MF*plus*

USER MANUAL

MRU AIRfair since 1984 ®
EMISSION MONITORING SYSTEMS

62826GB

Edition: 2023-03-22 V1.10.EN

1 Table of contents

Operation Manual –

Please carefully read and follow all instructions before operating the analyzer.

Inspect Shipment for Damage

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

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

Important notice!

This high quality electronic analyzer utilizes batteries that discharge even when the analyzer is not in use. Therefore it is very important to charge the batteries every 4 – 6 weeks, ***even if the analyzer is not in use.*** When it is fully charged***,*** the analyzer should be switched on and allowed to zero itself before being switched off again.

Failing to properly charge the batteries will void your warranty!

Save the original box and the packing material for use if the analyzer must be shipped in the future.

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

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

MRU GmbH
Fuchshalde 8 + 12
74172 Neckarsulm / Obereisesheim
GERMANY

Fon (+49) 71 32 99 62 0 (Reception)
Fon (+49) 71 32 99 62 61 (Service)
Fax (+49) 71 32 99 62 20
Email: info@mru.de
Homepage: www.mru.eu

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

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

2 Introduction

2.1 The Multi-purpose instrument MFplus

The Multi-purpose instrument is used for:

- Pipe tests
- Mobile gas leakage detection (option HC-sniffer)
- 2-channel differential pressure measurement
- Temperature measurement
- Differential temperature measurement
- Humidity measurement (incl. temperature and barometric pressure)
- Barometric pressure measurement
- Flow speed measurement using vane probe or Pitot tube with flow rate calculation
- 4-Pa-test

2.2 The company MRU GmbH

Your instrument is produced by the MRU GmbH in Neckarsulm Germany (founded in 1984), a medium sized company that specializes in developing, producing and marketing high quality emission monitoring analyzers. MRU GmbH produces a wide range of instruments, from standard analyzers up to tailor made industrial analyzers. MRU GmbH contact details are listed on the previous page.

2.3 Important general information (EN 50379) and VDI 4206

This analyzer is not designed to be used for continuous measurements.

Before using the instrument verify the condition of the various parts of the instrument, such as the probes, the ambient air conditions and the connectors for damage and/or blockages.

The use of the instrument for regulatory purposes is subject to special regulations (for example a periodical examination of the instrument). Please obtain the appropriate regulations from your local responsible authority.

2.4 Important information about the users/operation manual

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

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

The most important safety details are listed in chapter 3 (Safety Information). Additional safety details in other chapters are clearly marked with an ***attention*** sign.Safety information

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

2.5 Safety regulations

1. The MFplus may only be used as indicated in this manual.
2. Our instruments are checked according to the following regulations:
   VDE 0411 (EN61010) and **DIN VDE 0701** before they leave the MRU GmbH factory.
3. MRU technical products are designed and manufactured according to **DIN 31000/ VDE 1000** and **UVV = VBG 4** of the professional guilds for fine mechanics and electrical engineering.
4. MRU GmbH assures that the instrument complies to the essential requirements of the legal regulations of the member states of the electro-magnetic compatibility **(2014/30/E)** and to the low-voltage regulations **(3/23/EWG)**.

2.6 Specific safety regulations

1. Use only the battery charger supplied with the analyzer for this instrument
2. No part of the instrument, including the metal probe tube and all other metal parts & accessories are to be used as electric conductors.
3. The instrument is not to be used in or under water.
4. The instrument is not to be placed near or directly exposed to open fire or heat.
5. The specified probe temperature range is not to be exceeded, as the probe, temperature sensory mechanism and sensor could be damaged or destroyed.
6. The instrument shall void dropping.

2.7 Guideline for Li-Ion Batteries

- The battery pack is not accessibly for end users
- Li-Ion rechargeable battery pack for OPTIMA 7 Combustion Analyzer
- Do not heat or throw the battery pack of in fire.
  Do not charge and leave the battery pack at the high temperature.
- Do not deform, short-circuit, disassemble or modify the battery pack
- Do not allow the battery to be immersed in or wetted with water or sea water
- Do not subject the battery pack to a strong impact or throw it
- Do not cut, squeeze, tear at the cables of the battery pack
- Do not carry or store the battery pack together with material which have sharp edges or is electrical conductive in the same custody
- Not letting (+) terminal come in contact with (-) terminal or metal
- The above items may cause heat, fire and explosion

Your quality management MRU GmbH

3 Returned goods

Packing regulation of 12.07.1991

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

3.1 Return of hazardous waste

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

Die Rücklieferung muss für uns kostenfrei erfolgen.
Schadstoffhaltige Teile sind: z.B. elektrochemische Sensoren, Batterien und Akkus.

3.2 Return of analyzer according to ElektroG

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

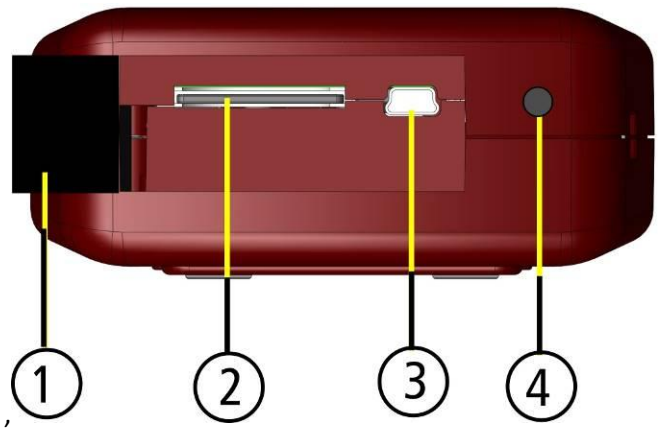
4 (not used)

5 Instrument description

5.1 Instrument front

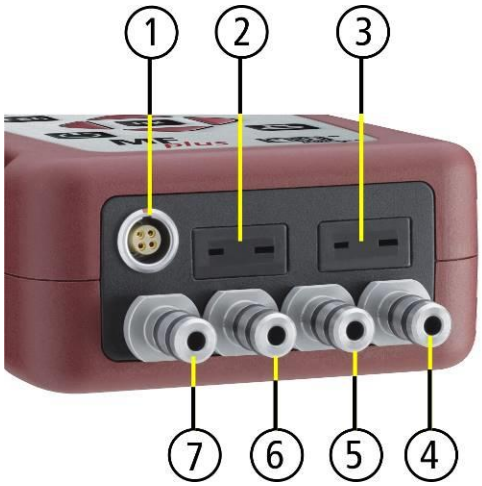
1	Display
2	Key pad

5.2 Connectors - top



1	Cover
2	SD-card reader (only by using a MRU-SD-CARD we can assure the compatibility of all analyzer functions)
3	USB-interface
4	IR-interface

5.3 Instrument Connectors - bottom side (Model pressure / temperature)

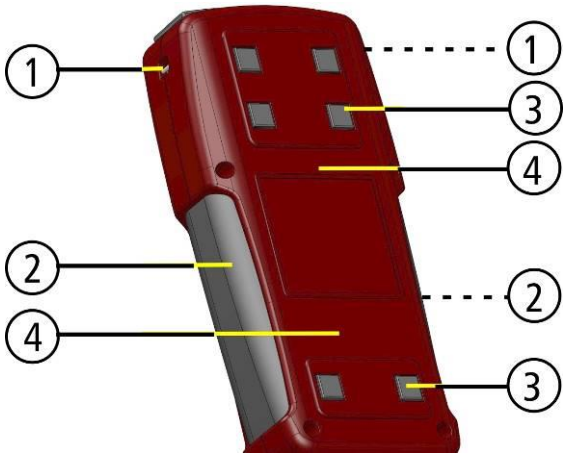


1	AUX connector
2	Temperature connector T2
3	Temperature connector T1
4	Pressure connector P1
5	Pressure connector P2
6	Pressure connector P3
7	Pressure connector P4

5.4 Instrument Connectors - bottom side (Model TRGI)

1	AUX connector
2	Temperature connector T2
3	Temperature connector T1
4	Pressure connector P1
5	Pressure connector P2
6	Pressure connector P3 (TRGI)

5.5 Instrument back



1	Eyelets for carrying strap
2	Handle strip
3	Analyzer feet
4	Fixing magnets

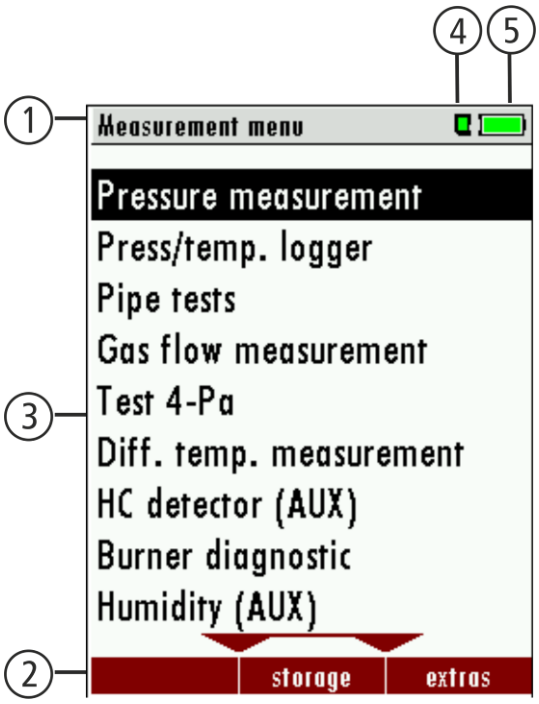
6 Accessoiries

A complete list of available accesoires can be found in the current price list of this instrument.

7 Operating

7.1 The Display

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



1	Menu bar
2	Function key bar
3	Display panel - Menu - Measurement value - …
4	SD-Card in the slot - Indication green Read- and write access - Indication yellow only Read access (SD-Card write protected)
5	Battery charge condition

7.2 The Keypad

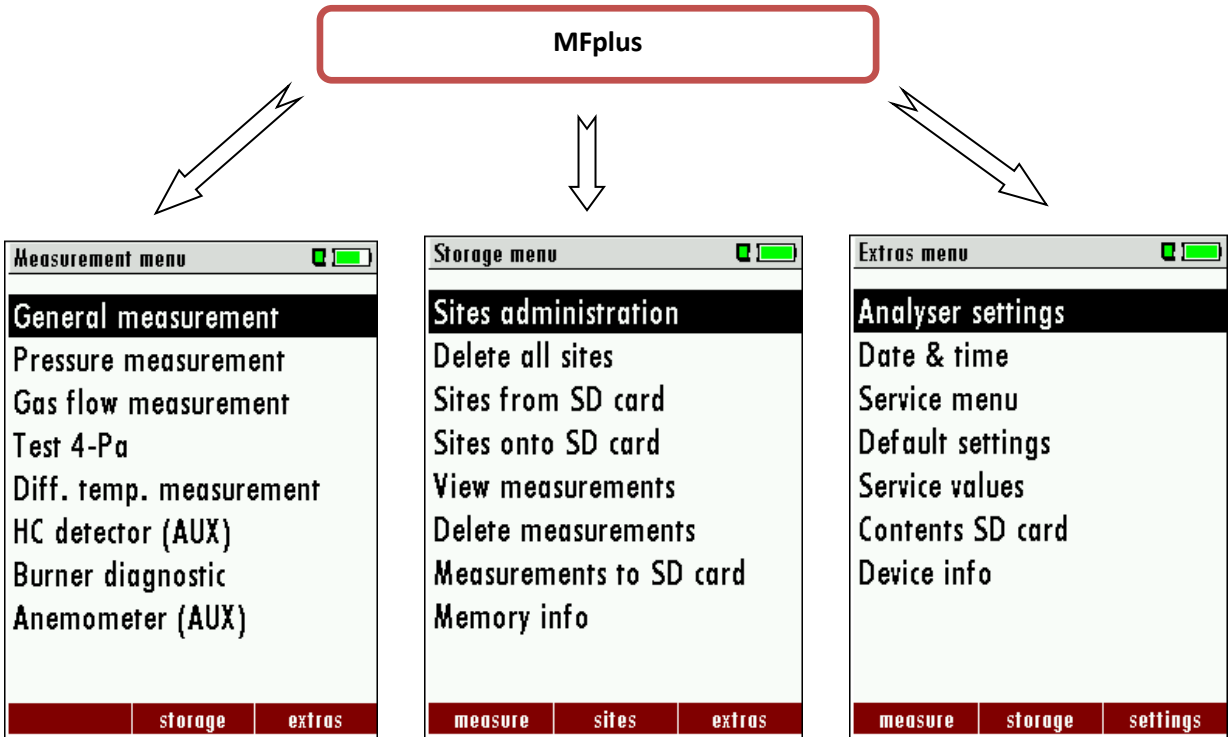
Description and function of the keys:

ON / OFF	Press to switch ON/OFF the instrument without delay.
Function Keys F1 F2 F3	Activates the functions seen on the display (2 function key bar)
Menu Key	Will show all available functions in the window that is currently in use – also those which have an individual key on the key pad like the printer and the three function keys.
ESC	Abort or return to the menu above
Arrow Keys	Jump in between lines, change values
OK	Confirmation key, select a marked menu point
Printer	Activates the printer function in the measurement and service window.

7.3 Menu configuration

The MFplus organizes all available actions in three main menus:

- Menu Measurement → all tasks for the measurement programs of the instrument. Here you can select all installed and available measurement programs.
- Menu Memory → all tasks for the management of the data memory available.
- Menu Extras → all the other available tasks – for management and customizing your instrument



Please read chapter 11for details

Please read chapter 12 for details.

Please read chapter 13 for details.

You can jump in between the 3 main menus with the 3 function keys (according to the displayed name on the screen).

8 First use of the instrument

After the instrument has been inspected and is ready for start up it can be switched on and personalized settings can be entered. These settings can be changed at any time.

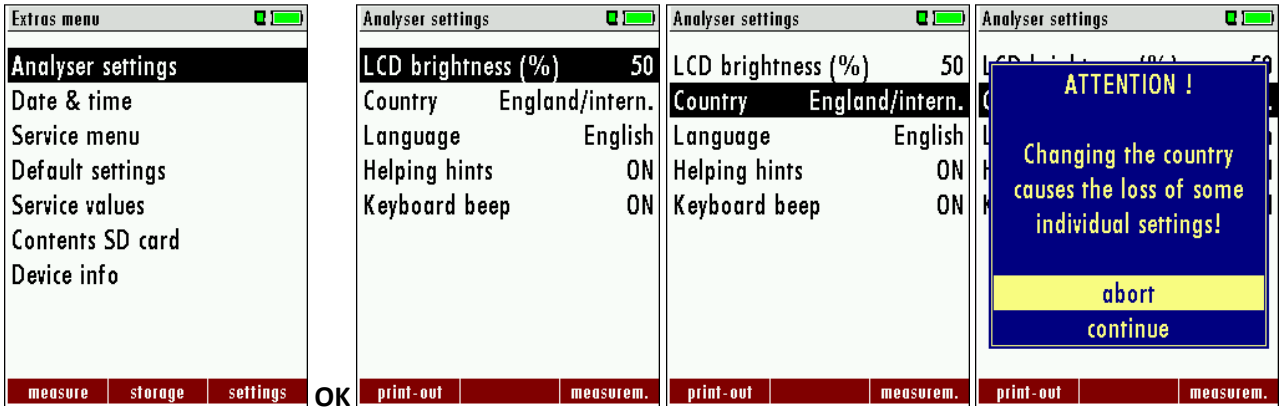
8.1 Analyzer ready for operation

- Unpack the analyzer, read the complete manual
- The instrument was shipped completely assembled, in working condition and ready for operation. It is
  recommended that the instrument is thoroughly inspected for completeness and damage.
- Recommendation: charge the batteries for 8 hours prior to use.
- Check/Change date and time

8.2 Instrument settings

The “Settings” menu allows configuring some instrument specific paramteres.

In the main menu “EXTRAS“ = “F3 key” - scroll down to “Settings“ then press the “OK“ key, By selecting a line the parameter value can be changed by the arrow keys.



LCD brightness	5 – 100 %	Display-brightness, depending on temperature and also on the personal judgement of the user, at 20°C a value of ca. 50% is normal
Language	DE/GB/FR/ITCZ/RO/TR/ ES/	Select device languages
Country	DE/USA/GB/IT/AT/RO/ ES/ plus others	Enables some country specific parameters
Helping hints	ON / OFF	Helpful hints activated or deactivated (explanation below)
Keyboard beeper	ON / OFF	Keyboard beeper activated or deactivated

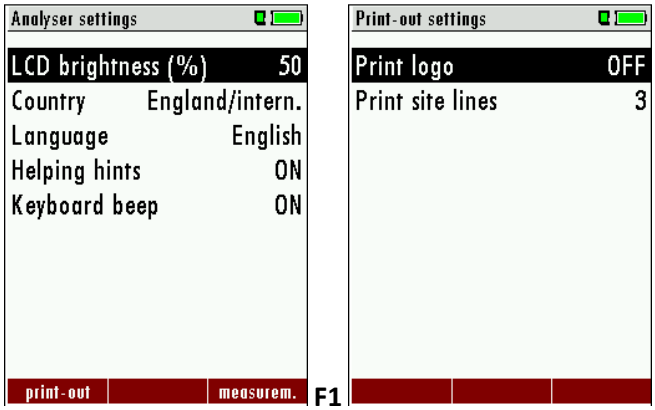
Explanation for “Helping hints”:

Some helpful hints which are very useful for an inexperienced user but are not needed by experienced users, can be activated or deactivated. The following hints will be affected:

“Reminder! Charge batteries at regular intervals!”
“Measurement stopped/started.”

