

HAND-HELD GAS ANALYSER

Manual

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madur
E L E C T R O N I C S

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1. INTRODUCTION

GA-12 gas analyser is a high quality hand-held analyser that is built using the most advanced materials and techniques. It is designated to measure combustion gases concentrations, to ease with boilers' regulations and for leakage tests. The device is closed in a durable and handy housing. The analyser is powered by four AA 1,5 alkaline batteries or by build-in Li-Ion battery (it allows to work with the device for up to 16 hours without recharging). Build-in IR diode allows to communicate with the Martel thermal printer, this makes possible to print the measurement results right in the measurement location.

We ask to devote some time to get familiar with this manual, as it allows you to know the device better and ease its maintenance. The proper handling assures the failure-free operation.

2. CONSTRUCTION OF THE GA-12 GAS ANALYSER

The GA-12 gas analyser is a device designed to perform combustion gases measurements and leakage tests, helps to maintenance boilers.

To ease the work with the analyser, it is closed in a handy, durable ABS housing of dimensions: 117x72x47. The device is powered by four R6 (AA) 1,5V batteries, or by internal Li-Ion battery, which allows to work in a tough conditions where there is no possibility to connect it to the mains.

2.1. Electric connections

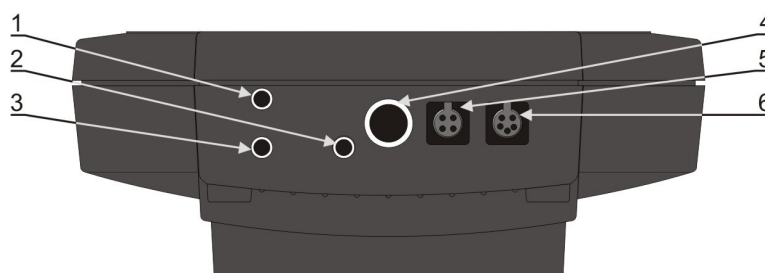
The analyser has a number of electric and pneumatic connections. They are all located on the top and bottom part of the analyser's housing. The connections of the top part are shown in the drawing below:



Drawing 1. Analyser's connection in the top part of the housing.

1. External power supply connector
2. IR diode for communication with suitable printer
3. RS-232 communication port

The connections available in the bottom part of the housing:



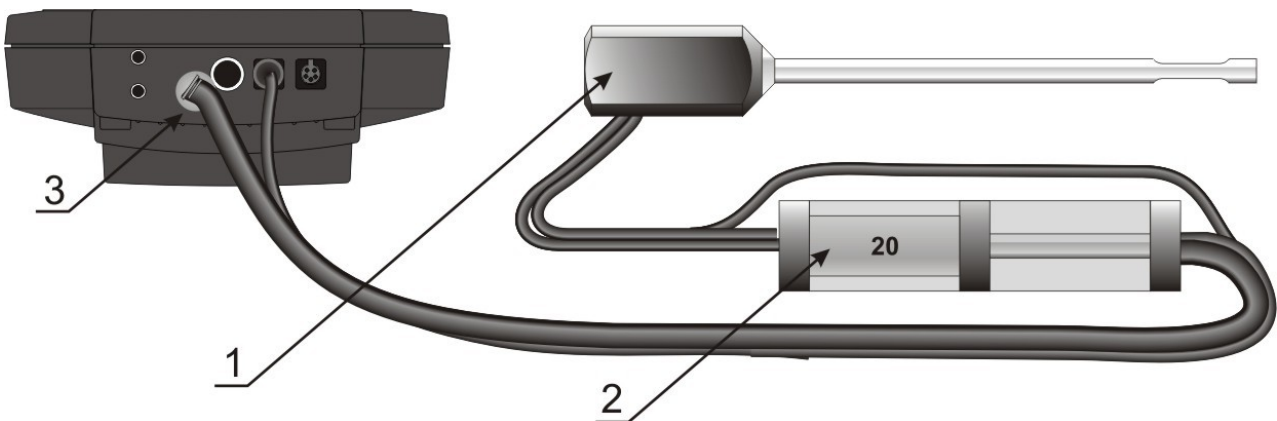
Drawing 2. Connections in the bottom part of the analyser

1. Press+ – inlet for the differential pressure sensor.
2. Inlet for the measurement gas.
3. Press- – inlet for the differential pressure sensor.
4. Gas outlet
5. Electric connection for the gas probe (for gas temperature measurement).
6. Ambient humidity sensor's connector

2.2. Gas channel

Elements of the analyser's gas channel:

1. Gas probe
2. In-line filter fitted on the gas probe's hose.
3. Gas chamber with electrochemical sensors inside of the analyser

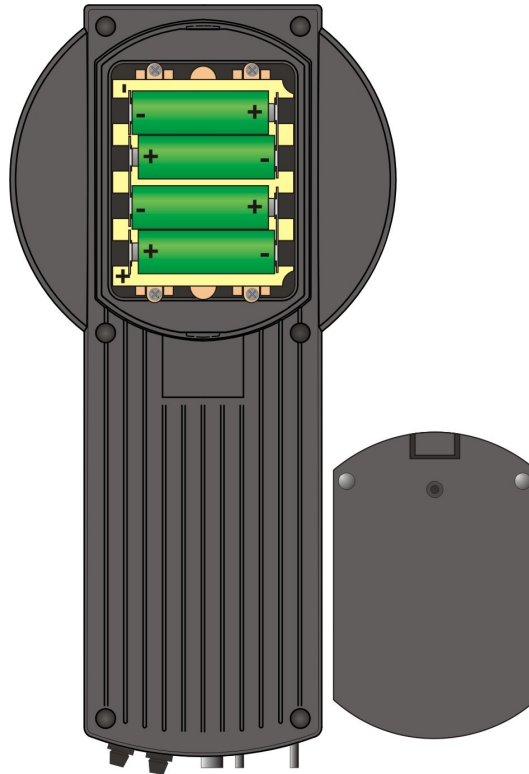


Drawing 3. Elements of the gas channel

2.3. Supply

GA-12 analyser is supplied by four R6 1,5V batteries or by internal Li-Ion battery.

