opSens

LifeSens

User Manual

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User manual

Opsens inc

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This warranty does not apply to the transducers sold for use with Opsens' signal conditioners.

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The product specifications and other information contained in this manual are subject to change without notice.

Opsens has made a concerted effort to provide complete and current information for the proper use of the equipment. If there are questions regarding this manual or the proper use of the equipment, contact Opsens inc at:

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WARNINGS

WARNING: HIGH PRESSURE!

High pressure gases and liquids are potentially hazardous. Energy stored in these gases or liquids can be released suddenly and with extreme force. High pressure systems should be assembled and operated only by personnel who have been trained in proper safety practices.

WARNING : HIGH STRAIN!

Highly strained materials and parts are potentially hazardous. Energy stored in these materials or parts can be released suddenly and with extreme force. Highly strained systems should be assembled and operated only by personnel who have been trained in proper safety practices.

WARNING: NOT EXPLOSION PROOF!

Installation of this instrument in an area requiring devices rated as intrinsically safe is not recommended.

WARNING: VOLTAGE SUPPLY!

Use only the wall plug-in power supply delivered with your instrument and verifies that the input voltage and frequency are compatible with the power outlet.

TABLE OF CONTENT

1. Quick start

1.1   LifeSens Powering

Connect the plug-in wall or tabletop power supply to a power outlet. Verify that the power supply complies with the voltage and frequency outlet. Connect the power cable to the LifeSens power connector (Figure 1.1).
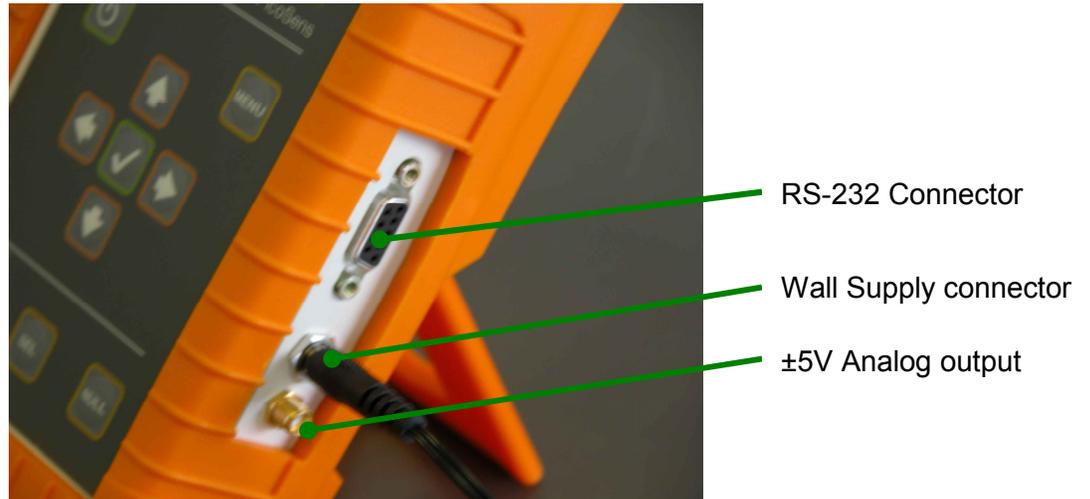

RS-232 Connector

Wall Supply connector

±5V Analog output

Figure 1.1: Electrical connectors

The LifeSens can also be operated from a 9-Volt battery. 9-Volt battery can be replaced by getting access to the battery compartment as follows: 1) Remove the rubber boot; 2) remove screws holding the battery panel, 3) install a 9-Volt battery with proper orientation of the polarity (Figure 1.2).
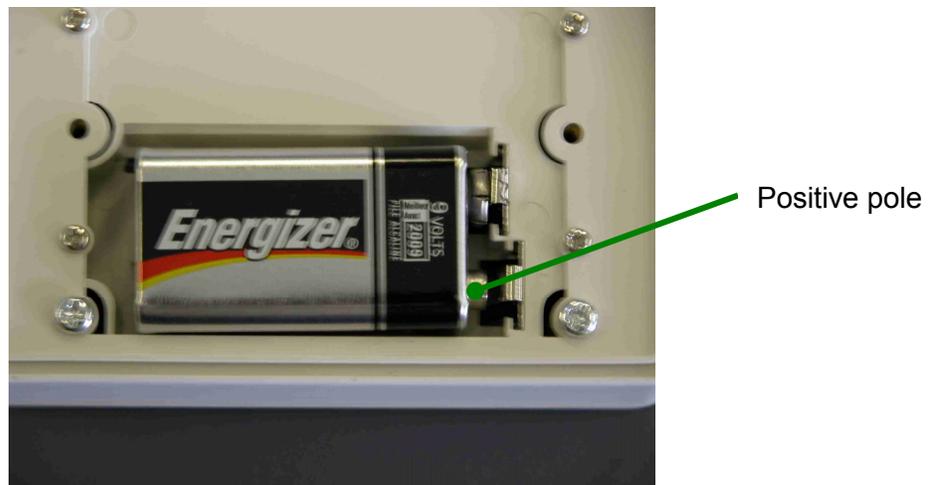

Positive pole

Figure 1.2: Polarity of 9V battery

Note: Battery operation is not provided for performing continuous measurements so it should be used for short term field measurements only.

1.2   Sensor Connection

Opsens fiber-optic sensors or transducers must be mated to the LifeSens output connector (Figure 2). The optical connector provided with the LifeSens is usually a square push-pull SC-type connector mounted with a SC-SC type mating. Remove the protective cap of the mating and engage the sensor connector with the orientation key properly oriented. It is a good practice to clean the sensor connector prior to connect it to the signal conditioner. Ask for Opsens Fiber-Optic Cleaning Guide for further information on how to clean fiber-optic connectors.