8.2.1 Setting printer type and print-out

In the main menu “EXTRAS“item analyzer settings: print-out settings.



Print logo ON/OFF: Print logo see chap. 13.1

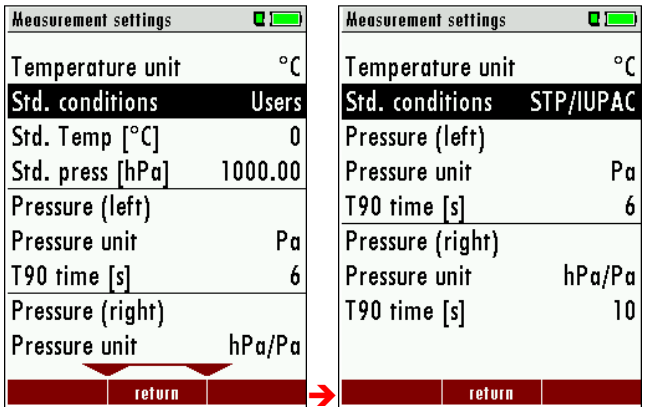
Print site lines 0 … 9: Line 1 (Site no.) is necessary, further lines (freetext) printable if necessary see chap. 13.2

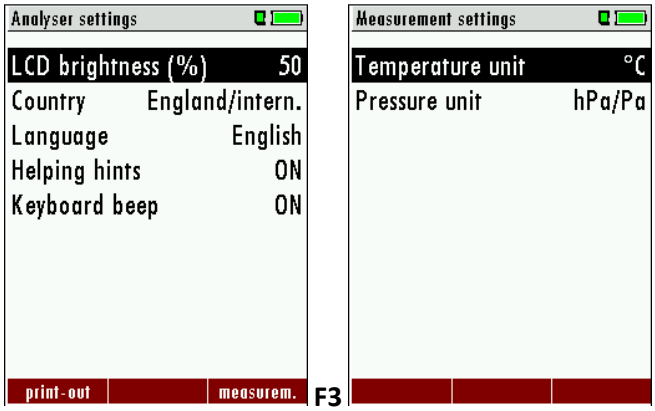
8.2.2 Measurement settings

Standard condition

The standard conditions for temperature and pressure are standard sets of conditions for experimental measurements to be established to allow comparisons to be made between different sets of data.

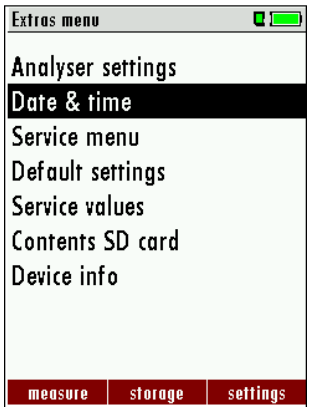
In the menu “measurement settings” you can choose the different std. conditions or you can also define the standard condition.





Temperature heating	°C or °F	Change the unit for temperature in all screens
Pressure unit	hPa/PA, hPa, kPa/Pa, kPa, mbar, mmH2O, cmH2O, inchH2O,mmHG, inchHG, PSI, Pa	Change the unit for pressure in all screens. The meaning of hPa/Pa and kPa/Pa is that the instrument performs a dynamic change of unit depending on the absolute value of pressure.

8.3 Setting time and date



OK

F2	Edit
▲, ▼	Change the marked number
◀ ▶	Move the cursor to the next position
ESC	Back to Extras menu

9 Maintenance and Cleaning

9.1 Cleaning

The MFplus needs to the long value preservation only one very low maintenance need:

- after longer disuse load battery first and afterwards approx. all 4 weeks

9.2 Service and Maintenance

- An annual service check and if necessary adjustment of the sensors at an MRU service department (www.mru.eu) are recommended for the preservation of value.
- With optional gas detector: In the case of a use to the pure leakage detection (maximum value search) a fubction check of the equipment is enough e.g. over an impact from a search gas bottle. A long-term continuous detector accuracy is guaranteed however only by an annually repeated calibration of the equipment.

10 Preparation for each measurement

If you switch on the analyzer with an instrument temperature below 0°, the message appears:

“Due to low device temperature the measuring accuracy is reduced”

If necessary, increase the instrument temperature to avoid measurement inaccuracies.

Switch off the analyzer.

Place the analyzer in a heated room, for example.

Wait until the device temperature exceeds 0°C (32° F).

Switch on the analyzer.

If no message appears, the measurement accuracy is restored.

10.1 Power supply

the instrument can be used with:

1. with the internal MRU battery (provided)
2. with the MRU battery charger (provided)

External equipment may only be connected while the analyzer is switched off!

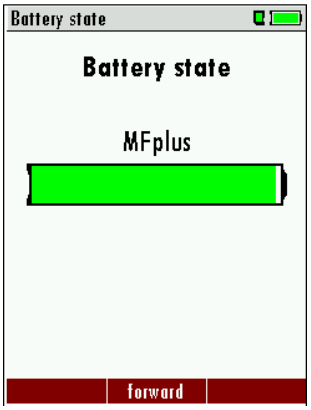
10.2 Auto Off

The instrument is automatically switched off after 60 minutes.

During a measurement or a battery charging cycle the auto off is deactivated.

10.3 Measurement with battery charger/battery charging

When ever you connect the instrument with external power supply (100..240 V / 50/ 60Hz) the battery of the instrument will be charged.



At the moment, if the battery is fully charged and the trickle charge mode begins an acoustic feedback will be played.

10.4 Measurement with battery (Battery monitoring)

The battery symbol in the top right corner displays the current battery charge condition.

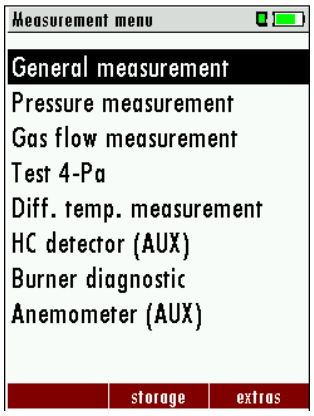
Approximately 15 minutes (depending on the instrument configuration) before the battery is drained, the battery symbol will start to blink red (about once per second).

If the battery is almost drained and the analyzer is not connected to the battery charger within one minute, then the instrument will switch off automatically to prevent deep discharge of the battery.

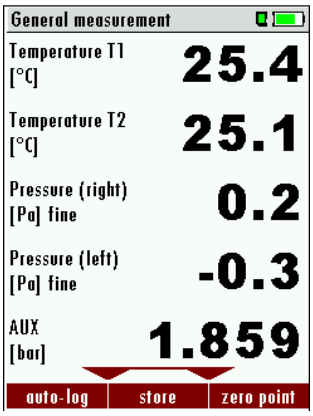
11 How to take a measurement

11.1 General measurement

The general measurement allows the simultaneous measurement of all existing sensors. The measurement can be stored individually and printed. Further, a long-term measurement can be recorded.



OK

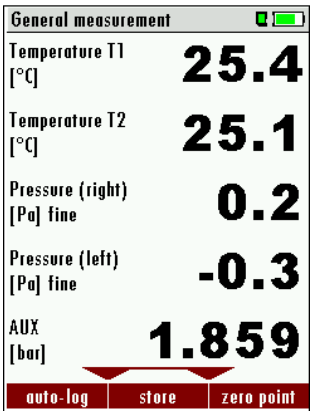


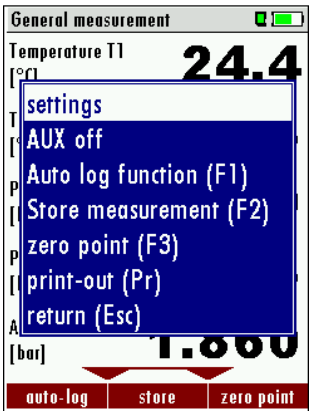
Only the connected sensors will be displayed.

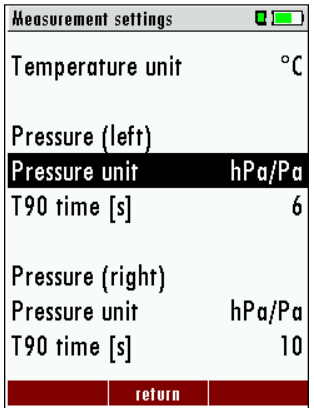
If the measuring window is full and the AUX sensor will be additional connected (menu key AUX on/AUX off) the last line can be chosen between differential temperature and AUX with the arrow keys up/down gewählt werden.

11.1.1 Settings

The temperature and pressure sensors can be setted individually via the menu button / settings.

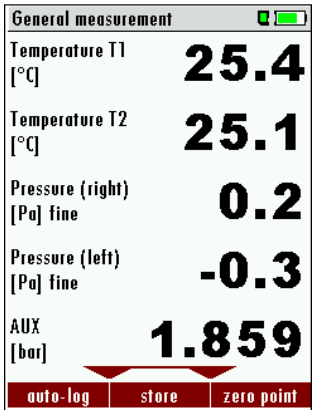




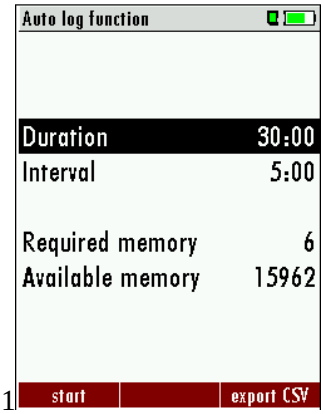


11.1.2 Pressure / Temperature logger

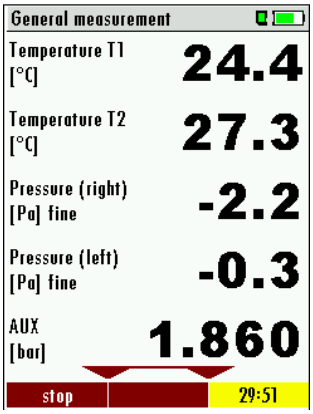
Using the DATA logging function the MFplus can protocoll pressure and temperature.
The user can widely adjust the properties of the measurering automatic to his current needs. The DATA will be saved onto the internal memory and can later be transferred onto the SD Card.



F1



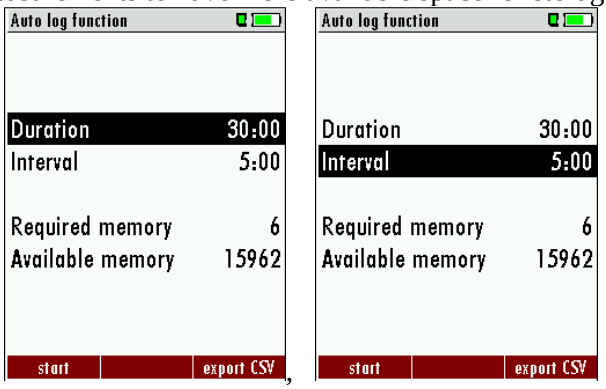
F1



To activate the DATA logging function press the F1 button „Log“.

11.1.3 DATA logging internal memory

The internal memory has a limited capacity, therefore the relationship between total measuring time and measuring interval also has ceratin limits, when the the measurering automatic saves values internally.
The MFplus will display the expected needed memory space. In case the needed memory space is bigger than the available memory space you can either reduce the measuring time or increase the measuring intervals.
You can also delete saved measurements to have more available space for storage.



11.1.4 Loggen DATA logging internal memory with automatic export to SD Card

This function allows a continious measurement over a period of 10 days. The SD card must be in the SD card slot. The MFplus will start saving the data in the internal memory and once the memory is full the data will automatically be transferred onto the SD Card. Each export will create a file (Format LOG000XX.csv).

11.1.5 Settings

- Measurement time in minutes(1 Minute – 24 hours or 10 days with SD Card)
  Total measung time of the measurering automatic.

- Intervall in seconds (1 second – 2 hours)
  Start the measurering automatic with the F1 button.
- With the F3 button the complete memory will be exported onto the SD Card.
  (if measurements are saved in the internal memory)

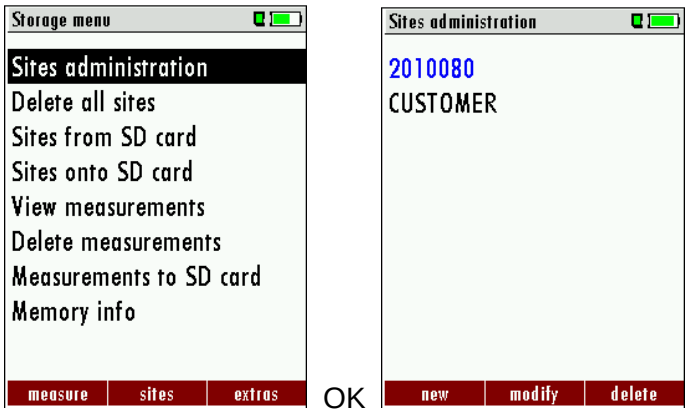
Start recording using the F1 button „Start“.
During recording the remaining time will be displayed.

Once recording is completed the data can be exported onto the SD Card using the F3 button. (In case you have selected „10 days SD-Card“
the data will be exported automatically.

11.1.6 Site selection

The saved measuremet data will be saved to the selected site.
Select the site where you want the data to be saved to before starting the measurering automatic. The site can be selected in the STORAGE MENU. With the buttons left and right you can select either the previous or

the next available site.



11.1.7 Evaluating data using Excel

Microsoft Excel - LOG00051.csv

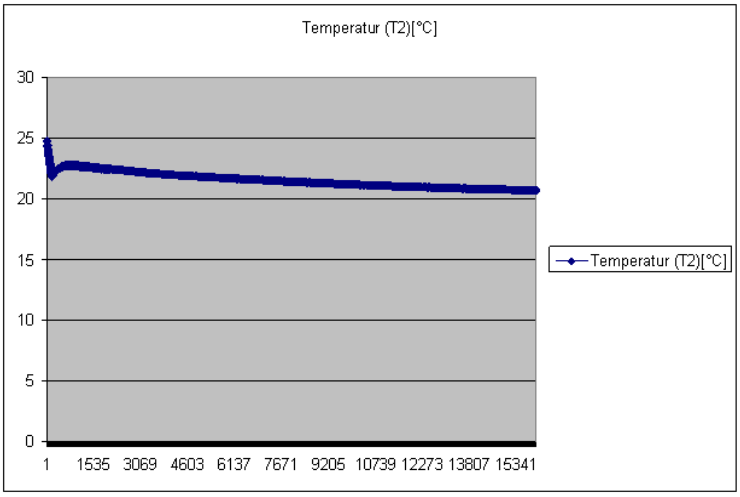
Datei Bearbeiten Ansicht Einfügen Format Extras Daten Fenster ?

Arial

A1 Anlagen-Nr.

	A	B	C	D	E	F	G	H	I
1	Anlagen-Nr.	Datum	Uhrzeit	Temperatur (T	Temperatur (T	Druck 2[hPa]	Druck 1[hPa]	Aux[bar]	Reserv.
2	Anlage #3#	25.02.2013	17:14:17	24,8	25	0	0	0	0
3	Anlage #3#	25.02.2013	17:14:18	24,7	25	0	0	0	0
4	Anlage #3#	25.02.2013	17:14:19	24,7	25	0	0	0	0
5	Anlage #3#	25.02.2013	17:14:20	24,8	25	0	0	0	0
6	Anlage #3#	25.02.2013	17:18:38	24,4	24,5	0	0	0	0
7	Anlage #3#	25.02.2013	17:18:39	24,4	24,5	0	0	0	0
8	Anlage #3#	25.02.2013	17:18:40	24,4	24,5	0	0	0	0
9	Anlage #3#	25.02.2013	17:18:41	24,4	24,4	0	0	0	0
10	Anlage #3#	25.02.2013	17:18:42	24,4	24,5	0	0	0	0
11	Anlage #3#	25.02.2013	17:18:43	24,4	24,5	0	0	0	0
12	Anlage #3#	25.02.2013	17:18:45	24,4	24,5	0	0	0	0
13	Anlage #3#	25.02.2013	17:18:46	24,4	24,4	0	0	0	0
14	Anlage #3#	25.02.2013	17:18:47	24,4	24,5	0	0	0	0
15	Anlage #3#	25.02.2013	17:18:49	24,4	24,5	0	0	0	0
16	Anlage #3#	25.02.2013	17:18:50	24,4	24,4	0	0	0	0
17	Anlage #3#	25.02.2013	17:18:51	24,4	24,5	0	0	0	0
18	Anlage #3#	25.02.2013	17:18:52	24,4	24,4	0	0	0	0

The saved Excel data can be modified.



