higher if you are in a submenu at the moment.



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4.2 Overview

After switching on the device a start screen appears (ill. 4.2), which is replaced by the component test after a short initialisation time (ill. 4.3). The component test verifies which components are installed in the SF₆-multimeter and whether they are ready for operation. The test of each component is confirmed (by a checkmark). If a component is missing or fails during the self-test a question mark“?” is indicated.

The next screen shows the number of days which are within the recommended calibration interval (ill. 4.4). If the recommended calibration interval is exceeded the number of negative days (ill. 4.5) is indicated. This menu is to be confirmed by pressing the navigation turning knob. In case the calibration interval is exceeded measurements can still be carried out with the device.

If one of the sensors is not present or failed the self-test a permanent placeholder (“- .-“) is indicated in the base menu instead of the measuring value. Such a placeholder is indicated temporarily even if the SF₆-multimeter in battery operation switches to the energy saving mode (ill. 4.8).

The base menu

After switching on the device the base menu remains visible (ill. 4.6). From the base menu all functions and other submenus can be selected. There is a status bar on the lower side of the screen on the display, which informs you on the user commands that can be started or on actual running commands.

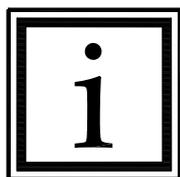
The values measured presently are indicated as from line 3 (SF₆-volume percentage, moisture and SO₂). In the sixth line the input pressure measured presently on the “Gas inlet“ is indicated.

The seventh line can be turned off (blank line) via the “Settings“ menu or the gas density or the gas temperature can be indicated (ill. 4.7). The gas density is determined with the gas temperature measured, the input pressure and the SF₆-volume percentage.

The units are indicated behind the measuring values and the following further explanations in the last column:

- SF₆-volume percentage; referring to the CF₄ carrying gas the „CF₄“ symbol is indicated for differentiation (only for option CF₄ as carrying gas).
- Gas humidity in °C or °F referring to atmosphere (atm) or under pressure in the compartment (i IN).
- SO₂-value as SO₂-concentration in ppm_v.
- Input pressure in bar p_e or p_a
- Selectively blank line or gas temperature in °C or °F or gas density in kg/m³ or lb/ft³

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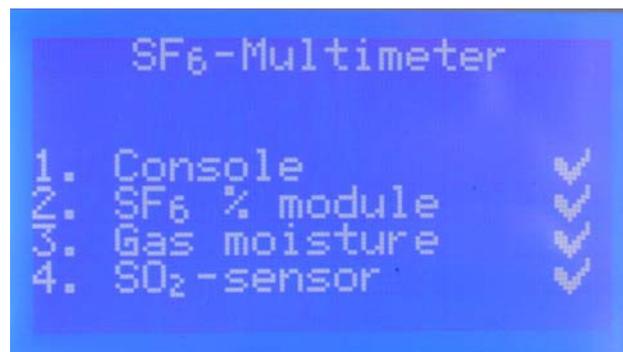


Note

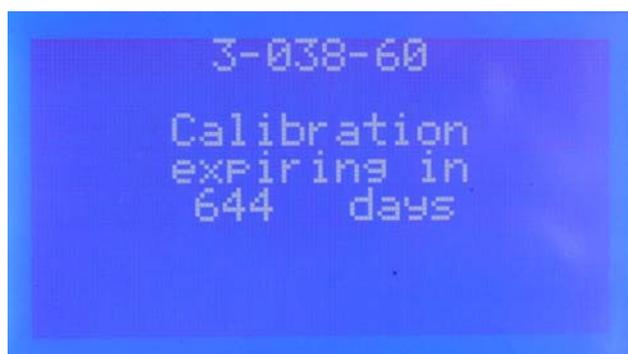
If no measurement is started no gas flows through the sensors. Thus the sensors only show measuring values which correspond to the present gas state in the sensors.



