INTELLIGENT MESSEN!
INTELLIGENT ANALYSIS!

ECOM®

Operating Instructions

ECOM® *EN3*

SAFTEY INSTRUCTIONS

Please observe all safety instructions in this manual carefully, in order to avoid danger and damage to people and property values.

REGULATIONS

The ecom-EN3 meets the requirements of:
- **DIN EN 50379 Part 2**
- **VDI 4206 Sheet 1**

Observe the relevant, valid standards, regulations and guidelines when working with the instrument!

TARGET GROUP

This manual is intended exclusively for authorized professionals.

WARNING

Adjustments at burners and boilers should be made only by specialists who are familiar with these installations.

Symbols

WARNING

Indicates that personal injury, or even life-threatening injury, may occur.
➡ **Indicates how the hazard can be avoided.**

DANGER

Indicates that material damage can occur.
➡ **Indicates how the hazard can be avoided.**

In both cases it is stated how the danger can be avoided.

Hints
Hints are marked with an information symbol.

➡ **Text sections marked with an arrow call for an action.**

INTENDED USE

The ecom-EN3 is designed for the following applications:
- Analysis of exhaust gases from combustion processes in combustion engines and combustion plants in the context of control measurements
- Analysis of pressure differences in combustion engines and combustion plants

WARNING

⚠️

The ecom-EN3 is explicitly NOT intended for the following applications:
- CONTINUOUS analysis of exhaust gases from combustion processes
- Use as a safety device or safety alarm device in gaseous environments or processes

DANGER

⚠️

The following substances impair the instrument´s operation:

- Solvent-containing vapours from cleaning agents, degreasers, wax polishes, adhesives
- Formaldehyde

The unauthorized use leads to the exclusion of any liability claims.

LIFE EXPECTANCIES SENSORS AND BATTERY

Following life expectancies apply to sensors and battery:
- O2 sensor: approx. 4 years
- CO sensor: approx. 4 years
- Li-Ion battery: approx. 2 years

CE DECLARATION OF CONFORMITY

The product complies with the relevant directives and is therefore CE marked. The conformity declaration can be requested from the manufacturer.

HINT

Strong electromagnetic fields can impair the function of the measuring instrument.
➡ Make sure that the measuring instrument is not exposed to strong electromagnetic radiation sources.

DISPOSAL

- Dispose the packaging material of the instrument in an environmentally sound manner.
- Old electrical equipment must be disposed in an environmentally sound manner by an authorized body. On request, we take back your old instrument purchased from us and guarantee for an environmentally friendly disposal.
- Defective batteries can be dispensed both at the factory and at the collection points of public waste disposal companies or at points of sale for rechargeable batteries!

WARNING	**Electric shock!**
	Current-carrying components at open housing!
	➡ **Before opening the instrument housing, disconnect the instrument from the mains supply at all poles.**

WARNING	**The instrument is operated with a Li-Ion battery!**
	The replacement of the battery must be carried out only by qualified personnel or by an ecom authorized service center.

DANGER	**Electrostatic discharge!**
	Electrostatic discharge can lead to damage to electronic components!
	➡ **Before handling the housing, ensure that you are unloaded. To do this, touch a grounded component (eg water pipes, radiators, etc.).**

Content

1. Instrument Design

1.1 ecom-EN3/-R, Transport variant aluminium-framed transport case

1	Holding clamp for the probe	2	Graphic display
4	Connection USB	5	Connections for Pa pressure sensor
7	Battery and sensors compartment	8	Connection sampled gas
10	Condensation trap (with peltier cooler) with fine dust filter	11	Connection gas temperature
13	Integral thermal printer	14	Connection AUX

1	Holding clamp for the probe	2	Graphic display	3	Slot for multi-media card (SD)
4	Connection USB	5	Connections for Pa pressure sensor	6	Connection pressure
7	Battery and sensors compartment	8	Connection sampled gas	9	Connection draught
10	Condensation trap (with peltier cooler) with fine dust filter	11	Connection gas temperature	12	Connection air temperature
13	Integral thermal printer	14	Connection AUX		

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1.2 ecom-EN3-F, Transport variant professional case

①	Holding clamp for the probe	②	Battery and sensors compartment	③	Graphic display
④	Connection Pressure	⑤	Connections for Pa pressure sensor	⑥	Slot for multi-media card (SD)
⑦	Connection USB	⑧	Integral thermal printer	⑨	Connection sampled gas
⑩	Condensation trap (with Peltier cooler) with fine dust filter	⑪	Connection draught	⑫	Connection gas temperature
⑬	Connection air temperature	⑭	Connection AUX		

1.3 ecom-EN3, Keyboard controls

1 Connection LED (active with existing BT or WiFi connection)	2 Info LED to display the device status	3 Battery LED to display the charge state
4 Function key (function shown on display)	5 ESC key (quit/exit menu)	6 Digital flowmeter
7 Enter key (confirm selection)	8 Cursor keys (Up/Down/Right/Left/Scroll)	9 Save key
10 Print key	11 ON / OFF key	12 Info key (access to control menu)

1.4 ecom-EN3, Connections at the instrument

(1)	Connection sampled gas	(2)	Connection draught	(3)	Connection gas temperature
(4)	Connection air temperature	(5)	Connection AUX	(6)	Connection Pa-Sensor
(7)	Connection pressure	(8)	Slot for multi-media card	(9)	Connection USB

1.5 ecom-EN3, Option heated probe for soot measurement

Heated probe for soot measurement

In order to perform a measurement of the soot content in the flue gas from oil firing systems, a filter paper is introduced into the exhaust path of the probe where the soot deposits during the measurement.

On the basis of the deposited amount of soot on the filter paper (blackening), it is possible to compare optically with a scale, which is the soot number. This makes it possible to evaluate the amount of soot in the flue gas.

The filter paper is heated in the probe to prevent the flue gas from cooling too much. This cooling of the flue gas would lead to condensation of water vapour from the flue gas and will distort the result of the measurement.

[i]   **Hint**

As an alternative to the heated probe, a hand soot pump can be used. The possible condensation of water vapour is however not prevented with a hand soot pump.

[i]   **Hint**

For further information on the procedure for soot measurement with the heated probe, please refer to chapter "4.7 Soot...Oil trace"

1.6 ecom-EN3, Option hand soot pump set

Hand soot pump set

In order to perform a soot measurement in the flue gas from oil firing systems, a hand soot pump can be used.

By a prescribed number of suction strokes with the hand soot pump, a defined amount of flue gas is drawn through an inserted filter paper. On the basis of the deposited amount of soot on the filter paper (blackening), it is possible to compare optically with a scale, which is the soot number. This makes it possible to evaluate the amount of soot in the flue gas.

Hint

The hand soot pump is TÜV tested and characterized by high quality in its processing and construction. This guarantees a long-term reliable function.

Hint

As an alternative to the hand soot pump, a heated probe can be connected directly to the measuring instrument. With this heated probe, the possible condensation of water vapour and thus falsification of the measuring result can be reliably prevented.
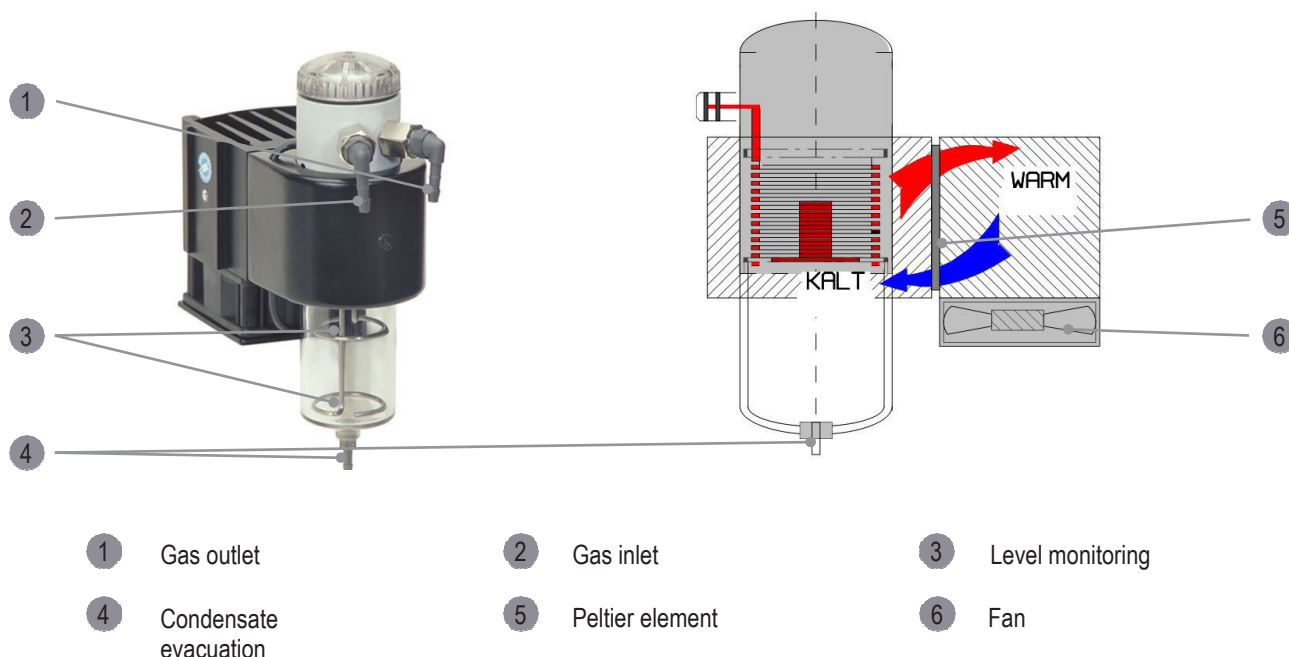
Hint

For further information on the procedure for soot measurement with the hand soot pump, please refer to the manual for the hand soot pump set.

1.7 Gas Cooler (option)

> **[i] Hint**
> **The ecom-EN3-F transport variant professional case is standard with a gas cooler.**

1	Gas outlet	2	Gas inlet	3	Level monitoring
4	Condensate evacuation	5	Peltier element	6	Fan

Exhaust gas with a temperature over the steam dew point (35 - 65 °C) is flown spiral via a long gas path thru a surface coated metal body with good thermal conductivity. The gas radiates its heat to this metal body. A Peltier element (semi-conductor cooling element) flown by a continuous current is thermal connected with this body and with a second metal body with cooling ribs and ventilation slots.

The flow thru the Peltier element creates a heat transfer from WARM to COLD, drains the heat of the metal body flown by gas and conveys it to the outer cooling body. This heat is conveyed thru a vertical forced ventilation to the surrounding air.

The condensation issued by the heat loss of the gas drops in a receptacle and is pumped out on request by a periodically working hose pump.

> **[i] Hint**
>
> **When the gas cooler is active, the power requirement of the instrument increases considerably. Therefore the cooling capacity of the gas cooler in the battery operation is reduced.**

> **[i] Hint**
>
> **The gas cooler can be deactivated in battery operation.**
> ➡ **To deactivate the activated gas cooler, press the <Enter> key when the measuring menu is active. Choose the menu point "Peltier I / 0" and press the <Enter> key again.**
>
> ➡ **To reactivate the deactivated gas cooler, repeat the above steps.**

1.8 Data Memory

When an SD card is inserted into the device, point measurements and data logger records can be stored.

