Pulsar Model 33
Sound Level Meter
User Manual

GENERAL FEATURES

The **MODEL 33** is a powerful, user-friendly instrument for acoustic measurements. It can work as a type-1 integrating-averaging sound level meter that complies with IEC 60651, IEC 60804 and IEC 61672 international standards and their EU counterparts EN 60651 and EN 60804. The MODEL 33 also complies with the American standards ANSI S1.4 and ANSI S1.43.

The **MODEL 33** is also a spectrum analyser measuring in real time and in one third octave bands and octave bands, with type 1 filters, which comply with IEC 61260 and EN61260. They also comply with ANSI S1.11.

Moreover, the **MODEL 33** offers the possibility to be upgraded with different modules to carry out advanced acoustic measurements.

Workings modes and functions

The **MODEL 33**, in its basic version (without modulus), has the following modes of working:

- Statistical Integrating Sound Level Meter
- Octave band real time spectrum analyser
- One third octave band real time spectrum analyser

As Sound Level Meter (S) it measures in the whole dynamic range (single scale) and simultaneously the following functions:

- The sound pressure level with 'S', 'F' and 'I' time averaging and their maximum and minimum values during the measurement period *and during the last second*[*]
- The peak sound pressure level corresponding to the measurement time *and to the last second*[*]
- The sound exposure level, also known as SEL.
- The equivalent continuous sound pressure level with programmable consecutive integration time T and its maximum and minimum values, also known as L_{eq}.
- The equivalent continuous sound pressure level with integration time one second[*]
- The equivalent continuous sound pressure level during the measurement period.
- The equivalent continuous sound pressure level with time averaging 'I' and programmable consecutive integration time T and integration time belonging to the measurement period.
- *125 ms Functions[*] (short functions)*:
    - *The Sound pressure level with 'S', 'F' and 'I' time weighting, sampled every 125 ms. 8 values per second*[*]
    - *The Peak sound pressure level corresponding to the latest 125 ms. 8 values per second*[*]
    - *The equivalent continuous sound pressure level with consecutive integration time of 125 milliseconds (Short Leq). 8 values per second*[*]

All these functions are measured simultaneously with the following frequency weightings:

- Frequency Weighting A
- Frequency Weighting C
- Frequency Weighting Z (zero): Frequency Weighting equal to 0 dB from 10 Hz to 20 kHz

It also measures the following functions:

- The total percentile levels corresponding to 1, 5, 10, 50, 90, 95 and 99 % of the entire measurement and the partial levels of each T interval of the sound pressure level with time averaging 'F' and frequency weighting A.

The **MODEL 33** also displays the following acoustic functions:

- The subtraction of the equivalent continuous sound pressure level with time averaging 'I' and the equivalent continuous sound pressure level, corresponding to the measurement time and to the programmable integration time T. These two functions measured with frequency weighting A, C and Z
- The subtraction of the equivalent continuous sound pressure level with frequency weighting C and the equivalent continuous sound pressure level with frequency weighting A, corresponding to the measurement time and to a programmable integration time T.

As an octave band spectrum analyser (1/1), it measures simultaneously and in all the dynamic range (single scale) the following functions:

- The equivalent continuous sound pressure level with programmable consecutive integration time T and without frequency weighting for each octave band centred on frequencies of 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hz.
- *The equivalent continuous sound pressure level with programmable consecutive integration time of 125 ms and without frequency weighting for each octave band centred on frequencies of 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hz* *
- *The equivalent continuous sound pressure level of the integration time 125 ms and with frequency weighting A, C and Z* *
- The equivalent continuous sound pressure level of the T integration interval with frequency weighting A, C and Z.
- The partial percentile levels corresponding to 1, 5, 10, 50, 90, 95 and 99 % of the equivalent continuous sound pressure level corresponding to the integration time T measured for each octave band.
- The partial percentile levels corresponding to 1, 5, 10, 50, 90, 95 and 99 % of the total equivalent continuous sound pressure level measured with frequency weighting A and corresponding to the integration time T.

The **MODEL 33** has a background noise evaluation screen where the following acoustic functions are shown:

- The value of the NC (Noise Criterion) curve corresponding to the measured spectrum
- The value of the NC curve that has not been exceeded in each octave band

As a one third octave band spectrum analyser (1/3), it measures simultaneously and in all the dynamic range (single scale) the following functions:

- The equivalent continuous sound pressure level with programmable consecutive integration time T and without frequency weighting for each one third octave band centred on frequencies of 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000 and 10000 Hz
- *The equivalent continuous sound pressure level with programmable consecutive integration time of 125 ms and without frequency weighting for each one third octave band centred on frequencies of 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250,*

315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000 and 10000 Hz[*]

See APPENDIX A: Functions for the names and definitions of each of the functions measured.

* The functions in *italics* are measured by the MODEL 33 but are not shown on its screen. The way to get the results of these functions is to make a real time measurement with the Capture Studio software application or making a recording and downloading the results to a PC with the help of Capture Studio.

Main features of the MODEL 33

The **MODEL 33** is an easy-to-use sound level meter that allows you to make sound measurements quickly and conveniently. The MODEL 33 measures simultaneously a wide range of functions, with which it is possible to calculate the most important acoustic evaluation indexes of the majority of countries in the world. The MODEL 33 makes a quantitative analysis (sound level meter parameters, spectral levels) and qualitative (impulsiveness indicators, low frequency, background noise evaluation in rooms, etc.)

The most important features of the MODEL 33 are the following:

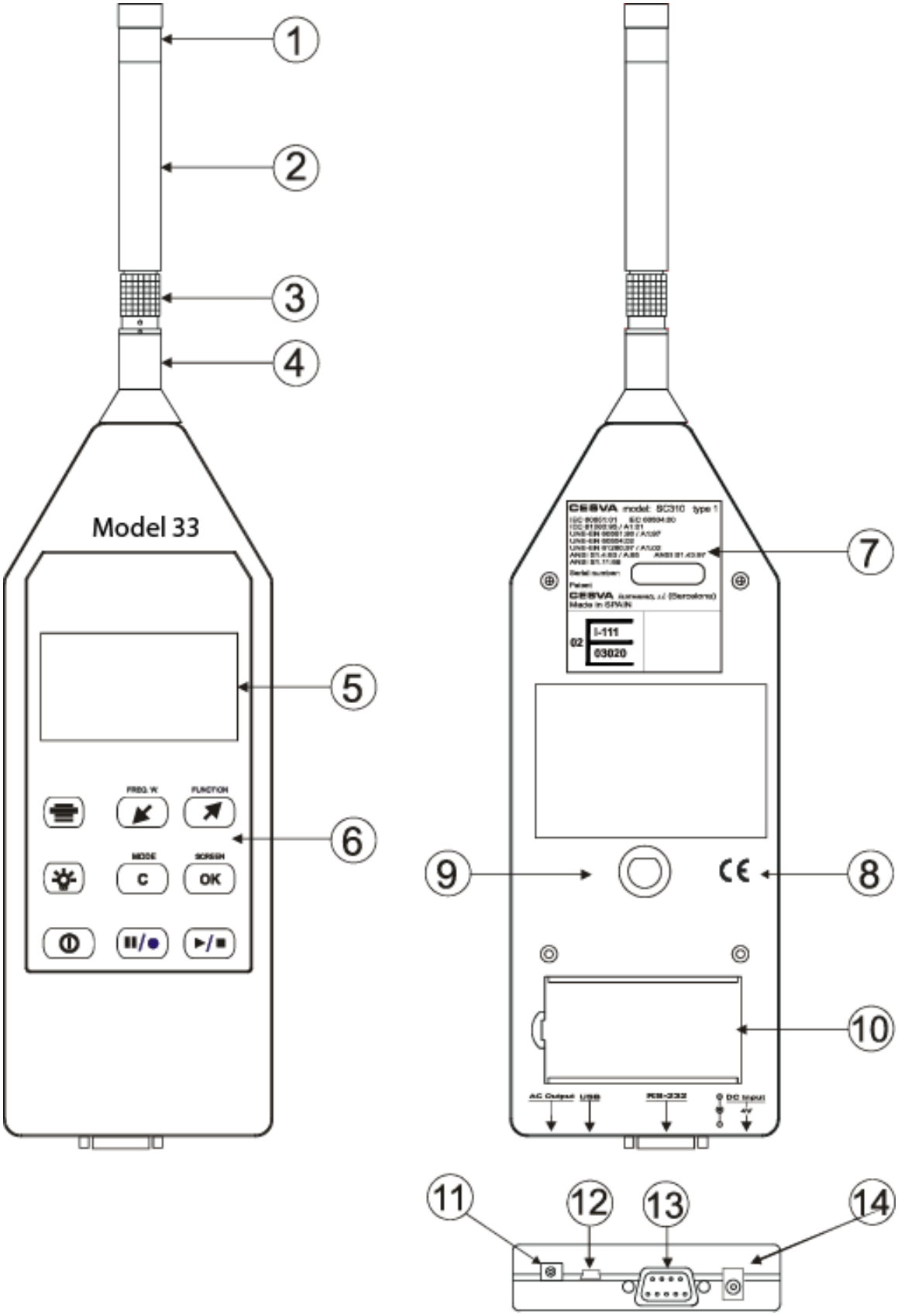
- The MODEL 33 has been designed to be user friendly; a single reading of the manual will allow you to work intuitively with it.
- The MODEL 33 has a single user range; there is therefore no need to adjust the scale prior to beginning a measurement, whatever the dynamic range of the sound event to be measured.
- Whether you use it as a sound level meter or spectrum analyser, the MODEL 33 simultaneously measures all functions with all the available frequency weightings (A, C and Z).
- The MODEL 33 preamplifier is detachable. You can uncouple it and move it away from the MODEL 33 by using the extension cables. The instrument can be complemented with an outdoor kit for taking measurements in the open air.
- The MODEL 33 is equipped with CAPTURE STUDIO communications software, allowing you to configure the instrument and download all the recorded data and real-time measurements into a personal computer. This way they can be viewed in electronic format, exported to other programmes and its data show in numeric and graphic format to generate reports.
- The MODEL 33 AC output is designed to pick up the direct preamplifier signal. This allows you to make a calibrated recording on a D.A.T. and subsequently analyse it both quantitatively (impulse or tonal sound level analysis) and qualitatively (exceptional sound event – shouts, undesirable noises, etc. – detection). The MODEL 33 is equipped with a 40 dB built-in amplifier to adapt the measurement range to the recording dynamic range.
- The MODEL 33's graphic screen displays the measured functions in both graphic and alphanumeric formats. The graphic display is highly practical when it comes to studying a sound event, evaluating its time history or analysing its spectral contents. The MODEL 33's screen lights up at the push of a button, allowing you to work in dim conditions or in the dark.
- The MODEL 33's membrane keyboard is absolutely flat. This way its excellent sound response is never impaired.

- The MODEL 33 has an internal memory for storing measured data. The storage of these data in the memory is configurable, allowing you to adapt the form of data recording to the kind of measurement being conducted.
- The MODEL 33 allows you to download data stored in memory simultaneously to the process of measuring and recording. This feature together with the possibility to configure the free space of memory as a circular memory identifies the MODEL 33 as the perfect platform for permanent acoustic monitoring.
- The MODEL 33 has multiple language support and once a language is selected, it will remain selected even if the unit is turned OFF
- The MODEL 33 can work with both 200 V polarised and prepolarised microphones. Each kind of microphone needs its corresponding preamplifier to work correctly.
- The MODEL 33 has two communication ports: RS-232 and USB. The USB port allows data to be downloaded at high speed rate and the RS-232 offers compatibility with all the computers and permits to generate communication ports through modem (telephone, mobile) or Wireless.

Description of the MODEL 33

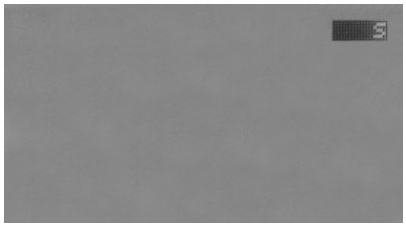
The main components of the **MODEL 33** are listed below, the numbers corresponding to those in the outline drawing:

1. **½'' condenser microphone**. The MODEL 33 is fitted with the MK 224 pre-polarised microphone
2. **Preamplifier**. The MODEL 33 is equipped with the removable PA-14 preamplifier (for MK:224) which is connected by the LEMO connector [3].
3. **LEMO-type preamplifier connector**. LEMO-type male plug preamplifier connector.
4. **LEMO-type sound level meter connector**. LEMO-type MODEL 33 sound level meter socket connector.
5. **Screen**. Illuminated LCD graphic screen.
6. **Membrane keyboard**. Extra-flat keyboard designed to reduce the reflections that may reach the microphone from the sound level meter case.
7. **Characteristics plate**. Showing the make, model and serial number of the sound level meter, along with all the standards it complies with as type 1.
8. **CE mark**. European approval mark.
9. **Tripod mount**. Built-in support for tripod with standard ¼" W thread (TR-1).
10. **Battery cover**. To change the battery, simply remove the cover.
11. **AC output**. Direct output from the preamplifier without frequency weighting. Specially designed to make recordings on D.A.T. medium.
12. **USB Connector**: mini-B USB type connector for digital bi-directional communication digital USB 1.1 full speed.
13. **RS-232 input/output connector**. SubD-type 9 pin-connector for serial connection of the sound level meter to a personal computer and phone connection through modem.
14. **DC input**: Input with which to connect to a DC mains supply (4-5 V, 100 mA). (AM240 or AM241)


1
2
3
4
Model 33
5
FREQ. W.
FUNCTION
6
MODE
SCREEN
C
OK
II/●
►/■
7
CESVA model: SC310 type 1
CESVA
Made in SPAIN
02
I-111
03020
9
8
10
AC Output
USB
RS-232
DC Input
11
12
13
14

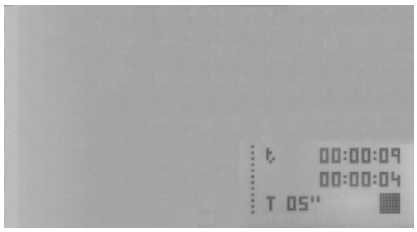
Screen

The current MODEL 33 mode is always indicated in the top right-hand corner of the screen:



- S Sound Level meter mode
- 1/1 Octave band Spectrum Analyser
- 1/3 One third octave band Spectrum Analyser

While the MODEL 33 is measuring, the following information appears at the bottom right of the screen:

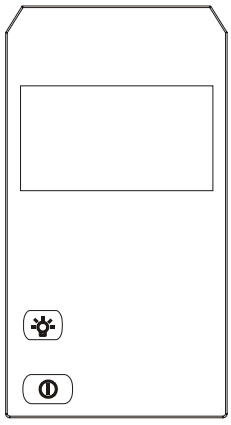


- The elapsed measurement time t
- The elapsed integration time (between 0 and T). (For L_T the MODEL 33 carries out consecutive integrations of T time, whether it is functioning as a sound level meter or spectrum analyser)
- The T integration time (for L_T only)
- State of measurement indication:
  - ■ measurement completed
  - ▶ measurement in progress
  - ▶ (flashing) measurement with recording in progress
  - ❚❚ measurement temporarily paused

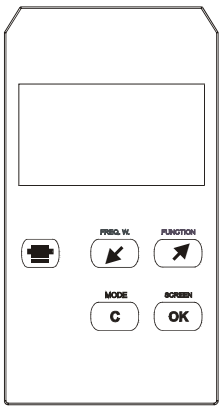
Hint: Do not confuse the elapsed measuring time (t) with the integration time (T)

Using the keyboard

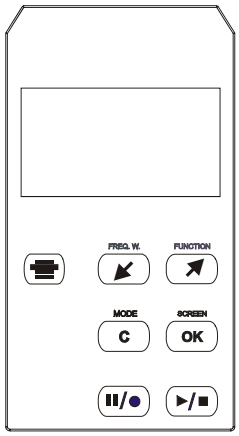
The following tables show the function of the different keys of the **MODEL 33.**



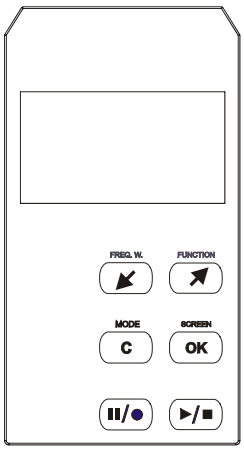
GENERAL KEYS:	
⏻	Key for switching the MODEL 33 on and off (RED)
🔆	Key for turning the screen light on and off



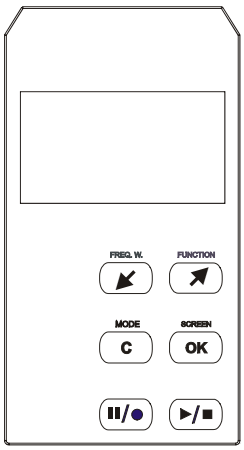
MODEL 33 MENU KEYS:	
☰	Key to access the MODEL 33 menu
↙	Key for moving downwards in the menu
↗	Key for moving upwards in the menu
OK	Key for confirming or switching options
C	Key for returning to the previous menu



MODEL 33 SOUND LEVEL METER KEYS:	
►/■	Key to begin or finish a measurement
II/●	a. Key to temporarily interrupt a measurement (PAUSE) (while the MODEL 33 is in ►) b. To start recording data into memory (when MODEL 33 is stopped i.e. ■)
FREQ. W. ↙	Key to select the frequency weighting displayed on the screen
FUNCTION ↗	Key to select the function displayed on the screen
SCREEN OK	Key to select the desired sound level meter screen: numerical, graphic, statistical or advanced
MODE C	Key to switch from sound level meter to 1/1 spectrum analyser
☰	Key to access the preferred numerical screen, from the numerical screen only



MODEL 33 1/1 OCTAVE SPECTRUM ANALYSER KEYS:	
►/■	Key to begin or finish a measurement
II/●	a) Key to temporarily interrupt a measurement (PAUSE) (while the MODEL 33 is in ►) b) To begin recording (when MODEL 33 is in ■)
FREQ. W. ↙	Key to return to the previous octave band
FUNCTION ↗	Key to go on to the next octave band
SCREEN OK	Key to select the desired 1/1 spectrum analyser screen: numerical, graphic, statistical or NC
MODE C	Key to switch from the 1/1 spectrum analyser to 1/3 spectrum analyser



MODEL 33 1/3 OCTAVE SPECTRUM ANALYSER KEYS:	
▶/■	Key to begin or finish a measurement
❚❚/●	c) Key to temporarily interrupt a measurement (PAUSE) (while the MODEL 33 is in ▶) d) To begin recording (when MODEL 33 is in ■)
FREQ. W.	Key to return to the previous third octave band
FUNCTION	Key to go on to the next third octave band
SCREEN OK	Key to select the desired 1/3 spectrum analyser screen: numerical spectrum analysis or graphic spectrum analysis
MODE C	Key to switch from the 1/3 spectrum analyser to the sound level meter mode

USING THE MODEL 33

This chapter contains all the information you need to configure and adjust the MODEL 33 and carry out sound level and spectrum measurements.

First steps

This section tells you what to do before starting to use the MODEL 33.

Material and literature

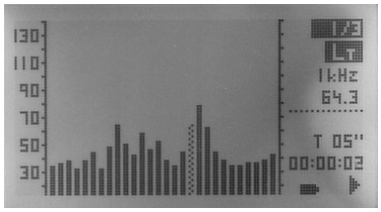
The first step is to check that all the material and literature supplied with the MODEL 33 is there:

Material:

- MODEL 33 sound level meter
- Case
- Wind screen
- 2 x AA (LR6) Batteries
- USB connection cable to connect the instrument to a PC
- Communication software to download data into a PC:
- Sound level meter User's Manual and Software Manual (this booklet)
- Warranty
- Verification certificate

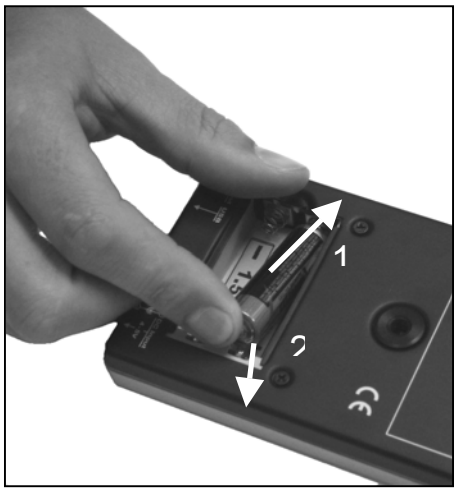
Should anything be missing, please contact Pulsar Instruments OR YOUR LOCAL distributor.

MODEL 33 power supply



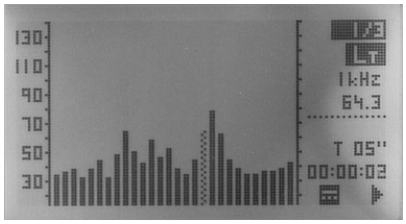
Before you turn the MODEL 33 on, the first thing you must do is connect it to a battery or other power supply.

The **MODEL 33** sound level meter is fed by two 1,5 V alkaline or lithium batteries sized AA (LR6) or by direct current [14]. For DC supply use the AM240 (V= 230 V, 50 Hz) or AM241 (V= 110 V, 60 Hz) model mains feeder. If both systems are used at the same time, the MODEL 33 selects the one offering the higher voltage. The maximum permitted input voltage is 4.2 volts. This means a "12 V" car battery should only be connected to the MODEL 33 through the AM140 converter.



