

## Instruction manual MSI EM200plus + EM200plus-i



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## 1. Reference notes

### 1.1 Approvals

The flue gas analyser MSI EM200plus is produced according the European Standards EN 50379 part 1, part 2 and part 3 and thus it is certified for official measurements.

### 1.2 Information for use

The MSI EM200plus is an electronic multiple channel measuring instrument for analysing the flue gas of combustions and industrial processes. The MSI EM200plus is unlicensed as a gas detection alarm or personal security equipment.

Any use of the MSI EM200plus requires a full understanding and strict adherence to these instructions and to national and international standards.

The instrument has only to be used for the purposes specified in here.

**The display screens used in this instruction manual are only examples!  
Only locked measurement value can be printed or stored.**

For the calculation of CO<sub>2</sub> and stack loss qA the instrument needs fuel specific parameter. In the fuel table of the instrument are stored: fuel oil, natural gas, city gas, coke oven gas, liquid gas, fuel oil S, pellets and hard coal.

### 1.3 Service

To maintain accuracy and correct function the MSI EM200plus should be checked and re-calibrated by authorized service people once a year.

### 1.4 Specifications for disposal according WEEE



As from 2005 EC specifications for disposal of electric and electronic equipment are valid. These are regulated in the 2002/96/EC directive and respective national law.

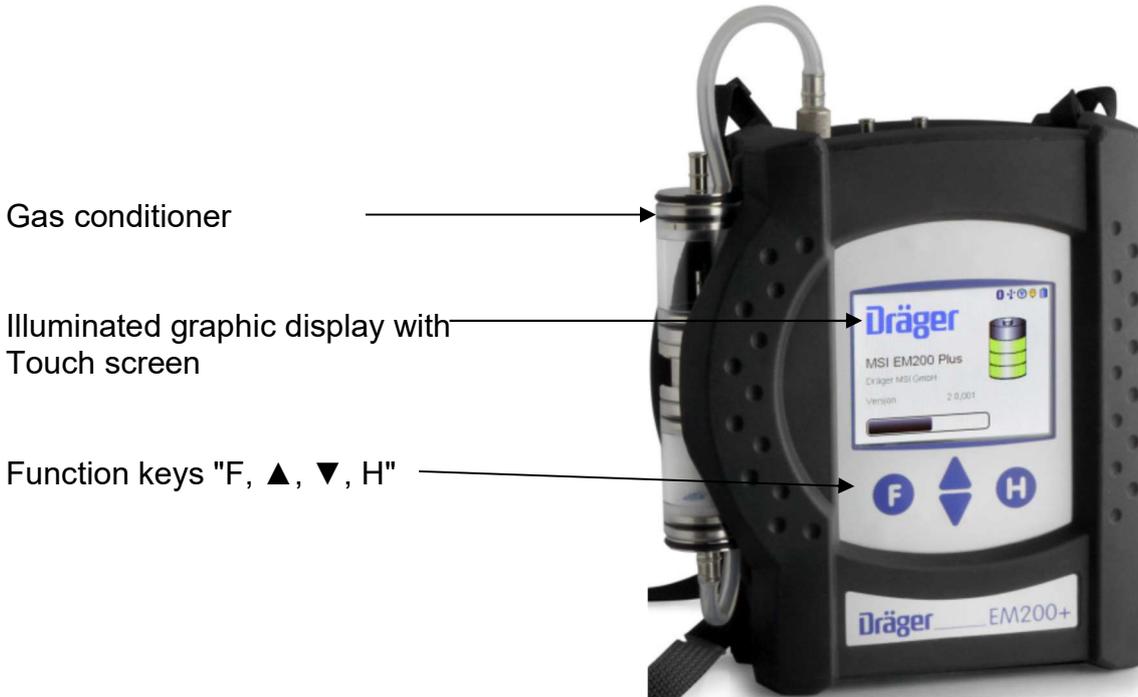
Essential content is the establishment of special collection and recycling facilities for private users. Since this device is not registered for private users, it is not allowed to dispose it in this way.

For disposal you can send it back to your local Dräger Safety organisation and if requested, get further information concerning this matter from Dräger MSI GmbH.

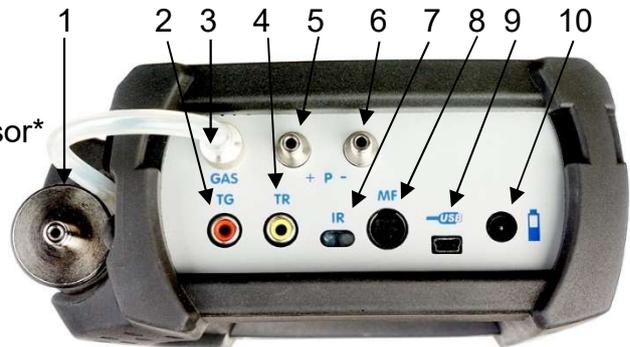
## 2. The instrument

The MSI EM200plus is an electronic multiple channel measuring instrument, analysing the flue gas concentrations and combustion data for engineers, service, environmental protection, etc..

All measurements and checks may be documented by printing or data storage.



- 1 = Gas conditioner
- 2 = Socket for thermocouple (TG)
- 3 = Gas inlet
- 4 = Socket for combustion temperature sensor\*
- 5 = Pressure inlet (+)
- 6 = Pressure inlet (-)
- 7 = LED and infrared transmitter
- 8 = Multiple function interface
- 9 = USB - interface
- 10 = Socket for charger



\* Here you can connect different combustion air temperature probes.

### 3. Starting up and operation

#### 3.1 Preparing for use

Make sure that all components are in good condition e.g.:

no condensate in the gas conditioner  
the filter fleece and the filter disks are clean  
the gas hoses are in good condition  
the probe is free from defects

Connect the gas conditioner with the gas inlet of the MSI EM200plus. Never forget to use the gas conditioner to protect the instrument, otherwise pump and sensors could be damaged.

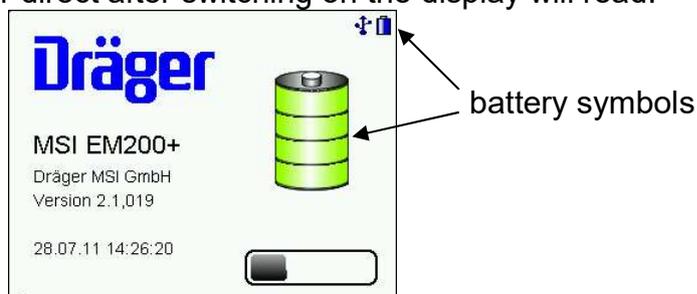
Verify that fresh air will be sucked through the gas conditioner before switching on, because the zero signals of the sensors are checked with fresh air.

#### 3.2 Push buttons

##### 3.2.1 Switching on / off the MSI EM200plus

**Switch on** the instrument by pushing for a second the buttons “F” and “H” together. If the annual service has to be done the instrument starts a month earlier to remind you to the service due date.

After pushing “F” (CONTINUE), or direct after switching on the display will read:



The battery symbols show the batteries capacity. The bar represents the progress of the run in of the el.-chem. sensors and the progress of the check function. In addition the time, the software version and a selected operator are shown.

The time of the system check is dependent on the stabilisation time of the O<sub>2</sub> sensor. Depending on the switch-off length and time the stabilisation time will be at least 30 seconds, possibly it can last more than 10 minutes. If errors have been detected, error messages will be generated and displayed.

**Switch off** the instrument by using the switch off function in the menu “selection of functions” or by pushing “F” until the display reads “Switch off” (approx. > 3 sec). If the O<sub>2</sub> value is less than 20 % or the CO value higher than 10 ppm during switching off, the pump will run on for 2 minutes. With a longer touch on the “F” button the pump will be switched off at once.

### 3.2.2 Functions of the push buttons

The functions of the push buttons are always shown in the last row of the display.

The MSI EM200plus is equipped with a touch screen. A contact at the display replaces the push button signal.

With the touch wipe function the display may be scrolled. With diagonal wiping numerical values may be changed.

If the central display button is used for two functions, one function is arranged in the right half of the displayed button and the other function in the left half.

With (III) a context menu will be opened.

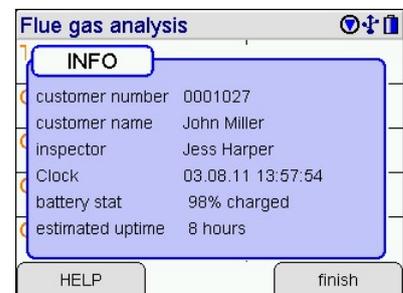
As a function of the menu the context menu offers different development possibilities and orders.



