OPERATION MANUAL

FORCE GAUGE

FG Series

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1. Introduction

The FG series force gauges are designed for measuring pressure or pulling force in laboratory, manufacturing and quality control applications.

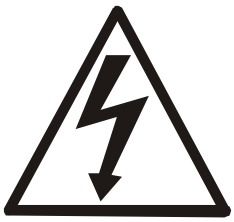
The gauge can be held in hand or mounted on a stand (using the four threaded holes at the bottom of the enclosure).

The RS232C serial connector allows the measurement results to be transmitted to a computer or a printer for further analysis or recording.

2. Set

The basic set includes the following elements:
1. Force gauge,
2. Push tips – 4 pcs, 1 hook tip, 1 extension piece
3. Power supply unit ~230 V 50 Hz / =12 V; 1.25 A,
5. SK-1 cord (dynamometer – computer),
6. SK-1 cable,
7. CD containing an operation manual and software,
8. Warranty.

3. Safety instructions



Read carefully the safety instructions included below. Observe these instructions to avoid electrocution or damage to the force gauge itself or other devices connected to the force gauge.

- Repairs and any necessary adjustments may only be conducted by qualified personnel.
- Do not use the force gauge when any part of the enclosure has been removed.
- Do not use the force gauge in potentially explosive atmospheres.
- Do not use the force gauge in areas with a high humidity.
- In the case of suspected damage to the force gauge, turn off the gauge and do not use it until it is examined by a specialised servicing facility.

4. Rules for handling a worn force gauge

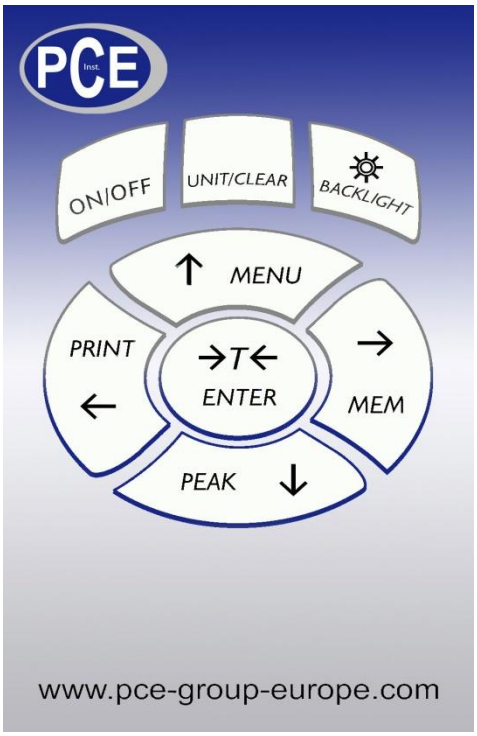
According to the applicable regulations on the protection of the environment, do not put worn electronic devices in containers for common waste.

- When put out of operation, a worn force gauge can be delivered to bodies authorised to collect old electronic equipment or to the point of purchase.

5. Technical data

Type	FG50	FG200
Maximum force measured	50 N (5kg)	200 N (20kg)
Reading graduation (d)	0.01 N (1 g)	0.1 N (10 g)
Accuracy	±0.4%	±0.4%
Measurement units	N, g, lb, oz, kg	
Maximum overload	±120%	
Operating temperature	-10 ÷ 40°C	
Interface	RS-232C	
Assistance software	Procell + Excel spreadsheet	
Display	graphic LCD 61 x 34 mm	
Measurement functions		
Power supply	NiMH R3 batteries (AAA size) – 6 pcs + power supply unit ~230 V 50 Hz / 12 V 1.2 A	
Gauge plunger	11 mm (thread M6 x 9 mm)	
Dimensions	210 x 110 x 40 mm	
Weight	700 g	

6. Keys and indicators



Main keys:

ON/OFF	- ON / OFF key (standby),
UNIT/CLEAR	- Change units / cancel selection or change a parameter value,
BACKLIGHT	- Turn on illumination (ECO mode),
ENTER	- Confirm / select an option or a digit,
→T← (*→0←*)	- Taring / resetting (entering the current reference value to be subtracted from the measured values in each consecutive measurement)

Navigation keys:

MENU	- Confirm the entered parameter or select a highlighted option,
↑	- Move cursor up or increase the digit marked by the cursor,
↓	- Move cursor down or decrease the digit marked by the cursor,
→	- Move to the next menu level or display the next option,
←	- Move to the previous menu level or display the previous option.

Function Keys:

PEAK	- Measure the maximum value,
MEM	- Save the result to the memory, press and hold – save to memory menu,
PRINT	- Print result (transmission via RS-232C connector).

Indicators:

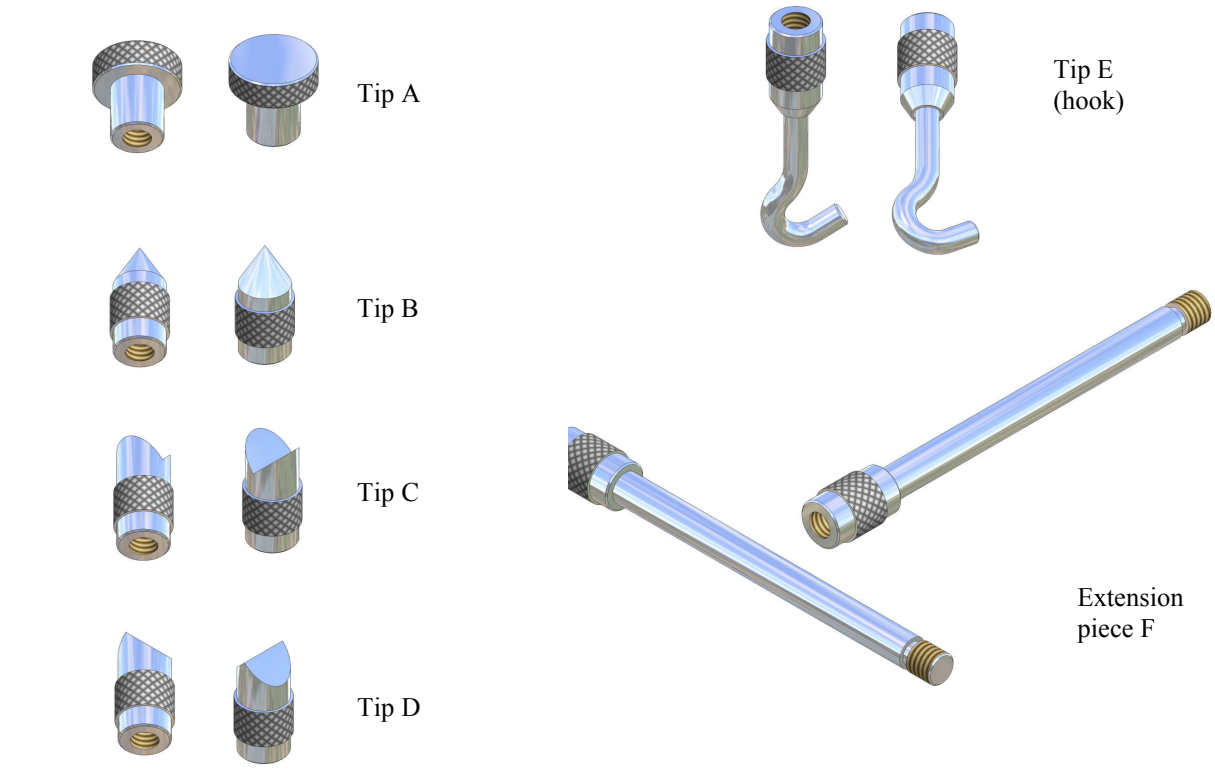
▬◢	- Indicates that the weighing result has stabilised,
OFF	- Appears after turning off the gauge using the *ON/OFF* key (standby),
SLW/FST	- Slow/fast measurement mode,
ACQ	- Automatically acquire measurement results.

Note:
Numbers are entered using the navigation keys. First, the cursor is placed in the right digit position.

7. Preparing the force gauge for operation

If the force gauge has been transported from an area with low temperature to an area with a higher temperature, e.g. during winter, water may condensate on the gauge's enclosure. In such a case, do not turn on the gauge's power supply, as it may lead to damage to the gauge or improper operation. Before turning on the gauge, leave it for 1 hour to acclimatise.

1. Take the gauge out of the case.
2. Fit a measurement tip suitable for the measurements to be conducted on the gauge plunger.



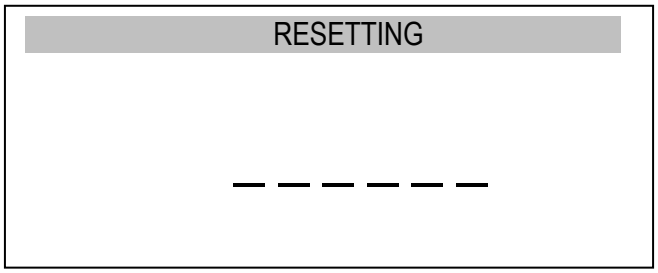
Intended use of the individual tips:
- tip A – measurement of surface pressure force,
- tip B – measurement of point pressure force,
- tip C – measurement of pressure on an axis or an edge,
- tip D – measurement of edge pressure force,
- tip E – hook for measuring pull force or suspending and weighing an object,
- tip F – extension piece suitable for all types of above-mentioned tips.

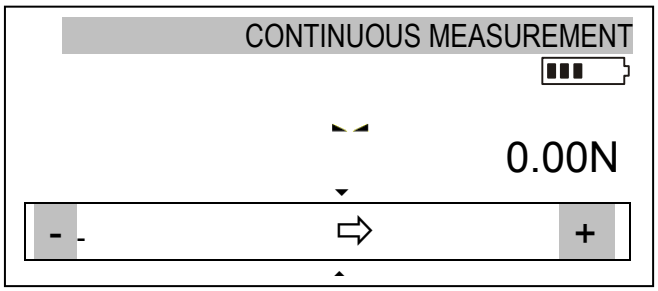
8. General rules for use

When transporting the force gauge, unscrew the measurement tip and put the gauge in the case to protect it against accidental pressure on the gauge plunger.