The analyser is equipped with external power supply connector (located in the top part of the analyser's housing) – it is dedicated only to internal Li-Ion battery and supplied by producer only when the Li-Ion battery option is selected. Power supply specification: 9÷18 VDC / 500mA



Drawing 4. R6 batteries arrangement

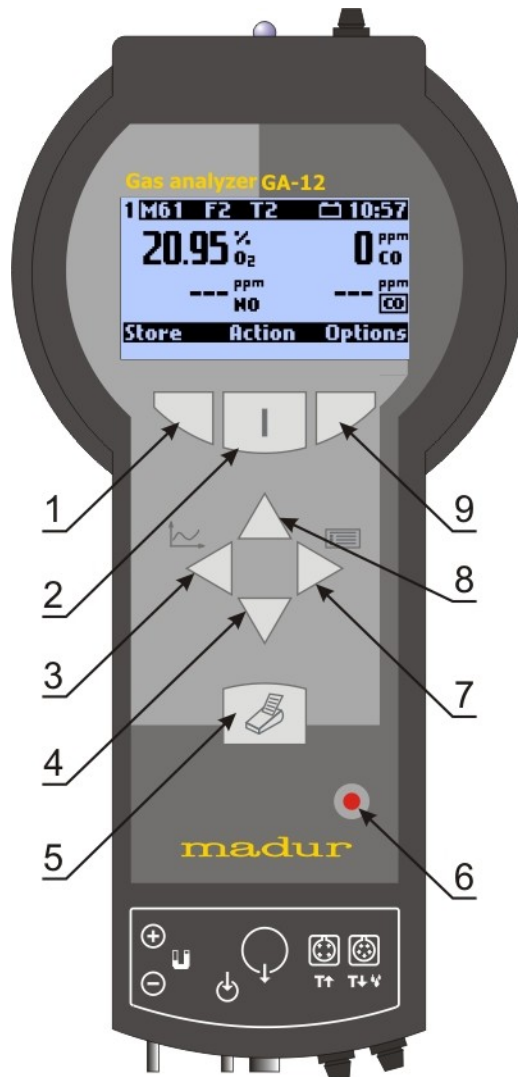
It is possible to use LR6 AA 1,5V alkaline batteries or 1,2V NiMH / NI-Cd rechargeable batteries.

When alkaline batteries are replaced with rechargeable ones and user will connect the power supply to analyser's connector, the batteries will NOT be CHARGED. One has to use third party chargers to recharge.

If the analyser is equipped Li-Ion battery then the battery cover is secured with screw and the analyser is equipped with external power supply that charges the inside battery.

3. MAINTENANCE OF GA-12

3.1. Keyboard







Drawing 5. GA-12 keyboard

Actions assigned to keyboard's keys:

1. Left function key – it evokes an action described in the display above this key.
2. Power-on button / Middle action key. When the device is off, to turn it on press and hold this button. When the device is already on, this key evokes actions described in the display above the key.
3. Left arrow key – during data edition move cursor left. It also allows to change an option or to call Graph screen.


4. Down arrow key – moves cursor down while navigating through screens and allows to switch between results screens.
5. Print – calls print screen.
6. Power-off button
7. Right arrow key – during data edition move cursor right. It also allows to change an option.
8. Up arrow key – moves cursor up while navigating through screens and allows to switch between results screens.
9. Right function key – it evokes an action described in the display above this key.

3.1.1. Entering numeric values

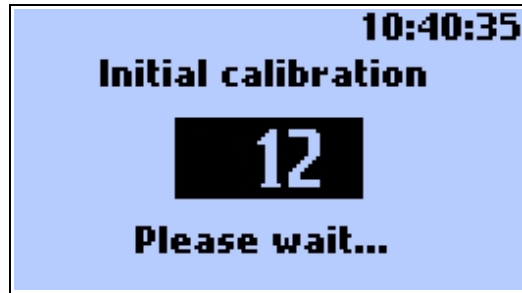
Use left / right ( & ) arrow keys to set a digit to change. Use up / down ( & ) arrow keys to change the digit.

3.2. Starting the analyser

Before turning on the analyser do the following:

1. Check the condition of the gas probe's in-line filter. If it is dirty or damaged it needs to be cleaned or replaced with the new one.
2. Connect the gaseous tubing to the analyser's gas inlet.
3. Place the gas probe in the fresh air – it will be used for the initial calibration of gas sensors.
4. Make sure that the gas outlet is not blocked.
5. Turn on the analyser by pressing and holding the  button. If the analyser doesn't start-up it may mean that its battery is discharged – replace the batteries with a new set or connect the external power supply.

After the start-up, the analyser proceeds with the initial calibration. During this phase it should draw the fresh air through the gas probe.



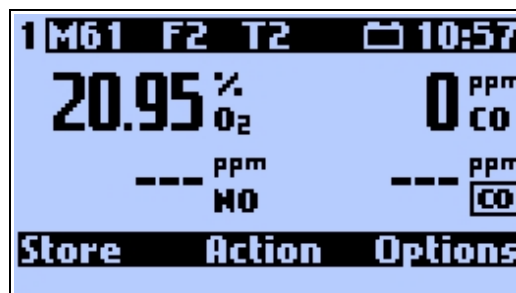
Drawing 6. Initial calibration screen.

