SoundAdvisor

Model 831C Sound Level Meter

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LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Larson Davis

SoundAdvisor
Model 831C
Reference Manual

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Record of Serial Number and Purchase Date
SoundAdvisor Model 831C **Serial Number: _____**

Preamplifier Model: _____ **Serial Number: _____**

Microphone Model: _____ **Serial Number: _____**

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Warranty
For warranty information, refer to our *Terms and Conditions of Sale* on our website, www.larsondavis.com/TermsConditions.aspx.

i.1 Contact Larson Davis

Website
www.larsondavis.com

Worldwide Corporate Headquarters
Larson Davis - a PCB Piezotronics division
3425 Walden Avenue
Depew, NY 14043-2495 USA

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Phone: 716-926-8243
USA fax: 716-926-8215

E-mail: sales@larsondavis.com

i.2 Download G4 LD Utility

G4 LD Utility (G4) software enhances the features, flexibility, and ease-of-use of Larson Davis instruments by providing setup utilities, instrument calibration, computer-based control of the instrument, data download and manipulation, printing, and export of data to third-party software for post processing and analysis.

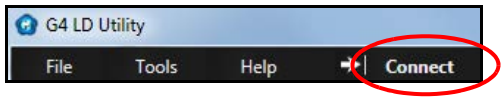
When you insert the G4 LD Utility software CD, it will start automatically. If it does not, access the CD drive and click LDsetup.exe. Alternatively you can download G4 at
http://www.larsondavis.com/G4

The install program prompts for any additional required information. A **PCB Piezotronics** menu item will be created under the Program menu item in the **Start** menu and a shortcut will be placed on the desktop.

i.2.1 Connecting SoundAdvisor to G4

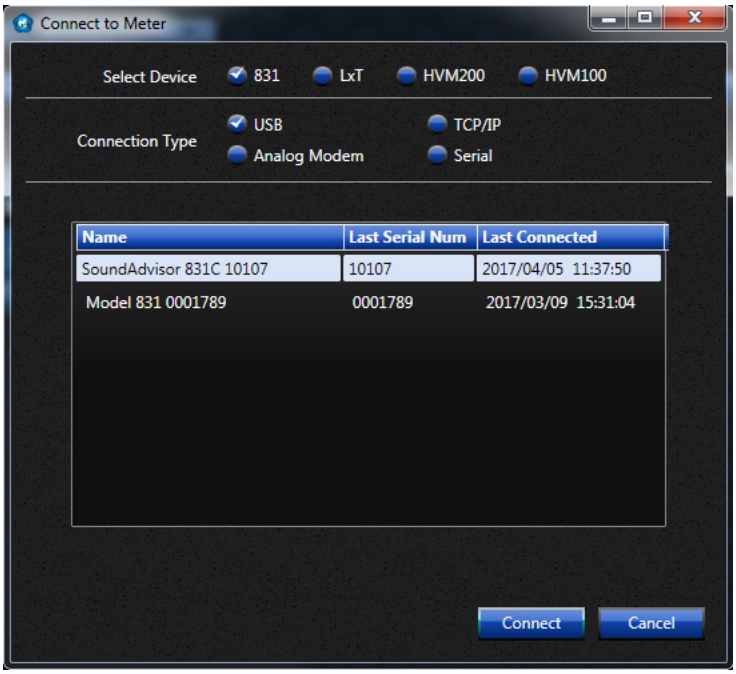
After installing G4 LD Utility, make your initial connection via USB cable from your instrument to PC. Press the power button ⏻ on SoundAdvisor to turn the instrument on. Launch the G4 software and click **Connect**.

FIGURE I-1 G4 LD Utility Connect



In the **Connect to Meter** dialog box, select the device and connection type. Instruments that are detectable via USB connection appear automatically in the list. When your instrument appears, select it and click **Connect** when the instruments appear. G4 can be connected to multiple instruments through both TCP/IP address and USB connection. For more information about G4 see the G4 LD Utility Manual.

FIGURE I-2 Connection To Meter



i.3 Using A Digital Reference Manual

Larson Davis is committed to the green practices of limited paper waste. In this effort, we only offer reference manuals in a digital PDF format. Digital notes and comments can be made in certain readers, and you are encouraged to print any procedures or sections for quick references that fit your needs. Each page is drafted on A4 size, and can be easily scaled to fit most printers. When printing set scaling to “Fit to Printable Area”.

FIGURE I-3 PDF View on Adobe Acrobat Pro

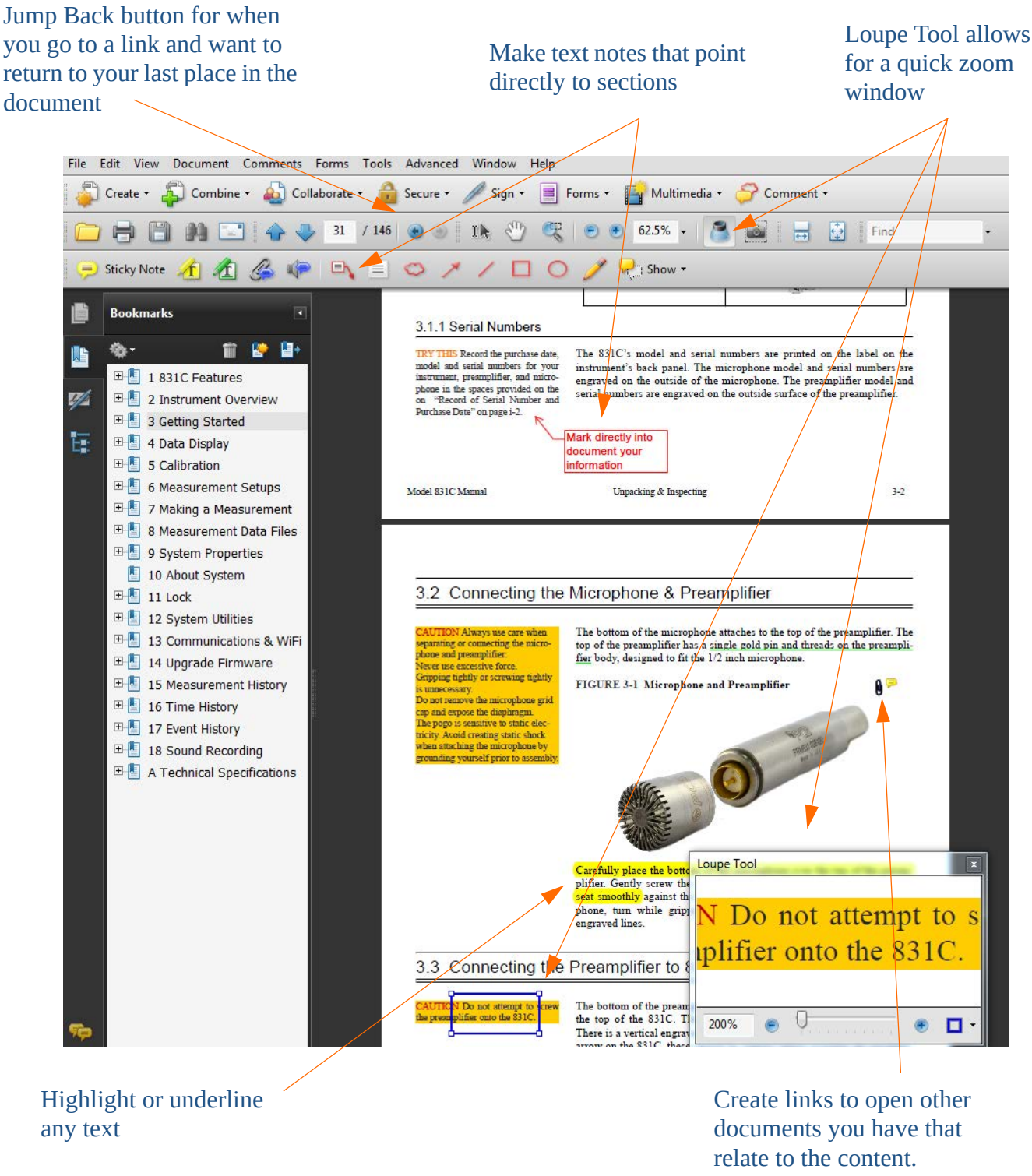


Table of Contents

Module 1 SoundAdvisor Features

1.1 Overview

TAKE NOTE The “C” in 831C stands for color.

The SoundAdvisor Model 831C (the SoundAdvisor, 831C, or meter) is a Class 1 acoustic monitoring instrument with a full-color touch screen that measures noise frequency, sound pressure level, and community and environmental sound.

G4 LD Utility (G4) software connects your meter through USB 2.0 high-speed and other wired and wireless methods to your PC. With G4 you can calibrate the meter, create setup files, download measurements, and analyze the results.

1.2 Basic Operations

TRY THIS Explore the interface, press buttons, change settings, and test the operations.

The SoundAdvisor performs the following operations:

- Measures sound: stop, pause, and resume measurement
- Display broadband and spectral sound values on a full-color display screen
- View live and stored data while a measurement is in process
- Log simultaneously to time, statistical measurement and event histories
- Use markers to annotate portions of time histories, including voice annotation
- Automatically back up data to prevent data loss on power failure
- Calibrate using a Precision Acoustic Calibrator, and store calibration history

- Time stamping for L_{max}, L_{min}, $L_{peak-(max)}$ single event metrics.
- Sync clock with PC, attached GPS, or Network Time Protocol (NTP)
- Create multiple Setup configurations using the Setup Manager
- Record audio in .wav and .ogg formats with event, manual, or time-based triggers

1.3 Applications

The SoundAdvisor monitors:

- City noise
- Construction noise
- Airport noise
- Nuisance noise
- Noise ordinance compliance
- Wind farm noise

1.4 Hardware Features

The SoundAdvisor is a precision integrating sound level meter with the following hardware features:

TAKE NOTE Up to 32GB USB memory can be purchased from Larson Davis as an option.

- 2 GB internal industrial grade data memory
- 240 x 320 full-color graphic LCD display with touchscreen user interface
- Quiet Touch elastomeric keypad
- 4-AA batteries provide upwards of 8 hours operating time, usable with NiMH, photo-lithium, lithium-Ion, and alkaline cells
- AC/DC output jack with full dynamic range option
- Compatible with 61 m (200 ft.) microphone extension cable (full scale to 20 kHz)
- Dust resistant durable plastic case with lanyard and tripod mount (tripod not included)
- USB 2.0 high-speed host connector for mass storage, weather sensors, USB headset, and WiFi communication devices
- USB 2.0 high-speed peripheral connector for control and data download by a PC
- I/O connector for power, weather transducers, logic input/output, and preamplifier communications

1.5 Performance Features

- Large dynamic range > 120 dBA
- RMS Detectors: Slow, Fast & Impulse
- RMS Frequency Weighting: A, C & Z
- Peak Frequency Weighting: A, C & Z
- Any Level™ Simultaneous measurement and display of Max and Min sound pressure levels (Slow, Fast and Impulse detectors), plus L_{eq} and Peak levels, all with A, C and Z frequency weighting
- Weather Measurements (Wind Speed and Direction, Temperature, and Humidity with SEN03x)
- Multiple language support: English, French, Italian, German, and Spanish
- Field-upgradeable firmware

1.6 Available Options

LEARN MORE To purchase options, see “Contact Larson Davis” on page ii-2.

The SoundAdvisor is delivered with all firmware options available at the time of manufacture already installed. However, only those options which have been purchased are enabled. Any of the other firmware options can be enabled at a later date, following purchase, using a file delivered from Larson Davis.

1.6.1 Purchase-Required Options

831C-LOG
Time History data logging with periods from 2.5 ms to 24 hours.

831C-OB3
Real-time 1/1 & 1/3 Octave Frequency Analysis .

831C-ELA
Measurement History for the manual or timed storage of statistical data, and exceedance-based Logging Analysis with Events.

831C-SR
Make event based and manual sound recordings that can be sent via email or SMS and stored in the measurement data.

831C-MSR
Measurement History for the manual or timed storage of statistical data with all sound recording capabilities.

831C-SW
Make direct USB communication with Sierra Wireless RV50 gateway.

1.7 Accessories

TAKE NOTE Some of these options may not be provided with systems designed for specific applications.

Unless otherwise noted, the SoundAdvisor is delivered with these standard accessories:

Microphone Preamplifier

PRM831

or

PRM2103

Microphone

377B02 1/2” free-field prepolarized microphone, 50 mV/Pa, providing performance conforming to Class 1 sound level meter standards

or

377C20 1/2” random incidence prepolarized microphone, 50 mV/Pa, providing performance conforming to Class 1 sound level meter standards

Software CD

G4 LD Utility Software for setup, measurement, download, and data viewing through CBL138 USB or TCP/IP

Accessory Kit

831-ACC includes:

- 831-CCS Hard Shell Case
- PSA029 Universal AC USB Power Adaptor
- CBL138 USB to mini-B cable, 1.8 m
- WS001 3 1/2” Windscreen
- 4 Rechargeable AA NiMH batteries

Other

Lanyard

1.7.1 Optional Accessories

Microphones

- 377C01 1/4” free-field prepolarized microphone, 2 mV/Pa, for higher level and/or higher frequency measurements (ADP043 adaptor required)
- 377C10 1/4” pressure prepolarized microphone, 1.0 mV/Pa, for higher level and/or higher frequency measurements (ADP043 adaptor required)

Microphone Preamplifiers

- 426E01 1/2” ICP Low Noise Microphone Preamplifier (requires adaptor ADP074)
- PRM2103 Outdoor Microphone Preamplifier
- PRM426A12 Outdoor Microphone Preamplifier

Environmental Protection

EPS2116 Environmental Shell

Protects microphone and preamplifier from rain and wind with mounting options for pipes, poles, and most tripods

EPS030-831

Weather-proof enclosure for remote noise monitoring; includes battery

NMS/EPS043

Weather proof enclosure for remote noise monitoring

NMS/EPS044

Solar powered noise monitoring system for outdoor, long-term, and unattended sound monitoring

Weather Data Acquisition

- 831-INT Interface Unit for use with 426A12 Outdoor Microphone Preamplifier and weather sensors

Communication

- DVX012, 013, 014, 015
- 831-INT-ET 831-INT with integrated Ethernet capability

GPS

GPS001 GPS Receiver, USB Magnetic Mount

Equivalent Electrical Impedance Adaptor

An equivalent electrical impedance adapter can be used in place of the microphone when very high impedance measurements need to be made and the instrument is being tested electrically. The adapter is simply a series capacitor with the same capacitance as the microphone it is replacing. The following adapters are available. If square wave pulse measurement is to be performed, then the adapter must also be used with a 100 kHz, low pass, T filter.

- ADP002 6.8pF BNC Input Adaptor for 1/4 in., 7pF microphone equivalent
- ADP090 12pF BNC Input Adaptor for 1/2 in., 12pF microphone equivalent
- ADP092 BNC In-Line Low Pass Filter 75kHz

Cables

Extension and Interface Cables

- Microphone Extension Cable: EXCXXX (shielded), where XXX is the length in feet (XXX = 010, 020, 050, 100 and 200 available)

- CBL138 USB Cable
- CBL139 AC/DC Output Cable

Cables for Environmental Monitoring

- CBL152 Cable; 426A12 to 831 Signal, 20’
- CBL153 Cable; 426A12 to 831-INT Control, 20’
- CBL154 Cable; 426A12 to 831C Control, 20’
- CBL203 Cable; PRM2103 to 831Control, 20’
- CBL208 Cable; PRM2103 to 831-INT Control, 20’

Cable for use with PSA027 Universal Input Power Supply AC Power Adaptor

- CBL140 Cable; 831 Power, 2.5 mm JACK, 1’

Power Supply

- PSA027 Universal 90-240 AC Power Adaptor providing power from electrical outlet, used to power the SoundAdvisor in conjunction with CBL140, CBL145 or CBL154. 1.25 A, 2.5X5.5X14 mm
- BAT015 External battery holder for the 831, holding 4 or 8 D-sized alkaline 1.5 volt batteries to extend run time

Tripods

- TRP001 Instrument/Camera Tripod with ADP032 1/2 in. microphone clip used with EPS2116
- TRP002 Microphone Stand with Boom
- TRP003 Support Tripod, heavy duty, can be used with EPS029, EPS030 and EPS2116
- ADP091 Mounting adapter, 426A12 TO TRP003
- TRP019 Permanent 17' tilt down pole.
- TRP020-06 Heavy duty 6' tripod
- TRP020-10 Heavy duty 10' tripod
- TRP020-15 Heavy duty 15' tripod
- TRP020-20 Heavy duty 20' tripod

Other Hardware

Calibrators

- CAL200 Class 1 Sound Level Calibrator, 94/114 dB @ 1 kHz
- CAL250 Class 1 Sound Level Calibrator, 114 dB @ 250 Hz

Soft Case

CCS032 pouch with belt clip

Optional Software

DNA (Data Navigation and Analysis) software

Module 2 Instrument Overview

2.1 Overview

The SoundAdvisor Model 831C accomplishes all tasks related to sound monitoring. The SoundAdvisor is a reliable and diversely competent meter. With the SoundAdvisor, you can:

- Measure all area sound
- Stream and record audio continuously or for events using sample rates up to 51.2 ksps in compressed or uncompressed format
- Communicate with via USB, Ethernet, cellular, or WiFi
- Operate completely from the device itself, or remotely using G4 LD Utility software
- Easily expand memory using USB memory
- Automatically synchronize the clock with Network Time Protocol (NTP) or GPS for optimal accuracy
- Select desired color theme on the full-color graphic LCD display with touchscreen user interface

This module describes the hardware and visual components that make up the SoundAdvisor.

2.2 Instrument

FIGURE 2-1 SoundAdvisor Instrument Overview (front)

FIGURE 2-2 Instrument Overview (bottom)

1. **AUX** connector intended for use with USB mass storage, cellular & dial-up modems, GPS, headphones, speakers, and future devices.
2. Hardware **Power** Switch when set to " 0 " completely powers down the SoundAdvisor for storage. Set to " | " for instrument operation.
3. **USB** Interface 2.0 peripheral full-speed port used for communication, full control, and downloading of data to PC. The PSA029 external power supply may be connected here. The maximum USB cable length is 1m and the cable is part number CBL138.
4. **AC/DC** 2.5 mm Output jack for analog AC/DC output signals.
5. The I/O Connector for peripherals and external power is typically used for external devices.

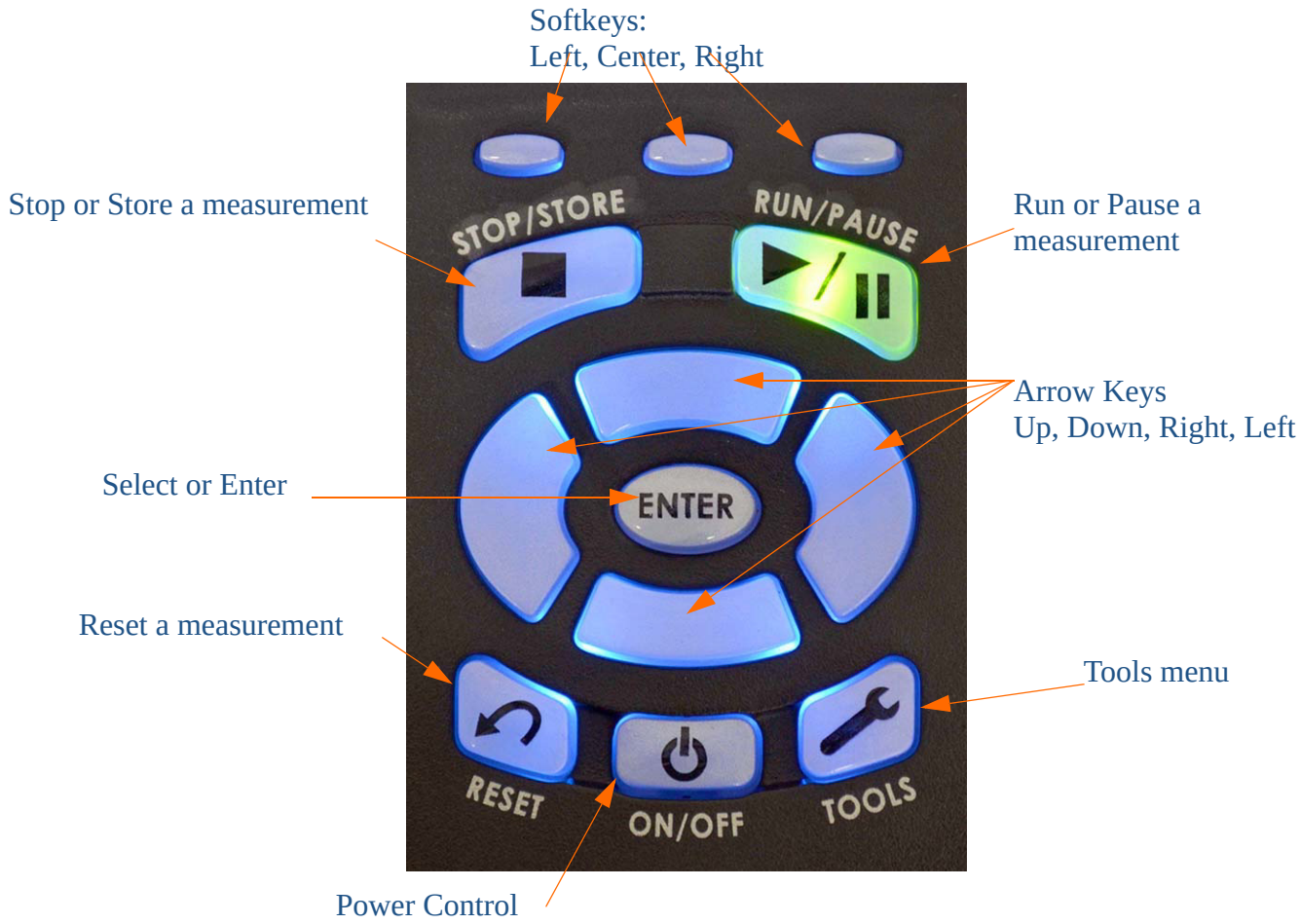
CAUTION DO NOT use the hardware power switch to turn the SoundAdvisor ON or OFF. This may cause data to be lost. The purpose of this switch is to disconnect the batteries for storage (1 to 2 weeks). If any longer, then remove the batteries from the meter.

CAUTION The AC/DC jack is not a headphone jack.

2.3 Keypad

The SoundAdvisor has 13 buttons that are used to start, stop, or pause measurement, navigate display, and safely power the meter off.

FIGURE 2-3 SoundAdvisor Keypad



2.3.1 Navigating and Selecting

To navigate the display on the meter, you can utilize the touch-screen feature and simply press your selection directly on the screen using the tip of your finger, or use the keypad.

Table 2.1 Navigating and Selecting

Action	Key(s)	Description
Navigate to tabs		Top left & right softkeys
Navigate to pages		Up & down arrow keys
Navigate within display (e.g., move highlighted octave band)		Left & right arrow keys

Table 2.1 Navigating and Selecting

Action	Key(s)	Description
Access content specific menu		There are times when a content specific menu appear on the screen. The associated top soft key will access that menu.
Exit a menu		The top middle soft key can be used to close or save. If you don't want to save, press it, and then select **no** to exit.
Navigate up & down in a display		The enter key can be used to move up and down on certain pages
Make a selection		The enter key can be used to make a selection

2.3.2 Basic Run Function

The basic run measurement functions can be executed using the following keys:

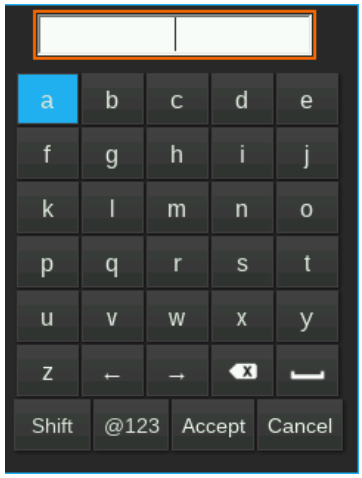
Table 2.2 Basic Run

Action	Key(s)	Description
Initiate a run		Start a measurement
Pause a run		While the SoundAdvisor is running, press this button to pause
Stop measurement		End a measurement during a run or pause
Store data file		Pressing the stop/store button while the meter is stopped will store the measurement data
Reset measurement		Press the reset key to clear measurement

2.3.3 Entering Text

The SoundAdvisor allows for complete operation from the meter itself. In instances where a text field will need to be edited, a keyboard will appear. Navigate the keyboard using the arrow keys  up & down and  left & right. Use the  key to make a selection.

FIGURE 2-4 Keyboard



2.4 Microphones and Preamplifiers

LEARN MORE For information on using the SoundAdvisor with the PRM2103 preamplifier, see the PRM2103 Manual.

The following microphone preamplifier is used with the SoundAdvisor:

- PRM831 1/2” Microphone Preamplifier

The following microphone are the most commonly used with the SoundAdvisor:

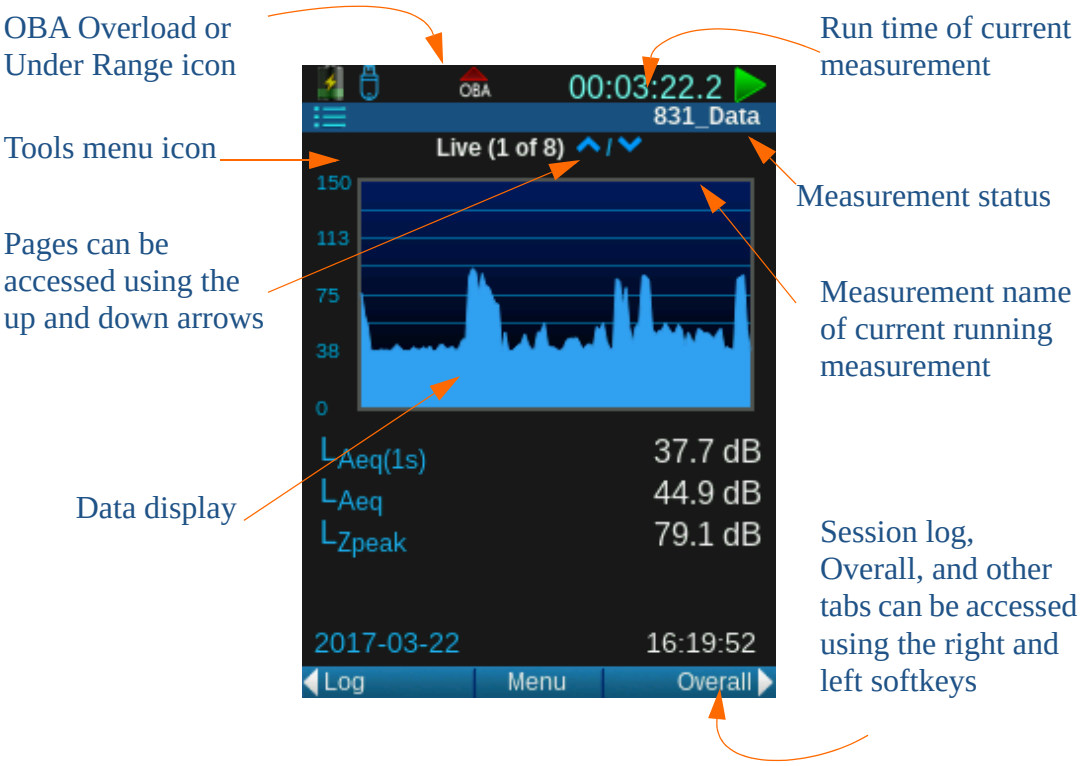
- 377B02 1/2” Free Field Microphone with nominal sensitivity of 50 mV/Pa
- 377C20 1/2” Random Incidence Microphone with nominal sensitivity of 50 mV/Pa
- 377C01 1/4” Free Field Microphone with nominal sensitivity of 2.16 mV/Pa (ADP043 adaptor required)
- 377C10 1/4” Pressure Microphone with nominal sensitivity of 1 mV/Pa (ADP043 adaptor required).

2.5 Displays and Icons

The SoundAdvisor has a full-color, back-lit LCD touchscreen. The color theme can be changed to dark or light from System Properties. See “System Properties” on page 9-1.

When the SoundAdvisor is first powered ON, the Live screen is displayed. When a measurement is in progress, the display is similar to Figure 2-5 Live Main Screen.

FIGURE 2-5 Live Main Screen



2.5.1 Measurement Data Tabs

TAKE NOTE There are seven (7) tabs of measurement data. Live, Overall, and Session Log are default. To learn more about additional tabs see “Measurement Setup” on page 6-1.

Measurement data is presented on three (3) main screens called “tabs” that can be navigated using the top left/right softkeys:

Live

- Data is continuously displayed on this tab whether there is a measurement running or not. Data displayed on the Live tab is not stored in the meter.
- Up to 13 pages of Live Measurement data

Overall

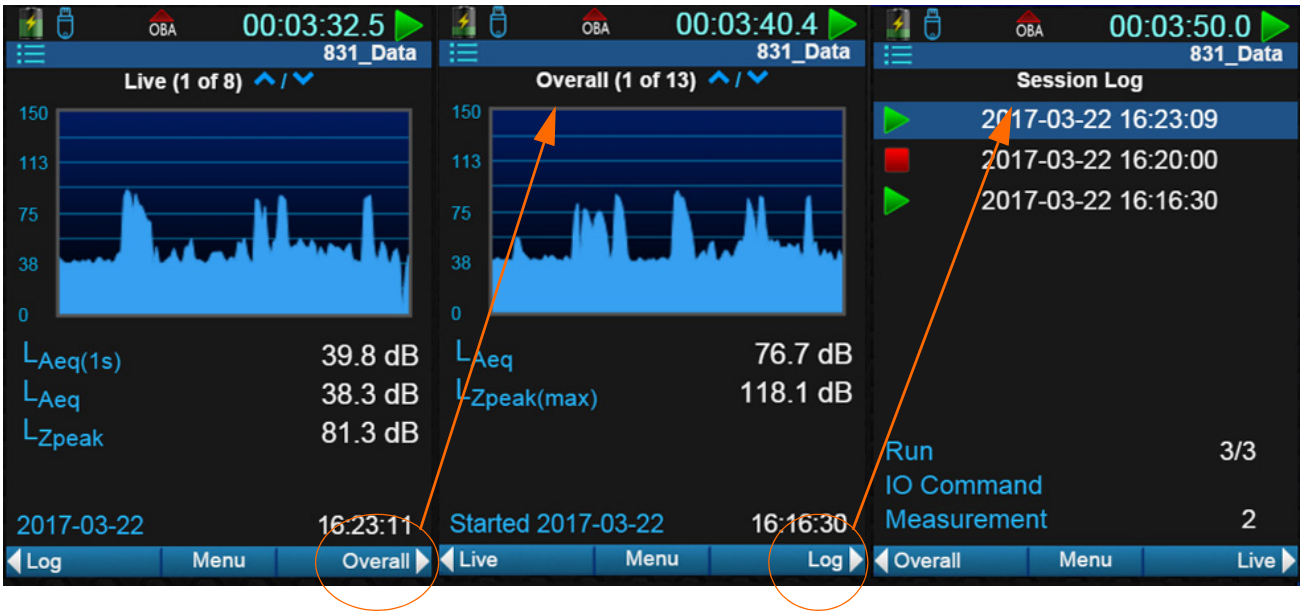
- Represents data measured and averaged beginning from the time the measurement was started until the elapsed time indicated at the top of the display. If the measurement is stopped, the elapsed time will stop. Pressing the run key again will continue the measurement. As long as there is no reset, the same measurement is continued.
- Up to 20 pages of Overall Measurement data

Session Log

LEARN MORE To learn more about the Session Log, see “Session Log Tab” on page 4-16.

- A record of actions during a measurement. A time-stamped record is made for every Run, Pause, Resume, Stop, and Sound Recording action. The source responsible for each action is also recorded. Resetting and storing data will clear the session record.

FIGURE 2-6 Measurement Data Tabs

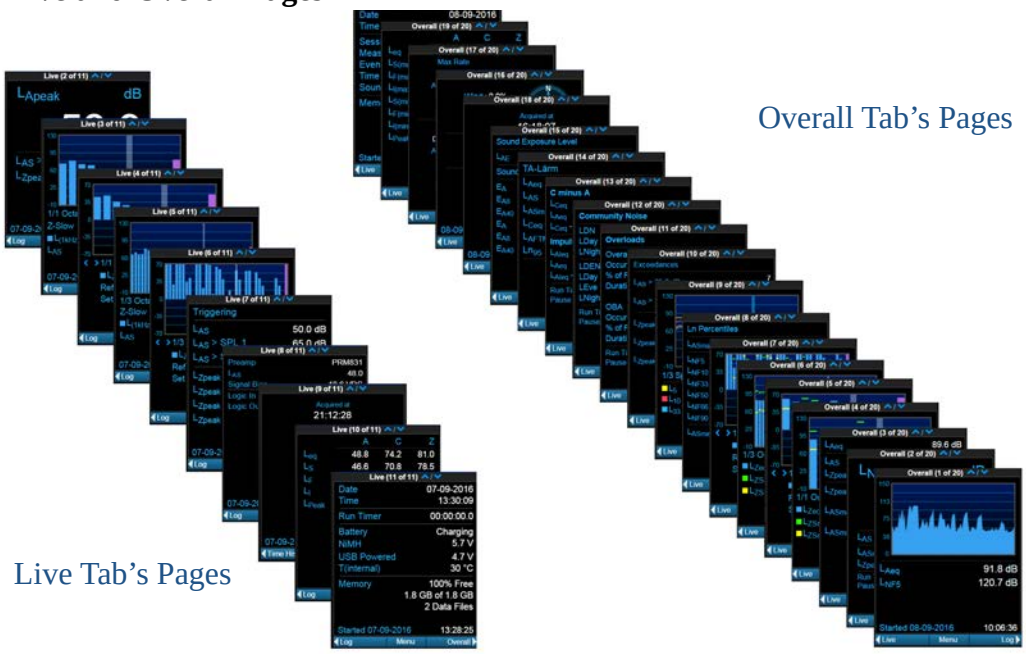


2.5.2 Pages

TAKE NOTE You may not have all the pages available on the SoundAdvisor. Additional pages of measurement data can be purchased through Larson Davis. "Contact Larson Davis" on page i-2.

The **Live** and **Overall** tabs each have data displays called "pages" that can be accessed using the up and down arrow keys. Figure 2-7 shows all the pages available for these tabs.

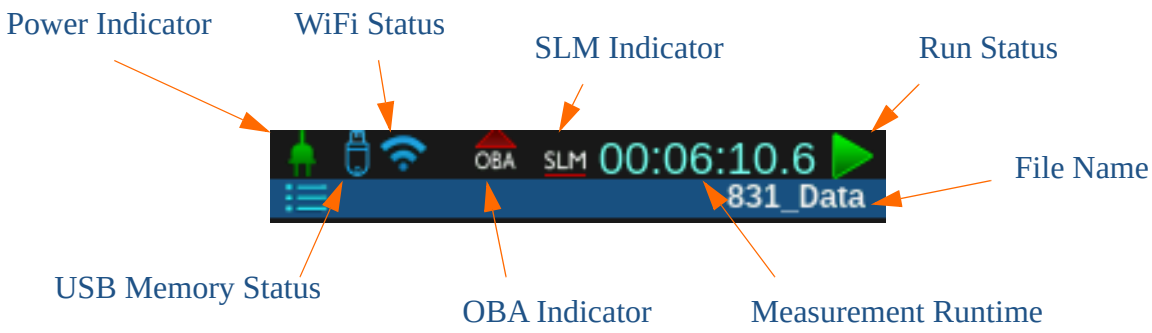
FIGURE 2-7 Live and Overall Pages



2.5.3 Status Bar Icons

The top status bar will alert the user the status of the meter, measurement, connection, and battery.

FIGURE 2-8 Status Bar



Power Indicators

TAKE NOTE The battery icon animates through the battery state cycle while charging.

Battery

The battery icon indicates the state of the battery charge by color and volume. Figure 2-9 Battery States indicates all the states of the battery going from fully charged to depleted, if read left to right. The bolt symbol appears over the battery icon if the battery is currently charging.

FIGURE 2-9 Battery States

External Power

The external power connection icon appears when the SoundAdvisor is powered from an external power supply or via the USB port.

FIGURE 2-10 External Power Icon

Battery Status Pending

While the SoundAdvisor is checking the battery status, this pending icon will appear until the battery percentage is determined.

FIGURE 2-11 Battery Status Pending Icon

WiFi Status

See “WiFi” on page 13-2.

USB Memory Status

See “USB Drive Storage” on page 8-5.

Input Overload Icon

When a signal from the preamplifier exceeds the calibrated input range of the SoundAdvisor, the Input Overload icon will appear. While the overload is present, the icon will flash.

If a measurement is running and an overload occurs, the icon shown below will flash during the overload.

FIGURE 2-12 SLM Overload Icon

When the overload has been removed, the icon will still be present (not flashing) to indicate that an overload has occurred during the measurement. A reset will clear the icon from the display.

When using a microphone having a sensitivity of 50 mV/Pa, the input overload will occur approximately as shown in Table 2.3.

Table 2.3 Input Overload Levels

Input Gain, dB	Overload Level, dB Peak
0	143
20	123

Under Range Icon

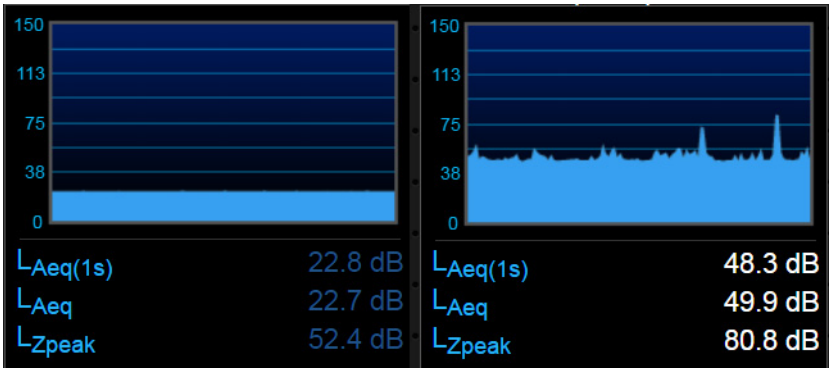
When the signal from the preamplifier drops to the point where the noise level of the instrument and the preamplifier influence the measurement, an under range condition exists. When this happens the Under Range Icon will appear.

FIGURE 2-13 Under Range Icon

As long as the under range condition exists, the icon will flash. When the measured level no longer produces an under range condition, the icon will be removed from the display.

At any time when a measured parameter is in an under range condition, its numeric display will alter in color, as shown in Figure 2-14.

FIGURE 2-14 Under Range vs. Normal Range Data Display



Under Range Display Normal Range Display

OBA Overload Icon

If the input to the Octave Band Analyzer becomes overloaded, the OBA Overload icon will appear to indicate the overload.

FIGURE 2-15 OBA Overload Icon

This icon operates similar to the Input Overload Icon shown in the above section “Input Overload Icon”.

When the OBA Range property is set to Low, the OBA Overload Icon will activate at a level 33 dB lower than it would had the OBA Range been set to Normal.

When using a microphone having a sensitivity of 50 mV/Pa, the input overload will occur approximately as shown in Table 2.4.

Table 2.4 OBA Overload Levels

Input Gain, dB	OBA Range	Overload Level, dB
0	Normal	143
20	Normal	123
0	Low	110
20	Low	90

OBA Under Range Icon

When the signal from the preamplifier drops to the point where the noise level of the instrument and the preamplifier influence the measurement, an under range condition exists.

When all filters of the OBA are “under range” the OBA Under Range Icon appears.

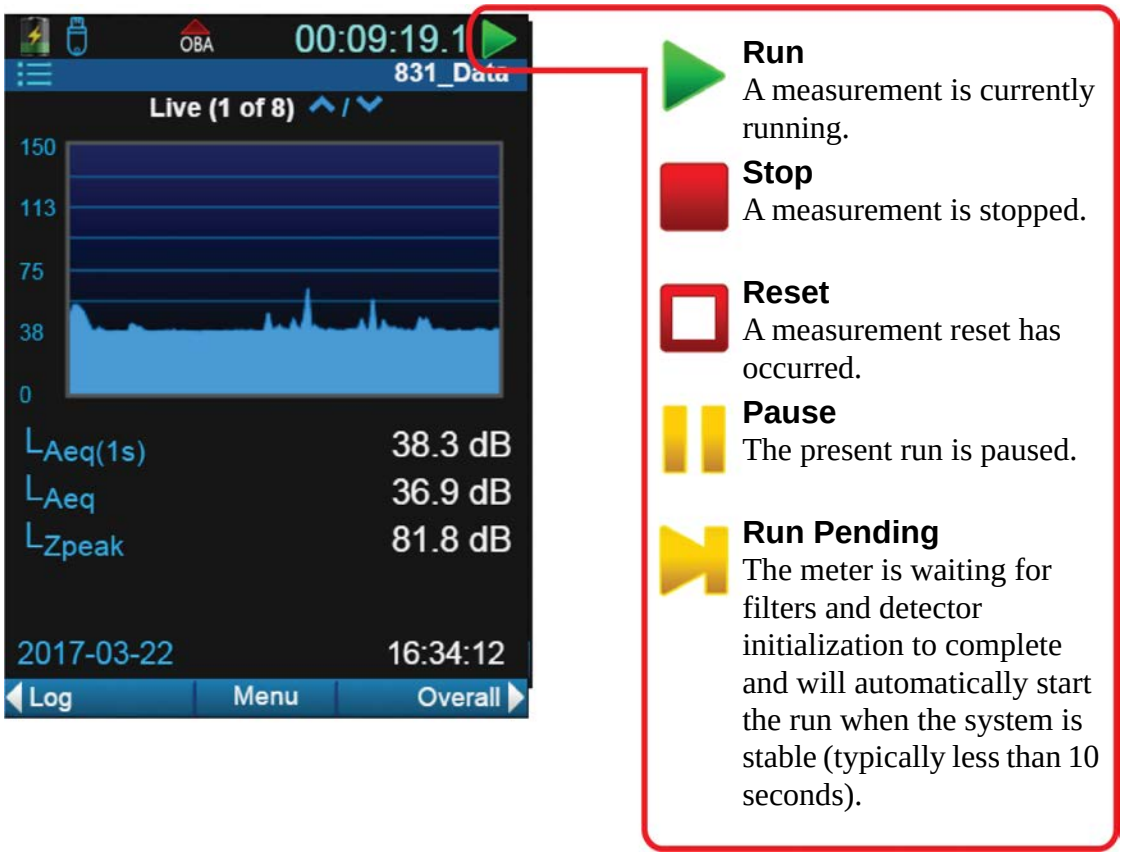
FIGURE 2-16 OBA Under Range Icon

As long as this under range condition exists, the icon will flash. When the measured OBA levels no longer produces an under range condition, the icon will be removed from the display.

Measurement Status

The state the meter is currently in will be indicated by a measurement status icon. The measurement status is indicated by five icons for the five states: run, stop, reset, pause, run pending.

FIGURE 2-17 Measurement Status Icons



If touch-screen is enabled, or you are operating the SoundAdvisor remotely, touching the icon will change the status with the following results:

Table 2.5 Touch Icon Results

Measurement State	Action	Resulting Measurement State
Run	Press Once	Stop
Run	Double Tap	Pause
Pause	Press Once	Run
Stop/Reset	Press Once	Run
Stop/Reset	Double Tap	Store
Run Pending	N/A	N/A
Power Save	Press Once	Run

Analog Power Save Icon

LEARN MORE To learn more about power saving options, see “Power” on page 9-3.

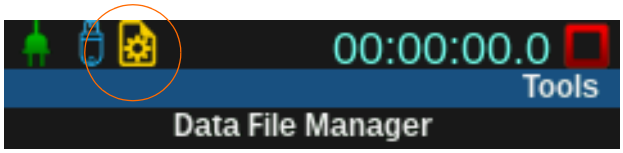
When the SoundAdvisor is not connected to a PC, it can be put in a power saving mode that shuts down the analog circuitry, including the preamplifier, to save battery power. The power save icon will be displayed in the location where the measurement status icons appear.

FIGURE 2-18 Analog Power Save Icon

File Operation Icon

The file operation icon will appear on the status bar to indicate that a file is currently being saved onto the USB, moved from the USB to meter, or is being copied. All these operations are done in the Data File Manager, see page 8-1. It is a standby icon that will disappear once the operation in complete.

FIGURE 2-19 File Operation Icon



2.5.4 Display Menus

The SoundAdvisor features and functions are organized into three general menus:

Main Menu

Accessed using the center softkey that indicates **Menu**

- Setup Manager
- Mark Sound Type
- Any Level Menu - Access on profile display by pressing ENTER
- Adjust Graph
- Print Screens (only available with printer inserted)

Tools Menu

Accessed using Tools or the menu icon on the display

- Data File Manager
- Calibrate
- Setup Manager
- System Properties
- About
- Lock
- System Utilities

- Communication
- Setup WiFi (if available)

Power Control

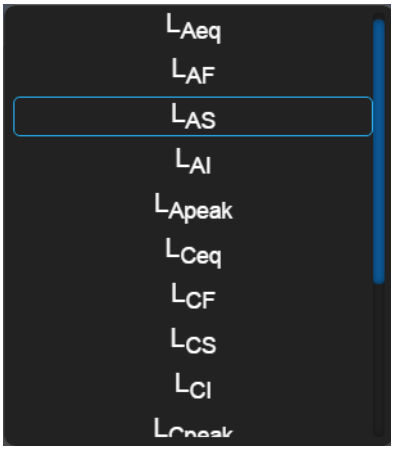
Accessed by pressing the ⏻ once

- Battery Information
- Display
- Off
- Reboot

Any Level Menu

To select which sound level parameter is to be used for the 2nd numerical value displayed, press the ENTER to open the menu.

FIGURE 2-20 Any Level Menu



Setup Manager

TAKE NOTE A new setup file can be created using G4 LD Utility and then moved on to the meter.

The Setup Manager is a platform that allows for measurements to be made with preset settings in what are called “setup files” or “setups”. From any tab or page on the meter, press the Menu soft key, select **Setup Manager**. The first display is a list of the setup files currently available on the meter. The **Active** setup is the current setup for all runs made. The **Default** setup can be made active, and it cannot be removed or deleted.

Select **Active** and navigate to the different settings using top left and right softkeys.

General

Name a measurement file, and add description.

TRY THIS Name a measurement file using the on screen keypad that appears once you select the measurement name.

SLM

Define the weightings, filters, and integration type for the measurement sound levels.

OBA

Set the parameters for the real-time octave band frequency analysis.

TAKE NOTE Enabling some settings will open more pages under the tabs in the data display.

LEARN MORE For more information on the Measurement Settings tabs and pages, “Measurement Setup” on page 6-1.

Ln
Define the Ln statistics.

Control
Define the way a measurement is performed, the timing, and the storage of measurement history records.

Time History
Enable the time history and select the metrics that are stored in the time history.

Triggers
Define the levels at which noise exceedance events will be triggered

Event History
Define the timing and options for events.

Markers
Define the marker types and enable markers.

Day/Night
Define the time periods and level penalties for community noise metrics.

Sound
Set the quality of sound recording and enable its usage.

Weather
Set the weather station type and values of external transducers for the measurement of wind speed, wind direction, temperature and humidity.

System Properties

LEARN MORE To learn more, see “System Properties” on page 9-1.

Power
Define battery type, if the external power source should charge the battery, and features like auto-off, power-save, backlights, keypad backlight, LCD brightness, and the external shutoff voltage.

Preferences
Set mic correction, auto-store, the AC output, reset properties, data storage location, GPS mode, and the time zone correction.

Locale
Set language preference, decimal symbol, date format, and the units in which the measurement is displayed.

Displays
Define the default start display, and toggle between tabs to hide or show pages.

Options
Hide or show purchased options on the meter.

Network
View the 831 INT-ET IP address and the external Ethernet IP and MAC addresses. Enable Watchdog is also on this page.

Email
Indicate recipients for email alerts.

Other
Set the Logic In, Logic Out, and heater.

Reference Spectra
Set values for the reference spectrum.

Device
Enter 30 characters per field of device information that will appear on the **About** page under the Tools menu.

Time
Set timezone and date/time manually.

NTP
Add local or global NTP time servers for the most accurate time updates on the meter.

Module 3 Getting Started

3.1 Unpacking & Inspecting

TAKE NOTE Report any damage or shortage immediately to PCB Piezotronics, Inc. See “Contact Larson Davis” on page i-2.

The SoundAdvisor is shipped in protective packaging. First, verify the package contains the items listed below. Retain the packaging for safe shipment for calibration service.

The SoundAdvisor should include:

Table 3.1 SoundAdvisor Package

		
SoundAdvisor Model 831C	PRM831 Microphone Preamplifier	377B02 1/2 Inch Microphone

The 831C-FF and 831C-RI should include all from Table 3.1 and Table 3.2:

Table 3.2 831C-FF Package

831C-CCS Hard Shell Case	
PSA029 Universal AC Power Adaptor	
WS001 3 1/2 inch Windscreen	
Lanyard	
4 - AA NiMH batteries	
G4 LD Utility Software	

Table 3.2 831C-FF Package

Calibration Certification	

3.1.1 Serial Numbers

TRY THIS Record the purchase date, model and serial numbers for your instrument, preamplifier, and microphone in the spaces provided on the "Record of Serial Number and Purchase Date" on page i-2.

The SoundAdvisor model and serial numbers are printed on the label on the instrument's back panel. The microphone model and serial numbers are engraved on the outside of the microphone. The preamplifier model and serial numbers are engraved on the outside surface of the preamplifier.

3.2 Connecting the Microphone & Preamplifier

CAUTION Always use care when separating or connecting the microphone and preamplifier:
Never use excessive force. Gripping tightly or screwing tightly is unnecessary.
Do not remove the microphone grid cap and expose the diaphragm.
The pogo pin is sensitive to static electricity. Avoid creating static shock when attaching the microphone by grounding yourself prior to assembly.

The bottom of the microphone attaches to the top of the preamplifier. The top of the preamplifier has a single gold pin and threads on the preamplifier body, designed to fit the 1/2 inch microphone.

FIGURE 3-1 Microphone and Preamplifier

Carefully place the bottom of the microphone over the top of the preamplifier. Gently screw the assembly together. The microphone body will seat smoothly against the preamplifier body. When removing the microphone, turn while gripping lightly the microphone body on the two engraved lines.

3.3 Connecting the Preamplifier to SoundAdvisor

CAUTION Do not attempt to screw the preamplifier onto the SoundAdvisor.

The bottom of the preamplifier has a 5 pin connector that fits snugly into the top of the SoundAdvisor. The connectors are keyed for correct alignment; There is a vertical engraved line on the preamplifier which aligns with the arrow on the SoundAdvisor, these should be aligned before inserting the preamplifier.

Insert the preamplifier into the mating connector on the SoundAdvisor. Press the assemblies together until a small click is heard.

3.4 Disconnecting the Preamplifier

On the front surface of the SoundAdvisor, just below the preamplifier connector, is a small button. Press and hold this button while gently pulling the microphone/preamplifier assembly out of the SoundAdvisor.

FIGURE 3-2 SoundAdvisor Release Button

3.5 Powering the SoundAdvisor

To facilitate any task you may have with the meter, you can power the SoundAdvisor with battery power or use an external power supply.

3.5.1 Battery Power

CAUTION Do not mix Alkaline and NiMH batteries.

CAUTION Do not mix batteries from different manufacturers.

CAUTION Replace all four batteries when installing fresh cells.

CAUTION The correct battery type must be specified in System Properties, as described in "Battery Type" on page 9-3.

CAUTION Do not charge non-rechargeable cells. Charge NiMH only.

CAUTION A Session Log entry "Charging Stopped" can be resolved by checking the batteries and ensuring the correct battery type is selected. Battery may be too old to charge. Battery may be read as incorrect battery

type, which may happen to fully discharged NiMH batteries. Use an external battery charger to restore charge, then install in meter. The batteries may be too hot or too cold, and the temperature may need to be brought between 0° C - 45° C.

The SoundAdvisor is compatible with the following batteries:

- Energizer, Duracell, and other nationally recognized brands:
    - AA nickel metal hydride (NiMH)
    - AA Alkaline
    - AA 1.5 Volt Lithium

Battery voltage is displayed on the Power Control screen that can be accessed by pressing ⏻.

The battery icon indicates the state of the battery charge by the color and fill of the battery icon.

FIGURE 3-3 Battery Status Icons

Full Charge Low Charge

Low Battery

As the battery nears end-of-life, the empty battery symbol will begin to flash. When the battery is at the end-of-life, the SoundAdvisor will stop running, save all data, and instrument status, then turn off. When the SoundAdvisor is turned on again, with fresh batteries or an external power supply, the unit returns to the state it was in when it shut down.

Install Batteries

The battery compartment of the SoundAdvisor is on the back of the instrument. When installing batteries, always insert 4 fresh AA batteries. Regard polarity markings when inserted batteries.

FIGURE 3-4 Insert Batteries

Charging Batteries using the SoundAdvisor

When using NiMH batteries and powering the SoundAdvisor from either the computer (via USB port) or from the PSA029 power supply, or from another external source, the batteries can be charged inside the instrument.

TAKE NOTE The charge time to completely recharge the cells is about seven hours when the instrument is powered off and using USB to charge.

To turn on charging follow these steps:

Step 1 On the SoundAdvisor meter, go to **Tools** menu → **System Properties**. You can go to the **Tools** menu by pressing on the meter.

Step 2 Select battery type as NiMH.

Step 3 **Charge** will automatically set to **On**. If you do not want your power source to charge your battery, set to **Off**.

Step 4 Select **Save**. A dialogue box will appear, select **Yes**.

Charge Status LED

The charge status indicated by an LED on ⏲ are as follows:

- LED ⏲ continuously lit: Charging
- LED ⏲ not lit: Not charging
- LED ⏲ winking: Charging stopped (battery fault)
- LED ⏲ fast blinking: meter is powering up or shutting down

3.5.2 External Power

The SoundAdvisor can be powered from a variety of sources including:

- USB port from a computer
- USB port from PSA029 power supply
- I/O port from PSA027 power supply (using CBL140 or CBL154)
- From an external +10.8 to +30 Volt mains power source

USB Port Power

The SoundAdvisor can be powered via the USB port with the PSA029 external power supply. The mini USB Type B connector is located on the bottom of the meter.

CAUTION If the SoundAdvisor is operated without batteries installed and power is interrupted, data may be lost.

With the PSA029 power supply connected and operating at rated conditions, the SoundAdvisor will operate properly with or without batteries installed.

Low Voltage Shutdown

The SoundAdvisor has a special feature to preserve the service life of an external battery by preventing it from being discharged excessively. When the battery voltage drops below the **External Shutoff Voltage** (default value +10.8 volts), but remains above +10.2 volts for one minute, the instrument will stop, save data and turn the SoundAdvisor off.

Power Loss

LEARN MORE To learn more about power loss, see “Low Power At Boot-Up” on page A-4.

When the SoundAdvisor is powered from an external supply and the input voltage falls below the indicated **External Shutoff Voltage** threshold, it will power off. When the SoundAdvisor turns off due to a low battery, it will automatically turn on 6 hours later and remain on if there is adequate power. If the battery is still discharged, the SoundAdvisor will turn back off and try again in another 6 hours. This feature is designed to allow the SoundAdvisor to automatically restart when powering is lost do to low solar situation or after an extended power outage.

Sudden Loss of External Voltage

If the external voltage is suddenly lost, for example when the external supply is disconnected or when mains power fails and there is no external battery, the SoundAdvisor will continue to run on internal batteries if they are present and in good condition. If battery power is not present, the SoundAdvisor will immediately switch to an internal recovery battery and power down safely.

External Power Icon

Without internal batteries, the external power is supplied through the USB connector, the battery icon is replaced with the External Power icon, and the meter is no longer using batteries to power.

If your meter has fully charged NiMH batteries and plugged in to a power source, this icon will indicate that it is using power from the external source, as well as not charging and not depleting any power from the batteries.

FIGURE 3-5 External Power Icon

3.5.3 Low Power At Boot-up

When the SoundAdvisor boots up a power check is performed. If the supplied power is too low, then a low power icon will display over top of the first display. For more information see Table A.2, “Low Power At Boot-Up”.

3.6 Turn the SoundAdvisor ON

After the SoundAdvisor is fully powered, either with an external power source or fresh batteries installed, it is time to power the meter on.

Press the **ON/OFF** button on the meter until the screen flashes and the green LED light under the button turns on; It will take a second.

3.6.1 Turn the SoundAdvisor OFF

The SoundAdvisor can be turned safely **OFF** after accessing the Power Control Page, see “Power Control Page” on page 3-9.

Alternatively, pressing and holding the power button for three seconds will begin a safe shut down. Pressing and holding the power button for 10 seconds will force a hard shutdown.

3.6.2 Power Display Pages

There are several pages of power control and display.

Power Control Page

While the SoundAdvisor is powered on, the **Power Control** page can be accessed by pressing the power button once. This is the best way to turn the meter off. Select **Off** to safely turn the meter off. Alternatively, press and hold the power button for three seconds and it will power down safely.

FIGURE 3-6 Power Control Page

Battery "quick look"

You can then use the top left softkey to select Off to power down the meter. This is the recommended method to powering down the meter.

Manage the display brightness and color theme

The right softkey will reboot the meter

Power Page in System Properties

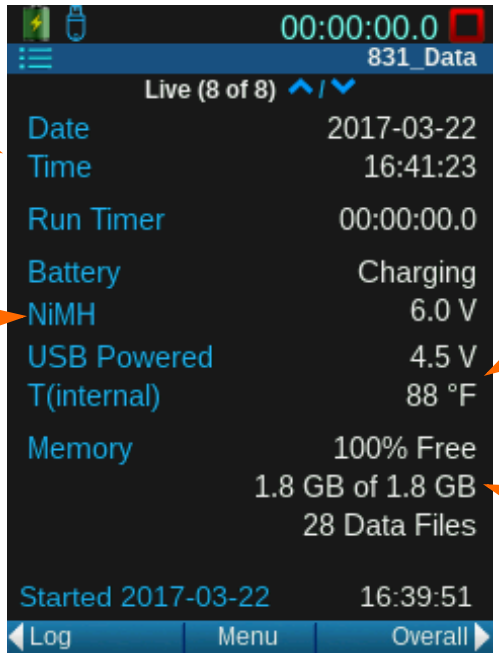
LEARN MORE For more information on the Power page, see "Power" on page 9-3.

To change the battery type, auto-off and other features use the **Power** page. It can be accessed through the **Tools → System Properties**.

Power Page on the Live Tab

Under the **Live** tab, on the last page (a shortcut would be to navigate "up" instead of "down" on the **Live** tab to reach the Power page), there is the **Power** page. On this page you can see all the battery, voltage, and memory storage of the SoundAdvisor. Settings cannot be changed, only viewed on this page.

FIGURE 3-7 Power Page on the Live Tab



The current date and time can easily be seen on this page.

Voltage of the battery and the USB external power source can be tracked here.

Checking the internal temperature of the meter periodically is always good safety practice.

The internal memory information is also available on the **Power** page.

3.7 Long Term Storage of SoundAdvisor

CAUTION DO NOT use the hardware power switch to turn the SoundAdvisor OFF. Permanent damage may occur. Press the ⏻ once and then select **Off**.

The Hardware Power Switch on the bottom of the SoundAdvisor disconnects the batteries from the SoundAdvisor hardware. The real-time clock will maintain its value while the switch is off. The power switch prevents battery drain when the meter is not in use for an extended period of time. If you plan to store the meter for more than two weeks, remove the batteries.

If the switch is in the “ 0 ” position, the batteries are disconnected. After installing batteries be sure to move the switch to the “ | ” position.

It should not be used to turn the SoundAdvisor ON and OFF. If the Hardware Power Switch is used to turn the SoundAdvisor OFF, data may be lost.

Module 4 Data Display

4.1 Overview

The SoundAdvisor takes a measurement, and simultaneously displays that same information in a variety of ways. At the same time you can take a measurement and view:

- Sound metrics in real time
- Frequency of sound at each octave.
- L_{eq}, L_S, L_{PEAK} of the overall or live sound
- Fast and Impulse detectors
- Temperature, GPS, and elevation that the sound was measured
- Sound weighted with specific values

4.2 Data Labels

The labels for sound metrics in the SoundAdvisor are designated by international standards. For many displayed values, the frequency and time weighting are indicated in the name of the metric.

For example, L_{AS} is the A-weighted sound pressure level measured using the Slow detector. Sound pressure level is often referred to as SPL.

4.3 Live Displays

LEARN MORE To learn about the tabs, pages, and general overview of the display of the SoundAdvisor see "Displays and Icons" on page 2-6.

