



# **CASTLE PRO-DX VOCIS**

**Version B**

**Sound Level Meter**

**Operating Manual**

**[www.castlegroup.co.uk](http://www.castlegroup.co.uk)**

Thank you for buying a Castle product, I am sure you will find both the goods and the service to be of the highest quality but if not, then please feel free to write to me personally and I will ensure that your needs are dealt with immediately.

This manual is designed to show you the operation of the goods you have purchased and a very brief insight into acoustics itself. If you would like to become a competent person in the eyes of the law, then you may like to know more about our Competent Persons training course for the Noise at Work Regulations.

It is my intention for Castle Group Ltd to provide a complete range of Noise and Vibration products and Services of the highest standard. If you would like to know more about any of our other products and services then please telephone on +44(0)1723 584250.

A handwritten signature in black ink, appearing to read 'S Bull', with a stylized flourish at the end.

Simon Bull  
Managing Director

# Copyright

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This manual is copyrighted with all rights reserved. The manual may not be copied in part or in whole without the prior written consent of Castle Group Ltd.

## Precautions

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- Only operate the instrument as described in this manual.
- These are precision instruments, protect from shocks and vibrations.
- Take special care with the microphone. The diaphragm is made from a very thin metal and is easily damaged.
- Ambient conditions for the operation of the unit are as follows:-
  - Temperature: -10°C to +50°C
  - Relative Humidity: 25 to 90%
- Protect the unit from extremes of temperature and humidity, direct sunlight and air with a high salt or sulphur content.
- Always turn the unit off after use. Remove the batteries from the instrument when not in use.
- Do not use any solvents or cleaning agents on the instrument. Use only a soft dry cloth or a soft cloth lightly moistened with water when necessary.
- Do not let any conductive objects, such as wire or metal scraps get into the unit.
- Do not try to disassemble the instrument or attempt any repairs as this will invalidate your warranty. Take a note of the condition of the instrument and contact your authorised Castle service station.
- To ensure continued precision performance of your instrument have it checked and serviced at regular intervals.

## Contacting Castle Group

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This manual contains complete operating instructions for the Castle Pro DX Vocis Meter, read it carefully and you will quickly become familiar with your instrument and its operation.

If you do encounter problems with the operation of your instrument please feel free to contact customer support with your enquiry on: -

Telephone:	+44 (0)1723 584250
Fax:	+44 (0)1723 583728
Website:	<a href="http://www.castlegroup.co.uk">www.castlegroup.co.uk</a>
Email:	<a href="mailto:techsupport@castlegroup.co.uk">techsupport@castlegroup.co.uk</a> <a href="mailto:sales@castlegroup.co.uk">sales@castlegroup.co.uk</a>

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# **Introduction**

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Thank you for purchasing your product from Castle Group Ltd. The Pro-DX Vocis range of sound level meters bring to you unrivalled power and usability with real time octave and one third octave measurement, just about all the sound parameters you could possibly need and the ability to have up to 128Mb of on-board memory... Sound measurement technology has finally arrived.

## **A Tough Case For All Weathers...**

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Not only is the physical design and construction of the Castle Pro-DX casing extremely tough and durable, it is also dust-proof and weatherproof! This means that, wherever you go and whatever you do, your Vocis can go with you without being letting you down.

## **Talking To the Outside World...**

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Saved data can be transmitted directly to the Castle GA505 Portable Printer providing ready formatted numeric and graphic print-outs. The Vocis series features a bi-directional RS232 interface for communication with a PC and with the printer interface cable to third party printers.

To gain the most out of your measured data, Castle dBdataPro software is the way to go. Post measurement analysis and presentation of graphical data can all be done using this package. dBdataPro allows seamless integration with word processing and spreadsheet packages enabling you to use your own standard report formats in programs that you are familiar with.

## **Simplicity and Power...**

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Using the meter couldn't be simpler. The intuitive Pro-DX operating system tells you where you are and what you want to do next. The massive power of the technology in the instrument is tamed by the user interface such that you are presented with information in a concise and unambiguous format. Menu choices are logical and straightforward and make maximum use of the clearly defined operation keys and the 'mobile phone' style 'soft' function keys.

## **Future Proof...**

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The built in software for these meters is designed to suit future upgrading for feature enhancements, legislative changes or instrument upgrades. Details are mailed to customers as soon as they become available. With Castle Pro-DX meters you will always be in step with the law and market requirements. Periodic enhancements or bug fixes to the software will be supplied free of charge for a period of one year from the purchase date.

## **Pro DX Vocis Variations**

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### **Industrial Safety – Vocis I**

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GA131I – Class 1, Parallel 1/1 Octaves

GA231I – Class 2, Parallel 1/1 Octaves

The Vocis I (Class 1 or Class 2) is primarily designed for use in Industry as an occupational hygiene or health and safety tool, or anywhere where there is a specific requirement for the measurement of 1/1 octave bands. The opportunity to automatically compare measurements with hearing protection attenuation data or noise control materials is a particularly useful feature. The measurement parameters included in this model allow for concise data to be monitored without the user being swamped with excessive and unnecessary information. The Class 1 model is particularly suitable for applications where the nature of the data is more critical, while the Class 2 version is well suited to most industrial screening and risk assessment applications.

### **Environmental – Vocis E**

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GA131E – Class 1, Ln's, No Filters

GA231E – Class 2, Ln's, No Filters

The Vocis E (Class 1 or Class 2) is primarily designed for environmental monitoring, where long-term data logging is the key consideration. The uncluttered nature of this variation means that long term, unattended measurements produce just the results needed. The Vocis E does not have frequency analysis, and as such offers a highly powerful data-logging tool.

### **Combined (Industrial / Environmental**

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GA131C – Class 1, Ln's, Parallel 1/1 Octaves

The Vocis C (Class 1 only) combines all the power and all the features of the Vocis I and E. This makes the Vocis C a multi-function sound level meter that will satisfy the needs of the most advanced user, whilst maintaining the usability for which Castle is renowned.

## **Multi Function**

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### **GA131M – Class 1, Ln's, Parallel 1/1 and 1/3 Octaves**

The Vocis M (Class 1 only) is the flagship of the Vocis range which proudly boasts all the features of the rest of the range and then adds 1/3 Octave band analysis to create the ultimate in hand-held sound analysis. The main features of this model are; Two channels, Parallel 1/1 and 1/3 Octave bands, 19 simultaneous parameters, A-HPD - Advanced Hearing Protection Database, Wide dynamic range, Low Noise Floor, Large memory capacity and ultimate user flexibility.

## **Basic**

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### **GA131B – Class 1, Parallel 1/1 Octaves**

The Vocis B (Class 1 only) is the entry level instrument of the Vocis range and is primarily aimed for safety officers who need to undertake Noise At Work assessments with ease. To allow this to happen this instrument is limited to a single channel, has no templates, HPD or Ln's and is also limited to Fast and Slow weighting. To make using the instrument as simple as possible the simultaneous Peak level is permanently C weighted and even though its simple to use and entry level, it still has full octave band analysis.

# Chapter 1

## Pre-Amplifier and Microphone Removal and Fitting

Measurement microphones by the very nature of their manufacture are precision components that are easily damaged through incorrect use. Great care must be taken when using the instrument to ensure the longevity of the microphone.

### Attaching & Removing the Pre-Amplifier

The microphone supplied with the GA131 type B is a pre-polarised ½" Microtech Gefell MK250.

On the pre-amplifier locate the orientation key and on the instrument locate the RED keying identification mark. Position the pre-amplifier so that the orientation key is in line with the RED mark and then gently push the pre-amplifier into the instruments socket. To pull the two connections tightly together and hold the pre-amplifier securely in place simply screw the knurled retaining ring in a clockwise direction over the instruments threaded top assembly. DO NOT TWIST THE MICROPHONE STEM.

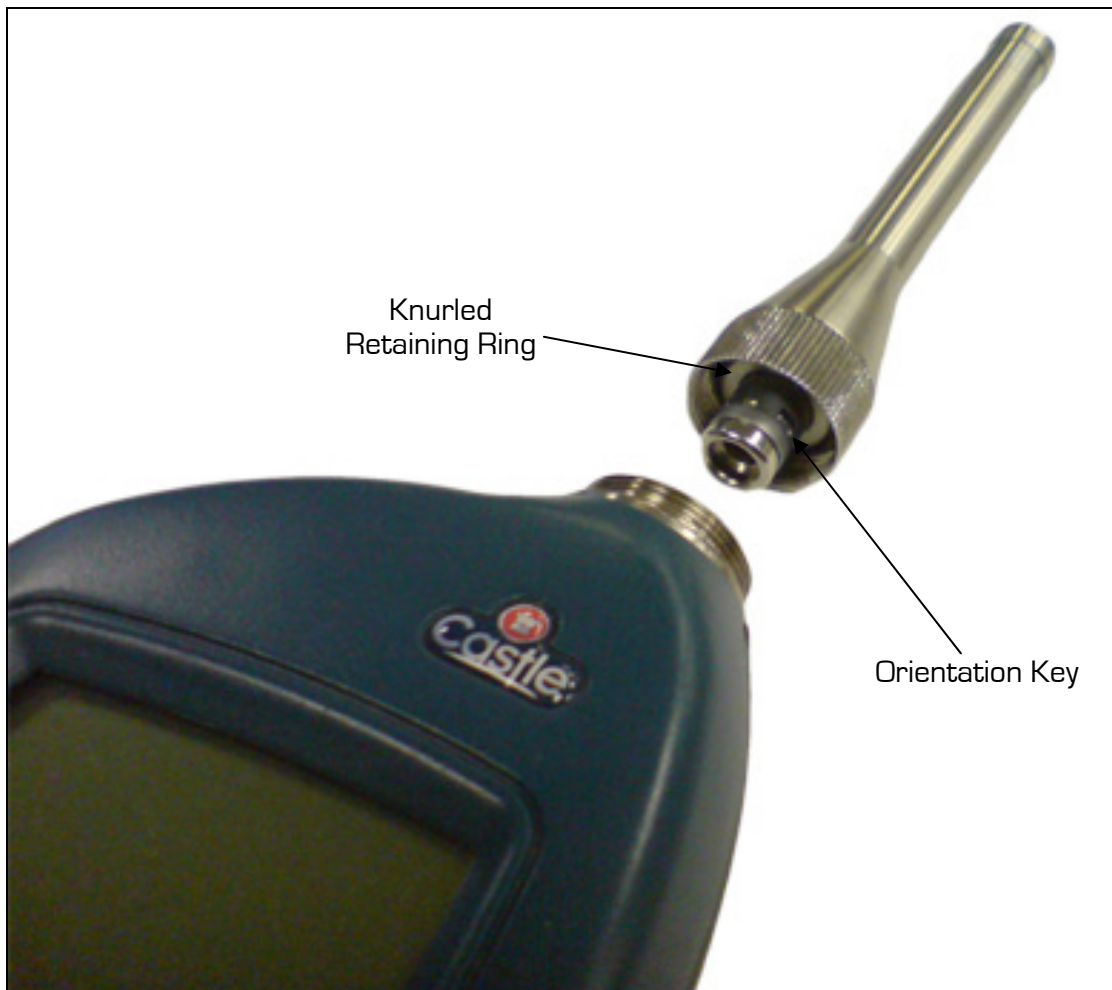


Figure 1 - Attaching the Pre-Amplifier

To remove the pre-amplifier unscrew the knurled retaining ring on the pre-amplifier and gently pull the pre-amplifier from the instrument.

## **Removal of Microphones**

---

The microphone type can be fitted to the pre-amplifier by screwing the microphone in a clockwise direction ensuring that the pre-amplifier spring pin is located centrally in the microphone. To remove the microphone unscrew in an anti-clockwise direction.

The microphone has a protection grid which can also be unscrewed and removed, great care must be taken to ensure that this is not removed. Underneath the protection grid is the microphone diaphragm which should never be touched or be subject to dust or dirt. Doing so may damage the microphone beyond repair or affect its acoustic response.

**PLEASE NOTE THAT YOUR INSTRUMENT MAY BE SUPPLIED WITH A PROTECTIVE WHITE PLASTIC CAP COVERING THE END OF THE MICROPHONE WHEN DELIVERED. THIS CAP MUST BE REMOVED PRIOR TO USING THE INSTRUMENT.**

## **Attaching & Removing the Microphone Extension Cable**

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To attach the microphone extension cable, insert the 5 pin connector into the instrument as illustrated in Figure 2 below. This is achieved by aligning the RED marks on both the instrument and connector and then gently pushing.

Align the orientation key on the pre-amplifier assembly with the RED identification mark on the tapered adaptor and then gently push the pre-amplifier assembly gently into the tapered adaptor. Screw the knurled retaining ring over the threaded tapered adaptor in a clockwise direction to make connection between the two connectors and securely hold the pre-amplifier in place.

To remove reverse the above procedure.



**Figure 2 - Attaching and Removing the Microphone Extension Cable**

# Chapter 2

## Measuring Sound

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Always calibrate your instrument prior to, and after taking measurements using a known sound source such as the Castle GA607 sound level calibrator. Whilst measuring always point your Castle Pro DX meter directly towards the noise source being measured.

### Sound Level – General Advice

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In some environments, high levels of noise can occur. The Castle Pro DX sound level meter has therefore been designed with six measurement ranges for complete accuracy up to sound levels of 140dB.

Before you record measurements take the time to ensure you have chosen the optimum range for the process to be recorded. Wherever possible, the optimum range is when the average measured signal is approximately half way between the top of the range and the bottom of the range.

Where high levels of noise are encountered the meter may register an overload and in these circumstances the meter will display that this has occurred, it is therefore advisable to determine if an Over Load occurs on the selected range. In such cases you will need to select a higher range to accommodate the higher peak levels. See **Technical Specifications** for peak range limits on each individual range.

If the noise levels are too low for the range selected then the meter will display an under range condition. Under these circumstances you will need to select a lower range.

For more detailed information see **Under Range & Overload Conditions** and **Range Selection**.

If measuring low level noise then be aware of the inherent noise levels caused by a combination of thermal and electrical noise from both the microphone and the sound level meter. Measuring data that lies within 10dB of the lowest quoted level on the lowest measuring range may be influenced by the self noise of the system. See **Technical Specifications** for inherent noise levels and range limits.

## **Reflections**

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The sound level meter operator and the sound level meter itself can interfere with the measurements being made, reflecting the noise signal. The Pro DX sound level meter case has therefore been designed to minimize reflections whilst also being of rugged construction.

To minimize reflections from the operator hold the sound level meter at arms length, mount the sound meter on a tripod or use a microphone extension cable.

## **Time Weighting**

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The time weighting is a time constant that modifies the response of the SPL (Sound Pressure Level).

The available standardised time weightings are as follows: -

### **Slow Weighting**

---

Shows a slow rise in the SPL even for a sharp rise in the noise level, likewise a rapid reduction in noise will be shown as a slow decrease in SPL. The rise and fall times applied for Slow Weighting are 1 second.

### **Fast Weighting**

---

Follows the noise level closer than slow weighting by displaying a fast rise and fall in the SPL. The rise and fall times applied for Fast Weighting are 125m Seconds.

# Frequency Weighting Filters

---

Frequency Weightings are where the Sound Pressure Level (SPL) is modified by use of filtering. On your Pro DX Meter this filtering is done digitally through a powerful DSP (Digital Signal Processor). All of the weightings on your Pro DX Meter are standardised between 10Hz and 20,000Hz. The available standardised time weightings are as follows: -

## 'A' Weighting

---

The SPL is filtered in such a manner as to reflect the hearing response of a human ear. Generally this is the most common used frequency weighting. When selected your data will be displayed as dBA (decibels A weighted).