Insert SD card as shown
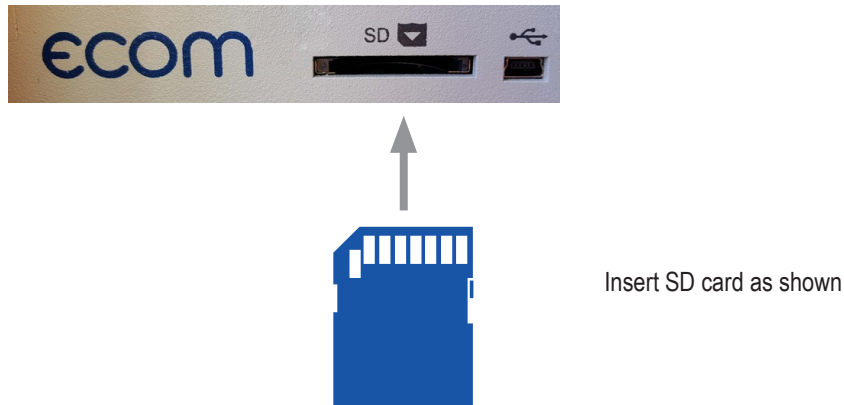
ᵒ   To start point measurements or data logger records, insert the SD card as shown in the SD card slot and let it fully engage.

Hint

The SD card must have the following characteristics:
- min. card volume 32 MB - max.32 GB (UHC)
- card formatted on 16 bit FAT or FAT32

WARNING

Never pull out cards during data record - data loss and damaging of the multi-media-card are possible!

All values of a point measurement are stored in a text file with the name "J2KDV-xx.txt". The text file is stored automatically in the main directory of the SD card.

All values of a data logger record are stored in a csv file with the naming "J2KDL-xx.csv". Sequential files are automatically numbered from 0 ... 99.

The data in the text file and the csv file are stored in the same structure.
You will find further information on the data format in the chapter "Technical data".

The files can be transferred to a PC using a card reader. Both file types can be imported or opened using MS Excel.

1.9 ecom-EN3, Option Interface Wi-Fi (WLAN)

If the instrument is equipped with the Wi-Fi option, this interface can be used to display the current measured values in an App of ecom. The following functions can be used in the App:

- Live display of current measured values

- Export of stored measured values as * .pdf or * .csv

- Activate the function "Print measured values" on the measuring instrument

- Activate the function "fresh air purge CO sensor" on the measuring instrument

Hint

For the start-up of the Wi-Fi interface and for further information on the corresponding settings, please refer to the chapter "Adjustments".

1.10   ecom-EN3, Option interface BLE (Bluetooth Low Energy)

If the device is equipped with the BLE option, this interface can be used to display the current measured values in an App of ecom. The following functions can be used in the App:

- Live display of current measured values

- Export of the stored measured values as * .pdf or * .csv

- Activate the function "Print measured values" on the measuring instrument

- Activate the function "fresh air purge CO sensor" on the measuring instrument

Hint

For the start-up of the BLE interface and for further information on the corresponding settings, please refer to the chapter "Adjustments".

Hint

Make sure that before each measurement

        - the device has no visible defects
        - the measuring system is tight (see leak test chapter 11.5)

2.1 Turn on the instrument and check the battery

The instrument is switched on with the <I / 0> key.

Hint

After switching on the instrument or before starting a measurement, check the charging status of the battery.
    ➡   **Check the charging status of the battery in the status line and / or in the menu "Control".**

The instrument is supplied with charging power supply. The instrument can also be operated with the internal battery for an extended period of time.
When recharging the battery is necessary, the instrument will emit a battery warning. This is done acoustically and via a message in the display.

Hint

The battery warning is activated when the battery voltage is less than 6.5 V. Less than 6.0 V the operation with battery is no longer possible
    ➡   **The operation must continue via the charging power supply.**

WARNING	**The instrument is operated with a Li-Ion battery!**
⚠	**The battery must be replaced only by qualified personnel or by ecom or an ecom authorized service center.**

2.2 Navigation in the menu

When the instrument is switched on, the start screen is displayed, followed by the main menu.

Gas analysis
Soot..Oil trace
Data processing
Adjustments
Control
Diagnostics

Up to 5 submenus are displayed simultaneously in the main menu. Hidden submenus can be displayed by scrolling with the arrow keys.

Menu	Meaning	Comment
Gas analysis	Perform gas analysis	
Mean value	Perform gas analysis with mean value calculation	
Soot...Oil trace	Input of soot measurement results	Start soot measurement (units with soot measurement)
Data processing	Assign measurements / Data transfer	only with inserted MM card
Adjustments	Modify instrument adjustments	
Control	Check operation state of instrument	
Diagnostics	- Read-out of firing automate	Only with ecom-AK
	- delta-T measurement - Heating check - 4 Pa test	

2.3 Calibration of the sensors, use of the database and fuel type selection

Before you can start the measurement procedures, the instrument performs the following steps:

1. Automatic adjustment of the sensors (calibration phase)
2. Query: Use of the database
3. Query: Selection of the fuel type

Select the sub-menu "Gas analysis" and confirm with <Enter>.
The instrument starts the automatic calibration of the sensors (calibration phase). This calibration phase is completed after 60 s.

[i] **Hint**

Position the probe only in the exhaust pipe when the calibration phase of 60 s has been completed!

```
Do you wish to
use the data
processing?

Select:   ⟨✓⟩
    YES        NO
```

While the calibration phase is active, the query for using the database is displayed:

If the measured values of the subsequent gas analysis are to be assigned to a plant or a customer, confirm the query with "Yes".
➡   Press the <F1> key.

For the following steps see chapter "4.8 Data processing during the measurement"

If the measured values of the subsequent gas analysis are not to be assigned to a plant or to a customer, e.g. for a fast control measurement, confirm the query with "No".
➡   Press the <F1> key.

Then select which fuel type is used in the combustion.

```
Fuel type

Fuel oil

CO2max  A1      B
15.4    0.50    0.007

Select:   ⟨⋀⋁✓⟩
```

➡   To scroll through the list of fuel types stored in the instrument, scroll up or down with the arrow keys.

➡   Select the appropriate fuel by confirming with the <Enter> key.

The following fuel types are stored in the instrument as standard:

Fuel type	CO2 max	Factor A2	Factor B
Fuel oil	15,4	0,68	0,007
Natural gas	11,8	0,66	0,009
City gas	11,7	0,63	0,011
Coke oven gas	10,2	0,60	0,011
Liquid gas	14,0	0,63	0,008

WARNING

For the combustion of solid fuels (wood / pellets / wood chips), a filtering device recommended by ecom must always be used (see illustration)!

Filter plate for combustion of solid fuels

Washing bottle for combustion of solid fuels

Probe prefilter

If the calibration has been successfully completed and all previous queries have been answered, the instrument is ready for operation.

[i] **Hint**

The following minimum times must be observed in order to obtain correct measured values:

> **- 1 minute for fresh air calibration of the sensors**
> **- 2 minutes for stable measured values at the instrument**

[i] **Hint**

To obtain accurate measurement values it's important to re-calibrate the instrument after each measurement (at the latest after one hour)!

> ➡ **To calibrate the sensors, proceed as follows:**
> **- Switch off the instrument and wait for the switch off phase**
> **- Switch on the device and refer to chapter "2. Measurement Preparations".**

The current measured values of the active sensors are displayed in the measurement menu. In addition, various measuring procedures are available:

Display	Meaning	Comment
Gas analysis 1	Display of 4 definable measured values	Select the measured values with the <F4> key
Gas analysis 2	Display of 4 definable measured values	Select the measured values with the <F4> key
Gas analysis 3	Display of 8 definable measured values	Select the measured values with the <F4> key
CO measurement	Display of 4 measured values for testing CO with O2 reference	Gas path check
O2 Check	Display of 3 measured values for testing the O2 in combustion air	Set the zero point of the pressure sensor with the <F4> key
Draught measurement	Display of the measured value Draught / Pressure and storing a reference value	While this measurement procedure is active, the gas pump remains inactive Set the zero point of the pressure sensor with the <F4> key Storing a reference value with <save>
Flow measurement	Display of 3 measured values for testing the flow inside an exhaust pipe	Set the zero point of the pressure sensor with the <F4> key Enter the cross-section in the exhaust pipe with the <F1> key

[i] **Hint**

For a detailed description of the individual measuring procedures, see the following sections.

4. Measurement procedure gas analysis

4.1 Gas analysis

The measurement procedure for gas analysis can be used for most control measurements in order to determine the gas components, temperatures and ratios in the measured combustion process.

Design of the measurement displays gas analysis 1..3

The following measurement displays are available for the gas analysis procedure:

Measurement display: Gas analysis 1 + 2

Measurement display: Gas analysis 3

① Switch-off CO-Sensor key <F3>	② Hotkey key <F1>	③ Store and print values key <F2>
④ Symbol cooler ON /OFF	⑤ Hotkey key <F4>	
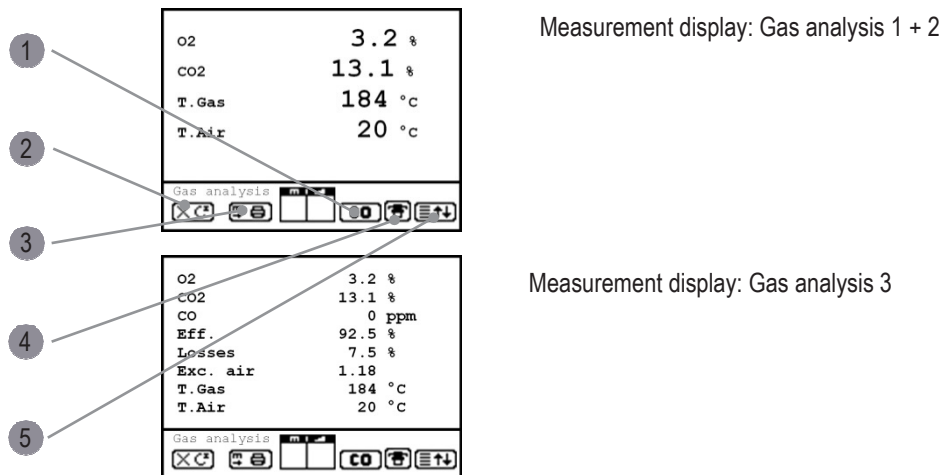
The following functions are available in all 3 measurement displays:

Pressing <F1> enables to switch, from the values display, to a menu point selected before or on „Standby" (see chapter Adjustments). Possible menu points are: Soot...Oil trace, Data processing, View memory, Display values, Fuel type, Efficiency (K), Internal, Adjustments. Furthermore you can switch back from any random menu point to the values display with <F1>.

Press <F2> to print out the values simultaneously to their recording in the intermediate memory.

Press <F3> to cut the CO sensor from the gas path so that it is protected against too high concentrations.