1. When conducting measurements by hand, make sure that the direction of the measured force is identical with the gauge's axis (axis of the gauge plunger). Otherwise, only a component force along the gauge's axis will be measured.
2. The gauge allows for resetting in the entire measurement range (this operation is called taring in the case of measuring the mass) by pressing the →*T(0)*← key. Resetting/taring does not extend the measurement range but only subtracts the entered reference value from the measured value.
3. The measurement mechanism is a precision device and is sensitive to shocks and vibrations. It is not allowed to hit the measurement tip against any objects.
4. Do not overload the gauge above the maximum overload value (20%).

9. Turning on the gauge





Place the gauge in the operating position, e.g. horizontal position (by laying it on a table). Turn on the gauge by pressing the *ON/OFF* key.

When necessary, plug the gauge's power supply unit to a ~230 V/50 Hz socket and connect the power supply unit's plug to the gauge's 12 V socket.

The gauge automatically tests the electronic subassemblies and then resets. During this operation, the gauge should remain stationary and its sensor should not be affected by any forces.

After the resetting has been successfully completed, the gauge indicates zero.

Unsuccessful resetting is signalled by an appropriate message.

Note:

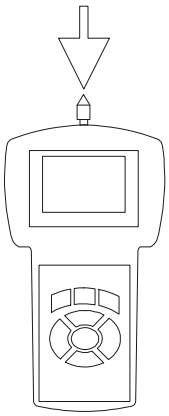
It is possible to accelerate the resetting process by pressing the *MENU* key, which will recall the results from the previous resetting.

If the batteries are low, leave the gauge's external power supply unit ON until they are fully recharged. The batteries' charge level is signalled by an indicator in the upper section of the display.

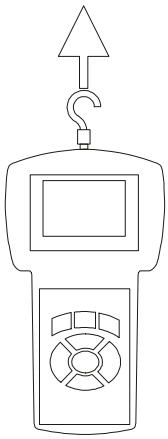
10. Description of measurement methods

The gauge can be used to measure pressure and pull forces. In addition, when mounted properly, it can be used as suspension scales to measure the mass.

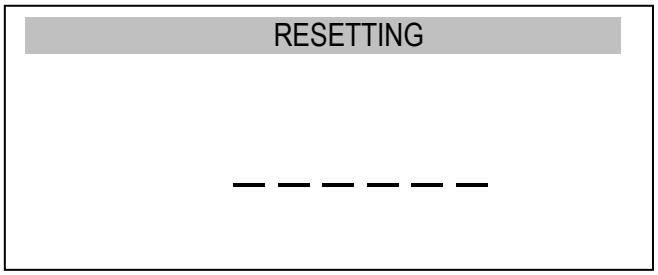
10.1 Measuring actual and peak value of a pressure/pull force

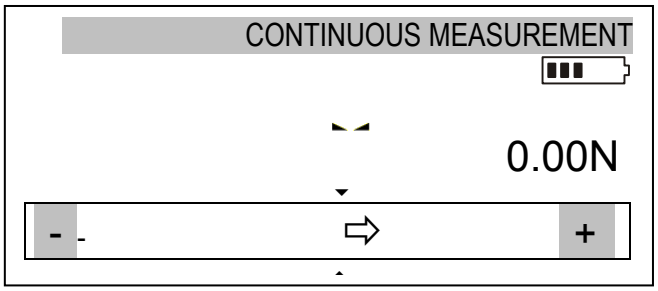


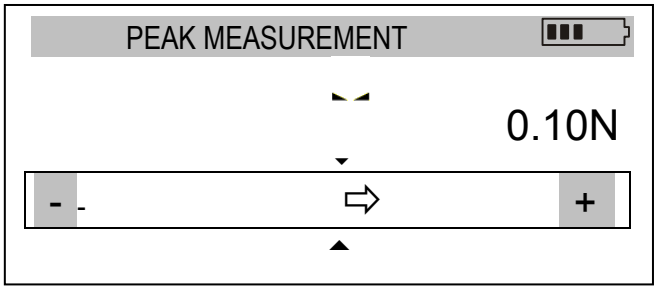
Measuring pressure force



Measuring pull force







Before starting the measurement, choose a suitable measurement tip, screw it to the gauge plunger and reset the gauge in the operating position, e.g. horizontal position (laying the gauge on a table). The resetting process starts automatically after turning on the gauge or by pressing the →*T(0)*← key.

To perform the measurement, indicate the force direction using an arrow in the display's lower bar section and "+" (pressure) or "-" (pull force) symbol.

To change the measurement from the actual value (continuous measurement) to the maximum value (peak measurement), use the *PEAK* key.

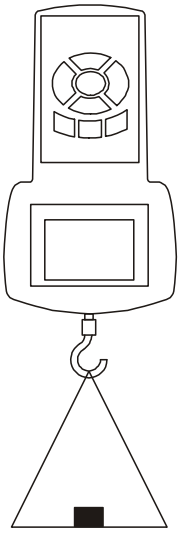
When measuring a force whose direction changes, the gauge indicates the value of the force exerted in the direction in which the maximum value was last exceeded.

10.2 Measurement of the mass – using the gauge as scales

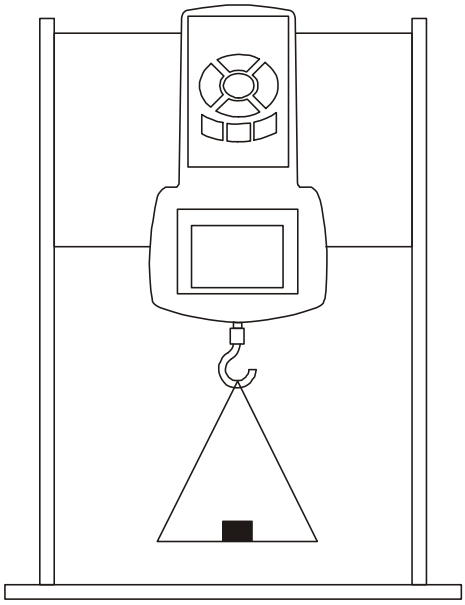
When using an additional element (bowl, basket, etc.) for suspending an object to be weighed, the gauge can be used to measure the mass. In the case of measurements which do not require a high level of precision, the gauge can be hand-held. To ensure maximum precision of the measurement, the gauge should be mounted on a stand using the four threaded holes at the bottom of the enclosure or it can be suspended using a special suspension element (option available on request).
Since the value of the gravity force used to calculate the mass depends on the gravitational acceleration in the location where the gauge is used, the device is calibrated for a specific value of the gravitational acceleration. The factory preset value is the gravitational acceleration in Gdańsk (g_R = 9.81415 m/s^2). In the case of significant differences, see the value applicable for the gauge's shipment address. When transporting the gauge to a location where the gravitational acceleration differs significantly, recalibrate the gauge.
The values of the gravitational acceleration for some of the Polish cities are presented in the table below.

Gravitational acceleration for selected cities

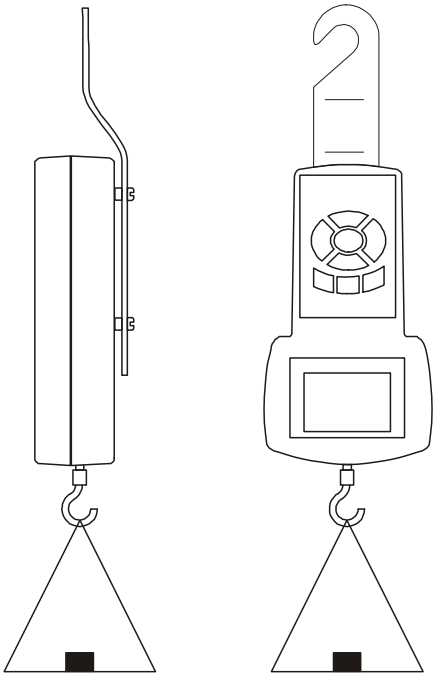
City	g_R[m/s^2]	City	g_R[m/s^2]
AXIS	9.81415	Olsztyn	9.81354
Gdańsk	9.81446	Łódź	9.81164
Gdynia	9.81453	Mława	9.81295
Białystok	9.81294	Opole	9.81076
Bydgoszcz	9.81327	Piła	9.81330
Chojnice	9.81342	Poznań	9.81266
Cieszyn	9.80960	Przemyśl	9.80991
Częstochowa	9.81061	Przeworsk	9.81009
Elbląg	9.81430	Radom	9.81146
Ełk	9.81361	Rybnik	9.81008
Gliwice	9.81025	Rzeszów	9.81010
Gorzów Wielkopolski	9.81305	Słupsk	9.81449
Grudziądz	9.81368	Suwałki	9.81377
Kalisz	9.81184	Szczecin	9.81370
Katowice	9.81008	Tarnów	9.81005
Kielce	9.81063	Toruń	9.81313
Koszalin	9.81427	Warszawa	9.81240
Kraków	9.81005	Włocławek	9.81288
Leszno	9.81206	Wrocław	9.81131
Lublin	9.81128	Zielona Góra	9.81190



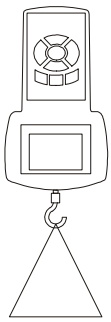
Measurement
using a hand-held gauge



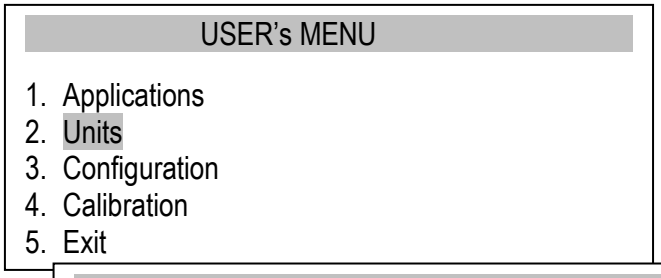
Measurement using a gauge
mounted on a stand
(stand available on request)



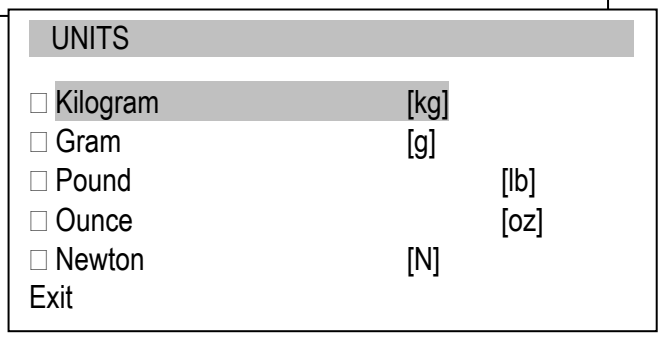
Suspended weight measurement
(suspension element available on request)



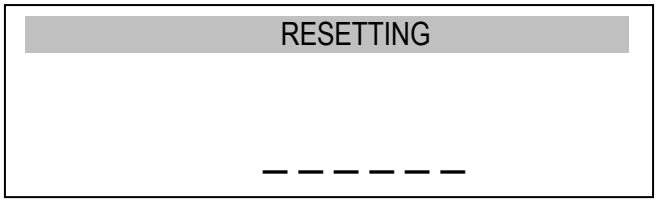
Screw the hook tip to the gauge plunger, suspend a bowl on the hook and place the gauge in the operating position (as shown in the figure). The display's indications will rotate by 180°.