The icon in the top-left corner of the screen shows the load of the battery. When the initial calibration is done, the Parameter's screen is displayed. It allows to check / set measurement parameters.

3.3. Screens

3.3.1. Results screens


To enter the Results screen (available from any other screen) press ESC or Results function keys. The drawing below shows an example Results screen:









Drawing 7. Results screen

In the top part of the display there is an informative bar. The meaning of the symbols, starting from the left:

- **1** - The first out four possible Results screen. To switch between those screens use up / down arrow keys.
- **M61** - Informs about the the available memory for reports. M61 means there is a space for another 61 reports.
- **F2** - Selected fuel. The analyser has 10 fuels stored in its memory – 6 are defined by producer, user can modify the remaining 4 fuels and their parameters. Fuels are numbered fro 0 to 9.

- T_2 - Results averaging time. Times available to select: 2; 10; 20; 30; 60; 120; 180 seconds.
-  - informs about the battery load. When the battery discharges, its symbol changes to inform about the current load:

	>80%
	>60%
	>40%
	>20%
	>10%
	<10%

Drawing 8. Battery load symbol

If the external supply is plugged-in then the battery symbol changes to: .

- 12:48 - Current time.

In the bottom part of the display there is a function keys' description bar. Function keys are located beneath the display, their action may vary depended on the screen user is currently viewing. The function currently assigned to each of the function keys is described on this bar. More information can be found in chapter: Menu.

The middle part of the screen shows current results and calculations. The analyser samples results every 2 seconds. All values are averaged according to the selected averaging time. Averaging time is set by user in the Measurement parameters. Averaging time is used for "smoothing" the results:

The example 1: averaging time = 2 seconds

In time T_0 the analyser shows result measured / calculated in time T_0 .

In time T_2 the analyser shows result measured / calculated in time T_2 .

The example 2: averaging time = 10 seconds

In time T_{10} the analyser shows result: $(T_0 + T_2 + T_4 + T_6 + T_8) / 5$

In time T_{12} the analyser shows result: $(T_2 + T_4 + T_6 + T_8 + T_{10}) / 5$

The contents of the screens can be freely defined by the user. To do so, one must use PC computer software – *mPortable.exe*. The program can be found on the software CD included with the analyser. On the CD there are also several configuration examples: "ResScreens_1.bin", ..."ResScreens_4.bin"

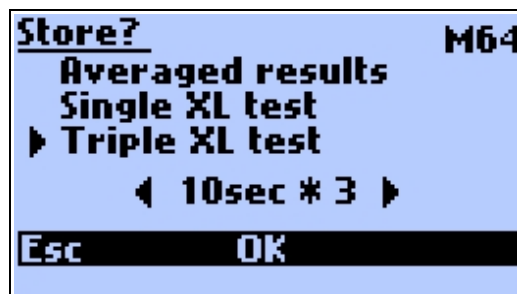
Keyboard short-cuts to the following screens and options available from the Results screen:

- Store? - Left function key (M+)
- Action - Middle function key
- *Measurement parameters* - Right function key
- Graph - Left arrow key
- Menu - Right Arrow Key
- *Print?* - Printer button key

3.3.2. Store?

To access *Store?* Screen press left function key on any other screen.

Measurement results are stored into reports. Report contains all the measured values. If the report is to contain the chimney draught or the soot test, user must perform suitable measurement or to enter soot test results.



Drawing 9. *Store?* screen

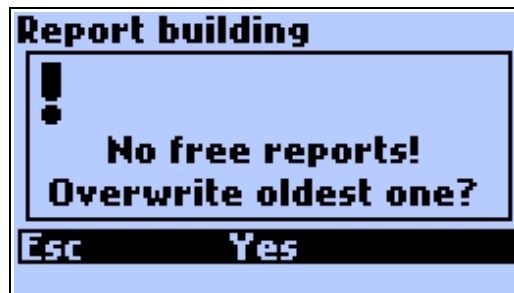
Store? Screen has three options:

- *Current results* – Results that are currently shown on the display (currently measured) are stored
- *Single XL measurement* – Averaged results are stored. XL (extra large) describes special data format with a long averaging time. XL time can be set in the Parameters II screen or at the current screen using left / right arrow keys. Available storage times: 10s, 20s, 30s, 1min, 2min, 5min, 10min, 15min, 20min, 30min.

When the XL test is running, the battery load icon is replaced with a number of the current XL test (X1, X2, X3) and the clock counts time till the end of the test. The analyser beeps every two seconds when the test is running.

- *Triple XL measurement* – Storage of three single XL measurement, one after the other. Each measurement is stored a separate report.

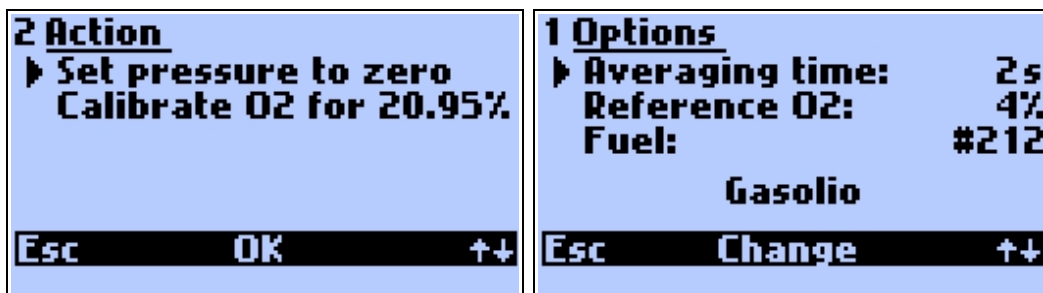
If the analyser's memory is full, the attempt to store another report will warn the user with the screen in the drawing below:



Drawing 10. Warning about the memory being full.

