

Integrating Sound Level Meter and Datalogger

Model 407780A



Introduction

Thank you for selecting the Extech Instruments Model 407780A. This device is shipped fully tested and calibrated and, with proper use, will provide years of reliable service. Please visit our website (www.extech.com) to check for the latest version of this User Guide, Product Updates, and Customer Support.

Features

The Sound Level Meter complies with the requirements of IEC 61672-1:2003 standard for a Class 2 instrument.

The instrument contains several features which permit sound level measurements under a variety of conditions.

Features include:

- Five measurement ranges
- Fast, Slow and Impulse time weighting settings
- **A** and **C** frequency weighting settings
- Storage of up to 32000 measurement records
- USB serial port for downloading records to a computer or real time analysis
- AC/DC signal outputs are available from a single standard 3.5mm coaxial socket suitable for use with a frequency analyzer, level recorder, FFT analyzer, graphic recorder, etc.
- Leq, SEL, SPL MAX, SPL MIN, PH (Peak Hold), L05, L10, L50, L90, and L95, ten measured parameters are monitored during measurement
- Preset measurement time
- Sound level alarm output connector

Instrument Care

- Do not attempt to remove the mesh cover from the microphone as this will cause damage and affect the accuracy of the instrument.
- Protect the instrument from impact. Do not drop it or subject it to rough handling. Transport it in the supplied carrying case.
- Protect the instrument from water, dust, extreme temperatures, high humidity and direct sunlight during storage and use.
- Protect the instrument from air with high salt or sulphur content, gases and stored chemicals, as this may damage the delicate microphone and sensitive electronics.
- Always switch the instrument off after use. Remove the batteries from the instrument if it is not to be used for a long period of time. Do not leave exhausted batteries in the instrument, as they may leak and cause damage.
- Clean the instrument only by wiping it with a soft, dry cloth or, when necessary, with a cloth lightly moistened with water. Do not use solvents, abrasives, alcohol or cleaning agents.

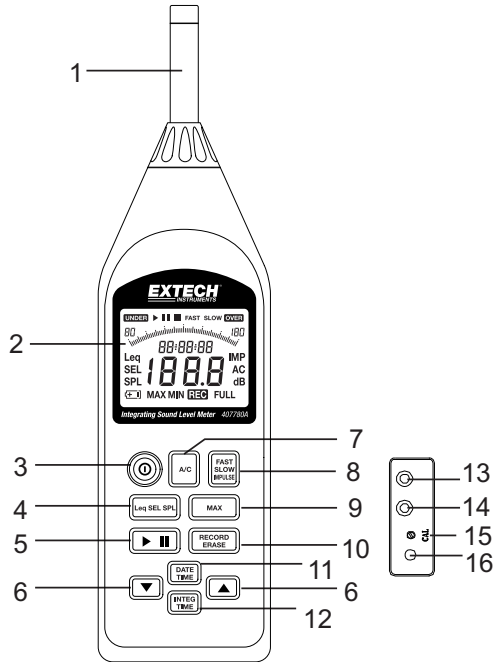
Meter Description

1. 1/2-inch microphone
2. LCD display
3. Power button
4. Leq / SEL / SPL select button
5. RUN / Pause button
6. UP/DOWN range setting buttons.
7. A / C Frequency weighting select switch
8. FAST / SLOW / IMPULSE time weighting select switch.