Pressing <F4> also enables to switch, from the values display, to a menu point selected before or on „Standby" (see chapter Adjustments).

4.1.1 Adaptation of the displays for gas analysis

[i] Hint

The position of the measured and calculated values (gas analysis sub-menu) on the display pages is free selectable

➡ For alteration of the existing succession, proceed as follows:

- Press <Enter> / „Display values" / <Enter> to activate the function
- Select line with cursor keys (Up/Down)
- Select desired parameter with cursor keys (Right/Left)
- Repeat procedure until desired layout is completed
- Press <Enter> to deactivate the function

4.1.2 Positioning the probe, search the core stream

[i] Hint

The correct positioning of the probe in the gas stream is necessary in order to achieve an impressive measuring result.

➡ To correctly position the probe in the gas stream, proceed as follows:

- Connect the probe hose to the device "connection gas temperature"
- Position the sampling probe in the exhaust channel, so that the thermocouple is fully surrounded with the gas (see drawing).

| 1 | Gas stream | 2 | Protection bow | 3 | Probe tip |

4   Core stream search

Position the sampling probe in the exhaust channel (Position in the hottest gas temperature area).

Observe trend for T.Gas in the measurement display.

As long as the display shows an arrow in upwards direction, the measured temperature increases, it means the probe tip moves towards the core stream center.

If an arrow in downwards direction is displayed, it means you move the probe away from the core stream and the temperature sinks.

CO_2, efficiency, losses, excess air and dew point are calculated values. They can only be calculated if realistic values for the basic parameters like O_2 and the temperatures are available. It must be ascertained that:

$$O_2 < 20{,}7\ \%\ \text{and}\ T.\text{Gas} - T.\text{Air} > 0\ °C$$

are given. If the gas temperature falls below the dew point (between 25 and 65 °C), so efficiency will be calculated with condensation gain. In this case a (K) is displayed after „Efficiency". Correct measurement values are displayed first after a short delay, necessary for the gas transport and the build-up of a stable electrochemical reaction to the sensors. This time period lasts approx. 1 to 1.5 minute. For recording, printout and evaluation, wait until the values do not change anymore. If deviations higher than 2 ppm still occur by the gas values, they can be due to unstable pressure conditions in the exhaust channel.

```
O2              3.2 %
CO2            13.1 %
CO               0 ppm
Eff.            92.5 %
Losses           7.5 %
Exc. air        1.18
T.Gas            184 °C
T.Air             20 °C

Gas analysis
```

If the measurement values are stable and the results can be printed out, press the key <Save> to transfer the values in the intermediate memory (caution: store separately gas analysis, CO, O2 check and draught measurements). They will be kept there for a later printout and, if need be, for a final data record storage.

1   Measurement stored in intermediate memory

4.1.3 Printing measured values

There are two ways to print measurements:

1. Print of the measurements stored in intermediate memory

To print the measured values stored in the previous step, press the <Print> key. The complete content of the intermediate memory will be printed.

2. Printing the currently displayed values, including storage in intermediate memory

To print the measured values currently displayed, press the key <F2>. At the same time the measured values are stored and overwrite existing intermediate stored values.

Hint

Use the option "Print the currently displayed values" to adjust the time of optimal measurement results and to print them immediately.

4.1.4 CO-Overload Protection

The CO sensor is protected against overload by the system.

If the limit of 2500 ppm or 4000 ppm (depending on the model) at the CO sensor is exceeded, the internal additional fresh air purging pump is switched on, which supplies fresh air to the CO sensor.

When the CO overload protection is active, the CO indicator flashes in the status bar of the measurement screen, and the <Info> status LED changes from "green" to "red".

WARNING

If the opening for the supply of fresh air to the CO sensor is closed, the sensor can not be purged with fresh air and will be damaged or destroyed during overload.

➡ **Do not lock fresh air opening for fresh air pump!**

1   Fresh air opening

If the CO sensor has been purged sufficiently with fresh air (X disappears behind CO) and the measured values are within the permissible range, the fresh air flushing pump is switched off.

The CO indicator in the status bar of the measurement screen no longer flashes and the status LED <Info> changes from "red" to "green".

Hint

The "CO automatic" option can be used to set how the fresh air flushing pump is switched off after sufficient purging of the CO sensor:
- **automatically**
- **must be triggered manually**

➡ **To deactivate the CO automatic option, deactivate the corresponding option in the menu Adjustments \ Internal \ CO-Automatic with "No".**

➡ **To switch off the fresh air flushing pump with the CO automatic deactivated, press the <F3 <key.**

4.2 Measurement procedure gas analysis: CO measurement

The gas channel check, called also CO measurement, is used for the technical check of gas-fired plants in regards of safety aspects. Hereby the CO concentration in the gas channel is measured after the flow safety device and calculated on an undiluted value (oxygen rest content in flue gas = 0%). As the gas conditions after the flow safety device are no more homogeneous because of the flow in of secondary air and consequently the core stream measurement can be erratic, the analysis of the exhaust gas is performed along the totality of the exhaust pipe diameter. A multi-hole probe (optional accessory) is hereby used as sampling probe.

The calculated value shown on the line „CO 0 %" corresponds to the measured CO concentration supposed the oxygen content would amount 0% by the same exhaust gas volume. It is consequently the undiluted CO content in exhaust gas. If the values indication is stable, press <Record> to store the result in the intermediate memory. If a printout of the values should occur simultaneously to the recording in the intermediate memory press <F2> (the complete content of the intermediate memory will be printed out).

1 — Measurement stored in intermediate memory

4.3 Measurement procedure gas analysis: O₂ Check

This measurement is performed by room-independent plants like gross calorific value plants. It is determined if exhaust gas flows into the combustion air (O_2 content drops down / CO content can be present) and herewith influence on the combustion quality. For this analysis, a special multi-hole probe (optional accessory) should be used. If the value indicated is stable, press <Save> to store the value in the intermediate memory. If a printout of the values should occur simultaneously to the recording in the intermediate memory, press <F2> (the complete content of the intermediate memory will be printed out).

Measurement display: O₂ Check

4.4 Measurement procedure gas analysis: Draught measurement

A trend indication for the draught conditions in the exhaust channel can already be viewed during the gas analysis. Nevertheless the value for the chimney draught will not be stored together with the gas values while pressing <Save> because the differential pressure sensor tends to drifts because of its sensibility. For an exact measurement, it is consequently advised to re-calibrate this sensor just before sampling and documenting the value.

```
┌─────────────────────────────┐
│          Pressure           │
│                             │
│  Draught  -0.12 hPa         │
│                             │
│  Recorded value:            │
│         -0.12 hPa           │
│                             │
│  ⊠↻  ⊞⊟           ⌂P•0      │
└─────────────────────────────┘
```

The display shows the current value as well as the recommendation to re-set the zero point of the sensor. Disconnect the draught hose from the instrument for a short moment and press <F4>. The sensor is herewith re-calibrated.

Re-connect the draught tubing. The display shows the exact measurement value which can be stored while pressing <Record> and added to those results previous stored in the intermediate memory. The stored value is shown on the display. Press <ESC> to exit the draught measurement menu.

4.5 Measurement procedure gas analysis: Flow measurement Pitot tube (option)

This measurement can be done with a Pitot tube. At first the pitot factor of the pitot tube must be entered („Adjustments" / „Internal" / „Pitot factor"). After connecting the Pitot tube to the instrument, the zero point of the sensor can be set with <F4>. With <F1> the cross section of the flow channel can be entered (needed for calculation of the flow rate). After the Pitot tube is positioned in the flow channel, the display shows the speed (m/s) and the flow rate (Nm^3/h). If the value indicated is stable, press <Save> to store the value in the intermediate memory. If a printout of the values should occur simultaneously to the recording in the intermediate memory, press <F2> (the complete content of the intermediate memory will be printed out).

① Connections for Pitot tube

② Measurement stored in intermediate memory
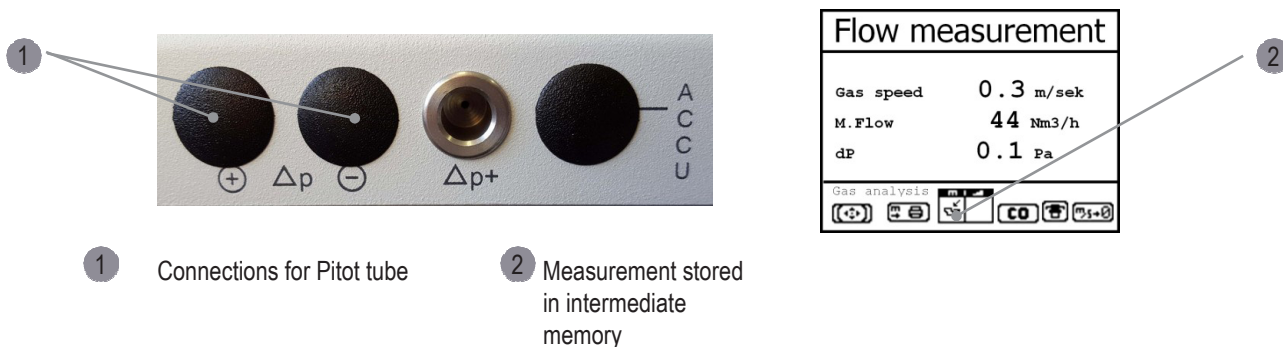
4.6 Measurement procedure gas analysis: Soot...Oil trace

The sub-menu "Soot...Oil trace" enables the input of measured results for boiler temperature, soot dots and oil trace. Select the desired line on the display and activate the input with <Enter>. The input for boiler temperature can be made one with help of the instrument keyboard. Press <Enter> to store the value in the data record of the measurement.

```
┌─────────────────────────────┐
│      Soot..Oil trace        │
├─────────────────────────────┤
│ Boiler temp. :   66°C       │
│ 1.Soot meas. :   -.-        │
│ 2.Soot meas. :   -.-        │
│ 3.Soot meas. :   -.-        │
│ Oil trace    :   ----       │
├─────────────────────────────┤
│ Select: ▲▼✓                 │
└─────────────────────────────┘
```

```
┌─────────────────────────────┐
│      Soot..Oil trace        │
├─────────────────────────────┤
│ Boiler temp. :   66°C       │
│ 1.Soot meas. :   1.0        │
│ 2.Soot meas. :   0.5        │
│ 3.Soot meas. :   1.5        │
│ Oil trace    :   NO         │
├─────────────────────────────┤
│ Select: ▲▼✓                 │
└─────────────────────────────┘
```

[i] **Hint**

To use the automatically soot measurement, you have to select the fuel type oil!

4.6.1 Soot measurement

The soot dot measurement is to be performed with the optional heated pistol grip probe which heating function prevents the filter paper to become wet because of the humidity issued by the combustion condensate. The filter paper slot is hereby heated up to approx. 70 °C. Switch hereto the probe heating of the pistol grip probe while selecting „Adjustments / Internal / Probe heating / <F1>".
Insert a filter paper in the paper slot. Select the line „1st Soot meas.". Press <Enter> to start the measurement. The display shows the volume to be sucked and the pump starts sampling. If the soot dot analysis are made with a manual pump the sucking procedure can be interrupted while pressing <F4> (result value can immediately be entered).

