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SOUND EXAMINER
SOUND LEVEL METER
SERIES SE-400
(WITH INTRINSICALLY SAFE MODELS)

USER MANUAL

SE-401/SE-402
non-IS models

SE-401/SE-402
Intrinsically Safe models

QUEST™

Sound Examiner Intrinsically Safe Sound Level Meter Model SE-400 IS Series

Dangers, Warnings, Cautions & Battery

DANGER!

Failure to observe the following procedures may result in serious personal injury

- Contains built-in lithium polymer battery. **DO NOT** incinerate or dispose of in fire. **DO NOT** disassemble, alter, or re-construct.
- This product must **NOT** be charged in hazardous locations.

WARNING!

Failure to observe the following procedures could damage the instrument

- Read the manual before operation.
- Do not store in temperatures outside -20°C to 60°C (-13°F 140°F).
- **DO NOT** immerse in liquids.
- Condensation may damage your instrument.

Caution!

General

- Substitution of components may impair the accuracy of the instrument. Repair should be performed by authorized service personnel only.
- The battery in this instrument has limited shelf life, even if never used.
- A non-condensing environment is required for proper measurements.
- **DO NOT** charge battery outside the range of 0°C to 40°C (32°F to 104°F).
- Battery run-time may be reduced when operating at lower than 0°C (32°F) temperatures.
- Contains Lithium Cell 4.2V/1500 mAH **DO NOT** attempt to replace in a hazardous location.

Intended Use

The SE-400 Series IS models are intended to measure sound pressure levels in air and may measure in certain hazardous locations as identified by the User Warnings, Safety Markings, and Standard information page iii, part number: 053-777. Consult your company's safety professional for local standards, or call TSI at 1-800-680-1220 (USA) or (651) 490-2860.

Sound Examiner
Sound Level Meter
Model SE-400 Series
(non-IS models)

Dangers, Warnings, Cautions & Battery

DANGER!

Failure to observe the following procedures may result in serious personal injury

- Not for use in explosive or hazardous locations. This product is not intrinsically safe.
- Contains built-in lithium polymer battery. **DO NOT** incinerate or dispose of in fire. **DO NOT** disassemble, alter, or re-construct.

WARNING!

Failure to observe the following procedures could damage the instrument

- Read the manual before operation.
- Do not store in temperatures outside -20°C to 60°C (-13°F to 140°F).
- **DO NOT** immerse in liquids.
- Condensation may damage your instrument.
- Substitution of components may impair the accuracy of the instrument. Repair should be performed by authorized service personnel only.

Caution!

General

- The battery in this instrument has limited shelf life, even if never used.
- A non-condensing environment is required for proper measurements.
- DO NOT charge battery outside the range of 0°C to 40°C (32°F to 104°F).
- Battery run-time may be reduced when operating at lower than 0°C (32°F) temperatures.

Intended Use

The SE-400 Series non-IS models are intended to measure sound pressure levels in air. Consult your company's safety professional for local standards, or call TSI at 1-800-680-1220 (USA) or (651) 490-2860.

Sound Examiner SE-401 and SE-402 Intrinsically Safe/Sécurité Intrinsèque

Models: user warnings, safety markings, and standards information

	WARNING:	To prevent ignition of flammable or combustible atmospheres, there are no serviceable parts. Repair and battery replacement must be done by authorized service personnel only.
	Avertissement :	Pour éviter l'inflammation d'atmosphères inflammables ou combustibles, il n'y a pas de pièces réparables. Réparation et remplacement de la batterie doivent être effectués par le personnel de service autorisé.

	WARNING:	Substitution of components may impair intrinsic safety. **DO NOT** open.
	Avertissement :	La substitution de composants peut compromettre la Sécurité Intrinsèque.

	WARNING:	Contains built-in lithium polymer battery. **DO NOT** incinerate or dispose of in fire. **DO NOT** disassemble, alter, or re- construct.
	Avertissement :	Contient la batterie intégrée au lithium polymère. Ne pas incinérer ou jeter au feu. Ne pas démonter, modifier ou re-construire.

	WARNING:	To reduce the risk of explosion, recharge the battery outside of the hazardous locations.
	Avertissement :	Afin de prévenir l'inflammation d'atmosphères dangereuses, ne changer les batteries que dans des emplacements désignés non dangereux.

Safety Standards

- CE mark 0539 , SE-401 IS model and SE-402 IS model
- UL 913, Ed.8, 2015-10-16: Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1, Hazardous (Classified) Locations,
- EN 60079-0 (2014) EXPLOSIVE ATMOSPHERES - PART 0: EQUIPMENT - GENERAL REQUIREMENTS,
- CSA C22.2 NO. 60079-0 (2015) EXPLOSIVE ATMOSPHERES — PART 0: EQUIPMENT — GENERAL REQUIREMENTS,
- CSA C22.2 NO. 60079-11 (2014) EXPLOSIVE ATMOSPHERES — PART 11: EQUIPMENT PROTECTION BY INTRINSIC SAFETY,
- IEC 60079-0 (2016) EXPLOSIVE ATMOSPHERES. PT. 0: EQUIPMENT GENERAL REQUIREMENTS

- EN 60079-11 (2012): Explosive atmospheres – Part 11: Equipment protection by intrinsic safety
- IEC 60079-11 Ed. 6: (2012): Explosive atmospheres - Part 11: Equipment protection by intrinsic safety

Safety Markings

Manufacturer	TSI Incorporated
Equipment/model	SE-401 Intrinsically Safe Class1/Type 1 model SE-402 Intrinsically Safe Class 2/Type 2 model
Hazardous Locations Class	II 1 G Ex ia IIB T4 Ambient temperature range: -20ºC to +50ºC
Certificate number	IECEx UL 13.0006X, Class I, Division 1, Groups C and D; Exi is defined as Intrinsically Safe and Sécruité Intrinsèque (DEMKO 13 ATEX 1210031X)
Maximum charge input voltage	Um=5.5V
Maximum input current	Ii = 500 ma

TSI Contact/Service Information

Should your TSI equipment need to be returned for repair or for recalibration, please contact the service department at the following number or access the online form via http://rma.tsi.com. For technical issues, please contact Technical Support.

Service Department and Technical Support: 1-800-680-1220 (USA) or (651) 490-2860

E-mail: technical.services@tsi.com

Internet: www.tsi.com

International customers

Contact your local, factory-authorized distributor from whom the product was purchased. You can obtain the name and contact information of your local factory-authorized distributor from TSI Incorporated by using the e-mail or telephone information listed above.

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CHAPTER
1

Introduction

The TSI Sound Examiner SE-400 Series are sound level meters used to measure noise over time with robust logging capabilities, selective measurement values, and with a variety of end-user applications including occupational noise measurements and assessment of environmental noise levels.

Models and options

There are five models offered in the Sound Examiner Series including intrinsically safe (IS) and non-intrinsically safe models. The differences between models are accounted for by three primary characteristics: intrinsic safety, accuracy of measurement, and remote microphone measurement capability. The table below summarizes the differences between the models.

Sound Examiner Models/Series	Intrinsically safe	Class/Type 1	Class/Type 2	Remote capability with removable preamp	External outputs: AC/DC	Serial printing (SoundPatrol add-on option)	USB connectivity	Removable Preamp
SE-402 IS	*		*				*	
SE-401 IS	*	*					*	
SE-401 Non-IS		*		*	*	*	*	
SE-402 Non-IS			*		*	*	*	
SE-402R Non-IS			*	*	*	*	*	*

Table 1-1: Sound Examiner SE-400 IS and non-IS models explained

Sound Examiner SE-400 Series Overview

Display and keypad

The keypad is used to run and stop your sessions, view your measurement values, select specific set up parameters, and power on and off the sound level meter.

Diagram and functionality

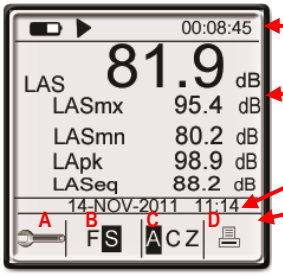
The following diagram for SE-400 series explains the features on the keypad and the display's screen indicators.

Keypad	Description
1. Soft keys	There are four soft keys which are used as additional menu options when working with specific screens (e.g., measurement screen).
2. Backlight key	Used to illuminate the background of the display screen. (i.e., low lighting environment, nighttime session.)
3. Up Arrow key	Used to toggle through menu/setup options and scrolls through the values on the measurement screen.
4. Left Arrow key	Used to navigate through menus and setup parameters.
5. Run/Stop key	Used to run and stop a logged session.
6. Right Arrow key	Used to navigate through menus and setup parameters.
7. Enter key	Used to select menus and confirm setup parameter changes.
8. Down Arrow key	Used to toggle through menu/setup options and scrolls through the values on the measurement screen.
9. On/Off/Esc key	Used to power on, power off and/or escape or move back one screen.

Table 1-2: Keypad keys identified

Screen components identified

The SE-400 Series has four screen components identified below.



Screen indicators

Main screen

Time & Date/error messages

Softkey menus

A: Settings, **B**: Fast/Slow Time Response
C: A, C, or Z Frequency Weighting
D: SoundPatrol feature provides printing capability (non-IS models only)

Figure 1-1: SE-400 Series Screen

Connectors/Ports

The Hardware connector ports are identified below.

➢ **Note:** The SE-400 IS models are equipped with USB connector only.

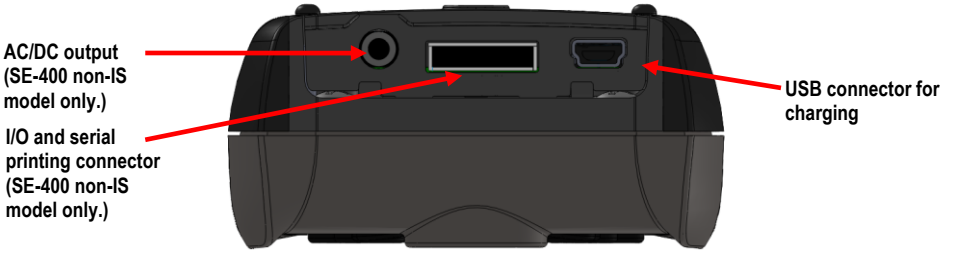


Figure 1-2: Connector and ports

USB

A USB cable is shipped with each Sound Examiner. One end fits the mini port in the instrument. The other end fits a standard USB connector on a personal computer.

A USB connection to a computer allows files to be transferred, settings to be downloaded to the instrument, and post-session analysis to be performed with the DMS software. It is also used to charge the internal battery of the SE-400 Series.

TSI Detection Management Software (DMS)

DMS is a software application from TSI that is used for a variety of Sound Examiner functions, including the ability to display and manipulate data after it is downloaded to the computer from the instrument. Additionally, DMS is used to download measurement data for advanced graphing, charting, and reporting analysis.

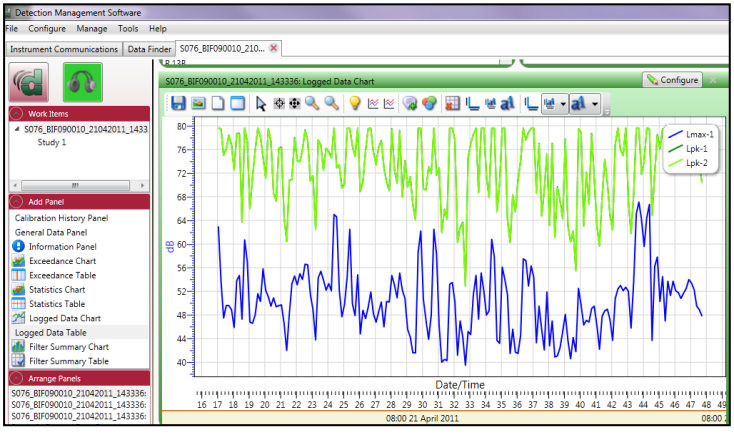


Figure 1-3: Acoustic data and DMS charting example

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CHAPTER
2

Getting Started

This chapter provides the basic information you need to "get up and go" essentially right out of the box, including receiving your first glimpses of sound pressure level (SPL).

Checking the equipment

If your instrument was sent in a storage case, you will want to remove the packaging and acquaint yourself with the equipment, so you can quickly get started. The items below are included in a "standard" Sound Examiner SE-400 Series kit with a calibrator.

Figure 2-1: Identify SE-400 Series equipment

Turning on

To turn on the SE-400 Series, press the key until the start screen appears. Note: the warm-up is 10 seconds.

Soft Keys

The soft key menus provide additional/extension menus on the display and may be available in the measurement, setup, and calibration screens. See Table 2-1 for details.

Soft Keys	Explanation
	Setup icon—The setup icon is used to access the main menu options including: unit information, settings, calibration, memory, time-date, communications, and security (for secure run and secure setup modes).
FS	**Fast or Slow Response Time**—The response time setting determines how quickly the unit responds to fluctuating noise. Typically, noise is not constant. If you were to try to read the sound level without a response time, the readings would fluctuate so much that determining the actual level would be extremely difficult. While the terms slow and fast have very specific meanings (time constraints), they work very much as you would expect. The fast response would result in a more fluctuating sound level reading than would the slow response.
ACZ	**A, C, or Z Frequency Weighting**—These are frequency filters that approximate the equal loudness response of human hearing at low, medium, and high SPL's. **A** frequency weighting is the most commonly used filter defined in the international standard IEC 61672:2003. Common applications of **A** weighting include industrial noise applications and community noise regulations. The **A** frequency weighted filter makes the sound level meter respond closer to the way the human ear responds to noise at lower levels. It attenuates the low frequency noise below several hundred Hertz as well as the high frequency above six thousand Hertz. **C** frequency weighting is intended to represent how the ear responds to very high levels. **Z** weighting is a type of flat response.
	Printer icon—Used for an add-on feature, referred to as the SoundPatrol (available on SE-400 Non-IS models only.) This feature enables one to print to a hand-held printer while measuring or after a run (or session). **Note**: This may be used for noise enforcement situations.
CAL	**CAL**—Cal, or Calibration screen, is used for calibrating the SE-400 Series.
LOCK	**LOCK**—Shortcut to the secure modes screen. Enables and disables secure and setup modes.
▲	**Up Arrow indicator**—Used in the calibration screen to increase the calibration value.
▼	**Down arrow indicator**—Used in the calibration screen to decrease the calibration value.

Table 2-1: Soft Keys explained

Screen indicators

The screen indicators, located at the top of the display, are a notification tool to alert the user of operational functions. See Table 2-2 for details.

Indicators	Explanation
	Secure/Lock indicator—Appears if security for run or setup is enabled.
OL	**Overload indicator**—Appears whenever the level measurement exceeds the range of the instrument.
UR	**UnderRange indicator**—Appears whenever a level measurement is below the range of the instrument.
▶	**Run indicator**—Appears when a session is running (measuring integrating measurements.)
■	**Stop indicator**—Appears when the current session is stopped.
00:00:00	**Run Time**—Displays the current elapsed logged session run time in hours, minutes, and seconds.
	Battery charge status—Blinks when the battery is low and needs charging. The battery icon shows the status/level of the internal battery. A full battery indicates the SE-400 Series is fully charged where as a non-shaded battery icon indicates the battery power is low. When charging, the battery icon will appear as a scrolling, shaded battery charge icon.

Table 2-2: Screen indicators

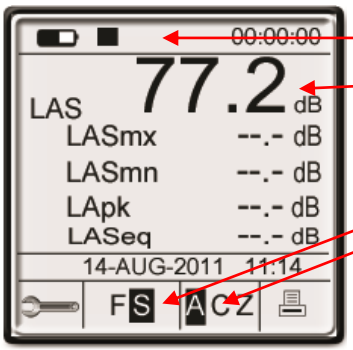
Measurement/Start screen

When powering on, the measurement screen displays six measurements which include: SPL, Max, Min, Peak, L_{EQ}, and L_{AE} (sound exposure level). The sound pressure level (SPL) measurement is continuously updated while the remaining measurements are updated during a log session. The sound exposure level is displayed as a summary value. See Measurements, Chapter 4, for more details.

Measurement screen views

There are two different measurement views:

- A multi-measurement screen displays five measurements. Press ▲/▼ arrow to scroll through measurements.
- A single measurement displays one measurement in larger font. Press ▲/▼ arrow to scroll through the measurements.
- To toggle between the two types of screens, press ↵ key.



Stop icon

Sound Pressure Level

- Noted as LAS, A-weighted and slow response

Figure 2-2: Measurement screen displaying multiple measurements

Navigating

- To navigate through the menus and data screens, press the ▼/▲ arrow ◄/► arrows, or press one of the soft keys ◉.

Navigating: single measurement screen

- The **Enter** ↵ key is used to select menus and toggle through settings.
- The **On/Off Esc** ⏻ key is also used as a navigational tool to move back one level. If you press **ESC** repeatedly, you will return to the start screen.

Turning off

To turn off the SE-400 Series, ensure the meter is stopped.

➢ **Note:** The stop ■ indicator will be at the top of the measurement screen.

1. Press and hold the ⏻ key until the measurement screen disappears.
   - The SE-400 Series will countdown from 3 seconds prior to turning off.

Charging

The SE-400 Series is charged using the supplied USB charger or a personal computer's USB port. A fully depleted battery will require approximately 8 hours to fully charge when using the external battery charger.

➢ **Note**: TSI recommends charging using the supplied USB charger. Some computers are unable to supply the required power to charge the SE-400. In such a case, the SE-400 will display the following warning: "Low USB power to charge".

When charging, the battery indicator will scroll, shading in the indicator. When the battery is fully charged, the battery indicator will stop scrolling. (See figure below.)

Charging states

- A fully charged battery state indicates approximately 18 hours of run-time without a backlight for the non-IS models and 9 hours for IS models.
- A low battery state will display a blinking non-shaded battery icon .
- A charging battery state will appear as if the battery icon capacity is increasing.

Battery indicator:
Charging state: the battery indicator scrolls until the battery is fully charged.

Figure 2-3: Charging state for **SE-400 Series**

CHAPTER
3

Setup/instrument configuration

The SE-400 Series is shipped with default setup parameters. These customizable parameters include the following:

- Time response and frequency weighting
- General meter settings (Exchange rate, Language, Contrast)
- Viewing instrument information
- Time-date setting
- Lock/Secure run and setup modes
- Memory: deleting/clearing memory
- Auto-Run: time date setting

Response time and frequency weighting settings

Sound level measurements are performed typically with **A** frequency weighting, a slow time response and a 3 dB exchange rate. The time response and frequency weightings may be changed via the soft keys on any measurement screen when in stop mode.

1. To change the frequency weighting, repeatedly press the corresponding soft key to toggle and select **A**, **C**, or **Z**.
2. To change the response time, press the corresponding soft key to select either **F** (**Fast**) or **S** (**Slow**).

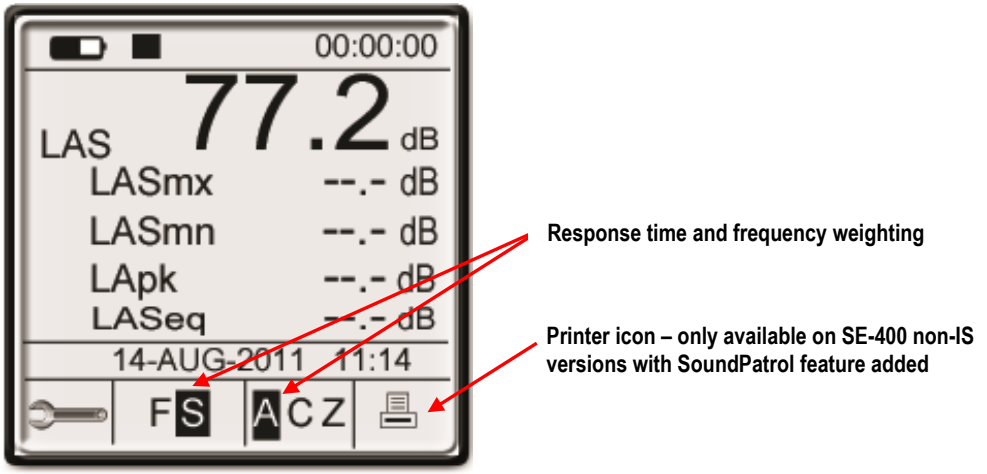


Figure 3-1: Response time and frequency weighting

Opening the setup screen for instrument configuration

The settings can be accessed or changed when in stop mode by selecting the icon via the corresponding soft key (see "**A**" below). The Setup screen appears. (See "**B**" below).

A. Start screen /Measurement screen

Setup icon:
Press the soft key to open the menu.

Soft key:
Press to select the corresponding setup menu.

B-1: Setup screen (non-IS models)

B-2: Setup screen (IS models)

Figure 3-2: Opening the Setup screen

Meter settings

The Meter Settings screen is used to select general instrument parameters including the log interval, exchange rate, language, contrast, and peak weighting. Table 3-1 outlines the meter/general settings on the SE-400 Series.

➢ **Setting up meter parameters**

1. From the setup screen, press ▼/▲ keys to select **Settings** and press ↵ key.

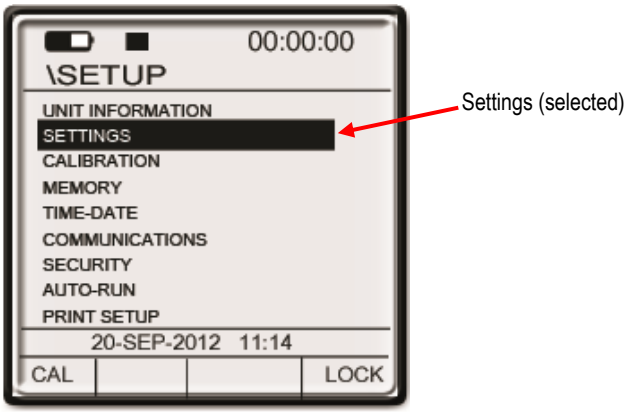


Figure 3-3: Choosing meter settings

2. To select one of the meter settings, press ▼/▲ keys. Once selected, press ↵ key.
   - This moves the selection to the changeable /value field.)
3. To change the log rate, exchange rate, peak weighting, language, and/or contrast, press ▼/▲ keys. Press ↵ key to save the selection. Repeat as necessary or escape to abort.

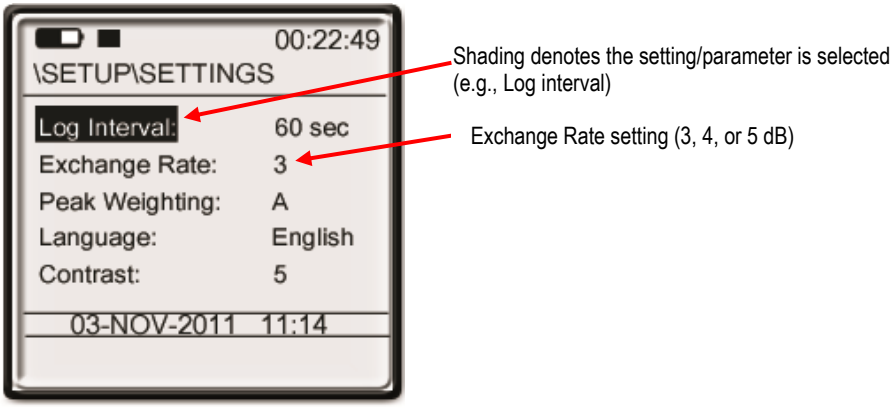


Figure 3-4: Choosing meter settings

4. Once the settings are selected, press key to return to a measurement screen.

Meter settings	Explanations
Log Interval	The logging interval is the logging rate between the logging events. For example, 30 second logging rate will measure/log and save in 30 second increments. The selectable parameters include: 5 seconds, 15 seconds, 30 seconds, 60 seconds, 5 minutes, 15 minutes, 30 minutes, and 60 minutes.
Exchange Rate	The exchange rate is also known as the Doubling Rate, and refers to how the sound energy is averaged over time. The optional exchange rate settings are 3, 4, or 5 dB. (Refer to Figure 3-4 for more information.)
Peak Weighting	The peak weighting parameters are selectable as A, C or Z weighting. ➢ **Note**: peak weighting may be different than SPL weighting. (Please refer to the Glossary for more information.)
Language	The language setting has eight different selections including: • English, French, Spanish, Italian, Portuguese, German, Chinese (Simplified), Korean.
Contrast	The contrast setting is used to increase or decrease the darkness/lightness of the display. Contrast settings include: • 1 to 10 settings in which 10 equates to the darkest display setting and 1 equates to the lightest display setting.

Table 3-1: Meter settings explained

SE-400 Series information details

In the Unit Information screen, the instrument model, serial number, the hardware, software, and secondary software revision numbers are identified. (**Note**: For information on models/features refer to Table 1-1.)

➢ **Unit Information screen**

1. From the setup screen, select **Unit Info** by pressing the / keys and press key.

Figure 3-5: Unit Information screen

Time and date setting

The Time-Date is used to set-up the current time and date parameters. These settings are used in many of the charts and graphs in the software and when viewing calibration history and/or time-history measurements on the instrument.

➢ **Setting the Time and Date parameters**

1. From the setup screen, select **Time-Date** by pressing the ▼/▲ keys and press ↵ key.
2. To change the **Time** or **Date** fields, press the ▼/▲ key to select and press ↵ key.
3. Press ▼/▲ arrows to change the values. To move to the next field press ◄/► arrows.
4. Press ↵ key to save or escape to abort.
   - Repeat steps 2 through 4 to change Time and/or Date.
5. To exit the screen, press ⏻ key. (This will return to the previous screen. To return to the start screen, press ⏻ key a second time.)

Figure 3-6: Time and Date Setup screen

Auto-Run and setting timed run

With a Timed Run mode, you program the instrument's duration (or timed run) and then manually start your study. The Auto-Run will end when the duration expires.

➢ **Setting the Timed Run**

1. From the setup screen, select Auto-Run by pressing the ▼/▲ keys and press ↵ key.

2. Auto-Run will appear. To select disabled or timed run field, press the ↵ key.

Figure 3-7: Auto-Run screen

3. To select timed run, press ▼/▲ keys until it appears and press ↵ key. The duration field will appear. (See Figure 3-8 below.)
   - ***Note:*** to turn off this feature repeat this step until disabled appears.

4. To enter in a time, press ↵ key to move the time field. Using the ▼/▲ keys, change the time and press ↵ key while repeating this to move to the hours, minutes and seconds field.

5. Press ↵ key to save and press ⏻ key twice to return to the measurement screen.
   - ***Note:*** Remember to manually press **Run** key to begin the Timed Run.

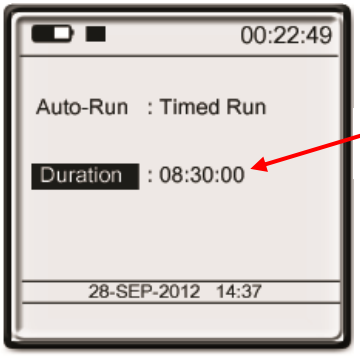


Figure 3-8: Auto-Run screen

Security: locking and unlocking run/setup

You can prevent people from inadvertently terminating a session or changing settings with the security/lock feature enabled. Once the code is entered, the security feature will prevent someone from stopping a run and/or changing the setup parameters.

A 4-digit pin code is used to enable and disable (or change) the security/lock setting.

➢ **Note*:*** to **unlock (or change)**, a default lock key may be used if the lock code is not available/forgotten. The default code is 9157.

☑ **Lock/unlock: secure run**

When in secure run mode, a lock symbol will appear in the screen indicator section. The end-user cannot stop the session unless one unlocks the SE-400 Series.

➢ **Note**: if stop is pressed during secure run, the screen will display the following alert message, "In secure run mode". To unlock, type in the 4-digit code and press the **Enter** key.

☑ **Lock/unlock secure setup**

- When in secure setup mode, a lock symbol appears in the screen indicator section. To unlock, type in the 4-digit code and press the enter key.

➢ **Secure run mode and secure setup mode (locking & unlocking)**

1. From the setup screen, select **Security** by pressing the ▼/▲ keys and press ↵ key.
2. To enter a **code**, press the ▼/▲ keys to select a value. Press ◄/► keys to move to the next field. Repeat as necessary until the 4-digit code is entered.
3. Press ↵ key to save the code or ESC key to abort.
4. To exit the screen, press ESC key.
5. To **unlock**, press the lock soft key or navigate to the security menu selection from the setup screen.

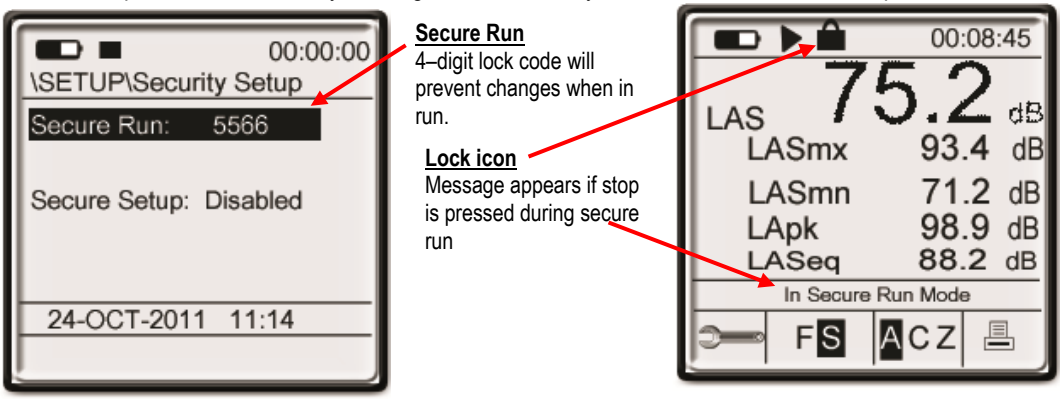


Figure 3-9: Secure run and measurement screen

Memory and space

Deleting files and viewing memory

In the Memory screen, you have the option of deleting all sessions from the memory. It also displays the number of sessions in memory, used space, and the remaining memory space (called “free space”).

➢ **Viewing memory and/or deleting files**

1. From the setup screen, select **Memory** by pressing / keys.

2. **Delete all sessions** will be shaded. Press key and a Confirm pop-up screen will appear.

3. Press key to select **Yes** and press key to delete files.

   - To cancel, either press key when **No** is shaded or press key.

4. To exit the screen, press key. (This will return to the previous screen.) To return to a measurement/main screen, press key a second time.)

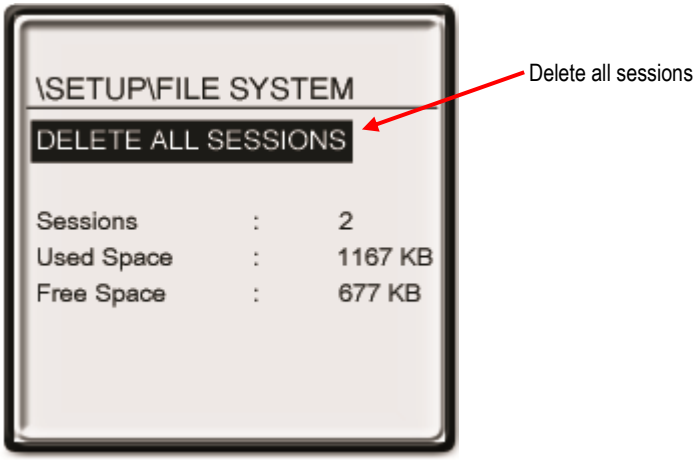


Figure 3-10: Deleting sessions/files and viewing memory

Resetting the SE-400 Series

At times, you may need to reset the instrument if it is unresponsive during run or stop modes.

1. To reset, press and hold key for about 8-10 seconds and the instrument will power off.

Calibrate, measure, run, and saved results

This chapter provides you with the tools used to perform a field test and review the data results. It also details how to work with the SoundPatrol feature and a brief overview of DMS setup, downloading, and viewing data in charts and graphs.

Overview of running a session

The list below is a brief overview of the steps for running a sound level session.

Operation/Field Testing

1. **Turn on the Sound Examiner.**
   a. **LAS: the current Sound Pressure Level is displayed.**
   b. **Clear memory (if needed by using the memory menu from the setup screen).**
2. **Adjust your settings to fit the specifications for your session (if applicable).**
3. **Calibrate the SE-400 Series.**
4. **Position the instrument in the field at a 0 degree angle towards the noise source. (Connect appropriate external devices if applicable.)**
5. **For integrated/time history measurements, press the Run/Stop key to start the session. Press Run/Stop key to stop the session.**
6. **Review your measurement results on the Sound Examiner display or review the data in Detection Management Software (DMS).**

Calibrate

It is recommended to calibrate your Sound Examiner SE-400 Series before and after a run to ensure highly accurate measurement results. The SE-400 microphone is sensitive to humidity and pressure changes. Calibrating the instrument prior to taking measurements assures the instrument is accurate for the current environment. Performing a calibration after a log session (post-cal) verifies that environmental conditions have not significantly changed during the log session.

