NOVA compact

MRU AIRfair
since 1984
EMISSION MONITORING SYSTEMS

64664GB

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!

Content

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 (Li-Ion) every 4 - 6 weeks, *even if the analyzer is not in use.*
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
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Fon (+49) 71 32 99 62 0 (Reception)
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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.

1. General information

1.1. The company MRU GmbH

Your analyzer 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.

Factory 1
(service department,
development
division,
sales department
administration)

Factory 2
(Product division)

1.2. Important general information (EN 50379) and VDI 4206

This analyzer is not designed to be used for continuous measurements.
Before using the analyzer verify the condition of the various parts of the analyzer, such as the probe, the ambient air conditions, the condensate separator, star filter and the connectors for damage and/or blockages.
When starting up the analyzer it will take between 1 – 3 minutes to set to zero depending on the condition of the sensors and of ambient.
The minimum zeroing time of the analyzer to achieve correct measurement values can be expected by 1.5 minutes!
Caution: Exposure to acids; aggressive gases such as sulphur; vapours such as thinners, gasoline, alcohol and paint, etc. can damage, reduce the life of, or destroy the sensors.
The life of the sensors depends on how they are used, maintained and treated. Typical average life expectations are: O_2 - 2 years; CO - 2 - 3 years and NO - 3 years.

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

The battery life is at least 500 charge-discharge cycles. With increasing number of cycles is reduced specified in the technical data devices operating time per battery charge.

1.3. 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 analyzer properly and sets forth safety and environmentally friendly procedures.
It is the responsibility of all users to read and familiarize themselves with this manual, paying particular attention to the safety instructions.

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

1.4. 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.

Safety regulations

The analyzer may only be used as indicated in this manual. Our analyzers are checked according to the following regulations:
VDE 0411 (EN61010) and **DIN VDE 0701** before they leave the MRU GmbH factory.
MRU technical products are designed and manufactured according to **DIN 31000/ VDE 1000** and **UVV = VBG 4** of the professional guilds for fine mechanics and electrical engineering.
MRU GmbH assures that the analyzer complies to the essential requirements of the legal regulations of the member states of the electro-magnetic compatibility **(89/336/EWG)** and to the low-voltage regulations **(3/23/EWG)**.

Specific safety regulations

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

Attention:

Caution: Moisture, being pumped out of the condensates trap can be slightly acidic.
In case of skin contact IMMEDIATELY: clean affected parts of the body.
Avoid getting liquid in eyes.
Please carefully clean all parts that come into contact with the condensates.
After measurement, vent the analyzer with ambient air and allow the probe to cool.
A hot probe could cause burns or ignite flammable material.

Electrochemical sensors are by their operating principle not only sensitive to the gas they are intended for, but for other gases as well. This cross sensitivity is compensated by MRU for the typical application of flue gas analysis. However, unusual high concentration levels of single gas components might lead to a reduced measurement accuracy of other gas components and to a temporary change of the sensitivity of sensors, which may require several hours recovery time. Especially concentration levels as high as several % for single gas components may affect the measurement of other gas components at ppm level.
Those applications need to be discussed with MRU in detail.

Guideline for Li-Ion Batteries

- The battery pack is not accessibly for end users
- Li-Ion rechargeable battery pack for NOVA*plus*
- 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

1.5.   Packing

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.

1.6.   Return of hazardous waste

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

1.7.   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.

2.   Analyzer description

2.1.   Introduction

The main task of the NOVAcompact gas analyzer is in supporting the following applications:

- Precise control- and adjustment measurements for Gas- , oil or wood fired burners

- Flue gas measurement according to 1. BImSchV and KÜO (German regulations)

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

- Measurements at CHP's (cogeneration heat and power engines) with CO-sensor protection by means of a Purafil filter
- Proof of sufficient combustion air supply „4 Pa – test"
- Anemometer (Option Flow velocity, using either a Pitot tube or a vane)
- Differential measurements of pressure and temperature
- Mobile Gas detector (Option HC-sniffer)
- Leak testing device (Option external pressure sensor)

The multiple options and multiple connections possibilities of external sensors often replaces the need of additional measuring equipment(s). Ask our sales reps. for available options and accessories or check out our MRU website.

2.2.   Gas flow diagram

In combination with the sample gas probe, analyzer filtered off a partial volume of sample gas from the combustion channel, and analyzes it by means of electrochemical sensors on its ingredients.
Pressure (draft) and temperature are measured by the design of the exhaust probe directly at the probe tip.

Gas flow diagram with purge pump:
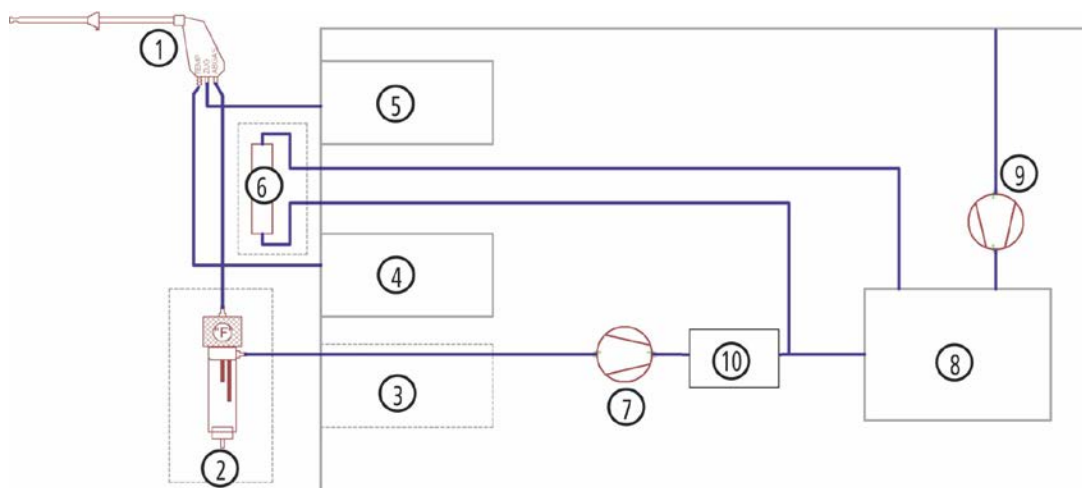
Position	Description
1	Gas sampling probe
2	Condensate separator (option)
3	Gas cooler (option)
4	Temperature measurement
5	Pressure measurement
6	Purafil filter for CHP's (option)
7	Gas pump
8	Sensor chamber
9	Purge pump
10	Flow measurement

The use of solid filter unit here is optional, but in the context of solid measurement generally recommended to protect the sensors against high loads.

2.3. Front- and side view

1	Keypad	12	Connector pressue /draft +
2	Display	13	Connector sample gas
3	Printer	14	Mini USB port
4	Bluetooth aerial	15	SD-card reader (only by using a MRU-SD-CARD we can assure the compatibility of all analyzer functions)
5	Connector external filter unit	16	Connector power supply
6	Connector external filter unit	17	Filter
7	Connector AUX	22	Gas outlet. During a measurement, the blow-out openings must not be covered.
8	Connector Temp 1 (T Air)		
9	Connector Temp 2 (T Gas)		
10	Connector pressure / draft -		
11	Connector TRGI		

2.4. Connectors at the side
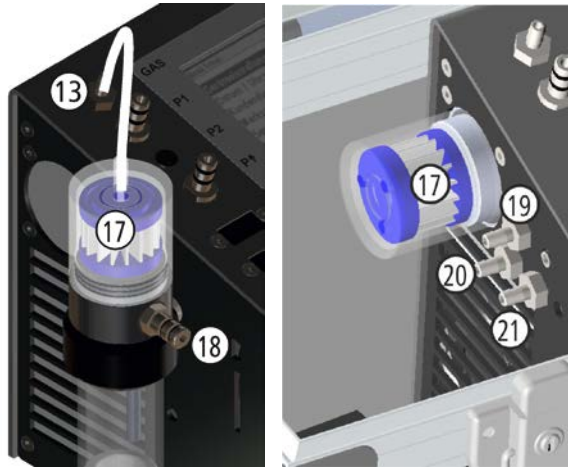
13	Connector gas inlet
18	Connector sample gas probe
17	Filter
19	Connector Purafil filter
20	Connector Purafil filter
21	Condensate outlet

Condensate separator   Gas cooler

2.5. Condensate separator

Disconnect the hoses at the gas entrance port (1) and the gas exit port (2). Lift the condensate separator upwards out of the mounting bracket next to the base unit. Liquid that is poured out of the condensate separator can be lightly acidic.
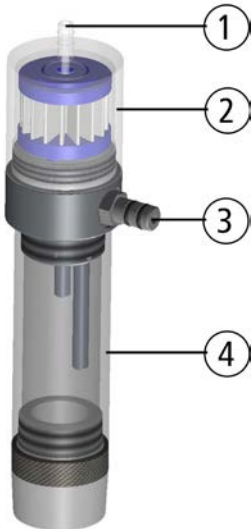
The condensate show glass and the bottom plug are screwed into each other and can easily be taken apart from each other (for cleaning and drying the condensate separator). He filter housing can also be unscrewed to replace the pleated filter. Please pay special attention when reassembling the condensate separator that all the O-Rings are in the right position and that they are not damaged. After each dismounting of the condensate separator we recommend you to perform an instruments leak proof test.