## 'C' Weighting

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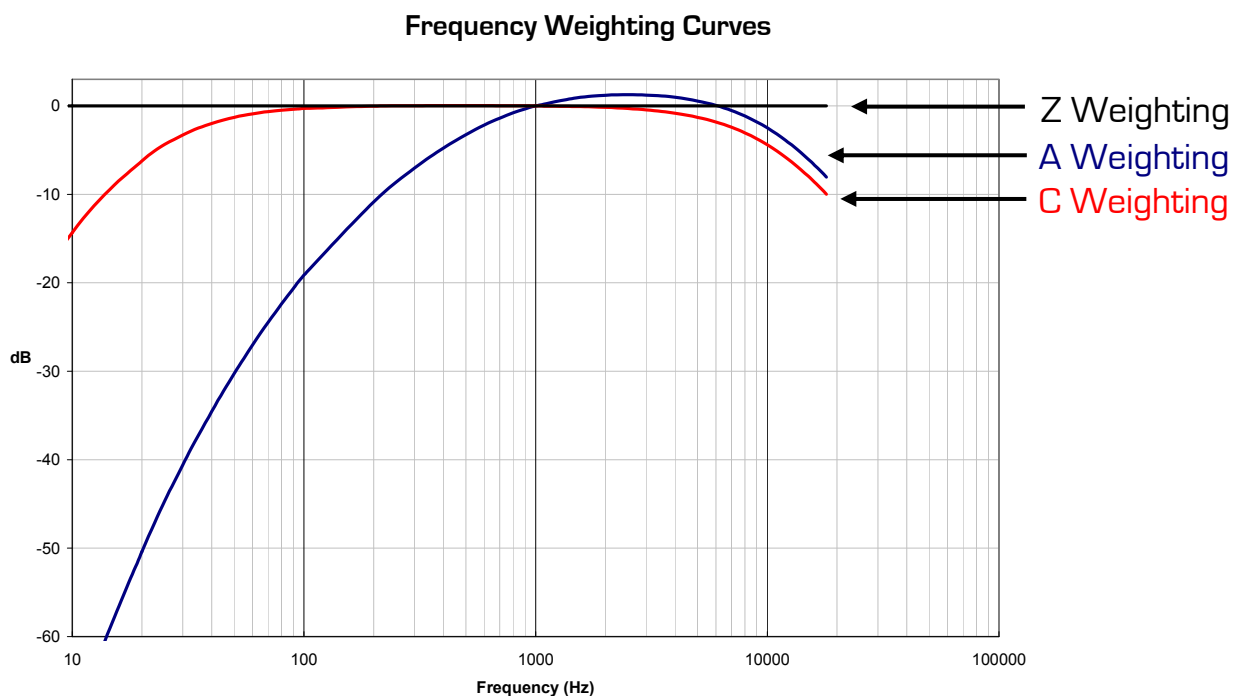
This does not filter the SPL as much as 'A' weighting and is generally used for the acoustic emissions of machinery and for peak sound levels. When selected your data will be displayed as dBC (decibels C weighted).

## 'Z' Weighting

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No filtering of the SPL occurs, i.e. the SPL is un-weighted which is often referred to as the FLAT or LIN response. This weighting is generally used in conjunction with octave band filters. When selected your data will be displayed as dBZ (decibels Z weighted).

The graph below shows the frequency response for each of the weightings available on your Pro DX Meter: -



**Figure 3 – Frequency Weighting Curves**

# Overload and Under Range Conditions

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## Overload Condition

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An overload condition occurs when the peak signal starts to exceed the signal handling capability of the pre-amplifier circuitry.

If the noise source is greater than 0.1dB over the top of the range selected, an overload condition occurs and an overload indicator is displayed on your meter. In such circumstances it is highly recommended you change to a higher range with a lower sensitivity (i.e. less gain) as your meter will be out of specification.

The overload indicator will remain for a minimum of one second or while the overload condition remains.

In real time operation, where time average or sound exposure parameters are shown and an overload condition has occurred, the overload indication is latched on and can only be removed by resetting the parameters.

Whilst recording, where time average or sound exposure parameters are shown and an overload condition has occurred, the overload indication is latched on and is only reset after the recording has been stopped.

If whilst recording an overload occurs, then an overload flag is saved for the channel that caused the overload condition.

Overload indicator locations are shown for each display mode below: -

### SLM Mode Overload Indicators

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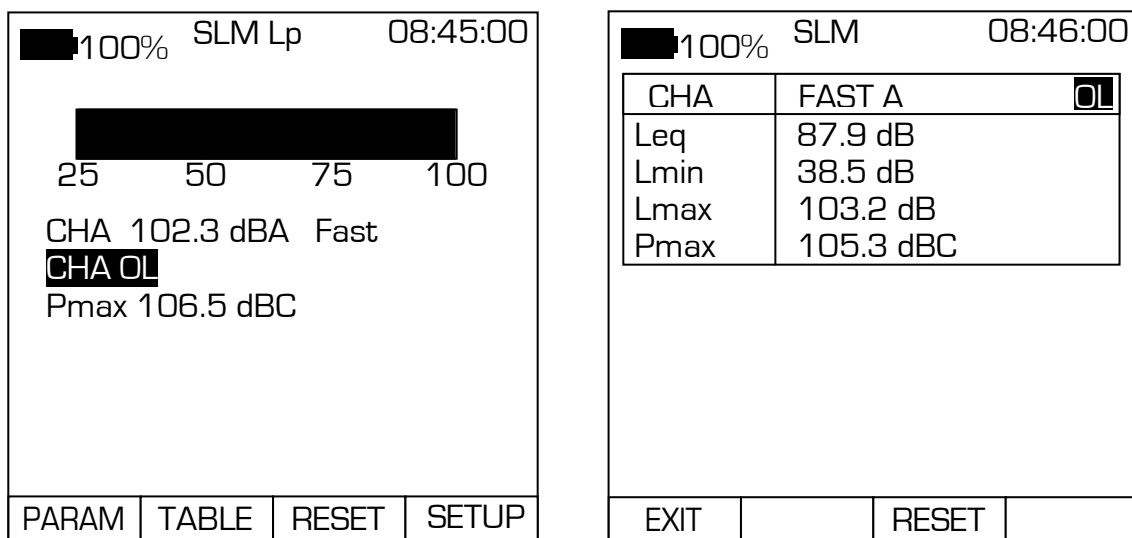
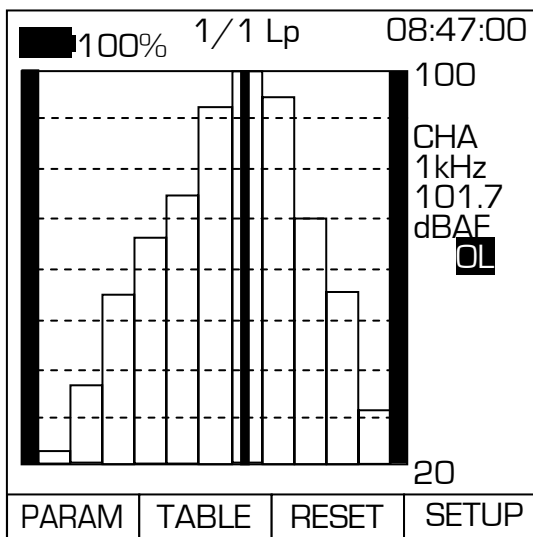


Figure 4 - SLM Mode Overload Indicators

# Full Octave Mode Overload Indicators



100% 1/1 Lp 08:47:10

Hz	dB	AP	dB
16	22.2	CHA	100.8
31.5	38.5		
63	40.2	Pmax	dBC
125	56.3	CHA	104.2
250	67.2		
500	91.6		
1k	101.7		
2k	94.1		
4k	70.1		
8k	56.1		
16k	23.6		

**CHA OL**

Use <> To  
Change Param

EXIT			RESET
------	--	--	-------

100% 1/1 Leq 08:47:20

Hz	dB	AP	dB
16	22.2	CHA	100.8
31.5	38.5		
63	40.2	Pmax	dBC
125	56.3	CHA	104.2
250	67.2		
500	91.6		
1k	101.7		
2k	94.1		
4k	70.1		
8k	56.1		
16k	23.6		

**CHA OL**

**OL Occurred**

Use <> To  
Change Param

EXIT			RESET
------	--	--	-------

Figure 5 - Full Octave Mode Overload Indicators

## Under Range Condition

An under range condition occurs when the noise source is more than 0.1dB below the bottom of the range selected, at which point an under range indicator will be displayed on your meter. In such circumstances it is highly recommended to change to a lower range with a higher sensitivity (i.e. more gain) as your meter will be out of specification.

The under range indicator will remain for a minimum of one second or while the under range condition remains. Under Range indicator locations are shown for each display mode below: -

### SLM Mode Under Range Indicators

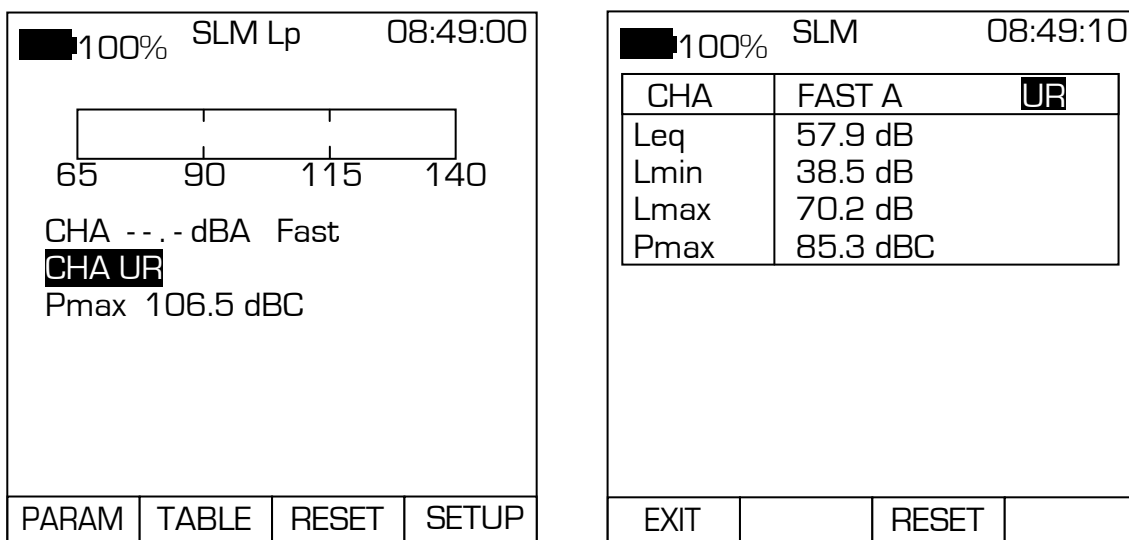


Figure 6 - SLM Mode Under Range Indicators

### Full Octave Mode Under Range Indicators

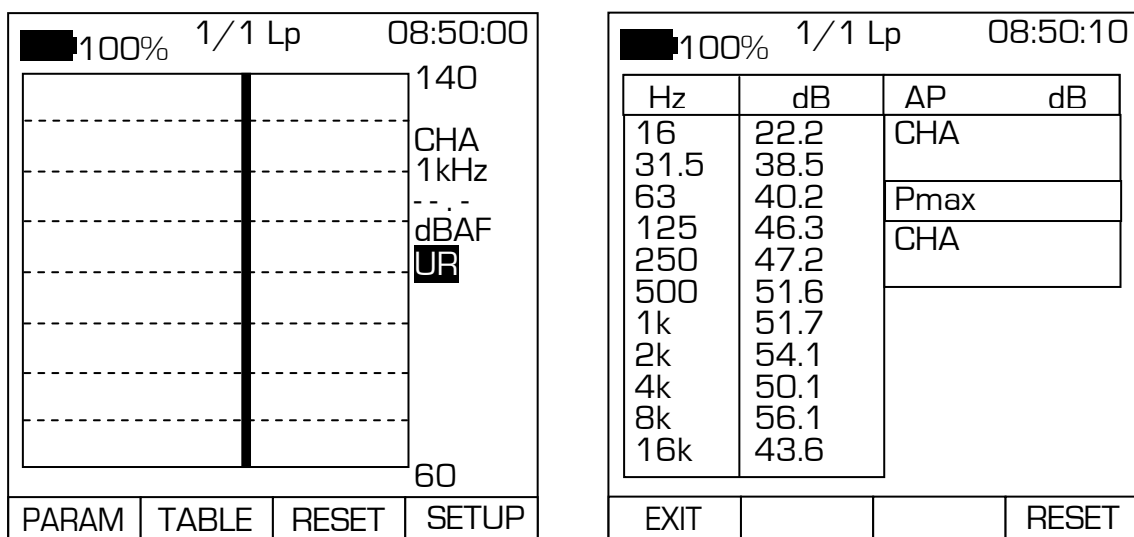


Figure 7 - Full Octave Mode Under Range Indicators

## Measuring Ranges

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The Pro DX Vocis sound level meter has been specifically designed to utilise six measuring ranges. The six ranges ensure complete accuracy throughout the entire dynamic range whilst ensuring the instrument remains low power.

The measuring display ranges available are as follows: -

SLM Mode [dB]	Full Octave Mode [dB]
15 - 90	10 - 90
25 - 100	20 - 100
35 - 110	30 - 110
45 - 120	40 - 120
55 - 130	50 - 130
65 - 140	60 - 140

The displayed range on Full Octave Mode is intentionally different for graphing purposes only. The linear operating range remains as given at 75dB.

# Chapter 3

## Getting Started

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Your Pro DX Vocis meter has two running states of operation:-

- Real Time

- Recording


Real Time operation does not record any measurements (see **Real Time Operation** for more information and procedures).

To record data and obtain the meter must be placed into Recording Operation (see **Recording Operation** for more information and procedures).

When the meter is first switched on, the meter defaults to Real Time Operation.

Your meter is equipped with a simple to use navigation system using the four Light Blue keys (**Soft Keys**) located at the top of the keypad.

Where appropriate, on the display directly above each Soft Key will be a description, pressing the Soft Key will bring up further menus or change the function as described.

The **Main Menu** is activated by pressing the **MENU** Key  once. Pressing the Menu Key again will put the instrument into Real Time measurement mode.

The Main Menu and other sub menus use a numbered menu system. When displayed you are presented with a list of selectable options, to activate the required option press the corresponding number using the numeric keypad on your instrument.

Some options may also have further sub-menus where further options are listed.

The **Main Menu** and **Sub Menus** are described in detail in **Chapter 4**.