ill. 4.2



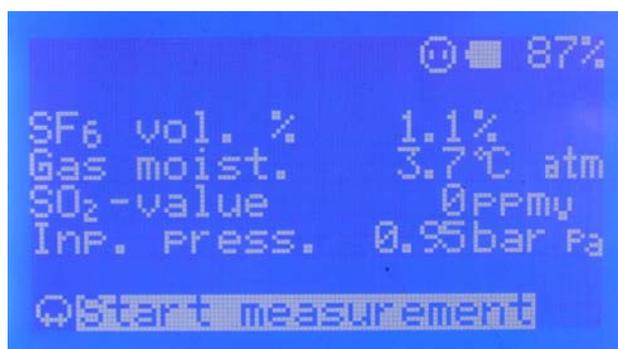
ill. 4.3



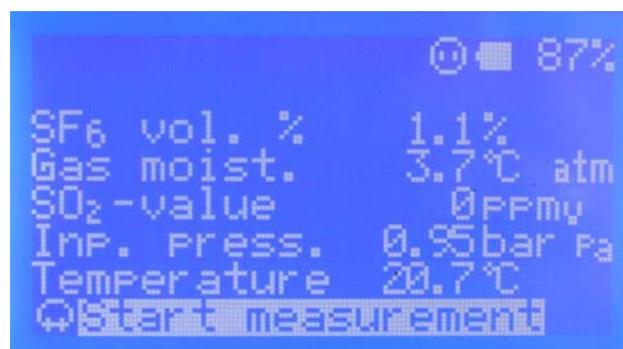
ill. 4.4



ill. 4.5

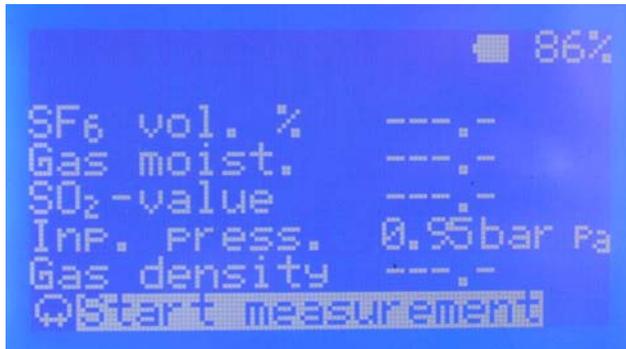


ill. 4.6

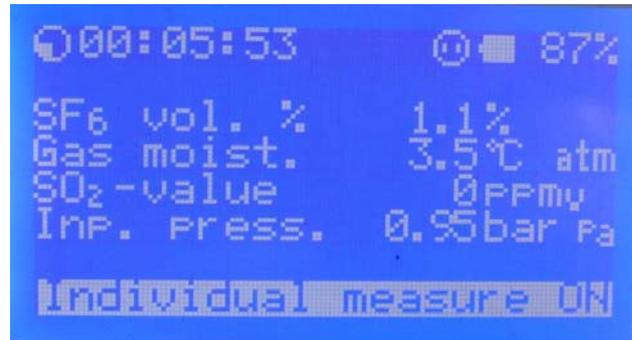


ill. 4.7

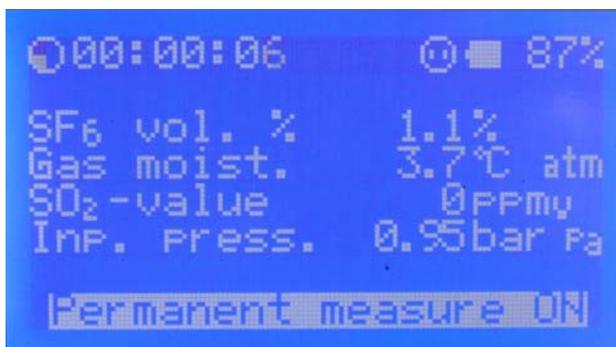
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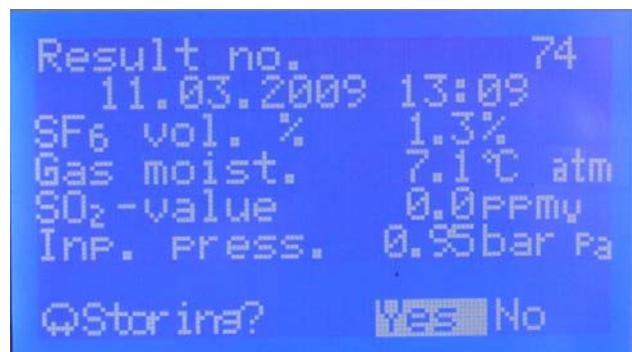
ill. 4.8