When the MODEL 33 is fed by the DC input, the symbol ⎓ will appear in the bottom right-hand corner of the screen

To fit the batteries, raise the battery compartment lid [10] at the rear of the MODEL 33. Insert the batteries as indicated in the drawing that appears inside the batteries compartment; to do that press the negative pole against the spring and fit the battery so that the positive pole presses against the flat metallic contact.



When the battery is insufficiently charged to allow the MODEL 33 to work properly, a battery icon appears in the bottom right-hand corner of the sound level meter screen (see figure).

When this icon appears, the MODEL 33 batteries must be replaced. The MODEL 33 will show the symbol for 5 minutes and if a measurement or a recording is in progress, it will stop it and will show the message “BATTERY FLAT” and then the MODEL 33 will automatically switch itself off.

To replace the batteries, stop the measurement in progress and switch the sound level meter off. To remove the batteries, open the battery compartment and press the battery against the spring and pull it up, holding the battery by its positive pole, as shown in the figure.

TIPS:

If you are not going to use the MODEL 33 for some time, remove the battery to prevent damage caused by battery leakage.

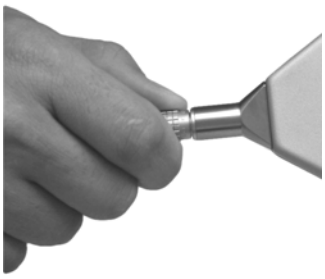
Make sure you always carry spare batteries with you, since you may be measuring somewhere where it isn’t easy to find new ones

Connecting and disconnecting the preamplifier, using the extension cable and the outdoor kit

The MODEL 33 preamplifier is completely detachable. This allows you to move the preamplifier + microphone set away from the sound level meter and user. In this way you can operate the MODEL 33 far from the place of measurement, thereby avoiding possible interference. To do this, use the CNR-003, CNR-010 or CNR-030 extension cable.

WARNING! When you connect or disconnect the preamplifier + microphone set, the sound level meter must be switched off.

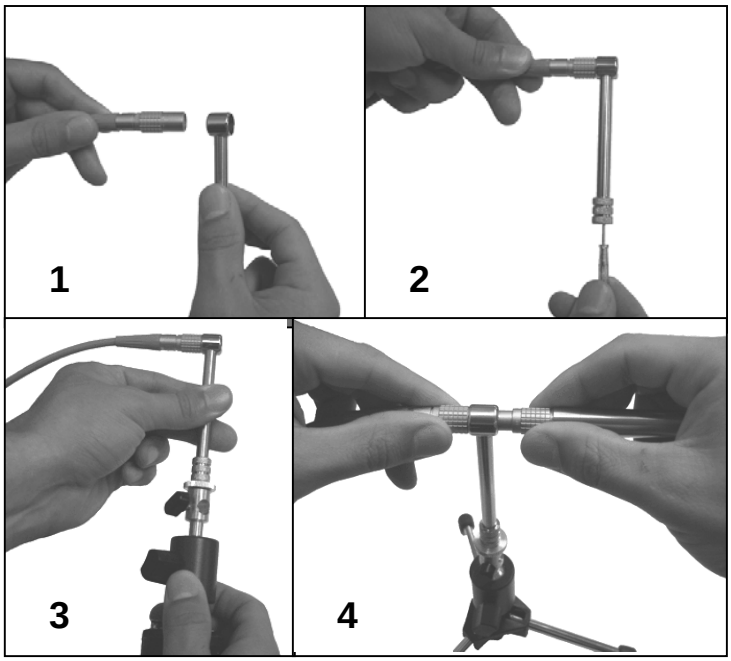
To detach the preamplifier from the sound level meter, pull the preamplifier connector [3], as shown in the figure. Do not pull the preamplifier itself [2].



To reconnect the preamplifier to the sound level meter, introduce the preamplifier LEMO male plug [3] into the sound level meter LEMO socket [4] until they click together. The red dot on the preamplifier connector must coincide with the red dot on the sound level meter connector.

VERY IMPORTANT! Do not attempt to detach or connect the preamplifier by unscrewing or screwing the connector [3]. This will damage the sound level meter.

NOTE: Extension cables do not have any effect inside the measuring frequency band. In any case, it is necessary to readjust the MODEL 33 when using extension cables.



If you have purchased any of the extension cables, you can use the TR001 adapter to fit the preamplifier + microphone to the TR-1 tripod. To do that, follow the next steps:

1) Put the LEMO socket of the extension cable through the TR001 adapter.
2) Fix it with the help of the screwdriver.
3) Screw the adaptor into the tripod.
4) Plug in the preamplifier.

Beginning a measurement

Starting the MODEL 33

To start the MODEL 33, press the key: 

The logo, together with the **MODEL 33** sound level meter model will appear on screen. A few seconds later, the initial screen predetermined in the menu configuration option will appear (see 0).

If the MODEL 33 does not switch on, check that fully charged batteries are fitted or that it is connected to a suitable power supply (see 0).

Selecting the measurement mode

Once the sound level meter is switched on, the initial screen appears, which may be one of the sound level meter mode screens, one of the octave band spectrum analyser mode screens or one of the one third octave band spectrum analyser mode screens.

The MODEL 33 has, in its basic version (no modulus), 3 measurement modes:

- Sound Level Meter mode 
- Octave band spectrum analyser 
- One third octave band spectrum analyser 

To identify the current measurement mode, just look at the top right-hand corner of the screen.

As long as the MODEL 33 is stopped (■), you can always sequentially switch between the modes by pressing this key: 

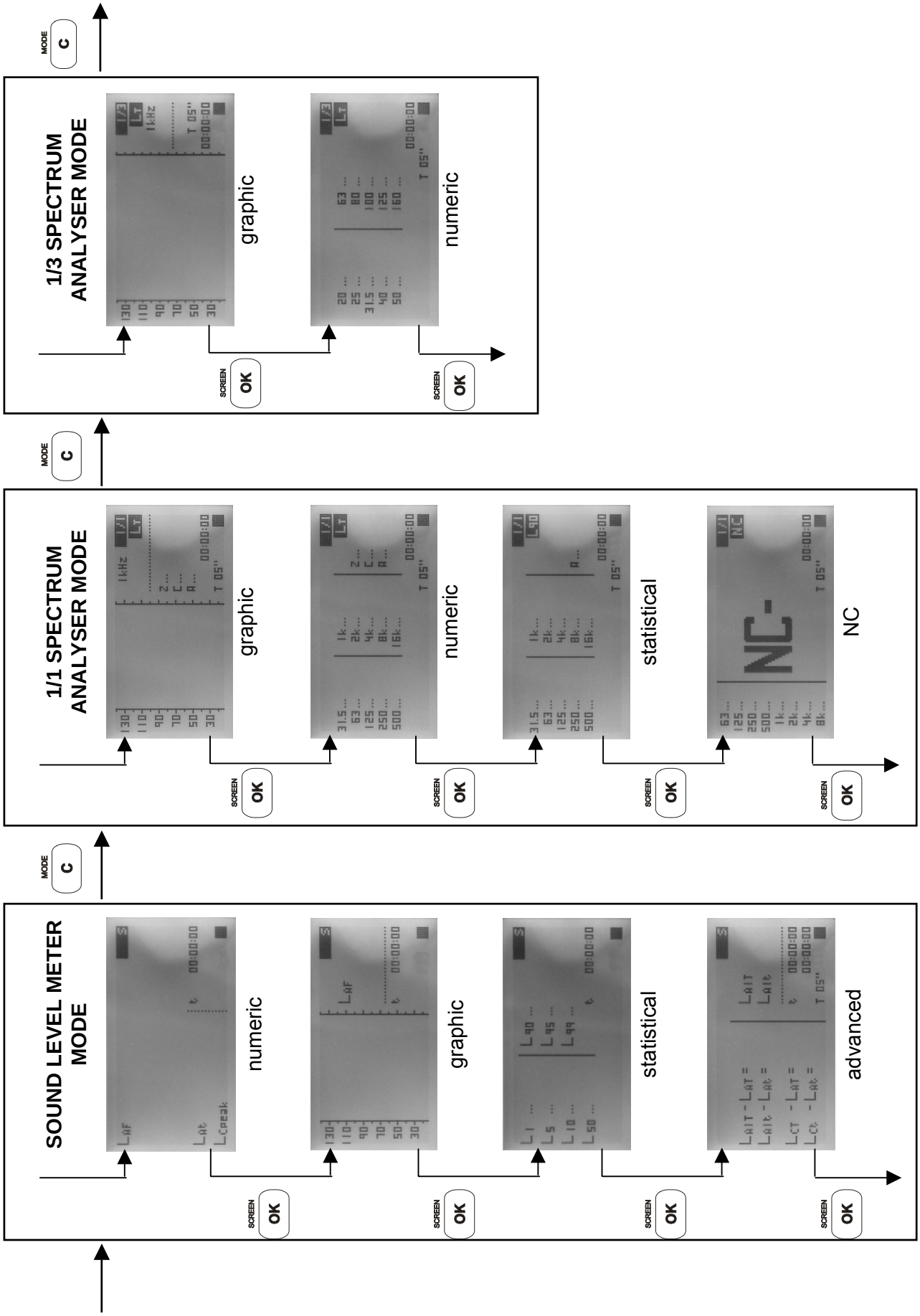
When you change the mode, a sign identifying it will appear in the screen, during a few seconds.

Each mode has several screens. To see them sequentially just press the key: 

Each time you return to a mode where you have previously been, the MODEL 33 will show the screen where you last worked.

Next, all screens of each mode are detailed:

- SOUND LEVEL METER MODE: The sound level meter mode has 4 screens:
  - SOUND LEVEL METER NUMERIC SCREEN
  - SOUND LEVEL METER GRAPHIC SCREEN
  - SOUND LEVEL METER STATISTICAL SCREEN
  - SOUND LEVEL METER ADVANCED SCREEN
- 1/1 SPECTRUM ANALYSER MODE: This mode has the next 4 screens:
  - 1/1 SPECTRUM ANALYSER MODE GRAPHIC SCREEN
  - 1/1 SPECTRUM ANALYSER MODE NUMERIC SCREEN
  - 1/1 SPECTRUM ANALYSER MODE STATISTICAL SCREEN
  - 1/1 SPECTRUM ANALYSER MODE NC SCREEN
- 1/3 SPECTRUM ANALYSER MODE: this mode has 2 screens:
  - 1/3 SPECTRUM ANALYSER MODE GRAPHIC SCREEN
  - 1/3 SPECTRUM ANALYSER MODE NUMERIC SCREEN


SOUND LEVEL METER MODE
numeric
graphic
statistical
advanced
1/1 SPECTRUM ANALYSER MODE
numeric
graphic
statistical
NC
1/3 SPECTRUM ANALYSER MODE
numeric
graphic
MODE
C
SCREEN
OK

Checking the MODEL 33

It is advisable to check the **MODEL 33** before beginning a measurement, adjust its sensitivity if necessary, and check it again once measurement has terminated.

To check the **MODEL 33** use the model **MODEL 100B** sound calibrator as follows:

1) Insert the **MODEL 33** into the **MODEL 100B** calibrator, introducing the microphone into the calibration cavity. Make sure the microphone reaches the bottom of the cavity and is parallel to the calibrator axis (see figure). This may require a little effort since the sound level meter must fit exactly into the calibrator. Insert the MODEL 33 gently; otherwise you might damage the microphone.
2) Turn the calibrator on and check the state of the batteries. The luminous indicator must be lit throughout the calibration process.
3) Select the 94 dB level on the calibrator.
4) Apply the free field to pressure corrections of the microphone at 1 kHz and those corresponding to the influence of atmospheric pressure, temperature and humidity in the calibrator. The free field to pressure correction for **MK:224** at 1 kHz is 0.3 dB. That is, the MODEL 33 should be set to read 93,7dB.
5) Switch the MODEL 33 to numeric sound level meter mode (0) using the keys:

   SCREEN OK MODE C

6) Select the sound pressure level with fast time weighting (FAST) $\mathbf{L_{AF}}$, $\mathbf{L_{CF}}$ or $\mathbf{L_{ZF}}$ as the function to measure. NOTE: The frequency weighting makes no difference since calibration takes place at 1 kHz.
7) Begin measuring with the MODEL 33 in numeric sound level meter mode: ▶/■
8) Check that the value which appears at the top of the screen (large digits) coincides with the value of 94.0 dB corrected with the corresponding corrections normally (93.7 dB).

If the value of the reading differs more than ± 0.3 dB from the calculated value, the sound level meter sensitivity needs adjusting. If not, the meter is reading correctly and there is no need to readjust its sensitivity.

If the results of checking the MODEL 33 show a deviation of more than 0.3 dB, adjust the sensitivity as follows:

1) Press the key ▶/■ to finish the measurement process.
2) Do not switch the MODEL 100B calibrator off; keep it in the calibration position.
3) Next press ☰ to access the **MODEL 33** menu.
4) The display will show the sound pressure level measured by the **MODEL 33**:

5) Use the keys ↙ and ↗ to adjust the calculated value (94 dB + corrections).

6) Confirm by pressing the key OK. Then C to go back to the MODEL 33 menu.

TIPS:

- The **Model 100B** has two sound levels. We recommend you use the 94 dB level to check the MODEL 33 and the 104 dB level to check its linearity.
- Once the checking process is complete, switch the calibrator off ("OFF").

Measuring in sound level meter mode

The sound level meter mode is suitable for measuring global sound pressure levels, both instantaneous and averaged based on integration (equivalent level). The **MODEL 33** simultaneously measures all the functions with all the frequency weightings (A, C and Z) and provides statistical data of the measurements, including maximum and minimum values and percentiles (see APPENDIX A: Functions). The MODEL 33 also measures "short" information: Information of the measured functions supplied each 125 m, this is perfect to analyse short periods of time, source identification and detection of transitory acoustic events.

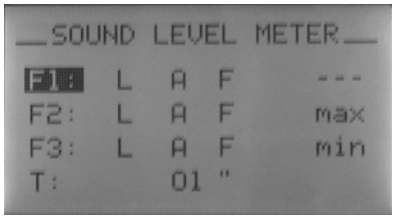
Outstanding among the applications of the **MODEL 33** are its ability to measure the sound level of noisy activities, urban and road traffic, and machines such as pneumatic drills and pumps, to measure appropriate parameters to ensure sound protection for workers and to measure sound parameters to evaluate levels of sound pollution including impulsive indicators, etc.

Prior adjustments: Preferential screen and integration time

Before beginning a measurement in sound level meter mode, the following parameters should be configured:

- The 3 functions that appear simultaneously on the numeric preferential screen.
- The integration time for the equivalent continuous sound pressure level function with T integration time. This integration is carried out in consecutive intervals of duration T.

To configure these parameters, access the SETTINGS ➔ SOUND LEVEL METER option on the MODEL 33 menu (see 0)



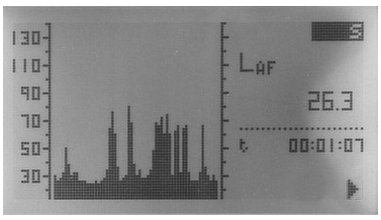
When the previous screen appears, select the function you want to configure, F1, F2, F3 or T, by using the ↙ and ↗ keys, then press OK. Use the C key to cancel.

Modify the F1, F2 and F3 functions as follows:

- Select frequency weighting A, C or Z using ↙ and ↗ and press OK.
- Select the acoustic function using keys ↙ and ↗ and press OK to confirm. You may choose from the following functions:
    - o Fast (F)
    - o Slow (S)
    - o Impulse (I)
    - o Equivalent level with programmable integration time (T)
    - o Equivalent level with total integration time (t)
    - o Sound exposure level (E)
    - o Peak level (Peak).
- Using the keys ↙ , ↗ and OK, select the value of the function you want: instantaneous (- - -), minimum (min) or maximum (max).

For more information on the names of the different functions, see APPENDIX A: Functions.

The preferential numeric screen of the sound level meter mode (see 0) displays the main function (F1) in large digits in the top right-hand corner of the screen and the two secondary functions (F2 and F3) in the bottom left-hand corner. The function defined in F1 is the one displayed on the graphic screen of the sound level meter mode.



Modify the T parameter as follows:

- Select its numerical value using ↙ and ↗ and confirm by pressing OK. The T integration time may be configured from:
    - o 1 to 59 seconds (1'' – 59 '')
    - o 1 to 59 minutes (1' – 59')
    - o 1 to 99 hours (1H – 99 H)

Finally, select the time units in seconds (''), minutes (') or hours (H) using ↙ and ↗. Then press OK to confirm. Use the C key to cancel and return to the menu and again to go to the measurement screen.

Beginning a measurement

First of all, check that there is no measurement in progress (■). If there is, (▶ or ❚❚), press ▶/■ to stop it.

Next, switch the MODEL 33 to sound level meter mode and select the screen you want to see displayed (numeric, graphic or statistical sound level meter), either from the **MODEL 33** menu or by pressing the keys:

SCREEN OK MODE C

Once you have selected the screen, press ▶/■ to set the measurement process in motion.

Functions display

The MODEL 33 measures all functions simultaneously. Described below are the different formats in which the acoustic functions are displayed while measurement is in progress. If you change the kind of display, the function or the frequency weighting, this does not interrupt the measurement in progress.

Numeric sound level meter screen

When you access the numeric sound level meter mode, this presents the preferential screen, which displays functions F1, F2 and F3, defined in the configuration of the preferential numeric screen of the sound level meter mode (0). This allows you to see, on the same screen, the three functions you want of all those that the sound level meter measures.

FREQ. W.

By pressing ↙ you change the frequency weighting displayed for the three functions.

FUNCTION

By pressing ↗ you change the displayed function (see table) and access the other functions measured by the MODEL 33.

The numeric screen of the sound level meter mode displays the following information:

- The main function (large digits)

- The secondary functions: except on the preferential screen, these are the maximum and minimum values of the main function (see table).

Main function	Secondary function 1	Secondary function 2
F1	F2	F3
L_{XF}	L_{XFmax}	L_{XFmin}
L_{XS}	L_{XSmax}	L_{XSmin}
L_{XI}	L_{XImax}	L_{XImin}
L_{XT}	L_{XTmax}	L_{XTmin}
L_{Xt}	L_{XE}	L_{Xpeak}
X: may be any frequency weighting, A, C or Z		

By pressing SCREEN you display the preferential screen again.

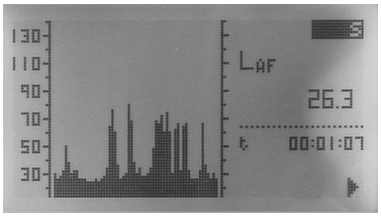
By pressing OK you access the graphic sound level meter mode.

The MODEL 33 measures “short” functions (125 ms Functions) but they are not shown in the screen. They only can be seen by making a real time connection between the MODEL 33 and the Capture Studio software or by making a recording with the Model 33 and then downloading the registers to Capture Studio. These functions are following ones:

- Sound pressure level with time averaging ‘S’, ‘F’ and ‘I’, sampled every 125 ms. 8 values per second.
- Peak sound pressure level corresponding to the latest 125 ms. 8 values per second.
- Equivalent continuous sound pressure level with consecutive integration time 125 milliseconds (Short Leq). 8 values per second.

Graphic sound level meter screen

This screen displays the following information:

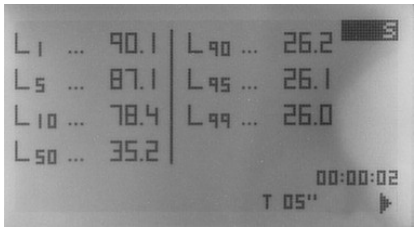


- The numerical value of the function defined, as F1 on the sound level meter mode preferential screen (0).
- The time history of this function (60 values).

By pressing SCREEN OK you access the statistical sound level meter mode.

Statistical sound level meter screen

This screen displays the following information:



- Value of the partial percentiles L_1, L_5, L_{10}, L_{50}, L_{90}, L_{95} and L_{99} of each consecutive T duration interval (integration time). Percentiles are calculated from the sound pressure level with time averaging 'F' and frequency weighting A in 0.1 dB classes.

By pressing SCREEN OK you access the advanced sound level meter mode.

To display the total percentiles (for the entire measurement) you have to stop the measurement as they can only be calculated after the measurement is complete (see sections 0 and 0)

Advanced sound level meter screen

In the advanced sound level meter screen some special acoustic functions are shown. Its measurement gives complementary information to the one given in the numeric sound level meter screen.

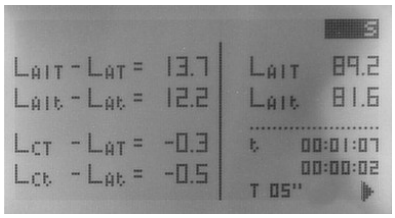
In this group of functions, one can find impulsivity detectors, indicators of low spectral content and several functions from international, national or local standards.

The MODEL 33, in its basic version (without modulus), has the following functions on this screen:

Name	Function
L_{XIT}	The equivalent continuous sound pressure level with time averaging 'I' and programmable consecutive integration time T.
L_{XIt}	The equivalent continuous sound pressure level with time averaging 'I' belonging to the measurement period, measured with frequency weighting A, C and Z
L_{XIT} - L_{XT}	The subtraction of the equivalent continuous sound pressure level with time averaging 'I' and the equivalent continuous sound pressure level, corresponding to the programmable integration time T. These two functions measured with frequency weighting A, C and Z
L_{XIt} - L_{Xt}	The subtraction of the equivalent continuous sound pressure level with time averaging 'I' and the equivalent continuous sound pressure level, corresponding to the measurement time. These two functions measured with frequency weighting A, C and Z
L_{CT} - L_{AT}	The subtraction of the equivalent continuous sound pressure level with frequency weighting C and the equivalent continuous sound pressure level with frequency weighting A, corresponding to a programmable integration time T.
L_{Ct} - L_{At}	The subtraction of the equivalent continuous sound pressure level with frequency weighting C and the equivalent continuous sound pressure level with frequency weighting A, corresponding

	to the measurement time.
X: Any of the frequency weightings A, C or Z	

When you access the advanced sound-meter mode, the following screen will appear:



When you press FREQ. W. the frequency weighting will change (for the functions indicated).