- ***Note:*** Performing calibrations also ensures the microphone is operating correctly and not damaged (i.e., torn or contaminated diaphragm.

You can calibrate the instrument in the field with reference to the output of a calibrated sound source. TSI offers a line of acoustic calibrators that are available for performing calibration of the Sound Examiner such as the TSI AcousticCal AC-300 Calibrator and the QC10/20 calibrator.

Performing a Calibration

Before beginning your calibration, confirm/check the calibrator has sufficient battery power to perform the calibration. Also, you will want to insert the calibrator adapter into the upper cavity of the calibrator.

1. Ensure the SE-400 Series is turned On, stopped, and not logging.
2. Attach the calibrator and calibrator adapter to the SE-400 Series. Set the calibrator to 1000 Hz and 114 dB (if it is selectable).

3. Turn on the Calibrator by pressing the key.

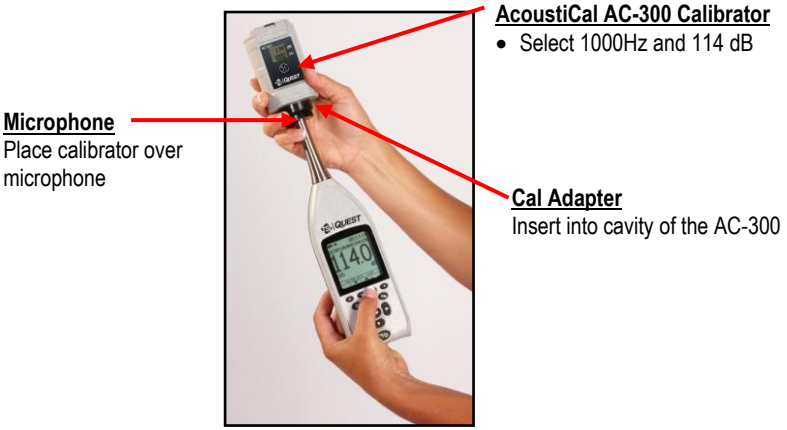


Figure 4-1: SE-400 Series and calibrating

4. From the main measurement screen, press the corresponding soft key for the menu.
5. Press the **Cal** soft key or select **Calibration**.

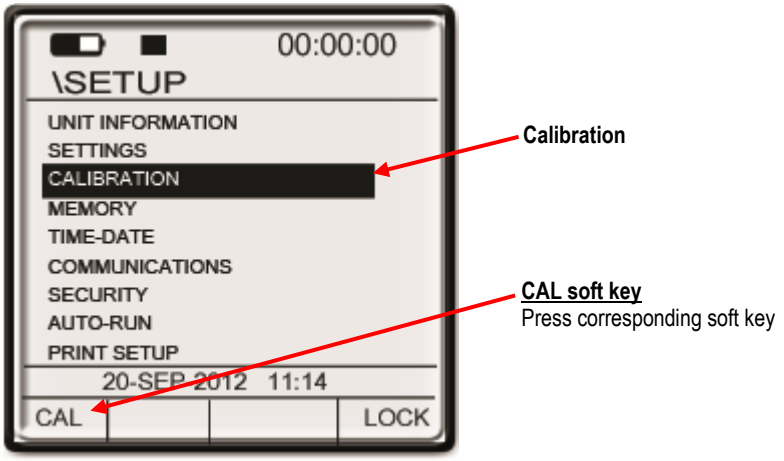
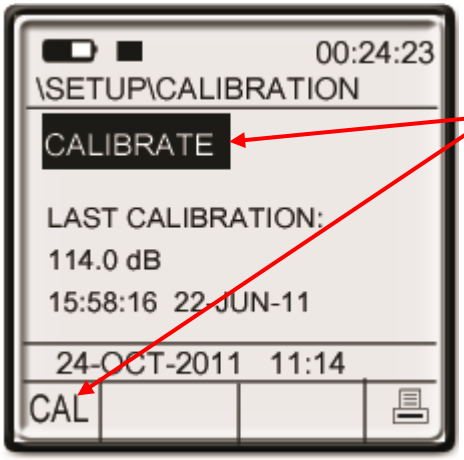


Figure 4-2: Calibration soft key selection

6. In the calibration screen, either press the **CAL** soft key or press the key.

   ➢ **Note:** the calibration screen details the last calibration and is saved into the memory of the instrument. If you download your data to DMS (software), the calibration history is saved to the session and is viewable/printable in the software.



Opening CAL screen (to perform calibration)
Either press the key or press the **Cal** soft key

Figure 4-3: Calibration screen

7. In the calibration screen, press the corresponding ▲/▼ soft keys or press / to adjust to the specific dB level (noted on the calibrator).

Calibrating
Match the dB level from the calibrator to the SE-400 Series by pressing either the corresponding soft keys or the up/down arrow keys

Figure 4-4: CAL screen

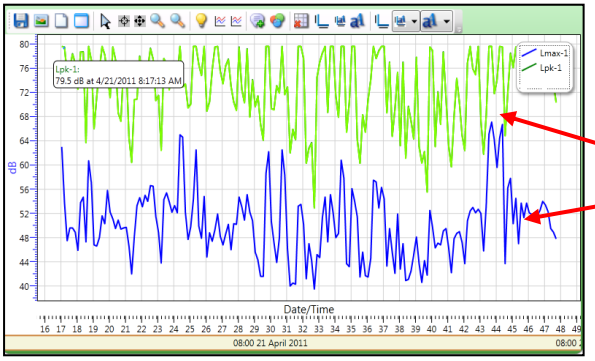
8. Press the key to save the changes or escape to abort.
9. Press the key twice to return to the main measurement screen.

Measure

Logged Data

Logged measurements compute the peak, maximum, minimum, sound exposure, and average values over a run- time at the user selected logged interval.

When in a run (or a session), logged data is automatically stored in the instruments memory. The summary data is viewable on the display of the instrument while the logged data is viewable in DMS. Below is an example of DMS' logged data chart.



- **Peak** values over the run-time
- **Maximum** values over the run-time

Figure 4-5: Example of logged data in DMS

Windscreen

The SE-400 Series features a removable windscreen, which is primarily used to help reduce noise effects from wind with minimal effects on the readings. It is recommended to place and use the windscreen over the microphone at all times to help protect the microphone.

Windscreen
The windscreen is placed over the microphone

Figure 4-6: SE-400 Series with windscreen

Positioning and tripod mount

For area monitoring and general sound level sessions, hand-held measurements are conducted by positioning the microphone directly at the noise source.

To perform stationary sound level measurements, a tripod may be used by connecting the SE-400 Series to the tripod mount while positioning it at a 0-degree incidence angle.

Figure 4-7: Measurement positioning and tripod mount

Measurements and displayed parameters

The measurements and labels which appear on the display will change based on the selected frequency weighting and response time. For example, A-weighting and Slow Response will display the following labels: LASmx, LASmn, LASeq, and L_{AE}.The frequency weighting and response time are customizable within DMS (software). The selectable measurements are explained below. (Please see Glossary of Terms in Appendix B for more information).

Measurement/ Parameters	Explanations
SPL/L_{AS}	**Sound pressure level** – is the basic measurement of noise loudness, expressed in decibels. SPL measured with A-weighting and slow time response is displayed as “LAS” or “SPL”.
LAS_{MX}	**Maximum sound pressure level** with A-weighting and slow response. (Displayed when in run or stop modes.)
LA_{PK}	**Peak sound pressure level** with **A**-weighting. (Displayed when in run or stop modes.)
LAS_{EQ}	**Average sound pressure level** with 3,4, or 5 dB exchange rate. (Displayed when in run or stop modes.)
LAS_{MIN}	**Minimum SPL with C-weighting and slow response**. (Displayed when in run or stop modes.)
L_{AE}	***Sound Exposure Level (SEL)* or Level Exposure (LE) –** The sound exposure level averages the sampled sound over a one second period. Assuming the sampled run time to be greater than one second, SEL is the equivalent one-second noise that would be equal in energy to the noise that was sampled. SEL is typically measured using a 3dB exchange rate without a threshold. (L_{AE} is not used by OSHA.)

Table 4-1: Measurement notations

Run, stop, and view results

The run/stop key is used to run and stop integrating measurements, which is saved as a session. The viewable measurement screens include the multi-measurement screen (which is the default screen) and the single measurement screen. When the SE-400 Series is in stop mode, it will display the summary data until the instrument is powered off or the run key is pressed.

1. To start a session, press the key. The **Run** icon will appear with a run-time clock indicating the current duration of your session.

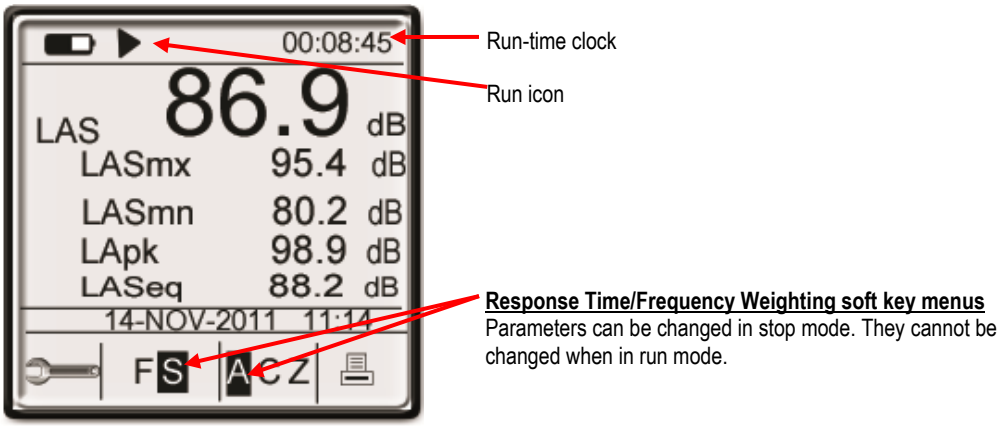


Figure 4-8: Main/multi- measurement screen in Run mode

2. To stop a session, press the key. The **Stop** icon will appear.
   - **Note:** the duration of the session is indicated by the run-time clock.
3. To view a single large measurement, press the key. To view different measurement parameters, press the / arrow keys.

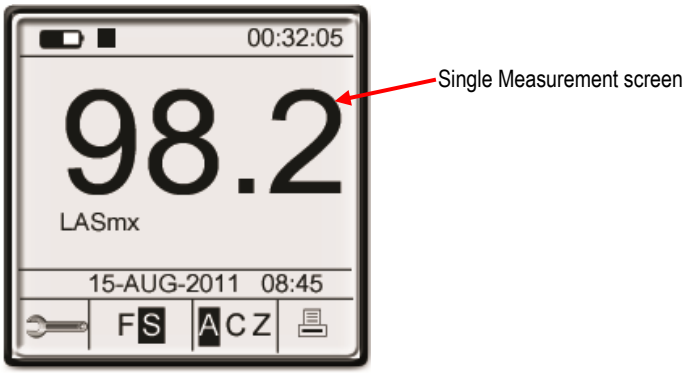


Figure 4-9: Single measurement screen in stop mode

Viewing past sessions

The SE-400 will automatically save and store all of the run/stops performed on the instrument, which is also known as session data. You may view past sessions using the Memory menu from the Setup screen. Once selected, it will display summary data (such as LAS_{MX}, LAS_{MN}, LZ_{PK}, LAS_{EQ}, L_{AE}), session name, date, and run-time. The steps below explain how to review the session data.

1. From the measurement screen, press the soft key.
2. From the setup screen, press / keys to select **Memory** and press key.
3. With **Session Directory** selected (indicated by the black shaded bar), press key.

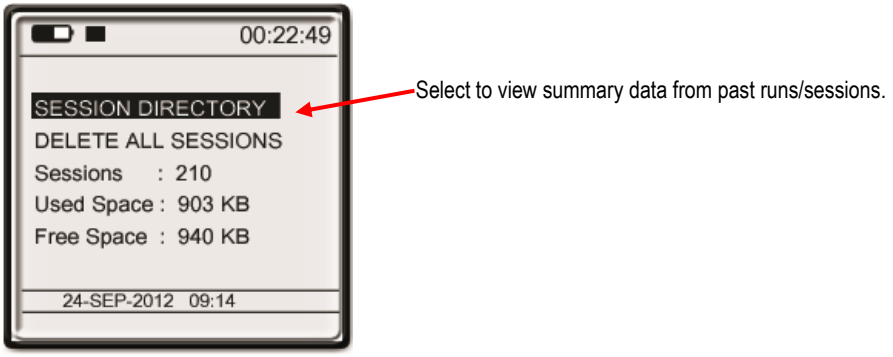


Figure 4-10: Session directory screen

4. Press / arrow keys to select a specific session and press key to view data.
   - **Note**: the SE-400 series runs are stored as, "S0000xx.ses" and will display with the most recent at the top of the page.

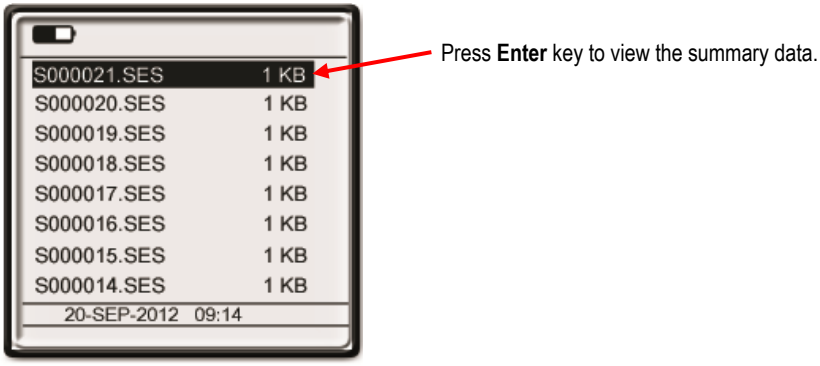


Figure 4-11: Saved sessions

5. When selected, the session summary screen appears as indicated in Figure 4-12.

➢ **Note:** to return to the previous screen, press the key.

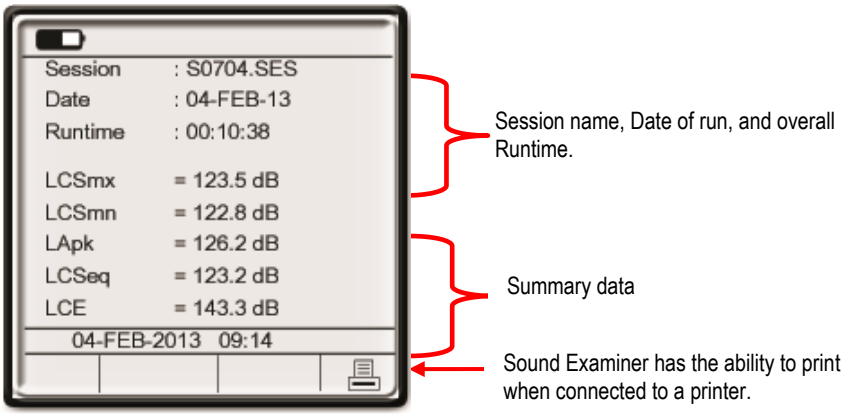


Figure 4-12: Reviewing Session Data

Download and view logged data

If you will be using DMS to view your data (or measurements), this section will guide you through communicating between the Sound Examiner SE-400 Series and DMS which will enable you to view time history data in logged data charts and tables with reporting and storage capabilities as displayed below.

➢ **Note:** reference the online DMS help for more information.

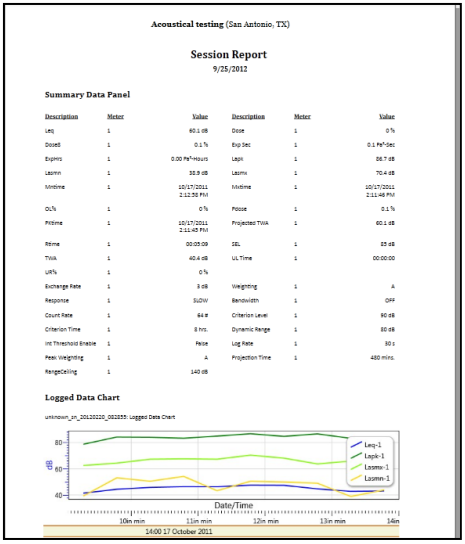


Figure 4-13: Sample Sound Examiner data report

DMS & downloaded measurements

When you download the data via the the instrument download panel, the data is stored and viewable via the data finder page with advanced charting, tables, and reporting capability. The information is stored in customizable bar charts and/or tables with measurements/parameters displayed on the top navigational bar.

➢ **Viewing data in DMS**

1. SE-400 Series and communicating with DMS

A. Turn On SE-400 Series

B. Plug in USB cable from SE-400 Series to the computer

2. DMS Welcome page and instrument communication

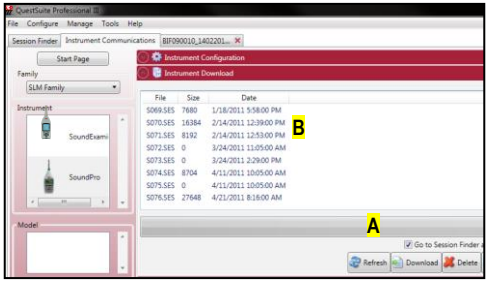
A. Click on Download button (see **A** below).

3. SE-400 Series and Downloading

A. Select the **SLM family** and the **Sound Examiner** from the Instrument window.

B. Click Download button (See **A**)

- ***Note***: the downloaded files are listed by file name, size, and date under the instrument download section. See **B**.



4. Viewing your data

A. In the Data Finder page, you can view the parameters in this page. To further analyze and/or print either double-click on a session/study or select Analyze or Quick Report buttons.
(See **A** to view an example of logged data and table data).

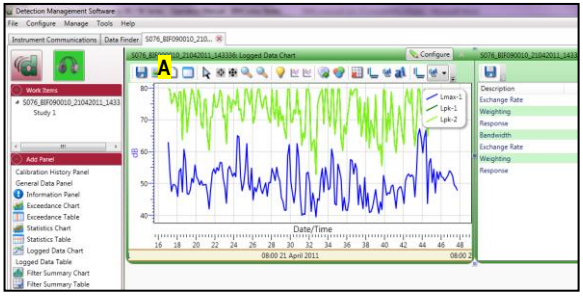


Figure 4-14: Downloading files from DMS to SE-400 Series

SoundPatrol feature (non-IS models only)

In some applications, the SoundPatrol feature is used for noise enforcement assessment with the capability to print to a cabled hand-held portable printer. If purchased, the feature operates by pressing the print icon from one of the measurement or calibration screens.

Connecting the printer and settings

The portable thermal printer and the SP-Fuji cable, 057-341, is used to communicate between the SE-400 Series and the portable thermal printer. Before using the printer for the first time, set the DIP switches (located on side next to RS232C port) using the settings listed below:

Dip Switch	Function	Switch Setting
1	Interface Selection	Off (wireless) On (wired interface)
2	Communication mode	On
3	Reserve	Off/On
4	Start selection	Off/On

The Baud Rate settings may be changed to: 4800, 9600, 19200, 115200 via the setup screen. Please follow below to connect the printer and view/change the baud rate setting.

- **Connecting the printer and adjusting/viewing the baud rate for the SoundPatrol feature**

1. Connect the SP Fuji cable, 057-341, by inserting it into the serial port on the bottom of the SE-400 non-IS models.
2. Turn on the portable printer by depressing and holding the power button for about 1 second. A green LED blinks when the printer is ready.
   - **Note***:* Refer to the portable thermal printer manual to power on (with either AC/DC power adapter or insert Li-ion battery.)
3. To set/view the baud rate, open the **Communications** screen by pressing key from the setup screen. (Skip steps 3 – 5 if not applicable.)
4. Press key to move to the editable field and press / keys to select a setting.

5. Press key to save the changes. Press key to return to the setup screen. Press a second time to view the measurement screen.

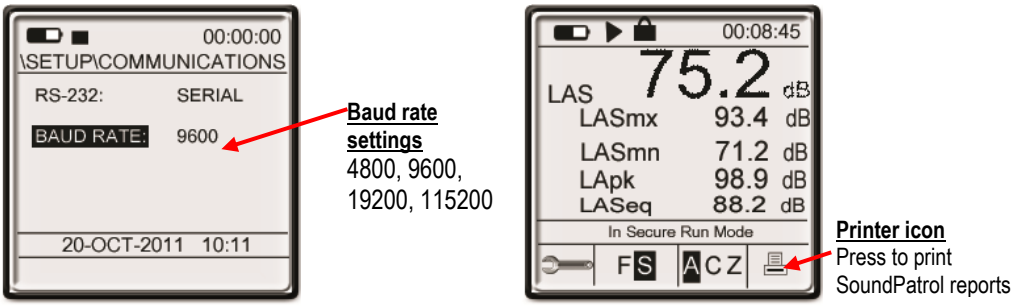


Figure 4-15: Baud rate setup and print icon

Print setup for summary reports

With the SoundPatrol feature (SE-400 Non-IS models only), you have the option to change the measurements and other parameters to appear on the summary data report. The two options include printing a specific parameter or omitting a parameter from the report.

➢ **Changing the summary report print settings**

1. From the setup menu, press / keys to select **Print Settings** and press key.
2. To select a parameter to change, press / keys and then press key to move to the second column.
3. To change to **Print** or **Omit**, press / and press key to save and return to the first column.

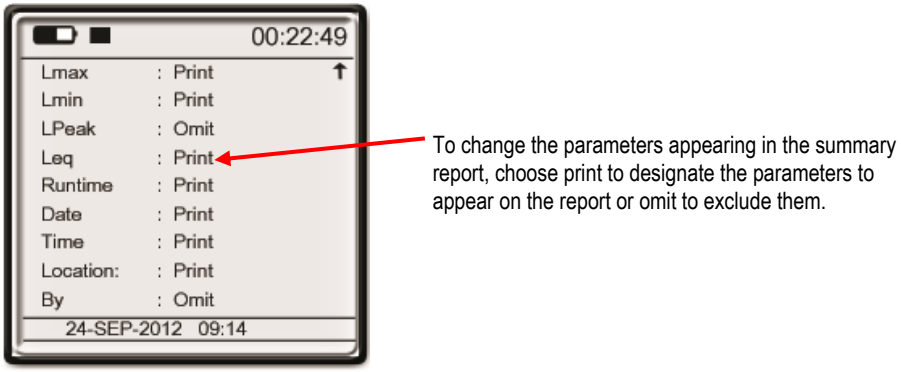


Figure 4-16: Print Setup screen

4. Repeat steps 2 and 3 to change what appears on the hand-held print report. To return to the measurement screen, press key twice.

Printing and reports

The SoundPatrol features (non-IS models only) an easy to access print icon, located on the measurements and calibration screens, which is used for report printing when connected to the handheld printer (sold as an option). The following three reports are explained below.

SoundPatrol Reports and Samples	Description
1-Second Continuous Data Report: TResponse = SLOW Time, SPL, L_{EQ}, Weight = C 2, 68.0, 67.4 3, 69.0, 68.0, 4, 70.1, 68.4, 5, 71.3, 69.2 6, 71.2, 69.8, 7, 68.1, 69.8, TSI SE-400 R.10D S/N: SEK06BETA06	The 1-second continuous data report provides a printout of 1- second measurements of the sound pressure level values and the average (L_{EQ}) values at the appropriate time response (fast/slow) and frequency weighting (**A**, **C**, or **Z**). • To print the 1-second continuous data report, power on the SE-400 Series and press the key while the printer is connected. Once in run mode, press the soft key from the measurement screen and the connected hand-held printer will print the report. At any time, press icon to end the printing. The handheld printer will stop the 1-second report.
Summary Data Report: TResponse = SLOW SPL_{MAX} = 78.8 dBA L_{EQ} = 71.5 dBA L_{AE} = 84.9 dBA SPL_{MIN} = 64.4 dBA Runtime = 00:00:17 Date: 15-Mar-2012 Time: 9:21:54 Location:_____ By: _____	The summary data report displays the time response and the summary data parameters including the maximum sound pressure level (SPL), the average SPL (L_{EQ}), the minimum SPL, the runtime, date, time, location, and a by field (for an optional signature). These parameters may be changed via the print setup menu. (See Print setup section above.) ➢ **Note**: this report will print after the 1-second continuous data report has finished printing (or is stopped). • To print the summary data report, press key on the SE-400 while the printer is connected. Press the soft key. Press on the SE-400 and the summary data report will appear after the 1-second continuous report.
Calibration Report: TSI /Quest SE-400 R.10D S/N: SEK06BETA06 TResponse = SLOW CALIBRATION DATE: 14:21:05 15-MAR-12 CALIBRATION INFO: Old SPL = 113.8 dBA Ref Level = 114.0 dBA New SPL = 114.0 dBA	The calibration report displays the time response setting, the calibration date and time, the previous SPL (noted as old), the reference level value, and the new calibrated level. • To print the calibration report, press the soft key from the calibration screen while connected to the printer. To access from a measurement screen, press the icon and then press the CAL soft key.

Microphone preamp

The removable preamplifier (model SE-402R non-IS when equipped) can be used for remote distance monitoring. An extension cable is connected between the SE-402R model and the preamplifier. (The cable may be purchased separately, see Accessories in Appendix A).

Attaching the preamp

1. Place the preamp connector over the mating connector at the top of the instrument. Gently press down while rotating the preamp until the preamp connector drops slightly in place.
2. Rotate the preamp ring until secure.

Connecting an extension cable

Optional Extension cables are available from TSI. They are typically used to make remote measurements by distancing the microphone from the instruments body.

1. To connect the microphone to the extension cable, first remove the preamp from the SE-400 and familiarize yourself with the extension cable ends.

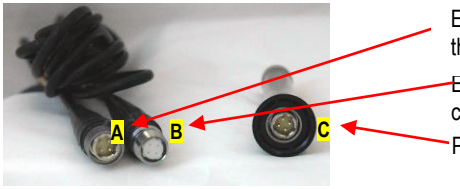


Figure 4-17: Example of extension cable and preamp

2. Insert the extension cable's pins (see **B** above) into the preamp, noting it will snap into place when the pins are aligned correctly. Next, twist the black nut (on the preamp) counter-clockwise unit it fits securely.
3. Insert the opposite end of the extension cable to the top of the SE-400 and twist the silver ring until it is fastened down.

Figure 4-18: SE-400 Series with extension cable and preamp attachment (when equipped)

Sound Examiner (non-IS models) and logging rates

When logging is enabled, the following parameters are logged: L_{MAX}, L_{MIN}, L_{Peak}, and L_{EQ} at a specific logged interval. The SE-400 non-IS models will log approximately 57,600 records per parameter in 60 seconds at 40 days with a 2 MB card.

Below is a table outlining different logged intervals with the number of days it will log.

Logging Rates (seconds or minutes)	Days	Logged Records
5 sec.	3	57,600
15 sec.	10	57,600
30 sec.	20	57,600
60 sec.	40	57,600
5 min.	200	57,600
15 min.	599	57,600
30 min.	2,070	57,600
60 min.	4,140	57,600

APPENDIX
A

Specifications

Standards/Directives

- **IEC 61672-1 (2002)** - Electroacoustics, Sound Level Meters, and Part 1: Specifications.
- **IEC 61010-1 (2010) (2002):** Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use – Part 1: General Requirements. (Revision/Edition 3).
- **IEC 61000-4-2 (2008):** Electromagnetic Compatibility (EMC) – Part 4-2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test.
- **IEC 61000-4-3 (2008):** Electromagnetic Compatibility (EMC) – Part 4-3: Testing and Measurement Techniques – Radiated, Radio-Frequency, Electromagnetic Field Immunity Test.
- **ANSI S1.4-1983 (R2006)** - American National Standard, Specification for Sound Level Meters.
- **ANSI S1.43-1997 (R2007)** - American National Standard, Specifications for Integrating Averaging Sound Level Meters.
- **CE mark 0539**, SE-401 IS model and SE-402 IS model
- **UL listed E87792**, SE-401 IS model and SE-402 IS model

Acoustical Characteristics

Microphones

- Supports Class/Type 1 and Class/Type 2 microphones
- BK4936 (or equivalent) – Free-field, Class/Type 1 Microphone, (standard), ½" diameter (1.3cm), Electret
- QE7052 (or equivalent) – Free-field, Class/Type 2 Microphone, (standard), low cost ½" diameter (1.3 cm), Electret

Measurements

Parameters	L_{AS}, L_{MAX}, L_{MIN}, L_{PK}, L_{EQ}/L_{AVG}, L_E, Elapsed Time
Frequency Weighting	A, C, Z
Peak Frequency Weighting	A, C, Z
Response Time	Fast and Slow
Range	110 dB total dynamic measurement range Overall measurement range 30 to 140 dBA (single range)
Max Peak Level	143 dB (sampled peak)
Exchange Rates	3, 4, 5 dB
Status Indicators	Run, stop, battery status, OL (overload), UR (under-range), Run-Time, locked status

Calibration

Calibration method	Manual user adjustment with external calibrator. Calibration history will display date/time of calibration.

Mechanical Characteristics

Physical Characteristics

Size	11.2" (L) x 2.8" (W) x 1.3" (H) (with preamp & microphone); 28.4. cm (L) x 7.1 cm (W) x 3.3 cm (H)
Weight	410 g/14.5 oz. (SE-401 IS model including preamp and microphone) 410 g/14.5 oz. (SE-402 IS model including preamp and microphone) 367.5 g/12.96 oz. (SE-401 model including preamp and microphone) 380.5 g/13.42 oz. (SE-402 model including pre-amp and microphone)
Housing	Stainless fiber filled ABS Polycarbonate with light gray front and dark gray backing.
Tripod Mount	Standard photographic mount on backside accepts ¼" – 20 screw threads
Ingress Protection	IP65
Drop Protection	Minimum 2 meter onto concrete, 2 times on each face. Microphone damage acceptable, no other loss of function, data or power.

Environmental Characteristics

Operating Temperature (per IEC61672)	-10˚C to 50˚C (14˚F to 122˚F)
Humidity	0 to 90% RH, non-condensing
Storage Temperature	-20˚C to 60˚C (-4˚F to 140˚F)
Battery Charge Temperature	0˚C to 40˚C (32˚F to 104˚F)
Atmospheric Pressure	**Operating: 80 to 110 kPa; Storage: 50 to 150 kPa**

User Interface Characteristics

Logged data	Stored logged data includes: L_{MAX}, L_{MIN}, L_{PK}, L_{eq}. Use TSI Detection Management Software (DMS) to interpret data files.
Summary data	Stored session summary data includes: L_{MAX}, L_{MIN}, L_{PK}, L_{eq}, L_E (Level exposure) and user settings. Use TSI Detection Management Software (DMS) to interpret data files.
Logged rates	5, 15, 30, 60 seconds and 5, 15, 30, 60 minutes
Display languages	English, Spanish, German, French, Italian, Portuguese, Simplified Chinese, Korean, and Czech
User Interface	12 Keypad Keys: Run/Stop, On/Off/Esc, Enter, Backlight, 4 arrowed keys (up, down, right, left), 4 Soft Keys
Keypad type	Elastomeric
Display	Transflective 128 x 128 pixel resolution with LED backlighting Display update rate: 1 x second Display resolution: 0.1 dB
Backlight	Modes include: low intensity, high intensity and off (SE-400 non-IS models). Modes include: dim, bright, and off (SE-400 IS models).

