CEL-62X SERIES SOUND LEVEL METER

HB3340-02

OPERATOR'S MANUAL

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1. INTRODUCTION

CEL-62X Series is a range of Sound Level Meters designed to meet the demands of worldwide industrial health and safety professionals as well as general noise measurement applications. The instrument encompasses functionality from basic sound level measurement to integrating and real-time octave band analysis.

The CEL-62X instrument is based on the very latest digital signal processing technology and has a crisp, vibrant colour TFT LCD display. This precision instrument is designed to bring your noise measurements up to date giving confident and reliable performance fully compliant with international standards.

Data is stored in a .csv format, compliant with MS Office applications, and through the USB connection, the .csv files can be copied to a PC without the need for any propriety software packages.

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2. INSTRUMENT FEATURES

The CEL-62X Sound Level Meter comprises of several variants, where the 'X' represents a number which determines the model variant and subsequent features. Subsequent letters denote the frequency analysis capability, 'A' for broadband, 'B' for 1/1 octave band and 'C' for 1/3 octave, e.g. CEL-620C.

CEL-620

An integrating meter providing A, C, and Z frequency weightings, Fast Slow and Impulse time weightings with cumulative storage and PC connectivity functions. A single measurement range of 140dB RMS is standard. Simultaneous L_{Aeq} and L_{Ceq} values are measured for use in the HML selection of hearing protection method. L_{avg} is available with a selectable threshold. This model is available in Class 1 or Class 2 accuracy standards.

CEL-621

Additional parameters are added for the measurement of environmental noise. Statistical parameters ($L_{n\%}$) are available and can be altered to suit specific environmental legislation.

Frequency Analysis

Models providing 'Integrating' functionality combined with addition of 1/1 Octave bands (B model) or both 1/1 Octave and 1/3 Octave bands (C model) analysis. This instrument is designed to satisfy the demands of all industrial noise at work applications. Octave results may be displayed graphically or in numerical form and can be A, C or Z frequency weighted. Advanced DSP processing provides fast parallel processing of Octave results from 16Hz to 16kHz, or 1/3 Octave results from 12.5Hz to 20kHz. This model is available in Class 1 or Class 2.

DESCRIPTION (*Refer to Figure 1)*

The CEL-62X has a compact, ergonomic and robust 'rubber grip' case design that sits the instrument comfortably in the hand when not mounted on a tripod. The ½" microphone (under windshield 1) can be removed from the fixed preamplifier (2). The windshield (1) should be used to cover and protect the microphone at all times.
When the instrument is switched ON (3) it will run through its own software initialisation and then default to a Stop mode (Red Bar) screen.

To navigate within a screen use the Cursor Keys (6). Not all the screens have navigable fields on the display. To navigate from one screen to another, use the Soft Keys (5). To start a 'run' (measurement), press the **Run/Stop** Key (7); to stop the run press the same key again.

The instrument has a single measurement range to 140dB (RMS) and 143.3dB (C) peak. No range adjustment is needed which greatly simplifies operation.

The CEL-62X can be 'explored' just like a USB memory device and the data files of the individual measurements are saved in a .CSV (Comma Separated Variable) format that is compatible with MS Office applications. This means that no software needs to be installed onto a PC to retrieve the data.

The CEL-62X measures all the required parameters simultaneously with the required frequency and time weighting.



1 – Windshield (covering removable microphone), 2 – Fixed Pre-amplifier, 3 – ON/OFF Key, 4 – Display, 5 – Soft Keys, 6 – Navigation Cursor Keys, 7 – Run/Stop Key.

Figure 1 CEL-62X Series

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BATTERY INSTALLATION (Refer to Figure 2)

CAUTION: The batteries can be zinc carbon, alkaline or rechargeable. Do not mix battery types.

The CEL-62X Instrument requires three AA batteries. Remove the battery compartment cover. Check correct polarity. Fit the batteries. Refit the battery cover. Press and release the **ON/OFF** Key. Check the battery condition symbol shows the battery has a good charge.

Note: For long term tests, where the batteries may become exhausted, use a 12VDC supply to power the CEL-62X. The 12VDC can be plugged in at any time and will be automatically used instead of the batteries. When downloading data to a PC the CEL-62X can be powered by the USB connection. The 12VDC or USB connection will not re-charge batteries. With 12VDC or USB connected the battery condition symbol will show full charge and not the actual condition of any installed batteries.

To extend battery life, if the CEL-62X is not making a measurement run and there are no key presses, the instrument will automatically turn off after a period of 5 minutes. This auto power off facility is disabled when the CEL-62X is powered from 12VDC or USB. The auto power off facility is independent of the backlight time settings – see paragraph E – Set Backlight below.

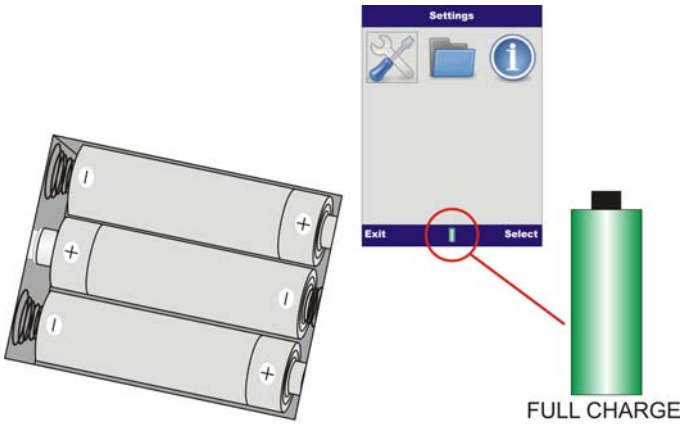


Figure 2 Battery Charge Indicator and Battery Installation.

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3. OPERATION

A. SWITCH ON the CEL-62X INSTRUMENT (Refer to Figure 3)

Press the **ON/OFF** Key to switch the instrument on (see Figure 1). The instrument software screens have been designed with colour coded top and bottom bars to enable the user to know at a glance which part of the firmware (operating system) is currently being accessed.

Colour coding is as follows:

RED – Stop screens. These screens are displayed when the instrument has completed initialisation after power-up, as well as prior to taking a measurement run.

BLUE – Setting screens. These screens are used to set up the instrument correctly and includes settings such as date and time, language and backlight.

LIGHT BLUE – Memory Results screens. This is where the results from measurement runs are viewed.

GREEN – Run screens. These screens show a measurement run is in progress. Measured values are stored in the Memory Results.

YELLOW – Calibration screen. This screen is automatically displayed upon application of a 1kHz Acoustic Calibrator. This is where the instrument is calibrated prior to a run.

This is a precision instrument and should be calibrated before use to ensure accurate measurements.

Also care should be taken that the operator does not unduly affect the sound field. Ideally the instrument should be mounted on a sturdy tripod with the microphone perpendicular to the source of the sound to be measured – the operator should be as far behind the instrument as possible. If the instrument is to be hand held, then the arm of the operator should be stretched out as far as possible to minimise reflections from the operator's body. Refer to Appendix B for the affects of the instrument on the sound field.

CEL- 62XA – When the instrument is powered up, the initialisation screens will be displayed first, followed by the Graph screen in the Stop mode (Red Bars). Press **Menu** (A) to access the Menu screen.

CEL- 62XB or CEL-62XC – When the instrument is powered up, the initialisation screens will be displayed first, followed by the Octave (or 1/3 Octave on C models) screen in the Stop mode (red bars). Press **View** (B) to see the Graph screen. Press **Menu** (A) to access the Menu screen.

The instrument is ready to make measurement immediately after the initialisation screens have been displayed (approximately 10 seconds after switch ON).



Figure 3 Switch ON the CEL-62X (Sheet 1)

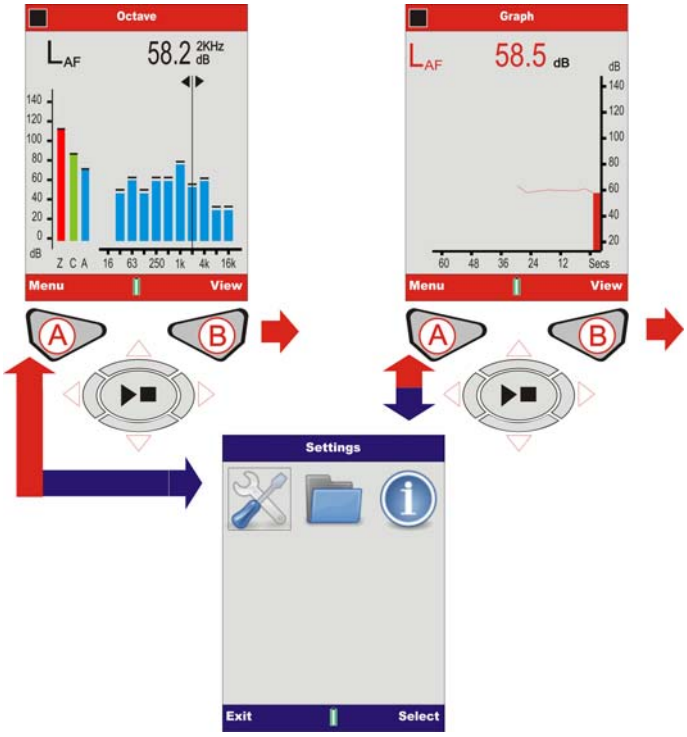


Figure 3 Switch ON the CEL-62X (Sheet 2)

B. SETTINGS SCREENS (Refer to Figure 4)
Note: Press **Exit** (A) at any time to go back to the previous screen.

SETTINGS

The Settings menu allows configuration of instrument setup, time/date, language, backlight, run duration timer and calibration level.

Use the **Left/Right** Cursor Keys (C) to navigate to the Settings icon (1) and press **Select** (B).

CHANGING FROM 1/1 OCTAVE TO 1/3 OCTAVE

CEL-62XC models have both 1/1 octave and 1/3 octave functionality. In order to change between 1/1 octave and 1/3 octave, use the Cursor Keys (C) to navigate to the Octave icon (3) and press **Select** (B). Use the Cursor Keys (C) to navigate to either 1/1 octave or 1/3 octave icon and press **Select** (B).

Note: This option is only available on 1/3 octave CEL-62XC models.

SETUP

This menu allows selection of the parameters to be viewed during a measurement run. Note that regardless of the Measurement View selected, all parameters will be stored simultaneously and can be viewed via a PC. Use the Cursors Keys (C) to navigate to Setup icon (2) and press **Select** (B).

MEASUREMENT VIEW.

Predefined views are available to satisfy measurements for international workplace noise legislation. Use the **Up/Down** Cursor Keys (C) to highlight the required view and press **Activate** (B) to select the Measurement View. The Measurement View with the word 'Active' next to it will be used for measurement runs. To view the details press **View** (B).

On CEL-621 units, two fixed Environmental Views are available which provide additional statistical parameters ($L_{n\%}$) and parameters unique to workplace noise are removed.

USER 1 AND 2 SETTINGS.

Two customisable views are available in which measurement weightings and parameters can be set. When one of these views is Active by pressing **Activate** (B), press (B) again to edit the view. The **Left/Right** Cursor Keys are used to make changes and the **Up/Down** Cursor Keys are used to move to the next field. On this screen you can define the following:

RESPONSE (Random/Freefield)

Random microphone response is typically used to conform to US legislation for workplace noise whereas Freefield is used throughout the EU.

LAVG THRESHOLD (70-90dB)

The threshold is used for the calculation of L_{AVG}, which is the level at which all noise below is ignored. Note with threshold set to zero the threshold is off.