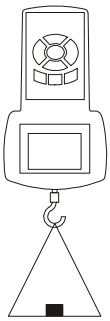
To change force units to mass units, press the *UNIT/CLEAR* or *MENU* key several times. When using the *MENU* key, move the cursor to *Units* and press *ENTER*.



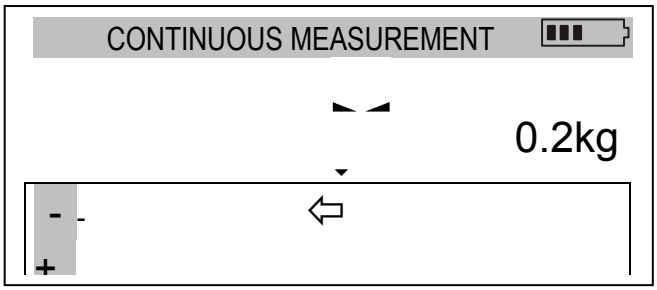
Move the cursor to a mass unit (*kilogram* or *gram*) and press *ENTER*.



Reset the gauge in the operating position by pressing the →*T(0)*← key.



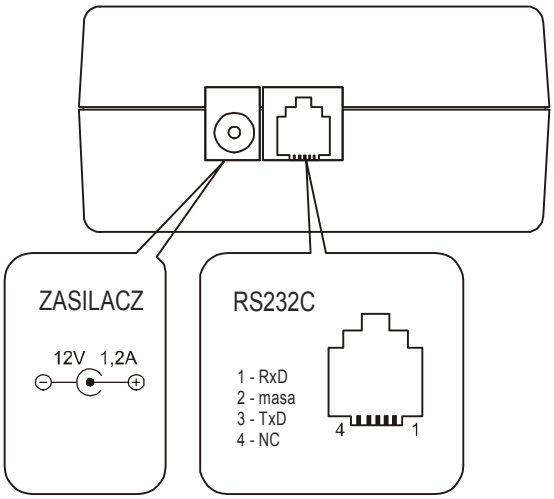
Place the object to be weighed on the bowl.



Read the mass.

11. Connecting external devices

The force gauge is equipped with a socket for an external power supply unit and RS232C serial connector for a printer or a computer.



PL	EN
ZASILACZ	POWER SUPPLY UNIT
masa	earth

Description of the data transmission protocol when working with a computer *(LonG):*

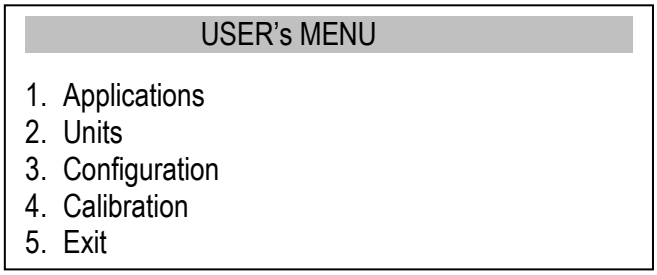
The scales transmit the result as follows (8 bits, 1 stop, no parity, 4,800 bps):
Computer→Gauge: initiating signal S I CR LF (53 h 49 h 0Dh 0 Ah),
Gauge→Computer: gauge indication according to the following format (16 bytes).

Description of individual bytes:

byte 1 - "-" or space
byte 2 - space
byte 3÷4 - digit or space
byte 5÷9 - digit, comma or space
byte 10 - digit
byte 11 - space
byte 12 - k, l, c, p or space
byte 13 - g, b, t, c or %
byte 14 - space
byte 15 - CR
byte 16 - LF

12. User's Menu

The User's Menu includes all functions and options necessary to operate the gauge or extend its functionalities.

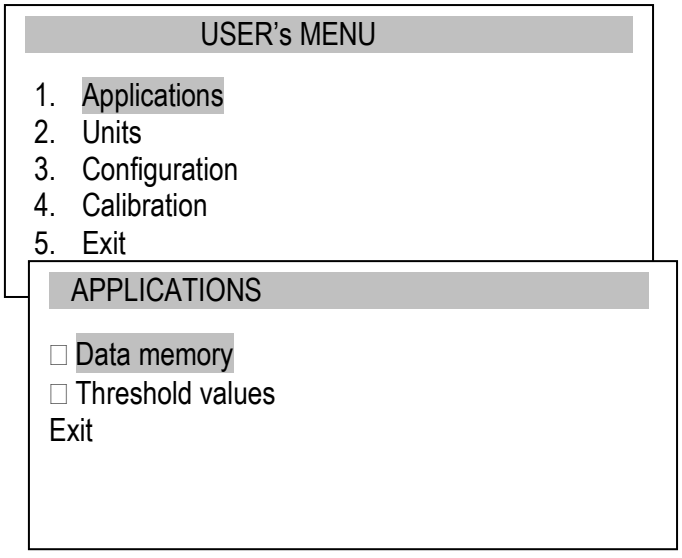


To use the options of the USER's MENU, use the *MENU* key. Move the cursor to the desired option and press *ENTER*.

The menu includes:
1. *Applications* – advanced measurement functions,
2. *Units* – select measurement units,
3. *Configuration* – set the gauge's mode of operation,
4. *Calibration* – adjust the measurement accuracy using an external standard of mass.
5. *Exit*.

13. Applications

This selection includes the following functions to effectively assist you with the measurement:
- memory operations and data analysis,
- comparison with two threshold values (*MIN / MAX*).

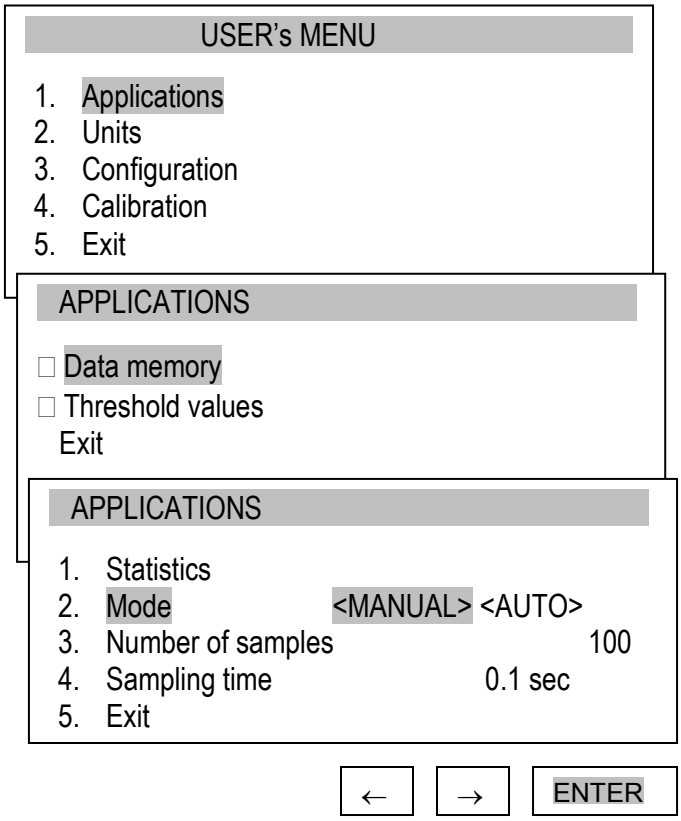


Move the cursor to *Applications* and press *ENTER*.

Move the cursor to the desired application and press *ENTER*.

13.1 Data memory

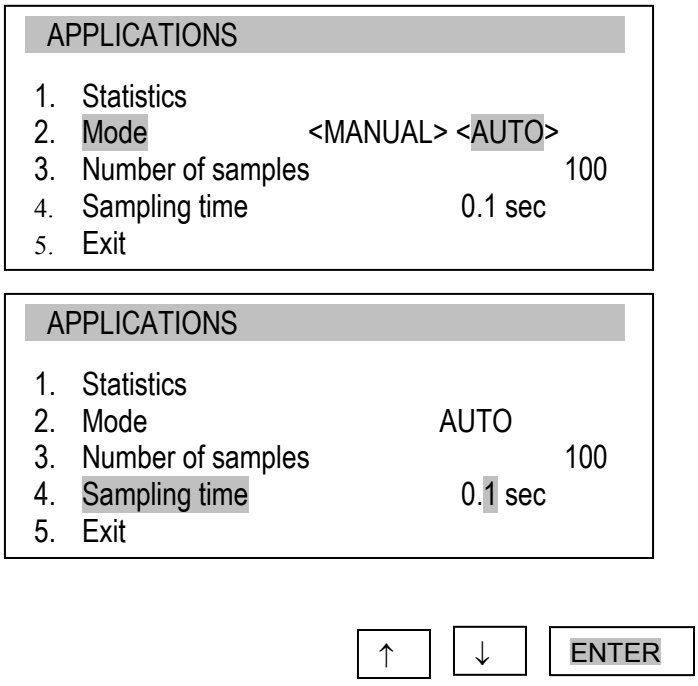
The *Data memory* application allows for the following:
- presentation of the collected measurements, saving, reading, erasing memory (*Statistics),*
- selecting the mode for collecting data,
- exit.



Move the cursor to *Applications* and press *ENTER*.

Move the cursor to *Data memory* and press *ENTER*.

Setting the mode for collecting data:
- *MANUAL* – each time after *MEM* is pressed,
- *AUTO* – automatically at specified intervals.