Power/Electrical Characteristics

Battery for SE-401 and SE-402 non-IS models	Lithium Polymer (2500 mAHr), rechargeable. Run-Time: 18 hours minimum (excluding the backlight)
Battery for SE-401 and SE-402 IS models	Lithium Polymer Pack/Nominal 3.7V/1500 mAH, rechargeable. (TSI manufactured, p/n: 073-709). Run-Time: 8 hours minimum (excluding backlight).
Battery Life	3 years or 500 cycles (service replaceable)
Battery Charge	USB cable is provided with instrument. Battery charge time: 8 hours (approximately) for non-IS models
Internal memory	2 MB (34 days at 1-minute logging)
Communications	USB Interface
External DC Power Input	High power USB port 500 mA or external USB charger
Standard microphones	• Class/Type 1 Precision BK4936 microphone • Class/Type 2 General QE7052 microphone
Preamplifier	Removable preamp directly accepts ½" (13.2 mm) microphone
Remote Cable	Up to 15 meters (50 feet) of cable with negligible signal loss

Ports and connections

AC/DC Output	3.5 mm stereo (tip-AC, center ring, ring-Gnd)
I/O connector	RS-232
USB	Conforms to USB 2.0, mini-USB connector

SE-400 Series models and part numbers

Part Number	Sound Examiner SE-400 Kit Description
SE-402 non-IS	Sound Examiner **SE-402 non-IS** Includes meter with Class/Type 2 Microphone, USB cable, external power cord with USB, windscreen, calibrator adapter, carry case, and user manual.
SE-401 non-IS	Sound Examiner **SE-401 non-IS**, Includes meter with Class/Type 1 Microphone, Remote Option, USB cable, external power cord with USB, windscreen, calibrator adapter, carry case, and user manual.
SE-402-10 non-IS	Sound Examiner **SE-402-10 non-IS** kit includes meter with Class/Type 2 Microphone, AC-300 Calibrator, USB cable, external power cord with USB, windscreen, calibrator adapter, carry case, and user manual.
SE-401 non-IS -AC3	Sound Examiner **SE-401 non-IS -AC3** kit includes meter with Class/Type 2 Microphone, AcoustiCal AC-300 Calibrator, Class/Type 1 Microphone, Remote Option, USB cable, external power cord with USB, windscreen, calibrator adapter, carry case, and user manual.
SE-402-R non-IS	Sound Examiner Kit **SE-402-R non-IS** with removable preamp kit includes meter with Class/Type 2 Microphone, 53-575 USB cable, meter, with removable preamp, 53-321 USB power supply, 59-344 WS-7 windscreen , 56-990 calibrator adapter and 53-711 carrying case, and user manual.
SE-402-R-10 non-IS	Sound Examiner **SE-402-R-10 non-IS** kit with removable preamp and QC-10 calibrator kit includes meter with Class/Type 2 Microphone, with removable preamp, AC-300 calibrator, USB cable, external power cord with USB, windscreen, calibrator adapter, carry case, and user manual.
SE-402 Intrinsically Safe model	Sound Examiner **SE-402 Intrinsically Safe model**, Includes meter with Class/Type 2 Microphone, USB cable, external power cord with USB, windscreen, calibrator adapter, carry case, and user manual.
SE-401 Intrinsically Safe model	Sound Examiner **SE-401 Intrinsically Safe model**, Includes meter with Class/Type 1 Microphone, USB cable, external power cord with USB, windscreen, calibrator adapter, carry case, and user manual.

Accessories (sold separately)

Part Number	Description
056-990	Calibrator Adapter for 0.50" (or 1.3 cm) diameter microphone for QC-10/20 or AcoustiCal AC-300 adapter (one included)
	AcoustiCal Calibrator for Class/Type 1 Microphones (114 dB at 250 Hz and 1000 Hz)
	QC-10 Sound Calibrator for Class/Type 2 Microphones with single output (114 dB at 1000 Hz)
059-045	Tripod (approximately 46" or 117 cm)
059-899	Extension Cable ICM-2 Microphone Cable (2 feet/61 cm)
059-733	Extension Cable ICM-10 Microphone Cable (10 feet/3 m)
059-734	Extension Cable ICM-50 Microphone Cable (50 feet/15.24 m)
053-321	External USB power cable with international AC plugs
053-575	USB cable (one included)
053-711	Carrying case (one included)
059-344 (WS-7)	Windscreen (one included)
N/A (SPDP-Printer)	Thermal printer, type FTP628, rechargeable Li-ion battery (1850 mAh) with belt clip, AC adapter/charger, printer cable, and a roll of thermal paper.
057-342	Fujitsu Cable for SoundPatrol SE-400 thermal portable printer
057-343	Cable open ended tinned wires for SoundPatrol SE-400 user printer
053-764	Assembly 3.5 mm patch cable
057-258	Thermal paper: Five roll pack for use with the SPDP-Printer
N/A	Detection Management Software (DMS) (one included)
056-317	QE7052 Free-field, Class/Type 2 Microphone, (standard), low cost ½" diameter (.52")
059-523	BK4936 - Free-field, Class/Type 1 Microphone, (standard), ½" diameter (.52")
N/A	Sound Examiner SE-400 Series User Manual (one included)

APPENDIX
B

Glossary of Terms

dB

Sound Level Meters use the decibel as the unit of measure known as Sound Pressure Level (SPL). SPL uses the ratio between a reference level of 20 microPascals (.00002 Pascals) and the level being measured.

SPL = 20 log (measured level/reference level)

Example: the SPL for 1 Pascal is 20 log (1 Pascal/.00002 Pascal) = 94 dB. 20 microPascals (.00002 Pascals) is considered the average threshold of hearing.

A whisper is about 20 dB. A normal conversation is typically from 60 to 70 dB, and a noisy factory from 90 to 100 dB. Loud thunder is approximately 110 dB, and 120 dB borders on the threshold of pain.

Dynamic range

The range of input amplitudes on any given range setting over which the instrument can produce a meaningful response. The bottom of the dynamic range is the instrument's Noise Floor for that range setting, and the top of the dynamic range is the maximum input signal that will not overload the instrument on that range setting.

Exchange Rate (ER)

Also known as the Doubling Rate, this refers to how the sound energy is averaged over time. Using the decibel scale, every time the sound energy doubles, the measured level increases by 3 dB. This is the 3 dB Exchange Rate that most of the world uses. For every increase of 3 dB in the time weighted average, the measured dose would double.

Some organizations such as OSHA in the U.S. have argued that the human ear self-compensates for changing noise levels and they felt that the 3 dB Exchange Rate should be changed to more closely match the response of the human ear. OSHA currently uses a 5 dB Exchange Rate which would mean that the reported dose would double with every 5 dB increase in the time weighted average. The Exchange Rate affects the integrated reading L_{AVG}, Dose, and TWA but does not affect the instantaneous sound level. (Please refer to www.osha.gov for more information.)

L_{AVG}

Average sound level measured over the run time. This becomes a bit confusing when thresholds are used. Any sound below the threshold is not included in this average. Remember that sound is measured in the logarithmic scale of decibels therefore the average cannot be computed by simply adding the levels and dividing by the number of samples. When averaging decibels, short durations of high levels can significantly contribute to the average level.

Example: Assume the threshold is set to 80 dB and the Exchange Rate is 5 dB (the settings of OSHA's Hearing Conservation Amendment). Consider taking a one-hour noise measurement in an office where the **A**-weighted sound level was typically between 50 dB and 70 dB. If the sound level never exceeded the 80 dB threshold during the one-hour period, then the L_{AVG} would indicate a reading of zero. If 80 dB was exceeded for only a few seconds due to a telephone ringing near the instrument, then only those seconds will contribute to the L_{AVG} resulting in a level perhaps around 40 dB (notably lower than the actual levels in the environment).

$$L_{avg} = ER \left[log_2 \int_0^{RTIME} 2^{LS/ER} \, dt - log_2 (RTIME) \right] dB$$

L_{EQ}

The true equivalent sound level measured over the run time. The term L_{EQ} is functionally the same as L_{AVG} except that it is only used when the Exchange Rate is set to 3 dB and the threshold is set to none.

L_E

The sound exposure level averages the sampled sound over a one-second period. Assuming the sampled run time to be greater than one-second, level exposure is the equivalent noise that would be equal in energy to the noise that was sampled. SEL is typically measured using a 3 dB exchange rate without a threshold. (L_{AE} is not used by OSHA.)

L_{Mn}

Minimum SPL. Lowest SPL measured over a time interval.

L_{Mx}

Maximum SPL. Highest SPL measured over a time interval.

Logging

In sound studies, the saving of measurements at fixed intervals during a study, where each measurement is determined from data processed in the previous logging interval.

L_{Pk}

Peak SPL. This is the highest instantaneous value obtained during a study or a session. A peak SPL measurement is affected by the frequency response setting but not by the time response setting of the meter.

Noise

Unwanted sound.

Noise Floor

The signal magnitude at the bottom of the instrument's linear range. Input signals below the noise floor cannot be differentiated from the internal noise of the instrument.

Overload (OL)

An overload will occur whenever the input signal exceeds the dynamic range of the instrument.

Pascal (Pa)

Unit of pressure equal to 1 Newton per square meter.

Reference pressure

The sound pressure at the threshold of human hearing, as measured under standard conditions. This generally accepted magnitude of this pressure is 2 .00002 Pascals.

Response time (Fast “F”, Slow “S”)

Selectable time response settings used in the Sound Examiner measurements. The response time is a standardized exponential time weighting of the input signal according to fast (F) or slow (S) time response relationships. Time response can be described with a time constant. The time constants for fast and slow responses are 0.125 s, 1.0 s.

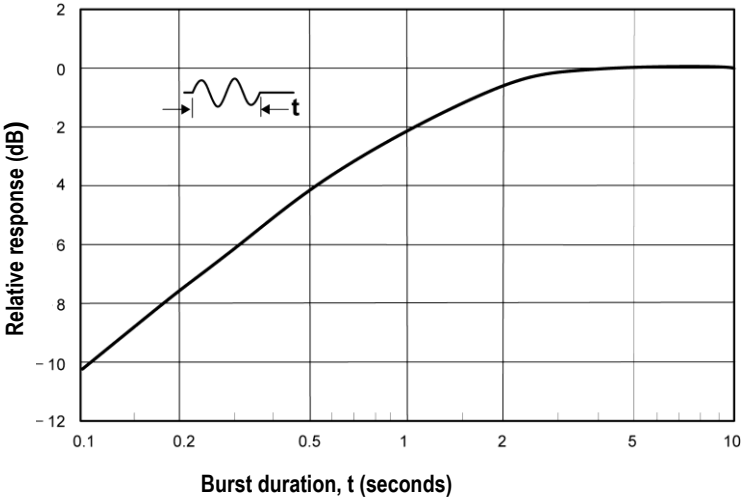


Figure B-1: Slow response to a tone burst

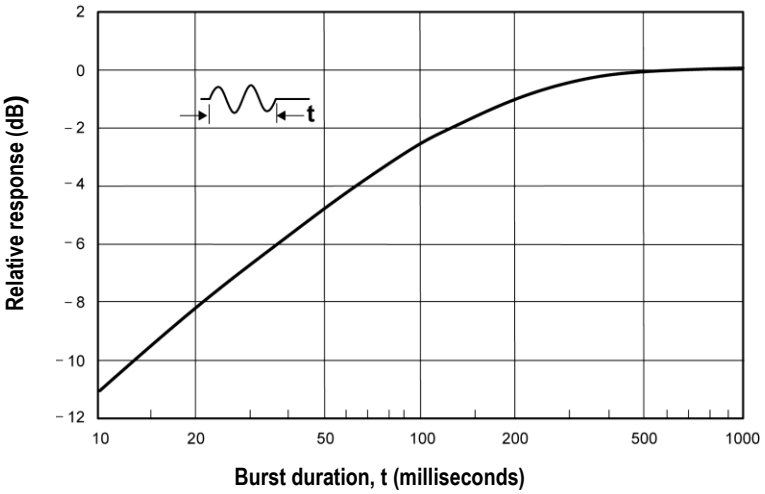


Figure B-2: Fast response to a tone burst

SPL/L_{AS}

Sound pressure level. A ratio of one sound pressure to a reference pressure. Because of the enormous dynamic range of the human ear, the ratio is calculated logarithmically by the formula below, where L_r is the reference pressure.

$$SPL = 20 \log\left(\frac{L}{L_r}\right) dB$$

Threshold

An SPL value that defines a lower level of acceptable values. Only SPL samples that exceed the threshold are used in some calculations.

Upper Limit (UL)

The total time during a study that the SPL exceeds the Upper Limit meter setting.

Weighting (A, C, Z)

SPL measurements are commonly weighted (scaled) in relation to their frequency components in order to provide a consistent basis for comparison to other measurements of the same type. The three Sound Examiner curves are plotted in Figure B-3.

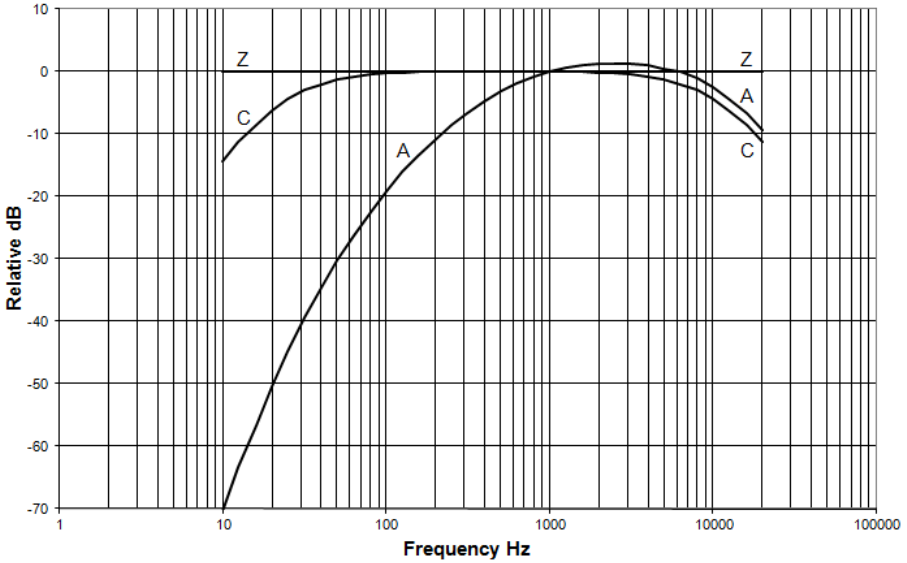


Figure B-3: All frequency weightings plotted together

Windscreen

A covering for a microphone that reduces disturbances caused by wind and direct contact with other surfaces.

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APPENDIX
C

Contact/Service information

This section gives directions for contacting TSI Incorporated for technical information and directions for returning the SE-400 Sound Examiner for service.

Technical Support Contacts

If you have any difficulty setting or operating the instrument, or if you have technical or application questions about this system, contact TSI's Technical Support.

North America and Asia Pacific		Europe, Middle East, and Africa	
Telephone:	1-800-680-1220 (USA); +1 651-490-2860 (Outside USA)	**Telephone**:	+49 241-52303-0
Fax:	+1 651-490-3824	**Fax:**	+49 241 52303-49
E-mail:	technical.services@tsi.com	**E-mail:**	tsigmbh@tsi.com

Service Contact Information

If your instrument does not operate properly, or if you are returning the instrument for service, visit our website at http://rma.tsi.com for a Return Material Authorization, or contact Customer Service.

North America and Asia Pacific		Europe, Middle East, and Africa	
TSI Incorporated 1060 Corporate Center Drive Oconomowoc, WI 53006-4828		**TSI Instruments Ltd.** Stirling Road Cressex Business Park High Wycombe, Bucks HP12 3ST United Kingdom	
Telephone:	1-800-680-1220 (USA); +1 651-490-2860 (Outside USA)	**Telephone:**	+44 (0) 149 4 459200
E-mail:	technical.services@tsi.com	**E-mail:**	tsiuk@tsi.com

Returning for Service

Visit our website at http://rma.tsi.com and complete the on-line “Return Merchandise Authorization” form or call TSI at 1-800-680-1220 (USA) or (651) 490-2860, or 001 651 490 2860 (International) for specific return instructions.

Customer Service will need the following information:

- The instrument model number
- The instrument serial number
- A purchase order number (unless under warranty)
- A billing address
- A shipping address

Use the original packing material to return the instrument to TSI. If you no longer have the original packing material, seal off any ports to prevent debris from entering the instrument and ensure that the display and the connectors on the instrument front and back panels are protected. This instrument is very fragile and must be packed in a manner appropriate for a precision instrument.

Calibration

The Sound Examiner and TSI field calibrator devices should be examined regularly by the factory. An annual calibration is recommended. (Please see Contact Information above.)

Warranty

(For country-specific terms and conditions outside of the USA, please visit www.tsi.com.)

Seller warrants the goods, excluding software, sold hereunder, under normal use and service as described in the operator's manual, to be free from defects in workmanship and material for **12 months**, or if less, the length of time specified in the operator's manual, from the date of shipment to the customer. This warranty period is inclusive of any statutory warranty. This limited warranty is subject to the following exclusions and exceptions:

a. Hot-wire or hot-film sensors used with research anemometers, and certain other components when indicated in specifications, are warranted for 90 days from the date of shipment;

b. Pumps are warranted for hours of operation as set forth in product or operator's manuals;

c. Parts repaired or replaced as a result of repair services are warranted to be free from defects in workmanship and material, under normal use, for 90 days from the date of shipment;

d. Seller does not provide any warranty on finished goods manufactured by others or on any fuses, batteries or other consumable materials. Only the original manufacturer's warranty applies;

e. This warranty does not cover calibration requirements, and seller warrants only that the instrument or product is properly calibrated at the time of its manufacture. Instruments returned for calibration are not covered by this warranty;

f. This warranty is **VOID** if the instrument is opened by anyone other than a factory authorized service center with the one exception where requirements set forth in the manual allow an operator to replace consumables or perform recommended cleaning;

g. This warranty is **VOID** if the product has been misused, neglected, subjected to accidental or intentional damage, or is not properly installed, maintained, or cleaned according to the requirements of the manual. Unless specifically authorized in a separate writing by Seller, Seller makes no warranty with respect to, and shall have no liability in connection with, goods which are incorporated into other products or equipment, or which are modified by any person other than Seller.

The foregoing is **IN LIEU OF** all other warranties and is subject to the LIMITATIONS stated herein. **NO OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE. WITH RESPECT TO SELLER'S BREACH OF THE IMPLIED WARRANTY AGAINST INFRINGEMENT, SAID WARRANTY IS LIMITED TO CLAIMS OF DIRECT INFRINGEMENT AND EXCLUDES CLAIMS OF CONTRIBUTORY OR INDUCED INFRINGEMENTS. BUYER'S EXCLUSIVE REMEDY SHALL BE THE RETURN OF THE PURCHASE PRICE DISCOUNTED FOR REASONABLE WEAR AND TEAR OR AT SELLER'S OPTION REPLACEMENT OF THE GOODS WITH NON-INFRINGING GOODS**.

TO THE EXTENT PERMITTED BY LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF SELLER'S LIABILITY FOR ANY AND ALL LOSSES, INJURIES, OR DAMAGES CONCERNING THE GOODS (INCLUDING CLAIMS BASED ON CONTRACT, NEGLIGENCE, TORT, STRICT LIABILITY OR OTHERWISE) SHALL BE THE RETURN OF GOODS TO SELLER AND THE REFUND OF THE PURCHASE PRICE, OR, AT THE OPTION OF SELLER, THE REPAIR OR REPLACEMENT OF THE GOODS. IN THE CASE OF SOFTWARE, SELLER WILL REPAIR OR REPLACE DEFECTIVE SOFTWARE OR IF UNABLE TO DO SO, WILL REFUND THE PURCHASE PRICE OF THE SOFTWARE. IN NO EVENT SHALL SELLER BE LIABLE FOR LOST PROFITS, BUSINESS INTERRUPTION, OR ANY SPECIAL, INDIRECT, CONSEQUENTIAL OR INCIDENTAL DAMAGES. SELLER SHALL NOT BE RESPONSIBLE FOR INSTALLATION, DISMANTLING OR REINSTALLATION COSTS OR CHARGES. No Action, regardless of form, may be brought against Seller more than 12 months after a cause of action has accrued. The goods returned under warranty to Seller's factory shall be at Buyer's risk of loss, and will be returned, if at all, at Seller's risk of loss.

Buyer and all users are deemed to have accepted this LIMITATION OF WARRANTY AND LIABILITY, which contains the complete and exclusive limited warranty of Seller. This LIMITATION OF WARRANTY AND LIABILITY may not be amended, modified or its terms waived, except by writing signed by an Officer of Seller.

Service Policy

Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call TSI's Customer Service department at 1-800-874-2811 (USA) or +001 (651) 490-2811 (International).

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Data Addendum: SE-400 Series measuring to IEC 61672-1

About this data addendum

This data addendum presents submission information for testing the Sound Examiner SE-400 Series sound level meter to the IEC61672-1 standard. The SE-400 Series is a data logging sound level meter.

Note: The nominal microphone sensitivity is -28 dB.

Linear operating range (sections: 5.5.10, 5.5.11, 9.2.7e, 9.3e, 9.3f)
The starting level for measuring level linearity is 114 dB at all frequencies. Calibration point is 114 dB at 400 mV @ 1 kHz.

Type/Class 1 and Type/Class 2	
Equivalent input voltage	0.400 VRMS
Capacitance	12 pF
Resistance	>1G

Linear operating range with SPL A-Weighting and LEQ A-Weighting (sections: 5.5.10, 5.5.11, 9.2.7e, 9.3e, 9.3f)
Note: Reference level 114 dB, Cal Point: 400mVrms = 114 dB @ 1 kHz

Frequency	SPL A-Weighting		LEQ A-Weighting	
	Linear Operating Range (dB)		Linear Operating Range (dB)	
31.5	75	**140**	75	**140**
1000	34	**140**	34	**140**
4000	33	**140**	33	**140**
8000	37	**140**	37	**140**
12500	42	**140**	42	**140**

Linear operating range with SPL C-Weighting and LEQ C-Weighting (sections: 5.5.10, 5.5.11, 9.2.7e, 9.3e, 9.3f)
Note: Reference level 114 dB, Cal Point: 400mVrms = 114 dB @ 1 kHz

Frequency	SPLC-Weighting		LEQ C-Weighting	
	Linear Operating Range (dB)		Linear Operating Range (dB)	
31.5	**43**	**140**	**43**	**140**
1000	**38**	**140**	**38**	**140**
4000	**39**	**140**	**39**	**140**
8000	**42**	**140**	**42**	**140**
12500	**47**	**140**	**47**	**140**

Linear operating range with SPL Z-Weighting and LEQ Z-Weighting (sections: 5.5.10, 5.5.11, 9.2.7e, 9.3e, 9.3f)
Note: Reference level 114 dB, Cal Point: 400mVrms = 114 dB @ 1 **kHz**

Frequency	SPL Z-Weighting		LEQ Z-Weighting	
	Linear Operating Range (dB)		Linear Operating Range (dB)	
31.5	44	140	44	140
1000	44	140	44	140
4000	44	140	44	140
8000	44	140	44	140
12500	44	140	44	140

Electrical signal input (sections: 5.1.15, 9.3)
The equivalent input voltages for Type/Class 1 and Type/Class 2 at 1 kHz are listed below.

Maximum input level (sections: 5.1.16, 9.3i)
The maximum acoustic input level is 150 dB. The maximum level at the electrical input is 11 VAC.

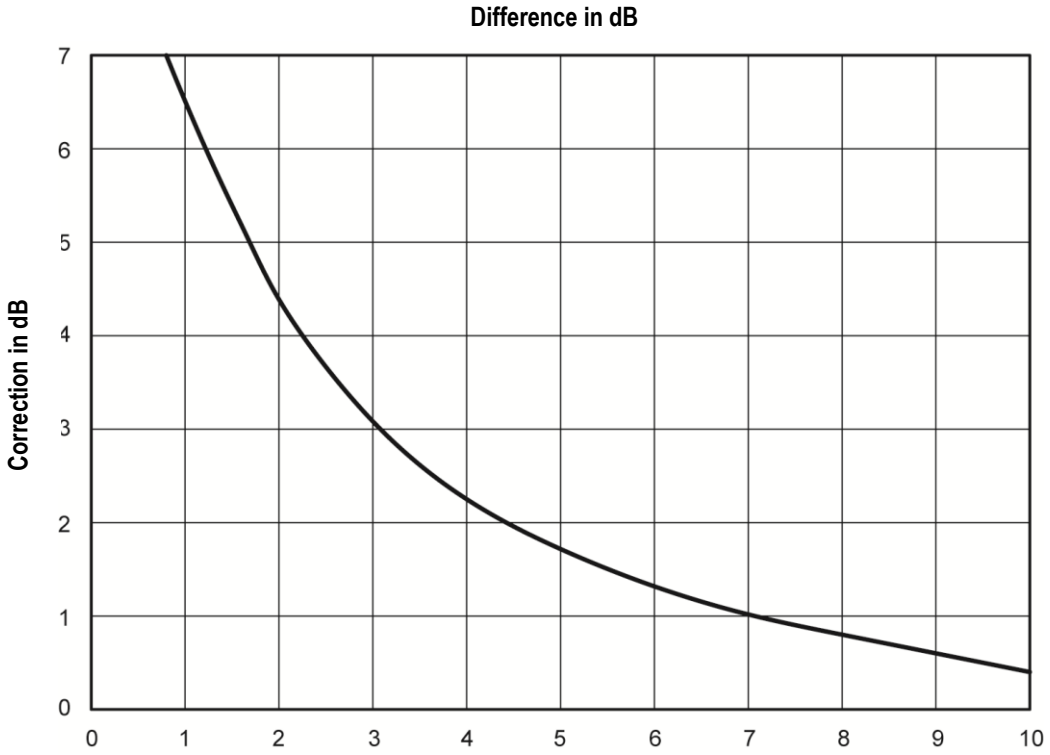
Self generated noise levels (sections: 5.6.1 5.6.2 5.6.3, 9.3)
Level of self-generated noise in decibels (dB). Applies to time average and both fast and slow time weighting.

To measure 12 pF 50 Ohm connect a standard 50 Ohm terminator to the 073-738,12 pF 50 Ohm input adapter, to the preamp input.

Microphone	A-Weighting	C-Weighting	Z-Weighting
QE4936	26.1	29.6	34.9
QE7052	28.3	30.8	35.4
12 pF 50 Ohm input adapter	25.6	29.3	34.9

Peak C Level Range
The nominal peak C level range is 55 dB to143 dB.

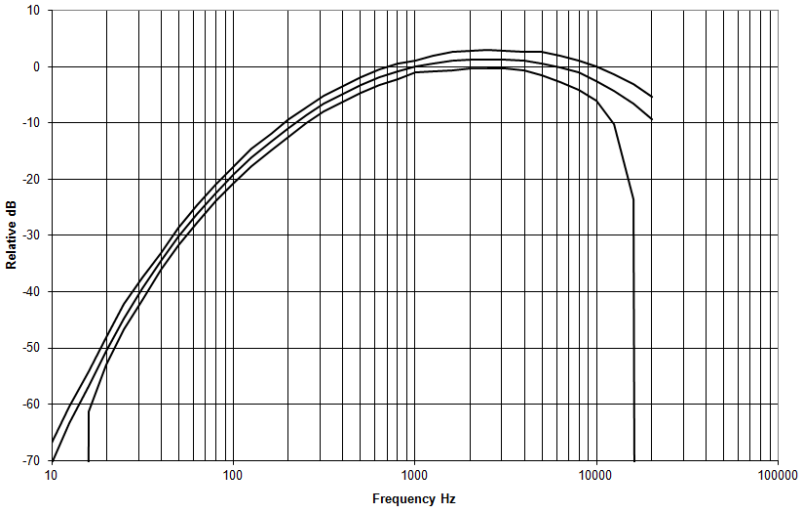
Effects of background noise (sections: 5.6.4, 5.6.5, 9.2.5d)
Background noise can cause considerable error in measurement when its intensity is close to that of a particular sound source of interest. When it is not possible to eliminate or reduce the background noise, use the curve shown in Figure 4 to correct for the effect of the background noise on the measurement. For example, if the background noise is 45 dB and the sound of interest measures 51 dB, the difference between measurement and background noise is 6 dB. From Figure 4, for a 6 dB difference, 1.3 dB should be subtracted from the measurement. The correct measurement is therefore 51 dB- 1.3 dB = 49.7 dB.



Frequency weighting (sections: 5.1.10, 5.4.12)

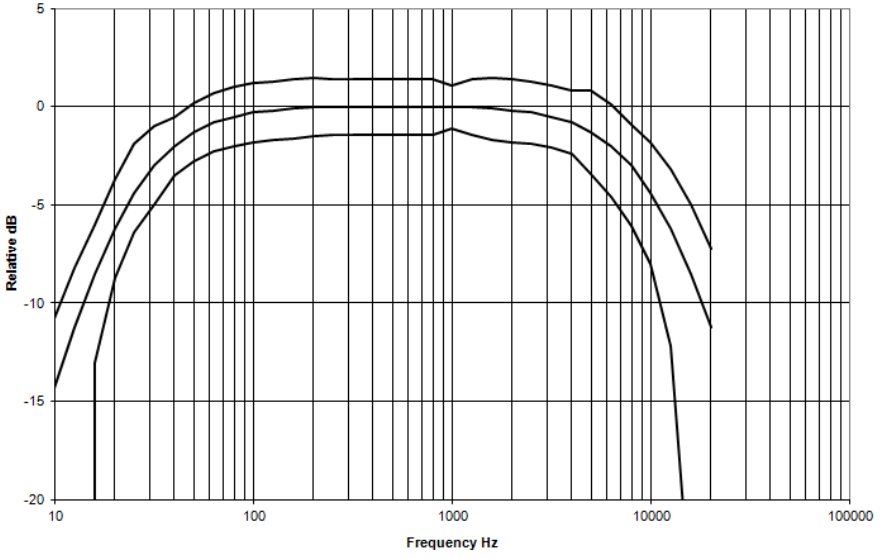
A-Weighting Nominal

The graph below is the nominal A weighting frequency response



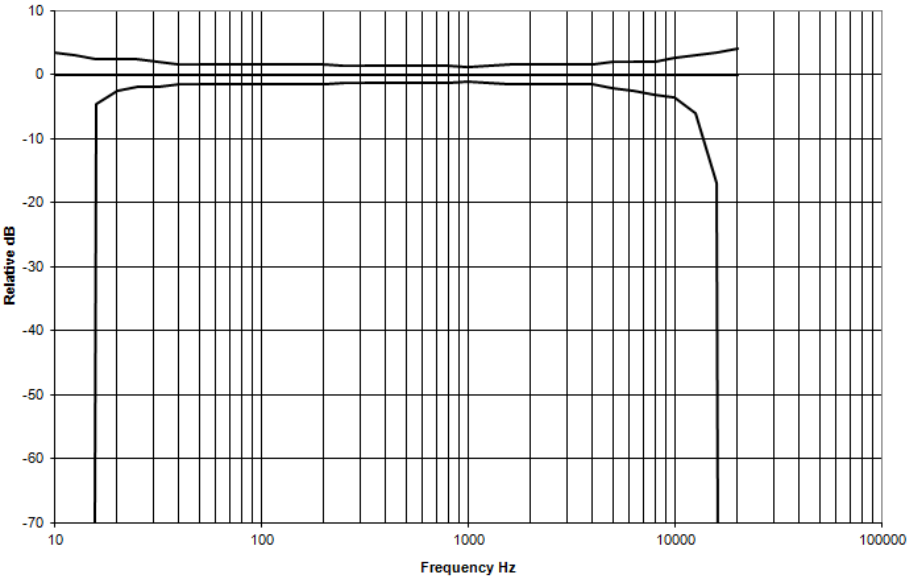
C-Weighting Nominal

The graph below is the nominal C weighting frequency response



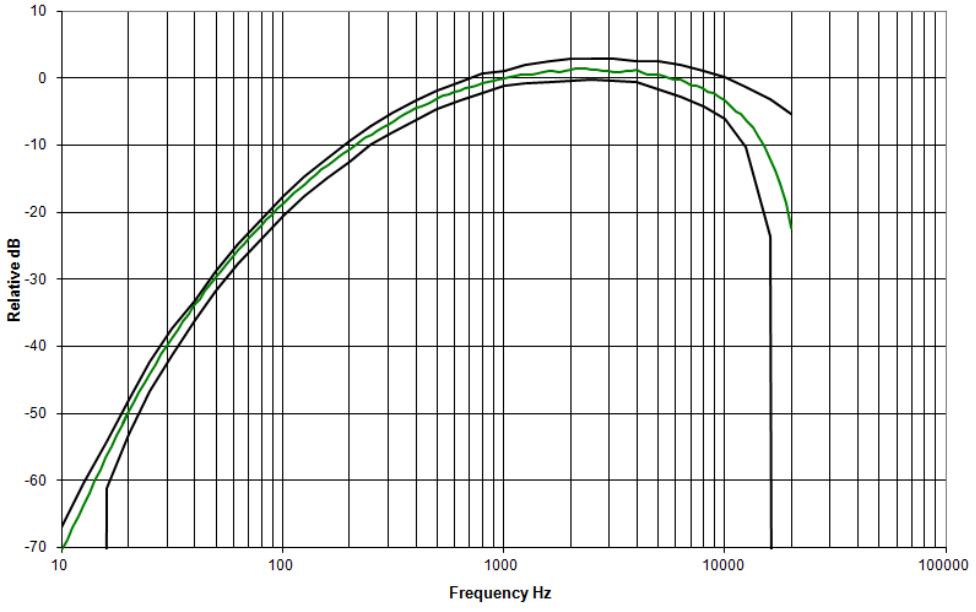
Z-Weighting Nominal

The graph below is the nominal Z weighting frequency response



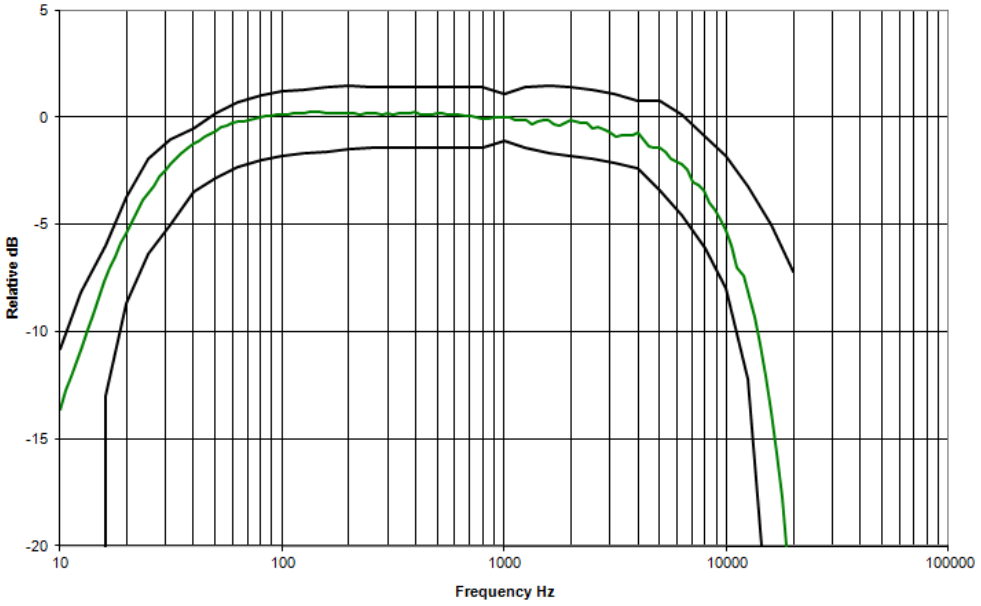
A-Weighting Typical

The graph below is the frequency typical A weighting frequency response



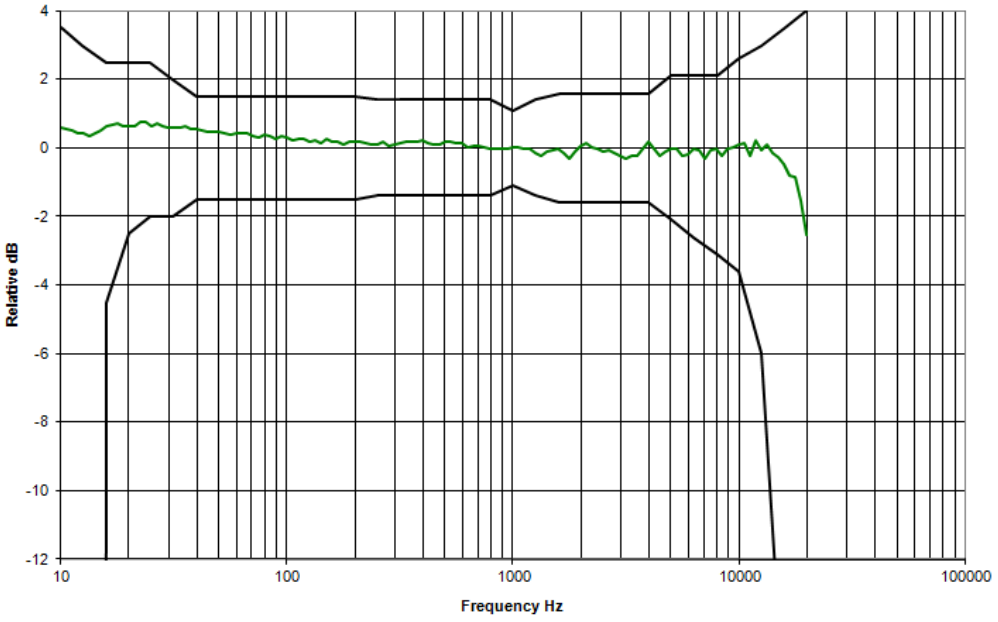
C-Weighting Typical

The graph below is the frequency weighting Typical C weighting frequency response.