OCTAVE WEIGHTING (A, C or Z)

The frequency weighting used to display 1/1 or 1/3 octave band results. Note that regardless of the settings selected, Z weighted measurements are stored so the data can be post-processed on a PC to C or A weighting.

OCTAVE TIME CONST (F or S).

The time weighting used to display 1/1 or 1/3 octave band results. Regardless of the selection, both time weightings are stored simultaneously for L_{MAX} results. Time weightings of Fast (F) or Slow (S) do not apply to L_{eq} measurements.

Press the **Run/Stop** Key (D) to restore defaults. Press **Functions** (B) to open the Functions screens for the selected 'User 1 View'.

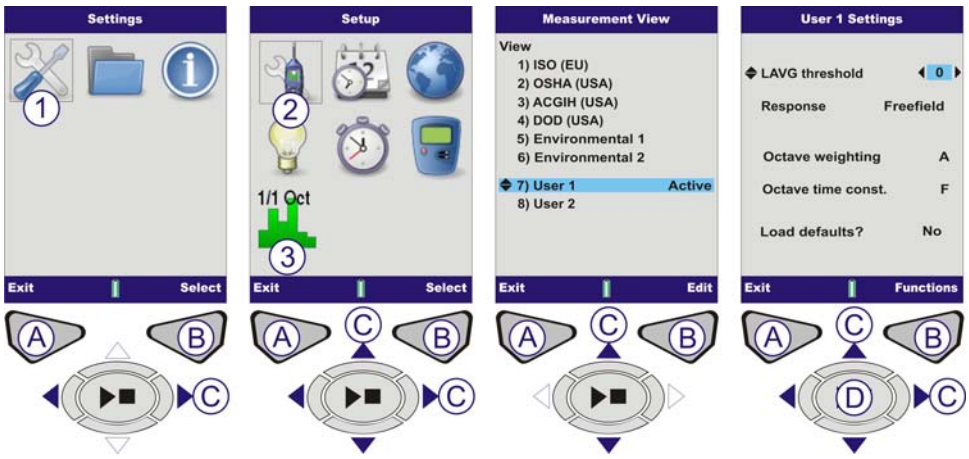


Figure 4 Setting Options (Sheet 1)

USER 1 AND 2 MEASUREMENT PARAMETERS

The Functions screens allow the Operator to select up to nine functions for the measurement 'run'. A counter replaces the battery level indicator at the foot of the screen. The counter displays the number of parameters selected.

Press **Functions** (B) and use the Cursor Keys (C) to navigate to the next parameter.

The first screen shows Sound Pressure Level (SPL) and L_{eq} values. The parameters displayed during a measurement run are highlighted in green.

The Main SPL value is highlighted in red, which is the SPL value shown in Stop and Run modes. To select the Main value press and hold the **Run/Stop** Key (D) until the parameter is highlighted in red.

Other parameters can be added. Navigate to the appropriate parameter that is to be added. A rectangle indicates the selected parameter. Press the **Run/Stop** Key (D) to select the parameter. The parameter is highlighted green to show it is selected. Repeat for any subsequent parameters that need to be selected and access the additional screen by pressing **More** (B). Press **Back** (A) to exit and any changes will be automatically saved.

The CEL-621 will have an additional screen to adjust the stored statistical data. Within these setups, $L_{n\%}$ values can be switched on and off as required and one of the L_n values can be varied to any percentage between 0.1 and 99.9%.

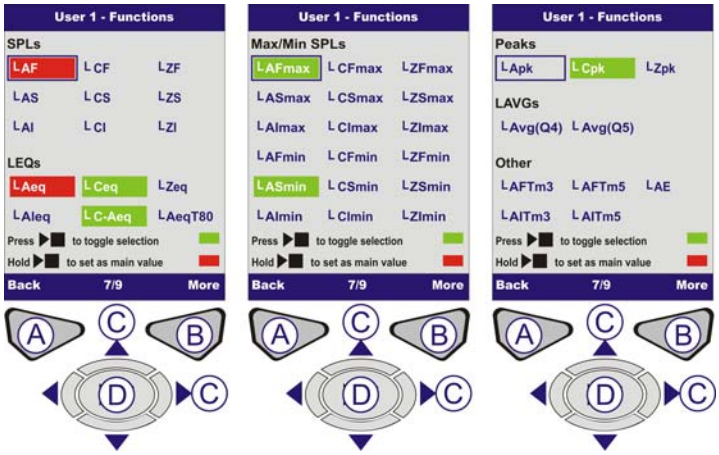


Figure 4 Settings Options (Sheet 2)

C. DATE AND TIME SCREENS (Refer to Figure 5)

SETTINGS

From the Menu screen use the Cursor Keys (C) to navigate to the Settings icon (1) and press **Select** (B).

SET CLOCK

Use the Cursors Keys (C) to navigate to the Set Clock icon (2) and press **Select** (B)

SET TIME

The screen will be displayed with the Time field highlighted. To set the time press **Edit** (B). The hours will be highlighted in red, use the **Up/Down** Cursor Keys (C) to adjust the settings and the **Left/Right** Cursor Keys (C) to move between the hours, minutes and seconds. When the correct time has been set, press **Save** (B).

SET DATE

Press the **Up/Down** Cursor Key (C) to highlight the Date Field. Press **Edit** (B) the day will be highlighted in red, use the **Up/Down** Cursor Keys (C) to adjust the settings and the **Left/Right** Cursor Keys (C) to move between the day, month and year. When the correct date has been set, press **Save** (B).

CLOCK SET.

The time and date is now set. Press **Exit** (A) to go back to the Set Clock screen.

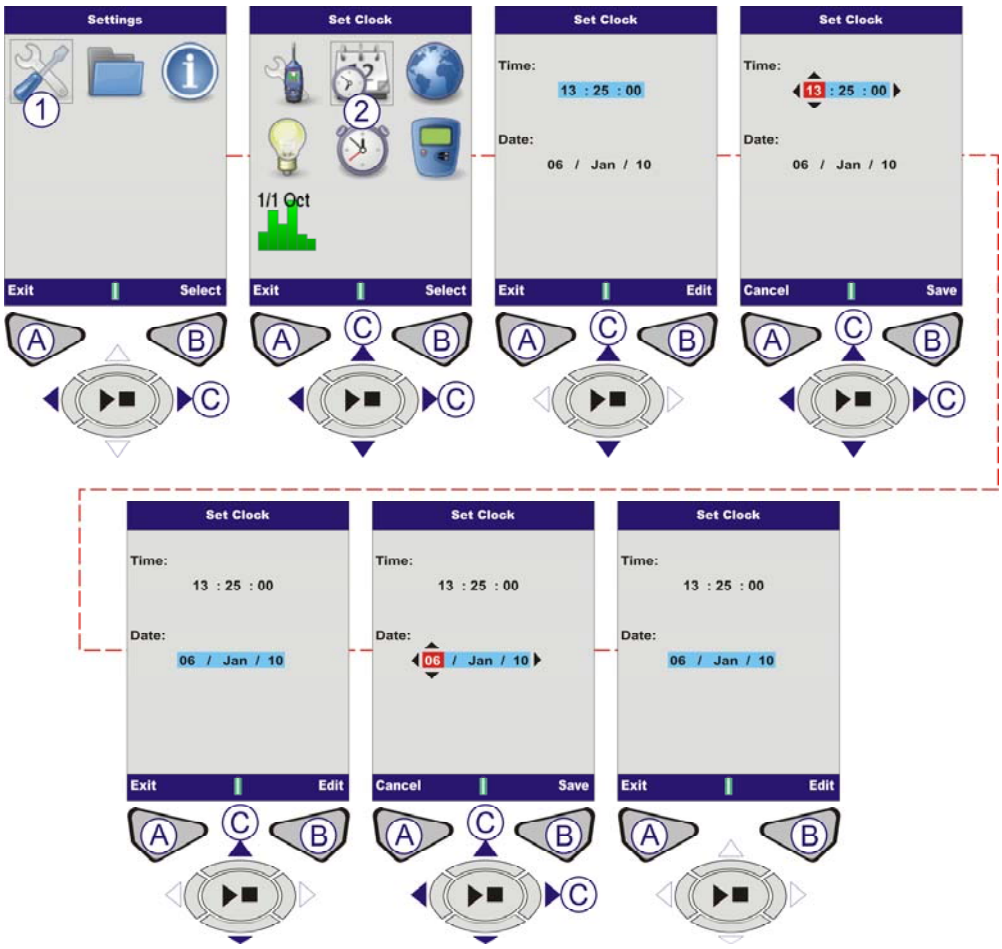


Figure 5 Set Date and Time

D. SET LANGUAGE (Refer to Figure 6)

LANGUAGE

From the Menu screen use the Cursor Keys (C) to navigate to the Settings icon (1). Use the Cursor Keys (C) to navigate to the World icon (2). Press **Select** (B).

Use Cursors Keys (C) to choose the desired language and press **Select** (B). Press **Exit** (A) when finished.

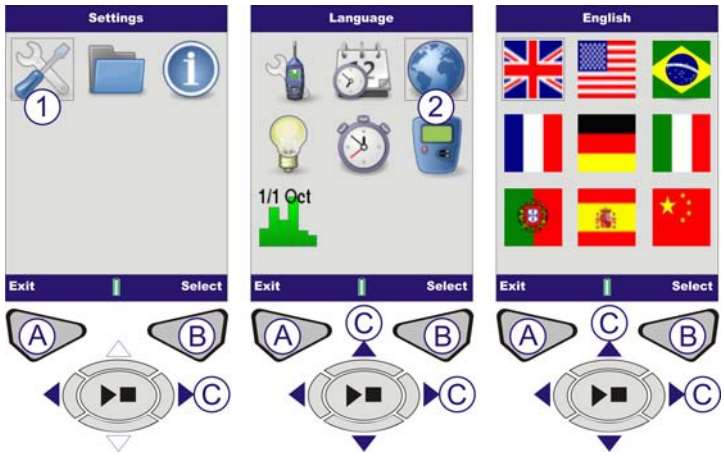


Figure 6 Set Language

E. SET BACKLIGHT (Refer to Figure 7)

BACKLIGHT

From the Menu screen use the Cursor Keys (C) to navigate to the Settings icon (1). Use the Cursor Keys (C) to navigate to the Backlight icon (2). Press **Select** (B).



Figure 7 Set Backlight (Sheet 1)

ACTIVATION

The screen will be displayed with the Activation field highlighted. To set the Activation mode press **Edit** (B). Use the **Left/Right** Cursor Keys (C) to toggle between the following backlight modes:

KEYPRESS- The backlight stays on for a set Duration following any key press.

ON- Backlight remains on continuously. If the ON option is selected the Duration setting will be disabled.

DURATION

If the Activation mode is set to Key press, the duration the backlight remains on can be set. Press the **Up/Down** Cursor Keys (C) to highlight the Duration field. To set the Duration press **Edit** (B). The minutes will be highlighted, use the **Up/Down** Cursor Keys (C) to adjust the settings and the **Left/Right** Cursor Keys (C) to move between the minutes and seconds. When the Duration has been set, press **Save** (B).