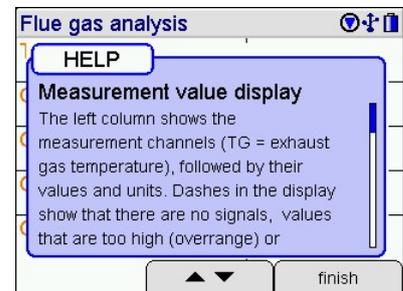
The contact with sharp object can destroy the display.

### 3.3 Info screen and help function

By longer pushing the right button an info screen will open. The info function informs about the selected customer number and name, the selected operator, date and time and status and uptime of the battery.



Now a help function can be selected. The help function gives information and support about the selected menu.



### 3.4 Test of measuring gas duct

Instruments with integrated gas duct control monitor the gas duct continuously. If the gas flow is too small an error message is generated and displayed. The tightness of the complete measuring gas duct may be proved by closing the gas inlet of the probe. After a short while the error message “gas duct low” will be shown if the measuring gas duct is tight.

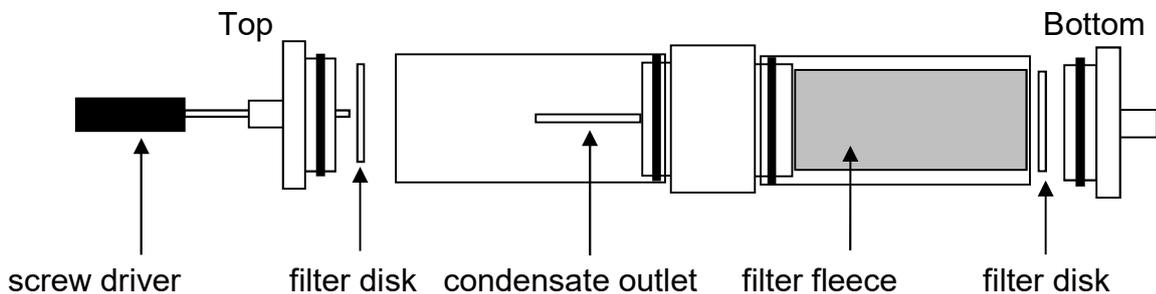
Instruments without gas duct control may only be tested by an indirect method. Close the gas inlet of the probe, if the measuring gas duct is tight, the performance of the instrument’s pump will change and a change of the pump sound may be heard. If a change of the pump sound will not be heard, the measuring gas duct has to be checked with a flow meter.

### 3.5 Terminating measurement

After the measurement remove the probe from the exhaust gas and allow fresh ambient air to be sucked in for 1 to 2 minutes. After this, switch off the instrument.

Empty and clean the gas conditioner. Check the filter fleece and the filter disks and replace them if they are visibly dirty. For pushing out the filter disks use a small screw driver or a paper clip.

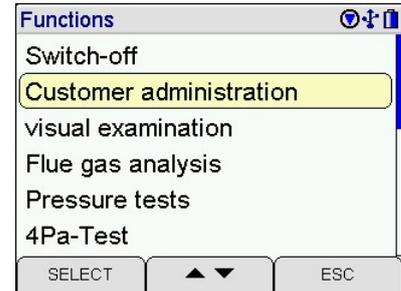
Gas conditioner:



## 4. Selection of functions

Selectable functions are:

Switch-off	= Switches off the instrument
Customer administration	= Selection or input of customer data
Visual examination	= Documentation of visual examination
Flue gas analysis	= Select type of flue gas measurement
Pressure tests	= Selection of pressure measurements
4Pa-Test	= Menu "4Pa-test" (option)
Heating check	= Menu "Heating check" (option)
CO ambient	= Ambient air CO measurement
Gas pipe checks	= Selection of gas pipe checks
BCI diagnostic	= Start of the reading out of digital burner controllers of Siemens (Landis & Staefa) and Honeywell (Satronic) using Dual-BCI-S (option)
Data management	= Menu "data processing"
Info	= Info function
Measurement settings	= Settings for measurement
Device settings	= Settings for instrument



## 5. Selection or input of customer data

With the PC program „PC200P“ it is possible to compile a list with customer number, name and customer data and send all or parts of it to the instrument. If customer data are stored, you may select one of them or alter them with this function. If no data are stored for the customer, you may create new customer data with this function.

With (SELECT) the marked customer number will be adopted. The adopted customer number is effective for all following measurements until a different customer number is selected or the instrument is switched off.

With (III) the context menu will be opened.



With (Edit) the marked customer number and if existing customer data will be shown.

With (SELECT) this data can be edited and with (END) it will be stored.

With (New) new customer data can be applied as follows: customer number, name, installation type, location, installation number, street, postal code, city, customer name, customer street, customer postal code, customer city, customer phone, boiler manufacturer, boiler type and year, boiler power, burner manufacturer, burner type and year, burner technique and fuel type.

With (Search) a customer name can be searched in the stored data.

With (Delete) the complete customer data can be deleted. It is only possible to delete single customer data if the function is activated and no measuring data are stored.

The screenshot shows a window titled "Customer data" with a list of fields and their values: Customer no. 0001027, Name John Miller, Install.type boiler, Location cellar 3, Inst.No. 0001, and Street Kings Road 45. At the bottom, there are three buttons: "SELECT", a directional pad (up, down, left, right arrows), and "END".

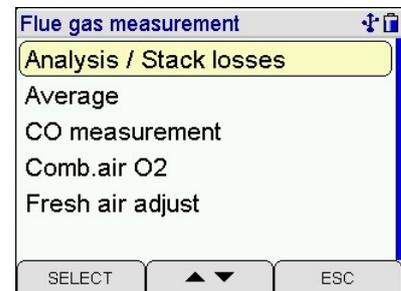
## 6. Visual examination

The result of the visual examination can be commented and documented.

The screenshot shows a window titled "Visual inspection" with a "Visual inspection" label and two buttons: "OK" and "Not OK". Below this is a "Comment:" label followed by two empty text input fields. At the bottom, there are two buttons: "CONTINUE" and "END".

## 7. Flue gas measurement

### 7.1 Select type of flue gas measurement



Selectable functions are:

Analysis / Stack losses	= Flue gas analysis / Stack losses calculation
Average	= Average measurement
CO measurement	= CO measurement
Comb. air O2	= O2 measurement of combustion air in ducts
Fresh air adjust	= zero point calibration with fresh ambient air

#### 7.1.1 Preparing for flue gas analysis and average measurement

Connect the hose of the probe with the gas conditioner and the plug of the thermocouple (marked red) with the socket marked "TG". The combustion temperature sensor is plugged into the socket "TR".

Is "Analysis / Stack losses" or "Average" been chosen the fuel type selection is called.

After starting the burner please wait until the combustion is steady going. Direct after start burner may emit high concentrations of toxic gases and soot and this would needlessly pollute the instruments sensors.

#### 7.1.2 Fuel type selection

Select the wanted fuel type.

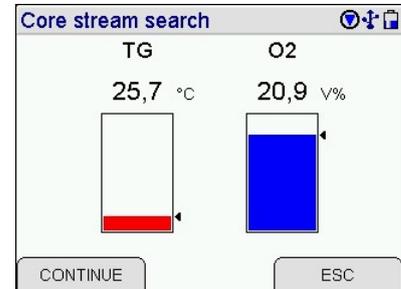
Was the pump switched of before starting the measurement, a small stabilisation time will follow.



## 7.1.3 Core stream detection

In the flue gas stream exist some regions, where only parts are filled with exhaust gas. Therefore it is important to take the gas out of the core stream. The core stream is characterised by maximum temperature and minimum O<sub>2</sub> concentration. This program helps to fix the probe in the core stream.

Insert probe into flue gas pipe, move probe position until the probe tip is situated in the core stream (highest temperature) and secure this probe position with the fixing cone.



## 7.1.4 Measurement of the flue gas draft

This function only appears in analysis and average measurement if flue gas draft measurement is activated.

For measurement with a standard probe, plug the hose of the gas conditioner from the gas inlet onto the (+) pressure inlet.

With (HOLD) the actual shown reading will be locked. The pressure value in this case will be locked and unlocked independent from the other values.

After the measurement is finished connect the tube to the gas inlet again!



## 7.1.5 Input of boiler temperature

This function only appears in analysis and average measurement if input is activated.

With (INPUT) the boiler temperature may be adjusted.



### 7.1.6 Input of soot numbers

This function only appears in analysis and average measurement if input is activated.

With (INPUT) the boiler soot numbers may be entered.

Soot measurement	
Soot 1	0,0
Soot 2	0,0
Soot 3	0,0
Oil der.	NO
<div style="display: flex; justify-content: space-between; width: 100%;"> <span>CONTINUE</span> <span>INPUT</span> </div>	

If all inputs have been done, with (NEXT) will be skipped to results.