Z-Weighting Typical

The graph below is the Typical Z weighting frequency response



Nominal BK4936 microphone frequency response, diffraction and reflection corrections (section: 5.2.8)
Note: Add correction to electrical frequency response.

Nominal Frequency Hz	Nominal corrections in dB
63	0.6
80	0.4
100	0.3
125	0.4
160	0.2
200	0.2
250	0.3
315	0.1
400	0.2
500	0.2
630	0.2
800	0.0
1000	0.0
1059	0.0
1122	0.0
1189	-0.1
1259	0.0
1334	-0.2
1413	-0.2
1496	-0.1
1585	0.0
1679	-0.2
1778	-0.2
1884	-0.1
1995	0.0
2113	0.1
2239	0.0
2371	0.0
2512	-0.2
2661	-0.1
2818	-0.1
2985	-0.2

Nominal Frequency Hz	Nominal corrections in dB
3162	-0.3
3350	-0.3
3548	-0.1
3758	0.0
3981	0.2
4217	0.0
4467	-0.2
4732	-0.1
5012	-0.1
5309	0.0
5623	-0.2
5957	-0.2
6310	-0.1
6683	0.0
7079	-0.4
7499	0.0
7943	0.0
8414	-0.2
8913	-0.1
9441	-0.1
10000	-0.1
10593	-0.1
11220	-0.4
11885	0.0
12589	-0.1
13335	-0.1
14125	-0.4
14962	-0.5
15849	-0.7

Nominal BK4936 microphone frequency response, diffraction and reflection with windscreen corrections (section: 5.2.8)
Note: Add correction to electrical frequency response.

Nominal Frequency Hz	Nominal corrections in dB
63	0.6
80	0.4
100	0.3
125	0.4
160	0.2
200	0.2
250	0.3
315	0.2
400	0.3
500	0.2
630	0.3
800	0.0
1000	0.0
1059	0.1
1122	0.1
1189	0.1
1259	0.2
1334	-0.1
1413	0.1
1496	0.1
1585	0.2
1679	0.1
1778	0.2
1884	0.2
1995	0.3
2113	0.4
2239	0.3
2371	0.3
2512	0.2
2661	0.3
2818	0.3
2985	0.2

Nominal Frequency Hz	Nominal corrections in dB
3162	0.1
3350	0.2
3548	0.2
3758	0.3
3981	0.4
4217	0.2
4467	-0.1
4732	-0.1
5012	-0.1
5309	0.0
5623	-0.2
5957	-0.2
6310	-0.1
6683	0.0
7079	-0.4
7499	0.0
7943	0.0
8414	-0.3
8913	-0.3
9441	-0.3
10000	-0.3
10593	-0.2
11220	-0.4
11885	-0.2
12589	-0.3
13335	-0.5
14125	-0.9
14962	-1.0
15849	-1.2

Nominal BK4936 microphone frequency response, diffraction and reflection with random incidence corrector (RICR) corrections (section: 5.2.8)
Note: Add correction to electrical frequency response.

Nominal Frequency Hz	Nominal corrections in dB
63	0.7
80	0.5
100	0.4
125	0.5
160	0.3
200	0.3
250	0.4
315	0.2
400	0.3
500	0.2
630	0.3
800	0.1
1000	0.0
1059	0.0
1122	0.1
1189	0.1
1259	0.3
1334	0.2
1413	0.1
1496	0.1
1585	0.2
1679	0.3
1778	0.3
1884	0.2
1995	0.3
2113	0.5
2239	0.5
2371	0.4
2512	0.3
2661	0.4
2818	0.4

Nominal Frequency Hz	Nominal corrections in dB
2985	0.3
3162	0.3
3350	0.6
3548	0.7
3758	0.8
3981	1.0
4217	0.9
4467	0.8
4732	1.0
5012	1.1
5309	1.4
5623	1.4
5957	1.5
6310	1.8
6683	2.1
7079	2.1
7499	2.6
7943	2.8
8414	3.0
8913	3.3
9441	3.6
10000	3.7
10593	4.0
11220	3.8
11885	4.0
12589	4.0
13335	3.6
14125	2.8
14962	2.3

Nominal BK4936 microphone frequency response, diffraction and reflection with RICR and windscreen corrections (section: 5.2.8)
Note: Add correction to electrical frequency response.

Nominal Frequency Hz	Nominal corrections in dB
63	0.6
80	0.4
100	0.3
125	0.4
160	0.2
200	0.2
250	0.3
315	0.2
400	0.2
500	0.2
630	0.2
800	0.0
1000	0.0
1059	0.0
1122	0.1
1189	0.1
1259	0.2
1334	0.1
1413	0.2
1496	0.2
1585	0.3
1679	0.3
1778	0.4
1884	0.4
1995	0.5
2113	0.6
2239	0.6
2371	0.6
2512	0.5
2661	0.7
2818	0.7

Nominal Frequency Hz	Nominal corrections in dB
2985	0.6
3162	0.7
3350	0.8
3548	1.0
3758	1.1
3981	1.3
4217	1.2
4467	1.1
4732	1.2
5012	1.3
5309	1.6
5623	1.6
5957	1.8
6310	2.0
6683	2.4
7079	2.3
7499	2.9
7943	3.2
8414	3.1
8913	3.4
9441	3.6
10000	3.7
10593	3.8
11220	3.6
11885	3.3
12589	3.0
13335	2.2
14125	1.3
14962	0.9
15849	0.0

Nominal BK4936 microphone frequency response, diffraction and reflection with remote preamp corrections (section: 5.2.8)
Note: Add correction to electrical frequency response.

Nominal Frequency Hz	Nominal corrections in dB
63	0.5
80	0.3
100	0.2
125	0.3
160	0.1
200	0.1
250	0.2
315	0.1
400	0.2
500	0.1
630	0.2
800	0.0
1000	0.0
1059	0.1
1122	0.1
1189	0.1
1259	0.2
1334	0.0
1413	0.0
1496	-0.1
1585	-0.1
1679	-0.2
1778	-0.1
1884	-0.2
1995	-0.2
2113	-0.2
2239	-0.1
2371	-0.1
2512	-0.1
2661	-0.1
2818	-0.1

Nominal Frequency Hz	Nominal corrections in dB
2985	-0.1
3162	-0.2
3350	-0.2
3548	-0.3
3758	-0.2
3981	-0.2
4217	-0.3
4467	-0.4
4732	-0.3
5012	-0.1
5309	0.0
5623	-0.5
5957	-0.8
6310	-0.6
6683	-0.1
7079	-0.4
7499	-0.4
7943	-0.6
8414	-0.7
8913	0.0
9441	-0.4
10000	-0.7
10593	-0.1
11220	-0.4
11885	-0.5
12589	0.1
13335	-0.4
14125	-0.5
14962	-0.4
15849	-0.8

Nominal BK4936 microphone frequency response, diffraction and reflection with remote preamp and windscreen corrections (section: 5.2.8)
Note: Add correction to electrical frequency response.

Nominal Frequency Hz	Nominal corrections in dB
63	0.4
80	0.2
100	0.2
125	0.2
160	0.0
200	0.0
250	0.1
315	0.0
400	0.1
500	0.0
630	0.1
800	-0.1
1000	0.0
1059	0.1
1122	0.1
1189	0.1
1259	0.3
1334	0.1
1413	0.0
1496	0.0
1585	0.0
1679	0.0
1778	0.1
1884	0.0
1995	0.1
2113	0.1
2239	0.2
2371	0.2
2512	0.3
2661	0.3
2818	0.3

Nominal Frequency Hz	Nominal corrections in dB
2985	0.3
3162	0.3
3350	0.3
3548	0.3
3758	0.3
3981	0.3
4217	0.2
4467	0.0
4732	0.2
5012	0.3
5309	0.4
5623	-0.1
5957	-0.2
6310	0.2
6683	0.7
7079	0.2
7499	0.3
7943	0.2
8414	0.1
8913	0.5
9441	-0.1
10000	0.0
10593	0.0
11220	-0.8
11885	-1.3
12589	-1.8
13335	-2.5
14125	-2.8
14962	-2.6
15849	-2.9

Nominal BK4936 microphone frequency response, diffraction and reflection with remote preamp and RICR corrections (section: 5.2.8)
Note: Add correction to electrical frequency response.

Nominal Frequency Hz	Nominal corrections in dB
63	0.4
80	0.2
100	0.1
125	0.2
160	0.0
200	0.0
250	0.1
315	0.0
400	0.1
500	0.0
630	0.2
800	0.1
1000	0.0
1059	0.1
1122	0.1
1189	0.2
1259	0.4
1334	0.2
1413	0.1
1496	0.0
1585	-0.1
1679	0.0
1778	-0.1
1884	-0.1
1995	0.1
2113	0.2
2239	0.1
2371	0.2
2512	0.2

Nominal Frequency Hz	Nominal corrections in dB
2661	0.3
2818	0.2
2985	0.3
3162	0.3
3350	0.4
3548	0.4
3758	0.5
3981	0.6
4217	0.6
4467	0.6
4732	0.8
5012	1.2
5309	1.4
5623	1.0
5957	1.0
6310	1.5
6683	2.2
7079	2.0
7499	2.2
7943	2.4
8414	2.8
8913	3.6
9441	3.1
10000	3.6
10593	4.1
11220	3.7
11885	4.0
12589	4.1
13335	3.5
14125	3.1
14962	2.4
15849	1.7

Nominal BK4936 microphone frequency response, diffraction and reflection with remote preamp RICR, & windscreen corrections (Section: 5.2.8)
Note: Add correction to electrical frequency response.

Nominal Frequency Hz	Nominal corrections in dB
63	0.3
80	0.1
100	0.0
125	0.1
160	-0.1
200	-0.1
250	0.0
315	-0.1
400	0.0
500	-0.1
630	0.1
800	0.0
1000	0.0
1059	0.1
1122	0.2
1189	0.2
1259	0.4
1334	0.3
1413	0.2
1496	0.1
1585	0.0
1679	0.1
1778	0.1
1884	0.1
1995	0.3
2113	0.5
2239	0.4
2371	0.6
2512	0.6
2661	0.7
2818	0.7
2985	0.7

Nominal Frequency Hz	Nominal corrections in dB
3162	0.8
3350	0.8
3548	0.9
3758	1.0
3981	1.0
4217	1.0
4467	1.0
4732	1.2
5012	1.5
5309	1.7
5623	1.3
5957	1.4
6310	2.1
6683	2.7
7079	2.5
7499	2.7
7943	3.0
8414	3.2
8913	3.8
9441	3.2
10000	3.9
10593	4.1
11220	3.4
11885	3.4
12589	2.9
13335	2.1
14125	1.5
14962	0.7
15849	0.1

Nominal QE7052 microphone frequency response, diffraction and reflection corrections (section: 5.2.8)
Note: Add correction to electrical frequency response

Nominal Frequency Hz	Nominal corrections in dB
63	0.6
80	0.4
100	0.3
125	0.4
160	0.2
200	0.2
250	0.3
315	0.2
400	0.2
500	0.2
630	0.2
800	0.0
1000	0.0
1250	0.1
1600	0.2
2000	0.3
2500	0.3
3150	0.3
4000	0.9
5000	1.0
6300	1.4
8000	1.1

Nominal QE7052 microphone frequency response, diffraction and reflection corrections with windscreen (section: 5.2.8)
Note: Add correction to electrical frequency response

Nominal Frequency Hz	Nominal corrections in dB
63	0.5
80	0.3
100	0.1
125	0.2
160	0.0
200	0.1
250	0.2
315	0.0
400	0.1
500	0.0
630	0.2
800	0.0
1000	0.0
1250	0.3
1600	0.3
2000	0.5
2500	0.6
3150	0.6
4000	1.1
5000	1.0
6300	1.3
8000	0.7

Pressure to free field corrections with BK4936 microphone (sections: 5.2.8, 9.2.7d)
Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	BK4936 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	0.0
50	-0.1
63	-0.1
80	-0.1
100	-0.1
125	-0.1
160	-0.1
200	-0.2
250	-0.1
315	0.0
400	0.1
500	0.2
630	0.1
800	0.0
1000	0.0
1250	0.0
1600	0.2
2000	0.4
2500	0.5
3150	0.8
4000	1.6
5000	2.1
6300	3.1
8000	3.9
10000	5.3
12500	6.2
16000	8.4

Pressure to free field corrections with BK4936 microphone and windscreen (sections: 5.2.8, 9.2.7d)
Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	BK4936 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	0.0
50	-0.1
63	-0.1
80	-0.1
100	-0.1
125	-0.1
160	-0.1
200	-0.2
250	-0.1
315	0.0
400	0.1
500	0.2
630	0.1
800	0.0
1000	0.0
1250	0.0
1600	0.2
2000	0.4
2500	0.5
3150	0.8
4000	1.6
5000	2.1
6300	3.1
8000	3.9
10000	5.3
12500	6.2
16000	8.4

Pressure to free field corrections with BK4936 microphone and RICR (sections: 5.2.8, 9.2.7d)
Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	BK4936 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	0.0
50	-0.1
63	-0.1
80	-0.1
100	-0.1
125	-0.1
160	-0.1
200	0.0
250	0.0
315	0.2
400	0.2
500	0.2
630	0.2
800	0.1
1000	0.0
1250	0.2
1600	0.4
2000	0.7
2500	1.0
3150	1.5
4000	2.5
5000	3.4
6300	5.0
8000	6.8
10000	9.1
12500	10.3
16000	10.5

Pressure to free field corrections with BK4936 microphone and RIC and windscreen (sections: 5.2.8, 9.2.7d)
Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	BK4936 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	0.0
50	-0.1
63	-0.1
80	-0.1
100	-0.1
125	-0.1
160	-0.1
200	-0.3
250	-0.2
315	-0.1
400	-0.1
500	-0.1
630	0.0
800	0.0
1000	0.0
1250	0.4
1600	0.2
2000	0.7
2500	1.3
3150	1.9
4000	2.5
5000	3.7
6300	5.3
8000	6.9
10000	9.4
12500	9.2

Pressure to free field corrections with BK4936 microphone and RICR, windscreen, and remote preamp (sections: 5.2.8, 9.2.7d)

Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	BK4936 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	0.0
50	-0.1
63	-0.1
80	-0.1
100	-0.1
125	-0.1
160	-0.1
200	-0.2
250	-0.1
315	0.0
400	0.1
500	0.2
630	0.1
800	0.0
1000	0.0
1250	0.2
1600	0.6
2000	0.9
2500	1.2
3150	1.8
4000	2.8
5000	3.5
6300	5.3
8000	7.1
10000	9.2
12500	9.3
16000	9.1

Pressure to free field corrections with BK4936 microphone and remote preamp (sections: 5.2.8, 9.2.7d)
Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	BK4936 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	0.0
50	-0.1
63	-0.1
80	-0.1
100	-0.1
125	-0.1
160	-0.1
200	-0.2
250	-0.1
315	0.0
400	0.0
500	0.1
630	0.1
800	0.0
1000	0.0
1250	0.2
1600	0.1
2000	0.2
2500	0.6
3150	0.9
4000	1.3
5000	2.1
6300	2.7
8000	3.3
10000	4.8
12500	6.4
16000	8.4

Pressure to free field corrections with BK4936 microphone and remote preamp and windscreen (sections: 5.2.8, 9.2.7d)

Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	BK4936 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	0.0
50	-0.1
63	-0.1
80	-0.1
100	-0.1
125	-0.1
160	-0.1
200	-0.1
250	0.0
315	0.0
400	0.0
500	0.1
630	0.0
800	-0.1
1000	0.0
1250	0.3
1600	0.2
2000	0.5
2500	0.9
3150	1.4
4000	1.7
5000	2.4
6300	3.1
8000	3.8
10000	5.2
12500	6.2
16000	7.8

Pressure to free field corrections with BK4936 microphone and remote preamp and windscreen (sections: 5.2.8, 9.2.7d)

Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	BK4936 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	0.0
50	-0.1
63	-0.1
80	-0.1
100	-0.1
125	-0.1
160	-0.1
200	-0.3
250	-0.1
315	0.0
400	0.0
500	0.0
630	0.0
800	0.1
1000	0.0
1250	0.4
1600	0.1
2000	0.4
2500	0.9
3150	1.4
4000	2.0
5000	3.4
6300	4.8
8000	6.4
10000	9.0
12500	10.5
16000	10.8

Pressure to free field corrections with BK4936 microphone and remote preamp and RICR (sections: 5.2.8, 9.2.7d)
Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	BK4936 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	0.0
50	-0.1
63	-0.1
80	-0.1
100	-0.1
125	-0.1
160	-0.1
200	-0.3
250	-0.1
315	0.0
400	0.0
500	0.0
630	0.0
800	0.1
1000	0.0
1250	0.4
1600	0.1
2000	0.4
2500	0.9
3150	1.4
4000	2.0
5000	3.4
6300	4.8
8000	6.4
10000	9.0
12500	10.5
16000	10.8

Pressure to free field corrections with QE7052 microphone (sections: 5.2.8, 9.2.7d)
Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	QE7052 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	-0.1
50	0.0
63	-0.1
80	-0.2
100	-0.3
125	-0.3
160	-0.3
200	0.0
250	0.1
315	0.1
400	0.1
500	0.1
630	0.1
800	0.0
1000	0.0
1250	0.0
1600	0.2
2000	0.4
2500	0.5
3150	0.5
4000	1.3
5000	2.3
6300	4.4
8000	5.0
10000	4.5
12500	5.6
16000	7.9

Pressure to free field corrections with QE7052 microphone with windscreen (sections: 5.2.8, 9.2.7d)
Note: Add to pressure response to get 0°incidence free-field response. B&K 4226 calibrator may be used to determine the pressure field response.

Frequency in Hz	QE7052 microphone Pressure Field to Free Field Corrections in dB
32	0.1
40	-0.1
50	0.0
63	-0.1
80	-0.2
100	-0.3
125	-0.3
160	-0.3
200	-0.3
250	-0.2
315	-0.1
400	-0.1
500	-0.1
630	0.0
800	0.0
1000	0.0
1250	0.2
1600	0.3
2000	0.5
2500	0.8
3150	0.9
4000	1.5
5000	2.3
6300	4.3
8000	4.7
10000	3.9
12500	5.2
16000	7.2

Pressure to random incidence corrections with BK4936 microphone (section 5.2.7)
Note: Added to the pressure response to calculate random incidence response.

Frequency in Hz	BK4936 microphone Random Incidence Corrections in dB
32	0.3
40	0.3
50	0.2
63	0.1
80	0.0
100	0.0
125	0.1
160	0.0
200	0.0
250	0.1
315	0.0
400	0.1
500	0.0
630	0.1
800	0.2
1000	0.0
1250	0.2
1600	-0.3
2000	0.1
2500	0.2
3150	0.3
4000	0.4
5000	0.8
6300	1.2
8000	1.3
10000	2.2
12500	2.4
16000	3.6

Pressure to random incidence corrections with BK4936 microphone and windscreen (section 5.2.7)
Note: Added to the pressure response to calculate random incidence response.

Frequency in Hz	BK4936 microphone & windscreen Random Incidence Corrections in dB
32	0.4
40	0.3
50	0.2
63	0.2
80	0.0
100	0.0
125	0.1
160	0.0
200	0.0
250	0.1
315	0.0
400	0.2
500	0.0
630	0.1
800	0.0
1000	0.0
1250	0.1
1600	-0.2
2000	0.1
2500	0.4
3150	0.6
4000	0.9
5000	1.1
6300	1.4
8000	1.4
10000	2.2
12500	2.3
16000	3.0

Pressure to random incidence corrections with BK4936 microphone and RICR (section 5.2.7)
Note: Added to the pressure response to calculate random incidence response.

Frequency in Hz	BK4936 microphone & RIC Random Incidence Corrections in dB
32	0.3
40	0.3
50	0.1
63	0.1
80	0.0
100	-0.1
125	0.0
160	-0.1
200	-0.1
250	0.0
315	0.0
400	0.1
500	-0.1
630	0.1
800	0.0
1000	0.0
1250	0.2
1600	-0.3
2000	0.0
2500	0.2
3150	0.4
4000	0.9
5000	1.7
6300	2.6
8000	3.7
10000	5.6
12500	6.2
16000	5.7

Pressure to random incidence corrections with BK4936 microphone, RICR, and windscreen (section 5.2.7)
Note: Added to the pressure response to calculate random incidence response.

Frequency in Hz	BK4936 microphone & RIC & windscreen Random Incidence Corrections in dB
32	0.3
40	0.2
50	0.1
63	0.1
80	0.1
100	0.0
125	-0.1
160	0.0
200	0.0
250	0.0
315	0.0
400	0.2
500	0.1
630	0.0
800	0.0
1000	0.0
1250	0.2
1600	0.2
2000	0.5
2500	0.8
3150	1.1
4000	1.7
5000	2.3
6300	3.2
8000	4.1
10000	5.9
12500	5.2
16000	3.9

Pressure to random incidence corrections with BK4936 microphone, RICR, windscreen, and remote preamp (section 5.2.7)
Note: Added to the pressure response to calculate random incidence response.

Frequency in Hz	BK4936 microphone, RICR, windscreen & remote preamp Random Incidence Corrections in dB
32	0.3
40	0.2
50	0.1
63	0.1
80	0.1
100	0.0
125	-0.1
160	0.0
200	0.0
250	0.0
315	0.0
400	0.2
500	0.1
630	0.0
800	0.0
1000	0.0
1250	0.2
1600	0.2
2000	0.5
2500	0.8
3150	1.1
4000	1.7
5000	2.3
6300	3.2
8000	4.1
10000	5.9
12500	5.2
16000	3.9

Pressure to random incidence corrections with BK4936 microphone & remote preamp (section 5.2.7)
Note: Added to the pressure response to calculate random incidence response.

Frequency in Hz	BK4936 microphone & remote preamp Random Incidence Corrections in dB
32	0.4
40	0.4
50	0.3
63	0.2
80	0.1
100	0.1
125	0.1
160	0.0
200	0.0
250	0.2
315	0.1
400	0.2
500	0.1
630	0.2
800	0.1
1000	0.0
1250	0.4
1600	0.0
2000	0.1
2500	0.3
3150	0.4
4000	0.6
5000	0.9
6300	1.3
8000	1.5
10000	2.2
12500	2.6
16000	3.6

Pressure to random incidence corrections with BK4936 microphone, remote preamp, and windscreen (section 5.2.7)
Note: Added to the pressure response to calculate random incidence response.

Frequency in Hz	BK4936 microphone, remote preamp, & windscreen Random Incidence Corrections in dB
32	0.3
40	0.3
50	0.2
63	0.1
80	0.0
100	-0.1
125	0.0
160	-0.1
200	-0.1
250	0.1
315	0.0
400	0.1
500	-0.1
630	0.1
800	-0.2
1000	0.0
1250	0.4
1600	0.0
2000	0.1
2500	0.6
3150	1.0
4000	1.5
5000	2.1
6300	2.5
8000	3.1
10000	4.6
12500	5.0
16000	7.1

Pressure to random incidence corrections with BK4936 microphone, remote preamp, and RICR (section 5.2.7)
Note: added to the pressure response to calculate random incidence response.

Frequency in Hz	BK4936 microphone, remote preamp, & RICR Random Incidence Corrections in dB
32	0.5
40	0.5
50	0.4
63	0.3
80	0.2
100	0.1
125	0.2
160	0.1
200	0.1
250	0.3
315	0.2
400	0.3
500	0.1
630	0.2
800	0.0
1000	0.0
1250	0.3
1600	0.1
2000	0.2
2500	0.4
3150	0.7
4000	1.1
5000	1.8
6300	2.7
8000	3.8
10000	5.6
12500	6.1
16000	5.3

Pressure to random incidence corrections with QE7052 (section 5.2.7)
Note: Added to the pressure response to calculate random incidence response.

Frequency in Hz	QE7052 microphone Random Incidence Corrections in dB
32	0.4
40	0.3
50	0.3
63	0.2
80	0.1
100	0.0
125	0.0
160	-0.1
200	-0.1
250	0.0
315	-0.1
400	0.0
500	-0.2
630	0.0
800	-0.1
1000	0.0
1250	0.1
1600	-0.5
2000	-0.3
2500	-0.3
3150	-0.2
4000	0.2
5000	1.1
6300	2.5
8000	3.0
10000	1.9
12500	2.2
16000	3.3

Pressure to random incidence corrections with QE7052 microphone and windscreen (section 5.2.7)
Note: Added to the pressure response to calculate random incidence response.

Frequency in Hz	QE7052 microphone & windscreen Random Incidence Corrections in dB
32	0.4
40	0.3
50	0.3
63	0.2
80	0.1
100	0.0
125	0.0
160	-0.1
200	-0.1
250	0.0
315	-0.1
400	0.0
500	-0.1
630	-0.1
800	0.0
1000	0.0
1250	0.0
1600	-0.3
2000	0.1
2500	0.3
3150	0.4
4000	0.7
5000	1.5
6300	2.8
8000	2.9
10000	1.5
12500	2.0
16000	2.8

Windscreen corrections with BK4936 microphone
***Note:** add to the windscreen response to calculate the response without the windscreen.

Frequency in Hz	Corrections in dB
1000	0.0
1250	-0.2
1600	-0.2
2000	-0.3
2500	-0.4
3150	-0.4
4000	-0.2
5000	0.0
6300	0.0
8000	0.0
10000	0.1
12500	0.2
16000	0.5

Windscreen corrections with BK4936 microphone and random incidence corrector ring (RICR)
***Note:** add to the windscreen response to calculate the response without the windscreen.

Frequency in Hz	Corrections in dB
1000	0.0
1250	0.1
1600	-0.1
2000	-0.2
2500	-0.2
3150	-0.3
4000	-0.3
5000	-0.2
6300	-0.3
8000	-0.3
10000	0.0
12500	1.0
16000	1.4

Windscreen corrections with BK4936 microphone, RICR, and remote preamp
***Note:** add to the windscreen response to calculate the response without the windscreen.

Frequency in Hz	Corrections in dB
1000	0.0
1250	0.0
1600	-0.1
2000	-0.2
2500	-0.4
3150	-0.5
4000	-0.4
5000	-0.4
6300	-0.5
8000	-0.5
10000	-0.4
12500	1.2
16000	1.6

Windscreen corrections with BK4936 microphone and remote preamp
***Note:** add to the windscreen response to calculate the response without the windscreen.

Frequency in Hz	Corrections in dB
1000	0.0
1250	-0.1
1600	-0.2
2000	-0.4
2500	-0.4
3150	-0.5
4000	-0.4
5000	-0.3
6300	-0.4
8000	-0.5
10000	-0.4
12500	0.2
16000	0.6

Windscreen corrections with QE7052 microphone
***Note:** add to the windscreen response to calculate the response without the windscreen.

Frequency in Hz	Corrections in dB
1000	0.0
1250	-0.2
1600	-0.2
2000	-0.3
2500	-0.4
3150	-0.4
4000	-0.2
5000	0.0
6300	0.0
8000	0.0
10000	0.1
12500	0.2
16000	0.5

Display and Integration (sections: 5.15.5, 5.15.6, 5.15.7, 9.2.5f)
The display update rate is 1 second. The display is updated every second during integration.

Resetting Overload, Under Range, Maximum, and Peak (section 9.2.5 k)
Press the run key to reset. This will reset the measurement data and the indicators. The time to reset is immediate.

Minimum/Maximum integration time (sections: 5.17.1, 5.17.2)
The Minimum/Maximum integration time for measurement time-average levels.

Measurement type	Time average levels
Minimum	1 second
Maximum	99 hours

Reference direction (section: 9.2.5a)
The reference direction is at 0º for both BK4936 and QE7052 microphone. The equivalent random incidence direction is 70º.

AC/DC Output Characteristics (section 5.16.1)

AC Output:
Weighting: Z-Weighting
Range of Signal: +/- 2.5 Vp
Output Impedance: 2K Ohm
Recommended load impedance: > 40K Ohms

DC Output:
Weighting: A, C, or Z (as set by user)
Range of Signal: 0 to 3.3Vdc, 1mV = 0.1dB (i.e. 450mV = 45.0dB), Under-range ~ 0Vdc, Overload >= 2.0Vdc
Output Impedance: 1K Ohm
Recommended load impedance: > 20K

Cable and radio frequency emission (sections: 5.18.1, 5.18.2, 9.3n)
The charging cable is a shielded 1 meter long USB cable.

Battery voltage range and power supply (sections: 5.20.2, 5.20.3, 9.3j)
The charging circuit stops charging when the battery voltage reaches its maximum of 4.1 Volts DC. The unit shuts down when the minimum battery voltage of 3.4 volts DC is reached. The instrument may be operated with a USB power cable.