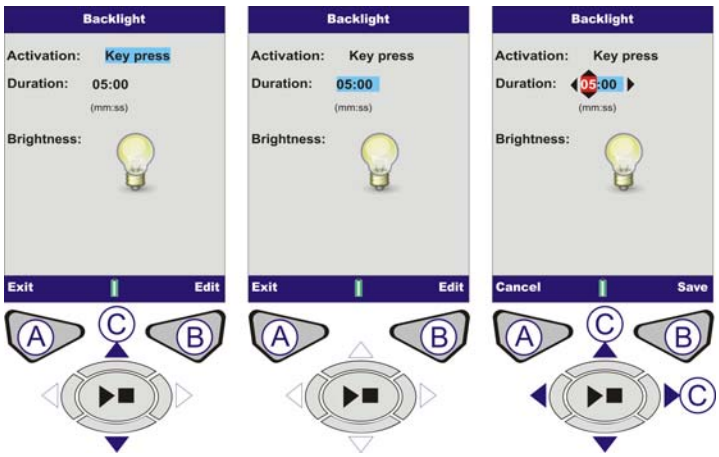


Figure 7 Set Backlight (Sheet 2)

BRIGHTNESS

The backlight brightness affects the battery life. For improved battery performance use the lowest brightness level suitable for your environment.

Press the **Up/Down** Cursor Keys (C) to highlight Brightness icon. To set the Brightness press **Edit** (B). The Brightness icon will be highlighted, use the **Left/Right** Cursor Keys (C) to adjust the brightness. When the Brightness has been set, press **Save** (B).

Press **Exit** (A) to go back to the Settings screen.



Figure 7 Set Backlight (Sheet 3)

F. SET RUN DURATION (Refer to Figure 8)

RUN DURATION

The Duration timer allows measurements runs to be performed over a specified time. At the end of this time the measurement will automatically be stopped. From the Menu screen use the Cursor Keys (C) to navigate to the Settings icon (1). Use the Cursor Keys (C) to navigate to the Run Duration icon (2). Press **Select** (B).

DURATION TIMER

The screen will be displayed with the Duration timer field highlighted. Press **Edit** (B) to set the Duration timer. Use the **Left/Right** Cursors (C) to toggle between either On or Off. Press **Save** (B) to continue.

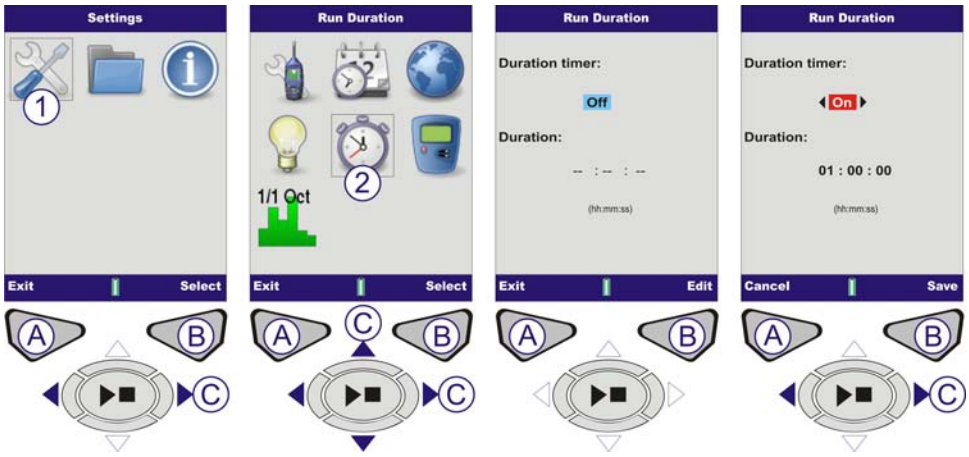


Figure 8 Run Duration (Sheet 1)

DURATION

Press the **Up/Down** Cursor Keys (C) to highlight the Duration field. To set the Duration press **Edit** (B). The hours will be highlighted, use the **Up/Down** Cursor Keys (C) to adjust the settings and the **Left/Right** Cursor Keys (C) to move between the hours, minutes and seconds. Range of duration/integration time is 00:00:01 to 24:00:00 in 1 second steps. When the Duration has been set, press **Save** (B).

Press **Exit** (A) to go back to the Settings screen.

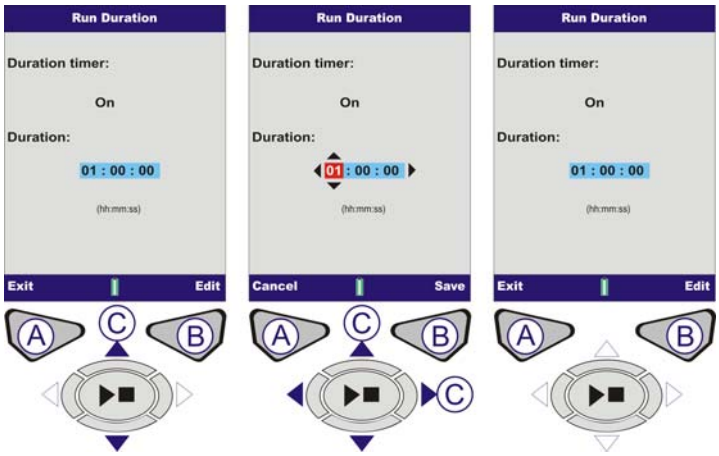


Figure 8 Run Duration (Sheet 2)

G. CAL. REF. LEVEL (Refer to Figure 9)
Note: For Instrument Calibration refer to Section K – Calibration Screens.

For free field and microphone corrections to the calibrator level refer to "Sound Calibrators – Level Corrections" in Appendix B.

CAL. REF. LEVEL

The Calibration Reference Level is used to set the instrument's calibration level to the exact level of your calibrator plus any other required corrections. Calibration levels can be set from 93-95dB or 113-115dB. A 1kHz calibrator must be used.

From the Menu screen use the Cursor Keys (C) to navigate to the Settings icon (1). Use the Cursor Keys (C) to navigate to the Cal. Ref Level icon (2). Press **Select** (B).

The Calibration Reference Level (Cal. Ref. Level) screen will open with the last level used for calibration. Press **Edit** (B) to alter the level.

The first digit can be selected 0 or 1 only, other digits can be 0-9. Use the **Up/Down** Cursor Keys (C) to adjust the digits and the **Left/Right** Cursor Keys (C) to move between digits. Press **Save** (B).

Press **Exit** (A) to go back to the Settings screen.

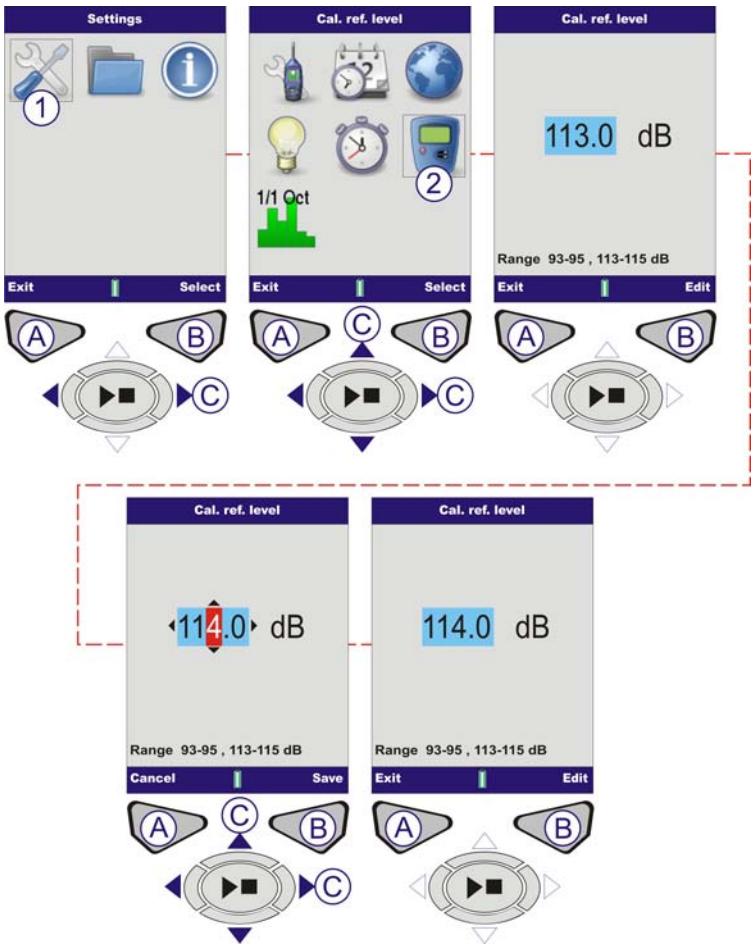


Figure 9 Calibration Reference Level

H. VIEW MEMORY RESULTS (Refer to Figure 10)

This is where the results from completed runs are stored. The Runs are stored in a chronological order, with the latest run at the top of the list.

MEMORY RESULTS 

From the Menu screen use the Cursor Keys (C) to navigate to the Memory Results icon (1). Press **Select** (B) to access the memory.

From the chronological list of Runs stored use the **Up/Down** Cursors Keys (C) to select a Run. When a Run has been selected, press **Select** (B).

This screen gives the operator the choice to view the selected a Run, or to delete it. Use the Cursor Keys (C) to navigate to the View Results icon (2) and press **Select** (B).

The Results screen displays an overview of measurement data for the selected a Run. This is read only. To see the specific results, press **View** (B).

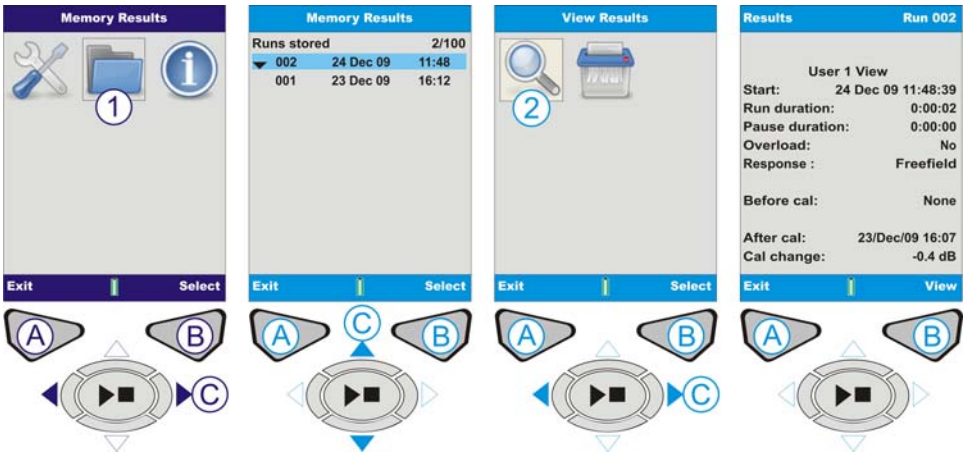


Figure 10 View Memory Results (Sheet 1)

The Octave values (CEL-62XB and C models only) saved in the Results are displayed in a graphical format. Use the **Left/Right** Cursor Keys (C) to move the cursor (1) across the graph. Each graph bar represents an octave band measured in Hz or KHz.

Use the **Up/Down** Cursors Keys (C) to toggle between parameters such as L_{MAX} and L_{AEQ} (2).

To view the numerical results (CEL-62XB and C models only), press **View** (B).

On CEL-62XC models, use the **Up/Down** Cursors Keys (C) when viewing numerical results to alter the frequencies viewed.

Press **Exit** (A) to leave the Results or **View** (B) to cycle the Results screens again.

Note: On CEL-62XC models either 1/1 octave values or 1/3 octave values will be displayed dependent on the setup at the time of measurement.