# Keypad Layout

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Figure 8 - Keypad Layout

# Sample Screen Layouts

## Sound Level Meter Mode (screens may vary slightly depending on type)

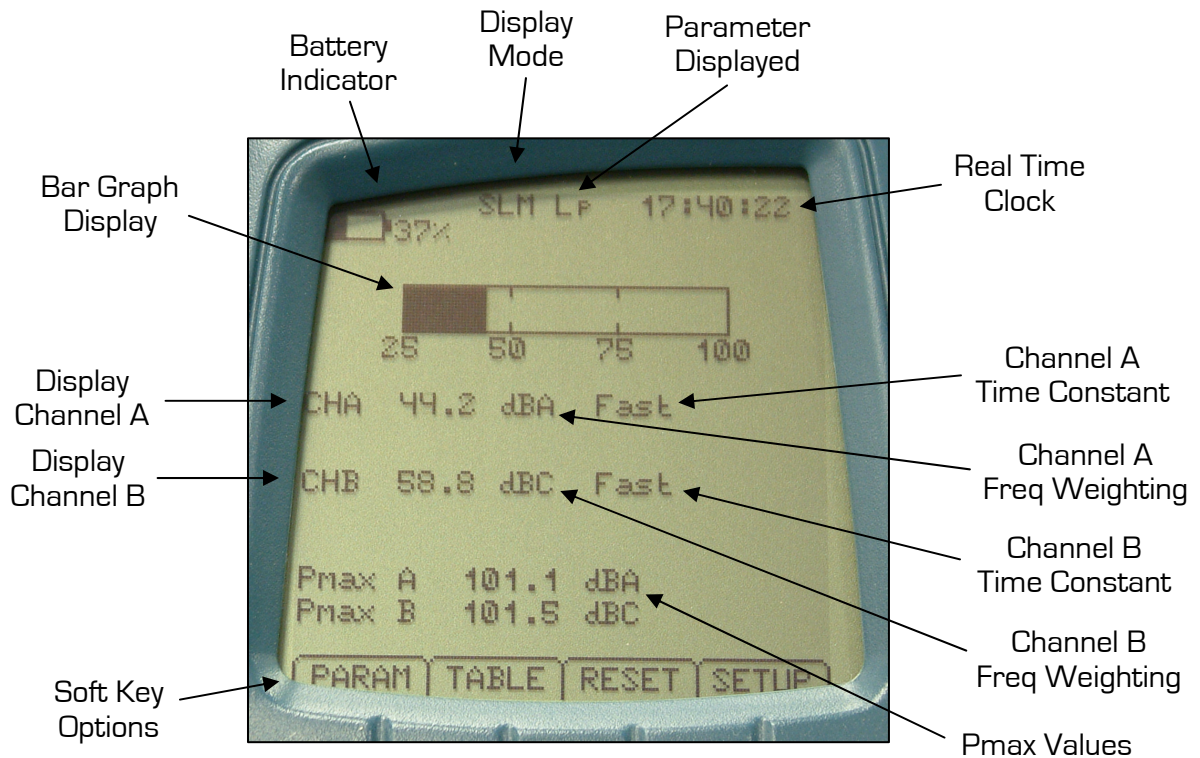


Figure 9 - SLM Mode Screen Layout

## Octave Band Mode (screens may vary slightly depending on type)

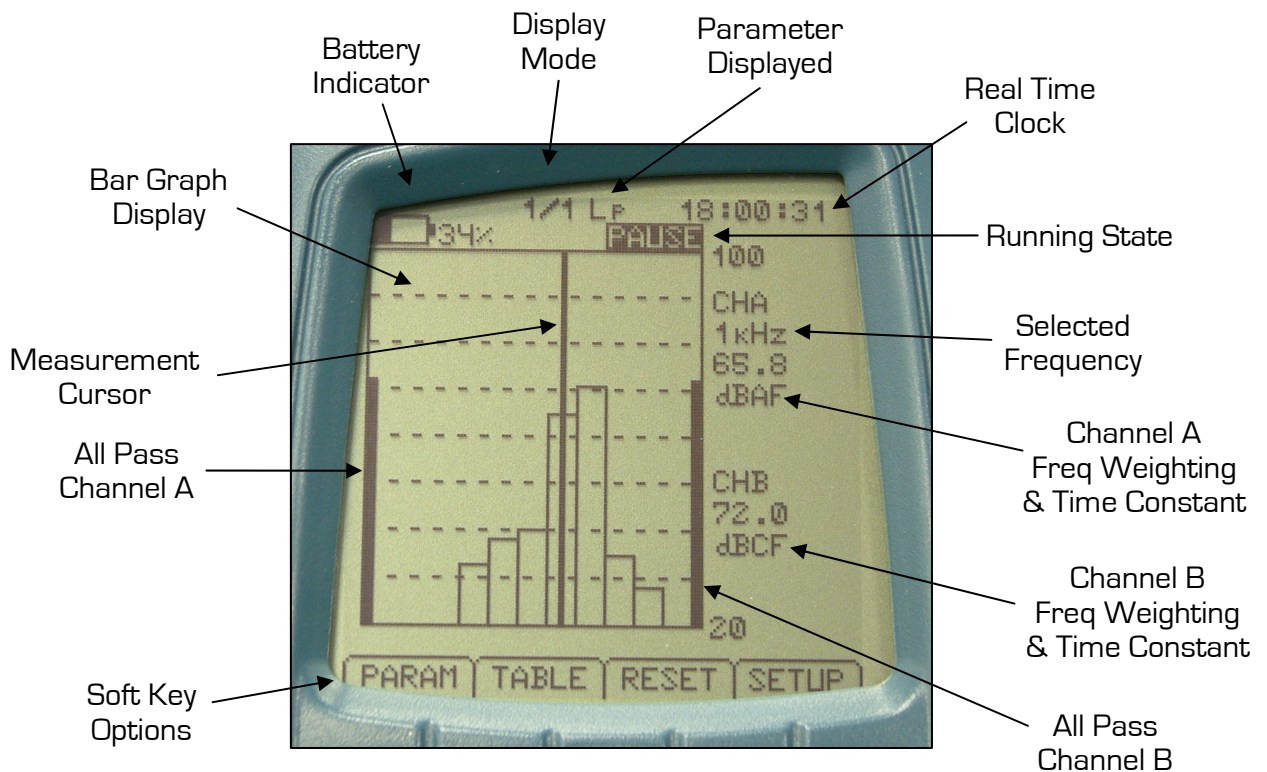


Figure 10 - Full Octave Mode Screen Layout

## Powering Your Pro DX Vocis Meter

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Your Pro DX Vocis meter can be powered from either 6 \* AA batteries or an external Castle 12V DC Power Supply which can be purchased separately if required (PSU3).

The battery compartment is located on the rear of your instrument and its cover can easily be removed and fastened by the use of your thumb or a coin if required. Place each individual battery with the positive terminal to the positive markings which are moulded into the case in the battery compartment. To achieve higher battery life of your instrument it is strongly recommended you use Alkaline type batteries.

**With your Pro DX meter off, keypad scanning circuitry is still active within your meter. It is therefore recommended you remove at least one battery whilst not in use. This procedure will ensure you get the maximum life span from your batteries.**

To power the instrument via the Castle DC Power Supply, firstly plug your PC or Printer cable into the 9 pin male connector located at the base of the unit. The correct orientation is such that the flying DC socket connected to the 9 pin female connector on the cable is inserted in the base of your Pro DX meter. Your DC power supply is now inserted into the flying DC socket.

Your Pro DX meter is equipped with a battery level indicator; this is given both graphically and as a percentage readout on the meters display. If batteries are low the indicator will flash **LOW** and if not changed the instrument will auto power down. When your Pro DX meter is powered externally via the DC power supply this indicator will remain at 100%.

To preserve your data always turn your instrument off using the Power Key.

Below is a typical graph which approximately indicates the Pro DX battery level with respect to time.

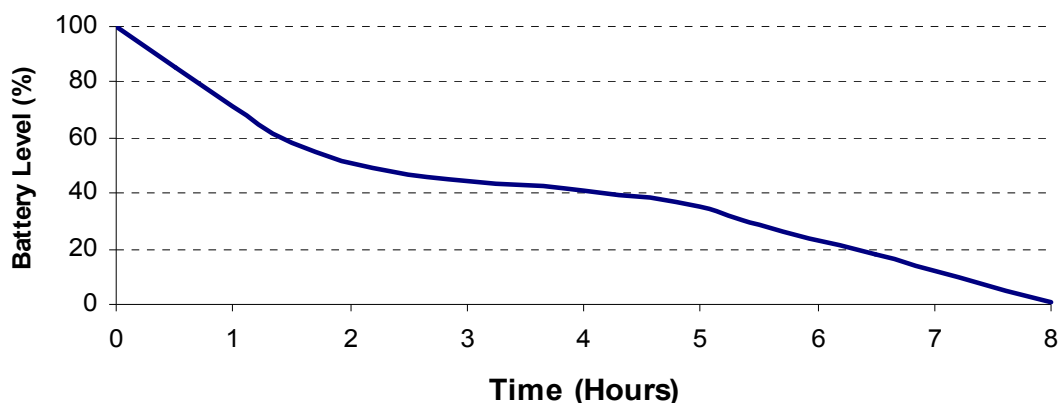



Figure 11 - Approximate Alkaline Battery Life

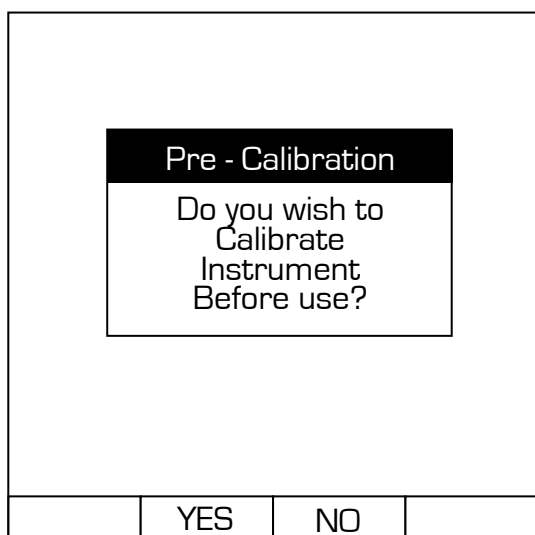
## Switching Your Pro DX Vocis Meter On/Off

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To turn on your instrument press and hold the Power On/Off key  for approximately one second. Your instrument will emit a single beep to inform you that the instrument is activated.

Your meter will now begin its boot sequence, display the start-up screen and initialise the internal digital signal processor. Once the boot sequence is complete you will be prompted if you wish to calibrate your instrument by selecting either **YES** or **NO**. Use the light blue Soft Keys directly beneath the display to confirm your selection.


It is recommended that you calibrate your instrument before use, see the heading **Calibration** in **Chapter 4** for detailed information on calibration of your instrument.



**Figure 12 - Pre-Calibration**

After calibration or if the calibration is bypassed your meter will be ready for operation in Real Time mode with the previously used settings.


To turn your instrument off press the Power On/Off key  at any time.

Please be aware that the Power On/Off key  is disabled whilst the instrument is recording.

To preserve your data always turn your instrument off using the Power Key.

# Chapter 4

## Main Menu Structure

The **Main Menu** is activated by pressing the **MENU** Key  once. Pressing the Menu Key again will put the instrument into Real Time measurement mode.

Your Pro DX Vocis meter is equipped with a simple to use numbered menu system. To select an option simply press its corresponding number key on the Alpha / Numeric keypad of your instrument.

The **Main Menu** and **Sub Menu** options are listed below: -

## Main Menu

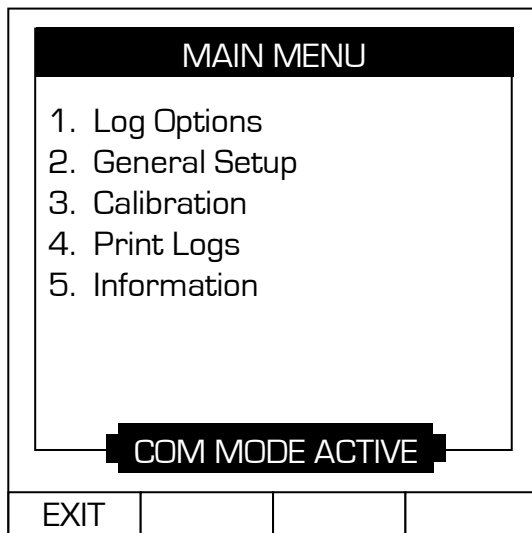


Figure 13 - Main Menu Options

Function	Description
Log Options	Change instrument settings, manage recordings
General Setup	Set and change generic instrument parameters and settings
Calibration	For performing user field calibration
Print Logs	Send stored data directly to a portable printer
Information	Specific instrument details including battery levels

**Please be aware that all communications made to your PC via a standard serial cable or a USB to RS232 adaptor are made when the instrument is in the Main Menu.**

## Log Options

---

Logs are recordings made by the user that contain all the data for specific events. Saving a log allows the user to view the recorded information again on the instrument or download to a PC using the software dBdataPro [available separately].

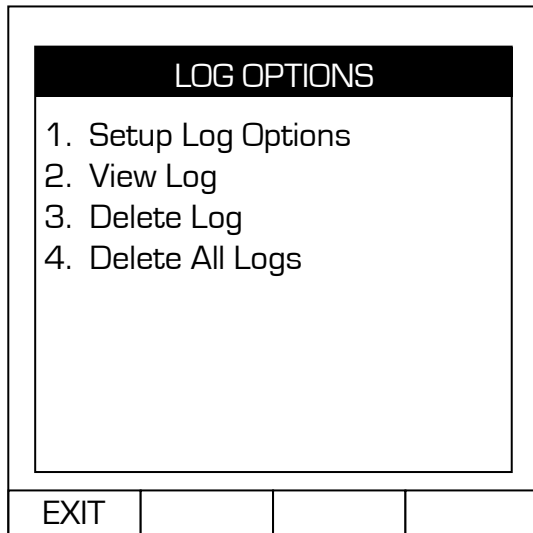


Figure 14 – Log Options

## Setup Log Options

---

Select this option to setup the instrument with the required settings for creating a log (also available using Soft Key 4 in Real Time view screens).

See **Setup Options** in **Chapter 5** for details on changing the settings.

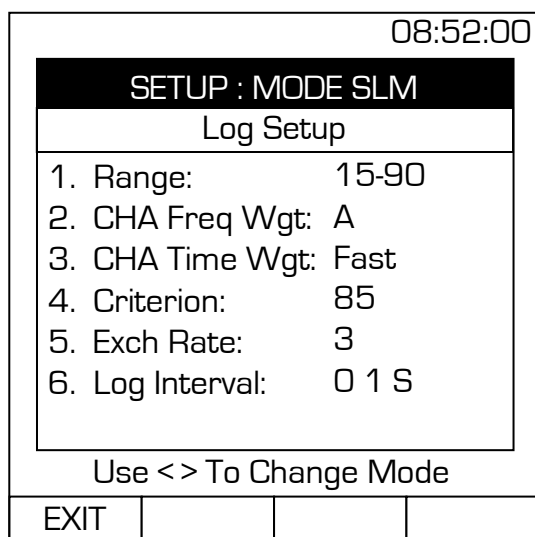


Figure 15 – Setup Log Options

When settings have been made press **Soft Key 1** labelled **EXIT** to return to the Real Time view screen with the settings applied.

## View Log

---

Selecting this option from the LOG OPTIONS menu displays a list of saved log files. Where more than 8 files are saved use **Soft Keys 2** and **3** labelled **UP** and **DOWN** respectively to scroll through the list of available files.

VIEW LOG	
1. TEST1	09/10/2007
2. TEST2	09/10/2007
3. TEST3	10/10/2007
4. TEST4	10/10/2007
5. TEST5	11/10/2007
6. TEST6	11/10/2007
7. TEST7	12/10/2007
8. TEST8	12/10/2007

EXIT		DOWN	SEARCH
------	--	------	--------

Figure 16 - View Log Screen

To search for a file or files using a filter press **Soft Key 4** labelled **SEARCH**.

Enter Search Characters			
Upper Case Mode			

EXIT	NUMBER		
------	--------	--	--

Figure 17 - Search for Saved Logs Screen

Enter search characters using the alpha / numeric keypad. Toggle entry between numbers and letters using **Soft Key 2** labelled as **NUMBER** or **LETTER**. Press **OK** to confirm or **Soft Key 1** labelled **EXIT** to return to the previous screen.

In each case select which file you wish to view from the displayed list using the numeric keypad.

When a recorded log file has been selected the **LOG INFORMATION** screen is displayed which shows the start time and date, the operating mode (SLM , 1/1) , frequency weightings and the log interval length.

LOG INFORMATION	
Start date:	12/10/2007
Start time:	09:45:00
Mode:	1/1
Channel A:	A Fast
Log Interval:	10 Sec

EXIT	DATA	CUMUL	
------	------	-------	--

**Figure 18 - Log Information Screen**

Press **Soft Key 2** labelled **DATA** to view the recorded interval data or **Soft Key 3** labelled **CUMUL** to view the recorded cumulative data.

When viewing interval data, repeat press **Soft Key 2** labelled **DATA** to view each recorded interval in turn.

To change the viewable parameter for either interval or cumulative data, press **Soft Key 4** labelled with an **ARROW** and then repeat press **Soft Key 1** labelled **PARAM** until the required parameter is displayed.

To return to the log information screen press the **Soft Key** labelled **INFO** when displayed.

Printing is also possible by selecting the **Soft Key** labelled **PRINT** when displayed.

To return to the previous screen select **Soft Key 1** when labelled as **EXIT**.

## Delete Log

---

Selecting this option from the LOG OPTIONS menu displays a list of saved log files that can be individually deleted. Where more than 8 files are saved use **Soft Keys 2** and **3** labelled **UP** and **DOWN** respectively to scroll through the list of available files.

DELETE LOG	
1. TEST1	09/10/2007
2. TEST2	09/10/2007
3. TEST3	10/10/2007
4. TEST4	10/10/2007
5. TEST5	11/10/2007
6. TEST6	11/10/2007
7. TEST7	12/10/2007
8. TEST8	12/10/2007

EXIT		DOWN	SEARCH
------	--	------	--------

Figure 19 - Delete Log Screen

To search for a file or files using a filter press **Soft Key 4** labelled **SEARCH**. Enter search characters using the alpha / numeric keypad. Toggle entry between numbers and letters using **Soft Key 2** labelled as **NUMBER** or **LETTER**. Press **OK** to confirm or **Soft Key 1** labelled **EXIT** to return to the previous screen.