NOTE: always replace the protective dust cap on the mating when there is no sensor connected. Always replace the protective dust cap on the sensor fiber-optic connector when not in used
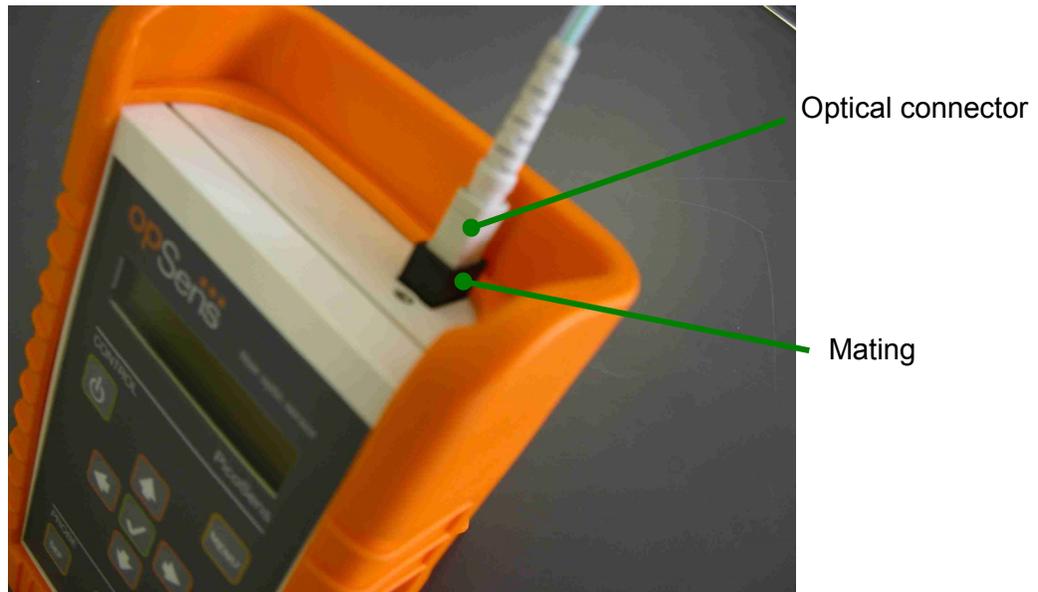

Optical connector

Mating

Figure 2: SC mating for connecting the fiber-optic sensor

1.3   LifeSens setup

The LifeSens is compatible with Opsens' WLPI type OPP-M pressure sensor. To properly use a specific sensor, its corresponding Sensor Type and Gauge Factor(s) must be entered into the LifeSens non-volatile memory as explained next. These numbers contain the parameterization factors of the sensor that is the sensor type and the sensor calibration parameters. These factors are indicated on a label fixed on the optical cable of the sensor, nearby the optical connector as indicated on the left figure.
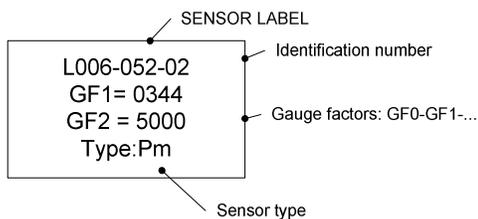
The label shows the identification number of the sensor (used for record purpose only), the Gauge Factors GF1, GF2 and the Sensor Type.

SENSOR LABEL

L006-052-02
GF1= 0344
GF2 = 5000
Type:Pm

Identification number

Gauge factors: GF0-GF1-...

Sensor type

1.4   Define a sensor

Before selecting a specific sensor, it must be defined that is its corresponding Sensor Type and Gauge Factor must be stored into the non-volatile memory of the LifeSens. The following example shows how to define a P1 type temperature sensor.

DEF	Enter Define Sensor Menu	➜`Def    Pr`
✓	Confirm Define Sensor Menu	
⬆	Select Sensor Type; use up or down arrow keys	➜`Type   Pm`
✓	Select Pm type by pressing (√)	
✓	Use Default Name or select a name for the sensor using up or down arrow keys (00 to 99 numbers only). Select sensor name by pressing (√)	➜`Pr Pm``01`
✓	Default Gauge Factor GF1	➜`GF1 0500`
⬆ ➡	Enter Gauge Factor GF1; use arrow keys and validate the entry with the confirm (√) key	➜`GF1 0344`
✓	Repeat above procedure for GF2	➜`GF2 5000`
NULL	Quit the menu	

1.5   Select a sensor among previously defined sensors

Once a sensor is defined, it can be selected from the defined sensor list as indicated below.

| SEL | Enter Sensor Select Menu | ➔ `Sel Pm01` |

| ⬇ | Select a defined sensor in the list | ➔ `Sel Pm01` |

| ✔ | Confirm selection | ➔ `  0    mmHg` |

1.6   Zeroing a sensor (when required)

If required, zeroing a sensor is easily done with the NULL button.

| NULL | Used with sensors that require zeroing | ➔ `  0    mmHg` |

2.   LifeSens Operating Principle

The LifeSens is a fiber-optic white light interferometric signal conditioner having the capability of accurately measuring the absolute path length difference of various type of sensing interferometers. Opsens produces a variety of interferometric sensors that are based on either so-called Fabry-Perot interferometer (low-finesse version) configuration or the polarization interferometer configuration. For example, Opsens pressure sensors are based on a Fabry-Perot sensing interferometer where the distance between the two mirrors of the interferometer varies as a function of the measured parameter. In all cases, the sensing interferometer is made so its path length difference varies with the physical parameter of interest. The path length difference of the sensing interferometer is accurately measured with a nanometer resolution and this over 30 000 nanometers range.

Physical measurements are possible if the path length difference of the sensing interferometer is a univocal function of the parameter under scrutiny. This being the case, the LifeSens must know the relation between the path length difference and the physical parameter. The Gauge Factors, or equivalently the calibration factors, that comes with each interferometric sensor contain all the information needed by the LifeSens to perform the conversion from the measurement of the path length difference to the physical value being measured.

For readers that may need to have a better understanding of the operating principle of the LifeSens, we refer to the white paper IMP0002 entitled "Opsens White Light Polarization Interferometry Technology" available on Opsens' web site: http://www.opsens.com/pdf/WLPI.pdf.

3.   Sensor type

The type of the sensors depends of the physical parameter to be measured. ***Pm*** is used to defined the ***OPP-M pressure sensor for the Medical*** industry.

Other sensors such as   the T-type (T1, T2, etc) are used for defining temperature sensors, the P-type (P1, P2, Pv, Pm, Pn, etc) are used for defining pressure sensors and the S-type are used for defining strain sensors.   There are also special type definitions that are the N-type and the X-type, which are not related to any specific sensor.   These are needed for internal calibration purpose only and should not be used unless instructions have been given by Opsens to do so.

4. Local Operation

4.1 Keyboard

4.1.1 Switch on/off

The LifeSens is switched on/off with this button.

4.1.2 Menu Button

Menu button gives access to the system menus. Once in the menu, this button brings the user one level higher into the menu hierarchy. Once at the root, the system will exit the menu and goes back to measurement display.

4.1.3 Left/Right Arrows

Left/Right arrows allows navigating 1) within the Gauge Factors of a given sensor being defined, selected, modified or deleted, 2) it allows moving from one digit to the other when a value is being entered or 3) returning to previous selection.