ill. 4.9



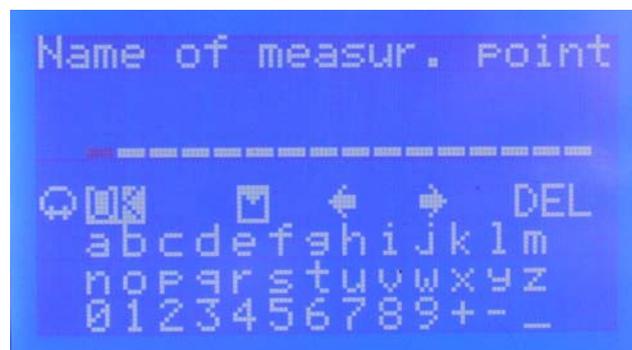
ill. 4.10



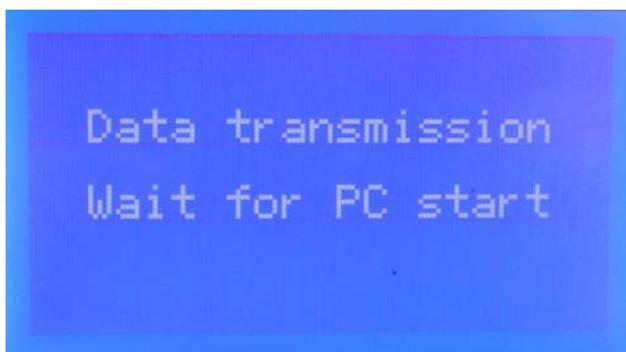
ill. 4.11



ill. 4.12



ill. 4.13



ill. 4.14



ill. 4.15

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4.3 Menu description

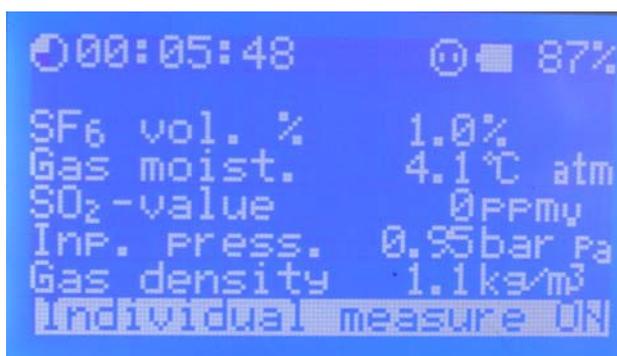
The menu navigation on the display is self-explanatory. Therefore not every detail is described in the following explanation.

The following menu items can be selected:

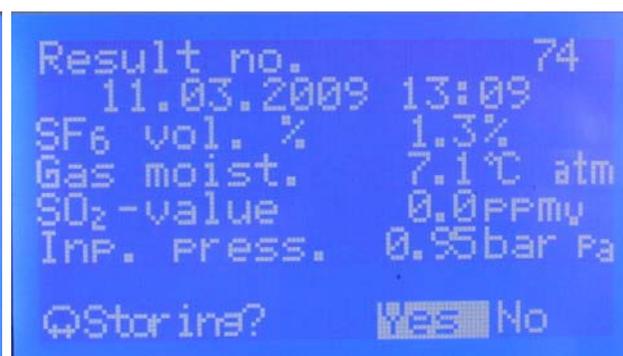
4.3.1 “Start measurement“

This item starts on the basis of the settings adjusted. The measurement is started by pressing the navigation turning knob. Measurements can be carried out in the “Individual measurement” or “Permanent measurement” mode.

In the individual measurement mode the solenoid valves open and the preset time for the individual measurement is running (ill. 4.16). The time meter can be observed in the first line on the top of the left hand side. The time meter counts backwards. During the measurement the measuring values are updated permanently. If the time meter reaches zero the solenoid valves close automatically and the measurement is completed. If necessary, the SO₂-sensor is rinsed with air. The measuring values are recorded and there is a query whether the measuring values should be saved or not (ill. 4.17).



ill. 4.16



ill. 4.17

In case of “Storing? yes” selection the measuring values can be stored by indicating the user name and a name for the measuring point.

The permanent measurement mode is provided for the application in an industrial process or if measuring values are to be monitored permanently for a longer time. The time meter on the top of the left hand side starts at zero and counts upwards. The measuring data in the permanent measurement mode is also permanently updated on the display. The switching contacts for the measuring value volume percentage and for the measuring value dew point temperature switch according to the settings. The permanent measurement mode can be left again with the **X**-button (ESC-key). The recent measuring values are also indicated.

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4.3.2 “Data transmission“

The selection of the window “**Data transmission – Wait for PC start**“ (ill. 4.14) is necessary so that the measuring values stored in the flash memory can be transmitted to a PC or Laptop by means of the programme on the enclosed CD. The menu item can be left again with the **X**-button (ESC-key). See chapter 5.



Note

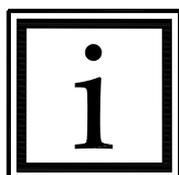
The “**Data transmission – Wait for PC start**“ menu item must be selected before a transmission of the measuring data on PC or Laptop is possible.

4.3.3 “Measuring data“

After calling the “**Measuring data**“ menu item all measuring values stored in the flash memory can be indicated on the display with indication of the user name, name of measuring point with date, time and consecutive number (via navigation with the navigation turning knob, see chapter 4.1).

Delete measuring data in the flash memory:

If the **measuring data** menu item is left again with the **X**-button (ESC-key) a window with the query **Delete all data?** appears automatically. This query call is to be replied to with **Yes** or **No** with the **X**-button (ESC-key), which corresponds to “No“.



Note

Only all measuring data can be deleted on the flash memory. It is not possible to delete individual measuring data.