By pressing SCREEN OK you access the numerical sound-meter screen.

Interrupting measurement

When you press ▮▮/● the measurement will be temporarily interrupted. The state of measurement indicator will change from ▶ to ▮▮. While the MODEL 33 is in pause mode (▮▮) you may continue to consult the functions measured prior to the temporary interruption. To resume measurement, press ▶/■ .

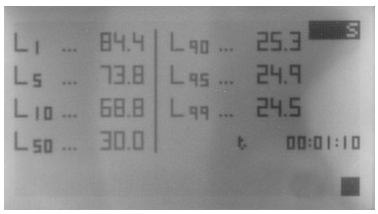
When you press ▶/■ measurement will stop. The state of measurement indicator will change from ▶ to ■.

Consulting measured data

While the MODEL 33 is in stop mode (■) you may consult all the functions measured so far.

To consult them, follow the same procedure as described in the section 0 on displaying data while measurement is in progress.

When measurement has stopped (■) you may display the value of the total percentiles (belonging to the total measurement time t). The statistical sound-meter mode screen displays the following information:



- Value of the total percentiles L_1, L_5, L_{10}, L_{50}, L_{90}, L_{95} and L_{99}.
- Total measurement time t.

Measuring in spectrum analyser mode 1/1

The spectrum analyser mode 1/1 is ideal for conducting real-time measurement of sound-pressure levels, both frequential values for octave bands centred on frequencies 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hz (without frequency weighting), and global values with all frequency weightings (A, C and Z). The MODEL 33 measures all these functions simultaneously, in real time, together with the 'short' levels (125 ms) and seven percentiles for each of the octave bands as well as the global percentiles. The MODEL 33 features a room background noise evaluation screen based on the NC (Noise Criterion) curves.

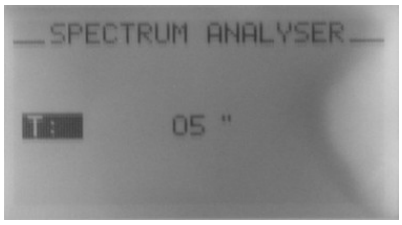
Major applications of this mode include measurement of soundproofing, frequential analysis of industrial, environmental and workplace noise, analysis of noise generated by air-conditioning systems and room background noise.

Prior adjustments: integration time

Before beginning to measure in spectrum analyser mode, the following parameters should be set:

- The integration time (T) used in the evaluation of spectral and global levels. This integration is carried out in consecutive T time intervals.

To set this parameter, select the SETTING ➔ SPECTRUM ANALYSER option from the MODEL 33 menu.



Press OK to begin setting the T parameter and then follow the procedure detailed below:

- Choose the numerical value using ↙ and ↗ and confirm by pressing OK. T integration time may be set from:
    - o 1 to 59 seconds (1'' – 59 '')
    - o 1 to 59 minutes (1' – 59')
    - o 1 to 99 hours (1H – 99 H)
- Finally, select the time units: seconds (''), minutes (') or hours (H) with the help of ↙ and ↗ and press OK to confirm. Use C to cancel or return to the menu.
- If you select "t" as the integration time numerical value (it lies between values 1 and 99), the integration time will coincide with the measurement time. This is a practical option when it comes to evaluating the ideal integration time. To apply this option, carry out a measurement with "t" integration time and calculate the time needed for the bands in which you are interested to stabilise.

Beginning measurement

First of all, ensure that the sound level meter is not carrying out any measurement process (■). If it is (▶ or ❚❚) press ▶/■ to stop it.

Next, set the MODEL 33 in spectrum analyser 1/1 mode and select the screen you want to view (numerical, graphic statistical or NC spectrum analyser 1/1) using the keys:

SCREEN OK MODE C

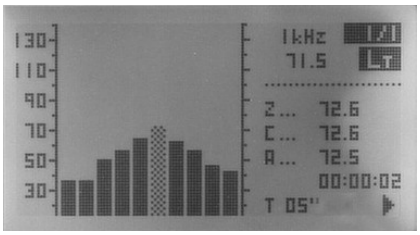
One you have selected the screen, press ▶/■ to set the measurement process in motion.

Functions display

The **MODEL 33** measures all functions simultaneously. Described below are the different ways of displaying the acoustic functions while measurement is taking place. If you change the kind of display (screen), octave band or parameter, measurement will continue uninterrupted. While measurement is in progress, however, you cannot switch from one measurement mode to another.

Graphic spectrum analyser 1/1 screen

This screen displays the following information in real time:



- Graph showing the continuous equivalent sound-pressure levels with T integration time (bars ■) in real time for octave bands centred on frequencies 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hz (without frequency weighting).
- Numerical value of the continuous equivalent sound-pressure level with T integration time for the selected octave band (bar ▩) (without frequency weighting).
- Central frequency of the selected octave band (bar ▩).
- Global continuous equivalent sound-pressure level with T integration time and frequency weightings A, C and Z.

To change the selected octave band (bar ▩) press ↙ (left) and ↗ (right).

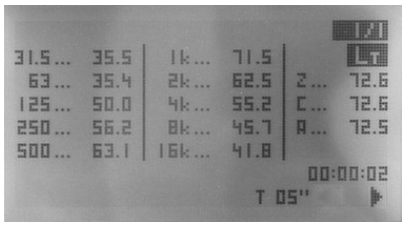
By pressing SCREEN OK you access the numerical spectrum analyser 1/1 screen.

The MODEL 33 measures "short" functions (125 ms functions), although these are not displayed on the screen. They may be viewed only through the software by means of real-time connection with the sound level meter or by making a recording and subsequently downloading it into a PC. These functions are:

- Continuous equivalent sound-pressure level with consecutive integration time of 125 ms (Short Leq) in real time for octave bands centred on frequencies 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hz (without frequency weighting).
- Global continuous equivalent sound-pressure level with 125 ms integration time and frequency weightings A, C and Z.

Numerical spectrum analyser 1/1 screen

This screen displays the following information in real time:



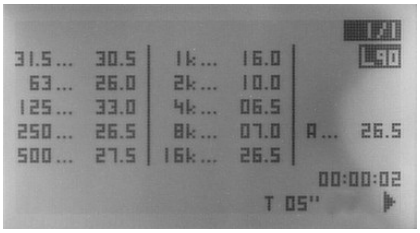
- Continuous equivalent sound-pressure level with T integration time for octave bands centred on frequencies 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hz (without frequency weighting).
- Global continuous equivalent sound-pressure level with T integration time and frequency weightings A, C and Z.

By pressing SCREEN OK you access the statistical spectrum analyser 1/1 screen.

> NOTE: The global sound-pressure levels with frequency weightings A, C and Z are values measured by the sound level meter. They are never calculated by applying the discrete coefficients that these filters define to the values measured by octave band. Indeed, if they were thus calculated, appreciable differences would be observed. Frequency weighting filters are filters continuous in frequency, while the use of coefficients by bands is merely an approximation to them.
>
> Regarding the Z filter, remember that it has a zero value from 10 Hz to 20 kHz. Consequently, when measuring spectrums with a high spectral content in the low frequency (between 10 and 20 Hz), it may happen that the energy sum of the values measured by octave bands differs from the global value measured with frequency weighting Z.

Statistical spectrum analyser 1/1 screen

This screen displays the following information in real time:



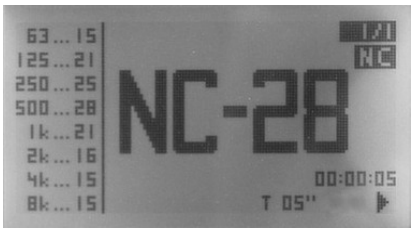
- Percentile selected (top right-hand corner of the screen) from among L_1, L_5, L_{10}, L_{50}, L_{90}, L_{95} and L_{99}.
- The value of the selected percentile belonging to the sound-pressure level measured for the octave bands centred on frequencies 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hz (without frequency weighting) and for each consecutive interval of T (integration time) duration.
- The value of the selected percentile belonging to the total sound-pressure level with frequency weighting A.

By pressing SCREEN OK you access the NC spectrum analyser 1/1 screen.

NOTE: The percentile levels are calculated on the basis of the 125 ms continuous equivalent pressure levels. The width of the classes is 0.5 dB.

NC Spectrum analyser 1/1 screen

This screen displays the following information in real time:



- The value of the NC (Noise Criterion) curve that does not exceed the measured spectrum. In other words, the value of the NC curve that defines this spectrum.
- The value of the NC (Noise Criterion) curve that has not been exceeded in each octave band. This information serves to ascertain which octave band fixes the value of the NC curve of the total spectrum. That is, at least one of these values must be equal to the value of the NC curve

By pressing SCREEN OK you access the graphic spectrum analyser 1/1 screen.

Stopping measurement

By pressing ▮▮/● you temporarily halt measurement. The state of measurement indicator will change from ▶ to ▮▮. While the **MODEL 33** is in pause mode (▮▮) you may continue to consult the functions measured until the measurement was temporarily interrupted. To resume measurement, press ▶/■ .

By pressing ▶/■ you stop measurement. The state of measurement indicator will change from ▶ to ■.

Consulting the measured data

While the **MODEL 33** is not measuring (■) you may consult all the functions measured so far.

To consult them, apply the same formula described in section 0 to display data while measurement is in progress.

Measuring in spectrum analyser 1/3 mode

The spectrum analyser 1/3 mode has been designed to measure spectral contents with one-third octave definition. The MODEL 33 conducts a frequency analysis in bands from 20 Hz to 10 kHz. This analysis is carried out in real time for all bands and throughout the entire dynamic range of measurement (without scale changes), measuring the continuous equivalent sound-pressure level with integration time programmable from 1 second to 99 hours. Simultaneously, and in real time, the MODEL 33 measures "short" levels (125 ms integration time) for all bands.

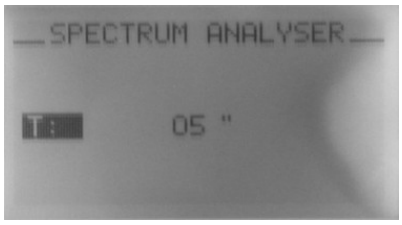
The major applications of this mode include characterisation of soundproofing by one-third octaves in an extended range of frequencies, evaluation of tonal components and the detection and identification of noise sources.

Prior adjustments: Integration time

Before beginning measurement in spectrum analyser mode, the following parameters should be set:

- Integration time (T) used in the evaluation of spectral and global levels. This integration is carried out in consecutive intervals of T time.

To set this parameter, select the SETTINGS ➔ SPECTRUM ANALYSER option from the MODEL 33 menu.



Press the key OK to begin setting the T parameter and then follow the procedure below:

- Select your numerical value using ↙ and ↗ and confirm by pressing OK. Integration time T may be set from:
    - o 1 to 59 seconds (1'' – 59 '')
    - o 1 to 59 minutes (1' – 59')
    - o 1 to 99 hours (1H – 99 H)
- Finally, select the time units: seconds (''), minutes (') or hours (H) with the help of ↙ and ↗ and press OK to confirm. Use C to cancel or return to the menu.
- If you choose "t" as your numerical integration time value (it lies between values 1 and 99) the integration time will coincide with measuring time. This option is useful when it comes to evaluating ideal integration time. To apply the option, make a measurement with integration time "t" and calculate the time needed for the bands in which you are interested to stabilise.

Beginning measurement

First of all, ensure that the sound level meter has no measuring operation in progress (■). If it has (► or ❚❚) press ►/■ to stop it.

Next, set the MODEL 33 in spectrum analyser 1/3 mode and choose the screen you want to display (numerical or graphic spectrum analyser 1/3) with the following keys:

SCREEN OK MODE C

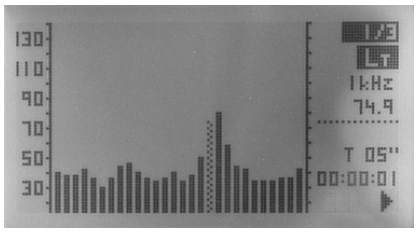
Once you have selected your screen, press ▶/■ to set the measurement process in motion.

Functions display

The **MODEL 33** measures all functions simultaneously. Described below are the different ways of displaying the acoustic functions while measurement is in progress. If you decide to change the kind of display (screen) or one-third octave band, this will not halt the measurement process. While measurement is being carried out, however, you cannot switch from one measurement mode to another.

Graphic spectrum analyser 1/3 screen

This screen displays the following information in real time:



- Graph of the continuous equivalent sound-pressure levels with integration time T (bars ■) in real time for one-third octave bands centred on the frequencies 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000 and 10000 Hz (without frequency weighting).
- Numerical value of the continuous equivalent sound-pressure level with integration time T for the chosen one-third octave band (bar ▩) (without frequency weighting).
- Central frequency of the chosen one-third octave band (bar ▩).

To change the chosen one-third octave band (bar ▩) press ↙ (left) and ↗ (right).

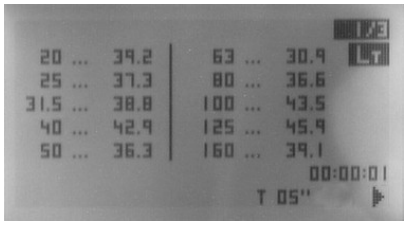
By pressing SCREEN OK you access the numerical spectrum analyser 1/3 screen.

The SC130 measures "short" (125 ms) functions, although these are not displayed on-screen. They may be viewed only through the software, through real-time connection with the sound level meter or by making a recording and subsequently downloading it by means of the software into a PC. These functions are:

- Continuous equivalent sound-pressure level with 125 ms consecutive integration time (short Leq) in real time for one-third octave bands centred on frequencies 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000 and 10000 Hz (without frequency weighting).

Numerical spectrum analyser 1/3 screen

This screen displays the following information in real time:



- Continuous equivalent sound-pressure level with integration time T for the one-third octave bands centred on frequencies 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000 and 10000 Hz (without frequency weighting).

This screen displays the 28 measured one-third octave bands. To view them, press ↙ and ↗.

By pressing SCREEN OK you access the graphic spectrum analyser 1/3 screen.

Interrupting measurement

By pressing ▮▮/● you temporarily interrupt measurement. The state of measurement indicator will change from ▶ to ▮▮. While the MODEL 33 is in pause mode (▮▮) you may continue to consult the measured functions prior to the temporary interruption of measurement. To resume measurement, press ▶/■.

By pressing ▶/■ you stop measurement. The state of measurement indicator will change from ▶ to ■.

Consulting measured data

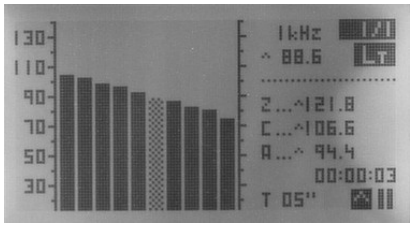
While the MODEL 33 is not measuring, (■) you may consult all the measured functions.

To consult them, apply the same procedure as described in the section 0 on viewing data while measurement is in progress

Overload indicator

The MODEL 33 is equipped with an overload indicator for each function. If overloading occurs during measurement, the ^ sign will appear before the function affected by overloading. When a function registers overload, its corresponding measurement will be incorrect.

When overloading occurs, the ^ indication will appear in the bottom right-hand corner of the screen.



MODEL 33 menu: Register and setting management

This section describes all options accessible from the MODEL 33 menu, a major one of which is memory management and MODEL 33 settings (screens, language, date and time, etc.).

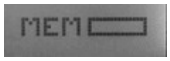
When supplied, the MODEL 33 is programmed with an initial setting that allows you to carry out measurements without having to reset the unit prior to beginning measurement.

Access to the menu

To access the MODEL 33 menu press: 

The following screen will appear:

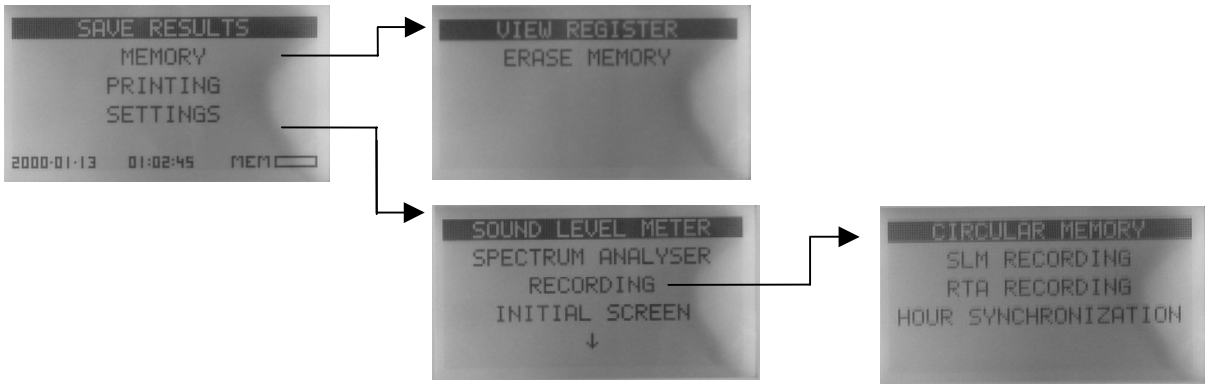
This screen displays the main setting menu together with the date and time of the MODEL 33 clock. It also tells you how much memory space is available.

- Memory empty ➔ 

- Memory full ➔ 

The MODEL 33 menu

The MODEL 33 sound level meter menu is structured as follows:



To browse through the setting menu, use the keys described in the section on 0.

Described below are each of the options accessible from the menu:

Register management

- SAVE RESULTS:
  When you select this option, the MODEL 33 will record the final results of all the functions measured in the memory. The MODEL 33 indicates the register number in which the data has been recorded. For further information, see section 0.
- MEMORY:
  This option allows you to manage the MODEL 33 memory.
  - MEMORY ➔ VIEW REGISTER
    This allows you to view the registers recorded in the sound level meter. For further information, see section 0.
  - MEMORY ➔ ERASE MEMORY
    This option allows you to completely erase the MODEL 33 memory. All the registers stored in the memory (results and recordings) will be deleted. For further information, see section 0.

Printing

- PRINTING:
  This option allows you to prepare the RS-232 port for connection to a serial printer. For further information, see chapter 0.

Settings

- SETTINGS:
  This option allows you to set several features of the MODEL 33, such as definition of the initial screen, adjusting the clock/calendar, selecting language or adjusting the sensitivity of the unit.
  - SETTINGS ➔ SOUND LEVEL METER
    This option allows you to define the 3 acoustic functions displayed on the preferential screen of the numerical sound meter mode, as well as the integration time T of the continuous equivalent sound-pressure level. For further information, see section 0.
  - SETTINGS ➔ SPECTRUM ANALYSER
    This option allows you to define the integration time used in evaluation of spectral and global levels T in the spectral analysis 1/1 and 1/3 modes. For further information, see sections 0 and 0.
  - SETTINGS ➔ RECORDING

This option allows you to set the periodicity and functions to be stored by the MODEL 33 when a recording is made

SETTINGS ➔ RECORDING ➔ CIRCULAR MEMORY

This allows you to select the circular memory option described in section 0. Through this option, the MODEL 33 will use its free memory space as a circular buffer. In other words, as this space fills, the MODEL 33 will continue to store data while deleting the oldest data stored in this space.

- SETTINGS ➔ RECORDING ➔ SLM RECORDING

  This option allows you to set the periodicity and data that the MODEL 33 will store when conducting a recording in sound level meter mode. For further information, see section 0.

- SETTINGS ➔ RECORDING ➔ RTA RECORDING

  This option allows you to select the periodicity and the data that the MODEL 33 will store having made a recording in spectrum analyser modes 1/1 and 1/3. For further information, see sections 0 and 0.

- SETTINGS ➔ RECORDING ➔ HOUR SYNCHRONISATION

  This option sets the MODEL 33 so that all recordings begin on the hour. For example, if a recording begins at 10'13 hrs, the MODEL 33 will wait until 11'00 hrs before beginning to measure and store data in the memory. For further information, see section 0.

o SETTINGS ➔ INITIAL SCREEN:

This option allows you to select the predetermined screen that will appear each time you turn the MODEL 33 on.

- NUMERICAL SLM: sets the numerical sound level meter screen as predetermined.
- GRAPHIC SLM: sets the graphic sound level meter screen as predetermined.
- STATISTICAL SLM: sets the statistical sound level meter screen as predetermined.
- ADVANCED SLM: sets the advanced sound level meter screen as predetermined.
- NUMERICAL RTA 1/1: sets the numerical spectrum analyser screen per octave band.
- GRAPHIC RTA 1/1: sets the graphic spectrum analyser screen per octave band.
- STATISTICAL RTA 1/1: sets the statistical spectrum analyser screen per octave band.
- NC RTA 1/1: sets the NC spectrum analyser screen per octave band for noise room analysis.
- NUMERICAL RTA 1/3: sets the numerical spectrum analyser screen per one-third octave band.
- GRAPHIC RTA 1/3: sets the graphic spectrum analyser screen per one-third octave band.

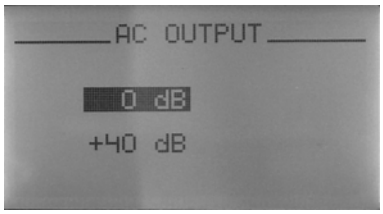
o SETTINGS ➔ SENSITIVITY ADJUSTMENT:

This option allows you to adjust the sensitivity of the MODEL 33. For further information, see section 0 verification of the MODEL 33.