4.1.4 Up/Down Arrows

Up/Down arrows allows navigating 1) between menu items of a given hierarchical level, or 2) it allows changing a value being entered.

4.1.5 Confirmation button

Confirmation button permits confirming 1) a new value being entered, 2) confirm the selection of a menu item then moving one hierarchical level lower, 3) refreshing displayed value in the case of diagnostic.

4.1.6 Define Button

This button is short cut that brings the user directly to the menu item for defining the Gauge Factor of a new sensor.

4.1.7 Select Button

SEL This button is a short cut that brings the user directly to the menu item for selecting a new sensor being used.

4.1.8 Null Button

NULL This button allows to cancel most operations taking place, and return directly to the measurement display. This button is also used for zeroing a sensor when the system is not within the menu (measurement display mode).

4.2   Sensor-related functions

The functions below are related to the definition of the Sensor type and Gauges Factors to permit the conversion of the optical measurement into a physical quantity. Those functions are then related specifically to a given sensor.

4.2.1 Define sensor

The Sensor Type and Gauge Factors which define a specific sensor must be entered into the LifeSens for getting a meaningful physical measurement. Methods for defining a sensor are described in Figure 3. As shown on the figure, one can access to the Define menu level with the **MENU** button or uses the shortcut **DEF** button. The number of defined sensors is limited to eight and trying to define an additional sensor will make the LifeSens to display Mem Full message. The user is first asked to define the type of sensor being defined, for example Type Pm (see the sensor label for the type to enter). Once the type is confirmed with ✅ button, an allocation for this type of sensor is added to the sensor list stored in the LifeSens memory. The system then gives a default name to the sensor, from 01 to 08, e.g. Pr Pm01. The type of sensor is always part of the name, while the last two digits can be specified by the user (00 up to 99). Two different sensors cannot have the same last two digits. If the user tries adding a sensor number already used, the system will not permit the change and will use the default name. After confirming the sensor type, the used is requested to enter the Gauge Factor value(s). Depending of the sensor type, one, two or more GF values must be entered. These factors are indicated on a label fixed on the optical cable of the sensor, nearby the optical connector.

4.2.2 Select sensor

The user must select, within the list of defined sensors (maximum of eight), the specific sensor connected to the unit. Failure to do so will make the LifeSens to display meaningless readings. Methods for selecting the Gauge Factors are described in Figure 4. Once the sensor is selected, a confirmation message is displayed for about 1 second before it comes back to measurement display.

4.2.3 Modify Gauge Factor

The user can modify a previously entered Gauge Factor. The method for modifying a Gauge Factor is described in Figure 5. It is not possible to modify the type of sensor. The sensor must in this case be deleted, and a new sensor definition must be made.

4.2.4 Delete Defined Sensor

A defined sensor can be deleted from the LifeSens memory as described in Figure 6. When a sensor is being deleted, a confirmation message is displayed, for example Del Pm01. To accept deleting the sensor, press the confirmation button ☑ or use Menu Button 🔳 or the Null button 🔳 to cancel the operation.

4.3   System Setting

The functions below are used to setup specific parameters of the LifeSens. Some of the settings are not necessary related to a specific sensor.

4.3.1 Average

The user can set ON or OFF the averaging mode (ON by default). When on, the measurements either displayed on the front panel display, output on the analog output or on the RS-232 port is the result of the average of two sequential measurements based on the running average method. So even when averaging takes place, the output on the analog output is refreshed at a rate given by the sampling rate of the LifeSens. Note that the front panel display is refreshed a rate never higher than 3 measurements per second. The method to set the averaging is described in figure 7. This parameter is not saved and is lost when the system is switched off.

4.3.2 Analog output

The analog output parameters comprise the scale factor and the offset. The scale factor corresponds to the physical unit per Volt (unit/V) outputted by the system, while the offset corresponds to the physical value at which the user may want the analog output to be at zero volt. For example, one may desire to have 100 mmHg/V, being offset at 5mm Hg. The analog output voltage is thus given by:

$$Pressure = [Voltage\ output] \times 100\ mmHg/V + 5\ mmHg.$$

The method to change the analog output parameters is described in Figure 8. A default value is defined by the LifeSens to give access to the whole available range. Any new scale factor is saved in the non-volatile memory. This value is used whenever the system is switched on and off, and whenever the sensor is de-selected and re-selected. If the sensor is deleted, then its analog scale factor is lost. By default, the offset value is 0. New offset value is not saved and it is lost when the system is switched off, or when the sensor is de-selected.

4.3.3 Auto

(Reserved for future use)

4.3.4 Unit Mod

The LifeSens signal conditioners has two types of units to display and to output the measurement readings: the physical unit mode (mmHg) and the nanometer unit mode which provides a measurement of the cavity length of the sensor interferometer. The physical unit mode is the default mode and it is used most of the time. The nanometer unit mode is useful for establishing the calibration curve of the sensor that is the cavity length as a function of the measurand (pressure). For practical reasons, Opsens use the cavity length for calibrating its sensors. The cavity length is defined as half of path length difference of the interferometer. In the case of a Fabry-Perot interferometer, this length corresponds to the distance in between the two mirrors of the interferometer.

4.4   System Diagnostic

The user can look through a variety of LifeSens internal parameter for diagnosing potential problem with the system as described in Figure 10. The available diagnostics parameters are shown below. Diagnostic values can be refreshed by depressing confirmation button ✅.

Parameters		Description
Lg	2.6V(volt)	Light level
Ga	1.3(no unit)	Amplifier gain
Lm	47% (%)	Lamp driving level
Ct	18 %(%)	Signal contrast
SNR	485(no unit)	Signal quality

The following table shows diagnostic values with good signal, poor signal, or with a broken sensor ("fault"). A fault condition results in a "No Signal" being displayed.

Parameter	Good signal	Poor Signal	Fault
Lg	> 2.2	< 2.2	—
Ga	< 2.0	> 2.0	—
Lm	< 90 %	> 90 %	—
Ct	> 15 %	< 15 %	—
SNR	> 200	< 200	< 100

NOTE: Without a sensor connected, the instrument shows the message "NoS" or "No Signal" on its display.

In the unlikely situation that this message appears while a sensor is connected to the unit, take note of the diagnostic parameters and contact Opsens technical support.

During a No Signal condition, the analog output and the serial ports output constant values as follow:

Output	No Signal condition output value
Analog	0 Volt
RS-232	65 536.0

4.5   Calib

(Reserved for future use)

4.6   Null button

The Null button is used to cancel an operation that takes place within the menu, and exit the menu. In the display mode the null button is used for zeroing the selected sensor, i.e. referencing the sensor to the actual value. For example, when using a pressure gauge, it is always required to zero the sensor at a known zero pressure state. Depending on the type of sensor being used, the null button will perform differently.