In each case select which individual file you wish to delete from the displayed list using the numeric keypad. You will be prompted with a warning screen: -

WARNING	
DO YOU WANT TO DELETE THIS LOG ?	
TEST3	

	YES	NO	
--	-----	----	--

Figure 20 – Delete Log Warning Screen

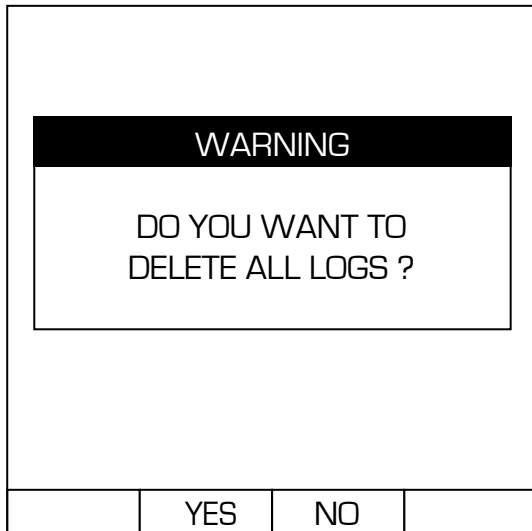
Select **Soft Key 2** labelled **YES** to delete the selected file and return to the previous screen. Press **Soft Key 3** labelled **NO** to return to the previous screen without deleting the selected file.

## Delete All Logs

---

Select this option from the LOG OPTIONS menu to delete all saved log files. Use with extreme caution as deleted logs are non recoverable.

Upon selecting you will be prompted with a warning screen: -



**Figure 21 – Delete All Logs Warning Screen**

Select **Soft Key 2** labelled **YES** to delete all saved files and return to the previous screen. Press **Soft Key 3** labelled **NO** to return to the previous screen without deleting the files.

## General Setup

---

**General Setup** can be accessed by selecting **option 2** from the **Main Menu**.

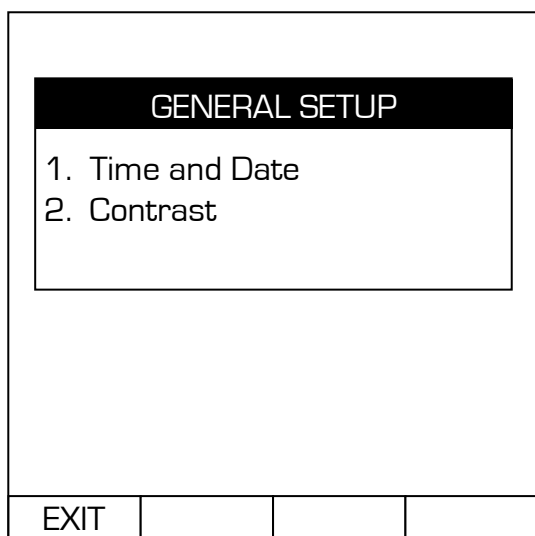


Figure 22 – General Setup Options

## Time and Date

---

Select this option display the **SET TIME AND DATE** selection screen. Choose option 1 to change the date and option 2 to change the time: -

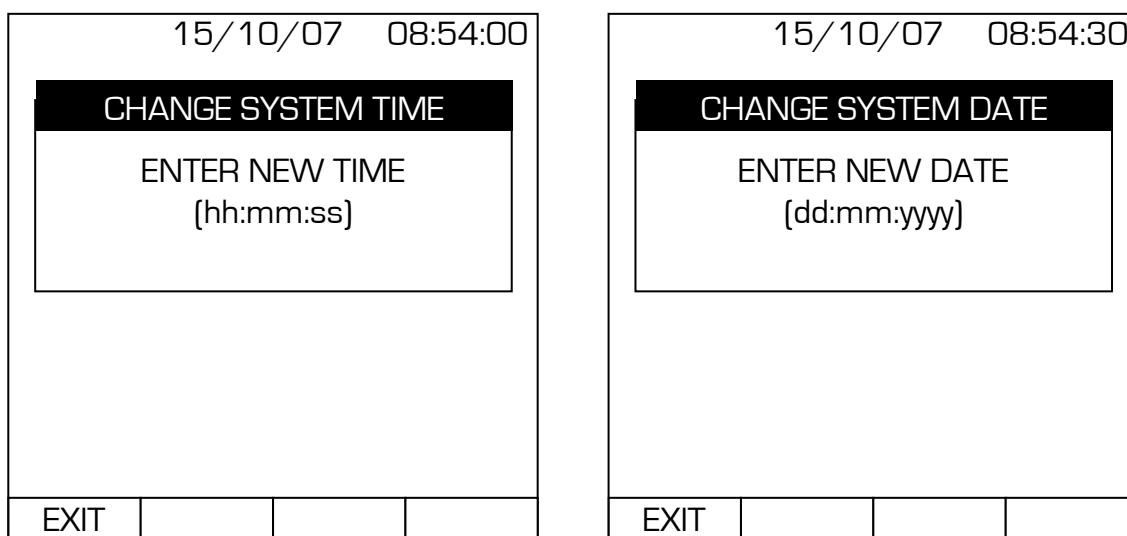


Figure 23 - Date & Time Entry Screens

Enter both the time and date using the numeric keypad. The date is entered using the format dd/mm/yyyy whilst the time is entered using the 24 hour format hh:mm:ss.

As an example, if the date was 12<sup>th</sup> July 2006 you would press the following on your keypad **12072006**, and if the time was 7:02 pm you would enter the following on your keypad **190200**.

Press **OK** to confirm or use the **Left Arrow** key on your keypad to erase any errors. Press **Soft Key 1** labelled **EXIT** to return to the previous screen.

## Contrast

---

Select this option to adjust the screen contrast: -

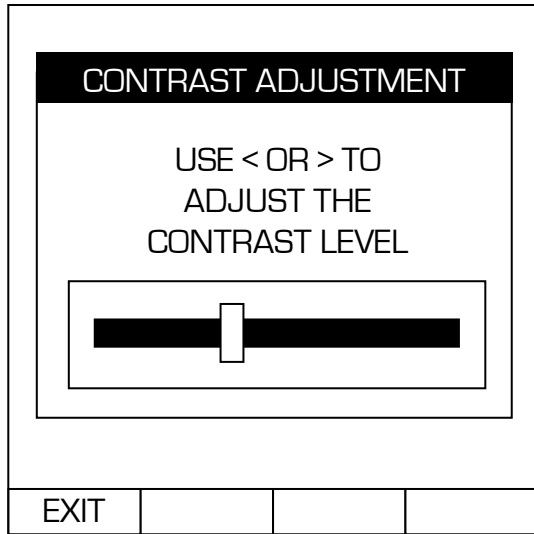


Figure 24 - Contrast Adjustment Screen

Use the **Left** and **Right Arrow** Keys ◀ ▶ to adjust the contrast, **Left Arrow** to decrease and **Right Arrow** to increase. Press **Soft Key 1** labelled **EXIT** to return to the previous screen.

## Calibration

---

It is recommended that the instrument's calibration is checked and adjusted where necessary with a calibrator before readings being taken. The calibration should be re-checked after taking readings to confirm the validity of the results. The calibrator recommended for use is the Castle GA607, which supplies typically 94dB/ 104dB (relative to 20 $\mu$ Pa pressure) at a frequency of 1kHz.

Calibration can be completed from first power on, or alternatively by selecting Option 3 labelled **Calibration** from the Main Menu.

On the calibration screen you will be presented with a calibration level, this is the previous level your instrument was calibrated to. This figure can be adjusted up or down with a resolution of  $\pm 0.1$ dB or  $\pm 1$ dB by using the 4 Light Blue Soft Keys.

Ensure the calibrator is attached to the microphone by gently inserting the microphone into the cavity of the calibrator. A certain amount of resistance should be felt whilst inserting the microphone as the o-ring seal on the calibrator forms a seal around the microphone. Ensure that the calibrator is switched on and set to the chosen level and all correction factors for atmospheric pressure and microphone type have been accounted for. Please refer to your Castle Calibrator Manual for more detail.

The pressure to free-field correction value to be applied when used with Castle calibrators GA607, GA601 and a B&K 4231 are as follows: -

### Microtech Gefell MK250 Microphone Capsule

Castle GA607 Calibrator Pressure To Free Field Correction	= -0.2dB
Castle GA601 Calibrator Pressure To Free Field Correction	= -0.2dB
B&K 4231 Calibrator Pressure To Free Field Correction	= -0.2dB

When you have selected the correct calibration figure and have the calibrator in position press the OK button on your instrument to begin calibration. Your instrument will display **CALIBRATING INSTRUMENT TO** and an elapsed time. Calibration completes in 5 seconds.

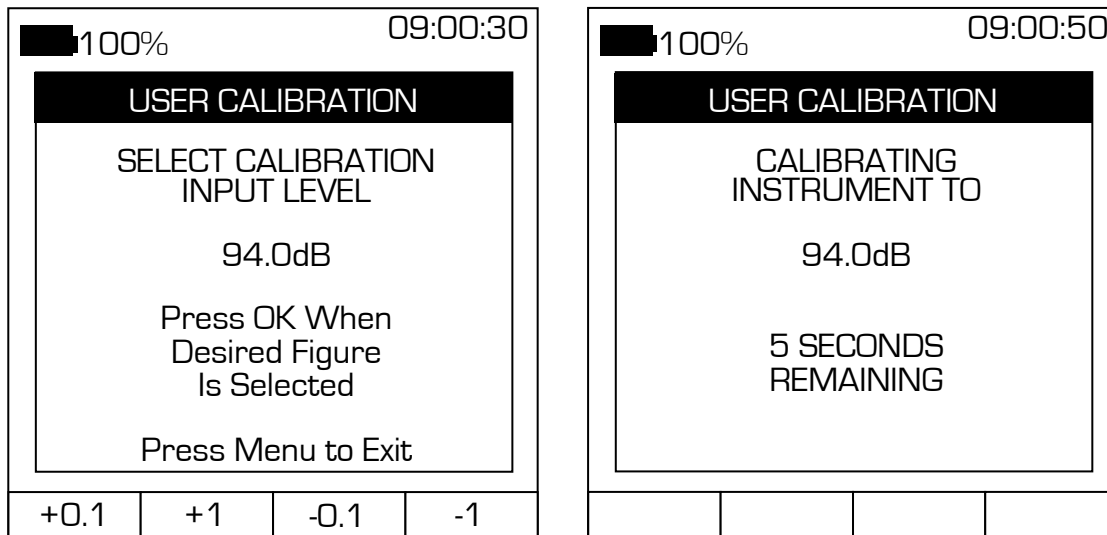


Figure 25 - User Calibration Screen

If the calibration is interrupted or the input level is not within  $\pm 3$ dB of the chosen reference level then the display will show **CALIBRATION FAILURE**. Check to make sure the calibrator is switched on and emitting the correct level before proceeding again as indicated above. Please note that the calibrator automatically turns OFF after approximately 1 minute.

***TIP:***

*Refer to the manual for your GA607 calibrator for further information on setting up correction levels.*

## Print Logs

---

Selecting this option from the **Main Menu** displays a list of saved files. Where more than 8 files are saved use **Soft Keys 2** and **3** labelled **UP** and **DOWN** respectively to scroll through the list of available files.

PRINT LOG	
1. FILE1	12/10/2007
2. FILE2	12/10/2007
3. FILE3	12/10/2007
4. FILE4	12/10/2007
5. FILE5	12/10/2007
6. FILE6	12/10/2007
7. FILE7	12/10/2007
8. FILE8	12/10/2007

EXIT		DOWN	SEARCH
------	--	------	--------

Figure 26 – Print Log List Screen

To search for a file press **Soft Key 4** labelled **SEARCH**. Enter search characters using the alpha / numeric keypad. Toggle entry between numbers and letters using **Soft Key 2** labelled as **NUMBER** or **LETTER**. Press **OK** to confirm or **Soft Key 1** labelled **EXIT** to return to the previous screen.

In each case select which file you wish to print from the displayed list using the numeric keypad and then select which data from the log you wish to be printed: -

PRINT LOG	
1. Entire Log	
2. Selected Interval	
3. Cumulative Data	

EXIT			
------	--	--	--

Figure 27 – Print Log Data Selection Screen

Press **Soft Key 1** labelled **EXIT** to return to the previous screen without printing.

## Information

---

Select this from the **Main Menu** to display the following specific instrument information: -

Information
Instrument Model
Serial Number
Firmware Version Number
Factor Re-Calibration Date
Remaining Main Battery Charge
Remaining Lithium Battery Charge
Free Space Available (kilobytes)

Press **Soft Key 1** labelled **EXIT** to return to the Main Menu screen.

# Chapter 5

## Real Time Operation

---

Real Time operation can be identified by having a Soft Key option labelled RESET also no recording duration timer is displayed.

## Display Modes

---

The Pro DX Vocis type B has two display modes, these are as follows: -

- SLM Mode (Sound Level Meter or Broadband)
- Full Octave Band Mode (1/1)

Each display mode can display information graphically or in a tabular format. By default the meter displays the information graphically.

## Graphical Display Screens

---

The following parameters are available graphically: -

- Lp - The weighted running rms (Root Mean Square) value
- Leq - The weighted, time averaged value
- Lmin - The minimum Lp level reached
- Lmax - The maximum Lp level reached

In SLM mode the parameter Pmax is also displayed on the screen. Pmax is the highest peak level (C Weighted) of the instantaneous sound level.

Whilst viewing the parameters graphically, the parameter displayed can be changed by pressing **Soft Key 1** labelled **PARAM**.

The graphical display screens for the parameter Lp are illustrated below for each mode: -

### SLM Mode

---

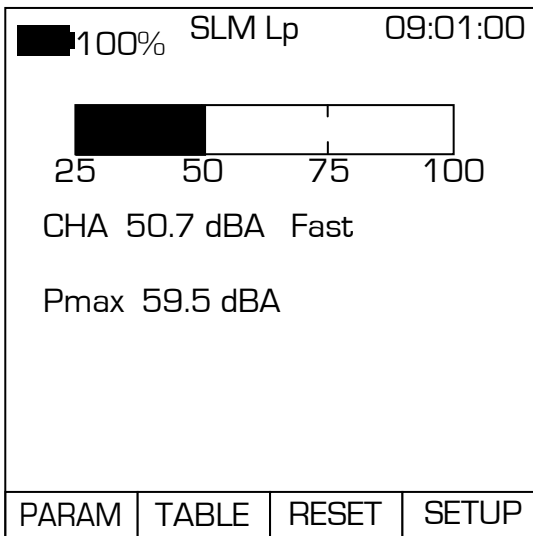


Figure 28 – Graphical SLM Mode Display Mode Screen

### Full Octave Mode

---

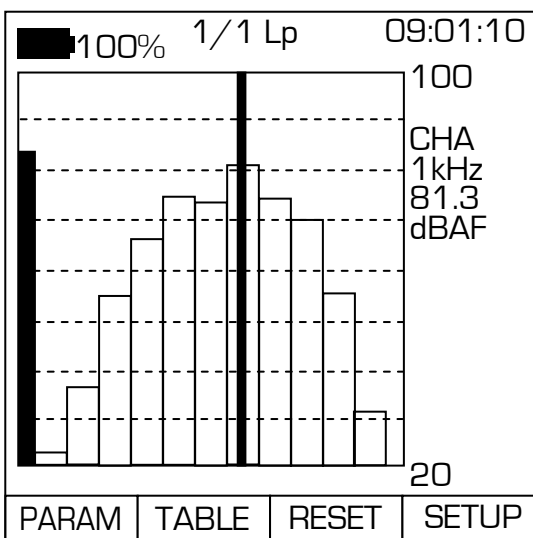


Figure 29 – Graphical Full Octave Mode Display Screen

## Tabular Display Screens

---

To view data in tabular format press **Soft Key 2** labelled **TABLE**. To return to viewing graphically press **Soft Key 1** labelled **EXIT**.

The tabular display screens are illustrated below for each mode: -

### SLM Mode

---

The following parameters are available in tabular format: -

- Leq, Lmin, Lmax, Pmax

■ 100%		SLM	09:01:30
CHA	FAST A		
CHA	57.9 dB		
Lmin	38.5 dB		
Lmax	70.2 dB		
Pmax	85.3 dBC		
EXIT		RESET	

Figure 30 - Tabular SLM Mode Display Screen

### Full Octave Mode

---

The following parameters are available in tabular format: -

- Lp, Leq, Lmin, Lmax, Pmax

The Lp figure is displayed individually as an All Pass (AP) or cumulative figure of all the octave bands along with the Pmax figure at the right hand side of the screen.

Individual Full Octave or Third Octave data is also displayed for the following parameters: -

- Lp, Leq, Lmin, Lmax

Use the **Left** and **Right Arrow** Keys ◀▶ to scroll through the different parameters.