Soot measurement	
Soot 1	1,0
Soot 2	0,0
Soot 3	0,0
Oil der.	NO
<div style="display: flex; justify-content: space-between; width: 100%;"> <span>NEXT</span> <span>+/-</span> <span>ESC</span> </div>	

## 7.2 Flue gas analysis / stack losses

### 7.2.1 Display of main analysis values

If dashes are displayed this means there exist no value or the value is too big (exceeds measuring range) or the calculation is forbidden (e.g. division by zero).

By tipping a value a screen will open with a graphical diagram of this value.

Flue gas analysis	
TG	154,0 °C
O2	5,3 v%
CO	84 ppm
CO-0	112 ppm
CO2	11,5 v%
<div style="display: flex; justify-content: space-between; width: 100%;"> <span>CONTINUE</span> <span>HOLD</span> <span>ESC</span> </div>	

Only locked values can be printed or stored.

The actual and the locked values are displayed. The pressure value is only locked if the additional pressure measurement is deactivated.

Flue gas analysis		
TG	154,0 °C	154,0 °C
O2	5,3 v%	5,3 v%
CO	84 ppm	84 ppm
CO-0	112 ppm	112 ppm
CO2	11,5 v%	11,5 v%
<div style="display: flex; justify-content: space-between; width: 100%;"> <span>CONTINUE</span> <span>HOLD</span> <span>ESC</span> </div>		

The calculation of flue gas loss for condensing boilers can be activated.

If this function is deactivated or (CONTINUE) is pushed, the display screen in table form is called.

Flue gas analysis	
O <sub>2</sub>	5,3 v%
TCA	21,2 °C
TG	154,0 °C
qA-CB	--- %
Eta-CB	--- %
CONTINUE	HOLD ESC

The used abbreviations for the measuring channels mean:

- TCA = combustion air temperature
- TG = flue gas temperature
- T dew = dew point temperature
- qA = flue stack losses
- qA-B = flue stack losses for condensing boilers
- Eta = efficiency
- Eta-B = efficiency for condensing boilers

### 7.2.2 Display screen in table form

If the calculation of gas concentrations in mg/m<sup>3</sup> is deactivated, this display screen is not shown.

In the first column the measuring channel is displayed.

In the second column the measured values in ppm are shown and in the third column the measured values are displayed calculated in mg/m<sup>3</sup>.

The fourth column shows the resulting reference values in mg/m<sup>3</sup> or mg/MJ or mg/kWh using the O<sub>2</sub>-reference value (here 3 %) and the dimension unit (here mg/kWh). The O<sub>2</sub>-reference value and the dimension unit may be modified in the menu “measurement settings”.

Flue gas analysis			
	ppm	mg/m <sup>3</sup>	mg/kWh
CO	84	105	128
O <sub>2</sub> ref. 3 v%			
CONTINUE	HOLD	ESC	

### 7.2.3 Result of flue gas analysis

With (▲▼) the reading may be scrolled and thus all measured and calculated values can be shown.

With (REF) a selected customer number is shown in the result display. The customer number can be changed before storing.

With (CONTINUE) the “documentation menu” is called.

Result	
Time	03.08.11 14:42
Fuel	Fuel oil
TG	154,0 °C
TCA	21,2 °C
O <sub>2</sub>	5,3 v%
qA	6,7 %
CONTINUE	▲ ▼ REF

### 7.3 Average measurements

In many cases average values are measured to get repeatable results at time varying combustions. For this a defined time for averaging is required.

So at bigger combustions a half hour mean value is demanded, on the other hand for with solid fuels fired combustions the averaging for 15 minutes is required.

For measuring the efficiency in Germany a regulation exists to measure the efficiency for 30 seconds, because the different response time of temperature and O<sub>2</sub> concentration measurement may lead to an incorrect stack loss calculation, especially when the core stream varies. The measurement of average values avoids this and makes it possible to get more accurate results of the stack loss.

The average time of 30 sec, 60 sec, 15 min or 30 min may be selected in the function “measurement settings”.

#### 7.3.1 Display of main analysis values

Displayed are the measuring channels, the values and the dimensions. If dashes are displayed this means there exist no value or the value is too big (exceeds measuring range) or the calculation is forbidden (e.g. division by zero).

Flue gas average 60 s		ⓘ ⚙ ⚠	
TG	154,0 °C		
O <sub>2</sub>	5,3 v%		
CO	84 ppm		
CO-0	112 ppm		
CO <sub>2</sub>	11,5 v%		
CONTINUE		START	ESC

With (START) the average measurement will run for the selected average time.

Average 0:05		ⓘ ⚙ ⚠	
TG	154,0 °C		
O <sub>2</sub>	5,3 v%		
CO	84 ppm		
CO-0	112 ppm		
CO <sub>2</sub>	11,5 v%		
CONTINUE		ESC	

The current and the mean measurement values are displayed. As described in the chapter “flue gas analysis” the display screen in table form of the average values of the gas concentrations, the separate measurement of flue gas draft, the input of boiler temperature and the input of soot numbers may be called.

After the average measurement is finished “result of average measurement” is called.

Flue gas average 60 s		ⓘ ⚙ ⚠	
TG	154,0 °C	154,0 °C	
O <sub>2</sub>	5,3 v%	5,3 v%	
CO	84 ppm	84 ppm	
CO-0	112 ppm	112 ppm	
CO <sub>2</sub>	11,5 v%	11,5 v%	
CONTINUE		ESC	

## 7.3.2 Result of average measurement

With (CONTINUE) the “documentation menu” is called.

Result	
Time	03.08.11 14:45
Average	60 s
Fuel	Fuel oil
TG	154,0 °C
TCA	21,2 °C
O2	5,3 v%
CONTINUE	▲ ▼ REF

## 7.4 CO measurement

In some cases, requested by regional rules, the concentration of O<sub>2</sub>, CO and CO undiluted in the stack gas is of interest.

CO measurement	
O2	5,3 v%
CO	84 ppm
CO-0	112 ppm
HOLD CANCEL	

Locked measurement values are displayed and can be unlocked.

CO measurement	
O2	5,3 v%
CO	84 ppm
CO-0	112 ppm
CONTINUE	HOLD CANCEL

With (CONTINUE) the result of the CO measurement is displayed.

With (CONTINUE) the „documentation menu“ is called.

CO measurement	
Time	02.08.11 10:28
O2	5,3 v%
CO	84 ppm
CO-0	112 ppm
CONTINUE	▲ ▼ REF

### 7.5 Combustion air O<sub>2</sub> measurement in air ducts

At room-air independent combustions the tightness of the combined combustion-air duct and flue exhaust system may be checked by measuring the O<sub>2</sub> concentration in the air duct with a special multi hole probe.

First connect the hose of the probe with the gas conditioner.

In fresh air the value of the O<sub>2</sub> concentration is 21 Vol. %.

If the flue exhaust pipe is not tight, the O<sub>2</sub> concentration will decrease, because flue gas is mixed with the combustion air. Displayed are the O<sub>2</sub> value in the air duct (O<sub>2</sub>-CA), the difference to 21 % and the CO value in the air duct (CO-CA).

Combustion O <sub>2</sub>	
O <sub>2</sub> -CA	5,3 V%
O <sub>2</sub> -Diff	15,7 V%
CO-CA	84 ppm
<div style="display: flex; justify-content: space-between;"> <span>CONTINUE</span> <span>HOLD</span> <span>CANCEL</span> </div>	

With (CONTINUE) the pressure measurement in the air duct is called.

For pressure measurement in the air duct plug the hose of the gas conditioner from the gas inlet onto the (+) pressure inlet.

Combustion O <sub>2</sub>	
P-CA	0,00 hPa
<div style="display: flex; justify-content: space-between;"> <span>CONTINUE</span> <span>HOLD</span> <span>Zero</span> </div>	

With (CONTINUE) the result of the combustion air O<sub>2</sub> measurement is called.

With (CONTINUE) the “documentation menu” is called

Combustion O <sub>2</sub>	
Time	02.08.11 10:44
O <sub>2</sub> -CA	5,3 V%
O <sub>2</sub> -Diff	15,7 V%
CO-CA	84 ppm
P-CA	0,00 hPa
<div style="display: flex; justify-content: space-between;"> <span>CONTINUE</span> <span>▲ ▼</span> <span>REF</span> </div>	

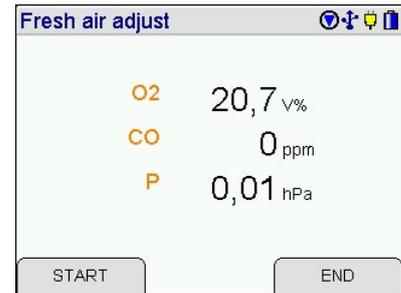
### 7.6 Fresh air adjust

This function allows a zero point calibration of all el.-chem. sensors and of the pressure sensor, before starting a flue gas analysis.