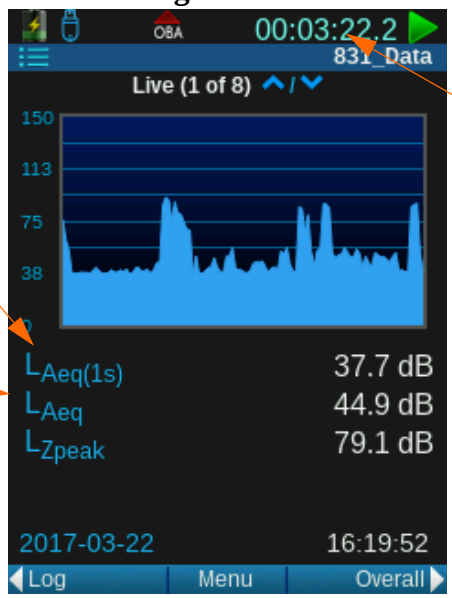
TRY THIS Use the ⟨ or ⟩ keys to navigate up or down through pages.

When the SoundAdvisor is turned ON, the default first display is the Live tab. The measurements displayed on the Live tab are always active, real-time measurements. The displayed values are not controlled by the ▶/⏸ (RUN/PAUSE) key. This allows you to view the current SPL without disrupting any overall data.

For example, suppose you are making a measurement and an unwanted event takes place, causing you to stop the measurement. With the measurement stopped, you can monitor the actual level on the Live tab to be certain that the residual effects of the unwanted event have died down before beginning a new measurement.

4.3.1 SLM Page

FIGURE 4-1 Live Tab: Sound Level Profile Page



L_{Aeq}, 1 second averaging, using frequency weighting and detector selected in setup.

The duration of the current measurement. This will reset when an auto-store occurs, or a measurement in reset.

User-selected SLM parameter

L_{Zpeak} using frequency weighting selected in setup

The profile page presents a recent history of L_{Aeq} calculated for each second. The graph presents the last 120 seconds of the measurement.

The first numerical level displayed, L_{Aeq}(1s) in this example, is the most recently graphed 1 second value. The frequency weighting, and possibly the detector, will correspond to those selected in setup for the RMS value.

TRY THIS While on this page, press the ENTER key, select a new parameter and look where the data is displayed.

The 2nd numerical level display, L_{Aeq} in this example, corresponds to a user-selected parameter. The default value is L_{AS}. The selection of this value is described in “User-Selected SLM Parameter” on page 5-3.

The 3rd numerical level displayed, L_{Zpeak} in this example, is the current measurement from the 1s peak detector. The frequency weighting will correspond to that selected in setup for the peak value.

User-Selected Parameter

To select which sound level parameter is to be used for the 2nd numerical value displayed, press the ENTER to open the menu.

FIGURE 4-2 User-Selected Menu

4.3.2 Big Digit Sound Level

The big digit display is the easiest to observe both the instantaneous sound level and if the sound exceeds a trigger level that the user defines.

FIGURE 4-3 Live Tab: Big Digit Display Page

4.3.3 Octave Band Analyzer

TAKE NOTE This feature requires the 831C-OB3 option.

There are four pages that relate to octave bands. The bands on the 1/1 Octave pages represent the bandwidth of one full octave, and the height of each band is amplitude of sound at that frequency. The 1/3 Octave band pages are similar, but each band represents a bandwidth of 1/3 octave.

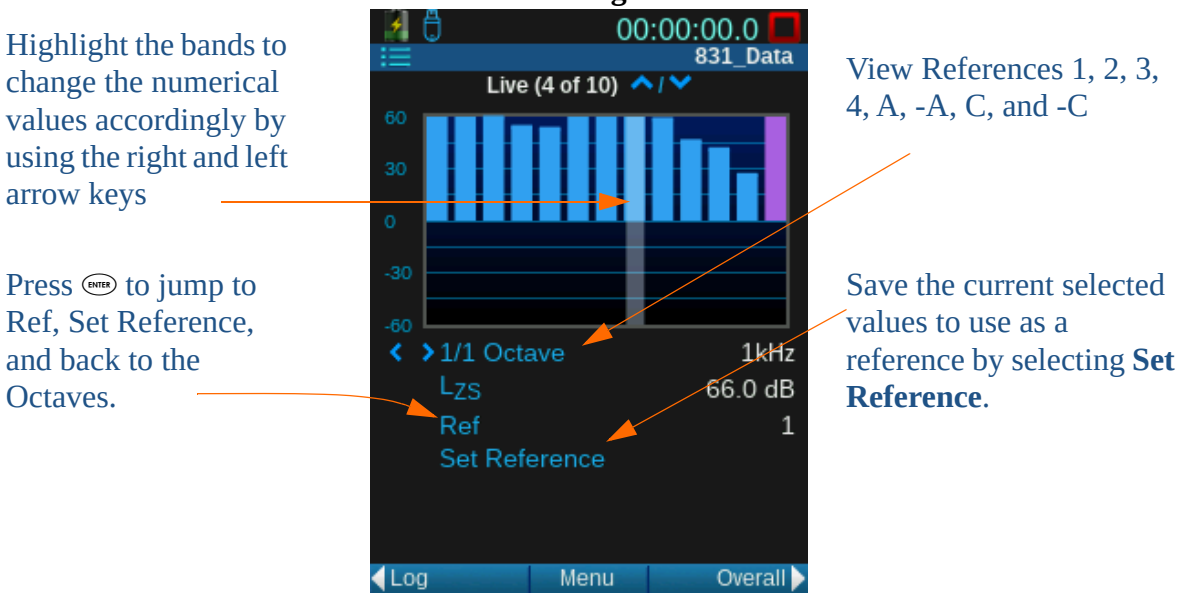
FIGURE 4-4 Live Tab: 1/1 Octave Band Page

4.3.4 Normalized Octave Band

TAKE NOTE The normalized octave band pages are shown because on a setup OBA page, the Spectral Ln is turned ON

Similar to the regular octave band pages in display, the normalized band pages are showing octave bands and the numerical values of the highlighted band. However, the data is normalized using a selected reference spectrum.

FIGURE 4-5 Live Tab: Normalized Octave Band Page

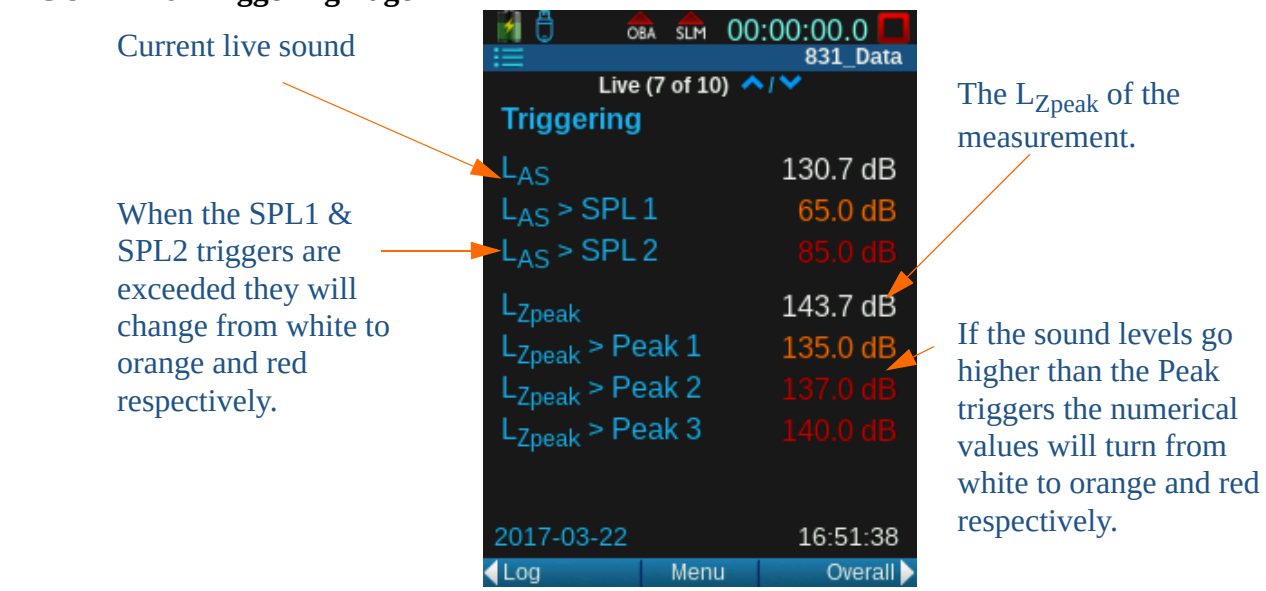


TAKE NOTE The reference spectra can be configured by navigating **Tools Menu ⇢ System Properties ⇢ Reference Spectra**.

4.3.5 Triggering

After indicating the decibel of a trigger on a setup, view this page to show when the trigger has been exceeded.

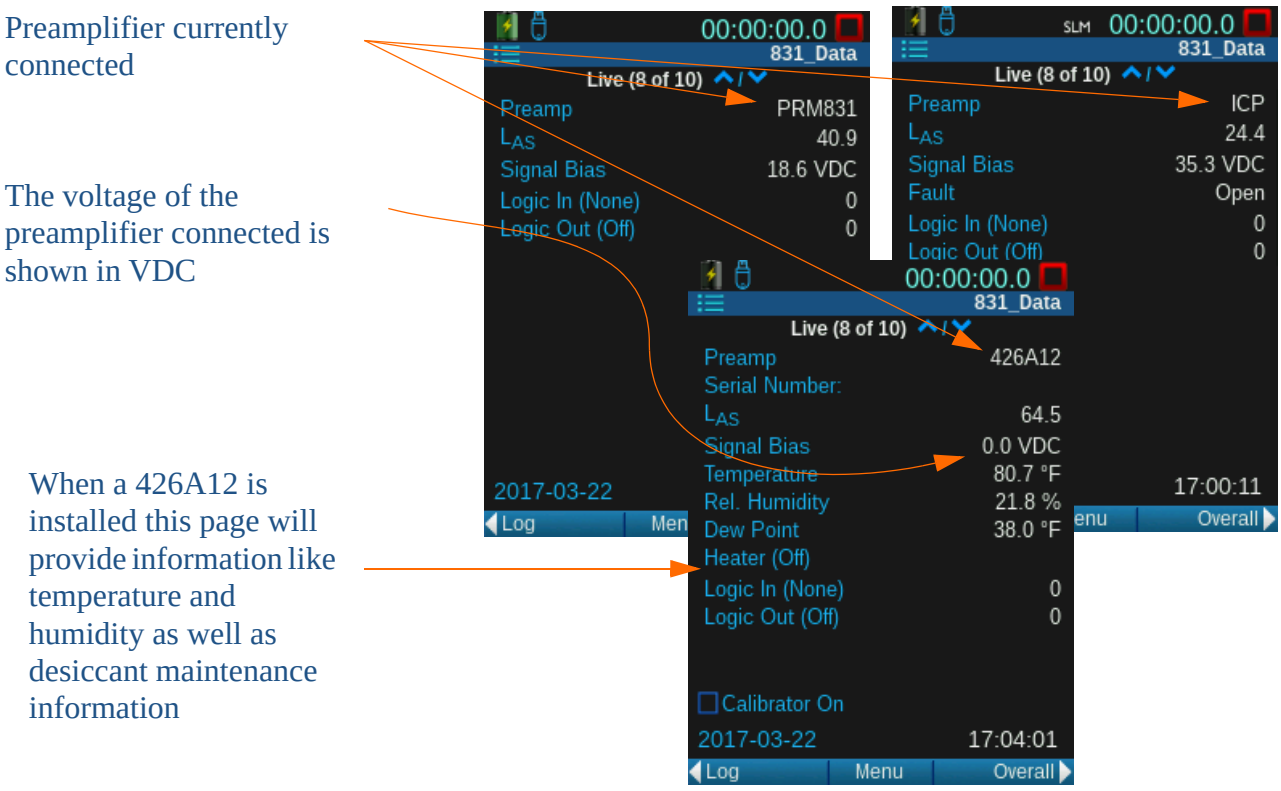
FIGURE 4-6 Triggering Page



4.3.6 Preamplifier Interface Page

The information on the preamplifier interface page is used to validate the proper operation of the meter.

FIGURE 4-7 Preamplifier Interface Page



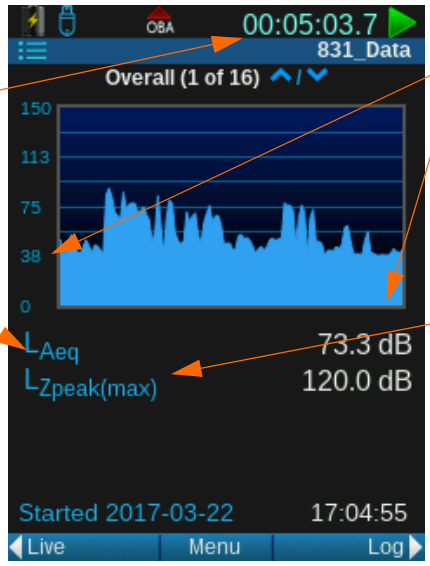
4.4 Overall Displays

TAKE NOTE Not all the pages available will be covered in this section, as they are optional. To inquire about more functionality, "Contact Larson Davis" on page i-2.

The Overall tab is similar to the Live tab, with an SLM page and subsequent pages showing sound data, except that the Overall tab is showing the data collected from a current measurement. The overall data will continue to collect until the measurement is stopped and saved, or a reset has occurred.

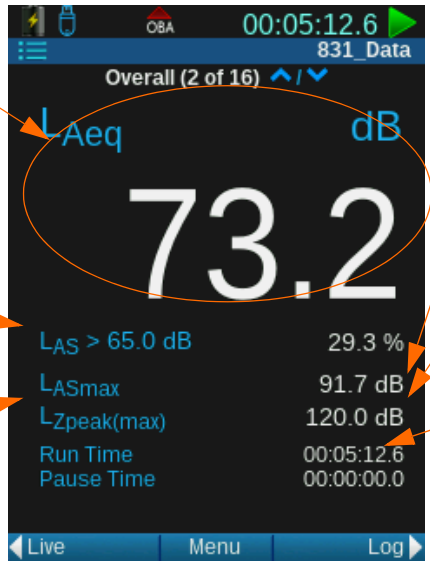
4.4.1 SLM Display

FIGURE 4-8 Overall Tab: SLM Page



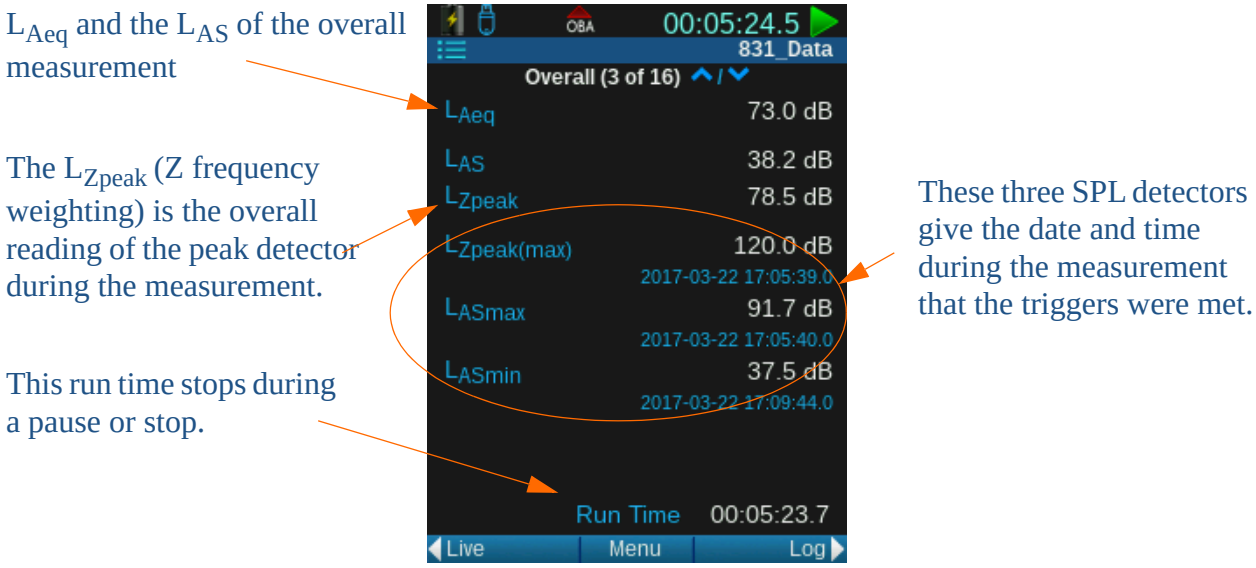
4.4.2 Big Digit

FIGURE 4-9 Overall Tab: Big Digit Page



4.4.3 L_{eq}

FIGURE 4-10 Overall Tab: Leq Page



$L_{Zpeak(max)}$

The highest level the peak detector has measured during the run time of the measurement. A date and time of occurrence is recorded with this event. It's considered the peak hold.

L_{ASmax}

The highest level the SPL detector has measured during the run time of the measurement. It's considered the max hold.

L_{ASmin}

The lowest level the SPL detector has measured during the run time of the measurement. A date and time of occurrence is recorded with this event.

4.4.4 Octave Band Analyzer

TAKE NOTE The octave band pages are shown because the 831C-OB3 has been purchased, and on a setup OBA page, the Bandwidth is turned ON.

There are four pages that relate to octave bands. The bands on the 1/1 Octave pages represent the bandwidth of one full octave, and the height of each band is the frequency at which that sound is at that particular octave. The 1/3 Octave band pages are similar, but each band represents a bandwidth of 1/3 octave.

LEARN MORE To learn more about the octave band pages, see "Octave Band Analyzer" on page 4-3.

The Overall Tab's octave band pages only show the data since the first run was initiated and clear after a reset. The numerical values are color coded to assist in determining where the numerical values are in each octave band. For example, the blue box next to the L_{Aeq} data indicates that the blue bands are the same data.

FIGURE 4-11 Overall Tab 1/1 Octave Band Page

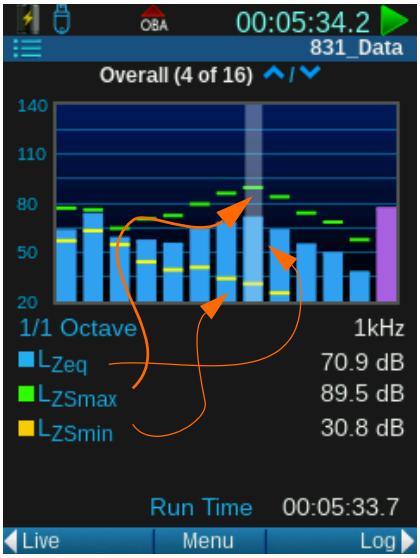


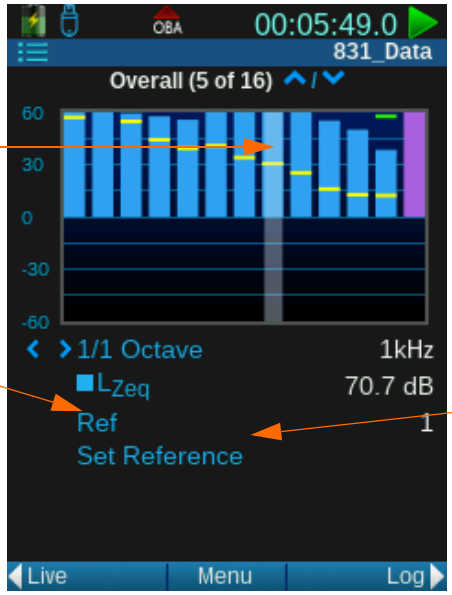
Table 4.1 Overall Octave Band Colors

L_{eq}	"Leq" is the average sound level of the highlighted frequency band for the duration of the measurement.
L_{max}	L_{max} is the maximum sound level of the highlighted frequency band. The maximum spectrum is determined by the Max Spec setting. **Bin Max** When set to Bin Max, it is the maximum value which occurred during the entire measurement for that frequency band. Since individual frequency bands may reach their maximum levels at different times, this spectrum might be one which never occurred at any instant during the measurement period. **At Max** When set to At Lmax, it is the instantaneous spectrum at the moment when the broadband maximum occurred (such as LSmax).
L_{min}	L_{min} is the minimum sound level of the highlighted frequency band for the duration of the measurement. Since individual frequency bands may reach their minimum levels at different times, this spectrum might be one which never occurred at any instant during the measurement period.

4.4.5 Normalized Octave Band

Similar to the Octave Bands pages in display, normalized band numerical values of the highlighted band. The data is then normalized using a Spectral Ln indicated in a setup.

FIGURE 4-12 Overall Tab: Normalized Octave Bands



Highlight the bands to change the selected frequency by using the left and right arrow keys

Press ENTER to jump to Ref, Set Reference, and back to Octaves

The user defined references are determined by navigating **Tools Menu** ⇢ **System Properties** ⇢ **Reference Spectra**

Set Spectra by selecting Set Reference after making changes to the weighting and reference.

Table 4.2 Reference Spectra Options

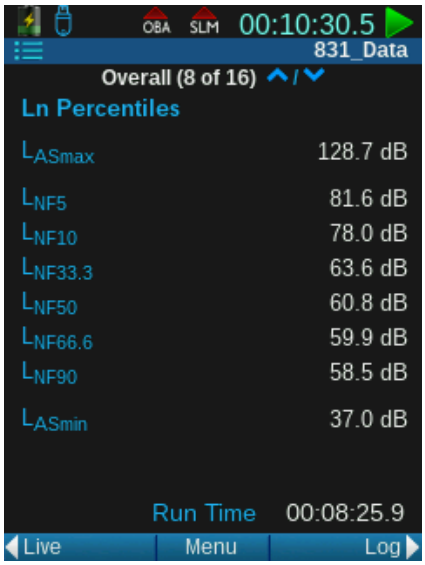
User Defined	1 2 3 4
Positive Frequency Weighting	A C
Negative Frequency Weighting	-A -C

In the case that the frequency components are too small or large, use the Adjust Graph function described in “Adjust Graph Scale” on page 4-17.

4.4.6 Ln Percentiles

TAKE NOTE The Ln percentile levels can be adjusted on the Ln page of the setup. **Setup Manager ⇢ Ln Percentiles**.

FIGURE 4-13 Overall Tab: Ln Percentiles Page



LEARN MORE L_{NF50} = 39.9 dB means that the Fast (F) time weighted level exceeded 39.9 dB 50% of the time.

An Ln is a statistical measurement of the level that is exceeded “n” percent of the time. The statistics are based on the level defined by the current weighting and detector.

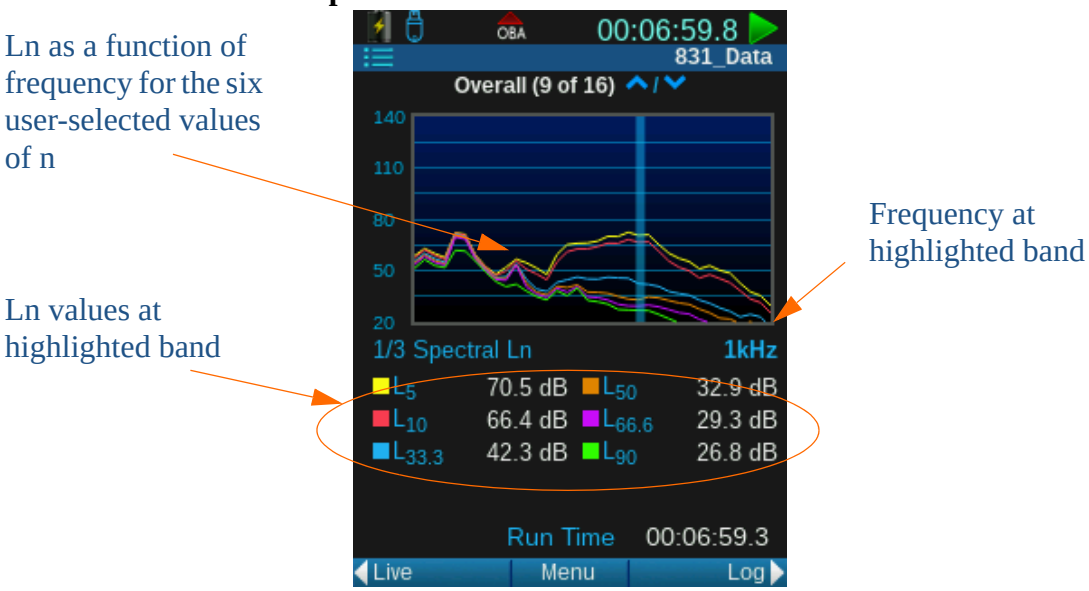
The Ln Percentiles page displays the Ln statistics for the measurement based on the run time. Also shown are the maximum and minimum sound levels measured.

The values of Ln are calculated from an amplitude distribution table, ranging from 0 to 200 dB, in 0.1 dB increments. As a result, it is possible to calculate Ln values from values of n ranging from 00.01% to 99.99%.

The values shown represent the six values which were selected for display on the setup. At any time during a measurement, any or all of these Ln values can be changed, so that Ln values corresponding to different values of n may be displayed.

4.4.7 1/3 Spectral Ln

FIGURE 4-14 Overall Tab: 1/3 Spectral Ln



TRY THIS Using the ⟨ and ⟩ keys, move the highlighted band to show the values for a different octave.

4.4.8 Exceedances

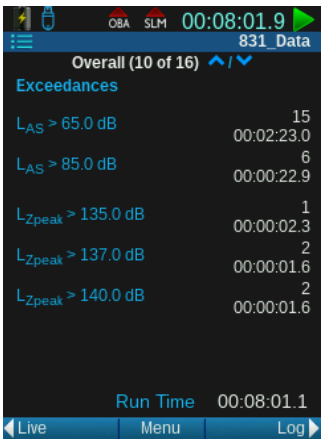
TAKE NOTE The exceedance levels are determined as triggers during a setup. They can be adjusted on **Setup Manager ⇢ Triggers**.

An exceedance occurs when the level defined by the current weighting and detector exceeds a present trigger level.

The exceedances page has two LAS and three Lpeak exceedance values, and each time one of them is exceeded during a run it will add to the counter, and turn the numerical value orange or red.

FIGURE 4-15 Overall Tab: Exceedances Page

During the exceedance

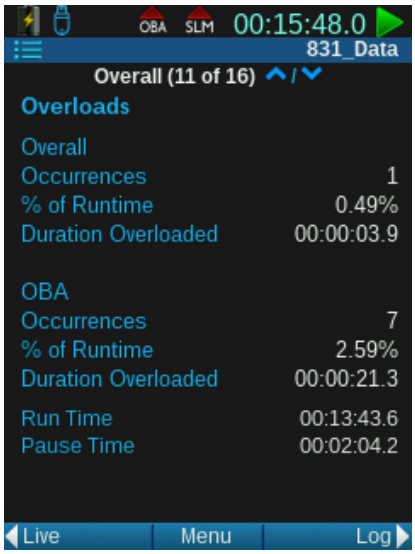


After the exceedance

4.4.9 Overloads

The Overloads page shows the number of times, the percent of time, and the amount of time that the Sound Level Meter and the OBA have been overloaded.

FIGURE 4-16 Overall Tab: Overloads Page



4.4.10 Community Noise

TAKE NOTE The metric CNEL is equivalent to LDEN.

The Community Noise page displays the values LDN and LDEN which are commonly used to evaluate community noise. Since community noise metrics are based upon full day measurements, they do not present valid data for measurements less than 24 hours duration.

FIGURE 4-17 Overall Tab: Community Noise Page

LEARN MORE For the formulas used to determine the LDEN, see “Day/Night” on page 6-8.

LDEN

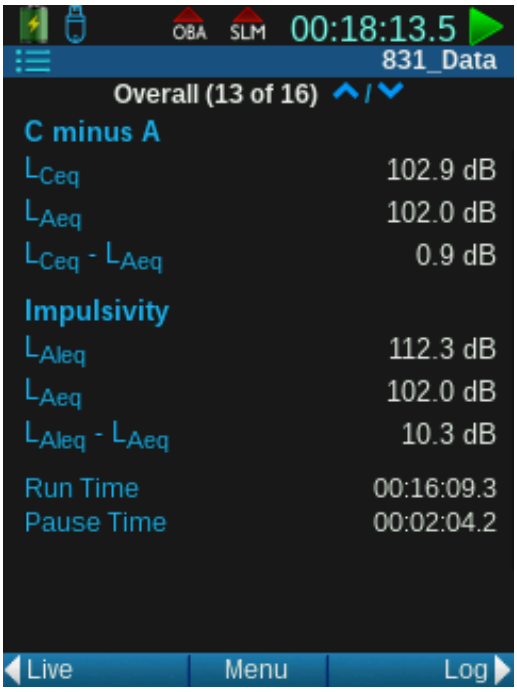
Although the standard ISO 1996-2:2007 specifies default values used in the calculation of LDEN, in practice the time values defining the day, evening and night periods may be changed, as permitted by Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. It is important to verify prior to measurement that the values have been properly defined for your purposes. The values can be adjusted on the setup, navigate **Setup Manager** ⇢ **Day/Night**.

4.4.11 C Minus A Impulsivity Page

The “C minus A” metric provides an indication of the low frequency content of noise measured by subtracting the A weighted equivalent level from the C-weighted equivalent level.

The integrated levels for LAeq are always calculated using the linear detector, regardless of the value selected in the SLM Setup. The LAIeq value is from the impulse detector.

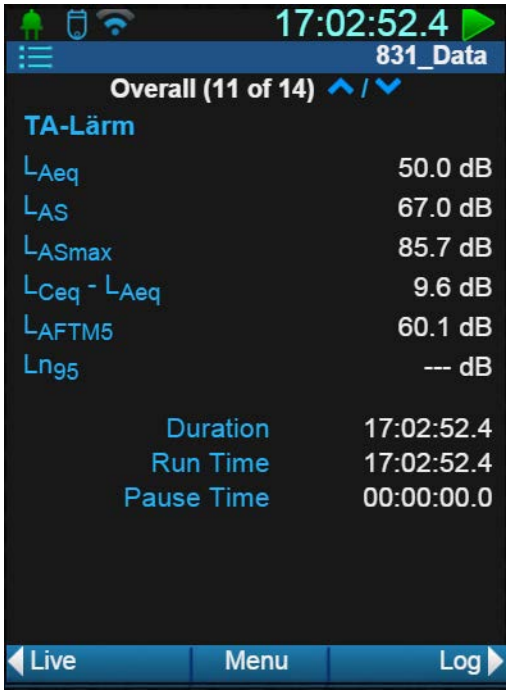
FIGURE 4-18 C Minus A Impulsivity



4.4.12 TA-Lärm

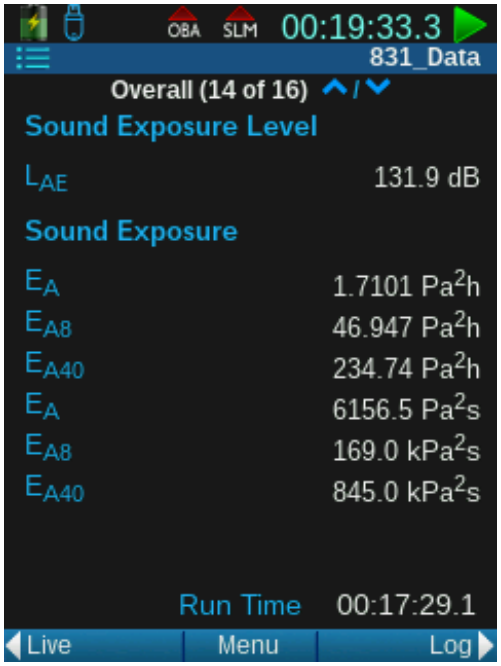
This metric is primarily used in Germany. To turn off this display, or any other display that is not related to your measurement, see “Displays” on page 9-10.

FIGURE 4-19 TA-Larm



4.4.13 Sound Exposure Level Page

FIGURE 4-20 Sound Exposure Level Page



4.4.14 Metrics Matrix Page

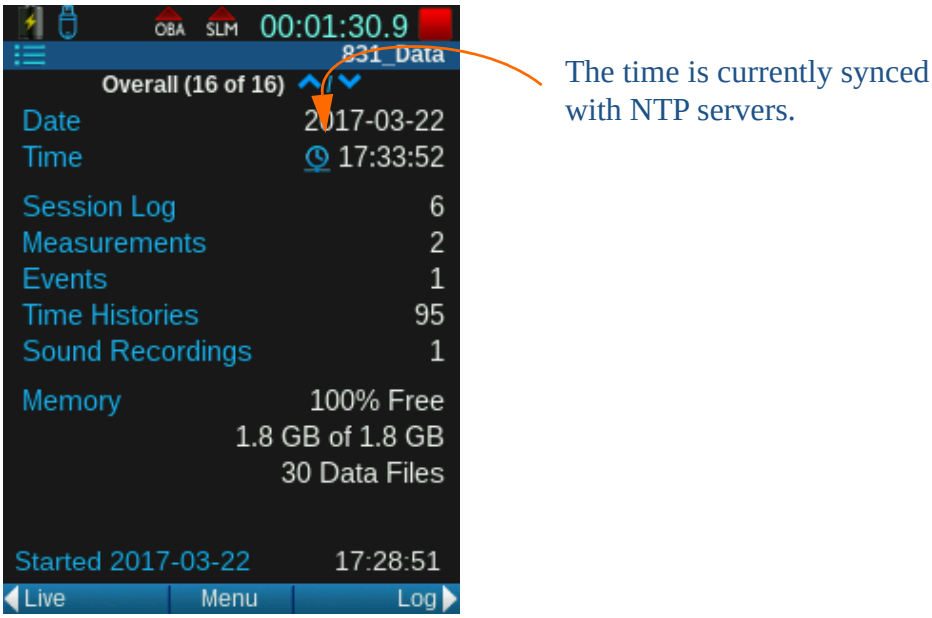
The metrics matrix page shows all the data the meter is always measuring in one page. You can use the ENTER key to move the cursor and enable more information to appear, like to see when a peak was measured.

FIGURE 4-21 Metrics Matrix page

4.4.15 Power Page

The power page on the Overall tab will show all the records for that measurement, in addition to the memory used on the meter.

FIGURE 4-22 Overall Power Page

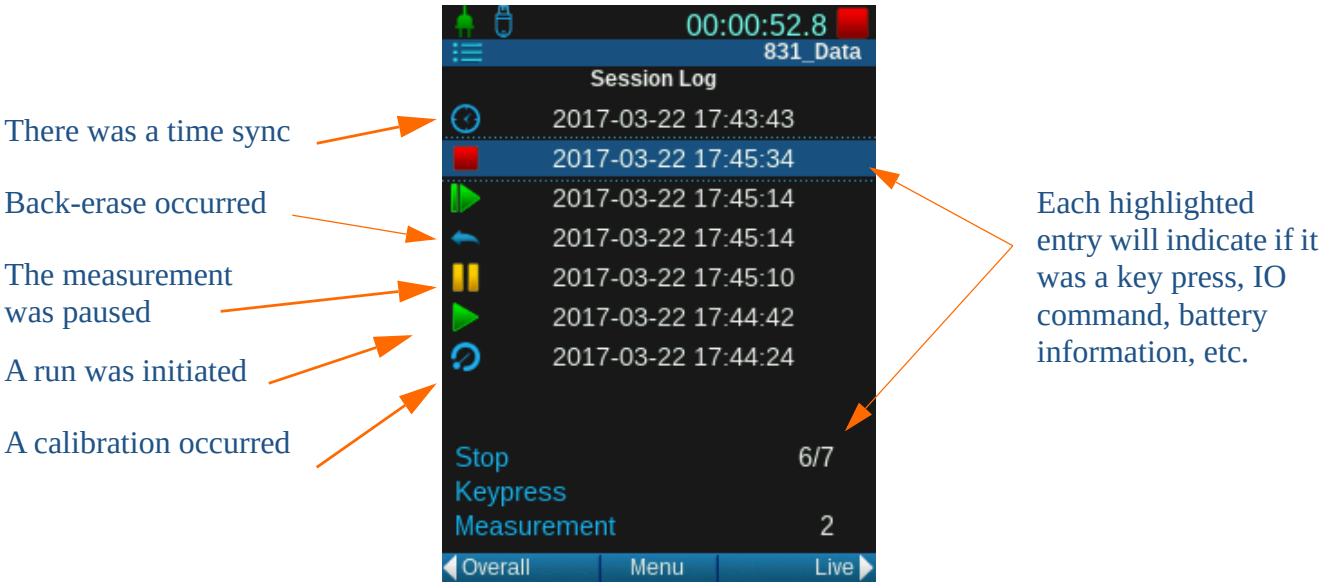


4.5 Session Log Tab

The Session Log is a record of data accumulation actions and indications of errors. Resetting and storing data will clear the session record. A time-stamped record is made for every Calibrate, Run, Pause, Resume, Stop, Voice Message and Sound Recording etc. action. The source responsible for each action is also recorded. Actions include the following:

- Key press
- Measurement Stop
- Measurement Run
- Measurement Pause
- Resume from Pause
- Measurement reset
- Calibration record and change
- Back-erase
- Marker set
- Timer
- GPS Time Sync
- Low battery
- Charging Stopped
- Out of memory
- Preamplifier connect/disconnect
- Create new average
- 831 INT-ET (Communication Failure)
- USB Connection detected
- NTP Time Sync
- System time change

FIGURE 4-23 Session Log



4.6 Adjust Graph Scale

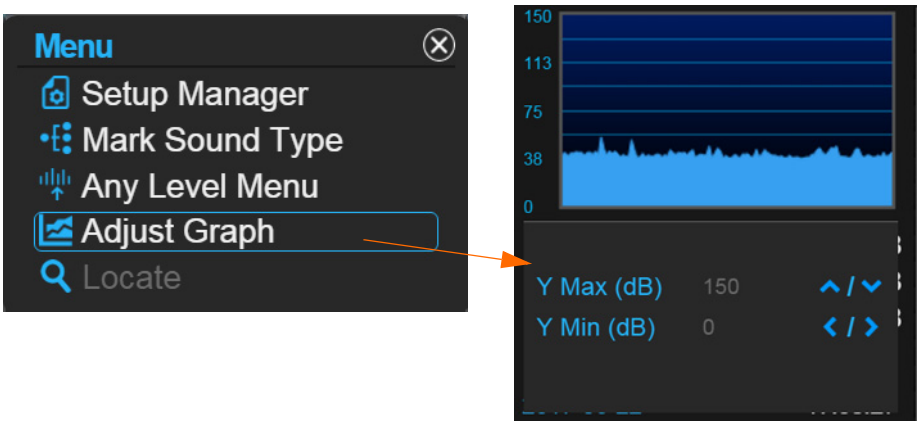
The default amplitude (dB) setting for the graphic display of sound pressure level versus time and frequency spectra are as indicated in the table:

Table 4.3 Default Settings for the Graphical Display

Level vs. Time Graphs	20 dB to 140 dB
Frequency Spectra, Normal Range	20 dB to 140 dB
Frequency Spectra, Low Range	-10 dB to 110 dB

To change the scaling of any one of these graphs, navigate **Menu** ⇢ **Adjust Graph**. Use your right and left navigation keys to select a new Y Max and Y Min, then press ENTER to save.

FIGURE 4-24 Adjust Graph



Module 5 Calibration

5.1 Calibration Overview

5.1.1 Sensitivity Determination

The primary role of sound level meter calibration is to establish a numerical relationship between the sound level at the diaphragm of the microphone and the voltage measured by the meter so that the sound pressure level can be read directly from the display of the meter in units of dB. The result of a calibration is the determination of the sensitivity of the meter, including microphone and preamplifier, typically in units of dB re 1V/Pa or mV/Pa.

5.1.2 Overload/Under Range Conditions

A secondary role of calibration is to determine the sound level which would overload the instrument and the minimum sound level which can be accurately measured, referred to as the under range level. This requires knowledge of the electrical noise levels of the microphone, preamplifier and the instrument circuitry.

5.1.3 Calibration Stability

The SoundAdvisor maintains a stable value of sensitivity over long periods of time. Significant changes in sensitivity, or a pattern of small but regular sensitivity changes, are indicative of problems with the measurement system. To assist you in identifying these situations, the SoundAdvisor provides two notifications:

1. Calibration History
Data and date/time of the ten most recent ten calibrations

2. Large Change Notification

During calibration, an automatic comparison is made between the sensitivity determined by the calibration and the previous value. A warning will appear when the difference between these two values exceeds 3 dB.

5.2 Calibration Displays

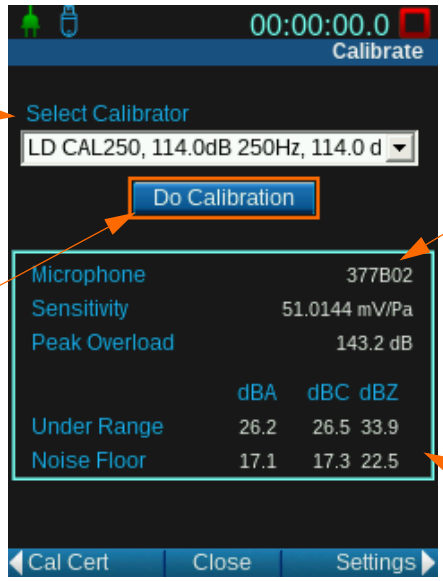
LEARN MORE Calibration Histories can be viewed in more detail using G4 LD Utility.

The Calibrate function has four pages: Calibrate, Calibration Settings, Calibration History, and Calibration Certification.

Before performing a calibration, visit all pages and ensure that the settings are correct, this will prevent any errors that may occur. To access the calibration functions on the SoundAdvisor, navigate **Tools Menu** ⇢ **Calibrate**.

5.2.1 Calibrate Page

FIGURE 5-1 Calibrate



Select the correct calibrator you will be using for the calibration.

Turn the calibrator on, place over microphone, and press **Do Calibration** to begin.

The microphone type, sensitivity, and peak overload values are available on this page

The under range and noise floor capabilities.

Under Range

The Under Range Level is the higher of the following:

1. Noise Floor plus 9.14 dB (under range shown when self noise contributes ≥ 0.5 dB to the readings).
2. Actual point where the log-linearity exceeds maximum permitted value.
   Except for very low noise level microphones, the under range level is usually determined by the noise floor plus 9.14 dB.

Noise Floor

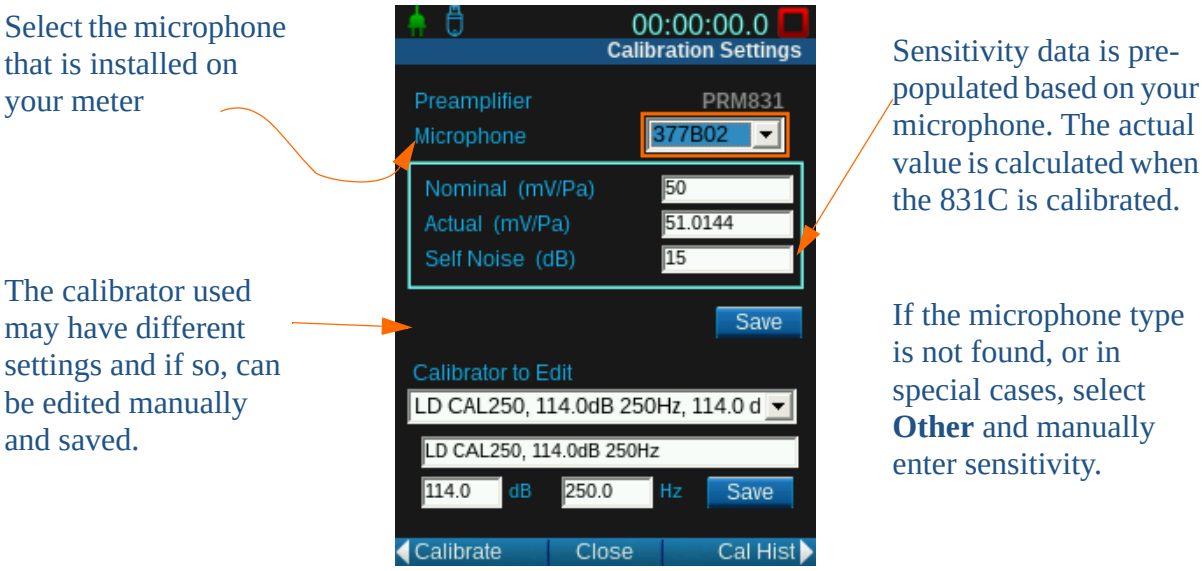
The noise floor is calculated as the energy sum of microphone self noise, preamplifier self noise and instrument self noise. The appropriate noise floor, as well as the nominal sensitivity, is computed automatically in the SoundAdvisor with the following preamplifiers and their commonly paired microphones:

- PRM831
- PRM2103
- 426A12
- ICP with ADP074

When a calibration has been performed using any of preamplifiers listed above, that calibration information is saved for that preamplifier. If the preamplifier is switched out and replaced with a different type of preamplifier, then the calibration information already saved for that new preamplifier type is used. As long as the same microphone is being used with that preamplifier, the calibration should be correct.

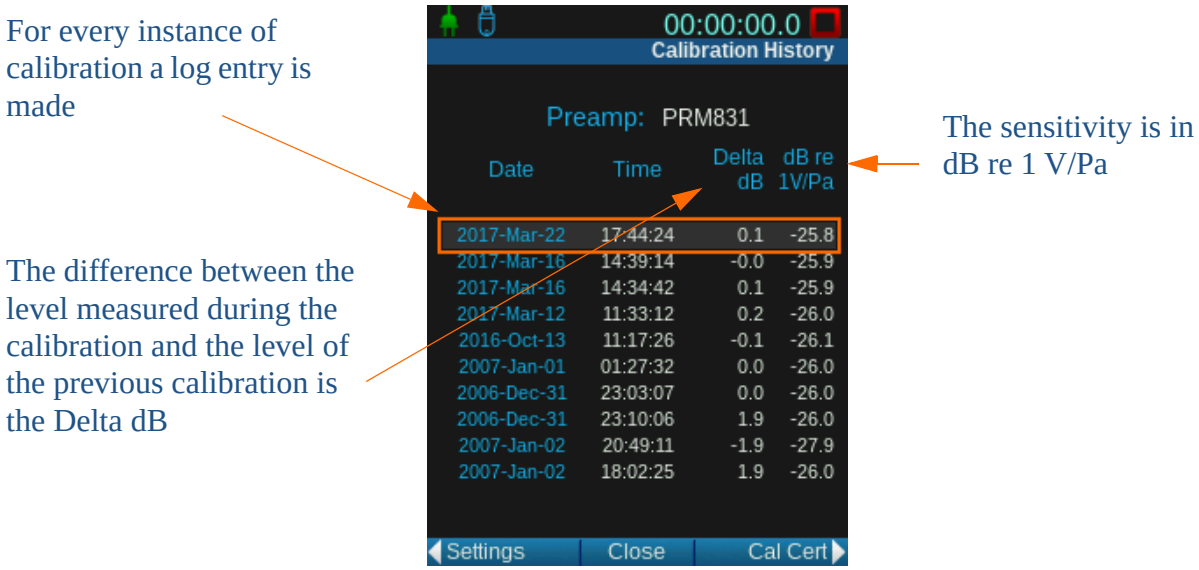
5.2.2 Calibration Settings

FIGURE 5-2 Calibration Settings



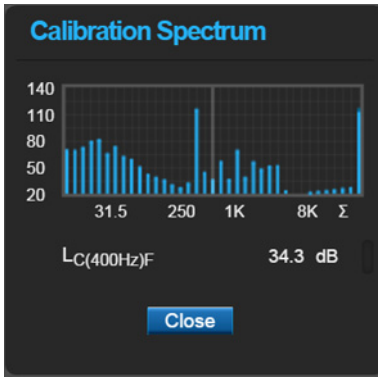
5.2.3 Calibration History

FIGURE 5-3 Calibration History



Select a log entry and a calibration spectra box will appear.

FIGURE 5-4 Calibration Spectrum



5.2.4 Calibration Certification

A certification interval of one year is recommended, but this can be lengthened, shortened, or disabled depending on the applicable requirements.

FIGURE 5-5 Calibration Certification

The date of the last certification and the due date for the next certification.

The certification interval can be changed to reflect your own certification time line.

A reminder will be displayed as a popup X number of days before the interval time has expired.

5.3 Choosing a Calibrator

TAKE NOTE If using a 1/4 inch microphone an adaptor ADP024 is required.

Larson Davis recommends the following calibrator for the SoundAdvisor:

- Larson Davis Model CAL200: 94/114 dB @ 1 kHz

The following instances will require a correction:

- Using Free Field Microphone
  - Check calibration data shipped with calibrator
- The calibrator and instrument are at a temperature other than room temperature (23° C) or not near sea level.
  - Check calibration data shipped with calibrator
- The instrument is used in one environment and moved to another (e.g. meter moved to or from 85 kPa static pressure elevation)
  - Calibration check will need to be done in new environment.

FIGURE 5-6 Larson Davis CAL200

5.4 Performing a Calibration

LEARN MORE Refer to the calibrators operating instruction for more information.

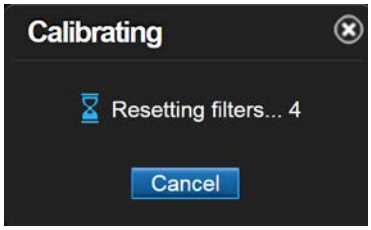
Step 1 Navigate **Tools Menu** ⇢ **Calibrate**.

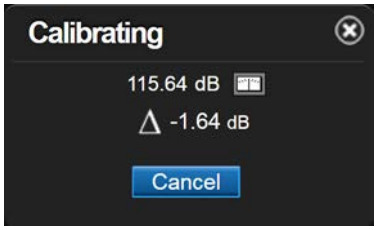
Step 2 Select calibrator from drop down menu that matches your own. The **Other** option can be configured in the “Calibration Settings” on page 5-3.

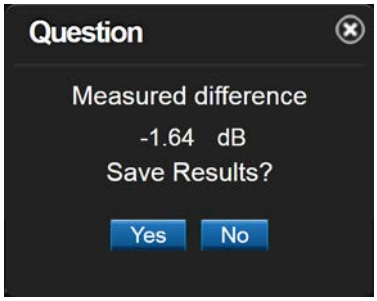
Step 3 Carefully insert the 1/2” microphone into the 1/2” microphone opening at the bottom of the calibrator.

Step 4 Turn calibrator **ON**. The calibrator will turn off after one minute, so use within that time, or press the button again.

Step 5 Select **Do Calibration** button on SoundAdvisor.







Step 6 Select **Yes** when complete.

The calibration is now complete.

If there is an error message, then the calibration is suspected to have been performed incorrectly. If an error message is received, check all settings and perform the calibration again, ensuring the calibrator is turned **ON**.

Module 6 Measurement Setup

6.1 Overview

The SoundAdvisor makes measurements based on values indicated in a **Setup File** (setup). The setups are managed in the **Setup Manager**.

TAKE NOTE Any setup can be created and stored on the SoundAdvisor or in G4 LD Utility.

This module describes how to edit the **Active** setup for quick use and how to create a user-defined **Setup File**.

The SoundAdvisor can make a number of measurements for your specific task by defining a setup, including the following types:

- L_{eq}, L_{max}, L_{min} corresponding to user-selected values of frequency weighting and detector
- L_{peak} and $L_{peak(max)}$ corresponding to a user-selected value of frequency weighting
- 1/1 and/or 1/3 octave real-time spectra
- Six values of Ln based on six user-selected values of the percentage parameter n
- Count of the number of times the levels (SPL and Peak) exceed user-selected values
- Sound exposure and sound exposure level data

6.2 Setup Manager

TAKE NOTE If the SoundAdvisor is connected to G4, when you load the Setup Manager, a dialogue box may appear “Setting in use by another connection. Continue?” If you create a setup or make changes on the meter, **Refresh List** in G4 to sync changes.

All the measurement settings can be found in the **Setup Manager**. It can be accessed by going to any menu and then selecting **Setup Manager**. The first page displays the **Setup Files** (setups) currently saved on the meter. **Active** and **Default** will always be present on the meter.

The settings are organized into tabs that can be accessed using the left and right softkeys from the main **Setup Manager** view. Navigate back to the Setup Manager page to be prompted to save or discard any changes made.

The first page of the Setup Manager shows all saved setup files currently on the SoundAdvisor. Any other setup files listed may be activated, edited, and/or deleted. To activate a setup file, select the setup file and choose **Set to Active**.

Before defining any settings or settings values in a setup, it is good practice to set the **Default** to **Active** to clear any user defined settings. See “Default to LD Default Setup” on page 6-9.

FIGURE 6-1 Setup Manager

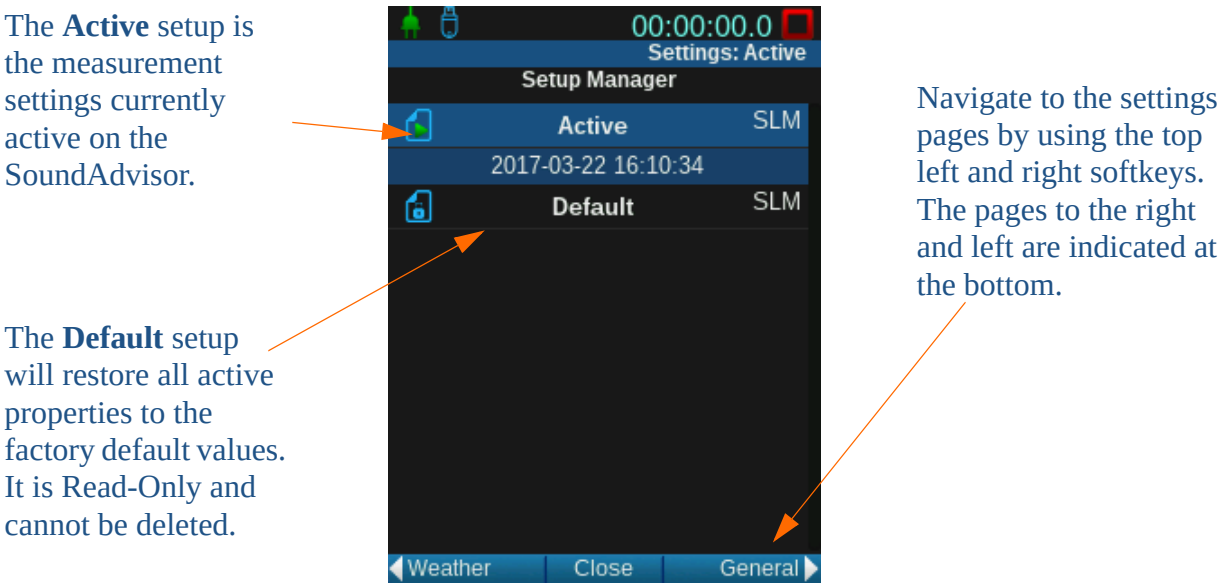
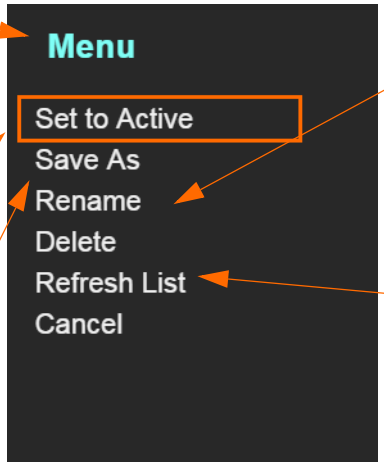


FIGURE 6-2 Setup Manager Menu

By selecting any of the setup files, a Menu will appear.

You can set any setup file to active, or to restore to default settings, set the **Default** setup to active.

This is how you create a new setup. First select **Default** then choose **Save As**.



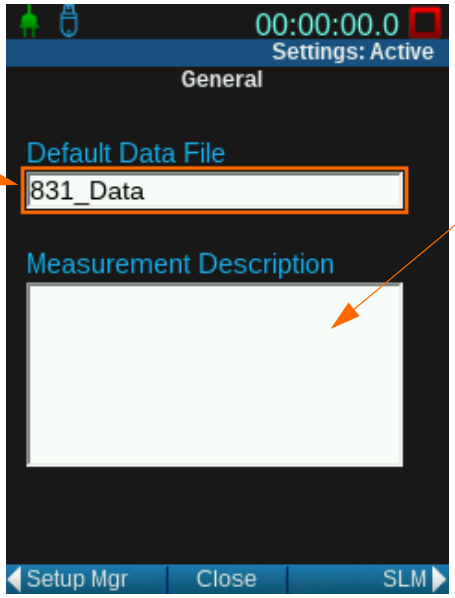
You cannot delete or rename **Active** or **Default**.

Any changes that are made but not shown may be a symptom of a sync issue, **Refresh List** will fix this issue.

6.2.1 General

FIGURE 6-3 Setup Manager: General Settings

Enter a file name that will appear in the file name field on the meter, and all measurement data files saved will have this name as a pretext.



Enter up to 250 characters describing the specifics of this measurement setup. The description will appear in the downloaded data files.

TRY THIS While on the meter, select a text field and a keyboard will appear to assist in entering text.

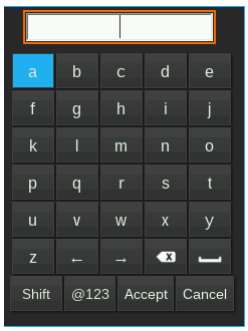
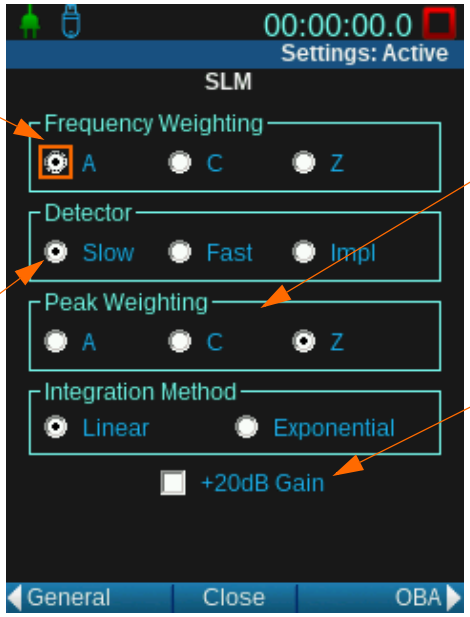


FIGURE 6-4 Setup Manager: SLM Settings

The weighting for the measurement can be made in A (default), C, or Z.

Detectors affect how quickly the sound is being measured. It can be changed to slow, fast, or impulse.



The default peak weighting is Z, but can be changed to A or C.

20 dB Gain can be checked when measuring low level sounds, or when the sound level is near background noise level. Uncheck to set gain to 0 dB.

The integration method has two options:

Linear

This is the default and most used integrating method. Linear integrates only the energy during a given period of time. It does not show a decay slope of a fast, slow, or impulse exponential detector.

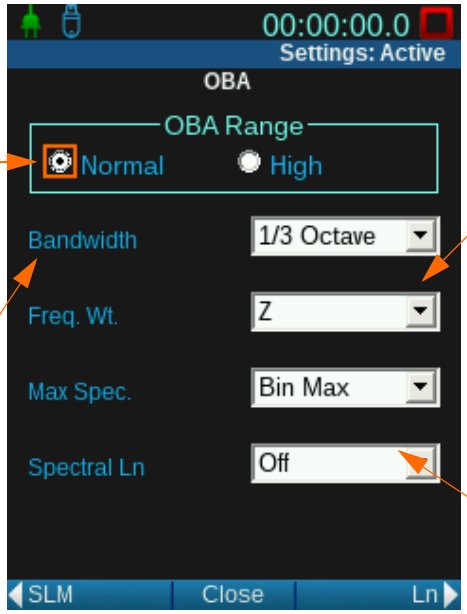
Exponential

Exponential integration shows a long decay of energy after an impulse, and it may hide small events or loud impulsive events. This integration is not commonly used. In addition, if performing time history measurements of 10 ms or less, linear must be used and not exponential.

Although the 831C measures levels at all three detector settings and frequency weighting settings, some features require a single combination. The level defined by the detector and frequency weighting selected is used for the computation of Ln, exceedances, sound exposure, and events.

6.2.3 OBA

FIGURE 6-5 Setup Manager: OBA Settings



Normal (120 dB full scale) and High (140 dB full scale)

Select 1/1 Octave bandwidth, 1/3 Octave bandwidth, or both simultaneously.

Choose the weighting for the 1/1 Octave and/or 1/3 Octave bandwidth frequency analysis: A, C, Z.

Spectral Ln values can be measured using 1/1 or 1/3 octave bandwidths. If both 1/1 and 1/3 are selected, Spectral Ln will only measure for 1/3 bandwidth.

TAKE NOTE For measurement range specifications, see Table A.5, “Table A.3 Octave Band Analysis 1/1 Octave Linearity Range,” on page A-9.

The Maximum Specification has two options:

Bin Max

When set to Bin Max, it is the maximum value which occurred during the entire measurement for that frequency band. Since individual frequency bands may reach their maximum levels at different times, this spectrum might be one which never occurred at any instant during the measurement period.