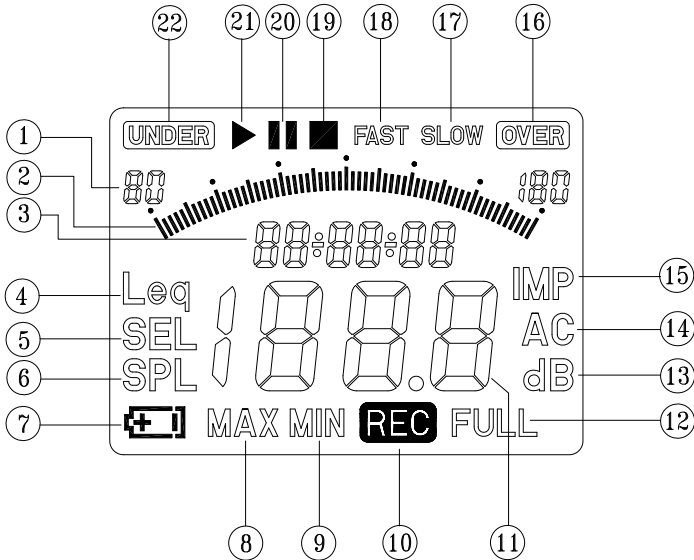
FAST: 125ms, **SLOW:** 1 second,
IMPULSE: 35ms with slow decay

9. MAX button
10. RECORD / ERASE button
11. Real time clock button
12. Integration time button
13. Alarm output
14. AC/DC output
15. CAL (calibration) adjustment
16. External power input

- USB input (located on bottom, not shown)
- Tripod mounting screw (located on rear, not shown)
- Battery cover (located on rear, not shown)



Display Description



1. Sound level range indicator (5 ranges): 30–90dB, 40–100dB, 50–110dB, 60–120dB and 70–130dB
2. Bar graph represents the current sound level (1dB resolution).
3. Date/time and elapsed time indicator: **year - month - day** or **hour: minute : second**.
During integrating this indicator displays the elapsed time in seconds.
When viewing the **Peak Hold** value this indicator displays **PH**.
When viewing the percentile values this indicator displays **L:05, L:10, L:50, L:90** or **L:95**.
4. Leq: Equivalent continuous sound level reading
5. SEL: Sound exposure level reading
6. SPL: Time-weighted sound level reading Sound Pressure Level
7. Low-battery indication
8. MAX: When displayed flashing it indicates that the Maximum time-weighted sound level reading is shown. When it is displayed solid it indicates that the Maximum sound level reading is displayed.
9. MIN: Minimum sound level reading.
10. REC : Indicates that Data recording is in process
11. Sound level reading (0.1dB resolution): 30.0 – 130.0dB
12. FULL: Indicates that the recording memory bank has been filled

13. dB: Sound level unit (decibel)
14. A, C: **A** or **C** frequency weighting indicator.
15. IMP: Impulse time weighting indicator
16. OVER: Over-range indicator appears flashing when over-range measurements have been included in the sound level measurement data recording session.
17. SLOW: **Slow** time weighting indicator
18. FAST: **Fast** time weighting indicator
19. ■ : Indicates that integrating sound level measurements have been stopped.
20. ■■ : Indicates that integrating sound level measurements are paused.
21. ► : Start and continuous integrating measurement indicator.
22. UNDER: Under-range indicator appears flashing when under-range measurements have been included in the sound level measurement data recording session.

Operation

The meter has two modes of operation, Sound Level Meter mode and Integrating Sound Level Meter mode.

Sound Level Meter measurements

1. Press the **Ⓢ** button to switch the meter ON. The initial state depends on the conditions set when the meter was last switched off.
2. Press the **A/C** button to select the desired frequency weighting.
3. Press the **FAST/SLOW/IMPULSE** button to select the desired response time.

Note: Refer to local standards to select the proper weighting and response time for the measurements to be performed. Requirements vary according to country and type of test. OSHA requires Slow and A weight for many of their workplace tests.

4. Use the **▲ ▼** buttons to select the desired dB range. Choose a setting in which the bar graph indication registers approximately in the middle of the range. If the **OVER** indicator appears during a measurement, the upper limit of the selected range has been exceeded. Increase the range setting until the symbol remains off during measurements. Similarly, if the **UNDER** indicator appears, reduce the range setting until the symbol remains off. Both indicators are non-latching and will clear when the correct range is selected.
5. Hold the instrument comfortably in hand (away from the body) or position it on a tripod. Point the microphone toward the noise source, the sound pressure level will be displayed on the meter's LCD display
6. The numeric level indication on the display shows the currently measured sound level. The reading is updated once per second.
7. Press the **MAX** button to display the maximum sound level encountered during a measurement period; the **MAX** indicator will blink appear on the display. Press the **MAX** button again to exit this mode
8. Press **DATE/TIME** to change from current time **hour : minute : second** display to current date **year – month - day** display. The display will revert to the current time display after 2 seconds.

