Technical Description

ecom® J2K-BA

Flue Gas Analyser ecom-J2K

1. Application Field

The instrument is suitable for energetical measurements and flue gas analysis at combustion plants fired with solid, gaseous and liquid fuel types according to the 1. BImSchV.
The flua gas analyser ecom-J2K is designed a modular way and can be fitted with up to 5 electrochemical sensors (standard O2 and CO / optional NO, NO2 and SO2). The parameters sucking air temperature and gas temperature as well as chimney draught, an integral protocole printer and a sampling system with 2.2 m gas hose belong to the features of the standard version.

2. Design and Operation Principle

A measurement gas pump sucks the gas continuously via a coaxial probe with double-pipes (internal pipe with thermoelement - gas and gas temperature; external pipe - chimney draught) or alternatively via a multi-holes probe and drives it thru a condensation trap, as well as particle and chemical filters to the electrochemical sensors.

Depending on the gas concentration, the measuring electrodes of the sensors issue electrons which are identified as current signals and processed. All electrochemical sensors are temperature-compensated within the operation field between +5 and + 40 °C. The measurement values can be converted internally on a free selectable O_2 reference value in concentration values in mg/m^3 and protocolable.

A fresh air calibration (duration: 3 minutes) and an automatic system check occur generally by each switch-on procedure of the system. After the calibration phase, all measurement and calculation values are available. The measurement results are shown on the backlit graphics display. All relevant values can be displayed simultaneously. A zoom function enables the emphasized illustration of the mesurement values.

The instrument consists of a compact basic module storing the measurement technique and of a removable control module. The control module enables the monitoring of the basic module via radio (frequency 915 MHz).

The temperature sensor for combustion air analysis can either be connected to the control or to the basic module. The thermal printer, fitted in the standard version, is integrated into the basic module. The condensation trap, combined with an electronic position monitoring avoids the penetration of humidity.

Additional protection againts humidity and condensation into the instrument is ascertained by an electrical measurement gas cooler and an automatic condensate evacuation sytem. The ecom-J2K also performs automatic dry soot tests with the optional heated pistol grip probe. As alternative to the standard thermal printer a matrix printer is available as option.

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Instructions Manual

ecom-J2K

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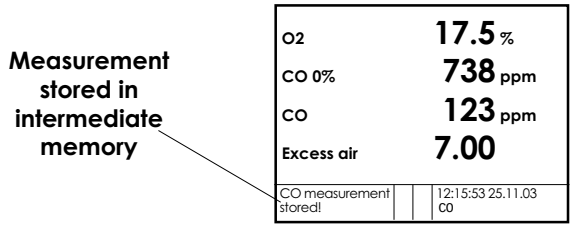
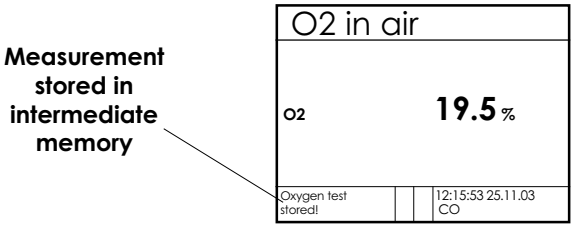
The calculated value shown on the line CO 0 % corresponds to the measured CO concentration supposed the oxygen content would amount 0% by the same exhaust gas volume.
It is consequently the undiluted CO content in exhaust gas. If the value indication is stable, press the key **<Memory>** (disk symbol) to store the result in the intermediate memory.



6.3. Oxygen test

This measurement is performed by room-independant plants like gross calorific value plants .
It is determined if exhaust gas flows into the combustion air (O2 content drops down) 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 the key **<Memory>** (disk symbol) to store the value in the intermediate memory.



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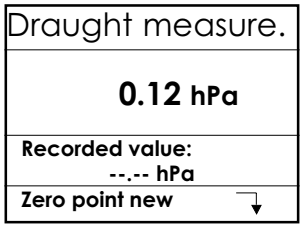
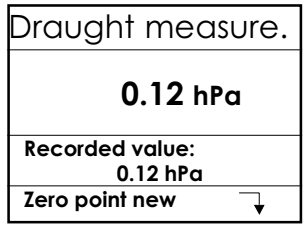
6.4. Draught measurement

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

. Access the menu while selecting the sub-menu **"Draught measurement"**. The current value is displayed as well as the instruction to adjust the zero point of the sensor.
. Release hereto the draught hose from the instrument for a short moment and press **<F4>**. The sensor is herewith re-calibrated.