Electrostatic discharges (section 6.5.2, 9.2.7 b)
Exposure to electrostatic discharges will not change operating state, change of configuration or corruption or loss of stored data.

AC power and radio frequency (sections: 6.6.1, 6.6.3, 6.6.4, 9.2.7c, 9.3o)
No effect was observed in any orientation or configuration of the SE-400 SERIES within a 60 Hz 80 A/m magnetic field. During radio frequency immunity testing, a 3-meter USB cable was connected between the SE-400 Series and a computer USB port. The SE-400 Series was set to display SPL.

Directional windscreen corrections (section: 7.2)

Note: in dB re:20 uPA

Frequency in Hz	0 Degree Incidence Angle	30 Degree Incidence Angle	60 Degree Incidence Angle	90 Degree Incidence Angle	120 Degree Incidence Angle	150 Degree Incidence Angle	180 Degree Incidence Angle	Random Field
1000	0.2	0.1	0.0	0.0	0.0	0.0	-0.2	0.0
1250	0.3	0.1	0.1	0.1	0.1	0.0	-0.5	0.1
1600	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	0.0	-0.1
2000	-0.3	-0.2	-0.2	0.0	0.0	0.0	0.1	-0.1
2500	-0.1	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	-0.2
3150	0.1	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2	-0.3
4000	0.5	-0.2	-0.4	-0.5	-0.5	-0.4	-0.6	-0.5
5000	1.1	0.0	-0.2	-0.3	-0.4	-0.4	-0.7	-0.3
6300	1.1	0.0	-0.1	0.0	-0.1	-0.2	-0.5	-0.1
8000	1.8	0.1	-0.2	0.3	0.6	0.5	0.0	0.1
10000	3.1	0.3	0.0	0.1	0.7	1.2	0.8	0.1
12500	6.1	0.4	-0.9	0.7	1.6	0.8	0.1	0.4
16000	8.2	1.0	0.9	1.1	1.8	2.0	1.0	0.9

Sound level meter type (sections: 5.1.4, 5.1.7, 7.3, 9.2.1 a, and 9.2.5b)
Class 1 when using the BK4936 microphone. Class 2 when using the QE7052 microphone. Group X. Model SE-400 Series. This is applicable with all accessory configurations. The configuration for normal mode of operation with the SE-400 Series is operating the instrument without the remote cable and windscreen. To conform to the specifications for directional response and frequency weightings, the instrument is mounted in a free-field facility using strings.

General Information (section 9.3)
The reference sound pressure level is 114 dB. The one range is the reference range. The microphone reference point is the center of the microphone face.

Environmental effects (section 6.1.2 and 9.3L)

The typical time intervals needed to stabilize after changes in environmental conditions include:

- For temperature change of 10 ºC (18 ºF) allow at least 5 minutes.
- For relative humidity change of 30% (non-condensing) allow at least 30 minutes.
- For static pressure change of 10 kPa allow at least 5 seconds.

Microphones

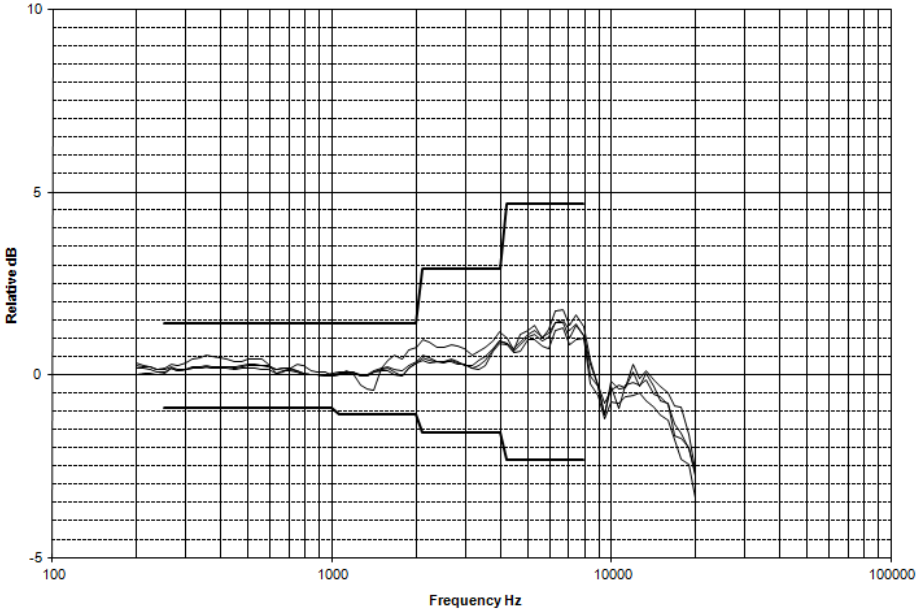
The Microphones section includes the Class/Type 2 General QE7052 microphone with accessories and the Class/Type 1 Precision BK4936 microphone with accessories. The listing below details the sections for the directional frequency response of the microphones with the units side or back facing towards the sound source.

- QE7052 microphone side facing
- QE7052 microphone back facing
- QE7052 microphone with windscreen side facing
- QE7052 microphone with windscreen back facing
- BK4936 microphone side facing
- BK4936 microphone back facing
- BK4936 microphone with windscreen back facing
- BK4936 microphone with windscreen side facing
- BK4936 microphone using remote preamp
- BK4936 microphone using windscreen & remote preamp
- BK4936 microphone with random incidence corrector ring (RICR) side facing
- BK4936 microphone with RICR back facing
- BK4936 microphone with RICR and windscreen side facing
- BK4936 microphone with RICR and windscreen back facing
- BK4936 microphone with remote preamp and RICR
- BK4936 microphone with remote preamp, RICR, and windscreen

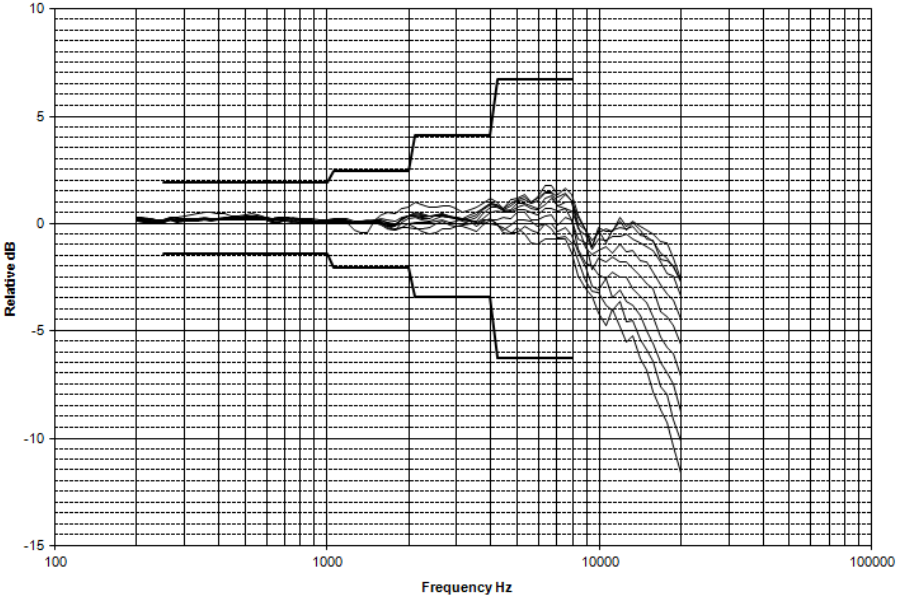
QE7052 microphone back facing

Tolerance: IEC 61672 class 2

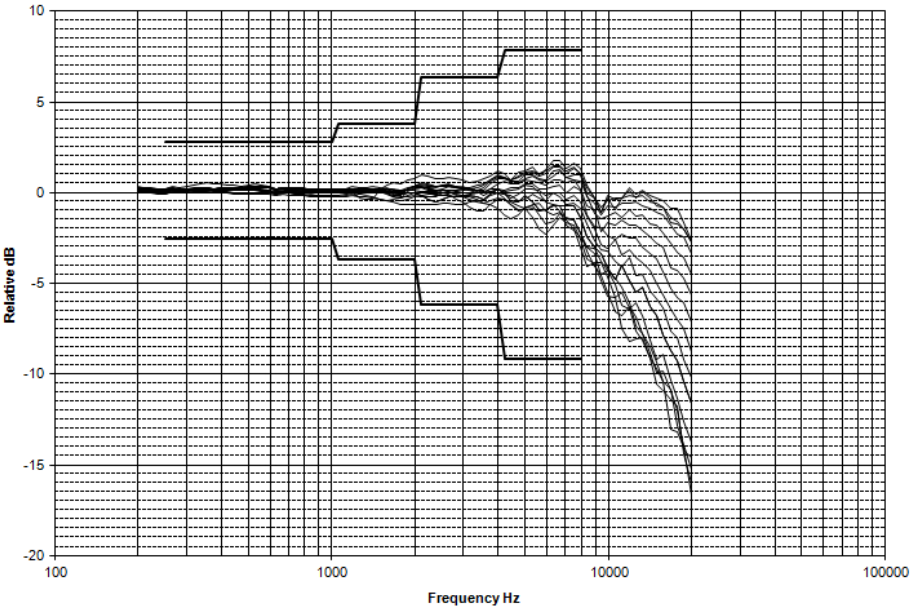
Directional frequency response facing back toward sound source (0º-30ºincidence angles)



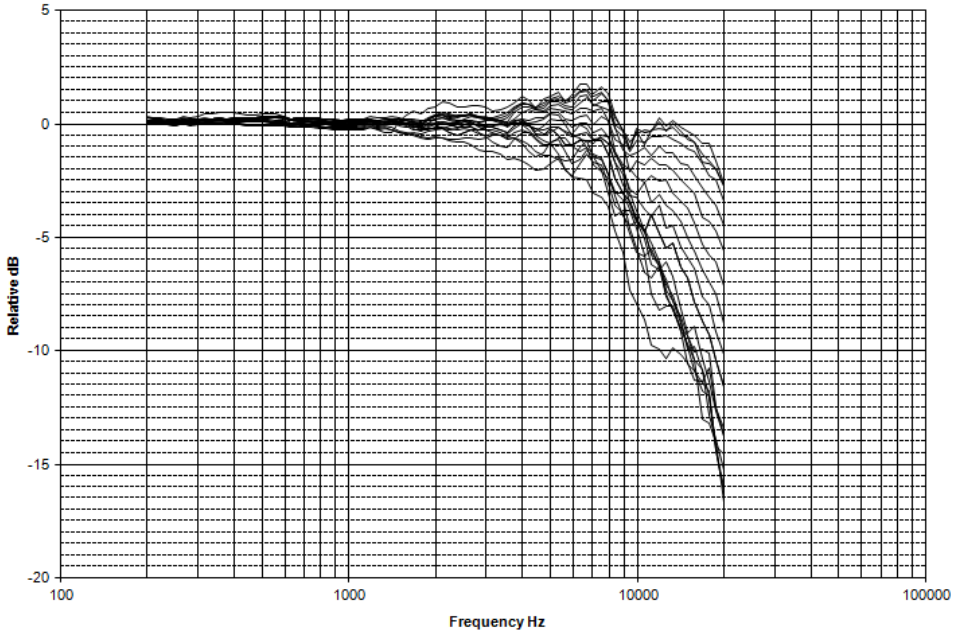
Directional frequency response facing back toward sound source (0º-90º incidence angles)



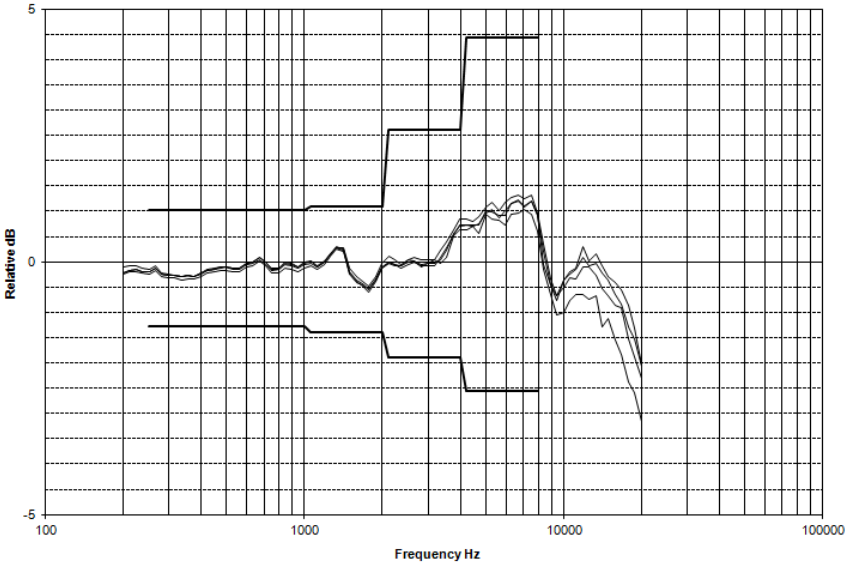
Directional frequency response facing back toward sound source (0º-150º incidence angles)



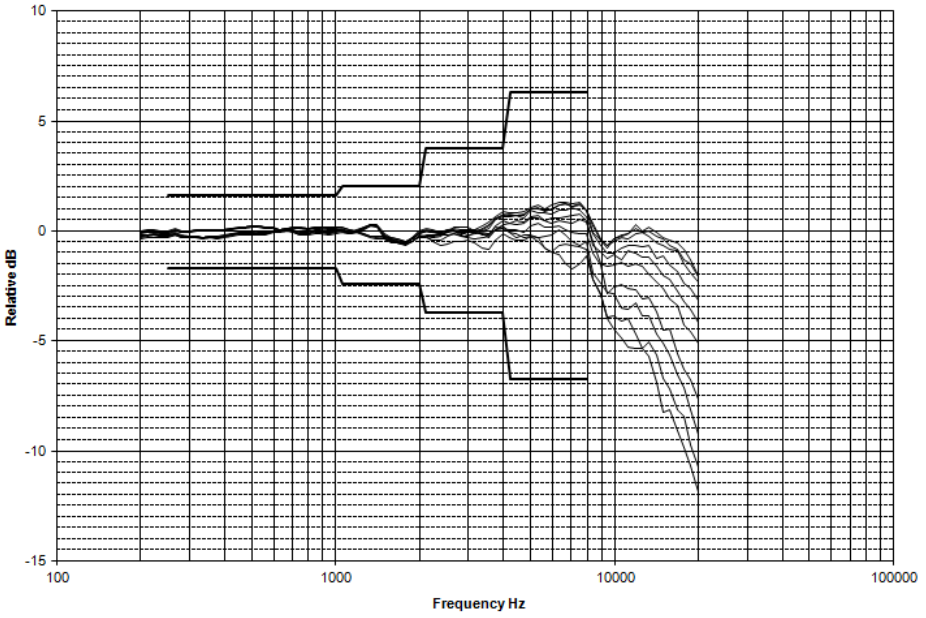
Directional frequency response facing back toward sound source (0º-180º incidence angles)



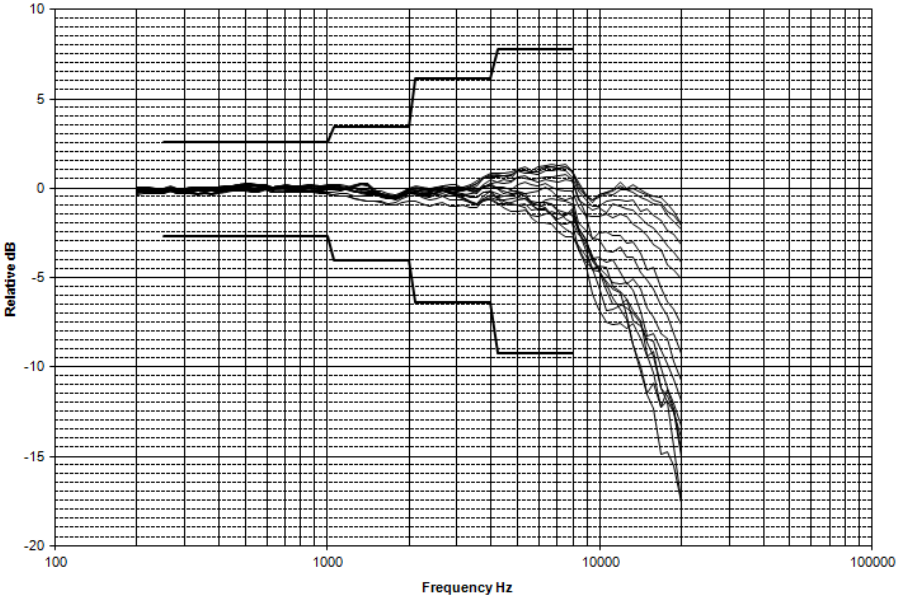
QE7052 microphone side facing
Tolerance: IEC 61672 class 2
Directional frequency response positioned side toward noise source (0º-30ºincidence angles)



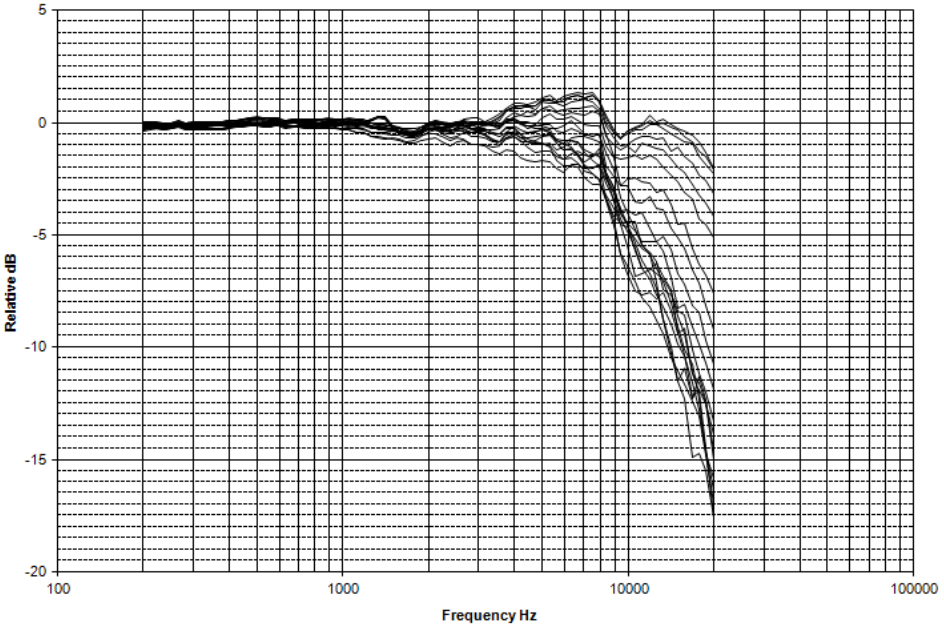
Directional frequency positioned side toward noise source (0º-90º incidence angles)



Directional frequency response positioned side toward noise source (0º-150º incidence angles)



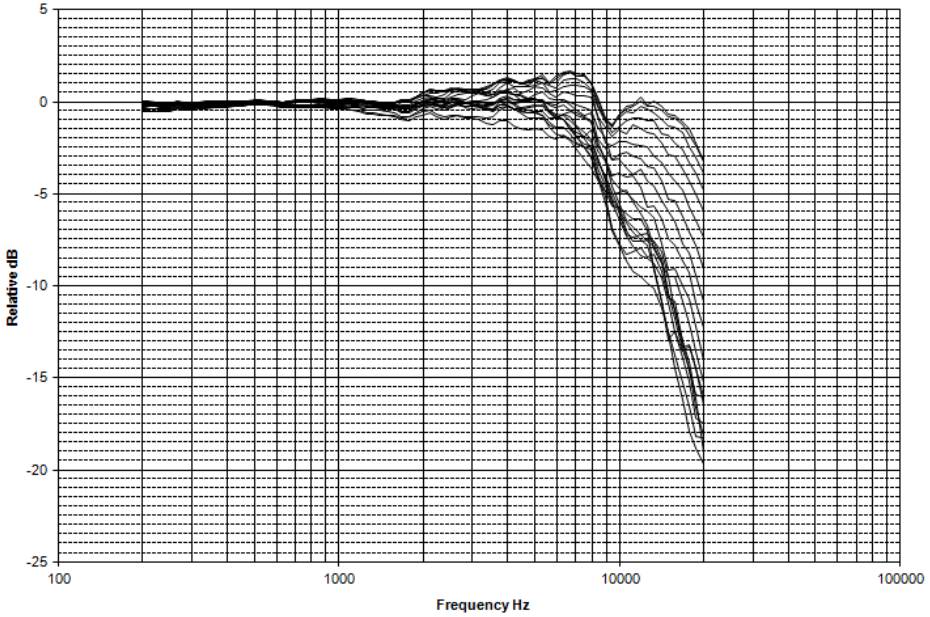
Directional frequency response positioned side toward noise source (0º-180º incidence angles)



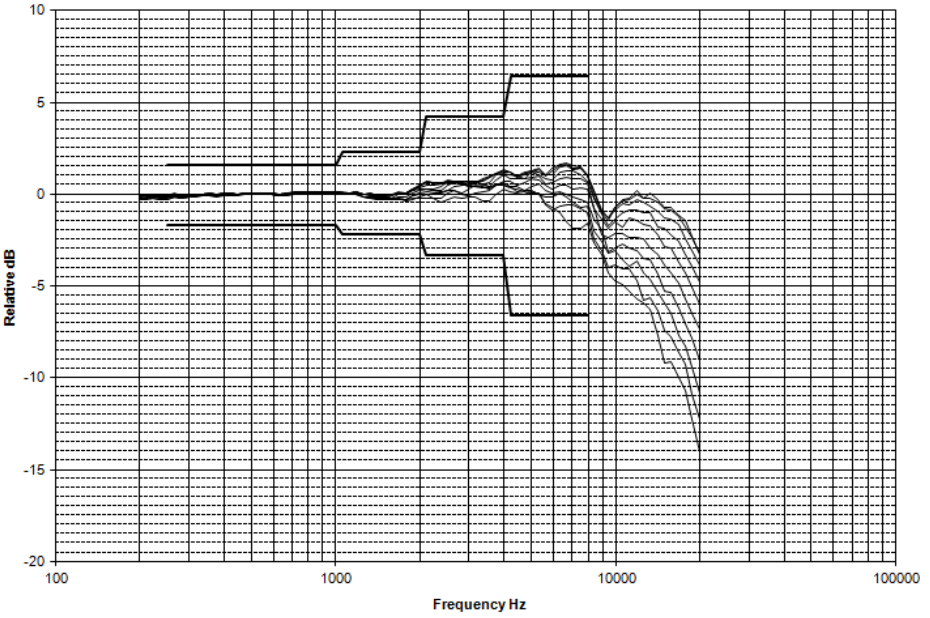
QE7052 microphone with windscreen side facing

Tolerance: IEC 61672 class 2

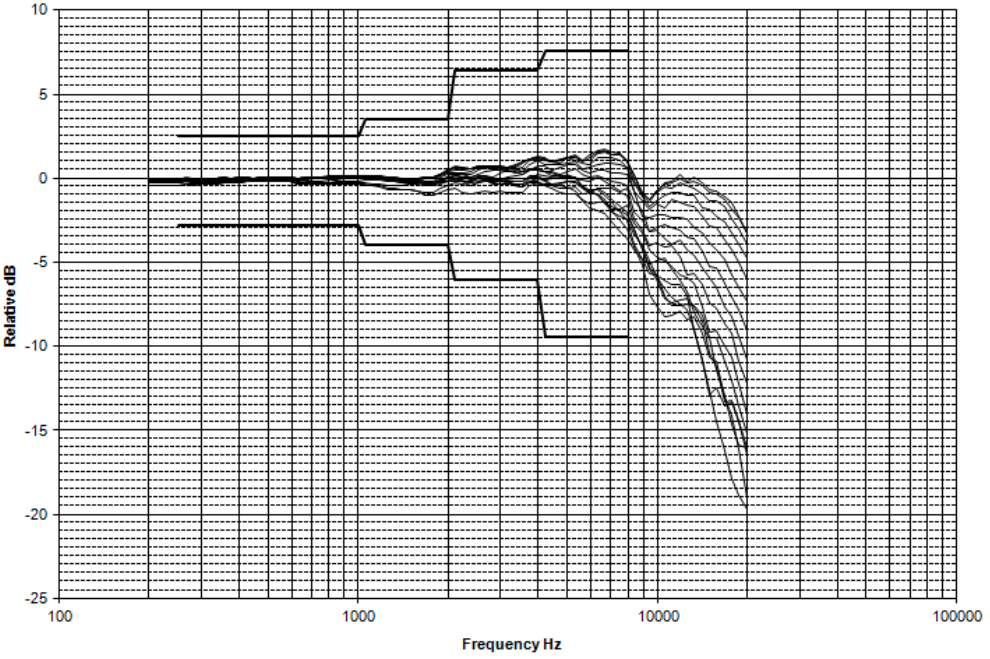
Directional frequency response positioned side toward noise source (0º-30ºincidence angles)



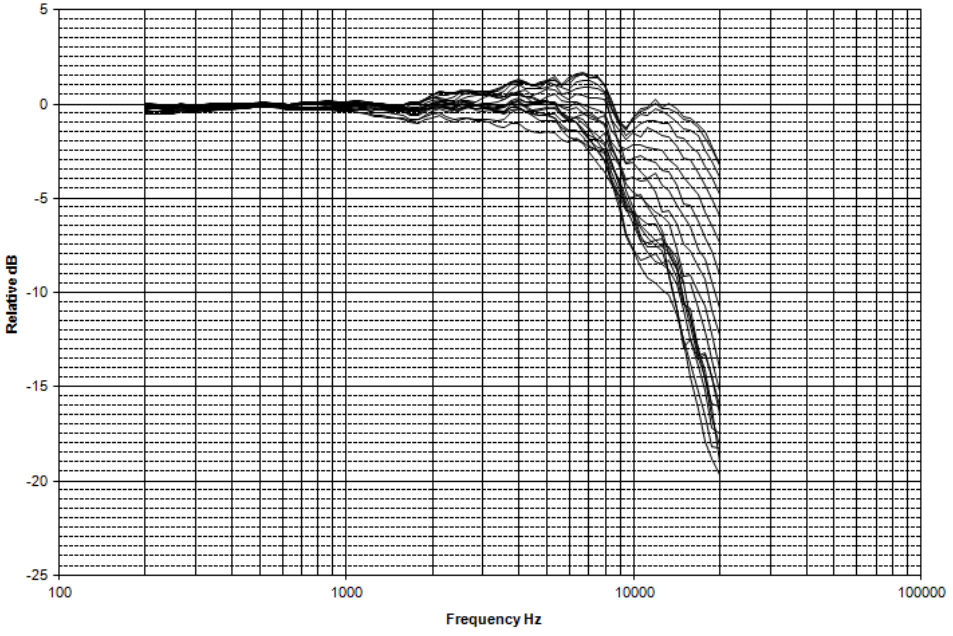
Directional frequency response positioned side noise source (0º-90º incidence angles)



Directional frequency response positioned side noise source (0º-150º incidence angles)



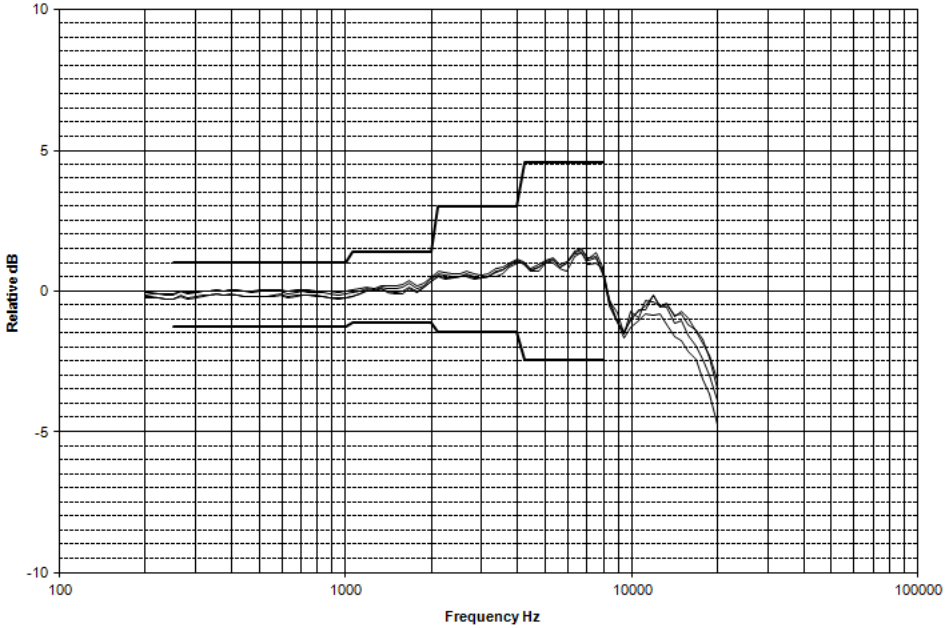
Directional frequency response positioned side noise source (0º-180º incidence angles)



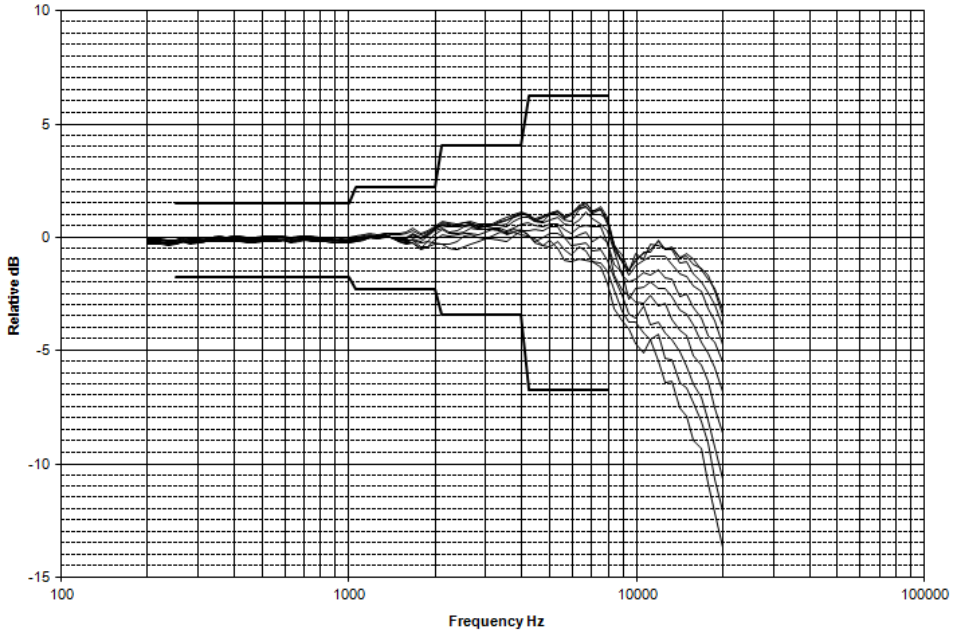
QE7052 microphone with windscreen back facing

Tolerance: IEC 61672 class 2

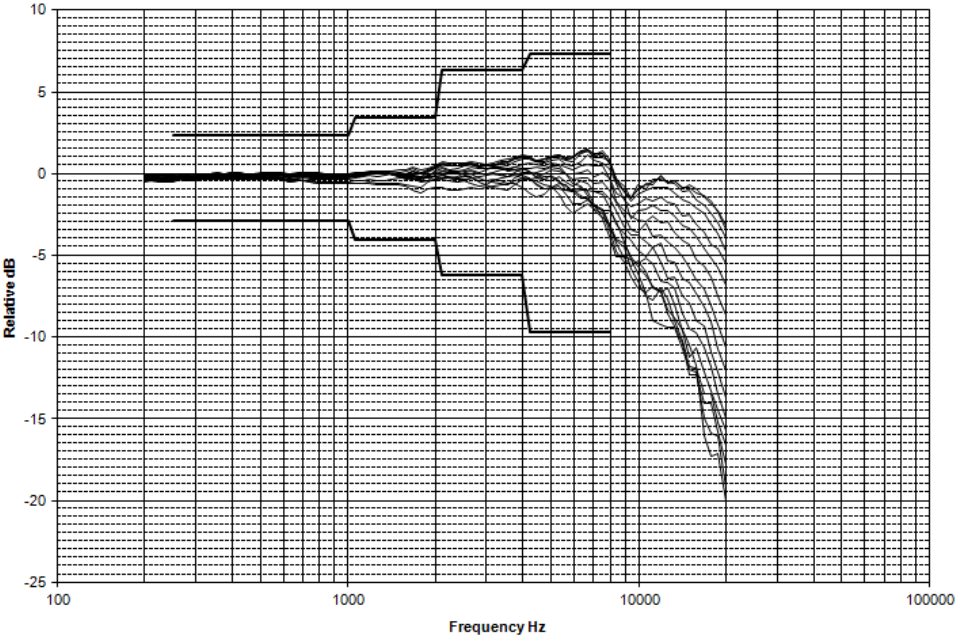
Directional frequency response positioned facing side toward noise source (0º-30ºincidence angles)