At Lmax

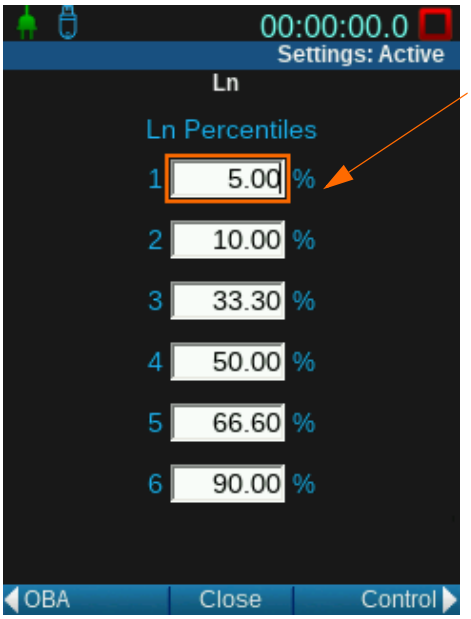
When set to At L_{max}, it is the instantaneous spectrum at the moment when the broadband maximum occurred (such as L_{ASmax}).

6.2.4 Ln Percentiles

The Ln value is the sound level that has exceeded n% of the total measurement time. For example, a value of n=90%, a displayed value for L90 of 35dB means that for 90% of the measurement period the dB level was at or above 35dB. These statistical values are commonly used to describe the characteristics of non-steady sound such as environmental noise.

In order to be able to calculate Ln values, the SoundAdvisor creates an amplitude distribution table over the range 0 to 200 dB, in amplitude increments of 0.1 dB. This data permits the calculation of Ln values for any value of n in the range 00.01 to 99.99%.

FIGURE 6-6 Setup Manager: Ln Percentiles Settings

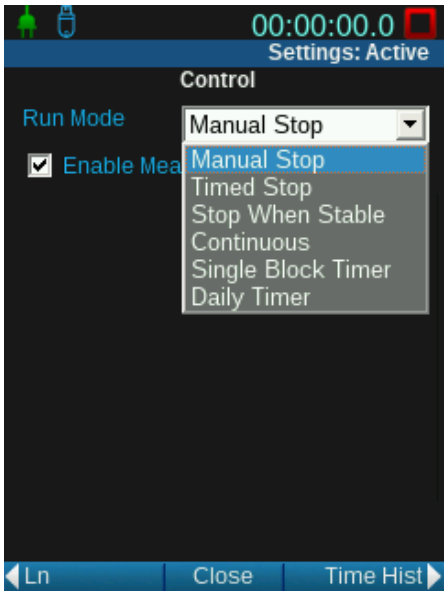


TAKE NOTE You can edit the values of Ln during a measurement and view it without stopping or pausing the run.

6.2.5 Control

The SoundAdvisor has six run modes to control the time duration of a measurement. The most simple are Manual Stop, Timed Stop, and Stop when Stable. The more advanced are the Continuous, Single Block Time, and Daily Timer modes.

FIGURE 6-7 Setup Manager: Control Settings



Manual Stop

The measurement is initiated manually.

Timed Stop

The measurement is initiated manually, and will stop automatically after a user-defined period of time.

Stop When Stable

Set a dB and time for a stability parameter and if detected, the measurement will stop.

Continuous

Upon booting up the meter, a measurement will automatically run for user-defined time and will store data at user-defined times. Continuous mode will resume automatically after 5 minutes into a Pause.

TAKE NOTE When combined with the Measurement History feature, these modes produce a sequence of measurements made and stored at regular time intervals.

Single Block Timer

One measurement will automatically start and stop at user-defined times.

Daily Timer

One or more measurements will start and stop at user-defined times, at daily intervals. This mode is often used to make a work area survey that follows a worker's daily schedule.

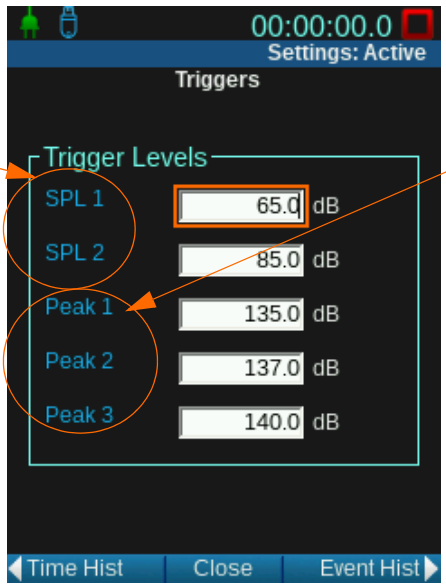
6.2.6 Triggers

Triggers specify the instances where the measured sound level exceeds a user-defined parameter. Triggers are used for events, exceedances, and alert emails.

The event is initiated when the sound level rises above the trigger level and ends when the sound level drops 2 dB below the trigger level. This hysteresis is to avoid the creation of multiple exceedances when the sound level is fluctuating about the threshold.

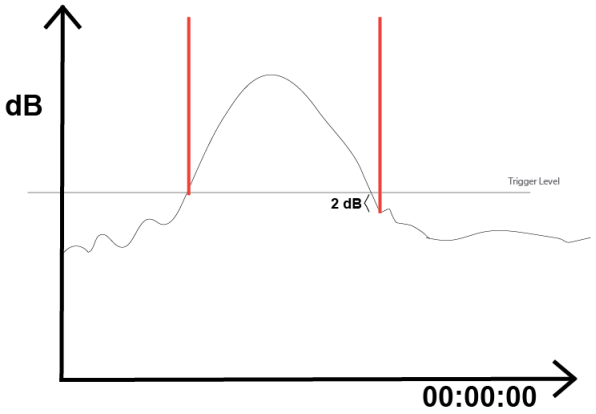
FIGURE 6-8 Setup Manager: Trigger Setting Page

SPL Trigger Levels: When the measured SPL (Slow, Fast, or Impulse) exceed the trigger level, the event begins. The SPL used is defined by the current weighting and detector.



Peak Trigger Level: Three levels can be set independently from the SPL triggers. The peak has a fast response time, these triggers can identify impulsive noises (e.g., gun shots) which would normally not be recorded.

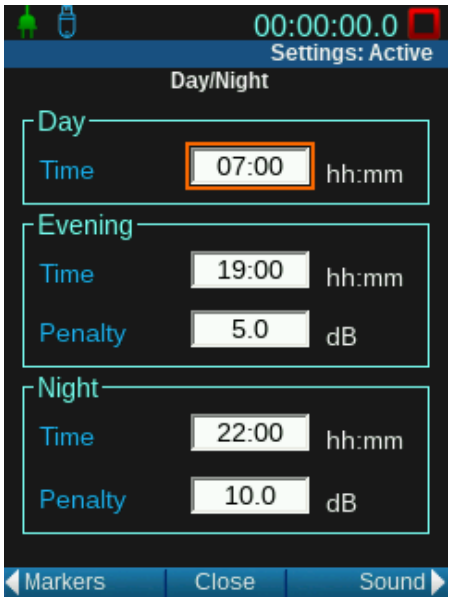
FIGURE 6-9 Triggers Graph



6.2.7 Day/Night

Although the standard ISO 1996-2:2007 specifies default values used in the calculation of LDEN, in practice the time values defining the day, evening and night periods may be changed. This is permitted by Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. It is important to verify prior to measurement that the values have been properly defined for your purposes.

FIGURE 6-10 Setup Manager: Day/Night Settings Page



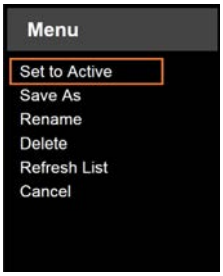
L_{DN}

The default day/night level LDN is defined by a specific formula, see “Day-Night Average Sound Level (DNL, Ldn)” on page C-3.

L_{DEN}

The default day-evening-night level LDEN is defined by a formula, see “Community Noise Equivalent Level (CNEL, Lden)” on page C-2.

6.3 Default to LD Default Setup



The **Default** setup is the factory measurement settings for the SoundAdvisor. It is read-only and cannot be deleted. If set to **Active**, it will restore the settings to the factory default values.

To set to active, navigate to the Setup Manager through either the Tools Menu or Main Menu and then select the Default setup by pressing enter. Then select **Set to Active**.

6.4 User Defined Setup

TRY THIS Use the Setup Manager in G4 LD Utility to manage setups, store setups, and transfer them to and from the SoundAdvisor.

TAKE NOTE If settings are changed in the Active setup, they will not be saved in your new setup. Change settings on your setup, then set to **Active** for optimal operation.

While measurements can be made by defining values on the **Active** setup, you can also save all your settings in a user-defined setup. The setup can be stored and called to **Active** at anytime. This setup can be transferred to a PC, and then transferred to a different SoundAdvisor as well.

Follow these steps to create a user-defined setup:

Step 1 Navigate to any menu on the SoundAdvisor (Tools or Main), then select **Setup Manager**.

Step 2 Select the **Active** setup.

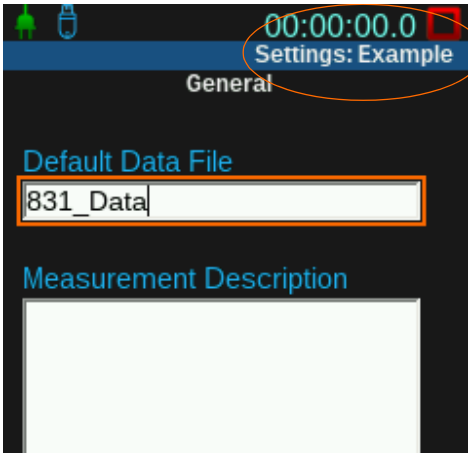
Step 3 Select **Save As**.

Step 4 Enter name of your setup. Select **OK**.

Step 5 Your setup can be made **Active** by selecting and **Set to Active**.

To know which setup you are making changes to, see the top right of the screen to see the name of your setup:

FIGURE 6-11 Settings: Setup Name



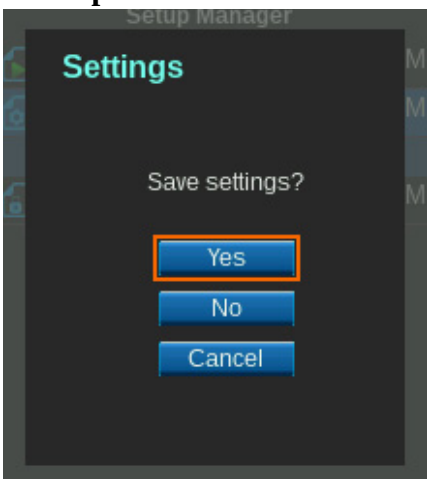
6.5 Exiting the Setup Manager

To exit Setup Manager, select **Close**.

TAKE NOTE If settings have been changed that you want to save, you will need to select **Close** to save.

A dialogue box will appear. Selecting **Yes** will save and close. Selecting **No** will not save, and return you to the main Setup Manager screen, where you can then choose **Close**. If you select **Cancel** you will return to the previous without saving or closing.

FIGURE 6-12 Setup Manager Save Prompt



Module 7 Making a Measurement

7.1 Overview

Making a measurement on the SoundAdvisor can be as simple as viewing a live reading of the area using the Big Digit display, or as sophisticated as setting it up with environmental accessories, deploying it in the field, and logging measurements when the sound level is above 80 dB over the course of many months in all weather conditions. For both tasks, understanding the basics of measurement making is essential.

Quick Measurement Steps:

Step 1 Power **On** the SoundAdvisor

Step 2 Navigate to **Overall** display.

Step 3 Press **Run** ▶/II.

Step 4 When finished, press **Stop** ■.

Step 5 Press **Store** ■ and save your data file.

7.2 Before You Start

Before performing a measurement, follow these steps to ensure the measurement is performed properly:

LEARN MORE Each step has a link to the first 6 Modules in the manual, and if read through, will lead to optimal performance of the SoundAdvisor.

Step 1 Connect preamplifier and microphone to the SoundAdvisor.
For complete instructions, see “Connecting the Preamplifier to SoundAdvisor” on page 3-4

Step 2 Turn Meter **ON** ⏻.
For complete instructions, see “Turn the SoundAdvisor ON” on page 3-8

Step 3 Navigate to **Setup Manager** and indicate or check all values desired for your measurement.
For complete instructions, see “Setup Manager” on page 6-2

Step 4 Calibrate the meter.
For complete instructions, see “Performing a Calibration” on page 5-6

7.2.1 Position the SoundAdvisor

The best position for sound recording is to mount the SoundAdvisor on a tripod. If held in hand, position your body away from and on an angle to the meter to minimize interference of the sound field at the microphone resulting from body reflections. The microphone should be angled away from the body.

If using a free-field microphone like the 377B02, the meter should be “pointed” at the sound source being measured.

FIGURE 7-1 Optimal Hand Held Position

Microphone Extension Cable

TAKE NOTE Always position the preamplifier/microphone in a way to minimize the effect of reflections on the sound field near the microphone.

A shielded microphone extension cable may be placed between the meter and the preamplifier/microphone if needed for the measurement position. No correction is necessary when using Larson Davis Model EXCXXX microphone extension cables in combined lengths up to 200 feet. XXX is the length in feet (XXX = 010, 020, 025, 035, 050, 060, 100 and 200) available.

Windscreen

Wind blowing across the microphone generates pressure fluctuations on the microphone diaphragm which can produce errors in the measurement. As a result, when performing measurements in the presence of low level airflows, it is recommended that a windscreen be placed over the microphone. Larson Davis provides the WS001 windscreen, a 3 1/2" diameter ball made of open cell foam which can be placed over the microphone and preamplifier.

FIGURE 7-2 Windscreen

7.2.2 Area Sound Field Check

Starting a measurement during a dramatic sound change can affect your data in an unwanted way. Before starting any measurement, check the area sound field by navigating to **Live** on the meter and ensuring your measurement is ready to begin.

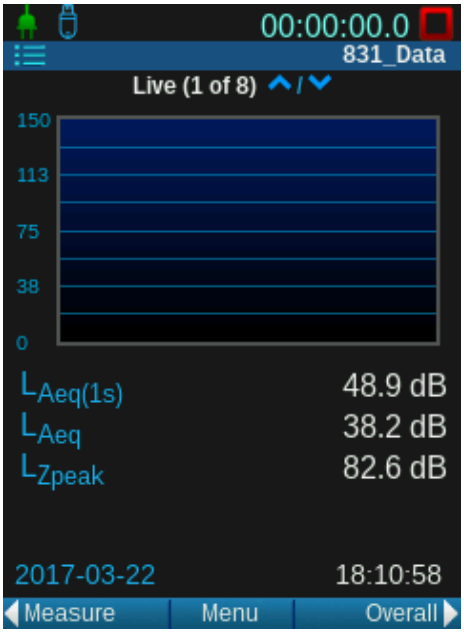
While every task is unique, the following scenario is standard for a basic measurement:

- The live sound is steady and within range. See "SLM Performance" on page A-2 and "Low Level Sound Fields" on page 7-8.

- The time reads 00:00:00.0 on both the **Live** and **Overall** displays. (Otherwise the previous measurement was not stored or reset.)
- The measurement status icon is set to **Stop**.

For more information, see “SLM Page” on page 4-2

FIGURE 7-3 Standard Area Sound Field Before Measurement



7.3 Performing the Measurement

LEARN MORE To learn more about the displays and icons, see “Displays and Icons” on page 2-6

At this point you are ready to begin a measurement.

Navigate to **Overall** on the SoundAdvisor and press **RUN**.

Keypad LED Indicators

When performing a measurement, the state of the SoundAdvisor is indicated in several ways: measurement state icon, **Overall** display animation, and the red and green illumination of the **STOP/STORE** and **RUN/PAUSE** keys.

Table 7.1 Measurement State LED Indicators

Measurement State	Red LED		Green LED	
Stopped	Winking	**-*-*	Off	
Paused	Flashing	*-*-	Flashing	-*-*
Running	Off		Winking	**-*-*
Waiting for valid data to begin running	Delayed wink	----*	Off	

The Measurement Range

The measurement ranges over which the SoundAdvisor meets the standards depends upon the selected frequency weighting. Measurements which include levels outside this range should not be considered accurate. An overload indication will appear when levels are above the range. However, it isn't recommended to rely on measurements where the levels are below the lower limit of the specified range.

Overload

As part of the calibration procedure, the overload level (dB Peak) and the under range sound pressure levels for A, C and Z weighting are determined for the instrument setup and microphone/preamplifier combination being used. When a signal from the preamplifier exceeds the calibrated input range of the SoundAdvisor, an overload condition exists. To learn more see "Input Overload Icon" on page 2-10

Under Range

When the signal from the preamplifier drops to the point where the noise level of the instrument and the preamplifier influence the measurement, an under range condition exists. To learn more, see "Under Range Icon" on page 2-10

7.3.1 Pausing the Measurement

TAKE NOTE A measurement may be paused and resumed multiple times.

At any time the measurement of overall data can be temporarily paused. During a pause, the run clock will not stop and instantaneous data will continue to be displayed on the **Live** display.

After a pause, press the RUN/PAUSE key to resume the measurement. The overall data will not be affected by any acoustic events occurring during the time period that the SoundAdvisor was paused.

Erase Previous 5-10 Seconds of Measurement

The SoundAdvisor has a back-erase feature that allows for a quick erase of the last 5 to 10 seconds of measured data. This feature is used to erase sounds that are recorded, but not wanted in the overall measurement.

Enable Back-Erase Feature

The back erase is visible on the Overall page, when the measurement is paused, and only after the measurement has run more than 5 seconds since the last run or resume.

The back erase feature is unavailable when any of the following have been enabled in the **Active** setup:

- Measurement History
- Event History
- Spectral Ln
- Event Sound Recording

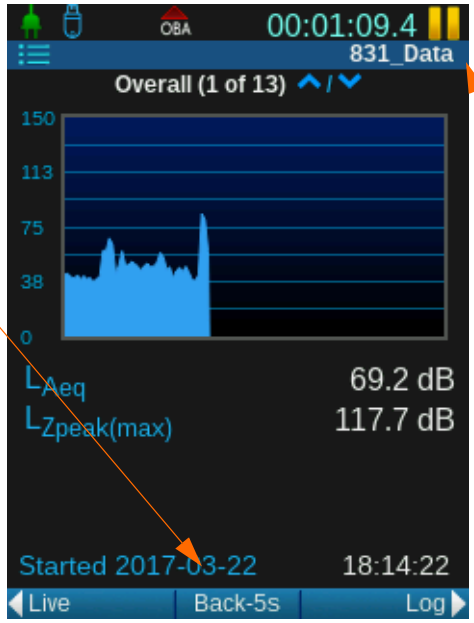
TAKE NOTE Pressing any other key besides the back-erase option will end the back-erase state.

FIGURE 7-4 Back Erase

The Back Erase feature is located where Menu typically is.

Undo appears as an option after a ten second erase.

After the first erase, you can erase an additional 5 seconds (not an additional 10).



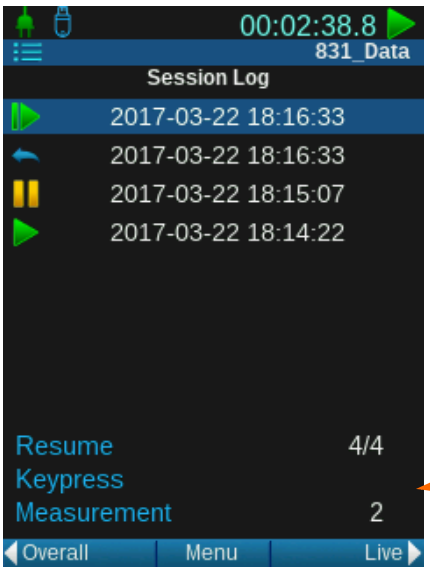
To close Back Erase, start a run again or **Stop** the measurement.

Session Log

The session log will have an icon to indicate data had been erased.

FIGURE 7-5 Back Erase in the Session Log

Back erase icon will appear when a part of the measurement was erased during a pause.



The amount of time that was erased will be shown in the information box.

Time History Records

The time history starts from the time the data was restored. The erased data will be marked as **Back Erase** as the record type.

FIGURE 7-6 Measurement Data for Back Erase

Record #	Date	Time	Record Type	Cause	#	TH Record
1	2016-10-03	17:16:53	Run	Key	1	0
2	2016-10-03	17:17:17	Pause	Key	1	0
3	2016-10-03	17:17:28	Back Erase	Key	-10	0
4	2016-10-03	17:17:28	Resume	Key	2	0
5	2016-10-03	17:17:55	Stop	Key	2	0

7.3.2 Resetting a Measurement

CAUTION The measurement data will be lost if not saved. Additionally, saved data will not be lost during a reset.

CAUTION If a reset happens while a measurement is running or paused, the SoundAdvisor will automatically stop the measurement for the reset, and data will be removed.

A measurement often needs to be reset when a radical noise event takes place that is unnecessarily recorded in your data. For example, an aircraft passing overhead when attempting to measure the background noise in a normally quiet area.

To reset a measurement in progress, stop the measurement then press the (RESET) key. This will erase all data previously measured and reset the run time clock to zero. A reset will not reset stored data files, only the current run. A reset can be initiated when the SoundAdvisor is running, paused, or stopped.

7.3.3 Stopping the Measurement

The SoundAdvisor can be stopped during a run or a pause, and will stop the run clock. Resuming a run will continue the overall measurement which has been stopped. The run clock will also begin again from the time indicated when the stop occurred.

7.4 Storing the Measurement

TAKE NOTE A measurement can only be stored when the SoundAdvisor is stopped.

TAKE NOTE You cannot save a file with the same name as a currently saved data file. If you want the new data file to replace the old data file, you will need to rename or delete the old file first. See “Measurement Data Files” on page 8-1

To store a measurement, follow these steps:

Step 1 Press the **Stop** button to stop the measurement.

Step 2 Press the **Store** button (unless your preferences are set to Auto-store, then the first Stop will store or prompt to store).

Step 3 You will be prompted to save the file. You can change the name of the data file by highlighting the name and pressing **Enter** (ENTER), and an editor will appear. When finished, select **Yes** to save.

7.5 Low Level Sound Fields

As long as the sound level being measured is within the measurement range shown in "SLM Performance" on page A-2, inherent (self-generated) noise and linearity problems can be ignored. It is possible to manually correct the measured RMS sound pressure levels for the typical inherent noise levels (see the noise floor specifications in "SLM Performance" on page A-2) as long as the difference between the measured sound level and the inherent noise level is greater than 3 dB. This is done by subtracting the inherent sound level from the total sound level using the following formula:

$$Lcorr = 10Log\left(10^{(Lmeas)/10} - 10^{(Linh)/10}\right)$$

where
Lcorr = corrected sound level

Lmeas = measured sound level

Linh = inherent noise level

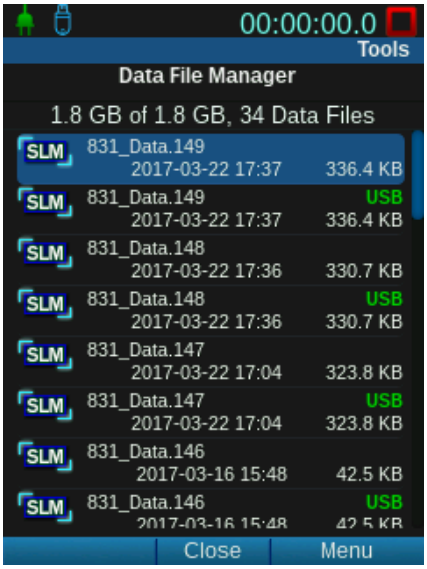
Module 8 Measurement Data Files

8.1 Overview

TAKE NOTE A basic measurement records about 42.5 KB.

For every measurement saved, a new data file is created on the SoundAdvisor. The SoundAdvisor saves up to 1.8 GB of data in internal memory. Additionally, an external USB drive can be used to store more data.

FIGURE 8-1 Data File Manager

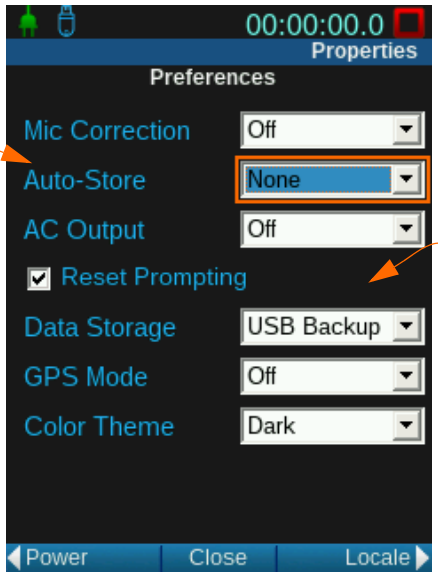


8.2 Data Storage Preferences

To indicate where measurement files are stored by default, navigate **Tools** ⇢ **System Properties** ⇢ **Preferences**.

FIGURE 8-2 Preferences Page

Every stop will store a measurement if Auto-store is set. You can be prompted to confirm the store, or it can be automatic.



Your measurement can store on the internal memory, USB drive, or both.

LEARN MORE To save a file on the USB drive see "Save File to USB Drive" on page 8-6.

8.2.1 SFTP and Cloud Storage

After a measurement data file is created, it can save on the meter, USB drive, and also upload directly to a remote storage service. Cloud storage is managed in **System Properties** ⇢ **Cloud Storage**. However, not all connections can access this page. Only through G4 LD Utility on the Setup Manager tab can this functionality be managed.

To authorize SFTP or cloud storage on the SoundAdvisor, see "Cloud Storage" on page 9-13.

8.3 Data File Manager

Data File Manager is a directory of all saved measurement data files.

FIGURE 8-3 Data File Manager

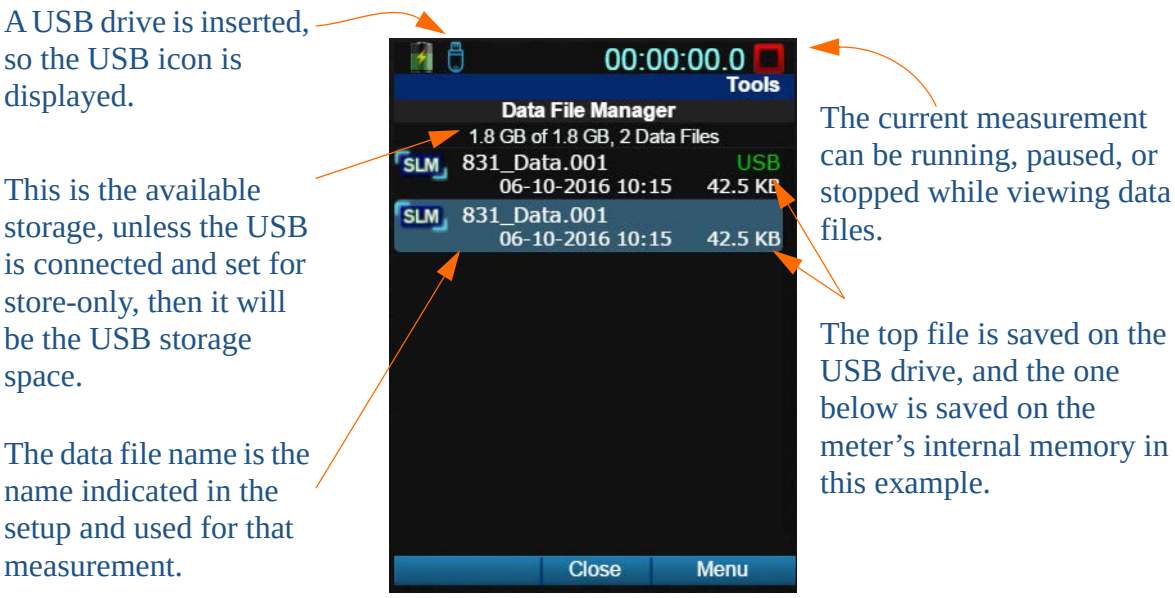
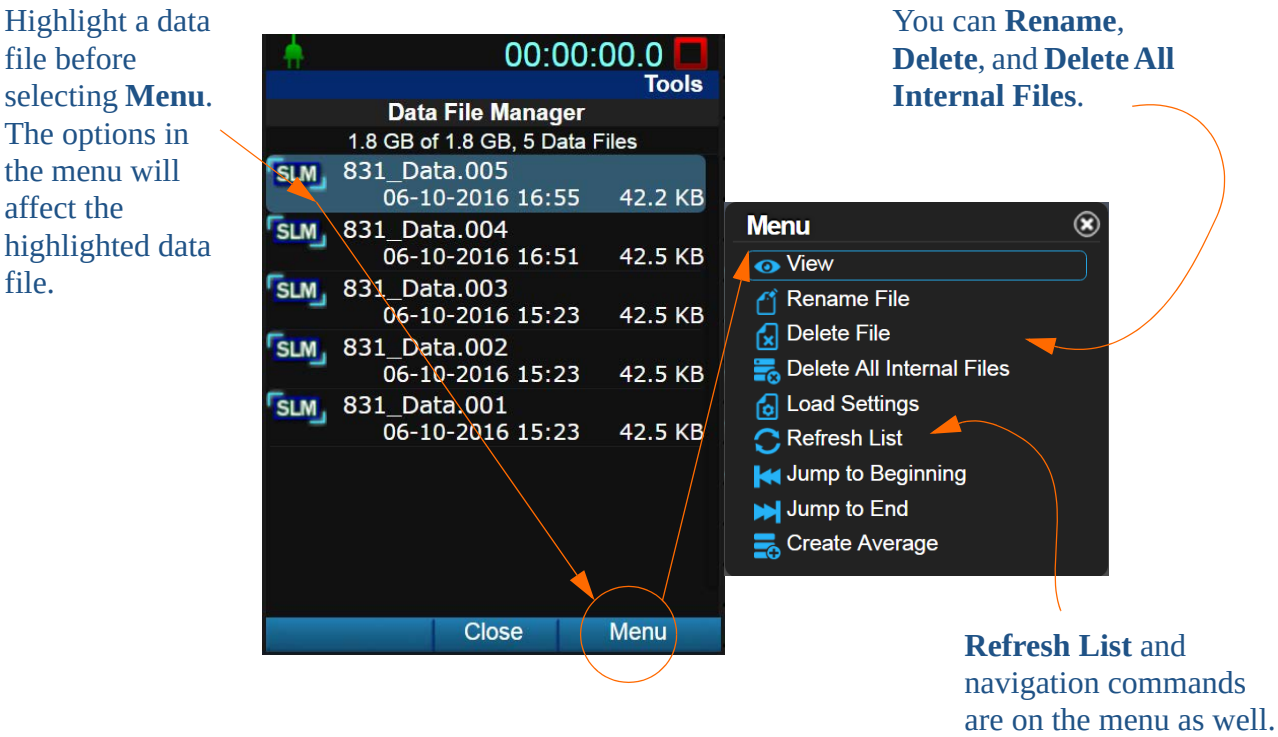


FIGURE 8-4 Data File Manager Menu



8.3.1 View Measurement Data File

Navigate **Menu** ⇢ **Data File Manager** ⇢ Highlight desired data file ⇢ **Menu** ⇢ **View**.

A read-only display of the **Overall** and **Session Log** tabs will show the data from that measurement. To indicate that you are seeing a measurement data file and not the live data, the data file icon will appear next to the data file name.

FIGURE 8-5 Data File Icon

8.3.2 Load Settings

A saved data file's settings can be loaded to the **Active** setup to be used for a measurement.

TAKE NOTE Ensure that you save your current settings before loading. You will lose any settings you had on the **Active** setup. On how to do this, see "User Defined Setup" on page 6-9.

Stop any measurement currently running or paused before loading the new settings. Navigate to **Menu** ⇢ **Data File Manager** ⇢ Highlight desired data file ⇢ **Menu** ⇢ **Load Settings**.

There is no indication that the settings were loaded, so it is encouraged to review the **Active** setup after loading. Close the Data File Manager, navigate **Menu** ⇢ **Setup Manager** then cycle through the **Active** settings.

8.3.3 Create Average

Create Average takes a saved data file and adds its average as an instance to the unsaved **Overall** measurement.

- Any unsaved measurement will be overwritten with the new average instance.
- You can add multiple files to the average and each appears as a new instance in the overall measurement. However, each file can only be added once.
- A measurement can run after the averages are loaded, though not recommended for averaging purposes.
- After data files are averaged, you can save the new data as a single file.

Follow these steps to create an average of your data file(s):

Step 1 Navigate to **Menu** ⇢ **Data File Manager**.

Step 2 Highlight desired data file.

Step 3 Select **Menu**.

Step 4 Select **Create Average**.

Step 5 Highlight a different data file.

Step 6 Select **Menu**.

Step 7 Select **Add to Average**.

Step 8 Repeat Steps 4-6 until all data files you want to average have been added.

Step 9 After all the data files are averaged, close the **Data File Manager** and navigate to the **Overall** display to view data.

Step 10 Save the new data file by pressing **Store** .

8.3.4 Limited Access

Step 11 The SoundAdvisor can be accessed by several different sources at once, however the Data File Manager can only be access by one user, one source at any given time. If another user is in the Data File Manager and a second attempts to open it, they will be prompted to end the first user's session to start their own.

8.4 USB Drive Storage

The SoundAdvisor has a built in USB port where an external memory drive can be inserted, and where measurement data files can be saved.

When the USB drive is inserted, the USB Drive Icon will appear next to the battery state icon on the meter.

FIGURE 8-6 USB Drive Icon

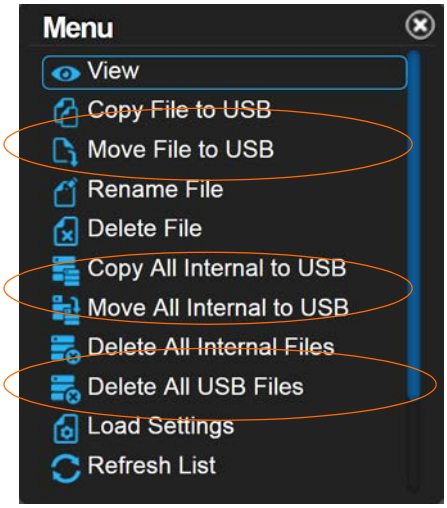
When USB is inserted, the Data File Manager shows a list of all the data files stored on this USB device. The files saved to the USB device are denoted by the green text **USB** over the file size.

If the "Data Storage Preferences" is set to **USB** only, this icon will appear:

FIGURE 8-7 USB Only Storage Icon

The **Menu** has additional items when a USB drive is detected.

FIGURE 8-8 Data File Manager USB Menu



If your settings indicate that the measurements be stored on a USB drive and no USB drive is inserted, this icon will appear. Files will save to the meter until you insert a USB drive.

If the USB drive is removed during a measurement, the icon below will appear and the measurement will end and data with that measurement will not be visible on the meter. When the USB drive is reinserted you will be notified that there is unsaved data and prompted to save or delete the measurement data. You cannot continue with that same measurement.

FIGURE 8-9 USB Not Inserted Icon

In the scenario where USB is set to primary, but was inserted during a measurement run-- the files will save internally until the next reset. This is indicated by the following icon.

FIGURE 8-10 USB Inserted During Run

8.4.1 Save File to USB Drive

Follow these steps to save a data file to a USB drive manually:

Step 1 Insert USB drive to the SoundAdvisor. Wait for the USB icon to appear on the top left of the screen (about ten seconds).

Step 2 Navigate to **Menu** ⇢ **Data File Manager**.

Step 3 Highlight desired data file.

Step 4 Select **Menu**.

Step 5 Select desired action:

- **Copy File to USB**
  - •The data file will be copied onto the USB drive. The original file will remain saved on the SoundAdvisor.
- **Move File to USB**
  - •The original data file will move onto the USB drive, and no longer in internal memory.
- **Copy All Internal to USB**
  - •All data files on the SoundAdvisor will be copied onto USB drive. The original data files will remain saved in internal memory.
- **Move All Internal to USB**
  - •All original data files on the SoundAdvisor will be moved onto the USB drive, and no longer be saved in internal memory.

Step 6 Check **Data File Manager** to confirm desired action was completed.

8.5 File Naming System

Measurement data files saved cannot be named the same, so there are two ways that files names are automatically generated on the SoundAdvisor. These naming conventions are a product of the run mode indicated in a setup. See "Control" on page 6-6.

The following table explains the data naming conventions used on the SoundAdvisor:

Table 8.1 Data File Naming Systems

Run Mode	File Naming Convention	Example	Additional Information
Manual Stop	"Default Data File".NNN	831_Data.001	The "Default Data File" can be changed on the **General** setup page. Once the numbers reach 999, the next data file will be .001.
Continuous	YYMMDDHex.LD0	1610110A.LD0	In this mode, the name will be a time stamp with the year, month, and day followed by a hex number that increments.

8.6 Out Of Memory

In order to ensure that all measured data can be stored, the SoundAdvisor will stop automatically when the amount of available memory drops to 10 MB. If the unsaved data is less than 800 kB, you can save it after the forced stop.

Download all data to an external drive or PC, or delete, before performing another measurement.

Module 9 System Properties

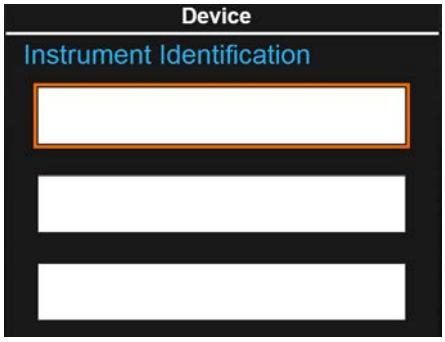
9.1 Overview

System Properties are control functions of the SoundAdvisor and not related to sound measurement or calculations, but rather instrument properties and instrument settings.

9.2 Device

Enter 30 characters per field of device information that will appear on the **About** page under the Tools menu. See “About System” on page 10-1.

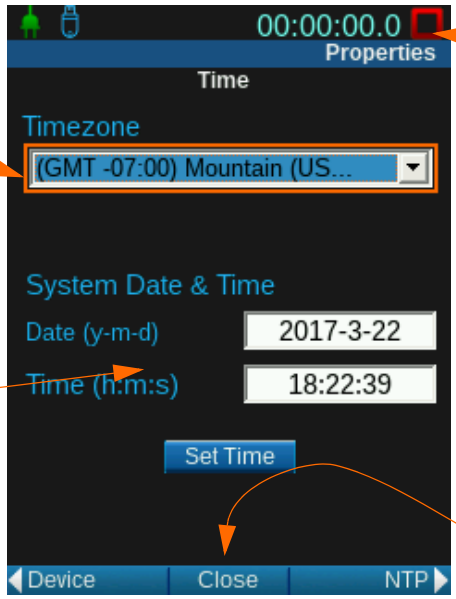
FIGURE 9-1 Instrument Identification



9.3 Time

There are several ways that you can update the time on the meter: GPS, NTP servers, PC clock, or manually set the time. This page is designed for the manual set, but is still automatic for daylight savings, just as long as your timezone is set accurately.

FIGURE 9-2 Set Date/Time & Timezone



Set your time zone first then select **Save**.

If you have NTP time it is not necessary to set this. If you want to manually set time and override any syncing, adjust this and select **Set Time**.

The time will not update if the meter is running or paused. Stop the measurement before setting time, otherwise the time will wait to update until the next **Stop**.

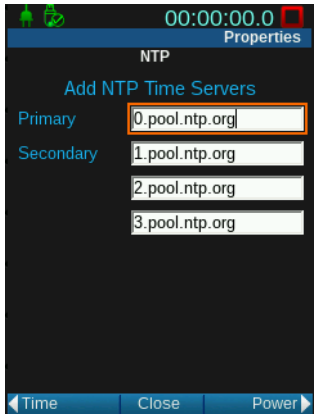
Close to save all changes.

TAKE NOTE To sync the SoundAdvisor with a PC time, use G4 LD Utility under the **Maintenance** tab of the **Meter Manager**. For more information refer to the **G4 LD Utility Reference Manual**.

9.4 NTP

The SoundAdvisor communicates with NTP servers to sync the internal clock with the most accurate time. This requires a valid Internet connection either through Ethernet, wireless modem, or WiFi.

FIGURE 9-3 NTP Servers



When your time has successfully been synced with NTP servers, the NTP icon will appear next to your time. See Figure 9-4 NTP Icon.

FIGURE 9-4 NTP Icon

If the time is synced with NTP and Internet connection is then loss, the SoundAdvisor will attempt to reconnect the servers for up to 2 1/2 hours. During this time the icon will remain. If the servers cannot be reached after that time, the icon will disappear.

9.5 Power

9.5.1 Battery Type

The SoundAdvisor can be powered by Nickel-Metal Hydride, Alkaline, or Lithium AA batteries. It should always be defined on this System Properties Power page to prevent damage to meter. This information is also used for the calculation of the battery life.

FIGURE 9-5 Battery Type

LEARN MORE To learn more, see “Battery Power” on page 3-4.

CAUTION Do not mix Alkaline and NiMH batteries.

CAUTION Do not mix batteries from different manufacturers

CAUTION Replace all four batteries when installing fresh cells

CAUTION The correct battery type must be specified, based on the battery type installed. Serious damage, injury, or fire can occur when the battery type is set to NiMH but Alkaline or Lithium batteries are installed because the internal charger will be enabled.

9.5.2 Charge

The SoundAdvisor can charge Nickel Metal Hydride batteries that are installed properly. Charge is an On and Off feature that is only available when you have Nickel-Metal Hydride batteries.

9.5.3 Auto-Off

Auto-Off time is the duration of time the instrument will stay on when there is no activity. Any of these actions will keep the meter on and reset the Auto-Off time:

- Button presses
- Running a measurement
- USB communications

Pressing the ⏻ (ON / OFF) key will return the instrument and the display to the state it was in when the Auto-Off time expired.

FIGURE 9-6 Auto-Off

9.5.4 Analog Power-Save

FIGURE 9-7 Power Save Icon

In the power save mode, battery power will significantly reduce by shutting down the analog circuitry and the signal processing activities.This feature is designed to shut down all data collecting processing to save on battery.

The analog power-save time is the duration of time the instrument will stay fully powered after a measurement has stopped. The analog circuitry, including power to the preamplifier will shut down when the instrument has been stopped for the time set. Starting a measurement or performing a reset will restore power to the analog circuitry and the instrument can run the measurement after a ten second delay.

Performing a calibration will also restart the analog power-save time.

FIGURE 9-8 Analog Power-Save

9.5.5 Backlights On

Backlights-On is the duration the SoundAdvisor display will be back lit after the last key press. Selecting **Always** on will increase power consumption.

FIGURE 9-9 Backlights On

9.5.6 Keypad Backlight

By toggling keypad backlights to **Off**, the blue LED under all the keys will turn off. The Red LED on **STOP/STORE**, and the green LEDs under the **RUN/PAUSE** and **ON/OFF** will remain on.

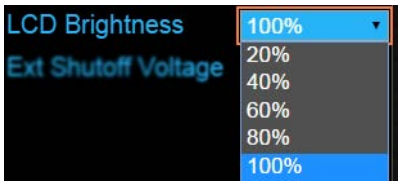
LCD Brightness

TAKE NOTE Using the backlight on bright setting will significantly increase power consumption and decrease battery life.

You can set the intensity of the backlight of the LCD screen to 100%, 80%, 60%, 40%, or 20%.

In the event that the battery life is below 10%, the SoundAdvisor will override the user setting and downgrade to 50% LCD Brightness, unless the user setting is below 50% brightness, then it will remain the same.

FIGURE 9-10 LCD Brightness



9.5.7 External Shutoff Voltage

To avoid damaging the internal batteries when the voltage of an external battery drops too low, you can set an external shutoff voltage. The SoundAdvisor will shut off automatically when the external voltage drops below this level.

LEARN MORE To learn more about this settings, see Table A.2 "Low Power At Boot-Up" on page A-4.

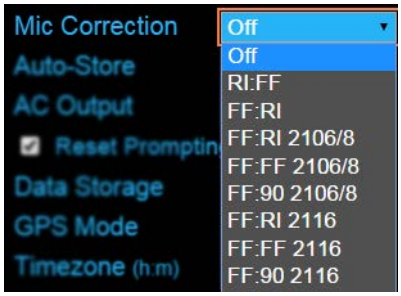
The default level is 10.8 volts, but you can enter a value in the range 10 to 25 volts if your battery usage is other than standard.

9.6 Preferences

9.6.1 Microphone Correction

When using a free-field microphone, a correction can be applied to provide a random incidence response or, when using a random incidence microphone, a correction can be applied to provide a free-field response.

FIGURE 9-11 Mic Correction



9.6.2 Auto-Store

The Auto-store feature applies to all measurements taken on the device.

None

All storage must be done manually, unless in the continuous daily auto-store mode indicated in a setup.

TAKE NOTE When a store occurs, whether prompt or auto, the measurement is reset at the time of the store.

Prompt

When the Stop button is pressed, or a stop occurs, you will be prompted to save the measurement data file.

Store

A measurement is automatically stored when a measurement is stopped.

Table 9.1 Run Mode Behavior for Auto-store

Run Mode	Type of Stop	Auto-Store Preference	
		Prompt	**Store**
Timed Stop	Timer-activated final stop	Prompts when timer is complete	File automatically stored
	Manually activated	No action performed	No action performed
Stop When Stable	Timer-activated stop	Prompts when stable	File automatically stored
	Manually activated	Prompts when stopped	File automatically stored
Single Block Timer	Timer-activated stop	Prompts when timer completes	File automatically stored
	Manually activated	Prompts when stopped	File automatically stored

Table 9.1 Run Mode Behavior for Auto-store

Run Mode	Type of Stop	Auto-Store Preference	
Daily Timer	Timer-activated stop	No prompt; File automatically stored	File automatically stored
	Manually activated	No action performed	No action performed

9.6.3 AC Output

The AC output is a full dynamic range AC/DC output. It does not drive a headset or headphones.

LEARN MORE Refer to "SoundAdvisor Model 831C Instrument Platform" on page A-1.

If the signal is set to **Off**, then the AC/DC output is not powered.

FIGURE 9-12 SoundAdvisor AC/DC Output Jack

9.6.4 Reset Prompting

If a measurement is made that is unwanted, you can press the Reset button to clear the unsaved data. By checking the Reset Prompt box, the meter will give you a dialogue box to confirm a reset before clearing the data.

9.6.5 Data Storage

This feature indicates where your data file will store:

TAKE NOTE If a USB drive is not inserted, data files will save onto the SoundAdvisor memory, regardless of indicated preference.

Internal

Data files saved manually and through auto-store will save onto the SoundAdvisor 2 GB memory (1.8 GB usable).

USB

Data files saved manually and through auto-store will save onto the inserted USB drive.

USB Backup

Data files will save on both the SoundAdvisor internal memory and inserted USB drive.

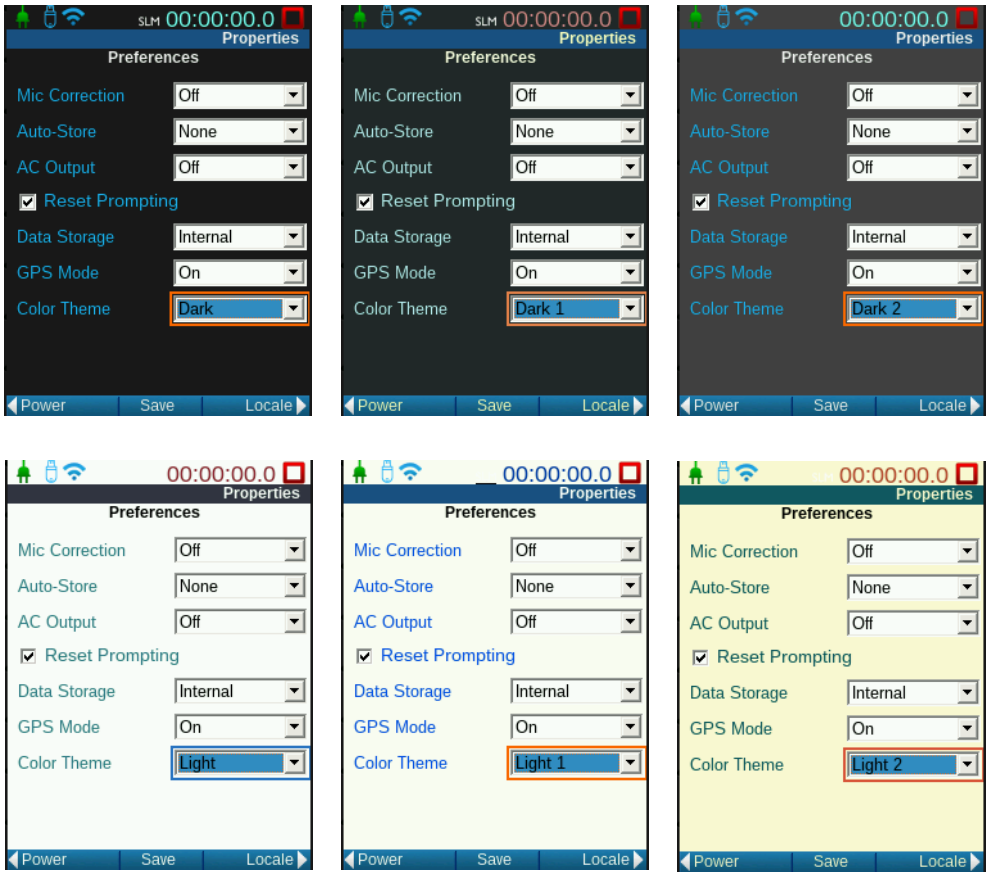
9.6.6 GPS Mode

GPS mode will need to be **On** if a GPS device is inserted in the Aux drive, and you wish to use it.

9.6.7 Color Theme

The SoundAdvisor LCD screen has six options for color themes: three light and three dark. The light screens are encouraged to be used when sunlight or outdoor settings are mostly present when operating the meter, and the dark themes are better for indoor or low light use.

FIGURE 9-13 Color Themes



9.7 Localization

Language

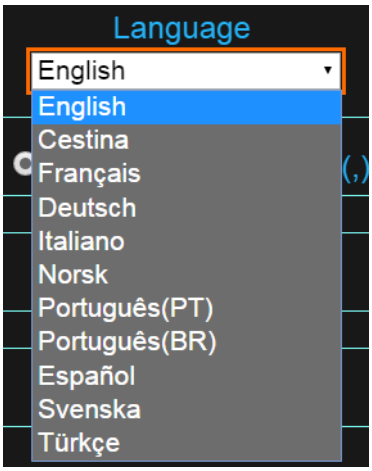
The SoundAdvisor has a built in language translation feature, where you can set your language preference.

The following languages are available:

- English

- Cestina
- Français
- Deutsch
- Italiano
- Norsk
- Português (PT)
- Português (BR)
- Español
- Svenska
- Türkçe

FIGURE 9-14 Language Selection



Decimal Symbol

Depending on your preference, the decimal symbol on the units of measurement can be a period or a comma. Select the radio button of the desired symbol, and save to make changes.

Date Format

The SoundAdvisor has two date formats day-month-year and year-month-day. Both options are in two number digit displays. For example: 2017-02-14. Select the radio button of the desired format, and save to make changes.

Units

The default units for the SoundAdvisor is SI (International System of Units), however you can change this to English units. Select the radio button of the desired unit, and save to make changes.

9.8 Displays

When you power your meter on, the first display page defaults to the profile page of the **Live** display. This can be changed on the Displays page.

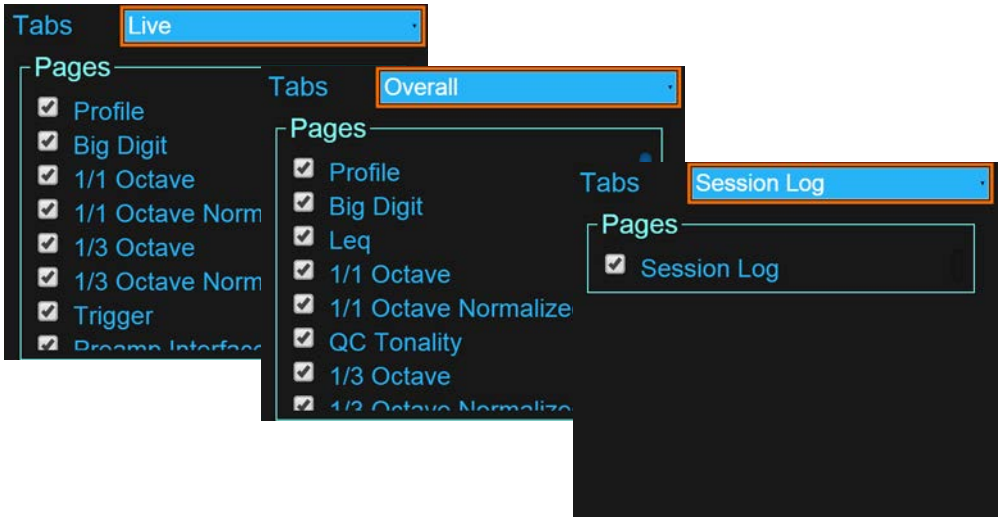
Start

Start refers to the display that is shown first when you boot up the SoundAdvisor. You can choose any of the main displays available to you. Select your option from the drop down box, save, and close. The next time your meter powers on, you will see your start display.

Tabs & Pages

Each **Tab** chosen will show a new list in the **Pages** section. You can check or uncheck pages depending on what you want shown on the meter. This feature will hide unwanted page displays, not delete them.

FIGURE 9-15 Display Options



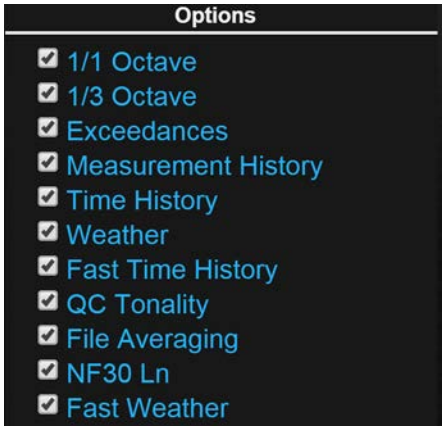
9.9 Options

TAKE NOTE Default options will not appear in the list as they cannot be disabled.

You can enable or disable options installed on the SoundAdvisor. Disabling an option does not delete the option, and it can be enabled at anytime.

A reboot is required after any changes are made.

FIGURE 9-16 Options Enable/Disable



9.10 Network

See “Communications & WiFi” on page 13-1.

9.11 Email

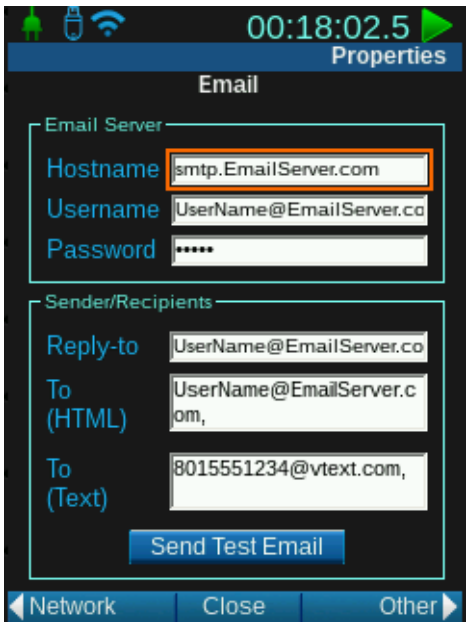
TAKE NOTE Email alerts can be enabled on a Event History setup, see “Setting up the Measurement” on page 17-1. Once enabled, the email preferences from System Properties will be used for the alerts.

The SoundAdvisor with a network connection can be setup to send email and/or text alerts for sound events and other features. When SPL 2 trigger is exceeded during a measurement, as well as noise that exceeds the PEAK 3 trigger will initiate an alert. Email is also used for cloud storage notifications, see “Cloud Storage” on page 9-13.

To set up email alerts, follow these steps:

Step 1 Navigate **System Properties** → **Email**.

FIGURE 9-17 Email



TAKE NOTE The email server the SoundAdvisor connects to needs to be SMTP server with TLS authentication (using port 587). When setting up an email account through a public server (i.e. Gmail or Yahoo), you may need to enable SMTP access for the account, typically through secure login settings. To avoid spam filters, add the host email addresses to your contact list.

Step 2 Enter an email hostname, username, and password.

Step 3 Enter the email addresses the recipients will reply-to.

Step 4 Indicate the email address for the text alert. For this field, the phone number @ carrier email address will be accepted. For example, 80155555555@vtext.com will send a text message to a Verizon Wireless mobile device.

Step 5 Send a test email.

If an email or text does not deliver within a few minutes of initiating a test, check to see if your meter is connected to the Internet and a proxy is not filtering your alerts. Contact your local IT support for more help.

Step 6 **Save** and **Close**.

9.11.1 Enable Email Alerts for Noise Events

Step 1 Enable email alerts on an **Event History** setup, and make active. See "Setting up the Measurement" on page 17-1.

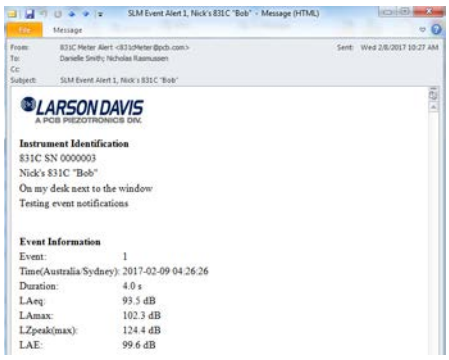
Step 2 Indicate your SPL 2 Trigger Level. This decibel, when exceeded during a run, will trigger an email alert. See "Triggers" on page 6-7.

Step 3 To send a sound recording of the exceedance, see "Event Sound Recording" on page 18-4. Select **Save Event Sound**. A .wav file will be created when an event occurs.

HTML Emails will have the event sound recording attached unless:
1. Event sound recording is disabled.
2. Current sound recording is not finalized when the Event ends.
3. Event sound recording is too large to attach to the email

TAKE NOTE The alert will not be sent until the snapshot time and compression time has expired after the event has triggered. There may be additional time depending on your local proxy.

Step 4 Run a measurement. When the SPL 2 or Peak 3 Triggers are exceeded, an email will be sent with a sound recording attached to the recipients you have indicated.



9.12 Cloud Storage

After a measurement data file is created, it can save on the meter, USB drive, and also upload directly to a remote storage service. Cloud storage is managed in **System Properties** → **Cloud Storage**. However, not all connections can access this page. Only through G4 LD Utility on the Setup Manager tab can this functionality be managed.

To authorize communication from the SoundAdvisor to a SFTP or Dropox account, follow these steps:

TAKE NOTE This function can only work if the SoundAdvisor has access to the internet via WiFi or Ethernet.

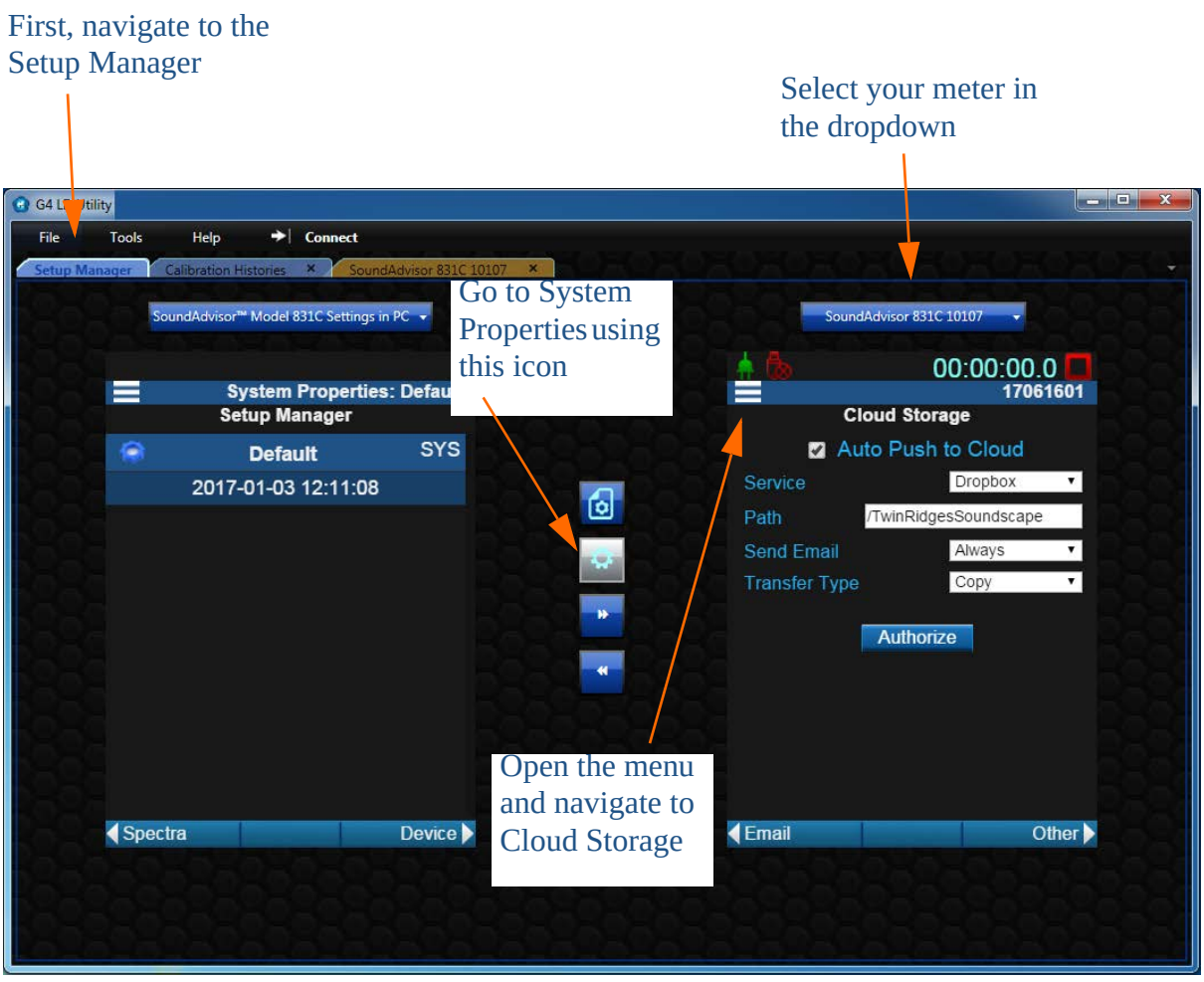
Step 1 Launch G4 LD Utility.