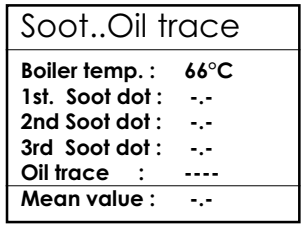


. Fix the draught hose again. The display shows the exact measurement value which can be stored while pressing **<Memory>** and added to the previous results in the intermediate memory. The stored value is shown on the display.
. Press **<ESC>** to quit the differential pressure measurement menu.

6.5. Soot...Oil trace

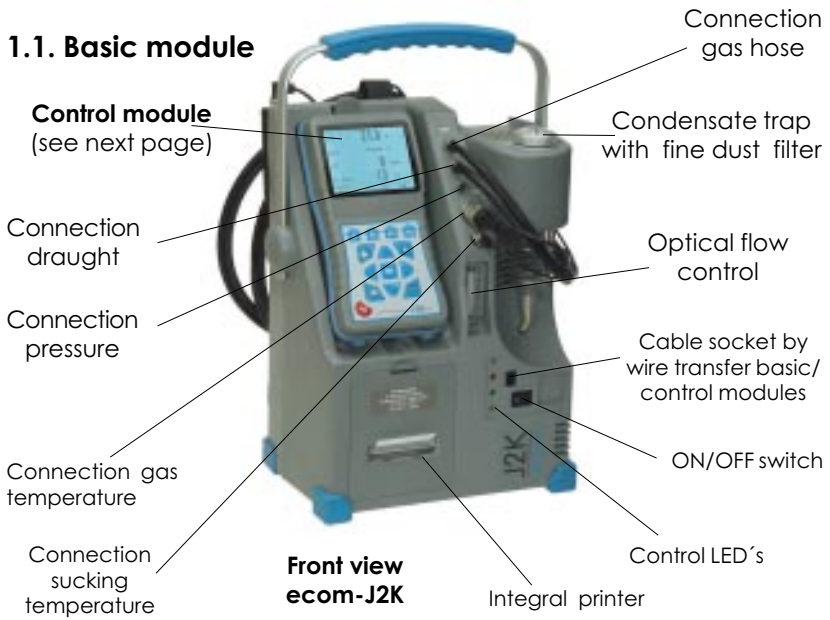
The sub-menu **"Soot...Oil trace"** enables the input of measured results for boiler temperature, soot dots and oil trace.

. Select the line **„Boiler temp.“** and press **<OK>** to activate the input. The input can be made using the numerical keys.
. Press **<OK>** to store the value in the data record of the measurement.

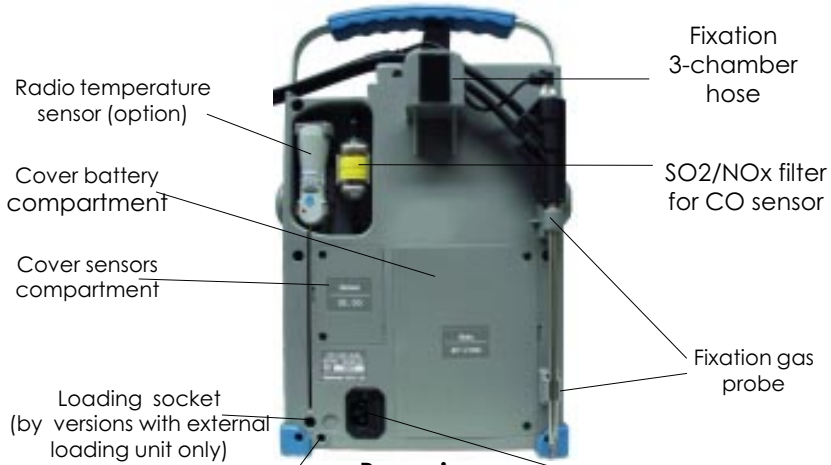


1. Instrument design

1.1. Basic module



Front view ecom-J2K



Rear view ecom-J2K

Connection condensate evacuation (active by automatic condensation trap)

Connection mains power plug (by version with internal loading unit only)

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.