- SETTINGS ➔ AC OUTPUT

  The alternating current output of the MODEL 33 is directly proportional to the signal obtained at the preamplifier output.

  This option allows you to adjust the gain of this output: 0 dB or 40 dB.

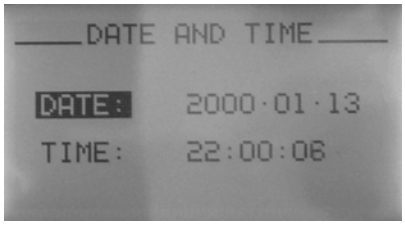


- SETTINGS ➔ LANGUAGE

  This option allows you to select the language in which all the messages and menus of the MODEL 33 will be displayed. To access the option, with the sound meter on press MENU ➔ go to SETTINGS with ➔ OK ➔ go to LANGUAGE ➔ OK ➔ select the language ➔ OK.

- SETTINGS ➔ DATE AND TIME

  This option allows you to adjust the date and time of the MODEL 33 clock.



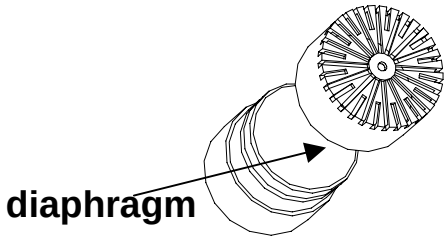
Turning the MODEL 33 off

To turn the MODEL 33 off, make sure no measurement is in progress (■) and press:

Warnings and precautions

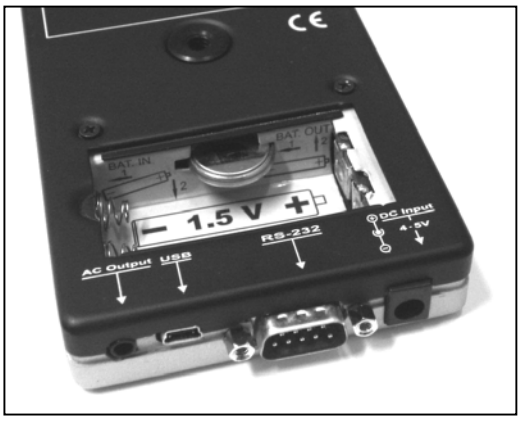
- When you connect or disconnect the microphone, use the strength of your fingers only, never tools. Never connect or disconnect the microphone when the MODEL 33 is working. If you use a 200 V polarised microphone, and the sound level meter is switched on, there will be 200 volts at the central preamplifier contact. This is not dangerous, though it might make you drop the microphone.
- Never dismantle the microphone, as this may cause permanent damage.
- Keep the microphone dust free and far from sharp-pointed objects.
- Avoid excessive damp and sudden temperature changes, since these may lead to condensation on the microphone.

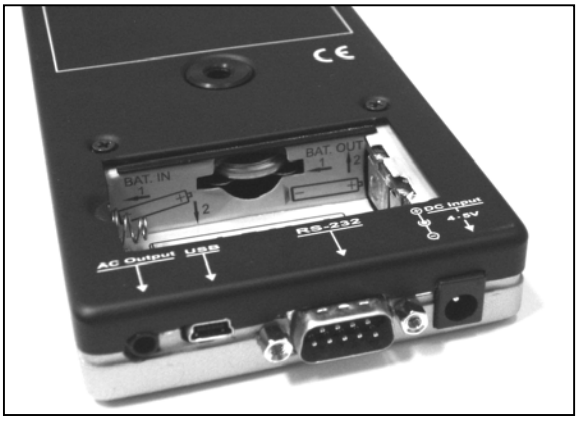
- Remove the microphone's protective mesh only when strictly necessary. Never touch the diaphragm. If the diaphragm is very dirty, carefully remove the dust using a fine camel's-hair brush.



- If the MODEL 33 receives any knocks or blows, these are detected by the microphone and may alter the value of the measurement.
- It is advisable to isolate the MODEL 33 from vibrations. Pads of foam rubber or similar materials are usually enough for this purpose.
- When measurement is conducted outdoors, affix the microphone windscreen supplied, since the wind may produce a loud noise.
- When you carry out measurements by holding the **MODEL 33** in your hand, do so with your arm fully outstretched. To avoid interference, we recommend you use the **TR-1** tripod and t microphone extension leads. Remember that you may disconnect the preamplifier + microphone set only when the **MODEL 33** is switched off.
- We advise you to check the MODEL 33 before and after each measurement using the MODEL 100B acoustic calibrator. See section 0.
- If you do not intend to use the MODEL 33 for a long period of time, remove the batteries.
- The **MODEL 33** sound level meter is built to work reliably for a long time. If you do not manage to correct any anomaly either by changing the batteries or consulting the manual, get in touch with an official dealer. Under no circumstances allow non-authorised personnel to attempt to repair the unit.
- The Model 33 is equipped with a built-in clock fed by a 3 V CR2032-type lithium button battery, which allows you to save the time, programming and sensitivity adjustment. The average lifespan of the lithium battery is 10 years.

  When the battery runs out, the built-in MODEL 33 calendar/clock will return to 00'00 hrs on 01/01/2000. Access the MODEL 33 menu to consult the calendar. The battery must be replaced immediately. Remove it from the accessible slot in the battery-holder compartment (see photo) and either replace it with a new one or contact your official dealer.





Data Recording

The MODEL 33 built-in memory registers the values of the measured functions. When you switch off the unit the saved data is not lost and may be retrieved and displayed directly on the MODEL 33 or downloaded into a PC. The memory may also be erased directly from the MODEL 33.

Two kinds of registers may be saved in the memory:

- The final results of a measurement.
- Continuous recordings of functions with programmable recording time.

Saving results

Once you have completed a measurement (■), the results may be stored in the memory by selecting the SAVE RESULTS option from the main menu. The MODEL 33 will indicate the register number in which to record the data.

The MODEL 33 stores the following information:

- Sound level meter mode:
    - Sound pressure level with fast frequency weighting.
    - Sound pressure level with slow frequency weighting.
    - Sound pressure level with impulse frequency weighting.
    - Continuous equivalent sound pressure level with integration time T.

  And their maximum and minimum values.
    - Continuous equivalent sound pressure level of the entire measurement.
    - The sound exposure level (S.E.L.).
    - The sound pressure peak level.
    - Continuous equivalent sound pressure level with impulse frequency weighting and integration time T for the entire measurement.

  All measured with frequency weightings A, C and Z.
    - Date and time of the beginning of measurement
    - Measurement and integration times.
    - Total percentiles: 1%, 5%, 10%, 50%, 90%, 95% and 99%
- Spectrum analyser 1/1 mode:
    - Continuous equivalent sound pressure level with integration time T for octave bands centred on frequencies 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and16000 Hz (without frequency weighting).
    - Seven percentiles L_1, L_5, L_{10}, L_{50}, L_{90}, L_{95} and L_{99} corresponding to the last period of integration T for octave bands centred on frequencies31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and16000 Hz (without frequency weighting) and for the global value with frequency weighting A.
    - Continuous global equivalent sound pressure level with integration time T and frequency weightings A, C and Z.
    - Integration time T.
    - The date and time of the beginning of measurement.

- Spectrum analyser 1/3 mode:

- Continuous equivalent sound-pressure level with consecutive programmable integration time T and without frequency weighting for each of the one-third octave bands centred on frequencies 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000 and 10000 Hz
- Integration time T.
- Date and time of the beginning of measurement.

The MODEL 33 may store a total of 1000 final results, either in sound meter mode or in spectrum analyser 1/1 or 1/3 modes.

Carrying out a recording

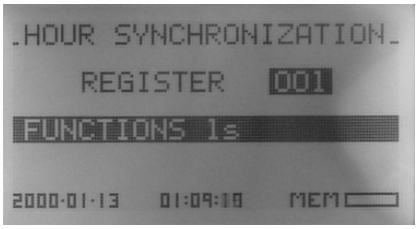
A recording consists of conducting a measurement and storing a series of functions with a certain periodicity in the memory. These functions and periodicity are specified, for each mode, in the recording setting. The main difference between the different kinds of recording lies in the 'number of functions / storing time' compromise. See section 0.

Before beginning a recording, make sure there are no measurements in progress (■).

To begin a recording, press  . The screen will display the kind of recording together with the register number. Next the functions selected for the type of recording will be saved periodically in the memory until you stop the recording by pressing  . During the recording process, the measurement in progress icon (▶) will flicker.

Time synchronisation

The MODEL 33 allows you to begin recording on the hour (hh:00:00). To access this option, select SETTING ➔ RECORDING ➔ TIME SYNCHRONISATION from the MODEL 33 menu. Once the setting has been made, all recordings will begin on the hour. In other words, once recording has been set in motion, the MODEL 33 screen will display the message TIME SYNCHRONISATION and will wait until the built-in clock reaches the set time to begin displaying and saving data.



Kinds of recording

Recording in sound meter mode

The option SETTING ➔ RECORDING ➔ SOUND METER RECORDING allows you to set the periodicity and functions to be saved in the MODEL 33 memory when a recording is made in sound meter mode. Six possibilities are available:

- **1s functions**: these save all the functions measured each second:
    - L_{XF}, L_{XS}, L_{XI} and their maximums and minimums each second plus total measurement time.
    - L_{XT} and its total measurement time maximums and minimums.
    - L_{XT} with T=1s, L_{Xt}, L_{XIT}, L_{XIt} and L_{XE}
    - L_{Xpeak} and its maximum each second.

    $_X$: with frequency weightings A, C and Z

- **125ms functions**: save all measured functions every 125 ms, 'short' functions:
    - L_{XF}, L_{XS}, L_{XI} sampled every 125 ms. 8 values per second.
    - L_{XT} with 125 ms consecutive integration time (Short Leq). 8 values per second.
    - L_{Xpeak} 8 values per second.

    $_X$: with frequency weightings A, C and Z

- **1s + 125ms functions**: save all the 1s and 125 ms 'short' functions.

These 3 types of recording are conceived for short-duration measurements.

- **F1 each second**: saves the main function programmed on the preferential screen second by second.
- **F1, F2 and F3 each second**: saves the 3 functions programmed on the preferential screen second by second.
- **L_T + L_{IT} and percentiles every T**: each T (integration time) saves the continuous equivalent level and the continuous equivalent level with impulse ('I') temporary weighting and with frequency weightings A, C and Z, together with the partial percentile levels corresponding to 1, 5, 10, 50, 90, 95 and 99% of the T interval.

These kinds of recording are conceived for long-duration measurements such as studies of environmental noise, traffic noise and so forth.

- **F1, F2 and F3 each second (+)**: saves the following functions every second:
    - L_{Cpeak} of each second.
    - L_{AF} sampled every 125 ms. 8 values per second.
    - L_{AT} with 125 ms consecutive integration time (Short Leq). 8 values per second.
    - F1, F2 and F3 each second.

This type of recording is very practical in that it saves the basic sound-measurement functions: Short Leq, Fast every 125 ms (as from here you may calculate statistical data), the peak level and three sound-measurement functions to choose from.

The following table shows the memory storage capacity of the different types of recording in sound level meter mode:

Type of recording	Storage capacity
1s functions	4 days 16 hours
125ms functions	3 days 5 hours
1s + 125ms functions	2 days 8 hours
F1 each second	8 months 14 days
F1, F2 and F3 each second	3 months 19 days
F1, F2 and F3 each second (+)	18 days 22 hours
L_T + L_{IT} and partial percentiles every T	T= 1 s ➔ 28 days 18 hours T= 1 min ➔ 4 years 9 months

F1, F2 and F3 are the acoustic functions chosen by the user on the preferential screen. They may be any of those that the MODEL 33 measures in sound meter mode.

Recording in spectrum analyser 1/1 mode

Recording in spectrum analyser 1/1 mode may be set through the SETTINGS ➔ RECORDING ➔ RTA RECORDING option, in which by means of the following options you may set the periodicity and functions to be stored in the memory:

- **T functions**: once each integration time T has come to an end, the following values are stored in the memory:
    - L_T for each of the octave bands centred on frequencies 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and16000 Hz
    - Global L_T with frequency weightings A, C and Z.
    - 1, 5, 10, 50, 90, 95 and 99% partial percentile levels corresponding to the integration interval T for each of the octave bands and for the global level with frequency weighting A.

This kind of recording is conceived for long-duration measurements such as studies of environmental noise and traffic noise, for which average noise spectral information is needed.

- **125ms functions**: saves the following 'short' functions every 125 ms:
    - L_T with 125 ms consecutive integration time for each of the octave bands centred on frequencies 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hz
    - Global L_T with 125 ms consecutive integration time and frequency weightings A, C and Z.

- **T + 125ms functions**: every 125 ms saves the '125 ms functions' and every T the 'T functions'.

These 2 types of recordings are specially designed to obtain highly detailed temporary spectral information and ideal for detecting and monitoring noise sources such as vehicle traffic on roads and air traffic at airports.

- **L_T each T**: once each integration period T has come to an end, the following values are stored in the memory:
    - o L_T for each of the octave bands centred on frequencies 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hz
    - o Global L_T with frequency weightings A, C and Z.

This type of recording is very similar to T functions. It is ideal for when no statistical information need be stored. In this way, longer storage times are attained.

The following table shows the storage capacity for the different kinds of recordings in spectrum analyser 1/1 mode:

Type of recording	Storage capacity
T functions	T= 1 s ➔ 4 days 6 hours T= 1 min ➔ 8 months 17 days T= 1 hour ➔ 42 years 10 months
125ms functions	3 days 5 hours
t + 125ms functions	T= 1 s ➔ 3 days 7 hours T= 1 min ➔ 3 days 14 hours T= 1 hour ➔ 3 days 17 hours
L_T each T	T= 1 s ➔ 28 days 18 hours T= 1 min ➔ 4 years 9 months

Recording in spectrum analyser 1/3 mode

Through the SETTING➔ RECORDING ➔ SPECTRUM ANALYSER RECORDING option on the MODEL 33 menu you may select the way to store the measured data in the memory:

- **T functions**: once each integration period T has come to an end, the following values are stored in the memory:
    - o L_T for each of the one-third octave bands centred on frequencies 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000 and 10000 Hz

This type of recording is conceived for long-duration measurements, such as studies of environmental noise and traffic noise, which require detailed spectral information concerning average noise levels.

- **125 ms functions**: save every 125 ms the following 'short' functions:
    - o L_T with 125 ms consecutive integration time for each of the one-third octave bands centred on frequencies 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000 and 10000 Hz

- **T + 125ms functions**: save every 125 ms the '125 ms functions' and every T the 'T functions'.

These 2 types of recording are specially designed to obtain highly detailed temporal and spectral information, and are ideal for the detection of tonal components.

- **L_T each T**: once each integration period T has come to an end, the following values are stored in the memory:
    - o L_T for each of the one-third octave bands centred on frequencies 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000 and 10000 Hz

This kind of recording coincides with T functions.

The following table shows the storage capacity of the different types of spectrum analyser 1/3 mode recordings:

Type of recording	Storage capacity
T functions and L_T each T	T= 1 s ➔ 13 days 15 hours T= 1 min ➔ 2 years 3 months
125 ms functions	1 day 17 hours
T functions + 125ms	T= 1 s ➔ 19 hours 32 minutes T= 1 min ➔ 1 day 16 hours T= 1 hour ➔ 1 day 17 hours

The storage times for each type of recording correspond to one single recording, until the memory is completely full.

The MODEL 33 has sufficient capacity for up to 1000 registers (final results or recordings) of whatever type.

When the built-in memory is full, no more recordings may be made and no more final results saved. If you attempt to do this, the 'MEMORY FULL' message will appear on screen. If the memory reaches its maximum capacity before a recording has finished and the CIRCULAR MEMORY option is inactive (see 0), data recording will stop, although measurement will continue. When the measurement is complete, the final result will be stored in the memory.

Circular memory

The MODEL 33 allows you to configure the empty memory space as a circular data-storage buffer. That is, when you select the SETTINGS ➔\ RECORDING ➔\CIRCULAR MEMORY option from the menu the empty memory space will be configured as a circular buffer, while the already occupied memory space remains unaffected. This means that as from this moment onwards, when you begin a recording, the MODEL 33 will save data until its memory is full. When this moment comes, it will continue to save data, though deleting the oldest data stored in the memory space prior to beginning the recording. This space will always contain the latest data measured.

This feature, together with the opportunity to download data while recording or measurement are in progress, allows you to have a limitless memory at your disposal, provided you periodically download stored data.

Viewing the register

This option allows you to display on screen the final result of the registers stored in the MODEL 33 memory. Access the option by selecting MEMORY ➔ VIEW REGISTER from the MODEL 33 menu.

By pressing ↙ , ↗ and OK , the MODEL 33 allows you to select the register you want to view. The screen will display an index of all the registers stored in the memory (register number + date and time when the measurement process began).

To view the different functions, follow the procedure described in sections 0, 0 and 0. Information for the graphic sound meter mode screen is not available.

Erasing the memory

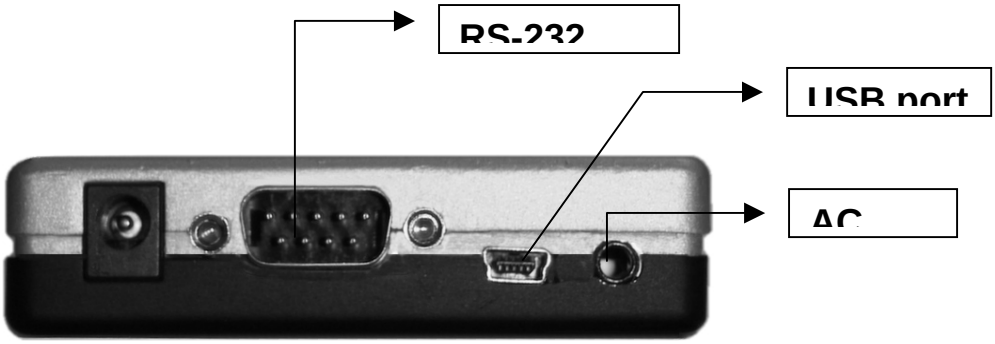
This option allows you to sweep the memory completely clean. Prior to your doing this, the MODEL 33 will request confirmation. MEMORY ➔ ERASE MEMORY.

IMPORTANT NOTE: If the mains feed to the sound level meter is suddenly cut off while recording is in progress, the recording will remain incomplete. It will not be possible to display the recording on the MODEL 33 and 'RECORDING INCOMPLETE' will appear on the screen if you attempt to view. Neither will you be able to download the data into a PC, nor will it be possible to make further recordings unless you completely erase the memory. We therefore recommend that when you connect the MODEL 33 to the direct current AM240 or AM241 feeder, insert new batteries into the sound meter. This will prevent your losing data in the event of a power cut, since the unit will commute to battery feed. If the mains feed is not restored before the battery runs out, just before the batteries go flat the MODEL 33 will stop measuring and gradually switch itself off.

DATA TRANSFER AND PRINT-OUT

The MODEL 33 has 3 data outputs:

- AC output: an analogical output directly proportional to the preamplifier output.
- RS-232 communication port: a two-way digital serial port to link with a PC or connect with a serial printer.
- USB communications port: a two-way digital full-speed USB 1.1 port to link with a PC..



AC output: recording of calibrated measurements

The AC output is proportional to the preamplifier output. This allows you to connect a D.A.T. (Digital Audio Tape) to this output using the CN1DA cable and make a calibrated recording of a measurement. To do this, follow the steps detailed below:

1) Connect the AC output of the MODEL 33 to the D.A.T. recorder.
2) Adjust the input gain of the D.A.T. recorder and the output gain of the AC output (see section 0) to adapt the margin of the measured signal to that of the D.A.T. recording.
3) Begin the recording process.
4) Record a calibration signal. We recommend you use the MODEL 100B calibrator. It is sufficient to record the 1 kHz and 94 dB tone generated by the calibrator.
5) Begin measurement.
6) Once measurement is completed, record the calibration signal once again.

The D.A.T.-recorded signal may be analysed subsequently by adjusting the D.A.T. output and the input stage of the analysis equipment to ensure that measurement of the calibration signal is correct.

The MODEL 33 AC output also allows you to listen to the signal currently being measured and thereby ascertain whether it is being interfered with by other noises.

RS-232 communications port

The RS-232 communications port allows you to transmit in real time the functions measured and those stored in the memory to a PC. It also allows you to transfer the measured functions to a serial printer.

When supplied, the MODEL 33 is set by default to communicate with a PC; consequently, the print mode is deactivated. To change this setting, select the PRINTING option from the

MODEL 33 menu. When this option is activated, communication with the PC via the RS-232 port (though not via the USB port) is deactivated.

You may transfer data to a PC in one of three different ways:

- Transfer via cable: though slow, this type of transfer is compatible with PCs that are not equipped with a USB communications port.

Real-time printout of the measured functions is available for the sound meter (S) and octave band spectrum analyser (1/1) measurement modes.

The sound meter (S) mode prints out the three functions programmed as F1, F2 and F3 second by second:

The spectrum analyser mode prints out, each T, the spectral and global values with frequency weightings A, C and Z:

The serial printer must have 80 columns.

The format of the serial transmission is as follows:

Speed	9600 bauds
Data bits	8
Parity	None
Stop bits	1

In order to print, the PRINTING option of the MODEL 33 menu must be activated. While it is activated, it will not be possible to carry out serial communication with a PC. When you switch the MODEL 33 off, the PRINTING option is automatically deactivated.

