User Manual for the Pulsar Model 80 Assessor Sound Level Meters

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Preface

Thank you for purchasing the Model 80 Series "Assessor" Sound Level Meter. These instruments have been designed to be simple to use, and to provide the functions and features needed from a modern Sound Level Meter.

This manual describes the procedure that should be followed to set up and operate the Model 80 Sound Level Meters, as well as comprehensive technical information, using optional accessories as well as troubleshooting.

If you are a new user of Sound Level Meters or new to the Model 80 Series Sound Level Meters, first read Section 1 Introduction to familiarise yourself with the features, components and accessories supplied. Then read the following sections for step-by-step instructions on how to use the instrument.

The different versions of the Model 80 Series are:

Model 81A Type 1 with Lex,8h Calculator
Model 82A Type 2 with Lex,8h Calculator

Model 81A Type 1 with dB(C)-dB(A) Measurement
Model 82A Type 2 with dB(C)-dB(A) Measurement

Model 83A Type 1 with 1:1 Octave Band Filters
Model 84A Type 2 with 1:1 Octave Band Filters

The Model 80 Series Sound Level Meters meet the requirements for Type 1 and Type 2 Sound Level Meters according to IEC 60651 and 60804 depending upon the version of the instrument.

They also meet the new IEC 61672-1:2003 standard for Class 1 Group X or Class 2 Group X Sound Level Meters as appropriate. Please refer to Appendix 2 for full technical details of the Model 80 Series Sound Level Meters.

Manual Contents

This manual is composed of 6 Sections, a Glossary and 4 Appendices.

Section 1, Introduction, is an overview of the Model 80 Series Sound Level Meter's features, capabilities and options.

Section 2, Getting Started, provides a quick overview of how to begin using the instrument and how to carry out the basic measurements.

Section 3, Using the Model 80 Series, describes the operation of the instrument, the options and the configurations available.

Section 4, Maintenance & Care, describes the procedure that should be followed to ensure the instrument operates as efficiently as possible, including changing batteries.

Section 5, Troubleshooting, provides helpful information on how to perform some simple checks and suggests courses of action if the Model 80 Series Sound Level Meter does not seem to be working properly.

The Glossary defines general Acoustic terminology and includes a list of acronyms and abbreviations used in this manual. The appendices contain technical information and specifications for the Model 80 Series Sound Level Meters.

In this manual, the Model 80 refers to all versions of the instrument and is used as a generic term rather than as a reference to an instrument.

Messages and Symbols

Messages are used in this manual to bring important information to your attention. The different message types are indicated as shown below.

Pay attention! A caution informs you that improper use of the equipment or failure to follow instructions may cause data loss or may damage the equipment.

Please read. A note is a hint or advice that helps you make best use of the equipment and accessories.

Section 1 Introduction

Measurement Functions

All versions of the Model 80 provide the same measurement functions. These are:

Function	Weightings
Measurement Time	
Leq	dB(A)
Peak	dB(C)

The Model 81CA and 82CA add the measurement of a dB(C)-dB(A) value and the Model 83A and Model 84A have 1:1 Octave Band Filters.

Calculation of LEX,8h in the Sound Level Meters

The Model 80 Sound Level Meters have a unique feature, that being the display of LEX,8h levels at the end of the measurement period. At the end of the measurement, the instrument takes the measured Leq value and calculates the effective noise exposure for different exposure durations.

This is covered in more detail in Section 4.

Options & Accessories

The Model 80 Series are also available with a range of options and accessories that can enhance the performance and applications of the instrument. For full details, please contact Pulsar Instruments Plc or your local representative. The most commonly used accessories are listed below.

Model 100B	Acoustic Calibrator
WS90	Windshield
C1	Carrying Case
TR1	Tripod

"Assessor Extra" Data Logging Upgrade

The Model 80 Sound Level Meters can be upgraded to add Data Logging. If this option is ordered for the instrument, the unit will store up to 100 measurements which can be downloaded to a PC using the Pulsar Analyser software program.

Please note that the operation of the instrument is the same for instruments with and without the data logging upgrade.

Please contact Pulsar Instruments for more details of the "Assessor Extra" Data Logging Upgrade and the Pulsar Analyser Software program.

This symbol is used to indicate that the function/feature relates to the Assessor Extra Data Logging Upgrade. Where this symbol is shown the feature/function is available only if the "Assessor Extra" Data Logging upgrade has been fitted to the instrument. Please contact Pulsar Instruments Plc for more information.

Unpacking and checking the Sound Level Meter

Carefully remove the instrument from its shipping container and inspect it for possible damage or missing items. If the meter appears to be damaged or something is missing, contact Pulsar Instruments Plc or your local representative immediately.

The basic Model 80 Series instrument is supplied with the following standard accessories:

Model 80 Series User Manual
Batteries 2 x AA

In addition, the Type 1 instruments are supplied with an MV:200C Preamplifier and a microphone box. The microphone capsule will be fitted to the MV:200C Preamplifier before shipping.

If you have ordered the instrument as a complete measurement kit, you will have also received some further items such as an Acoustic Calibrator, Carrying Case and Windshield.

Please refer to the manual supplied with the Acoustic Calibrator (where supplied) for details of fitting the battery and operation of this unit.

Assembly

The Model 80 instruments are supplied fully assembled apart from the MV:200C Preamplifier for Type 1 instruments and the batteries.

Preamplifier

The Type 1 versions of the Model 80 (Model 81A, 81CA & 83A) are supplied with a removable preamplifier, the MV:200C. This preamplifier must be connected to the Sound Level Meter ***before*** the unit is switched on. This unit is connected to the top of the instrument using a locking ring. To connect the MV:200C Preamplifier, follow the diagram below:

1. Insert the preamplifier into the socket on the Sound Level Meter
2. Ensure the connector has located into the socket
3. Tighten the Locking Ring.

Do not cross thread the locking ring. Damage caused by misuse is not covered by the warranty for the instrument.

Removing the Preamplifier

Do not twist the preamplifier body. Unscrew the locking ring and pull the preamplifier from the Sound Level Meter.

Using Microphone Extension Cables

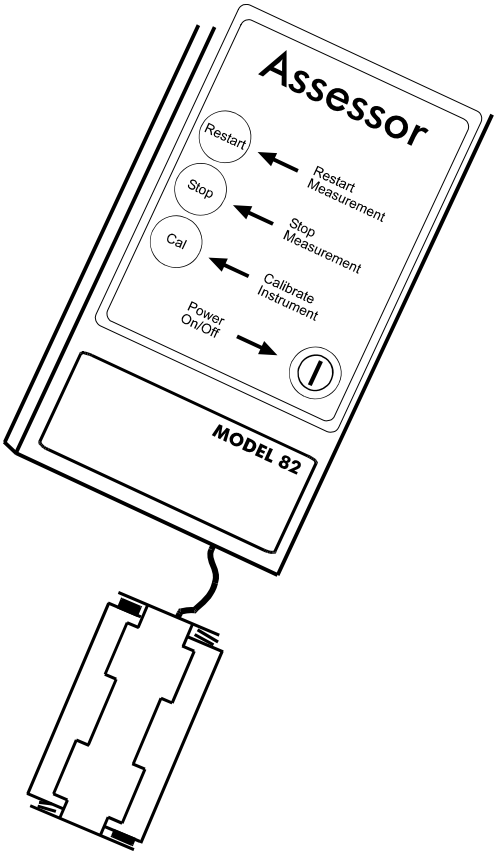
The Type 1 instruments can be used with a microphone extension cable if the instrument is fitted with the removable preamplifier. If a microphone extension cable is to be used during a measurement, the instrument must be calibrated with the cable attached.

Connect the microphone extension cable in the same manner as the MV:200C Preamplifier.

Batteries

The batteries of the Model 80 are located behind the cover on the bottom of the instrument. Slide the cover to the right hand side to remove and to access the battery holder.

Ensure the instrument is switched off. Remove the battery holder from the instrument and insert the batteries. The Model 80 instruments use two AA type batteries, also known as LR6.



Ensure that the batteries are inserted correctly. ***DO NOT*** reverse the polarity of the batteries as this may cause damage to the instrument.

Windshield

The Model 80 Series can be used with a WS90 Foam Windshield which will reduce the noise levels generated by air turbulence over the microphone capsule.

The windshield should also be used in order to protect the microphone capsule of the Sound Level Meter from dust and fluids which may affect the performance of the instrument.

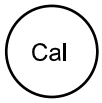
To use the WS90 Windshield, push the hole in the windshield over the microphone of the Sound Level Meter.

The WS90 Windshield must be removed before the Sound Level Meter can be calibrated.

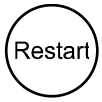
Keypad Functions

Model 81A & Model 82A

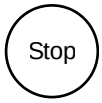
Power
Switch On & Off the Sound Level Meter



Cal
Calibrates the Sound Level Meter



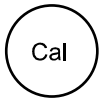
Restart
Starts a new measurements. Resets the current measurement if the instrument is running



Stop
Stops the current measurement

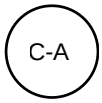
Model 81CA & Model 82CA

Power
Switch On & Off the Sound Level Meter

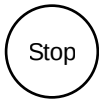


Cal
Calibrates the Sound Level Meter

Restart
Starts a new measurements. Resets the current measurement if the instrument is running



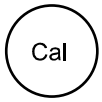
C-A
Starts a measurement of the dB(C)-dB(A) function



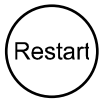
Stop
Stops the current measurement

Model 83A & Model 84A

Power
Switch On & Off the Sound Level Meter

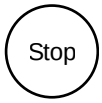


Cal
Calibrates the Sound Level Meter



Restart
Starts a new measurements. Resets the current measurement if the instrument is running

C-A
Starts a measurement of the Octave Band function



Stop
Stops the current measurement

Making a measurement with the Model 81A & 82A Instruments

Please read this section very carefully. It contains important information making and storing measurements with the Model 80 Sound Level Meters.

Switching On

Press the Power Button to switch on the Sound Level Meter.

Calibration

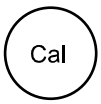
If a microphone extension cable is to be used during a measurement, the instrument must be calibrated with the cable attached.