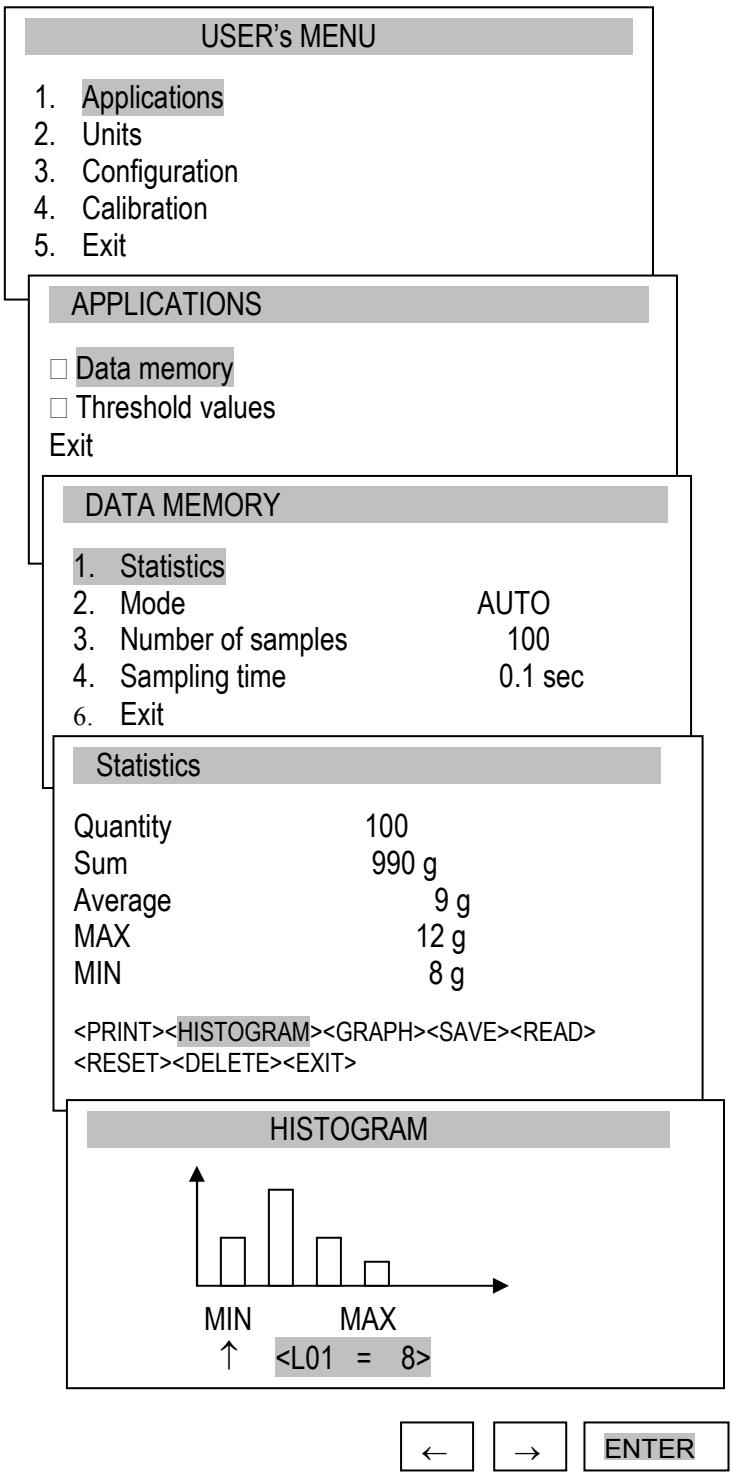


After selecting *AUTO*, enter the number of samples (max 100) and sampling time (0.1÷99.9 s.).

To start the collection of measurements, exit the menu and press *MEM* several times or press *MEM* for automatic save. When in the automatic save mode, press and hold *MEM* to go to the data save menu.

Presentation of collected measurements (Statistics)

The *Statistics* option allows for the following forms of presentation of the collected data:
<*PRINT*> – transmission to a printer,
<*HISTOGRAM*> – bar graph,
<*GRAPH*> – graph with a time axis.



Move the cursor to *Applications* and press *ENTER*.

Move the cursor to *Data memory* and press *ENTER*.

Move the cursor to *Statistics* and press *ENTER*.

Select one of the options from the lower menu bar:
- *PRINT* – transmission to a printer,
- *HISTOGRAM* – bar graph,
- *GRAPH* – graph with a time axis.

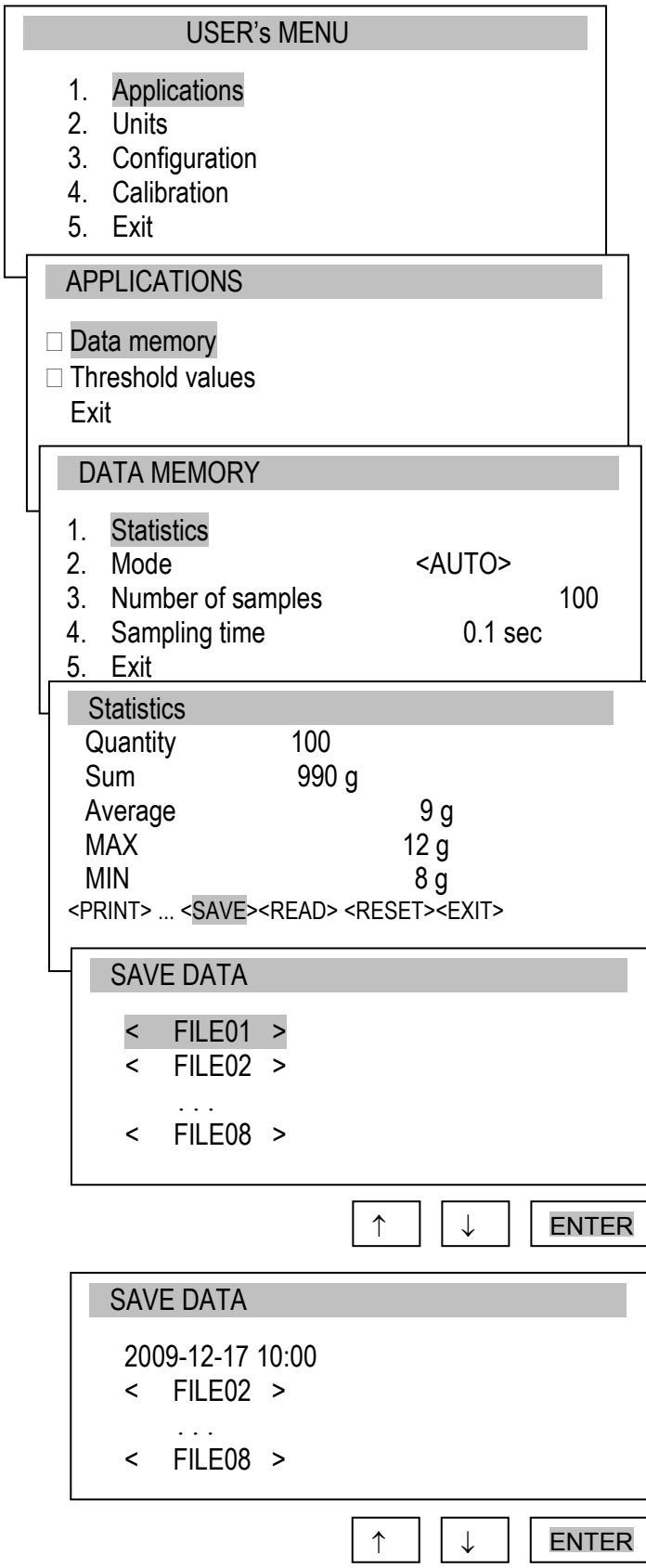
. . .

- *RESET* – erases the entire memory,
- *DELETE* – deletes a selected memory file.

Indicators L... =... provide the size of the bar indicated by the ↑ arrow.
To move the arrow (scroll the graph), use the ← and → keys.

Save, read, erase memory (Statistics)

The *Statistics* option allows for the following:
< *SAVE* > – saves the data currently presented,
< *READ* > – reads a file from the memory,
< *RESET* > – erases the data currently presented,
< *DELETE*> – deletes a selected data file.



Move the cursor to *Applications* and press *ENTER*.

Move the cursor to *Data memory* and press *ENTER*.

Move the cursor to *Statistics* and press *ENTER*.

The following options (lower bar) will appear:
- . . .
- *SAVE* – saves the measurements currently presented,
- *READ* – reads a measurement file,
- *RESET* – erases the memory,
- *EXIT* – exits the option.

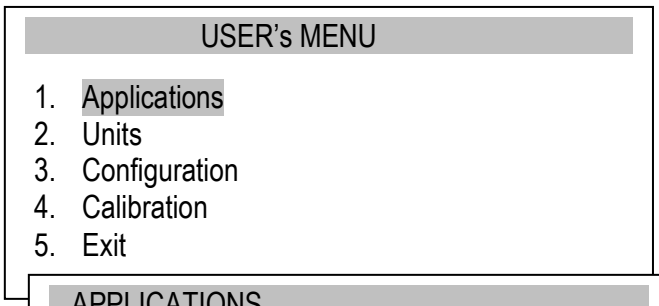
Select the *SAVE* option.

Select a file (FILE) to be saved.

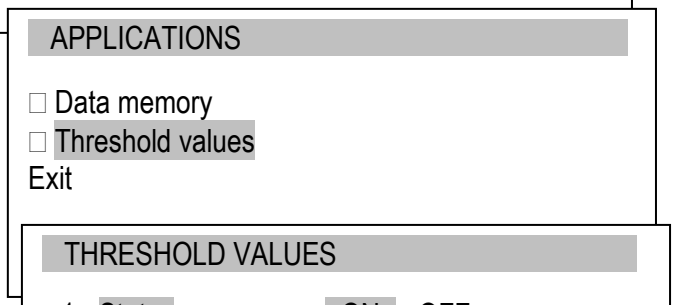
The default file name includes date and time. Confirm the default file name or enter another name using the →, ←, ↑ and ↓ keys.

13.2 Comparison with threshold values MIN / OK / MAX

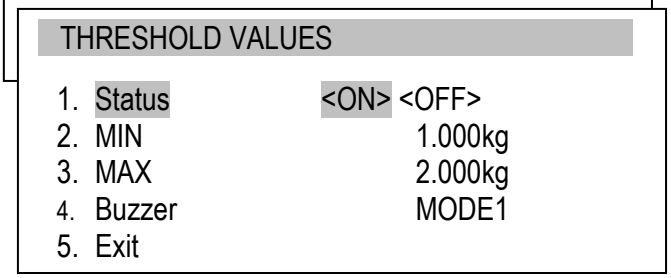
This selection includes the following functions to effectively assist you with the measurement:
- memory operations and data analysis,
- comparison with two threshold values (*MIN / MAX*).