4.6.1   Pm, Pressure sensors

Pm type sensors will zero the sensor relative to atmospheric pressure. An internal manometer will be used to correct the pressure measurement against atmospheric pressure.
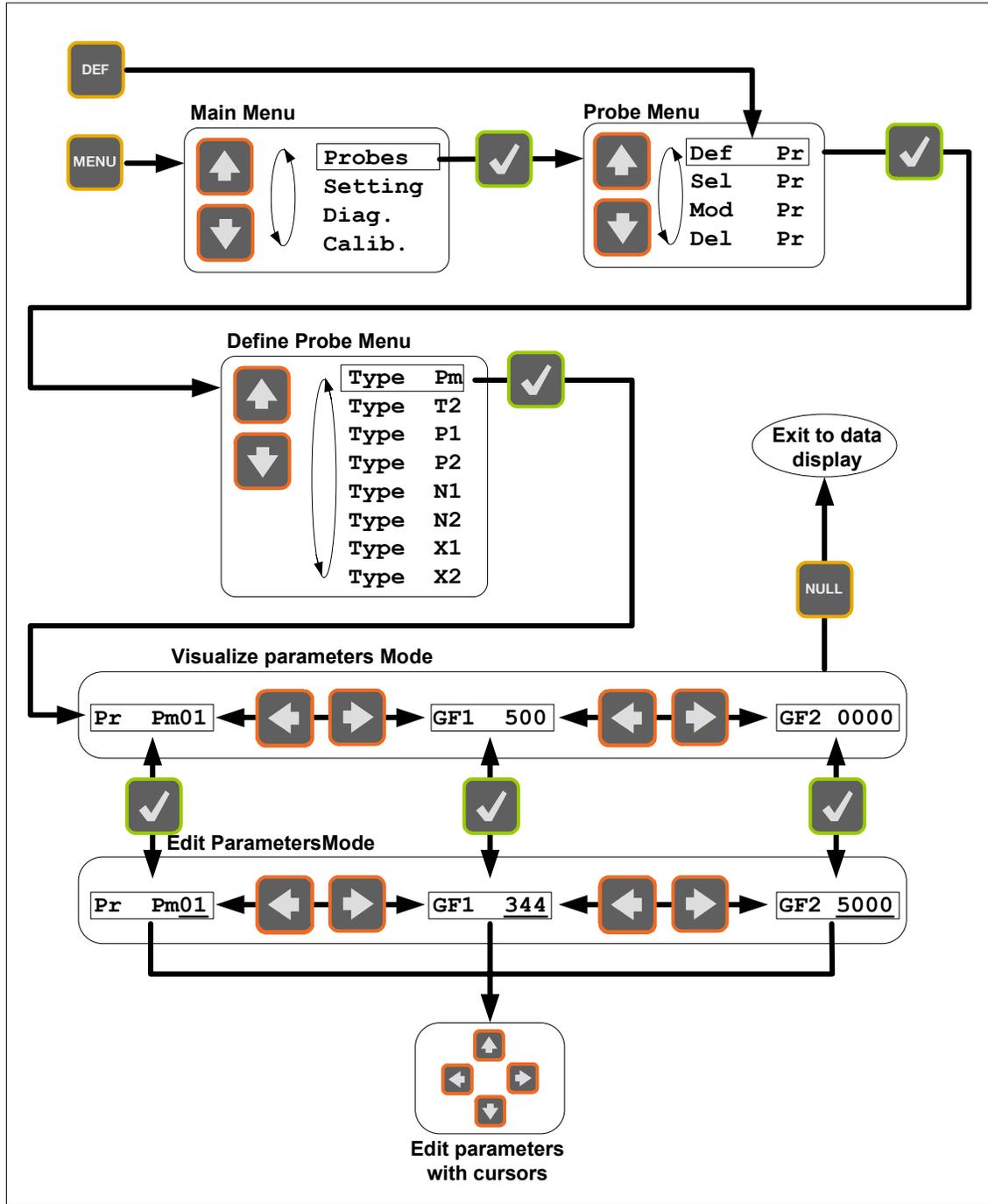
4.7   Defining a sensor (Menu levels)