Integrating Sound Level Meter measurements

The integrating sound level mode will measure the sound level over time and calculate the following results:

Leq	Equivalent continuous sound level measurement
SEL	Sound exposure level measurement
SPL MAX	Maximum sound level measurement
SPL MIN	Minimum sound level) measurement
(PH)	Peak Hold sound level measurement
Percentile	Sound level (L05, L10, L50, L90 and L95) measurement

When using this meter in a mode other than the sound level measurement mode, all processing functions provided by the meter are performed simultaneously. For example, when equivalent continuous sound level measurement is selected the exposure level and percentile level are also determined.

1. Press the **Ⓢ** button to switch ON the meter.
2. Press the **A/C** button to select the desired frequency weighting.
3. Press the **FAST/SLOW/IMPULSE** button to select the desired response time.
4. Use the **▲ ▼** buttons to select the desired dB range. Choose a setting in which the bar graph indication registers near the middle of the range. If the **OVER** or **UNDER** indicators switch ON frequently, change the level range setting.
5. Setting the integrating measurement time. (Default or Manual)

Default times:

- a. Press the **INTEG TIME** button once to select a default integrating time.
- b. Use the **▼ ▲** buttons to select the measurement time.
- c. The selection will cycle through: 1sec, 3sec, 10sec, 30sec, 1min, 5min, 8min, 10min, 15min, 30min, 1hour, 8hours, 24hours.
- d. After 5 seconds of inactivity the meter will store the displayed selection and return to the normal mode.

Manually set time:

- a. Press and hold **INTEG TIME** for 3 seconds to manually set the integration time.
- b. A flashing cursor indicates the currently selected parameter (seconds).
- c. Use the **▼ ▲** buttons to set desired second.
- d. Press the **INTEG TIME** button to move to the next parameter (minutes), repeat this procedure until the desired minutes and hours have been set. Press the **INTEG TIME** button to store the setting and to exit this mode. The maximum measurement time setting is 100 hours.

6. Press the ► || button to start the measurement, the ► symbol and the elapsed measurement time is displayed.
 - When the measurement time has elapsed, the measurement automatically terminates and the ■ symbol is displayed.
 - During measurements, the ► || button can be used to pause and resume a test.
 - During pause, the pause symbol || is displayed.
 - To terminate the measurement, press and hold the ► || button for 2 seconds.
 - If an under or over range condition occurs at least once during measurement, the **OVER** or **UNDER** indicator appears to indicate that the recorded data contains over-range or under-range data.
 - During this procedure most of the buttons, such as the **A/C** button and level range buttons, are inoperative. Only the ► || button and the **Leq SEL SPL** buttons can be used. All other settings must be made before starting the measurement.
 - Pause intervals are not included in the measurement time.

7. When the measurement is completed, paused or in progress, press the **Leq SEL SPL** button to cycle through and display the following measurement results.
 - Leq : Equivalent continuous sound level with start measurement time.
 - SEL : Sound exposure level with terminate measurement time.
 - SPL MAX : Maximum sound level with time.
 - SPL MIN : Minimum sound level with time.
 - PH : Peak Hold sound level
 - L:05→5% percentile sound level
 - L:10→10% percentile sound level
 - L:50→50% percentile sound level
 - L:90→90% percentile sound level
 - L:95→95% percentile sound level
 - SPL INST→Current sound level with current time.
 - If **OVER** is flashing, the recorded data contains over-range measurements.
 - If **UNDER** is flashing, the recorded data contains under-range measurements.

8. Press and hold the ► || button for 2 seconds to exit this measurement mode, clear the measured result, and to return to the normal sound level measurement mode.