There is a pleated filter mounted in the condensate separator. This filter filters rough particles out of the flue gas. This pleated filter is washable and can be reused up to five times (filter must be completely dry before being used again). The filter should be replaced or washed when it changes its color from to brown or grey. A frequently washed or replaced filter will avoid dirt getting inside the analyzer will therefore avoid damage to your analyzer.

2.6.   Gas sampling probes

The NOVAcompact is available with different probes, both with fixed and exchangeable probe tubes.

A complete list of available probes can be found in the current price list of this analyzer.

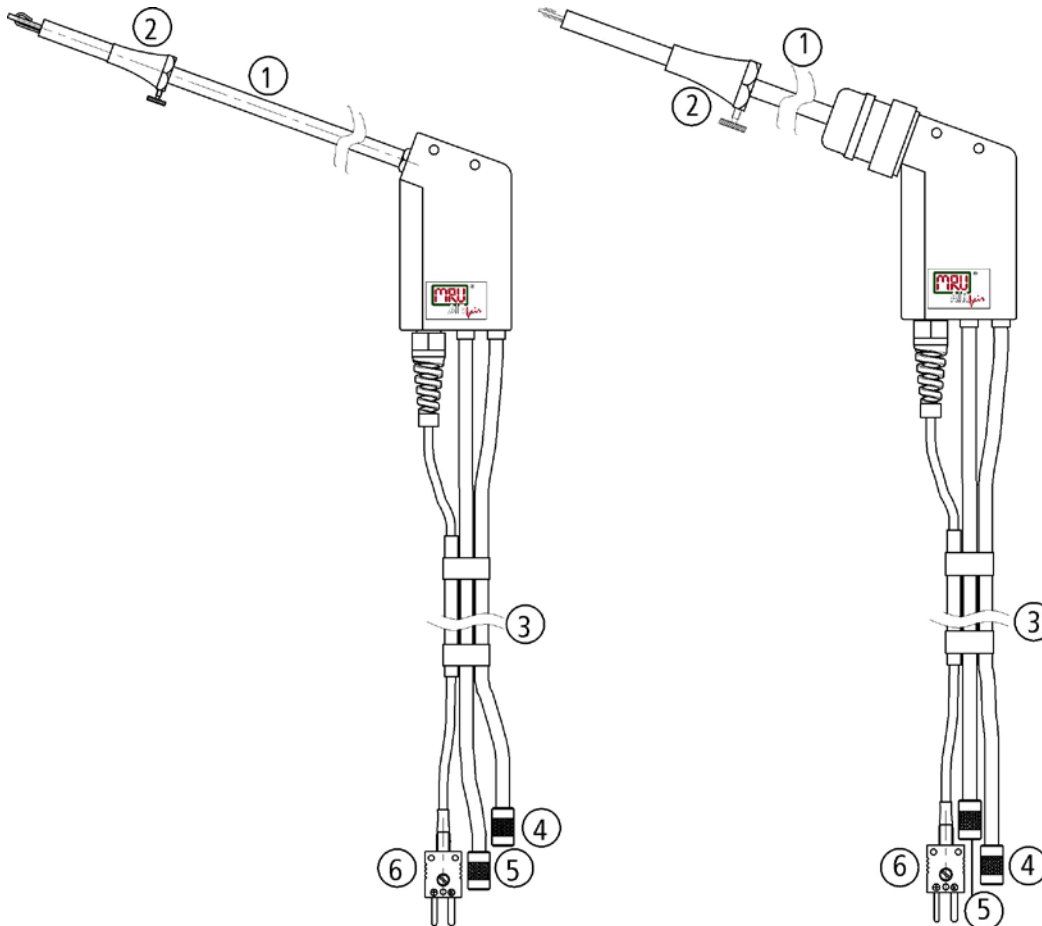Below are two different probe types:

Probe
with 250 mm probe pipe (fixed)
and 2,2 m sampling line

Probe
with 300 mm exchangeable probe pipe
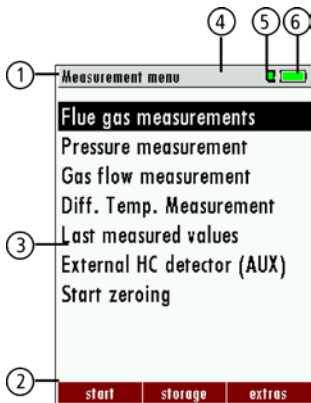and 2,2 m sampling line

1	Probe tube
2	Probe cone (high grade steel)
3	Triple hose
4	Connector for sample gas measurement
5	Connector for pressure/draft measurement
6	Connector for temperature measurement

3. Operating the analyzer

3.1. The Display

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

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

Keypad

ON/OFF	Press to start the analyzer without delay. The power off function will be delayed to protect the sensors. If there is not enough ambient air the analyzer will recommend the purging of the sensors.
Function Keys	Activates the functions seen on the display (2 function key bar)
Menu key	Will show all available functions in the window that is currently in use – also those which have an individual key on the key pad like the printer and the three function keys. *NOTE:* *By pressing this button, you get an overview of all functions.*
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.

3.2.   Menu configuration

The analyzer organizes all available actions in three main menus:

Menu Measurement	all tasks for the measurement programs of the analyzer. 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 analyzer.

NOVAcompact

Measurement menu	Storage menu	Extras menu
Flue gas measurements	**Sites administration**	**Settings**
Pressure measurement	Delete all sites	Date & time
Gas flow measurement	Sites from SD card	Service menu
Diff. Temp. Measurement	Sites onto SD card	Default settings
Last measured values	View measurements	Service values
External HC detector (AUX)	Delete measurements	Leak proof test
Start zeroing	Measurements to SD card	Contents SD card
	Memory info	Device info
start storage extras	measure sites extras	measure storage settings

The topic „Flue gas measurements"is a standard feature in every analyzer and is explained in chapter 7. Other menu points are optional and will be explained either in this manual or in an additional manual or flyer.

Please read chapter 8 for details.

Please read chapter 9 for details.

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

4. First use of the Analyzer

After the analyzer 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.

4.1. Analyzer ready for operation

- Unpack the analyzer, read the complete manual

- The analyzer was shipped completely assembled, in working condition and ready for operation. It is recommended that the analyzer is thoroughly inspected for completeness and damage.

- Recommendation: charge the batteries for 8 hours prior to use.

- Check/Change date and time

4.2. Analyzer settings

The "Settings" menu allows configuring some instrument specific parameters.

- Display-brightness
- Brightness of the condensate separator LED
- Selection of the device languages
- Selection of the country specific parameters like fuel types, calculated values etc.
- Helpful hints activated
- Keyboard beeper activated or deactivated
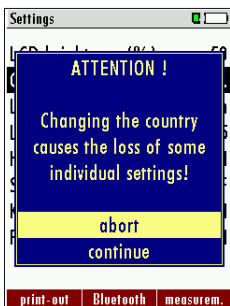
LCD brightness	5 – 100 %	Display-brightness, depending on temperature and also on the personal judgement of the user, at 20°C a value of ca. 50% is normal
Language	option	Select device languages
Country	option	*ATTENTION:* *By changing the country the O2 reference values settings are lost. The fuel list is reset. Similarly, country-specific defaults and methods of measurement are selected as a result.*
LED condensate trap	0 … 150	Change the brightness of the condensate separator LED
Helping hints	ON / OFF	Helpful hints activated or deactivated (explanation below)
Keyboard beeper	ON / OFF	Keyboard beeper activated or deactivated
Power-on logo	ON / OFF	Logo will be show during power-ON of the analyzer

Settings measurement

Temperature unit	°C, °F	Change the unit for temperature in all screens
Pressure unit	Pa, hPa/Pa, hPa, kPa/Pa, kPa, mbar, mmH2O, cmH2O, inH2O, mmHg, inHg, PSI,	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.
Draft unit	Pa, hPa/Pa, hPa, kPa/Pa, kPa, mbar, mmH2O, cmH2O, inH2O, mmHg, inHg, PSI,	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.
Core flow search	ON / OFF	Core flow search before start of each flue gas measurement: activated or deactivated
Combustion calculation	ON / OFF	If the combustion calculation is switched off following items will be changed: - no fuel types, respectively always "Sample Gas" - no measuring values losses, Verluste, ETA, ETAcond, Dev. point - no measuring value CO2, except it will be measured - no measuring values CO/NO/,,,. in [mg/kWh]/[mg/MJ] - no fuel type will be shown on the menu bar and print-out
Input soot & T-Boiler	ON / OFF	Input soot and T-boiler values for print-outs and/or storage: activated or deactivated
Annular-gap test	ON / OFF	Annular-gab measurement: 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:
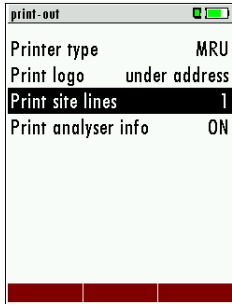
"Zeroing finished, Sensors are ready. Analyzer ready for measurement."
"Reminder! Charge batteries at regular intervals!"
"Measurement stopped/started."