Additional information about the file format can be found in chap. 13.4.3 Exporting data, in the user manual

IMPORTANT: please use the AC/DC adaptor for long term measurements..

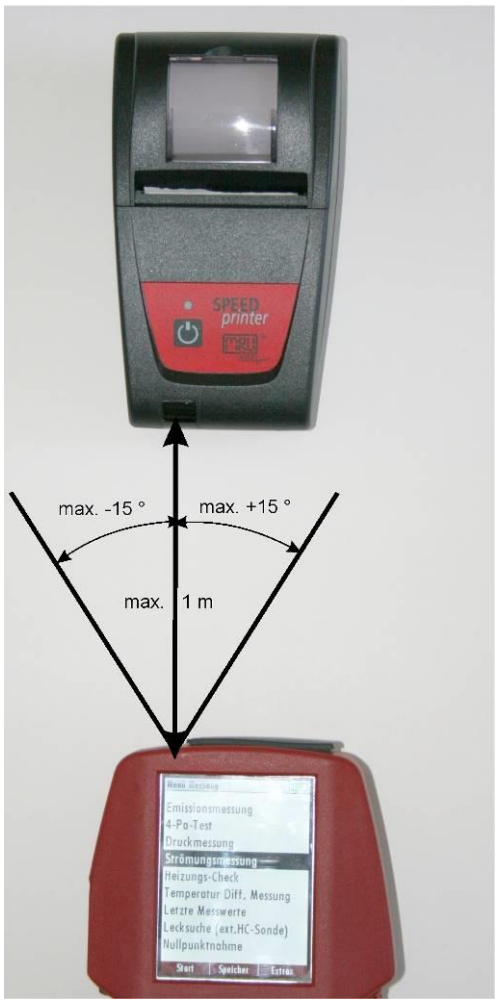
11.2 Storage the measuring results

If in the function key bar "store" is indicated, you can store with the accompanying function key F2 or F3 the measurement in the data memory. The function of the data memory is explained in chapter 12.

11.3 Printing the measurement results

While in the measurement window pressing the printer key will send the information to the IR printer.

The speed printer (IR desktop printer) Art. No. 62693 must be aligned in addition as follows:



All values that can be seen in the measurement window on all three pages will be printed, double measurement values will only be printed once.

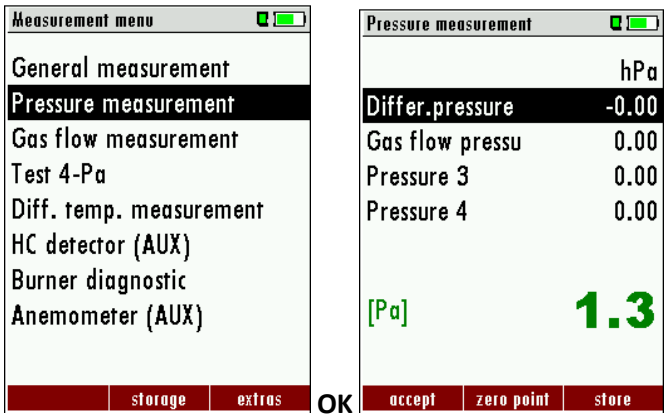
Further technical specifications as well as battery and paper rolls changes please see separate printer manual.

11.4 Pressure measurement

Pressure (4 values) is measured and saved to the selected measurement name. The actual measured value is displayed in the middle of the display. The 4 measurement names can be changed as desired.

The hose on the draft + connector must be connected for draft measurements.

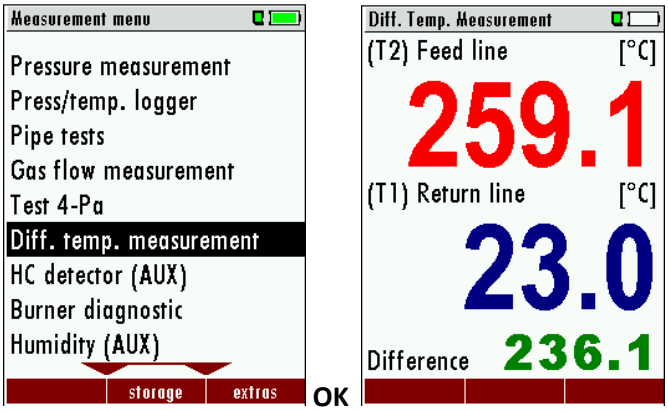
The second hose on the Delta P- connector must be connected for differential measurement.



▲, ▼	Select the measurement name 1-4
F1	Save the measured value to one of the measurement name
F2	Zeroing the pressure sensor
F3	Change the name of the measurement category
ESC	Return to the measurement menu

11.5 Differential temperature measurement

The MFplus can display two temperature values in the menu Differential Temperature if two temperature sensors are connected to T1 and T2. The instrument will also calculate and display the differential temperature.



Note:
The accuracy of the difference temperature measurement is guaranteed only on use of the MRU temperature sensors.

12 Data Storage

12.1 Organisation of the data memory

Basis of the data memory of the MFplus is a set of sites stored in the device. Every site exists of an unique site number and 8 freely usable text lines which can have, e.g., the address, customer name etc.

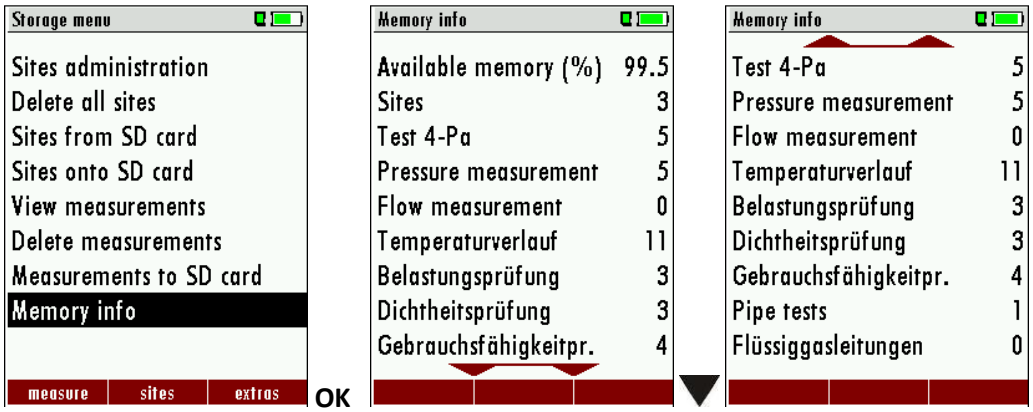
The device can store up to 4000 different sites.

Sites can be created in the device and be changed, or could be imported from a PC program. Attention: sites created in the device and site data changed in the device will not be updated towards the PC. The device does only transmit to the PC the measurement values, but no information about site data.

Measurements are stored by assigning them to a site. Measurements can be, on this occasion, singles flue gas measurements or other measuring programmes available in the device.

12.2 Information about the data memory

In the menu item "storage" you select „memory info“to get information about the actual memory volume. The part of free memory, the total number of the stored sites and the number of the measurements stored all together, split in the kind of the measurement is listed.



12.3 Site administration

In the menu item “Sites administration” you are able

- view all data of the stored sites
- create new sites
- change date of existing sites
- delete sites

Attention:
In the device new created sites and changes in the data of a site will not transmit to the PC back

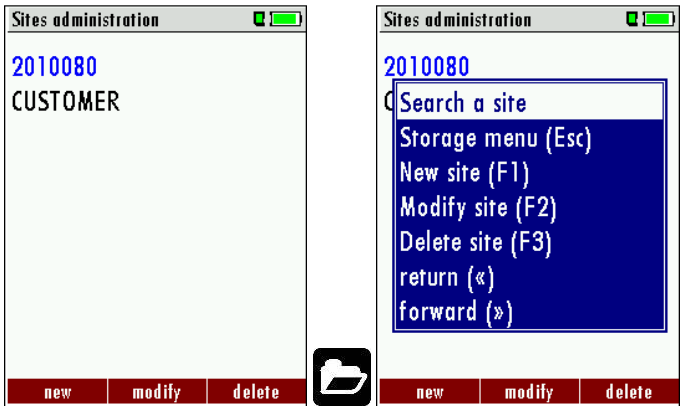
12.3.1 View and search sites

If the menu item "Site administration" will be selected for every stored site will be displayed with:

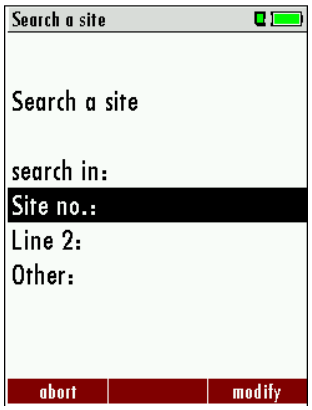
- of the unequivocal site number in the first line which is set down because of this meaning colorfully,
- the other 8 free text lines.

With the arrow keys on the left / on the right you scroll by all sites.
In this menu item, as well as in the menus for viewing the measurements, you can filter straight after sites by using a search mask.

- Select with the menu key "Search a site"

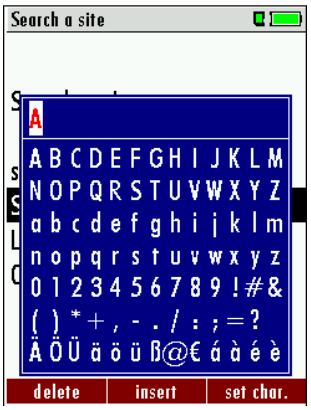


- Now you can enter the text to be searched for the first line, i.e. the site number, or for the second line, or for the rest of the text lines.

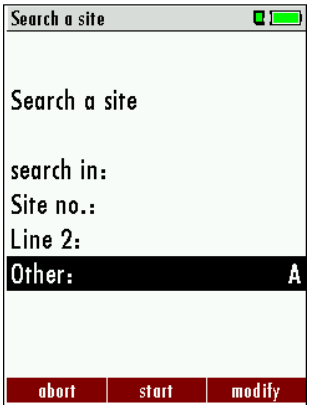


- Select the line for searching (site no. No., line 2, or rests) and select F3 "modify"

- Now in the indicated text input field you can enter a combination of letter, character and figures for whose occurence is searched in the selected text field. Press then "OK".



- Select after input of the search text F2 = "start"



- If only one site is found as a result of the search, this is displayed. If became several sites the total number is found in the header viewed and you can scroll by this found standing with the arrow keys.

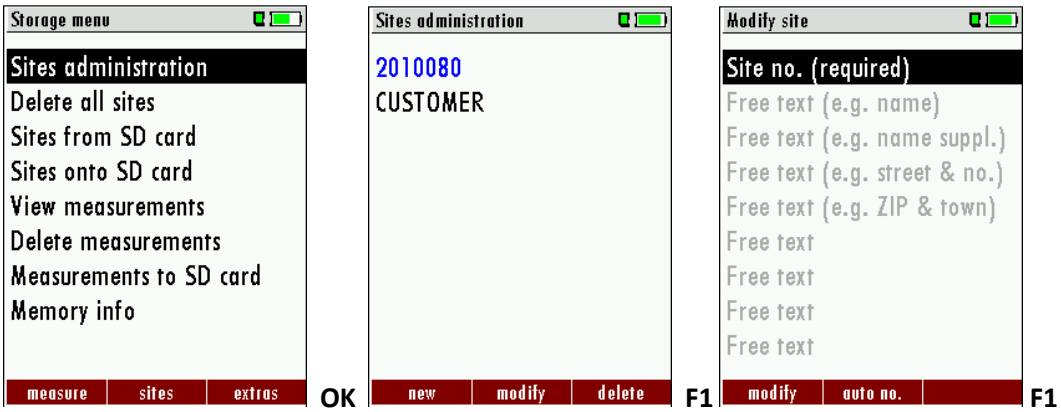
◀ ▶	Page through the sites
🗁	Menu key: Search site ▲, ▼: Selection of the input field **F3:** Input mask, see chap. 15.1 **F2:** Start search ◀ ▶: According to the search criteria found sites page through. If no saved site with the search criteria agrees occurred the Me-dung: „Search unsuccessfully“
ESC	Back to storage menu

12.3.2 New entry and change of sites

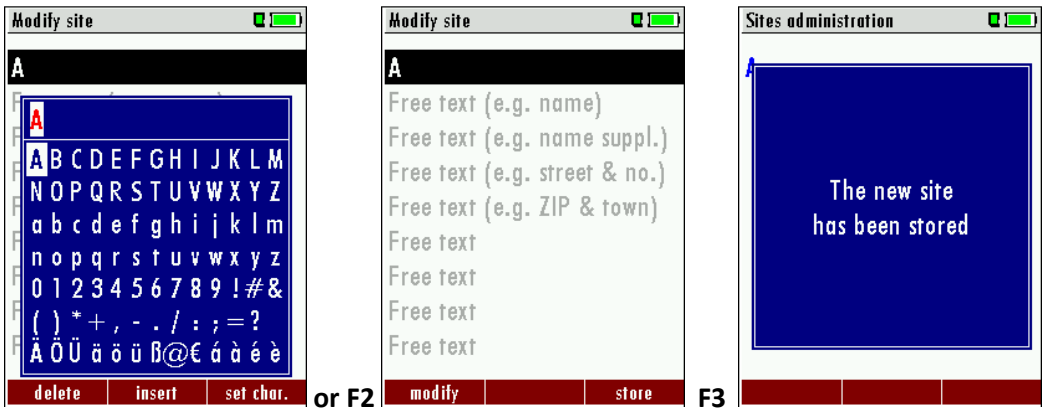
In the menu item "Sites administration" you can new entry sites and change data of existing sites.

Select F1 = "new" for a new site. Besides, it is displayed:

- The first line which must contain an unequivocal site number to the identification of the site. With the function F2 = „auto no. “can assign the device automatically a free site number.
- All further free text lines which can contain, e.g., name and address.



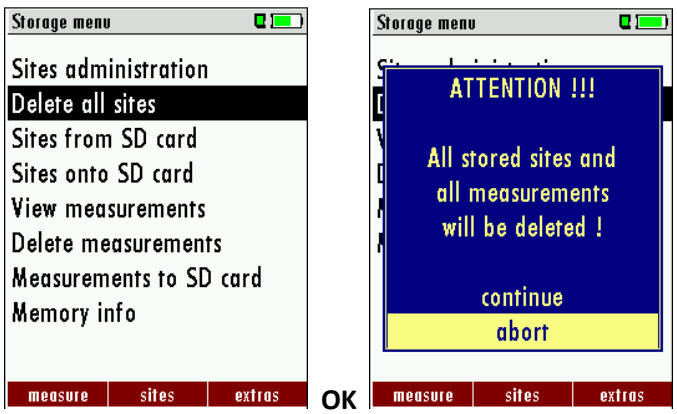
In the new site or an existing site you can change the data while you select the too change line, F1 = "modify" select and use the text input field for editing of the text. Conclude the text input field with "OK" and store the
updates with F3 = "store".



12.3.3 Delete sites

You are able to

- delete the displayed sites only by selecting the menu entry "F3" = “delete
- or delete all sites at the same time



This user's decision must be confirmed. (see chap. 15.2)

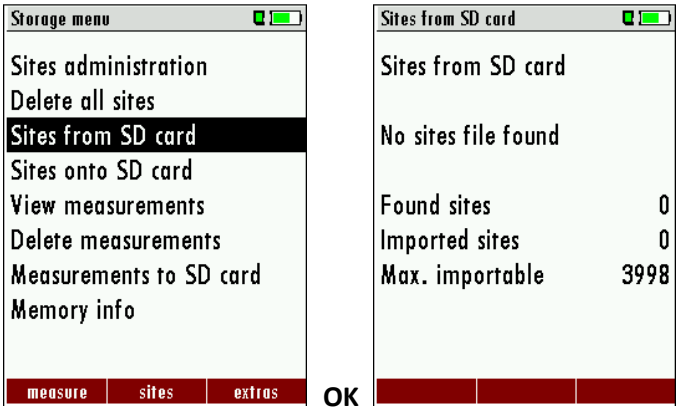
12.4 Data transfer via SD Card (Option)

The data exchange format is CSV. A character-separated values (CSV) file is a simple text format for a database table. Each record in the table is one line of the text file. Each field value of a record is separated from the next by a character. MFplus uses a semi-colon ';' as value separator (other implementations use sometimes a comma). Implementations of CSV can often handle field values with embedded line breaks or separator characters by using quotation marks or escape sequences. CSV is a simple file format that is widely supported, so it is often used to move tabular data between different computer programs, for example Microsoft Excel™ or Access™, that support the format. Also other computer programs offer this type of interface because it is widely spread and easy to use.

The following functions are available from Software Version 1.11 and higher:

- Import of Sites
- Export of Sites
- Measurements

12.4.1 Import of Sites



With this function you can Import Sites which have been created on a computer or another instrument.