Calibrating the Sound Level Meter

Select the calibration level on the Acoustic Calibrator. For most users, this will be 94dB when using a Model 100B Calibrator.

Gently push the calibrator onto the microphone capsule, slowly twisting clockwise.

Press the CAL button to start the calibration procedure



During the calibration, the instrument will display the calibration status.

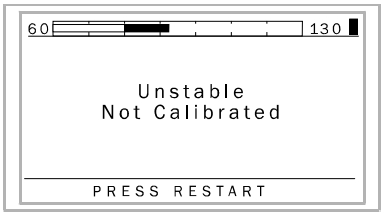
If the calibration is successful, the instrument will display the calibration level. Press the Start button to begin a new measurement or to return to the main screen.

If the calibration is not successful, the instrument will display an error message. These are shown below.

The calibration level is below the set level. Check that the Calibrator is switched on and that it is connected correctly to the Sound Level Meter.

The calibration level is above the set level. Check that the Calibrator is set to the correct level.

The calibration level is unstable. This maybe caused by high background noise levels. Move to a quieter location and retry the calibration.

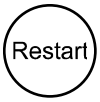


Please note that if the CAL button is pushed when the instrument is running and making a measurement, the current measurement will be stopped and the information discarded. The measurement information will not be stored in the instrument memory.

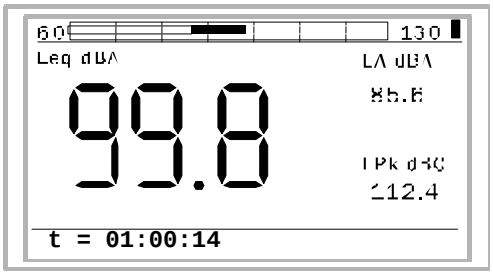
To Remove the calibrator, gently pull the calibrator whilst twisting the calibrator clockwise. This will help to ensure that the microphone capsule does not become unscrewed from the instrument.

Starting the measurement

Press the Restart button to begin the measurement.



The instrument will display the Leq in dB(A), the LCPeak and the Sound Level (LA) along with the measurement time.

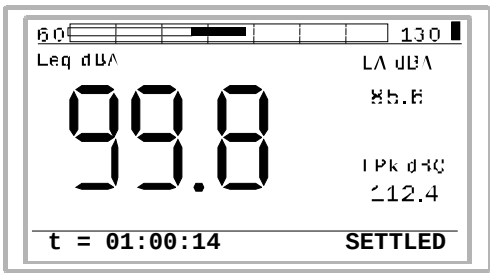


The instrument will continue to run until one of the following conditions occurs:

- The user presses the Stop button
- The user Resets the current measurement by pressing the Restart button.

Indication that the Leq value has settled

The Model 80 monitors the Leq level, and when it has settled, the display will show "SETTLED"as shown.

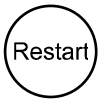


For this to occur, the Leq level must be stable to within ±0.3dB for 5 seconds. This is to be used as an indication that the measurement has settled. This should not be used as an indication that the measurement time is sufficient. Always refer to any Regulations, Standards or Guidelines that are in force for details of making a noise measurement.

Resetting the measurement

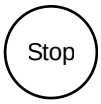
If any of the following keys are pressed during a measurement, the current measurement will be cancelled and the measurement restarted:

Restart
Resets the current measurement and starts a new measurement. The current measurement information will be discarded.

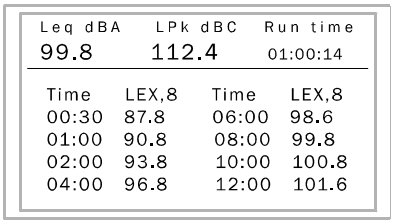


Stopping & reviewing the measurement

Press the Stop button to finish the measurement.



When the measurement is complete, the instrument will display the measurement data for the last measurement.



Leq dBA	LPk dBC	Run time
99.8	112.4	01:00:14

Time	LEX,8	Time	LEX,8
00:30	87.8	06:00	98.6
01:00	90.8	08:00	99.8
02:00	93.8	10:00	100.8
04:00	96.8	12:00	101.6

Please note that if a new measurement is started, the last measurement will be overwritten and the information lost.

Ensure that measurements have been recorded before making a new measurement.

Refer to section 4 for details of the calculation of LEX,8h and how this relates to the measured noise levels.

If the instrument is fitted with the "Assessor Extra" Data Logging upgrade, the measurement is automatically stored into the instrument memory when the Stop button is pressed or when the measurement ends.

Switching off the instrument

Press and hold the Power Button to switch off the Sound Level Meter.

Making a measurement with the Model 81CA & 82CA Instruments

Please read this section very carefully. It contains important information making and storing measurements with the Model 80 Sound Level Meters.

Switching On

Press the Power Button to switch on the Sound Level Meter.

Calibration

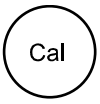
If a microphone extension cable is to be used during a measurement, the instrument must be calibrated with the cable attached.

Calibrating the Sound Level Meter

Select the calibration level on the Acoustic Calibrator. For most users, this will be 94dB when using a Model 100B Calibrator.

Gently push the calibrator onto the microphone capsule, slowly twisting clockwise.

Press the CAL button to start the calibration procedure



During the calibration, the instrument will display the calibration status.

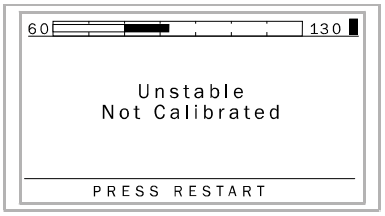
If the calibration is successful, the instrument will display the calibration level. Press the Start button to begin a new measurement or to return to the main screen.

If the calibration is not successful, the instrument will display an error message. These are shown below.

The calibration level is below the set level. Check that the Calibrator is switched on and that it is connected correctly to the Sound Level Meter.

The calibration level is above the set level. Check that the Calibrator is set to the correct level.

The calibration level is unstable. This maybe caused by high background noise levels. Move to a quieter location and retry the calibration.



Please note that if the CAL button is pushed when the instrument is running and making a measurement, the current measurement will be stopped and the information discarded. The measurement information will not be stored in the instrument memory.

To Remove the calibrator, gently pull the calibrator whilst twisting the calibrator clockwise. This will help to ensure that the microphone capsule does not become unscrewed from the instrument.

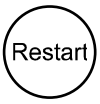
Making Measurements

The Model 81CA and Model 82CA instruments can measure noise using two different methods:

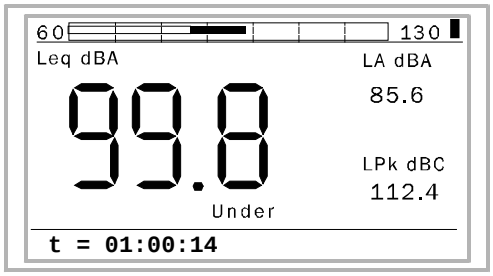
Measurement Type	Measurement Functions
Broadband	$L_{Aeq,t}$, L_{CPeak}, $L_{EX,8h}$
C-A	$L_{Ceq,t} - L_{Aeq,t}$

Starting a Broadband measurement

Press the Restart button to begin the measurement.



The instrument will display the Leq in dB(A), the LCPeak and the Sound Level (LA) along with the measurement time.



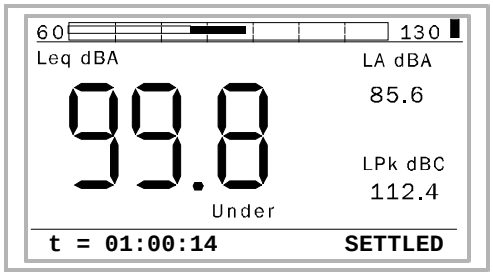
The instrument will continue to run until one of the following conditions occurs:

- The user presses the Stop button
- The user Resets the current measurement by pressing the Restart button.

Indication that the Leq value has settled

The Model 80 monitors the Leq level, and when it has settled, the display will show "SETTLED" as shown in the figure below.

The Model 80 monitors the Leq level, and when it has settled, the display will show "SETTLED"as shown.

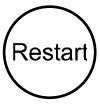


For this to occur, the Leq level must be stable to within ±0.3dB for 5 seconds. This is to be used as an indication that the measurement has settled. This should not be used as an indication that the measurement time is sufficient. Always refer to any Regulations, Standards or Guidelines that are in force for details of making a noise measurement.

Resetting the measurement

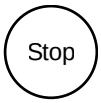
If any of the following keys are pressed during a measurement, the current measurement will be cancelled and the measurement restarted:

Restart
Resets the current measurement and starts a new measurement. The current measurement information will be discarded.

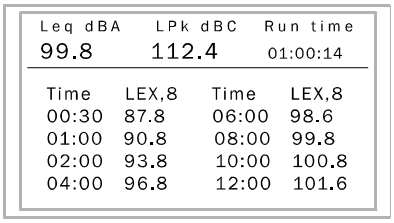


Stopping & reviewing the measurement

Press the Stop button to finish the measurement.



When the measurement is complete, the instrument will display the measurement data for the last measurement.



Please note that if a new measurement is started, the last measurement will be overwritten and the information lost.

Ensure that measurements have been recorded before making a new measurement. Refer to section 4 for details of the calculation of LEX,8h and how this relates to the measured noise levels.

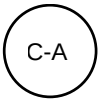
If the instrument is fitted with the "Assessor Extra" Data Logging upgrade, the measurement is automatically stored into the instrument memory when the Stop button is pressed or when the measurement ends.

Making a C-A Measurement

If the C-A buttons is pressed during a Broadband Measurement, the instrument will pause the Broadband Measurement and start the C-A Measurement. At the end of the C-A measurement the instrument will display the dB(C)-dB(A) data. Pressing the C-A button at this time will return to the Broadband measurement which will continue.

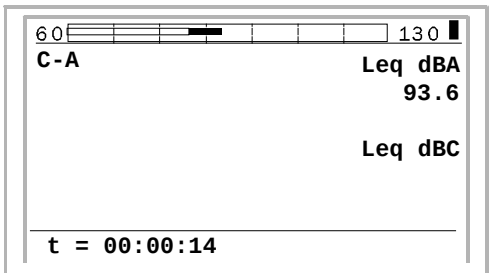
If the instrument is fitted with the "Assessor Extra" Data Logging upgrade, the C-A measurement is automatically stored into the instrument memory when the instrument reverts to the Broadband measurement.