4.3. Setting printer type and print-out

Unter SETTINGS ⟶ PRINT-OUT the kind of print-out can be selected:

Print logo ON/OFF	Print logo
Print option SHORT/LONG	SHORT: Print-out without area for signature and site information
Print site lines 0 … 9	Line 1 (Site no.) is necessary, further lines (freetext) printable
Print device info	To measuring print out can be shorter designed, while the device info will be left out. In some print outs (adjustment, service ...) the info will be printed forever.

4.4. Bluetooth settings

With SETTINGS ⟶ BLUETOOTH the Bluetooth parameter can be set.

If RemoteData, OnlineView or MRUConnect (PDA) with Bluetooth is used, the SLAVE move mode must be selected. The auto connect mode must be switched OUT.

4.5. Setting time and date

With SETTINGS ⟶ DATE & TiME this parameters can be set.

F2	Edit
▲, ▼	Change the marked number
◄►	Move the cursor to the next position
ESC	Return to *Extra-Menu*

4.6. Configuration of measurement program

(Flue gas measurements) Select one of the 6 configurable measurement programs.
For each of the programs the following parameters can be configured:

- CO ppm limit: adjustable value for the CO sensor protection. If the CO value in the flue gas is higher than the adjusted value in the analyzer, the purge pump will be activated and the sensor will be protected against high CO concentrations. (Optional)
- Selectable fuel types: choose and select from the available fuel type list
- Measurement windows: configuration of what and where will be displayed in the 3 measurement value windows.
- Zoom – window: select what will be displayed in the zoom - window
- Program name

The following program is have pre configured:

- "Test Program" indented for use at instrument maintenance and calibration

The configuring of each measurement program, you make after calling the program concerned measurement / flue gas measurement menu.

Setting the CO ppm limit values

The CO ppm limit can be adjusted in the window SELECTION MEAS. PROGRAMM / CO LIMIT⟶ F1

| ▲, ▼, ◀▶	The CO-ppm limit value can be adjusted in 100 ppm steps between 100 ppm and 4.000 ppm / 10.000 ppm
OK or **ESC**	Return to the measurement window
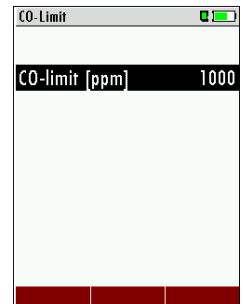
Fuel type selection and O2 reference

(only if combustion calculation is ON)

Each time you start a measurement program you can select a fuel type from the fuel type short list. This short list is linked to the measurement program and can be configured as a sub set of fuel types from the total fuel type list.

▲, ▼,	Select a program
OK	Show a pre selected fuel type
F2	Show the list of all fuel types
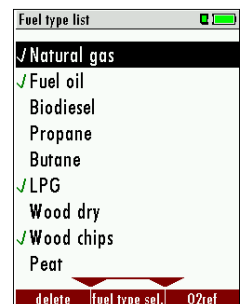
First select a program then press OK – then press the F2 key in the window "Fuel type selection". All available fuel types are displayed: they can be added to or removed from the short list by using the F1 key. Added fuel types have a check mark in front of the fuel type.

To each fuel type the parameters are displayed by selecting F3 "O2Ref". All parameters are displayed read-only except the O" reference value that can be changed

| **F1**	Add / remove a fuel type
F2	Exit the fuel type list
F3	Input O2-ref with the keys ◀▶

User definable fuel types

(only if combustion calculation is ON)

Here, four fuels are adjusted individually. The name as well as the parameters are adjustable. As the other fuel types, they can be pre-selected or left out.

Note: The last 4 fuel types at the list are the user fuel types. The user fuel types are coloured green.

F1	Add or remove selected fuel to the pre-selected fuel types
F2	Back to the window "Fuel type selection"
F3	Modify fuel type parameters
F2	Modify fuel type name
OK	Save the new fuel type name
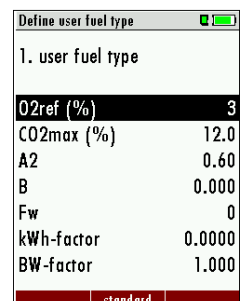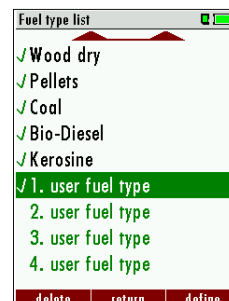
Configuration of the measurement window (display content)

Start the measuring program – once you are inside the measuring window press the menu- key.
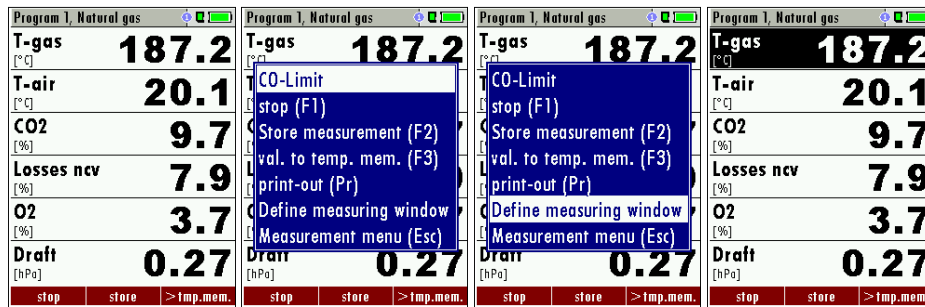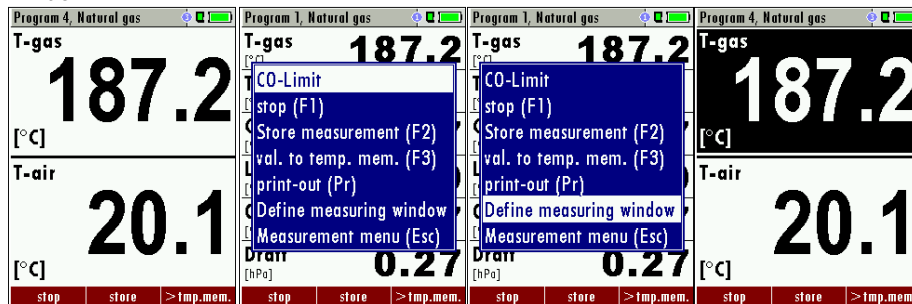
Now you select "define measuring window" and press the OK key. The top value will now be marked black – this black bar can be moved up and down. Move it to the position that you would like to change or to the position where you want to add a measuring value. Once you have reached the position you van uses the arrow left and right keys to change the measuring value.

When all your changes have been made, you press again the **menu** key. Now you select "Save measuring window". All your changes will be saved and all saved values will be printed when using the printer function.

Start the measuring program – once you are inside the measuring window press the **menu** key.

Configuration of the zoom function

For each measurement program you have 3 zoom windows with two selectable values for each window.

▲, ▼,	Change Zoom window 1..3
◀▶	Change measuring values
F1 📁, 📁	Save measuring window and save configuration

Change measurement program names

In the "Fuel type selection" window you can edit the marked program name with the F3 key and then change the program name.

4.7.   Core flow search

You can choose if you want a core flow search before every measurement or not. This function is only possible in the programs 1 -4. Enabling the core flow search isa global instrument setting valid for all programs and therefore described in chapter 4.2

5. Maintenance and cleaning

5.1. Cleaning

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

- now and then: Cleaning of the probe and the probe tube

- after every measurement: remove gas sampling tube from the analyzer, so that the hose can dry

- after longer disuse load battery first and afterwards approx. all 4 weeks
- check filter: external filter reconnect for CHP measurements

5.2. 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 function 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.

5.3. Service-Maintenance Plan

A check of analyzer at our Service Department is necessary:

- after **1000 working hours** or

if it has been more than 11 months since the last check.

When next powered on, you will be remindered to the execution of the annual customer service.

A complete service at a MRU service station (for MRU services station please see: www.mru.eu) contains the function control and calibration and/or cleaning of the following components:
Sensors, pumps, internal/external hose lines, battery, draft sensor, electronics, time and date, temperature sensors, gas sampling probes, condensate separator

6. Preparation for each measurement

6.1. Power supply

The analyzer can be used with:

- with the internal MRU battery (provided)
- with the MRU battery charger (provided)

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

6.2. Auto-off

The instrument is automatically switched off after 60 minutes.
During a measurement or a battery charging cycle the auto off is deactivated.

6.3. Measurement with battery charger/battery charging

When ever you connect the analyzer with external battery charger (90..260 V / 50/ 60Hz) the battery will be charged.