Proceed as follows:

. Switch on the probe heating while selecting **„Adjustments / Probe heating / <F1>“**.
. Insert a filter paper in the paper slot.
. Select the line **„1st. soot dot“**.
. Press **<OK>** to start the measurement. The display shows the decreasing 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. Proceed as follows:

. Release the filter paper from the probe slot.
. Compare the greyness with the opacity scale.
. Input the result using the numerical keys and press **<OK>**.
. Repeat this procedure until all 3 soot dot analysis are completed. The mean value will be calculated and automatically stored.

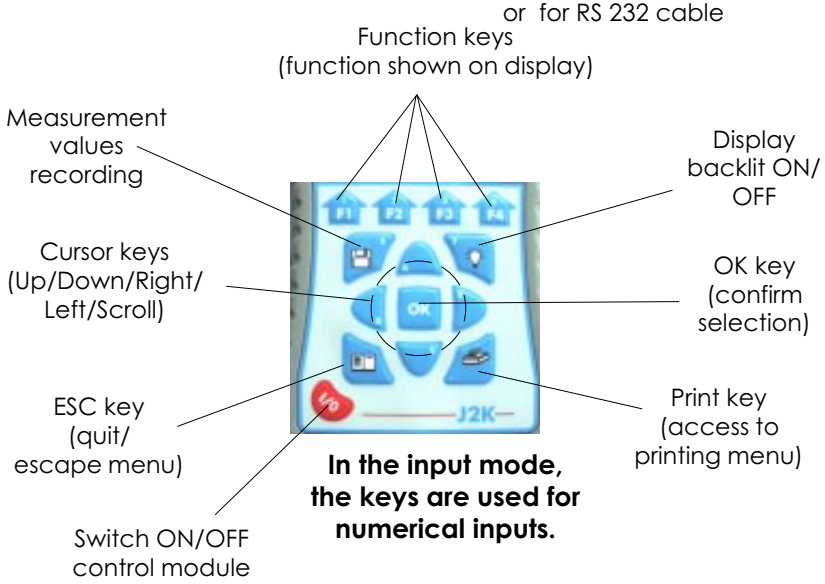
The result of the oil trace check is to be documented as follows:

. Set the cursor on the line **"Oil trace"**.
. Input the result with **<OK>** (**"NO"**, **"YES"** or **"- - -** ")

Soot...Oil trace	
Boiler temp. :	**66°C**
1st Soot dot :	**1.0**
2nd Soot dot :	**0.5**
3rd Soot dot :	**1.5**
Oil trace :	**NO**
Mean value :	**1.0**

. Press **<ESC>** to quit the menu once all necessitated inputs have been entered. The measurement is now completed.

1.2. Control module

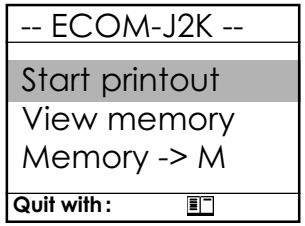


In the input mode, the keys are used for numerical inputs.

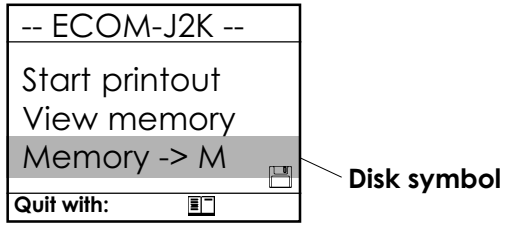
6.6. Measurement record and printout

Important: Once the gas analysis is completed, transfer the values recorded in the intermediate memory into the internal memory otherwise they could get lost by switch-off of the instrument!

. Press **<Print>** (printer symbol) to enter the printing menu. The sampled data can be be checked one more time (**„View memory“**, **<OK>** and scroll with the cursor keys).



. Press **„Memory -> M“** and **<OK>** to transfer all data -if correct- in the internal memory. Once the transfer is completed, a **"Disk symbol"** appears on the bottom right of the display and a printout can be started (**„Start printout“** and **<OK>**).



. Press **<ESC>** to turn back to the gas analysis menu.