The File name must have the name "anlagen.csv" (anlagen = german for sites) . The file has no column heading that means that the first line already has user data. Each line has a minimum of 9 columns (with 8 semi-colons) and the first field in the line will be the site number. All data will be imported as long a site number is available. Per field a maximum of 24 characters will be imported, too long words will be cut off.

Example file with 8 valid sites (4 with 9 lines and 4 with less lines):

A1-Z1;A1-Z2;A1-Z3;A1-Z4;A1-Z5;A1-Z6;A1-Z7;A1-Z8;A1-Z9

A2-Z1;A2-Z2;A2-Z3;A2-Z4;A2-Z5;A2-Z6;A2-Z7;A2-Z8;A2-Z9

A3-Z1;A3-Z2;A3-Z3;A3-Z4;A3-Z5;A3-Z6;A3-Z7;A3-Z8;A3-Z9

A4-Z1;A4-Z2;A4-Z3;A4-Z4;A4-Z5;A4-Z6;A4-Z7;A4-Z8;A4-Z9

A5-Z1;A5-Z2;A5-Z3;A5-Z4;;;;;

A6-Z1;A6-Z2;;A6-Z4;;;;;

A7-Z1;;;A7-Z4;;;;;

A8-Z1;;;;;;;;

Example file with 2 invalid sites (1 with not enough fields and 1 with missing site number):

A1-Z1;A1-Z2

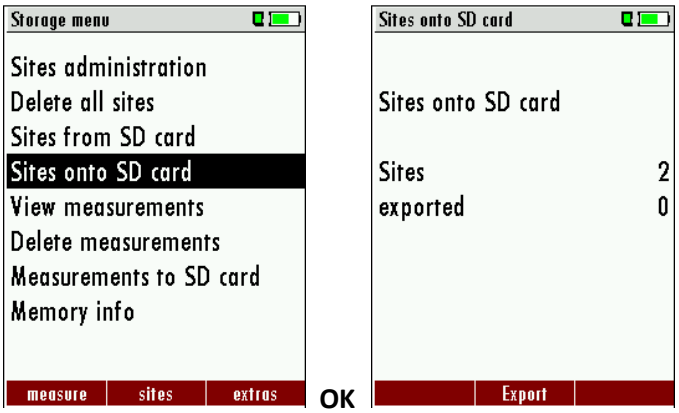
;A1-Z2;A1-Z3;A1-Z4;A1-Z5;A1-Z6;A1-Z7;A1-Z8;A1-Z9

Important:

Whilst importing data from the SD Card to the instrument there is no check for double site numbers (Line 1), neither inside of the file that is imported nor between the file and the sites already inside the instrument. The instrument can easily handle double site numbers but you could face problems with double site numbers when exporting them again to a computer program (see also Export of Measurements).

However the instrument marks the files that have been imported successfully. If you try to import a file with the same instrument that is already in the instrument you will get a red information screen.

12.4.2 Export of Sites



This function can be used for an instrument back up or if you wish to supply the instrument information to a computer program or another instrument. This is very handy if you have made some modifications inside the instrument (site) for example if you have modified the phone number of a customer and this modification needs to be updated in the computer software, or if a second analyzer needs to have the same site information.

The File format ist the same as described above„Import of Sites“.

Only the file name is different, the file name will be ‚ANLxxxxx.csv', in which the xxxxx are continuing 5 digit numbers with leading zeros. If the file must be imported into another instrument, the file must first be renamed into “anlagen.csv”.

12.4.3 Export of Measurements

This function is used to export the measurements from the instrument to a computer program.

Attention! This function is not suitable for back up or for the transfer to another instrument because the exported file can not be imported again!

The created file has the name ‚EMIxxxxx.csv', in which the xxxxx are continuing 5 digit numbers with leading zeros.

12.4.4 Export of Differential Pressure Measurements

The same function as under 12.4.3(Export of Measurements) only the file name is different.

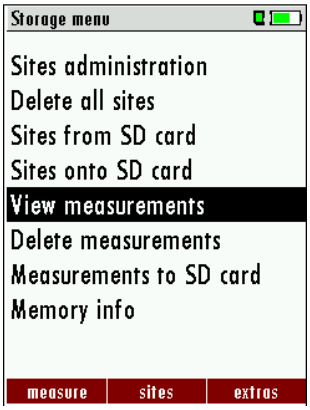
The created file has the file name “DDMxxxxx.csv“, in which the xxxxx are continuing 5 digit numbers with leading zeros.

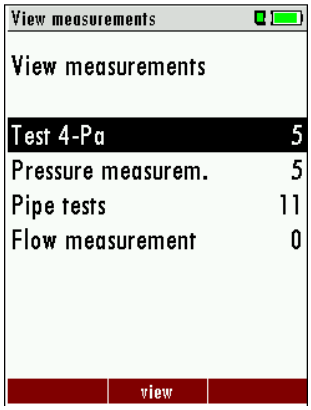
The created file has a column header with the following information: Site number, Date/Time, as well as 4 saved pressure measurements.

12.5 Measurements in the data memory

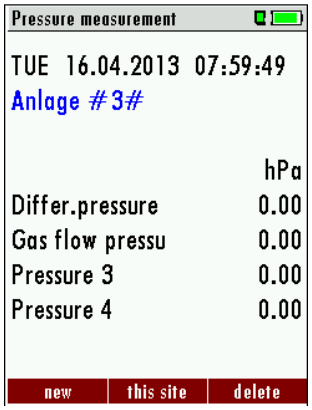
12.5.1 View measurements

In the menu item „View measurements“you can inspect the stored measurements. After selection of this item you receive first an overview of the number of the stored measurements according to measuring type.





- Select a measuring type.
- Then you receive first a page with context information to the stored measurement. Scroll with the arrow keys by the context information of the stored measurements.



- With F2 = "measured value" are displayed the measured data of the stored measurement in detail, available in 3 measuring value pages, as they are defined in the measuring value window.

- With ESC you return to the context information of the measurement.

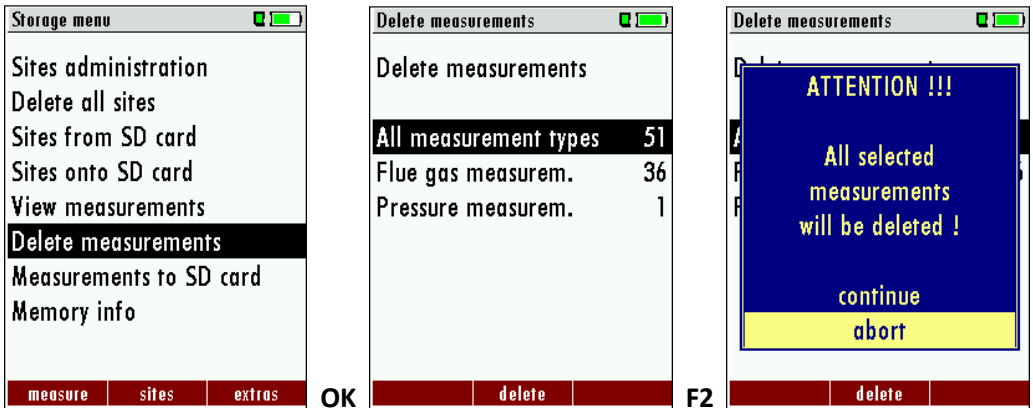
  You have the possibility to display only those data that are assigned to a single site:.

- either F1 = „this site“ , while a measurement of the desired site is displayed.
  With F1 = „all sites“ you cancel this filter again.
- or while you select with the menu key the function "search a site" and execute, as described in the chapter site administration.

12.5.2 Delete measurements

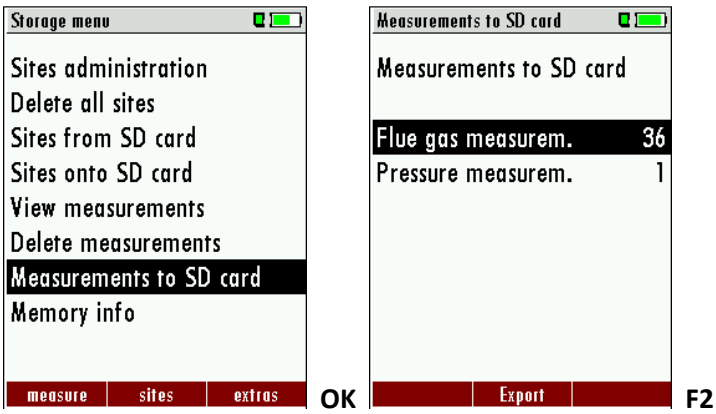
You are able to

- delete single measurements, while they are displayed – press the key F3 = "delete" .
- or delete all measurements of a measuring type.



12.5.3 Export measurements to a SD card (optional)

The MFplus offers the possibility to export all stored measurements to a SD card.



By confirming with the F2 key the data transmission / export on the SD card is started.

During the data export the display reads „please wait”. A write error to SD card is reported by the instrument. Make sure that the SD card is not write protected.

The data are stored as a csv-file (e.g., EMI01032.csv) on the SD card. The filename exists of a sequential number which fixes the device.

This file is editable on your Notebook/PC with a program like e.g. Microsoft® EXCEL or OpenOffice® Calc. With possible problems with the using of your computer programs please read your software documentations or ask your software dealer.

13 EXTRAS / Settings

The MFplus is delivered in a standard software configuration which should cover most needs. However, there are many ways to tailor the settings to your individual needs if required. The possibilities are highly flexible and individual adaptable.

Use the variable possibilities to adapt your instrument to your own needs and customize the measurement menu, the measurement window, the printer out put and many other features. Usually this is something you will do once you receive the instrument, once you have adapted your instrument you will most probably don't make much changes in future, but you can when ever you need and want to do so.

After you have made any changes in the configuration, you should switch off the instrument to save all the changes that have been made. Next time that you start up the instrument, all changes will have been made.

13.1 User definable Logo print out

Overview:

The Logo file can be created out of a Bitmap using the program "MFpluslusPrnLogoCreator.exe" which comes with the analyzer CD. The generated file will be transferred from your computer to the analyzer using the SD card (only once). Once transferred the Logo can either be printed above or below the customer address or you can choose not to print the logo at all.

Converting a Bitmap into a Logo file:
Use the enclosed Windows-Program "MFplusPrnLogoCreator.exe"
(MRU Product CD / Software / MFplusPrnLogoCreator).

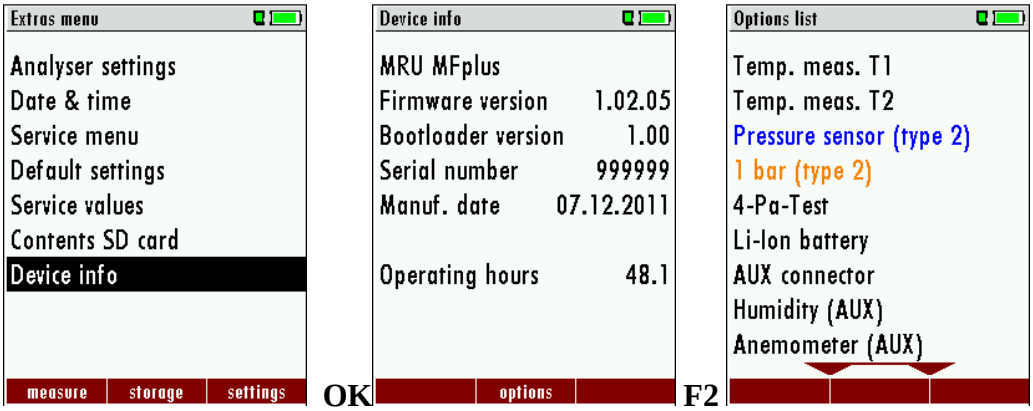
The Bitmap can have any color depth bit ideal is a color depth of 1-bit black-white. The horizontal resolution must have 384 pixels. If necessary the Bitmap can be adjusted using a picture editing program (not included on the CD).

The vertical resolution of the Bitmap must be a multiple of 24, where 24 is the minimum and the maximum is 480 pixels. If necessary the Bitmap can be adjusted using a picture editing program (not included on the CD).

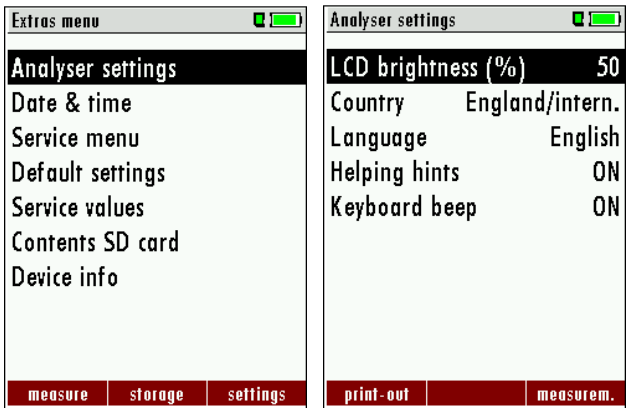
Die erzeugte Logo-Datei muss "lg_print.mru" genannt werden (wird vom Programm vorgeschlagen).
Die Größe der erzeugten Logo-Datei darf 16896 Bytes nicht übersteigen (wird vom Programm geprüft).

Transferring the Logo file per SD card to the analyzer:

Copy the created file "lg_print.mru" onto the SD card (root).

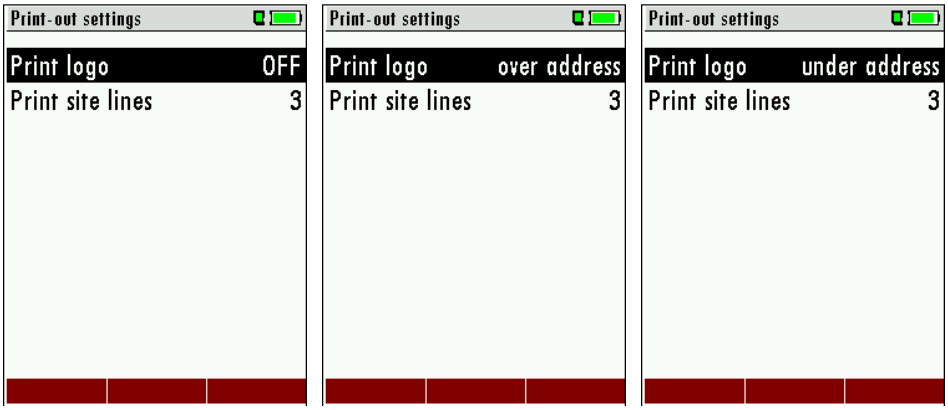


Switch on the analyzer then navigate to – Extras (F3) Analyzer info options. Now insert the SD card into the SD card slot, the unit will conform the upload with a short beep and on the screen you will see a short message – Logo installed.



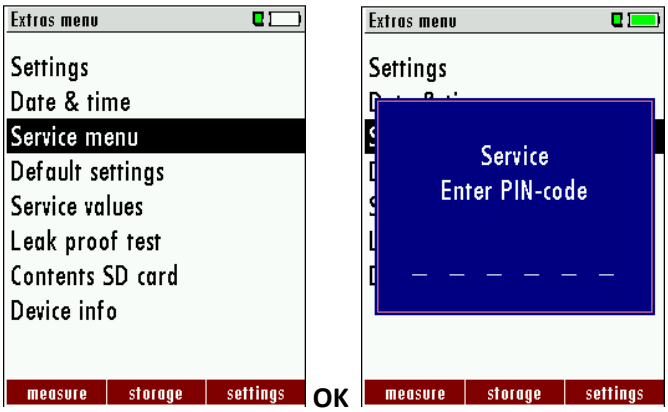
Printer Logo setting:

As soon as the Logo has been installed and the printer type is set on MRU, the Logo print will be available in the menu “extras / settings (print Logo).



13.2 Maintenance adjustment menu

The Maintenance adjustment menu is secured with a Pin Code to protect it against unauthorized users.

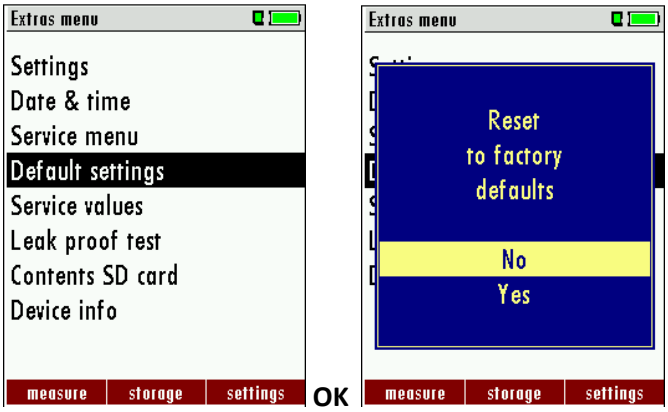


If you enter a wrong pin code you will be exited into the “Extra Menu” again.

Please contact MRU GmbH if you need the Pin Code for your instrument.

Press the Enter key if you should have landed in this menu by accident and you will be exited into the “Extra Menu” again.

13.3 Manufacturer default settings



The analyzer will be reset to original delivery settings.