Press the C-A button to begin the start the dB(C)-dB(A) measurement function.

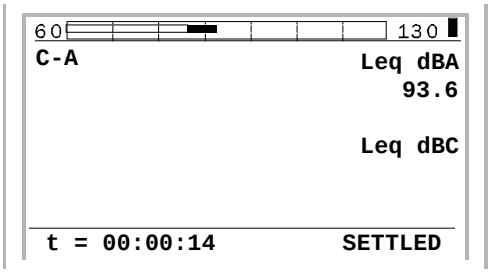


The blue indicator will light up next to the "C-A" button to show that the instrument is in C-A Mode.

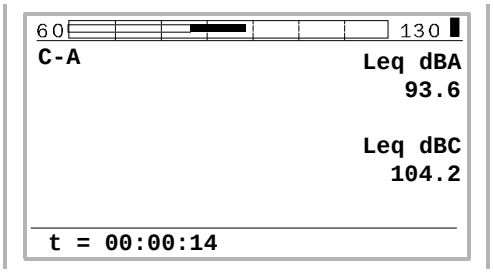
The instrument will firstly measure the Leq value in dB(A) until the level settles.



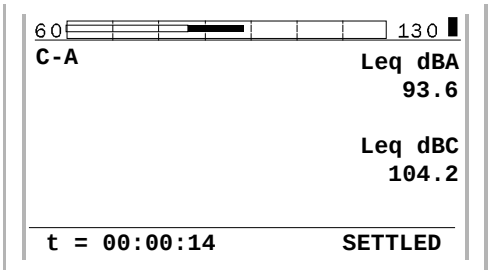
When the Leq dB(A) value has settled, the instrument will show "SETTLED" and will start the dB(C) measurement.



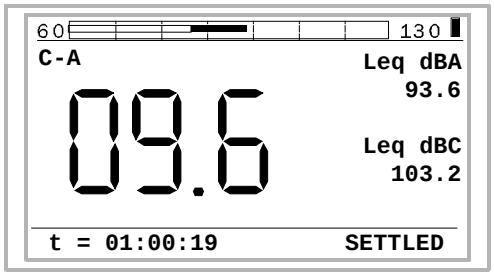
The instrument will measure the Leq value in dB(C) until the level settles.



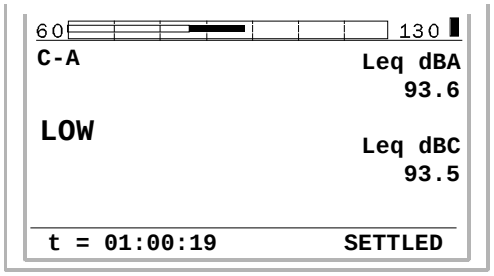
When the Leq dB(C) value has settled, the instrument will show "SETTLED"



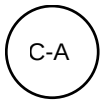
The resulting dB(C)-dB(A) value is shown and the measurement will stop



If the dB(C) value is lower than the dB(A) value, the display will show "LOW" to indicate this.



Press the C-A button to return to the Broadband Measurement Mode. The Broadband Measurement will continue from the point at which the C-A button was pressed.



If the instrument is fitted with the "Assessor Extra" Data Logging upgrade, the C-A measurement is automatically stored into the instrument memory when the instrument reverts to the Broadband measurement.

Switching off the instrument

Press and hold the Power Button to switch off the Sound Level Meter.

If the power button is pressed, the measurement data will be stored in the memory of the instrument. This is only available where the "Assessor Extra" Data Logging upgrade has been fitted.

Making a measurement with the Model 83A & 84A Instruments

Please read this section very carefully. It contains important information making and storing measurements with the Model 80 Sound Level Meters.

Switching On

Press the Power Button to switch on the Sound Level Meter.

Calibration

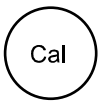
If a microphone extension cable is to be used during a measurement, the instrument must be calibrated with the cable attached.

Calibrating the Sound Level Meter

Select the calibration level on the Acoustic Calibrator. For most users, this will be 94dB when using a Model 100B Calibrator.

Gently push the calibrator onto the microphone capsule, slowly twisting clockwise.

Press the CAL button to start the calibration procedure



During the calibration, the instrument will display the calibration status.

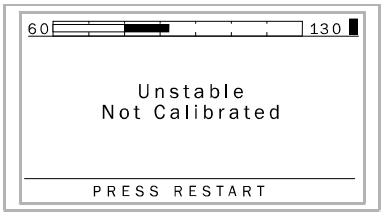
If the calibration is successful, the instrument will display the calibration level. Press the Start button to begin a new measurement or to return to the main screen.

If the calibration is not successful, the instrument will display an error message. These are shown below.

The calibration level is below the set level. Check that the Calibrator is switched on and that it is connected correctly to the Sound Level Meter.

The calibration level is above the set level. Check that the Calibrator is set to the correct level.

The calibration level is unstable. This maybe caused by high background noise levels. Move to a quieter location and retry the calibration.



Please note that if the CAL button is pushed when the instrument is running and making a measurement, the current measurement will be stopped and the information discarded. The measurement information will not be stored in the instrument memory.

To Remove the calibrator, gently pull the calibrator whilst twisting the calibrator clockwise. This will help to ensure that the microphone capsule does not become unscrewed from the instrument.

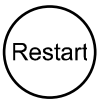
Making Measurements

The Model 83A and Model 84A instruments can measure noise using two different methods:

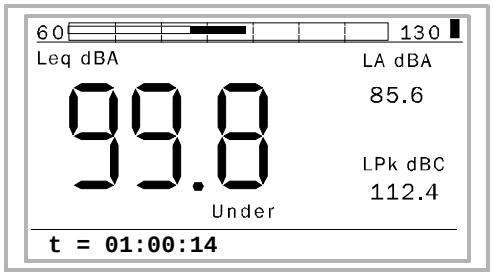
Measurement Type	Measurement Functions
Broadband	$L_{Aeq,t}$, L_{CPeak}, $L_{EX,8h}$
1:1 Octave Band Mode	$L_{Zeq,t}$

Starting a Broadband measurement

Press the Restart button to begin the measurement.



The instrument will display the Leq in dB(A), the LCPeak and the Sound Level (LA) along with the measurement time.



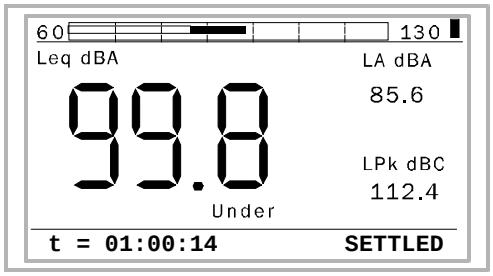
The instrument will continue to run until one of the following conditions occurs:

- The user presses the Stop button
- The user Resets the current measurement by pressing the Restart button.

Indication that the Leq value has settled

The Model 80 monitors the Leq level, and when it has settled, the display will show "SETTLED" as shown in the figure below.

The Model 80 monitors the Leq level, and when it has settled, the display will show "SETTLED"as shown.

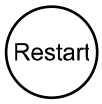


For this to occur, the Leq level must be stable to within ±0.3dB for 5 seconds. This is to be used as an indication that the measurement has settled. This should not be used as an indication that the measurement time is sufficient. Always refer to any Regulations, Standards or Guidelines that are in force for details of making a noise measurement.

Resetting the measurement

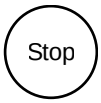
If any of the following keys are pressed during a measurement, the current measurement will be cancelled and the measurement restarted:

Restart
Resets the current measurement and starts a new measurement. The current measurement information will be discarded.

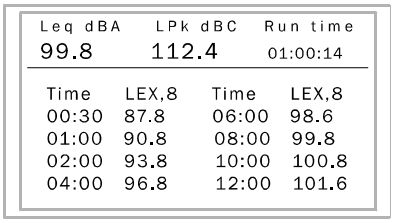


Stopping & reviewing the measurement

Press the Stop button to finish the measurement.



When the measurement is complete, the instrument will display the measurement data for the last measurement.



Please note that if a new measurement is started, the last measurement will be overwritten and the information lost.

Ensure that measurements have been recorded before making a new measurement. Refer to section 4 for details of the calculation of LEX,8h and how this relates to the measured noise levels.

If the instrument is fitted with the "Assessor Extra" Data Logging upgrade, the measurement is automatically stored into the instrument memory when the Stop button is pressed or when the measurement ends.

Making an Octave Band Measurement

If the Octave buttons is pressed during a Broadband Measurement, the instrument will pause the Broadband Measurement and start the Octave Band Measurement. At the

end of the Octave Band measurement the instrument will display the Octave Band data.

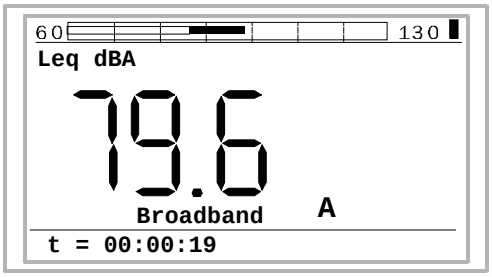
Pressing the Octave Band button at this time will return to the Broadband measurement which will continue.

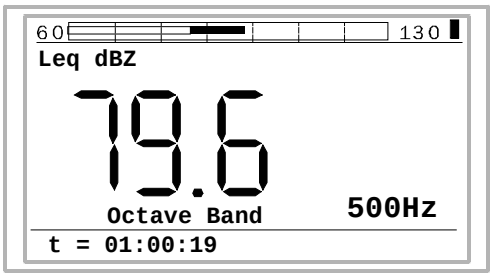
If the instrument is fitted with the "Assessor Extra" Data Logging upgrade, the Octave Band measurement is automatically stored into the instrument memory when the instrument reverts to the Broadband measurement.

Press the Octave button to begin the start the Octave Band measurement function.