2. Power supply

Used accumulators can be returned to us or brought to recycling stations of public waste disposal companies respectively accumulators selling stores!

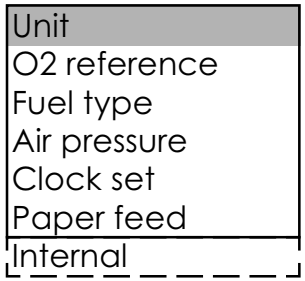
The basic module of the ecom-J2K is delivered either with external or with internal loading unit (depending on features selected). In both cases the instrument can be operated upon a longer time period with the internal accumulator (6 V; 7,2 Ah). Connecting the external or the internal charging unit to mains power is only compulsory to recharge the accumulators and to operate the Peltier cooler and the heated pistol grip probe.
The accumulatos should be recharged when the instrument shows a corresponding message (acoustical warning and display information). The accumulators loading stand can be checked, looking at the voltage information on the display (menu "**Control**"). The accu warning is activated when the value „ACC.B“ is smaller than 6 V. By 5,8 V the power operation via accus is no more possible. The instrument must be further powered via external or internal charging unit.

Never use batteries, in order to operate the control module of the ecom-J2K!

The control module of the ecom-J2K is powered by 3 nickel-metal-hydride accumulators (type AA). In case of need, the accumulators can be recharged by docking the control module to the basic module.
Hereby 2 functions can be selected (**„Adjustments / „Internal“ / „Reloading function“ / <OK>**):

1. **Recharging function ON (<F1> = YES):**
   - accus slowly and carefully recharged
   - recommended adjustment by frequent use
2. **Recharging function OFF (<F4> = NO):**
   - accus quickly recharged
   - recommended adjustment for occasional use

7. Adjustments



Additionally to the **ecom-J2K** functions described previously, various adjustments can be made in the instrument.

. From the main menu select the sub-menu **"Adjustments"** and confirm with **<OK>**.
A selection of modifiable parameters, adjustable according to the application, is displayed.
. Place the cursor on the desired line and press **<OK>** to call up or modify the adustment.

The modifiable parameters are:

Unit (adjustment with **cursor keys**):
- Calculation of gas concentrations in:

  - ppm = volume concentration (parts per million)
  - mg/m³ = mass concentration per volume unit
  - -mg/kWh (undiluted) = mass concentration per power unit
  - mg/MJ (undiluted) = mass concentration per power unit
  - ppm (undiluted) = volume concentration (parts per million)
  - mg/m³ (undiluted) = mass concentration per volume unit

Undiluted:
- Conversion of the gas concentration on selected reference oxygen:

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

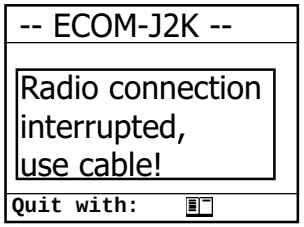
  - Conversion formula:

$$E_{ref} = E_{meas} * \frac{21 - O_{2ref}}{21 - O_{2meas}}$$

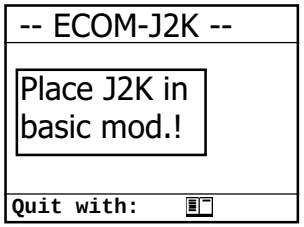
O2 reference
(for ppm and mg/m³ units - Input after **<OK>** pressing):
  - Input of 02 reference value O_{2ref}

3. Radio communication basic / control module

Thanks to the detachable control module the basic module can be monitored wireless. The information exchange between control and basic modules is performed via radio transmission (868 MHz) with a coverage of approx. 50 m (by free sight).
By interruption of the radio communication, a message is displayed inviting to use a cable. By persisting disturbances of the radio communication between basic & control modules, a cable (option) can take over the transfer (fix the cable to the respective DATA socket of the basic and of the control modules).



If the basic module is switched-off and the control module not, the display will show an error message which will invite you to place the control module on the docking station of the basic module (may alsoavoid to forget the control module!).



Observe this order, quit with **<ESC>** and finally switch off the control module.