Step 2 Connect to the meter with either USB or TCP/IP. See “Connecting SoundAdvisor to G4” on page i-3.

Step 3 Navigate to the Setup Manager tab. Open your meter’s System Properties.

Step 4 Using the bottom arrows or the menu, navigate to **Cloud Storage**.

FIGURE 9-18 G4 LD Utility - Cloud Storage



Step 5 Select **Auto Push to Cloud** to activate this feature.

Step 6 Choose the service you want to use: SFTP or Dropbox.

Step 7 **Dropbox**: Indicate the file path you want your data files to save. Do not use special characters.
SFTP: Indicate the host IP followed by the port number. You can leave the port off and it will default to port 22. Enter your username and password.

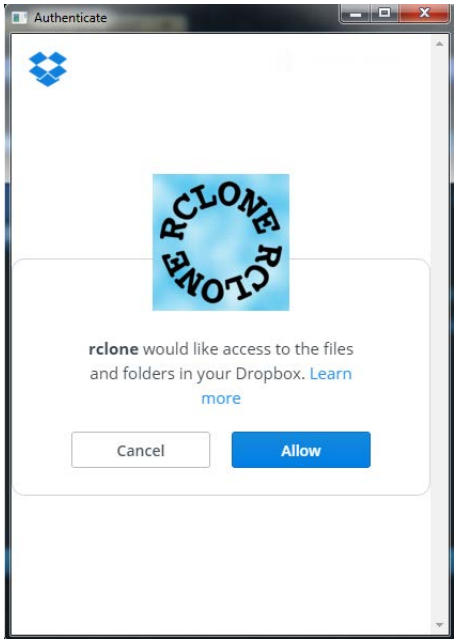
Step 8 If email is setup on the meter, choose to send an email Always, Never, or On Failure. See "Email" on page 9-11.

Step 9 Indicate a transfer type; Either Copy or Move the data file. Copy will continue to save on the USB or meter, as indicated. See "Data Storage Preferences" on page 8-1.

TAKE NOTE You only need to authorize an account once. If you wish to change the account, you will need to reauthorize. Changing a folder path does not necessitate reauthorization.

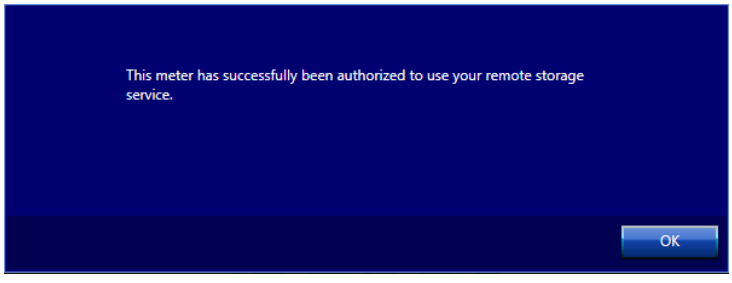
Step 10 Select **Authorize**.
Dropbox: A separate window will appear. Connect to cloud storage account. After login, you will need to authorize rclone to access the folder. By allowing this, the SoundAdvisor will be able to upload data files into the path indicated.

FIGURE 9-19 RCLONE Access



Step 11 When finished, you will receive a success message.

FIGURE 9-20 SFTP Success



9.13 Other

9.13.1 Logic I/O

FIGURE 9-21 Logic In Logic Out

Logic In

TAKE NOTE The CBL170 I/O Interface Cable can be used to make an electrical connection to external devices.

The Logic Input line receives a signal from an external device, which can initiate one of these actions by an external trigger:

Run/Stop

Event

You will need Time History (831C-ELA) option on your meter, and have it enabled for that measurement.

Marker

You will need Time History (831C-LOG) option on your meter, and have it enabled for that measurement. Marker #1 will be initiated for the **Recording Time** indicated in the setup, even if there is no sound recording. If sound recording is enabled for Marker #1, a sound recording will occur at this time as well.

Logic Out

The Logic Out line transmits a signal to an external device, defining one of these states:

Run State

When the Logic Out is set to Run State, then the output will be driven high when the SoundAdvisor is running and will be driven low when it is stopped.

LEARN MORE To learn more about defining event triggers, see “Triggers” on page 6-7.

Event

You will need Time History (831C-ELA) option on your meter, and have it enabled for that measurement. When the Logic Out is set to Event, then the output is activated with an event trigger.

Marker

You will need Time History (831C-LOG) option on your meter, and have it enabled for that measurement. When a marker is initiated, the output is activated for the **Recording Time** as indicated in the setup.

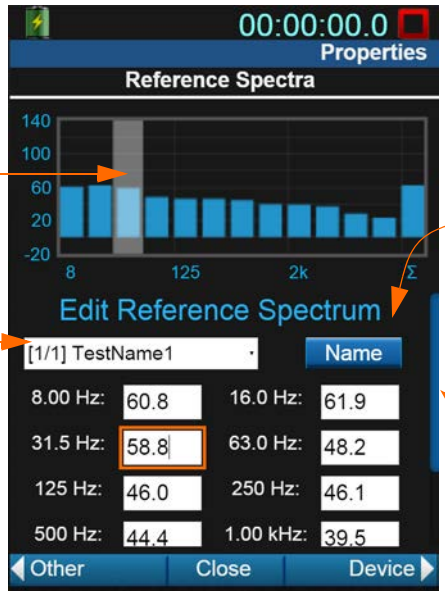
9.13.2 Heater

If a heater is detected as part of a preamp, this drop down will be enabled, and you can choose to have the heater turn on automatically, always be on, or always be off.

9.14 Set Reference Spectra

When you view the normalize octave band data, you can choose a negative or positive A or C weighting, or you can define up to four unique reference spectra. These references can be seen on the Live "Normalized Octave Band" on page 4-4., Overall "Normalized Octave Band" on page 4-9., and Overall "1/3 Spectral Ln" on page 4-10..

FIGURE 9-22 Set Reference Spectra



Use any of the navigation keys to highlight a band, press ENTER enter to bring up the keyboard to define that octave.

Selecting **Name** allows you to rename any of the user-defined reference spectrum.

This drop down takes you to all four 1/1 Octave and four 1/3 Octave band options, and you can indicate the frequency for each selection.

There are twelve octaves that can be defined for 1/1 Octave, and 36 for 1/3 Octave, and as you navigate through the list, the screen will scroll down.

Module10 About System

TAKE NOTE No user input is required on these pages.

System information about the SoundAdvisor can be found in the **Tools** menu. It includes the following:

- Instrument Information
  - Serial Number
  - Manufactured Date
  - Firmware Version
  - Preamplifier inserted
- Standards
  - ANSI
  - IEC
- Installed Options

TAKE NOTE To purchase more options on the SoundAdvisor, “Contact Larson Davis” on page i-2.

FIGURE 10-1 Tools Menu

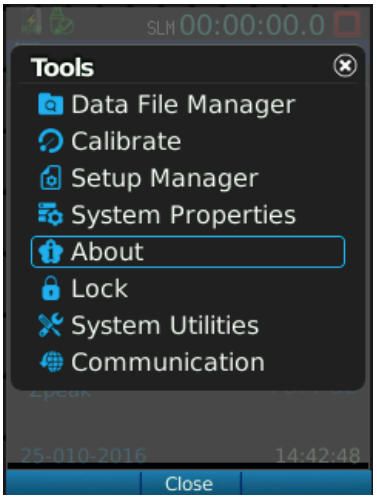
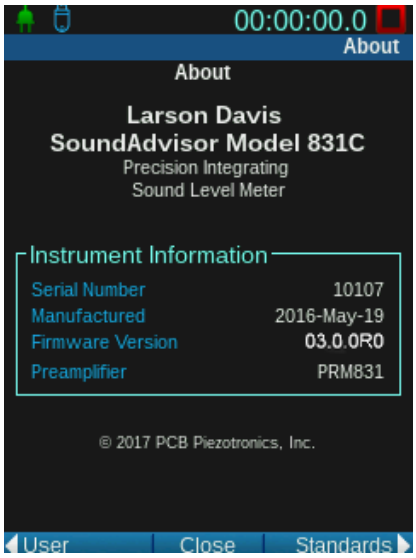
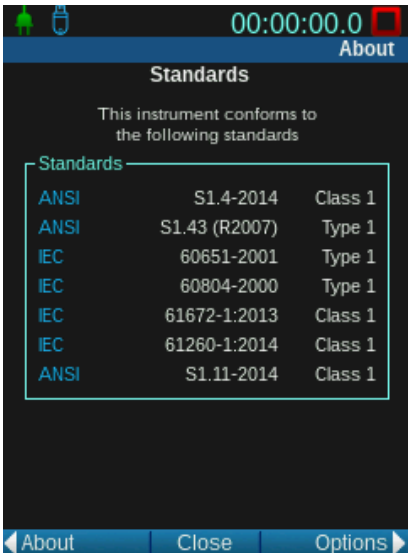
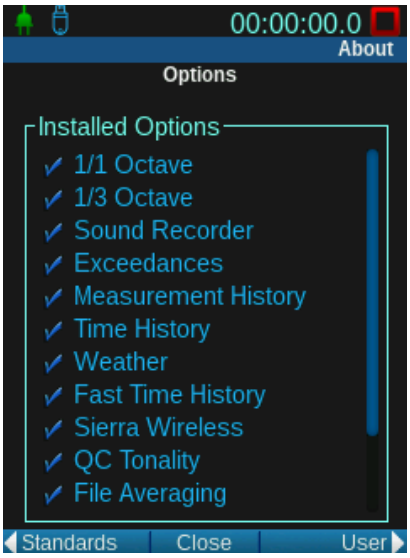


FIGURE 10-2 About







Module11 Lock

11.1 Overview

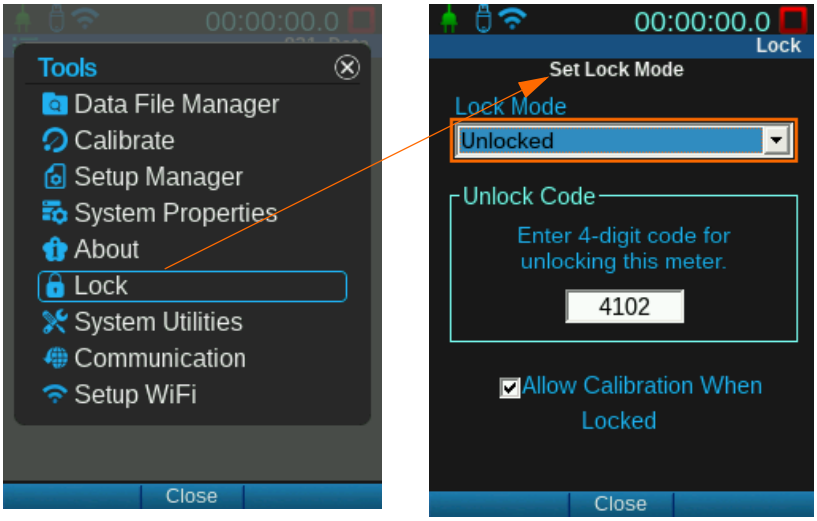
To prevent unauthorized use or tampering with measurements and data, you can lock the SoundAdvisor. There are three options of tamper-proof security provided by this feature.

11.2 Lock Meter

To lock your meter follow these steps:

Step 1 Navigate **Tools** ⇢ **Lock**.

FIGURE 11-1 Tools Menu



TAKE NOTE Record your unlock code in a secure place, in order to recall the code when needed. Your code can also be retrieved via G4 LD Utility. Navigate to Maintenance tab and choose **Lock/Unlock**.

Step 2 Choose **Lock Mode**.

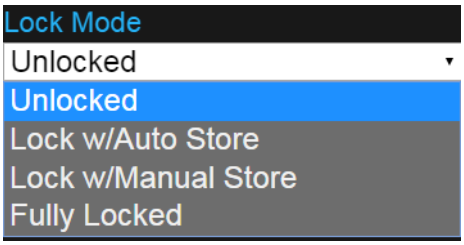
Step 3 Enter unique code of 1-4 digits. The first digit should not be a zero since any leading zeros will be ignored. This means that a code indicated as “0123” will be saved to the meter as “123”.

Step 4 Check or uncheck **Allow Calibration when Locked**.

Step 5 Close and Save.

11.3 Lock Modes

FIGURE 11-2 Lock Mode Menu



There are three lock modes each with different degrees of security:

Refer to Table 11.1 on page 11-4 for constraints on the various lock modes.

Unlocked

The SoundAdvisor is completely unlocked and you can access all features, data displays, and change any setting.

Lock with Auto Store

LEARN MORE To learn more about **Big Digit**, see “Big Digit Sound Level” on page 4-3.

The data display will default to **Big Digit** and you cannot navigate to any other views.

A measurement can run, stop, and store in this lock mode. Measurement cannot be paused in this mode. When the measurement is stopped, a dialog box will appear, “Measurement OK?” with Yes and No buttons. Selecting Yes will save the measurement with an auto-generated file name. Selecting No will cause a reset without saving.

If System Properties indicates an autostore prompt, you will be prompted to change file name and save file. If you select No, the measurement will stop and data will remain on the meter.

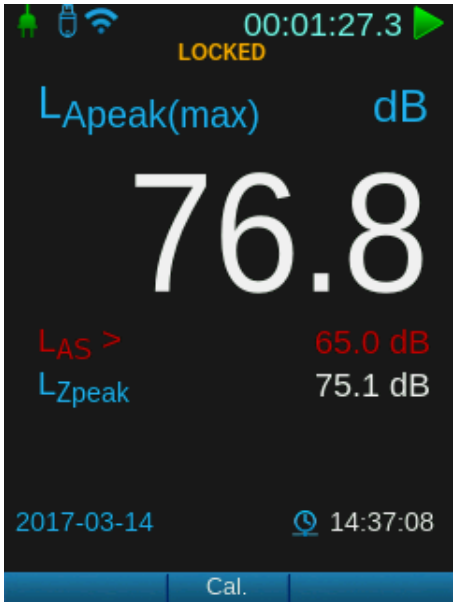
Lock with Manual Store

The data view will default to **Big Digit** and you cannot navigate to any other views.

A measurement can run, stop, store, and reset in this lock mode.

If you’ve indicated an auto-store mode in your current setup file, it will run and store as indicated in the setup.

FIGURE 11-3 Locked with Auto/Manual Store

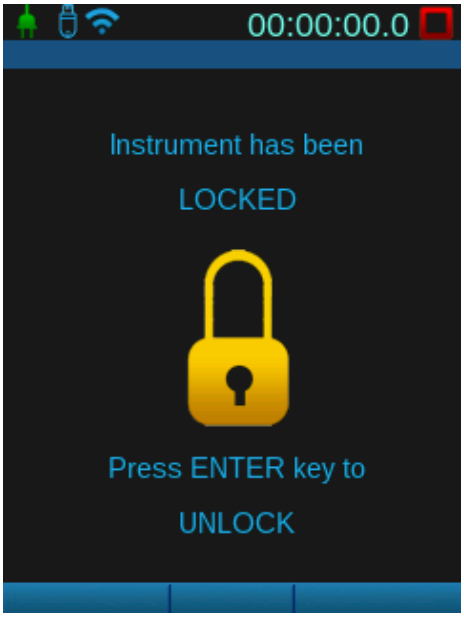


Fully Locked

A fully locked screen shows only the padlock image. In this lock mode you can run a measurement, but cannot pause, stop, or reset. You can fully lock the screen while a measurement is running.

If you have indicated an auto-store mode in your current setup file, it will run and store as indicated in the setup.

FIGURE 11-4 Locked Screen



11.4 Allow Calibration When Locked

While in any of the three lock modes, the SoundAdvisor can be calibrated, if the measurement is stopped and the **Allow Calibration When Locked** was checked in the Lock Mode settings dialog.

Press the center softkey to navigate to the Calibrate display. For information on how to calibrate, see “Calibration” on page 5-1.

11.5 Constraints

Table 11.1 Allowed Operations During Lock

Lock Mode	Run	Pause	Stop	Reset	Calibration
Lock with Auto Store	Yes	No	Yes	Yes	Yes (when stopped)
Lock with Manual Store	Yes	No	Yes	Yes	Yes (when stopped)
Fully Locked	Yes	No	No	No	Yes (when stopped)

The SoundAdvisor can be accessed, locked/unlocked, settings can be changed, and the measurement can run, pause, stop and store during a lock when operated using G4 LD Utility.

11.6 Unlock

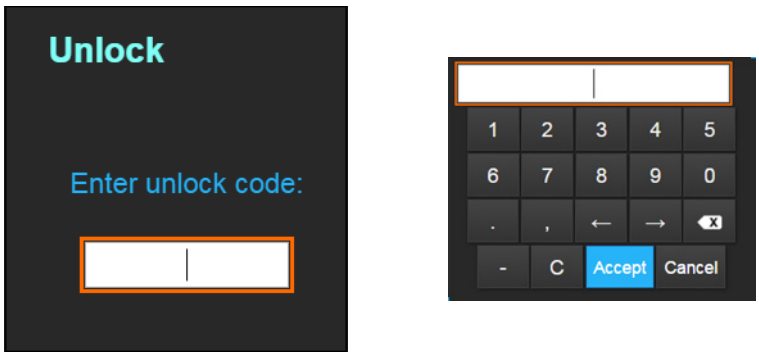
To unlock the SoundAdvisor, follow these steps:

Step 1 Press the Tools or ENTER Enter key.

Step 2 To access keyboard, press ENTER enter again.

Step 3 Enter your code, then press ENTER.

FIGURE 11-5 Unlock



To unlock your SoundAdvisor via G4 LD Utility follow these steps:

Step 1 Connect your SoundAdvisor to G4.
See "Connecting SoundAdvisor to G4" on page i-3.

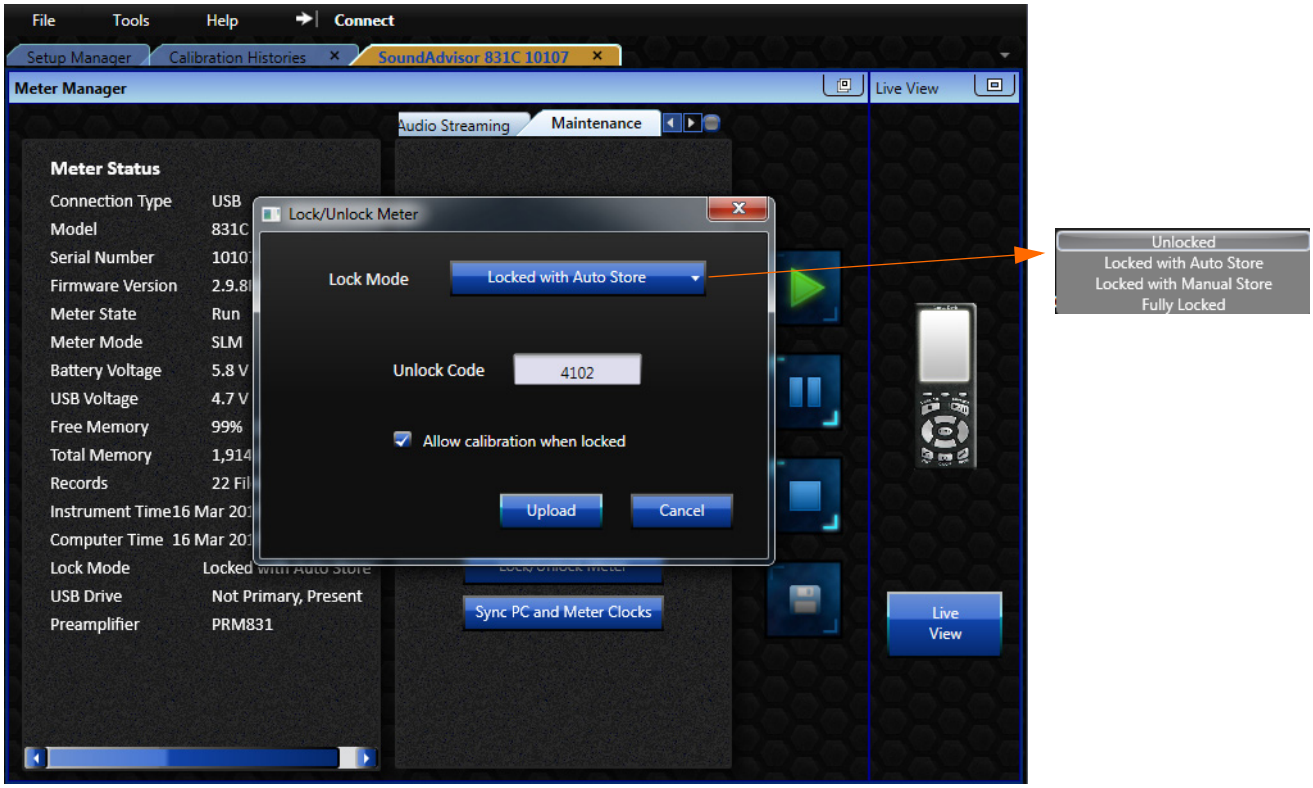
Step 2 On Meter Manager navigate to the Maintenance tab.

Step 3 Select **Lock/Unlock**.

Step 4 Change lock mode to **Unlock**. Or use the code visible to enter into the unlock code dialogue on the meter.

Step 5 Select **Upload**.

FIGURE 11-6 G4 LD Utility Lock/Unlock



Module12 System Utilities

The System Utilities repairs or recovers any file system problems.These functions are similar to what would be used to manage any hard drive.

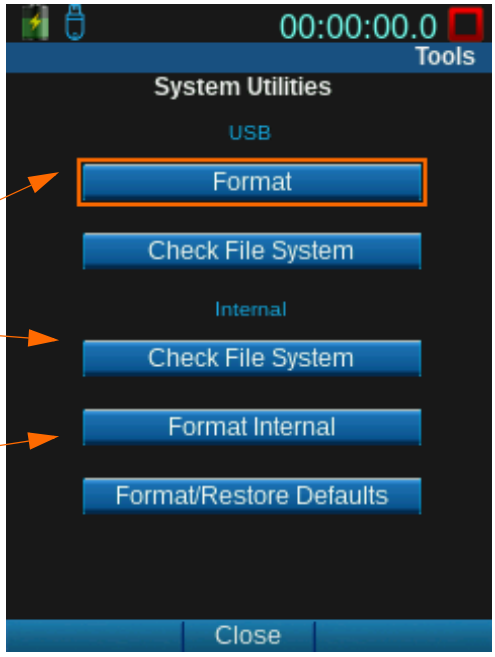


FIGURE 12-1 System Utilities

CAUTION A loss of data will occur while formatting. Make sure all wanted files are backed up on a another device.

Checking the file system will detect and repair problems.

Format the data storage of the area indicated: USB or Internal.

TAKE NOTE System preferences and settings are preserved during internal formatting.

TAKE NOTE A reset is required to do any of these functions if a measurement is running, stopped, or paused.

Format and Restore Defaults

This function formats the internal data storage in the SoundAdvisor memory. The meter is then restored to factory settings. All internal data will be erased. User calibrations and calibration history data will be erased as well.

12.1 Bad Flash Blocks

After a system file check, and bad flash block may be detected.

The Flash memory device used by the SoundAdvisor contains a controller that performs dynamic bad block mapping. In the event that a flash block fails after it has been written, that is a bad block.

CAUTION Data in a bad flash block is usually unrecoverable. Files should be checked for errors if this message is displayed.

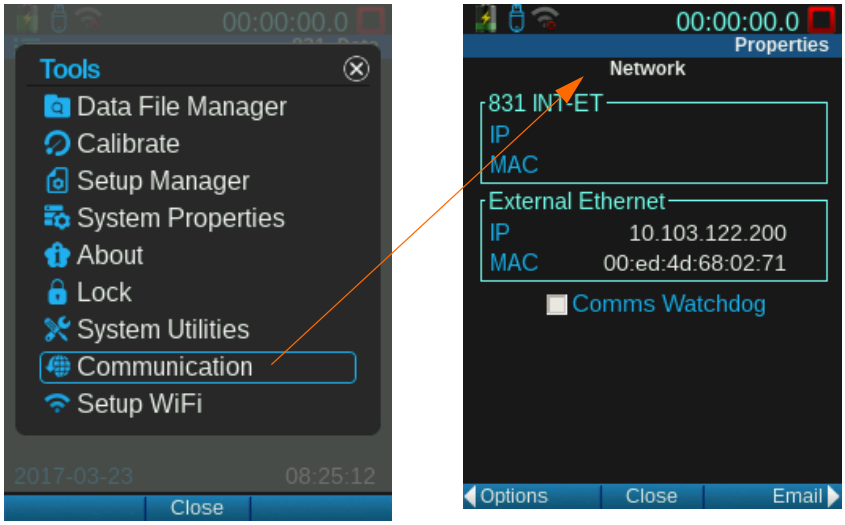
In this case data, download data from the SoundAdvisor onto a USB or PC, and then perform a file system format. Performing a file-system format forces the controller to re-map all bad blocks.

Module13 Communications & WiFi

13.1 Communication

The **Communication** information, which comprises of network password, IP address, and MAC address, can be found in two ways: the **Tools** ⇢ **Communication** or **System Properties** ⇢ **Network**.

FIGURE 13-1 Tools Menu



13.1.1 Network

831-INT-ET

The 831-INT-ET IP and MAC addresses can be found here.

Watchdog

The Communications Watchdog reboots the SoundAdvisor system in the event of a communication failure with either the 831-INT-ET or the analog modem. It is automatically enabled when connected to a 831-INT-ET, though you can disable it on the **Network** page. A countdown of 5 minutes will appear on the Live Preamp display until the 831-INT-ET is rebooted.

13.2 Connecting to an Ethernet Port

TAKE NOTE Ethernet connections consume a high amount of power. It is recommended to use a USB or external power source while connected via Ethernet.

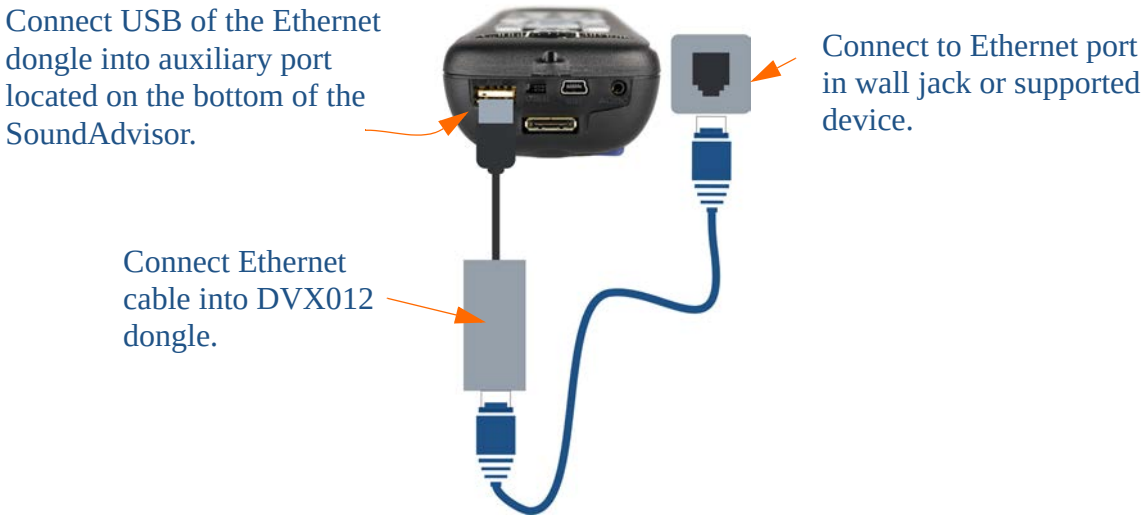
To connect the SoundAdvisor to an Ethernet port, follow these steps:

Step 1 Verify you have the following equipment:

- SoundAdvisor Model 831C
- DVX012 USB/Ethernet dongle
- Ethernet cable
- A functional Ethernet network port

Step 2 Connect the assembly as shown in Figure 13-2 SoundAdvisor Connected to Ethernet.

FIGURE 13-2 SoundAdvisor Connected to Ethernet



13.3 WiFi

The SoundAdvisor has a built in USB port where the WiFi dongle can be inserted, alternatively a USB hub can be used so multiple USB devices can be mounted at the same time. When the WiFi dongle is inserted, the WiFi status icon will appear on the top display on the meter.

FIGURE 13-3 WiFi Not Connected Icon

After a WiFi connection is made the icon bars will turn from gray to blue, depending on the strength of th signal.

FIGURE 13-4 WiFi Connected, Signal Strength Indication Icon

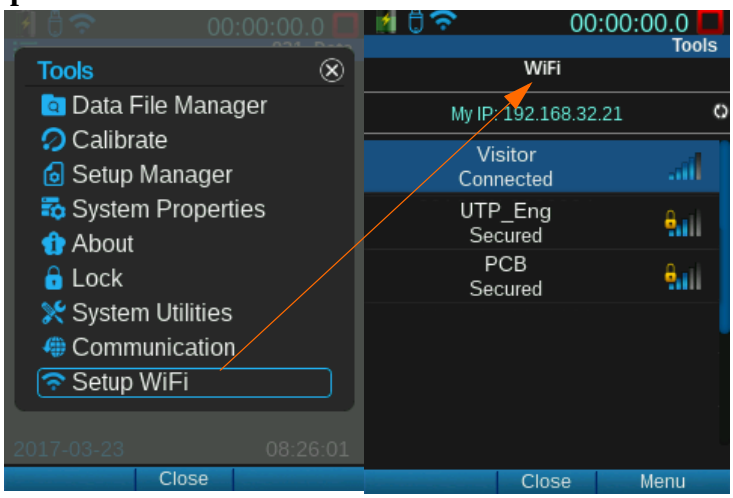
If your meter is set as an Access Point, so other devices can connect to its signal, then the Access Point icon will appear.

FIGURE 13-5 SoundAdvisor Access Point Icon

13.3.1 Connecting to WiFi Network

The WiFi page can be accessed by navigating **Tools** ⇢ **Setup WiFi**.

FIGURE 13-6 Tools, Setup WiFi



To establish a WiFi connection over a network, follow these steps:

TAKE NOTE It is best to make the initial connection to a WiFi network while also connected via USB, if possible.

Step 1 Connect a WiFi USB adapter.

Step 2 Navigate **Tools** ⇢ **Setup WiFi**. See Figure 13-6 Tools, Setup WiFi.

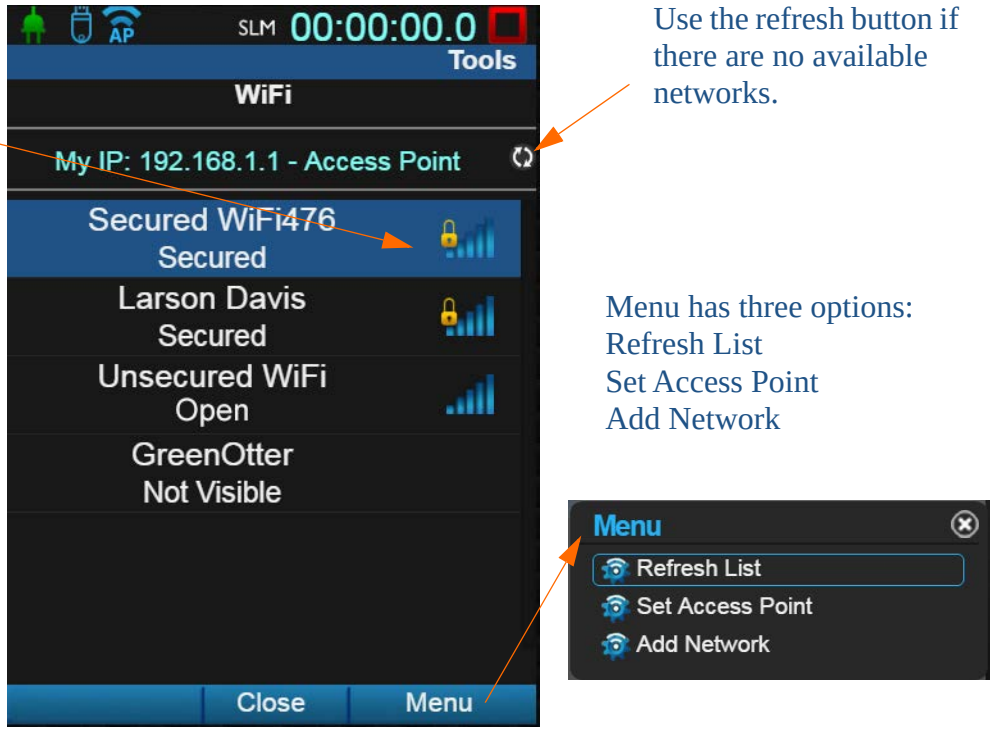
Step 3 Select an available network. If no network appears on the list, select **Menu** and select **Refresh List**.

TRY THIS To connect to a hidden network, click **Menu** ⇢ **Add Network** and provide network name

Step 4 Enter the network password, if required, and click **Add**.

Step 5 Verify your network connection details by clicking the newly added network from the list.

FIGURE 13-7 WiFi Setup



13.3.2 Access Point

The SoundAdvisor can be set as an access point. In this state it sends out a WiFi signal that other devices can connect to, like a mobile device. Multiple devices can connect to the meter at once.

The password to connect to the SoundAdvisor WiFi is: wifi831c.

TAKE NOTE If multiple mobile devices attempt to access the meter via web browser at once, an error may be issued. If an error is issued, close the browser on all devices, then navigate one at a time, ensuring each is loaded before the next.

Module14 Upgrade Firmware

14.1 G4 LD Utility

TAKE NOTE You'll need to download the latest G4 LD Utility software. For steps on how to do this, see "Download G4 LD Utility" on page i-3.

G4 LD Utility (G4) is used to install firmware and option upgrades, as well as providing remote control of the SoundAdvisor and downloading data to your PC.

Access the Larson Davis website to see if you are using the most recent version. If not, download the latest version from the website.

The installer will be in a zip format. Unzip the file and copy the folder "CD" to the desktop and run setup.exe in the CD folder. Follow the instructions to install the upgrade.

If using the G4 LD Utility disc, insert and download on to your machine.

Once download is complete, launch G4. The shortcut will be on the desktop. Double click this shortcut to launch the software.

FIGURE 14-1 G4 LD Utility Software Shortcut

14.2 Upgrading SoundAdvisor Firmware

TAKE NOTE The SoundAdvisor can be connected via USB or via TCP/IP address, if the meter is connected to the Internet. To learn more, see "Communications & WiFi" on page 13-1.

G4 is used to implement the firmware upgrade and perform the following steps:

Step 1 Turn the SoundAdvisor on.

Step 2 Connect the meter to the PC (or laptop) via the USB cable CBL138, which is part of the PSA029 power supply.

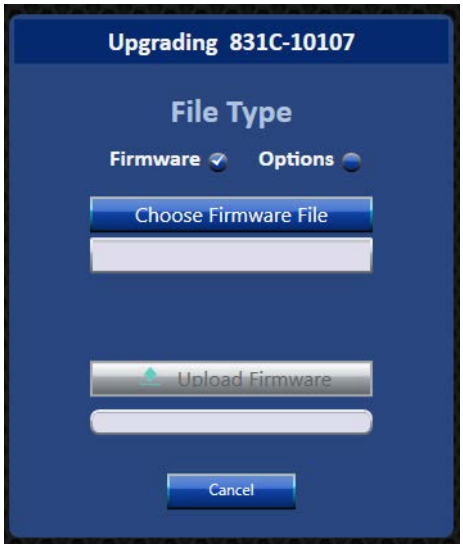
Step 3 Launch G4.

Step 4 Navigate **File** ⇢ **Upgrade Firmware or Options** on G4.

Step 5 Select your meter, click **Connect**.

Step 6 After communication has been established, the **Upgrading Firmware/Options** will appear.

FIGURE 14-2 Upgrading Firmware/Options



Step 7 Check the radio button for **Firmware**.

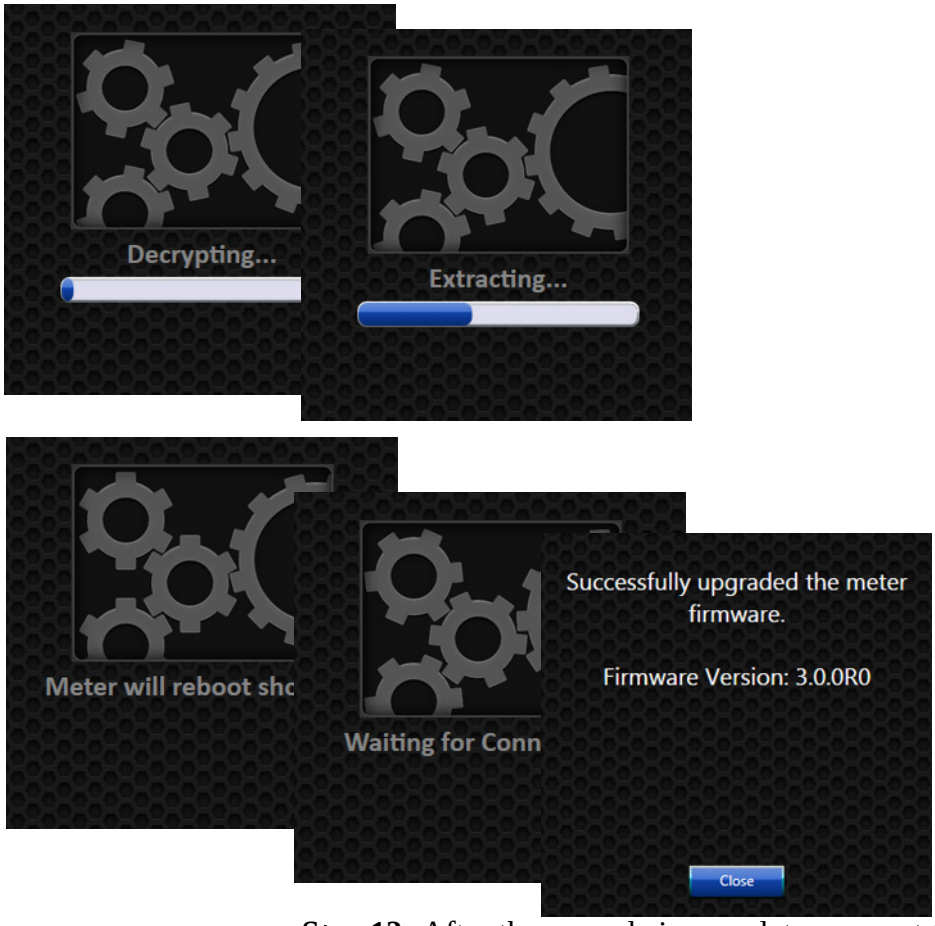
Step 8 Select **Choose Firmware File**. The default folder will be C:\Program Files (x86)\PCB Piezotronics\G4\Firmware

Step 9 Choose latest firmware from this folder or navigate to a **.fw831c** firmware file, select and open file.

Step 10 Select **Upload Firmware.**

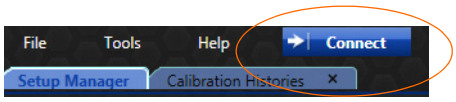
Step 11 A progress bar will appear under the **Upload Firmware** button followed by progress screens.

FIGURE 14-3 Upgrade Firmware/Options Progress



Step 12 After the upgrade is complete, connect the SoundAdvisor to G4 by selecting **Connect**, see "Connecting SoundAdvisor to G4" on page i-3.

FIGURE 14-4 G4 Connect Button



14.3 Upgrading Options

14.3.1 Saving an Option Upgrade File

You will receive your .opt file from Larson Davis via email. Save this file on your PC to your desktop (or save in another location and make note of it).

14.3.2 Upgrading With Optional Firmware

After saving the file to your PC, follow these steps:

Step 1 Follow steps 1-6 of "Upgrading SoundAdvisor Firmware" on page 14-1.

Step 2 Choose the radio button for **Options**.

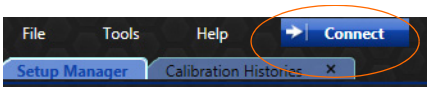
Step 3 Select **Choose Option File**. Navigate to .opt file saved onto your PC. Select and open file.

Step 4 Select **Upload Option.**

Step 5 A progress bar will appear under the **Upload Option** button.

Step 6 After upgrade is complete, connect the SoundAdvisor to G4, see “Connecting SoundAdvisor to G4” on page i-3.

FIGURE 14-5 G4 Connect Button



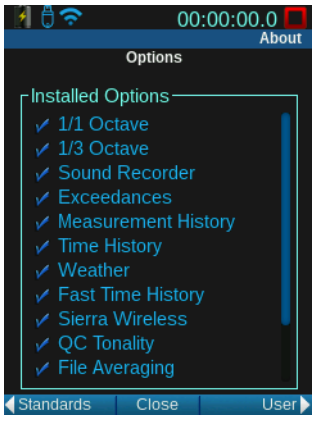
14.4 Enabling/Disabling Optional Firmware

While option firmware, once installed, will be enabled by default on your meter, you can disable and re-enable the option manually. To do this, follow these steps:

Ensure Option is Downloaded

Step 1 Using the SoundAdvisor, navigate **Tools** ⇢ **About** ⇢ **Options**. Ensure there is a check mark next to a your option. This shows that the option has been successfully uploaded to your meter.

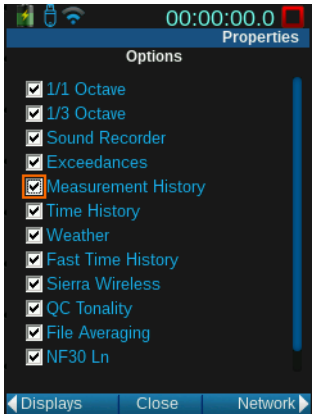
FIGURE 14-6 Options Enabled



Hide/Unhide Option

Step 2 Navigate **Tools** ⇢ **System Properties** ⇢ **Options**.

FIGURE 14-7 User-defined Options Enabled



TAKE NOTE While making changes to the **Preferences**, if you have any unsaved data or are currently running a measurement, you will be notified that a reset will be needed to make changes. Select **OK** and press button to reset the measurement.

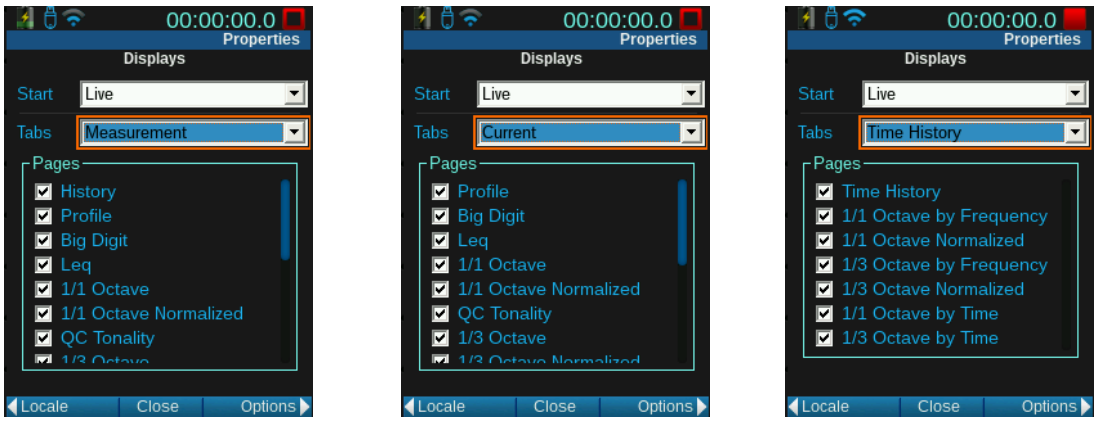
Step 3 Check the options you wish to be available on the meter. Uncheck any options you want hidden.

Hide/Unhide Displays

Step 4 Use the right soft key to navigate to **Displays**.

Step 5 Under **Tabs** select tab of your option. Check all that you want visible.

FIGURE 14-8 Displays



Step 6 **Close** and save.

Module15 Measurement History

15.1 Overview

TAKE NOTE Firmware options 831C-ELA or 831C-MSR (MSR does not include events) must be purchased and enabled in order to use this option.

The following module provides the procedures using the Measurement History option on the SoundAdvisor. Measurement History is a sequence of measurements contained in one file, as defined in a setup file.

15.2 Enabling Measurement History

To ensure that the **Measurement History** option is successfully enabled and visible, see "Enabling/Disabling Optional Firmware" on page 14-4.

15.3 Setting up the Measurement

While measurement parameters can be indicated directly in the **Active** setup, it is good practice to first create a user-defined setup file for any specific measurement you perform. Once created, you can make that setup active. The following section will discuss how to do this.

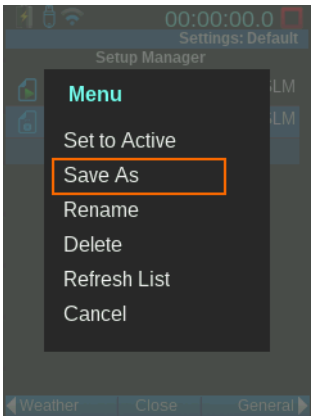
15.3.1 Create Measurement History Setup File

To create a new setup file, follow these steps

Name the Setup

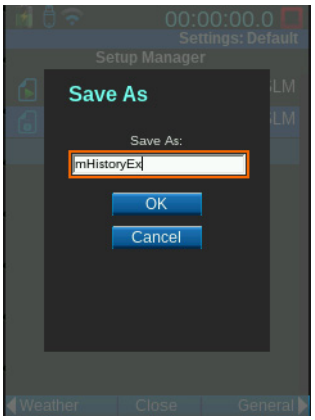
Step 1 Navigate to Tools or Menu ⇢ **Setup Manager**. Arrow down to **Default** and press **ENTER**. A **Menu** will appear. Select **Save As**.

FIGURE 15-1 Setup File Save As



Step 2 Name file a unique name. This example will use "mHistoryEx" as the setup file name. **Save**.

FIGURE 15-2 Name File



Specify Run Mode

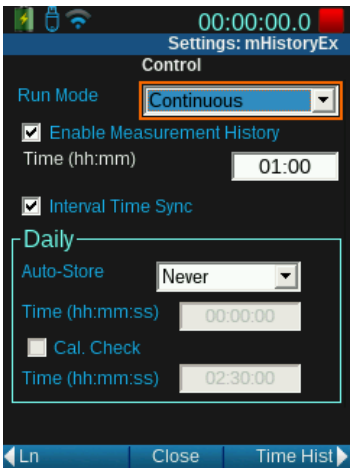
TRY THIS Review "Measurement Setup" on page 6-1 and indicate all the parameters for each setup page that need for your measurement.

Step 3 With your setup highlighted, use the top right softkey to navigate to **Control**. Choose a run mode:

Continuous and Timer Modes

For these run modes, when the Measurement History is enabled, a series of measurements will be performed automatically, each running for a user-defined time interval, until the file is stored.

FIGURE 15-3 Continuous Mode



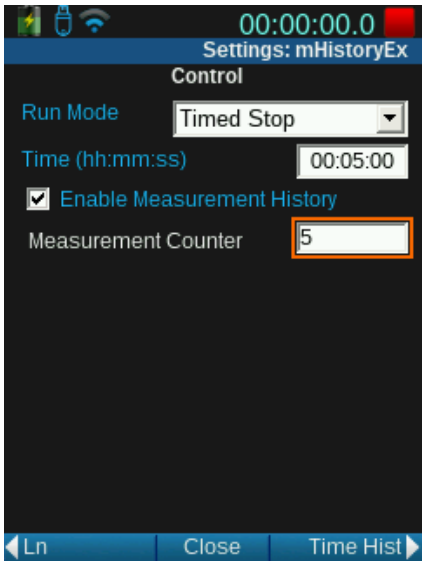
- Interval Time
    - This is the time each measurement interval will be. The minimum permitted Interval Time is one minute; if a zero value is entered, it will default to one minute.
- Interval Time Sync
    - This feature ensures that all measurement records, after the first, will begin at a time of day equal to a multiple of the measurement time selected. For example, if the interval time is five minutes and the measurement begins at 08:14:00 (hh:mm:ss format), the first measurement will be cut short such that the subsequent measurements will begin at 08:15, 08:20, 08:25, etc.
- Daily Auto Store
    - As your measurement is being made, your measurement can be stopped and stored automatically throughout the day. For example, you can have an interval time of ten minutes, and store **24/day**, so every hour a file will be created, and the measurement will be reset, and each file will contain six measurement intervals.

Timed Stop Mode

This mode, when Measurement History is enabled, has a feature not included in the other run modes: the ability to automatically measure and store a user-defined number of records, then stop. Subsequent runs, each manually initiated, will produce the same number of stored measurements.

TAKE NOTE In order to use the measurement counter, your time needs to be greater than 00:01:00.

FIGURE 15-4 Timed Stop Mode



In this example the time is 00:05:00 and the measurement counter is 5. This means that the measurement will run for 5 minutes, five times, each time creating a new record.

Manual and Stop When Stable Mode

For these run modes, when Measurement History is enabled, at the conclusion of a measurement, the data must be manually saved. Checking the “Enable Measurement History” check box does not add additional parameter fields to the display as it does with Continuous, Single Block Timer and Daily Timer modes.

With Measurement History enabled, sequentially pressing the ■ and ▶/❚❚ keys will store the measurement and initiate another measurement, eliminating the need to perform a separate data store operation.

Step 4 After indicating a mode and settings, **Save**.

Make Setup Active

Step 5 In the Setup Manager, select the **MHistoryEx** setup and select **Set To Active**.

15.4 Making a Measurement

To begin your measurement, press ▶/❚❚ (RUN/PAUSE) on the meter. For a basic measurement run overview, see “Making a Measurement” on page 7-1.

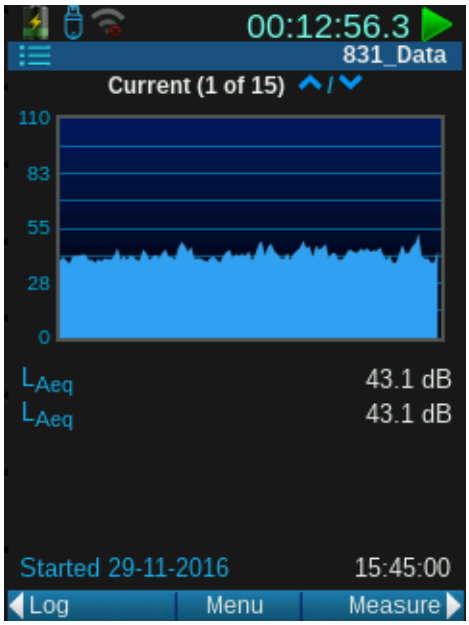
15.5 Viewing Measurement Data

15.5.1 Current Data Display

When the first measurement is in progress, the data will display on the Current tab. When that measurement is complete, its data will display on the Measurement tab. The Current tab is then reset and begins displaying data for the next measurement in progress. As a result, at any time the Current tab displays the measurement in currently progress.

Current can display data pages just like Live or Overall, depending on the firmware options enabled and the setup used. Press the ◠ and ◡ keys to navigate through these different pages. For more information on these pages, see “Data Display” on page 4-1.

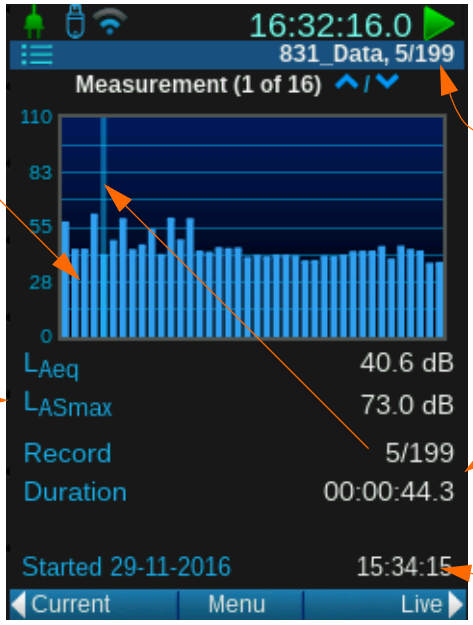
FIGURE 15-5 Current Data Display



15.5.2 Measurement History Data Display

The Measurement tab can display data for any one of the previously completed measurements. These measurement records are numbered in sequence from the first to the last.

FIGURE 15-6 Measurement History



Graph of Leq values for each record, in sequence by time

Leq and max values of the measurement (cursor position)

Selected record number/ Number of measurements

Measurement duration

Data and time measurement started

Changing Displayed Record

The selected record number for which data is being displayed is indicated in the upper right next to the measurement name as you navigate up and down through the pages.

Non-Spectra Displays

With the exception of frequency spectra displays, the ⟨ and ⟩ keys are used to step the selected measurement record number to the right or left, respectively.

Frequency Spectra Displays

When a frequency spectrum is displayed, the ⟨ and ⟩ keys are used to highlight to the left or right so that the levels can be displayed for different frequency bands. To change the displayed record, shift to a non-spectrum display to make the change then return to the frequency spectrum display.

15.5.3 Data File

To view the full scope of each measurement history record, open the data file which can be accessed after the measurements is stored, see “Storing Measurement History” on page 15-6. The data file can be downloaded using G4 LD Utility, additionally it can viewed on the meter, navigate **Tools** ⇢ **Data File Manager**.

TAKE NOTE What is logged is dependent on the firmware and options installed. For example, if the OBA option is present then the measurement history record will have OBA Leq, min and max.

For this example, every hour the **Current** measurement is stored as a measurement history record. The sound exceedance count and duration, overloads, and OBA can be viewed in the file.

FIGURE 15-7 Measurement History Data File (G4 View)

	A	B	C	D	E	F	G	H	I	J	K	L
1	Record #	Date	Time	Run Duration	Run Time	Pause	LAeq	LAE	LASmin	LASmin Time	LASmax	LASmax Tim
2	1	2017-05-05	02:01:46	00:58:13.9	00:58:13.9	00:00:00.0	37.5	73.0	32.5	02:59:09	44.6	02:22:(
3	2	2017-05-05	03:00:00	01:00:00.0	01:00:00.0	00:00:00.0	34.0	69.5	32.8	03:13:29	43.0	03:30:(
4	3	2017-05-05	04:00:00	01:00:00.0	01:00:00.0	00:00:00.0	34.0	69.6	32.8	04:38:38	41.6	04:29:1
5	4	2017-05-05	05:00:00	01:00:00.0	01:00:00.0	00:00:00.0	34.0	69.6	32.8	05:11:33	48.0	05:54:(
6	5	2017-05-05	06:00:00	01:00:00.0	01:00:00.0	00:00:00.0	34.5	70.0	33.1	06:07:32	48.6	06:52:(
7	6	2017-05-05	07:00:00	01:00:00.0	01:00:00.0	00:00:00.0	34.9	70.5	33.2	07:39:34	52.0	07:46:3
8	7	2017-05-05	08:00:00	01:00:00.0	01:00:00.0	00:00:00.0	51.5	87.0	33.1	08:15:07	75.5	54:1
9	8	2017-05-05	09:00:00	01:00:00.0	01:00:00.0	00:00:00.0	48.9	84.5	33.2	09:43:50	67.2	09:40:4
10	9	2017-05-05	10:00:00	01:00:00.0	01:00:00.0	00:00:00.0	51.6	87.1	33.6	10:25:55	70.0	10:41:1
11	10	2017-05-05	11:00:00	01:00:00.0	01:00:00.0	00:00:00.0	51.9	87.5	32.9	11:52:26	70.6	11:08:3
12	11	2017-05-05	12:00:00	01:00:00.0	01:00:00.0	00:00:00.0	52.5	88.0	33.6	12:13:31	72.5	12:39:5
13	12	2017-05-05	13:00:00	00:57:40.2	00:57:40.2	00:00:00.0	48.2	83.6	33.3	13:29:09	71.5	13:57:(

Using the scroll in G4, the data continues to the right.

15.6 Storing Measurement History

Although the measurement history data can be displayed during a measurement and after it has been stopped, the data has not been stored to memory. To store the data, press the ▣ (Stop/Store) key.

Module16 Time History

16.1 Overview

TAKE NOTE Firmware option 831C-LOG must be purchased and enabled in order to use this option.

The following module provides the procedures for performing a measurement file using the Time History option on the SoundAdvisor. Time History is a collection of metrics recorded in a user-defined time interval.

16.2 Metrics Logged

Time Intervals

The interval range is from 2.5 ms to 24 h.

Available Metrics

The following table represents data that is displayed dependent on the time interval chosen.

Table 16.1 Time History Available Metrics

Time Interval		2.5, 5, 10 ms	20 & 50ms	100 & 200 ms	500 ms, 1 s, 2 s	5 s -24 h
Time History						
$L_{\omega eq}$			●	●	●	●
$L_{\omega peak}$			●	●	●	●
$L_{\omega}S_{Max}$				●	●	●
$L_{\omega}F_{max}$				●	●	●
$L_{\omega}I_{max}$				●	●	●
$L_{\omega}S_{min}$				●	●	●
$L_{\omega}F_{min}$				●	●	●
$L_{\omega}I_{min}$				●	●	●
$L_{\omega}S_{SPL}$			●	●	●	●
$L_{\omega}F_{SPL}$			●	●	●	●
$L_{\omega}I_{SPL}$			●	●	●	●
LC_{eq}-LA_{eq}				●	●	●
LI_{eq}-L_{eq}			●	●	●	●
OBA Bandwidth						
Leq	1/1	●*	●*	●	●	●
	1/3	●*	●*	●	●	●
Lmax	1/1			●	●	●
	1/3			●	●	●
Lmin	1/1			●	●	●
	1/3			●	●	●
SPL	1/1		●	●	●	●
	1/3		●	●	●	●
LAFTM5						●
Miscellaneous						
Ln Statistics					●	●
Battery Voltage				●	●	●
Internal Temperature				●	●	●
External Power				●	●	●
Millisecond Time						
Tms		●	●	●	●	●
Weather**		●	●	●	●	●

* Only 1/1 Octave or 1/3 Octave can be chosen, not both.
** 1 second resolution and will not update between queries at faster than 1 second.
ω is the weighting A, C, or Z

16.3 Enabling Time History

To ensure that the **Time History** option is successfully enabled and visible, see “Enabling/Disabling Optional Firmware” on page 14-4.

16.4 Setting up the Measurement

While measurement parameters can be indicated directly in the **Active** setup, it is good practice to first create a user-defined setup file for any specific measurement you perform. Once created, you can make that setup active. The following section will discuss how to do this.

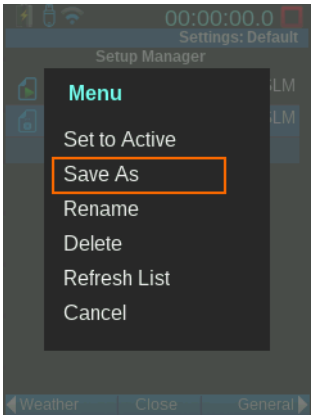
16.4.1 Create Time History Setup File

To create a new setup file, follow these steps

Name the Setup

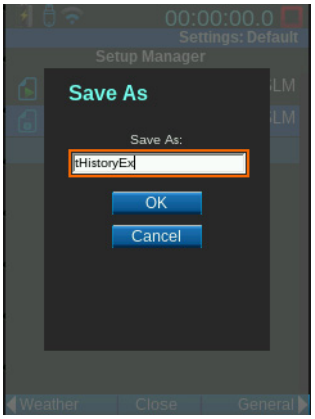
Step 1 Navigate to Tools or Menu → **Setup Manager**. Arrow down to **Default** and press **ENTER**. A **Menu** will appear. Select **Save As**.

FIGURE 16-1 Setup File Save As



Step 2 Name the file a unique name. This example will use “tHistoryEx” as the setup file name. **OK**.

FIGURE 16-2 Name File



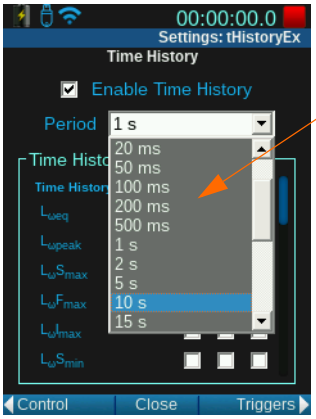
Specify Time History Options

TRY THIS Review "Measurement Setup" on page 6-1 and indicate all the parameters for each setup page that you need for your measurement.

Step 3 With your setup highlighted, use the top right softkey to navigate to **Time History**. Check **Enable Time History**.

Step 4 Indicate the desired time period.