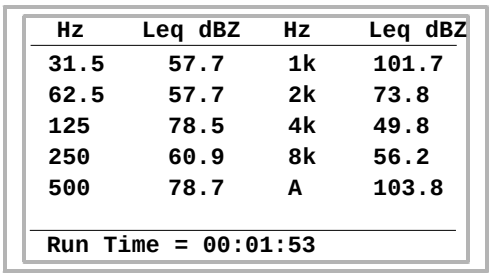
The blue indicator will light up next to the "Octave" button to show that the instrument is in Octave Mode.

The instrument will start with the dB(A) level and will then step through the Octave Bands from 8kHz to 31.5Hz





When the measurement has completed, the instrument will display the data.



Hz	Leq dBZ	Hz	Leq dBZ
31.5	57.7	1k	101.7
62.5	57.7	2k	73.8
125	78.5	4k	49.8
250	60.9	8k	56.2
500	78.7	A	103.8

Run Time = 00:01:53

Press the Octave button to return to the Broadband Measurement Mode. The Broadband Measurement will continue from the point at which the Octave button was pressed.

If the instrument is fitted with the "Assessor Extra" Data Logging upgrade, the C-A measurement is automatically stored into the instrument memory when the instrument reverts to the Broadband

measurement.

Switching off the instrument

Press and hold the Power Button to switch off the Sound Level Meter.

If the power button is pressed, the measurement data will be stored in the memory of the instrument. This is only available where the “Assessor Extra” Data Logging upgrade has been fitted.

Switching off the instrument

Press and hold the Power Button to switch off the Sound Level Meter.

If the power button is pressed, the measurement data will be stored in the memory of the instrument. This is only available where the “Assessor Extra” Data Logging upgrade has been fitted.

Calculation of LEX,8h in Broadband Mode

The Pulsar Model 80 Assessor Sound Level Meters provide a unique method of displaying the noise exposure or LEX,8h, which has been calculated from the Run Time and the measured Leq.

Please note that LEX,8h is a calculated figure and is not an value that is measured. It is also important to understand the principles behind the parameters of Leq and LEX,8h before undertaking a noise assessment or survey.

What is Leq?

L_{eq} is effectively the "average" noise level over a certain period of time. Strictly speaking, this is not correct, as L_{eq} is a linear integral of the noise over a period of time, divided by time and then expressed as a decibel. A Sound Level Meter that provides L_{eq} is an Integrating-Averagering Sound Level Meter, as this is the process required to measure and display L_{eq}.

Important facts to remember about Leq:

1. There is no Time Weighting applied to L_{eq}.

Fast, Slow and Impulse Time Weightings are only used with Sound Level (SPL), which is based on the exponential average of rms.

2. Leq must have a measurement time associated with it.

3. There is no "sampling time" associated with the measurement of Leq.

Leq is a true energy intergral, and includes all of the noise that occurred during the measurement period.

What is LEX,8h?

LEX,8h is defined by the UK Noise at Work Regulations as "the total personal noise exposure to noise at work (this figure is normalised to an 8 hour day), taking into account of the average levels of noise in working areas and the time spent in them, but taking no account of any ear protectors (earmuffs or earplus) worn."

Basically, LEX,8h is a measured Leq value expressed as an 8 hour. The formula to calculate LEX,8h is:

$$LEP,d = 10\log_{10}\left(\frac{1}{T_0}\int_0^{T_e}\left[\frac{p_A(t)}{p_0}\right]^2 dt\right)$$

where:
T_e = the duration of the person's personal noise exposure to sound
T_0 = 8 hours = 28,800 seconds
p_0 = 20µPa
$P_A(t)$ = the time varying value of A-weighted instantaneous sound pressure in pascals in the undistrurbed field in air at atmospheric pressure to which the person is exposed (in the locations occupied during the day), or the pressure of the disturbed field adjacent to the person's head adjustced to provide a notional equivalent undistured field pressure.

Effectively, $P_A(t)$ is the measured Leq value expressed in Pascals rather than in decibels.

Important facts to remember about LEX,8h:

1. LEX,8h is not a measured value.

It is calculated from the Exposure Time and from the measured Leq value.

2. LEX,8h is normalised to an 8 hour day.

This means that a measurement for a worker exposed to noise for 8 hours can be compared to the exposure of a person who works for 12 hours. LEX,8h is always normalised to 8 hours.

3. LEX,8h may be written is $L_{EX,8h}$

This is the same parameter, but written in a slightly different way. The Model 80 Sound Level Meters use LEX,8h.

How is LEX,8h calculated?

Example 1, 90dB(A) Leq measured for 30 minutes

The measurement made with the Model 80 Sound Level Meter gives the following information:

Run Time 00:30:00 (30 minutes)
Leq dB(A) 90.0

The LEX,8h calculated from this information would be:

LEX,8h = 78.0 dB(A)

In this example, the calculation is that the person is exposed to 90.0 dB(A) for 30 minutes, and then for the other 7½ hours of the working day the person receives no further noise exposure.

This is the important fact about the calculation of LEX,8h. The assumption is that the person is not exposed to any further noise during the rest of the day.

Example 2, 85dB(A) Leq measured for 6 hours

The measurement made with the Model 80 Sound Level Meter gives the following information:

Run Time 06:00:00 (6 hours)
L_{eq} dB(A) 85.0

The LEX,8h calculated from this information would be:

LEX,8h = 83.8 dB(A)

In this example, the calculation is that the person is exposed to 85.0 dB(A) for 6 hours, and then for the other 2 hours of the working day the person recieves no further noise exposure.

This is the important fact about the calculation of LEX,8h. The assumption is that the person is not exposed to any further noise during the rest of the day.

Example 3, 85dB(A) Leq measured for 12 hours

The measurement made with the Model 80 Sound Level Meter gives the following information:

Run Time 12:00:00 (12 hours)
L_{eq} dB(A) 85.0

The LEX,8h calculated from this information would be:

LEX,8h = 86.8 dB(A)

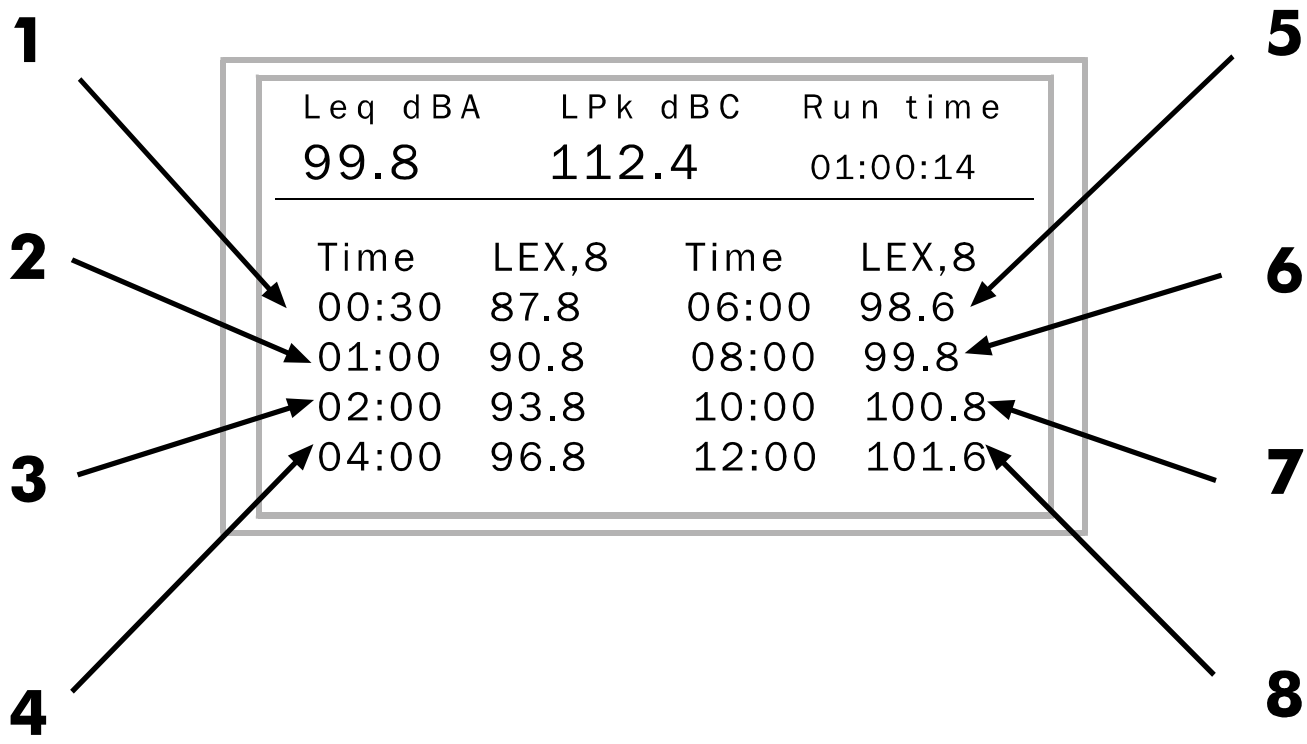
In this example, the calculation is that the person is exposed to 85.0 dB(A) for 12 hours. Because the Run Time is longer than the "standard" 8 hour day, the measurement is normalised to 8 hours, giving the LEX,8h a higher value than the L_{eq}.

How is LEX,8h displayed in the Sound Level Meters?

The Pulsar Model 81A & 82A Sound Level Meters use a slightly different method to display the LEX,8h as the instrument does not know how long the person would be working in the measured noise level for.

For example, if a measurement was made for 20 minutes, the instrument does not know if the person worked for only 20 minutes, or if they continued for a longer period.

Therefore, the Pulsar Model 81A & 82A Sound Level Meters provide a unqiue method of viewing the measured Leq and the projected LEX,8h values for different durations.