3.3.3. Action

Action screen is called from one of the Results screen by pressing the middle function key. This screen contains quick access to functions useful during the measurements



Drawing 11. Action screen.

There are more functions available in the Action screen than one screen can display, to scroll press the Right function key **++**. Below we present functions available from the Action screen:

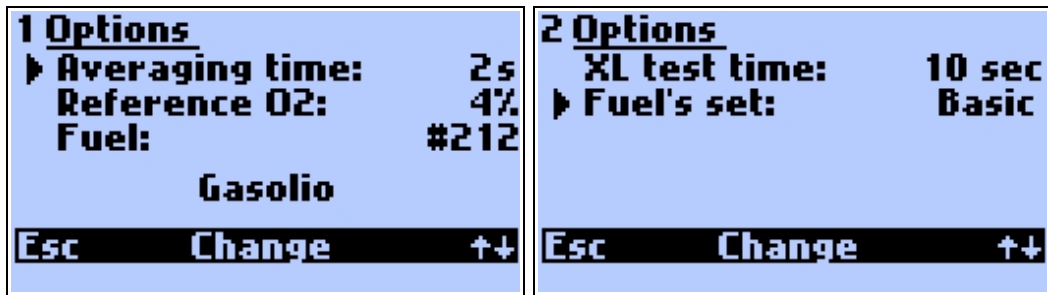
- **HOLD *** – Currently measured results are frozen on the screen. Press again the same function key to unfreeze the results. HOLD mode is indicated by flashing * over the middle function key.

HOLDing the result may also disable the pump. This setting is made from the PC software mPortable.exe – option “*Pump stop when HOLD*”. If this option is on, then every HOLD of the results will stop the pump until the results are unfrozen.

- Pressure measurement – allows to perform differential pressure measurement (see chapter: Pressure measurement)
- Soot measurement – allows to enter 3 values of the soot test.
- Ambient CO measurement – starts the measurement of CO concentration in the ambient air (see chapter: Ambient CO test)
- Leakage test – starts test for gas system tightness
- Zero the pressure sensor – this command performs relative zeroing of the pressure sensor. This means that the currently measured value of pressure is assumed as the zero. It is important to perform the zero pressure sensor only before starting the measurements. Moreover, the analyser should be in the same position during the measurements as it was during zeroing the pressure sensor.
- Calibrate O₂ – to increase the accuracy of long-term measurements, the GA-12 analyser allows to calibrate O₂ sensor on the fresh air. Before calibrating the sensor one must remember to extract the probe from the stack and wait for O₂ sensor values to stabilise.

3.3.4. Measurement parameters

To access Measurement parameters screen press right function key while in the Results screen. This is where one can adjust basic parameters that have influence on the measurement results.



Drawing 12. Measurement parameters screen

Parameters that user can adjust here:

- *Averaging time* – The analyser stores, in its internal buffer, the results every 2 seconds. However the results displayed on the screen are averaged for the selected time. To select averaging time press Change function key or left / right arrow keys. Available averaging times: 2, 10, 20, 30, 60, 120, 180 seconds.
- *Reference O2* – this is the oxygen value used for calculations of e.g. mass concentrations of gases referred to oxygen. Use left / right arrow keys to change the O2 reference value. Range of change 0..13%, step 1%. If, in the PC software's setting, one of the following is selected: *Önorm fuels* or *Use O2ref from fuel data*, then it is not be possible to change the O2 reference value from the analyser's settings – the O2 reference value stored in fuel parameters is used.
- *Fuel* – Currently set fuel – its parameters are used for all the calculations. Fuel parameters are stored in the analyser from the PC software. From the analyser's menu, user can select one of the stored fuels – use Change function key or left / right arrow keys. The fuel number is display on the right, the fuel's name is displayed in the line beneath.
- *XL measurement* – sets the time of single XL measurement. Use Change function key or left / right arrow keys to adjust it. Available XL measurement times: 2s, 6s, 10s, 20s, 30s, 1min, 2min, 3min.
- *Fuel* – Currently selected fuel, its parameters are used for calculating values. Parameters of fuels F0÷F5 are defined by producer and stored permanently in the device and they cannot be changed. Fuels F6÷F9 are editable by user from the PC software. To change the Fuel press Change function key or use

left / right arrow keys. The number in the line, on the right (in the drawing above it is #212) represents the number of the fuel in the PC software database, below this line there is the fuel's name.

- *XL test time* – the time of a single XL test. To change it press the Change function key or left / right arrow keys. Available to select: 10s, 20s, 30s, 1min, 2min, 5min, 10min, 15min, 20min, 30min.
- *Fuel's set* – allows to select the default set of fuels F0÷F5. Depended on the norms (e.g. in different countries) the default fuels may have different parameters.

Available set of fuels:

- Standard

#	Name	CO ₂ max [%]	HV [MJ/kg]	A	B	α	O ₂ rel [%]	Vss [m ³]	Vair [m ³]	Td [°C]
F0	Light oil	15,4	42,7	0,50	0,007	52	3	10,53	11,20	48,0
F1	Natural gas	11,7	35,9	0,37	0,009	32	3	8,56	9,54	56,0
F2	Town gas	13,1	16,1	0,35	0,011	32	3	3,61	3,90	60,0
F3	Coke-oven gas	10,2	17,4	0,29	0,011	32	3	3,86	4,28	64,3
F4	Liquid gas	14,0	9,32	0,42	0,008	32	3	22,30	24,36	55,0
F5	Extra light oil	15,3	4,18	0,42	0,000	52	3	10,53	11,20	47,0

Table 1. Parameters of the standard set of fuels

- Önorm (Austrian)