FIGURE 16-3 Time History Time Periods



For a list of all the periods, see "Time Intervals" on page 16-1

Step 5 Enable the desired options for the time period. There are specialized acoustic metrics, octave spectra, and non acoustical metrics like battery level and weather available. Not all options will be available for every time period, see Table 16.1, "Time History Available Metrics," on page 2-16 for a complete list.

Step 6 **Save**.

Make Setup Active

Step 7 In the Setup Manager, click the **tHistoryEx** setup and select **Set To Active**.

16.5 Making a Time History Measurement

To begin your measurement, press (RUN/PAUSE) on the meter. For a basic measurement run overview, see "Making a Measurement" on page 7-1.

16.6 Markers

TAKE NOTE Markers can also initiate a sound recording, see "Manual Sound Recording" on page 18-2.

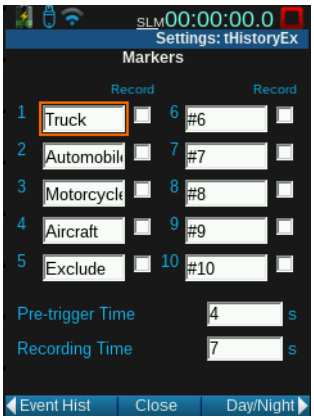
The SoundAdvisor Time History option also includes markers; With markers you can mark a sound type. While the measurement is running, for example, if a motorcycle enters the area, you can mark that current sound as a motorcycle noise and it is saved in the time history data.

To mark a sound type, follow these steps:

Step 1 Follow steps 1-6 of "Create Time History Setup File".

Step 2 Navigate to **Markers**.

FIGURE 16-4 Markers



Indicate Markers

Step 3 You can edit any of the 10 markers names. If you have Sound Recording on your meter, see "Marker Sound Recording" on page 18-3.

Step 4 **Save**.

Make Setup Active

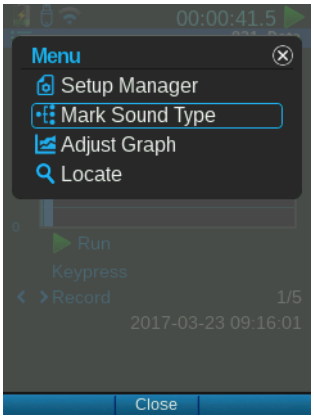
Step 5 In the Setup Manager, click the **tHistoryEx** setup and select **Set To Active**.

Make a Measurement

Step 6 Run a measurement. Navigate to **Time History** or **Live**.

Step 7 Navigate **Menu** → **Mark Sound Type**.

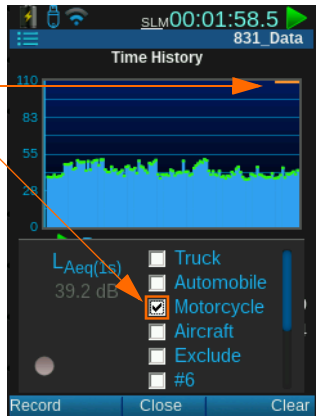
FIGURE 16-5 Mark Sound Type Menu



Step 8 A partial menu will appear over your Time History tab. Use can select any of the markers to mark that sound type, deselect when you want to end the mark.

FIGURE 16-6 Mark Sound Type

By selecting “Motorcycle” the sound is marked as “Motorcycle” until you deselect.



16.7 Viewing Time History Data

16.7.1 Time History Data Display

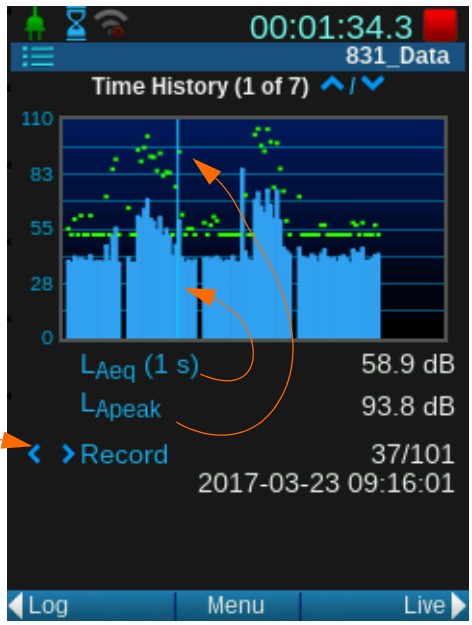
Single Value Metrics

After the first time interval has passed, the data will display on the Time History tab in single values.

Time History can display data pages just like Live or Overall, depending on the firmware options enabled and the setup used. Press the ▭ and ▭ keys to navigate through these different pages. For more information on these pages, see “Data Display” on page 4-1.

FIGURE 16-7 Time History

Use the ENTER key to toggle from **Record** to the metric view.

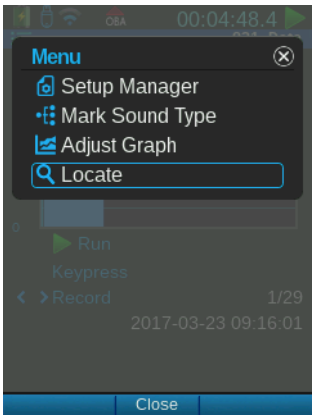


The blue bands show the L_{Aeq} for the time interval, and the green mark is the metric data, in this example L_{APeak}.

Locate Record Number

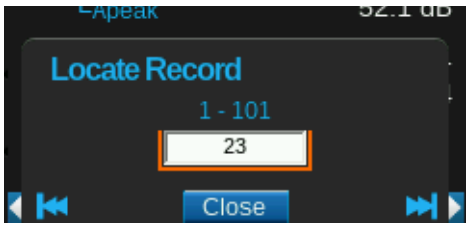
To rapidly change the record number, rather than use the cursor to step through the range of records you can use the **Locate** feature. While on the **Time History** tab, press the Menu softkey and then select **Locate**.

FIGURE 16-8 Locate Record



After selecting **Locate**, the Locate Record menu will appear.

FIGURE 16-9 Locate Record Menu



Enter the desired record number and that record will highlight. You can use the top left and right softkeys to jump to the first or last record. Notice that there are 101 records in this example, and if you choose a number higher than 101, it will default to 101, overriding your request.

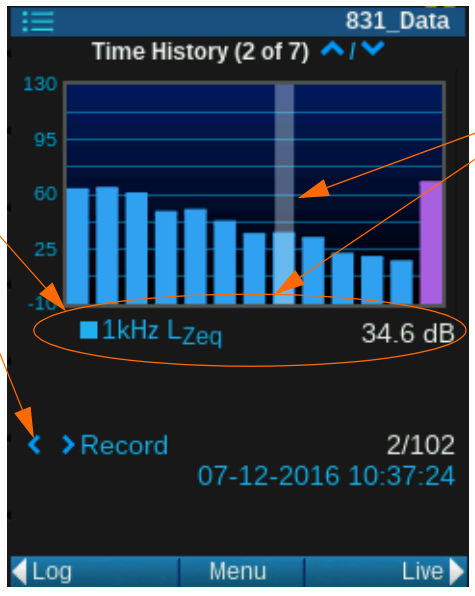
Time History Octave Spectra Displays

If you indicated OBA metrics, multiple pages will be available to view on the **Time History** tab.

FIGURE 16-10 Time History 1/1 Octave

Use the ENTER to jump your cursor from frequency or record number.

LEARN MORE To learn more about octave page displays, see "Data Display" on page 4-1.



The highlighted band is the $L_{\omega eq}$ average sound level of for the duration of the measurement at that frequency.

Use the ⟨ and ⟩ keys to highlight the desired band and the numerical values below will reflect the information at that octave.

Changing Displayed Record

The selected record number for which data is being displayed is indicated at the bottom of the page, the last value stated, as you navigate through the pages.

TRY THIS Use the ENTER button on each visible **Time History** page to test which values you can change on each page.

Octave Displays

The ⟨ and ⟩ keys are used to step the selected measurement record number to the right or left, respectively.

To change the octave view, use the ENTER to jump your cursor from record number to frequency, and use the ⟨ and ⟩ keys to highlight to the left or right so that the levels can be displayed for different frequency bands.

16.8 Storing Time History

Although the time history data can be displayed during a measurement and after it has been stopped, the data has not been stored to memory. To store the data, press the ■ (Stop/Store) key.

Module17 Event History

17.1 Overview

TAKE NOTE Firmware option 831C-ELA must be purchased and enabled in order to use this option.

The following module provides the procedures for performing a measurement using the Event History option on the SoundAdvisor.

17.1.1 Level Based Events

Events are initiated and stored when the measured sound level exceeds the trigger levels **SPL1** or **Peak 1** for the specified minimum duration. **SPL1** and **Peak 1** are specified on the Triggers tab and the minimum duration is specified on the Event History tab.

17.2 Enabling Event History

To ensure that the **Event History** option is successfully enabled and visible, see “Enabling/Disabling Optional Firmware” on page 14-4.

17.3 Setting up the Measurement

While measurement parameters can be indicated directly in the **Active** setup, it is good practice to first create a user-defined setup file for any specific measurement you perform. Once created, you can make that setup active. The following section will discuss how to do this.

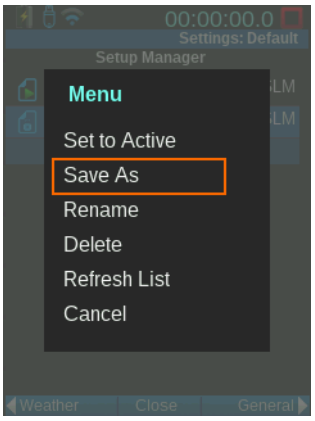
17.3.1 Create Event History Setup File

To create a new setup file, follow these steps

Name the Setup

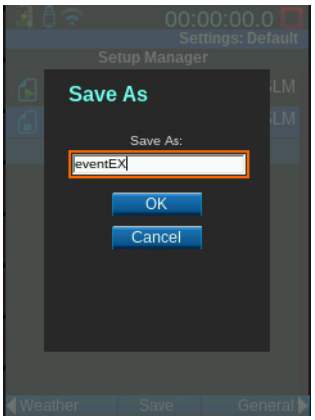
Step 1 Navigate to Tools or Menu ⇢ **Setup Manager**. Arrow down to **Default** and press **ENTER**. A **Menu** will appear. Select **Save As**.

FIGURE 17-1 Setup File Save As



Step 2 Name the file a unique name. This example will use “eventEx” as the setup file name. **OK**.

FIGURE 17-2 Name File



Specify Trigger Options

TRY THIS Review “Measurement Setup” on page 6-1 and indicate all the parameters for each setup page that you need for your measurement.

Step 3 With your setup highlighted, use the top right softkey to navigate to **Triggers**. Keep triggers at default or indicate new values depending on your measurement.

Specify Event History Options

Step 4 Navigate to **Event History**.

Step 5 Check **Event History** then indicate the “Minimum Duration” and “Continuation Period”.

FIGURE 17-3 Event History Settings

Check **Event History** to enable the feature.

TAKE NOTE If you are using this feature with **Sound Recording**, your Minimum Duration cannot be more than the time set for the buffer. See “Sound Recording” on page 18-1.

Minimum Duration

In situations where only noise events lasting longer than a certain time interval are needed, you can select a minimum duration requirement for the storage of noise events data. The maximum limit is 60 s.

Continuation Period

Each noise event is initiated when the sound level exceeds the SPL1 or Peak 1 level. There may be situations where sound level drops below the threshold for a short period of time before rising above it again, in which case you may prefer to consider this a continuation of the event rather than the conclusion of the event and the beginning of another. **Continuation Period** is the time the sound level can fall below the threshold level and still be considered in the same event.

Beginning when the levels both drop below their thresholds, if either lever rises above its respective threshold over a time interval equal to the continuation period, the noise event is considered complete. If, however, there is an exceedance of a threshold during the continuation period, the event is considered to be continued as if there had been no level drop below a threshold.

Step 6 Indicate the Trigger Method. See “Triggering Method” on page 17-6.

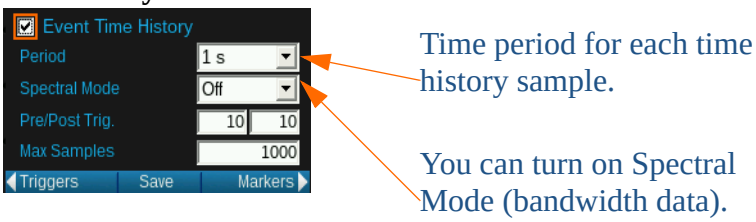
Email Alerts

Step 7 Indicate if you want an email or text to alert you when the SPL 2 or PEAK 3 has been triggered. This feature can send real-time email and texts with sound files (compressed .ogg, email only) over a network connection as well. To set up email recipients, see “Email” on page 9-11.

Event Time History

Step 8 Check **Event Time History**. This feature enables time history to be measured as part of each event history.

FIGURE 17-4 Event Time History



Pre/Post Trigger

TAKE NOTE The samples size is indicated as the **Period**.

Pre-trigger sets the amount of samples to be included that occurred prior to the event threshold exceedance triggering the event.

Post-trigger sets the number of samples to be included that occurred after the end of the event. The end of the event is defined as after the sound level has dropped below the trigger, so the last sample will include a drop in the sound level. The post trigger is after this sound level drop.

Maximum Samples

For some events you may want to limit how many samples are recorded. You can limit 10-9999 samples per event. Once this maximum is reached, no samples will be recorded, even if the event continues or post trigger samples were set.

TAKE NOTE If the sample size is set for 1 second and the event is 15 seconds, but the maximum samples is 10, only the first ten will be recorded as Time History samples. There will be no post trigger recorded, no matter what it was set for, because the maximum samples was reached.

Step 9 **Save**.

Make Setup Active

Step 10 In the Setup Manager, click the **eventEx** setup and select **Set To Active**.

17.4 Making an Event History Measurement

To begin your measurement, press (RUN/PAUSE) on the meter. For a basic measurement run overview, see “Making a Measurement” on page 7-1.

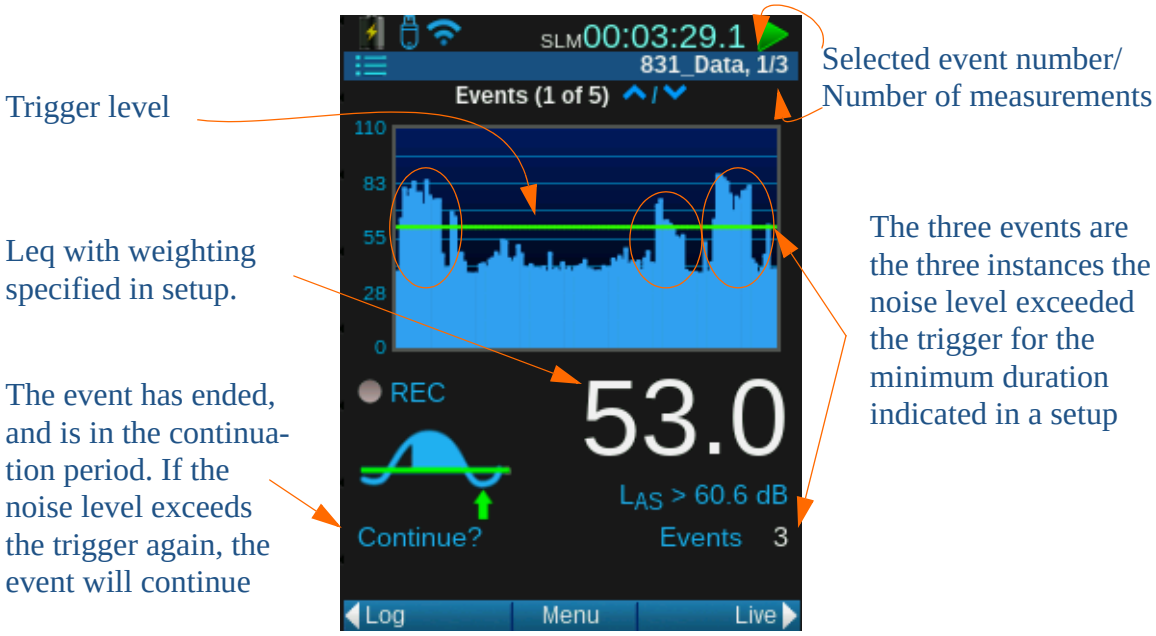
17.5 Viewing Event History Data

Single Value Metrics

After the first time interval has passed, the data will display on the Event History tab in single values.

Event History can display data pages just like Live or Overall, depending on the firmware options enabled and the setup used. Press the ▭ and ▭ keys to navigate through different pages. For more information on pages, see "Data Display" on page 4-1.

FIGURE 17-5 Event History



17.5.1 Exceedance Icon

FIGURE 17-6 Exceedance Icon

Ready
All the pre-samples have been recorded and it is waiting for an event

Trigger
The sound level exceeds the trigger level.

Valid
The sound level has exceeded the trigger level for the minimum duration.

Continue?
The sound level is below the trigger level and is in the continuation period until the event continues or the event ends.

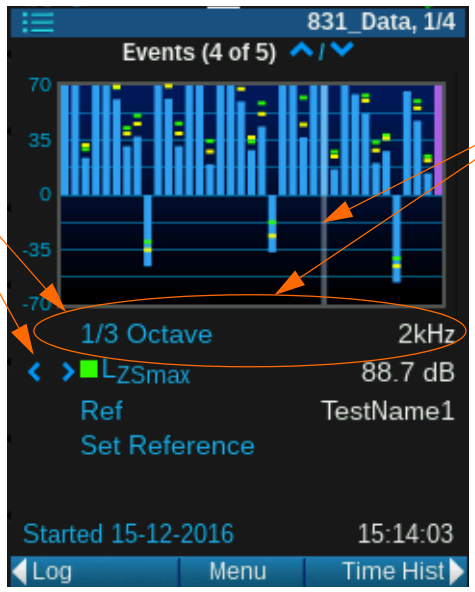
17.5.2 Event History Spectral Display

LEARN MORE To learn more about octave page displays, see “Data Display” on page 4-1.

If you indicated OBA metrics, multiple pages will be available to view on the **Time History** tab.

FIGURE 17-7 Time History 1/1 Octave

Use the ENTER to jump your cursor from frequency, OBA, or reference.



The highlighted band is the $L_{\omega eq}$ average sound level of for the duration of the event at that frequency.

LEARN MORE To learn more about octave page displays, see “Data Display” on page 4-1.

Use the ⟨ and ⟩ keys to highlight the desired band and the numerical values below will reflect the information at that octave.

Changing Displayed Record

The selected record number for which data is being displayed is indicated at the bottom of the page, the last value stated, as you navigate through the pages.

TRY THIS Use the ENTER button on each visible **Event History** page to test which values you can change on each page.

Octave Displays

The ⟨ and ⟩ keys are used to step the selected event number to the right or left, respectively.

To change the octave view, use the ENTER to jump your cursor from record number to frequency, and use the ⟨ and ⟩ keys to highlight to the left or right so that the levels can be displayed for different frequency bands.

17.6 Storing Event History

Although the event history data can be displayed during a measurement and after it has been stopped, the data has not been stored to memory. To store the data, press the ■ (Stop/Store) key.

17.7 Triggering Method

17.7.1 Level Triggering

LEARN MORE To learn more about Triggers see “Exceedances” on page 4-11.

Level triggering is static throughout the entire measurement. There is no offset. All triggers will be determined by their set threshold level exactly.

FIGURE 17-8 Event History with Level Triggering

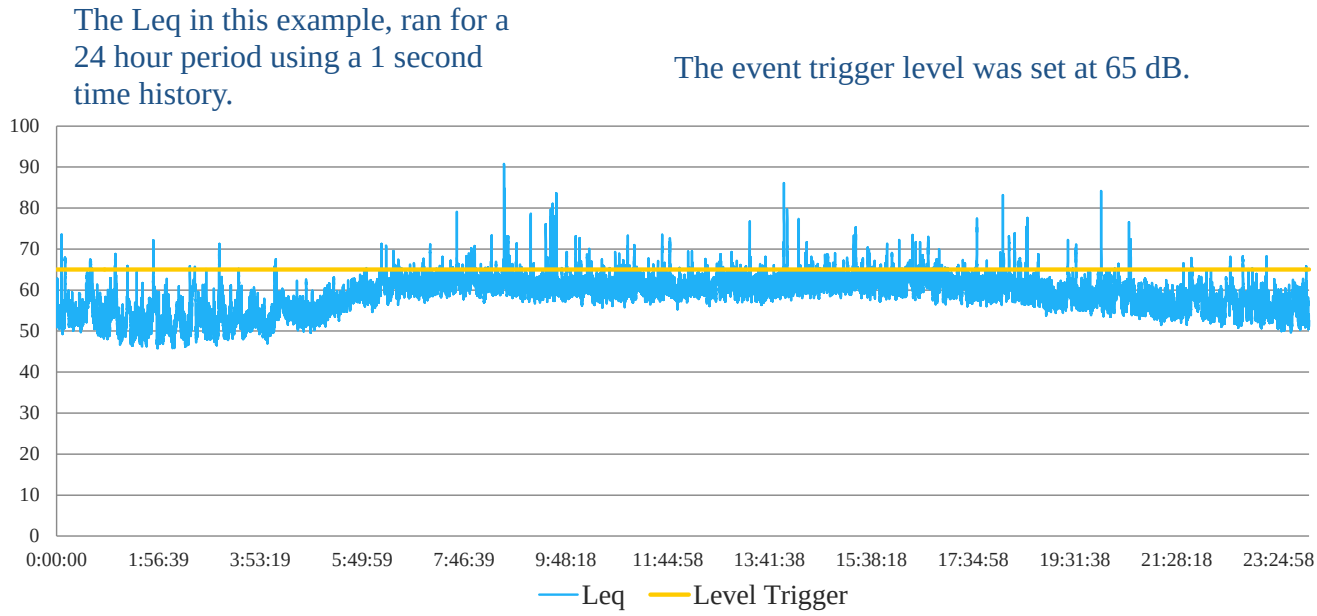
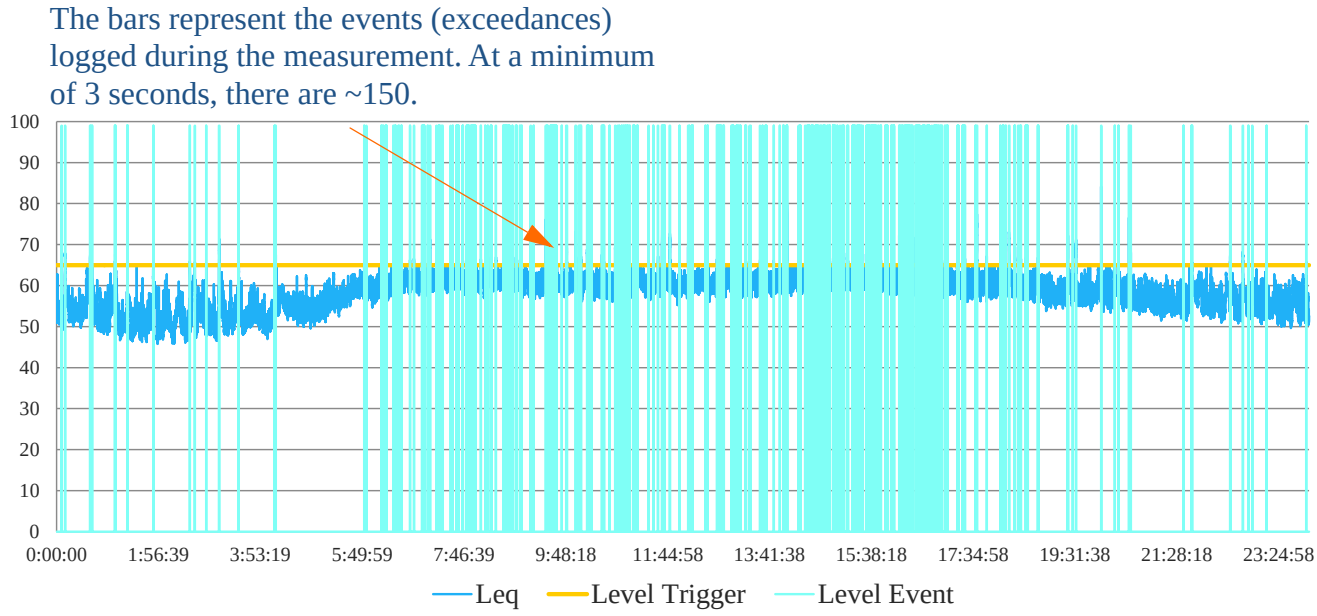


FIGURE 17-9 Event History with Level Triggering, events



17.7.2 Dynamic Triggering

With dynamic triggering, the event tracks the background noise level, and adjusts the trigger accordingly. The trigger level is adjusted to equal the background noise plus an offset.

FIGURE 17-10 Event History with Dynamic Triggering

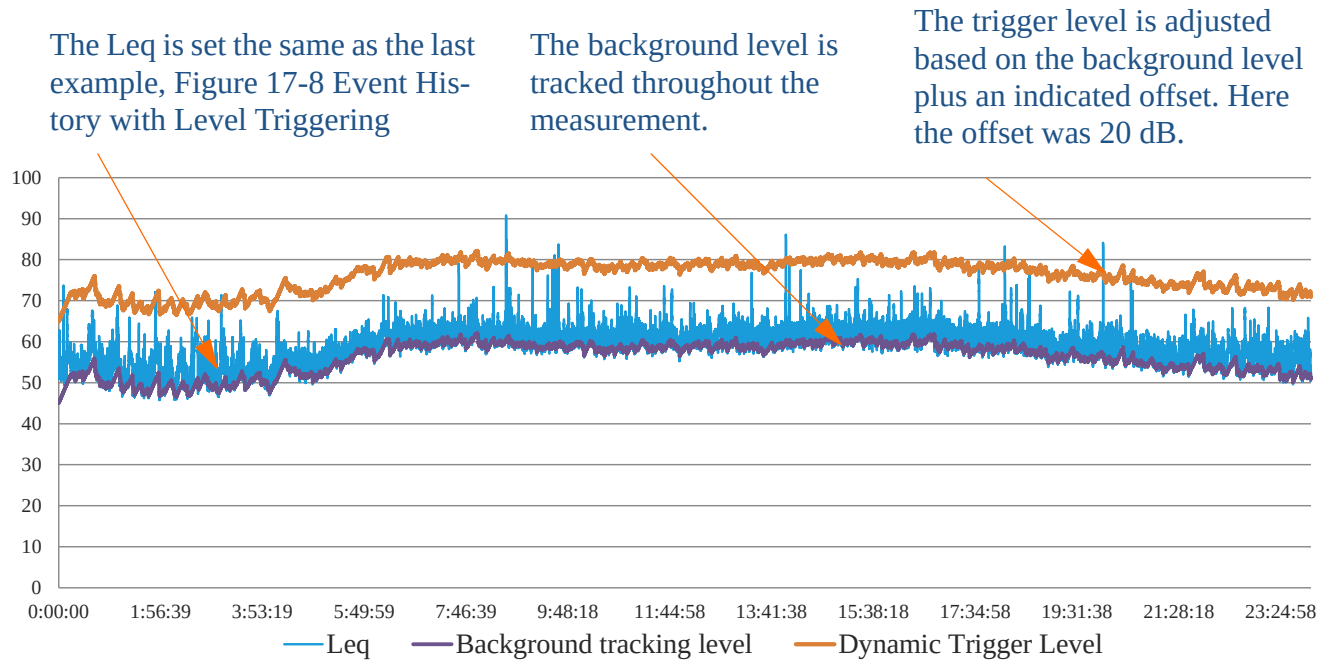
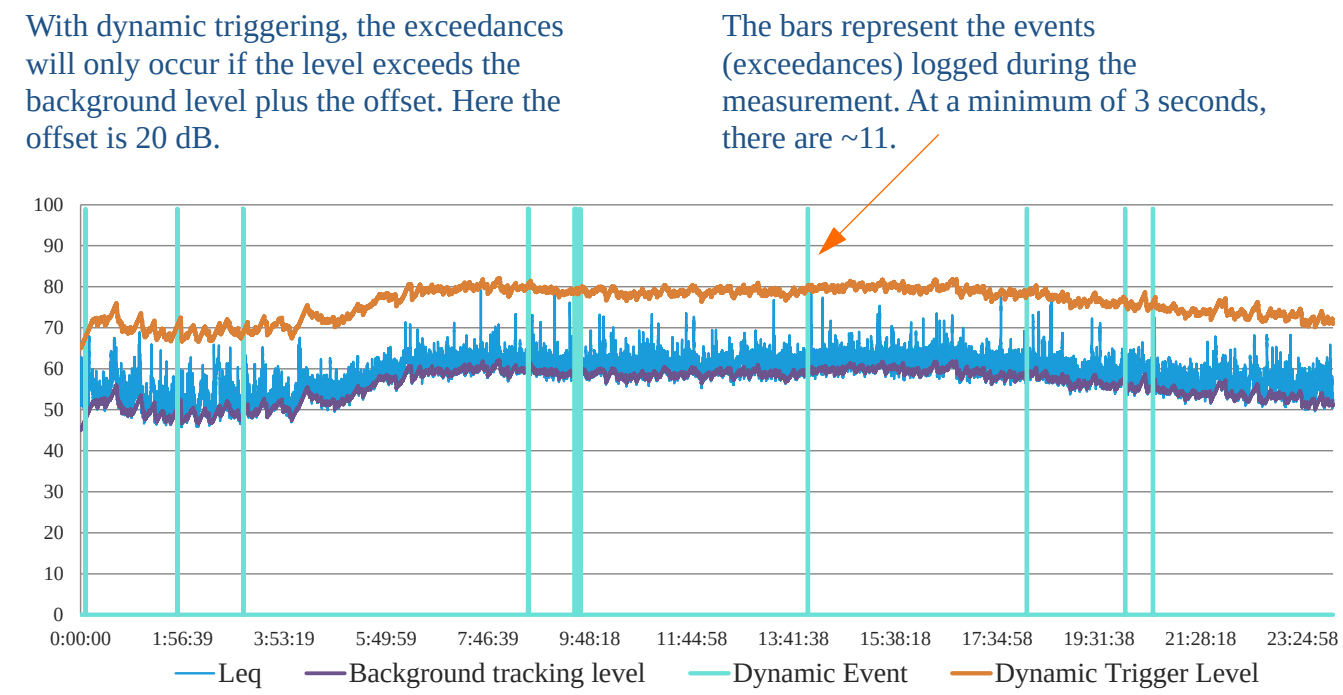


FIGURE 17-11 Event History with Dynamic Triggering, events



Background Level

The background sound level used with dynamic triggering is the user-indicated Ln level, calculated using an algorithm which includes the rise

rate in dB per minute. There are five Dynamic Trigger Parameters options available:

Table 17.1 Dynamic Response

Setting Number	Tracking Ln Percentile	Rise Rate, dB/ minute	Description
1	95%	1/2	Lower tracking level
2	90%	1/3	Slow
3	90%	1/2	Default, normal operation
4	90%	1	Fast
5	80%	1	Fast and higher tracking level

When the measurement first begins, the background tracking level is set to:

- Trigger Level SPL 1 - Offset = Initial Background Level

As the sound level increases above the tracking level, the tracking level will increase at the rise rate. As the sound decreases below the tracking level, the tracking level will decrease at the rate determined by the dynamic response (Ln Percentile and its rate).

The dynamic trigger level is set to:

- Background level + Offset = Trigger Level

Module18 Sound Recording

18.1 Overview

TAKE NOTE Firmware option 831C-SR must be purchased and enabled in order to use this option.

The following module provides the procedures for performing a sound recording using the Sound Recording option on the SoundAdvisor.

18.2 Enabling Sound Recording Option

To ensure that the **Sound Recording** option is successfully enabled and visible, see “Enabling/Disabling Optional Firmware” on page 14-4.

18.3 Create Setup File

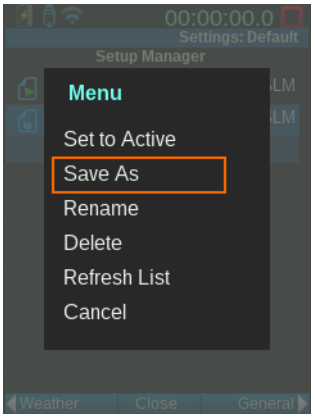
While measurement parameters can be indicated directly in the **Active** setup, it is good practice to first create a user-defined setup file for any specific measurement you perform. Once created, you can make that setup active. The following section will discuss how to do this.

To create a new setup file, follow these steps

Name the Setup

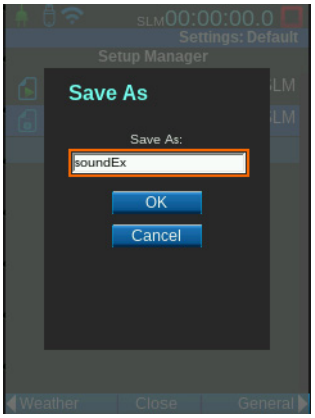
Step 1 Navigate to Tools or Menu ⇢ **Setup Manager**. Arrow down to **Default** and press **ENTER**. A **Menu** will appear. Select **Save As**.

FIGURE 18-1 Setup File Save As



Step 2 Name the file a unique name. This example will use "soundEx" as the setup file name. **OK**.

FIGURE 18-2 Name File



18.4 Manual Sound Recording

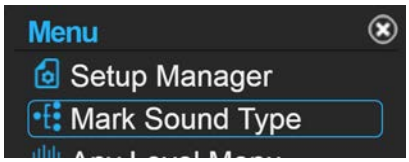
TAKE NOTE The sound recording will also stop when the memory is full. Note that if left recording, the memory will fill and create very large files that will be time consuming to download and playback.

During a run, you can manually record any sound the meter is currently measuring. To make a manual sound recording, follow these steps:

Step 1 Ensure a measurement is currently running.

Step 2 While on **Live (Profile)** or **Time History**, use the center softkey and navigate **Menu** ⇢ **Mark Sound Type**.

FIGURE 18-3 Mark Sound Type



Step 3 This menu is used to assign markers to the sound, however it is also used to manually record. Use the left softkey to initiate a sound record.

Step 4 To stop recording, select **Stop**, **Close**, or stop the measurement.

18.5 Marker Sound Recording

TAKE NOTE Markers can be used to simply mark the sound occurrence with a name, or when enabled for sound recording, also initiate a sound recording. See “Markers” on page 16-4.

TAKE NOTE This type of sound recording is manual and not automatic.

In order to identify the source or some other characteristic of a sound being recorded, then you can use markers and attach one or more to a sound recording.

These markers can then be used to initiate sound recordings from the markers setup menu.

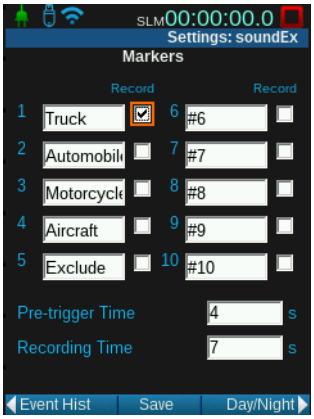
To make a sound recording using markers, follow these steps:

Step 1 If not already created, make a setup file. Follow the steps in section “Create Setup File” on page 18-1..

Step 2 Navigate **Setup Manager** ⇢ Highlight your setup file ⇢ **Markers**.

Step 3 Choose one or more to enable sound recording. In this example, **Truck** marker will be enabled.

FIGURE 18-4 Setup Manager Markers



Step 4 **Save**.

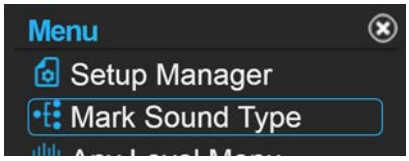
Make Setup Active

Step 5 In the Setup Manager, click the **soundEx** setup and select **Set To Active**. **Close**.

Step 6 Run a measurement.

Step 7 While on **Live (Profile)** or **Time History**, navigate **Menu** ⇢ **Mark Sound Type**.

FIGURE 18-5 Mark Sound Type



Step 8 A small overlay will appear on the bottom half of the screen with a list of all the markers. When one marker is selected, the recording time begins. When finished, a sound record is now available marked as **Truck**.

FIGURE 18-6 Mark Sound Type Sound Recording

18.6 Event Sound Recording

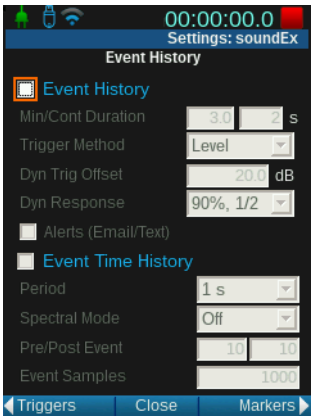
When an exceedance has been met an event begins, and this event can also initiate an automatic sound recording. In order to perform this type of sound recording, follow these steps:

LEARN MORE To learn more about Event History, see “Event History” on page 17-1.

Step 1 If not already created, make a setup file. Follow the steps in section “Create Setup File .

Step 2 Navigate **Setup Manager** ⇢ Highlight your setup file ⇢ **Event History**.

FIGURE 18-7 Event History



Step 3 Enable **Event History**.

Step 4 Navigate to **Sound**. Enable **Save Event Sound**.

FIGURE 18-8 Sound Event

TAKE NOTE If Event History is not enabled, but Event Sound is, a sound recording is still made on an exceedance as an exceedance sound recording.

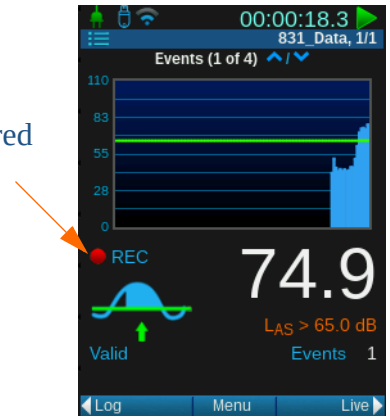
Step 5 **Save**. Select setup, **Set to Active**. **Close**.

Step 6 Run a measurement.

TAKE NOTE If a second event is triggered during a sound recording, the sound recording will extend. This can continue on until there are no more events. The sound recording will only be associated with the first event, though contain all the sound for the subsequent events.

Step 7 In this example, when the measured sound is above 65 db (SPL 1 Trigger Level) for at least 2 seconds (trigger time) it will record the 11 seconds (pre-trigger + snapshot time) of the sound.

FIGURE 18-9 Sound Event



TAKE NOTE A second sound recording cannot begin until the minim duration has elapsed since the last sound recording.

Constraints

If you indicate the minimum duration and pre-trigger values greater than the constraint, an error message will appear and the values will automatically adjust to be within the correct range.

Refer to the following table on the maximum values you can indicate for the minimum duration (Event History) and pre-trigger (Sound).

TAKE NOTE The 51.2 sample rate serves a unique function: when used with Time History records, the sound recording and the time history record will be synced. At any other rate, filter delays allow for decimation so the sound recordings are not perfectly synced.

Table 18.1 Sound Recording Constraints

Sample Rate	Minimum Duration + Pre-Trigger ≤
8 ksps	60 s
16 ksps	30 s
24 ksps	20 s
48 ksps	10 s
51.2 ksps	9.375 s

18.6.1 Measurement History Sound Recording

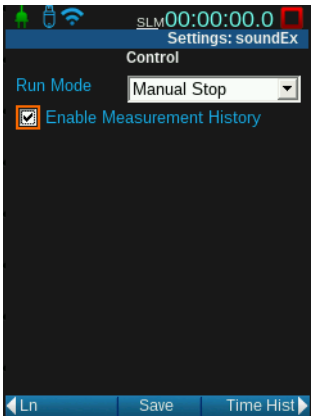
LEARN MORE To learn more about Measurement History, see “Measurement History” on page 15-1.

You can initiate a sound recording with each new measurement using the **Measurement History** option. At the beginning of each new measurement, a snapshot will record. To create a measurement using Measurement History and Sound Recording, follow these steps:

Step 1 If not already created, make a setup file. Follow the steps in section 18.3 Create Setup File on page 18-1.

Step 2 Navigate **Setup Manager** ⇢ Highlight your setup file ⇢ **Control**.

FIGURE 18-10 Sound Recording Control



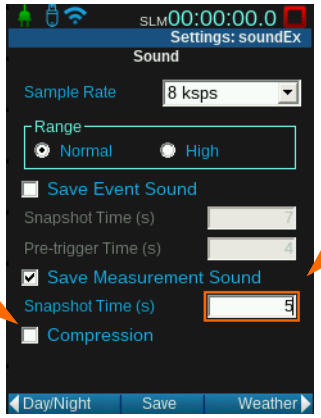
Step 3 Select a control, in this example **Manual Stop** will be used.

Step 4 Select **Enable Measurement History**.

Step 5 Navigate to **Sound**. Enable **Save Measurement Sound**.

FIGURE 18-11 Measurement Sound

If compression is selected, sound recordings are saved as compressed .ogg files, reducing the amount of memory required for sound recording.



The snapshot time (< 9999 s) is the time in seconds that will record after the measurement begins.

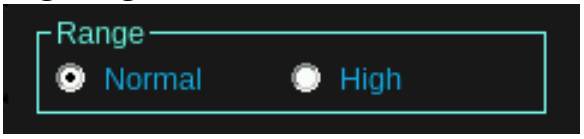
TAKE NOTE While you can indicate the sound record up to 9999 s, the actual time may be limited by the sample rate and the memory size.

Step 6 **Save**. Select setup, **Set to Active**. **Close**.

Step 7 Run a measurement. The first 5 seconds, in this example, will be recorded. Every stop followed by a run will have another sound record.

18.7 Sound Recording Range

FIGURE 18-12 Sound Recording Range



Resolution

Sound recordings are saved with 16-bit resolution which provides a measurement range of ~90 dB. This means that it is capable of recording sound signals with amplitudes no more than 90 dB below the level at which the selected range will overload. When the overload level is

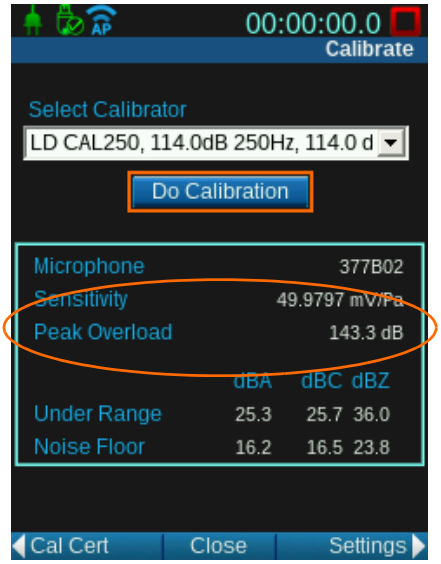
expressed in terms of peak level and the signal level as root-mean-square (RMS), this range is actually 93 dB. Note, however, in practice this lower limit is the internal noise floor of the instrument.

Peak Overload

Before the meter can calculate the peak overload, the microphone type must be set accurately. To ensure the correct microphone is set, navigate **Tools** ⇢ **Calibrate** ⇢ **Settings**, see "Calibration" on page 5-1.

You need the Peak Overload value to calculate the sound recording range. Additionally, setting the gain at either 0 dB or 20 dB (**Menu** ⇢ **Setup Manager** ⇢ **SLM**) and whether the range is set to normal or high (**Menu** ⇢ **Setup Manager** ⇢ **Sound**), will result in different values of upper and lower limits for any given microphone.

FIGURE 18-13 Peak Overload



18.7.1 Sound Recording Range Calculation

When the **peak overload**, **range**, and **gain** have been set for the SoundAdvisor, the sound recording range can be calculated using the table below:

Table 18.2 Sound Recording Range Calculator

Range	High		Normal	
Instrument Gain	0 dB	+20 dB	0 dB	+20 dB
Upper Limit	Peak Overload - 0 dB	Peak Overload - 20 dB	Peak Overload - 31 dB	Peak Overload - 51 dB
Lower Limit Level	Upper Limit - 93 dB			
Sound Recording Range	Lower Limit Level — Upper Limit			

For example, if the following settings were active for a measurement setup:

- Range: High
- +20 Gain
- Peak Overload: 143.3

Then the Sound Recording Range would be 30.3 dB — 123.3 dB.

18.7.2 Quality

The quality of the sound recording depends on the levels of sound being recorded and the instrument gain and range used in the setup. If the sound level exceeds the upper limit, clipping will occur. If the sound level drops below the lower limit of the sound recording range, then its signal will be lost in the noise during playback. Because of this, the selection of the gain and range should be made with the characteristics of the anticipated sound in mind.

When measuring very loud noise levels (gun blasts, sonic booms, space shuttle lift off) use the High range. When trying to identify quiet noise sources (crickets, airplanes flying at 3000 ft, national park soundscape studies, people talking in the vicinity of the microphone) and don't mind very loud noises being clipped (distorted), use the Normal range.

18.8 Sound Recording Playback

TAKE NOTE G4 LD Utility on a PC will playback all audio files recorded or saved.

Sound recordings are saved as .wav (uncompressed) and .ogg (compressed) files and can be played back on the SoundAdvisor if a USB compatible device is inserted, or on a PC using G4 LD Utility.

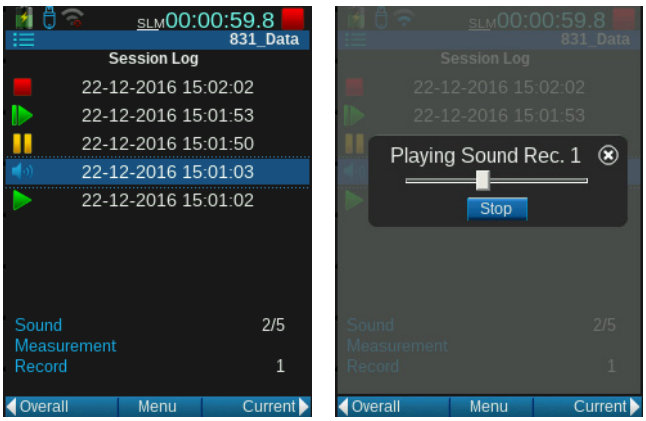
18.8.1 USB Headphone/Speaker

The SoundAdvisor supports a USB Audio headphone or headset for audio playback.

18.8.2 Playback from Session Log

You can play back a sound recording from the **Session Log** tab on the SoundAdvisor, as long as a playback device is inserted.

FIGURE 18-14 Session Log Playback



18.9 Storing Sound Recordings

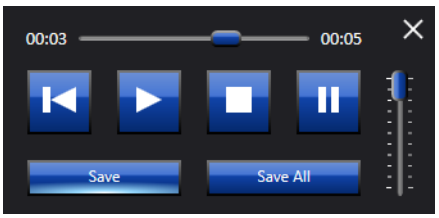
Playback can continue until you've saved your data file. You can download your data file using G4 LD Utility to listen to the saved data files. Alternatively, you can hear saved sound recordings in the **Data File Manager**.

FIGURE 18-15 Saved Data File

A	B	C	D	E	F	G	H
Record #	Date	Time	Record Type	Cause	#	TH Record	Sound Record
1	2017-01-27	14:10:24	Run	IO	1	1	
2	2017-01-27	14:10:24	Sound	Measurement	1	2	Sound Record 1
3	2017-01-27	14:10:49	Sound	Event	2	27	Sound Record 2
4	2017-01-27	14:14:17	Stop	IO	1	236	

After your data file has been downloaded, you can find your sound recordings on the Session Log, Measurement History, and Event History tabs (depending on your measurement setup). A player will appear if you select the sound record.

FIGURE 18-16 File Player



18.9.1 Sound Recording File Size

To determine the file size of a sound recording, refer to the following table which describes an approximate file size for a sixty second sound recording:

TAKE NOTE The .wav file sizes in Table 18.3 are accurate (rounded to the nearest 50 kB), and the .ogg file sizes are approximations-- as it is unique to the sound recording. Use the table to estimate memory space needed for your measurement.

Table 18.3 60 Second Sound Recording File Sizes

Sample Rate	.wave	.ogg
8 ksps	0.96 MB	200 kB
16 ksps	1.98 MB	350 kB
24 ksps	2.88 MB	450 kB
48 ksps	5.67 MB	600 kB
51.2 ksps	6.14 MB	650 kB

Appendix A Technical Specifications

A.1 Overview

Specifications apply to the SoundAdvisor Model 831C used with a 377B02 microphone, PRM831 microphone preamplifier and EXC020 20 foot (6 m) preamplifier extension cable.

A.2 SoundAdvisor Model 831C Instrument Platform

Standards Met

Safety: IEC 61010-1:2010: Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use

Table A.1 Safety Marks

CE	CE-mark indicates compliance with the EMC and Low Voltage Directives
C-Tick	C-Tick indicates compliance with the EMC and Low Voltage Directives for Australia and New Zealand
	cUL/UL and SAA
WEEE	WEEE mark indicates compliance with the EU WEEE Directive

EMC Emission: CISPR 11:2015 with Amend 1 (EN 55011)
EMC Immunity: EN 61672-1:2013, EN 61000-6-2:2005

Other Standards: Test results and certificates compliant with ISO 17025

Supplied Microphone

Model 377B02, 1/2” free-field, prepolarized condenser microphone
Typical Sensitivity: 50 mV/Pa (+/-1.5 dB) corresponding to -26 dB re. 1 V/Pa
Frequency Response: 3.15 Hz to 20 kHz (+/-2 dB)
Capacitance: 12 pF

Microphone Preamplifier

Model PRM831, 1/2” dia x 2.88”
Typical Preamplifier Attenuation: 0.08 dB
Connector: 5-Pin Male, Switchcraft TA5MLAUX
Mating Connector: 5-Pin Female, Switchcraft TA5FLAUX
Extension Cables: A preamplifier extension cable may be placed between the meter and the preamplifier/microphone with no degradation for lengths up to 200 feet (61 m).

Microphone polarization voltage: 0 V (no polarization provided, use pre-polarized microphones)

SLM Performance

		PRM831 with 377B02 Microphone (dB)		Direct Input (dBµV)	
Gain		**0 dB**	**+20 dB**	**0 dB**	**+20 dB**
Measurement Range[1]	**A**	24-140	20-120	n/a	n/a
	C	26-140	25-120	n/a	n/a
	Z	36-140	33-120	n/a	n/a
Typical Noise Floor[1]	**A**	16.3	15.6	8.3	-0.1
	C	16.8	16.3	6.9	-1.4
	2	23.4	23.2	12.3	3.0
Linearity Range[2]	**A**	≥117	≥102	≥120	≥108
		23-140	18-120	20-140	12-120
	C	≥114	≥96	≥121	≥110
		25-140	24-120	19-140	10-120
	Z	≥104	≥87	≥117	≥104
		36-140	33-120	23-140	15-120
Peak Range[2]	**A**	65-143	44-123	65-143	46-123
	C	66-143	45-123	63-143	46-123
	Z	68-143	59-123	64-143	46-123
SPL Max Level[2]		≥140	≥120	≥140	≥120
Peak Max Level[2]		≥143	≥123	≥143	≥123

1. Microphone and electrical self-noise included
2. Electrical measurement, frequency 1k Hz

User Interface

Keyboard: 13 keys, quiet elastomer touch with blue back-lighting for measurement control and data navigation

Status Indicators:

- Red LED under the STOP/STORE key indicates measurement stopped
- Green LED under the RUN/PAUSE key indicates measurement running
- Green LED under the power key indicates battery charge and power on/off in progress

Display:

- TFT full color LCD, 240 by 320 dot matrix
- White backlight with adjustable brightness and on–time
- Touch screen to assist in data navigation and measurement control
- Multiple color themes for various lighting conditions

Display update rate: ≤ 1 s

Lock: User interface may be locked and unlocked

Languages: Czech, English, French, German, Italian, Norwegian, Portuguese, Russian, Spanish, Swedish, Turkish

Input

Connector: Latching 5-pin circular connector, mates to PRM831 or EXCxxx cables

Preamplifier Supply: 36 volt at 5mA available to power preamplifier

Input Impedance: ≥ 100kΩ || 300 pF

Direct Input: Absolute maximum of ±35 V, DC bias readout 0 to +35 V

Gain Control: Selectable 0 or +20 dB gain

Full Scale Input 0 dB Gain: ±14.14 Vpeak AC

Full Scale Input +20 dB Gain: ±1.414 Vpeak AC

ICP Input (use ADP074): Constant current of 4 mA, maximum voltage of 28 V

Sample Rate: 51,200 sps

USB Client Interface

Type: USB 2.0 High–Speed Mini–B connector

Power Draw: ≤ 500mA from PC, USB Hub, or PSA029

Supported Hosts:

- Computer with SLM Utility-G4
- Ethernet Dock 831INT-ET
- NoiseTutor
- Computer with custom software using SWW-G4-SDK or SWW-G4-WIN

USB Host Interface

Type: USB 2.0 High–Speed, standard A connector

Supported Devices:

- USB Flash Memory Drive, up to 32GB FAT-32 Format, PN 831-M
- Ethernet Adapter, 1G/100M/10M, PN DVX012
- Ethernet Adapter & USB Hub, 1G/100M/10M, PN DVX013
- WiFi Wireless Adapter, Edimax EW-7811Un, or D-Link DWA-121, PN DVX014

- GPS Receiver HOLUX M-215, PN GPS001
- Multi–Metric Weather Sensor, Vaisala WXT520, PN SEN031
- Ultrasonic Wind Sensor, Vaisala WMT52, PN SEN032
- Wireless LTE Gateway, Sierra Wireless Air-Link RV-50, PN COM-RV50-DC-E or COM-RV50-DC-U

AC/DC Output

Connector: 2.5mm (3/16") Sub-Miniature Phone Jack, AC Output on RING, DC Output on TIP
AC Output Selections: (1) Off, (2) 0 dB, (3) +20 dB, (4) +40 dB, and (5) Preamp 10V
Gains of 0, +20 and +40 are relative to measurement full scale.
AC Output Voltage: For 0 dB through +40 dB selection: ±2.12 Vpeak Maximum (-16.5dB re. to input), suitable for LINE inputs
For Preamp selection: ±14.14 Vpeak Maximum
AC Output Impedance: 1kΩ || 1000pF
AC Output Frequency Weighting: No frequency weighting is applied. Includes input's 0.1Hz high-pass filter only
DC Output Voltage: 10 mV/dB, +2.2 V maximum, 0V ≈ 0dB & 2V ≈ 200dB
DC Output Impedance: 1kΩ || 1000pF

AC Performance

		0 dB Gain	20 dB Gain
AC Output Setting	**Output re input (dB)**	**Maximum* (dB re 20 µPa)**	**Maximum* (dB re 20 µPa)**
Off	Off	Off	Off
Out + 0 dB	-16.5	140	120
Out +20 dB	-36.5	120	100
Out +40 dB	-56.5	100	80
Preamp 10V	0.0	140	120
* Results for typical 377B02 microphone, actually sensitivity effects results			

I/O Connector

Provides External Power, Analog and Digital I/O, and enhanced capabilities for 831-INT
Mating connector: Hirose ST40X-18S or ST60X-18S
Logic Output: Output driven 0 to +3V through 1kΩ, setting selects function
Logic Input: Input accepts 0 to +3.3V, ≈50kΩ load, setting selects function
External Power: +10 to +25 V, 500mA, self resetting fuse
Digital Sensor Port: Synchronous serial port for PRM2103 and 426A12 metrics
Preamplifier Control: Digital control lines for preamplifier calibration check and overload detection
Windspeed Pulse Input: Input accepts 0 to +3 pulses from anemometer (+5V tolerant), 100kΩ load, setting selects function
Analog Inputs: 3 channels, 0 to +2.5 V, 100kΩ load, settings for scale and offset

I/O Connector Pinouts

The pinouts for the I/O Connector are as shown below:

Pin #	Description	Signal Type
1	Ground, Digital and Power Supply	Ground
2	Logic Out 1, Logic Control Output	Output, 0 to +2.7 V
3	831 Activity	Output, 0 to +2.7 V
4	Logic In, Logic Control Input	Input, 0 to +5 V
5	Ground, Digital and Power Supply	Ground
6, 7	Vext, External Power Input	Input, +10.8 to +30 V, 0.5 A auto-resetting PTC fuse
8	SensorClk_L, LD 426A12 digital sensor clock	Output, open drain, +20 V max. open and 50 mA max. closed
9	SensorDIO, LD 426A12 digital sensor data	Bi-directional, +2.7 to +5 V logic, open drain
10	CalOn_H, LD 426A12 calibration signal on	Output, 0 to +2.7 V
11	Ovld, LD 426A12 overload detection signal	Input, 0 to +5 V
12	Mains Power Status; OK when +2.7 V	Input, 0 to +2.7 V
13	+2.7 V to supply logic switches	Output, +2.7 V through 220 Ω
14	WindSpeedIn, Pulse input for wind speed sensors	Input, +5 Vpp max.
15	Vwthr1, Analog to Digital Converter Input, Wind Direction	Input, 0 to +2.048 V, 100k Ω load, scale with series resistor
16	Vwthr2, Analog to Digital Converter Input, Temperature	
17	Vwthr3, Analog to Digital Converter Input, Humidity	

Pin #	Description	Signal Type
18	Analog Ground, Signal ground for pins 15 through 17	Ground

1. To enable the “Logic In, Logic Control Input” feature, when making your own cable, pin 12 (Mains Power Status) must be driven by a resistance lower than about 20kΩ. This may be done by connecting a 10kΩ resistor from pin 12 to either pin 13 (+2.5V, to simulate running on Mains power) or to pin 1 or 5 (Ground, to indicate running on external battery power). Pin 4 needs to be driven high to assert the Logic In and pulled low to de-assert the input. It should not be left floating. This can be done with a momentary push-button switch from pin 4 to pin 13 with a 10kΩ pull down resistor to ground (10kΩ from pin 4 to pin 1 or 5).

Battery

Size: 4 x AA size cells (LR6)
Types: 1.5 V Alkaline, 1.2 V NiMH rechargeable, 1.5 V Photo–Lithium
Typical Operating Time: > 8 hours continuous measurement

External Power

Via USB Client Connector: Powered by computer or PSA029 Power Adapter, 5.0 ±0.5 V typical, 16 V absolute maximum

External DC Power Supply

Provides power to operate instrument, supply USB Host port with 500mA, and charge batteries
Recommended Supplies: Use cable CBL140 with PSA027, CBL154 for 426A12, or Model 831-INT Interface with Mains and battery supplies
Voltage: +10 to +25 V
Supply Current Requirement: 1.0 A minimum
Power Consumption: < 5.5 W (no USB Host devices, not charging, backlights off)
<5.4 W (WiFi)
<5.5 W (USB Memory)
<5.4 W (backlights on)

Table A.2 Low Power At Boot-Up

Power Level	Power Source	Parameters	Icon	Action
Low	External	< External Shutoff Voltage[1] + 0.8 V		Warning Only
	Internal	< 4.2 V		
Very Low	External	< External Shutoff Voltage + 0.5 V		Halts boot-up process[2]
	Internal	< 4.1 V		Halts boot-up process and shuts down.
Dead	External	< External Shutoff Voltage - 0.2 V	N/A	Aborts boot-up and shuts down.
	Internal	< 3.8 V	N/A	

1. The External Shutoff Voltage is a user defined setting, see 9.5.7 "External Shutoff Voltage" on page 9-5
2. The boot up process halts for one minute, if power is not restored within one minute, then the meter will shut off for a period of time before powering back on. When the meter powers back on is determined by the number of times trying to boot with failed power, see Table A.3.