4.3.4 ”Settings“

All settings which refer to the measurement and the indication of the units are done in the “**Settings**“ menu,

choose between:

- | | | |
|---------------------|-------------|--|
| ■ Temperature unit: | as desired: | °C
°F |
| ■ Gas density unit: | as desired: | kg/m ³
lb/ft ³ |
| ■ Moisture unit: | as desired: | °C under atmosphere
g/m ³ under atmosphere
ppm _V
ppm _M |



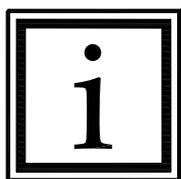
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- Pressure unit: as desired: bar
psi
Pa
MPa
- Pressure mode: as desired: p_e overpressure
p_a absolute pressure
- Carrying gas: as desired: N₂
CF₄ (only for option)
- Limit value (volume): 0.0 to 99.9 Vol.-%
- Limit value (dew point): -50.0 to +10.0 °C dew point
- Measuring mode: 300 to 900 s (5 to 15 min)
(individual measurement)
- Measuring mode: permanent measurement, individual measurement
- Switch-off time: 1 min to 15 min
(in battery operation)
- Additional indication: as desired switched off
Temperature
gas density
- Contrast (display): 0 to 100 %
- Language: as desired German
English
French
Spanish
Italian
- Beeper: as desired: on
off
- Time: Hour: Minute: Second
- Date: Year: Month: Day:
- System info: The settings window -> system info offers information on the software versions, the serial numbers and calibration date (ill. 4.15).

4.4 Storage of measuring data

After running down of the individual measurement or after interruption of the permanent measurement an indication similar to illustration 4.11 appears on the display.

The selection **Yes** or **No** and the confirmation is made by turning the navigation turning knob. In case **No** is selected the measuring values are rejected and the base menu appears again. In case **Yes** is selected the user can input a user name with up to 10 digits in the next window (ill. 4.12) and after OK up to 17 digits (ill. 4.13). After another OK the measuring data and the current number of the measurement are stored on the flash memory in the device. Then the device returns to the base menu (ill. 4.6).



Note

Most processes can be interrupted again with the **X** -button (ESC-key) if they have not yet been carried out completely.

4.5 Carrying out a measurement

1. Switch on the SF₆-multimeter with the “ON/OFF” push button.
2. Set or check the **Settings** -> **Measuring mode** menu to “Individual measurement” or “Permanent measurement” via the “Start measurement” base menu (see navigation with the navigation turning knob chapter 4.1). The measuring mode set last is always kept.
3. Start the **Settings** -> **temperature unit, gas density unit, moisture unit, pressure unit, pressure mode and carrying gas** mode if necessary via the base menu and select the corresponding units and measuring modes. The units set last and measuring modes are kept as well so that settings according to item 2 and item 3 could only be necessary occasionally.
4. Close the “Purge” valve to the stop by turning clockwise.



Warning

Before connecting the measuring gas hose to the device ensure that the “Purge” valve is closed by turning clockwise. Otherwise sensitive parts of the measuring systems could be damaged by coupling the hose to the “Gas compartment”.

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5. Connect the measuring gas hose to the coupling (DN8 or DN20) by means of the self-closing miniature coupling and connect it to the “gas inlet”. Connect the coupling (DN8 or DN20) to the compartment.

Note: In case moisture (e. g. by condensation) is visible on the couplings it must be wiped with a dry and lint-free cloth beforehand. Then dry the couplings with a commercial hairdryer for several minutes, however the temperature of the couplings must not exceed 70°C. If moisture penetrated in the measuring gas hose disconnect it from the device and rinse it with dry gas for about 5 minutes (e. g. nitrogen). The connecting coupling on the compartment to be tested must also be dry and clean.



Oil or condensated moisture must not penetrate the SF₆-multimeter.

Make sure that the pressure in the gas compartment to be measured does not exceed p_e 10 bar before the SF₆-Multimeter is connected.

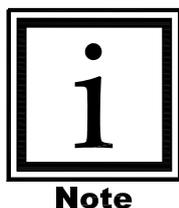
6. Rinse the measuring gas hose by opening the “Purge” valve for 2-3 seconds.



Only purge for 2 – 3 seconds. Ensure that the “Gas outlet” (reverse of device) is not closed and overpressure is not generated by a connected measuring gas recovery system.

Attention: The overpressure in the measuring gas system is not monitored while purging.

7. The measurement is started via the base menu by the “**Start measurement**” command line by pressing the navigation turning knob. The set measuring time is counted downwards by the time meter left on the top of the display. If the zero value is reached the measuring values on the display are recorded and the individual measurement is completed.



The solenoid valves in the SF₆-multimeter open automatically during the measurement. If there is back pressure e. g. because the “Gas outlet” is closed on the outlet or the SF₆-gas cannot be transported the input solenoid valve is closed and the measurement is interrupted by a message. The back pressure cannot continue to increase. Prior to carrying out a second measurement the back pressure must be relieved.

8. After the termination of automatic measuring process in the individual measurement mode the query **Storing? Yes No** appears.



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4.6 Execution of a permanent measurement

1. Switch on the SF₆-multimeter with the "ON/OFF" push-button.
2. Call the **Settings** -> **Measuring mode** menu via the "Start measurement" base menu and set to **permanent measurement**. Make further settings according to chapter 4.4 point 2. The measuring mode set last is always kept.
3. Further procedure as described in chapter 4.4 points 4. and 6.
4. Note: During the permanent measurement the time meter on the top on the left hand side of the display counts upwards.
5. The permanent measurement mode can only be left again by the **X**-button (ESC-key). The measuring values measured last also appear in a separate window. (ill. 4.6).
6. After termination of the measuring process in the permanent measurement mode the query **Storage? Yes No** appears.