Once the battery is fully charged the analyzer will switch to trickle charge mode. At the moment, if the battery is fully charged and the trickle charge mode begins, an acoustic feedback will be played.
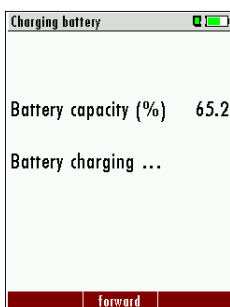
6.4. Measurement with battery (Battery monitoring)

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

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

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

6.5.   Operation temperature

If the analyzer has been stored at low temperatures, it will require some time to equilibrate to the ambient temperature before being switched on. If it does not equilibrate, condensation will occur inside the analyzer!
If the temperature is out of its operation range, you will see the following messages on the display.

Once one of these messages appears you will not be able to use the analyzer, it will give an acoustic signal until it has reached the specified operation temperature between +5°C and +45°C.

6.6.   Condensate separator

The condensate separator must be checked before and after each measurement!

Please check if the condensate separator must be **emptied a**nd if the star filter is still **white**.

White = good for measurement   dark = replace

6.7.   Connectors and leak tightness

- Check all push on connectors for proper fit.
- Check all hoses, hose connectors and the condensate separator.
- Start separate instrument tightness test (see chap. 9.4)

6.8.   Power ON and zeroing

Press the ON key. The analyzer will start zeroing without any further action from the user.

The probe shall **NOT** be installed in the stack during zeroing!
While the analyzer is zeroing you will see a blinking →0.0← symbol in the task bar indicating the progress of zeroing.
Once the zeroing cycle is finished the analyzer is ready for measurement.
If any defective sensors will be detected during the zeroing cycle you will get an error message on the display.

Repeating the zeroing
The zeroing can be repeated at any time as long as the probe is not inside the stack. In the main menu you select "Zeroing", and after the displayed message press the OK key.

7. How to take a Measurement

Every **NOVA***compact* is capable of making a complete flue gas measurement. How to perform this is described below.
The description of other optional available measurement programs can be read in additional flyers.
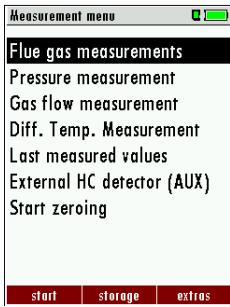
7.1. Selection of the measurement program

In the measurement menu select "Flue gas measurements" then select one of the available programs.
If you press the F1 key "Start" in the measurement menu, you will be directed directly into the measurement screen, using the parameters (program and fuel type) that have been selected last time the analyzer was used.
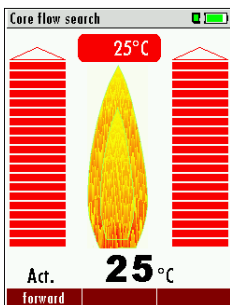
7.2. Core flow search

Before using the core flow search it must be switched-ON
(Chapter 4.2).
The core flow search will help you to find the optimal measurement point in the stack. The core flow can be identified by the maximum flue gas temperature.
In high reaction time the analyzer displays the trend of the flue gas temperature. Insert the probe pipe slowly into the stack and position your probe tube when you have reached the maximum flue gas temperature that is displayed.
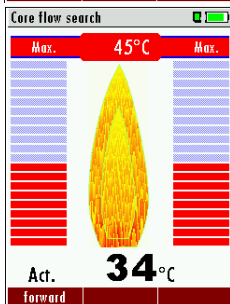
Positioning the probe in the core flow:

Insert the probe pipe slowly into the stack and position your probe pipe when you have reached the maximum flue gas temperature that is displayed (see temperature maximum value on the display – in this case 34°C).
Maximum temperature has been reached when the arrows (left picture) disappear, max. (right picture) appears in place of the arrow, and the beeper signal stops. Moving away from the max. temperature will result in the bars moving away from the max. temperature (1 bar is equivalent to 1°C). Once the right core flow has been achieved, the probe is fixed with the probe cone screw.

7.3. Measured Value Display

After the core flow search you will see the measurement values on the display.
Measurement values can be organized on three pages, each page displaying 6 measurement values. The order of the display is operator settable. (see chap. 4.6).
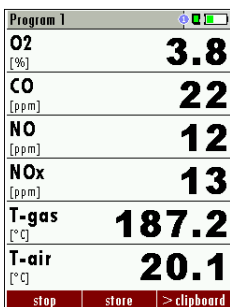
There are direct measured values available such as Oxygen and Temperature as well as calculated values such as dew point, efficiency and CO_2. You will also find the same measurement value in different calculated values such as CO in ppm or CO in mg/kWh.

Values that cannot be displayed are indicated with dashes. Possible reasons for value not being displayed are:

- Electro chemical sensor was detected as defective during zeroing.
- External temperature sensors are not connected.
- The measurement value T-Gas is usually read at the connector "T-Gas/AUX" (depending on configuration) or if not available from the connector "T1"
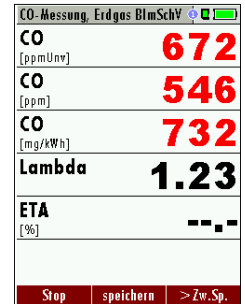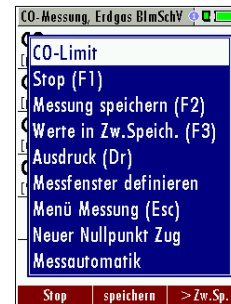
There are three measurement windows available, with the arrow keys left and right moving between them.
Zoom function, each with two values, is activated by moving the arrow keys up and down.
Moving arrow keys left and right pages between the two zoom windows.
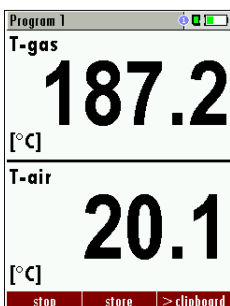
7.4. CO-limit (without purging)

If the CO limit value is exceeded, the color of the measured CO values changes (red).

7.5. CO purging (optional)

When the CO ppm limit is reached the analyzer will start the CO purging pump to protect the CO sensor from getting saturated with CO. Other values will not be affected while the CO sensor is being purged.

While the CO sensor is being purged the CO value is not displayed and dashes will appear on the display. The dashes will remain red as long as the CO value is higher than the CO ppm limit, and they will turn black once a level below the selected ppm value has been reached. The purging does not stop automatically: it must be turned off by the user.

Press the "Folder" menu key and select "purge pump off" to cancel the CO purging function.

If during the flue gas measurement exceeded the configured CO-limit, the device activated the purge function. Thus, the CO - sensor is protected before high CO - without that other measured values are distorted.
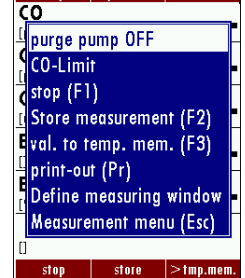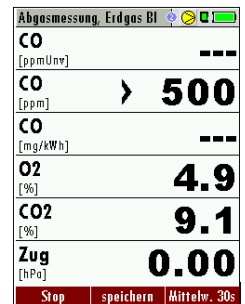
7.6. CO/H2 and CO high (optional)

If that exceeds CO the CO threshold, then to CO high, the measured value is red indicated - also the calculated values - is switched.

The CO value exceeds 10.000 ppm to % is in such a way switched (example 1.00%).

If the CO value sinks below the CO threshold, then the red CO value becomes again black

Starting from this moment the purge pump can be switched off over the menu key again.

7.7. Specific measurement applications

30 second average value calculation according to 1. BImSchV_2010

This function is available if you have received your unit with German configuration.

This option is started with the F3 button in the measuring window.

In the right bottom corner of the display the countdown from 30 to 0 will be displayed. Once the countdown is completed the measurement will stop automatically.

The per 30 seconds determined loss Values will be market in the measurement print out.
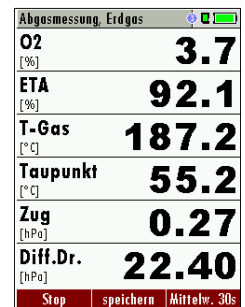
Annular-gap measurement program

This program is used to find leaks in the double walled exhaust duct of condensing boilers. It is done by measuring the O_2 value in the combustion air.

For this measurement MRU offers an annular gap probe (Part no. 56352) which can be connected to the condensate separator of the analyzer.

Optional you can connect the annular gap probe with an adaptor (Part No. 11652) to the tip of the probe pipe.

Test program

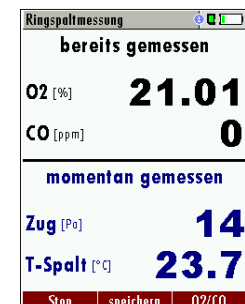This test program is made for testing facilities that will test these analyzers with test gases and don't need to make any modifications.
In this program you will only see measured values and no calculated values at all.

CO ambient

In some countries the measuring program CO environment is demanded. The objective of this measuring program is the proof of CO concentration in the environment of the measuring point.
In the case of the country setting in the main menu the menu option is indicated „CO ambient".
The current CO value (zeroing) as a check is indicated. (This value must be approx. 0 ppm!)
The CO ambient measurement starts through pressing the key **F3** at the measuring point.
The current CO (ambient) and CO (peak) values will be indicated.
The measuring result will be indicated by pressing the **F3** key. This can be printed out by the **printer**-key.
With the **ESC** key one reaches back in the main menu.