Be aware that your configurations will be deleted, such as:

Settings

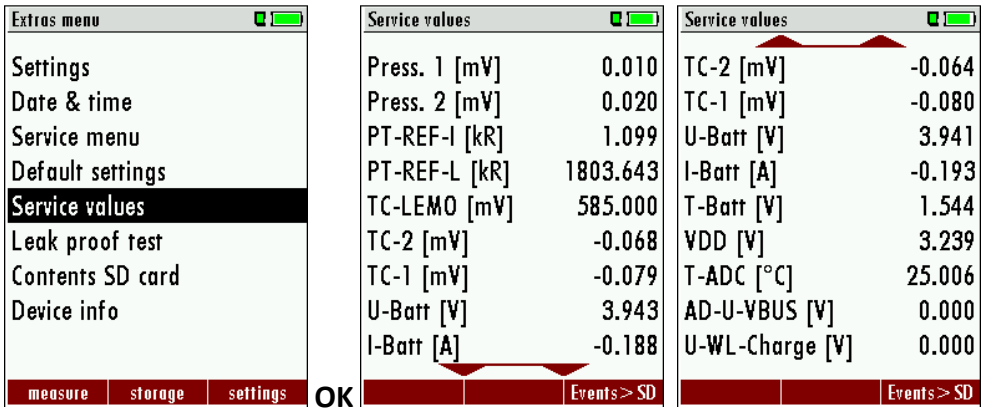
LCD brightness(%)	50
Helping hints	ON
Printer type	MRU

.

13.4 Service values

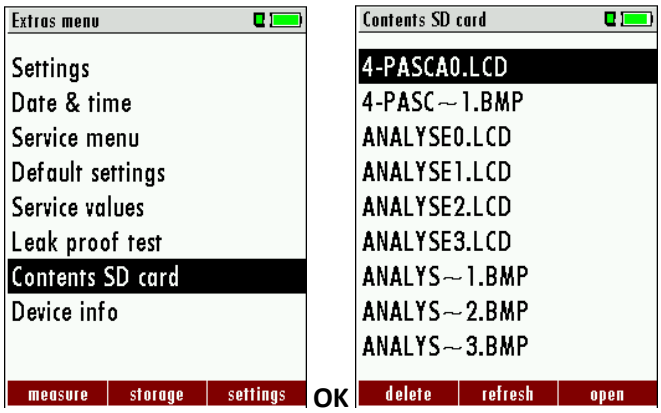
Should your instrument display an error message after zeroing, then you can use the Service value menu to get detailed information about possible defects. In this menu you will see all service values of the sensors and also other parameters.

In case of a defect contact the MRU service department. The MRU service technician will ask you about these values or he will ask you to send them by fax or email.



▲, ▼	Jump between the lines
F2	Export of the service values to the SD card
ESC	return

13.5 Contents SD card



The contents of the SD card will be displayed. With F3 the selected file can be opened.

13.6 Instrument information

Here you will find information about the analyzer and the installed options.

Use the F2 button to see the installed options.

14 Technical specifications

14.1 General Specifications

Deutsch		English
Betriebstemperatur	-10°C ... +45 °C / 14 °F ... 113 °F	Operating temperature
Rel. Luftfeuchtigkeit bei Betrieb, nicht-kondensierend	95%	Rel. Humidity, non-condensing
Lagertemperatur	-20°C ... +50°C / -4°F ... 122°F	Storage Temperature
Akku intern, Betriebszeit	NiMH: 15h Li-Ion: 30h	Internal Battery Pack, operating hours
Stromversorgung ext. USB Netzteil	USB 5V 1A	Power Supply USB power supply externally
Gewicht	470 g	Weight
Maße (BxHxT)	90 x 205 x 38 mm^3	Size (WxHxD)
Gehäusematerial	PA6 GF 30	Housing Material
Schutzart mit Schutzkappe	IP40	Protection Class with protection cap
Bluetooth Frequenzbereich und Ausgangs-leistung	EDR Power @ 2.402 GHz:5.5* dBm EDR Power @2.441 GHz: 7.5*dBm EDR Power @2.480 GHz: 8.5* dBm BLE Power@2.402 GHz: 5.5* dBm BLE power @2.440GHz: 7.5* dBm BLE power @2.480 GHz: 8.5*dBm Typische Werte/ Typical values	Bluetooth frequency range and output power

14.2 Measured Values

Temperatur	T	Temperature
Anzahl und Typ der Thermoelementanschlüsse	2x Typ K Mini	Qty and type of thermocouple inputs
Messbereich, abhängig vom verwendeten Füh-ler	-200 °C - 1300 °C	Measuring Range, depending on actual probe type
Genauigkeit abs. / vom Messwert	±1°C / 1%	Accuracy abs. / reading
unterstützte Einheiten	°C, °F	supported units
Differenztempeaturberechnung	•	calculation of differential tempera-

ture

Druck	P	Pressure
Anzahl gleichzeitiger Druckmessungen (jeweils einer der u.a. Messbereiche)	2	Qty of simultaneous pressure measurements (each with one of the measuring ranges below)
Anschluss über Metallstutzen	•	Metal connectors
unterstützte EInheiten	Pa, mbar, PSI, inH2O	supported units
Messbereich	**100 mbar**	**Measuring Range**
Genauigkeit (abs./ vom Messwert)	± 0,02 mbar / 1%	Accuracy (abs. /reading)
Differenzdruck		Differential Pressure
Messbereich	**250 mbar**	**Measuring Range**
Genauigkeit (vom Endwert)		Accuracy (Full Scale)
Differenzdruck	± 2%	Differential Pressure
Messbereich	**1 bar**	**Measuring Range**
Genauigkeit (vom Endwert)		Accuracy (Full Scale)
Differenzdruck	± 2%	Differential Pressure
Messbereich	**300 ... 1200 hPa**	**Measuring Range**
Genauigkeit	± 3 hPa	Accuracy
Barometrischer Druck		Barometric Pressure

14.3 Calculated values

Strömungsgeschwindigkeit (optional)	**v**	**Velocity** (optional)
basierend auf Differenzdruckmessung mit Prandtlrohr		*based on differential pressure measurement with Pitot tube*
Messbereich typisch	1 m/s ... 40 m/s	typical measuring range
Absolutdruckmessung(setzt den Absolutdrucksensor von oben voraus)	•	absolute pressure measurement (requires abs. pressure sensor above)
basierend auf Flügelradmessung		based on vane anemometer
Messbereich (abhängig von Flügelrad-Typ)	0,25 - 35 m/s	measuring range (depending on actual vane type)
Feuchte- & Temperatursonde	**RH**	**Humidity & Temperature Probe**
Messbereich Feuchte	3 - 98 %	Measuring Range Humidty
Genauigkeit Feuchtemessung abs.	± 3% RH	Accuracy Humidity Measurement
Messbereich Umgebungstemperatur	-20 °C ... +80°C	Measuring Range Ambient Temperature
Genauigkeit Umgebungstemperaturmessung	± 1°C	Accuracy Ambient Temperature Measurement

Gasleitungsprüfung - Belastungsprüfung		
Messbereich	0 - 1500mbar	Measuring Range
Genauigkeit (abs. / vom Messwert)	±4 mbar / 2%	Accuracy (abs. /reading)
setzt 1bar - Sensor von oben voraus		
Gasleitungsprüfung - Dichtheitsprüfung		
Messbereich	0 - 200 mbar	Measuring Range
Genauigkeit (abs. / vom Messwert)	±0,5 mbar / 3%	Accuracy (abs. /reading)
setzt 1bar - Sensor von oben voraus		
Gasleitungsprüfung - Gasleckmenge		
Messbereich	0 - 8 l/h	Measuring Range
Genauigkeit (abs. / vom Messwert)	±0,2 l/h / 5%	Accuracy (abs. /reading)
mit 1bar - Sensor oder 100 mbar - Sensor		
Gaslecksuche		**Gas Sniffer**
Messbereich CH_4	5 - 20000 ppm	Measuring Range CH_4
Überlast	100000 ppm	Overload
Auflösung	1 ppm	Resolution
Ansprechzeit	T_{90}< 5s	Response Time

14.4 Data Communication

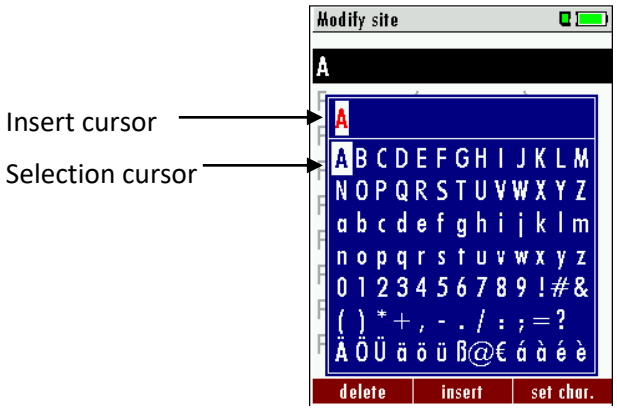
Deutsch	**Anga-be**	**English**
USB Anschluss	•	USB interface
SD Karte		SD card
für SW update, Datenaustausch, erweiterterter Datenspeicher	>= 2GB	for SW update, data exchange or extended data memory

15 Appendix

15.1 Text input

A numbers of texts and names can be changed to your own needs.
(for example: the names of the user defined fuel types, site names, the names of the measurement programs)

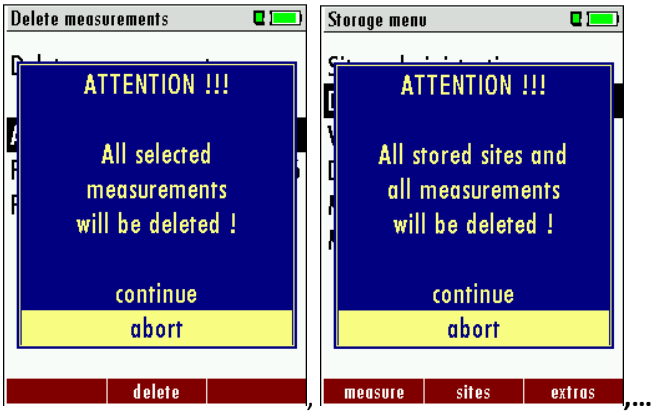
When you select the text input, the following window will pop up:



▲, ▼, ◀, ▶	Select a letter, number or sign
F1 – delete	The letter left of the cursor will be deleted
F2 – insert	Selected letter or number will be inserted
F3 – over write	Selected letter or number will over write the current letter or number
ESC	Abort the window, changes will NOT be saved

15.2 Asking the user for a decision (pop up window)

The MFplus will ask you now and then to confirm the action that will be taken.



▲, ▼	Select a line
OK	Confirm the action
ESC	Abort the window, changes will NOT be saved

15.3 Using the USB-Port

This port is used for data transfer from your analyzer to your PC / Laptop using the MRU Online View (Version 2.XX). The first time you want to use your analyzer for data transfer to your PC or laptop, you have to "mate" the MFplus and your PC / Laptop. (Requires operating system Windows XP or Windows 7).

Your PC / Laptop will recognize the MFplus USB- HID (Human Interface Device).

Check list:

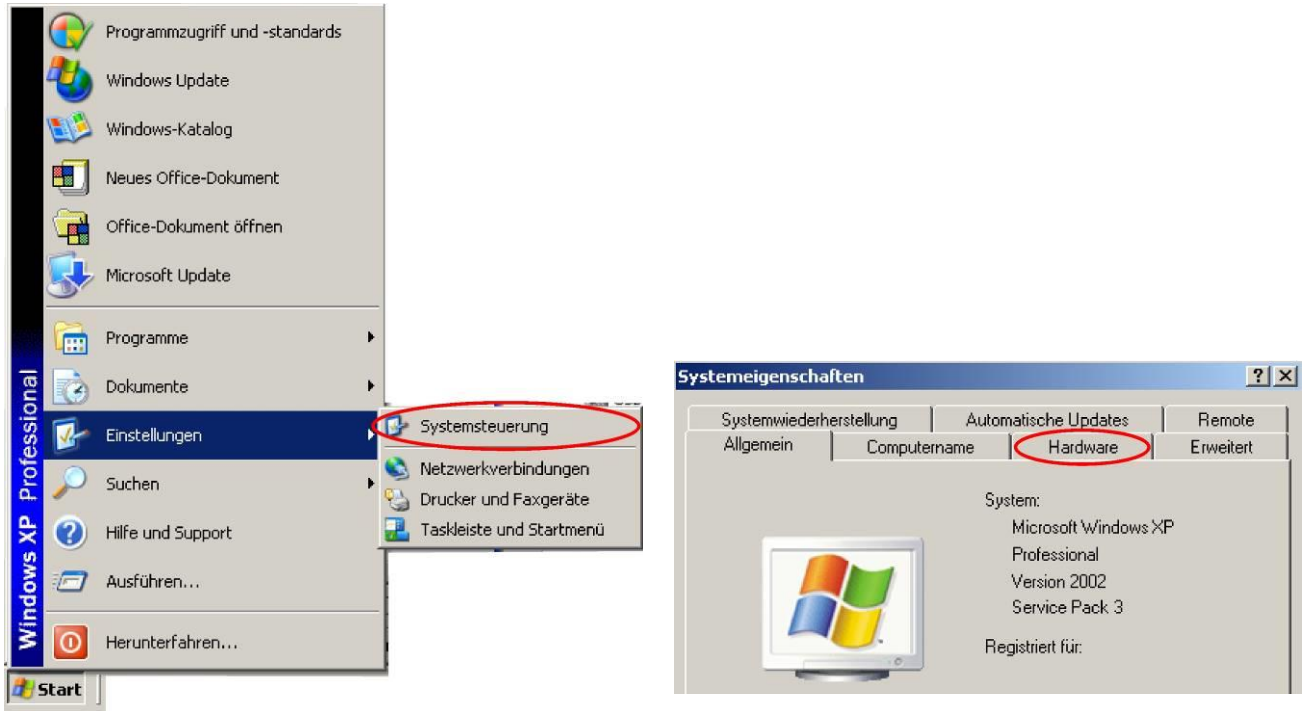
1. Switch on the MFplus
2. Connect the USB cable to the MFplus
3. Connect the USB cable into a free USB port at your PC/Laptop
4. The PC/Laptop must be powered on
5. The above seen information „New hardware found" will be displayed above the USB-Icon of your PC/Laptop

If this is not the case, then you have a problem with your USB-Connection of your PC/Laptop.

Check in your Device Manager if the analyzer is ready for operation.
The MFplus is as HID-conform unit registrated.

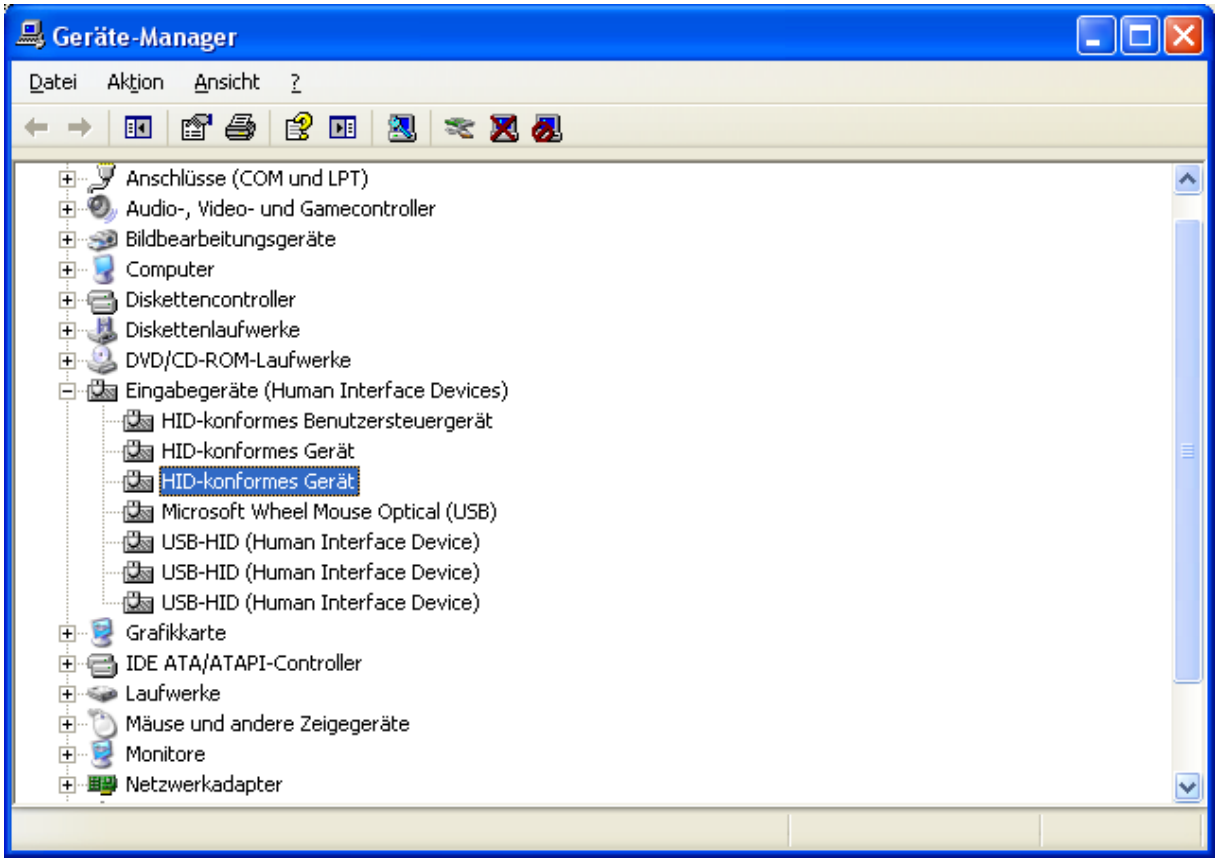
Windows XP: Press the START button – then select the CONTROL PANEL – select SYSTEM – selct HARDWARE – select DEVICE MANAGER

Windows 7: for Windows 7 there are several possibilities, please read your Windows 7 manual for details.