Figure 3: Defining a sensor

Sensor Type and Gauge Factor(s) must first be entered into the LifeSens memory to permit the conversion of the sensing interferometer path length difference into physical measurements.
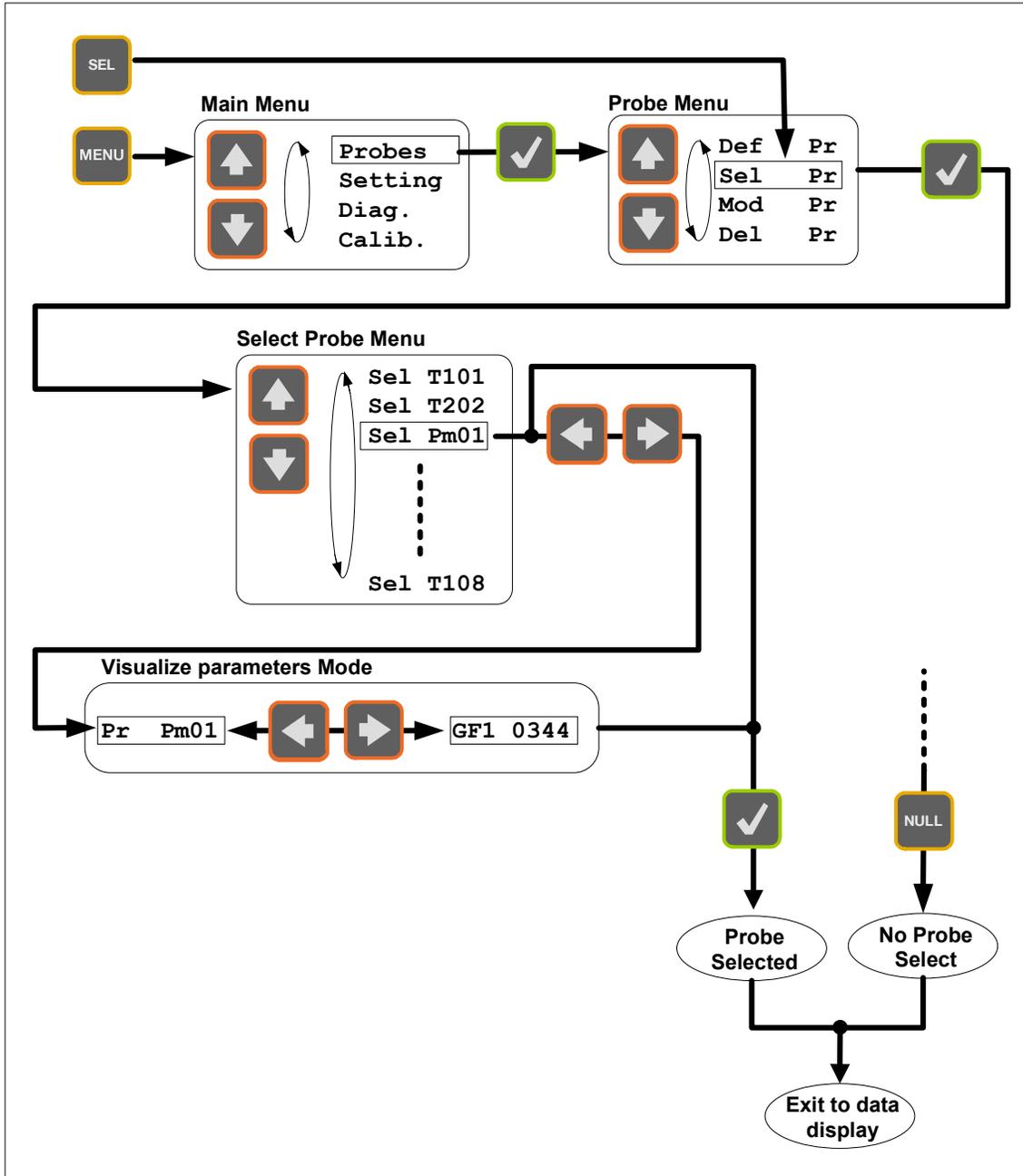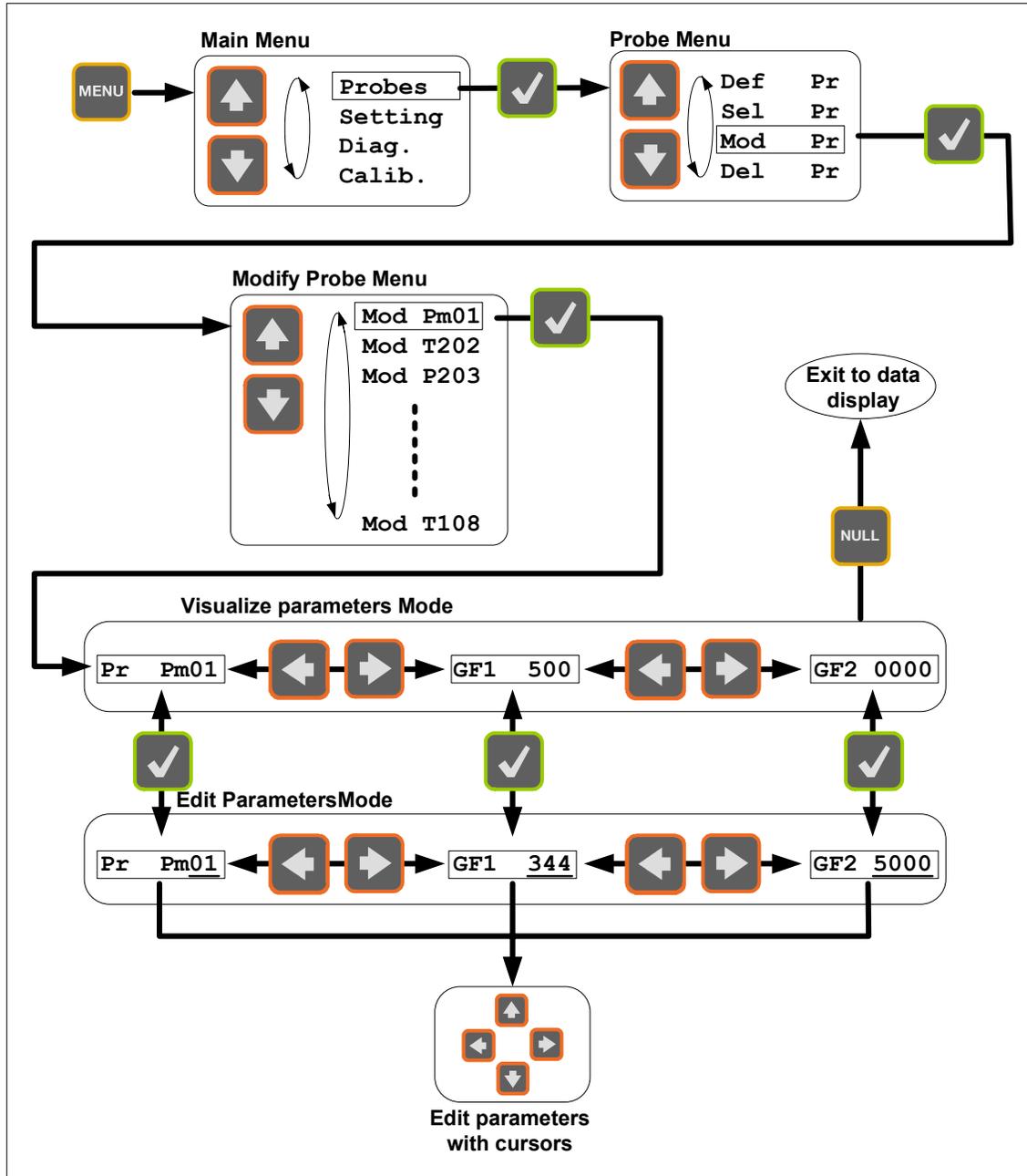
4.8   Selecting a sensor (Menus levels)

Figure 4: Selecting a sensor

Sensor must be selected among those defined into the LifeSens internal memory.

4.9   Modifying Gauge Factor(s) (Menus levels)

Figure 5: Modifying Gauge Factor(s)

Gauge Factors saved into the internal memory can be modified.