Once 1,63 litre has been sucked in, the instrument will instruct to input the opacity degree. Release the filter paper from the probe slot. Compare the greyness with the opacity scale. Input the result using the numerical keys and press <Enter>. Repeat this procedure until all 3 soot dot analysis are completed. The mean value will be calculated and automatically stored.

4.6.2 Oil trace

The result of the oil trace check will be documented as follows:

- Place cursor on line "Oil trace"
- Consign the result with <Enter> ("No", "Yes" or "- - - ")

Once all inputs have been entered, press <ESC> to exit the menu. The measurement is now complete.

4.8 Measurement procedure gas analysis: Data processing

To call up plant data already recorded or to create a new file, the following possibilities are available:

4.8.1 Create new
(is automatically selected by first use of a MM card)

To create a new file, a numerical number should be assigned. Select „Create new" and confirm with <Enter>. Input a random number (max. 16 figures) using the keyboard:

- use the cursor keys <Up/Down/Right/Left> to select
  the figure (selected figure outlined by a black background)
- press <Enter> to accept the figure (press <F2> to delete
  the last figure if needed)
- repeat this procedure until the desired number is complete.

```
Selection upon:
Search word
Memory number
Create new

Quit with: ⬅
```

Example: "25.09.2009"

Tip: We suggest a date-related input to easily find the data record later on via the search function.

After confirming with <F1> it is possible to enter a text via the keyboard (max. 6 lines with 20 characters each) which is printed out and can be used for data processing purposes. Proceed as follows:

- select text line 1 using the cursor keys <Up/Down> and confirm with
  <Enter>
- select with <F3> the keyboard mode (4 keyboard modes are available)
- select with the cursor keys <Up/Down/Right/Left> the desired
  character (selected character outlined by a black background)
- press <Enter> to accept the character
  (press <F2> to delete the last character)
- repeat this procedure until the desired text is complete.

- proceed as follows to correct a character:
- press <F4> to interrupt the character selection
- use the cursor keys <Right/Left> to select the character requiring correction
- activate with <F4> the character selection and correct character

- return with <F1> to character selection and call up next line for
  process

The input is closed with <ESC> and the next available data record is activated. Press <ESC> to return to the gas analysis menu.
Memory number: For check of the plant already stored in the instrument, the selection upon record number is most appropriate.

4.8.2 Memory number

For check of the plant already stored in the instrument, the selection upon record number is most appropriate.

Selection upon:
Search word
Memory number
Create new
`Quit with:` ⏎

Select „Memory number" and confirm with <Enter>. Input a random data memory number:

Input number
3
Please use the numerical keys!

Example: "3" for data record number 3

Press <Enter> once the input is completed to call up said data memory number. The cursor keys <Up/Down> enable the check of the record numbers.

Press <F1> to select the first memory number.

Press <F2> to select the last memory number.

Press <F4> to delete the content of the selected memory number.

Press the <Enter> to select the currently displayed memory number and store the following measurements under this memory number.

Finally press <ESC> to start the gas analysis.

4.8.3 Search word

If the plant code is known, it is possible to find the plant data stored with help of a search machine. Select hereto "Search word" and confirm with <Enter>. Using the software keyboard, input at least 3 connected figures of the plant

After input completion, press <F1> to start the search. All files matching this code will be filtered. The resulting selection can be scrolled using the cursor keys:

- <F1> for selection start
- <F2> for selection end

```
┌─────────────────────────┐
│ Memory number 1         │
├─────────────────────────┤
│                         │
│                         │
├─────────────────────────┤
│ 25.09.2014          ▧   │
├─────────────────────────┤
│ ◄◄   ►►          🗑     │
└─────────────────────────┘
```

Example: "25.09" for plant code 25.09.2009

① ── Measurement available

Once found, activate the desired data record with <Enter>. The last measurement on this plant can be viewed pressing <Enter> / „View memory" / <Enter>.

All measured and calculated values can be called up on 5 display pages, using the cursor keys to step thru.

```
┌─────────────────────────┐   ┌──────────────────────────────┐   ┌──────────────────────────────┐
│ Memory number 1         │   │ O2            3.2 %          │   │                              │
├─────────────────────────┤   │ CO2          13.1 %          │   │ O2          17.5 %           │
│                         │   │ CO              0 ppm        │   │ CO 0%      738 ppm           │
│                         │   │ Eff.         92.5 %          │   │ CO         123 ppm           │
│                         │   │ Losses        7.5 %          │   │ Exc. air   7.00              │
├─────────────────────────┤   │ Exc. air     1.18           │   │                              │
│ 25.09.2014              │   │ T.Gas         184 °C         │   │                              │
├─────────────────────────┤   │ T.Air          20 °C         │   ├──────────────────────────────┤
│        12:15 25.09.14   │   │ Gas analysis  12:15 25.09.14 │   │ CO measurement  12:15 25.09.14 │
│                         │   │ Memory number 1              │   │ Memory number 1              │
└─────────────────────────┘   └──────────────────────────────┘   └──────────────────────────────┘

┌─────────────────────────┐   ┌──────────────────────────────┐   ┌──────────────────────────────┐
│    O2 value in air      │   │     Soot..Oil trace          │   │     dT-measurement           │
├─────────────────────────┤   ├──────────────────────────────┤   ├──────────────────────────────┤
│ O2         19.5 %        │   │ Boiler temp. :   65°C        │   │ T1        70.4 °C            │
│ CO            3 ppm      │   │ 1.Soot meas. :   0.5         │   │ T2        56.3 °C            │
│ Draught    0.01 hPa      │   │ 2.Soot meas. :   0.3         │   │ dT        14.1 °C            │
│                         │   │ 3.Soot meas. :   0.7         │   │                              │
│                         │   │ Oil trace    :   NEIN        │   │                              │
├─────────────────────────┤   ├──────────────────────────────┤   ├──────────────────────────────┤
│ O2 value in air 12:15 25.09.14 │ Soot..Oil trace 12:15 25.09.14 │ dT-measurement 12:15 25.09.14 │
│ Memory number 1         │   │ Memory number 1              │   │ Memory number 1              │
└─────────────────────────┘   └──────────────────────────────┘   └──────────────────────────────┘
```

Press <ESC> to escape the previous measurement data and the recording of the current data can start.

5. Measurement procedure mean values

By mean value measurement function, measurements can be sampled within an adjustable time frame and mean values can be calculated. Should the several measurement values or the mean value result be stored a storage place has to be selected as described in chapter 7. If the function "Store" is activated, based on this storage place all measurements will be written consecutively on the next storage places. If the function "Store" is not activated, the mean value result can be stored on MMC with <Print> / „Memory -> M.

Once the fresh air calibration is completed, select the menu point „Mean values". Before starting, the parameters „Measurement time", „Scanning", „Printer" and „Record" should be checked or modified if need be. The meaning is respectively:

- Measurement time = Time frame during which the mean values will be sampled
- Scanning = Time interval between the measurements considered for mean value calculation
- Printer = Documentation of measurements serving to the mean value calculation
- Store = All measurements for mean value calculation will be stored

```
Gas analysis
Mean value
Soot..Oil trace
Data processing
Adjustments
Control
Diagnostics
```

```
        Mean value
Start measurement
Measurement time
Scanning
Printer
Store


Select:  ∧∨✓
```

„Measurement time" and „Scanning" can be adjusted as follows:
- select menu point and confirm with <Enter>
- set the desired time using the numerical keys:
    0.01 = 1 sec = minimal value
    59.59 = 59 min : 59 sec = maximal value
- confirm with <Enter>

The settings for „Printer" can be changed as follows:
- select menu point and confirm with <Enter>
- select desired adjustment with cursor keys
- confirm with <Enter>

The setting for „Store" can be changed as follows:
- select menu point and confirm with <Enter>
- activate memory function with <F1> or
- deactivate it with <F4>

By 'Start measurement' / <Enter> the evaluation of the measurement values will be started. On the display the actual mean values will be shown (will be updated with new measurement values / switch to the actual values with cursor keys <up/down>). It is possible to scroll through the values with the cursor keys <right/left>. With <F2> you can interrupt and with <F4> stop the measurement.

After finishing the measurement time a protocol of the results with all mean values can be printed (key <Print>).

```
O2              3.2 %
CO2            13.1 %
CO                0 ppm
Eff.           92.5 %
Losses          7.5 %
Exc. air       1.18
T.Gas           184 °C
T.Air            20 °C

Mean value
15:35min
```

6. Measurement procedure Diagnostics

6.1 Fault diagnostic

The ecom-EN3 is able to receive and to process information provided via cable transfer by the ecom-AK (read-out head for digital firing automates).

➡ Out of the main menu, select the sub-menu "Fault diagnostic" and confirm with <Enter>. The ecom-EN3 tries to establish a connection with the ecom-AK (display message: „Search in process").
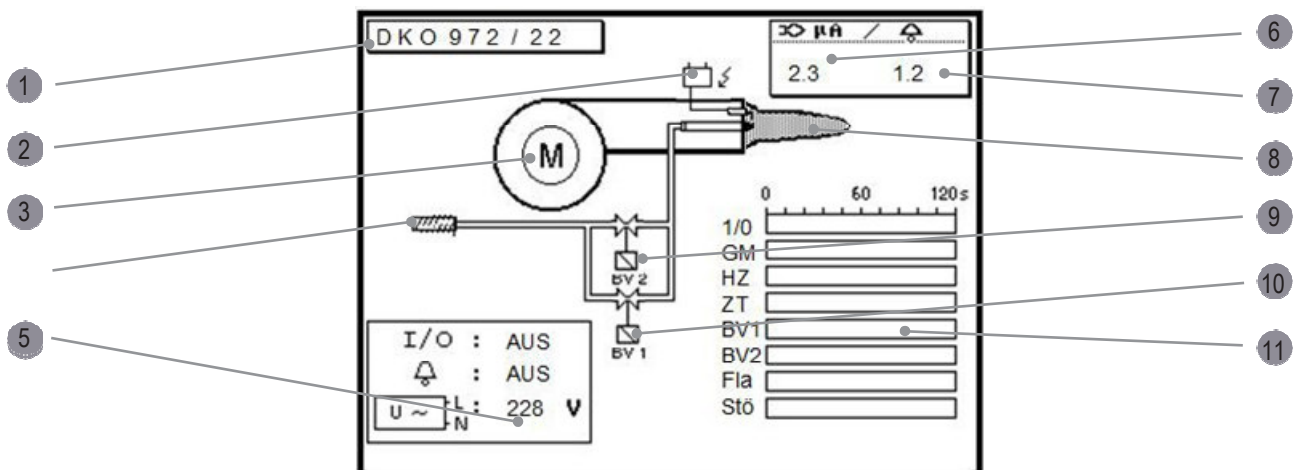
By successful attempt, the current burner operation stand is displayed as a graphic on the display. The operation stand can be recorded (max. 120 sec). Press <Enter> to initiate a new recording (reset).

ecom-AK   ecom-EN3

11 Recording of operation stand (max. 120 sec.):

1/0 = Continuous phase	RM = Fan motor	OV = Oil preheater	RZ = Ignition
BV1 = Valve 1st stage	BV2 = Valve 2st stage	FL = Flame identified	Err = Disturbance

Reset = Starts a new recording (confirm with <Enter>)

1 Model name	**2** Ignition is active	**3** Engine on
4 Oil heater/ Air pressure monitor is on	**5** Operation voltage	**6** Flame signal is
7 Flame signal min	**8** Flame identified	**9** Valve 2 is on
10 Valve 1 is on	**11** Recording of operation stand (max. 120 sec.)	