(The grafics may look different on your PC/Laptop as shown in this manual!)

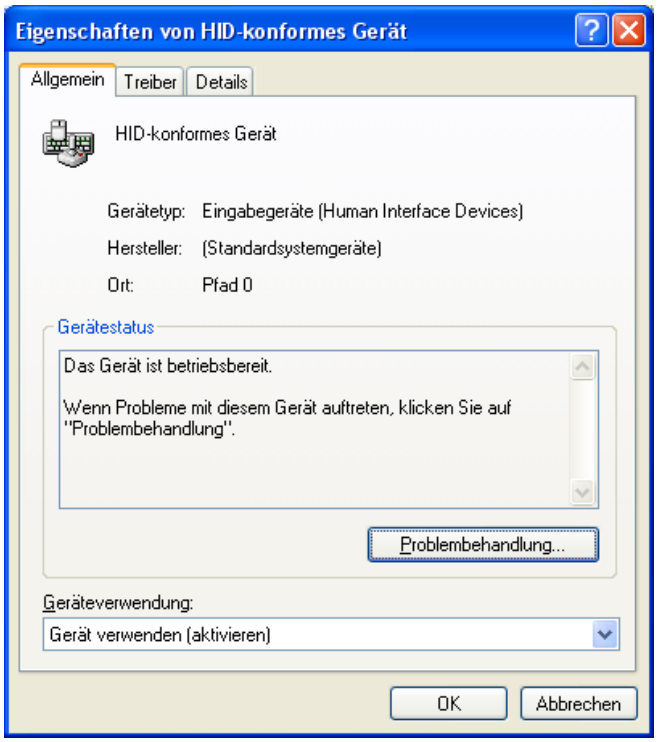
(

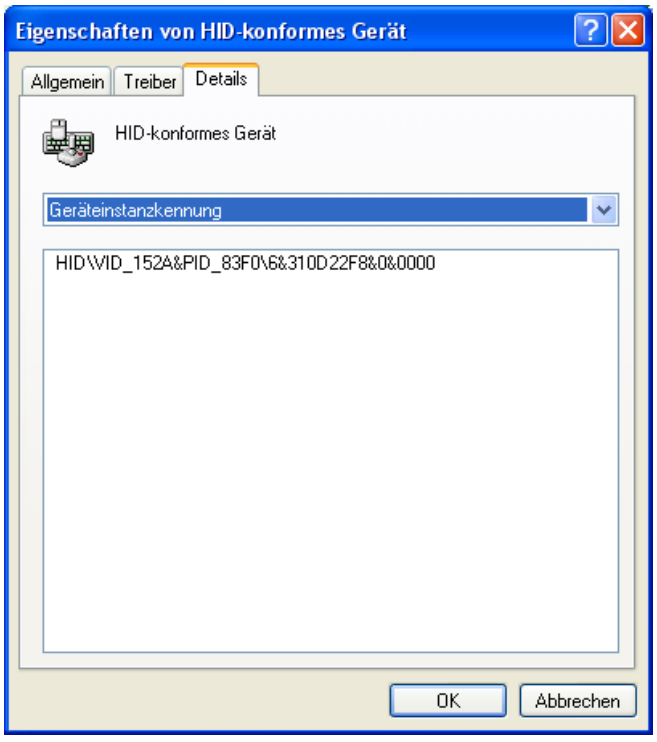


The MFplus is registrated as HID-conform unit.

In the Generel folder you can see if the unit is ready for operation.

In the detail folder the instrument is registered with the VID 152A.





In case the instrument is not ready for operation, choose a different USB instrument to check the USB port on your computer, and/or connect the MFplus to a different computer to locate the error.

15.4 Errors

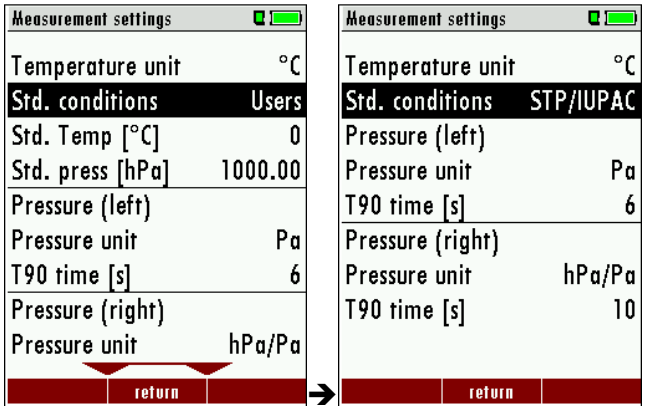
1. Effect	2. Error indication	3. Cause	4. Solution
Device cannot be switched off by pressing the OFF key.	LED behind the condensate separator is on and the LCD display is dark	Device does not react on any key.	Press ESC and ON simultaneously! EMERGENCY OFF After this, the date and time have to set new.
Inside of the device is too cold, device not ready for operation.	Display indication: “Device too cold” or audible sound every 5 sec..	e.g. device was stored in a cold place during winter.	Put the device to a warm room and wait
Measurement accuracy reduced	Display indication: Due to low device temperature the measuring accuracy is reduced!	Device temperature below 0°C (32° F)	Warm up the analyzer
No measurement possible		Device cannot be switched on or does not react after being switched on. Battery discharge	Connect the device to the line power in order to charge the battery.
Measurement without exact temperature values.	Temperature indication: - - - , - °C	Thermo element defective, balancing network interrupted or not connected.	Call our after-sales service. Remove probe from the gas duct and condensate from the probe tube.

15.5 Options

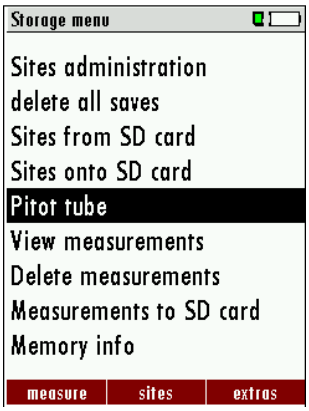
15.5.1 Standard condition

The standard conditions for temperature and pressure are standard sets of conditions for experimental measurements to be established to allow comparisons to be made between different sets of data.

In the menu “measurement settings” you can choose the different std. conditions or you can also define the standard condition.



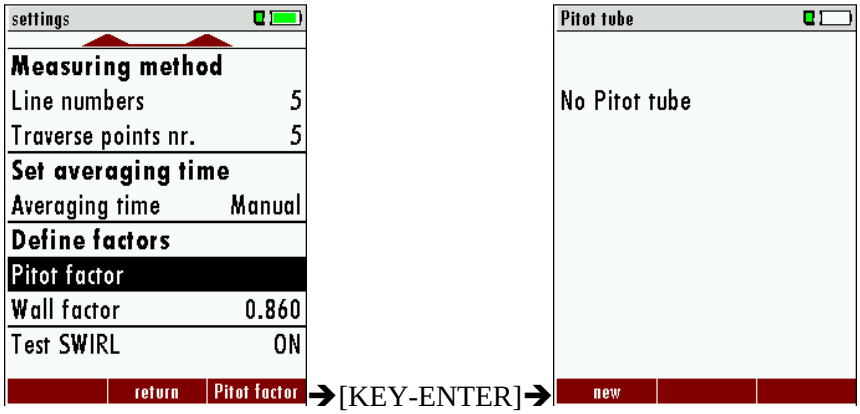
15.5.2 Library of pitot tube (option)



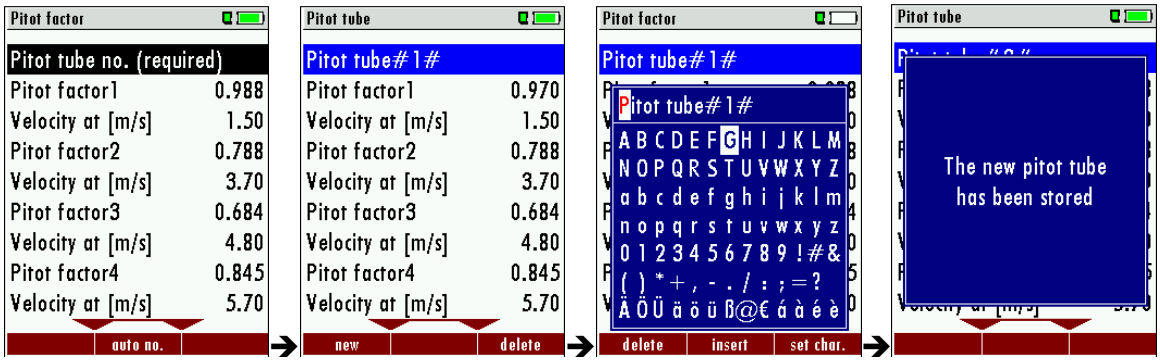
The MFplus give you the possibility to manage 5 coefficients and calculate the correct K according to the actual velocity.

You can store until 100 pitot tubes.

Insert a new pitot tube:
It is possible to insert a new pitot tube from the Storage menu or from the settings of gas flow measurement. With the key F1 you can create a new pitot tube.



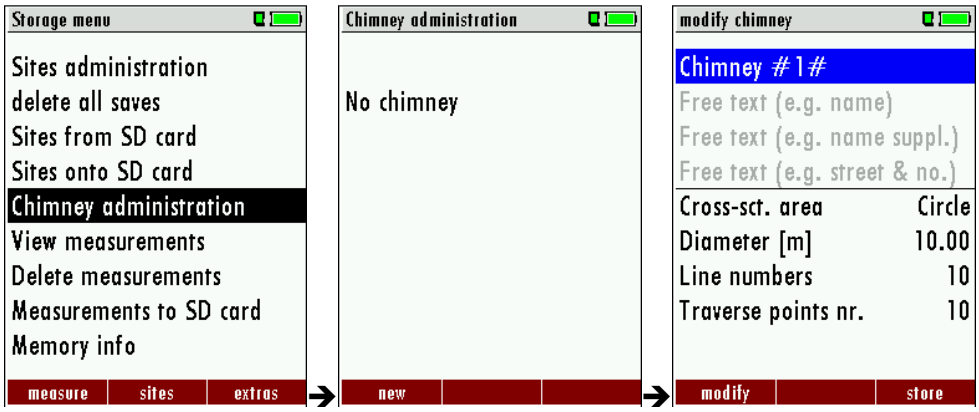
Before start the gas flow measurement, you should load the saved parameter of the pitot tube. If there is no saved pitot tube the measurement will be done with a default parameter.



With the key F3 you can delete the tube. Before delete the pitot tube make sure that the pitot tube was never be used in a measurement otherwise you can't export the information about the parameter of the used pitot tube in CSV.

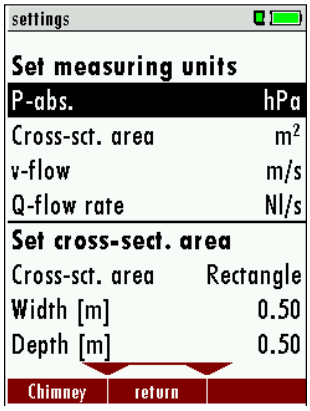
15.5.3 Library of chimney (option)

The Library of chimney gives you the possibility to recall the chimney details in the setting menu, instead of insert them manually before starting every measure.



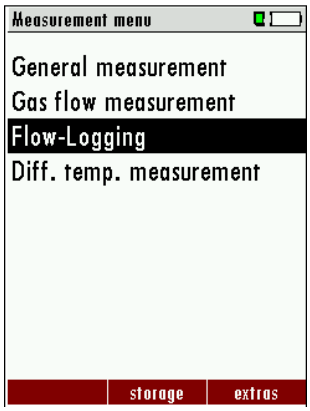
After get the details of the chimney, with the key F3 you can save the parameter of the chimney.

You can load the parameter of chimney before start the measurement in the menu setting of flow gas measurement.



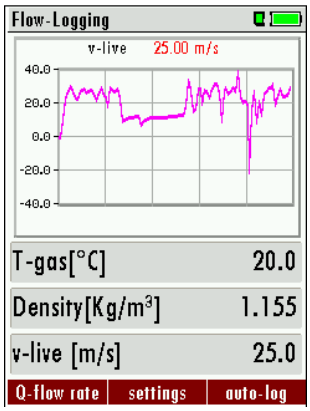
NB: If you delete the chimney, the all assigned measurements will be deleted.

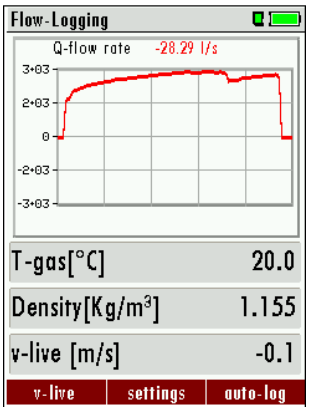
15.5.4 Data logger of flow (option)



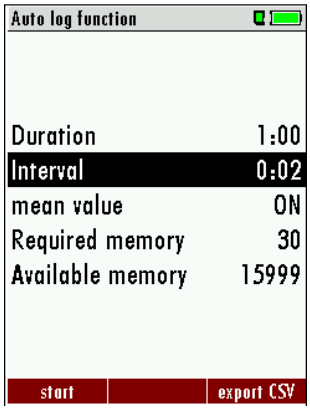
In the menu “measurement menu” you find the Flow-Logging.

The flow velocity and the volume flow will be presented in the form of graphic, this helps to check the stability of the flow. With the Key “right/left „ you can switch to the other measurement and with the key F1 you can chose the flow velocity or the volume flow.

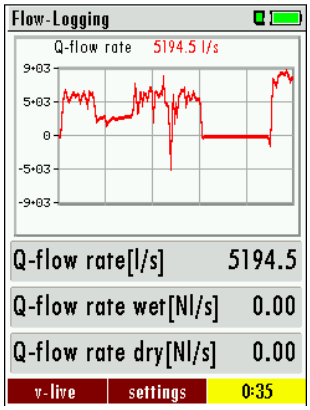




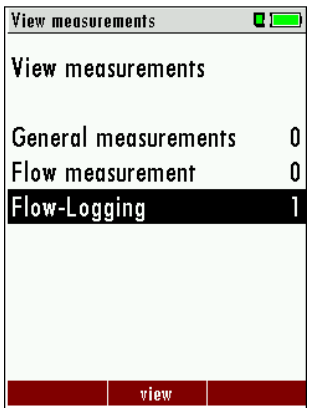
With the key F3 “auto-log” another window appears (see the picture below).



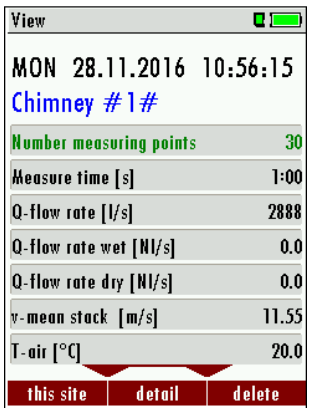
After the setting, the logging of flow will be started and the measurement will be saved. At the end of the measurement you will hear a beep. This means that the logging of data is finished.



In the menu “storage”➔”View measurement” you can see the saved measurement.



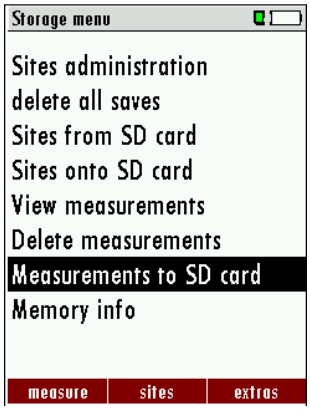
[KEY ENTER]



You can also export the measurement as CSV file, if the option SD card is activated.

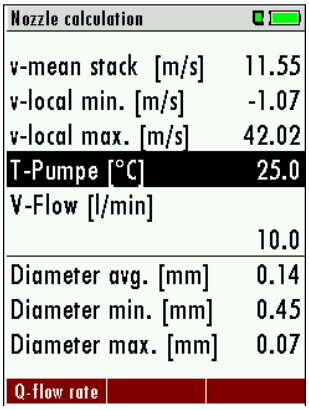
15.5.5 Calculation of the sampling (option)

First you should go to the menu “View measurments” and choose the “Flow measurements” or “Flow-Logging”.