Setting the Current Time and Date

Date and time information is stored with each stored record block. Therefore, it is important to ensure that this information is correct.

1. Press **Ⓚ** to switch OFF the meter.
2. Press and hold the **DATE TIME** button and then press the **Ⓚ** button to switch ON the meter to enter the date and time setting mode.
3. A flashing cursor indicates the currently selected parameter (seconds), use the **▲ ▼** buttons to set the current second.
4. Press the **DATE TIME** button to move to the next parameter (minutes) and use the **▲ ▼** buttons to set the current minute.
5. Repeat step 4 to set the current hour, day, month, and year.
6. Press **DATE TIME** to store the new date and time, and to exit this mode.

Recording Data

In the Integrating Sound Level Meter mode the meter can record and store measurement data. Memory capacity is 32000 records which can be stored in up to 255 blocks. Recording can start when integration begins or at a preset time. The stored data cannot be viewed on the meter's display; it must be downloaded using the supplied PC software.

1. Setting the data sampling rate.
 - a) Press the **Ⓚ** button to switch OFF the meter.
 - b) Press and hold the **INTEG TIME** button and then switch the meter ON, the **Intr** symbol and the sample rate in seconds will be displayed.
 - c) Use the **▲ ▼** buttons to set the sampling rate (1 to 255 seconds).
 - d) Press **INTEG TIME** to store the setting and exit this mode.
2. Set the integrating functions as described previously.
3. Press the **RECORD ERASE** button to prepare for recording. The **REC** symbol will appear on the display.
4. Press the **▶ ||** button. The measurements will start and the **REC** symbol will begin to flash, indicating that data are being stored.
5. If integration is paused, recording will also pause.
6. When the memory is filled (32000 data points or 255 blocks used), the **REC FULL** symbol will be displayed.

7. To set the recording function to start at a preset time;
 - a) Press and hold the **DATE TIME** button for 2 seconds to enter the PRESET recording start-time setting mode, the **PrE** symbol will be displayed.
 - b) A flashing cursor indicates the currently selected parameter (seconds), use the **▲ ▼** buttons to set the current second.
 - c) Press the **DATE TIME** button to move to the next parameter (minutes) and use the **▲ ▼** buttons to set the current minute.
 - d) Repeat step c) to set the current hour, day, month, and year.
 - e) Press **DATE TIME** to store the start time, and to exit this mode.
 - f) The **▶** and **||** symbols will flash until the start time has been reached. The **▶** and **||** symbols will then stop flashing and the **REC** symbol will begin flashing, indicating that the measurements are being taken and that recording has started.

Clearing stored data

1. Press the **Ⓞ** button to switch OFF the meter.
2. Press and hold the **RECORD ERASE** button and then press the **Ⓞ** button to switch ON the meter.
3. The **CLr** symbol will appear on the display indicating that the data have been erased.

Analog outputs

The analog outputs provide analog signals proportional to the measured values for recorders and other devices. The outputs require a 3.5mm stereo mini-plug.

AC Output:

An AC signal corresponding to the frequency-weighted signal is available at this connector.

Output voltage: $2V_{rms} \pm 100mV_{rms}$ (scale upper limit)

Output impedance: approx. $5k\Omega$

Load impedance: $\geq 1M\Omega$

The output voltage when the instrument is in calibration mode (-6dB from scale upper limit, 1000Hz sine wave) is $0.5V_{rms}$.

DC Output:

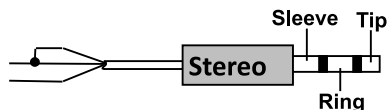
A level-converted DC signal generated by RMS detection and logarithmic compression is available at this connector. The signal reflects the frequency and time weighting settings of the instrument.

Output voltage: $10mV \pm 0.1mV/dB$


Output impedance: approx. $5k\Omega$

Load impedance: $\geq 1M\Omega$

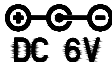
The output voltage when the instrument is reading 94dB is nominally 0.94V DC.