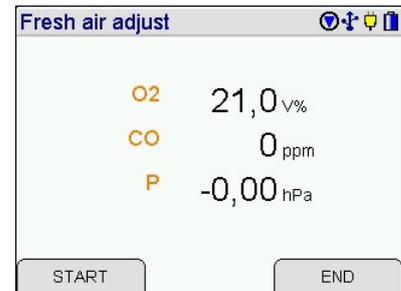
The display asks to care that fresh air may be sucked through the gas conditioner.

Fresh air adjust	
Inlet fresh air!	
<div style="display: flex; justify-content: space-between;"> <span>CONTINUE</span> <span>CANCEL</span> </div>	

Fresh air should be sucked in and no tube should be connected to the pressure inlets.



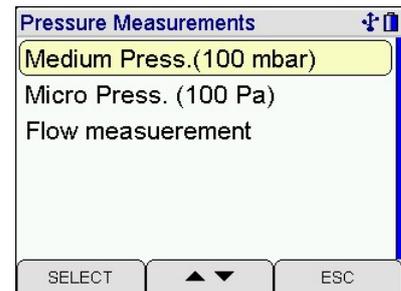
With (START) all zero points will be recalibrated.



## 8. Pressure measurements

Selectable pressure measurements are:

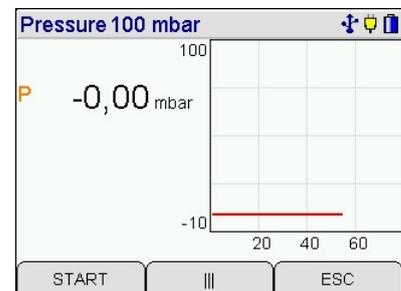
- Medium press. = pressure measurement up to 100 mbar
- Micro press. = pressure measurement up to 100 Pascal
- Flow measurement = flow measurement (only MSI EM200plus-i)



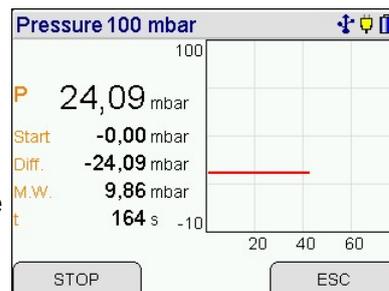
### 8.1 Medium pressure measurement

For pressure measurement (gas or nozzle pressure) connect pressure inlet (+) via pressure probe with the measuring point. For differential pressure measurement connect the pressure inlet (+) to the measuring point with the higher pressure.

Displayed are the pressure value with its dimension unit and a graphic with the deviation of pressure.



In the top line the actual type of pressure measurement is shown. On the left of the display screen the first value is the actual pressure value, the second value is the actual pressure at the beginning of this measurement, the third is the difference to the start value, the fourth is the mean value of the running measurement. The fifth value informs how long the pressure measurement is running.



## 8.2 Micro pressure measurement

For initial operation of gas fired heaters you need often to measure very low differential pressures. So e.g. the company "Buderus" requires in their installation manual for Logamax plus GB 162-80/100, to adjust the differential pressure ( $p_{\text{gas}}-p_{\text{air}}$ ) at -5 Pa.

The instrument therefore measures the pressure in the range of -100 to + 100 Pascal (100 Pa = 1 hPa) with a resolution of 0.1 Pascal.

The damping default in this case is "high". The damping setting of "low pressure measurement" does not affect the damping setting of other pressure measurements.

The further function is like it is written in "medium pressure measurement".

## 8.3 Flow measurement (only MSI EM200plus-i)

The gas velocity in the stack differs often in different points of a cross section; therefore several measurements have to be done to get a correct mean value.

The gas velocity can be averaged out of 60 individual measurements.

If "flow measurement" has been selected, the fuel type selection is called.

### 8.3.1 Fuel type selection

The measured differential pressure depends from the gas velocity but the gas type (mass of the gas) and the stack gas temperature will also matter. The gases in the stack are calculated from the fuel type.

After selection of the fuel type the flue gas temperature is called.

### 8.3.2 Flue gas temperature

The temperature dependence can not be neglected regarding stack gas opposite to measurement of gases with ambient air temperature. For this the stack gas temperature has to be measured and its influence has to be corrected.

The measurement of the stack gas temperature is done with a gas probe with integrated thermocouple. Connect the plug of the thermocouple with the bushing (marked TG) of the MSI EM200plus-i and insert the probe into the stack.

With (CONTINUE) the displayed stack temperature is accepted.

### 8.3.3 Start of flow measurement

The measurement of gas velocity is done with a pitot tube by measuring the differential pressure between total pressure and static pressure. To do this, the tubes outlet of total pressure has to be connected with the + pressure inlet and the outlet of the static pressure with the – pressure inlet of the MSI EM200plus-i.

Flow measurement	
Flow actual	18,3 m/s
Last value	17,6 m/s
Average	13,7 m/s
Measurements	10
MEASURE ZERO READY	

Displayed are the active flow, the result of the last measurement, the calculated average value of the temporary stored measurements and the number of all temporary stored measurements. With (ZERO) the active flow may be set to zero (zero point adjustment). With (MEASURE) the active flow will be temporary stored and the value is shown as last. The number of the temporary stored measurements will increase.

With (READY) the result of the flow measurement will be displayed.

With (CONTINUE) the documentation menu will be called.

Result	
Time	03.01.12 09:22
TG	32,0 °C
Measurement:	11
Average	14,4 m/s
CONTINUE REF	

## 9 Ambient air CO measurement

In some countries (e.g. Spain) exists a regulation, to measure ambient air CO at the site of a combustion to prove their tightness. For this the MSI EM200plus needs no external sensor. At a place with fresh air, without CO content, the value has to be 0 ppm. Is the reading not 0 ppm, pull the hose off of the gas inlet of the gas conditioner and wait for a while. Push (ZERO). The displayed value will become zero, this zero point is independent from the CO zero point of normal flue gas measurements.

Slip the hose on the gas inlet again!

After pushing (CONTINUE) the display reads the actual CO value of the ambient air.

CO ambient	
CO-A	-3 ppm
CONTINUE Zero ESC	

CO ambient	
CO-A	0 ppm
HOLD CANCEL	

# Instruction Manual Dräger MSI EM200plus + EM200plus-i

With (CONTINUE) the result of the ambient air CO measurement is displayed.



With (CONTINUE) the “documentation menu” is called.

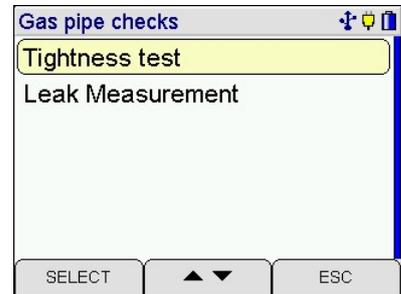
## 10. Gas pipe checks

### 10.1 Selection of gas pipe checks

Selectable functions are:

Tightness test = semiautomatic tightness test  
Leak measurement = leak rate measurement

**Observe national and international regulations concerning the handling of explosive gases!**



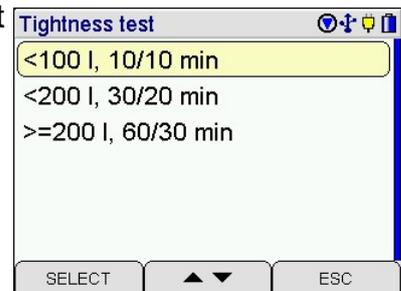
### 10.2 Semiautomatic tightness test according to DVGW-TRGI 2008

(not EM200plus with heating check or 4 Pa test)

The regulated stabilisation and measuring time for the different volumes of the gas pipes are displayed.

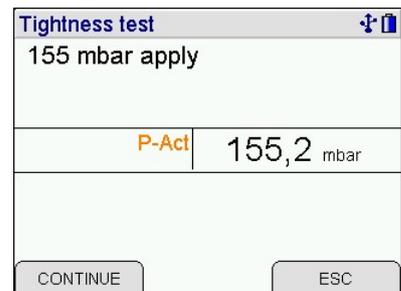
With (START) the stabilisation and measuring time of the marked volume will be adopted.

Connect the gas pipe with the pressure inlet (+) of the instrument.



Connect a hand pump and a valve with the gas pipe and increase the pressure to a little bit more than 155 mbar.