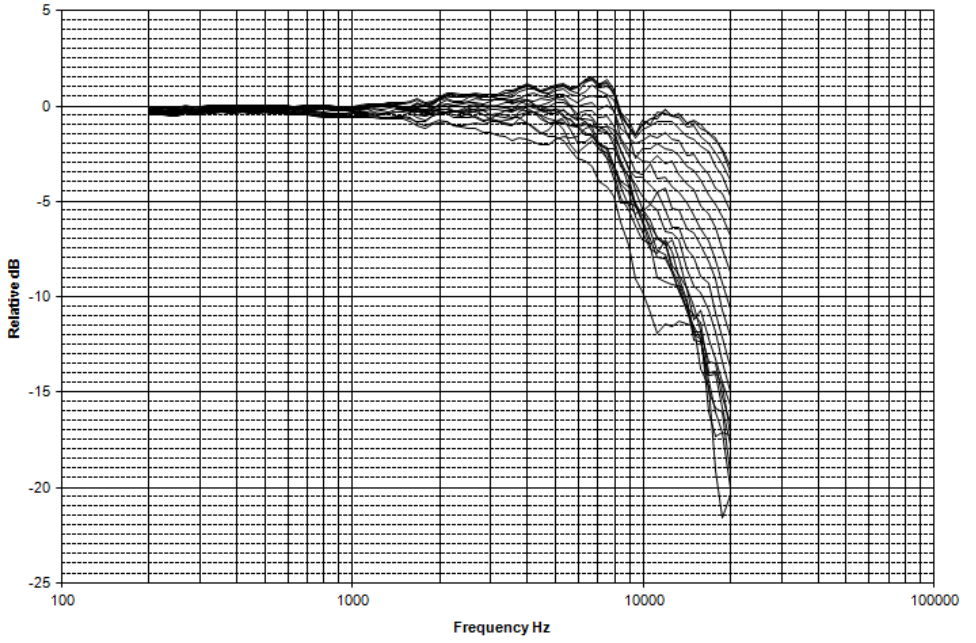
Directional frequency response positioned facing toward noise source (0º-90º incidence angles)



Directional frequency response positioned facing toward noise source (0º-150º incidence angles)



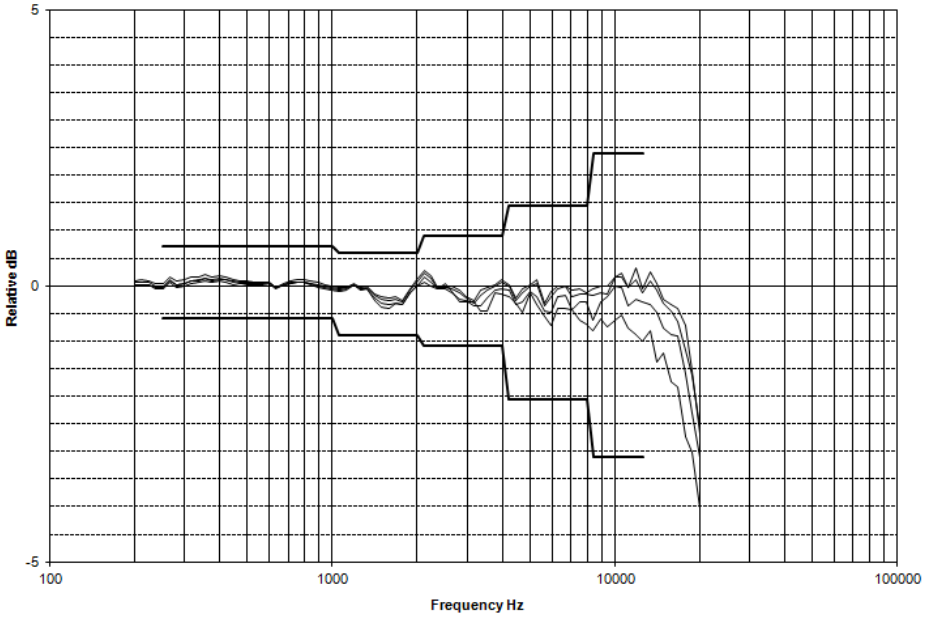
Directional frequency response positioned facing toward noise source (0º-180º incidence angles)



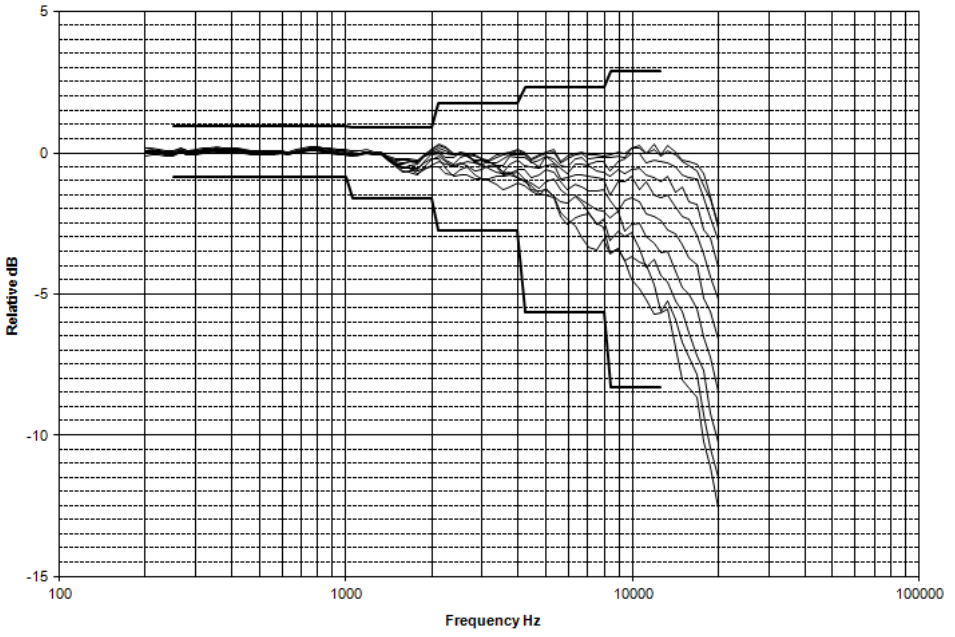
BK4936 microphone side facing

Tolerance: IEC 61672 class 1

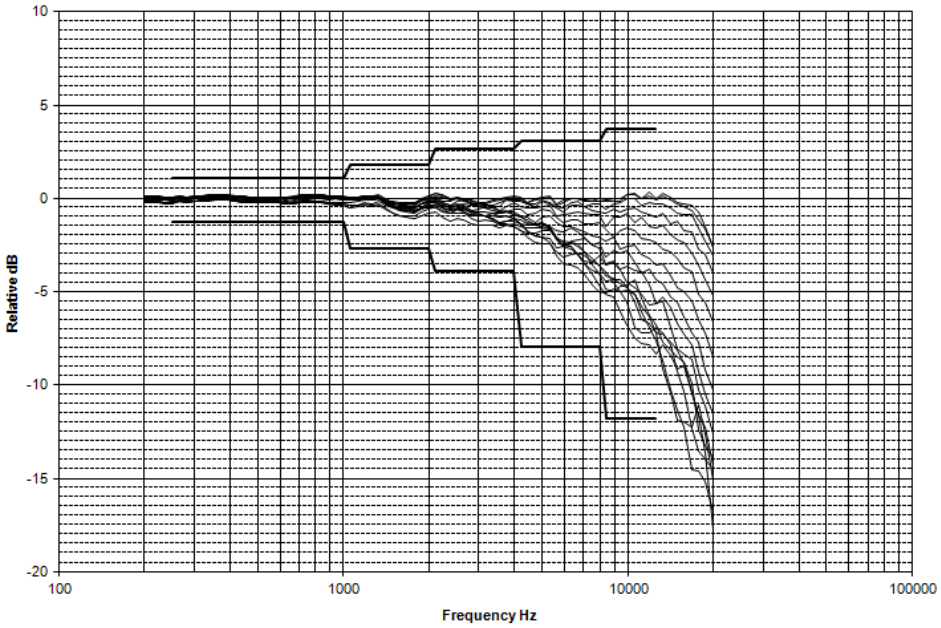
Directional frequency response positioned with side toward noise source (0º-30ºincidence angles)



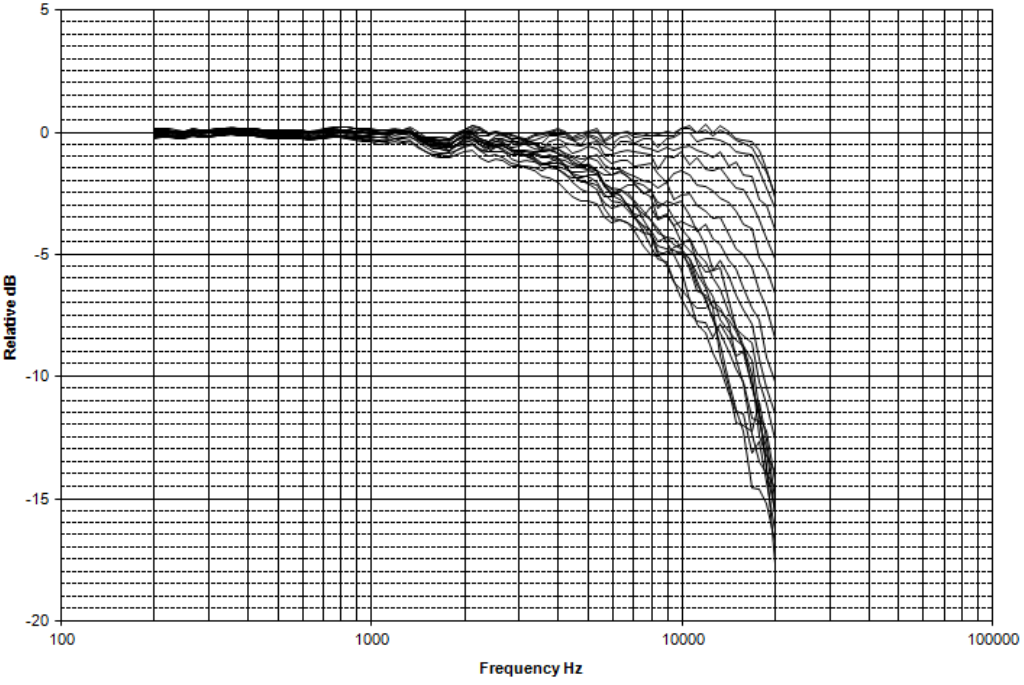
Directional frequency response positioned with side toward noise source (0º-90º incidence angles)



Directional frequency response positioned using side toward noise source (0º-150º incidence angles)



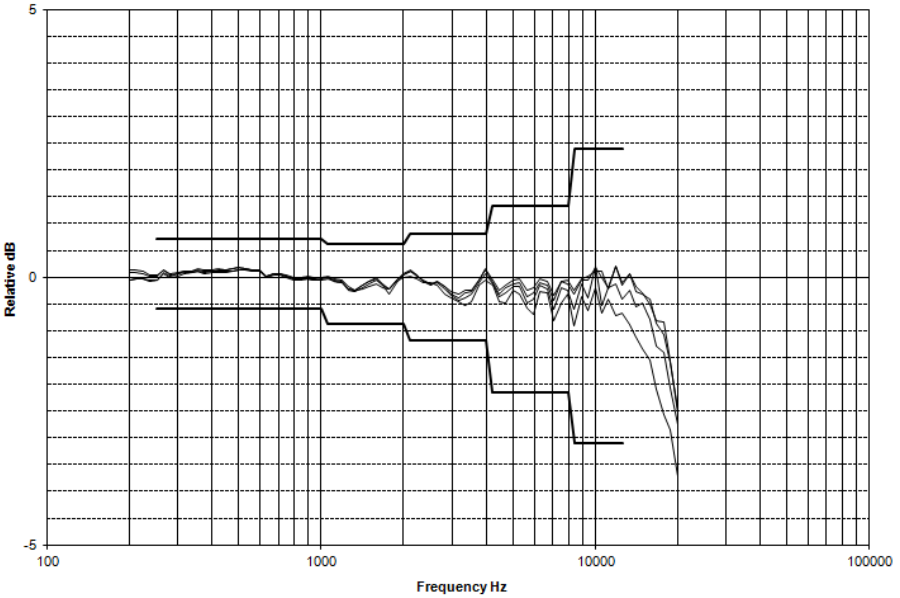
Directional frequency response positioned using side toward noise source (0º-180º incidence angles)



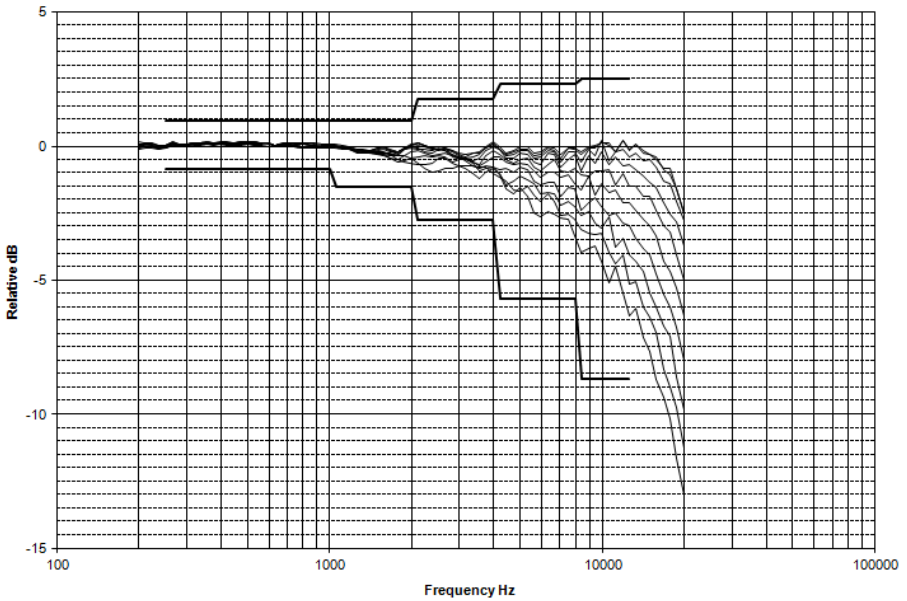
BK4936 microphone back facing

Tolerance: IEC 61672 class 1

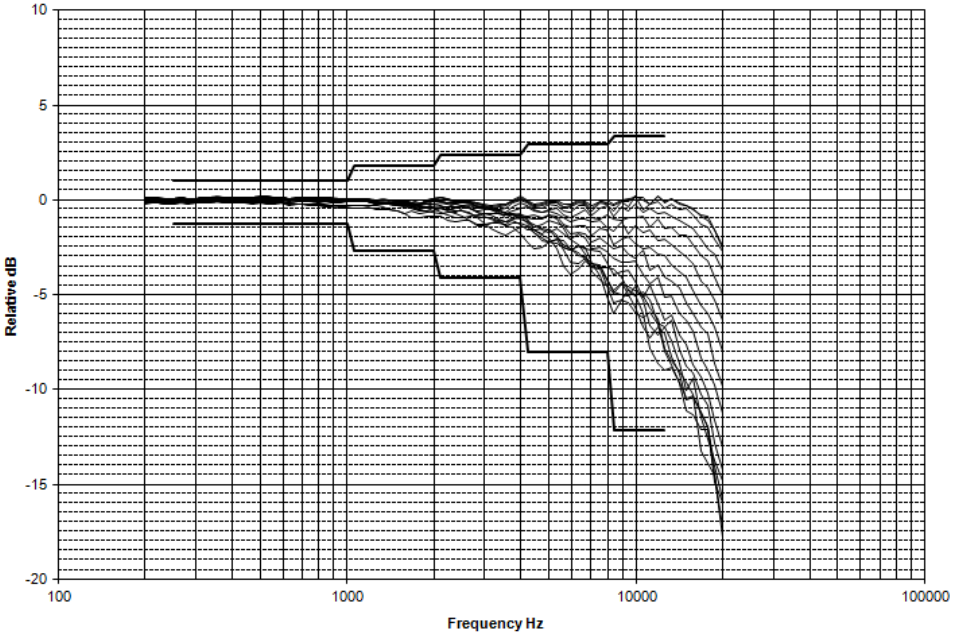
Directional frequency response positioned back-side toward noise source (0º-30ºincidence angles)



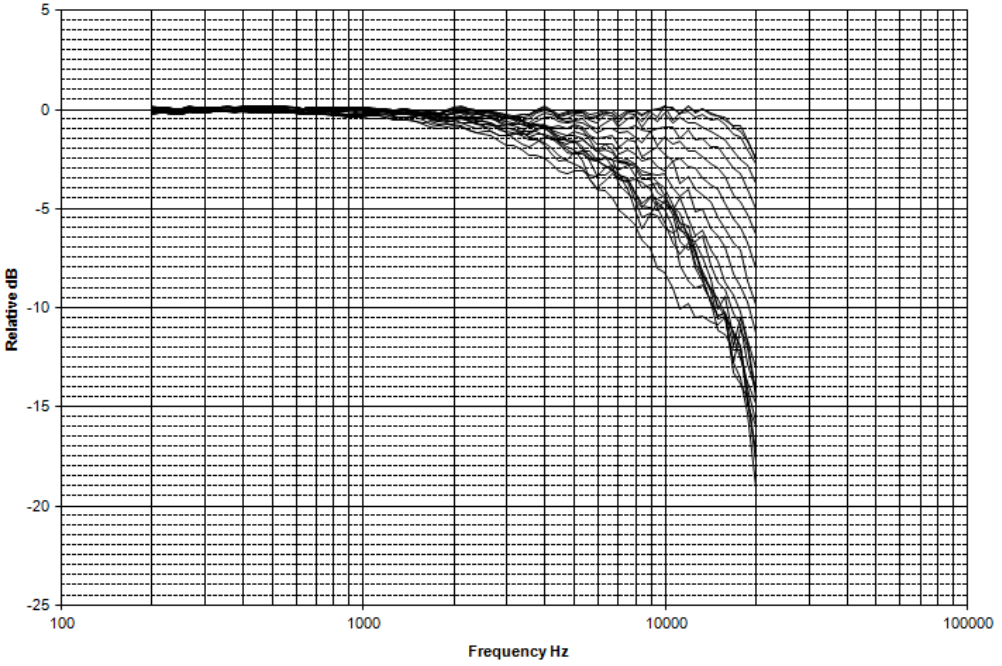
Directional frequency response positioned back-side toward noise source (0º-90º incidence angles)



Directional frequency response positioned back-side toward noise source (0º-150º incidence angles)



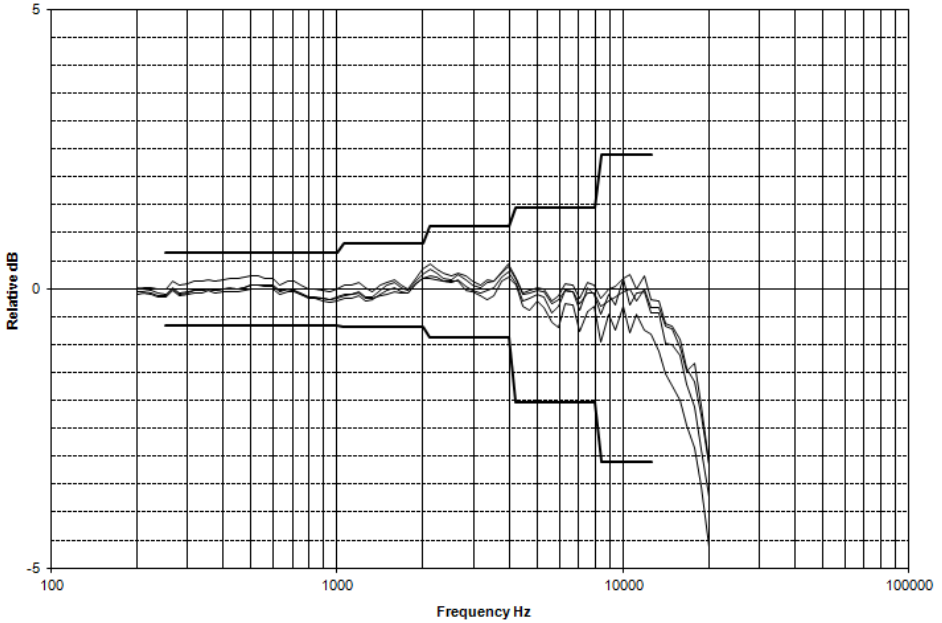
Directional frequency response positioned back-side toward noise source (0º-180º incidence angles)



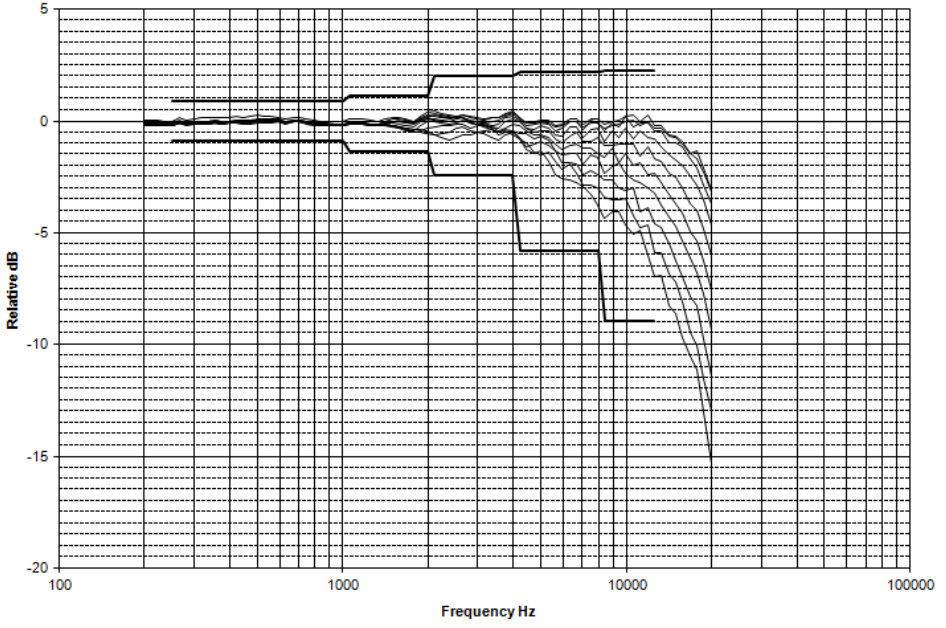
BK4936 microphone with windscreen back facing

Tolerance: IEC 61672 class 1

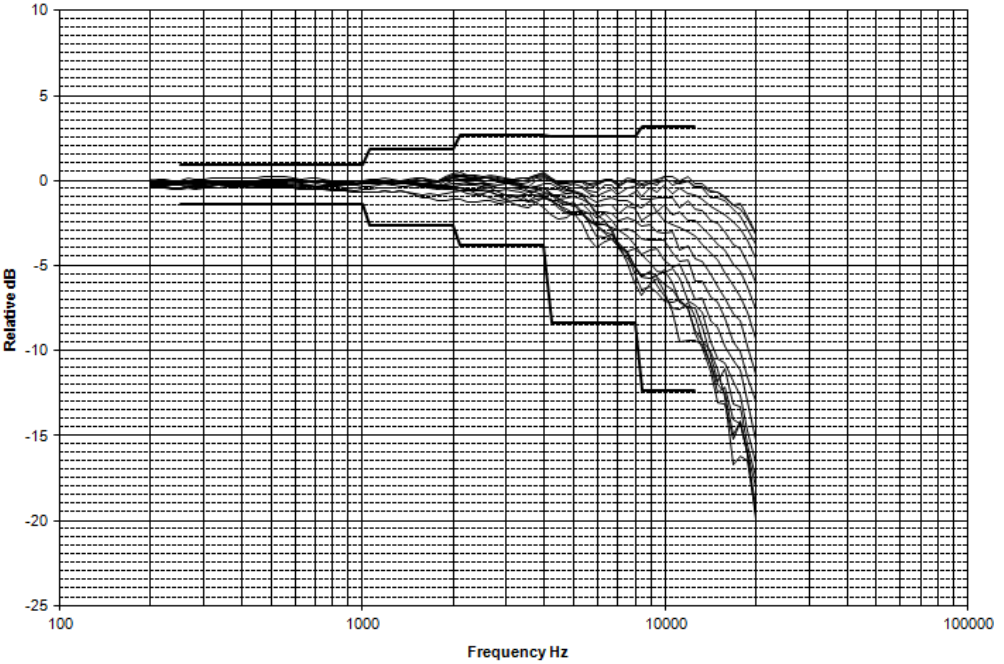
Directional frequency response positioned back-side toward noise source (0º-30ºincidence angles)



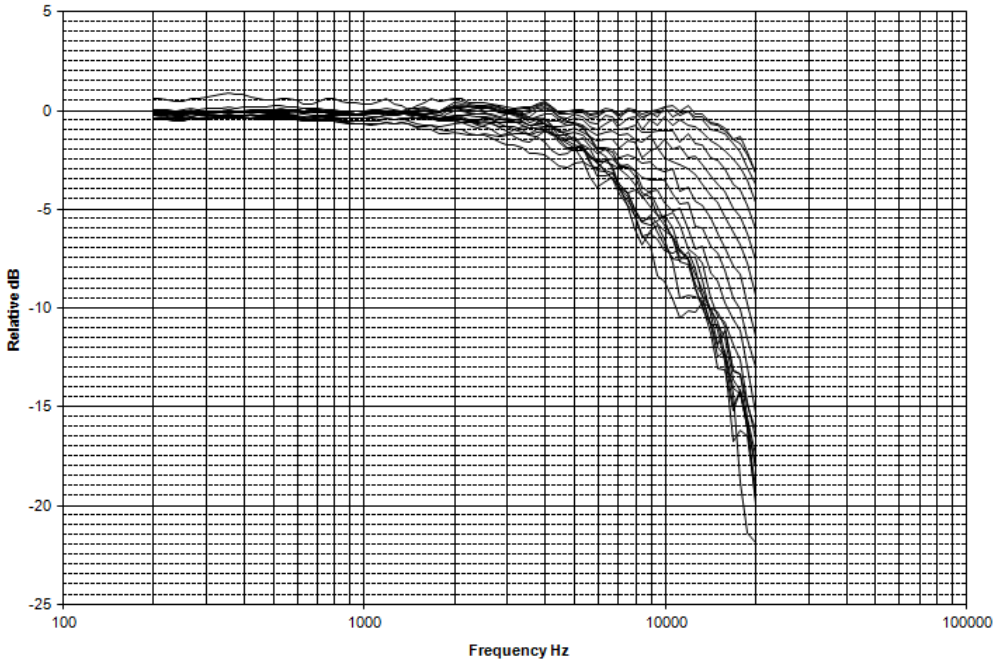
Directional frequency response positioned back-side toward noise source (0º-90º incidence angles)



Directional frequency response positioned back-side toward noise source (0º-150º incidence angles)



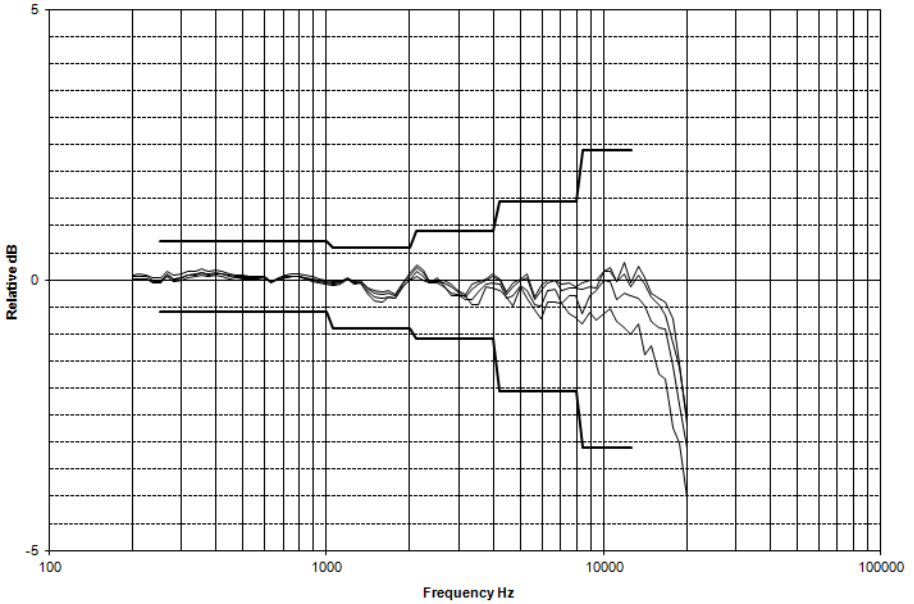
Directional frequency response positioned back-side toward noise source (0º-180º incidence angles)



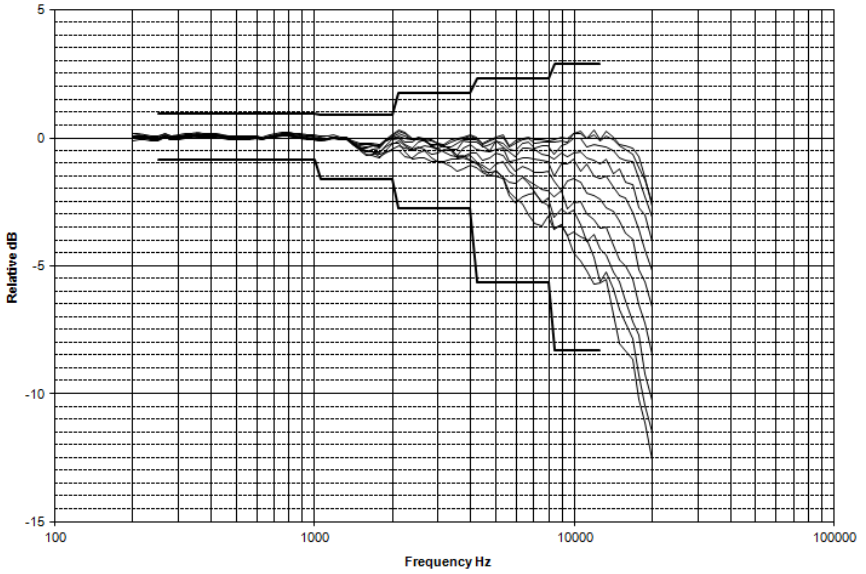
BK4936 microphone with windscreen side facing

Tolerance: IEC 61672 class 1

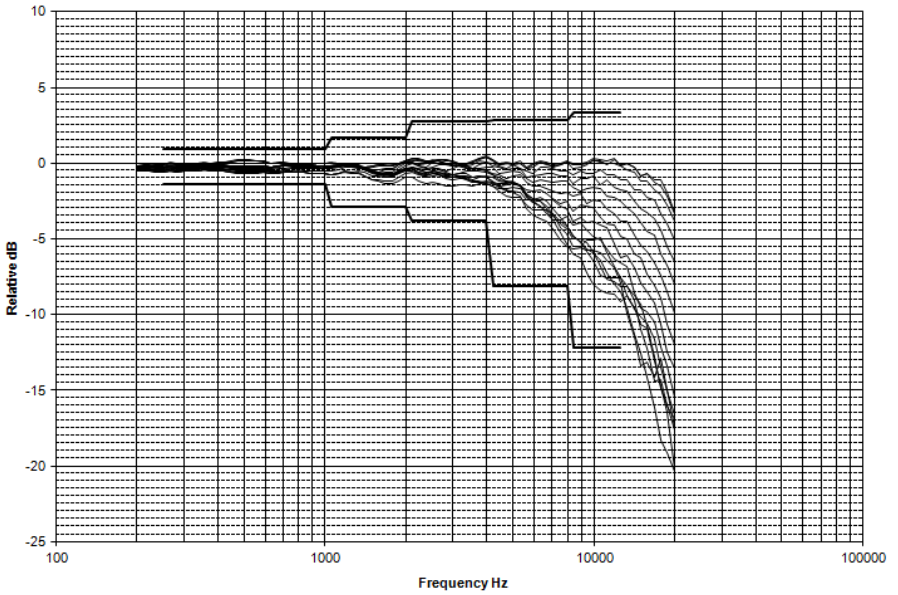
Directional frequency response positioned side toward noise source (0º-30ºincidence angles)