Use the cursor keys (Up/Down) to call up further data of the firing automate. On the 2nd display page the current error and the number of burner starts are displayed.

```
        Current error
No error !


Number of startups total   677
Service counter actual     142

Further pages: [AV]
```

1   Current error

2   Number of burner starts at a total resp. since reset of firing automate

Last 2 errors (Satronic) Last 5 errors (Siemens) (Scroll errors using <Right/Left>)

4   Error statistics (number of errors)

5   Monitoring times of firing automate

```
        Error history
Flame signal during
straylight check
After:    001       12 sec
Stat :    2.2 µA    225 V
Total        :        46
Straylight   :        22
Safety time  :         9
Loss of flame :       17
FT/LW        :         0
Select: [AV<>]
```

The 3rd display lists information about error history (type and volume of information depending on firing automat).

```
        Timing values
Safety time (TSA)       4.9 sec
Delay time valve 2     40.0 sec
Pre-ignition time      17.0 sec
Post-ignition time     20.0 sec
Delay straylight sup.  11.5 sec
Straylight supervision  5.0 sec
Rest time TSA (actual)  4.1 sec


Select: [AV]
```

The 4th display page lists information about the monitoring times (type and volume of information depending on firing automate).

6.2 delta-T Measurement

With the ecom-EN3 a difference temperature measurement is possible. For measurements at pipes (e.g. water-in and water-out of heating systems), special temperature sensors are needed, available from your authorized ecom agency. Out of the main menu point "Diagnostics" select the sub-menu "dT measurement" and confirm with <Enter>.

The instrument indicates the temperature T1 (sensor at connection „Gas temperature"), the temperature T2 (sensor at connection „Air temperature") and the difference between both temperatures (T1 - T2). Press <Save> to store the result in the intermediate memory. A printout can be started with <Print>.

```
┌─────────────────────────┐
│ dT measurement          │
├─────────────────────────┤
│ T1          70.4 °c      │
│ T2          56.3 °c      │
│ dT          14.1 °c      │
│                          │
│ ⊠⟳  ⊡🖶 ☞               │
└─────────────────────────┘
```

①   Measurement stored in intermediate memory

6.3 Heating Check (option)

The heating check is a simple, expressive process to evaluate a complete heating plant (heat production, distribution and transfer) from the energetic point of view. Hereby the single plant components get inspected by the heating engineer in a combination of measurements and visual assessment and valued in regards of their energetic quality acc. to a negative point system of maximum 100 points. The higher the score, the farer the current plant is away from the desirable energetic stand and the higher the energy saving potential would be if modernization measures are conducted. In combination with the special probes required hereto, the ecom-EN3 is able to perform the measurement of the heating check parameters: gas losses, ventilation losses and surface losses. Out of the main menu point "Diagnostics", select the sub-menu "Heating Check" and confirm with <Enter>.

The gas losses measurement is to be performed with the instrument´s sampling probe in the gas core stream after menu call up. Once the measurement is recorded with <Save> (disk symbol) the conversion of the measurement results in negative points is available under the menu point „Results".

The surface losses measurement is performed by a temperature sensor specific for surfaces. The temperature difference between boiler surface and room temperature (air temperature sensor) is determined and the percentage loss is calculated. Once the menu point is called up, the boiler performance must be inputted. To easy the measurement width, depth and height of the boiler can also be entered (dimensions will be memorized for surface calculation). Please proceed as follows:

- activate respective input window with <Enter>
- inputs values using the keys numerical function
- confirm input with <Enter> or:
- adjust values using the cursor keys <Right/Left>

If no boiler dimensions are inputted, press **<F1>** (Start) to activate the measurement recording. Here the dimensions for all surfaces must be inputted.

Press <F3> (Start + ->) to start the real measurement. Proceed as follows:

- select surface (boiler side) to be measured with <F1> or <F2>
- position surface sensor record temperature difference with <Memory>
- up to 10 values can be recorded per surface out of which a mean value will be calculated automatically
- if need be, cancel measurements with <F4>
- repeat this procedure for each surface

Surface losses		
-0-	Wid. --- m	
	Hei. --- m	
	Surf --- m2	
	T.S. --- °C	
	T.A. --- °C	
	T.S. 21.5 °C	
	T.A. 21.5 °C	
Surfa.	Store	

Surface losses		
-1-	Wid. 1.20 m	
	Hei. 1.20 m	
	Surf 1.44 m2	
	T.S. 40.5 °C	
	T.A. 21.5 °C	
	T.S. 42.5 °C	
	T.A. 21.5 °C	
Surfa.	Store	

Flow probe

Once all surface temperatures have been determined, quit the menu with <ESC>. The surface losses get automatically calculated. The value conversion in negative points is available in the menu point „Results".

The ventilation loss measurement is performed by a flow probe 30 sec. after burner switch-off. This measurement can be performed at the earliest 5 min. after instrument´s switch-on as the pressure sensor requires this period of time for stabilization. Once the menu is called up, the values for air pressure, external temperature, boiler performance and exhaust gas pipe diameter must be inputted. Hereto proceed as follows:

- open respective window with <Enter>
- input figures using numerical function of keys
- confirm input with <Enter> or:
- adjust values using the cursor keys <Right/Left>

Press <F1> (Start) prior to going thru the following steps to start the measurement:

- release tubing of the flow probe
- wait for zeroing of pressure sensor
- re-connect tubing of the flow probe
- position flow probe into exhaust gas pipe
  (observe mark for flow direction)
- switch off burner and simultaneously press <F1> or:
- press <F2> to activate timer (5 sec.) and switch off burner by beep
- after approx. 30 sec. the measurement value converted in negative points is available

An overview of the measurements is available under „Results". Press <Print> to print them out.

```
         Heating Check
Gas losses    √
Surface losses √
Ventilation losses √
Results
Cancel

Select:  [∧∨√]
```

```
         Heating Check
Gas loss   2.9 %
Points     2.6
Surf. Lo.  2.29 %
Points     3.4
Vent. lo.  3.11 %
Points     3.0
Quit with:  [⬅]
```

6.4 4 Pa Measurement (option)

The simultaneous operation of room-dependent firing place and air evacuation system can lead to dangerous low pressure conditions. With the ecom-EN3 it is possible to check the low pressure limit value of 4 Pa and to document in a diagram the time course of the low pressure value. Once the menu point is called up, the measurement is to be performed as follows:

- connect capillary hose for room where burner is installed to „-"

- connect capillary hose for reference place (staircase or outside air to „+"

- operate firing and evacuation systems with maximal performance

- open window resp. connection door to burner room and check the correct evacuation of the exhaust gases

- zero pressure sensor with <F4>

- position capillary hose for reference location

- start record pressure value course with <F1> (Start) (an acoustical signal is issued every 30 sec. which can be deactivated / re-activated pressing <F2>)

- record pressure by opened window resp. connection door

- close window resp. connection door after approx. 30 sec. and check low pressure

- after approx. 30 sec. open window resp. connection door and check zero point

- close window resp. connection after approx. 30 sec. and check low pressure

- after approx. 30 sec. re-open window or connection door and check zero point

- after approx. 30 sec. close window resp. connection door and check low pressure

Once the measurement time is completed, the diagram can be viewed on the display (use <F3> to emphasize illustration 1x, 2x, 4x, 8x times or A for automatic). Start a printout if needed with <Print>.

6.5 Pressure Tests (option)

WARNING

⚠️

1.   **Use only air or inert gas for check!**
2.   **Respect the „Technical Rules for Gas installations"!**
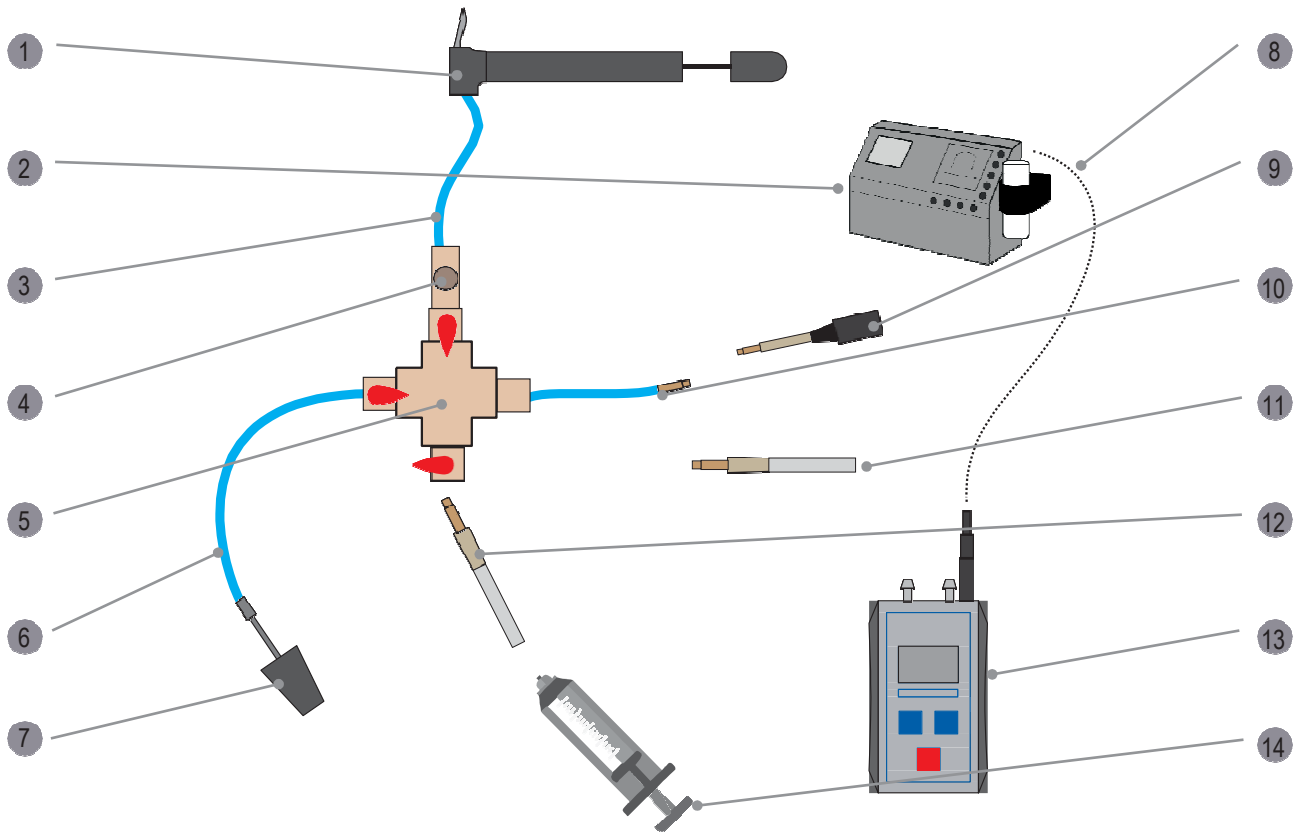
①	Air pump	②	ecom-EN3	③	Connection hose (Pump - Cross piece)
④	Safety valve	⑤	Cross piece	⑥	Connection hose (Gas system - Cross piece)
⑦	Conic test stopple, One-pipe counter cap or High-pressure test stopple	⑧	Electrical connection ecom-EN3 / UNO	⑨	Connection ecom-EN3 (delta p-)
⑩	Connection hose (ecom-EN3 / UNO - Cross piece)	⑪	Connection ecom-UNO (+)	⑫	Connection Squirt or Soot pump
⑬	ecom-UNO (only for Loading and Tightness Test)	⑭	Syringe		

The following measurement procedures are available in the Pressure tests menu:

- Pressure Test
- Loading Test
- Tightness Test
- Usage property

In the menu Pressure Tests / Setup adjustments can be made for each measurement procedure.