100%		1/1 Lp		09:01:40	
Hz	dB	AP	dB		
16	17.9	CHA	94.6		
31.5	38.5	Pmax	dBC		
63	40.2		CHA	98.8	
125	55.3	Use <> To Change Param			
250	60.7				
500	82.6				
1k	90.7				
2k	89.4				
4k	88.4				
8k	75.1				
16k	32.6				
EXIT			RESET		

Figure 31 – Tabular Full Octave Mode Display Screens

## Resetting Parameter Values

---

Pressing the **Soft Key** labelled **RESET** or the **OK** button when viewed graphically or in tabular format will reset all parameters and any latched overload indicators.

Parameters are updated after the refresh rate time period.

## Setup Options

---

Whilst viewing data graphically press **Soft Key 4** labelled **SETUP** to display and change display and logging parameters. The setup screen displays which display mode the instrument is currently in. Use the **Left** and **Right Arrow** Keys ◀ ▶ to switch to the required display mode (Full Octave or SLM).

Once selections have been made press **Soft Key 1** labelled **EXIT** to return to real time operation utilising the selections made. All settings are remembered when the instrument is powered down.

09:02:00			
<b>SETUP : MODE SLM</b>			
Log Setup			
1. Range:	15-90		
2. Freq Wgt:	A		
3. Time Wgt:	Fast		
4. Criterion:	85		
5. Exch Rate:	3		
6. Log Interval:	0 1 S		
Use <> To Change Mode			
EXIT			

Figure 32 - Setup Options

## Changing the Range

---

Change the range by selecting **Option 1** labelled **Range**. The range selection will highlight and flash, changes can be made using **Soft Key 2** labelled **UP** and **Soft Key 3** labelled **DOWN**.

Press the **OK** key to accept the change.

The measuring display ranges available are as follows: -

SLM Mode [dB]	Full Octave Mode [dB]
15 - 90	10 - 90
25 - 100	20 - 100
35 - 110	30 - 110
45 - 120	40 - 120
55 - 130	50 - 130
65 - 140	60 - 140

For more information on ranges see **Measuring Ranges** in **Chapter 2**.

## Changing the Frequency Weighting

---

To change the frequency weighting of the instrument select **Option 2** labelled **Freq Wgt.**

The frequency weighting selection will highlight and flash, changes can be made using **Soft Key 2** labelled **UP** and **Soft Key 3** labelled **DOWN**.

Press the **OK** key to accept the change.

The frequency weighting filters available are as follows: -

Frequency Weighting
A
C
Z (Linear or Flat)

For more information on frequency weighting see **Frequency Weighting Filters** in **Chapter 2**.

## Changing the Time Weighting

---

To change the time weighting of the instrument select **Option 3** labelled **Time Wgt.**

The time weighting selection will highlight and flash, changes can be made using **Soft Key 2** labelled **UP** and **Soft Key 3** labelled **DOWN**.

Press the **OK** key to accept the change.

The time weighting constants are as follows: -

Time Weighting
Fast
Slow

For more information on time weighting see **Time Weighting Filters** in **Chapter 2**.

## Changing the Criterion Level

---

The criterion is used in the calculation of the parameter DOSE, this value is generally set at 85dB for use in the UK.

To allow for changes in legislation or for use in other countries the criterion can be set to one of the following levels: -

Criterion Levels (dB)
75
80
85
90

Select **Option 4** labelled **Criterion**, the criterion level will highlight and flash. Adjust the level using **Soft Key 2** labelled **UP** or **Soft Key 3** labelled **DOWN** accordingly.

Press the **OK** key to accept the change.

## Changing the Exchange Rate Level

---

The exchange rate is used in the calculation of the parameter DOSE, this value is generally set at 3dB for use in the UK.

To allow for changes in legislation or for use in other countries the exchange rate can be set to one of the following levels: -

Exchange Rate (dB)
3
4
5

Select **Option 3** labelled **Exchange Rate**, the exchange rate level will highlight and flash. Adjust the level using **Soft Key 2** labelled **UP** or **Soft Key 3** labelled **DOWN** accordingly.

Press the **OK** key to accept the change.

## Changing the Log Interval

---

This setting is changed whilst in real time mode but only used whilst recording and is the time interval that data is repeatedly recorded.

The Log Interval unit can be in either **Seconds**, **Minutes** or **Hours** and the period can have values between **01** and **99**.

To change the Log Interval settings, select **Option 6** labelled **Log Interval** on page 1 of the available options.

Use the **Left** and **Right Arrow** Keys (◀▶) to highlight the first or second digit value, or the unit of time. The highlighted item also flashes.

Use **Soft Key 2** labelled **UP** and **Soft Key 3** labelled **DOWN** to adjust the digit values between **0** and **9** and the units to either **M**, **S** or **H** for minutes, seconds and hours respectively.

Press the **OK** key to accept any changes. Repeat the procedure as required.

As an example set as **6 0 S** or **0 1 M** for a log interval of 1 minute (60 seconds).

### **TIP:**

*Ensure you set an appropriate Log Interval Length. Inadvertently setting this to 1 second will capture and record vast amounts of information and is perfectly suitable for short duration recordings, however long duration recordings at these short duration log intervals will inevitably mean huge file sizes resulting in slow download to a PC and viewing on your Vocis instrument.*

A short duration recording may be considered as 1 to 5 minutes. At most a Pro DX Vocis meter will store 1852 bytes at each log interval. If the log duration is 5 minutes and with a log interval of 1 second, the total amount to save is: -

- $1852 * 60 * 5 = 555,600$  bytes (approximately 0.5 Mega Bytes)

This is a fairly large log file and in the majority of instances it is not necessary to contain all this information. Setting the log interval to 5 seconds may be acceptable.

If your recording length is in hours rather than minutes, then set your log interval accordingly. A common figure is 5 minutes.

## Shortcut Keys


---

The Pro DX Vocis Range type B has 5 shortcut keys which are only available on the Real Time Graphical display screens and are listed below: -

Shortcut Key	Function
2	Up Range
4	Change Frequency Weighting Channel A
5	Change Mode (Instrument Specific)
6	Change Time Weighting Channel A
8	Down Range

# Chapter 6

## Recording Operation

Recording is achieved by pressing the **STOP / RECORD** Key  on your instruments keypad.

All settings/parameters from within SETUP in Real Time mode will be used or logged when a recording is started.

It is not possible to reset any parameter, change range or adjust any settings whilst recording.

Recording operation can be identified by having a duration value showing the total duration that the recording has been running and the mnemonic **►REC◄** by the side of the total duration.

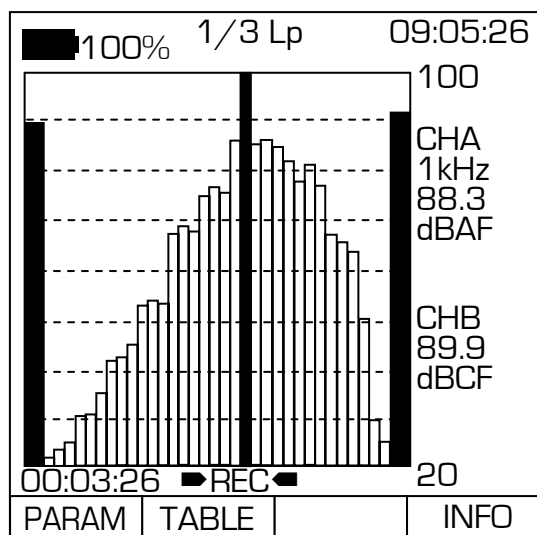




Figure 33 - Sample Recording Screen

**NOTE:** The sample screen shown indicates the instrument is recording using 1/3 octave bands which is only available on the GA131M.

As with real time operation it is possible to change the displayed parameter and view data in a tabular format. See **Real Time Operation** in **Chapter 5** for procedures.

By pressing the **PAUSE** Key  on the keypad it is possible to pause the recording. The mnemonic **►REC◄** will be replaced with **►PAUSE◄** to identify the instrument is in pause mode. No data is being recorded or calculated in pause mode. The option to change the displayed parameter and view in tabular format can still be achieved whilst in pause mode.

To revert back to instantaneous readings press the **PAUSE** Key once again.

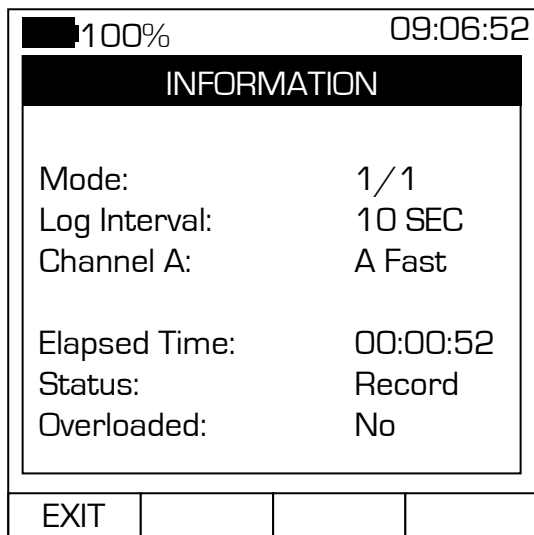
The **Power On/Off** Key  is disabled whilst Recording to prevent the instrument from accidentally powering down with probable data loss.

## Viewing Log Information

---

To view specific information about the recording press **Soft Key 4** labelled **INFO** whilst viewing graphically.

The information screen gives you the template name if loaded, the mode of operation, the log interval selected, frequency and time weightings for each channel, the elapsed time of the recording, if the instrument is recording or in paused and if the overload flag has been triggered.




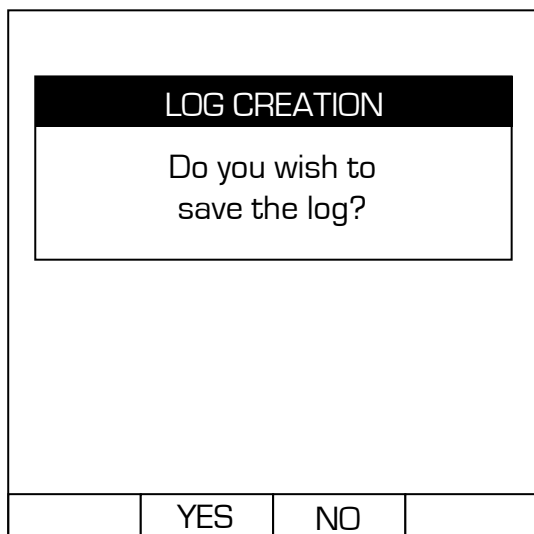
**Figure 34 - Log Information Screen**

To return to viewing the recording data graphically press **Soft Key 1** labelled **EXIT**.

## Ending a Recording

---

To stop recording at any time, press the **STOP / RECORD** Key  on your instruments keypad again and the **LOG CREATION** screen will be displayed asking if you wish to save the log: -

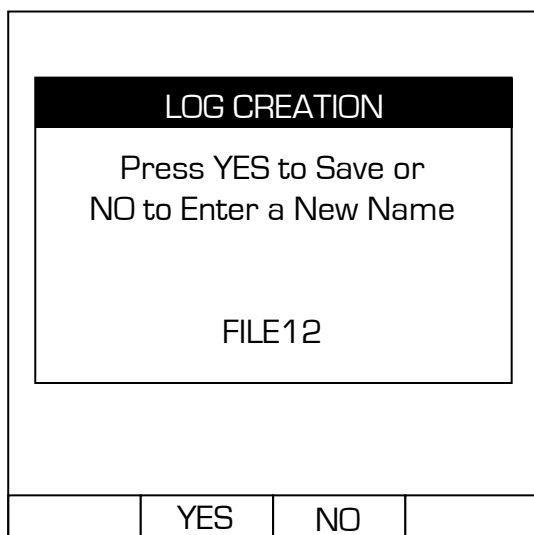


The screenshot shows a screen with a black header bar containing the text "LOG CREATION". Below the header, the text "Do you wish to save the log?" is displayed. At the bottom of the screen, there are four buttons: "YES", "NO", and two empty buttons.

Figure 35 – Save Log Screen

To return to real time operation without saving the log data press **Soft Key 3** labelled **NO**.

To save the recorded data as a log file press **Soft Key 2** labelled **YES**. A new **LOG CREATION** screen will be displayed prompting to save the file using the last file name used or if a new name is to be used.



The screenshot shows a screen with a black header bar containing the text "LOG CREATION". Below the header, the text "Press YES to Save or NO to Enter a New Name" is displayed. Below this text, the file name "FILE12" is shown. At the bottom of the screen, there are four buttons: "YES", "NO", and two empty buttons.

### **TIP:**

*Note that the default file name will over write the previous log so beware when naming files.*

Figure 36 - Save or Rename Log Screen

To save using the current file name and return to real time operation press **Soft Key 2** labelled **YES**. To enter a new file name press **Soft Key 3** labelled **NO**. Enter the new name using the alpha/numeric keypad. A maximum of 8 characters can be used. Use **Soft Key 2** labelled **NUMBER** or **LETTER** to toggle between entering numbers or letters. Press the **Left Arrow** key to delete entries and press **OK** to save and return to real time operation.

# Chapter 7

## Miscellaneous

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### Backlight

---

Your Pro DX Vocis meter is equipped with even illumination EL backlighting.

The backlight can be turned on or off at any time by pressing the **Back Light Key** which is located on the bottom right hand side of your keypad.

Generally in daylight conditions the backlight will not be visible hence care must be implemented to avoid unnecessary use as the backlight function will reduce the battery life span.

### Downloading Recordings To a PC

---

Using the software dBdataPro (available separately) it is possible to download the stored recordings on your meter to your PC allowing the data to be viewed and printed in professional reports.

Communication between a PC and your Vocis meter is made via the 9 pin connector at the base of your instrument.

To allow your instrument to be found by the software your instrument must be displaying the **Main Menu** screen.

For comprehensive instructions please refer to the dBdataPro user manual.

## Available Accessories

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GA607:	Dual Level Class 1 Calibrator
GA505:	Portable, Battery Operated, Thermal Printer DPU-414
ZL1083-01:	Printer Cable for use with GA505 (1 Metre)
PC007:	dBdata Pro Windows Analysis Software (supplied with ZL1103-02)
ZL1103-02:	PC to Vocis Download Cable (2 Metres)
KA016:	Kit Case for Vocis and Printer (GA505)
KA018:	Weatherproof Enclosure
PSU4:	Power Supply
ZL1092-01:	Microphone Extension Cable (1 Metre)
ZL1092-10:	Microphone Extension Cable (10 Metres)
ZL1061-01:	AC Output Cable (1 Metre)
MKDXP:	Pre Amplifier Assembly (Class 1 GA131 Series)
MKDXPC2:	Pre-Amplifier Assembly (Class 2 GA231 Series)
MK75:	ACO 7146 Microphone (Class 2)
MK78:	Microtech Gefell MK250 Microphone (Class 1)
KG202:	Windshield 90mm
KG205:	Windshield 60mm

## Trouble Shooting Guide

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Question	Answer
The instrument will not power on.	Check condition of batteries and replace if required.
	If batteries are inserted and are of adequate charge, remove one battery for approximately 10 seconds and replace.
The Instrument is not responding to sound levels.	Turn the instrument Off, wait 10 seconds to allow the instrument to reset and then turn back On.
	Ensure the microphone pre-amplifier is correctly connected to the instrument.
The overload indicator is permanently on.	Change to a higher range.

## Instrument Disposal

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The symbol shown here can be found on your instrument and means that the product is classed as electrical or electronic equipment and should be disposed of at the end of its life separately to your commercial or household waste.

The Waste of Electrical and Electronic Equipment Directive (2002/96/EC) has been established to help reduce the influx on landfill sites and effectively treat hazardous substances by using best practices for the recovery and recycling of products.

There are various collection systems in place within the EU for the disposal of your product. To find the nearest UK waste recycling point in your area, enter your postcode in the website [www.recycle-more.co.uk](http://www.recycle-more.co.uk)

For more information please contact your local authority, the dealer where you purchased your product or Castle Group Ltd.

## **Warranty and After Sales Service**

---

Castle Group Ltd design and manufacture precision instruments, which if treated with reasonable care and attention should provide many years of trouble free service.

In the unlikely event of a fault occurring with your product during the warranty period, the instrument should be returned in its original packaging to Castle Group Ltd or to an authorised agent. Please enclose a clear description of the fault to ensure your instrument is dealt with as quickly as possible.