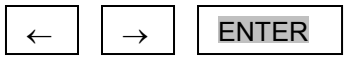


Move the cursor to *Applications* and press *ENTER*.



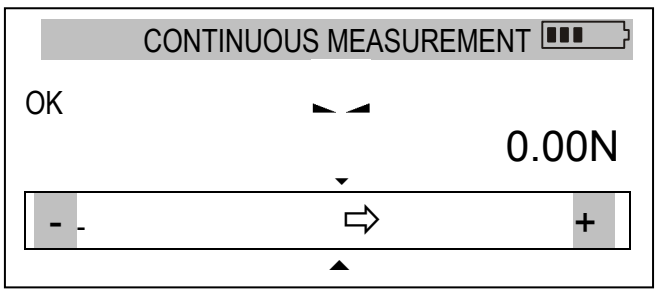
Move the cursor to *Threshold values* and press *ENTER*.





Activate the comparison by setting *Status* to *ON*:
- enter the *MIN* value – lower threshold,
- enter the *MAX* value – upper threshold.

Select the option for sound signalling (*Buzzer*):
- *MODE1* – short signal upon exceeding *MIN*, long signal upon exceeding *MAX*,
- *MODE2* – interrupted signal below *MIN*, above *MAX* – continuous signal, for *OK* – no signal.

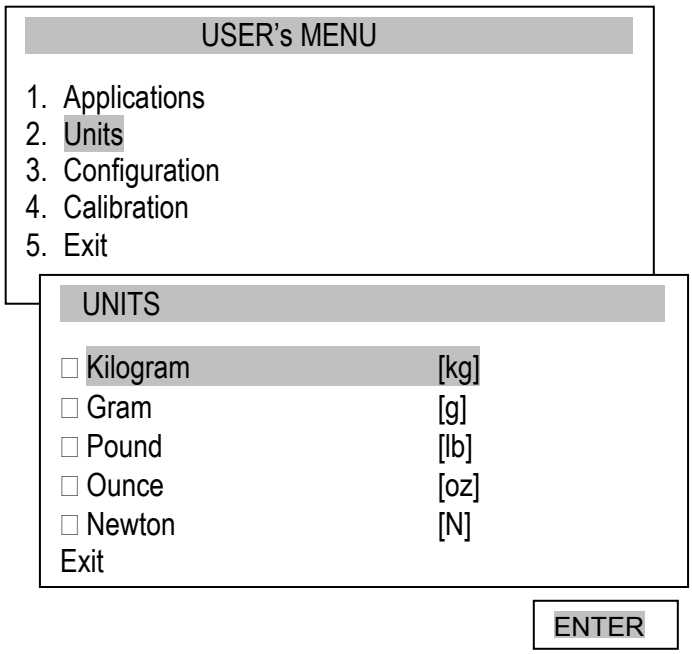


Exit the menu, start the measurement and observe the *MIN*, *OK* and *MAX* indicators on the gauge's display.

14. Units

The following units are available to the user:
- kilogram (kg)
- gram (g)
- Pound: 1 lb = 453.592374 g
- ounce: 1 oz = 28.349523 g
- Newton: 1 N = 0.10197 kg

To change the units, press the *UNIT/CLEAR* or *MENU* key several times.

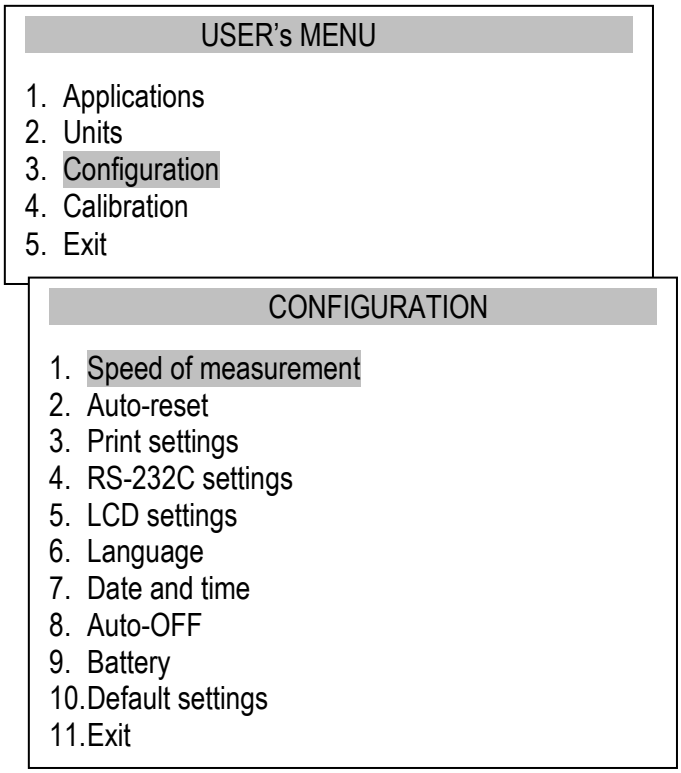


Press the *MENU* key, move the cursor to *Units* and press *ENTER*.

Move the cursor to the desired unit and press *ENTER*.

15. Configuration

This selection includes all options for setting the gauge's modes of operation.

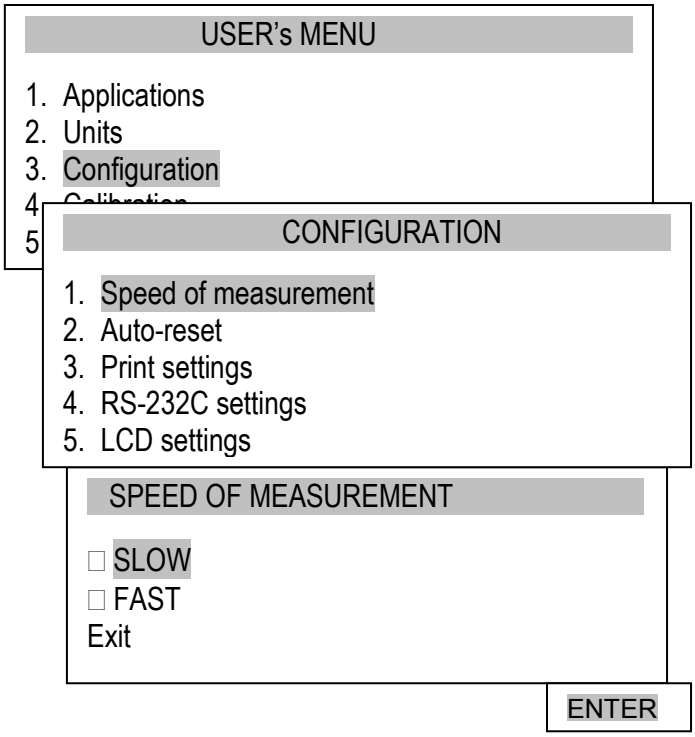


Move the cursor to *Configuration* and press *ENTER*.

Move the cursor to the desired option and press *ENTER*.

15.1 Speed of measurement

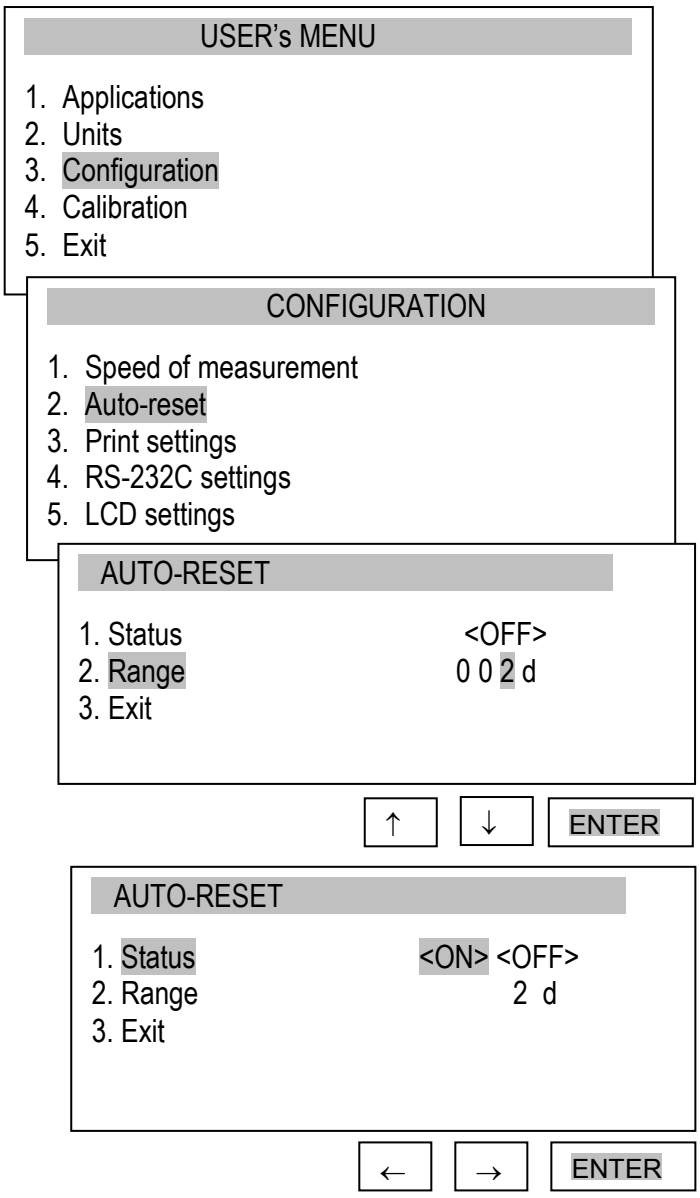
To obtain clear measurement results, it is recommended to adjust the speed of measurement to the dynamic properties of the measured object.



Press *ENTER* to select one of the options:
- *SLOW* – slow measurement,
- *FAST* – fast measurement.

15.2 Auto-reset

When activated, this option automatically maintains zero indications on the gauge, if the gauge's sensor is not affected by any external force or if the zero indication was produced by pressing the *→T(0)←* key. The range of values (calculated in the gauge's reading graduation near zero) subject to the reset must be entered under the *Range* option (3 digits).