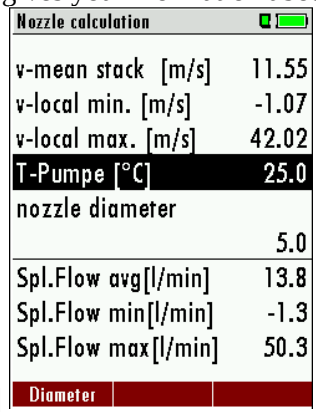


Select the measurement witch you want to calculate the nozzle. With the context menu select “the Nozzle calculation”.

A new window appears with the name “Nozzle calculation” and gives you information about the diameter of the nozzle or the flow rate.

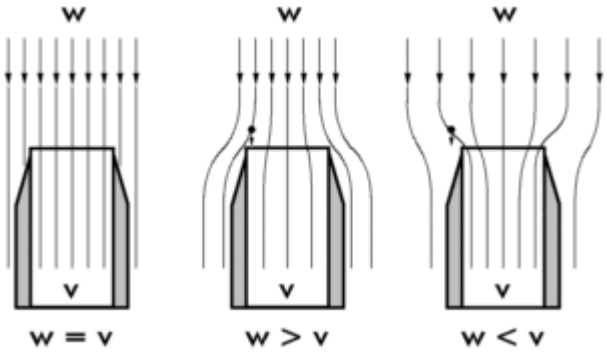


[KEY-F1]



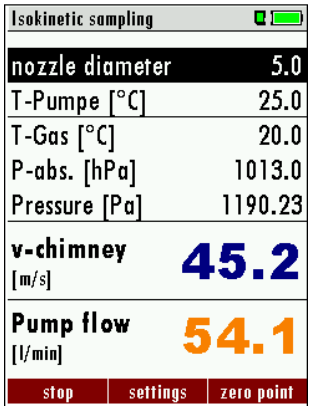
15.5.6 Isokinetic sampling (option)

The measurement of dust must be done in isokinetic sampling that means that the velocity inside the sampling nozzle is the same velocity of the stack.



Source: www.photometer.com

With the option Isokinetic sampling you can have the information about the flow velocity inside the chimney and the pump flow.



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Technical data change w/o notice!

Date of issue: 20130508

Date of issue: 20131217

Date of issue: 20150128

Date of issue: 20161128

Date of issue: 20191110

Date of issue:20230322

MF*plus*

USER MANUAL
OPTION
FLOW MEASUREMENT

MRU AIRfair since 1984 ®
EMISSION MONITORING SYSTEMS

64668GB

Content

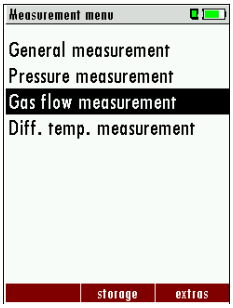
Die leeren Seiten der Bedienungsanleitung sind kein Fehler sondern herstellungsbedingt erforderlich!

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

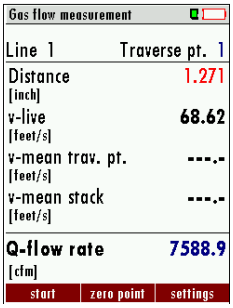
Пустые страницы в инструкции по эксплуатации не ошибка, а требуется производством!

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

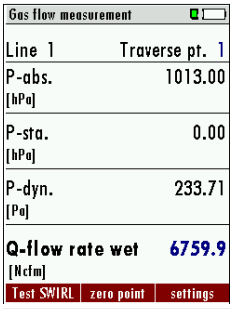
1. Flow measurement with the MF-plus



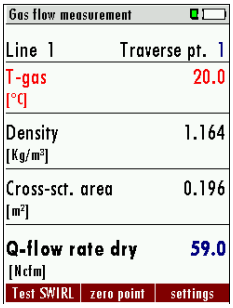
The option flow measurement enables you to measure flow velocity.



In addition to the flow velocity, information such as measuring line and measuring spot, where the PITOT tube is places, is displayed.
(V-current) is the currently determined flow velocity. This is determined by Eq. [4].
The local average value of the flow velocity (v-local average) is the total of the current flow velocities divided by the current flow velocity (see Eq. [5]).
This is only displayed during measurement.
The average value of the duct flow velocity (v-duct average) is the total of the determined local average values (v-local average) divided by the current number of measuring spots (see Eq. [6]).
The flow rate (vol.-flow) is calculated by Eq. [7]. During the measurement the local average flow rate is displayed (see Eq. [8]). At the end of the measurement the average flow rate of the stack is displayed, calculated by Eq. [9].



By pressing the arrow buttons left or right, additional information such as temperature, dynamic pressure, the gas density as well as the duct cross-sectional area will be displayed.



A default value of 20°C will be set if sensor (T2) is not connected.

1.1. Zeroing

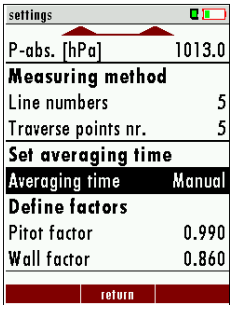
During zeroing the ambient temperature, the ambient pressure and the dynamic pressure are determined. The zeroing can be started using the "F2" button.

Zeroing should be performed before EVERY measurement!

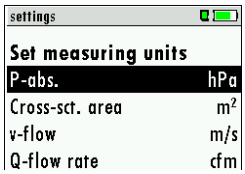
1.2. Adjustment menu

The adjust menu can be opened using either the „F3" button or the „Menu key" button.

In this menu, parameters for the flow measurement are determined. These adjustments have to be done prior to the measurement.

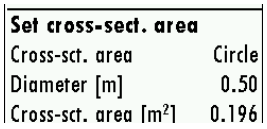


1.1.1 Units



P-abs. describes the unit of the absolute pressure. (hPa/inchHG)
Cross-sectional describes the unit of the cross-sectional area e.g. m², feet², inch², cm².
V-flow describes the unit of the flow velocity in either m/s or feet/s.
Flow-vol. describes the unit of the volume flow rate. The flowing units are available: l/s, Nl/s, m³/h, Nm³/h, cfm, Ncfm.
Nl/s, Nm³/h, Ncfm mark the standardized volume flow rates.

1.1.2 Cross section

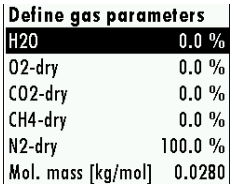


Here the geometry of a stack such as length or diameter can be entered. One can choose between „circle", „rectangle", „square" or „oval".
After selection of the geometry the stack measurements can be entered. The min. and max. values are related to the selected units (see chart 1).

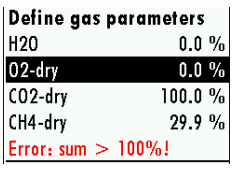
Units	m		feet		Inch		cm	
	min	max	min	max	Min	max	min	max
Length	0,01	10	0,01	35	0,1	400	2	1000
Diameter								

Chart 1: Threshold values length in relation to units

1.1.3 Gas parameters

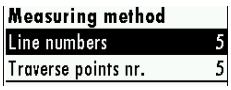


O2, CO2, H2O, CH4, N2 identify the gas ratio in percent. An error message will be displayed if the total of the gas ratio is above 100%.



Error: The total is above 100%

1.1.4 Measurement method



Here the number of measuring lines and measuring spots per line can be entered. The total number of lines and spots are limited to 10, in total 100 measurement can be performed.

1.1.5 Averaging time

Two modes can be viewed here, the automatic and the manual measurement.
The automatic measurement is timer dependent. The timer can be set between 10 seconds and 10 minutes. The manual measurement must be stopped by the user.

1.1.6 Factors

Two factors have to be entered: Pitot factor (see Pitot tube) and v-flow correction (between 0.1 and 10).
The v-flow correction factor is only used for spot measurement.

1.3. Performing a measurement

Prior to a measurement the parameters (e.g. geometry and length of the stack, gas ratio and number of measuring spots, etc.) must be entered in the adjustment menu.

1.1.7 Manual measurement

To activate the manual measurement, the average time must be set to manual (adjustment menu).

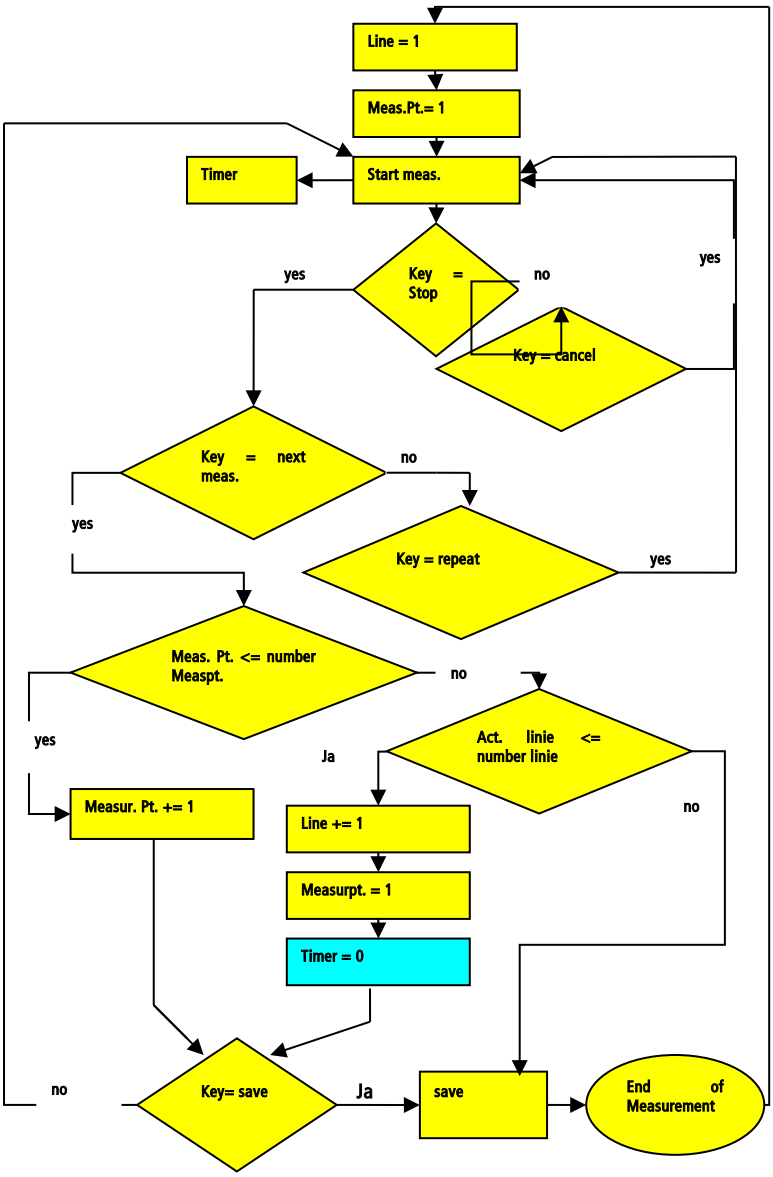
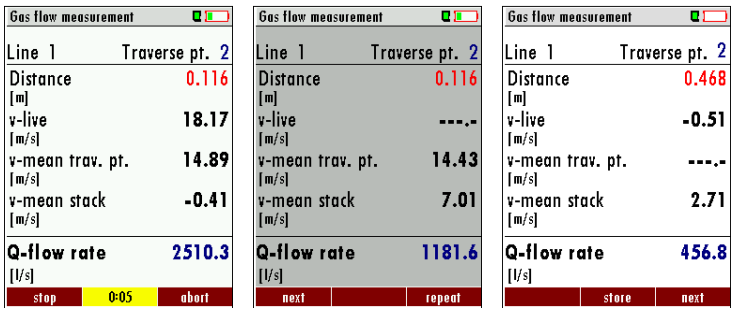
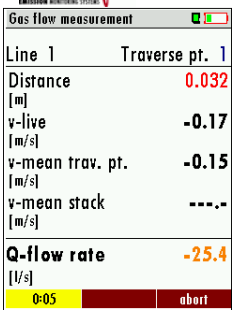


Image 14 shows the measurement sequence in the manual mode. The button „F1“ (Start) starts the measurement. During measurement the measurement can be stopped or aborted. The screen will turn from white to gray if the measurement is stopped, which means that the measurement for the current measurement point is completed. You can now press “F3” to repeat this measurement or press “F1” to make the next measurement. After pressing “F1” you can either save “F2” the measurement or perform the next measurement “F3”.

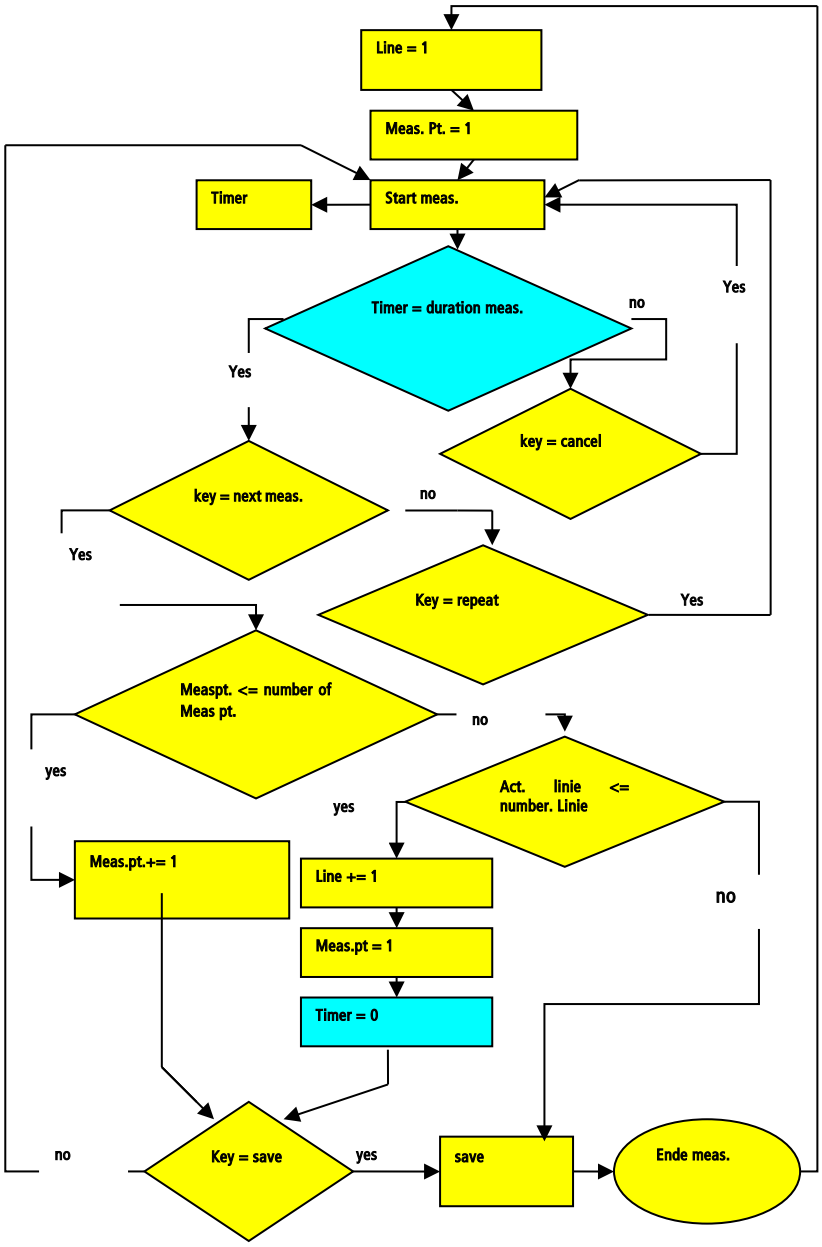


„Starting measurement“ „Stopping measurement“ „End the measurement“



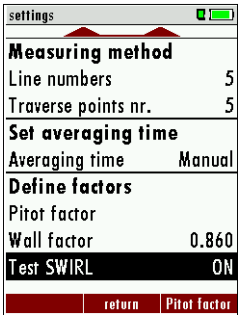
1.4. Automatic measurement

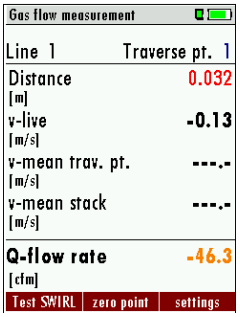
The automatic measurement is timer dependent.
The measurement stops when the defined times has elapsed.
To activate this mode select the adjustment menu and select the measuring time. The measurement is started with the "F1" button, when the time has elapsed the next measurement for the next measurement point can be started. (The rest of the measurement procedure is identical with the manual measurement.