The printer lead must be connected to the RS-232 port via the MA101 adapter.

USB communications port

The USB communications port transfers data at high speed. It is therefore ideal for downloading large volumes of data stored by the MODEL 33.

Data transfer to a PC: communication software

The communication software supplied with the **MODEL 33** (**Capture Studio**), allows you to carry out the following operations:

- Transfer in real time of the data measured by the MODEL 33 to a PC
- Downloading of registers stored in the MODEL 33.
- Register management (erasure, etc.).
- Sound meter programming (time, sound-meter mode functions, spectrum analyser 1/1 and 1/3, etc.).

The MODEL 33 allows you to download recorded data as it is being recorded. In other words, while data is being recorded, it may also be downloaded. This feature, together with the memory setting as a circular buffer, places a limitless memory at your disposal. All you need do is periodically download data before the memory reaches its maximum capacity.

To carry out these options, you must insert a communications port -- either an RS-232 or a USB -- between the MODEL 33 and the PC.

Further information regarding how the application software works is available in its 'help' menu.

TECHNICAL SPECIFICATIONS

Measurement range

L_F, L_S, L_I, L_E, L_t and L_T functions			
Upper limit of the indicator:	0 dB		
Lower limit of the indicator:	157.0 dB		
Operating limits are modified by the sensitivity of the microphone.			
For MK:224 + PA-14:	FREQUENCY WEIGHTING		
	A	**C**	**Z**
Primary Range			
Upper limit	120.0	120.0	120.0
Lower limit	30.0	32.0	38.0
Measurement Range (with nominal sensitivity of microphone):			
Upper limit	137.0	137.0	137.0
Upper limit for crest factor 3:	130.0	130.0	130.0
Upper limit for crest factor 5:	126.0	126.0	126.0
Upper limit for crest factor 10:	120.0	120.0	120.0
Lower limit	24.5	26.0	31.0
Electrical Noise (with nominal sensitivity of the microphone) (typical):	14.4	16.8	21.9
Electrical Noise at 20ºC (electrical + thermic of microphone) (typical):	19.6	21.1	25.9

L_{peak} Function	
Upper limit of the indicator:	0 dB
Lower limit of the indicator:	160.0 dB
Operating limits are modified by the sensitivity of the microphone.	
Linear measurement range with MK:224 and C-250	
Minimum upper limit	140.5 dB
Upper limit with nominal sensitivity of microphone	141.0 dB

Detector - Functions L_F, L_S and L_I

Complies with IEC 60651:01 type 1 standard.

For electrical calibration, use the ADM0C130 adapter.

Maximum error in the maximum response to a tone burst		
Function	**Duration of the tone burst (ms)**	**Maximum error (dB)**
L_F	200	± 1.0
L_S	500	± 1.0
L_I	20	± 1.5
	5	± 2.0
	2	± 2.0

Maximum error for signals with crest factor ≤ 3:	± 0.5 dB
Maximum error for signals with crest factor ≤ 5:	± 1.0 dB
Maximum error for signals with crest factor ≤ 10:	± 1.5 dB
Maximum overshot: L_F : L_S :	 1.1 dB 1.6 dB
Maximum error of level linearity (31.5 to 12500 Hz):	± 0.7 dB
Maximum error of differential level linearity (31.5 to 12500 Hz):	± 0.2 dB

Peak detector - L_I function	
Decay rate:	2.9 dB/s ± 0.5 dB/s
Onset time constant:	< 3.5 ms

Peak detector - L_{peak} function

Onset time constant:	< 75 μs

Integrator - L_T, L_t and L_E functions

Complies with the IEC 60804:00 type1 standard

Linearity range:	110 dB
Pulse range:	65 dB
Response time to a steady input signal:	2 s

Frequency weighting

Complies with the IEC 60651:01 type 1standard.

Frequency weightings available	
Function	**Weighting**
L_{peak}	A, C or Z
L_F	A, C or Z
L_S	A, C or Z
L_I	A, C or Z
L_E	A, C or Z
L_T	A, C or Z

L_t	A, C or Z
L_x (percentiles)	A

The following table shows the A and C frequency weightings and tolerance for type 1.

Frequency (Hz)	Weighting A (dB)	Weighting C (dB)	Tolerance for type 1 (dB)
16	- 56.7	- 8.5	+ 3; -∞
31.5	- 39.4	- 3.0	± 1.5
63	- 26.2	- 0.8	± 1.5
125	- 16.1	- 0.2	± 1
250	- 8.6	- 0.0	± 1
500	- 3.2	- 0.0	± 1
1.000	0	0	± 1
2.000	+ 1.2	- 0.2	± 1
4.000	+ 1.0	- 0.8	± 1
8.000	- 1.1	- 3.0	+1.5; -3
16.000	- 6.6	- 8.5	+ 3; -∞

Frequency weighting Z (zero) is equivalent to 0 dB from 10 Hz to 20 kHz. The tolerance for type 1 is the one defined by frequency weightings A and C.

AC output

Frequency weighting:	Linear
Sensitivity at 137 dB and 1 kHz (Gain: 0 dB):	6.5 Vrms (typical)
Upper limit:	8.1 Vrms (typical)
Output impedance:	100 Ω
Gain	0 or 40 dB ± 0.2 dB
Connector with 1.3 mm central pin	Central pin ➔ AC signal

Octave band filters

Type 1 filters in compliance with IEC 61260:1995/A1:2001.

Frequency evaluation system	Base 10
Reference attenuation	0 dB
Operative linearity range	same as the measurement range

Octave band nominal central frequencies	
Nominal central frequency	**Exact base 10 frequency**

31.5 Hz	31.623 Hz
63 Hz	63.096 Hz
125 Hz	125.89 Hz
250 Hz	251.19 Hz
500 Hz	501.19 Hz
1 kHz	1.000 Hz
2 kHz	1.995.3 Hz
4 kHz	2.511.9 Hz
8 kHz	7.943.3 Hz
16 kHz	15.849 Hz

Measurement range (octave band spectrum analyser)

L_T Function	
for MK:224 + PA-14:	
Measurement range (with linearity error lower than 0.4 dB):	
Octave bands with nominal central frequency	
Lower than 63 Hz: Upper limit:	137 dB
Lower limit:	31 dB
From 63 Hz to 8 kHz: Upper limit:	137 dB
Lower limit:	20 dB
Higher than 8 kHz: Upper limit:	137 dB
Lower limit:	25 dB
The noise (electrical + thermic of the microphone) is, as a minimum, 10 dB lower than the lower limit of the measurement range.	

Third octave band filters

Type 1 filters in compliance with IEC 61260:1995/A1:2001.

Frequency evaluation system	Base 10
Reference attenuation	0 dB
Operative linearity range	same as the measurement range

Third octave band nominal central frequencies			
Nominal central frequency	**Exact base 10 frequency**	**Nominal central frequency**	**Exact base 10 frequency**
20 Hz	**19.95 Hz**	500 Hz	**501.19 Hz**

25 Hz	25.12 Hz	630 Hz	630.96 Hz
31.5 Hz	31.62 Hz	800 Hz	794.33 Hz
40 Hz	39.81 Hz	1000 Hz	1000.00 Hz
50 Hz	50.12 Hz	1250 Hz	1258.93 Hz
63 Hz	63.10 Hz	1600 Hz	1584.89 Hz
80 Hz	79.43 Hz	2000 Hz	1995.26 Hz
100 Hz	100.00 Hz	2500 Hz	2511.89 Hz
125 Hz	125.89 Hz	3150 Hz	3162.28 Hz
160 Hz	158.49 Hz	4000 Hz	3981.07 Hz
200 Hz	199.53 Hz	5000 Hz	5011.87 Hz
250 Hz	251.19 Hz	6300 Hz	6309.57 Hz
315 Hz	316.23 Hz	8000 Hz	7943.28 Hz
400 Hz	398.11 Hz	10000 Hz	10000.00 Hz

Measurement range (one third octave spectrum analyser)

L_T Function	
for MK:224 + PA-14:	
Measurement range (with linearity error lower than 0.4 dB):	
One third octave bands with nominal central frequency	
From 20 Hz to 31,5 Hz: Upper limit:	137 dB
Lower limit:	28 dB
From 40 Hz to 5 kHz: Upper limit:	137 dB
Lower limit:	20 dB
From 6,3 kHz to 10 kHz: Upper limit:	137 dB
Lower limit:	24 dB
The noise (electrical + thermic of the microphone) is, as a minimum, 10 dB lower than the lower limit of the measurement range.	

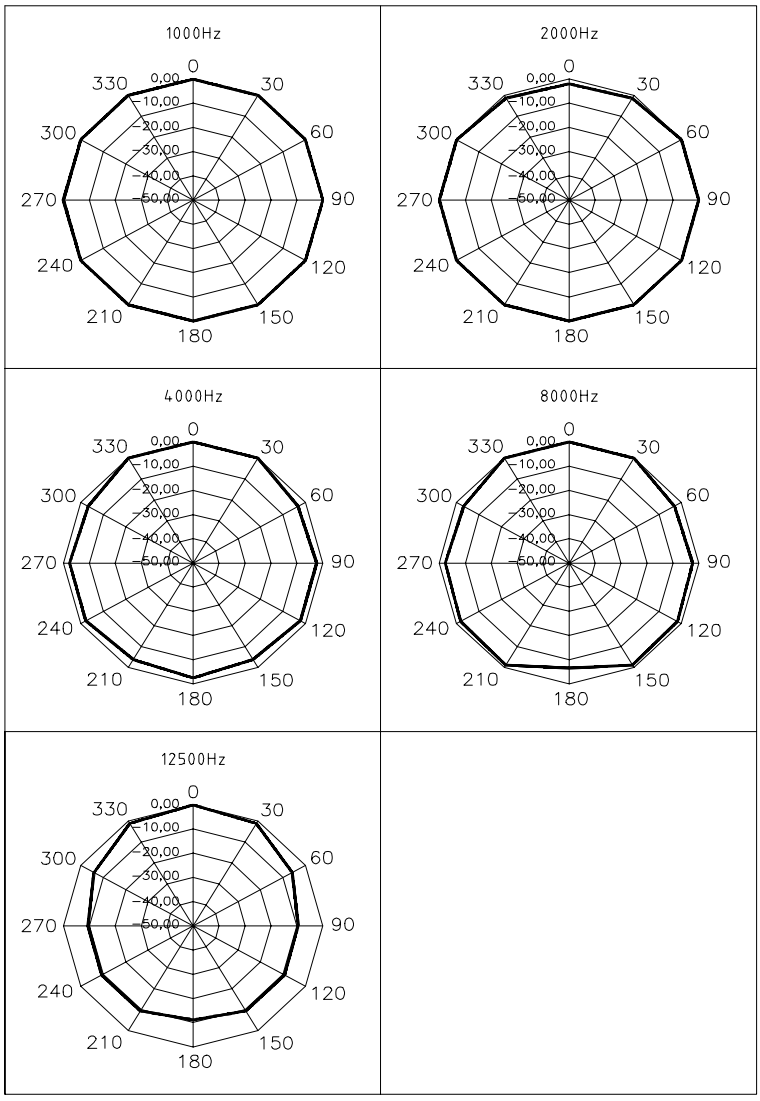
Microphone

MK:224 Microphone			
½ ″ prepolarised condenser microphone			
Polarisation	0 V		
Nominal capacitance	18.0 pF		
Nominal sensitivity:	50 mV/Pa in reference conditions		
The serial number is printed on the microphone			
Constant pressure to free field correction MK:224			
Frequency (Hz)	**Correction (dB)**	**Frequency (Hz)**	**Correction (dB)**

125	0.0	*2.000*	0.4
250	0.0	*4.000*	1.3
500	0.0	*8.000*	3.7
1.000	0.0		

Directivity

Sensitivity variation at 30° and 90°		
Frequency (Hz)	**30° (dB)**	**90° (dB)**
40 - 1.000	0.1	0.2
1.000 - 2.000	0.3	0.4
2.000 - 4.000	0.3	0.4
4.000 - 8.000	1.0	2.0
8.000 - 12.500	1.4	5.7



Effect of the accessories on the microphone

Effect of the windscreen	< 1 dB for frequencies < 10 kHz < 3 dB for frequencies < 12.5 kHz
Effect of the extension cables	The extension cables do not influence into the measuring frequency band. A recalibration is not necessary when using the extension cables.

Reference conditions

Type of sound field:	Free
Reference direction	Perpendicular to the microphone diaphragm
Reference sound pressure level:	94 dB (referred to 20 μPa)
Reference frequency:	1 kHz
Reference temperature:	20 °C
Reference relative humidity:	65 %
Reference atmospheric pressure:	1,013 mbar

Warm-up time

Warm-up time	30 seconds

Temperature influence

Operation range:	-10 to +50 °C
Maximum error (-10 to +50°C):	0.5 dB
Storage without batteries	-20 to +60 °C

Humidity influence

Operation range:	30 to 90 %
Maximum error at 30%< R.H.<90% at 40°C and 1 kHz:	0.5 dB

Storage without batteries:	< 93 %

Electromagnetic compatibility

Influence of the Magnetic Fields	In a magnetic field of 80 A/m (1 oersted) at 50 Hz, the reading will be under 25 dB(A)
Sound pressure level at which the MODEL 33 meets the requirements of radiated electromagnetic field.	74 dBA
Set of accessories tested in the verification of the electromagnetic compatibility requirements.	The ones described in chapter 0.
Configuration for the normal mode of working.	Sound level meter mode, L_{AF} function.
Configuration for the reference orientation.	The MODEL 33 in vertical position, with the MODEL 33 main axis (preamplifier) perpendicular to the field propagation direction

Vibration influence

For frequencies from 20 to 1,000 Hz and 1 m/s²:	< 75 dB(A)

Batteries & External supply

Battery	
Two AA sized (LR6) 1.5 V batteries	
Typical battery life with continuous use: Sound Level Meter Spectrum Analyser 1/1 Spectrum Analyser 1/3	 15:00 hours 13:00 hours 11:30 hours
External Supply	
Voltage input range	3.8 to 4.2 V DC
Minimum supply current	100 mA
For DC supply use the AM240 or AM241model mains feeder does not accept any responsibility in the case of the use of t main feeders other than the recommended.	

Dimensions and weight

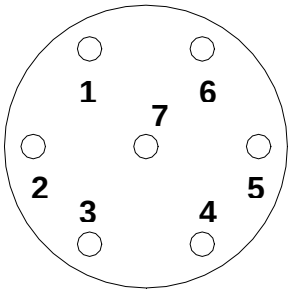
Dimensions:	341 x 82 x 19	mm
Weight:	With battery 550 Without 500	g g

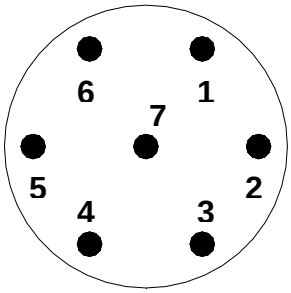
Preamplifier connector

The preamplifier is connected to the MODEL 33 by means of LEMO-type connectors: a socket LEMO connector in the sound level meter and a male plug LEMO-type connector in the preamplifier. The pin out of the connectors is the following (exterior view):

SOCKET

MODEL 33





MALE PLUG

Preamplifier

1	Not connected
2	Signal ground
3	200 V polarisation voltage
4	Signal
5	+ 28 V
6	+ 28 V
7	Power ground

Memory

64 MB

Calibration

Use the **MODEL 100B** calibrator

Standards

Standards
EN 60651:94 (A1:94) (A2 :01) type 1, EN 60804:00 type 1, EN 61260:95 (A1:01) type 1
IEC 60651:01 type 1, IEC 60804:00 type1, IEC 61260:95 (A1:01) type1

ANSI S1.4:83 (A1 :85) type 1, ANSI S1.43:97 type 1, ANSI S1.11:86 type 1
CE mark. Complies with 73/23/CEE and CEM 89/336/CEE low-tension regulations, the latter amended by 93/68/CEE.

Notes

Notes
Should your **MODEL 33** cease to comply with any of these specifications, contact your nearest official service technicians, who will gladly check, adjust and/or repair it for you.
The **MODEL 33** should be calibrated and tested by a competent entity, at least, once a year.

Accessories

Standard accessories	Optional accessories
Carrying Pouch	Calibrator **Model 100**
Wind screen **UA237**	Tripod **TR-1**
Programme for PC	Carrying Case CK250
Cable for connection to a PC USB-USB	Mains feeder (V= 230, 50 Hz) **AM240** Mains feeder (V= 110, 60 Hz) **AM241**
2 x AA 1.5 V batteries	Outdoor kit **TK-1**
	Microphone extension cable 3 m **CN-003** Microphone extension cable 10 m **CN-010** Microphone extension cable 30 m **CN-030**
	Tripod adaptor **TR-001**
	DC converter/regulator for external battery (car battery) **AM140**
	AC output audio cable **CN1DA**

APPENDIX A: Functions

Function summary table

Sound level meter mode functions

Function	Frequency weighting	Nomenclature	Maximum value	Minimum value
Sound pressure level with fast time weighting (Fast)	A	L_{AF}	L_{AFmax}	L_{AFmin}
	C	L_{CF}	L_{CFmax}	L_{CFmin}
	Z	L_{ZF}	L_{ZFmax}	L_{Zfmin}
Sound pressure level with slow time weighting (Slow)	A	L_{AS}	L_{ASmax}	L_{ASmin}
	C	L_{CS}	L_{CSmax}	L_{CSmin}
	Z	L_{ZS}	L_{ZSmax}	L_{Zsmin}
Sound pressure level with impulse time weighting (Impulse)	A	L_{AI}	L_{AImax}	L_{AImin}
	C	L_{CI}	L_{CImax}	L_{CImin}
	Z	L_{ZI}	L_{ZImax}	L_{ZImin}
Equivalent continuous sound pressure level with integration time T	A	L_{AT}	L_{ATmax}	L_{ATmin}
	C	L_{CT}	L_{CTmax}	L_{CTmin}
	Z	L_{ZT}	L_{ZTmax}	L_{ZTmin}
Equivalent continuous sound pressure level of the entire measurement	A	L_{At}	-	-
	C	L_{Ct}	-	-
	Z	L_{Zt}	-	-
Sound exposure level S.E.L.	A	L_{AE}	-	-
	C	L_{CE}	-	-
	Z	L_{ZE}	-	-
Sound pressure peak level	A	L_{Apeak}	-	-
	C	L_{Cpeak}	-	-
	Z	L_{Zpeak}	-	-
Equivalent continuous sound pressure level with time weighting I and integration time T.	A	L_{AIT}	-	-
	C	L_{CIT}	-	-
	Z	L_{ZIT}	-	-
Equivalent continuous sound pressure level of the entire measurement with time weighting I.	A	L_{AIt}	-	-
	C	L_{CIt}	-	-
	Z	L_{ZIt}	-	-
Dynamic subtraction of the equivalent continuous sound pressure level with time weighting I and the Equivalent continuous sound pressure level, both with integration time T.	A	$L_{AIT} - L_{AT}$	-	-
	C	$L_{CIT} - L_{CT}$	-	-
	Z	$L_{ZIT} - L_{ZT}$	-	-
Dynamic subtraction of the equivalent continuous sound pressure level with time weighting I and the Equivalent continuous sound pressure level, both with integration time equal to the measurement time.	A	$L_{Ait} - L_{At}$	-	-
	C	$L_{Cit} - L_{Ct}$	-	-
	Z	$L_{Zit} - L_{Zt}$	-	-
Dynamic subtraction of the equivalent continuous sound pressure level with frequency weighting C and A, both with integration time T.	A y C	$L_{CT} - L_{AT}$	-	-
Dynamic subtraction of the equivalent continuous sound pressure level with frequency weighting C and A, both with integration time equal to the measurement time.	A y C	$L_{Ct} - L_{At}$	-	-

Measurement time	-	t	-	-
Integration time	-	T	-	-
Percentile 1%	A	L_1	-	-
Percentile 5%	A	L_5	-	-
Percentile 10%	A	L_{10}	-	-
Percentile 50%	A	L_{50}	-	-
Percentile 90%	A	L_{90}	-	-
Percentile 95%	A	L_{95}	-	-
Percentile 99%	A	L_{99}	-	-

-: unavailable

1/1 Spectrum analyser mode functions

Function	Freq. Wei.	Name	TOTAL	31.5	63	125	250	500	1 k	2 k	4 k	8 k	16 k
Equivalent continuous sound pressure level with integration time T	-	L_T	-	X	X	X	X	X	X	X	X	X	X
Percentile 1%	A*	L_1	X*	X	X	X	X	X	X	X	X	X	X
Percentile 5%	A*	L_5	X*	X	X	X	X	X	X	X	X	X	X
Percentile 10%	A*	L_{10}	X*	X	X	X	X	X	X	X	X	X	X
Percentile 50%	A*	L_{50}	X*	X	X	X	X	X	X	X	X	X	X
Percentile 90%	A*	L_{90}	X*	X	X	X	X	X	X	X	X	X	X
Percentile 95%	A*	L_{95}	X*	X	X	X	X	X	X	X	X	X	X
Percentile 99%	A*	L_{99}	X*	X	X	X	X	X	X	X	X	X	X
Equivalent continuous sound pressure level with integration time T	A	L_{AT}	X	-	-	-	-	-	-	-	-	-	-
	C	L_{CT}	X	-	-	-	-	-	-	-	-	-	-
	Z	L_{ZT}	X	-	-	-	-	-	-	-	-	-	-

X: available - :unavailable

* Frequency weighting A is used in the calculation of the total percentiles.