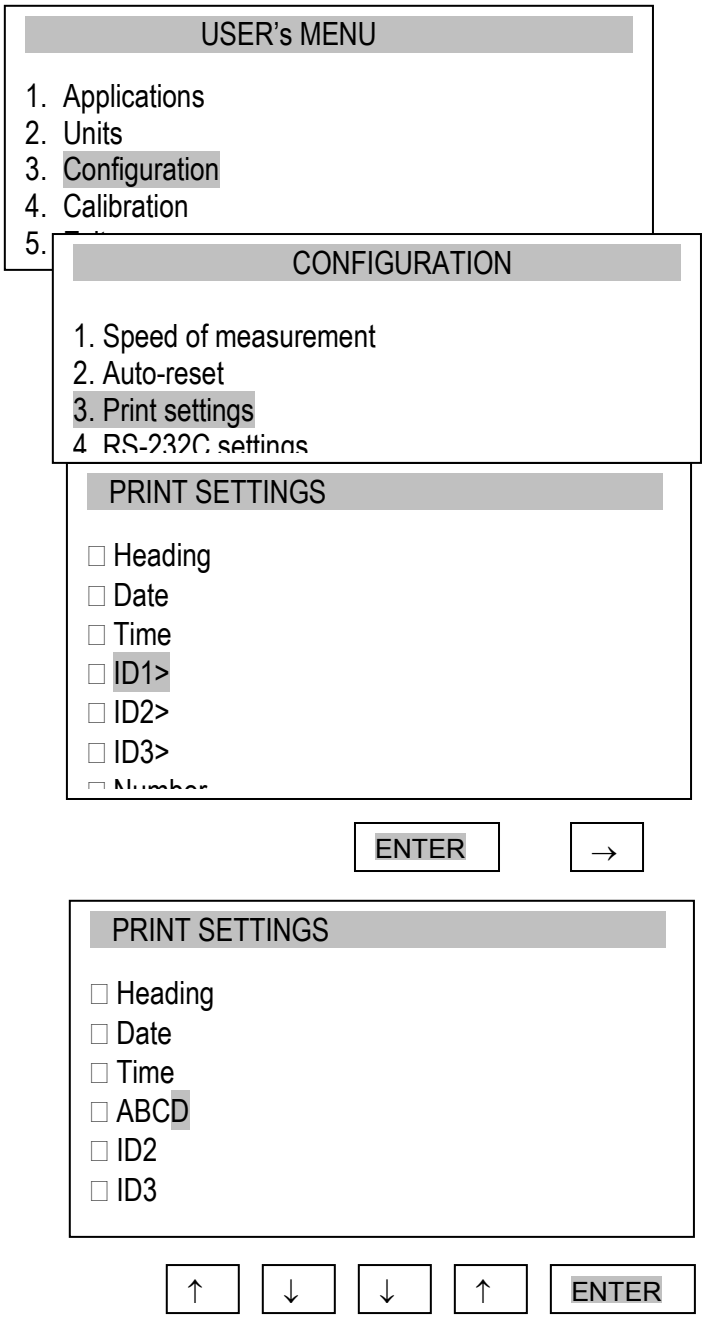


Use the navigation keys and *ENTER* to select *Status* and one of the following options:
- *ON* – auto-reset ON,
- *OFF* – auto-reset OFF.

Next, select *Range* and use ↑, ↓, →, ← and *ENTER* to enter the auto-reset range (in reading graduation).

15.3 Print settings

According to the requirements of GLP procedures, it is possible use an external printer to produce print-outs from the gauge including text information.



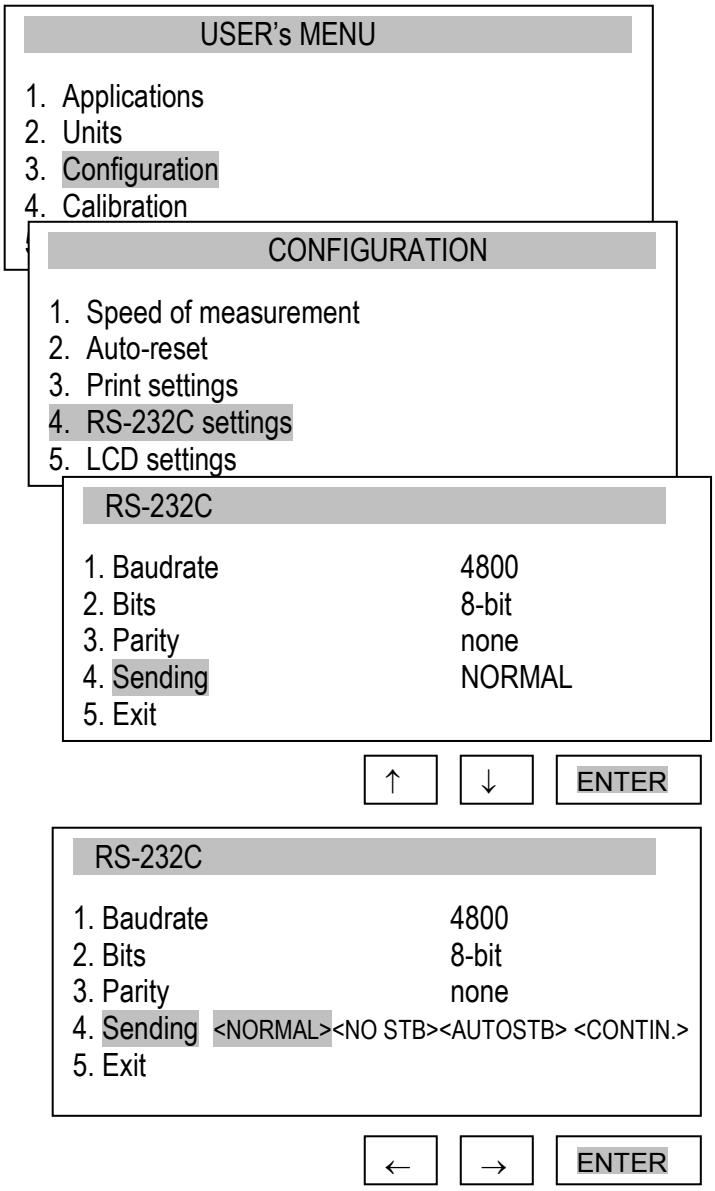
Use the navigation keys and *ENTER* to select *Print settings* and the suitable print components.

ID1, ID2, ID2 – text strings (up to 20 characters) forming the lines of the print-out, entered using the gauge's navigation keys.

To enter the characters, select *ID* using *ENTER* and press →. The characters are entered using the navigation keys ↑ and ↓. To move the cursor to the consecutive positions, use ← and →. To confirm the entered string, press *ENTER*. To delete a character, enter space.

15.4 Setting parameters for the RS-232C serial connector

The parameters of the serial connector must be suitable for the device receiving the signal.

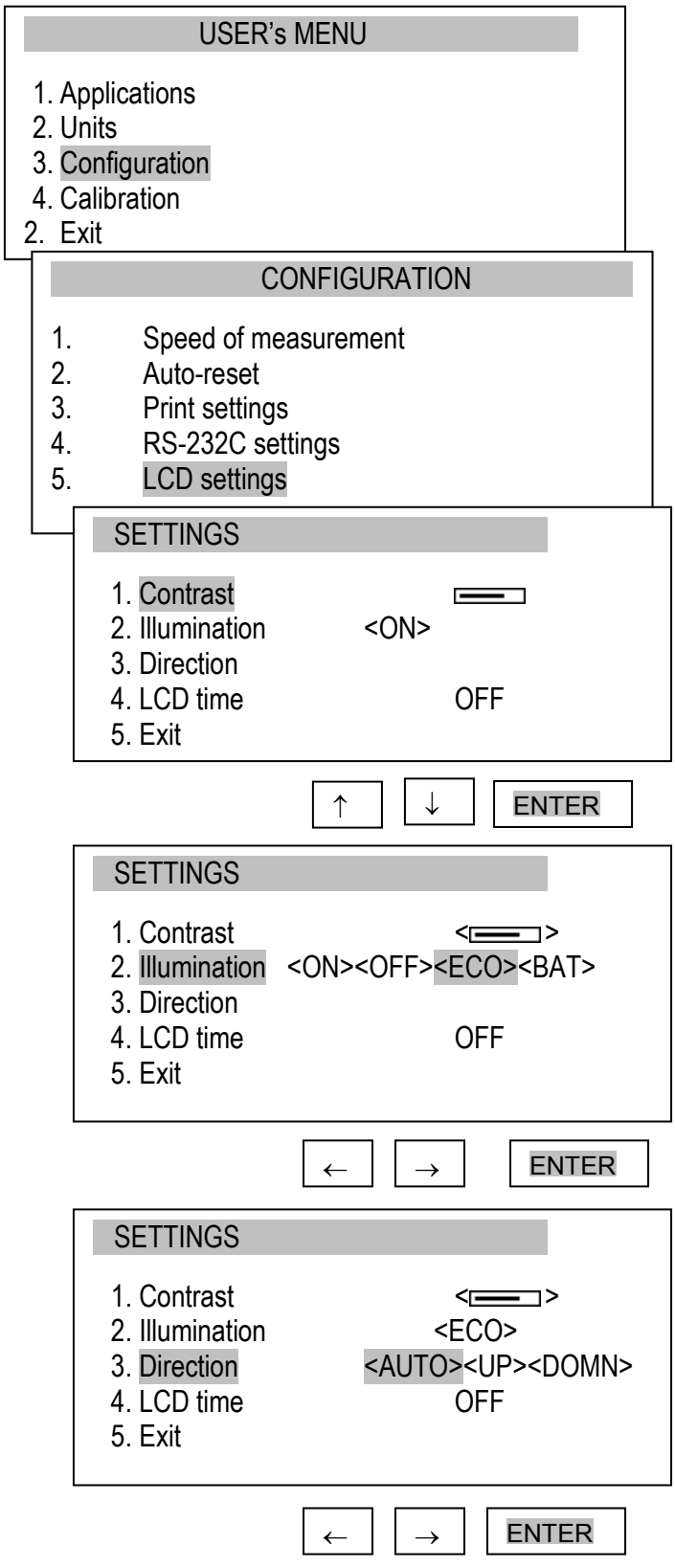


Parameters to be set:

- *Baudrate* – transmission and receiving rate (4,800 ÷ 115,200 bps),
- *Bits* – number of bits which constitute a character (7 or 8 bits),
- *Parity* – control of parity (no control, even – confirmation of parity, or odd – confirmation of odd parity),
- *Sending* – transmission method during measurement:
  - *NOCAL* – after using the *PRINT* key, with stable result,
  - *NOSTB* – after using the *PRINT* key, irrespectively of the result stability,
  - *AUTOSTB* – automatically after the result has stabilised,
  - *CONTIN.* – continuous transmission, approx. every 0.1 s.