Any misuse or unauthorised repairs will invalidate your warranty.

Damage to your product caused by faulty or leaking batteries is not covered by the warranty.

Details of the warranty cover are available upon request from Castle Group Ltd or your authorised agent.

All instruments designed and manufactured by Castle Group Ltd adhere to strict British and International standards. To ensure your instrument remains compliant with these standards it is highly recommended that your instrument is returned annually for calibration.

Annual calibration is particularly important for cases in which instrument readings are to be used in litigation or compliance work.

For warranty or service please return your instrument to: -

The Service Department  
Castle Group Ltd  
Salter Road  
Cayton Low Road Industrial Estate  
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# Chapter 8

## Technical Specification

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### Instrument Standards:

IEC 61672-1: 2002 Class 1 Group X  
BS EN 61672-1:2003 Class 1 Group X  
IEC 60651: 1979 Type 1 + A1: 1993 + A2: 2000 Group X  
BS EN 60651: 1994 Type 1 Group X  
IEC 60804: 2000 Type 1 Group X  
BS EN 60804: 2000 Type 1 Group X  
IEC 61260: 1995 + A1: 2001 Class 2  
BS EN 61260: 1996 Class 2

### Frequency Weightings:

'A' and 'C' to IEC 61672-1: 2002 Class 1 and IEC 60651: 2001 Type 1  
'Z' to IEC 61672-1: 2002 Class 1

### Resolution:

All Parameters: 0.1 dB

### Warm up time:

≤ 2 minutes

### Environmental Stabilization Time:

30 minutes

### Frequency Range:

#### Acoustic Characteristics

Microphone	Frequency Range (Hz)
MK250	12.5 to 20,000

#### Electrical Characteristics

1 Hz to 20,000 Hz

### Total Measuring Range:

The difference between the lowest possible measurement on the most sensitive range and the highest level on the least sensitive range at a frequency of 1 kHz.

A Weighted	28 - 140
C Weighted	33 - 140
LIN or 'Z' Weighted	37 - 140

### Linear Operating Range (IEC 61672:2002):

Test start point for frequencies > 31.5Hz = 94.0dB on the following display ranges, otherwise 84.0dB:

25 - 100	35 - 110	45 - 120	55 - 130	65 - 140
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Test start point for frequency of 31.5Hz = 84.0dB on the following display ranges, otherwise 74.0dB:

25 - 100	35 - 110	45 - 120	55 - 130	65 - 140
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### A Weighted

Display Range (SLM Mode)	Display Range (1/1 or 1/3 Mode)	Frequency (Hz)				
		31.5 (dB)	1000 (dB)	4000 (dB)	8000 (dB)	12,500 (dB)
15 - 90 dB	10 - 90 dB	29 - 53	28 - 90	33 - 90	29 - 90	23 - 89
25 - 100 dB	20 - 100 dB	31 - 63	28 - 100	33 - 100	30 - 100	25 - 99
35 - 110 dB	30 - 110 dB	35 - 73	35 - 110	35 - 110	35 - 110	35 - 109
45 - 120 dB	40 - 120 dB	45 - 83	45 - 120	45 - 120	45 - 120	45 - 119
55 - 130 dB	50 - 130 dB	55 - 93	55 - 130	55 - 130	55 - 130	55 - 129
65 - 140 dB	60 - 140 dB	65 - 103	65 - 140	65 - 140	65 - 140	65 - 139

### C Weighted

Display Range (SLM Mode)	Display Range (1/1 or 1/3 Mode)	Frequency (Hz)				
		31.5 (dB)	1000 (dB)	4000 (dB)	8000 (dB)	12,500 (dB)
15 - 90 dB	10 - 90 dB	33 - 90	33 - 90	34 - 90	33 - 90	30 - 87
25 - 100 dB	20 - 100 dB	35 - 100	33 - 100	34 - 100	33 - 100	30 - 97
35 - 110 dB	30 - 110 dB	49 - 110	35 - 110	35 - 110	35 - 110	35 - 107
45 - 120 dB	40 - 120 dB	59 - 120	45 - 120	45 - 120	45 - 120	45 - 117
55 - 130 dB	50 - 130 dB	69 - 130	55 - 130	55 - 130	55 - 130	55 - 127
65 - 140 dB	60 - 140 dB	79 - 140	65 - 140	65 - 140	65 - 140	65 - 137

### LIN or 'Z' Weighted

Display Range (SLM Mode)	Display Range (1/1 or 1/3 Mode)	Frequency (Hz)				
		31.5 (dB)	1000 (dB)	4000 (dB)	8000 (dB)	12,500 (dB)
15 - 90 dB	10 - 90 dB	37 - 90	37 - 90	37 - 90	38 - 90	33 - 90
25 - 100 dB	20 - 100 dB	37 - 100	37 - 100	37 - 100	38 - 100	33 - 100
35 - 110 dB	30 - 110 dB	52 - 110	38 - 110	39 - 110	38 - 110	35 - 110
45 - 120 dB	40 - 120 dB	63 - 120	45 - 120	45 - 120	46 - 120	45 - 120
55 - 130 dB	50 - 130 dB	73 - 130	55 - 130	55 - 130	57 - 130	57 - 130
65 - 140 dB	60 - 140 dB	83 - 140	65 - 140	65 - 140	65 - 140	65 - 140

## Level Ranges: SLM Mode Operation

(IEC 60651:1979 / IEC 60804:2000 & IEC 61672-1:2000 where stated):

Display Range	Linear Operating Range (IEC 60804: 2000 4kHz)	Primary Indicator Range (IEC 60651 : 1979 1kHz)	Peak Range (C Weighted)  (IEC 60804: 2000) (IEC 60651: 1979) (IEC 61672-1: 2002)
15 - 90 dB	33 - 90 dB	28 - 70 dB	55 - 93 dB
25 - 100 dB	33 - 100 dB	28 - 80 dB	55 - 103 dB
35 - 110 dB	35 - 110 dB	35 - 90 dB	63 - 113 dB
45 - 120 dB	45 - 120 dB	45 - 100 dB	73 - 123 dB
55 - 130 dB	55 - 130 dB	55 - 110 dB	83 - 133 dB
65 - 140 dB	65 - 140 dB	60 - 120 dB	93 - 143 dB

Primary Indicator Range allows for a crest factor of 10 (20dB)

## Level Ranges: Full Octave Band Mode Operation

(IEC 60651:1979 / IEC 60804:2000 & IEC 61672-1:2000 where stated):

Display Range	Linear Operating Range (IEC 60804: 2000 4kHz)	Primary Indicator Range (IEC 60651 : 1979 1kHz)	Peak Range (C Weighted)  (IEC 60804: 2000) (IEC 60651: 1979) (IEC 61672-1: 2002)
10 - 90 dB	33 - 90 dB	28 - 70 dB	55 - 93 dB
20 - 100 dB	33 - 100 dB	28 - 80 dB	55 - 103 dB
30 - 110 dB	35 - 110 dB	35 - 90 dB	63 - 113 dB
40 - 120 dB	45 - 120 dB	45 - 100 dB	73 - 123 dB
50 - 130 dB	55 - 130 dB	55 - 110 dB	83 - 133 dB
60 - 140 dB	65 - 140 dB	60 - 120 dB	93 - 143 dB

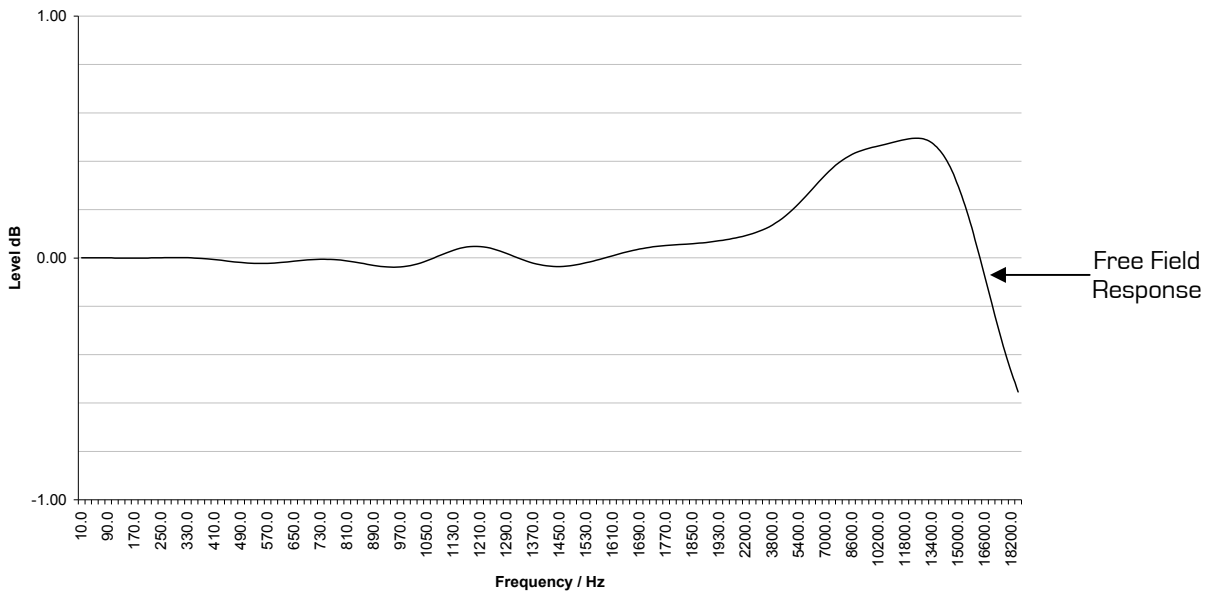
Primary Indicator Range allows for a crest factor of 10 (20dB)

## Microphone:

Microtech Gefell ½" Electret Condenser Microphone Cartridge Type MK250:

Type (MK250)	Specification
Diameter (inch)	0.5 (13.2mm)
Response Type	Free-Field
Polarization (V)	0
Frequency Range (Hz)	3.5 - 20000 (±2dB)
Sensitivity (mV/Pa)	50
Capacitance (pF)	18
Reference Point	Centre of Diaphragm
Max. Sound Pressure Level (dB) For No Damage	146
Temperature Coefficient (dB/°C)	-0.01
Instrument Range	All GA131 Variations

Microtech Gefell Type MK250 Typical Microphone Response:



Microtech Gefell Type MK250 Typical Microphone Response:

Hz	dB	Hz	dB	Hz	dB
12.5	0.0	1330	0.04	5310	0.13
16	0.0	1410	0.0	5620	0.145
20	0.0	1500	-0.035	5960	0.16
25	0.0	1580	-0.03	6310	0.18
31.5	0.0	1680	0.015	6680	0.21
40	0.0	1780	0.04	7080	0.23
50	0.0	1880	0.055	7500	0.26
63	0.0	2000	0.07	7940	0.3
80	0.0	2110	0.07	8410	0.31
100	0.0	2240	0.07	8910	0.36
125	0.0	2370	0.073	9440	0.39
160	0.0	2510	0.077	10000	0.43
200	0.0	2660	0.08	10600	0.44
250	0.0	2820	0.08	11200	0.45
315	0.0	2990	0.08	11900	0.46
400	0.0	3160	0.085	12600	0.48
500	-0.01	3350	0.09	13300	0.49
630	-0.02	3550	0.09	14100	0.5
800	-0.01	3760	0.09	15000	0.48
1000	-0.035	3980	0.095	15800	0.41
1060	-0.035	4220	0.1	16800	0.27
1120	-0.015	4470	0.11	17800	0.03
1190	0.02	4730	0.11	18800	-0.23
1260	0.05	5010	0.12	20000	-0.55

**Typical Inherent Noise Level:**

A combination of Electrical and Microphone Thermal Noise.

MK250 Microphone

Range	'A' Weighting	'C' Weighting	'Z' Weighting
15 - 90	<18dB[A]	< 21 dB[C]	< 27dB[Z]
25 - 100	<18dB[A]	< 21 dB[C]	< 27dB[Z]

**Electrical Signal Input:**

Electrical signals can be applied to the Pro-DX Vocis range of sound level meters by removing the acoustical microphone and replacing with a dummy microphone having a series capacitor of 18pF ±2%. The BNC termination is then used to interface with a suitable signal generator with an output impedance of 600Ω at 1kHz.

**Maximum Peak to Peak Electrical Signal Input For No Damage:**

40 Volts

**Typical Electrical Self Generated Noise Level:**

Range	'A' Weighting	'C' Weighting	'Z' Weighting
15 - 90	<18dB(A)	< 21dB(C)	< 27dB(Z)
25 - 100	<18dB(A)	< 21dB(C)	< 27dB(Z)

**Case Reflections Only with MK250 microphone fitted:**

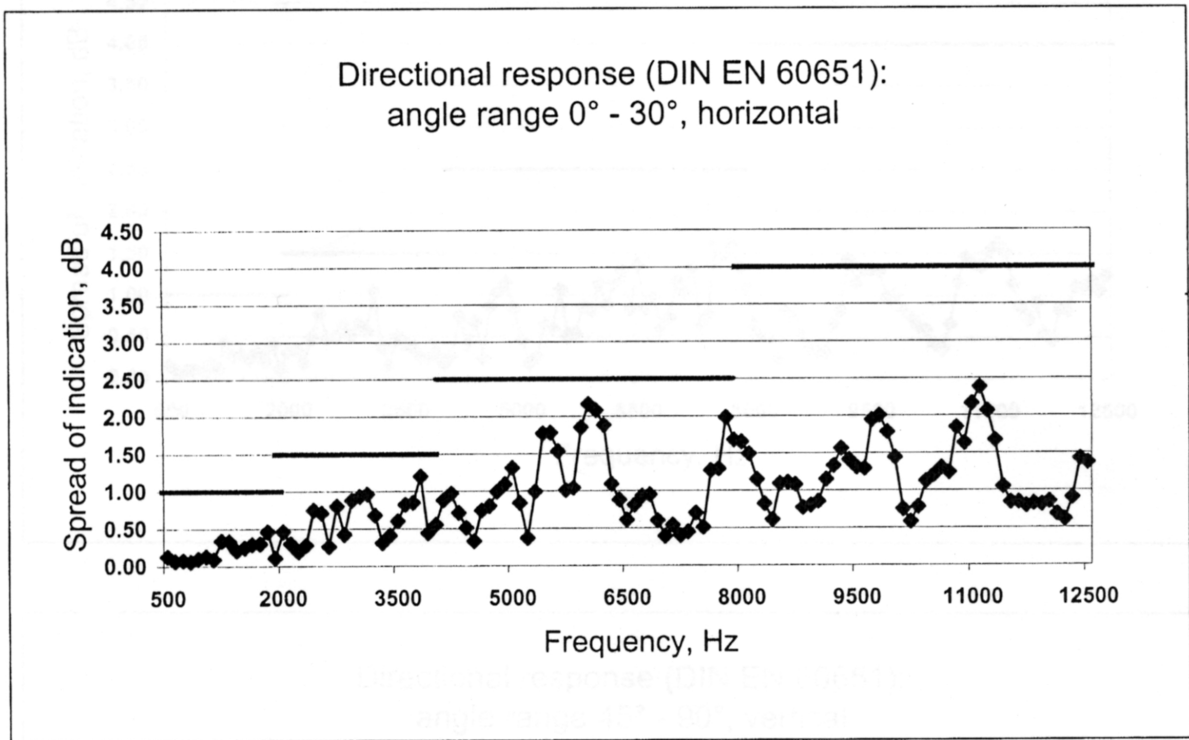
Absolute error at 1kHz equals -0.1dB

Frequency (Hz)	Error in dB re 1kHz
63.00	0.0
80.00	0.0
100.00	0.0
125.00	0.0
160.00	0.1
200.00	-0.1
250.00	0.0
315.00	0.4
400.00	0.4
500.00	0.2
630.00	0.0
800.00	-0.1
1000.00	REF
1059.25	-0.5
1122.02	-0.1
1188.50	0.0
1250.00	0.2
1333.52	0.4
1412.54	-0.6
1496.24	0.4
1600.00	0.7
1678.80	0.5
1778.28	0.5
1883.65	0.2
2000.00	0.1
2113.49	-0.9
2238.72	-0.9
2371.37	0.2
2500.00	0.3
2660.73	0.4
2818.38	0.8