7.8. Temporary buffer

The NOVA*compact* gives the possibility to set the momentary values into a temporary buffer during effecting and continuing the measurement. Later on, the values can be brought back from the temporary buffer to the measuring window in order to print them out or / and to save them.

Set values into temporary buffer

During an actal measurement you can set the actual values into the temporary buffer
Operation:
• the function „val. to temp. mem." of the menu (accessible about the menu button)
• or, provided that offered, the function key F3 with the text

To bring values back from the temporary buffer

With stopped measurement you are able to change the indicated values with the buffer content.
Operation:
• the function „v./tmp.mem." of the menu (accessible about the menu button), or
• the function key F3 with the text

Now you can change the current values and the values of the temporary buffer with the key F3.This change of the actual values with the values of the temporary buffer memory can be executed several times one after the other
Now it is possible to print and save as usual one of both measurements.

7.9. 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 8.

7.10. Input of boiler temperature, soot values and derivative

In fact, the OPTIMA 7 has no soot measurement, but you can nevertheless insert, save and print soot data.
Before using this function it must be switched-ON

After a flue gas measurement is finalized, the externally determined soot data can be entered.
The input of the boiler temperature occurs with the arrow keys left/right
Afterwards the determined soot values and the derivate can be set - with the fuel oil.
Change of the line with the arrow keys up/down.
Save the entered data with the F3–key.
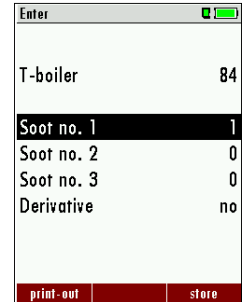
7.11. Printing the measurement results

Measurement results can be printed using the printer button. Printer line feed is activated when pressing the printer button outside of a measuring screen. All measurement values which are activated in the measurement screen will be printed (values which are selected more than once will only be printed once).

7.12. End of measurement

A current emission measurement can be stopped at any time with the F1 key. The display will change its colour and the measurement will be frozen. At the time you stop the measurement all measured values are still available and can be viewed at a later time (see chap. 7.13).
Return to the measurement menu by pressing the ESC key.

7.13. Last measurement results

The analyzer allows the viewing of the last measurement after a measurement is completed. In the main menu "Measurement" select the point "last meas. values". The last values can be viewed, printed and/or saved.
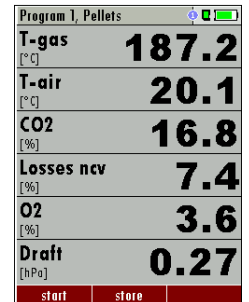
Above the F1 key "Start" instead of "Stop" is displayed. Pressing this key will continue the measurement.

7.14. 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

If the pressure is too high following error message appears:
Error message pressure sensor "pressure too high"
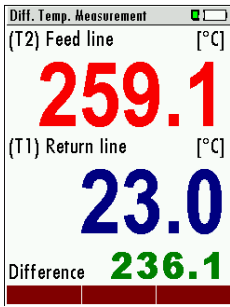
7.15. Differential temperature measurement

In the differential temperature measurement menu two temperatures can be measured simultaneously by using the T1 and T2 connectors. Both measured temperatures and the difference between the temperatures will be displayed.

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

7.16. Flow monitoring (option)

The optional flow monitoring in case of an error the following message will be displayed.

7.17. CHP Measurement (option)

For measurements on CHPs must be used a Purafil filter at the connectors 19 and 20 for CO Sensor protection.

8.   Data storage

8.1.   Organisation of the data memory
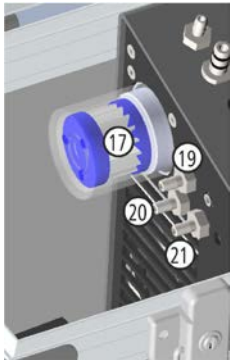
Basis of the data memory of the analyzer is a set of sites stored in the device. Every site exists of an unique site number and 8 freely usable text lines which can have, e.g., the address, customer name etc.
The device can store up to 4000 different sites.
Sites can be created in the device and be changed, 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.

8.2.   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.

8.3.   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
- any change to data of a site will not be transmitted to a PC

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

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 colourfully,
- 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 occurrence is searched in the selected text field. Press then "OK".
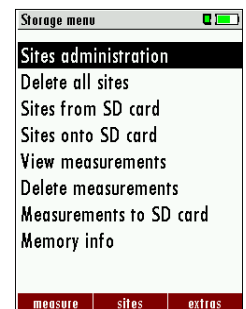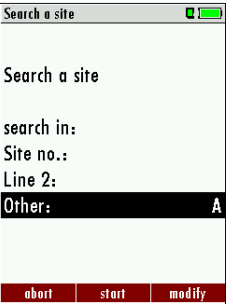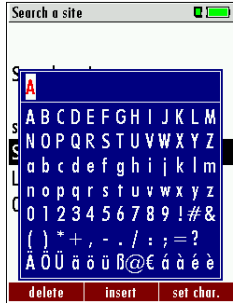
- Select after input of the search text F2 = "start"
- If only one site is found as a result of the search, this is displayed. If became several sites the total number is found in the header viewed and you can scroll by this found standing with the arrow keys.

◀▶	Page through the sites
📂	Menu key: Search site ▲, ▼ : Selection of the input field **F3:** Input mask **F2:** Start search ◀▶ : According to the search criteria found sites page through. If no saved site with the search criteria agrees occurred the message: „Search unsuccessfully"
ESC	Back to storage menu

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".
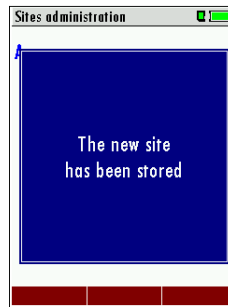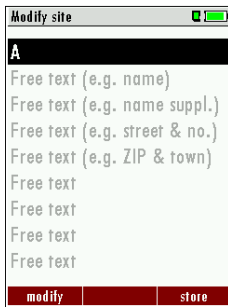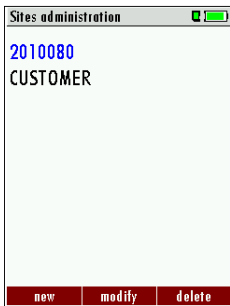
Delete sites

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. 11.2).

8.4.   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. NOVA*compact* 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
- Export of Flue Gas Measurements
- Export of Differential Pressure Measurements

Import of Sites

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

Export von Anlagen

This function can be used for an analyzer back up or if you wish to supply the analyzer information to a computer program or another analyzer. This is very handy if you have made some modifications inside the analyzer (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 analyzer, the file must first be renamed into "anlagen.csv".

Export of Flue Gas Measurements

This function is used to export the measurements from the analyzer to a computer program.
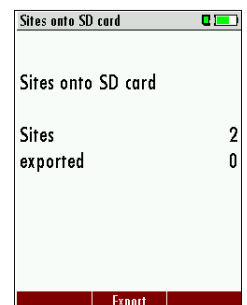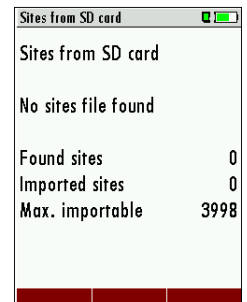
Attention! This function is not suitable for back up or for the transfer to another analyzer because the exported file can not be imported again!

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

The created file has a column header with the following information: Site number, Date/Time, Measuring program name, Fuel type, CO2max, O2reference, and all measured values that the analyzer can measure as well as the soot numbers, Derivate and T-Boiler.

Example:

	A	B	C	D	E	F	G	H	I	J	K
	Site no.	Date & time	meas.progra	fuel type	CO2max [%]	O2ref [%]	T-gas [°F]	T-air [°F]	Dewpoint [°F]	O2 [%]	CO2 [%]
1											
2	BOILER	THU 30.09.2(	Program 1	Natural gas	11.7	3.0	--.-	73.5	--.-	21.0	--.-
3	BOILER	THU 30.09.2(	Program 1	Natural gas	11.7	3.0	--.-	73.0	--.-	21.0	--.-
4	BOILER	THU 30.09.2(	Program 1	Natural gas	11.7	3.0	--.-	73.0	--.-	21.0	--.-
5	BOILER	THU 30.09.2(	Program 1	Natural gas	11.7	3.0	--.-	72.5	--.-	21.0	--.-
6	BOILER	FRI 01.10.20:	Program 1	Natural gas	11.7	3.0	--.-	72.5	--.-	21.0	--.-
7	A FURNACE	TUE 05.10.20(	Program 1	Natural gas	11.7	3.0	81.0	--.-	113.0	11.7	5.2
8	A FURNACE	TUE 05.10.20(	Program 1	Natural gas	11.7	3.0	81.0	--.-	113.0	11.7	5.2
9	A FURNACE	TUE 05.10.20(	Program 1	Natural gas	11.7	3.0	82.5	--.-	112.5	11.7	5.1
10	A FURNACE	TUE 12.10.20(	Program 1	Natural gas	11.7	3.0	84.5	--.-	132.5	2.7	10.2

Export of Differential Pressure Measurements

The same function as Export of Flue Gas 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.