The instrument recognizes the pressure and with (CONTINUE) it asks to close the valve.



Is the valve closed start the stabilisation with (CONTINUE).

The actual pressure in the tested gas pipe and the elapsed stabilisation time are displayed.

Tightness test	
Stabilisation	
P-Act	154,1 mbar
Time	7:40 min
ESC	

After the stabilisation time (according to volume 10 to 60 min) the measurement starts automatically.

During the measurement the display informs about the pressure at the beginning, the actual pressure and the elapsed measuring time.

Tightness test	
Measurement	
P-Start	154,1 mbar
P-Act	154,1 mbar
Time	1:22 min
ESC	

After the measuring time the measurement will be finished automatically and the pressure at the beginning, the pressure at the end and the difference are displayed.

With (CONTINUE) the “documentation menu” is called.

Tightness test	
04.08.11 10:47	
Duration	10 min
P-Start	154,1 mbar
P-End	154,1 mbar
dP	0,0 mbar
CONTINUE	
REF	

## 10.3 Leak rate measurement (DVGW TRGI 2008)

With the MSI EM200plus it is possible to realize a leak rate measurement for gas pipe with 23, 50 respectively 100 mbar operational pressure. Are all installed consumers disconnected from the gas pipe by closed valves, the pressure has to be increased to 50, 55 respectively 110 mbar.

The measurement of gas pipes with an operational pressure of 100 mbar (test pressure 110 mbar) is not available in EM200plus with heating check or 4 Pa test.

Shut the gas pipe by valves. After determination of volume and increasing the pressure in the gas pipe up to 50, 55 respectively 110 mbar the pressure of the gas pipe will be measured for 1 min after the stabilisation phase. The leaking rate will be calculated, displayed and may be documented. If the measurement is made with ambient air, the result has to be multiplied with 1.68 to get the leak rate for natural gas.

### 10.3.1 Evaluation of gas pipe volume

Is the volume of the gas pipe known, change to “Frac volume” with (CONTINUE). Put in the first fraction of volume. Adopt it with (STORE) and put in the next fraction.

Pipe volume	
Inputs	1
Total	3,8 l
Section	'VOL'
Frac volume	4,8 l
STORE +/- READY	

Is the volume of the gas pipe unknown, the volume can be calculated with the diameter and the length of the gas pipe. Selectable diameters are: 'VOL', 35 mm, 28 mm, 22 mm, 15 mm, 2", 1½", 1¼", 1", ¾" and ½". With (CONTINUE) may be changed to “Length” and the length of the gas pipe fraction with the marked diameter may be putted in.

Pipe volume	
Inputs	3
Total	12,7 l
Section	1 1/2"
Length	3,0 m
CONTINUE +/- READY	

With (STORE) the fraction will be adopted. With (READY) the calculated gas pipe volume will be adopted and all fractions may be printed.

Pipe volume	
Inputs	3
Total	12,7 l
CONTINUE PRINT ESC	

With (CONTINUE) may be changed to the start of the leak measurement.

### 10.3.2 Start of leak measurement

Selectable operational pressures are 23 mbar, 50 mbar and 100 mbar. The test pressures are 50 mbar, 55 mbar and 110 mbar (DVGW TRGI 2008).

Connect the instrument with the gas pipe and (CONTINUE).

Leak measurement	
P-Test	50 mbar
P-Nom.	23 mbar
CONTINUE +/- ESC	

Close the gas supply (e.g. main valve behind the gas meter). Connect hand pump and valve with the gas pipe and increase the pressure to a little bit more than the test pressure.

Leak measurement	
Apply 50 mbar test pressure	
P-Act	0,0 mbar
ESC	

After a stabilization time of 30 seconds the measurement will start automatically.

Leak measurement	
Stabilisation	
P-Act	50,3 mbar
Time	0:14 min
ESC	

The currently calculated leak rate, the pressure at the beginning of the measurement, the actual pressure value and the elapsed measuring are displayed.

Leak measurement	
Measurement	
Leak rate	0,8 l/h
P-Start	50,4 mbar
P-Act	47,8 mbar
Time	0:53 min
ESC	

After 1 minute the measurement will be finished and the calculated volume, the duration of the measurement, the pressure at the beginning of the measurement, the measured pressure difference and the leak rate in l/h calculated for the operational pressure will be displayed.

Leak measurement	
02.08.11 13:46	
Volume	12,7 l
M.duration	1 min
P-Start	50,4 mbar
dP	3,1 mbar
Leak rate	1,0 l/h
CONTINUE	REF

## 11. Special functions

### 11.1 Measuring combustion air temperature

The MSI EM200plus is equipped with a built-in temperature sensor, which is able to measure in first approximation the temperature of the ambient (room temperature) and where applicable the temperature of the combustion air.

Is no external sensor plugged in the instrument gives a warning hint after the check function. In order to enhance the accuracy of the measurement and according to the requirements of EN 50379 part 1-3, it is recommended to use an external temperature probe. The instrument recognises if an external probe is connected and takes automatically the results measured by the adapted probe.

### 11.2 Automatic switch off

In order to increase the battery life time the instrument is provided with a standby function.

## 11.3 Shelter of the CO sensor

The instrument is equipped with a special function protecting the sensors from getting harmed by too high CO concentrations.

Already during the first contact with the flue gas the instrument realises how fast the concentration rises and recognises if the measuring range (8,000 ppm) will be exceeded.

### 11.3.1 Instruments without extension of CO measuring range

In instruments without extension of the CO measuring range the pump is switched off and the display demands to draw in fresh air.

With pushing a button the pump may be started again. Has the concentration been very high, it is possible that the concentration at the sensor is still > 8,000 ppm. In this case bars are displayed as the CO value.

Don't start measuring until the concentration is < 1,000 ppm.

### 11.3.2 Instruments with extension of CO measuring range

The instrument will start the flushing pump to protect the CO sensor and activate the extension of CO measuring range. CO may now be measured up to 3.000 %. The O<sub>2</sub> sensor remains active.

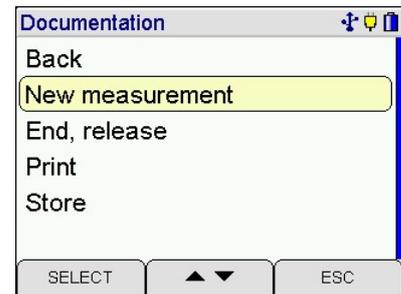
If the CO concentration becomes less than 0.600 % the flushing pump is switched off and the instrument will display the CO measurement values in ppm again.

## 11.4 Online data transfer

The instrument possesses an online data transfer feature. During normal measurement all measured data are transferred to the USB interface.

With the software **DERAS** from Dräger MSI all measured values may be shown online (numeric or graphic) on a PC's monitor. The software allows additional storing of the values in a chosen interval. The stored data may be printed in numeric or graphic charts.

## 12. Documentation menu



Selectable functions are:

- Back = Calls the last display screen of actual measurement
- New Measurement = Start of a new measurement of the same type
- End, release = End of measurement, the results are released
- Print = The result is printed on an IR-printer
- Store = Calls menu “store data”

## 13. Data processing

### 13.1 Store data

If no customer number is selected, the data will be stored with the type of measurement, date and time.

With (▲▼) mark number.



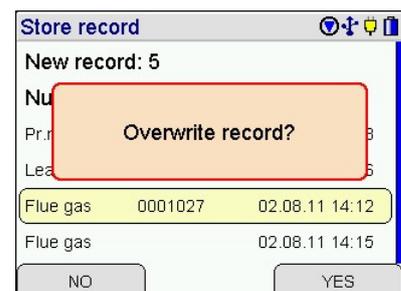
With (SELECT) call “selection and input of customer number”. This function makes it possible, to alter the displayed customer ID, to select another existing number or to create a new customer number.

With (▲▼) mark the wanted data record (a new or an existing one). The records may be displayed and stored with date, time and customer ID.

With (STORE) “New record” all values may be stored together with date and time.



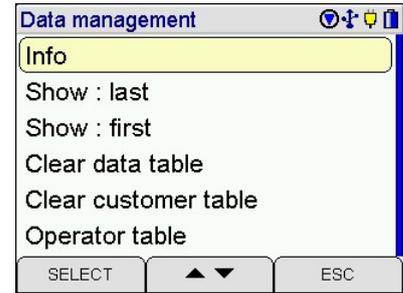
Is an existing data record selected, it could be overwritten.