4.10 Delete Gauge Factor (Menus levels)
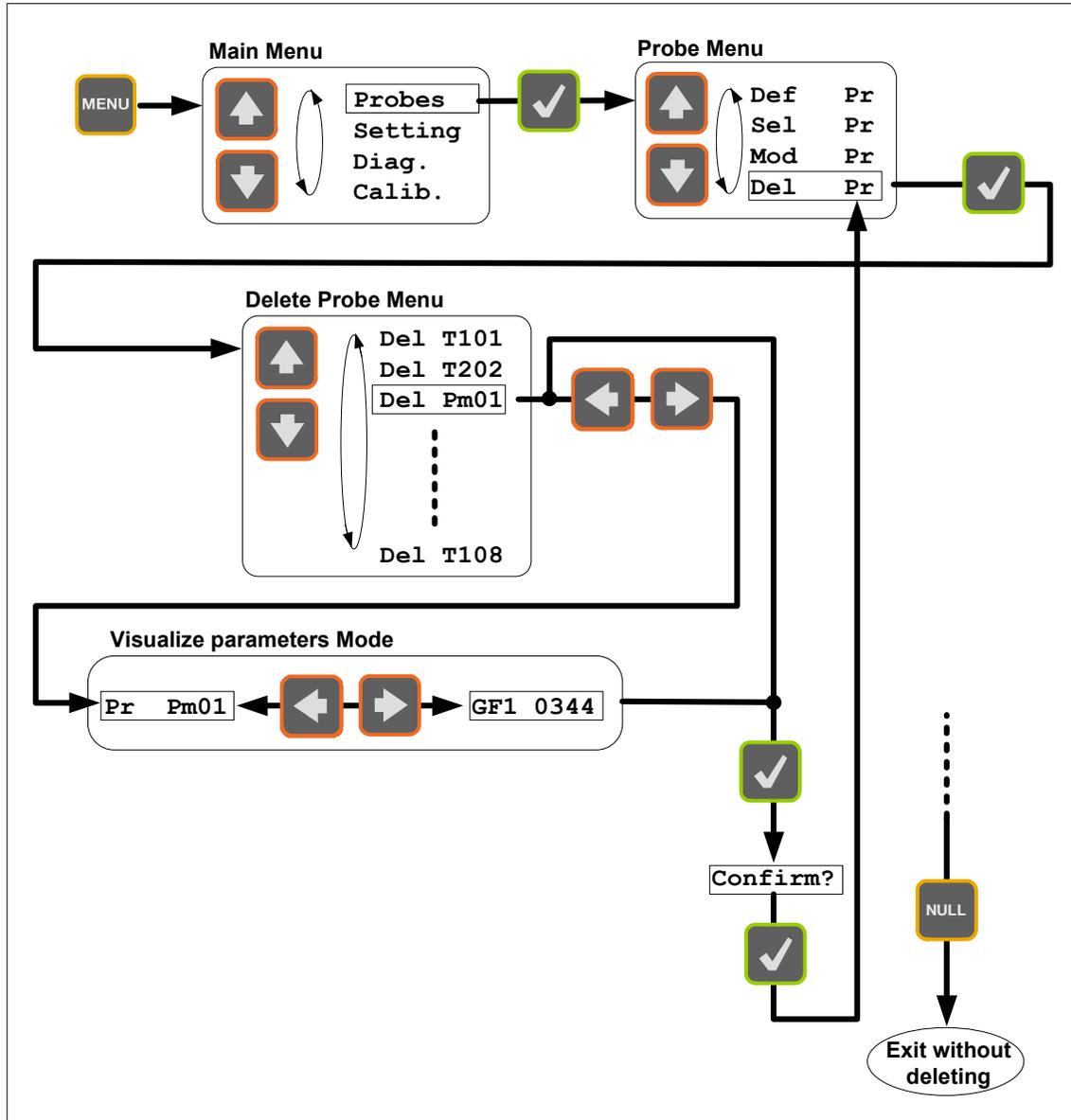
Figure 6: Delete Gauge Factor

Gauge Factors can be deleted from the internal LifeSens memory.

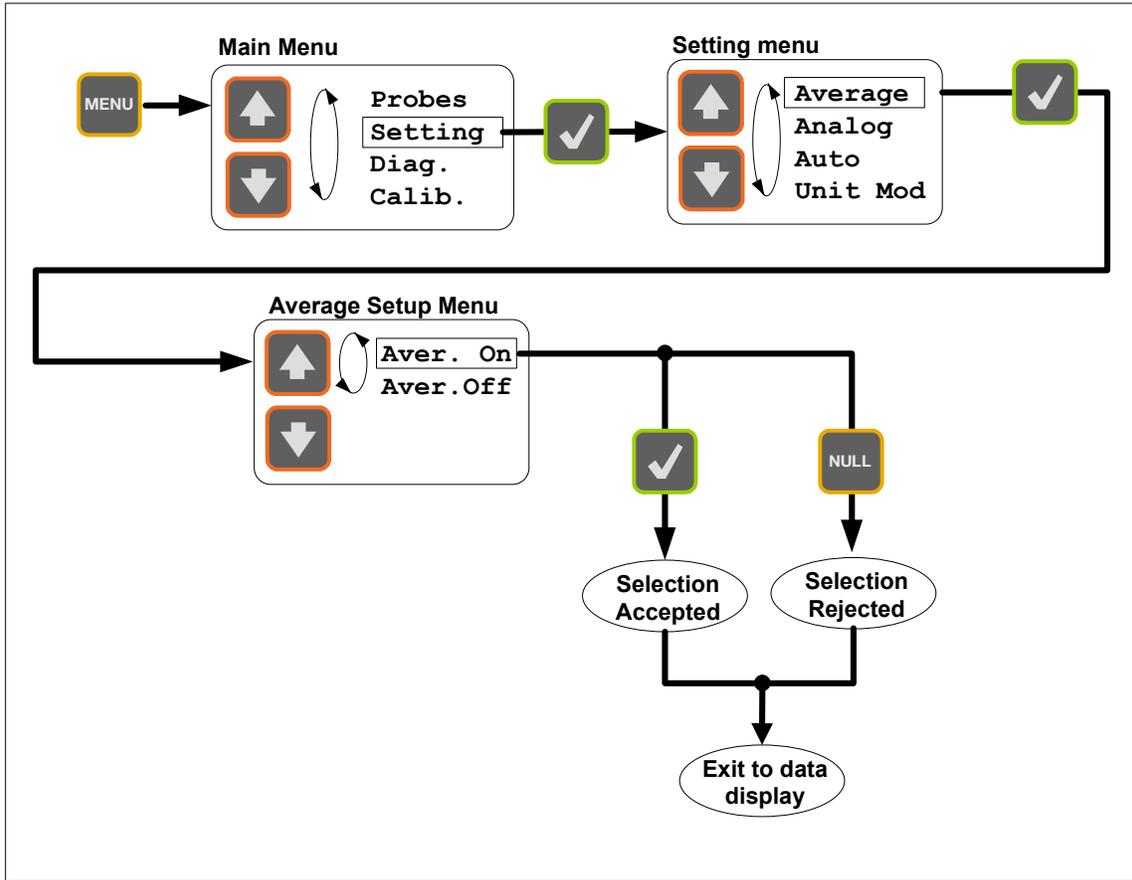## 4.11 Averaging measurements (Menus levels)