## 8.5. Measurements in the Data Memory

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 flue gas measurement or another 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.
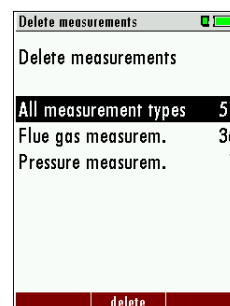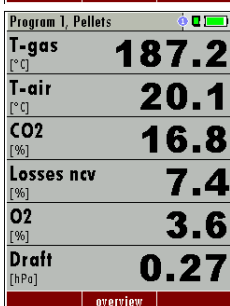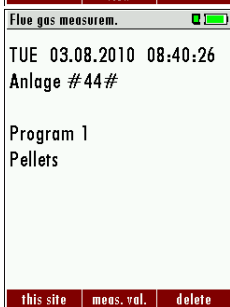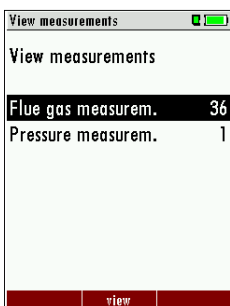
Delete measurements

You are able to

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

Export measurements to a SD card (option)

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.
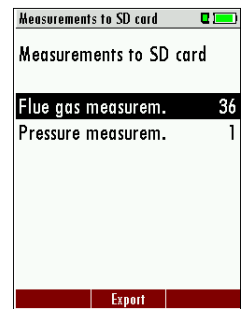
9.   EXTRA / Settings

The analyzer 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 analyzer 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 analyzer, once you have adapted your analyzer 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 analyzer to save all the changes that have been made. Next time that you start up the analyzer, all changes will have been made.

9.1.   Maintenance adjustment menu

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 analyzer.
Press the Enter key if you should have landed in this menu by accident and you will be exited into the "Extra Menu" again.
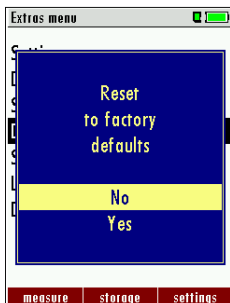
9.2.   Manufacturer default settings

The analyzer will be reset to original delivery settings.
Be aware that your configurations will be deleted, such as:

CO-ppm limits
Fuel type list activation
Measurement window selection
and others.

9.3.   Service values

Should your analyzer display an error message after zeroing (for example: „O2-Sensor not OK"), 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.
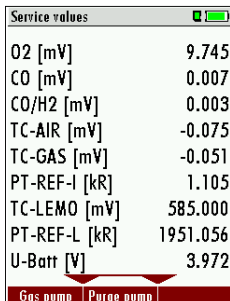
▲, ▼	Jump between the lines
F1	Function test gas pump (on / off)
F2	Function test purge pump (on / off)
ESC	return

9.4. Leak proof test

With the leak proof test the system is checked by the device (incl. the condensate separator) up to the probe spike on undensity. The internal gas pump generates in addition a subpressure which is measured over the built-in draft sensor and is observed for a period of 10 seconds. Based on the decrease of pressure the leakness of the system will be determined.+

Operation

- The leak proof test cap # 61382 (for probe tubes Ø 8 mm) must be put on the probe tip.
ATTENTION:
The probe spike before the density test clean! (With depositions on the tube the cap does not seal.)

Art.-# 61382

- Launch under "extras" the leak proof test on which the following window will pop up:

Leak proof test	Leak proof test	Leak proof test	Leak proof test
Establ. pressure ...	Test in process ...	Result: OK	Result: leakage!
Install test cap		Remove test cap!	Check device !
			Remove test cap
			OK
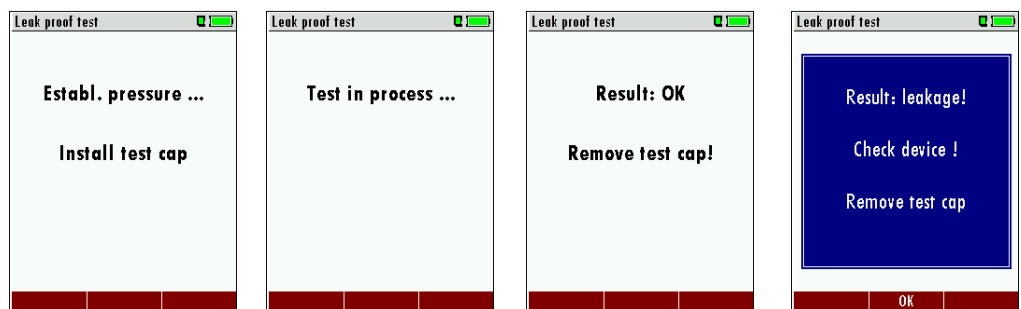
- If of the leak proof test is not passed the probe must be checked including the hosing as well as the condensate separator.

If no undensity is ascertained in these external parts the analyzer has to be checked in a service department
(worldwide service departments see www.mru.eu

9.5.   Contents SD card

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

9.6.   Analyzer info

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

Press the F2-key to see the installed options.
With the F1-key you get information about the date of the last 7 service procedures

10. Technical specifications

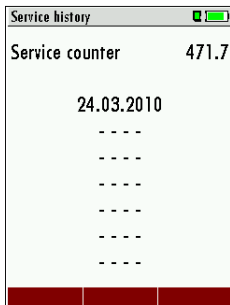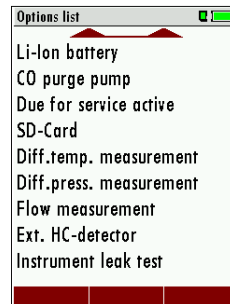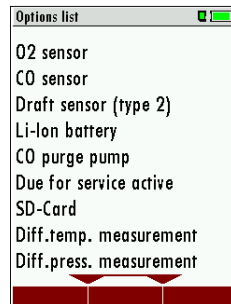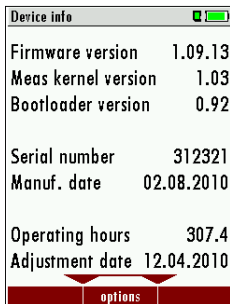| Measured values	NOVAcompact
O₂ measuring range	0 - 21,0 Vol-%
Accuracy	± 0,2 Vol-% abs.
Reaction time T90*	< 20 s
CO (H₂ komp.) measuring range	0 - 4.000 ppm, overload up to 10.000 ppm
Accuracy	± 10 ppm or** 5 % of the measured value ≤ up to 4.000 ppm or** 10 % of the measured value up to 10.000 ppm
Reaction time T90*	< 40 s
CO high measuring range	0 - 4.000 ppm, overload up to 20.000 ppm
Accuracy	± 100 ppm or** 5 % of the measured value up to ≤ 4.000 ppm or** 10 % of the measured value up to 20.000 ppm
Reaction time T90*	< 40 s
NO measuring range	0 - 1.000 ppm, overload up to 5.000 ppm
Accuracy	± 5 ppm or** 5 % of the measured value up to ≤ 1.000 ppm or** 10 % of the measured value up to 5.000 ppm
Reaction time T90*	≤ 30 s
Flue gas temperature T_A	
Measuring range	0 - 650 °C with high grade steel probe pipe
Measuring range	0 - 1.100 °C with Inconel probe pipe
Accuracy	± 2 °C ≤ 200 °C
	1 % of the measured value > 200 °C
Ambient air temperature T_L	
Measuring range	0 - 100 °C
Accuracy	± 1 °C
Draft	
Measuring range	± 100 hPa
Accuracy	± 0,02 hPa or 1% of the measured value
Differential pressure	
Measuring range	± 100 hPa
Accuracy	± 0,02 hPa or 1% of the measured value
Max suction range gas pump	150 hPa
Typical gas flow	60 l/h

| Calculated values	(fuel dependent)
CO_2 Measuring range	0 - CO_2 max
Accuracy	± 0,3 Vol-% absolut
Dew point	°C
Losses qA	0 - 99,9 %
Efficiency ή	0 - 120 %
Measured values as	mg/Nm^3, O_2 in relation, mg/KWh, NOx as mg/Nm^3 NO_2, CO/CO2 ratio
	** ** which ever is larger

11. Appendix

11.1. 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
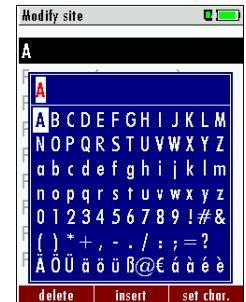
11.2. Asking the user for a decision (pop up window)

The analyzer 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

11.3. Firmwareupdate

Switch ON the device.
Select F3 settings/Device info

For the case that there should be problems by the update we need some information of you.
Please write down your Firmware-Version (e.g. 1.33.00)_____
Please write down your serial number   (e.g. 301231)_____
You need the latest file `1102.fwb'. In case you get it in a zip archive you have to extract it before usage. This file contains all firmware types and the analyser will extract the correct type out of this file automatically.
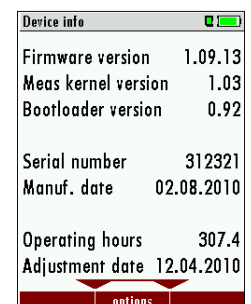
Performing an update:

- copy the file '1102.fwb' to a SD card in the root directory (that means in no directory)
- insert the SD card into the analyser and switch on the analyzer
- wait until you will be asked: Firmware found. Install now?
- acknowledge with 'install'
- the update mechanism starts……….
- wait about 45 seconds, press any key at this time
- then the analyser will reboot with the new firmware
- confirm with „OK"
- finished

11.4. 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 analyzer and your PC / Laptop. (Requires operating system Windows XP or Windows 7).