External power source

Insert the plug of an AC adaptor or external battery pack into the DC 6V (DC source from 5V to 6V) socket on the side of the instrument. When a connector is inserted into this socket, the internal batteries will be disconnected and the instrument will be powered from the external source. The low battery symbol  will appear on the display if the external voltage is insufficient for the instrument to provide accurate measurements.

Note: Ensure that the external power source is connected with the polarity as indicated in the following diagram; otherwise damage may be caused to the instrument and external power source.



Windscreen

When making measurements in strong winds, wind noise and strong air movements at the microphone can cause measurement errors. Such effect can be reduced by using the windscreen.

Tripod Mounting

For long-term measurements, the instrument may be mounted on a standard camera tripod using the rear integral $\frac{1}{4}$ " x 20 UNC mounting thread.

Alarm output

If the measured dB level exceeds the set limit, the over limit signal will appear at the alarm output connector (5Vdc output). The output signal will remain active as long as the sound level exceeds the set limit

Setting the sound level alarm high limit:

1. Switch the meter OFF.
2. Press and hold the **LEQ SEL SPL** button while switching the meter ON.
3. Release the **LEQ SEL SPL** button; the **ALARM** symbol (along with the currently set limit) is displayed.
4. Use the **▲ ▼** buttons to set the desired sound level high limit value.
5. Press **LEQ SEL SPL** button to store the setting and to exit this mode.

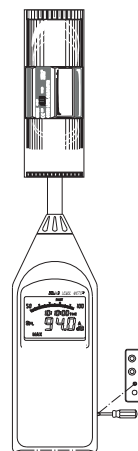
Software Installation and Operation

For installation and operating instructions, please refer to the contents of the supplied CD-ROM.

Calibration

Calibrating the Integrating Sound Level Datalogger requires an acoustical calibrator such as the Extech Model 407766 or 407744.


1. Configure the meter as follows:
 - Display: SPL (dBA)
 - Time weighting mode: FAST
2. Insert the microphone into the opening of the acoustical calibrator.
3. Switch the calibrator ON.
4. Adjust the meter's calibration potentiometer as shown in the accompanying diagram until the meter's display matches the acoustical calibrator output signal (typically 94 or 114dB).
5. Switch the calibrator OFF.
6. Remove the calibrator from the microphone very slowly to avoid damaging the microphone.
7. In cases where adjusting the potentiometer does not affect the displayed reading, or where the adjustment cannot produce the appropriate displayed reading, please return the unit for service.





Maintenance & Cleaning

- Service not covered in this manual should be performed by qualified personnel
- Periodically wipe the case with a dry cloth. Do not use abrasives or solvents.

Battery Installation

When the low battery icon  appears on the display, there is insufficient power to make accurate measurements and the batteries must be replaced.

1. Press the  button to switch off the instrument.
2. Loosen the screw in the battery cover and remove the cover from the battery compartment. Retain the screw and cover.
3. Observing correct polarity, insert four AA batteries.
4. Replace and secure the battery cover.
5. Press the  button to switch ON the instrument; Check for correct operation.



Never dispose of used batteries or rechargeable batteries in household waste. As consumers, users are legally required to take used batteries to appropriate collection sites, the retail store where the batteries were purchased, or wherever batteries are sold.

Disposal: Do not dispose of this instrument in household waste. The user is obligated to take end-of-life devices to a designated collection point for the disposal of electrical and electronic equipment.

Other Battery Safety Reminders

- Never dispose of batteries in a fire. Batteries may explode or leak.
- Never mix battery types. Always install new batteries of the same type.