1/3 Spectrum analyser mode functions

Function	Freq. Wei.	Name	TOTAL	20	25	31,5	40	50	63	80	100	125	160
Equivalent continuous sound pressure level with integration time T	-	L_T	-	X	X	X	X	X	X	X	X	X	X

Function	200	250	315	400	500	630	800	1000	1250	1600	2000	2500
Equivalent continuous sound pressure level with integration time T	X	X	X	X	X	X	X	X	X	X	X	X

Function	3150	4000	5000	6300	8000	10000
Equivalent continuous sound pressure level with integration time T	X	X	X	X	X	X

X: available - :unavailable

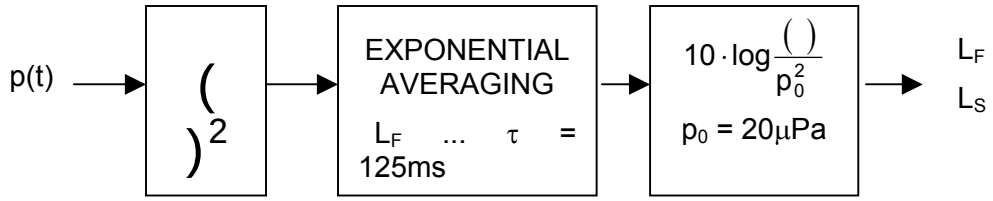
All functions are measured simultaneously in all modes.

Definition of functions

Sound pressure level with fast and slow time weightings

L_F (Fast) RMS value with 125 ms fast exponential averaging, in decibels.

L_S (Slow) RMS with 1 s slow exponential averaging, in decibels.



p(t): instantaneous sound pressure

To obtain a stable reading, the sound level meters feature two kinds of responses: 'F' and 'S'. The 'F' response has an exponential averaging circuit time constant of τ = 125 ms, and the 'S' response of τ = 1 s.

'F' response is recommended for measuring sound levels that fluctuate relatively little, such as vehicle noise, while 'S' response is recommended for noises that very more.

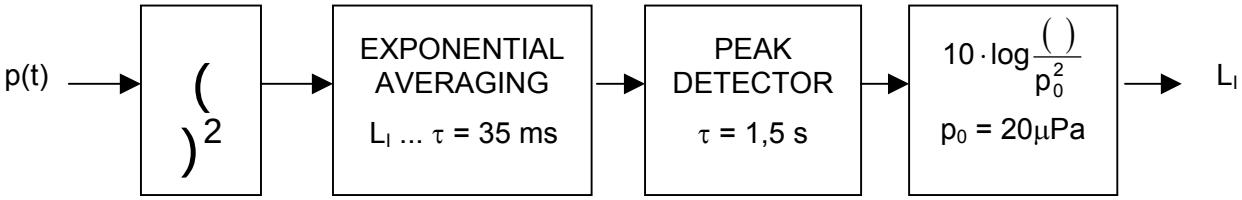
$$L_{S,F} = 20 \cdot \log \left(\frac{\left(\frac{1}{\tau} \int_{-\infty}^{T} p^2(\zeta) \cdot e^{-(t-\zeta)/\tau} d\zeta \right)^{1/2}}{p_o} \right)$$

p(t): instantaneous sound pressure

p_0: reference sound pressure (20 μPa)

Sound pressure level with 'I' time weighting

L_I (Impulse) Maximum short-term RMS value with exponential averaging of 35 ms, in decibels.



p(t): instantaneous sound pressure

The 'I' characteristic is designed to detect impulse noise, like shots or blows. The 'I' function has a very fast exponential averaging circuit time constant: τ = 35 ms, and a peak detector that retains the measured value long enough for it to be displayed.

Sound pressure peak level

L_{peak} (Peak) The highest absolute instantaneous sound pressure value since the beginning of the measurement, in decibels.

Equivalent continuous sound pressure level

L_T and L_t Equivalent continuous sound pressure level. This is the linear average of the instantaneous sound pressure square from the beginning t_1 to the end t_2. The duration of the measurement is therefore $T = t_2 - t_1$

$$L_{eqT} = 10 \cdot \log\left(\frac{1}{T}\int_{t_1}^{t_2}\frac{p^2(t)}{p_0^2}dt\right)$$

p(t): instantaneous sound pressure
p_0: reference sound pressure (20 μPa)
T: duration of the measurement

The equivalent sound pressure level is the pressure level that, kept constant throughout the entire measurement interval, has the same sound energy as the measured sound event.

The equivalent continuous sound pressure level function is ideal for measuring variable sound events such as road traffic or sound events that due to their long duration cover a wide range of sound pressure levels, such as environmental measurements.

Percentile levels are the perfect complement to the equivalent continuous sound pressure level function.

The **MODEL 33** measures the equivalent continuous sound pressure levels **L_t** and **L_T**.

The **L_t** equivalent level is the equivalent level of the interval measured, that is, for each instant it gives us the value of the equivalent level from the beginning of the measurement to that instant. When measurement has been completed, the **L_t** value corresponds to the equivalent level of the entire measurement from beginning to end.

The **L_T** equivalent level is the equivalent level corresponding to integration time T (a programmable parameter). It is displayed every T time period. In other words, every T time period the **MODEL 33** shows the equivalent level of the last T time period.

Sound exposure level (SEL)

L_E (SEL) Sound exposure level. This is the sound level that, kept constant for 1 second, presents energy equivalent to the energy accumulated throughout the entire measurement, in decibels.

$$L_E = 10 \cdot \log\left(\frac{1}{T_0} \int_0^T \frac{p^2(t)}{p_0^2} dt \right)$$

p(t): instantaneous sound pressure
p_0: reference sound pressure (20 μPa)
T: duration of the measurement
T_0: 1 second

Its relation with the equivalent continuous level is the following one:

$$L_t = L_E - 10 \cdot \log\left(\frac{t}{T_0} \right)$$

Percentile levels

L_{99}, L_{95}, L_{90}, L_{50}
L_{10}, L_5 y L_1 These are the levels that were exceeded during 99%, 95%, 90%, 50%, 10%, 5% and 1% of the analysis time, in decibels.

In Sound Level Meter mode they are calculated with classes of 0.1 dB using the function **L_{AF}**. In the 1/1 spectrum analyser mode they are calculated with classes of 0.5 dB and using the function **L_{AT}**.

In some English speaking countries, the percentile levels are known as the exceedence levels, or the statistical levels, or simply as L_n values, where 'n' is a number from 0.1 to 99.9.

APPENDIX B: Reverberation Time Module

The module of reverberation time measurement (RT) of the Model 33 Sound Level Meter includes 2 news measurement modes: Octave band RT measurement (1/1) (63 Hz a 4 kHz) R 1/1 and one third octave band RT measurement (1/3) (50 Hz a 5 kHz) R 1/3, for each of this modes allows:

- The simultaneously measurement of the reverberation time T_{20} and T_{30} by the interrupted noise method for the specified octave bands
- The automatic detection of the decay curve and its slope estimation through a least square approximation.
- The possibility of storing the results in memory: Values of T_{20}, T_{30} and decay curves, for each octave bands.

The module of measurement of the RT is not included with the MODEL 33. It is an optional module and it can be acquired when buying the MODEL 33 or later To incorporate it, you just have to contact your official Pulsar distributor and supply him the serial number of your sound level meter. In a few days you will receive a CD with the activation program.

Activation of the Reverberation Time Module

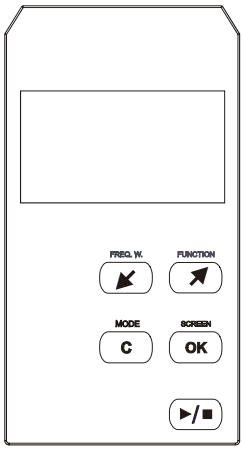
To activate the reverberation time module (RT):

- Insert in the CD-ROM drive the CD that you have received. The activation program 'MODEL 33 RT module Activator' will be automatically executed. If not, you should execute the SETUP.EXE program in the CD-ROM drive.
- Follow the steps.

To verify that your SLM already has the RT module.

Verify that the sound level meter it is turn on and stopped (■), press the key MODE C sequentially until the new modes appears. They can be identify by the name that appears in the screen when changing the mode "REVERBERATION TIME 1/1" or "REVERBERATION TIME 1/3" or by the indicator shown in the upper right part of the screen R 1/1 or R 1/3.

Using the keyboard



1/1 and 1/3 REVERBERATION TIME KEYS FOR MODEL 33:	
►/■	Key to begin or terminate a measurement of reverberation time
FREQ. W. ↙	Key to return to the previous third octave band
FUNCTION ↗	Key to go on to the next third octave band
SCREEN OK	Key for confirming the steps of the process of RT measurement
MODE C	Key to change the mode, when the MODEL 33 is ■

Using the MODEL 33

Starting the MODEL 33

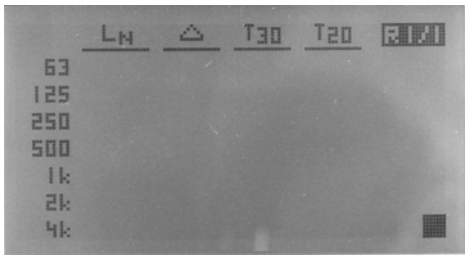
To start the MODEL 33, press the key: ⏻

The logo, together with the **MODEL 33** sound level meter model will appear on the screen. A few seconds later, the initial screen predetermined in the menu configuration option will appear.

If the MODEL 33 does not switch on, check that a fully charged battery is fitted or that it is connected to a suitable power supply.

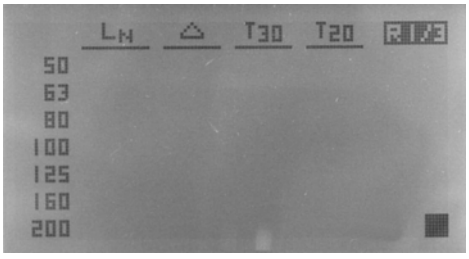
Access to the Reverberation Time Mode 1/1

Switch on the MODEL 33 and check there is no measurement in progress (■), sequencially press the MODE C key until appears “REVERBERATION TIME 1/1”. Next will appear in the screen the Reverberation Time mode screen. This mode will be distinguished because the R 1/1 indication that will appear on the upper right part from the screen.



Access to the Reverberation Time Mode 1/3

Switch on the MODEL 33 and check there is no measurement in progress (■), sequentially press the MODE C key until appears “REVERBERATION TIME 1/3”. Next will appear in the screen the Reverberation Time mode screen. This mode will be distinguished because the R 1/3 indication that will appear on the upper right part from the screen.



End the MODEL 33

To switch off the MODEL 33, check there is no measurement in progress (■) and press: ⏻

MODEL 33 menu

While there is no measurement in progress (■) it can be accede to the MODEL 33 menu by pressing: ☰

All the menu options are available.

To turn back to the measurement mode press: C

Measuring the Reverberation Time by octave bands

Measuring the Reverberation Time

The REVERVERATION TIME 1/1 mode of the **MODEL 33** measures simultaneously the reverberation time (T_{20} and T_{30}) for all the octave bands (from 63 Hz to 4 kHz) through the interrupted noise method.

This method lies in obtaining the sound pressure level decay according to time inside the room that it is being studied. This decay is obtained exciting the room with random noise of broadband or of limited bandwidth and recording the decay level of the sound pressure when making a sudden interruption of the noise emission.

To do this measurement, you will need an omni directional sound pressure source (FPA-120) to emit a broadband noise (pink noise).

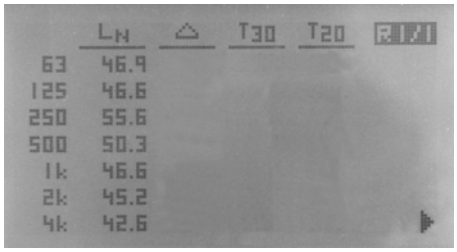
From among the applications of this mode you should point up the measurement of the reverberation time in rooms, the measurement of the absorption coefficient in reverberant rooms, the measurement of the acoustic insulation in buildings and of building elements.

Beginning a measurement

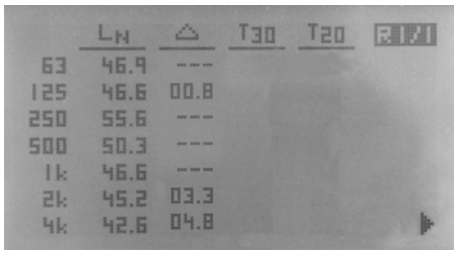
First of all, check that is no measurement in progress (■) . If there is, (▶ o ❚❚), press ▶/■ to stop it.

Next, switch the MODEL 33 to REVERBERATION TIME 1/1 mode and follow the next steps:

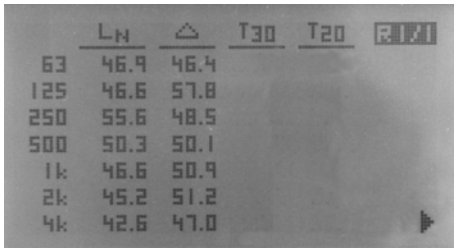
- Be sure that the noise emission of the sound pressure source is stopped.
- Press ▶/■ to start the measurement process. First it will measure the sound pressure level corresponding to the background noise L_N. At the screen it will appear this level for all octave band (Equivalent level of 1 second in dB).



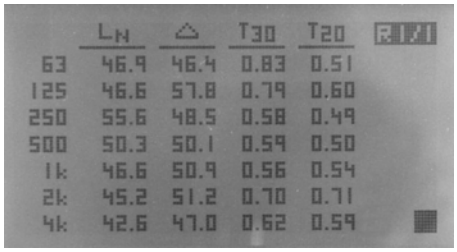
- Press OK to validate this measurement. You will see that these values will stop oscillating. These values will be taken as the background noise level to calculate the RT. At the screen it will appear a new column of values that concern to the increase of the sound pressure level respect the background noise Δ (in dB).



- Increase progressively the sound pressure level until you obtain a sound pressure level of 35 dB upper to the background noise for calculating the T_{20} and 45 dB upper to the background noise for calculating the T_{30}.
- When the source is emitting the necessary sound pressure level, you should wait some seconds to make the acoustic field reach the stationary state.
- Press OK to validate this level. You will see that these values will stop oscillating. The initial maximum levels to calculate the RT will be obtained from these values.

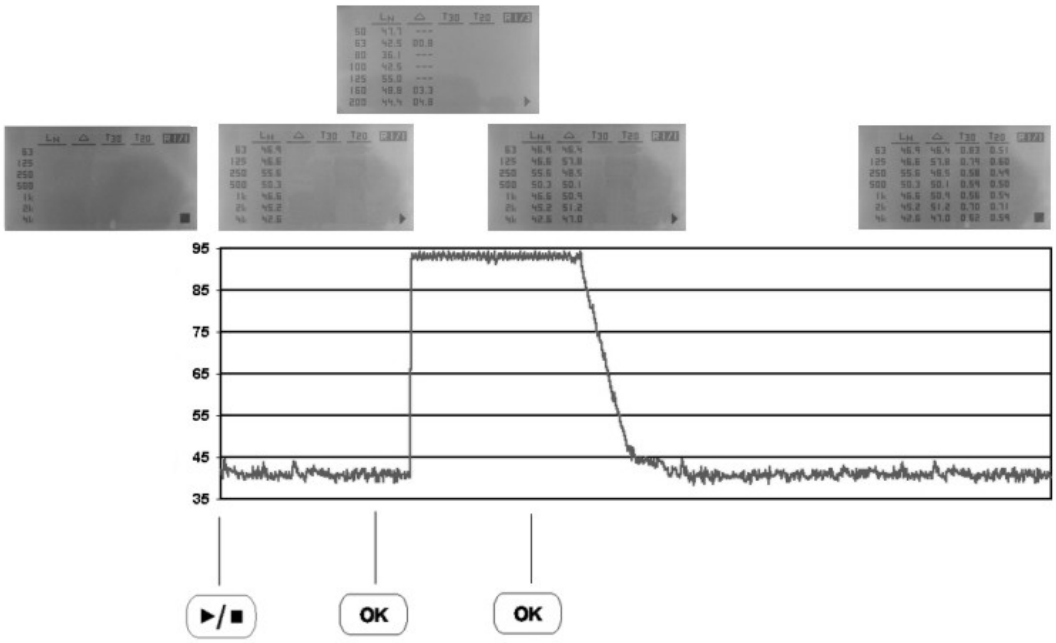


- From this instant, the MODEL 33 will wait until you interrupt the noise emission.
- Stop the noise emission.
- After a few seconds from the noise emission stop, it will appear at the screen the values of T_{30} and T_{20} and the measurement will finish automatically showing up (■) on the screen.



The SC-30 also measures the decay curves of the sound pressure level, but this only can be displayed by recording the final result of the measurement and downloading these data to the computer through the **CAPTURE Studio** software application.

At the next graphic you can see all the Reverberation Time measurement process:



Stopping the measurement

While the measurement is in progress, it can be stopped by pressing ▶/■ . The state of measurement indicator will switch from ▶ to ■.

Overload indicator

The **MODEL 33** has an overload indicator. If during the measurement an overload has occurred, it will appear the sign **^** before the value of the function affected.

While there is an overload, the sign ^ will appear in the bottom right-hand corner of the screen.

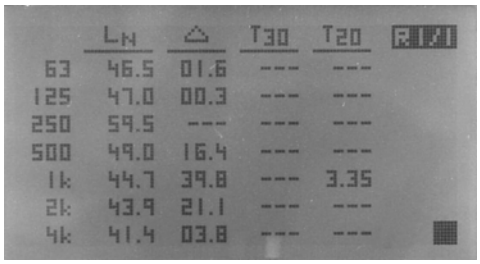
If during the measurement the sign appears, the MODEL 33 will have not validate the measured values and it can not pass to the next measurement step.

If the overload occurs during the decay curve measurement, the measurement will be aborted automatically.

Indicator (---)

If the --- indicator appears after finishing a measurement, can be because:

- The sound pressure level reached over the background noise is not enough to calculate the parameter (T_{20} ➔ Δ>35 dB and T_{30} ➔ Δ>45).
- The reverberation time cannot be calculated.



Measuring the Reverberation Time by one third octave bands

Measuring the Reverberation Time

The REVERVERATION TIME 1/1 mode of the **MODEL 33** measures simultaneously the reverberation time (T_{20} and T_{30}) for one third octave bands (de 50 Hz a 5 kHz) through the interrupted noise method.

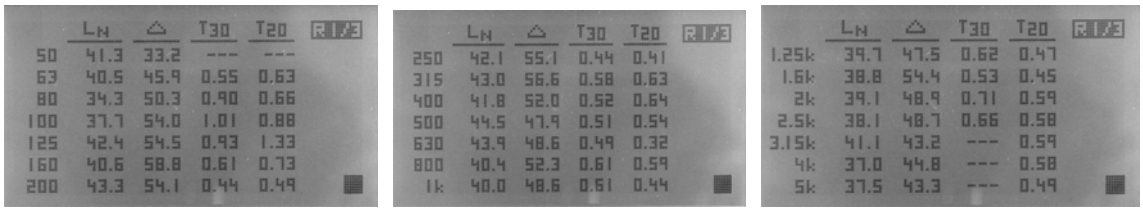
This method lies in obtaining the sound pressure level decay according to time inside the room that it is being studied. This decay is obtained exciting the room with random noise of broadband or of limited bandwidth and recording the decay level of the sound pressure when making a sudden interruption of the noise emission.

To do this measurement, you will need an omni directional sound pressure source (FPA-120) to emit a broadband noise (pink noise).

From among the applications of this mode you should point up the measurement of the reverberation time in rooms, the measurement of the absorption coefficient in reverberant rooms, the measurement of the acoustic insulation in buildings and of building elements.

Visualizing the third octave bands

The MODEL 33 shows the measured data for all the third octave bands in three different sections (50 – 200 Hz), (250 Hz – 1 kHz) and (1,25 kHz – 5 kHz) to accede to its visualization press ↙ and ↗. Each section can be change even when there is no measure in progress (■) both there is a measure in progress (▶).

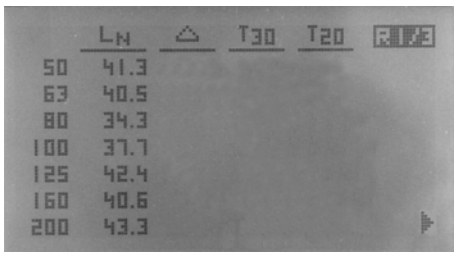


Beginning a measurement

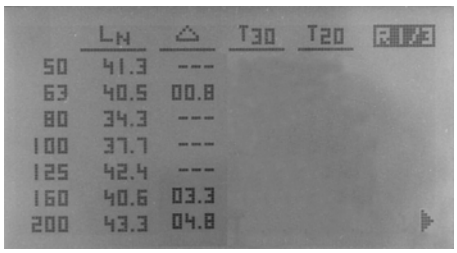
First of all, check that is no measurement in progress (■) . If there is, (▶ o ❚❚), press ▶/■ to stop it.

Next, switch the MODEL 33 to REVERBERATION TIME 1/3 mode and follow the next steps:

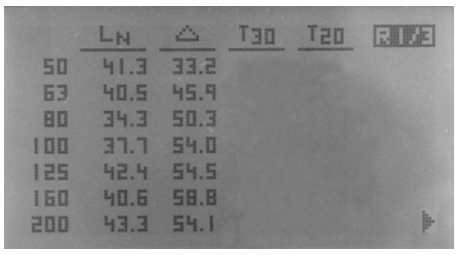
- Be sure that the noise emission of the sound pressure source is stopped.
- Press ▶/■ to start the measurement process. First it will measure the sound pressure level corresponding to the background noise L_N. At the screen it will appear this level for all octave band (Equivalent level of 1 second in dB).