Your PC / Laptop will recognize the analyzer as USB- HID (Human Interface Device).
Check list:

- Switch on the analyzer
- Connect the USB cable to the analyzer
- Connect the USB cable into a free USB port at your PC/Laptop
- The PC/Laptop must be powered on
- 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 analyzer is as HID-conform unit registrated.
Windows XP: Press the START button – then select the CONTROL PANEL – select SYSTEM – select HARDWARE – select DEVICE MANAGER
Windows 7: for Windows 7 there are several possibilities, please read your Windows 7 manual for details.
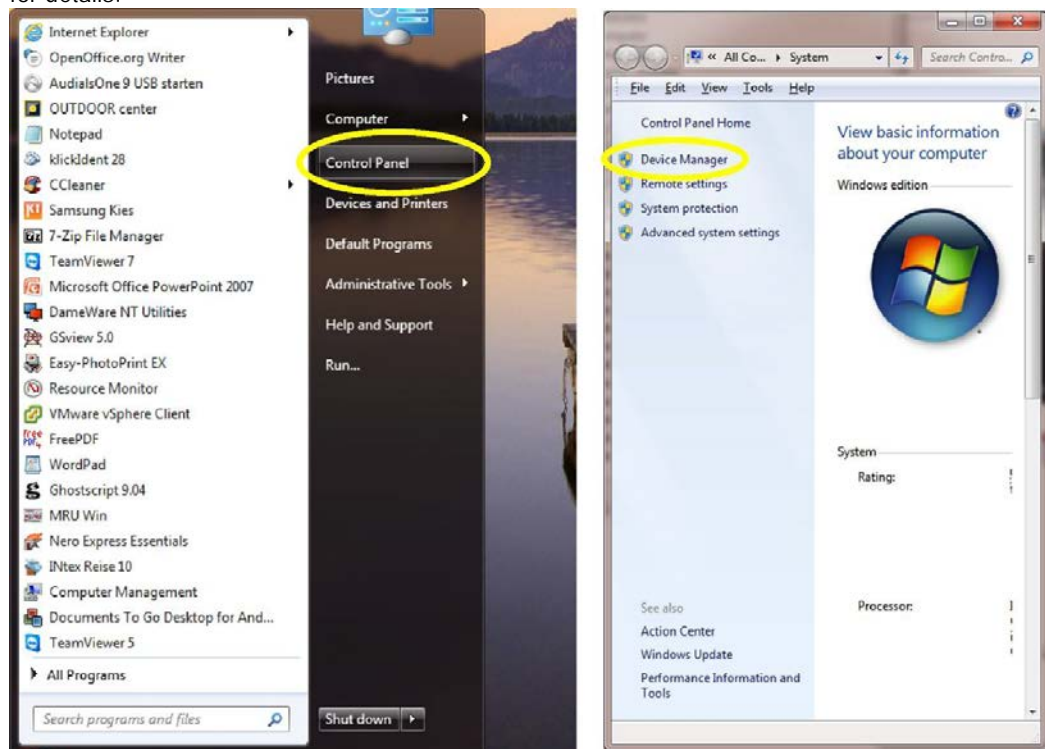
(The graphics may look different on your PC/Laptop as shown in this manual!)
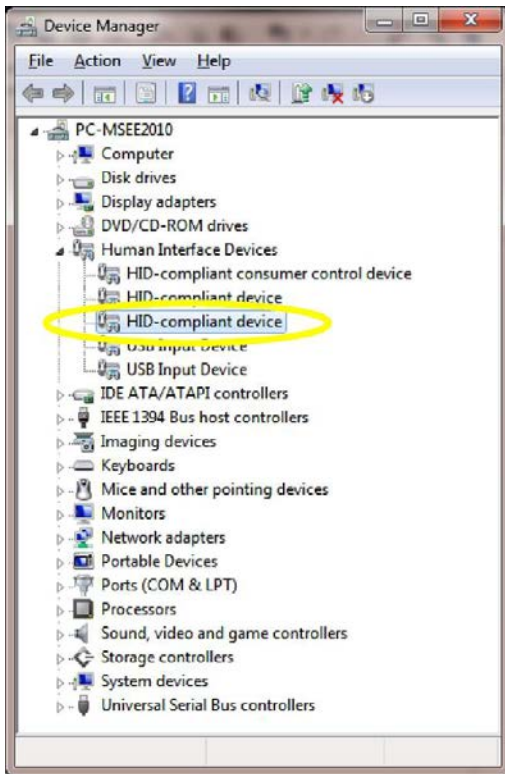
The analyzer is registrated as   In the General folder you can see if
a HID-conform unit.   the unit is ready for operation.
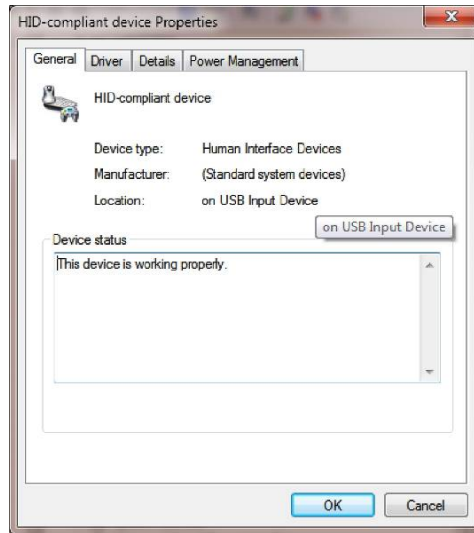
In case the analyzer is not ready for operation, choose a different USB instrument to check the USB port on your computer, and/or connect the analyzer to a different computer to locate the error.
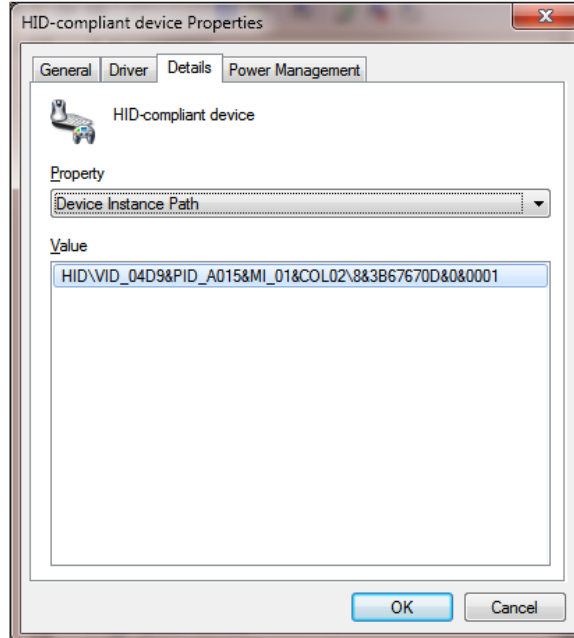
11.5. Analysis and calculations

Continuous measured values	Unit
O_2	[%]
Temp. Ambient air (Thermo-Element)	[°C] [°F]
Temp. Flue gas (Thermo-Element)	[°C] [°F]
CO	[ppm]
Draft	[hPa]

Available conversions	CO	NO
[ppm] related to. on 0% rest O_2 (undiluted)	X	X
[ppm] related to. on fuel type dependent O_2 reference value	X	X
[mg/m^3]	X	X
[mg/kWh]	X	X
[mg/MJ]	X	X
[mg/m^3] on fuel type dependent O_2 reference value	X	X

Further continously caculated values	Unit
CO_2	[%]
Efficiency ETA	[%]
Efficiency condensed	[%]
Losses	[%]
Losses condensed	[%]
Lambda	-
Dew point	[°C]
CO/CO2 ratio	[%]

Losses and efficiency are calculated by means of net calorific value.
These values are than referenced for the gross calorific value for condensing boilers only.
(efficiency > 100)
The calculations of efficiency and exhaust losses are performed using Siegert's formula.