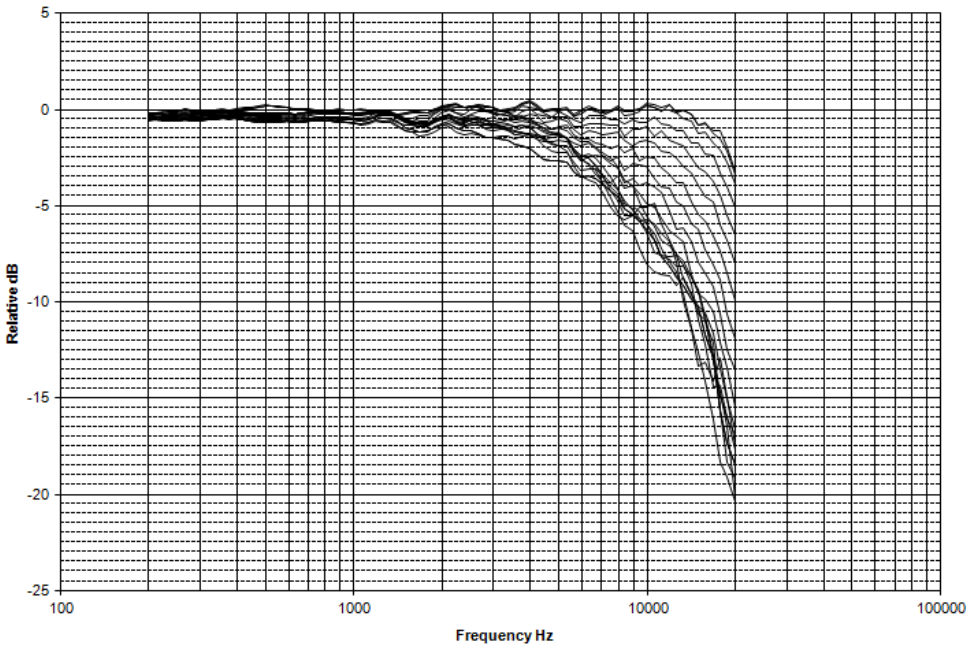
Directional frequency response positioned side toward noise source (0º-90ºincidence angles)



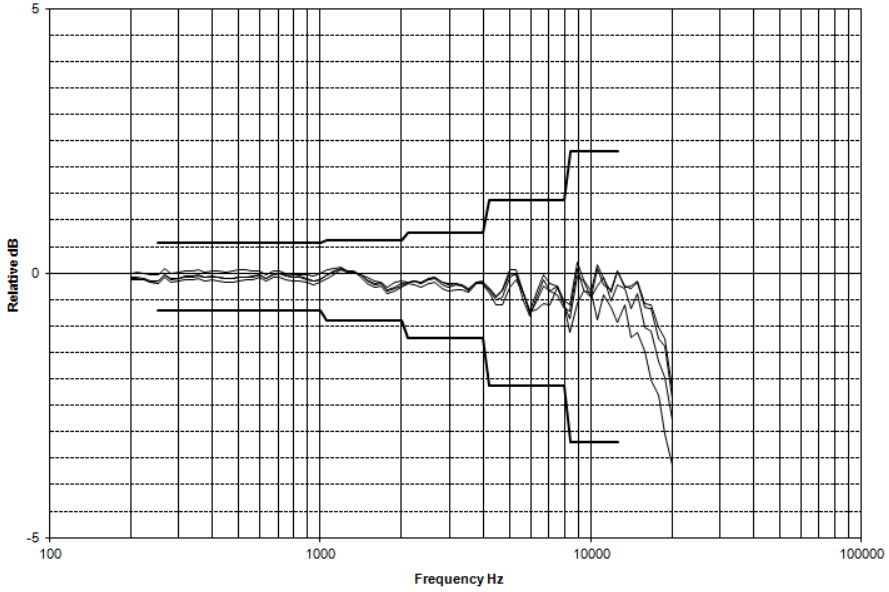
Directional frequency response positioned side toward noise source (0º-150º incidence angles)



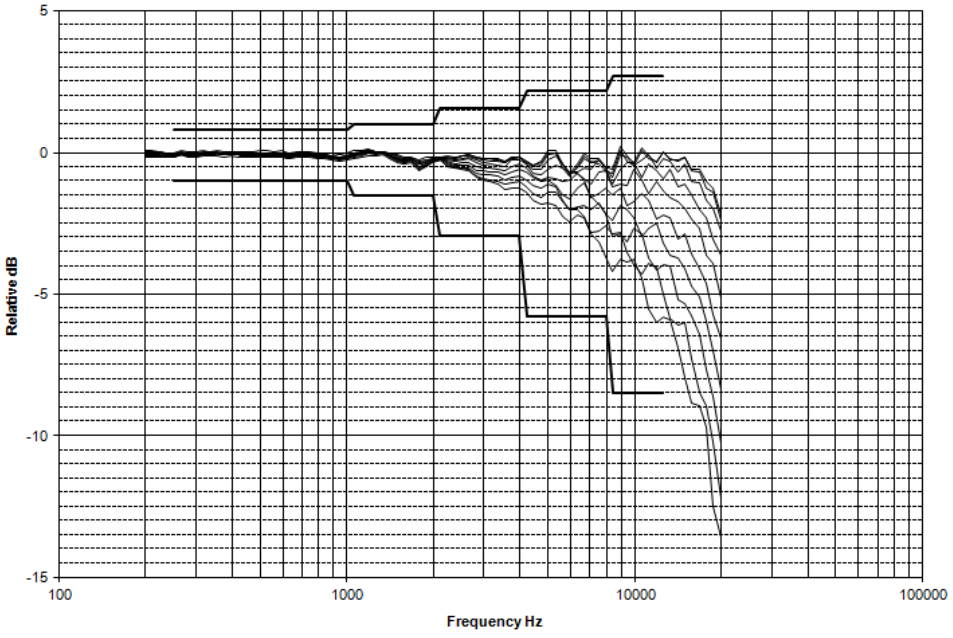
Directional frequency response positioned side toward noise source (0º-180º incidence angles)



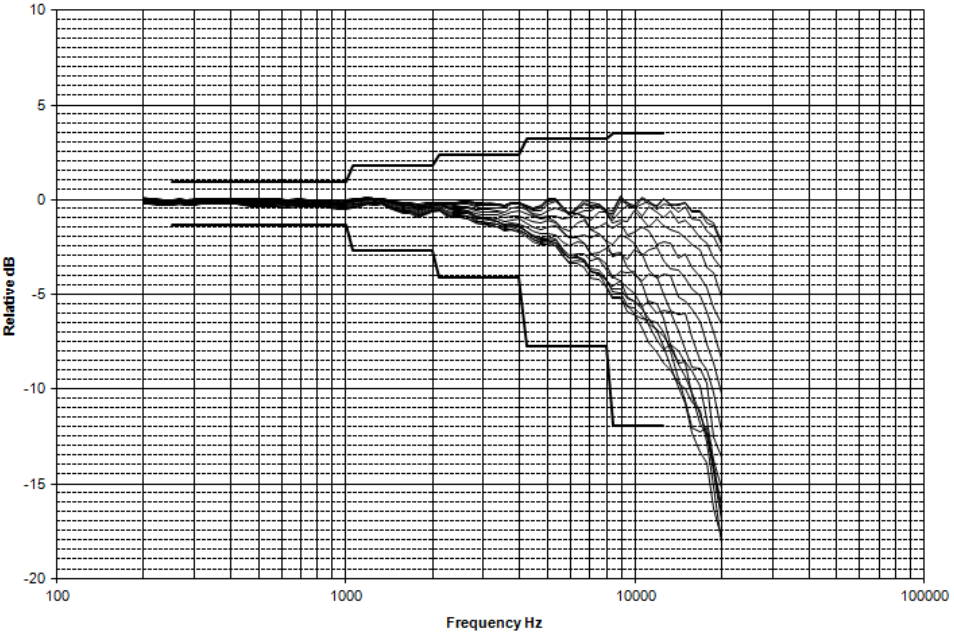
BK4936 microphone using remote preamp
Tolerance: IEC 61672 class 1
Directional frequency response positioned with a remote preamp (0^0-30^0incidence angles)



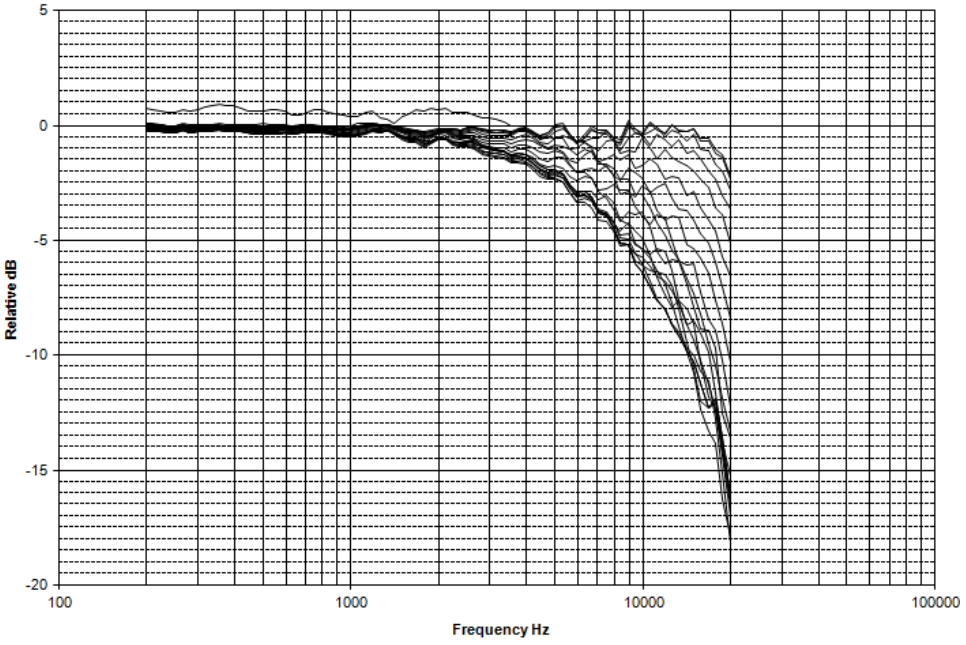
Directional frequency response positioned with a remote preamp (0^0-90^0 incidence angles)



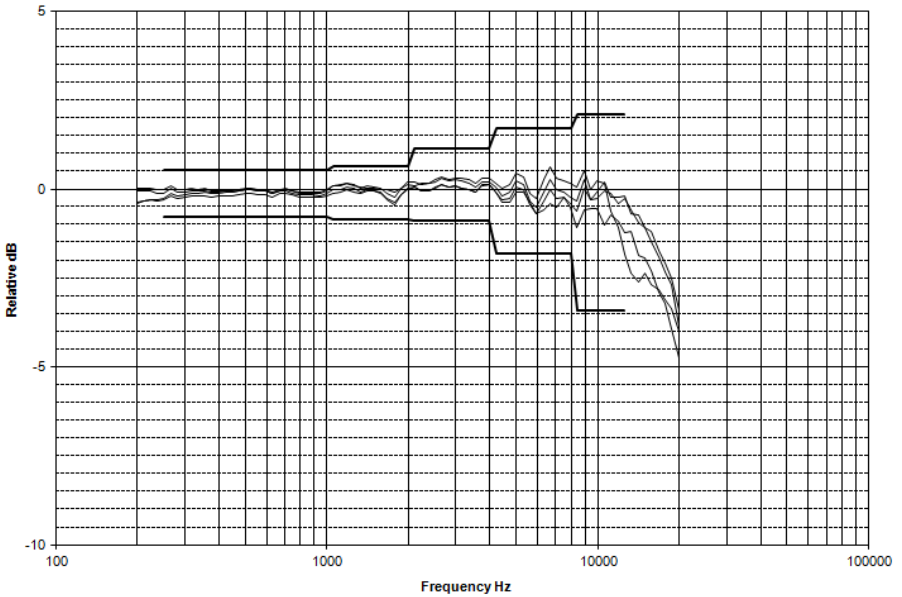
Directional frequency response positioned with a remote preamp (0^{O}-150^{O} incidence angles)



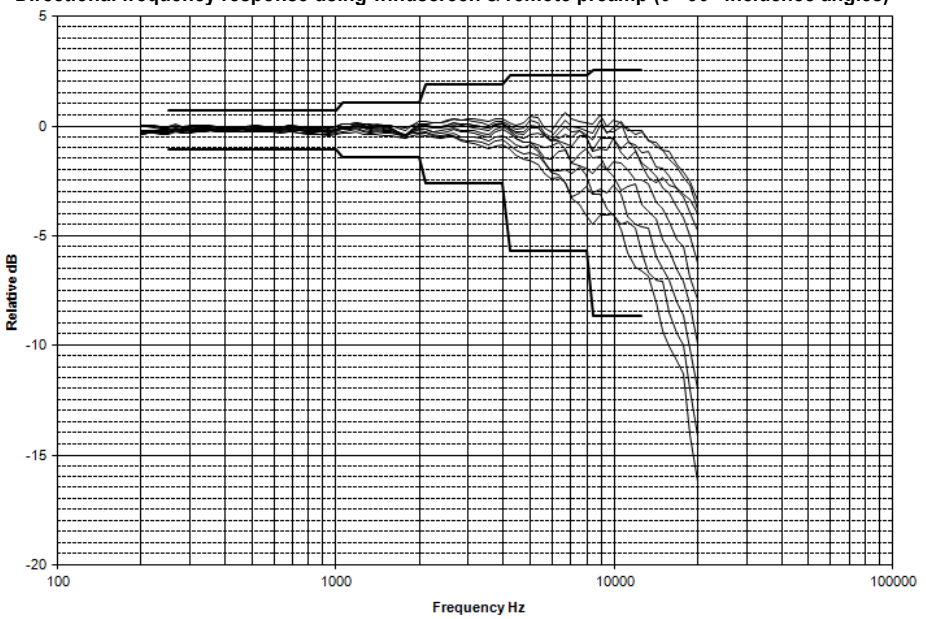
Directional frequency response positioned with a remote preamp (0^{O}-180^{O} incidence angles)



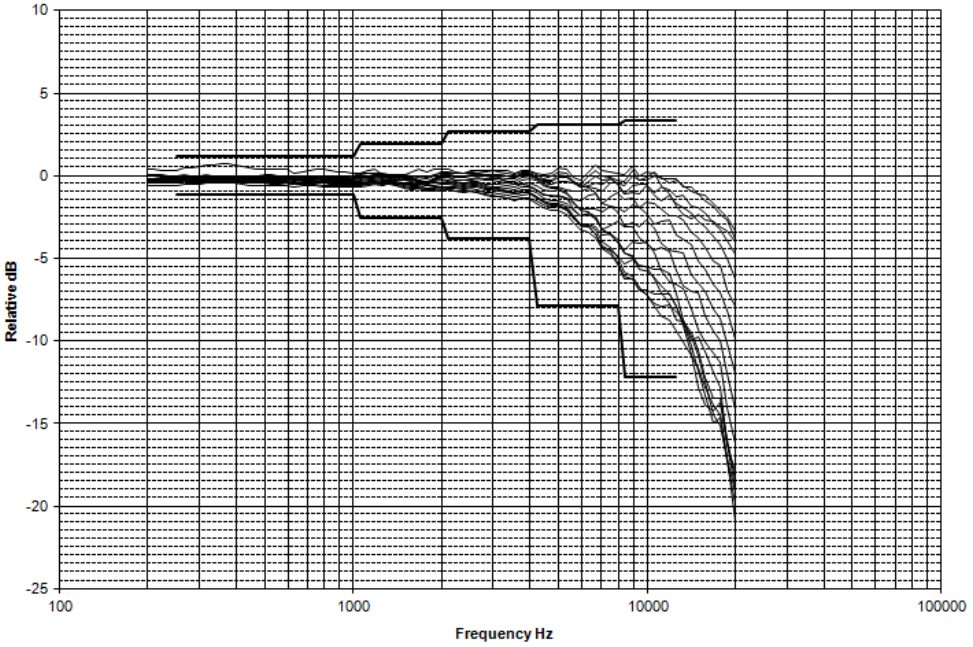
BK4936 microphone using windscreen & remote preamp
Tolerance: IEC 61672 class 1
Directional frequency response using windscreen & remote preamp (0°-30°incidence angles)



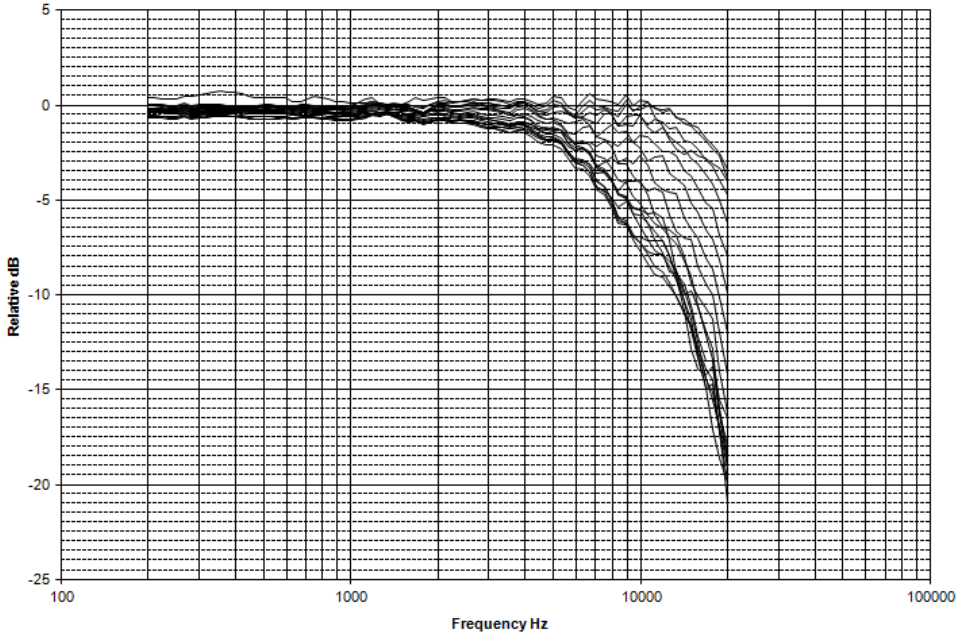
Directional frequency response using windscreen & remote preamp (0°-90° incidence angles)



Directional frequency response using windscreen & remote preamp (0º-150º incidence angles)



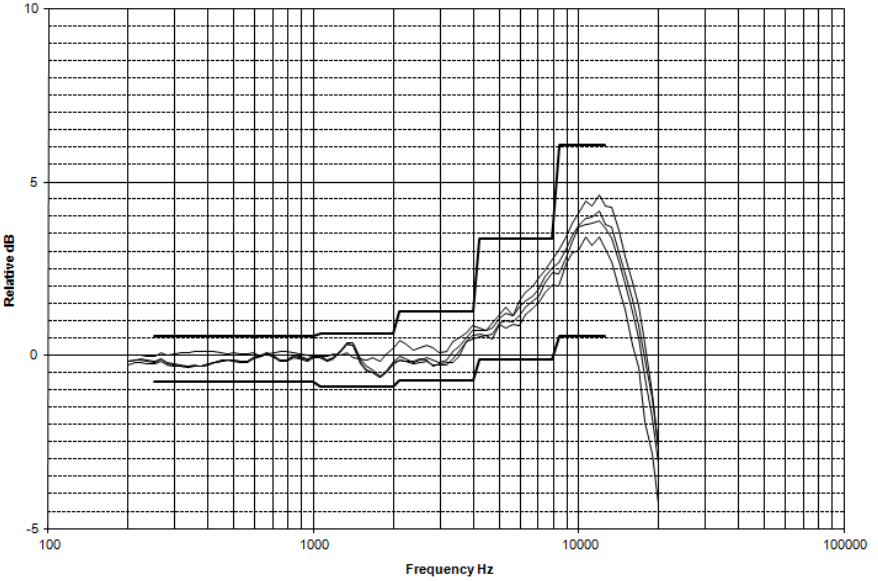
Directional frequency response using windscreen & remote preamp (0º-180º incidence angles)



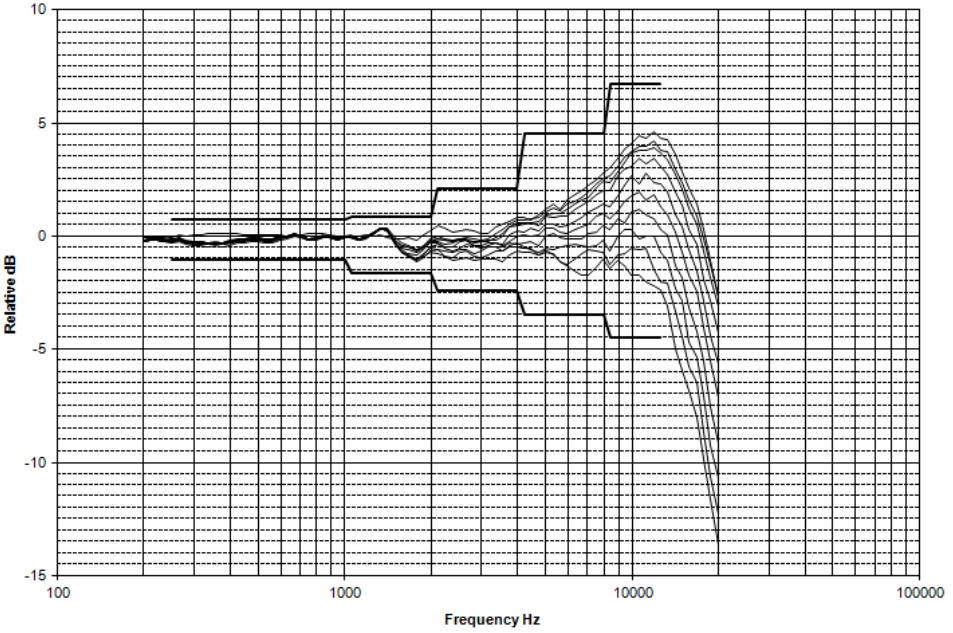
BK4936 microphone with RICR side facing

Tolerance: IEC 61672 class 1

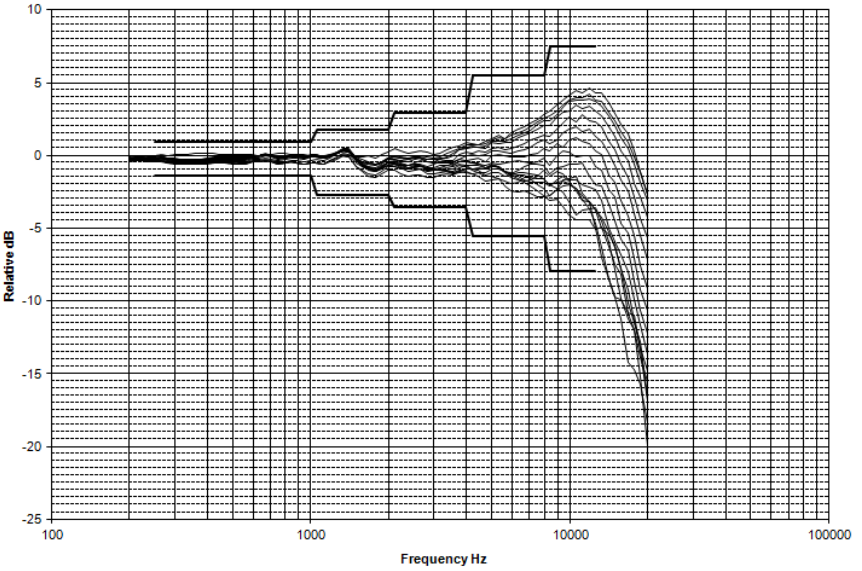
Directional frequency response positioned side toward noise source (0º-30ºincidence angles)



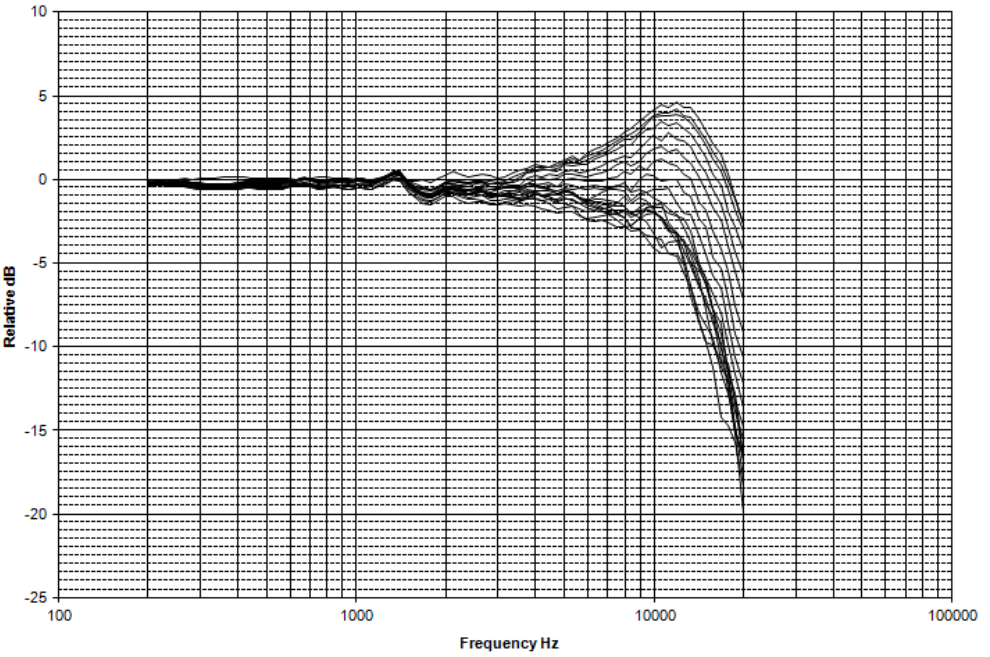
Directional frequency response positioned side toward noise source (0º-90ºincidence angles)



Directional frequency response positioned side toward noise source (0º-150ºincidence angles)



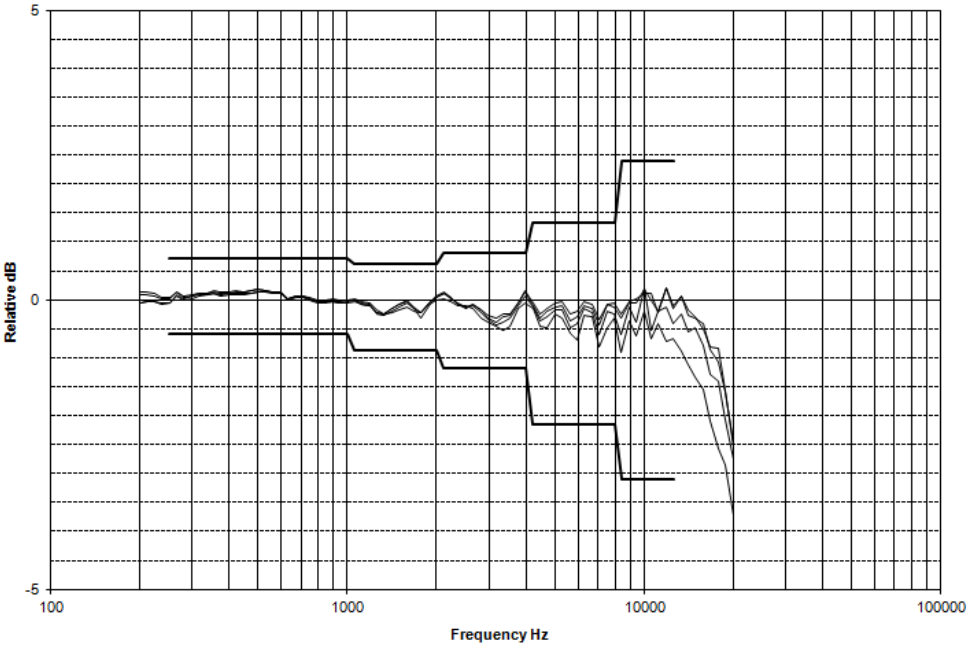
Directional frequency response positioned side toward noise source (0º-180ºincidence angles)



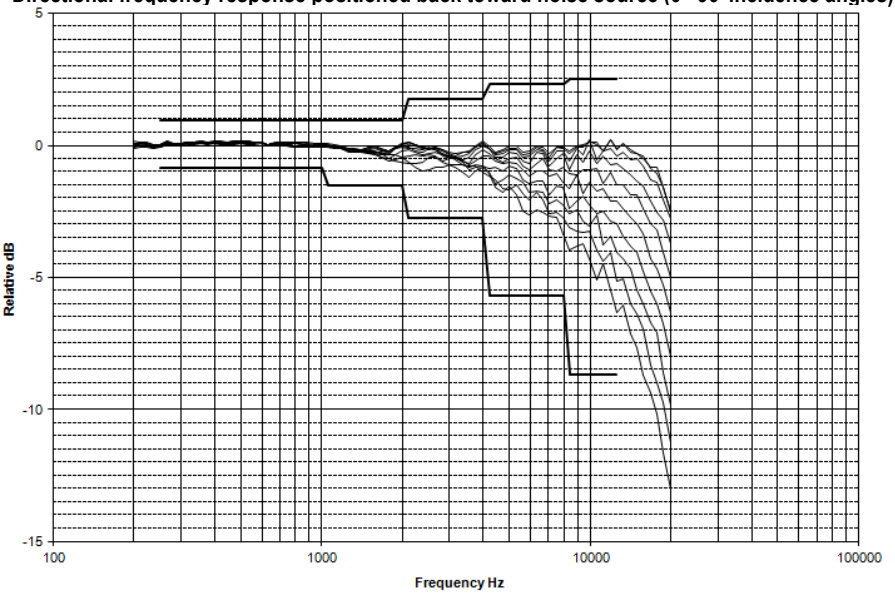
BK4936 microphone with RICR back facing

Tolerance: IEC 61672 class 1

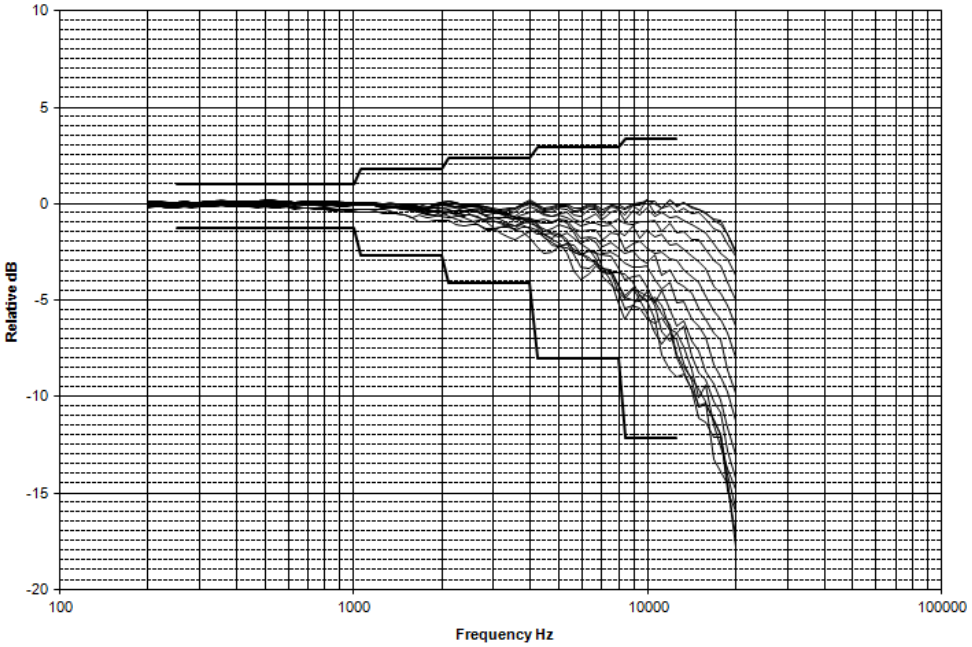
Directional frequency response positioned back toward noise source (0º-30ºincidence angles)