Fuel type (press **<OK>** to access selection list):
- Modification of adjusted fuel type (e.g. by measurements at combi-plants)

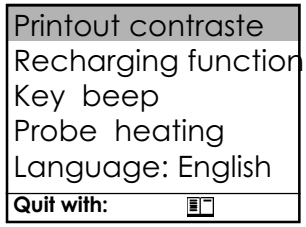
Air pressure (press **<OK>** to access menu):
- Input of barometric air pressure for dew point calculation

Clock set (press **<OK>** to access setting menu):
- Correction of internal clock with cursor keys

Paper feed (press **<OK>** to activate paper feeding):
- Paper feed line by line

Internal (press **<OK>** to open menu):
- Further instrument setttings:

Printout contraste (0..9)
(press **<OK>** to access input menu):
- Printer contraste adjustment



Recharging function
(**<F1>** for YES / **<F4>** for NO):
- Careful (**<F1>**) or quick (**<F4>**) recharging of the control module accumulators

Key beep (**<F1>** for YES / **<F4>** for NO):
- Acoustical signal by key pressing

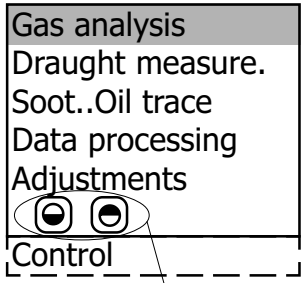
Probe heating (**<F1>** for YES / **<F4>** for NO):
- ON/OFF switch for probe heating for soot measurement (by use of the optional heated pistol grip probe)

Language: English
- Shows the language currently programmed (3 languages selectable)

4. Instrument switch-on

1. Always position the probe in the exhaust pipe first after the calibration phase is over !
2. Never operate the instrument in the transport case or bag !

Once the control module has been switched on (key **<I/0>**), the main menu is displayed. 6 sub-menus with the following functions are displayed (non-visible sub-menus can be called up scrolling the arrow keys):

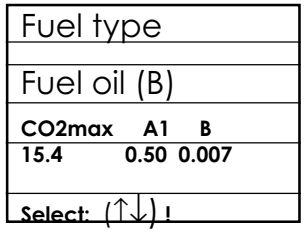


Display contraste adjustable with F1 and F2

- Gas analysis : Perform gas analysis
- Draught measure. : Perform draught or pressure measurement
- Soot...Oil trace : Input of soot measurements results
- Data processing : Assign measurements/Load or send data
- Adjustments : Modify instrument adjustments
- Control : Check operation state of instrument

. To perform concrete measurements, first switch on the basic module (switch located under the condensation trap).
. Use the arrow keys to select the sub-menu **"Gas analysis"**.
. Confirm with **<OK>**. The instrument starts a 3-minutes calibration phase and the fuel types selection list is displayed.

The following fuel types are selectable*:



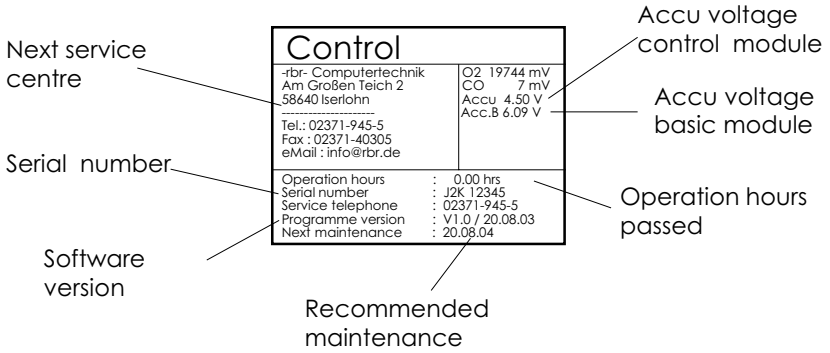
Fuel types acc. to 1st. BImSchV
Fuel oil (B)
Natural gas (B)
City gas (B)
Coke oven gas (B)
Liquid gas (B)

Use the arrow keys to select the desired fuel type and confirm with **<OK>**.