#	Name	CO ₂ max [%]	HV [MJ/kg]	A	B	α	O ₂ rel [%]	Vss [m ³]	Vair [m ³]	Td [°C]
F0	Erdgas	11,8	34,4	0,37	0,010	32	3	8,56	9,54	56,0
F1	Flüssiggas	16,0	94,7	0,43	0,008	32	3	22,30	24,36	55,0
F2	Heizöl extraleicht	15,3	42,9	0,5	0,007	52	3	10,53	11,2	47,0
F3	Heizöl leicht	15,7	42,0	0,52	0,007	52	3	10,53	11,2	48,0
F4	Holz (Brik-Pel)	20,3	15,6	0,65	0,010	69	13	3,87	3,90	57,5
F5	Kohle	18,7	31,0	0,61	0,005	69	6	7,70	7,91	44,3

Table 2. Parameters of the Önorm set of fuels (Austrian)

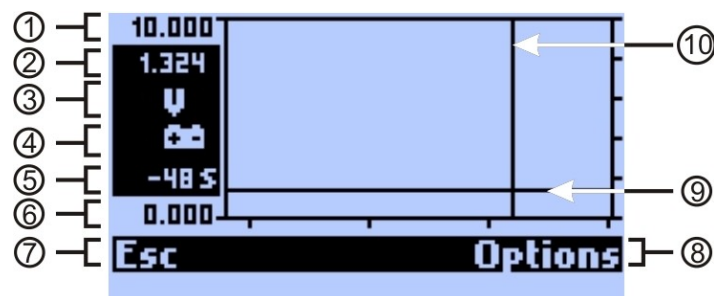
- Italian

#	Name	CO ₂ max [%]	HV [MJ/kg]	A	B	α	O ₂ rel [%]	Vss [m ³]	Vair [m ³]	Td [°C]
F0	Gas naturale	15,4	42,7	0,66	0,007	52	3	10,53	11,20	48,0
F1	GPL	11,7	35,9	0,63	0,009	32	3	8,56	9,54	56,0
F2	Gasolio	13,1	16,1	0,68	0,011	32	3	3,61	3,90	60,0
F3	Olii combustibili	10,2	17,4	0,68	0,011	32	3	3,86	4,28	64,3
F4	Holz (Brik-Pel)	20,3	15,6	0,65	0,010	69	13	3,87	3,90	57,5
F5	---	18,7	31,0	0,61	0,005	69	6	7,70	7,91	44,3

Table 3. Parameters of the Italian set of fuels

3.3.5. Graph

The analyser keeps in its buffer measurement results for the last 190 seconds – this allows to show results in a graph form. The current result is displayed on the right side of the graph, the “oldest” values are on the left. The graph is scrolled from left to right according to the time passing.



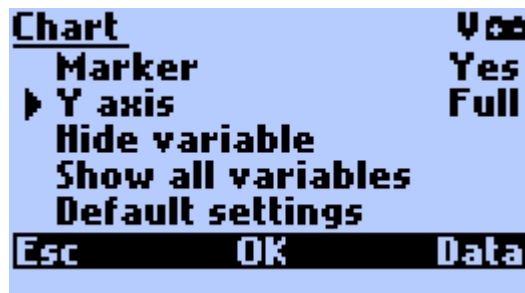
Drawing 13. Graph screen

Graph screen contains the following elements:

1. Y axis maximum value.
2. Currently measured value, or, if the marker is on, the value indicated by the marker.
3. Value's unit (in the drawing it is voltage unit: V). It appears automatically with the measurement value (2).
4. Measurement value (in the drawing: the measurement value is battery voltage – represented by the battery icon). To change the measurement value use up/down arrow keys.
5. Marker's time – indicates the time the marker is pointing at. In the drawing it shows value measured 64 seconds ago. To change the position of the marker use left / right arrow keys.

6. Y axis minimum value.
7. ESC – returns to standard Results screen.
8. Options – calls Graph options screen
9. Value's graph for the last 190 seconds
10. Marker – allows to view the result value for the selected time.

3.3.5.1. Graph options



Drawing 14. Graph options screen

Here user can change the graph settings. Use up / down arrow keys to navigate through the available options, press Change function key to turn on / off the selected option.

Description of the graph options:

- Marker – Shows / hides the marker on the graph.
- Y axis – allows to change the way the Y axis is defined:
 - Auto – the scale is set automatically according to the minimal and maximal value currently visible in the screen.
 - Full – the scale is equal to the maximum possible range for the specified value.
 - Manual – the scale is defined by user in the PC software.
- Hide variable – hides the variable from the graph (variable's symbol is shown in the top right part of the screen).
- Show all variables – shows all variables on the graph screen.
- Default settings – restores graph default settings.

3.3.6. Menu

From any of the Results screen user can call Menu screen – press right arrow key.

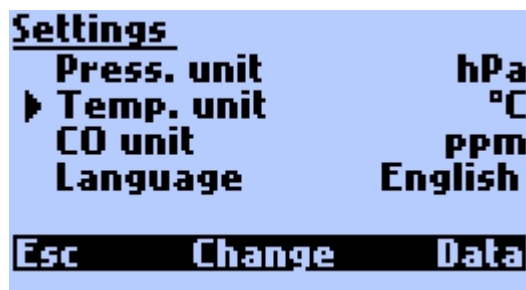


Drawing 15. Menu screen.

Each line of the Menu screen calls the following screens with settings and calibrations:

- Settings – device basic settings
- Burner regulation – monitors the most important parameters of the burner to ease with its regulation
- Reports – allows to view the reports stored in the device memory.
- Clock – allows to change clock settings
- Service – Service settings

3.3.6.1. Settings



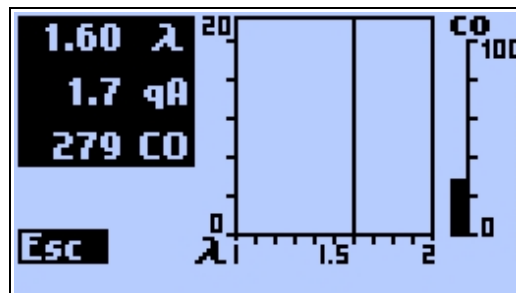
Drawing 16. Settings screen

Basic settings of the analyser. Navigate using up / down arrow keys, change settings by pressing Change function key or by left / right arrow keys.