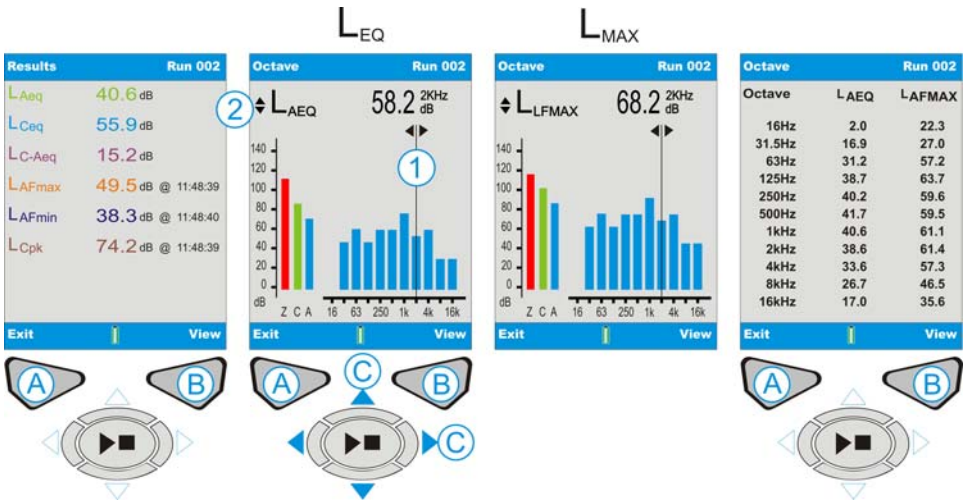


Figure 10 View Memory Results (Sheet 2)

I. DELETE MEMORY RESULTS (Refer to Figure 11)

From the chronological list of Runs use the **Up/Down** Cursors Keys (C) to select a Run. When a Run has been selected, press **Select** (B).

This screen gives the operator the choice to view the selected a Run, or to delete it. Use the Cursor Keys (C) to navigate to the Delete icon (2) and press **Select** (B).

This screen asks the operator to either delete only the current run or to delete all the runs within the memory. Use the **Up/Down** Cursors Keys (C) to make the required selection and press **Select** (B). The next screen asks for final confirmation to permanently delete the Run. Press the **Tick** (A) to confirm. The Run will be permanently deleted. If unsure, press the **Cross** (B) to go back the Memory Results list.

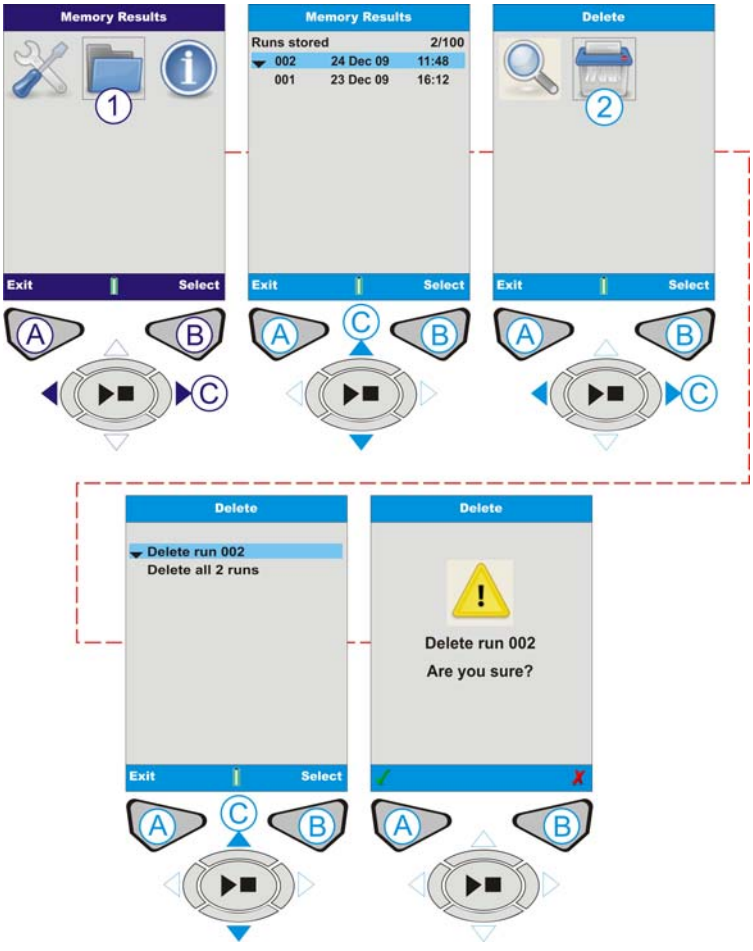


Figure 11 Delete Memory Result

J. RUN SCREENS (Refer to Figure 12)

The Instrument has four Run screens: The Main screen, the Graph screen, the Octaves screens and the Octaves Values screen, the last two of which are only available on the CEL-62XB and CEL-62XC.

Switch **ON** the instrument as detailed in Figure 3.

CEL-62XA – Press the **Run/Stop** Key (D) to go to the Graph screen.

CEL-62XB and CEL-62XC– OCTAVE screen. Press the **Run/Stop** Key (D) to go to the Octaves screen (or 1/3 Octave on CEL-62XC model).

All CEL-62X Models – The "Play" symbol is displayed in the top left hand corner of the screen. The "Pause" symbol is in the bottom left hand corner of the screen. The left hand Soft Key (A) is the **Pause/Run** feature. When Pause is selected, 'Paused' will be displayed on the screen. The incremental run number and duration are displayed in the top right hand corner of the screen. If the Run Duration Timer is set, a 'stopwatch' symbol (1) will appear next to the countdown timer. The Run Duration timer is enabled and disabled in SETTINGS (Refer to Figure 8). If the Run Duration is not set, the digital timer will count up until the run is stopped manually by pressing the **Run/Stop** Key (D).

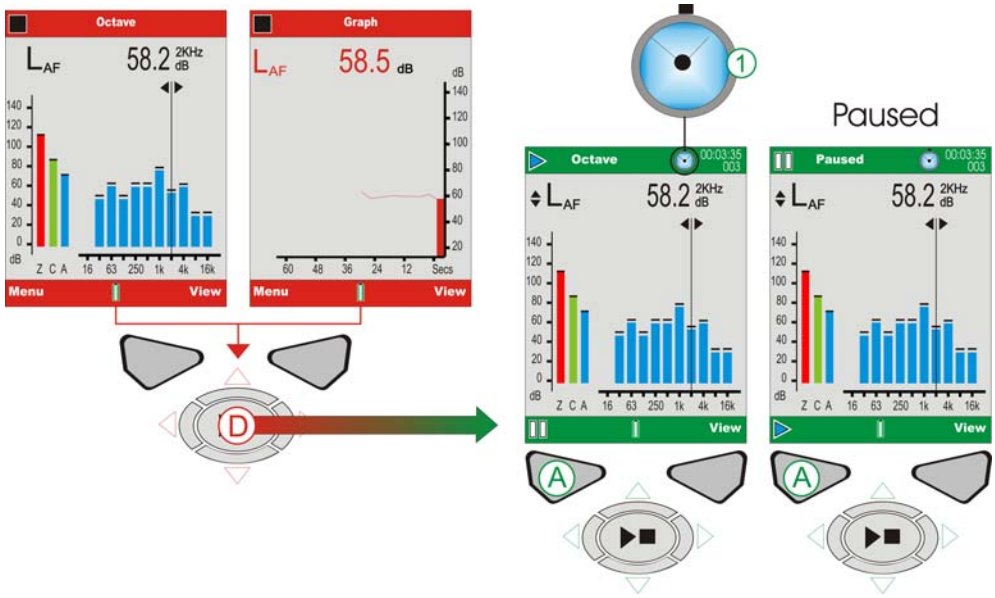


Figure 12 Run Screens

CEL-62XA (Refer to Figure 13). The broadband values can be viewed as a bar graph on the Main screen, or as a graphical time history on the Graph screen. Pressing **View** (B) toggles between Graph and Main screens.



Figure 13 CEL-62XA Run Screens

CEL-62XB & CEL-62XC (Refer to Figure 14).

The CEL-62XB and CEL-62XC provides two additional octave screens shown in Figure 14. Press **View** (B) to toggle the four available screens. Use the **Left/Right** Cursor Keys (C) to move across the frequency bands (1) when in graphical view. Use the **Up/Down** Cursor Keys (C) to toggle between LMAX and LEQ parameters (2).

Each graph bar represents an octave band measured in Hz or kHz. To view a table of the octave values, press **View** (B).

On CEL-62XC models, use the **Up/Down** Cursor Keys (C) when viewing numerical table to alter the 1/3 octave frequencies viewed.

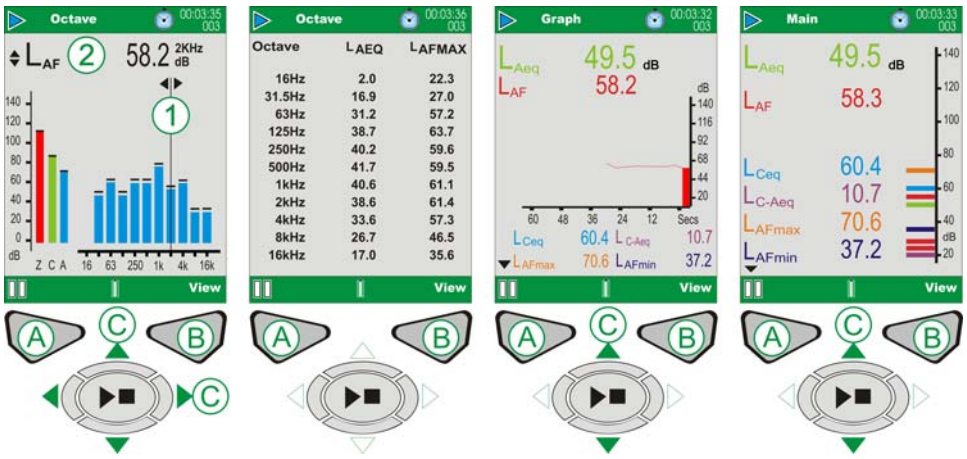


Figure 14 CEL-62XB & C Main Run Screens

K. INSTRUMENT CALIBRATION (Refer to Figure 15)

Note: The Instrument must be at a STOP screen before the Acoustic Calibrator is fitted.

For calibrator reference level adjustment refer to Section G.

Calibrations should be performed before and after measurements. Fit the acoustic calibrator over the removable microphone and push it home. Switch the calibrator on using **ON/OFF** Key (1). The Instrument detects the signal and automatically activates the calibration screen (yellow bars). Press the **Tick** (B) to begin calibration. The instrument will be calibrated and the word PASSED displayed. A 'calibration change' value is shown at the bottom of the screen. This identifies the change since the previous calibration. Remove the acoustic calibrator. Press **Exit** (A) to go back to the Stop screen. Press and hold the acoustic calibrator **ON/OFF** Key to switch the calibrator off.