The example below shows a measurement of 01:00:14 (1 hour and 14 seconds) and an Leq value of 99.8dB(A).
1. If the person had worked in this level for **30 minutes**, their LEX,8h would have been **87.8 dB(A)**

2. If the person had worked in this level for **1 hour**, their LEX,8h would have been **90.8 dB(A)**

3. If the person had worked in this level for **2 hours**, their LEX,8h would have been **93.8 dB(A)**

4. If the person had worked in this level for **4 hours**, their LEX,8h would have been **96.8 dB(A)**

5. If the person had worked in this level for **6 hours**, their LEX,8h would have been **98.6 dB(A)**

6. If the person had worked in this level for **8 hours**, their LEX,8h would have been **99.8 dB(A)**

7. If the person had worked in this level for **10 hours**, their LEX,8h would have been **100.8 dB(A)**

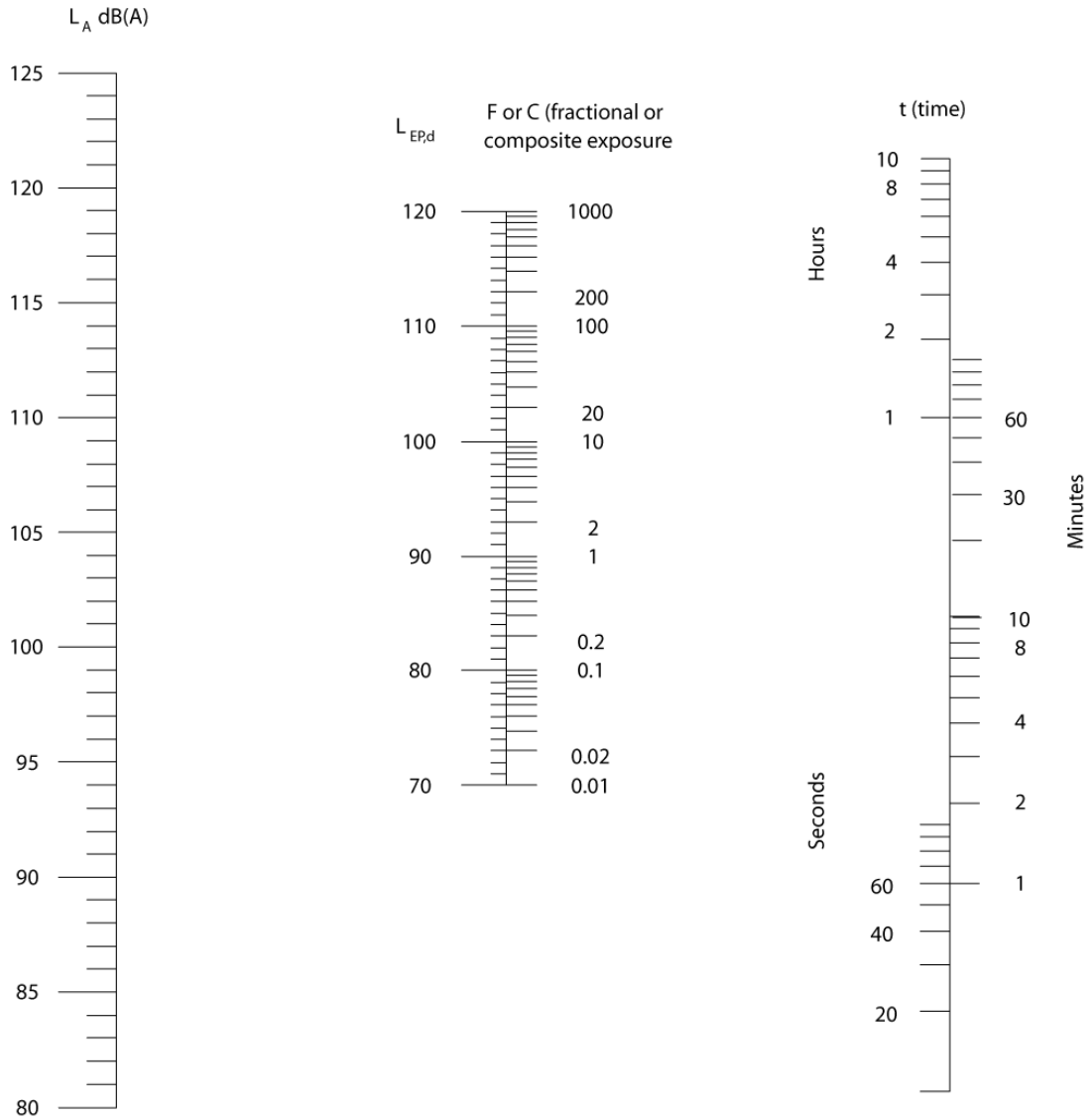
8. If the person had worked in this level for **12 hours**, their LEX,8h would have been **101.6 dB(A)**

Using a nomgram to calculate LEX,8h

LEX,8h can be calculated using a Nonogram chart such as the one shown below.

To use this chart:

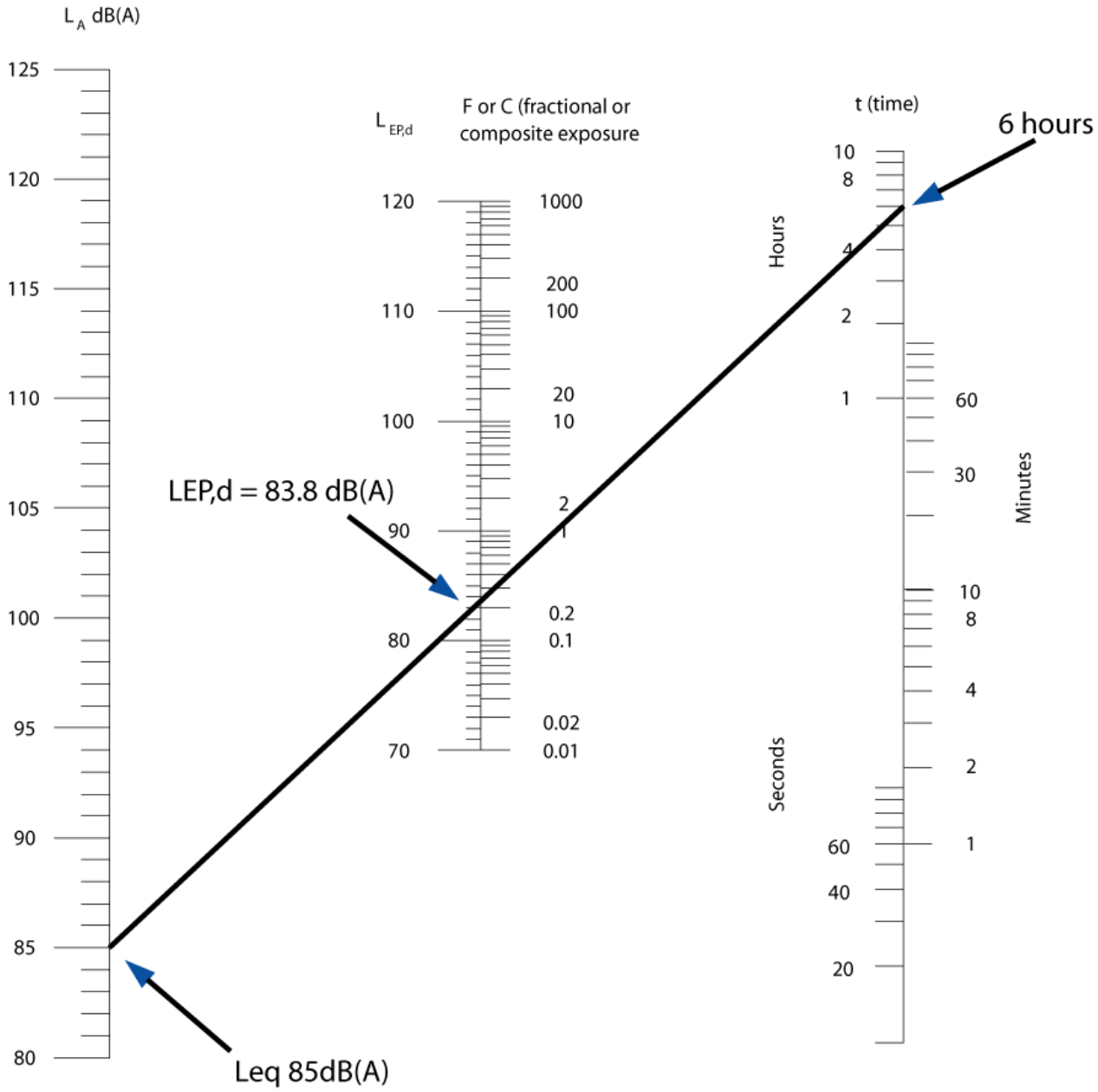
1. Locate the Leq value on the left hand side.
2. On the right handside, locate exposure time. This is ***not*** the time of the measurement but is the time over which the person will be exposed to the noise.
3. In the centre, read the LEX,8h from the line.



An example of using a Nomogram to calculate LEX,8h

Using the example 2 from above, an Leq of 85.0 dB(A) measured fo 6 hours:

1. Locate 85.0 dB on the left hand side of the chart.
2. On the right hand side of the chart, locate 6 hours
3. Draw a line between these two points. Where this meets the LEX,8h line in the middle of the graph, read off the LEX,8h figure.



Maintenance & Care

The Model 80 Series are precision measurement instruments and should be treated with care. Do not allow the instrument to be exposed to substances which may cause damage to the components of the unit. If the instrument is to be used in an environment where particles such as dust may come into contact with the instrument, always use a Windshield (WS90) to protect the microphone capsule.

The instrument is not waterproof and should not be used in situations where moisture will form or condense on the microphone capsule or the instrument body. If using the instrument outdoors, use a suitable outdoor measurement kit which has been specifically designed to protect the instrument.

If the instrument becomes dusty, wipe it down with a cloth that is lightly dampened with water or a mild detergent. Do not use aromatic hydrocarbons, chlorinated solvents, or methanol-based fluids when wiping down the meter.

Do not clean the microphone capsule. Do not remove the microphone grill as this can cause severe damage to the membrane. Physical damage to the microphone capsule is not covered by the instrument warranty.

If you experience any problems with the operation of the instrument, refer to page 33 for basic troubleshooting. If this does not solve the problem, contact Pulsar Instruments Plc or your local representative for further assistance.