6.5.1 Pressure Test

The "Pressure Test" up to 100 hPa is deposited as a measurement routine in the ecom-EN3. Proceed as follows:

1. Close the conduit with a suitable adapter (test stopple, high-pressure stopple or one-pipe counter cap).

2. Connect the components as described before.

3. Scroll with cursor keys <Up/Down> to the menu "Pressure Test". Activate with <Enter>.

4. Create the pre-adjusted test pressure (max. 100 hPa) with the air pump.

5. Interrupt the connection to the air pump (switch-off the ball valve) and start "Pressure Test" with <Enter>.

6. Wait for stabilization time (the measurement will start automatically).

7. Once the measurement time is over, the result is displayed and can be printed by pressing <Print>.

8. If the menu "Pressure Test" is selected again, so the result can be called up with <F4> (as long as the ecom-EN3 is on) or a new measurement can be started with <F1>.

The following adjustments can be made in the menu Pressure Tests / Setup for the procedure "Pressure Test":

Parameter	Meaning	Adjustment	Factory setting
Stabilization time		1 … 120 min	1 min
Measurement time		1 … 120 min	5 min

6.5.2 Loading Test

The „Loading Test" acc. to DVGW – TRGI Process Instructions G 600 by pipes (operation pressure up to 100 hPa) is deposited as a measurement routine in the ecom-EN3. Proceed as follows:

1. Connect the ecom-UNO to the connection AUX of the ecom-EN3.

2. Close the conduit with a suitable adapter (test stopple, high-pressure stopple or one-pipe counter cap).

3. Connect the components as described before.

4. Scroll with cursor keys <Up/Down> to the menu „Loading Test". Activate with <Enter>.

5. Create the pre-adjusted test pressure with the air pump (the unit beeps as soon as the pressure level is achieved).

6. Interrupt the connection to the air pump (switch-off the ball valve).

7. Wait for stabilization time (if the pressure remains in the range „test pressure +/- 10% during stabilization time, so the measurement will start).

8. Once the measurement time is over, the result is displayed and can be printed by pressing <Print>.

9. If the menu „Loading Test" is selected again, so the result can be called up with <F4> (as long as the ecom-EN3 is on) or a new measurement can be started with <F1>.

The following adjustments can be made in the menu Pressure Tests / Setup for the procedure "Loading Test":

Parameter	Meaning	Adjustment	Factory setting
Stabilization time		1 … 240 min	1 min
Measurement time		10 … 240 min	10 min
Test pressure		90 … 1200 hPa	1000 hPa

6.5.3 Tightness Test

The „Tightness Test" acc. to DVGW – TRGI Process Instructions G 600 by pipes (operation pressure up to 100 hPa) is deposited as a measurement routine in the ecom-EN3. Proceed as follows:

1. Connect the ecom-UNO to the connection AUX of the ecom-EN3.

2. Close the conduit with a suitable adapter (test stopple, high-pressure stopple or one-pipe counter cap).

3. Connect the components as described before.

4. Scroll with cursor keys <Up/Down> to the menu „Tightness Test". Activate with <Enter>.

5. Create the pre-adjusted test pressure with the air pump (the unit beeps as soon as the pressure level is achieved).

6. Interrupt the connection to the air pump (switch-off the ball valve).

7. Wait for stabilization time (if the pressure remains in the range „test pressure +/- 10% during stabilization time, so the measurement will start).

8. Once the measurement time is over, the result is displayed and can be printed by pressing <Print>.

9. If the menu „Tightness Test" is selected again, so the result can be called up with <F4> (as long as the ecom-EN3 is on) or a new measurement can be started with <F1>.

The following adjustments can be made in the menu Pressure Tests / Setup for the procedure "Tightness Test":

Parameter	Meaning	Adjustment	Factory setting
Stabilization time		1 … 120 min	1 min
Measurement time		10 … 120 min	10 min
Test pressure		90 … 160 hPa	150 hPa

6.5.4 Usage property

The „Usage property" acc. to DVGW – TRGI Process form G 624 by conduits is memorised as a measurement routine by the ecom-EN3.
The calculation of the leak rate happens automatically ac-cording to the following equation and corresponds herewith to the procedure of the DVGW-TRGI Process Form G 624:

$$VB = V/TM * ((PA + P1)/(PA + P2)-1) * PB/P1 * f$$

Parameter	Meaning
VB	Gas leak volume in operation state (l/h)
V	Pipe content in litres
TM	Measurement duration in hours
PA	Barometer stand in hPa
P1	Test pressure at meas. beginning in hPa
P2	Test pressure at measurement end in hPa
PB	Maximal gas operation pressure in hPa
f	Factor for consideration of gas type

Proceed as follows:

1. Close the conduit with a suitable adapter (test stopple, high-pressure stopple or one-pipe counter cap).

2. Connect the components as described before.

3. Scroll with cursor keys <Up/Down> to the menu „Usage property". Activate with <Enter>.

4. Choose the gas type (f) with cursor keys <Up/Down> and confirm with <Enter>. The following gas types are recorded with their respective factors:

Gas
Natural Gas
Air
Town Gas
Propane
Butane
Hydrogen

5. Type in the maximal operation pressure (PB) with the instrument keyboard and confirm with <Enter>.

6. The pipe volume (V) is needed for the calculation of the leak rate. The ecom-EN3 offers two possibilities:

a. Type in pipe volume (V):
- Choose NO at the inquiry „Calculate Volume automatically ?"
- Type in pipe volume (V) with the instrument keyboard and confirm with <Enter>.

b. Calculate pipe volume automatically (V):
- Choose YES at the inquiry „Calculate Volume automatically ?".
- Connect the squirt or soot pump as described before.
- Open ball valve and wait until the pressure is stabilized.
- Choose syringe or soot pump with the cursor keys <right/left>.
- Start volume calculation with <Enter>.
- Sample the test volume with squirt or soot pump. The decrease of pressure must be min. 2 hPa (otherwise operate squirt or soot pump several times).
- Close ball valve and confirm with <Enter>.
- Choose number of strokes with the cursor keys < right/left > and confirm with <Enter>.

7. Create the pre-adjusted test pressure with the air pump (the unit beeps as soon as the pressure level is achieved).

8. Interrupt the connection to the air pump (switch-off the ball valve).

9. Wait for stabilization time (if the pressure remains in the range „test pressure +/- 10% during stabilization time, so the measurement will start).

10. Once the measurement time is over, the result is displayed and can be printed by pressing <Print>.

11. If the menu „Usage property" is selected again, so the result can be called up with <F4> (as long as the ecom-EN3 is on) or a new measurement can be started with <F1>.

The following adjustments can be made in the menu Pressure Tests / Setup for the procedure "Usage Property":

Parameter	Meaning	Adjustment	Factory setting
Stabilization time		1 … 270 min	1 min
Measurement time		10 … 240 min	10 min
Test pressure		20 … 160 hPa	50 hPa
Max. operation pressure		10 … 100 hPa	23 hPa

7. After Measurement

After the measurements have been completed, the following things have to be observed BEFORE turning the instrument off.

7.1 Save measurement, print measurement

Hint

Once the gas analysis is completed and a memory place is chosen before, transfer the values recorded in the intermediate memory on the MM card, otherwise they would get lost by switch-off of the instrument!
➡ **To store measured values permanently on the MM card, proceed as follows**

```
    --ECOM-EN3--
Start printout
View memory
Memory -> M
Input text
Select: [∧∨✓]
```

Press <Print> (printer symbol) to enter the printing menu.

The sampled data can be checked one more time („View memory", <Enter> and scroll with the cursor keys). The cursor keys can be used to scroll through the measurement screens.

```
    --ECOM-EN3--
Start printout
View memory
Memory -> M
Input text
Select: [∧∨✓]
```

By selecting the "Insert text" menu item, the plant identifier can be entered or changed.

See chapter "Measurement procedure gas analysis: Data processing" for more information.

```
    --ECOM-EN3--
Start printout
View memory
Memory -> M
Input text          ⬕
Select: [∧∨✓]
```

All data correct? Then press „Memory -> M" and <Enter> to transfer them in the internal memory or on the MM card ("Symbol memory" is shown in black in the measurement mode). The inputted text is taken over into the data record only by transfer on MM card.

```
    --ECOM-EN3--
Start printout
View memory
Memory -> M
Input text
Select: [∧∨✓]
```

Select („Start printout" and <Enter>) to print out the data.

Press <ESC> to turn back to the gas analysis mode.

Hint

The functions „View memory", „Memory -> M" and „Input text" can also be selected out of the measurement mode with <Enter>.
➡ **To access these functions directly via the measurement screen, press the <Enter> key.**

7.2 To-Dos before switching off

Before switching off the device, the following points must be observed:

- Correct stowage of the probe
- Checking the fine dust filters
- Emptying the water trap

WARNING

⚠️

The hot probe can cause damage to the instrument or to the transport system.
➡ **Let the probe cool down before stowing it!**

WARNING

⚠️

Highly contaminated filters can affect the volumetric flow in the gas path and therefore the measurement
➡ **Check the condition of the particle filter.**
➡ **Replace the particle filter when the contamination of the filter is equivalent to a soot number of approx. 2 - 3.**

WARNING

⚠️

For instruments without automatic condensate emptying, condensation water from the condensation tank can flow into the gas path inside the instrument and damage the sensors.
➡ **Empty the condensate trap before transporting the instrument.**

(Only for devices WITHOUT automatic condensate emptying.)

➡ **Emptying the water trap as follows:**

1. Pull the drain hose
2. Drain the condensate
3. Re-attach the drain hose

8. Control

The electrochemical sensors for gas analysis are submitted to a wearing process and do age. They alter their output values along the time depending on the gas concentration, the exposure time and the soiling grade of the sampled gas.
The program monitors the sensors and corrects drifts. But if the drifts and the correlated measurement errors increase, an error message is displayed. In this case the corresponding sensor must be changed by an authorized service centre.