Figure 7: Averaging measurements

Averaging: twenty sequential measurements are averaged (running average method) for obtaining even smoother signal.
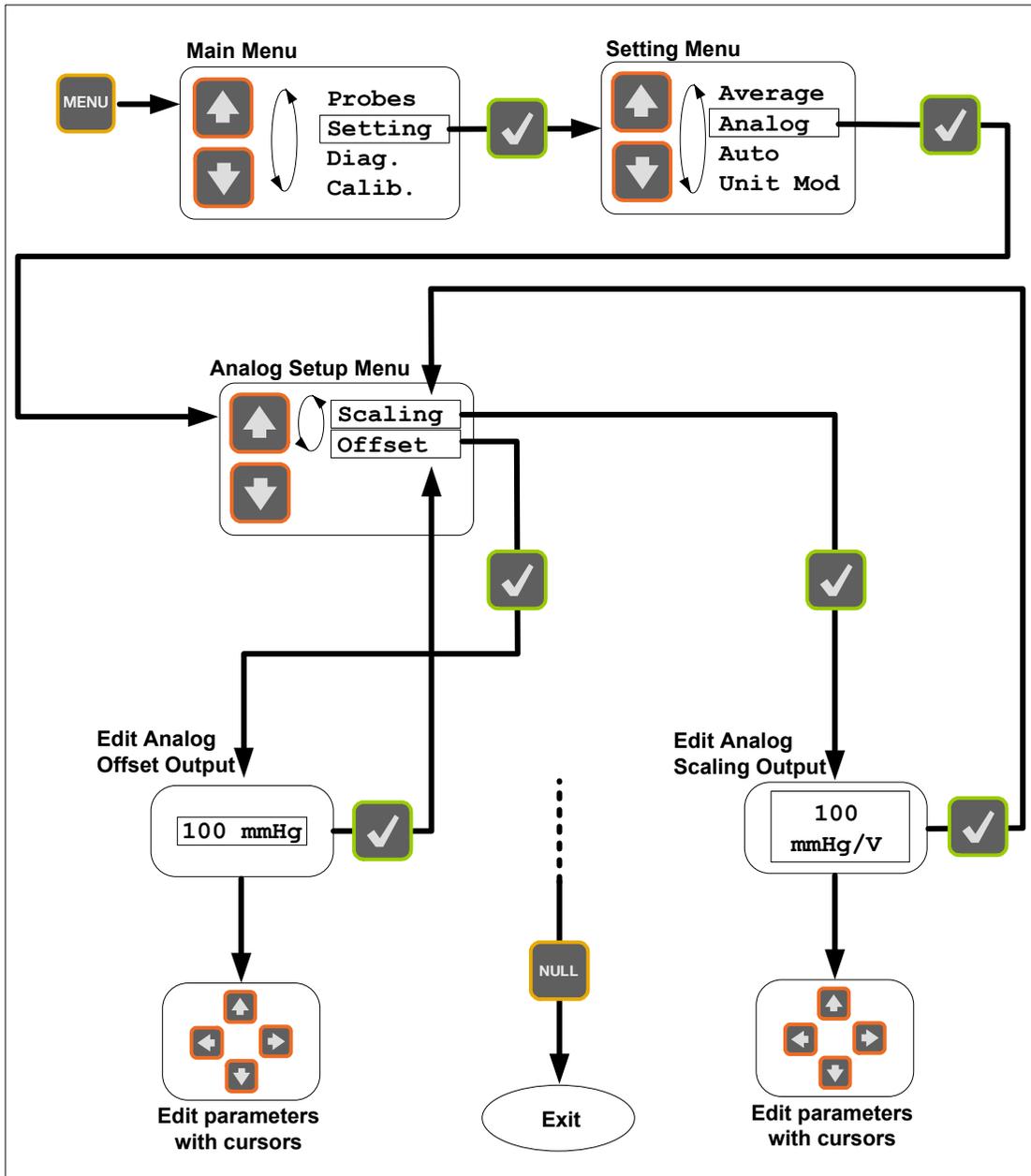
4.12 Setting the analog output (Menus levels)

Figure 8: Setting up Analog output

Both the scale factor and offset can be setup according to user requirements.

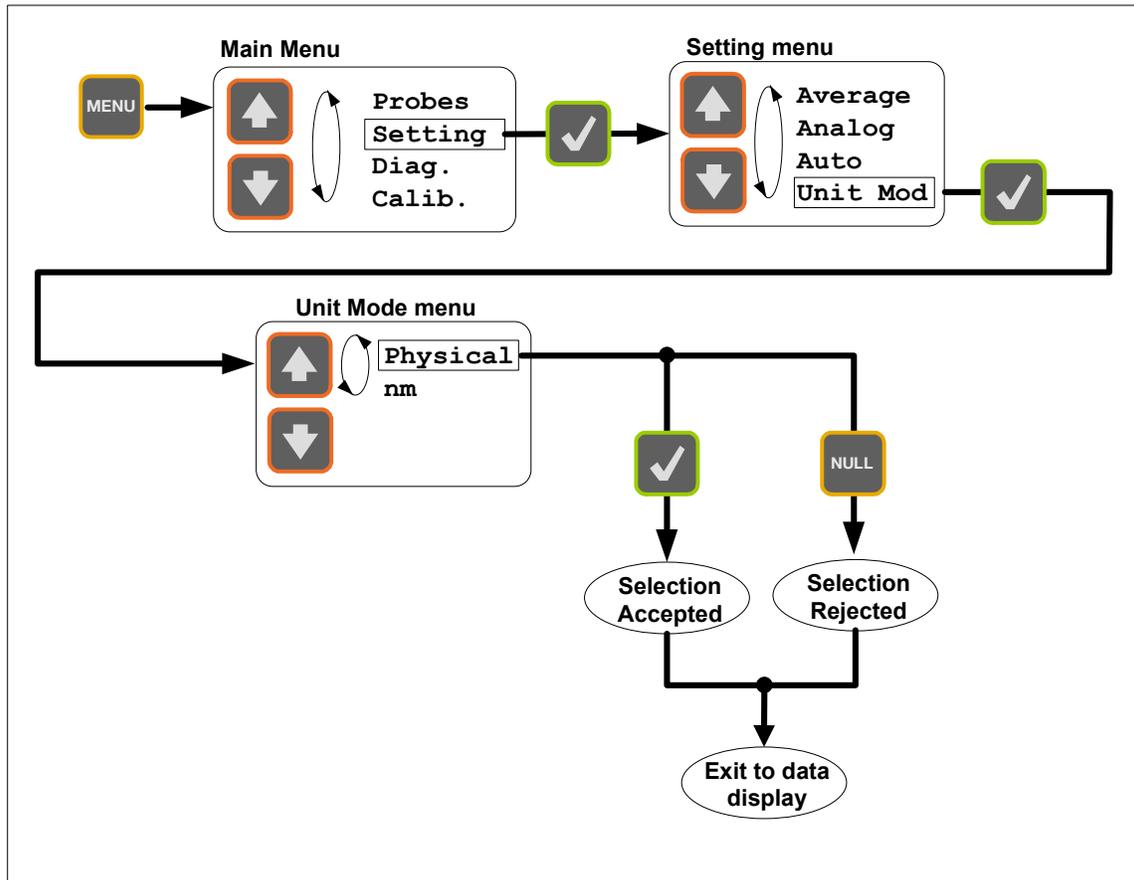## 4.13 Unit mode (Menus levels)