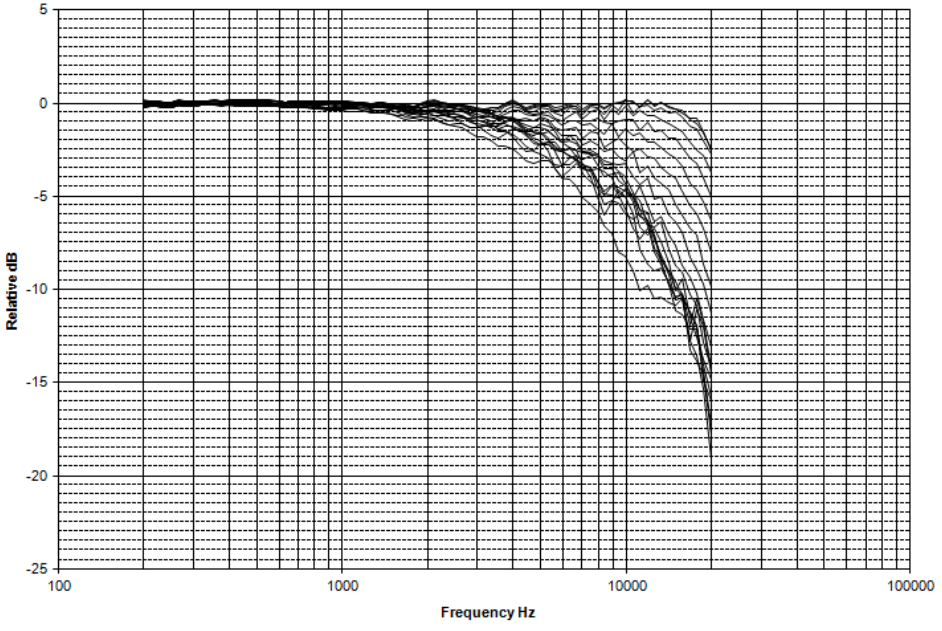
Directional frequency response positioned back toward noise source (0º-90ºincidence angles)



Directional frequency response positioned back toward noise source (0º-150ºincidence angles)



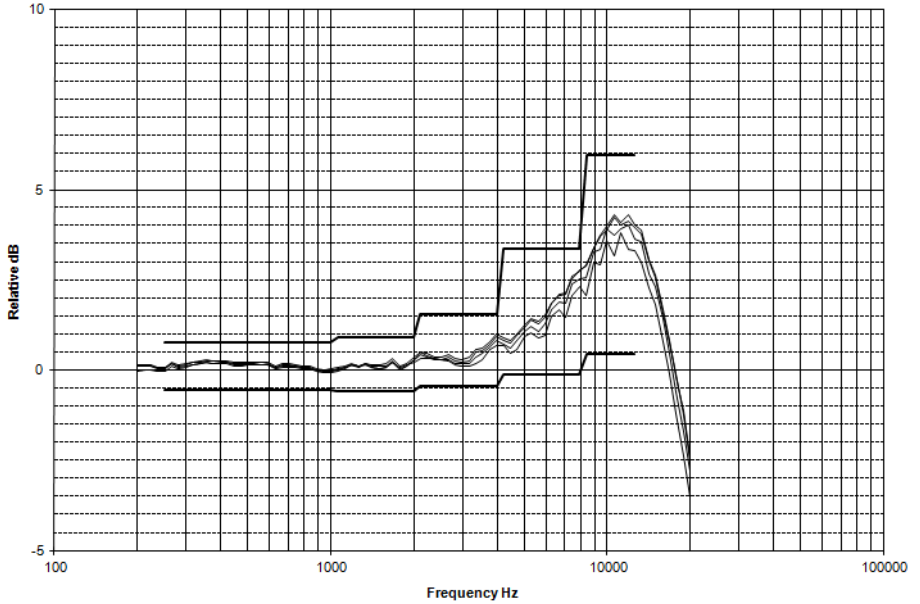
Directional frequency response positioned back toward noise source (0º-150ºincidence angles)



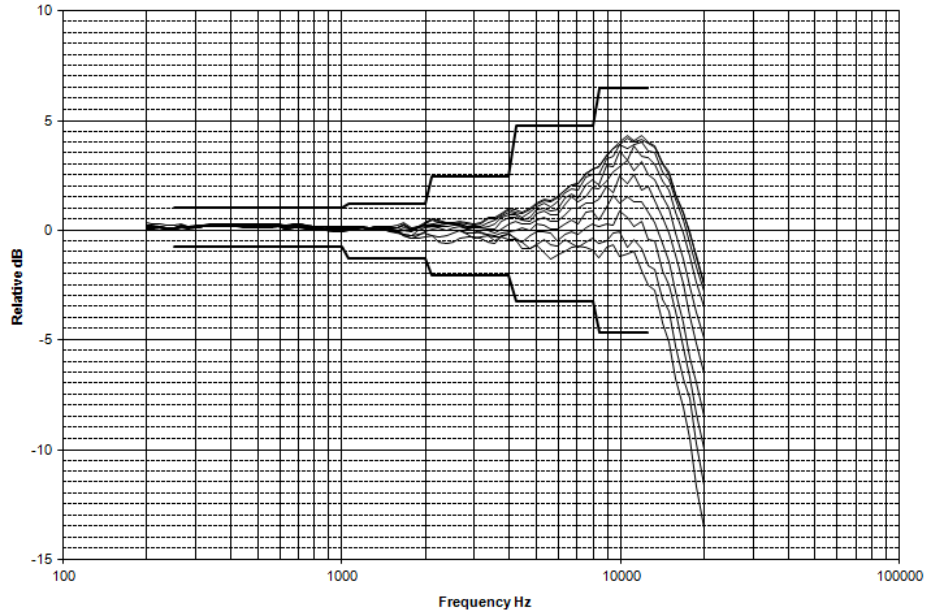
BK4936 microphone with RICR and windscreen side facing

Tolerance: IEC 61672 class 1

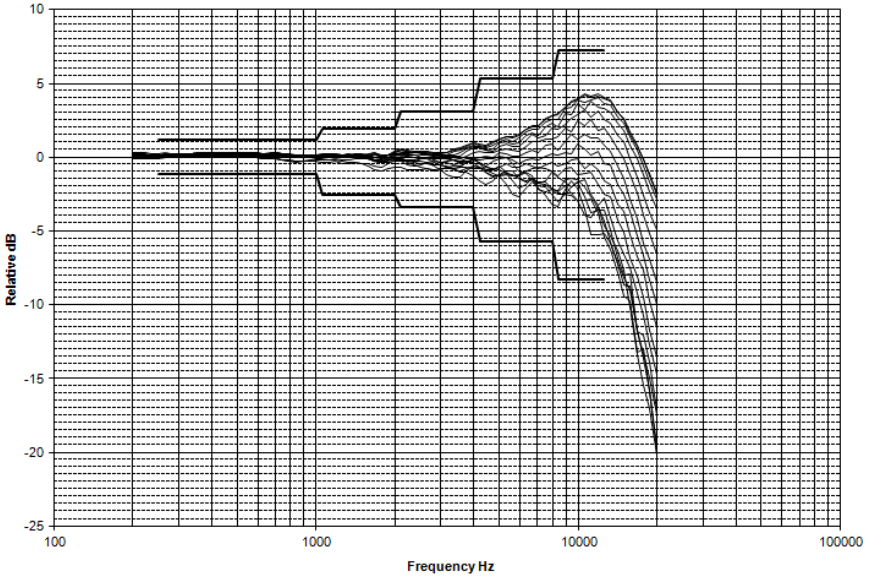
Directional frequency response positioned side toward noise source (0º-30ºincidence angles)



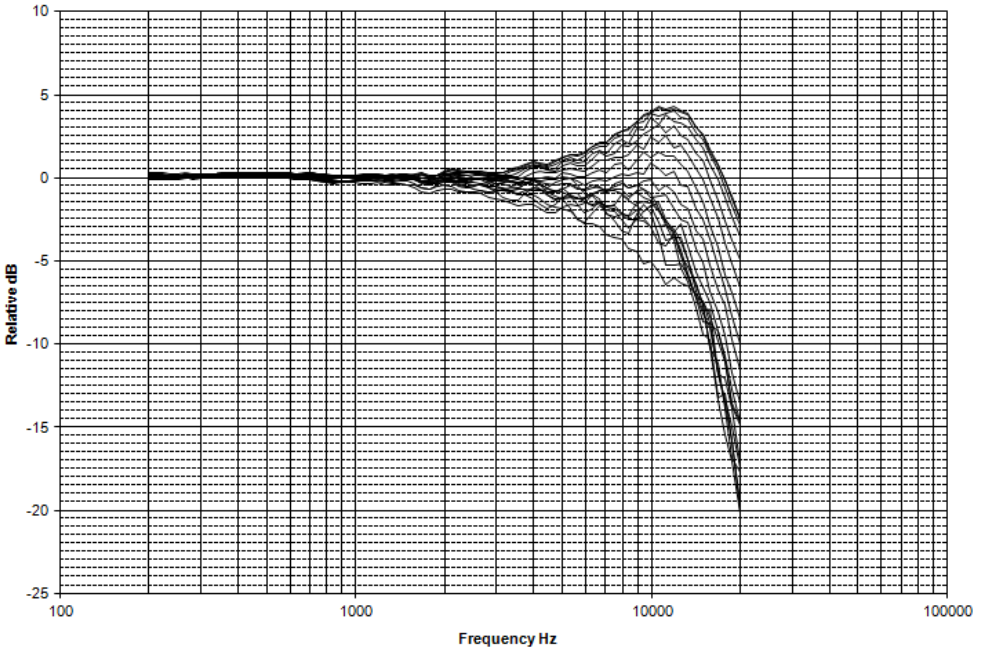
Directional frequency response positioned side toward noise source (0º-90ºincidence angles)



Directional frequency response positioned side toward noise source (0º-150ºincidence angles)



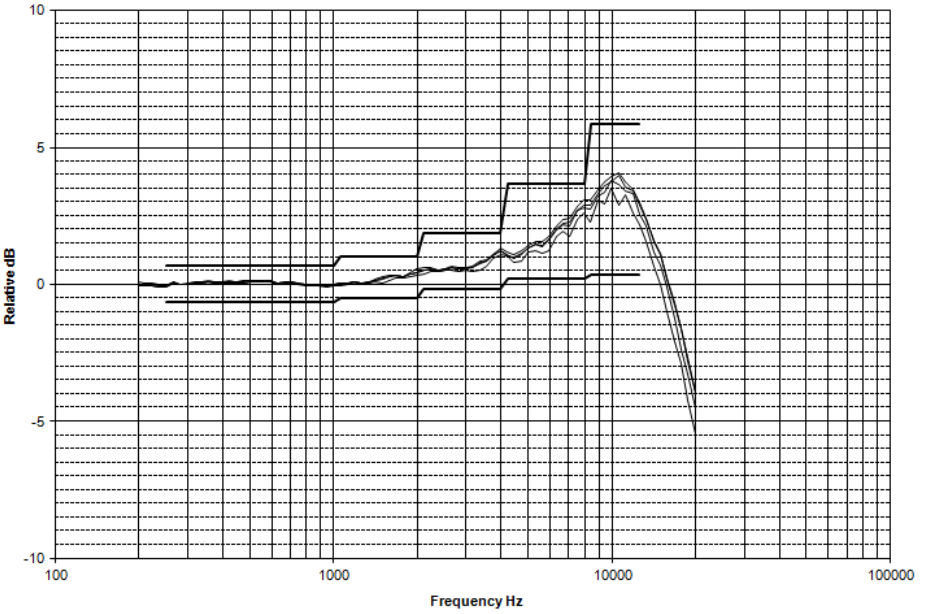
Directional frequency response positioned side toward noise source (0º-180ºincidence angles)



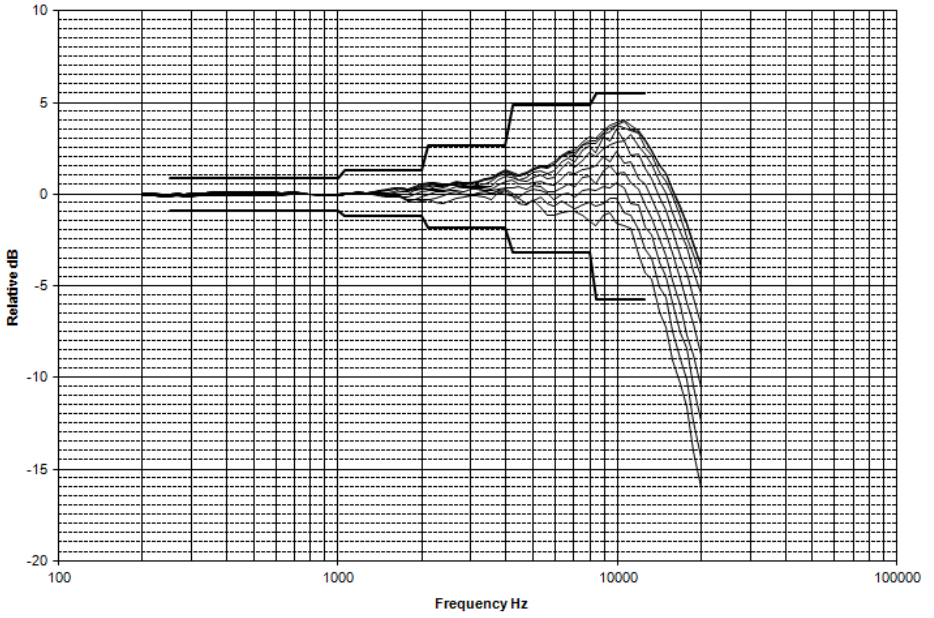
BK4936 microphone with RICR and windscreen back facing

Tolerance: IEC 61672 class 1

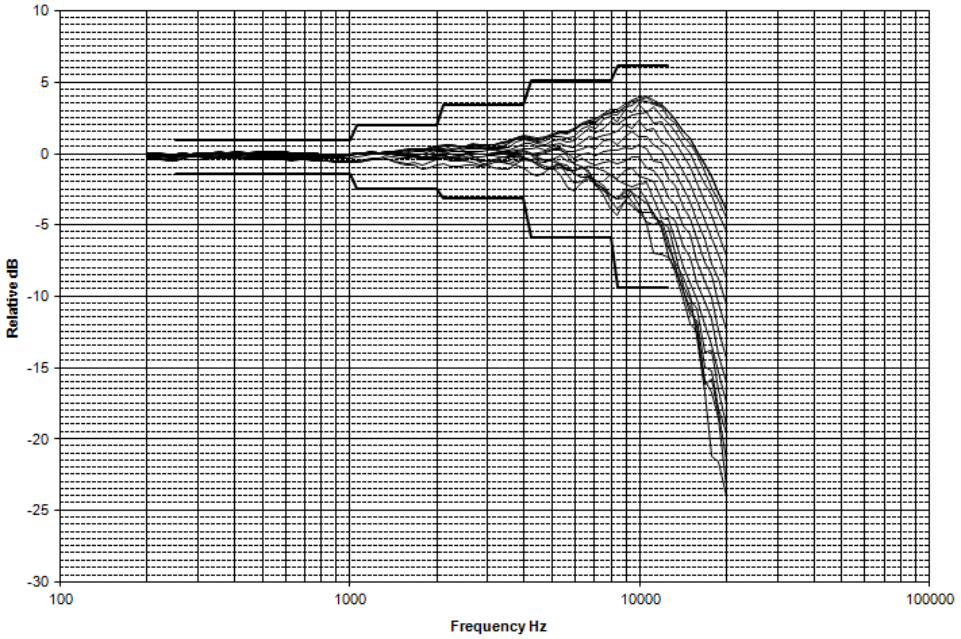
Directional frequency response positioned back toward noise source (0°-30°incidence angles)



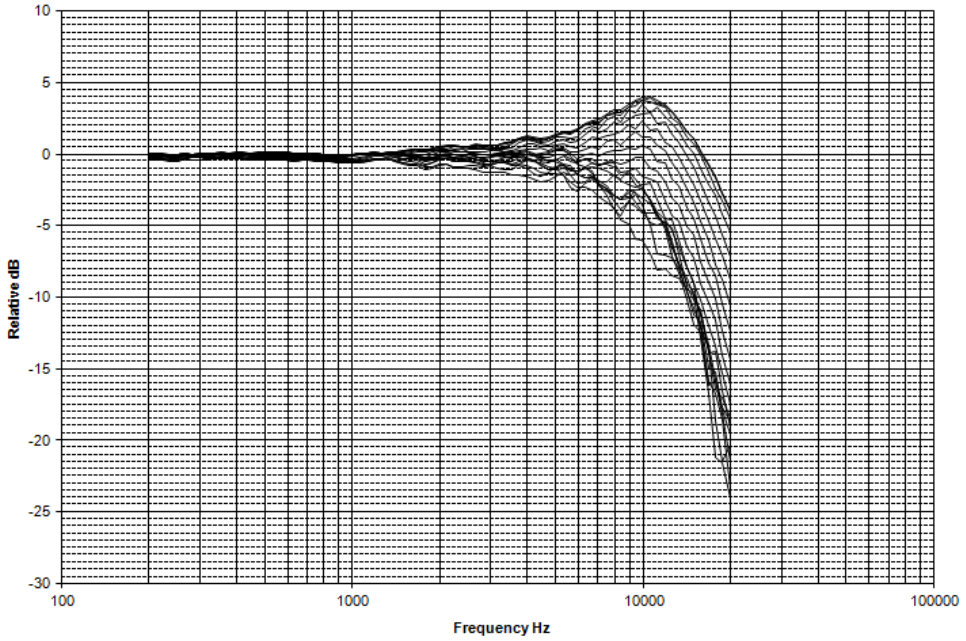
Directional frequency response positioned back toward noise source (0°-90°incidence angles)



Directional frequency response positioned back toward noise source (0º-150º incidence angles)



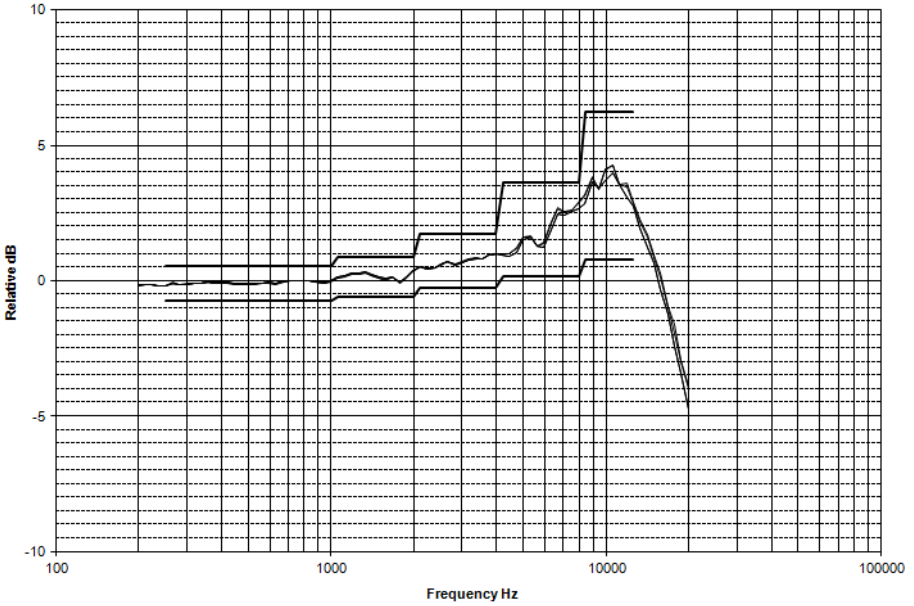
Directional frequency response positioned back toward noise source (0º-180º incidence angles)



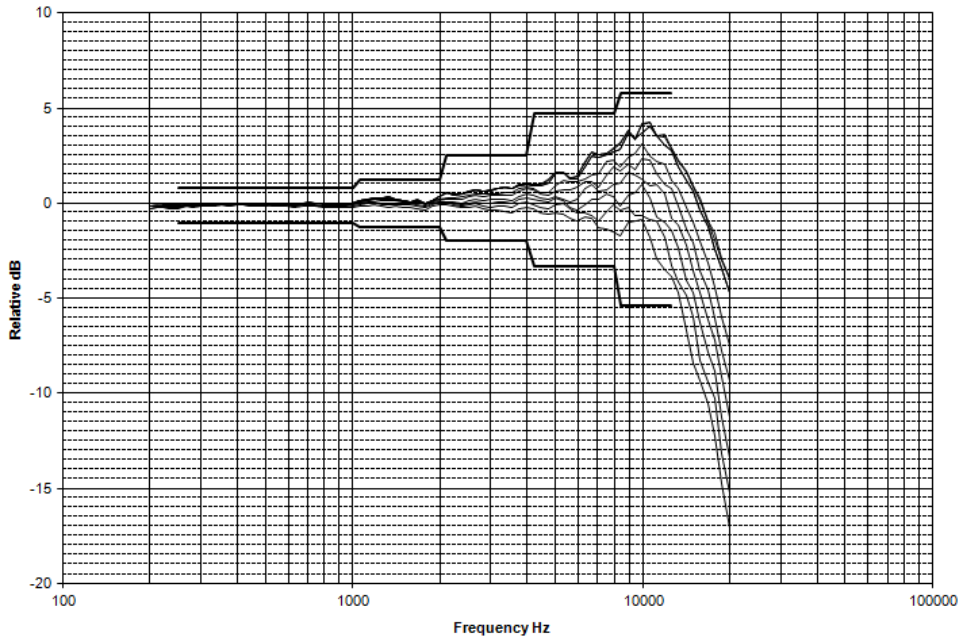
BK4936 microphone with RICR and remote preamp

Tolerance: IEC 61672 class 1

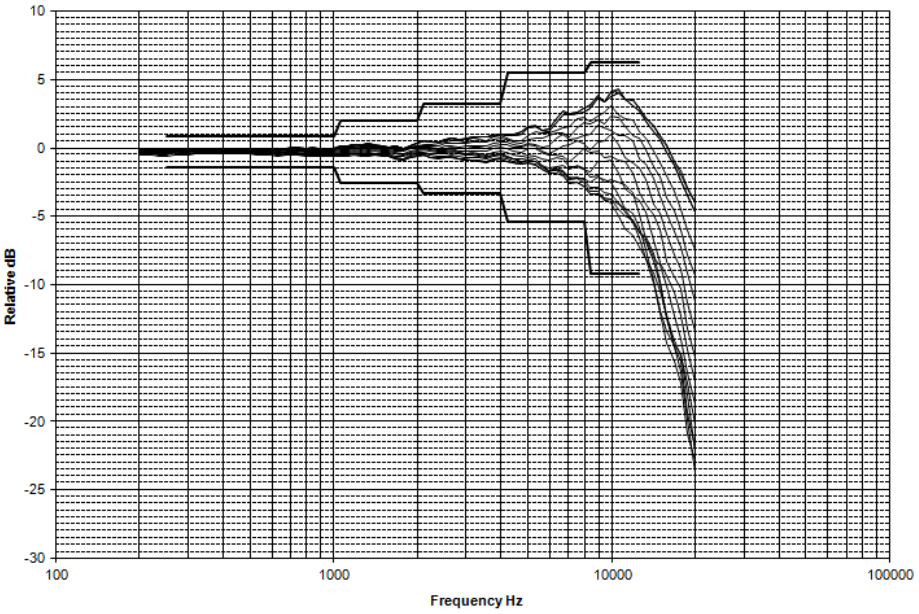
Directional frequency response positioned toward noise source (0º-30ºincidence angles)



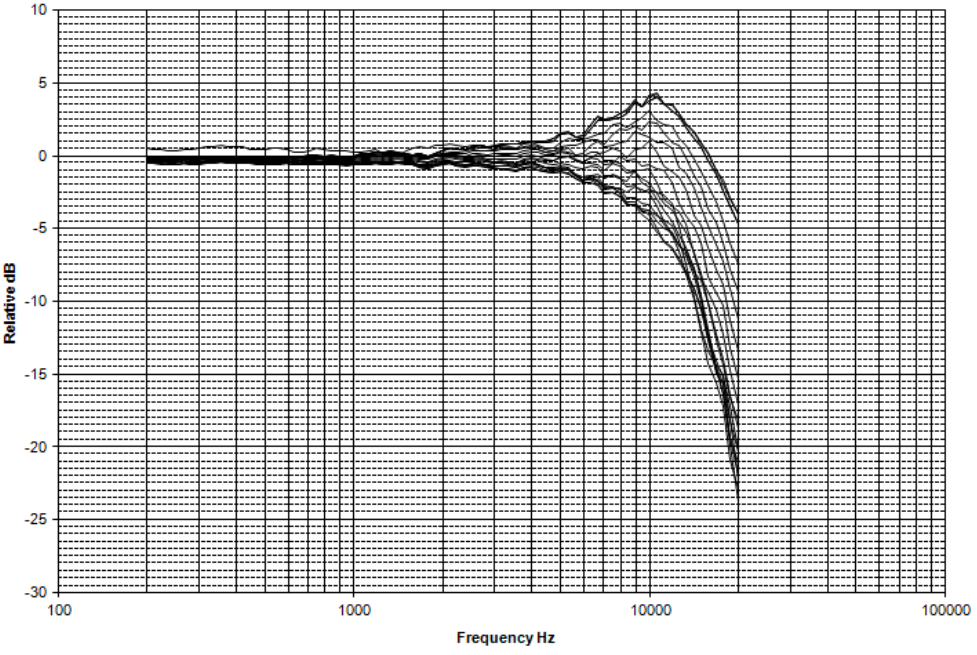
Directional frequency response positioned toward noise source (0º-90ºincidence angles)



Directional frequency response positioned toward noise source (0º-150ºincidence angles)



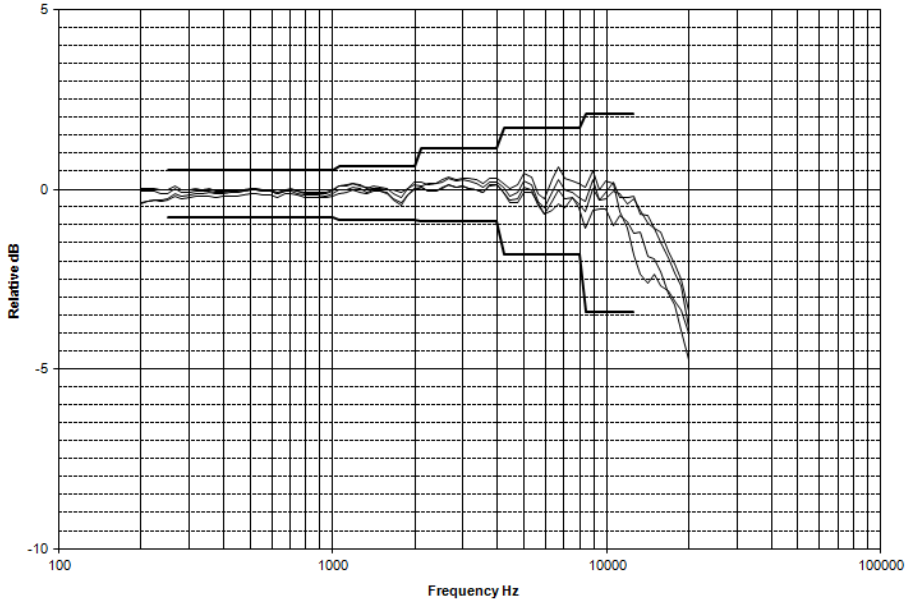
Directional frequency response positioned toward noise source (0º-180ºincidence angles)



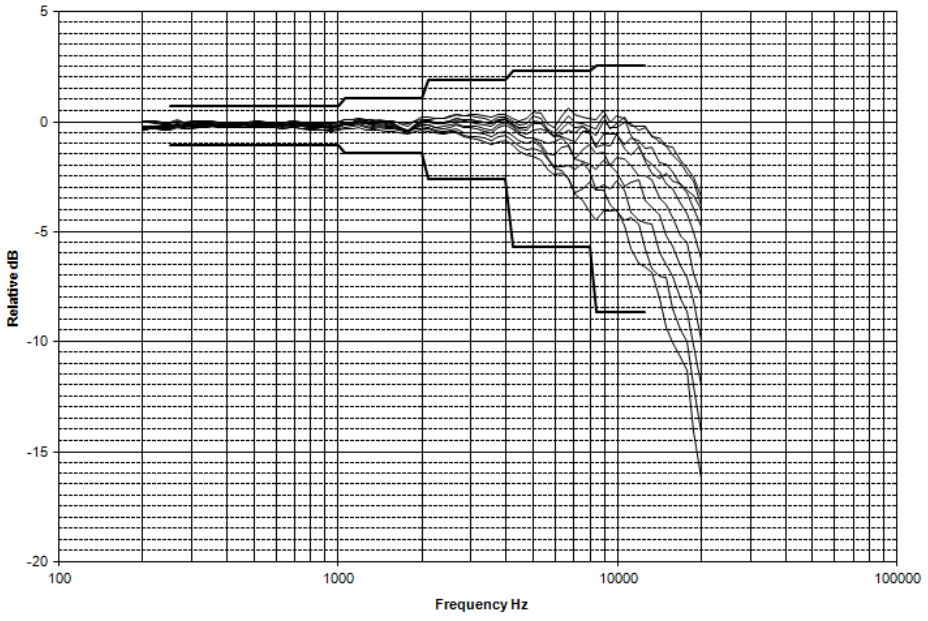
BK4936 microphone with remote preamp, RICR, and windscreen

Tolerance: IEC 61672 class 1

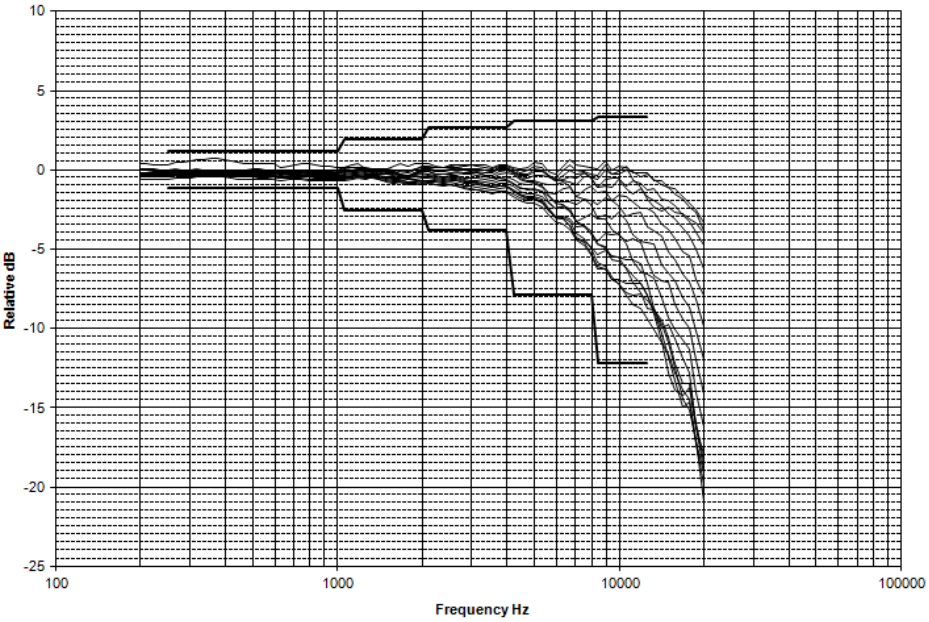
Directional frequency response positioned toward noise source (0º-30ºincidence angles)



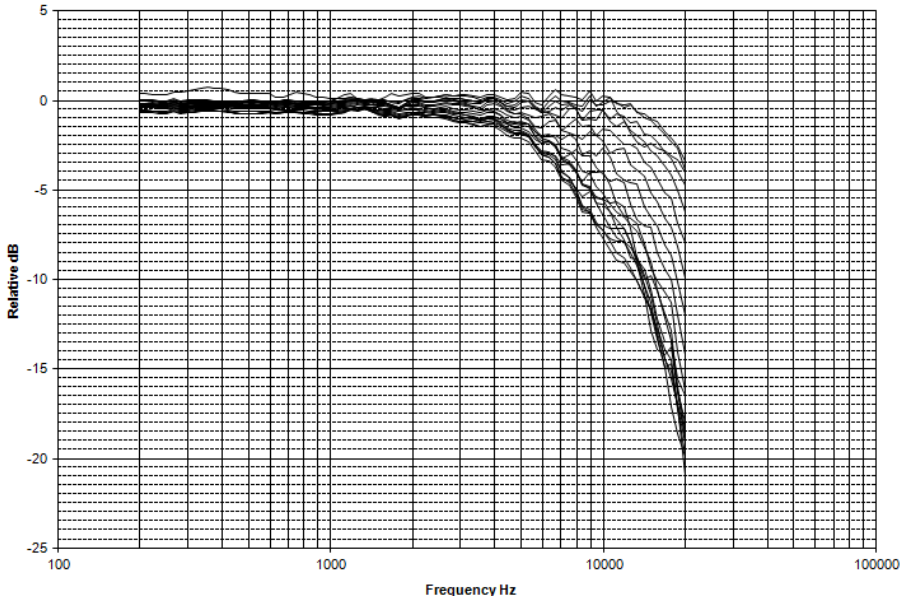
Directional frequency response positioned toward noise source (0º-90ºincidence angles)



Directional frequency response positioned toward noise source (0º-150ºincidence angles)



Directional frequency response positioned toward noise source (0º-180ºincidence angles)



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