Setting available to change here:

- Press. Unit – allows to change the unit of the pressure – it is used in the printouts and to present values on the screen. Available units: hPa, Pa, mmH₂O and inH₂O.
- Temp. unit – allows to change the temperature unit. Available: °C or °F.
- CO unit – if the analyser is equipped with high range CO sensor it allows to change the unit of CO measurements: ppm or %
- Language – allows to change the analyser's language. As default English and German are always loaded to the analyser's memory. It is possible to order the device with your national language. In case of accidental change of language, to restore the default language, press left function key when starting up the analyser. The default analyser's language is selected from the PC software.

3.3.6.2. Burner regulation



Drawing 17. Burner regulation screen.

Burner regulation screen is useful when user needs to regulate a burner. On the left side of the screen the analyser shows currently measured values: excess air coefficient α , stack loss q_A , and CO concentration. On the right part of the screen there is a graph that shows changes of excess air coefficient α and CO concentration.

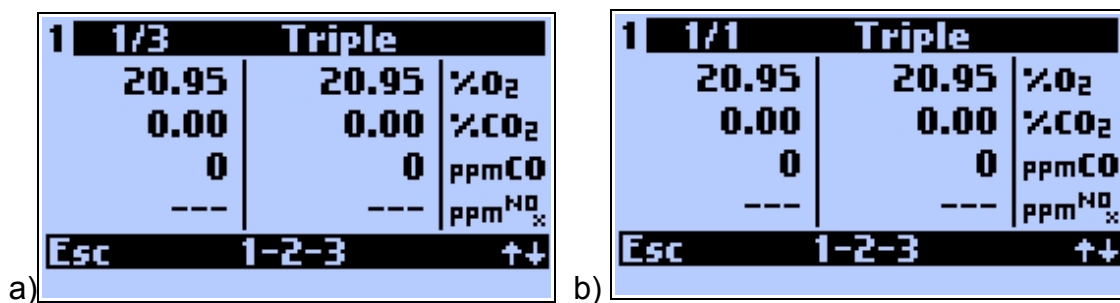
3.3.6.3. Reports

This screen allows to manage the stored reports.



Drawing 18. Reports screen

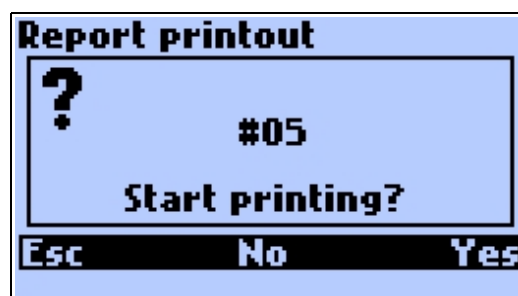
To view a report select it from the Reports screen (use up / down arrow keys) and press Right arrow key. Each report consists of four screens which contains stored values of measurements. Right function key (beneath the icon **++**) switches between the contents of the report. Each screen is organised into columns. The left column shows results of a single measurement. The middle column shows averaged results of three measurements – in case of triple XL test report. In case of single report the left and the middle column show the same results (as shown in the drawings below). The right column shows the label and the unit of the value. In the top bar there is an info about the type of the stored report: (1/1) – Single XL test; (1/3; 2/3; 3/3) – triple XL test.



Drawing 19. Report's results screen: a) Single XL test 1/1; b) Triple XL test 1/3.

The middle function key 1-2-3 switches between the following measurements reports of a triple XL test.

The Print function key in the Reports screen calls the screen in the picture below:



Drawing 20. Confirmation of a single report printout

Pressing Esc or No returns to previous window. Yes starts the printout.

If a report you want to print is a part of 3 XL test then a bit different screen is called:



Drawing 21. Confirmation of one of 3XL test printout

Esc returns to previous screen. Yes prints selected report from the 3XL test. Triple averages and prints results of all three 3XL test in one printout.

Be sure that the printer is on and that its receiver is directed at the top part of the analyser (where the IR communication diode is installed).

To erase a report from analyser's memory press Erase function key. You will be asked to confirm deletion with the screen below:

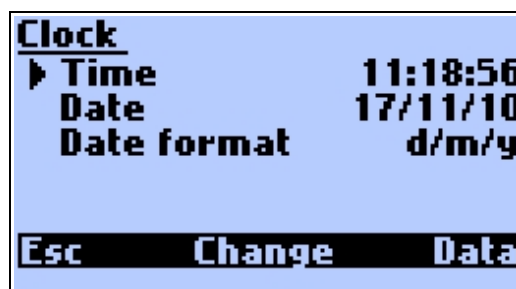


Drawing 22. Confirmation before erasing a report from analyser's memory.

Esc returns to previous window. Yes erases the selected report, and All erases all the reports stored in the memory.