**Country specific fuel types will obviously be programmed on demand.*

8. Control

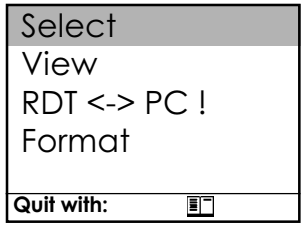
The electrochemical sensors used for the gas analysis are submitted to a wearing process and consequently age. Along the operation period, they alter their output values depending on gas concentration, flow duration and soiling degree of the measured gases.
The programme controls the sensors and corrects drifts. 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 authorised service centre.
The control menu informs about the current status values for the sensors as well as about:



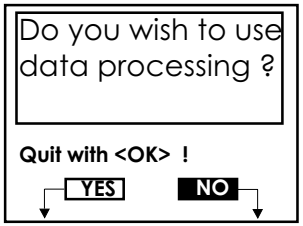
9. Data Processing

These functions can be selected in the menu **„Data Processing“**:

Select:
For search or creation of plants file for measurement values assignment (compare chapter 5.)

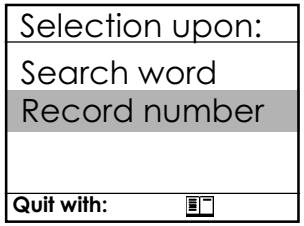


The instrument will then enquire if you wish to use the data bank. If you want to assign the sampled data to a specific plant, so press **<F1>** (**<F4>** = no: -> themeasurement will be performed without assignment).



5. Input or select plant specific data

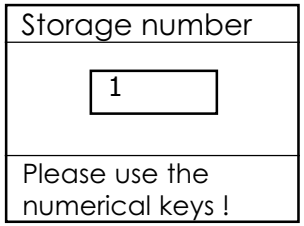
To call up plant data recorded in the J2K or to create a new file, the following possibilities are available:



Record number: To create a new file, a numerical number can be assigned.

. Select **„Record no.“** and confirm with **<OK>**.
. Input a random record number (1 -1500):

Example: "1" for record number 1



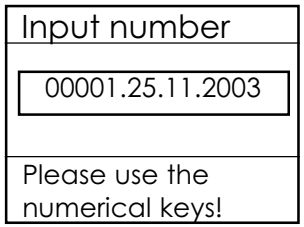
. Press **<OK>** after input in order to call up the record number.
. Press **<F3>** to determinate the next free record number (calculated from record number 1).
. Press **<F4>** to input a plant-related code.

Tip: As only figures (max. 16) can be entered, we suggest a date-related input to easily find the data record later on via the search function (search per date):

e.g.:00001.25.11.2003

Plant number or similar

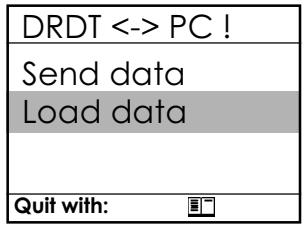
Measurement date



. Activate the storage number with **<OK>** once the input is completed.
. Press again **<OK>** to enter the gas analysis menu.

View:
Recorded values to a selected plant can be viewed (compare chapter 5.).

DFÜ <-> PC !:



Load data:
Enables the data import from e.g. specific chimney sweepers software programmes. The transfer is made with ANSI font characters and 14400 Baud (please check the transfer options of your software !).
Proceed as follows:

1. Connect ecom-J2K and PC via RS232 cable.

2. Select **"Load data"** and confirm with **<OK>**.

3. Answer the displayed question with **YES** (**<F1>**).

4. Decide if the data recorded can be cancelled (**<F1>** for **YES** / **<F4>** for **NO**).

5. Start the data transfer on your PC.

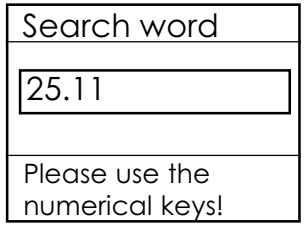
Send data:
With this function the data records completed with measurement values can be transferred to the PC programme (procedure similar to chapter **„Load data“**).

Format:
This function is usually needed by the initial adjustment of the instrument at our factory (preparation of internal memory for data record).
Caution: All stored values will be cancelled!

Search word: If the plant code is known, it is possible to find the plant data stored with help of a search machine.