Figure 9: Unit Mode

The user can select the signal conditioner to display and output the measurement reading in physical units or in nanometer units.

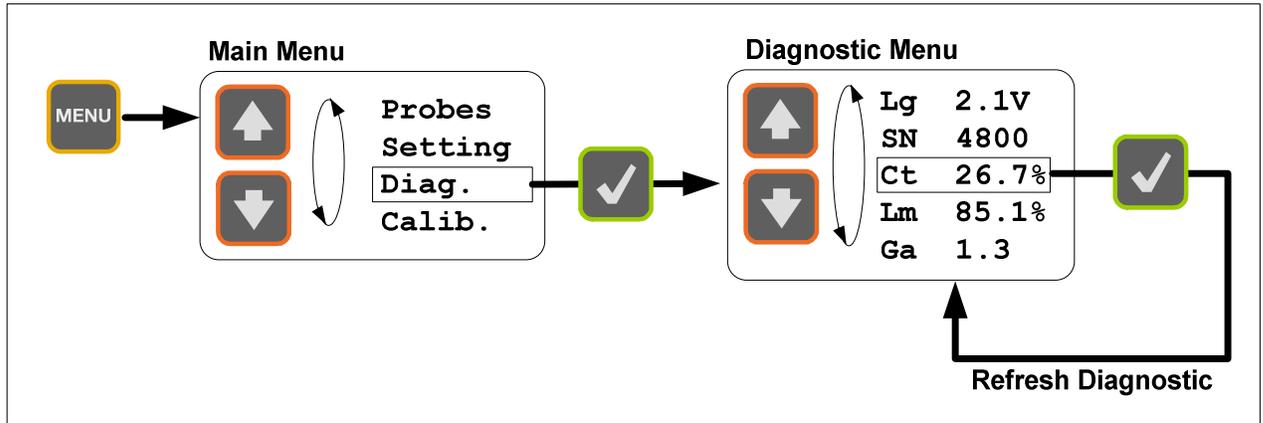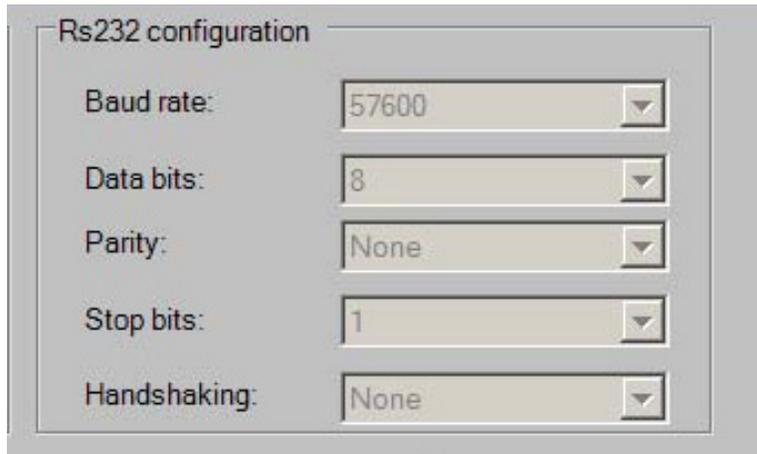## 4.14 Diagnostic (Menus levels)

Figure 10: Diagnostic

- The user can look through a variety of diagnostic parameters for diagnosing potential problem with the LifeSens or the fiber-optic sensor. The available diagnostic parameters are as follows.

Diagnostic parameters:	Unit
Light level (Lg)	Volts
Signal-to-noise ratio (SN)	(no unit)
Signal contrast (Ct)	%
Lamp driving level	%
Amplifier gain (Ga)	(no unit)

5.   Remote operation

The LifeSens signal conditioner comes with a RS-232 serial communication interface to allow control with a remote computer. The RS-232 interface settings are indicated on the following figure.

Figure 12: RS-232 interface setting

The LifeSens serial interface remote control commands are based on the standard SCPI syntax (**S**tandard **C**ommands for **P**rogrammable **I**nstrumentation). The user can create its own remote control software using the various SCPI commands available for the LifeSens. But for ease of operation, Opsens provides its own control software, called SoftSens, which gives access to all the functionalities of the LifeSens conditioner. See SoftSens user manual for how to remotely control the LifeSens conditioner.

For those who which to develop their own remote control software, ask for Opsens Serial communication user manual to get all the information about serial interfacing with Opsens signal conditioners.

6.   LifeSens specifications

Number of channels	One
Compatibility	All Opsens WLPI transducers
Full scale	5 000 nm (Fabry-Perot cavity length change)
Resolution	±0.5mmHg
Precision	±1mmHg below 50mmHg, 3% above
Sampling rate	250Hz for LifeSens
Output interface	±5 Volts and RS-232 standard
Input power	9 to 24 VDC (AC/DC wall-transformer adapter included)
Consumption	1.8 Watts typical
Battery	9V
Enclosure	Plastic casing with a removable rubber boot protection
Dimensions (without rubber boot protection)	45 mm (H) x 105 mm (W) x 165 mm (L)
Storage temperature	-40 °C to 65 °C
Operating temperature	0 °C to 45 °C
Humidity	95 % non condensing
Light source life span	40 000 hours MTBF