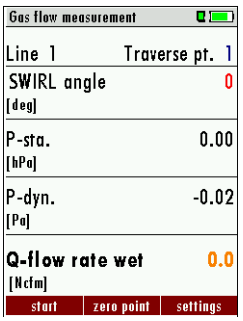
1.5. SWIRL

To make a correct measurement of the flow in a chimney, it should be verified if there is swirl or cyclonic flow inside the duct. This test should be done in every point of the grid before starting the measurement.
The user should insert the pitot in the correct measuring point of the grid and then rotate it at 90° to check if in this point the differential pressure is 0 Pa. If it is 0 Pa all is ok, there is no swirl.
The MFplus give you the possibility to insert the angle of SWIRL in every measuring point before pressing start. With the keys „right/left" you can activate the SWIRL option and with the Key „ESC"you return to the window „gas flow measurement".
With the Key F1, you ca show the window with Angle (see picture below) and with the key up and down you can change the value of the Angle



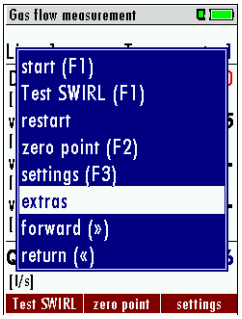


➔[KEY-F1]➔

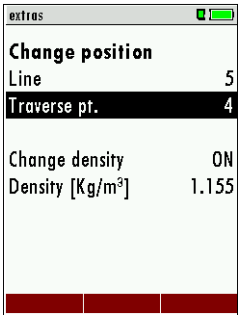


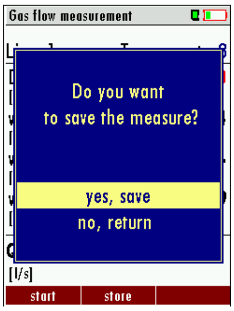
1.6. Change the density and the position of measurement

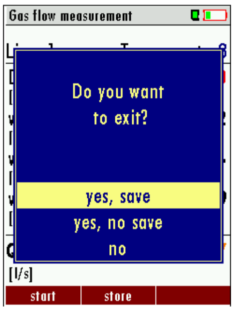
During the measurement and in the menu Extras of the gas flow measurement you can change the density of the gas or jump to another line or point.



➔

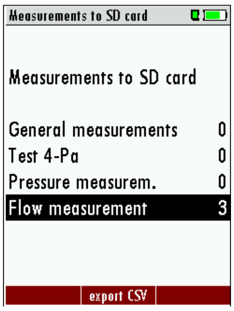






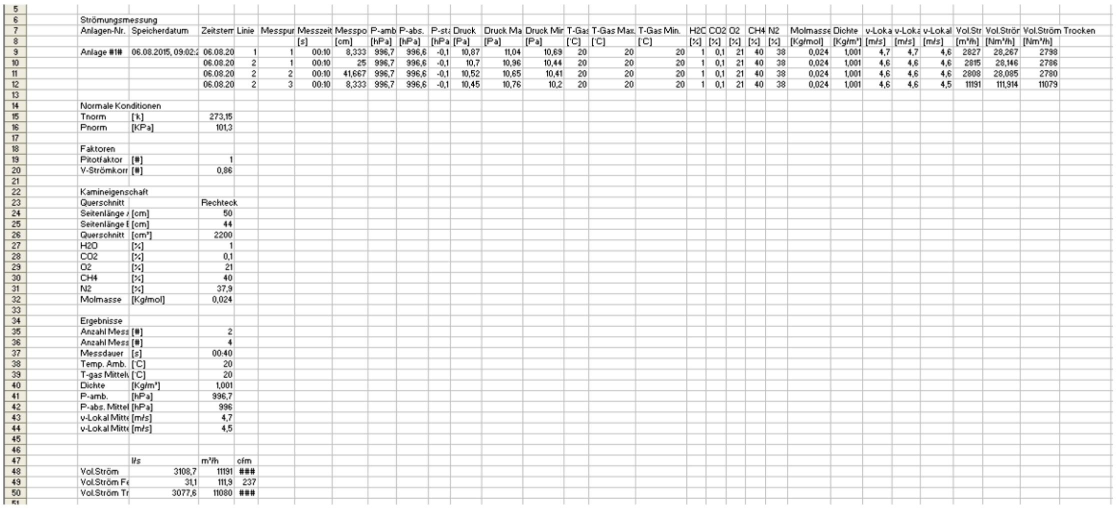
1.7. Storing a measurement

A measurement can be stored after each measurement cycle. When pressing the “F2” button, you will be asked if you want to store the measurement or return to the measurement. You will also be asked if you want to store the results when exiting the measuring screen.
When storing a measurement it must be assigned to a site.
Stored measurements can be view in the storage menu (view measurements).
Once a measurement has been stored the next measurement can be performed.



1.8. Exporting a measurement to the SD-card

In the storage menu the stored measurements can be exported in CSV format to the SD card.



Strömungsmessung

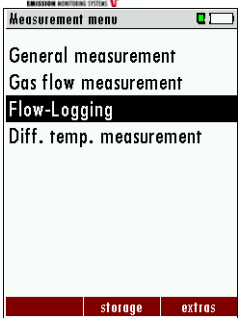
Anlagen-Nr.	Speicherdatum	Zeitstem	Linie	Messpur	Messzeit	Messpo	P-amb	P-abs.	P-sta	Druck	Druck Ma	Druck Min	T-Gas
					[s]	[cm]	[hPa]	[hPa]	[hPa	[Pa]	[Pa]	[Pa]	[°C]
Anlage #1#	06.08.2015, 09:02:2	06.08.20	1	1	00:10	8,333	996,7	996,6	-0,1	10,87	11,04	10,69	20
		06.08.20	2	1	00:10	25	996,7	996,6	-0,1	10,7	10,96	10,44	20
		06.08.20	2	2	00:10	41,667	996,7	996,6	-0,1	10,52	10,65	10,41	20
		06.08.20	2	3	00:10	8,333	996,7	996,6	-0,1	10,45	10,76	10,2	20

T-Gas Max.	T-Gas Min.	H2O	CO2	O2	CH4	N2	Molmasse	Dichte	v-Loka	v-Loka	v-Lokal	Vol.Str	Vol.Strön	Vol.Ström Trocken
[°C]	[°C]	[%]	[%]	[%]	[%]	[%]	[Kg/mol]	[Kg/m³]	[m/s]	[m/s]	[m/s]	[m³/h]	[Nm³/h]	[Nm³/h]
20	20	1	0,1	21	40	38	0,024	1,001	4,7	4,7	4,6	2827	28,267	2798
20	20	1	0,1	21	40	38	0,024	1,001	4,6	4,6	4,6	2815	28,146	2786
20	20	1	0,1	21	40	38	0,024	1,001	4,6	4,6	4,6	2808	28,085	2780
20	20	1	0,1	21	40	38	0,024	1,001	4,6	4,6	4,5	11191	111,914	11079

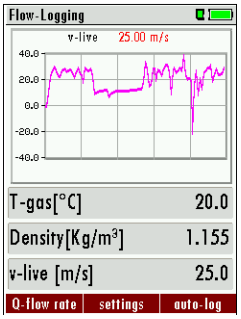
Normale Konditionen			
Tnorm	[°k]	273,15	
Pnorm	[KPa]	101,3	
Faktoren			
Pitotfaktor	[#]	1	
V-Strömkorr	[#]	0,86	
Kamineigenschaft			
Querschnitt		Rechteck	
Seitenlänge A	[cm]	50	
Seitenlänge B	[cm]	44	
Querschnitt	[cm²]	2200	
H2O	[%]	1	
CO2	[%]	0,1	
O2	[%]	21	
CH4	[%]	40	
N2	[%]	37,9	
Molmasse	[Kg/mol]	0,024	
Ergebnisse			
Anzahl Mess	[#]	2	
Anzahl Mess	[#]	4	
Messdauer	[s]	00:40	
Temp. Amb.	[°C]	20	
T-gas Mittelw	[°C]	20	
Dichte	[Kg/m³]	1,001	
P-amb.	[hPa]	996,7	
P-abs. Mittel	[hPa]	996	
v-Lokal Mitte	[m/s]	4,7	
v-Lokal Mitte	[m/s]	4,5	
	l/s	m³/h	cfm
Vol.Ström	3108,7	11191	###
Vol.Ström Fe	31,1	111,9	237
Vol.Ström Tr	3077,6	11080	###

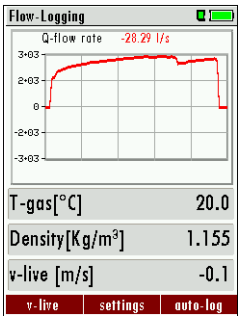
1.9. Data logger of flow (option)

In the menu "measurement menu" you find the Flow-Logging.

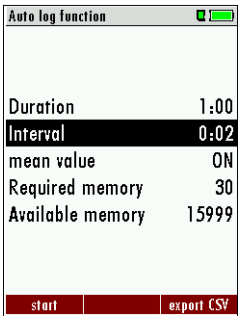


The flow velocity and the volume flow will be presented in the form of graphic, this helps to check the stability of the flow. With the Key "right/left „ you can switch to the other measurement and with the key F1 you can chose the flow velocity or the volume flow.

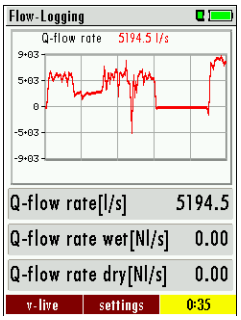


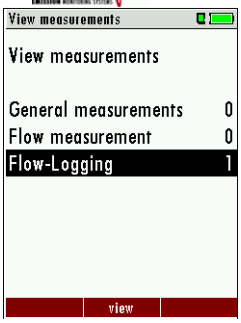


With the key F3 "auto-log" another window appears



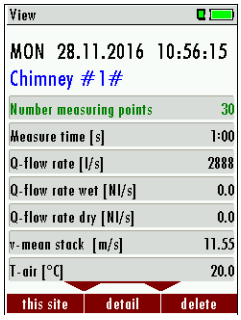
After the setting, the logging of flow will be started and the measurement will be saved. At the end of the measurement you will hear a beep. This means that the logging of data is finished.





In the menu "storage"➔"View measurement" you can see the saved measurement.

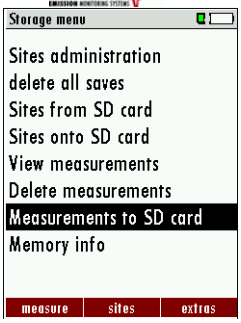
[KEY ENTER]



You can also export the measurement as CSV file, if the option SD card is activated.

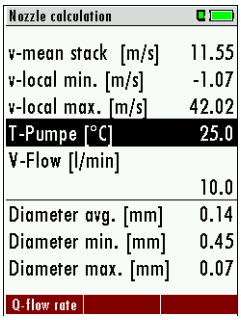
1.10. Calculation of the sampling (option)

First you should go to the menu "View measurements" and choose the "Flow measurements" or "Flow-Logging".

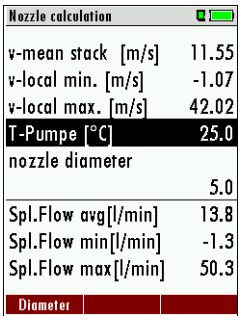


Select the measurement witch you want to calculate the nozzle. With the context menu select "the Nozzle calculation".

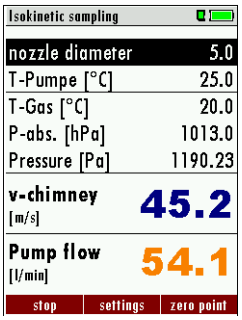
A new window appears with the name "Nozzle calculation" and gives you information about the diameter of the nozzle or the flow rate.



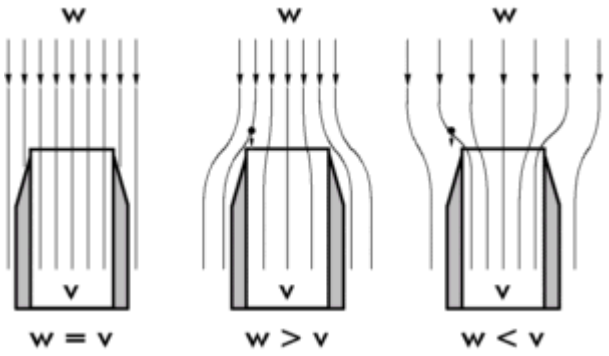
[KEY-F1]



1.11. Isokinetic sampling (option)



The measurement of dust must be done in isokinetic sampling that means that the velocity inside the sampling nozzle is the same velocity of the stack.



With the option Isokinetic sampling you can have the information about the flow velocity inside the chimney and the pump flow.

1.12. Appendix

1.1.8 Calculation of the molecular weight

The molecular weight of a gas is depending on the gas ratio, these are calculated by Eq. [1]:

$$M = 0.00001*(32*[O_2]+44*[CO_2]+18*H_2O+16*[CH_4]+28*[N_2])$$

Equation 1: Molecular weight

Unit of the molecular weight is $M = [\frac{Kg}{mol}]$

1.1.9 Calculation of the gas density

The gas density is calculated by Eq. 2]:

$$\rho = \frac{P_{abs} * M}{RT_{gaz}}$$

Equation 2: Gas density

Whereat

ρ : Gas density in $[\frac{Kg}{m^3}]$

P_{abs} Identifies the absolute pressure in [Pa]

M : Molecular weight in $[\frac{Kg}{mol}]$

R : Gas constant and to be 8.314 $[\frac{J}{mol * K}]$

T_{gaz} : Gas temperature in Kelvin

1.1.10 Calculating the current flow velocity

The flow velocity is determined using the Pitot tube, measuring the pressure in combination with the gas density see Eq. [3]).

$$\tilde{v} = \sqrt{\frac{2*\overline{\Delta P}}{\rho}}$$

Equation 3: Flow velocity

$\tilde{v}$: flow velocity in [m/s]

$\overline{\Delta P} = \frac{\sum_{i}^{m} \Delta P}{m}$: average value of the pressure difference in [Pa]

ρ : Gas density in $[\frac{Kg}{m^3}]$

The geometry of the Pitot tube is considered using the Pitot factor.

$$v_{mom} = K_{wall} * K_{pitot} \sqrt{\frac{2*\overline{\Delta P}}{\rho}}$$

Equation 4: Flow velocity with Pitot factor

K_{pitot} : Pitot factor

K_{pitot} : Wall factor

1.1.11 Calculating the local average value of the flow velocity

The local average value of the flow velocity is the amount of the flow velocities divided by the number of current flow velocities.

$$v_{lok,mittel} = \frac{\sum_{k}^{n} v_{mom}}{n}$$

Equation 5: local average flow velocity

Whereas v_{mom} is the current flow velocity and n is the amount of measurements.

1.1.12 Calculating the average value of the stack flow velocity

The average value of the stack flow velocity is the amount of the local average values divided by the amount of measuring points.

$$v_{ka\,\min,mittel} = \frac{v_{lok,mittel}}{n_p}$$

Equation 6: local average value of the stack flow velocity

Whereas $v_{lok,mittel}$ der local average value of the flow velocity and n_p amount of measuring points.

1.1.13 Calculating the actual volume flow

The actual volume flow is the current flow velocity multiplied by the cross-sectional area

$$q_{v,mom} = v_{mom} * A$$

Equation 7: volume flow

$q_{v,mom}$: current volume flow in [m³/s]

v_{mom} : current flow velocity in [m/s]

A : Cross-sectional area in [m²]

1.1.14 Calculating the local average flow velocity

The local average flow velocity is calculated by Eq. [8]

$$q_{lok,mittel} = v_{lok,mittel} * A$$

Equation 8: local average flow velocity

$q_{lok,mittel}$: local average volume flow in [m³/s]

$v_{lok,mittel}$: local average flow velocity in [m/s]

A : Cross-sectional area in [m²]

1.1.15 Calculating the average value volume flow of a stack

The average value of the volume flow of a stack is calculated by Eq. [9]

$$q_{ka\min,mittel} = v_{ka\min,mittel} * A$$

Equation 9: average value volume flow of a stack

$q_{ka\min,mittel}$: average value volume flow of a stack in [m³/s]

$v_{ka\min,mittel}$: average value of the stack flow velocity in [m/s]

A : Cross-sectional area in [m²]

1.1.16 Calculating the standardized volume flow (wet and dry)

The standardized volume flow (wet) is calculated by Eq. [10]:

$$q_{Feucht} = V * \frac{P_c}{1013.1} * \frac{273{,}15}{T_{gas}} * \frac{\varphi_{H2o}}{100}$$

Equation 10: standardized volume flow (wet)

The standardized volume flow (dry) is calculated by Eq. [11]:

$$q_{Trocken} = V * \frac{P_c}{1013.1} * \frac{273{,}15}{T_{gas}} * \frac{100 - \varphi_{H2o}}{100}$$

Equation 11: standardized volume flow (dry)

1.1.17 Calculating the swirl

$v_c = \cos\theta_{meas} v_{meas}$

Where

$\cos\theta_{meas}$ is the cosine of the angle measured.

v_{meas} ist he velocity measured.

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