. Select **"Search word"** and press **<OK>**.
. Input 4 related figures of the plant code:

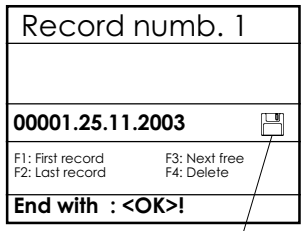
Example: "25.11"
for plant code 00001.25.11.2003



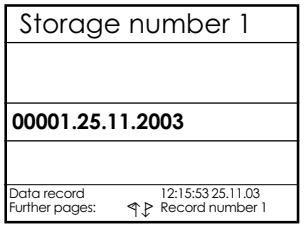
. Press **<OK>** after input to start the searching process. All possible correspondences with this figures sequence will be filtered. The selection can be stepped thru with the arrow keys (F1 for selection beginning, F2 for selection end).

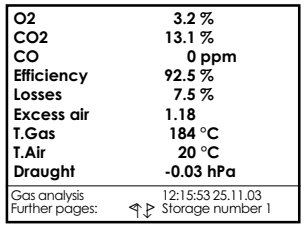
. Press **<OK>** to activate once the desired data block is found,
. Press **<Print> / „View memory“ / <OK>** to view the previous analysis at this plant.
.

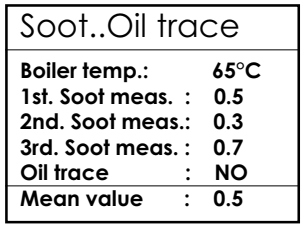
All measured and calculated values can be called up on 4 display pages using the arrow keys to step thru.

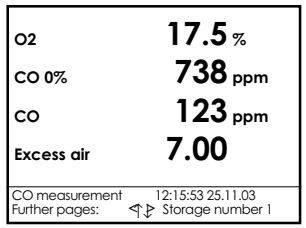


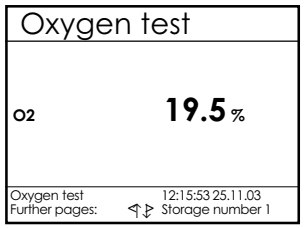
Measurement available











. Press twice **<ESC>** to quit the previous measurement. The recording of the current measurement values can begin.

10. Maintenance advices

Do not use any other sensor or feeler from other manufacturers otherwise the TÜV approval will not be valid anymore !

We recommend to send your instrument one time a year, however after max. 500 operation hours, to the next authorised service centre for maintenance.

Please note that service made by service centres not authorised by rbr-Computertechnik GmbH will result in an immediate and complete lost of any warranty!

The following advices will be of help for the daily check and maintenance of single parts or assemblies:

Fine dust filter
Screw off the cover and check the state of the particle filter. Change it once the filter has a grey colour (= ± number 2-3 of the soot comparison scale).

Fine dust filter

Sensors
The sensors get calibrated with the reference gas fresh air by each switch-on procedure. The state of the sensors is permanently controlled by the instrument. New sensors age along the operation period because of the wearing of the reagents (oxygen sensor) and due to soiling respectively exceeding concentrations beyond the nominal measurement range (toxic sensors).
The output values of the sensors are (enter menu **"Control"**):

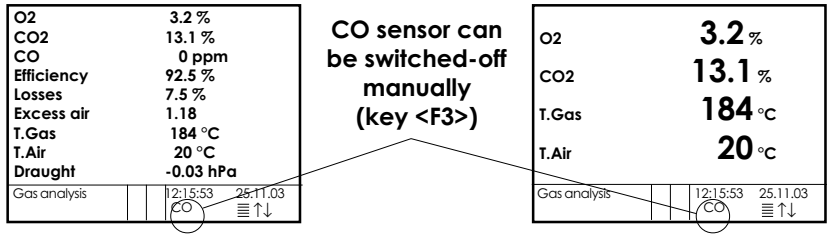
O2	approx. 18000 mV
Others	0 mV (+/- 150)

6. Gas measurement

6.1. Gas analysis

Important: re-calibrate the instrument after each measurement (after one hour at the latest) to get correct results !

After the 3-minutes calibration phase, the instrument switches over to the measurement mode. The gas measurement values can be viewed on 4 display pages (2 x gas analysis; 1 x CO measurement; 1 x oxygen test). Use the cursor keys to scroll the pages.



The position of the measured and calculated values (gas analysis) on the display pages is free selectable. For alteration of the exisiting succession respectively personal listing, proceed as follows:

- Press **<F4>** to activate the function.
  - select the line with the cursor keys (up/down),
  - select the measured or calculated value with the cursor keys (right/left),
  - repeat this procedure until all modifications are completed.
- Press **<F4>** to deactivate the function.