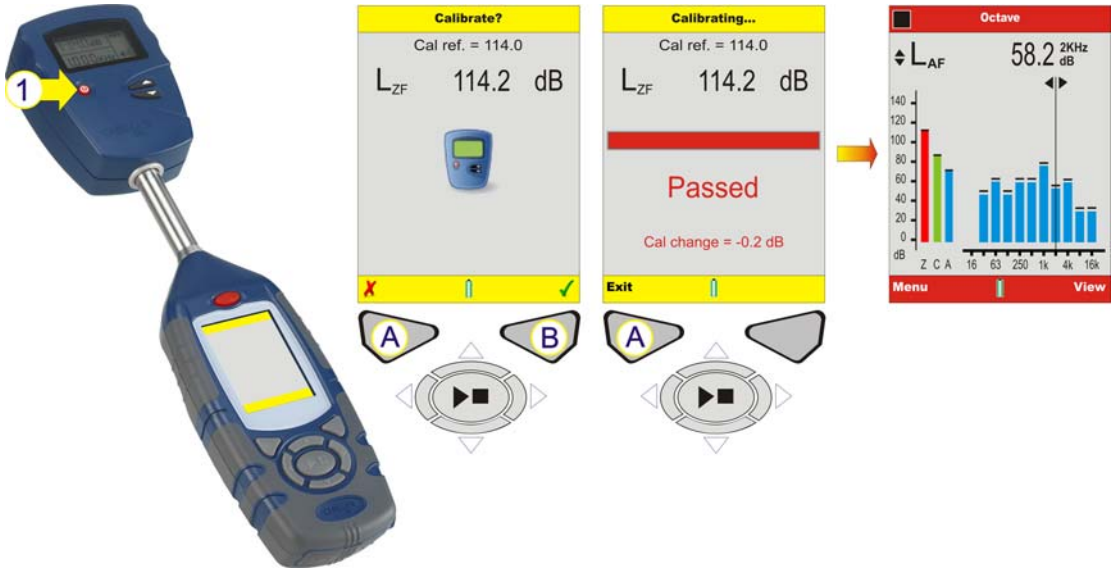


Figure 15 Instrument Calibration

L. EXTRACTING DATA (Refer to Figure 16)

Each measurement run is stored as a file within the CEL-62X in a .CSV format. This format will automatically open with MS EXCEL or similar office applications. The files are named consecutively from 1 to 100, so the first run will be named R001.CSV. All measurement parameters are contained within these files, regardless of the displayed parameters selected within the instrument setup.

The CEL-62X acts as a removable storage device when connected to a PC by the CMC51 cable. See Figure 18 for the location of the USB connection on the CEL-62X Series. Once connected, the PC will automatically detect the instrument is connected and within a few seconds have installed the necessary drivers. An Explorer window will open on the PC to show the files on the instrument. Simply copy the files to your PC as required.

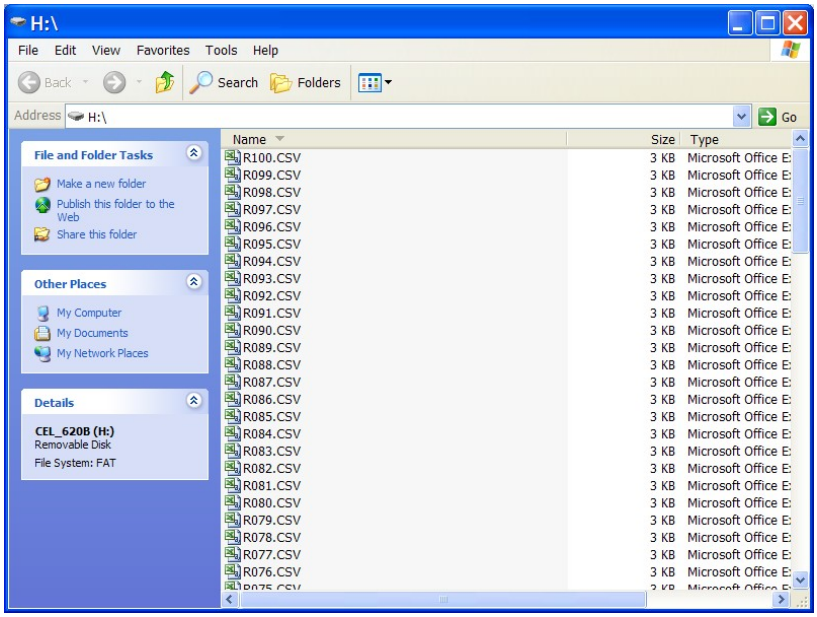


Figure 16 Measurement Data Files

M. SYSTEM TOOLS (Refer to Figure 17)

The system tools menu can be accessed from the startup screen by pressing the **Left/Right** Cursor Keys (C) together. Note that these functions need not be used within general operation and stored results will be lost if incorrectly used. Their primary function is for calibration laboratories or diagnostic purposes. Three options are available:

'Recover USB Disk Files' copies files stored in the backup E^2 memory to the USB disk.

'Set USB Disk R/W' allows the mass storage device to have data written to it. Note that this is primarily used for testing purposes.

'Format All Memory' will format the USB memory. **CAUTION:** All measurement data will be lost!

Use the **Cursor** Keys (C) to highlight the required option and press **Select** (B). When selected a final confirmation will be shown, press the **Tick** (A) to confirm or the **Cross** (B) to cancel. Once finished press **Exit** (A).

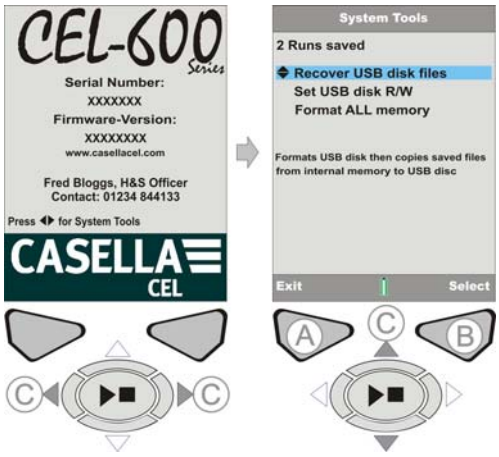


Figure 17 System Tools

4. STORAGE

Keep the Instrument and the associated equipment in its padded case at all times when not in use. Keep the Instrument dry, in a dust free environment, and away from heat generating and ozone generating sources. If the Instrument is not going to be used for a week or longer, remove the batteries from the battery compartments.

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5. LOW AND HIGH SOUND LEVELS

Low Level Sounds.

Providing the sound level being measured is within the linearity range (refer to Appendix B paragraph “e - Linear operating range”), self generated noise and linearity corrections can be ignored.

When the measured RMS sound level is below the linearity range and 3 dB above the self generated noise (refer to Appendix B paragraph “h - Self generated noise), it is possible to correct the measured level by the following formula:

Note: As the CEL62X is a single range instrument capable of reading to zero dB, and the only non linearity error will be due to self generated noise, then there is no under-range indicator.

$$L_{act} = 10\log(10^{(L_{ms})/10} - 10^{(L_{sg})/10})$$

Where L_{act} = Actual corrected sound level

L_{ms} = Measured sound level

L_{sg} = Self generated noise level

High Level Sound (Overload).

When a sound level is detected that is above the linear operating range, the display will indicate overload by a red upward facing arrow at the top of the display.

If the CEL-62X is not completing a measurement run then the overload indication will automatically reset approximately 2 seconds after the sound level is reduced to below overload.

If the CEL-62X is completing a measurement run then the overload indication will remain, even if the overload sound level is reduced, until the measurement run is terminated manually or by the timer. If the data collected during the run is viewed on the CEL-62X, or downloaded to a PC, then an overload will be reported in the data.

Refer to sections **F,H** & **J** to set run durations, memory results and run screens.

6. SPECIFICATIONS

GENERAL

The CEL-62X provides SPL, Integrating and Octave band noise measurement compliant with the following international standards:-

IEC 61672-1 2002-5 (Electro-Acoustics – Sound Level Meters) Group 'X' instruments. Performance of Class 1 or 2 as relevant to instrument model.

IEC 60651: 1979, IEC 60804: 2000, ANSI S1.4: 1983, ANSI S1

1/1 Octave and 1/3 Octave Filters comply with EN61260: 1996, Class 0 and ANSI S1.11 1986, Order-3 Type 0C.

MEASUREMENT RANGE

Single measurement range up to 140.2dB (A) RMS and 143.3dB (C) Peak. Linearity range from 10dB above noise floor.

RMS FREQUENCY WEIGHTINGS

A, C and Z filter weightings, satisfying IEC 61672-1: 2002 Class 1.

OCTAVE MEASUREMENT

Real-time 11 bands with centre frequencies from 16Hz to 16KHz. Displayed Spectrum may be pre-weighted with A, C or Z.

Z weighted octaves only are stored to be post weighted in dB36 software.

PEAK MEASUREMENT

A, C and Z weighted from 65.0 to 143.3dB

RMS DETECTOR

Digitally derived True root-mean-square detection (RMS), 0.1dB display resolution.

NOISE FLOOR

Total inherent Noise including microphone thermal noise @20°C - <22dB(A) Class 1, <30dB(A) Class 2.

Electrical Noise floor <20dB(A).

FREQUENCY RESPONSE

6Hz to 20kHz (upper and lower 3dB frequencies). Digital Sampling rate 67.2KHz

Overall Class 1 and 2 frequency response compliant with IEC 61672-1: (2002)

TIME WEIGHTINGS

Fast, Slow and Impulsive according to IEC 61672-1: (2002).

CORRECTION FILTERS

Built in correction filter for random incidence sound pressure fields.

REFERENCE DIRECTION

For free field measurements the reference direction is perpendicular to the microphone diaphragm.

REFERENCE CONDITIONS

23^{o}C air temperature, 50% Relative Humidity,

101.325kPa atmospheric pressure.

Nominal reference level = 114.0dB at 1kHz

OPERATING ENVIRONMENTAL CONDITIONS

Humidity: 5 to 90%RH in the absence of condensation.

Temperature range: -10 to +50^{o}C (Class 1), 0 to +40^{o}C (Class 2)

Pressure: 65 to 108kPa

EFFECT OF TEMPERATURE

Electrical stability of instrument < ±0.2 dB over the range -10 to +50^{o}C

EFFECTS OF HUMIDITY

Less than ±0.5dB over the range 25 to 90% relative humidity (non-condensing), relative to the value at reference conditions.

STORAGE ENVIRONMENTAL CONDITIONS

Humidity: 0 to 90%RH in the absence of condensation.

Temperature: -20 to +60^{o}C**.**

Pressure: 65 to 108kPa

MICROPHONE

Class 2: CEL-252 ½" Class 2, 30mV/Pa pre-polarised back electret.

Class 1: CEL-251 ½" Class 1, 50mV/Pa pre-polarised back electret.

Note: Instrument has fixed preamp so class is determined by microphone only.

CALIBRATION

Auto calibration by application of 1KHz calibrator, nominal level 114 or 94dB +/-1dB.

Auto calibrated to a user specified reference level with recording of date, time and offset.

POWER SUPPLY

External DC: 9 to 14V DC at typically 170mA. 2.1mm Power Connector.

Batteries: 3x AA Alkaline or rechargeable cells

Battery Life: Typically >8 hours in Broadband mode with backlight continuously on low intensity. High backlight setting will have a detrimental affect on battery life.

12 hours measuring with backlight off.

INTERNAL CLOCK:

Date and time accuracy better than 2 sec per day.

LANGUAGES:

English (default), Spanish, French, German, Italian, Portuguese, Chinese, and Brazilian Portuguese.

ELECTROMAGNETIC COMPATIBILITY

Instrumentation is designed and tested to comply with the following EMC and ESD Standards:

IEC 61000-4-2 Testing and Measuring Techniques - Electrostatic discharge immunity tests.

IEC 61000-4-3 Electromagnetic compatibility (EMC) - Radiated electromagnetic field tests.

IEC 61000-4-6 Electromagnetic compatibility (EMC) - Immunity to conducted disturbances induced by radio frequency fields. Tested at 10V/m or greater.

EFFECTS OF AC POWER FREQUENCY FIELDS

Less than ±0.5dB change from 74dBA 925Hz reference level when subjected to 160A/m AC magnetic field at 50 and 60Hz.