Troubleshooting

This section contains information which may solve simple operational problems you may encounter. If you are unable to solve the problem or experience any problems with the assembly or operation of the instrument contact Pulsar Instruments Plc or your local representative for further assistance

Basic Operation

Symptom	Possible Cause	Possible Remedy
The instrument does not switch on	The batteries are not fitted	Fit new batteries and switch on
	The batteries are flat or very low	Fit new batteries and switch on
	The batteries are not correctly fitted	Remove the batteries and check the polarity of the batteries
	The instrument has become corrupted	Contact your local distributor or Pulsar Instruments Plc

Calibration

Symptom	Possible Cause	Possible Remedy
The calibration fails: Too Low	The Acoustic Calibrator is not switched on	Switch on the Acoustic Calibrator and retry
	The Acoustic Calibrator is not fitted correctly	Check that the Acoustic Calibrator is fitted according to the instructions supplied.
	The Preamplifer is not fitted correctly. Type 1 Instruments only	For Type 1 Instruments, refer to page 8 for details of fitting the preamplifier.
	The microphone capsule is loose or not fitted	Check that the microphone capsule is tight and fitted correctly
	Calibration level set to a different level	Set the calibration level to the value provided by the Acoustic Calibrator.
	The Microphone may be damaged	Contact Pulsar Instruments Plc or your local representative for assistance
The calibration fails: Too High	The Acoustic Calibrator is set to a higher level than the expected level	Set the Acoustic Calibrator to the correct level
The calibration fails: Unstable	The background noise level is within 15dB of the calibration level	Move to a location where the background noise level is more than 15dB below the calibration level
	The Microphone may be damaged	Contact your local distributor or Pulsar Instruments Plc

Glossary

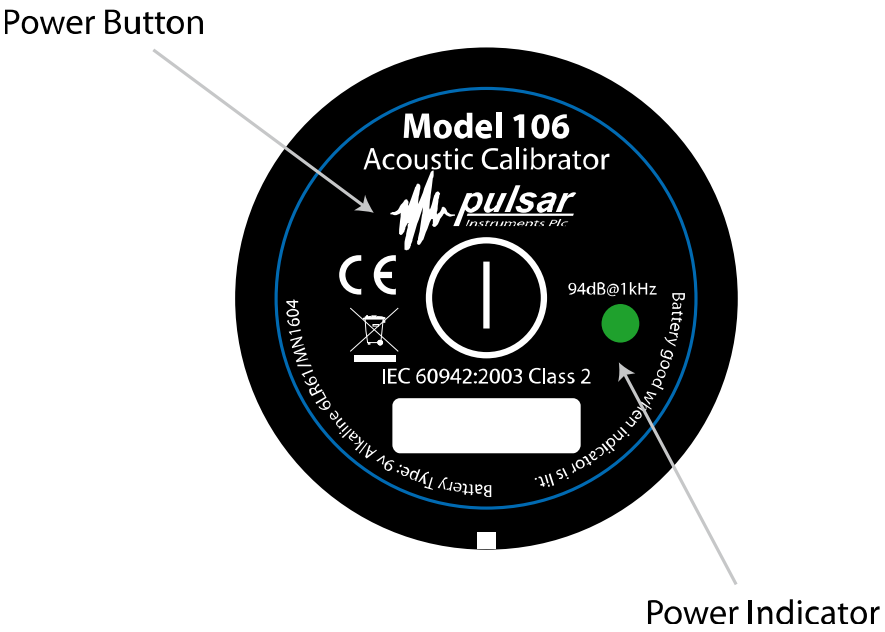
'A' Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
Acoustic Calibrator	An instrument that provides a reference noise source that is used to calibrate and check the performance of a Sound Level Meter.
C Weighting	A standard weighting of the audible frequencies used for the measurement of Peak Sound Pressure level.
CE Marking	A label used to show that the Sound Level Meter conforms to the specification of a European Directive
dB(A)	Decibels A weighted
dB(C)	Decibels C Weighted
Fast Time Weighting	A standard time weighting applied by the Sound Level Meter
IEC 60651:1979	The International Standard for Sound Level Meters
IEC 60804:1984	The International Standard for Integrating & Integrating-Averaging Sound Level Meters
IEC 61672-1:2003	The International standard for Sound Level Meter and Integrating Averaging Sound Level Meters that replaces both IEC 60651 and IEC 60804
Impulse Time Weighting	A standard time weighting applied by the Sound Level Meter
Integrating Averaging Sound Level Meter	A Sound Level Meter which accumulates the total sound energy over a measurement period and calculates an average
$L_{Aeq,t}$	Equivalent continuous sound pressure level. A measure of the average sound pressure level during a period of time, t, in dB with 'A' weighting.
L_{AF}	Sound level with 'A' Frequency weighting and Fast Time weighting
L_{Cpeak}	Peak Sound pressure level with 'C' frequency weighting
LEX,8h	Daily personal noise exposure
L_{eq}	Equivalent continuous sound pressure level. A measure of the average sound pressure level during a period of time, t, in dB
Overload	The input to the Sound Level Meter is too high for the current measurement range. Change the range
Peak	The maximum value reached by the sound pressure at any instant during a measurement period (in dB usually with C frequency weighting)
Sound Level	Sound Pressure Level with a Frequency weighting, such as dB(A)
Sound Level Meter	An instrument for measuring various noise parameters
SPL	Sound Pressure Level, the basic measure of noise loudness, expressed in decibels
Type 1	Laboratory & Field Grade for Sound Level Meters
Type 2	General Field Grade for Sound Level Meter
Under Range	The input to the Sound Level Meter is too low for the current measurement range. Change the range

Model 105 & 106 Acoustic Calibrators

Operation.

Switching on the Calibrator

Press the Power Button on the end of the Calibrator to switch the unit on. The Indicator will illuminate to show that the unit is operating.



The calibrator will automatically switch off after 5 minutes to preserve battery power.

To switch off the calibrator manually, press the power button again and the indicator will extinguish to show that the unit is switched off.

Permanent-on Mode

For some applications there may be a need to have the calibrator switched on continuously. To allow for this, the calibrator can be turned on by pressing and holding the power button for three seconds.

Release the button and the indicator will flash to show that the unit is in permanent-on mode. Press the power button to switch off the calibrator.

Calibrating a Sound Level Meter.

Push the microphone of the Sound Level Meter into the cavity at the end of the calibrator. Ensure the microphone is fully inserted into the cavity and is past the 'O' ring seals. The microphone should be parallel to the body of the calibrator. Also ensure that the small bleed-hole next to the microphone cavity is not blocked as this could cause damage to the microphone.

Most modern Sound Level Meters have electronic calibration with the level adjusted automatically. Adjust the Sound Level Meter to the correct level where applicable. When correcting the value generated by the calibrator a correction for the type of microphone capsule may need to be applied (see Appendix 2)

Background Noise

In order for the calibrator to operate as intended, the ambient acoustic noise level should be no greater than 80dBA.

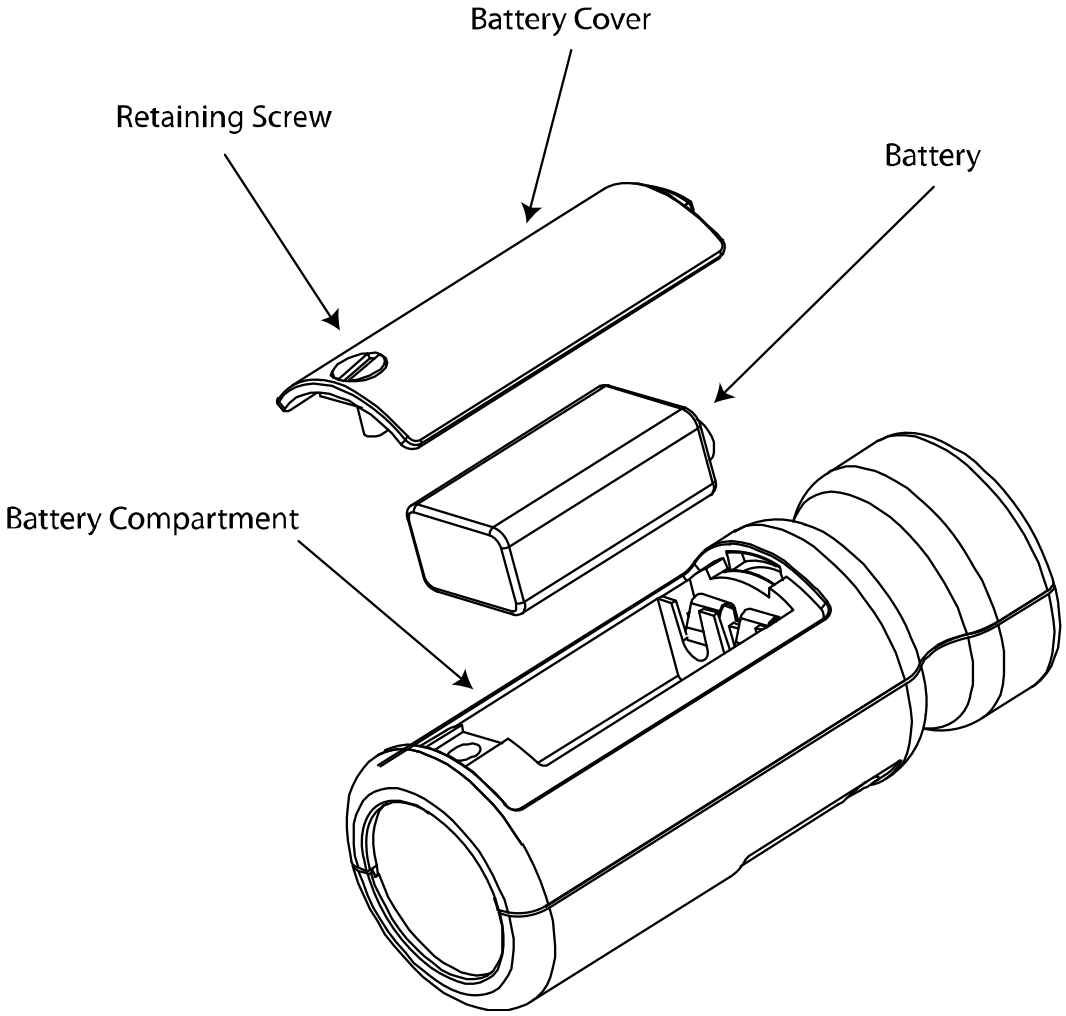
Stabilisation

In order for the sound pressure level and frequency to stabilise after switching the calibrator on when coupled to a microphone, a period of at least 3 seconds should be allowed before performing a calibration.