11.6. Fuel types

General information

$O2\max = 20.9\%$ O2 content

$O2 =$ measured O2 value [%]

$O2bez =$ O2-reference value [%] (fuel specific)

$CO2\max =$ CO2max-value [%] (fuel specific)

$V_{AG\min,tr} =$ Flue gas volume, dry and O2-free (fuel specific)

CO2, Lambda, losses, efficiency

$$CO2 = CO2_{max}\cdot\left(1-\frac{O2}{O2_{max}}\right)$$

$$\lambda = \frac{CO2_{max}}{CO2} = \frac{O2_{max}}{O2_{max}-O2}$$ (prefer the 2nd O2 formula!)

$$losses = \left(T_{fluegas}-T_{air}\right)\cdot\left(\frac{A_2}{O2_{max}-O2}+B\right)$$ (temp. in °C, A2 and. B fuel specific)

$$efficiency = 100\% - losses$$

Dew point

(DIN 4705, part 1, page 17)

$$t_P = \frac{4077,9}{23,6448-\ln(p_D)}-236,67$$ with $$p_D = \frac{H2O}{100}*p_L$$ with

$$H2O = 1,1+\frac{100}{1+\frac{f_W}{CO2}}$$

tP	: dew point temp. in °C	H2O	: water vapour content [%]
pD	: steam part. pressure	fW	: humidity value of fuel [%]
pL	: atmospheric pressure	CO2	: carbon dioxide content [%]

At standard pressure (1013 hPa) the dew point is calculated:

$$t_P = \frac{4077,9}{23,6448-\ln\left(1,1+\frac{100}{1+\frac{f_W}{CO2}}\right)-\ln(1013)}-236,67 = \frac{4077,9}{16,7241-\ln\left(1,1+\frac{100}{1+\frac{f_W}{CO2}}\right)}-236,67$$

CO- conversion of CO [ppm]

$$COunv[ppm] = CO[\frac{ppm}{0\%O2}] = CO[ppm]\cdot\lambda$$

$$CO[\frac{ppm}{O2bez}] = CO[ppm]\cdot\frac{O2\max-O2bez}{O2\max-O2}$$

$$CO[\frac{mg}{m^3}] = CO[ppm]\cdot 1,249$$

$$CO[\frac{mg/m^3}{O2ref}] = CO[\frac{mg}{m^3}] \cdot \frac{O2\max - O2ref}{O2\max - O2}$$

$$CO[\frac{mg}{kWh}] = CO[\frac{mg/m^3}{0\%O2}] \cdot \frac{V_{AG\min,tr}}{H_{u,n}} = CO[\frac{mg}{m^3}] \cdot \lambda \cdot \frac{V_{AG\min,tr}}{H_{u,n}}$$

$$CO[\frac{mg}{MJ}] = \frac{CO[\frac{mg}{kWh}]}{3,6} \quad CO[\frac{mg}{MJ}] = \frac{CO[\frac{mg}{kWh}]}{3,6}$$

NO-conversion of NO [ppm]

$$NOundel[ppm] = NO[\frac{ppm}{0\%O2}] = NO[ppm] \cdot \lambda$$

$$NO[\frac{ppm}{O2ref}] = NO[ppm] \cdot \frac{O2\max - O2ref}{O2\max - O2}$$

$$NO[\frac{mg}{m^3}] = NO[ppm] \cdot 1,339$$

$$NO[\frac{mg/m^3}{O2ref}] = NO[\frac{mg}{m^3}] \cdot \frac{O2\max - O2ref}{O2\max - O2}$$

$$NO[\frac{mg}{kWh}] = NO[\frac{mg/m^3}{0\%O2}] \cdot \frac{V_{AG\min,tr}}{H_{u,n}} = NO[\frac{mg}{m^3}] \cdot \lambda \cdot \frac{V_{AG\min,tr}}{H_{u,n}}$$

$$NO[\frac{mg}{MJ}] = \frac{NO[\frac{mg}{kWh}]}{3,6}$$

$$NO[\frac{ppm}{14\%CO2}] = NO[ppm] \cdot \frac{O2\max - 1,8\%}{O2\max - O2}$$

NO2-conversion of NO2 [ppm]

No conversions of NO2! All the values of interest are in the NOx conversion.

NOx-conversion of NO [ppm] (possible also of NO2 [ppm])

$$NOx[ppm] = NO[ppm] \cdot 1,05$$ (if no NO2-sensor exists)

$$NOx[ppm] = NO[ppm] + NO2[ppm]$$ (if a NO2-sensor exists)

$$NOx\,unv[ppm] = NOx[\frac{ppm}{0\%O2}] = NOx[ppm] \cdot \lambda$$

$$NOx[\frac{ppm}{O2bez}] = NOx[ppm] \cdot \frac{O2\max - O2bez}{O2\max - O2}$$

If NOx is specified in mg, it has to be considered, that all the NO in the atmosphere will become NO2. Therefore the conversion factor ppm => mg is factor of NO2.

$$NOx[\frac{mg}{m^3}] = NOx[ppm] \cdot 2,053$$

$$NOx[\frac{mg/m^3}{O2bez}] = NOx[\frac{mg}{m^3}] \cdot \frac{O2\max - O2bez}{O2\max - O2}$$

$$NOx[\frac{mg}{kWh}] = NOx[\frac{mg/m^3}{0\%O2}] \cdot \frac{V_{AG\min,tr}}{H_{u,n}} = NOx[\frac{mg}{m^3}] \cdot \lambda \cdot \frac{V_{AG\min,tr}}{H_{u,n}}$$

$$NOx[\frac{mg}{MJ}] = \frac{NOx[\frac{mg}{kWh}]}{3,6}$$

$$NOx[\frac{ppm}{14\%CO2}] = NOx[ppm] \cdot \frac{O2\max - 1,8\%}{O2\max - O2}$$

11.7. Fuel type list

Deutschland			O2max	20,96	
Brennstoff	CO2max	A1	A2	B
Prüfgas	0,0	0,00	0,00	0,000
Erdgas (LL)	11,8	0,37	0,66	0,009
Erdgas (E)	12,1	0,37	0,64	0,009
Heizöl EL	15,4	0,50	0,68	0,007
Heizöl S	15,9	0,50	0,66	0,007
Flüssiggas P/B	13,7	0,42	0,63	0,008
Propan	13,7	0,43	0,66	0,007
Butan	14,1	0,45	0,67	0,007
Bio-Diesel	15,7	0,46	0,62	0,005
Holz trocken	20,3	0,60	0,62	0,009
Pellets	20,3	0,74	0,77	0,000
Kohle	19,1	0,59	0,65	0,009
Braunkohle	19,4	0,39	0,42	0,009
Torf	19,8	0,66	0,70	0,010
Kokereigas	10,8	0,29	0,60	0,011
Stadtgas	11,7	0,35	0,63	0,011

Fuel lists for further countries receive you on requirement or on our Internet site: www.mru.eu

11.8. Errors

Error diagnosis regarding the measuring device

1. Effect	2. Error indication	3. Cause	4. Solution
Device cannot be switched off by pressing the OFF key.		Device does not react on any key.	Press ESC and ON simultaneously! RESET 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
Measuring values are not correct		Incorrect zeroing	Vent device with fresh air and re-start!
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.
Wrong measuring values	Measuring range exceeded: Value O_2 too high Values CO and CO_2 to low	Connection probe – device not correct. Leakage at probe / tube / condensate separator, pump does not suck correctly	Perform tightness test! By visual control of probes, tubes condensate separator, leaking parts could be found.
Wrong measuring values	Gas temperature is too hot or alternates	Probe is not plugged in correctly, defective cable in the probe line, formation of condensate at the probe tip.	Check probe plug respectively probe line regarding damages (loose connection), remove condensate from the probe tip.

Error diagnosis regarding the condensate separator

1. Effect	2. Cause	3. Solution
Dirt and / or humidity inside the device No filter effect Sensor failure Pump failure	Fine filters are wet and / or dirty.	Check filters more often Renew them if necessary (white = OK) Brown-black = renewal
Wrong measuring values	Cover, intermediary unit, plexiglass tube and locking pieces are not tightly fixed respectively screwed	Check tightness with every filter change.

11.9. Declaration of conformity

EU-Konformitätserklärung
Declaration of conformity

CE
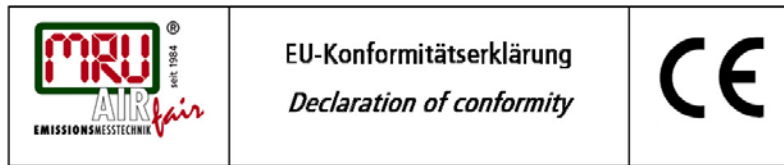
MRU Messgeräte für Rauchgase und Umweltschutz GmbH

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Person authorized to compile the technical documents

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Straße / *street:*	Fuchshalde 8 + 12
Ort / *city:*	74172 Neckarsulm
Land / *country:*	Deutschland / *Germany*

Produkt/Product

Bezeichnung / *designation:*	Gasanalysator / *Gas analyser*
Produktname / *name:*	NOVAcompact
Funktion / *function:*	Gasanalyse / *gas analysis*

Hiermit erklären wir, dass das oben beschriebene Produkt allen einschlägigen Bestimmungen entspricht, es erfüllt die Anforderungen der nachfolgend genannten Richtlinien und Normen:
We declare the conformity of the product with the applicable regulations listed below:

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

Neckarsulm, 01.07.2016

Erwin Hintz, Geschäftsführer / *Managing Director*

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