Specifications

Applicable standards: IEC61672-1: 2003 Class 2
IEC60651: 1979 Type 2
ANSI S1.4: 1983 Type 2
IEC60804: 1985 Type 2

Parameters:

A	A frequency weighting sound pressure level
C	C frequency weighting sound pressure level
FAST	Fast time weighting
SLOW	Slow time weighting
IMP	Impulse time weighting
SPL	Current time-weighted sound pressure level
Leq	Equivalent continuous sound level (A or C)
SEL	Sound exposure level (A or C)
SPL MAX	Maximum sound pressure level (A or C)
SPL MIN	Minimum sound pressure level (A or C)
PH	Peak Hold sound pressure level (A or C)
L:05	5% percentile sound level (A or C)
L:10	10% percentile sound level (A or C)
L:50	50% percentile sound level (A or C)
L:90	90% percentile sound level (A or C)
L:95	95% percentile sound level (A or C)
SPL MAX	Maximum time-weighted sound pressure level (MAX symbol blink)

Measurement range: 30 to 130dB

Peak Hold ranges:

30 – 90 range	63 – 93dB Peak Hold
40 – 100 range	73 – 103dB Peak Hold
50 – 110 range	83 – 113dB Peak Hold
60 – 120 range	93 – 123dB Peak Hold
70 – 130 range	103 – 133dB Peak Hold

Self-generated noise level:

Typical values at 23°C (73.4°F), using the nominal microphone equivalent capacitance of 27pF (30-90dB range)

Weighting	Electrical	Total
A	22.7dB	26.1dB
C	21.8dB	29.5dB

Linearity operating range: A-weighted, 1000Hz, 60dB dynamic range.

Total linear operating range: In accordance with IEC 61672-1, A-weighted, 1000Hz: 30dB to 130dB.

Level range selection: 5 ranges in 10dB steps 30 to 90dB, 40 to 100dB, 50 to 110dB, 60 to 120dB, 70 to 130dB

Linear Operating Ranges (L.O.R.)

RANGE: 30 – 90 dB. Test starting point 64 dB for all weightings and frequencies except 31.5Hz A-weighted, for which the starting point is 44 dB.

FREQUENCY Hz	WEIGHTING	L.O.R. dB	WEIGHTING	L.O.R. dB
31.5	A	36.1 – 50.6	C	39.5 – 87.0
1000	A	36.1 – 90.0	C	39.5 – 90.0
4000	A	36.1 – 90.0	C	39.5 – 89.2
8000	A	36.1 – 88.9	C	39.5 – 87.0

RANGE: 40 – 100 dB. Test starting point 74 dB for all weightings and frequencies except 31.5Hz A-weighted, for which the starting point is 54 dB.

FREQUENCY Hz	WEIGHTING	L.O.R. dB	WEIGHTING	L.O.R. dB
31.5	A	40.0 – 60.6	C	40.0 – 97.0
1000	A	40.0 – 100.0	C	40.0 – 100.0
4000	A	40.0 – 100.0	C	40.0 – 99.2
8000	A	40.0 – 98.9	C	40.0 – 97.0

RANGE: 50 – 110 dB. Test starting point 84 dB for all weightings and frequencies except 31.5Hz A-weighted, for which the starting point is 64 dB.

FREQUENCY Hz	WEIGHTING	L.O.R. dB	WEIGHTING	L.O.R. dB
31.5	A	50.0 – 70.6	C	50.0 – 107.0
1000	A	50.0 – 110.0	C	50.0 – 110.0
4000	A	50.0 – 110.0	C	50.0 – 109.2
8000	A	50.0 – 108.9	C	50.0 – 107.0

RANGE: 60 – 120 dB. Test starting point 94 dB for all weightings and frequencies except 31.5Hz A-weighted, for which the starting point is 74 dB.

FREQUENCY Hz	WEIGHTING	L.O.R. dB	WEIGHTING	L.O.R. dB
31.5	A	60.0 – 80.6	C	60.0 – 117.0
1000	A	60.0 – 120.0	C	60.0 – 120.0
4000	A	60.0 – 120.0	C	60.0 – 119.2
8000	A	60.0 – 118.9	C	60.0 – 117.0

RANGE: 70 – 130 dB. Test starting point 104 dB for all weightings and frequencies except 31.5Hz A-weighted, for which the starting point is 84 dB.