Changing the Battery

The Model 105 & Model 106 acoustic calibrators use a single 9v alkaline battery. This type of battery is known as 6F22 or NEDA 1604. It is also commonly known as PP3.

1. Unscrew the screw holding the battery cover on, using a coin.
2. The battery, type 6F22 (PP3) can now be eased out of its holder and replaced. The battery should be eased out terminal side first by pushing against the spring at the other end. Ensure that the battery is inserted with the correct polarity with the negative terminal at the contact with the larger cutout.



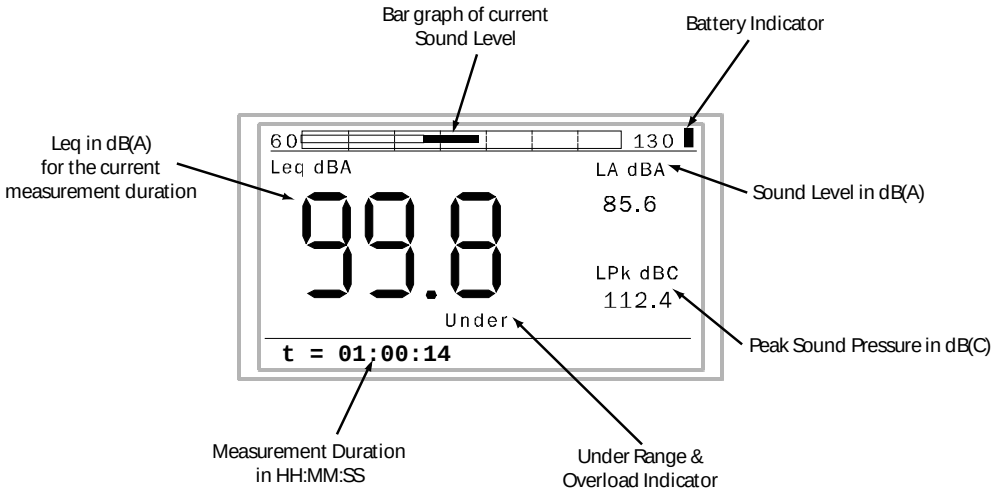
Battery type.

The battery should be an alkaline battery, not an ordinary dry cell. The battery is 9 volts when new and will operate the calibrator down to 6.4 volts. When the battery voltage is below 6.6 volts but above 6.4 volts, the power LED will flash to indicate that the battery voltage is low. When the battery voltage is below 6.4 volts the calibrator will not turn on. A discharged battery may allow switch-on but will soon drop in voltage and indicate low battery or switch off.

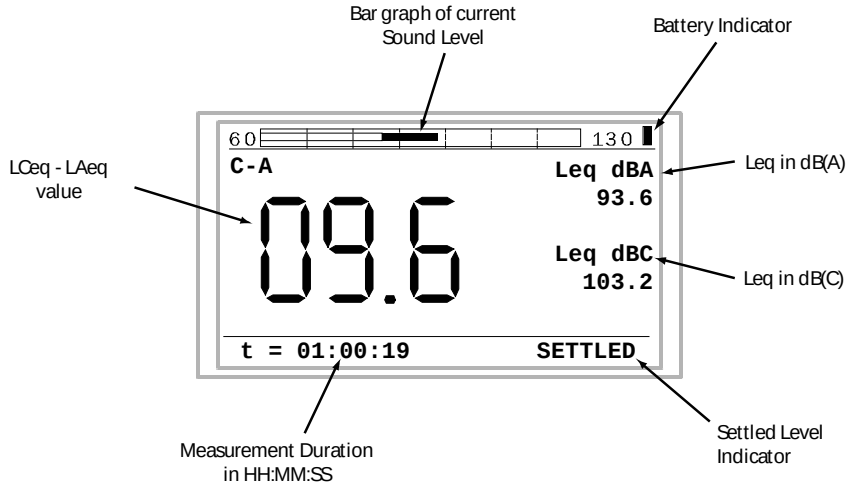
Specification.

Frequency	1kHz ± 1%
Sound Level	94dB re 20µPa
Standardisation	Model 105 - IEC 60942:2003 Class 2 Model 106 - IEC 60942:2003 Class 1
Distortion	Less than 2%
Operating Humidity	25 to 90% Relative Humidity
Operating Static Pressure	65 kPa to 108kPa
Operating Temperature	-10°C to +50°C
Storing Temperature	-20°C to +60°C
Effective Volume	6.19 cm^3 ± 0.2 cm^3
Cavity Diameter	0.525 inch
Battery	1 x 9v 6F22 (Neda 1604)
Battery Life	Approx 15 Hours Continuous Use
Battery Voltage	9v Nominal (10v Maximum, 6.4v Minimum)
Weight with Battery	185g
Dimensions	135mm x Ø48mm

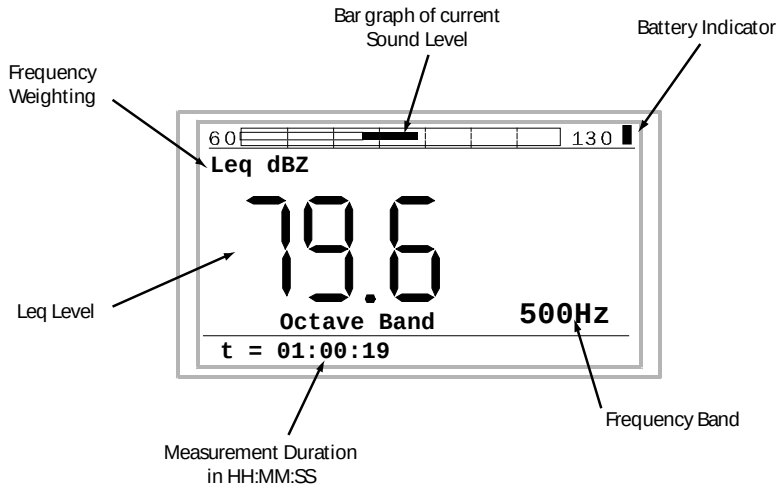
Appendix 1 Display Functions



Broadband measurement display indicators

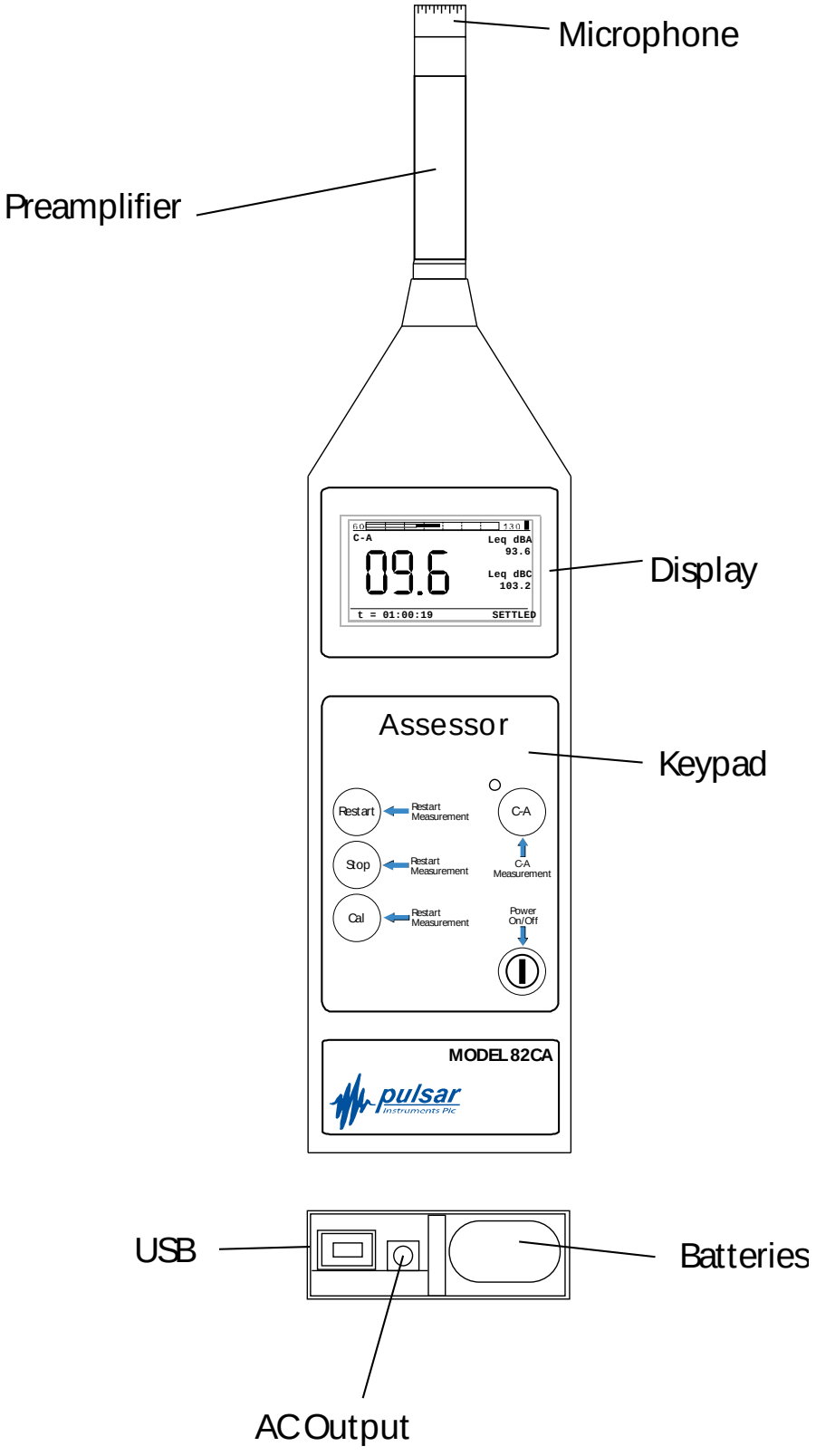


C-A Mode Display Indicators



Octave Band Mode Display Indicators

Appendix 2 Instrument Layout



Appendix 3 Rating Plate Information

The Model 80 Series meet the requirements of IEC60651:1979 and IEC60804:1985. These specifications require that this manual provides detailed information to verify that the specifications are met. While much of the data required is in the body of this manual, the points required to be detailed are listed below in the order in which they occur in the IEC specification. The numbers marked after to IEC number refer to that documents paragraph numbers for reference.