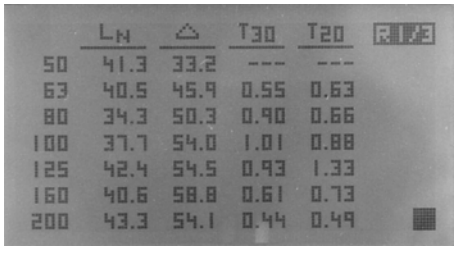
- Press OK to validate this measurement. You will see that these values will stop oscillating. These values will be taken as the background noise level to calculate the RT. At the screen it will appear a new column of values that concern to the increase of the sound pressure level respect the background noise Δ (in dB).



- Increase progressively the sound pressure level until you obtain a sound pressure level of 35 dB upper to the background noise for calculating the T_{20} and 45 dB upper to the background noise for calculating the T_{30}.
- When the source is emitting the necessary sound pressure level, you should wait some seconds to make the acoustic field reach the stationary state.
- Press OK to validate this level. You will see that these values will stop oscillating. The initial maximum levels to calculate the RT will be obtained from these values.

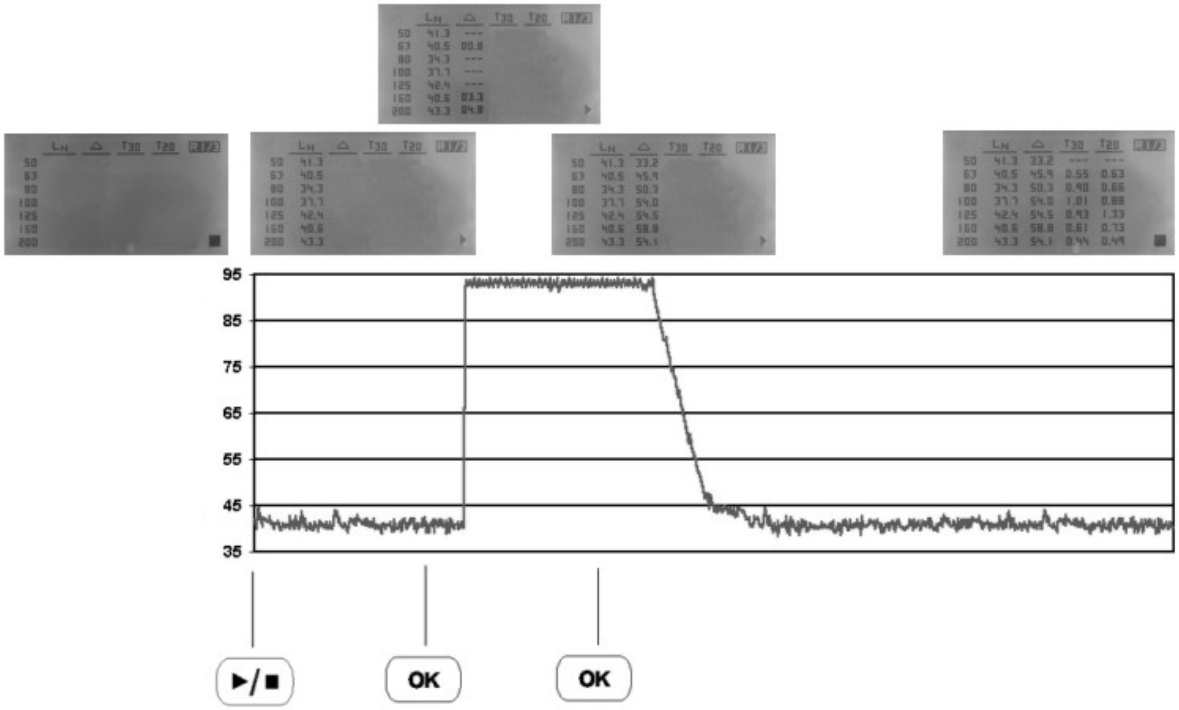


- From this instant, the MODEL 33 will wait until you interrupt the noise emission.
- Stop the noise emission.
- After a few seconds from the noise emission stop, it will appear at the screen the values of T_{30} and T_{20} and the measurement will finish automatically showing up (■) on the screen.



The SC-30 also measures the decay curves of the sound pressure level, but this only can be displayed by recording the final result of the measurement and downloading these data to the computer through the **CAPTURE Studio** software application.

At the next graphic you can see all the Reverberation Time measurement process:



Stopping the measurement

While the measurement is in progress, it can be stopped by pressing ►/■ . The state of measurement indicator will switch from ► to ■.

Overload indicator)

The **MODEL 33** has an overload indicator. If during the measurement an overload has occurred, it will appear the sign **^** before the value of the function affected.

While there is an overload, the sign ^ will appear in the bottom right-hand corner of the screen.

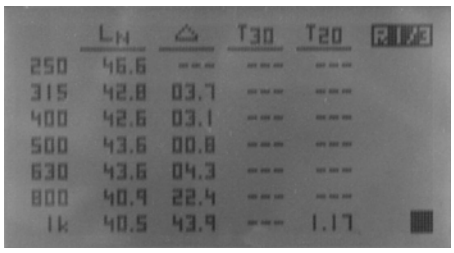
If during the measurement the sign appears, the MODEL 33 will have not validate the measured values and it can not pass to the next measurement step.

If the overload occurs during the decay curve measurement, the measurement will be aborted automatically.

Indicator (---)

If the --- indicator appears after finishing a measurement, can be because:

- The sound pressure level reached over the background noise is not enough to calculate the parameter (T_{20} ➔ Δ>35 dB and T_{30} ➔ Δ>45).
- The reverberation time cannot be calculated.



Data register

The values of the measured functions may be stored in the **MODEL 33** internal memory. When the unit is switched off, the data is saved and may be retrieved and displayed directly from the **MODEL 33** or transferred to a PC. The memory may be erased directly from the **MODEL 33**.

Saving results

Once a measurement has been completed (■), the results may be stored in the memory. Do this by selecting the SAVE RESULTS option from the main menu The **MODEL 33** indicates the register number under which the data has been saved.

The **MODEL 33** saves in memory, in the REVERBERATION TIME 1/1 mode for all the octave bands centred at 63, 125, 250, 500, 1000, 2000 and 4000 Hz frequencies and in the REVERBERATION TIME 1/3 mode for all the third octave bands centred at 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000,1250, 1600, 2000, 2500, 3150, 4000 and 5000 Hz frequencies the following information:

- Reverberation Time T_{20} and T_{30}.
- Sound pressure level of background noise.
- Initial maximum sound pressure level.
- Decay curve: Time history of the sound pressure level decay.

The MODEL 33 can store more than 7900 final results in REVERBERATION TIME 1/1 mode and more than 2600 in REVERBERATION TIME1/3 mode.

View register

This option allows you to display on the screen the final results of the registers stored in the **MODEL 33** memory. To use this option, access VIEW REGISTER on the **MODEL 33** menu.

The **MODEL 33** allows you to select, using the keys ↙ , ↗ and OK, the register you want to display, and an index will appear on-screen showing all the registers stored in the memory (register number + date and time of the beginning of the measurement process).

Information on the decay curve is not available.

Technical Specifications

Measurement Range

The decay curves are measured from the equivalent levels with integration time:

Integration time of the equivalent level		
1/1 octave band	**1/3 octave band**	**Integration time**
63 Hz	50 Hz	40 ms
	63 Hz	40 ms
	80 Hz	40 ms
	100 Hz	20 ms
125 Hz	125 Hz	20 ms
	160 Hz	20 ms
	200 Hz	10 ms
250 Hz	250 Hz	10 ms
	315 Hz	10 ms
	400 Hz	10 ms
500 Hz	500 Hz	10 ms
	630 Hz	10 ms
	800 Hz	10 ms
1 kHz	1 kHz	10 ms
	1.25 kHz	10 ms
	1.6 kHz	10 ms
2 kHz	2 kHz	10 ms
	2.5 kHz	10 ms
	3.15 kHz	10 ms
4 kHz	4 kHz	10 ms
	5 kHz	10 ms

The range of measurement for the T_{20} and T_{30} functions is:

T_{20}		
1/1 octave band	**1/3 octave band**	**T_{20}**
	50 Hz	0,28 s a 17,1 s
63 Hz	63 Hz	0,28 s a 17,1 s
	80 Hz	0,28 s a 17,1 s
	100 Hz	0,14 s a 17,1 s

125 Hz	125 Hz	0,14 s a 17,1 s
	160 Hz	0,14 s a 17,1 s
	200 Hz	0,07 s a 17,1 s
250 Hz	250 Hz	0,07 s a 17,1 s
	315 Hz	0,07 s a 17,1 s
	400 Hz	0,07 s a 17,1 s
500 Hz	500 Hz	0,07 s a 17,1 s
	630 Hz	0,07 s a 17,1 s
	800 Hz	0,07 s a 17,1 s
1 kHz	1 kHz	0,07 s a 17,1 s
	1.25 kHz	0,07 s a 17,1 s
	1.6 kHz	0,07 s a 17,1 s
2 kHz	2 kHz	0,07 s a 17,1 s
	2.5 kHz	0,07 s a 17,1 s
	3.15 kHz	0,07 s a 17,1 s
4 kHz	4 kHz	0,07 s a 17,1 s
	5 kHz	0,07 s a 17,1 s

T_{30}		
1/1 octave band	**1/3 octave band**	**T_{30}**
	50 Hz	0,28 s a 11,4 s
63 Hz	63 Hz	0,28 s a 11,4 s
	80 Hz	0,28 s a 11,4 s
	100 Hz	0,14 s a 11,4 s
125 Hz	125 Hz	0,14 s a 11,4 s
	160 Hz	0,14 s a 11,4 s
	200 Hz	0,07 s a 11,4 s
250 Hz	250 Hz	0,07 s a 11,4 s
	315 Hz	0,07 s a 11,4 s
	400 Hz	0,07 s a 11,4 s
500 Hz	500 Hz	0,07 s a 11,4 s

	630 Hz	0,07 s a 11,4 s
	800 Hz	0,07 s a 11,4 s
1 kHz	1 kHz	0,07 s a 11,4 s
	1,25 kHz	0,07 s a 11,4 s
	1,.6 kHz	0,07 s a 11,4 s
2 kHz	2 kHz	0,07 s a 11,4 s
	2,5 kHz	0,07 s a 11,4 s
	3,15 kHz	0,07 s a 11,4 s
4 kHz	4 kHz	0,07 s a 11,4 s
	5 kHz	0,07 s a 11,4 s

Estimation of the slope of the decay curve

The estimation of the slope of the decay curve is automatically achieved from the lineal regression by least square approximation of itself.

Standards of measurement and calculation

You can make measurements and calculations according the next standards:

Standards of measurement and calculation
ISO 3382:1997 Measurement of the reverberation time of rooms
ISO 354:1985 Measurement of sound absorption in a reverberation room
ISO 140:1998 Measurement of sound insulation in buildings and of building elements

Function summary table

Reverberation time mode functions

Function	Freq. Weigh	63	125	250	500	1 k	2 k	4 k
Reverberation TimeT_{30}	-	X	X	X	X	X	X	X
Reverberation Time T_{20}	-	X	X	X	X	X	X	X
Sound pressure level of the background noise	-	X	X	X	X	X	X	X
Initial maximum sound pressure level	-	X	X	X	X	X	X	X
Time history of the decay curve	-	X	X	X	X	X	X	X

X: available - : without freq. weighing

All the functions are measured simultaneously

Function	Freq. Wei.	63	80	100	125	160	200	250	315	400	500	630	800
Reverberation TimeT_{30}	-	X	X	X	X	X	X	X	X	X	X	X	X
Reverberation Time T_{20}	-	X	X	X	X	X	X	X	X	X	X	X	X
Sound pressure level of the background noise	-	X	X	X	X	X	X	X	X	X	X	X	X
Initial maximum sound pressure level	-	X	X	X	X	X	X	X	X	X	X	X	X
Time history of the decay curve	-	X	X	X	X	X	X	X	X	X	X	X	X

Function	Freq. Wei.	1k	1k25	1k6	2k	2k5	3k15	4k	5k
Reverberation TimeT_{30}	-	X	X	X	X	X	X	X	X
Reverberation Time T_{20}	-	X	X	X	X	X	X	X	X
Sound pressure level of the background noise	-	X	X	X	X	X	X	X	X
Initial maximum sound pressure level	-	X	X	X	X	X	X	X	X
Time history of the decay curve	-	X	X	X	X	X	X	X	X

X: available - : without freq. weighing

All the functions are measured simultaneously

Definition of functions

Decay curve

Decay Curve Decay of the sound pressure level according to time inside the room after the source is stopped. This decay can be measured after a real cut of the continuous emission of a sound source at the room that is being studied.

Reverberation Time

T_{30} Is the time in seconds that is required for the sound pressure level to decreases 60 dB, calculated on a line from a lineal regression by least squares approximation of a decay curve measured from a 5 dB level below the initial level, until a level 35 dB lower than the initial one.

T_{20} Is the time in seconds that is required for the sound pressure level to decreases 60 dB, calculated on a line from a lineal regression by least squares approximation of a decay curve measured from a 5 dB level below the initial level, until a level 25 dB lower than the initial one.

The reverberation time of a room is one of the most important parameters to evaluate its acoustics properties. Its measurement has important applications on the field of noise control in rooms, Concert halls and Lecture rooms. The reverberation time measurement is essential for calculation of the acoustic insulation in buildings and of building elements, and for the measurement of absorption in reverberant room.

APPENDIX C: Extended frequency range module for 1/3 octave band analysis

The Extended Frequency Module for 1/3 octave band analysis of the MODEL 33 sound level meter includes 2 new measurement modes: spectrum analyser in 1/3 octave band in the low part of the spectrum (6.3 Hz to 2.5 kHz) < 1/3 and spectrum analyser in 1/3 octave band in the high part of the spectrum (800 Hz to 20 kHz) > 1/3, it is made a real time analysis for each of this modes and in all the measurement dynamic range (no range change) measuring the equivalent continuous sound pressure level with a programmable integrating time from 1 second to 99 hours. Simultaneously, the MODEL 33 measures, in real time, "short" levels (125 ms integration time) for the corresponding bands.

The major applications of this mode include: the frecuencial analysis of noise produced by machinery especially at low frequency, the evaluation of tonal components, the detection and identification of noise sources, etc.

The Extended Frequency Module for 1/3 octave band analysis of the MODEL 33 it is not included with the MODEL 33. Is an optional module and it can be acquired when buying the MODEL 33 or later. To incorporate it, you just have to contact your official distributor and supply him the serial number of your sound level meter and manage the transaction. In a few days you will receive a CD with the activation program.

Activation of the Extended frequency analysis module

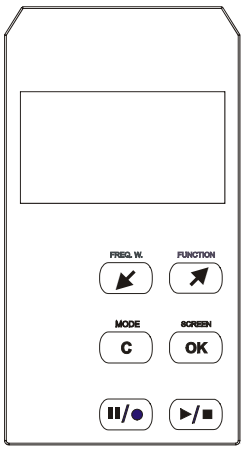
To activate the Extended frequency analysis module (EF):

- Insert in the CD-ROM drive the CD that you have received. The activation program 'MODEL 33 EF module Activator' will be automatically executed. If not, you should execute the SETUP.EXE program in the CD-ROM drive.
- Follow the steps.

To verify that your SLM already has the EF module.

Verify that the sound level meter it is turn on and stopped (■), press the key MODE C sequentially until the new modes appears. They can be identified by the name that appears in the screen when changing the mode "SPECTRUM ANALYSER 1/3 6.3 Hz - 2.5 kHz" or "SPECTRUM ANALYSER 1/3 800 Hz – 20 kHz" or by the indicator shown in the upper right part of the screen < 1/3 or > 1/3.

Using the keyboard



MODEL 33 KEYS 1/3 EXTENDED SPECTRUM ANALYSER MODE	
▶/■	Key to begin or terminate a measurement
II/●	a) Key to temporarily interrupt a measurement (PAUSE) (while the MODEL 33 is in ▶) b) To start recording data into memory (when MODEL 33 is stopped i.e. ■)
FREQ. W.	Key to return to the previous third octave band
FUNCTION	Key to go on to the next third octave band
SCREEN OK	Key to select the desired 1/3 extended spectrum analyser screen: numerical spectrum analysis or graphic spectrum analysis
MODE C	Key to change mode, when MODEL 33 is in ■

Using the MODEL 33

Starting the MODEL 33

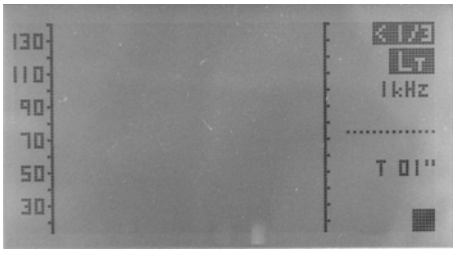
To start the MODEL 33, press the ⏻ key:

The logo, together with the **MODEL 33** sound level meter model will appear on the screen, a few seconds later, the initial screen predetermined in the menu configuration option will appear.

If the MODEL 33 does not switch on, check that a fully charged battery is fitted or that it is connected to a suitable power supply.

Access to the Lower extended Spectrum Analyser1/3 mode <

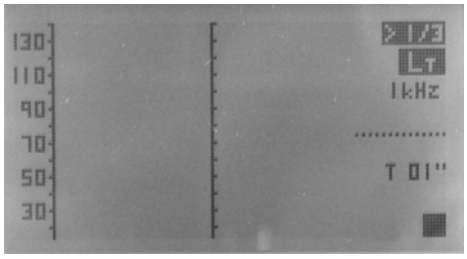
Switch on the MODEL 33 and check there is no measurement in progress (■), sequentially press the MODE C key until appears “SPECTRUM ANALYSER 1/3 6.3 Hz - 2.5 kHz”. Next the Lower extended Spectrum Analyser 1/3 screen will appear. This mode can be identified by the < 1/3 indication that will appear in the upper right corner of the screen.



Access to the Higher extended Spectrum Analyser1/3 mode >

Switch on the MODEL 33 and check there is no measurement in progress (■),sequencially press the MODE C key until appears “SPECTRUM ANALYSER 1/3 800 Hz – 20 kHz”. ”. Next will

appear in the screen the Higher extended Spectrum Analyser 1/3. This mode will be distinguished because the > 1/3 indication that will appear on the upper right part from the screen.



End the MODEL 33

To switch off the MODEL 33, check there is no measurement in progress (■) and press: ⏻

MODEL 33 menu

While there is no measurement in progress (■) it can be accede to the MODEL 33 menu by pressing: ☰

All the menu options are available.

To turn back to the measurement mode press: C

Measuring in Lower extended Spectrum Analyser 1/3 mode <

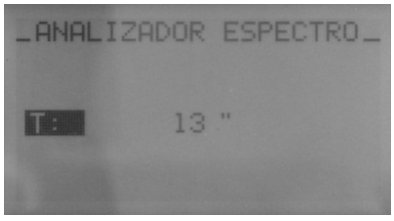
In this mode, the MODEL 33 makes a frequency analysis in real time in the one-third octave band from 6.3 Hz a 2.5 kHz. Measuring the continuous equivalent sound-pressure level with a programmable integrating time for all the bands.

Prior adjustments: Integration time

Before beginning measurement in spectrum analyser mode, the following parameters should be set:

- Integration time (T) used in the evaluation of spectral and global levels. This integration is carried out in consecutive intervals of T time.

To set this parameter, select the SETTINGS ➔ SPECTRUM ANALYSER option from the MODEL 33 menu.



- Press the key OK to begin setting the T parameter and then follow the procedure below:

- Select your numerical value using ↙ and ↗ and confirm by pressing OK. Integration time T may be set from:
    - o 1 to 59 seconds (1'' – 59 '')
    - o 1 to 59 minutes (1' – 59')
    - o 1 to 99 hours (1H – 99 H)

- Finally, select the time units: seconds (''), minutes (') or hours (H) with the help of ↙ and ↗ and press OK to confirm. Use C to cancel or return to the menu.
- If you choose "t" as your numerical integration time value (it lies between values 1 and 99) the integration time will coincide with measuring time. This option is useful when it comes to evaluating ideal integration time. To apply the option, make a measurement with integration time "t" and calculate the time needed for the bands in which you are interested to stabilise.

Beginning measurement

First of all, ensure that the sound level meter has no measuring operation in progress (■). If it has (▶ or ❚❚) press ▶/■ to stop it.

Next, set the MODEL 33 in Lower extended spectrum analyser 1/3 mode < and choose the screen you want to display (numerical or graphic) with the following keys:

SCREEN OK MODE C

Once you have selected your screen, press ▶/■ to set the measurement process in motion.

Functions display

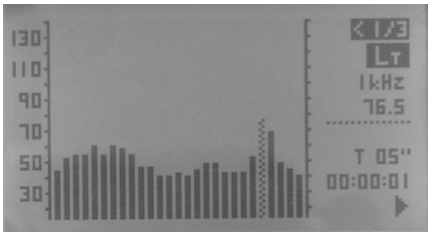
The **MODEL 33** measures all functions simultaneously.

The value of the measured functions is actualised each time that the consecutive integration time, each T. Less in case that it is chosen the "t" integration time, then it will be actualised each second.

Described below are the different ways of displaying the acoustic functions while measurement is in progress. If you decide to change the kind of display (screen) or one-third octave band, this will not halt the measurement process. While measurement is being carried out, however, you cannot switch from one measurement mode to another.