Table A.3 Power On After External Power Fail Schedule

Powers On	Time Since Last Power Fail
1st Attempt	20 minutes
2nd Attempt	1 hour
3rd Attempt	2 hours
4th Attempt	4 hours

Table A.3 Power On After External Power Fail Schedule (Continued)

Powers On	Time Since Last Power Fail
5th Attempt	6 hours
6th Attempt	12 hours
7th - 16th Attempt	24 hours

Power-on Time

< 2 minutes

Real-Time Clock

Drift <0.3 s drift per 24 hour period over full operating temperature range, battery back-up powered
Backup Time 1 year rechargeable battery backup

Data Storage

Internal: 2 GB non-volatile flash memory dedicated to data and user setups

External: Up to 32 gigabyte USB Flash Memory Drive

Environmental Conditions

Operating Temperature: –30 to +50°C (–22 to 122°F)
Storage Environment: –30 to +60° C (–22 to +158°F), less than 90% RH
Temperature Sensitivity: < 0.5 dB error, –10 to +50°C (14 to 122°F) at 1kHz
Humidity Sensitivity: < ±0.5 dB error, 25% to 90% relative humidity at 40°C (104°F) at 1kHz

Personal Characteristics

Dimensions:
- 290 x 71 x 41 mm (11.35") includes microphone and preamplifier
- 224 x 71 x 41 mm (8.80") instrument body only

Weight:
- 531.6 g (18.8 oz) including batteries, preamplifier and microphone
- 489.2 g (17.3 oz) including batteries

A.3 SoundAdvisor Model 831C Base Software

Standards Met

Sound Level Standards:
- IEC 61672-1:2013 Class 1, Group X
- IEC 60651 Ed 1.2 (2001) plus Amendment 1 (1993-02) and Amendment 2 (2000-10) Type 1, Group X
- IEC 60804 (2000-10) Type 1, Group X
- ANSI S1.4-2014 Class 1
- ANSI S1.4-1983 (R2006) plus Amendment ANSI S1.4A-1985 (R2006) Type 1
- ANSI S1.43-1997 (R2007) Type 1
- DIN 45657 Sound level meters - Additional requirements for special measuring tasks

Correction Filters

- Frequency response correction filters are available for sound field/microphone type and for environmental protection accessories.
- Note: “RI” indicates “Random Incidence” and “FF” indicates “Free-Field”
- For microphone 377B20: RI to FF
- For microphone 377B02: FF to RI
- For microphone 377B02 with EPS2106/8: FF to RI, FF to FF, FF:90°
- For microphone 377B02 with EPS2116: FF to RI, FF to FF, FF:90°

Table A.4 SLM with PRM831 and 377B02 Microphone

Frequency	0° Free Field Corrections[1,2]	0° Free Field Corrections with WS[1,2]	0° Free Field Corrections[1,3]	0° Free Field Corrections with WS[1,3]	expanded uncertainty of Corrections [1,4]
Hz	dB re 1 kHz	dB re 1 kHz	dB re 1 kHz	dB re 1 kHz	dB
31.62	-0.14	-0.14	-0.09	-0.09	0.25
63.10	-0.11	-0.11	-0.09	-0.09	0.25
125.89	-0.21	-0.21	-0.20	-0.20	0.25
251.19	-0.08	-0.08	-0.09	-0.09	0.25
501.19	-0.22	-0.12	-0.22	-0.12	0.25
1000.00	0.00	0.00	0.00	0.00	0.25
1995.26	-0.05	-0.45	-0.02	-0.42	0.25
3981.07	0.76	0.76	0.78	0.78	0.25
7943.28	2.91	3.21	3.30	3.60	0.35
12589.25	5.85	6.15	6.42	6.72	0.50
15848.93	7.74	7.34	8.46	8.06	0.50

1. add numbers in this column to levels read on the SLM to correct to the 0° Free Field level at frequency
2. From B&K 4266 Calibrator
3. From B&K UA033 EA
4. Corrections at 95% confidence.
EA - Electrostatic Actuator
WS - Windscreen
Note: Data was taken at reference conditions 23° C, 50% RH, 101.3 kPa

Measurement System

Integration Method:

- Equivalent level integration method can be Linear or Exponential.
- Exponential integrates the output of the selected time weighting (Slow, Fast or Impulse)

Integration Time:

- Minimum: 0.1 s
- Maximum, <0.5dB error: > 23 days

Frequency Weightings: A, C, Z parallel and simultaneous for each Time Weighting, selected frequency weighting (A, C or Z) indicated by ω
Peak Frequency Weightings: A, C, Z parallel, selected peak frequency weighting (A, C or Z) indicated by ρ
Time Weightings/Detectors: Slow, Fast, Impulse, Linear and Peak simultaneously, selected time weighting (S, F or I) indicated by τ
Peak Rise Time: 30 µs

Measurements

Instantaneous “Live” Metrics

For display and profile graph, not stored with measurement.
A primary frequency and time weighting is selected by setting for RMS and Peak level to display, all levels are available in an “Any Level” matrix.

Time Weighting	A	C	Z	Units
Linear	L_{Aeq}	L_{Ceq}	L_{Zeq}	dB
Slow	L_{AS}	L_{CS}	L_{ZS}	dB
Fast	L_{AF}	L_{CF}	L_{ZF}	dB
Impulse	L_{AI}	L_{CI}	L_{ZI}	dB
Peak	L_{Apeak}	L_{Cpeak}	L_{Zpeak}	dB

Overall Metrics

A primary frequency and time weighting is selected by setting for RMS and Peak level to display, all levels are available in an “Any Level” matrix.

Time Weighting	A	C	Z	Units
Linear[1]	L_{Aeq}	L_{Ceq}	L_{Zeq}	dB
Linear[2]	L_{ATeq}	L_{CTeq}	L_{ZTeq}	dB
Slow Maximum	L_{ASmin}	L_{CSmin}	L_{ZSmin}	dB
Slow Minimum	L_{ASmax}	L_{CSmax}	L_{ZSmax}	dB
Fast Minimum	L_{AFmin}	L_{CFmin}	L_{ZFmin}	dB
Fast Maximum	L_{AFmax}	L_{CFmax}	L_{ZFmax}	dB
Impulse Minimum	L_{AImin}	L_{CImin}	L_{ZImin}	dB
Impulse Maximum	L_{AImax}	L_{CImax}	L_{ZImax}	dB
Peak	$L_{Apeak(max)}$	$L_{Cpeak(max)}$	$L_{Zpeak(max)}$	dB

1. Linear integration method selected by user
2. Exponential Integration method selected by user

Occurrence Time for Minimum and Maximum Levels

Time Weighting	A	C	Z	Units
Slow Maximum	T_{ASmin}	T_{CSmin}	T_{ZSmin}	y/m/d h:m:s
Slow Minimum	T_{ASmax}	T_{CSmax}	T_{ZSmax}	y/m/d h:m:s
Fast Minimum	T_{AFmin}	T_{CFmin}	T_{ZFmin}	y/m/d h:m:s
Fast Maximum	T_{AFmax}	T_{CFmax}	T_{ZFmax}	y/m/d h:m:s
Impulse Minimum	T_{AImin}	T_{CImin}	T_{ZImin}	y/m/d h:m:s
Impulse Maximum	T_{AImax}	T_{CImax}	T_{ZImax}	y/m/d h:m:s
Peak	$T_{Apeak(max)}$	$T_{Cpeak(max)}$	$T_{Zpeak(max)}$	y/m/d h:m:s

Percentile Levels, percentages n1 through n6 selectable, 0.01 to 99.99%
Statistics are sampled every 10ms from the selected frequency and time weighted detector.

		Units
1	$L_{\omega Tn1}$	dB
2	$L_{\omega Tn2}$	dB
3	$L_{\omega Tn3}$	dB
4	$L_{\omega Tn4}$	dB
5	$L_{\omega Tn5}$	dB
6	$L_{\omega Tn6}$	dB

Exceedance Metrics, exceedance levels (L1, L2, P1, P2 and P3) selectable in dB from 0.0 to 200.0, counts each time the level rises above the threshold and measure the duration while above the level minus 2dB.

	Label	Count	Duration
SPL 1	$L_{\omega T > L1}$	0 to 99999	h:m:s.s
SPL 2	$L_{\omega T > L2}$	0 to 99999	h:m:s.s
Peak 1	$L_{\omega T > P1}$	0 to 99999	h:m:s.s
Peak 2	$L_{\omega T > P2}$	0 to 99999	h:m:s.s
Peak 3	$L_{\omega T > P3}$	0 to 99999	h:m:s.s

Overload count and duration metrics

- Occurrences, count from 0 to 99999: nnnnn
- Overload Percentage: nnn.nn %
- Duration Overloaded: h:m:s.s
- Elapsed Run-Time: h:m:s.s
- Elapsed Pause-Time: h:m:s.s

Community Noise

- Day Night Level, midnight to midnight
  - LDN
- Daytime portion of Day Night Level
  - Lday (T_{day} - T_{night})
- Nighttime portion of Day Night Level
  - LNight (T_{night} - T_{day})
- Day Evening Night Level, midnight to midnight
  - LDEN
- Daytime portion of Day Night Level
  - LDay (T_{day} - T_{eve})
- Evening-time portion of Day Night Level
  - LEve (T_{eve} - T_{night})
- Nighttime portion of Day Night Level
  - LNight (T_{night} - T_{day})

C minus A
mathematical subtraction of C and A weighted equivalent levels

Linear	Exponential	Units
L_{Aeq} - L_{aeq}	L_{ATeq} - L_{aTeq}	dB

Impulsivity

Mathematical subtraction of impulse and linear equivalent levels

Linear	Exponential	Units
$L_{AIeq} - L_{Aeq}$		dB

Location, GPS (internal or external GPS, records last fix of measurement):

- Latitude: dg m.m
- Longitude: dg m.m
- Elevation: m or feet
- Time Acquired: h:m:s

Measurement Control

Multiple control modes provide for manual and automated measurements
Manual: Manually control measurements-- RUN, PAUSE, RESUME, STOP, STORE
Timed Stop: Start manually and runs for set run time (1 second to 99 hours)
Stop When Stable: Start manually and runs until levels are stable
Continuous: Start manually or at power on and runs without interruption, Daily Auto-Store available, special restart after low battery features enabled
Single Block Timer: Runs from a set date and time to another date and time
Daily Timer: Runs for up to three time blocks per day qualified by a start date and an end date

Measurement Status

Measurement status is indicated on the display and with lights below the STOP and RUN keys. Stopped Reset, Stopped, Run, Paused, Stored, Standby
Icons on display indicate Overload, battery state and memory status.

Back–Erase

Erase the previous five or ten seconds from a measurement.

A.4 SoundAdvisor Model 831C Octave Band Analysis Software – Option 831C-OB3

Standards Met

Octave Filter Standards: IEC 61260-1:2014/Part 1, 1/1 and 1/3-octave Bands, Class 1, Group X, all filters
ANSI/ASA S1.11-2014/Part 1, 1/1 and 1/3-octave Bands, Class 1, Group X, all filters

Bandwidth

1/1 Octave, 1/3 Octave, or simultaneous 1/1 and 1/3 Octave

Filter Type and Sample Rate

Digital filters are sampled at a rate of 51,200 samples per second, with base 10 center frequencies and have real-time performance for all filters. The 0 dB gain setting and “high” OBA range is the reference range and the reference input signal is .5 Volt rms at 1 kHz.

1/1 Octave Center Frequencies

8 Hz to 16 kHz

1/3 Octave Center Frequencies

6.3 Hz to 20 kHz

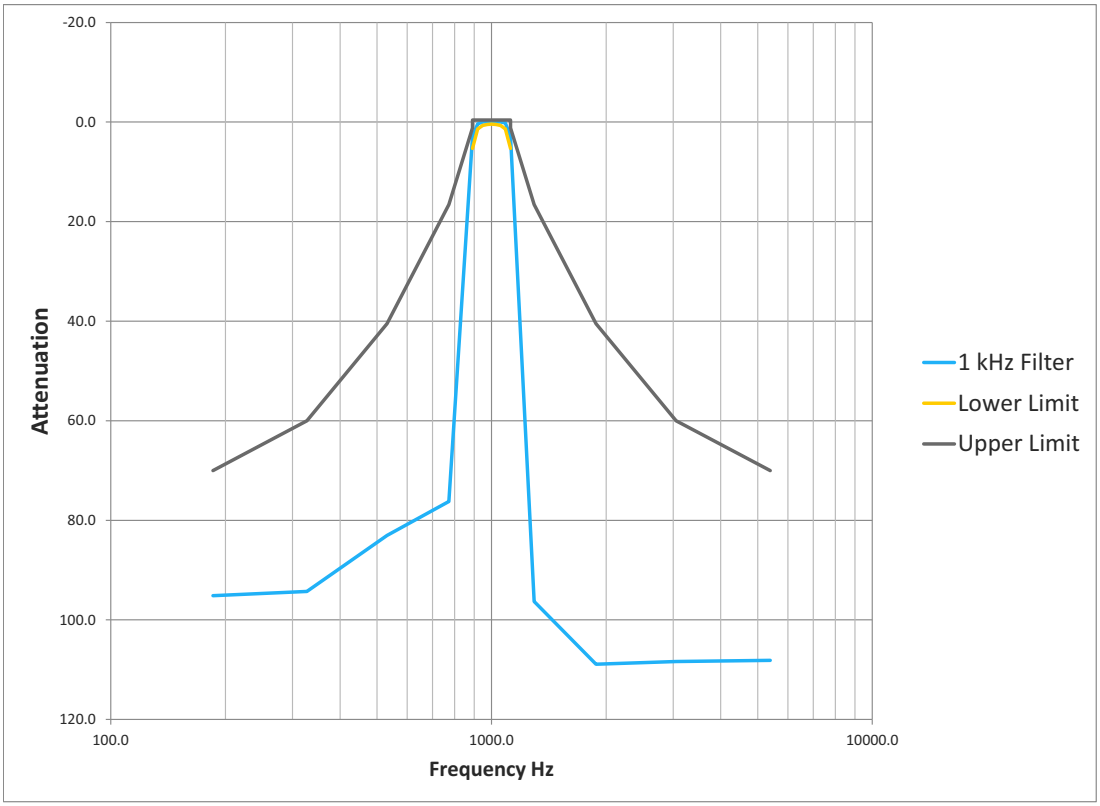
Measurement Range

Normal (110 dB full scale) and High (140 dB full scale).

Filter Shape

1/3 octave band centered at 1 kHz. Overlaid with the Class 1 limit curves.

FIGURE A-1 Filter Shape



Filter Linearity

Table A.5 Table A.3 Octave Band Analysis 1/1 Octave Linearity Range

Nominal Frequency (Hz)	High OBA Range		Normal OBA Range	
	0 dB Gain (dB)	+20 dB Gain (dB)	0 dB Gain (µdB)	+20 dB Gain (dB)

Nominal Frequency (Hz)	High OBA Range		Normal OBA Range	
	0 dB Gain (dB)	+20 dB Gain (µdB)	0 dB Gain (µdB)	+20 dB Gain (µdB)

PRM831	8.0	≥ 108 32 to 140	≥ 89 31 to 120	≥ 80 30 to 110	≥ 61 30 to 90
	16.0	≥ 110 30 to 140	≥ 92 28 to 120	≥ 83 27 to 110	≥ 64 27 to 90
	31.5	≥ 112 29 to 140	≥ 95 26 to 120	≥ 86 25 to 110	≥ 66 24 to 90
	63.0	≥ 113 27 to 140	≥ 97 23 to 120	≥ 88 22 to 110	≥ 69 21 to 90
	125	≥ 113 27 to 140	≥ 100 20 to 120	≥ 91 19 to 110	≥ 73 18 to 90
	250	≥ 113 27 to 140	≥ 103 17 to 120	≥ 94 16 to 110	≥ 76 15 to 90
	500	≥ 111 29 to 140	≥ 105 15 to 120	≥ 96 14 to 110	≥ 78 13 to 90
	1000	≥ 109 31 to 140	≥ 105 15 to 120	≥ 97 14 to 110	≥ 79 12 to 90
	2000	≥ 106 34 to 140	≥ 104 16 to 120	≥ 96 15 to 110	≥ 79 11 to 90
	4000	≥ 103 37 to 140	≥ 102 18 to 120	≥ 93 17 to 110	≥ 78 12 to 90
	8000	≥ 100 40 to 140	≥ 99 21 to 120	≥ 91 20 to 110	≥ 76 14 to 90
	16000	≥ 97 43 to 140	≥ 96 24 to 120	≥ 88 23 to 110	≥ 74 17 to 90

Direct Input	8.0	≥ 102 110 to 39	≥ 98 23 to 120	≥ 101 9 to 110	≥ 89 1 to 90
	16.0	≥ 108 110 to 32	≥ 106 14 to 120	≥ 108 2 to 110	≥ 92 -2 to 90
	31.5	≥ 120 110 to 20	≥ 118 3 to 120	≥ 111 -1 to 110	≥ 96 -6 to 90
	63.0	≥ 119 110 to 22	≥ 117 3 to 120	≥ 110 0 to 110	≥ 95 -5 to 90
	125	≥ 117 110 to 24	≥ 115 5 to 120	≥ 108 2 to 110	≥ 94 -4 to 90
	250	≥ 115 110 to 26	≥ 113 7 to 120	≥ 106 4 to 110	≥ 93 -3 to 90
	500	≥ 112 110 to 28	≥ 111 9 to 120	≥ 104 6 to 110	≥ 91 -1 to 90
	1000	≥ 109 110 to 31	≥ 109 12 to 120	≥ 101 9 to 110	≥ 88 2 to 90
	2000	≥ 106 110 to 34	≥ 106 15 to 120	≥ 98 12 to 110	≥ 86 5 to 90
	4000	≥ 103 110 to 37	≥ 103 18 to 120	≥ 95 15 to 110	≥ 83 8 to 90
	8000	≥ 100 110 to 40	≥ 100 21 to 120	≥ 92 19 to 110	≥ 80 11 to 90
	16000	≥ 97 110 to 43	≥ 96 24 to 120	≥ 88 22 to 110	≥ 77 14 to 90

Table A.6 Octave Band Analysis 1/3 Octave Linearity Range

Nominal Frequency (Hz)	High OBA Range		Normal OBA Range	
	0 dB Gain (dB)	+20 dB Gain (dB)	0 dB Gain (µdB)	+20 dB Gain (dB)

Nominal Frequency (Hz)	High OBA Range		Normal OBA Range	
	0 dB Gain (dB)	+20 dB Gain (µdB)	0 dB Gain (µdB)	+20 dB Gain (µdB)

Table A.6 Octave Band Analysis 1/3 Octave Linearity Range

PRM831	6.3	≥ 107 34 to 140	≥ 90 31 to 120	≥ 81 29 to 110	≥ 62 28 to 90
	8.0	≥ 108 32 to 140	≥ 91 29 to 120	≥ 82 28 to 110	≥ 63 27 to 90
	10.0	≥ 110 30 to 140	≥ 92 28 to 120	≥ 83 27 to 110	≥ 64 26 to 90
	12.5	≥ 111 29 to 140	≥ 93 27 to 120	≥ 85 25 to 110	≥ 65 25 to 90
	16.0	≥ 112 28 to 140	≥ 94 26 to 120	≥ 86 24 to 110	≥ 66 24 to 90
	20.0	≥ 114 27 to 140	≥ 95 25 to 120	≥ 87 24 to 110	≥ 67 23 to 90
	25.0	≥ 115 25 to 140	≥ 96 24 to 120	≥ 88 23 to 110	≥ 68 22 to 90
	31.5	≥ 116 24 to 140	≥ 97 23 to 120	≥ 89 22 to 110	≥ 69 21 to 90
	40.0	≥ 117 23 to 140	≥ 99 22 to 120	≥ 90 21 to 110	≥ 70 20 to 90
	50.0	≥ 118 22 to 140	≥ 100 21 to 120	≥ 91 20 to 110	≥ 71 19 to 90
	63.0	≥ 119 22 to 140	≥ 101 20 to 120	≥ 91 19 to 110	≥ 72 18 to 90
	80.0	≥ 120 21 to 140	≥ 102 19 to 120	≥ 92 18 to 110	≥ 73 17 to 90
	100	≥ 120 20 to 140	≥ 103 18 to 120	≥ 94 17 to 110	≥ 74 16 to 90
	125	≥ 121 20 to 140	≥ 104 17 to 120	≥ 95 16 to 110	≥ 75 15 to 90
	160	≥ 121 20 to 140	≥ 105 16 to 120	≥ 96 15 to 110	≥ 76 14 to 90
	200	≥ 120 20 to 140	≥ 106 15 to 120	≥ 97 14 to 110	≥ 77 13 to 90
	250	≥ 119 21 to 140	≥ 107 14 to 120	≥ 98 12 to 110	≥ 79 11 to 90
	315	≥ 119 22 to 140	≥ 108 13 to 120	≥ 99 11 to 110	≥ 80 10 to 90
	400	≥ 118 23 to 140	≥ 109 12 to 120	≥ 100 10 to 110	≥ 81 9 to 90
	500	≥ 117 23 to 140	≥ 110 11 to 120	≥ 101 9 to 110	≥ 82 8 to 90
	630	≥ 116 24 to 140	≥ 110 10 to 120	≥ 101 9 to 110	≥ 83 7 to 90
	800	≥ 115 25 to 140	≥ 110 10 to 120	≥ 102 9 to 110	≥ 84 7 to 90
	1000	≥ 114 27 to 140	≥ 110 10 to 120	≥ 102 9 to 110	≥ 84 6 to 90
	1250	≥ 113 27 to 140	≥ 110 10 to 120	≥ 102 9 to 110	≥ 85 6 to 90
	1600	≥ 112 29 to 140	≥ 109 11 to 120	≥ 101 9 to 110	≥ 85 5 to 90
	2000	≥ 111 29 to 140	≥ 109 12 to 120	≥ 100 10 to 110	≥ 85 6 to 90
	2500	≥ 110 30 to 140	≥ 108 12 to 120	≥ 100 10 to 110	≥ 84 6 to 90
	3150	≥ 109 31 to 140	≥ 107 13 to 120	≥ 99 11 to 110	≥ 84 6 to 90
	4000	≥ 108 32 to 140	≥ 106 14 to 120	≥ 98 12 to 110	≥ 83 7 to 90
	5000	≥ 107 34 to 140	≥ 105 15 to 120	≥ 97 13 to 110	≥ 82 8 to 90
	6300	≥ 106 35 to 140	≥ 104 16 to 120	≥ 96 14 to 110	≥ 82 9 to 90
	8000	≥ 105 36 to 140	≥ 103 17 to 120	≥ 95 15 to 110	≥ 81 9 to 90
	10000	≥ 104 37 to 140	≥ 102 18 to 120	≥ 94 16 to 110	≥ 80 10 to 90
	12500	≥ 103 38 to 140	≥ 101 19 to 120	≥ 93 17 to 110	≥ 79 11 to 90
	16000	≥ 101 39 to 140	≥ 100 20 to 120	≥ 92 18 to 110	≥ 78 12 to 90
	20000	≥ 100 40 to 140	≥ 99 21 to 120	≥ 91 19 to 110	≥ 77 13 to 90

Direct Input	6.3	≥ 99 41 to 140	≥ 97 24 to 120	≥ 104 6 to 110	≥ 86 4 to 90
	8.0	≥ 102 39 to 140	≥ 100 21 to 120	≥ 106 4 to 110	≥ 90 0 to 90
	10.0	≥ 104 36 to 140	≥ 101 19 to 120	≥ 109 1 to 110	≥ 92 -2 to 90
	12.5	≥ 106 34 to 140	≥ 102 18 to 120	≥ 110 0 to 110	≥ 93 -3 to 90
	16.0	≥ 108 33 to 140	≥ 105 15 to 120	≥ 111 -1 to 110	≥ 94 -4 to 90
	20.0	≥ 123 18 to 140	≥ 115 5 to 120	≥ 112 -2 to 110	≥ 95 -5 to 90
	25.0	≥ 125 16 to 140	≥ 121 -1 to 120	≥ 113 -3 to 110	≥ 95 -5 to 90
	31.5	≥ 124 16 to 140	≥ 122 -2 to 120	≥ 114 -4 to 110	≥ 96 -6 to 90
	40.0	≥ 123 17 to 140	≥ 122 -2 to 120	≥ 114 -4 to 110	≥ 97 -7 to 90
	50.0	≥ 123 18 to 140	≥ 121 -1 to 120	≥ 113 -3 to 110	≥ 97 -7 to 90
	63.0	≥ 122 18 to 140	≥ 121 -1 to 120	≥ 112 -2 to 110	≥ 97 -7 to 90
	80.0	≥ 122 19 to 140	≥ 120 0 to 120	≥ 112 -2 to 110	≥ 98 -8 to 90
	100	≥ 121 19 to 140	≥ 119 1 to 120	≥ 111 -1 to 110	≥ 98 -8 to 90
	125	≥ 120 20 to 140	≥ 119 2 to 120	≥ 111 -1 to 110	≥ 99 -9 to 90
	160	≥ 119 21 to 140	≥ 118 2 to 120	≥ 110 0 to 110	≥ 99 -9 to 90
	200	≥ 119 22 to 140	≥ 118 2 to 120	≥ 110 1 to 110	≥ 99 -9 to 90
	250	≥ 118 22 to 140	≥ 117 3 to 120	≥ 109 1 to 110	≥ 98 -8 to 90
	315	≥ 117 23 to 140	≥ 117 4 to 120	≥ 109 1 to 110	≥ 97 -7 to 90
	400	≥ 117 24 to 140	≥ 116 4 to 120	≥ 108 2 to 110	≥ 96 -6 to 90
	500	≥ 116 24 to 140	≥ 116 4 to 120	≥ 108 3 to 110	≥ 95 -5 to 90
	630	≥ 115 25 to 140	≥ 115 5 to 120	≥ 107 3 to 110	≥ 94 -4 to 90
	800	≥ 115 26 to 140	≥ 114 6 to 120	≥ 106 4 to 110	≥ 94 -4 to 90
	1000	≥ 114 27 to 140	≥ 113 7 to 120	≥ 105 5 to 110	≥ 93 -3 to 90
	1250	≥ 113 27 to 140	≥ 112 8 to 120	≥ 104 6 to 110	≥ 92 -2 to 90
	1600	≥ 111 29 to 140	≥ 111 9 to 120	≥ 103 7 to 110	≥ 91 -1 to 90
	2000	≥ 111 30 to 140	≥ 110 10 to 120	≥ 102 8 to 110	≥ 90 0 to 90
	2500	≥ 110 31 to 140	≥ 109 11 to 120	≥ 101 9 to 110	≥ 89 1 to 90
	3150	≥ 109 32 to 140	≥ 108 12 to 120	≥ 100 10 to 110	≥ 89 2 to 90
	4000	≥ 108 33 to 140	≥ 107 13 to 120	≥ 99 11 to 110	≥ 88 3 to 90
	5000	≥ 107 34 to 140	≥ 106 14 to 120	≥ 98 12 to 110	≥ 87 4 to 90
	6300	≥ 106 35 to 140	≥ 105 15 to 120	≥ 97 13 to 110	≥ 86 5 to 90
	8000	≥ 105 36 to 140	≥ 104 16 to 120	≥ 96 14 to 110	≥ 85 5 to 90
	10000	≥ 104 36 to 140	≥ 103 17 to 120	≥ 95 15 to 110	≥ 84 6 to 90
	12500	≥ 103 37 to 140	≥ 102 18 to 120	≥ 94 16 to 110	≥ 83 7 to 90
	16000	≥ 101 39 to 140	≥ 101 19 to 120	≥ 93 17 to 110	≥ 82 9 to 90
	20000	≥ 100 40 to 140	≥ 100 20 to 120	≥ 92 18 to 110	≥ 81 10 to 90

FIGURE A-2 Self-generated noise levels for 1/1 octave filters with PRM831

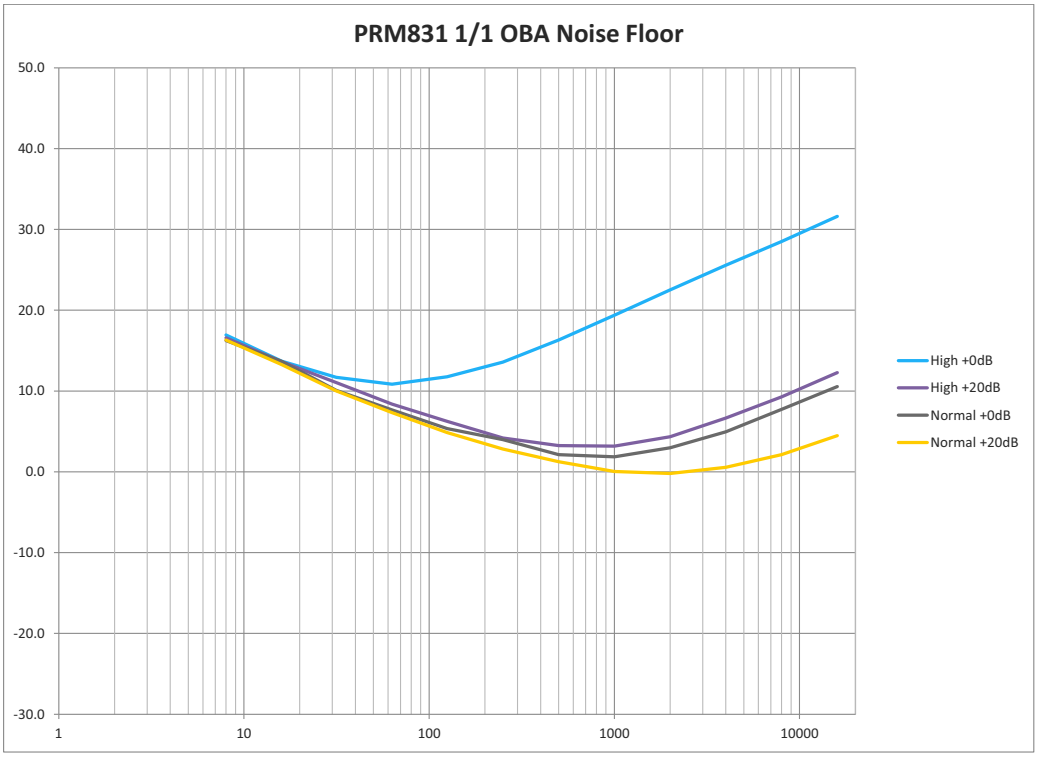


FIGURE A-3 Self-generated noise levels for 1/1 octave filters with direct input

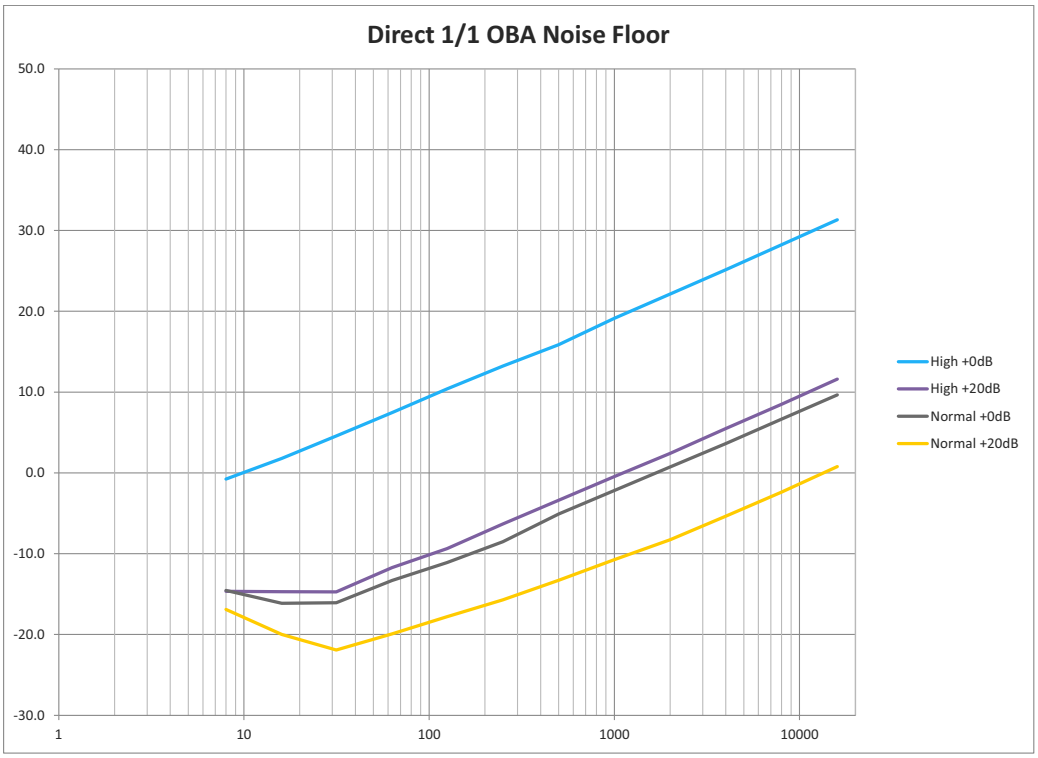


FIGURE A-4 Self-generated noise levels for 1/3 octave filters with PRM831

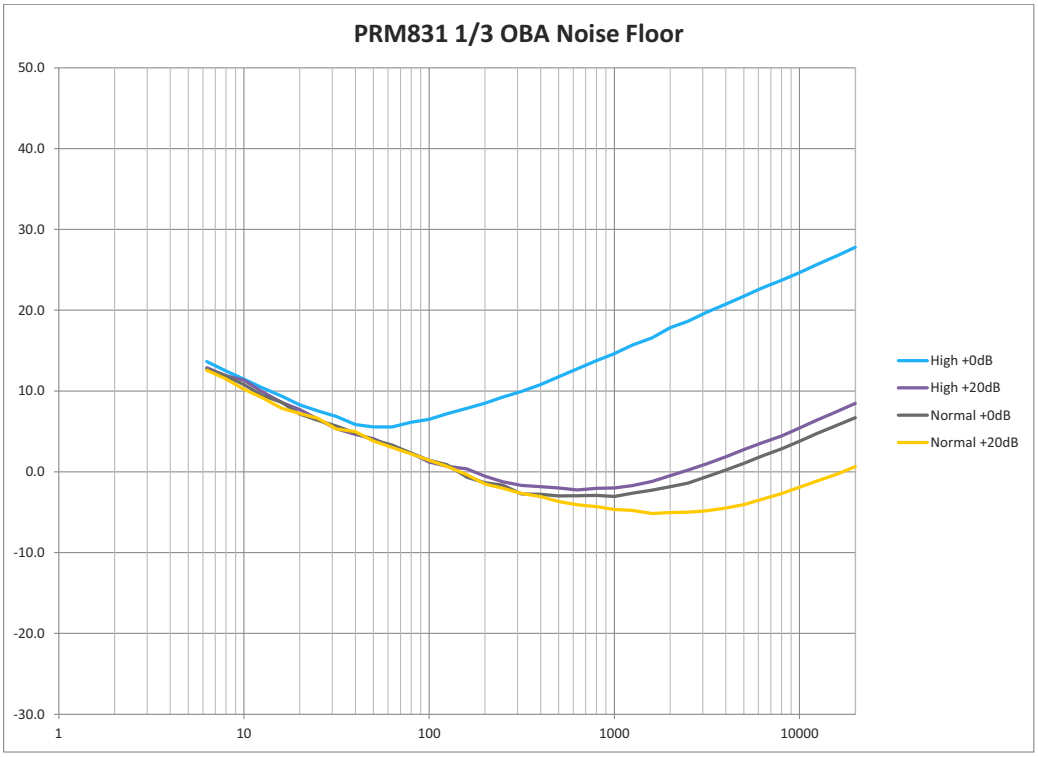
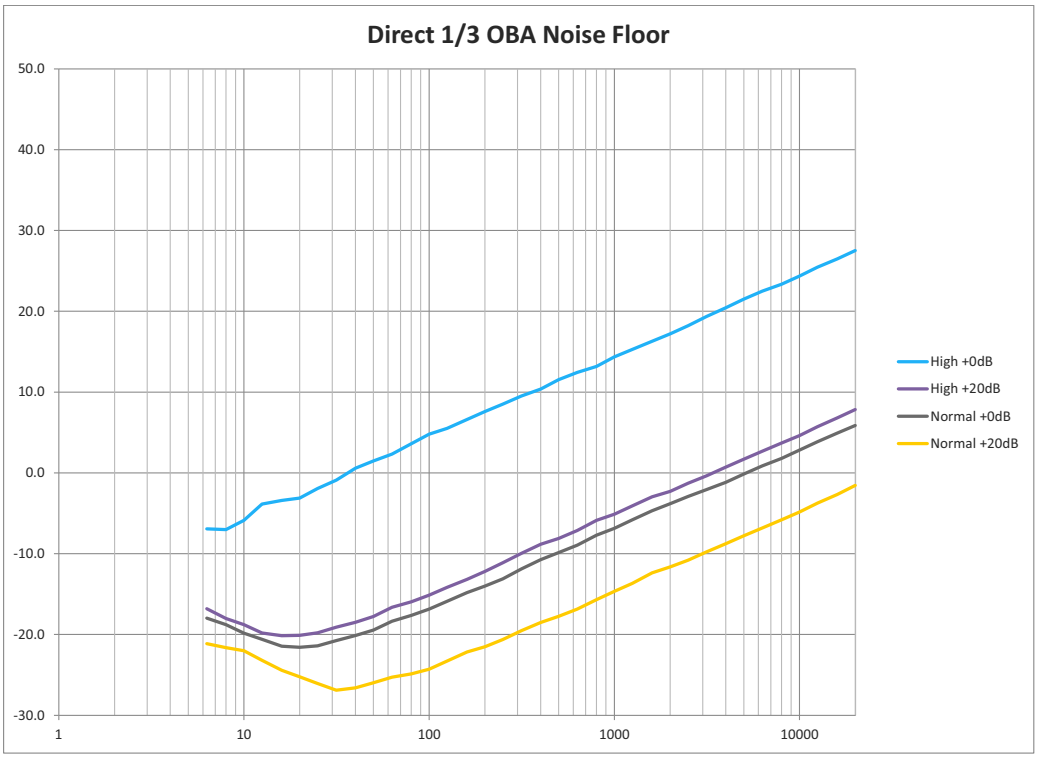


FIGURE A-5 Self-generated noise levels for 1/3 octave filters with direct input



OBA Measurement System

Integration Method: Follows setting for SLM
Frequency Weightings: Independent of setting for SLM, selected frequency weighting (A, C or Z) indicated by ω
Time Weightings/Detectors: Follows setting for SLM, time weighting (S, F or I) indicated by τ

OBA Measurements

Instantaneous "Live" Metrics: *For display and profile graph, not stored with measurement.*

	Linear	Exponential	Units
OBA Live Equivalent Level Spectrum, 1s	$L_{\omega eq(f)}$	$L_{\omega Teq(f)}$	dB

Overall Metrics:

	Linear	Exponential	Units
OBA Overall Equivalent Level Spectrum	$L_{\omega eq(f)}$	$L_{\omega Teq(f)}$	dB
OBA Overall Maximum Level Spectrum	$L_{\omega max(f)}$	$L_{\omega Tmax(f)}$	dB
OBA Overall Minimum Level Spectrum	$L_{\omega min(f)}$	$L_{\omega Tmin(f)}$	dB

Percentile Spectrum Levels, uses same percentages n1 through n6 selected in SLM, 0.01 to 99.99%
Statistics are sampled every 100ms from the selected OBA frequency weighting and time weighting into 0.1 dB wide amplitude classes

		Units
1	$L_{\omega Tn1(f)}$	dB
2	$L_{\omega Tn2(f)}$	dB
3	$L_{\omega Tn3(f)}$	dB
4	$L_{\omega Tn4(f)}$	dB
5	$L_{\omega Tn5(f)}$	dB
6	$L_{\omega Tn6(f)}$	dB

A.5 SoundAdvisor Model 831C Event Logging Software – Option 831C-ELA

Measurement History

Time Period: Selectable from 1 minute to 99 hours 59 minutes
Synchronization: Selectable to sync to time-of-day clock, for periods of 1, 2, 5, 10, 15, 20, 30 minutes, and 1, 24 hours
Measurements: Same measurements as Overall measurement

Event History

Detection Methods: Level or Dynamic
Level Triggering: Events are initiated and stored when the measured sound level exceeds the trigger levels SPL1 and Peak 1 for the specified minimum duration and ends when not triggered for the continuation time
Dynamic Triggering: Trigger level is offset above a background tracking level
Trigger Levels: Selectable from 0 to 200 dB for the SPL ($L_{\omega T}$) or Peak ($L\rho_{peak}$)
Dynamic Trigger Offset: Selectable from 3 to 99.9 dB for SPL ($L_{\omega T}$) above background tracking level
Dynamic Trigger Response: Selectable from five combinations of background tracking rate and tracking percentile
Minimum Duration: Selectable from 0 to 9.9 s
Continuation Period: Selectable from 0 to 9 s
Event Time History: Selectable On or Off

- **Period**: Selectable for periods 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s, and 5 s
- **Pre-event Samples**: Selectable from 0 to 99
- **Post-event Samples**: Selectable from 0 to 100
- **Maximum Samples**: Selectable up to 9999
- **Spectral Mode**: Selectable On or Off, enables Spectral Event Time History (requires 831C-OB3)

Event Measurements:

- Date and Time of initial occurrence
    - yyyy-mmm-dd hh:mm:ss
- Date and Time of maximum occurrence

    - yyyy-mmm-dd hh:mm:ss
- Duration of event
    - hh:mm:ss.s

	Linear	Exponential	Units
Equivalent Level	$L_{\omega eq}$	$L_{\omega Teq}$	dB
Sound Exposure Level	$L_{\omega E}$	$L_{\omega TE}$	dB
Sound Exposure	$E_{\omega E}$	$E_{\omega TE}$	Pa^2s
OBA Live Equivalent Level Spectrum (requires 831C-OB3)	$L_{\omega eq(f)}$	$L_{\omega Teq(f)}$	dB
OBA Live Maximum Level Spectrum (requires 831C-OB3)	$L_{\omega max(f)}$	$L_{\omega Tmax(f)}$	dB

		Units
Maximum Level	$L_{\omega Tmax}$	dB
Maximum Peak Level	$L\rho_{peak}$	dB

	Linear	Exponential	Units
Event Time History Equivalent Level	$L_{\omega eq}$	$L_{\omega Teq}$	dB
Event Time History Equivalent Level 1/1 or 1/3 Spectra (requires 831C-OB3)	$L_{\omega eq(f)}$	$L_{\omega Teq(f)}$	dB

A.6 SoundAdvisor Model 831C Time History Software – Option 831C-LOG

Time-History Measurement System

The Time History can log an abundant selection of acoustic and non-acoustic metrics at equal time intervals.
Time Period: Selectable for periods 2.5 ms, 5 ms, 10 ms, 20 ms, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s, 5 s, 10 s, 15 s, 20 s, 30 s, 1 min, 2 min, 5 min, 10 min, 15 min, 20 min, 30 min, 1 h, and 24 h
Synchronization: Selectable to sync to time-of-day clock, for periods of 1, 2, 5, 10, 15, 20, 30 seconds; 1, 2, 5, 10, 15, 20, 30 minutes; and 1, 24 hours

Acoustic Measurements

Metrics are individually selectable.
Period < 20 ms:

- OBA 1/1 Leq*
- OBA 1/3 Leq*

Period ≥ 20ms:L_{Aeq}, L_{Ceq}, L_{Zeq}, L_{APeak}, LCpeak, L_{Zpeak}
Period ≥ 100 ms:

- L_{Aeq}, L_{Ceq}, L_{Zeq}, L_{Apeak}, L_{Cpeak}, L_{Zpeak}
- L_{AS}, L_{AF}, L_{AI}, L_{CS}, L_{CF}, L_{CI}, L_{ZS}, L_{ZF}, L_{ZI}
- L_{ASmax}, L_{AFmax}, L_{AImax}, L_{CSmax}, L_{CFmax}, L_{CImax}, L_{ZSmax}, L_{ZFmax}, L_{ZImax}
- L_{ASmin}, L_{AFmin}, L_{AImin}, L_{CSmin}, L_{CFmin}, L_{CImin}, L_{ZSmin}, L_{ZFmin}, L_{ZImin}
- L_{Ceq}-L_{Aeq}, L_{AIeq}-L_{aeq}, L_{AFTtm5}

With option 831-IH: L_{twa1}, L_{twa2}

Non-Acoustic Measurements

Metrics are individually selectable.
Millisecond Resolution, Period < 1 s: Tms
Period ≥ 100 ms: Battery Voltage, External Power, Internal Temperature
426A12 or PRM2103 Metrics: Internal Temperature, Internal Humidity
SEN031 Metrics: Windspeed; Wind Gust Speed; Wind Direction; Temperature: Avg, Min & Max; Humidity: Avg, Min & Max; Barometric Pressure
SEN032 Metrics: Windspeed; Wind Gust Speed; Wind Direction
**OBA processing must be available by option 831C-OB3 and enabled by OBA Bandwidth setting.*

A.7 Frequency Response

The following data was taken using the Larson Davis Model 831 Sound Level Meter with a PRM831 preamplifier at degrees increasing by 10, starting with 0° and rotating to 250°. The frequency was measured in Hertz and ranged from ~200 Hz to 20K Hz.