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5. Transmission of the measuring data on a PC or Laptop

The stored measuring data of the SF₆-multimeter can be transmitted for filing on a PC or Laptop.

Prior to the first data transmission the Setup-programme for loading the USB-driver must be executed once.

5.1 Installation of the USB-driver

Conditions: Operating system: Windows 2000 or XP
 MS - Excel 2000 or 2003

1. Call the programme PreInstaller.exe from the CD of the \CP210x\Win2K_XP directory and indicate a suitable destination directory e. g. under C:\Programme\...
2. Switch on the SF₆-Multimeter.
3. Connect the enclosed USB-cable to the SF₆-Multimeter and PC or Laptop.
4. Call the number of the COM interface. This number is needed later.

For this execute the following commands under Windows XP:

Start -> Settings -> System control -> Administration -> Computer administration -> Device - Manager -> connections (COM and LPT). The driver must indicate the "CP210x USB to UART Bridge Controller (COM ...)" message. If there is no message from the driver it is not installed correctly or there is no USB-connection to the SF₆-multimeter.



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5.2 Readout the measuring data from the SF₆-multimeter

Condition:

Installation of the driver must have been executed according to chapter 5.1. For the reading out a data record the measuring data of at least one measurement must be available in the SF₆-multimeter.

Procedure:

1. Connect the PC and SF₆-multimeter (front side USB interface) to the USB-cable.
2. Select the **Data transmission** menu item with the navigation turning knob on the SF₆-multimeter and then press the navigation turning knob. The message ill. 4.14. appears.

Data transmission

Wait for PC start

3. Start the "SF₆_measuring record_Rev_xx.xls" programme.
Allow the macro option if necessary. The programme can be found on the CD of the ...\\Excel-Macro\\ directory.
4. Set the COM-Port to the number, which has been determined according to chapter 5.1, item 4. Store this data file and use it as "SF₆-measurement report_Rev_xx.xls" template.

When using such a template the COM-Port on the computer being used need never been adjusted again.

5. Call the "Template SF₆-measuring record_Rev_xx.xls" file according to point 3.
6. Press the **Transmission complete!** button. The data of the SF₆-Multimeter is transmitted into the worksheet.
7. Answer the query **Storing now?** with **Yes** or **No**. If it is answered with **Yes** a window opens in which a name for the measuring report can be selected individually. In case of **No** the measuring data remain in the file. But they can be stored with the storage Excel-command or storage under ...

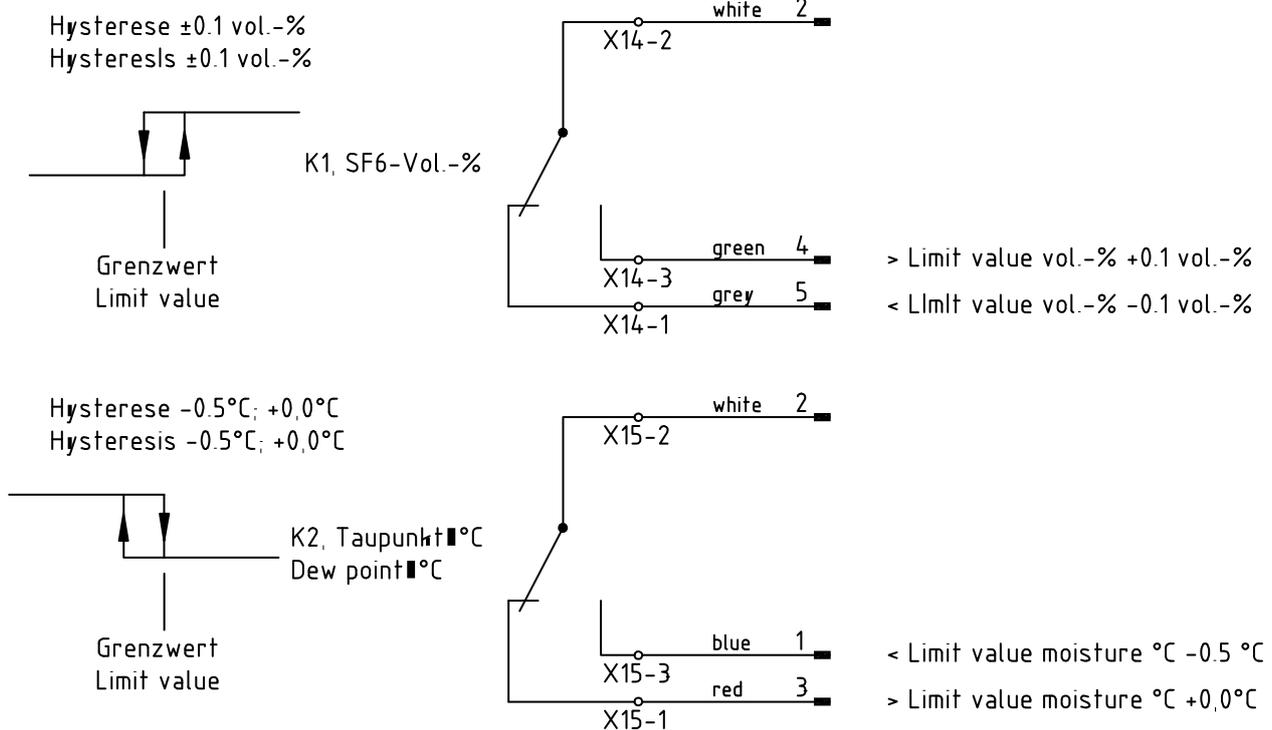
Note: Only delete the measuring data in the worksheet with the **Delete** button.