Graphic lower extended spectrum analyser 1/3 screen <

This screen displays the following information in real time:



- Graph of the continuous equivalent sound-pressure levels with integration time T (bars ▇) in real time for one-third octave bands centred on the frequencies 6.3, 8, 10, 12.5, 16, 20, 25, 31,5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000 and 2500 Hz (without frequency weighting).
- Numerical value of the continuous equivalent sound-pressure level with integration time T for the chosen one-third octave band (bar ▒) (without frequency weighting).
- Central frequency of the chosen one-third octave band (bar ▒).

To change the chosen one-third octave band (bar ▒) press ↙ (left) and ↗ (right).

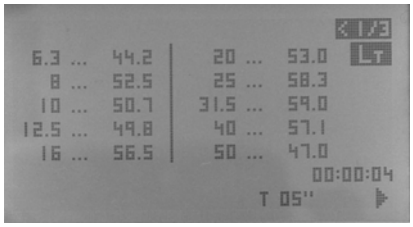
By pressing SCREEN OK you access the numerical lower extended spectrum analyser 1/3 screen.

The SC130 measures "short" (125 ms) functions, although these are not displayed on-screen. They may be viewed only through the software, through real-time connection with the sound level meter or by making a recording and subsequently downloading it by means of the software into a PC. These functions are:

- Continuous equivalent sound-pressure level with 125 ms consecutive integration time (short Leq) in real time for one-third octave bands centred on frequencies 6.3, 8, 10, 12.5, 16, 20, 25, 31,5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000 and 2500 Hz (without frequency weighting).

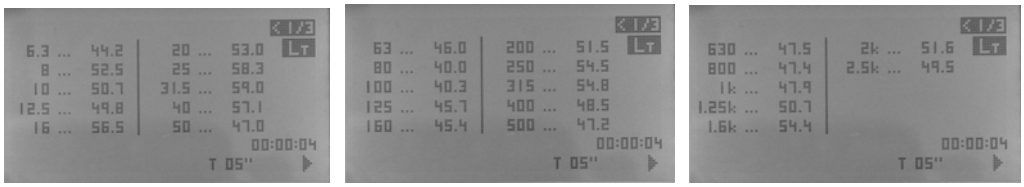
Numerical lower extended spectrum analyser 1/3 screen <

This screen displays the following information in real time:



- Continuous equivalent sound-pressure level with integration time T for the one-third octave bands centred on frequencies 6.3, 8, 10, 12.5, 16, 20, 25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000 and 2500 Hz (without frequency weighting).

This screen displays the 27 measured one-third octave bands. To view them, press ↙ and ↗.



SCREEN
OK

By pressing you access the graphic lower extended spectrum analyser 1/3 screen.

Interrupting measurement

By pressing II/● you temporarily interrupt measurement. The state of measurement indicator will change from ▶ to ▮▮. While the MODEL 33 is in pause mode (▮▮) you may continue to consult the measured functions prior to the temporary interruption of measurement. To resume measurement, press ▶/■ .

By pressing ▶/■ you stop measurement. The state of measurement indicator will change from ▶ to ■.

Consulting measured data

While the MODEL 33 is not measuring, (■) you may consult all the measured functions.

To consult them, apply the same procedure as described in the section 0 on viewing data while measurement is in progress.

Overload indicator

The MODEL 33 is equipped with an overload indicator for each function. If overloading occurs during measurement, the ^ sign will appear before the function affected by overloading. When a function registers overload, its corresponding measurement will be incorrect.

When overloading occurs, the ^ indication will appear in the bottom right-hand corner of the screen.

Measuring in Higher extended Spectrum Analyser 1/3 mode >

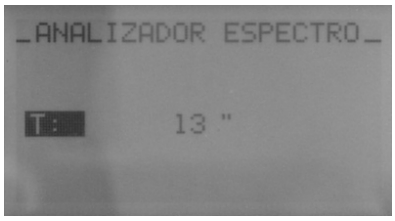
In this mode, the MODEL 33 makes a frequency analysis in real time in the one-third octave band from 800 Hz to 20 kHz. Measuring the continuous equivalent sound-pressure level with a programmable integrating time for all the bands.

Prior adjustments: Integration time

Before beginning measurement in spectrum analyser mode, the following parameters should be set:

- Integration time (T) used in the evaluation of spectral and global levels. This integration is carried out in consecutive intervals of T time.

To set this parameter, select the SETTINGS ➔ SPECTRUM ANALYSER option from the MODEL 33 menu.



Press the key OK to begin setting the T parameter and then follow the procedure below:

- Select your numerical value using ↙ and ↗ and confirm by pressing OK. Integration time T may be set from:
    - o 1 to 59 seconds (1'' – 59 '')
    - o 1 to 59 minutes (1' – 59')
    - o 1 to 99 hours (1H – 99 H)
- Finally, select the time units: seconds (''), minutes (') or hours (H) with the help of ↙ and ↗ and press OK to confirm. Use C to cancel or return to the menu.
- If you choose "t" as your numerical integration time value (it lies between values 1 and 99) the integration time will coincide with measuring time. This option is useful when it comes to evaluating ideal integration time. To apply the option, make a measurement with integration time "t" and calculate the time needed for the bands in which you are interested to stabilise.

Beginning measurement

First of all, ensure that the sound level meter has no measuring operation in progress (■). If it has (▶ or ❚❚) press ▶/■ to stop it.

Next, set the MODEL 33 in Higher extended spectrum analyser 1/3 mode < and choose the screen you want to display (numerical or graphic) with the following keys:

SCREEN OK MODE C

After select the desired screen, press ▶/■ to start the measurement process.

Functions display

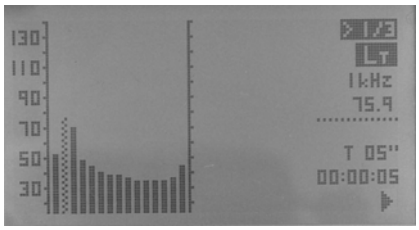
The **MODEL 33** measures all functions simultaneously.

The value of the measured functions is actualised each time that the consecutive integration time, each T. Less in case that it is chosen the "t" integration time, then it will be actualised each second.

Described below are the different ways of displaying the acoustic functions while measurement is in progress. If you decide to change the kind of display (screen) or one-third octave band, this will not halt the measurement process. While measurement is being carried out, however, you cannot switch from one measurement mode to another.

Graphic higher extended spectrum analyser 1/3 screen >

This screen displays the following information in real time:



- Graph of the continuous equivalent sound-pressure levels with integration time T (bars ▮) in real time for one-third octave bands centred on the frequencies 800, 1000, 1250, 1600, 2000, 2500, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 16000 and 20000 Hz (without frequency weighting).
- Numerical value of the continuous equivalent sound-pressure level with integration time T for the chosen one-third octave band (bar ▩) (without frequency weighting).
- Central frequency of the chosen one-third octave band (bar ▩).

To change the chosen one-third octave band (bar ▩) press ↙ (left) and ↗ (right).

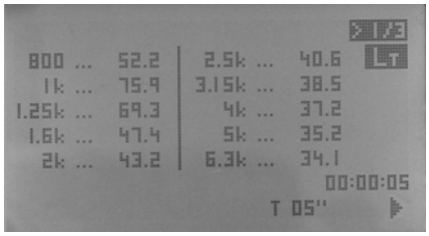
By pressing SCREEN OK you access the numerical higher extended spectrum analyser 1/3 screen.

The SC130 measures "short" (125 ms) functions, although these are not displayed on-screen. They may be viewed only through the software, through real-time connection with the sound level meter or by making a recording and subsequently downloading it by means of the software into a PC. These functions are:

- Continuous equivalent sound-pressure level with 125 ms consecutive integration time (short Leq) in real time for one-third octave bands centred on frequencies 800, 1000, 1250, 1600, 2000, 2500, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 16000 and 20000 Hz (without frequency weighting).

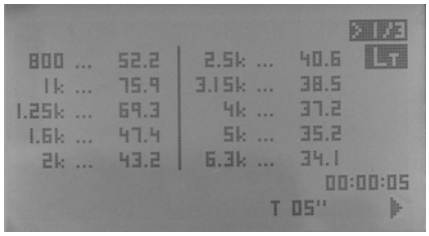
Numerical higher extended spectrum analyser 1/3 screen >

This screen displays the following information in real time:



- Continuous equivalent sound-pressure level with integration time T for the one-third octave bands centred on frequencies 800, 1000, 1250, 1600, 2000, 2500, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 16000 and 20000 Hz (without frequency weighting).

This screen displays the 15 measured one-third octave bands. To view them, press ↙ and ↗.



By pressing SCREEN OK you access the graphic higher extended spectrum analyser 1/3 screen.

Interrupting measurement

By pressing ❚❚/● you temporarily interrupt measurement. The state of measurement indicator will change from ▶ to ❚❚. While the MODEL 33 is in pause mode (❚❚) you may continue to consult the measured functions prior to the temporary interruption of measurement. To resume measurement, press ▶/■.

By pressing ▶/■ you stop measurement. The state of measurement indicator will change from ▶ to ■.

Consulting measured data

While the MODEL 33 is not measuring, (■) you may consult all the measured functions.

To consult them, apply the same procedure as described in the section 0 on viewing data while measurement is in progress.

Overload indicator

The MODEL 33 is equipped with an overload indicator for each function. If overloading occurs during measurement, the ^ sign will appear before the function affected by overloading. When a function registers overload, its corresponding measurement will be incorrect.

When overloading occurs, the ^ indication will appear in the bottom right-hand corner of the screen.

Data registering

The MODEL 33 built-in memory registers the values of the measured functions. When you switch off the unit the saved data is not lost and may be retrieved and displayed directly on the MODEL 33 or downloaded into a PC. The memory may also be erased directly from the MODEL 33.

Two kinds of registers may be saved in the memory:

- The final results of a measurement.
- Continuous recordings of functions with programmable recording time.

Saving results

Once you have completed a measurement (■), the results may be stored in the memory by selecting the SAVE RESULTS option from the main menu. The MODEL 33 will indicate the register number in which to record the data.

The **MODEL 33** stores the following information:

- Lower extended spectrum analyser 1/3 mode <:
    - Continuous equivalent sound-pressure level with consecutive programmable integration time T and without frequency weighting for each of the one-third octave bands centred on frequencies 6.3, 8, 10, 12.5, 16, 20, 25, 31,5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000 and 2500 Hz.
    - Integration time T.
    - Date and time of the beginning of measurement.
- Higher extended spectrum analyser 1/3 mode >:
    - Continuous equivalent sound-pressure level with consecutive programmable integration time T and without frequency weighting for each of the one-third octave bands centred on frequencies 800, 1000, 1250, 1600, 2000, 2500, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 16000 and 20000 Hz.
    - Integration time T.
    - Date and time of the beginning of measurement.

The MODEL 33 may store a total of 1000 final results.

Carrying *out* a recording

A recording consists of conducting a measurement and storing a series of functions with a certain periodicity in the memory. These functions and periodicity are specified, for each mode, in the recording setting. The main difference between the different kinds of recording lies in the 'number of functions / storing time' compromise. See section 0.

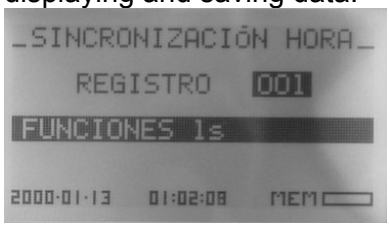
Before beginning a recording, make sure there are no measurements in progress (■).

To begin a recording, press  . The screen will display the kind of recording together with the register number. Next the functions selected for the type of recording will be saved periodically in the memory until you stop the recording by pressing  . During the recording process, the measurement in progress icon (▶) will flicker.

Time synchronisation

The MODEL 33 allows you to begin recording on the hour (hh:00:00). To access this option, select SETTING ➔ RECORDING ➔ TIME SYNCHRONISATION from the MODEL 33 menu. Once the setting has been made, all recordings will begin on the hour. In other words, once recording has been set in motion, the MODEL 33 screen will display the message TIME

SYNCHRONISATION and will wait until the built-in clock reaches the set time to begin displaying and saving data.



Kinds of recording

Recording in lower extended spectrum analyser 1/3 mode <

Through the SETTING➔ RECORDING ➔ SPECTRUM ANALYSER RECORDING option on the MODEL 33 menu you may select the way to store the measured data in the memory:

- **T functions**: once each integration period T has come to an end, the following values are stored in the memory:
    - o L_T for each of the one-third octave bands centred on frequencies 6.3, 8, 10, 12.5, 16, 20, 25, 31,5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000 and 2500 Hz

This type of recording is conceived for long-duration measurements, such as studies of environmental noise and traffic noise, which require detailed spectral information of the measured noise.

- **125 ms functions**: save every 125 ms the following 'short' functions:
    - o L_T with 125 ms consecutive integration time for each of the one-third octave bands centred on frequencies 6.3, 8, 10, 12.5, 16, 20, 25, 31,5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000 and 2500 Hz
- **T + 125ms functions**: save every 125 ms the '125 ms functions' and every T the 'T functions'.

These 2 types of recording are specially designed to obtain highly detailed temporal and spectral information, and are ideal for the detection of tonal components.

- **L_T each T**: once each integration period T has come to an end, the following values are stored in the memory:
    - o L_T for each of the one-third octave bands centred on frequencies 6.3, 8, 10, 12.5, 16, 20, 25, 31,5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000 and 2500 Hz

This kind of recording coincides with T functions.

The following table shows the storage capacity of the different types of lower extended spectrum analyser 1/3 mode recordings:

Type of recording	Storage capacity
T functions and L_T each T	T= 1 s ➔ 14 days 15 hours T= 1 min ➔ 2 years 4 month

125 ms functions	1 day 19 hours
T functions + 125ms	T= 1 s ➔ 20 hours 15 min T= 1 min ➔ 1 day 18 hours T= 1 hour ➔ 1 day 19 hours

The storage times for each type of recording correspond to one single recording, until the memory is completely full.

The MODEL 33 has sufficient capacity for up to 1000 registers (final results or recordings) of whatever type.

When the built-in memory is full, no more recordings may be made and no more final results saved. If you attempt to do this, the 'MEMORY FULL' message will appear on screen. If the memory reaches its maximum capacity before a recording has finished and the CIRCULAR MEMORY option is inactive (see 0) data recording will stop, although measurement will continue. When the measurement is complete, the final result will be stored in the memory.

Recording in higher extended spectrum analyser 1/3 mode <

Through the SETTING➔ RECORDING ➔ SPECTRUM ANALYSER RECORDING option on the MODEL 33 menu you may select the way to store the measured data in the memory:

- **T functions**: once each integration period T has come to an end, the following values are stored in the memory:
    - L_T for each of the one-third octave bands centred on frequencies 800, 1000, 1250, 1600, 2000, 2500, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 16000 and 20000 Hz

This type of recording is conceived for long-duration measurements, such as studies of environmental noise and traffic noise, which require detailed spectral information of the measured noise.

- **125 ms functions**: save every 125 ms the following 'short' functions:
    - L_T with 125 ms consecutive integration time for each of the one-third octave bands centred on frequencies 800, 1000, 1250, 1600, 2000, 2500, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 16000 and 20000 Hz

- **T + 125ms functions**: save every 125 ms the '125 ms functions' and every T the 'T functions'.

These 2 types of recording are specially designed to obtain highly detailed temporal and spectral information, and are ideal for the detection of tonal components.

- **L_T each T**: once each integration period T has come to an end, the following values are stored in the memory:
    - L_T for each of the one-third octave bands centred on frequencies 800, 1000, 1250, 1600, 2000, 2500, 2500, 3150, 4000, 5000, 6300, 8000, 10000, 12500, 16000 and 20000 Hz

This kind of recording coincides with T functions.

The following table shows the storage capacity of the different types of higher extended spectrum analyser 1/3 mode recordings:

Type of recording	Storage capacity
T functions and L_T each T	T= 1 s ➔ 25 days 1 hours T= 1 min ➔ 4 years 2 month
125 ms functions	3 days 5 hours
T functions + 125ms	T= 1 s ➔ 36 hours 24 min T= 1 min ➔ 3 days 3 hours T= 1 hora ➔ 3 days 5 hours

The storage times for each type of recording correspond to one single recording, until the memory is completely full.

The MODEL 33 has sufficient capacity for up to 1000 registers (final results or recordings) of whatever type.

When the built-in memory is full, no more recordings may be made and no more final results saved. If you attempt to do this, the 'MEMORY FULL' message will appear on screen. If the memory reaches its maximum capacity before a recording has finished and the CIRCULAR MEMORY option is inactive (see 0) data recording will stop, although measurement will continue. When the measurement is complete, the final result will be stored in the memory.

Circular memory

The MODEL 33 allows you to configure the empty memory space as a circular data-storage buffer. That is, when you select the SETTINGS ➔ RECORDING \CIRCULAR MEMORY option from the menu the empty memory space will be configured as a circular buffer, while the already occupied memory space remains unaffected. This means that as from this moment onwards, when you begin a recording, the MODEL 33 will save data until its memory is full. When this moment comes, it will continue to save data, though deleting the oldest data stored in the memory space prior to beginning the recording. This space will always contain the latest data measured.

This feature, together with the opportunity to download data while recording or measurement are in progress, allows you to have a limitless memory at your disposal, provided you periodically download stored data.

Viewing the register

This option allows you to display on screen the final result of the registers stored in the MODEL 33 memory. Access the option by selecting MEMORY ➔ VIEW REGISTER from the MODEL 33 menu.

By pressing ↙ , ↗ and OK , the MODEL 33 allows you to select the register you want to view. The screen will display an index of all the registers stored in the memory (register number + date and time when the measurement process began).

To view the different functions, follow the procedure described in sections 0 and 0.

Technical specifications

Third octave band filters

Type 1 filters in compliance with IEC 61260:1995/A1:2001.

Frequency evaluation system	Base 10
Reference attenuation	0 dB
Operative linearity range	same as the measurement range

Third octave band nominal central frequencies			
Nominal central frequency	**Exact base 10 frequency**	**Nominal central frequency**	**Exact base 10 frequency**
6,3 Hz	**6,31 Hz**	400 Hz	398,11 Hz
8 Hz	7,94 Hz	500 Hz	**501,19 Hz**
10 Hz	10,00 Hz	630 Hz	630,96 Hz
12,5 Hz	12,59 Hz	800 Hz	794,33 Hz
16 Hz	**15,85 Hz**	1000 Hz	1000,00 Hz
20 Hz	**19,95 Hz**	1250 Hz	1258,93 Hz
25 Hz	25,12 Hz	1600 Hz	1584,89 Hz
31,5 Hz	31,62 Hz	2000 Hz	1995,26 Hz
40 Hz	39,81 Hz	2500 Hz	2511,89 Hz
50 Hz	50,12 Hz	3150 Hz	3162,28 Hz
63 Hz	63,10 Hz	4000 Hz	3981,07 Hz
80 Hz	79,43 Hz	5000 Hz	5011,87 Hz
100 Hz	100,00 Hz	6300 Hz	6309,57 Hz
125 Hz	125,89 Hz	8000 Hz	7943,28 Hz
160 Hz	158,49 Hz	10000 Hz	**10000,00Hz**
200 Hz	199,53 Hz	12500 Hz	**12589,25Hz**
250 Hz	251,19 Hz	16000 Hz	15848,93 Hz
315 Hz	316,23 Hz	20000 Hz	19952,62 Hz

Measurement range (one third octave spectrum analyser)

L_T Function	
for MK:224 + PA-14:	
Measurement range (with linearity error lower than 0.4 dB):	
One third octave bands with nominal central frequency	
From 6,3 Hz to 16 Hz: Upper limit:	137 dB
Lower limit:	39 dB
From 20 Hz to 31,5 Hz: Upper limit:	137 dB
Lower limit:	28 dB
From 40 Hz to 5 kHz: Upper limit:	137 dB
Lower limit:	20 dB
Higher than 5 kHz: Upper limit:	137 dB
Lower limit:	24 dB
The noise (electrical + thermic of the microphone) is, as a minimum, 10 dB lower than the lower limit of the measurement range.	

Standards

Standards
UNE-EN 60260:95 (A1:01) type 1
EN 61260:95 (A1:01) type 1
IEC 61260:95 (A1:01) type 1
ANSI S1.11:86

Function summary table

1/3 Lower Extended Spectrum analyser mode functions <

Function	Freq. Wei..	Name	TOTAL	6,3	8	10	12,5	16	20	25	31,5	40	50
Equivalent continuous sound pressure level with integration time T	-	L_T	-	X	X	X	X	X	X	X	X	X	X

Function	63	80	100	125	160	200	250	315	400	500	630	800

Equivalent continuous sound pressure level with integration time T	X	X	X	X	X	X	X	X	X	X	X	X

Function	1000	1250	1600	2000	2500
Equivalent continuous sound pressure level with integration time T	X	X	X	X	X

X: available - :unavailable

All functions are measured simultaneously in all modes.

1/3 Higher Extended Spectrum analyser mode functions <

Function	Pond	Nom	TOTAL	800	1000	1250	1600	2000	2500	3150	4000
Equivalent continuous sound pressure level with integration time T	-	L_T	-	X	X	X	X	X	X	X	X

Function	5000	6300	8000	10000	12500	16000	20000
Equivalent continuous sound pressure level with integration time T	X	X	X	X	X	X	X

X: available - :unavailable

All functions are measured simultaneously in all modes.

Pulsar Instruments Offices

The addresses given below are the Pulsar Instruments Plc offices. Pulsar Instruments Plc also have approved distributors and agents is many countries worldwide. For details of your local representative, please contact Pulsar Instruments Plc at the address below.

Contact details for Pulsar Instruments Plc authorised distributors and agents are also available from the Internet Web site at the address shown below.

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