A.7.1 Plane Parallel To Display Screen

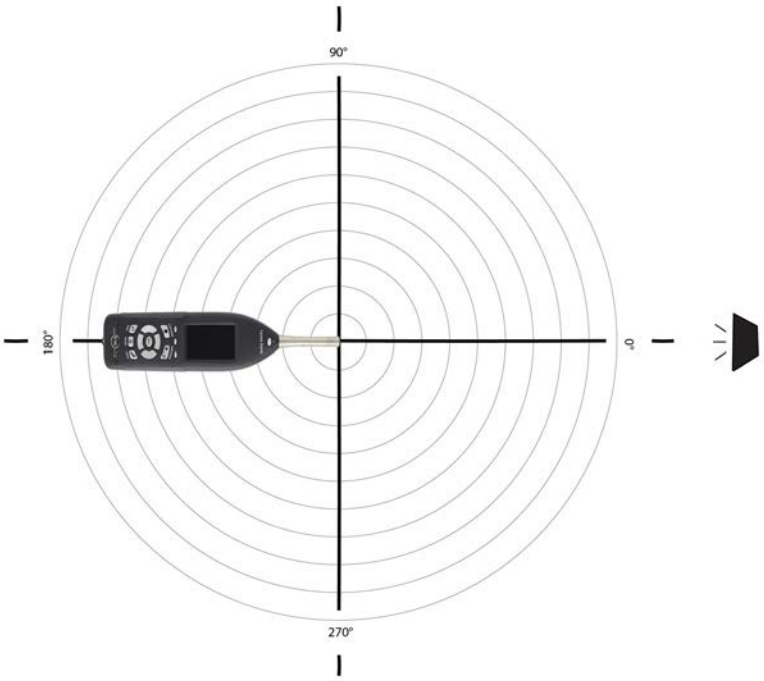


FIGURE A-6 Model 831 with 377B02 Microphone

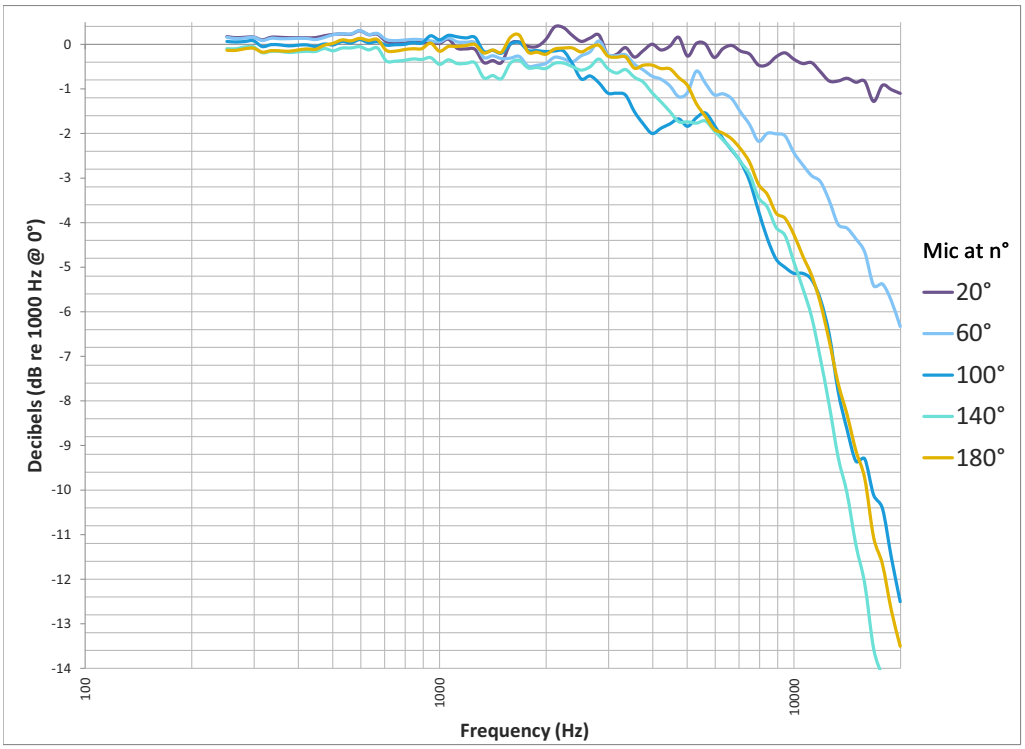


FIGURE A-7 Model 831 with 377B02 Microphone

FIGURE A-8 Model 831 with 377B02 Microphone

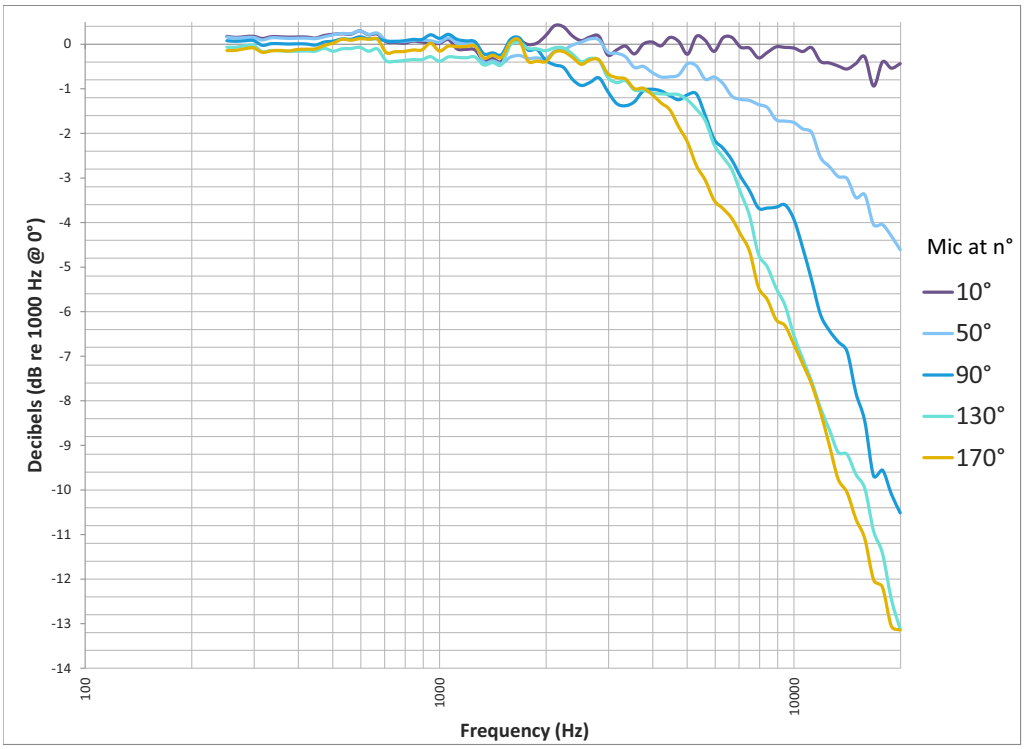


FIGURE A-9 Model 831 with 377B02 Microphone

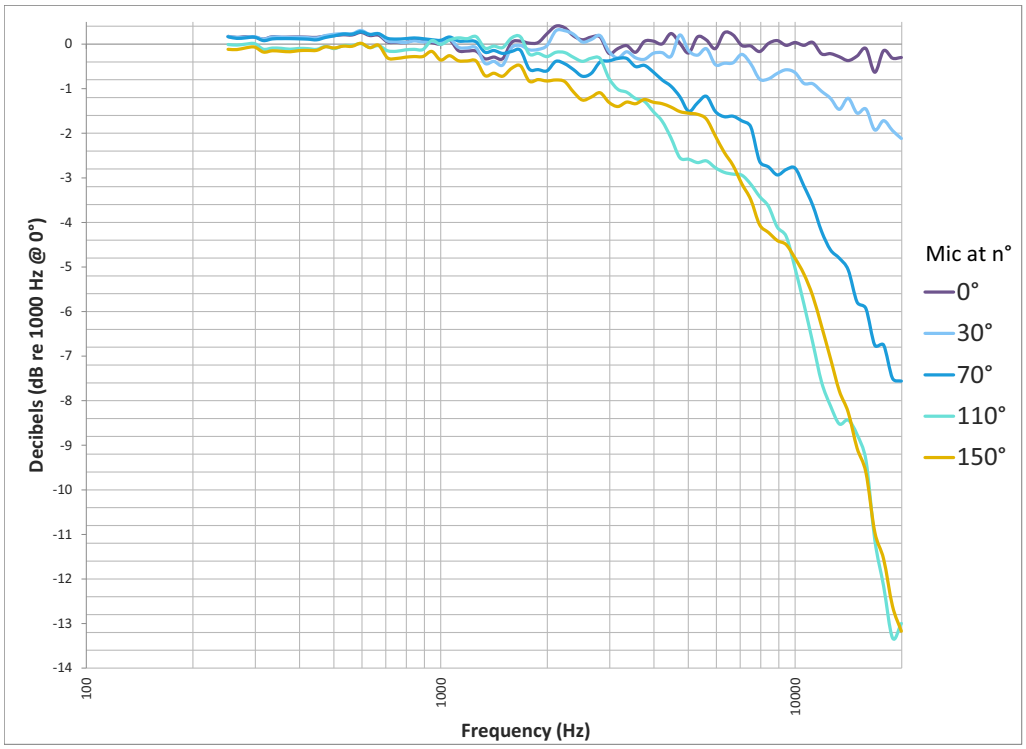


FIGURE A-10 Directional Characteristics

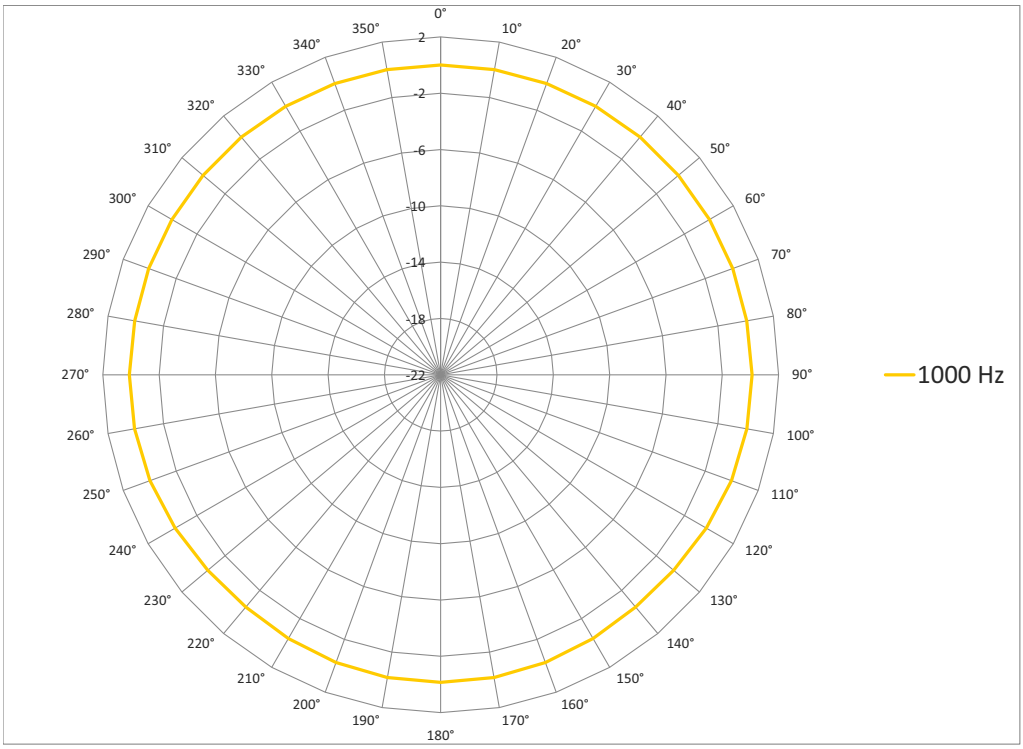


FIGURE A-11 Model 831 with 377B02 Microphone

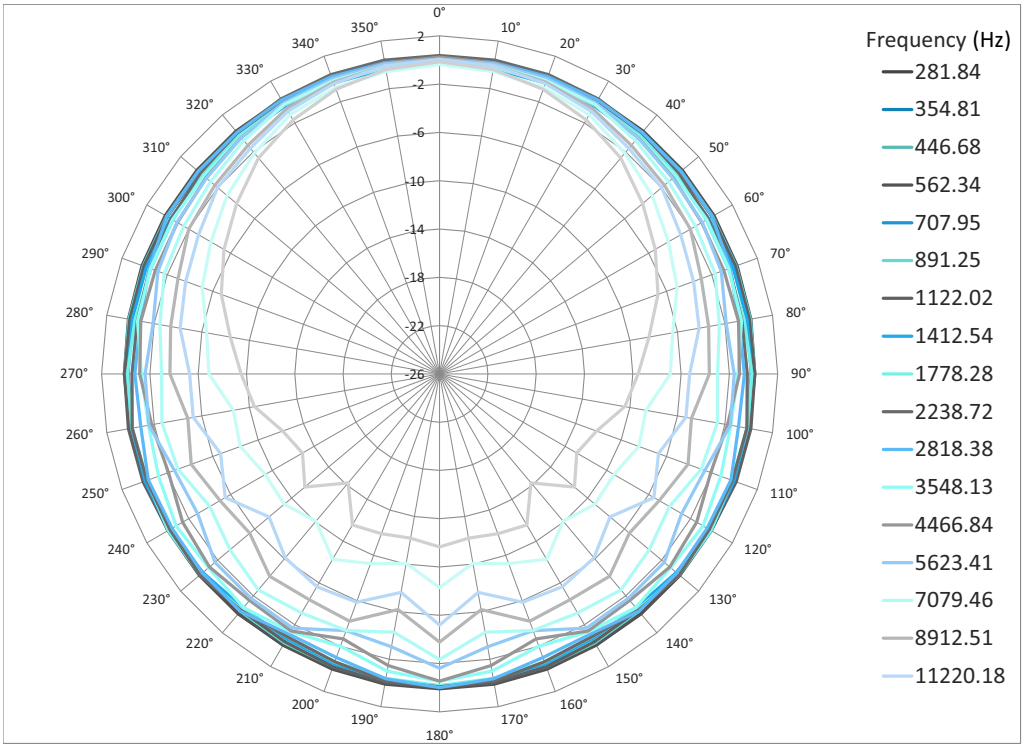


FIGURE A-12 Model 831 with 377B02 Microphone

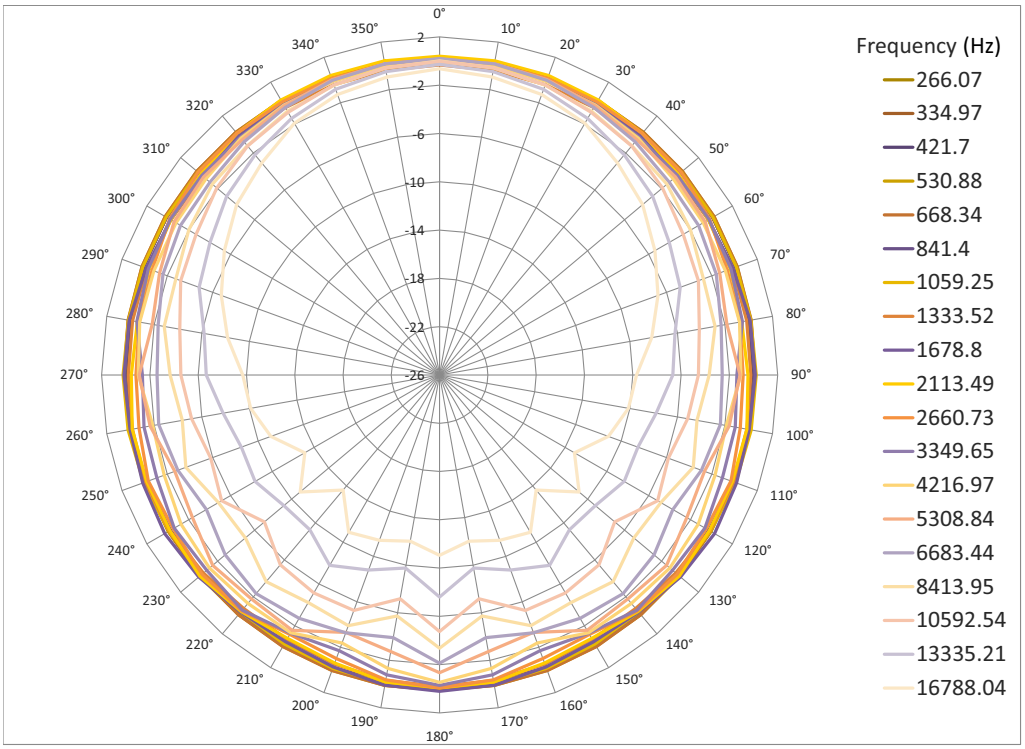


FIGURE A-13 Model 831 with 377B02 Microphone

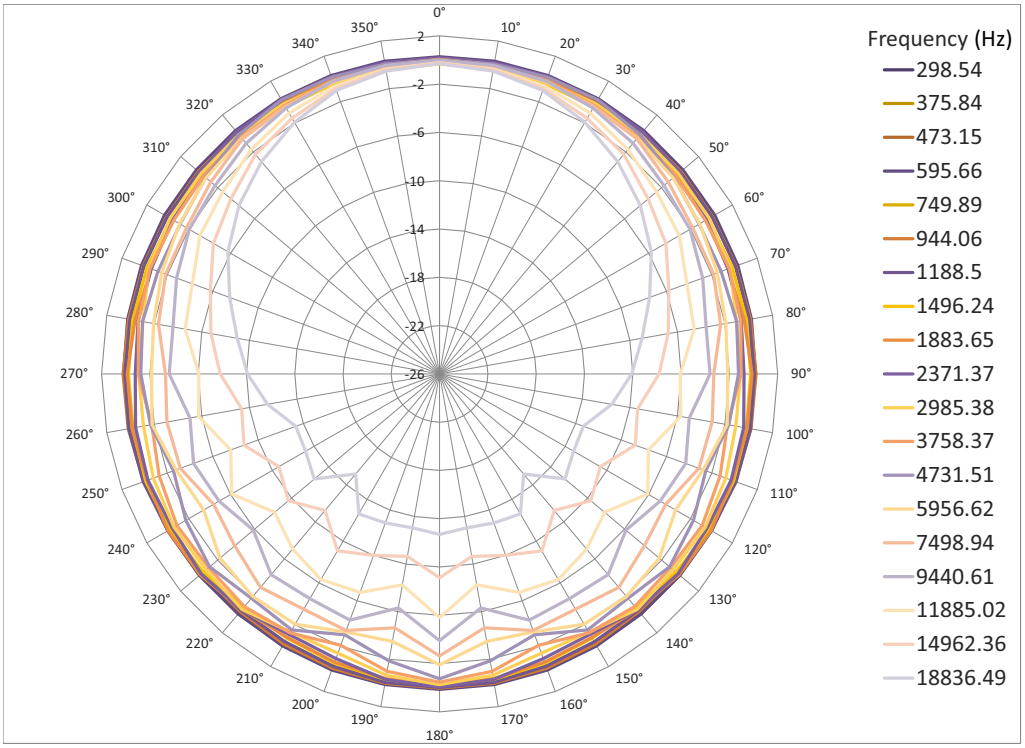


FIGURE A-14 Model 831 with 377B02 Microphone

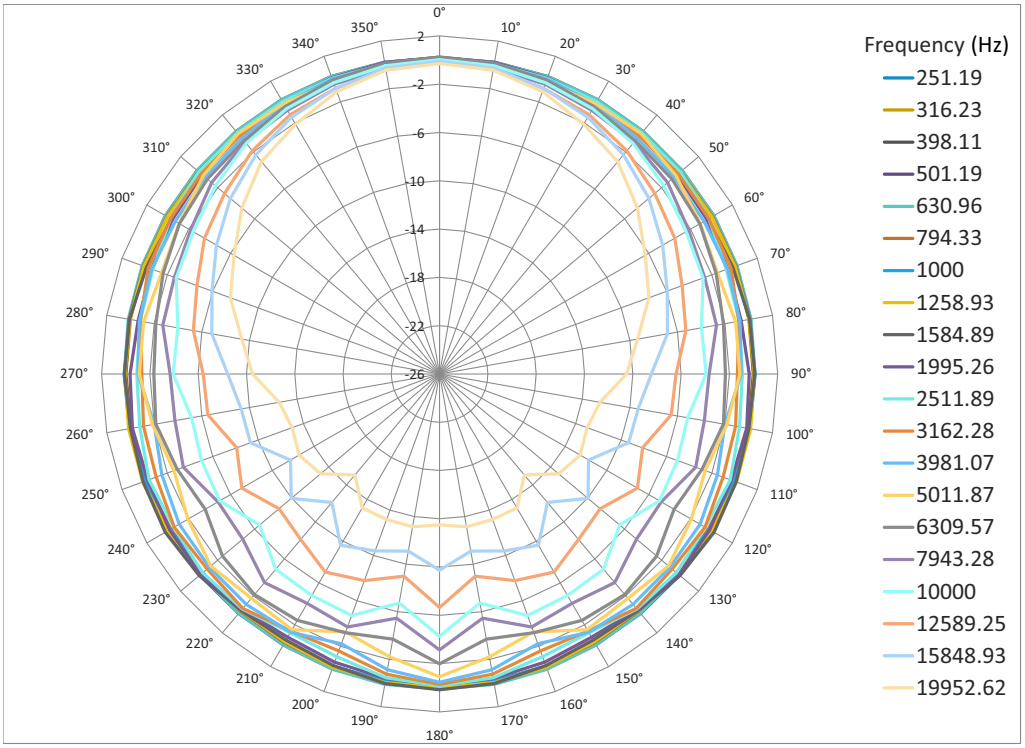


FIGURE A-15 Model 831 with 377C20 Microphone

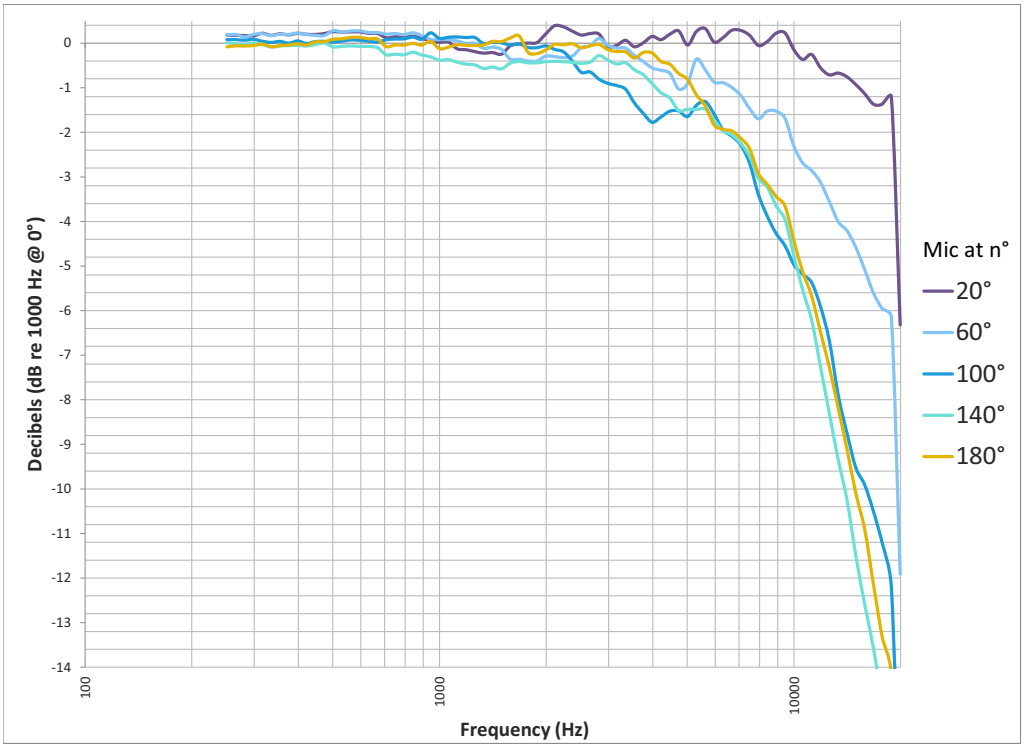


FIGURE A-16 Model 831 with 377C20 Microphone

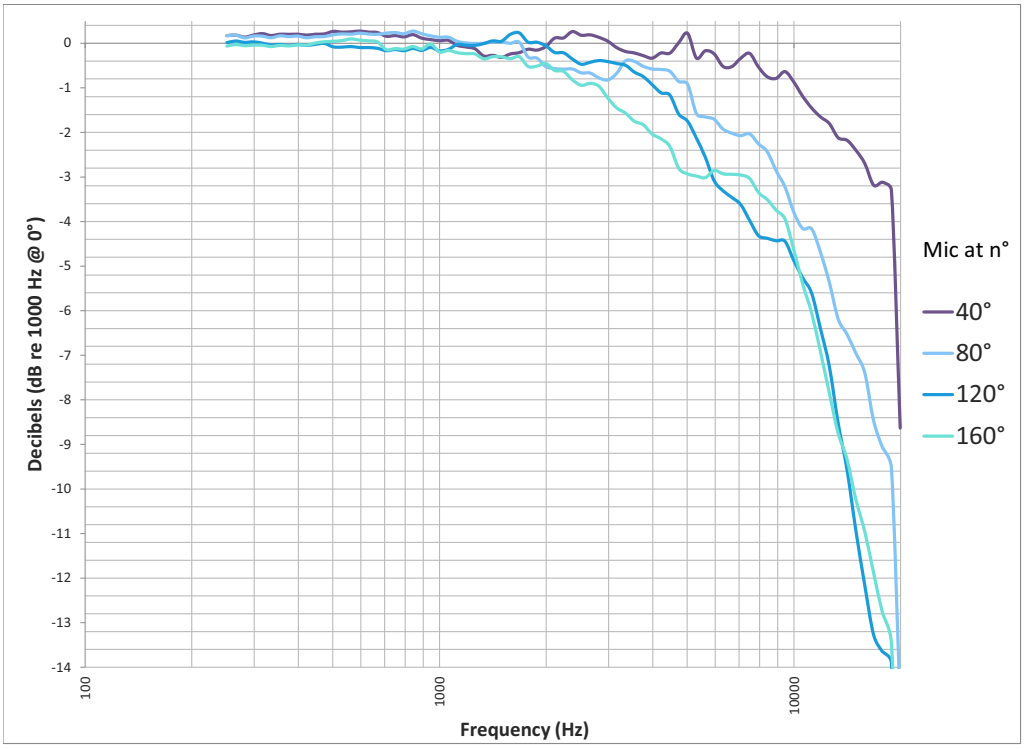


FIGURE A-17 Model 831 with 377C20 Microphone

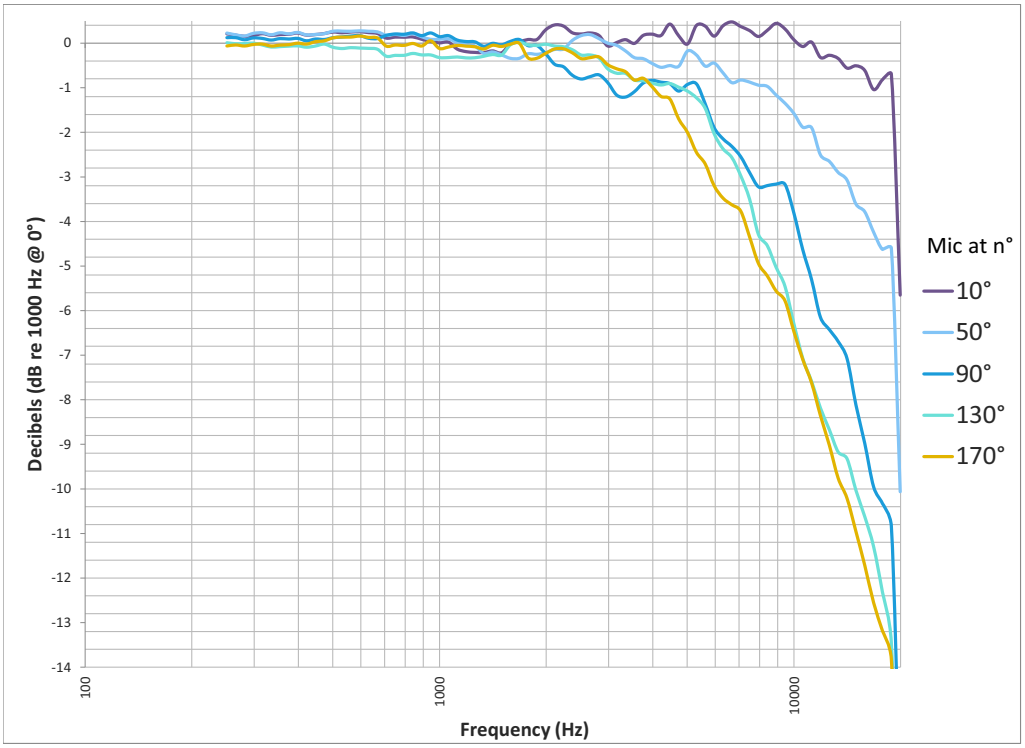


FIGURE A-18 Model 831 with 377C20 Microphone

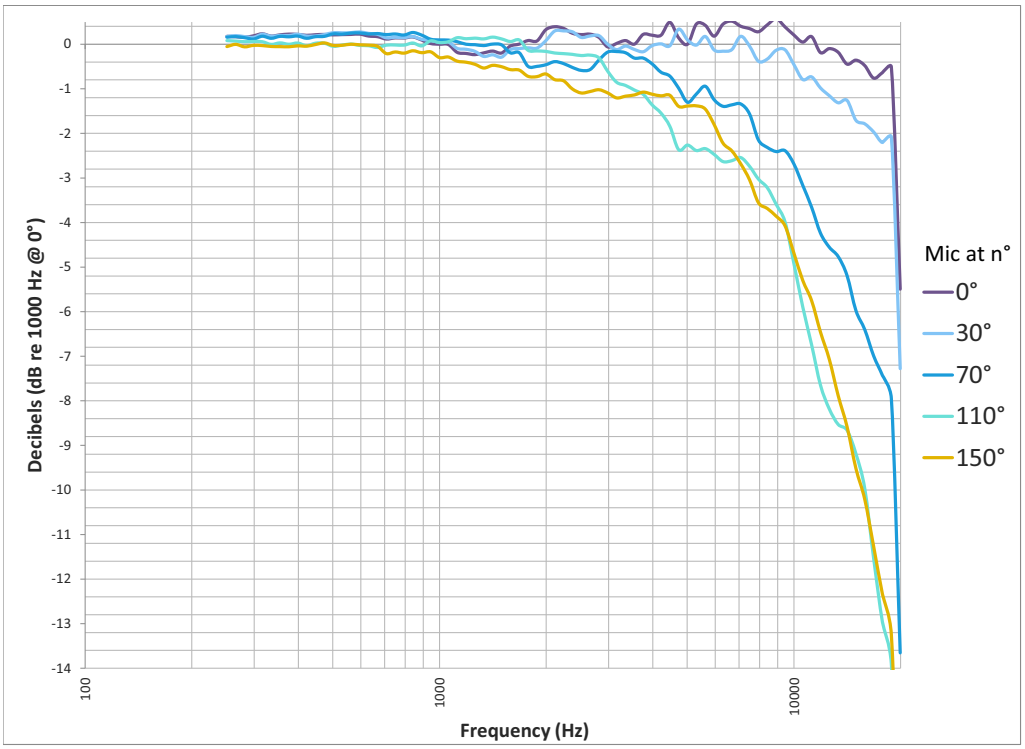


FIGURE A-19 Model 831 with 377C20 Microphone

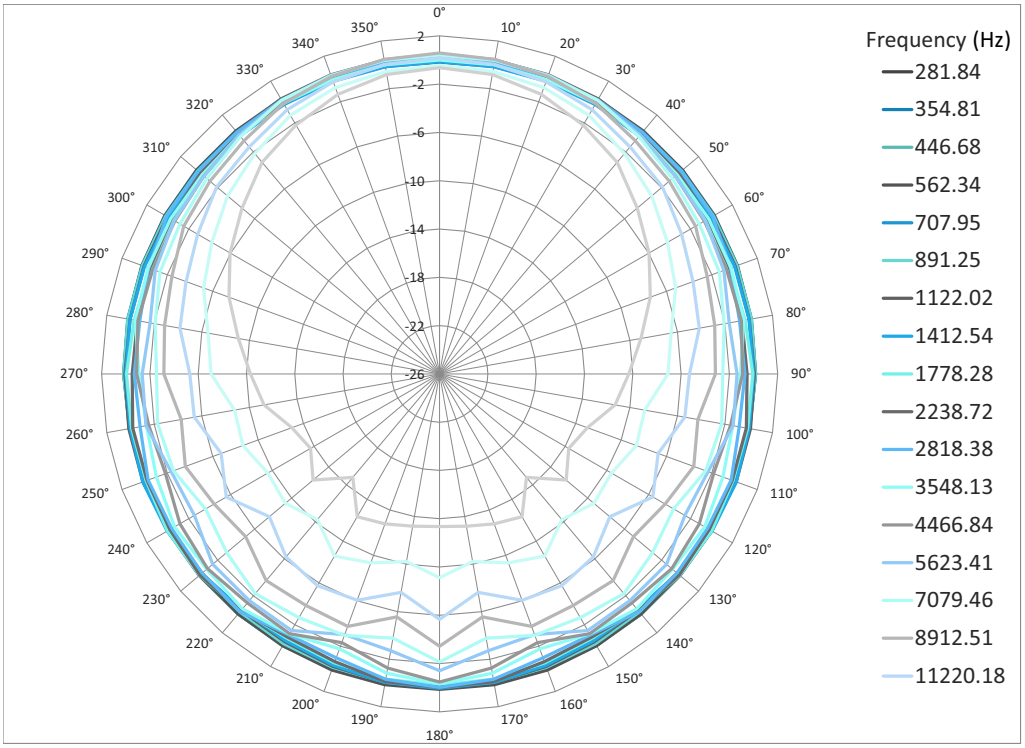


FIGURE A-20 Model 831 with 377C20 Microphone

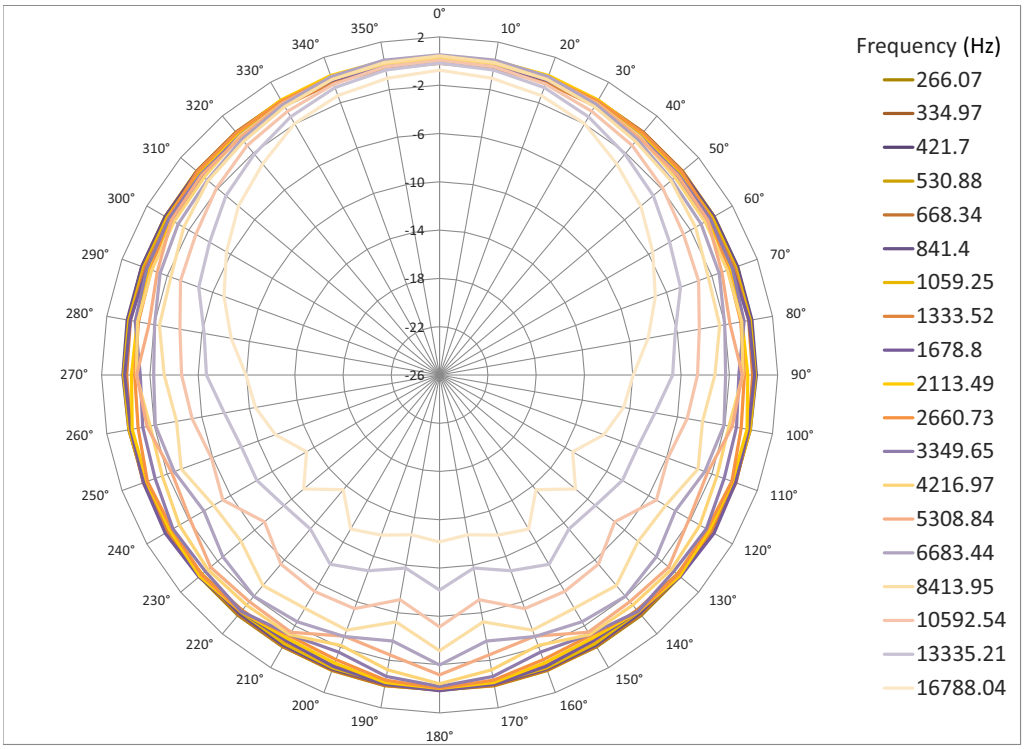


FIGURE A-21 Model 831 with 377C20 Microphone

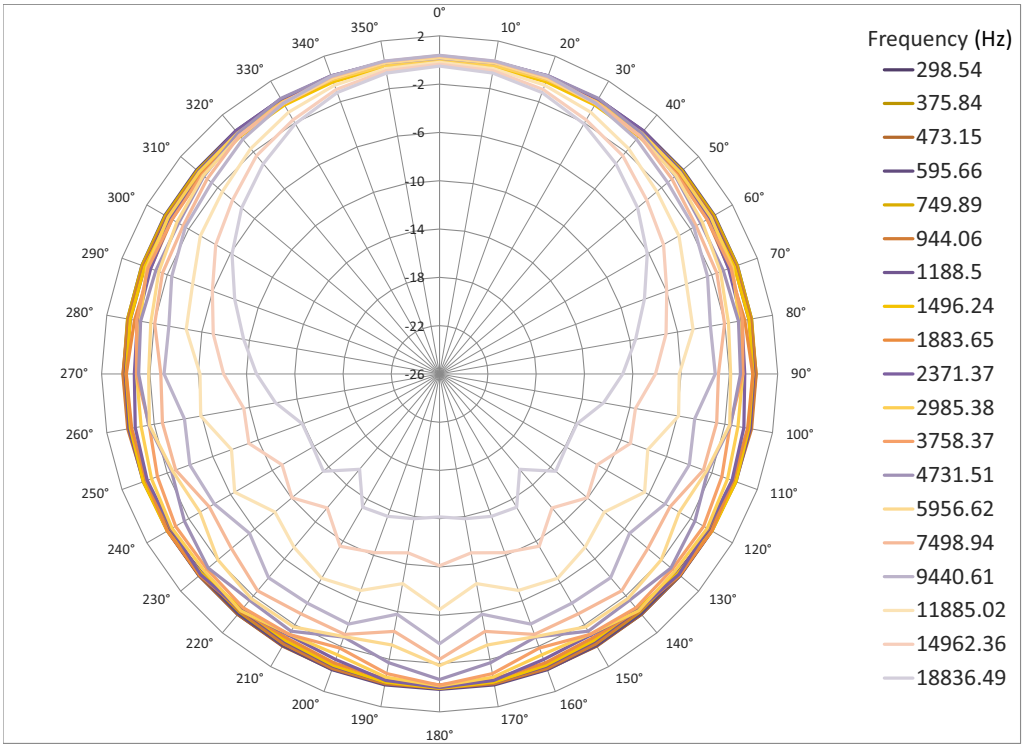
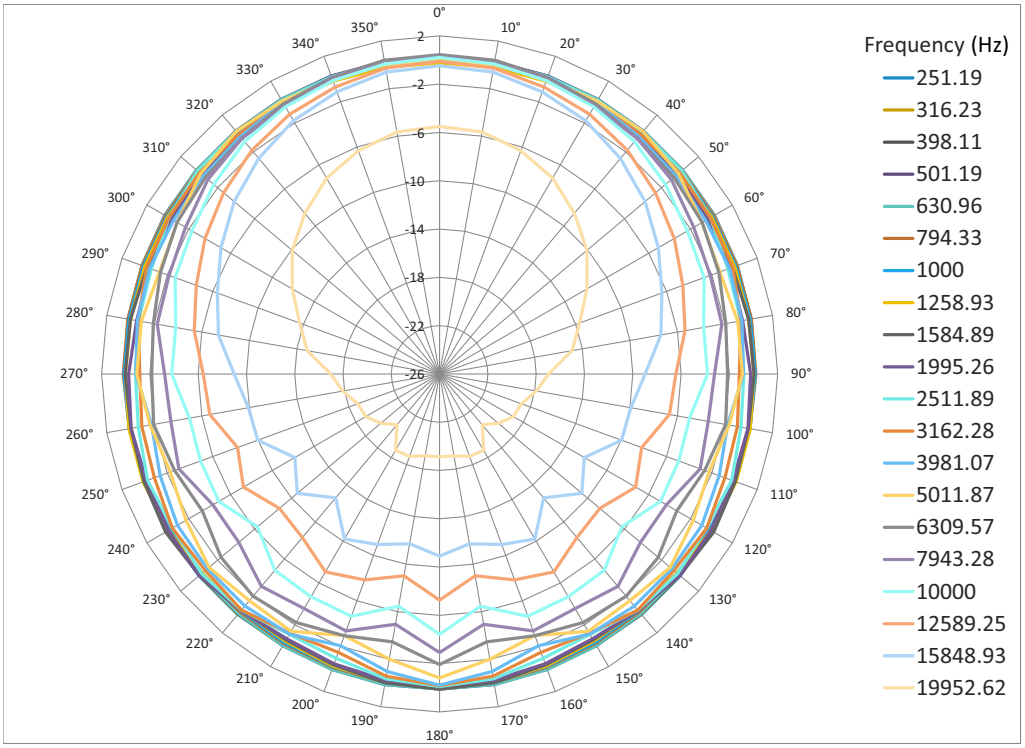


FIGURE A-22 Model 831 with 377C20 Microphone



A.7.2 Perpendicular to Plane of Display Screen

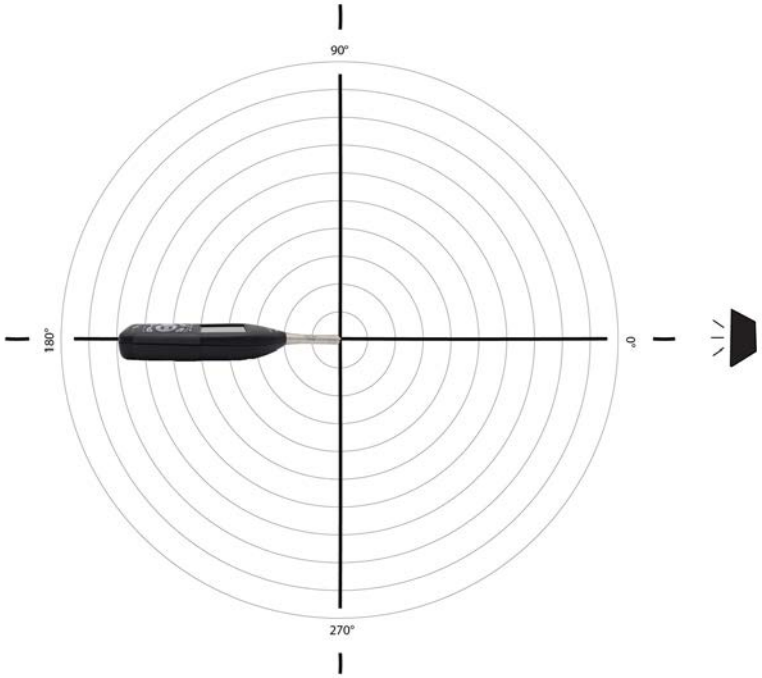


FIGURE A-23 Model 831 with 377B02 Microphone

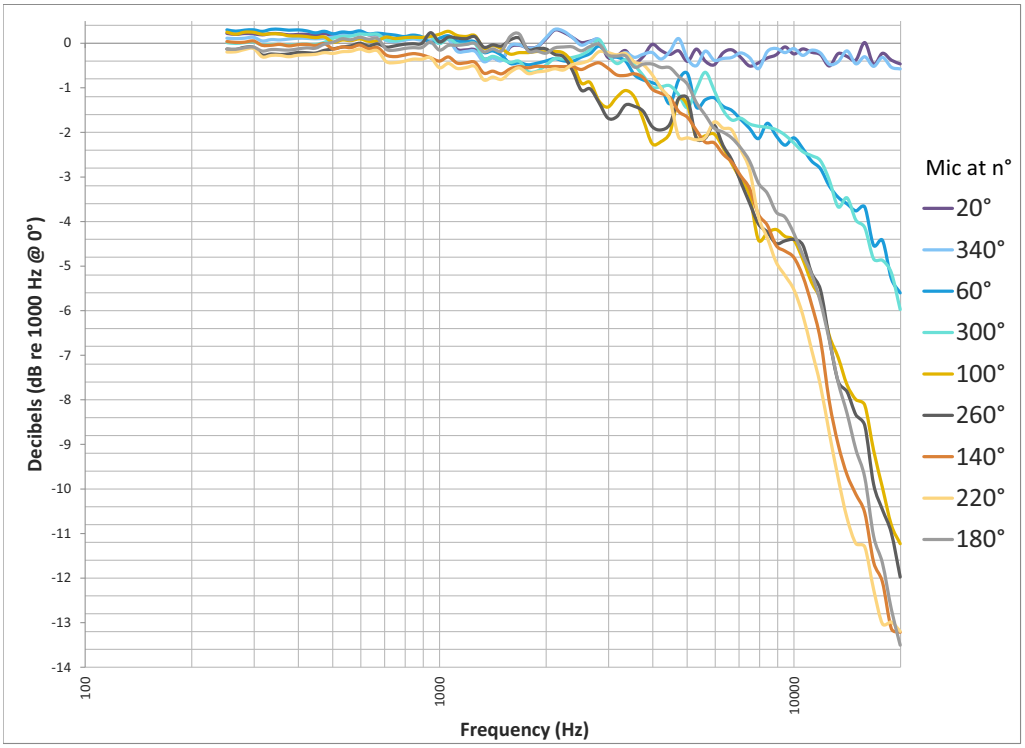


FIGURE A-24 Model 831 with 377B02 Microphone

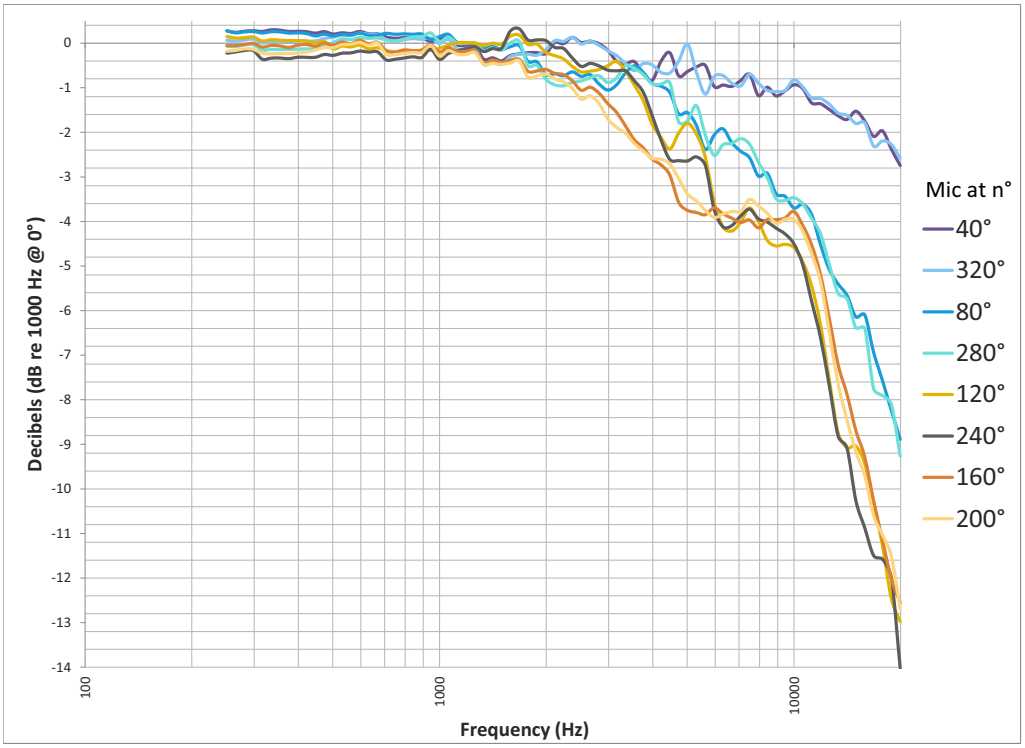


FIGURE A-25 Model 831 with 377B02 Microphone

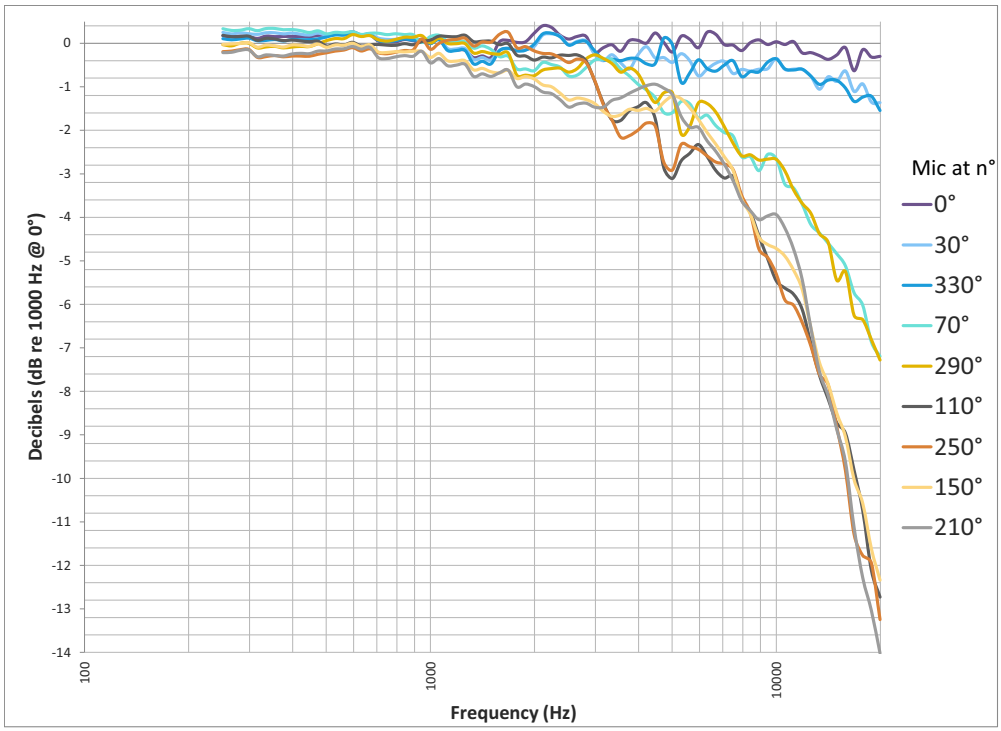


FIGURE A-26 Model 831 with 377B02 Microphone

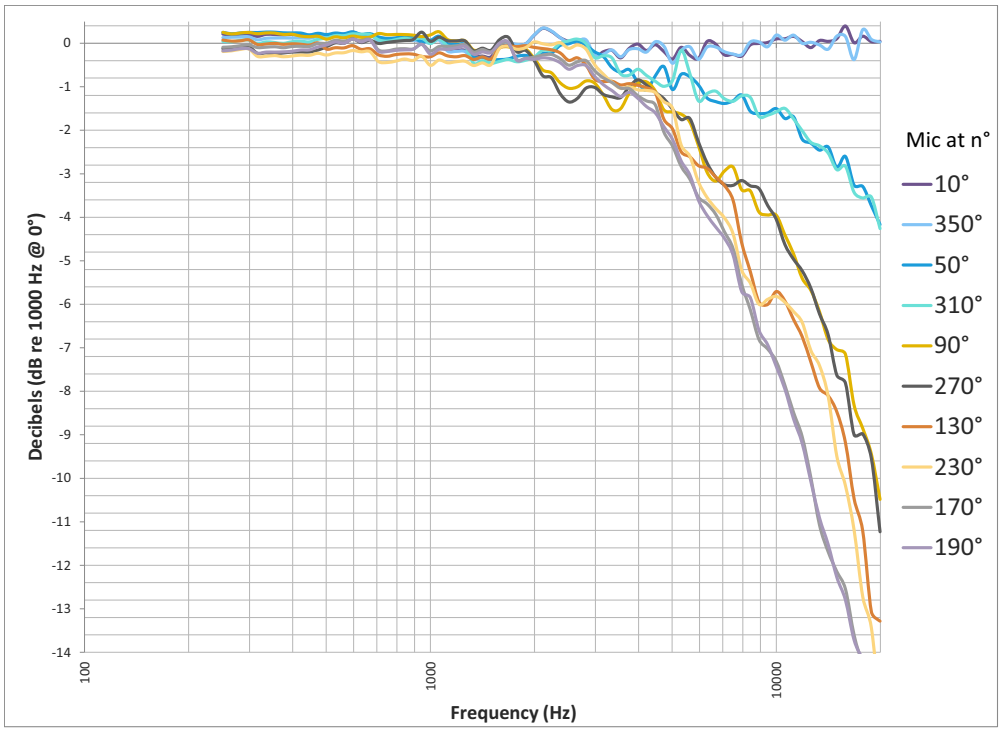


FIGURE A-27 Model 831 with 377B02 Microphone

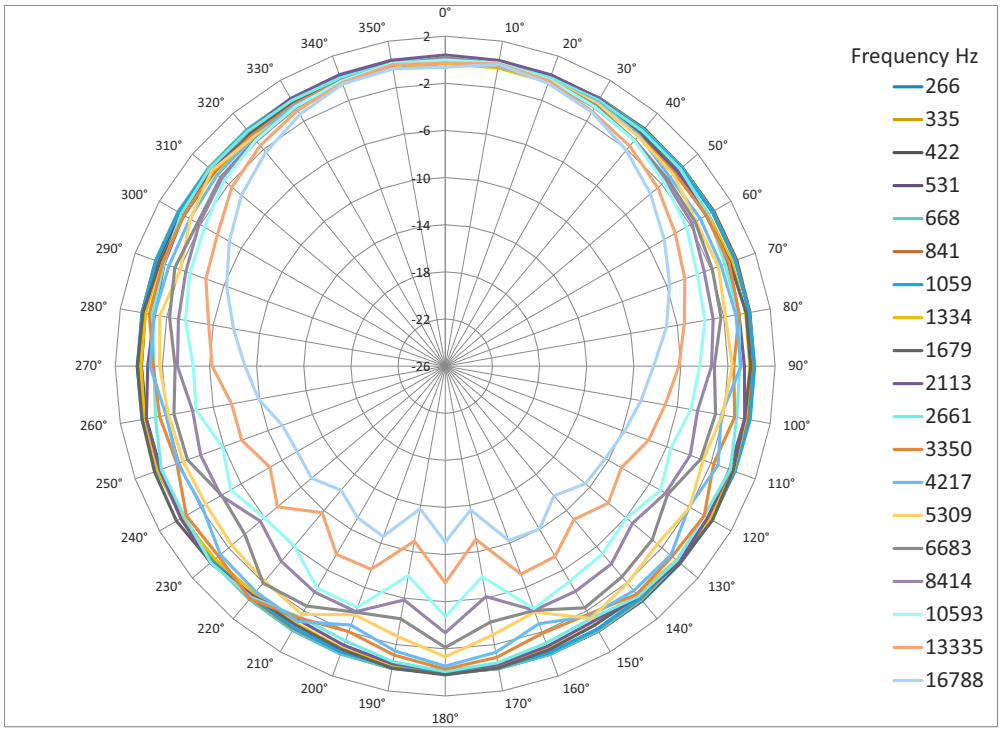


FIGURE A-28 Model 831 with 377B02 Microphone

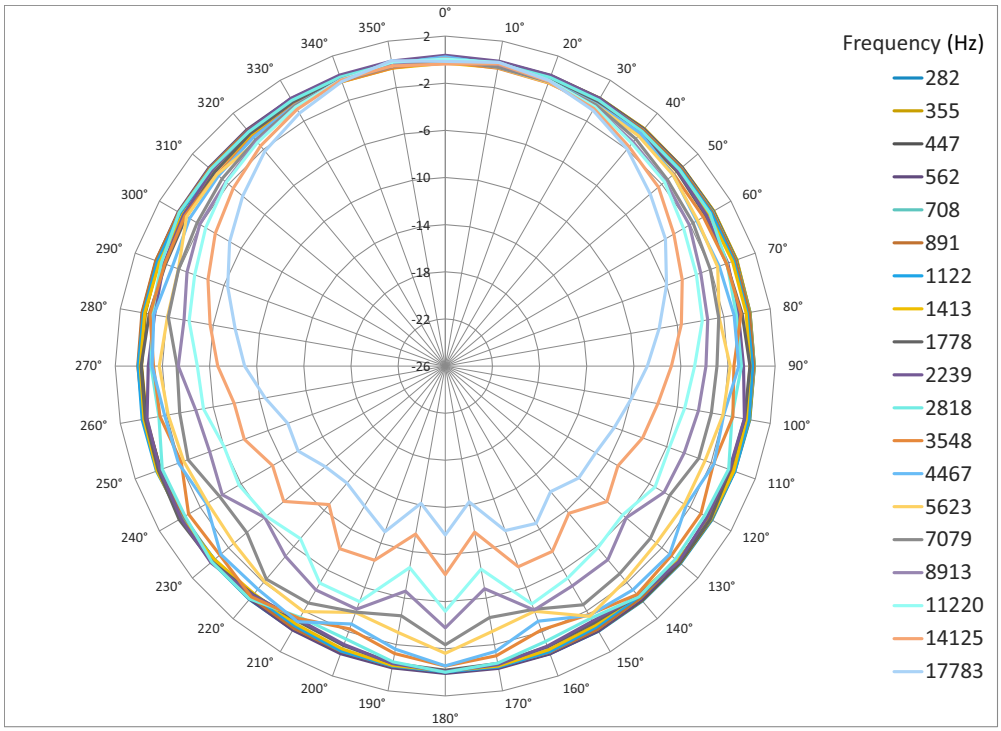


FIGURE A-29 Model 831 with 377B02 Microphone

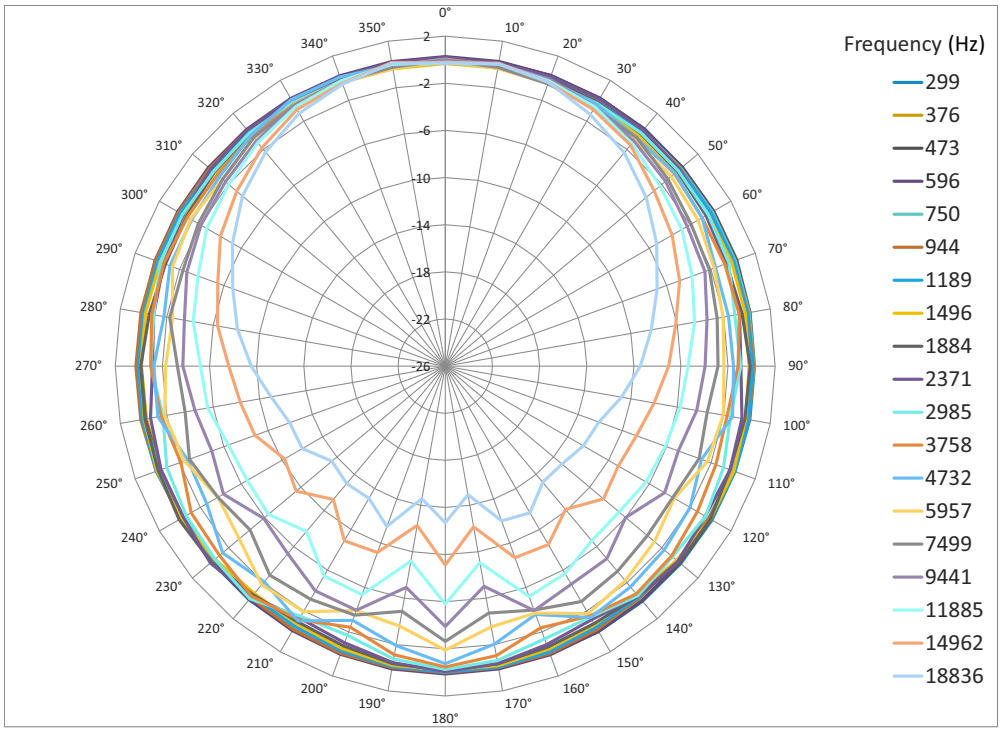


FIGURE A-30 Model 831 with 377B02 Microphone

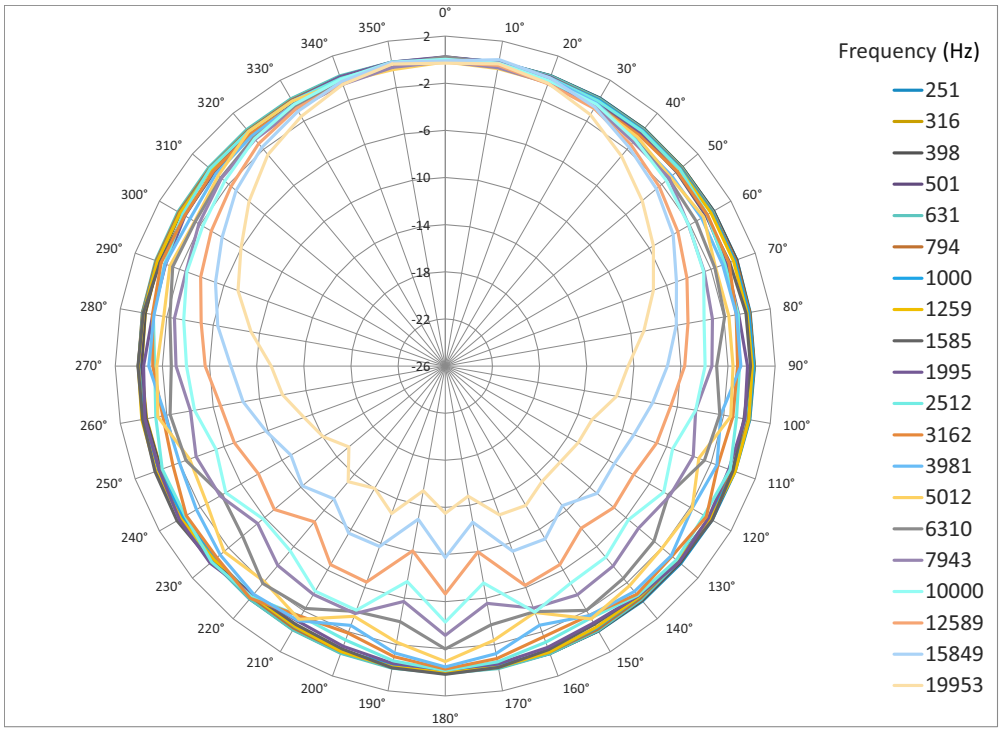


FIGURE A-31 Model 831 with 377C20 Microphone

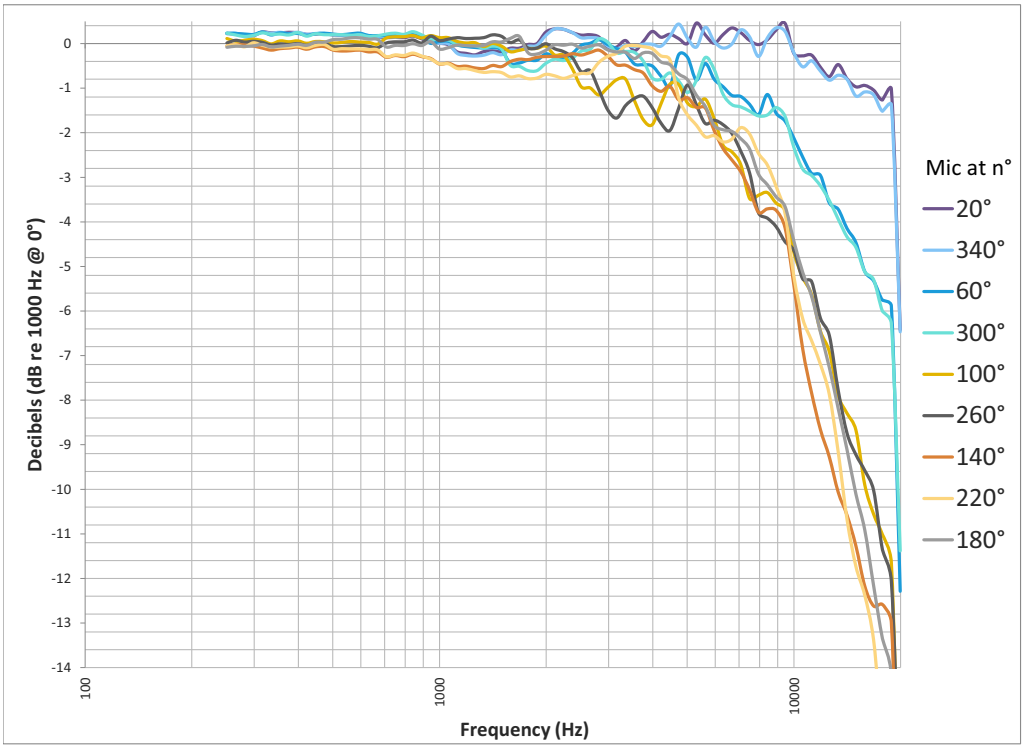


FIGURE A-32 Model 831 with 377C20 Microphone

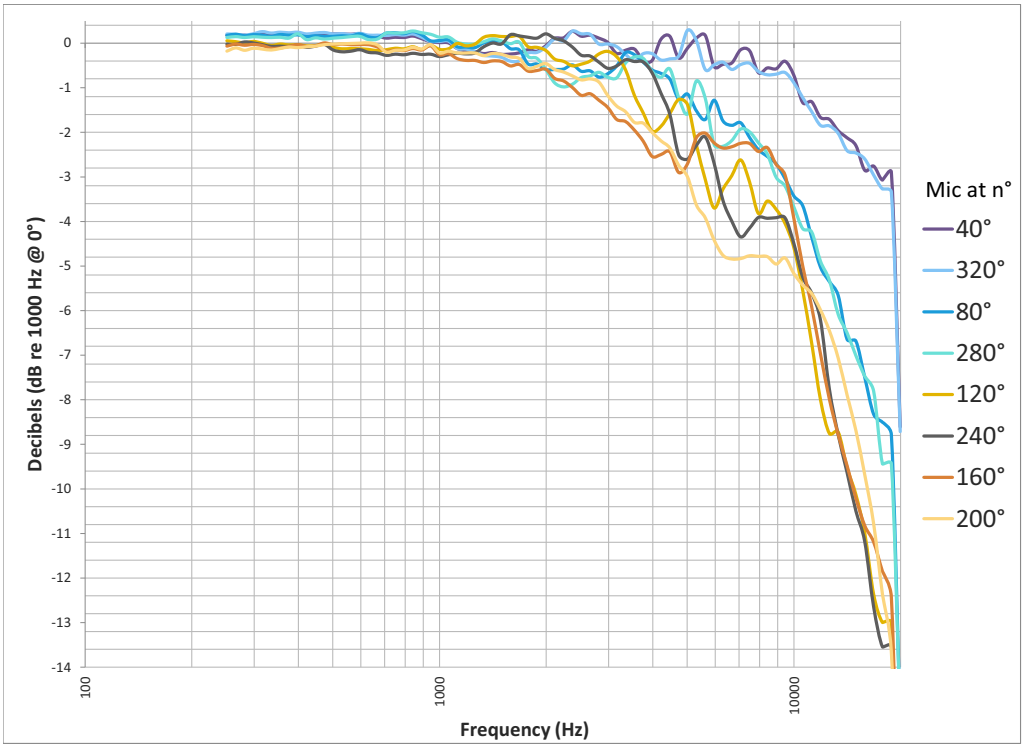


FIGURE A-33 Model 831 with 377C20 Microphone

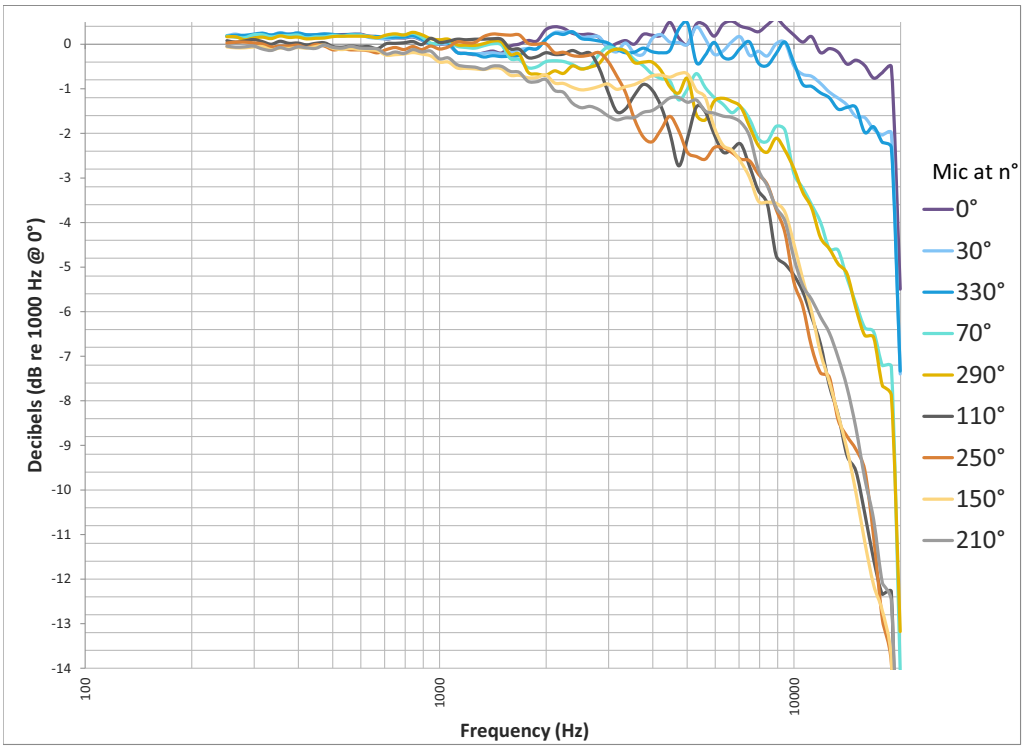


FIGURE A-34 Model 831 with 377C20 Microphone

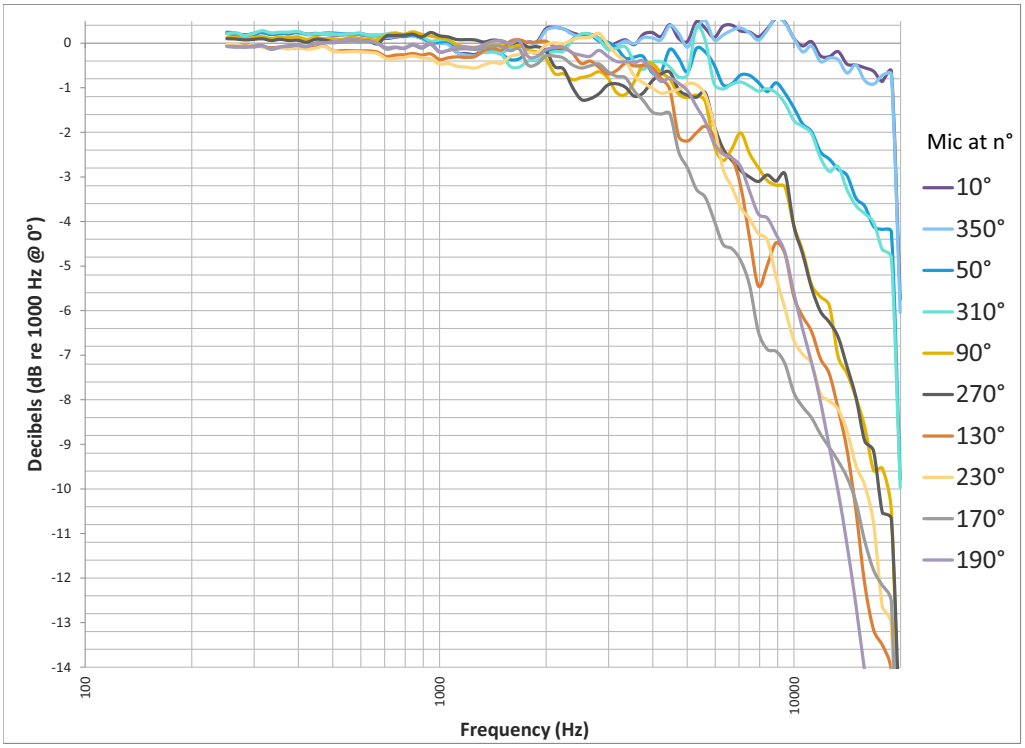


FIGURE A-35 Model 831 with 377C20 Microphone

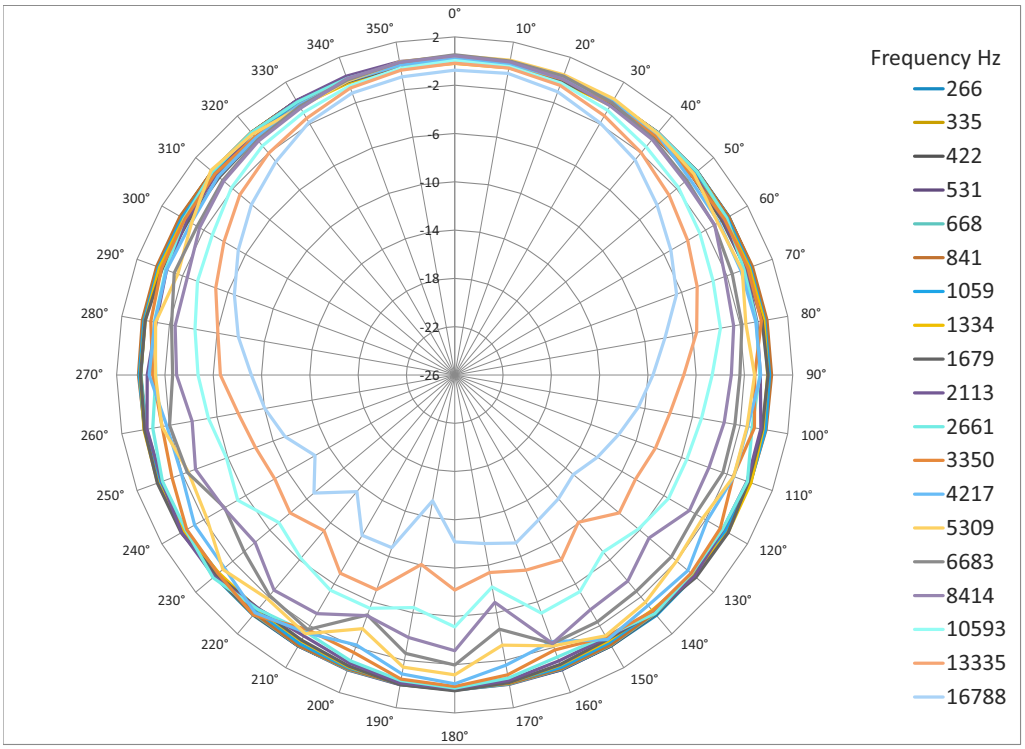


FIGURE A-36 Model 831 with 377C20 Microphone

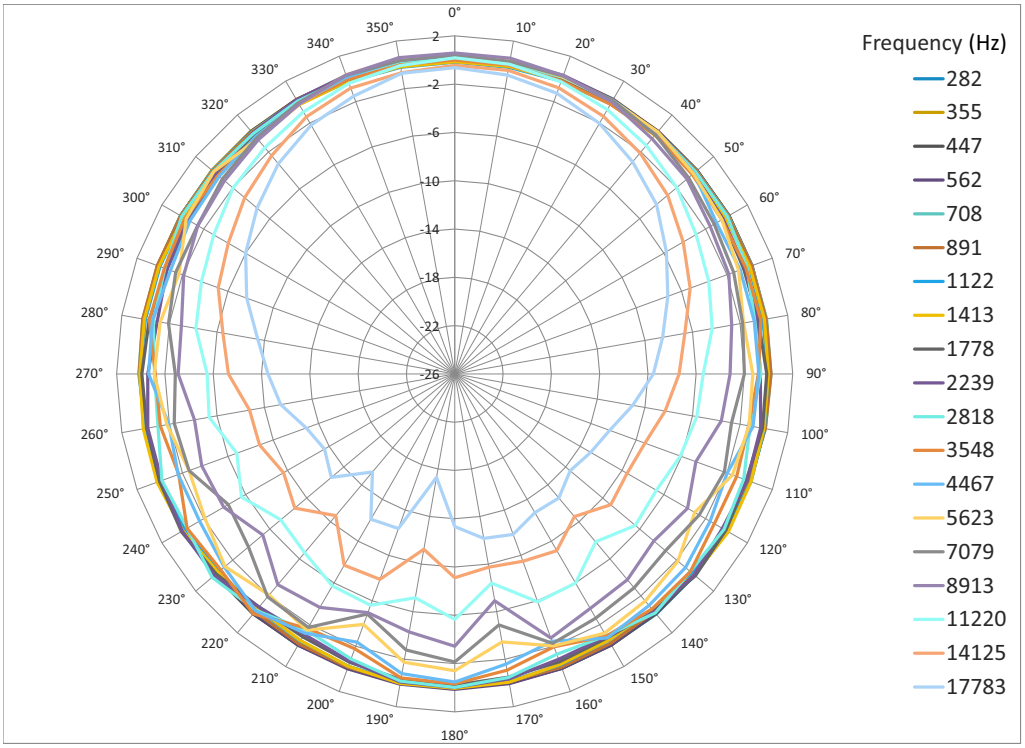


FIGURE A-37 Model 831 with 377C20 Microphone

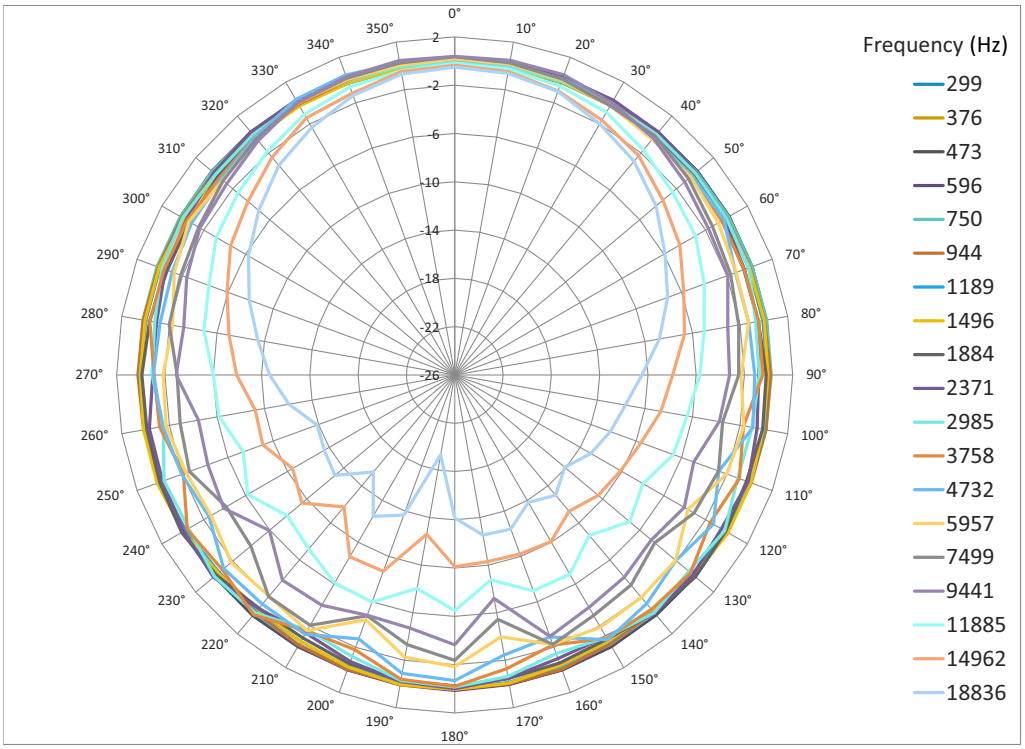
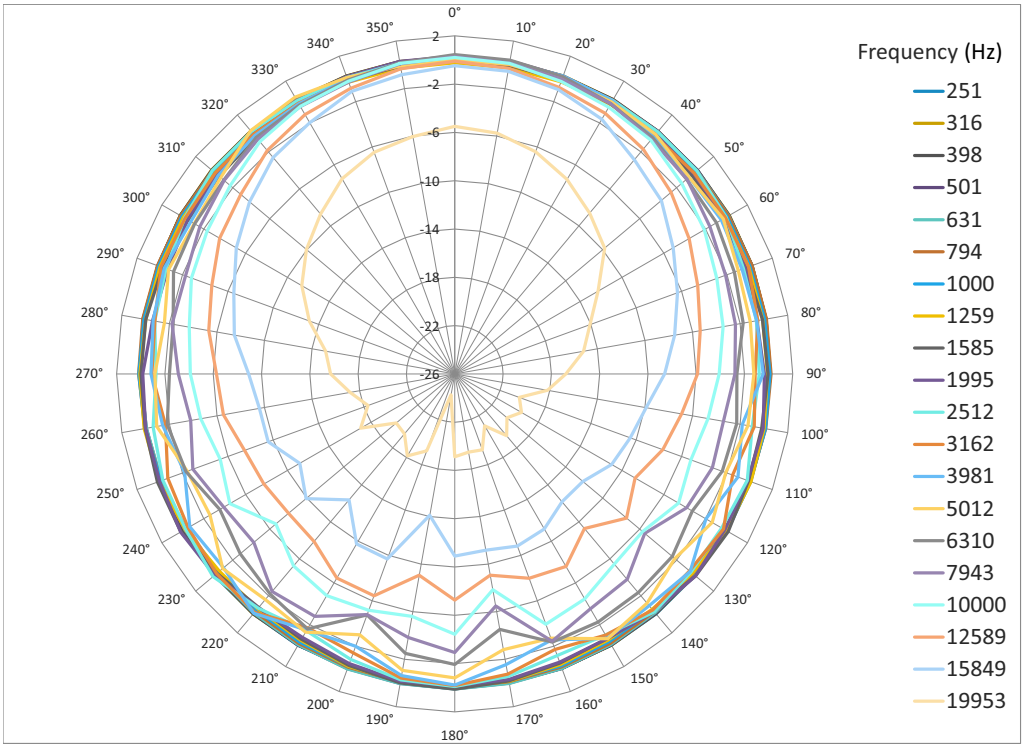


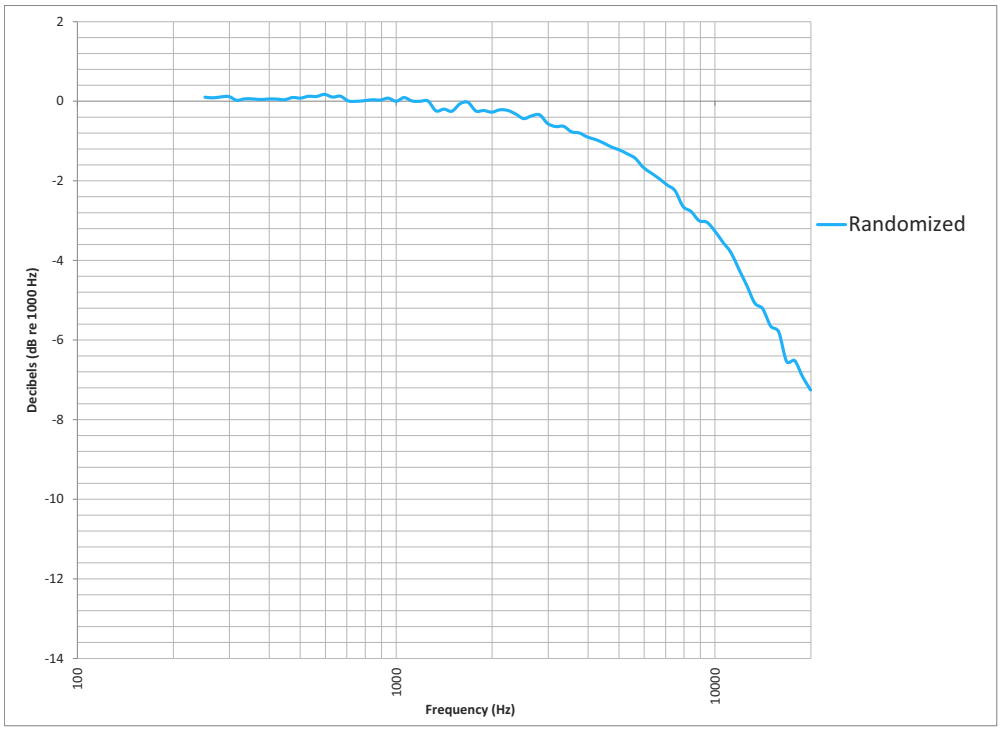
FIGURE A-38 Model 831 with 377C20 Microphone



A.7.3 Random Incidence

Normalized to 1 kHz at 0 degrees.