TRIPOD MOUNTING

Socket to mount on standard 1/4" (Whitworth) camera tripod thread.

DISPLAY

320x240 Transmissive Colour TFT. Update period 0.5 seconds.

MEMORY

Micro SD 1GB Non-volatile internal.

CONNECTIVITY (Refer to Figure 18)

USB: Mini B to download to dB36 software or to explore via Windows Explorer to obtain .CSV file.

AC OUTPUT: Via 2.5mm stereo audio jack (Barrel ground, Tip AC output) provided for remote monitoring, DAT tape / PC wav file recording or headphone applications.

Approx 0.4V RMS full scale output corresponding to 96dB. Output impedance approx 2.2kΩ. Load impedance should be as high as possible, and for connection cable in excess of 0.5 metres coaxial cable should be used. It is recommended that cable length should be kept to below 10 metres.

The AC output corresponds to the Z weighted response of the sound level meter.

DC OUTPUT: Via 2.5mm stereo audio jack (Barrel ground, Ring DC output) provided for chart recorders, loggers etc. (note: some offset and scaling will be required on the measuring system for accurate measurements).

Approx 1.4V DC full scale output corresponding to 140dB. Output impedance approx 2.2kΩ. Load impedance should be as high as possible.

The DC output corresponds to the A weighted, Fast time response of the sound level meter.

Note: DC power input ground should be kept isolated from any signal ground.



Figure 18 Connectivity

PHYSICAL CHARACTERISTICS

Dimensions: (WxHxD) 71.5x 230.0x 31.0mm for instrument including microphone and preamplifier.

Weight: <310g including batteries.

AVAILABLE PARAMETERS

Broadband

DISPLAYED FUNCTIONS			SLM RESPONSE						NOTES
Function	Format	Displayed Example	RMS Weight (w)			Time Weight (t)			
			Z	C	A	F	S	I	
SPL	L(wt)	L_{AF}	√	√	√	√	√	√	Measures single W and T weighting
SPLmax	L(wt)mx	L_{ZSMAX}	√	√	√	√	√	√	Lmx adopts frequency weighting as selected for SPL
SPLmin	L(wt)mn	L_{ZSMIN}	√	√	√	√	√	√	Lmn adopts frequency weighting as selected for SPL
L_{EQ} integrating	L_WEQ	$L_{AEQ,}$	√	√	√	NA	NA	NA	SPL value changes to LEQ during a measurement run. (Simultaneous C&A)
Lpeak	L(w)Pk	L_{CPEAK}	√	√	√	NA	NA	NA	A peak only available on user setups
LIEQ integrating	L(w)IEQ	LA_{IEQ}	NA	NA	√	NA	NA	√	Impulsive L_{EQ}.
L_{AEQ} T80	L_{AEQ} T80	L_{AEQ} T80	NA	NA	√	NA	NA	NA	L_{AEQ} with Threshold and Q=3 (ACGIH)
L_{AE}	L(w)E	L_{AE}	NA	NA	√	NA	NA	NA	
L_{TM3}	LTM3	L_{TM3}	NA	NA	√	√	NA	NA	
L_{TM5}	LTM5	L_{TM5}	NA	NA	√	√	NA	NA	
*L_{AVG} integrating	L(w)AVG	$L_{AVG,}$	NA	NA	√	NA	√	NA	L_{AVG} based on selectable threshold 70-90dB, Q5 or Q4 and Slow weighting.
HML	LC-LA	L_C-L_A	NA	√	√	NA	NA	NA	L_{EQ} only, L_{avg} not required

Additional 1/1 Octave & 1/3 Octave Band Functions for CEL-62XB & CEL-62XC

DISPLAYED FUNCTIONS			SLM RESPONSE						NOTES
Function	Format	Displayed Example	RMS Weight (w)			Time Weighting (t)			
			Z	C	A	F	S	I	
SPL	L(wt)	L_{AF}	√	√	√	√	√	NA	
SPLmax	L(wt)mx	L_{ZSMAX}	√	√	√	√	√	NA	Only Z weighting is saved
L_{EQ} integrating	$L_{W}EQ$	$L_{AEQ,}$	√	√	√	NA	NA	NA	Only Z weighting is saved

DEFAULT SETUP MATRIX

SETUP	ISO	OSHA	DOD	ACGIH	USER 1	USER 2	Environmental 1	Environmental 2
Exchange Rate	3	5	4	3	3	5	3	3
Threshold	0	80	80	80	0	90	0	0
Broadband Parameters	L_{AF} L_{Aeq} L_{Ceq} L_{C-Aeq} L_{AFmax} L_{Cpeak}	L_{AS} L_{avg} L_{ASmax} L_{Zpeak} L_{C-Aeq}	L_{AS} L_{avg} L_{ASmax} L_{Zpeak} L_{C-Aeq}	L_{AS} $L_{Aeq\ (T80)}$ L_{ASmax} L_{Zpeak} L_{C-Aeq}	L_{AF} L_{Aeq} L_{Ceq} L_{C-Aeq} L_{AFmax} L_{Cpeak} L_{AFmin} L_{AF10} L_{AF50} L_{AF90} L_{AF95}* L_{AF99}*	L_{AS} L_{avg} L_{Ceq} L_{ASmax} L_{Zpeak} L_{C-Aeq} L_{ASmin} L_{AF10} L_{AF50} L_{AF90} L_{AF95}* L_{AF99}*	L_{AF} L_{Aeq} L_{AFmax} L_{Zpeak} L_{AFmin} L_{AF10} L_{AF90}	L_{AF} L_{Aeq} L_{AFmax} L_{Zpeak} L_{AFmin} L_{AF10} L_{AF50} L_{AF90} L_{AF95} L_{AF99}
Octaveband Parameters	L_{AF} L_{Aeq} L_{AFmax}	L_{AS} L_{Aeq} L_{ASmax}	L_{AS} L_{Aeq} L_{ASmax}	L_{AS} L_{Aeq} L_{ASmax}	L_{AF} L_{Aeq} L_{AFmax} L_{AF10} L_{AF50} L_{AF90} L_{AF95}* L_{AF99}*	L_{AS} L_{Aeq} L_{ASmax} L_{AF10} L_{AF50} L_{AF90} L_{AF95}* L_{AF99}*	L_{AF} L_{Aeq} L_{AFmax} L_{AF10} L_{AF90}	L_{AF} L_{Aeq} L_{AFmax} L_{AF10} L_{AF50} L_{AF90} L_{AF95} L_{AF99}

*4 Ln% values are fixed, 1 is variable in User 1 and User 2 setups.

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7. SERVICING AND WARRANTY ARRANGEMENTS

To ensure conformity with the specification, this instrument is thoroughly inspected and it's accuracy verified prior to dispatch. All technical information is filed under the instrument serial number, which should be quoted in any correspondence. The manufacturer undertakes to rectify any defect in the instrument directly attributable to faulty design or assembly and which becomes apparent during the warranty period. In order to take advantage of this warranty, the instrument must be returned, carriage paid, to the manufacturer's factory or accredited agent, where necessary repairs will be carried out.

The warranty period runs for 24 months from the date of receipt of goods, with exceptions on certain specialised components supplied by other manufacturers that may be warranted for shorter or longer periods by their actual manufacturers. In all such cases, the benefit of these undertakings will be passed on to the user. CASELLA CEL's liability is limited to items of their own manufacture, and they do not accept liability for any loss resulting from the operation or interpretation of the results from this equipment. To obtain repair under warranty, the instrument should be packed and returned in it's original packing or an equivalent either to CASELLA CEL's local agent, or in the case of U.K. domestic sales, to the CASELLA CEL Service Department at Bedford. Please include the following information:

Instrument Type(s), Serial Number(s) and Firmware Version Number(s), Customer name and address, Contact name and phone number, details of any PC and Software involved, including Version Number(s), reason for returning the equipment with a detailed description of the fault and a list of any error messages that may have been displayed.

The necessary adjustments or repairs will be carried out, and the instrument returned as soon as possible. After the warranty has expired (except on approved accounts) service work is undertaken against quotations and all packing and transit costs are charged extra.

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8. APPENDIX A

GLOSSARY OF TERMS

This Appendix gives a glossary of the acoustic terminology used in this manual. For further information, please contact Casella CEL or your local representative.

A, C and Z WEIGHTING (WEIGHTED)

A standard weighting of the audible frequencies designed to approximate the response of the human ear to noise.

ACOUSTIC CALIBRATOR

An instrument that provides a reference noise source with a standard level and frequency used to calibrate and check the performance of sound level meters and noise dosimeters.

Decibel (dB)

The standard physical unit for measuring sound level and noise exposure.

dB(A)

A-weighted sound level in decibels.

dB(C)

C-weighted sound level in decibels.

dB(Z)

Z-weighted sound level in decibels.

FAST TIME WEIGHTING

A standard time weighting applied by the sound level measurement instrument.

L_{AE}

The A-weighted exposure level is the level that would contain the same amount of energy in one second as the actual noise has during the whole measurement period.

L_{Aeq}

The A-weighted equivalent level is the level that would contain the same amount of noise energy as in the actual noise, effectively giving an average level over the measurement period. Following the ISO procedures, doubling the energy results in a 3dB change in the Leq. This is denoted by exchange rate Q=3. For example, if the noise level in a factory was a constant 85dB and the measurement period was 4 hours, the LAeq would be 85dB(A). The calculation of LAeq does not use a threshold as in the calculation of LAVG, except for the LAEQ (T80) parameter defined for the ACGIH standard.

L_{AF}

The A-weighted sound level measured with Fast time weighting.

L_{AS}

The A-weighted sound level measured with Slow time weighting.

L_{ASmax}

The maximum A-weighted sound level measured with Slow time weighting.

L_{AVG}

This is a parameter used in OSHA measurements. It is the average sound level over the measurement period (equivalent to Leq). Normally the term is used when the exchange rate Q is some value other than 3, such as for measurements used for the OSHA Hearing Conservation Amendment with Q=5. A Threshold value is used during the calculation of LAVG, where any levels below the threshold are not included. For example, assume the threshold level is set to 80dB and the exchange rate is 5dB (Q = 5). If a one hour measurement was taken in an environment where the noise levels vary between 50 and 70dB, the sound level would never exceed the Threshold so the

instrument would record no value for the LAVG. However, if the sound level exceeds the 80dB Threshold for only a few seconds, only these seconds will contribute to the LAVG, giving a level of around 40dB, which is much lower than the actual ambient sound levels in the measured environment.

L_{Cpeak}

The peak C-weighted sound level.

$L_{EP,d}$ ($L_{EX,8h}$)

This is the daily personal noise exposure defined by ISO 1999. It is the LAeq normalised to an 8 hour Criterion Time, i.e. a standard day. Assuming the noise level for the rest of the 8 hour reference period is “quiet”, the LEP,d will be: lower than the Leq when the measurement duration is less than 8 hours, equal to the Leq for a measurement of 8 hours, higher than the Leq for measurements longer than 8 hours. For example, if a noise measurement was made for 4 hours and the LAeq value was 90dB(A), the LEP,d value would be calculated to be 87dB(A) as the measurement duration is half the 8 hour Criterion Time and the exchange rate is 3 dB.

L_{Ceq}

The C-weighted equivalent level is the level that would contain the same amount of noise energy as in the actual noise, effectively giving an average level over the measurement period. Following the ISO procedures, doubling the energy results in a 3dB change in the Leq. This is denoted by exchange rate Q=3.