3.3.6.4. Clock

Clock option allows to set the time and date



Drawing 23. Clock settings

Clock options available:

- Time – use left / right arrow keys to select a digit to change, use up / down arrow keys to change the digit:

**Drawing 24. Time adjustment**

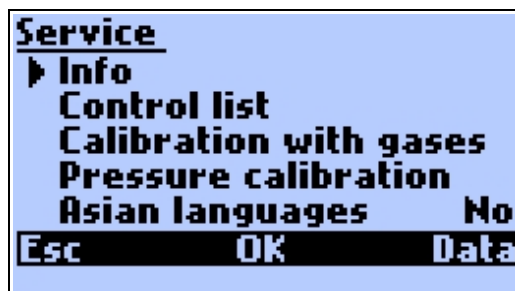
- Date:

**Drawing 25. Date adjustment**

- Date format – allows to select how the date is displayed, two formats are available: dd/mm/yy (day/month/year) or mm/dd/yy (month/day/year)

3.3.6.5. Service

Options available in the Service menu should be carried out by authorised staff. Changes of options here may cause improper operation or even malfunction.

**Drawing 26. Service menu screen.**

Options available in the menu screen:

- Info – displays detailed information about the analyser:

1 GA12 info		2 GA12 info	
Software:	5.4.2	O2 sensor:	O2-A2
Serial No:	12347039	CO sensor:	CO-AF
Last report:	#00044	NO sensor:	---
Fast printer:	Yes	XX sensor:	---
Pdif sensor:	20hPa	CO range:	4kppm
Esc	↑↓	Esc	↑↓
Data		Data	

Drawing 27. Information in the Info screen.

- Control list – displays all measured by the analyser signals. This is useful when troubleshooting.

1 Control list			
Ta	27	0.0	32767

Tg	---	---	32767
Tc	27	2518.7	16347
O2	20.95		22078
Esc	↑↓		Data

Drawing 28. Control list screen

- Calibration with gases – allows gaseous calibration of the device.
- Pressure calibration – allows to perform pressure sensor calibration.
- Asian languages – allows to display Asian language characters. If the device is equipped with large Flash memory (512 kB) it is possible to load Chinese language via PC software.

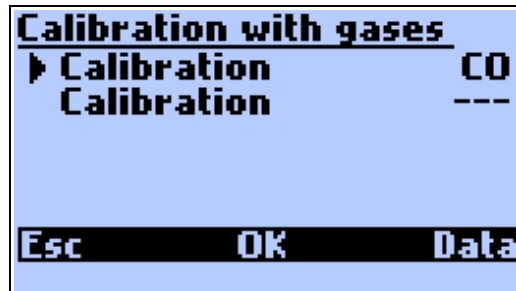
If the access to the calibration options is restricted (it is possible to do so from the PC software) the following screen appears:



Drawing 29. Restriction to the calibration option

3.3.6.5.1. CALIBRATION WITH GASES

If the calibration option is not restricted to the user the screen shown in the picture below appears. There, please select the sensor you wish to calibrate.



Drawing 30. The selection of the sensor for the gaseous calibration.

Any change to the sensor calibration made by unauthorised personnel can cause the lost of the proper calibration data, which, in a consequence, makes the device useless for the measurements.

Therefore, the calibration procedure can be taken only as the last resort! Be sure you are familiarised with the procedure and you are equipped with suitable calibration gases.

The calibration of the sensor is made with a reference (calibration) gas of a known concentration. The reference gas should be applied to the sensor for at least 4 minutes. After each calibration it is necessary to ventilate the device with a fresh air for at least 15 minutes.

Before proceeding with the calibration, the warning screen is displayed:



Drawing 31. Calibration warning screen

Calibration			CO
	ppm	M	S
CO	0	2998	-4
NO	---	-17	---
▶ Concentration			403
Esc	Change		OK

Drawing 32. Calibration of the gas sensor.

The calibration screen contains a table with sensor's signals. The description of the values in the table:

- *ppm* – currently measured gas concentration.
- *M* – signal stored during the last calibration.
- *S* – sensor's current signal.

Below the table there is a reference gas concentration value. Press *Change* function key to enter the concentration of the reference gas you intend to use during the calibration.

Follow the steps below to proceed with the calibration:

1. Enter the concentration value of your reference gas.
2. Supply the analyser with the reference gas for at least four minutes – wait until the signals in columns ppm and S are stable.
3. Confirm the calibration by pressing OK function key.

3.3.6.5.2. PRESSURE CALIBRATION

Before proceeding with the pressure calibration, the warning screen is displayed:



Drawing 33. Calibration warning screen.

Any change to the pressure sensor calibration made by unauthorised personnel can cause the lost of the proper calibration data, which, in a consequence, makes the device useless for the pressure / draught measurements.

Therefore, the calibration procedure can be taken only as the last resort! Be sure you are familiarised with the procedure and you have suitable equipment required for pressure calibration.

To perform the pressure calibration the precise reference pressure sensor is required.

Pressure calibration		
	Signal	Pa
Measured	1	0.0
Stored	15660	13.0
▶ Pressure		13
Esc	Change	OK

Drawing 34. Pressure calibration screen.

The pressure calibration screen contains a table with the values:

Measured – current values of signal (uV) and pressure (Pa)

Stored – values of signal and pressure from the last pressure calibration

Below the table there is a reference pressure value. Press *Change* function key to enter the reference pressure (measured with the precise, reference pressure sensor)


Follow the steps below to proceed with the calibration:

1. Enter the value of the reference pressure.
2. Supply the reference pressure to the analyser pressure inlet – wait until the signals in columns Signal and Pa are stable.
3. Confirm the calibration by pressing OK function key.

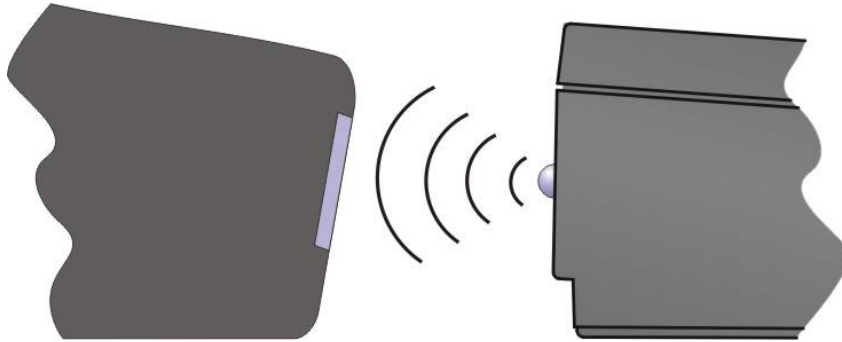
3.3.7. Print?