The following data assumes the fitting of a Type 1 microphone capsule unless otherwise stated. Although a Type 2 instruments have an identical electronic design and should meet the electrical performance tests to Type 1 this is not guaranteed and it should be assumed that Type 2 tolerances apply as specified in the relevant standards to electrical as well as acoustic performance.

IEC804/651 11.2.1

The MK:216 or MK:215 Type 1 Electret microphone is used for the Model 81A or Model 82A, mounted on the plug- in pre-amplifier MV:200C. An extension cable or gooseneck is not required to meet fully the standards claimed.

IEC804/651 11.2.2

The reference direction of incidence is parallel to the sides of the case towards the microphone capsule.

IEC804/651 11.2.3

The range of measurement for Leq measurement with a standard assembly is:-
: 60 to 130 dBA

For signals with a crest factor of up to 10 the top span of the unit can be reduced by up to 17dB. This means that a signal with a crest factor of ten will produce an overload at 17dB below the expected top of the range selected. The reading of this signal will be within the tolerances of IEC60651 up to the point where the overload occurs.

The range of measurement for Peak measurement is:-
: 100 to 143 dB(C)
The peak values are valid for 3dB above and 40dB below the top of each range unless an overload occurs.

IEC804 11.2.4

Linearity (and pulse range)

There is one measurement range, 60dB(A) to 130dB(A), to 143dB(C) Peak

With 'A' Frequency Weighting, for each range the linearity range exceeds 70dB and the pulse exceeds 73dB except for the lowest range where the linearity and pulse range are reduced by 5dB due to the higher noise floor.

IEC804 11.2.7 IEC651 11.2.4

The reference sound pressure is 1 Pa (94dB).

IEC804 11.2.5
The Integration period cannot be preset and is determined by the user controls.

IEC651 11.2.5
The frequency weighting characteristic for measurements apart from Peak is A weighting. Peak has a fixed C weighting.

IEC651 11.2.6
Not Fitted

IEC804 11.2.9 IEC651 11.2.7
An acceleration of 0.1g over the frequency range 63 - 4kHz results in a reading of less than 50dB on any axis or weighting.

IEC804 11.2.10 IEC651 11.2.8
1 oersted produces a reading of less than 50dB on any weighting.

IEC804 11.2.11 IEC651 11.2.9
The units operate from - 10 degree C to + 50 degree C with a maximum reading change of +0.5dB but is typically less than 0.3dB..

IEC651 11.2.10
We recommend that the operator should be at least 1m from the microphone during measurement.

IEC804 11.2.12 IEC651 11.2.11
The unit will meet its specification at any humidity from 0 to 95 % RH.

IEC804 11.2.13 IEC651 11.2.12
Maximum storage temperature of +60 degree (+50 degree extended period) and 50% RH should be observed. Care should be taken when taking an instrument rapidly from sub zero temperatures to room temperature or above as condensation can take place inside the instrument and temporarily affect accuracy. No long-term damage should take place however.

IEC804 11.2.14 IEC651 11.2.13
Use of a 2m, 5m or 10m extension cables will not affect the calibration.

IEC804 11.2.15 IEC651 11.2.14
The WS90 windscreen has a small effect on frequency response as follows:

Up to 1kHz	no effect
1259Hz	+0.1dB
1585Hz	+0.2dB
1995Hz	+0.3dB
2512Hz	+0.3dB
3162Hz	+0.3dB
3981Hz	+0dB
5012Hz	-0.1dB
6310Hz	-0.1dB
7943Hz	+0dB
10000Hz	-0.2dB
12590Hz	-0.7dB

IEC804 11.2.16 IEC651 11.2.15
The use of a pistonphone (PF:101C) is recommended to ensure long term compliance but for general short term compliance the Model 100B is used. They should be returned to the factory annually to be checked against a secondary or transfer standard. Any corrections specified in the calibrator or pistonphone manual should be applied for temperature or barometric pressure variation.

IEC804 11.2.17 IEC651 11.2.16
The observer should be behind the case for optimum results. The operator should ever be at the side or in front of the unit.

IEC804 11.2.18 IEC651 11.2.17
Apart from the microphone and pre-amplifier no other device needs to be attached to make complete measurements.

IEC804 11.2.19 IEC651 11.2.18
The limitations on the electrical impedance that may be connected to the optional outputs:- Any real, positive impedance of zero ohm upwards. Optimum load impedances are specified in this manual. No guarantee on performance can be made if non-Pulsar supplied cables are used.

IEC804 11.2.6 IEC651 11.2.19
The reference frequency used for calibration is 1kHz.

IEC804 11.2.8 IEC651 11.2.20
The reference range for IEC 651 purposes is from 60dB to 130dB.

IEC804 11.2.20 IEC651 11.2.21
The warm up period is less than 10 secs although it is recommended that the unit should be switched on for at least one minute before calibration to provide optimum accuracy. Never attempt calibration of an instrument that has not stabilised in temperature with its surroundings if you are seeking accurate results.

IEC804 11.2.21
The settling time before valid Leq readings of constant signals are within 0.5dB of their final reading is 10secs and within 0.1dB within 1minute.

IEC804 11.2.22
The battery life is greater than 12 hours with continuous use for average readings at 20dB below top of scale and at reference conditions. This value will vary dependant on the quality of the Alkaline batteries used and will diminish if levels near top of scale are constantly monitored or if the batteries are at a low temperature.

IEC651 11.2.22
Not applicable.

IEC804/651 11.2.23
See microphone data.

IEC804/651 11.2.24
Consult Pulsar Instruments Plc

IEC804/651 11.2.25
Dummy microphone impedance is 18 pF in series with 50ohm.

IEC651 11.2.26
Primary indicator range is 65dB to 105dB on the centre reference range.

IEC651 11.2.27
Manual only.

IEC651 11.2.28
Contact Pulsar Instruments Plc

IEC804 11.2.26
An overload will always occur before non-linear distortion takes place.

IEC804 11.2.27
The instrument can be factory set for random incidence as an option.

IEC804 11.2.28
The indicator range extends beyond the linearity range.

Appendix 4 Specifications

Instrument Versions

Model 81A, Model 81CA & Model 83A	Type 1
Model 82A, Model 82CA & Model 84A	Type 2

Applicable Standards

Sound Level Meter

IEC 60651:1979 Type 1 I or Type 2 I
IEC 60804:1985 Type 1 or Type 2
IEC 61672-1:2003 Class 1 or 2 Group X

Microphone

Type 1	Class+ Type 1 pre-polarized Free-field ½" Condenser
Type 2	Class+ Type 2 pre-polarized Free-field ½" Condenser

Capacitance 18pF

Microphone Preamplifier

Type 1	MV:200C Removable Preamplifier
Type 2	MV:200C Integral Preamplifier

Frequency Weightings

Channel 1	'A'
Channel 2	'C' for Peak

Amplitude Weighting

Q=3 (True Energy Integration)

Measurement Range

60dB(A) to 130dB(A) Type 1 & Type 2
143dB(C) Peak

Noise Floor (Typical)

54dB(A) Type 1 & Type 2

Available Measurements

Model 81A & Model 82A

L_{Aeq} Equivalent Continuous Sound Level, dB(A)
LEX,8h Daily Personal Noise Exposure, dB(A)
L_{Cpeak} Peak Sound Pressure, dB(C)
Measurement Duration

Model 81CA & Model 82CA

L_{Aeq} Equivalent Continuous Sound Level, dB(A)
L_{Cpeak} Peak Sound Pressure, dB(C)
$L_{Ceq} - L_{Aeq}$ Equivalent Continuous Sound Level
Measurement Duration

Model 83A & Model 84A

L_{Aeq} Equivalent Continuous Sound Level, dB(A)
L_{Cpeak} Peak Sound Pressure, dB(C)
1:1 Octave Band Filters in dB(Z)
Measurement Duration

Display

Graphical LCD with Quasi-Analogue Display
Warnings for Overload, Under Range
Battery Level
Frequency Weighting
Elapsed measurement time
Measurement Range
Instrument settings

Weight

450 gms

Dimensions

Type 1	340mm x 75mm x 25mm
Type 2	300mm x 75mm x 25mm

Batteries

2 x 1.5v Alkaline LR6/AA

Battery Life

Broadband Typically >18 hours

Battery voltage is continuously monitored and warning is given on display of impending low battery condition. When batteries approach end of life the unit will store any data required and switch off automatically.

Environmental

Temperature

Operating	-10°C to +50°C
Storage	-20°C to +60°C

Humidity

Up to 95% RH Non Condensing

Electromagnetic Performance

EN 55022:1998
EN 61000-4-2:1995
EN 61000-4-3:2002
EN 61000-4-8:1994

Appendix 5 CE Certificate of Conformity

Pulsar Instruments Plc Hunmanby UK
CE Certificate of Conformity

CE 02

Manufacturer: Pulsar Instruments Plc
Acoustic House, Bridlington Road
Hunmanby, North Yorkshire, YO14 0PH
United Kingdom
Telephone +44 1723 518011

Equipment Description

The following equipment manufactured after 1st January 2004:

Model 82A "Assessor" Integrating Sound Level Meter
Model 81A "Assessor" Integrating Sound Level Meter
Model 82CA "Assessor" Integrating Sound Level Meter
Model 81CA "Assessor" Integrating Sound Level Meter
Model 84A "Assessor" Integrating Sound Level Meter
Model 83A "Assessor" Integrating Sound Level Meter

Along with their standard accessories

According to EMC Directives 89/336/EEC and 93/98/EEC

meet the following standards

EN 50081-1 (1992)

Generic emission standard for residential, commercial and light industry

EN 50082-1

RF immunity implies that sound level indications will not be affected by more than "0.5dB at a background level of 74dB(A) or less.

Signed Dated 1st March 2004

S. O Rourke
Director

Guarantee

Pulsar Instruments Plc offers a 12 month guarantee on all of their units. This covers all parts and labour excepting only damage caused by the user. Because of the unique fragility of microphones, only internal short or open circuits are accepted as faults and not accident damage. The guarantee requires the user to return the unit to their nearest authorised Pulsar Instruments Plc Agent. This guarantee is in addition to any statutory rights in your country.

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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