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6. Limit value contacts – Pin allocation Out Vol.-% Moisture

The Pin allocation for the use of the limit value contacts results from illustration 6.1. The limit value contacts are only activated by Permanent measurement.

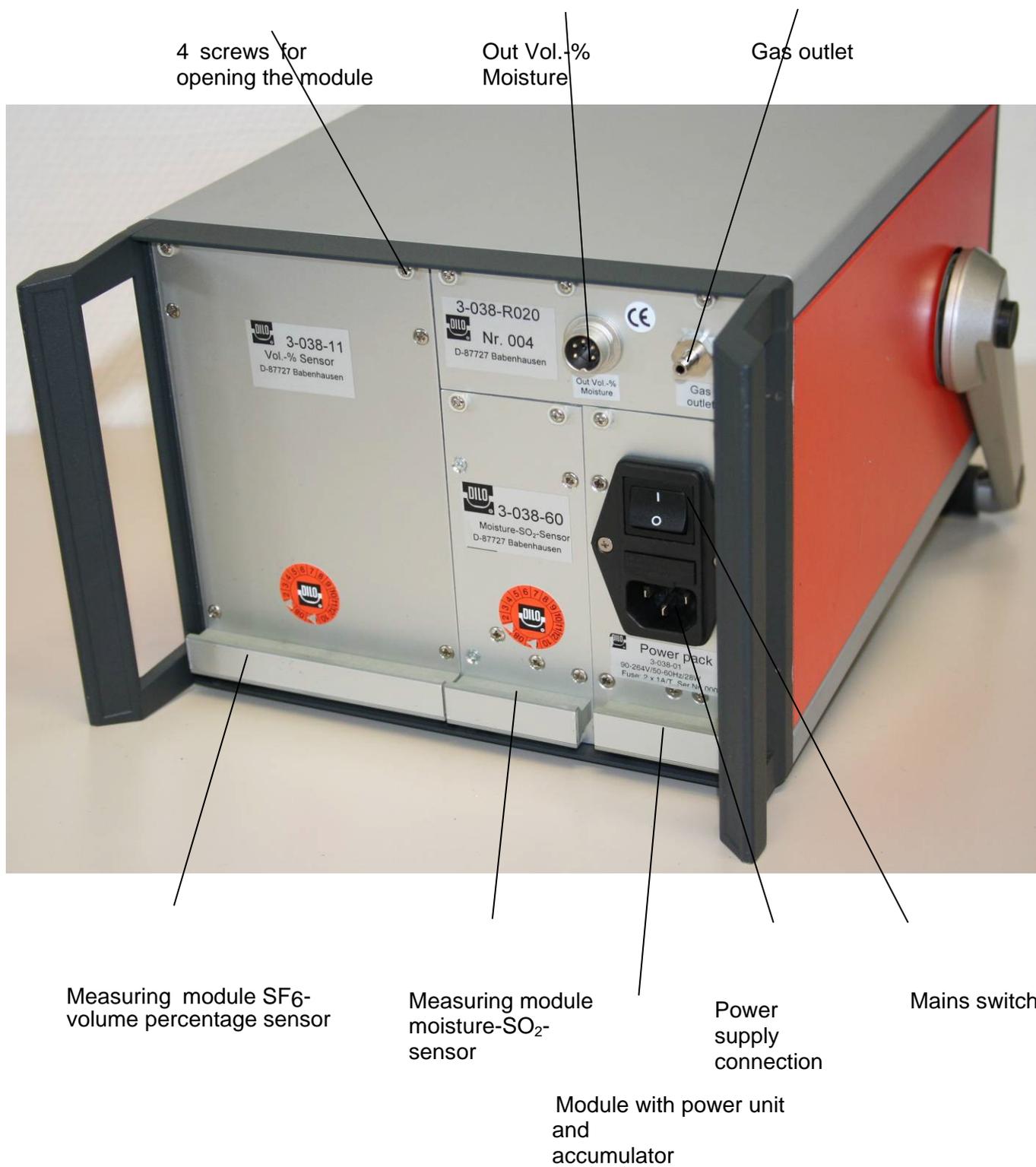
Stifte an Buchse Rückseite
Plns on socket on the back



III. 6.1 Pin allocation of the limit value contacts for SF₆-volume percent and dew point °C

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7. Back view of the SF₆-multimeter





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7.1 Returning of the measuring gas modules

When returning the modules to the manufacturer use appropriate packing to avoid any damage in transit.