FREQUENCY Hz	WEIGHTING	L.O.R. dB	WEIGHTING	L.O.R. dB
31.5	A	70.0 – 90.6	C	70.0 – 127.0
1000	A	70.0 – 130.0	C	70.0 – 130.0
4000	A	70.0 – 130.0	C	70.0 – 129.2
8000	A	70.0 – 128.9	C	70.0 – 127.0

Frequency range: Overall characteristics including microphone: 31.5 to 8000Hz

Frequency weighting: A, meets the requirement of IEC 61672-1 for class 2 **A** weighting.
C, meets the requirement of IEC 61672-1 for class 2 **C** weighting.

Time weighting (RMS detection): Fast, according to IEC 61672-1 class 2.
Slow, according to IEC 61672-1 class 2.
Impulse, according to IEC 61672-1 class 2.

Reference conditions:

Type of the acoustic field: Free
Reference sound pressure level: 94.0dB (related to 20µPa)
Reference level range: 60 to 120dB
Reference frequency: 1000Hz
Reference temperature: +23°C (73.4°F)
Reference relative humidity: 50%RH
Reference static pressure: 101.325 kPa
Reference incidence direction: Perpendicular to the front of the microphone diaphragm.

Calibration:

Acoustical calibrator (Extech 407744 or equivalent)

Calibration check frequency is 1000Hz.

Nominal calibration level for the free field: 94.1dB

Nominal calibration level for the diffuse field: 94.0dB

Frequency for acoustic testing: 8000Hz

Warm-up time: ≤ 2 min

Sampling interval: Bar graph indication \rightarrow 125 ms approx.
Numeric indication \rightarrow 1 sec approx.

Data record capacity: Data can be stored in memory.
Max. 32000 readings can be stored
Max. 255 blocks

LCD Display

Display screens:

4 digit numerical indication of sound level, from 30.0 to 130.0dB with 0.1dB resolution.

Bar-graph indication of current sound level with 1dB resolution.

Sound level range indicator: 30–90dB, 40–100dB, 50–110dB, 60–120dB or 70–130dB in five ranges.

Time display; year – month – day and hour: minute: second.

Display update rate: 1 second

Display's start-up indication: Depends on the condition of meter when it was last switched off.

Warning indications:

Out-of-range indications:

OVER displayed at upper limit of the range

UNDER displayed at lower limit of the range

Outputs

AC output (using selected frequency weighting)

Output voltage: 2Vrms (at full-scale of the range)

Output impedance: 5k Ω

Load impedance: ≥ 1 M Ω

DC output

Output voltage: 10mV/dB

Output impedance: 5k Ω

Load impedance: ≥ 1 M Ω

I/O connector: Sound level meter control from, and data output to, PC (USB)

Alarm output: 5Vdc, typical

Power requirements

4 x 1.5V IEC R6P (size "AA") manganese super heavy duty batteries or equivalent

Battery life: Approx. 24 hours

External power source: DC voltage from 5V to 6V; Current rating: Approx. 20mA @ 6V

Ambient conditions:

Operating conditions: -10°C to +50°C (14 to 122°F), 30% to 90%RH non-condensing

Storage conditions: -10°C to +60°C (14 to 140°F) <70%RH non-condensing

Effect of temperature: < 0.5dB from -10 to +50°C (14 to 122°F),

Effect of humidity: < 0.5dB (for 30%RH to 90%RH at 40°C [104 °F], 1000Hz)

Effect of vibration: A 40 Hz 1m/s vibration produces no noticeable effect.

Effect of magnetic field: No noticeable effect.

Standards Compliance:

: indicates compliance with applicable European Union Directives.

EMC Emission: IEC 61000-6-3, Generic emission standard for residential, commercial and light industrial environments. No significant emissions from the instrument. IEC 61672-1, Instrumentation standard classification group X and performance class 2 sound level meter.

EMC Immunity: IEC 61000-6-2, Generic standard-Immunity for industrial environments. No degradation in performance when subjected to 10V/m un-modulated.

Dimensions: Approx. 265(L)×72(W)×36(H) mm (10.4 x 2.8 x 1.4")

Weight Approx. 380g (including battery): (13.4 oz.)

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