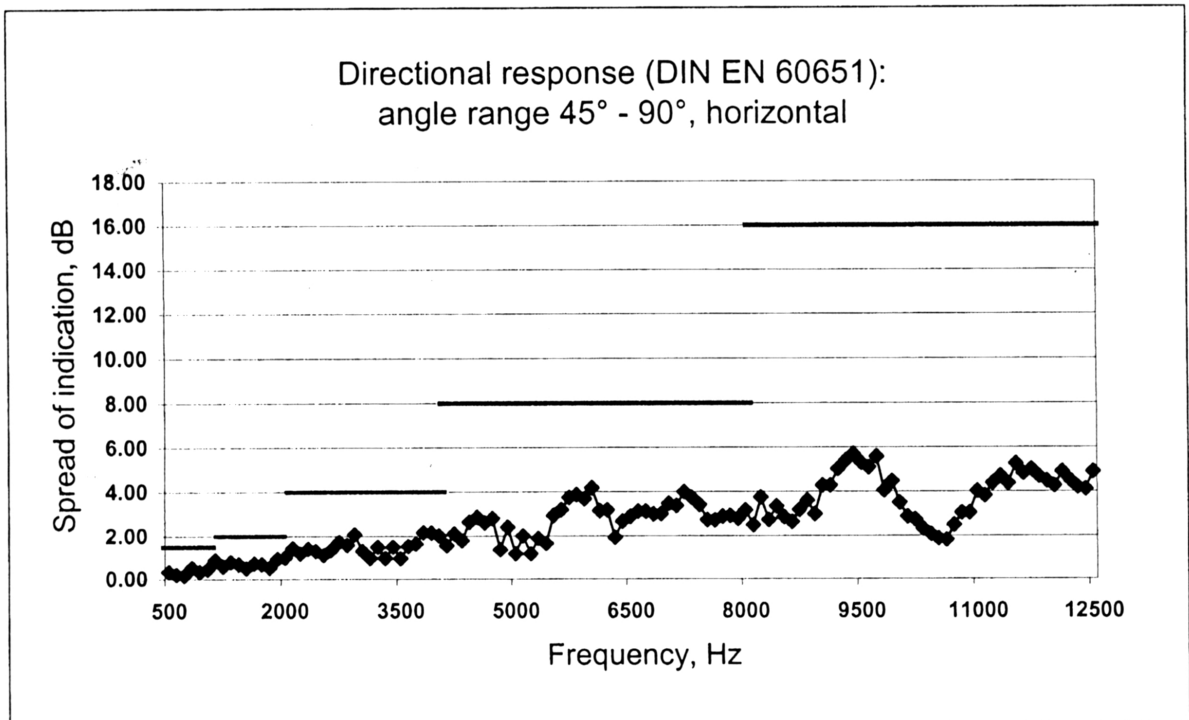
Frequency (Hz)	Error in dB re 1kHz
2985.38	0.4
3150.00	-0.4
3349.65	-0.7
3548.13	-0.4
3758.37	0.5
4000.00	-0.4
4216.97	-0.1
4466.84	0.5
4731.51	-0.1
5000.00	-0.5
5308.84	-0.1
5623.41	0.6
5956.62	0.0
6300.00	0.3
6683.44	0.1
7079.46	-0.3
7498.94	-0.6
8000.00	0.3
8413.95	0.4
8912.51	-0.1
9440.61	0.4
10000.00	-0.3
10592.54	0.5
11220.18	-0.3
11885.02	-0.1
12500.00	0.1
13335.21	0.4
14125.38	0.0
14962.36	-0.3
16000.00	-0.4

**Case Reflections:**

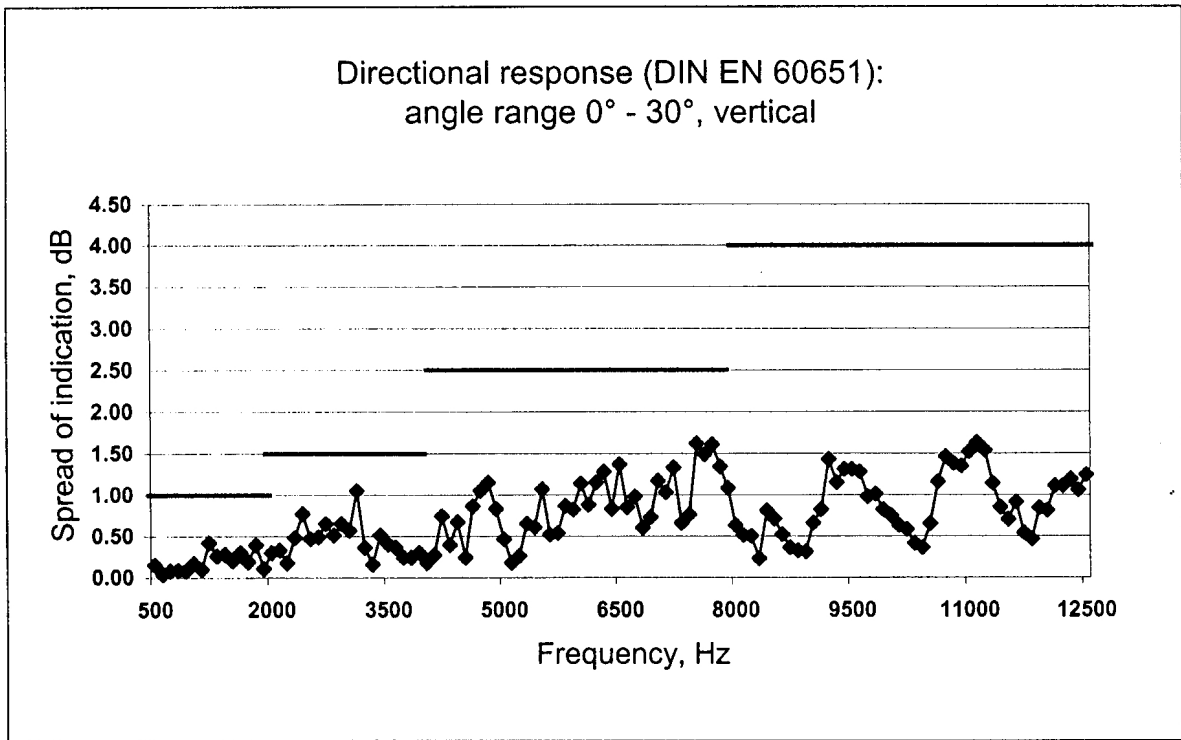
Directional Response, Angle 0° - 30°, Horizontal



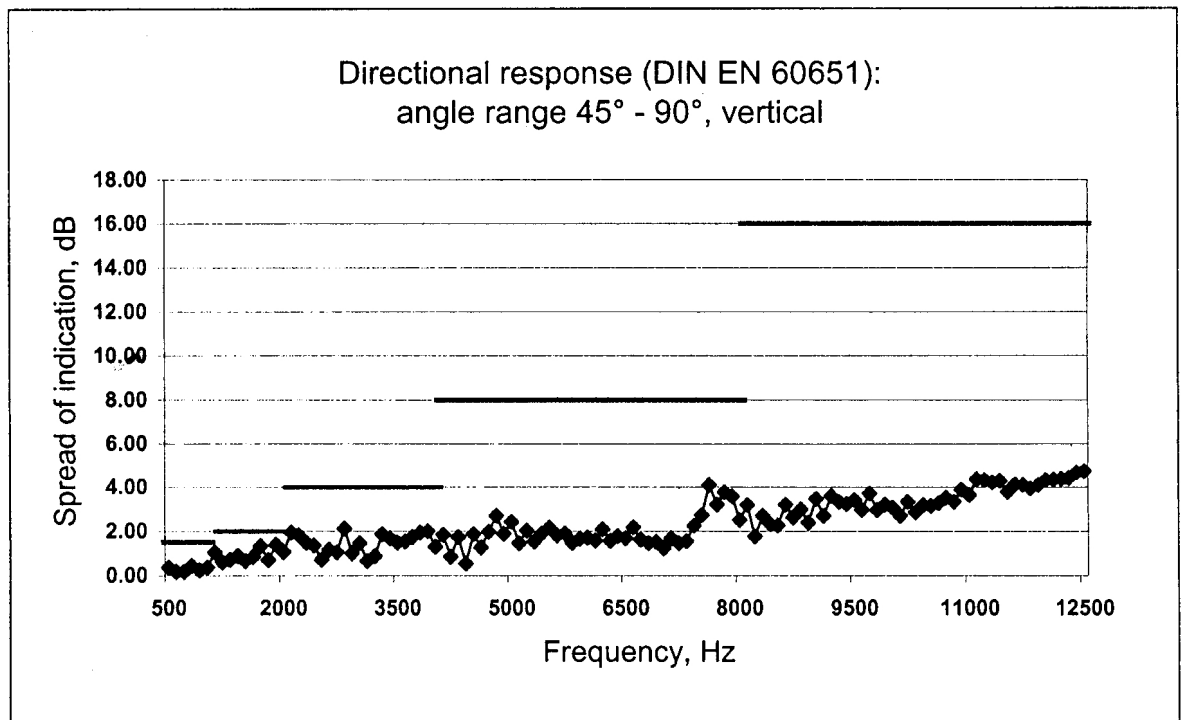
Directional Response, Angle 45° - 90°, Horizontal



Directional Response, Angle 0° - 30°, Vertical



Directional Response, Angle 45° - 90°, Vertical



## Normal Operating Mode:

Display Mode = Broadband (SLM)

Class 1 instruments fitted with pre-amplifier type MKDXP and microphone MK250.

Pre-amplifier assemblies are clearly labeled with type and unique serial number.

Windshields types KG202 or KG205 may be used and fitted by gently placing the windshield over the microphone which is mounted on the pre-amplifier. Push the windshield down over the microphone and pre-amplifier as far as the groove allows.

See 'Pre-Amplifier and Microphone Removal and Fitting' section for the procedure to attach and remove the pre-amplifier and microphone to either a class 1 or class 2 instrument.

## Effect of Fitting Accessories:

GA131B meters fitted with either windscreen or using the microphone extension cable will remain within class 1 tolerances.

## Windscreens

### 90mm Diameter Windscreen (KG202)

Frequency (Hz)	Error in dB re 1kHz
31.5	-0.2
63	-0.2
80	-0.2
100	-0.2
125	-0.1
160	-0.2
200	-0.2
250	-0.1
315	-0.2
400	-0.2
500	-0.3
630	-0.2
800	-0.1
1000	REF
1250	0.0
1600	0.2
2000	0.3
2500	0.3
3150	0.2
4000	-0.4
5000	-0.4
6300	-0.1
8000	-0.8
10000	-0.5
12500	-1.2
16000	-1.6

Absolute error at 1kHz equals +0.2dB

### 60mm Diameter Windscreen (KG205)

Frequency (Hz)	Error in dB re 1kHz
31.5	-0.2
63	-0.1
80	-0.2
100	-0.1
125	-0.1
160	0.0
200	-0.1
250	-0.1
315	-0.1
400	0.0
500	0.0
630	0.0
800	0.0
1000	REF
1250	0.0
1600	0.3
2000	0.0
2500	0.5
3150	0.4
4000	0.5
5000	-0.1
6300	-0.5
8000	-0.2
10000	-0.5
12500	-0.9
16000	-1.3

Absolute error at 1kHz equals +0.2dB

**Extension Cable**

**ZL1092-01 (1 metre)**

Frequency (Hz)	Error in dB re 1kHz
31.5	0.0
63	0.0
80	0.0
100	0.0
125	-0.1
160	0.1
200	-0.1
250	0.0
315	0.0
400	0.1
500	0.1
630	0.1
800	0.1

Frequency (Hz)	Error in dB re 1kHz
1000	REF
1250	-0.1
1600	0.0
2000	0.0
2500	0.1
3150	-0.3
4000	0.1
5000	0.0
6300	0.1
8000	-0.2
10000	-0.1
12500	-0.1
16000	-0.1

Absolute error at 1kHz equals 0.0dB

**Typical Actuator to Free Field Correction Factors:**

Frequency (Hz)	MK250 Microphone (dB)
25	0.0
31.5	0.0
40	0.0
50	0.0
63	0.0
80	0.0
100	0.0
125	0.0
160	0.0
200	0.0
250	0.0
315	0.0
400	0.0
500	0.0
630	0.0
800	0.0
1000	0.0
1250	0.1
1600	0.1
2000	0.2
2500	0.4
3200	0.6
4000	1.0
5000	1.4
6300	2.1
8000	3.1
10000	4.6
12500	6.0
16000	8.5
20000	10.3

**Adjustment Data Test Frequency**

8kHz

## Calibration Reference Conditions:

<b>Sound Field:</b>	Free Field
<b>Air Temperature:</b>	23°C (73°F)
<b>Relative Humidity:</b>	50%
<b>Atmospheric Pressure:</b>	101.325kPa
<b>Sound Pressure Level:</b>	94dB
<b>Reference Level Range:</b>	55 – 130 dB (Automatically selected whilst calibrating)
<b>Reference Frequency:</b>	1kHz (Used as Calibration Check Frequency)

The reference direction of incidence for all microphones is perpendicular to the front face (diaphragm surface) of the microphone.

## Manufacturers Data:

Uncertainty figures for all manufacturers data are under review at the time of going to print. Please contact Castle Group Ltd for up-to date information.

## Measurement Parameters:

Lp (SPL), Leq, Lmax, Pmax (Lpeak) [C Weighted], Ltm3, Ltm5, LAE5, Lmin, DOSE %, projected DOSE %, user definable criterion (75, 80, 85 or 90), user definable exchange rate (3, 4 or 5), Lex (Lep'd) , projected Lex (Lep'd), 1/1 Octave values in Lp, Leq, Lmax, Lmin.

## Display:

Electro-Luminescent, White Back-lit LCD panel (160x160 pixels)

Sound Level Meter and Analyzer Display

Numerical: Tabular results on-screen

Bar graph: 1/1 octaves

Refresh Rate ≤ 500ms

Displayed parameter at each update interval is the value at the time of the update interval.

It is recommended that a calculation settling period of 60 seconds is allowed for in any data log file.

## Temperature Operating range

-10°C to +50°C

**Warning:** DO NOT subject the instrument to temperatures greater than 70°C or less than -20°C for any length of time.

## Effect of Temperature:

Accuracy better than ± 0.5 dB over the range -10°C to +50°

Storage range: 0% to 90% relative humidity in the absence of condensation

## Vibration:

From 20Hz to 1kHz at 1 ms<sup>-2</sup> no noticeable effect

## Humidity:

< 0.5 dB from 25% RH to 90% RH

## Effects of Humidity:

Less than 0.5 dB over the range 25% to 90% relative humidity (provided there is no Condensation), relative to the value at 50% relative humidity and 40°C.

**Operator presence in Free Field:**

No noticeable effect when operator standing more than 2m behind instrument

**Overload:**

Positive overload warning when the input circuits saturate

**Log time Intervals:**

User definable in one second intervals (all parameters).

Minimum integrating period equals 1 second.

Maximum potential log size recommended at 67,500 intervals (1/3 octave with Ln's selected)

**Timer Function:**

A Program Log Timer to give multiple Start-Stop timings.

**Time:**

Battery backed Real Time clock and calendar

**Memory:**

2Mb on-board FLASH

2Mb on-board RAM

128Mb Useable for File Storage

**Communication Port:**

**RS-232:** 115200 max. Baud-rate, 8 bit, no parity, bi-directional 9 pin 'D'-sub

**Output Socket:**

**AC Output:** Unweighted, 0.953V rms at full scale on each range

Load Impedance > 10K recommended

Short circuit protected

Cable Colours: Red - Signal, Blue - Ground

**Batteries:**

**Internal Backup:** CR2032 coin cell

**Main:** 6 x MN1500 (size AA) alkaline cells

**Life:** 8 hours continuous use (approx) without backlight

**Min Battery Level:** 7.5V DC

**External Power Supply:**

**Mains Power (option):** 12V DC mains adapter 1.25A, Centre Terminal +12v, Outer Terminal 0V

Powered from nominal AC supply of 230V  $\pm$ 10% , 50/60Hz

**Min Voltage Level:** 11V DC

**Max Voltage Level:** 18V DC

**Processing:**

A to D Converter: 24-bit Stereo, 60kHz sampling  
DSP: 32-bit 61MHz processor sampling at 60kHz  
Controller: 100MHz, 486SX running at 16MHz

**Overall Dimensions:**

**Dimensions:** 250mm x 100mm x 50mm (approx.) without microphone assembly  
**Weight:** 870g including microphone assembly and batteries

# EC Declaration of Conformity



The CE marking of the Castle Pro DX Vocis Sound Level Meter indicates compliance with the EMC Directive.