The calibration and final control in accordance with the DILO quality assurance is indicated with month and year on the test badge.

In case the device is operated longer than the time interval for calibration recommended a warning message appears when switching on the device (ill. 4.5). The device can still be operated.

The calibration service for the device is listed below.

Calibration of 3-038-10 measuring module, SF ₆ -volume percentage sensor	3-038-20
Calibration of 3-038-11 measuring module, SF ₆ -volume percentage sensor	3-038-21
Calibration of 3-038-60 measuring gas module, moisture SO ₂ -sensor (0-100 ppm _v)	3-036-22
Calibration of 3-038-62 measuring gas module, moisture SO ₂ -sensor (0-20 ppm _v)	3-036-23
Calibration of 3-038-63 measuring gas module, moisture SO ₂ -sensor (0-500 ppm _v)	3-036-24

8. Fault correction

It is not recommended to carry out repair works of the SF₆-Multimeter by yourself. (except for disassembling the single modules).

Do not carry out any works on the modules. In case of malfunction return them to the manufacturer of the device.

If there is no indication after switching on the device check whether the yellow “Operating” LED lights up. If not, the SF₆-multimeter should be connected to the power supply in order to load the accumulator. For this purpose it must be switched on. Furthermore, check whether the correct power supply is available and the mains plug is fixed tightly.

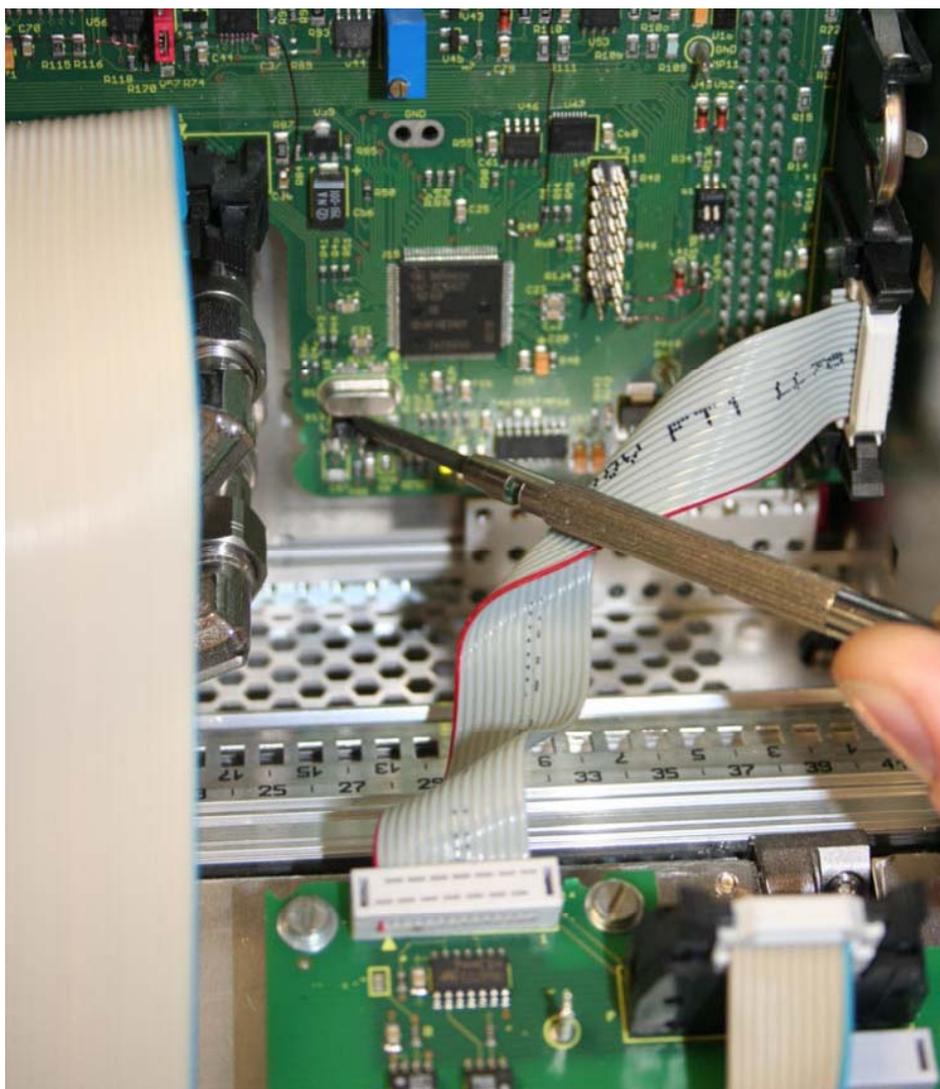
If this is correct and the yellow “Operating” LED does not light up check the mains fuse which is near the mains switch on the back of the device and can be opened by pulling out. In case the mains fuse is all right the SF₆-multimeter can be reset in the base status. For this purpose establish a connection between the two pins with a screwdriver according to illustration ill. 8.1.