The control menu informs about the current status values for the sensors. Further information is also consigned on 3 display pages (use cursor keys to scroll)

The following status values are available:

- battery voltage (charging status); is displayed as a symbol in all menus:

① Full charge   ② Half charge   ③ Empty

```
O2   19744 mV
CO       7 mV
Accu  6.09 V

Operation hours  :    8.45 hrs
Total            :   18.75 hrs
Next unit check  :   01.07.10
Service tel.     :02371-945-303
Further pages: ⊼⊽
```

Parameter	Meaning
[Sensor] #### mV	Output voltage of the sensor
Akku #,## V	Output voltage of the battery
Operation hours:	Operation hours since last service
Total:	Total operation hours
Next unit check:	Date of the next recommended service
Service tel.:	Phone number of the next service center

```
Program version   :V1.2 19.11.09
Serial no.        :EN3-0001
CO purges         : 15
Error counter     : 21
Operation hours  :    8.45 hrs
Total            :   18.75 hrs
Next unit check  :   01.07.10
Service tel.     :02371-945-303
Further pages: ⊼⊽
```

Parameter	Meaning
Program version:	Software version
Serial no.:	Serial number of the instrument
CO purges:	Amount of CO switch-offs
Error counter:	Amount of errors

```
Last service (history)

25.08.09      88 hrs
14.08.10     145 hrs
23.08.11     205 hrs
19.08.12     322 hrs
--.--.--
--.--.--
Further pages: ⊼⊽
```

Parameter	Meaning
Last service (history)	Collection of the last maintenance

Additionally to those ecom-EN3 functions described previously, various adjustments can be made in the instrument, which have an effect on the measurement procedures, the functionality or the output and display of measured values.

```
            Adjustments
Unit
Second unit
Ref. O2
Fuel type
Select:  ▲▼✓
┌─────────────────────┐
┆Set clock            ┆
┆Paper feed           ┆
┆Internal             ┆
└─────────────────────┘
```

The following adjustments are available in the Adjustments menu:

Parameter	Meaning	Adjustment	Factory setting
Unit	Calculation and display of gas concentrations	ppm mg/m³ mg/kWh (undiluted) mg/MJ (undiluted) ppm (undiluted) mg/m³ (undiluted)	ppm
Second unit	Second calculation and display of gas concentrations	ppm mg/m³ mg/kWh (undiluted) mg/MJ (undiluted) ppm (undiluted) mg/m³ (undiluted)	ppm
Ref. O2	Reference O2	0,0 … 21,0 %	0,0%

Hint

The term "undiluted" refers to the conversion of the gas concentration to a definable reference oxygen content according to the following formula:

$$E_{ref.} = E_{meas} * \frac{21-O2_{ref.}}{21-O2_{meas}}$$

Hint

mg/kWh and mg/MJ are always calculated on 0% O2 basis.

The following adjustments are available in the Adjustments menu: (continuation):

Parameter	Meaning	Adjustment	Factory setting
Fuel type	Modification of adjusted fuel type	Fuel oil Natural gas City gas Coke oven gas Liquid gas	Fuel oil
Set clock	Correction of internal clock		
Paper feed	Paper feed line by line		
Internal	Further instrument settings -- see following table--		
Air leak test	Check the tightness of the instrument see Chapter 11.5		

The following adjustments are available in the Adjustments / Internal menu:

Parameter	Meaning	Adjustment	Factory setting
Print contrast	Print contrast adjustment with cursor keys	9 steps	Step 5
Key beep	Acoustical signal by key pressing	Yes, No	Yes
Language: ###	Selected language	system dependent	
Colour scheme	Sets the colours used	4 schemes to choose from	Colour scheme 1
F1 Hotkey	Assign the link using the <F1> key	see Chapter 4.1	Standby
F4 Hotkey	Assign the link using the <F4> key	see Chapter 4.1	Display values
Values options	Adustments for efficiency, excess air and temperature	All parameters in the table on the following page	
CO-Automatic	Enable / Disable CO sensor switches on after purging automatically	On, Off	On
USB	Settings for the USB interface	All parameters in the table on the following page	
Bluetooth	Settings for the Bluetooth interface	All parameters in the table on the following page	
WLAN	Settings for the WiFi interface	All parameters in the table on the following page	
Pitot factor	Input of Pitot factor for flow rate calculation	0,20 - 2,00	0,93
Printout	Settings for defining the printout	All parameters in the table on the following page	

The following adjustments are available in the Adjustments / Internal / Values options menu:

Parameter	Meaning	Adjustment	Factory setting
Temperature	Not available at all instruments	°C or °F	°C
Excess air	Excess Air as proportionate number or in %	proportionate number or %	proportionate number
Eff.(C)	Efficiency calculation with or without condensation gain	On, Off	On
Draught	Unit of draught measurement	hPa, mmH2O, "H2O, PSI, mbar	hPa

The following adjustments are available in the Adjustments / Internal / USB menu:

Parameter	Meaning	Adjustment	Factory setting
Transfer speed		1200 … 115200 Baud	38400 Baud
Protocol		DAS = DAS NT 2 Enhanced = DAS 5 ---- = no protocol	Enhanced

The following settings are predefined in the Settings / Internal / Bluetooth (BLE) menu and can NOT be changed:

Parameter	Meaning	Adjustment	Factory setting
Transfer speed		115200 Baud	115200 Baud
Protocol		Enhanced	Enhanced

The following adjustments are available in the Adjustments / Internal / WLAN menu:

Parameter	Meaning	Adjustment	Factory setting
Access Point OR Existing Network	Set whether the instrument is to be used as a WiFi access point OR to connect to an existing WiFi network	Access Point, Existing Network	Access Point

Hint

The Access Point setting is necessary to connect the ecom-EN3 to mobile devices (smartphones, tablets) via the Wi-Fi interface.
➡ **Activate "Access Point" to connect the ecom-EN3 with mobile devices via WLAN / Wi-Fi.**

The following settings are available in the Adjustments / Internal / WiFi menu if the instrument has been defined as an access point:

Parameter	Meaning	Adjustment	Factory setting
Start / Stop WLAN	Activate the WiFi interface (available only with deactivated Auto Connect)	Start WiFi, Stop WiFi	-
(Without) Auto Connect	Enable / Disable automatic connection	Yes, No	Yes
Channel	Set which radio channel is to be used for the communication	1 ... 13	1
Security	Assign a password to secure the WiFi connection	Yes, No Password entry	No 1234567890

The following settings are available in the Adjustments / Internal / WiFi menu if the instrument has been defined as an existing network:

Parameter	Meaning	Adjustment	Factory setting
Start / Stop WLAN	Activate the WiFi interface (available only with deactivated Auto Connect)	Start WiFi, Stop WiFi	-
(Without) Auto Connect	Enable / Disable automatic connection	Yes, No	Yes
Existing Network	Search for Existing Network		
WPA-Password	Assign a password to secure the WiFi connection	Password entry	

The following adjustments are available in the Adjustments / Internal / Printout menu:

Parameter	Meaning	Adjustment	Factory setting
Footer for the Printout		8 x 24 signs	
Selection of measurement and calculation values for printout			

[i]

Hint

The footer of the printout can be defined as desired, e.g. to print out the company address of the instrument user on every printout of the measured values.

➡ **To adjust the footer of the printout, proceed as follows:**

1. **Activate character selection list with <F4>.**
2. **Select keyboard type with <F3> (4 different keyboards available).**
3. **Use the cursor keys to select the desired character (selected character is outlined by black background).**
4. **Confirm selection while pressing <Enter>.**
5. **Repeat procedure until desired text is complete.**
6. **Once input for line 1 is completed, deactivate the characters selection mode with <F4> and move to the second line with the cursor key <Down>.**
7. **Once all lines have been processed as desired, exit the menu with <ESC>.**

Hint

The number and order of the measured values on the printout can be defined as desired.

➡ **To adjust the number and order of the measured values on the printout, proceed as follows:**

1. **Use the <F1> key to activate the value selection**
2. **Navigate to the corresponding line <up / down>**
3. **Select the measured value by pressing the <Enter> key**

The following measurement and calculation values can be selected for the lines of the printout:

1	T.Air	26	CO mg/N	51	SO2 mg/kWh
2	T.Gas	27	CO mg/kWh	52	SO2 mg/MJ
3	T.Boiler	28	CO mg/MJ	53	H2
4	T.Sensor	29	NO ppm	54	H2S
5	O2	30	NO ppm/N	55	Gas speed
6	CO	31	NO mg	56	Mass flow
7	NO	32	NO mg /N	57	CO x% Italy
8	NO2	33	NO mg/kWh	58	Eff._Hs
9	NOx	34	NO mg/MJ	59	Difference Temperature
10	SO2	35	NO2 ppm	60	Not used
11	CxHy	36	NO2 ppm/N	61	H2 ppm
12	CO2	37	NO2 mg	62	H2 ppm/N
13	Efficiency	38	NO2 mg/N	63	H2 mg
14	Losses	39	NO2 mg/kWh	64	H2 mg/N
15	Excess Air	40	NO2 mg/MJ	65	H2S ppm
16	Dew point	41	NOx ppm	66	H2S ppm/N
17	Poison Index	42	NOx ppm/N	67	H2S mg
18	Draught	43	NOx mg	68	H2S mg/N
19	Soot	44	NOx mg/N	69	Air pressure
20	Oil trace	45	NOx mg/kWh	70	Not used
21	Blank Line	46	NOx mg/MJ	71	CO Unit 2
22	Line	47	SO2 ppm	72	NO Unit2
23	CO ppm	48	SO2 ppm/N	73	NO2 Unit 2
24	CO ppm/N	49	SO2 mg	74	NOx Unit 2
25	CO mg	50	SO2 mg/N	75	SO2 Unit 2

10. Data processing

10.1 Storage on MM card

Hint

When an MM card is inserted into the instrument, it is used to store measured values and plant data. This storage must be triggered manually or can be automated (data logger)

Data processing
Select
View
Memory (M)
Format
Quit with: ⬅

DRT <-> PC !
Datalogger

By selecting the menu item "Select", plants for the assignment of measured values can be searched for or set up (for further information see chapter "Measurement procedure gas analysis: Data processing").

By selecting the menu item "View", stored measured values can be viewed (for further information see chapter "Measurement procedure gas analysis: Data processing").

By selecting the menu item "Memory (M)", all stored measurements (sorted by record number) can be viewed.

Date			Fuel type
1	01.09.09	11:01	Fuel oil
2	01.09.09	11:02	Fuel oil
3	01.09.09	11:04	Fuel oil
4	01.09.09	11:07	Fuel oil
5	01.09.09	11:11	Fuel oil
6	01.09.09	11:23	Fuel oil
7	01.09.09	11:44	Fuel oil
8	01.09.09	11:53	Fuel oil

Select: ⋀⋁✓

➡ Single measurement results can be called up as follows:

- Select desired record number with the cursor keys and confirm with <Enter>
- confirm desired record number with <Enter>
- Scroll with the cursor keys <up/down>
- Press <ESC> to exit

By selecting the "Format" menu item, the entire MM card can be formatted. This function is usually needed by initial adjustment of the instrument at our factory (preparation of MM card for data recording).

WARNING

When the "Format" menu item is selected and confirmed, all stored data on the MM card inserted in the instrument will be irrevocably deleted.