15.5 LCD settings

This option adjusts the gauge's display to external lighting conditions.



Use the navigation keys and *ENTER* to select *LCD settings*. Next, use →, ← and *ENTER* to set the contrast at which the display is best legible.

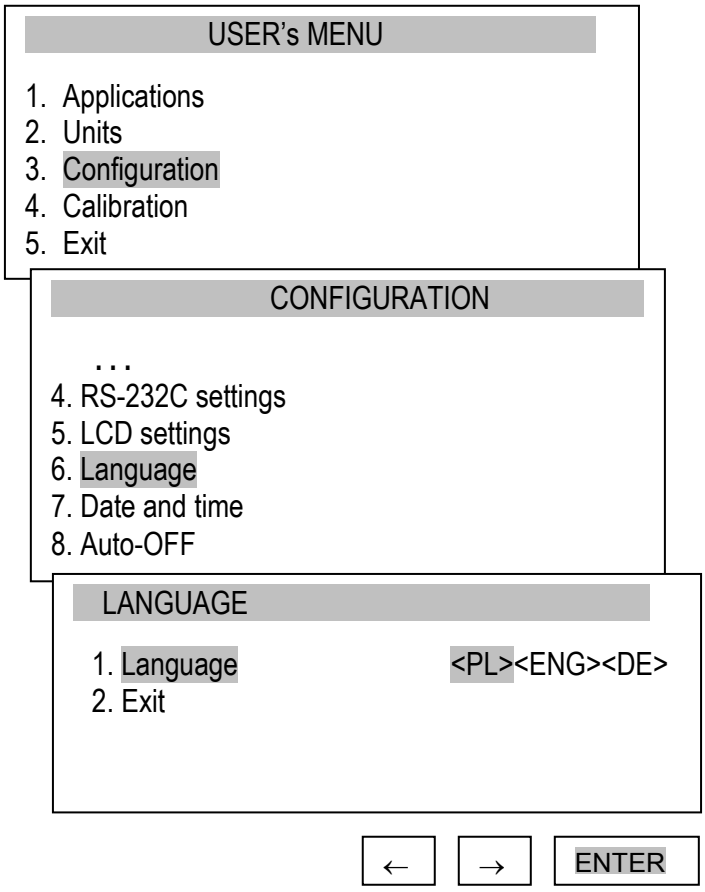
When setting *Illumination*, select one of the following options:
- *OFF* – illumination OFF,
- *ON* – illumination continuously ON,
- *ECO* – to illuminate, use the *BACKLIGHT* key,
- *BAT* – illumination is turned off after 30 seconds to save the batteries.

The *DIRECTION* option is used for selecting the display's direction:
- *AUTO* – automatic rotation of the displayed image,
- *UP* – standard direction,
- *DOMN* – inverted image.

The *LCD TIME* option displays the date and time during measurement in the display's upper bar.

15.6 Selecting the menu language

Three menu languages are available:
<PL> – Polish,
<ENG> – English,
<DE> – German.

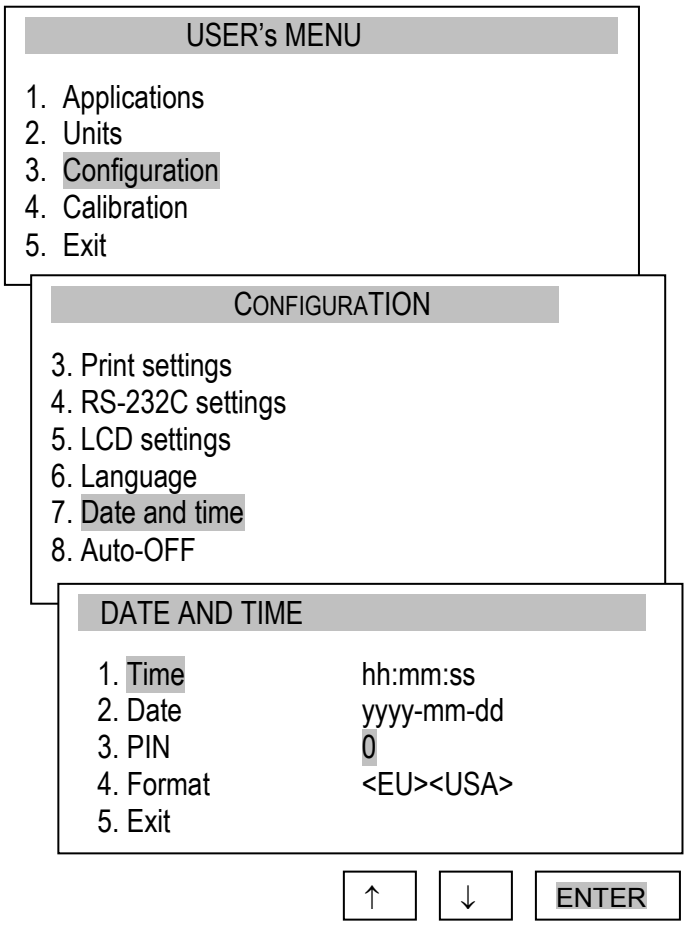


Use the navigation keys and *ENTER* to select *Language*. To select one of the available menu languages, use the →, ← keys and *ENTER*.

To enter a new code (*NEW*), select the *PIN* option. When entering a new code, type in the same number twice (message: *REP*.).

15.7 Setting date and time

This option is used for entering the current date and time. Access to this setting is secured by the PIN code.



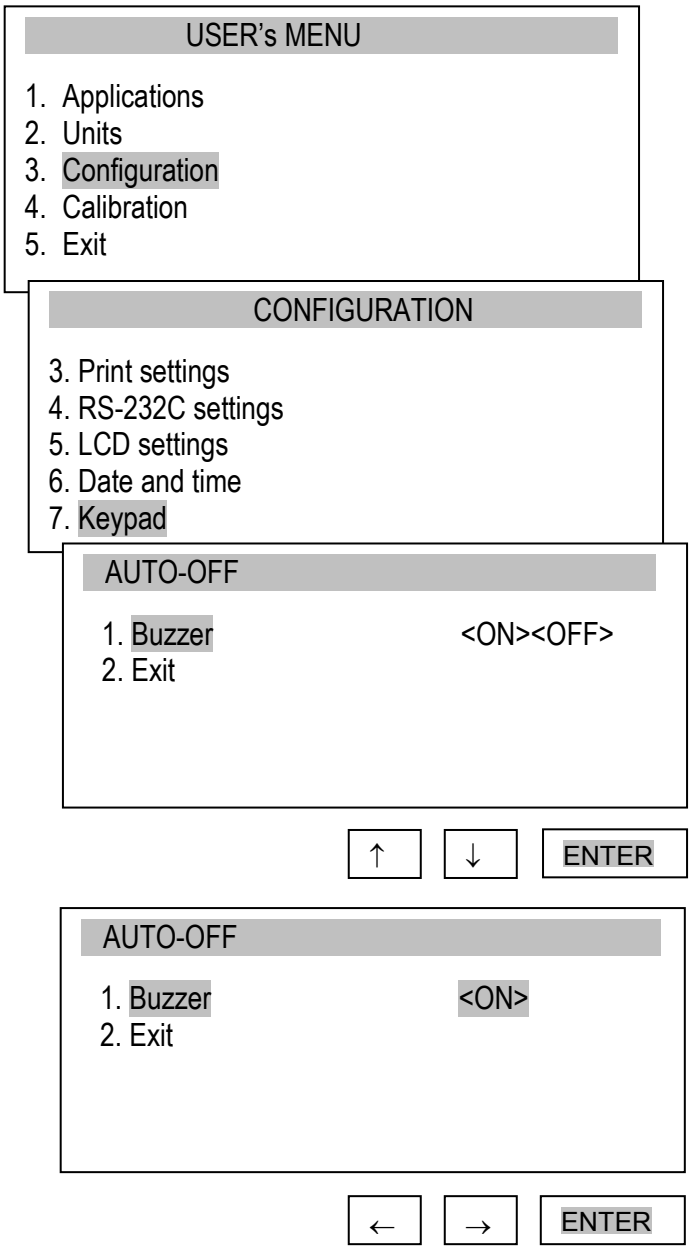
Use the navigation keys and *ENTER* to select *Date and time.* If a *PIN* has already been entered (other than 0), after selecting *Time* or *Date*, the cursor will move to the *PIN* option, where a correct 4-digit *PIN* has to be entered. To enter the correct digits, use the ↑, ↓, →, ← keys and *ENTER.*

To enter a new code (*NEW*), select the *PIN* option. When entering a new code, type in the same number twice (message: *REP*.).

The *FORMAT* option allows for the selection of the date format on print-outs.