Print?		
▶ Averaged results		1
Stored report		5
Last screen		
Esc	OK	Data

Drawing 35. Print? screen

To call the Print? Screen press  function key. The last measured values are stored in the analyser's buffer from where they can be printed. The analyser can print averaged results or results from a specified report. The numbers on the right represents the printout form. Report forms (1÷8) can be changed by pressing left / right arrow key. Printout forms can be defined from the PC software. Forms 1÷4 can be freely defined by user, forms 5÷8 are defined by producer and cannot be modified. Forms 5 and 6 are defined for measurement results, forms 7 and 8 are defined for reports.

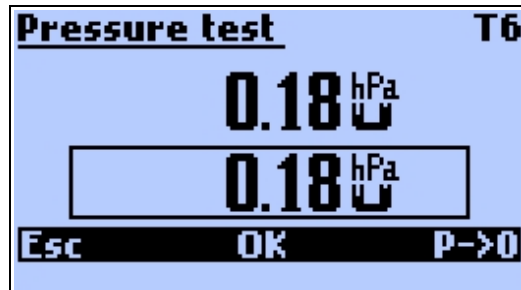
Before printing, turn the printer on and direct its communication IR diode towards the analyser's IR diode (the maximal distance between the analyser and the printer is 2 m)



Drawing 36. The direction of the analyser towards the printer in order to print.

4. MEASUREMENTS

4.1. Pressure measurement

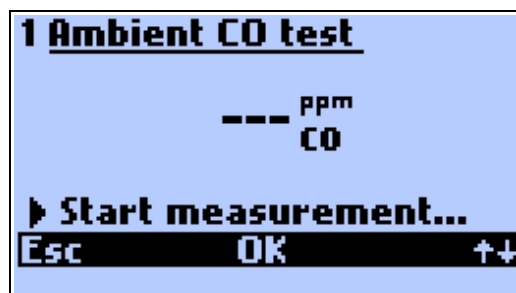


Drawing 37. Pressure measurement test

Pressure measurement is called from the screen Action and allows to perform fast measurement of the differential pressure. The right function key $P \rightarrow 0$ allows to perform zero the pressure sensor. The middle function key *OK* stores the currently measured pressure. Then this measurement can be shown on the screen or printed. *Esc* function key returns to the previous screen.

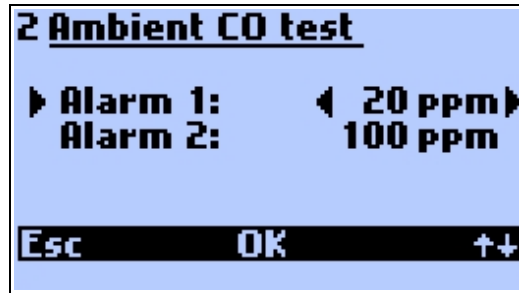
4.2. Ambient CO test

Ambient CO test is called from the screen Action. The analyser measures the concentration of CO gas in the ambient air for the 60 seconds and stores the averaged result from the test in the analyser's memory.



Drawing 38. CO ambient test screen.

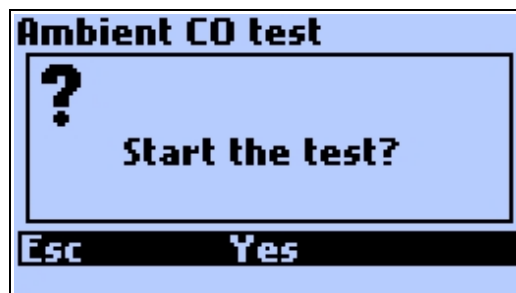
On enter, the Ambient CO screen shows the result from the previous test ('---' value means there was no previous result). Press the *OK* function key to start the measurement. To change the Ambient CO test settings press the **++** function key. There the threshold values can be set. If those thresholds are exceeded the analyser alarms them with the beep sound.



Drawing 39. Thresholds of the Ambient CO test.

Alarm 1 is the first threshold and can be set from 1 to 20 ppm (with 5 ppm step). If this level is exceeded the analyser beeps once every 1 second. Alarm 2 sets the second threshold level. It can be set from 20 to 100 ppm (step every 10 ppm). If this level is exceeded the analyser beeps twice every 1 second. To change the threshold press left / right arrow keys or *OK* function key. To return to previous window use *Esc* or **++** function keys.

The Ambient CO test is preceded with the screen below:



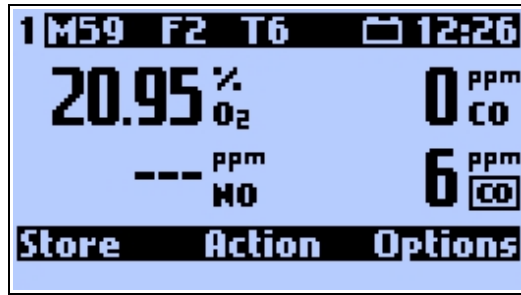
Drawing 40. Confirmation of the Ambient CO test.

During the test, the analyser shows time till the end of the test in the top right corner of the screen. In the middle of the screen the averaged result (since the beginning of the test) is presented.



Drawing 41. The result of Ambient CO test.

When the test is done, the result is stored into the analyser's memory and can be shown in the analyser's Results screen.



Drawing 42. Ambient CO concentration shown in the Results screen (top bottom value).