PEAK

The maximum level in dB reached by the sound pressure at any instant during a measurement period. With the CEL-62X, peak is measured with either C, Z or A weighting. It is the true peak level of the pressure wave, which should not be confused with the highest sound pressure level, termed Lmax.

SLOW TIME WEIGHTING

A standard time weighting applied by the noise measurement instrument.

SPL

The sound pressure level. This is the basic physical measure of noise, and is normally expressed in dB.

THRESHOLD

A threshold level below which sound is excluded from calculation. OSHA measurements use an 80 dB threshold.

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9. APPENDIX B ADDITIONAL INFORMATION

IEC61672-1:2002 section 9.3 (Information for testing)

a) Reference Sound Pressure Level

The reference sound pressure level is selectable to be 94 dB or 114 dB.

b) Reference Level Range

The CEL-62X is a single level range instrument of 0 to 140 dB.

c) Microphone Reference Point

The microphone reference point is the centre of the diaphragm of the microphone. The 0^o reference direction is perpendicular to the microphone diaphragm.

d) Acoustical Frequency Response Testing

The pressure to free field correction data for the CEL-251 microphone used for periodic testing.

Frequency	0^o Free Field Corrections using a Bruel & Kjear 4226 Calibrator	0^o Free Field Corrections with Wind Screen using a Bruel & Kjear 4226 Calibrator	0^o Free Field Corrections using a Bruel & Kjear UA0033 Electrostatic Actuator	0^o Free Field Corrections with Wind Screen using a Bruel & Kjear UA0033 Electrostatic Actuator	Expanded Uncertainty of Corrections at 95% probability (k=2)
Hz	dB	dB	dB	dB	dB
31.5	-0.1	-0.1	-0.1	-0.1	0.2
63	-0.2	-0.2	-0.2	-0.2	0.2
125	-0.2	-0.2	-0.2	-0.2	0.2
250	-0.2	-0.2	-0.2	-0.2	0.2
500	-0.2	-0.2	-0.2	-0.2	0.2
1000	0	0.1	0	0.1	0.2
2000	0.3	0.7	0.3	0.7	0.3
4000	0.7	1.4	0.8	1.5	0.3
8000	2.8	2.5	3.1	2.8	0.4
12500	5.3	4.1	6.2	5.0	0.6
16000	6.4	4.5	7.8	5.9	0.6

e) Linear Operating Range

The lower and upper limits of the linear operating ranges for electrical input, or using a CEL-251 microphone; (add 10dB to the lower limit when using a CEL-252 microphone)

Weighting	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
A	30 to 100	30 to 140	30 to 141	30 to 138	30 to 134
C	32 to 137	32 to 140	32 to139	32 to 136	32 to 132
Z	38 to 140	38 to 140	38 to 140	38 to 140	38 to 140
C Peak	65 to 140	65 to 143	65 to 142	65 to 139	65 to 135

f) Linearity Measurements Starting Point

The starting point for measuring level linearity errors is 114dB.

g) Electrical Input

The input device to apply electrical signals to the pre-amplifier is a series 18pF +/- 5% capacitor. The CEL-516-02 can be used for this purpose. The electrical self generated noise can be measured with the supplied shorting plug attached to the CEL-516-02.

h) Self Generated Noise

Combination of CEL-251 microphone thermal noise and meter electrical noise.

Weighting	Electrical Typical dB	Electrical Max dB	Microphone Thermal dB	Combined Typical dB	Combined Max dB
A	18.0	20.0	16.0	20.0	22.0
C	21.0	23.0	16.8	22.0	24.0
Z	28.0	30.0	16.8	28.0	30.5

Note: The CEL-252 microphone has a thermal noise of typically 20dBA – the combined typical and max noise levels will be 1.5dB higher than above.

i) Highest Level

The highest sound pressure level designed to be measured by the CEL-62X sound level meter when fitted with a 50mV/Pa microphone is 140dB. The highest peak to peak voltage that can be applied to the pre-amplifier input via the CEL-516-02 is 28.5V.

j) Power Supply Voltage Range

The CEL-62X can be powered from three internally fitted AA batteries, or an external 12VDC supply (2.1mm connector, tip +ve), or 5VDC USB supply from a PC.

Internal batteries – range 3 to 5 volts. The battery condition symbol will start to flash as a warning when the batteries have discharged to 3.3 volts, and the meter will stop a run and turn off when the batteries have discharged to less that 3 volts to ensure no data is measured that does not meet the requirements of IEC 61672.

12VDC supply range is 9 to 14 volts.

USB supply range is 4.5 to 5.5 volts.

k) Display Device

The display device will display the complete linear operating range.

l) Environmental Stabilisation Time

The typical time to stabilise after sudden changes in environment conditions.

5 minutes after a 10 ^{o}C change in temperature.

5 minutes after a 30% change in humidity (non-condensing).

15 seconds after a 5kPa change in ambient pressure.

m) Electric Field Strength Greater Than 10 V/m

The CEL-62X was not tested for field strengths greater than 10 V/m.

n) EMC Emissions

Emissions were no greater in any one plane or any mode of operation.

o) EMC Susceptibility

The CEL-62X has slightly higher susceptibility with the Y plane facing the radiating antenna.



X is in the direction of the microphone, Z is in the direction of the display, and Y is in the direction side-on to the case.

Casella CEL-62X with CEL-251 Microphone Free Field response with and without Wind Screen.

Nominal Frequency	Actual Frequency	0 Degree Free Field Response	0 Degree Free Field Corrections	Effect of Wind Screen	0 Degree Free Field Response with wind Screen	0 Degree Free Field Corrections with Wind Screen	Expanded uncertainty of Corrections (k=2)
Hz	Hz	dB	dB	dB	dB	dB	dB
250	**251.19**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.16**
315	316.23	-0.1	0.1	0.0	-0.1	0.1	0.16
400	398.11	0.1	-0.1	0.0	0.1	-0.1	0.16
500	**501.19**	**0.1**	**-0.1**	**0.0**	**0.1**	**-0.1**	**0.16**
630	630.96	0.0	0.0	0.1	0.1	-0.1	0.17
800	794.33	0.1	-0.1	0.1	0.2	-0.2	0.18
1000	**1000.00**	**-0.1**	**0.1**	**0.1**	**0.0**	**0.0**	**0.19**
1250	1258.92	0.0	0.0	0.2	0.2	-0.2	0.19
1600	1584.89	-0.4	0.4	0.3	-0.1	0.1	0.20
2000	**1995.26**	**-0.2**	**0.2**	**0.4**	**0.2**	**-0.2**	**0.21**
2240	2238.72	0.1	-0.1	0.4	0.5	-0.5	0.21
2500	2511.88	0.4	-0.4	0.5	0.9	-0.9	0.21
2800	2818.38	0.2	-0.2	0.5	0.7	-0.7	0.22
3150	3162.27	-0.3	0.3	0.6	0.3	-0.3	0.22
3550	3548.13	-0.9	0.9	0.7	-0.2	0.2	0.23
4000	**3981.07**	**0.0**	**0.0**	**0.7**	**0.7**	**-0.7**	**0.23**
4500	4466.83	0.0	0.0	0.7	0.7	-0.7	0.25
5000	5011.86	-0.1	0.1	0.6	0.5	-0.5	0.26
5600	5623.40	-0.4	0.4	0.5	0.1	-0.1	0.28
6300	6309.56	-0.7	0.7	0.2	-0.5	0.5	0.29
7100	7079.45	-0.1	0.1	-0.1	-0.2	0.2	0.32
8000	**7943.27**	**-0.3**	**0.3**	**-0.3**	**-0.6**	**0.6**	**0.35**
8500	8413.94	-0.4	0.4	-0.4	-0.8	0.8	0.38
9000	8912.49	-0.6	0.6	-0.5	-1.1	1.1	0.41
9500	9440.59	-0.8	0.8	-0.5	-1.3	1.3	0.44
10000	9999.98	-0.9	0.9	-0.7	-1.6	1.6	0.46
10600	10592.52	-0.8	0.8	-0.7	-1.5	1.5	0.48
11200	11220.16	-0.6	0.6	-0.9	-1.5	1.5	0.50
11800	11885.00	-1.0	1.0	-1.0	-2.0	2.0	0.52
12500	12589.23	-0.7	0.7	-1.2	-1.9	1.9	0.53
13200	13335.19	-1.0	1.0	-1.3	-2.3	2.3	0.55
14000	14125.35	-0.9	0.9	-1.4	-2.3	2.3	0.57
15000	14962.33	-1.0	1.0	-1.5	-2.5	2.5	0.59
16000	**15848.90**	**-0.9**	**0.9**	**-1.9**	**-2.8**	**2.8**	**0.60**
17000	16788.00	-1.0	1.0	-2.1	-3.1	3.1	0.60
18000	17782.76	-1.0	1.0	-2.4	-3.4	3.4	0.60
19000	18836.45	-1.0	1.0	-2.7	-3.7	3.7	0.60
20000	19952.58	-1.3	1.3	-2.6	-3.9	3.9	0.60

Corrections below 250Hz are 0.0dB

CEL-62X with CEL-251 Microphone directional response (dB) relative to zero degrees.

Orientation of CEL-62X - Display at 0 degrees relative to ground.