15.8 Turning the sound ON/OFF when using the keypad (buzzer)

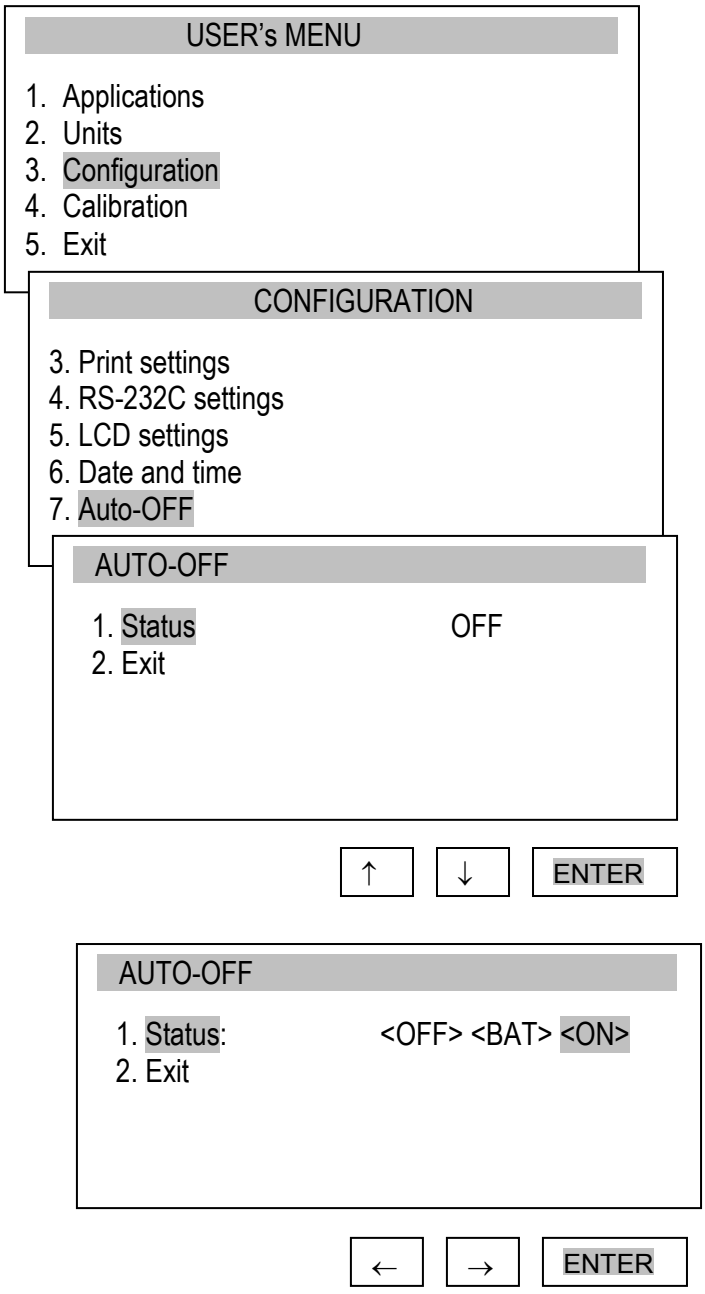
This options turns ON or OFF the sound signalling that a key on the keypad has been pressed. When the sound is turned on, the user usually does not apply excessive force when pushing the keys.



Use the navigation keys and *ENTER* to select *Keypad* and *Buzzer,* and one of the following options:
- *ON* – sound ON,
- *OFF* – sound OFF.

15.9 Automatic power OFF (Auto-OFF)

This option allows for an automatic cut-off of the gauge's power supply to save the battery's energy.

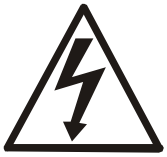


Use the navigation keys and *ENTER* to select *Auto-OFF* and *Status,* and one of the following options:

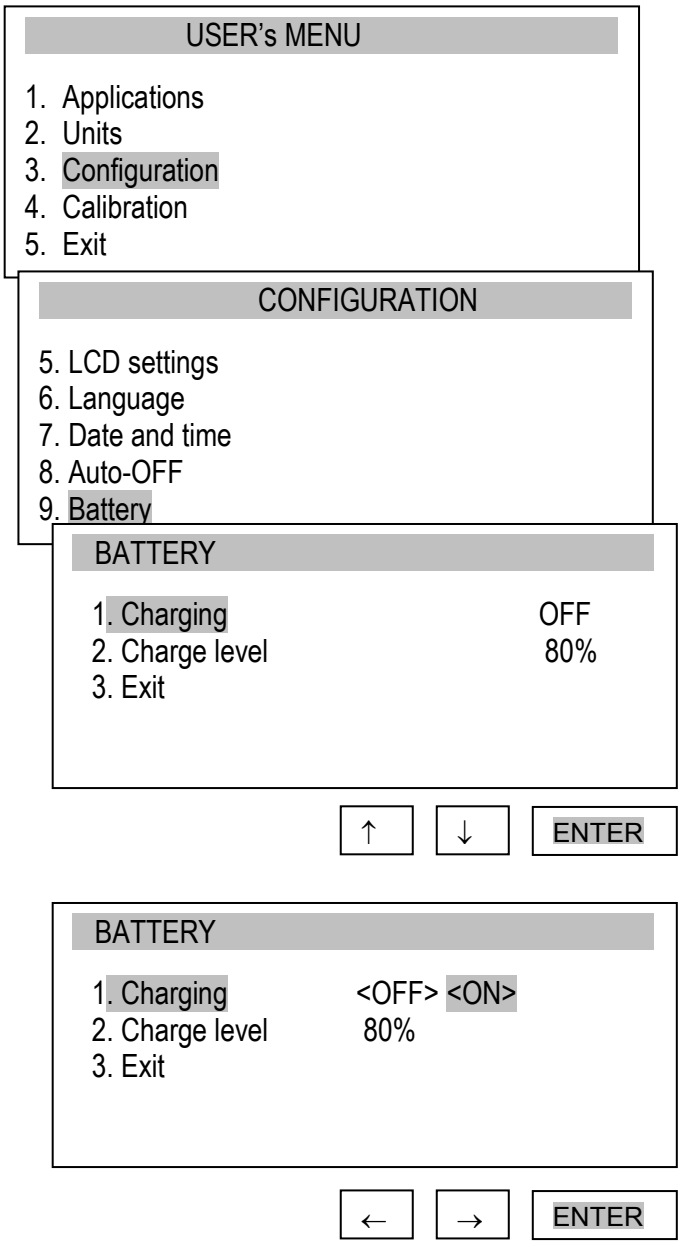
- *ON* – the power is turned off after 5 minutes, the indications remain unchanged,
- *BAT* – the power is turned off when the battery is low,
- *OFF* – the power is not turned off.

15.10 Monitoring the batteries' charge level (Battery)

This option is used for reading the charge level of the batteries and allows for the charging to be turned off to protect ordinary batteries, if such batteries are used instead of rechargeable batteries.



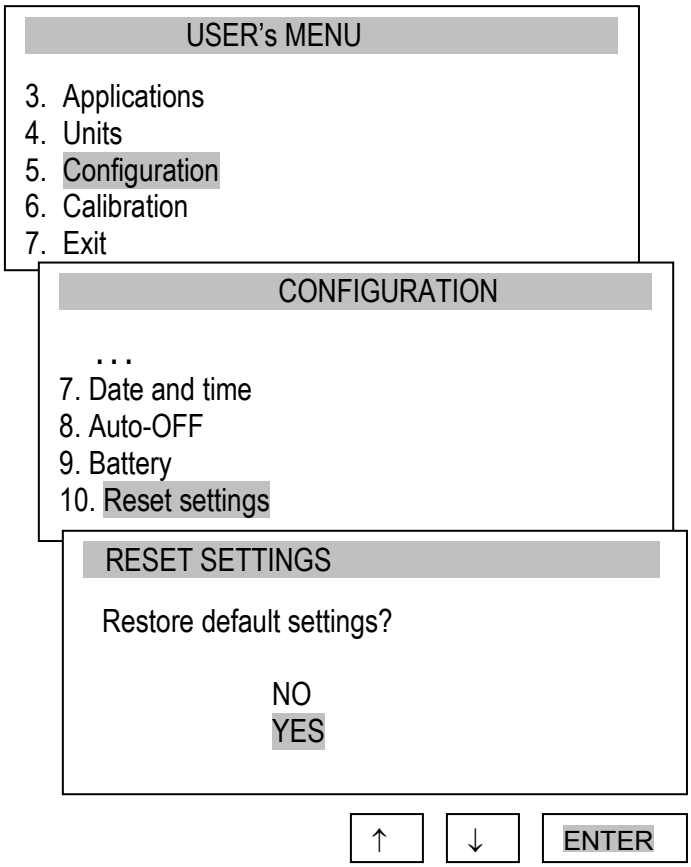
Charging ordinary batteries used instead of rechargeable batteries may lead to major damage to the gauge.



Use the navigation keys and *ENTER* to select *Battery* and *Charging,* and one of the following options:
- *ON* – charging ON,
- *OFF* – charging OFF.

15.11 Reset settings

This option restores factory settings (default settings) for all options.

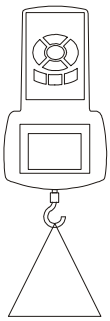


Use the navigation keys and *ENTER* to select *Reset settings* and the option *YES.*

As a result of restoring factory settings, the gauge will reset and start continuous measurement.

16. Calibration

To calibrate the gauge, select the method of applying load. For this purpose, use a stand or suspend a standard of mass on the gauge.



Reset the gauge without load using the →*T(0)*← key.

USER's MENU

6. Applications
7. Units
8. Configuration
9. Calibration
10. Exit

CALIBRATION

1. Calibration
2. Load <5kg> <20kg><10kg><...>
3. g = 9.81416m/s2
4. Geographical location
5. Exit

↑ ↓ ENTER

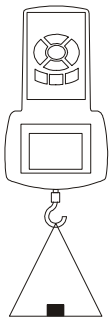
Use the navigation keys and *ENTER* to select *Calibration* and *Load.*

Select the load depending on the standard of mass. The <...> option allows for entering any value.

Enter the gravitational acceleration to correctly convert mass (kg) into force (N).

If the exact "g" value is not known, enter the parameters of the geographical location (latitude and above mean sea level). The "g" value will be calculated automatically.

Apply the standard of mass to the gauge.



CALIBRATION

1. Calibration
2. Load 5kg
3. g = 9.81416m/s2
4. Geographical location
5. Exit

↑ ↓ ENTER

Use the navigation keys and *ENTER* to select *Calibration* and wait until the calibration process is completed.

17. Maintenance, troubleshooting and repairing minor types of damage

1. Keep the gauge clean.
2. When using the force gauge, make sure that no contamination gets between the gauge plunger and the enclosure. Upon identifying any contamination, remove it using a tool which does not conduct electricity.
3. Unauthorised persons may not perform any repairs.
4. Have the gauge repaired by your local servicing facility. A list of servicing facilities is enclosed in the warranty.

Messages and faults:

Message/fault	Cause	Recommendation
The message RESETTING is displayed for an extended period of time.	Resetting process disturbed	Keep the gauge in motionless position and press →*T(0)*←
Message: AD range exceeded (+/-)	Resetting process disturbed	Put the gauge in horizontal position and turn it off and on using the *ON/OFF* key.
The values indicated by the gauge diverge significantly from correct values	Gauge out of adjustment	Contact a servicing facility to calibrate the gauge
Units displayed are different from the selected units	*UNIT/CLEAR* key pressed by accident	Press the *UNIT/CLEAR* key several times to display the correct units

Notes