Castle Group Ltd declares that the: -

- *Pro DX Vocis GA131 / GA231 Sound Level Meter*

has in accordance with the following Directive: -

- *89/336/EEC 'The Electromagnetic Compatibility Directive' and associated amending Directives*

been designed and manufactured to the following specification: -

- *EN61326-1:1997 + A1:1998*

meeting the following tests:-

- *Radiated Emissions:* *EN55022:1995 Class: A*
- *ESD:* *EN61000-4-2:1995*  
*Levels: ±4kV[C], ±8kV[A]*
- *RF EM Amplitude Mod:* *EN61000-4-3:1996:*  
*Levels: 3V/m & 10V/m (Compliance not guaranteed beyond 10V/m)*

Normal mode of operation is SLM or broadband display mode. No differences in radio frequency emissions are apparent between operating modes of the instrument.

No performance or function degradation is noticeable whilst subject to electrostatic discharge or a.c power frequency and radio frequency fields under any operating mode with the meter. Greatest susceptibility to a.c power frequencies at 180° to source.

Approved cables for use with Castle Pro DX meters to comply with these specifications: -

<b>Cable</b>	<b>Order Code</b>	<b>Length</b>
Printer	ZL1183-01	1m
PC to Vocis	ZL1103-02	2m
Microphone Extension	ZL1092-01	1m
Microphone Extension	ZL1092-10	10m

We hereby declare that the instruments named above have been designed to comply with the relevant sections of the above referenced specifications, and that the above named instruments comply with all essential requirements of the Directive.

EMC tests conducted at the standard test level of 74dB

# Chapter 9

## A Guide to Acoustical Terms and Units

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### Sound Pressure Level (SPL)

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Sound level meters measure acoustic pressure, and by international agreement they are calibrated in decibels (dB). The Sound Pressure Level in decibels is defined as:

$$SPL = 20 \log \frac{P}{P_0}$$

Where: P is the measured **rms** sound pressure  
P<sub>0</sub> is the reference **rms** sound pressure.

Note that the decibel is a ratio of two quantities which have dimensions of power, and is not a unit.

The reference sound pressure P<sub>0</sub> is by agreement taken as 20 μPa, which is the minimum audible pressure to a person with 'normal' hearing. The use of a logarithmic scale, such as the decibel permits the wide range of audible sound pressures (approximately 1,000,000 to 1) to be compressed into a scale of 120 units. Hence a faint whisper may be measured as 20dBA where as a chipping hammer of a road workman may produce 105dBA.

### Standardised frequency curves

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Because the ear is relatively insensitive to very low and very high frequencies, sound level meters have by international agreement weighted frequency responses. Hence different frequency weightings will produce for the same sound source different SPL readings.

Castle sound level meters may have any one of three frequency weightings.

- 'A' weighting, which best expresses the human ears response to loudness is the most commonly used frequency weighting.
- 'C' weighting, this is often used to ascertain the acoustic emissions of machines it has a much broader spectrum than that of the 'A' weighting curve.
- Zero or 'Z' weighting (some times termed un-weighted). It may vary between differing instruments as its characteristics are very dependent on the quality of the microphone and associated pre-amplifier. It is often used in conjunction with octave band filters. A typical Z weighted response would be flat from 20 Hz to 16 KHz.

## Time weighting - Fast, Slow, Impulse and Peak

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It is important to understand that the SPL is an rms (root mean square) quantity and is therefore averaged within the constraints of an averaging time constant. These time constants are helpfully termed Slow, Fast and Impulse and are sometimes referred to as the time weighting.

The SPL therefore is not only affected by the frequency weighting but by the time weighting of the instrument also. Hence by selecting **Slow** on the sound level meter a sharp rise in noise will be shown as a gradual rise in the SPL, alternatively a sharp fall in noise will be shown as a gradual decrease in the SPL. By using the **Fast** weighting on the instrument in both of the above scenarios the SPL will rise and fall on a more rapid scale. The **Impulse** response is not as commonly used as the above, it is used in situations of sharp impulsive noises typically a piling operation may require an impulse time weighting. It has a very fast rise time but a very slow exponential fall time.

The **Peak** weighting is very different from Slow, Fast and Impulse weighting in that it is not an rms quantity. It is simply the crest of the sound pressure level and it is shown as the highest Peak achieved within the measuring period. The rise time of the Peak is extremely sharp and it is not uncommon for the Peak to be much higher than the SPL (rms).

## Lmax, Lmin, Peak

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Lmax is the highest rms sound pressure level within the measuring period (with slow, fast or impulse time weighting selected).

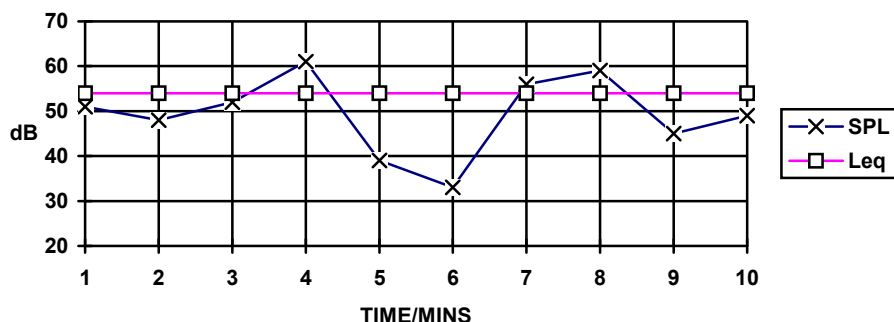
Lmin is the lowest rms sound pressure level within the measuring period (with slow or fast time weighting selected).

Peak is the crest (linear) of the sound pressure within the measuring period, not rms.

## Leq - Equivalent Continuous Sound Pressure Level

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Leq is the constant noise level that would result in the same total sound energy being produced over a given period. It can be measured in either A-Weighted, C-Weighted, or Z-Weighted mode.



Leq can be described mathematically by the following equation:

$$L_{eqT} = 10 \log_{10} \left[ \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} \left( \frac{P(t)}{P_0} \right)^2 dt \right]$$

Where: Leq is the equivalent continuous linear-weighted sound pressure level re 20 µPa, determined over a measured time interval TM (sec's).

P(t) is the instantaneous sound pressure of the sound signal.

P<sub>0</sub> is the reference sound pressure of 20 µPa.

When the instantaneous A-weighted sound pressure (P<sub>A</sub>) of the sound signal is introduced, then the equivalent continuous A-weighted sound pressure level determined over time interval T<sub>M</sub> is as follows:

$$L_{Aeq} = 10 \log_{10} \frac{1}{T_M} \int_0^{T_M} \left[ \frac{P_A(t)}{P_0} \right]^2 dt$$

In practice when measuring noise it is possible to take Leq readings with your instrument of short duration i.e. <5 minutes providing all variations of noise emissions are covered. If the measured environment changes greatly, then the longer the Leq reading is taken, the more accurate the measurement.

### **L<sub>AE</sub>, Level Exposure (formerly SEL)**

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This is in effect an Leq normalised to 1 second. It can be used to compare the energy of noise events which have different time duration's. The L<sub>AE</sub> can be described mathematically as below.

$$L_{AE} = 10 \log_{10} \int_0^{T_M} \left[ \frac{P(t)}{P_0} \right]^2 dt$$

Where T<sub>M</sub> is measured in seconds.

### **DOSE**

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DOSE is a percentage measure of noise exposure similar to L<sub>EX</sub>, and can be described with the following statement: 100% DOSE = 85dBA for 8 hours

The operation of dose can be mathematically described by the following equation which relates the percentage exposure D to the integrated sound power.

$$D = \frac{100}{T_c} \int_0^T \uparrow \left( \frac{L - L_c}{q} \right) dt$$

Where:

↑	represents the anti-log
D	= Percentage exposure [%].
T <sub>c</sub>	= Criterion sound duration [usually 8 hours].
T	= Measurement duration in (hr)
L	= Weighted sound level
L <sub>c</sub>	= Criterion level [usually dBA]
q	(Exchange rate parameter, expressed as dB) =(3/log2) for an exchange rate of 3 dB [Approx 9.96578] =(5/log2) for an exchange rate of 5 dB [Approx 16.61096]

For discrete time intervals at a constant sound level the equation can be rewritten as below:

$$D = \frac{100}{T_c} t_i 10^{\frac{L_i - L_c}{q}}$$

Where:

L<sub>i</sub> = Weighted sound pressure level in the ith time interval  
 t<sub>i</sub> = Time spent in the ith interval (hr)

The dose can be converted to an Leq.

$$L_{eq} = L_c + 10 \cdot \log_{10} [(D/100) \cdot (T_c/T_M)]$$

Where:

Leq = the equivalent continuous sound level, with A-weighting, from the time T<sub>M</sub>.  
 L<sub>c</sub> = Typically 85 dBA in the UK.  
 D = indicated dose index [%].  
 T<sub>c</sub> = reference time base 8 hours.  
 T<sub>M</sub> = measurement time in hours.

Tables D1, D2 & D3 give examples of how DOSE is related to exposure time and L<sub>EX</sub> (assuming a criterion of 85 100% DOSE = 85dBA for 8 hours.)

Table D1. Effect of changing SPL

SPL (dBA)	Exposure Time (hours)	Dose (%)	Lex (dBA)
95	8	800	95
91	8	400	91
88	8	200	88
85	8	100	85
82	8	50	82
79	8	25	79

Table D2. Effect of changing exposure time.

SPL (dBA)	Exposure Time (hours)	Dose (%)	Lex (dBA)
85	16	200	85
85	12	150	86.76
85	8	100	85
85	4	50	82
85	2	25	79
85	1	12.5	76

Table D3. Effect of changing SPL and exposure time.

SPL (dBA)	Exposure Time (hours)	Dose (%)	Lex (dBA)
88	4	100	85
85	8	100	85
80	8	31.5	80
82	4	25	79
79	4	12.5	76

Each time the sound level increases by 3dB the DOSE doubles given the same exposure time, similarly if the sound level decreases by 3dB the DOSE will halve for the same exposure time.

Doubling the exposure time doubles the DOSE and halving the exposure time halves the DOSE given the same sound level.

### **Projected DOSE**

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DOSE measurements usually require the noise exposure to be measured over a full 8 hour working day. This can be simplified by using Projected DOSE.

Projected DOSE allows the present accumulated DOSE over the elapsed logged time duration to be projected forward to give the predicted 8 hour dose.

For example, if you had been logging for 30 minutes with an accumulated DOSE of 5%, the Projected DOSE would show:

$$5\% \times 8 \text{ hours} / 0.5 \text{ hours} = 80\% \text{ DOSE.}$$

i.e. you would receive an 80% DOSE if you were to stay in this area with the same equivalent level of noise for the full 8 hours.

The following should be taken into consideration when reporting Projected DOSE figures:

1. The Projected DOSE assumes that the current DOSE rate at the time of reading will remain constant, i.e. the sound level does not change over the measurement period compared to the total 8 hour period.

2. The Projected DOSE will be more accurate if the measurement duration is as long as possible.
3. DOSE, and therefore Projected DOSE are measured with 'A' frequency weighting selected.
4. If, say, a 12 hour day is worked the 8 hour Projected DOSE should simply be multiplied by 1.5 (i.e. 12/8) to calculate what the DOSE would be after 12 hours.

### **Lex Daily Personal Noise Exposure.**

Lex is a measure of exposure that depends not only on the sound pressure level but also on the duration of the noise exposure. It is intended to be used to measure the daily exposure of a worker, and therefore is dependent on shift duration. Unlike DOSE, Lex is displayed as a dB(A) value, and is derived from the equation shown below.

$$L_{EX} = 10 \log_{10} \frac{1}{28800} \int_0^{T_M} \left[ \frac{P_A(t)}{P_o} \right]^2 dt$$

Note the similarity between this definition and that of Leq. Since Lex is normalised to 8 hours the Lex would equal the 8 hour Leq of a worker exposed for 8 hours.

Although similar to Leq, Lex, will present a different value to the Leq if the exposure time is greater than or less than 8 hours. See tables, D1, D2, and D3.

The relationship between Lex and DOSE is given by the following equations:

$$L_{EX} = 85 + 10 \cdot \log_{10} [\text{DOSE}/100] \quad (\text{For a criterion level of 85})$$

$$L_{EX} = L_{eq} + 10 \cdot \log_{10} [t/T]$$

Where:        t = logging time  
                   T = 8 hours reference (28800 seconds)

Note that Lex is a logarithmic measurement as opposed to DOSE which is a linear function. Hence DOSE can be added arithmetically but since Lex is logarithmic, values cannot be added arithmetically.

Each time the sound level increases the Lex increases. If the exposure time doubles, say 4 hours to 8 hours, the Lex increases by 3dB.

## Glossary of Acoustical Terms

This section describes and defines many terms used in acoustics.

Term	Unit or Abbreviation	Definition
Decibels	dB	Ten times the logarithm (to base 10) of the ratio of two mean square values of sound pressure.
Frequency	Hz	The number of cyclical variations per unit time
Octave Bands	Hz	Frequency ranges in which the upper limit of each band is twice the lower limit. Octave bands are identified by their geometric mean frequency or centre frequency.
Sound Power	W	The acoustic power of a sound source expressed in Watts.
Sound Power Level	$L_W$	The acoustic power radiated from a given sound source as related to a reference power level (typically $10^{-12}$ W); expressed in decibel as: $L_W = 10 \log_{10} \left( \frac{W}{10^{-12}} \right) dB$ or $L_W = 10 \log_{10} W + 120 dB$ W = acoustic power in Watts. i.e. 1 Watt = 120 dB for $L_W$
Sound Pressure	P	Fluctuations in air pressure caused by the presence of sound waves.
Sound Pressure Level	SPL	The ratio expressed in decibels of mean - square sound pressure to a reference mean - square pressure which by convention has been selected to be equal to the assumed threshold of hearing. $SPL = 20 \log_{10} \left( \frac{P}{P_0} \right)$ Where: SPL = Sound Pressure Level P = Root Mean Square sound pressure $P_0 = 2 \times 10^{-5} \text{ Nm}^{-2}$ $= 20 \mu\text{Pa (RMS)}$
Weighting Network	A - dB(A)	An electronic or digital filter in a sound level meter which approximates under defused conditions the frequency response of the human ear. The A - Weighting network is the one most commonly used.
Equivalent Continuous A - Weighted Sound Pressure Level	$L_{AeqT}$	The equivalent continuous level which is a measure of the energy content of a sound over a time period. It gives a single figure expressing the equivalent of a varying level. It is an energy average.

Term	Unit or Abbreviation	Definition
Equivalent Continuous A - Weighted Sound Pressure Level	$L_{AEG-T}$	The equivalent continuous level which is a measure of the energy content of a sound over a time period. It gives a single figure expressing the equivalent of a varying level. It is an energy average.
Dose	D	Noise dose is a percentage number where: 100% Dose = 85 dB(A) for 8 hours. Note that not only is the sound level important (85 dBA) but also the time a person was exposed (8 hours).
Dose per Hour	DOHR	Designed to show the Dose exposure over each hour.
Projected Dose	Proj D	Projected dose allows the present accumulated dose over the present logged time duration to be projected forward to give the predicted 8 hour dose. This assumes the logged dose rate remains constant over the 8 hour period. A time inhibit on Castle instruments prevents projections being made if the measurement duration is less than five minutes.
Noise Exposure	$L_{EX}$	<p>Personal noise exposure; usually referred to a daily 8 hour rate. "Exposed" means exposed whilst at work; expressed in dB(A)</p> $L_{EX} = 10 \log_{10} \frac{1}{T_0} \int_0^{T_e} \left[ \frac{P_A(t)}{P_0} \right]^2 dt$ <p>Where:  <math>T_e</math> = the duration of the person's personal exposure to sound.  <math>T_0</math> = 8 hours = 28800 seconds.  <math>P_0</math> = 20 <math>\mu</math>Pa  <math>P_A</math> = the time - varying value of A weighted instantaneous sound pressure in Pascal's in the undisturbed field in air at atmospheric pressure to which the person is exposed.</p>
Percentile Sound Levels	$L_n$	The dB(A) level exceeded n% of the time.

## Disclaimer

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## Instrument Details

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For your records and for future correspondence with Castle Group Ltd regarding your instrument, please complete the following details: -

Instrument Model

Instrument Serial Number

Purchase Date