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Prior to the removal of the mains fuse unplug the power plug.
If the mains fuse is replaced only use the same type.

See chapter 2.1 “Technical data”.



III. 8.1 Reset of the SF₆-multimeter in the base status

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9. B151R20 Discharge gas collection unit (available as an option)

Legal directives becoming more and more strict and the voluntary self-commitment of the SF₆-users also require the collection of used gas even of smallest amounts of SF₆, as being discharged during measurements. For this purpose, the discharge gas collection unit has been developed.

The SF₆-multimeter is equipped with a connection on the back of the device so that it can be connected to an external discharge gas collection unit.

This connection allows the SF₆-Multimeter to be operated with or without the discharge gas collection unit.

In normal condition the output is open that means the measuring gas can escape into the atmosphere without any problems.

If the discharge gas collection unit is connected the measuring gas is collected in a depressurized condition via the connecting hose.

After having reached the internal consumption capacity of the discharge gas collection unit the installed compressor switches on automatically and the collected measuring gas flows into an internal gas cylinder, which can take a higher pressure and the gas can be filled in another vessel later.



ill. 9.1 B151R20 Discharge gas collection unit

The B151R20 Discharge gas collection unit is not included in the scope of supply of the SF₆-Multimeter.



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10. Appendix

Moisture Content Conversion Chart for SF₆ at atmospheric pressure

°F	°C	PPM _m	PPM _v
30	-1	780	6326
28	-2	700	5677
27	-3	625	5069
25	-4	575	4663
23	-5	500	4055
21	-6	450	3650
19	-7	410	3325
18	-8	390	3163
16	-9	350	2839
14	-10	320	2595
12	-11	290	2352
10	-12	260	2109
9	-13	240	1946
7	-14	220	1784
5	-15	200	1622
3	-16	185	1500
1	-17	175	1419
0	-18	150	1217
-2	-19	145	1176
-4	-20	135	1095
-6	-21	120	973
-8	-22	110	892
-9	-23	100	811
-11	-24	90	730
-13	-25	80	649
-15	-26	70	568
-17	-27	64	519
-18	-28	57	462
-20	-29	50	406
-22	-30	44	357
-24	-31	40	324
-26	-32	36	292
-27	-33	32	260
-29	-34	29	235

°F	°C	PPM _m	PPM _v
-31	-35	27	219
-33	-36	24	195
-35	-37	22	178
-36	-38	19	154
-38	-39	17	138
-40	-40	15	122
-42	-41	13	105
-44	-42	12	97
-45	-43	11	89
-47	-44	9	73
-49	-45	8.5	69
-51	-46	7.5	61
-53	-47	6.8	55
-54	-48	6	49
-56	-49	5.5	45
-58	-50	5	41
-60	-51	4.2	34
-62	-52	4	32
-63	-53	3.5	28
-65	-54	3	24
-67	-55	2.5	20
-69	-56	2.3	19
-71	-57	2	16
-72	-58	1.7	14
-74	-59	1.5	12
-76	-60	1.3	11



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Best Practice – Correct Dew Point Measurement

Dew point measurement is quite complex. In order to get correct or stable dew point values during measurement the following basic rules need to be adhered to:

Measurement carried out on SF₆ bottle:

1. The SF₆ bottle filled with liquid gas must always be placed horizontally prior to measurement, thus causing gas mixture inside the bottle.
2. The pressure reducer must be made of stainless steel (see Z340R10 adapter kit for measuring devices) => **NO rubber diaphragm!!!**
3. No rubber hoses may be used between bottle / gas compartment and measuring device!
4. If possible, only the 6m long measuring gas hose (included in the scope of supply) should be used. Using longer hoses may cause longer measuring time and dew point falsification.

Conditions having negative effects on dew point values:

1. Use of rubber hoses in measuring line
2. Extreme differences in ambient temperature
3. Alternating measurements with humid and dry gas on the same gas compartment
4. Multiple measurements with automatic pumping back on the same gas compartment
5. Measurements on gas compartments with down piping
6. Rinsing time too short when starting measurements with unknown gas inside hose

Remedial action when dew point values differ:

1. Check the above-mentioned points
2. Set hose length to 12m (=> longer rinsing time)
3. Manual rinsing when gas quality is unknown
4. First measurement without automatic pumping back. Second measurement with automatic pumping back results in correct dew point.

In general, the operating temperature of measuring device needs to be observed:

3-031:	+ 5°C to 35°C
3-037 / 3-038 Multimeter:	0°C to +40°C
3-038 Multi Analyser:	-10°C to +40°C