Nominal Frequency (Hz)	Actual Frequency (Hz)	0 Deg	10 Deg	20 Deg	30 Deg	40 Deg	50 Deg	60 Deg	70 Deg	80 Deg	90 Deg	100 Deg	110 Deg	120 Deg	130 Deg	140 Deg	150 Deg
500	501.19	0.00	0.01	0.01	0.00	-0.02	-0.05	-0.09	-0.20	-0.20	-0.26	-0.32	-0.35	-0.37	-0.36	-0.36	-0.34
630	630.96	0.00	0.02	0.04	0.05	0.06	0.06	0.05	-0.06	-0.06	-0.15	-0.25	-0.33	-0.38	-0.40	-0.41	-0.41
800	794.33	0.00	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	-0.04	-0.14	-0.29	-0.41	-0.45	-0.46	-0.42
1000	1000.00	0.00	0.01	0.03	0.03	0.04	0.05	0.06	0.02	0.02	0.01	-0.02	-0.14	-0.31	-0.38	-0.34	-0.29
1250	1258.92	0.00	0.02	0.03	0.01	-0.08	-0.21	-0.33	-0.15	-0.15	-0.05	-0.07	-0.15	-0.32	-0.59	-0.63	-0.51
1600	1584.89	0.00	0.00	0.00	-0.04	-0.09	-0.12	0.01	0.00	0.00	-0.07	0.20	0.18	0.03	-0.29	-0.61	-0.45
2000	1995.26	0.00	0.03	0.06	0.02	-0.20	-0.49	-0.36	-0.30	-0.30	-0.13	-0.25	-0.12	0.02	-0.19	-0.69	-0.98
2240	2238.72	0.00	-0.01	-0.12	-0.35	-0.50	-0.40	-0.56	-0.46	-0.46	-0.63	-0.41	-0.64	-0.24	-0.45	-0.94	-1.28
2500	2511.88	0.00	-0.08	-0.35	-0.60	-0.55	-0.70	-1.09	-1.37	-1.37	-0.98	-1.05	-0.85	-0.86	-0.75	-1.08	-1.60
2800	2818.38	0.00	-0.03	-0.06	0.06	-0.01	-0.76	-0.93	-1.59	-1.59	-1.60	-0.92	-1.19	-1.29	-0.64	-0.91	-1.84
3150	3162.27	0.00	-0.07	-0.04	0.29	0.41	0.11	-0.07	-0.72	-0.72	-0.97	-1.26	-0.70	-0.73	-0.69	-0.46	-1.24
3550	3548.13	0.00	-0.02	0.06	0.58	0.95	0.50	0.87	-0.54	-0.54	-0.40	-0.38	-0.20	-0.48	-0.55	-0.22	-0.66
4000	3981.07	0.00	-0.10	-0.58	-1.00	-0.75	-0.96	-0.29	-1.17	-1.17	-1.84	-1.75	-1.67	-1.22	-1.86	-1.32	-1.90
4500	4466.83	0.00	0.12	0.26	-0.18	-0.57	-1.11	-0.76	-1.06	-1.06	-1.70	-2.28	-2.28	-1.23	-1.70	-1.44	-1.52
5000	5011.86	0.00	-0.12	-0.57	-0.28	-0.41	-0.83	-1.52	-1.00	-1.00	-1.77	-2.63	-2.54	-2.24	-1.69	-2.71	-2.05
5600	5623.40	0.00	-0.13	-0.10	-0.07	-0.39	-0.88	-1.05	-1.10	-1.10	-1.21	-2.21	-2.66	-2.52	-1.59	-2.57	-1.97
6300	6309.56	0.00	0.03	0.50	0.47	0.22	-0.09	-0.88	-1.62	-1.62	-1.27	-1.82	-2.42	-2.64	-2.36	-2.36	-2.59
7100	7079.45	0.00	0.04	0.07	-0.45	-1.21	-1.38	-1.33	-3.14	-3.14	-2.42	-3.01	-4.30	-4.12	-3.39	-2.70	-4.15
8000	7943.27	0.00	-0.10	-0.41	-0.55	-0.61	-1.36	-1.79	-2.97	-2.97	-3.78	-2.67	-4.08	-4.64	-3.96	-3.80	-4.48
8500	8413.94	0.00	0.19	-0.15	-0.40	-1.00	-1.13	-2.07	-2.69	-2.69	-4.11	-3.20	-3.82	-5.66	-4.53	-4.05	-4.45
9000	8912.49	0.00	-0.21	-0.18	-0.75	-1.03	-1.72	-1.96	-2.25	-2.25	-4.89	-3.90	-3.40	-6.09	-4.88	-4.44	-4.72
9500	9440.59	0.00	0.33	-0.21	-0.23	-0.58	-1.18	-2.38	-2.72	-2.72	-4.04	-4.07	-3.56	-6.49	-4.93	-4.45	-5.00
10000	9999.98	0.00	-0.32	-0.55	-0.90	-1.43	-2.00	-2.30	-3.20	-3.20	-3.74	-5.31	-4.73	-6.06	-6.30	-4.77	-4.87
10600	10592.52	0.00	-0.21	-0.05	-0.51	-0.86	-1.67	-2.42	-4.85	-4.85	-4.05	-5.98	-5.57	-5.96	-6.64	-5.33	-5.81
11200	11220.16	0.00	0.17	-0.38	-0.62	-1.24	-1.87	-2.57	-4.84	-4.84	-4.29	-6.15	-5.55	-6.62	-7.64	-5.84	-6.57
11800	11885.00	0.00	0.10	-0.45	-0.71	-1.39	-1.95	-2.83	-4.67	-4.67	-5.10	-5.99	-6.49	-6.43	-8.77	-6.67	-7.11
12500	12589.23	0.00	-0.01	-0.59	-1.03	-1.44	-2.32	-3.12	-4.75	-4.75	-6.33	-6.14	-7.87	-6.60	-9.13	-7.33	-7.62

Maximum expanded uncertainty of above data with 95% probability (k=2)

500Hz to 1kHz	0.3dB
>1kHz to 4kHz	0.5dB
>4kHz to 8kHz	1.0dB
>8kHz to 12.5kHz	1.5dB

CEL-62X with CEL-251 Microphone directional response (dB) relative to zero degrees.

Orientation of CEL-62X - Display at 90 degrees relative to ground.

Nominal Frequency (Hz)	Actual Frequency (Hz)	0 Deg	10 Deg	20 Deg	30 Deg	40 Deg	50 Deg	60 Deg	70 Deg	80 Deg	90 Deg	100 Deg	110 Deg	120 Deg	130 Deg	140 Deg	150 Deg
500	501.19	0.00	0.00	0.00	0.00	-0.01	-0.03	-0.06	-0.11	-0.16	-0.21	-0.25	-0.27	-0.28	-0.28	-0.28	-0.27
630	630.96	0.00	0.00	0.02	0.04	0.06	0.07	0.06	0.02	-0.04	-0.12	-0.21	-0.28	-0.33	-0.34	-0.34	-0.34
800	794.33	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.05	0.02	-0.07	-0.20	-0.31	-0.35	-0.36	-0.33
1000	1000.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.04	0.03	0.04	0.04	-0.08	-0.26	-0.34	-0.30	-0.23
1250	1258.92	0.00	0.01	0.03	0.02	-0.07	-0.22	-0.34	-0.31	-0.15	-0.05	-0.03	-0.05	-0.24	-0.59	-0.65	-0.51
1600	1584.89	0.00	-0.01	-0.03	-0.09	-0.15	-0.15	0.02	0.16	0.01	-0.05	0.24	0.24	0.11	-0.25	-0.64	-0.47
2000	1995.26	0.00	-0.01	0.01	-0.05	-0.28	-0.50	-0.36	-0.20	-0.31	-0.07	-0.26	-0.09	0.15	-0.11	-0.73	-1.05
2240	2238.72	0.00	-0.07	-0.24	-0.49	-0.56	-0.36	-0.54	-0.87	-0.59	-0.54	-0.28	-0.54	-0.10	-0.27	-0.92	-1.35
2500	2511.88	0.00	-0.10	-0.30	-0.44	-0.42	-0.80	-1.12	-0.82	-1.25	-0.95	-0.79	-0.72	-0.75	-0.45	-1.02	-1.58
2800	2818.38	0.00	-0.02	0.01	0.14	-0.02	-0.76	-0.84	-1.22	-1.37	-1.78	-1.18	-0.94	-1.12	-0.34	-0.69	-1.88
3150	3162.27	0.00	0.07	0.26	0.57	0.41	0.02	-0.06	-1.16	-0.83	-0.68	-1.38	-0.80	-0.52	-0.26	-0.21	-1.36
3550	3548.13	0.00	-0.12	0.07	0.77	1.23	1.10	1.03	0.44	-0.53	-0.38	-0.31	-0.26	-0.45	-0.49	0.62	-0.59
4000	3981.07	0.00	-0.27	-0.82	-1.02	-0.98	-0.98	0.18	-0.16	-1.03	-1.78	-1.55	-1.66	-1.13	-1.64	-0.51	-1.49
4500	4466.83	0.00	0.14	0.10	-0.57	-0.96	-2.12	-1.25	-0.69	-1.10	-2.06	-2.95	-2.20	-2.33	-1.84	-1.34	-1.50
5000	5011.86	0.00	-0.22	-0.42	0.14	-0.03	-0.18	-2.12	-1.99	-0.54	-1.24	-2.52	-2.73	-2.35	-1.45	-2.52	-1.18
5600	5623.40	0.00	-0.14	-0.12	-0.60	-0.45	-0.69	-0.37	-2.01	-1.84	-0.68	-2.16	-2.45	-2.31	-2.50	-2.53	-0.85
6300	6309.56	0.00	0.30	0.96	0.94	0.22	-1.14	-1.36	-0.25	-1.95	-2.02	-1.50	-2.13	-3.21	-3.48	-2.99	-1.10
7100	7079.45	0.00	0.16	0.06	-0.99	-1.64	-1.27	-0.83	-2.04	-3.21	-2.66	-2.37	-4.39	-3.44	-2.61	-3.21	-4.29
8000	7943.27	0.00	-0.28	-0.34	-0.55	-0.47	-1.52	-1.83	-1.99	-2.41	-4.06	-3.14	-3.68	-5.20	-3.60	-4.02	-4.53
8500	8413.94	0.00	-0.08	-0.66	-0.73	-1.06	-1.11	-2.71	-2.49	-2.77	-4.26	-4.25	-3.27	-6.01	-4.69	-4.62	-5.45
9000	8912.49	0.00	0.01	0.15	-0.40	-0.93	-1.50	-1.36	-3.30	-2.57	-3.43	-4.29	-2.58	-5.63	-4.75	-4.34	-5.53
9500	9440.59	0.00	-0.12	-0.61	-0.98	-1.07	-1.95	-2.23	-3.69	-3.05	-3.79	-6.18	-3.46	-7.41	-4.96	-5.05	-5.91
10000	9999.98	0.00	-0.12	-0.03	-0.36	-1.42	-1.54	-2.70	-2.36	-3.47	-3.48	-4.85	-4.69	-6.53	-6.43	-5.02	-5.12
10600	10592.52	0.00	0.09	-0.66	-0.64	-0.95	-2.05	-2.18	-3.76	-5.49	-4.18	-5.30	-7.67	-4.94	-7.23	-5.49	-5.74
11200	11220.16	0.00	-0.16	-0.36	-1.00	-1.78	-2.14	-3.28	-3.76	-4.71	-4.82	-5.82	-7.95	-5.48	-8.29	-6.30	-6.97
11800	11885.00	0.00	-0.17	-0.40	-1.05	-1.36	-2.36	-3.06	-3.89	-4.67	-6.56	-6.05	-8.09	-5.45	-9.54	-6.80	-7.32
12500	12589.23	0.00	-0.34	-0.59	-1.05	-2.02	-2.69	-3.45	-4.72	-5.59	-7.47	-6.61	-8.44	-6.05	-10.78	-7.16	-8.12

Maximum expanded uncertainty of above data with 95% probability (k=2)

500Hz to 1kHz	0.3dB
>1kHz to 4kHz	0.5dB
>4kHz to 8kHz	1.0dB
>8kHz to 12.5kHz	1.5dB

Sound Calibrators – Level Corrections

Sound level calibrators apply sound pressure to a microphone in a closed cavity. The response of a microphone in a free field at 1kHz will be slightly different to that of a pressure field. Also some calibrators are affected by the volume of the microphone changing the volume of the calibrator cavity.
The wind screen has an affect on the free field response at 1kHz and this can be compensated for during calibration.

Calibration corrections for the CEL-251 and CEL-252 Microphones.

Calibrator	Calibration Level Correction no Wind Screen	Calibration Level Correction with Wind Screen	IEC 60942
Casella CEL-110/1	-0.1dB	0.0dB	Type 1
Casella CEL-110/2	-0.1dB	0.0dB	Type 2
Bruel & Kjear 4231	-0.1dB	0.0dB	Type 1 approved
Cirrus CR:515	-0.1dB	0.0dB	Type 1 approved

Examples
The CEL-62X can be calibrated at a nominal level of 94dB or 114dB dependent on the type of calibrator used.

If a CEL-110/1 is used and the certified output of the calibrator is 113.98dB, and it is intended to use the sound level meter without the wind screen, then the calibration level will need to be set to 113.88, rounded to 113.9dB.
Calibrator level 113.98
Correction -0.1
Calibration level = 113.88 rounded to 113.9dB

If a Cirrus CR:515 is used and the certified output of the calibrator is 94.04dB, and it is intended to use the sound level meter with the wind screen fitted, then the calibration level will need to be set to 94.04, rounded to 94.0dB
Calibrator level 94.04
Correction 0.0
Calibration level = 94.04 rounded to 94.0dB

See Section G. in the manual to set the calibration level.
See Section K. in the manual to calibrate the sound level meter.