### 13.2 Data menu

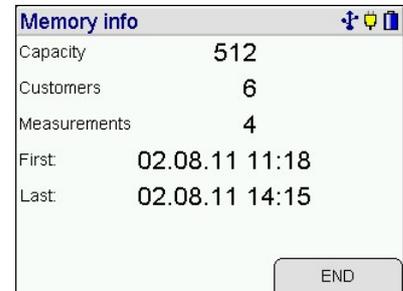
Selectable functions are:

- Info = info function of the data menu
- Show: last = shows last stored data record
- Show: first = shows first stored data record
- Clear data table = deletes all stored data records
- Clear customer table = deletes all stored customer data records
- Operator table = sight and adaption of the operator table



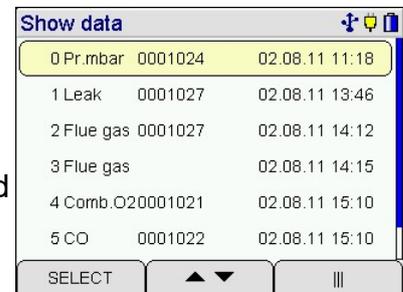
### 13.3 Info function of data menu

The display informs about the number of possible data records, the number of stored customer and measurement records and the date and time of the first and the last storing.

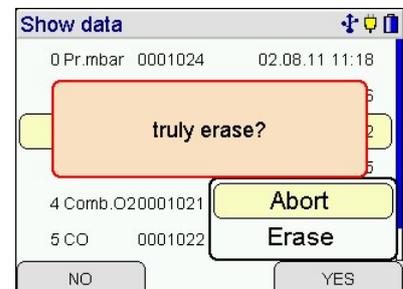


### 13.4 Show and delete stored data records

If "Show: first" or "Show: last" has been called, the stored data records are displayed. In the first case the first data record is marked, in the other case the last one is marked. Displayed are the type of measurement, customer ID, date and time of storing. With (SELECT) you may display the result screen of this measurement.



With the context menu a single data record may be deleted if the function is activated.

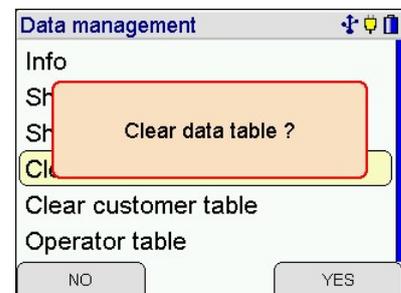


Following types of measurement may be shown:

Flue gas	= flue gas analysis / stack losses / average values
CO	= CO measurement
Comb. O <sub>2</sub>	= combustion air O <sub>2</sub> concentration in air ducts
Pr.mbar	= pressure measurements in the range up to 100 mbar
Pr.Pa	= pressure measurements in the range up to Pascal
CO amb.	= CO concentration in ambient air
BCI	= burner diagnostic
Tightn.	= tightness test of gas pipes
Leak	= leak rate measurement of gas pipes
Vis.insp.	= visual inspection

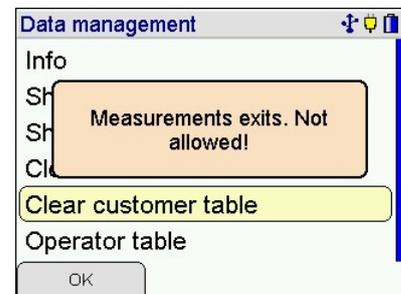
## 13.5 Clear data table

With (YES) all stored data records are deleted.



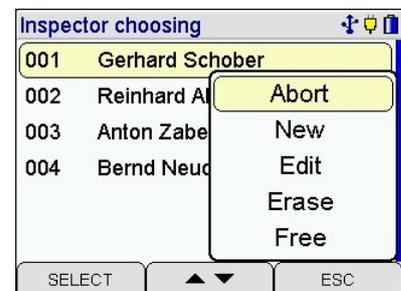
## 13.6 Clear customer table

The customer table only can be deleted, if no data records are stored.



## 13.7 Operator table

In the operator table you can built up a list of different operators. The selected operator is connected with the stored data record. An operator only can be deleted, if no data records are stored. Is (FREE) selected, no operator is connected to the measurements.



## 14. Info function

The instrument informs about the analyser (MSI EM200+), the manufacturer (Dräger MSI GmbH), the version of the firmware (e.g. 2.1.020) the serial number of the analyser, the date of the next service and actual date and time.

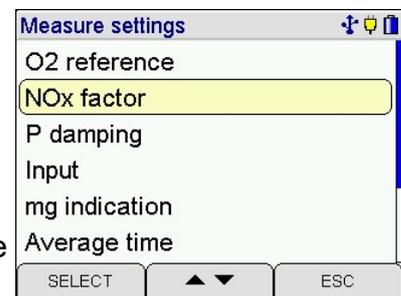
With (CONTINUE) all warning hints and error messages are displayed and a complete system report can be printed.



## 15. Measurement settings

Selectable functions are:

O <sub>2</sub> reference	= adjustment of the O <sub>2</sub> reference value
NO <sub>x</sub> -factor	= adjustment of NO <sub>x</sub> factor
P damping	= select the damping of the pressure sensor
Input	= activates / deactivates the input of boiler temperature and soot numbers
mg indication	= activates / deactivates the mg indication
Average time	= selection of the time for average measurement
Draft	= activates / deactivates additional measurement of chimney draft
Condens. boiler	= activates / deactivates stack loss calculation for condensing boilers
Factory settings	= restore measurement factory settings



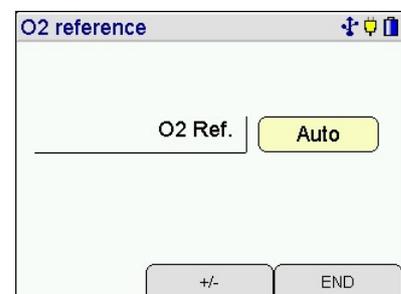
### 15.1 O<sub>2</sub> reference

With (+/-) the O<sub>2</sub> reference value may be modified.

Selectable settings are "Auto" and O<sub>2</sub> reference values from 0 % up to 21 %. "Auto" means, the O<sub>2</sub> reference value depends of the fuel type (liquid and gaseous fuels = 3 %).

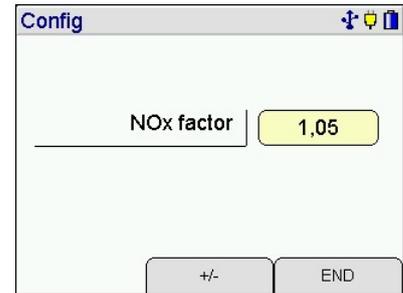
Concentrations regarding to the reference O<sub>2</sub> are calculated as follows:

$$CO_{\text{reference}} = CO_{\text{measured}} * (21 - O_2_{\text{reference}}) / (21 - O_2_{\text{measured}})$$



### 15.2 NOx factor (only for instruments with option NO sensor)

This function calculates NOx, if the part of NO<sub>2</sub> from NO is known. Is e.g. from a measurement known, that the NO<sub>2</sub> part is 5 % from the NO concentration, the NO measurement value has to be multiplied with 1.05, to get NOx. For this adjust the NOx factor to 1.05.

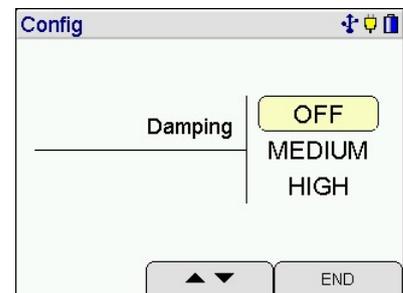


### 15.3 Damping of the pressure sensor

Selectable damping settings are:

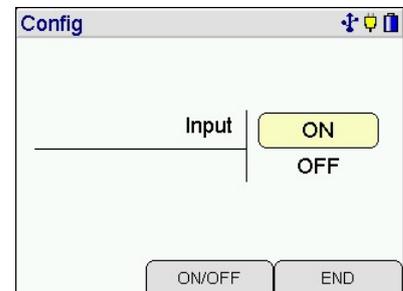
- OFF = no damping
- MEDIUM = medium damping
- HIGH = strong damping

The selected damping remains held even after switch off.



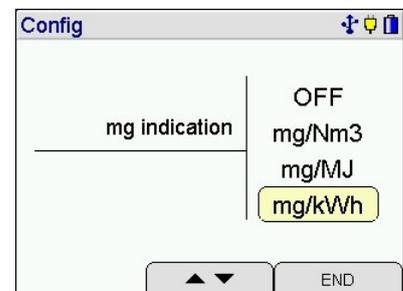
### 15.4 Input

Activating / deactivating the input of boiler temperature and soot numbers.