➡ **Select the menu item "Format" only if ALL data present on the MM card are no longer required.**

10.2 Data logger

When a MM card is inserted into the instrument, a data logger recording can be performed. The measured values are stored one after the other on the MM card depending on the recording interval set and are merged into a file with the format * .csv.
The measured values can be evaluated using MS Excel or open office CALC.

[i] Hint

The data logger is ONLY available when a MM card is inserted into the instrument.
➡ **To use the data logger, insert a MM card into the instrument.**

The following adjustments are available in the Data processing / Data logger menu:

Parameter	Meaning	Adjustment	Factory setting
Data logger	Start, Stop Data logger	Yes, No	No
Save to MMC	Adjustment of the interval time for data logger recordings	1 … 999 s	1 s
CSV-Header	Adjustment of data logging with or without column headings	On, Off	Off

If the data logger becomes active or becomes active again after an interruption, a new file is created on the MM card, in which all subsequent measured values of the recording are saved. The files have a predefined name and are numbered consecutively.

[i] Hint

Each measurement is assigned its own file with collected measured values. Each file is automatically named and numbered.
➡ **To select the correct data logger file use the date identification:**

J2KDL-00.csv -- oldest file
J2KDL-01.csv
J2KDL-02.csv
J2KDL-XX.csv -- newest file

10.3 Data connection to PC

If the device is connected to a PC, measured values and plant data can be synchronized with a PC software from ecom.

The following software solutions are available:

- ecom-DAS NT 2 (10.3.1)
- ecom-DAS 5(10.3.2)
- PC software (10.3.3)

10.3.1 Data recording with PC Software ecom-DAS NT 2

In addition to data logger recordings the data could also be transferred online via USB or AUX to the software "ecom-DAS NT 2".

The following interfaces can be used for communication with the software:

- USB
- AUX = RS232

[i] Hint

A driver is required to communicate with the PC software DAS NT 2 via the USB interface.

> **➡ To download and install the necessary USB driver, see https://www.ecom.de/en/downloads/**

[i] Hint
The transmission speed and the protocol are pre-defined for the smooth communication of the instrument with the PC software DAS NT 2 via USB interface.

> **➡ To enable communication with the PC software DAS NT 2, the following settings must be made in the menu Adjustments / Internal / USB:**

Parameter	Meaning	Adjustment	Required setting for DAS NT 2
Transfer speed		1200 … 115200 Baud	1200 Baud
Protocol		DAS = DAS NT 2 Enhanced = DAS 5 ---- = no protocol	DAS

[i] Hint

For further information on importing from the PC software and exporting to the PC software, please refer to the operating instructions of the corresponding PC software.

10.3.2 Data recording with PC Software ecom-DAS 5

The software "ecom-DAS 5" can be used to display and record measured values. Via the MM card, customer and measurement data can be exchanged between the software and the instrument. A recording of point and continuous measurements can be done via USB or WLAN.

Hint

A driver is required to communicate with the PC software DAS 5 via the USB interface.

➡ **To download and install the necessary USB driver, see https://www.ecom.de/en/downloads/**

Hint

The protocol is pre-defined for the smooth communication of the instrument with the PC software DAS 5 via USB interface.

➡ **To enable communication with the PC software DAS 5, the following settings must be made in the menu Adjustments / Internal / USB:**

Parameter	Meaning	Adjustment	Required setting for DAS 5
Transfer speed		1200 … 115200 Baud	1200 … 38400 Baud
Protocol		DAS = DAS NT 2 Enhanced = DAS 5 ---- = no protocol	Enhanced

Hint

For the smooth communication of the device with the PC software ecom-DAS 5 via the interface WLAN, setting parameters are predefined.

➡ **To enable communication with the PC software DAS 5, the following settings must be made in the menu Adjustments / Internal / WLAN:**

Parameter	Meaning	Adjustment	Required setting for DAS 5
Access Point		Access Point, Existing Network	Access Point
(Without) Auto Connect		Yes, No	Yes

Hint

For further information on importing from the PC software and exporting to the PC software, please refer to the operating instructions of the corresponding PC software.

10.3.3 Data recording with PC Software: Import and Export of Data

[i] Hint

With the PC software "MiniDV", plant data can be quickly and conveniently created and managed. These plant data can be imported into the instrument in order to store measured values under these plant data.

➡ **To import plant data from the PC software into the instrument, proceed as follows:**

- **Connect ecom-EN3 and PC via USB cable.**
  (if the connection is correct, "USB" appears in the lower right corner of the display)
- **Select "Load data" and confirm with <Enter>.**
- **Answer the displayed question with YES (<F1>).**
- **Decide if the data recorded can be cancelled (<F1> for YES / <F4> for NO).**
- **Start the data transfer on your PC.**

[i] Hint

The instrument is used to add measured values to plant data, which were created before with the PC software. These complete data sets, consisting of plant data and measured values, can be exported from the instrument and managed in the PC software "MiniDV".

➡ **To export data from the instrument to the PC software, proceed as follows:**

- **Connect ecom-EN3 and PC via USB cable.**
  (if the connection is correct, "USB" appears in the lower right corner of the display)
- **Select "Send data" and confirm with <Enter>.**
- **Answer the displayed question with YES (<F1>).**
- **Start the data transfer on your PC.**

10.4 Data recording with App via WiFi

To display and storage of measured values, the App "ecomMANDER" for smartphones is available.
The following operating systems are supported by the App:

- iOS
- Android

If the instrument is connected to the App via WiFi, the current measured values of the instrument can be displayed directly in the App.
The measured values can be saved and exported together with the customer information to be entered. These exported data can be sent for example by e-mail.
The following file formats can be exported:

- *.pdf
- *.csv

[i] **Hint**

For the smooth communication of the instrument with the Apps via WiFi, setting parameters are predefined.

➡ **To enable communication with the Apps, the following settings must be made in the Adjustments / Internal / WLAN menu:**

Parameter	Meaning	Adjustment	Required setting for Remote Display App
Access Point		Access Point, Existing Network	Access Point
(Without) Auto Connect		Yes, No	Yes

10.5 Data recording with Apps via BLE

To display and storage of measured values, the App "ecomMANDER" for smartphones is available.
The following operating systems are supported by the App:

- iOS
- Android

If the instrument is connected to the App via Bluetooth (BLE), the current measured values of the instrument can be displayed directly in the App.
The measured values can be saved and exported together with the customer information to be entered. These exported data can be sent for example by e-mail.
The following file formats can be exported:

- *.pdf
- *.csv

Hint

For the smooth communication of the instrument with the Apps via Bluetooth (BLE), setting parameters are predefined.

➡ **To enable communication with the Apps, the following settings are fixed in the Adjustments / Internal / Bluetooth menu:**

Parameter	Meaning	Adjustment	Required setting for ecom connect App
Transfer speed			115200 Baud
Protocol			Enhanced

To secure the accuracy of your measuring instrument we recommend the annual check by an authorized ecom partner.

WARNING

⚠️

If sensors from other manufacturers are used, the TüV approval of the instrument expires.
➡ **Use only sensors from ecom or from an ecom authorized service centre.**

WARNING

⚠️

Service made by service centres non-authorised by ecom GmbH will result in a complete and immediate loss of any warranty!
➡ **Have service work performed only by ecom or by ecom authorized service centre.**

[i] **Hint**

In the case of strong use (e.g. permanent several hours of measurement per day, rough conditions etc.) shorter intervals between checks should be selected.
➡ **Please contact your ecom partner. All ecom partners are listed under www.ecom.de.**

The following components should be checked every time the instrument is used:

11.1 Fine dust filter

Procedure for testing:

1. Unscrew the cap.
2. Check the condition of the particle filter.
3. Replace the cap.

[i] **Hint**

Change the fine dust filter once the filter has a grey colour.
➡ **Replace the fine dust filter if the filter has a gray colour of 2 ... 3 on the soot comparison scale.**

11.2 Gas sensors

The sensors get calibrated with the reference gas fresh air by each switch-on.
New sensors age along the operation time because of the wearing of the reagents (oxygen sensor) and due to soiling respectively exceeding concentrations beyond the nominal measurement range (toxic sensors).

Their state of the sensors is permanently checked by the instrument.
The output values of the sensors are listed in the menu "Control". The reference values of the sensors are:

Sensor	Reference value output voltage
O2	12000 mV
Others	0 mV (+/- 150 mV)

Hint

If an error message occurs during the calibration phase, a further calibration phase can help to calibrate all installed sensors sufficiently.
➡ **If after several repetitions of the calibration phase an error message occurs during the calibration phase, the instrument has to be checked.**

Hint

The O$_2$ sensor must display a value > 7000 mV.
➡ **If an output voltage <7000 mV is displayed in the "Control" menu after the calibration phase, the O$_2$ sensor must be replaced.**

Hint

The CO sensor is protected against overload by the internal programme.
➡ **For further information on CO overload protection, please refer to the chapter "CO-Overload Protection"**

11.3 Probe and tubing

Depending on the frequency of use, probe and tubing should be regularly cleaned in order to release particle deposits and to prevent early wearing due to corrosion.
The hose can be cleaned (flow warm water in then dry respectively blow water drops out) after loosening all plug-in connections on the instrument and on the probe.
O-rings of the hose connections should occasionally be greased with acid-free grease.

11.4 Printer paper

Replace the printer paper as follows:

Unlock the printer by pulling on the tab on the printer cover. Remove the plastic holder of the spent paper roll and insert the new paper roll as shown. Leave some paper stand out and close the printer cover.

| ① | Tab of the printer cover | ② | Printer cover | ③ | Paper roll |

12. Technical Data

Parameter	Range	Principles
O2	0 ... 21 vol.%	electrochemical
CO	0 ... 10000 ppm	electrochemical
NO (Option)	0 ... 5000 ppm	electrochemical
NO2 (Option)	0 ... 1000 ppm	electrochemical
SO2 (Option)	0 ... 5000 ppm	electrochemical
H2S (Option)	0 ... 1000 ppm	electrochemical
CO% (Option)	0 ... 63000 ppm	electrochemical
CO2 (Option)	0 ... 20 vol.%	infrared
CO2	0 ... CO2max	calculated
T.Gas	0 ... 500 °C	NiCr-Ni
T.Air	0 ... 99 °C	Semi-conductor
Pressure	0 ... +/- 100 hPa	DMS bridge
Efficiency	0 ... 120 %	calculated
Losses	0 ... 99,9 %	calculated
Excess air	1 ... ∞	calculated
CO-undiluted (Reference-O2 adjustable)		calculated
Flue gas dew point		calculated

Power Supply: Battery charger: 230 V / 50 Hz~; Battery: 7,20 V / 11,6 Ah
Protocol printer: integral; 58 mm paper width; individual footer printout

Indication: graphic display; backlit
Dim. (W x H x D):   (400 x 275 x 205) mm
Weight: approx. 7 kg complete with sampling system

Limits:

Ambient temperature: +5 … +40 °C
Humidity: max. 90 % rF, not condensing

Transport and operation of the instrument only in the following transport variants:

- Transport variant aluminium-framed transport case
- Transport variant professional case