FIGURE A-39 Random Incidence



Appendix B Measuring IEC61672-1

B.1 Overview

This appendix presents information for measuring the sound level meter functionality of the Larson Davis SoundAdvisor Model 831C Sound Level Meter according to IEC61672-1 Edition 2.0 2013-09.

B.2 Section 9.3

a) Reference Sound Pressure Level
The reference sound pressure level is 114 dB re 20 µPa.

b) Reference Level Range
The reference level range is 0 dB gain (SLM) and High Range (OBA).

c) Microphone Reference Point
The microphone reference point is the center of the diaphragm of the 377B02 microphone.

d) Periodic Testing
Table A.4, “SLM with PRM831 and 377B02 Microphone,” on page A-6 lists values of 831C with PRM831 and 377B02 Microphone adjustment data of A-weighted levels used for periodic measurements.

e) Frequency Response and Corrections
See Table A.4, “SLM with PRM831 and 377B02 Microphone,” on page A-6.

Table B.1 831C with PRM831 and 377B02 Microphone average frequency responses and corrections Required by IEC 61672-1

Exact Frequency	0° Free Field Response	0° Free Field Corrections[1]	Effect of Wind Screen	Wind Screen on 831C 0° Free Field	0° Free Field Corrections with Wind Screen on 831C[1]	expanded uncertainty of Corrections '@ 95%
Hz	dB	dB	dB	dB	dB	dB
251.19	-0.03	0.03	0.03	0.00	0.00	0.25
316.23	-0.11	0.11	0.15	0.04	-0.04	0.25
398.11	0.12	-0.12	-0.03	0.09	-0.09	0.25
501.19	0.14	-0.14	0.00	0.14	-0.14	0.25
630.96	0.18	-0.18	-0.09	0.09	-0.09	0.25
794.33	0.15	-0.15	-0.07	0.08	-0.08	0.25
1000.00	0.00	0.00	0.00	0.00	0.00	0.25
1059.25	0.00	-0.00	0.11	0.11	-0.11	0.25
1122.02	-0.12	0.12	0.03	-0.09	0.09	0.25
1188.50	-0.21	0.21	0.13	-0.08	0.08	0.25

Table B.1 831C with PRM831 and 377B02 Microphone average frequency responses and corrections Required by IEC 61672-1

1258.93	-0.39	0.39	0.31	-0.08	0.08	0.25
1333.52	-0.29	0.29	0.21	-0.08	0.08	0.25
1412.54	-0.27	0.27	0.20	-0.07	0.07	0.25
1496.24	-0.13	0.13	0.07	-0.06	0.06	0.25
1584.89	-0.02	0.02	0.23	0.21	-0.21	0.25
1678.80	0.01	-0.01	0.24	0.25	-0.25	0.25
1778.28	-0.01	0.01	0.26	0.25	-0.25	0.25
1883.65	-0.08	0.08	0.40	0.32	-0.32	0.25
1995.26	0.20	-0.20	0.43	0.63	-0.63	0.25
2113.49	0.36	-0.36	0.40	0.76	-0.76	0.35
2238.72	0.24	-0.24	0.53	0.77	-0.77	0.35
2371.37	0.01	-0.01	0.59	0.60	-0.60	0.35
2511.89	-0.03	0.03	0.60	0.57	-0.57	0.35
2660.73	0.19	-0.19	0.42	0.61	-0.61	0.35
2818.38	0.00	-0.00	0.55	0.55	-0.55	0.35
2985.38	-0.27	0.27	0.35	0.08	-0.08	0.35
3162.28	-0.04	0.04	0.30	0.26	-0.26	0.35
3349.65	0.01	-0.01	0.11	0.12	-0.12	0.35
3548.13	-0.13	0.13	-0.01	-0.14	0.14	0.35
3758.37	0.10	-0.10	-0.00	0.10	-0.10	0.35
3981.07	0.10	-0.10	0.00	0.10	-0.10	0.35
4216.97	-0.03	0.03	-0.20	-0.23	0.23	0.45
4466.84	0.35	-0.35	-0.22	0.13	-0.13	0.45
4731.51	0.06	-0.06	-0.39	-0.33	0.33	0.45
5011.87	-0.08	0.08	-0.39	-0.47	0.47	0.45
5308.84	-0.04	0.04	0.04	0.00	0.00	0.45
5623.41	-0.02	0.02	-0.09	-0.11	0.11	0.45
5956.62	0.04	-0.04	-0.16	-0.12	0.12	0.45
6309.57	0.21	-0.21	0.14	0.35	-0.35	0.45
6683.44	0.02	-0.02	0.25	0.27	-0.27	0.45
7079.46	0.04	-0.04	0.12	0.16	-0.16	0.45
7498.94	0.01	-0.01	-0.14	-0.13	0.13	0.45
7943.28	-0.03	0.03	-0.29	-0.32	0.32	0.45
8413.95	0.27	-0.27	-0.39	-0.12	0.12	0.55
8912.51	0.06	-0.06	0.13	0.19	-0.19	0.55
9440.61	0.01	-0.01	-0.03	-0.02	0.02	0.55
10000.00	0.01	-0.01	0.21	0.22	-0.22	0.55
10592.54	0.07	-0.07	0.09	0.16	-0.16	0.55
11220.18	0.05	-0.05	-0.05	0.00	0.00	0.55

Table B.1 831C with PRM831 and 377B02 Microphone average frequency responses and corrections Required by IEC 61672-1

11885.02	-0.01	0.01	-0.20	-0.21	0.21	0.55
12589.25	0.23	-0.23	-0.26	-0.03	0.03	0.55
13335.21	0.24	-0.24	-0.26	-0.02	0.02	1.00
14125.38	0.08	-0.08	-0.15	-0.07	0.07	1.00
14962.36	0.05	-0.05	-0.01	0.04	-0.04	1.00
15848.93	-0.23	0.23	0.41	0.18	-0.18	1.00
16788.04	-0.20	0.20	0.14	-0.06	0.06	1.00
17782.79	-0.15	0.15	-0.08	-0.23	0.23	1.00
18836.49	-0.18	0.18	-0.41	-0.59	0.59	1.00
19952.62	-0.13	0.13	-1.33	-1.46	1.46	1.00

1. Add numbers in this column to levels read on the 831 to correct the level at a specific frequency

Table B.2 Directional Response of 3 1/2” Windscreen

Frequency (Hz)	Angle from Reference Direction (Degrees)[1]												
	0	**15**	**30**	**45**	**60**	**75**	**90**	**105**	**120**	**135**	**150**	**165**	**180**
251.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
266.07	0.00	0.00	0.03	-0.03	0.00	0.00	0.00	-0.03	0.03	0.00	-0.03	-0.03	0.00
281.84	0.00	0.10	0.07	-0.03	-0.07	0.00	0.03	0.00	0.07	0.00	-0.03	0.03	0.00
298.54	0.07	0.07	0.00	0.00	-0.03	0.00	0.03	-0.03	-0.03	0.03	-0.10	0.03	0.00
316.23	0.00	0.03	0.07	0.00	-0.07	-0.03	0.00	-0.03	0.03	-0.03	-0.10	0.07	0.00
334.97	0.00	0.00	0.03	0.00	-0.07	-0.03	0.07	-0.13	0.00	0.00	-0.07	0.07	0.00
354.81	0.03	0.07	0.10	-0.03	-0.07	0.00	0.00	-0.03	0.03	0.03	-0.03	0.03	0.00
375.84	0.03	0.07	0.03	0.00	-0.03	-0.03	0.00	-0.03	0.03	0.00	-0.10	0.00	0.00
398.11	0.00	0.00	0.10	-0.03	-0.03	0.00	0.00	-0.03	0.07	-0.03	-0.07	0.07	0.07
421.70	0.00	0.00	0.07	0.03	-0.07	-0.03	0.00	-0.03	0.03	0.00	-0.07	0.00	0.00
446.68	0.00	0.03	0.03	-0.03	0.00	-0.03	0.10	0.03	0.03	0.00	0.00	0.00	0.00
473.15	0.03	0.03	0.03	0.00	0.03	-0.03	0.07	0.00	0.03	0.00	-0.07	0.03	0.00
501.19	0.10	0.10	0.13	0.07	-0.03	0.07	0.00	0.00	0.13	0.10	-0.07	0.03	0.00
530.88	0.03	0.10	0.13	0.07	-0.07	0.07	0.03	0.03	0.07	0.00	-0.03	0.03	0.00
562.34	0.10	0.10	0.13	0.07	0.03	0.07	0.00	-0.03	0.13	0.10	-0.03	0.00	0.07
595.66	0.07	0.10	0.13	0.07	-0.03	0.03	0.00	0.00	0.10	0.07	-0.03	0.07	0.00
630.96	0.03	0.00	0.07	-0.03	0.00	0.07	0.10	0.07	0.13	0.10	0.03	0.10	0.10
668.34	0.10	0.10	0.13	0.07	0.03	0.00	0.03	0.03	0.07	0.00	0.03	0.10	0.00
707.95	0.10	0.10	0.13	0.07	0.03	0.07	0.10	0.07	0.03	0.10	0.03	0.10	0.00
749.89	0.10	0.10	0.13	0.07	0.00	-0.03	0.10	0.07	0.13	0.10	0.03	0.10	0.10
794.33	0.10	0.10	0.13	0.07	0.03	0.13	0.10	0.07	0.13	0.10	0.03	0.10	0.10
841.40	0.03	0.07	0.10	0.07	0.03	0.07	0.10	0.10	0.03	0.10	0.03	0.10	0.10
891.25	0.10	0.07	0.10	0.00	0.03	0.07	0.03	0.07	0.13	0.07	0.03	0.10	0.10
944.06	0.13	0.17	0.20	0.07	0.07	0.07	0.13	0.17	0.20	0.17	0.03	0.17	0.13
1000.00	0.20	0.10	0.13	0.07	0.03	0.17	0.10	0.17	0.23	0.10	0.03	0.10	0.10
1059.25	0.10	0.10	0.23	0.17	0.13	0.07	0.10	0.07	0.13	0.10	0.03	0.10	0.10

Table B.2 Directional Response of 3 1/2” Windscreen

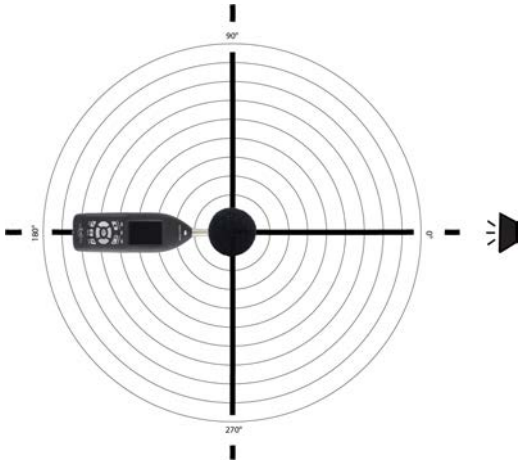
1122.02	0.20	0.23	0.23	0.13	0.13	0.17	0.10	0.17	0.23	0.20	0.13	0.13	0.10
1188.50	0.20	0.10	0.23	0.07	0.13	0.17	0.10	0.17	0.13	0.20	0.13	0.17	0.10
1258.93	0.13	0.17	0.23	0.17	0.13	0.17	0.23	0.13	0.23	0.17	0.13	0.10	0.20
1333.52	0.20	0.20	0.33	0.27	0.13	0.17	0.20	0.23	0.23	0.20	0.13	0.20	0.10
1412.54	0.20	0.20	0.23	0.17	0.23	0.17	0.20	0.27	0.23	0.20	0.13	0.17	0.20
1496.24	0.23	0.20	0.23	0.17	0.23	0.17	0.20	0.27	0.23	0.27	0.13	0.10	0.20
1584.89	0.33	0.30	0.37	0.30	0.27	0.27	0.33	0.27	0.30	0.27	0.20	0.27	0.30
1678.80	0.30	0.30	0.40	0.37	0.33	0.27	0.30	0.27	0.33	0.20	0.17	0.20	0.27
1778.28	0.40	0.40	0.43	0.37	0.33	0.33	0.40	0.37	0.33	0.40	0.13	0.30	0.30
1883.65	0.40	0.40	0.43	0.37	0.33	0.37	0.40	0.37	0.33	0.30	0.23	0.30	0.30
1995.26	0.40	0.50	0.43	0.47	0.43	0.47	0.40	0.37	0.37	0.40	0.23	0.33	0.30
2113.49	0.50	0.50	0.53	0.47	0.43	0.47	0.40	0.47	0.43	0.37	0.33	0.33	0.40
2238.72	0.50	0.50	0.53	0.47	0.43	0.47	0.50	0.47	0.47	0.40	0.30	0.40	0.40
2371.37	0.50	0.50	0.53	0.47	0.43	0.47	0.50	0.47	0.53	0.50	0.33	0.50	0.40
2511.89	0.50	0.57	0.53	0.57	0.50	0.57	0.53	0.53	0.53	0.50	0.37	0.47	0.47
2660.73	0.53	0.53	0.57	0.57	0.50	0.50	0.60	0.50	0.53	0.50	0.43	0.50	0.43
2818.38	0.57	0.53	0.57	0.60	0.50	0.50	0.53	0.53	0.57	0.57	0.43	0.57	0.50
2985.38	0.40	0.50	0.43	0.57	0.43	0.50	0.57	0.53	0.57	0.57	0.37	0.50	0.50
3162.28	0.40	0.40	0.53	0.50	0.33	0.57	0.50	0.47	0.53	0.50	0.43	0.50	0.50
3349.65	0.30	0.40	0.37	0.37	0.37	0.43	0.40	0.40	0.43	0.43	0.40	0.50	0.50
3548.13	0.23	0.27	0.33	0.30	0.23	0.37	0.33	0.33	0.37	0.40	0.33	0.40	0.40
3758.37	0.20	0.23	0.13	0.17	0.23	0.27	0.20	0.23	0.33	0.37	0.27	0.40	0.30
3981.07	0.10	0.10	0.13	0.13	0.00	0.13	0.10	0.10	0.23	0.20	0.13	0.27	0.23
4216.97	0.03	0.00	0.10	0.03	-0.10	0.07	0.00	-0.03	0.07	0.03	0.03	0.10	0.13
4466.84	0.00	-0.07	-0.07	-0.07	-0.17	-0.07	-0.10	-0.10	-0.07	0.00	-0.07	0.00	0.00
4731.51	-0.30	-0.20	-0.17	-0.23	-0.27	-0.30	-0.30	-0.43	-0.27	-0.20	-0.37	-0.20	-0.20
5011.87	-0.17	-0.20	-0.17	-0.30	-0.27	-0.23	-0.40	-0.33	-0.37	-0.40	-0.37	-0.30	-0.30
5308.84	0.00	-0.10	-0.07	-0.23	-0.30	-0.33	-0.40	-0.43	-0.47	-0.50	-0.60	-0.43	-0.43
5623.41	0.00	-0.07	-0.03	-0.17	-0.20	-0.33	-0.37	-0.43	-0.47	-0.50	-0.53	-0.43	-0.43
5956.62	0.17	0.07	0.10	-0.13	-0.17	-0.23	-0.33	-0.37	-0.43	-0.50	-0.57	-0.50	-0.40
6309.57	0.10	0.20	0.23	-0.03	-0.07	-0.03	-0.10	-0.33	-0.37	-0.40	-0.47	-0.40	-0.30
6683.44	0.13	0.10	0.20	0.07	-0.03	-0.03	-0.13	-0.17	-0.27	-0.33	-0.40	-0.40	-0.20
7079.46	0.03	0.07	0.07	0.07	0.03	0.00	-0.10	-0.13	-0.17	-0.27	-0.27	-0.23	-0.13
7498.94	-0.10	-0.10	-0.07	-0.03	-0.07	-0.03	-0.20	-0.23	-0.27	-0.20	-0.27	-0.10	-0.10
7943.28	-0.30	-0.37	-0.30	-0.23	-0.33	-0.23	-0.33	-0.40	-0.37	-0.33	-0.33	-0.20	-0.17
8413.95	-0.40	-0.37	-0.37	-0.43	-0.53	-0.43	-0.57	-0.57	-0.57	-0.50	-0.43	-0.23	-0.37
8912.51	-0.40	-0.50	-0.37	-0.53	-0.67	-0.63	-0.70	-0.73	-0.73	-0.80	-0.73	-0.50	-0.50
9440.61	-0.37	-0.40	-0.37	-0.50	-0.67	-0.70	-0.70	-0.83	-0.77	-0.90	-0.93	-0.77	-0.60
10000.00	-0.13	-0.20	-0.27	-0.43	-0.57	-0.57	-0.77	-0.83	-0.77	-0.90	-0.97	-0.90	-0.70
10592.54	-0.20	-0.20	-0.17	-0.40	-0.47	-0.47	-0.70	-0.83	-0.83	-0.83	-0.97	-0.87	-0.70
11220.18	-0.47	-0.43	-0.37	-0.43	-0.53	-0.47	-0.70	-0.90	-0.77	-0.80	-0.77	-0.90	-0.67
11885.02	-0.67	-0.73	-0.63	-0.60	-0.73	-0.57	-0.83	-0.90	-0.83	-0.87	-0.73	-0.70	-0.70
12589.25	-0.57	-0.73	-0.83	-0.87	-0.97	-0.97	-1.00	-1.00	-1.00	-1.17	-1.07	-0.90	-0.90
13335.21	-0.70	-0.67	-0.63	-0.83	-1.00	-1.17	-1.10	-1.07	-1.07	-1.37	-1.53	-1.20	-1.13
14125.38	-0.40	-0.50	-0.57	-0.60	-0.90	-1.00	-1.00	-1.20	-1.17	-1.37	-1.63	-1.47	-1.20

Table B.2 Directional Response of 3 1/2” Windscreen

14962.36	-0.70	-0.73	-0.53	-0.73	-0.97	-0.90	-1.10	-1.33	-1.23	-1.50	-1.53	-1.43	-1.13
15848.93	-0.90	-0.90	-0.97	-1.03	-1.27	-1.13	-1.30	-1.60	-1.37	-1.57	-1.37	-1.40	-1.17
16788.04	-0.90	-1.07	-1.00	-1.30	-1.33	-1.47	-1.50	-1.53	-1.40	-1.70	-1.77	-1.43	-1.43
17782.79	-0.87	-0.93	-0.93	-1.10	-1.33	-1.53	-1.70	-1.57	-1.67	-1.73	-2.30	-2.00	-1.70
18836.49	-0.90	-1.10	-0.90	-1.10	-1.43	-1.43	-1.70	-1.83	-1.80	-1.83	-2.13	-2.27	-1.77
19952.62	-1.27	-1.30	-1.13	-1.47	-1.73	-1.67	-2.07	-2.30	-1.97	-2.23	-2.13	-1.97	-1.67

1. The corrections which should be subtracted from the measured data when using the Larson-Davis Model WS001 3½ inch diameter windscreen with a ½ inch Larson-Davis microphone are as indicated in the following table

FIGURE B-1 Windscreen Direction



f) Linear Operating Range

Table B.3 Linear Operating Range

Gain	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
0 dB	22.6 dB to 100.5 dB	22.6 dB to 140 dB	22.6 dB to 141 dB	22.6 dB to 138.9 dB	22.6 dB to 135.7 dB
20 dB	18 dB to 80.5 dB	18 dB to 120 dB	18 dB to 121 dB	18 dB to 118.9 dB	18 dB to 115.7 dB

g) Linear Measurement Starting Point

Table B.4 Linear Measurement Starting Point

Gain	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
0 dB	74.5 dB	114 dB	115 dB	112.9 dB	109.7 dB
20 dB	54.5 dB	94dB	95 dB	92.9 dB	89.7 dB

h) Electrical Insert Signals

The electrical design of the input device to insert electrical signals into the preamplifier is a series 12pF ± 5% capacitor. The Larson Davis ADP090 is used for this purpose. The ADP090 is also use for noise floor measurements by attaching the included BNC short on the front of the ADP090.

i) Self Generating Noise in Low Level Sound Field

Table B.5 SLM Noise Levels

Self Generated Electrical Noise	0 dB Gain		20 dB Gain	
Weighting	Typical (dB)	Max (dB)	Typical (dB)	Max (dB)
A	10	12	6	9
C	13	16	12	15
Z	22	25	22	25
Self Generated Total Noise	0 dB Gain		20 dB Gain	
Weighting	Typical (dB)	Max (dB)	Typical (dB)	Max (dB)
A	16	19	16	17
C	17	20	16	19
Z	23	26	23	26

Note: Combination of the electronic noise and the thermal noise of the 377B02 microphone at 68 °F (20 °C) measured in a sealed and vibration isolated cavity with an averaging time of 60 seconds. Electronic noise of the instrument with an ADP090 (12 pF) in place of the microphone highest anticipated self-generated noise.

j) Highest Sound Pressure Level

The highest sound pressure level the Larson Davis 831C is designed to accommodate at the level of overload is 140 dB. The maximum peak-to-peak voltage is 28 Vpp input through the ADP090.

k) Battery Power Voltage Range

The battery power supply voltage range for which the 831C conforms to this standard:
16.8 Volts maximum
The 831C will shut down if the battery is below 4.0 Volts when used with alkaline batteries. Therefore from 4.0 to 16.8 Volts is the usable range of battery voltage. The instrument will shut off to ensure that no data is taken that would not meet the requirements of IEC 61672.

l) Typical Stabilization Time

The typical time interval needed to stabilize after changes in environmental conditions:
For a temperature change of 5 °C then 30 minutes are required.
For a static pressure change of 5 kPa then 15 seconds are required.
For a humidity change of 25% (non-condensing) then 30 minutes are required.

m) Field Strength > 10 V/m

The 831C was not measured for field strengths greater than 10 V/m.

n) Radio Frequency Emission

The mode of operation of the 831C that produces the greatest radio frequency emission levels is with the 831C set to run with the LCD backlights on, an external charger (PSAA20R-120 charger), Ethernet dongle, and USB cable attached and with an EXC020 (20' microphone extension cable) between the PRM831 and meter.

o) AC Power and Radio Frequency Susceptibility

The mode of operation of the 831C that produced the least immunity to the effects of exposure to AC power-frequency and radio frequency field is with the 831C set to run with the LCD backlights on, an external charger (PSAA20R-120 charger), Ethernet dongle, and USB cable attached and with an EXC020 (20' microphone extension cable) between the PRM831 and meter.

FIGURE B-2 EM Field Orientation

Appendix C Glossary

C.1 Overview

This appendix contains technical definitions of key acoustical and vibration terms commonly used with Larson Davis instruments. The reader is referred to American National Standards Institute document S1.1-1994 (R2004) for additional definitions. Specific use of the terms defined are in the main body of the text.

C.2 Glossary of Terms

Allowed Exposure Time (T_i)

The allowed time of exposure to sound that a constant A-weighted sound level in a chosen Criterion Level, Criterion Duration, and Exchange Rate.

The equation for T_i is

$$T_i = \frac{T_c}{2^{(L_{avg}-L_c)/Q}} = \frac{T_c}{10^{(L_{avg}-L_c)/q}}$$

where L_c is the Criterion Level, Tc is the Criterion Duration, Q is the Exchange Rate, q is the Exchange Rate Factor and L_{avg} is the Average Sound Level.

Example: If $L_c = 90$, $T_c = 8$, $Q = 3$ and $L_{avg} = 95$ then

$$T_i = \frac{8}{2^{(95-90)/3}} = \frac{8}{10^{(95-90)/10}} = 2.52 = 2 \text{ hours and } 31 \text{ minutes}$$

This means that if a person is in this area for 2 hours and 31 minutes he will have accumulated a Noise Dose of 100%.

Standard: ANSI S12.19.

See “Exchange Rate (Q), Exchange Rate Factor (q), Exposure Factor (k)” on page C-6.

Average Sound Level (L_{avg})

The logarithmic average of the sound during a Measurement Duration (specific time period), using the chosen Exchange Rate Factor. Exposure to this sound level over the period would result in the same noise dose and the actual (unsteady) sound levels. If the Measurement Duration is the same as the Criterion Duration, then L_{avg}=LTWA(L_C) where the Measurement Duration (specified time period) is $T=T_2-T_1$ and q is the Exchange Rate Factor. Only sound levels above the Threshold Level are included in the integral. Standard: ANSI S12.19

$$L_{avg} = qLog_{10}\left(\frac{1}{T}\int_{T_1}^{T_2} 10^{(L_p(t))/q}\,dt\right)$$

Community Noise Equivalent Level (CNEL, L_{den})

A rating of community noise exposure to all sources of sound that differentiates between daytime, evening and nighttime noise exposure. The equation for it is

$$L_{den} = 10\log_{10}\left\{\frac{1}{24}\left[\sum_{0000}^{0700} 10^{(L_i+10)/10} + \sum_{0700}^{1900} 10^{L_i/10} + \sum_{1900}^{2200} 10^{(L_i+5)/10} + \sum_{2200}^{2400} 10^{(L_i+10)/10}\right]\right\}$$

The continuous equivalent sound level is generally calculated on an hourly basis and is shown in the equation as L. The levels for the hourly periods from midnight to 7 a.m. have 10 added to them to represent less tolerance for noise during sleeping hours. The same occurs from 10 p.m. to midnight. The levels for the hourly periods between 7 p.m. and 10 p.m. have 5 added to them to represent a lessened tolerance for noise during evening activities. They are energy summed and converted to an average noise exposure rating.

Criterion Duration (Tc)

It is the time required for a constant sound level equal to the Criterion Level to produce a Noise Dose of 100%. Criterion Duration is typically 8 hours.

Example: If the Criterion Level = 90 dB and the Criterion Duration is 8 hours, then a sound level of 90 dB for 8 hours, will produce a 100% Noise Dose. See Noise Dose. Standard: ANSI S12.19

Criterion Sound Exposure (CSE)

The product of the Criterion Duration and the mean square sound pressure associated with the Criterion Sound Level when adjusted for the Exchange Rate. It is expressed in Pascals-squared seconds when the exchange rate is 3 dB, where q is the Exchange Rate Factor. See Exchange Rate.

$$CSE = T_c 10^{L_c/q}$$

Standard: ANSI S1.25

Criterion Sound Level (L_c)

It is the sound level which if continually applied for the Criterion Duration will produce a Noise Dose of 100%. The current OSHA Criterion Level is 90 dB.

Standard: ANSI S12.19

Daily Personal Noise Exposure ($L_{EP,d}$)

It is the level of a constant sound over the Criterion Duration that contains the same sound energy as the actual, unsteady sound over a specific period. The period is generally shorter, so the sound energy is spread out over the Criterion Duration period.

Example: If the Criterion Duration = 8 hours and the specific period is 4 hours and the average level during the 4 hours is 86 dB, then the $L_{EP,d}$ = 83 dB.

Day-Night Average Sound Level (DNL, L_{dn})

A rating of community noise exposure to all sources of sound that differentiates between daytime and nighttime noise exposure. The equation for it is

$$L_{dn} = 10Log_{10}\left\{\frac{1}{24}\left[\sum_{0000}^{0700} 10^{(L_i+10)/10} + \sum_{0700}^{2200} 10^{L_i/10} + \sum_{2200}^{2400} 10^{(L_i+10)/10}\right]\right\}$$

The continuous equivalent sound level (See definition) is generally calculated on an hourly basis and is shown in the equation as L.

The values for the hourly periods from midnight to 7 a.m. have 10 added to them to represent less tolerance for noise during sleeping hours. The same occurs from 10 p.m. to midnight. They are energy summed and converted to an average noise exposure rating.

Decibel (dB)

A logarithmic form of any measured physical quantity and commonly used in the measurement of sound and vibration. Whenever the word level is used, this logarithmic form is implied. The decibel provides us with the possibility of representing a large span of signal levels in a simple manner as opposed to using the basic unit Pascal for acoustic measurements.

It is not possible to directly add or subtract physical quantities when expressed in decibel form since the addition of logarithmic values correspond to multiplication of the original quantity.

The word level is normally attached to a physical quantity when expressed in decibels; for example, L_p represents the sound pressure level.

The difference between the sound pressure for silence versus loud sounds is a factor of 1,000,000:1 or more, and it is very unpractical to use these large numbers. Therefore, a measure that would relate to “the number of zeros” would help, for example, 100,000 would be equal to 50 and 1000 would be equal to 30 and so on. This is the basic principal of the dB measure.

All dB values are unit free and therefore, the dB value is not the value of the quantity itself, but the ratio of that quantity to an actual reference quantity used. Thus, for every level in decibels there must be a well defined reference quantity. Sound versus vibration uses different references, but the dB principal is the same. When the quantity equals the reference quantity the level is zero. To keep dB values above zero, the reference is generally set to be the lowest value of the quantity that we can imagine or normally wish to use. Before explaining the calculation of dB values, it is useful to remember the following rules of thumb when dB values are used for sound levels:

- Doubling of the Sound Pressure = 6 dB
- Doubling of the Sound Power = 3 dB
- Doubling of the Perceived Sound Level = (approx) 10 dB

Note: The latter is frequency and level dependent, but the value “10 dB” is a good rule of thumb, especially around 1 kHz.

Table C.1 shows the actual value of a specific item, such as sound power, for which the sound level is calculated. First, the sound power value is divided with the reference used and then the ten-based logarithm is applied. This value is then multiplied by 10 to create the decibel value (see equation below).

For every 10 decibels, a unit called Bel is created. The decibel stands for: deci for “one tenth” and bel for “Bel” (compare decimeter). The relationship between Bel and decibel is thus: 1 Bel = 10 decibels. It is not possible to directly add or subtract decibel values, since addition of logarithmic values correspond to multiplication of the original quantity.

Table C.1 Sound Level

Power form, squared units		Level form
Ration of Value to Reference	**Exponential Form of Ratio**	**10•Exponent**
1	10^0	0
10	10^1	10
100	10^2	20
200	$10^{2.3}$	23
1,000	10^3	30
10,000	10^4	40
100,000	10^5	50
1000,000	10^6	60

Each time the sound pressure level increases by 6 dB, the corresponding sound pressure value is doubled and thus multiplied by 2. Each time the sound power level increases by 3 dB, the sound power value is multiplied by 2. Thus, it is important to notice that a doubling of the sound power is equal to 3 dB, and a doubling of the sound pressure is equal to 6 dB, since a doubling of the sound pressure will result in a quadruple increase of the sound power. The advantage with using dB is simply that they remain the same even if we use sound pressure or sound power. Compare this to the use of voltage and power units in electrical engineering, units being related by P~V2. In table 2 an illustration is made of values calculated on sound pressure, non-squared units.

The original definition of decibel was intended for power-like quantities, such as sound power. If we consider sound pressure levels instead (usually denoted P in acoustics), the equation will be the same, since the “two” in the squared units will

move from within the bracket and become a 20 log instead of a 10 log and thus compensate for using linear or quadratic units. Please note that it is not allowed to use 20 log for squared units, since that expression assumes that we use linear units, like sound pressure in acoustics or voltage in electrical engineering. This is illustrated in equation below:

$$dB = 10Log_{10}\left[\frac{P^2}{P_0{}^2}\right] = 20Log\left[\frac{P}{P_0}\right] \quad ;p_0 = 20\mu Pa$$

Table C.1 illustrates how a a tenfold increase of the sound pressure will result in an increase in 20 dB steps, while sound power increases in 10 dB steps. See the linear form (Table C.1) and compare with equation above. In conclusion, dB values are always the same, independent of using sound power or sound pressure as the base unit. A 6 dB increase implies four times the sound power or two times the sound pressure.

Table C.2 Sound Power Increase

Linear form, non-squared units		Level form
Ration of Value to Reference	**Exponential Form of Ratio**	**20•Exponent**
1	10^0	0
10	10^1	20
100	10^2	40
200	$10^{2.3}$	46
1,000	10^3	60
10,000	10^4	80
100,000	10^5	100
1000,000	10^6	120

Department of Defense Level (LDOD)

The Average Sound Level calculated in accordance with Department of Defense Exchange Rate and Threshold Level. See Average Sound Level

Dose

Noise Dose (D) on page C-12

Detector

The part of a sound level meter that converts the actual fluctuating sound or vibration signal from the microphone to one that indicates its amplitude. It first squares the signal, then averages it in accordance with the time-weighting characteristic, and then takes the square root. This results in an amplitude described as rms (root-mean-square).

Eight Hour Time-Weighted Average Sound Level (L TWA(8))

It is the constant sound level that would expose a person to the same Noise Dose as the actual (unsteady) sound levels. The equation for it is

$$L_{TWA(8)} = L_c + qLog_{10}\left(\frac{D}{100}\right)$$

NOTE: This definition applies only for a Criterion Duration of 8 hours.

Standard: ANSI S12.19

Energy Equivalent Sound Level (Leq)

The level of a constant sound over a specific time period that has the same sound energy as the actual (unsteady) sound over the same period.

$$L_{eq} = 10Log_{10}\left[\frac{\int_{T_1}^{T_2} p^2(t)dt}{p_o^2 T}\right]$$

where p is the sound pressure and the Measurement Duration (specific time period) T=T2-T1. See "Sound Pressure Level (SPL, Lp)" on page C-14..

Exchange Rate (Q), Exchange Rate Factor (q), Exposure Factor (k)

It is defined in ANSI S1.25 as "the change in sound level corresponding to a doubling or halving of the duration of a sound level while a constant percentage of criterion exposure is maintained." The rate and the factors are given in the table below.

Table C.3 Exchange Rate

Exchange Rate, Q	Exchange Rate Factor, q	Exposure Factor, k
3.01	10	1
4	13.29	.75
5	16.61	.60
6.02	20	.50

Standard: ANSI S12.19

Far Field

There are two types of far fields: the acoustic far field and the geometric far field.

Acoustic Far Field: The distance from a source of sound is greater than an acoustic wavelength. In the far field, the effect of the type of sound source is negligible. Since the wavelength varies with frequency (See the definition of Wavelength), the distance will vary with frequency. To be in the far field for all frequencies measured, the lowest frequency should be chosen for determining the distance. For example, if the lowest frequency is 20 Hz, the wavelength at normal temperatures is near 56 ft.

(17 m); at 1000 Hz, the wavelength is near 1.1 ft. (1/3 m). See the definition of Acoustic Near Field for the advantages of being in the acoustic far field.

Geometric Far Field: The distance from a source of sound is greater than the largest dimension of the sound source. In the far field, the effect of source geometry is negligible. Sound sources often have a variety of specific sources within them, such as exhaust and intake noise. When in the far field, the sources have all merged into one, so that measurements made even further away will be no different. See the definition of Geometric Near Field for the advantages of being in the geometric far field.

Free Field

A sound field that is free of reflections. This does not mean that the sound is all coming from one direction as is often assumed, since the source of sound may be spatially extensive. See the definitions of near and far fields for more detail. This definition is often used in conjunction with reverberant field.

Frequency (Hz, rad/sec)

The rate at which an oscillating signal completes a complete cycle by returning to the original value. It can be expressed in cycles per second and the value has the unit symbol Hz (Hertz) added and the letter f is used for a universal descriptor. It can also be expressed in radians per second, which has no symbol, and the greek letter w is used for a universal descriptor. The two expressions are related through the expression $\omega=2Pf$.

Frequency Band Pass Filter

The part of certain sound level meters that divides the frequency spectrum on the sound or vibration into a part that is unchanged and a part that is filtered out. It can be composed of one or more of the following types:

Low Pass: A frequency filter that permits signals to pass through that have frequencies below a certain fixed frequency, called a cutoff frequency. It is used to discriminate against higher frequencies.

High Pass: A frequency filter that permits signals to pass through that have frequencies above a certain fixed frequency, called a cutoff frequency. It is used to discriminate against lower frequencies.

Bandpass: A frequency filter that permits signals to pass through that have frequencies above a certain fixed frequency, called a lower cutoff frequency, and below a certain fixed frequency, called an upper cutoff frequency. The difference between the two cutoff frequencies is called the bandwidth. It is used to discriminate against both lower and higher frequencies so it passes only a band of frequencies.

Octave band: A bandpass frequency filter that permits signals to pass through that have a bandwidth based on octaves. An octave is a doubling of frequency so the upper cutoff frequency is twice the lower cutoff frequency. This filter is often further subdivided in 1/3 and 1/12 octaves (3 and 12 bands per octave) for finer frequency resolution. Instruments with these filters have a sufficient number of them to cover the usual range of frequencies encountered in sound and vibration measurements.The frequency chosen to describe the band is that of the center frequency. Note table in Frequency Filter - Frequency Weighting.

Frequency Filter - Weighted

A special frequency filter that adjusts the amplitude of all parts of the frequency spectrum of the sound or vibration unlike band pass filters. It can be composed of one or more of the following types:

A-Weighting: A filter that adjusts the levels of a frequency spectrum in the same way the human ear does when exposed to low levels of sound. This weighting is most often used for evaluation of environmental sounds. See table below.

B-Weighting: A filter that adjusts the levels of a frequency spectrum in the same way the human ear does when exposed to higher levels of sound. This weighting is seldom used. See table below.

C-Weighting: A filter that adjusts the levels of a frequency spectrum in the same way the human ear does when exposed to high levels of sound. This weighting is most often used for evaluation of equipment sounds. See table below.

Flat-Weighting: A filter that does not adjust the levels of a frequency spectrum. It is sometimes an alternative selection for the frequency-weighting selection.

Z-Weighting: Similar to a flat-weighting curve, this is a bandpass filter with a pass-band from 10 Hz to 20 kHz.

Table C.4 Frequency Filter Response

Center Frequencies, Hz		Weighting Network Frequency Response		
1/3 Octave	**1 Octave**	**A**	**B**	**C**
20		-50.4	-24.2	-6.2
25		-44.7	-20.4	-4.4
31.5	31.5	-39.4	-17.1	-3.0
40		-34.6	-14.2	-2.0
50		-30.2	-11.6	-1.3
63	63	-26.2	-9.3	-0.8
80		-22.5	-7.4	-0.5
100		-19.1	-5.6	-0.3
125	125	-16.1	-4.2	-0.2
160		-13.4	-3.0	-0.1
200		-10.9	-2.0	0
250	250	-8.6	-1.3	0
315		-6.6	-0.8	0
400		-4.8	-0.5	0
500	500	-3.2	-0.3	0
630		-1.9	-0.1	0
800		-0.8	0	0
1000	1000	0	0	0
1250		0.6	0	0
1600		1.0	0	-0.1

Table C.4 Frequency Filter Response

Center Frequencies, Hz		Weighting Network Frequency Response		
1/3 Octave	**1 Octave**	**A**	**B**	**C**
2000	2000	1.2	-0.1	-0.2
2500		1.3	-0.2	-0.3
3150		1.2	-0.4	-0.5
4000	4000	1.0	-0.7	-0.8
5000		0.5	-1.2	-1.3
6300		-0.1	-1.9	-2.0
8000	8000	-1.1	-2.9	-3.0
10000		-2.5	-4.3	-4.4
12500		-4.3	-6.1	-6.2
16000	16000	-6.6	-8.4	-8.5
20000		-9.3	-11.1	-11.2

L_{eq}

See “Energy Equivalent Sound Level (Leq)”, “Sound”, and “Time Weighting”.

Level (dB)

A descriptor of a measured physical quantity, typically used in sound and vibration measurements. It is attached to the name of the physical quantity to denote that it is a logarithmic measure of the quantity and not the quantity itself. The word decibel is often added after the number to express the same thing. When frequency weighting is used the annotation is often expressed as dB(A) or dB(B).

Measurement Duration (T)

The time period of measurement. It applies to hearing damage risk and is generally expressed in hours.

Standard: ANSI S12.19

Microphone Guidelines

Microphone - Types: A device for detecting the presence of sound. Most often it converts the changing pressure associated with sound into an electrical voltage that duplicates the changes. It can be composed of one of the following types:

Capacitor (Condenser): A microphone that uses the motion of a thin diaphragm caused by the sound to change the capacitance of an electrical circuit and thereby to create a signal. For high sensitivity, this device has a voltage applied across the diaphragm from an internal source.

Electret: A microphone that uses the motion of a thin diaphragm caused by the sound to change the capacitance of an electrical circuit and thereby to create a signal. The voltage across the diaphragm is caused by the charge embedded in the electret material so no internal source is needed.

Microphone - Uses: The frequency response of microphones can be adjusted to be used in specific applications. Among those used are:

Frontal incidence (Free Field): The microphone has been adjusted to have an essentially flat frequency response when in a space relatively free of reflections and when pointed at the source of the sound.

Random incidence: The microphone has been adjusted to have an essentially flat frequency response for sound waves impinging on the microphone from all directions.

Pressure: The microphone has not been adjusted to have an essentially flat frequency response for sound waves impinging on the microphone from all directions.

What a microphone measures: A microphone detects more than just sound. The motion of a microphone diaphragm is in response to a force acting on it. The force can be caused by a number of sources only one of which are we interested: sound. Non-sound forces are: (1) direct physical contact such as that with a finger or a raindrop; (2) those caused by the movement of air over the diaphragm such as environmental wind or blowing; (3) those caused by vibration of the microphone housing; and (4) those caused by strong electrostatic fields.

Rules:
1. Do not permit any solid or liquid to touch the microphone diaphragm. Keep a protective grid over the diaphragm.
2. Do not blow on a microphone and use a wind screen over the microphone to reduce the effect of wind noise.
3. Mount microphones so their body is not subject to vibration, particularly in direction at right angles to the plane of the diaphragm.
4. Keep microphones away from strong electrical fields.

A microphone measures forces not pressures. We would like the microphone to measure sound pressure (force per unit area) instead of sound force. If the pressure is applied uniformly over the microphone diaphragm a simple constant (the diaphragm area) relates the two, but if the pressure varies across the diaphragm the relationship is more complex. For example, if a negative pressure is applied on one-half the diaphragm and an equal positive pressure is applied to the other half, the net force is zero and essentially no motion of the diaphragm occurs. This occurs at high frequencies and for specific orientations of the microphone.

Rules:
1. Do not use a microphone at frequencies higher than specified by the manufacturer; to increase the frequency response choose smaller microphones.
2. Choose a microphone for free field or random incidence to minimize the influence of orientation.

A microphone influences the sound being measured. The microphone measures very small forces, low level sound can run about one-billionth of a PSI! Every measurement instrument changes the thing being measured, and for very small forces that effect can be significant. When sound impinges directly on a microphone the incident wave must be reflected since it cannot pass through the microphone. This results in the extra force required to reflect the sound and a microphone output that is higher than would exist if the microphone were not there. This is more important at high frequencies and when the microphone is facing the sound source.

Rules:

1. Do not use a microphone at frequencies higher than specified by the manufacturer; to increase the frequency response choose smaller microphones.
2. Choose a microphone for free field or random incidence to minimize the influence of orientation.

A microphone measures what is there from any direction: Most measurements are intended to measure the sound level of a specific source, but most microphones are not directional so they measure whatever is there, regardless of source.

Rules:

1. When making hand-held measurements, keep your body at right angles to the direction of the sound you are interested in and hold the meter as far from your body as possible. Use a tripod whenever possible.
2. Measure the influence of other sources by measuring the background sound level without the source of interest. You may have to correct for the background.

Near Field

There are two types of near fields: the acoustic near field and the geometric near field.

Acoustic Near Field: The distance from a source of sound is less than an acoustic wavelength. In the near field, the effect of the type of sound source is significant. Since the wavelength varies with frequency (See the definition of Wavelength), the distance will vary with frequency. The most common example of a near field is driving an automobile with an open window. As you move your ear to the plane of the window, the sound pressure level builds up rapidly (wind noise) since most of the pressure changes are to move the air and very little of it compresses the air to create sound. Persons not far way, can hardly hear what you hear. The acoustic near field is characterized by pressures that do not create sound that can be measured in the far field. Therefore measurements made here are not useful in predicting the sound levels far way or the sound power of the source.

Geometric Near Field: The distance from a source of sound is less than the largest dimension of the sound source. In the near field, effect of source geometry is significant. Sound sources often have a variety of specific sources within them, such as exhaust and intake noise. When in the near field, the sound of a weaker, but close, source can be louder than that of a more distant, but stronger, source. Therefore measurements made here can be used to separate the various sources of sound, but are not useful in predicting the sound levels and sound spectrum far from the source.

Noise

Typically it is unwanted sound. This word adds the response of humans to the physical phenomenon of sound. The descriptor should be used only when negative effects on people are known to occur. Unfortunately, this word is used also to describe sounds with no tonal content (random):

Ambient: The all encompassing sound at a given location caused by all sources of sound. It is generally random, but need not be.

Background: The all encompassing sound at a given location caused by all sources of sound, but the source to be measured. It is essentially the sound that interferes with a measurement.

Pink: It is a random sound that maintains constant energy per octave. Pink light is similar to pink noise in that it has a higher level at the lower frequencies (red end of the spectrum).

White: It is a random sound that contains equal energy at each frequency. In this respect, it is similar to white light.

Noise Dose (D)

It is the percentage of time a person is exposed to noise that is potentially damaging to hearing. Zero represents no exposure and 100 or more represents complete exposure. It is calculated by dividing the actual time of exposure by the allowed time of exposure. The allowed time of exposure is determined by the Criterion Duration and by the sound level (the higher the level, the shorter the allowed time). The sound levels must be measured with A-frequency weighting and slow exponential time weighting. See "Projected Noise Dose" on page C-12.

$$D = \frac{100T}{T_c} 10^{(L_i - L_c)/q}$$

where T is Measurement Duration, T_c is Criteria Time, L_i is TWA, L_c is Criteria Level, q is exchange rate factor; see "Exchange Rate (Q), Exchange Rate Factor (q), Exposure Factor (k)" on page C-6.

Standard: ANSI S12.19

Noise Exposure

"Sound Exposure (SE)" on page C-13.

OSHA Level (LOSHA)

The Average Sound Level calculated in accordance with the Occupational Safety and Health Administration Exchange Rate and Threshold Level.

Preamplifier

A part of the sound level meter that matches a particular model of microphone to the meter. It must be chosen in conjunction with a microphone and a cable that connects them.

Projected Noise Dose

It is the Noise Dose expected if the current rate of noise exposure continues for the full Criterion Duration period.

Single Event Noise Exposure Level (SENEL, LAX)

The total sound energy over a specific period. It is a special form of the Sound Exposure Level where the time period is defined as the start and end times of a noise event such as an aircraft or automobile passby.

Sound

The rapid oscillatory compressional changes in a medium (solid, liquid or gas) that propagate to distant points. It is characterized by changes in density, pressure, motion, and temperature as well as other physical quantities. Not all rapid changes in the medium are sound (wind noise) since they do not propagate.

The auditory sensation evoked by the oscillatory changes.

Difference between sound and noise: Sound is the physical phenomenon associated with acoustic (small) pressure waves. Use of the word sound provides a neutral description of some acoustic event. Generally, noise is defined as unwanted sound. It can also be defined as sound that causes adverse effects on people such as hearing loss or annoyance. It can also be defined as the sound made by other people. In every case, noise involves the judgment of someone and puts noise in the realm of psychology not physics.

Rules:

1. Use word sound to describe measurements to remove the emotional overtones associated with the word noise. Some sound metrics use noise in their name and it is proper to use the name as it is.

Sound Exposure (SE)

It is the total sound energy of the actual sound during a specific time period. It is expressed in Pascals-squared seconds.

$$SE = \int_{T_1}^{T_2} p_A^2(t)dt$$

where p_A is the sound pressure and T_2 - T_1 is the Measurement Duration (specific time period). When applied to hearing damage potential, the equation is changed to where k is the Exposure Factor. See "Exchange Rate (Q), Exchange Rate Factor (q), Exposure Factor (k)" on page C-6.

Standard: ANSI S1.25

Sound Exposure Level (SEL, LE)

The total sound energy in a specific time period. The equation for it is

$$SEL = 10Log_{10}\left[\frac{\int_{T_1}^{T_2} p^2(t)dt}{p_0^2 T}\right]$$

The sound pressure is squared and integrated over a specific period of time (T_2-T_1) this is called the sound exposure and has the units Pascal squared- seconds or Pascal squared- hours. P_0 is the reference pressure of 20 µPa and T is the reference time of 1 second. It is then put into logarithmic form. It is important to note that it is not an average since the reference time is not the same as the integration time.

Sound Pressure

The physical characteristic of sound that can be detected by microphones. Not all pressure signals detected by a microphone are sound (e.g., wind noise). It is the amplitude of the oscillating sound pressure and is measured in Pascals (Pa), Newtons per square meter, which is a metric equivalent of pounds per square inch. To measure sound, the oscillating pressure must be separated from the steady (barometric) pressure with a detector. The detector takes out the steady pressure so only the oscillating pressure remains. It then squares the pressure, takes the time average, and

then takes the square root (this is called rms for root-mean square). There are several ways this can be done.

Moving Average: The averaging process is continually accepting new data so it is similar to an exponential moving average. The equation for it is

$$p_{rms} = \sqrt{\frac{1}{T}\int_{t_s}^{t} p^2(\xi)e^{-(t-\xi)/T}d\xi}$$

The sound pressure is squared and multiplied by a exponential decay factor so that when the time of integration is near the current time (t) it is essentially undiminished. For times older (less) than the current time, the value is diminished and so becomes less important. The rate at which older data are made less influential is expressed by the constant T. The larger it is, the slower the decay factor reduces and the slower the response of the system to rapid changes. These are standardized into three values called Time Weighting. See the values below.

Fixed Average: The averaging process is over a fixed time period. The equation for it is

$$p_{rms} = \sqrt{\frac{1}{(T_2 - T_1)}\int_{T_1}^{T_2} p^2(t)dt}$$

The sound pressure is squared and averaged over a fixed time period. Unlike the moving average, the sound pressures in all time intervals are equally weighted.

Sound Pressure Level (SPL, Lp)

The logarithmic form of sound pressure. It is also expressed by attachment of the word decibel to the number. The logarithm is taken of the ratio of the actual sound pressure to a reference sound pressure which is 20 Micro-pascals (μ Pa). There are various descriptors attached to this level depending on how the actual sound pressure is processed in the meter:

Instantaneous: The time varying reading on a meter face on in a meter output due to changes in the sound pressure. The reading will depend on the time-weighting applied.

The fundamental relationship between the two is logarithmic

$$L_p = 20\log_{10}\left[\frac{p_{rms}}{p_0}\right] \qquad p_{rms} = p_0 10^{L_p/20}$$

where p_0 is the reference sound pressure of 20 µPa. The square of the sound pressure is a power-like quantity that can be expressed in the original form of the level definition

$$L_p = 10\log_{10}\left[\frac{p_{rms}^2}{p_0^2}\right] \qquad p_{rms}^2 = p_0^2 10^{L_p/10}$$

Sound Pressure Level can be converted to sound pressure as follows. If the sound pressure is 1 Pascal, then the sound pressure level is

$$L_p = 20\log_{10}\left[\frac{1}{20 \bullet 10^{-6}}\right] = 20\log_{10}[50000] = 20[4.699] = 94.0dB$$

Calibrators often use a level of 94 dB so they generate a sound pressure of 1 Pascal.

If the sound pressure level = 76.3 dB, then the sound pressure is

$$Pa = 20 \bullet 10^{-6} \bullet 10^{76.3/20} = 20 \bullet 10^{3.815-6} = 20 \bullet 10^{-2.185} = 20[0.0065] = 0.13$$

Energy Average (L_{eq}): The value of a steady sound measured over a fixed time period that has the same sound energy as the actual time varying sound over the same period. This descriptor is widely used. It is a fixed average. See “Sound Pressure” on page C-13..

Impulse: The value of an impulsive sound. The reading will depend on the time-weighting applied.

Unweighted Peak: The peak value of a sound with a meter that has flat frequency weighting and a peak detector.

Weighted Peak: The peak value of a sound with a meter that has a frequency weighting other than flat and a peak detector.

Sound Power (W)

The sound power emitted by a sound source. It is measured in Watts.

Sound Power Level (PWL, Lw)

The logarithmic form of sound power. It is also expressed by attachment of the word decibel to the number. The logarithm is taken of the ratio of the actual sound power to a reference sound power, which is 1 pico-watt. Sound power level cannot be measured directly, but can only be deduced through measurements of sound intensity or sound pressure around the source. The equation for it is

$$L_w = 10\log_{10}\left[\frac{W}{W_0}\right] \qquad W = W_0 10^{L_w/10}$$

Sound Speed

The speed at which sound waves propagate. It is measured in meters per second. It should not be confused with sound or particle velocity which relates to the physical motion of the medium itself.

$$c = 20.05\sqrt{\text{degC} + 273} \qquad \text{m/sec}$$

$$c = 49.03\sqrt{\text{degF} + 460} \qquad \text{ft/sec}$$

Spectrum (Frequency Spectrum)

The amplitude of sound or vibration at various frequencies. It is given by a set of numbers that describe the amplitude at each frequency or band of frequencies. It is often prefixed with a descriptor that identifies it such as sound pressure spectrum. It is generally expressed as a spectrum level.

Taktmaximal-5

An integration of the five second maximum A frequency weighted, fast time weighted sound pressure levels.

$$L_{AFTM5} = 10 \bullet \log\left[\frac{\sum\left(10^{\frac{L_{AF\max 5s(n)}}{10}}\right)}{n}\right]$$

Where:

$L_{Amax\ 5s(n)}$ is the maximum A-weighted fast exponential time weighted sound pressure level for each n 5-second time period and n is the number of 5 second periods accumulated during the measurement.

Threshold Sound Level (Lt)

The A-weighted sound level below which the sound produces little or no Noise Dose accumulation and may be disregarded. It is used for hearing damage risk assessment.

Standard: ANSI S1.25

Time Weighted Average Sound Level (TWA, LTWA(TC))

It is the level of a constant sound over the Criterion Duration, that would expose a person to the same Noise Dose as the actual (unsteady) sound over the same period. If the Exchange Rate is 3 dB then the TWA is equal to the Leq.

$$L_{TWA(TC)} = K\log_{10}\left(\frac{1}{T}\int_{T_1}^{T_2} 10^{(L_p(t))/K}dt\right)$$

Where TC=T_2-T_1 and K is the Exchange Rate Factor. It is used for hearing damage risk assessment.

Standard: ANSI S12.19

Time Weighting The response speed of the detector in a sound level meter. There are several speeds used.

Slow: The time constant is 1 second (1000 ms). This is the slowest and is commonly used in environmental noise measurements.

Fast: The time constant is 1/8 second (125 ms). This is a less commonly used weighting but will detect changes in sound level more rapidly.

Impulse: The time constant is 35ms for the rise and 1.5 seconds (1500 ms) for the decay. The reason for the double constant is to allow the very short signal to be captured and displayed.

Vibration The oscillatory movement of a mechanical system (generally taken to be solid). It is used as a broad descriptor of oscillations.

Wavelength (l) The distance between peaks of a propagating wave with a well defined frequency. It is related to the frequency through the following equation

$$\lambda = \frac{c}{f}$$

where c is the sound speed and f is the frequency in Hz. It has the dimensions of length.

Wavenumber (k) A number that is related to the wavelength of sound and is used to compare the size of objects relative to the wavelength or the time delay in sound propagation. It is related to wavelength through the following equation

where l is the wavelength, c is the sound speed, f is the frequency in Hz, and w is the radian frequency. It has the dimensions of inverse length.

$$k = \frac{2\pi}{\lambda} = \frac{2\pi f}{c} = \frac{\omega}{c}$$