### 15.5 mg indication

- OFF = mg indication disabled
- mg/Nm<sup>3</sup> = indication in ppm and mg/m<sup>3</sup>
- mg/MJ = indication in ppm and mg/MJ (Mega-Joule)
- mg/kWh = indication in ppm and mg/kWh



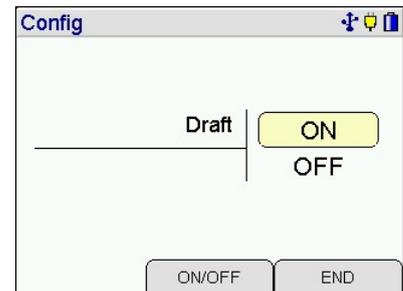
### 15.6 Average time

- 30 s = 30 seconds average time
- 60 s = 1 minute average time
- 15 min = average time needed for solid fuel combustions
- 30 min = 1/2 hour average time



### 15.7 Draft

Switches on and off the additional measurement of chimney draft.



### 15.8 Efficiency and stack loss

The stack loss of normal boilers is calculated as follows:

$$qA = (TG - TCA) * [( A2 / (21 - O2) ) + B ]$$

- With: TG = flue gas temperature
- TCA = combustion air temperature
- O2 = oxygen concentration of flue gas in Vol. %
- A2, B = fuel type dependent constants

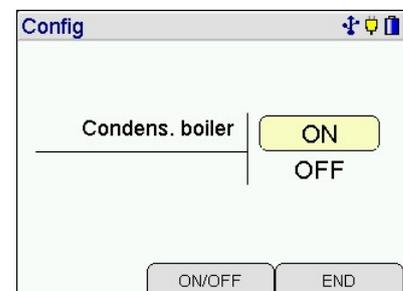
This stack loss is always calculated and displayed as qA and can be printed and stored. The efficiency is calculated from the stack loss as follows:  $\eta = 100 - qA$ .

If the calculation for condensing boilers is enabled the energy has to be considered, which became free when the flue gas condensates. Now the calculation of the stack loss for condensing boilers is:

$$qA_{CB} = qA - qA_{Cond}$$

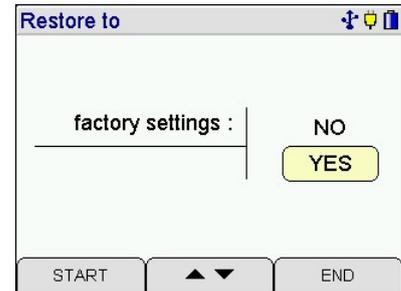
At this  $qA_{Cond}$  is a function, which depends from the fuel type, the flue gas temperature, and the difference "T<sub>dew</sub> – TG". The value of this function is zero or negative. T<sub>dew</sub> means "dew point temperature".

The stack loss for condensing boilers is displayed additionally as qA-CB, and may be printed and stored. The efficiency for condensing boilers is calculated from the stack loss qA-CB as follows:  $\eta_{CB} = 100 - qA_{CB}$ .



## 15.9 Measurement factory settings

With this function all modified measurement settings may be cancelled and the factory settings may be restored.



## 16. Device settings

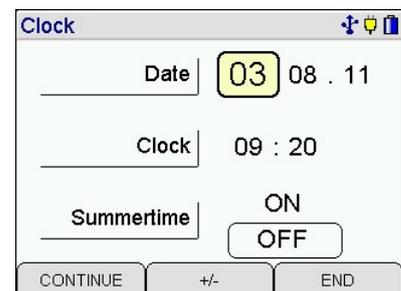
Selectable functions are:

Clock	= adjust date and time
Delete measurement	= delete a single data record
Backlight	= adjust backlight
Key beep	= switch on / off the key beep
Standby	= adjust standby time
Printer	= select HP or MSI printer protocol
Info window	= touch wipe of info window
Touchpad	= calibrate touchpad
Factory settings	= restore instrument factory settings
Language	= select language of display text



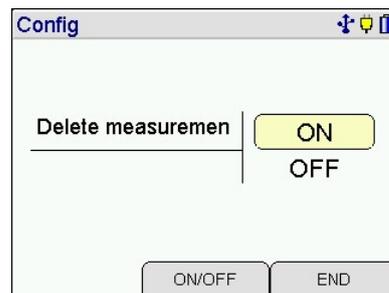
### 16.1 Date and time

Adjustment of date, time and automatic summertime.



## 16.2 Delete single measurement

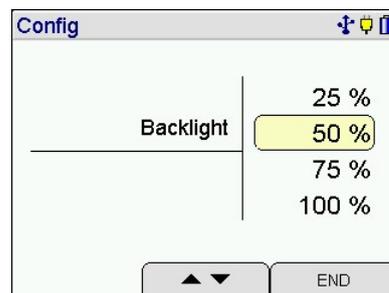
This function may allow deleting a single data record.



## 16.3 Backlight

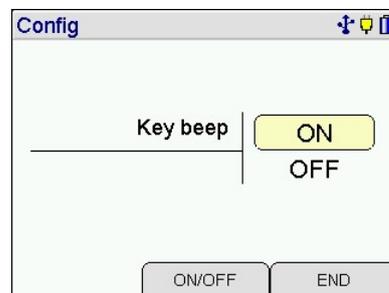
Selectable intensity levels are: 25 %, 50 %, 75 % und 100 %.

The selected intensity level remains held even after switch off.



## 16.4 Key beep

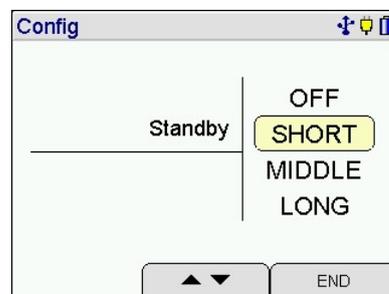
Switching on and off the key beep.



## 16.5 Standby

Adjustment of standby time.

- |        |   |
|--------|---|
| OFF    | = switch off standby function   |
| Short  | = switch off backlight after 30 s,<br>switch off instrument after 30 min    |
| MIDDLE | = switch off backlight after 60 s,<br>switch off instrument after 60 min    |
| LONG   | = switch off backlight after 10 min,<br>switch off instrument after 180 min |



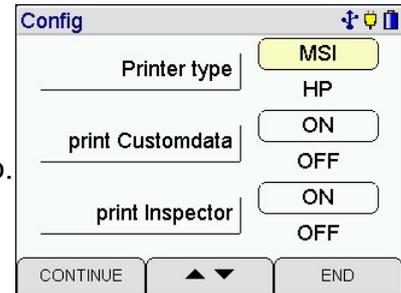
## 16.6 Printer

Printer MSI IR3: Data transfer and printing is much quicker than with HP compatible printers.

Printer HP: Data transfer is conforming to the HP protocol and fits to all HP compatible printers, of course for MSI IR3 too.

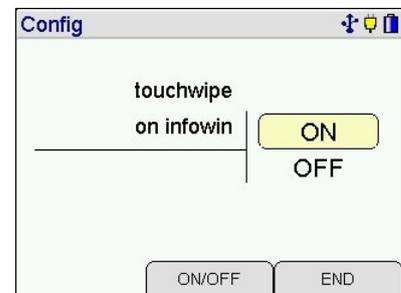
It may selected, if customer address and / or operator name will be printed.

The selected function remains held, even after switch off.



## 16.7 Info window

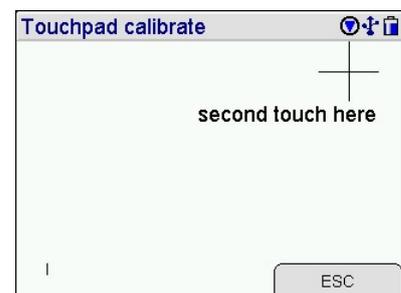
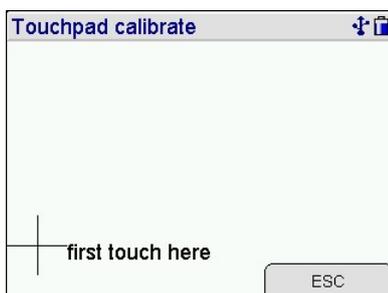
Switching on and off of the touch wipe function in the info window.



## 16.8 Touchpad

A calibration of the touch pad can be necessary so that the contact on the display will be realized at the right points.

**Be careful that you don't harm the display.**



First touch the middle of point 1 with a sharp object, e.g. a ball pen, after that retry it in point 2.

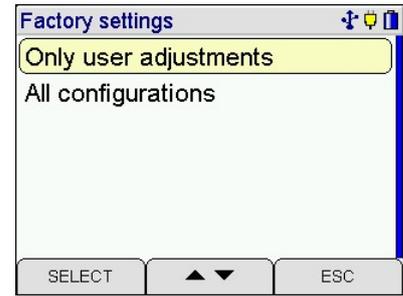
Now the touch pad is recalibrated and the contacts on the display will be realized at the right points.