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

$O_2 < 20{,}5\ \%$ and
T.Gas - T.Air > + 5 °C

are given. The dew point can only be calculated accurately if in the menu **"Adjustments"** the current barometric air pressure value has been inputed. This value cannot be determined by the ecom-J2K.

If an error message is displayed during calibration and cannot be eliminated despite several calibration phases, so the instrument must be checked by a qualified and authorised service centre. The oxygen sensor must show a value >7000 mV, otherwise it must be changed by an authorised service centre.

The CO sensor is protected against exceedings by the internal programme. If the limit value of 4000 ppm is exceeded, a second pump switches on and flows the sensor with fresh air.

SO2/NOx filter
On the instrument back and along the gas path leading to the CO sensor, a chemical filter is placed for the filtering of the SO2 and NOx particles contained in the gas. The filter is to be changed as soon as the beads get a grey colour (colour change step by step: pink = original state > brown > black > grey > white).

Probe and hose
Depending on the frequency of use, probe and hose should be regularly cleaned in order to release particle deposits and to prevent early wearing due to corrosion.

. Release the connections at the instrument and at the probe grip to free the hose.
. Clean the hose (flow warm water in then dry respectively blow water drops out).

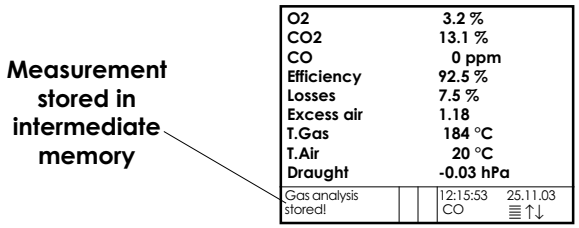
The O-rings should occasionally be greased with an acid-free lubricant.

Change printer paper roll

. Release the printer cover.
. If necessary, extract the paper rest out of the printer (**"Adjustments"**/ **"Paper feed"/<OK>**).
. Remove the printer shaft and place the new paper roll on the printer shaft.
. Insert the paper end in the slot (you must face the roll inner side with the lateral rbr-printing).
. Press(**"Adjustments"/"Paper feed"/<OK>**) to transport ± 10 cm paper thru the printer.
. Place the printer shaft back in the fixation.
. Insert the paper thru the cover of the printer compartment.
. Close the printer compartment while fixing the cover.

Correct measurement are displayed first after a short delay, necessary for the gas transport and the build-up of a stable elctrochemical reaction at the sensors.
This time period lasts approx. between 1 and 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.

If the measurement values are stable and the results can be printed out, press the key **<Record>** (disc symbol) to transfer the values in the intermediate memory (caution: store gas analysis and CO measurement values separately). The values are stored for a later printout and, if need be, for a final data record storage.



6.2. CO measurement (gas channel check)

For the technical check of gas-fired plants in regards of safety aspects the gas channel check called also CO measurement is used.
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 homegeneous because of the flow in of secundary air and consequently the stream core 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.

11. Technical Data

Parameter	Range	Principle
O2	0 ... 21 vol-%	Electrochemistry
CO	0 ... 4.000 ppm	Electrochemistry
NO (Option)	0 ... 2.000 ppm	Electrochemitry
CO_2	0 ... CO_{2max}	Calculation
T-G	0 ... 500 °C	NiCr/Ni
T-Air	0 ... 99 °C	Semi-conductor
Differential pressure	0 ... +/- 20 hPa	DMS bridge
Efficiency	0 ... 99,9 %	Calculation
Losses	0 ... 99,9 %	Calculation
Excess air	1 ... ∞	Calculation
CO undiluted (adjustable ref. O_2)		Calculation
Flue gas dew point		Calculation

CO sensor purge thru separate fresh air pump
Electronic condensate monitoring

Power supply Mains power 220 V / 50 Hz~; accu 6 V / 3,2 Ah

Protocole printer integral; 58mm paper width;
printout end individually labellable

Indication graphic display; backlit

Dimensions (L x H x D) 250mm x 430mm x 200mm

Weight approx. 5.5 kg with standard sampling probe

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