## 16.9 Instrument factory settings

The function "Only user adjustments" cancels all modified settings and restores the factory settings.

The function "All configurations" does this too and restores additionally all configurations which are made with the PC-software, e.g. modified printer text or modified display screens.

With (SELECT) an assurance inquiry follows.



## 17. Warning hints, error messages and operation references

Already after being switched on, as well as during the measurement process, the instrument checks the function of all measuring channels. Warning hints and error messages are shown before the selection of functions or during normal function.

### 17.1 Warning hints

#### 17.1.1 TCA intern active

This warning hint (TCA = **T**emperature sensor for **C**ombustion **A**ir) is displayed if no external sensor is plugged in or if the instrument can not recognise it. The instrument switches to an internal temperature sensor, so that the stack loss and the efficiency may be measured without an external temperature sensor. The internal temperature sensor has not the accuracy and the response time of an external sensor and does not meet the demands of the EN 50379.

#### 17.1.2 TG missing / fault

This warning hint (TG = **T**emperature sensor for **F**lue **G**as) is displayed, if the thermocouple of the probe can not be detected, because it is missing (probe has no thermocouple) or because the thermocouple or the plug is faulty. All values, which need this temperature, are displayed as "- - -".

## 17.2 Error messages

Error message	Error cause	Remedy
O2 sensor	probe has been in flue sensor defect	calibrate again with fresh air service
CO sensor	probe has been in flue sensor defect	calibrate again with fresh air service
NO sensor	NO sensor has been without current others like CO sensor	check function, load battery see CO sensor
pressure sensor	sensor with pressure during calibration sensor defect	calibrate again without pressure service

Error message	Error reason; remedy
system temperature	operating temperature range exceeded; vary temperature, service
junction temperature	operating temperature range exceeded; vary temperature, service
battery temperature	operating temperature range exceeded; vary temperature, service
battery voltage	voltage not between 4.4 V and 6.5 V; replace battery (service)
battery current	battery current for charging or operating too high; service
battery error	battery manager data error; charge battery
set clock	clock lost data; charge battery, set clock
gas flow	gas flow out of operating range; check gas duct, service
options	data record options error; factory service
settings	wrong settings; check and change settings
calibration data	error in calibration data record; service
data memory	error in memory data record; service
next service	next service data error; service
fuel table	fuel table error; reload fuel table with PC program "PC200P"
display table	display table error; reload display table with PC program "PC200P"
printer table	printer table error; reload printer table with PC program "PC200P"
system configuration	system configuration error, service

## 17.3 Operation references

### 17.3.1 Operation references - symbols

On the display symbols may indicate following activated functions:

Symbol 1	charge of battery	
Symbol 2	battery is charging	
Symbol 3	error	
Symbol 4	internal pump is working	
Symbol 5	USB connection	
Symbol 6	Bluetooth connection	
Symbol 7	measuring range extension	

### 17.3.2 Electric power supply

The instrument possesses a rechargeable nickel metal hydride battery. In principle only the provided charger may be used for charging the instrument. The sensors of the instrument need continuous power supply (as well if the instrument is switched off). Please charge the instrument timely. Charge the measuring device after every use.

The charge condition of the battery is checked by the instrument and displayed. Becomes the voltage and the capacity of the battery too low, this is indicated by red flashing of a LED. The battery should be charged immediately.

The charging lasts 1 to 4 hours, depending on the charge condition. During charging the LED on top of the instrument is lighted red. At the beginning of the charging a green flashing of the LED indicates that battery and charging system are checked. After finishing of the charging the red light of the LED changes to green. That means the battery gets only conservation charge.

If the charging circuit has an error detected, the LED will flash green and red together. Please note, that the measuring instrument may be charged only at ambient temperatures between + 5 °C and + 35 °C. Do not charge or store the instrument in the sun.

Change battery only with an original MSI spare part.

If the charging has been forgotten, the instrument will be shut off automatically. If it is impossible to switch on the instrument, because of low voltage, plug in the charger and switch on the instrument again!!

## 18. Technical data

### 18.1 General technical data

general technical data	
humidity	10 - 90 % RH not condensing
barometric pressure	800 ... 1,100 hPa
operating temperature	+5 °C ... + 40 °C
storage temperature	-20 °C ... + 50 °C
dimensions	ca. 165 mm x 195 mm x 75 mm
weight	ca. 1,100 g
approvals	EN 50379 Part 1-3
charger	wall power supply prim. 100 - 240 V; sec. 12 V; 0.8 A
battery	internal NiMH battery, 4.8 V 2,000 mAh
gas sampling	membrane pumps for gas sampling and for cleansing of the sensor with fresh air in case of CO measuring range extension (Option)
gas conditioning	integrated, position independent, gas conditioning cartridge with condensate trap and particle filter
interfaces	USB as PC interface infrared for printer and PDA multiple function interface for accessory devices
display	colour display with touch screen

## 18.2 Technical data of measured and calculated values

Measure-	Principle	Range	Resolution	Accuracy
temperature combustion air	PTC	-10...+100 °C	0.1 °C	< ± 1 °C
temperature flue gas	thermocouple	-10...1000 °C	0.1 °C	< ± 2 °C or < ± 1.5% of mv
O <sub>2</sub> , oxygen	el.-chem. sensor	0 ... 25 Vol. %	0.1 Vol. %	< ± 0.3 Vol. %
CO, carbon monoxide	el.-chem. sensor, H <sub>2</sub> -compensated	0 ... 8,000 ppm	1 ppm	0... 4,000 ppm: < ± 20 ppm or < ± 5 % of mv
CO+ *, carbon monoxide	measuring range extension	0.600..3.000 Vol. %	0.001 Vol. %	< ± 10 % of mv
NO *, nitrogen monoxide	el.-chem. sensor	0 ... 2,000 ppm	1 ppm	± 5 ppm or < 5 % of mv
NO <sub>2</sub> *, nitrogen dioxide	el.-chem. sensor	0 ... 200 ppm	1 ppm	0 ... 100 ppm: ± 5 ppm or < 5 % of mv
SO <sub>2</sub> *, Sulfide dioxide	el.-chem. Sensor	0 ... 3,000 ppm	1 ppm	0 ... 500 ppm: ± 10 ppm or < 5 % of mv
low pressure	piezo-resistance	-100 ... +100 Pa	0.1 Pa	< ± 2 Pa or < ± 5 % of mv
draft	piezo-resistance	-10 ... +100 hPa	0.01 hPa	< ± 0.5 hPa or < ± 1% of mv
pressure (difference)	piezo-resistance	-10 ... +100 mbar	0.01 mbar	< ± 0.5 mbar or < ± 1% of mv
<b>Calculated values</b>				
CO, undiluted	calculated	0 ... 9,999 ppm	1 ppm	
CO <sub>2</sub>	calculated	0 ... 20 Vol. %	0.1 Vol. %	
stack loss	calculated	-20 ... +100 %	0.1 %	
excess air	calculated	1.00 ... +9.99 %	0.01 %	
CO, NO, SO <sub>2</sub> , NO <sub>2</sub>	calculation in	mg/ Nm <sup>3</sup> , mg/ kWh or mg/MJ		

mv = Measuring value, \* = option

## 19. Maintenance and service

### 19.1 Storing

El.-chem. gas sensors react to gases in the ambient, even if the instrument is switched off. Make sure, that the instrument is stored in a place with room temperature without contamination with solvents, exhaust gases or combustibles and that it becomes recharged periodically.

### 19.2 Maintenance

The gas conditioning cartridge should be cleaned after been in use. In addition to that, the cartridge should be checked due to tightness (O-ring seal). The filter discs and fleece have to be changed if dirty.

The housing of the instrument can be cleaned with a damp cloth. Take care that the gas outlet at the bottom of the instrument will not get blocked.

### 19.3 Service

In order to assure accurate measurement and the reliability of the functions the instrument should be checked according to requirement of EN 50379 and if applicable be calibrated by an authorised service point once a year.

### 19.4 Consumables and accessories

Printer with infra-red data transmission 5600401

Paper for IR-printer 5690151

Consumable set 2 5600411  
consisting of:

10 x disc filter

20 x filter fleece ø 26

## 20. China RoHS 2

Part Name	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
O2 sensor	X	O	O	O	O	O
PCBA main	X	O	X	O	O	O
PCBA display	X	O	X	O	O	O
Brass parts	X	O	O	O	O	O

This table is prepared in accordance with the Provisions of SJ/T 11364.

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

X: Indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.